



Eugene City Council

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EUGENE CITY COUNCIL AGENDA

November 10, 2025

5:30 p.m. CITY COUNCIL WORK SESSION

City Council meetings will continue to be held in hybrid format using in person and virtual meeting technology. Information about online or other options for access and participation will be available at <https://www.eugene-or.gov/3360/Webcasts-and-Meeting-Materials>

**Meeting of November 10, 2025;
Her Honor Mayor Kaarin Knudson Presiding**

Councilors

Greg Evans, President
Eliza Kashinsky
Jennifer Yeh
Mike Clark

Lyndsie Leech, Vice President
Matt Keating
Alan Zelenka
Randy Groves

5:30 p.m. CITY COUNCIL WORK SESSION

1. WORK SESSION: Airport Terminal Renovation and Expansion Update

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EUGENE CITY COUNCIL

AGENDA ITEM SUMMARY



Work Session: Airport Terminal Renovation and Expansion Update

Meeting Date: November 10, 2025
Department: Public Works
www.eugene-or.gov

Agenda Item Number: 1
Staff Contact: Cathryn Stephens, A.A.E.
Phone: 541-682-5430

ISSUE STATEMENT

This is an informational work session to provide an update regarding the Eugene Airport Renovation and Expansion Project (EUG TREX), projects that are receiving federal funding, construction status, and next steps. This update will also provide detailed financial analysis of the Concourse C Expansion and the launch of the Lift Off EUG Feasibility Study.

BACKGROUND

The last Airport-focused Council Work Session in September 2024 provided an overview of project development, an economic impact study that reinforced the importance of EUG TREX to the region, details on a phased project approach, a status check of work to garner grant funding, and next steps needed to continue to advance the projects.

Since 2019, passenger numbers at EUG have increased 41 percent. This includes pulling approximately 14 percent of local passengers back from driving north to Portland International Airport (PDX). Even so, 29 percent of passengers in our regional community are still making that drive and with the terminal facility at EUG over-capacity, this is unlikely to change until additional gates are added.

AIRPORT CAPITAL IMPROVEMENT PROGRAM UPDATE

As part of the Airport Capital Improvement Program, several projects have been completed or are under construction. Each project listed below details only those projects utilizing federal funding sources.

Concourse A: Asphalt Apron Rehabilitation – This project focused on rehabilitating the existing asphalt apron, including approximately 500,000 sq. ft. of terminal ramp rehabilitation and strengthening of the subgrade in key areas to improve safety and efficiency. This project also included new pavement markings, drainage improvements, and signage and lighting upgrades.

Total estimated cost of project: \$7,391,412

Federal share: \$6,929,448

Local share: \$461,964

Wildish Bid: \$5,317,219.25

Construction timeline: Substantially complete

34R Drainage Improvements/Wetland Mitigation – This project included drainage improvements with the addition of a pump station and 0.42 acres of wetland mitigation within the 34R Runway Protection Zone (PRZ) and will improve safety for aircraft operations. This project entails culvert cleaning, drainage improvements, addition of a pump station, adding soil and regrading existing farmed agricultural land at the end of Runway 34R.

Total estimated cost of project: \$1,245,489

Federal share: \$1,167,645

Local share: \$77,844

Wildish Bid: \$916,395

Construction timeline: Project underway, completion expected Nov. 28, 2025

Concourse A Expansion – This project adds approximately 7,000 square feet to an underutilized connector bridge as central shared seating space for all Concourse A gates. This expansion allows for construction of an ADA emergency exit lift, improving accessibility for all passengers, and upgrades to existing restrooms, enhancing safety and overall passenger experience with an added economic benefit of accommodating more passengers, job creation, and increased airport revenue.

Total estimated cost of project: \$21,984,251

Federal share \$17,899,468

Local \$4,084,783

New possible funding sources: Connect Oregon Grant, Congressionally Directed Spending

Estimated construction timeline: 2026-2027

Grant status: This project was postponed, then revived with the re-establishment of Federal BIL funding allocations.

Outbound Baggage Expansion – This project includes the design and construction of the building facilities to support a new fully in-line explosives detection system (EDS). Specific project components include the building shell, building electrical, building MEP (mechanical, electrical, plumbing), civil site improvements, new apron pavement, utility improvements, and stormwater improvements. TSA will enter into another transaction authority (OTA) agreement for allocable construction costs.

Design Phase

Total estimated cost of design: \$5,451,577

TSA share: \$1,377,722

PFC share: \$3,235,978

Local share: \$837,876

Design timeline: Substantially complete

Construction Phase

Total estimated cost of construction: \$49,416,798

Estimated TSA share: \$12,757,117

Estimated local share (Bond funded): \$36,659,681

Potential Federal share: FAA ATP Grant

New possible funding sources: Connect Oregon Grant

Construction timeline: Dependent on bond funding

Concourse C Expansion Financial Analysis

Airport staff have identified nearly half of the needed funding for EUG TREX, shown in the blue section below. Funding sources include federal grants, passenger facility charges (PFCs), airport revenue, and bond funding backed by PFCs. The project total cost shows the maximum amount utilizing a 30-year bond.

The section in green shows the portion of the EUG TREX for which funding has not yet been identified. Construction costs in the region are extraordinarily high, with the total project costs noted below quite daunting. Without the availability of additional bonding capacity, work on the Ticket Counter expansion, Concourse C, and Bag claim expansion projects could not happen until 30 years from now.

PROJECT DESCRIPTION	PROJECTED COSTS	FUNDING
Enabling projects	\$32,759,895	Funding identified includes <ul style="list-style-type: none">Federal grantsPassenger facility charges (PFC)Airport revenueBond funding
Concourse A expansion and ADA egress ramp	\$21,984,251	
Outbound baggage screening and in-line screening	\$57,767,741	
Taxiway and runway rehabilitation	\$35,839,948	
Terminal apron rehabilitation and construction	\$43,310,800	
Public access road realignment	\$9,367,009	
Parking – long term expansion	\$2,500,000	
Parking – economy lot expansion	\$5,000,000	
	\$208,529,644	
Ticket counter expansion design and construction	\$37,599,139	Funding not identified
Concourse C design and construction	\$177,570,750	
Bag claim expansion	\$25,763,608	
	\$240,933,497	

Additional detail on the Advanced Terminal Planning Study and the Concourse C Economic Impact can be found online at <https://www.eugene-or.gov/5327/2024-EUG-Economic-Impact-Study>.

Lift Off EUG Feasibility Study

Waiting 30 years to build out the Concourse C group of projects is untenable as the Airport is already over-capacity. Passenger numbers are projected to more than double over the next 15 years and without major facility expansion that demand - and the economic benefit that comes from that demand - will go elsewhere.

November 10, 2025 Work Session – Item 1

As a result, Airport staff have been exploring non-traditional sources of funding, which could include additional state and federal grant funding, congressionally directed spending, public-private partnerships, naming rights, and benefactor funding. To further explore these options, Airport staff are launching the Lift Off EUG Feasibility Study, which will help gauge which of these options are viable.

The [Lift Off EUG](#) website details this initiative. Please watch the Lift Off EUG: The Future of the Eugene Airport video first and then explore the website for additional information.

PREVIOUS COUNCIL DIRECTION

[February 22, 2023, Work Session](#)

Council received information on the Advanced Terminal Planning Study recently completed by the Airport Division of the Public Works Department.

[September 18, 2024, Work Session](#)

Council received information on the Eugene Airport Terminal Renovation and Expansion Project (EUG TREX). An overview was provided of the project development and an economic impact study that reinforces the importance of EUG TREX to the region. Also introduced was a phased project approach, a status check of work to garner grant funding, and next steps needed to continue to advance the project.

COUNCIL OPTIONS

This work session is informational, and no action is requested at this time. A future work session will be scheduled to discuss next steps needed to continue to advance the capital program.

CITY MANAGER'S RECOMMENDATION

This work session is informational only.

SUGGESTED MOTION

None.

ATTACHMENTS

- A. EUG Advanced Terminal Planning Study
- B. The Economic Impacts of Eugene Airport on the Local and Regional Economy, 2024

FOR MORE INFORMATION

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***EUG Advanced Terminal
Planning Study***

DECEMBER 8, 2022



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CHAPTER 2

PROJECT OVERVIEW



2.1 INTRODUCTION

Eugene Airport conducted advanced terminal planning based on recommendations established in the 2018 Airport Development Plan Update in addition to incorporating the more recent impacts of new airline entrants, unexpected growth and recovery after COVID, passenger recapture from PDX and the addition of new destinations for existing airlines.

As reported by the airport staff, the Eugene Airport terminal has reached capacity as of September 2021, with all ticket counters, all gates, all remain overnight (RON) aircraft parking spaces under full utilization. To accommodate the projected additional passenger demand and airline activity beyond this date, EUG will need to expand its infrastructure.

This planning study consisted of four phases:

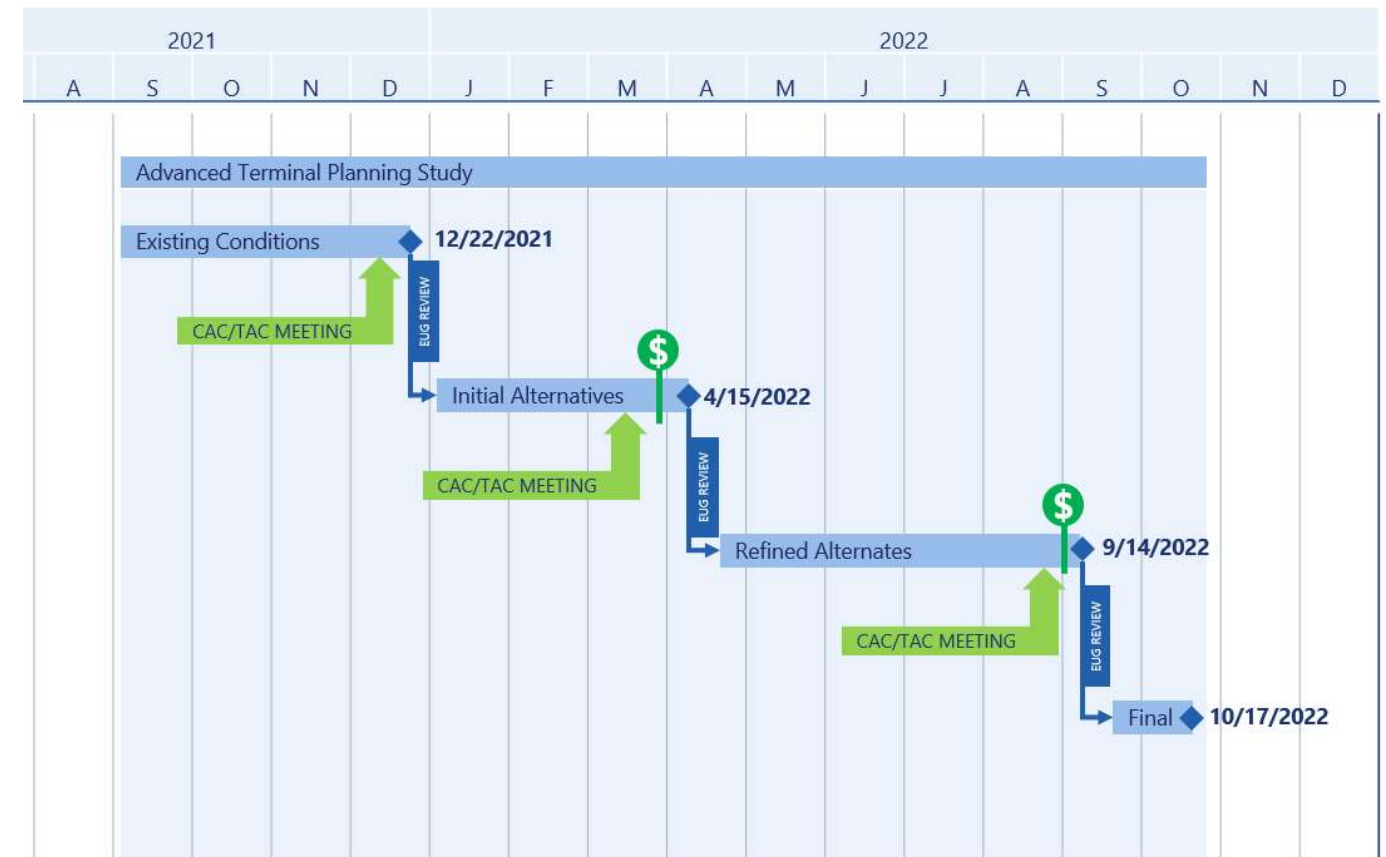
- **Existing Conditions Assessment** - preliminary information on the existing conditions of the facility and systems, and the development of a sustainable business strategy.
- **Conceptual Planning** – updated forecast considerations, stakeholder survey responses, airport programming, and initial alternatives.
- **Refined Alternates** – refinements of selected alternatives.
- **Recommended Solutions** – identification and improvements to preferred alternatives .

The project timeline is illustrated in Figure 2-1.

2.2 PROJECT COMPONENTS

As a key part of the project, all components will incorporate the City of Eugene CAP 2.0 Action Plan. The ensuing design process will require elements to be developed to LEED Silver certifications or better. The Envision Framework may be used to supplement LEED and is further evaluated in section 3.1.2. The following were analyzed as part of this study:

- Ticketing and Airline Ticket Offices (ATO) Expansion
- Outbound Baggage (screening and make-up) Reconfiguration and Expansion
- Baggage Claim Expansion
- Support Area Modifications (Security Screening Checkpoint and Vertical Circulation core)
- Airport Administration (proposed new space)
- Concourse A Expansion/Modifications
- Concourse C (proposed new concourse)
- Charter Terminal (proposed new)
- Understanding the potential requirements of Advanced Air Mobility (AAM) inclusion



2.2.1 Ticketing, ATO and Outbound Baggage

With the arrival and departure of larger aircraft and higher numbers of passengers, the ticketing and outbound baggage facilities will need to be improved to support the Airport's future mission. The ticketing component will not only consider the need for expansion to accommodate additional ticket agent positions, but will examine the existing infrastructure with regards to emerging practices and technologies such as self check-in, bag drops and common use facilities. The outbound baggage component will examine efficiencies gained by changes to the way baggage is currently screened and processed including coalescing all screening into a single, more efficient configuration with dedicated make-up devices. Each concept will be developed and validated to confirm that its construction would not preclude or hinder other expansion projects in the future.

2.2.2 Baggage Claim

The baggage claim component examines the existing baggage claim area and associated back-of-house areas to verify their capacity and provide options for future expansion to accommodate the additional passengers expected with the combined terminal expansions.

2.2.3 Concourse A Expansion

This component will analyze the functional viability of developing and expanding Concourse A to provide larger holdroom space to align better with the proposed fleet mix. The options examined included widening of the bridge to Concourse A, infilling the corners, and the potential of an extension of Concourse A to the northwest. These improvements are evaluated for implementation based on their ability to assist in providing a long-term solution for the Airport.

2.2.4 Concourse C Expansion

To enable and support the future mission of the Airport and the expected growth, the 2018 Airport Development Plan required additional gates to be constructed and for the new Concourse to tie into the existing terminal at the second level just east of the top of the vertical circulation component. This study evaluates and validates the number of gates required based upon the most current available information, then develops high-level conceptual alternatives for the expansion. This expansion will include holdrooms, concessions areas, circulation, restrooms, storage, and utility space on the upper level and covered storage and staging areas for ground service equipment (GSE), operations space for airlines, and storage space for concessions on the apron level. The routing of GSE for baggage, maintenance, and services for the expansion will tie into the existing routing and infrastructure at the existing terminal.

2.2.5 Administrative Spaces

Expanded administrative spaces including an Emergency Operations Center (EOC) would be relocated to the airport terminal to facilitate staff access to all the areas of the Airport (both the airside and landside). The proposed location for this is over the Outbound Baggage expansion.

2.2.6 Charter Terminal

An option was studied to include a charter terminal as part of the Concourse C expansion that would allow for a secure way to separate charter passengers from others. The primary goal of this study was to identify and include the programming elements for a charter terminal and ensure that the placement of a charter component would not adversely impact future expansion opportunities. The charter terminal is expected to include waiting areas, screening facilities, baggage make-up, and bag claim space on a lower level so that this facility can be separate from the concourse. It also includes its own landside access, entry, and bus loading. To facilitate this, a swing gate configuration is proposed to allow for the maximum usability of contact positions when a charter flight is not using it.

2.2.7 AAM Preparation

Advanced Air Mobility (AAM) is an emerging airborne technology that incorporates community friendly, environmentally friendly, and cost-effective aircraft to transport passengers in both rural and urban environments. With an approximate round-trip range of 325 miles, AAM is poised to offer the Eugene Airport the ability to draw passengers from a much larger area through the use of regional vertistops and a local vertiport located on the airport or on airport property. While this evolving technology and market is still in its infancy, the current state of the industry was examined including discussions with manufacturers and service providers to determine if any AAM options should be taken into consideration to sustain an initial and growing AAM presence at the terminal.

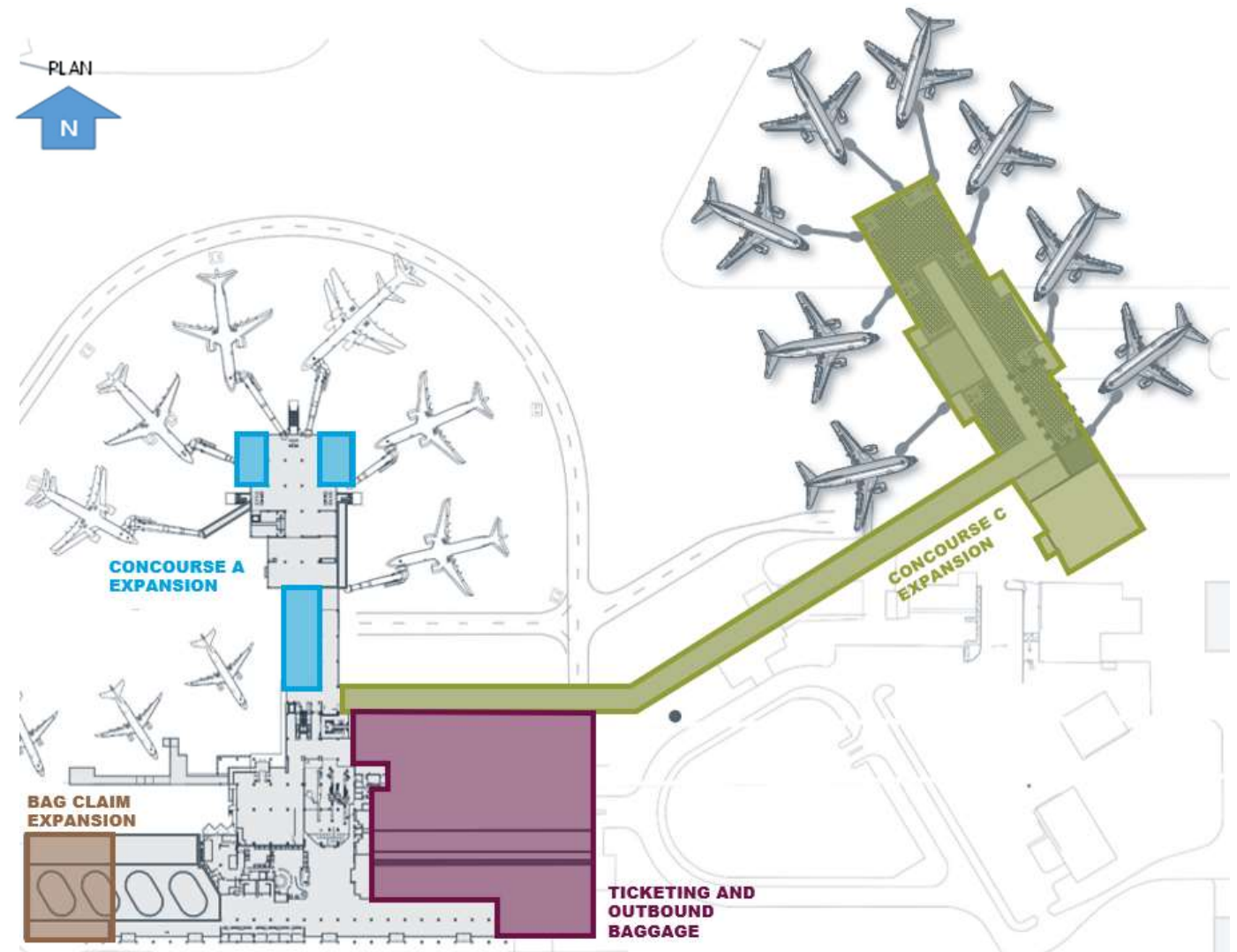


FIGURE 2-2
OVERALL SITE PLAN WITH EXPANSIONS

Attachment A

CHAPTER 3

SUSTAINABILITY BUSINESS STRATEGY



FIGURE 3-1
LEED CATEGORIES



FIGURE 3-2
ENVISION FRAMEWORK

3.1 DEVELOPMENT OF SUSTAINABILITY BUSINESS STRATEGY

3.1.1 Introduction

In 2000, the City of Eugene (City) issued a Sustainable Building Policy that requires all new construction of City buildings over 10,000 square feet or more to achieve the United States Green Building Council (USGBC)'s Leadership in Energy and Environmental Design (LEED) Silver certification. LEED is a third-party rating system that provides a framework for improving the efficiency through creating green buildings. Because the terminal program will encompass an area greater than 10,000 sf, it is subject to the City's Sustainable Building Policy.

In 2014, the City passed a Climate Recovery Ordinance (CRO) and recently finalized their Climate Action Plan 2.0 (CAP 2.0) in 2020. The City has set four ambitious goals for the reduction of greenhouse gas emissions including goals for city facilities and operations. The City's CAP 2.0 continues the momentum created by the CRO and established actions to reach climate goals most quickly while focusing on equity and collaboration with community partners. CAP 2.0 appears to have several intersections with the EUG terminal program; however, LEED may not fully address CAP 2.0 needs.

As a buildings-oriented framework, LEED focuses on energy, water, materials, and site development issues across nine categories (Figure 3-1).

Similar to other sustainability rating systems, the LEED framework can enhance environmental performance and reduce long-term operating costs, but it does not address broader social elements of sustainability. Additionally, LEED

does not provide a mechanism to evaluate or understand the long-term climate change impacts and overall resilience of the facility.

Because of this, it may be more beneficial to use the Institute for Sustainable Infrastructure's (ISI's) Envision rating system in lieu of the LEED requirements of the Sustainable Building Policy. Developed through a collaborative effort between the American Public Works Association (APWA), the American Council of Engineering Companies (ACEC), and the American Society of Civil Engineers (ASCE), the Envision rating system aids planners, designers, developers, and infrastructure owners in the design and construction of projects that offer the opportunity for increasing levels of sustainability. Whereas traditional green standards and rating systems only applied to occupied buildings, Envision encompasses building standards and civil infrastructure projects to create a holistic approach to incorporating sustainability into infrastructure.

3.1.2 The Envision Framework

Envision is a holistic sustainability framework and rating system that enables a thorough examination of the sustainability and resilience of all types of civil infrastructure. It is the only comprehensive tools that can assist government agencies, designers, consultants, and contractors in delivering infrastructure that tackles climate change, addresses public health needs, cultivates environmental justice, creates jobs, and spurs economic recovery.



FIGURE 3-3
ENVISION AND CAP2.0

The Envision rating system has 64 sustainability indicators, called “Credits” that address the full range of sustainability across five different categories (Figure 3-2, Figure 3-3). These categories include:

- **Quality of Life:** Addresses well-being, mobility, and community
- **Leadership:** Addresses collaboration, planning, and economy
- **Resource Allocation:** Addresses materials, energy, water
- **Natural World:** Addresses siting, conservation, ecology
- **Climate and Resilience:** Addresses emissions and resilience`

Similar to LEED, project teams pursue credits in each category for points that may ultimately lead to an Envision verification award. Differing from the LEED rating system, however, are the lack of required prerequisites. Envision was designed to be flexible and adaptable to each project, and designers have the choice to pursue credits that are applicable to their project to receive an Envision Award. Award levels for Envision range from:

- **Verified** (20% of total points available)
- **Silver** (30% of total points available)
- **Gold** (40% of total points available)
- **Platinum** (50% of total points available)

Because of its flexible and adaptable nature, many airports across the country are embracing Envision to enhance the sustainable and resilient performance of their projects. To date, there have been nine publicly Envision-verified airport projects, several of which have included terminal facilities, including:

- **LaGuardia Airport:** Central Terminal Building Replacement (also pursuing LEED Silver)
- **San Diego International Airport:** Terminal 2 Expansion (also awarded LEED Platinum)

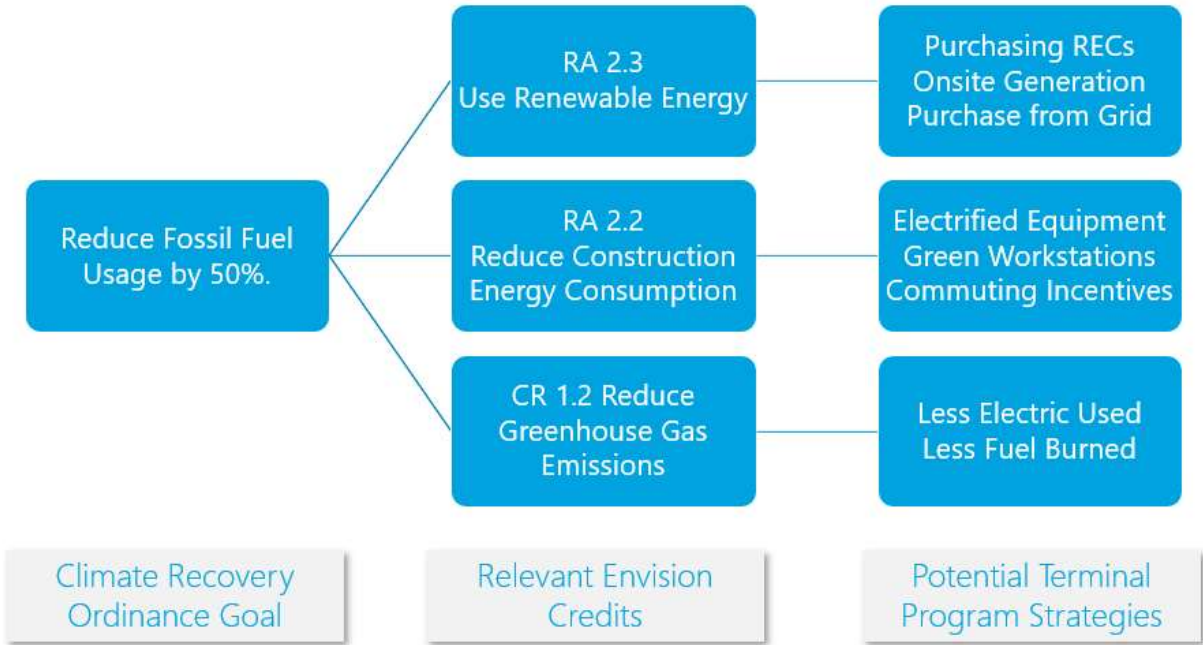


FIGURE 3-4
ENVISION AND CITY CRO GOALS

3.1.3 LEED vs. Envision

Both LEED and Envision provide a framework for improving sustainable design and have several areas of overlap in credits between the systems, such as light pollution, stormwater runoff quality, and alternative transportation. When looking at the two-rating systems side-by-side, there are Envision-similar credits for at least 29 of the 44 credits in the LEED V4 rating system. Of the 15 remaining credits in the LEED rating system not covered by a credit in the Envision rating system, several relate to both parking characteristics and indoor air quality standards (Envision focuses on outdoor air quality). A summary of these credit similarities and differences is provided in Table 3-1.

TABLE 3-1 LEED-ENVISON CREDIT COMPARISON

LEED Category	LEED Credit	Envision Similar Credit
Location and Transportation	Sensitive Land Protection	NW 1.4 Preserve Undeveloped Land
	High-Priority Site	NW 1.1 Preserve Sites of High Ecological Value
	Surrounding Density & Diverse Uses	QL 1.1 Improve Community Quality of Life
	Access to Quality Transit	QL 2.2 Encourage Sustainable Transportation
	Bicycle Facilities	QL 2.2 Encourage Sustainable Transportation
	Reduced Parking Footprint	No similar Envision credits.
	Green Vehicles	No similar Envision credits.
Sustainable Sites	Construction Pollution Prevention	QL 1.6 Minimize Construction Impacts
		NW 2.4 Protect Surface and Groundwater Quality
		CR 2.1 Avoid Unsuitable Development
		RA 3.1 Preserve Water Resources
		CR 2.2 Assess Climate Change Impacts
	Site Assessment	NW 3.4 Control Invasive Species
		NW 3.5 Protect Soil Health
		QL 3.3 Enhance Views and Local Character
	Site Development	QL 3.1 Enhance Equity and Social Justice
	Open Space	NW 1.4 Preserve Undeveloped Land
Water Efficiency	Outdoor Water Use Reduction	QL 3.3 Enhance Views and Local Character
	Indoor Water Use Reduction	QL 3.4 Enhance Public Space and Amenities
	Building Level Water Metering	NW 2.2 Manage Stormwater
	Cooling Tower Water Use	CR 1.3 Reduce Greenhouse Gas Emissions
	Water Metering	QL 1.5 Minimize Light Pollution
Energy and Atmosphere	Fundamental Commissioning and Verification	RA 3.2 Reduce Operational Water Consumption
	Minimum Energy Performance	RA 3.2 Reduce Operational Water Consumption
	Building Level Energy Metering	RA 3.4 Monitor Water Systems
	Fundamental Refrigerant Management	No similar Envision credits.
	Enhanced Commissioning	RA 3.4 Monitor Water Systems
	Optimize Energy Performance	RA 2.4 Commission & Monitor Energy Systems
	Demand Response	RA 2.1 Reduce Operational Energy Consumption
	Renewable Energy Production	No similar Envision credits.
	Enhanced Refrigerant Management	RA 2.3 Use Renewable Energy
Materials and Resources	Green Power & Carbon Offsets	No similar Envision credits.
		RA 2.3 Use Renewable Energy
	Storage and Collection of Recyclables	RA 1.3 Reduce Operational Waste
	Construction and Demolition Waste Management Planning	RA 1.4 Reduce Construction Waste
	Building Life-Cycle Impact Reduction	CR 1.1 Reduce Net Embodied Carbon
	Environmental Product Declarations	RA 1.1 Support Sustainable Procurement Practices
	Sourcing of Raw Materials	RA 1.1 Support Sustainable Procurement Practices
	Material Ingredients	RA 1.2 Use Recycled Materials
Indoor Environmental Quality	Construction and Demolition Waste Management	RA 1.1 Support Sustainable Procurement Practices
	Minimum Indoor Air Quality Performance	RA 1.4 Reduce Construction Waste
	Environmental Tobacco Smoke Control	No similar Envision credits.
	Enhanced Indoor Air Quality Strategies	No similar Envision credits.
	Low Emitting Materials	No similar Envision credits.
	Construction Indoor Air Quality Management Plan	No similar Envision credits.
	Indoor Air Quality Assessment	No similar Envision credits.
	Thermal Comfort	No similar Envision credits.



TABLE 3-2
SOCIAL JUSTICE AND ENVISION CREDITS

Envision Credit	Intent
QL 1.1 Improve Community Quality of Life	Improve the net quality of life of all communities affected by the project and mitigate negative impacts to communities.
QL 1.2 Enhance Public Health & Safety	Protect and enhance community health and safety during operation.
QL 1.3 Improve Construction Safety	Enhance public and worker safety during construction.
QL 1.4 Minimize Noise and Vibration	Minimize noise and vibrations during operations to maintain and improve community livability.
QL 1.5 Minimize Light Pollution	Reduce backlight, uplight, and glare without jeopardizing safety during operations.
QL 1.6 Minimize Construction Impacts	Minimize or eliminate the temporary inconveniences associated with construction.
QL 2.1 Improve Community Mobility and Access	Plan the project as part of a connected network that supports all transportation modes for the efficient movement of people, goods, and services.
QL 3.1 Advance Equity and Social Justice	Ensure that equity and social justice are fundamental consideration within project processes and decision making.
QL 3.2 Preserve Historic & Cultural Resources	Preserve or restore significant historical and cultural sites and related resources.
QL 3.3 Enhance Views and Local Character	Preserve or enhance the physical, natural, and/or community character of the project site and its surroundings.
QL 3.4 Enhance Public Space and Amenities	Improve amenities and publicly accessible spaces to enhance community livability.
LD 1.2 Foster Collaboration & Teamwork	Enhance project sustainability through interdisciplinary collaboration and teamwork.
LD 1.3 Provide for Stakeholder Involvement	Early and sustained stakeholder engagement and involvement in project decision making.
LD 2.2 Plan for Sustainable Communities	Incorporate sustainability principles into project selection/identification in order to develop the most sustainable project for the community.
LD 3.1 Stimulate Economic Prosperity & Development	Support economic prosperity and sustainable development, including job growth, capacity building, productivity, business attractiveness, and livability.
LD 3.2 Develop Local Skills & Capabilities	Expand the knowledge, skills, and capacity of the community workforce to improve their ability to grow and develop.

Envision includes numerous criteria that promote social equity, community engagement, integrated project design, and contributions to the local economy; issues that more closely align with more recent City goals expressed the Climate Action Plan 2.0 (CAP 2.0) (Figure 3-4). Envision’s emphasis on equity and social justice highlights a significant gap in the LEED rating system. A summary of these credits and their intent is provided in Table 3-2.

The LEED rating system approaches emission reductions through priorities such as energy reductions, renewable energy, and material selection. However, it does not specifically require project teams to account for the greenhouse gas emissions produced by the operation of their facilities. It also lacks a mechanism to evaluate the qualitative impacts of greenhouse gas emissions from a community and equity perspective. The Envision Rating System not only provides a framework to evaluate greenhouse gas emissions generated by the project, but also encourages project teams to assess the potential impacts that the project may have to the greater community. A summary of credits that can show support for these activities in the Envision Rating System is provided in Table 3-3.

TABLE 3-3
ENVISION GREENHOUSE GAS EMISSION CREDITS

Envision Credit	Intent
CR 1.1 Reduce Net Embodied Carbon	Reduce the impacts of material extraction, refinement/manufacture, and transport over the project life.
CR 1.2 Reduce Greenhouse Gas Emissions	Reduce greenhouse gas emissions during the operation of the project, reducing project contribution to climate change.
CR 1.3 Reduce Air Pollutant Emissions	Reduce emissions of air pollutants: particulate matter (including dust), ground-level ozone, carbon monoxide, sulfur oxides, nitrogen oxides, lead, and volatile organic compounds.
QL 2.2 Encourage Sustainable Transportation	Expand accessibility to sustainable transportation choices including active, shared, and/or mass transportation.
RA 2.3 Use Renewable Energy	Meet operational energy needs through renewable energy sources.

TABLE 3-4
ENVISION CLIMATE CHANGE RESILIENCE CREDITS

Envision Credit	Intent
CR 2.2 Assess Climate Change Vulnerability	Develop a comprehensive climate change vulnerability assessment.
CR 2.3 Evaluate Risk and Resilience	Conduct a comprehensive, multihazard risk and resilience evaluation.
CR 2.4 Establish Resilience Goals and Strategies	To support increased project and community resilience through the establishment of clear objectives and goals.
CR 2.5 Maximize Resilience	Increase resilience, life-cycle system performance, and the ability to withstand hazards by maximizing durability.

As the CAP 2.0 identified potential climate change threats that may cause impacts on the City of Eugene, understanding the risk that these threats pose to the Terminal will be critical. Although the LEED Sustainable Sites category includes a credit to consider the potential impacts of climate change, it is focused on just the identification of potential threats and does not include a risk or vulnerability assessment. The Envision rating system outlines an approach to understanding risk, vulnerability and how to achieve resilience. These Climate and Resilience credits not only aim to understand the risk and vulnerability to the project, but also encourages project teams to look beyond the project to the risks and vulnerability of the community at large. A summary of credits that can show support for these activities in the Envision Rating System is provided in Table 3-4.



3.1.4 Using LEED as a Reference Point

Both Envision and LEED frameworks provide a common basis and starting point for discussion on how to improve sustainable performance and there are opportunities to selectively draw on the best guidance that is available from each to inform and influence different aspects of the design of projects. LEED provides more specificity in performance targets for their credits in terms of energy efficiency, water reduction, and materials whereas Envision by comparison provides flexibility in similar performance requirements. Project teams who decide to pursue Envision over a LEED Certification can still use the specific performance targets in the LEED framework to set minimum performance targets for the project and address gaps in the Envision Rating Systems in terms of indoor air quality and parking.

The concurrent application of LEED principles for an Envision Verification can create opportunities for cross-collaboration and knowledge sharing that can ultimately drive improved outcomes for all classes of buildings and infrastructure.

3.1.5 The Three Guiding Principles

To support the goals and intent of the City of Eugene's Climate Action Plan 2.0 (CAP 2.0), both sustainability and resilience will be integrated as part of the planning and design process. Consistent with the Envision framework and incorporating airport-applicable LEED principles, three guiding principles will be used to guide decision-making and enhance sustainability of the terminal program: Quality of Life, Resources and Environment, and Climate and Resilience. The three guiding principles (Figure 3-5) include the following:

- » **Quality of Life:** The Quality-of-Life guiding principle seeks to answer two questions: How will the terminal enhance community quality of life and will it be fair, equitable and inclusive? It seeks to address and identify opportunities to increase the value of the terminal and the Airport to not just the travelling public, but the greater Eugene community while maintaining equity, accessibility, and inclusivity.
- » **Resources and Environment:** The Resources and Environment principle also seeks to answer two questions: how will the terminal reduce energy, water and waste and will it minimize impacts on the environment? Ultimately, this principle seeks to identify opportunities to make the facility more energy, water, and waste efficient while balancing and minimizing impacts to the environment.
- » **Climate and Resilience:** The Climate and Resilience principle asks two final questions: Can the terminal be resilient and adaptable to future changes and how will it contribute to greenhouse gas emissions? Using this principle as a guide, we will look for solutions to make the terminal more flexible and adaptable to future changes and identify opportunities to reduce greenhouse gas emissions.

These guiding principles incorporate concepts developed in both the Envision and LEED frameworks, as well as several of the CAP 2.0 recommended actions.

3.1.6 Sustainability Opportunities

Based on the selected preferred alternative, there are a number of sustainability opportunities that can be considered and are aligned with the three sustainability guiding principles.

3.1.6.1 Expanded Concession Spaces

The preferred alternative presents an opportunity for the Airport to expand its concession spaces, offering an opportunity for new businesses to operate in the terminal. The Airport may want to consider giving preference to concession and retail businesses that are local to the Eugene community. Concessionaires owned by local businesses

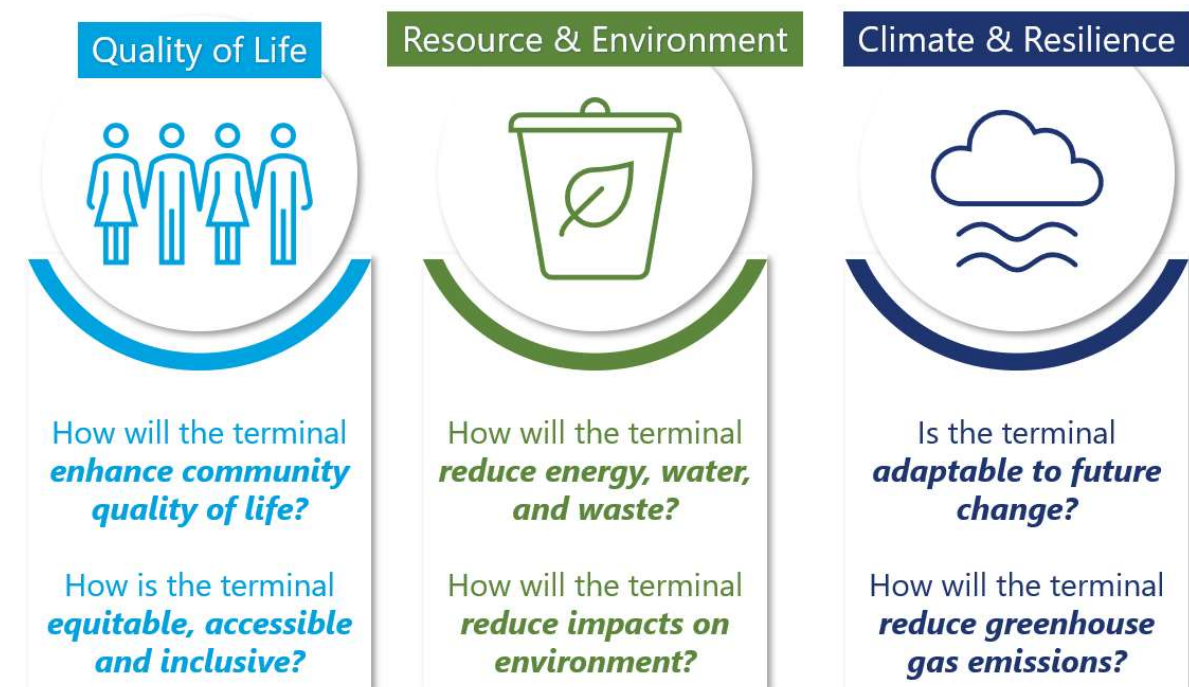


FIGURE 3-5
GUIDING PRINCIPLES

can promote the local character of the community near the Airport. While visitors fly in and out, they can enjoy some of best food and goods that Eugene has to offer.

3.1.6.2 Open Outdoor Areas

The preferred alternative presents an opportunity to incorporate an outdoor terrace area near the concessions. The open terrace would provide natural views of the landscape and allow passengers to relax before their flight. Outdoor spaces can reduce the stress felt by passengers and improve the travel experience.

3.1.6.3 Optimized Building Orientation

The orientation of a building has a major impact on sun exposure, affecting both daylighting potential and passive solar heating potential. The preferred alternative provides a north-south facing terminal area. This orientation allows for passive heating and cooling which can improve the energy efficiency of the building. It also provides opportunities for daylighting in the terminal.

3.1.6.4 Large Windows

The preferred alternative presents an opportunity to incorporate large windows throughout the terminal. Beyond the visual effects that this can provide, large windows can improve energy efficiency of the building. Passive lighting from large window spaces could provide light for the terminal during daylight hours, reducing the need for energy to power lighting in the terminal during the day.

When the facility progresses into design, the use of window glazing technologies (e.g., SmartGlass) should be explored further to increase the energy efficiency of the facility.

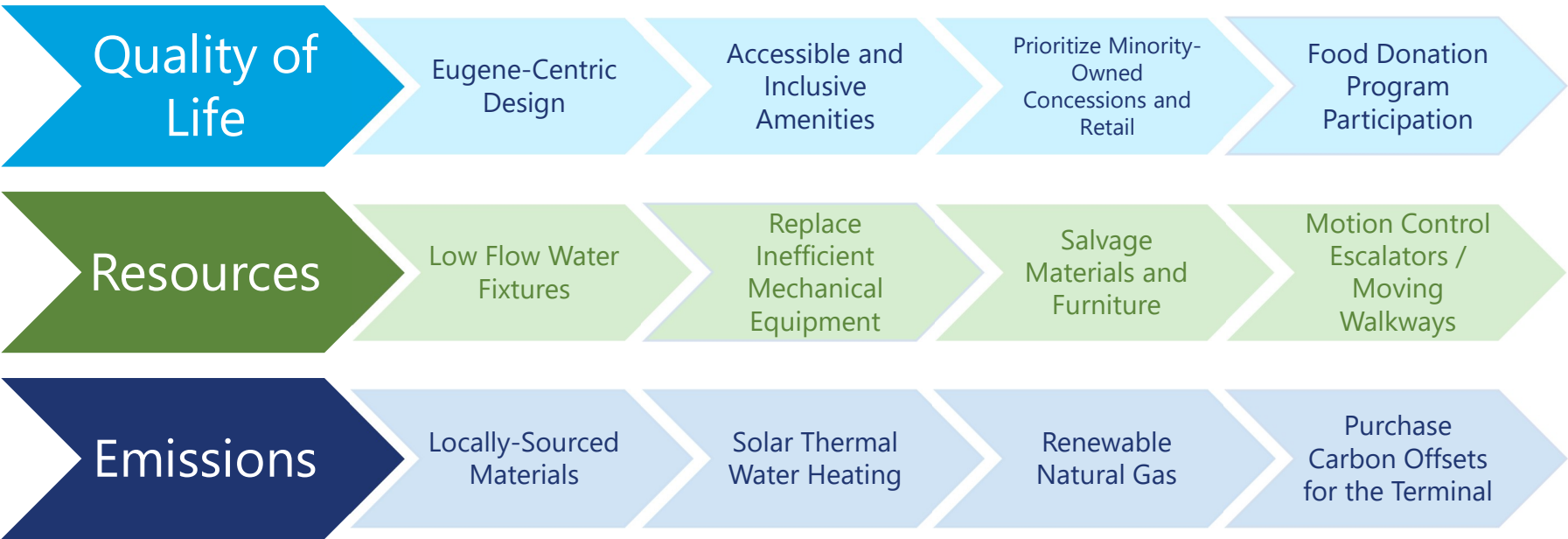


FIGURE 3-6
SUSTAINABLE RECOMMENDATIONS FOR DESIGN

3.1.6.5 Material Selection

A combination of wood and steel framed gravity systems has been proposed for the material selection of the preferred alternative. (Refer to Section 8 for more information). Compared to concrete alternatives, wood and steel have lower embodied carbon and produces less waste over its useful life. Additionally, steel can be infinitely recycled and reused without degradation.

3.1.7 Future Sustainability Opportunities

There are a number of sustainability opportunities that should be explored further in future phases of design associated with any of the areas of expansion identified. Some examples of these opportunities are included in Figure 3-6.

Attachment A

CHAPTER 4

EXISTING CONDITIONS AND TERMINAL ASSESSMENT



4.1 EXISTING CONDITION VALIDATION / INFRASTRUCTURE ASSESSMENT

4.1.1 Introduction

The current terminal building was constructed in 1964 and expanded in both 1988 and 2014. The landside portion of the terminal building contains ticketing, baggage screening, baggage make-up, passenger screening, rental cars, and bag claim areas. This area is connected to Concourse B on the ground level and Concourse A over a walkway bridge. Concourse A is a two-level structure with the upper level containing 6 gates with hold rooms and concessions while the lower level contains storage and airline operations spaces. Concourse B is on the ground level and consists of four ground loading gates. The Airport Administration offices and the TSA offices can be found outside of the terminal building on the other side of the employee parking lot (Figure 4-1).

In general, the EUG terminal building has been constructed of durable materials with appropriate hardening of surfaces with tile near high traffic areas with some minor wear visible in the public spaces. Back of house spaces have considerably more wear but are primarily superficial in nature. Previous expansions have been well thought out providing ample space for TSA passenger screening and clear passenger flow throughout the facility.

While the existing terminal building is well maintained, sustained growth and the evolution of the airline industry is pushing upon the boundaries and limitations of the existing building resulting in functional deficiencies primarily in capacity for both passengers and airlines.

An existing condition assessment was completed in order to establish the baseline for the expansions considered as part of this planning study. This existing condition validation was performed at a high level, generally by performing a visual observation of the existing terminal building and is divided into the following focus areas:

- Architecture
- Civil/Airfield
- Structural
- Mechanical
- Electrical
- Plumbing
- Fire Protection
- IT/Security
- Baggage Handling Systems



FIGURE 4-1
EXISTING BUILDING AND SITE LAYOUT



FIGURE 4-2
TICKETING LOBBY

4.1.2 Architecture

Architectural condition validation focuses on the finishes and condition of the existing spaces adjacent to the proposed expansions of Concourse C, Concourse A and ticketing / outbound baggage functions. Some review of the other public spaces have been included as appropriate where shared finishes and other considerations may impact future development.

4.1.2.1 Ticketing and Outbound Baggage

The existing ticketing lobby consists of multiple clustered ticketing positions beneath a linear canopy. Conveyor systems leading to baggage screening devices are positioned behind the counters. The ceiling consists of linear light fixtures and a wood slat ceiling system broken by glulam beams. The floor finishes consist of tile near the ticket counters and carpet beyond. Observed finishes are in generally good condition including the millwork, floor tiles and carpet. Capacity remains the primary issue at this component with the airport reporting that existing ticket counter positions are at capacity with existing airlines facing space reductions to allow for new airline entrants. Shallow queuing space limitations have been noted by the airport during traditionally busy holiday seasons (Figure 4-2).

- Carpeting – Fair condition, some wear observed typical of carpet of this age.
- Tile flooring – Good condition, minimum wear noted.
- Wall and soffit – Good condition, minor scuffs noted.
- Ceiling finishes – Very Good condition, minimum wear or damage. Lighting fixtures appear to be non-LED.



FIGURE 4-3
MEETER/GREETER LOBBY

4.1.2.2 Landside Concessions and Meeter/Greeter

The existing landside concessions and meeter/greeter lobby is centrally located within the terminal building and connects the ticketing lobby with the bag claim, restaurant, and the TSA security screening checkpoint. Landside restrooms and a corridor to an elevator to the second level conference room can be accessed to the north side of the security checkpoint. The floor finishes consist of carpet up to the TSA checkpoint. The ceiling is double height and follows the contours of the roof and appears to be in good condition with minimal wear visible (Figure 4-3).

- Carpeting – Good condition, some wear observed typical of the carpet of this age with some minor wear visible near the restrooms and restaurant.
- Wall and soffit – Good condition, minor scuffs noted.
- Ceiling finishes – Good condition, minimum wear or damage.



FIGURE 4-4
BAG CLAIM LOBBY



FIGURE 4-5
TYPICAL AIRLINE OFFICE SPACE

4.1.2.3 Bag Claim and Car Rental

The existing bag claim and car rental area was expanded in 2014. The bag claim consists of two carousels with conveyors depositing baggage from above. Adjacent to the bag claim area is a car rental counter with 6 positions and a smaller shuttle counter position. Currently 4 positions are occupied with 2 available positions. The shuttle position is also currently unoccupied. The floor finishes consist of tile near the counters and carpet beyond. The ceiling consists of linear light fixtures and a wood slat ceiling system broken by glulam beams (Figure 4-4).

- Carpeting – Good condition, minimal wear noted.
- Tile flooring – Good condition, minimum wear noted.
- Wall and soffit – Good condition, minor scuffs noted.
- Ceiling finishes – Very Good condition, minimum wear or damage.

4.1.2.4 Outbound Baggage and Airline Offices

The existing outbound baggage facilities and airline offices are accessed from behind the ticket counters. Due to the high number of airlines at the airport and the limitations on space, the airline office corridors are sometimes shared by more than one airline. This area behind the ticket counters also includes office space and baggage screening space used by the TSA. The floor finishes consist of vinyl composition tile with vinyl wall base. The walls are painted gypsum board. The ceiling consists of 2' x 4' fluorescent light fixtures set in a 2' x 4' acoustical ceiling grid (Figure 4-5).

- VCT flooring – Poor condition, scuffed and stained with areas of heavy use in the office. Fair to Good in the baggage screening areas.
- Wall and soffit finishes – Poor condition, scuffs and stains noted throughout, Fair to Good in the baggage screening areas.
- Ceiling finishes – Good condition, minimum wear or damage. Lighting fixtures appear to be non-LED.



FIGURE 4-6
CONCOURSE A HOLDROOM SEATING

4.1.2.5 Concourse A

Concourse A is accessed through an elevated walkway bridge once passengers pass through the centralized security screening checkpoint. A retail and dining concession is located at the entrance to the concourse with a large common holdroom area that is shared by all the gates. With the arrival and departure of larger aircraft, Concourse A currently experiences high passenger loads at multiple points throughout the day and during the holiday peak periods. The walls are painted gypsum board with wall protector at the base at the columns and some walls. The floor is carpet in the holdroom areas and tile near the gates. The ceiling consists of linear light fixtures and a wood slat ceiling system (Figure 4-6).

- Carpeting – Fair condition, some wear observed typical of the carpet of this age.
- Tile flooring – Good condition, minimum wear noted.
- Wall and soffit – Fair condition, scuffs and some staining noted throughout to approximately 6' above the floor, some minor wall damage behind seating where wall protection was not present.
- Ceiling finishes – Very Good condition, minimum wear or damage. Lighting fixtures appear to be non-LED.



FIGURE 4-7
LANDSIDE CANOPY

4.1.2.6 Exterior Finishes

The exterior finishes consist of green metal panel at the upper portions of the walls and synthetic stucco in the lower portion of the walls. Exposed wooden beams can be seen at the entry of the building. Wooden soffits are used at the entry overhangs. Aluminum soffits are used at the open stairs with stucco soffits above the baggage handling entrances (Figure 4-8).

- Metal Panel – Good condition with some minor staining typical of metal panel of this age. Fair to Poor condition at the drains and roof edges at the enclosed stairs with visible rust and staining (Figure 4-9).
- Metal Soffits – Good to Fair condition with some rusting visible at the penetrations and perimeters.
- Stucco Soffits – Fair condition at the baggage handling entrances with some staining throughout, notably at the edges away from the lower wall.
- Exposed Wood – Generally Fair condition with some deterioration noted at the exposed ends of the glulam beams that are covered with a metal plate (Figure 4-7).
- Synthetic Stucco – Generally Good condition with some minor wear and staining near the base.
- Glazing and Window Systems – Good condition, minimal damage with no fogging that would show evidence of seal failure.



FIGURE 4-8
TYPICAL AIRSIDE EXTERIOR FINISHES



FIGURE 4-9
OPEN STAIR ENTRANCE

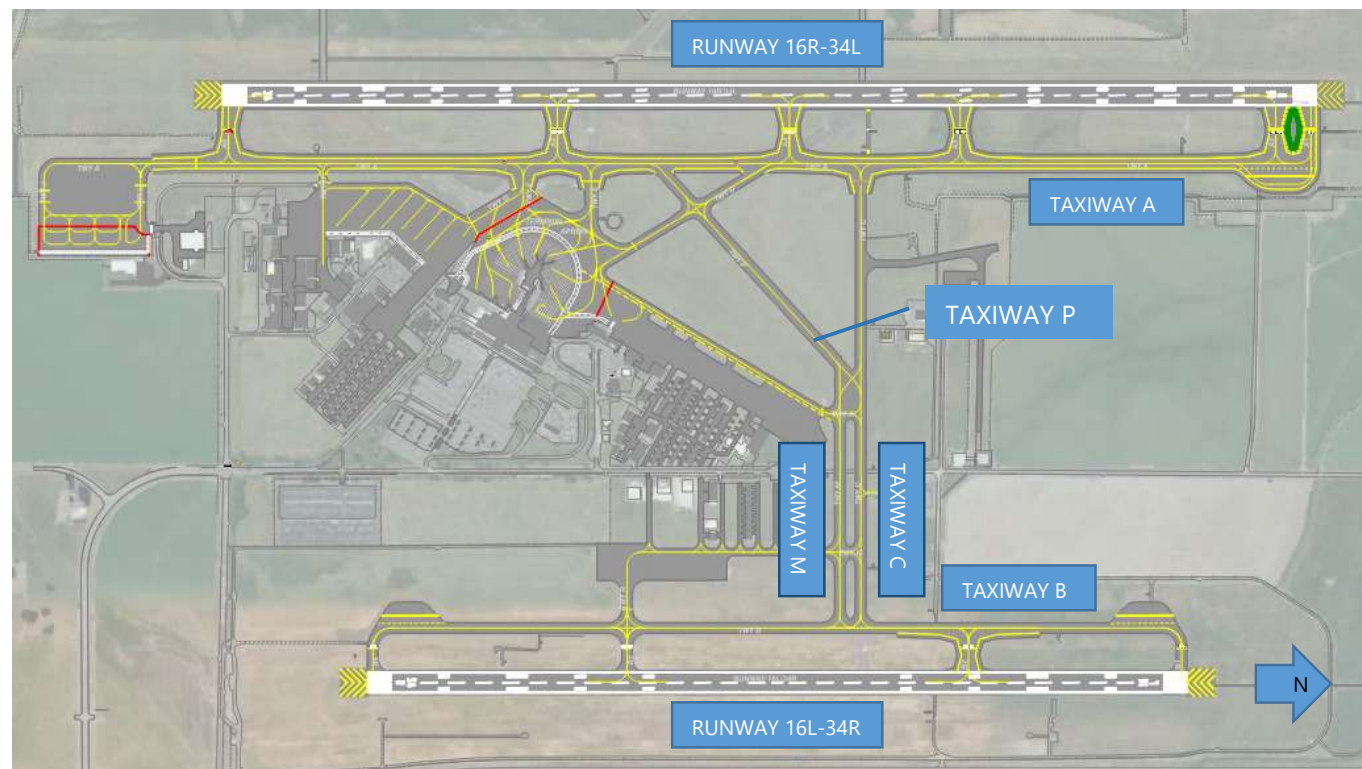


FIGURE 4-10
EXISTING AIRFIELD CONFIGURATION

4.1.3 Civil/Airfield

Airfield existing condition validation focuses on the extensive network of runway, taxiway, and apron pavements around the airport terminal. There are currently two asphalt runways, a network of 28 taxiways that vary in size and usage, and designated Remain Overnight (RON) parking positions.

4.1.3.1 Runway Facilities

The primary runway, Runway 16R-34L, is approximately 8,009 feet in length by 150 feet wide with asphalt shoulders. This runway is currently considered to be in good condition and is primarily used by commercial airline traffic, larger private jets, and cargo operations. Taxiway A runs parallel to Runway 16R-34L and offers five connectors for access to and from the runway. The runway size and classification allow for a diverse fleet of commercial aircraft to use the facility. There are currently no plans or forecasted need to lengthen or expand the runway facility (Figure 4-10).

The secondary parallel runway, Runway 16L-34R, is approximately 6,000 feet in length by 150 feet wide with asphalt shoulders. This runway is primarily used by general aviation aircraft and private jet traffic to separate general aviation operations from commercial operations. Taxiway B parallels the runway with four connectors that offer access to the runway. Runway 16L-34R is also used for commercial traffic when the primary runway is closed. The length of this runway creates restrictions for commercial aircraft, particularly in the summer on hot days. Increased commercial traffic at the Airport is expected to further increase the importance of this runway in keeping operational separation. The runway was rehabilitated in the summer of 2021 with an expected design life of 20 years. Currently, there are no plans or forecasted need to lengthen or expand this runway facility.

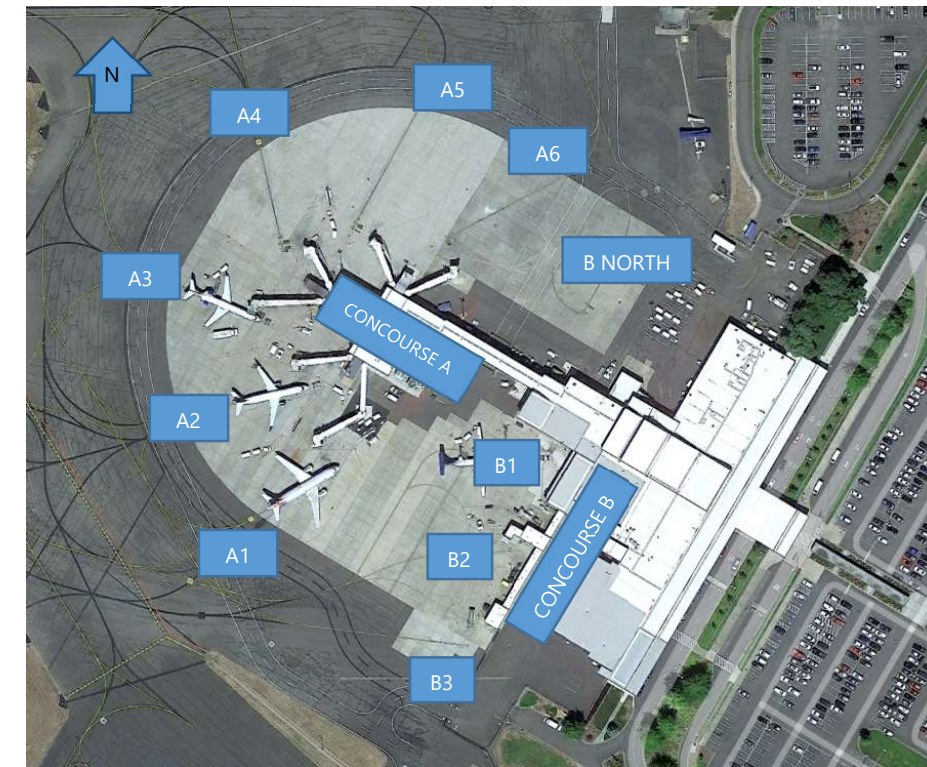


FIGURE 4-11
EXISTING COMMERCIAL APRON FACILITIES

4.1.3.2 Taxiway Facilities

The network of taxiways that support the primary runway, Runway 16R-34L, were designed to accommodate Taxiway Design Group (TDG) 5 aircraft that allow larger commercial aircraft such as the Boeing 767 and Airbus A350 to utilize these facilities if required. However, other than occasional charters, the Airport typically does not see aircraft larger than Boeing 737 (TDG 3) or Airbus A321 (TDG 3) type aircraft. Taxiways A, A1, A2, A3, A4, A5, A6, E, and F were rehabilitated in successive projects between the years 2015 and 2020. Asphalt shoulders were also constructed along the taxiways. This network of taxiways that support the primary runway is in good condition and can safely accommodate the current fleet mix.

4.1.3.3 Commercial Apron Facilities

The existing concrete commercial apron can be seen in Figure 4-11. In general, the apron is in good condition and is not showing any signs of failure. This existing apron configuration accommodates parking aircraft at the A Gates and B Gates. Currently there are six parking positions at Concourse A that correspond to Gates A1-A6. The design aircraft for each parking position varies but generally can accommodate up to a Boeing 757-200 at Gates A2-A6 and up to a Boeing 737-900 at Gate A1. Currently the Airport operates a "Common Gate" system where airlines can be assigned to a specific gate at Concourse A based on availability and ability of a gate to handle a given sized aircraft. The current parking positions at Concourse A allow for the maximum flexibility for the Airport as the current fleet mix that uses the airport regularly can be accommodated at any of the A Gates (Figure 4-11).

Concourse B area features three parking positions that correspond with Gates B1-B3. These gates serve primarily smaller regional aircraft as the parking positions and the taxilanes to reach the parking positions are constrained by

adjacent gates. In general, these gates are primarily used by Bombardier Q400 as well as Embraer 175 and smaller aircraft.

North of the Concourse A walkway is a parking position that the Airport refers to as “B North”. This position is primarily used as a Remain Overnight (RON) space for regional aircraft such as the Embraer 175 and smaller aircraft. The maximum size of the aircraft that utilizes this space is constrained by aircraft parked at Gate A6, the terminal building, and ground service equipment that is stored adjacent to the parking position. If needed, this parking position can be utilized as a loading and unloading facility for regional aircraft.

Deicing operations currently take place on the commercial ramp and adjacent taxilanes. The latest airport deicing plan identifies five different positions on the asphalt portion of the apron where aircraft deice during the winter months when conditions require. The current deicing operations do not require containment and collection of the deicing fluid. As the airport continues to improve and modify the areas surrounding the existing terminal and concourse areas, the location and layout of the deicing positions will be analyzed and optimized.

4.1.3.4 Remain Overnight (RON) Facilities

The Airport currently has three designated Remain Overnight (RON) parking positions, sometimes referred to as “heavy pads”. They are both north and south of the existing Concourse A (Figure 4-12). The north heavy pads are made up of four concrete slabs that correspond to aircraft landing gear and allow two aircraft to be parked. The northern most heavy pad can accommodate up to a Boeing 737 MAX 9 while the pad just to the south can accommodate up to a Boeing 757-200. The primary constraints for these existing heavy pads include adjacent taxiways, orientation of the pads, and adjacent buildings (Figure 4-12).

South of existing Concourse A is the south heavy pad. This heavy pad is located on the general aviation ramp and consists of one large concrete slab. This concrete pad allows parking of one commercial sized jet aircraft (up to Boeing 737-900). The constraints on this parking position include adjacent taxilanes, adjacent aircraft parking, and the size of the concrete pad itself.

Lastly, as previously mentioned, the parking position at B North is used as a RON position when needed. The specifics of this parking position can be found in the previous section.

The Airport consistently utilizes all the existing parking positions at Concourse A and B overnight. Furthermore, multiple days every week all three heavy pad positions are also full. With continued additions in airlines, routes and passengers at Eugene Airport expected, planning and design has begun to construct a remain overnight (RON) apron north of Concourse A in the vicinity of the existing heavy pads. This RON apron will be constructed out of concrete and will be able to accommodate up to five Boeing 737 MAX 9 aircraft. When complete, this apron will allow the airport to increase their RON capacity from three aircraft parking positions currently available at the heavy pads, to six parking positions including the RON apron and south heavy pad. Additionally, the RON apron will be designed with Concourse C in mind and the ability to provide additional parking positions in the future should the need arise. The completion of the RON apron will give the Airport more flexibility to accommodate additional aircraft overnight and could possibly increase the attractiveness to existing or new airlines that would like to increase or establish service at the Airport.



FIGURE 4-12
EXISTING HEAVY PADS AND NEW RON APRON LOCATION

4.1.3.5 Cargo Facilities

The existing cargo apron and associated facilities are located at the far south end of Taxiway A. This asphalt apron primarily serves smaller cargo aircraft such as the Cessna 208 Caravan and the Beechcraft 1900. These aircraft are operated by feeder cargo airlines that are associated with UPS and FedEx. Operationally these aircraft typically arrive in the morning from Portland International Airport (PDX), remain idle during the day on the apron, and then depart in the late afternoon to return to PDX.

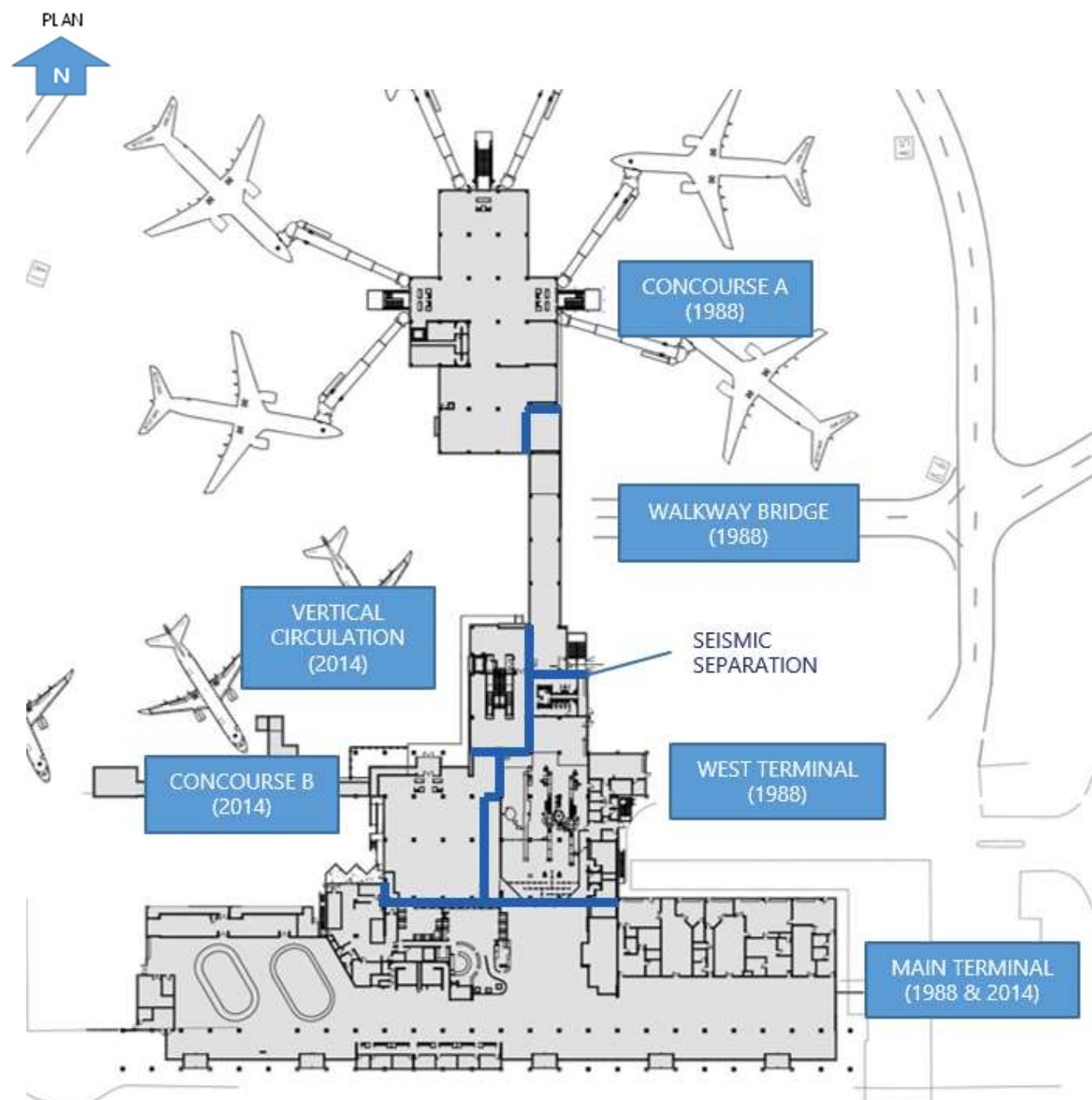


FIGURE 4-13
EXISTING BUILDINGS AND EXPANSION PLAN

4.1.4 Structural

Structural condition validation focuses on the locations where the potential additions will interface with the existing structures. The existing airport terminal building comprises of six individual structures:

- Main Terminal (Original construction with expansions in 1988 and 2014)
- West Terminal (1988 expansion)
- Walkway Bridge (1988 expansion)
- Concourse A (1988 expansion)
- Concourse B (2014 expansion)
- Vertical Circulation (2014 expansion)

The existing buildings noted above are seismically separated as independent structures with a seismic separation gap that permits them to move independently during a seismic event (Figure 4-13). While the structural framing and architectural components must remain independent, non-rigid mechanical, electrical and plumbing components may be designed to pass through the gap between the two buildings provided adequate measures are taken to allow for movement of the buildings.

Due to existing finishes concealing many of the structural elements, observation was limited to those components that were readily exposed. A cursory review of the available structural drawings from 1988 expansion was also performed. The following sections describe structural considerations at the existing structure adjacent to the locations of the potential expansions. A 2019 seismic evaluation of the Main Terminal, West Terminal, Walkway Bridge and Concourse A indicating seismic deficiencies should be referenced in conjunction with this report and is included in the appendix.

4.1.4.1 CONCOURSE A

4.1.4.1.1 Concourse A and Walkway Bridge

Concourse A and Walkway Bridge buildings are both two-story steel frame structures constructed as part of the 1988 expansion. The structural roof assemblies consist of untopped metal deck over steel wide flange beams and girders. The second floors are constructed similarly to the roofs, except there is a concrete topping slab over the metal deck. The roof and floor girders are supported by wide flange steel columns that transfer the load down to the concrete foundations. The foundations primarily consist of conventional shallow concrete footings including isolated spread footings and continuous grade beams. The vertical lateral force resisting systems are steel moment frames. As noted above, the existing structures are seismically separate from the adjacent structures. The ground story of the Walkway Bridge does not have perimeter walls and is open to the exterior. The existing foundations are primarily shallow grade beams, in the range of five to six feet wide.

The 2019 Seismic Evaluation identified a seismic deficiency in the metal deck diaphragm connection to the structural steel moment frames for Concourse A and Walkway Bridge. The metal deck diaphragm is not directly connected to the wide flange steel moment frame girders as these girders are dropped below the wide flange steel beams (Figure 4-14). Additional seismic load should not be imposed on the existing structures without retrofit.

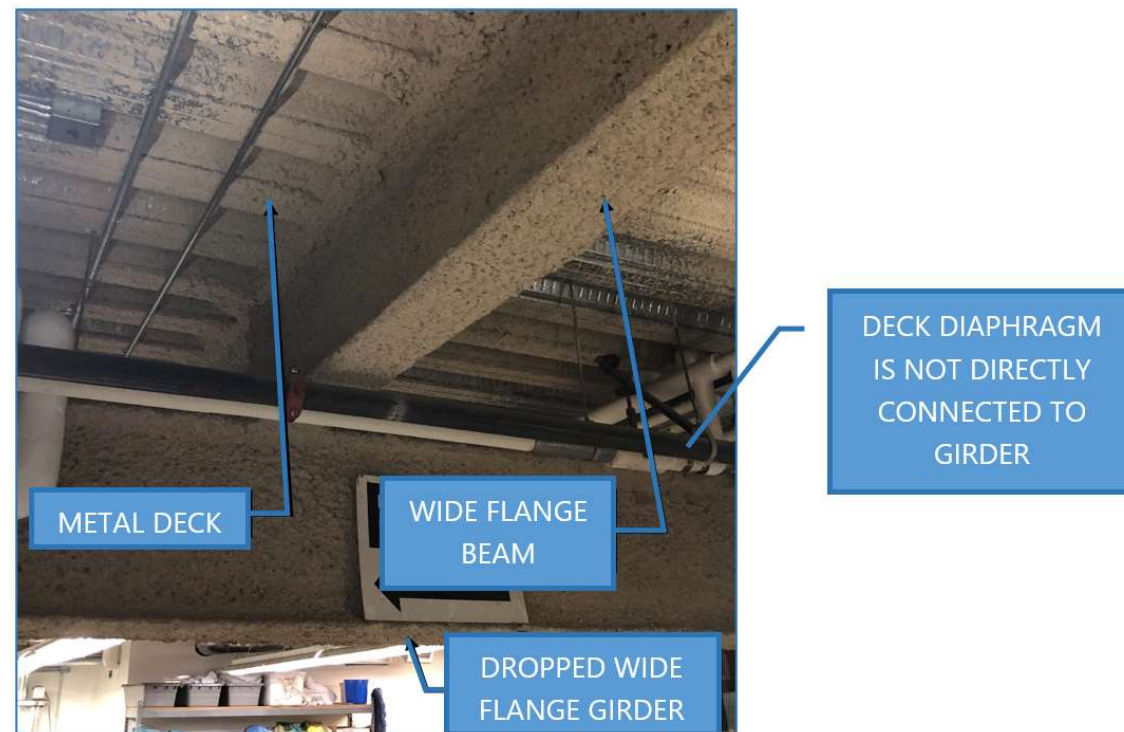


FIGURE 4-14
TYPICAL GIRDER DROPPED BEAMS

4.1.4.1.2 Vertical Circulation Building

The Vertical Circulation Building is a partial two-story structure that was constructed in the 2014 expansion. Roof framing consists of plywood over wood I-joists that are supported by a combination of steel wide flange and wood glulam beams. Second floor construction consists of concrete fill over metal deck and steel wide flange beams. Roof and floor beams are supported by wide flange steel columns that transfer loads down to the concrete foundations. The foundations primarily consist of continuous concrete grade beams. The lateral force resisting system is steel moment frames. The Vertical Circulation structure is seismically separate from the adjacent structures, including the Walkway Bridge, the West Terminal, and Concourse B.

The Walkway Bridge addition occurs between Concourse A, the Walkway Bridge, and Vertical Circulation, which are three independent structures. As such, the addition must remain structurally independent from at least two of the existing structures to prevent interconnecting the existing structures.

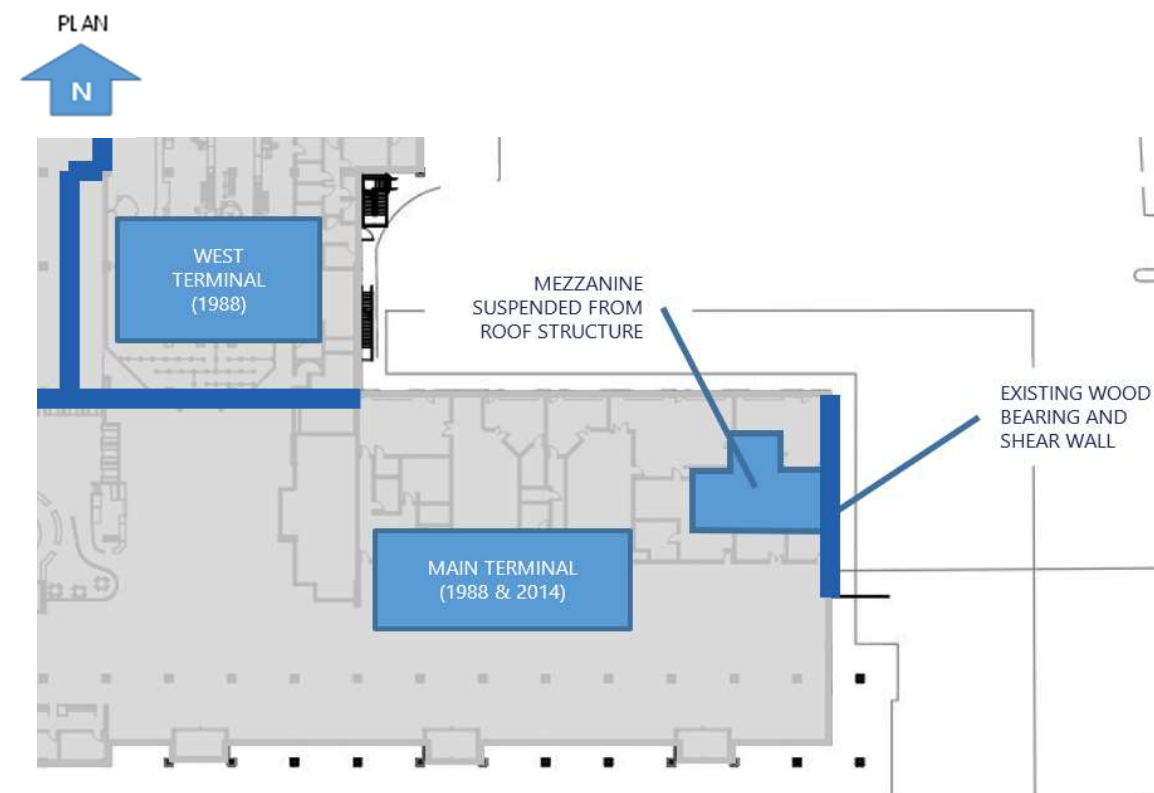


FIGURE 4-15
TICKETING AND OUTBOUND BAGGAGE

4.1.4.2 TICKETING AND OUTBOUND BAGGAGE

4.1.4.2.1 Main Terminal Building and Bag Claim

The existing Main Terminal Building is a single-story wood frame structure with a mechanical mezzanine that is suspended from the roof in the northwest corner of the building. The Main Terminal was expanded in 1988 and again in 2014. Roof framing consists of plywood sheathing over wood I-joists that span to curved glulam beams or wood stud bearing walls. The beams are supported by a combination of wide flange, tube steel, and concrete columns that carry load down to the concrete foundations. The foundations consist of continuous grade beams, isolated spread footings, and pile caps with supporting piles. The lateral force resisting system is primarily steel moment frames. The Main Terminal is seismically separate from the West Terminal (Figure 4-14).

The north exterior wall of the Main Terminal is a wood frame shear wall that resists lateral forces. If significant modifications such as openings will be added to join the new and existing spaces, a new lateral resisting element within the existing Main Terminal building may be necessary as a retrofit (Figure 4-15).

The existing mezzanine is suspended from the roof structure. The 2019 Seismic Evaluation identified a deficiency in the lateral resistance of the mezzanine. Supplemental lateral bracing was recommended. The 2019 Seismic Evaluation also identified a seismic deficiency in the existing plywood sheathed roof diaphragm of the Main Terminal Building, therefore, additional lateral load should not be added to the existing structure without retrofit.

4.1.4.2.2 West Terminal Building

The West Terminal Building is a two-story steel frame structure constructed in the 1988 expansion. There is a large second floor opening that creates a high bay space from the ground floor to the roof. The structural roof assembly consists of untopped metal deck over steel wide flange beams and girders. The second floor is constructed similarly to the roof, except there is a concrete topping slab over the metal deck. The roof and floor girders are supported by wide flange steel columns that carry load down to the concrete foundations. Foundations primarily consist of conventional shallow concrete footings including isolated spread footings and continuous grade beams. The lateral force resisting system is steel moment frames. The West Terminal is seismically separate from the Main Terminal and the other surrounding structures.

The 2019 Seismic Evaluation identified a seismic deficiency in the metal deck diaphragm connection to the structural steel moment frames of the West Terminal. The metal deck diaphragms are not directly connected to the wide flange steel moment frame girders, as these girders are dropped below the wide flange steel beams. This is the same seismic deficiency previously referred to at Concourse A and Walkway Bridge in section 4.1.4.1.1. Additional seismic load should not be imposed on the existing structures without retrofit.



FIGURE 4-16
SIEMENS BAS CONTROL PANELS



FIGURE 4-17
AIR COMPRESSOR SERVING EXISTING PNEUMATIC CONTROLS

All systems are controlled by the central Building Automation System (BAS) (Figure 4-16). The system was installed by Siemens in 2006 and has been upgraded throughout the project.

The control systems are in good operating condition according to discussions with airport staff except for some existing pneumatic controls (Figure 4-17) that will be replaced as part of an ongoing replacement project. The airport staff noted that their goal is to phase out and replace all the pneumatic controls with DDC controls to optimize the terminal building's performance and minimize power and fuel consumption.

4.1.5.1 Existing FCUs Efficiency

The existing FCU are highly energy intensive and are hard to maintain. There are over 50 fan coil units throughout the building serving the majority of the Concourse A, B and ticketing area, including the ATO. Some fan coil units still have pneumatic controls and they must stay on during occupied periods to provide the necessary outside air at constant speed. This situation creates a constant electrical load that must be met to operate the fans within each of the FCUs. Other disadvantages of utilizing FCUs, are issues with the moisture removal and the potential of local breeding grounds for allergens and pathogens.

Exploration of alternative HVAC systems could significantly improve efficiency by reducing or eliminating the constant electrical load to operate the large quantity of FCUs

4.1.5.2 Existing Systems' Capacity Study

Some of the options investigated include using the existing chilled and hot water plant systems' untapped capacities to provide cooling and heating to the proposed Concourse A expansion, baggage claim expansion, and ticketing / outbound baggage expansion. A complete study of the existing chiller and boiler plant must be conducted to determine the untapped capacities of these systems.

The existing HVAC system at EUG consists primarily of chilled water cooling and hot water hydronic heating systems. Interior air handling units serving the main ticketing lobby, the central lobby including the security screening checkpoint (SSCP) and bag claim spaces while the rest of the terminal and Concourses A and B are served by a four-pipe fan coil unit system.

4.1.5.3 Air Handling

The terminal building consists of three main air handling units that are housed in its associated mechanical room. They mainly serve the ticketing hall, the main entrance area, and bag claim area. AHU-1 & 2 are part of the original terminal building equipment that was installed back in 1988 and they are at the end of their useful life. AHU-3 was replaced during the airport upgrade and the terminal expansion project in 2016. All AHUs are single zone variable volume units, and they consist of heating and cooling coils, a fixed minimum outside air and charcoal filters.

Most of the terminal building and main concourses are served by fan coil units. Each fan coil unit consist of hot water and chilled water coils and filter section. Outside air is delivered to the fan coil unit by 14 dedicated outside air fans.

4.1.5 Mechanical

The existing central HVAC plant is located on the first level of Concourse A and the central cooling plant is in room 1601 (E) Chillers. The main air conditioning equipment consists of three identical chillers, a heat exchanger, and chilled and condenser water pumps. The condenser water system consists of two fluid coolers located outside on the apron south of the 1602 (E) Boiler Room. The central heating plant is in room 1602 (E) Boiler Room where the main equipment consists of two identical condensing boilers, and primary and secondary hot water pumps.

