DESIGN STANDARDS

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Photo by Henry Becerra

1.1 General Requirements

1.2 Introduction

San Antonio International Airport (SAT) has an unprecedented opportunity to re-envision itself by connecting its users to the cultural and historical character of its city and region. In addition to world famous landmarks, it is the multicultural vibrancy, connectivity to nature, and positive community spirit that make San Antonio an extraordinary destination.

The objective for SAT Design Standards is to achieve coherence, continuity, and compatibility for all buildings on San Antonio International Airport property. The design standards set forth here are intended to assist A/E, any consultant under contract with SAAS, in providing a design which supports SAT's initiative to unify a rapidly growing airport into a single, comprehensive, modernized whole, delivering a unified passenger and employee experience, across the entire SAT campus, now and into the future.

These standards will be used in conjunction to the SAT Design Guidelines, to customize a vision for SAAS built environment.

1.3 SAT Design Guidelines

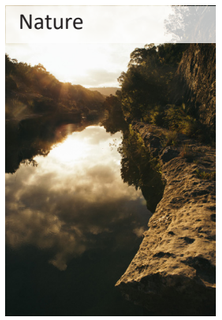
The A/E will review the design guidelines prior to beginning the design and utilizing the standards for each project. The SAT Design Guidelines can be accessed via (need link). Below is a summary of these Guidelines.

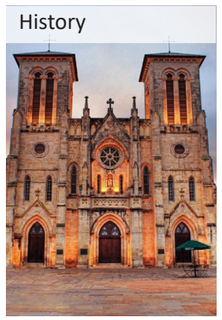
1.3.1 Design Principles

There are 4 design principle for projects, which are described further in the SAT Design Guidelines:

As the gateway to the region, SAT forms the first and last impressions for its visitors as they arrive and depart the city. SAT has selected the following four Principles as a lens through which to see the airport. These principles force each A/E to view design challenges in a consistent manner, and in turn connect the users experience from curb to gate.

The four design Principles are founded upon and inspired by the characteristics that define San Antonio:





1.3.2 Elements of Design

This list of nine design Elements described below represent SAT's qualitative priorities when considering development at the airport. Successful design will incorporate the Elements in a subtle, non-intrusive manner. The Elements described here should not only reflect the character of San Antonio, but they should also function well together to enhance the user experience by fostering communication, reducing distractions and inconveniences- -clutter, noise, glare, congestion--and facilitating user comfort. Deviations from this approach that are based on the SAT Design Guidelines are permitted but require approval from the SAT PM.

1.3.2.1 Materiality

Material selections should represent native San Antonio—capturing the sense of walking under a live oak tree or strolling along the River Walk. They should incorporate the colors and palettes of the local landscape, both built and natural, as well as reflect the local culture. Material finish should be balanced and subtle, rather than heavy handed. In choosing materials, consider user comfort, touch, and sustainability.

1.3.2.2 Light

Special attention should be paid to lighting. Natural light should be abundant throughout, with purpose-driven lighting complemented by anti-glare, artificial illumination. Light could recall specific memories as one walks around San Antonio. For instance, A/E could be inspired by the glint of the River Walk or the dappled effect found under the many large live oak trees. Conversely, urban examples could also be used to support a concept. Note how many structures light up at sunset around the city, instantly and profoundly changing the street scape.

1.3.2.3 Color

San Antonio embodies and embraces color. This provides an opportunity to incorporate the city's bold palette into design, without being overbearing or trendy. Color is ever present in every aspect of the community, from food to dress to celebrations. The architecture of San Antonio remains boldly on civic display. For example, the Central Library is Enchilada Red. The contrast between neutrals and colors is balanced: often, neutral colors serve as the backdrop to hidden, brightly colored elements. Rather than feeling transitory or ephemeral, color feels integral to daily life in San Antonio.

1.3.2.4 Form

Consistent with the other Elements, form should be derived while looking through the lens of the principles. Created in direct response to the subtropical climate, the region's buildings have adapted to mitigate direct sunlight. Heavy masonry walls keep interiors cool. Openings are limited and set deeply into facades. This balance allows natural light in, while simultaneously blocking out unwanted heat. Now, innovative glazing and high-performance exterior envelopes provide A/E much more flexibility towards resolving this challenge. The region's vernacular style, derived over centuries of Spanish occupation, offer a rich architectural vocabulary.

1.3.2.5 Rhythm

Consider the ways in which rhythm can be used to layer in references to history—reflecting patterns inspired by Native American textiles or iconography from colonial roots. Light and music can be used as inspiration to create patterns and rhythms, as well.

1.3.2.6 Furniture

Until the 1870's, most Texans bought their furniture from local cabinet makers. The majority were Southerners, but a significant minority were German immigrants. In the mid-19th century, a third of cabinet makers were German. The primary woods were pine, cedar, and walnut. The rapid expansion of the railroad ultimately replaced traditional furniture making in the region. The rustic style, however, persevered. Furniture should be selected on the basis of comfort first. However, it is important to understand and honor the established craft of the region. Function is vital, taking into account the variety of users and their needs. Seating should be available for waiting areas, for those who want to work, and for those who want to lounge. Kid- and family-friendly furnishings are important, as are areas that can accommodate large groups. Durability, sustainability, versatility and comfort are all important considerations.

1.3.2.7 Technology

Technology is constantly evolving, and SAT will keep pace. Consider how current and future technology can be used to improve the user experience, from self check-in kiosks, to charging stations, and including discrete visual wayfinding displays. It is critical that SAT is urgent in adopting newer technologies that enable safer and more convenient travel for all users at the airport, allowing the airport to serve more people and continue to grow.

1.3.2.8 Landscape

Landscaping is a vital part of the airport's sense of place and can have a soothing effect on stressed travelers. It needs to reflect San Antonio's natural environment and that of the surrounding region. It will serve as a familiar welcome to residents and will help form an inimitable first impression for visitors. Inspiration can be taken from the karst landscapes, the nearby Hill Country, and the local canopied, tree-lined River Walk. Priority should be given to native species, which offer sustainability and drought resistant cost-savings. Any landscape design should reinforce sight lines, in order to promote intuitive way finding, helping users navigate the airport campus. Non glare illumination should highlight specific features, creating memorable markers. Consider the potential of shaded, outdoor rooms that naturally mitigate the stress inherent in travel.

1.3.2.9 Art

Art is integral to the San Antonio experience, and its inclusion is a requirement at the airport. Fortunately, spectacular examples can be found throughout the city, as well as its world class museums. Emphasis should be given to local artists who are adept at mixing traditional media with modern meaning. Art can be used to enhance wayfinding, demarcate spaces, and serve as meeting points. It can be playful and made to be seen, or demure and contribute to the overall airport experience more subtly.

1.4 SAT Design Standards

These standards define a unified thematic and technical approach for all projects, either new construction or renovation at San Antonio International Airport. These standards are to be adhered to by all A/E under contract with or to the Airport.

Additional goals of the SAT Design Standards include:

- Increase cost effectiveness of A/E resources.
- Construction cost efficiencies realized through standardization of building systems, materials, fixtures, and equipment.
- Maintenance cost reduction by limiting types of repairs and material stock required.
- Focusing resources on standard procedures for standardized systems.

These standards may also be utilized for projects in the San Antonio Airport System. The A/E will work with the SAT PM to understand which sections may apply for different projects.

1.4.1 Expectations of Development

The SAT Design Standards will be a living document. Refer to the change management process in the Design Submittal Requirements chapter for the process to update the standards.

1.5 Code Information

Design will comply with requirements and provisions of the latest building codes as approved and amended by City of San Antonio (CoSA) and coordinated with SAT. The list of the latest adopted building-related codes can be found under Current Codes and Ordinances on the City of San Antonio Development Services (DSD) website: https://www.sanantonio.gov/DSD/Constructing/Codes-and-Ordinances.

1.6 Accessibility

Facilities and improvements must be accessible to the physically mobility impairments and must comply with Texas Accessibility Standards (TAS) and the Americans with Disability Act (ADA) Guidelines.

Using the TAS and ADA Standards as a starting point, develop the facility design to follow the principles of Universal Design.

TAS - https://www.tdlr.texas.gov/ab/abtas.htm

ADA - https://www.ada.gov/law-and-regs/design-standards/2010-stds/

1.7 Other SAAS Standards

In addition to the SAT Design Standards, there are several airport wide standards to be utilized for each project. These standards have been referenced in various sections throughout the document, but are also listed here for ease of reference and are also located on the Airport's website at the following link: https://flysanantonio.com/business/about-saas/construction-development/

- SAAS BIM Standards Manual
- SAAS Brand Guidelines
- San Antonio Airport System Sustainable Airport Manual (SAASSAM) - https://flysanantonio.com/wp-content/uploads/2022/02/SUSTAINABLE-AIRPORT-MANUAL.pdf
- Wildlife Hazard Management Plan
- Airport Construction/Event Security Plan
- Wayfinding and Signage Master Plan

1.8 Art Program

As a facility of the City of San Antonio, the Airport is home to both Public Art and rotating temporary exhibits. Public Art at the airport is managed in partnership with Public Art San Antonio (PASA). The Galleries@SAT is the airport's rotating exhibit series. The program is intended to enhance the visual environment of the airport and encourage meaningful engagement with San Antonio's unique and diverse culture.

All placement of Art will need to be coordinated with SAT Properties and the SAT Art Director.




1.9 Glossary

A/E : Any consultant (team) under contract with SAAS to perform design services. This term also includes the design builder depending on the procurement method.

SAAS : San Antonio Airport System, abbreviation to be used when discussing the entire airport system including Stinson Municipal Airport.

SAT : San Antonio International Airport

SAT PM : Main point of contract between the A/E and the Airport. This role may be fulfilled by the following, but not limited to a city designated representative, project manager, or director.

SSF : Stinson Municipal Airport

1.10 Photo Citations

Photo by Luisa Brimble [pg. 3]

Photo by Kin Man Hui [pg. 3]

Photo by Joe Dudeck [pg. 4]

Photo by San Fernando Cathedral [pg. 4]

Photo by Radovancev Zarko [pg. 4]

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Photo by Carlos Ayala [pg. 5]

Photo by Debby Ledet [pg. 5]

Photo by Marcela Resendez [pg. 5]

Photo by Port San Antonio [pg. 5]

Photo by Jonas Allert [pg. 5]

Photo by Marcela Resendez [pg. 6]

Photo of "¡Adelante San Antonio!" by San Antonio artist team Dos Mestizx, Suzy González and Michael Menchaca [pg. 7]

Photo of BAC 1-11 Archway by San Antonio artist team Dos Mestizx, Suzy González and Michael Menchaca [pg. 7]

Photo of Mural by San Antonio artist team Los Otros Murals [pg. 7]

Photo of Mural by San Antonio artist team Eva Sanchez [pg. 7]

02

Photo by Weston Mackinnon

2.1 Sustainability

2.1.1 Overall

In 2011, the San Antonio Airport System (SAAS) developed and implemented a Sustainability Plan for SAT, whose objective is to demonstrate how an entity may make measurable progress toward more efficient use of energy, water and materials, while reducing negative environmental and social impacts.

To complement the City of San Antonio (CoSA's) effort to provide sustainability leadership in the community, San Antonio Airport System developed a Sustainable Airport Manual (SAASAM) in September 2021. An aiport-specific guiding document for the improving the sustainable performance of buildings at SAAS.

In addition, a Carbon Policy Statement, dated August 2021, the SAAS indicated the following: The Aviation Department will work to ensure new construction meets rigorous energy efficiency standards, including the use of energy effiicent construction equipment by developing the SAASAM. This manual will serve as a key tool to reduce resource consumption during the planning, development, and construction of airport facilities in line with the City's sustainability and climate resiliency goals.

Generally, sustainability considerations revolve around maximizing efficiency in and around the Airport.

- Reduce the carbon footprint at the Airport caused by vehicle emissions.
- Improvement of accessibility to the Airport.
- Use existing infrastructure in the proposed alternatives whenever possible.

2.1.2 Design Criteria

2.1.2.1 SAASSAM Standards

- SAASSAM(San Antonio Airport System Sustainable Airport Manual), vol1 Building Design and Construction SUSTAINABLE-AIRPORT-MANUAL.pdf (flysanantonio.com)
- SAASSAM is applicable to all new construction and major renovation of occupied and unoccupied buildings greater than 1,000 square feet (SF). These applicable projects are provided in the table below.

Type of Project	Description	Examples
New Construction – Occupied Building	Project consisting of facilities that once complete will be occupied by employees and passengers.	Terminals, Concourses, Guard Posts, Air Rescue and Firefighting Facilities, Cargo Facilities, Air Traffic Control Towers
New Construction – Unoccupied Buildings	Project consisting of facilities that do not have regular occupants (without permanent staff).	Pump Stations, Lighting Vaults, and Fuel Stations
Major Renovations	Projects that include renovated areas of at least 4,000 sq ft or with a construction cost greater than $3M or include the replacement of HVAC, electrical, plumbing, significant envelope modifications, and/or major interior renovations.	Terminal Gut-Rehab, Office Building Upgrades, Bathroom Remodels

2.1.2.2 Required Reviews

- The Design Consultant will need to fill out the SAASSAM Compliance Checklist Tool. An electronic version is available upon request from Environmental Stewardship. Contact Info is listed below
- All Sustainability documents will be evaluated by the Environmental Stewardship Division for compliance with SAASSAM and Carbon policy memo as required.

SAASSAM CRITERIA CHECKLIST

Performance Target	Compliant?	Comments
ID-1: INTEGRATED DESIGN		
Responsible Discipline: Planning and Development		
Supporting Discipline: N/A		
Meet performance target of forming an integrated design team, conducting a design charrette, developing project specific sustainability goals, revisiting sustainability elements of the project at each major milestone, documenting records of decisions and keeping detailed meeting minutes.	Exempt - Incompatible	
ID-2: GREEN MEETINGS		
Primary Discipline: Planning and Development		
Supporting Disciplines: N/A		
Green Meeting Plan has been submitted.		
AE-1: INDOOR AIR QUALITY PERFORMANCE		
Primary Discipline: Mechanical		
Supporting Disciplines: N/A		
Meet the minimum requirements of Sections 4 through 7 of ASHRAE 62.1-2016, Ventilation for Acceptable Indoor Air Quality (or most current version)		
HSS-5: ACCESS FOR OCCUPANT WELL-BEING AMENITIES		
Primary Discipline: Architectural		
Supporting Disciplines: Mechanical		
Provide ADA accessible spaces/equipment dedicated to at least three of uses discussed in the SAASSAM, considering compatibility with airport operations. Spaces are sized adequately or repeated frequently enough to allow use by all occupants		
HSS-6: DESIGN FOR ENHANCED RESILIENCE		
Primary Discipline: Architectural		
Supporting Disciplines: Mechanical, Electrical		
Building design is responsible to reasonably expected natural disasters and weather events exacerbated by climate change.		

SAN ANTONIO AIRPORT SYSTEM SUSTAINABLE AIRPORT MANUAL COMPLIANCE CHECK

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2.1.2.3 Additional References:

- San Antonio climate ready, action and adaptation plans https://www.sanantonio.gov/sustainability/SAClimateReady
- FAA Airport Sustainability - https://www.faa.gov/sustainability
- CAAP, Climate Action and Adaptation Plan.
- Environment Stewardship
  Environmental Stewardship - San Antonio International Airport (flysanantonio.com)
- IECC 2021 or current - minimal amendments
- USGBC LEED (Current Version) - Projects are not currently required to be LEED Certified, but design teams are encouraged to incorporate sustainable elements in their designs and this document may be used as a resource.

2.1.2.4 Vehicular Emissions

Terminal and renovation projects will strive to reduce the carbon footprint at the Airport caused by vehicle emissions.

- Hydrant fueling system to replace fuel delivery trucks on the airfield
- Incorporate future flexibility for transit to connect to the City and for driverless vehicles.
- Reduce curb congestion with proposed Ground Transportation Center.
- Accommodate electric vehicles and the change in Ground Service Equipment fleet from gas to electric power.
- Incorporate opportunities for electric shuttles and charging in the lower level of the ConRAC garage.

2.1.2.5 Additional Considerations

Other items the design teams are encouraged to investigate regarding sustainability at the airport include:

- Reduce waste and provide energy management by utilizing existing infrastructure whenever feasible.
- Benefits of vertical farming and potential locations to contribute to CoSA's goal for sustainable food.
- Rainwater harvesting at the parking garages for irrigation and car washing.
- Air quality monitoring to enhance the building occupants' experience.

2.2 Glossary

CAAP :	Climate Action and Adaptation Plan
ConRAC :	Consolidated Rental Car Facility
CoSA :	City of San Antonio
FAA :	Federal Aviation Administration
IECC :	International Energy Conservation Code
LEED :	Leadership in Energy and Environmental Design
SAAS :	San Antonio Airport System
SAT :	San Antonio Airport
USGBC :	United States Green Building Council

03

Photo by Robin Leeann

3.1 General

3.1.1 Purpose

The Design Submittal Requirements Chapter provides the A/E a walkthrough of several processes required by the Airport.

3.2 Design Standards Review Committee Process

3.2.1.1 Design Standards Review Committee

The committee for the design standards will be made up of persons from SAT Aviation Construction and Development (C&D) section. This group will manage the content and update the document periodically to continually enhance and expand the content over time. The goal of this "living document" is maintain existing information and provide an efficient framework for incorporating newer design criteria in the future. As information is gathered from future design and construction projects, Construction and Development will review the applicability of creating, revising, or replacing content to address new technologies, materials, and methods.

3.2.1.2 Variance Request, Change Management Submittal, Appeals Process

- Changes will be implemented by variance and change requests
- Variance Requests will be submitted to the SAT Project Manager, in writing, by A/E, Contractors, Airlines, Car Rental Agencies, Airport Tenants, TSA, CBP and Vendors to address a project specific change.
- Change Requests will be submitted by the SAT Project Manager to Construction and Development to address permanent revisions to the Standards.

3.2.1.3 Final Approval

The SAT Project Manager is responsible for submitting a Change Request. The request will need to include supporting documentation from the change request initiator for consideration of the proposed change to a Project. Supporting documentation may include, but is not limited to:

- Rationale for the variance request including specific benefits the proposed change may provide and how it will be implemented.
- Enhancement of operations, durability, warranty, and ease of maintenance to support the project change including:
    - Product/Manufacturer Cut Sheets
    - Drawings
    - Samples
    - Schedule Benefits
    - Life Cycle Cost Benefits

3.3 Overall Project Schedule

The project delivery method and the contract will dictate the team in charge of providing the components listed. Prior to the preparation of the Design Documents, the A/E shall first consult in detail with SAT and carefully analyze any information concerning the requirements of the Project including, but not limited to, any design, construction, scheduling, budgetary, or operational requirements, limitations, and objectives, as well as the Design scope specification(s).

A/E to provide an overall project schedule for review prior to project setup.

Components of the Overall Project Schedule

- Baseline Design Schedule
- Project Milestones
- Deliverables
- Review Schedule
- Baseline Construction Schedule.

3.4 Stakeholder Engagement Plan:

Prior to the Design Process Kick Off Meeting, the A/E will put together a Stakeholder Engagement Plan in collaboration with the SAT PM to understand which groups need to review and at which phase within the project schedule.

Reviews will be required by various stakeholders including, but not limited to:

- Construction & Development will designate an SAT Project Manager for each project - Every phase of the project will need to be reviewed by the SAT PM.
- Accessibility - For all projects impacting ground transportation, parking, restrooms, and other areas affected by Texas Accessibility Standards (TAS).
- AEC - reviews documents affecting Airport emergency management.
- Airport Facilities – Review of documents impacting the Airport's electrical, mechanical, fire protection, plumbing facilities.
- Airport Security - reviews documents impacting entry/exit of facilities on or past the SIDA line.
- CBP For all projects within or adjacent to the Customs Border Patrol spaces, review proposed design with CBP and their associated standards.
- City of San Antonio IT - reviews documents affecting airport technology and wired and wireless networks.
- Customer Experience - reviews each design phase to manage impacts on customers.
- DSD – City of San Antonio Development Services provides review of code analysis and design submittals.
- Facilities Fleet Maintenance and Materials
- Horticulture - reviews documents affecting vegetation and green spaces on Airport property.

- Parking - reviews documents affecting Airport parking.
- Properties – Coordinates reviews for tenants including Greenfield, new construction and major renovations/additions. Tenant application, business plan for large builds, and drawings submittals. Properties will coordinate with additional stakeholders including Car Rental Agencies and Airlines.
- SAT AICC - reviews documents affecting Airport communications.
- SAT Airfield Operations requires work plans be submitted for review and approval, including holding a pre-work meeting prior to accessing the site.
- SAT ARFF - reviews of documents impacting Airport's pedestrian and ground vehicle travel routes.
- SAT Environmental Stewardship - reviews each design phase for sustainability planning and noise management purposes.
- SAT Safety & Wildlife – review each design phase for risk management purposes.
- Terminal Services - reviews each design phase for impact to terminal areas.
- TSA - For all projects adjacent to the Security Checkpoint, Baggage Screening and TSA Lease Spaces, review the proposed design with TSA and reference the TSA Design Guidelines. .
- USO - For projects around terminal B baggage claim area and the USO lounge itself.

The following diagram is an example of a Stakeholder Engagement Plan to be modified as required by the A/E.

Figure 1 – Example of Stakeholder Engagement Plan

3.5 Comment/Response Tracking Spreadsheet

As indicated in the design Tasks and Deliverables sections, each design submittal stage will include a Comment/Response Tracking Spreadsheet.

The spreadsheet will be utilized to track comments and decisions via a master living document in spreadsheet format which will hold Airport and A/E comments placed on a shared drive for the team. Comments to be included in the spreadsheet by close of business the day prior to the milestone meeting for discussion during the meeting. This spreadsheet will also be printed to PDF at each milestone for record purposes.

3.6 SAT Badge and ID

Prior to design and construction, the A/E, Contractor will need to identify individuals who must possess an airport-issued SAT Security Identification Media (badge) for unescorted access to the Security Identification Display Area (SIDA) and Sterile Areas.

The SAT Badge and ID Office are responsible for the issuance of airport Security Identification Media (badges) to employees who work and require access to the San Antonio International Airport. A/E will need to be badged to access the site. If not, badged, A/E will need to coordinate with SAT PM and SAPD for access to secure areas.

Badge issuance is limited to those individuals who have cleared the FBI-based Criminal History Records Check (CHRC) as well as the TSA-based Security Threat Assessment (STA) and have frequent and recurring needs for access.

It should be noted, the badge is and always remains the property of SAT and will be surrendered upon the demand of the employer, SAT Security and/or Operations, within 24 hours of termination of employment.

Everyone is required to contact the office at 210.207.3526 or via email at aviation.satbadgeoffice@sanantonio.gov to schedule an appointment for all badge processes.

For Office Location, Hours of Operations, Badge Requirements, and Pricing refer to

https://flysanantonio.com/business/careers-at-sat/tenants-employee-resources-forms/

3.7 Design Report

Along with the tracking spreadsheet at each stage of design submittals, a Design Report (DR) will be required. The Design report shall be updated with each subsequent submittal.

The DR shall include at a minimum the understanding and analysis of the Project requirements and identifying any design, construction, scheduling, budgetary, and operational requirements. A/E shall include proposed solutions, design alternatives if appropriate, and final design decisions by discipline.

The DR will also include the opinion of probable cost, long lead items, list of acceptable manufacturers, list of special inspections required, value engineering descriptions, updated Design Schedule, and Decisions by the Airport and/or Stakeholder.

In coordination with the Airport, the DR may include items in the General Specifications for their agreement with the contractor such as the scope of the work description, project milestones, liquidated damages, construction durations, weather days allowed, list of bid items and schedules, bid alternates, etc.

The Airport will be required to supply Asbestos and Lead Paint inspection reports, unless dictated otherwise in the contract agreement.

3.8 Design Tasks and Deliverables

The following submittals will be anticipated for each design milestone. The A/E will coordinate with the SAT PM the list of deliverables per project basis.

These design tasks and deliverables are listed as guidelines for the A/E team and are subject to change according to the project delivery method and the contract agreement.

3.8.1 Design Process Kick-Off Meeting

3.8.1.1 A kick-off meeting shall take place before beginning design. The kick-off meeting shall:

- Involve City representatives and appropriate design team members and disciplines.
- Establish the starting point for design, e.g. what is known and not known to date, what direction has been documented and the applicability of that documentation.
- Define stages at which there will be formal and informal reviews, presentations, milestones, and submittals.
- Establish what formal reviews and approvals are required to be performed by the Airport via the Stakeholder Engagement Plan. Each formal review will require the documentation be delivered to the identified stakeholder (3) days prior to the formal review.
- Review the cost and schedule guidelines and programming document and make changes as required through discussions with the stakeholders to the extent they are defined.

3.8.2 Design Phases

The major design phase deliverables include Conceptual/Schematic Design (SD) “30%”, Design Development (DD) “50-60%”, and Contract Documents (CD) “90%-Issue for Construction”. Note, many systems and components require intermediate documentation and/or presentations to secure Airport approval. Confirm with the SAT PM, each anticipated design deliverable and milestone according to the project delivery method and the contract agreement.

3.8.3 Design Phase Deliverables

At each level of completion, adequate information shall be provided to support design intent, scope definition, and the estimated budget.

3.8.4 Review Comment/Response Tracking Spreadsheet

At each submittal stage, the Project Contract will dictate the delivery and time frames for review. The following timeframes are provided for guidance. Within fifteen (15) calendar days of document submission by the A/E, the Airport shall provide a list of written comments. Additional time may be required under certain circumstances, particularly if there are interfaces with other projects, or if outside agency approval are necessary. The A/E shall be expected to promptly respond in writing to these comments within ten (10) calendar days of submission by the Airport, unless agreed to otherwise in writing. The responses must be thorough, and specifically address the issue in question. Note specific actions already taken or planned actions with a completion time commitment. Such responses as "done" or "will comply" are not acceptable.

3.8.5 General Project Document Requirements

3.8.5.1 Programming Document

The Airport will provide its objectives, limitations, program requirements, Project budget requirements information regarding the Project

- Consult with City to further define and clarify City's requirements for the Project, and available data;
- Identify, consult with, and analyze the requirements of governmental authorities having jurisdiction to approve parts of the Project;
- Inspect existing site conditions;
- Review laws, ordinances and regulations that are applicable to the design and construction of the Project, and correlate them to the Project;
- Include the design-to-budget target amount as one of the basis for the Programming Document;

A/E shall furnish an addendum reflecting any agreed upon updates to the original Programming Document with each submission for the Conceptual/ Schematic Design “SD”, Design Development “DD” and Contract Documents “CD” submittals. This addendum will be included in each submittal and continue through the design process as the Design Report (DR).

3.8.5.2 Contract Specifications

- All Contract Specifications shall be prepared by A/E in current version CSI Format in accordance with the CSI Manual of Practice.
- The specifications will need to reference testing methods provided by the Airport. All testing methods identified will need to meet the current code at a minimum and may be modified to suit best practices.

3.8.5.3 Contract Drawings

- All Contract Drawings shall be produced using AutoCAD or REVIT software in accordance with the SAAS BIM Standards Manual.
- A/E shall carefully select a drawing scale that will serve all disciplines. Provide key plans when floor plans are matched over more than one sheet. A prominent North arrow shall be consistently placed on each plan sheet. North shall be shown in a consistent direction on any plan drawings. A numerical and graphic scale shall be placed on all plan and detail sheets and/or partial plans and details, as appropriate.
- A standard drawing sheet size title block and necessary title block data will be agreed to by the Airport and A/E based on required data and A/E input. A simplified sheet layout may be proposed for presentation drawings.
- When abbreviations are used, their use must be consistent across all documents. Do not use the same abbreviation for two different words. The same abbreviation shall be used for the same item throughout.
- "NOT IN SCOPE" or "NOT IN CONTRACT" references must be used very carefully to refer only to items that are not the scope of the overall Contract. They must not be used to refer to things that are not a part of one discipline, Sub- consultant, or subcontractor.
- All details must be referenced from somewhere on the plans, elevations or sections.
- Avoid large complex "details." Break such details up into adjacent details in an exploded fashion that highlights the unique elements of the detail and avoids obscuring important details.
- Use isometric details liberally to describe conditions where multiple interfaces are the subject.
- Schedules must be as uniform as possible in the order of information and format across all disciplines. The order of room number, room name, equipment designation, etc. must be the same in all schedules.

3.8.5.4 Code Analyses

A/E is responsible for performing and shall prepare Code Analyses and schedule meetings with Code Officials. The Airport will be invited to all such scheduled meetings. A/E shall provide written responses to reviews from Code Officials within ten (10) calendar days of receiving the review comments unless agreed to otherwise in writing. A/E must schedule all Code Reviews to be completed before Airport's acceptance of final documents.

In general Code Reviews for life safety, hazardous materials, and fire sprinkler design are performed by the Development Services Department (DSD).

3.8.5.5 Design Calculations

A/E is responsible for performing and shall prepare Project Calculations as required for code compliance. This includes but is not limited to:

- Area calculations that are based on occupational loads and area allowances per person, to include occupied spaces;
- Systems driven by people flows, such as elevators, escalators, major entry points;
- Mechanical subsystems, such as HVAC systems, plumbing fixture counts, water pressure; and
- Electrical subsystems such as generator capacity, electrical demand load, and lighting levels.

3.8.5.6 Cost Estimates

For each Opinion of Probable Cost Estimate, the A/E will need to review with the SAT PM the template required based on project delivery in order to transfer summary information into the City's tracking methods.

Estimates for the opinion of probable cost should be performed by an AACE (or other recognized) certified cost estimator and perform cost estimates according to the appropriate level of detail. For example:

Level 1 - Order (Range) of Magnitude

Level 2 - Schematic/Conceptual Design

Level 3 - Design Development

Level 4 - Construction Document, and

Level 5 - Bid

3.8.6 Pre-Design Services

The Pre-Design Stage initiates confirmation of the current Program and begins with the A/E assembling and reviewing data related to existing conditions, use patterns, and facility(s) policies. The Pre-Design Stage includes A/E reviewing the programming documentation and providing comments and any recommendations for updates.

Tasks

3.8.6.1 Project Set Up

Compile existing requirements and policies: This data needs to be sought out by A/E through interviews, work sessions, and scrutiny of data repositories. Although A/E is responsible to identify the complete list of information they will need include:

- Overall Program criteria
- Facility/Site Policy
- Facility/Site Goals
- Facility/Site operations
- Facility/Site and other user operations and use patterns
- Legal and Regulatory requirements
- Building codes
- Health-related regulatory requirements
- Environmental
- Design Limitations

- Architectural (aesthetic, operational)
- Engineering (safety, maintainability)
- Regulatory
- Schedule and Phasing
- Existing Facility/Site Standards and Programs
- Signage and graphics
- Concessions
- Service and Utility
- Security
- Building Management System (BMS)
- Other planning projects
- Characteristics
- Impacts

3.8.6.2 Analyze Site

A thorough site analysis including the assessment of numerous existing studies, reports, and drawings.

- Survey Site physical characteristics
- Topographic survey
- Geographic - surround land use and transportation
- Climatic, weather data
- Existing Geotechnical Data
- Utilities
- Assess existing structures
- Facility/Site systems (Security, BMS)
- Review available documents
- Survey existing buildings
- Analyze accuracy and shortcomings of available documents
- Backfill necessary data as required.
- Determine current patterns of Facility/Site usage for the following:
    - Access
    - Traffic
    - Parking
    - Pedestrian
    - Scheduled Events
    - Service
    - Concessions

3.8.6.3 Update Programming Document (PD) & DR

- Organize, analyze, and evaluate assembled data
- Summarize Facility/Site Goals and Objectives, as they relate to this Program
- Confirm sizing for all individual facility components including building services
- Establish relationship considerations between components, noting flows from component to component, and develop use/relationship diagrams
- Note operational and spatial characteristics for individual facility components
- Confirm appropriate net-to-gross factors
- Compile overall Space Tabulation
- Determine logistics considerations.
- Preferred and existing materials and systems
- Construction limitations
- Package the Programming Document in an orderly updateable format

3.8.6.4 Set Program Cost Target

- Overall Project
- By project element

3.8.6.5 Presentation of Findings of the Pre-Design Stage

Deliverables

3.8.6.6 Design Report updates including:

- Revisions to Program Goals and Objectives
- Updates to the Design Schedule

3.8.6.7 Programming Document updates including:

- Space Tabulation
- Index of Assembled Data including a brief description of each item

3.8.6.8 Cost Estimate

- Opinion of Probable Cost

3.8.7 Conceptual and Schematic Design

This work represents at a minimum the initial stages of design and shall be packaged for formal review at two distinct points: after the development of the major architectural and systems design concepts and again the completion of this stage of work.

This stage of design provides the framework for refining the Programming Document, formulating a design philosophy, and developing architectural and engineering systems solutions. The Conceptual and Schematic Design Stage includes the preparation of studies, drawings, diagrams, data sheets, and other documents illustrating the general scope requirements, restrictions, scale, and relationship of

components, for presentation and approval. The Schematic Design Stage documents must be clear enough to explain what the Program involves economically, legally, practically, and aesthetically.

Task

3.8.7.1 Evaluate Data and Formulation of Design Schemes

3.8.7.2 Expand Programming Document by Discipline

3.8.7.3 Investigate building systems.

- Typical building systems including mechanical, electrical, plumbing, and structural.
- Facility/Site Special Systems including audio-visual, and building management system(s).
- Circulation including elevators, escalators

3.8.7.4 Write Statement of Design Solution

Prepare a statement of design principles to be observed in the design of architectural and building systems throughout the Program.

3.8.7.5 Prepare Facility/Site Planning Studies

A/E is solely responsible for the planning of Facility/Site-related issues.

3.8.7.6 Generate Concept Design Alternatives to address:

- Public and staff service areas issues
- Functional space layouts
- Major facility systems
- General facility aesthetics
- Patterns of usage
- Site Layout

3.8.7.7 Security Features

3.8.7.8 Document the criteria provided for each specific project, a summary of how the facility meets or doesn't meet each major requirement or design element, and sketches as required to describe the Project site.

3.8.7.9 Facilitate schematic concept design review workshops

3.8.7.10 Select the optimal schematic concept design scheme in conjunction the Airport

3.8.7.11 Develop optimal scheme into a Schematic Design solution and prepare required submittals.

Deliverables

3.8.7.12 Schematic Design Presentation materials

- Schematic design narrative
- Site and plan organization

3.8.7.13 Update Design Report Expand to include systems descriptions, a brief evaluation of alternate systems and provide data and calculations as required to back up systems analysis as selected

- A detailed schedule of space allocation
- Architectural - spatial organization and sequence, standards for support services (restrooms, building services, curb, tenant areas).
- Civil/site design requirements - identify on-site/off-site utility loads and projected needs, storm, sanitary water, fire protection, drainage, site access, parking, site lighting, fences, etc.
- Structural - identify typical floor loadings; establish typical structural framing system; indicate range of structural steel (lbs./sq. ft.), and reinforcing (lbs./cu. yd.) quantities; describe special requirements for foundations and framing.
- Mechanical - identify energy source, equipment type and operation, HVAC loads, solar energy review, energy conservation factors, process systems, and space requirements.
- Plumbing – identify plumbing fixtures and systems.
- Electrical. - Provide electrical load criteria, and lighting levels including overall electrical load target.
- Security, alarm and control systems, access control and keying.
- Fire detection and alarm – describe systems and code requirements, list fire separation systems, fire and smoke detection, alarm and control.
- Building automation systems (intelligent building) Integration for communications, data management, security fire protection, HVAC, lighting, etc.
- Emergency and legal standby systems
- Public Address System
- Other
    - Acoustical requirements, if any, between exterior and interior of facility, and between interior spaces.
    - Landscaping, interiors, Fixed FF&E
- Inclusion of design guidance from Schematic design approvals

3.8.7.14 Schematic Specifications.

List proposed specification sections with short outline specification for materials and systems selected.

3.8.7.15 Schematic Design Drawings

- Scale as required to clearly describe the design
- Vicinity Plan - Area map showing major streets, access, major surrounding developments, transportation systems planned and existing, and the Facility/Site.

- Site Plan - Program as a roof plan, facility ground floor elevation, rough grading, all surrounding streets, roads, accesses, parking, walks, other constructed elements, and major landscape features. It is important that this plan clearly indicate truck loading locations, food service access, and the particular needs of special events staging and access related issues.
- Overall Floor Plans - showing floor layouts, square footages of the Program with spaces labeled as to use. Major and important dimensions shall be shown.
- Typical partial layouts at larger scale where needed for drawing clarity:
- Facility Elevations - (minimum scale 1"=16'), major elevations, indicating finish, with overall and floor-to-floor dimensions, rough grade elevations and descriptive notes.
- Facility Sections - (minimum scale 1"=16'), a minimum of one longitudinal and one transverse section, showing the most informative sections to explain the vertical organization of the facility. Floor elevations shall be shown.
- Wall Sections - Typical construction detail wall sections to explain the major construction systems and finishes proposed.
- Structural Drawings - (minimum scale 1"=16'), typical floor plan showing location of columns, beams and girders, type of floor system, foundation plans, substructure plans and superstructure plans to ascertain system and typical bay and any unusual structural details.
- MEP drawings - (minimum scale 1"=16'), showing locations of major equipment (boilers, chillers, AHU's) to verify rough sizes of mechanical rooms and plenum spaces, penthouse sizes, transformer and switch gear rooms, toilets, pump rooms, etc.
- Construction Phasing Plan- showing all major development for present and future growth, as required.

3.8.7.16 Code Analyses

Life Safety and Building Code Analysis

3.8.7.17 Design Calculations.

Overall Estimates of utility demands and system sizes

3.8.7.18 Cost Estimates.

Opinion of probably cost estimate based on the Schematic Design documentation.

3.8.8 Design Development Documents

This is the design stage when the final detailed scope, size and character of the Program is firmed up. Architectural forms and details are developed and structural, mechanical and electrical systems are refined to respond to the comments provided.

Tasks

3.8.8.1 Evaluate Data and Review Design

- Evaluate revisions to data.
- Review and revise the selected design scheme in response to changes in criteria, and comments.
- Confirm regulatory criteria through consultation with authorities and obtain preliminary approvals.

3.8.8.2 Prepare System Studies or provide recommendations for:

- Electronic signage
- Video/IT Systems
- Public address systems
- Infrastructure connections including but not limited to: water, sewerage, telecom, fire alarm, building management, lighting controls
- Assessment of existing capacities, and if inadequate, recommendations for augmentation.
- Locations of connection points
- Logistics of routing

3.8.8.3 Generate Design Development Documentation

Civil

- Civil layouts and calculations to be coordinated with Architectural and Landscaping. Review size and location of subgrade utilities with appropriate disciplines. Establish final scope of on-site and off-site engineering needs.

Architectural

- Develop and expand architectural design to define final scope, relationships, forms size and appearance of the Program through detailed drawings, three- dimensional sketches, working models, etc.
- Refine material selections, finishes and color schemes

Structural

- Develop selected structural system
- Verify loads, member sizes and clearances
- Final review soils analysis/test boring report and establish foundation approach

Mechanical

- Refine mechanical loads
- Confirm system and equipment selection, establish clearance requirements, equipment and chase locations
- Analyze energy conservation measures
- Coordinate loads with structural and electrical disciplines
- Size major duct lines
- Coordinate space requirements, clearances and visual impact Architectural
- Analyze acoustical and vibration requirements
- Develop diagrammatic fire protection and storm layouts
- Determine utility tie-in locations and routing

Electrical

- Verify electrical loading requirements with lighting levels, mechanical equipment, elevator equipment, and other power needs
- Coordinate lighting layout with lighting designer, Architectural and Interiors
- Establish equipment locations, shaft sizes and locations
- Select lighting features
- Requirements for the integration of the numerous controls and special systems into the existing Facility/Site infrastructure for these systems.
- Coordinate equipment loading, locations and space requirements with Mechanical, Civil, Structural, Landscaping, and Architectural disciplines.
- Determine utility tie locations and routing

Plumbing

- Refine plumbing calculations
- Confirm system and fixture and fitting selection, establish clearance requirements, equipment, distribution, and piping locations
- Analyze energy conservation measures
- Coordinating piping with structural and electrical disciplines
- Size major pipe lines

IT/Security/Audio Visual/Acoustical Plans

- Develop diagrammatic fire protection and storm layouts
- Determine utility tie-in locations and routing

Landscaping

- Design areas requiring soft and hardscaping
- Develop plant list
- Establish hardscape components list
- Coordinate lighting and service furniture requirements with other disciplines and City

Signage and Graphics

- Prepare Signage and Graphics program in accordance with City guidelines

Interior Design and FF&E

- Develop interior design furnishing and equipment layouts.
- Develop sketches and construction details of special design features. Develop furniture and finishes list to identify final scope.

Deliverables

3.8.8.4 Develop a complete list of projected drawings and specification sections to be included in Construction Document package

3.8.8.5 Design Development Presentation materials

- Rendered Perspectives of major exterior and interior spaces
- Material and Color Boards

3.8.8.6 Design Development Specifications

- General, special, and supplementary conditions ready for review and discussion with the airport.
- Comprehensive, abbreviated methods, materials, and systems descriptions in tune with the drawings.
- Selected equipment data sheets and material, fixture catalog cuts.
- Landscaping material information and requirements, soils and planting requirements, irrigation criteria, and other pertinent data and requirements.

3.8.8.7 Design Development Drawings: Scale as required to clearly describe the intent

General

- Cover sheet with pertinent information identifying Program, City, A/E firm(s), and all Sub-consultants.

Civil

- Site and Topo Survey
- Test boring/test pit plan
- Site Plan showing finish grading, legal property boundaries, setbacks and easements, rights-of-way, sewers, manholes, hydrants and other subsoil utilities and vaults, roads, drives, parking and paving, facility and equipment locations and dimensions. Demolition data shall be included if pertinent.
- Typical and special construction details for ramps, stairs, railings, paving types and patterns, light standards, fountains and exterior furnishings.

Architectural

- Plan drawings of all floors to a scale that clearly explains the designer's intent and indicates:
    - Overall building plan
    - Exterior wall type and thickness
    - Structural grid, including column locations
    - All interior fixed space layouts, i.e., facility cores, elevators, stairs, shafts, toilets, equipment rooms and interior partitions, including doors w/swing
    - Dimensions, space designations, floor elevations, door type and partition type indications, and other pertinent notes
    - Floor pattern plans as required for public spaces, circulation, and any other areas with special floor treatments
    - Built-in furniture and equipment location, clearly identifying items NIC or OFCI

- Blow up plans including furniture and equipment layouts, floor treatments as required for:
    - Detail plans and sections of core elements, clearly identifying clearances, shaft requirements and dimensions and special details for:
    - Stairs
    - Toilet facilities
- Elevations include the following:
    - Total full height of facades including roof structures, mechanical equipment enclosures.
    - All fenestration and louvers fixed and related to interior walls and internal floor heights.
    - Overall facility floor heights and slab elevations. Indicate location of facility and detail section
    - Indicate setbacks, facility profile relationship to adjacent (existing) buildings, expansion joints, etc.
    - Both graphically and by notes identify finishes, surface patterns, etc.
- Detail elevations to clarify key elements as required to augment facility elevations, including:
    - Building recesses, court yards
    - Typical building bay
    - Building entry
    - Fenestration patterns, divisions, and venting arrangements
    - Masonry patterns and coursing
    - Building sections, to explain changes in grade, overall floor-to-floor and floor-to-ceiling dimensions and clearances, at same scale as floor plans.
    - Indicate floor slab elevations, vertical dimensions, column lines, and label major spaces.
    - Transverse section
    - Longitudinal section
    - Detail wall sections, major different conditions at wall sections to convey basic building perimeter construction systems and materials clearly dimensioned and noted to show:
        - Foundation and below grade construction,
        - Typical wall construction,
        - Back up structure and abutting floor system,
        - Window type and location,
        - Exterior finishes (masonry coursing), insulation, and interior finishes, furring,
        - Mechanical penetrations,
        - Parapet and roof construction, and
        - Key all sections to elevations.

    - Large scale details (scale as required) for clarifying critical or relevant details, keyed to floor plans sections or other drawings as required for:
        - Window types, sill, mullions, jamb and head details, glazing type and venting
        - Hollow metal (typical only),
        - Frame types (typical only),
        - Metal and glass walls,
        - Special details for surface trim and finishes,
        - Special design related items, as required,
        - Built in furniture, counters, display cases and millwork,
        - Interior elevations of typical and special spaces interfaced with and cross- referenced floor and reflected ceiling plans,
        - Suspended ceiling lines, floor elevations and level changes,
        - Mechanical, electrical and structural conditions and restrictions,
        - Wall treatment and materials clearly identifying design intent, and
        - All pertinent notes and dimensions
- Reflected ceiling plans for typical and special spaces including exterior soffits and canopies if required. Indicate:
    - Lighting layout,
    - Soffits, coves, furring treatments,
    - Skylights,
    - Ceiling material, special features,
    - Acoustical treatments,
    - Relationship with partitions,
    - Interface with window details,
    - Access panels,
    - HVAC registers, etc.
    - Exposed structure,
- Schedules - keyed to floor plans and elevations, listing:
    - Interior finishes,
    - Doors and frames,
    - Door Hardware,
    - Windows and glazing,
    - Louvers, and
    - Partition Types.

Structural

- Foundation plan and typical details.
- Floor plans at same scale as architectural.
- Typical floor framing plans, including sizing of beam drops, slab openings, thickness and depressions.

- Framing indication and governing sizing at roof structures, penthouse and bulkheads and the like.
- Non-typical framing scheme where required for lobby, floors at grade, and the like.
- All column indications established
- Final column schedule
- Preliminary details and sections to adequately indicate structural system.
- Preliminary details for major unique conditions that impact on scheme
- Details indicating accommodation with mechanical/electrical at areas of major interface.

Mechanical

- Typical system requirements and special conditions for HVAC, plumbing, waste, fire protection and control systems and in any interfaces with other disciplines and existing systems
- Typical floor plans by system, as required, at same scale as architectural, showing single line distribution systems, locating major equipment and size and clearance requirements, showing shafts (dimensioned) chases, mechanical rooms and required floor/wall penetrations.
- Plans (of special floors, lobby, roof, other) showing equipment locations and clearance requirements for boiler, air handling and cooling equipment; provide sections as required
- Special details for equipment such, fire water pumps, etc.
- Equipment room layouts at 1/4"= 1 '-0" minimum scale.
- Flow diagrams, riser diagrams, etc.

Electrical

- Typical and special requirements for electrical work including interfaces with other systems and Facility/Site-wide infrastructure
- Typical floor plans, at same scale as architectural showing shaft locations, typical and special lighting and power requirements, showing single line power distribution system, locating major equipment, size and clearance requirements including height.
- Plans of special equipment rooms (panel, Motor Control Centers, transformers, generators, control panels, UPS, etc.), indicating critical dimensions at 1/4"= 1 '-0" minimum scale.
- Riser and other diagrams to explain communication system, data, security, fire and smoke detection/annunciation, etc.
- Single Line Diagram summarizing overall electrical distribution system.

Plumbing

- Typical system requirements and special conditions for plumbing related to HVAC, fire protection, storm, and control systems and in any interfaces with other disciplines and existing systems
- Typical floor plans by system, as required, at same scale as architectural, showing piping, fixtures, locating major equipment and size and clearance requirements, showing shafts (dimensioned) chases, and required floor/wall penetrations

- (Plans of special floors, lobby, roof, other) showing equipment locations and clearance requirements
- Special details for plumbing fixtures
- Floor diagrams, riser diagrams, etc.

IT/Security/Audio Visual/Acoustical Plans

- Develop diagrammatic fire protection and storm layouts
- Determine utility tie-in locations and routing

Landscaping

- Landscaping planting plans and detailed plant material schedules.
- Large scale plans to describe areas requiring detailed definition.
- Elevations and sections at a scale and quantity as may be necessary to explain the design
- Typical and special construction details for ramps, stairs, railings, paving types and patterns, light standards, and exterior furnishings.

Signage and Graphics

- Major Signage schedule
- Major mounting details unique to the Program

Interiors and FF&E

- Large scale plans of area requiring FF&E
- Typical FF&E details

3.8.8.8 Code Analyses

- Fire and life safety codes
- Sprinkler Design requirements
- Hazardous materials handling
- Electrical Safety
- ADA compliance

3.8.8.9 Cost Estimates

- Update opinion of probable cost estimate based on the Design Development documentation.

3.8.9 Construction Documents

The Construction Document Stage consists of the preparation of detailed drawings and specifications to identify the specific materials, quantities, methods and systems required to build the Program. All Value Engineering items identified in the Design Development phase and accepted by the Airport shall be incorporated into the documents by completion of this phase.

Tasks

3.8.9.1 Present final design, material and color selections to Airport for approval

3.8.9.2 Develop Construction Specifications and Drawings for submittal at the agreed upon milestones in the design schedule. The following are the minimum requirements and should be thorough and completed consistent with the standard of practice.

- Check and coordinate all documents
- Complete Construction Specifications
- Complete Construction Drawings
- Complete Design Calculations for all systems
- Compile documents to be issued for Information Only (Product information, data sheets, etc.)

3.8.9.3 Submit 90% Construction Drawings and Code Analysis to regulatory and building departments for conformance to Fire and Life Safety codes

- Respond to City's comments and Code Official's comments, and incorporate agreed upon changes to stamped and sealed Final Deliverables.

3.8.9.4 Provide a Professional signature and stamp where required by law.

Deliverables

3.8.9.5 Construction Document Presentation Materials

- Material and Color Boards
- Renderings showing significant exterior and interior materials and color selections
- Systems presentation material for technical review

3.8.9.6 Contract Specifications

- Supplemental and General Conditions
- All Divisions or as required
- Sections to be "Issued for Information Only", such as those for City Furnished Equipment.
- List of Design-Builder Submittals as required in the Contract Specifications

3.8.9.7 Contract Drawings

General

- Cover sheet with pertinent information identifying Program, City, A/E firms and major Sub-consultants
- Drawing Index sheet(s) listing all drawings in the package.
- Legend, symbols, abbreviations and general notes sheet. This should be a common sheet for all disciplines.
- Building Code Analysis per the requirements of the Fire Marshal of the City of San Antonio

Civil

- Detail site plan
- Plan drawings that clearly explain the design intent, completely dimensioned to facilitate construction. Included are:
  - Demolition plan
  - Excavation plan
  - Grading and drainage plans, including existing and modified contours
  - Utility routing plans
  - Utility detail plans
  - Paving and roadway alignment plans
- Profile drawings shall include:
  - Storm sewer
  - Sanitary sewer
  - Potable/fire water
  - Irrigation water
  - Power/telephone duct banks
- Sections of utilities and paving including
  - Duct bank sections

Architectural

Plan drawings of all floors (1/8"=1'-0" scale) indicating:

- All building walls and partitions showing type, materials and thickness
- All interior fixed space layouts
- All dimensions, space designations and numbers, floor elevations, door type/swing, window type and operation, finishes and other pertinent notes
- Built-in furniture and equipment locations, clearly indicating items NIC or by City
- Building sections and interior and exterior elevation keys
- Structural grid and column indications

Detail plans for toilets, building core, stairs, elevators, shafts, equipment rooms, etc., indicating:

- Dimensions, clearances and space designations
- Furniture and equipment layouts
- Structural grid including column locations
- Wall and partition thickness
- Door and door swings
- Floor patterns

Elevations showing:

- Complete facades including roof structures and other features
- Fenestration, louvers and other facade elements fixed and related to structural grid and internal floor heights
- Overall building heights and floor elevations
- Location of building and detail section cuts
- Setbacks, building profile relationship to adjacent buildings, expansion joints, etc.
- Finishes and surface patterns, etc., graphically and by note

Detail elevations depicting key elements as necessary to supplement building elevations, including:

- Building recesses, court yards
- Typical bay
- Building entry
- Fenestration patterns, divisions and venting
- Masonry patterns and coursing
- Ornamentation features

Building sections

- Showing changes in elevation, floor-to-floor and floor-to-ceiling dimensions, with major spaces labeled. Include transverse and longitudinal sections as required to describe the facility design.
- Detail wall sections, major different conditions at wall sections to convey basic building perimeter construction systems and materials (3/4" scale) clearly dimensioned and noted to show:
    - Foundation and below grade construction
    - Typical wall construction
    - Back up structure and abutting floor system
    - Window type and location
    - Exterior finishes (masonry coursing), insulation, and interior finishes, furring
    - Mechanical penetrations
    - Parapet and roof construction
    - Key all sections to elevations

Large scale details (scale as required) for clarifying critical or relevant details, keyed to floor plans sections or other drawings as required for:

- Window types, sill, mullions, jamb and head details, glazing type, and venting
- Hollow metal (typical only)
- Frame types (typical only)
- Metal and glass walls
- Special details for surface trim and finishes
- Special design-related items, as required

- Built-in furniture, counters, display cases, and millwork
- Interior elevations of typical and special spaces, interfaced with and cross-referenced floor and reflected ceiling plans.
- Suspended ceiling lines, floor elevations, and level changes
- Mechanical, electrical, and structural conditions and restrictions
- Wall treatment and materials clearly identifying design intent
- All pertinent notes and dimensions.

Reflected ceiling plans for typical and special spaces including exterior soffits and canopies if required. Indicate:

- Lighting layout
- Soffits, coves, furred building features
- Skylights
- Ceiling material, special features
- Acoustical treatments
- Relationship with partitions
- Interface with window details
- Sprinklers
- Access panels
- HVAC registers, etc.
- Exposed structure

Schedules - comprehensive, keyed to floor plans and elevations, listing:

- Interior finishes
- Doors and frames
- Door Hardware
- Windows and glazing
- Louvers
- Partition Types

Structural

- Foundation Plan(s) at same scale as architectural plans including:
    - Foundation layout.
    - Footing elevations
    - Column grid
    - Typical and special details
- Floor Plan(s) at same scale as architectural plans showing:
    - Floor elevations
    - Column grid
    - Floor openings
    - Section and detail indications

- Framing Plans including:
  - Beam, girder and joist sizes
  - Slab openings and depressions
  - Slab elevations
  - Section and detail indications
  - Roof Plan(s) similar to floor plan
- Sections
  - Typical trusses, beams, girders and joists
  - Columns and foundations
  - Walls
- Schedules
  - Details
  - Footing
  - Truss
  - Beam
  - Joist
  - Column

Mechanical

- Mechanical drawings shall indicate all requirements and special conditions for HVAC, plumbing, waste, fire protection and control systems
- Site Plan indicating connection to offsite utilities
- Floor Plans for each system, at same scale as architectural, showing:
  - Detailed system layouts indicating sizes of system components
  - Location of mechanical equipment rooms
  - Location of all equipment required for system operation, showing clearances and interfaces with other equipment
  - Complete extent of system routing, including connections to existing systems
- Large Scale Plans
- Sections
- Riser diagrams
- Equipment and Fixture Schedules
- Details

Electrical

- Electrical drawings shall indicate all requirements and special conditions for electrical, electronic, lighting, communications, data transmission, fire and smoke detection and alarm, security, and control systems.
- Site Plan indicating on-site distribution and connection to off-site service, street and parking lighting system, and irrigation system.

- Floor plans, for each system, at same scale as architectural, indicating the location of:
  - Power distribution and supply
  - Lighting
  - Fire and smoke detection and alarm
  - Communications (telephone, data, public address)
  - LAN for special systems
  - Complete extent of system routing, including connections to existing systems
  - Security System (access control, IDS, CCTV)
  - EMCS for HVAC Control System and Lighting Control System
- Large Scale Plans (X" = 1 '-0") showing:
  - Equipment rooms
  - Panels and MCC's
  - Transformers
  - Generators
- Riser Diagrams
  - Security
  - Fire alarm
  - LAN
  - Communications
- Schedules
  - Panel boards
  - Luminaires
  - Conduit and Wire
  - MCC's
  - Details
- Single Line Diagrams

Plumbing

- Typical system requirements and special conditions for plumbing related to HVAC, fire protection, storm and control systems and in any interfaces with other disciplines and existing systems
- Typical floor plans by system, as required, at same scale as architectural, showing piping, fixtures, locating major equipment and size and clearance requirements, showing shafts (dimensioned) chases, and required floor/wall penetrations.
- Plans of special floors, lobby, roof, other showing equipment locations and clearance requirements.
- Special details for plumbing fixtures.
- Floor diagrams, riser diagrams, etc.

IT/Security/Audio Visual/Acoustical Plans

Landscaping

- Layout Plans showing:
  - Overall site layout
  - Special pavements
  - Retaining Walls, steps, and ramps
  - Site furniture
  - Lighting fixtures
  - Special vehicular areas and pedestrian circulation
  - Water features
  - All other elements as included in the program
- Grading Plans at same scale as layout plans, including:
  - Elevations of various terrain or paved levels
  - Elevations of retaining walls, steps and ramps
  - Elevations of decks and walkways
  - Location of all drainage structures
  - Indication of surface water runoff
- Planting Plans at same scale as layout plan, showing quantity, size and description of the following:
  - Trees and shrubs
  - Groundcover
  - Specimen material
  - Planting details
- Irrigation Plans at same scale as planting plan, to include:
  - Irrigation head layout
- Exterior Lighting Layout Plans indicating:
  - Landscape uplighting
  - Walkway lighting
  - Activity areas lighting
- Exterior Details, Sections and Blow-ups (scale according to complexity) for:
  - Paving, steps and ramps
  - Lighting fixtures
  - Retaining walls and railings
  - Drainage and curbing
  - Site furniture
  - Planting

Signage and Graphics

- Schedule of all signage
- Large scale elevations of each sign type
- Mounting details

Interior and FF&E

- Furniture layouts
- Fixture layouts, elevations and details
- Equipment layouts, elevations and details

3.8.9.8 Code Analyses – A/E to provide code analysis of each of the following:

- Final Fire and life safety codes
- Final Sprinkler Design requirements
- Final Hazardous materials handling
- Final Electrical Safety
- Final ADA/TAS compliance
- Final Facility/Site related regulations

3.8.9.9 Design Calculations

- Final Design Calculations for Civil, Structural, Mechanical and Electrical disciplines
- Final calculations as required to support Code Analyses

3.8.9.10 Cost Estimates

Update opinion of probable cost estimate based on the Issue for Construction Documents

3.8.9.11 Drawing Documentation and native files in electronic format.

3.9 Construction Administration

The Construction Administration activities provide support to the Construction Process for the duration of the Construction period and beyond, until Program closeout. The Construction Administration documents must be clear enough to be useful to the Airport's personnel as a long-term resource.

3.9.1 Submittals

3.9.1.1 Review of subcontracted construction and material supply and how it relates to the construction documents and design intent.

- Product data
- Systems design, including shop drawings, calculations, performance verification
- Installation requirements
- Maintenance data
- Operations data, including training materials
- Warranties
- Testing and inspection data

3.9.1.2 Maintain a log of all submittals required in the Contract Specifications and their status

3.9.1.3 Review and take action on all submittals as many times as required to solve construction issues

3.9.1.4 Provide and maintain Control Samples at the Jobsite

3.9.2 Periodic observations

Provide on-site observations for all disciplines at a frequency appopriate to the observed activities to ensure aesthetic quality and design integrity.

3.9.3 Change Order Documents

- Drawings and Specifications
- Change Order cover documents

3.9.4 Responses to RFIs

3.10 Construction Tasks and Deliverables

3.10.1 Construction services will include but not be limited to:

- Construction Design and Planning
- Scheduling and Cost control
- Subcontracting and Procurement
- Project Coordination
- Testing, Material Testing Coordination and Inspection
- Coordination

3.11 Construction Phase

Prior to the beginning of a Construction Project, the Security Division will need to determine if their involvement and/or TSA involvement is required. The Airport Security Program (ASP) describes how the airport, and all internal and external users of the airport will comply with federal regulations and mandates relating to aviation security. Prior to the request being submitted to TSA, a coordinated walk thru and/or review of plans must be conducted with Airport Security – Compliance.

A Security Vulnerability Assessment will then be performed that weigh the appropriate security and safety measures to current security threats & risks, and to fulfill TSA requirements. This assessment may impact the existing airport security posture and measures and could include recommending or mandating modifications to the projects to meet the minimum security requirements. TSA requires a minimum 60 calendar days prior to start date for review. During the duration of the project/ event Airport Security- Compliance should be included in all meetings.

For all security related items, please refer to the Security Plan (Need Link).

For all initial construction activities, SAPD needs to be involved in escorting individuals in sterile areas when not badged and monitor traffic closures.

3.12 Baseline Construction Schedule

- The Baseline construction schedule is the final approved construction schedule that indicates the start and finish of construction and shows the order in which the Design-Builder/Contractor proposes to carry out the construction work.
- Prior to Construction Notice to Proceed, provide a recommended list of Submittals that the City should approve.
- Provide a Construction Progress Schedule: The Construction Progress Schedule, is a required monthly submittal showing construction process as it relates to the approved Baseline Construction Schedule.

3.13 Construction Design and Planning

3.13.1 Overall Phasing and staging plans

3.13.1.1 Prior to detailed work on construction phasing, prepare for review by Airport conceptual construction operations and traffic maintenance plans indicating for each phase the flow of vehicular and pedestrian traffic (traffic management), temporary barricades, facilities and roadways, traffic control and protection, temporary HVAC services, and project schedule milestones.

3.13.1.2 Graphic drawing accompanied with descriptive text for each proposed phase of construction is a minimum requirement.

3.13.1.3 Overall phasing plans for each phase of construction with detail notes accompanied with each disciplines' separate detail drawings prepared for each phase of construction is a minimum requirement.

3.13.1.4 The Project will involve significant construction improvements in a physically constrained, heavily traveled environment. Contractor shall meet with Airport to review working hour and roadway lane restriction requirements.

3.13.1.5 Contractor shall develop temporary signage plans for various phases of construction. These plans shall be submitted to Airport for review and acceptance.

3.13.1.6 Contractor shall verify that the Project is constructible and that traffic impacts are minimized, and public safety is not compromised.

3.14 Phasing/sequencing requirements

3.14.1 Facility/Site Events

3.14.1.1 Where applicable schedule construction operations to allow existing facilities to remain in uninterrupted service during scheduled operations. Do not perform any construction operation prior to receiving a review and acceptance from SAT PM, which also will coordinate with the affected stakeholders.

3.14.1.2 Provide temporary dust proof enclosures and protection as required to sequence construction and maintain event operations.

3.15 Monthly Phasing plans

3.15.1.1 Each month contractor shall submit the Monthly Phasing Plan. The Phasing Plan will indicate the next calendar (thirty [30] days) work in graphic and written format.

3.15.1.2 Show all normal public, Facility/Site operational circulation impacts, the need for temporary facilities, security impacts, equipment locations, and changes affecting current crane permits.

3.15.1.3 Indicate any creation of temporary hazardous conditions such as excavations, fuel storage, welding, lifts and cranes for unloading materials, and pavement cutouts near walking areas.

3.15.1.4 Show all Temporary Facilities that will be in use during the next thirty (30) calendar days.

3.15.1.5 Identify dates during the next thirty (30) calendar days when utility interruptions are anticipated.

3.15.1.6 Identify equipment placements, haul routes, access routes, safety concerns, parking, material staging areas, significant areas of work, note temporary signage, etc.

3.15.1 Haul routes

Contractor shall be responsible for developing construction haul routes for the Project including haul route requirements and impacts to traffic and ground transportation facilities. Prepare haul route plans and submit them to Airport for review and acceptance.

3.15.2 Roadways and parking

The following are Airport objectives to be achieved in phasing sequencing of roadway and parking activities:

- Electrical power shall not be disturbed to offices, entrances, exits, and lighting.
- Integrity of the parking perimeter shall not be compromised.
- Queuing areas must be in place for entrances and exits.
- Clear signage for entry and exit of the parking shall be in place at all times.

3.15.3 Notice of changes

Establish a procedure to give adequate notice to tenants (event organizers, concessionaires, etc.) of changes that may impact them.

3.16 Project Coordination

3.16.1 Coordination with other concurrent projects

3.16.1.1 Develop a procedure to coordinate access, including elevator access, to all tenant areas during the same hours construction is taking place. Loading and stocking shall occur during off hours for which the event subcontractor shall be responsible for the overtime PREMIUM of the hoist/elevator operator.

- Develop a procedure for permitting visitors to the construction area.
- Coordinate tenant contractor access to building systems and utilities.

3.17 Commissioning

The energy-related systems that will be included in the commissioning process activities include as a minimum.

- Heating, ventilating, air conditioning, and refrigeration (HVAC&R) systems (mechanical and passive) and associated controls
- Lighting and daylighting controls

3.17.1 Reports

Commissioning Report, prepared with the City and by the independent Commissioning resource providing all performance testing, and verifying that the Project's related systems are installed and calibrated and perform as intended.

Written report of each test/inspection, including complete details of conditions, methods, and results shall be signed by responsible individual.

3.17.2 Reference standards

Where products or workmanship is specified by reference to a document not included in the Contract Documents, comply with the requirements of the document, except where more stringent requirements are specified compliance with the more stringent requirement is necessary.

3.18 Off-site storage

With prior approval by Airport and in the event, Contractor elects to store materials at an off-site location, abide by the following conditions, unless otherwise agreed to in writing by Airport.

3.18.1 Store materials in a commercial warehouse meeting the criteria stated below.

- Provide insurance coverage adequate not only to cover materials while in storage, but also in transit from the off-site storage areas to the Project Site.

- Inspection by City's representative is allowed at any time. City's inspectors must be satisfied with the security, control, maintenance, and preservation measures.
- Materials for this Project are physically separated and marked for the Project in a sectioned-off area.

3.19 Project Closeout

3.19.1 Record Drawings

Throughout construction, maintain mark-ups of Construction Drawings documenting

- All significant changes made during construction
- Locations of field-routed systems
- Accurate locations for concealed systems routing, particularly those buried or cast in concrete.
- Connection and tie-in data
- Update electronic Construction Drawings and/or Shop Drawings as required in accordance with the SAT BIM Standards.

3.19.2 Operations & Maintenance Manuals

Assemble each operation and maintenance manual using the manufacturer's latest standard commercial data and include all additional information is unique to the Project. The manual shall incorporate any comments made on the previous submittals, along with final readings on all settings and gauges taken while the system is in fully satisfactory operation.

3.19.3 Warranties

A legal "warranty" is an assurance by one party of the existence of a fact on which another party can rely. Include a copy of all guarantees and warranties issued to, and executed in the name of, the City. The Contractor shall verify with the City that all Warranties and Bonds have been completed, executed, submitted, and accepted.

3.19.4 Training

Each Operation and Maintenance Manual shall include training course material used to train airport staff, including slides and other presentation material. Coordinate training sessions with the SAT PM and required stakeholders. All training sessions will be recorded.

3.20 Quality Assurance and Quality Control

3.20.1 Design Phase

During the project set up stage, each A/E will provide to the SAT PM their team's plan to coordinate quality control prior to each milestone. It is recommended for a third party team member not associated with the project to provide this review prior to each milestone.

3.20.2 Construction Phase

The Quality Control Program primarily consists of applying a three-phase control approach to each definable features of work (DFOW)

Phases

3.20.2.1 Definable Features of Work (DFOW)

- A definable feature of work is typically defined as a task which is:
  - Separate and distinct from other tasks
  - Has a separate control requirement
  - May be identified by different trades or disciplines
- In order to manage the quality control of the various scopes of work the Project Team will create a Definable Features of Work

3.20.2.2 3-Phase Quality Control System

- Quality Control (QC) consists of tests, inspections and observations before installation commences, during first work-in-place, and periodically while installation continues
- The 3 phases of Quality Control are:
  - Preparatory Phase
  - Initial Phase
  - Follow-up Phase
- The three phases noted above are to be performed for each DFOW. These phases of QC allow to plan, schedule, and install work in an orderly, consistent way that minimizes reworkList for the project

3.20.2.3 Preparatory Phase

- This phase will be held prior to beginning any work on any definable segment of work, according to the following steps:
  - A review of each paragraph of applicable specifications
  - A review of the contract plans
  - A check to assure that all materials and/or equipment have been tested, submitted, and approved
  - A check to assure that provisions have been made to provide required control inspections and testing
  - An examination of the work area to assure that all required preliminary work has been completed and is in compliance with the contract

- The SAT PM/OWNER/OWNER'S REP shall be notified at least 48 hours in advance of beginning any of the required action of the preparatory phase. This phase shall include a meeting conducted by the CONTRACTOR Project Team
- The goal of this meeting is to focus CONTRACTOR and subcontractor's quality efforts on preventing deficiencies rather than detecting deficiencies and will include discussions of the following (but not limited to) topics:
    - A review of the appropriate job hazard analysis to assure preventative safety measures are in place. Discuss and document the specific safety measures for each scope of work
    - Procedures for constructing the work including repetitive deficiencies. Documentation of the construction tolerances and workmanship standards applicable to the phase of work. The Contractor shall instruct applicable workers as to the acceptable level of workmanship required to meet contract specifications
    - Discuss and document the anticipated production rates and milestones to complete this scope of work

3.20.2.4 Initial Phase

- This phase is to be performed as soon as a representative segment of the item of work has been accomplished
- Initial Phase inspections are tentatively scheduled at the Preparatory Meeting and are held once work has commenced
- The features of an Initial Phase inspection are as follows:
    - A check of preliminary work to ensure it is following contract requirements. Review minutes of the preparatory meeting
    - Verification of full contract compliance. Verify and document required control inspection and testing on the Inspection/ Testing Log
    - Establish level of workmanship and verify that it meets minimum acceptable workmanship standards
    - Resolution of all differences
    - Safety check to include compliance with and upgrading of the safety plan and activity hazard analysis. Review the activity analysis with each worker and compare to procedures documented in the Preparatory Phase
    - Schedule verification to ensure that progress milestones are appropriate and achievable. Compare to the anticipated production rates documented in the Preparatory Phase
    - The SATPM/OWNER/OWNER'S REP shall be notified at least 24 hours in advance of beginning the initial phase. Exact location of initial phase shall be indicated for future reference and comparison with follow-up phases

3.20.2.5 Follow-up Phase

- Follow-up inspections are to be performed daily or as frequently as necessary to assure continuing compliance with contract requirements until completion of the particular segment of work. These inspections will include:
    - Examine the quality of workmanship

    - Review and documenting of control testing and test results
    - Examine for use of defective or damaged materials and review corrective measures required
    - Check for dimensional requirements
    - Verify safety compliances continue to be met
    - Verify progress milestones are being met
- Final follow-up checks shall be conducted, and all deficiencies corrected prior to the start of additional features of work which may be affected by the deficient work. The Contractor shall not build upon or conceal nonconforming work.
- NOTE: Additional preparatory and first initial phase inspections will be conducted on the same construction activity if:
    - The quality of on-going work is unacceptable
    - There are changes in the responsible third party QC consultant's organization
    - There are changes in onsite production supervision or work crews
    - Work on a construction activity is resumed after a substantial period of inactivity, or
    - Other problems develop

3.20.2.6 Testing

- As a part of the site-specific QCP the CONTRACTOR Project Team will prepare a Testing and Inspection Plan for the project outlining inspections and tests required by the contract documents
- Based on the requirements of the specifications, information on the Testing and Inspection Plan will include:
    - Who will perform the inspection or test
    - Test or inspection description
    - Test or inspection frequency
    - CONTRACTOR QCA will maintain a project inspection and testing log with documentation of all inspections and testing performed for CONTRACTOR and all subcontractors' scopes of work
- Quality control testing on this project will be done by a third party testing lab. Results of all tests and inspections performed by Testing lab will be submitted to the QCA in a detailed report

3.20.3 Non-conformance Tracking Procedure

3.20.3.1 Whenever a member of the CONTRACTOR Project Team, owner, architect or consultant notes a non-conformance, partially complete or complete, installation of the item in question will not continue until the non-conforming work is corrected and conforms to the requirements of the contract documents

3.20.3.2 Non-conforming items are described on a Non-Conformance Report (NCR) and tracked on a Non-Conformance Report Log

3.20.3.3 CONTRACTOR Project Team is responsible for tracking its non-conforming work and the same for work performed by all subcontractors. Any item that is not corrected immediately will be recorded on the Non-Conformance Report Log

3.20.3.4 The CONTRACTOR non-conformance procedure is as follows:

- Non-conforming work items are recorded on a NCR Form with a unique tracking number and tracked on a NCR Log
- CONTRACTOR QCA will update the NCR Log indicating the status of NCR's in process
- After the corrective action(s) are complete, the work will be verified and documented by CONTRACTOR QCA
- If the corrective action is acceptable to all parties, the NCR will be closed and the NCR Log updated accordingly

3.20.3.5 In some cases, the disposition may be "accept as is" with no rework or corrective action(s) required, as approved by owner, architect, consultant or building official, as applicable. In these cases, the NCR will be closed and the NCR Log updated

3.20.4 Inspections

3.20.4.1 Punch-Out Inspection

- When the work is substantially complete a Punch-Out Inspection will be conducted by the CONTRACTOR to verify quality, workmanship, and completeness
- Administrative items will be reviewed for submittal and approval:
  - As-built drawings
  - Any applicable operation and maintenance manuals
  - Other items required by specification sections
  - Name, phone number, and address of the warranty single point of contact
- A punch list will be prepared during the walk-through and reviewed with all parties. Comments and observations will be documented and an estimated date by which deficiencies will be corrected will be noted on the punch list

3.20.4.2 Pre-Final Inspection

- The Pre-Final inspection will take place as soon as possible after the Punch- Out Inspection and upon notice from the Contractor that all items noted during the Punch-Out Inspection have been corrected
- The purpose of the Pre-Final Inspection is to ensure proper completion of the contract document requirements. The parties responsible for verification of completion will be present and identified
- At this inspection the Owner Designated Representative, and/or Design Team will develop a specific list of incomplete and/or unacceptable work and will subsequently furnish this list to the Contractor

3.20.4.3 Final Acceptance Inspection

The Final Acceptance Inspection will be conducted by Owner and consultant(s). All specific items previously identified through the previous inspections will have been corrected and all remaining work will be complete and acceptable prior to date of Final Inspection. A listing of incomplete or unacceptable work will be developed by the Owner and consultant(s) and furnished to the CONTRACTOR.