From the central HVAC plant, chilled and hot water supply and return piping distributed throughout the building serves air handling units (AHU), fan coil units (FCU) and unit heaters (UH). There are three single zone variable volume air handling units serving the main spaces of the terminal building. AHU-1 is located in 1006 Mezzanine Room and serves the ticketing lobby. AHU-2 is located in room 2001 Mechanical and serves the central lobby. AHU-3 is located in room 2000 Mechanical and serves the bag claim and rental car area. FCUs are located throughout the building serving the rest of the terminal area. These include, but are not limited to, ATO office spaces, airside and landside restaurant, rental car spaces, storage rooms, "back of house" spaces, and Concourse A and Concourse B holdrooms. Unit heaters are located throughout the building as required for local space/area heating.



FIGURE 4-18
NEW CHILLER #3 OF 2016 TERMINAL UPGRADE



FIGURE 4-19
HEAT EXCHANGER DEDICATED TO WATER-SIDE ECONOMIZER



FIGURE 4-20
FLUID COOLERS AT CONCOURSE A



FIGURE 4-21
LEAD CHILLED WATER SECONDARY PUMP WITH VFD

4.1.5.4 Chilled Water System

Chilled water for cooling is produced and generated by three Trane water cooled rotary screw type chillers. Each chiller is rated for 110 tons of capacity, with a total of 330 tons of cooling. Two of the chillers were installed in 2006 as part of the terminal HVAC improvement project. The third chiller was added in 2016 as part of the airport upgrade and the terminal expansion project (Figure 4-18). The airport confirmed the sequencing of the chillers and noted that two chillers operate during milder temperatures and the third chiller operates when outdoor temperatures are above 90 degrees.

The chiller water plant also benefits from the water-side economizer that provides lower operational cost with energy savings throughout the year and when weather permits. The water-side economizer was installed as part of the terminal expansion project which included a remote heat exchanger located inside the mechanical room (Figure 4-19).

Chilled water is distributed via centrifugal end-suction pumps in a primary/secondary pumping configuration. The secondary pumps deliver chilled water to the AHUs and fan coil units in variable volume fashion with variable frequency drives (Figure 4-21).

The chilled water piping was designed for future expansion and has multiple valved and capped locations for future connection. Due to these unused capped locations, the existing chilled water plant will likely have additional capacity available, but the exact amount is not known and has not yet been reviewed or calculated but will be reviewed as part of the expansion design.

There are two fluid coolers for the chilled water system located just outside of the mechanical room on the southeast corner of Concourse A (Figure 4-20). The Evapco fluid cooler was installed in 2006 as part of the terminal HVAC improvement project and the Marley fluid cooler was installed during the airport upgrade and terminal expansion project in 2016. The fluid coolers produce condenser water for the chiller water plan and are essential for the water side economizer operation. They are sized for approximately 450 tons of heat rejection and are configured for Duty/Stand-by operation. The condenser water fluid is based on a 30% propylene glycol mix primarily for freeze protection. The airport confirmed that both towers provide sufficient heat rejection. During the site visit it was noted that the fluid coolers needed to be serviced and cleaned.

There are two constant volume centrifugal end-suction condenser water pumps and one variable volume centrifugal end-suction pump that is part of the water side economizer cycle.



FIGURE 4-22
CONDENSER WATER PUMPS AT BOILER ROOM



FIGURE 4-23
CONDENSING BOILERS IN THE BOILER ROOM

4.1.5.5 Hot Water System

Hot Water Heating for the terminal is provided by two Aerco Benchmark 2000 MBH, gas fired hot water condensing boilers (Figure 4-23). One of the condensing boilers was installed as part of the airport HVAC improvement project in 2006 and the other was installed in 2016 as part of the terminal expansion project. The boilers are configured for Duty/Stand-by operation.

Hot water is distributed through the building via a primary/secondary pumping arrangement with end-suction centrifugal pumps. The primary pumps are dedicated to each boiler and operate when its associated boiler is enabled in constant volume fashion. The secondary pumps distribute hot heating water to the terminal building and are variable volume pumps with variable frequency drives. They operate when the heating plant is enabled and are configured for duty/ stand-by control (Figure 4-22).

The hot water piping was designed for future expansion and has multiple valved and capped locations for future connection. Similar to the chilled water, it is likely that the existing hot water boilers have additional capacity available, but the exact amount is not known, and has not yet been calculated but will be reviewed as part of the future expansion design.

The main mechanical room containing the cooling and heating plants is in the east side of Concourse A and does not appear to pose any restrictions to the proposed Concourse A expansion concepts.



FIGURE 4-24
EMERGENCY GENERATOR



FIGURE 4-25
COMM ROOM ABOVE BAGGAGE HANDLING

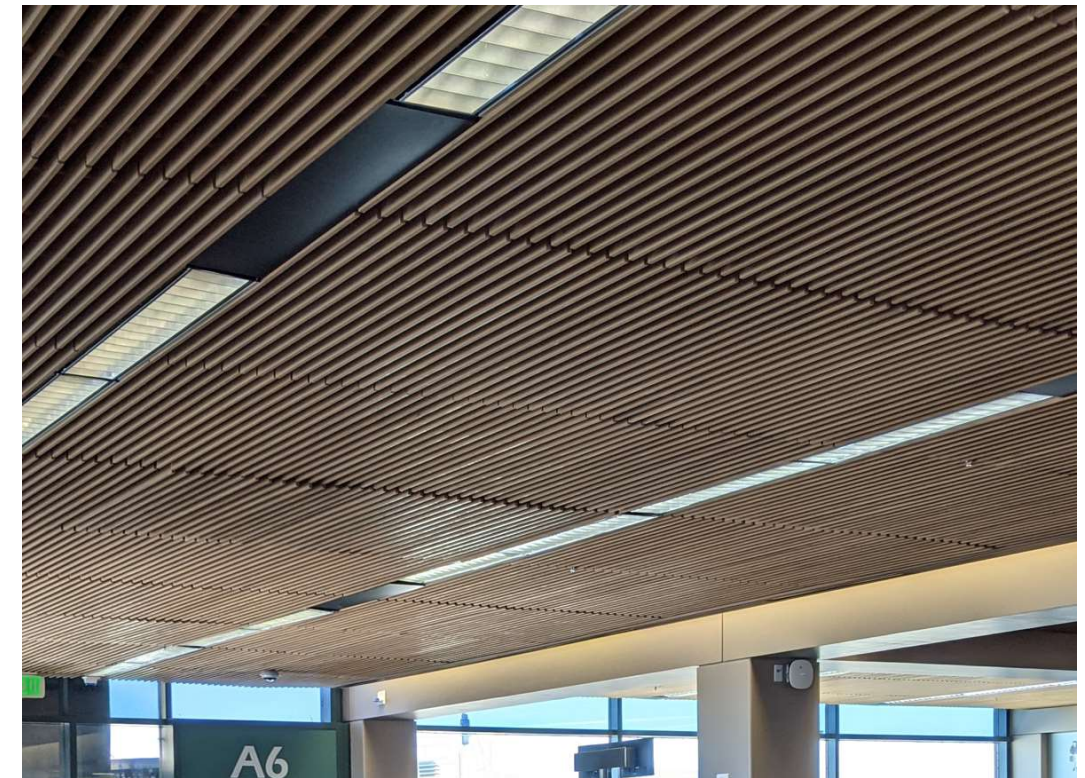


FIGURE 4-26
TYPICAL LINEAR FIXTURES IN WOOD CEILING

4.1.6 Electrical

4.1.6.1 Electrical Systems

The current electrical systems throughout the terminal consist of a main 2500A switchboard, with associated distribution panelboards, transformers, lighting systems, and general power systems. The emergency power for the terminal is provided by a 350KW generator with distribution equipment (Figure 4-24). The existing main distribution systems are in good condition and not nearing end of life cycle for standard industry expectations.

4.1.6.2 Electrical Distribution Systems

The main electrical service is distributed from switchboard SB1 and distribution board DP1. The main breakers for both the utility feed and generator feed are fitted with ground fault protection required per the NEC. These boards feed the two secondary distribution switchboards located throughout the terminal. The existing 350kW stand-by generator was installed during the terminal expansion project. The generator and generator room are in excellent condition.

The public areas of the terminal building have adequate access to power outlets. The pre-screening waiting and the post-screening holdrooms have powered seating and charging stations throughout. The gate counters do not have adequate amounts of power outlets for the latest airline standards. Future gate counter design would need to address this deficiency.

4.1.6.3 Lighting Systems

Currently the lighting system consists of fluorescent, high pressure sodium, incandescent, and metal halide fixtures. The existing terminal landside lobby including the meet/greet area, ticketing and bag claim, is illuminated using magnetic ballast fluorescent and incandescent fixtures (Figure 4-26).

The existing terminal airside, including holdrooms, is illuminated using fluorescent fixtures. There is substantial glazing in both these areas. Retail spaces have a good amount of inefficient incandescent lighting.

There is a full building lighting control system that is not currently utilized due to lack of training and manuals from when the system was installed. The energy efficiency of the lighting could be improved by simply commissioning the lighting control system, and providing training to the staff on operating it properly going forward.

4.1.6.4 Communication Systems

The current communications systems throughout the terminal consist of backbone infrastructure supporting telephone, data networks (Passenger processing, Wi-Fi, FIDS, BIDS, etc.), a paging system (headend, speakers, and microphones), and security systems (access-controlled doors and surveillance cameras). These systems are powered via UPS units connected to emergency power (Figure 4-25).



FIGURE 4-27
EXISTING LAVATORY AT LANDSIDE RESTROOM



FIGURE 4-28
EXISTING WC AT LANDSIDE RESTROOM

4.1.7 Plumbing

The plumbing systems were originally installed in 1988 and upgraded as part of the subsequent terminal expansion projects. The plumbing systems in the terminal building consist of touchless, sensor operated flush valve toilets and urinals, and touchless, sensor operated lavatory faucets. Fixtures and facilities are in generally good condition with normal wear and tear exhibited for their age (Figure 4-27 and Figure 4-28).

4.1.7.1 Domestic Water

Domestic cold water for the building is provided by a 6" domestic water main that enters the north side of the building in the mechanical room located behind the men's and women's toilets near the escalator landing. There is a separate 2-1/2" domestic water line stubbed into the building at the northwest corner of the terminal for a future build-out.

Hot water for the terminal plumbing system is provided by multiple gas fired water heaters, with a hot water recirculating system. The water heaters are in a mechanical room near the restroom and concession area in the terminal.

4.1.7.2 Natural Gas

Natural gas is provided to the building by a 4" gas main and meter located near the mechanical room at Concourse A and serves both the boiler room and the concessions. A separate 2" gas service and meter are located outside near

storage room 1312 to the north of the terminal and serves the existing kitchen/restaurant. This gas line runs under the slab at the south end of the terminal where the existing kitchen is located.

4.1.7.3 Drainage

Sanitary wastewater is conveyed through the building to an exit point on the north side of the terminal. The existing gravity main is a 6" line which has adequate capacity for the current building drainage loads. There is a sanitary waste lift station located in the mechanical room in Concourse A of the terminal that collects sanitary drainage from fixtures located above. This system discharges through 2" force mains to a site force main located nearby.

Storm drainage for the terminal is provided by primary roof drains with secondary overflow drains. The primary drains are piped internally throughout the building and connect to a 15" stormwater site main at the south west side of the terminal building, a 12" stormwater site main on the north east side of the terminal building, and a 10" stormwater site main on the east side of the terminal building. Overflow drains are piped independently to overflow downspout nozzles located on the building exterior above grade.



FIGURE 4-29
TICKETING LOAD BELTS TC1, TC2, AND TC3



FIGURE 4-30
TICKET COUNTER ASSOCIATED WITH TC3 LOAD BELT



FIGURE 4-31
TICKETING LOAD BELT TC4

4.1.8 Outbound Baggage

The existing baggage handling system that serves the outbound flights at the Eugene Airport (EUG) consists of five load conveyors located in the terminal's check in area. Each conveyor includes a separate screening area and ends in a separate make-up area on the apron level (Figure 4-29).

Passengers are processed at the check in counters (Figure 4-30) for their outbound flights by the airline's agents. Passengers' checked bags are placed on one of the five load belts located behind the counters. Each load belt, TC1-01, TC2-01, TC3-01, TC4-01, and TC5-01 convey bags to five independent mini-inline Checked Baggage Inspection Systems (CBIS). Bags are transported from the check-in area through a security door to a baggage screening area. Once bags are cleared, they are conveyed through openings in the building wall to their associated run-out pier located in a baggage make-up area. Bags transferred to the piers in the baggage make-up area are manually sorted for their respective flights and then manually handled and transferred outside of the make-up areas on the apron where the baggage carts are staged.

None of the Ticket Counter (TC) subsystems are integrated onto a centralized Maintenance Diagnostic System / Maintenance Information System (MDS/MIS) in the Baggage Control Room (BCR); they are only shown on their local Master Control Panels (MCP). Integrating these subsystems into the MDS/MIS display in the BCR will help manage the subsystems, track faults, and identify jams more quickly.

4.1.8.1 Ticketing Area

Airline Ticketing Office (ATO) doorways prevent induction conveyors from spanning the length of all counters, thus some the counters require manual transport of baggage to the conveyor. Existing conveyors are much narrower (24") than standard 36" wide belts. Power turns on these narrow belts have tighter radii than that of standard belts and thus do not allow conveyance of items such as long military duffle bags, skis, bows, and gun cases, which greatly increases the need for manual transfer of oversize bags to the screening area (Figure 4-31).

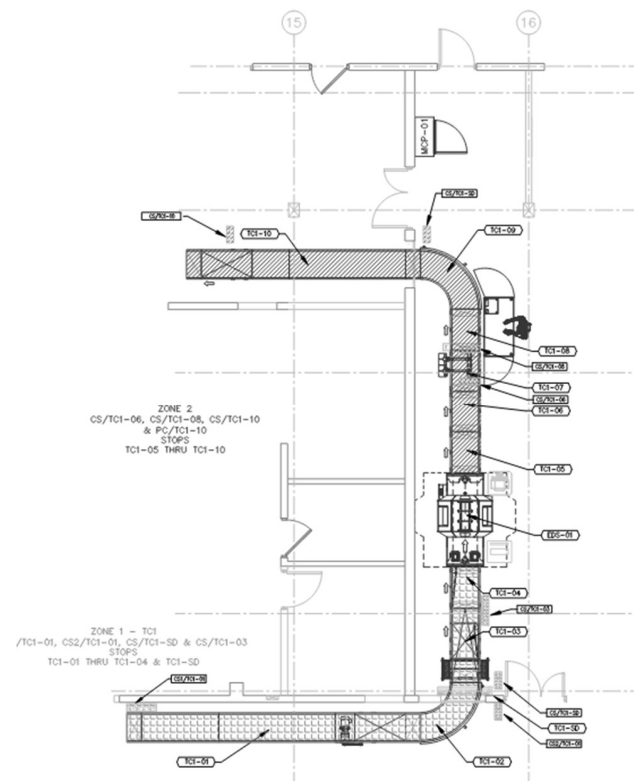


FIGURE 4-32
TC-1 MINI-INLINE CBIS

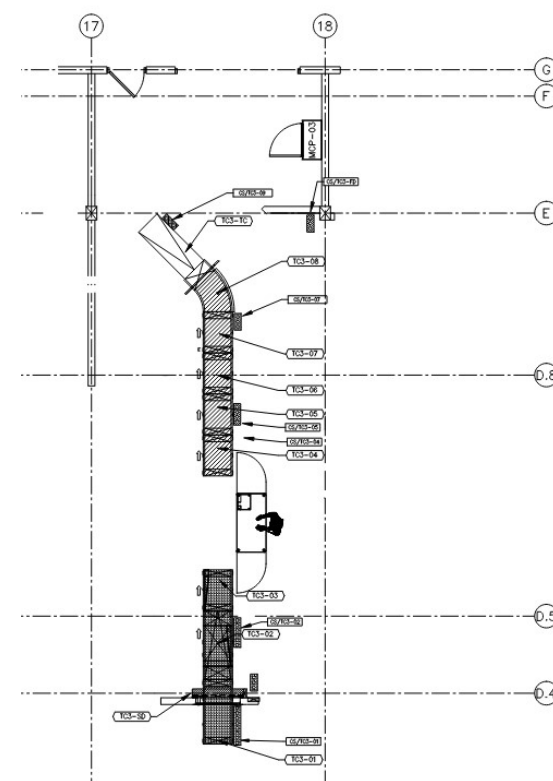


FIGURE 4-33
TC-2 MINI-INLINE CBIS

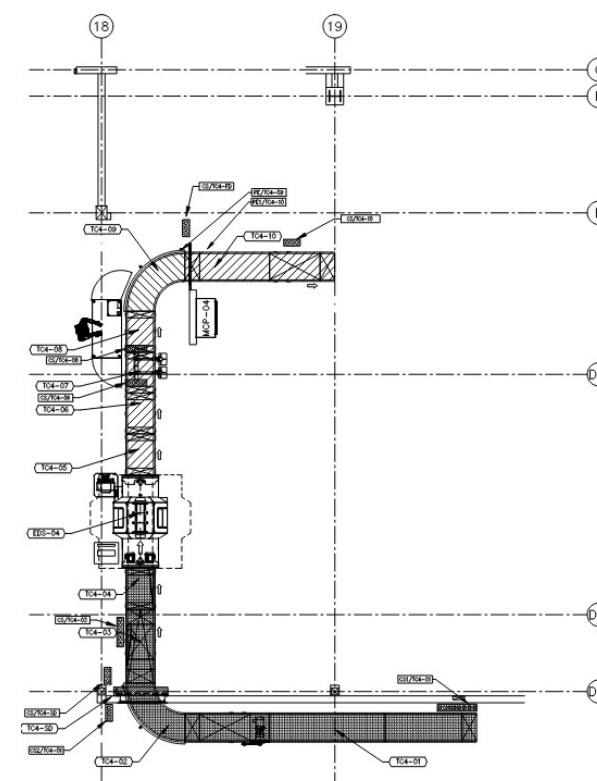


FIGURE 4-34
TC-3 ETD CBIS

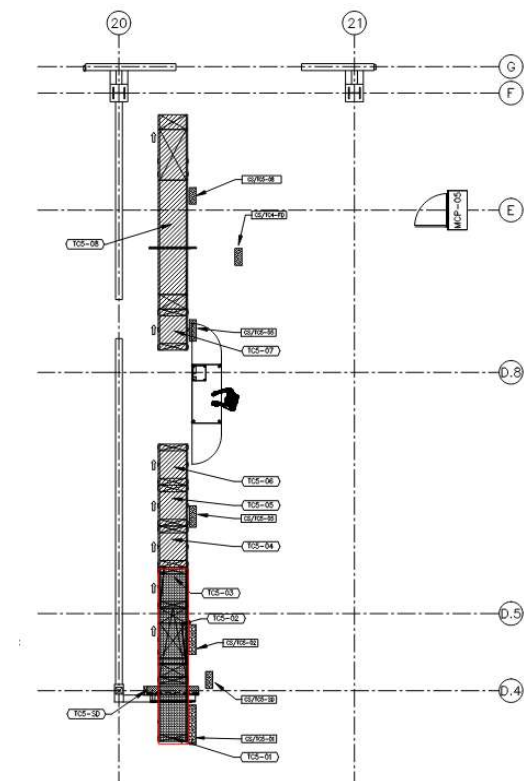


FIGURE 4-35
TC-4 MINI-INLINE CBIS

4.1.8.2 Checked baggage Inspection Systems (CBIS)

The TC1, TC2, TC4, and TC5 subsystem are each configured with a load belt in the ticketing area followed by a power turn conveyor that transports bags through a fire/security door to a mini-inline screening system (Figure 4-32, Figure 4-33, Figure 4-34, Figure 4-35). The mini-inline system screens bags through a type II (low throughput) Explosives Detection System (EDS) device. Cleared bags continue to be transported through a fire/security door to a pier located on the apron for baggage make-up and transferred to baggage carts. Bags alarmed by the EDS stop on belts downstream of the screening machine and are transferred by TSA Security Officers (TSOs) to one of the two adjacent baggage inspection tables. After these bags are given a clear status, they are manually placed back on the conveyor belts and are transported through the fire security door to the make-up area and transferred to baggage carts (Figure 4-36 and Figure 4-37).

The TC3 baggage system is considered an Explosive Trace Detection (ETD) system and is configured with a short load belt in the ticketing area which transports bags through a fire/security door to a screening area. Once bags arrived in the screening area they are lifted and placed manually to a baggage inspection table for ETD screening. Cleared bags are manually inducted on a transport conveyor adjacent to the baggage inspection table and are transported through a fire/security door to a short pier located in the baggage make-up and then manually transported to the apron area to be loaded onto baggage carts.

While TC1, TC2, TC4, and TC5 are considered fully automated mini-inline systems, they can each process only a low volume of bags. TC3 has a reduced capability for processing bags as it is not currently equipped with an EDS device.

Each bag inducted in these systems needs to be inspected manually via ETD. As these facilities were designed using TSA's Planning Guidelines and Design Standards (PGDS) V4.0, the current TSA screening operations for the TC3 subsystem does not meet ergonomic requirements as set by forth by the PGDS V7.0.

Checked Baggage Inspection Systems (CBIS) include Level 1 screening machines and security conveyor tracking zones and allow for oversize screening. The Consolidated Baggage Reconciliation Area (CBRA) performs Level 3 security screening by the TSO using Electronic Trace Detection (ETD) units. Currently, TSA screening operations occur in multiple separate rooms, do not meet capacity requirements, and require significantly more personnel than a consolidated Checked Baggage Inspection System (CBIS) and Checked Baggage Resolution Area (CBRA).



FIGURE 4-36
TC2 CBRA



FIGURE 4-37
TD3 AND TC4 CBRA



FIGURE 4-38
CART STAGED OUTSIDE OF TC4 MAKE-UP AREA

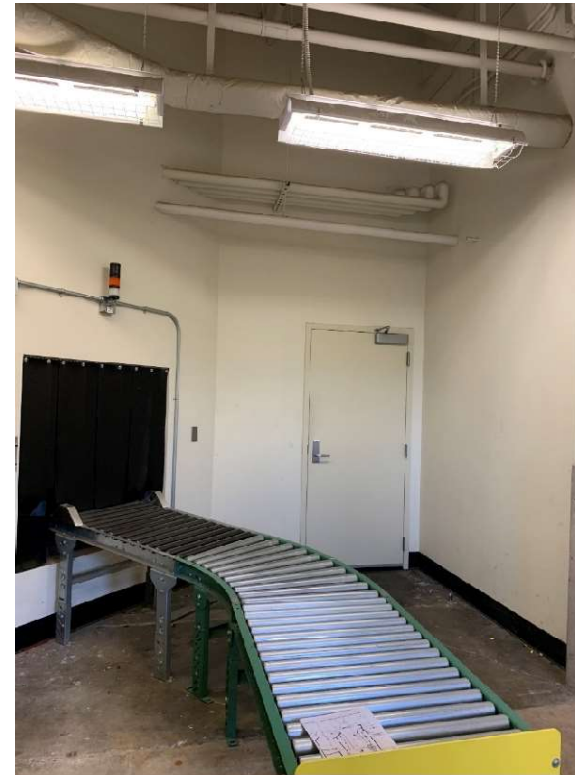


FIGURE 4-39
TC3 MAKE-UP AREA



FIGURE 4-40
TC4 MAKE-UP AREA

4.1.8.3 Baggage Make-up Rooms

The five individual baggage make-up areas have short run-out piers with a reduced capability to store bags in the event that they are not picked up as soon as they arrive in the baggage make-up area. This condition potentially causes bags to back up into the screening area (Figure 4-40). Piers for TC3 are equipped with gravity rollers which require significantly more manual handling of baggage (Figure 4-39). Due to space constraints, baggage carts cannot be staged next to the piers requiring bags to be manually transferred over extended distances. This transfer does not meet PGDS V7.0 ergonomics requirements (Figure 4-38).

The existing operations rely heavily on manual bag transfer in the CBIS and make-up areas, limits bag throughput, does not provide common ticket counter bag induction feeds to the screening areas, and are prone to frequent baggage back up due to their reduced capability to store bags upstream and downstream of the screening machines and in the make-up areas. The existing layout also does not have capability to expand for future growth.

Attachment A

CHAPTER 5
STAKEHOLDER ENGAGEMENT

5.1 STAKEHOLDER SURVEYS AND INTERVIEWS

Community involvement is a critical component of this project. The airport recognizes the importance of making sure that the public understands the need for airport expansion, is supportive of the magnitude of the expansion, and has the opportunity to be involved in selecting the aesthetics, feel, and experience of the final product.

The Airport staff identified the different groups from which information was solicited.

Advisory groups were separated into three different groups:

- » Technical Advisory Committee (TAC)
 - City of Eugene
 - Oregon State University
 - Airport Concessions
 - Airport FBO
 - TSA
 - FAA
 - Commercial Air Service Consultant
- » Community Advisory Committee (CAC)
 - Business Community Leaders
 - Eugene Area Chamber of Commerce
 - University of Oregon
 - Airport Advisory Committee
 - Tourism Industry Representatives
 - Sustainability Commission
- » Airline Partners
 - Southwest
 - Delta
 - Expressjet
 - American
 - Allegiant
 - Alaska
 - Horizon Air
 - United
 - Avelo

The design team developed an online survey and invited members of the various groups to respond.



FIGURE 5-1
PROJECT OUTLINE HIGHLIGHTING STAKEHOLDER INTERACTION

Questions ranged from specifics such as how many ticket counter positions might the different airlines need in five and ten years based on expected growth, to questions about opinions regarding the future of the airport such as the evolution of sustainability initiatives, and the role of new technologies such as Advanced Air Mobility and the use of renewable energy.

Surveys were followed up with interviews of the various advisory groups to garner clarification on responses and offer the opportunity for additional input.

The responses were tabulated and resulted in some insights that had implications on the ultimate design of the identified areas of expansion.

5.1.1 Stakeholder Considerations - Airline

5.1.1.1 Ticketing

Airlines noted that the ticket counters are adequately sized and expect that the need for ticket counter positions will increase modestly in the next five years with an increase in 1-2 positions typically, and a potential need for up to 2-4 total new positions in ten years.

Currently customers are typically segregated into VIP and standard lines with most airlines offering a separate self bag check / self service line. Several airlines currently use kiosks and offer self-bag tagging but do not use curbside check-in and have no plans to implement curb-side check-in. Spaces for self-bag tagging and kiosks are expected to remain the same for the foreseeable future. One airline noted the use of a proprietary mobile agent software with the use of airline employees with mobile devices in lieu of self-service kiosks.

5.1.1.2 Queuing

Airlines noted that the queuing is insufficient with a strong demand for more queuing space, especially in the mornings when the lines tend to intermingle. Follow up meetings with airlines indicated that queuing is a significant problem when charters are boarding and due to the required clearances around the entry vestibules and most airlines noted additional queuing is expected to be needed in the future with the shift to larger aircraft

5.1.1.3 Airline Ticketing Office (ATO) spaces

Most airlines noted that existing ATO spaces are insufficient and lacking in amenities and noted that employees expect a restroom, kitchenette with sink and a refrigerator at each ATO at a minimum. Even in cases where a shared breakroom has been provided, the airlines expect that they will still want a small dedicated breakroom for their staff.

5.1.1.4 Holdrooms and Concessions

All airlines noted that the holdrooms are undersized resulting in space being limited to standing-room-only when flights are delayed. Most airlines also noted that concessions are currently inadequate on the airside and landside with the primary complaint from passengers being that there is a lack of quick-service restaurants and kiosks such as coffee and snacks and a lack of freshly prepared/cooked food.

Most airlines noted a preference for dedicated gates but that a mix of common use and dedicated gates would be acceptable.

5.1.1.5 Charter

Most airlines noted either current or anticipated future charter flights pending demand.

5.1.1.6 Electrification of Ground Service Equipment (GSE)

Most airlines indicated a general push towards electrification and the purchase of electrified vehicles when non-electric vehicles are replaced. Airlines with limited flights indicated that they will continue to use ground handlers.

5.1.2 Stakeholder Considerations – CAC and TAC

5.1.2.1 Flight Frequency

Most respondents indicated that they fly primarily for leisure and less than 4 times per year total. All respondents indicated an anticipated increase in the number of flights in the next two years. Most cited post-pandemic resumption of travel or “making up for lost time” due to the pandemic for their increase in travel.

5.1.2.2 Landside Experience

Almost all respondents rated the ease of travel to and from the airport highly, with about half being disappointed with the lack of availability of other transit options. Several respondents noted a lack of parking during the holidays especially when arriving and all lots are completely full with no other way to reach the airport.

Most respondents rated the current ticketing, baggage claim, restrooms, and security checkpoint highly however comments were made with queuing space during the holidays or busy times.

5.1.2.3 Airside Experience

The average score for the existing airside experience was in the middle of the range with several respondents indicating problems with seating, especially during peak periods. Several respondents noted that the existing seating quality is adequate but many charging stations were inoperable and amenities were lacking in the Concourse B holdrooms.

5.1.2.4 Concessions Experience

Landside concessions were rated with average scores while airside concessions scored higher. Restaurant comments indicated a lack of variety and being frequently sold out with excessive lines at the airside location. Concessions comments were favorable with customers appreciating the local/Oregon products.

5.1.2.5 Sustainability

When rating the overall importance of the different sustainability initiatives at the Airport, resilience to the effects of climate change and renewable energy topped the list with electric vehicle (EV) charging slightly below that. Administrative sustainability initiatives such as LEED and Envision were felt to be the least important.

Attachment A

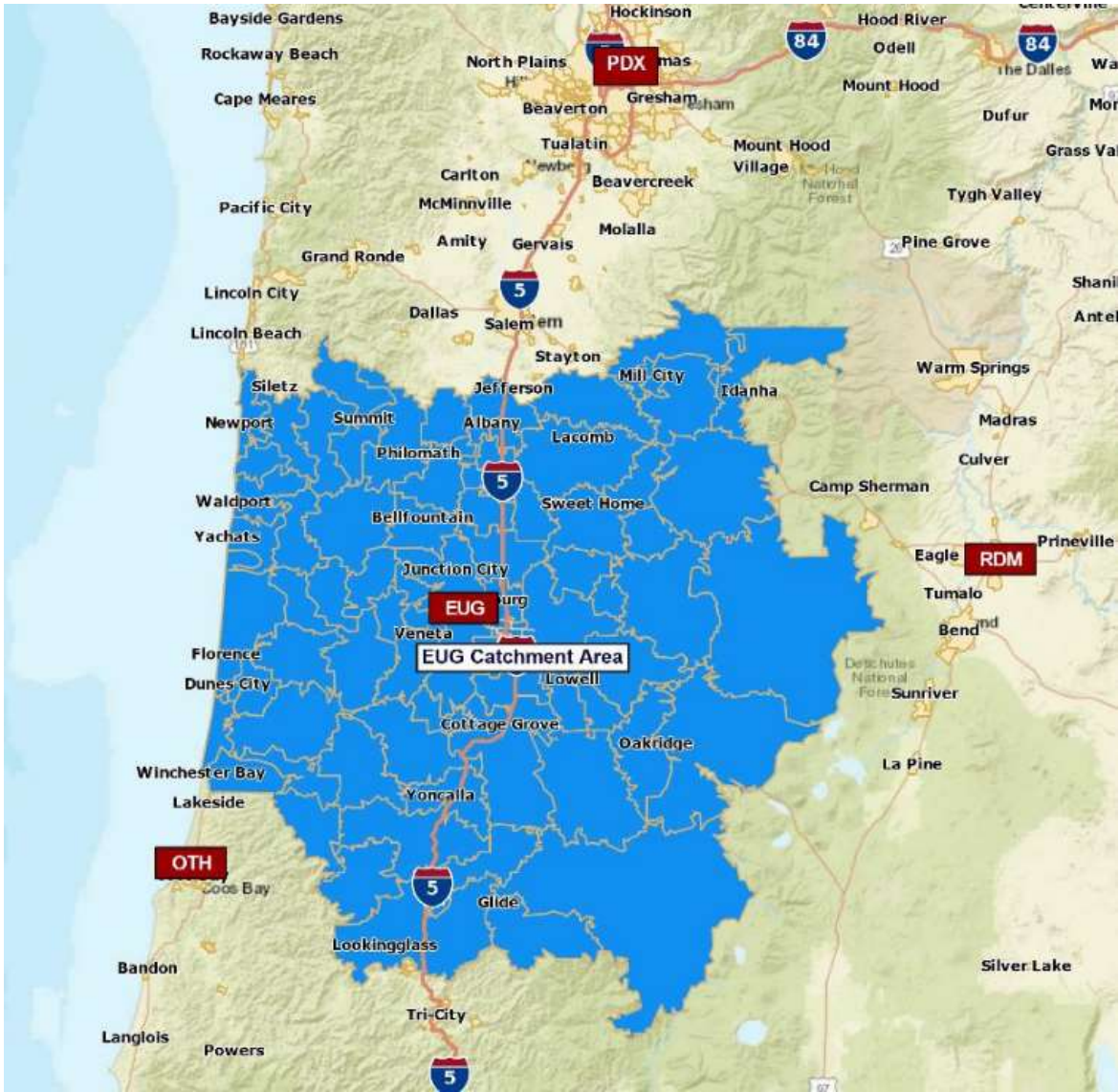
CHAPTER 6

AVIATION DEMAND FORECAST CONFIRMATION

6.1 AVIATION DEMAND

Eugene Airport has experienced notable change in its commercial passenger activity since the completion of the 2018 Airport Development Plan forecast. The entire aviation industry was negatively impacted by the COVID-19 pandemic (public health emergency) that began in the Spring of 2020 and has continued as airports experience various levels of recovery. As can be seen in this section, EUG has not only recovered considerably quicker than many airports in the US, but it has resumed a positive growth trajectory.

FIGURE 6-1
EUG CATCHMENT AREA



Source: Mead & hunt 2021

¹ Eugene Airport Passenger Demand Analysis, Dec 31, 2021. Mead & Hunt. Pg 5.

While this study was not tasked with a formal aviation demand forecast analysis, a confirmation of the existing Airport Development Plan forecast utilizing the latest enplanement, operations and flight schedule data to establish an average day in the peak month was completed for terminal capacity purposes. Additional information included a passenger demand analysis study provided by the Airport’s air service consultant.

6.2 REGIONAL FACTORS

6.2.1 Airport Catchment Area

An important regional factor affecting the passenger growth rate of the Eugene Airport is the increased use of the airport by residents in the catchment area. The airport catchment area is the area around Eugene that the airport is expected to draw passengers from and is based on the driving time between Eugene and other competing airports. This area comprises of approximately 83 zip codes and had a population of 725,836 people in 2021 (Figure 6-1)¹.

6.2.2 Growth of Market Share

As shown on Table 6-1, although the overall market for domestic flights is down 16% and the overall market for international flights is down 60%, the total percentage of passengers in the EUG catchment area flying out of the Eugene Airport reached 67% in 2021, an improvement of 10 percentage points compared to 2019, while passengers diverting to PDX decreased from 43% to 33%.

The largest percentage change was seen with international passengers where EUG recaptured 12.4% of the total, going from 41% of the market share to 54%. For domestic passengers, 68% chose to fly out of EUG while 32% flew out of PDX, an improvement of 9.1%².

TABLE 6-1
AIRPORT USE – DOMESTIC & INTERNATIONAL COMPARISON

Rank	Originating Airport	CY 2019		CY 2021		Change	
		PAX	%	PAX	%	PAX	%
Domestic							
1	EUG	1,101,408	59	1,072,514	68	-28,874	9.1
2	PDX	768,782	41	506,031	32	-262,751	-9.1
Subtotal		1,870,190	100	1,578,545	100	-291,646	
International							
1	EUG	75,442	41	39,305	54	-75,442	12.4
2	PDX	107,242	59	33,927	46	-107,242	-12.4
Subtotal		182,683	100	73,232	100	-109,451	
Domestic and International							
1	EUG	1,176,850	57	1,111,819	67	-65,031	10.0
2	PDX	876,024	43	539,958	33	-336,066	-10.0
Subtotal		2,052,874	100	1,651,777	100	-401,097	

Source: Mead & hunt 2021

² Eugene Airport Passenger Demand Analysis, Dec 31, 2021. Mead & Hunt. Pg 9.

6.3 FORECAST CONFIRMATION

An abbreviated 20-year enplanements forecast confirmation was generated using up-to-date aviation and socioeconomic data, airline schedules, input from the Airport’s air serviced consultant, as well as industry trends to better reflect the long-term outlook for commercial passenger growth at the Airport.

6.3.1 Enplanements Forecast

The last Airport Development Plan forecast projected Eugene Airport to increase its enplanements at 3.5 percent annually over the short-term from its base year total in 2015. In 2019, the Airport far exceeded this forecast, with over 590,000 enplanements³, or 15.3 percent.

Then in 2020, it decreased by 55.2 percent from its 2019 totals, due to the public health emergency. In 2021, Eugene Airport made a strong recovery with a 111.7 percent increase in its enplanements, leaving it only 5.1 percent less than its 2019 total. Further in 2022, Eugene Airport surged past its 2019 levels, with the most up-to-date enplanement data through September showing that it is tracking to reach a total of almost 780,000 enplanements by the end of CY 2022.

This forecast verification exercise explored traditional forecasting methodologies such as multiple variable regression analyses using socioeconomic data, as trend analyses, and the FAA Terminal Area Forecast (TAF) 2021⁴. Three forecasts were developed – a base case forecast, which the gating study was built on, and alternative high and low growth forecasts.

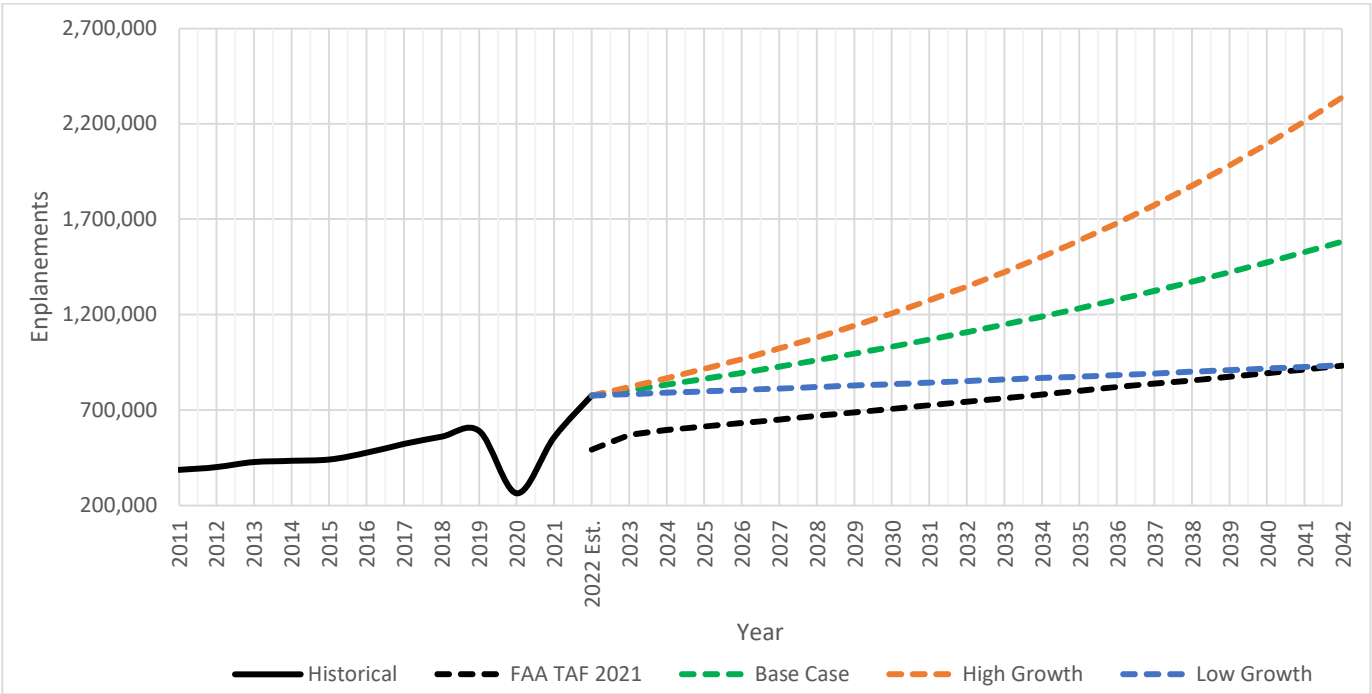
The FAA TAF 2021 showed growth for the Airport over the next 20 years with a 3.2 percent annual growth rate, but it did not anticipate their expected 2023 enplanement total would be reached by the Airport as early as 2019. Furthermore, the FAA TAF 2021 enplanement total for 2022 is 283,000 less than what it is actually tracking. The base case forecast uses the up-to-date enplanement totals for 2022 and assumes the historical annual growth rate from 2004-2019 at 3.6 percent over the forecast horizon reaching 1.58 million enplanements. This range of years selected omitted two years associated with the pandemic, because the Airport has already shown full recovery easily surpassing its 2019 totals.

The alternative high growth forecast assumes the Airport will continue to track with a more aggressive period of increase that existed from 2009-2019 at 5.7 percent, reaching 2.3 million enplanements by 2042. The alternative low growth scenario forecast was developed using the projected growth rate of Lane County population⁵ from 2022-2042, which produces a more conservative approach to the Airport’s recovery. The low growth forecast increases at an annual rate of 0.9 percent, reaching 930,000 enplanements in 2042.

Figure 6-2 and Table 6-2 compare the three enplanement forecasts with the FAA TAF 2021.

³ Source: Bureau of Transportation Statistics T-100 Market data.
⁴ FAA TAF 2021 was published in March 2022.

FIGURE 6-2
ENPLANEMENTS FORECAST



Note: The total enplanements for CY 2022 were estimated from October 2022-December 2022.
Source: RS&H, 2022; FAA TAF 2021

TABLE 6-2
ENPLANEMENTS FORECAST COMPARISON

Year	FAA TAF 2021	High Growth	Base Case	Low Growth
2022*	493,036	776,240	776,240	776,240
2027	650,860	1,022,723	927,635	813,181
2032	744,054	1,347,472	1,108,559	851,880
2037	838,497	1,775,341	1,324,769	892,421
2042	932,663	2,339,073	1,583,148	934,891
Annual Growth Rates				
2022-2027	5.7%	5.7%	3.6%	0.9%
2027-2032	2.7%	5.7%	3.6%	0.9%
2032-2042	2.3%	5.7%	3.6%	0.9%
2022-2042	3.2%	5.7%	3.6%	0.9%

Note: 1- The FAA TAF uses fiscal year October – September.

⁵ Lane County was used as the immediate Airport Service Area for the purposes of socioeconomic analyses. Wood & Poole, Inc, 2021 was used for the analyses.



6.3.2 FAA TAF Comparison

A key consideration in the development of aviation forecasts is comparison of the forecast with the FAA TAF. The TAF is the official forecast for active airports in the National Plan of Integrated Airport Systems (NPIAS) and is prepared to meet budget and planning needs of the FAA.

In an Airport Development Planning (formerly Master Planning) process, FAA Order 5050.4B, National Environmental Policy Act (NEPA) Implementing Instructions for Airport Actions, paragraph 706.b(3) notes “the sponsor’s 5-year forecast should be within 10 percent of the TAF, and a 10-year forecast should be within 15 percent of the TAF.” For the purposes of this Advanced Terminal Study, it is recognized that the actual passenger numbers and current trends in commercial service provide more relevant data points.

Table 6-3 shows that the base case forecast exceeds the FAA TAF 2021 for the five-year (2027) and ten-year (2032) forecast horizons due to the notable difference in the FAA TAF’s estimation for 2022 versus where it is tracking to actually end. Overall, the annual growth rate is consistent to the TAF, but because of the difference in 2022 it exceeds it by 43 percent at Base Year +5 and 49 percent at Base Year +10 respectively. If the TAF was adjusted to where the Airport is tracking for 2022 and increased at its annual growth rate over the twenty years (as shown in the right side of Table 6-3), the base case forecast would meet the FAA TAF 10 percent and 15 percent thresholds.

TABLE 6-3
FAA TAF COMPARISON

Year	FAA TAF 2021	Base Case Forecast	Difference	Adjusted TAF	Base Case Forecast	Difference
Base Year +5	650,860	927,635	43%	910,348	927,635	1.9%
Base Year +10	744,054	1,108,559	49%	1,067,626	1,108,559	3.8%

Source: RS&H, 2022; FAA TAF 2021

6.3.3 Design Day Flight Schedule

An analysis of historical enplanements from 2015-2019 showed that July averaged the greatest share of any month for passengers throughout the year. The flight schedule from a day in July 2022 was used to prepare a base year design day flight schedule (DDFS). The schedule preparation included pertinent details such as marketing and operating airlines, equipment, seat counts, and load factors. These considerations and inputs were applied to the schedule to generate an annual total of enplaned passengers reflective of the historical 2022 total.

To prepare each forecast year DDFS, various modifications to the schedule were made including increases to load factors⁶, up-gauging of aging aircraft, increased frequencies, and new markets. Specific details of newly added flights were based on input from meetings with the Airport, the Airport’s air service consultant and their working knowledge of potential plans by the airlines.

These assumptions are based on the DDFS of the base year, or July 2022 and the original DDFS is a snapshot of an average day on the busiest month for passenger traffic during that year. Because some flights may not have been daily or differed slightly on that particular day, it is possible that some frequencies and markets may also differ from

⁶ Based on the projections made in the FAA Aerospace Forecast FY 2022-2042,

other schedules in 2022. In 2022, operations were nearly balanced between regional jets⁷ (50 percent) and narrowbodies (50 percent).

Base Year +5

In the base year +5 (2027 forecast) the DDFS follows the FAA Aerospace Forecast projection for load factors increasing it up to 81.8 percent. It is assumed all Bombardier Q400 (DH4) would be retired and up-gauged to Embraer ERJ 175 (E75) regional jets which have the same seat count. One Embraer ERJ 175 (E7W) was also up-gauged to an Airbus 220-100 (221). Four new flights were added to the schedule, increasing the daily total to 34 daily departures and 13 different destinations.

- Denver International Airport (DEN) on a 737-700 (73W).
- Hollywood Burbank Airport (BUR) on a 737-800 (738). This flight already, existed but was bi-weekly and not previously included on this DDFS.
- Hollywood Burbank Airport on a Boeing 737 MAX 8 (7M8), resulting in a second BUR frequency for EUG.
- Phoenix Sky Harbor International Airport (PHX) on a Bombardier CRJ-900 (CR9) resulting in a second daily PHX frequency.

Base Year +10

In the base year +10 (2032 forecast) the DDFS increases the load factor to 82.3 percent. In this forecast period, it is assumed that five Airbus 319 (319) aircraft will be up-gauged to Boeing 737-900ER (739) aircraft. Four new flights were added to the schedule, increasing the daily total to 38 daily departures and 14 different destinations.

- Dallas-Fort Worth International Airport (DFW) on a Boeing 737-800, giving the Airport a second daily DFW frequencies on the DDFS.
- Los Angeles International Airport (LAX) on an E7W, giving the Airport a total of four LAX frequencies on the DDFS.
- Boise Airport (BOI) on an E75, giving the Airport its first frequency to BOI.
- Chicago O'Hare International Airport (ORD) on a 7M8, giving EUG its second daily frequency.

Base Year +15

In the base year +15 (2037 forecast) the DDFS increases the load factor to 82.9 percent. In this forecast period, all remaining 73W are up-gauged to 7M8. Additionally, one E75 and one 73H are up-gauged to Boeing 737 MAX 9 (7M9) aircraft. Four new flights were added to the schedule, increasing the daily total to 42 daily departures and 16 different destinations.

- Sacramento International Airport (SMF) on a 7M8, giving EUG its first frequency on the DDFS.
- Phoenix Sky Harbor International Airport (PHX) on a 7M8, resulting in a third frequency by an existing airline.
- San Diego International Airport (SAN) on an 7M9, giving EUG its first SAN frequency on the DDFS.
- Salt Lake City International Airport (SLC) on an A221, giving EUG its fourth daily frequency.

⁷ The regional jets grouping in this study also includes the Bombardier Q400 (DH4)

Base Year +20

In the base year +20 (2042 forecast) the DDFS increases the load factor to 83.4 percent. In this forecast period, two E75 aircraft are up-gauged to 7M9, and two E7W aircraft are up-gauged to 221. Five new flights were added to the schedule, increasing the daily total to 47 daily departures and 17 different destinations.

- Minneapolis-St Paul International Airport (MSP) on a 221, providing the first daily frequency to MSP.
- A second MSP frequency, provided by a different airline on a 738, increasing the Airport's daily frequency to two.
- A second SAN frequency, provided by a different airline, on a 7M8, increasing the Airport's daily frequency to two.
- San Francisco International Airport (SFO) on a 739, increasing the Airport's daily frequency to SFO to four.
- Denver International Airport (DEN) on a 7M8, increasing the Airport's daily frequency to five between two airlines.

Based on the 2042 DDFS, the Airport's operations would shift from an even 50-50 split in 2022, to narrowbodies becoming more common at 74 percent compared to regional jets at 26 percent.

Attachment A

CHAPTER 7

PEAK PERIOD ANALYSIS

7.1 PASSENGER FLOW SIMULATION

The CAST Terminal simulation model suite was used to determine the peak period passenger flows and aircraft gating demands on the terminal. CAST Terminal is a simulation modeling software used to evaluate terminal building operations. The analysis incorporated the design day flight schedules for the 2022, 2027, 2032, 2037, and 2042 demand levels as defined in the previous section.

7.1.1 Peak Period Counts

The peak period counts for passenger flows and aircraft operations were completed for 20-minute, 30-minute, and 60-minute rolling peaks.

The peak period passenger count analysis included a departing passenger reporting profile that was assumed to represent the passenger behavior on an average day at EUG. The reporting profile assumed that the first passenger of a particular departing flight would enter the terminal building two hours prior to the scheduled departure time and the last passenger would enter the terminal building 45 minutes prior to the scheduled departure time.

For arriving passengers, the analysis assumed the first passenger would disembark the aircraft three minutes after the scheduled block time to represent the delay associated with passenger boarding bridge maneuvering and aircraft door opening. The passenger deplane rate was set at 16 passengers per minute.

The departing passenger count represents the number of enplaning passengers entering the terminal building from the landside and the arriving passenger count represents the number of deplaning passengers entering the terminal building from arriving aircraft. The total passenger count represents the greatest combined sum of departing and arriving passengers entering the building throughout the day.

The peak period passenger flow analysis results are summarized in Table 7-1. The results show that the departing and arriving passenger counts increase throughout the planning period. The rolling 60-minute passenger counts throughout the day are depicted in Figure 7-1, Figure 7-2, Figure 7-3, Figure 7-4, and Figure 7-5. The charts show that the rolling 60-minute peak periods for departing and arriving passenger counts occurs around the same time period (midmorning) during the 2022, 2027, and 2032 design days.

TABLE 7-1
PEAK PERIOD PASSENGER COUNTS

	2022	2027	2032	2037	2042
Departing Passenger Count					
Peak 20-Min	168	160	186	258	318
Peak 30-Min	238	235	275	379	476
Peak 60-Min	416	463	535	714	867
Arriving Passenger Count					
Peak 20-Min	357	357	404	462	462
Peak 30-Min	384	384	427	570	570
Peak 60-Min	443	443	546	704	900
Total Passenger Count					
Peak 20-Min	361	401	463	518	552
Peak 30-Min	429	465	543	607	747
Peak 60-Min	669	715	824	922	1201

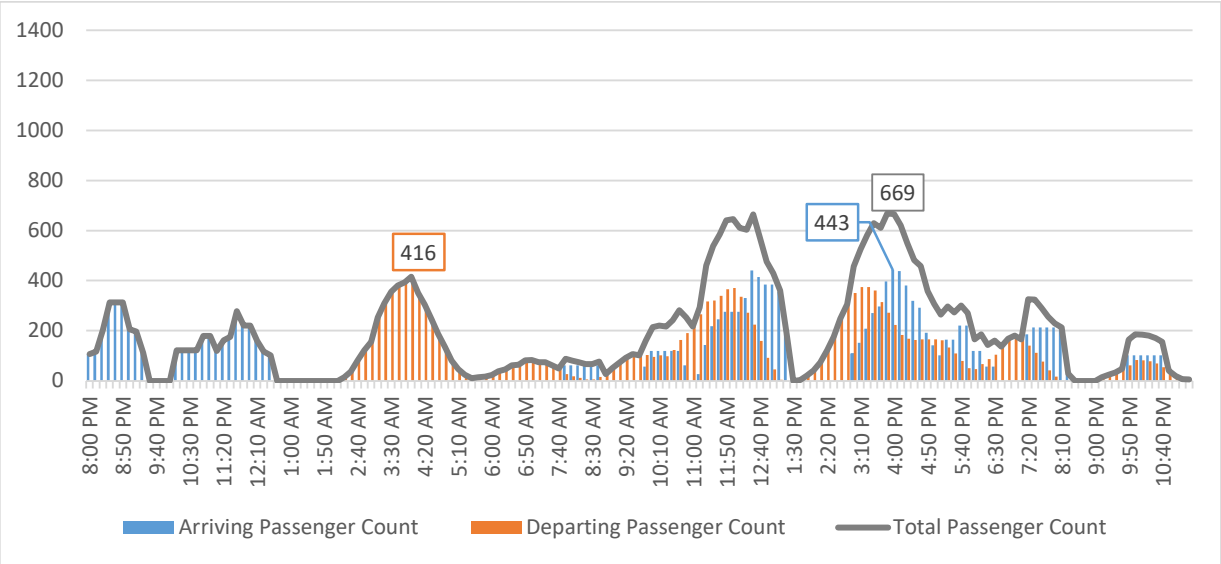


FIGURE 7-1
ROLLING 60-MINUTE PASSENGER FLOW – 2022

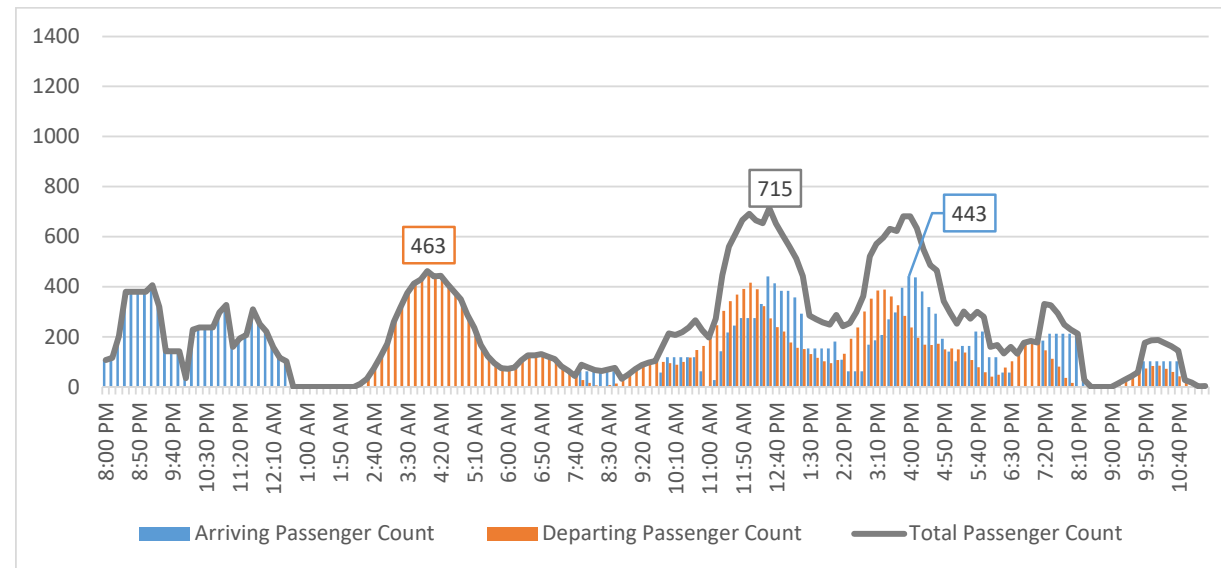


FIGURE 7-2
ROLLING 60-MINUTE PASSENGER FLOW – 2027

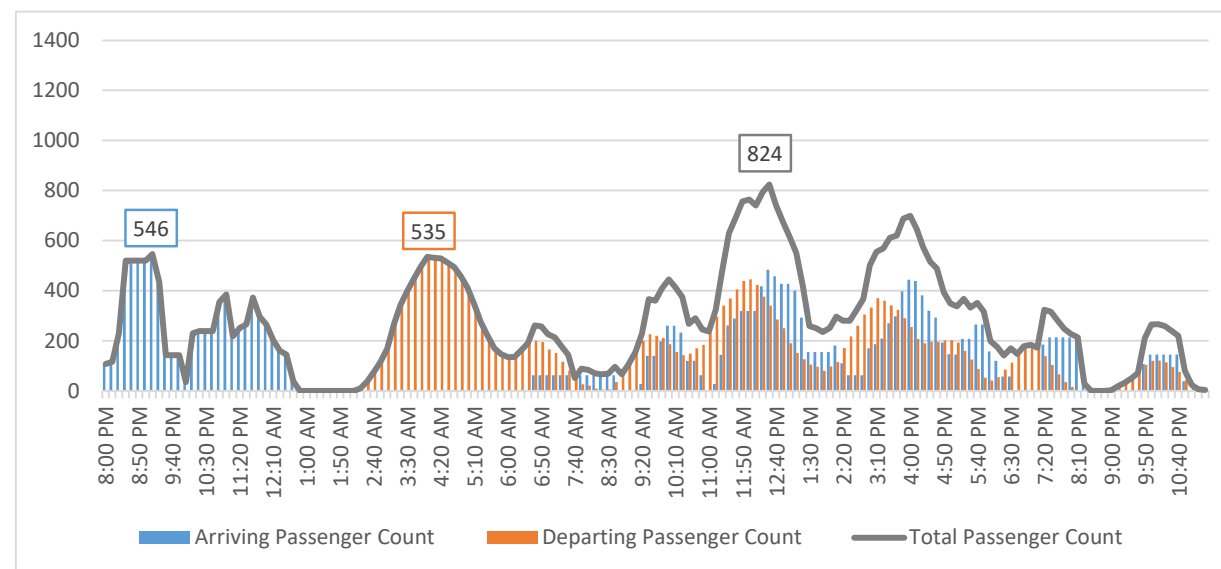


FIGURE 7-3
ROLLING 60-MINUTE PASSENGER FLOW – 2032

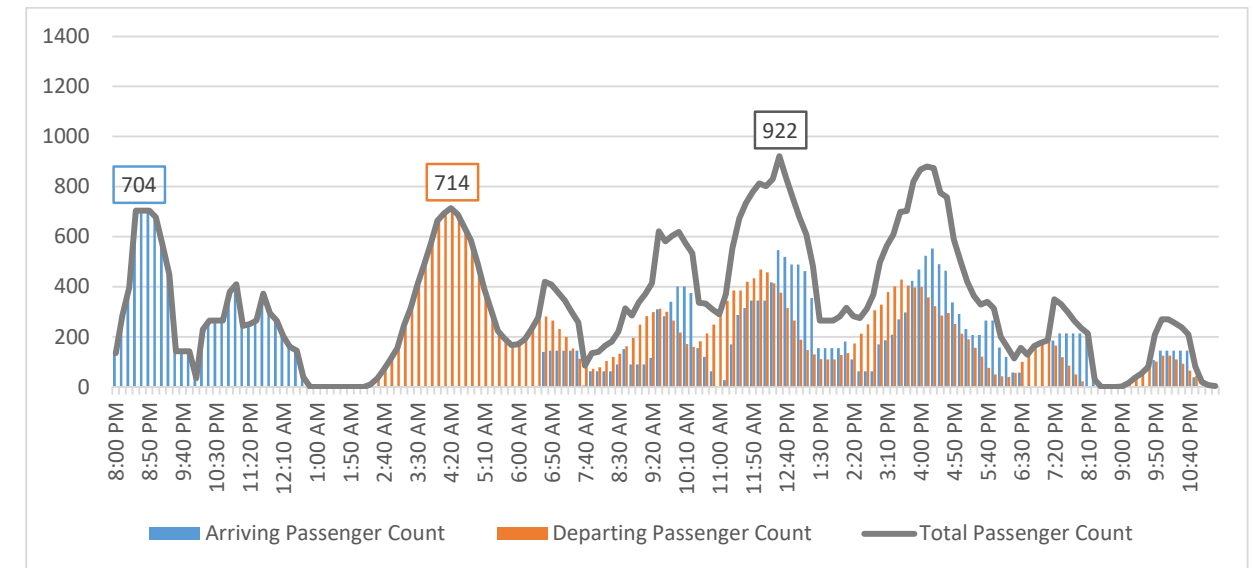


FIGURE 7-4
ROLLING 60-MINUTE PASSENGER FLOW – 2037

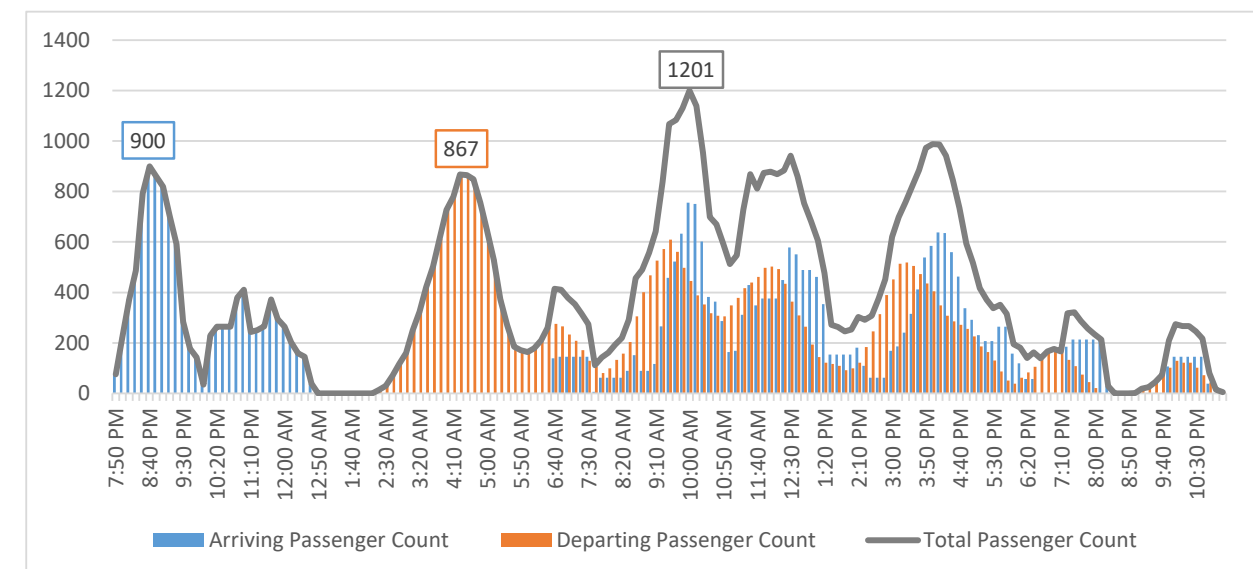


FIGURE 7-5
ROLLING 60-MINUTE PASSENGER FLOW – 2042

7.1.2 Aircraft Gate Allocation

The aircraft gate allocation analysis evaluated a gating scenario of how flights can be allocated to the available gates based on the design day flight schedules for 2022, 2027, 2032, 2037, and 2042.

The analysis methodology assumes that Gate B-North is not available for aircraft parking when Concourse C construction begins (expected to begin in 2027). The analysis also assumes that Gate B1, Gate B2, and Gate B3 are size restricted to the Embraer 175 aircraft (and smaller) and are not fully utilized. Airlines are averse to using these Gates since they require passenger ground loading which results in a lower passenger level of service compared to gates equipped with passenger boarding bridges. The analysis considered a 15-minute buffer time between all flights to be

sufficient and that aircraft would remain overnight at the gate, as applicable. Though not used for passenger loading and unloading, there are three existing remain overnight (RON) aircraft parking positions located near the terminal. These are remote aircraft parking positions used to park aircraft that cannot be accommodated at the terminal. Historically, these RON positions are occupied during the overnight time period. Per input from Airport staff, it is anticipated that two out of the three RON positions will be occupied three days per week and all three RON positions will be occupied four days per week in 2023.

The design day gating scenario assumed that all gates were preferentially assigned to airlines but available for use by other airlines as necessary. The design day gating scenario analysis results are described in Table 7-2 and depicted in Figure 7-6, Figure 7-7, Figure 7-8, Figure 7-9, and Figure 7-10. Figure 7-6 also illustrates the three existing RON

positions in use in 2022. While not illustrated in Figure 7-7, Figure 7-8, Figure 7-9, and Figure 7-10, a varying number of RON positions will remain into the future to accommodate overflow aircraft parking from the terminal building as well as irregular operations (e.g., weather delayed aircraft or aircraft grounded due to unscheduled maintenance).

The analysis results show that the peak period for aircraft parking demand occurs overnight during the design day in each forecast year. The analysis results show that the overnight demand can be accommodated with the existing gates in the 2022 design day. Three new gates are recommended to accommodate the near-term (2027) overnight design day demand, assuming that the industry-wide pilot shortage is resolved in the next few years. The near-term recommended gate count reflects the need for two gates to accommodate the forecast scheduled demand on the average day plus one new gate recommended to accommodate peak day and/or irregular operations, such as flight diversions. Five new gates are recommended for the mid-term (2032) overnight design day demand – similarly composed of four gates for forecast scheduled demand on average day plus one new gate recommended to accommodate peak day and/or irregular operations. **Eight new gates are recommended for the long-term (2042) overnight design day demand** – similarly composed of seven gates for forecast scheduled demand on average day plus one new gate recommended to accommodate peak day and/or irregular operations

TABLE 7-2
PEAK PERIOD GATE UTILIZATION

	2022	2027	2032	2037	2042
Peak Period Occupied Gate Count	8	10	12	13	15
Recommended New Gate Count (Concourse C)	-	3	5	6	8

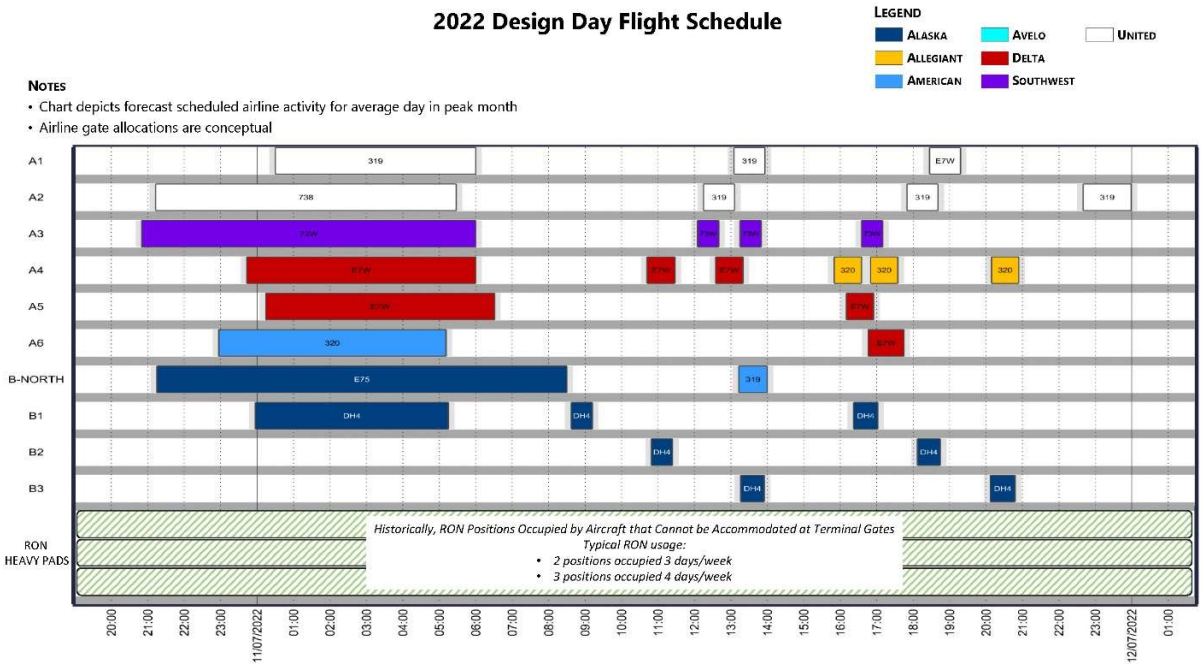


FIGURE 7-6
2022 DESIGN DAY GATING SCENARIO

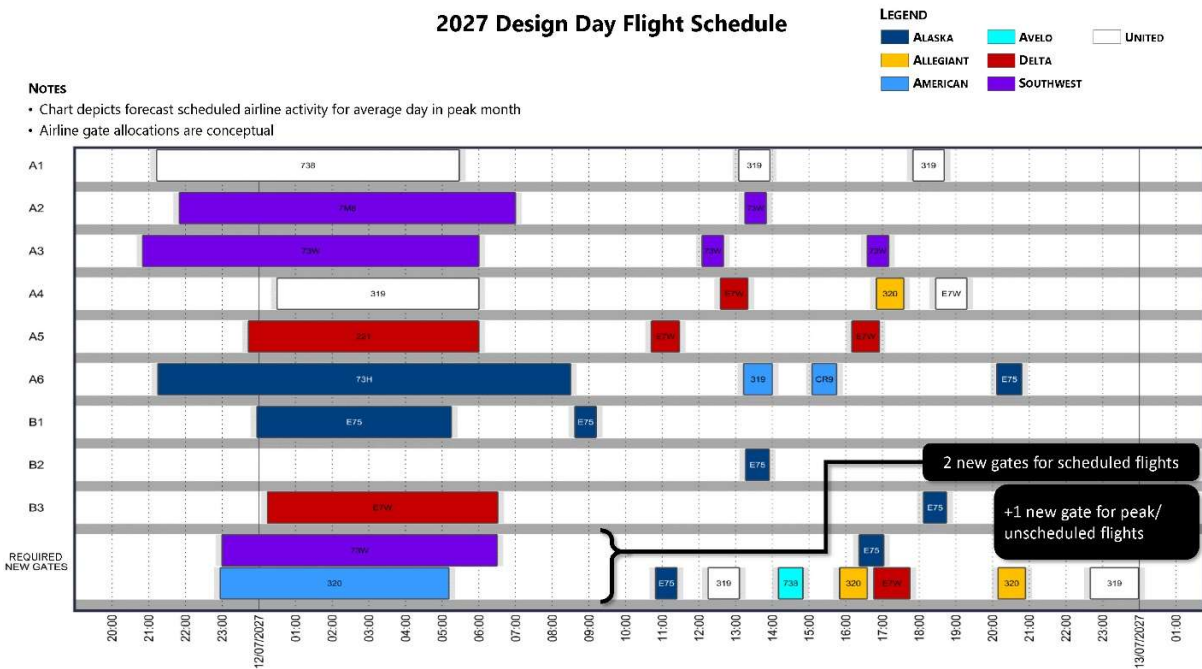


FIGURE 7-7
2027 DESIGN DAY GATING SCENARIO

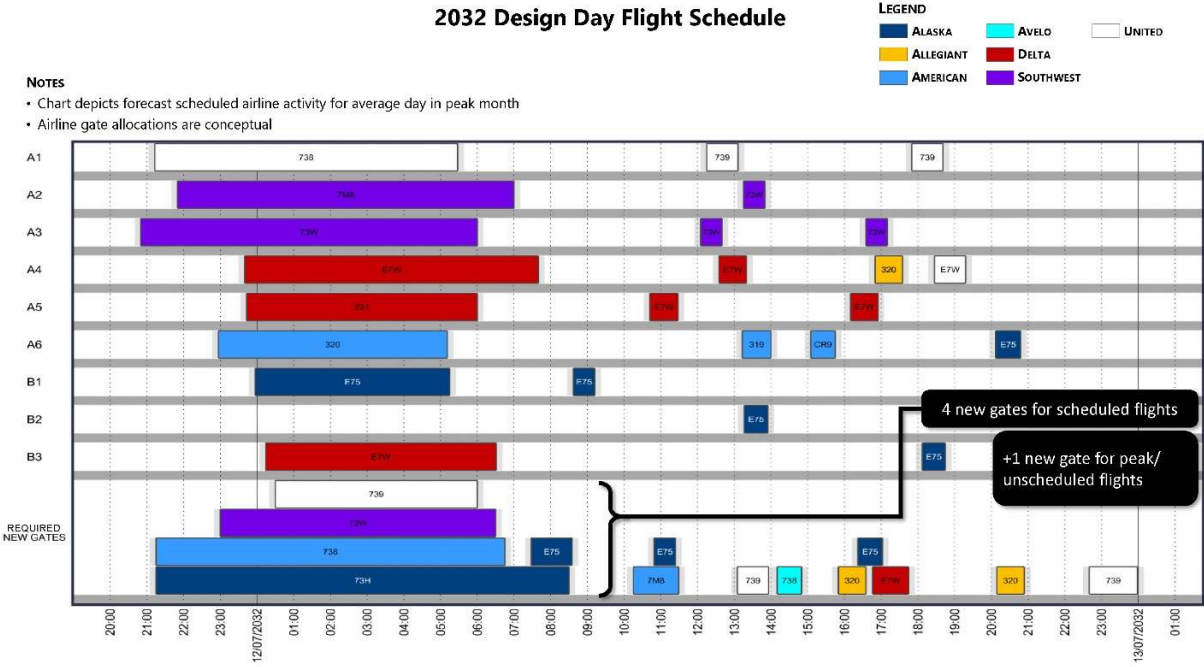


FIGURE 7-8
2032 DESIGN DAY GATING SCENARIO

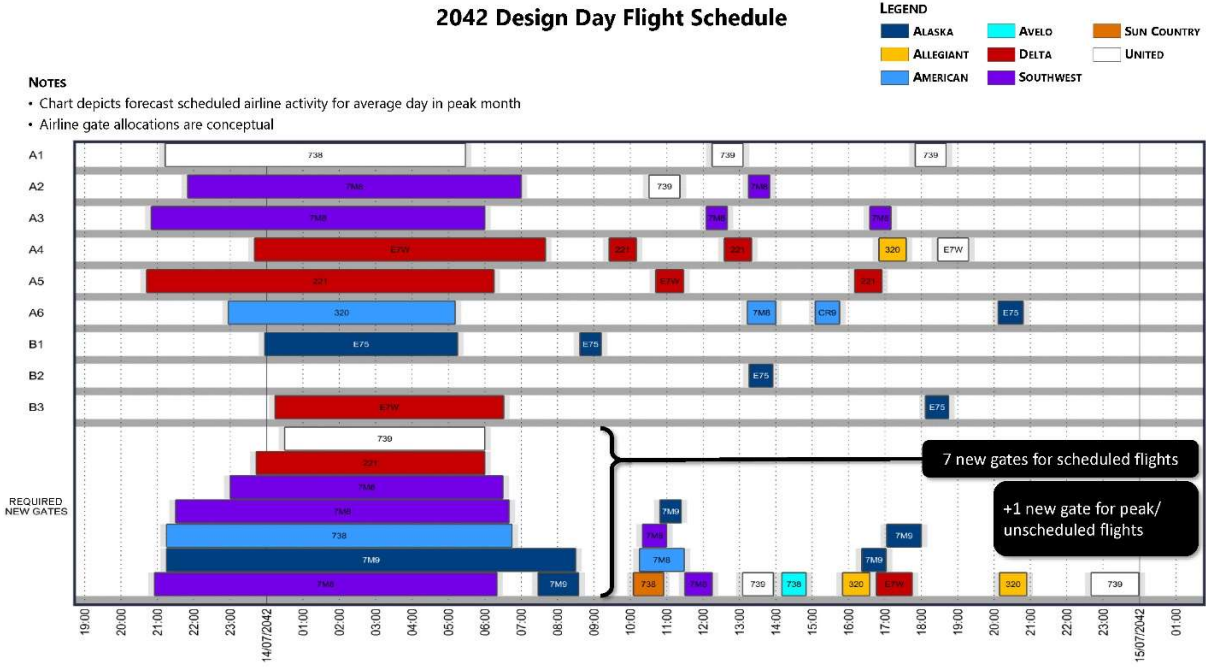


FIGURE 7-10
2042 DESIGN DAY GATING SCENARIO

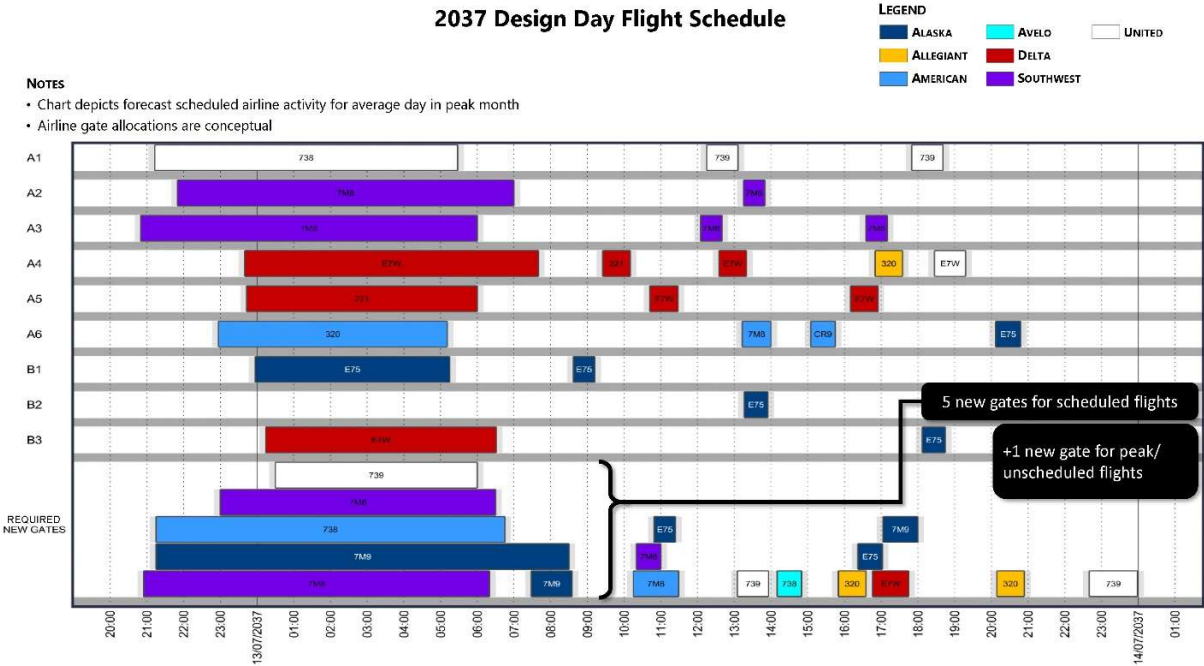


FIGURE 7-9
2037 DESIGN DAY GATING SCENARIO

Attachment A

CHAPTER 8

TERMINAL AREA PROGRAM REQUIREMENTS

8.1 PASSENGER TERMINAL AND LANDSIDE FACILITIES

Industry guidelines and professional experience were used to assess the existing capacity and future requirements for the functional areas of the terminal focused on in this report, corresponding with proposed annual enplanement growth in the planning periods.

The terminal building was separated into functional areas that delineate types of space to align with the areas of expansion recommended herein. For the planning periods, the projected enplanement activity levels were used to determine the amount of space required to accommodate operations. Existing conditions were then compared to the projected requirements.

The components of the terminal facility that were assessed are listed below.

- » **Airline Space:** The areas of the terminal used for ticketing/check-in, active, and queuing spaces, as well as airline ticketing offices.
- » **Baggage Service:** The areas of the terminal used to handle inbound and outbound baggage, including facilities necessary to perform baggage sorting, offloading, and retrieval.
- » **Holdrooms:** The areas of the terminal where passengers wait to board an aircraft, including airline customer service counters, boarding queues, and other amenities.

The following sections will focus on each functional area and identify the appropriate program area requirements based on current planning practices, a projected domestic flight schedule, and observed conditions.

8.1.1 Methods and Assumptions

The terminal building programmatic requirements were estimated based upon airport terminal planning best practices and recommended methodologies which can be credited to various industry resources.

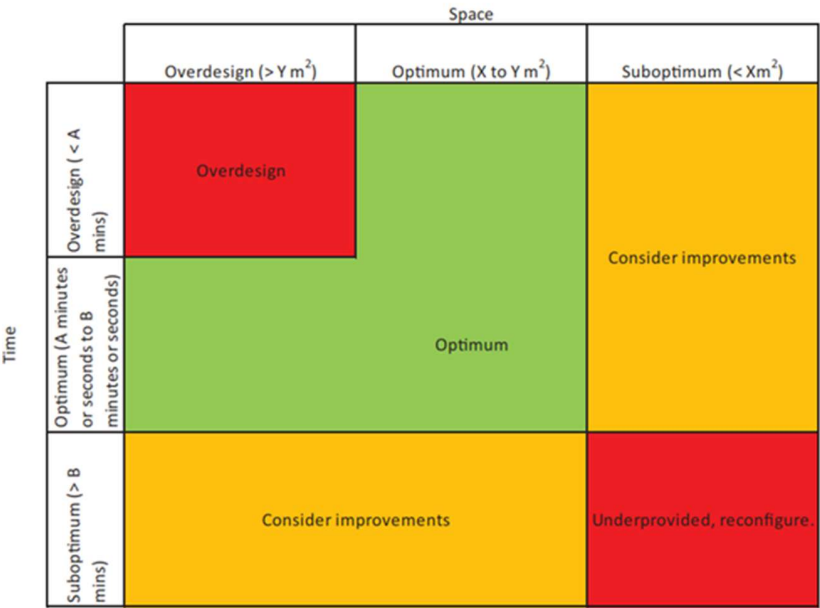
- » Airport Passenger Terminal Planning and Design – Airport Cooperative Research Program Report 25, 2010, Volumes 1 and 2
- » IATA Airport Development Reference Manual, 11th Edition, 2019
- » Federal Aviation Administration (FAA) Advisory Circular, AC No: 150/5360-13, Planning and Design Guidelines for Airport Terminal Facilities 1988

The flight schedules used for this analysis are referenced in Section 6.3.3 of the forecasting chapter.

According to IATA guidelines, level of service (LOS) of many terminal facilities is directed by space (queuing) and time (waiting). Table 8-1 shows IATA’s LOS space-time diagram, with the X-axis defining the amount of space available per occupant, and the Y-axis representing the wait time for passengers in queue. The goal is to offer an acceptable LOS by targeting values in the “optimum” range.

Table 8-3 shows IATA’s LOS standards for each of the passenger terminal functional areas focused on as part of this study. Due to the initial space guidelines data being presented in square meters, the figures shown in the table are converted to square feet and rounded. The actual calculations were conducted using the non-rounded figures. The data presented by IATA indicates a range for optimum design, therefore, the figures used for the calculations are indicated with a red square.

TABLE 8-1
IATA LEVEL OF SERVICE (LOS) SPACE/TIME DIAGRAM



Future terminal requirements are mostly determined by identifying the number of peak-hour passengers projected to flow through the terminal. Passenger activity is not evenly distributed during the peak hour, but usually follows a distribution curve. The flight schedule is used to determine the peak hour in which the most passengers would be at any specific processor based on the distribution. Table 8-2 provides a summary of passenger and flight activity for the Planning Activity Level (PAL)s, which are the benchmark periods in the project where this data is used to determine facility requirements. The PAL benchmark periods, which are specifically used for building planning activities, also correspond with the milestone forecast years indicated in the previous chapter.

TABLE 8-2
PASSENGER ENPLANEMENT/DEPLANEMENT DATA

PASSENGER TERMINAL PROGRAM	Existing	Baseline Forecast				Surplus/(Deficit)				
	2022	PAL 1 2027	PAL 2 2032	PAL 3 2037	PAL 4 2042	Existing 2022	PAL 1 2027	PAL 2 2032	PAL 3 2037	PAL 4 2042
Commercial Traffic										
Annual Enplaned Passengers	776,240	927,635	1,108,559	1,324,769	1,583,148	0	(151,395)	(332,319)	(548,529)	(806,908)
Total Peak Hour Enplaned	416	463	535	714	867	0	(47)	(119)	(298)	(451)
Total Peak Hour Deplaned	443	443	546	704	900	0	0	(103)	(261)	(457)
Total Peak Hour Combined	669	715	824	922	1,201	0	(46)	(155)	(253)	(532)

Source: RS&H Analysis, 2022



These numbers are calculated with both O&D (origin and destination), and connecting passengers, but due to the nature of traffic at EUG, it is assumed that there are no connections and all passengers either begin or end their journey at this airport.

TABLE 8-3
IATA LEVEL OF SERVICE SPACE AND TIME GUIDELINES

LOS Guidelines		SPACE GUIDELINES [sf/PAX]			MAXIMUM WAITING TIME GUIDELINES Economy Class [minutes]			MAXIMUM WAITING TIME GUIDELINES Business Class /First Class/Fast Track [minutes]			OTHER GUIDELINES & REMARKS		
		Over-Design	Optimum	Sub-Optimum	Over-Design	Optimum	Sub-Optimum	Over-Design	Optimum	Sub-Optimum	Over-Design	Optimum	Sub-Optimum
Public Departure Hall (well-wishers)		> 25.0	22.0 - 25.0	< 22.0	n/a			n/a			Optimum proportion of seated occupants: 15 - 20% *		
Check-in	Self-Service Kiosk (Boarding Pass/Bag Tagging)	> 19.0	14.0 - 19.0	< 14.0	< 1.0	1.0 - 2.0	> 2.0	< 1.0	1.0 - 2.0	> 2.0	(queue width: 1.4m – 1.6m)		
	Bag Drop (queue width: 1.4m - 1.6m)	> 19.0	14.0 - 19.0	< 14.0	< 1.0	1.0 - 5.0	> 5.0	< 1.0	1.0 - 3.0	> 3.0			
	Check-in Desk (queue width: 1.4m - 1.6m)	> 19.0	14.0 - 19.0	< 14.0	< 10.0	10.0 - 20.0	> 20.0	< 3.0	Business Class 3.0 - 5.0	> 5.0			
								< 1.0	First Class 1.0 - 3.0	> 3.0			
Security Control (queue with: 3.5- to 4.0-feet)		> 13.0	11.0 - 13.0	< 11.0	< 5.0	5.0 - 10.0	> 10.0	< 1.0	Fast Track 1.0 - 3.0	> 3.0			
Immigration Control - Outbound Passport Control (queue width: 3.5- to 4.0-feet)	Staffed Desk	> 13.0	11.0 - 13.0	< 11.0	< 5.0	5.0 - 10.0	> 10.0	< 1.0	Fast Track 1.0 - 3.0	> 3.0	Optimum proportion of seated occupants: 50 - 70% * Maximum Occupancy Rate < 60.0% 60.0% - 70.0% > 70.0%		
	Automatic Border Control	> 13.0	11.0 - 13.0	< 11.0	< 1.0	1.0 - 5.0	> 5.0	n/a					
Gate Holdrooms/ Departure Lounges	Seating	> 24.0	19.0 - 24.0	< 19.0	n/a			n/a					
	Standing	> 16.0	13.0 - 16.0	< 13.0									
Immigration Control - Inbound Passport Control (queue with: 3.5- to 4.0-feet)	Staffed Desk	> 13.0	11.0 - 13.0	< 11.0	< 5.0	5.0 - 10.0	> 10.0	< 1.0	Fast Track 1.0 - 5.0	> 5.0			
	Automatic Border Control	> 13.0	11.0 - 13.0	< 11.0	< 1.0	1.0 - 5.0	> 5.0	n/a					
Baggage Claim	Narrowbody Aircraft	> 18.0	16.0 - 18.0	< 16.0	< 0.0	0.0 / 15.0	> 15.0	< 0.0	0.0 / 15.0	> 15.0	The first waiting time relates to "first passenger to first bag". The second waiting time relates to "last bag on belt" (counting from first bag delivery)**		
	Widebody Aircraft	> 18.0	16.0 - 18.0	< 16.0	< 0.0	0.0 / 25.0	> 25.0						
Customs Control		> 19.0	14.0 - 19.0	< 14.0	< 1.0	1.0 - 5.0	> 5.0	< 1.0	1.0 - 5.0	> 5.0	Waiting times refer to a procedure when 100% of the passengers are being checked by Customs		
Public Arrivals Hall (meeters-greeters)		> 25.0	22.0 - 25.0	< 22.0	n/a			n/a			Optimum proportion of seated occupants: 15 - 20% *		

SOURCE: IATA ADRM

8.1.2 Terminal Building Sizing and Programming

The passenger terminal program summary in Table 8-4 shows all the focus elements of the program described in this chapter. The program required for PAL 1-4 will need expansion beyond the existing facility. Further analyses in this chapter will show that certain program functions will need additional space, while others may be oversized.

8.1.2.1 Airline Space

The ticketing area counter analysis is based on the peak-hour passenger demand derived from the flight schedules and statistical demand distribution curves. The analysis provides a total program area for the airport to organize with the various airlines utilizing the ticketing area. Table 8-5 shows the assumptions used to calculate the various airline space program elements associated with the ticketing/check-in process.

Table 8-6 breaks down the specific elements of the airline space including back-of-house airline ticket offices (ATOs). The analysis shows that the current area allocated to ticketing/check-in functions is not large enough in any of the PALs to accommodate the demand from increased passenger traffic, and additional space will be required. The figures shown below incorporate area for self-service kiosks and bag-drop positions.

TABLE 8-4
TERMINAL BUILDING REQUIREMENTS

PASSENGER TERMINAL PROGRAM	Existing	Baseline Forecast				Surplus/(Deficit)				
	2022	PAL 1 2027	PAL 2 2032	PAL 3 2037	PAL 4 2042	Existing 2022	PAL 1 2027	PAL 2 2032	PAL 3 2037	PAL 4 2042
Airline Space	7,558	11,683	13,615	18,808	23,367	(4,125)	(4,125)	(6,057)	(11,250)	(15,809)
Baggage Service Space	12,287	40,764	42,889	47,784	50,084	(21,002)	(28,477)	(30,602)	(35,497)	(37,797)
Gate Holdroom Space	13,755	26,486	31,779	34,425	39,728	(9,266)	(12,731)	(18,024)	(20,670)	(25,973)

Source: RS&H Analysis, 2022
Note: All Figures Shown in Square Feet (sf) Unless Otherwise Noted

TABLE 8-5
AIRLINE SPACE KEY ASSUMPTIONS

Assumption Elements	Units	Value
Originating Passengers	%	100
Passengers Using Check-In Facility	%	50
Typical Transaction Time	Minutes	3
Maximum Wait Time in Queue	Minutes	15
Check-In Counter Width	Feet	5.5

Source: ACRP/IATA

TABLE 8-6
AIRLINE SPACE REQUIREMENTS

AIRLINE SPACE	Existing	Baseline Forecast				Surplus/(Deficit)				
	2022	PAL 1 2027	PAL 2 2032	PAL 3 2037	PAL 4 2042	Existing 2022	PAL 1 2027	PAL 2 2032	PAL 3 2037	PAL 4 2042
Ticket Counter Length (lf)	148	270	315	433	540	(122)	(122)	(167)	(285)	(392)
Ticket Counter Area	1,630	2,196	2,562	3,532	4,392	(566)	(566)	(932)	(1,902)	(2,762)
Ticket Counter Active Area	1,630	1,980	2,310	3,190	3,960	(350)	(350)	(680)	(1,560)	(2,330)
Ticket Counter Queuing	1,779	2,557	2,968	4,111	5,115	(778)	(778)	(1,189)	(2,332)	(3,336)
Ticket Office and Administration	2,519	4,950	5,775	7,975	9,900	(2,431)	(2,431)	(3,256)	(5,456)	(7,381)
TOTAL AIRLINE SPACE	7,558	11,683	13,615	18,808	23,367	(4,125)	(4,125)	(6,057)	(11,250)	(15,809)

Source: RS&H Analysis, 2022
Note: All Figures Shown in Square Feet (sf) Unless Otherwise Noted

8.1.2.2 Baggage Service

All departing passengers with checked baggage begin at the ticketing counters where their bags are tagged and placed on conveyor belts operating behind the counters. This system moves the baggage to the separate TSA screening rooms, through the screening device, and out to the outbound baggage areas where the bags are loaded on the appropriate carts and taken to the aircraft.

Arriving bags are taken off the aircraft, placed on carts, and taken to the inbound baggage device, which consists of two conveyor belts which take the baggage to their respective baggage claim carousels. The carousels are adjacent to the car rental counters at the southwest part of the landside terminal. Table 8-7 shows the key assumptions used to calculate the required areas for baggage service.

Table 8-8 breaks down the specific elements of the baggage service space. The analysis shows that all elements of baggage service are undersized. Included in the chart is carousel length in linear feet (lf) which helps determine the sizing of additional claim devices.

TABLE 8-7
BAGGAGE SERVICE KEY ASSUMPTIONS

Assumption Elements	Units	Value
Checked Bags per Passengers	Bags	0.7
Bags per Cart/Container	Bags	50
Baggage Make-Up/Offloading Area per Cart	Square Feet	500
Bag Claim Device Frontage per Person	Linear Feet	1.5
Bag Claim Device Plate Depth (Sloped Plate)	Linear Feet	18
Bag Claim Active Passenger Access Depth	Linear Feet	15

Source: ACRP/IATA

TABLE 8-8
BAGGAGE SERVICE REQUIREMENTS

BAGGAGE SERVICE	Existing	Baseline Forecast				Surplus/(Deficit)				
	2022	PAL 1 2027	PAL 2 2032	PAL 3 2037	PAL 4 2042	Existing 2022	PAL 1 2027	PAL 2 2032	PAL 3 2037	PAL 4 2042
Baggage Claim Carousel Length	290	419	474	542	542	(129)	(129)	(184)	(252)	(252)
Baggage Claim Carousel Area	8,138	11,209	12,694	14,509	14,509	(3,071)	(3,071)	(4,556)	(6,371)	(6,371)
Inbound Baggage Service Area	1,434	4,830	5,470	6,250	6,250	(3,396)	(3,396)	(4,036)	(4,816)	(4,816)
Outbound Baggage Area	2,715	24,725	24,725	27,025	29,325	(14,535)	(22,010)	(22,010)	(24,310)	(26,610)
TOTAL BAGGAGE SERVICE SPACE	12,287	40,764	42,889	47,784	50,084	(21,002)	(28,477)	(30,602)	(35,497)	(37,797)

Source: RS&H Analysis, 2022

Note: All Figures Shown in Square Feet (sf) Unless Otherwise Noted

8.1.2.3 Holdrooms

Holdrooms are required for each gate and are determined by the aircraft seating capacity, flight load factor, and planned ratio of seated to standing passengers. Additional calculations include a percentage of passengers that are away from the gate, spending time elsewhere, such as in restaurants, shops, or wandering the terminal. Holdrooms typically include a gate counter with two positions, associated queue space for boarding, and circulation for enplaning/deplaning passengers. A reduction factor is included for combined holdrooms based on the separation of departure times for each flight. Table 8-9 shows the key assumptions used for the holdrooms.

The peak holdroom demand is calculated by the largest aircraft planned to use each gate served by the space. Table 8-10 shows the holdroom requirements over the planning periods. Concourse A shows the need for expansion to better meet the LOS standards for its six gates. As shown below, the space needs to be doubled to accommodate the design aircraft. Concourse B shows a surplus as it currently serves four gates, while the future PALs only require serving one gate as Concourse C construction will decommission the regional aircraft stands and eliminate gate B-North. The remaining 3 ground load positions will be able to serve RJ aircraft only. Concourse C is the proposed new concourse which begins with three gates in PAL 1 and expands to eight gates in PAL 4.

TABLE 8-9
HOLDROOMS KEY ASSUMPTIONS

Assumption Element	Units	Value
Design Aircraft – A and C Concourses	Aircraft Type	Boeing 737 MAX 9
Aircraft Seating Capacity – A and C Concourses	Seats	179
Design Aircraft – B Concourse	Aircraft Type	Embraer 175
Aircraft Seating Capacity – B Concourse	Seats	76
Load Factor	%	90
Passengers Away from Gate	%	30
Seated Passengers	%	70
Seated Passenger Area	Square Feet/Passenger	19.4
Standing Passengers	%	30
Standing Passenger Area	Square Feet/Passenger	12.9
Reduction Factor for Combined Holdrooms	%	5

Source: ACRP, RS&H

TABLE 8-10
HOLDROOMS REQUIREMENTS

GATE HOLDROOMS	Existing	Baseline Forecast				Surplus/(Deficit)				
	2022	PAL 1 2027	PAL 2 2032	PAL 3 2037	PAL 4 2042	Existing 2022	PAL 1 2027	PAL 2 2032	PAL 3 2037	PAL 4 2042
Concourse A Holdrooms	7,756	15,889	15,889	15,889	15,889	(8,133)	(8,133)	(8,133)	(8,133)	(8,133)
Concourse B Holdrooms	5,999	2,647	2,647	2,647	2,647	(1,133)	3,352	3,352	3,352	3,352
Concourse C Holdrooms	0	7,950	13,243	15,889	21,192	0	(7,950)	(13,243)	(15,889)	(21,192)
TOTAL GATE HOLDROOM SPACE	13,755	26,486	31,779	34,425	39,728	(9,266)	(12,731)	(18,024)	(20,670)	(25,973)

8.2 CHARTER TERMINAL AND LANDSIDE FACILITIES

EUG handles a large amount of charter aircraft due to the local universities and their respective sports programs. The charter program is shown separately from the passenger terminal program to illustrate the requirements to accommodate a charter aircraft. It is intended that the charter component will be integrated into the Concourse C development and that the allocated gate will operate in a “swing” capacity such that it can be separated from other standard use gates when accommodating charters. Table 8-11 shows the design aircraft used for the charter calculations.

The charter terminal program summary in Table 8-12 shows the elements of the program needed to accommodate a charter flight. Many services that are found in the passenger terminal facility are not required in this analysis, such as airline ticket offices, due to periodic use and alternating users who would have ticket offices in the main check-in/ticketing hall. This allows the program to be reduced to the bare minimum to conduct a charter operation while adhering to certain LOS standards described in the previous section.

8.2.1.1 Airline Space

The ticketing counters for the charter terminal are calculated similarly to the main check-in ticketing hall, however, a longer wait time is utilized due to all passengers being dropped off at the same time as they are all part of one group being handled in an organized manner. Table 8-13 shows the key assumptions used for the charter airline space and Table 8-14 breaks down the specific elements of the charter airline space.

TABLE 8-11
CHARTER TERMINAL AIRCRAFT KEY ASSUMPTIONS

Assumption Element	Units	Value
Design Aircraft – Charter Terminal	Aircraft Type	Boeing 757-200
Aircraft Seating Capacity – Charter Terminal	Seats	199

Source: RS&H Analysis, 2022

TABLE 8-12
CHARTER TERMINAL FACILITY REQUIREMENTS

CHARTER TERMINAL	Existing	Baseline Forecast				Surplus/(Deficit)			
	2022	PAL 1 2027	PAL 2 2032	PAL 3 2037	PAL 4 2042	PAL 1 2027	PAL 2 2032	PAL 3 2037	PAL 4 2042
Airline Space	0	2,500	2,500	2,500	2,500	(2,500)	(2,500)	(2,500)	(2,500)
Baggage Service Space	0	7,200	7,200	7,200	7,200	(7,200)	(7,200)	(7,200)	(7,200)
Gate Holdroom Space	0	4,390	4,390	4,390	4,390	(4,390)	(4,390)	(4,390)	(4,390)
TOTAL GATE HOLDROOM SPACE		14,090	14,090	14,090	14,090	(14,090)	(14,090)	(14,090)	(14,090)

Source: RS&H Analysis, 2022

Note: All Figures Shown in Square Feet (sf) Unless Otherwise Noted

TABLE 8-13
CHARTER TERMINAL AIRLINE SPACE KEY ASSUMPTIONS

Assumption Elements	Units	Value
Originating Passengers	%	100
Passengers Using Check-In Facility	%	100
Typical Transaction Time	Minutes	3
Maximum Wait Time in Queue	Minutes	30
Check-In Counter Width	Feet	5.5

Source: ACRP/IATA

TABLE 8-14
CHARTER TERMINAL AIRLINE SPACE REQUIREMENTS

AIRLINE SPACE	Existing	Baseline Forecast				Surplus/(Deficit)			
	2022	PAL 1 2027	PAL 2 2032	PAL 3 2037	PAL 4 2042	PAL 1 2027	PAL 2 2032	PAL 3 2037	PAL 4 2042
Ticket Counter Length (lf)	0	55	55	55	55	(55)	(55)	(55)	(55)
Ticket Counter Area	0	550	550	550	550	(550)	(550)	(550)	(550)
Ticket Counter Active Area	0	550	550	550	550	(550)	(550)	(550)	(550)
Ticket Counter Queuing	0	1,400	1,400	1,400	1,400	(1,400)	(1,400)	(1,400)	(1,400)
TOTAL AIRLINE SPACE	0	2,500	2,500	2,500	2,500	(2,500)	(2,500)	(2,500)	(2,500)

Source: RS&H Analysis, 2022

Note: All Figures Shown in Square Feet (sf) Unless Otherwise Noted



8.2.1.2 Baggage Service

The baggage service component of the charter terminal consists of a baggage belt to convey the checked baggage from the counters to the outbound baggage sorting. Inbound baggage handling consists of a drop-off area and bypass for carts, and an active area inside the terminal for hand-placed baggage delivery. Due to the sporadic use of this facility, a baggage claim carousel is not considered in this analysis and is replaced with a baggage retrieval area. Table 8-15 shows the key assumptions used to calculate the required areas for baggage service.

Table 8-16 breaks down the specific elements of the baggage service space.

TABLE 8-15
CHARTER TERMINAL BAGGAGE SERVICE KEY ASSUMPTIONS

Assumption Elements	Units	Value
Checked Bags per Passengers	Bags	0.7
Bags per Cart/Container	Bags	50
Baggage Make-Up/Offloading Area per Cart	Square Feet	500

Source: ACRP/IATA

TABLE 8-16
CHARTER TERMINAL BAGGAGE SERVICE REQUIREMENTS

BAGGAGE SERVICE	Existing	Baseline Forecast				Surplus/(Deficit)			
	2022	PAL 1 2027	PAL 2 2032	PAL 3 2037	PAL 4 2042	PAL 1 2027	PAL 2 2032	PAL 3 2037	PAL 4 2042
Baggage Claim Active Area	0	2,100	2,100	2,100	2,100	(2,100)	(2,100)	(2,100)	(2,100)
Inbound Baggage Service Area	0	2,800	2,800	2,800	2,800	(2,800)	(2,800)	(2,800)	(2,800)
Outbound Baggage Area	0	2,300	2,300	2,300	2,300	(2,300)	(2,300)	(2,300)	(2,300)
TOTAL BAGGAGE SERVICE SPACE	0	7,200	7,200	7,200	7,200	(7,200)	(7,200)	(7,200)	(7,200)

Source: RS&H Analysis, 2022
Note: All Figures Shown in Square Feet (sf) Unless Otherwise Noted

8.2.1.3 Holdrooms

The charter terminal holdroom is being conceptualized to utilize an existing or planned commercial gate which will be enlarged accordingly and feature a retracting/sliding divider to keep the charter traffic sequestered from the scheduled airline traffic as policies and procedures may be unique to the charter operation.

The holdroom will include a gate counter with two positions, associated queue space for boarding, and circulation for enplaning/deplaning passengers. Table 8-17 shows the key assumptions used for the holdrooms.

Table 8-18 shows the holdroom requirements over the planning periods.

TABLE 8-17
CHARTER TERMINAL HOLDROOM KEY ASSUMPTIONS

Assumption Element	Units	Value
Load Factor	%	100
Passengers Away from Gate	%	0
Seated Passengers	%	70
Seated Passenger Area	Square Feet/Passenger	19.4
Standing Passengers	%	30
Standing Passenger Area	Square Feet/Passenger	12.9
Reduction Factor for Combined Holdrooms	%	0

Source: ACRP

TABLE 8-18
CHARTER TERMINAL HOLDROOM REQUIREMENTS

GATE HOLDROOMS	Existing	Baseline Forecast				Surplus/(Deficit)			
	2022	PAL 1 2027	PAL 2 2032	PAL 3 2037	PAL 4 2042	PAL 1 2027	PAL 2 2032	PAL 3 2037	PAL 4 2042
Charter Holdroom	0	4,390	4,390	4,390	4,390	(4,390)	(4,390)	(4,390)	(4,390)
TOTAL GATE HOLDROOM SPACE	0	4,390	4,390	4,390	4,390	(4,390)	(4,390)	(4,390)	(4,390)

Source: RS&H Analysis, 2022
Note: All Figures Shown in Square Feet (sf) Unless Otherwise Noted

Attachment A

CHAPTER 9
CONCEPTUAL PLANNING

9.1 CONCEPTUAL PLANNING CRITERIA

The conceptual planning of terminal expansion areas uses the information developed in chapters 4-7. The number of additional gates to meet the forecasted demand along with recommended functional area requirements define the spatial and organizational deficiencies in the existing facility. Understanding these leads to identifying the most appropriate opportunities for expansion and reconfiguration while attaining an optimal level of service for passengers.

Each of the following sections will present and discuss the initial options developed for the project followed by the Rough Order of Magnitude (ROM) cost estimate. Due to the conceptual level of the design, a range for each estimate is provided that attempts to take into account any design changes or updates that may occur during final design and any market changes that would affect the prices of products and materials. A more detailed breakdown of the cost estimate can be found in the appendix.

9.2 OUTGOING BAGGAGE

The outgoing baggage area consists of the conveyor system taking the checked baggage from the ticket counters, the TSA screening area, space for sorting and loading baggage onto ground service equipment (GSE), GSE circulation space, and space for storage.

User Feedback: The existing baggage areas are located behind the ticketing space and are currently divided into multiple smaller baggage handling rooms. This leads to inefficiencies with the inability to share the load for large flights leading to unused TSA screening equipment while baggage is backing up on the conveyor.

Design Impact: The space required for the outbound Baggage Handling System (BHS) was determined based on the flight analysis results. The total space required for the outbound baggage handling system in a single-story terminal building is approximately 25,500 SF and is approximately 15,000 SF per story in a two-story building expansion. The space allocated for the outbound BHS includes:

- » A Checked Baggage Inspection System (CBIS) configured with one redundant and one non-redundant EDS for a total of two screening machines of type 1 (medium throughput EDS).
- » A Checked Baggage Resolution Area (CBRA).
- » A sortation area that can be configured with either slopped plate or flat plate make-up devices. The benefits of flat plate devices include a smaller footprint and lower cost compared to slopped plate devices. The primary drawback is that they store less bags than the slopped devices. For this study slopped plate were considered for make-up devices to ensure that sufficient bag storage is available in case bags are sent to the make-up device prior to staging carts around the device or bags not retrieved from the device within the time allocated for the respective flight. The space to be allocated for the make-up area includes the sortation conveyor lines, workspace around the devices and space for staging the baggage carts.

9.2.1 Outgoing Baggage Option 1

Option 1 is designed to fit in a single story building for the terminal expansion.

This option provides a PGDS v7.0-compliant automated inline Checked Baggage Inspection System (CBIS) with a 1+1 EDS machine matrix, an oversize bag induction conveyor line, and three ticket counter induction belts. The induction belts merge into a common line that transfers bags to the east end of the ticketing hall. Ticket counter lines are configured to provide ample space for passenger queuing at the ticket counters.

The bags then travel through an Automated Tag Reader (ATR) and Baggage Measurement Array (BMA) to initiate CBIS bag tracking.

Out-of-gauge (OOG) bags divert ahead of the screening lanes and merge onto the CBRA alarm line. In-gauge bags are scanned in either of the EDS screening lanes then merge back to a common line. Level 1 Vertical Sorters Units (VSU) separate clear bags from non-clear bags ahead of Level 2. A VSU sorts clear and OSR alarm bags at Level 2. Clear bags transfer directly to the baggage make-up area and alarm bags travel to the new CBRA with nine sliding tabletop Baggage Inspection Stations (BISs) for Level 3 screening. A re-insert line in the CBRA merges onto the main ticket counter line. TSA officers (TSOs) load clear bags onto the CBRA clear line for transfer to make-up. The make-up area is configured with two slope plate make-up devices configured in-line so only two drive aisles are needed for cart staging. An ATR in the bagroom sorts the bags to the two make-up devices.

RS&H

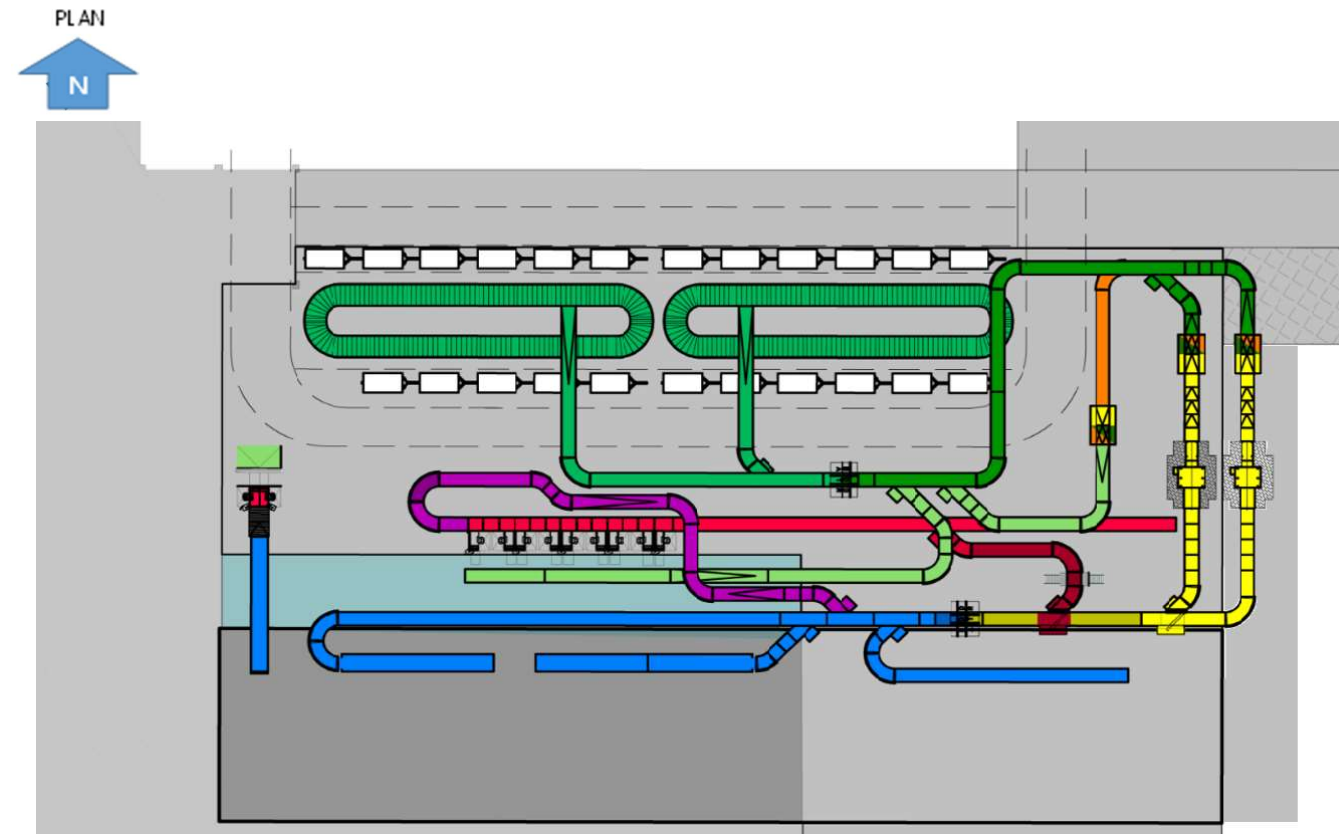


FIGURE 9-1
OUTGOING BAGGAGE OPTION 1

An oversize conveyor on the west end of the ticketing hall transfers oversize bags from the ticketing hall to the baggage make-up area. A single BIS at the end of the belt in the make-up area is available for TSOs to screen all oversize bags. This option was selected for further refinement.

Benefits: The single level BHS design is optimal for bag tracking due to the reduced number of inclining and declining conveyors compared to the two-level BHS design. Additionally, there is more bag storage upstream of the CBRA compared to the other two options and the CBRA is easily expandable to accommodate future growth,

Drawbacks: This option experiences reduced merging capability for the easternmost ticket counter line due to the reinsert line merging upstream. The longer re-insert line increases overall BHS cost and cart staging is more difficult compared to option 2. Finally, the single level BHS design requires larger building footprint compared to a two-level BHS design.

Rough Order of Magnitude Cost: \$31,800,000 - \$37,200,000

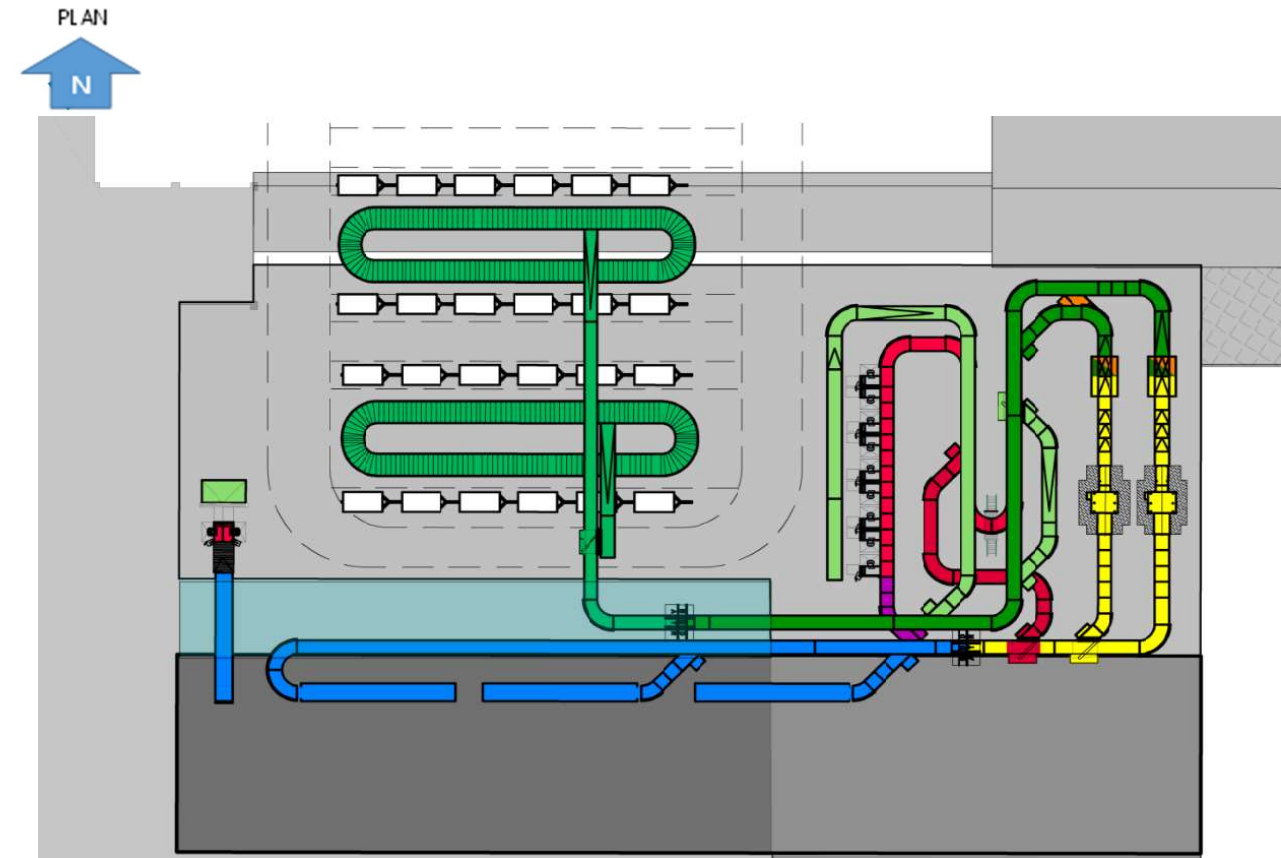


FIGURE 9-2
OUTGOING BAGGAGE OPTION 2

9.2.2 Outgoing Baggage Option 2

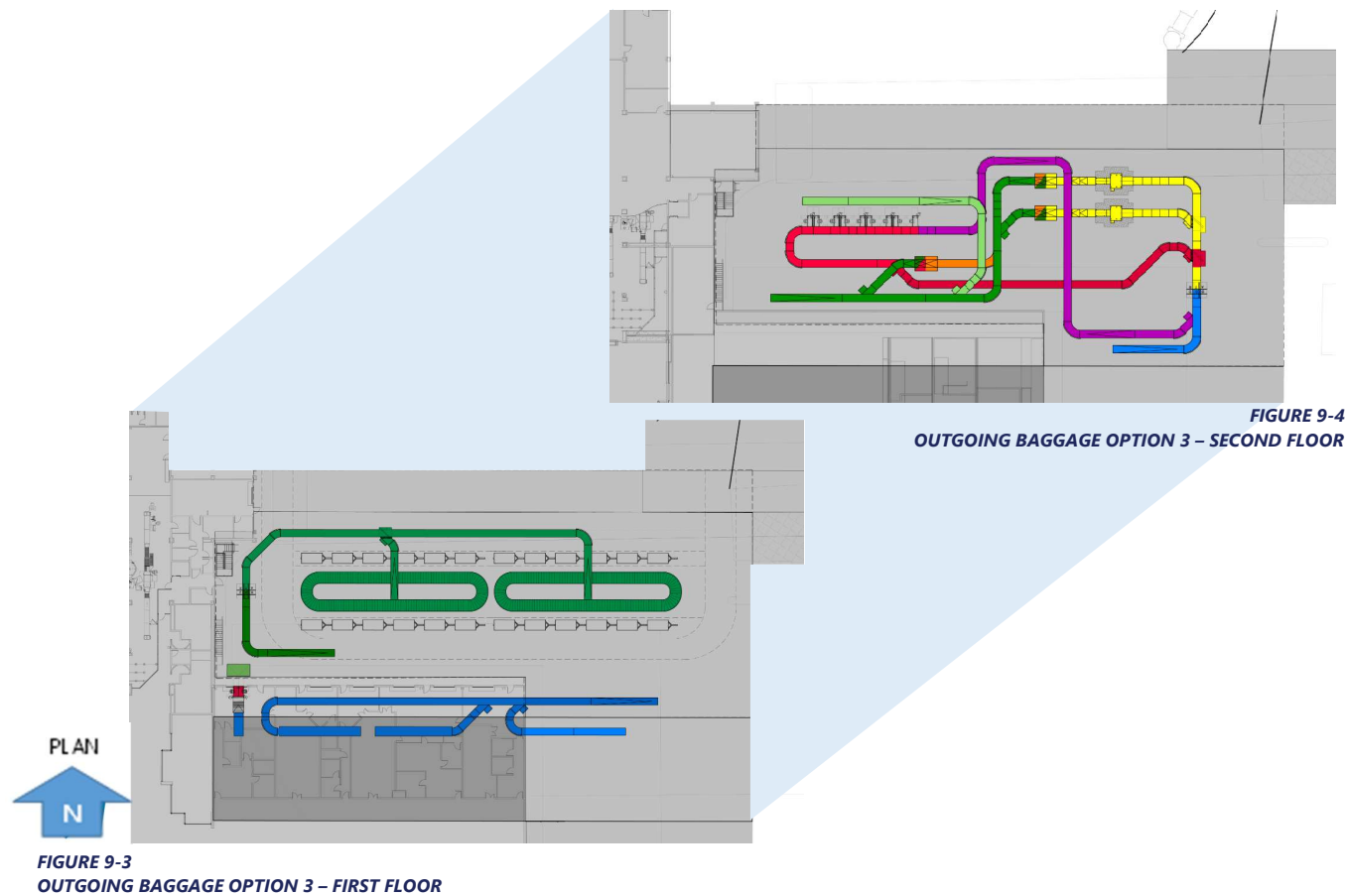
Option 2 is designed to fit in a single story building for the terminal expansion. This option has the same functional description and baggage screening process as Option 1, but with the following key differences:

- » Level 2 decision point uses a high-speed diverter rather than a VSU.
- » Make-up devices are in a stacked configuration requiring three drive aisles for cart staging.

Benefits: Similar to Option 1, this single level BHS design is optimal for bag tracking due to a reduced number of inclining and declining conveyors compared to a two-level BHS design. Cart staging is the least difficult in this option as no make-up staging area intrudes on other make-up staging areas. This option also has the lowest bag travel time and cost due to compactness of the BHS.

Drawbacks: Single level BHS design requires a larger building footprint compared to two level BHS design

Rough Order of Magnitude Cost: \$31,000,000 - \$36,400,000



9.2.3 Outgoing Baggage Option 3

Option 3 is designed to fit in a two-story terminal expansion. .

Option 3 is functionally similar to Options 1 and 2 but has the functions split across two levels (Ticketing induction and make-up sortation are on the lower apron level and CBIS/CBRA screening on the upper level). The second level uses a VSU for sortation while make-up devices are configured similar to Option 1.

Benefits: The two level BHS design requires a smaller building footprint compared to a one level BHS design and the CBRA is easily expandable to accommodate future growth without building expansion.

Drawbacks: This option has the highest overall cost due to longer transport lines. A reinforced floor structure is required for the second level due to the weight of the screening machines at approximately 18,000 lbs. per EDS. The two-level BHS design is less optimal for bag tracking due to an increased number of inclining and declining conveyors compared to the one level BHS design. Additionally, cart staging is more difficult compared to option 2 with the highest bag travel time

Rough Order of Magnitude Cost: \$32,500,000 - \$37,900,000

9.3 TICKETING AND ATO

The ticketing area consists of the circulation space immediately behind the ticket counters, the counters themselves, the active area immediately in front of the counters, the queuing area behind the active area and circulation space, and the airline ticketing offices (ATO) located behind the counters which includes offices and break rooms. Based upon discussions with the existing airlines, the following factors were discussed that would impact the ultimate design and configuration of this space.

Ticket Counters and Kiosks

User Feedback: Several airlines indicated a move towards passenger self-ticketing functions with limited full-service counter use. In these cases passengers would use a self-service kiosk or be assisted by an airline employee with a mobile device before completing baggage check-in at the counter. Each airline indicated varying needs however all required a single centrally located counter for bag drop flanked by kiosks either perpendicular or parallel to the bag drop. Parallel was noted to be preferred to avoid conflicts in the queuing areas. One airline indicated the desire to maintain all full service counters for the foreseeable future.

Design Impact: Accommodating both of these cases will require a modular ticket counter layout with the option to provide more or fewer counters as airline needs change with minimal rework of power and data connections. Use of kiosks would require fewer ticket counters spread further apart to allow for queuing to occur at both the kiosks and the bag drop without impacting each other. Both Option 1 and Option 2 (below) provide for a similar configuration of ticket counter with the possibility of an accessible trench for power and data spine running the length of the ticketing area.

Airline Ticket Office (ATO) Amenities

User Feedback: Airlines indicated a need to provide increased amenities within their Airline Ticketing Offices (ATO) including a sink, refrigerator, and restroom nearby. Currently not all of the ATO spaces include these amenities.

Design Impact: Both Option 1 and Option 2 consolidate and relocate the TSA screening facilities to provide more space for the ATO functions. Expansion of the ticketing area will extend this ATO space zone to provide a similar amount of space for future ticket counters and adequate space for ATOs with improved amenities.

Ticket Area Queuing

User Feedback: Queuing space is insufficient during morning rushes and when boarding certain charter flights. Additionally, to provide adequate clearance around exit vestibules, queuing space is extremely limited at the ticket counters nearby.

Design Impact: Option 1 provides for a similarly sized queuing space but extends the ticketing area to the east allowing for possible reorientation of the queuing system as needed to provide flexible queuing area and circulation. Option 2 relocates the ATO spaces to the upper level, accessed by stairs and a shared elevator to allow the bulk of the ticket counters to be moved to the northwest, allowing for a deeper queuing space. Additionally, Concourse C expansion alternatives consider the inclusion of a charter component that would eliminate the overcrowding in the main terminal ticketing area during those events. The charter facility would be in a location separate from the existing ticketing area, thus the associated queue and circulation issues would be nullified.

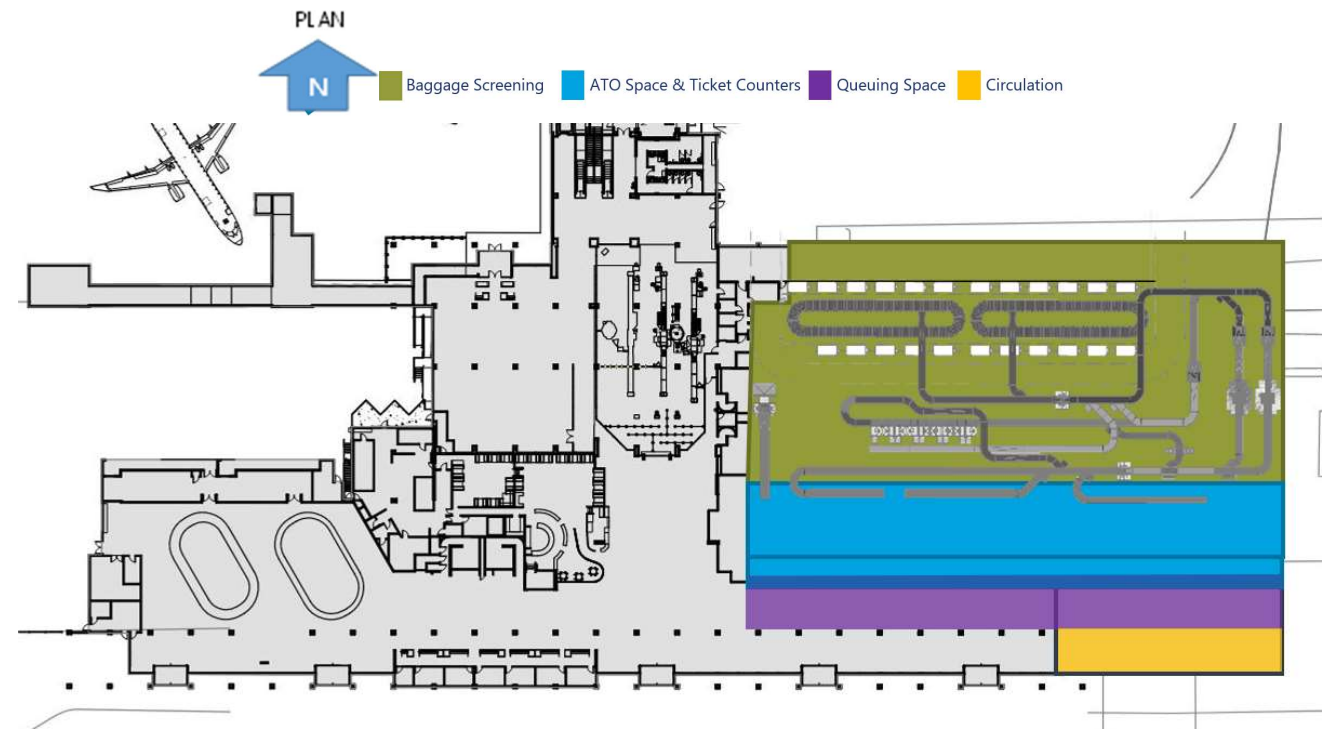


FIGURE 9-5
TICKETING OPTION 1

9.3.1 Ticketing and ATO Option 1

Option 1 includes extending the existing ticketing and ATO spaces to the plan-east by adding another 10,000 SF +/- of total area. Option 1 maintains the existing alignment of the ticket counters and extends the existing overall configuration of the ticketing lobby. The existing TSA baggage screening spaces are eliminated and relocated to the new consolidated baggage screening system in the Outgoing Baggage space allowing the existing ATO spaces to be upgraded and reconfigured for optimal use. This option was selected for further refinement.

Benefits: This option requires minimal impact and reconfiguration to the existing lobby space and may be able to utilize the existing electrical and communication raceways that currently supply the existing ticket counters. Similarly water and plumbing connections that currently supply the existing ATO spaces can be reused and expanded to serve additional spaces. As a single story expansion matching the existing in general shape and massing, this option can be expanded in a straightforward way by duplicating the existing architectural and structural elements.

Drawbacks: This option would not provide the additional queuing depth requested by the Users which would impact the flexibility of the Ticketing area for kiosk service and maintains some of the queuing issues near the existing entry vestibules.

Rough Order of Magnitude Cost: \$30,800,000 - \$36,000,000

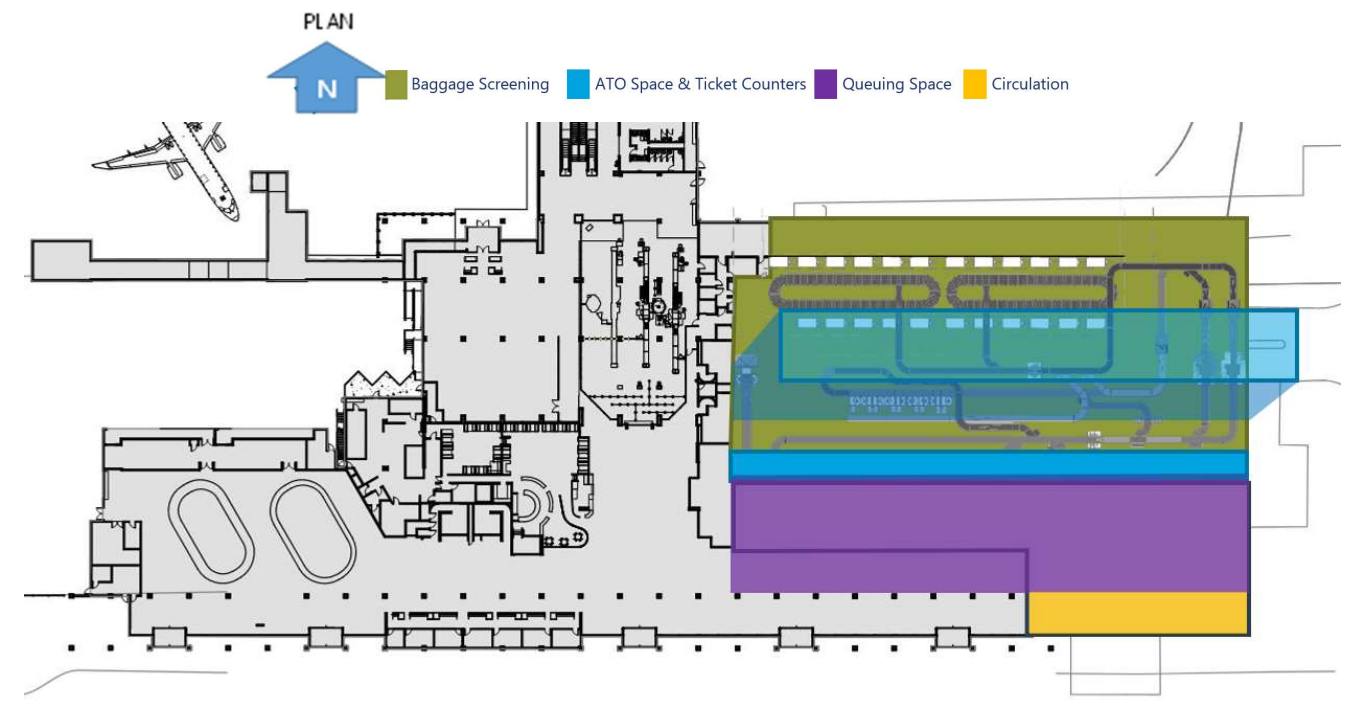


FIGURE 9-6
TICKETING OPTION 2

9.3.2 Ticketing and ATO Option 2

Similar to Option 1, the overall floor area added to the Ticketing and ATO spaces is approximately 10,000 SF +/- with the existing TSA spaces relocated to the baggage screening area. In Option 2, however, the new and existing ATO spaces are located on an upper level above the Outgoing Baggage expansion. This allows the ticket counters to be moved to the north providing significant additional space for queuing.

Benefits: This option provides the most flexibility for the queuing and ticketing area with the ability to accommodate highly variable future airline ticketing area needs and can better satisfy the airline requirements for kiosk queuing and clearance around the vestibules. The total available square footage available is higher in the same building footprint with upper level space.

Drawbacks: First costs are higher with this option as new infrastructure will need to be provided at the new ticket counter locations and ATO locations. Upper level square footage will also need to be provided at a higher cost than ground level square footage. Access to the upper level ATO spaces will be required via stairs and elevator.

Rough Order of Magnitude Cost: \$34,700,000 - \$40,600,000

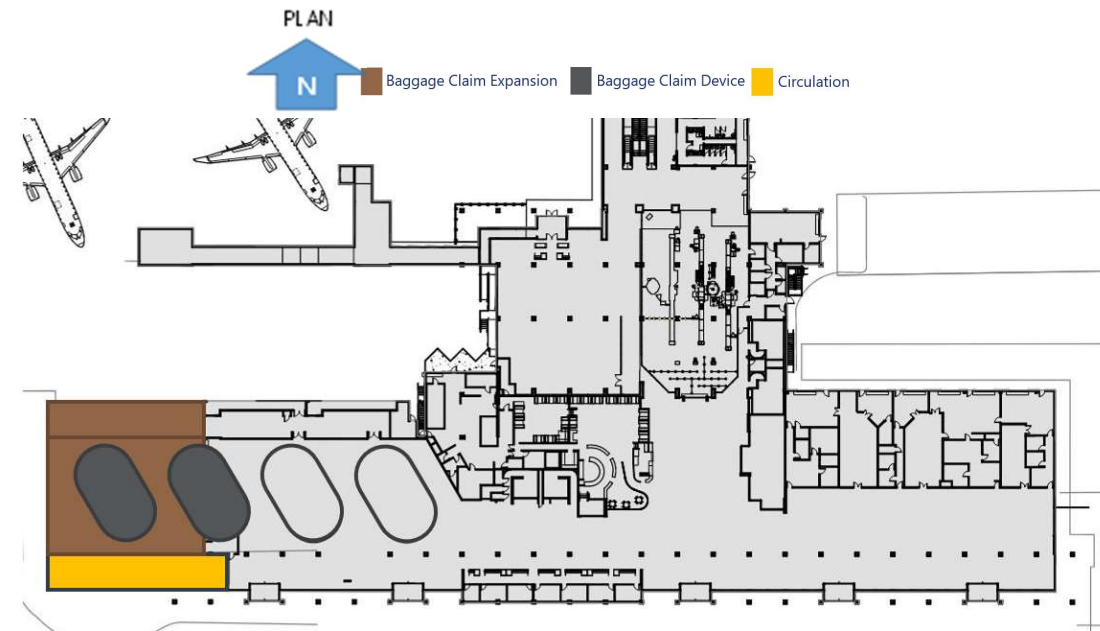


FIGURE 9-7
BAG CLAIM EXPANSION

9.4 BAGGAGE CLAIM

The existing bag claim area consists of two bag claim devices with conveyors that deposit baggage from above. This area of the building was expanded and renovated in 2014. No feedback was received related to the bag claim area with users generally happy with the service provided. Due to the relatively recent renovation, the existing bag claim should be maintained but expanded for the increased anticipated passenger load by extending the building and adding two more bag claim devices to accommodate future growth and their corresponding drop-off conveyors that will feed the new carousels from above.

Rough Order of Magnitude Cost: \$21,300,000 - \$25,100,000

9.5 CONCOURSE A EXPANSION

The existing Concourse A area consists of six gates with approximately 5,000 SF of shared holdroom space, two concession spaces featuring one for food and beverage and one for convenience retail. Each of the existing gates are paired with adjacent boarding bridges. Based upon discussion with the existing airlines and users, the following factors were discussed that would impact the ultimate design and configuration of this space.

Holdroom Size

User Feedback: Airlines and travelers indicated that the existing holdrooms are too small, especially during holidays and other high use periods.

Design Impact: The existing holdrooms were designed for smaller aircraft and is undersized for the current fleet mix. For the current fleet mix of 737 MAX 9's, an optimal holdroom space of 3,200 SF or a minimum of 2,500 SF should be provided per aircraft. Option 1 accommodates additional holdroom space by adjusting the number of flights at the gates at the same time. Option 2 includes expansion space to better accommodate holdroom space for all flights.

Concessions

User Feedback: Airlines indicated that customers have noted a lack of grab-and-go options and difficulty in getting fast-service food quickly such as a coffee. Travelers have also noted that seating area at the restaurant is difficult to find though the tables that have been added to the Walkway Bridge are frequently used.

Design Impact: Additional seating area for the restaurant is needed to accommodate travelers during the busiest times of the year.

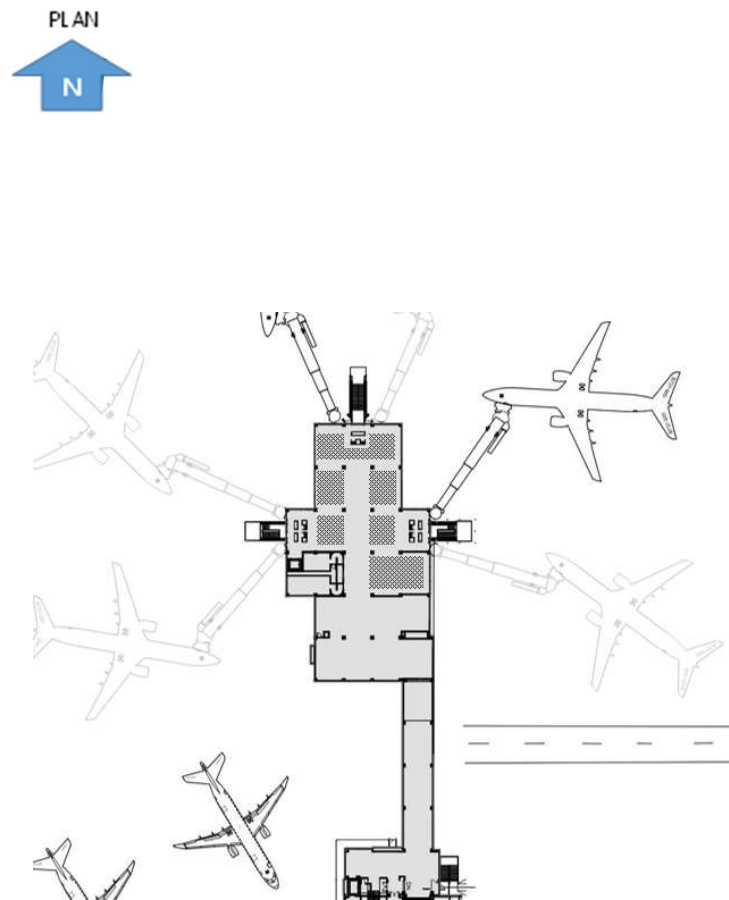


FIGURE 9-8
CONCOURSE A – OPTION 1

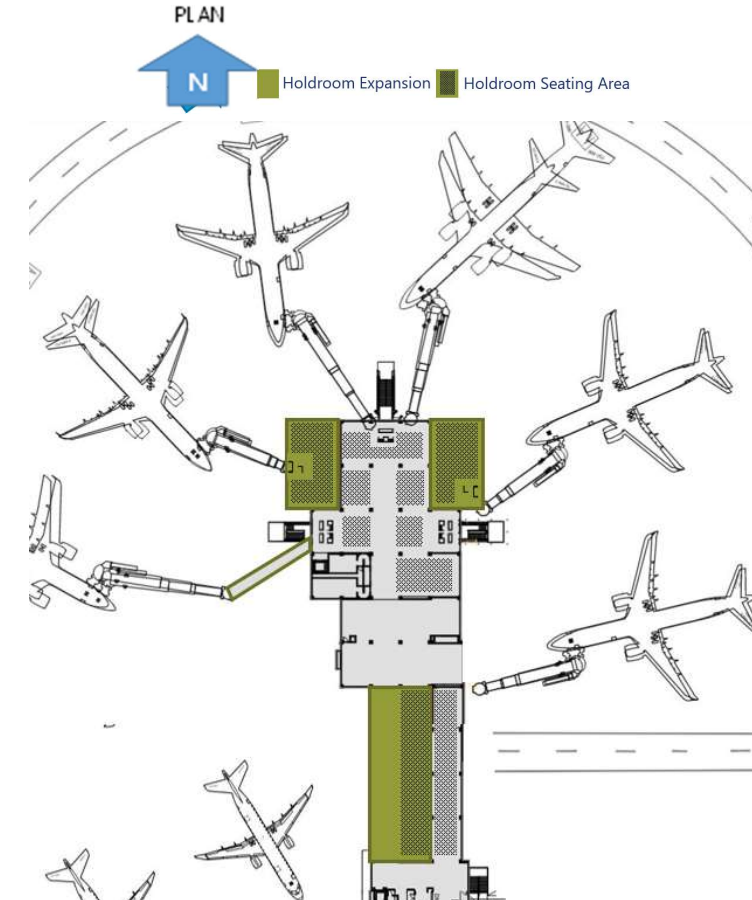


FIGURE 9-9
CONCOURSE A – OPTION 2

9.5.1 Concourse A Expansion Option 1

Concourse A was originally designed for aircraft smaller than the current design aircraft, the 737 MAX 9. Option 1 consists of allowing Concourse A to remain in the existing configuration. However, in order for the holdrooms to meet the minimum Level of Service (LOS) requirements it would need to be reserved for smaller aircraft only with the ability to have approximately two simultaneous 737 MAX 9 flights if needed. Note that as aircraft up-gauge over time, Concourse A would be able to service fewer and fewer flights.

Benefits: This option would allow funds to be focused and spent on the newer portion of the building, the area that is expected to be used for the longest time rather than as a band-aid to update the oldest concourse that will eventually be removed.

Drawbacks: The drawback of this option lies primarily in the limitations placed upon the scheduling of aircraft and the ability to keep only smaller aircraft at this concourse. In the near term, reserving Concourse A for smaller aircraft will be possible however as flights up-gauge additional gates at Concourse C will need to be added sooner to accommodate the anticipated schedule resulting in underutilization of Concourse A.

Rough Order of Magnitude Cost: \$1,270,000 - \$1,300,000 for addition of fixed bridge extension for gate A6.

9.5.2 Concourse A Expansion Option 2

The second option for Concourse A involves increasing the holdroom space to be able to meet the minimum service level recommended for the design aircraft, the 737 MAX 9. In this case, holdroom expansions would be created at Gate A2 and Gate A5 with Gate A6 relocated to the walkway bridge. An expansion at the walkway bridge can provide additional seating area for both Gate A6 and the concessions nearby. This option was selected for further refinement.

Benefits: This option would allow Concourse A to be expanded and continue to be used to service 6 design aircraft.

Drawbacks: The drawback of this option lies primarily in the disruption that would be experienced while under construction with overall capacity temporarily reduced during some phases. This can be partially offset by sequencing the construction after the construction of Concourse C. Additionally as the existing mechanical and electrical systems are already at capacity, additions to this area will require upgrading the MEP systems of the entire concourse, allocating more funds to the part of the airport most likely to be replaced in the future.

Rough Order of Magnitude Cost: \$9,100,000 - \$10,600,000

9.6 CONCURSE C EXPANSION

Concourse C is the primary expansion expected as part of the Advanced Terminal Planning process. In order to avoid impacting the existing operations at Concourse A during construction, Concourse C will attach to the existing terminal building at the 2014 Vertical Circulation expansion adjacent to the walkway bridge. This expansion will extend to the northeast with a walkway before arriving at the first gate. Based on the forecast study, initial layouts looked at a total of five gates in PAL2 in addition to restrooms, concessions, administrative office space, and a charter terminal. The charter terminal will include both lower level and upper level facilities and will be located adjacent to a gate that can be used as a swing gate for charter flights and non-charter flights. The initial program for Concourse C consisted of:

- » Holdrooms: 16,000 SF
- » Administration space
- » Restrooms will be included in the spaces above
- » Concessions: 2,800 SF
- » Charter terminal / swing gate: 4,000 SF at Upper Level
- » Circulation

Concessions

User Feedback: Airlines indicated that customers have noted difficulty in getting fast-service food quickly such as a coffee or a sandwich. Airlines also noted that the inability to add hoods to the concession spaces prevents concessionaires from offering fresh food which is the direction that the industry is moving towards.

Design Impact: Concessions space will be included and located on the outer wall whenever possible to allow for hoods and ventilation so that hot food can be served. The concessions areas will be located such that all passenger holdrooms have access to concessions nearby.

Walking Distance

User Feedback: Limit the travel distance from the existing terminal to the new gates.

Design Impact: Existing gate A6 will be relocated to allow Concourse C gates to be parked closer to the terminal building shortening walking distance to the first gate. Additionally, moving walkways can be provided to reduce travel time to the new gates.

Apron Paving

User Feedback: Users indicated concerns with extensive areas of new pavement and a desire to reduce the amount of paved space where possible.

Design Impact: While most of the proposed site is already paved, some designs lend themselves to requiring less pavement area and will be evaluated based on that as one of the criteria.

Pet Relief and Gender Neutral Restrooms

User Feedback: Users noted a desire for pet relief locations and gender neutral bathrooms.

Design Impact: Restrooms and service cores will be sized to accommodate gender neutral bathrooms and pet relief centers wherever possible.

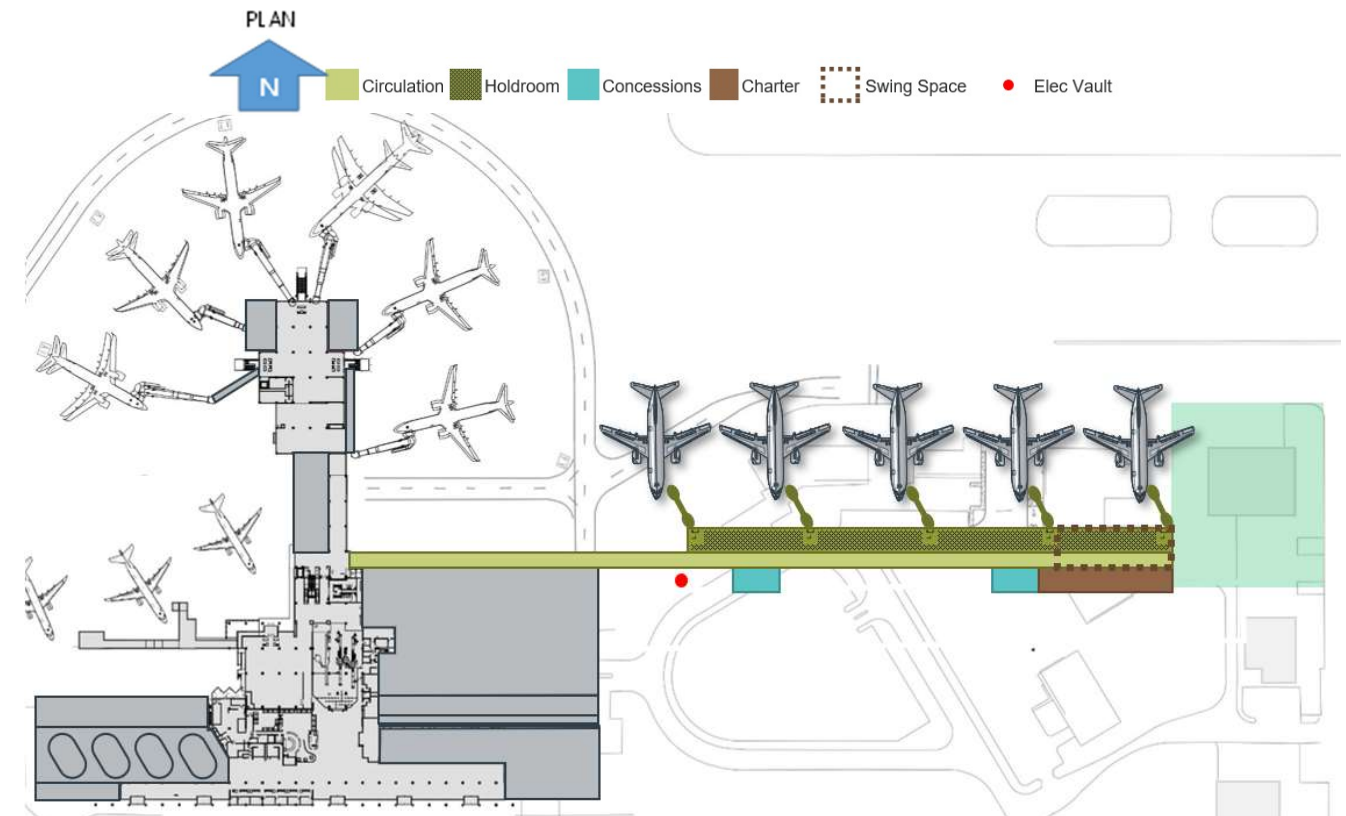


FIGURE 9-10
CONCURSE C – OPTION 1

9.6.1 Concourse C Expansion Option 1

As with all the options, Option 1 extends Concourse C to the northeast with the use of a linear bridge element. The overall configuration of the holdroom is in a linear single-loaded fashion with gates spaced regularly along the full length.

Benefits: This option is the most straightforward with passengers able to visually see all the gates upon entering the concourse. Aircraft movement is also less complicated than option 2 or 3. The walking distance from the existing terminal to the first gate is the shortest at 270’.

Drawbacks: A long concourse doesn’t see as much potential efficiency as a more centralized concourse with multiple concessions areas needed to service the full length of the holdrooms. The holdrooms themselves are located in a linear fashion with minimal ability to share capacity with adjacent holdrooms and the walking distance to the furthest holdroom is a longest at 840’. Outside the Concourse, this option also has the largest pavement requirements of the 3 options and strongly impacts the GA facility and construction occurs very close to the existing electrical vault near the existing parking lot.

Rough Order of Magnitude Cost: \$63,800,000 - \$74,600,000

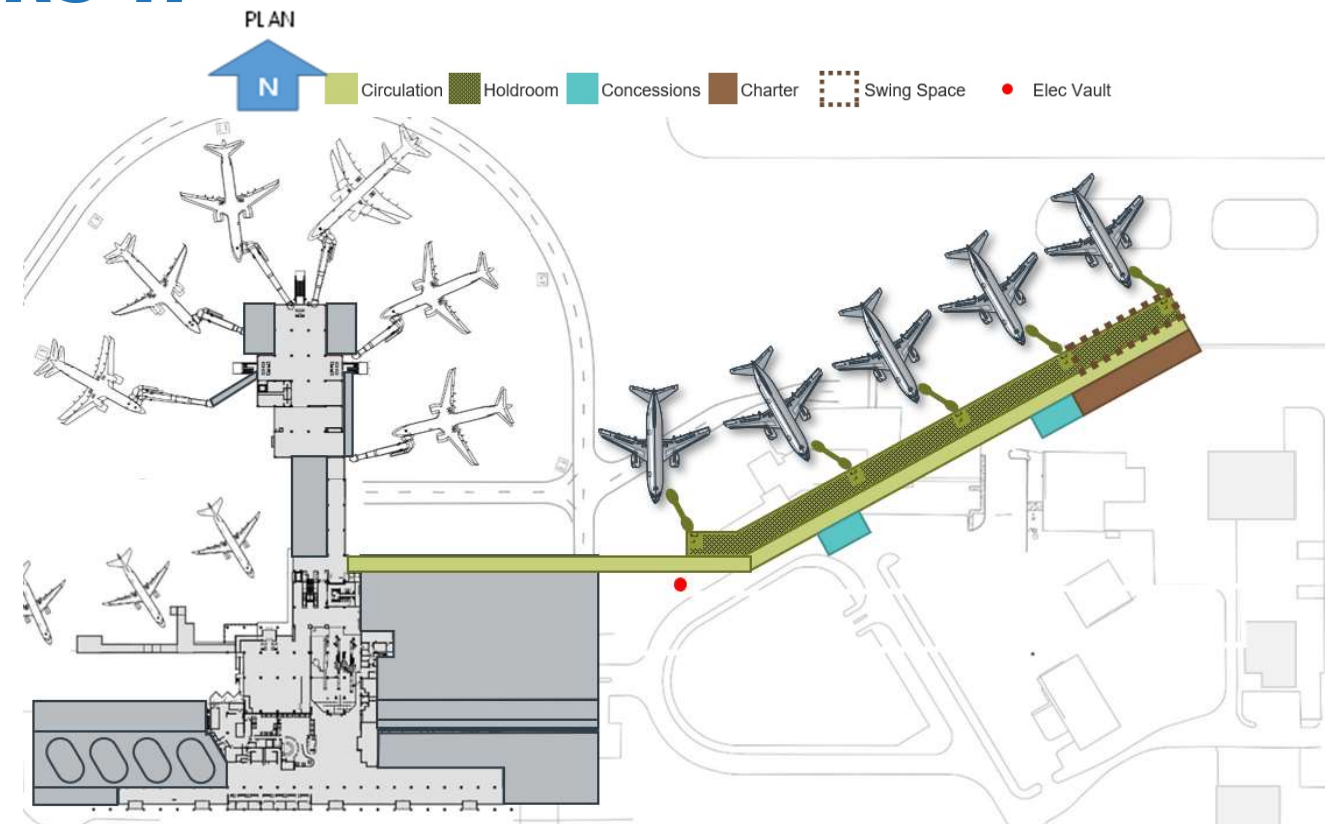


FIGURE 9-11
CONCOURSE C – OPTION 2

9.6.2 Concourse C Expansion Option 2

Option 2 developed from Option 1 with the goal of angling the terminal away from the existing GA space. While this option succeeds at avoiding impact on the GA facilities, the other drawbacks of Option 1 are unchanged.

Benefits: This option is similarly straightforward compared to Option 1 although the bend in the concourse prevents passengers from being able to see the entire length upon entry. The bend in the concourse also avoids impacting the GA facilities and provides more landside space for parking.

Drawbacks: The primary drawbacks are similar to Option 1 and although the GA facilities are avoided in the 5-gate configuration, additional expansion beyond 5 gates will result in impact to the GA facilities once again.

Rough Order of Magnitude Cost: \$21,300,000 - \$25,100,000

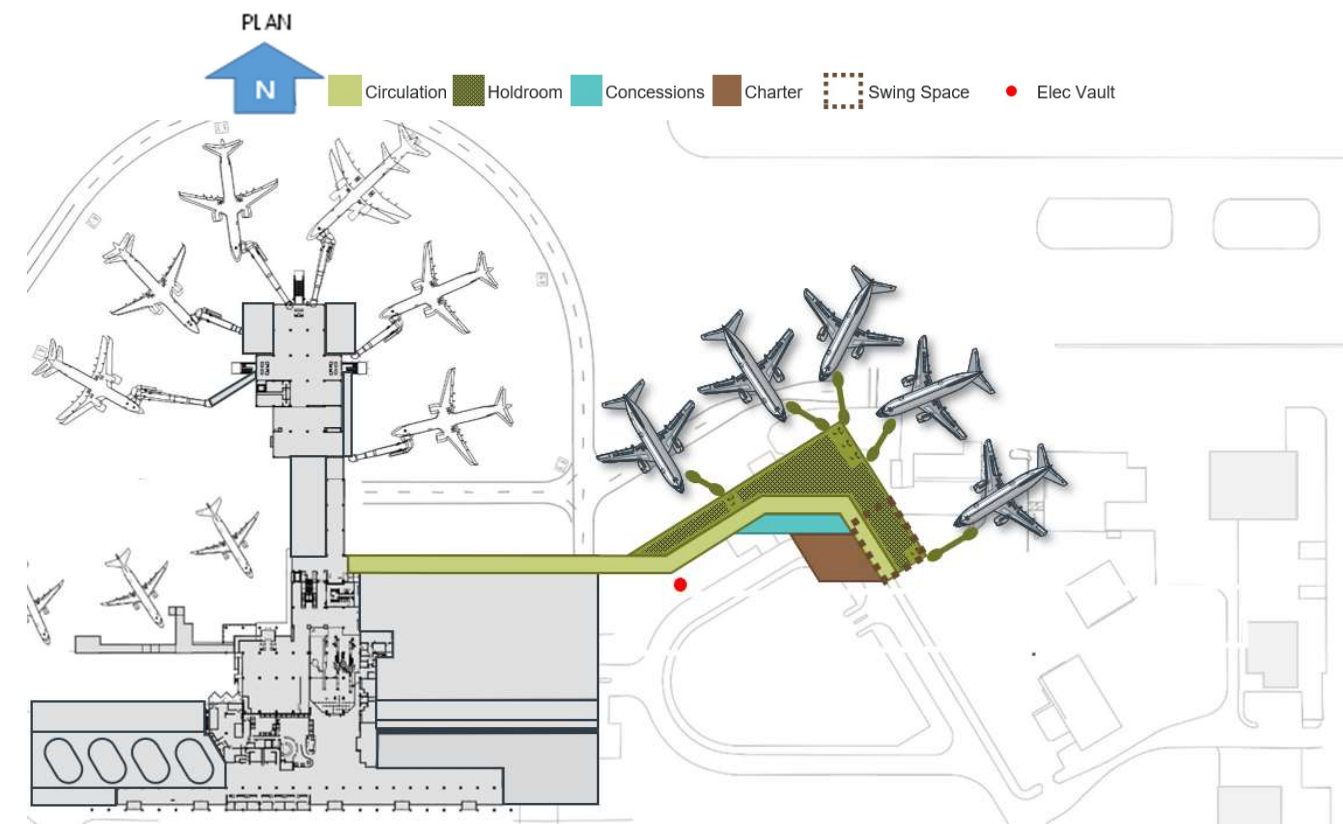


FIGURE 9-12
CONCOURSE C – OPTION 3

9.6.3 Concourse C Expansion Option 3

Option 3 provides a more center loaded design with most of the holdroom spaces located at the center of the expansion and adjacent to the central concessions area. This option was selected for further refinement.

Benefits: Efficiency can be found in this option with all of the gates able to be serviced by a central concessions area with multiple adjacent holdrooms able to handle passenger overflow. This option also has the shortest distance to the last gate at 630'. Outside of the concourse, the required pavement area is slightly less than Option 1 but more than Option 4. Impact to the GA Facility is minimized in both Option 3 and Option 4.

Drawbacks: Due to the arrangement of the gates, the first gate is the furthest from the existing terminal at 410' and the location of multiple gates at the center may lead to some difficulty in segregating areas for specific gates or airlines. Due to the centralized layout, expansion beyond the initial 5 gates will also be difficult without significant rework.

Rough Order of Magnitude Cost: \$58,500,000 - \$68,400,000

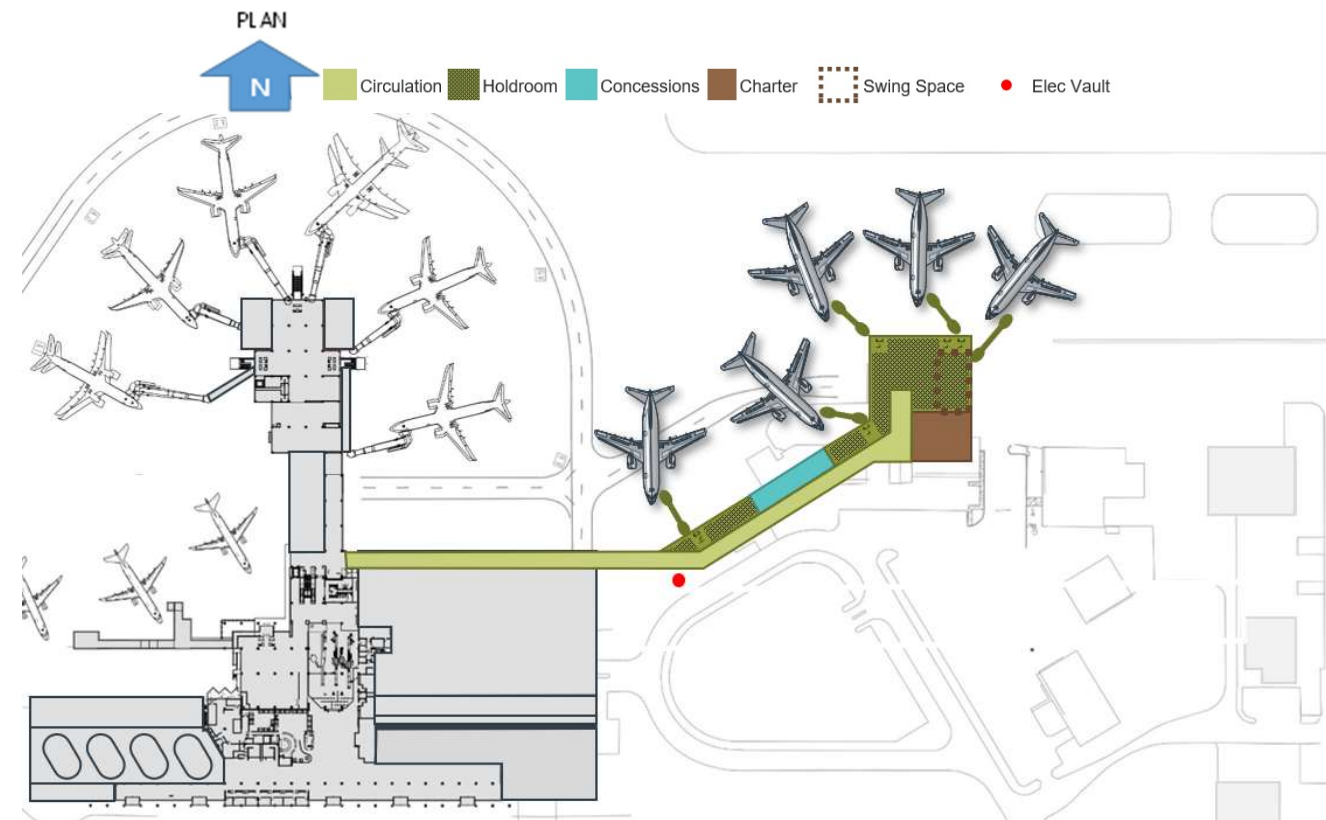


FIGURE 9-13
CONCOURSE C – OPTION 4

9.6.4 Concourse C Expansion Option 4

Option 4 is similar to Option 3 in that multiple gates are clustered allowing for efficiencies in shared holdroom and facility access. Unlike Option 3, this clustered holdroom is located at the end of the concourse forming a node.

Benefits: Although more heavily weighted towards the end of the concourse, this option shares many of the benefits of Option 3 with multiple adjacent holdrooms and the ability to centrally locate concessions. Similar to Option 1, this option allows for the first gate to be 260' away from the existing terminal. Impact to the GA facility is minimized in both Option 3 and Option 4.

Drawbacks: With a hybrid layout, the first gate is linear similar to Option 1 and the other four gates are clustered similar to Option 3. This leaves minimal flexibility for Gate 1 but the other gates have the ability to utilize adjacent overflow space. Additionally, while the node concentrates the holdrooms and allows for flexibility, the area itself isn't large enough to also include centralized concessions. Expansion of this option is possible however this would put the new gates further from the concessions resulting in multiple concession zones.

Rough Order of Magnitude Cost: \$53,600,000 - \$62,700,000

CHAPTER 10

REFINED ALTERNATIVES

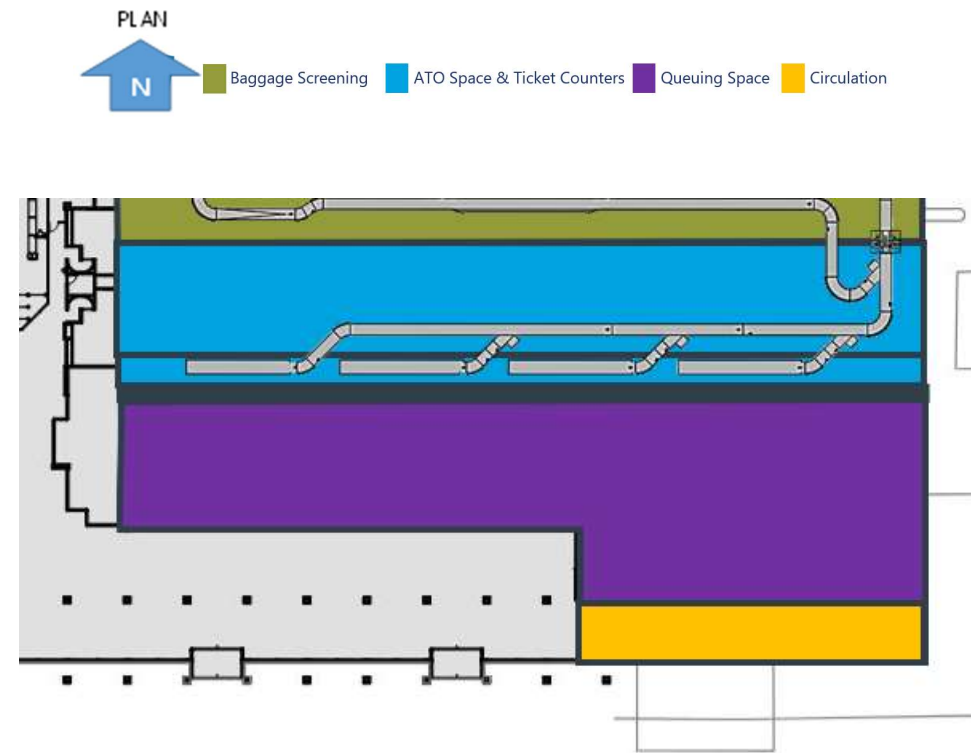


FIGURE 10-1
TICKETING REFINED ALTERNATIVE

10.1 TICKETING AND ATO

The refined alternative for the Ticketing and ATO spaces is a hybrid of Concept Option 1 and 2 with a larger footprint in a single story configuration to allow for renovated and updated amenities in the ATO spaces and adequate queuing space for high traffic periods and for emerging technologies such as mobile check-in and additional kiosks.

User Feedback: Airlines prefer not to have their ATO spaces on the second floor but expressed a strong desire to have additional queuing space as the existing queuing space becomes congested most days in the morning and during holidays.

Design Impact: Without going to a second story, the other option is to provide additional queuing is to extend the Ticketing and ATO space towards the airside.

Benefits: This option allows for the ATO spaces to be fully renovated to meet airline requirements for amenities, provides significant additional queuing space and can optimally accommodate the new baggage system.

Drawbacks: As all of the ATO spaces and ticket counters are being relocated, phasing will be more complicated to allow for the airport to function during construction. This can potentially be accomplished by building the new ticket counters and ATO spaces behind the operational ticket counters with a phased transition plan.