3.21 Glossary

A/E Any consultant (team) under contract with SAAS to perform design services. This term also includes the design builder depending on the procurement method.

Airport Reference to the client, this may include any entity within the San Antonio Airport System.

Contractor Under contract with SAAS to perform construction services from mobilization through project completion. This term also includes the design builder depending on the procurement method.

SAT PM Main point of contact between the A/E and the Airport. This role may be fulfilled by the following, but not limited to a city designated representative, project manager, or director.

ADA	Americans with Disability Act
AICC	Airport Integrated Control Center
AHU	Air Handling Unit
ARFF	Aircraft Rescue and Fire Fighting
ASP	Airport Security Program
BIM	Building Information Modeling
BMS	Building Management System
CBP	Customs and Border Patrol
CD	Contract Documents
CHRC	Criminal History Records Check
DD	Design Development
DFOW	Definable Features of Work
DR	Design Report
DSD	Development Services Department
FF&E	Furniture, Fixtures and Equipment
HVAC	Heating, Ventilation and Air Conditioning
MEP	Mechanical Electrical Pluming
NCI	New Construction Inspection
NCR	Non-Conformance Report
OAC	Operations Advisory Council
OFCI	Owner Furnished-Contractor Installed
PD	Programming Document
QC	Quality Control
QCP	Quality Control Plan
RFI	Request for Information
SAAS	San Antonio Airport System
SAPD	San Antonio Police Department
SAT	San Antonio International Airport
SD	Schematic Design
SIDA	Security Identification Display Area
STA	Security Threat Assessment
SUE	Subsurface Utility Engineering
TSA	Transportation Security Administration
USO	United Service Organizations

04

SAN ANTONIO INTERNATIONAL AIRPORT

Photo by Alexia Rodriquez

4.1 Landscaping

4.1.1 Landscaping Design

Landscaping is a vital part of the airport's sense of place and can have a soothing effect on stressed travelers. It needs to reflect San Antonio's natural environment and that of the surrounding region. It will serve as a familiar welcome to residents and will help form an inimitable first impression for visitors. With this in mind, landscaping should be aesthetically pleasing, adapted, and approved by the Airport to ensure safety for both visitors and aircrafts.

Because landscaping at an airport has the potential to create wildlife attractant issues, the FAA has issued Advisory Circulars that address a variety of landscaping concerns. An FAA Advisory Circular (AC) is guidance that must be adhered to by all FAA Part 139 certificated airports or airports that receive federal funding, of which SAT is included under.

4.1.1.1 Required Reviews

- Review with Horticulture is required by the Design Team at the planning stage for any landscaping designs.
- Review with City Arborist for landscaping requirements.
- All new or changes in any landscape plan must be approved by the airport Wildlife Biologist and Airport Horticulturist.

4.1.1.2 FAA AC 150/5200-33B provides guidance on certain land uses that have the potential to attract hazardous wildlife on or near public-use airports. Section 2-7 of this AC states: "Airport operators should ensure that plant varieties attractive to hazardous wildlife are not used on the airport. Disturbed areas or areas in need of re-vegetating should not be planted with seed mixtures containing millet or any other large-seed producing grass."

4.1.1.3 Thinning the canopy of trees, or selectively removing trees to increase their spacing, can help eliminate bird roosts that form in trees on airports."

- An approved list of trees, shrubs, and ground cover for vegetation is comprised of species screened by SAT's maintenance staff for general attractant features such as fruit, berries, height, density, branching structure, crown shape, planting density and arrangement, and location relative to the airfield and significant habitat features.

4.1.2 Materials

Materials list for SAT Airport shall be defined with both FAA Requirements and the San Antonio Requirements.

4.1.3 FAA Vegetation Cover Requirements

This is not intended to replace landscape designer plans for developed sites where decorative landscaping involving trees, shrubs, mulch, planting beds and decorative grasses are used. Deviations or changes to the listed types or the use of any native flowering plants such as naturalization with wild flower attempts must pre-approved by the airport's Wildlife Administrator before receiving a building permit. For more information, refer to the FAA Advisory Circular 150/5200-33A for Hazardous Wildlife Attractants on or Near Airports and FAA Advisory Circular 150/5370-10H (or most recent version), Standards for Specifying Construction of Airports.

For the purposes of the airport, the following definitions describing use and mowing pattern shall control what vegetation seed or sod is allowed. Non-Public areas routinely mowed are the Air Operations Area and open fields on the approach or take off path leading to the runways. Non-public areas not routinely mowed are open fields not close by any road system or any buildings on the airport (i.e undeveloped land). Lawn or Public use areas are developed areas around buildings and streets, will be mowed regularly with irrigation.

- Permanent Warm Season Mix (planting window April 15 – August 30)
  - Bermuda Cynadon dactylon
  - Buffalo Grass Bouteloua dactyloides (AKA Buchloe dactyloides)
- Temporary Cool Season (planting window September 1 – April 14)
  - Perennial Rye Lolium perenne (must be mowed short by April)
  - Tall Fescue Festuca arundinacea

4.1.4 Site Design Elements

In Areas along Roadways, parking lots, and building facades A/E shall use the CoSA design standards for development of the plans for each specific project with the boundary of the Airport. This includes Low Impact Development Standards as a best practice, and the use of the CoSA Core Elements for design. Specific materials shall represent San Antonio vernacular. These elements could include but are not limited to the following:

4.1.4.1 Design Characteristic:

- Limestone or materials that emulate native stone
- Natural Wood Colors such as pecan or mesquite
- Design influences of historical stone missions with a sense that things are built to last and are locally available.
- Landscape should establish a sense of place, used as guides or wayfinding, and be calming and relaxing to the visitors.

4.1.4.2 Planting:

- Adaptive and Natives. Provide Xeriscaping where feasible.
- Avoid Palm Trees
- Flowering good, but avoid Fruit bearing (FAA restrictions)
- Avoid Cactus (Maintenance issue)
- Hearty Vegetation that can be trimmed regularly
- Smaller trees preferred to deter wildlife and dimensions. The A/E to review with Horticulture and the Wildlife Biologist to identify the maximum size over the lifespan and how far away from the curb.

4.1.4.3 San Antonio Airport Systems Approved Plant List

- Understory - Crape myrtle, Vitex, Yaupon Holly, Texas Mountain Laurel, Mexican Buckeye, Texas Redbud, Mexican Olive, Evergreen Sumac, Desert Willow, Prairie Flameleaf Sumac, Texas Persimmon, Huisache, Retame, Western Soapberry, Mesquite, Eve's Necklace

- Shrubs - Compacta Cenizo, Blue Twister Sotol, Pride of Barbados, Giant Hesperaloe, Arizona Yellow Bells, Agarita, Spineless Prickly Pear, Weber's Agave, Texas Lantana, Rock Rose
- Palm - Texas Sabal Palm
- Grasses - Bermuda grass

4.1.4.4 Seeding – See the Appendix of this chapter for Seeding Standards.

4.1.4.5 Wildlife Mitigation Landscape Requirement San Antonio Airport System

Due to the potential hazard that birds and wildlife create on and around airports, The FAA has issued an Advisory Circular AC. 150/5200-33B Hazardous Wildlife Attractants on or near Airports. This Advisory Circular states recommendations that airports should follow to help in reducing wildlife around airports.

San Antonio International Airport has completed a wildlife study required by the FAA;

- Wildlife Hazard Assessment (WHA) - Completed 2012
- Wildlife Hazard Management Plan (WHMP) – Refer to the Appendix of this chapter

With the results of the WHA and WHMP, and the FAA Advisory Circular, the San Antonio International Airport has put in place some measures to help with reducing hazardous wildlife.

- All new or changes in any landscape plan must be approved by the Airport Wildlife Biologist and Airport Horticulturist.
- Only vegetation on the approved San Antonio Airport plant list may be planted on airport property.
- Maintenance around your lease hold must be maintained to include:
  - Emptying trash cans regularly, with all dumpster lids closed when not in use
  - No accumulation of waste material that could become a wildlife habit
  - Properly discarding of food waste
  - Grass height should be in the range of 4 to 8 inches no higher
- No water ponding
- Feeding of any wildlife or birds is strictly prohibited per Airport Rules and Regulations.

4.1.4.6 Planting Bed

- Locate mow strips, rock beds, or potted plants next to exterior walls of the terminal to reduce machinery and noise adjacent to the terminal.
- Pots can be updated seasonally for color changes and be used for additional security reasons.
- Black much is preferred. When providing crushed granite need to provide consistency in colors.
- Use boulders, but need to be scaled to the space for appropriate design

- Use Planting layouts and design to create a south Texas feel (ie plantings coming out of rocks and walls)
- Natural Wood Colors such as pecan or mesquite
- Design influences of historical stone missions with a sense that things are built to last and are locally available.
- Landscape should establish a sense of place, used as guides or wayfinding, and be calming and relaxing to the visitors.
- Provide secured wall or ground mounted hose bibs near plant beds for maintenance.

4.1.4.7 Hardscape Site Materials

- Permeable Pavers/Architectural Pavers
- Stamped and stained concrete
- Decomposed Granite
- Natural Stone

4.1.4.8 Site Furniture

- Benches need to include architectural elements to deter public from laying down. Materials need to be durable and low maintenance. Concrete preferred.
- Trash Receptacles/Recycling Bins need to be located in strategic locations and correctly sized.
- Charging Stations
- Shade Structures
- Bike Racks located in short term parking and employee parking. Need minimal due to lack of connected bike networks.

4.1.5 Site Plans

- A site plan shall be prepared for all new and site projects. The site plan shall delineate all existing and proposed facilities and features. The site plan shall provide a clear schematic of the intended land use, project or building layout, site and project dimensions, access points, proximity to existing structures, etc.
- This plan will be used to initiate coordination among the Airport departments, the FAA, and tenants adjacent to the site.

4.2 Airside Design

4.2.1 Scope and Purpose

This section is a compilation of design criteria for numerous materials, components, and assemblies that must be incorporated into the civil design of all projects. The A/E shall review this section in preparing the design drawings and customized Contract Specifications and shall incorporate all relevant requirements into the documents.

4.2.2 General Provisions

Projects must comply with requirements of several regulatory agencies, including Federal Aviation Administration (FAA) Federal Aviation Regulations (FAR) listed below:

- Part 77: Objects Affecting Navigable Airspace
- Part 139: Certification and Operations: Land Airports Serving Certified Air Carriers
- Part 150: Airports
- Part 151: Federal Aid to Airports
- Part 152: Airport Aid Program

SAT has the right to Airport has the right to question the final grades to insure there will be no water ponding, contractor to re-survey at their expense.

The A/E shall incorporate appropriate references to nationally accepted standards for the design, fabrication, and installation of particular equipment. Also, the A/E shall include in the design appropriate reference to the Airports' published Orders & Instructions (O&I) which address such topics as security, vehicle operations, AOA licensing, badging, radio communications, display of signs, and key control.

4.2.3 Design Aircraft

The A/E Statement of Work will specify the Aircraft Design Group that the structure will be designed to accommodate

4.2.4 Height Limitations

The A/E shall include in requirements for all demolition and construction within the Airports that the height of Contractor equipment shall be limited to a height that shall not penetrate the Federal Aviation Regulations (FAR) Part 77 imaginary surfaces, unless otherwise approved in writing by the Airport. Prior to beginning work, the Contractor shall notify the Airport Operations of the height of all cranes, boom trucks, scaffolds, or similar vehicles or construction that will be within the AOA.

4.2.5 Excavation and Trenching

On the AOA, no trenches shall remain open overnight unless the Contractor is working on a closed portion of the Airport and special permission is obtained from Airport Operations. Any open holes or trenches shall be prominently marked with cones, barricades, and orange flags; layout of barricades shall meet the requirements of the FAA Advisory Circular and shall have steady-burning red lights attached if a trench is left open overnight. Coordinate with Airport Operations with regard to all barricades and lights. Excavation slopes or trenching shall be in accordance with all OSHAA, TxDOT and FAA Criteria.

4.2.6 Air Operations Area (AOA) Pavements

Designs for pavements and their related features on the AOA for runways, taxiways, taxi lanes, and aircraft parking aprons shall be developed utilizing the latest FAA Advisory Circulars as guidance. Where appropriate, the A/E shall evaluate and consider the applicability and use of recycled materials in pavement design and construction specifications. The use of recycled material in concrete pavements should be determined on a project-to-project basis based on the scope of work and material and pavement performance requirements, etc., and shall adhere to the requirements set forth in FAA AC 150/5370-10 — Standard Specifications Construction of Airports, sustainable and recycling specifications, including:

- Item P-219 Recycled Concrete Aggregate Base
- Item P-306 Econocrete Base Course, which allows the use of crushed recycled concrete as aggregate
- Items P-401 and P-403 Plant Mix Bituminous Pavements (Base, Leveling or Surface Course), which allow the use of Reclaimed Asphalt Pavement in the mix design
- Item P-501 Portland Cement Concrete Pavement, which allows the use of crushed recycled concrete pavement as an aggregate
- AOA vehicle pavements need to be designed to ARFF and fueling vehicles

4.2.7 Storm Drainage (Airside)

4.2.7.1 General

All airside civil design shall follow the requirements of the FAA Advisory Circulars and Regulations. In addition, the criteria standards set forth below shall be incorporated in the design.

Storm drainage systems on the AOA shall be developed utilizing the latest FAA Advisory Circular as guidance. OSHA confined space requirements shall be incorporated into the design of storm drainage structures. Storm drainage on land side shall be developed utilizing the Texas Department of Transportation (TxDOT) requirements as guidance.

4.2.7.2 All storm drain pipes and structures within the AOA must be aircraft rated or have airport approval to use traffic rated pipe Storm Drain Pipe Size

Storm drainage lines shall be designed and sized to meet hydraulic requirements, except that the minimum pipe size shall be 18" diameter from the first and highest storm drain structure in any branch. HDPE pipe may be used and shall have at least 12" of cover from the finish subgrade elevation.

4.2.7.3 Storm Drain Pipe Material

Storm drainpipes and culverts shall be Reinforced Concrete Pipe (RCP) and may be High Density Polyethylene (HDPE) pipe. As a minimum RCP pipes shall be Class III per ASTM C76 with a compressive concrete strength of 4000 psi when tested per ASTM C39. HDPE pipe shall have an annular corrugated exterior with a smooth inner wall and a Manning's "n" rating of 0.012. The HDPE pipe shall meet the requirements of type-S pipe under AASHTO M294. Installation of HDPE pipe shall conform to ASTM D2321 and AASHTO Section 30 for highway applications. The design A/E shall evaluate the two pipes and recommend the pipe that best suits the project conditions. The A/E shall provide a written evaluation of the pipe material chosen and shall consider the costs of all materials required for proper installation of the pipe of its intended service life.

- It is encouraged to use RCP or CMP on the campus unless otherwise approved by the airport.
- French drains may use slotted PVC pipe.

4.2.7.4 Joints

The use of field applied bituminous as a joint sealing method for RCP is prohibited. The use of HDPE pipe is prohibited under pavement. When utilizing HDPE pipe in lieu of Class 3 RCP (in turf areas), joints for HDPE pipe can be one of the following types: soil tight, silt tight, and watertight.

The A/E shall determine the appropriate joint type and coupling based upon application of site conditions. Joint sealers must meet FAA.

4.2.7.5 Video Inspection

All storm pipes and structures shall be cleaned and flushed and visually inspected. All new storm piping smaller than 18" diameter and all storm piping of any size that will be beneath buildings, site structures, or aircraft pavements shall be videotaped after flushing and prior to turnover to the Authority. Test reports and videotapes shall be submitted to the Airport. The A/E shall consider and recommend videotaping of any storm piping 18" and larger if special conditions exist that may dictate such testing. The scope of all videotaping requirements shall be clearly stated in the Contract Documents.

4.2.7.6 Frames, Covers and Grates in the Aircraft Traffic Areas:

A/E shall ensure that each frame and cover or grate unit installed in an aircraft traffic area will have fastening members to prevent it from being dislodged by traffic but that will allow easy removal for access to the structure. Provide this requirement in each technical section of the specifications that specify frames & covers and grate units.

- Grate must be aircraft rated grate
- Ensure an Advisory Circular (AC) is referenced similarly to AC 150/5370-10H

4.2.7.7 Frames, Covers and Grates in Non-Aircraft Traffic Areas:

- See Landside Civil Design Standards.
- Ensure an Advisory Circular (AC) is referenced similar to AC 150/5370-10H

4.2.7.8 Location of Manhole Opening with Respect to the Structural Wall:

The manhole opening shall be offset 7" from the inside surface of the structural wall containing the manhole steps. This offset equals the dimension that the manhole step protrudes from the wall. Refer to AC 150/5370-10H Part 11 – Drainage PP 575-611.

4.2.8 Vegetation

The A/E shall design all projects so that the work required in the Construction Documents incorporates all relevant requirements as set forth below. In addition, the A/E shall design project in accordance with FAA Standards and Specifications for Erosion and Sediment Control and Stormwater Management. Landscaping is required to be completed in accordance with the Airport's Wildlife Hazard Management Plan and only include elements that do not attract birds.

4.2.9 Security Fencing and Vehicle Gates

4.2.9.1 AOA Fence

AOA Fence shall be galvanized steel with three strands barbed-wire extension arms. If a black PVC galvanized steel fence is preferred, please review it with SAT PM. A typical minimum height of 8 ft. with 3 strands of barbed wire is to be maintained at all locations. Where site conditions compromise the accessible fence height, the height and barbed wire configuration shall be adjusted to maintain the minimum safe height. In critical areas, the bottom edge of the fence fabric shall be anchored or buried for additional safety and security. Fence shall be designed with a wildlife deterrent skirt and vegetation free zones, where necessary, per the actual site conditions and recommendations from wildlife hazard assessment and/or security plan.

Electrical grounds shall be constructed where a power line passes over the fence. Any permanent opening below the fence because of natural or manmade features such as drainage ditches shall be provisioned with a culvert system or other security features to prevent entry under the fence. Culverts or structures which cross under the fence shall not exceed 18 inches in width at the widest point unless equipped with security grates.

All permanent fencing shall include appropriate SAIA signage and shall be spaced at a minimum of 300 feet along the fence and in 2 languages.

- All fence components must meet the requirements of FAA item F-162, chain link fence, unless otherwise directed in the plans or by the owner's representative.
- All fence posts, rails, and braces must be galvanized tubular steel pipe conforming to the requirements of ASTM F1083, Group 1A, with TYPE B External coating and TYPE B or D internal coating.
- The installation of all fence footings and foundations must be made to drain away from the fence line at 0.25" per foot unless otherwise indicated.
- All fence components must be installed vertical, straight, and true to line. The longitudinal gradient of the top of the fence shall follow the general gradient of finished grade.
- Any openings under fences causing the bottom of the bottom rail or tension wire to be more than two inches above the ground and the opening to be greater than 96 square inches shall be closed by adding additional line posts and fabric at the discretion of the owner's representative.
- Any fence components installed in floodplain will require the approval of floodplain development permit by the county of Bexar, Texas. Refer to FEMA map firm no.48029C0265G.
- A commercial fence permit application must be submitted to and approved by the city before any installation or demolition of fence components may occur.
- Coordinate with airport security prior to commencement of any construction operations.
- The contractor is responsible for the security of all temporary openings in the AOA at all times. Each opening must be manned by an owner-approved, badged contractor employee who has undergone Access Control Portal Specialist (ACPS) Training until the opening is closed and approved by the owner'' representative. No unauthorized person shall be allowed to pass through the opening.
- The contractor is required to maintain the existing and proposed AOA fence throughout the project duration and is required to repair any damage caused by contractor operations in accordance with the project details and specifications at no additional cost to the owner.
- Take precautionary measures to protect all existing above-ground or below-ground components that are designed to remain in place. Repair or replace at no additional expense to the owner any

components designated to remain in place that is damaged by the contractor at no additional expense to the owner provide a detailed plan for repair/replacement to the owner's representative for review and approval prior to performing work.

- Excavation of existing materials for fence installation and subsequent embankment must be completed in accordance with FAA P-152, excavation, subgrade, and embankment. Disturbed earth must be re-vegetated in accordance with FAA item T-901, SEEDING.
- Obstructions not able to be removed from within the designated limits of the fence shall require a jog around the obstruction in accordance with appropriate modifications or as otherwise directed by the owner's representative.
- Chain link fabric and wires must be mounted on the Non-AOA side of the fence, stretched taut, and securely fastened.
- All fence posts shall be capped with either a ball cap or barbed wire mount.
- All dimensions, sizes, gauges, weights, and thicknesses shown are the minimum acceptable.
- All concrete must meet the requirements of FAA item P-610, STRUCTURAL PORTLAND CEMENT CONCRETE.
- Fence and gates, regardless of length or use, must be grounded.
- All SWPPP/Erosion control measures shall be installed prior to performing any earth-disturbing activities.
- Payment for installation of fence components will be as noted in the technical specifications or BID proposal. Measurement for payment of fence of the type installed will be made from the center of post to center of post along a horizontal line, excluding vertical grade changes. Measurement will not include gate openings.
- Fence demolition shall include the removal of fence post foundations and backfilling holes as necessary. Payment shall be included in the F-162-5.4 and F-162-5.5 pay items.

4.2.9.2 Temporary Fence

Temporary Fence shall be galvanized steel with single strand barbed-wire.

4.2.9.3 Construction Fence

Chain link fence with construction screening that includes approved SAT Signage. This fence will surround contractor laydown yard and construction material when in view of the public.

4.2.9.4 Refer to the Appendix for typical fencing standards and details for the Airport.

4.3 Landside Design

4.3.1 Fences and Gates

4.3.1.1 Leased Property Fencing. All fencing on leased property is the responsibility of the Tenant and shall be aesthetically pleasing. This can be accomplished by use of material matching or similar to adjacent structures. Chain link fencing shall be screened with plantings where appropriate. Planting materials must be approved by SAT Project Manager.

4.3.2 Design Speeds.

The Design Speed represents the maximum safe speed that can be maintained over a section of roadway and is influenced by the required posted speed limit, terrain, functional road classification and economic considerations. All design criteria shall be commensurate with selected design speeds. All selected design speeds shall be presented to the SAT Project Manager for review and approval prior to final design.

4.3.2.1 Freeway. Currently, Interstate 410, highway 281 and Wurzbach Parkway are the only designated major arterials on the airport. The posted speed limit on Interstate 410 and highway 281 is sixty-five (65) mph, Wurzbach Parkway is sixty (60) mph. The posted speed limit on the various City roadways is regulated by the City of San Antonio Public Works Department (Speed Limit Signs (sanantonio.gov)).

4.3.2.2 Primary Arterial System. The Interstate 410 access roads are considered a primary arterial and are currently posted at forty-five (45) mph throughout.

4.3.2.3 Secondary Arterial System. Posted speed limits of 30-35 mph with through routes linking major roadways and providing access to major facilities. Posted speed limits as approved by Airport Engineer.

4.3.2.4 Terminal Loop Road. The posted speed limit for the terminal loop road utilized for passenger loading and unloading zones shall be fourteen (14) mph.

4.3.2.5 Local Road System. This type of local access road provides a direct access to abutting property (parking lots, Terminals, lease sites, etc.) for local traffic circulation movements and shall have posted speed limits of fourteen (14) mph.

4.3.2.6 Ramps. The design speed for on and off ramps shall be determined in accordance with TxDOT criteria. Under conditions of restricted geometrics on certain ramp connections, the design speed shall not be less than twenty-five (25) mph.

4.3.3 Design Vehicles

4.3.3.1 Size and Weight - The physical and operating characteristics of an authorized vehicle of designated type establishes roadway design controls to accommodate the vehicle of that type. All new and major reconstruction of roadways shall be designed to meet minimum requirements set forth for WB-62 design vehicles with a minimum turning radius of 65', unless waived by the Airport after review, in which case the design vehicle shall be single-unit (SU) truck as an absolute minimum. TxDOT has established minimum turning paths for these design vehicles to be used as controls in geometric design. It is vitally important that fire-fighting and other emergency equipment be capable of maneuvering on all circulation roads.

4.3.3.2 Load limits shall conform to the minimum requirements set forth for Federal and State highways.

4.3.4 Turning Radii

As approved by Airport Engineer or per commercial driveway design standards by City of San Antonio.

4.3.5 Alignment Criteria

All roadway alignment criteria to be in accordance with federal and state roadway design standards.

4.3.5.1 Stopping Sight Distance. Safe stopping sight distance shall be established using wet pavement conditions and, as the controlling design vehicle, the passenger car with eye height at 3.5 feet and the object height of 2.0 feet to be seen by the driver. Design values shall be in accordance with the requirements listed in the TxDOT Roadway Design Manual.

4.3.5.2 Horizontal Curvature. The maximum degree of curvature shall conform to the design values listed in the TxDOT Manual for a particular design speed.

4.3.5.3 Vertical Curvature. Length of vertical curves is determined by the algebraic sum of gradients and the design speed. The K-values listed in the TxDOT Manual for crest curves and sag curves shall be used in calculating the minimum required lengths of vertical curves.

4.3.5.4 Superelevation. The maximum rate of superelevation is 0.06 feet per foot.

4.3.5.5 Ramp Geometry. All on and off ramps and direct connections to arterials shall be designed for a minimum of one (1) lane of traffic operation with provisions for emergency parking unless otherwise directed.

4.3.5.6 Maximum and minimum grades. Minimum and maximum grades shall be as stated in the TxDOT manual.

4.3.6 Pavement Design

4.3.6.1 Pavement Design Reference. The latest edition of the Texas Department of Transportation (TxDOT) Highway Design Section Operations and Procedures Manual contains the basic design criteria standards and guidelines that will be the reference document for the future roadway projects at the Airports unless otherwise specified. Deviation from these criteria will not be allowed without written approval from the Airport Engineer. Construction Specifications shall be taken from "City of San Antonio Standard Specifications for Construction", latest edition, published by City of San Antonio Public Works Department, except as modified herein. No variance from these specifications or the modifications herein may be made without the approval of the Airport Engineer for the San Antonio Airport System (referred to throughout as the Airport Engineer).

4.3.6.2 Roadway Pavement Section – Follow TxDOT designs standards.

4.3.7 Obstruction Clearances

4.3.7.1 Clear Zones. A clear, unobstructed, relatively wide and flat (4:1 or flatter slope) area beyond the edge of the travel lane is required for all new and major reconstruction projects.

4.3.7.2 Horizontal Clearances. Horizontal clearances shall be measured from edge of the travel lane to the face of obstruction such as column, bent cap or wall. Horizontal clearance shall be in accordance with the Texas Department of Transportation, Highway Design Section, Operations and Procedures Manual.

4.3.7.3 Safety Treatment of Drainage Structures. Culvert headwalls and other drainage systems shall have appropriate safety treatments.

4.3.7.4 Vertical Clearances. The minimum effective vertical clearance for arterial and collector roads shall be sixteen (16) feet, six (6) inches over the usable roadway including shoulders. Minimum effective vertical clearance for all other roadways shall be fourteen (14) feet six (6) inches. These clearances provide provision for future resurfacing. Please note that effective vertical clearances over roadways with sag curves shall take into account the length of the longest design vehicle and wheel locations as they affect the height of the top of the vehicle.

4.3.8 Traffic Signals

4.3.8.1 Roadway Signs -The design of signs for roadways shall be in accordance with the Texas Manual for Uniform Traffic Control Devices (MUTCD), latest edition. The signs, posts, breakaway features and foundations shall conform to TxDOT Standards.

4.3.8.2 Where pedestrian signals are provided at pedestrian street crossings, it should include accessible pedestrian signals and pedestrian push buttons complying with sections 4E.08 through 4E.10 of the MUTCD

4.3.9 Vehicular Barriers and Guardrails

4.3.9.1 Concrete Traffic Barriers. Concrete Traffic Barriers (CTB) shall be installed on the AOA side of AOA gates parallel to and three feet from the gate.

4.3.10 Cross Section Elements

4.3.10.1 Pavement Width -The minimum standard lane width of twelve (12) feet shall apply to all roadway systems under this section, except ramps where a minimum standard lane width of fourteen (14) feet shall be used as approved by the Fire Marshal. Bi-directional two- lane roads without usable shoulders require a total pavement width of not less than thirty-four (34) feet. Air Operations Area (AOA) and Aircraft Rescue and Fire Fighting (ARFF) pavement width should be according to Airside Design section.

4.3.10.2 Shoulders - On major, high design speed (equal to or greater than 50 mph), uncurbed facilities, a minimum traversable shoulder width of ten (10) feet is required.

- On one-lane ramps, shoulders shall be placed on each side of the travel lane for a combined effective width to allow a stalled or stopped vehicle to be passed. Outside shoulders shall be a minimum of six (6) feet, and inside shoulders a minimum of two (2) feet.
- Six (6) inch curbs shall be used primarily on collector, service roads, and other low speed (less than 50 mph) type facilities. They shall not be used in connection with high-speed facilities, expressways, and ramp areas. Where needed for drainage purposes at ramps, curbs shall be mountable type. On two-lane, two-way roads, a minimum of two (2) feet on each side for curb and gutter shall be included in the total width of the roadway.

4.3.10.3 Speed Change Lanes - This section shall apply to auxiliary lanes with respect to median openings and at-grade intersections supplementary to through traffic movements. The required length of the auxiliary lanes and size of median opening for turning vehicles shall be in accordance with applicable standards as outlined in the TxDOT Manual.

4.3.10.4 Cross Slope -The standard cross slope on all new paving projects and major reconstruction paving projects is ¼ inch per foot of pavement width.

4.3.10.5 The design of these features shall be based on good engineering practice for the specific feature and based on similar designs used by the City of San Antonio. The design shall consider the functional characteristics of the installation as well as the familiarity of the driver with the installation.

4.3.11 Subgrade, Soils, and Pavement Testing Investigation Program

Each project A/E shall prepare a recommended soils program for the San Antonio Airport's Project Manager's review and approval. A final soils report shall be submitted with the final construction documents and included as an appendix to the Project Report.

4.3.12 Subgrade Treatment

Subgrade treatment should be as recommended by the geotechnical engineer.

4.3.13 Earthwork

4.3.13.1 SAT Airport has the right to question the final grades to ensure there will be no water ponding, contractor to re-survey at their expense.

4.3.13.2 Excavation of Structures: All excavation for structures and structure footings shall be made to the lines and grades or elevations shown on the plans. The excavation shall be of sufficient size to permit the placing of the full width and length of the structure or structure footings shown. The elevations of the bottoms of footings, as shown on the plans, shall be considered as approximate only; and the A/E may order, in writing, changes in dimensions or elevations of footings necessary to secure a satisfactory foundation.

4.3.13.3 All bracing, sheathing, or shoring shall be performed as necessary to implement and protect the excavation and the structure as required for safety or conformance to governing laws.

4.3.13.4 Unless otherwise provided, bracing, sheathing, or shoring involved in the construction of this item shall be removed after the completion of the structure. Removal shall be effected in a manner which will not disturb or mar finished masonry.

4.3.13.5 After each excavation is completed, the Contractor shall notify the A/E to that effect; and concrete or reinforcing steel shall be placed after the A/E has approved the depth of the excavation and the character of the foundation material.

4.3.13.6 Backfill for Structures

4.3.13.7 After a structure has been completed, the area around it shall be filled with approved material per City of San Antonio Criteria and as recommended by geotechnical engineer.

4.3.13.8 Backfilling shall not be placed against any structure until permission is given by the A/E.

4.3.14 Sidewalks

4.3.14.1 Sidewalks. Pedestrian concrete walks shall be constructed between buildings and other essential locations where such a need may occur. The minimum standard width for sidewalk pavement shall be four (4) feet with proper cross slope for adequate drainage. The minimum standard walkway pavement shall be of four (4) inch thick concrete reinforced with flat 6-inch X 6- inch, W2.9 x W2.9, welded wire fabric on a minimum two (2) inch sand cushion. Rolled wire fabric will not be permissible as walkway or other reinforcing. Provide contraction joints spaced every four (4) feet (approximate). Pre-molded one-half (½) inch expansion joint material spaced at thirty-two (32) feet is required. Unless allowed otherwise in the adopted Building Code, sidewalks terminating at building doors shall be constructed as landings flush with the finish floors to the interior of the building. Slopes at landings shall not exceed 2 percent (1/4 inch) slope.

4.3.14.2 Curb cuts and ramps shall meet the accessibility requirements of the Americans with Disabilities Act and Texas Accessibility Standards.

4.3.15 Drainage

See Section 4.7 Stormwater.

4.3.16 Structures

4.3.16.1 Retaining walls. Wherever slopes must be steeper than a slope of 4:1 (four horizontal units to one vertical unit), the use of retaining walls will usually be required and the design shall be approved by a Structural Engineer. Either vertical or battered wall faces are acceptable. Exposed concrete may be required to be buff color with surface texture matching that of adjacent buildings. Trenching or sprinkler systems shall not be allowed in the passive soil area unless approved by SAT Project Manager.

4.3.16.2 The effect of wall movement due to expansive soils shall be taken into account and, when necessary, appropriate design steps shall be taken to minimize them.

4.3.16.3 The factor of Safety for overturning shall be 1.5 minimum and 2.0 maximum. The factor of safety for sliding and circular soil arc failure shall be minimum of 1.5. Expansion joints shall be provided every ninety (90) feet maximum, and contraction joints every thirty (30) feet maximum per the design approved by the Structural Engineer.

4.3.17 Pavement Markings

4.3.17.1 Fire Lane Markings: Fire lanes shall be marked with a six (6) inch painted red stripe. The words "FIRE LANE NO PARKING" shall be stenciled in white paint, four (4) inch high letters with a ¾- inch stroke. The interval between stenciled signs shall be adequate to inform the public of the existence of the fire lane but in no event shall the interval be greater than twenty (20) feet. Markings shall be on each side of the designated fire lane. The shade and type of paint shall comply with State of Texas specifications for traffic paint.

4.3.18 Perimeter Security Road

4.3.18.1 Security Gates and Other Security Devices Across Fire Apparatus Access Roads: All automatic gates and devices across required fire apparatus access roads shall open upon activation of building fire alarm system and remain open until such time that the fire alarm is reset. All automatic gates and devices shall incorporate a fail-safe manual backup or release. All gates and devices shall permit the safe exit of emergency vehicles at all times. To be coordinated with SAT Airport security for location, sizing and security measures required.

4.4 Irrigation

4.4.1 Landscape Irrigation System

Installation of automatic watering systems is required for the entire area along major entrance roadways, the infield areas and any designated landscape areas with the exception of areas previously noted under the section on Retaining Walls. Outlying areas such as the secondary service roads in support areas, perimeter planting areas, and airfield grass areas do not require sprinkler systems. However, truck watering of trees in these areas will be necessary for the first two (2) years after initial planting

4.4.2 Sleeving

It is important that all irrigation related sleeving be installed for newly-developed areas so that sprinkler systems can be incorporated without the disruption of transportation systems. It is required that PVC (polyvinyl chloride) piping be used in general planting areas.

4.4.3 Approved Manufacturers

- All irrigation materials and equipment are to be manufactured by “Rainbird” or approved equivalent. This provides common equipment throughout the Airports, allowing maintenance personnel to make necessary repairs while maintaining a quality system. All pipe and fittings shall be schedule 40 PVC.
- Irrigation Controlles - All irrigation controllers shall be “Rainbird” stainless steel cabinet models, such as the ESP-SAT-TW-SS controllers or an approved equivalent. All irrigation satellite controllers must be connected to a Cluster Control Unit (CCU) by a two-wire path (Maxicable or PE- 39 “telephone type” wire). All new sites must have a CCU with stainless steel cabinet with two-wire path to each satellite controller. Each CCU must have a Maxicom compatible freeze sensor and rain sensor.
- Freeze Sensors - Freeze sensors shall be Hunter Industries “Freeze-Clik” or approved equivalent (temperature set point at 3°C +/- 2°C (37°F), 24 VAC 6 amp rating, closed above 3°C and open below 3°C). Freeze sensor shall be mounted at a height and location that is out of direct sunlight and where free outdoor air circulation is possible. Each freeze sensor must be attached by a two-wire path (of no lighter gauge than 20 AWG) to a Rainbird M51300 Sensor Decoder. Sensor decoders must be housed in the base of a stainless steel controller cabinet (within an existing satellite controller cabinet, a CCU cabinet, or a separately installed cabinet). The sensor decoder shall be also connected to the Maxicom two-wire path.

- Rain Sensors - Rain sensors shall be Rainbird Rain Counter model number S-300 or approved equivalent (tipping bucket / magnetic reed switch style; rainfall per tip: 0.01”). Each rain sensor must be attached by a two-wire path (of no lighter gauge than 20 AWG) to a Rainbird M51200 Pulse Decoder. Pulse decoders must be housed in the base of a stainless steel controller cabinet (within an existing satellite controller cabinet, a CCU cabinet, or a separately installed cabinet). The pulse decoder shall be also connected to the Maxicom two-wire path.
- Wiring - Wiring shall be 12 gauge-UF irrigation wire using 3M brand “DBY” or “DBR” connectors.
- Maintenance Equipment - Maintenance equipment shall consist of Rainbird manufactured equipment. “Rainbird Maxicom” type or approved equivalent shall be used for computer-controlled systems.
- Gate Valves - All gate valves of four (4) inch or three (3) inch size shall be Mueller or equivalent with standard cube head on stem. Valve stack shall be standard cast iron or equivalent with appropriate cast iron lid. Electric remote control valves shall be “Rainbird” GB-Series valves or an approved equivalent. All electric valves shall be enclosed in a standard 10-inch valve box.
- Large Grass Areas - The large open grass areas along primary access roads for each airport shall be irrigated with rotor type heads distributing water from forty (40) to ninety (90) feet in diameter, depending on the available pressure. Sprinklers of substantial construction, such as “Rainbird” 900 or 950 Eagle or Falcon heads or approved equivalent, shall be used to withstand the abuse normally associated with heavy maintenance equipment. These rotor heads shall be on KBI Schedule 80 swing joints or equivalent.
- Small Grass Areas - Small grassed areas, which occur adjacent to roadway paving, shall be sprinkled with smaller diameter pop-up heads so that close control can be maintained on windblown mist. All pop-up spray heads shall be “Rainbird” 1800 Series, or approved equivalent, with appropriate nozzles and nozzle screens.
- Groundcover Irrigation – Groundcover areas along all access roadways and in the fields shall be irrigated according to the size of the planting areas and obstructions within these areas. The groundcover underplanting for tree dominated areas will require “Rainbird” 1812 Series with appropriate spacing and proper nozzles, to provide adequate coverage. Large open plantings of groundcover shall incorporate rotor type heads such as “Rainbird” 5000 Series rotors, model 5004, or approved equivalent with proper nozzles for proper coverage.
- Quick Coupler Valves - Flush lawn quick coupler valves, “Rainbird” 33D or approved equivalent, shall be provided in all landscape planted areas. They shall be located so that all trees and planting areas can be reached by a one hundred (100) foot length of hose.
- Irrigation Piping - Irrigation piping shall not be installed on top of roadway slopes or along retaining wall toes, unless cut-off valves are positioned at lower levels and away from structure.
- Deflection - Longitudinal deflection at each pipe joint shall not exceed one degree in any direction.
- Pipe Bedding: After the trench has been cut to a depth below the barrel of the pipe a distance of three inches, the bedding shall be brought to a point slightly above grade with compacted sand. Bell holes shall be formed, if required, a trough scooped out to grade and the pipe laid and jointed as specified. The sand shall then be brought up in uniform layers of either side of the pipe and over the pipe to a point level with the top of the pipe. Density shall be at least 90 percent of maximum density as determined by ASTM D 698. Moisture content shall be within minus 2 to plus 4 of optimum.

- Temporary Irrigation - Temporary irrigation systems used to establish the growth of turf in airfield areas require special considerations. Approval by both the City Engineer and the Airport General Manager or their designee is necessary prior to final design.
- Backflow Preventors - All landscape irrigation systems connected to the main City supply shall have backflow preventors installed and certified.

4.5 Water Utility Distribution

4.5.1 General

The domestic water system must be designed and installed in accordance with TCEQ requirements, Facility Design Guidelines & Standards for City Buildings and Parks by City of San Antonio (COSA), latest edition, the COSA Specifications for Construction by the COSA Public Works Department, latest edition, and San Antonio Water System (SAWS) Construction Specifications, latest edition unless otherwise revised or altered by requirements of this Manual or specifically approved by the SAT Project Manager.

This Section includes various aspects of water main design including replacement criteria, sizing, depth, embedment, and location. Also included are design criteria for various water appurtenances including different types of valves, fire hydrants, flush points, meters along with corrosion protection system.

Water distribution mains shall be designed in conformance with "30 TAC §290: Public Drinking Water", as enforced by Texas Commission on Environmental Quality (TCEQ), Latest Edition, and with all applicable laws, regulations, codes and standards.

4.5.2 Potable Water Supply

All proposed connections to or extensions of the Potable Water Systems (PWS) shall be described by plans, specifications, and contract requirements.

4.5.3 Water Piping Sizing

4.5.3.1 Water Pipeline Network

- The potable water pipeline network is classified according to Table below:
- Table 4.11.3.1: Site Water Main Classification

Type	Typical Size Range (in)	Direct Service Connection
Distribution Main	16" and Smaller	Permitted
Transmission Main	Larger than 16"	Not Permitted unless approved by SAT Project Manager

4.5.3.2 Looped Mains

Where practical, new water main installations shall be looped to improve system water flow.

4.5.3.3 Water Demand

San Antonio Airport water system must be able to supply water at rates which fluctuate over a wide range during different times of year and hours of the day.

4.5.3.4 Size/Capacity Determination Criteria

- Pipe shall be sized for the combined maximum day demand and fire flow demand.
- The Engineer of Record shall submit water use calculations showing average day demand, maximum day demand, peak hourly demand, building square footage and total acres for the proposed use. The average day demand, peak day demand, and peak hour demand used in design shall be approved by SAT Project Manager.
- Pressure reducing valves (PRV), as required by the plumbing code, shall be installed inside the building, beyond the outlet side of the meter but not within owner's meter box, and must be illustrated and identified on site utility plan.
- The A/E shall coordinate with SAT Project Manager for minimum operating pressure and maximum allowable velocity requirements. The design shall meet TCEQ standards at a minimum.

4.5.3.5 Fire Flow

- Required Fire flow and duration shall be as specified by the International Fire Code (IFC), Appendix B, latest edition, or by the National Fire Protection Association (NFPA) Standard No. 1, Chapter 18, table 18.4.5.2.1 whichever is more stringent. A/E shall coordinate with SAT Project Manager for fire flow requirement.
- Emergency demands are considered to be fire flow requirement plus peak day demand.

4.5.3.6 Sizing Criteria

The water mains must be sized in accordance with any approved master plan established for that area. If a master plan is not available, the sizing of the water main must be based on engineering analysis of initial and future demand of the area to be served. Water transmission and distribution mains must be sized to meet peak daily water demand plus required fire flow plus any additional criteria as needed. When site-specific data is unavailable, A/E shall use the most conservative data while meeting or exceeding the following minimum criteria for sizing distribution mains.

Minimum Pipe Size

- General Area: Minimum 8- inch main shall be used for all general areas.
- Industrial Area: Minimum 12- inch main for industrial areas shall be used.
- Non-Standard Pipe Sizes: 14-inch, and 18-inch water pipes are considered nonstandard and shall not be used unless approved by SAT Project Manager.

4.5.4 Depth of Cover

The depth of cover is measured from the top of the pipe to the natural or finished ground surface above the pipe and shall be per TCEQ requirements.

4.5.5 Location

4.5.5.1 New Main Installation

New water mains shall be placed outside paved areas and as dictated by the design requirements. The main should be located, where maintenance can be accomplished with the least interference with traffic, structure, and other utilities.

4.5.6 Horizontal Alignment

4.5.6.1 Change in Direction

Changes in horizontal alignment shall be achieved by deflection of joints or by use of fittings. Deflection of pipe joints at fittings is prohibited. Longitudinal bending of pipe is not allowed.

The maximum bend for waterlines is 45- degrees.

4.5.6.2 Pipe Laying

All water mains shall be laid as straight as possible between intersections and follow right-of-way or centerline alignment curves at a uniform distance from the right-of-way or centerline, as appropriate.

4.5.6.3 Joint Deflection

The maximum deflection angles of pipe joint are typically restricted to 50% of the manufacturer's recommendation. Otherwise, horizontal bends will be required.

4.5.6.4 Bends

Horizontal bends shall be restrained type fittings/joints and shall also be blocked with concrete as necessary. Horizontal bends shall also be placed such that the concrete blocking can be poured against undisturbed earth and will not bear against the backfill or bedding of another utility.

4.5.6.5 Stationing

Stations must be to the tenth of foot (Ex: STA. 1+90.5). If necessary, station equations can be used at a point along the alignment where the stationing changes. The station equation generally represents the meeting of two stationing systems or the change in authority over the centerline.

4.5.7 Vertical Alignment

4.5.7.1 Change in Direction

Changes in vertical alignment shall be achieved by deflection of joints or by use of fittings. Deflection of pipe joints at fittings is prohibited. Longitudinal bending of pipe is not allowed. The maximum bend for waterlines is 45- degrees.

4.5.7.2 Pipe Laying

Mains are to be installed as straight as possible, but excessive depths shall be avoided. This is due to limited ability of standard equipment by operations to reach these mains and the soil conditions.

4.5.7.3 High Points

Excessive high points that trap air and restrict water flow must be avoided. High points should be designed to coincide with the location of proposed fire hydrants, where possible. Where high points are unavoidable, air valves should be considered.

4.5.7.4 Bends

Vertical bends shall be restrained type fittings/joints and to be blocked with concrete as necessary. All pipe will be restrained with retainer glands and concrete blocking.

4.5.7.5 Slope

The vertical change in slopes is restricted to 50% of the manufacturer's recommended deflection. Otherwise, vertical bends will be required. Pipe Material & Embedment

4.5.7.6 Pipe Material Selection

Potable water piping four (4) inches and larger should be AWWA C-900, Class 200 PVC with elastomeric gasket push-on joints. Higher pipe classes can be used if required by A/E design calculations.

- Fittings should be cement mortar lined and appropriately coated and protected mechanical joint ductile iron.

Potable water piping smaller than four (4) inches should be AWWA C-900, Class 200 PVC with elastomeric gasket push on joints.

- Fittings should be PVC of equal strength.
- Pipe materials other than PVC may be used in accordance with SAWS Standards or as permitted by the SAT Project Manager.

All angles, bends, tees etc. should be stabilized with concrete thrust blocks sized by the A/E. Appropriately spliced and terminated tracer wire should be laid with all non-metallic water line.

Line valves should be placed at all points of connection to existing water lines, at branch intersections and any other location necessary for adequate control of the water system. Typically the number of valves at an intersection will equal the number of branches less one. Adequately supported air/vacuum relief valves should be installed as required along the main in enclosures to facilitate draining and maintenance/inspection.

Pipe material shall be selected based on lowest life cycle cost. PVC is the preferred material for smaller pipe sizes (≤16" diameter). Other materials such as ductile iron and steel may be specified upon approval by the SAT Project Manager.

When a metal pipe including concrete cylinder, ductile iron or steel is specified, the pipe must be protected from corrosion. Corrosion protection measures should be part of any pipeline design using these materials. For ductile iron pipes a minimum single layer of 8-mil liner low density polyethylene (LLDPE) wrapping is required. When steel pipe is utilized, the pipe interior lining shall be cement-mortar and exterior coating shall

be either cement-mortar, tape or polyurethane as approved by the SAT Project Manager. All joints on metal pipe shall be bonded, and in locations with reactive soils or induced currents a cathodic protection system may be necessary.

4.5.7.7 Fittings

All PVC and ductile iron pipe shall use full body ductile iron fittings. Compact fittings are not allowed. All 90-degree bends shall be avoided in the system, if possible.

4.5.7.8 Embedment Requirements

A/E shall specify class of embedment and its detail on design drawings. The type of embedment to be used is determined by pipe material and depth of cover. For flexible pipe, Engineer of Record shall prepare a technical memorandum that includes the maximum pipe deflection anticipated by the pipe. Pipe deflection shall not be more than 50% of manufacturer's recommendation.

4.5.8 Separation Distance Between Water & Wastewater Mains

When a water main is installed near an existing wastewater facility, conveyance, or appurtenance, separation requirements of 30 TAC §290.44(e), as enforced by TCEQ, govern the minimum separation distances.

When new potable water distribution lines are constructed, they shall be installed no closer than nine (9) feet in all directions to wastewater collection facilities. All separation distances shall be measured from the outside face of each of the respective pieces.

4.5.8.1 Cross Connection

4.5.8.2 No physical connection shall be made to a drinking water supply system where a potential or actual contamination hazard exists unless the public water system is protected from contamination. Any appurtenance shall be designed and constructed so as to prevent any possibility of sewage entering the drinking water system.

4.5.8.3 Backflow and Siphonage

The rules of 30 TAC §290.44(h) apply to backflow and siphonage control.

4.5.9 Connection to Existing Mains

Testing and Chlorination: A new valve shall be installed at the point of connection for water main extensions to facilitate testing and chlorination of the new main prior to its placement into service.

Tapping Water Mains: Where services require the tapping of any existing water distribution main, the A/E shall specify that the Contractor employ a qualified specialty contractor to perform this service. Tapping of all water mains shall be done in accordance with AWWA standards and coordinated with SAT Project Manager.

Wet Connection: Shall be according to directions from SAT Project Manager.

4.5.9.1 Tapping Sleeve and Valve

SAWS Standard specifications for construction, latest edition can be used as a reference for additional information on tapping sleeves and valves.

Tapping sleeve and valve shall be used whenever possible for connections to existing mains to avoid interruption of water services.

The use of size on size taps shall not be permitted , only cut-in tees shall be used within the system unless otherwise approved by SAT Project manager. Taps are restricted to at least one standard pipe size smaller than the tapped pipe. (e.g. If the existing main is 16-inches, the largest pipe that can be tapped will be 12-inches.)

Full-body tapping sleeves shall be used. A tapping sleeve will not be allowed if the materials and conditions of the existing main preclude tapping.

4.5.9.2 Cut in Connections

Connections 4" and larger of new mains to existing mains shall be made by cutting in a tee. Tapping sleeves may be allowed in lieu of cutting in a tee on a case-by-case basis.

If the system needs an additional valve, then a cut-in connection with a valve and tee should be used.

4.5.10 Water Services and Connections

4.5.10.1 General Requirements

Water services shall be in accordance with SAWS. The A/E shall co-ordinate with SAT Project Manager for service connection location and detail.

Water meters shall be placed within the public right-of-way (ROW)

Water services are not to cross railroad, interstate or state highways.

Water meter boxes and its appurtenances are not allowed in sidewalks, paved areas, driveways or load bearing pavement.

Service taps, regardless of type, shall not be made in vaults.

Permanent domestic water services shall not be supplied from fire hydrant leads.

Domestic water service may tap into fire loop or lead-in, provided that the domestic tap is located prior to the backflow preventer, which is located at lease boundary/ROW.

Service taps on fire loop after the backflow preventer are prohibited.

Each site (tenant) must have its own water service which must not cross any existing or projected lot (or lease) line(s).

4.5.11 Dead End Mains

4.5.11.1 General Requirements:

Dead-end main situations are to be avoided whenever possible. "Dead-end main" means a water main over fifty feet long and not being fed from both ends at the time of installation.

4.5.12 Abandonment of Water Mains

Where possible abandoned water mains shall be removed.

Water mains shall be abandoned by cutting and plugging where it is not possible to remove the existing pipe.

The cut and plug shall be as close to the main left in service as practical unless there is other impending utility work planned that could disturb the plug. If the new main is to be constructed to connect to the existing main at the point of cut, a cut and plug is not required. If the main to be abandoned at a tap and valve, the abandoned tapping sleeve and valve shall be removed.

4.5.12.1 Abandonment of Water Appurtenances Fire Hydrants:

Removed/Salvaged fire hydrants shall be disposed as per or handed over to SAT Project Manager.

4.5.12.2 Valves

Small Valve: Valves smaller than 16-inches are not to be salvaged. Upon removal of the valve cover, stack, and stem extension, the valve body must be abandoned by filling with 2 sacks per cubic yard mix of sand to a point at least 12-inches below the pavement.

Large Valve: Valves 16-inch and larger may be salvaged if requested by SAT Project Manager.

4.5.12.3 Abandonment of Vaults

Vaults shall be abandoned by filling with sand and/or gravel compacted to 90% (95% in pavement) of maximum standard proctor dry density.

The bottom of the vault shall be filled with class B concrete up to the top of abandoned pipe openings.

4.5.13 Galvanic Anode Cathodic Protection

This section is applicable to all metal water pipes and fittings where corrosive environments or soil may potentially damage the pipes and appurtenances. Typically, soil resistivity less than 1000 ohms-cm can be considered as extremely corrosive soil.

Within the Airport boundary, all metal piping and fittings shall be protected by a cathodic protection system that is designed by a National Association of Corrosion Engineers (NACE) certified professional and installed by a licensed contractor. The following shall be submitted to the SAT Project Manager prior to any equipment installation:

- Qualifications of the Contractor's Corrosion Engineer and Corrosion Technician.
- Proposed alternate installation methods, proposed alternate testing methods.
- Catalog cuts, bulletins, brochures, or data sheets for all materials specified herein.
- Certification that the equipment and materials proposed meet the SAWS Specifications and intent of the Specifications.
    - Magnesium Anodes and lead wire
    - Pipe Lead, Anode Header and Bond Wire
    - Connectors
    - CP Test Stations
    - Below Grade CP Test Boxes
    - Pipe Flange Insulating Kits
    - Coating for Buried Pipe Flanges and Fittings
    - Alumino-Thermic Weld Kits
    - Weld Coating
    - Plastic Warning Tape
    - Insulating Putty
    - Rubber Splicing Tape
    - Electrical Tape
- The following shall be submitted to the SAT Project Manager after completion of the work.
    - Wire connection testing
    - Insulating joint testing, before and after backfill
    - Casing insulator testing, before and after backfill
    - Joint bond testing, before and after backfill
    - System check-out report with certification by the Contractor's Corrosion Engineer.
    - Record Drawings shall be submitted and approved by the SAT Project Manager before the work is considered complete

A/E to coordinate with the SAT Project Manager regarding the method of corrosion protection used. Below stated methods can be applied as directed by SAT Project Manager.

Where applicable, materials and equipment shall bear evidence of UL approval and conform to the requirements of all applicable federal, state and local laws, codes and regulations.

4.5.14 Testing Procedures

All tests shall be coordinated with and verified by SAT Project Manager.

4.5.14.1 Hydrostatic Testing and Chlorination:

All water mains shall be hydro-statically tested and chlorinated before being put in service. The Contractor shall be responsible for conducting hydrostatic tests and chlorination. Water Hydrostatic testing operations shall be according to SAWS Standard specifications for construction, latest edition.

4.5.14.2 Disposal:

The chlorinated water can be hauled off in water trucks or discharged into wastewater manholes as approved by SAT Project Manager.

The chlorinated water can be discharged to a storm drain or sheet flow in open field with proper de-chlorination method as approved by SAT Project Manager.

4.5.14.3 Disinfection:

Disinfection of the water lines shall be according to SAWS standard specifications for construction unless stated otherwise by the SAT Project Manager. All Bac-T samples will be collected and tested by the third party National Environmental Laboratory Accreditation Program (NELAP) certified laboratories as directed by SAT Project Manager.

4.5.15 Water Utility Distribution System Isolation Valves

4.5.15.1 Gate Valves

Gate valves shall be in accordance with the SAWS standard specifications for construction. Below statements shall apply unless stated otherwise by the SAT Project Manager. There shall be a valve on each fire hydrant lead restrained to the main.

Valves shall be located at the intersection of two or more mains and shall be spaced so that no more than three (3) customers will be without water during a shutout. For lines smaller than 24-inches, typical spacing should be 1500 feet. Mains 24-inches and larger shall be valved at intervals not to exceed 2,000 feet.

Branch piping (both new and future branches) shall be separated from the main with gate valves.

Valves shall be located so that isolating any segment of water main requires closing of no more than three (3) valves.

Water mains shall be designed so that valves can be installed vertically unless conditions dictate otherwise.

4.5.15.2 Vaults:

Valves shall be per SAWS standard specifications for construction.

4.5.16 Water Utility System Fire Hydrants

Fire Hydrants shall be designed and installed in accordance with SAWS Standard Specification Item No. 834. With standard reference from COSA Standard Specification for Construction, TCEQ 290 Rules and Regulations for Public Regulations for Public Water Systems, applicable American Water Works Association (AWWA) standards, and Society of Protective Coatings standards.

The materials for fire hydrant installations shall conform to the specifications contained within the latest revision of SAWS' Material Specification Item No. 95-10, "Specifications of Pipe Joint Restraint Systems", Item No. 95-10, Item No.113-02, "Ductile Iron Restrained Joint Fittings for Use on Ductile Iron", and Item No. 21-30, "Fire Hydrants".

PVC pipe is not allowed.

Stems shall be stainless steel.

Hydrants shall be connected to mains as shown in the contract documents or as directed by the SAT Project Manager.

Installation on Water Mains: Ductile iron pipe, cast iron and ductile iron fittings, and valves used in the placement of fire hydrants and connections to the main will be considered part of the fire hydrant installation and not a part of the main connection.

4.5.17 Water Meters

Water meters shall be required at all service points and shall be sized in accordance with good design practice for the service intended. Standard specifications for construction from SAWS shall be used as a reference for guidance on water meter and meter box installation.

4.5.18 Outlets

Blind flanges or plugs, as applicable, shall be furnished and installed on all valves located at outlet points or terminal points where the water main does not continue. Dead-end main structures shall be avoided whenever possible. If unavoidable, dead-end mains shall be designed to accommodate periodic flushing. The following two design alternatives shall be considered as per SAT Project Manager's guidance:

- Locate a fire hydrant less than 50 feet from the main's end.
- Install a smart flush at the main's end.

4.5.19 Air Release Valves, Air/Vacuum Valves and Combination air Valves

Valves and Combination air Valves Automatic air release (and vacuum release) valves shall be installed at high points on water transmission mains 16-inches and above to exhaust and admit air to prevent vacuum conditions and air related surges.

4.5.19.1 Air Release Valve Design:

The A/E is responsible for determining the size and type of air release valves necessary to assure the water system operates properly based upon the water system characteristics and shall provide calculations determining the size and type of valves for review by SAT Project Manager when requested. Air release valves may be necessary on any size of main.

At a minimum, on water mains 16 inches in diameter and larger, and on smaller mains where appropriate, combination air valves will be placed at all high points and air/vacuum valves shall be placed at the down-slope side of all gate valve locations. Air/vacuum and vacuum release valves shall be approved on a case-by-case basis.

A/E to follow the guidelines provided in SAWS standard specifications for construction on the Air release assemblies.

4.5.20 Purging and Flush Points

4.5.20.1 Flush Points:

Flush points are to be installed primarily to flush water mains as needed.

General Requirements

- Fire hydrants shall not be used in lieu of flush points unless stated otherwise by SAT Project Manager.
- Flush points shall not be designed to flush water to storm drains in order to prevent migration of chlorine residual in storm water system.
- The developer may need to extend a lateral to the end of the cul-de-sac so that it can be used to flush the water thru a flush point.

4.5.20.2 Type:

Smart flush is recommended as flush unit. At minimum the flush unit should have following probes/sensors:

- Combined Chlorine
- Temperature
- Total Chlorine

4.5.20.3 PH:

Dechlorination option should be included in the flush system.

4.5.20.4 Size:

Flush points shall be 2 inches or larger based on design calculations.

4.5.20.5 Location:

- Dead-end mains
- High/Low Valve Assembly

4.5.21 Sampling Stations

The A/E shall coordinate the need for and the location of Sampling Stations with SAT Project Manager.

4.5.22 Backflow Preventer and Detector Check Valves

Backflow prevention device shall be considered at the following locations to protect public water system from cross contamination:

- Commercial property water service line
- Dedicated irrigation lines
- Fire Lines

4.5.22.1 Water Service Connections:

All temporary construction water services shall be provided with a line sized reduced pressure zone-double check backflow preventer valve assembly and water meter. Services shall not be initiated until backflow prevention devices have been tested and approved for operation by a TCEQ certified tester. All original test forms shall be returned to SAT as directed by the Project Manager.

4.5.22.2 Backflow Preventers:

Where the service line provides potable water for a domestic service and also connects with other closed or chemically treated systems that could foreseeable contaminate the potable water line, a backflow preventer shall be installed. Drains off the backflow preventer assembly shall be drained to the sanitary sewer. Taps to mains, to provide water for fire protection or other closed pipe systems, shall have a double check valve assembly at the fire line tap. An alternate method of backflow prevention consisting of a 12-inch air gap between an unrestricted overflow of an atmospheric makeup tank and the source of water is also acceptable. All double check and reduced pressure backflow preventers must be certified for operation after installation by a TCEQ certified tester. All original test forms shall be returned to the SAT, as directed by the Project Manager.

4.5.22.3 Detector Check Valves:

A single Detector Check (DC) on closed fire line shall typically be used to measure fire flow for approved automatic fire sprinkler only.

- Typical size of a Detector Check (DC) is 4" (min.), 6", 8" and 10" as necessary. A 5/8"- 1" Nutating Disc Positive Displacement (PD) meter is also typically used in a bypass line conjunction with Detector Check (DC).
- Bypass line in a dedicated fire line should not be used for domestic use.

On looped private fire mains, a Detector Check (DC) shall be installed on both taps to the public main.

4.5.22.4 Reduced Pressure Backflow Preventer:

All pressure reducing backflow preventers that are installed to protect high-hazard services from back-flowing must be tested annually from the date they are installed and certified by a TCEQ certified tester. All original test forms shall be returned to SAT, as directed by the Project Manager. Provide weather protection and automatic heated enclosure if located outside.

4.5.23 Thrust Blocking

4.5.23.1 Thrust Blocks:

Thrust blocking/Anchorage and joint restraint shall be according to SAWS standard specifications for construction.

Suitable anchorage/thrust blocking or restrained joint shall be provided at all of the following main locations: dead ends, plugs, tees, crosses, valves, and bends.

4.6 Sanitary Sewer System

4.6.1 General Information

The sanitary sewer system must be designed, installed and tested in accordance with Texas Commission on Environmental Quality (TCEQ) requirements and SAWS (San Antonio Water System) requirements.

Sanitary sewer and the storm sewer should be shown on separate sheets along with profiles unless approved by SAT Project Manager.

All pipes penetrating exterior walls below grade must be installed properly to prevent breakage due to building settlement or expansive soil.

Profiles on sewer lines should be shown for all pipes sized six (6) inches and greater. The profiles should show as a minimum: depth of cover, other utility crossings, slope, inverts, pipe material and class of pipe.

4.6.2 Sanitary Sewer Main Sizing

The sanitary sewer mains shall be sized based on 30 TAC §217.53, with the following additional requirements. The A/E shall complete an analysis of the initial and future flows of the area to be served. The collection and interceptor main shall be sized for the peak hr. flows, which is based on the estimated average daily flow. When site-specific data is unavailable, A/E shall use the most conservative data while meeting or exceeding the following criteria for sizing sanitary sewer mains:

Sanitary sewer lines shall be designed to minimize turbulence to prevent release of sulfide gases and subsequent corrosion.

Velocity: Wastewater mains shall have slopes that allow the flows to achieve velocities of 3.0 fps, if possible. The minimum velocity shall not fall below 2.0 fps. Should slopes not permit achievement of a velocity of 2.0 fps pump stations shall be employed. Slopes that will create a flow velocity in excess of 10.0 fps shall be

avoided unless approved by SAT Project Manager. Velocity shall be determined by the Manning Equation.

- Service: The size of the services must be at least one standard size smaller than the proposed and existing sanitary sewer main.

4.6.2.1 Minimum Pipe Sizes

The minimum pipe diameter for any public gravity sanitary sewer collection main shall be 6 inches and service lines should be no less than 4 inches.

4.6.2.2 Minimum and Maximum Slope

Refer to 30 TAC §217.53, for selecting sanitary sewer main slopes.

4.6.3 Sanitary Sewer Pipe Materials and Embedment

The pipe material selection and the embedment requirements for sanitary sewer pipe shall be according to SAWS standard specifications for construction Item No. 848.

Materials for sanitary sewer pipe and fittings shall be either rigid or flexible. All sanitary sewer PVC shall be green, white pipe is prohibited

4.6.4 Depth of Cover

The depth of cover is measured from the top of the pipe to the natural or finished ground surface above the pipe. The main must be deep enough to serve adjacent properties. Buoyancy of sewers shall be considered, and flotation of the pipe shall be prevented with appropriate construction methods where high groundwater conditions are anticipated.

If fill or embankment placed over existing sanitary sewer mains exceeds six (6) feet above the existing ground, SAT Airport Manager approval is required. The minimum depth of cover over the upper-most projection of the main shall be as per TCEQ requirements.

4.6.5 Locations

Mains shall be located outside of the roadway footprint within the ROW and should follow the roadway.

- Sanitary sewer manholes shall not be located in the flow line of an existing creek or drainage area.
- Install the replacement main in the same trench as the existing main at six (6) to twelve (12) inches below the existing grade, if feasible
- Install the replacement main three (3) feet parallel to the existing main, as measured from the outside edge of both pipes.

4.6.6 Horizontal Alignment

The horizontal alignment must meet the minimum requirements as set in 30 TAC §217.53, with the following additional requirements.

- All mains should be laid as straight as possible.
- Stations shall be to the tenth of a foot (Ex: STA. 10+11.4).

4.6.7 Vertical Alignment

The vertical alignment must meet the minimum requirements as set in 30 TAC §217.53., with the following additional requirements.

- Vertical bends are not typically allowed unless otherwise approved by SAT Project Manager.
- Design slopes shall be to the nearest hundredth of a percent (Ex: Slope 5.20%).
- Elevations shall be shown to the nearest hundredth of a foot (Ex. El. 495.95).

4.6.8 Separation Distance between Sanitary Sewer and Reclaimed and Water Mains

When a sanitary sewer main is built near an existing water facility, conveyance, or appurtenances, 30 TAC §217.53, governs the minimum separation distances.

4.6.9 Connections to Existing Mains

The connection, shall always be at a manhole, including all laterals.

4.6.10 Sanitary Sewer Service Lateral

- Sanitary sewer service lateral installation shall be in accordance with SAWS standard specifications for construction.
- Each lease property must have its own sanitary sewer service lateral which must not cross any existing or projected lease line(s).
- Sample and inspection ports are required for service lines when industrial waste monitoring is required. They shall be located at the lease line within the public right-of-way (ROW) to indicate the line of responsibility of the utility.
- They shall not be located in traffic areas, paved parking areas or sidewalks, these areas shall require manholes.

4.6.10.1 Location

Sanitary sewer service lateral should be located ten feet downstream of the water service.

A sanitary sewer clean-out shall be installed at lease line as a demarcation between public and private line.

Sanitary sewer clean-outs are not allowed in sidewalks, paved areas, load bearing pavement, or driveways, these areas will require a manhole unless stated otherwise by SAT Project Manager.

The sanitary sewer service lateral should be at a depth sufficient to ensure the dwelling to be connected, will be served using a preferred lateral grade of 2 % (min. 1%) and minimum cover of 4 feet.

The top of the downstream manhole should be a minimum of 18 inches below the finish floor (FF) elevation of the dwelling to be connected. In cases where this is not achievable approval must come from SAT Project Manager and will generally require a backwater valve device and damage waiver from the user.

4.6.11 Inverted Siphon

The inverted siphons/sag pipes must meet the minimum requirements as set in 30 TAC §217.53, and the designs shall be approved by the SAT Project Manager.

4.6.12 Force Mains

Force mains are required whenever lift stations are required and will be in full compliance with 30 TAC §217, with the following additions as needed by the SAT Project Manager.

Lift station/force main systems shall be evaluated for their sulfide generation potential and their ability to achieve scouring velocities during average dry weather flow periods. If the evaluation indicates that sulfide concentration of greater than two (2) ppm and solids deposition are likely, the design shall:

- Define a workable sulfide control technique that will minimize sulfide formation in the force main,
- Include launching stations and recovery points to allow cleaning of the force main, and
- Protect the gravity main and manholes downstream of the force main from corrosion. The length of pipe to be protected shall be determined on a case- by-case basis.

The maximum time required to flush the force main shall be calculated on the basis of average dry weather flow. Flush time shall be calculated for average dry weather flow. A/E shall provide the calculated flush time for SAT Project Manager approval.

The force main shall discharge into its own distinct manhole. (I.e., multiple force mains shall not discharge into a single manhole.)

Thrust restraint when required shall be shown on the plan view.

4.6.12.1 Pipe Materials:

All force main piping must meet the minimum requirements as set in 30 TAC §217.64, and the pipe joints shall comply with 30TAC §217.65, with the following additional requirements.

SAWS standard specifications for construction shall be used as guidance for force main pipe material requirements.

4.6.12.2 Identification of Force Main Pipes:

All force main piping must meet the identification requirements as set forth in 30 TAC §217.66.

4.6.12.3 Velocities:

All pipe velocities shall meet requirements as set in 30 TAC §217.67, with the following additional requirements.

Force mains shall be sized so that the flow velocity is between three (3.0) and six (6.0) feet per second at initial and ultimate development.

4.6.12.4 Detention Time:

The detention time requirements shall meet the minimum requirements as set in 30 TAC §217.67.

4.6.12.5 Connection to Gravity Main:

- Shall meet the minimum requirements as set in 30 TAC §217.67.
- A force main must terminate in an appropriate structure..
- The discharge end of a force main inside a manhole must remain steady and produce non-turbulent flow.
- A receiving sanitary sewer collection system must accept the maximum pump discharge without surcharging.

4.6.12.6 Odor Control:

Odor control shall be in accordance with the requirements as set in 30 TAC §217.67.

4.6.12.7 Air Release Valves in Force Mains:

All force main air release valves must meet the minimum requirements as set in 30 TAC §217.67, with the following additional requirements.

Location and size of all air release valves shall be evaluated for odor or nuisance potential to adjacent property by the A/E. The use of air release valves shall be restricted to installations where there are not possible alternatives.

4.6.12.8 Valves:

All force main valves must meet the minimum requirements as set in 30 TAC §217.67.

4.6.12.9 Force Main Testing:

All force main testing must meet the minimum requirements as set in 30 TAC §217.68,

4.6.13 Sanitary Sewer Lift Stations

All sanitary sewer lift stations shall be designed strictly in accordance with 30 TAC §217.59-63. Lift stations utilizing dry wells will not be allowed. All concrete utilized in lift stations shall be polymer concrete.

- Engineer of Record shall submit maximum wet weather flow, maximum dry weather flow, average dry weather flow and minimum dry weather flow to SAT Project Manager for approval. Lift station shall be designed to handle the maximum wet weather flow for its service area.
- Force main pipe size shall be per maximum dry weather flow. Average dry weather flow shall be used to determine the average detention time in the wet well. Minimum dry weather flow shall be used to determine the maximum detention time in the wet well.
- The bottom of the wet well shall have a minimum slope to the intake of two (2) vertical to one (1) horizontal. There shall be no projections in the wet well, which would allow deposition of solids.
- The wet well volume shall be sized to provide adequate storage volume at peak design flows and a pump cycle time of sufficient duration to prevent pump short cycling and consequential motor damage. Contractor/ Engineer shall provide operation and maintenance manuals to SAT Project Manager.

4.6.13.1 Preliminary Design Submittal:

A preliminary design submittal will be required for each lift station. The submittal report shall be prepared by a professional A/E registered in the State of Texas. The report shall include a brief summary of project scope, plans, a basin map, influent hydraulic calculation, wet well volume calculation, pipe size calculation, velocity, ground water levels in proposed site area, proposed system's effect on existing system's capacity, and opinion of probable construction cost for lift station, force main and annual operating and maintenances cost.

Engineer of record shall provide the odor control measure. The potential odor determination must include the estimated flows immediately following construction and throughout a system's 50-year expected life cycle.

- Lift stations will only be considered a viable option if the cost analysis clearly shows that the gravity sanitary sewer mains are not economically feasible.
- All lift station designs shall consider the potential for future expansion. The design of lift station shall incorporate a wet well sized for the final capacity of the lift station.

4.6.13.2 Wet Well Detention Time:

A/E shall calculate the detention time in the wet well for the maximum wet weather flow. The static head shall be calculated for "pump on" and "pump off" elevations in the wet well.

4.6.13.3 Site Selection:

Lift station sites must meet the minimum requirements as set in 30 TAC §217.59,

4.6.13.4 Wet Well and Valve Vaults

The design of all wet wells valve vaults must meet the minimum requirements as set in 30 TAC §217.60.

4.6.13.5 Lift Station Pumps:

All lift stations pumps must meet the minimum requirements as set in 30 TAC §217.61, with the following additions.

- A minimum of two (2) pumps shall be required for all lift station. The capacity of the pumps shall be such that the maximum wet weather flow can be handled with the largest pump out of service.
- The net positive suction head (NPSH) required by the pump selected shall be compared with the NPSH available in the system at the eye of the impeller. The A/E shall consult the pump manufacturer for the NPSH required values for that pump and compare them with calculated values for the NPSH available. The NPSH available should be greater than the NPSH required for a flooded suction pump. A/E shall provide the NPSH calculation to SAT Project Manager for approval.

4.6.13.6 Lift Stations Piping:

All lift station piping must meet the minimum requirements as set in 30 TAC §217.62, with the following additional requirements. All suction piping shall be flanged ductile iron and have a minimum diameter of four (4) inches. Each pump shall have a separate suction pipe.

- Suction piping shall have a velocity of three (3) to five (5) fps.
- All suction pipes inside the wet well shall be equipped with a flare type, down- turned intake. The distance between the bottom of the flare and the floor of the wet well shall be between D/3 and D/2 where D is the diameter of the flare inlet.

4.6.13.7 Electrical Requirements:

All electrical appurtenances and equipment must meet the minimum requirements as set in 30 TAC §217.63, and §217.326, and the latest adopted National Electrical Code (NEC).

4.6.13.8 Head Loss Curves:

- Data points for the system capacity curve shall be provided in tabular form and graphed with pump head capacity curve on the same graph. Pump output in gpm at maximum and minimum head shall be clearly shown on the system curve for each pump and combination of pumps.
- Pumps with the highest efficiencies at all operating points shall be used.

4.6.14 Abandonment of Sanitary Sewer Mains and Appurtenances

Sanitary sewer mains and appurtenances abandonment shall be according to SAWS standard specifications for construction.

4.6.15 Corrosion Control

For corrosion control of Sanitary Systems, refer to section 4.5.13 of this manual. In addition to the soil reactivity for corrosion control, consideration shall be given to corrosion control for exposures to the gases produced by the sanitary sewer system.

4.6.16 Pre and Post CCVT

Prior to testing, all new sanitary sewer lines must be inspected with a video system and a copy of the tape submitted to SAT Project Manager for approval.

Modifications to existing lines or replacement of existing mains shall be inspected both preconstruction, and post construction.

Pre and post construction video requirement shall be according to SAWS standard specification.

4.6.17 Testing Procedures

All installed Sanitary Sewer System pipe must be tested in accordance with the provisions of 30TAC §217.57.

Leakage test on PVC pipe should be a low-pressure air test performed as set forth by the Uni-Bell PVC Pipe Association. Deflection tests should be by a mandrel pull thirty (30) days following trench backfill. All tests should be witnessed by the Owner.

4.6.18 Manholes

All manholes shall meet the minimum requirements as set in 30 TAC §217.55, construction of the Sanitary Sewer Manholes shall be in accordance with SAWS standard specifications for construction with the following additional requirements. Manholes shall be located and spaced so as to facilitate inspection and maintenance of the sanitary sewer main. All manholes must be accessible to maintenance equipment, including 2½ ton straight trucks, dump trucks, vacuum trucks, and standard (not compact) sizes of backhoes and loaders.

Provide thirty (30) inch diameter minimum size access openings for all sanitary manholes.

In isolated cases, construction of all-weather access roads may be necessary for manhole and/or Sanitary sewer line access. Manholes shall be placed at the following locations

- Intersections of mains.
- Horizontal alignment changes.
- Vertical grade changes.
- Change of pipe size.
- Change of pipe material.
- The point of discharge of a force main into a gravity sanitary sewer main.
- At the upstream end of mains.

Sanitary sewer manholes materials shall be according to SAWS standard specifications for construction.

4.6.18.1 Manhole Frames and Covers

All manhole frames and covers must meet the minimum requirements as set in 30 TAC §217.55, with the following additional requirements.

- For all manholes located within the AOA, all FAA requirements must be met.
- All sanitary system manhole covers must be clearly marked with "Sanitary Sewer" visible on the cover.

All manholes must include a concrete pad around the frame and cover with an ID number clearly marked on the upstream side of the manhole pad. A/E shall provide the detail for manhole ID.

4.6.18.2 Manhole Sizes

All manholes shall be sized to meet the minimum requirements as set in 30 TAC §217.55, except that deep manholes shall be required to be a minimum of 60" in diameter when over 15' deep, and a minimum of 72" in diameter when the depth is over 25 ft. deep. A/E shall check following scenario prior to sizing the manhole:

4.6.18.3 Drop Manholes

This can be used where the incoming pipe(s) is 2' or higher than the outgoing pipe.

4.6.19 Sanitary Sewer Cleanouts

Cleanouts should be provided for all service laterals and be located at each bend, at connections to manholes and everyone ninety (900) feet in straight pipe runs. Cleanouts should be installed on all four (4) inch sanitary sewer service lines as required to facilitate line cleaning.

4.7 Stormwater

This section provides criteria for performing drainage design and guidance on what standards the landside drainage design shall conform to. It is not the intent of this document to instruct the A/E in the usage or applicability of these criteria. Engineering training, experience, and judgment must be used in the performance of drainage design tasks. The means and methods used in completing the design

are under the direction of the A/E, who will be required to submit supporting design calculation summaries and software models as part of the plan and report submittals during the various phases of the design. The drainage calculation results will be required in the plan of record.

The Unified Development Code (UDC) for San Antonio is the basic reference for drainage design, although it does not address some drainage design items in sufficient detail. The TxDOT Hydraulic Design Manual can cover some of these areas. Note that the City of San Antonio requires designs to conform to different storm frequencies than TxDOT does. A performance check using City of San Antonio Design Storm Criteria Manual (latest edition) may be necessary for project designs governed by TxDOT design storm criteria. Construction Specifications shall be taken from "City of San Antonio Standard Specifications for Construction", latest edition, published by City of San Antonio Public Works Department, except as modified herein. No variance from these specifications or the modifications herein may be made without the approval of the SAT Project Manager. Care should be exercised in specifying pipe and drainage structure materials to be adequately protected from environmental conditions. A/E are advised to review the geotechnical report before specifying the pipe materials.

- The following latest editions of the documents shall be used as guidance for stormwater drainage design:
    - City of San Antonio Public Works Design Guidance Manual.
    - City of San Antonio Unified Development Code
    - Appendix H - City of San Antonio Public Works Storm Water Design Criteria Manual.
    - Appendix F – Floodplains – Areas of Special Flood
    - TxDOT (Texas Department of Transportation) Hydraulic Design Manual
    - San Antonio River Basin Low Impact Development Technical Design Guidance Manual.

Any conflict between these referenced documents and the criteria shall be brought to the attention of SAT Project Manager for resolution.

4.7.1 Design Criteria

The City of San Antonio, Bexar County, and the San Antonio River Authority (SARA) along with 19 suburban communities, have formed the Bexar Regional Watershed Management (BRWM) partnership. A BRWM technical committee agreed on and adopted regional modeling standards, which are to be used when modeling floodplains and watercourses. Refer to City of San Antonio Public Works Design Guidance Manual (latest edition).

4.7.1.1 Landside Storm Design

- Storm drainage design in those areas referred to as the "Landside" shall be governed by the latest edition of the City of San Antonio Unified Development Code – Appendix H. Minor head losses in storm drain systems as well as other coefficients presented in this Design Criteria Manual shall supersede those presented in the City of San Antonio Storm Water Design Criteria Manual where they differ. In instances where a conflict arises between the Landside Design and the Air Operations Area (AOA) Design, the more conservative criteria shall govern.

4.7.1.2 Determination of Design Discharge

- In order to properly determine the design storm runoff for a given installation, consideration must be given to the design storm rainfall, the runoff coefficient as affected by the surface condition and by the geometry of the watershed, plus the influence of the time of concentration. The runoff coefficients and minimum inlet times (time of concentration) to be used in determining runoff shall be documented for review and approval. Adjustments to the runoff coefficients may be required to account for future build out conditions.
- For drainage areas less than two hundred (200) acres, the basis for computing runoff shall be the rational formula (as defined in UDC Appendix -H) or an alternative method provided it is acceptable to the SAT Project Manager. For drainage areas two hundred (200) acres or greater, the basis for computing runoff shall be a unit hydrograph method (as defined in UDC Appendix - H), preferably the Soil Conservation Service (SCS) Dimensionless Unit Hydrograph method as contained in the U.S. Army Corps of Engineers Hydrologic Engineering Center HEC-HMS "Hydrologic Modeling Systems".

4.7.1.3 Design of Closed Storm Drainage System

- In the preparation of hydraulic designs, a thorough investigation shall be made of all existing structures and their performance on the waterway in question. All new closed storm drainage systems must be designed for the ultimate twenty-five (25)-year storm if the cumulative drainage area within the system is less than one hundred (100) acres. If the cumulative drainage area within the system is more than one hundred (100) acres, the system should be designed for the ultimate one hundred (100)-year storm. A/E must refer to UDC Appendix – H for HGL and ponding requirements.

4.7.1.4 GI/LID Strategies

- Green Infrastructure or Low Impact Development (GI/LID) strategies is a selection of stormwater drainage management approaches and technologies that utilize and/or mimic the natural hydrologic cycle methods of infiltration, evapotranspiration and reuse.
- San Antonio River Basin Low Impact Development Technical Design Guidance Manual (most recent version) can be used as a reference if the SAT Project Manager decides to use the GI/LID strategies - water drainage management for the project.
- Roadway developments or expansions shall incorporate GI/LID strategies in compliance with UDC Appendix - H.

4.7.1.5 Design and Placement of Manholes and Inlets

- Manholes or combination manholes and inlets shall be placed wherever necessary for clean-out and inspection purposes. Place manholes at changes in direction, junctions of pipe run, and at intervals of three hundred (300) to five hundred (500) feet in long pipe runs where the size or direction is not changed. The invert of the manhole section shall be rounded to match the inverts of the pipes entering the manhole in order to reduce eddying and resultant head losses. For manholes that are larger than the incoming or outgoing pipes, expansion losses can sometimes be significant. The use of aircraft rated manholes and covers may be required in some cases depending on location and shall be coordinated with the SAT Project Manager.

4.7.1.6 Flow in Storm Drains and Their Appurtenances

- Storm drains shall be designed to have a minimum mean velocity of three 3 feet per second flowing full. The maximum design velocity shall be according to the UDC.

4.7.1.7 Drainage of Unpaved Areas Adjacent to Buildings

- Unpaved areas adjacent to buildings shall be sloped to direct surface water and roof drainage away from buildings at a minimum slope of five (5%) percent in the first ten (10) feet of horizontal distance. Unpaved areas shall be permanently stabilized with vegetative cover to prevent erosion and soil loss. Surfaces paved with concrete or bituminous pavement shall have a slope of not less than 0.5 percent in the direction of drainage, to prevent ponding.

4.7.1.8 Drainage of Unpaved Areas Not Occupied by Buildings

- Portions of the site not occupied by buildings or pavement shall have adequate continuous slopes to drain toward watercourses, drainage swales, roadways, and storm drainage inlets. Drainage swales or channels shall be sized and sloped to accommodate the design runoff. Sheet flow across sidewalks is allowable when necessary due to site conditions but is discouraged. The concentrated runoff shall be carried under walkways in pipes or by suitable sidewalk drains. Swales shall be used to intercept water at the top and bottom of banks where large areas are drained. To provide positive drainage, a slope of not less than two (2%) percent for turfed areas is desirable. Slopes shall be designed to ensure non-erosive runoff velocities. Turf banks, where required, shall be graded to permit the use of gang mowers, providing a maximum slope of four (4) horizontal to one (1) vertical or as recommended by project geotechnical engineer. The tops and bottoms of all slopes shall be gently rounded in a transition curve for optimum appearance and ease of maintenance

4.7.2 Storm Sewers

4.7.2.1 Flow in Gutters

- The criteria for the flow in gutters shall be as stated in UDC Appendix-H

4.7.2.2 Storm Drain Inlets

- Information on various inlets are available in the Section 8 of UDC Appendix - H that shall be used to determine the capacity and efficiency of the particular type of inlet chosen. When designing inlets, freedom from clogging or from interference with traffic shall take precedence over hydraulic considerations. Precast units may be used for load bearing applications only with the approval of the SAT Project Manager.

4.7.3 Design of Open Channels

Backwater analysis is to be developed for major channels to establish water surface elevation and to avoid adverse impacts on adjacent properties. All new channels shall be designed using the ultimate twenty-five (25) year storm event with freeboard if the drainage area to the channel is less than one hundred (100) acres, one hundred (100) year storm event with freeboard for drainage areas more than one hundred (100) acres. Refer to UDC – Appendix H for freeboard information. Channels shall be concrete lined for velocities over 8 feet per second.

4.7.4 Design of Culverts

Design frequency and methods presented in the UDC Appendix – H shall be used.

4.7.5 Runoff Reduction

The use of LID techniques may be used to reduce runoff. See San Antonio River Basin Low Impact Development Technical Design Guidance Manual (latest edition) for guidance.

4.7.6 Design of Detention Structures

Open surface detention structures shall comply with UDC Appendix – H. Requirements for detention must be coordinated with COSA and approved by the SAT Project Manager.

4.7.7 Emergency Overflow Structures

The purpose of an auxiliary/emergency spillway is to provide a controlled overflow relief for storm flows in excess of the design discharge for the storage facility. A suitable auxiliary/emergency spillway section for a detention facility is a broad crested weir, cut through the original ground next to the embankment. The transverse cross section of the weir is typically trapezoidal in shape. Refer to Unified Development Code - Appendix H for further information.

4.7.8 Drainage Report

All drainage designs shall be contained in a Drainage Report and shall be submitted to the SAT Project Manager for review and approval. The Drainage Report shall be in such form as to provide the basis for timely and consistent review and will be made a part of the permanent record for future evaluation as a chapter in the Project Report. The drainage report shall contain the following:

- Description and plan of existing drainage facilities.
- Description and plan of proposed drainage facilities (which may be half size reduction of preliminary or final design plans).
- Drainage area map.
- Description of analysis.
- Description of flow testing.
- All calculations associated with the determination of runoff coefficients, volume of runoff, time of concentration, inlet size, culvert or pipe size and elevation of hydraulic gradient, discharge flow and velocity and any other items pertinent to the drainage design.
- Consideration of drainage alternatives and recommended facilities. Usage of rainwater containment tanks for irrigation is encouraged where feasible.
- A certification signed and sealed by licensed professional engineer registered in the State of Texas that the design procedure is in full compliance with the requirements of these criteria.
- Description of measures taken for velocity dissipation to ensure non-erosive velocities at points of discharge.
- All calculations associated with the drainage design shall be included in tabular form in the final design plans.

- The drainage area map shall be no smaller than a one (1) inch equals two hundred (200) feet scale, and show all streets, building pads and other existing and proposed features. The drainage area map shall show the boundary of the drainage area contributing runoff into the proposed system. The area shall be further divided into numbered sub-areas to determine flow concentration points or inlet location(s). Drainage area maps shall show streets, land-use and land-use boundaries, existing ground elevations on two (2) foot contours, and a summary table of peak design flows for sub-areas with acreage, runoff coefficient, and inlet time shown.
- Quantity and direction of design flow within streets, alleys, natural and manmade drainage ways and at all system intersections shall be clearly shown on the drainage area map. Existing and proposed drainage inlets, storm drainage systems and drainage channels shall be clearly shown and differentiated on the drainage area map.

4.7.9 Manholes, Catch Basins, and Inlets Materials and Design Standards

4.7.9.1 Materials and Design of manholes, catch basins, and inlets shall be in accordance with the UDC Appendix H – Storm Water Design Criteria Manual Chapter 8.

4.7.10 Pipe Materials for Storm Drains, Trench Drains, and Culverts

4.7.10.1 Pipe Materials for Storm Drains, Trench Drains, and Culverts shall be in accordance with the UDC Appendix H – Storm Water Design Criteria Manual Chapter 8.

4.7.11 Environmental

4.7.11.1 Storm Water Pollution Prevention Plan:

- For projects disturbing greater than one acre, a Storm Water Pollution Prevention Plan, including an erosion control plan, must be submitted to the SAT Project Manager along with a signed Notice of Intent before a Notice to Proceed will be issued. Erosion control measures shall be designed and implemented to effectively prevent the discharge of sediments to the storm drain system and receiving waters. Care shall be taken in the design and implementation of such measures to ensure that a safety hazard, such as ponding water on a roadway, does not occur. Further, it is important to recognize that water retention causes a bird attractant and hazard to navigation so no retention can be developed on airport property and that any detention areas must discharge water to a dry bottom condition within 24 hours.

4.7.11.2 Storm Water Quality:

- All new or renovated facilities must be designed to minimize the impact of stormwater discharges on the environment and assure that the facility can be operated in compliance with environmental laws and regulations. The facility Operator is the company, agency, or entity that will have operational control of daily activities at the facility following the issuance of a Certificate of Occupancy/Use.

4.7.11.3 Preliminary Actions:

- In order to ensure compliance with the above-described objectives, the Operator shall submit the following documents to SAT Project Manager prior to making any application for a construction permit to construct or renovate a facility from which there will be a change in stormwater discharge:
- Documents, prepared by the Operator, describing the type and nature of all activities to occur at the site that could potentially impact stormwater quality, runoff velocity, runoff volume, or watershed characteristics.
- Documents, prepared by the Operator, detailing the operational controls that will be implemented at the facility. This could possibly be in the form of an operational stormwater pollution prevention plan (SWPPP), or the format could be less structured. In any case, the operational measures/restrictions to be employed at the facility must be clearly stated.
- A certification, sealed by the engineer of record, stating that "Based upon the above representations made by the Operator, the proposed structural controls will impel storm water discharged from the facility to meet EPA benchmark standards."

4.8 Glossary

AASHTO :	American Association of State Highway and Transportation
AC :	Advisory Circular
AOA :	Air Operation Area
ARFF :	Aircraft Rescue and Fire Fighting
ASTM :	American Society for Testing and Materials
AWWA :	American Water Works Association
BRWM :	Bexar Regional Watershed Management
CCU :	Cluster Control Unit
CIP :	Clean In Place
CMP :	Corrugated Metal Pipe
CoSA :	City of San Antonio
CPS :	Corrosion Protection System
CTA :	Central Terminal Area
CTB :	Concrete Traffic Barriers
CTS :	Corrosion Test Station
FAA :	Federal Aviation Administration
FAR :	Federal Aviation Regulations
FDC :	Fire Department Connection
FF :	Finish Floor
DC :	Detector Check
DIPRA :	Ductile Iron Pipe Research Association
GC :	Galvanic Protection
GI :	Green Infrastructure
HDPE :	High Density Polyethylene
ICCP :	Impressed Current Cathodic Protection
LCD :	Liquid Crystal Display
LID :	Low Impact Development
LLDPE :	Liner Low Density Polyethylene
MUTCD :	Manual for Uniform Traffic Control Devices
NACE :	National Association of Corrosion Engineers
NEC :	National Electrical Code
NELAP :	National Environmental Laboratory Accreditation Program
NFPA :	National Fire Protection Association

NPSH :	The Net Positive Suction Head
O&I :	Orders & Instruction
OSHA :	Occupational Safety and Health Administration of the United States
PDWF :	Peak Dry Weather Flow
PRV :	Pressure Reducing Valves
PVC :	Polyvinyl Chloride
PVC :	The Vertical Point of Curvature
PVI :	The Point of Vertical Intersection
PVT :	The vertical Point of Tangency
RCCP :	Reinforced Concrete Cylinder Pipe
RCP :	Reinforced Concrete Pipe
ROW :	Right of Way
SAT :	San Antonio Airport
SCS :	Soil Conservation Service
SSS :	Surgeons Scrub Sink
SWPPP :	Storm Water Pollution Prevention Plan
TCEQ :	Texas Commission on Environmental Quality
TxDOT :	Texas Department of Transportation
UDC :	Unified Development Code
USDA :	United States Department of Agriculture

4.9 Appendix

4.9.1 KSAT seeding spec 2021

Updated October 12, 2016

ITEM T-901 SEEDING

FOR ALL AREAS OUTSIDE THE AOA MOVEMENT AREA

DESCRIPTION

901-1.1 This item shall consist of soil preparation, seeding and fertilizing or liming the areas shown on the plans or as directed by the Engineer in accordance with these specifications.

MATERIALS

901-2.1 SEED The species and application rates of grass, legume, and cover-crop seed furnished shall be those stipulated herein. Seed shall conform to the requirements of Fed. Spec. JJJ-S-181.

Seed shall be furnished separately or in mixtures in standard containers with the seed name, lot number, net weight, percentages of purity and of germination and hard seed, and percentage of maximum weed seed content clearly marked for each kind of seed. The Contractor shall furnish the Engineer duplicate signed copies of a statement by the vendor certifying that each lot of seed has been tested by a recognized laboratory for seed testing within 6 months of date of delivery. This statement shall include: name and address of laboratory, date of test, lot number for each kind of seed, and the results of tests as to name, percentages of purity and of germination, and percentage of weed content for each kind of seed furnished, and, in case of a mixture, the proportions of each kind of seed.

Seed	Minimum Seed Purity (Percent)	Minimum Germination (Percent)	Rate of Application lb./acre (or lb./1,000 S.F.)
Bermuda and Giant Bermuda grass (hulled), Cynodon Dactylon	95	90	1.5 lb/1,000 SF
Annual Rye Grass (Added to mix between October 1 and March15)	95	90	10 lb/1,000 SF
NOTE : An empty bag of seed with seed tag attached will need to be submitted to Airport Wildlife Biologist 210-207-1663			
70/30 Wood/Cellulose Blend fiber mulch			2,000 lb/acre
Fertilizer	W		400 lb/acre
Water	For 14 days after seeding watering must occur daily with a ¼ to ½ inch applied to area (unless an rain event occur)		
Binder			Per manufacturer's instructions

Seeds shall be applied as follows:

Seeding shall be performed during the period between **[ ]** and **[ ]** inclusive, unless otherwise approved by the Engineer.

901-2.2 LIME. Lime shall be ground limestone containing not less than 85% of total carbonates, and shall be ground to such fineness that 90% will pass through a No. 20 mesh sieve and 50% will pass through a No. 100 mesh sieve. Coarser material will be acceptable, providing the rates of application are increased to provide not less than the minimum quantities and depth specified in the special provisions on the basis of the two sieve requirements above. Dolomitic lime or a high magnesium lime shall contain at least 10% of magnesium oxide. Lime shall be applied at the rate of the rates as recommended by the **soil test analysis that is to be conducted by the Contractor** prior to construction. All liming materials shall conform to the requirements of ASTM C 602.

901-2.3 FERTILIZER. Fertilizer shall be standard commercial fertilizers supplied separately or in mixtures containing the percentages of total nitrogen, available phosphoric acid, and water-soluble potash. They shall be applied at the rate and to the depth specified herein, and shall meet the requirements of Fed. Spec. A-A-1909 and applicable state laws. They shall be furnished in standard containers with name, weight, and guaranteed analysis of contents clearly marked thereon. No cyanamide compounds or hydrated lime shall be permitted in mixed fertilizers.

The fertilizers may be supplied in one of the following forms:

a. A dry, free-flowing fertilizer suitable for application by a common fertilizer spreader;
b. A finely-ground fertilizer soluble in water, suitable for application by power sprayers; or
c. A granular or pellet form suitable for application by blower equipment.

Fertilizers shall be slow release commercial fertilizer and shall be spread at the rate as recommended by the **soil test analysis that is conducted by the Contractor**.

901-2.4 SOIL FOR REPAIRS. The soil for fill and topsoiling of areas to be repaired shall be at least of equal quality to that which exists in areas adjacent to the area to be repaired. The soil shall be relatively free from large stones, roots, stumps, or other materials that will interfere with subsequent sowing of seed, compacting, and establishing turf, and shall be approved by the Engineer before being placed.

901-2.5 HYDRO MULCHING. Hydro mulching - 100% virgin wood cellulose fiber mulch shall be;

- Free of growth or germination inhibiting ingredients.
- Specially manufactured for use in hydraulic seeding and mulching equipment.
- Minimum organic matter content of 95%.
- Minimum moisture content of 12%.
- Water absorption potential of 800 -900% for wood cellulose fiber mulch.
- Quantity and rate shall be per the manufacturer's recommendation for use as a metering agent to apply seed uniformly over designated area.

901-2.6 Contractor shall apply hydro-mulch with hydro-seeding in all locations as designated on the plans or by the engineer.

CONSTRUCTION METHODS

901-3.1 ADVANCE PREPARATION AND CLEANUP. After grading of areas has been completed and before applying fertilizer and ground limestone, areas to be seeded shall be raked or otherwise cleared of stones larger than 2 in (50 mm) in any diameter, sticks, stumps, and other debris that might interfere with sowing of seed, growth of grasses, or subsequent maintenance of grass-covered areas. If any damage by erosion or other causes has occurred after the completion of grading and before beginning the application of fertilizer and ground limestone, the Contractor shall repair such damage. This may include filling gullies, smoothing irregularities, and repairing other incidental damage.

An area to be seeded shall be considered a satisfactory seedbed without additional treatment if it has recently been thoroughly loosened and worked to a depth of not less than 5 in (125 mm) as a result of grading operations and, if immediately prior to seeding, the top 3 in (75 mm) of soil is loose, friable, reasonably free from large clods, rocks, large roots, or other undesirable matter, and if shaped to the required grade.

However, when the area to be seeded is sparsely sodded, weedy, barren and unworked, or packed and hard, any grass and weeds shall first be cut or otherwise satisfactorily disposed of, and the soil then scarified or otherwise loosened to a depth not less than 5 in (125 mm). Clods shall be broken and the top 3 in (75 mm) of soil shall be worked into a satisfactory seedbed by discing, or by use of cultipackers, rollers, drags, harrows, or other appropriate means.

901-3.2 WET APPLICATION METHOD.

a. General. The Contractor may elect to apply seed and fertilizer (and lime, if required) by spraying them on the previously prepared seedbed in the form of an aqueous mixture and by using the methods and equipment described herein. The rates of application shall be as specified in the special provisions.

b. Spraying Equipment. The spraying equipment shall have a container or water tank equipped with a liquid level gauge calibrated to read in increments not larger than 50 gallons (190 liters) over the entire range of the tank capacity, mounted so as to be visible to the nozzle operator. The container or tank shall also be equipped with a mechanical power-driven agitator capable of keeping all the solids in the mixture in complete suspension at all times until used.

The unit shall also be equipped with a pressure pump capable of delivering 100 gallons (380 liters) per minute at a pressure of 100 lb / sq in (690 kPa). The pump shall be mounted in a line that will recirculate the mixture through the tank whenever it is not being sprayed from the nozzle. All pump passages and pipe lines shall be capable of providing clearance for 5/8 in (15 mm) solids. The power unit for the pump and agitator shall have controls mounted so as to be accessible to the nozzle operator. There shall be an indicating pressure gauge connected and mounted immediately at the back of the nozzle.

The nozzle pipe shall be mounted on an elevated supporting stand in such a manner that it can be rotated through 360 degrees horizontally and inclined vertically from at least 20 degrees below to at least 60 degrees above the horizontal. There shall be a quick-acting, three-way control valve connecting the recirculating line to the nozzle pipe and mounted so that the nozzle operator can control and regulate the amount of flow of mixture delivered to the nozzle. At least three different types of nozzles shall be supplied so that mixtures may be properly sprayed over distance varying from 20 to 100 ft (6 to 30 m). One shall be a close-range ribbon nozzle, one a medium-range ribbon nozzle, and one a long-range jet nozzle. For case of removal and cleaning, all nozzles shall be connected to the nozzle pipe by means of quick-release couplings.

In order to reach areas inaccessible to the regular equipment, an extension hose at least 50 ft (15 m) in length shall be provided to which the nozzles may be connected.

c. Mixtures. Lime, if required, shall be applied separately, in the quantity specified, prior to the fertilizing and seeding operations. Not more than 220 pounds (100 kg) of lime shall be added to and mixed with each 100 gallons (380 liters) of water. Seed and fertilizer shall be mixed together in the relative proportions specified, but not more than a total of 220 pounds (100 kg) of these combined solids shall be added to and mixed with each 100 gallons (380 liters) of water.

All water used shall be obtained from fresh water sources and shall be free from injurious chemicals and other toxic substances harmful to plant life. Brackish water shall not be used at any time. The Contractor shall identify to the Engineer all sources of water at least 2 weeks prior to use. The Engineer may take samples of the water at the source or from the tank at any time and have a laboratory test the samples for chemical and saline content. The Contractor shall not use any water from any source that is disapproved by the Engineer following such tests.

All mixtures shall be constantly agitated from the time they are mixed until they are finally applied to the seedbed. All such mixtures shall be used within 2 hours from the time they were mixed or they shall be wasted and disposed of at locations acceptable to the Engineer.

d. Spraying. Lime, if required, shall be sprayed only upon previously prepared seedbeds. After the applied lime mixture has dried, the lime shall be worked into the top 3 in (8 cm), after which the seedbed shall again be properly graded and dressed to a smooth finish.

Mixtures of seed and fertilizer shall only be sprayed upon previously prepared seedbeds on which the lime, if required, shall already have been worked in. The mixtures shall be applied by means of a high-pressure spray that shall always be directed upward into the air so that the mixtures will fall to the ground like rain in a uniform spray. Nozzles or sprays shall never be directed toward the ground in such a manner as might produce erosion or runoff.

Particular care shall be exercised to insure that the application is made uniformly and at the prescribed rate and to guard against misses and overlapped areas. Proper predetermined quantities of the mixture in accordance with specifications shall be used to cover specified sections of known area.

Checks on the rate and uniformity of application may be made by observing the degree of wetting of the ground or by distributing test sheets of paper or pans over the area at intervals and observing the quantity of material deposited thereon.

On surfaces that are to be mulched as indicated by the plans or designated by the Engineer, seed and fertilizer applied by the spray method need not be raked into the soil or rolled. However, on surfaces on which mulch is not to be used, the raking and rolling operations will be required after the soil has dried.

901-3.3 MAINTENANCE OF SEEDED AREAS. The Contractor shall protect seeded areas against traffic or other use by warning signs or barricades, as approved by the Engineer. Surfaces gullied or otherwise damaged following seeding shall be repaired by regrading and reseeding as directed. The Contractor shall mow, water as directed, and otherwise maintain seeded areas in a satisfactory condition until final inspection and acceptance of the work. **The Contractor shall coordinate the timing of watering the seeded area with Airport Operations. At a minimum the Contractor shall water the seeded area nightly (after midnight) for two months after the seed has been placed. If an acceptable stand has not be produced the Contractor shall continue to water the seeded area twice a week (nightly after midnight) for an additional month. The contractor shall coordinate mowing, fertilizing and watering of the seeded areas with Airport Operations until an acceptable stand of grass has been achieved.**

When either the dry or wet application method outlined above is used for work done out of season, it will be required that the Contractor establish a good stand of grass of uniform color and density to the satisfaction of the Engineer. A grass stand shall be considered adequate when bare spots are one square foot or less, randomly dispersed, and do not exceed 3 percent of the area seeded. If at the time when the contract has been otherwise completed it is not possible to make an adequate determination of the color, density, and uniformity of such stand of grass, payment for the unaccepted portions of the areas seeded out of season will be withheld until such time as these requirements have been met.

METHOD OF MEASUREMENT

901-4.1 The quantity of Hydro-Mulch Seeding to be paid for shall be the number of acres measured on the ground surface, completed and accepted.

BASIS OF PAYMENT 901-5.1 Payment shall be made at the contract unit price per acre or fraction thereof, which price and payment shall be full compensation for furnishing and placing all material and for all labor, equipment, tools, and incidentals necessary to complete the work prescribed in this item. Payment will be made under:

Item T-901 5.1 Hydro-Mulch Seeding – per acre

MATERIAL REQUIREMENTS

ASTM C 602 Agricultural Liming Materials ASTM D 977 Emulsified Asphalt FED SPEC A-A-1909 Fertilizer

END OF ITEM T-901

ITEM T-904 SODDING DESCRIPTION

REQUIRED METHOD FOR ALL AOA MOVEMENT AREA

904-1.1 This item shall consist of furnishing, hauling, and placing approved live sod on prepared areas in accordance with this specification at the locations shown on the plans or as directed by the Engineer.

MATERIALS

904-2.1 SOD. Sod furnished by the Contractor shall have a good cover of living or growing grass. This shall be interpreted to include grass that is seasonally dormant during the cold or dry seasons and capable of renewing growth after the dormant period. All sod shall be obtained from areas where the soil is reasonably fertile and contains a high percentage of loamy topsoil. Sod shall be cut or stripped from living, thickly matted turf relatively free of weeds or other undesirable foreign plants, large stones, roots, or other materials that might be detrimental to the development of the sod or to future maintenance. At least 70% of the plants in the cut sod shall be composed of the species stated in the special provisions, and any vegetation more than 6 in (150 mm) in height shall be mowed to a height of 3 in (75 mm) or less before sod is lifted. Sod, including the soil containing the roots and the plant growth showing above, shall be cut uniformly to a thickness not less than that stated in the special provisions.

904-2.2 LIME. Lime shall conform to the requirements of 901-2.2.

904-2.3 FERTILIZER. Fertilizer shall conform to the requirements of 901-2.3.

904-2.4 WATER. The water shall be sufficiently free from oil, acid, alkali, salt, or other harmful materials that would inhibit the growth of grass. It shall be subject to the approval of the Engineer prior to use.

904-2.5 SOIL FOR REPAIRS. The soil for fill and topsoiling of areas to be repaired shall conform to the requirements of 901-2.4.

CONSTRUCTION METHODS

904-3.1 GENERAL. Areas to be solid, strip, or spot sodded shall be shown on the plans. Areas requiring special ground surface preparation such as tilling and those areas in a satisfactory condition that are to remain undisturbed shall also be shown on the plans.

Suitable equipment necessary for proper preparation of the ground surface and for the handling and placing of all required materials shall be on hand, in good condition, and shall be approved by the Engineer before the various operations are started. The Contractor shall demonstrate to the Engineer before starting the various operations that the application of required materials will be made at the specified rates.

904-3.2 PREPARING THE GROUND SURFACE. After grading of areas has been completed and before applying fertilizer and limestone, areas to be sodded shall be raked or otherwise cleared of stones larger than 2 in (50 mm) in any diameter, sticks, stumps, and other debris which might interfere with sodding, growth of grasses, or subsequent maintenance of grass-covered areas. If any damage by erosion or other causes occurs after grading of areas and before beginning the application of fertilizer and ground limestone, the Contractor shall repair such damage. This may include filling gullies, smoothing irregularities, and repairing other incidental damage.

904-3.3 APPLYING FERTILIZER AND GROUND LIMESTONE. Following ground surface preparation, fertilizer shall be uniformly spread at a rate which will provide not less than the minimum quantity of each fertilizer ingredient, as stated in the special provisions. If use of ground limestone is required, it shall then be spread at a rate that will provide not less than the minimum quantity stated in the special provisions. These materials shall be incorporated into the soil to a depth of not less than 2 in (50 mm) by discing, raking, or other methods acceptable to the Engineer. Any stones larger than 2 in (50 mm) in any diameter, large clods, roots, and other Jitter brought to the surface by this operation shall be removed.

904-3.4 OBTAINING AND DELIVERING SOD. After inspection and approval of the source of sod by the Engineer, the sod shall be cut with approved sod cutters to such a thickness that after it has been transported and placed on the prepared bed, but before it has been compacted, it shall have a uniform thickness of not less than 2 in (50 mm). Sod sections or strips shall be cut in uniform widths, not less than 10 in (250 mm), and in lengths of not less than 18 in (45 cm), but of such length as may be readily lifted without breaking, tearing, or loss of soil. Where strips are required, the sod must be rolled without damage with the grass folded inside. The Contractor may be required to mow high grass before cutting sod.

The sod shall be transplanted within 24 hours from the time it is stripped, unless circumstances beyond the Contractor's control make storing necessary. In such cases, sod shall be stacked, kept moist, and protected from exposure to the air and sun and shall be kept from freezing. Sod shall be cut and moved only when the soil moisture conditions are such that favorable results can be expected. Where the soil is too dry, permission to cut sod may be granted only after it has been watered sufficiently to moisten the soil to the depth the sod is to be cut.

904-3.5 LAYING SOD. Sodding shall be performed only during the seasons when satisfactory results can be expected. Frozen sod shall not be used and sod shall not be placed upon frozen soil. Sod may be transplanted during periods of drought with the approval of the Engineer, provided the sod bed is watered to moisten the soil to a depth of at least 4 in (100 mm) immediately prior to laying the sod.

The sod shall be moist and shall be placed on a moist earth bed. Pitch forks shall not be used to handle sod, and dumping from vehicles shall not be permitted. The sod shall be carefully placed by hand, edge to edge and with staggered joints, in rows at right angles to the slopes, commencing at the base of the area to be sodded and working upward. The sod shall immediately be pressed firmly into contact with the sod bed by tamping or rolling with approved equipment to provide a true and even surface, and insure knitting without displacement of the sod or deformation of the surfaces of sodded areas. Where the sod may be displaced during sodding operations, the workmen when replacing it shall work from ladders or treaded planks to prevent further displacement. Screened soil of good quality shall be used to fill all cracks between sods.

The quantity of the fill soil shall not cause smothering of the grass. Where the grades are such that the flow of water will be from paved surfaces across sodded areas, the surface of the soil in the sod after compaction shall be set approximately 1 1/2 in below the pavement edge. Where the flow will be over the sodded areas and onto the paved surfaces around manholes and inlets, the surface of the soil in the sod after compaction shall be placed flush with pavement edges.

On all areas to be sodded, the sod shall be pegged in-place with wooden pegs not less than 12 in (300 mm) in length and have a cross-sectional area of not less than 3/4 sq. in (18 so mm). The pegs shall be driven flush with the surface of the sod.

904-3.6 WATERING. Adequate water and watering equipment must be on hand before sodding begins, and sod shall be kept moist until it has become established and its continued growth assured. In all cases, watering shall be done in a manner that will avoid erosion from the application of excessive quantities and will avoid damage to the finished surface. **The Contractor shall coordinate the timing of watering the sodded area with Airport Operations. At a minimum the Contractor shall water the sodded area nightly (after midnight) for two months after the sod has been placed. If an established turf has not been produced the Contractor shall continue to water the area twice a week (nightly after midnight) for an additional month. The contractor shall coordinate mowing, fertilizing and watering of the sodded areas with Airport Operations until an acceptable turf has been established.**

904-3.7 ESTABLISHING TURF.

a. General. The Contractor shall provide general care for the sodded areas as soon as the sod has been laid and shall continue until final inspection and acceptance of the work.

b. Protection. All sodded areas shall be protected against traffic or other use by warning signs or barricades approved by the Engineer.

c. Mowing. The Contractor shall mow the sodded areas with approved mowing equipment, depending upon climatic and growth conditions and the needs for mowing specific areas. In the event that weeds or other undesirable vegetation are permitted to grow to such an extent that, either cut or uncut, they threaten to smother the sodded species, they shall be mowed and the clippings raked and removed from the area.

904-3.8 REPAIRING. When the surface has become bullied or otherwise damaged during the period covered by this contract, the affected areas shall be repaired to re-establish the grade and the condition of the soil, as directed by the Engineer, and shall then be sodded as specified in 904-3.5.

METHOD OF MEASUREMENT

904-4.1 This item shall be measured on the basis of the area in square yards of the surface covered with sod and accepted.

BASIS OF PAYMENT

904-5.1 This item will be paid for on the basis of the contract unit price per square yard for sodding, which price shall be full compensation for all labor, equipment, material, staking, and incidentals necessary to satisfactorily complete the items as specified.

Payment will be made under:

Item T-904-5.1 Sodding - per square yard.

END OF ITEM T-904

ITEM T-905 TOPSOILING

DESCRIPTION

905-1.1 This item shall consist of preparing the ground surface for topsoil application, removing topsoil from designated stockpiles or areas to be stripped on the site or from approved sources off the site, and placing and spreading the topsoil on prepared areas in accordance with this specification at the locations shown on the plans or as directed by the Engineer.

MATERIALS

905-2.1 TOPSOIL. Topsoil shall be the surface layer of soil with no admixture of refuse or any material toxic to plant growth, and it shall be reasonably free from subsoil and stumps, roots, brush, stones (2 in or more in diameter), and clay lumps or similar objects. Brush and other vegetation that will not be incorporated with the soil during handling operations shall be cut and removed. Ordinary sods and herbaceous growth such as grass and weeds are not to be removed but shall be thoroughly broken up and intermixed with the soil during handling operations. The topsoil or soil mixture, unless otherwise specified or approved, shall have a pH range of approximately 5.5 pH to 7.6 pH, when tested in accordance with the methods of testing of the association of official agricultural chemists in effect on the date of invitation of bids. The organic content shall be not less than 3% nor more than 20% as determined by the wet-combustion method (chromic acid reduction). There shall be not less than 20% nor more than 80% of the material passing the 200 mesh (0.075 mm) sieve as determined by the wash test in accordance with ASTM C 117.

Natural topsoil may be amended by the Contractor with approved materials and methods to meet the above specifications.

905-2.2 INSPECTION AND TESTS. Within 10 days following acceptance of the bid, the Engineer shall be notified of the source of topsoil to be furnished by the Contractor. The topsoil shall be inspected to determine if the selected soil meets the requirements specified and to determine the depth to which stripping will be permitted. At this time, the Contractor may be required to take representative soil samples from several locations within the area under consideration and to the proposed stripping depths, for testing purposes as specified in 905-2.1.

Ready-to-Plant, Mulch and Topsoil

Ready-to-Plant, Mulch and Professional Topsoil will be addressed on a case by case basis. These soils are generally contract spec soils that will be mixed per the required specifications. The P&D Division should approve the spec and source before the contractor brings the soil on to the airport.

Soil must not be imported or without a completed Soil Management Plan (SMP) authorization (see attached form) issued/approve by ESD and/or P&D. A *Soil Screening Plan* must be prepared and followed for all projects. At a minimum, soils should be analyzed for the following:

Chemical of Concern (COC)	Test Method
Total Petroleum Hydrocarbon (TPH)	TX1005
Benzene, Toluene, Xylene and Ethylbenzene (BTEX)	8021 or 8260
Polycyclic Aromatic Hydrocarbons (PAH) [4]	8310 or 8270
Metals (RCRA-8) plus Antimony, Beryllium and Nickel	200.7

[4] - TPH testing will be used to screen for PAHs using method TCEQ-1005. If the laboratory reports any detection of hydrocarbons in the carbon range greater than nC12, then the sample with the highest concentration of hydrocarbons in the > nC12 range must be analyzed for PAHs. The PAH results will be compared to the PAH results listed above.

See Appendix B in the SMP for the acceptable concentrations of Chemicals of Concern (COCs).

Sampling Frequencies

Soil Importation	One (1) composite sample per 1,000 cubic yards (or less)*. Additional visual screening of imported soil is required at a minimum of one (1) per every five (5) trucks*.

CONSTRUCTION METHODS

905-3.1 GENERAL. Areas to be topsoiled shall be shown on the plans. If topsoil is available on the site, the location of the stockpiles or areas to be stripped of topsoil and the stripping depths shall be shown on the plans.

Suitable equipment necessary for proper preparation and treatment of the ground surface, stripping of topsoil, and for the handling and placing of all required materials shall be on hand, in good condition, and approved by the Engineer before the various operations are started.

905-3.2 PREPARING THE GROUND SURFACE. Immediately prior to dumping and spreading the topsoil on any area, the surface shall be loosened by discs or spike-tooth harrows, or by other means approved by the Engineer, to a minimum depth of 2 in (50 mm) to facilitate bonding of the topsoil to the covered subgrade soil. The surface of the area to be topsoiled shall be cleared of all stones larger than 2 in (50 mm) in any diameter and all litter or other material which may be detrimental to proper bonding, the rise of capillary moisture, or the proper growth of the desired planting. Limited areas, as shown on the plans, which are too compact to respond to these operations shall receive special scarification.

Grades on the area to be topsoiled, which have been established by others as shown on the plans, shall be maintained in a true and even condition. Where grades have not been established, the areas shall be smooth-graded and the surface left at the prescribed grades in an even and properly compacted condition to prevent, insofar as practical, the formation of low places or pockets where water will stand.

905-3.3 OBTAINING TOPSOIL. Prior to the stripping of topsoil from designated areas, any vegetation, briars, stumps and large roots, rubbish or stones found on such areas, which may interfere with subsequent operations, shall be removed using methods approved by the Engineer. Heavy sod or other cover, which cannot be incorporated into the topsoil by discing or other means shall be removed.

When suitable topsoil is available on the site, the Contractor shall remove this material from the designated areas and to the depth as directed by the Engineer. The topsoil shall be spread on areas already tilled and smooth-graded, or stockpiled in areas approved by the Engineer. Any topsoil stockpiled by the Contractor shall be rehandled and placed without additional compensation. Any topsoil that has been stockpiled on the site by others, and is required for topsoiling purposes, shall be removed and placed by the Contractor. The sites of all stockpiles and areas adjacent thereto which have been disturbed by the Contractor shall be graded if required and put into a condition acceptable for seeding.

When suitable topsoil is secured off the airport site, the Contractor shall locate and obtain the supply, subject to the approval of the Engineer. The Contractor shall notify the Engineer sufficiently in advance of operations in order that necessary measurements and tests can be made. The Contractor shall remove the topsoil from approved areas and to the depth as directed. The topsoil shall be hauled to the site of the work and placed for spreading, or spread as required. Any topsoil hauled to the site of the work and stockpiled shall be rehandled and placed without additional compensation.

905-3.4 PLACING TOPSOIL. The topsoil shall be evenly spread on the prepared areas to a uniform depth of 2 in (50 mm) after compaction, unless otherwise shown on the plans or stated in the special provisions. Spreading shall not be done when the ground or topsoil is frozen, excessively wet, or otherwise in a condition detrimental to the work. Spreading shall be carried on so that turfing operations can proceed with a minimum of soil preparation or tilling.

After spreading, any large, stiff clods and hard lumps shall be broken with a pulverizer or by other effective means, and all stones or rocks (2 in (50 mm) or more in diameter), roots, litter, or any foreign matter shall be raked up and disposed of by the Contractor. after spreading is completed, the topsoil shall be satisfactorily compacted by rolling with a cultipacker or by other means approved by the Engineer. The compacted topsoil surface shall conform to the required lines, grades, and cross sections. Any topsoil or other dirt falling upon pavements as a result of hauling or handling of topsoil shall be promptly removed.

METHOD OF MEASUREMENT

905-4.1 Topsoil obtained on the site shall be measured by the number of cubic yards of topsoil measured in its original position and stripped or excavated. Topsoil stockpiled by others and removed for topsoiling by the Contractor shall be measured by the number of cubic yards of topsoil measured in the stockpile. Topsoil shall be measured by volume in cubic yards computed by the method of end areas.

BASIS OF PAYMENT

905-5.1 Payment will be made at the contract unit price per cubic yard for topsoiling (obtained on the site). This price shall be full compensation for furnishing all materials and for all preparation, placing, and spreading of the materials, and for all labor, equipment, tools, and incidentals necessary to complete the item.

Payment will be made under: Item T-905-5.1 Topsoiling -per cubic yard.

TESTING MATERIALS

ASTM C 117 Materials Finer than 75 pm (No. 200) Sieve in Mineral Aggregates by Washing

END OF ITEM T-905

Wildlife Hazard Management Plan

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Per FAA AC 150-5200-36B
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May 2022

Table of Contents

List of Acronyms

AEI	Adams Environmental, Inc.
AET	Adams Environmental Team
AICC	Airport Integrated Control Center
AOA	Airport Operating Area
ATC	Air traffic Control
AWC	Airport Wildlife Consultants
DM	Duty Manager
CFR	Code of Federal Regulations
CPS	City Public Service
FAA	Federal Aviation Administration
MBTA	Migrator Treaty Act
NOTAM	Notice to Airmen
QWB	Qualified Wildlife Biologist
SAT	San Antonio International Airport
SAAS	San Antonio Airport Systems
TPWD	Texas Department of Wildlife
T&E	Threatened and Endangered
TTPP	Trap, Transport and Process Permit
USACE	United State Army Corps of Engineers
USFWS	United States Fish and Wildlife Service
WHG	Wildlife Hazard Group
WHMP	Wildlife Hazard Management Plan

Page Amendment Log

Date of Amendment	FAA Approval	Pages	Description
03/07/2014	March 31 2014	ALL (1-17)	Change Airport logo, Change Wildlife Manager to Qualified Wildlife Biologist , Yearly revisions on Wildlife Hazard Mitigation Action
04/10/2015	July 1 2015	Pages (1,2,4-12,14,15, Depredation permit)	Annual review of WHMP,
4-20-2016	June 6 2016	1-11,13,14	Annual Review of WHMP
5/1/2017	May 17 2017	1-17	Annual Review of WHMP
5/17/2018	July 6 2018	1-17	Annual Review of WHMP
5/22/2019	November 7, 2020	1-21	Annual Review of WHMP
5/26/2020	September 17,2020	1-21	Annual Review of WHMP
5/25/2021	October 21 2021	1-21	Annual Review of WHMP
5/24/2022		1,2,3,5,9 ,13,14, &17	Annual Review of WHMP

Introduction

Pursuant to the Code of Federal Regulations (CFR) Title 14 Part (§) 139.337, San Antonio International Airport (SAT) developed this Wildlife Hazard Management Plan (WHMP) in cooperation with the Adams Environmental Team (AET) comprised of Adams Environmental, Inc. (AEI) and Airport Wildlife Consultants (AWC). This WHMP shall be reviewed periodically by SAT's Qualified Wildlife Biologist and shall be updated as recommendations are implemented and as changing circumstances merit. All changes made to the WHMP shall be sent to the Federal Aviation Administration (FAA) for approval, and shall be documented in the Table of Revisions of this document.

San Antonio International Airport Staff have diligently reported wildlife strikes since 1990. According to the FAA National Wildlife Strike Database, a total of 1550 bird and wildlife strikes have been reported for SAT from 1990-2021. In 2009 the airport hired a full time wildlife manager to mitigate wildlife on and around the airfield. In 2014 Wildlife Manager became the Qualified Wildlife Biologist for the San Antonio International Airport. The primary wildlife hazards identified on or near the airport included jackrabbits, white-tailed deer, feral hogs, blackbirds, pigeons, mourning doves, white-winged doves, black vultures, turkey vultures, and caracaras. Blackbirds, pigeons, mourning doves, white-winged doves are most frequently involved in strikes at SAT, but vultures pose the greatest hazard to aircraft due to their size, flying behavior, and potential to cause damage. Some raptors including red-tailed hawks, Swainson's hawks, and American kestrels were also observed. Wildlife attractants in the area were stockpiles of gravel and demolition materials, trees (especially in public areas), and minor accumulations of trash. Off-site attractants include lakes, ponds, streams, city sponsored green belts and parks, and power lines. Waterfowl tend to congregate on lakes and ponds in the area, but do not present a major problem for the airport.

Individuals Having Authority

The San Antonio Aviation Director has the authority and responsibility of designating a Qualified Wildlife Biologist to implement the WHMP. Several divisions within SAT have responsibilities outlined in this WHMP and will incorporate them into their programs. Clear communication among airport personnel is essential for the WHMP to succeed. Personnel working at the airport should communicate resource needs, recommendations, and progress to the designated Qualified Wildlife Biologist. The SAT Qualified Wildlife Biologist will obtain FAA approval of the WHMP and will review the WHMP and any amendments for compliance with Federal, State and local laws and regulations.

Specifically, the following personnel at the airport are generally responsible for the following:

- **Aviation Director:** Designate a Qualified Wildlife Biologist at SAT to monitor and implement all management activities as described in the WHMP. Oversee funding and budgeting of the WHMP.
- **Qualified Wildlife Biologist:** Perform and coordinate wildlife mitigation for the Wildlife Hazard Management Program at SAT.
- **Airport Operations Staff:** Work closely with the Qualified Wildlife Biologist to mitigate wildlife hazards at SAT. Inspect AOA for wildlife activity. Collect animal remains from strikes for identification by the Qualified Wildlife Biologist. Communicate the nature and location of any identified wildlife attractants or hazards to the Qualified Wildlife Biologist upon discovery. Communicate wildlife-related emergency situations to the airport community, as appropriate. Notify the Qualified Wildlife Biologist of attractants on the AOA and assist with the removal as requested. Assist the Qualified Wildlife Biologist with wildlife control activities. Enforce the "No

Feeding" policy for airport employees found feeding wildlife on airport property. Record all wildlife activity on or around SAT property in the OPS daily log

- **Airport Integrated Control Center (AICC):** Route all wildlife-related inquiries (telephone calls, letters, etc.) to the Qualified Wildlife Biologist and disseminate notification of wildlife hazard conditions to the FAA as requested.
- **Airport Maintenance Division:** Communicate observations of wildlife and attractants to the Qualified Wildlife Biologist. Maintain the perimeter fences and culverts to exclude mammals such as coyotes, feral dogs, and jackrabbits. Assist with habitat and landscape modification to minimize attraction to wildlife. Remove any accumulated refuse on the airport. Minimize pooling of water formed by rain or artificial sources. Coordinate landscaping changes or vegetation removal with the Qualified Wildlife Biologist to minimize the attraction by wildlife. Conduct landscaping operations during hours of bird inactivity. Control weeds and insects using the appropriate pesticides. Coordinate with the Qualified Wildlife Biologist to provide specialized equipment required for wildlife hazard management.
- **Air Traffic Control Tower:** Warn pilots of observed or reported wildlife hazards. Delay aircraft movements to avoid wildlife strikes, as appropriate. Record strikes on the Wildlife Strike Report Form, FAA 5200-7, and forward the completed form to the Qualified Wildlife Biologist. Advice the Qualified Wildlife Biologist of all wildlife activity observed on or around the airfield by completing and submitting the Daily Wildlife Activity Report Form. Update Automatic Terminal Information System with current bird watch condition as reported by the Qualified Wildlife Biologist or Operations Supervisor.
- **Airline Representatives and Pilots:** Notify SAT ATC of wildlife activity observed on approach, departure, or while on the airfield. Record strikes on the Wildlife Strike Report Form, FAA 5200-7, and forward the completed form to the Qualified Wildlife Biologist.
- Wildlife Hazard Group: Will Review significant wildlife hazards from the previous year. Review the effectiveness of wildlife control procedures. Evaluate the impact of off airport projects to KSAT operations and make recommendations. Review any future airport projects, expansion plans, and nearby land-use changes that may affect wildlife patterns around KSAT. The WHG will review and make recommendation to the Wildlife Hazards Management Plan (WHMP). WHG will be hosted by the Qualified Wildlife Biologist to include at a minimum, Airport Operations, Airfield Maintenance, Airport Integrated Control Center (AICC), Air traffic Control (ATC) and Airport Horticulture and or additional division as needed. The WHG will meet at a minimum on an annual (October) basis to discuss wildlife hazards.
- .

Wildlife Hazard Mitigation Actions

Wildlife Population Management

Task	Date Completed	Status	Completion Date
Black Vultures and Turkey Vultures			
Coordinate with CPS to place bird deterrents on the power line towers where vultures are roosting. Although some mechanical types of deterrents are available, the most successful one appears to be use of effigies. The airport should obtain permission from the USFWS to kill several vultures and hang them approximately 200 to 300 feet above the ground within tower structures.			As needed
All airport property, especially that along Wetmore Drive, Starcrest Drive, and the Salado Creek basin should be regularly inspected for dead animals. If animals are found in these areas, the carcasses should be removed and properly disposed.			Weekly
Mourning Doves and White-Wing Doves			
Vegetation on the AOA should be regularly mowed and grasses should not be allowed to form seed heads.			On going
Stockpiling of sand and gravel within the AOA should be avoided when possible. Areas of exposed grit and gravel should be removed or covered with plastic.			On-going
Deterrents such as noise, shell crackers, pyrotechnics, and scarecrows should be combined with occasionally killing birds with a pellet rife so that the birds will associate lethal action with noise. Note that this must be coordinated with the USFWS and TPWD.			As Required
Increase trapping efforts to help with control			On-going
Great-Tailed Grackles			
Trees used for roosting should be trimmed to reduce the number of perching sites. Plastic tape or strips should be hung within the tree canopy.			On-going / annually Fall / Spring
Where water is available, grackles can be harassed by placing a sprinkler head inside tree canopy and periodically spraying water during the night when the birds are roosting.			When available
When changes to landscaping a change from thick shrubs should be removed and replaced with widely spaced sagebrush or Xeriscape featuring native sage brushes and cactus.			When able
A pilot study should be initiated to test the use of white Christmas lights inside the canopy trees to deter grackles. The lights could be wrapped or allowed to hang from branches.			When available
Pyrotechnics and noisemakers combined with the lethal take of birds should be used to harass large flocks of grackles late at night when flights are not scheduled.			As Required
Rock Pigeons			
Pigeons are currently using ledges within the parking structure for roosting. These ledges could be altered by sloping them to an angle of 45° or more or by treating them with bird deterrent materials such as spikes and nets.	Will leave open due the continuous amount of construction work at the airport		May 2023

Buildings and other structures on airport property should be inspected to determine if crevices or holes are present. If they are found, these holes and crevices should be blocked or sealed using screening, concrete, bricks, or similar substances.			On-going / weekly
Trapping or lethal take of pigeons on a regular basis can harass and decrease populations and by making roosting areas unsafe and undesirable.			On-going
Moderate Priority Bird Species			
Barn, cliff, and cave swallows: These birds are attracted by insect populations in the area, and deterring them from the AOA will be difficult. These birds are acclimated to man's activities and do not necessarily respond well to harassment procedures. During the nesting period, the parking structure and buildings should be inspected for nesting sites and those sites destroyed. Permits from USFWS and TPWD will be required.			As Required daily during nesting season (April-September) All garage parking, Terminal – A-B lower curb
Starlings were also listed as moderate priority species and tend to congregate with grackles. Methods used to control and harass grackles should be effective for starlings.			As Required
Raptors and Falcons: Continue practices that are minimizing the occurrence of small mammals and remove areas of water accumulation on the AOA to decrease attraction of American kestrels to the AOA. Wooded areas on airport property should be inspected regularly for hawk nests and those nests destroyed. These practices would require coordination with the USFWS.			On-going / quarterly
Nighthawks: Minimize insect populations congregating around lights on the AOA by removal of lights where possible and application of insecticides. This should assist in minimizing the population of nighthawks on the AOA.			As Required
Caracaras: Remove any dead animals from runways and other locations in the AOA to minimize attraction of the AOA to caracaras.			As Required
Off AOA roadways inspections for caracaras removal			Weekly
Black-bellied whistling ducks, great blue herons, and great egrets: Remove impounded surface water on the AOA to deter these species.			As Required
Rodent and Rabbits			
Continue to monitor rodents on the airfield and initiate control programs as necessary.			On-going Quarterly
Under current game regulations, it is legal to shoot jackrabbits at any time of year and there is no bag limit. In addition to vegetation management, we suggest that the best method for this species would be to take rabbits on a regular basis. Hunts could be conducted at night using silent fire arms, such as high powered air rifles, and spotlights.			On-going (monthly/Quarter)
Other Mammals			

Striped skunks: Removal of suitable habitat for burrows should decrease the occurrence of this mammal on the AOA. Place a 6 inch layer of fragmented rock around concrete structures to make the areas unsuitable for burrowing and decrease populations on the AOA. Lethal removal using air rifles or trapping of this animal could also be used.			On-going
White-tailed deer and wild hogs: Properly maintain fences. Some lethal take may be required and would involve coordination with TPWD. It is important to prevent overpopulation of deer outside of the AOA to prevent deer from considering land inside the AOA as potential feeding areas.			As Required
Deer trapping with a wildlife capturing service and Texas Parks and Wildlife Trap Transport and Process permits			As needed/
Coyotes: Although they are a low priority species, the coyote has presented definite problems for aircraft within the AOA. Any coyotes encroaching on the AOA should be lethally removed. Drainage grates and fences should be properly maintained.			As Required
Domestic and Feral Cats and Dogs: If possible, these animals should be captured and removed from the AOA. Captured animals should be turned over to animal control services provided by the City of San Antonio. Repeat offenders should be lethally removed using air rifles or similar measures. Proper fence maintenance should deter encroachment of dogs from the AOA. Control of birds and small mammals will deter encroachment of cats.			On-going

Habitat Modification

Task	Date Completed	Status	Completion Date
Water Management. Habitat that is characterized by relatively persistent standing water comprises less than 1% Great Blue herons, Great Egrets, Black-Bellied Whistling Duck, American Kestrels, and Northern Harriers have been			
Observed in and around this habitat hunting for frogs, other aquatic wildlife, and small mammals foraging or drinking water.			
Areas temporarily inundated on the AOA are monitored on a regular basis by the Qualified Wildlife Biologist to determine if they attract wildlife that could potentially strike aircraft. All such persistent accumulations of water are dispersed or drained whenever practical.			Monitored after every rain event

All landscape change or improvement must be review by Qualified Wildlife Biologist and Horticulture manager			Every new and any changes to landscaping
Chronic wet areas are identified and accumulated water is removed and prevented by grading or draining, as appropriate. Coordination with the USACE will be required for jurisdictional waters.			Monitored after every rain event
In accordance with FAA AC 150/5200-33B, all retention and detention basins on SAT property are monitored for drainage within 48 hours of a rain event. Any retention and detention basin that does not drain within 48 hours is modified to drain or fitted with a wire grid to deter use by waterfowl and wading birds.			Monitored after every rain event
Minor swales in depressions areas are heavily used by jackrabbits for forms. These areas should be mowed or filled with fractured limestone gravel and treated with Roundup.			On-going Weekly
All depressions potentially accumulating water for more than 48 hours should be filled with fractured limestone gravel (2-4 inch diameter) to prevent further erosion and to minimize growth of vegetation and accumulation of water.			Monitored after every rain event
Outside of the AOA are several surface waters that attract various wildlife hazards. SAT should coordinate with the property owners and encourage them to maintain the surface waters in a manner to discourage use by waterfowl and other wildlife, where possible.			On-Going
Grass Management. Grass Habitat in the AOA is maintained by periodic mowing and comprises about 75% of the AOA. It is dominated by short grass with about 2-5% of the vegetation being broadleaf herbaceous plants.			
Grasses on the entire AOA should be maintained at a height of no more than 10 inches, preferably 6 inches. The entire AOA be intensively managed by mowing to ensure that wildlife will not be attracted to certain sections of the AOA.			On-going
All mowing activities should be conducted at night when attraction to wildlife is minimal.			As possible
Currently, the dominant grasses on the AOA are small seeded. If large seeded grasses become established in areas, they should be removed immediately.			As Required
The AOA supports a very healthy and diverse population of insects that attract insect eating birds. Regular mowing of grasses to minimize accumulation of litter will encourage a decrease in insect populations. Pesticides could be used to decrease insect populations.			On-going
In an effort to make these areas less attractive to jackrabbits, they should be maintained at a shorter height or filled with fractured limestone gravel and maintained plant-free with Roundup.			As Required

Hyromulching seeding only allow in area outside of all movement areas and must be approved by Wildlife Biologist before activities are done			As Required
Sodding is the only vegetation change allowed in the movement area.			As Required
Tree Management.			
No trees will be planted on SAT airport owned property			As required
Prune tree canopies annually to discourage their use as grackle and blackbird roosts.			On-going Bi-annually
Ornamental Landscaping. Minimize use of ornamental trees and shrubs used to enhance airport aesthetics. Use varieties that are unattractive to wildlife. Avoid species which produce edible fruits, seed, nuts, or berries.			
Monitor trees to identify roosting by grackles, starlings, blackbirds, and other birds. Trees should be thinned, topped, or removed if necessary. Dense shrubs should not be used because of the attraction to grackles for nesting.			Monthly
When possible landscape should be changed to Xeriscape dominated by a variety of cacti, short, well-spaced sagebrush, and native flowering plants, where possible.			On-going
New landscaping projects on airport property will be reviewed by the Qualified Wildlife Biologist and Airport Horticulturist to minimize the use of new ornamental landscaping that may be attractive to hazardous wildlife.			As Required
Prior to any decision to utilize vegetation screens for noise control, their potential for creating a bird hazard to aircraft must be carefully weighed against the anticipated noise benefits.			As Required
Weed Control. Weeds often grow on the airfield and around the perimeter fences. Weeds that produce seed or provide cover should be controlled using appropriate herbicides			
Many of the areas protected according to storm water regulations are not well-maintained and dense populations of weeds and grasses are becoming established silt fences. All new construction projects should stipulate that silt fences be maintained by regular mowing.			As Required
Most construction sites are temporary and can be very attractive to wildlife. All of these areas should either be treated with proper herbicides or mowed to manage vegetation.			On-going
Stockpiles should temporary and removed within 90 days. No vegetation should be allowed to grow on them (must be maintained)			As Required

Structure Management

Task	Date Completed	Status	Completion Date

Airfield Structures. Airfield structures such as runway lights, ramp and taxiways signs, Instrument Landing systems towers, and light poles can serve as roosts and nesting areas for wildlife			
Several materials ranging from spikes to sticky substances should be used to discourage birds from using signs for perches where required.			As Required
Periodically treat a 1-foot buffer area around concrete structures/footings in the AOA with a non-selective herbicide, such as Roundup, to prevent growth of vegetation			On-going /monthly
The areas around the concrete pads should be excavated approximately 4 inches deep, filled, tightly packed with 3-inch diameter fragmented limestone or similar size gravel to discourage burrowing by skunks and other small mammals.			On-going
Small equipment storage buildings should be placed flat on concrete pads or protected by a metal or rock/concrete skirt to prevent use of the space under the structures by wildlife.			On-going
Some older buildings have vertical crevices or crawlspaces under the building which should be obstructed using bricks, fencing material, or sheet metal to prevent encroachment of wildlife. Skirts should be excavated about 6 inches deep into the soil.			On-going
Airport Structures. Parking garages, shades for parking attendants, hangers and airport buildings provide roosting perching, or nesting habitat for birds.			
All vegetation in and around tenant structures and properties should be trimmed to a height of no more than six to 10 r inches.			On-going weekly check

Weeds and seed producing plants around tenant buildings and storage areas should be controlled either by using Roundup or hand removal.			As Required
All trash should be placed in dumpsters with properly maintained tops that are kept closed and sealed at all times.			Checked weekly
Lengthy outside storage of equipment and materials should be completely avoided.			As Required
Stockpiles of soil, gravel, and other materials should be kept weed-free and should be removed within 90 days.			As Required
All low areas, drainages, and artificial containers potentially accumulating water should be removed or filled to prevent accumulation of water.			As Required
Excessive irrigation resulting in runoff into ditches or accumulation of water in pools should be avoided.			As Required
Bird nests or roosting areas observed on tenant buildings or property should be removed as allowed by the Migratory Bird Treaty Act.			As Required
New Parking garage CONRAC will need to be monitor for bird activities (swallows, pigeons nesting)			May 2021
AOA Fence. The only exclusionary method used at SAT for wildlife management is construction of a fence surrounding the AOA. The fence is currently well-maintained with only a few areas that require repair. n Date			
Periodically place dirt and gravel at the base of the fence to prevent wildlife from digging under the fence and entering the AOA.			As Required
Repair holes and other gaps in the fence.			On-going

Gaps between buildings and fences should be modified to minimize gaps by moving the post, filling the gap with a small section of fence or screen, or attaching the fence and/or post directly to the building.			On-going
Any gates that are not required for the operation of the airport should be removed and replaced with fencing.			As Required
	North Perimeter fence completed, with area that have wildlife fencing		
Other Task	**Date Completed**	**Status**	**Completion Date**
Continue WHA survey points on a Monthly rotation all points 1-15 AM/PM			On-going/ Monthly
Small mammals and rodent AOA survey will be on a quarterly rotation (January,April,July,October)			On-going/ Quarterly
Work with Animal Care Service to increase timely pick up of stray dogs and cat that are trapped at the airport			On-going
Wildlife hazardous training for Operation / maintenance (are activity involved in wildlife control)			On-going /
Airport Wildlife hazard training (for airport personnel that are not activity involved in wildlife control)			On-going / annually
Will try to establish a better line of communication between ATC and the Qualified Wildlife Biologist on bird strike that are reported to the Airport			ongoing
Rodent bait station maintained and service every quarter (around all parking areas and outside of the terminals)			Quarterly

Honeybee Swarms removal, from time to time the airport will have swarms of bee move across the airport. When the Bee swarms land in an area that will affect employee and or public safety. The bee will be harmless removed and place in the airport Apiary or other bee friendly areas		As needed
Old construction area removal of silt fence		May 2023
Construction debris on the AOA, 281 area		May 2023
Storage of airport surplus supplies stored on AOA 281 area		May 2023

Land Use Changes

The Qualified Wildlife Biologist should participate in all land-use planning and mitigation efforts sited for SAT property including the initial phases of airport building projects. The Qualified Wildlife Biologist should identify wildlife attractants in any new airport design or plan and recommend modifications that discourage use by wildlife whenever possible. SAT staff should be involved in identifying and reviewing proposed off-site projects that may attract hazardous species of wildlife or will likely increase bird numbers within flight zones on adjacent property. These wildlife hazards created by land-use changes should be discussed with local planning authorities for collaboration with wildlife control activities. Incompatible land-uses near the airport include developments with water reservoirs, parks with artificial ponds, wetlands, waste handling facilities, and wildlife refuges/sanctuaries.

Permits and Regulations

As outlined below, several regulations and permits apply to wildlife management activities at airports in Texas. Many of these regulations relate to safety, methods, and special considerations or restrictions which are usually specified on the depredation permits.

Resident Game Birds. Resident game birds, such as quail and pheasant, are non-migratory. Although they are not regulated by the MBTA and no Federal permit is required for take, they are protected by State law and a TPWD depredation permit may be required before take.

Migratory Game Birds. Migratory game birds (ducks, geese) are regulated by the USFWS pursuant to the MBTA and State laws. At least two separate permits are required for take of migratory game birds: the Federal depredation permit and appropriate State permits.

Migratory Bird Depredation Permit (CFR 50, Part 13). A depredation permit to take federally-protected migratory birds can be obtained by contacting the local USDA Wildlife Services office and requesting a Federal Fish and Wildlife License/Permit Application.