Rough Order of Magnitude Cost: \$29,200,000 - \$34,100,000

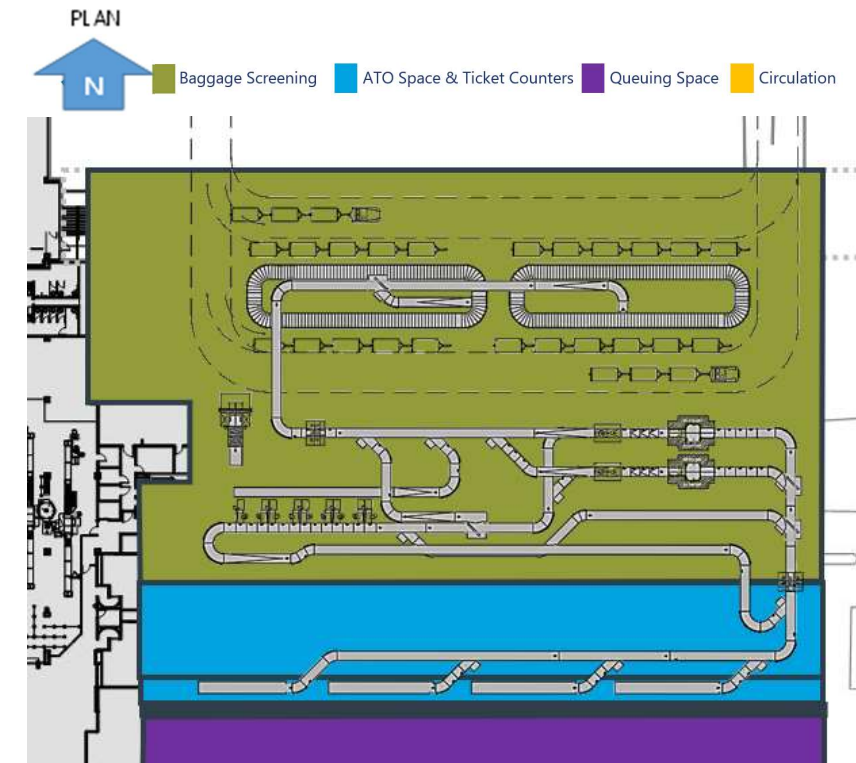


FIGURE 10-2
OUTGOING BAGGAGE REFINED ALTERNATIVE

10.2 OUTGOING BAGGAGE

The refined alternative for the outgoing baggage design is a modified version of Concept Option 1 and expands the outgoing baggage area to the Concourse C walkway.

User Feedback: Ease of future expansion needs to be included in the design and the location of multiple conveyors above the ATO spaces will make service difficult.

Design Impact: Expanded outgoing baggage area allows for better placement of all equipment.

Benefits: Expanding the enclosure makes more efficient use of the space by closing small gaps between the additions and provides structure for, and allows expansion of, the administrative spaces above. This baggage handling design takes advantage of the advantage of the additional space by realigning the equipment to allow for better GSE flow and future expansion.

Drawbacks: First costs are higher due to the additional footprint of the expansion.

Rough Order of Magnitude Cost: \$57,300,000 - \$67,500,000

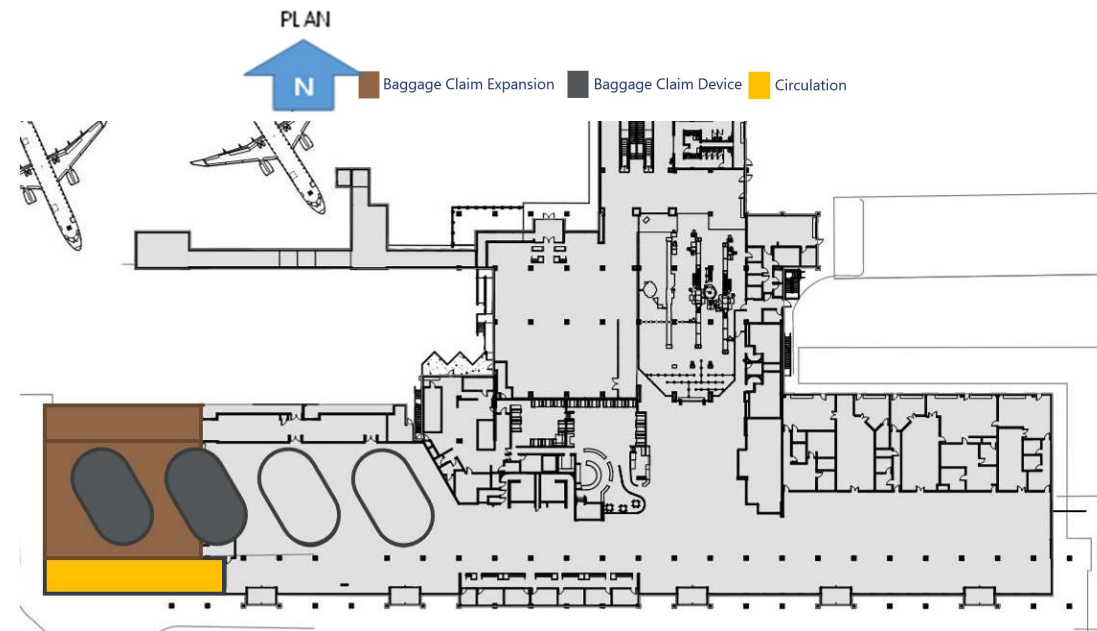


FIGURE 10-3
BAG CLAIM EXPANSION REFINED ALTERNATIVE

10.3 BAGGAGE CLAIM

The refined alternative for baggage claim remains the same as the Conceptual Design with the existing bag claim configuration duplicated and expanded to two additional units.

User Feedback: Users are generally happy with the service provided.

Design Impact: Additional modules similar to existing will be constructed at the end of the baggage claim lobby.

Benefits: Due to the modular nature of the bag claim devices and back of house service areas, this design should allow the easternmost bag claim to continue operation during construction with additional units becoming available as construction progresses to the west.

Drawbacks: Continued expansion of will result in multiple independent bag claim devices without a centralized way to distribute baggage in the future.

Rough Order of Magnitude Cost: \$21,300,000 - \$25,100,000

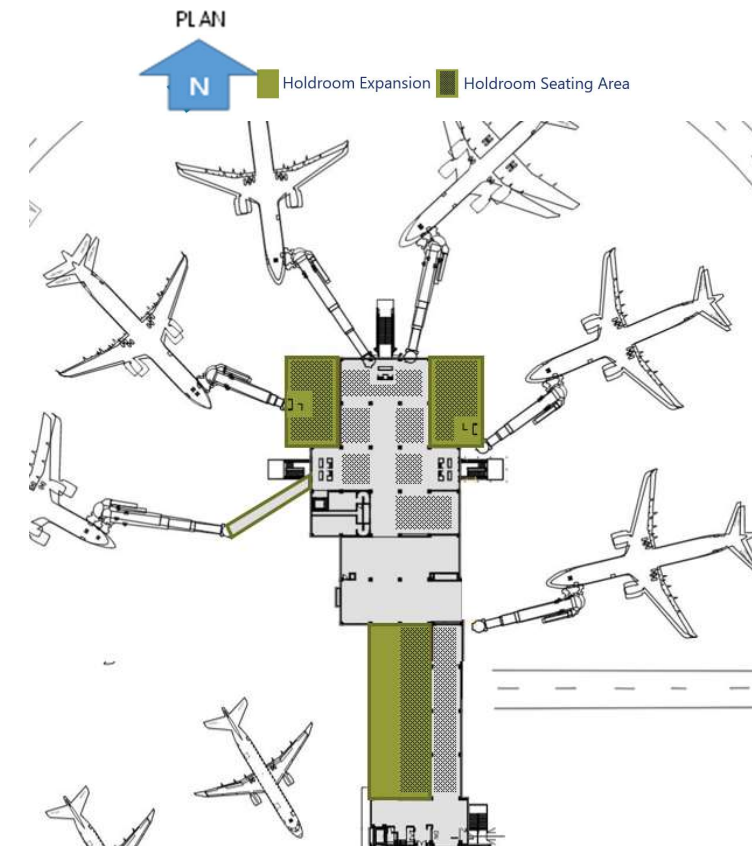


FIGURE 10-4
CONCOURSE A REFINED ALTERNATIVE

10.4 CONCOURSE A EXPANSION

The refined alternative for Concourse A adds three holdroom areas and a fixed bridge to expand the holdroom sizes to meet the minimum service level requirements for a 737 MAX 9. The fixed bridge relocates Gate 6 to allow for better aircraft circulation to Concourse C.

User Feedback: Airports expressed desire to relocate aircraft from Concourse B to a position with a bridge.

Design Impact: Conceptual Option 1 is not feasible with the additional holdrooms required due to the relocation of aircraft from Concourse B.

Benefits: This option would allow Concourse A to be expanded and continue to be used to service six design aircraft at a minimal level of service, or six smaller aircraft at a higher level of service.

Drawbacks: Disruption will be experienced while under construction with overall capacity temporarily reduced during some phases. Additionally, as the existing mechanical and electrical systems are already at capacity, additions to this area will require upgrading the MEP systems of the entire concourse.

Rough Order of Magnitude Cost: \$9,100,000 - \$10,600,000

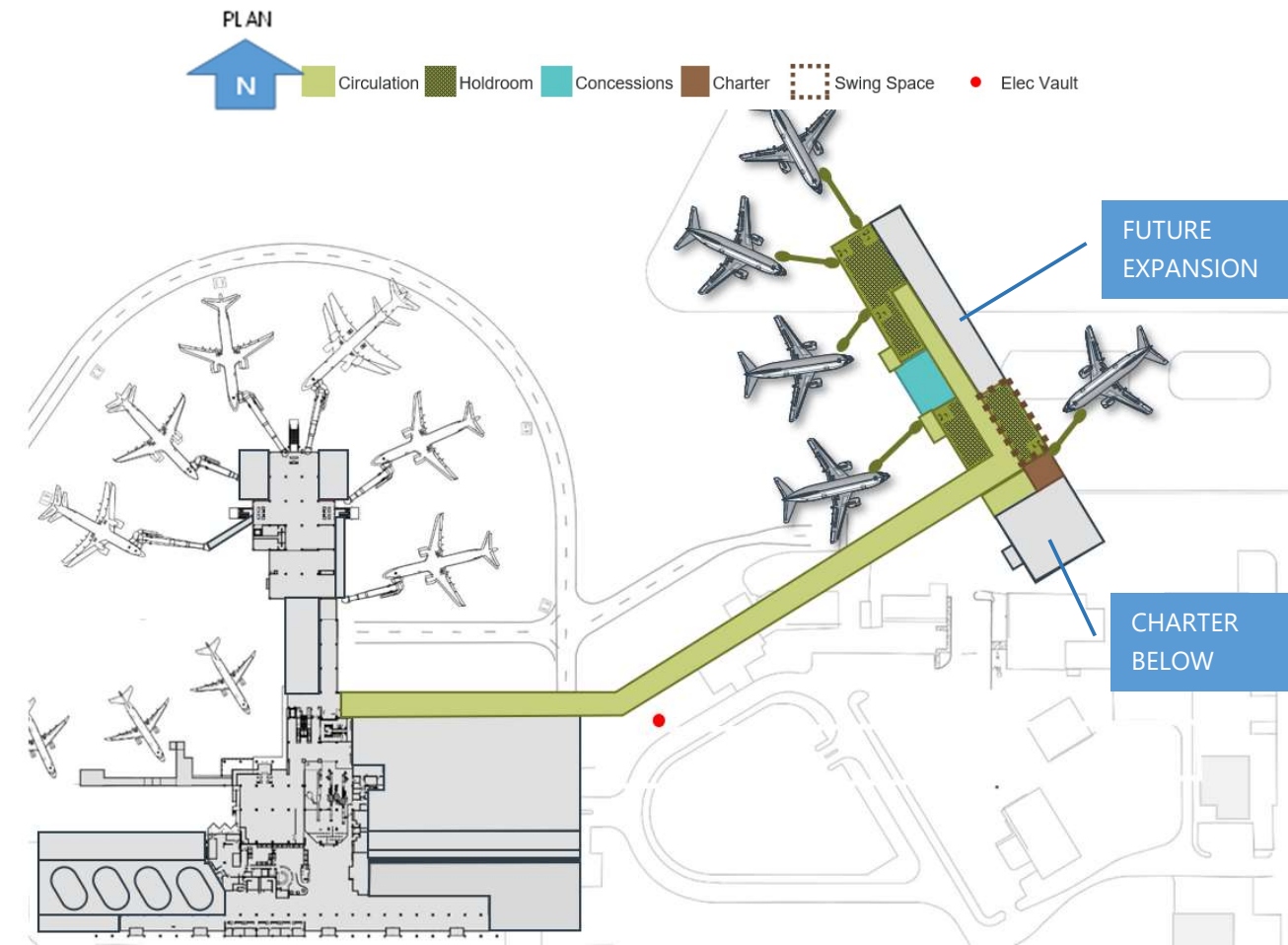


FIGURE 10-5
CONCOURSE C REFINED ALTERNATIVE

10.5 CONCOURSE C EXPANSION

The refined alternative for Concourse C evolved from Option 3's end-node design. The holdrooms and concessions are relocated from their locations along the bridge to create a larger efficient double-loaded pier configuration with holdrooms clustered around a central large concessions space. In this option the charter terminal is located primarily on the landside lower level and is proud of the main portion of the building allowing it to better take advantage of the landside parking and approach and allows it to be included or eliminated as a cost savings consideration during design without redeveloping the entirety of the concourse.

Impact on GA Facility

User Feedback: Minimize impact on existing GA facility, including when considering future expansion.

Design Impact: Pier configuration allows for expansion up to eight total gates without impacting the GA facility. Future expansion allows for the construction of an additional pier beyond the first as needed.

Concessions

User feedback: Multiple concessions will not be viable and will not provide the desired service level for customers with any expansion.

Design Impact: The concessions are relocated to the center of the holdrooms allowing for equal access. The larger square footage allows for a larger sit down restaurant with quick service capability or multiple small concessions.

Support Spaces

User Feedback: Provide ample support spaces including a gender-neutral restroom suite.

Design impact: Service core at the walkway is sized to accommodate men's, women's and an equally sized gender-neutral restroom suite in addition to a mother's room and pet relief space.

Benefits: In this revised option, all of the holdrooms have easy access to the concessions and support spaces such as restrooms and mother's rooms to maximize concessions revenue and convenience. The spacing between Concourse C and Concourse A allows for ease of movement of aircraft in the alley between the two. Additionally, this concourse is better aligned with the existing runways and planned future taxiway and taxilane reconfiguration projects that will make aircraft movements safer and more efficient, and is aligned to make maximum use of the existing RON parking that will become apron parking for Concourse C. This option also provides more clearance around the existing electrical vault that cannot be relocated.

Drawbacks: The walkway is the longest in this option although this can be ameliorated with efficient use of moving walkways to quickly bring passengers from the existing terminal to a single efficient destination. Cost is higher than other options but this can be easily expanded to eight gates with minimal impact to 5-gate operations.

Rough Order of Magnitude Cost: \$121,100,000 - \$142,800,000

CHAPTER 11

RECOMMENDED SOLUTIONS

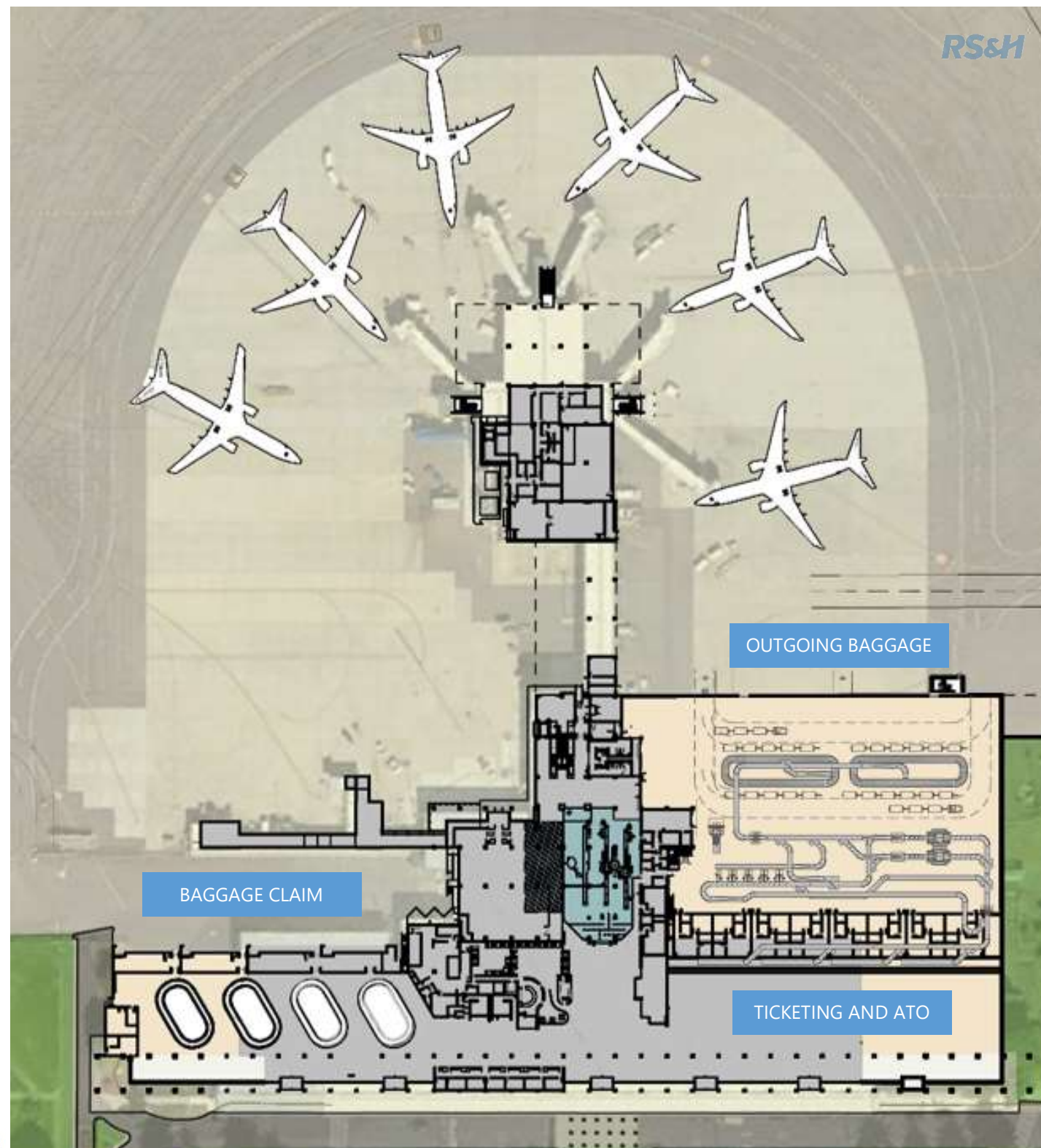


FIGURE 11-1
MAIN TERMINAL – RECOMMENDED ALTERNATIVE – EXISTING BUILDING EXPANSIONS

11.1 RECOMMENDATIONS

Each of the following subsections will describe the recommended modifications/adjustments/expansions to the primary focus areas and present a Rough Order of Magnitude (ROM) cost estimate range. The detailed analysis resulting in the recommendations are described in the body of this report and the conceptual cost estimates can be found in the appendix.

11.1.1 Ticketing and ATO Expansion

The recommended alternative to the Ticketing and ATO space relocates the ATO spaces towards the airside, increases the queuing space substantially for both existing and new ticket counter locations, and accommodates the addition of amenities in the ATO spaces as requested by the airlines. This additional 15,000 SF of increased queuing space also allows for flexibility for future airline ticketing methods such as advances in kiosks or staff-led mobile check-in. Behind the ticket counters, up to eight ATO suites with restroom and kitchenette amenities are included. The final number of ticket counter positions may vary based on the ultimate configuration of each airline's specific passenger and baggage check-in procedures (Figure 11-1).

Rough Order of Magnitude Cost: \$29,200,000 - \$34,100,000

11.1.2 Outgoing Baggage Reconfiguration and Expansion

The recommended alternative for the Outgoing Baggage modifications extends the building plan north to the proposed Concourse C walkway. This enlargement benefits all of the components in this area (Figure 11-1) such as allowing more space for baggage screening, a consolidated make-up area, better tug circulation, ease of future expansion, and area to accommodate the addition of new administrative spaces, restrooms, and other support areas adjacent to the proposed passenger walkway to Concourse C above.

To improve security and efficiency the baggage equipment concept is a fully inline automated screening system that complies with TSA's no-lift policy and has an efficient 1+1 configuration with an out-of-gauge (OOG) line merging onto the alarm line and an oversize conveyor subsystem. The absence of incline or decline conveyors makes this design optimal for bag tracking. This configuration allows for room for the upstream expansion of the checked baggage resolution area (CBRA) to accommodate future growth.

Rough Order of Magnitude Cost: \$57,300,000 - \$67,500,000

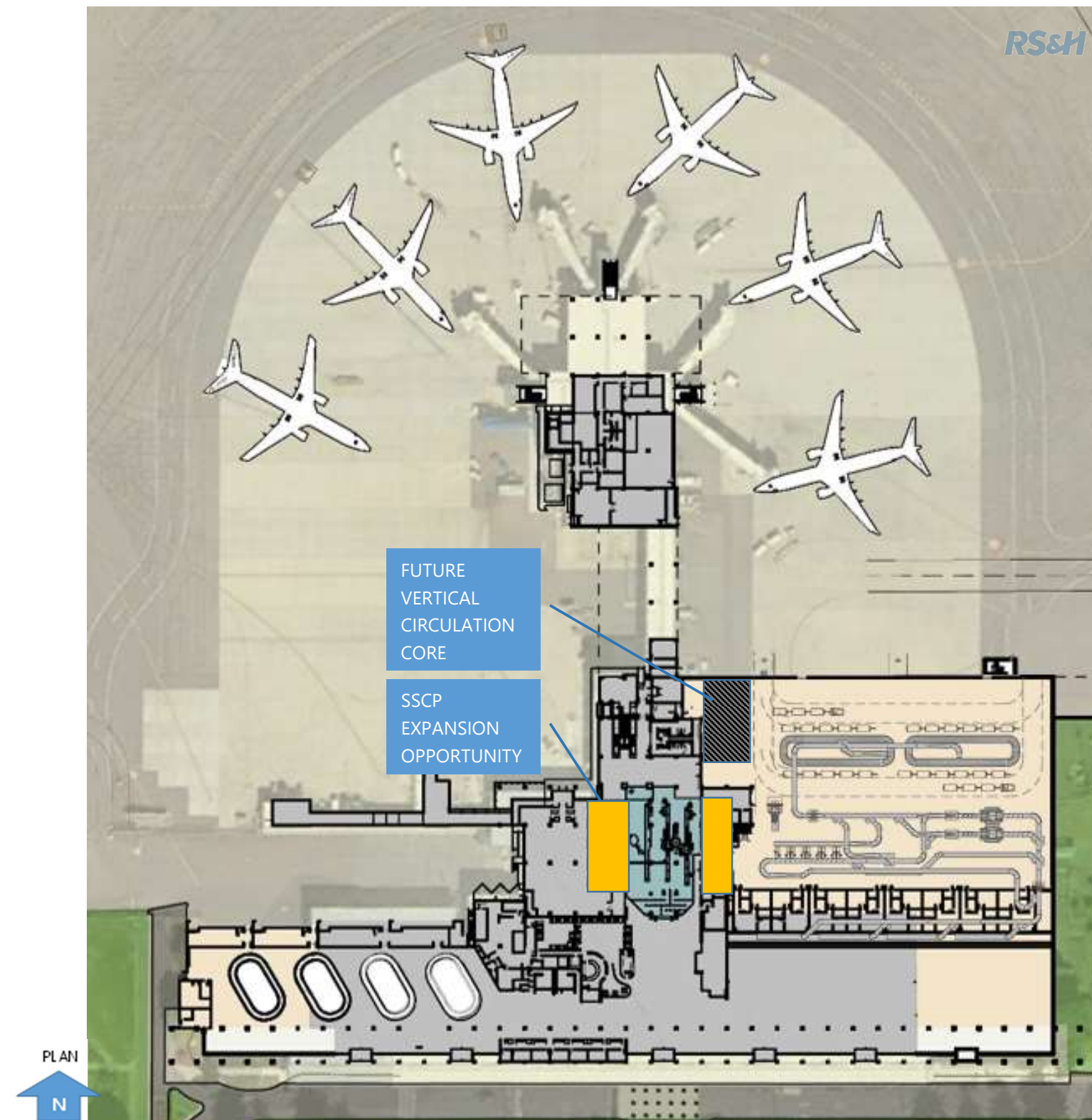


FIGURE 11-2
MAIN TERMINAL – RECOMMENDED ALTERNATIVE – ADDITIONAL SUPPORTING AREAS

11.1.3 Baggage Claim Expansion

The recommended alternative for the bag claim area consists of extending the building plan west and adding two new baggage carousels with conveyors that deposit baggage from above. The expansion will be similar to the recent improvements from 2014 and include the relocation of the existing police office area and storage at the end of the Bag Claim area (Figure 11-1).

Rough Order of Magnitude Cost: \$21,300,000 - \$25,100,000

11.1.4 Support Area Modifications

Although the following areas are currently sufficient in size, the ultimate configuration of the terminal expansion may determine that improvements to these supporting spaces are required as well.

11.1.4.1 Security Screening Checkpoint (SSCP)

As the number of gates increases, the Security Screening Checkpoint (SSCP) will need to be reviewed along with TSA staff to ensure that the throughput of the checkpoint meets the demand. While current TSA guidelines indicate smaller square footage requirements per lane due to more efficient equipment, additional space could be required. Portions of the Concourse B holdroom and the existing TSA offices and elevator could be used as SSCP expansion space with a new elevator installed as part of the Concourse C expansion. The TSA could be relocated to an area adjacent to the new administrative space on the upper level (Figure 11-2).

11.1.4.2 Expanded Vertical Circulation

To improve passenger flow and provide redundancy in the vertical circulation, there is the opportunity to provide a second escalator/stair/elevator assembly on the plan east side of the bridge to Concourse A (Figure 11-2).

11.1.5 Airport Administration

The recommended administrative space for the airport is located above the baggage handling expansion and attached to the first leg of the passenger walkway with easy access to both landside and airside facilities. As additional offices are needed for the airport or other tenants such as the TSA, this administrative area can continue to expand over the baggage handling space (Figure 11-3).

Rough Order of Magnitude Cost: \$4,000,000 - \$4,200,000

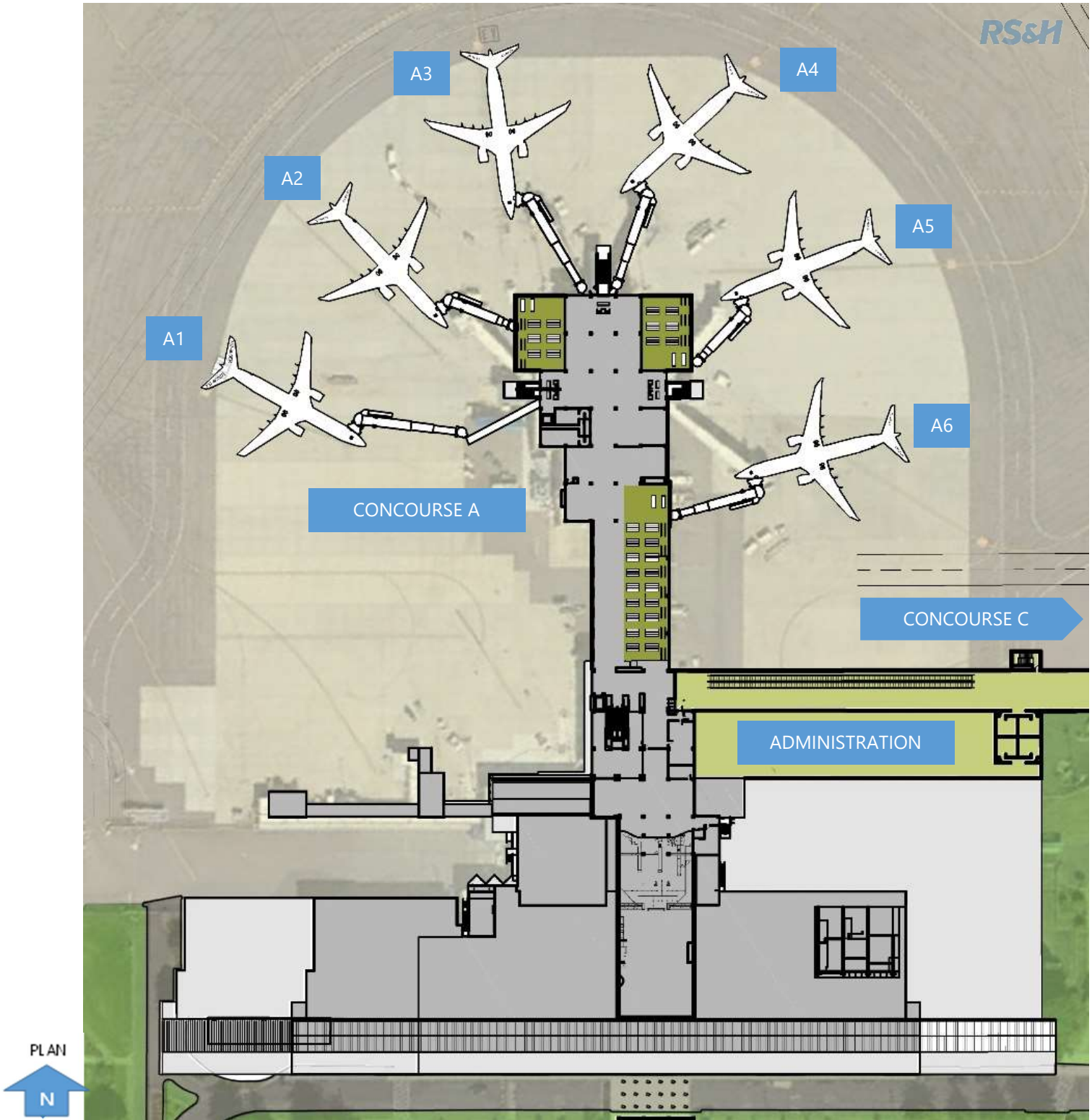


FIGURE 11-3
CONCOURSE A – RECOMMENDED ALTERNATIVE – UPPER LEVEL AND ADMIN

11.1.6 Concourse A Expansion/Modifications

The recommended alternative for Concourse A increases the holdroom spaces to more closely meet the minimum area recommended for the design aircraft, the 737 MAX 9. In this alternative, holdroom expansions would be created at Gate A2 and Gate A5 with Gate A6 relocated to the walkway bridge. Widening of the walkway bridge would provide additional seating area for both Gate A6 and the concessions nearby (Figure 11-3).

These expanded holdroom seating areas will improve the level of service for the design aircraft, and provide higher level of service for smaller regional aircraft.

The higher density of seating, and the potential comingling with adjacent concessions spaces, will likely increase concession profitability.

Rough Order of Magnitude Cost: \$9,100,000 - \$10,600,000

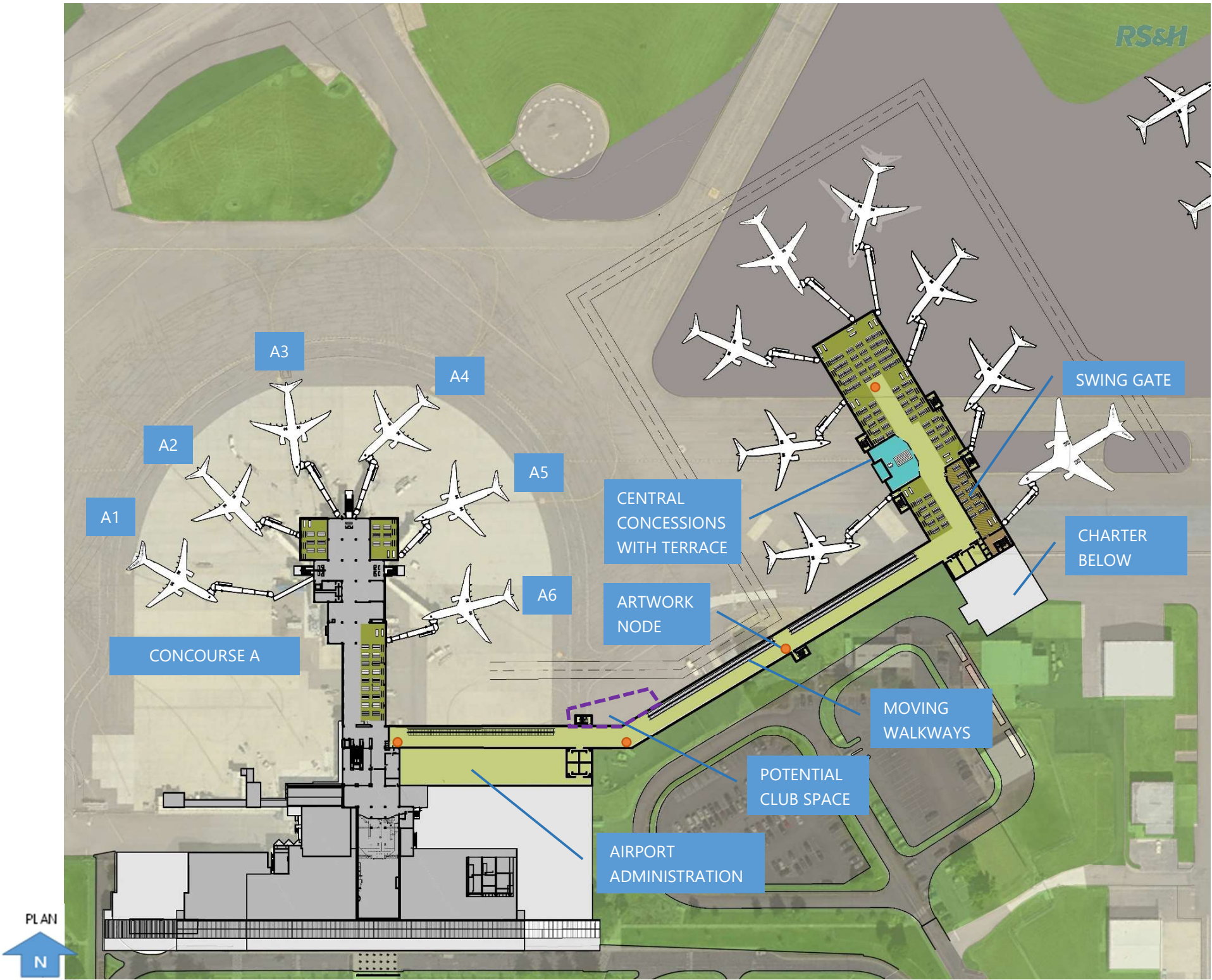


FIGURE 11-4
CONCOURSE C – RECOMMENDED ALTERNATIVE – UPPER LEVEL

11.1.7 New Concourse C

With the continued growth of airline traffic and the updated passenger data available at the time of this document, the recommended alternative for the proposed Concourse C is an 8-gate expansion. The double loaded pier offers the maximum efficiency and use of available space while the central concessions area provides unique opportunities for multiple vendors to have equal access to all the holdrooms in the concourse (Figure 11-4).

Although the walkway to Concourse C is lengthy, it provides the necessary clearance at the central alley for aircraft maneuverability and provides some additional opportunities along the procession. For example, an opportunity exists for the inclusion of a VIP club or airline club mid way between the concourses providing a sweeping view of the airfield, and artwork nodes along the journey can be placed identifying areas of interest, changeable exhibits, or other elements that define Eugene and its surroundings.

Rough Order of Magnitude Cost: \$124,500,000 - \$146,400,000

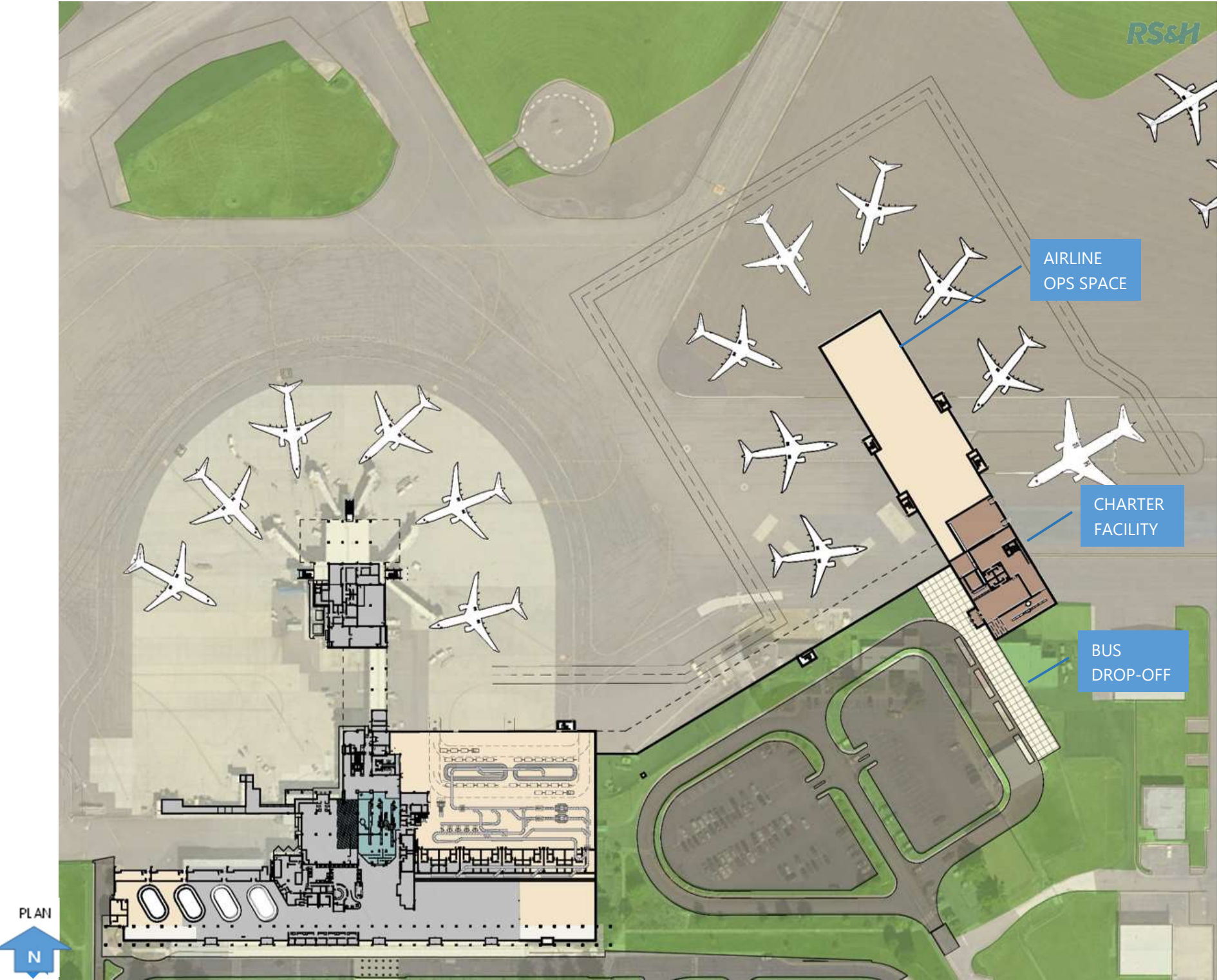


FIGURE 11-5
CONCOURSE C – RECOMMENDED ALTERNATIVE – LOWER LEVEL

11.1.8 Charter Terminal

During discussions with university representatives, the primary anticipated user of the charter terminal, a strong preference was indicated for their passengers to be completely separated from other passengers using the terminal building. This layout achieves that through the use of a swing gate (a gate area that can be closed off to standard travelers when being used for charter services, but opened up to all of Concourse C otherwise). On the lower level, the charter facility is self-sufficient and includes ticketing, passenger screening, baggage screening, baggage pick up, and access to the upper level hold rooms. A parking loop integrating existing parking approaches and layouts allows buses to drop off large groups of passengers without needing to completely redevelop the site. The remaining space is reserved for Airline Ops offices (Figure 11-5).

Rough Order of Magnitude Cost: \$8,600,000 - \$9,200,000

11.1.9 Concourse C Conceptual Images

The following pages include conceptual images of what the Concourse C expansion may look like. While these images are ideas only, further development in the next phase will refine the spaces, materials, and experience of the expansion areas to incorporate elements of the local environment and region into the design.

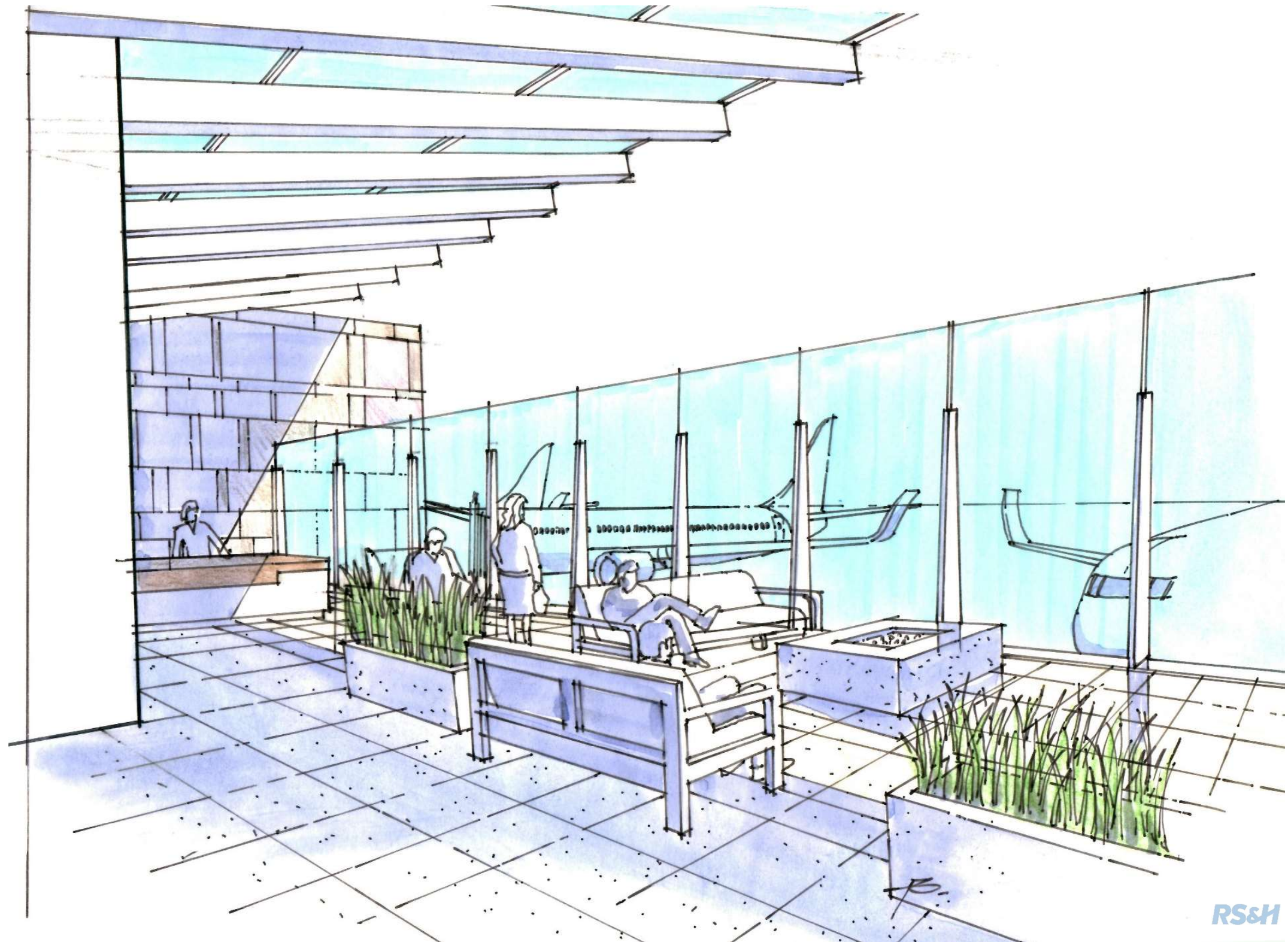


FIGURE 11-6
CONCOURSE C – TERRACE CONCEPT



FIGURE 11-7
CONCOURSE C CONCEPT – AERIAL RENDERING FROM CONCOURSE A

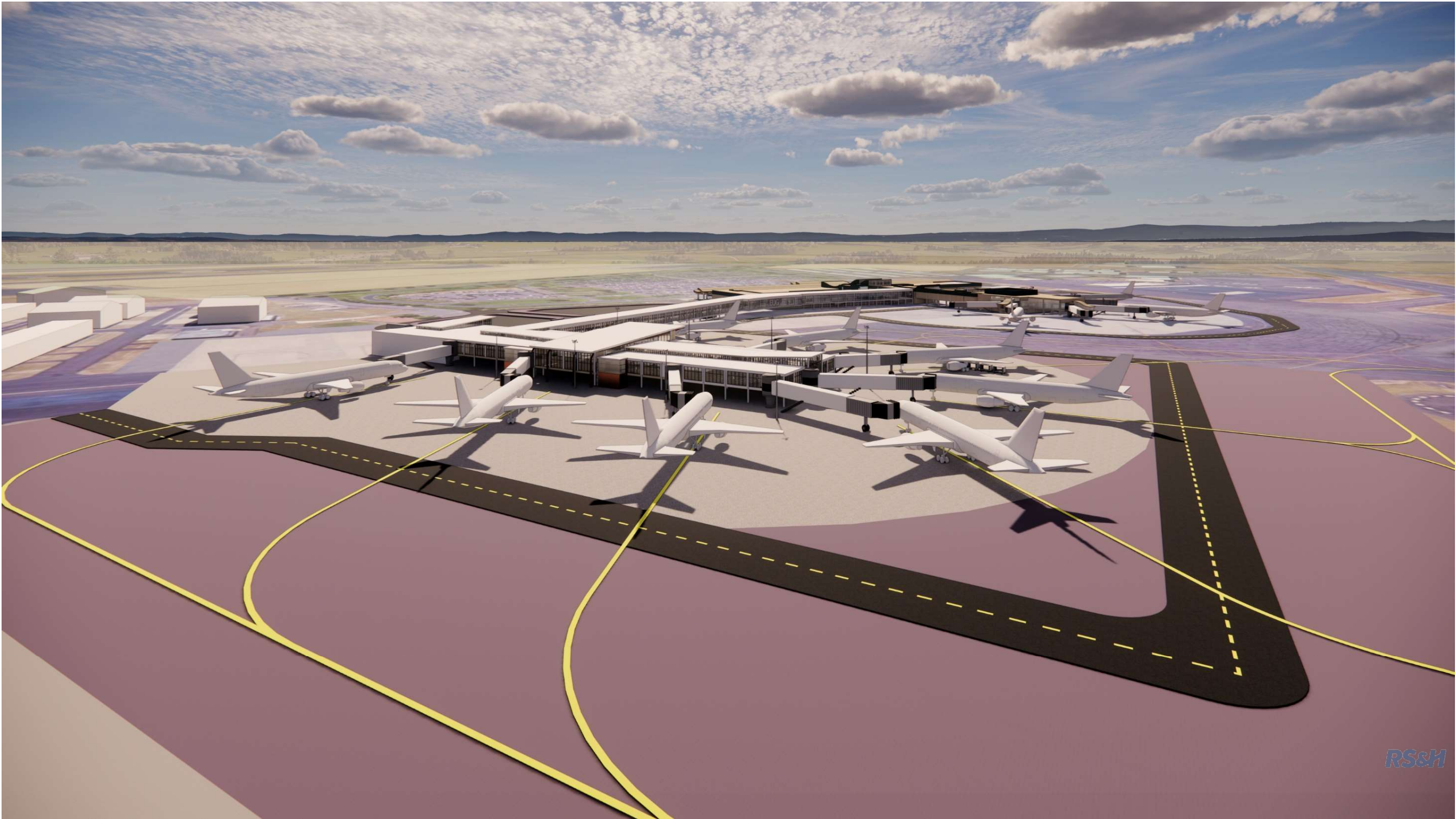


FIGURE 11-8
CONCOURSE C CONCEPT – AERIAL RENDERING FROM CONCOURSE C



FIGURE 11-9
CONCOURSE C CONCEPT – NIGHT RENDERING

CHAPTER 12

SYSTEMS CONSIDERATIONS AND ADVANCED AIR MOBILITY

12.1 STRUCTURAL CONSIDERATIONS

At the conceptual level, the primary structural considerations are construction material type and structural integration/isolation. The options to be considered are based on the size, shape, and function of the proposed expansion additions and their locations relative to the existing structure.

12.1.1 Construction Material Type

Wood, steel, reinforced concrete, and reinforced masonry are the common material construction type options. The selection of a particular material and/or system is dependent on myriad considerations: construction type (as required by the applicable building code), building occupancy classification, number of stories, overall building height, floor plan layout, and architectural programming. For the one- and two-story structures proposed for the addition expansion, steel and wood framed construction are the most efficient and economical options. This is consistent with the existing Airport buildings, which are predominantly a combination of steel and wood framing.

For this project, the combination of wood and steel framed gravity systems will likely provide the appropriate balance between economy and aesthetic functionality. Wood framing is typically more economical and steel permits longer beam spans with fewer supports and shallower beam framing, resulting in more open floor plans with pragmatic flexibility.

In addition to the gravity framing system, another key difference between wood and steel systems is the type of lateral systems used to resist wind and seismic forces. Plywood sheathed wood stud walls are economical, however they require significant lengths of solid wall segments that can be restrictive to open floor plans and highly fenestrated exterior walls. In contrast, the lateral force resisting systems in steel construction are more expensive but require fewer structural elements, permitting a higher degree of design flexibility. Steel systems comprise braced frames and moment frames. Braced frames utilize diagonal steel braces to resist lateral forces (see Figure 12-3). Moment frames rely on fixed beam to column connections to develop frame action. There are no diagonal elements in moment frames and thus they permit the most open floor plans, see Figure 12-2 for an illustration. There is a significant cost premium for moment frames due to larger heavier beam and column as well as additional welding requirements at the beam to column connections. The cost premium of moment frames is further escalated by the number of frames required; moment frames are typically weaker than braced frames, with two to three times more frames being required to support a building.

As open floor plans and flexible future re-programming spaces are desirable for the function of most of the proposed expansions, we recommend structural steel framing as the preeminent structural material used for both the gravity and lateral systems. Wood framing will be integrated where it fits within the function and layout of an expansion, for improved economy and aesthetic purposes.

Another key consideration is the future cost and availability of construction materials circa project construction. Recent world events have lead to a sharp price increase coupled with a decrease in the availability of common construction materials. Both the engineered wood and structural steel markets have been significantly impacted. The future market and lead time availability for these materials is unknown, but should be considered and discussed before making the final decision.

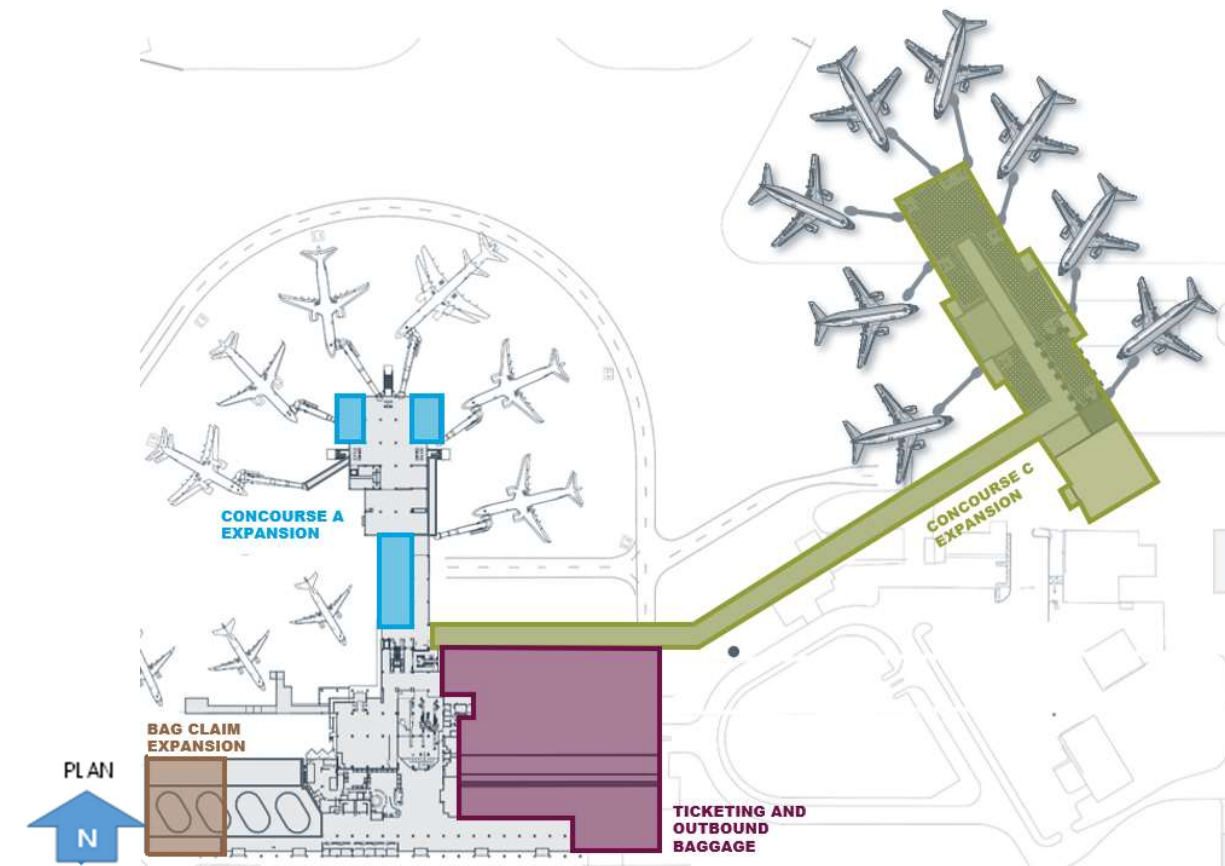


FIGURE 12-1
EXISTING BUILDINGS AND EXPANSION PLAN

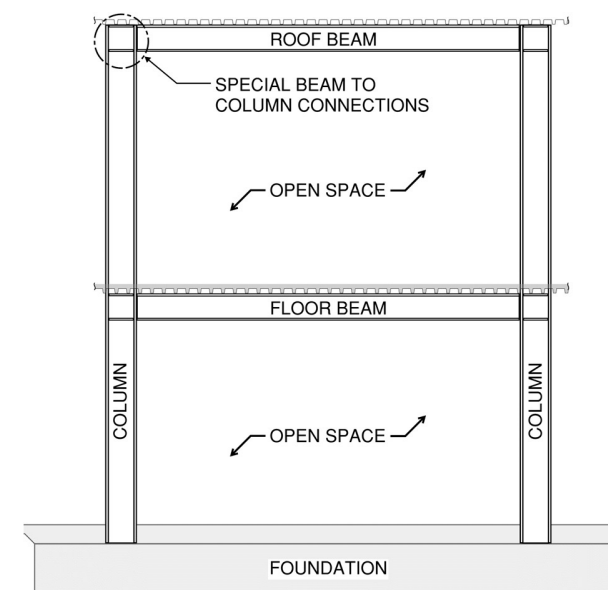


FIGURE 12-2
STEEL MOMENT FRAME ELEVATION

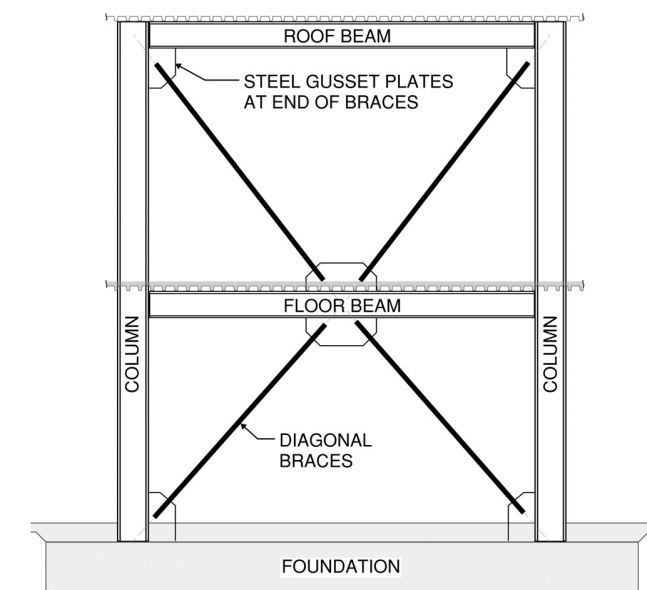


FIGURE 12-3
STEEL BRACED FRAME ELEVATION

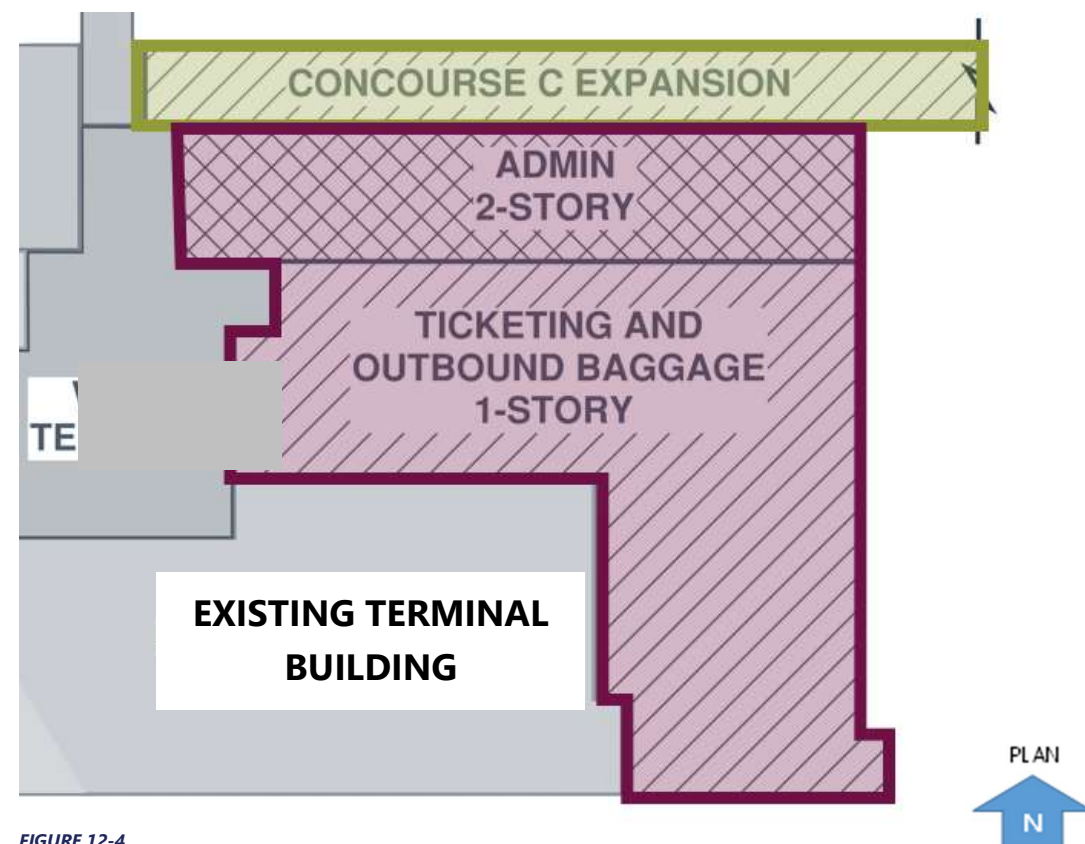


FIGURE 12-4
TICKETING AND OUTBOUND BAGGAGE PLAN DIAGRAM

12.1.2 Considerations for Integration vs. Isolation of New Structures.

When a new structure or addition is located adjacent to an existing structure there are many structural considerations and factors that affect whether the new building can be structurally integrated into the existing building or if it should be structurally independent of the existing building. The following are some of the questions to be considered:

- » Will the new building have a vertical lateral force resisting system compatible with the existing building for both strength and stiffness?
- » If they are rigidly connected can adequate load paths be developed in both the new and existing buildings?
- » New structural components will be required at the buildings' interface. How will these new members integrate with the existing structure and existing foundation system?
- » What structural components of the existing structure, including foundations, need to be modified or demolished at the buildings' interface and are there detrimental ramifications to the existing structure?
- » If the new building is not compatible with the existing structure, a seismic separation will be required.
- » What is the required size of this separation? How do MEP systems cross this separation? How is the separation waterproofed?
- » There will be redundant gravity and lateral elements on both sides of the separation. How will these systems interface at the foundation?
- » Are there construction sequencing or programming issues with either integration or isolation solutions?

12.1.3 Ticketing and Outbound Baggage

The proposed expansion for the ticketing and outbound baggage expansion occurs around the northwest corner of the Main Terminal Building, wrapping the west face until it intersects the West Terminal. The expansion will also interface with the proposed Concourse C expansion (see Figure 12-4). The proposed expansion is a single-story structure with a partial second story adjacent to the Concourse C expansion.

12.1.3.1 Ticketing and Outbound Baggage Material Construction Type

We recommend structural steel for the construction of the ticketing and outbound baggage Expansion, with wood elements integrated where appropriate. If the building layout can accommodate a significant amount of interior solid wall, a wood frame structure may be an option.

12.1.3.2 Ticketing and Outbound Baggage Considerations for the Adjacent Structures

The expansion will interface with the Main Terminal, West Terminal, and the proposed Concourse C expansion. The following are structural considerations where the expansion will interface with other structures:

- » The use of seismic separations between the new expansion and the surrounding structures.
 - The Main Terminal and West Terminal are seismically independent structures. The proposed expansion around these structures will be designed to maintain this seismic separation, thus limiting how the infill may be rigidly interconnected to the existing structures.
 - Interconnecting the structure of the Concourse C expansion with the ticketing and outbound baggage expansion may improve the structural efficiency and thus the economy of the buildings. To facilitate this type of economical design it would be beneficial for the expansions to be designed simultaneously as part of a single project.
 - The 2019 seismic evaluation identified a seismic deficiency in the existing plywood sheathed roof diaphragm of the Main Terminal. If the structure of the new expansion is rigidly interconnected with the Main Terminal, the deficiency should be addressed or the addition should be designed such that it does not impose additional force demands on the existing diaphragm.
- » There are overhangs on the north and west face of the Main Terminal Building, which can be removed so that the new expansion can abut the shell of the existing building.
- » The north exterior wall of the Main Terminal is a solid wood frame shear wall that resists lateral forces. If the wall will be fenestrated or demolished in order to join the new and existing spaces, then a new lateral resisting element may be necessary within the existing structure.
- » The existing foundations of the Main Terminal are typically concrete pile caps with piles. New columns should be located clear of existing pile caps so that new load is not imposed on the existing piles.

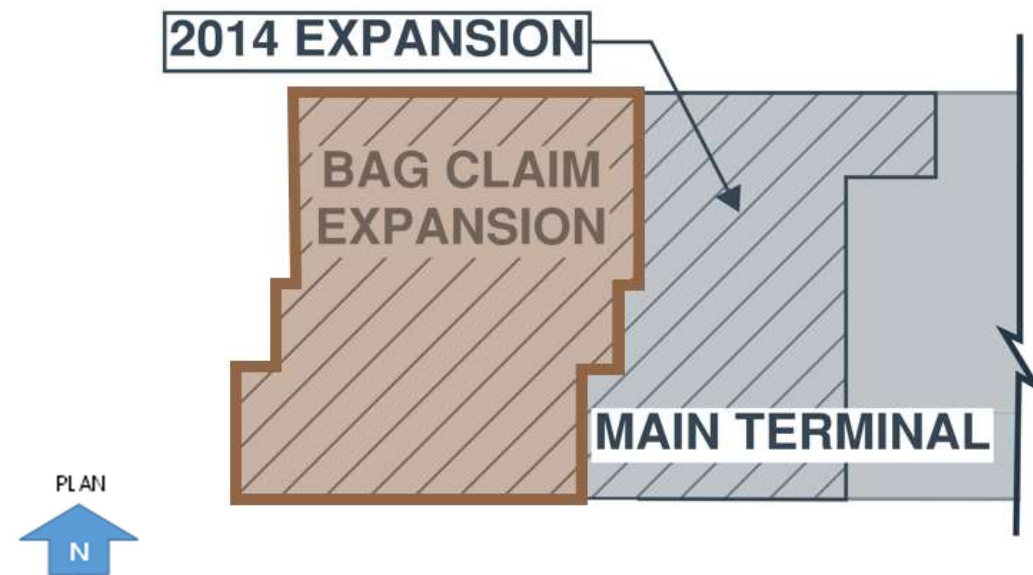


FIGURE 12-5
BAG CLAIM EXPANSION PLAN DIAGRAM

12.1.4 Bag Claim Expansion

The existing bag claim occurs in the southwest corner of the Main Terminal and was constructed during the 2014 expansion. The proposed bag claim expansion extends the existing one-story structure to the southwest (see Figure 12-5).

12.1.4.1 Bag Claim Expansion Material Construction Type

To facilitate an open floor plan, we recommend construction materials similar to the existing Main Terminal, which consists of a combination of wood and steel framing. Roof construction is plywood over wood I-joists, with glulam girders. The girders are supported from steel columns. Lateral forces are resisted by a combination of steel moment frames and wood frame shear walls; shear walls are used in locations where solid walls fit into the floor plan.

12.1.4.2 Bag Claim Expansion Considerations for the Adjacent Structures

The following are structural considerations between the existing Main Terminal Building and the proposed bag claim expansion:

- » If the gravity and lateral systems of the proposed expansion are similar to that of the existing building, then interconnecting the structures without a seismic separation is an option. Interconnecting structures is typically more economical than installing a seismic separation.
- » The southwest exterior wall of the Main Terminal is a solid wood frame shear wall that resists lateral forces. If the wall will be fenestrated or demolished in order to join the new and existing spaces, then a new lateral resisting element may be necessary within the existing structure.

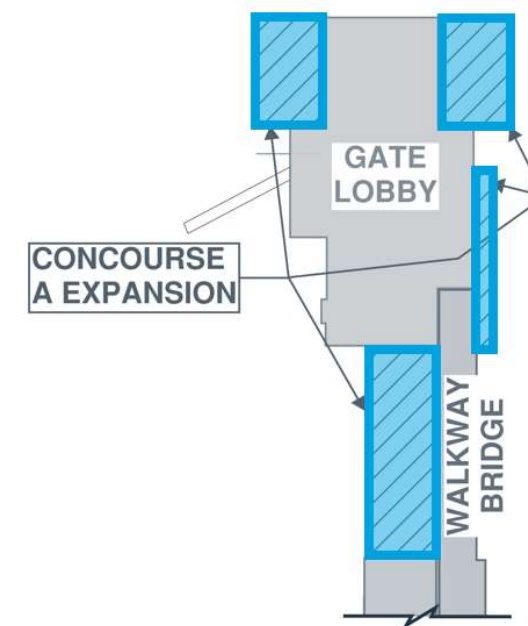


FIGURE 12-6
CONCOURSE A EXPANSION PLAN DIAGRAM

12.1.5 Concourse A Expansion

The proposed Concourse A expansion includes three additions around the Gate Lobby, Walkway Bridge, and Vertical Circulation, see Figure 12-6.

12.1.5.1 Concourse A Expansion Material Construction Type

To facilitate open floor plans, we recommend construction materials similar to the existing Gate Lobby and Walkway Bridge, which consist of structural steel with moment frames for lateral resistance. Alternatively, to reduce the size of seismic separation joints and to improve economy, steel braced frames may be utilized where appropriate.

12.1.5.2 Concourse A Expansion Considerations for the Adjacent Structures

The following are structural considerations where the expansion will interface with other structures:

- » The use of seismic separations between the new expansion and the surrounding structures.
 - The Walkway Bridge, Gate Lobby, and Vertical Circulation are structurally independent structures. The proposed infill expansion between these structures will be designed to maintain this seismic separation, thus limiting how the infill may be rigidly interconnected to the existing structures.
 - The 2019 Seismic Evaluation identified a seismic deficiency in the connection of the floor and roof diaphragms to the steel moment frames of the Gate Lobby and Walkway Bridge. The floor and roof diaphragms are not directly connected to the wide flange steel moment frame girders, as these girders are dropped below the wide flange steel beams. Additional seismic load should not be imposed on the existing structures without retrofit.
- » At the perimeter of the buildings, the existing foundations are typically shallow continuous grade beams and are in the range of five feet to six feet wide.
 - New columns will be located near the existing structure and may be supported on the existing concrete grade beams. Supplemental concrete will likely be needed to strengthen the existing foundations. This approach will require consultation with a geotechnical engineer, as they can advise on considerations such as settlement, allowable soil bearing pressures and underpinning requirements.
 - Alternately, as programming permits, new columns may be located beyond the existing grade beam and supported on new foundations thus reducing the potential for settlement and underpinning of the existing structure.

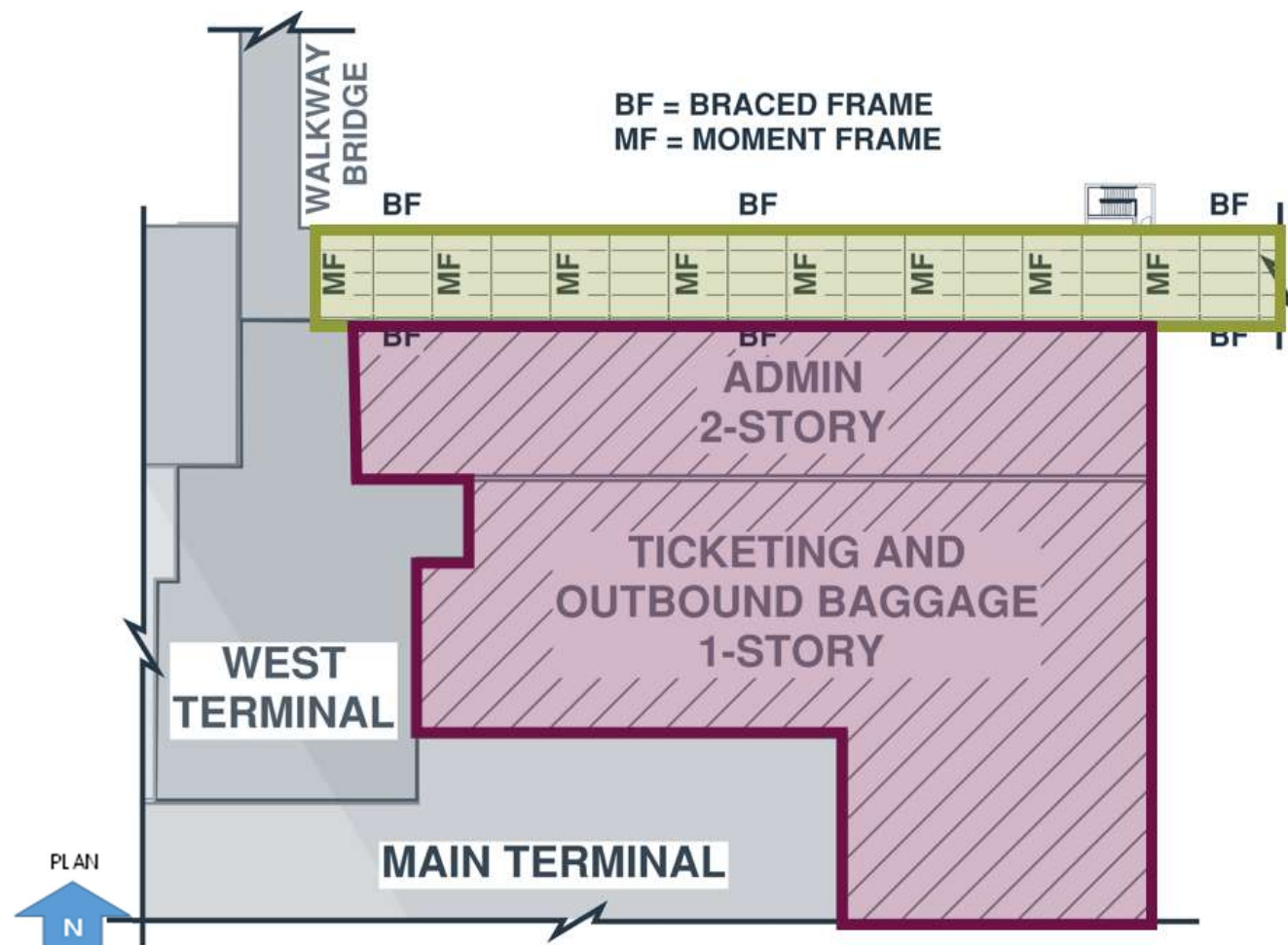


FIGURE 12-7
CONCOURSE C EXPANSION OPTION 1 – PRELIMINARY CONCEPT FRAMING DIAGRAM

12.1.6 Concourse C Expansion

The proposed Concourse C expansion includes a walkway extending out to a new terminal. The walkway consists of a two-story structure with part of the ground floor open to the exterior with the intended use of covered storage and staging. The expansion will interface with the Walkway Bridge, West Terminal Building, and the ticketing and outbound baggage expansion.

12.1.6.1 Concourse C Expansion Material Construction Type

The second story of the expansion typically consists of a long open corridor which requires an open floor plan, making structural steel an appropriate framing material. One option is to utilize moment frames in the transverse direction to provide open corridors, with braced frames in the longitudinal direction where braces can be located inboard of and parallel to the exterior walls. See Figure 12-7 for a conceptual framing diagram.

12.1.6.2 Concourse C Expansion Considerations for the Adjacent Structures

The expansion will interface with the Walkway Bridge, West Terminal Building, and the ticketing and outbound baggage expansion. The following are structural considerations where the expansion will interface with the surrounding structures:

- » The use of seismic separations between the new expansion and the surrounding structures.
 - The Walkway Bridge and West Terminal are structurally independent structures. The proposed expansion between these structures will be designed to maintain this seismic separation, thus limiting how the infill may be rigidly interconnected to the existing structures.
 - Interconnecting the structure of the Concourse C expansion with the ticketing and outbound baggage expansion may improve the structural efficiency and thus the economy of the buildings. To facilitate this type of economical design it would be beneficial for the expansions to be designed simultaneously as part of a single project.
 - The 2019 seismic evaluation identified a seismic deficiency in the connection of the floor and roof diaphragms to the steel moment frames of the Walkway Bridge and West Terminal Building. The floor and roof diaphragms are not directly connected to the wide flange steel moment frame girders, as these girders are dropped below the wide flange steel beams. Additional seismic load should not be imposed on the existing structures without retrofit.
- » At the building interface, the existing foundations of the Walkway Bridge and West Terminal extend in the range of 6'-0" to 10'-0" from the perimeter columns.
 - New columns may be located near the adjacent structure and supported on the existing footings. Supplemental concrete will likely be needed to strengthen the existing foundations. This approach will require consultation with a geotechnical engineer, as they can advise on considerations such as settlement, allowable soil bearing pressure, and underpinning.
 - Alternately, as programming permits, new columns may be located beyond the existing grade beam and supported on new foundations thus reducing the potential for settlement and underpinning of the existing structure.

12.2 COMMUNICATIONS/SECURITY CONSIDERATIONS

The existing communications and security systems will be extended to serve the ticketing / outbound baggage, bag claim, Concourse A, and Concourse C expansions. The sizing and location of a new MDF and new IDF rooms to serve these areas will consider day one requirements as well as space for future expansion, comply with Building Industry Consulting Service International, Inc. (BICSI) and Telecommunications Industry Association (TIA) standards and be connected via homeruns of 24 strand single-mode fiber optic cable. The new MDF and existing MDF will be connected via multi-mode and single mode fiber as required to support City-managed IT systems (data, access control, video surveillance, Wi-Fi and telephone) and systems belonging to tenants (airlines/vendors). The telephone demarc located in the existing MDF will remain (refer to Figure 12-9).

For ease of maintenance, system components specified will be the same manufacturer and model of the existing systems installed and maintained by firms contracted by EUG. These components include access control panels, card readers, power supplies, electronic locks, video surveillance cameras, and network recording. The security systems will be managed, monitored, and controlled by EUG Airport Security.

12.2.1 Access Control System

The existing Access Control System (ACS) is a CCure system manufactured by Software House. The field-installed panels are IP addressable iStar Pro controllers and will be expanded to address the requirements to comply with the design criteria. Refer to Figure 12-8 for a typical security equipment wall elevation. Card readers with integrated keypads will be used at SIDA and AOA entry points, equipment rooms, and other areas as determined during design.

Locking arrangements for the access-controlled doors will be designed to meet TSA and life safety code requirements. Doors separating the sterile area from public areas or the AOA will be equipped with time-delay locking where allowed by code. Where allowed, these doors will be provided with card readers on both sides to allow authorized users to enter or exit the sterile area.

12.2.2 Networked Video Management System

The existing Networked Video Management System (NVMS) will be expanded to address the video surveillance requirements necessary to comply with the design criteria. Multi-sensor cameras providing a 180-degree view will be installed to provide coverage of the concourse interior and holdroom areas. Entry and exit to the SIDA or AOA, passenger loading bridge doors, and elevators will be monitored by high resolution fixed cameras. Additional PTZ cameras will be used as a secondary means of surveillance along the concourse and where requested by Airport Security. All-new cameras will be configured to automatically queue up video to the ACS workstations during an alarm event. The project will include an expansion of the existing NVMS storage to record all new cameras for a minimum of 30 days.

12.2.3 Data/Cabling Design

The design contains telecommunications infrastructure to support the ticketing / outbound baggage, bag claim, Concourse A, and Concourse C expansions, including premise distribution, conduit, cable tray, fiber optic and copper cabling, work area outlets for voice/data, and Wi-Fi systems. The design includes new telecommunication rooms with equipment cabinets, open frame racks, communication enclosures, and grounding and bonding. Single-mode backbone fiber optic cabling will be extended from the existing Main Distribution Frame room (MDF) to each new comm room in a star topology.

Work area outlets will consist of faceplates and jacks connected to horizontal copper cables to support both voice and data connectivity to the new IDF rooms in the ticketing / outbound baggage, bag claim, Concourse A, and Concourse C expansions. Gate check-in counters will have voice/data cabling for both common use and (where required) airline-specific systems routed to dedicated shared comm rooms. Ceiling mounted outlets will be connected to Wi-Fi wireless access points throughout the ticketing / outbound baggage, bag claim, Concourse A, and Concourse C expansions.

12.2.3.1 Premise Distribution

New cable trays and conduits will be provided to extended backbone cabling from the new MDF to the new IDF rooms in the ticketing / outbound baggage, bag claim, Concourse A, and Concourse C expansions. In addition to the cable tray, a minimum of two (2) 4-inch conduits will be provided with one (1) dedicated for EUG use and one (1) for use by the airline(s) or others. Connectivity for low voltage systems will be provided by fiber-optic backbone cabling installed in the conduits or cable tray back to the new MDF. New multi-mode and single mode fiber will be provided

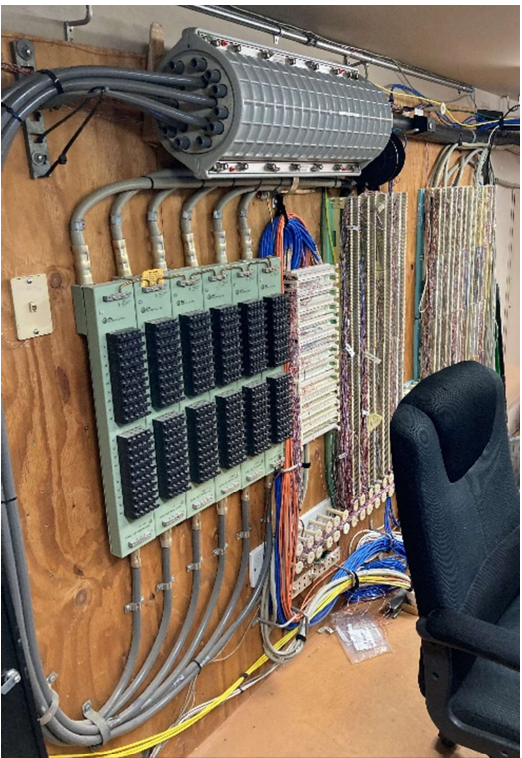


FIGURE 12-9
EXISTING TELEPHONE DEMARC

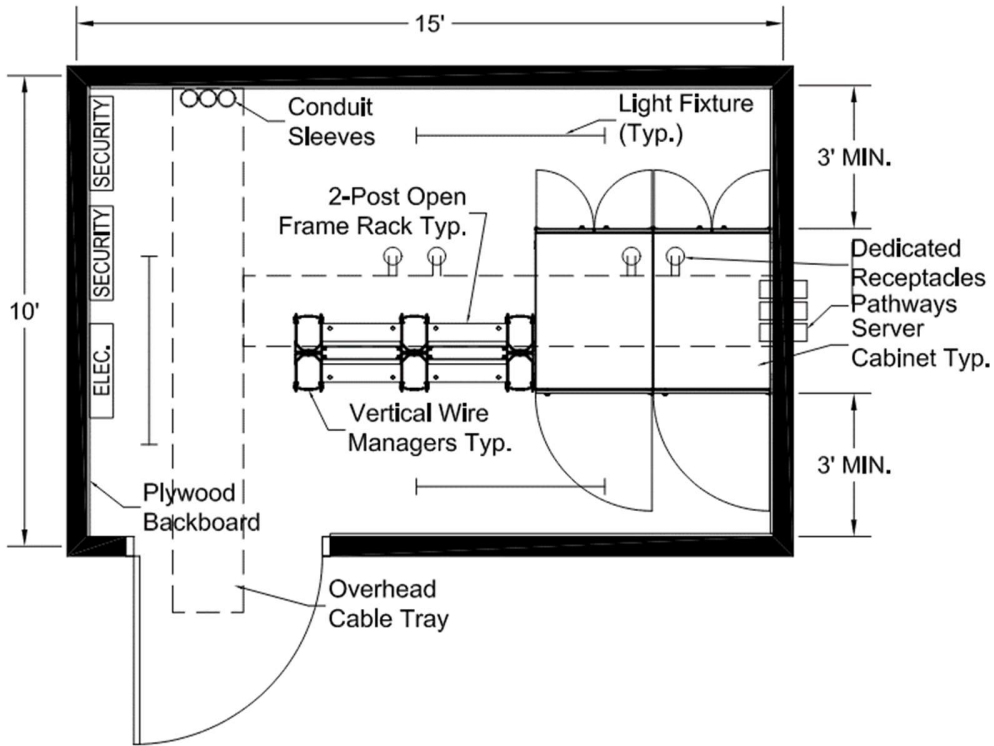


FIGURE 12-8
TYPICAL IDF ROOM LAYOUT (MINIMUM)

as required to support existing Airport systems (data, access control, video surveillance, Wi-Fi and telephone) and systems belonging to tenants (airlines/vendors).

Cable trays, conduits, surface-mounted raceways, and other cable pathway requirements, including j-hooks and sleeves for building interiors, will be specified with sizes identified by the requirements based on fill capacities, cable size, quantities of cables, separation requirements for each area, with vertical/riser cable supports, conduit and outlet box requirements for work area outlets, conduits, pull boxes, etc.

12.2.3.2 Telecommunications Room

The design will provide additional comm rooms to serve communications equipment in the ticketing / outbound baggage, bag claim, Concourse A, and Concourse C expansions. These rooms will be designed to support the termination of backbone cables, and horizontal cable (copper and fiber) for EUG and airline systems. Lockable equipment cabinets and open frame equipment racks will be provided for termination hardware, network switches, uninterruptible power supply (UPS) with backup batteries, and space allocated for future expansion. The design will also include provisions for cable management, cable runways, and backboards in the room.