Depredation Order for Blackbirds, Cowbirds, Grackles, Crows, Magpies, Canada Geese, and Cormorants. A Depredation Order is a Federal regulation which authorizes the take of certain bird species involved in damage situations, without a Federal permit.

Birds That Are Exempt from Federal/TX Protection. Starlings, pigeons, house sparrows and various "pet" birds such as monk parakeets are exotic (non-native) bird species that are not afforded Federal protection. Therefore, the birds, or their nests, eggs, or young may be taken without a permit.

Game Mammals. The taking of game mammals requires a State hunting license issued by the TWPD. Cottontail rabbits, tree squirrels, and white-tailed deer are game mammals.

Trap, **Transport and Process Permit** form the Texas Parks and Wildlife White-tailed Deer Permit is a mechanism to help reduce deer population densities in areas where white-tailed deer are overpopulated.

Furbearers, Predatory, and Non-game Mammals. In Texas, a trapping license issued by TWPD is required for furbearers.

Feral Domestic Mammals. In Texas, take of feral mammals such as dogs and cats does not require a Federal or State permit.

Reptiles and Amphibians. In Texas, all reptiles and amphibians are protected, and their take would require a State Permit or a valid hunting license.

Federal Threatened and Endangered (T&E) Species. The Federal Endangered Species Act (Sec. 2 [16 U.S.C. 1531]) protects plants and animals which may be threatened with extinction. This Act also protects wildlife habitat. Once listed, a T&E species cannot be taken or harassed without a special permit. If a significant hazard exists with a listed species that jeopardizes air safety, the USFWS and/or the TWPD should be contacted for assistance.

Eagle Permits. Eagles are afforded Federal protection under the Bald and Golden Eagle Protection Act, which requires that a Federal permit be obtained in order to harass these birds.

Resources

SAT Safety / Wildlife Division will procure and dedicate a vehicle for wildlife management. The vehicle will be equipped with radio communications and warning lights, along with critical wildlife management equipment.

Supplies that are normally available at the airport include, but are not limited to:

- 15 mm pyrotechnic pistol launchers (Bird bombs/bangers and screamers)
- Cleaning supplies for all firearms and pyrotechnic launchers
- Catch poles
- Exclusion materials such as metal spikes and bird netting
- Cage trap for dogs (e.g., Tomahawk 110B)
- Cage trap for cats/raccoons (e.g., Tomahawk 108)
- Small cage or cloth bag for holding bats
- Cardboard animal crate
- Binoculars
- Large Dog kennel
- Snake tongs
- Communications equipment
- Gloves – thin leather gloves to handle bats, latex gloves to handle birds or carcasses
- Heavy duty Leather Gloves
- Garbage bags – various sizes
- Re-sealable bags – various sizes
- Refrigerator or chest freezer to preserve bird carcasses for identification by the Qualified Wildlife Biologist
- Bird strike collection supplies alcohol pads and zip lock bags of diffident sizes
- High power pellet rifle for lethal control of birds and mammals
- 12 gauge shotgun for control of hazardous birds and wildlife
- 12 gauge shotgun shell (steel shot)
- Mylar tape
- Night Vision Goggles
- Digital SLR Camera with minimum of 500 mm lens (zoom lens is preferable)
- Spotlight (Hand-held)
- Dissecting Microscope (Plant and Wildlife ID)
- Sat Wildlife Field Guide
- National Geographic birds of North America
- Copy of SAT's Depredation Permit
- Tool box (pliers, hammer, screwdrivers, cable ties, and other basic tools)
- Wildlife Biologist will have/ carrier a current State of Texas hunting license
- Bee suit and gloves

The following resource documents are maintained in the Qualified Wildlife Biologist's office:

- Field guides to wildlife identification
- Prevention and Control of Wildlife Damage (2-binder manual, on CD or available on the web at *http://wildlifedamage.unl.edu/handbook/handbook/*)

- FAA Wildlife Hazard Management at Airports manual – available on the web at *http://wildlife.pr.erau.edu/EnglishManual/EngStart.pdf*
- Transport Canada reference manual for wildlife control procedures at airports – available on the web at *http://www.tc.gc.ca/CivilAviation/Aerodrome/WildlifeControl/tp13549/menu.htm* .
- Advisory Circular 150/5200-36B - Qualifications for Wildlife Biologist Conducting Wildlife Hazard Assessments and Training Curriculums for Airport Personnel Involved in Controlling Wildlife Hazards on Airports
- Advisory Circular 150/5200-33C - Hazardous Wildlife Attractants On or Near Airports
- Advisory Circular 150/5200-38 - Protocol for the Conduct and Review of Wildlife Hazard Site Visits, Wildlife Hazard Assessments, and Wildlife Hazard Management Plans
- Document Information
- Advisory Circular 150/5200-32B - Reporting Wildlife Aircraft Strikes
- SAT's Wildlife Hazard Assessment
- SAT's Wildlife Hazard Management Plan
- SAT's Federal Fish And Wildlife Depredation Permit

Airport Operations vehicles contain the supplies listed below to facilitate an immediate response to wildlife hazards. Personnel are responsible for responding to emergency calls to disperse animals from the runways.

- 15 mm pyrotechnic pistol launchers
- 15 mm pyrotechnics (bangers, screamers, starter caps, etc.)
- Bird identification field guide
- Binoculars
- Latex gloves
- Heavy duty Leather Gloves
- Snake tongs
- Catch pole
- Cardboard animal crate
- SAT's Bird Strike kits
- Garbage bags and re-sealable sandwich bags
- Data sheets (FAA Form 5200-7, wildlife activity sheets)
- Sat Wildlife Field Guide
- National Geographic birds of North America
- Large dog Kennel (stored in OPS area for ease of access when needed)
- Bird strike collection box of supplies to collect samples as need

SAT can also contact The City of San Antonio Animal Care Services to respond to domestic animal bites, remove stray dogs, and pick up bats for rabies testing, and to assist with animal issues that are out of our scope and capacity. Contact:

The City of San Antonio Animal Care Services
4710 State Highway 151
Shannon Wade Sims Assistant Director
Shannon.sims@sanantonio.gov
W: 210-207-6657 C: 210-216-0050

WILDLIFE HAZARD MANAGEMENT PROCEDURES

Overview

Wildlife observed on SAT determined to pose hazards to aviation are managed using safe, effective, legal, and environmentally responsible direct control techniques. Because wildlife hazards at airports are variable and complex, it is essential to adopt a flexible, innovative, and adaptive approach to managing such hazards. Wildlife identification guides and handbooks are available for use by wildlife control personnel at SAT.

Depredation Permit

The US Fish & Wildlife Depredation Permit will be annually (April) renewed, to reflect current operation personal and bird numbers. Current permit will be kept in Airport Wildlife Biologist Office in Terminal A and in wildlife control vehicle at all time.

Wildlife Patrol

SAT's Airport Operations personnel will conduct at least one wildlife patrol at SAT during each shift. The patrol will monitor and respond to wildlife hazards on the airfield and will coordinate their activities through the Qualified Wildlife Biologist. Airport Operations personnel will be annual trained in wildlife identification, wildlife management techniques, and safe operations. They will have radio-equipped vehicles and adequate wildlife control supplies. Airport Operations personnel will maintain clear communications with the ATC, in accordance with FAA radio protocols, and will record all observations of wildlife-related activity (e.g., notable hazards, animals killed or dispersed, unusual wildlife behavior, etc.) in the airport wildlife log.

Routine runway sweeps will be conducted at least once per shift, and the presence of any dead animals found that were involved in strikes with aircraft will be recorded on FAA Form 5200-7 (Appendix E). All dead birds or mammals found on runways and taxi-ways or within 200 feet of the runway centerline will be considered the result of a strike unless the death was undoubtedly due to some other cause. Bird or mammal remains of unknown species will be placed in a zipped plastic bag and placed in a freezer with the FAA Form 5200-7 attached for later inspection and identification. In addition to carcasses found on the airport, wildlife strikes will also include: (1) strikes reported by pilots, (2) evidence of wildlife strikes found and reported by aircraft maintenance personnel, and (3) direct observation of a strike by SAT personnel. All wildlife strike forms will be submitted to the Qualified Wildlife Biologist for reporting to the FAA. Wildlife strike forms may be submitted electronically to the FAA at *http://www.wildlife-mitigation.tc.faa.gov* . Printouts of FAA strike report will be retained in the Airport Operations Office.

General Wildlife Hazard Control Measures

Each wildlife hazard that develops will be investigated by the Qualified Wildlife Biologist to determine a practical solution. When appropriate, an integration of multiple methods will be employed for maximum effectiveness. The Qualified Wildlife Biologist will work proactively to minimize attraction of the airport and surrounding areas to birds by manipulating and managing habitat. The initial response to deter most species will be harassment with frightening devices, followed by lethal methods, when necessary. A primary key to successful wildlife control is persistence and innovation. Techniques will be applied based on safety, effectiveness, practicality, and environmental considerations. Most control techniques retain

their effectiveness when used judiciously and in conjunction with other methods. Therefore, the methods chosen will depend largely on the situation and the species involved. Finally, personnel involved in direct control will be made aware of the potential diseases that wildlife can carry and will take appropriate precautions. SAT's wildlife hazard management program will be guided by the following principles:

- Wildlife will be harassed immediately and consistently
- Wildlife breeding and reproduction on the airport will be discouraged, reduced, or eliminated
- Persistent hazardous wildlife will be removed
- SAT will adhere to all laws, regulations, policies, permits, and licenses.

Communication with ATC

SAT Airport Operations personnel are equipped with radios and have received proper training to utilize the radios. If an immediate hazard exists that might compromise the safety of air traffic at SAT, the Airport Operations personnel coordinates with the ATC to modify arriving or departing air traffic until the hazard is eliminated. Although the ATC is not expected to monitor all wildlife hazards on the airfield and still direct air traffic, ATC personnel notifies the Airport Operations Supervisor immediately if pilots report on or off airport wildlife hazards or ATC personnel observe any hazards.

SAT Airport Operations personnel conduct physical inspections of movement areas and other areas critical to wildlife hazard management as part of the daily protocol. All observed wildlife is documented and all data sheets are maintained in the Airport Wildlife Log. This Airport Wildlife Log is retained in the Airport Operations Office. If no wildlife is observed, a record indicating that an inspection was conducted and that no animals were observed is entered into the Airport Wildlife Log. During periods of exceptionally heavy wildlife activity (e.g., migratory periods, outbreaks of insects etc.), the Airport Operations Supervisors consult with the Qualified Wildlife Biologist and a Notice to Airmen (NOTAM) is issued, as appropriate. Airport Operations Supervisors also consult with the Qualified Wildlife Biologist to mitigate the issue if possible.

Evaluation

Overview

As noted above, the WHMP will be evaluated at least annually. The WHMP will also be evaluated following multiple wildlife strikes by an air carrier aircraft; if an air carrier aircraft experiences substantial damage from striking wildlife or if an air carrier aircraft experiences an engine ingestion of wildlife. The Qualified Wildlife Biologist will determine the effectiveness of the WHMP at reducing wildlife strikes at SAT and monitor the status of hazard reduction projects, including their completion dates.

Meetings

The WHG will meet at least annually, but the group may meet more frequently if situations warrant, as determined by the Qualified Wildlife Biologist. The group will examine the effectiveness of the plan in reducing wildlife hazards at SAT, and examine the information presented in the WHA and continued monitoring reports to determine necessary actions to further reduce wildlife hazards.

Wildlife Strike Database

SAT will document the presence of any wildlife population, any hazard that exists due to the presence of the wildlife population, and any wildlife strikes at SAT. This is accomplished primarily through the job responsibilities placed on SAT Airport Operations personnel. The Qualified Wildlife Biologist is required to document wildlife strikes through completion of FAA Form 5200-7 for species identification and submittal to the FAA, and completion of various internal records specific to SAT. Additionally, Airport Operations personnel are required to conduct daily checks of the airfield, identify possible wildlife attractants, and monitor wildlife populations.

FAA Form 5200-7 will be completed and submitted electronically by the Qualified Wildlife Biologist. A printed copy of each strike form and the Airport Wildlife Log will be maintained in the Airport Operations Office. Prior to each annual WHG meeting, a summary of wildlife strikes will be prepared by the Qualified Wildlife Biologist and will be reviewed by the WHG at the meeting. The summary will be developed based on strike data and will list wildlife species involved in strikes, identify trends, and strike numbers. This information will be used to identify emerging needs and to contribute to the evaluation of wildlife hazard management programs at SAT. If unacceptable increases in wildlife strikes and populations are observed, the cause should be determined and the WHMP modified to address the problem.

Airport Expansion

Airport expansion plans will be reviewed by the Qualified Wildlife Biologist or a designee to ensure that new developments will not inadvertently result in increased wildlife hazards to aircraft operations. If necessary, coordination among the Airport Operations, Airport Maintenance, City of San Antonio Planning Department, and the Qualified Wildlife Biologist will be conducted through the WHG to review potential impacts of airport development of wildlife hazards at SAT, and to modify the proposals and/or the WHMP to reduce or eliminate potential or emerging hazards.

Training

Training is essential for personnel involved with the WHMP. The Qualified Wildlife Biologist will establish training for all personnel that might be working in a wildlife deterrence capacity in the proper selection and application of control methods as well as wildlife species identification.

An FAA Qualified Wildlife Biologist will provide specialized training courses for all Airport Operations Division personnel actively engaged in wildlife hazard management work at SAT. Wildlife hazardous training will be accomplished every 12 consecutive calendar months and will be documented. The purpose of the training will be to familiarize personnel involved with wildlife hazard management with basic wildlife identification and dispersal techniques. The training may include hands-on training using pyrotechnics, and other deterrent equipment, with an emphasis on safety and effectiveness. These training courses will be available to all personnel who have responsibility in dispersing wildlife at SAT. They will be customized to fit the needs of individual recipients and situations, and will incorporate management issues relating directly to SAT wildlife strikes, populations, and physical environment. Instruction will be tailored to competence levels and areas of participating personnel.

San Antonio Airport Systems Wildlife Training SOP's

- All Wildlife Training will be schedule and track thought the Airport Safety Division
- Wildlife Training Course will only be taught by a Qualified Wildlife Biologist (Marcus Machemehl Q.W.B)

- All Wildlife Training documentation (Sign in Sheets, Test and Copies of the Certificates) will be kept by the Qualified Wildlife Biologist. These documents will be made available to the FAA Inspector(s) during the Airport Certification Inspection. These documents will be stored in Qualified Wildlife Biologist office.
- Employees required attending Annual Wildlife Hazard Training for actively involved in wildlife training: (FAA required Part 139 training)
    - All OPS Supervise and Agents and OPS Manger
    - All Stinson Airside Employees and Manager
- Employees that are required thought SAAS for report and informing of wildlife condition
    - All Airside Maintenance Employees that report to Airfield Facilities Manager
    - All Airport Safety Division Employees that report to Airport Safety Manager
    - Other Selective Employees required by Qualified Wildlife Biologist

Shotgun Standard Operating Procedure

San Antonio International Airport (SAT)

Shotgun Rifle for Hazardous Wildlife Mitigation

Standard Operating Procedures

- ALWAYS KEEP THE GUN POINTED IN A SAFE DIRECTION.
- ALWAYS KEEP YOUR FINGER OFF THE TRIGGER (OUTSIDE THE TRIGGER GUARD) UNTIL READY TO SHOOT.
- ALWAYS KEEPTHE ACTIONOPEN AND FIREARM UNLADED UNTIL READY TO USE.
- KNOW YOUR TARGET AND WHATS IS BEYOND. When on shooting range, be mindful also of adjacent areas and act accordingly.
- Be sure the gun is safe to operate.
- Know how to use the firearm safely.
- Use only the correct ammunition for your firearm.
- Store firearms in a manner that they are not accessible to unauthorized person(s).
    - This shotgun will be used on AOA (Airport Operating Area and airport properties to mitigate hazardous wildlife only.
    - This shotgun will be used as a last resort to remove hazardous birds/wildlife from AOA / airport properties.
    - This shotgun will not be used around any building.
    - This shotgun will be used in a discreet manner as to not alert the public.
    - This shotgun will be store as follows:
        - Gun safe located in Safety/Wildlife Office (T-A door #1218) Wildlife Biologist has control of combination to safe.
        - Wildlife truck (truck # 184713 “903”) Wildlife truck will be located at all time with Wildlife Biologist in control of keys to truck.
    - This shotgun will remain unloaded and the action open until ready to shoot.
    - This shotgun will be only used by trained and authorized personnel approved in writing by the Aviation Director, Deputy Aviation Director, and Airport Safety Manager.
    - Prior to this shotgun being used, Qualified Wildlife Biologist will call the Airport Integrated Control Center AICC) and request the Duty Manger (DM) broadcast bird dispersal activities including location(s).
    - All necessary communication will be communicated to Air Traffic Control Tower related to movement area activities.
    - Airport Operation 203 & 213 will be notified of any hazardous wildlife on or around the AOA.
    - Qualified Wildlife Biologist will attend an approved NRA shotgun training every 2 years

Please refer any question (s) pertaining to this SOSP to SAT Qualified Wildlife Biologist; Marcus Machemehl Q.W.B. (O) 210-207-1663 or (C) 979-595-0306, Email marcus.machemehl@sanantonio.gov

Wildlife Biologist Weapon Badge

SAN ANTONIO INTERNATIONAL AIRPORT

Wildlife Control Certified

The bearer of this badge, Marcus Machemehl Q.W.B, is duly authorized by the Aviation Deputy Director of San Antonio International Airport Systems to carry and use weapons including firearms for the removal of wildlife hazards on the SAAS Airfields. The bearer has received training in the proper handling and usage of firearms and deterrents that include but are not limited to pistol and shotgun platforms. The bearer also assumes all liability and accountability for any actions taken during wildlife

_____

Wildlife Biologist

_____

Airport Safety Manager

_____

Aviation Deputy Direct

_____

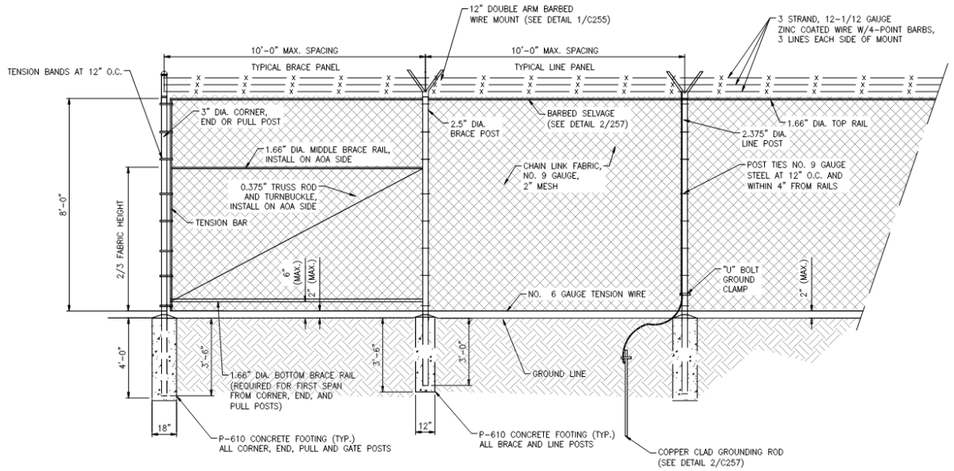
Date Issued

Shotgun used table log

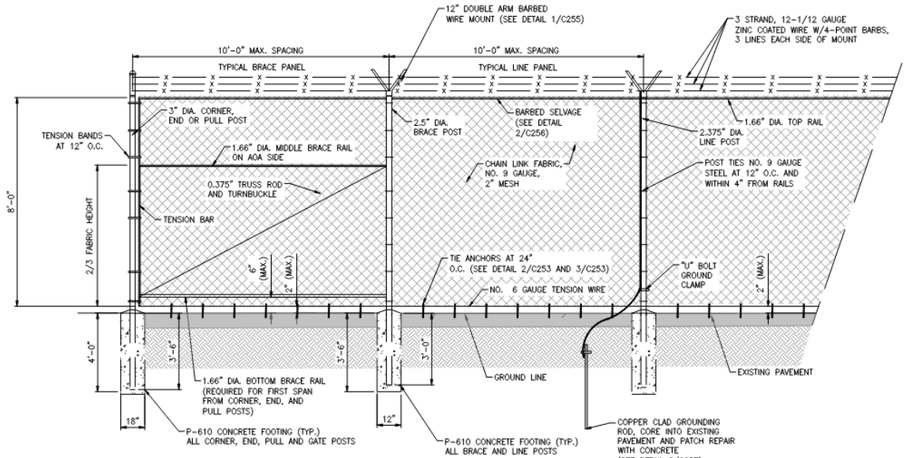
Date	Person Using Firearm	Reason for Use	Was Firearm Discharged?	If So, How Many Rounds Fired?	Outcome

4.9.3 Air Operations Area (AOA) Perimeter Fence

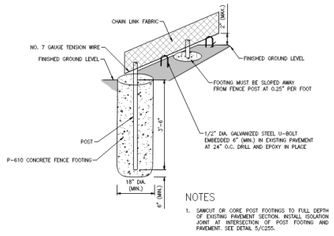
The following details are shown as SAT's preference for the AOA fence. These details are provided as a guide to the A/E and are not to scale.



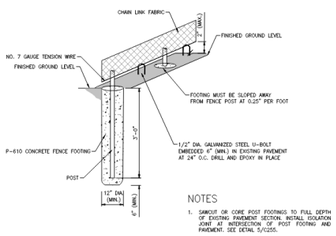
Standard 8' Chain Link Fence (In Turf)



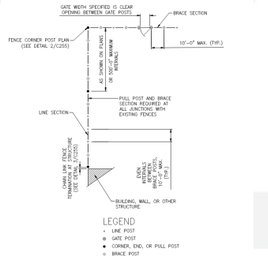
Standard 8' Chain Link Fence (In Pavement)



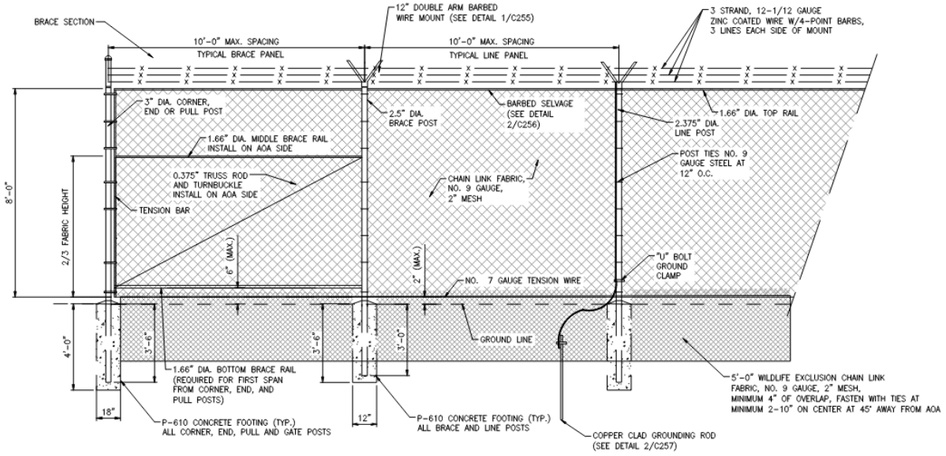
Standard Fence Corner, End, Pull, and Gate Posts Footing Detail (In Pavement)



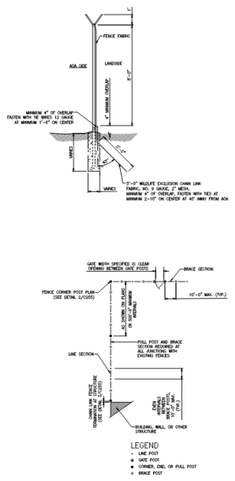
Standard Fence Brace and Line Post Footing (In Pavement)



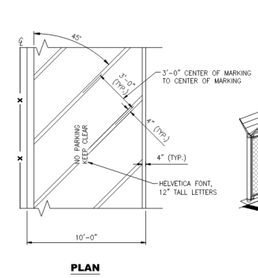
Typical Standard Fence Layout



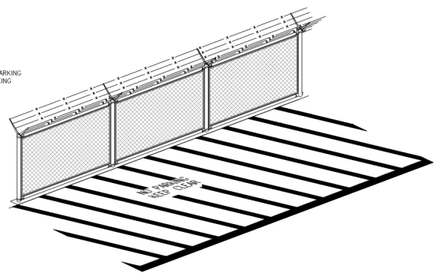
Wildlife Exclusion Fence



Typical Standard Fence Layout



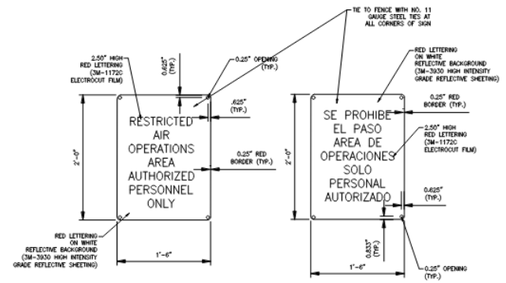
PLAN



NOTES

1. USE 4" THICK SOLID YELLOW STRIPE.
2. PAINT "NO PARKING KEEP CLEAR" EVERY 50'-0" ON CENTER, WITH FONT TYPE HELVETICA, 12" TALL.
3. INSTALL PAVEMENT MARKING MATERIALS IN ACCORDANCE WITH FAA P-620, RUNWAY AND TAXIWAY MARKINGS.

No Parking Pavement Marking Detail

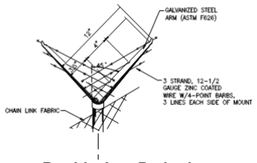


Restricted Area Warning Sign Detail

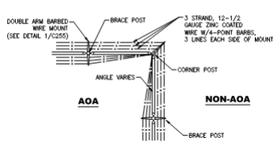
METHOD OF TYING FABRIC TO BRACE RAILS AND TENSION WIRES

Fence Connection Details

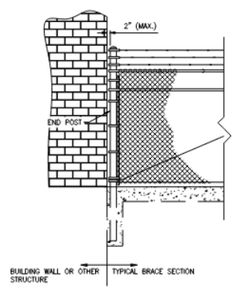
Method of Fastening Stretcher Bar to Post



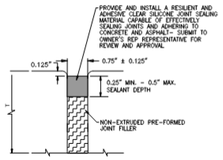
Double Arm Barbed Wire Mount Detail



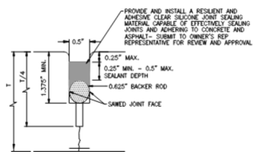
Fence Corner Post Plan



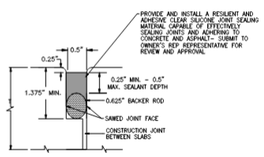
Chain Link Fence Termination at Structure



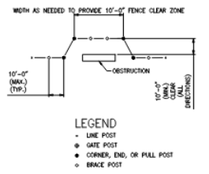
Isolation Joint Sealant Detail



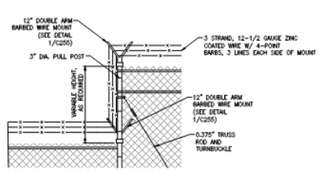
Construction Joint Sealant Detail



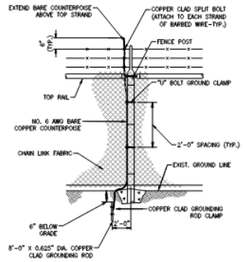
Construction Joint Sealant Detail



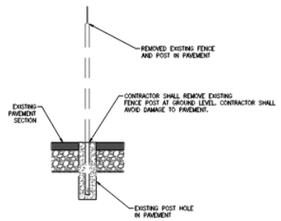
Jog in Fence Around Obstruction



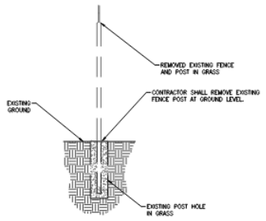
Fence Height Transition Detail



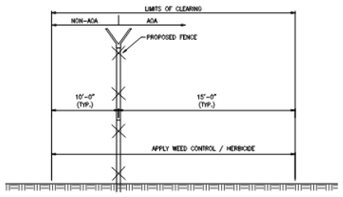
Typical Fence Grounding Detail



Fence Post Removal in Pavement



Fence Post Removal in Grass



Clearing Detail

Photo by Henry Beccera

STRUCTURAL SYSTEMS

DESIGN STANDARDS | CHAPTER 5

05

SAN ANTONIO INTERNATIONAL AIRPORT

5.1 Overall

This manual establishes general criteria to which the structural system must be designed to provide protection of life, health and property in the environments provided. This chapter defines general design criteria that applies to the design of structural systems at the SAT Airport.

5.2 Design Criteria

5.2.1 Building Structures

- This section shall apply to all building structures that provide for pedestrian access in any form.

5.2.2 Structural Codes and Standards

- 2018 International Building Code with Amendments or latest edition.
- ASCE 7-16: Minimum Design Loads for Buildings and Other Structures
- Material Specific Codes & Standards by reference from the above:
- American Institute of Steel Construction, Specification for Structural Steel Buildings AISC 360, 2016
- American Institute of Steel Construction, Code of Standard Practice for Steel Buildings & Bridges AISC 303, 2016
- AISC 341-16: Seismic Provisions for Structural Steel Buildings
- Steel Deck Institute: Design Manual for Composite Decks, Form Decks and Roof Decks
- Steel Joist Institute: Standard Specifications and Load Tables for Steel Joists
- AISI 2016: Specification for the Design of Cold-Formed Steel Structural Members
- American Welding Society, Welding Codes (AWS) D1.1
- "Standard for Steel Tanks, Standpipes, Reservoirs and Elevated Tanks, for Water Storage"
- American Concrete Institute, Building Code Requirements for Structural Concrete, ACI 318, 2019
- ACI Manual of Standard Practice for Detailing Reinforced Concrete Structures
- American Society of Testing Materials (ASTM)
- Portland Cement Association (PCA)
- Applicable Standards
- Post-Tensioning Institute (PTI) Post-Tensioning Manual", Latest Edition
- Prestressed Concrete Institute (PCI) PCI Handbook, Latest Edition
- Applicable Standards
- Miscellaneous standards for properties, manufacture and installation of specific items not fully covered by above standards.

5.2.3 Loads

5.2.3.1 Live Loads

Minimum Live loads shall be as shown below. They shall comply with the minimum requirements of the Applicable codes. Live loads shall be modified as needed due to additional requirements.

▪ Typical Elevated Floor	100 psf (2000 pounds Concentrated)
▪ Mechanical Rooms	150 psf
▪ Rest Rooms	50 psf
▪ Rest Room Partition allowance	20 psf
▪ Roof	20 psf
▪ Ceiling and Mechanical	10 psf (Min)
▪ Stairs	100 psf
▪ Roofing and Insulation	10 psf
▪ Moveable platforms	100 psf
▪ Catwalks for Maintenance Access	40 psf

5.2.3.2 Wind Loads

Determined in accordance with Section 26 of ASCE 7. Use a minimum wind speed of 115 mph for SAT.

5.2.3.3 Exposure and Category

- Exposure C
- Risk Category III

5.2.3.4 Wind Loads Airside Face

Wind load for Terminal buildings at the airside face only shall be 50 psf applied to any 15 square foot area for components and cladding, per FAA AC 150/5300-13, Chapter 8, "The Effects and Treatment of Jet Blast. This load need not apply at inset penthouse structures forty (40) feet above the apron level. This load is a result of aircraft jet blast plus meteorological conditions.

5.2.3.5 Seismic Design Criteria

Parameter	Value
Design Method	Equivalent Lateral Force Procedure
Risk Category	III
Importance Factor	1.25
Site Class	D
Short Period Spectral Acceleration Ss	0. 082g
Long Period Spectral Acceleration S1	0.034g
Seismic Design Category	A
Seismic Force Resisting System	Based on the Lateral Framing System

5.2.3.6 Roof Loads

Live loads for roof levels where additional future floors will or may be constructed shall be 100 psf minimum or the code required load for the proposed future occupancy whichever is greater.

5.2.4 Materials and Unit Stresses

5.2.4.1 Concrete

Non-prestressed concrete for structural elements shall be designed for a minimum twenty-eight (28) day compressive strength (fc') of 4000 psi, or as dictated by design requirements. All concrete exposed to the elements shall be designed with 3% to 6% entrained air. Adequate equipment shall be provided for heating concrete materials and protecting concrete during freezing or near-freezing weather.

Prestressed concrete for structural elements shall be designed for a minimum twenty-eight (28) day compressive strength (fc') of 5000 psi.

Drilled piers shall be sized based on the recommendations by the Geotechnical engineer. Drilled piers will have a minimum concrete strength of 3000 psi.

Concrete subject to freezing temperatures while wet shall have 3.5 percent to 6.5 percent air entrainment at point-of-placement, unless noted otherwise. Admixtures shall be used with care and compatibility shall be verified by testing laboratories.

5.2.4.2 Structural Steel

Structural steel shall conform to the following:

- W, WT Shapes: ASTM A 572, Grade 50, ASTM A 992.
- S, M, HP, and Channels: ASTM A 36, A 572 Grade 50.
- Angles and Plates: ASTM A 36, A 572 Grade 50.
- Base Plates ASTM A 572, Grade 50
- Pipes: ASTM A 53, Grade B.
- Tubes: ASTM A1085 or ASTM A 500 Grade C.
- Erection Bolts: ASTM A 325.
- High Strength Bolts: ASTM A 325
- Anchor Bolts and Rods: ASTM F 1554 Grade 55, Weldable.
- High Strength Low Alloy (HSLA) Steel: ASTM A 588 steel will be allowed with prior approval for high-mast light poles and base plates. HSLA steel shall not be used in areas of high moisture or water unless a proper surface treatment is utilized. Concrete pier pedestals for high-mast light poles shall be at least thirty-six (36) inches above finish grade.

5.2.4.3 Prestressing Tendons

Tensile stress in prestressing tendons due to jacking force shall not exceed 0.94 fpy (specified yield strength of prestressed tendons), psi. Prestressed members shall be designed using 7-wire strand having an ultimate tensile strength of 270,000 psi and conforming to ASTM A-416.

Low relaxation strands may be considered in design if they meet ASTM A421, ASTM A416, and ACI Building Code 3.5.5 and Commentary.

5.2.4.4 Reinforcing Steel

All reinforcing steel shall comply with ASTM A615 Grade 60 or 80 and shall be shop fabricated when delivered to the site.

Clear concrete cover on reinforcing shall be as follows unless otherwise shown:

- Concrete cast against and permanently exposed to earth 3 inches
- Concrete exposed to earth or weather:
- #6 through #18 bars 2 inches
- #5 bar, W31 or D31 wire, and smaller 1-1/2 inches
- Concrete not exposed to weather or in contact with the ground:
- Slabs, walls, joists:
- #14 and #18 bars 1-1/2 inches
- #11 bar and smaller 3/4 inches
- Beams, columns:
- Primary reinforcement, ties, stirrups, spirals 1-1/2 inches
- Shells, folded plate members:
- #6 bar and larger 3/4 inches
- #5 bar, W31 or D31 wire, and smaller 1/2 inch
- Beams and girders 1-1/2 inch interior, 2" exterior

5.2.4.5 Structural Foundation Systems

- Allowable foundation capacities shall be determined from geotechnical investigations under the direction of a professional geotechnical engineer registered in the State of Texas.
- Foundations shall be designed to prevent uplift and differential settlement, as well as load bearing requirements. Top of exterior Footings/ pier caps shall be located a minimum of two feet below the outside finished grade. The subgrade of buildings shall be prepared based on the Geotechnical recommendations.

5.2.5 Elevated Floors

5.2.5.1 Horizontal Framing Systems

Floor systems at Terminal buildings shall be designed to eliminate excessive vibrations from pedestrian and people-mover cart traffic. The design shall fall within the slightly perceptible range or better of the foot fall vibration scale.

Framing systems shall be designed considering requirements for future floor openings. Avoid using post install anchors for future beam and column connections Use embed plates in concrete members where possible for future expansion. Do not make connections to existing beams, columns, walls and slabs with explosive or dry powder inserts.

5.2.5.2 Openings

Openings in structural slabs shall be detailed to prevent the spalling of concrete edges. Diagonal reinforcement shall be provided at corners, re-entrant slabs and floor penetrations.

5.2.6 Expansion Devices and Materials

In addition to ACI 318, refer to ACI 504R for various joint treatments and to ACI 224R and ACI 224R-01 for crack controls.

5.3 Parking Structures

All criteria specified in the section Building Structures shall also apply to parking structures except as amended in the following.

5.3.1 Material Selection

Structural steel shall not be considered for the vertical and horizontal framing system unless approved by the SAT Project Manager. The preferable framing system for the parking garages will be:

- Cast in place post-tensioned concrete system
- Precast concrete system

5.3.2 Live Loads

- Uniform load 40 psf
- Concentrated load 3000 pounds on 4.5"x4.5" area
- Roof live load 40 psf plus rain or snow load
- Vehicle Barriers for passenger cars 6000 pounds (1'-6" to 2'-3" above floor)
- Roof installed solar Panels 20 psf plus weight of Panels

5.3.3 Precast Double-Tees:

Do not install bottom connections into legs of double tees. Provide Side penetrations into legs where possible. Utilize pre-drilled holes as much as possible. No powder actuated inserts are allowed into legs of double tees or slabs.

Existing double-tee roof and floor systems shall be evaluated for loads, penetrations, or attachments by a registered structural engineer, licensed to practice in the State of Texas.

5.3.4 Steel

All exposed miscellaneous steel used for concrete supports and connections shall be hot dip galvanized and retouched after installation.

5.3.4.1 Detailing

Detailing for structural steel shall comply with the requirements of AISC 360, latest edition.

5.3.4.2 Connections

Steel moment connections shall be designed using the Allowable Stress Design (ASD) Specification or the Load and Resistance Factor Design (LRFD) Specification for Structural Steel Buildings.

All concrete embedments shall be encased with sufficient anchorage to prevent cracking or rapid failure. Corrosion resisting finishes shall be used on all structural embedments.

All connections, whether designed by the consulting engineer, the suppliers, or structural detailers, shall be designed and sealed by a professional structural engineer registered in the State of Texas.

5.3.5 Concrete Protection and Durability

Corrosion Protection -Calcium chloride and admixtures containing chlorides should not be used in concrete for parking structures. Admixtures shall be used with care and compatibility shall be verified by testing laboratories.

Protection of embedded metals including concrete cover over reinforcement, post- tensioning tendons, pretensioned connections for precast systems, dissimilar metals, and embedded metal conduit should meet or exceed the minimum ACI 318 requirements.

Increased cover of 1 ½" for top Reinforcement of slabs shall be provided.

Epoxy coated reinforcement will be used for concrete slabs.

ACI 362.1R, ˜Guide to the Design of Durable Parking Structures should be consulted for pertinent information concerning corrosion inhibitors, cathodic protection and protection of concrete. The guidelines for applied sealers or membrane treatments shall be followed.

5.3.6 Expansion Devices and Materials

Expansion joint seals and isolation joints shall be designed to prevent the following defects or failures:

- Migration, bleeding into or staining abutting materials.
- Deformation sufficient to become unsightly or cause leakage.
- Chalking, picking up dust or excessive color change.
- Adhesive or cohesive failures. A/E to confirm materials utilized hold up to high traffic or environment as required.
- In addition to ACI 318, the designer should refer to ACI 504R for various joint treatments and to ACI 224R and ACI 224R01 for crack controls.

5.3.7 Elastomeric Bearings

Bearings shall be designed as a plain pad with a seventy (70) durometer elastomer or laminated pads with a sixty (60) durometer elastomer.

5.3.8 Parapet Systems

Systems which are integral or monolithic with supporting structural systems shall be designed such that damage to the parapet will not adversely affect the supporting system. The use of isolation joints and membrane protection is important at roof connections.

5.3.9 Drainage Systems

Systems shall be designed and located such that structural elements (i.e., reinforcing steel, tendons, beam flanges, lighting column base plates, etc.) shall take precedence. Use the least number of bends for unimpeded flow. Clean outs shall be placed at every 100-feet.

5.3.10 Clearances

Structure clearances should take into account the type of vehicle accessing the level. Large trucks need clearance of 8'-2" and Level 1 is currently 9'-10". The A/E will need to review with the ARFF Stake holder Group, required clearance needed at certain levels to accommodate existing and future ARFF vehicles.

5.4 Aircraft Bridge Structures

This section shall apply to all bridges, tunnels, culverts, vaults and all other structures supporting aircraft or under runways, taxiways or aprons. Such structures shall conform to the minimum requirements set forth in this Manual and FAA AC 150/5300-13 (latest edition). Unless specifically approved by the City Engineer all aircraft rated bridges shall be structural steel.

5.4.1 Airplane Design Group

Structures at SAT shall be designed and proportioned to accommodate Airplane Design Group VI as defined in FAA AC 150/5300-13. Structures at SAT shall be designed and proportioned to accommodate Airplane Design Group III.

Each element of the structure shall be designed to accommodate the most demanding airplane under this design group. This may result in more than one airplane being used in designing a particular structure (i.e., bridge width may be controlled by the airplane with the longest wingspan, whereas another airplane may have higher wheel loads, thus controlling beam design).

5.4.2 Live Loads

Structures shall be designed for the following airplane loads:

- Spans less than two (2) feet in the shortest direction, including manholes lids and grates - uniform live load of 250 psi.
- Span lengths two (2) to ten (10) feet in the shortest direction - the greater of a uniform live load varying between 250 psi and 50 psi in inverse proportion to the span length or the maximum number of wheel loads for the airplane which can be applied to the structure.
- Span lengths greater than ten (10) feet in the shortest direction - wheel loads for the design airplane.

5.4.3 Impact

For those elements listed in Group A (defined below), the live load shall be increased by the following percentages. This increase will account for impact loads and vibration:

- 30 percent - Parking aprons and low speed taxiways. 40 percent - High speed taxiways and runways.
- 100 percent - Touchdown areas of runways.

Live loads shall not be increased by impact for those items in Group B (defined below):

5.4.3.1 Group A

- Superstructure, columns and pedestals which support the superstructure with rigid, fixed or expansion bearings, or which are rigidly attached to the superstructure, and legs of rigid frames.
- The portions above the ground line of piers that are rigidly connected to the superstructure as in rigid frame or continuous structures.

5.4.3.2 Group B

- Abutments, retaining walls, piers, pile caps and pilings which are not rigidly connected to the superstructure.
- Buried foundations, footings and supporting soil, and structures with three (3) feet or more of earth cover.
- Impact for structures covered with fill shall vary from the percentage shown at ground level to zero (0) percent at a depth of ten (10) feet.

5.4.4 Braking Force

Longitudinal forces due to braking shall be included in the design of all structures subject to direct wheel loads. This braking force shall be the following percentages of live load without impact:

- 30 percent - Parking aprons and low speed taxiways.
- 70 percent - High speed taxiways and runways.

5.4.5 Clearances

Vertical clearances for aircraft bridges over roadways and horizontal clearances to piers from these roadways shall be the same as those described in Section under Obstruction Clearances.

5.4.6 Materials

Construction material specifications, strengths, handling, storage and testing shall comply with the latest version of the American Association of State Highway and Transportation Officials (AASHTO) "Standard Specifications for Highway Bridges".

5.4.7 Design Load Combinations

In addition to live and dead loads, the following loadings shall be taken into account: earth pressure, buoyancy, wind (including jet blast and uplift), shrinkage, temperature, longitudinal force, stream flow, construction loads and any special loads. Loads shall be applied in such a manner as to produce the maximum stresses.

Loading combinations shall be the same as those described in latest version of the AASHTO's "Standard Specifications for Highway Bridges," and interim specifications.

5.5 Highway Bridges

This provision shall apply to structures with spans greater than twenty (20) feet and whose function is to carry roadway traffic. This section does not apply to parking structures or ramp systems within them.

5.5.1 Specifications

Highway bridges shall be designed in accordance with AASHTO's "Standard Specifications for Highway Bridges," with interim specifications.

5.5.1.1 Live Loads

- All bridges on arterial roads shall be designed for an HS20-44 live load plus impact.
- Bridges along secondary roads shall be designed for an HS20-44 live load plus impact unless waived by the City Engineer, in which case the design live load shall be HS15-44 plus impact.

5.5.1.2 Bridge Widths

Generally, bridge width from face of rail to face of rail shall be at least as wide as the approach roadway's usable shoulder.

5.5.1.3 Clearances

For horizontal and vertical clearance requirements, refer to

5.5.1.4 Materials

This section shall govern materials used in the construction of highway bridges and incidental items relating to these structures.

- Concrete materials, quality, classes of, and proportioning shall comply with the applicable sections of the Texas Department of Transportation (TxDOT) "Standard Specifications for Construction of Highways, Streets, and Bridges". At the discretion of the City Engineer, Construction Specifications may be taken from "Standard Construction Specifications for Wastewater Collection Systems, Water Lines, Storm Drainage, Street Paving, and Traffic", latest edition, published by the City of San Antonio Department of Public Works and Engineering, except as modified herein. No variance from these specifications or the modifications herein may be made without the approval of the City Engineer for the San Antonio Airport System (referred to throughout as the City Engineer).
- Structural steel, forgings, castings, anchor bolts, pipe, tubing, bolting of and welding of shall comply with the applicable sections of the TxDOT "Standard Specifications for Construction of Highways, Streets, and Bridges".

- Reinforcing steel material and bending shall comply with the applicable sections of the TxDOT "Standard Specifications for Construction of Highways, Streets and Bridges
- Prestressing steel, packing, storing, handling, working drawings and construction methods shall comply with the applicable sections of the TxDOT "Standard Specifications for Construction of Highways, Streets, and Bridges".

5.6 Pedestrian Bridges

Pedestrian bridge length, width, height and construction materials shall comply with the Building Code. The best location for bridges will be in the high traffic zones to provide better circulation.

5.6.1 Vertical Clearances

Vertical clearances over roadways shall be sufficient for the emergency and maintenance vehicles and other traffic to easily pass under them. Use a minimum clearance of 13'-0".

5.6.2 Design

Different structural framing options are acceptable but following considerations must be made and discussed with SAT before starting the design.

- Both independent and fixed to building types of structure for the bridges are acceptable. The design team will need to consider the existing column bays and impact to the existing building and traffic when locating new columns and foundations for the Pedestrian bridges.
- Security in the bridges is a priority. Bridge framing should be open such that any crime in the bridge should be detectable from ground.

5.6.3 Materials

Construction material specifications, strengths, handling, storage and testing shall comply with the IBC Building Code and TxDOT "Standard Specifications for Construction of Highways, Streets and Bridges".

5.6.4 Design Loads and Loading Combinations

- The minimum live load shall be 100 psf. Where equipment and small vehicles are anticipated to use this structure, live loads shall be increased accordingly.
- In addition to live and dead loads, the following loadings shall be taken into account: earth pressure, buoyancy, wind (including jet blast and uplift), shrinkage, temperature, stream flow, construction loads and any special loads. Loads shall be applied in such a manner as to produce the maximum stresses.

5.6.5 Retaining Walls

- Retaining wall design and materials shall comply with the applicable sections of the Building Code and the geotechnical investigation report for that project.
- The effect of wall movement due to expansive soils shall be taken into account and, when necessary, appropriate design steps shall be taken to minimize them.
- The factor of safety for overturning shall be 1.5 minimum. Expansion Joints must be provided every ninety (90) feet maximum and contraction joints every thirty (30) feet maximum.

5.6.6 Tunnels

- Tunnels shall include all below grade, enclosed structures used by pedestrians, vehicles or to hold utilities.
- Due to the varied applications of tunnels, the design criteria shall be established on a project to project basis.
- Items of particular interest which should be addressed are: waterproofing, ventilation, lighting and utilities, drainage, exiting, fire protection, cathodic protection/corrosion control and overburden loading.

5.7 Glossary

AASHTO :	American Association of Highway and Transportation officials
ACI :	American Concrete Institute
AISC :	American Institute of Steel Construction
AISI :	American Iron and Steel Institute
ASCE :	American Society of Civil Engineers
ASD :	Allowable Stress Design
ASTM :	American Society for Testing and Materials
AWS :	American Welding Society
FAA :	Federal Aviation Administration
HSLA :	High Strength Low Alloy
IBC :	International Building Code
LRFD :	Load and Resistance Factor Design
PCA :	Portland Cement Association
PCI :	Prestressed Concrete Institute
PTI :	Post Tensioning Institute
TxDOT :	Texas Department of Transportation

06

SAN ANTONIO INTERNATIONAL AIRPORT

Photo by Sean Pavone Photo

6.1 General

The objective for the architectural design standards is to align and elaborate on the SAT design Guidelines to achieve continuity for designs of future renovation and new construction at San Antonio International Airport. To better assist designers in providing a design which supports SAT's initiative to approach building opportunities on the same conceptual basis, this chapter is divided into locations within and around the Terminal Building. These standards will support SAT's vision to provide a unique sense of place, improve the passenger and user experience, ease of maintenance, sustainable and durable materials and provide a unified look and feel throughout the entire Airport.

For all materials, furniture, equipment and accessories, the A/E will need to specify locally sourced, American-made materials to provide quick ship capabilities and ease of replacement. Materials will need to be durable, sustainable and easily cleaned including antimicrobial properties for self cleaning where feasible. Any deviation to these standards will need to be reviewed by the SAT PM.

6.2 ConRAC

6.2.1 Definitions & Locations

The CONRAC has a quick turnaround (QTA) facility that includes fueling, vacuuming, washing, and light maintenance. It also has 2,600 ready/return parking spaces. A bridge over the terminal roadway connects the CONRAC to the mezzanine level of the SAT terminal.

- Consider smooth vehicle traveling for "ready & return"
- Create intuitive wayfinding elements
- Provide straight and safe pedestrian pathways
- Quick Turn Around area(QTA) on-site (light maintenance)
- Common use vs Proprietary for Rental Car Counters
- One key take-away from the first meeting was the need for safe pedestrian travel to/from parking garages/lots and ConRAC.

6.2.2 Design Criteria

6.2.2.1 Currently the goal for SAT is to have a consistent look across the counters for the tenants for a cohesive look, but also allow for the tenant to introduce their own branding in designated areas. Currently the car rental counters are proprietary and are able to modify the back wall for branding purposes. Any deviation to the standardized look and configuration for a public facing tenant counter will need to be reviewed by SAT on a case by case basis.

6.2.2.2 Because the main passenger type of SAT is leisure and families. Passengers should have visibility and ease of access to the ConRAC to start their next step on their journey and upon return.

6.2.3 Innovation

Design teams will need to keep in mind future technology and trends such as the remote check-in process which will allow passengers to check-in, print bag tags and bag drop while returning their rental car. This process reduces long lines and congestion in the Terminal check-in hall and a negative passenger experience.

6.3 Curbside

6.3.1 Definitions & Locations

Safety is paramount at curbside. Therefore, it is essential to understand the purpose and correct zones for all the various vehicles servicing this inherently busy space.

Non-direct illumination should ensure user security at night.

Paving, exterior structures and all urban grade furniture should be virtually maintenance free and deter laying down.

Trash and recycling containers should be provided.

Users should intuitively and quickly understand how to navigate to parking.

The use of color, lighting, shade, and landscape will create a positive impression of the curbside area. Ample space should be provided for picking up and dropping off passengers, including large groups, whether it is families dropping off or picking up a loved one, or large groups of military members arriving or departing.

Visitors will need a variety of amenities here: luggage carts, check-in kiosks, service animal relief areas, and accommodations for accessibility requirements.

6.3.2 Curbside Check-in

6.3.2.1 Standardized curbside check-in desks with airline specific inserts and signage to decrease visual clutter

6.3.2.2 Utilize consistent form and lighting to highlight curbside check-in and distinguish it from other curbside zones

6.3.2.3 Provide sufficient space for curbside check-in queues so that passenger travel paths into the terminal are unobstructed

- Curbside Check In / Baggage Drop Off
- Create zones for waiting area separate from smoking area.
- Provide ample space to the curb to allow for large groups to congregate at ticket counters as needed.
- Allows space for passengers to recompose themseleves before entering the terminal building.
- Provides ample wheelchair storage to continue to allow pedestrian traffic.

6.4 Ticketing

6.4.1 Definitions & Locations

The Check-in (or ticketing) area is a pre-security space within the terminal building where airline ticketing agents interface with passengers--selling tickets, printing boarding passes and checking luggage. It usually sees high passenger traffic.

- Passenger Methods: Account for the different methods of check-in
- Space Organization: Provide ample space for different user groups
- Sound: Consider how sound can be used to create a calming atmosphere.

6.4.2 Ticket Counters

- The current configuration of the ticket counters is in a line configuration with a back wall for conveyors and Airline branding. Future construction should include a continuous back wall with digital signage to allow for ease of relocation and flexibility in programming.
- Ticketing counters should be common use and accessible. Public face is consistent but inserts can be customized per airline standards.
- A telescoping lift will be required if a shelf is located above the counters for maintenance.

6.4.2.1 Finishes

- Finishes should include solid surface for horizontal surfaces of counters and stainless steel or an equally durable material for vertical surfaces in high traffic areas.
- A/E to coordinate standard finishes with SAT PM in all Airport Common Areas for review.

6.4.3 Self Check-In

6.4.3.1 Standalone units distributed throughout the departure hall to allow for more open space.

6.4.3.2 Units are used for check-in, printing of boarding passes and self-tagging of baggage, the process must be completed before proceeding to the baggage drop counter

6.4.3.3 Units provided by the Airline will be branded accordingly. Unit style and location will need to be reviewed by the SAT PM for continuity purposes.

6.4.3.4 Needs to incorporate tamper-proofing for data and electrical.

6.4.3.5 Innovation

- The A/E team will need to review the SAT opportunities to provide an island style ticket counter to save space and provide dual loading from counters onto the conveyor where feasible.
- The A/E will need to review with SAT opportunities to incorporate the international style baggage induction system where baggage is placed directly on the belt adjacent to the counter and introduced into the system to avoid employee lifting where feasible.

6.5 Entry Vestibule

6.5.1 Definitions & Locations

The Entry Point to the airport is the threshold between the curbside and the interior of the building, specifically at the departure level. It acts as the front door to the terminal building, welcoming passengers as they disembark from different transportation modes and providing passenger amenities like baggage trolleys, curbside check-in, and re-composure areas outside of the pedestrian traffic flow. The entry point includes clearly defined entry vestibules.

- Daylight: Consider how to mitigate and control light to provide passenger comfort
- Space: Accommodate Vehicles and Passengers
- Design should also be focused on the legibility of signage, clarity of circulation path, passenger amenities, queue length, and average vehicle delay.
- Articulate entry through form, color, or material selection to visually highlight for wayfinding.
- Consider changes in plane between face of vestibule and face of building to create zones for:
- Recomposure
- Curbside check-in/Baggage
- Luggage trolley
- Wheelchair storage The Exit Point to the airport is the threshold between the curbside and the interior of the building, specifically at the arrivals level. It allows passengers to locate ground transportation options, waiting areas, and service animal relief zones.

6.5.2 Flooring

6.5.2.1 Walk-off mats need to include a recessed grid system with non-slip treads over a deep well to minimize maintenance and improve traction with a terrazzo flooring surround. Design teams will need to review options where grid systems will not come loose.

6.5.3 Entry Vestibule Doors

6.5.3.1 Incorporate glazed automatic entrance doors and windshields as appropriate, at building entrances, loading/unloading areas, and provide adequate openings for baggage conveyors and carts.

6.6 Security Checkpoint

6.6.1 Definitions & Locations

The Security Checkpoint is the area in which TSA screens passengers and their carry-on bags to intercept prohibited items. Prior to entering the security checkpoint each passenger is required to have their identification and boarding pass validated by TSA.

- Provide employee designated lanes at least for the first part in the morning because crew and public are being processed at the same time.
- Delineate the TSA zone and SAT zone
- Flexibility
- Lighting/Finishes
- Views
- Private Screening Area
- Post Security – Sense of Place, Comfort
- Provide sufficient room for "re-composition" area (where travelers put shoes and belts back on) and away from concessions to prevent the two areas from mixing.
- The A/E team will need to review requirements with TSA and how to incorporate the TSA Guidelines. Bring in TSA early to define requirements and tie-in strategy with the rest the building. Provide ample time for TSA to respond to all inquiries. Refer also to Design Submittal Requirements of when to engage various stakeholders.

6.6.2 Flexibility

Flexible Lanes allows for changes to checkpoint in real time, they can expand and contract to account for peak periods and there is an opportunity for enhanced wayfinding and/or graphics.

6.6.2.1 Access flooring can provide flexibility to adapt to changing security technologies and requirements with limited downtime and construction cost. Consider utilizing raised access flooring, walker duct, or structural framing with enlarged beams to allow for additional cores where feasible.

6.6.3 Views

- Views to the exterior can introduce daylight to relieve stress, etc.
- Passengers like clear sight lines to the Security Check Point to see the end. Design space so that travelers can see "the goal in sight", and prevent turning around corners.

6.6.4 Finishes

- Playful lighting, varied material/color pallet to provide visual interest
- Easy to maintain, no slope durable flooring and ceiling finishes.

6.6.5 Innovation

A/E teams should consider the following equipment where feasible and review with the SAT PM and TSA:

6.6.5.1 Computed Tomography (CT) Screening Equipment - Considerations for incorporating CT technology:

- To eliminate the impact of vibration on CT equipment, structural floors must meet enhanced criteria for stiffness.
- Higher voltage and amperage is required for electrical service.
- Design teams should always reference the latest version of the Checkpoint Requirements and Planning Guide (CRPG) for approved equipment.

6.6.5.2 Automated Screening Lane (ASL) - a property handling system allowing for the simultaneous divestment of multiple passengers and the automatic return of property bins to the divestment zone.

- SAAS is interested in Automated Screening Lane (ASL) equipment to reduce bottlenecks. The goal is to provide as much automation as possible.

6.6.5.3 Enhanced Advanced Imaging Technology Automated (eAIT) - The Rohde & Schwarz (R&S) QPS201 system requires only a few milliseconds to scan passengers, which can speed check-point screening operations and increase throughput.

6.6.5.4 Biometric Authentication Technology (BAT) - Travel Document Checker Similar to self-check-in kiosks, passengers would scan credentials, self-authenticate, and enter the checkpoint through a control point. It is also being pursued secure location doors.

6.7 Pedestrian Bridges

6.7.1 Definitions & Locations

The pedestrian bridge enables safe access to other parts of the Airport in high-traffic areas while also protecting travelers from the elements. Bridges can be located in the parking garage to the terminal, terminal to the terminal or surface parking to the terminal.

6.7.1.1 Design Criteria:

- The design team will need to include exterior glazing which maximizes potential views of the roadway, terminal and airfield.
- Art opportunities and/or buildings aesthetics at the bridge should take into account regional context.
- Open Air bridges may be utilized if they protect people from the elements, but only may be used when connecting two unconditioned spaces.
- Enclosed bridges will be utilized when connecting to any conditioned space while mitigating energy loss at the entrances.

- Bridges connecting terminal to terminal, or interior locations within the terminal can provide interest with views to the airside.
- Ease of maintenance. Framing that allows bird nesting is to be avoided.

6.7.1.2 Access:

- Security in the bridges is a priority and should be placed at a level for people accessing the bridges to be detectable from the ground.
- Circulation in the bridge should accommodate opportunities for an art program, walking and resting areas.

6.7.1.3 Innovation:

The A/E should consider current and future trends while discussing clearance for height and width and accommodate technology to move people from one point to the other faster while maintaining safe access.

6.8 Parking

6.8.1.1 Definitions & Locations

Airport-managed lots provide passengers with alternatives for specific passenger needs, including options for long-term, short-term parking structures and economy lots with shuttles to/from the airport terminals.

6.8.1.2 Design Criteria:

- Utilize color for purpose to introduce intuitive wayfinding and identify egress points. Color integrated into the exterior screen would be too much.
- Ease of maintenance is a priority for parking structures.
- Exterior screens would need to allow for airflow and visibility for the public to locate the next place on their journey. Perforated screens if used will need to be limited in size and preferable displayed art work. Lighting and fabric may be used for accents, but will need to include a maintenance program to understand when replacement is required.
- Provide a well-lit interior to give the impression of a bright and clean space. Currently the interior is painted white to provide this.
- Future design teams should look for opportunities to texturize or conceal blank facades with architectural elements such as exterior screens, landscaping or artwork.
- Art – to be utilized to provide sense of place and wayfinding. Also to enhance the visibility of entrances.

6.8.1.3 Access:

- Provide clear pathways designated by color in front of vehicles, covered walkways and bridges over roadways for safe access for pedestrians accessing the parking structure.
- Consider multiple ramps for redundancy for entry and egress to the parking structure.

6.8.1.4 Innovation:

- Plan for future innovative technologies including autonomous vehicles which will require smaller parking footprints and accommodate electrical vehicles with hard wired or wireless charging stations.
- The A/E team should consider capacity enhancements reviewed in the strategic development plan such as:
  - Integration of a Ground Transportation Center
  - Public and employee parking expansion
  - Taxicab/TNC staging areas
  - Rideshare staging areas
  - Future urban air mobility facilities

6.9 Customs and Border Protection Facilities

6.9.1 Definition & Location

The Customs and Border Protection (CBP) of the U.S. Department of Homeland Security (DHS) operate the FIS facilities at SAT. The CBP administrative and support spaces should be located within the sterile perimeter and be accessible from the primary and secondary processing areas.

Any project adjacent to and inside of a CBP area needs to be coordinated with CBP and then design team will need to reference the CBP Specific Technical Design Standards.

These facilities are located at:

- Terminal A for passengers and crew members of international commercial flights.
- Strive to provide passengers a comfortable experience to build upon SAT's vision for a welcoming and inviting airport.
- Reduce passengers' stress by providing natural daylight when appropriate, comfortable seating arrangements, and comforting color tones in the area around them.
- Provide wide hallways to travel from aircraft to FIS with hands-free automatic doors.
- Existing the CBP area needs to be separate from the arrivals greeters to alleviate congested areas and additional stress.
- For future planning, A/E should consider allocating space for future equipment including, but not limited to conveyor belt, international carrier waster disposal. The A/E will need to review the cost benefit analysis for any future equipment and review with the SAT PM.

6.10 Baggage Claim

6.10.1 Definitions & Locations

Baggage claim areas allow passengers to reclaim their checked bags, reunite with loved ones and associates, and orient themselves before heading to ground transportation options. These high-use, public spaces provide a parting impression of the airport while acting as a threshold to the larger city of San Antonio.

Special consideration should be given to:

- Wayfinding
- Acoustic treatment of surfaces
- Durability of surfaces and ease of navigation with wheeled baggage and carts
- Daylight and views
- Possible landscape or art act as an ecological and cultural bridge to San Antonio.

6.10.2 Design Criteria

6.10.2.1 Incorporate daylight and views into baggage claim by way of windows, light wells, clerestories, or skylights. It enables the followings:

6.10.2.2 Decrease power demand for electrical lighting

6.10.2.3 Orient passengers towards building ground transportation exits,

6.10.2.4 Highlight building form and materials.

6.10.3 Furniture

6.10.3.1 Provide sufficient quantities and a variety of furniture types to accommodate waiting individuals, large groups, families, and trainees. Furniture should be comfortable and durable, but also discourage laying down.

6.10.3.2 Maintain wide aisles between seating to accommodate passengers with baggage.

6.10.3.3 Provide powered seating and tables with integrated electrical outlets for improved durability. Interested in wireless technologies. If USB is provided, then it needs to be swapped out easily.

6.10.3.4 Provide a mix of seating types: traditional tandem or beam seating, soft, or lounge seating, and table seating at both dining and bar heights.

6.10.3.5 Select highly durable, cleanable, sustainable furniture.

6.10.3.6 Select furniture arrangements most likely to discourage sleeping through its length, configuration, or added accessories like arm rests and tables.

6.10.3.7 Incorporate seating types that allow for families and large groups to sit together.

6.10.3.8 Consider furniture as a means to obtain pops of color against a neutral background.

6.10.4 Interior Landscape

Consider use of interior landscaping to delineate zones within large spaces as well as introduce biophilia to aid in alleviating stress for the traveling public.

6.10.5 Baggage Claim Zones

6.10.5.1 Migrant Processing - There needs to be large room and/or an open space to allocate enough space to accommodate migrants and processing procedures, for gathering apart from the traveling public gathering lounge.

6.10.5.2 Waiting & Recomposure

- Provide right-sized areas for both waiting (families, military, and migrants) and recomposure (primarily families).
- Provide sufficient room outside of pedestrian traffic flow to allow for comfortable waiting.

6.10.5.3 Baggage Claim Devices

- Currently SAT utilizes flat plate devices which hug the wall.
- For future equipment the Airport would like to review the use of flat plate vs. inclined devices. Refer also the BHS section of the Design Standards.
- Advantages to an inclined device include processing a larger capacity of bags. A belt needs to reach the device from above or below, make-up device can be centered.
- Provide oversized belt straight conveyor.

6.10.5.4 Baggage Service Office

- Provide baggage service desk spaces adjacent to but recessed from circulation paths to allow adequate space for queuing.
- Provide baggage service desks that are uniform in appearance to passengers but allow for custom millwork inserts to be incorporated on the agent side to meet airline needs.
- Utilize dynamic signage in lieu of static signage to identify airlines and allow for greater future flexibility.
- Utilize durable, cleanable finishes at all contact surfaces. See list for allowable and prohibited finishes.
- Provide secure baggage storage spaces that are concealed from passengers' view.

6.10.5.5 Baggage Service Desks

- Need to have line of sight to baggage claim device.
- Common use BSO will need to have dynamic signage to be able to change branding as needed

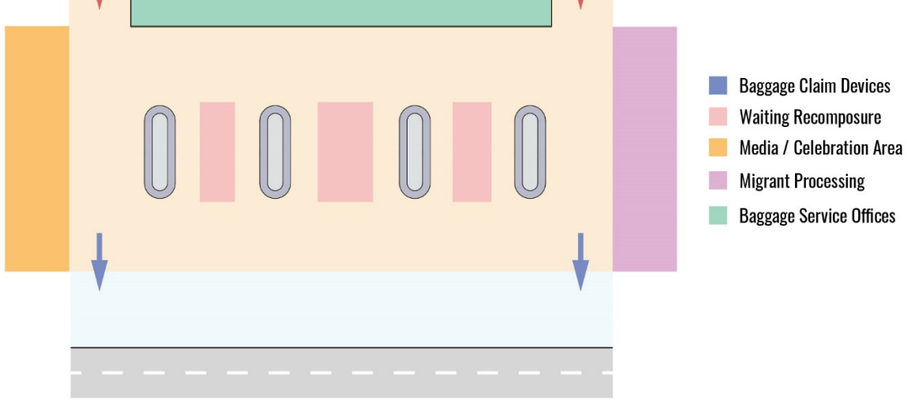
6.10.5.6 Media / Celebration

Provide space to allocate additional public visiting the Airport for media and/or celebration events to not congest with space for the traveling public.

6.10.6 Baggage Claim Zone Configurations

The following diagrams illustrate different configurations of zones within the baggage claim:

- Baggage Claim Devices
- Public Waiting / Recomposure
- Media / Celebration
- Migrant Processing
- Baggage Service Offices



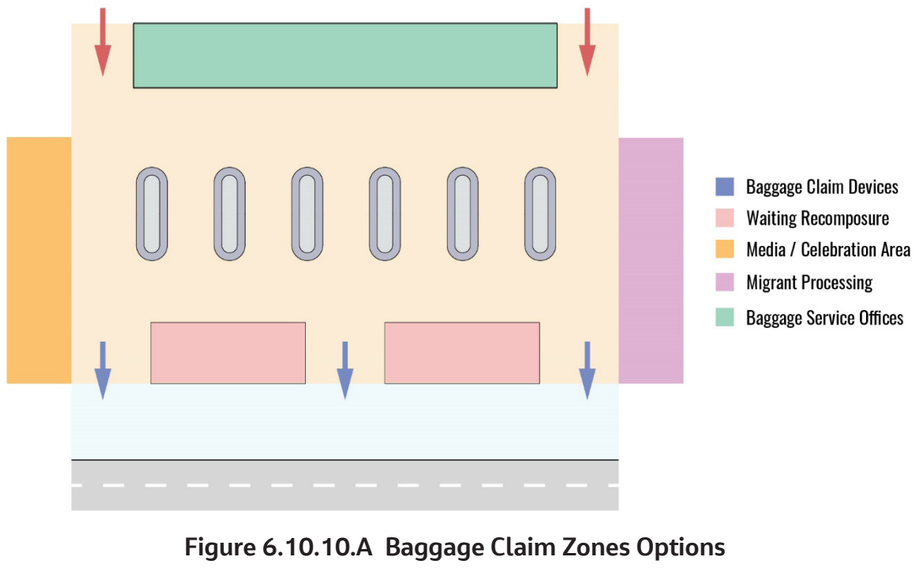


Figure 6.10.10.A Baggage Claim Zones Options

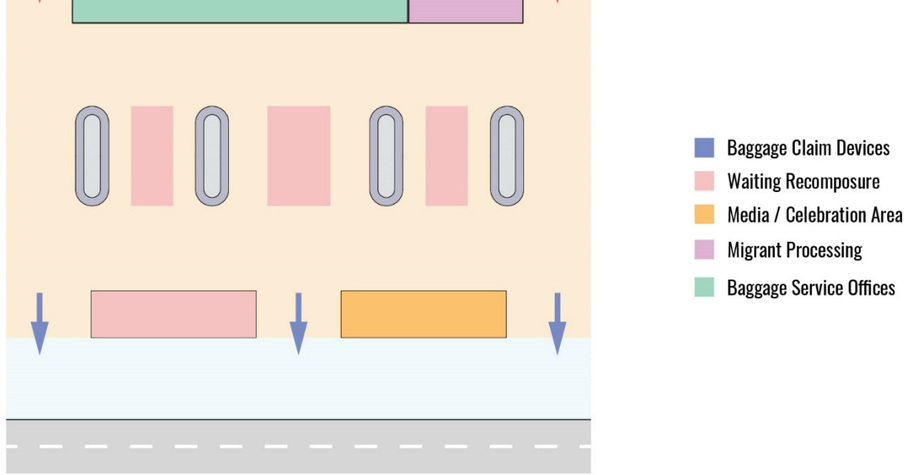


Figure 6.10.10.B Baggage Claim Zone Options

6.11 Concourse

6.11.1 Definitions & Locations

The concourse consist of walkways, hold rooms, concession areas, and other passenger amenities post-security. Concourses connect passengers to their gates for boarding.

- Clear signage and wayfinding are critical to the passenger experience.
- Adequate circulation width must be provided to handle varying numbers of passengers.
- Natural daylight and views to the outside should be maximized

6.11.2 Children's zone

6.11.2.1 For maintenance and safety seasons, SAT prefers the Children's area to be sponsored by a tenant. The tenant would be responsible for maintaining the area.

6.11.2.2 Increase visibility so parents can observe children playing from various points nearby.

6.11.2.3 Provide natural light, where practicable.

6.11.2.4 Explore the use of color, pattern, and texture for an immersive experience, while also speaking to SAT's regional identity.

6.11.2.5 Provide professionally engineered play equipment of appropriate scale and materials on fall rated flooring for improved safety.

6.11.2.6 Provide sensory sensitive spaces where applicable.

6.11.3 Outdoor Room

6.11.3.1 Offer outdoor spaces for an alternative to traditional holdroom or concessions area seating.

6.11.3.2 Incorporate views of the airfield or surrounding city, if practicable.

6.11.3.3 Provide amenities for increased thermal comfort, like misters or fire pits.

6.11.3.4 Incorporate landscape elements as a thematic unifier, reference to the local environment, and source of visual relief.

6.12 Gate Holdrooms

6.12.1 Definitions & Locations

The hold room area consists of the passenger seating/lounge area, gate agent desks, podium, and circulation, which should offer passengers a comfortable and relaxing space to utilize while awaiting departure.

6.12.2 Holdroom Arrangement

6.12.2.1 The A/E should be mindful and allow for queuing impacts upon pedestrians walkways and furniture. Queue space from boarding bridge area straight to concourse. Preference is for queuing against the windows

6.12.2.2 The following diagrams illustrate different zones within the holdroom. Coordinate with the SAT PM and Airline for specific arrangements.

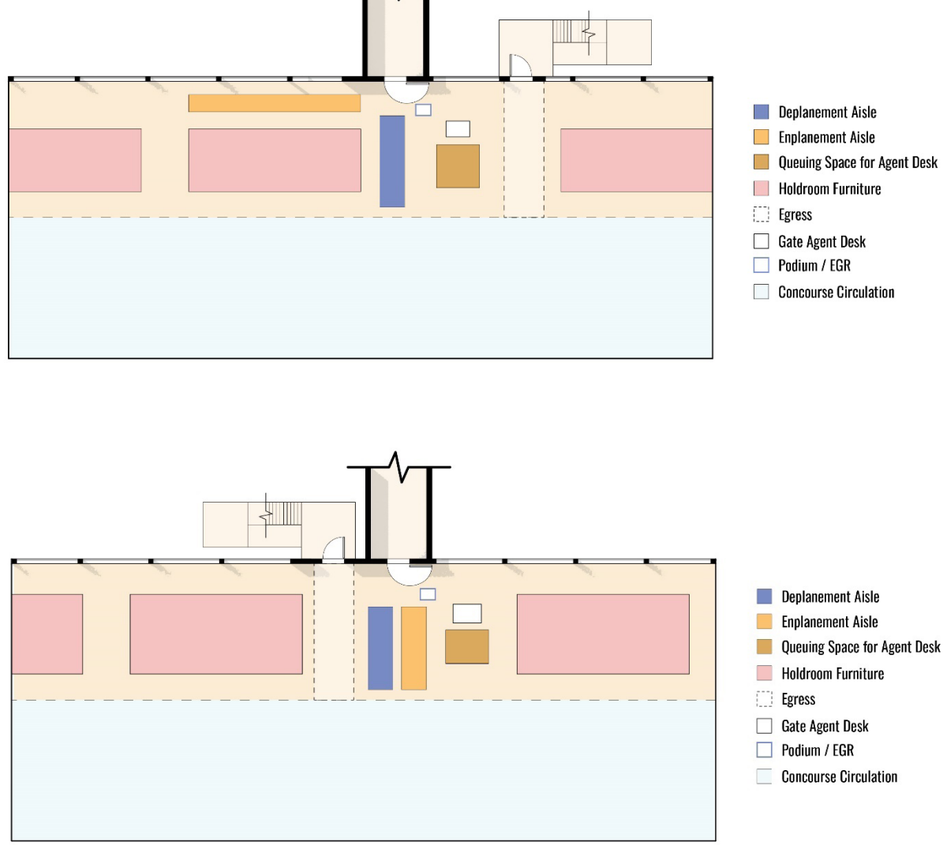


Figure 6.12.2 Enplanement and Deplanement Aisle Options

6.12.3 Access

6.12.3.1 Design teams need to take into account for multi-use storage when planning holdrooms including airline, wheelchair and janitor storage.

6.12.3.2 For security, prevent gaps behind back wall specifically behind gate agents for access to the exterior.

6.12.3.3 Consider access to mechanical and storage behind walls and make sure these spaces have ease of access.

6.12.3.4 Consider spaces for the ARFF to access the public areas in the event of an emergency.

6.12.3.5 Allocate space in aisles between holdroom seating to accommodate larger bags for the traveling.

6.12.4 Furniture

6.12.4.1 Provide powered seating and tables with integrated electrical outlets for improved durability with no USBs, but provide Wireless Charging where feasible. Percentage of powered seating will be reviewed for each proposed design.

6.12.4.2 Provide a mix of seating types: traditional tandem or beam seating, soft or lounge seating, and table seating at both dining and bar heights.

6.12.4.3 Select highly durable, cleanable, sustainable furniture. Utilize materials with up to a 2 Million Double Rub rating.

6.12.4.4 Select furniture arrangements most likely to discourage sleeping through its length, configuration, or added accessories like arm rests and tables.

6.12.4.5 Incorporate seating types that allow for families and large groups to sit together.

6.12.4.6 Consider furniture as a means to obtain pops of color against a neutral background.

6.13 Concessions

6.13.1 Definitions & Locations

Concessions are businesses located in an Airport engaged in the sale of consumer goods or services to the public under an agreement with an Airport. These high-use, public spaces provide a parting impression of the airport while acting as a threshold to the larger city of San Antonio.

Special consideration should be given to:

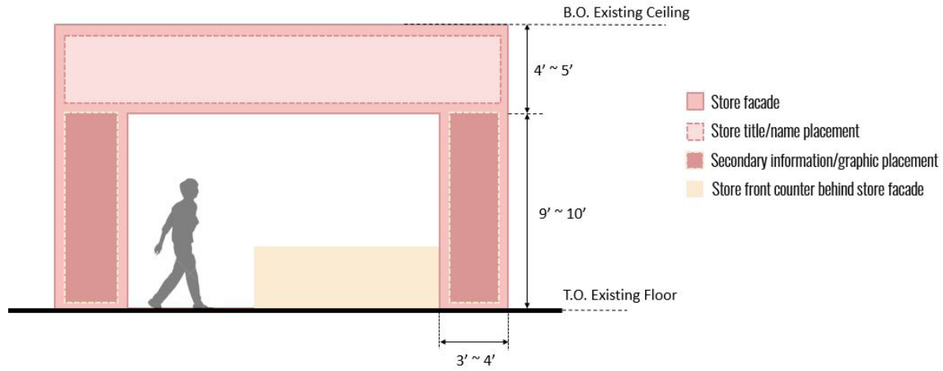
- Wayfinding
- Acoustic treatment of surfaces
- Durability of surfaces and ease of navigation with wheeled baggage and carts
- Daylight and views

6.13.2 Neutral Frame:

6.13.2.1 The neutral frame is the space allocated at the threshold between the Airport and interior of the Concessions. Typically the neutral frame is located at entry points into the Concessions.

6.13.2.2 SAT prefers clean lines at this threshold, but does not want to restrict the Concessions to a standard set of dimensions to promote creativity and opportunities to work in regional context. Each proposed design will need to be reviewed with the SAT PM and Properties to encourage a partnership and collaboration of the design of the portal.

The following diagram illustrates an example of the neutral frame and proposed zones for signage and branding.



6.13.2 Typical Neutral Frame Elevation

6.13.3 Security Enclosure

6.13.3.1 Provide one common aesthetic and branded for the security grilles.

6.13.3.2 Provide design with signage to alert customers when shop will be closed and reopened. No paper print outs. Hours for concession or QR Code showing what is open if concession is closed.

6.13.3.3 Prefer enclosures which roll from the side and larger panes

6.13.4 Furniture in Common Seating Areas

All furniture provided in common seating areas will need to be reviewed with the SAT PM and Properties for style and configuration.

6.13.4.1 Provide individual seating which does not make a lot of noise when moving.

6.13.4.2 The future design team will need to provide additional options for review regarding food courts. Items to consider include:

6.13.4.3 Should be able to hang the purse on the back of the chair.

- Outlets and hooks at every bar seat
- Smaller counter dedicated for accessibility with movable seats
- Back of House Access
- Consider common corridors for back of house concessions operations to include but not limited to trash removal, concessions supplies, and storage.
- Build in redundancy in vertical transportation when accessing different levels.
- All finishes should be used to hold up high traffic and heavy use. Consider utilizing CMU with high build paint, sealed concrete, and fiber reinforced paneling up to 4'-0" above the floor.

6.13.5 Innovation:

The A/E should consider current and upcoming trends to review with the Airport such as:

6.13.5.1 SAT currently includes a "Take and Go Concessions" model which provides customs to choose an item and self check out.

6.13.5.2 Shared Kitchens -

- One shared kitchen or "Ghost Kitchen" in the back with a food hall for multiple concessions to utilize.
- Would be able to have a sunken walk in because always a kitchen.
- Build in redundancy in vertical transportation.
- Encourage the use of shared kitchens, maximizing sq. ft. for revenue.

6.13.5.3 Autonomy for robotic concessions, ranging from a size similar to a shopping cart to a full automated free standing kiosk.

6.13.5.4 Common corridors for back of house concession operations to include but not limited to trash removal, concession supplies and storage.

6.14 Vertical Circulation

Vertical circulation elements primarily consist of moving walkways, escalators, elevators, and stairs. Provide priority to dependability and uniformity. Locally sourced equipment is preferred for maintenance and quick ship capabilities for replacement parts.

- Major considerations include Dependability and Uniformity
- If located outdoors, equipment must be outdoor rated.
- Distance between each device depends on the layout, building code and the level of service.

6.14.1 Moving Walkways/Escalators

6.14.1.1 Flush preferred to raised moving walkways.

6.14.1.2 Build in redundancy in areas with limited access from different levels, for example, from apron to concourse level.

6.14.1.3 Consider utilizing a double railing to mitigate broken panes and debris in between

6.14.1.4 Glass Balustrade Panels

6.14.1.5 Stainless Steel Panels

6.14.1.6 LED Comb Lighting

6.14.1.7 Abuse resistant shroud (reinforced stainless steel, backing)

6.14.1.8 Consider utilizing a double railing to mitigate broken panes and debris in between.

6.14.2 Elevators – Public Passenger elevator Cabs (within weight allowance per manufacturer)

6.14.2.1 Flooring

Approved materials

- Porcelain, Engineered Stone - Thru body tile or slab
- Porcelain Panels

Prohibited Materials

- Ceramic tile (non thru-body)
- Rubber flooring/resilient tile or sheet product
- Walk off mat/carpet
- Wood/laminate

6.14.2.2 Walls (Must be vandal resistant)

Approved Materials

- Stainless Steel Panels (reinforced/heavy gauge)
- Back-lit Stone Panels
- Glass Panels - Interested in glass elevators due to aesthetics
- High Pressure Laminate Panels
- Plastic/Resin Panels
- Other Panelized Metals
- Stone Tile (engineered)

Prohibited Materials

- PLAM Panels
- Perforated Metal
- Wood Panels

6.14.2.3 Ceilings

Approved Materials
- Stainless Steel Panels
- Luminous Panel/Resin/Plastic
- Wood Panels

Prohibited Materials
- Perforated Metal Panels

6.14.2.4 Lighting
- LED Downlights
- LED Strip Cove Lights
- Luminous Ceiling

6.14.2.5 Elevator Entry Portals
- Stainless Steel (reinforced)
- Glass Panels
- Other Metals

6.14.3 Elevator Non-Public (Service)

6.14.3.1 Flooring
- Zinc coated tear plate
- Rubber Floor

6.14.3.2 Walls
- Removable Padding (hooks)
- Car Buffer Rails
- Zinc coated tear plate
- Powder Coated Steel

6.14.3.3 Ceilings
- Stainless Steel
- Powder Coated Steel

6.14.3.4 Lighting
- Linear LED Light Fixtures

6.14.3.5 Doors
- Overhead Gates where any cart traffic (not where passengers can occupy)
- Sliding Doors

6.14.3.6 Entry Portal
- Stainless Steel (reinforced/heavy gauge)

6.14.4 Stair – Interior Public Stairs (Enclosed) – no exposed utilities

6.14.4.1 Railing

Approved Materials
- Stainless Steel
- Wood/Engineered Wood

Prohibited Materials
- Powder coated steel

6.14.4.2 Stair Tread/Riser (non-slip)
- Stone/Engineered
- Thru-Body Tile with metal edges
- Terrazzo
- Precast Concrete
- Concrete Tile

6.14.5 Stair – Interior Public Stairs (open)

6.14.5.1 Handrail

Approved Materials
- Stainless Steel
- Wood/Engineered Wood

Prohibited Materials
- Powder coated steel

6.14.5.2 Railing Panel (Balustrade Panel)
- Tempered/Safety Glass
- Metal Panel
- Edge-lit LED Panel
- Cable Ties
- Stainless Steel
- Resin/Plastic

6.14.5.3 Stair Tread/Riser
- Terrazzo
- Thru-Body Tile with metal edges
- Stone/Engineered
- Sealed/Stained Concrete
- Precast Concrete
- Concrete Tile

6.14.6 Stair - Interior Non-Public Stairs

6.14.6.1 Railing
- Powder coated steel
- Painted Steel

6.14.6.2 Stair Tread/Riser
- Sealed concrete
- Metal Grating (exterior only)
- Precast Concrete

6.14.6.3 Walls
- CMU
- Sealed Concrete
- Gypsum (zinc coated tear plate wainscot), painted, heavy duty water-based urethane
- Gypsum (abuse resistant at contact areas), painted, heavy duty water-based urethane

6.14.6.4 Ceilings
- Open to Structure
- Acoustical Lay-In

6.15 Service Animal Relief Area

6.15.1 Exterior:

6.15.1.1 Meet the requirements set forth in FAA Circular AC 150/5360-14A for Service Animal Relief Areas.
- Three-dimensional prop.
- Weather protected.
- Accessible.

6.15.1.2 Provide drinking water for service animals.

6.15.1.3 Provide drainable, artificial turf installation specifically designed for service animal relief areas.

6.15.1.4 Consider placing in corners of the building structures which aren't usable

6.15.2 Interior:

6.15.2.1 Meet the requirements set forth in FAA Circular AC 150/5360-14A for Service Animal Relief Areas including, but not limited to the following:
- Dedicated exhaust system to mitigate odor.
- All indoor and secured facilities would feature artificial turf flooring, a drainage system, and artificial or 3D object
- 24/7 availability
- Bags and waste receptacles are provided for added convenience.
- Wheelchair accessible
- Wall mounted sink, recessed soap dispenser, automatic hair dryer, and paper towel dispenser
- Wall mural to help both animals and humans feel more at ease. (Optional)
- Dog Play Area (Optional)

6.16 Building Envelope

6.16.1 Glazing

6.16.1.1 Sun control is a concern in terminal B at SAT currently including Glare from the clerestory in Concourse B and heat gain is a concern in Terminal A.

6.16.1.2 Internal sun shading is allowable but will need to be reviewed with the airport for maintenance concerns/cost. A Cost Benefit Analysis for life span and replacement as a maintenance program will need to be provided for consideration.

6.16.1.3 Architectural elements such as eaves and overhangs should also be considered for sun control.

6.16.1.4 A double glazed system with internal shades is not recommended due to expense and higher maintenance.

6.16.2 Exterior Surfaces

6.16.2.1 Exterior Envelope to provide material palette reflective of regional identity with warm, neutral backgrounds with accents of color.
- Corten Steel
- Lime Stone
- Copper
- Wood / Wood-like (Maple, Pecan, and Walnut)

6.16.3 Roofing

The roof supports several systems and keeps our occupants sheltered. It is the face of the airport from the sky.

6.16.3.1 Acceptable Roof type :

- Cool roofs: As indicated in CoSA Design Standards, 2017, Cool Roofs are required for new construction and should be considered on all major renovations. A cool roof is one that has been designed to reflect more sunlight and absorb less heat than a standard roof. Cool roofs can be made of a highly reflective type of paint, a sheet covering, or highly reflective tiles or shingles.
- PVC : A single ply roofing system made from polyvinyl choloride. As a cool roof membrane, it carries both Energy Star and Cool Roof ratings.
    - No asphalt based products are allowed above or over PVC roof material.
    - Provide white 60 mil minimum PVC roof membrane on standard roofs; 85 mil PVC on unusual surfaces.
    - Flame spread index is 25 at minimum when tested in accordance with ASTM E84.
- SBS: Adhered styrene-butadiene-styrene (SBS) modified bitumen reinforced two-ply membrane system, with a granulated cap sheet, adhered with no VOC cold application cement.
    - Excellent hail and puncture resistance and good weatherability. Recommended on critical facilities and roofs that will receive extraordinary foot traffic. Not recommended in environment where oil and grease are present.
    - Standing Seam Metal Roof – A concealed fastener metal panel system that features vertical legs and a broad, flat area between the two legs.
    - Standing Seam Metal roofing systems provide various aesthetics solutions for straight, convex or concave curved, tapered, and compound curved for dome applications. The system also provides a wide range of finishes to introduce color.

6.16.3.2 General Design Criteria

- Select the roofing system on a life-cycle cost basis.
- For ease of maintenance, specify a long-lasting premium roofing system commensurate with the facility life cycle and architectural theme.
- Design shall account for the slope of the building frame. This is preferred over other methods, such as tapering the roof to achieve a positive slope.
- Provide roof drainage overflows through parapet walls, where roof tie-in drain overflows are not constructive.
- Provide slip-resistant walkway pads on low-slope roofs subject to heavy foot traffic to prevent roof damage
- At roof walkways, penthouse door entries, and other high-traffic roof areas, walking treads shall be provided with a color contrasting to the filed color to clearly define the pathways.

- Provide adequate clearance between roof surfaces and other objects to allow access for roof repairs and replacement.
- Maintain clear access pathways to get maintenance materials and equipment to and across the roofs. This includes coordinating conduits, piping, and expansion joints. Do not install pipes or conduits across walkways without installing permanent low slope crossover ramps, with hand rails and slip resistant walking surface for delivering materials using hand trucks.
- Do not design for use of access hatches or forklift/crane without approval.
- Specify a minimum slope of 1/2" per foot to ensure positive drainage of the roof surface.
- Specify 1" slope per foot for roofing crickets, diamonds, and saddles.
- Do not use pop rivets on exposed sheet metal details.
- Provide 1/2" coverboard.
- Roof safety tie downs to be considered for all new/existing roof projects.

6.16.3.3 Parapets

- Provide 42" high parapet walls or rails on roofs, bridges, and other elevated walk surfaces above 48"; where not feasible, provide other fixed fall protection system for 2 or more concurrent personnel.
- Parapets, cants, and curbs should be used to provide an overall pleasing and unified appearance for the building facade, concealing unsightly or complex roof-scapes. Their design should respond to the specific conditions and sight lines of the individual project.
- Parapets to be designed to slope inwards towards roof.
- Provide flashing as recommended by the manufacturer.

6.16.3.4 Gutter

- Buildings with gutters shall have downspouts connected to storm drainage system. Any downspout which daylights will need to be reviewed by the SAT PM.
- Exposed galvanized metal is not allowed unless approved by SAT PM

6.16.3.5 Roof Drain

- Roof drains shall be designed to avoid water damage to structural system.
- For drains located at low points, consider the deflected position of the structure under load.
- Interior roof drains are preferred over perimeter drains on low-slope roofs.
- Exposed galvanized metal is not allowed unless approved by SAT PM.

6.16.3.6 Roof Expansion Joints

- If expansion joints (EJ) are required, verify they are placed at the high point, with drainage directed away.
- Expansion joints shall allow movement in three directions.
- Interior and exterior EJ are specified wherever the wall can move relative to an abutting wall, curb, or other building component.
- Curbs for expansion joints, area dividers, roof hatches, and rooftop equipment shall be sized to permit a base flashing height that is a minimum of 8" and a maximum of 12", from top of curb to top of roofing.

6.16.3.7 Roof Sealant

- Sealants shall be approved by the manufacturer of adjacent surfaces for compatibility.
- No silicone sealants are allowed. Exceptions are products that specify a particular sealant for warranty, such as Dow 795.

6.16.3.8 Skylight

- Silicone sealants are not acceptable except for glazing systems designed for silicone joints. All exterior envelope penetrations subject to weather shall have redundancy built into the weatherproofing.
- Coordinate the interface with other exterior closure trades so the combined exterior wall system components function properly.
- Ensure uniformity of color and visual appearance of all frame components and glazing surfaces.
- Maintain single source responsibility for the entire system, including fabrication, installation, and total coordination of all work.
- Skylights shall be designed for personnel loading without additional fall protection.

6.17 Building Interior - Public Accessible Areas

Finishes utilized in the areas accessible to the public will need to craft a cohesive experience that conveys San Antonio's signature characteristics and creates a unique sense of place. Providing a unified look and feel throughout the entire Airport is pertinent to the selection process for finishes in each project.

Allocate space for media/celebration access for additional public visiting the airport to not congest the traveling public.

6.17.1 Walls

6.17.1.1 Approved Materials:

- High Pressure Laminate Panels (various finishes)
- Wood or Wood-Look Panels (at non-contact and decorative accent areas only. No veneer.)
- Metal Paneling (reinforced, heavy gauge)
- Natural/Engineered Stone Paneling
- Glass/Aluminum Systems (All treatments applied to glass must be on the back unexposed side or laminated. Framing system may function as wall base. No additional base application is required.)
- Resin/Plastic Panels (decorative accents only)
- Thru-Body Tile
- Glass Tile/Ceramic Mosaic Tile (decorative accents only)
- Gypsum Board, painted (at non-contact areas only, acrylic satin finish or epoxy)
- Perforated Imaging Metal Paneling (at non-contact areas only)
- Concrete Tile
- Fiber Cement Panels
- Porcelain Panels
- Painted and Powder Coated Metals (at non-contact areas only)

6.17.1.2 Prohibited Materials:

- Applied Faux Finish Materials and Paints
- Speckle Paint Finish
- Wood Veneer

6.17.2 Acoustics

Control of noise within large public spaces or interior spaces with sensitive information, and control of aircraft noise intrusion into occupied spaces, is a major consideration in the building design.

Term	Abbreviation	Definition
Decibel	dB	The unit of sound pressure level as a ratio between a measured sound pressure level and the reference pressure.
Field Sound Transmission Class	FSTC	The difference between the STC and FSTC is that the FSTC is a field performance and includes sound leads and flanking paths. Typically, FSTC = STC-5
Impact Isolation Class Rating	IIC	The rating of impact noise heard through the floor/ceiling in the space below/above.
Noise Criterion	NC	A rating system based on the octave band sound pressure levels for a given noise spectrum. The NC value is determined when the given noise spectrum does not exceed any sound pressure levels of the lowest possible NC curve. These curves are based on satisfactory speech communication without being annoying.
Reverberation Time	N/A	The time, in seconds, taken for a sound within a space to decrease by 60dB after the sound source has stopped.
Speech Intelligibility	N/A	The measure of how comprehensive speech is in a given condition, using the STI.
Sound Transmission Class	STC	The STC is an integer rating given to a building partition that denotes how well a building partition attenuates airborne sound. It is based on a laboratory performance of a test sample.
Speech Transmission Index	STI	STI is the objective measurement predictor of speech transmission quality.

6.17.2.1 Acoustic Criteria are provided for the following:

- Background noise levels within occupied spaces due to HVAC system and mechanical equipment noise using Noise Criteria Curves (NC).
- Exterior noise ingress from aircraft and vehicular traffic operations using Noise Criteria Curves (NC).
- Acoustical separation between occupied spaces and between non-occupied mechanical room spaces and occupied spaces using field transmission class (FSTC).
- Impact Isolation using impact insulation (IIC).
- Reverberation time occupied spaces to control noise levels within large spaces and achieve acceptable speech intelligibility of public address annoucnments using reverberation time and speech transmission index (STI).
- Minimum exterior building attenuation to reduce noise intrusion from both landside traffic movements and airside aircraft operations.

6.17.3 Ceilings

6.17.3.1 Must be cleanable, durable and antimicrobial. All selected ceilings need to be suited for the space, ie. ceilings near or adjacent to food courts need to be made for that area.

- Need to be readily accessible for ease of maintenance. Utilize smooth surfaces which are easy to clean.

6.17.3.2 Need to provide adequate space above ceiling for both data and electrical.

6.17.3.3 Provide the appropriate sound attenuation with regards to all ceiling types including ACT with insulation on top for noise control.

- Sensitive conversations
- Restroom Noise Control

6.17.3.4 Approved Materials:

- Acoustical Lay-In Tile Ceiling (No custom sizes. Use only where access is required. Use of broad uninterrupted expanses of lay-in ceiling in public areas requires approval.)
- Acoustical Wood Ceilings/Wood Veneer/Wood-Look
- Acoustical Metal Ceilings
- Other Panelized Metals with acoustical treatments and baffles
- Gypsum Panelized Systems (curves/ angles/geometric shapes)
- Gypsum Board (at non-contact areas only--painted, eggshell finish or acrylic satin finish)
- Perforated Metal Decking with acoustical baffles (Roof fasteners must be concealed from view. Electrical and data conduits and sprinkler piping must be concealed from view within the decking).

6.17.3.5 Prohibited materials:

- Exposed structure in areas under 12' in height.
- Broad uninterrupted expanses of non-acoustical ceilings, i.e gypsum board and the like.

6.17.4 Flooring

6.17.4.1 All flooring selections must take ease of "wheeled bag traffic" and maintenance into consideration.

6.17.4.2 Approved Materials:

- Epoxy Terrazzo
- Terrazzo Tile
- Thru-Body Tile
- Porcelain
- Natural/Engineered Stone Slab
- Carpet tile / Composite Textile (Kinetex) - Carpet tile should be designed and laid out for ease of replacement. Focus on replacement of discrete portions.
- Large-Format Porcelain Panels

6.17.4.3 Tile must have high compressive strength and be able to sustain repeated heavy traffic of maintenance lifts without damage.

6.17.4.4 All porous materials must be appropriately sealed

6.17.4.5 Prohibited Materials:

- Epoxy terrazzo with mirrored aggregate intended for placement in direct sunlight.
- Wood/engineered wood/laminate
- Ceramic tile
- Concrete tile
- Concrete terrazzo
- Exposed/sealed/stained concrete
- VCT (in public accessible areas)
- Resilient tile or sheet product.
- Raised transition strips.
- Broadloom Carpet Rolls

6.17.5 Wall Base

6.17.5.1 Base shape needs to take into account cleaning methods at the floor level. Cove base will not be permitted unless approved by the SAT PM.

6.17.5.2 All porous materials must be appropriately sealed

6.17.5.3 Approved Materials:

- Epoxy Terrazzo
- Stainless Steel (Heavy gauge and reinforced backing.)
- Natural/Engineered Stone Slab or Tile
- Thru-body Tile
- Porcelain

6.17.5.4 Prohibited Materials:

- Rubber and Resilient Base
- Wood
- Tile with Integral Cove

6.17.6 Public Finishes - Column Covers

6.17.6.1 Make attempts to standardize column cover sizes for replacement and maintain attic stock.

6.17.6.2 Incorporate easier means for cable pulling.

6.17.6.3 Consider the use of digital column wraps.

6.17.6.4 Orthogonal corners must have corner guards/protective corner treatment. Preference for rounded corners and smooth corner guard surfaces.

6.17.6.5 Approved Materials:

- Stainless steel (fingerprint resistant)
- Wood (at non-contact/accent areas only)
- High Pressure Laminate Panels (various finishes)
- Other natural metals (at non-contact/accent areas only)
- Glass/glass and aluminum systems (at non-contact areas only)
- Plastic/Resin (decorative accents only)
- Engineered/Natural Stone
- Concrete
- Gypsum board (at non-contact areas only, acrylic satin finish or epoxy)

6.17.6.6 Prohibited Materials:

- Full height Plastic/resin

6.17.7 Door/Frames Types for Public and Non-public Spaces

Where enclosing lease owned areas with hard walls, hollow metal doors and frames need to be included.

Where required, door assemblies are fire-rated and labeled in order to comply with all criteria for the fire rating. Doors and door frames have a painted finish on both surfaces.

6.17.7.1 Provide hollow metal frames only.

6.17.7.2 Color to be selected by the Architect and approved by SAT PM.

6.17.7.3 Door Hardware to be compatible with Sargent Signature Series Key large format interchangeable cores. All door hardware will need to accept the large formal interchangeable cores.

6.17.7.4 Prohibited door types include:

- Any single sided door that slides on a track. Barn door, pocket doors,
- No saloon doors or dutch doors.

6.17.7.5 Doors leading from unsecured areas of the terminal to the AOA which are not under the visual control of authorized personnel are required to be locked or equipped with alarms signaling unauthorized use. Fire codes usually permit the locking of emergency exits provided they contain panic knock-out devices.

6.17.8 Casework

6.17.8.1 Approved Materials

- High Pressure Laminate Panels (various finishes, preferably through-color)
- Metal Clad or Laminated Panels (reinforced, heavy gauge)
- Porcelain Panels
- Solid Surface Paneling
- Engineered Stone Paneling
- Epoxy Terrazzo (approval depends upon appropriate use of material)
- Plastic/Resin Panels (decorative accents only)
- Solid Wood (decorative accents only)

6.17.8.2 Prohibited Materials

- Ceramic Tile
- Concrete, Concrete Tile, or Concrete Panels
- Wood Veneer
- Fiberglass Reinforced Plastic Panels

6.18 Building Interior - Nonpublic spaces

6.18.1 Airline Support Offices

Airline offices include ATO offices and other airline administrative spaces. At SAT, the ATO offices are located immediately behind or adjacent to the ATO counters, to provide support functions for the customer service agents.

Other offices may include functions such as housing the airline station manager. The amount and location of these offices (ATO, operations area, office location on a terminal upper level, etc.) are dependent on individual airline requirements and preferences, as well as space availability.

- Natural daylight and views to the outside should be maximized.
- Must promote a positive, healthy, and productive work environment for the occupants.
- Any interior spaces accessible by the public must complement the design of adjacent airport spaces.
- Any exterior facades visible to passengers shall be complementary to the building exterior.
- Separation between the Airport and airline tenant is dictated by the lease and the lease line.
- Airlines don't need to be buy American standards, but all materials need to meet local and state codes.

6.18.2 Finish Levels

6.18.2.1 Two levels of finishes have been established to allow tenants to choose how the interiors for their make ready space will be provided and impact initial cost.

6.18.2.2 Level 1 - Unfinished Space

- Mechanical, Electrical, Plumbing and Fire Protection provided.
- Sealed Concrete flooring.
- Walls - Concrete walls and/or finished gyp. Bd. Walls.

6.18.2.3 Level 2 - Finished Space

- Mechanical, Electrical, Plumbing and Fire Protection provided.
- Painted Gyp. Bd. Or Concrete walls
- ACT Tile ceilings in make ready package - base package - certain type of ceiling tile, certain type of lighting, exceed those standards, then the Airline will have to pay above that.
- Flooring

6.18.2.4 Prohibited Materials

- VCT will need to be luxury VCT
- The use of “Liquid Nails” as an adhesive is prohibited.

6.18.2.5 Approved Materials

- Sealed concrete, integral staining and polished concrete are approved materials.
- Porcelain Tile
- No rolled materials, tiles will only be included.
- Carpet - A/E will need to coordinate with Environmental what types of adhesive are acceptable to install Carpet.

6.18.3 Vacating a Space

6.18.3.1 Return space to base finishes.

6.18.3.2 Paint, flooring would remain unless needed to replace, ceiling tiles would be repaired when needed.

6.18.4 Airport Support Offices:

The SAAS administration offices are split between Terminal A Mezzanine and a facility on Sandau Road. Terminal operations offices are in other locations scattered throughout the apron level of both terminals. Many other administrative and operations functions for the Airport are located outside of the terminal.

Design Considerations include:

- Natural daylight and views to the outside should be maximized.
- Must promote a positive, healthy, and productive work environment for the occupants.
- Any interior spaces accessible by the public must complement the design of adjacent airport spaces.
- Any exterior facades visible to passengers shall be complementary to the building exterior of the Airport.

6.18.5 Flooring

6.18.5.1 Approved Materials:

- Carpet/Textile composite tile
- Porcelain tile
- No-wax resilient tile or sheet flooring – stairwells, janitor closet, and storage areas
- Sealed, stained or dyed Polished Concrete may be approved under special circumstances
- Vinyl Composition Tile may be approved under special circumstances.

6.18.6 Walls

6.18.6.1 Provide a higher STC rating at walls surrounding offices to reduce sounds passing through walls.

6.18.6.2 Approved Materials

- Gypsum Board, painted (at non-contact areas only, acrylic satin finish or epoxy)
- Aluminum Storefront
- Durable impact resistant vinyl wallcovering
- Painted concrete masonry units

6.18.7 Break Rooms

6.18.7.1 Break Room types vary across the Airport

6.18.7.2 Typical break room includes a TV, sink, refrigerator (1 to 2), Vending machines, nonmonitored grab and go selections.

6.18.7.3 Locker rooms separate for maintenance and ACS, separate male, female locker rooms and showers.

6.18.7.4 Kitchen area:

- Garbage disposal. A/E to review with SAT if a grease trap is required.
- If food is available for sale, the equipment will need to be rated for commercial use and will require different code requirements.

6.18.8 Conference Rooms

6.18.8.1 Collaboration spaces

6.18.8.2 Marker Boards - material provided needs to be easy to maintain. Frosted glass can be utilized and is easy to maintain.

6.18.8.3 Acoustical panels are required if there is hard floors or hard walls.

6.18.8.4 All tables need to have dedicated power with full capacity for each seated position.

6.19 USO

6.19.1 Definitions & Locations

The USO operates a lounge that provides hospitality for traveling service members and their families. Because of the large military presence in the San Antonio area, especially for training, there are large numbers of service members traveling weekly.

- Support spaces within the lounge (baggage storage, food storage, etc.) need to be sufficient.
- Provide clear sign to indicate location

6.19.2 Program

The A/E will need to coordinate future designs with program standards set by the USO and incorporate the following:

- Rooms for Children, luggage, storage
- Prefer restrooms nearby, and maintained by the Airport
- Charging stations for accessories and portable batteries
- Provide power per person according to Occupancy
- Separate rooms for changing, sleeping room, children room, luggage room, storage room.
- Need a comm room in the USO.
- Pantry
- Mini conference rooms for meeting could be used as a quiet room. Pods can be used for quiet places for calls.
- Business center with two computers and a printer.
- Gaming console and TVs
- FIDS are required
- PA System, in addition to an emergency speaker system.
- Sleeping Room will need laundry service - private, quiet place with a bed or cot for overnight sleepers.
- Provide blankets and cleaning rags.
- Provide shower facilities

6.19.3 USO – Entry

6.19.3.1 An easy to find centralized location is preferred.

6.19.3.2 Controlled entry point with buzzer and a way to verify eligibility before entering such as a camera to show ID at the door.

6.19.3.3 Double door with sliding door would be preferred to accommodate oversized baggage and for accessibility.

6.19.3.4 Back of house door access needs to be 4'-0" wide with a 180 swing to accommodate wider push carts.

6.19.4 USO – Storage

6.19.4.1 Provide built in storage within the USO interior with visibility. Preference for large keyed locked cabinets. Capacity needs to include up to two large sized bags per person.

- The A/E should collaborate with the Airport to understand if bags can be checked when entering the USO to accommodate members needing to check in bags prior to when Airlines will allow.
- Provide additional storage space within the USO interior for cleaning supplies.

6.19.4.2 Weapons Storage - Currently deploying service members with weapons are not allowed to leave the locked weapon. Firearms, ammunition, and firearm parts are prohibited in carry-on baggage and may be transported in checked baggage only.

6.20 Storage / Trash

6.20.1 Custodial

Provide additional closets and storage spaces for custodial service to house mop buckets, large trash dollies, carts with paper products, etc.

6.20.2 Waste Receptacles

Trash/Recycling receptacles, compactors need to be located near the terminal for ease of foot access. Located on the Apron level with truck access. Need to be protected overhead, but provide additional height clearance for lifting of the trash compactor.

6.20.3 Tenant Storage

Storage Types: Interior vs. Exterior storage may include fenced in spaces with lock at access points. The A/E will need t review any storage enclosed, or unenclosed provided outside of tenant lease lines with the SAT PM and Properties..

6.21 Airport Police Terminal

6.21.1 Airport Temporary Confinement

- Centrally locate holding cells and break room space.
- Provide Internet access, table, refrigerator, to store food. Area with a desk for interrogation purposes, radio charging stations.
- Temporarily store hazmat baggage, PPE gear and long gun storage.

6.22 Public Restrooms

6.22.1 Definition & Location

Restrooms are often the first and last places people go during travel. Therefore, restrooms need to be inviting, bright, and clean.

6.22.1.1 Restrooms should be designed to be spacious enough for passengers with luggage, families, groups and people with disabilities.

6.22.1.2 Introduce natural daylight and views to the outside, if possible

6.22.1.3 Queuing space should be provided to prevent congestion that could affect circulation in the adjacent concourse.

6.22.1.4 Be able to maintain while occupied

6.22.1.5 Large entry for two way travel.

6.22.1.6 SAT prefers to use lower height sinks instead of step in front of sink. This is more inclusive since it allows access for children and wheelchairs.

6.22.1.7 Provide Plumbing chases to access all plumbing fixtures. 3'0" width preferred where feasible.

6.22.1.8 Wayfinding

- Need to have clear signage.
- Silhouette and place wayfinding on the floor
- Wayfinding and easy to see from the corridors. Sight lines to see the restroom.
- Utilize blade signage protruding out so you can see it from the concourse

6.22.1.9 The following diagram illustrates the preferred typical layout for the public restroom.

Figure 6.20.1.9 : Public Restroom Layout

6.22.2 Sensory Considerations

6.22.2.1 Public restroom sinks should not dispense water hotter than 110°, and hand sinks for employees cannot exceed 120° by most state laws.

6.22.2.2 The public restrooms should have access to hot and cold water via faucets, while the lower sink should have water temperature suitable for children.

6.22.3 Toilet Partitions

6.22.3.1 Materials

- Stainless steel
- Powder coated metal
- Phenolic – pictured
- Glass
- Solid Surface

6.22.3.2 Functions

- Occupancy sensors/indicators
- Additional privacy including concealing any gaps at the partition
- Additional storage
- Doors swing out
- Full height
- Mounting options – a hybrid of floor and ceiling mounted

6.22.4 Restroom Accessories

Towel dispensers and hand dryers should be located adjacent to sinks (on same wall) to avoid water dripping on floors and creating a slip hazard.

6.22.4.1 Review style of lavatory with SAT PM. Currently all options of lavatories including trough, individually mounted and a hybrid option are acceptable as long as solid surface materials are provided.

6.22.4.2 Provide all touchless fixtures

6.22.4.3 Shelf at Lavatory

6.22.4.4 Coat Hangers

- Provide coat/purse hanger in the restrooms in partition and at sink
- Provide hooks where feasible at the lavatories within the restroom for bag/clothing storage.

6.22.4.5 Provide surface mounted accessories at all toilet partitions to prevent cutouts in partitions.

- Provide zero cent sanitary napkin dispensers in the women's restroom.
- Provide optional feminine hygiene product dispenser at no cost in the women's restroom.

6.22.4.6 No free standing trash receptacle

6.22.5 Smart Restroom Systems

6.22.5.1 Utilizes predictive, real time, and historical data analysis to provide insight into the status of restroom cleanliness and overall janitorial operations.

6.22.5.2 It can integrate with different sensors including throughput counters, smart consumable dispensers, feedback solutions, digital signage, staff monitoring and stall occupancy systems.

6.22.5.3 With a user-friendly mobile application, smart restroom system provides the front line with restroom maps and live sensor data, so teams can proactively address restocking and cleaning needs.

6.22.5.4 Dynamic Signage to be flush with wall, signage showing how many stalls are available and if cleaning in progress.

6.23 Nonpublic Restroom

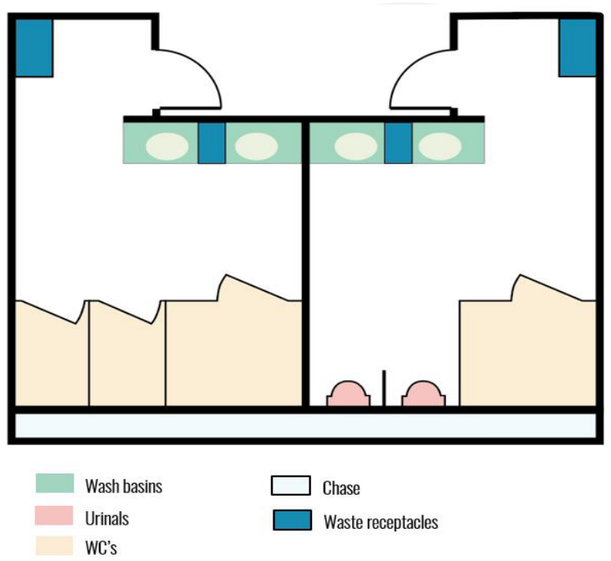
6.23.1 Definition & Location

These back of house spaces should be durable and utilitarian, but also pleasant, clean, and accessible. The universal design approach includes improved usability characteristics to ensure they are usable to the greatest extent possible by people of all ages and abilities, even if a particular feature has a more limited target group.

6.23.1.1 Introduce natural daylight and views to the outside, if possible.

6.23.1.2 Location of restroom. Coordinate with SAT PM preferred level of finish.

- Level 1 Finish - Utilitarian and durable
- Level 2 Finish – Mid-level finishes
- Level 3 - High end.



6.21.1 Nonpublic Restroom Layout

6.23.2 Toilet Partitions.

6.23.2.1 Provide additional privacy by covering any partition gap

6.23.2.2 If partition goes up will need to include additional light fixture, sprinkler head, exhaust

- Doors swing out
- A/E to review proposed mounting option with SAT PM on a project by project basis for all back of house restrooms. Mounting options to include:
- Floor
- Ceiling
- Hybrid of both Floor and Ceiling

6.23.2.3 Materials:

- Stainless steel
- Powder coated metal
- Phenolic – pictured
- Glass
- Solid Surface

6.23.3 Toilet Accessories

6.23.3.1 Only provide a hand dryer at the sink. If a wall mounted hand dryer is provided, prefer recessed in wall with a solid surface niche to be able to clean.

6.23.3.2 Paper towels will be provided in every restroom.

6.23.3.3 No occupancy sensors in back of house.

6.23.3.4 Provide standardized touchless fixtures for ease of maintenance and replacement.

6.23.3.5 Provide attic stock of fixtures and coordinate with the SAT PM on potential storage locations.

6.23.3.6 Soap dispenser - keep as simple as possible in back of house locations. Top filled dispensers preferred.

6.24 Passenger Amenities

6.24.1 Gender Neutral Restroom

The gender neutral restroom is a unisex public toilet not separated by gender or sex. These restrooms at the Airport will be single rooms. Provide where feasible and separate from family restroom.

6.24.2 Family Restroom

The family restroom is a private restroom with only one toilet, lavatory, and a baby changing station. Where feasible, allocate space for:

- An additional lavatory at a lower mounting height to accommodate children.
- And additional children's height toilet
- A separate bolted in chair

6.24.3 Universal Changing Place

The Universal Changing Places is a Companion Care Restroom which includes a powered height-adjustable adult changing station. These rooms will also include accessible toilet, handrails, paper towels, waste receptacle, and hand dryer.

6.24.3.1 Considerations for future universal changing places:

- Accessible shower
- Duress alarm
- Track Hoist
- Wide tear off paper roll installed in a dispenser next to the Table
- Automatic lights
- Height adjustable sink
- Low noise hand dryer to address sensory issues
- Low noise accessible toilet to address sensory issues

6.24.4 Nursing Mothers Room

A nursing mother's room must be functional, private space which is not a restroom with a place to sit and a flat surface, other than the floor, to place the breast pump and other supplies.

- Nursing room should be easy to clean and warm and inviting. Not sterile and cold
- Provide Sanitizing wipes
- Power outlets
- Can be divided in stalls.
- Comfortable seating – needs to be mounted to the floor.
- Wheelchair accessible
- Changing Table
- Consider providing built in furniture for additional children while waiting.

6.24.5 Nonpublic Nursing Mother Rooms

See public Nursing Mother Rooms for design criteria.

6.24.5.1 Options for future nursing mother rooms could potentially include:

- Shared space between airlines or common spaces where feasible.
- These rooms may also be utilized.

6.25 Glossary

ACS : Airport Customer Service

ACT : Acoustic Ceiling Tile

ADA : The Americans with Disabilities Act

ARFF : Aircraft Rescue and Fire Fighting

ASL : Automated Screening Lane

ASTM : American Society for Testing and Materials

ATO : Airport Traffic Organization

BAT : Biometric Authentication Technology

BHS : Baggage Handling System

BSO : Baggage Service Office

CBP : Customs and Border Protection

ConRAC : Consolidated Rental Car Facility

CRPG : Checkpoint Requirements and Planning Guide

CT : Computed Tomography

eAIT : Enhanced Advanced Imaging Technology Automated

FAA : Federal Aviation Administration

NDA : Non Disclosure Agreement

OSHA : Occupational Safety and Health Administration

PVC : Polyvinyl Chloride

QTA : Quick Turn Around

SAAS : San Antonio Airport System

SAT : San Antonio Airport

SDP : Service Delivery Point

STC : Sound Transmission Class

TSA : Transportation Security Administration

USB : Universal Serial Bus

USO : United Service Organizations

VCT : Vinyl Composition Tile

07

PLUMBING

Photo by Andres Nunez

7.1 Plumbing

7.1.1 Overall

This Chapter defines general design criteria for plumbing systems utilized at San Antonio Airport (SAT) facilities.

The intent of the SAT Plumbing design criteria is to establish a baseline to coordinate and augment the criteria used by the City of San Antonio (COSA). Plumbing system design will consider construction, commissioning, and operation phases of the building life cycle.

7.1.2 Design Criteria

7.1.2.1 Code Requirements

Design will comply with requirements and provisions of the latest International Plumbing Code (IPC), as approved and amended by City of San Antonio (COSA) and coordinated with SAT.

The Architect/Engineer (A/E) is responsible for consulting SAT aviation standards, airport regulations and design manuals to determine applicability and identify potential conflicts with the plumbing design. It is also the A/E's responsibility to verify location and the adequacy of record information prior to design and construction, and comply with all of the requirements set forth in the most current edition of local codes, and to coordinate the development of the design at all stages with SAT, Aviation Department and Development Services Department, as needed.

If a conflict between this document and any other code or requirement arises, use the most restrictive requirement and inform the SAT Project Manager.

7.1.2.2 Plumbing Design

Discharge of sump pumps to the storm sewer system is prohibited without written approval from the SAT.

For public restrooms, non-public restrooms and janitor closet rooms, the A/E will consider fixtures and accessories that comply with latest SAT Public Restroom Design intent for best cleaning practices.

The plumbing system designer will study water usage periods and will operate pumps just prior to usage periods and limit operation of pumps as much as possible. A 7-day, 12-hour timer will be installed to control pump operation, especially during peak demand periods, as an energy reduction measure. Design, fabrication, construction, final inspection, and testing will follow International Organization for Standardization (ISO) 9001.

The A/E is responsible for providing a design that does not have cross connections. Identify any cross connection device preventers on drawings.

The A/E should incorporate water conservation in the design. The plumbing system should be designed around low water consumption fixtures. All specified fixtures, hardware, and trim must conform to the requirements of the International Plumbing Code (IPC).

Recirculation systems must be demand-initiated. They may not be solely timer-or temperature-based.

7.1.2.3 Plumbing Basis of Design

The design analysis should include at a minimum the following items:

- Plumbing fixture determination, listing quantity and types of fixtures
- Building population (number of males and number of females)
- Fixture units for drainage, venting, cold and hot water piping
- Roof areas used in determining storm drainage pipe sizes
- Capacities of all equipment and tanks

Show calculations clearly so that any changes that become necessary during construction are made efficiently. When tables used in the design are taken from publications, indicate the title, source, and date of the publication. Provide the model number and manufacturer of each major piece of equipment for which space was allocated.

7.1.2.4 Flow Velocities

The A/E should limit the flow velocity in the design to reduce noise, prevent corrosion, and water hammer:

- Velocity for cold water should not exceed seven (7) feet per second.
- Velocity for hot water should not exceed five (5) feet per second for water temperature of 140 F and less.
- Velocity for hot water should not exceed three (3) feet per second for water temperature greater than 140 F.
- For pipes ½-inch and smaller, use lower velocities to guard against localized high velocities.

7.1.3 Design Coordination

Design considerations will also include the involvement of multiple SAT teams (infrastructure, operations and maintenance, and electric). Stakeholder involvement during design charrettes is key to the projects.

When designing security checkpoint facilities, coordination with TSA at the early phase of the project is required. The A/E shall account for 1-1.5 years for TSA to fully respond to all inquiries.

7.1.4 Triturator- Aircraft Lavatory Waste Disposal Site

7.1.4.1 Interior to Building

The triturator shall consist of a grinder pump connected to sanitary drain either located in a sump pit adjacent to the unload area or above the sump pit on grating to ensure that any leaks are contained. The sump shall have its own sanitary drain. The area where the vehicle is parked shall be sloped to a sanitary drain. A source of water for the truck shall be located in the area and shall have plumbing code required backflow prevention measures. Flexible hose will connect the pump to the offloading vehicle. Coordinate requirements with airline equipment.

- Emergency fixtures such as eye wash and emergency shower shall be located in the space and shall be provided with tepid water.
- A sink may be located in the space if directed by SAT.
- All installations shall follow current plumbing code requirements, local code amendments and any other requirements by the AHJ.

7.1.5 Design of Multi-Story Parking Deck Drainage

Multi-story buildings intended for parking, rental car services, and areas exposed to substantial amounts of water, (including wash bays, vehicle service areas, etc.) must have multi-layer protection against leaks to the floor(s) below. These buildings must be equipped with elevated parking deck drainage systems and provide secure, reliable, and durable waterproofing and seals.

The A/E must provide a comprehensive design that addresses drain water paths on topping slabs, on waterproofing membranes, against walls, and through porous building materials such as concrete.

When relying on waterproofing membranes for drainage, trench and floor drains must have outlet clamping collars or a similar configuration for proper membrane attachment and seal.

Drain clamping collars must be installed at the same height of the waterproofing membrane to be effective. Trench drains must be carefully selected to meet this criterion and match the membrane depth and geometry.

When a waterproofing membrane is used, it is prohibited to terminate the membrane adjacent to a drain without proper attachment and seal to the drain outlet with clamping collars or a similar configuration.

7.1.6 Materials and Equipment

All materials, parts and equipment shall be evaluated in order to select suppliers and sources. SAT prefers the use of local sources when possible, and sources that can improve future needs for service and replacement of materials and equipment.

Select plumbing material based on soil and water analysis information.

Design plumbing system to mitigate corrosion of materials. All connections between dissimilar materials in the piping system should be made with dielectric unions or couplings.

Water Analysis should include the following parameters as minimum: Water Temperature (C), Total Alkalinity, Phenolphthalein (P) (as CaCO3), Methyl Orange (M) (as CaCO3), Aluminum (as Al), Calcium (as Ca), Dissolved Oxygen (as O2), Dissolved Carbon Dioxide (CO2), Chloride (as CL), Conductance (specific) (as micromhos at 25 C), Copper (as Cu), Hardness (Total) (as CaCO3), Iron (as Fe), Magnesium (as Mg), Manganese (as Mn), Nitrate (as NO3), pH (prior to any recarbonation), Phosphate, Orthophosphate (as PO4), Polyphosphate (Metaphosphate) (as PO4), Organic Phosphate (PO4), Total dissolved solids on evaporation at 180 C, Suspended solids, non-filterable, Silica (as SiO2), Sulfate (as SO4), Zinc (as Zn), Water Temperature (C), pH, Chlorine, free (as CL2), Chlorine, Total (as CL2), Microbial testing.

7.1.6.1 Piping Materials

Piping must meet the following requirements, unless noted otherwise:

- Domestic Cold Water (inside): K or L copper with silver solder (solder 95% Tin – 5% Antimony) lead free.
- Domestic Cold Water (outside): Cast iron mechanical joint Class 150 or polyvinyl chloride (PVC).
- Domestic Hot Water (inside): K copper with silver solder (solder 95% Tin – 5% Antimony) lead free.
- Domestic Hot Water (outside above ground only): K copper or steel with silver solder (solder 95% Tin – 5% Antimony) lead free, where applicable.
- Sanitary Sewer (inside): Cast iron above grade, PVC below grade. For highly acidic waste at sinks or equipment inclusive but not limited to USDA grinders (food prep) or concession areas - PVC above and below grade.
- Sanitary Sewer (outside): PVC, except for above ground where pipe may be exposed to UV light degradation.
- Subsoil Drainage: Perforated PVC, PVC.
- Equipment Vents: Steel.
- Heating, Ventilation and Air- Conditioning (HVAC) Equipment Unit Drains: Hard drawn copper drainpipe with silver solder (solder 95% Tin – 5% Antimony) lead free.

7.1.6.2 Pipe Unions, Adapters, Isolators and Air Chambers

Insulating Unions and Adapters: Provide dielectric insulating unions or adapters as required between copper pipe, steel pipe, and equipment. Dielectric insulators/adapters will contain nylon insulation.

Proper vibration isolation will be provided to prevent excessive noise or transmission of vibration to the building structure. This is due to the operation of machinery or equipment, or due to interconnected piping, ductwork, or conduit.

A single vibration isolation manufacturer will supply equipment for any one project.

The vibration isolation manufacturer and manufacturer's representative will have been engaged in the business of vibration isolation for no less than five years.

Provide an 18-inch air chamber at each hot and cold water outlet adjacent to the fixture outlet. Diameter of chamber will be a minimum of 1½ times that of the service line to the fixture device.

Chamber and cap will be of the same material as supply piping.

7.1.6.3 Pipe Supports

All pipes must be adequately supported throughout and will withstand the effect of gravity loads and stresses. Generally, hangers will be split ring or clevis type; however, trapeze hangers constructed of steel channels with welded spacers and steel rods may be specified. An engineered system may use pre-engineered hangers and supports. All hangers and supports will comply with Manufacturer's Standardization Society (MSS) Standards. Vertical pipes must be supported at each floor with pipe clamps.

Provide pipe saddles fabricated from galvanized metal, for insulated pipe, extending at least 12 inches in length and covering a minimum of half-pipe circumference.

Generally, the gauge will be as follows:

- Pipe Diameter USS Gauge Up to 3 inches - No. 22
- Three through 6 inches - No. 16
- Above 6 inches - No. 12

The piping system design will include lateral bracing with pipe hangers and supports to prevent swaying. Piping systems must meet SAT seismic zone requirements.

7.1.6.4 Motors

Motors will be American National Standards Institute (ANSI)/National Electrical Manufacturers Association (NEMA) MG 1 high efficiency.

7.1.6.5 Pumps

The A/E should determine the sufficiency of the water pressure available at the building to meet the required minimum fixture outlet pressure. Provide detailed pressure loss calculations including losses attributed to meters, fittings, pipe, backflow preventers, and pipe risers.

- In-Line Circulating Pumps: Pumps will be low lead or stainless-steel for domestic water service. Provide a line size ball valve on suction and discharge side of the pump. Provide unions or bolted flange connection on each side of the pump. Pressure taps and thermometer wells are not required on in-line circulators. Sleeve type bearings are acceptable for in-line pumps.

- Submersible Pumps: Generally, submersible pumps are avoided where possible except electric power manholes. Diaphragm actuated pumps are preferred rather than float actuated pumps.

- Sump Pumps: Generally, duplex sump pumps are required when located in a mechanical/electrical equipment room containing high voltage switchgear or motor control panels. A simplex pump may be used if the area does not contain critical equipment. Provide a mechanical alternator on duplex pumps and provide a separate circuit and circuit breaker for each pump. Provide check valves, bypass pipe work, and valves as required (in-line check valves are not recommended). Pumps will be complete with automatic float switch with rod, rod guide, and copper float. Pumps will be of the wet-pit type, complete with gas tight sump cover, curb ring, and grease lubricated, including grease (Alemite or Zerk) fittings extended to the pump base plate. Pumps will be heavy duty, fully submersible, vertical centrifugal, open non-corrosive vortex impeller type with vertical drip-proof type motor with anti-friction grease lubricated bearings. Where sump pumps are installed to provide protection for mechanical/electrical equipment, a high water alarm bell will be provided in the area and alarm contacts will be provided for a central monitoring system.

- Sewer Ejector Pumps: Sewer ejector pump design and selection design criteria are the same as those listed for sump pumps, except sewer ejector pumps will be of the standard 3-inch, grinder type. These are specifically designed and installed for the purpose intended. The A/E shall conduct a comprehensive sewer ejector pump sizing fitted for the specific project when necessary.

- Where pumps of any type are installed in a lift station, they will be equipped with a high water alarm, a red flashing beacon to indicate alarm status, and remote/visual monitoring capabilities, such as M80 or similar notification systems.

7.1.6.6 Drains

Floor Drains: All toilet rooms will be equipped with at least one floor drain or minimum number as required by the applicable code. A trap primer system will be provided for floor drains in public restrooms. Do not locate drains under equipment, machinery, cabinets, appliances, etc. or within 6 inches of any wall. All floor drains must be readily accessible. Drains will have sealed leaves to prevent odors resulting from infrequent use. Trap guards may be used in lieu of trap primers.

- All janitors' closets should be arranged with the sink near the door and a floor drain in the room.
- All mechanical rooms containing air conditioning equipment shall have a floor drain. Mechanical room floor drains should be four (4) inches minimum in size, with a deep seal and connected with trap primers.
- Floor drains must be four (4) inches in size serving an eighty (80) or larger square foot area. Smaller areas should contain three (3) inch or two (2) inch floor drains as required.

Roof Drains: Roof drains will be compatible with the roof system and will not be located within the structure. The roof drain system should be designed per IPC. The size of the vertical conductors and leaders, building storm drain (if applicable), building storm sewer (if applicable), and any horizontal branches of such drains or sewers should be based on the one-hundred (100) year hourly rainfall rate. The gutter must meet Architectural Sheet Metal Manual by Sheet Metal and Air Conditioning Contractors' National Association. The roof drain must also meet the requirements of ASME A 112.21.

- Roof drains should be run separately from all other storm water sources to a manhole outside the building. Downstream from this manhole, the piping should be sized sufficiently large to prevent roof drain water from impeding the proper flow from area drains. All piping dropping more than fifty (50) feet should be welded construction.
- Do not use an internal roof drainage system. Internal roof systems are susceptible to roof collapses due to rain water accumulation and system failure resulting in interior damage. A built-in gutter system where drainage passes through interior spaces or is concealed in the exterior wall cavity is prohibited.
- The design should provide leave guard system for gutter.
- Provide a clean-out for each downspout connection to underground collection system and locate the bottom the clean-out at least 6 inches above ground.
- Reducing the pipe size of a roof leader along the direction of flow is prohibited since it would cause an obstruction of flow.
- Do not restrict the water flow from the roof leader. The roof should drain ten (10) feet from the building wall into the storm water system or the ground. Sanitary Sewer (outside): Refer to the SAT Sanitary Sewer Design Standards.

Grease Traps: Wastewater from disposers, sinks, dishwashers, floor drains, and floor sinks in food service facilities will drain to a grease collection system or through a grease trap or grease interceptor serving one or more facilities. Installation will comply with the applicable plumbing code. Kitchen areas will have under sink automatic grease traps.

All grease waste piping will be insulated. Additionally, exposed piping will have an outer metal jacket and heat tracing to prevent issues during cold weather

Sanitary sewer systems conveying, or potentially conveying grease, will consider design with cleanouts at 50 foot intervals.

7.1.6.7 Water Heaters

The A/E Should calculate the hot water storage and demand requirements of the facility. Indicate the basis for the calculations including the incoming and storage water temperatures, the facility type, fixture types, fixture quantities, and the demand and storage factors.

Domestic Hot Water Recirculation: Reference the plumbing code by which the domestic hot water recirculation rate is calculated. Calculate the recirculation rate and recirculation pump head.

No more than 0.5 gallons of water may be stored in any piping or manifold between the hot water source (i.e., water heater or recirculation loop) and any hot water fixture.

To account for additional water that must be removed from the system before hot water can be delivered (i.e., water stored in the fixture itself or water that cools off while moving from the heater to the point of use), no more than 0.6 gallons of water may be delivered to a fixture before hot water arrives.

Standard water heaters will adhere to the following requirements:

- Water heaters will be glass lined storage type.
- Electric water heaters are preferred and will be Underwriters' Laboratories, Inc. (UL) listed.
- All standard water heaters will have a 10-year limited warranty.
- All energy saver water heaters will meet the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Standards for Energy Efficiencies, latest edition.

- Water heater drains will have valves and will be plumbed to a floor drain with copper piping.

- All water heaters will be readily accessible.

- Electric water heaters located in ceiling/attic spaces will be accessible by permanent ladder or stairway, an unobstructed walkway (minimum 24 inches in width) and a 30 inches by 30 inches minimum work platform with lights located over the walkway and service area. Locate the light switch at the access opening.

- Gas water heaters will have an automatic gas shut-off device and will be equipped with an American Gas Association certified draft hood. Water heaters will utilize electric ignition devices.

7.1.6.8 Plumbing Fixtures and Accessories

- Exposed Metal Parts: All exposed metal work at fixtures will be brass with chromium plate. All faucets, fittings, supply stops for fixtures, and similar devices will be furnished from a single manufacturer unless otherwise required. Each fixture will contain standardized interchangeable operating units made up of separate renewable stem, seat, washer retainer, and nut. All faucets and fittings must close with the water pressure. All fixtures will be installed with supply stops/valves accessible at the fixtures. All fixtures must be approved by the SAT PM.

- All fixtures and accessories listed apply to SAT owned, operated, or maintained buildings. Some fixture and accessory preferences may change over time depending upon current maintenance warehouse stocking. Tenants may have different preferences and will be consulted.

- All specified fixtures must meet accessibility requirements.

- The system should provide the capability to easily replace any valves and plumbing equipment with another device procured from multiple sources.

- On renovation projects, an effort will be made to match existing fixtures and trim. On renovation projects where fixtures and trim cannot be matched and on new projects, fixtures will be WaterSense labeled American Standard or an approved equal.

Currently the Terminal experiences hard water type issues on all plumbing fixtures due to high demand. It is recommended the A/E present to the SAT PM, options to alleviate this issue, such as a soft water processing plant.

Water Closets: Wall-hung and floor-mounted water closets are acceptable. Water closets will be white, vitreous china, siphon jet, elongated bowl, with white open-front seat without a cover. SAT favors the use of Kohler Kingston as the basis of design.

Urinals: Wall-hung urinals are preferred. Urinals will be white, vitreous china, washout type.

Flush Valves: Flush valves for water closets an urinals in Terminal facilities will be as follows:

- Sloan automatic flush valves, or similar product. SAT favors matching model used in Terminal A. A/E to review proposed products with SAT PM.

- Non-concealed, top mounted, with manual override is preferred.

- Automatic sensor for operation of each water closet, with required transformers, controls and complete wiring diagrams for separate operation in each toilet; and as recommended and approved by flush valve manufacturers.

Lavatories: Wall-hung, white enameled, cast iron, or white enameled cast iron self-rimming lavatories with 20-inches by 18-inches rectangular basin with splash back are preferred. Faucets will be Kohler brand, or approved equivalent, self-closing adjustable from 5 to 15 seconds.

Electric Water Coolers (EWCs): Wall hung Elkay with bottle fillers, or equivalent electric water coolers, are preferred. EWCs will meet accessibility requirements. The A/E will investigate the possibility of using a central water cooling/filtering system if approved by SAT PM.

Service Sinks: Service sinks will be white enameled cast iron, 20 inches by 22 inches, blank back with wall hanger supports. Faucets will be a Kohler brand, or equivalent, wall-mounted rough plated faucet with valve units, vacuum breaker, wall brace, and threaded spout with pail hook. Trap will be adjustable standard for 3-inch pipe connection with cleanout plug and strainer, enameled inside. Rim guard will be 9 inches and 12 inches stainless-steel rim guard, front and sides.

Mop Basins: Mop basins will be a one-piece mop service basin, size 24 inches by 24 inches by 12 inches high outside, with Type 304 stainless-steel, 20 gauge cap, continuous on all sides, with wall flashing on back and sides as required. Provide silicone base for full seal at floor and grout the entire installation level. Service faucet will be chrome plated with vacuum breaker, integral stops, adjustable wall brace, pail hook, 3/4-inch hose thread on spout, and 8-inch spread. Hose and hose bracket will be 30-inches long, flexible, heavy-duty with 3/4-inch rubber hose, cloth reinforced, with 3/4 inch chrome coupling at one end. Five-inch-long bracket by 3 inches wide, with rubber grip. Mop hanger will be 24 inches long by 3 inches wide, 18-gauge No. 302 stainless-steel attached with flat head and slotted machine screws.

7.1.6.9 Backflow Preventers

Backflow Preventers: A backflow preventer will be installed where the service line provides potable water for domestic water service and connects with other closed or chemically treated systems that could foreseeably contaminate the potable water line. Drains off the backflow preventer assembly will be drained to the sanitary sewer. Taps to mains, to provide water for fire protection or other closed pipe systems, will have a double check valve assembly at the fire line tap. An alternate method of backflow prevention consisting of a 12-inch air gap between an unrestricted

overflow of an atmospheric makeup tank and the source of water is also acceptable. All double check and reduced pressure backflow preventers must be certified for operation after installation by a Texas Commission on Environmental Quality (TCEQ) certified tester.

Reduced Pressure Backflow Preventers: All pressure reducing backflow preventers that are installed to protect high-hazard services from back flowing, must be tested annually from the date they are installed and certified.

Provide a double check backflow preventer when domestic service is connected to the service water main. A backflow preventer will be installed on any domestic water line serving other closed or chemically treated systems that could foreseeably contaminate the potable water line. All backflow preventers will be installed in a readily accessible location, no more than 4 feet above the floor.

Temporary Water Service (Backflow Preventer): All temporary construction water services will be provided with a line sized backflow preventer, double check valve assembly. Services will not be initiated until backflow prevention devices have been approved by the SAAS Project Manager.

7.1.6.10 Emergency Eyewash and Safety Shower

Emergency eyewash and safety showers will be installed at apron level near every fuel shut-off switch (EFSO). Emergency showers and eyewash stations will conform to ISEA Z358.1. Waste connections will not be required for emergency showers and eyewash.

7.1.6.11 Drinking Fountains

Drinking fountains are to be electric, wall type, surface mounted into a wall recess thirty (30) inches wide x fourteen (14) inches deep, except where ADA requirements dictate a different configuration. It is prohibited to construct fountains into the walls so that a building alteration is required.

7.1.7 Sedimentation and Corrosion Material in a New Piping System

The A/E is responsible for checking the water quality and the plumbing equipment requirements. Several water heater manufactures would not provide a warranty if the water quality is outside of the manufacture's standards. For example:

- Corrosion damage and heater failures resulting from pH levels of lower than six (6) or higher than eight (8) are not covered by the warranty.
- Total dissolved solids in excess of two thousand (2,000) ppm will accelerate lime and scale formation in the heat exchanger. Heat exchanger failure due to total dissolved solids in excess of two-thousand (2,000) ppm is a non-warrantable condition.
- If water hardness exceeds the maximum level of seven (7) grains per gallon (120) ppm, the water should be softened to a hardness level no lower than five (5) grains per gallon (85.5 ppm).

- Water softened as low as zero (0) to one (1) grain per gallon (17.1 ppm) may be under saturated with respect to calcium carbonate, resulting in water that is aggressive and corrosive.
- A/E must require the identification of potable, non-potable water, natural gas, and other plumbing systems in the specification in accordance with ASME 13, ANSI 13, and ANSI Z 535 and safety regulations. Refer to Division 22 Appendix of CoSA Standard.

7.1.8 Soil Corrosivity Information

Provide information on the water quality from the utility system and number of water quality complaints to the water utility company from facilities within one (1) to two (2) miles from the proposed building.

Information on the utility lines should include material and year of construction within one (1) to two (2) miles from the proposed building.

Use only dielectric union in all dissimilar metals and test all unions. The A/E should include these requirements in the drawings.

The A/E is required to check the corrosivity and scale forming tendency of the water supply. Material selection should take into consideration corrosivity and scale forming tendency of the water supply and soil corrosivity.

7.1.9 Plumbing Drawings

Coordinate drawings with other disciplines. The drawings must be accurate and to scale, showing fixtures, equipment, and piping in their proper locations.

Provide large-scale details of congested areas on the drawings, with dimensions locating all work relative to structural features of the building.

Show riser diagrams of soil, waste, drain, and vent stacks and water risers for all buildings in excess of one story.

Plumbing riser diagrams must be drawn for each riser on the project. The risers must show all piping from the under-floor through the roof.

Cleanouts should be shown on plans and on riser diagrams.

Calculate the grade of drain lines and establish invert elevations.

Provide each set of drawings with a legend covering symbols and abbreviations as indicated in ASHRAE Handbook, Fundamentals. Where practical, group all notes, legends, and schedules at the right of the drawings above the title block.

Unless directed otherwise, graphic symbols must be in accordance with ASME Standard Y32.4, Graphic Symbols for Plumbing Fixtures for Diagrams Used in Architecture and Building Construction. Refer to Division 22 Appendix of CoSA Standard.

Show calculation on the drawings to include roof areas, wall areas, and rainfall rate in inches per hours.

Location of drain pipes and floor drains should be detailed in the drawings.

The drawing should include the information in the diagram (source 2009 National Standards Plumbing Code).

Include Hot water Volume Calculations in drawings.

Water Service: Unless directed otherwise, place the following note on the applicable drawing: "Water pipe sizes are based on a minimum working pressure of a ___ psig at a flow rate of___ gpm at the location where the main service enters the building." When water pressure is not known, assume pressure to be the pressure that will not exceed the required minimum residual pressure, plus allowances for pressure due to friction and pressure required for elevation of the highest water outlet. Provide pressure information, flow rates, water supply fixtures, piping material, valves, gauges, temperature, and other information in the riser diagrams.

7.1.10 Installation

All piping in buildings will be identified using pipe marker bands, with direction of flow arrows, at 10-foot intervals in concealed spaces; 20-foot intervals in exposed areas and on each side of any penetrated wall, ceiling, or floor. Pipe marker color coding will follow industry practice ANSI/American Society of Mechanical Engineers (ASME) A13.1, Scheme for Identification of Piping Systems.

50-50 solder will not be used for any pipe joints. When applicable, compression and flare fittings will be used when tying into equipment. No direct buried copper piping will be permitted inside or outside facilities. The use of ferrous metal pipe and fittings under slabs will be reviewed on a case-by-case basis.

No plumbing system components may be installed within any Air Handling Unit, ductwork, or room used as a plenum conveying supply air, return air, outside air, or mixed air. This should not prohibit connection of AHU components, such as humidifiers, to the water supply system, nor prohibit connection of trapped condensate pans and humidifier drains indirectly to the drainage system. This will also not prohibit plumbing system components in ceiling spaces used as return air plenums, nor prohibit drains in raised floor supply plenums.

Where the seasonal design temperature of the cold water entering a building is below the seasonal design dew point of the indoor ambient air, and where condensate drip will cause damage or create a hazard, insulate plumbing piping with a vapor barrier type of insulation to prevent condensation.

Neither water nor drainage piping should be located over electrical wiring, computer, or equipment unless adequate protection against water (including condensation) damage has been provided. Insulation alone is not adequate protection against condensation.

Chilled water piping, domestic water piping, sanitary drains, roof drains, gas lines, fuel lines, steam lines, water mains, and other utility lines are prohibited in electronic equipment areas, kitchen areas, and record storage areas, unless needed to serve the equipment in those areas.

Pipe sleeves will be provided for all pipes passing through masonry and concrete construction. The annular space between pipes and sleeves must be permanently sealed, and sleeves below grade must be watertight. Fire rated penetrations need to be sealed according to code.

Pipe joints must not be made closer than 12 inches to a wall, ceiling, or floor penetration, unless such pipe is welded.

Pipes penetrating exterior walls below grade must be installed in a manner to prevent breakage due to building settlement while maintaining a watertight seal.

Pressure piping, including gas piping, should not be located under slabs within buildings. Where such placement is unavoidable, the piping must be run in a sleeve and vented at each end so that leakage can be channeled off without pressurizing the underside of the slab.

Piping should not be run in concrete floors. Piping should not be buried beneath the lowest floor level, with the exception of soil pipe. At every point where piping and ductwork penetrate a floor slab, except slabs on grade, a cast-in sleeve or other waterproof curbing at least two (2) inches high should be provided.

All air conditioning unit chilled water coils should be provided with control valves, either of the 3-way or 2-way type as required by the system. No wild coils will be permitted. 2-way valves are preferred except as required at the end of a main to maintain flow through the system and/or pumps.

Gas regulator vent should be located a minimum of thirty-six (36) inches from electrical equipment.

Fixtures, equipment, and piping: Fixtures, equipment, and piping material should be compatible with the life of the structure.

Piping and valves and equipment should be identified. Concealed piping and valves should be accessible for maintenance and repairs. Valves and equipment should be accessible and should have sufficient clearance from other equipment for maintenance.

Number each valve and provide the function of the valve. Identify the location of the valve in the ceiling grid.

Provide a facility layout in the mechanical room that identifies all valves and plumbing equipment.

The plumbing system should be designed to mitigate corrosion of materials.

Place required expansion joints at a high point of the roof, with drainage diverted away from the joint.

Use access panel or other method to cover cleanouts. Locate cleanout a minimum of thirty-six (36) inches from the wall. All penetration should be sealed to prevent potential pest problems.