UPS power fed by emergency power circuits will be provided by electrical (Div 26) to power the communications equipment and other critical systems located in the equipment rooms.

Work Area Outlets (WAO) served	Minimum floor space (ft2)	Typical dimensions (ft)
Up to 200	150	10 X 15
201 to 800	400	20 X 20
801 to 1600	800	20 X 40
1601 to 2400	1200	30 X 40

TABLE 12-1
MINIMUM FLOOR SPACE (FROM TIA-569-C)

12.2.3.3 Physical Characteristics

IDFs will have a minimum of 150 square feet (10' x 15'). Refer to Table 12-1 for the minimum recommended room sizes based on the number of WAOs served.

IDFs will be secure rooms for the termination of backbone and horizontal cables and be accessible from the designated area being served and on the same level. For example, airside hold rooms will have a local, airside IDF and landside ticket counters will have a local, landside IDF. Within the room, lockable equipment cabinets and/or two-post equipment racks with wire managers will be provided to mount patch panels, wire management, active network devices, and other communications equipment. Entrance doors must swing out and be a minimum of 3' wide by 80" tall, or larger if necessary for the equipment to be installed with a minimum clear height of 10' between the finished floor and the ceiling or the lowest point of clearance.

IDFs will also be free of pipes and ductwork not specifically serving equipment within the space and must not share space with other equipment (electrical, mechanical, plumbing, etc.) or other services (janitorial, storage, etc.). IDFs will be dedicated spaces supporting telecommunications and low voltage systems equipment.



FIGURE 12-10
EXISTING WALL-MOUNTED SECURITY EQUIPMENT IN MDF



FIGURE 12-11
EXISTING EQUIPMENT RACKS IN MDF

12.2.3.4 Telecommunications Grounding And Bonding

Grounding requirements for telecommunications equipment, including racks, cabinets, enclosures, cable runways, etc. will be provided. Requirements will include shielded/metallic armored cables, entrance protectors, and grounding at cable tray and metallic conduit locations. Requirements for both the electrical contractor and the telecommunications contractor will be provided in the written specifications and drawings.

12.2.3.5 Voice/Data Campus And Backbone Cables

Connectivity for voice/data, fire alarm, access control, and video surveillance service will be provided by fiber-optic backbone cabling installed in new and existing cable trays and conduits from the existing MDF (Figure 12-10, Figure 12-11) to the Concourse B expansion comm rooms. Termination hardware to support incoming and outgoing data networks and telephony will be provided for by the communications design and pathways for fiber optic and copper backbone cables and termination hardware will be specified to support connections within the concourse. Fire alarm control panels (FACPs) located in Concourse B expansion will be connected back to the terminal via fiber cables as part of the data design and these FACPs will connect back to the comm center on dedicated fiber for connectivity into the existing system.

12.2.3.6 Horizontal Cabling

The design for horizontal cabling from the Concourse B expansion comm rooms will include category 6 cabling to RJ-45 jacks (white for voice, blue for data, gray for Wi-Fi) and faceplate with proper labeling. Plenum rated cables will be supported on J-hooks and routed to the nearest cable tray where installed above the suspended ceilings. Cables will be installed in conduit where exposed or required by code.

12.2.3.7 Wireless Fidelity (Wi-Fi) Design

The design will include an expansion of the Airport's existing Wi-Fi system including horizontal cabling from to the IDF rooms with category 6 cabling to gray RJ-45 jacks and faceplates terminated above the suspended ceilings and terminated in the equipment cabinets/racks. Plenum rated cables will be supported on J-hooks and routed to the nearest cable tray and cables will be installed in conduit where exposed or required by code.

12.2.3.8 Cable Television (CATV) Distribution Design

The design will include infrastructure to extend the existing CATV distribution system to new IDF rooms and include new coax from the comm room to taps above the suspended ceiling for connection of jumpers to TV outlets. Specific requirements will be defined during the design phase of the project.

Provisions for mounting radio antennas or satellite dishes will be provided on the roof with an empty conduit to the nearest comm room. The antenna mounting will provide space for the tenant and service provider equipment and will also provide space for mounting Land Mobile Radio antennas for airport, airline, public safety, and ground handling communications. Specific requirements will be defined during the design phase of the project.

12.2.4 Paging System Design

The existing analog paging system and headend equipment (manufactured by Bogen) is located in the existing MDF above baggage makeup. This system will remain however, it is recommended a new IP based paging system be included for new and renovated areas where feasible as an eventual facility-wide replacement system. The design will include horizontal cabling for speakers and ambient noise sensors to the IDF rooms. Cables will be installed above the suspended ceilings and terminated in the equipment cabinets/racks. The design will include a dedicated network, PoE switches, speakers, microphones, and amplifiers. Where necessary, equipment matching the existing equipment will be provided. Plenum rated cables will be supported on J-hooks and routed to the nearest cable tray where installed above the suspended ceilings. Cables will be installed in conduit where exposed or required by code. Pages will be made using the VoIP phone system and separate paging microphones. A tie between the two systems will be provided to facilitate automated announcements and pages from the connected microphones on either system or the VoIP phone system.

12.2.5 Flight Information Display System (FIDS) Design

Flight information displays (FIDS) will be provided as coordinated with EUG and the architect. The FIDS will be an extension of the airports existing system. Category 6 data cabling for each FIDS will be routed to the nearest IDF room and terminated in the equipment cabinets/racks. Where required, category 6 data cabling for airline branded FIDS/GIDS (as coordinated with the airlines and the architect) will be routed to the Concourse B expansion comm rooms and terminated in the airline racks.

12.2.6 Voice Over Internet Protocol (VoIP) System Design

Telephones will be an extension of the Airport's existing VoIP phone system. Handsets will be provided by EUG. Provisions for the connection of telephone handsets will be provided at gate check-in counters, passenger boarding bridges, and any Airport or airline information space. Provisions for additional VoIP telephones will be provided as coordinated with EUG during the design. Category 6 data cabling for the phones will be routed to the nearest IDF room and terminated in the equipment cabinets/racks.

12.3 MECHANICAL CONSIDERATIONS

Mechanical considerations include the selection of systems to serve the ticketing / outbound baggage, bag claim, Concourse A, and Concourse C expansions. Considerations and recommendations in the HVAC design for the airport expansion are based on existing conditions, initial costs as well as operation and maintenance costs, replacement costs, the life and serviceability of the building to provide the best benefits and solutions to the airport. All these recommendations and measures will be evaluated in more detail during design phase for implementation into the construction documents.

The new terminal expansion includes ticketing / outbound baggage, bag claim, Concourse A, and Concourse C. A preliminary HVAC block load calculation was performed to estimate the cooling and heating demands and requirements for the recommended alternative layouts. The expected occupancy of each option was estimated based on the forecasted passenger flow simulation, discussed earlier in this report. Eugene, Oregon resides in Zone 4 of the ASHRAE 90.1 Climate Zone Map, therefore, the zone 4 minimum construction requirements were assumed for building envelope including walls, roofs, windows, doors, etc. Each expansion and its respective options will be explored below.

Pricing for mechanical, electrical and plumbing options are included in the cost estimates at an average cost per square foot. The details of options listed in these chapters may significantly change based on the ultimate design of the building envelope or where modifications to the existing building or systems are required.

12.3.1 Ticketing/ATO and Outbound Baggage

For this expansion area, although there were three initial options from a buildings and equipment perspective, there are only two options to consider in relation to HVAC loads and one final recommended alternative to consider. Looking at the ticketing and ATO area Option 1, shown in Figure 9-5, it is a single-level layout with the addition of space area. Option 2, shown in Figure 9-6, is a two-level design that finds the ATO offices placed on the second floor. For the outbound baggage area, the first two options, shown in Figure 8-3 and Figure 8-4, are single-level designs and the third outbound baggage option, shown in Figure 9-4 and Figure 9-3, is a two-level design. Based on the construction assumptions, the maximum simultaneous occupancy load, the space types, and allocation of people, the loads are summarized in Table 12-3.

Area – Option #	Tons of Cooling	MBH of Heating
Ticketing and ATO Recommended Alt	40	200
Outbound Baggage Recommended Alt	45	160

TABLE 12-3
TICKETING AND OUTBOUND BAGGAGE SUMMARY

It is proposed that these areas will be served by a variable air volume (VAV) system utilizing 2/4 pipe AHUs and terminal units for zone temperature control. The outbound baggage area will be heated with hot water unit heaters and ventilated with makeup air unit(s).

12.3.2 Baggage Claim

For this expansion area, only one architectural layout option was explored. The existing bag claim area is to be extended to add two new baggage claim carousels. The expansion, depicted in Figure 9-7, consists of approximately 10,000 square feet of additional baggage claim space. Based on the construction assumptions, the maximum

Area	Tons of Cooling	MBH of Heating
Bag Claim	20	120

TABLE 12-2
BAG CLAIM SUMMARY

simultaneous occupancy load, the type of space, and allocation of people, the loads were calculated and summarized in Table 12-2. It is proposed that these areas will be served with new single zone VAV AHU.

12.3.3 Concourse A Expansion

For Concourse A and the connector expansion, Option 2, illustrated in Figure 9-8, adds two new holdroom spaces, and a new concessions area. Based on the construction assumptions, the maximum simultaneous occupancy load and the types of space the people are allocated to, the preliminary loads are shown in Table 12-4.

It is recommended to replace all of the existing fan coil units with a new Variable Air Volume air handling unit and VAV terminal hot water reheat units to serve the existing concourse and the proposed expansion options.

Area – Option #	Tons of Cooling	MBH of Heating
Concourse A Concession – Option 2	20	120
Concourse A Holdroom North – Option 2	12	75
Concourse A Holdroom South – Option 2	15	80
Total Option 2 (Recommended)	50	275

TABLE 12-4
CONCOURSE A SUMMARY

12.3.4 Concourse C Expansion

Concourse C is the primary expansion expected as part of the Advanced Terminal Planning project. Although five architectural options were detailed in Figure 9-10 through Figure 8-16, they all are similar in square footage and program. Therefore, only the recommended alternative for the Concourse C expansion was considered for the purposes of producing the HVAC load assumption. The recommended alternative includes an updated program and scope and consists of of holdroom space, concessions, lower and upper levels charter space combined with ops space. Based on the construction assumptions, the maximum simultaneous occupancy load, the space types, and allocation of people, the loads were calculated and summarized in Table 12-5.

Area	Tons of Cooling	MBH of Heating
Concourse C Charter – Recommended Alt	30	165
Concourse C Concession North – Recommended Alt	8	45
Concourse C Corridor – Recommended Alt	55	250
Concourse C Holdroom – Recommended Alt	100	415
Total Recommended Alt	193	875

TABLE 12-5
CONCOURSE C SUMMARY

It is recommended that Concourse C and its connector be served by a Variable Air Volume air handling unit and VAV terminal hot water reheat units.

12.3.5 Main System Selection

Various building Heating Ventilation and Air Conditioning (HVAC) systems were evaluated to determine the best viable method to provide HVAC to Eugene Airport Terminal and Expansion. The largest mechanical consideration is to build a new central cooling and heating plant (central plant) near new Concourse C. Other options are discussed below.

12.3.5.1 Option 1 – One New Central Cooling and Heating Plant for the Entire Airport

Option 1 would be to abandon the existing central plant and provide new service to both the existing building and new building expansions from a new central cooling and heating plant located within the main terminal. This option would be considered the most ambitious approach, however it would prepare the airport for their future needs and provide the best operations and maintenance options in the future. The central plant would be located in the new Concourse C or near the circulation space. The new heating and cooling plant would be sized to meet the demands of the existing terminal and the new expansions and it would also be sized for future expansions by providing space for future equipment, such as chillers, boilers, pumps, etc. The main chilled and hot water distribution piping would be sized for this future expansion also and would provide tapped tees for continuation of the system.

Benefits: The central cooling and heating plant is capable of higher efficiencies and energy savings due to the large size of the systems and the diversity of the locations served. Additionally, having one centralized location for major equipment, with a new and modern central plant design, would greatly improve operations and maintenance costs.

Drawbacks: This option may abandon some equipment with useful life remaining with significant phasing, coordination, demolition, and construction cost implications as all the chilled water and hot water main piping would have to be demolished and replaced with new service from the new central plant. This option has the highest first cost price.

12.3.5.2 Option 2 – Existing and New Central Cooling and Heating Plant

Option 2 considers serving the Concourse A, bag claim and ticketing / outbound baggage expansions from the existing central plant. An existing HVAC plant capacity evaluation will need to be completed to determine if the plant has the capacity for the additional loads. If it is deemed insufficient, certain portions of the HVAC plant such as chillers, heat exchanger, boilers, pumps (chilled water, condenser water, hot water) or fluid coolers would have to be added to meet the additional loads. A new centralized chilled water and hot water plant would be provided to serve Concourse C and potential future expansion within that area of the facility.

Benefits: With respect to Option 1, there are significantly less phasing, demolition, and construction cost implications, as most of the existing system is retained but some equipment may need to be replaced. This option also has a lower first cost price as the new cooling and heating plant would be smaller than the one proposed in Option 1.

Drawbacks: The airport will have two central cooling and heating plants that require operation and maintenance in different locations.

12.3.5.3 Option 3 – Packaged DX Roof Top Units

Option 3 serves all the new expansion areas with VAV packaged DX roof top equipment. The existing central plant would stay in operation serving the existing areas, but no additional cooling or heating capacities would be added and this option would eliminate the need for a new central plant in Concourse C. The quantity of RTUs would be determined by block load calculations and zoning.

Benefits: Lowest first cost. Minimal phasing, demolition, and construction cost implications as all of the existing system would be retained, and no chilled water and hot water piping replacement would be required.

Drawbacks: Packaged DX roof top equipment is less efficient than central cooling and heating plant served equipment. Decentralized equipment is more time consuming and difficult to maintain than centralized equipment.

12.3.6 Sub System Selection

Under Options 1 and 2 as noted in 12.3.4, the central cooling and heating plants must be paired with a sub system. All new expansions including Concourse A, bag claim, ticketing / outbound baggage expansions and Concourse C expansions could be served with FCUs or AHUs, although Concourse C will most likely be served by AHUs. Each area should be considered individually. The final design may utilize a combination of FCUs and AHUs. These two options will be explored below.

12.3.6.1 Option 1 – New FCUs

In some locations, new FCUs can be installed. A dedicated outside air unit would be ducted to the mixed air plenum of the FCUs to provide the necessary outside requirements. Chilled and hot water supply and return lines would be extended and provided from the existing or new central plant.

Benefits: This Option 1 drastically minimizes the scope of work compared to Option 2 and has the lowest first cost. All existing air handling and fan coil units remain. Minimal demolition is needed.

Drawbacks: As previously noted, the four pipe FCU system is energy intensive. Decentralized equipment is harder to maintain than centralized equipment.

12.3.6.2 Option 2 – New Variable Air Volume Air Handling Units

The second option would be to keep the existing AHUs, remove all the existing FCUs and replace them with variable volume AHUs with VAV terminal units. The existing or new central HVAC plant would then serve the new AHUs. Mechanical room space would be allocated for the AHUs with one mechanical room located at the first level of the new Walkway Bridge expansion. It would house one or two AHUs and serve the existing and new portions of Concourse A, the existing Concourse B, existing rental car spaces, new bag claim space, and other existing miscellaneous spaces in the vicinity previously served by FCUs. Another mechanical room would be provided as a part of the ticketing/outgoing baggage expansion. It would house one or two AHUs and would serve the existing and new baggage expansion, the existing ATO spaces and other existing spaces in the vicinity previously served by FCUs.

Benefits: Energy intensive FCUs are removed from the airport and replaced with highly efficient variable air volume AHUs with VAV distribution. The existing central HVAC plant is salvaged and repurposed. The centralized nature of the system makes equipment maintenance more accessible and prevents increased maintenance disturbances in occupied spaces. The increased efficiency provides substantial cost savings over the course of its lifespan.

Drawbacks: Large demolition and construction cost implications. Construction phasing challenges. Air handling unit mechanical rooms require high square footage in centralized locations.

12.3.6.3 Variable Air Volume (VAV) Air Handling Unit System with 100% Economizer Mode Description

Traditional Variable Air Volume (VAV) systems provide conditioned air at constant temperature to specified zones. They are well suited for airport environments due to the diversity of the spaces. Their performance during part load conditions make them the most commonly used system for new construction over outdated constant volume systems. The new VAV AHUs will be located inside a mechanical room and will consist of a fan wall technology and chilled and hot water coils. In addition to the incredible efficiencies of VAV AHU systems, these units will be equipped with 100% economizer modes. The economizer mode is enabled when the enthalpy (total heat content) of the outdoor air is lower than that of the return air. This is referred to as “free cooling.” The energy consumption for cooling is reduced by taking in more outdoor air than required for ventilation and relieving the excess return air to the outdoors. Under favorable conditions, all of the return air can be relieved and replaced by 100% outdoor air. It is estimated that in

Eugene, Oregon, there are 2,600 hours during the year where “free cooling” can be utilized (approximately 30% of the total 8,760 total hours in a year), greatly improving the efficiency of these systems.

Benefits: Low energy consumption due to economizer cooling instead of mechanical refrigeration and heat recovery capabilities. Heat/cooling and seasonal changeover is simple and adaptive with controls. Life expectancies are longer than that of FCUs with lower operation and maintenance costs.

Drawbacks: First cost is higher than RTUs. Large floor plans for mechanical room, shaft, and ductwork.

12.3.6.4 Option 3 –Packaged Rooftop DX Units

This third option, packaged RTUs, was explored above in section 12.3.3. It is important to note that this decentralized equipment does not require a central cooling and heating plant. Also, as stated previously, this option does not have to be all or nothing. RTUs could be used in conjunction with Options 1 or 2 for areas that are hard to serve or do not fit within the capacities of the central cooling or heating plants.

12.3.7 Air Distribution for AHU and RTU Options

For the AHU and RTU options explored above, zone airflow distribution must be considered. The areas the AHUs and RTUs serve will be split into zones that will be served by variable air volume (VAV) boxes with hot water re-heat. These VAV boxes come in two variations. The first is the simple VAV box that consists of a volume air damper whose position is set by a thermostat. VAV boxes will be utilized for interior zones. The second variation, used for exterior zones, is the fan powered variable air volume (FPB) box. FPBs include the volume air damper and a return fan that allows the unit to recirculate the air within the space, providing cooling and heating capabilities that VAV boxes cannot.



FIGURE 12-12
LAVATORY OPTION 1



FIGURE 12-13
LAVATORY OPTION 2



FIGURE 12-14
LAVATORY OPTION 3

12.4 PLUMBING CONSIDERATIONS

12.4.1 New Restrooms

The new restrooms at the Concourse C expansion will follow modern airport trends and increased hygiene considerations. All electrically powered components will be hardwired to minimize maintenance needs. Water closets and urinals will be wall mount with touchless, sensor activated automatic flush valves. Restrooms will be designed with walkable chases. A janitor's room will be provided for maintenance and cleaning purposes. The lavatory area has three options, with varying budgets and sophistication, which are explored below. The images for these restrooms are examples only showing the anticipated range of equipment available for selection and how they're integrated into the lavatory system.

12.4.1.1 Lavatory Option 1

The latest trend in restroom design is creating a completely touchless, all-in-one hand washing and drying experience. The lavatories are multi station, wall mounted, with shared trough style basins. They are provided with three rough in holes per station, fit with automatic sensor activated soap dispenser, faucet and hand dryer (Figure 12-12).

Benefits: The most modern and sophisticated lavatory design for airports. All-in-one hand washing and drying experience. Less mess created and easy to clean.

Drawbacks: The costliest option. With so many sensors, maintenance could be challenging, but this is partially mitigated with the provided hardwired fixtures.

12.4.1.2 Lavatory Option 2

Similar to the first option, the lavatories are multi station, wall mounted, with shared trough style basins. The key difference is each station is only provided two rough in holes, fit with automatic sensor activated soap dispenser and faucet. Paper towel dispensers or hand drying machines can be provided between mirrors (Figure 12-13).

Benefits: A modern and sophisticated lavatory design for airports. Less costly than the first option. Easy to clean.

Drawbacks: Still expensive compared to third option.

12.4.1.3 Lavatory Option 3

Finally, the third option continues the aesthetic of the existing airport. There are countertop vanities with oval undermount lavatory basins and each lavatory has a touchless automatic faucet and soap dispenser. Paper towel dispensers or hand drying machines can be provided between mirrors (Figure 12-14).

Benefits: This design is more in line with the existing restrooms but is still a modern lavatory design for airports. Least costly.

Drawbacks: More difficult to install than countertops with integral basins. Outdated design that will not age well at this point.

12.4.2 Roof Drainage System

The existing roof drainage system uses a combination of primary roof drains, emergency roof drains and scupper drains. The primary roof drains have internal storm piping and are routed below grade where they connect to the civil storm management system. Emergency roof drains have internal storm piping and are routed down through exterior walls where they discharge with downspout nozzles outside onto grade. The scupper drains discharge to grade directly below.

Concourse C will be provided with primary and emergency roof drains. The existing building expansions include the Concourse A, bag claim, and ticketing / outbound baggage expansions. They will be provided new primary and emergency roof drains for new roof areas. Scupper drains at the new expansion and existing building interfaces must be considered. They most likely will be infilled and replaced with emergency roof drains with internal storm piping that discharge with downspout nozzles onto grade.

12.4.3 Commercial Kitchen

For the Concourse C concession, a kitchen exhaust hood, exhaust fan, and natural gas fired make up air will be provided by the concessionaire. Kitchen grease exhaust air duct and supply will connect to the equipment. Exhaust air duct for dishwasher exhaust systems will be connected to tenant provided dish hoods or direct to dishwashing equipment as required. The kitchen grease interceptor will be located near the concourse for easy access and maintenance

12.4.4 Natural Gas

The natural gas service at the airport will be upgraded and extended from the main service entrance to Concourse C to accommodate the heating demands and the concessions.

12.5 ELECTRICAL CONSIDERATIONS

The primary electrical considerations for the Eugene airport involve improving reliability, redundancy, and efficiency. In order to ensure the electrical requirements for the new expansions are met, an investigation of interface requirements with the existing terminal was performed including calculations of expected loads, methodology for assigning main service, standby power requirements, and emergency lighting concepts.

12.5.1 New Service

Using an energy consumption per volume methodology, a new service size of 2,500 amps will be required to serve the proposed design in addition to providing 25% spare capacity. This proposed design load includes power for the Concourse C expansion and also includes the existing ticketing and outgoing baggage spaces as well as the expansion areas. By removing the existing ticketing and outgoing baggage areas from the existing service, capacity is freed up and the existing service is better able to serve the existing building, the baggage claim expansion and the Concourse A expansion (Figure 12-15 and Table 12-6).

12.5.2 Existing Service

Removing the existing ticketing and outgoing baggage areas from the existing 3,000A switchboard, will facilitate capacity on the existing distribution network for the Concourse A and bag claim expansion. Additional electrical distribution panels will be required to provide circuitry to these expanded locations (Table 12-7).

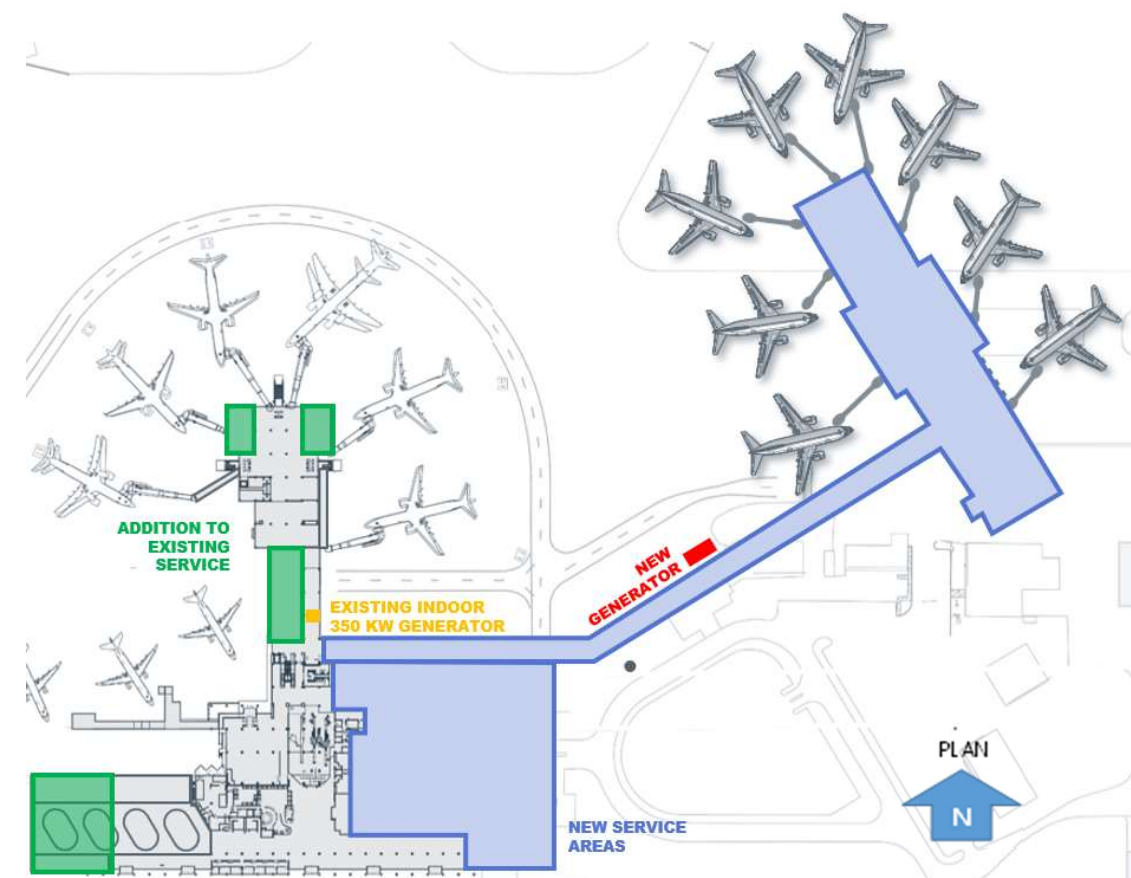


FIGURE 12-15
EXISTING BUILDINGS AND EXPANSION PLAN

LOAD TABULATION						
VOLTAGE: 480 PHASE: 3 OFFICES (SF): 0 RESTAURANTS (SF): 9,000 STORES (SF): 0 HALLS, CORRIDORS, CLOSETS, STAIRWAYS (SF) 5,000 STORAGE SPACES (SF): 0 TOTAL BUILDING AREA (SF): 14,000						
LOAD TYPE	NEC REFERENCE	LOAD (VA/SQ FT) OR QUANTITY	TOTAL CONNECTED LOAD (VA)	CONNECTED LOAD (VA)	DEMAND FACTOR	CODE LOAD (VA)
LIGHTING - OFFICES	TABLE 220.12	1.3	0	0	125%	0
LIGHTING - RESTAURANTS	TABLE 220.12	1.5	13,500	13,500	125%	16,875
LIGHTING - STORES	TABLE 220.12	1.9	0	0	125%	0
LIGHTING - HALLS, CORRIDORS, CLOSETS, STAIRWAYS	TABLE 220.12	0.5	2,500	2,500	125%	3,125
LIGHTING - STORAGE SPACE	TABLE 220.12	0.25	0	0	125%	0
RECEPTACLES	NEC 220.12	1	14,000	14,000	100%	14,000
HVAC (COOLING) - OFFICES	ENGINEER ESTIMATE	5	0	0	100%	0
HVAC (COOLING) - RESTAURANTS	ENGINEER ESTIMATE	3	27,000	27,000	100%	27,000
HVAC (COOLING) - STORES	ENGINEER ESTIMATE	4	0	0	100%	0
HVAC (COOLING) - HALLS, CORRIDORS, CLOSETS, STAIRWAYS	ENGINEER ESTIMATE	1	5,000	5,000	100%	5,000
HVAC (COOLING) - STORAGE SPACE	ENGINEER ESTIMATE	0.25	0	0	100%	0
HVAC FPB HEAT (kW): 208 (25 HP) TBE	ACTUAL		208,000	0	100%	0
LARGEST MOTOR (A): 34 (25 HP) TBE	ACTUAL	1	28,267	28,267	100%	28,267
BAG CLAIM (A): 100	ACTUAL	1	100,000	100,000	100%	100,000
GPU (kVA): 90	ACTUAL	1	90,000	90,000	100%	90,000
PBB (A): 10	ACTUAL	1	8,314	8,314	100%	8,314
PCA (A): 120 (45 TON COOL)	ACTUAL	1	99,766	99,766	100%	99,766
EXISTING (kW): 0	ACTUAL (NEC 220.87)	-	0	0	125%	0
EXISTING (kVA): 700	ACTUAL	-	700,000	700,000	125%	875,000
NEW	NEC FACTOR 25% LARGEST MOTOR (VA)					
	CODE LOAD (VA)					
	SPARE CAPACITY					
	CODE LOAD W/ SPARE CAPACITY (VA)					
	CODE LOAD W/ SPARE CAPACITY (A)					
	GENERATOR CAPACITY (kW)					
	GENERATOR CAPACITY (A)					
EXISTING	GENERATOR LOAD % (80% Max)					
	SERVICE SIZE USING 100% RATED MAIN (A)					
	CODE LOAD (A)					
	GENERATOR CAPACITY (kW)					
	GENERATOR CAPACITY (A)					
	GENERATOR LOAD % (80% Max)					
	SERVICE SIZE USING 100% RATED MAIN (A)					
NEW & EXISTING TOTAL	CODE LOAD (A)					
	GENERATOR CAPACITY (kW)					
	GENERATOR CAPACITY (A)					
	GENERATOR LOAD % (80% Max)					
	SERVICE SIZE USING 100% RATED MAIN (A)					
	CODE LOAD (A)					
	GENERATOR CAPACITY (kW)					

TABLE 12-7
LOAD TABULATION – EXISTING SERVICE

12.5.3 Generator

The existing 350KW generator is only sized to serve the critical loads in the existing Terminal; therefore an additional generator is necessary for the terminal expansion.

12.5.3.1 Generator Option 1 – Use Two Stand-by Generators

The existing generator was installed in 2016 and is in very good condition. Maintaining the existing generator is the cost-effective option. However, as it is only sized for critical loads in the existing terminal, an additional secondary generator is necessary for the proposed Concourse C expansion and outbound baggage expansion.

Benefits: Lowest first costs as only a smaller second generator is required.

Drawbacks: Maintenance of two separate generators will be required.

LOAD TABULATION						
VOLTAGE: 480 PHASE: 3 OFFICES (SF): 2,000 RESTAURANTS (SF): 12,800 STORES (SF): 0 HALLS, CORRIDORS, CLOSETS, STAIRWAYS (SF) 35,000 STORAGE SPACES (SF): 0 TOTAL BUILDING AREA (SF): 49,800						
LOAD TYPE	NEC REFERENCE	LOAD (VA/SQ FT) OR QUANTITY	TOTAL CONNECTED LOAD (VA)	CONNECTED LOAD (VA)	DEMAND FACTOR	CODE LOAD (VA)
LIGHTING - OFFICES	TABLE 220.12	1.3	2,600	2,600	125%	3,250
LIGHTING - RESTAURANTS	TABLE 220.12	1.5	19,200	19,200	125%	24,000
LIGHTING - STORES	TABLE 220.12	1.9	0	0	125%	0
LIGHTING - HALLS, CORRIDORS, CLOSETS, STAIRWAYS	TABLE 220.12	0.5	17,500	17,500	125%	21,875
LIGHTING - STORAGE SPACE	TABLE 220.12	0.25	0	0	125%	0
RECEPTACLES	NEC 220.12	1	49,800	49,800	100%	49,800
HVAC (COOLING) - OFFICES	ENGINEER ESTIMATE	5	10,000	10,000	100%	10,000
HVAC (COOLING) - RESTAURANTS	ENGINEER ESTIMATE	3	38,400	38,400	100%	38,400
HVAC (COOLING) - STORES	ENGINEER ESTIMATE	4	0	0	100%	0
HVAC (COOLING) - HALLS, CORRIDORS, CLOSETS, STAIRWAYS	ENGINEER ESTIMATE	1	35,000	35,000	100%	35,000
HVAC (COOLING) - STORAGE SPACE	ENGINEER ESTIMATE	0.25	0	0	100%	0
HVAC FPB HEAT (kW): 208 (25 HP) ELEV	ACTUAL	1	208,000	208,000	100%	208,000
LARGEST MOTOR (A): 34 (25 HP) ELEV	ACTUAL	1	28,267	28,267	100%	28,267
GPU (kVA): 90	ACTUAL	5	90,000	450,000	100%	450,000
BHS (A): 87	ACTUAL	1	72,330	72,330	100%	72,330
PBB (A): 10	ACTUAL	5	8,314	41,569	100%	41,569
PCA (A): 120 (45 TON COOL)	ACTUAL	5	99,766	498,831	100%	498,831
EXISTING (kW): 0	ACTUAL (NEC 220.87)	-	0	0	125%	0
EXISTING (kVA): 0	ACTUAL	-	0	0	125%	0
NEW	NEC FACTOR 25% LARGEST MOTOR (VA)					
	CODE LOAD (VA)					
	SPARE CAPACITY					
	CODE LOAD W/ SPARE CAPACITY (VA)					
	CODE LOAD W/ SPARE CAPACITY (A)					
	GENERATOR CAPACITY (kW)					
	GENERATOR CAPACITY (A)					
NEW & EXISTING TOTAL	GENERATOR LOAD % (80% Max)					
	SERVICE SIZE USING 100% RATED MAIN (A)					
	CODE LOAD (A)					
	GENERATOR CAPACITY (kW)					
	GENERATOR CAPACITY (A)					
	GENERATOR LOAD % (80% Max)					
	SERVICE SIZE USING 100% RATED MAIN (A)					

TABLE 12-6
LOAD TABULATION – NEW SERVICE

12.5.3.2 Generator Option 2 - Single Stand-by Generator

Option 2 consists of replacing the existing generator and providing a larger single backup for the entire Terminal building. This can include either the full load or critical loads only. This single generator can be located on-site to produce 480V or it can be located remotely to provide medium voltage to the terminal and stepped down at a new transformer.

Benefits: Single point of maintenance. Removing the existing indoor generator provides additional indoor space for airport utilization.

Drawbacks: Higher first cost, removes existing fairly new generator.

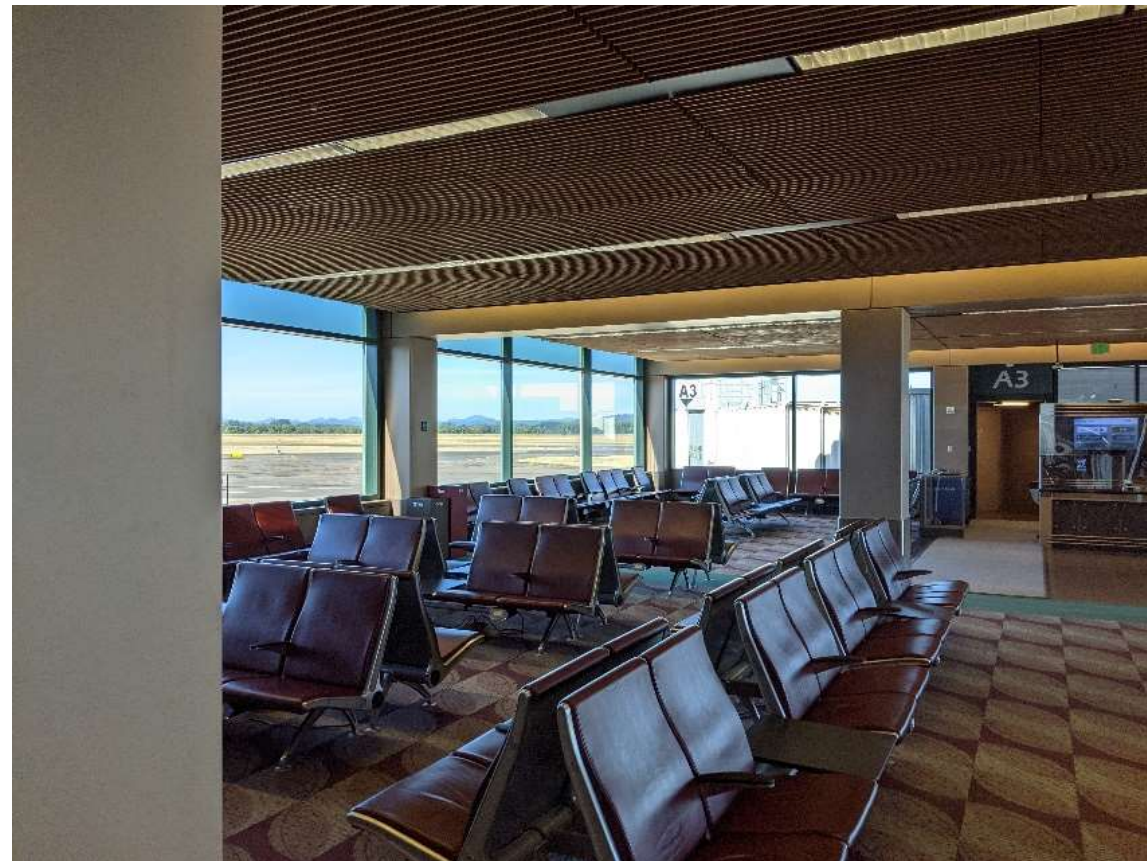


FIGURE 12-16
EXISTING GATE A3 HOLDROOM

12.5.4 Lighting

All areas of new construction will utilize efficient LED luminaires as required for LEED and Envision certifications. In the adjacent spaces to those being expanded, it is recommended that the existing inefficient fluorescent fixtures be replaced with LEDs. This will not only reduce the energy consumption of the existing lighting but also improve the aesthetics of the ceiling by avoiding a transition from outdated fluorescent luminaires to LEDs. Retrofitting the existing fluorescent luminaires with LEDs and replacing the current lens may be a cost-effective alternative to replacing the entire luminaire (Figure 12-16).

12.5.5 Lighting Controls

The existing lighting control system is underutilized and the current daylight harvesting zones adjacent to the proposed expansions may no longer be effective. An overhaul of the existing lighting controls as part of the Terminal Renovation project would be effective in providing a simplified user interface and full utilization of a new lighting control system. The lighting control system may also be integrated into the BMS for simplified control and energy management.

12.5.6 Grounding / Lightning Protection

The building expansions will require additional ground loops and lightning protection that ties back into the existing systems. This is required to protect the building, equipment, and people within. Providing a central antenna array will allow all antennas to be maintained in a single location and an array would also allow for a simplified and cost-effective grounding system.

12.5.7 Apron Lighting

Concourse C will require apron lighting that conforms to IES RP-37. The apron light poles may be located at grade or roof mounted to allow for more space at the apron level. LED flood lights will be utilized in lieu of the existing non-LED luminaires. Retrofitting or replacing the existing apron lighting with LED's will reduce the current energy consumption and provide a uniform appearance to the airside.

12.5.8 Electrification and AAM (Advanced Air Mobility)

While AAM is discussed in more detail in the following section, an AAM facility for multiple aircraft and equipment will require an independent electric feed from the utility. Additionally, the location of an AAM landing pad will require apron level lighting requirements as noted in 12.5.7 above. Generally, electrification of airports is driving the overall electrical demand higher than historic industry estimates.

At the Eugene airport, between AAM and vehicle charging, energy requirements are expected to increase beyond the utility's current limits. Developing a comprehensive electrification plan that includes augmenting the utility with onsite generation, would be recommended to manage the campus wide electrical needs, in addition to the terminal project itself.



FIGURE 12-18
ADVANCED AIR MOBILITY DIAGRAM

12.6 ADVANCED AIR MOBILITY (AAM) OVERVIEW

12.6.1 Introduction

Advanced Air Mobility (AAM) is an upcoming transportation model that consists of short range electric vehicles with a range of about 650 miles that utilizes the airport as a central transportation hub, either as a destination connecting the airport to local vertistops or as a service and maintenance facility. Several manufacturers have been interviewed that are at the forefront of AAM development in an attempt to provide a snapshot of the current status of the industry.

12.6.2 Aircraft

The first fleets are most likely to consist of small aircraft like what are commonly available today with fixed wings and requiring runways to take off and land but modified to be hybrid or fully electric (Figure 12-19). The first vertical take-off and landing (VTOL) aircraft are expected to arrive in 2025 or 2026 but won't represent a large portion of the fleets until much later as equipment is developed further and the infrastructure is put into place. The fixed wing aircraft will use existing small aircraft runways and airport facilities and will be more limited while future VTOL aircraft will be more



FIGURE 12-19
AAM AIRCRAFT EVOLUTION

flexible and able to take off and land in much more limited locations such as parking lots and existing rooftop helipads.

12.6.3 Usage

AAM will use a network of vertiports, located at larger central facilities like airports, and regional vertistops that may consist of only a landing platform. While still in development, there are three primary usages for Advanced Air Mobility:

- » The first is in providing last mile or first mile travel such as connecting passengers arriving at Eugene directly to local attractions or to take people from a regional location to the airport for long distance flights.
- » The second is in providing what is essentially a taxi or Uber alternative where passengers can travel from one destination to another within the same city such as between two office buildings or two local tourist attractions while using the airport as a central refueling hub.
- » The third is as a replacement for short haul flights such as between Eugene and Portland.

12.6.4 Facility at EUG Airport

With three varying business models, trying to determine the optimal location for an advanced air mobility hub at the airport is problematic. Typical configurations call for small aircraft passengers to transit through a remote FBO however for customers that route through the airport to their ultimate destination, direct access to the landside of the terminal is needed so that passengers can get screened before boarding a flight. In this case, landing at an FBO then

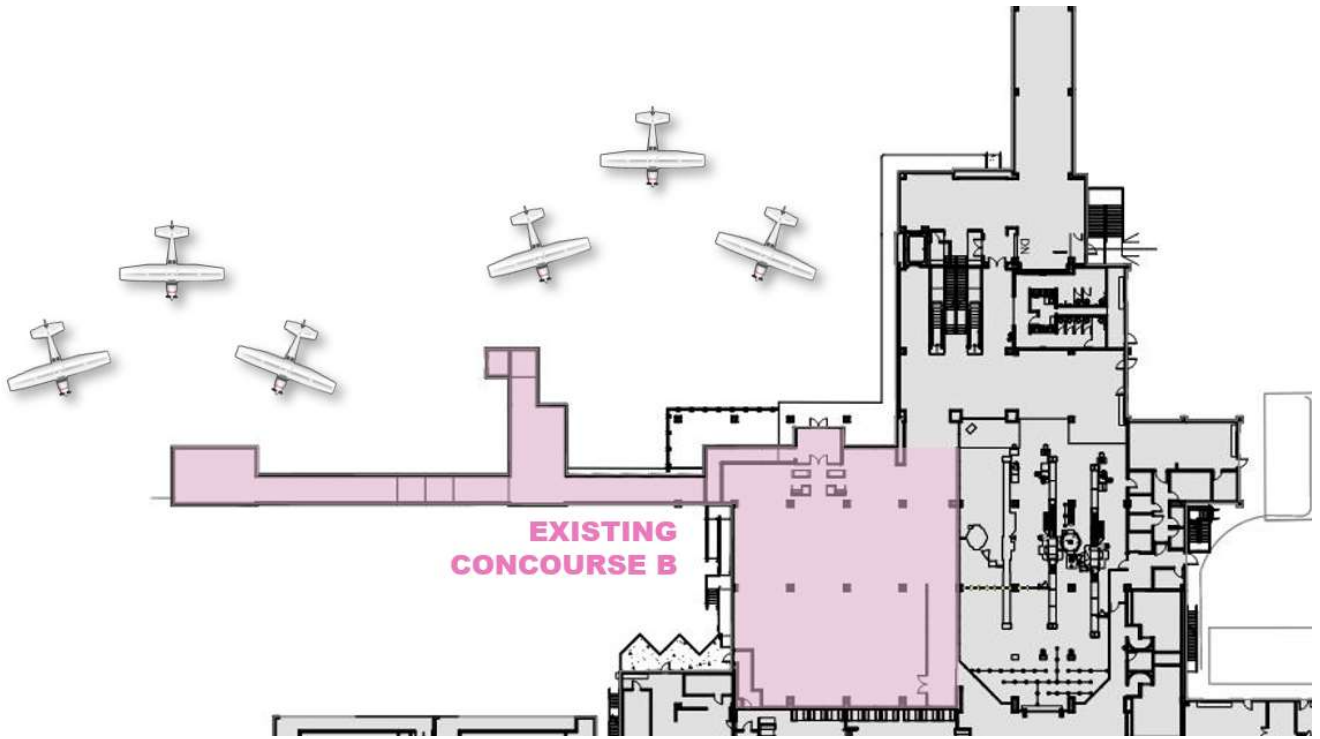


FIGURE 12-17
ADVANCED AIR MOBILITY CONCOURSE B - NON-VTOL

taking another 20 minutes to get to the terminal building would be inconvenient. On the other hand, locating the AAM facility next to the terminal building also creates problems due to the 10 or 20 small aircraft congesting the airspace as they jockey for position around the terminal building.

EUG has a unique opportunity in that the current airlines that utilize Concourse B have expressed a desire to utilize boarding bridges for their aircraft and will relocate service to Concourse A or Concourse C. This allows the existing Concourse B to be retrofitted for AAM service if needed as it already has holdroom seating and is served by a local concession. This facility will be most easily utilized by the early iterations of AAM aircraft that use small fixed wing vehicles however future VTOL aircraft can also be accommodated with some renovations (Figure 12-17).

12.6.5 Infrastructure

One of the issues that all manufacturers and service providers have been dealing with is the lack of a single unifying charging solution. Some manufacturers are proposing battery swaps, while others are looking at using charging trucks or fixed turbochargers. While each will have a significant impact on the local electric grid, the hardware required to accommodate them are vastly different.

While a specific single charging solution isn’t available, the airport can still prepare for AAM by ensuring electrical capacity is available at the airport for electrified aircraft, vehicles and service equipment that are coming in the future. Typical electrical loads for different types of AAM aircraft are shown in Table 12-8

Aircraft Type	Description	Electrical Requirements
GA Type Electric Aircraft	Similar to an Automobile DCFC	150 kW per charge point
eVTOL (Shorter range, up to 150 miles)	Similar to an EV truck DCFC	900kW to 1mW per charge point
eVTOL (Longer range, over 150 miles)	DCFC	1.5mW per two charge points (currently the most common configuration)
eCTOL	DCFC	1mW per Charge Point

Source: Advanced Air Mobility Workgroup White Paper, 2022

TABLE 12-8
AAM AIRCRAFT ELECTRICAL REQUIREMENTS

CHAPTER 13

APPENDICES

13.1 STATEMENT OF PROBABLE COST

EUGENE AIRPORT TERMINAL EXPANSION



September 9, 2022
Revision #3

EUGENE AIRPORT TERMINAL EXPANSION



STATEMENT OF PROBABLE COST

Prepared by:
Steve Gunn

President
Construction Focus, Inc.

Prepared for:
RS&H Architecture
Denver, CO

Summary of Probable Cost

	LOW SIDE	HIGH SIDE
Ticketing Improvments		
Hardcost:	18,780,178	
Markups (Low & High):	10,377,142	15,304,466
RANGE TOTALS	29,157,320	34,084,644
34,700 SF	\$/SF: \$840.27	\$982.27
Outbound Baggage Improvments		
Hardcost:	39,483,689	
Markups (Low & High):	21,817,038	32,176,308
RANGE TOTALS	61,300,727	71,659,997
55,066 SF	\$/SF: \$1,113.22	\$1,301.35
Baggage Claim Expansion		
Hardcost:	12,585,820	
Markups (Low & High):	5,921,951	9,224,071
RANGE TOTALS	18,507,771	21,809,891
14,000 SF	\$/SF: \$1,321.98	\$1,557.85
Concourse A Expansion		
Hardcost:	5,836,100	
Markups (Low & High):	3,224,785	4,755,993
RANGE TOTALS	9,060,885	10,592,092
12,500 SF	\$/SF: \$724.87	\$847.37
Concourse C Expansion		
Hardcost:	85,755,143	
Markups (Low & High):	47,384,712	69,884,146
RANGE TOTALS	133,139,855	155,639,289
Bldg 95,942 SF	Total \$/SF: \$1,054.64	\$1,232.86
Bridge 30,300 SF		
SUMMARY RANGE TOTALS	251,166,558	293,785,914
NOTES Wage rates: BOLI		
GENERAL EXCLUSIONS Design fees, permit fees, system development fees, utility hookup charges, testing, BOLI fee. Hazardous materials abatement, moving expenses, anti-graffiti coating, fireproofing. Overexcavation, rock excavation, wet weather sitework. Commissioning. FFE		

EUGENE AIRPORT TERMINAL EXPANSION
TICKETING
Statement of Probable Cost

1/1

Ticketing Improvments	QTY	UNIT	\$/UNIT	TOTAL \$
Facility Construction & Services	34,700	SF		
SHELL				
1-Story Shell	19,300	SF	205.20	3,960,360
INTERIORS				
Level 1				
Ticketing (new)	4,200	SF	159.33	669,196
Circulation/Queuing (new)	6,300	SF	124.02	781,303
Ticketing (renovated)	5,760	SF	207.13	1,193,081
Circulation/Queuing (renovated)	8,640	SF	161.22	1,392,952
ATO	8,800	SF	159.33	1,402,125
Remodel Adjacent Spaces	500	SF	32.40	16,200
Miscellaneous	500	SF	27.00	13,500
OTHER SERVICES				
Demolition	34,700	SF	14.58	505,926
Temporary Relocation & Services	34,700	SF	5.40	187,380
CIVIL & MEP				
Mechanical	34,700	SF	38.65	1,341,210
Power Plant	34,700	SF	33.04	1,146,620
Power & lighting	34,700	SF	71.37	2,476,414
Communications	34,700	SF	6.86	237,973
Elec safety & security	34,700	SF	5.97	207,242
Plumbing	34,700	SF	6.97	241,923
Fire Sprinklers	34,700	SF	4.50	156,161
Civil	34,700	SF	60.55	2,101,091
Site Utilities	34,700	SF	21.60	749,520
Hardcost Total:				18,780,178
Low-High Range for the markups is included below. This range is presented because the design has not been completed and market conditions might change at the time of bidding.				
Markups to the Hardcost				
	Low Side Total		High Side Total	
Estimating Contingency	15.00%	2,817,027	25.00%	4,695,045
General Conditions	8.00%	1,727,776	8.00%	1,878,018
Insurance	1.60%	373,200	1.60%	405,652
Profit & Overhead	6.00%	1,421,891	6.00%	1,545,534
Performance Bond	1.20%	301,441	1.20%	327,653
Escalation	6.00%	1,525,291	14.00%	3,868,491
Solar & Green Energy	1.50%	404,202	1.50%	472,509
CMGC Participation	6.00%	1,641,060	6.00%	1,918,385
OR Gross Receipts Tax	0.57%	165,255	0.57%	193,181
Markups Total:		10,377,142		15,304,466
TOTAL:		29,157,320		34,084,644

ARCH: RS&H
DWG DATE: 2022/08/29
DESIGN LEVEL: Concept

CONSTRUCTION FOCUS, INC.
541-686-2031
EUGENE, OREGON

ESTIMATE DATE: Sept. 9, 2022
REVISION #: 3
CONST. START: 2 QTR_2024

EUGENE AIRPORT TERMINAL EXPANSION
OUTBOUND BAGGAGE
Statement of Probable Cost

1/1

Outbound Baggage Improvments	QTY	UNIT	\$/UNIT	TOTAL \$
Facility Construction & Services	55,066	SF		
SHELL				
1-Story Shell	27,400	SF	205.20	5,622,480
2-Story Shell (footprint area)	13,600	SF	297.00	4,039,200
INTERIORS				
Level 1				
Bag Makeup (new)	34,850	SF	24.01	836,693
Circulation/Queuing (new)	6,150	SF	124.02	762,701
Bag Makeup (renovated)	2,926	SF	31.21	91,323
Circulation/Queuing (renovated)	2,240	SF	161.22	361,136
Remodel Adjacent Spaces	500	SF	32.40	16,200
Miscellaneous	500	SF	27.00	13,500
Level 2				
Admin	7,500	SF	90.10	675,783
Exiting Circulation	400	SF	561.72	224,688
OTHER SERVICES				
Demolition	55,066	SF	14.58	802,862
Baggage Handling/Screening Equipment	1	LS	0.00	12,000,000
Temporary Relocation & Services	55,066	SF	5.40	297,356
CIVIL & MEP				
Mechanical	55,066	SF	38.65	2,128,388
Power Plant	55,066	SF	33.04	1,819,590
Power & lighting	55,066	SF	71.37	3,929,862
Communications	55,066	SF	6.86	377,643
Elec safety & security	55,066	SF	5.97	328,876
Plumbing	55,066	SF	6.97	383,912
Fire Sprinklers	55,066	SF	4.50	247,815
Civil	55,066	SF	60.55	3,334,255
Site Utilities	55,066	SF	21.60	1,189,426
Hardcost Total:				39,483,689
Low-High Range for the markups is included below. This range is presented because the design has not been completed and market conditions might change at the time of bidding.				
Markups to the Hardcost				
	Low Side Total		High Side Total	
Estimating Contingency	15.00%	5,922,553	25.00%	9,870,922
General Conditions	8.00%	3,632,499	8.00%	3,948,369
Insurance	1.60%	784,620	1.60%	852,848
Profit & Overhead	6.00%	2,989,402	6.00%	3,249,350
Performance Bond	1.20%	633,753	1.20%	688,862
Escalation	6.00%	3,206,791	14.00%	8,133,166
Solar & Green Energy	1.50%	849,800	1.50%	993,408
CMGC Participation	6.00%	3,450,186	6.00%	4,033,237
OR Gross Receipts Tax	0.57%	347,434	0.57%	406,147
Markups Total:		21,817,038		32,176,308
TOTAL:		61,300,727		71,659,997

ARCH: RS&H
DWG DATE: 2022/08/29
DESIGN LEVEL: Concept

CONSTRUCTION FOCUS, INC.
541-686-2031
EUGENE, OREGON

ESTIMATE DATE: Sept. 9, 2022
REVISION #: 3
CONST. START: 2 QTR_2024

EUGENE AIRPORT TERMINAL EXPANSION
BAGGAGE CLAIM
Statement of Probable Cost

1/1

Baggage Claim Expansion				QTY	UNIT	\$/UNIT	TOTAL \$
Facility Construction & Services				14,000	SF		
SHELL							
1-Story Shell Addition				9,214	SF	205.20	1,890,713
INTERIORS							
Level 1							
Baggage Claim Addition				11,000	SF	172.23	1,894,504
Remodel Adjacent Spaces				2,000	SF	32.40	64,800
Miscellaneous				1,000	SF	27.00	27,000
OTHER SERVICES							
Demolition				14,000	SF	10.00	140,000
Baggage Handling Equipment				1	LS	0.00	5,000,000
Temporary Relocation & Services				14,000	SF	5.40	75,600
CIVIL & MEP							
Mechanical				14,000	SF	38.65	541,122
Power Plant				14,000	SF	33.04	462,613
Power & lighting				14,000	SF	71.37	999,130
Communications				14,000	SF	6.86	96,012
Elec safety & security				14,000	SF	5.97	83,614
Plumbing				14,000	SF	6.97	97,606
Fire Sprinklers				14,000	SF	4.50	63,005
Civil				14,000	SF	60.55	847,702
Site Utilities				14,000	SF	21.60	302,400
Hardcost Total:							12,585,820
Low-High Range for the markups is included below. This range is presented because the design has not been completed and market conditions might change at the time of bidding.							
Markups to the Hardcost							
	Low Side Total		High Side Total				
Estimating Contingency	15.00%	1,887,873	25.00%	3,146,455			
General Conditions	8.00%	1,157,895	8.00%	1,258,582			
Insurance	1.60%	250,105	1.60%	271,854			
Profit & Overhead	6.00%	952,902	6.00%	1,035,763			
Performance Bond	1.20%	202,015	1.20%	219,582			
Escalation	6.00%	1,022,197	14.00%	2,592,528			
Solar & Green Energy	1.50%	82,095	1.50%	127,871			
CMGC Participation	6.00%	333,305	6.00%	519,158			
OR Gross Receipts Tax	0.57%	33,564	0.57%	52,279			
Markups Total:	5,921,951		9,224,071				
TOTAL:	18,507,771		21,809,891				

ARCH: RS&H
DWG DATE: 2022/08/29
DESIGN LEVEL: Concept

CONSTRUCTION FOCUS, INC.
541-686-2031
EUGENE, OREGON

ESTIMATE DATE: Sept. 9, 2022
REVISION #: 3
CONST. START: 2 QTR_2024

EUGENE AIRPORT TERMINAL EXPANSION
CONCOURSE A
Statement of Probable Cost

1/1

Concourse A Expansion				QTY	UNIT	\$/UNIT	TOTAL \$
Facility Construction & Services				12,500	SF		
SHELL							
2nd Level (Breezway at 1st Level)				10,500	SF	222.48	2,336,040
INTERIORS							
Concourse Level							
Holdroom				10,500	SF	89.83	943,261
Remodel Adjacent Spaces				1,000	SF	32.40	32,400
Miscellaneous				1,000	SF	27.00	27,000
OTHER SERVICES							
Jet Bridges Relocation (3 each)				12,500	SF	24.00	300,000
Temporary Relocation & Services				12,500	SF	5.40	67,500
CIVIL & MEP							
Mechanical				12,500	SF	38.65	483,145
Power Plant				12,500	SF	33.04	413,048
Power & lighting				12,500	SF	71.37	892,080
Communications				12,500	SF	6.86	85,725
Elec safety & security				12,500	SF	5.97	74,655
Plumbing				12,500	SF	6.97	87,148
Fire Sprinklers				12,500	SF	4.50	56,254
Civil (Excludes Pavement)				12,500	SF	3.03	37,844
Hardcost Total:							5,836,100
Low-High Range for the markups is included below. This range is presented because the design has not been completed and market conditions might change at the time of bidding.							
Markups to the Hardcost							
	Low Side Total		High Side Total				
Estimating Contingency	15.00%	875,415	25.00%	1,459,025			
General Conditions	8.00%	536,921	8.00%	583,610			
Insurance	1.60%	115,975	1.60%	126,060			
Profit & Overhead	6.00%	441,865	6.00%	480,288			
Performance Bond	1.20%	93,675	1.20%	101,821			
Escalation	6.00%	473,997	14.00%	1,202,166			
Solar & Green Energy	1.50%	125,609	1.50%	146,836			
CMGC Participation	6.00%	509,973	6.00%	596,154			
OR Gross Receipts Tax	0.57%	51,354	0.57%	60,033			
Markups Total:	3,224,785		4,755,993				
TOTAL:	9,060,885		10,592,092				

ARCH: RS&H
DWG DATE: 2022/08/29
DESIGN LEVEL: Concept

CONSTRUCTION FOCUS, INC.
541-686-2031
EUGENE, OREGON

ESTIMATE DATE: Sept. 9, 2022
REVISION #: 3
CONST. START: 2 QTR_2024

EUGENE AIRPORT TERMINAL EXPANSION
CONCOURSE C
Statement of Probable Cost

1/1

Concourse C Expansion		QTY	UNIT	\$/UNIT	TOTAL \$
Facility Construction & Services		95,942	SF		
BASE WORK					
	Demolish Gate B North	5,000	SF	14.58	72,900
	Relocate Existing Gate 6	5,000	SF	21.60	108,000
SHELL					
	1-Story Shell	9,700	SF	205.20	1,990,440
	2-Story Shell	41,610	SF	297.00	12,358,170
	2nd Level (Breezway at 1st Level) (Bridge)	30,300	SF	222.48	6,741,144
INTERIORS					
	Ground Level				
	Charter Misc.	1,809	SF	81.00	146,529
	Airline Ops	34,000	SF	90.10	3,063,550
	Baggage Handling	3,800	SF	24.01	91,232
	Baggage Screening	900	SF	26.17	23,552
	Baggage Claim	4,400	SF	172.23	757,801
	ATO	500	SF	90.10	45,052
	Ticketing Lobby	3,300	SF	159.33	523,797
	Security Screening	2,600	SF	124.02	322,443
	Concourse Level				
	Concessions	3,400	SF	11.83	40,208
	Holdroom	29,300	SF	89.83	2,632,148
	Swing Holdroom	4,200	SF	85.30	358,253
	Charter	853	SF	81.00	69,093
	Restrooms	2,080	SF	153.58	319,438
	Egress Core Circulation	2,800	SF	561.72	1,572,813
	Remodel Adjacent Spaces	1,000	SF	32.40	32,400
	Miscellaneous	1,000	SF	27.00	27,000
	Concourse Level				
	Bridge	30,300	SF	124.02	3,757,697
OTHER SERVICES					
	Jet Bridges (8 ea)	8	EA	1,242,000.00	9,936,000
	Temporary Relocation & Services	95,942	SF	5.40	518,087
	Baggage Handling/Screening Equipment	1	LS	0.00	2,000,000
	People Movers	1	LS	0.00	800,000
CIVIL & MEP (Building)					
	Mechanical	95,942	SF	38.65	3,708,309
	Power Plant	95,942	SF	33.04	3,170,289
	Power & lighting	95,942	SF	71.37	6,847,035
	Communications	95,942	SF	6.86	657,970
	Elec safety & security	95,942	SF	5.97	573,004
	Plumbing	95,942	SF	6.97	668,894
	Fire Sprinklers	95,942	SF	4.50	431,770
	Civil (Excludes Pavement)	95,942	SF	60.55	5,809,304
	Site Utilities	95,942	SF	21.60	2,072,347
	Bridge Civil & MEP	30,300	SF	113.96	3,452,905
	New Pavement	359,056	SF	28.00	10,053,568
Hardcost Total:					85,755,143
Low-High Range for the markups is included below. This range is presented because the design has not been completed and market conditions might change at the time of bidding.					
Markups to the Hardcost					
		Low Side Total		High Side Total	
	Estimating Contingency	15.00%	12,863,271	25.00%	21,438,786
	General Conditions	8.00%	7,889,473	8.00%	8,575,514
	Insurance	1.60%	1,704,126	1.60%	1,852,311
	Profit & Overhead	6.00%	6,492,721	6.00%	7,057,305
	Performance Bond	1.20%	1,376,457	1.20%	1,496,149
	Escalation	6.00%	6,964,871	14.00%	17,664,529
	Solar & Green Energy	1.50%	1,845,691	1.50%	2,157,596
	CMGC Participation	6.00%	7,493,505	6.00%	8,759,840
	OR Gross Receipts Tax	0.57%	754,596	0.57%	882,116
	Markups Total:		47,384,712		69,884,146
	TOTAL:		133,139,855		155,639,289

13.2 SEISMIC EVALUATION (2019)



HOHBACH-LEWIN INC.
STRUCTURAL ENGINEERS

Fifth Street Public Market, Suite 302
296 East Fifth Ave
Eugene, OR 97401
Phone: (541) 349-1701

**Eugene Airport Terminal
Eugene, Oregon**



Seismic Evaluation Report

Prepared For:
**City of Eugene
Eugene, OR**

Project No: H-L 13242E
Date: February 14, 2019

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Appendix A: ASCE 41-13 Tier 1 Screening

Appendix B: ASCE 41-13 Tier 2 Evaluation

Appendix C: Cost Estimate

EXECUTIVE SUMMARY

Hohbach-Lewin Structural Engineers, Inc. was retained by the City of Eugene to perform a seismic evaluation of the Eugene Airport Terminal. The objective of the study was to perform additional studies as required to clearly identify deficiencies, provide conceptual retrofit recommendations and generate associated costs to help you secure the grant funds in order to perform the work.

In 2016, Hohbach-Lewin Structural Engineers, Inc. performed a limited seismic evaluation on the Airport Terminal Building as part of a comprehensive project which included limited seismic evaluations on approximately 40 of the City’s facilities. The previous evaluation for the Airport Terminal Building included a Tier 1 Screening in accordance with ASCE/SEI 41-13, Seismic Evaluation and Retrofit of Existing Buildings. The ASCE 41 Tier 1 Screening is an assessment tool that identifies potential seismic deficiencies based on building construction type, building geometry, and limited quantitative analysis. The Tier 1 Screening identified several potential seismic deficiencies which form the basis for the additional seismic evaluation of the current project. A copy of the ASCE 41-13 Tier 1 Screening and other relevant sections from the *City of Eugene Seismic Evaluation Report* are included in Appendix A for reference.

To further assess the potential deficiencies identified in the Tier 1 Screening, Hohbach-Lewin has performed an ASCE 41-13 Tier 2 Deficiency-Based Evaluation. The Tier 2 Evaluation is well suited for use with existing buildings, as it contains guidance for evaluation of older structures which may not comply with the current detailing requirements and construction practices consistent with the current building code. The Tier 2 Evaluation identified numerous deficiencies, as noted in the Findings and Discussion section of this report. Based on the results of the Tier 2 Evaluation, recommendations for structural seismic retrofit measures are provided in the Retrofit Recommendations section of this report. Conceptual plan and detail sketches were developed to inform a “level of magnitude” cost estimate. The cost estimate (provided by Steve Gunn/Construction Focus) is included in Appendix C.

Two seismically separated portions of the building, the Vertical Circulation and Terminal B Expansion, were not included in the current evaluation. These sections were constructed as part of a 2014 Airport Expansion Project, designed as Risk Category III structures in accordance with the 2010 Oregon Structural Specialty Code (2009 International Building Code) and therefore deemed acceptable by inspection.

Reference Figure 1 for the nomenclature used to refer to different sections of the Terminal.

BUILDING DESCRIPTION

The Eugene Airport Terminal consists of several one and two-story steel moment frame structures. Original construction drawings are not available. This report is based on information from construction drawings for two major expansions to the terminal building: in 1988 and 2014. The 1988 expansion included additions to the Main Terminal and the Terminal A Concourse, which is comprised of three seismically-separate structures: Gate Lobby, Walkway Bridge and West Terminal. The 2014 work included expansion of the south wing of the Main Terminal and two new seismically-separated structures to the south of the West Terminal: Terminal B and the Vertical Circulation. See Figure 1 below.

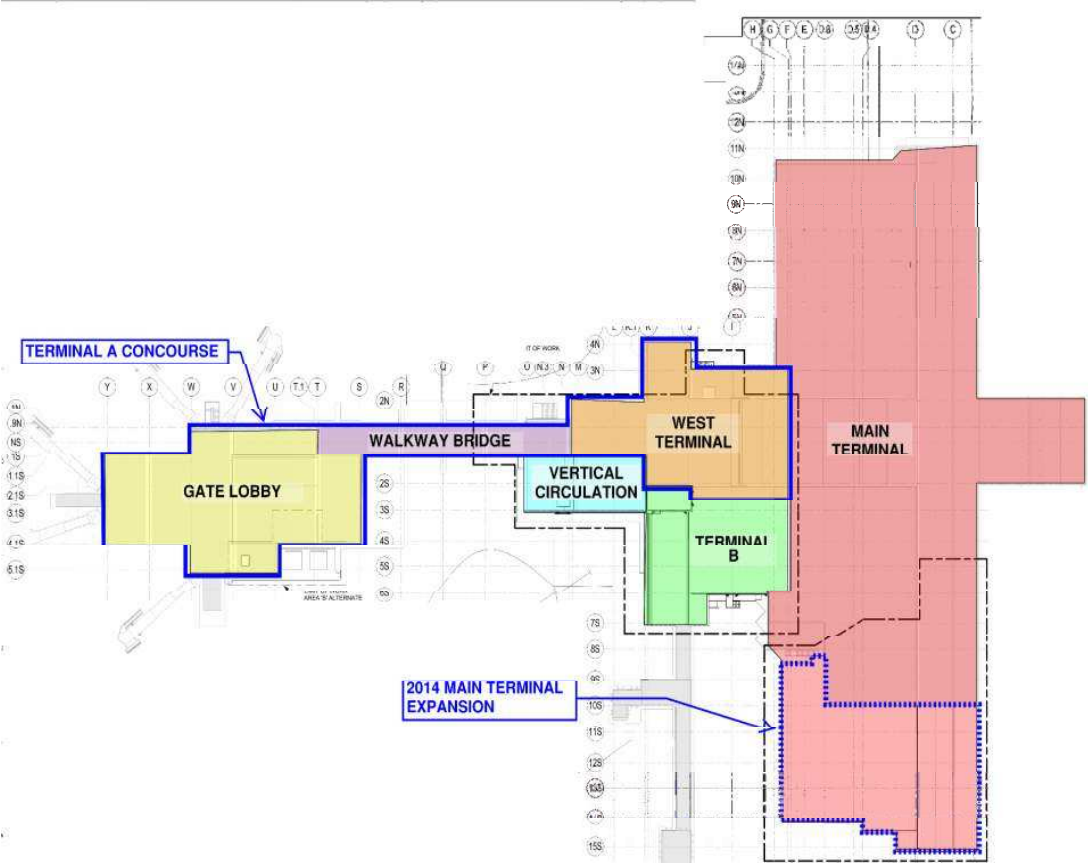


Figure 1 – Eugene Airport Terminal Key Plan

Main Terminal Building

The Main Terminal building is roughly rectangular and measures approximately 520 feet north-south by 145 feet east-west including the 2014 expansion. It is a single-story structure with a mechanical mezzanine in the north wing.

Roof framing consists of unblocked plywood sheathing supported by wood I-joists that span between curved glulam beams. The beams are supported by steel columns.

The floor is slab-on-grade construction and the foundation consists of a mixture of isolated shallow spread footings and piles. The piles are not described or detailed in the available drawings.

The mezzanine is framed with plywood sheathing supported by wood I-joists which span between glulam beams. The mezzanine is suspended from the glulam roof beams with threaded rods and steel brackets. Lateral bracing of the mezzanine is not indicated on the available drawings.

Seismic forces originating in the Main Terminal are distributed by the plywood diaphragm and resisted primarily by steel moment frames. In the north-south direction, frames consisting of W12x79 columns and W18x50 beams are present on the west side of the building and frames consisting of W12x96 and W12x79 columns and W16x40 beams are present in two lines on the east side of the building. The frames on the east side are oriented with the weak axis of the columns; the frames on the west side are oriented with the strong axis of the columns. In the east-west direction, frames are present on each column line (20 feet on center) utilizing W18x86 beams and the same W12x96 and W12x79 columns on the east side of the building, however, they are oriented with the strong axis in this direction. The roof glulam beams act as collectors to deliver seismic forces to the east-west frames.

The 2014 expansion is similar, except that all columns are W12x96 and have been oriented so that the moment frames are in the strong axis direction. W18x86 and W16x67 beams have been used. Additionally, the 2014 expansion includes several plywood-sheathed steel stud walls located at the south end of the terminal.

Terminal A Concourse

The Terminal A Concourse includes three structures from the 1988 expansion: Gate Lobby, the Walkway Bridge and the West Terminal. Each structure is two-stories with similar framing. The three areas are seismically separated from each other and the main terminal.

The West Terminal is approximately 155 feet by 80 feet and features a partial second floor; a 60-foot by 60-foot opening in the floor occurred for escalator access, creating a high-bay space from the ground floor. Note that these escalators were removed in the 2014 expansion. The Gate Lobby is approximately 180 feet by 60 feet. The Walkway Bridge provides access between the Gate Lobby and the West Terminal and is 180 feet long by 20 feet wide.

The second floor consists of composite concrete fill over a steel deck. The deck spans between steel wide-flange beams which are supported by dropped wide-flange girders. The bottom flange of the beams bear directly on the top flange of the girders. At some locations, the girders are dropped further and the beams bear on a built-up boxed section that fills the gap between the bottom of the beam and top of the dropped girder below. The girders are supported by steel wide-flange columns.

The roof in each area consists of un-topped steel deck. The deck spans between steel wide-flange beams which are supported by dropped wide-flange girders, similar as noted above at the second floor. The girders are supported by steel wide-flange columns.

The ground floor is slab-on-grade construction and the foundation system typically consists of grade beams running north-south supporting each line of columns. At the Walkway Bridge, the footings are isolated spread footings at each column.

Seismic forces are resisted by steel moment frames located at every column line (30 feet on center in the north-south direction and 20 feet on center in the east-west direction). The roof and floor decks act as structural diaphragms, but due to the dropped girders, the decks are not continuously attached in the north-south direction, which limits the ability of the diaphragm to transfer in-plane forces. Frame columns are typically W12x136, oriented with the strong axis in the north-south direction and the weak axis in the east-west direction. W16x50 moment frame beams are used in both the north-south and east-west directions at the roof. Moment frame beams at the second floor are W24x76 in the north-south direction and W18x76 in the east-west direction.

Terminal B

The Terminal B area is a 100-foot by 100-foot single-story structure that is seismically separated from the Main Terminal and the West Terminal. It includes a small second-story portion that is an extension of West Terminal.

Roof framing is similar to the main terminal and consists of plywood sheathing supported by wood I-joists and curved glulam beams. The beams are supported by steel columns.

The partial second floor is framed similar to the second floor of the vertical circulation area (see below).

The ground floor is slab-on-grade construction and the foundation system consists of isolated spread footings at the gravity columns and grade beams at the moment frames.

Seismic forces are distributed by the roof and floor diaphragms to moment frames on each perimeter side of the structure. Moment frame columns at the partial second story are boxed W12x96 sections located at each corner of the partial second story. W12x96 columns are used at the other moment frames. Moment frame beams are W18x50 at the second story and W16x31 at the roof over the partial second story. W16x67 and W18x50 beams are used at the roof.

Terminal B was part of the 2014 Expansion and was designed for a recent building code. Therefore, it was not included in this evaluation.

Vertical Circulation

The vertical circulation area is a 40-foot by 80-foot high-bay structure with a partial second floor that is seismically-separated from the West Terminal and Terminal B.

Roof framing consists of plywood sheathing supported by wood I-joists and curved glulam beams. The beams are supported by steel columns.

The second floor consists of composite concrete over steel deck supported by steel-wide flange beams and columns.

The ground floor is slab-on-grade construction and the foundation system consists of isolated spread footings at the gravity columns and grade beams at the moment frames.

Seismic forces are distributed by the roof and floor diaphragms to moment frames on each perimeter side of the structure. A single-story moment frame is located below the partial second floor. Moment frame columns are typically W12x96. Beams are W16x40 or W18x50 at the second floor and W16x67 or W16x40 at the roof. The single-story frame has W12x50 columns and a W16x40 beam.

The Vertical Circulation was part of the 2014 Expansion and was designed for a recent building code. Therefore, it was not included in this evaluation.

REFERENCE DOCUMENTS

The following documents were available and used for this study.

- Architectural drawings titled Eugene Terminal Expansion by P.L. Jacobson, Architect, 57 Sheets, dated February 1988.
- Architectural drawings titled Eugene Airport Terminal Expansion by RS&H Architects-Engineers-Planners, 99 Sheets, dated May 23, 2014.
- Structural drawings titled Eugene Terminal Expansion by John H. Herrick Consulting Structural Engineers, Inc., 30 Sheets, dated February, 1988.
- Structural drawings titled Eugene Airport Terminal Expansion by Hohbach-Lewin, Inc., Structural Engineers, 32 Sheets, dated September 8, 2014.

The 1988 construction drawings do not provide a design basis; however, they appear consistent with the 1985 Uniform Building Code. The 2014 additions were designed as Risk Category III structures in accordance with the 2010 Oregon Structural Specialty Code (2009 International Building Code).

ASCE 41-13 TIER 2 DEFICIENCY-BASED EVALUATION

The Tier 2 Deficiency-Based Evaluation is an analysis of each potential deficiency identified by the Tier 1 Screening. The following tasks were completed as a part of our seismic evaluation:

- A Performance Objective of Immediate Occupancy with a Seismic Hazard Level of 75% of the BSE-1N, as defined above for the Tier 1 Screening.
- A second Performance Objective of Life Safety with a Seismic Hazard Level of 75% of the BSE-2N (consistent with the hazard level specified in the SRGP guidelines).
- Material strengths and properties were typically established based the existing drawings. Where properties were not provided, the ASCE 41-13 “default” values were used based on the age of the building.
- The Linear Static analysis procedure was selected in accordance with ASCE 41-13 Sections 5.2.4 and 7.3.1.2.
- Seismic forces were computed and applied to the potentially deficient elements identified in the Tier 1 Screening.
- Demands at each element were compared to the capacity of the element using designated “m-factors” in ASCE 41-13.
- Where elements were identified as deficient, retrofit recommendations are proposed.

SUMMARY OF ASCE 41-13 TIER 1 SCREENING POTENTIAL DEFICIENCIES

The Tier 1 deficiencies considered in the Tier 2 Evaluation are listed below. See the Tier 1 Screening in Appendix A for a further description of each item. The items listed as unknown deficiencies in the Tier 1 screening, including Liquefaction, Beam Penetrations, and Deep Foundations, remain unknown. Upon further review, the item “Drift” from the Tier 1 screening was discovered to no longer apply.

- Mezzanines
- Flexural Stress Check
- Redundancy
- Transfer to Steel Frames
- Steel Columns
- Panel Zones
- Strong Column-Weak Beam
- Compact Members
- Out-Of-Plane Bracing
- Bottom Flange Bracing

- Diagonally Sheathed and Unblocked Diaphragms

FINDINGS AND DISCUSSION

The Tier 2 evaluation identified the following deficiencies:

- A. The mezzanine at the Main Terminal Building is hung from the roof structure and is not independently braced for lateral forces.
- B. The existing unblocked, stapled plywood roof diaphragm at the Main Terminal Building does not have adequate shear capacity.
- C. At the Terminal A Concourse, Floor and Roof girders are dropped below typical beams. A shear connection does not appear to be provided between the diaphragms and the girders, resulting in insufficient load path to the frames.

For item B, the retrofit recommendations in the following section of the report are based on transferring code level diaphragm design forces from the diaphragms to the frames. This is consistent with the Life Safety Performance Objective, which is a lesser standard than the Immediate Occupancy Performance Objective, which requires the connections to develop the capacity of the frames or the diaphragm. Existing obstructions are anticipated to occur above dropped beams, such as pipes, conduits, ducts, etc., which will hinder the ability to install continuous connections therefore limiting the force that can be transferred.

In addition to the items noted above, the anchorage of the steel columns to the foundations (Tier 1 Screening “Steel Columns”) is deficient for the Immediate Occupancy Performance Objective, which requires that the anchorage develop the capacity of the column or the uplift capacity of the footing. The columns are embedded into concrete plinths that are doweled to the foundations, but the dowel reinforcing is insufficient to develop the capacity of the columns. Therefore, the anchorage was evaluated for the Life Safety Performance Objective, which requires the anchorage to be evaluated for the seismic demand. Except for (4) columns at the Main Terminal, the anchorage is sufficient for the demand. Due to the redundancy from the number of frames in the Main Terminal, the four identified columns are not considered to be of actionable concern, as lateral loads can be redistributed to other frames.

RETROFIT RECOMMENDATIONS

Retrofit measures are provided for each of the four buildings for deficiencies A, B, and C noted in the Findings and Discussion section of the report. Sketches approximating a conceptual retrofit are provided for illustration and costing.

I. Main Terminal Retrofit Recommendations

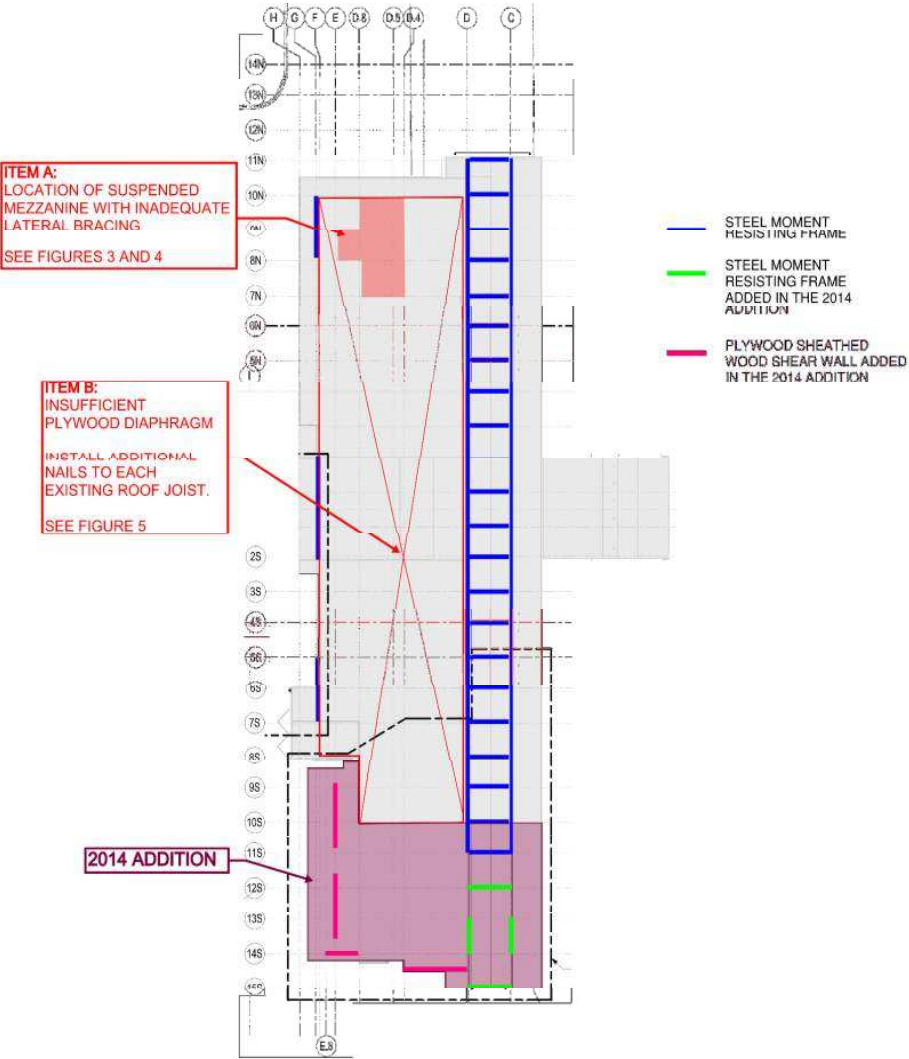


Figure 2 – Main Terminal Building Conceptual Retrofit Key Plan

- A. Plywood shear walls are required to brace the suspended mezzanine to the roof, see Figures 3 and 4.
- B. The unblocked, stapled plywood roof diaphragm has insufficient strength to span between the moment frames on lines D and F. See Figure 5 for supplemental nailing to be added to the existing roof plywood.