7.1.11 Flexibility

As noted in throughout this Standard, the A/E will consider the latest technology in designing the plumbing systems. Considerations are inclusive, but not limited to, off-peak conditions, power consumption, and energy conservation. The A/E will also consider future expansion and growth as applicable to each project.

7.1.12 Service and Access

Maintainability will be considered in all equipment layouts. Adequate space, as prescribed in relevant standards and as per the manufacturer, will be taken into account.

Easy access shall be provided to all working parts of all plumbing devices. Items of plumbing requiring periodic maintenance or repair should not be permanently sealed in masonry walls.

All floor drains must be readily accessible.

All water heaters will be readily accessible.

Electric water heaters, located in ceiling/attic spaces, will be accessible through an access door or by removing ceiling tiles. No asbestos containing material (ACM) will be used.

Make provisions for dispersion of chemical treatment for public banks of urinals.

Grease removal equipment should be outside of the facility.

7.1.13 Sustainability

The A/E will employ sustainable strategies that, in aggregate, use a minimum of 25 percent less water than the water usage baseline calculated using the table below.

Additionally, all newly installed toilets, urinals, lavatory faucets, and shower heads that are eligible for labeling must be WaterSense labeled.

Commercial Fixtures, Fittings, and Appliances Current Baseline

Water Closets (Toilets*)	1.28 gallons per flush (gpf)
Urinal*	0.5 gpf
Public Lavatory (restroom) Faucet	0.5 gpf at 60 psi all others except private applications
Private Lavatory Faucet*	0.5 gpm at 60 psi.
Kitchen Faucet (excluding faucets used exclusively for filling operations)	1.5 gpm at 60 psi
Shower Head*	2.0 gpm at 80 psi per shower stall
*WaterSense label available for this product type	

The A/E will consider using such techniques as controlling hot water temperatures and water pressures and providing faucets with flow restrictors. To provide maximum energy efficiency, the system must consider the following measures: economic use of thermal insulation, automatic shutdown of water heating and circulating systems, use of waste heat from HVAC systems, use of off-peak power, occupancy sensors for automatic flushing, use of automatic closing faucets, and use of minimum energy consuming equipment.

All energy saver water heaters will meet the ASHRAE Standards for Energy Efficiencies, latest edition.

The design, fabrication, and construction will be coordinated with SAT regarding the following:

- Airport Cooperative Research Programs (ACRP) Synthesis 10; Sustainability Practices that explore environmental, economic, and social issues.
- The Transportation and Research Board (TRB) ACRP Synthesis 21: Airport Energy Efficiency and Cost Reduction explores energy efficiency improvements being implemented at airports across the country that are low cost and short payback.
- TRB's ACRP Report 42: Sustainable Airport Construction Practices explore a set of best practices, methods, procedures, and materials that if implemented during construction may have a sustainable, positive economic, operational, environmental, or social effect.

Non-public Areas: Non-public restrooms, janitor closets, equipment rooms, storage rooms (applicable as discussed with SAT) and pet areas will be designed with hose bibbs.

A/E will evaluate materials and equipment with respect to local Green Building Manuals and Standards to consider new technologies that may become cost efficient.

7.1.14 Testing and Training

7.1.14.1 Testing

All tests will comply with certification agencies' standards and practices. Details regarding testing procedures will be approved by the SAT Project Manager, and test results must be witnessed and verified by SAT.

7.1.14.2 Training

Operations and maintenance manuals for all equipment will be a project deliverable provided by the Contractor and will contain applicable information facilitating the operation and maintenance of relevant equipment.

7.2 Glossary

ACRP : Airport Cooperative Research Program

ACM : Asbestos Containing Material

A/E : Architect/Engineer

ANSI : American National Standards institute

ASHRAE : American Society of Heating, Refrigerating and Air Conditioning Engineers

ASME : American Society of Mechanical Engineers

CoSA : City of San Antonio

EFSO : Emergency Fuel Shut-Off

EWC : Electric Water Coolers

HVAC : Heating, Ventilation, and Air Conditioning

IPC : International Plumbing Code

ISEA : International Safety Equipment Association

ISO : International Organization for Standardization

MSS : Manufacturer's Standardization Society

NEMA : National Electrical Manufacturers Association

SAAS : San Antonio Airport System

TCEQ : Texas Commision on Environmental Quality

TRB : Transportation and Research Board

TSA : Transporation Security Administration

UL : Underwriters' Laboratories

08 ELECTRICAL

SAN ANTONIO INTERNATIONAL AIRPORT | DESIGN STANDARDS | CHAPTER 8

Photo by Eric Francis

8.1 Electrical

8.1.1 Overview

These Electrical Design Standards have been developed and adopted by the San Antonio Aviation Department to assure superior quality and workmanship resulting in projects that have long life expectancy, are less vulnerable to damage, and are easily maintained. It is not the intention of these Standards to make project design and installation unreasonably difficult or costly. If a consultant or tenant has an alternate, code approved method that they would like to be considered, they may contact the San Antonio Aviation Department Project Manager. Communication must be in writing, and the request will be reviewed on a case-by-case basis. Approval of an alternate request does not constitute a waiver of these standards.

- If a conflict between this document and any other code or requirement arises, use the most restrictive requirement, and inform the San Antonio Aviation Department Project Manager.
- Buy American – Use of Foreign Equipment DCI shall indicate in the proposal all components that may be of foreign manufacture. If any are intended to be used, DCI shall note the country of origin. Equipment of foreign manufacture must meet U.S. codes and standards.

8.1.2 Code and Regulation Requirements

All electric designs must comply with the Federal Aviation Administration – Advisory Circulars and the latest applicable City of San Antonio codes and ordinances. The A/E is responsible for consulting SAAS aviation standards, airport regulations and design manuals to determine applicability and identify potential conflicts with the design of electrical power and lighting systems. It is also the A/E's responsibility to verify location and the adequacy of record information prior to design and construction, comply with all of the requirements set forth in the most current edition of local codes, and to coordinate the development of the design at all stages with SAAS, Aviation Department and Development Services Department, as needed.

8.1.2.1 The design, testing, and method of installation furnished under the requirements of this document will conform to the latest publications or standard rules of the IEEE, NEMA, UL, NFPA, ASTM, ANSI, NEC with City of San Antonio Amendments, Insulated Cable Engineers Association, and the InterNational Electrical Testing Association.

8.2 Power System Studies

The A/E shall provide power system studies to verify proper design and operation of the facility to the point of connection to the existing electrical systems. The A/E is also responsible for contacting and obtaining all utility data required to complete the relay coordination study from the respective Electric Utility Department or Private Utility Company including existing upstream protective device types and setting.

8.2.1 Load Flow Analysis

The purpose of the load flow calculations shall be to analyze the steady-state (quiescent) performance of the power system under various operating conditions and to study the effects of changes in equipment configuration. The load flow studies shall be able to determine the following:

- Component or circuit loadings
- Steady-state bus voltages
- Reactive power flows
- Transformer tap settings
- System losses
- The load flow analysis shall be conducted under two modes of operation. The loading under the first mode of operation shall be based on the instantaneous load values collected during the field effort. The loading under the second mode of operation shall be based on 80% design criteria of the load centers. Where equipment such as switchgear or switchboards are provided with main-tie-tie-mains, the analysis should represent both the normal mode with buss 1 and buss 2 supplied from main 1 and main 2 and the tie-mode with buss 1 and buss 2 supplied from one of the two mains.

From the results of the load-flow/voltage drop calculations, an analysis and report shall be prepared, based on the NEC, to indicate areas of overloaded conductors/ load-centers and areas of excessive voltage drop in the conductors.

Load Analysis for Service Entrance Equipment, Including Feeders: Complete a load analysis (Basis of Design).

Load Analysis for Service Entrance Transformer:

- Apply the demand and diversity factors to the final load analysis to determine the transformer size.
- For building designs, the service transformer shall not exceed 12 VA/square foot of facility gross floor area or 70% of the total connected load on installations served by transformer rated at 300 kVA or greater, unless required due to building function. The A/E to review with the SAT PM if additional load is required.
- Load Analysis for Emergency/Standby Generator: Provide sizing calculations including starting kVAs for step loads with modeling for starting voltage drop.
- Load Analysis for Alternate Energy Systems: Provide maximum power calculations applicable to the type of alternate energy system. Identify actual power delivered from source.
- Load Analysis for Uninterruptible Power Supply (UPS): Provide sizing calculations as appropriate for the selected battery type and application.
- Load Analysis Criteria:
    - Assign a "0%" demand factor for fire pump loads in demand calculations

for energy usage estimates but include fire pump loads in NEC calculations as required by building code.

- Size the service conductors (continuous current rating) in accordance with NFPA 70. Minimum design ampacity rating shall be larger than the ampacity rating of the main overcurrent protective device.
- Design the incoming service, including spare conduit to fully unload the maximum rating of the service equipment.
- Design main service equipment to provide a minimum of approximately 15% combination of spare devices/space to accommodate future work.
- Select appropriate size transformers based on the standard available three phase ratings and the calculated demand load of the facility.
- For small systems 225 amps or less, or for small modifications to large systems, the load analysis can be performed manually using the above criteria. For larger systems, a load analysis using computer software tools is necessary to evaluate properly all of the possible facility modes of operation.

8.2.2 Arc-Flash Study

An arc flash hazard study will be performed after the fault current and protective device coordination studies have been completed. The study will determine hazards that exist at each major piece of electrical equipment, including, switchboards, panelboards, motor control centers, uninterruptible power supplies, transfer switches, starters, variable frequency drives, disconnects, and transformers. The arc flash hazard study will consider operation during normal conditions, alternate operations, emergency power conditions, and any other operations which could result in maximum arc flash hazard.

Arc Flash Hazard Analysis calculations shall lead to a selection of a level of Personal Protective Equipment (PPE) that is a balance between the calculated incident energy exposure and the work activity being performed, while meeting the concerns of:

- Providing adequate protection
- Avoiding the need for more protection than is warranted
- Resiliency requirements for the owners critical systems and review of the coordination study analysis.

Results of the Arc Flash Hazard Analysis shall be used to identify the flash-protection boundary and the incident energy at assigned working distances throughout any position or level in the overall electrical generation, transmission, distribution, or utilization system.

The analysis shall include, but shall not be limited to, the following:

- A tabulation of the symmetrical RMS bolted fault current available and X/R ratio at each piece of electrical equipment.
- A tabulation of the arc fault current available at each piece of electrical equipment.

- A list containing the incident energy and the flash-protection boundary for all electrical equipment.
- A list containing each piece of electrical equipment, its corresponding incident energy, hazard rating, and the required Personal Protective Equipment.

Arc Flash Hazard Report: Complete and accurate arc flash analysis information in the Arc Flash Hazard Report shall be submitted. The report shall be submitted to San Antonio Aviation Department for review before the final report is prepared. The calculated values for flash-protection boundary, working distance, incident energy, and required Personal Protective Equipment shall be submitted and will be prominently displayed on electrical equipment.

Final selection of required Personal Protective Equipment shall be subject to review and acceptance by the San Antonio Aviation Department. The PPE required will be based on incident energy rating, voltage, industry standards including OSHA, NFPA, 70E and NFPPA 70B.

Arc Flash Labeling: After approval of the Arc Flash Hazard Report, Arc flash warning labels shall be furnished and installed on the applicable electrical equipment. All electrical equipment shall be provided with the appropriate ANSI compliant arc flash labeling. Labels shall include the flash protection boundary distance, incident energy, and minimum required Personal Protective Equipment

8.2.3 Coordination Study

A coordination study analyzes the characteristic curves of the fuses and breakers and compares them against one another on log-log plots. This study is to include recommended settings to provide an optimum balance between equipment protection and selective isolation that is consistent with the operating requirements of the overall power system.

As a minimum, the coordination study for the power distribution system shall include the following:

- Time-current curves for each protective relay or fuse showing graphically that the settings will provide protection and selectivity within industry standards. Each curve shall be identified, and the tap and time dial settings shall be specified. Include with each curve sheet a complete title and one-line diagram with legend identifying the specific portion of the system covered by that particular curve sheet. Include a detailed description of each protective device identifying its type, function, manufacturer, and time-current characteristics. Tabulate recommended device tap, time dial, pickup, instantaneous, and time delay settings.
- Time-current curves and points for cable and equipment damage.
- Circuit, time-current curves for utility protective devices, interrupting device operating and interrupting times.
- Indicate maximum fault values on the graph.
- In the coordination study include utility company device characteristics, utility currrent, maximum and minimum available fault current parameters for modeling scenarios, system medium-voltage equipment relay and device characteristics, low-voltage equipment circuit breaker trip device characteristics, pertinent transformer characteristics, pertinent motor and generator characteristics, and

characteristics of other system load protective devices. Include at least all devices down to largest branch circuit and largest feeder circuit breaker in each motor control center, and main breaker in branch panelboards.

- Include all adjustable settings for ground fault protective devices. Include manufacturing tolerance and damage bands in plotted fuse characteristics. Terminate device characteristic curves at a point reflecting the maximum symmetrical or asymmetrical fault current to which the device is exposed.

- When emergency generator is provided, include phase and ground coordination of the generator protective devices. Show the generator decrement curve and damage curve along with the operating characteristic of the protective devices. Obtain the information from the generator manufacturer and include the generator actual impedance value, time constants and current boost data in the study. Do not use typical values for the generator.

- For motor control circuits, show the MCC full-load current plus symmetrical and asymmetrical of the largest motor starting current and time to ensure protective devices will not trip during major or group start operation.

- Modeling software is to be pre-approved and all native files and authorization for owners or owners designee for use of the model are to be provided for the arc-flash study, coordination study and short circuit study, load-flow analysis.

8.2.4 Short Circuit Study

A short circuit study is an analysis of an electrical system that determines the magnitude of the currents that flow during an electrical fault. This study will provide an evaluation of the electrical power systems and the model numbers and settings of the protective devices. The report will be a certified report summarizing the short circuit study and conclusions or recommendations which may affect the integrity of the electric power distribution system. As a minimum, the report shall include the following:

- One-Line Diagram:
    - Location and function of each protective device in the system, such as relays, direct-acting trips, fuses, etc.
    - Type designation, current rating, range or adjustment, manufacturer's style, and catalog number for all protective devices.
    - Power, voltage ratings, impedance, primary and secondary connections of all transformers.
    - Type, manufacturer, and ratio of all instrument transformers energizing each relay.
    - Nameplate ratings of all motors and generators with their sub-transient reactances.
    - Sources of short circuit currents such as utility ties, generators, etc.
    - All significant circuit elements such as transformers, cables, breakers, fuses, etc.
    - Emergency as well as normal switching conditions.

    - The time-current setting of existing adjustable relays and direct-acting trips, if applicable.

- Impedance Diagram:
    - Available MVA or impedance from the utility company.
    - Local generated capacity impedance.
    - Bus impedance.
    - Transformer and/or reactor impedances.
    - Cable impedances.
    - Equipment impedances.
    - System voltages.
    - Grounding scheme (resistance grounding, solid grounding, or no grounding).

- Calculations:
    - The paths and situations where short circuit currents are the greatest shall be determined. Assume bolted faults and calculate the 3-phase and line-to-ground short circuits of each case.
    - The maximum and minimum fault currents shall be calculated.

8.2.5 Motor Starting/Flicker Analysis

- Motor calculations shall account for both starting and running current.

- Provide a motor starting/flicker analysis for motors 40 horsepower (HP) and greater for 480 volt systems and for 25 HP for systems rated for 240 volts and below. Verify that the voltage drop at the service entrance does not exceed 5% percent during motor starting.

8.2.6 Harmonic Current Limits

Harmonic analysis shall determine the harmonic current distortion and the voltage distortion at the utility service and at equipment designated as critical by the airport.

The harmonic current distortion of any individual device or piece of equipment specified in the design documents shall not exceed values given in IEEE 519.

8.2.7 Preservation of Power Quality

Low voltage power and distribution system designs of facilities with computers and other sensitive electronic loads shall require the installation of isolation transformers and dedicated grounding systems that shall comply with IEEE1100.

8.2.8 Emergency Lighting and Power

The design professional shall design the electrical power system such that it operates at a 95% to 97% lagging power factor during peak estimated demand load conditions. The power factor must not become leading under minimum load conditions. This may require coordination with the electrical utility company if the power factor supplied is already low.

8.3 Design Criteria

8.3.1 Overall

8.3.1.1 The A/E will need to coordinate with SAT PM and Airport Duty Manager with AICC needs to be notified and meet with stakeholders 2-3 weeks prior to any shutdowns. Coordinate with SAT PM if schedule varies due to project type.

8.3.1.2 Coordinate with the SAT PM and Airport Facilities Electrical Team modifications variances to the electrical standards.

8.3.2 Interior Electrical System

The information contained within this section applies to electrical work inside of the building limits.

8.3.2.1 Electrical Rooms

- Distribution within the building shall be via readily accessible electric rooms or closets. Electric rooms or closets must be independent from all other types of closets, e.g., communications, telephone, custodial, etc.
- Cleaning of Electrical Rooms
    - Work involving modifications to or in electrical rooms shall include the entire area be cleaned by the contractor prior to demobilization, including removal of all debris, surface dust, etc.
- New electrical rooms need to be sized such that there is 25% spare wall space.
- Electrical rooms shall not be used for any storage purposes and should be dedicated for electrical equipment only.
- Adequate ventilation for heat producing and/or heat sensitive electrical equipment must be provided – gravity/ natural convection type wherever possible.
- Water piping is not allowed in transformer vaults and main switchgear areas. The City must not be exposed to the risks that can result from lack of proper design attention to this requirement.
- Electrical- Separate rooms shall be designated to accommodate the immediate and/or future installation of on-site co-generation of power (i.e., micro-turbine engines or fuel cells).

8.3.2.2 Equipment

Electrical Equipment Clearances: Adequate equipment clearances and safe escape routes must be maintained to allow safe access to and around equipment. Working space shall not include access lane. Lane shall be a minimum three (3) feet clear distance.

- Provide two (2) exits around work area.
- Provide doors that allow removal of electrical equipment.
- Provide a minimum three (3) feet clearance around the electrical equipment and from any wall.
- Provide a working space of three (3) feet or the width of the equipment (whichever is greater), in front of the electrical equipment.
- The headroom of the working spaces around switchboards or control centers shall not be less than seven (7) feet distance from the floor to ceiling.
- If the electrical equipment exceeds seven (7) feet, provide minimum headroom not less than the height of the equipment plus twenty-four (24) inches.
- Within the headroom working space height requirement, other equipment associated with electrical installation located above or below the electrical equipment will be permitted to extend not more than six (6) inches beyond the front of the electrical equipment. The intent of this requirement is to preclude the installation of equipment, such as a transformer, in the working space for other electrical equipment, such as panel board; this type of installation impedes access and can create an unsafe working condition.
- Do not locate piping, ducts, or equipment foreign to the electrical installation in the dedicated equipment space.

8.3.2.3 Switchgear

- Switchgear shall be Metal Enclosed with a main bus that shall be copper and shall be tin plated at joints. The main bus shall have bracing of 100,000, 65,000 and 45,000 amp symmetrical short circuit rating. Switchgear shall have all equipped spaces and 25% spare breaker capacity.
- Freestanding switchboard construction shall be specified for bus sizes larger than 800 amps. Freestanding equipment shall be installed on 4" or 6" concrete pad.

8.3.2.4 Distribution Panels

- There should be a distribution panel in each electrical room to serve all downstream panels in the room.
- Each electrical panel shall be dedicated to serve specific types of electrical loads such as lighting, HVAC, large power, receptacle loads, communication/IT, emergency lighting and emergency power.
- All new panels shall be designed such that they have 30% spare

capacity, breakers, and spaces.

- Freestanding distribution panels shall be specified for bus sizes larger than 800 amps. Freestanding equipment shall be installed on 4" or 6" concrete pad.
- All panels shall have feed through lugs.

8.3.2.5 Panels

- Panel main bus may be copper or aluminum with a main breaker. Main breaker and branch circuit breaker shall be bolt on type and thermal - magnetic type with inverse time delay and instantaneous trips. Sizing and arrangement of mains and branch breakers shall be as indicated on the drawings.
- Panels shall have conductor color code identification.
- The following shall be used as guidelines for bus bracing and breaker interrupting rating, when interrupting rating calculations are not available;
- 600V & 480Y- 277V AC – 42,000 AIC
- 208Y/120V & 240V/120V AC – 22,000 AIC
- All panels shall have feed through lugs.
- Coordinate with the SAT PM and Airport Facilities Electrical Team modifications/variances to the electrical standards.

8.3.2.6 Transformers

- Distribution Transformers - Distribution transformers will be three (3) phase, 1500, 2500, or 3000 kVA, 12.47 KV – 5 KV or 12.47 KV – 480/277 V, provided by the utility company. Furnish equipment pads in accordance with utility company requirements.
- Dry Type Transformers – Dry type transformers will be three (3) phase, 15, 30, 45, or 75 kVA, 480/277 V, 208/120V or 240/120V. Furnish 4" equipment pads.
- Transformer Sizing - Transformers for tenant improvement projects shall be sized on the basis of calculated/demand load plus 25% or the connected load, whichever is higher.
- All ceiling mounted transformers must be supported from the building structure independent of all other systems and a continuous ceiling must separate the transformer from the plenum

8.3.2.7 Conduits

- Primary and Secondary service entrance conduits shall be concrete encased. Verify requirements for service entrance with Utility provider. The primary duct bank shall be marked with red dye.
- Notification Requirement - Notify utility provider if access to their manholes or vaults is required.
- PVC conduit, Schedule 40 or thicker, may be used underground, direct buried or concrete encased. Conduit bends shall be IMC, PVC coated. Direct buried cable is prohibited. Direct buried metallic conduits require

PVC coating or approved equal coating to protect against corrosion. A hazard warning tape must be installed 6" below grade directly above the conduit when the trench is backfilled. The section of vertical conduit from 6" below grade shall be rigid or PVC 6' above grade. All concrete encased PVC schedule 40 conduits shall have a minimum of 1 #3 rebar in each corner of duct, running parallel to the conduit runs.

- Electrical Metallic Tubing (EMT) may be used where permitted by code except where subject to mechanical or physical damage 6'-0" above floor, if exposed. EMT may not be used in concrete or underground. EMT fittings shall be steel compression type only and a minimum of 3/4". In wet areas, all conduits are to be rigid.
- Galvanized rigid metal conduit (RMC) and intermediate metal conduit (IMC) couplings shall be threaded type only. RMC and IMC shall comply with the following spacing guidelines when using pull boxes, hand holes or fittings:
- Outdoor feeder installations shall have a maximum spacing of 400' between manholes.
- Indoor/outdoor branch circuit installations shall have a maximum length of 90'.
- Indoor feeder circuit installations shall have a maximum length of 150'.
- The above guidelines do not preclude meeting NEC #342.24 & 344.22 limits on the maximum number of bends in a conduit run.
- All boxes (except in-ground) shall be supported independent of the conduit to the structure of the building.
- Device boxes shall be a minimum of 4" x 4" x 1-1/2" (use a device ring) and independently supported to the structure of the building.
- Liquid tight flexible metal conduit (for damp or wet locations) shall be used for connection to all movable, rotating or vibrating equipment, including dry type transformers. Flex connection shall not be used as equipment grounding conductor. Liquid tight flexible metal conduit shall be 6 feet or less in length except where code allows exceptions and a separate equipment grounding conductor shall be run with liquid tight flexible metal conduit.
- Flex metal or MC type cable, 6 feet or less in length, shall only be used, where allowed by building code, for connection of light fixtures above ceilings. A separate equipment grounding conductor shall be run with flex metal conduit.

8.3.2.8 Conductors

- Copper shall be used for all wiring, except aluminum wire 1/0 and larger may be used for temporary service conductors.
- Minimum size #12 AWG, except control wiring may be #14-#18 AWG depending on the application. All conductors #10 AWG and smaller shall be solid type unless used for control wiring. Wire sizes #8 AWG and larger shall be stranded construction. Control wiring shall be stranded.
- Total voltage drop shall be less than 5%. Limit feeder drop to less than two 2% and branch circuit drop to less than 3%.
- All direct buried counterpoise group wire shall be size toi meet the

most restrictive of NEC, BICSI, UL and LPI requirements (No 6. AWG minimum where allowed by these requirements), stranded bare copper wire conforming to ASTM #B-3 and B-8.

- Interior power wiring for power and lighting shall be color coded as follows:

480Y/277V, 3ø, 4W	208Y/120V, 3ø, 4W	240/120V, 1ø, 3W
Aø - Brown	Aø - Black	Aø - Black
Bø - Purple	Bø - Red	Cø - Blue
Cø - Yellow	Cø - Blue	N - White
N - Gray	N - White	Ground - Bare
Ground - Bare	Ground - Bare	Iso GND - Green
Iso GND - Green	Iso GND - Green	

- If the conductor size must be increased due to voltage drop, do not increase the size of the overcurrent protection device for the circuit. The overcurrent protection device may be protecting downstream equipment and increasing the size of the overcurrent setting can reduce the level of equipment protection. If the phase conductor size is increased for voltage drop, increase the size of the equipment grounding conductor proportional to the circular mil increase of the phase conductor.

8.3.2.9 Receptacles

- All receptacles shall be tamper proof in public areas. All electrical outlets shall be labeled with the associated panel and circuit information. No USB general purpose outlets allowed.
- Provide adequate power outlets to serve equipment in all spaces. Power should be provided along the perimeter walls in accordance with all current applicable codes. In addition, convenience floor power should also be provided throughout large open areas to allow for the greatest flexibility of space use.
- When locating outlets, special attention should be paid to the possible location of office equipment and furniture.
- Provide GFCI receptacles in all areas subject to washdown and in all locations required by NEC.

8.3.2.10 Lighting Fixtures

This section shall include interior, exterior attached to buildings, exterior steps, stairways and parking structures.

- All fixtures to be LED unless approved by San Antonio Aviation Department. Illumination levels should follow Illuminating Engineering Society (IES) standards. Illumination levels should follow Illuminating Engineering Society (IES) standards.
- Use 4100 kelvin as the standard temperature for all LED bulbs. This is a cool white and is the recommended color temperature for offices and work-spaces.
- In general, light levels and fixtures need to align with furniture and equipment locations.

- All remote drivers shall be installed such that they are readily accessible without the use of a lift.
- Lighting system shall be designed in accordance with IES recommendations to provide an energy efficient system with minimum maintenance.
- Battery (sealed, recombination lead calcium type) operated emergency lights and exit lights will be used to illuminate all means of egress, unless other stand-by power or redundant power systems are available.
- Exit lights shall be installed on a dedicated circuit with no other equipment connected to it. Provide constant un-switched power to keep battery charged if battery backup is provided. All exit lights shall be “LED” types with a minimum twenty (20) year warranty.
- Long term lamp and fixture maintenance should be considered in location of all fixtures. Use very long life lamps in areas difficult to re-lamp and areas along roadways. All proposed installations are required to be supported by a life cycle cost analysis.
- The use of custom fixtures is discouraged. Utilize the same/similar lighting fixtures as much as possible at the same project location.

8.3.2.11 Lighting Controls

This section shall include interior, exterior attached to buildings, exterior steps, stairways and parking structures.

- Lighting controls for occupancy control, vacancy control, time of day control and daylight harvesting shall be installed as required by the adopted energy code. For applications not required by code consider use of occupancy sensor controls and dimming for energy management.
- Allow for 24-hour override.
- Lighting controls should be located within eighteen inches (18”) of the entry door(s) of individual, interior spaces.
- Light sources, power supplies and controls are to be rated and warranted for a long useful life to increase the time between maintenance cycles.

8.3.2.12 Metering

- Each tenant shall submeter their electrical usage. Revenue metering shall be provided at all external tenant facilities. Install metering equipment enclosure in accordance with utility service provider guidelines. All revenue meters shall be smart metering type where trending will be possible through a SCADA system.
- Smart meters shall be kilowatt-hour and kilowatt demand with pulse transmitter. Smart meters must be able to be connect to a SCADA system for trending and monitoring.

8.3.2.13 Grounding

Consideration shall be given to local conditions affecting grounding methods. Ground resistance shall not exceed limits as established by IEEE for type of facility.

- Ground rods shall be ¾" x 10' stainless steel, minimum. Ground rods shall be designed and installed per the National Electric Code.
- All ground connections shall be bolted (where accessible) or by the exothermic process.
- Exothermic welds shall be coated against corrosion where direct buried.
- All premises ground rods or other NEC approved grounding electrodes shall be bonded together to form the grounding electrode system to limit the potential differences between them and their associated wiring system. There shall be no isolated ground or grounding systems.

8.3.2.14 Lightning Protection

- A Lightning Protection System shall be provided for all building structures on the Airport. The lightning protection system shall comply with the 1995 Edition of NFPA 780, Standard for the Installation of Lightning Protection Systems of the National Fire Protection Association. Installation shall be made under the direct supervision of a Certified Master Installer, whose certification has been granted by the Lightning Protection Institute (LPI). Except for cable fasteners, all components of the lightning protection system shall be listed and labeled by Underwriters Laboratories, Inc.
- For additions to buildings already having a lightning protection system, provide lightning protection in the new construction only and bond to the existing system.
- Upon completion of the work, the prime contractor is required to transmit on his letterhead an affidavit bearing the notarized signature of the LPI Certified Master Installer that the lightning protection system complies with NFPA 780 and, in building additions, that it has been bonded to the existing system.
- Provide lightning protection plan and details at an appropriate scale. Plan shall indicate locations and number of system components required. Show air terminal installation details, roof and wall penetration details, and details to show concealed components of the system. Coordinate roof and wall penetrations with other disciplines to ensure that the integrity of the facility envelope is not compromised.

8.3.2.15 Meeting Rooms and AV Projection

- Where a ceiling-mounted projector is designated, an electrical outlet should be located at the ceiling. Outlet location to be coordinated with projector location.
- Where podium is utilized, lighting controls should be either located within close proximity to or controlled from it.
- Lighting should be zoned in order to allow for the proper viewing of projected images.
- Room should be zoned in a manner which allows for light fixtures at / near the projection screen to remain off so as not to impede viewing of images on the screen.
- Consideration should be given to the utilization of a flat screen LCD television with data input, in lieu of a traditional projection screen and overhead projector.

8.3.2.16 Reference Standards

All grounding work shall conform to or exceed the applicable requirements of the following :

- Current edition of the NEC- National Fire Protection Association (NFPA)
- 70 National Electrical Code (NEC)
- ANSI/IEEE 80 - Guide for Safety in AC Substation Grounding
- ANSI/UL 467 - Safety Standard for Grounding and Bonding Equipment
- IEEE 142 - Grounding of Industrial and Commercial Power Systems

8.3.2.17 Quality Assurance

- All equipment furnished shall be listed by and shall bear the label of Underwriters' Laboratories, Incorporated, (UL) or of an independent testing laboratory acceptable to San Antonio Aviation Department in writing.
- The grounding system design depicted on the contract drawings is the minimum design required for each building or structure. Each system shall comply with the maximum resistance of 5 ohms to ground. Systems exceeding the maximum resistance specified shall be supplemented with additional grounding provisions and retested until the maximum specified resistance is achieved.
- Testing: Documented results on the completed ground systems for resistance to ground using an electrical ground resistance tester shall be submitted. The grounding system maximum resistance shall not exceed five ohms under normally dry conditions when measured by the resistance tester. Resistance values above five ohms shall be brought to San Antonio Aviation Department's attention. All grounded cables and metal parts shall be tested for continuity of connection. Test shall be witnessed by the San Antonio Aviation Department's inspector. The three point testing method is preferred when testing the grounding system or systems.

8.3.3 Exterior Electrical System

The information contained within this section applies to electrical work outside of the building limits, excluding airfield lighting.

8.3.3.1 Exterior Electrical Systems

- All electrical distribution shall be underground.
- Provide all ductwork, equipment pads and metering enclosures in accordance with FAA specifications and standards.
- Underground Electrical Circuits shall be installed in Schedule 40 PVC. Service entrance conduits shall be encased in concrete.
- Conductors shall be copper with insulation suitable for wet locations, sized based on NEC recommended maximum allowable voltage drops.

- Ground Connections shall be bolted (where accessible) or by the exothermic process. Considerations shall be given to local conditions affecting grounding methods. Ground resistance shall not exceed limits as established by IEEE Standard 142. Ground rods shall be ¾" x 10' stainless steel.
- Manholes and Handholes shall be provided with heavy duty traffic covers. All circuits shall be labeled with stamped brass tags.

8.3.3.2 Surge Suppression, Bonding and Grounding for Outdoor Systems

Surge Suppression, Bonding and Grounding, shall be included in the specifications and plans for any unprotected system that may be struck by lightning that would conduct the lightning energy to the inside of the facilities.

8.3.3.3 Exterior Lighting Systems

- All airport light sources shall be aimed in a manner that will not interfere with FAA Air Traffic Control Tower operations or piloting activities. Where lighting sources are directed toward runway ends or FAA towers, they shall be shielded as may be necessary to deflect the light source down and away from those areas. Lighting systems shall be designed in accordance with IES recommendations to provide an energy efficient system with minimum maintenance.
- New underground lighting systems shall be installed in direct buried Schedule 40 PVC. Splices shall be made in pole base or concrete splice box with heavy duty traffic cover or fixtures that require a particular ballast. Ballasts shall be located at the base of high poles rather than at fixture. Avoid use of unusual fixtures, tubes, voltages, et cetera.
- Conductor shall be copper and sized based on NEC recommended maximum allowable voltage drop.
- All ground connections shall be bolted (where accessible) or by the exothermic process. Considerations shall be given to local conditions affecting grounding methods. Ground resistance shall not exceed limits as established by IEEE Standard 142. All ground rods shall be stainless steel, ¾" x 10' 0" minimum.
- An equipment grounding conductor shall be routed with the phase conductors and bonded to each lighting pole to facilitate the operation of the upstream over-current protective device. The earth shall not be used as the sole equipment grounding conductor.
- Exterior and site lighting shall be designed to:
  - Photocells and time clocks should be used for automatic control of exterior lighting.
  - Promote "dark sky" policies.
  - Implement energy conservation and sustainability policies.

  - Discourage excessive lighting and harsh contrasts.
  - Limit the type of light fixtures, lamps and standards for maintenance purposes.
  - Create a safe environment.
- "Dark Sky" - Site lighting shall conform to requirements as specified in the Unified Development Code, Sec. 35-339.04. Military Lighting Overlay Districts - refer to DIVISION 26 APPENDIX
- Photocells and time clocks should be used for automatic control of exterior lighting.
- A/E should utilize photometric plans when designing light layouts to ensure adequate lighting levels. All lighting levels should be provided in footcandle units and meet the recommendations of the Illuminating Engineering Society of North America (IESNA).
- The COSA Project Manager/Representative may request additional information following the initial lighting plan submittal, such as:
  - A brief written narrative, with accompanying plan or sketch, which demonstrates the objectives of the lighting.
  - Photometric data, Color Rendering Index (CRI) of all lamps (bulbs), and other descriptive information on the fixtures, and if applicable or required, designation as Illuminating Engineering Society of North America (IESNA) "cutoff" fixtures.

8.3.3.4 Anchor Bolts and Poles

- Design Standards:
  - ACI 318, most current edition.
  - AISC, most current edition.
  - AASHTO, Specification for Design and Construction of Structural Supports for Highway Luminaries
- Corrosion Protection - Nuts and top ten (10) inches of anchor bolts shall be hot dipped galvanized. All base plates shall be exposed to air, no grout allowed.
- Anchorage - Anchor bolts shall have full embedment as required by ACI. Specify nut torque requirement.

8.3.3.5 Roadway Lighting

- The existing roadway lighting system is 480/277 volt, three phase, with power extending to pole bases underground in duct.
- Roadway lighting shall be per IES Type II or Type III with distribution obtained by reflectors or in some cases by refractors if approved by the City Engineer.

8.3.3.6 Apron Lighting

- This lighting shall be in accordance with IES Recommended Practice RP-14 "Airport Service Area Lighting".
- The A/E shall call for submittals of the manufacturer's lighting analysis to include point by point foot-candle calculations to demonstrate the proposal meets the design criteria. In addition, prior to the final acceptance, the Contractor must submit a report, of testing accomplished by an IES certified agency, showing that the installation complies with the specified criteria and the proposal calculated values. These tests shall indicate areas of unacceptable glare as indicated by FAA Air Traffic Controllers or pilots. All testing shall comply with IES recommendations. All adjustments in fixture aiming shall be accomplished by the Contractor at no additional cost to San Antonio Airport.

8.3.3.7 Airfield Lighting

Runway and taxiway lighting and visual aids shall be designed based on the design standards and requirements of the FAA Advisory Circulars, as appropriately supplemented by the National Electric Code (NEC) as it pertains to vault work and the commercial power side of the vault equipment.

8.3.3.8 Lighting and Visual Aid Systems and Fixtures -

- System layout configuration and fixture utilization and design shall be specified by all current applicable FAA Advisory Circulars. Airport operated lighting systems shall be designed for the most critical operational criteria (CAT II/III).
- In all specifications for lighting and electrical equipment, the item and manufacturer must be listed as approved for use by the FAA. In some instances, requirements above those required for FAA approval will be stipulated. These must be specified precisely; for example "Signs (L-858) - To withstand high wind velocity up to 200 mph regardless of location." Refer to specific sections for requirements.
- Fixtures shall be installed on deep bases (cans) housing the isolation transformers. Inset (shallow) bases shall not be used unless approved by the City Engineer.
- Runway Distance Remaining Signs and Taxiway Guidance Signs shall be internally lighted to match existing equipment.

8.3.3.9 Cable and Conduit -

- Direct burial cable is not permitted. All cables shall be placed in conduit. Bends in underground conduit system are not permitted without a junction box.
- All cables shall be tagged in manholes with heat sealing tags, Scotch HB-21 or approved equal, imprinted with the circuit number on each side of L823 connectors.
- 5KV series circuit cables shall be color coded as to circuit type (i.e. Runway CKT, Taxiway CKT, Sign CKT, etc.).

8.3.3.10 Electrical Manholes, Junction Boxes, and Pull Boxes -

- These structures shall be located outside of runway and taxiway safety areas (as defined in AC 150/5300-13) where maintenance personnel can service them without closing runways or taxiways, if possible. They shall sufficiently be raised, where allowed, above the surrounding grade to prevent ponding water on the structure and the top cover sloped to drain.
- A concrete apron shall be constructed around all electrical manholes located in turfed areas.
- Particular attention must be given to storm water drainage plans to prevent placement of electrical structures in areas of channeled for drainage.
- They shall have all joints and openings completely sealed and vermin proof. Secure covers with bolts.
- Structures, covers and frames in the runway and taxiway safety areas shall be heavy duty designed for aircraft at 250 psi tire pressures and wheel loads of at least 40,000 pounds. Homerun manholes and pull boxes shall be located at a maximum spacing of six hundred (600) feet.

8.3.3.11 Saw Kerfs -

- Saw kerfs are discouraged. However, where saw kerfs are required, only one 1" conduit per saw kerf is allowed.

8.3.3.12 Circuit Lockouts –

- No construction or maintenance shall be allowed on Airfield lighting circuits while the circuits are energized.
- The published circuit “Lock-out and Lock-in” procedures will be required to be followed for all work performed on the airfield.
- Confirm with Airport’s Operations Section the need for temporary circuits for extended outages (more than 1 work period, 8 to 12 hours).

8.4 Requirements in Specialty Areas

8.4.1 Entry

All equipment on dedicated outlets that are not intended to be unplugged should be hardwired to prevent travelers from unplugging. Provide additional convince outlets for public use.

8.4.2 Baggage Claim

All equipment on dedicated outlets that are not intended to be unplugged should be hardwired to prevent travelers from unplugging. Provide additional convince outlets for public use.

8.4.3 Ticket Counters

Ticket counters shall be hardwired via floor box or poke thru. Airlines are responsible

for providing power within the counters and millwork.

8.4.4 Checkpoint

A/E should always reference the latest version of the Checkpoint Requirements and Planning Guide (CRPG) for approved equipment and design requirements.

8.4.5 Passenger Boarding Bridge

Passenger Boarding Brides shall be on generator back up.

8.4.6 EV Charging

Plan for future innovative technologies including autonomous vehicles which will require smaller parking footprints and accommodate electrical vehicles with hard wired or wireless charging stations. EV to be sub metered.

8.4.7 Specialty Lighting

RGBW lighting and controls recommended in specialty areas.

8.4.8 Customs and Border Patrol

A/E should always reference the latest version of the U.S. Customs and Border Protection Standards for all design requirements.

8.5 Glossary

AASHTO :	American Association of Highway and Transportation Officials
ACI :	American Concrete Institute
A/E:	Architect / Engineer
AISC :	American Institute of Steel Construction
ANSI :	American National Standards institute
ASTM :	American Society for Testing and Materials
AWG :	American Wire Gauge
CFR :	Code of Federal Regulations
CKT :	Circuit

CoSA :	City of San Antonio
DCI :	Distributed Control Instrumentation
EMT :	Electrical Metallic Tubing
ETAP :	Electrical Transient and Analysis Program
FAA :	Federal Aviation Administration
HVAC :	Heating, Ventilation, and Air Conditioning
IEEE :	Institute of Electrical and Electronics Engineers
IES :	Instrumentation Electrical Services
IMC :	Intermediate Metal Conduit
LED :	Liquid Emitting Diode
LPI :	Lightning Protection Institute
MVA :	Mega Volt Ampere
NEC :	National Electrical Code
NEMA :	National Electrical Manufacturers Association
NFPA :	National Fire Protection Association
OSHA :	Occupational Safety and Health Administration
PPE :	Personal Protective Equipment
PVC :	Polyvinyl Chloride
RMC :	Rigid Metal Conduit
SAT :	San Antonio Airport
SCADA :	Supervisory Control and Data Acquisition
UL :	Underwriters Laboratories

09

SAN ANTONIO INTERNATIONAL AIRPORT

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9.1 Mechanical (HVAC)

9.1.1 Overall

This Chapter defines general design criteria for heating, ventilation and air conditioning (HVAC) systems utilized at San Antonio Airport (SAT) facilities.

The intent of the SAT Mechanical (HVAC) design criteria, is to establish a baseline to coordinate and augment the criteria used by the City of San Antonio (COSA). Mechanical system design will consider construction, commissioning, and operation phases of the building life cycle.

9.1.2 Design Criteria

9.1.2.1 Code Requirements

Design will comply with requirements and provisions of the latest International Mechanical Code (IMC), as approved and amended by City of San Antonio (COSA) and coordinated with SAT.

The Architect/Engineer (A/E) is responsible for consulting SAT aviation standards, airport regulations and design manuals to determine applicability and identify potential conflicts with the design of HVAC systems. It is also the A/E's responsibility to verify location and the adequacy of record information prior to design and construction, comply with all of the requirements set forth in the most current edition of local codes, and to coordinate the development of the design at all stages with SAT, Aviation Department and Development Services Department, as needed.

If a conflict between this document and any other code or requirement arises, use the most restrictive requirement and inform the SAT Project Manager.

9.1.2.2 HVAC Design and Sizing

All areas used primarily to accommodate people-oriented activities such as offices, concessions, concourses, cafeterias, etc., shall be air conditioned and heated. Areas classified as storage or manufacturing shall be mechanically ventilated and heated to minimum requirements of the Building Code. The criteria for a particular HVAC system will vary from building type to building type, or project to project, which may change certain parameters of initial design considerations.

Quality design will achieve internal environmental quality and thermal comfort balance. The provisions of the International Building Code (IBC), as approved and amended by the COSA shall apply to the installation, alterations, repairs, and replacement of mechanical systems, including equipment, appliances, fixtures, fittings and/or appurtenances, including ventilating, heating, cooling, air conditioning and refrigeration systems, incinerators, and other energy-related systems. Applicable codes and the project Basis of Design establish the minimum requirements. The Contractor will verify local code compliance with the Authority Having Jurisdiction.

- Heating: The winter indoor comfort design temperature will be 72°F dry-bulb (DB), unless otherwise indicated. Humidification is not required except for special purpose facilities.
- Cooling: Summer indoor comfort design temperature will be 75°F DB, unless otherwise indicated. The design relative humidity will be 50 percent. Cooling coils will be designed so the building annual relative humidity (RH) range will not exceed 60 percent RH. Face and by-pass coils must be used on all VAV systems to prevent high humidity conditions during partial load (i.e., control supply air temperature with face and by-pass). The use of face and by-pass coils may be reviewed on a case-by-case basis.
- Outdoor Design Temperatures:
- Summer – 97.6°F DB, 77.4°F WB Winter – 29.9°F DB.

These climatic temperatures represent temperatures used in calculations when designing relevant systems and shall be updated per latest ASHRAE Climate Design Conditions specific to the location.

The A/E shall discuss the HVAC zoning layout and seek approval by SAT prior to the start of the design process. The zoning strategy shall consider the full range of variability in people, building and equipment loads, operation and occupancy patterns of the building area and future uses of such spaces. Design shall prevent the creation of hot zones near windows, which has been a past issue at the ConRAC building and Terminal A. High traffic areas at Security Points and dense internal heat loads from security screening machines shall be well documented and included in HVAC load calculations.

The design of mechanical room and equipment should allow for the removal of the largest piece of equipment without dismantling the entire unit.

Main electrical switch gear should be in a separate room; avoid liquid conveying pipes above the gear.

All storage spaces and janitor's closets are to be ventilated and served with building exhaust air or a treated air supply.

As much as possible, telecommunication rooms are to be located on an exterior wall or near a mechanical room. Equipment serving the telecommunication system shall drain to the exterior wall or into a mechanical room.

Toilet rooms shall have supply air, exhaust and transfer air.

Exhausts from adjacent toilet rooms should be arranged to prevent sound transmission between men's and women's areas.

Transformer vaults should have separate ventilating fan or fans connected to emergency power supply. Vault must be vented to outside in accordance with the National Electric Code.

The A/E may be requested to provide equipment sizing calculations and psychometric calculations and charts, if applicable, to justify the selection of equipment (ex. AHUs, VAV boxes, pumps, chillers, boilers, control valves and dampers, etc.)

Include weather data used for design calculations and analysis in the design documentation.

Provide no more than a 1.25 safety factor for heating equipment and distribution sizing to account for morning warm-up.

Air distribution systems must be equipped with smoke detectors listed and labeled for installation in air distribution systems.

If possible, locate intakes and exhausts on different building faces, or at least thirty (30) feet apart.

Coordinate intake with the electrical plan for the location of generators.

Do not use mechanical rooms or air handling unit equipment rooms as return air plenums. Pumps, panel boxes, etc. should not be installed in a plenum.

Table 1 below is intended to complement the contents presented in 2018 IMC Table 403.3.1.1 regarding occupancy density based on the occupancy classification for specific airport areas. This table shall be used unless directed otherwise for a specific project or specific data is known/provided on occupancy.

OCCUPANCY CLASSIFICATION	OCCUPANCY DENSITY #/1000 FT2
Security check points	120
Check-in area	100
Concourse walkways	100
Gate waiting area	120
Baggage claim area	100

Table 1. Occupancy classification for specific airport areas.

HVAC design shall consider the use of the existing centralized chilled water infrastructure to serve all applicable spaces within the project scope. Although the use of the central chilled water system if the preferred approach, projects shall be evaluated on a case-by-case basis to determine whether independent HVAC units are appropriate (e.g. direct expansion roof top units). The HVAC design strategy must be approved by SAT management prior to the start of design activities.

The A/E shall consider the use of pressurized vestibules and air curtains at building entrances to improve efficiency and comfort levels in the conditioned space. Pressurized vestibules shall be integrated with building HVAC system in order to ensure acceptable air balance between the spaces and avoid excessive pressure differentials.

The A/E shall evaluate the use of portable or permanent smoke removal systems to be used after a fire event to clear the space of smoke. Design of HVAC zoning shall be done in coordination with fire alarm and evacuation strategies to allow building sections to be isolated and avoid entire airport evacuation.

9.1.2.3 Piping Design

A pipe stress analysis will be performed to ensure the system has adequate flexibility and to determine support, equipment reaction forces, and support spacing. Expansion loops and/or expansion joints will be provided where necessary to limit pipe stress or reaction forces in accordance with the applicable ASME B31 piping code. Where possible, the use of engineered expansion loops is preferred to expansion joints.

9.1.3 Design Coordination

Design considerations will also include the involvement of multiple SAT teams (infrastructure, operations and maintenance, electric). Stakeholder involvement during design charrettes is key to the projects.

The A/E's MEP Engineer will synchronize panel load distribution with the mechanical equipment and location. Designs with one side loaded electrical panels are not acceptable.

The A/E will consult and seek approval from SAT architectural team in order to select terminal devices and duct strategies that meet aesthetics and architectural goals.

When designing security checkpoint facilities, coordination with TSA at the early phase of the project is required. The design team shall account for 1-1.5 years for TSA to fully respond to all inquiries.

9.1.4 Materials and Equipment

9.1.4.1 Insulation

Pump Insulation: Chilled and hot water pumps will be insulated with flexible elastomeric cellular insulation. Pumps less than 30 horsepower may not be insulated, however; insulation will terminate at unions, flanges, etc., in a neat sealing manner, with pump bed plate section designed to drain all moisture.

Internal Duct: Generally, all ductwork except exhaust ductwork will be externally insulated in accordance with temperatures involved, the current International Energy Conservation Code (IECC), and International Fire Code. Ductwork insulation materials will be selected for the function involved, considering sound absorption coefficients, velocities, etc. Particular attention will be given to the first 20 feet of duct mounted on the supply (discharge) side of AHUs. The A/E will utilize double walled, perforated duct for sound absorption if required.

External duct, low velocity: Wrap may be used where insulation is not exposed to abuse. Where insulation may be subject to abuse, insulation will be 2-inch thick, 3-pound/cu. ft. density glass fiber with rigid board duct insulation, and complete with reinforced foil-kraft integral heavy vapor proof covering on the outside surface. Insulation will have a minimum compressive strength of 140 pounds per square foot at 10 percent deformation. Securely fasten all edges, joints, etc., to provide a vapor proof duct. Rigid insulation will be mechanically fastened to the duct.

External Duct High Velocity: Generally, high velocity ductwork requiring external insulation will be insulated with blanket wrap fiberglass insulation, 1-½ inch thick at 1 pound/cu. ft. density or minimum thermal resistance of 6.0, complete with a scrim kraft jacket. Facing overlapping joints will be at least 2 inches and held in place with outward clinching staples on approximately 4-inch centers. Underside of ducts exceeding 24 inches wide or 24 inches in diameter will be mechanically fastened.

High velocity, flexible duct, will be Underwriter's Laboratories, Inc. (UL) 181, Class I, with a rating to meet or exceed the National Fire Protection Association (NFPA) 90A-90B and reinforced with a perforated sheet metal inner jacket.

All piping and vessels with a surface temperature less than ambient temperature, will have a vapor barrier covering. The vapor seal will be continuous, unbroken, and adhere to the surface so that the insulation is airtight in order to minimize the possibility of vapor draining into the insulation material.

Form fitted polyurethane insulation will be used on all coil header piping to the extent necessary to include all valves, including flow control valves, and other appurtenances utilized to evaluate the performance of the coil.

Chilled Water Pipe Insulation: Generally, chilled water pipes will be insulated with 2-inch-thick insulation. ASHRAE Standards will be followed if the design requires a greater thickness. Outdoor and unconditioned indoors will be cellular glass. Jacket laps and butt strips must be adhered with vapor barrier adhesive or position sealing system. Tee fittings are not allowed due to bull head pressure. Insulate all fittings and valves using preformed fitting insulation of same material, density, and thickness as used for adjacent pipe.

Galvanized steel saddles, 16 gauge – 18 inches long, will be installed at all pipe supports to protect the insulation. Higher density insulating materials must be used at pipe supports, if required to prevent crushing/cutting of insulation. All exterior exposed pipes will have aluminum metal jacket as specified below.

Direct buried chilled water piping will be pre-insulated with urethane foam, 1½ inches thick. Joints will be piston-ring, internally guided, double-expansion joint, or a pack-less expansion joint.

All exterior exposed pipes will have aluminum metal jacket as described below. Direct buried chilled water piping will be pre-insulated with 2-inch thick urethane foam.

Hot Water Piping: Follow description above for chilled water piping, except, that vapor barrier is required on direct buried pipe only.

Condensate drain, refrigeration suction, and chilled water piping 2 inches and smaller, follow the description above for chilled water piping. Acceptable thickness will be 1 inch.

All chilled water and hot water piping, in tunnels or exposed to the outdoors, will have a smooth finish aluminum metal jacket. It may also have a small rib texture aluminum metal jacket on calcium silicate. The minimum jacket thickness will be .016 inch.

Chilled and hot water pumps will be insulated. Provide removable insulated enclosure over pump casing to facilitate pump maintenance.

9.1.4.2 Pipe Material

Hot and chilled water piping inside buildings will be steel.

Expansion joints will provide 200 percent absorption capacity of piping expansion between anchors. All chilled and hot water piping joints will be welded, therefore, special consideration must be given to pipe layout for expansion and contraction. Show pipe guide locations on all aboveground anchored piping. Show anchor locations on plans. Provide anchor detail(s).

Vertical pipes must be supported at each floor with pipe clamps.

Hot and chilled water piping inside buildings, with diameter of 4" or smaller may be type K or type L copper.

Underground hot and chilled water piping is NOT allowed without the approval of SAT.

Refrigerant piping will be Type ACR (Air-Conditioning and Refrigeration) copper, capped and cleaned. Joints will be purged with nitrogen.

9.1.4.3 Pumps

Impellers will be one piece, hydraulically and statically balanced, and keyed to the shaft. Impeller size will not be more than 90 percent of the maximum impeller size allowed for the pump casing.

Pump and motor bearings will be grease-lubricated and complete with Alemite (Zerk) fittings.

Provide variable volume pumping systems with variable frequency electric drives.

Provide pressure gauge taps with stop cocks and gauges on suction and discharge sides of the pump. Provide thermometer wells on suction and discharge sides of pumps.

Horizontal split case pumps will be constructed so that removal of pump shaft impeller, seal, bearings, etc., may be possible without the removal of the pump casing from the line, or disconnecting either suction or discharge connection.

Motors will be American National Standards Institute/National Electric Manufacturers Association (ANSI/NEMA) MG 1 High efficient.

Chilled water and hot water pumps will be arranged with suction and discharge headers to allow use of any pump with any chiller, cooling tower etc., as applicable.

Chilled water and hot water piping controls diagrams, indicating pump and equipment configuration, should be provided with location of all control devices shown. Control valves shall have their normal (fail) position indicated on the diagram.

Mechanical seal assembly will have replaceable seats.

Connections will be flanged or union connection (type depending on size, pipe, and work space restrictions).

9.1.4.4 Ductwork and Terminal Devices

All ductwork systems will be constructed and installed in accordance with Sheet Metal & Air-Conditioning Contractor's National Association (SMACNA) and ASHRAE guidelines, specifically SMACNA's "HVAC Duct Construction Standards – Metal and Flexible Ducts". For all AHUs, ductwork pressure class will be medium class constructed to 4-inch water gauge (w.g.) (minimum) seal class will be Class A. Any variable air volume system duct of 1 inch w.g. (250 Pa) and 1/2 inch w.g. (125 Pa) construction class that is upstream of terminal units will meet Seal Class B.

Ductwork material will be zinc-coated sheet steel of the thickness of the metal and stiffeners as indicated in the SMACNA Manual. The seams will be sealed per SMACNA's Standard Duct Sealing Requirements.

Plenum return is not acceptable. Return air must be ducted. All ductwork will be insulated. Airflow measuring stations accompanied with temperature sensors will be installed and interfaced to the Building Management System wherever a branch of ductwork handles 10 percent or more of the total cubic feet per minute (cfm) of the dedicated AHU.

Ductwork installed below the floor shall be avoided to eliminate the risk of flooding in the ductwork. The use of floor diffusers is discouraged unless no other reasonable solution exists. Duct in crawl spaces or below grade will be constructed with watertight joints and will be tested and proved tight before floors are poured. Underfloor duct systems may be constructed of fiberglass, polyvinyl chloride (PVC) or other approved non-metallic material.

Nonmetallic ducts are prohibited, unless approved by SAT

All variable volume terminal units will be equipped with at least a three-diameter length of straight rigid duct immediately upstream of the volume control devices.Acoustical duct liner is not allowed. Use double wall acoustic duct where sound attenuation cannot be accomplished by other methods and the duct is not serving occupancies that are sensitive to particulates. Increase the outside duct dimensions as required to maintain adequate internal cross sections.

Flexible ductwork will comply with UL 181 Class 1, and will meet or exceed NFPA 90A-90B rating. All diffusers will have dampered insulated boxes with minimum box height of 1 foot.

Ductwork will be leak-tested per SMACNA guidelines. Indicate those HVAC duct systems to be leak tested on the contract drawings. Specify the test type and test pressure for each duct system (supply air, return air, exhaust air, and outside air ductwork) subject to testing.

Indicate duct static pressure, seal and leakage classifications on the drawings in accordance with SMACNA-HVAC Air Duct Leakage Test Manual. Include a completed "Ductwork Construction and Leakage Testing Table" on the drawings.

Wherever ductwork is connected to fans, AHUs, or other equipment that may cause vibration in the ductwork, the connection to the equipment will be by a flexible insulated connection constructed of fire-resistant flexible canvas or other approved material. The connection will be suitable for the pressures at the point of installation.

Maximum length of flexible ductwork will be 6 feet.

All flexible ductwork connections to grilles and air devices will have a radius forming brace installed at the connection.

All kitchen duct will be fabricated and installed per SMACNA. All hoods (UL), ventilation, make-up air, supports and fire suppression will be compatible to relevant processes within the kitchen. Exhaust ducts will be sloped toward the hood.

All terminal devices, such as diffusers and grilles for supply and return air, will be coordinated with the SAT architectural team in order to meet aesthetics and architectural goals. In addition, the material of surfaces adjacent to a terminal device will be selected to prevent staining and ensure convenient cleaning processes.

Terminal devices will be selected to meet performance requirements while minimizing the visual impact on the architectural design. Concealed linear and T-bar diffusers are the preferred option for supply and return terminal devices, unless otherwise indicated. The use of nozzle diffusers is discouraged. In general, SAT encourages diffusers similar to those in Terminal B check-in area.

Ductwork taps to supply diffusers should be made using bellmouth or "boot" connections. Boot connections should be from the side of the duct, not the bottom. This will allow for a better location for the volume dampers.

Show all ductwork on the same plan for each floor: high pressure, low pressure, exhaust, etc.

Do not use the following types of duct construction where the potential for subterranean termite infestation is high:

- Sub-slab or intra-slab HVAC ducts.
- Plenum-type, sub-floor HVAC systems, as currently defined in Federal Housing Administration minimum acceptable construction criteria guidance.
- HVAC ducts in enclosed crawl spaces that are exposed to the ground.

HVAC systems where any part of the ducting is in contact with or exposed to the ground.subterranean termite infestation is high:

9.1.4.5 Chillers

Chiller selection and sizing shall be determined based on load calculations. The chillers shall be open drive, centrifugal type, using an approved refrigerant. All chiller prime movers for new equipment shall be electric driven and variable speed. Chillers shall have a maximum energy consumption of 0.60 kW/ton at design conditions. Chillers should be selected based on a lifecycle cost analysis.

Chiller design parameters:

- Chiller Entering Water Temperature - 56°F, unless noted otherwise
- Chiller Leaving Water Temperature - 40°F, unless noted otherwise
- Condenser Entering Water Temperature - 71°F, unless noted otherwise
- Condenser Leaving Water Temperature - 81°F, unless noted otherwise
- Chillers shall be furnished and piped in such manner as to provide easy access to the tube bundles for cleaning. Chiller machine motor, gear drive, and compressor shall be mounted on a common base to ensure shaft alignment.
- Chillers must be provided with controls to modulate operating capacity to match load, safety controls, limits, interlocks, and accessory devices to maintain efficient, safe operation per manufacturer's recommendations.

9.1.4.6 Boilers

Boilers shall be provided with dual burners and controls and shall be fired on natural gas. The boilers shall have a minimum efficiency of 80% and shall be provided with combustion controls to maintain maximum combustion efficiency over the full burner modulating range.

The boiler burners shall be arranged for a high turndown ratio for improved operation at low firing rates. Ultra-Low-NOx burners shall be used. Flue gas economizers should be considered and utilized if an economic study indicates that a suitable cost savings could be realized. Flue gas recirculation shall be provided to minimize air pollution effects.

9.1.4.7 Cooling Towers

For cooling towers and evaporative condensers, conduct a one-time potable water analysis, in order to optimize cooling tower cycles. Measure at least the five control parameters listed below:

Parameter	Maximum Level
Ca (CaCO3)	1,000 ppm
Total alkalinity	1,000 ppm
SiO2	100 ppm
Cl	250 ppm
Conductivity	2,000 uS/cm

Calculate the number of cooling tower cycles by dividing the maximum allowed concentration level of each parameter by the actual concentration level of each parameter found in the potable makeup water. Limit cooling tower cycles to avoid exceeding maximum values for any of these parameters. Achieve a minimum 10 cycles by increasing the level of treatment in condenser or make-up water and use a minimum 20 percent recycled non-potable water.

9.1.4.8 Air Handling Units (AHUs)

Provide a hand operated "auto/on/off" switch and remote control terminations at each air handling unit location with properly sized integral heaters. Also provide a fused disconnect switch at each location. AHU fans that provide more than 5,000 cfm of air will be AHRI certified semi-custom watertight and airtight units and will have fan array system with a separate VFD for each fan. There will be no condensation forming on the unit exterior and units will be provided with backdraft dampers to prevent short circuits.

Chilled water and hot water coils will be continuous copper tube type with copper or aluminum fins. See Coils sections for additional details.

Provide stainless-steel drain pan, insulated, sloped in two or more planes to eliminate stagnant water with a drain line no less than ¾-inch in diameter or size of tap on drain pan. Use a plugged tee for all changes in direction rather than a 90 degree ell. Condensation will be drained to the sanitary sewer.

AHU casings will be double-wall construction, galvanized steel rigid with minimum 2 inch thick injected closed cell foam insulation between the walls. The casing design will have no-thru-metal in the roof, walls, floor and doors. Under no circumstances will it be acceptable to have insulating materials exposed to the air stream. AHUs will meet ASHRAE 111 Casing Air Leakage Rating Class: CL6 and Casing Deflection Rating Class: CD2. AHUs will have factory mounted and tested controls, end devices with generic input and output signals.

Coil casing will be stainless-steel.

Fans – spring mounted fan drives with internal flexible connection on fan discharge. Use of belts is discouraged for motor-fan interface.

Bearings – 200,000 hours at maximum horsepower and speed, grease lubricated pillow block bearings with grease fittings accessible from outside the unit. Bearing will be protected from induced currents.

Air handling equipment must be equipped with filters as per ASHRAE 52.2. High efficiency filters will be provided on equipment over 5,000 cfm, medium efficiency filters on less than 5,000 cfm. Filters are to be provided with minihelic gauges (alarmed) that will measure pressure drop across the filter. Filters will be 2-inch thick throwaway, efficient, pleated type contained in rigid media frame with supporting maze across leaving face of media.

Medium efficiency filter design is – 500 foot/min, 0.28-inch w.g. initial resistance, MERV13.

High efficiency filter design is – 500 foot/ min, 0.68-inch w.g. initial resistance, MERV14. Generally, space conditioning filters will be 2 inch thick with dimensions of 20 inches x 20 inches, 20 inches x 25 inches, 16 inches x 20 inches or 16 inches x 25 inches, preferably.

Electric motor speeds in excess of 1,800 revolutions per minute (rpm) are discouraged. Fans will be selected for the highest efficiency and airfoil type is preferred. Motors will be ANSI/NEMA MG 1.

Custom outdoor AHUs will provide preconditioned make-up air to applicable HVAC systems throughout terminal facilities. Units must have an energy recovery device for additional energy savings, pre-filters, air purifier, high efficiency filter, hot water coil (pre-treat), chilled water coil, VFD controlled fan, CO2 monitor and control, stainless-steel interior liner, and the factory will provide units with mounted test ports. Casing Air Leakage Rating Class: CL6, Casing Deflection Rating Class: CD2. The units will also have the following:

- Pre-filters - medium efficiency pleated.
- Air purification systems will be capable of controlling microorganisms such as mold, bacteria, vapors, and other airborne particulates.
- Controlling gas phase contaminants including volatile organic compounds (VOCs) found in airport applications such as the following: Jet and automotive exhaust, Tri-cresyl phosphates, Aldehydes, Acetic acid, Carbon monoxide, Sulfur oxides, Bio effluents, Acetaldehyde, Acetic acid, Acetone, Allyl alcohol, Ammonia, Amyl alcohol, Butyric acid, Diethyl ketone, Ethyl acetate, Ethyl alcohol, Formaldehyde, Methyl alcohol, Hydrogen sulfide, Methane, Phenol, Toluene.

Reducing static space charges. Complies with UFC 4-010-01 (8 October 2003 including change 1, 22 January 2007) Standard 18. Emergency Air Distribution Shutoff for Antiterrorism Force Protection.

As tested by the Department of the Army, U.S. Army Dugway Proving Ground, Dugway, UT in conjunction with minimum MERV 13 rated filtration, the photocatalytic oxidation system must be able to remove or neutralize better than 98 percent of airborne bacterial spores. The entire assembly will bear the UL Classification Mark and be investigated in accordance with ANSI/UL 1598, “Luminaires,” and ANSI/UL 1995, “Heating and Cooling Equipment,” under the Air Duct Mounted Accessories category (ABQK). Compliance is to be verified by the UL Online Certifications Directory.

Access covers to water coils on the AHU housing will be readily removed for access to coil headers without piping disconnects or demolition of surrounding structures.

Cooling coil design will be based on the criteria described in this Standard.

Show condensate drain lines from air handling units, fan coil units, etc. Indicate required depth of water trap. Show slope from drain pan.

9.1.4.9 Rooftop Units

Rooftop systems will be completely self-contained, with factory wired controls, and factory assembled components and piping. Equipment will have 2-inch-thick pleated replaceable media filters. Compressors must have a 5-year warranty, including parts and labor (5 tons and under). All curb-mounted units will be furnished with appropriate enclosed engineered curbs to provide for level unit mounting with minimum 16-inch curb height above top of the roof deck surface. An alternative is a structural steel support frame with a minimum of 40-inch clearance above finished roof. All rooftop systems require approval from SAT and are generally discouraged.

9.1.4.10 Split DX Systems

Split systems will consist of furnace, coil section with direct expansion cooling coil, air-cooled condensing unit or heat pump, piping, controls, etc. All components will be factory wired and assembled. Furnaces will have filter racks complete with a 1-inch-thick throw-away filter. Compressors will have a 5-year warranty, including parts and labor (5 tons and under).

Split system air conditioners must have a Seasonal Energy Efficiency Ratio (SEER) rating of 13 or it must meet the latest version of the IECC requirement adopted by COSA and SAT, whichever is greater. Split system air conditioners are generally discouraged.

Fan-Coil Units (FCUs) will have a high, medium, low, and off switch where adjustments can be made without removal of the access door or unit housing. This switch will be easily accessible for room or area occupant's personal adjustments. FCUs will be double-wall construction as described for modular indoor AHUs. FCUs are generally discouraged. For rooms requiring redundant AHUs or computer room air-conditioning (CRAC) units, the A/E will consider using split direct expansion systems for redundancy. The system controls will allow for periodic start/stop of the unit.

FCUs will be equipped with replaceable pleated filters. A minimum of MERV 7 should be used but where the static pressure requirements allow higher MERV values, using up to MERV 13 should be attempted.

The use of FCUs will be limited to sizes below 2,000 cfm and will require prior approval from SAT.

9.1.4.11 Coils

Chilled water and hot water coils will be of the continuous copper tube type with copper or aluminum fins. Tubes will be counter flow with side coils into casing through removable panels and blank off sheets, maximum water velocity of 8 feet/second and either 1/2-inch or 5/8-inch outside diameter tubes, 12 fins/inch with copper headers, 1/2-inch tube thickness of 0.020 inch, 5/8-inch tube thickness of 0.025 inch. Maximum airflow velocity will not exceed 500 feet per minute. All coils will be cleanable and drainable. Each tube will be accessible without piping disconnect. Headers must be removable at the opposite end. All water coils will have maximum flow rate control devices in the return line.

Air Coil selection will comply with ARI 410, "Standard for Forced-Circulation Air-Cooling and Heating Coils".

All strainers should have blow-down valves with 3/4" hose end connections.

Provide coil entering and leaving air conditions on the drawings. For cooling coils include wet bulb, dry bulb, and dew point temperatures at the design flow rate. Ensure these conditions adequately cover the design latent load. For heating coils provide entering and leaving air temperature. Include face velocity for coil selection.

Chilled Water Cooling Coil selection:

- Coil entering water temperature – 42.5°F, unless noted otherwise
- Coil Water temperature rise – 16°F, unless noted otherwise
- Maximum air face velocity – 500 feet per minute

High Temperature Water Heater (HTHW) Heating coil selection:

- Coil entering water temperature – 240°F will be operable at 300°F
- Coil Water temperature drop – 60°F
- Maximum air face velocity – 500 feet per minute

Coil Valves: Control valves will be pressure independent control valve (PICV) two-way control valves. Use of three-way chilled water valves are prohibited.

9.1.4.12 General

MEP formed and or fabricated materials, except devices and equipment, will be produced and shipped within a 500-mile range of SAT facilities.

No recycled content will be allowed for MEP equipment.

Variable Frequency Drives (VFD): Ultra low harmonics.

Water hammer arrestors, air duct acoustic silencers, vibration sound mufflers, etc., may be included in the design. Design must decrease reverberations to make it more hearing friendly. Sone/NC levels will be per ASHRAE or as agreed to by the A/E.

9.1.5 Balancing and Testing

The balancing, testing, and adjusting of HVAC systems will be performed by an independent technical firm or balancing agency not involved in the design. The balancing firm will be Associated Air Balance Council or National Environmental Balancing Bureau certified. All tests will comply with certification agencies standards and practices.

Contract drawings must specify the valve size and flow for each application. When an existing system is modified, provide all information required for re-balancing in the construction documents. Detail installation of all flow control balancing valves.

9.1.6 Warranty

Warranties will be as provided below. Consult with SAT if additional warranties are beneficial for the specific project.

9.1.7 Metering and Sequence of Operation

A clear sequence of operations will be provided by the A/E in the construction documents. The record documents will reflect changes made during construction and start-up tests.

Meters and gages for HVAC Piping: Permanently installed British thermal unit (BTU) metering is required for all chilled and hot water applications served by a central utilities plant. Metering must provide flow, temperature, and BTU per hour values to the respective energy management system. Meters must:

- Record at intervals of one hour or less, and transmit data to a remote location.
- The system must be capable of storing all meter data for at least 36 months.
- The data must be remotely accessible.
- All meters in the system must be capable of reporting hourly, daily, monthly, and annual energy use.

All tenant facilities will be metered using revenue-grade metering devices.

Terminal facilities will be kept in positive pressure and will be monitored by gauges using pressure differential sensors, similar to Magnehelic. These sensors will be in multiple strategic locations inside the building.

Air pressure and velocity reading devices are required at each connection point between main sections of the airport. Consult SAT for detailed locations.

The A/E will consider that animal retention areas/facilities will be designed and kept at a negative pressure. Dedicated mechanical systems will be considered where applicable.

Terminal facilities will be designed to maintain pressurization while the boarding bridges are in use. Boarding gate sensors will provide a signal to the VAVs and outside air unit sensors in order to adjust the fresh air accordingly and prevent pressure loss.

ASHRAE 62.1, ventilation requirements, will be exceeded by 30 percent at a minimum. Eliminating energy waste and parasitic heating will be a key design element.

In terminal facilities, ceiling plenum return is not accepted. Provide airtight ducted return system.

Rotating equipment redundancy, N number of pumps, fans, etc.

If $N < 3 = N + 1$

If $N \geq 3 = N + 2$

Revenue metering will be provided at all tenant facilities for electricity, lighting, water, natural gas, chilled water (CHW) and heating hot water (HHW) flow, differential pressure, and differential temperature.

Install metering equipment enclosure in accordance with power provider guidelines.

All revenue meters will be smart meters where trending will be possible through a Supervisory Control and Data Acquisition (SCADA) and BAS. Meters must:

- Record at intervals of one hour or less, and transmit data to a remote location.
- The system must be capable of storing all meter data for at least 36 months.
- The data must be remotely accessible.
- All meters in the system must be capable of reporting hourly, daily, monthly, and annual energy use.

In addition to industry best practices and code requirements, the following key points will be included in the Sequence of Operations for HVAC controls:

- Supply an air temperature and pressure reset schedule according to the outside air temperature.
- System response to humidity conditions exceeding 60 percent relative humidity.
- Night time and weekend setup/setback schedule will be patterned to match the building usage for both terminal units and AHUs.
- Coordination of the use of return fans, such as turning the fan off when supply air pressure can be effectively maintained by the supply air fan only.
- Areas that require dedicated cooling support, such as data or communications rooms, must provide constant cooling (24/7/365).

Individual space control is desired for each totally enclosed office space or room. Individual terminal units, or a two-position damper, may be utilized with controls.

9.1.8 Flexibility

Baggage Handling System (BHS) equipment and security checkpoint equipment are usually an underestimated heat release source and results in complaints. A proper design coordinated with SAT is required at the occupied areas.

Piping and ductwork risers must be considered and designed as headers for future expansion. Likewise, there must be allowances in the electrical power circuits.

For terminal facilities, the design must have flexibility to accommodate future expansion, inclusive of new retail, food and beverage concessions and restrooms.

Booster pumps for chilled and hot water systems will be controlled via tie-in to the

central utilities plant distributed control system via the BAS control system. All requirements must be verified and approved by the BAS Administrator.

9.1.9 Mechanical Drawings

Drawings must show equipment, ductwork, service access panels, and piping sufficiently to indicate all aspects of installation. Provide sections and elevations to supplement plan views.

To ensure serviceability, show the minimum access area around mechanical equipment, for both ground level and above ceiling equipment. Identify space necessary to access and replace items that require maintenance, such as filters, coils, heat exchangers, tube bundles, strainers, and chillers on the drawings in three-dimensions.

All volume dampers should be shown on the plans.

The equipment actually installed on a project may be different from that used in the basis of design. Therefore, mechanical equipment schedules must reflect actual required equipment capacities as calculated, not capacities provided by manufacturers' catalog data. This helps ensure that the installed equipment is optimally sized for the application.

When drawing congestion is likely, ductwork and piping should not be shown on the same plan. Single line ductwork layouts are not allowed on final drawings; provide a two-line ductwork layout to scale.

Show thermostat locations on the plans, and humidistats when required.

Show hanger rods and structural supports for all ceiling or roof-mounted air handling units, heating/ventilating units, fan coil units, exhaust or supply fans, expansion tanks, etc., in drawing details.

Mechanical rooms must be drawn at no less than ¼" = 1'-0" (1:50). Congested mechanical rooms must be drawn at no less than ½" = 1'-0" (1:20). Mechanical room plans should be supplemented by at least one (1) section; at least two (2) sections for more complex, congested applications.

Provide a three (3)-dimensional isometric diagram representing the mechanical room piping or a two (2)-dimensional diagram indicating the entire system. Indicate shutoff valve locations to allow replacement of control valves and system components.

9.1.9.1 Control Valves schedule

Provide flow rates, minimum Cv or maximum pressure drop, nominal valve size, service (i.e. steam, hot water, etc.), configuration (i.e. 2-way or 3-way), and action (i.e. modulating or 2-position).

9.1.9.2 Outdoor Air Schedule

Provide an outdoor air schedule on the drawings. List the outdoor air to each zone with the number of anticipated occupants. Add a footnote to each schedule indicating that the number of occupants listed is for information purposes only.

9.1.9.3 Vibration Isolator Schedule

Where vibration and/or noise isolation is required, provide a vibration isolator schedule on the drawings indicating type of isolator, application, and deflection in inches.

9.1.9.4 Fouling Factors

Indicate fouling factors for all water-to-air and water-to-water heat exchangers (i.e. coils, converters, chillers, etc.). Indicate in the appropriate equipment schedule. Fouling factors must be accompanied with their appropriate English Units.

9.1.9.5 Pressure Gauges

Indicate pressure gauge ranges; system operating pressures should be midrange on the graduated scale.

9.1.9.6 Roof Fans

Details of roof exhaust fans must include a requirement for airtight seals between the fan frame and the wood nailer of the roof curb. The details must require the duct of ducted exhaust fans to extend up through the fan curb to a flanged and sealed termination at the top of the curb.

9.1.10 Service and Access

Avoid locating FCUs, VAVs and all air moving devices above ceilings of occupied spaces. This equipment must be located in perimeter locations with sufficient accessibility. Terminal units located above finished ceilings will have adequate ceiling access panels or other means of access to the unit for maintenance and removal. Except for lift out ceiling installation, all access panels will be hinged.

Drawings must indicate the location and size of access panels in floors, walls, and ceilings (except in lay-in tile applications) as required to access valves, smoke dampers, fire dampers, balancing dampers, balancing valves, air vents, drains, duct coils, filters, air flow monitoring stations, equipment, etc. The access panels must be painted to match adjacent surfaces.

Equipment with proprietary service tools, which are not available to anyone other than the manufacturer, are not acceptable.

Equipment located above ceiling must be identified on the ceiling grid. The identification tag must match what is on mechanical schedules. Provide removable tiles, panels, and doors as required for equipment and service panel access.

Minimum appliance access is thirty (30) inches by thirty (30) inches.

HVAC equipment operational information must be located within each mechanical room.

Provide a fused disconnect for unitary equipment such as AHUs.

Sensing bulbs and instruments will be accessible on mounted, vibration free supports.

If needed, provide access to units by catwalks or decks.

Adequate equipment rooms, shafts, ceiling spaces, and clear spaces around equipment will be allocated. The A/E must specify easily accessible color coded paint on visible equipment items. Free standing binnacle type, column type air ducts, or diffusers will be avoided. Equipment will be located beyond passengers' reach.

Access should be provided to mechanical room spaces without going through any assigned area such as a janitor closet.

Field lubricated ball bearing equipment is preferred over sleeve bearings. All air handling equipment will be selected and installed so that bearings can be replaced with minimum demolition of equipment or surrounding structures.

Bearing lubrication points will be extended to a central external accessible point and fitted with Alemite (Zerk) fittings.

Each component of an air handling system should be spaced in the unit so that there is ample room on all sides for inspection and maintenance and man-sized, hinged access doors should be provided for ready access to these spaces.

Mechanical equipment should be ground mounted outside or located within the building. It is preferable that equipment be located in hallways, exterior mechanical closets, mezzanines, or a mechanical yard in order to facilitate servicing equipment without moving furniture or disrupting staff.

Roof-mounted equipment is not preferred, this should be evaluated on a project by project basis, specifically where cost is a major challenge, space limitations, etc.

Provide a level mechanical area/slab. On sloped roofs with a 3:12 pitch or more, a level platform and guards are to be installed (IMC 306.5.1).

Walkways shall be provided to roof-mounted equipment so it may be serviced without walking/traffic directly on roof.

Roof-mounted equipment should be accessible by a stair. Hatches without stairs or use of external ladders are not acceptable.

Access covers to water coils on the AHU housing will be readily removed for access without piping disconnect or demolition of surrounding structures.

Provide hinged access doors with gaskets to AHU sections with view windows. Provide

marine lights in each AHU section with timer-driven light switches on outside of unit.

Chilled water and hot water control valves will be pressure independent with flanged or set in unions for easy removal.

Detail all accessories, to include pressure reducing valves (PRV), relief valves, and backflow preventers. Show pressure reducing and relief valve pressure settings.

Engineered vibration isolation will be provided to prevent excessive noise or transmission of vibration to the building structure due to the operation of machinery or equipment, or due to interconnected piping, ductwork, or conduit.

The vibration isolation system will consist of foundation, base, spring isolators, and rubber and shear pads as necessary to provide maximum isolation conforming to 2019 ASHRAE Handbook, HVAC Applications, Chapter 49 Table 1; or a local equivalent. Calculate or measure sound levels.

9.1.11 Sustainability

Design will follow ASHRAE 90.1 "Energy Standard for Building", ASHRAE 62.1 "Ventilation for Acceptable Indoor Air Quality", ASHRAE 55 "Thermal Comfort for Human Occupancy", and Federal Aviation Administration (FAA) Design Standards. SMACNA Indoor Air Quality (IAQ) Guidelines for Occupied Buildings under Construction, 2nd edition ANSI/SMACNA 008–2008, will be used for providing design and project management guidance in maintaining satisfactory IAQ of occupied buildings undergoing renovation or construction.

Design of mechanical systems will allow sub-meters and data collection within the building.

For unoccupied buildings after construction completion, prior to occupancy, and with all interior finishes installed, install new filtration media and, perform a building flush-out. This is performed by supplying a total air volume of 14,000 cubic feet of outdoor air per square foot of floor area while maintaining an internal temperature of at least 60°F and no higher than 80°F and relative humidity no higher than 60 percent.

Equipment manufacturers must have a presence (manufacturer, distributor, sales office) and will have established service centers within the San Antonio city limits. If none is available, manufacturer must have presence within 500 miles.

During construction, the Contractor will develop templates to track sustainability compliance for VOC Content levels product material disclosures, and regional materials.

Continuous Commissioning® (CC), or similar philosophy, will be reviewed and discussed with SAT for possible implementation. Training will be completed before commissioning, after occupancy, and one year after occupancy.

Select mechanical equipment that uses only refrigerants (naturally occurring or synthetic) that have an ozone depletion potential (ODP) of zero and a global warming potential (GWP) of less than 50.

9.1.11.1 Life Cycle Cost Analysis

- For projects requiring a Life Cycle Cost Analysis, these requirements will apply.
- The A/E Consultant will provide a narrative description of all system alternatives considered to include the results of the Life Cycle Cost Analysis (LCCA) and modeled energy use. The energy model must include model inputs and outputs, on optimized system level alternatives by energy type. A description of special mechanical systems such as compressed air, hydraulic, nitrogen, lubrication oil, etc. must also be included.
- The Consultant must show calculations and assumptions supporting equipment selections in a clear and organized manner. When charts or tables are used in the design analysis, cite the source and date of the publication. The Consultant must also provide calculations for sizing equipment, piping, ductwork and all accessories.
- Provide the model number and manufacturer of each major piece of equipment used as the basis for the design.

9.1.12 Execution

9.1.12.1 Installation

For all equipment and materials, installation will comply with manufacturers recommendations and the IBC and IEEE as amended by COSA. All ductwork will comply with SMACNA.

Penetrations within mechanical room floors should be made within three (3)' feet of housekeeping pads or perimeter curbs to avoid water damage into lower levels.

Exhaust fans should have walking platforms and railings when located on sloped roofs or must otherwise be of inline type no higher than 10 feet AFF.

9.1.12.2 Pre-Start Up

All hydronic piping will be hydrostatically tested prior to placing in service. The Contractor will fill the system with water and hydrostatically test to a pressure of 150% of the operating working pressure. During this process, all major equipment such as AHUs and pumps will be isolated. Once the test pressure is achieved, it must maintain the test pressure for a duration of four hours after the hydrostatic pump is removed. The test is successful with a zero pressure drop for the duration of the test.

At successful completion of hydrostatic testing, the system will be flushed for approximately two hours at a rate of 12 feet per second for a minimum of 15 minutes to remove any construction debris. During the flushing process, make-up water will be added at a rate equal to the flush water. A temporary trash pump will be used and all system pumps and major equipment, such as AHUs, must be isolated and bypassed.

Once the system is flushed, the Contractor will refill, circulate, and add an approved chemical cleaner to the system at a concentration recommended by the chemical manufacturer. The system will be allowed to circulate at a minimum rate of 7 feet per second for a duration of 24 hours. At the completion of the 24 hours, the Contractor will flush the system with potable water. SAT will deem the test satisfactory when the flush water has reached the water quality standard for potable water. If the test fails, the Contractor will be required to repeat the chemical cleaning process until required results are achieved. The potable water parameters will be measured at the beginning of the test.

9.2 Glossary

ACR : Air-Conditioning and Refrigeration

A/E: Architect / Engineer

AHU : Air Handling Units

ANSI : American National Standards institute

ASHRAE : American Society of Heating, Refrigerating and Air Conditioning Engineers

ASME : American Society of Mechanical Engineers

BAS : Building Automation System

BHS : Baggage Handling System

BTU : British Thermal Unit

CHW : Chilled Water

CoSA : City of San Antonio

ConRAC : Consolidated Rental Car Facility

CRAC : Computer Room Air- Conditioning

FAA : Federal Aviation Administration

FCU : Fan-Coil Units

GWP : Global Warming Potential

HHW : Heating Hot Water

HTHW : High Temperature Water Heater

HVAC : Heating, Ventilation, and Air Conditioning

IAQ : Indoor Air Quality

IBC : International Building Code

IECC : International Energy Conservation Code

IMC : Intermediate Metal Conduit

MERV : Minimum Efficiency Reporting Values

NEMA : National Electrical Manufacturers Association

NFPA : National Fire Protection Association

ODP : Ozone Depletion Potential

PBB : Passenger Boarding Bridge

PICV : Pressure Independent Control Valve

PVC : Polyvinyl Chloride

SAAS : San Antonio Airport System

SCADA : Supervisory Control and Data Acquisition

SEER : Seasonal Energy Efficiency Ratio

SMACNA : Sheet Metal & Air-Conditioning Contractor's National Association

TSA : Transportation Security Administration

UL : Underwriters' Laboratories

VFD : Variable Frequency Drive

VOC : Volatile Organic Compounds

10 FIRE PROTECTION

Photo by Christy Ash

10.1 Fire Suppression

10.1.1 Fire Protection

This chapter defines general design criteria for fire sprinkler systems and other fire suppression systems at San Antonio Airport System (SAAS) facilities.

All City buildings, regardless of minimum code requirements, must be provided with wet-pipe sprinkler fire protection systems throughout, except where disallowed by code or dry-pipe type is required for freeze or equipment protection reasons. All systems should be light hazard or greater, as may be required by code.

10.1.2 Design Criteria

10.1.2.1 Code Requirements

- Design will comply with requirements of the latest building code adopted and amended by the City of San Antonio as well as NFPA 13, 14, 20, 2001, and any other applicable codes as approved and amended by City of San Antonio, and coordinated with SAAS. The A/E is responsible for consulting SAAS aviation standards, airport regulations and design manuals to determine applicability. Identify and address potential conflicts with the design of the fire suppression systems.
- All systems must be in compliance with the Texas Insurance Code and NFPA.
- If there is a conflict between this design standard or any other code or requirement, use the most restrictive requirement and inform the SAAS project manager.

10.1.2.2 General Design

The fire suppression system will include, but not limited to, an automatic sprinkler system, standpipes with hose connections, clean agent systems, and pre-action sprinkler systems.

The wet sprinkler system should be zoned by terminal and with foresight into future renovation phases to minimize the impact of system impairment. Provide monitored butterfly valves to shut down sprinklers in certain areas where renovation may be frequent. Sprinkler piping should be upsized from what is hydraulically required to provide flexibility for future changes to the system.

10.1.2.3 Sprinkler Systems

The entire airport including its renovated areas shall be fully sprinklered with the following densities:

- Light hazard areas 0.10 gpm/sq. ft. over 1500 sq. ft.
- Ordinary hazard group 1 areas 0.15 gpm/sq. ft. over 1500 sq. ft.
- Ordinary hazard group 2 areas 0.20 gpm/sq. ft. over 1500 sq. ft.

Refer to NFPA 13 for increases in design area due to dry piping, sloped ceilings, etc. The spaces in the airport will have the following hazard classifications:

- Light Hazard – Gate seating areas, security checkpoints, gathering spaces, restrooms, offices, restaurant and cafeteria eating areas.
- Ordinary Hazard group 1 – Kitchens, mechanical and electrical spaces, IDF and MDF rooms, control rooms.
- Ordinary Hazard group 2 – Storage areas, baggage sorting and storage

Minimum size for main piping supplying fire sprinkler systems must be 6 inches in diameter.

10.1.2.4 Garages

A study should be conducted to determine how the garage should be sprinklered. The most recent IBC version requires all new buildings create new garage renovations and construction will include significant electric vehicle parking and charging station expansions. These create a new hazard in the garages that should be protected with a dry automatic sprinkler system. Use NFPA 13, and the IBC to determine based on garage height, area, and openness, if just the EV parking areas, the entire floor, or the entire garage should be sprinklered. The existing manual standpipe system should be tested and inspected to determine its condition. The existing manual standpipe can remain but should be replaced if significant corrosion is found.

Sprinkler types and finishes should be coordinated with the architectural plans for functional and aesthetic purposes. Use pendent sprinklers for areas with finished ceilings, and upright sprinklers for areas without ceilings. Sprinkler protection shall be provided above and below architectural ceilings such as grid, open cell, cloud, suspended, slat, and perforated ceilings. Sprinkler heads or cover plates should be custom painted by manufacturer to match the color of the ceilings and finishes in the architectural plan. Coordinate with the architectural and interior A/E to determine where to use concealed pendent sprinklers or recessed pendent sprinklers with escutcheons.

10.1.2.5 Pre Action Systems

Pre action systems may be used as the only fire protection system or with a clean agent system within certain spaces in the airport. These spaces include IT rooms, IDF and MDF rooms, uninterrupted power supplies, and control rooms. Pre action systems are to be fed from the main fire sprinkler riser. Pre action systems are to be double-interlocked. Activation can be initiated by spot type or aspirating smoke detection devices. All pre action systems shall be provided with a riser mounted or floor air compressor and a nitrogen generator.

10.1.2.6 Deluge Systems

The airport will have a deluge window sprinkler system as part of the B9 Gate Expansion project. Deluges systems should be used to create a separation when a fire rated wall cannot be installed. The deluge system must be initiated by an alarm device such as a heat or smoke detector. If

a deluge system is designed as a means of fire rating, a variance must be reviewed and accepted by SAAS facilities, the airport fire department, and the local AHJ.

10.1.2.7 Fire Shutters and Won Doors

Automatic fire shutters will be provided at any large vertical or horizontal opening for transferring baggage from a receiving area to the luggage pickup area. These shutters will close when a fusible link is activated by heat, and will create a physical separation between the two spaces and their fire loads. The A/E should place Won doors at large openings between terminals. These Won doors will be sequenced to close upon alarm activation.

10.1.3 Design Coordination

Design will be coordinated with other SAAS teams for system integration, and clash prevention. Electrical panels, pumps, air compressors, nitrogen generators and other monitored or powered equipment will be coordinated with electrical for power loads. Sprinklers will be coordinated with architectural features and ceilings to ensure adequate coverage above and below obstructions such as cloud, slat, open cell and perforated ceilings.

Rooms and spaces containing fire suppression equipment such as valves, testing equipment, etc. shall be provided with floor drains and temperature/climate control. These rooms should not have mixed uses such as custodial sinks and equipment that would provide access to fire sprinkler components by non-essential or unauthorized people.

10.1.4 Materials and Equipment

10.1.4.1 Piping & Drainage

Clean, pretreat, and prime all piping. Paint all sprinkler piping with one coat of red alkyd gloss enamel. Identify and paint all non-concealed sprinkler piping every 10 feet (Fire Riser or Fire Branch).

Piping for sprinkler systems is to be schedule 40 black steel for pipe sizes 4" and smaller. Schedule 10 piping is to be used for sprinkler and standpipe piping 6" and larger. Underground piping is to be ductile iron.

Piping in finished areas that do not have sprinklers directly connected them may be painted to match adjacent surfaces, provided piping is identified by painting two (2)-inch wide red alkyd gloss enamel bands every ten (10) feet and on both sides of wall, ceiling, or floor penetrations.

Hydraulic calculations must include a minimum pressure drop across backflow preventers of 12 psi, or the actual pressure drop, whichever is greater, regardless of type or size.

Secure all post indicator valves (PIVs) with a lock. Do not supervise PIVs with tamper switches.

Locate backflow preventers in the building or within a heated enclosure if freeze protection is necessary. Heat trace must not be used. Provide a low temperature supervisory alarm connected to the building FACP for heated enclosures. Locate backflow preventer assemblies no greater than thirty-six (36)-inches and no less than thirty (30) inches, measured from the bottom of the assembly, above finished floor.

Terminate all drainage piping or test piping from the fire pump or associated appurtenances (i.e., circulation relief valve, bowl drains, etc.), including backflow preventers, to the exterior of the building so it will not cause damage. The discharge shall not create an erosion problem. Discharge to the exterior must not interfere with exiting from the building. Water discharge must not cross an exit or exit discharge.

Drainage piping of less than ¾ -inch may discharge to a floor drain. The line discharging to the floor drain shall be center to the floor drain and a minimum clearance of three (3) inches from the outside of the pipe to the inside edge of the floor rain shall be provided.

Provide concrete splash blocks at main drain and inspector test connection discharge locations if not discharging to a paved surface. Protect outside ground and foundation from erosion.

Provide all equipment, i.e., control valves, backflow preventer, check valves, floor control valve assemblies with a minimum clearance of three (3) feet.

Do not provide side outlet tees using rubber gasket fittings.

Thrust rod and sleeve all pipe penetrations of grade floor slab.

Any drains, test connection pipe, etc that penetrate the exterior wall must do so not greater than two (2) feet above finished grade.

The drain/test connection must be piped to a location that will accept full flow and will not cause property damage when water is discharging. Discharge to any sink is not acceptable.

To facilitate testing, provide a permanently piped drain/test connection for each flow switch.

10.1.4.2 Valves

The A/E should discuss with the airport and provide butterfly valves or gate valves where required or requested by the airport.

Provide valve operation during normal condition and emergency condition.

The floor control valve assembly must consist of a control valve, check valve, water flow switch, drain/test connection, gauges, and must be electrically supervised.

Provide a separately zoned control valve assembly for piping serving Elevator Machine Rooms, Computer Rooms, Laboratories, and similar

rooms that require shunt-tripping of equipment simultaneously to the application of water. Locate the zoned control valve assembly outside of the area it serves in an easily accessible identified location.

Provide valve tamper switches (with tamper proof covers) for all normally open sprinkler system control valves, including isolation valves on backflow preventers.

10.1.4.3 Pumps

If needed, provide an electric fire pump and jockey pump that are sized to meet the most hydraulically demanding areas in the sprinkler and standpipe systems. The electrical load of the pumps should be coordinated with the electrical team to ensure that backup power can provide the necessary load.

10.1.4.4 Air compressors and Nitrogen generators

All dry and pre-action systems are to be provided with a riser mounted or floor mounted air compressor and a nitrogen generator. The nitrogen generators will reduce corrosion within the piping systems and improve system life.

10.1.4.5 Hangers and support

Provide hangers for all piping in accordance with NFPA 13. Coordinate hangers with structural plans for connections and support. Coordinate hangers with other MEP teams to avoid clashes and obstructions.

Provide thrust blocks at any change in direction for underground piping.

10.1.4.6 Control Panels

Provide a UL listed and approved controller panel that is rated for the electric fire pump and jockey pump. All pre-action systems are to be provided with a wall-mounted releasing panel that is easily accessible and within a reasonable proximity to the pre-action or deluge valve and/or the area protected. Avoid running wet pipe above all control panels.

10.1.5 Special Systems

The airport currently utilizes clean agent systems in some of its IT and control rooms. Clean agent systems should be provided in rooms specified by SAAS team and airport management in addition the pre action systems. The clean agent systems will be provided based on budget and the need to protect vital equipment. Clean agent systems must be calculated for appropriate design concentration and delivery times per NFPA 2001.

10.1.6 Hydraulic Calculations

Hydraulic calculations shall be conducted and submitted to show the water supply and/or pumps can provide the necessary demand. Hydraulic calculations should be conducted for each system including a pre action system, the most demanding area of the wet sprinkler system, the standpipe system, and the garage sprinkler system.

10.1.7 Drawings and Submittals

Submittals will be prepared in accordance with SAAS Specifications.

10.1.8 System Commissioning

Systems shall be tested and commissioned in accordance with SAAS procedure, NFPA 3, NFPA 4, NFPA 13, and NFPA 20.

10.2 Fire Alarm

10.2.1 Fire Alarm

This chapter defines general design criteria for fire alarm systems and their integration with other systems at San Antonio Airport System (SAAS) facilities.

10.2.2 Design Criteria

10.2.2.1 Code Requirements

- Design will comply with requirements of the latest building code adopted and amended by the City of San Antonio as well as NFPA 70, 72, and any other applicable codes as approved and amended by City of San Antonio, and coordinated with SAAS. The A/E is responsible for consulting SAAS aviation standards, airport regulations and design manuals to determine applicability and identify potential conflicts with the design of the fire suppression systems.
- If there is a conflict between this design standard or any other code or requirement, use the most restrictive requirement and inform the SAAS project manager.

10.2.2.2 General Design

The fire alarm system will include, but not limited to, fire and smoke detection, notification devices, control panels, manual pull stations, carbon-monoxide detection and annunciators. Provide duct smoke detection in HVAC system. Areas with pre-action sprinkler systems or clean agent suppression systems should be initiated by spot-type smoke or heat detection, or aspirating smoke detection.

Coordinate with airport officials to create an egress plan, and zone the fire alarm system accordingly. The alarm system can be zoned by terminal so that a partial evacuation of the airport can be achieved. The egress strategy could be to evacuate the terminal which had an alarm activation

and for the other terminal to shelter in place. Upon alarm activation, the new Won doors separating the terminals will close to create a separation. Coordinate with HVAC team and SAAS to have the fire alarm system activate smoke extraction and pressurization systems across the zones.

Provide a Bi-directional amplifier throughout the airport to increase the fire department's radio coverage and prevent dead zones in their communications. A bi-directional amplifier can be omitted only if the A/E conducts a model analysis on the new building materials and layout to prove that there are no spaces with weak radio coverage.

Replace existing detection in the garage with rate of rise detectors, and provide rate of rise detectors in any new garages.

10.2.2.3 Smoke Control

There are several smoke control and smoke purge systems that should be compared for cost by cost and effectiveness and then selected by airport officials. These systems are to be designed in accordance with IBC section 909.

The airport will use a smoke purge system. Consider permanent fans and ductwork to extract smoke after a fire. Coordinate with architectural team to place smoke barriers in strategic locations to manage smoke. If this is not an option due to space, budget, or other reasons then a mobile smoke purge unit can be purchased by the airport as an alternative solution. This decision must be coordinated with the architectural team, as the mobile unit requires an open window to exhaust smoke.

If the airport does decide to implement a partial egress strategy of only one terminal, then a pressurization smoke control system should be considered. This system is to include a series of intake and exhaust ducts with dedicated smoke control roof fan units. The system will activate upon alarm, and will create a pressure difference between the two terminals. The exhaust fans will extract air and smoke from the alarm zone, and the intake fans will supply air to the other areas of the building. This will help contain smoke spread to a single terminal across the Won doors and other openings.

10.2.2.4 Fire Alarm Control Panel

Provide addressable, site programmable fire alarm systems. At a minimum, provide the fire alarm control panel (FACP) with the following features:

- The ability to store at least four-hundred (400) events in the history log. These events must be stored in a non-volatile memory and remain in the memory until the memory is downloaded or cleared manually.
- Resetting of the control panel must not clear the memory from being retrieved on the integral LCD display.
- An integral LCD 80 character (minimum) alphanumeric display.
- Provide all smoke detectors connected to the FACP with an adjustable alarm verification feature. Initially set the alarm verification at twenty (20) seconds.

- FACP cabinets located in public spaces must be recessed and not be aesthetically. Locate the FACP and supplemental control panels in a year-round conditioned space within the building.
- Locate Notification Appliance Circuit (NAC) extender panels in electrical rooms on each floor.
- Locate panels less than five (5) feet above the finished floor, measured to the centerline of the panel.
- Each extender panel must be individually addressed.
- Provide a remote annunciator at the designated primary entrance unless directed otherwise.
- Control functions must be accessible only by user code or secured behind a locked panel.
- Provide panel in the manufacturer's NEMA 4 enclosure for panels subject to water spray/runoff under normal operating conditions and/or located in damp/dirty locations or, relocate to a suitable dry location.
- Conduit must not enter the top of a control panel cabinet for enclosures requiring a NEMA 4 designation.

10.2.2.5 Wiring, Circuits and Conduit

Paint all fire alarm junction boxes and covers red in unfinished areas (i.e., above ceilings, mechanical rooms, etc). In finished areas, conduit and junction boxes can be painted to match the room finish, the inside cover of the junction box must be identified as "Fire Alarm" and the conduit must have painted red bands ¾ -inch wide at ten (10) foot centers and at each side of a floor, wall, or ceiling penetration.

All terminations must be at a terminal strip.

All devices must have screw terminals.

Pull all conductors splice free. Where splices are unavoidable provide insulated barrier type terminal strips at junction points. The use of wire nuts, crimped connectors, or twisting of conductors is prohibited.

Run all wiring to control panels in the vertical or horizontal plane, make all turns at 90 degree angles, and tightly bundle and wrap all wire.

Identify all conductors individually with permanent markings.

Install all wiring in metallic conduit.

All wiring must be solid copper, except for speaker circuits or circuits requiring shielding.

All signaling line and initiating device circuits must be minimum sixteen (16) gauge wire.

Initiating device circuits used for flame detection devices must use shielded cable.

10.2.2.6 Air Handling Equipment

Provide access doors in finished ceilings at all fire damper locations. Size the access door to allow physical access to the duct.

Protect duct through-penetrations of fire rated partitions having a fire resistive rating of less than two (2) hours with fire stop systems listed/ approved for the particular opening size and duct assembly. If a listed/ approved fire stop system is not available for the particular assembly, protect the opening with a fire damper.

10.2.2.7 Fire Wall Identification

Identify all fire rated walls with signs stating the following: "Fire Wall Do Not Penetrate." For aesthetic reasons, this requirement does not apply to walls inside stairwells or public areas such as offices, lobbies, corridors, etc., that do not have drop ceilings. In areas with drop ceilings, paint notification on the wall above the drop/finished ceiling. In mechanical, electrical and other similar rooms, place signs at eight (8) feet above finished floor level. Space signs at a maximum of ten (10)-foot intervals. In rooms with raised flooring, place signs on fire walls under the floor with spacing of signage reduced to five (5) foot intervals. Apply signs using florescent red or orange paint over stencils. Letters must be a minimum of four (4) inches in height. Metal, plastic or paper decal signs are not acceptable. Take care when applying signage to prevent over-spray onto adjacent finishes.

10.2.2.8 Fire Department Lock Box

Key Boxes shall be installed on all new buildings or buildings being renovated that do not currently have a key box. The key box shall be located at or near the primary fire department access at eight feet (8') above the finish elevation. The approved San Antonio Fire Department key box shall be a "Knox Box."

10.2.2.9 Portable Fire Extinguishers and Cabinets

Portable fire extinguishers and cabinets shall be installed in accordance with the requirements in the IFC NFPA 10.

10.2.2.10 Final Life Safety/ Fire Protection Certification Documentation

The Fire Protection Engineer (FPE) shall provide certification that all life safety and fire protection features and systems have been installed in accordance with applicable criteria, the contract documents, approved submittals, and manufacturer's requirements.

This certification shall summarize all life safety and fire protection features, and shall bear the professional seal of the fire protection engineer.

10.2.3 Design Coordination

Design will be coordinated with other SAAS teams for system integration, and clash prevention. Alarm panels and annunciators will be coordinated with electrical for power loads. Detection and notification location will be coordinated with architectural features, ceilings, and walls.

10.2.3.1 HVAC

The fire alarm system will provide HVAC shutdown in accordance with required codes and standards. In-duct smoke detection will be provided as required and will be programmed to shut down the associated fan unit upon activation. Any smoke dampers and combination fire/smoke dampers will be provided with smoke detectors and relay modules to actuate damper closure

10.2.3.2 Fire Protection

The fire alarm system will monitor the fire sprinkler system for waterflow. Additionally provide smoke detection and control panels required for the activation of the double-interlock pre-action systems and clean agent systems in data and control rooms.

10.2.4 Drawings and Submittals

Submittals will be prepared in accordance with SAAS Specifications.

10.2.5 System Commissioning

Systems shall be tested and commissioned in accordance with SAAS procedure, NFPA 3, and NFPA 4, NFPA 70, NFPA 72.

10.3 Glossary

AHJ:	Authority having Jurisdiction
FACP:	Fire Alarm Control Panel
IBC :	International Building Code
IDF:	Independent Distribution Frame
IT:	Information Technology
MDF:	Main Distribution Frame
MEP:	Mechanical, Electrical and Plumbing
NFPA :	National Fire Protection Association
PIV:	Post Indicator Valves
SAAS :	San Antonio Airport System
UL :	Underwriters' Laboratories

10

11

Photo by Joey Nguyen

11.1 General

11.1.1 General Requirements

Communications/Low Voltage Systems design standards manual is intended to outline the system requirements and provide general understanding of each system's scope for the Communications, Security, Audiovisual, Radio, and other low voltage systems. Other applicable standards shall be followed to provide a holistic design approach.

This Document serves as a reference for A/E providing architectural, structural, electrical, mechanical engineering, Information Technology, and Security design. Adherence to this Document and the referenced standards will result in low voltage infrastructure and systems that are reliable, scalable, secure, serviceable, and conform to industry best practices and standards as learned over years of use.

Design Team is responsible for reviewing the Design Standards Manual in its entirety, ensuring the design of the project complies with the Manual, and for coordinating the design across all trades and disciplines.

Deviations from the Design Manual shall be explicitly requested and approved in accordance with the Exemption Request Process. Deviations shall be requested and approved by the processes dictated in the Design Submittal Requirements Chapter.

Communications/Low Voltage Systems design shall be coordinated with City of San Antonio and ITSD (Information & Technology Services Department) and shall be designed to fulfill and enrich the San Antonio Aviation Department's Vision, Mission, and Values and create exceptional user-centric spaces where passengers and personnel are safe and have the best technological experience.

- Vision: To be an exceptional airport system generating prosperity for South Texas.
- Mission: Empowered, professional team, providing optimal air service and phenomenal customer experience.
- Values: Teamwork, Integrity, Innovation, Professionalism.
- ITSD Departments Mission: We deliver quality City services and commit to achieve San Antonio's vision of prosperity for our diverse, vibrant, and historic community.

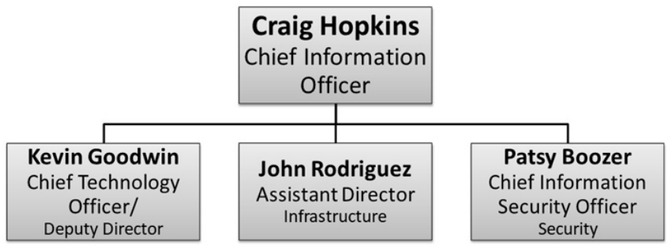


Figure 11.1.1 ITSD Division Chart

11.1.2 General Design Requirements

11.1.2.1 Regulations

All systems and equipment shall comply with applicable building, electrical, mechanical, and fire life safety codes including Airport requirements and standards, and the scope of project work.

11.1.2.2 Best Practices

Information & Technology Services Department(ITSD) follows the latest Building Industry Consulting Service International (BICSI) methodologies and American National Standards Institute(ANSI)/Telecommunications Industry Association(TIA) standards.

11.1.2.3 Hazardous Material

There is a possibility that portions of Information Technology(IT) projects may be in or cross through areas that may contain lead based-paint, Asbestos Containing Material (ACM's) and/or other materials classified as toxic or hazardous by ITSD or Federal regulations. The Contractor, and the Contractor's A/E, shall consider the impact of hazardous materials on this project.

11.1.2.4 Accessibility

Information Technology (IT) rooms shall be accessible from a corridor, stairwell, and/or a service elevator. IT Rooms shall not be constructed so that access is through a tenant area. IT rooms with chain link dividers inside shall be constructed with square tubing including the swing door. Needs to be installed with a self-closing device.

11.1.2.5 Clearances

IT Equipment cabinets require a minimum of (4) feet of clearance to walls that are opposite cabinet doors (3 ft clearance and 1 ft allocated for wall-mounted items), and minimum (3) feet between rows of cabinets (4 ft is preferred).

11.1.2.6 Products

Designs shall utilize systems and products which include:

- Long-life, industrial quality.
- Readily available products and components with service support available.
- Maintainable arrangements with multiple units.
- Readily available spare parts and materials that incorporate multiple equipment elements in key systems that can be provided for reduced capacity operation when portions are down for maintenance or failure.

11.1.2.7 Quality Control

The Design Consultant/Contractor shall perform a quality control review of all documents for completeness, constructibility, coordination with all building trades.

11.1.2.8 Penetrations

Conduit and cable tray penetrations through floors, walls, and roofs shall be coordinated and identified on the architectural and structural construction drawings. Proper cross-referencing between drawings shall be provided. Details for protection of all penetrations of fire resistive construction are required on plans submitted for construction approval permit.

11.1.2.9 Equipment Protection and System Protection

Project specifications shall clearly indicate that all equipment and systems intended for a project shall be properly protected from damage, corrosion, and weather during shipment, in-transit storage, job- site storage, field/ shop prep, installation, and checkout until the work is accepted by the Airport. Ends of piping, valves, and fittings shall be protected from abuse and the entry of moisture. Electrical equipment controls, and insulation shall be protected against moisture and water damage. ITSD may, at Contractor's risk and expense, disallow or reject the installation of previously approved equipment, if it is later determined to have deteriorated considerably during the Contractor's custody, such as during shipment, storage, and/or installation.

11.1.2.10 Seismic Calculations

All IT cabinets shall be designed to resist code prescribed forces, based on an estimated 2,000 pound cabinet weight. Calculations shall be stamped by a Texas Professional A/E and submitted for review by the Airport representative. Raceway support calculations shall be provided as determined by permit.

11.1.2.11 Seismic Anchoring

All equipment including conduit, J-Hooks, cable tray, and equipment cabinets which exert force on the structure other than those forces produce by gravity, and equipment shall be designed to meet local Code and detailed on the drawings that are coordinated with a responsible Texas Professional A/E.

11.1.2.12 Building Seismic Joints

All conduits, cable trays, etc. crossing a seismic joint shall be designed to accommodate the full joint movement in both directions and will require coordination with the Architect of Record.

11.1.2.13 IT Room Floor Loading

MPOE and IT rooms shall be rated for a minimum of 100 lbf/ft. Distributed Antenna System (DAS) rooms shall be rated at a minimum of 150 lbf/ft.

11.1.2.14 Water Sources

Except for dry-standing fire sprinkler pipes, there shall be no water or sewage pipes constructed, in and over IT rooms. Nor shall IT rooms be constructed adjacent to or under janitorial, restrooms or restaurants. The immediate environment surrounding an IT room cannot contain equipment such as steam boilers, compressors, chilled/hot water pipes, elevator/escalator equipment, electrical co-generation equipment, or waste processing. IT rooms shall not be in a flood zone and/or designed below grade.

11.1.2.15 New Construction

Existing IT infrastructure and systems that are in the way of new construction shall be surveyed and documented from end-to-end and a cutover plan prepared with little or no downtime. No utilities shall pass through a Telecommunications space except for utilities serving that space.

11.1.2.16 Renovation Projects

Existing IT infrastructure and systems that are in the way of new construction shall be surveyed and documented from end-to-end and a cutover plan prepared with little or no downtime. All cutover plans shall be approved by the Airport representative.

11.1.2.17 Generator

If a new generator is planned for the facility, then all IT room UPS's shall be connected to the generator. This applies to new construction and new MPOE, IT, and DAS rooms.

11.1.2.18 IT Outages Due to Construction

Information Technology infrastructure and systems that are directly or accidentally affected by building construction shall be immediately investigated from end-to-end and restored to the original working condition. Hourly reports shall be provided to ITSD on restoration progress.

11.1.2.19 Shared Use/Common Use Systems

ITSD follows the Standards and Recommended Practices established by the International Air Transportation Association (IATA) for the implementation of airline shared use/common use systems.

11.1.2.20 As-Built Drawings

All installations shall be provided with minimum of (3) sets of As-built

drawings and CD's (AutoCAD/Revit drawings in DWG/Revit file electronic format, drawn in the latest AutoCAD/Revit version), warranty documents, and maintenance manuals during closeout period prior to final acceptance by Airport. All known and unknown communications pathways and cabling identified during construction shall be shown on the final as-built drawings.

11.1.3 Drawings Requirements

11.1.3.1 Plan Coordination

Work shall be coordinated with all disciplines to ensure that size and location of all required conduits, cable trays, junction boxes etc., are indicated on the plans.

11.1.3.2 Sectional Views and Elevations

Sectional views and elevations that clearly define the details and space constraints shall be developed from floor plans included within the construction drawings. All Communications/Low Voltage Rooms shall have an elevation drawing of each wall. Room locations shall be depicted in plan view with expanded details shown by part plan at a scale no less than 1/4" = 1' – 0".

11.1.3.3 Project and as-built Drawings

- Documentation shall include the following as best details and explains the project.
  - Site plan
  - Floor plans
  - Shop drawings
  - Elevation drawings
  - Riser drawings
  - Maintenance Hole Butterfly Maps
  - Plan Views
  - System architecture and/or inter-connect single line diagrams
  - System logical communication and data flow diagrams
  - Point-to-point Interconnect diagrams
  - Calculations
  - Isometric drawings
  - Photographs
  - As-built prints of the conduit installation with routing
  - Final acceptance test data sheet
  - Updated Material List with quantities, model numbers and serial numbers
  - Equipment Specification Sheets
  - Test reports
  - Excel spreadsheets
  - MS Project schedules
  - Manufacturer manuals/data sheets/submittals on all equipment and materials used
  - Manufacturer representatives and telephone numbers
  - Operation manuals

11.1.3.4 Cutover Plans

Cutover plan diagrams shall be created to diagrammatically detail the step-by-step sequence required for an infrastructure or Communications/ Low Voltage system cutover. All cutover plans shall be approved by ITSD.

11.1.3.5 Warranties

Unless stated otherwise, warranties are minimum one year in duration and start upon final acceptance by Airport. Written warranties shall be registered in ITSD's name (not the contractor) and delivered to ITSD.

11.1.4 Infrastructure and System Commissioning

Commissioning is the comprehensive and systematic process of assuring that all Communications/Low Voltage systems are designed, installed, and tested to ITSD's requirements. A/E shall prepare the following elements for commissioning:

- Test Objectives
- Participating Stakeholders
- Test Types – Factory, Sub-Systems, System, Interfaces to other Systems
- Prerequisites for Testing
- Commissioning Plan/Procedures
- Schedule
- Acceptance Criteria
- Testing
- Floor Loading
- Certified Test Results
- Repeat Testing as required
- Analysis
- Test Report
- Warranties
- Users Training of Airport and Maintenance Personnel for special system use (including but not limited to Security, BAS (Building Automation System), PA (Paging), Audiovisual Systems, etc.)

11.1.5 Final Acceptance Requirements

Final acceptance of a Communications/Low Voltage system (including infrastructure) installation or upgrade requires the following to be completed as they are applicable:

- Punch list Completion
- Major Deliverables Verification
- Cable and Infrastructure Labels Verification
- Site Cleaning/Rubbish Removal
- As-Built Drawings/ Plans Submittal
- Laminated Drawings attached to the wall in each Telecommunications Room showing location of each outlet being served by that Room, and identified rack and patch panel the outlet terminated at.
- Electronic As-Built Files Submittal
- Equipment/ Material List Submittal
- O & M User Manuals Submittal
- Deliverables Received - Spare Equipment & Parts Delivery
- Keys Transfer
- Passwords Transfer
- Licensing
- Final Testing
- Test Reports/ Certificates Submittal
- Final Inspection
- Operations & Maintenance Training
- Users Training
- Users Training of Airport and Maintenance Personnel for special system use (including but not limited to Security, BAS (Building Automation System), PA (Paging), Audiovisual Systems, etc.)
- Contractors' Contacts
- Product Warranties
- Systems Warranties
- As-built Documentation
- Lessons Learned

11.1.5.1 Cable Management Records

- A/E shall follow TIA-606-D Administration Standard for Telecommunications Infrastructure Standard, or latest version.
- A/E shall specify to contractors to obtain the required data in the required form. Contractors then send the project data to ITSD at the Contractor's expense for verification and importability into ITSD system. The Contractor shall submit a request to ITSD for specifics and the required spreadsheet templates.

11.1.5.2 Training

A/E shall account for the following training and training documentation for new and upgraded systems:

- Operations manuals
- Technical Staff training by Contractor and/or 3rd party
- User's manuals
- User Staff training
- Equipment training
- Application training
- Application configuration Booklets
- Confined space training where applicable

11.1.6 Grounding and Bonding

- A/E shall follow TIA-607-D-1, or latest version.
- Install (1) Primary Bonding Busbar (PBB), previously known as Telecommunications Main Grounding Busbar (TMGB), in the MDF and (1) Secondary Bonding Busbar (SBB), previously known as Telecommunications Grounding Busbar (TGB), in each IDF.
- Install a Telecommunications Bonding Backbone (TBB), #4/0 AWG stranded green insulated copper conductor in a star topology between the PBB and each SBB in each building. When IDFs are stacked a single TBB can be daisy-chained between SBBs back to the PBB.
- Install an Equipment Bonding Conductor (EBC), #6 AWG green insulated conductor from the PBB or SBB as applicable to each cable runway system, equipment rack, cabinet, lightning protector, or multi-pair cable with a metallic element.
- Install a #4/0 AWG stranded green insulated Telecommunications Bonding Conductor (TBC) from the PBB to the main building electrical service ground in each building.
- In a metal frame (structural steel) building, where the steel framework is readily accessible within or external to the room; each SBB and PBB shall be bonded to the vertical steel metal frame using a minimum #2 AWG conductor. The connection to building steel does not eliminate the requirement for the TBB or TBC to the service ground.
- Install a Grounding Equalizer Conductor, #4/0 AWG stranded green insulated copper conductor to interconnect multiple TBBs on the top floor and every 3rd floor when required by TIA-607-D-1.
- When exceeding 13 feet the conductors shall be sized at 2 kcmil per linear foot of conductor length up to a maximum of 750 kcmil.
- Each rack shall have a Rack Bonding Busbar (RBB).

11.1.7 Firestopping

11.1.7.1 A/E shall follow TIA-569-E-ANNEX A.

11.1.7.2 Firestopping shall be provided for Communications and Low Voltage Pathways at penetration areas for fire rated walls and floors.

11.1.7.3 Firestopping shall meet or exceed the hour rating of wall or floor penetrated by the Low Voltage Pathway.

11.1.7.4 Firestopping shall comply with latest release of NEC NFPA 70.

11.1.7.5 Firestopping products and applications shall provide containment of smoke, fumes and flame with performance in accordance with ASTM E814-09 (UL 1479).

11.1.7.6 Follow Local Authority Having Jurisdiction and building code requirements.

11.1.7.7 Types of firestopping hardware and materials shall include:

- Mechanical firestopping products:
  - Conduit sleeves.
  - Cable tray penetrations.
  - Penetration frame products.
- Non-mechanical firestopping products:
  - Putties.
  - Caulks.
  - Cementitious / foams / intumescent materials.
  - Prefabricated Pillows, Blocks and Blankets.
- Firestopping products shall be installed per manufacturer's practices.
- Manufacturers include:
  - Specified Technologies Inc. (STI) SpecSeal.
  - 3M Products.
  - CSD Sealing Systems
- Contractor shall label each penetration upon firestop completion. The label shall contain the following items:
  - Manufacturer fire protection.
  - Products.
  - System no.
  - Hr. Rating
  - Installation by/company
  - Installation date
  - Repenetrated by/company
  - Repenetrated date
  - Job/ref no.
- Contractor shall take a photo or video of each penetration after labeling and submit to the AHJ and City of San Antonio Information Technology Services Department.

11.1.8 Labeling

Coordination with and approval by the City of San Antonio Information Technology Services Department is required on the specific site labeling schema.

11.1.9 Spaces and Areas

Low Voltage System (Communications, Security, Audiovisual, Hearing Loop, Radio, etc.) Requirements for each individual area shall be coordinated with City of San Antonio and ITSD (Information & Technology Services Department), Architect, and other disciplines.

Refer to Architectural Chapter 6 for Area descriptions.

Areas to be coordinated include but not limited to the following:

- ConRAC (Consolidated Rent-a-Car facility)
- Curbside
- Ticketing
- Entry Vestibule
- Security Checkpoint
- Pedestrian Bridges
- Customs and Border Protection Facilities
- Baggage Claim
- Concourses
- Gate Holdrooms
- Concessions
- Vertical Circulation
- Service Animal Relief Ara
- Publicly Accessible Areas

- Nonpublic spaces
- Restrooms
- Offices
- Break Rooms
- Conference Rooms

11.1.10 Standards for reference

All work, including but not limited to: cabling, pathways, support structures, wiring, equipment, installation, workmanship, maintenance and testing shall comply with the latest editions of the National Fire Protection Association (NFPA72), National Electrical Code, and National Electrical Safety Code, as adopted by City of San Antonio including all applicable local codes, rules and regulations. In case of discrepancy or disagreement between the documents noted above, the contractor shall satisfy the most stringent of the requirements.

Requirements set forth by first-respondor code, ordinance, or the Authorities having Jurisdiction (AHJ) shall supersede the requirements described herein and shall be met in their entirety.

Communications/Low Voltage Systems design shall be in accordance with the global and local codes, standards, and documents, including but not limited to the following:

11.1.10.1 CITY OF SAN ANTONIO STANDARDS

- Structured Cabling Infrastructure Guideline V1.5, 08/05/22 or latest.
  - Part 4 – Contractor Qualifications
  - Part 5 – Warranty
  - Part 6 – Nomenclature
  - Part 7 – City Infrastructure Standards
- City of San Antonio Physical Security System Infrastructure Guideline, 03/24/2014 or latest.
- Facility Design Guidelines & Standards for City Buildings and Parks, 01/23/2018 or latest.
  - Division 27 – Communications
- SAAS Strategic Plan Summary, 10/12/2017 or latest.

11.1.10.2 SAN ANTONIO INTERNATIONAL AIRPORT STANDARDS

- SAT Design Guidelines Phase I or latest.
- Airport Master Plan, 10/2020, 06/2021, 08/2022, or latest.
  - Section 2.12.3 Communications
- SAIA CRM User Journey Review, 09/30/2019 or latest.
- SA Airport System Strategic Development Plan – Terminal Facility Requirements, 12/05/2018 or latest.

- SAIA Standards and Specifications for Construction, 08/22/2016 or latest.
  - Section 3.11 - Tenant IT and Cable Policies, IT Service Request Procedures, etc.
  - Section 4.4 - Construction Criteria, Inspections and Compliance requirements, etc.
  - Section 5 – Structured Cabling Infrastructure Guidelines (duplicate of the COSA Structured Cabling Infrastructure Guideline)
- SAIA ConRAC – Tenant Design Criteria Manual, 08/11/2016 or latest.
  - Section P – Communication Systems
  - Section Q – CCTV System
  - Section R – Cable and Satellite TV
- SAIA Terminal A Design Criteria Manual, 03/08/2012 or latest.
- SAIA Terminal B Design Criteria Manual, 07/08/2009 or latest.
- City of San Antonio ITSD Div.27 and 28 requirements or latest.

11.1.10.3 INTERNATIONAL INDUSTRY STANDARDS

- TIA-526-7-A – Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant (July 2015, R2022) or latest.
- TIA-526-14-C – Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant (April 2015) or latest.
- TIA-568.0-E – Generic Telecommunications Cabling for Customer Premises (July 2022) or latest.
- TIA568.1-E – Commercial Building Telecommunications Cabling and Components Standard (March 2020) or latest.
- TIA-568.2-D – Balanced Twisted-Pair Telecommunications Cabling and Components Standard (August 2020) or latest.
- TIA-568.3-E – Optical Fiber Components Standard (September 2022) or latest.
- TIA-568.4-E – Broadband Coaxial Cabling and Components Standard (July 2022) or latest.
- TIA-568.5 – Balanced Single Twisted-pair Telecommunications Cabling and Components Standard (February 2022) or latest.
- TIA-569-E – Telecommunications Pathways and Spaces (June 2022) or latest.
- TIA-598-D – Optical Fiber Cable Color Coding (August 2018) or latest.
- TIA-606-D – Administration Standard for Commercial Telecommunications Infrastructure (October 2021) or latest.
- TIA-607-D – Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications (July 2021) or latest.
- TIA-758-B – Customer-owned Outside Plant Telecommunications

Infrastructure Standard (March 2012) or latest.

- TSB-162-B – Telecommunications Cabling Guidelines for Wireless Access Points (February 2021) or latest.
- Building Industry Consulting Services International (BICSI) TDMM, 14th Edition or latest.
- Building Industry Consulting Services International (BICSI) Outside Plant Design Reference Manual, 6th Edition or latest.
- International Building Code, 2018 edition or latest.
- Institute of Electrical and Electronics Engineers (IEEE) or latest.

11.1.11 Projects for reference

The following completed and current projects are listed for A/E's reference of the planned and recently completed modifications to the Airport systems, and coordination of lessons learned (based on the Project Status Quad Sheets from 10/10/22):

- 33-00068 Paging Modernization. Start: Dec 2020, planned completion: Jan 2023 [delayed].
- 33-00059 Airport EVIDS. Start: Aug 2022, planned completion: May 2023 [delayed].
- 33-00250 CCTV/ACS System Replacement. Start: Oct 2022, planned completion: Oct 2025.
- 33-03339 Network End of Life Replacement. Start: Mar 2022; planned completion: Sep 2023 [delayed]
- 33-00044 Outside Plant Campus IT Ring. Design start planned: Jan 2023, planned construction completion: Jan 2027.
- 33-00331 Terminal A New IDF Room. Design start: Nov 2022; planned construction completion: Sept 2023.
- 33-00295 Terminal B Gate Expansion. Start: Feb 2021; planned completion: Dec 2022.
- 33-00296 Terminal A Gate Expansion (Gate A16). Start: May 2021; planned completion: Dec 2022.
- 33-00333 Baggage Handling System Upgrade (High-Level Controls). Start: Aug 2020; completion: Oct 2022.
- 33-03313 Terminal A&B Critical Infrastructure Assessment. Start: Jan 2022; completion: Sep 2022.
- 33-00340 Terminal A Ground Loading Facility. Planning start: Sep 2022; planned construction completion: Dec 2023.
- 33-00032 Master Plan Update, SAT (Strategic Development Plan). Start: Mar 2018; planned completion: Oct 2022.
- 33-03336 Advanced Terminal Planning. Start: Jul 2022; planned completion: Mar 2023.
- 33-03324 ConRAC upgrades. Design start: Apr 2022; planned construction completion: Dec 2023.

- BIM Phase I: Scanning, Modeling, and Facilities Management Strategy. Start: Oct 2021; completion: Sep 2022.
- Police Bunker Power & Data. Planning start: Oct 2022; planned construction completion: Sept 20223.
- 33-00316 - Airfield Pkg 6: Taxiway RC Bypass Construction [completed in FY2022].
- 33-00194 - Airfield Pkg 6: Taxiway E Reconstruction [completed in FY2022].
- 33-03326 Stinson Building Modifications FY22 [completed in FY2022].
- 33-00052 Facilities Management Software Programs [completed in FY2022].
- 33-00056 Terminal A IT Cutover [completed in FY2022].

11.1.12 Lessons Learned, Design Considerations

The following lessons learned shall be accounted for by the A/E:

11.1.12.1 SAT is experiencing issues with systems being unplugged for phone charging. There need to be measures for hardwiring and securing elements.

11.1.12.2 Consider providing WAP infrastructure at kiosks in the middle of the space to avoid installing them in high ceilings where it can be difficult to install and maintain them.

11.1.12.3 Consider raised floor for power and data distribution flexibility.

11.1.12.4 CSO. Prefer to control access and know who is accessing the space to manage who is walking in at that time. Indoor security is preferred since it is hard to check many people especially during holiday season

- Pre-security: Allow people in or not allow people in. Double doors.
- Post security: be able to access the space at any time.

11.1.12.5 Provide Paging coverage in public restrooms.

11.1.12.6 Provide Information Display with touch screens to eliminate static information posters and the need to constantly reprint.

11.1.12.7 The signage shall be large and dynamic.

11.1.12.8 Instead of a conduit, consider a metallic raceway channel that can be shared between multiple entities. Cables can then be labeled and colored.

11.1.12.9 Audiovisual equipment selections shall be consistent so the personnel can understand its use easier.

11.1.12.10 Provide room schedulers at conference room entrances.

11.1.13 Innovation

The following Innovation shall be accounted for by the A/E. Exact requirements and scope shall be coordinated with the Airport and Architect.

11.1.13.1 Design shall include infrastructure for future technology and trends such as the remote check-in process which will allow passengers to check-in, print bag tags and bag drop while returning their rental car. This process reduces long lines and congestion in the Terminal check-in hall and a negative passenger experience.

11.1.13.2 Computed Tomography (CT) Screening Equipment - Considerations for incorporating CT technology:

11.1.13.3 Automated Screening Lane (ASL) - a property handling system allowing for the simultaneous divestment of multiple passengers and the automatic return of property bins to the divestment zone.

11.1.13.4 Enhanced Advanced Imaging Technology Automated (eAIT) - The Rohde & Schwarz (R&S) QPS201 system requires only a few milliseconds to scan passengers, which can speed check-point screening operations and increase throughput.

11.1.13.5 Biometric Authentication Technology (BAT) - Travel Document Checker

- Similar to self-check-in kiosks, passengers would scan credentials, self-authenticate, and enter the checkpoint through a control point.
- Are also being pursued for secure location doors.

11.1.13.6 Take and Go Concessions similar to Hudson News and the existing wall mounted vending store.

11.1.13.7 Autonomy for robotic concessions, shopping cart size.

11.1.13.8 Smart Restroom Systems.

11.1.13.9 Automated kiosk with dedicated outlets.

11.1.13.10 Different styles of kiosks, design needs to include flexibility to accommodate future technologies.

11.2 Telecommunications / Structured Cabling Systems

11.2.1 General

- A/E shall not deviate from this standard without explicit written approval from the City of San Antonio Information Technology Services Department project point of contact.
- Any deviations or substitutions shall immediately be brought to the attention of the owner's representative in writing for resolution with approval from the City of San Antonio(CoSA) ITSD project Point Of Contact.

- Where specific product brands are mentioned, an approved equivalent will be considered following an official submission of product literature and written acceptance by the City of San Antonio Information Technology Services Department.
- Where means, methods, and best practices are mentioned, contractor shall follow the manufacturers' and owner's requirements, industry standards, or code, whichever is most stringent.
- A Division 27 Communications Specification and Technology (T-Series) drawings for the structured cabling system shall be provided during the design development phase for each project unless noted otherwise by the SAT PM.
- Refer to Lessons Learned and Innovation Sections of this document for additional design considerations to be included in the design.

11.2.2 Entities / Networks

The following entities / dedicated networks shall be accommodated with appropriate separation as part of design:

11.2.2.1 Airport IT Network

11.2.2.2 Tenant Network (Airlines, Retail, Car Rentals, etc.)

- Tenant responsibilities are to coordinate their own service and connectivity from local providers.
- Tenants shall follow Airport's list of preferred vendors and contractors.
- Tenants shall have separate Internet service.
- Tenants space shall be segregated (cages are preferred, lockable cabinets are acceptable).
- Tenants are allowed to share Pathways with Airport IT.
- Tenant Spaces shall be COSA badged and require escort.
- If Tenant equipment is located in COSA space, separate lockable cabinets are required.

11.2.2.3 TSA (Transportation Security Administration) Network

- TSA can share pathways with Airport IT.
- TSA shall have separate Telecom rooms.
- TSA shall have lockable cabinets.
- TSA network design shall follow TSA Design Standards

11.2.2.4 Customs and Border Protection Network

- Customs and Border Protection Network shall follow Border Patrol Design Standards.

11.2.3 Diversity and redundancy

- Telecommunications pathway shall have redundancy with minimum (2) diverse pathways to each building, separated as far as possible (minimum of 25 ft separation). Pathway plans are to be coordinated and approved by Airport IT.
- Minimum (2) MPOE rooms shall be provided. Locate as close to the opposite edges of the building as practical. Refer to Section 11.2.6.1 MDF, for room requirements.

11.2.4 Incoming services

- Minimum (2) diverse pathways shall be provided to the Airport buildings.
- City is under contract with AT&T (1 circuit)
- City is currently negotiating a Spectrum Circuit (1 circuit) and leverage CPS dark fiber (2 circuits).
- Currently, (2) Service Providers provide cable, fiber, and phone services to the Airport:
    - Charter Communications (Spectrum) (Western portion of the Airport)
    - Grande Communications Network (Western and Eastern portion of the Airport)
- Other Service Providers in the Airport vicinity, but not currently providing services to the Airport:
    - Zayo Group
    - Windstream Enterprise
- Refer to 2021 (or later version) San Antonio International Airport Master Plan, Inventory of Existing Conditions, Section 2.12.3 Communications for more information.
- Request the latest Communications Utilities Plans from the Airport to coordinate the new and proposed OSP infrastructure.
- Minimum (4) 4" conduits shall be provided for new service provider's services.
- The service provider demarcation point shall be located inside the MDF.
- Contractor will be responsible for conduit pathways from MPOE to meet-me vault at the property line. Service Provider will be responsible for providing and terminating fiber from the street to the MPOE room.

Figure 2.12-4: Communications Utilities (Charter Communications)

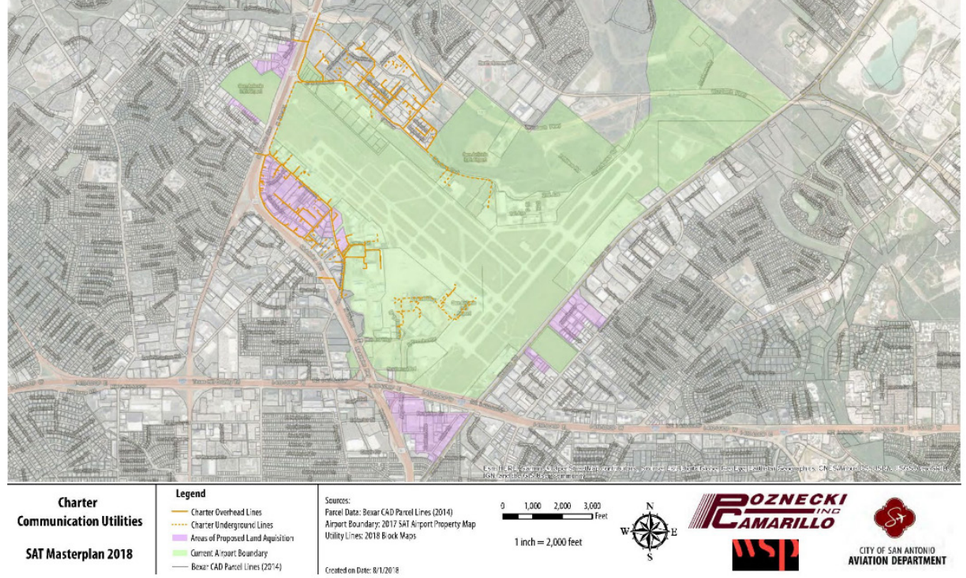


Figure 11.2.4a Communications Utilities (Charter Communications)

Figure 2.12-5: Communications Utilities (Grande Communications)

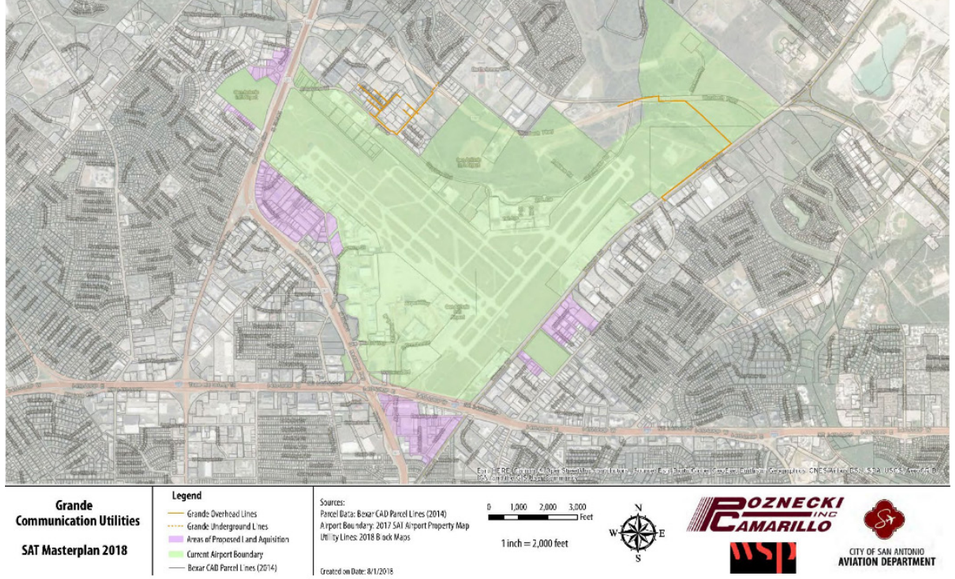


Figure 11.2.4b Communications Utilities (Grande Communications)

11.2.5 OSP (Outside Plant Infrastructure)

- Coordinate requirements with Civil Chapter 4.
- A/E shall coordinate with the new Fiber Ring Installation project (planned for fiscal year 2024).
- Minimum (4) 4" conduits, Schedule 80, with 4-Inch Maxcell (3) 3-cell mesh innerduct with mule tape rated for 2500 lbs with footage marks shall be installed between Telecommunications rooms.
- Conduits shall have no more than (2) 90-degree bends between pull boxes.
- Conduits shall not exceed 40% fill ratio.
- Minimum depth: 36" with orange metallic tracer 12" below grade.
- Provide pull box at each bend for all reverse bends. A reverse bend is a bend in the conduit that is between 100-degree to 180-degree.
- Provide Maintenance Holes or pull box at least every 600 feet for sections containing up to (1) 90 degree of bend, and at least every 350 feet for sections with the equivalent of (2) 90 degree bends.
- Maintenance Holes shall have a minimum size of 12 feet long 6 feet wide and 7 feet high.
- Maintenance Hole/Pull Box cover shall be rated for the location (e.g., airfield, roadways, parking lots, etc.)
- Handholes/pull boxes shall be a minimum 30 inches wide, 48 inches long and 30 inches tall.
- Provide a #6 AWG XHHW wire in one of the 4-inch conduits for tracing purposes.
- Pull boxes shall not be used in substitution of a 90-degreee bend.
- Conduit shall not change direction at a handhole / pull box.
- All utility connections and locations shall be coordinated with the Airport and the appropriate utility company.
- Tenants are responsible for all expenses related to connection to communications systems.
- The contractor shall request and have completed underground utility sweeps from the Airport prior to excavation of any material. Contractor shall expose all utility crossings.
- In order to provide operational safety, the Contractor shall notify the appropriate Airport Operations Center minimum 5 business days prior to any proposed activity that will shut down or otherwise affect the operation of any utility, system or operation so that a work area notice can be issued. No work can be performed without prior approval from the Airport. Also, notification shall be made to the Airport two (2) hours prior to commencement of work and prior to turning fire protection/detection systems, or any other system, on or off. The contractor is expected to give the following information when submitting the notice and again once in contact with the Operations Center:
  - Name and phone number of contractor.
  - System identification (i.e. electrical, water, IT, communications, security, sprinkler, fire alarm, including zoning identification, etc.).
  - Time the system will be deactivated.
  - Time the system will be reactivated.
  - Total time the system will be out of service.
  - The areas, activities, or zones that will be affected.
- All utilities shall be placed underground and shall follow all required specifications and design standards of the utility provider. Temporary power poles and above ground utility lines may be allowed if reviewed and approved by Airport and the City.
- The contractor shall maintain and protect all utilities on site.

- Rerouting of utilities as needed for development is the responsibility of the contractor, coordinating with utility companies and Airport as needed
- Any utilities encountered or damaged during construction shall be immediately repaired and/or coordinated with the appropriate utility company at no expense to Airport.
- The developer is responsible for obtaining capacity letters and design layouts from utility companies for existing utilities on site.
- The developer shall obtain all easements and necessary permits, and coordinate with the airport and utility companies. The developer will have all easements recorded and provide copies to the Airport.
- Easements for all utilities shall be reviewed and approved by the County and Airport, as required. All easements and easement language shall be coordinated with Airport.
- All communications/low voltage lines, cable, fiber optic, video, communication or other underground utilities that are installed underneath pavement shall be installed in an appropriately specified and sized conduit that allows for additional capacity in the future.

11.2.6 ISP (Inside Plant Infrastructure)

11.2.6.1 MDF (Main Distribution Frame)

- The MDF is a telecommunications space that serves a building or multi-building facility or campus.
- The MDF houses the entrance conduits, terminations, and cross connections for all incoming inter- building backbone cabling from the IDFs in other buildings on the campus and the intra-building backbone cabling from the IDFs in the building in which it resides, and cross-connects to user workstations.
- Wall and floor space shall be reserved for service provider demarcation equipment and incoming infrastructure terminations.
- Campus distribution network equipment, servers, and other centralized telecommunications related equipment will reside in the MDF.
- Minimum size: 2,000 sf (40' x 50'), no ceiling. Door shall be hinged to open outward. Door shall be a minimum of 36" wide and 84" high (Data Center requires a double door no smaller than 72" wide and 90" high)
- The minimum HVAC load shall be designed to displace 12KW of power, or 3.5 Tons, and shall be coordinated with the City of San Antonio Information Technology Services Department during the design and designed to load if the known load is greater at the time of design.
- A minimum of 50 Foot-Candle(FC) lighting measured 2 feet 6 inches above the finished floor shall be provided. Luminaires shall be mounted a minimum of 8 feet 6 inches above the finished floor.

Emergency lighting shall be provided.

- The MDF shall be equipped with a minimum of (2) dedicated 208 VAC 30 Amp electrical circuits terminated in separate J-boxes and (2) dedicated 120 VAC 20 Amp circuits mounted above each equipment cabinet or rack.
  - The (2) 208 VAC J-boxes shall be mounted to a uni-strut above the equipment cabinets or racks and shall be provided with a 7-foot "SO Type" cord with a female NEMA L6-30R receptacle on the end.
  - The (2) 120 VAC J-box shall be mounted to a uni-strut above the equipment cabinets or racks and shall be provided with a 7-foot "SO Type" cord with a female NEMA 5-20R receptacle on the end.
  - Cabinet/Rack circuits shall be provided with USP backup, and be connected to a Generator. Coordinate power backup requirements with Electrical design, City of San Antonio and ITSD.
- For convenience power, the MDF shall be equipped with 120-volt 20 Amp duplex NEMA 5-20R receptacles, with maximum (3) receptacles on each circuit. The originating electrical panel shall be equipped with a 20 Amp breaker per circuit.
- The MDF shall be equipped with a minimum of (20) equipment cabinets: (15) black ZetaFrame and (5) white ZetaFrame cabinets. Coordination with and approval by City of San Antonio Information Technology Services Department during the design is required.
- The MDF shall be equipped with cable runway encircling the room at 84-86 inches above the finished floor, and crossing the room above the equipment cabinets or racks (1) time.
- Cabinets shall be Chatsworth Zetaframe 48U x 800w x 1200 D and racks shall be with EIA 19- inch rails, 48 RMU overall height and rack mount unit markings engraved on the rails.
- The MDF door shall be equipment with a card reader and electrified door hardware.
- All cabinets and racks shall be equipped with horizontal and vertical cable management.
- Provide (1) fiber optic patch cord + 25% for each terminated strand.
- Provide (2) Category 6A path cords + 25% for each terminated port (1) for the patch panel side, and (1) for the workstation side. (Coordinate length with City of San Antonio and ITSD).
- All MDF/IDF walls shall be covered with 4'x8'x3/4'' fire rated AC grade plywood, a-side facing interior of room, painted with fire-retardant paint, leaving stamp exposed. Mount plywood vertically starting at 6" A.F.F. all plywood panels shall be moutned in contact with each other, leaving no gaps between panels.
- The room shall be free of water or drain pipes not directly constructed, in and over support of room equipment.

- The HVAC system in the room shall provide 24 hour-per-day, 365 days-per-year operation. Temperature and humidity shall be controlled to provide continuous operation. The temperature should be maintained between 18°-27°C / 64°-80°F. Humidity range is 40% and 60 %. HVAC operation shall be monitored by the control system.