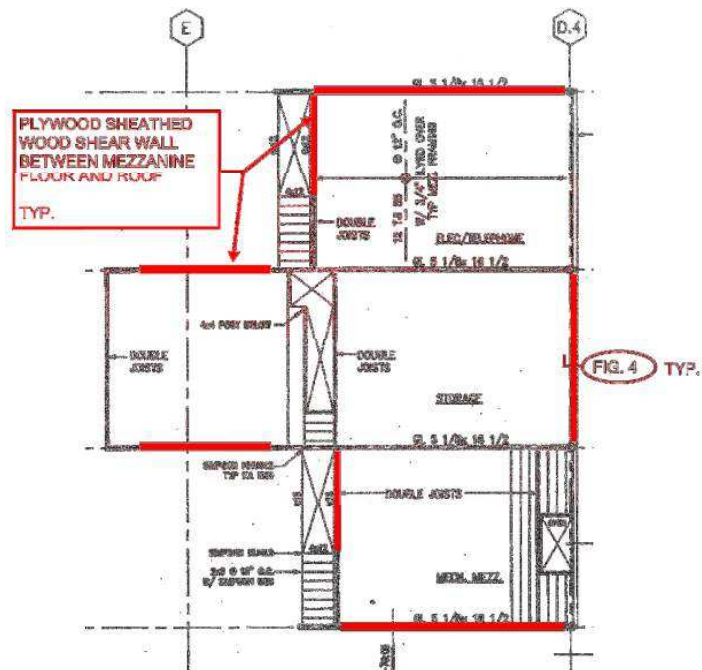


Figure 3 – Main Terminal Building Mezzanine Shear Wall Plan

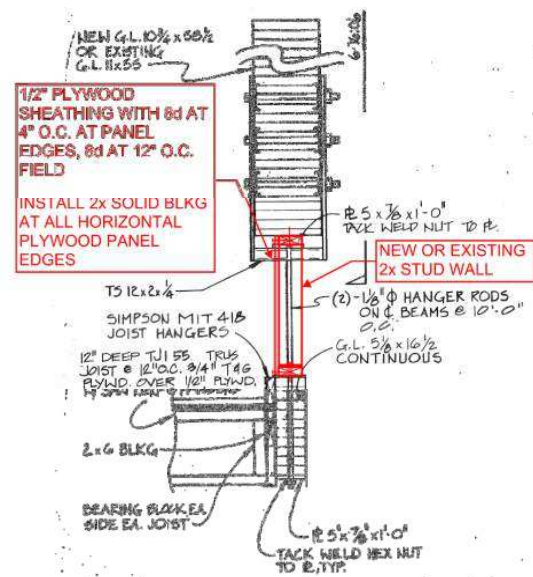


Figure 4 – Main Terminal Building Mezzanine Shear Wall Detail

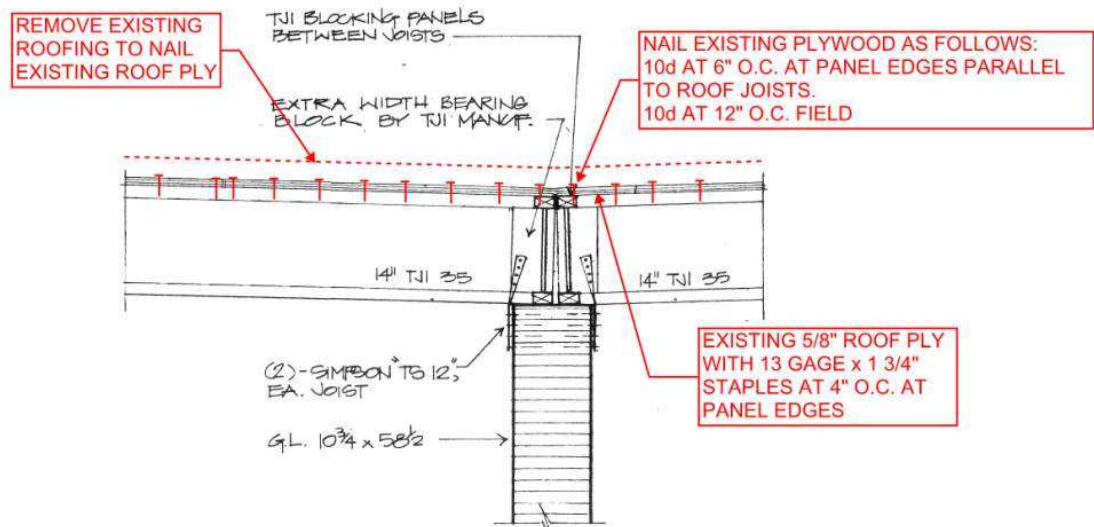


Figure 5 – Main Terminal Building Plywood Roof Diaphragm Nailing

II. West Terminal Retrofit Recommendations

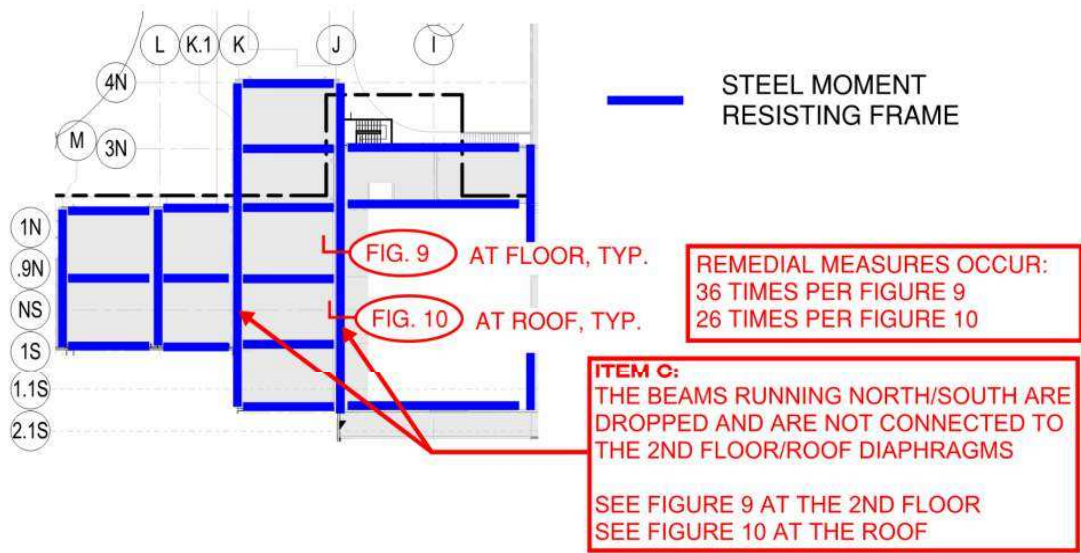


Figure 6 – West Terminal Building Conceptual Retrofit Key Plan

- C. Steel plates are required to between the 2nd floor deck and each girder that runs in the north-south direction, see Figure 9.
- C. Cold-form steel blocking is required between roof decking and each girder that runs in the north-south direction, see Figure 10.

III. Walkway Bridge Retrofit Recommendations

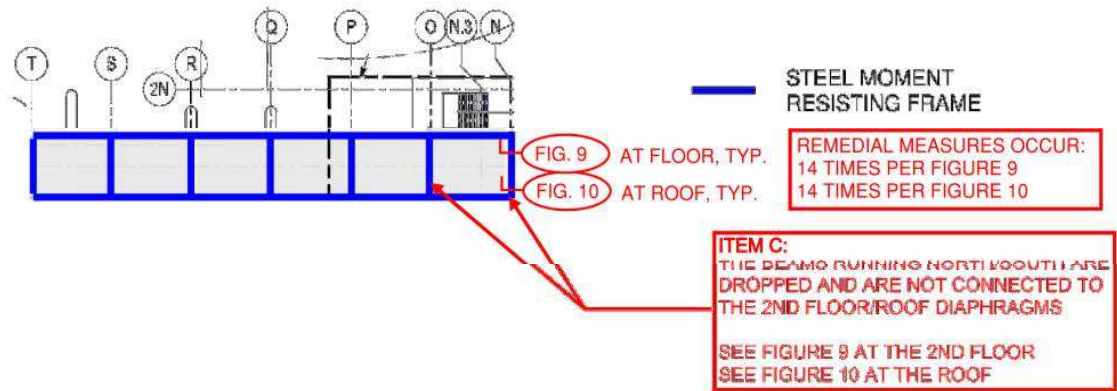


Figure 7 – Walkway Bridge Building Conceptual Retrofit Key Plan

- C. Steel plates are required to between the 2nd floor deck and each girder that runs in the north-south direction, see Figure 9.
- C. Cold-form steel blocking is required between roof decking and each girder that runs in the north-south direction, see Figure 10.

IV. Walkway Bridge Retrofit Recommendations

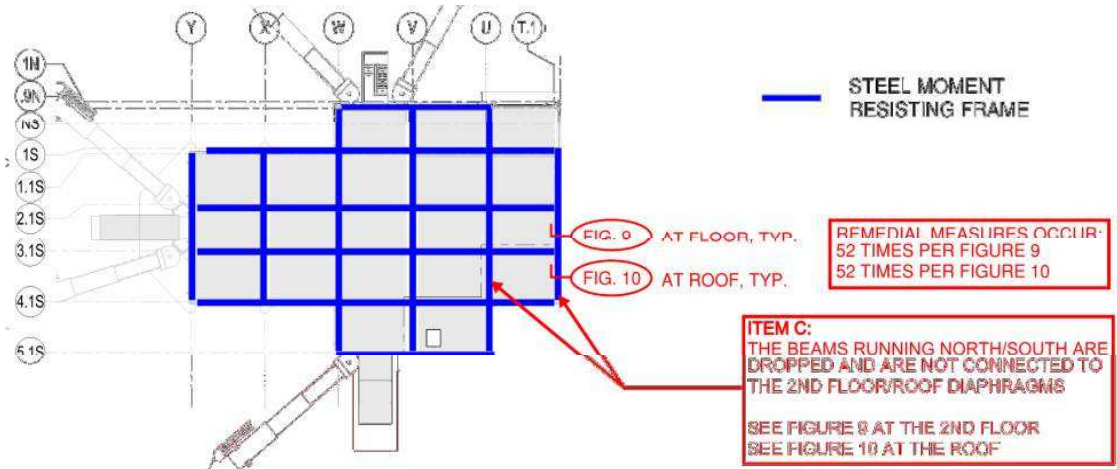


Figure 8 – Gate Lobby Building Conceptual Retrofit Key Plan

- C. Steel plates are required to between the 2nd floor deck and each girder that runs in the north-south direction, see Figure 9.
- C. Cold-form steel blocking is required between roof decking and each girder that runs in the north-south direction, see Figure 10.

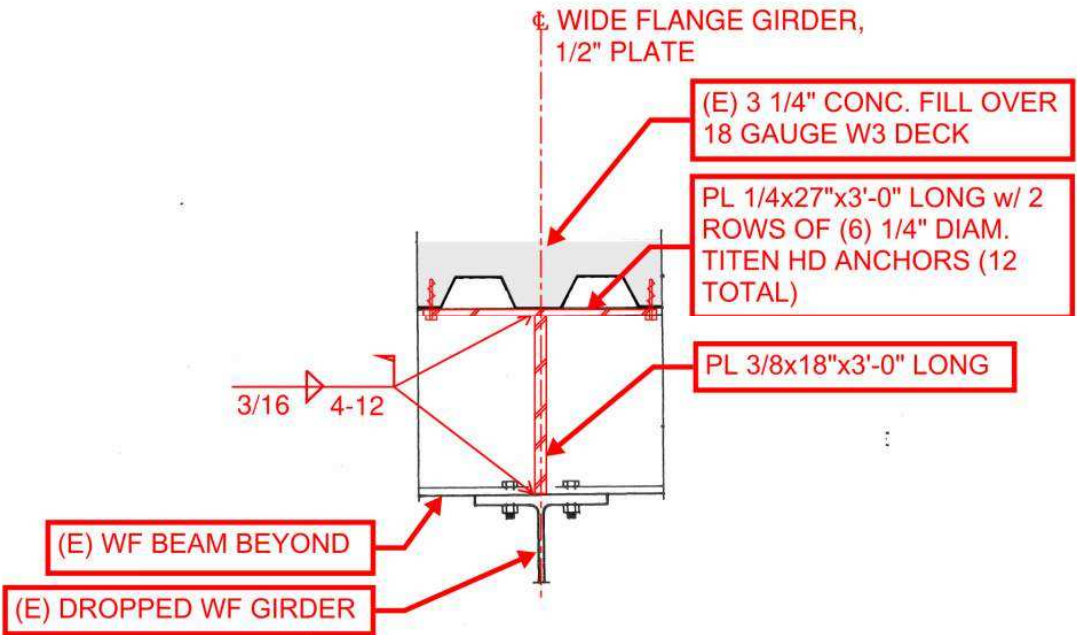


Figure 9 – West Terminal Building N/S 2nd Floor Beam attachment to Deck

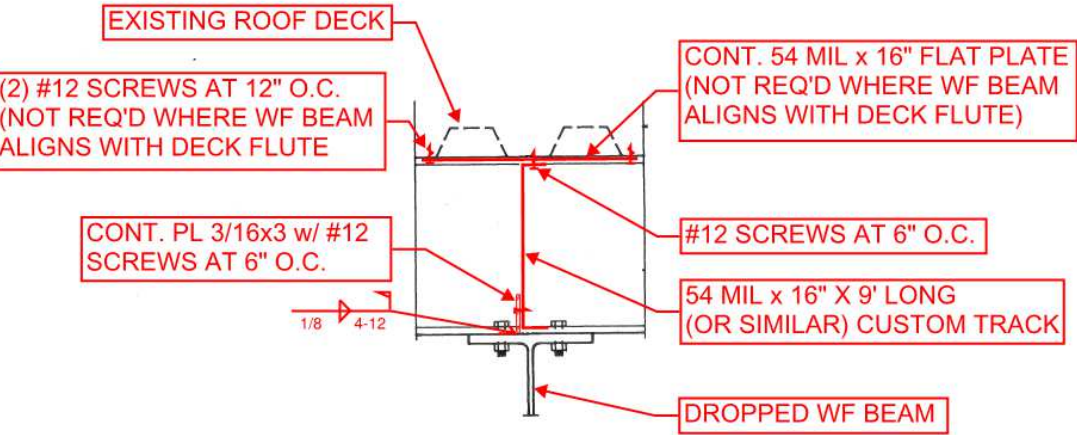


Figure 10 – West Terminal Building N/S Roof Beam attachment to Deck

APPENDIX A
Excerpt from 2016 City of Eugene Seismic Report
ASCE 41-13 Tier 1 Screening

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Project: AIRPORT TERMINAL Location: _____
Completed by: SD Date: 6/2016

16.1.2IO IMMEDIATE OCCUPANCY BASIC CONFIGURATION CHECKLIST

Very Low Seismicity

Building System

General

- ☐ NC N/A U LOAD PATH: The structure shall contain a complete, well-defined load path, including structural elements and connections, that serves to transfer the inertial forces associated with the mass of all elements of the building to the foundation. (Commentary: Sec. A.2.1.1. Tier 2: Sec. 5.4.1.1)
- ☐ NC N/A U ADJACENT BUILDINGS: The clear distance between the building being evaluated and any adjacent building is greater than 4% of the height of the shorter building. This statement need not apply for the following building types: W1, W1a, and W2. (Commentary: Sec. A.2.1.2. Tier 2: Sec. 5.4.1.2)
- ☐ ☒ NC N/A U MEZZANINES: Interior mezzanine levels are braced independently from the main structure or are anchored to the seismic-force-resisting elements of the main structure. (Commentary: Sec. A.2.1.3. Tier 2: Sec. 5.4.1.3)

Building Configuration

- ☐ NC N/A U WEAK STORY: The sum of the shear strengths of the seismic-force-resisting system in any story in each direction shall not be less than 80% of the strength in the adjacent story above. (Commentary: Sec. A.2.2.2. Tier 2: Sec. 5.4.2.1)
- ☐ NC N/A U SOFT STORY: The stiffness of the seismic-force-resisting system in any story shall not be less than 70% of the seismic-force-resisting system stiffness in an adjacent story above or less than 80% of the average seismic-force-resisting system stiffness of the three stories above. (Commentary: Sec. A.2.2.3. Tier 2: Sec. 5.4.2.2)
- ☐ NC N/A U VERTICAL IRREGULARITIES: All vertical elements in the seismic-force-resisting system are continuous to the foundation. (Commentary: Sec. A.2.2.4. Tier 2: Sec. 5.4.2.3)
- ☐ NC N/A U GEOMETRY: There are no changes in the net horizontal dimension of the seismic-force-resisting system of more than 30% in a story relative to adjacent stories, excluding one-story penthouses and mezzanines. (Commentary: Sec. A.2.2.5. Tier 2: Sec. 5.4.2.4)
- ☐ NC N/A U MASS: There is no change in effective mass more than 50% from one story to the next. Light roofs, penthouses, and mezzanines need not be considered. (Commentary: Sec. A.2.2.6. Tier 2: Sec. 5.4.2.5)
- ☐ NC N/A U TORSION: The estimated distance between the story center of mass and the story center of rigidity is less than 20% of the building width in either plan dimension. (Commentary: Sec. A.2.2.7. Tier 2: Sec. 5.4.2.6)

Low Seismicity: Complete the Following Items in Addition to the Items for Very Low Seismicity.

Geologic Site Hazards

- ☐ NC N/A ☒ LIQUEFACTION: Liquefaction-susceptible, saturated, loose granular soils that could jeopardize the building's seismic performance shall not exist in the foundation soils at depths within 50 ft under the building. (Commentary: Sec. A.6.1.1. Tier 2: 5.4.3.1)
- ☐ NC N/A U SLOPE FAILURE: The building site is sufficiently remote from potential earthquake-induced slope failures or rockfalls to be unaffected by such failures or is capable of accommodating any predicted movements without failure. (Commentary: Sec. A.6.1.2. Tier 2: 5.4.3.1)
- ☐ NC N/A U SURFACE FAULT RUPTURE: Surface fault rupture and surface displacement at the building site are not anticipated. (Commentary: Sec. A.6.1.3. Tier 2: 5.4.3.1)

Moderate and High Seismicity: Complete the Following Items in Addition to the Items for Low Seismicity.

Foundation Configuration

- ☐ NC N/A U OVERTURNING: The ratio of the least horizontal dimension of the seismic-force-resisting system at the foundation level to the building height (base/height) is greater than 0.6S_w. (Commentary: Sec. A.6.2.1. Tier 2: Sec. 5.4.3.3)
- ☐ NC N/A U TIES BETWEEN FOUNDATION ELEMENTS: The foundation has ties adequate to resist seismic forces where footings, piles, and piers are not restrained by beams, slabs, or soils classified as Site Class A, B, or C. (Commentary: Sec. A.6.2.2. Tier 2: Sec. 5.4.3.4)

Project: 06 - EUGENE AIRPORT TERMINAL Location: _____
Completed by: _____ Date: _____

16.4IO IMMEDIATE OCCUPANCY STRUCTURAL CHECKLIST FOR BUILDING TYPES S1: STEEL MOMENT FRAMES WITH STIFF DIAPHRAGMS AND S1A: STEEL MOMENT FRAMES WITH FLEXIBLE DIAPHRAGMS

Very Low Seismicity
Seismic-Force-Resisting System

- C ☒ NC N/A U DRIFT CHECK: The drift ratio of the steel moment frames, calculated using the Quick Check procedure of Section 4.5.3.1, is less than 0.015. (Commentary: Sec. A.3.1.3.1. Tier 2: Sec. 5.5.2.1.2)
- ☒ C NC N/A U COLUMN AXIAL STRESS CHECK: The axial stress caused by gravity loads in columns subjected to overturning forces is less than 0.10F_y. Alternatively, the axial stress caused by overturning forces alone, calculated using the Quick Check procedure of Section 4.5.3.6, is less than 0.30F_y. (Commentary: Sec. A.3.1.3.2. Tier 2: Sec. 5.5.2.1.3)
- C ☒ NC N/A U FLEXURAL STRESS CHECK: The average flexural stress in the moment frame columns and beams, calculated using the Quick Check procedure of Section 4.5.3.9, is less than F_y. Columns need not be checked if the strong column—weak beam checklist item is compliant. (Commentary: Sec. A.3.1.3.3. Tier 2: Sec. 5.5.2.1.2)

Connections

- ☒ C NC N/A U STEEL COLUMNS: The columns in seismic-force-resisting frames are anchored to the building foundation. (Commentary: Sec. A.5.3.1. Tier 2: Sec. 5.7.3.1)

Low Seismicity: Complete the Following Items in Addition to the Items for Very Low Seismicity.

Seismic-Force-Resisting System

- C ☒ NC N/A U REDUNDANCY: The number of lines of moment frames in each principal direction is greater than or equal to 2. The number of bays of moment frames in each line is greater than or equal to 3. (Commentary: Sec. A.3.1.1.1. Tier 2: Sec. 5.5.1.1)
- C NC ☒ N/A U INTERFERING WALLS: All concrete and masonry infill walls placed in moment frames are isolated from structural elements. (Commentary: Sec. A.3.1.2.1. Tier 2: Sec. 5.5.2.1.1)

Connections

- C ☒ NC N/A U TRANSFER TO STEEL FRAMES: Diaphragms are connected for transfer of seismic forces to the steel frames, and the connections are able to develop the lesser of the strength of the frames or the diaphragms. (Commentary: Sec. A.5.2.2. Tier 2: Sec. 5.7.2)
- C ☒ NC N/A U STEEL COLUMNS: The columns in seismic-force-resisting frames are anchored to the building foundation, and the anchorage is able to develop the least of the tensile capacity of the column, the tensile capacity of the lowest level column splice (if any), or the uplift capacity of the foundation. (Commentary: Sec. A.5.3.1. Tier 2: Sec. 5.7.3.1)

Moderate Seismicity: Complete the Following Items in Addition to the Items for Very Low and Low Seismicity.

Seismic-Force-Resisting System

- ☒ C NC N/A U MOMENT-RESISTING CONNECTIONS: All moment connections are able to develop the expected strength of the adjoining members based on the specified minimum yield stress of the steel. (Commentary: Sec. A.3.1.3.4. Tier 2: Sec. 5.5.2.2.1). Note: more restrictive requirements for High Seismicity.
- C ☒ NC N/A U PANEL ZONES: All panel zones have the shear capacity to resist the shear demand required to develop 0.8 times the sum of the flexural strengths of the girders framing in at the face of the column. (Commentary: Sec. A.3.1.3.5. Tier 2: Sec. 5.5.2.2.2)
- C NC ☒ N/A U COLUMN SPLICES: All column splice details located in moment frames include connection of both flanges and the web, and the splice develops the strength of the column. (Commentary: Sec. A.3.1.3.6. Tier 2: Sec. 5.5.2.2.3)
- C ☒ NC N/A U STRONG COLUMN—WEAK BEAM: The percentage of strong column—weak beam joints in each story of each line of moment-resisting frames is greater than 50%. (Commentary: Sec. A.3.1.3.7. Tier 2: Sec. 5.5.2.1.5)

- C ☒ NC N/A U COMPACT MEMBERS: All frame elements meet section requirements set forth by AISC 341, Table D1.1, for highly ductile members. (Commentary: Sec. A.3.1.3.8. Tier 2: Sec. 5.5.2.2.4)
- C NC N/A ☒ U BEAM PENETRATIONS: All openings in frame-beam webs are less than one quarter of the beam depth and are located in the center half of the beams. (Commentary: Sec. A.3.1.3.9. Tier 2: Sec. 5.5.2.2.5)
- ☒ C NC N/A U GIRDER FLANGE CONTINUITY PLATES: There are girder flange continuity plates at all moment frame joints. (Commentary: Sec. A.3.1.3.10. Tier 2: Sec. 5.5.2.2.6)
- C ☒ NC N/A U OUT-OF-PLANE BRACING: Beam—column joints are braced out-of-plane. (Commentary: Sec. A.3.1.3.11. Tier 2: Sec. 5.5.2.2.7)
- C ☒ NC N/A U BOTTOM FLANGE BRACING: The bottom flanges of beams are braced out-of-plane. (Commentary: Sec. A.3.1.3.12. Tier 2: Sec. 5.5.2.2.8)

Diaphragms (Stiff or Flexible)

- ☒ C NC N/A U PLAN IRREGULARITIES: There is tensile capacity to develop the strength of the diaphragm at reentrant corners or other locations of plan irregularities. (Commentary: Sec. A.4.1.7. Tier 2: Sec. 5.6.1.4)
- C NC ☒ N/A U DIAPHRAGM REINFORCEMENT AT OPENINGS: There is reinforcing around all diaphragm openings larger than 50% of the building width in either major plan dimension. (Commentary: Sec. A.4.1.8. Tier 2: Sec. 5.6.1.5)
- ☒ C NC N/A U OPENINGS AT FRAMES: Diaphragm openings immediately adjacent to the moment frames extend less than 15% of the total frame length. (Commentary: Sec. A.4.1.5. Tier 2: Sec. 5.6.1.3)

Flexible Diaphragms

- ☒ C NC N/A U CROSS TIES: There are continuous cross ties between diaphragm chords. (Commentary: Sec. A.4.1.2. Tier 2: Sec. 5.6.1.2)
- C NC ☒ N/A U STRAIGHT SHEATHING: All straight sheathed diaphragms have aspect ratios less than 1-to-1 in the direction being considered. (Commentary: Sec. A.4.2.1. Tier 2: Sec. 5.6.2)
- ☒ C NC N/A U SPANS: All wood diaphragms with spans greater than 12 ft consist of wood structural panels or diagonal sheathing. (Commentary: Sec. A.4.2.2. Tier 2: Sec. 5.6.2)
- C ☒ NC N/A U DIAGONALLY SHEATHED AND UNBLOCKED DIAPHRAGMS: All diagonally sheathed or unblocked wood structural panel diaphragms have horizontal spans less than 30 ft and aspect ratios less than or equal to 3-to-1. (Commentary: Sec. A.4.2.3. Tier 2: Sec. 5.6.2)
- ☒ C NC N/A U NONCONCRETE FILLED DIAPHRAGMS: Untopped metal deck diaphragms or metal deck diaphragms with fill other than concrete consist of horizontal spans of less than 40 ft and have aspect ratios less than 4-to-1. (Commentary: Sec. A.4.3.1. Tier 2: Sec. 5.6.3)
- ☒ C NC N/A U OTHER DIAPHRAGMS: The diaphragm does not consist of a system other than wood, metal deck, concrete, or horizontal bracing. (Commentary: Sec. A.4.7.1. Tier 2: Sec. 5.6.5)

High Seismicity: Complete the Following Items in Addition to the Items for Very Low, Low, and Moderate Seismicity.

Seismic-Force-Resisting System

- C ☒ NC N/A U MOMENT-RESISTING CONNECTIONS: All moment connections are able to develop the strength of the adjoining members or panel zones based on 110% of the expected yield stress of the steel per AISC 341, Section A3.2. (Commentary: Sec. A.3.1.3.4. Tier 2: Sec. 5.5.2.2.1)

Foundation System

- C NC N/A ☒ U DEEP FOUNDATIONS: Piles and piers are capable of transferring the seismic forces between the structure and the soil. (Commentary: Sec. A.6.2.3.)
- ☒ C NC N/A U SLOPING SITES: The difference in foundation embedment depth from one side of the building to another does not exceed one story high. (Commentary: Sec. A.6.2.4)



Page: _____
Project: 11230
By: JSL
Date: 6/20/16

PROJECT NAME Eugene Airport TERMINAL

ROOF		SLOPE: 0 in 12			
Description	Deck	Joists	Beams	Columns	Lateral
Roofing	3.0	3.0			3.0
5/8" Sheathing	1.9	1.9			1.9
Insulation	1.0	1.0			1.0
14" I-joist @ 24" o.c.		1.4			4.0
Framing (Steel and Glulams)					12.0
Ceiling		5.0			5.0
Misc.	1.5	1.0			1.0
M/E/P		2.1			2.1
Total (w/o slope)	7.4	15.4	0.0	0.0	30.0
Total (w/ slope)	7.4	15.4	0.0	0.0	30.0

Roof Snow Load: 27 psf

Escalator Area Floor

Description	Deck	Joist	Beams	Columns	Lateral
Floor Finishes	12.0				12.0
3.5" NWC o/ W3 Deck	63.0				63.0
Framing (Stl Beams and Cols)	18.0				18.0
Ceiling	3.0				3.0
Misc.	1.5				1.5
M/E/P	2.5				2.5
Partitions					10.0
Total	100.0	0.0	0.0	0.0	110.0

Floor Live Load: 100 psf



Page: _____
Project: 11230
By: JSL
Date: 6/20/16

PROJECT NAME Eugene Airport TERMINAL

WALLS		Typ	Glazing
Description	Exterior	Wall	
Wall Studs	2.0		
1/2" Plywood	3.0		
Gyp. Board/Finishes	6.2		
Misc.	1.8		
M/E/P	1.0		
Glazing/curtain wall			10.0
Insulation	1.0		
Total	15.0		10.0

SUBJECT: AIRPORT TERMINAL

A6

SUBJECT: _____
 PROJECT NO: 11230
 DATE: 6/20/16
 BY: JBL

SEISMIC MASSNORTH TERMINAL - ROOF

$$A = (150')(147') = 22,050 \text{ }^{\circ}$$

$$\text{WALL LENGTH} = 150' + 147' + 150' = 447'$$

CENTRAL TERMINAL - ROOF

$$A = (134.5')(110') + (76.5')(60') = 19,400 \text{ }^{\circ}$$

$$\text{WALL LENGTH} = 110'$$

SOUTH TERMINAL - ROOF

$$A = (200')(147') - (50')(36') = 27,600 \text{ }^{\circ}$$

$$\text{WALL LENGTH} = 200' + 147' + 200' = 547'$$

WEST TERMINAL - LEVEL 2 (ROOF IS SIMILAR)

$$A = (100')(80') + (30')(60') + (175')(40') = 16,800 \text{ }^{\circ}$$

$$\text{WALL LENGTH} = 275' + 275' = 550'$$

GATE LOBBY - LEVEL 2 (ROOF IS SIMILAR)

$$A = (80')(180') = 14,400 \text{ }^{\circ}$$

$$\text{WALL LENGTH} = 180' + 180' + 80' = 440'$$

SUBJECT: AIRPORT TERMINAL

A7

SUBJECT: _____
 PROJECT NO: 11230
 DATE: 6/20/16
 BY: JBL

SEISMIC MASS (CONT.)NORTH/CENTRAL/SOUTH BLDG

$$\text{ROOF AREA} = 22,000 \text{ }^{\circ} + 19,400 \text{ }^{\circ} + 27,600 \text{ }^{\circ} = 69,000 \text{ }^{\circ}$$

$$\text{WALLS} = 1100'$$

$$W = (69,000 \text{ }^{\circ})(30 \text{ psf}) + (1100')(15'/2)(15 \text{ psf}) = 2200 \text{ }^{\circ}$$

WEST BLDG

$$\text{ROOF/FLOOR AREA} = 31,200 \text{ }^{\circ}$$

$$\text{WALLS} = 990'$$

$$W_R = (31,200)(30 \text{ psf}) + (990')(15'/2)(15 \text{ psf}) = 1050 \text{ }^{\circ}$$

$$W_2 = (31,200)(110 \text{ psf}) + (990')(30'/2)(15 \text{ psf}) = 3650 \text{ }^{\circ}$$

11230
A8

USGS Design Maps Summary Report

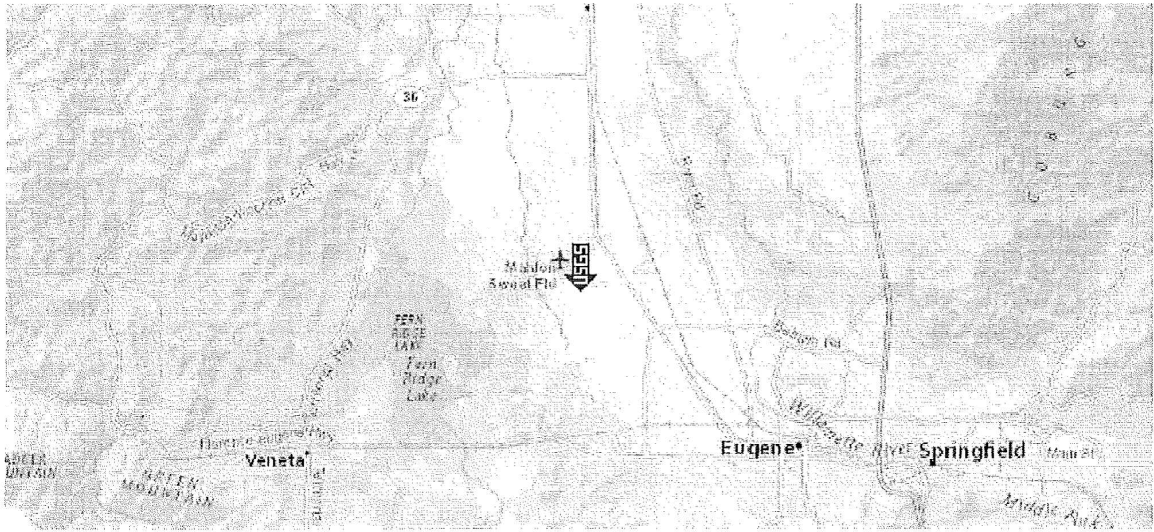
User-Specified Input

Report Title 90711 Northrup Dr: Eugene Airport TERMINAL
Tue June 7, 2016 20:30:04 UTC

Building Code Reference Document ASCE 41-13 Retrofit Standard, BSE-1N
(which utilizes USGS hazard data available in 2008)

Site Coordinates 44.12106°N, 123.20843°W

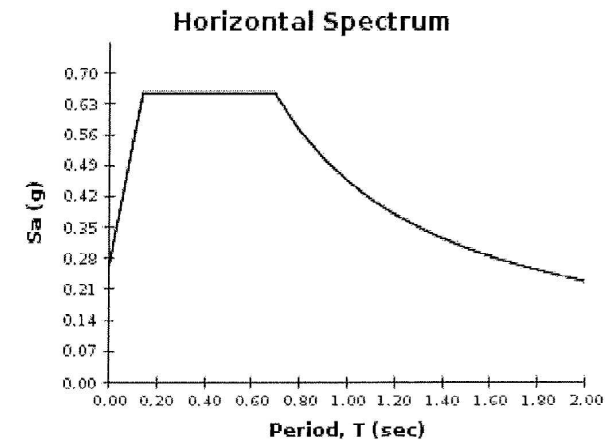
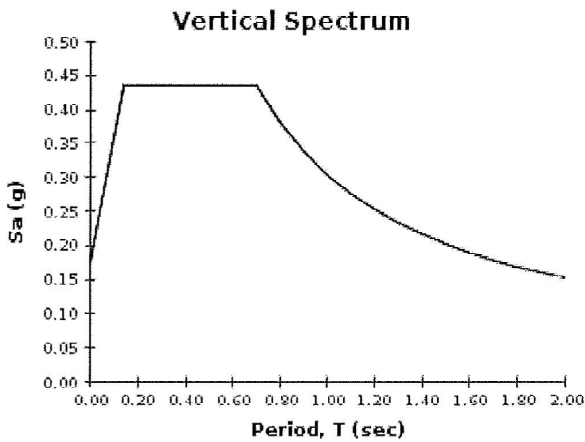
Site Soil Classification Site Class D - "Stiff Soil"



USGS-Provided Output

$S_{XS,BSE-1N} = 0.654 \text{ g} \times 0.75 = 0.490$

$S_{X1,BSE-1N} = 0.455 \text{ g} \times 0.75 = 0.341$



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SUBJECT: AIRPORT TERMINAL

A9

SUBJECT:

PROJECT NO: 11230

DATE: 6/20/16

BY: JSL

SEISMIC PARAMETERS

$T = 0.035 (15')^{0.80} = 0.31 \text{ s} \quad (\text{SINGLE STORY})$

$T = 0.035 (30')^{0.80} = 0.53 \text{ s} \quad (\text{TWO STORY})$

$T_s = S_{X1} / S_{X0} = 0.34 / 0.49 = 0.69$

$T_0 = 0.2 T_s = 0.10$

$T_0 < T < T_s \quad \therefore S_a = S_{Xs} = 0.49 \text{ g}$

$C = 1.0 \quad (\text{SINGLE STORY ; FLEX. DIAPH.})$

$1.1 \quad (\text{TWO-STOREY ; RIGID DIAPH.})$

$V = C S_a W$

$V_{ss} = (1.0)(0.49)(2200 \text{ k}) = 1080 \text{ k} \Rightarrow 15.7 \text{ psf}$

$V_{2s} = (1.1)(0.49)(4700 \text{ k}) = 2530 \text{ k}$



SUBJECT: AIRPORT TERMINAL

SUBJECT: A10
PROJECT NO: 11230
DATE: 6/20/16
BY: JSL

SHEAR DISTRIBUTION - TWO STORY

LEVEL	h	W	Wh	$\frac{Wh}{\sum Wh}$	F
R	30'	1050	31,500	0.37	940
2	15'	3650	54,750	0.63	1590
86,250					



SUBJECT: AIRPORT TERMINAL

SUBJECT: A11
PROJECT NO: 11230
DATE: 6/20/16
BY: JSL

DRIFT CHECK

SINGLE STORY TYP E/W FRAME

$V = (147')(20')(15.6\text{psf}) = 46^k$
W12x96 col & W12x72 col , W18x86 Beam
W12x96 takes $\frac{833}{(833+597)} = 58.7\%$ OF V
 $V_{96} = 27^k$ $V_{72} = 19^k$

W12x96 col
$$Dr = \left(\frac{K_b + K_c}{K_b K_c} \right) \left(\frac{h}{12E} \right) V_c = 0.005 \text{ OK}$$

 $K_b = I_b / L_b = 1530\text{in}^4 / 319\text{in} = 4.8\text{in}^3$
 $K_c = I_c / h = 833\text{in}^4 / 162\text{in} = 5.14\text{in}^3$
 $E = 29 \times 10^3 \text{ksi}$
 $V_c = 27^k$
 $h = 162\text{in}$

SINGLE STORY N/S FRAME

$V = (64')(20')(15.6\text{psf}) = 20^k/\text{col}$
W12x96 WEAK AXIS col W16x40 Beam
 $K_b = 2.2$
 $K_c = 2.0$
 $V_c = 20^k$
 $h = 132"$
 $Dr = 0.007 \text{ OK}$



SUBJECT: AIRPORT TERMINAL

A12

SUBJECT: _____

PROJECT NO: 11230

DATE: 6/20/16

BY: JSL

DRIFT CHECK (CONT.)TWO-STORY TYP E/W FRAME

$$V = (20')(36')(81 \text{ psf}) = 49\text{K}$$

W12x96 WEAK AXIS COL W18x76 BEAM

$$K_b = 3.7$$

$$K_c = 1.7$$

$$V_c = 49\text{K}$$

$$h = 160"$$

$$\Delta_r = 0.019 \text{ NG}$$

TWO-STORY TYP. N/S FRAME

$$V = 49\text{K} \text{ (AS ABOVE)}$$

W12x96 COL W24x76 BEAM

$$K_b = 5.8$$

$$K_c = 5.9$$

$$V_c = 49\text{K}$$

$$h = 140"$$

$$\Delta_r = 0.007 \text{ OK}$$



SUBJECT: AIRPORT TERMINAL

A13

SUBJECT: _____

PROJECT NO: 11230

DATE: 6/20/16

BY: JSL

COL AXIAL STRESS CHECKSINGLE STORY TYP. COL ON (D)

$$A_T = (20')(53') = 1060\text{ft}^2$$

$$DL = 25\text{psf}$$

$$SL = 25\text{psf}$$

$$P_u = (1.2(25) + 1.6(25))(1060\text{ft}^2) = 74\text{K}$$

$$A_s (W12x96) = 28.2\text{in}^2$$

$$f_c = 2.16\text{ksi} < 0.10F_y \text{ OK}$$

TWO STORY TYP. COL ON (K)

$$A_T = (20')(30') = 600\text{ft}^2$$

$$DL = 25\text{psf (KODF)} + 110\text{psf (FLURK)} = 135\text{psf}$$

$$SL = 25\text{psf}$$

$$LL = 100\text{psf}$$

$$P_u = \{ (1.2)(135) + (1.6)(100) + (0.5)(25) \} (600) = 200\text{K}$$

$$A_s (W12x96) = 28.2\text{in}^2$$

$$f_c = 7.1\text{ksi} > 0.10F_y \text{ NG}$$

§4.5.3.1.6 PROCEDURE

$$P_{ot} = \frac{1}{M_s} \left(\frac{2}{3} \right) \left(\frac{V_h}{L_n} \right) \left(\frac{1}{A} \right) = 2.7\text{ksi} < 0.3F_y \text{ OK}$$

$$M_s = 1.3$$

$$V/n = 98\text{K}$$

$$h = 30'$$

$$L = 20'$$

$$A = 28.2\text{in}^2$$

SUBJECT: AIRPORT TERMINAL

A14

SUBJECT: _____
 PROJECT NO: 11230
 DATE: 6/20/16
 BY: JS

FLEXURAL STRESS CHECKSINGLE STORY N/S FRAME

$$f_j = V_j \frac{1}{M_s} \left(\frac{n_c}{n_c - n_f} \right) \left(\frac{h}{2} \right) \left(\frac{1}{Z} \right)$$

$$V_j = 40^k$$

$$M_s = 3$$

$$n_c = 2$$

$$n_f = 1$$

$$h = 132"$$

$$Z = 2 \times 67 \text{ in}^3 (\text{cols}) \quad 2 \times 73 \text{ in}^3 (\text{BM})$$

$$f_j = \underline{13 \text{ ksi (cols)}}; \underline{12 \text{ ksi (BMs)}} \text{ OK}$$

TWO STORY N/S FRAME

$$V_j = 100^k$$

$$M_s = 3$$

$$n_c = 2 \quad n_f = 1$$

$$h = 160"$$

$$Z = 2 \times 147 \text{ in}^3 (\text{cols}) \quad 2 \times 200 \text{ in}^3 (\text{BM})$$

$$f_j = \underline{18 \text{ ksi (col)}} \quad \underline{13 \text{ ksi (BM)}} \text{ OK}$$

SUBJECT: AIRPORT TERMINAL

A15

SUBJECT: _____
 PROJECT NO: 11230
 DATE: 6/20/16
 BY: JS

TRANSFER TO STEEL FRAMES

$$\text{PLYWOOD ROOF DIAPH. CAPACITY } \sqrt{f_{ce}} = 430 \text{ #/ft}$$

TRANSFER TO E-W FRAME AT MAIN TERMINAL

$$\sqrt{f_{ce}} = 79' \times 430 \text{ #/ft} = 34^k$$

$$\text{CONN TO FRAME COL} = (10) \frac{7}{8}" \text{ BOLTS } \underline{\text{OK BY INSP.}}$$

TRANSFER TO N-S FRAME AT MAIN TERMINAL

NO DIRECT CONN OTHER THAN BEARING OF $\perp$ GLISS
 ON FLANGE OF COLUMNS. NG BY INSP.

TRANSFER TO E-W FRAME AT SECOND STORY

DIRECT CONN. W/ WELDED STAPS OK

TRANSFER TO N-S FRAME AT SECOND FLOOR

NO DIRECT CONN.; E-W BEAMS ARE ON TOP
 OF N-S BEAMS. NG BY INSP.



SUBJECT: AIRPORT TERMINAL

A16

SUBJECT: _____

PROJECT NO: 11230

DATE: 6/20/16

BY: JEL

STEEL COLUMNS

TYP. COL ANCHORAGE CONSISTS OF 8 - #6 DOWELS IN A CONCRETE PILE/BOLT BUILT AROUND THE COLUMN BASE.

$$T_{CE} = (8)(0.44 \text{ in}^2)(60 \text{ ksi}) = 210^{\text{K}}$$

TENSION CAPACITY OF COLUMNS

$$W12 \times 96 \quad A = 28 \text{ in}^2 \quad T = 1400^{\text{K}} > 210^{\text{K}} \text{ NG}$$



SUBJECT: AIRPORT TERMINAL

A17

SUBJECT: _____

PROJECT NO: 11230

DATE: 6/20/16

BY: JEL

PANEL ZONESSINGLE STORY E-W FRAME

$$W18 \times 86 \quad M_{CE} = (50 \text{ ksi})(186 \text{ in}^3) = 9300^{\text{K-in}}$$

$$\text{RED'D PANEL ZONE STRENGTH} = 0.8 M_{CE} = 7440^{\text{K-in}} \Rightarrow V_{CE} = 410^{\text{K}}$$

$$R_n = 0.6 F_y d_{ctw}$$

W12 x 72 col

$$R_n = (0.6)(50 \text{ ksi})(12.25 \text{ in})(0.43 \text{ in}) = 160^{\text{K}} \text{ NG}$$

W12 x 96 col

$$R_n = (0.6)(50 \text{ ksi})(12.71 \text{ in})(0.55 \text{ in}) = 210^{\text{K}} \text{ NG}$$

TWO-STOREY N-S FRAME

$$W24 \times 76 \quad M_{CE} = (50 \text{ ksi})(200 \text{ in}^3) = 10,000^{\text{K-in}}$$

$$\text{RED'D PANEL ZONE STRENGTH} = (0.8)(2)(10,000^{\text{K-in}})/24 = 670^{\text{K}}$$

W12 x 96 NG (SEE ABOVE)



SUBJECT: AIRPORT TERMINAL

A18
SUBJECT: _____
PROJECT NO: 11230
DATE: 6/20/10
BY: JSL

STRONG COL - WEAK BEAM

SINGLE STORY E-W FRAME

W18x86 $M_{CE} = 9300 \text{ K-in}$ (Beam)

W12x72 $M_{CE} = 5400 \text{ K-in}$ NG1

W12x96 $M_{CE} = 7400 \text{ K-in}$ NG1

> NG1

SINGLE STORY N-S FRAME

W16x40 $M_{CE} = 3650 \text{ K-in}$

W12x96 $M_{CE} = 3400 \text{ K-in}$ NG1

W12x72 $M_{CE} = 2450 \text{ K-in}$ NG1

> NG1

APPENDIX B
ASCE 41-13 Tier 2 Deficiency-Based Evaluation

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Seismic Shear Forces	B-16
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Project: 13242
By: TMR
Date: Nov-18



HOHBACH-LEWIN, INC. *STRUCTURAL ENGINEERS*

“Timely Solutions Based On Timeless Principles”

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13242

ASCE 41-13 Tier II Analysis Description

The following calculations include an ASCE 41-13 Tier II analysis for the Eugene Airport. The Airport consists of (6) seismically separate buildings, (4) of which were retrofitted in 1988 and (2) of which were constructed in 2014. The recent 2014 additions were designed as Risk Category III for the 2010 OSSC/2009 IBC are not included in this analysis. The (4) buildings analyzed within are:

- The Main Terminal
- The West Terminal
- The Walkway Bridge
- The Gate Lobby

Reference the Key Plan on page B-4.

The lateral force resisting system for each of the building consists of steel moment frames. The Main Terminal is the only single-story structure, and it consists of a wood roof framing. The West Terminal, Walkway Bridge, and Gate Lobby are all two-story structures with similar moment frames and steel member sizes. The roof is untopped steel deck and the floor is concrete fill over metal deck. Nearly every bay in each structure is a moment frame.

For an a more detailed description of each building, refer to the 'Building Description' section of the Seismic Evaluation Report.



PROJECT NAME

COE Airport ASCE 41 Tier 2

WOOD ROOF SLOPE: 0 in 12

Description	Lateral
Roofing	3.0
5/8" Sheathing	1.9
Insulation	1.0
14" I-joist @ 24" o.c.	4.0
Framing (Steel and Glulams)	12.0
Ceiling	5.0
Misc.	1.0
M/E/P	2.1
Total (w/o slope)	30.0
Total (w/ slope)	30.0

Roof Snow Load: 27 psf

METAL DECK ROOF SLOPE: 0 in 12

Description	Lateral
Roofing	3.0
3" Metal Deck	3.0
Insulation	1.0
Steel Beams	15.0
Ceiling	5.0
Misc.	1.0
M/E/P	2.0
Total (w/o slope)	30.0
Total (w/ slope)	30.0

Roof Snow Load: 27 psf

PER ASCE 41 7.2.2 - IF SNOW LOAD IS <30psf, IT CAN BE IGNORED.



Page: _____
Project: 13242
By: TMR
Date: Nov-18

PROJECT NAME COE Airport ASCE 41 Tier 2
FLOOR

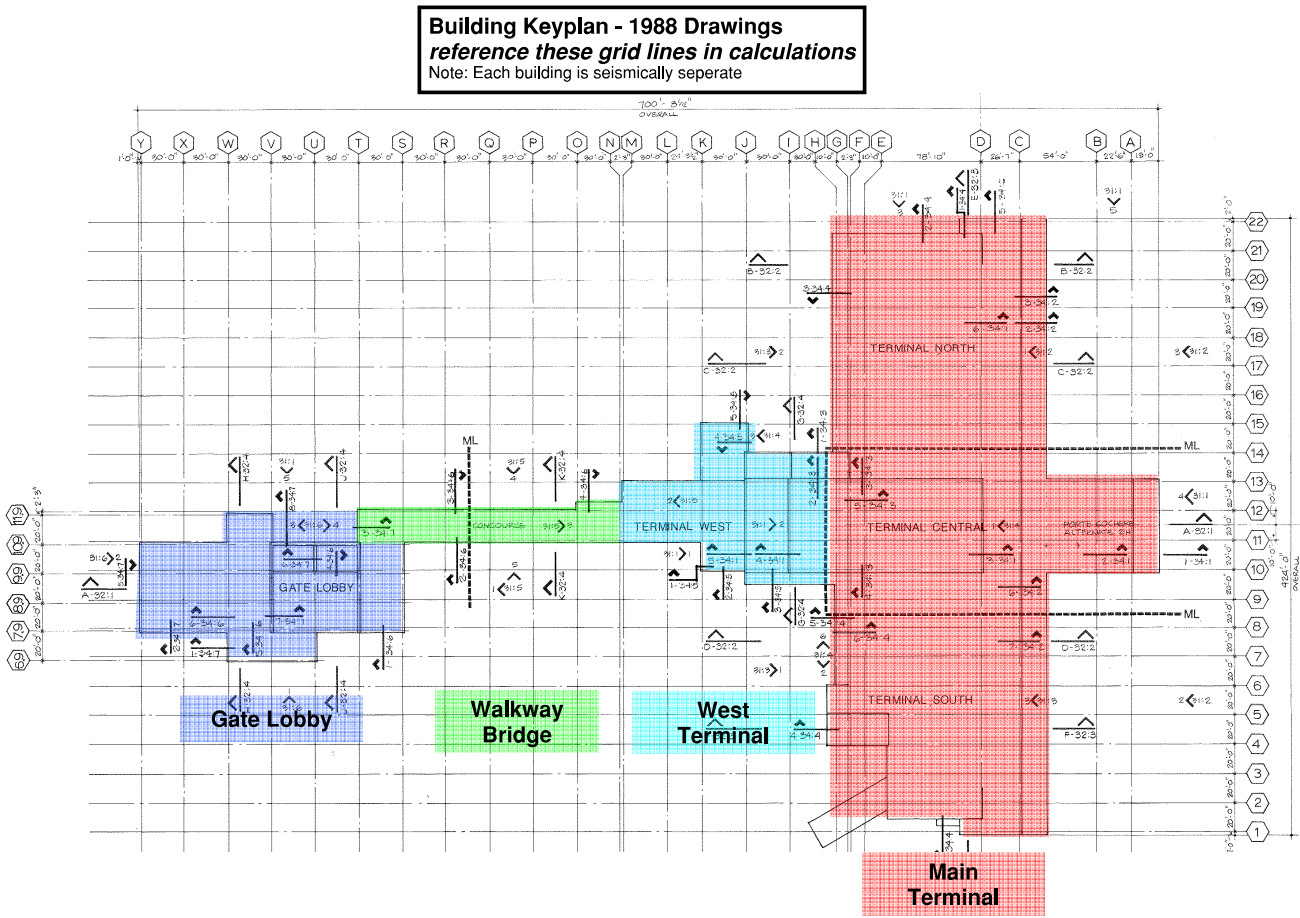
Description	Lateral
Floor Finishes	12.0
3.5" NWC o/ W3 Deck	63.0
Framing (Stl Beams and Cols)	18.0
Ceiling	3.0
Misc.	11.5
M/E/P	2.5
Total	110.0

Floor Live Load: 100 psf

PER ASCE 41 7.2.2 - 25% OF LL
PERMITTED, THEREFORE USE 25psf

WALLS

Description	Typ Exterior
Wall Studs	2.0
1/2" Plywood	3.0
Gyp. Board/Finishes	6.2
Misc.	1.8
M/E/P	1.0
Glazing/curtain wall	
Insulation	1.0
Total	15.0



Seismic Mass Calculation

Loading			
Roof	30	psf	← 30psf typical at roofs
Floor	110	psf	
Wall	15	psf	

Main Terminal, West Terminal, Gate Lobby and Walkway are all seismically seperated.

Main Terminal	Area (sf)	Ext. Wall Length (ft)	Avg. Wall Height (ft)
North Terminal - Roof	23200	465	15
Central Terminal - Roof	21000	120	15
South Terminal - Roof	19650	445	15

West Terminal			
West Terminal Roof	9600	370	15
West Terminal Floor	9000	370	30

Gate Lobby			
Roof	12600	450	15
Floor	12600	450	30

Walkway			
Roof	3600	350	15
Floor	3600	350	30

Main Terminal	W=	2031	kip
West Terminal Roof	W=	330	kip
West Terminal Floor	W=	1073	kip
Gate Lobby Roof	W=	429	kip
Gate Lobby Floor	W=	1487	kip
Walkway Roof	W=	147	kip
Walkway Floor	W=	475	kip

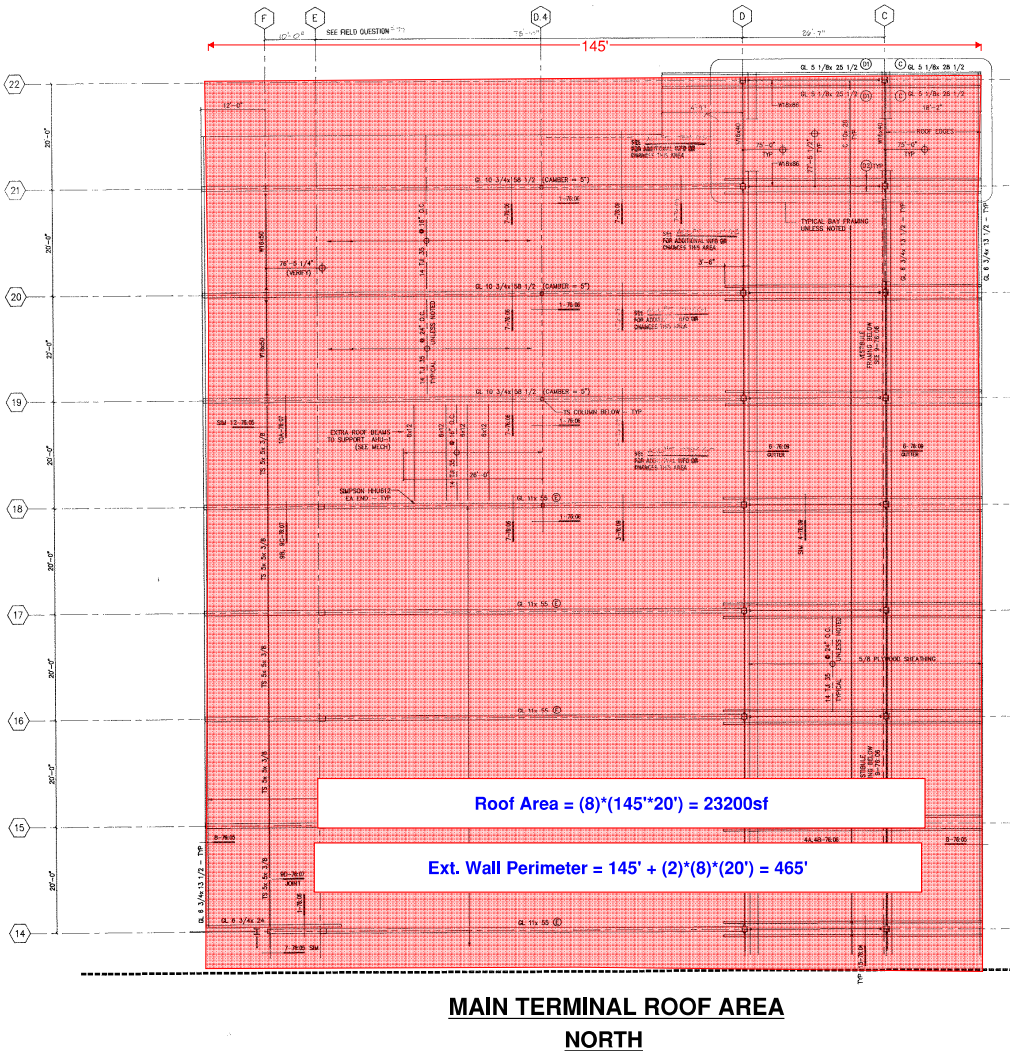
See the following sheets for building areas.

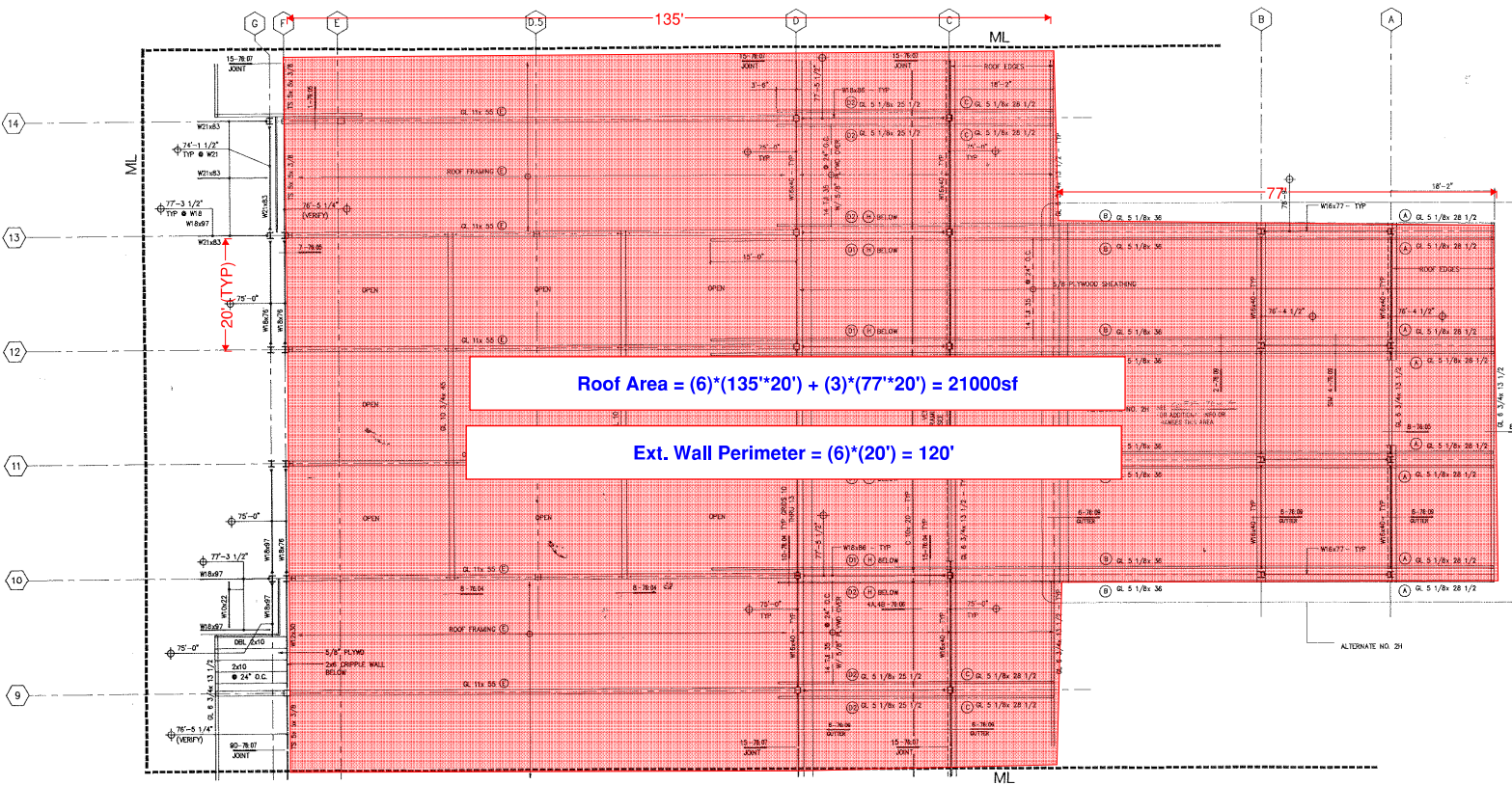
North/Central/South are one building, seismic forces distributed to moment frames via wood diaphragm.

Seismic forces distributed to moment frames via concrete fill over metal deck at floor and metal deck with no concrete at roof.

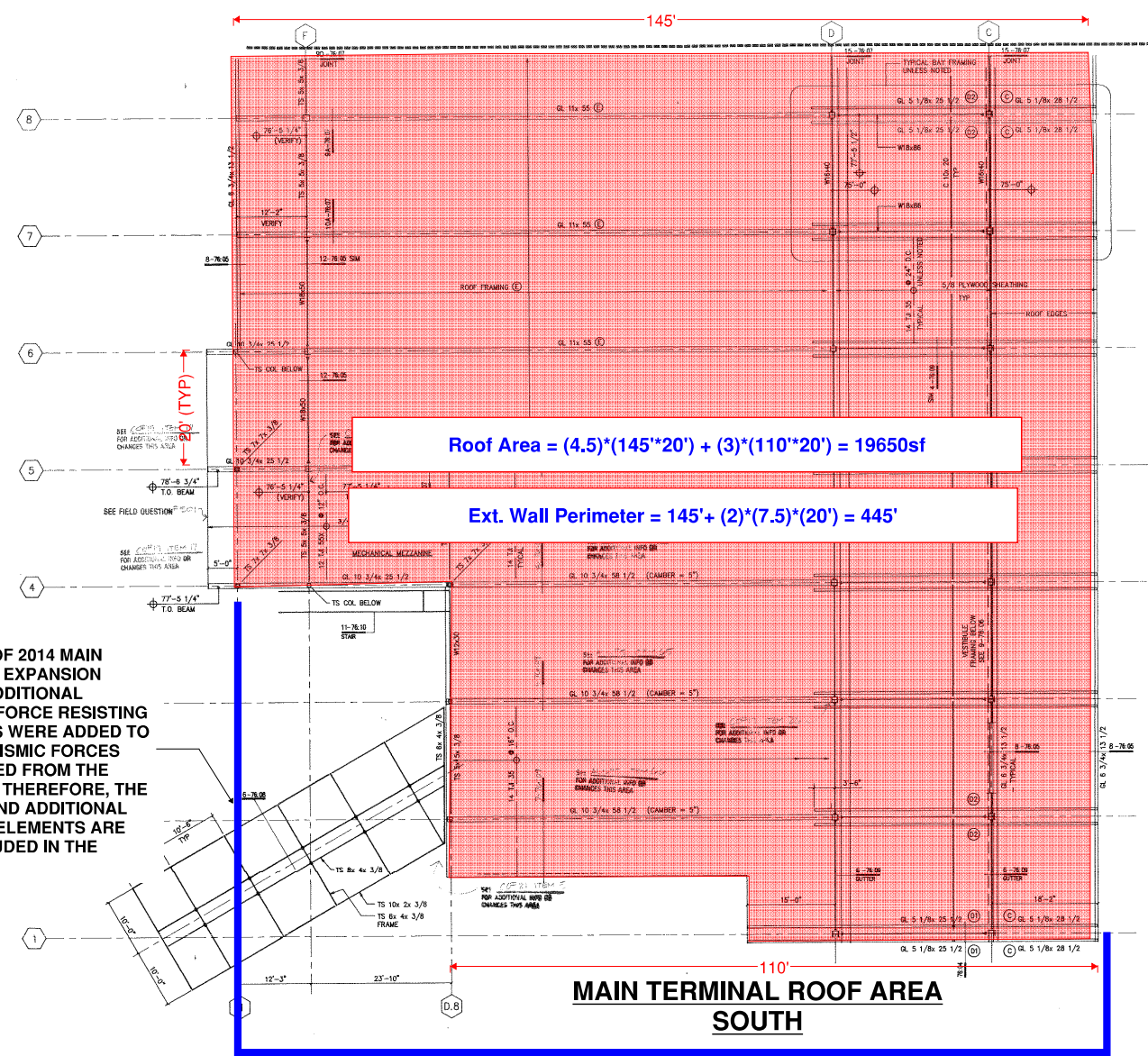
Seismic forces distributed to moment frames via concrete fill over metal deck at floor and metal deck with no concrete at roof.

Seismic forces distributed to moment frames via concrete fill over metal deck at floor and metal deck with no concrete at roof.



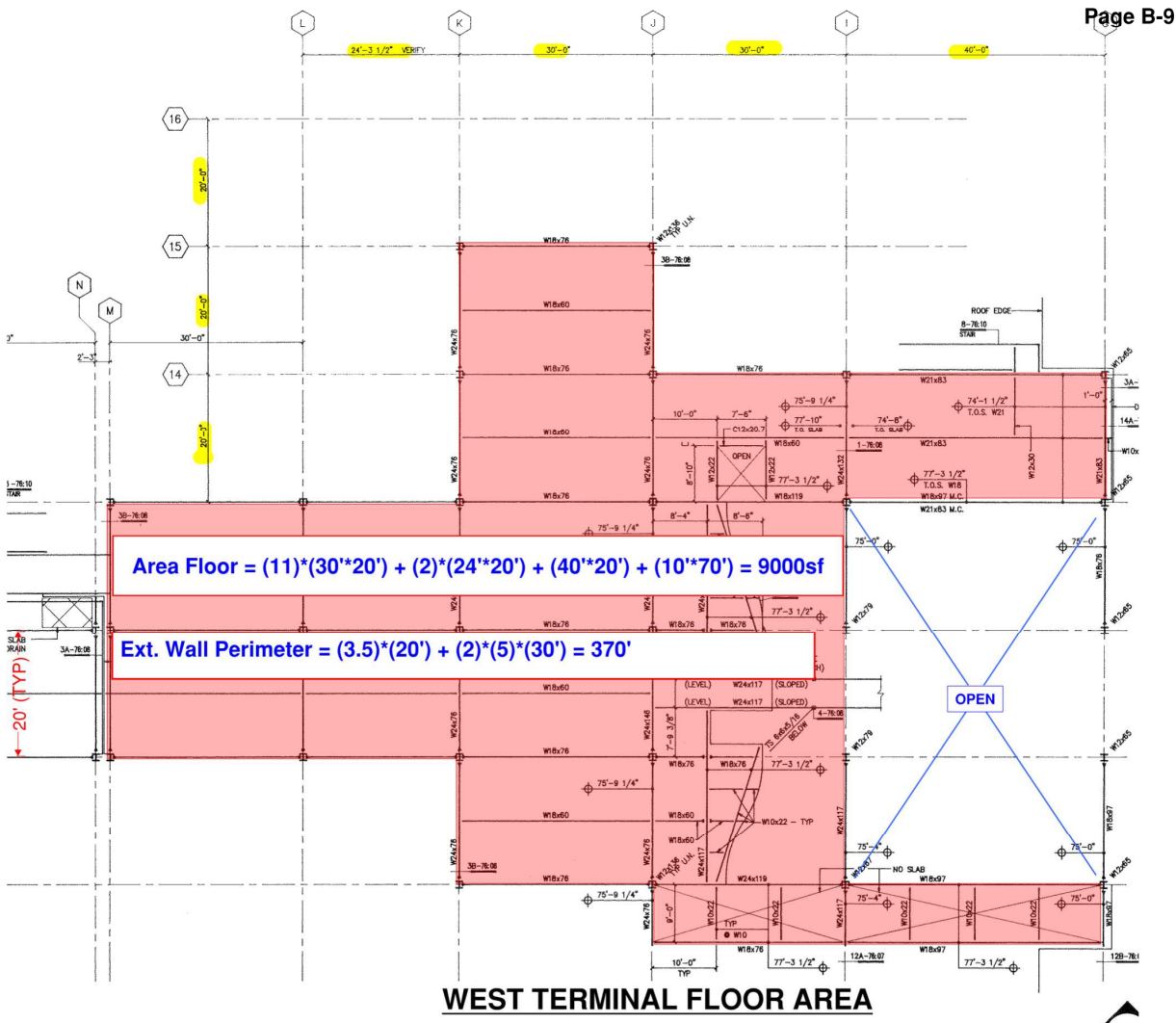
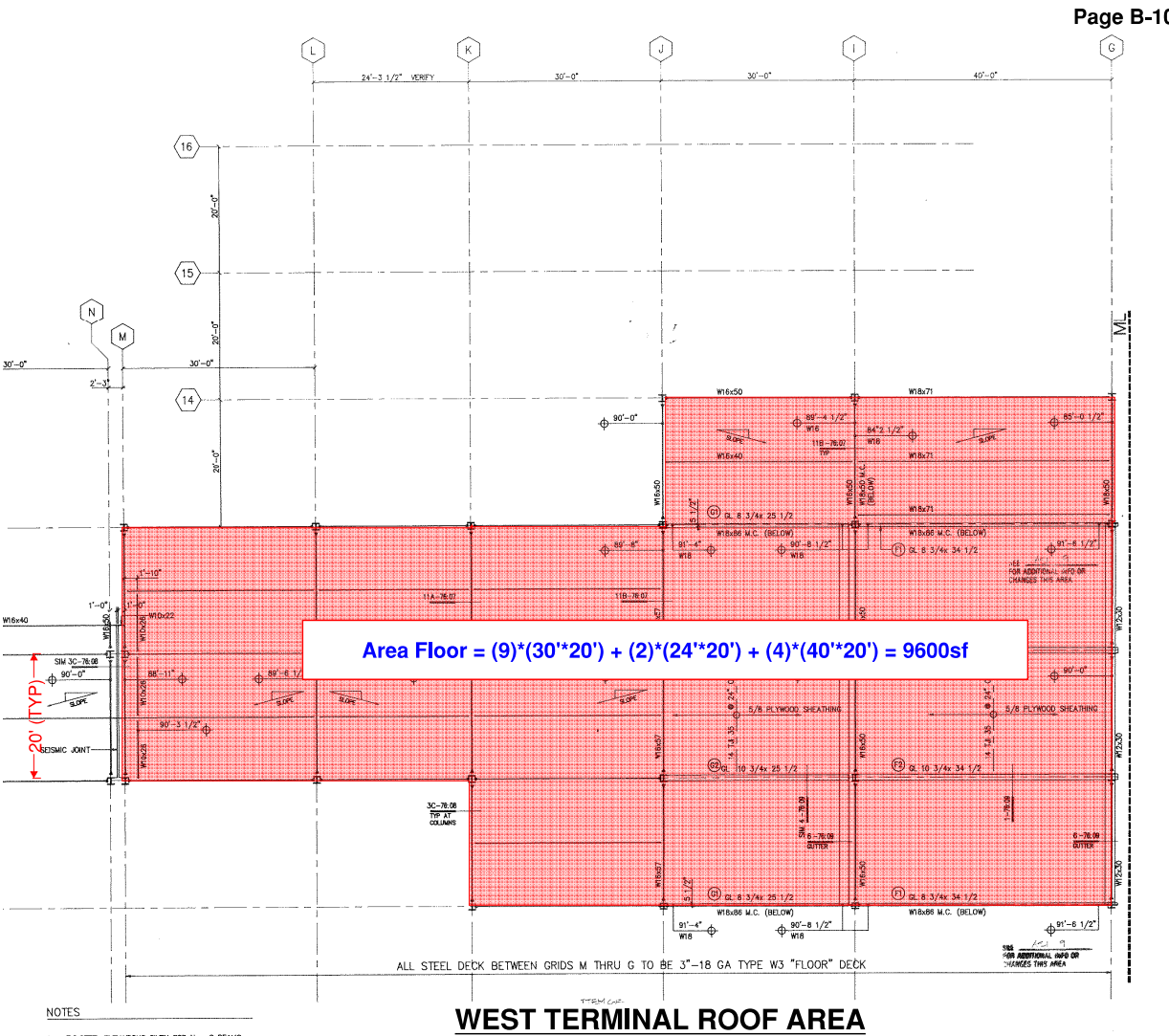


**MAIN TERMINAL ROOF AREA
CENTRAL**

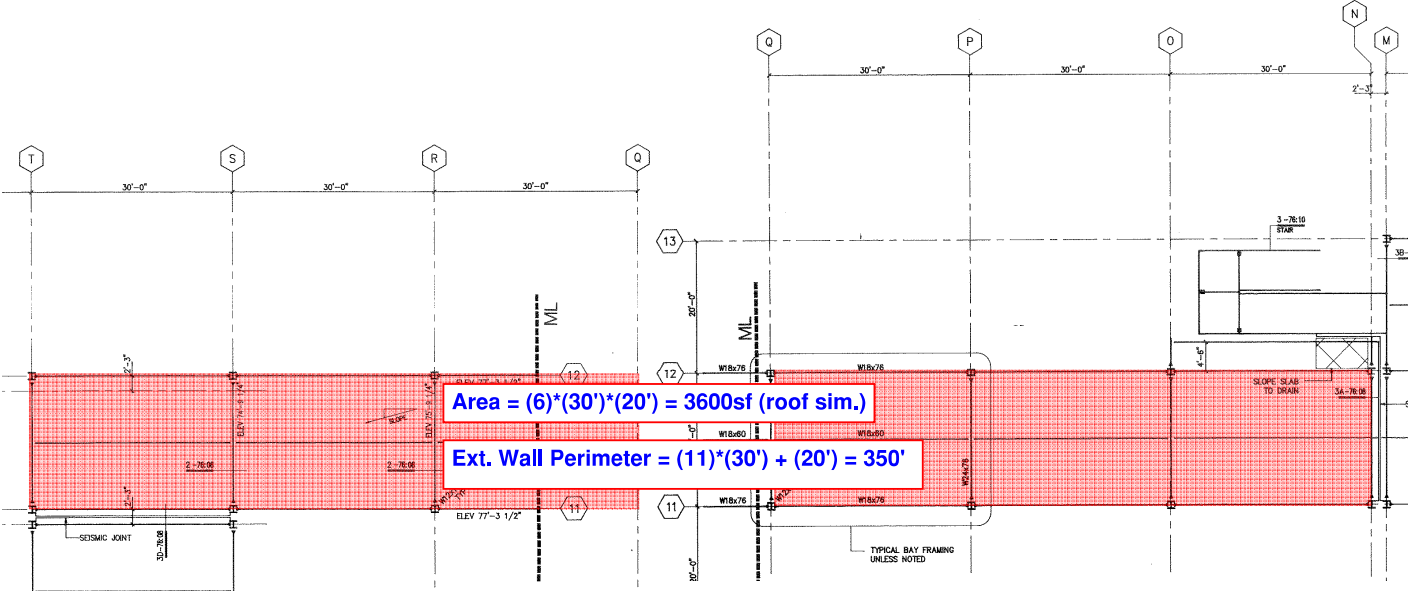


OUTLINE OF 2014 MAIN
TERMINAL EXPANSION
(N.T.S.). ADDITIONAL
LATERAL FORCE RESISTING
ELEMENTS WERE ADDED TO
RESIST SEISMIC FORCES
GENERATED FROM THE
ADDITION. THEREFORE, THE
WEIGHT AND ADDITIONAL
LATERAL ELEMENTS ARE
NOT INCLUDED IN THE
ANALYSIS.

**MAIN TERMINAL ROOF AREA
SOUTH**

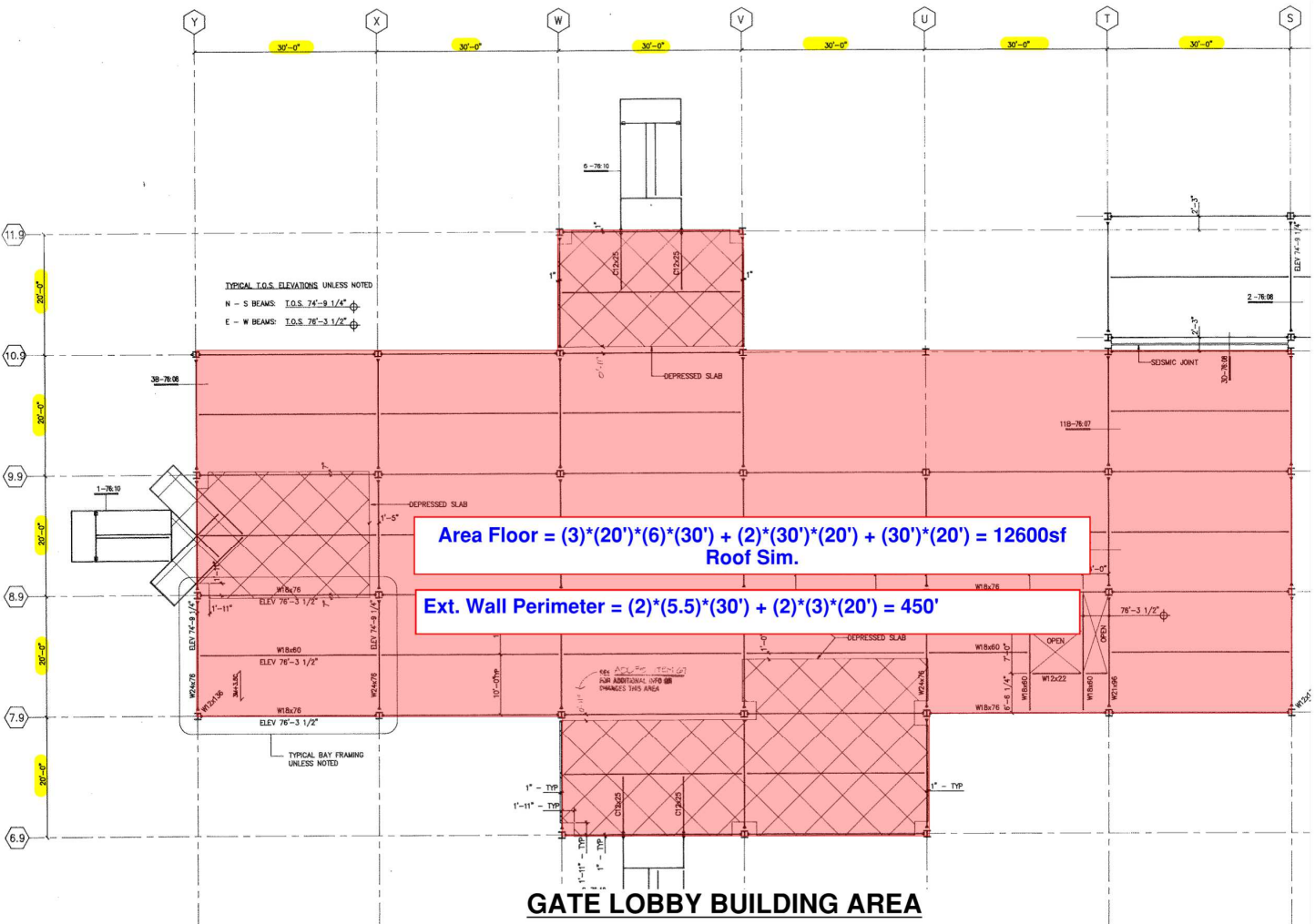


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WALKWAY BRIDGE BUILDING AREA

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GATE LOBBY BUILDING AREA

8/17/2018

Design Maps Summary Report

USGS Design Maps Summary Report

User-Specified Input

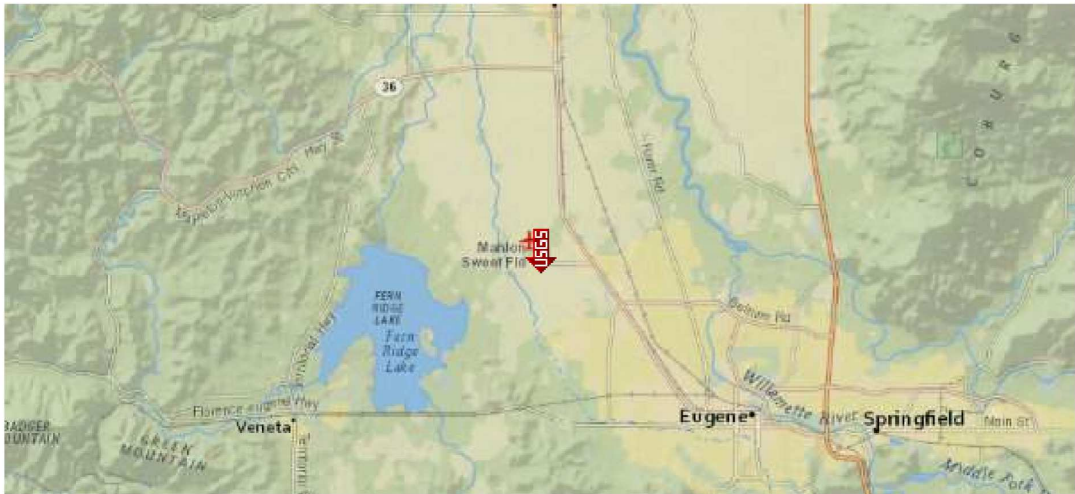
Report Title COE Airport
Fri August 17, 2018 16:01:32 UTC

Building Code Reference Document ASCE 41-13 Retrofit Standard, BSE-1N
(which utilizes USGS hazard data available in 2008)

Site Coordinates 44.1195°N, 123.21243°W

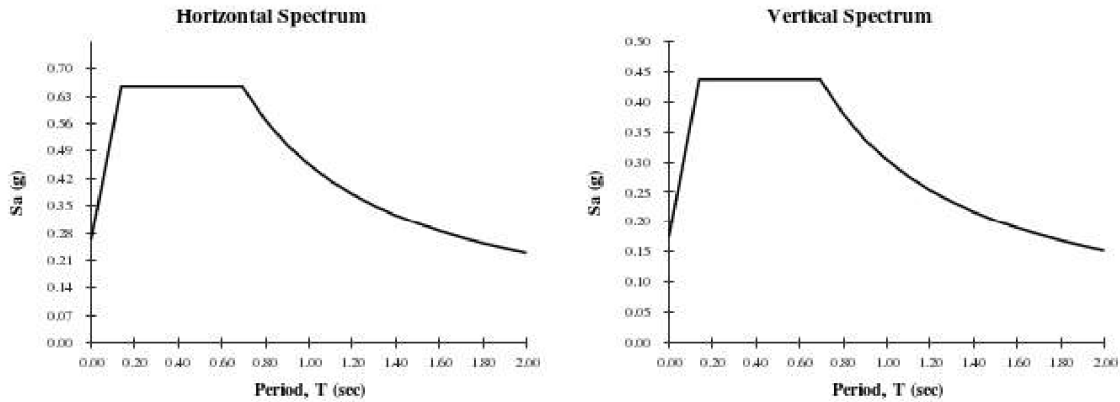
Site Soil Classification Site Class D – “Stiff Soil”

For Immediate Occupancy
performance level



USGS-Provided Output

$S_{XS,BSE-1N}$ 0.655 g x 75% = 0.491
 $S_{X1,BSE-1N}$ 0.456 g x 75% = 0.342 | 0.75 BSE-1N > BSE-1E per Oregon State Amendments
(BSE-1E, S_{XS} = 0.257)



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8/17/2018

Design Maps Summary Report

USGS Design Maps Summary Report

User-Specified Input

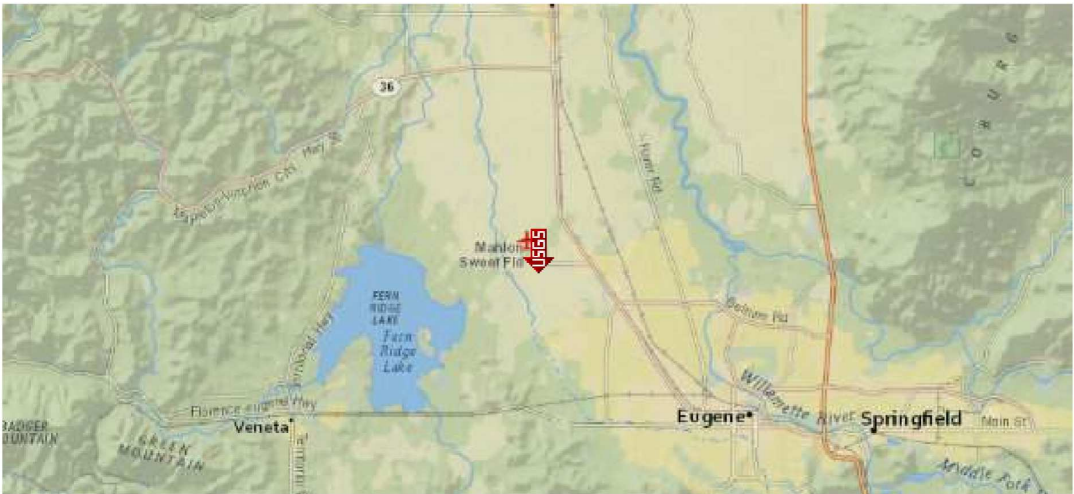
Report Title COE Airport
Fri August 17, 2018 16:39:51 UTC

Building Code Reference Document ASCE 41-13 Retrofit Standard, BSE-2E
(which utilizes USGS hazard data available in 2008)

Site Coordinates 44.1195°N, 123.21243°W

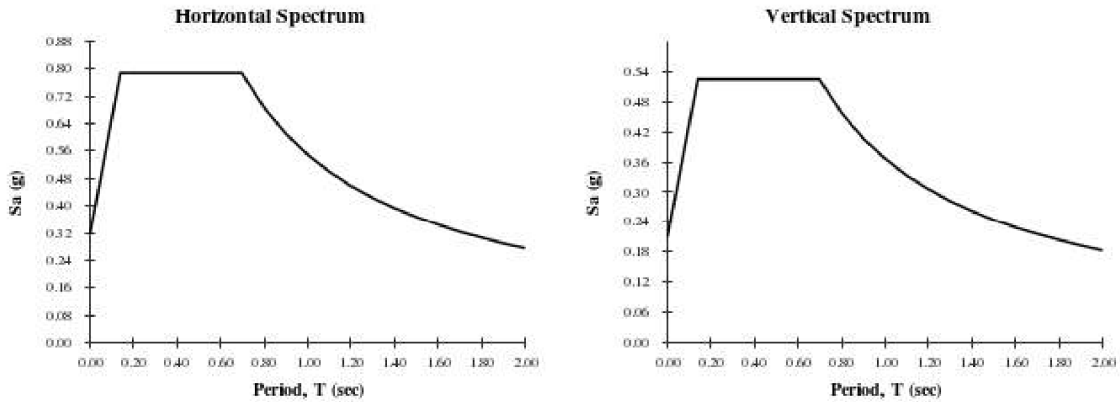
Site Soil Classification Site Class D – “Stiff Soil”

For Life Safety
performance level



USGS-Provided Output

$S_{S,5/50}$ 0.595 g $S_{XS,BSE-2E}$ 0.788 g
 $S_{1,5/50}$ 0.308 g $S_{X1,BSE-2E}$ 0.550 g



Although this information is a product of the U.S. Geological Survey, we provide no warranty, expressed or implied, as to the accuracy of the data contained therein. This tool is not a substitute for technical subject-matter knowledge.