11.2.6.2 IDF (Intermediate Distribution Frame)

- An IDF is a telecommunications space that resides in each building that requires more than a single telecommunications space from which to terminate horizontal workstation cables. There may be multiple IDFs in each building as required to maintain horizontal cable distances of 295 feet for the permanent link. Any cabling located in MPOE/MDF should also have the same nomenclature when cabling is being terminated as well.
- An IDF houses the terminations and cross connections for the intra or inter-building cabling from the MDF and the horizontal user workstation cabling in the area of the building that it serves.
- Building workstation access network equipment will reside in the IDF.
- The IDF may share space with other systems such as security panels and paging systems. Space allocation for other systems shall be coordinated with the applicable disciplines.
- The IDF shall be a minimum of 200 square feet with minimum clear lineal wall lengths of at least 10 feet by 20 feet, to accommodate (3) larger cabinets, no ceiling.
- The minimum HVAC load shall be designed to displace 4KW of power, or 2 Ton, and shall be coordinate with the City of San Antonio Information technology Services Department and designed to load if the load is greater and known at the time of design.
- A minimum of 50 FC lighting measured 2 feet 6 inches above the finished floor shall be provided. Luminaires shall be mounted a minimum of 8 feet 6 inches above the finished floor. Emergency lighting shall be provided.
- The IDF shall be equipped with a minimum of (2) dedicated 208 VAC 30 amp electrical circuits terminated in separate J-boxes and (1) dedicated 120 VAC 20 Amp circuit mounted above each equipment cabinet or rack.
    - The (2) 208 VAC J-boxes shall be mounted to a uni-strut above the equipment cabinets or racks and shall be provided with a 7-foot "SO Type" cord with a female NEMA L6-30 R receptacle on the end.
    - The (2) 120 VAC J-box shall be mounted to a uni-strut above the equipment cabinets or racks and shall be provided with a 7-foot "SO Type" cord with a female NEMA5-20 R receptacle on the end.
    - Cabinet/rack circuits shall be provided with USP backup, and be connected to a Generator. Coordinate power backup requirements with Electrical design, City of San Antonio and ITSD.
- For convenience power, the IDF shall be equipped with 20 Amp duplex NEMA 5-20R receptacles, with maximum (3) receptacles on each circuit. The originating electrical panel shall be equipped with a 20 Amp breaker per circuit.
- The IDF shall be equipped with a minimum (2) equipment cabinets or equipment racks. Coordination with and approval by City of San Antonio Information Technology Services Department during the design is required to determine with equipment cabinets or equipment racks shall be utilized.
- The IDF shall be equipped with cable runway encircling the room at 84-86 inches above the finished floor, and crossing the room above the equipment cabinets or racks (1) time.
- Cabinets and racks shall be black aluminum Standard Equipment Cabinets and Racks with EIA 19- inch rails, 84-inch (45 RMU) overall height and rack mount unit markings engraved on the rails.
- All cabinets and racks shall be equipped with horizontal and vertical cable management.
- Provide (1) fiber optic patch cord + 25% for each terminated strand.
- Provide (2) Category 6A path cord + 25% for each terminated port (1) for the patch panel side, and (1) for the workstation side. (Coordinate length with City of San Antonio and ITSD).
- All MDF/IDF walls shall be covered with 4'x8'x3/4'' fire rated AC grade plywood, a-side facing interior of room, painted with fire-retardant paint, leaving stamp exposed. Mount plywood vertically starting at 6" A.F.F. all plywood panels shall be mounted in contact with each other, leaving no gaps between panels.
- The room shall be free of water or drain pipes not directly constructed, in and over support of room equipment.
- The HVAC system in the room shall provide 24 hour-per-day, 365 days-per-year operation. Temperature and humidity shall be controlled to provide continuous operation. The temperature should be maintained between 18°-27°C / 64°-80°F. Humidity range is 40% and 60 %. HVAC operation shall be monitored by the control system.

11.2.6.3 Conduits and sleeves

- Minimum (4) 4" conduits shall be provided from MDF room to each IDF room.
- All conduits, sleeves and penetrations shall be properly fire-stopped to meet local code and to return the wall, floor or structure, back to its original rating.
- At each flush wall-mounted workstation location, install a 4 11/16 inch by 4 11/16 inch by 2-1/8 inch double-gang back box with double-gang mud ring at 18 inches above the finished floor and at appropriate height for wall mounted phones and above-counter and

millwork locations.

- Install a minimum of (1) 1-1/4" conduit from the double-gang box to above accessible ceiling in the room where double-gang box is located. If ceiling is not accessible, install conduit to nearest accessible ceiling.
- Conduit and sleeve fill shall not exceed 40%.
- Conduits and sleeves shall have bushings at both ends with a pull-string.

11.2.6.4 Cable trays and J-hooks

- Main cable pathway shall be wire-basket cable tray with the cables exiting the cable tray supported utilizing j-hooks installed a minimum of every 4-5 feet on center. Category 6A-rated J-hooks shall be installed utilizing appropriate hardware to support, join and attach j-hooks to structures.
- Cable tray and J-hook sizing and quantity shall be scaled to the application not to exceed 40 percent fill ratio.
- A separate j-hook pathway shall be provided for each media type from device location to technology cable tray.
    - Horizontal Data
    - Horizontal Wireless
    - Horizontal Audio/Visual
    - Horizontal Security
- Cabling in open ceilings and HVAC rooms shall be in conduit.
- All cable trays and conduits shall be bonded. Refer to grounding section for requirements.

11.2.6.5 Raceway

At locations where the workstation outlets cannot be installed flush in the wall, Surface Mounted Raceway that is appropriately sized and designed to meet the specific requirements shall be provided.

11.2.7 Backbone cabling

- Inter-building Backbone Fiber Optic Cabling shall be armored indoor/outdoor144-Strand single mode (color yellow) home run from the MDF to the primary IDF in each of the buildings on the campus and cosmetically dressed with fan-out kits as required. Provide a 10-foot service loop at both ends of each cable stored on the wall above or below the cable runway. Provide a 20-foot service loop in each manhole or pull box. Cables shall be labeled in each manhole / pull box. Cables shall be secured with Velcro in the MDF or IDF.
- Inter-building Backbone Copper Cabling shall terminate on UL-listed Category 5E 200-pair 110 IDC in/out lightning protection panels equipped with UL-listed Category 5E 5-pin gas tube protector modules. The secondary side of the panel shall be connected to a Category 5E 24-Port RJ-45 rack mounted patch panel.

- Intra-building Backbone Fiber Optic Cabling shall be armored plenum rated 48-Strand tight buffered single mode (color yellow) from the MDF to each of the IDFs in the building. Provide a 10-foot service loop at both ends of each cable stored on the wall above or below the cable runway. Cables shall be secured with Velcro in the MDF or IDF and in the cable runway.

11.2.8 Horizontal cabling

- Horizontal Data Cabling shall be installed from the patch panel in the MDF or IDF to the workstation location not to exceed 295 feet for the permanent link. Provide a 10' service loop in the MDF or IDF, and 1-foot of slack at the conduit stub-up above the outlet. Cable bundles shall be secured with Velcro.
- Category 6A UTP, plenum rated shall be used for the interior environment.
- Category 6A UTP, OSP-rated shall be used in the outdoor environment.
- Category 6A FTP, Panduit TX6A shall be used for Security Cameras and Wireless Access Points (WAP).
- Quantities as follows:
    - Office Workstations - (2) Category 6A outlets on each of (2) walls in each office up to 100 sf.
    - Overhead Projector location – (1) Category 6A outlet.
    - Audiovisual Control Panel – (1) Category 6A outlet.
    - Wireless Access Point – Minimum (1) Category 6A outlet, (2) Category 6A outlets are recommended per TIA-TSB-162B.
    - IP Camera – (1) Category 6A outlet.
- Refer to COSA Standard for cable colors.
- All faceplate colors shall be coordinated with the Architect or owner at the time of installation.
- Trim color will need to match and coordinate with electrical.

11.2.9 Wi-Fi

- A/E shall follow TIA-TSB-162-B Requirements.
- Indoor Wireless Access Points shall be provided throughout indoor spaces.
- Design to be based on occupancy, not universal WAP (wireless access point) spacing requirements. Placement shall be based on a Cisco-approved heat map and approved by COSA ITSD.
- Outdoor Wireless Access Points shall be provided throughout curbside areas, and not required at parking areas.
- Interior Wireless Access Point Cable shall be Category 6A, plenum-rated.
- Exterior Wireless Access Point Cable shall be Category 6A, OSP-rated.
- Provide building entrance terminals for cables feeding outdoor Wireless

Access Points.

- Coordinate Wireless Access Point model number and required weather-proof enclosure with City of San Antonio and ITSD.

11.2.10 Acceptable Manufacturers / Products

- Refer to COSA Communications latest standard for acceptable manufacturers and products.
- The following list of manufacturers / products is provided for reference only. Coordinate with City of San Antonio and ITSD for final selections.
- Where specific manufacturers / products are mentioned, an equivalent will be considered following an official submission of product literature and written acceptance by the City of San Antonio Information Technology Services Department.
    - Fiber Optic Cable: Commscope, General Express LT, Systimax
    - Copper Cable: Panduit, General, Mohawk, Superior, Systimax
    - Equipment Racks: Chatsworth
    - Fiber enclosure: Panduit, Corning
- End point terminations shall be Panduit product Category 6A.

11.2.11 Active Network Components

- Active network components (switches, servers, firewalls, storage, etc.) shall be provided by Airport IT.
- A/E shall coordinate space for the active network components to be included in the design.

11.2.12 Area-specific requirements and Lessons Learned

- A/E shall take into consideration cable ups and downs, distance to IDF room.
    - Consider using power injectors for devices located outside of distance limitation.
    - A/E shall conduct Circle/Diamond shape pattern study to support the IDF room locations.
- A/E shall provide exterior IDF cabinets in remote areas outside the buildings for providing data connectivity for exterior systems (e.g., vehicle tracking system, CCTV, Wireless, etc.)

11.3 Security Systems

11.3.1 General requirements

- The Physical Security System Infrastructure Guideline document is a guideline for physical security systems infrastructure and the associated spaces to be applied by the A/E for new or renovated facilities. Information herein is applicable to the Physical Security Consultant, IT Consultant, Architect, MEP, and contractors, and shall be taken into account for each project by all team members.
- This guideline applies to three separate electronic systems that make up the overall Physical Security System. These systems are Access Control, Intrusion Detection, and Video Surveillance.
- A/E shall not deviate from this guideline without explicit written approval from the owner.
- Any deviations shall immediately be brought to the attention of the owner's representative in writing for resolution.
- Where specific product brands are mentioned, an equivalent will be considered following an official submission of product literature and written acceptance by the City of San Antonio Information Technology Services Department.
- Where means, methods, and best practices are mentioned, contractor shall follow the manufacturers' and owner's requirements, industry standards, or code, whichever is most stringent.
- Data network cabling is addressed under "Structured Cabling Infrastructure Guideline". Physical security cabling from the field device and control panel is addressed within this document.
- Security System must comply with anti-terrorism requirements. Coordinate with Airport Security.
- Refer to Lessions Learned and Innovation Sections of this document for additional design considerations to be included in the design.

11.3.2 Asset value, threat, hazard, vulnerability, and risk assessment

- An assessment should be conducted as part of the design process for each building.

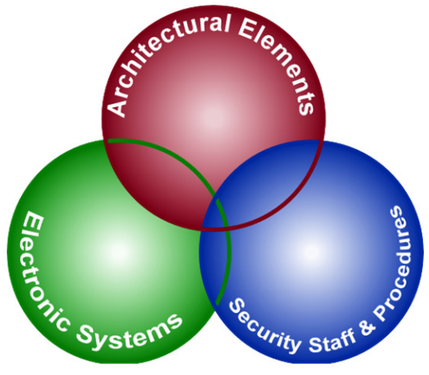
11.3.3 Security Design Criteria

The design process for the building as well as the security systems, should utilize proven systems and principles to design an integrated security program capitalizing on the synergistic strength of three basic security elements. These elements are illustrated in the diagram below and include:

- Architectural protective measures such as entry flow, locks, doors, etc.
- Operational measures relating to employee and visitor access control, security staffing, policies, and procedures.

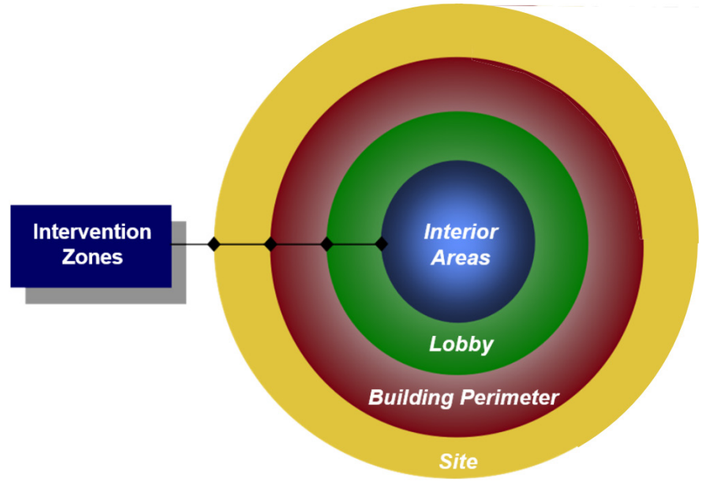
- Technical electronic security systems such as automated access control, alarm monitoring systems, video surveillance systems, etc.

The concepts and strategies explored during the design process for each building should follow the recognized security principles of Crime Prevention through Environmental Design (CPTED) and Concentric Circles of Protection. CPTED is a concept that attempts to utilize planned resources, such as architectural barriers, landscaping, and lighting, in conjunction with traditional electronic security elements to reduce vulnerability to crime. The concept of CPTED is based on the premise that the physical environment can be designed to produce behavioral effects that will reduce the incidence and fear of crime.



11.3.3a Security Design Elements Diagram

The concept of Concentric Circles of Protection is based on varying levels of protection originating at the furthest most perimeters and becoming increasingly more restrictive as one proceeds through each level to reach the most critical internal areas. Intervention zones are created to provide control locations and/or funneling points. These intervention zones provide an opportunity for response, evaluation, and control of intruders or unauthorized individuals. Examples of intervention zones may include personnel posted at lobbies, and the use of electronic systems such as card reader-controlled locations or intrusion detection devices. The following chart illustrates the various levels of protection.



11.3.3b Security Levels of Protection Diagram

11.3.4 Security Industry Standards

The following industry standards shall be adhered to unless specifically directed otherwise by the City of San Antonio Information Technology Services Department. The list is not all-inclusive and does not alleviate compliance with the latest applicable standards, codes, and best practices:

- Americans with Disabilities Act (ADA)
- Crime Prevention Through Environmental Design (CPTED)
- NFPA 70: National Electric Code (NEC)
- NFPA 101: Life Safety Code
- NFPA 730: Guide for Premises Security
- NFPA 731: Standard for the Installation of Electronic Premises Security
- BICSI's Electronic Safety and Security Design Reference Manual (ESSDRM)
- Underwriter's Laboratories (UL) Applicable Standards
- NECA 1: Standard Practice of Good Workmanship in Electrical Contracting
- Electronic Industries Alliance (EIA) Applicable Standards
- Telecommunications Industry Association (TIA) Applicable Standards
- Institute of Electrical and Electronics Engineers (IEEE) Applicable Standards
- Family Educational Rights and Privacy Act (FERPA)

- Texas Accessibility Standards (TAS)
- Illuminating Engineering Society of North America

11.3.5 Acronyms and nomenclature

- Access Control System (ACS)
- Data Gathering Panel (DGP)
- Intrusion Detection System (IDS)
- Digital Alarm Panel (DAP)
- Request-to-exit (REX)
- Video Surveillance System (VSS)
- Security Equipment Room - An environmentally controlled architectural space used for housing security equipment.

11.3.6 Security Spaces - Security Equipment Room

- The Security Equipment Room is a dedicated security space that serves a building.
- It is preferred a Security Equipment Room be provided in all facilities. If it is not possible for a Security Equipment Room to be provided, the Project Architect and Security Consultant shall coordinate with the City of San Antonio Information Technology Services Department to coordinate space for security equipment inside the MDF Room and applicable IDF Rooms.
- The Security Equipment Room houses terminations and cross-connections for all incoming security wiring from the security devices throughout the building.
- Fire alarm panels and building control panels shall not be located inside the Security Equipment Room. Space allocation for these systems needs to occur outside of the Security Equipment Room.
- The Security Equipment Room shall not be used for storage, or serve as a mechanical or electrical distribution space, nor shall it have within its space main electrical feeds, electrical switchgear, transformers, and water or sprinkler main lines.
- The Security Equipment Room shall be a minimum of 81 square feet with minimum clear lineal walls of at least 9 feet by 9 feet. The size of the Security Equipment Room shall be coordinated with and approved by the City of San Antonio Information Technology Services Department during the design.
- The Security Equipment Room shall be located adjacent to the building MDF Room.
- The Security Equipment Room shall not be located adjacent to or below restrooms or other water-based facilities or sources of EMI and mechanical vibration.
- The Security Equipment Room shall be equipped with a card reader and electrified door hardware.

- The minimum HVAC load shall be designed to displace 4KW of power, or 1 Ton, and shall be coordinated with the City of San Antonio Information Technology Services Department during the design and designed to load if the known load is greater at the time of design.
- Lighting shall be a minimum of 50 foot candles at 2 feet above the floor in the entire space
- All electrical service outlets shall be on emergency power, as well as shall have a UPS/battery back-up.
- Power for the Security Equipment Room shall be in two categories: dedicated and convenience.
    - Access Control System
        - Data Gathering Panels shall have a UPS/battery back-up and shall be equipped with dedicated power at the security riser backboard, consisting of a hard-wired connection to a 120VAC 20A emergency circuit.
        - Centralized Power Supplies shall have a UPS/battery back-up and shall be equipped with dedicated power at the security riser backboard, consisting of a hard-wired connection to a 120VAC 20A emergency circuit.
    - Intrusion Detection System
        - Digital Alarm Panels shall have a UPS/battery back-up and shall be equipped with dedicated power at the security riser backboard, consisting of a 120VAC 20A duplex outlet on an emergency circuit.
        - Centralized Power Supplies shall have a UPS/battery back-up and shall be equipped with dedicated power at the security riser backboard, consisting of a hard-wired connection to a 120VAC 20A emergency circuit.
    - Video Surveillance System
        - Video Surveillance System shall have a UPS/battery back-up and shall be equipped with dedicated power at the security riser backboard, consisting of a 120VAC 20A duplex outlet on an emergency circuit.
    - Convenience
        - The Security Equipment Room shall be equipped with 20 Amp duplex NEMA 5-20R receptacles every 6 feet, with maximum (3) receptacles on each circuit. The originating electrical panel shall be equipped with a 20 Amp breaker per circuit.

11.3.7 Access control System (ACS)

- Security Consultant shall coordinate with the City of San Antonio Information Technology Services Department on which ACS electronics and software shall be provided and installed by the Contractor and which by the Owner on the project-by-project basis. Coordinate if a physical security systems contractor hired directly by the City of San Antonio shall be utilized on the project-by-project basis.

- Security Consultant shall coordinate with the City of San Antonio Information Technology Services Department, San Antonio Airport (SAT) Security, Aviation Industry Computer-Based Training Committee (AICC) and San Antonio Airport Police Department (SAAPD) on all ACS device locations required per project.
- Acceptable equipment manufacturers have been listed for reference only.
    - ACS Software (See Exhibit 1 for List of Manufacturers and Products)
        - Hirsch Velocity is the current ACS software used by the City.
        - The existing server resides at the ITSD Frio Data Center.

11.3.7.1 General

A typical ACS system shall consist of data gathering panels, door interface modules, card readers, electrified locks, request exit devices, door position switches, power supplies, and cabling.

11.3.7.2 ACS Data Gathering Panel

- The data gathering panels are configured in two (2) and eight (8) position door panels and associated power supplies.
- All data-gathering panels shall be located in the Security Equipment Room or MDF Room of each building unless distances or pathways make it necessary to locate some panels in IDFs.
- The maximum security wiring distance from a data gathering panel to an ACS device is 1500'. If the ACS device cannot be reached within this distance, a data-gathering panel will be required in an IDF closer to the ACS device.
- All data-gathering panels shall have a UPS/battery back-up and shall be equipped with dedicated power at the security riser backboard, consisting of a hard-wired connection to a 120VAC 20A emergency circuit.
- All data gathering panels will require (1) dedicated data network drop at the security riser backboard location at 18" A.F.F.

11.3.7.3 ACS Door Configuration

- Security Consultant shall coordinate with the City of San Antonio, A/E, and door hardware consultant to determine the door hardware being provided for each applicable door and to ensure the proper door trim is provided depending on whether the door is in emergency egress or not.
- With the exception of the card reader rough-in, all conduit rough-ins / pathways will be provided on the secure side of the door.
- Security Wiring
    - Security Consultant shall design and coordinate the pathway for the ACS as required based upon the door hardware. The pathway will route into the nearest accessible ceiling.
    - Security wiring will consist of composite access control cable for the lock power, card reader, door contact, and REX applications from the DGP to the door.
    - Power will be 24VDC and provided via the security wiring from the centralized power supply, which is located at the applicable security riser.
    - The centralized power supply will require hard-wired connection to 120VAC, 20A emergency circuit.

11.3.7.4 ACS Interface to Fire Alarm System

The Security Consultant shall coordinate with the A/E and fire alarm designer and/or contractor to ensure the appropriate interface is provided to allow the automated unlocking of applicable emergency egress doors in a life safety situation as required.

11.3.7.5 Card Reader Control of Elevator Hallway Call Button

- Each facility and elevator will need to be evaluated and coordinated with the City of San Antonio to determine if the access control system will be required to interface with the elevator.
- When required, the Security Consultant shall coordinate with A/E team/elevator consultant during the design process to ensure the appropriate interface is provided to allow the hallway call function to be controlled through security system.
- Security Wiring
    - Security wiring will consist of a gray 18 AWG, 6-conductor wire from the card to the DGP.
    - Power will be 24VDC and provided via the security wiring from the centralized power supply, which is located at the applicable security riser.
    - The data gathering panel and centralized power supply will require hard-wired connection to 120VAC, 20A emergency circuit.

11.3.7.6 ACS Interface to Elevator Systems

- Each facility and elevator will need to be evaluated and coordinated with the City to determine if the access control system will be required to interface with the elevator.
- When required, the Security Consultant shall coordinate with the A/E team/elevator consultant during the design process to ensure the appropriate interface is provided to allow the hallway call function to be controlled through the security system.
- When required, all hallway call buttons for elevators on all floors shall be card reader controlled by the security system on a time programmable basis.
- When in the card reader control mode, the hallway call button shall be disabled. The passenger shall be required to hold their access card

up to a card reader mounted adjacent to the call button station. Upon a valid card read, the security system shall enable the call button. The passenger shall then push the desired call button. Once the passenger has pushed the button, the elevator control system shall illuminate the button and call the elevator to the floor.

- The elevator contractor shall provide one pair of terminals per controlled call button such that a dry contact closure across the terminals by the security system shall enable the call button. The button shall remain enabled for as long as the dry contact is closed.

11.3.7.7 Typical Doors requiring Access Control

Typical doors requiring Access Control include but not limited to the following:

- Main Entrance
- Weapons Storage
- Funds Storage
- Transaction Areas
- Pharmacy Spaces
- Medical Records Rooms
- Criminal Justice Information Systems (CJIS) Areas
- MDF and IDF Rooms
- Security Equipment Room
- AED Cabinets
- TSR-regulated doors
- Vehicular and pedestrian gates

11.3.8 Intrusion Detection System (IDS)

- Security Consultant shall coordinate with the City of San Antonio Information Technology Services Department on which IDS electronics and software shall be provided and installed by the Contractor and which by the Owner on the project-by-project basis. Coordinate if a physical security systems contractor hired directly by the City of San Antonio shall be utilized on the project-by-project basis.
- Security Consultant shall coordinate with the City of San Antonio Information Technology Services Department, SAT Security, AICC and SAAPD on all IDS device locations required per project.
- Acceptable equipment manufacturers have been listed for reference only.
  - IDS System Electronics and Software (See Exhibit 1 for List of Manufacturers and Products)
    - Bosch Intrusion Detection System is the current IDS system used by the City.

11.3.8.1 General

An IDS system shall consist of, digital alarm panels, arm/disarm keypads, expansion modules, dual technology motion sensors, sirens, network adapters, high temp sensors, power supplies, and wiring.

11.3.8.2 Digital Alarm Panel (DAP)

- Digital alarm panels will be wall mounted in the Security Equipment Room or MDF Room on a security riser backboard location.
- Digital alarm panels shall be located in the Security Room or MDF Room of each building unless distances or pathways make it necessary to locate some panels in IDFs.
- All digital alarm panels shall have a UPS/battery back-up and shall be equipped with dedicated power at the security riser backboard, consisting of a 120VAC 20A duplex outlet on an emergency circuit.
- All digital alarm panels will require (1) dedicated data network drop at the security riser backboard location at 18" A.F.F.
- All digital alarm panels will require (1) dedicated POTS line drop at the security riser backboard location at 18" A.F.F.

11.3.8.3 Arm/Disarm Keypad

- Keypads will be mounted at 48" A.F.F at the appropriate locations.
- Keypads will require a single gang backbox with a single gang device ring, and a 1" conduit stubbed out above the ceiling of the nearest accessible ceiling.
- Security Wiring
  - Security wiring to each IDS device will consist of a gray 18 AWG, 4- conductor wire from the DAP to keypad locations.
  - The maximum security wiring distance from a DAP to a keypad is 500'. If the keypad cannot be reached within this distance, a DAP will be required in an IDF closer to the keypad.
  - Power will be 24VDC and provided via the security wiring from the centralized power supply, which is located at the applicable security riser.
- Typical Keypad Locations:
  - Main Entry Vestibule
  - Staff Entrance Doors

11.3.8.4 Motion Detectors

- It is preferred that motion detectors be ceiling mounted when a lay-in ceiling is available.
- Ceiling-mounted motion detectors do not require a conduit rough-in or backbox.
- Coordinate ceiling-mounted locations with other ceiling-mounted devices (e.g., lights, fire exit signs, etc.).

- Ceiling mounted motion detectors should not be mounted near A/C vents as this could cause false alarms.
- Where lay-in ceiling is not available, wall-mounted motion detectors shall be utilized.
- Wall-mounted motion detectors will require a single gang backbox with a single gang device ring, and a 1" conduit stubbed out above ceiling of the nearest accessible ceiling.
- Wall mounted motion detector rough-in locations will be mounted within 6" of ceiling but not lower than 8'-6" and no higher than 10'-0".
- Security Wiring
    - Security wiring will consist of a gray 18 AWG, 4-conductor wire from the DAP to the motion detectors.
    - The maximum security wiring distance from a DAP to a motion detector is 500'. If the IDS motion detector cannot be reached within this distance, a DAP will be required in an IDF closer to the motion detector.
    - Security wiring shall be provided with 20 feet of slack left neatly coiled and stored at each end.
    - Power will be 24VDC and provided via the security wiring from the centralized power supply, which is located at the applicable security riser.
- Typical Motion Detector Locations:
    - All first floor rooms with exterior windows. In open areas sharing the same window, minimum every 30-feet from each other.
    - All floors above the first floor will have motion detectors within the hallways at stairwells or major cross-corridors.
    - Roof Access points.
    - Provide Glass Break Detectors in spaces with windows on the ground level. Coordinate layouts with Airport Security.

11.3.8.5 Door Position Switches

- Door position switches will be mounted at in the head of the door frame.
- Door position switches will require a ¾" hole in the head of the door frame and a ¾" x 1 5/8" hole in the top of the door.
- Security wiring will consist of a gray 18 AWG, 2-conductor wire from the DAP to the door position switch.
- The maximum-security wiring distance from a DAP to a door position switch is 500'. If the IDS door position switch cannot be reached within this distance, a DAP will be required in an IDF closer to the door position switch.
- Power will be 24VDC and provided via the security wiring from centralized power supply, which is located at the applicable security riser.
- Typical Door Position Switch Locations:
    - All exterior doors.
    - All doors with a card reader.

11.3.9 CCTV Video Surveillance

- Security Consultant shall coordinate with the City of San Antonio Information Technology Services Department on which CCTV/VSS electronics and software shall be provided and installed by the Contractor and which by the Owner on the project-by-project basis. Coordinate if a physical security systems contractor hired directly by the City of San Antonio shall be utilized on the project-by-project basis.
- Security Consultant shall coordinate with the City of San Antonio Information Technology Services Department, SAT Security, AICC and SAAPD on all VSS device locations required per project.
- Acceptable equipment manufacturers have been listed for reference only.
    - Video Surveillance System Software (See Exhibit 1 for List of Manufacturers and Products)
    - Genetec Video Management Software is the current software used by the system.
- Cameras shall be powered from PoE network switch located within the applicable MDF or IDF room.
- Security Consultant shall coordinate with IT Consultant to have one (1) Category 6A cable for data to each IP camera location. If the camera location is out of distance limitations for Category 6A cable, the Security Consultant shall coordinate with IT Consultant to have fiber and appropriate media converters at each IP camera location.

11.3.9.1 Camera Types and Mounting

- Interior Wall Mounted shall be mounted within 6" of ceiling but not lower than 8'-6" and no higher than 10'-0".
- Interior Ceiling Mounted cameras shall be mounted within the accessible ceiling tile or hard ceiling and shall be provided with support struts between ceiling grid and tie off to structure above.
- Exterior Wall Mounted cameras shall be mounted between 9'-0" A.F.F. and 15'-0" A.F.F depending on wall design and landscaping obstructions.
- Pan-Tilt-Zoom (PTZ) Cameras
    - Security Consultant shall coordinate with the City of San Antonio on when and where PTZ cameras are to be utilized.
    - Pan-Tilt-Zoom (PTZ) cameras will be powered from a power injector which requires a duplex outlet with a 120VAC 20A circuit dedicated to a power injector mounted in the applicable MDF Room or IDF Room. Field of View (FOV) will be coordinated by the stakeholder identified by the SAT PM during the design

submittal process.

- The exact location of the power will need to be coordinated in the applicable MDF Room or IDF Room.

- Exterior Pole Mounted Cameras
  - Project site shall be prepped for future pole mounted cameras.
  - High voltage and low voltage shall not share the same pathway. A dedicated pathway shall be provided for all low voltage security wiring.
  - Pole mounted cameras will be mounted between 12'-0" AFF and 15'-0" A.F.F. Coordinate with lighting poles.
  - Provide a duplex outlet with a 120VAC 20A circuit dedicated to a power injector within NEMA 4 enclosure mounted at base of the light pole.
- Exterior Camera Housing
  - All exterior cameras, including pole-mounted locations, shall be equipped with heater/blower.
  - Camera housings shall be powered from PoE network switch or power injectors located within the nearest MDF or IDF room.
  - Security Consultant shall coordinate with the City of San Antonio on the powering requirements for the exterior camera housing.
- Surge Suppression
  - Provide surge suppressor for all exterior mounted cameras.
  - Surge suppression shall be configured to protect video, power and data wiring for exterior cameras.

11.3.9.2 Typical Camera Coverage

Typical camera coverage areas include but not limited to the following:

- Utility Spaces
- Main Entrance
- Stairs
- Hallways
- Perimeter of Buildings
- Resource Areas within a Location
- Upper and lower curb zones
- Ticket halls
- Baggage claim areas
- Regulated doors
- Gate hold rooms
- Elevators

- Other as coordinated with Airport Security, AICC and SAAPD
- Field of View (FOV) for each area shall be coordinated with Airport Security.

11.3.10 Duress Button System

Provide Duress Buttons in Adult Changing rooms. Coordinate requirements with Airport Security.

11.3.11 Architectural Requirements and Recommendations

11.3.11.1 Lighting

- Adequate lighting is required throughout the building and site, within the parking areas, public areas, at the exterior of the building and in public interiors such as lobbies, corridors, and walkways.
- The following light levels are a compilation of IESNA recommendations, and shall be confirmed by Lighting Designer and Airport. The lighting levels should be considered to represent baseline requirements. Minimum luminance values are as follows:

EXTERIOR LIGHTING		
Application	Light Level (LUX)	Light Level (FC)
Building Entrances*	50	5
Building Emergency Exits	10	1
Loading Platforms and Docks	20	2
Building Surroundings	10	1
Roadways	5	.5
Landscaped Areas	5	.5
Parking	50 (avg.) 4:1 (avg:min)	5 (avg.) 4:1 (avg:min)

- Lighting levels at the exterior of building entrances should maintain the same illumination level of the interior lobby so as to avoid light reflection from the inside (if the exterior is darker than the inside, reflection will occur on the interior of the glass).
- Where applicable, lighting for perimeter fencing of a secure area should maintain a minimum of one foot candle and should be provided at the perimeter fence, extending at least 10 feet beyond the fence line. This lighting should be designed to project from within the secure area, out toward the fence to highlight perpetrators while silhouetting the security personnel.
- It should be noted that certain exterior lighting levels might not be possible due to local "light pollution" codes.

INTERIOR LIGHTING		
Application	Light Level (LUX)	Light Level (FC)
Elevators	100	10
Corridors	50	5
Lobbies	50	5
Stairways	100	10
Camera Locations	10	1

- Lighting will play an important role in deterring crime and maintaining a safe environment inside and around the buildings. The importance of lighting cannot be overemphasized.

11.3.11.2 Door Openings and Hardware

- Door and door frame construction should meet the penetration resistance of supporting walls. Frames should be securely attached to the walls. Gap tolerances should be limited to prevent forced entry.
- The door hardware consultant should coordinate electrified locking hardware for all controlled openings.
- All security controlled and monitored doors shall be equipped with high security closers.
- Hinge pins for all security-controlled doors shall be located on the secure side of the door. Where this is not possible and hinge pins are located on the non-secure side, fixed tamper proof hinge pins shall be used.
- All cylinders for security controlled and monitored doors shall be equipped with interchangeable cores.

11.3.11.3 Landscaping

- The building landscaping scheme should utilize elements to define traffic patterns and security zones, while providing maximum visibility across the site. Specific recommendations in regard to landscaping include:
  - Landscaping should not provide convenient places to hide and should provide for unobstructed surveillance from the building outward.
  - Tree canopies should maintain a 10'-0" distance above grade (minimum).
  - Ground shrubs and bushes should be limited to a height of 12" – 18" (maximum).
  - Planting of trees within parking lots should be avoided. Where this is not possible, consideration for clear lines of sight, both pedestrian and cameras, should be enforced.
  - A clear area around each building of at least 5 feet should be maintained to discourage access while facilitating easy surveillance.
  - Tangling or thorny underbrush should be used to dissuade access to certain areas such as:
  - Building perimeters – a clear zone of five feet around all building perimeters could be established with tangling or thorny underbrush or ground covering.
  - Potential Hiding Places – Building nooks or recesses that would accommodate concealment should be avoided entirely. Where this cannot be accomplished, tangling or thorny underbrush should be used to prevent access to these areas.

11.3.11.4 Signage

Signage should be used to direct all visitors and staff to the proper control points. Due to the size and multiple functions of some facilities, this will be a critical component in preventing accidental misuse of entrances into the facility.

11.3.11.5 Fencing

Coordinate requirements with Chapter 4 – Site / Civil.

Where chain-link fencing is considered for the protection of certain areas, the following guidelines are recommended:

- Fence shall be eight feet high (minimum), excluding top guard.
- Fence shall be constructed of nine gauge or heavier
- Mesh opening shall not be larger than two inches per side.
- Fence shall be fastened securely to rigid metal or reinforced posts set in concrete.
- Fence shall reach within two inches (maximum) of ground/paving.
- Provide (3) strands of barbed wire at the top of the fence with outriggers pointing toward the non-secure side of the fence.
- Coordinate with City of San Antonio, Airport Security, AICC and SAAPD for additional requirements.

11.3.11.6 Parking Areas

- Lines of sight should be maximized within parking areas, not only to facilitate security monitoring, but also to create a psychological feeling of openness and security to staff and visitors.
- The placement of critical building components (electrical, mechanical, communications, etc.) within the parking areas should be avoided. If this is not possible, these spaces should be physically protected against intentional, or more likely, accidental damage. This can be accomplished using bollards and/or chain link fencing.

11.3.12 As-Built Documentation

- Produce drawings depicting the condition of the Physical Security System as installed produced in Revit 2020, AutoCAD 2010 or higher and provided in hardcopy, electronically in Revit, .DWG and .PDF format.
- Include the exact dimensions and locations security riser wall elevations, conduit rough-in locations, device locations, wiring pathways and numbering and labeling scheme.

11.3.13 Summary of guidelines

- All aspects of this City of San Antonio Physical Security System Infrastructure Guideline shall be applied to the design process for both new and renovated facilities.
- Division 28 Security Wiring Specification and TS-Series drawings shall be commissioned and issued by the Architect during the design phases for each facility or project.

11.3.14 Exhibit 1 - Acceptable manufacturers / products

- The following list or manufacturers/products is provided for reference only and is not all inclusive. All manufacturers/products shall be verified by the Security Consultant for each project and confirmed with The City of San Antonio Information Technology Services Department prior to issuing any construction documents.
- Where specific manufacturers/products are mentioned, an equivalent will be considered following an official submission of product literature and written acceptance by the City of San Antonio Information Technology Services Department.

11.3.14.1 Access Control System

- Access Control System Server (Existing)
- Access Control System Software (Owner Provided/Owner Installed)
  - Hirsch Velocity
- Access Control System Data Gathering Panels (Owner Provided/Owner Installed)
  - Hirsch DIGI TRAC M2N2 and M8N2
- Access Control System Centralized Power Supply (Owner Provided/Owner Installed)
  - Altronix Lock Power Supply AL600ULACM
- Access Control System Wiring (Contractor Provided/Contractor Installed)
  - Belden 658AFS Composite
- Request to Exit Device (Owner Provided/Owner Installed)
  - Assa Abloy Securitron XMS Exit Motion Sensor
- Card Reader (Owner Provided/Owner Installed)
  - HID iCLASS/Prox/PIV - WS
- Electric Strikes (Owner Provided/Owner Installed)
  - HES 9500, HES 9600, Assa Abloy 7400 Series
- Intrusion Detection System
  - Intrusion Detection System Panel (Owner Provided/Owner Installed)
  - Bosch 9412 Series Panel
- Door Contact (Owner Provided/Owner Installed)
  - General Electric Sentrol Door Contacts
- Intrusion Detection System Wiring (Contractor Provided/Contractor Installed)

11.3.15 Exhibit 2 – Typical details

Refer to City of San Antonio Physical Security System Infrastructure Guideline from 03/24/2014 or latest version for the typical security details.

11.3.16 Emergency phone

- Emergency phones shall be provided including but not limited to the following locations:
  - Vertical core elevator lobbies on each floor;
  - Pedestrian entrances and exits to visitor and employee parking areas;
  - Every 300 feet along the perimeter of visitor and employe parking areas.
- Layouts, signage, and additional requirements shall be coordinated with City of San Antonio, Airport Security, AICC and SAAPD.

11.3.17 Area-specific requirements

Coordinate area-specific requirements with Airport Security.

11.4 Audiovisual Systems

11.4.1 General requirements

Audiovisual standards shall be coordinated with City of San Antonio and ITSD for the latest available equipment and layout requirements.

Refer to Lessons Learned and Innovation Sections of this document for additional design considerations to be included in the design.

11.4.2 Conference Room Audiovisual Systems

- The AV system shall consist of a display, transmitter and receiver, and keypad

control system. All functions of the system shall be self-contained in the conference room.

- Provide enclosures with active cooling to house the audiovisual equipment.
- Coordinate power requirements with Electrical Design.
- This system shall have minimum (3) available HDMI inputs and shall auto-switch, based on device priorities. A small form factor user PC shall be supplied, mounted on the table's underside, and connected to the switcher. When the system is booted up, this PC shall be the primary default source.
- If a user brings their laptop, the user shall have the ability to plug into one of two HDMI cables on the table. These shall synchronize with the user's laptop, prioritize the user PC, and auto-switch to the laptop input. When the user removes the HDMI input from their computer, the AV system shall default to the AV PC.
- All audio shall flow from the display speakers.
- The scaling transmitter shall extend to the display via shielded CAT6 cable through the provided pathways, where it shall be terminated at a receiver and connected to the display via HDMI. An owner-furnished cable television distribution shall connect to the on-board television tuner via COAX input on display. The display shall connect the RS-232 control port to the keypad mounted near the doorway to control the system.
- The specified keypad shall be mounted next to the existing light switch and control certain room functions. The keypad shall control power on/off for the display, volume up/down, source Laptop/Cable Tuner inputs, and channel up/down for the display tuner. Power for the keypad will be extended to the table and connect to a power adapter. All components shall connect to a six-outlet switch mounted under the table and connected to the poke-through available power.
- Provide dimmable LED pendant direct/indirect lighting, accent and down lighting. The fixtures to be controlled via occupancy sensors. The primary daylighting zones will include photocells that will dim the lighting depending on available daylight to a fixed lighting level.
- Audiovisual pathways shall be minimum 1-1/4" conduit sized based on maximum 40% conduit fill.

11.4.3 Paging Systems

- Provide Paging coverage in public restrooms.
- Audiovisual equipment selections shall be consistent so the personnel can understand its use easier.
- Provide room schedulers at conference room entrances and other areas coordinated with City of San Antonio and ITSD.
- Design: A/E shall provide "Turn-Key" paging system designs for both new and upgrades. A "Turn-Key" paging system means that the following will be designed and completed to the satisfaction of ITSD. Specific part numbers shall be coordinated with City of San Antonio and ITSD.
- Survey and Acoustical Engineering: A/E shall address the following elements in their design.
  - Acoustical Survey
  - Analysis with an acoustic analyzer and software
  - Audio and visual paging design
    - Audio
    - Visual
    - Head-end
    - Paging Stations
    - Speakers
    - Ambient Noise Sensors
    - Cabling
  - Recommendations on acoustical treatments
  - Cutover procedures
  - Test procedures
  - Fabrication
  - Assembly
  - Wiring and professional cable harness
  - Demolition of existing system equipment and cabling
  - Removal and recycling
  - Installation
  - Coordination
  - Supervision
  - Manufacturer On-Site System Configuration
  - 30-day on-site endurance testing
  - Inspection
  - System Acceptance
  - Survey of End-Users
  - Acoustical Analysis results as heat maps on floor plans
  - Certification
  - Equipment Specifications
  - Commissioning

- Configurations Ongoing software updates
- Equipment and software training
- Integration with ARCC (Airport Response Coordination Center), also known as DOC (Department Operation Center).

- Emergency Visual Paging: 55-inch (minimum) monitors shall be installed within the Security Screening Checkpoints. Monitor quantity and locations shall be directed by City of San Antonio and ITSD and the Airport ADA Coordinator. Additionally, a separate dedicated monitor shall be installed adjacent to each FIDS bank of monitors – match existing.
- Remote Reboot: Each visual paging monitor shall be plugged into an iBoot remote reboot module.
- Cabling: Each visual paging monitor shall be cabled with three (3) CAT 6A horizontal cables.
- Cameras: Each monitor shall contain a small goose-neck-mounted CCTV camera to provide feedback to the Department Operations Center of sent messages. Cameras shall be networked back into the system.

11.4.4 EVIDS (Electronic Visual Information Display Systems)

- Definitions:
  - Electronic Visual Information Display System (EVIDS)
  - Gate Information Display System (GIDS)
  - Terminal & Airline Support System (TASS)
  - Common Use Passenger Processing System (CUPPS)
  - Visual Docking Guidance System (VDGS)
  - Customs and Border Patrol (CBP)
  - Ramp Information Display System (RIDS)
  - Tug Driver Directional Signage (TDDS)
- A dedicated EVIDS system server shall be established for each building/facility. Additional displays in an existing facility may connect as an extension of the existing EVIDS system that currently supports the respective facility, and will be supported by existing servers and software and include all of the Terminal Airport Support Systems (TASS) Resource Management System functionality and interfaces. All programming, system configuration and set up, definition and development of new display content as required for accommodation of new display types for new gate configurations and aircraft types, and testing and commissioning of the EVIDS system expansion are included in the work. The work is propriety and to be completed by the existing EVIDS maintenance service provider. The contractor shall contact City of San Antonio and ITSD to determine whether additional system resources are required to support additional EVIDS implemented in existing facilities.

- Content for the displays shall be developed by the Contractor in EVIDS coordination workshops, with screen developments contributed to by ITSD representatives, A/E Team representatives, and airline representatives.
- Display types for the CBP areas of the project will require development of contents and control that is specific for CBP operations.
- Work shall include physical display equipment installation, equipment mounting hardware and structural attachments as required for proper installation of displays.
- Test Procedures/Tests: The Contractor will prepare test procedures and reports for the Contractor's field test and the performance verification test.
- Contractor will coordinate the work of this section with that of other trades as required to ensure that the entire work of this project will be carried out in an orderly, complete and coordinated fashion. Specific coordination tasks include meetings and provision of shop drawings for support of display equipment by the following trades:
  - Casework and millwork trades
  - Electrical Power trades
  - Telecommunication trades
  - Structural trades
- Contractor will coordinate closely with ITSD and the existing EVIDS service provider so that EVIDS service is not interrupted during system installation.
- Equipment: Contractor will contact City of San Antonio and ITSD for current LCD and LED display standards.
- Remote web accessed IP power reboot unit: EVIDS displays installed in hard to reach locations or displays noted in the Visual Display Diagrams in the drawing set shall be equipped with remote power reboot devices provided by the Contractor. They are designed to allow authorized web access for the purpose of power on, power off rebooting electrical equipment. Prior to ordering product, procurement, Contractor shall coordinate with City of San Antonio and ITSD for exact product manufacturer.
- Miscellaneous Hardware, Cabling and Wiring: Woven wrap around cable concealment sleeves shall be provided to conceal display cabling from public view. Design selection for products include:
  - Roundit 2000
  - Dura Wrap
  - F6
- Asset Tags and Equipment Inventory: Contractor will acquire and apply ITSD asset tags to each major equipment item. A list of asset tag numbers and locations shall be submitted for review by ITSD. Contractor shall record asset inventory in a MS Excel spreadsheet and submit to ITSD. Contractor to work with ITSD to determine what information should be captured in the asset

inventory spreadsheet.

- Spare Parts: Contractor to contact ITSD for spare parts quantities for each display type.
- Warranty: Materials and workmanship shall meet or exceed industry standards and be fully guaranteed for a minimum of two (2) years from Final Acceptance

11.4.5 FIDS (Flight Information Display System)

FIDS Requirements shall be coordinated with City of San Antonio and ITSD.

11.4.6 BID (Baggage Information Display System)

- BID system shall have large, clear, bright screens.
- Baggage Information Displays need to be big, dynamic, work with Airline Systems, support common use system approach.
- Take into consideration EVIDs upgrade project currently ongoing.
    - Tug Lane input will be a part of EVIDS.
    - Screens need to be larger and brighter
    - BID system requirements shall be coordinated with City of San Antonio and ITSD.

11.4.7 Hearing Loop System

Hearing Loop System requirements shall be coordinated with City of San Antonio and ITSD.

11.4.8 Digital Signage

- Provide Information Display with touch screens to eliminate static information posters and the need to constantly reprint.
- The signage shall be large and dynamic.
- Digital Signage system requirements shall be coordinated with City of San Antonio and ITSD.

11.4.9 Area-specific requirements

Area-specific requirements shall be coordinated with City of San Antonio and ITSD.

11.5 Radio Systems

11.5.1 General requirements

For the Radio System projects, Airport works directly with the preferred vendors

that are familiar with the requirements.

This section is not intended to be covered as part of the current design manual and included for general information only.

- DAS (Distributed Antenna System) projects are contracted to Service Providers (e.g., Verizon, etc.).
- For Emergency Radio Communications systems Federal Government Standards shall be followed.
- Apron Radio Systems / Airlines Radio Systems Standards are currently being set (separate project).
    - There are issues with NEC70 and NFPA101, NFPA70 (Chapter 8) regulations that need to be corrected before staring.
    - Airline Vendors shall adhere to Federal Regulations.
- Most of the Airport radio equipment is based on Motorola.
    - Services: The integrator shall meet the required qualifications, experience and expertise in the design and installation of Public Safety Radio systems and shall be an FCC Licensee qualified installer.
    - Areas requiring coverage are designated as critical by the 2018 NFPA 72, Section 24, NFPA 1221, IFC 510 and other information necessary to deploy complete and fully operational systems at these locations.
    - The system shall have expansion capabilities and the flexibility to support the addition or changes of radio frequencies and future building expansions and renovations.

11.5.2 Radio systems

Radio system including but not limited to the following shall be designed and coordinated with the Airport:

- ERRCS / Emergency Responder Radio System
- Cellular DAS (Distributed Antenna System)
- Wi-Fi (refer to Telecommunications section of the design manual)
- Apron Radio System

A/E shall ensure that building materials do not interfere with the proposed radio system layouts and eliminate dead spots.

11.5.3 Area-specific requirements

Area-specific requirements shall be coordinated with City of San Antonio and ITSD.

11.6 Glossary

ACS :	Access Control System
ADA :	Americans with Disabilities Act
AFF :	Above Finish Floor
AHJ :	Authority Having Jurisdiction
ANSI :	American National Standards Institute
ASL :	Automated Screening Lane
ASTM :	American Society for Testing and Materials
ARCC :	Airport Response Coordination Center
AWG :	American Wire Gauge
A / E:	Architect / Engineer
BAT :	Biometric Authentication Technology
BICSI :	Building Industry Consulting Service International
BIDS :	Baggage Information Display System
CBP :	Customs and Border Patrol
CoSA :	City of San Antonio
ConRAC :	Consolidated Rental Auto Center
CSI :	Construction Specifications Institute
CSO :	Chief Security Officer
CPTED :	Crime Prevention Through Environmental Design
CT :	Computed Tomography
CUPPS :	Common Use Passenger Processing System
DAP :	Digital Alarm Panel
DAS :	Distributed Antenna System
DGP :	Data Gathering Panel
DOC :	Department Operation Center
eAIT :	Enhanced Advanced Imaging Technology
EBC :	Equipment Bonding Conductor
EIA :	Electronic Industries Alliance
EMI :	Electromagnetic Interference
ERRCS :	Emergency Responder Radio System
ESSDRM :	Electronic Safety and Security Design Reference Manual
EVIDS :	Electronic Visual Information Display System
FERPA :	Family Educational Rights and Privacy Act
FIDS :	Flight Information Display System
GIDS :	Gate Information Display System
HDMI :	High-Definition Multimedia Interface
HVAC :	Heating, Ventilation, and Air Conditioning
IDF :	Intermediate Distribution Frame
IDS :	Intrusion Detection System
IEEE :	Institute of Electrical and Electronics Engineers
IESNA :	Illuminating Engineering Society of North America
ITSD :	Information & Technology Services Department
LCD :	Liquid Crystal Display
LED :	Light Emitting Diode
MDF :	Main Distribution Frame
MPOE :	Minimum Point of Entry
NEC :	National Electric Code

NECA : National Electrical Contractors Association

NFPA : National Fire Protection Association

NEMA : National Electrical Manufacturers Association

PBB : Primary Bonding Busbar

PC : Personal Computer

POC : Proof of Concept

PTZ : Pan Tilt Zoom

RIDS : Ramp Information Display System

STI : Specified Technologies Inc.

TAS : Texas Accessibility Standards

TASS : Terminal & Airline Support System

TBC : Telecommunications Bonding Conductor

TDDS : Tug Driver Directional Signage

TIA : Telecommunication Industry Association

UPS : Uninterruptible Power Supply

UL : Underwriter's Laboratories

UTP : Unshielded Twisted Pair

VDGS : Visual Docking Guidance System

VSS : Video Surveillance System

WAP : Wireless Application Protocol

12 SPECIALTY SYSTEMS

Photo by Henry Beccera

12.1 Baggage Handling System

12.1.1 Overall

The San Antonio International Airport (SAT) has two terminals (Terminal A and Terminal B that serves approximately 6 million passengers every year. There are eleven – (11) domestic and international airlines that provide regular commercial service. Airlines operating out of Terminal A are AeroMexico, Alaska Airlines, Allegiant Air, Delta, Frontier, Interjet, Southwest, Sun Country, and Volaris, Terminal B services American Airlines and United Airlines.

- There is one – (1) centralized checked baggage inspection area (CBIS) located in Terminal A that serves both SAT terminals.
- There are five – (5) L3 6600 checked baggage screening devices each rated at 505 bags per hour in a three – (3 (2+1)) device matrix and two – (2 (1+1)) device matrix.
- The Terminal A (AeroMexico, Alaska Airlines, Allegiant Air, Delta, Frontier, Interjet, Southwest, Sun Country, and Volaris) check-in ticket counter conveyor and curbside subsystems merge to form a mainline that feeds the three – (3) EDS device matrix,
- The Terminal B (American and United) take away and curbside subsystems merge to form the mainline that feeds the two – (2) EDS device matrix. Cross overs between the two – (2) mainlines were provided for load balancing and redundancy.
- Clear checked bags are then distributed to airline makeup devices:
- Terminal A has five – (5).
- Terminal B has two – (2).

12.1.2 Ticketing/Check-In

12.1.2.1 All ticket counters should have adjacent bag belt.

12.1.2.2 Self-bag drop can be semi-manned or unmanned and self-checking with capability to weigh bags at the check in station. Capability for a roving ticket agent should be provided. The bag can continue onto various systems. SAAS open to consider automated conveyors and self-service equipment at counters.

12.1.2.3 International style islands allow more ticketing density. They are typically manned. More electrical required for additional belts. Belt redundancy and multi direction routing should be considered to allow for maximum flexibility and to reduce prolonged/extensive shutdowns due to equipment failure

12.1.2.4 Islands offer a higher ticketing length if is there is sufficient distance, but do take up linear space.

12.1.2.5 Oversized baggage needs to be incorporated into system with no lobby screening as opposed to walked to back of house as it is currently done.

12.1.3 Outbound Baggage

Future standards to be developed in concert with the BHS Improvements and Terminal C Advanced Planning

12.1.4 Inbound Baggage

12.1.4.1 Inbound baggage shall be either flat-plate type claim devices or sloped-plate devices.

- Sloped-plate devices shall be fed by an offload belt system in the secure area that will route incoming bags to the top of the slope-plate device.
- Flat-plate devices may be routed from the claim area to the secure offload area and may not require a separate offload feed belt.
- Sloped-plate devices have higher bag capacities per linear foot of device than flat-plate devices but require more space and additional conveyor. Consideration should be given to the space required for anticipated flight capacities and the physical space available for the devices as well as any applicable feed systems.

12.1.5 Access

As the BHS concept design is developed, the next generation “State of the Art” equipment/systems that abide by industry equipment standards will be assessed and incorporated as is appropriate for the function desired.

These multiple technologies combined with an efficient layout allow for:

- Stable operation in case of equipment error
- Provide a transport route plan with the shortest distances of baggage transport

12.1.6 Innovation

Once the passengers’ baggage has reached the baggage sorting area, the autonomous baggage tractor intervenes in the following way –

12.1.6.1 An agent places the baggage in containers connected to the autonomous tractor.

12.1.6.2 The baggage tractor is a smart vehicle that moves autonomously around the airport to reach the aircraft. Its destination is pre-programmed via a touchscreen by an agent.

12.1.6.3 As it nears the aircraft, the tractor stops and the agent takes control of the vehicle and subsequently loads the baggage in the aircraft hold.

12.1.6.4 The vehicle returns to the baggage sorting area taking the same route in the reverse direction.

12.2 Passenger Boarding Bridges (PBB)

12.2.1 Definition

The passenger boarding bridge is an enclosed, elevated mobile walkway which extends from an airport terminal gate to an aircraft door, enabling passengers to board and disembark easily and efficiently.

12.2.2 Overall

PBBs shall be designed to meet U.S. Codes and Regulations that have been adopted by the passenger boarding bridge industry as described below.

- American Welding Society (AWS) Standards.
- American Institute of Steel Construction (AISC) Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings.
- American concrete Institute (ACI) Design Code ACI-318
- Structural Design and Corrugated Steel Panels based on Van Karmon Theory and on buckling studies by Peterson and Card.
- PBBs shall be designed and built utilizing the following preferred Materials:

Structural Steel Shapes	: ASTM-A992 (Grade 50)
Structural Tube	: ASTM-A500, GRADE C or ASTM A1085
Steel Pipe	: ASTM-A53, GRADE B
Steel Plates and Angles	: ASTM-A36
Steel Base Plate	: ASTM-A572, Grade 50
Anchor Bolts	: ASTM-F1554-GR55 Weldable
Hinge Pins	: ASTM-A311 Grades 1018 & 1144
Bolts	: High Strength SAE-J429 Grades 5 & 8 or ASTM-A325 & A490
Reinforcing Steel	: ASTM, A615 GRADE 60 or 80

12.2.3 Design Criteria

12.2.3.1 Structural

- Design the foundations for the Passenger Boarding Bridges based on load data provided by the PBB manufacturer. Submit Foundation designs for approval and record. Designs shall be signed and sealed by a Professional A/E registered in the state of Texas.
- Anchor Bolt Assemblies: Anchor Bolts shall be of ASTM F1554 material. Bolts, nuts, washers, and related components shall be hot-dipped galvanized in accordance with ASTM A 123 and ASTM A 153. Anchor bolt patterns and details for the new PBB's shall be provided by the PBB's manufacturer.
- Confirm the PBB configuration and foundation locations prior to fabricating any materials associated with the support column. Exact shaft locations and anchor bolt configuration may vary based on the actual PBB manufacturer and Model being provided. Provide drawings and template location for all anchor bolt locations and detailing all work required to set the anchor bolts.

- Provide tie-downs.

12.2.3.2 Mechanical

- Per SAAS request, adequate ventilation, heating, and cooling through the tunnel sections of the PBB must be provided in accordance with FAA HF-STD-001, paragraphs 13.2 and 13.3.
- Each boarding bridge shall be equipped with a dual HVAC system capable of providing separate cooling to the bridge and the aircraft, and simultaneously, when needed. It is prohibited to utilize a single system to serve both the bridge and the aircraft.
- Bridges directly connected to terminal facilities will be positively pressured, but at all times kept at a lower pressure than that of the terminal. This will prevent the movement of air from the bridges to the terminal.
- HVAC systems for boarding bridges must be sized for load at full bridge extension.
- Boarding bridge design will consider the use of small-size split units, such as cassette units, inside the bridge as a supplemental source of cooling (in addition to the main system), when appropriate.
- Bridge HVAC systems must be designed to modulate during unoccupied times in order to minimize energy use, while maintaining an acceptable indoor air quality.
- The A/E will evaluate selecting HVAC parts and equipment that are uniform across the entire project, when possible, and consistent with lessons learned on previously used PBB equipment. The A/E will consider SAAS negative experiences with certain bridge cooling systems in the past and consideration must be given to those experiences for all future projects.
- The A/E will consult and seek approval from SAAS architectural team in order to select strategies that meet aesthetics and architectural goals, minimize the amount and complexity of moving parts, and provide a "clean" and organized look in and around the exterior.
- Refer to Chapter 9 for additional information regarding mechanical design.

12.2.3.3 Electrical

- Provide a uniformity of parts to salvage and utilize the parts to refurbish other existing working bridges if one bridge goes down.
- Power back up capability on the bridge and should be on emergency back up.
- Recommend a consolidated power panel. Panel would be located on rotunda or building exterior. Every gate would be uniform.
- Minimize cables and cords on the apron.

12.2.3.4 Architectural

- The existing bridges are manufactured by Thyssen Krupp.
- R-value of walls should be maximized.
- A/E to review with SAT the preferred exterior and interior finishes as provided by the manufacturer.
- Allow for advertising possibilities on interior and exterior of PBB.

- If providing the option for a glass bridge, the A/E needs to include a cost benefit analysis for energy efficiency impact, maintenance, and aesthetics.

12.2.4 Rotunda Assembly

12.2.4.1 Design the Rotunda Assembly where no live or dead loads or vibrations are transmitted to the building. Rotunda floor to remain stationary and level at all times and provide a smooth transition between the terminal and telescoping tunnels. Flap-type seals provide weather protection between the rotunda and the hinged telescoping tunnel section. The rotunda shall provide a dry environment free from storm blown rainwater, snow, and ice.

12.2.4.2 Design rotunda assembly as the terminal end pivot for PBB's vertical and horizontal motion. As the main pivot for the PBB, the rotunda assembly shall allow the PBB to swing a total of 175°, 87.5° clockwise and 87.5° counterclockwise from the corridor centerline.

12.2.4.3 Locate slope, over-travel and operational swing limits on the rotunda assembly. Slope limits shall be adjustable up to 15% (8.53°) and set for an operational limit of 10% (5.71°) for both up and down slopes as needed to meet local operating conditions and requirements.

12.2.4.4 Provide Swing sensors at the rotunda, that sense the position of the PBB and sounds an audible alarm at the operator's control console prior to activation of the over-travel swing limit. These sensors shall be arranged to provide left and right swing limits and shall be adjustable over the full range of bridge swing

12.2.5 Telescoping Tunnels

12.2.5.1 Construct the exterior roof, wall, and floor panels of the telescoping tunnel sections from a minimum of 14 gauge (0.0747") formed galvannealed steel panels attached to a framework of angle and tubing. These panels are formed, welded, sealed and painted to form the tunnel enclosure allowing for a smooth exterior finish. Roof shall be flat to prevent the collection of water.

12.2.5.2 Provide a hinged transition ramp to accommodate the difference in elevation where telescoping tunnel sections overlap. Provide a very shallow slope in the transition area (approximately 3 feet measured with respect to the tunnel centerline). All hinged or elevated surfaces in walkways shall be designed to prevent tripping hazards. Handrails shall be provided on both sides of the tunnel in the ramp area. The tunnels shall be equipped with a mechanical stop.

12.2.5.3 Minimum interior clear dimensions for both two-tunnel and three-tunnel PBBs shall be as follows:

- Minimum Floor Width: 4'-10" (1473 mm)
- Minimum Interior Height: 6'-11" (2108mm)
- Minimum Inter-tunnel Ramp Width: 4'-8" (1422 mm)
- Minimum Corridor Width: 4'-4 1/2" (1334 mm)

12.2.6 Fire Protection

12.2.6.1 Clear signage for anyone in that area to be able to quickly shut down equipment

12.2.6.2 Fire blanket - collocate in remote locations. Emergency box on the wall.

12.2.6.3 The bridge is considered a piece of equipment and the manufacturer is responsible for the fire protection of the bridge to meet FAA and NFPA requirements.

12.2.6.4 Fire Extinguishers to be located on bridge.

12.2.7 Bridge Components/Accessories

12.2.7.1 Lift - wheelchair lift for the bridge

12.2.7.2 Docking equipment

12.2.7.3 Autoleveler and bridge operator, if there is an incident for the operator to have the right amount of data.

12.2.7.4 Phones are required be in the PBB

12.2.7.5 Electronic programmable cipher lock

- All new locks will need to match the existing boarding bridge locks. Basis of Design is the Mechanical Push button lock Simplex 1000 Series. The A/E team will need to include the following unless otherwise approved by the SAT PM.
- Fully mechanical lock with no battery
- Cylindrical latch with 3-hour UL/ULC fire rating on "A" labeled doors
- Single access code

12.2.7.6 Security: Provide CCTV cameras in the bridge and at the operational end of the bridge to have visibility of incidents.

12.2.7.7 A/E to review with SAT, a second baggage drop door on the PBBs as required by the Airline.

12.2.8 Electric tugs

A/E to review with SAT PM if tug location will be centralized or located at each PBB, this will also be dependent on Airline preference with the ultimate approval by SAT PM.

12.3 Glossary

ACI :	American Concrete Institute
AISC :	American Institute of Steel Construction
ASTM :	American Society for Testing and Materials
AWS :	American Welding Society
BHS :	Baggage Handling System
CBIS :	Checked Baggage Inspection System
CCTV :	Closed Circuit Television
EDS :	Explosives Detection System
HVAC :	Heating, Venting, and Air Conditioning
PBB :	Passenger Boarding Bridge
SAAS :	San Antonio Airport System
SAT :	San Antonio Airport

13

Photo by Willam Pate

13.1 Signage

13.1.1 Overall

The Wayfinding and Signage Master Plan was established in 2007 for wayfinding and signage through the airport campus excluding airfield and outer facilities.

- Clear and attractive graphics and way-finding signage should be provided to assist visitors. – CoSA
- Building plaques are required for all City buildings. Use the CoSA standard design template

13.1.1.1 Signage currently regulated by Wayfinding and Signage Master Plan:

- Terminal signs
- Curbside signs
- Ground transportation signs
- Parking facility signs

13.1.1.2 Signage not currently regulated by this document:

- Tenant/Concession/retail/advertising signs and standards
- Directory map artwork
- FIDS/ BIDS/ CUTE systems
- Life Safety /egress or Regulatory signs
- Egress evacuation map artwork
- Non-public airside/ runway/ exterior or back-of-house areas/ signage

When providing life safety signage not regulated by this document. The A/E will need to review with the SAT PM to provide consistency within the Airport including, but not limited:

- Fire Infrastructure – Standpipes
- Fire Department Connection points.
- Fire escape/exiting plans at building egress points. Readily visible and designed per CoSA standards.

13.1.1.3 The Master Plan establishes a ONE sign system to create an image for the airport through the use color palettes, fonts, font size, spacing, symbols and arrows. It also indicates the Terminals are the only destinations to be identified with a color, all other destinations (ie parking) shall be neutral color (Grey).

- Terminal
  - Background: Blue (PMS 294)
  - Text: White
  - Terminal A: Blue (PMS 300)
  - Terminal B: Green (PMS 356)
  - Terminal C: Yellow (PMS 116)
  - Terminal D: Red (PMS 485)
  - Neutral Areas: Gray
- The terminal/parking identifier colors are exclusively used. Use of these colors for sign fields, text or any other format is prohibited.
- Concourses
  - Background: Blue (PMS 294)
  - Text: White
  - Concourse A: Blue (PMS 300)
  - Concourse B: Green (PMS356)
  - Concourse C: Yellow (PMS 116)
  - Concourse D: Red (PMS 485)
  - Neutral Areas: Gray

13.1.1.4 Future A/E will need to revisit the signage master plan with regards to the advanced terminal planning and future construction.

13.1.2 Design Criteria

13.1.2.1 The following standards will need to be reviewed during the design process:

- Wayfinding and Signage Master Plans
  - Designed by Carter-Burgess
  - Designed 2007
- Terminal A Wayfinding Signage:
  - Designed by Labozan Associates
  - Installed 2012
- Terminal B Wayfinding and Signage
  - Designed by Klot
  - Installed 2010
- ACRP Wayfinding and Signing Guidelines for Airport Terminals and Landside (2011 or current)
- Texas Accessibility Standards (2012 or current)
- FAA advisory Circular 150/5200-31C
- Title VI and Executive Order 13166

13.1.2.2 Aesthetics

- Signage will need to be vandalism and tamperproof.
- Provide bilingual signage for exterior and interior
- Provide logos for airlines and rental cars instead of titles and won't have to translate logos.
- Include both vehicular and pedestrian specific signage that promotes a welcoming feel
- Explore opportunities for floor signage, art, or lighting indicating or reinforcing pedestrian path to terminals, elevator banks, etc.
- Explore opportunities for overhead art, lighting, or signage indicating or reinforcing pedestrian path to terminals, elevator banks, etc.

13.1.3 Signage Display

13.1.3.1 Dynamic –

- Digital signage which can be programmed to reflect changing messages and readily lends itself to advertisements.
- Digital signage is the preferred signage type moving forward at SAT. The A/E will need to review with the SAT PM reasons to vary from this direction.

13.1.3.2 Static -

- Cannot be altered without replacement of all or portion of sign.
- Prohibited Materials:
  - Foam core adhered to the wall

13.1.4 Building Signage

13.1.4.1 Directional - Indicates the path of travel for either vehicular or pedestrian traffic to reach a destination.

13.1.4.2 Identification - Indicates building elements and destinations.

13.1.4.3 Exterior Signage – Any lighted signage located facing the runway will need to be reviewed with Airfield Operations.

13.1.4.4 Fire Wall Identification

- Identify fire-rated walls with signs stating the following: “Fire Wall Do Not Penetrate.” In mechanical, electrical, and other similar rooms, place signs at eight (8) feet above the finished floor level. Space signs at a maximum of ten(10)- foot intervals.
- In rooms with raised flooring, place signs on firewalls under the floor with a spacing of signage reduced to five (5) foot intervals. Apply signs using fluorescent red or orange paint over stencils. Letters must be a minimum of four (4) inches in height. Metal plastic or paper decal signs are not acceptable.

13.1.4.5 Baggage Information Display System

- LCD or LED screens that are used to demonstrate real-time baggage information to passengers. The displays are typically located inside and around an airport terminal.
- Big
- Dynamic
- Work with Airline Systems

- Support Common Use System Approach

13.1.4.6 Any lighted signage located facing the runway will need to be reviewed with Airfield Operations.

13.1.5 Accessible

- Indicate accessible features to the public
- All areas dedicated for pet/service animal relief inside and outside of the terminal building will be identified as Service Animal Relief Area.

13.1.6 Placemaking

- Memorable objects and/or art that facilitate navigation through the facility, also utilized for monumental signage.

13.1.7 Restroom Signage

The A/E should review options for lighted restroom signage directions passengers to be seen at a distance and visually separate from other directional signage.

13.1.8 Parking Garages & Lots

13.1.8.1 Pedestrian Regulatory Signage

- Consistent graphics and messaging
- Unbranded, i.e. no SAT logo, to prevent signage replacement and visual clutter.
- Clearly define accessible paths in front of vehicles.
- Explore the use of large-scale graphics, color, and colored lighting to distinguish parking garage floors.
- Explore the parking garage façade as a potential location of dynamic signage reflective of the season, holidays, festivals, or conventions.

13.1.8.2 Vehicular Regulatory Signage

- Clearly designated loading zones, emergency vehicle zones, etc.
- Works in conjunction with vehicular striping.

13.1.8.3 Dynamic signage to indicate parking availability and Incorporate indicators for available stalls.

13.1.9 Site Signage

13.1.9.1 Roadways

For SAT follow Texas MUTCD revision 2, Oct 2014. Coordinate with TxDOT San Antonio office on highways and access roads, pavement markings, traffic signals designs and communication between city and sate signals. Coordinate traffic signal phasing between and CoSA and TxDOT.

- Vehicular Regulatory Signage
  - Clear, concise, legible messaging, facing perpendicular to traffic flow and without visual clutter
  - Unbranded, i.e. no SAT logo, to prevent signage replacement and visual clutter.
  - Adequate spacing/time for motorist response, i.e. speed limits decreased in advance of roadway splits, turns, etc. as is deemed appropriate by TxDOT guidelines for regulatory traffic signage.
  - No distracting banners, messaging, etc. near roadway signage.
- Vehicular Pavement Markings
  - Add lane markings that reinforce roadway signage messaging, i.e. lanes marked to indicate use for a given terminal approach, airport exit, etc.
  - Add pavement markings that reinforce vehicular and pedestrian regulatory messaging, i.e. emergency vehicle lanes, pedestrian crosswalks, etc.

13.1.9.2 Curbside and Ground Transportation Signage

- Pedestrian Regulatory Signage
  - Regulatory signs should not impact the visibility and effectiveness of other curbside directional, identification, or informational signage
  - Consistent graphics and messaging
  - Unbranded, i.e. no SAT logo, to prevent signage replacement and visual clutter.
  - Works in conjunction with other curbside elements such as pedestrian barriers to prevent jaywalking, etc.

- Vehicular Regulatory Signage

    - Provide strong identification to dedicated curb zones for Assisted Care, Taxi, etc. Clearly designate loading zones and emergency vehicle zones.

    - Works in conjunction with vehicular striping.

    - For SAT follow Texas MUTCD revision 2, Oct 2014. Coordinate with TxDOT San Antonio office on highways and access roads, pavement markings, traffic signal designs and communication between city and state signals. Coordinate traffic signal phasing between and COSA and TXDOT.

13.1.10 Temporary Signage

Temporary Signage for construction must be submitted for review and approval.

A/E to submit proposed design, with layout, graphics and color identified for review by the SAT PM and Branding.

13.2 Glossary

LCD :	Liquid Crystal Disply
LED :	Liquid Emitting Diode
PMS :	Pantone Matching System
SAT :	San Antonio Airport
TxDOT :	Texas Department of Transportation