Project: COE Airport ASCE 41 Tier 2

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Date: 10/12/2018
By: TMR

ASCE 41-13 Seismic Forces

Building Period - 7.4.1.2.2

$T = C_t H_n^\beta$ | Eq. 7-18

C_t	0.035	(Factor for moment frame buildings)
h_n	15 ft	(1-story) (At Main Terminal)
h_n	30 ft	(2-story) (At West Terminal, Gate Lobby, and Walkway)
β	0.8	(Factor for moment frame buildings)

$T_{1\text{story}} = 0.31$ s
 $T_{2\text{story}} = 0.53$ s
Note: Base shear is not affected by building period since $C_1 C_2$ as 1.1 was used as an alternative to equations per ASCE 41 Table 7-3.

75% BSE-1N	S_{X1}	0.34	S_{X5}	0.491	$T_s = S_{X1}/S_{X2}$	0.70	$T_0 = 0.2T_s$	0.14
BSE-2E	S_{X1}	0.55	S_{X5}	0.788	$T_s = S_{X1}/S_{X2}$	0.70	$T_0 = 0.2T_s$	0.14

Linear Static Procedure - 7.4.1.3

$V = C_1 C_2 C_m S_a W$ | Eq. 7-21

Where:

	$C_m = 1$	Table 7-4, 1-2 story moment frame
75% BSE-1N	$S_a = S_{X5}/B_1 = 0.491$	B1 = 1.0 for 5% critical damping (assumed) Table 7-3, $2 \leq m_{\max} < 6$
BSE-2E	$S_a = S_{X5}/B_1 = 0.788$	
	$C_1 C_2 = 1.1$	

Base Shear Coefficients			
75% BSE-1N	V =	0.54	W
BSE-2E	V =	0.87	W

$C_1 C_2 = 1.1$ is simplified method; try this first and adjust if necessary.



Project: COE Airport ASCE 41 Tier 2

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ASCE 41-13 Seismic Forces

Building Weights

	W (kip)
Main Terminal	2031
West Terminal Roof	330
West Terminal Floor	1073
Gate Lobby Roof	429
Gate Lobby Floor	1487
Walkway Roof	147
Walkway Floor	475

Vertical Distribution of Seismic Forces

7.4.1.3.2 West Terminal, Gate Lobby and Walkway are 2-story structures.

$W_x = C_{vx} W$ | Eq. 7-24

$C_{vx} = w_x h_x^k / \sum w_i h_i^k$ | Eq. 7-25 k = 1.0 for T < 1.0s

West Terminal

	h_x (ft)	w_x (kip)	C_{vx}	W_x (kip)
Floor	15	1073	0.6	869
Roof	30	330	0.4	571

Gate Lobby

	h_x (ft)	w_x (kip)	C_{vx}	W_x (kip)
Floor	15	1487	0.6	1215
Roof	30	429	0.4	701

Walkway

	h_x (ft)	w_x (kip)	C_{vx}	W_x (kip)
Floor	15	475	0.6	384
Roof	30	147	0.4	238

Seismic Shear Forces

75% BSE-1N	V =	0.54	W_x
BSE-2E	V =	0.87	W_x

Building seismic forces

	W_x (kip)	V (kip) 75% BSE-1N	V (kip) BSE-2E	Area (sf)
Main Terminal	2031	1097	1761	63850
West Terminal Roof	571	309	495	9600
West Terminal Floor	869	469	753	9000
Gate Lobby Roof	701	378	607	12600
Gate Lobby Floor	1215	656	1053	12600
Walkway Roof	238	129	207	3600
Walkway Floor	384	207	333	3600



HOHBACH-LEWIN, INC.
STRUCTURAL ENGINEERS

Project: COE Airport ASCE 41 Tier 2

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MAIN TERMINAL INDEX:

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THE TIER 1 DEFICIENCIES ARE ADDRESSED ON THE FOLLOWING PAGES:

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DCR WILL BE USED TO REPRESENT Q_{UD}/mQ_{CE} UNLESS NOTED OTHERWISE.

PER ASCE 41-13 EQN 7-16, $DCR = Q_{UD}/Q_{CE}$

FOR DEFORMATION CONTROLLED ACTIONS USING THE LINEAR STATIC PROCEDURE, ACCEPTANCE CRITERIA IS BASED ON $mQ_{CE} > Q_{UD}$. (EQN 7-36). THEREFORE, NOTATION IN THESE CALCULATIONS USE DCR TO REPRESENT $Q_{UD}/mQ_{CE} < 1.0$ WHICH IS THE EQUIVALENT OF $m > Q_{UD}/Q_{CE}$



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STRUCTURAL ENGINEERS

Project: COE Airport ASCE 41 Tier 2

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ASCE 41-13 Seismic Forces

FRAME LINE SHEAR FORCE DISTRIBUTION

Moment Frame Line Forces

**See keyplans for frame line tributary areas.*

Loading at Main Terminal

Total Roof Area (sf) 63850

Line	A _{trib} (sf)	% V _{tot}	# col	V _{0.75BSE-1N} (kip)	load per column	V _{BSE-2E} (kip)	load per column	Columns in this area will be checked for loading in both directions.
C	14308	0.22	22	246	11.2	395	17.9	
D	25428	0.40	22	437	19.9	701	31.9	
F	-	0.38	17	414	24.4	665	39.1	
16	2940	0.05	2	51	25.3	81	40.5	

SEE FOLLOWING PAGES FOR MOMENT FRAME TRIBUTARY AREA.

LINE 16 IS A TYPICAL E-W FRAME WHICH OCCURS BETWEEN LINE C AND D.



SUBJECT: COE AIRPORT

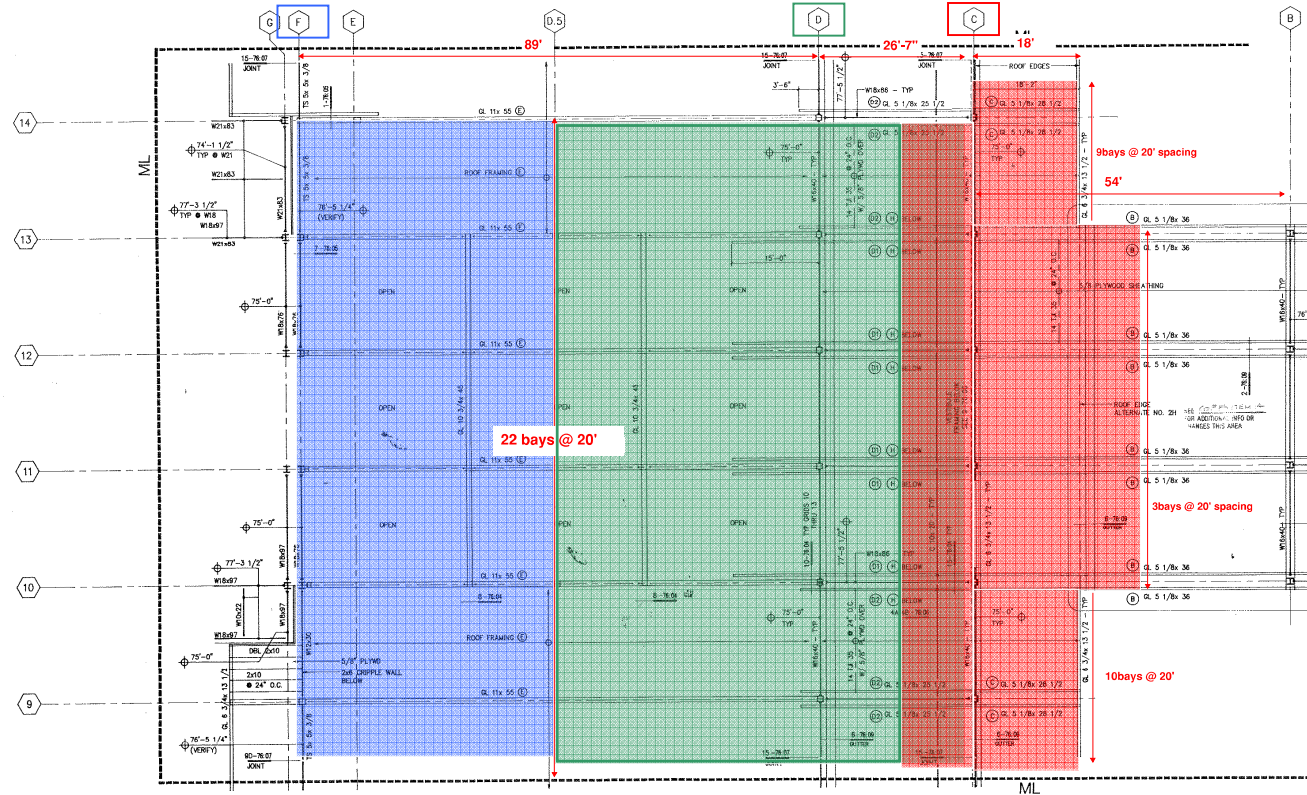
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PROJECT NO: 13222

DATE: 9/20/18

BY: TMR

Main Terminal Moment Frame Tributary Areas
ILLUSTRATIVE EXAMPLE FOR MOMENT FRAME SHEAR DISTRIBUTION. SEE HAND CALCULATION NEXT.



ILLUSTRATIVE EXAMPLE OF MOMENT FRAME LINE TRIBUTARY. HAND CALC NEXT PAGE.

MF TRIBUTARY AREAS

$$A_{TOTAL} \text{ MAIN TERMINAL} = 64000 \text{ SF}$$

LINE C

$$A_{TRIB} = 18' \times (19 \text{ bays} \times 20') + 26.6' / 2 \times (22 \text{ bays} \times 20') + 54' / 2 \times (3 \text{ bays} \times 20')$$

$$A_{TRIB} = 14300 \text{ SF}$$

LINE D

$$A_{TRIB} = (26.6' + 89' / 2) \times (22 \text{ bays} \times 20')$$

$$A_{TRIB} = 25400 \text{ SF}$$

LINE F

$$A_{TOTAL} = A_{TRIB C} + A_{TRIB D}$$

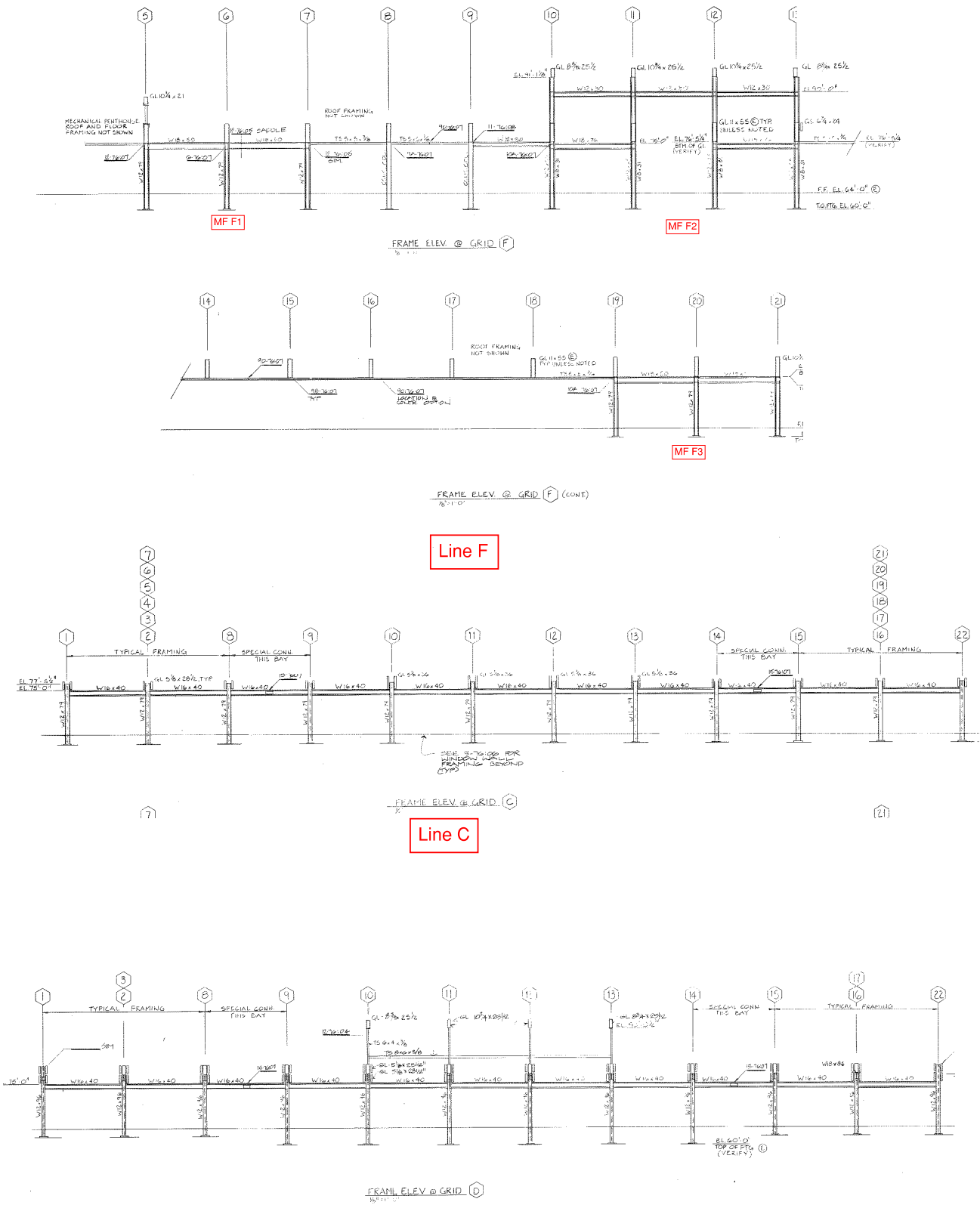
$$A_{TRIB} =$$

LINE 16

$$A_{TRIB} = 175' \times (20')$$

$$A_{TRIB} = 2900 \text{ SF}$$

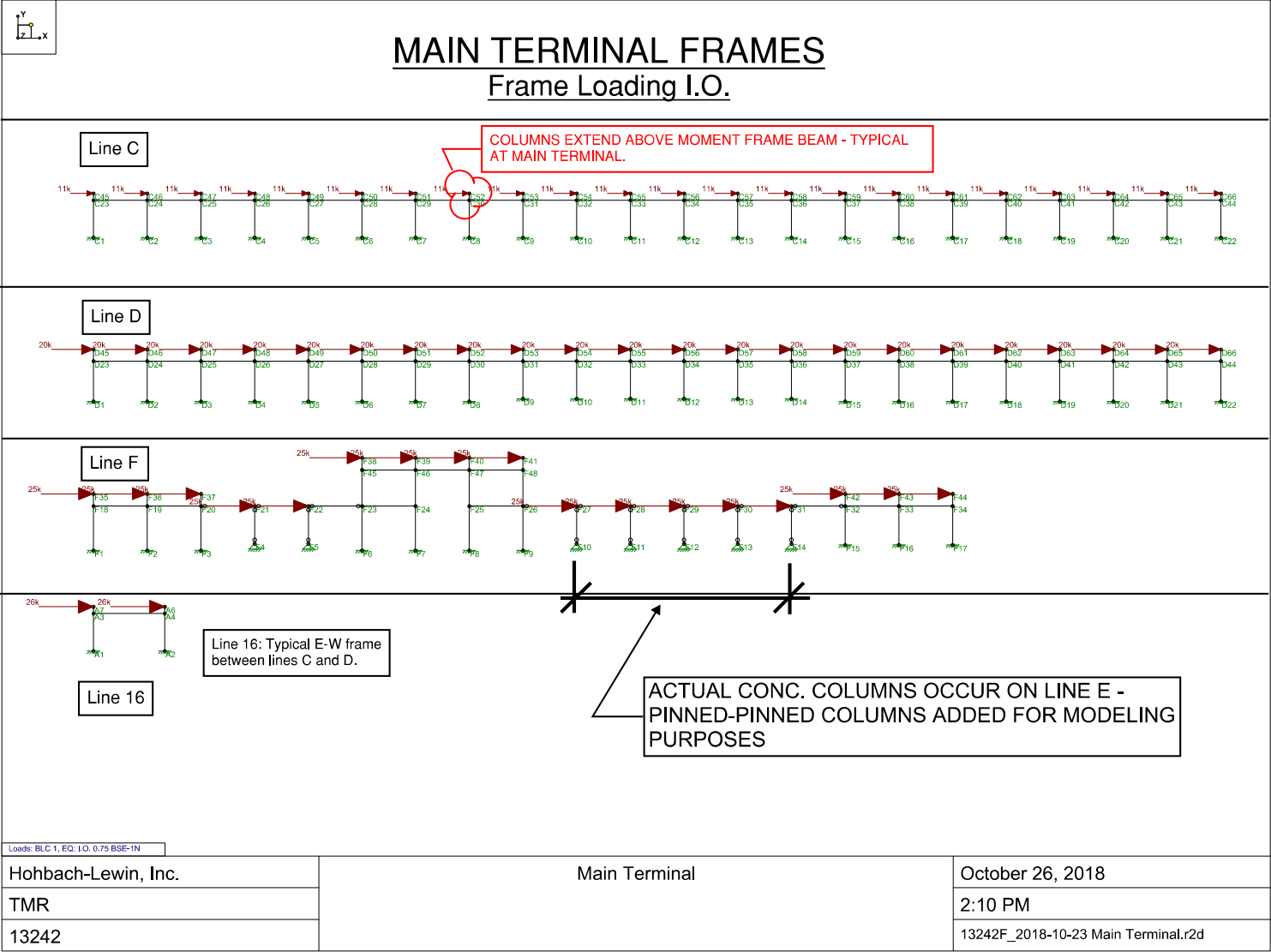
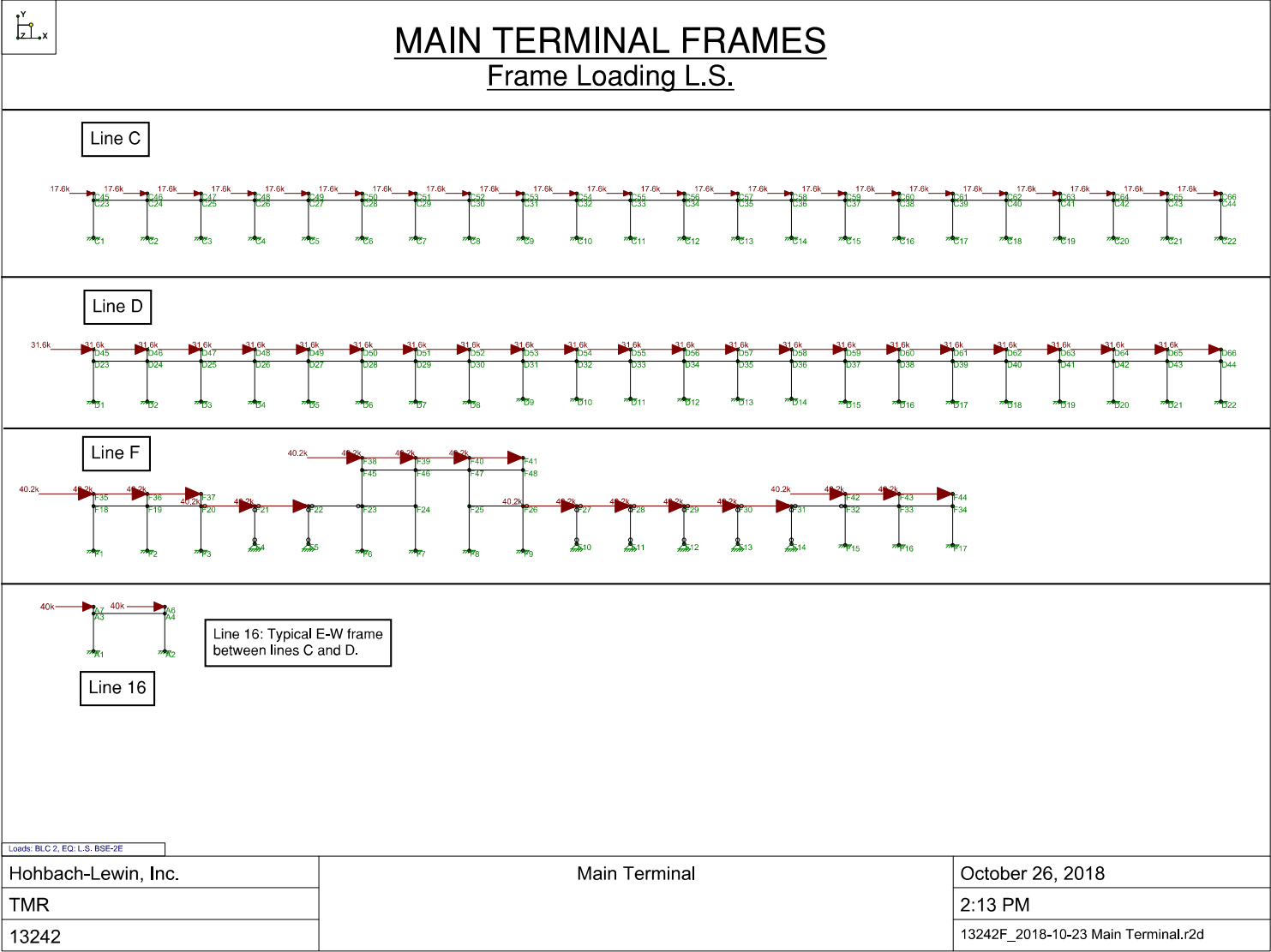
Main Terminal Moment Frame Lines



<div>MAIN TERMINAL FRAMES</div> <div>Member Sections</div>		
<div>Line C</div>		
<div>Line D</div>		
<div>Line F</div>		

SAMPLE MOMENT FRAME ELEVATIONS FROM 1988 AS-BUILTS.

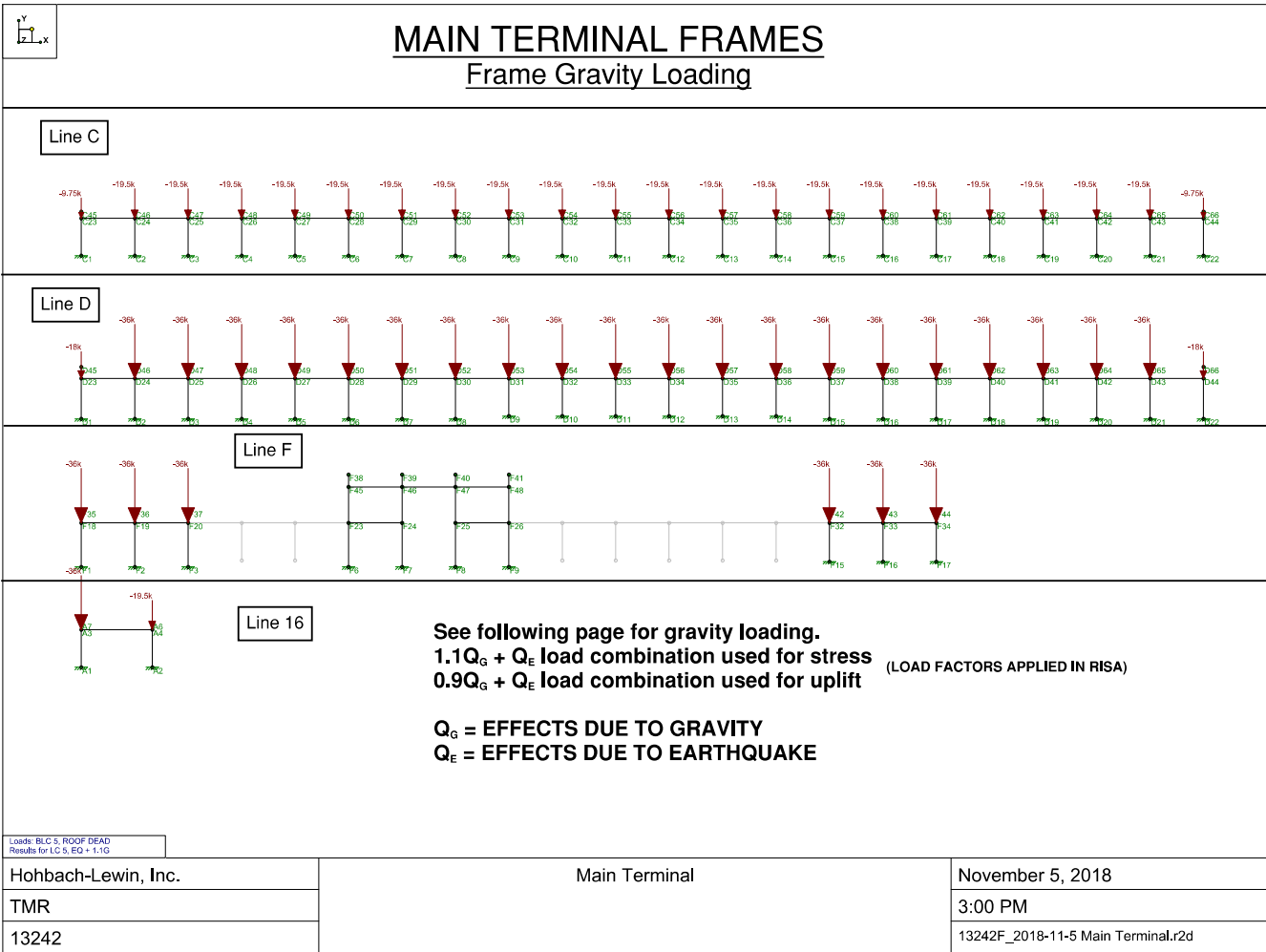
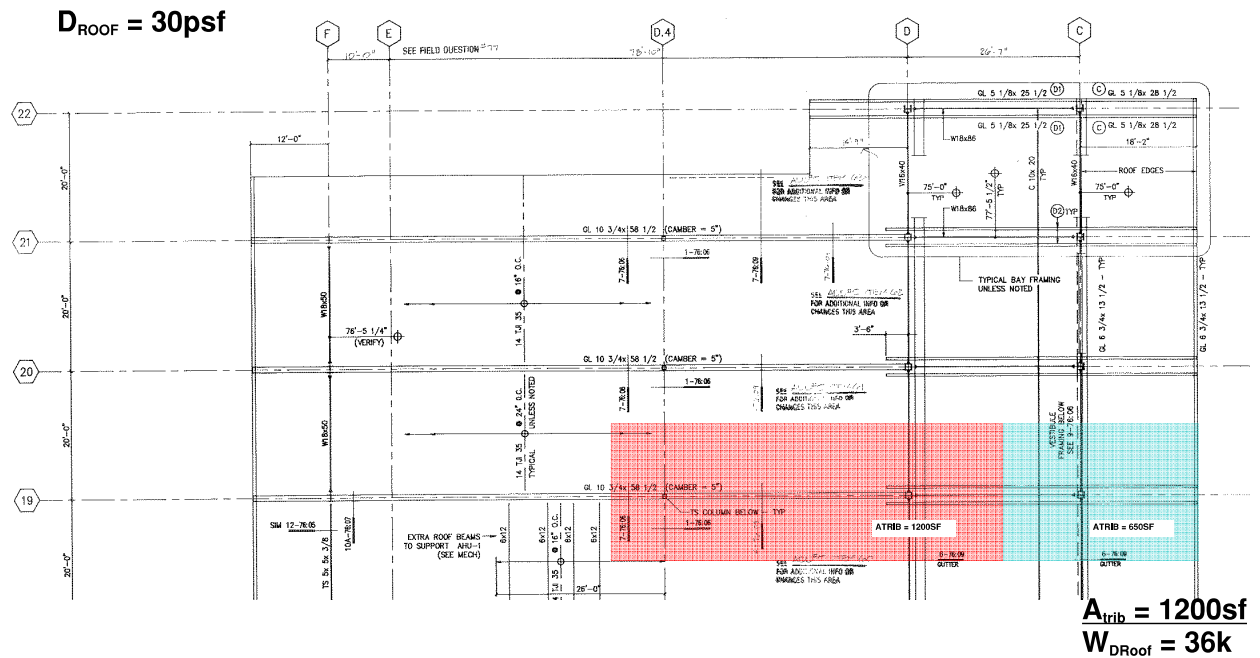
Reference sheets 74:01-02 in 1988 Structural As-Built



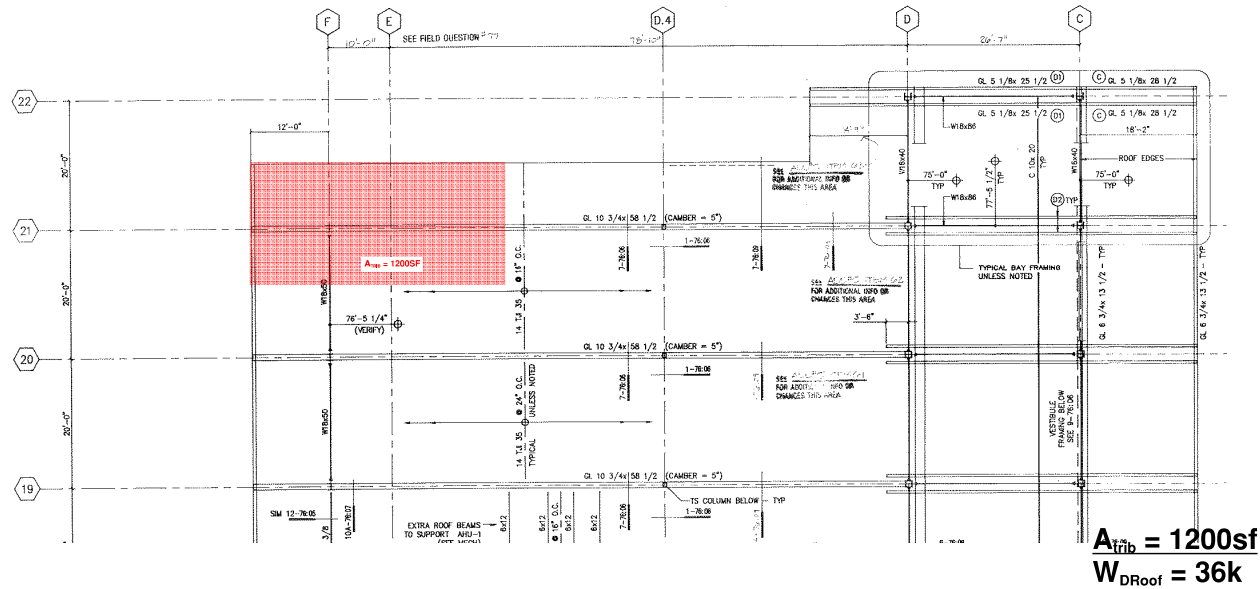


Project: COE Airport ASCE 41 Tier 2

MAIN TERMINAL GRAVITY LOADING



LINE D/C GRAVITY TRIBUTARY



LINE F GRAVITY TRIBUTARY

November 5, 2018
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Member Section Forces, By Combination

ENVELOPE FORCES

COLUMN A MAX

Company : Hohbach-Lewin, Inc.
Designer : TMR
Job Number : 13242

MAIN TERMINAL LINE C OUTPUT

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3:16 PM
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Member Section Forces, By Combination, (continued)

LC	Member Label	Section	Axial (k)	Shear (k)	Moment (k-ft)
		3	21.367	11.179	-72.965
5	M25	1	21.879	11.103	83.224
		2	21.879	11.103	5.507
		3	21.879	11.103	-72.211
5	M26	1	19.108	11.601	85.568
		2	19.108	11.601	4.36
		3	19.108	11.601	-76.848
5	M27	1	17.724	9.038	73.754
		2	17.724	9.038	10.488
		3	17.724	9.038	-52.779
5	M28	1	1.992	-7.002	-80.065
		2	1.992	-7.002	-10.049
		3	1.992	-7.002	59.967
5	M30	1	1.482	-4.419	-43.603
		2	1.482	-4.419	.583
		3	1.482	-4.419	44.768
5	M32	1	1.134	-5.691	-57.317
		2	1.134	-5.691	-.409
		3	1.134	-5.691	56.498
5	M34	1	.712	-4.76	-46.297
		2	.712	-4.76	1.303
		3	.712	-4.76	48.904
5	M36	1	.625	-5.052	-50.768
		2	.625	-5.052	-.245
		3	.625	-5.052	50.278
5	M38	1	.483	-4.996	-49.923
		2	.483	-4.996	.041
		3	.483	-4.996	50.006
5	M40	1	.357	-5.005	-50.06
		2	.357	-5.005	-.01
		3	.357	-5.005	50.04
5	M42	1	.233	-5.002	-50.023
		2	.233	-5.002	0
		3	.233	-5.002	50.023
5	M44	1	.111	-5.002	-50.022
		2	.111	-5.002	0
		3	.111	-5.002	50.02
5	M46	1	-.01	-5.002	-50.018
		2	-.01	-5.002	0
		3	-.01	-5.002	50.019
5	M48	1	-.131	-5.002	-50.02
		2	-.131	-5.002	0
		3	-.131	-5.002	50.022
5	M50	1	-.253	-5.003	-50.026
		2	-.253	-5.003	.001
		3	-.253	-5.003	50.028
5	M52	1	-.378	-5.004	-50.035
		2	-.378	-5.004	.002
		3	-.378	-5.004	50.039
5	M54	1	-.506	-5.005	-50.048
		2	-.506	-5.005	.003
		3	-.506	-5.005	50.054
5	M56	1	-.64	-5.007	-50.066
		2	-.64	-5.007	.004
		3	-.64	-5.007	50.074
5	M58	1	-.779	-5.009	-50.085
		2	-.779	-5.009	.002

COLUMN V MAX, M MAX

Company : Hohbach-Lewin, Inc.
Designer : TMR
Job Number : 13242

MAIN TERMINAL LINE C OUTPUT

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Member Section Forces, By Combination, (continued)

LC	Member Label	Section	Axial (k)	Shear (k)	Moment (k-ft)
		3	-.779	-5.009	50.09
5	M60	1	-.926	-5.014	-50.124
		2	-.926	-5.014	.017
		3	-.926	-5.014	50.158
5	M62	1	-1.079	-5.003	-50.086
		2	-1.079	-5.003	-.059
		3	-1.079	-5.003	49.969
5	M64	1	-1.258	-5.086	-50.496
		2	-1.258	-5.086	.361
		3	-1.258	-5.086	51.218
5	M66	1	-1.361	-4.657	-48.493
		2	-1.361	-4.657	-1.925
		3	-1.361	-4.657	44.643
5	M68	1	-1.962	-6.999	-59.705
		2	-1.962	-6.999	10.287
		3	-1.962	-6.999	80.279

BEAM A MAX, V MAX, M MAX

Company : Hohbach-Lewin, Inc.
Designer : TMR
Job Number : 13242

MAIN TERMINAL LINE D OUTPUT

November 5, 2018
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Member Section Forces, By Combination

LC	Member Label	Section	Axial (k)	Shear (k)	Moment (k-ft)
5	M71	1	4.739	14.628	135.797
		2	4.739	14.628	26.084
		3	4.739	14.628	-83.629
5	M72	1	44.356	20.33	163.949
		2	44.356	20.33	11.475
		3	44.356	20.33	-140.998
5	M73	1	38.787	19.275	158.572
		2	38.787	19.275	14.006
		3	38.787	19.275	-130.559
5	M74	1	39.766	19.398	159.017
		2	39.766	19.398	13.533
		3	39.766	19.398	-131.95
5	M75	1	39.6	19.306	158.379
		2	39.6	19.306	13.587
		3	39.6	19.306	-131.204
5	M76	1	39.613	19.247	157.891
		2	39.613	19.247	13.535
		3	39.613	19.247	-130.821
5	M77	1	39.723	19.152	157.195
		2	39.723	19.152	13.557
		3	39.723	19.152	-130.082
5	M78	1	39.096	19.185	157.118
		2	39.096	19.185	13.227
		3	39.096	19.185	-130.664
5	M79	1	39.101	23.138	177.817
		2	39.101	23.138	15.849
		3	39.101	23.138	-146.119
5	M80	1	39.71	23.191	177.856
		2	39.71	23.191	15.518
		3	39.71	23.191	-146.821
5	M81	1	39.587	23.134	177.488
		2	39.587	23.134	15.552
		3	39.587	23.134	-146.384
5	M82	1	39.613	23.133	177.486
		2	39.613	23.133	15.552
		3	39.613	23.133	-146.381
5	M83	1	39.487	23.191	177.855
		2	39.487	23.191	15.516
		3	39.487	23.191	-146.823
5	M84	1	40.109	23.134	177.793
		2	40.109	23.134	15.857
		3	40.109	23.134	-146.079
5	M85	1	40.094	19.181	157.093
		2	40.094	19.181	13.235
		3	40.094	19.181	-130.624
5	M86	1	39.481	19.151	157.187
		2	39.481	19.151	13.555
		3	39.481	19.151	-130.077
5	M87	1	39.587	19.246	157.876
		2	39.587	19.246	13.535
		3	39.587	19.246	-130.807
5	M88	1	39.601	19.303	158.361
		2	39.601	19.303	13.587
		3	39.601	19.303	-131.187
5	M89	1	39.43	19.396	158.999
		2	39.43	19.396	13.53

ENVELOPE FORCES

COLUMN A MAX

COLUMN V MAX, M MAX

Company : Hohbach-Lewin, Inc.
Designer : TMR
Job Number : 13242

MAIN TERMINAL LINE D OUTPUT

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Member Section Forces, By Combination, (continued)

LC	Member Label	Section	Axial (k)	Shear (k)	Moment (k-ft)
5	M90	1	40.435	19.268	158.528
		2	40.435	19.268	14.015
		3	40.435	19.268	-130.498
5	M91	1	34.782	20.348	164.03
		2	34.782	20.348	11.418
		3	34.782	20.348	-141.194
5	M92	1	34.903	14.663	135.959
		2	34.903	14.663	25.984
		3	34.903	14.663	-83.991
5	M93	1	5.372	-15.061	-171.629
		2	5.372	-15.061	-21.02
		3	5.372	-15.061	129.589
5	M95	1	5.042	-10.305	-99.409
		2	5.042	-10.305	3.642
		3	5.042	-10.305	106.693
5	M97	1	5.766	-11.119	-111.866
		2	5.766	-11.119	-.681
		3	5.766	-11.119	110.504
5	M99	1	6.369	-10.952	-109.446
		2	6.369	-10.952	.078
		3	6.369	-10.952	109.602
5	M101	1	7.063	-10.953	-109.602
		2	7.063	-10.953	-.075
		3	7.063	-10.953	109.451
5	M103	1	7.816	-10.94	-109.369
		2	7.816	-10.94	.031
		3	7.816	-10.94	109.432
5	M105	1	8.664	-10.818	-108.65
		2	8.664	-10.818	-.475
		3	8.664	-10.818	107.7
5	M107	1	9.478	-11.322	-110.964
		2	9.478	-11.322	2.252
		3	9.478	-11.322	115.469
5	M109	1	6.34	-11.821	-118.65
		2	6.34	-11.821	-.445
		3	6.34	-11.821	117.761
5	M111	1	3.149	-11.711	-117.06
		2	3.149	-11.711	.046
		3	3.149	-11.711	117.152
5	M113	1	.015	-11.723	-117.232
		2	.015	-11.723	0
		3	.015	-11.723	117.232
5	M115	1	-3.118	-11.71	-117.149
		2	-3.118	-11.71	-.049
		3	-3.118	-11.71	117.051
5	M117	1	-6.31	-11.823	-117.772
		2	-6.31	-11.823	.458
		3	-6.31	-11.823	118.688
5	M119	1	-9.443	-11.314	-115.391
		2	-9.443	-11.314	-2.252
		3	-9.443	-11.314	110.886
5	M121	1	-8.624	-10.82	-107.737
		2	-8.624	-10.82	.461
		3	-8.624	-10.82	108.659
5	M123	1	-7.775	-10.939	-109.419
		2	-7.775	-10.939	-.029

BEAM A MAX

Company : Hohbach-Lewin, Inc.
Designer : TMR
Job Number : 13242

MAIN TERMINAL LINE D OUTPUT

November 5, 2018
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Company : Hohbach-Lewin, Inc.
Designer : TMR
Job Number : 13242

MAIN TERMINAL LINE F OUTPUT

November 5, 2018
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Member Section Forces, By Combination, (continued)

LC	Member Label	Section	Axial (k)	Shear (k)	Moment (k-ft)
5	M125	3	-7.775	-10.939	109.361
		1	-7.021	-10.952	-109.446
		2	-7.021	-10.952	.075
		3	-7.021	-10.952	109.597
		1	-6.324	-10.951	-109.591
		2	-6.324	-10.951	-.081
		3	-6.324	-10.951	109.428
5	M129	1	-5.72	-11.121	-110.51
		2	-5.72	-11.121	.697
		3	-5.72	-11.121	111.905
5	M131	1	-4.988	-10.286	-106.593
		2	-4.988	-10.286	-3.737
		3	-4.988	-10.286	99.119
5	M133	1	-5.337	-15.103	-130.075
		2	-5.337	-15.103	20.958
		3	-5.337	-15.103	171.991

BEAM V MAX, M MAX

Member Section Forces, By Combination

LC	Member Label	Section	Axial (k)	Shear (k)	Moment (k-ft)
5	M136	1	11.906	33.298	203.686
		2	11.906	33.298	-71.023
		3	11.906	33.298	-345.731
5	M137	1	-8.298	-27.694	-318.186
		2	-8.298	-27.694	-41.241
		3	-8.298	-27.694	235.703
5	M139	1	39.424	46.991	358.021
		2	39.424	46.991	-29.656
		3	39.424	46.991	-417.333
5	M140	1	-30.289	-27.87	-236.817
		2	-30.289	-27.87	41.886
		3	-30.289	-27.87	320.589
5	M142	1	67.47	33.668	206.089
		2	67.47	33.668	-71.669
		3	67.47	33.668	-349.427
5	M151	1	-63.252	33.236	234.187
		2	-63.252	33.236	-40.007
		3	-63.252	33.236	-314.201
5	M152	1	-1.063	-45.829	-448.693
		2	-1.063	-45.829	9.596
		3	-1.063	-45.829	467.886
5	M153	1	-17.423	21.129	214.506
		2	-17.423	21.129	71.884
		3	-17.423	21.129	-70.738
5	M154	1	49.214	31.714	216.971
		2	49.214	31.714	-44.668
		3	49.214	31.714	-306.307
5	M155	1	3.385	32.777	250.914
		2	3.385	32.777	29.669
		3	3.385	32.777	-191.576
5	M156	1	-47.733	36.013	252.553
		2	-47.733	36.013	-44.557
		3	-47.733	36.013	-341.667
5	M157	1	-7.339	-45.857	-467.724
		2	-7.339	-45.857	-9.151
		3	-7.339	-45.857	449.422
5	M158	1	-1.875	28.674	215.171
		2	-1.875	28.674	21.621
		3	-1.875	28.674	-171.929
5	M159	1	61.771	37.531	269.523
		2	61.771	37.531	-40.112
		3	61.771	37.531	-349.746
5	M161	1	15.914	17.42	179.899
		2	15.914	17.42	62.316
		3	15.914	17.42	-55.267
5	M177	1	5.42	51.701	276.242
		2	5.42	51.701	-98.588
		3	5.42	51.701	-473.417
5	M178	1	70.848	-34.18	-390.742
		2	70.848	-34.18	-48.938
		3	70.848	-34.18	292.866
5	M180	1	40.123	70.434	467.914
		2	40.123	70.434	-42.731
		3	40.123	70.434	-553.376
5	M181	1	25.415	-33.657	-289.549
		2	25.415	-33.657	47.026

ENVELOPE FORCES

MF1 COL. V MAX, M MAX

MF1 BEAM A MAX, V MAX, M MAX

MF1 COL. A MAX

MF2 BEAM V MAX, M MAX

MF2 BEAM A MAX

MF2 COL. A MAX, V MAX, M MAX

MF3 BEAM A MAX, V MAX, M MAX

MF3 COL. V MAX, M MAX

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Designer : TMR
Job Number : 13242

MAIN TERMINAL LINE F OUTPUT

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3:20 PM
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Company : Hohbach-Lewin, Inc.
Designer : TMR
Job Number : 13242

MAIN TERMINAL LINE 16 OUTPUT

November 5, 2018
3:21 PM
Checked By: _____

Member Section Forces, By Combination, (continued)

LC	Member Label	Section	Axial (k)	Shear (k)	Moment (k-ft)
		3	25.415	-33.657	383.601
5	M183	1	73.257	50.415	269.101
		2	73.257	50.415	-96.405
		3	73.257	50.415	-461.911
5	M185	1	3.871	-17.423	-185.238
		2	3.871	-17.423	-11.007
		3	3.871	-17.423	163.225
5	M187	1	-3.906	-14.038	-142.851
		2	-3.906	-14.038	-2.467
		3	-3.906	-14.038	137.918
5	M189	1	-7.58	-15.914	-148.511
		2	-7.58	-15.914	10.628
		3	-7.58	-15.914	169.767

MF3 COL. A MAX

ENVELOPE FORCES

Member Section Forces, By Combination

LC	Member Label	Section	Axial (k)	Shear (k)	Moment (k-ft)
5	M1	1	23.67	27.842	237.006
		2	23.67	27.842	42.109
		3	23.67	27.842	-152.788
5	M2	1	-1.842	-15.93	-217.788
		2	-1.842	-15.93	-6.079
		3	-1.842	-15.93	205.631
5	M4	1	37.38	24.158	140.631
		2	37.38	24.158	-28.471
		3	37.38	24.158	-197.574

C1 A MAX, V MAX, M MAX

BEAM A MAX, V MAX, M MAX

C2 A MAX, V MAX, M MAX

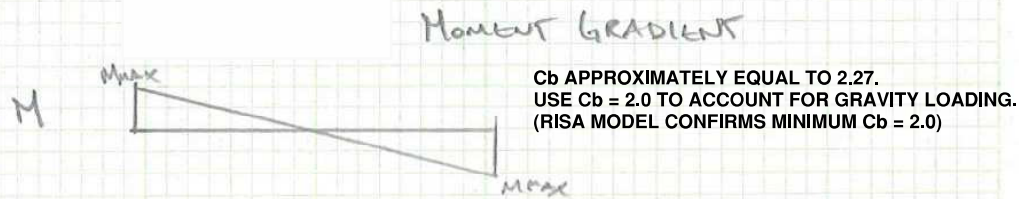
THIS PAGE DEMONSTRATES THAT THE EXISTING STEEL SECTIONS IN THE MOMENT FRAMES ARE NOT GOVERNED BY LATERAL TORSIONAL BUCKLING AND THAT THE PLASTIC MOMENT CAN BE USED IN THE FOLLOWING MEMBER CHECKS.

NOTE: THIS CHECK IS APPLICABLE TO ALL SECTORS OF THE AIRPORT, NOT ONLY THE MAIN TERMINAL

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MEMBER CHECK

VERIFY PLASTIC MOMENT WILL CONTROL.



IF ALL MEMBERS $L_b > L_r$ (CONSERVATIVE)

THEN $M_n = C_b M_r$

HOWEVER, $M_n < M_p$ FOR ALL MEMBERS

$C_b M_r > M_p \therefore M_p$ CONTROLS.

WEAKEST BEAM: W16x40

$$M_r = 189 \text{ k-ft}$$

$$M_p = 304 \text{ k-ft}$$

$$C_b M_r = 2 * (189 \text{ k-ft}) = 378 \text{ k-ft}$$

$\therefore$ USE M_p

MEMBERS WILL YIELD BEFORE LTB. (TYP)

WEAKEST COLUMN: W12x65

$$M_r = 231 \text{ k-ft}$$

$$M_p = 356 \text{ k-ft}$$

$$C_b M_r = 2 * (231 \text{ k-ft}) = 462 \text{ k-ft, THEREFORE USE } M_p$$

ALL MEMBERS CONTROLLED BY M_p

DCR REPRESENTS Q_{ud}/mQ_{ce} UNLESS NOTED OTHERWISE, SEE PG. B-17.



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BASED ON THE TIER 1 DEFICIENCIES LISTED BELOW, THE FRAME MEMBERS ARE TO BE ANALYZED. THE MEMBERS WILL BE CHECKED FOR THE AXIAL, SHEAR, AND FLEXURAL LOADS DETERMINED IN THE PRECEEDING RISA ANALYSIS.

TIER 1 DEFICIENCY - FLEXURAL STRESS & COMPACT MEMBERS:

THIS DEFICIENCY WAS TRIGGERED BY THE NON-COMPACT MEMBER CRITERIA PER AISC 341 TABLE D1.1. W12X79 COLUMNS ON LINE C AND F, W12X65 COLUMNS ON LINE F AND W18X76 BEAMS ON LINE F FAIL THIS CRITERIA. PER ASCE 41-13 5.5.2.1, THE MEMBERS ARE TO BE ASSESSED FOR THE EXPECTED FORCES WITH REDUCED M-FACTORS PER TABLE 9-4.

FROM THE FOLLOWING MEMBER ANALYSIS, THE MAXIMUM COMBINED E-W AND N-S FLEXURAL STRESS DCR FOR THE W12X79 COLUMN ON LINE C = $0.26 + 0.25 = 0.51$, THEREFORE - OK. THE MAXIMUM FLEXURAL STRESS DCR FOR THE W12X79 COLUMN ON LINE F = 0.73. THE MAXIMUM W12X65 FLEXURAL STRESS DCR = 0.67, THEREFORE - OK. THE MAXIMUM W18X76 BEAM FLEXURAL STRESS DCR = 0.41, THEREFORE - OK.

TIER 1 DEFICIENCY - PANEL ZONE STRENGTH:

THIS DEFICIENCY WAS TRIGGERED AS THE PANEL ZONES DO NOT HAVE THE CAPACITY TO DEVELOP 80% OF THE FLEXURAL STRENGTH OF THE GIRDERS. PER ASCE 41-13 A.3.1.3.5, THE PANEL ZONES ARE TO BE ASSESSED WITH THE EXPECTED FORCES.

FROM THE FOLLOWING MEMBER ANALYSIS, THE PANEL ZONES HAVE A MAXIMUM DCR OF 0.44 WHICH OCCURS ON LINE F. THEREFORE, THIS ITEM IS DEEMED COMPLIANT.

TIER 1 DEFICIENCY - STRONG COLUMN-WEAK BEAM:

THIS DEFICIENCY WAS TRIGGERED AS MANY FRAMES DO NOT MEET THE REQUIREMENTS OF STRONG COL.-WEAK BEAM. PER ASCE 41-13 5.5.2.1.5. COMPLIANCE CAN BE DEMONSTRATED BY ANALYZING THE FRAMES WITH AN M-FACTOR OF 2.5. DUE TO THE IMMEDIATE OCCUPANCY PERFORMANCE OBJECTIVE, COLUMNS ARE CHECKED WITH AN M-FACTOR < 2.5 (CONSERVATIVE).

FROM THE FOLLOWING MEMBER ANALYSIS, THE COLUMNS HAVE A MAXIMUM DCR OF 0.67. THEREFORE, THIS ITEM IS DEEMED COMPLIANT.

M-FACTORS ARE CALCULATED FOR THE FRAME MEMBERS BASED ON THE DUCILTiy OF THE SECTIONS.

THE M-FACTORS ARE USED IN THE ANALYSIS OF THE FRAMES IN THE FOLLOWING PAGES.

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ASCE 41-13 m-factors - Main Terminal

ASCE 341-10 Table D1.1 - Highly Ductile Width-to-Thickness Ratios

Flanges $b_f/2t_f < 0.3(E/F_{ye})^{0.5}$ $\lambda_{hd} = 6.9$ * F_{ye} = 1.1F_y
Webs $h/t_w < 2.45(E/F_{ye})^{0.5}$ $\lambda_{hd} = 56.3$

ASCE 41 Table 9-4

Steel Columns F_y = 50ksi - P/P_{CL} < 0.2**

Limit a: $b_f/2t_f \leq 52/F_{ye}^{0.5} = 7.0$ and $h_{tw}/t_w \leq 300/F_{ye}^{0.5} = 40.5$ m-factor I.O. L.S.
Limit b: $b_f/2t_f \geq 65/F_{ye}^{0.5} = 8.8$ or $h_{tw}/t_w \geq 460/F_{ye}^{0.5} = 62.0$ 2 6.0
1.25 1.25

	m-factor				Location
	$b_f/2t_f$	h/t_w	I.O	L.S.	
W12x65	9.92	24.9	1.25	2.0	Line F, MF-2
W12x79	8.22	20.7	1.5	2.7	Typ. Line C
W12x96	6.76	17.7	2.0	6.0	Typ. Line D

Steel Beams F_y = 50ksi

Limit a: $b_f/2t_f \leq 52/F_{ye}^{0.5} = 7.0$ and $h_{tw}/t_w \leq 418/F_{ye}^{0.5} = 56.4$ m-factor I.O. L.S.
Limit b: $b_f/2t_f \geq 65/F_{ye}^{0.5} = 8.8$ or $h_{tw}/t_w \geq 640/F_{ye}^{0.5} = 86.3$ 2 6
1.25 2

	m-factor				Location
	$b_f/2t_f$	h/t_w	I.O	L.S.	
W16x40	6.93	46.5	2.0	6.0	Typ. Line C and D
W18x50	6.57	45.2	2.0	6.0	Typ. Low beam at Line F
W18x76	8.11	37.8	1.5	3.5	Typ. High beam at Line F
W18x86	7.20	33.4	1.9	5.6	Typ. Between Line C and D

Therefore, members that do not meet compactness criteria for highly ductile members include W12x65, W12x79 and W18x76 in Main Terminal.

**Verify P/P_{CL} < 2.0 in the following calculations. Columns are lightly loaded, therefore it is expected that this criteria will be met.

DCR REPRESENTS Q_{UD}/mQ_{CE} UNLESS NOTED OTHERWISE, SEE PG. B-17.

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ASCE 41-13 Flexural Stress Check

I.O. Load = 0.75BSE-1N
L.S. Load = BSE-2E
Ratio the applied load to m-factor to determine controlling load case.

Frame Line: C Description: W12x79 weak axis columns w/ W16x40 beams. N-S Frames

	Applied Shear (k)	m-factor (col.)	Ratio	m-factor (beam)	Ratio
I.O. Load (k)	11	1.5	7.5	2.0	5.6
L.S. Load (k)	18	2.7	6.6	6.0	3.0

(I.O. controls)

Risa Output (Q_{UD}) (I.O. controlling)

Member	Section	Moment (k-ft) M	Shear (k) V	Axial (k) A
Column	W12x79	86	11.6	24
Beam	W16x40	80	7	2

**REFERENCE PAGES 28-30
FOR RISA OUTPUT**

Expected Strength (Q_{CE})

ASCE 41 Sec. 9.4.2.3, AISC 360 Tables 3-2 & 4-1

Use F_y = 1.1*50 ksi= 55ksi, per Table 9-3 ASCE 41

Beam:	W16x40	Column:	W12x79	(Column bent about minor axis, therefore LTB D.N.A.)
Q _{CE} = 1.1M _p (k-ft)	334	P _{CL} = 1.1P _n (k)	990	
Q _{UD} = M (k-ft)	80.0	P _{UF} = A (k)	24	
		M _{CE} = 1.1M _p (k-ft)	249	1.1F _y Z _y (Weak axis)
		M (k-ft)	86.0	

Column Check:	P _{UF} (k)	24	
	P _{CL} (k)	990	
	P _{UF} /P _{CL}	0.02	
	M _{CE} (k-ft)	249	
	M (k-ft)	86	
	m-factor	1.5	
	DCR:	0.25	

Beam Check:	Q _{UD} (k-ft)	80	
	m	2.0	
	Q _{CE} (k-ft)	334	
	mQ _{CE} (k-ft)	669	
	DCR:	0.12	

Panel Zone Check: m-factor for panel zones: 1.5 (I.O. loading)

Q _{CE} (k) =	0.55F _{ye} d _c t _p	Where d _c = column depth and t _p = thickness of panel zone (9-5)
d _c	12.4	
t _p	0.47	
Q _{CE} (k) =	160	
Q _{UD} = V (k) =	11.6	
	DCR:	0.07

W12X79 COLUMN AND W16X40 BEAM ARE SUFFICIENT FOR THE FLEXURAL STRESS, COMPACT MEMBER, PANEL ZONE, AND STRONG-COLUMN WEAK-BEAM DEFICIENCIES.



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ASCE 41-13 Flexural Stress Check

I.O. Load = 0.75BSE-1N
L.S. Load = BSE-2E

Ratio the applied load to m-factor to determine controlling load case.

Frame Line: D Description: W12x96 weak axis columns w/ W16x40 beams. N-S Frames

	Applied Shear (k)	m-factor (col.)	Ratio	m-factor (beam)	Ratio	
I.O. Load (k)	20	2.0	9.9	2.0	9.9	I.O. Controls
L.S. Load (k)	32	6.0	5.3	6.0	5.3	

Risa Output (Q_{UD}) (I.O. controlling)

Member	Section	Moment (k-ft) M	Shear (k) V	Axial (k) A
Column	W12x96	178	23	44
Beam	W16x40	172	15	9.5

REFERENCE PAGES 31-33
FOR RISA OUTPUT

Expected Strength (Q_{CE}) ASCE 41 Sec. 9.4.2.3, AISC 360 Tables 3-2 & 4-1

Use Fy = 1.1*50 ksi= 55ksi, per Table 9-3 ASCE 41

Beam:	W16x40	Column:	W12x96	(Column bent about minor axis, therefore LTB D.N.A.)
Q _{CE} = 1.1M _p (k-ft)	334	P _{CL} = 1.1P _n (k)	990	
Q _{UD} = M (k-ft)	172.0	P _{UF} = A (k)	44	
		M _{CE} = 1.1M _p (k-ft)	309	1.1FyZy (Weak axis)
		M (k-ft)	178.0	

Column Check:	P _{UF} (k)	44	$\text{For } \frac{P_{UF}}{P_{CL}} < 0.2,$ $\frac{P_{UF}}{2P_{CL}} + \frac{M_x}{m_x M_{CEs}} + \frac{M_y}{m_y M_{CEy}} \leq 1.0$ (9-11)	
	P _{CL} (k)	990		
	P _{UF} /P _{CL}	0.04		
	M _{CE} (k-ft)	309		
	M (k-ft)	178		
	m-factor	2.0	DCR:	0.31

Beam Check:	Q _{UD} (k-ft)	172	mQ _{CE} > Q _{UD}
	m	2.0	
	Q _{CE} (k-ft)	334	
	mQ _{CE} (k-ft)	669	
		DCR:	0.26

*SEE PAGE B-46.1 FOR
BEAM CHECK AS A
BEAM COLUMN

Panel Zone Check: m-factor for panel zones: 1.5 (I.O. loading)

$Q_{CE}(k) =$	$0.55F_{ye}d_c t_p$	Where d_c = column depth and t_p = thickness of panel zone (9-5)	
d_c	12.7		
t_p	0.55		
$Q_{CE}(k) =$	192	$mQ_{CE} > Q_{UD}$	
$Q_{UD}(k) =$	23	DCR:	0.12

W12X96 COLUMN AND W16X40 BEAM ARE SUFFICIENT FOR THE FLEXURAL STRESS, COMPACT MEMBER, PANEL ZONE, AND STRONG-COLUMN WEAK-BEAM DEFICIENCIES.



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ASCE 41-13 Flexural Stress Check

I.O. Load = 0.75BSE-1N
L.S. Load = BSE-2E

Ratio the applied load to m-factor to determine controlling load case.

Frame Line: 16 (Typ. E-W) Description: W12x79 (C2) and W12x96 (C1) columns strong w/ W18x86 beams. Typ. E-W Frame.

	Applied Shear (k)	m-factor (col.)	Ratio	m-factor (beam)	Ratio	
C1 I.O. Load (k)	25	2.0	12.6	1.9	13.2	I.O. Controls
C2 I.O. Load (k)	25	1.5	17.0	1.9	13.2	
C1 L.S. Load (k)	41	6.0	6.8	5.6	7.3	
C2 L.S. Load (k)	41	2.7	14.9	5.6	7.3	

Risa Output (Q_{UD}) (I.O. controlling)

Member	Section	Moment (k-ft) M	Shear (k) V	Axial (k) A
Column C1	W12x96	237	28	24
Column C2	W12x79	198	24	37
Beam	W18x86	218	16	2

REFERENCE PAGES 31-33
FOR RISA OUTPUT

Expected Strength (Q_{CE}) ASCE 41 Sec. 9.4.2.3, AISC 360 Tables 3-2 & 4-1

Use Fy = 1.1*50 ksi= 55ksi, per Table 9-3 ASCE 41

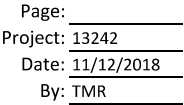
Beam:	W18x86	Column C1	W12x96	Column C2	W12x79
Q _{CE} = 1.1M _p (k-ft)	853	P _{CL} = 1.1P _n (k)	1100	P _{CL} = 1.1P _n (k)	989
Q _{UD} = M (k-ft)	218.0	P _{UF} = A (k)	24	P _{UF} = A (k)	37
		M _{CE} = 1.1M _p (k-ft)	674	M _{CE} = 1.1M _p (k-ft)	545
		M (k-ft)	237.0	M (k-ft)	198.0

Column Check C1:	P _{UF} (k)	24	<div>For $\frac{P_{UF}}{P_{CL}} < 0.2$,</div> <div>$\frac{P_{UF}}{2P_{CL}} + \frac{M_x}{m_x M_{CEs}} + \frac{M_y}{m_y M_{CEy}} \leq 1.0$</div> <div>(9-11)</div>
	P _{CL} (k)	1100	
	P _{UF} /P _{CL}	0.02	
	M _{CE} (k-ft)	674	
	M (k-ft)	237	
	m-factor	2.0	
	DCR:	0.19	OK

Column Check C2:	P _{UF} (k)	37	$\text{For } \frac{P_{UF}}{P_{CL}} < 0.2,$ $\frac{P_{UF}}{2P_{CL}} + \frac{M_x}{m_x M_{CEs}} + \frac{M_y}{m_y M_{CEy}} \leq 1.0$ (9-11)
	P _{CL} (k)	989	
	P _{UF} /P _{CL}	0.04	
	M _{CE} (k-ft)	545	
	M (k-ft)	198	
	m-factor	1.5	
	DCR:	0.26	OK

Beam Check:	Q _{UD} (k-ft)	218	$mQ_{CE} > Q_{UD}$	DCR:	0.13	OK
	m	1.9				
	Q _{CE} (k-ft)	853				
	mQ _{CE} (k-ft)	1636				

*SEE PAGE B-46.1 FOR
BEAM CHECK AS A
BEAM COLUMN



Panel Zone Check: *m-factor for panel zones:* 1.5 (I.O. loading)

$$Q_{CE}(k) = 0.55 F_{ye} d_c t_p \quad \text{Where } d_c = \text{column depth and } t_p = \text{thickness of panel zone (9-5)}$$

$$d_c = 12.4$$

$$t_p = 0.47$$

$$Q_{CE}(k) = 160$$

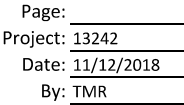
$$Q_{UD} = V(k) = 28$$

$$m_{QCE} > Q_{UD}$$

DCR: **0.17** OK

W12X96 AND W12X79 COLUMNS, AND W18X86 BEAMS ARE SUFFICIENT FOR THE FLEXURAL STRESS, COMPACT MEMBER, PANEL ZONE, AND STRONG-COLUMN WEAK-BEAM

COMBINING THE COLUMN DEMAND-CAPACITY RATIOS FOR LINE 16 WITH LINES C AND D SHOW COLUMNS LOADED IN EACH DIRECTION ARE SUFFICIENT.



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ASCE 41-13 Flexural Stress Check

L.S. Load = BSE-2E

Ratio the applied load to m-factor to determine controlling load case.

Frame Line: F - MF1

Description: *W12x79 columns strong w/ W18x50 beams. N-S Frames (S. end of main)*

	<i>Applied Shear (k)</i>	<i>m-factor (col.)</i>	<i>Ratio</i>	<i>m-factor (beam)</i>	<i>Ratio</i>
I.O. Load (k)	24	1.5	16.4	2.0	12.2
L.S. Load (k)	39	2.7	14.4	6.0	6.5

Risa Output (Q_{UD}) (I.O. controlling

<i>Member</i>	<i>Section</i>	<i>Moment (k-ft)</i> <i>M</i>	<i>Shear (k)</i> <i>V</i>	<i>Axial (k)</i> <i>A</i>
Column	W12x79	417	47	67
Beam	W18x50	320	28	30

**REFERENCE PAGES 34-36
FOR RISA OUTPUT**

Expected Strength (Q_{CE})

ASCE 41 Sec. 9.4.2.3, AISC 360 Tables 3-2 & 4-1

Use $F_y = 1.1 * 50 \text{ ksi} = 55 \text{ ksi}$, per Table 9-3 ASCE 41

Beam:	W18x50	Column:	W12x79
$Q_{CE} = 1.1M_p$ (k-ft)	463	$P_{CL} = 1.1P_n$ (k)	1022
$Q_{UD} = M$ (k-ft)	320.0	$P_{UF} = A$ (k)	67
		$M_{CE} = 1.1M_p$ (k-ft)	545
		M (k-ft)	417.0

Column Check:

P_{UF} (k)	67
P_{CL} (k)	1022
P_{UF}/P_{CL}	0.07
M_{CE} (k-ft)	545
M (k-ft)	417
m-factor	1.5

For $\frac{P_{UF}}{P_{CL}} < 0.2$,

$$\frac{P_{UF}}{2P_{CL}} + \frac{M_x}{m_x M_{CEX}} + \frac{M_y}{m_y M_{CEY}} \leq 1.0 \quad (9-11)$$

DCR: 0.55

Beam Check:

Q_{UD} (k-ft)	320
m	2.0
Q_{CE} (k-ft)	463
mQ_{CE} (k-ft)	926

$$mQ_{CE} > Q_{UD}$$

DCR: 0.35

***SEE PAGE B-46.1 FOR
BEAM CHECK AS A
BEAM COLUMN**

Panel Zone Check: *m-factor for panel zones:*

1.5 (I.O. loading

$Q_{CE}(k) =$	$0.55F_{ve}d_c t_p$	Where d_c = column depth and t_p = thickness of panel zone (9-5)	
d_c	12.4		
t_p	0.47		
$Q_{CE}(k) =$	160	$mQ_{CE} > Q_{UD}$	
$Q_{UD}(k) =$	47	DCR:	0.29

W12X79 COLUMNS, AND W18X50 BEAMS ARE SUFFICIENT FOR THE FLEXURAL STRESS, COMPACT MEMBER, PANEL ZONE, AND STRONG-COLUMN WEAK-BEAM DEFICIENCIES.



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ASCE 41-13 Flexural Stress Check

I.O. Load = 0.75BSE-1N
L.S. Load = BSE-2E

Ratio the applied load to m-factor to determine controlling load case.

Frame Line: F - MF2 Description: W12x65 columns strong w/ W18x76 beams low and W12x30 beams high. N-S Frames

	Applied Shear (k)	m-factor (col.)	Ratio	m-factor (beam)	Ratio
I.O Load (k)	24	1.25	19.5	1.5	15.9
L.S. Load (k)	39	2.0	19.6	3.5	11.2

I.O. controls. L.S. barely controls for column, therefore check as I.O and verify low DCR.

Risa Output (Q_{UD}) (I.O. controlling for beam, L.S. for column)

Member	Section	Moment (k-ft) M	Shear (k) V	Axial (k) A
Column	W12x65	350	38	62
Beam	W18x76	468	46	8

REFERENCE PAGES 34-36
FOR RISA OUTPUT

Expected Strength (Q_{CE}) ASCE 41 Sec. 9.4.2.3, AISC 360 Tables 3-2 & 4-1

Use Fy = 1.1*50 ksi= 55ksi, per Table 9-3 ASCE 41

Beam:	W18x76	Column:	W12x65
Q _{CE} = 1.1M _p (k-ft)	747	P _{CL} = 1.1P _n (k)	837
Q _{UD} = M (k-ft)	468.0	P _{UF} = A (k)	62
		M _{CE} = 1.1M _p (k-ft)	444
		M (k-ft)	350.0

Column Check:	P _{UF} (k)	62	<div>For $\frac{P_{UF}}{P_{CL}} < 0.2$,</div> $\frac{P_{UF}}{2P_{CL}} + \frac{M_s}{m_s M_{CEs}} + \frac{M_s}{m_s M_{CEy}} \leq 1.0$ <div>(9-11)</div>
	P _{CL} (k)	837	
	P _{UF} /P _{CL}	0.07	
	M _{CE} (k-ft)	444	
	M (k-ft)	350	
	m-factor	1.25	
	DCR:	0.67	

Beam Check:	Q _{UD} (k-ft)	468	<div>mQ_{CE} > Q_{UD}</div>
	m	1.5	
	Q _{CE} (k-ft)	747	
	mQ _{CE} (k-ft)	1143	
	DCR:	0.41	

Panel Zone Check: m-factor for panel zones: 1.5 (I.O. loading)

Q _{CE} (k) =	0.55F _{ye} d _c t _p	Where dc = column depth and tp = thickness of panel zone (9-5)
d _c	12.1	
t _p	0.39	
Q _{CE} (k) =	130	<div>mQ_{CE} > Q_{UD}</div>
Q _{UD} (k) =	38	
	DCR:	0.29

W12X65 COLUMNS, AND W18X76 BEAMS ARE SUFFICIENT FOR THE FLEXURAL STRESS, COMPACT MEMBER, PANEL ZONE, AND STRONG-COLUMN WEAK-BEAM DEFICIENCIES.



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ASCE 41-13 Flexural Stress Check

I.O. Load = 0.75BSE-1N
L.S. Load = BSE-2E

Ratio the applied load to m-factor to determine controlling load case.

Frame Line: F - MF3 Description: W12x79 columns strong w/ W18x50 beams. N-S Frames

	Applied Shear (k)	m-factor (col.)	Ratio	m-factor (beam)	Ratio
I.O Load (k)	24	1.5	16.4	2.0	12.2
L.S. Load (k)	39	2.7	14.4	6.0	6.5

I.O. Controls

Risa Output (Q_{UD}) (I.O. controlling)

Member	Section	Moment (k-ft) M	Shear (k) V	Axial (k) A
Column	W12x79	553	70	73
Beam	W18x50	391	34	71

REFERENCE PAGES 34-36
FOR RISA OUTPUT

Expected Strength (Q_{CE}) ASCE 41 Sec. 9.4.2.3, AISC 360 Tables 3-2 & 4-1

Use Fy = 1.1*50 ksi= 55ksi, per Table 9-3 ASCE 41

Beam:	W18x50	Column:	W12x79
Q _{CE} = 1.1M _p (k-ft)	463	P _{CL} = 1.1P _n (k)	837
Q _{UD} = M (k-ft)	391.0	P _{UF} = A (k)	73
		M _{CE} = 1.1M _p (k-ft)	545
		M (k-ft)	553.0

Column Check:	P _{UF} (k)	73	<div>For $\frac{P_{UF}}{P_{CL}} < 0.2$,</div> $\frac{P_{UF}}{2P_{CL}} + \frac{M_s}{m_s M_{CEs}} + \frac{M_s}{m_s M_{CEy}} \leq 1.0$ <div>(9-11)</div>
	P _{CL} (k)	837	
	P _{UF} /P _{CL}	0.09	
	M _{CE} (k-ft)	545	
	M (k-ft)	553	
	m-factor	1.5	
	DCR:	0.73	

Beam Check:	Q _{UD} (k-ft)	391	<div>mQ_{CE} > Q_{UD}</div>
	m	2.0	
	Q _{CE} (k-ft)	463	
	mQ _{CE} (k-ft)	926	
	DCR:	0.42	

Panel Zone Check: m-factor for panel zones: 1.5 (I.O. loading)

Q _{CE} (k) =	0.55F _{ye} d _c t _p	Where dc = column depth and tp = thickness of panel zone (9-5)
d _c	12.4	
t _p	0.47	
Q _{CE} (k) =	160	<div>mQ_{CE} > Q_{UD}</div>
Q _{UD} (k) =	70	
	DCR:	0.44

W12X79 COLUMNS, AND W18X50 BEAMS ARE SUFFICIENT FOR THE FLEXURAL STRESS, COMPACT MEMBER, PANEL ZONE, AND STRONG-COLUMN WEAK-BEAM DEFICIENCIES.



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MF3 BEAM IS HEAVIEST LOADED AXIAL AND FLEXURALLY. CHECK INTERACTION EQUATION TO DETERMINE IF BEAM NEEDS BRACING ASSUMING BEAM IS UNBRACED ABOUT BOTH AXIS.

CHECK BEAM AS A BEAM-COLUMN:
SECTION: W18X50 FLEXURAL m-FACTOR = 1.25
P_{UF} 71 kip P_{CL} = 1.1P_n = 191 kip P_{UF}/P_{CL} = 0.37
M_x 391 kip-ft M_{CEX} = 1.1M_p = 463 kip

P_{UF}/P_{CL} > 0.2, THEREFORE:
For $0.2 \leq \frac{P_{UF}}{P_{CL}} \leq 0.5$,
$$\frac{P_{UF}}{P_{CL}} + \frac{8}{9} \left[\frac{M_x}{m_x M_{CEX}} + \frac{M_y}{m_y M_{CEY}} \right] \leq 1.0$$
 ASCE 41-13 (9-10)
DCR: 0.97

SINCE BEAM INTERACTION EQUATION < 1.0, AND OTHER MOMENT FRAME BEAMS IN THE AIRPORT HAVE SIGNIFICANTLY LESS AXIAL FORCE COUPLED WITH LOWER FLEXURAL DCRs, IT IS SUFFICIENT TO ASSUME OTHER MOMENT FRAME BEAMS IN THE MAIN TERMINAL AND TERMINAL A CONCOURSE WILL MEET THIS CRITERIA.

THE FOLLOWING CALCULATION CHECKS THE UNBLOCKED WOOD DIAPHRAGM AT THE MAIN TERMINAL.



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Wood Diaphragm Check

		RATIO			
V _{tot}	1097 kip I.O.	<div>m-factor1.5731I.O. controls</div>			
V _{tot}	1761 kip L.S.	m-factor2.5704			
Building Width, (B)		147 ft			
Shear Uniform Load, (w)		7.5 klf I.O. w = V _{tot} /B			
Line	Length, L (ft)	Trib (ft)	Unit Shear, v (#/')	v = w*Trib/L	
East of C	420	19	338		
East of D	420	13	236		
East of F	420	45	791		
1-3/4" 13ga staples at 4" o.c. typical		Per IBC Table 2306.2(1)		v _{all} (#/')	
5/8" plywood typical				465 '=155plf *(1.5 m-factor)*(2.0 for nominal value)	
		Line	DCR:		
		East of C	0.7		
		East of D	0.5		
		East of F	1.7		

THE DCR = 1.7 EAST OF LINE F

THE EXISTING DIAPHRAGM IS TO BE RETROFITTED EAST OF LINE F AND WEST OF LINE D



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ASCE 41-13 Seismic Forces

Moment Frame Line Forces
**See keyplans for frame line tributary areas.*

Loading at Walkway
Total Roof Area (sf) 3600

WALKWAY BRIDGE E/W DIRECTION:
(2) PERIMETER FRAME LINES EA. TAKE 50% OF V_{TOT}

WALKWAY BRIDGE N/S DIRECTION:
7 TOTAL FRAMES, APPROX. LOADING = $1/7 * V_{TOT} = 0.14$

Line	A _{trib} (sf)	% V _{tot}	# bays	V _{0.75BSE-1N} (kip)	load per column	V _{BSE-2E} (kip)	load per column	Does not control, no need to check. See Gate Lobby check.
12 roof	-	0.5	6	64	9.2	103	14.8	
12 floor	-	0.5	6	104	14.8	166	23.8	
Q roof	-	0.14	1	18	9.2	30	14.8	
Q floor	-	0.14	1	30	14.8	48	23.8	

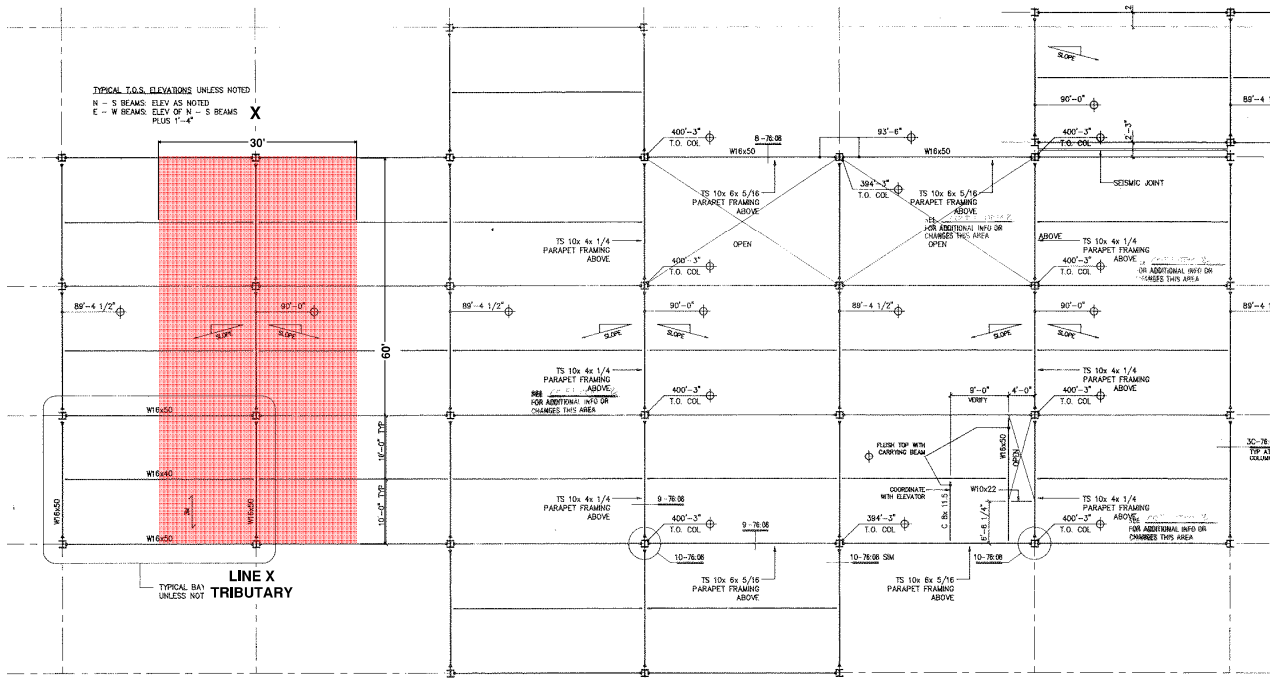
Loading at Gate Lobby
Total Roof Area (sf) 12600

Line	A _{trib} (sf)	% V _{tot}	# bays	V _{0.75BSE-1N} (kip)	load per column	V _{BSE-2E} (kip)	load per column	Columns in this area will be checked for loading in both directions.
8.9 roof	3600	0.29	6	108	15.4	173	24.8	
8.9 floor	3600	0.29	6	188	26.8	301	43.0	
X roof	1800	0.14	3	54	13.5	87	21.7	
X floor	1800	0.14	3	94	23.4	150	37.6	

GATE LOBBY TRIB. AREA, SEE FOLLOWING PAGES

GATE LOBBY FRAME LOADING > WALKWAY FRAME LOADING. THE GATE LOBBY AND WALKWAY CONSIST OF THE SAME FRAMES, THEREFORE CHECKS ON THE GATE LOBBY WILL APPLY TO THE WALKWAY.

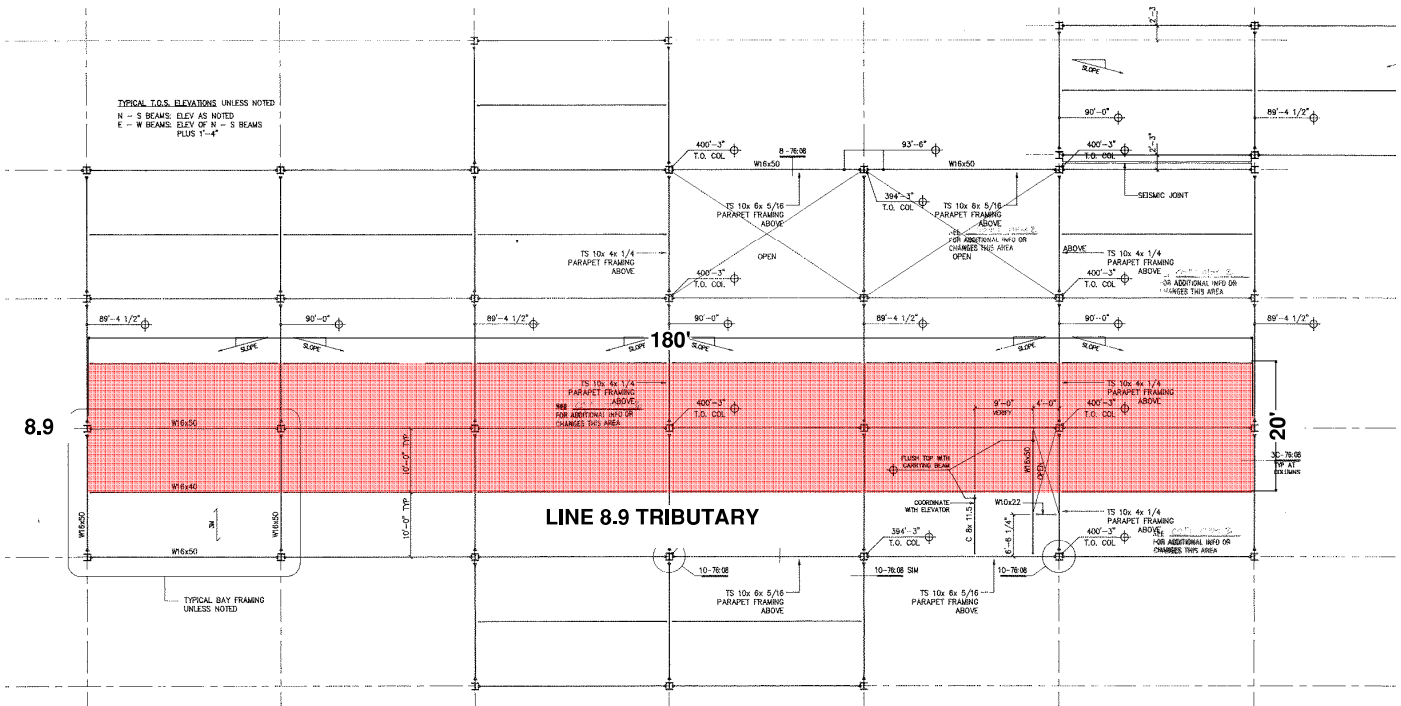
GATE LOBBY LINE X



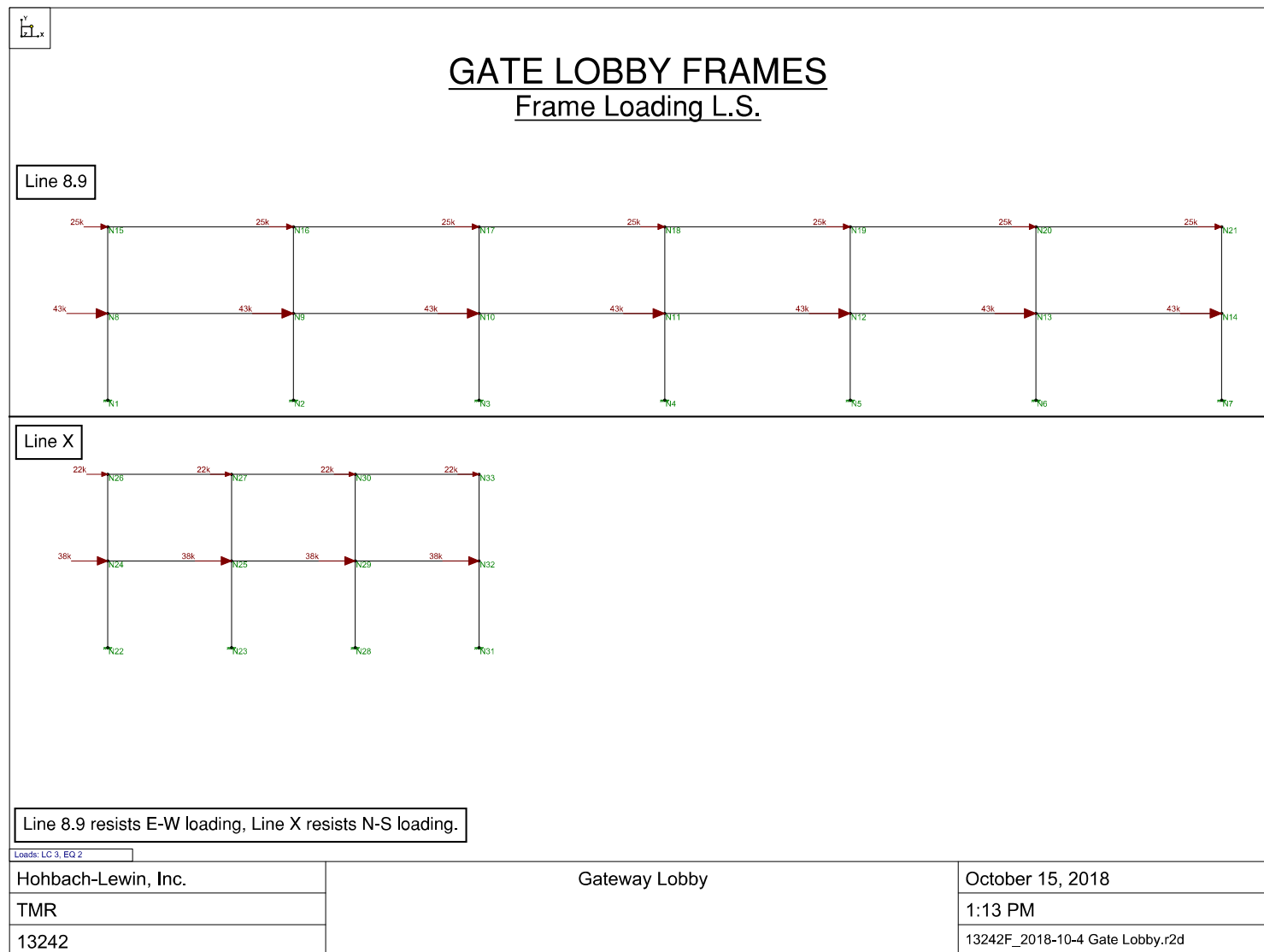
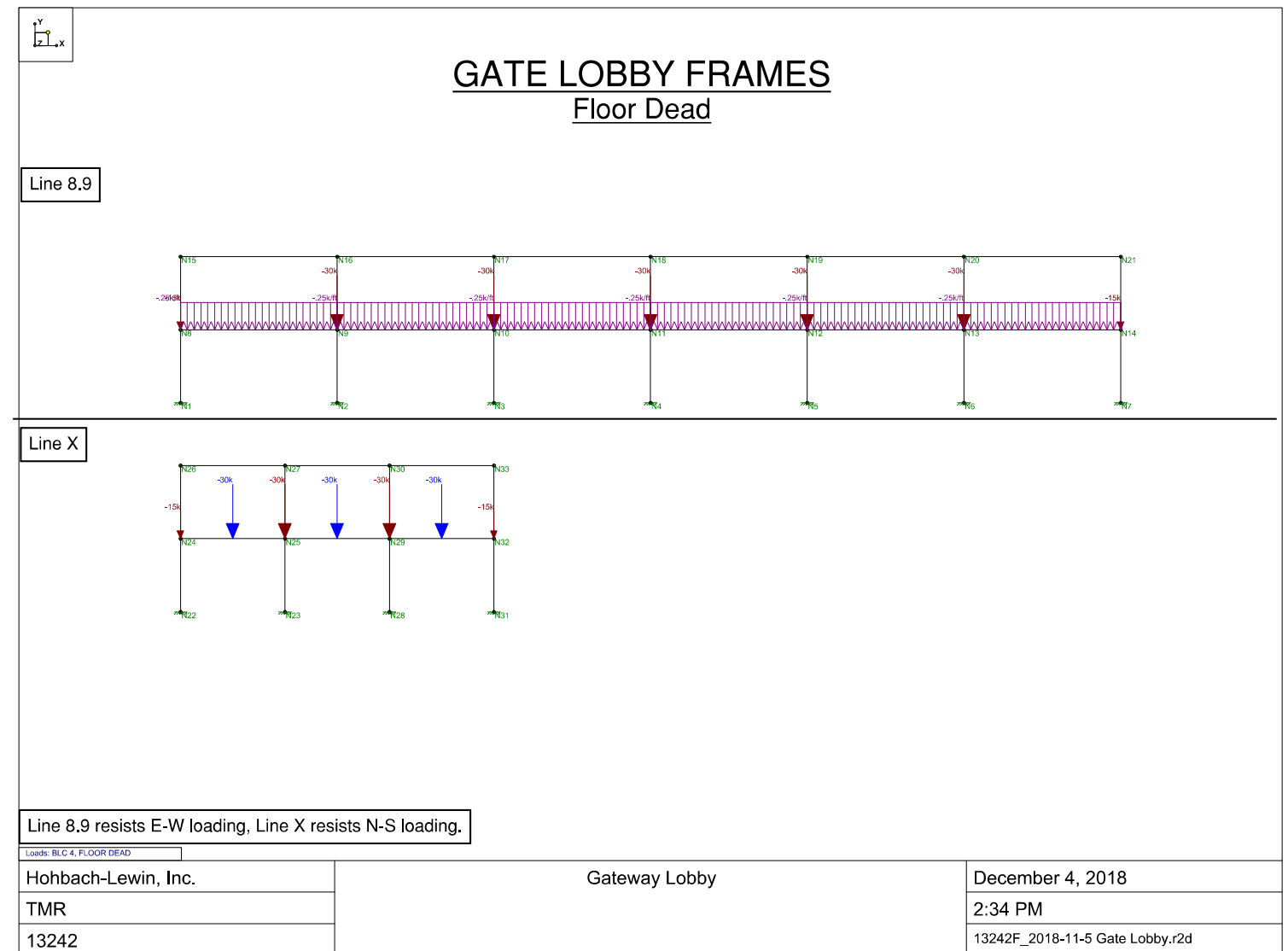
30'x60' = 1800SF

THE GATE LOBBY FRAMING IS MOSTLY REGULAR AND FRAMES OCCUR AT EVERY COLUMN IN EACH DIRECTION. THEREFORE IT IS REASONABLE TO DISTRIBUTE FORCES BASED ON TRIBUTARY.

GATE LOBBY LINE 8.9

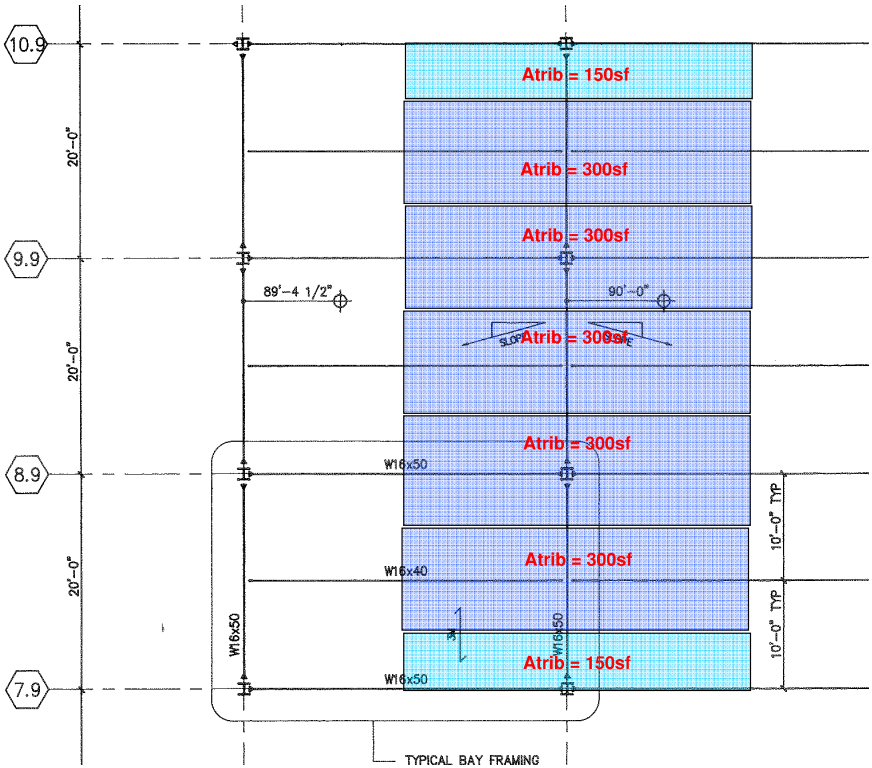


180'x20' = 3600SF



Roof = 30psf
Dfloor = 100psf
L = 100psf (use 25%L per ASCE 41 7.2.2 = 25psf)
S = 25 psf (<30psf therefore ignore per ASCE 41 7.2.2)

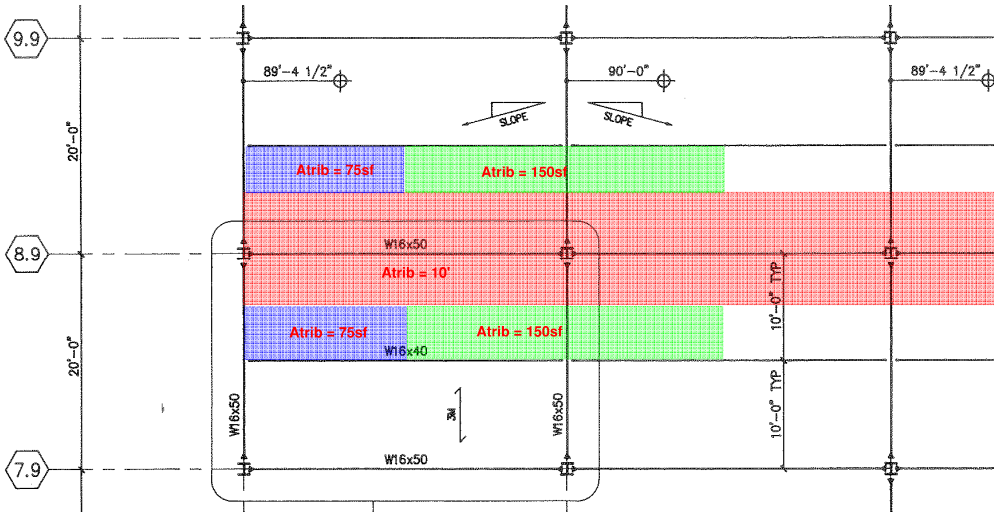
LOAD COMBOS:
USE $1.1Q_G + Q_E$ FOR STRESS
USE $0.9Q_G + Q_E$ FOR UPLIFT
PER ASCE 41 7.2.2



Atrib = 150sf
PDRoof = 4.5k
PDFloor = 15k
PL = 3.8k

Atrib = 300sf
PDRoof = 9k
PDFloor = 30k
PL = 7.5k

LINE X GRAVITY POINT LOAD TRIBUTARY
@ GATE LOBBY

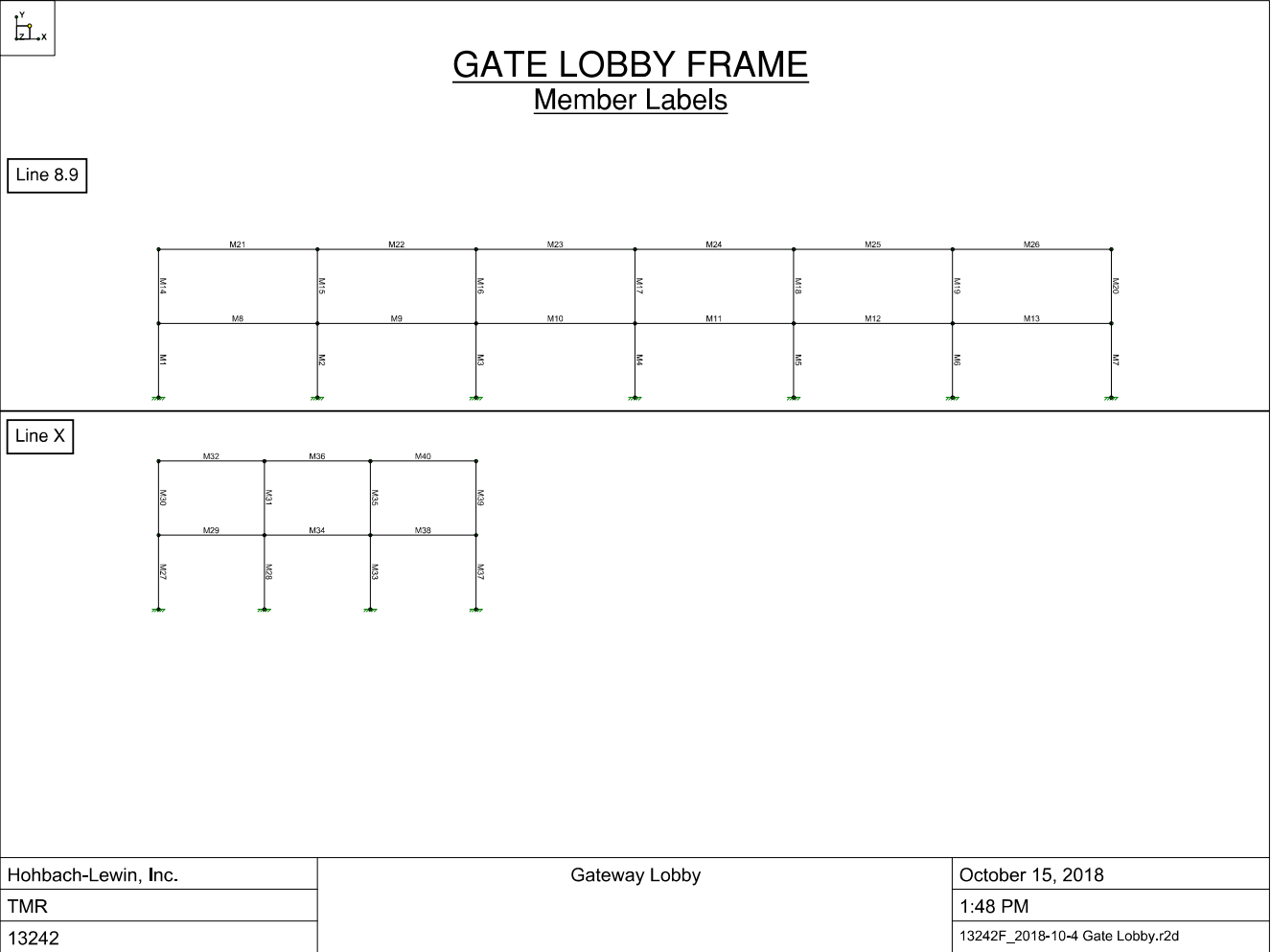


Atrib = 150sf
PDRoof = 4.5k
PDFloor = 15k
PL = 3.8k

Atrib = 300sf
PDRoof = 9k
PDFloor = 30k
PL = 7.5k

Atrib = 10ft
WDRoof = 0.3klf
WDFloor = 1klf
WL = 0.25klf

LINE 8.9 GRAVITY TRIBUTARY
@ GATE LOBBY



ENVELOPE FORCES

Member Section Forces (By Combination)

	LC	Member Label	Sec	Axial[k]	Shear[k]	Moment[k-ft]
1	5	M1	1	26.965	34.787	287.569
2			2	26.965	34.787	44.059
3			3	26.965	34.787	-199.45
4	5	M2	1	109.563	45.274	336.237
5			2	109.563	45.274	19.322
6			3	109.563	45.274	-297.594
7	5	M3	1	101.399	43.799	329.447
8			2	101.399	43.799	22.856
9			3	101.399	43.799	-283.735
10	5	M4	1	102.403	44.051	330.634
11			2	102.403	44.051	22.279
12			3	102.403	44.051	-286.076
13	5	M5	1	102.634	43.955	330.19
14			2	102.634	43.955	22.506
15			3	102.634	43.955	-285.179
16	5	M6	1	99.719	44.42	332.327
17			2	99.719	44.42	21.388
18			3	99.719	44.42	-289.551
19	5	M7	1	71.118	41.215	317.434
20			2	71.118	41.215	28.929
21			3	71.118	41.215	-259.575
22	5	M8	1	-2.069	1.825	-217.448
23			2	-2.069	-18.8	-90.14
24			3	-2.069	-39.425	346.543
25	5	M9	1	-1.149	8.028	-80.325
26			2	-1.149	-12.597	-46.051
27			3	-1.149	-33.222	297.597
28	5	M10	1	-.516	7.158	-99.783
29			2	-.516	-13.467	-52.462
30			3	-.516	-34.092	304.234
31	5	M11	1	-.006	7.261	-96.98
32			2	-.006	-13.364	-51.209
33			3	-.006	-33.989	303.937
34	5	M12	1	.459	7.523	-95.154
35			2	.459	-13.102	-53.305
36			3	.459	-33.727	297.918
37	5	M13	1	1.138	5.57	-110.935
38			2	1.138	-15.055	-39.802
39			3	1.138	-35.68	340.705
40	5	M14	1	4.515	5.718	17.998
41			2	4.515	5.718	-22.028
42			3	4.515	5.718	-62.053
43	5	M15	1	20.86	19.194	129.274
44			2	20.86	19.194	-5.085
45			3	20.86	19.194	-139.444
46	5	M16	1	19.769	17.431	113.645
47			2	19.769	17.431	-8.375
48			3	19.769	17.431	-130.396
49	5	M17	1	19.8	17.561	115.138
50			2	19.8	17.561	-7.786
51			3	19.8	17.561	-130.71
52	5	M18	1	19.872	17.42	113.912
53			2	19.872	17.42	-8.028
54			3	19.872	17.42	-129.969
55	5	M19	1	19.171	18.099	119.302
56			2	19.171	18.099	-7.393

COL.
MAX

BEAM V & M MAX

Member Section Forces (By Combination) (Continued)

	LC	Member Label	Sec	Axial[k]	Shear[k]	Moment[k-ft]
57			3	19.171	18.099	-134.087
58	5	M20	1	14.813	13.077	81.129
59			2	14.813	13.077	-10.407
60			3	14.813	13.077	-101.943
61	5	M21	1	9.782	-.435	-62.053
62			2	9.782	-5.385	-18.398
63			3	9.782	-10.335	99.508
64	5	M22	1	6.088	.625	-39.936
65			2	6.088	-4.325	-12.187
66			3	6.088	-9.275	89.812
67	5	M23	1	4.156	.594	-40.584
68			2	4.156	-4.356	-12.365
69			3	4.156	-9.306	90.103
70	5	M24	1	2.096	.594	-40.607
71			2	2.096	-4.356	-12.387
72			3	2.096	-9.306	90.083
73	5	M25	1	.176	.666	-39.886
74			2	.176	-4.284	-12.747
75			3	.176	-9.234	88.641
76	5	M26	1	-2.423	.037	-45.446
77			2	-2.423	-4.913	-8.877
78			3	-2.423	-9.863	101.943

BEAM A MAX



Company :
Designer : TMR
Job Number : 13242
Model Name : Gateway Lobby

GATE LOBBY LINE X OUTPUT

Nov 5, 2018
4:27 PM
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Member Section Forces (By Combination)

	LC	Member Label	Sec	Axial[k]	Shear[k]	Moment[k-ft]
1	5	M27	1	19.372	30.269	265.502
2			2	19.372	30.269	53.62
3			3	19.372	30.269	-158.263
4	5	M28	1	110.554	40.465	309.472
5			2	110.554	40.465	26.214
6			3	110.554	40.465	-257.044
7	5	M29	1	-2.012	-4.232	-177.932
8			2	-2.012	-4.232	-135.614
9			3	-2.012	-45.482	319.204
10	5	M30	1	2.978	4.856	19.67
11			2	2.978	4.856	-14.325
12			3	2.978	4.856	-48.321
13	5	M31	1	20.685	18.387	131.426
14			2	20.685	18.387	2.72
15			3	20.685	18.387	-125.986
16	5	M32	1	8.644	-1.972	-48.321
17			2	8.644	-1.972	-28.604
18			3	8.644	-11.872	90.112
19	5	M33	1	98.834	39.708	306.27
20			2	98.834	39.708	28.317
21			3	98.834	39.708	-249.635
22	5	M34	1	-.691	3.137	-69.267
23			2	-.691	3.137	-100.632
24			3	-.691	-38.113	280.503
25	5	M35	1	19.25	17.681	123.683
26			2	19.25	17.681	-.082
27			3	19.25	17.681	-123.846
28	5	M36	1	3.757	-1.086	-35.874
29			2	3.757	-1.086	-25.01
30			3	3.757	-10.986	84.855
31	5	M37	1	78.141	37.158	295.262
32			2	78.141	37.158	35.155
33			3	78.141	37.158	-224.951
34	5	M38	1	.682	.22	-92.815
35			2	.682	.22	-95.018
36			3	.682	-41.03	315.278
37	5	M39	1	16.487	13.076	90.327
38			2	16.487	13.076	-1.207
39			3	16.487	13.076	-92.742
40	5	M40	1	-.424	-1.637	-38.991
41			2	-.424	-1.637	-22.625
42			3	-.424	-11.537	92.742

COL.
MAX

BEAM MAX

BASED ON THE TIER 1 DEFICIENCIES LISTED BELOW, THE FRAME MEMBERS ARE TO BE ANALYZED. THE MEMBERS WILL BE CHECKED FOR THE AXIAL, SHEAR, AND FLEXURAL LOADS DETERMINED IN THE PRECEEDING RISA ANALYSIS.

TIER 1 DEFICIENCY - FLEXURAL STRESS & COMPACT MEMBERS:

THIS DEFICIENCY WAS TRIGGERED BY THE NON-COMPACT MEMBER CRITERIA PER AISC 341 TABLE D1.1. TYPICAL W18X76 BEAMS FAIL THIS CRITERIA. PER ASCE 41-13 5.5.2.1, THE MEMBERS ARE TO BE ASSESSED FOR THE EXPECTED FORCES WITH REDUCED M-FACTORS PER TABLE 9-4.

FROM THE FOLLOWING MEMBER ANALYSIS, THE 18X76 BEAMS IN THE GATE LOBBY AND WALKWAY HAVE A MAXIMUM FLEXURAL STRESS DCR = 0.3, WHICH OCCURS ON LINE 8.9. THEREFORE, OK.

TIER 1 DEFICIENCY - PANEL ZONE STRENGTH:

THIS DEFICIENCY WAS TRIGGERED AS THE PANEL ZONES DO NOT HAVE THE CAPACITY TO DEVELOP 80% OF THE FLEXURAL STRENGTH OF THE GIRDERS. PER ASCE 41-13 A.3.1.3.5, THE PANEL ZONES ARE TO BE ASSESSED WITH THE EXPECTED FORCES.

FROM THE FOLLOWING MEMBER ANALYSIS, THE PANEL ZONES HAVE A MAXIMUM DCR OF 0.15 WHICH OCCURS ON LINE 8.9. THEREFORE, THIS ITEM IS DEEMED COMPLIANT.

TIER 1 DEFICIENCY - STRONG COLUMN-WEAK BEAM:

THIS DEFICIENCY WAS TRIGGERED AS MANY FRAMES DO NOT MEET THE REQUIREMENTS OF STRONG COL.-WEAK BEAM. PER ASCE 41-13 5.5.2.1.5. COMPLIANCE CAN BE DEMONSTRATED BY ANALYZING THE FRAMES WITH AN M-FACTOR OF 2.5. DUE TO THE IMMEDIATE OCCUPANCY PERFORMAMNCE OBJECTIVE, COLUMNS ARE CHECKED WITH AN M-FACTOR <2.5 (CONSERVATIVE).

FROM THE FOLLOWING MEMBER ANALYSIS, THE COLUMNS HAVE A MAXIMUM DCR OF (0.19 + 0.41) = 0.60 FROM LINE X AND 8.9 THEREFORE, THIS ITEM IS DEEMED COMPLIANT.



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ASCE 41-13 m-factors - Walkway, Gate Lobby, West Terminal

ASCE 341-10 Table D1.1 - Highly Ductile Width-to-Thickness Ratios

Flanges	$b_f/2t_f < 0.3(E/F_{ye})^{0.5}$	$\lambda_{hd} = 6.9$	* F _{ye} = 1.1F _y
Webs	$h/t_w < 2.45(E/F_{ye})^{0.5}$	$\lambda_{hd} = 56.3$	

ASCE 41 Table 9-4

				m-factor	
				I.O	L.S.
Limit a:	$b_f/2t_f \leq 52/F_{ye}^{0.5}$	= 7.0	and $h_{tw}/t_w \leq 300/F_{ye}^{0.5}$	= 40.5	2 6.0
Limit b:	$b_f/2t_f \geq 65/F_{ye}^{0.5}$	= 8.8	or $h_{tw}/t_w \geq 460/F_{ye}^{0.5}$	= 62.0	1.25 1.25

	m-factor				Location
	$b_f/2t_f$	h/t_w	I.O	L.S.	
W12x136	4.96	12.3	2.0	6	Typ. Column Terminal A concourse

				m-factor	
				I.O	L.S.
Limit a:	$b_f/2t_f \leq 52/F_{ye}^{0.5}$	= 7.0	and $h_{tw}/t_w \leq 418/F_{ye}^{0.5}$	= 56.4	2 6
Limit b:	$b_f/2t_f \geq 65/F_{ye}^{0.5}$	= 8.8	or $h_{tw}/t_w \geq 640/F_{ye}^{0.5}$	= 86.3	1.25 2

	m-factor			
	$b_f/2t_f$	h/t_w	I.O	L.S.
W16x50	5.61	37.4	2.0	6.0
W18x76	8.11	37.8	1.5	3.5
W24x76	6.61	49.0	2.0	6.0

Therefore, members that do not meet compactness criteria for highly ductile members include W18x76 beams in the Terminal A concourse.



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ASCE 41-13 Flexural Stress Check

I.O. Load = 0.75BSE-1N	Ratio the applied load to m-factor to determine controlling load case.
L.S. Load = BSE-2E	

Frame Line: X	Description: W12x136 strong axis columns w/ W24x76 beams low and W16x50 beams high. N-S Frame at gate lobby
---------------	---

		m-factor (col.)	Ratio	m-factor (beam)	Ratio	(I.O. controls)
Roof I.O. Load (k)	14	2.0	6.8	2.0	6.8	
Floor I.O. Load (k)	23	2.0	11.7	2.0	11.7	
Roof L.S. Load (k)	22	6.0	3.6	6.0	3.6	
Floor L.S. Load (k)	38	6.0	6.3	6.0	6.3	

Risa Output (Q_{UD}) (I.O. controlling)

Member	Section	Moment (k-ft)	Shear (k)	Axial (k)
Column	W12x136	310	40	110
Beam Low	W24x76	318	45	2
Beam High	W16x50	93	7	9

REFERENCE PAGE 62
FOR RISA OUTPUT

Expected Strength (Q_{CE}) ASCE 41 Sec. 9.4.2.3, AISC 360 Tables 3-2 & 4-1

Use F_y = 1.1*50 ksi= 55ksi, per Table 9-3 ASCE 41

Beam:	W24x76	Column:	W12x136
Q _{CE} = 1.1M _p (k-ft)	917	P _{CL} = 1.1P _n (k)	1562
Q _{UD} = M (k-ft)	318.0	P _{UF} = A (k)	110
		M _{CE} = 1.1M _p (k-ft)	981
Beam:	W16x50	M (k-ft)	310.0
Q _{CE} = 1.1M _p (k-ft)	422		
Q _{UD} = M (k-ft)	93.0		

Column Check:	P _{UF} (k)	110
	P _{CL} (k)	1562
	P _{UF} /P _{CL}	0.07
	M _{CE} (k-ft)	981
	M (k-ft)	310
	m-factor	2.0

For $\frac{P_{UF}}{P_{CL}} < 0.2$,

$$\frac{P_{UF}}{2P_{CL}} + \frac{M_s}{m_s M_{CEs}} + \frac{M_y}{m_y M_{CEy}} \leq 1.0 \quad (9-11)$$

DCR: 0.19

Beam Check:	Q _{UD} (k-ft)	318
	m	2.0
	Q _{CE} (k-ft)	917
	mQ _{CE} (k-ft)	1833

@ Floor
mQ_{CE} > Q_{UD}

DCR: 0.17

	Q _{UD} (k-ft)	93
	m	2.0
	Q _{CE} (k-ft)	422
	mQ _{CE} (k-ft)	843

@ Roof
mQ_{CE} > Q_{UD}

DCR: 0.11

*SEE PAGE B-46.1 FOR
BEAM CHECK AS A
BEAM COLUMN



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Panel Zone Check:	<i>m-factor for panel zones:</i>	1.5	(I.O. loading)
$Q_{CE} (k) =$	$0.55F_{ye}d_ct_p$	<i>Where dc = column depth and tp = thickness of panel zone (9-5)</i>	
d_c	13.4		
t_p	0.79		
$Q_{CE} (k) =$	291	$mQ_{CE} > Q_{UD}$	
$Q_{UD} (k) =$	40	DCR:	0.14

W12X136 COLUMNS AND W24X76 BEAMS ARE SUFFICIENT FOR STRONG-COLUMN WEAK BEAM, FLEXURAL STRESS, PANEL ZONE AND COMPACT MEMBER DEFICIENCIES BASED ON THE LOW DCRs.

IF THE COLUMN DCRs ARE ADDED FROM LINE X AND LINE 8.9 TO ACCOUNT FOR THE COLUMNS BEING LOADED IN EACH DIRECTION, THE DCR IS STILL LESS THAN 1.0, THEREFORE OK.



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ASCE 41-13 Flexural Stress Check		
I.O. Load = 0.75BSE-1N		<i>Ratio the applied load to m-factor to determine controlling load case.</i>
L.S. Load = BSE-2E		
Frame Line: 8.9	Description:	W12x136 weak axis columns w/ W18x76 beams low and W16x50 beams high. E-W Frame at gate lobby

		<i>m-factor (col.)</i>	<i>Ratio</i>	<i>m-factor (beam)</i>	<i>Ratio</i>	
Roof I.O Load (k)	15	2.0	7.7	2.0	7.7	(I.O. controls)
Floor I.O Load (k)	27	2.0	13.4	1.5	17.5	
Roof L.S. Load (k)	25	6.0	4.1	6.0	4.1	
Floor L.S. Load (k)	43	6.0	7.2	3.5	12.3	

Risa Output (Q_{UD})		(I.O. controlling)		
Member	Section	Moment (k-ft)	Shear (k)	Axial (k)
Column	W12x136	336	45	110
Beam Low	W18x76	346	39	10
Beam High	W16x50	102	10	10

REFERENCE PAGES 60-61 FOR RISA OUTPUT

Expected Strength (Q_{CE})	ASCE 41 Sec. 9.4.2.3, AISC 360 Tables 3-2 & 4-1
---	---

Use Fy = 1.1*50 ksi= 55ksi, per Table 9-3 ASCE 41

Beam:	W18x76	Column:	W12x136
$Q_{CE} = 1.1M_p (k-ft)$	747	$P_{CL} = 1.1P_n (k)$	1562
$Q_{UD} = M (k-ft)$	346.0	$P_{UF} = A (k)$	110
		$M_{CE} = 1.1M_p (k-ft)$	449
		$M (k-ft)$	336.0
Beam:	W16x50		
$Q_{CE} = 1.1M_p (k-ft)$	422		
$Q_{UD} = M (k-ft)$	102.0		

Column Check:	$P_{UF} (k)$	110	For $\frac{P_{UF}}{P_{CL}} < 0.2,$ $\frac{P_{UF}}{2P_{CL}} + \frac{M_x}{m_xM_{CEs}} + \frac{M_y}{m_yM_{CEy}} \leq 1.0$ (9-11)
	$P_{CL} (k)$	1562	
	P_{UF}/P_{CL}	0.07	
	$M_{CE} (k-ft)$	449	
	$M_U (k-ft)$	336	
	m-factor	2.0	DCR:

0.41

Beam Check:	$Q_{UD} (k-ft)$	346	@ Floor
	m	1.5	$mQ_{CE} > Q_{UD}$
	$Q_{CE} (k-ft)$	747	
	$mQ_{CE} (k-ft)$	1143	DCR:
			0.30
	$Q_{UD} (k-ft)$	102	@ Roof
	m	2.0	$mQ_{CE} > Q_{UD}$
	$Q_{CE} (k-ft)$	422	
	$mQ_{CE} (k-ft)$	843	DCR:
			0.12

*SEE PAGE B-46.1 FOR BEAM CHECK AS A BEAM COLUMN



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Panel Zone Check: *m-factor for panel zones:* 1.5 (I.O. loading)

$Q_{CE}(k) = 0.55F_y d_c t_p$ Where d_c = column depth and t_p = thickness of panel zone (9-5)
 $d_c = 13.4$
 $t_p = 0.79$
 $Q_{CE}(k) = 291$ $mQ_{CE} > Q_{UD}$
 $Q_{UD}(k) = 45$ DCR: 0.15

W12X136 COLUMNS AND W18X76 BEAMS ARE SUFFICIENT FOR STRONG-COLUMN WEAK BEAM, FLEXURAL STRESS, PANEL ZONE AND COMPACT MEMBER DEFICIENCIES BASED ON THE LOW DCRs.

IF THE COLUMN DCRs ARE ADDED FROM LINE X AND LINE 8.9 TO ACCOUNT FOR THE COLUMNS BEING LOADED IN EACH DIRECTION, THE DCR IS STILL LESS THAN 1.0, THEREFORE OK.



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THE TIER 1 DEFICIENCIES ARE ADDRESSED ON THE FOLLOWING PAGES:

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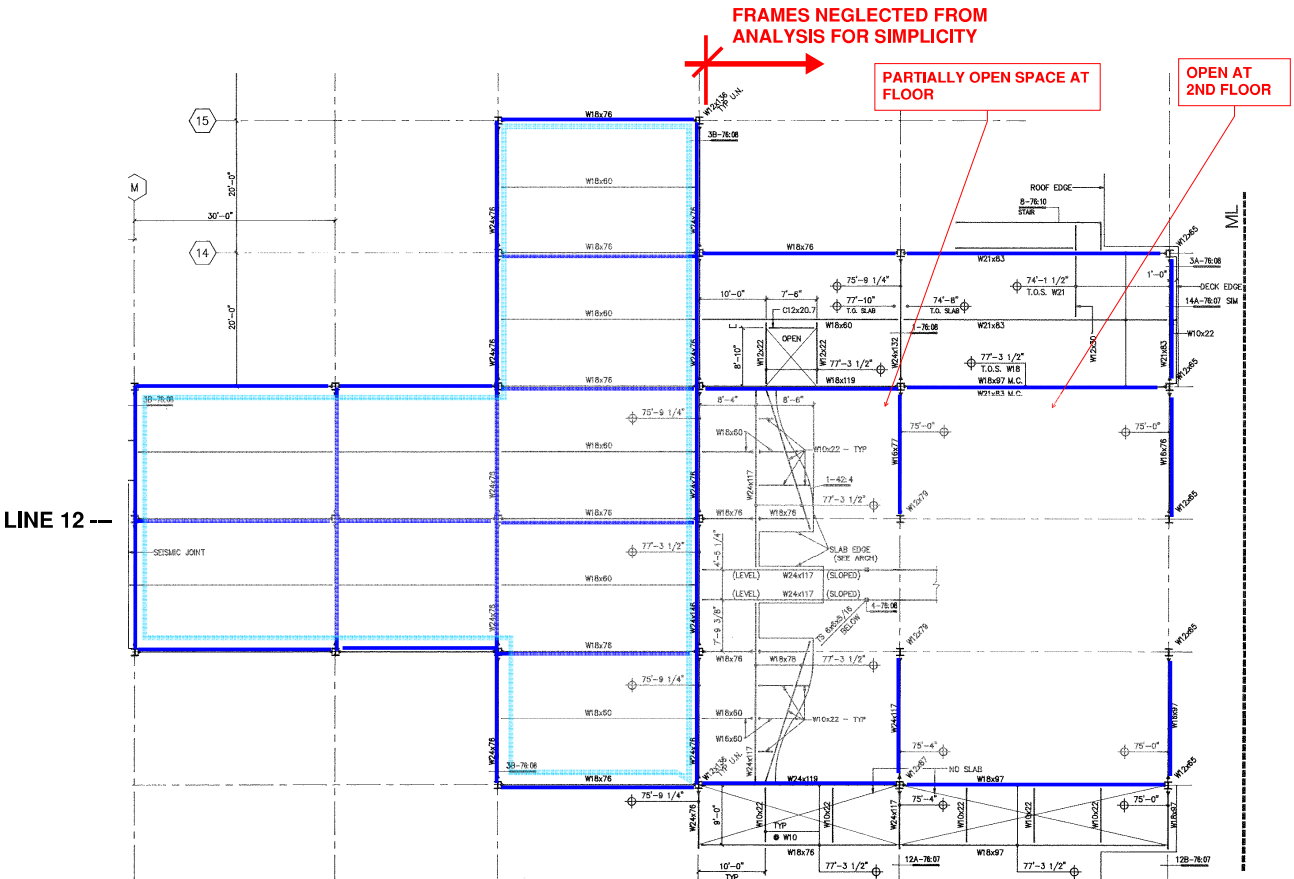
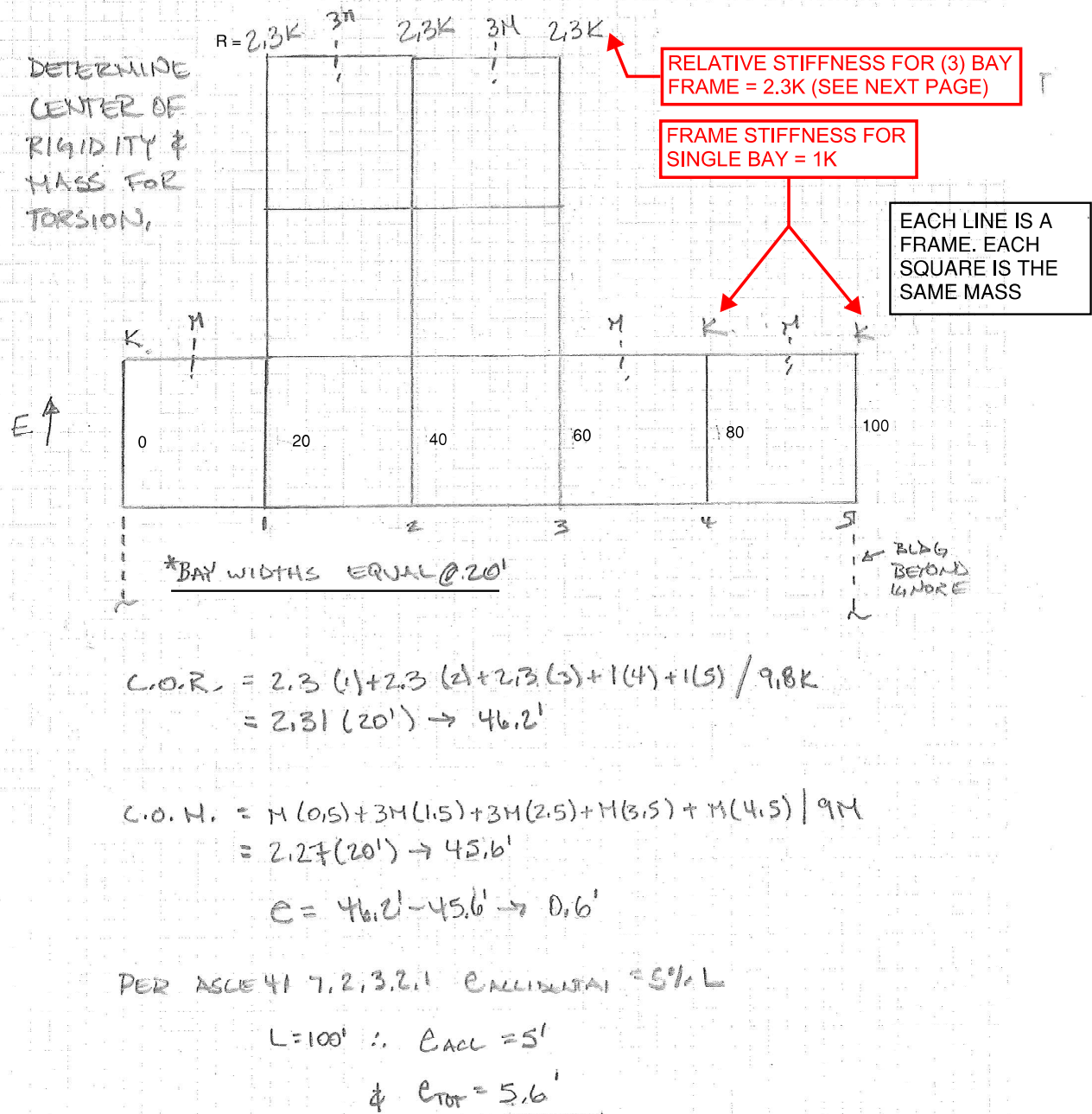


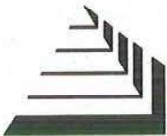
SUBJECT: LOE REPORT

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BY: TNR

West Terminal Floor Diaphragm - Torsional Effects

WEST TERMINAL ANALYSIS DESCRIPTION:
THE WEST TERMINAL IS TWO STORY AND INCLUDES OPENINGS IN THE 2ND FLOOR. SEISMIC LOADS ARE TO BE DISTRIBUTED BASED ON A RIGID 2ND FLOOR DIAPHRAGM ANALYSIS. DUE TO THE OPENINGS IN THE 2ND FLOOR, ALL FRAMES BEYOND THE OPENING ARE NEGLECTED FOR SIMPLICITY.





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A RISA model was created and 100kips was applied to a 3-bay frame and 1-bay frame in the West Terminal to determine the approximate stiffnesses of each frame.

LOADING TO FIND APPX. STIFFNESS OF FRAMES:

RECALL
VERT. DIST.: V_{ROOF} 0.3V
 V_{FLOOR} 0.7V

VERTICAL DISTRIBUTION OF SEISMIC FORCES AT 2-STORY FRAMES.

USE $V=100$ FOR STIFFNESS.

DEFLECTION OUTPUT FROM RISA

SINGLE BAY E-W DIRECTION $V=100K$ $\Delta=4"$ $K=25K/11$
3-BAY EW DIRECTION $V=100K$ $\Delta=1.75"$ $K=57K/11$

NORMALIZE TO SINGLE:
SINGLE - K
3-BAY - 2.3

See Rigid Diaphragm Analysis for West Terminal Loading.

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Rigid Diaphragm Analysis
West Terminal

Reference Pg 16 for West Terminal floor seismic load

Parameters	
Y-DIRECTION	
Floor Load	469.0 (k)
x-coord.	45.6 (ft)
ecc.	5.6 (ft)
x-bar	46.1 (ft)
$\Sigma Ry =$	10
I =	8276

CALCULATED ECCENTRICITY ON PREVIOUS PAGE

R = frame line stiffness

Floor load at frame line 12 in RISA

Force Distribution										
Line	LOAD DIR.	POS.	R	R*x	I	Vd-Y (k)	Vt-Y (k)	V-Y (k)	# COLs	Load per COL
L1	Y	0.0	1.00	0	2122	47.37	15.82	63.2	2.0	32
L2	Y	20.0	2.30	46	1562	108.96	20.59	129.5	4.0	33
L3	Y	40.0	2.30	92	84	108.96	4.79	113.7	4.0	28
L4	Y	60.0	2.30	138	447	108.96	11.01	120.0	4.0	30
L5	Y	80.0	1.00	80	1152	47.37	11.66	59.0	2.0	30
L6	Y	100.0	1.00	100	2909	47.37	18.52	65.9	2.0	33

Rigid Diaphragm Analysis for West Terminal Floor only. Roof consists of metal deck without concrete, therefore loads are distributed via tributary.

2ND FLOOR DESIGN FORCE DETERMINED FROM RIGID DIAPHRAGM ANALYSIS
DETERMINE ROOF LINE SHEAR BASED ON TRIBUTARY AREA

ASCE 41-13 Seismic Forces

Moment Frame Line Forces

*See keyplans for frame line tributary areas.

Loading at West Terminal

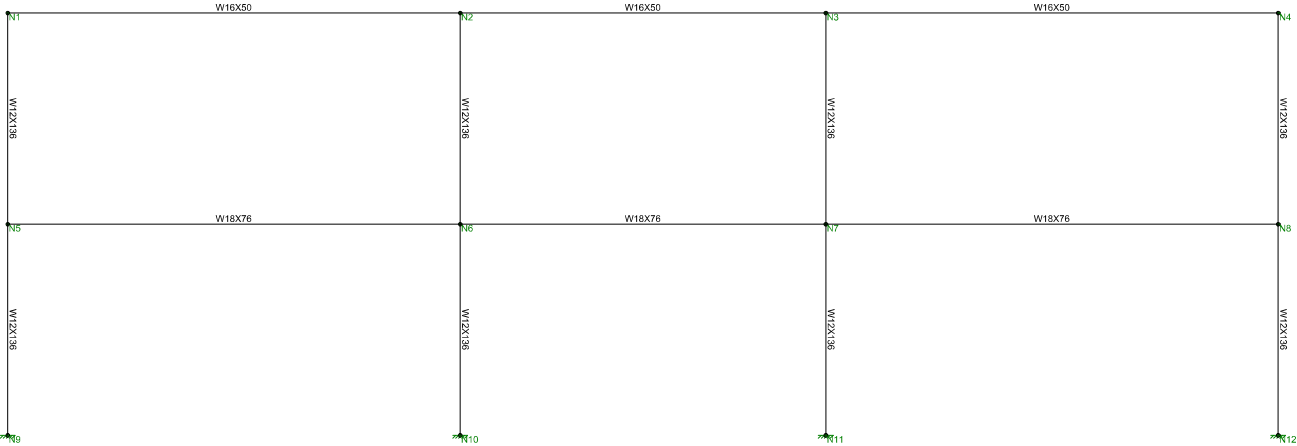
Total Roof Area (sf)	9600
Total Floor Area (sf)	9000

See rigid diaphragm analysis for torsional loads at floor area. Roof diaphragm acts flexible. Weak axis loading check in this area only.

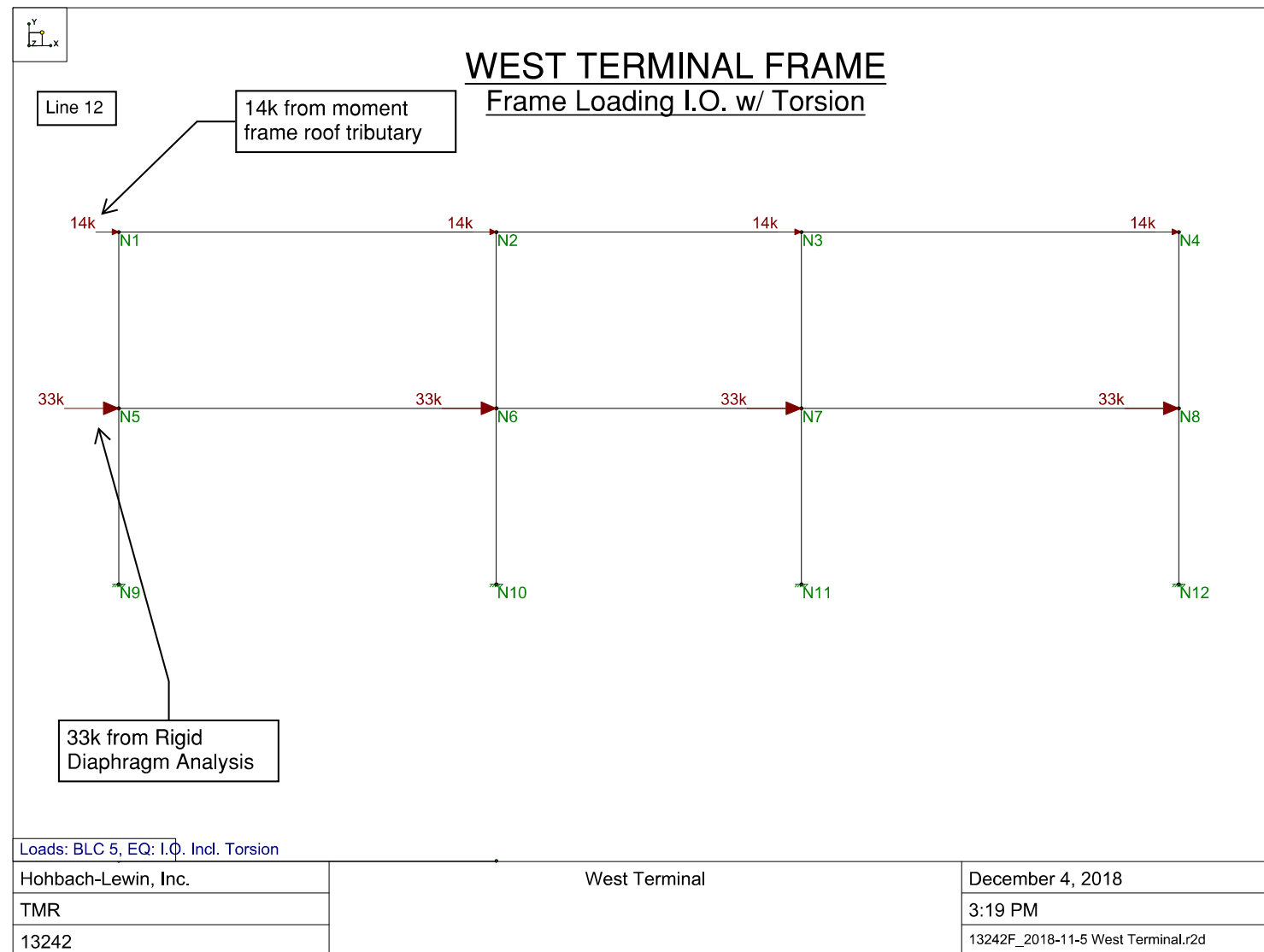
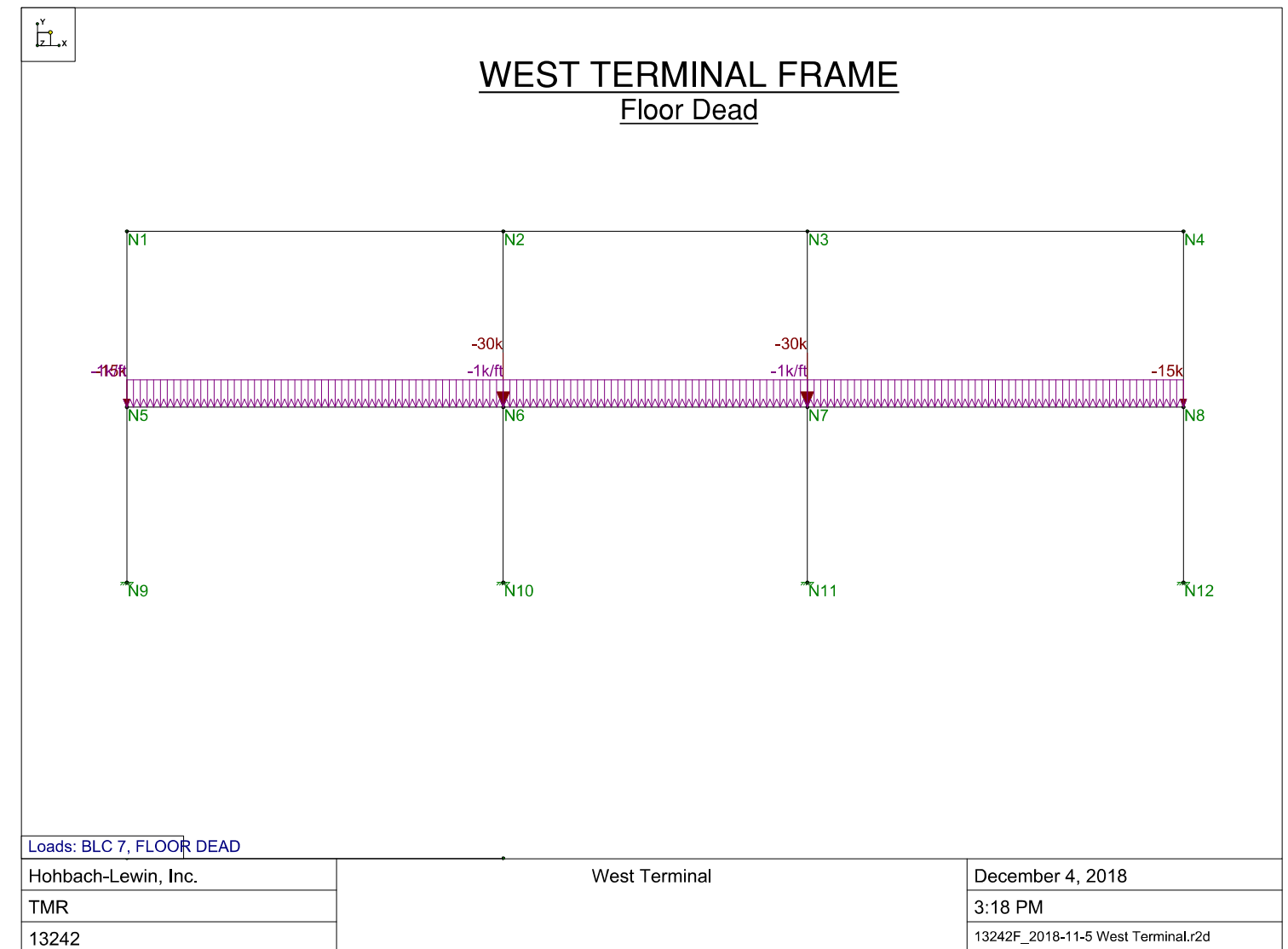
Line	A _{trib} (sf)	% V _{tot}	# bays	V _{0.75BSE-1N} (kip)	load per column	V _{BSE-2E} (kip)	load per column
12 roof	1700	0.18	3	54.7	13.7	87.7	21.9

WEST TERMINAL FRAME
Member Sections

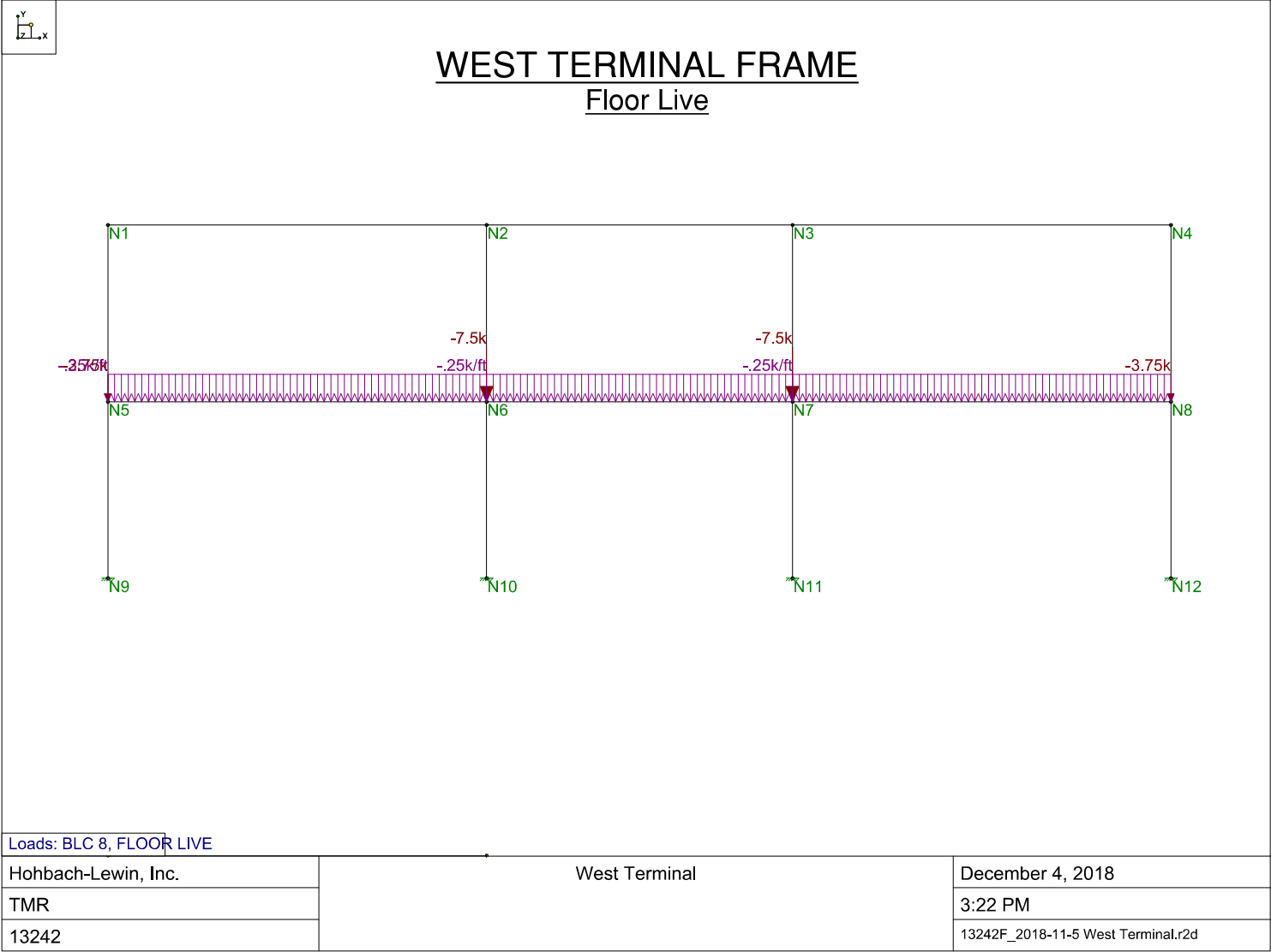
Line 12



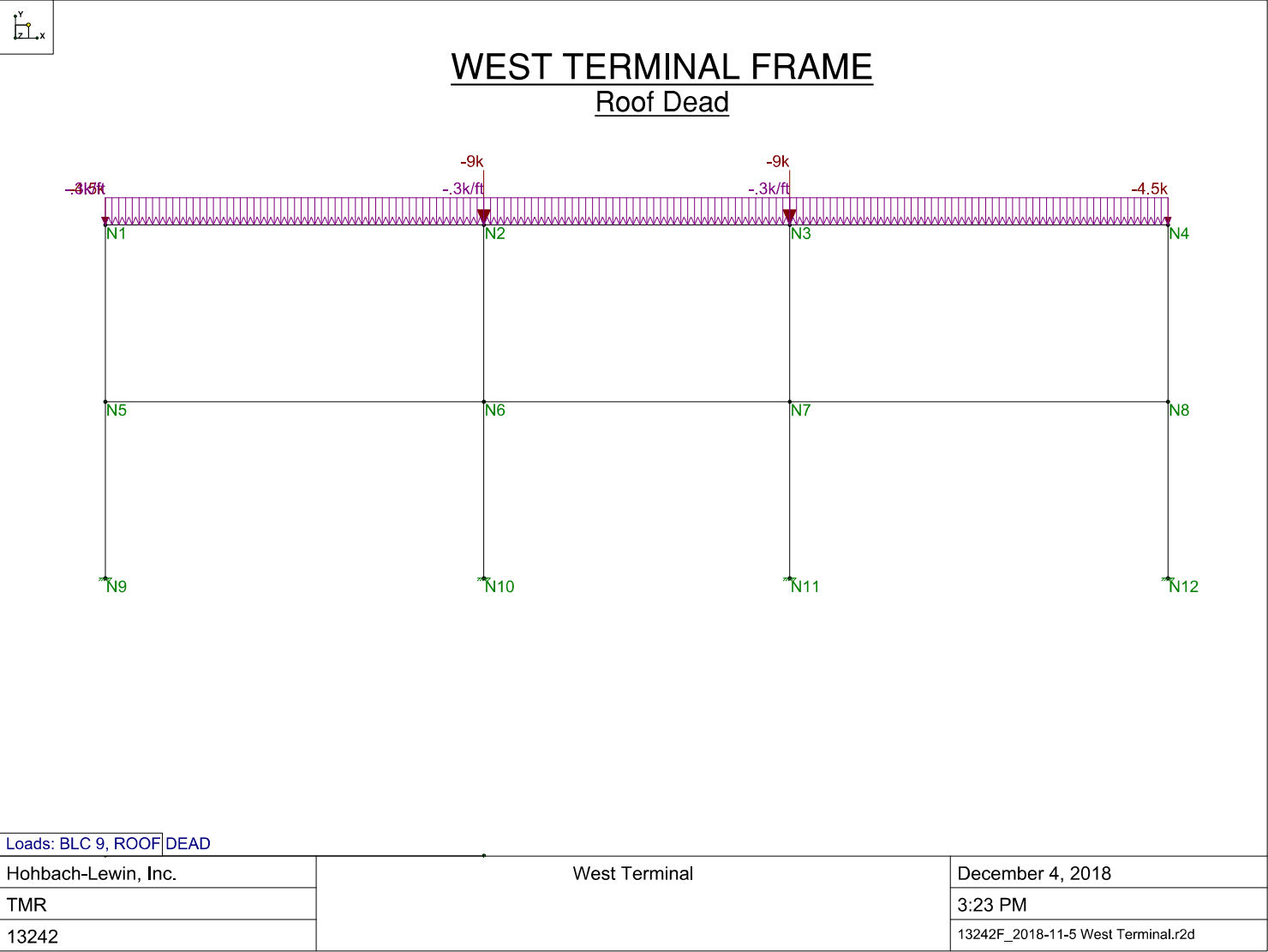
Hohbach-Lewin, Inc.	West Terminal	October 15, 2018
TMR		1:29 PM
13242		13242F_2018-10-4 West Terminal.r2d



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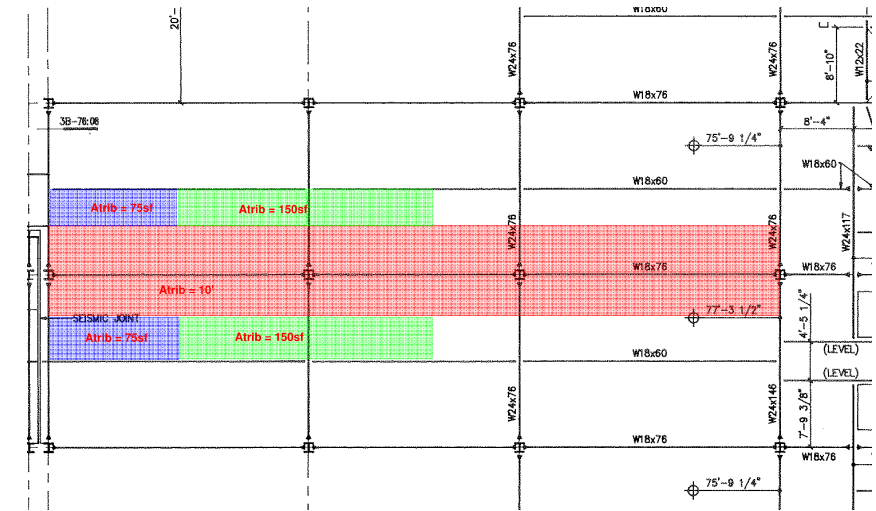


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Drroof = 30psf
Dfloor = 100psf
L = 100psf (use 25%L per ASCE 41 7.2.2 = 25psf)
S = 25 psf (<30psf therefore ignore per ASCE 41 7.2.2)

LOAD COMBOS:
USE $1.1Q_G + Q_E$ FOR STRESS
USE $0.9Q_G + Q_E$ FOR UPLIFT
PER ASCE 41 7.2.2

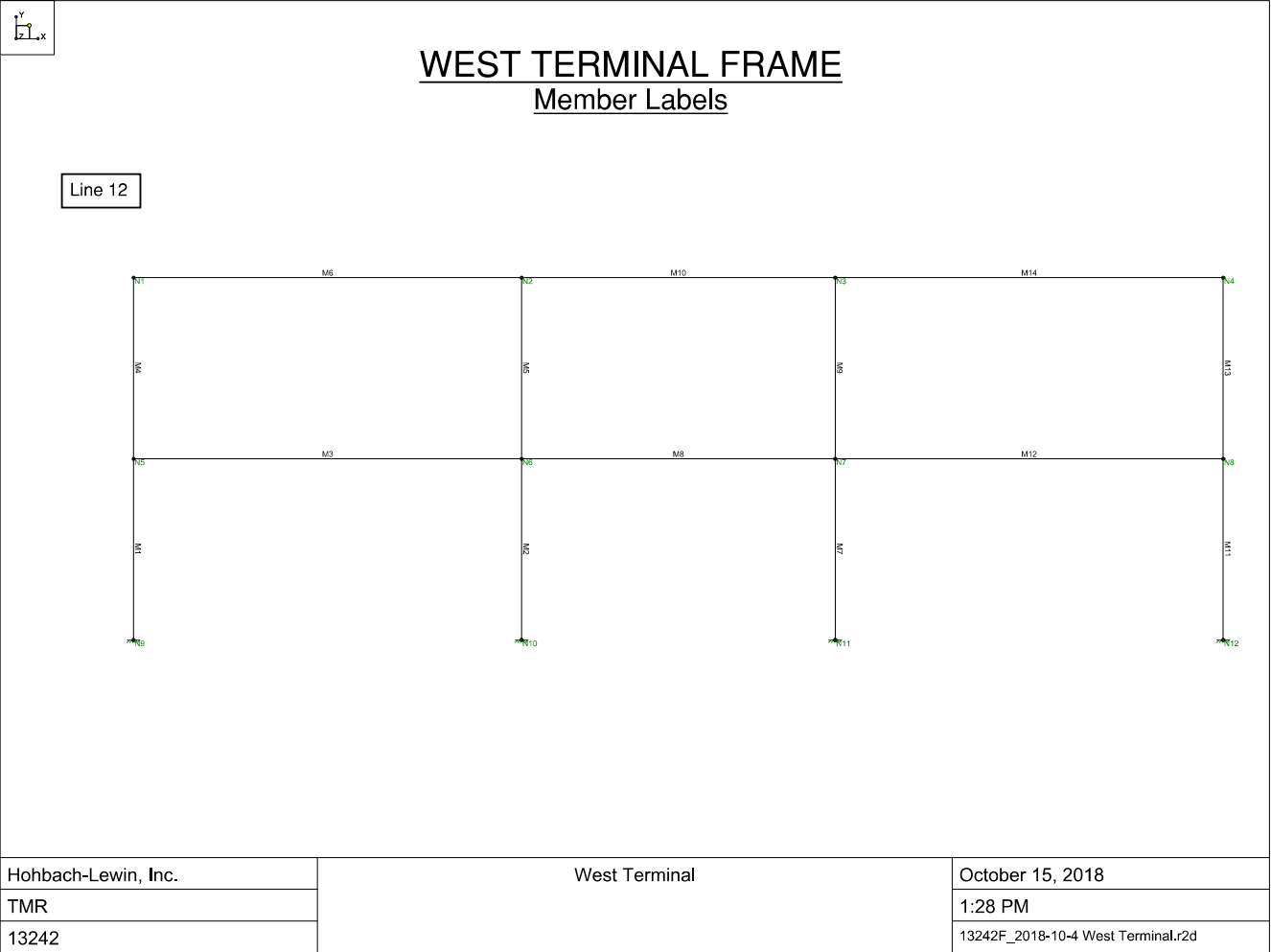


LINE 12 GRAVITY POINT LOAD TRIBUTARY
@ WEST TERMINAL

Atrib = 150sf
P_{DRoof} = 4.5k
P_{DFloor} = 15k
P_L = 3.8k

Atrib = 300sf
P_{DRoof} = 9k
P_{DFloor} = 30k
P_L = 7.5k

Atrib = 10ft
W_{DRoof} = 0.3klf
W_{DFloor} = 1klf
W_L = 0.25klf





Company :
Designer : TMR
Job Number : 13242
Model Name : West Terminal

WEST TERMINAL LINE 12 OUTPUT

Nov 5, 2018
4:31 PM
Checked By: _____



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ENVELOPE FORCES

Member Section Forces (By Combination)

	LC	Member Label	Sec	Axial[k]	Shear[k]	Moment[k-ft]
1	5	M1	1	26.246	40.412	331.444
2			2	26.246	40.412	48.56
3			3	26.246	40.412	-234.323
4	5	M2	1	97.4	53.424	391.829
5			2	97.4	53.424	17.858
6			3	97.4	53.424	-356.112
7	5	M3	1	-2.399	.903	-240.584
8			2	-2.399	-19.722	-99.441
9			3	-2.399	-40.347	351.076
10	5	M4	1	4.718	4.716	6.261
11			2	4.718	4.716	-26.748
12			3	4.718	4.716	-59.758
13	5	M5	1	17.924	21.133	143.11
14			2	17.924	21.133	-4.823
15			3	17.924	21.133	-152.756
16	5	M6	1	9.318	-.232	-59.758
17			2	9.318	-5.182	-19.157
18			3	9.318	-10.132	95.694
19	5	M7	1	100.381	50.731	379.365
20			2	100.381	50.731	24.251
21			3	100.381	50.731	-330.864
22	5	M8	1	-.59	-2.121	-148.146
23			2	-.59	-18.793	-21.358
24			3	-.59	-35.465	307.576
25	5	M9	1	20.054	18.005	115.704
26			2	20.054	18.005	-10.331
27			3	20.054	18.005	-136.366
28	5	M10	1	2.311	-2.108	-57.063
29			2	2.311	-6.11	-7.24
30			3	2.311	-10.111	91.097
31	5	M11	1	73.07	47.175	362.861
32			2	73.07	47.175	32.634
33			3	73.07	47.175	-297.594
34	5	M12	1	.807	3.612	-138.991
35			2	.807	-17.013	-38.49
36			3	.807	-37.638	371.387
37	5	M13	1	14.807	12.552	73.793
38			2	14.807	12.552	-14.073
39			3	14.807	12.552	-101.94
40	5	M14	1	-1.552	.043	-45.269
41			2	-1.552	-4.907	-8.789
42			3	-1.552	-9.857	101.94

COLOR KEY:

COLUMN MAX FORCES

HIGH BEAM MAX ENVELOPE FORCES

LOW BEAM MAX ENVELOPE FORCES

BASED ON THE TIER 1 DEFICIENCIES LISTED BELOW, THE FRAME MEMBERS ARE TO BE ANALYZED. THE MEMBERS WILL BE CHECKED FOR THE AXIAL, SHEAR, AND FLEXURAL LOADS DETERMINED IN THE PRECEEDING RISA ANALYSIS.

TIER 1 DEFICIENCY - FLEXURAL STRESS & COMPACT MEMBERS:

THIS DEFICIENCY WAS TRIGGERED BY THE NON-COMPACT MEMBER CRITERIA PER AISC 341 TABLE D1.1. TYPICAL W18X76 BEAMS FAIL THIS CRITERIA. PER ASCE 41-13 5.5.2.1, THE MEMBERS ARE TO BE ASSESSED FOR THE EXPECTED FORCES WITH REDUCED M-FACTORS PER TABLE 9-4.

FROM THE FOLLOWING MEMBER ANALYSIS, THE 18X76 BEAMS IN THE GATE LOBBY AND WALKWAY HAVE A MAXIMUM FLEXURAL STRESS DCR = 0.32, WHICH OCCURS ON LINE 12. THEREFORE, ITEM IS DEEMED COMPLIANT.

TIER 1 DEFICIENCY - PANEL ZONE STRENGTH:

THIS DEFICIENCY WAS TRIGGERED AS THE PANEL ZONES DO NOT HAVE THE CAPACITY TO DEVELOP 80% OF THE FLEXURAL STRENGTH OF THE GIRDERS. PER ASCE 41-13 A.3.1.3.5, THE PANEL ZONES ARE TO BE ASSESSED WITH THE EXPECTED FORCES.

FROM THE FOLLOWING MEMBER ANALYSIS, THE PANEL ZONES HAVE A MAXIMUM DCR OF 0.18 WHICH OCCURS ON LINE 12. THEREFORE, THIS ITEM IS DEEMED COMPLIANT.

TIER 1 DEFICIENCY - STRONG COLUMN-WEAK BEAM:

THIS DEFICIENCY WAS TRIGGERED AS MANY FRAMES DO NOT MEET THE REQUIREMENTS OF STRONG COL.-WEAK BEAM. PER ASCE 41-13 5.5.2.1.5. COMPLIANCE CAN BE DEMONSTRATED BY ANALYZING THE FRAMES WITH AN M-FACTOR OF 2.5. DUE TO THE IMMEDIATE OCCUPANCY PERFORMAMNCE OBJECTIVE, COLUMNS ARE CHECKED WITH AN M-FACTOR <2.5 (CONSERVATIVE).

FROM THE FOLLOWING MEMBER ANALYSIS, THE COLUMNS HAVE A MAXIMUM DCR = 0.47. THEREFORE, THIS ITEM IS DEEMED COMPLIANT.



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ASCE 41-13 m-factors - Walkway, Gate Lobby, West Terminal

ASCE 341-10 Table D1.1 - Highly Ductile Width-to-Thickness Ratios

Flanges	$b_f/2t_f < 0.3(E/F_{ye})^{0.5}$	$\lambda_{hd} = 6.9$	* F _{ye} = 1.1F _y
Webs	$h/t_w < 2.45(E/F_{ye})^{0.5}$	$\lambda_{hd} = 56.3$	

ASCE 41 Table 9-4

				m-factor	
				I.O	L.S.
Limit a:	$b_f/2t_f \leq 52/F_{ye}^{0.5}$	= 7.0	and $h_{tw}/t_w \leq 300/F_{ye}^{0.5}$	= 40.5	2 6.0
Limit b:	$b_f/2t_f \geq 65/F_{ye}^{0.5}$	= 8.8	or $h_{tw}/t_w \geq 460/F_{ye}^{0.5}$	= 62.0	1.25 1.25

	m-factor				Location
	$b_f/2t_f$	h/t_w	I.O	L.S.	
W12x136	4.96	12.3	2.0	6	Typ. Column Terminal A concourse

				m-factor	
				I.O	L.S.
Limit a:	$b_f/2t_f \leq 52/F_{ye}^{0.5}$	= 7.0	and $h_{tw}/t_w \leq 418/F_{ye}^{0.5}$	= 56.4	2 6
Limit b:	$b_f/2t_f \geq 65/F_{ye}^{0.5}$	= 8.8	or $h_{tw}/t_w \geq 640/F_{ye}^{0.5}$	= 86.3	1.25 2

	m-factor			
	$b_f/2t_f$	h/t_w	I.O	L.S.
W16x50	5.61	37.4	2.0	6.0
W18x76	8.11	37.8	1.5	3.5
W24x76	6.61	49.0	2.0	6.0

Therefore, members that do not meet compactness criteria for highly ductile members include W18x76 beams in the Terminal A concourse.



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ASCE 41-13 Flexural Stress Check

I.O. Load = 0.75BSE-1N	Ratio the applied load to m-factor to determine
L.S. Load = BSE-2E	controlling load case.

Frame Line: 12	Description: W12x136 weak axis columns w/ W18x76 beams low and W16x50 beams high. E-W Frame at West Terminal
----------------	--

		m-factor (col.)	Ratio	m-factor (beam)	Ratio	
Roof I.O Load (k)	14	2.0	6.8	2.0	6.8	(I.O. controls)
Floor I.O Load (k)	22	2.0	11.1	1.5	14.5	
Roof L.S. Load (k)	22	6.0	3.7	6.0	3.7	
Floor L.S. Load (k)	36	6.0	5.9	3.5	10.2	

Risa Output (Q_{UD}) (I.O. controlling)

Member	Section	Moment (k-ft)	Shear (k)	Axial (k)
Column	W12x136	392	53	100
Beam Low	W18x76	371	40	2.4
Beam High	W16x50	102	10	10

NOTE:
LOAD AT ROOF IS BASED ON TRIBUTARY TO FRAME.
LOAD AT FLOOR IS BASED ON TORSION FRO RIGID
DIAPHRAGM ANALYSIS ON PG B-73. THE LOAD AT
FLOOR SHOWN HERE IS WITHOUT TORSION AND IS ONLY
TO SHOW I.O. LOADING CONTROLS OVER L.S.

REFERENCE PAGE 83
FOR RISA OUTPUT

Expected Strength (Q_{CE}) ASCE 41 Sec. 9.4.2.3, AISC 360 Tables 3-2 & 4-1

Use F_y = 1.1*50 ksi= 55ksi, per Table 9-3 ASCE 41

Beam:	W18x76	Column:	W12x136
Q _{CE} = 1.1M _p (k-ft)	747	P _{CL} = 1.1P _n (k)	1562
Q _{UD} = M (k-ft)	371.0	P _{UF} = A (k)	100
		M _{CE} = 1.1M _p (k-ft)	449
		M (k-ft)	392.0
Beam:	W16x50		
Q _{CE} = 1.1M _p (k-ft)	422		
Q _{UD} = M (k-ft)	102.0		

Column Check:	P _{UF} (k)	100
	P _{CL} (k)	1562
	P _{UF} /P _{CL}	0.06
	M _{CE} (k-ft)	449
	M _U (k-ft)	392
	m-factor	2.0

For $\frac{P_{UF}}{P_{CL}} < 0.2$,

$$\frac{P_{UF}}{2P_{CL}} + \frac{M_s}{m_s M_{CEs}} + \frac{M_y}{m_y M_{CEy}} \leq 1.0 \quad (9-11)$$

DCR: 0.47

Beam Check:	Q _{UD} (k-ft)	371
	m	1.5
	Q _{CE} (k-ft)	747
	mQ _{CE} (k-ft)	1143

@ Floor
mQ_{CE} > Q_{UD}

DCR: 0.32

	Q _{UD} (k-ft)	102
	m	2.0
	Q _{CE} (k-ft)	422
	mQ _{CE} (k-ft)	843

@ Roof
mQ_{CE} > Q_{UD}

DCR: 0.12

*SEE PAGE B-46.1 FOR
BEAM CHECK AS A
BEAM COLUMN



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Panel Zone Check:	<i>m-factor for panel zones:</i>	1.5	(I.O. loading)
$Q_{CE} (k) =$	$0.55F_y d_c t_p$	<i>Where d_c = column depth and t_p = thickness of panel zone (9-5)</i>	
d_c	13.4		
t_p	0.79		
$Q_{CE} (k) =$	291	$mQ_{CE} > Q_{UD}$	
$Q_{UD} (k) =$	53	DCR:	0.18

THE FOLLOWING IS A SUMMARY ADDRESSING THE TIER 1 DEFICIENCY OF
MOMENT RESISTING CONNECTIONS FOR THE MAIN TERMINAL, WEST TERMINAL,
GATE LOBBY AND WALKING BRIDGE.



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Moment Connections

TIER 1 DEFICIENCY: MOMENT RESISTING CONNECTIONS

THE MOMENT FRAME BEAM TO COLUMN CONNECTIONS CONSISTS OF A CJP
WELD, WHICH HAS THE CAPACITY TO DEVELOP 100% OF THE BEAM FLEXURAL
CAPACITY. THE TIER 1 CHECK LIST REQUIRES THE CONNECTION TO DEVELOP
110% OF THE BEAM FLEXURAL CAPACITY.

ANALYSIS PROCEDURE

PER ASCE 41-13 5.5.2.2.1, NONCOMPLIANT CONNECTIONS ARE TO BE
EVALUATED FOR THE EXPECTED FORCES.

Beam	$M_{CE} = 1.1M_p$ (k-ft)	M (k-ft)	DCR	No m-factor applied here
<i>Main Terminal</i>				
W16x40	335	172	0.51	
W18x50	463	391	0.84	
W18x76	747	468	0.63	
W18x86	853	218	0.26	
<i>West Terminal/Gate Lobby</i>				
W16x50	422	102	0.24	
W18x76	747	371	0.50	
W24x76	917	318	0.35	

DCR'S TYPICALLY <<1.0

MAX BEAM DCR = 0.84 OCCURS ON LINE F, MF 3.

THE FOLLOWING PAGES ADDRESS THE TIER 1 DEFICIENCY OF STEEL COLUMNS (BASE ANCHORAGE) AT ALL LOCATIONS (MAIN TERMINAL, WEST TERMINAL, GATE LOBBY AND WALKING BRIDGE)



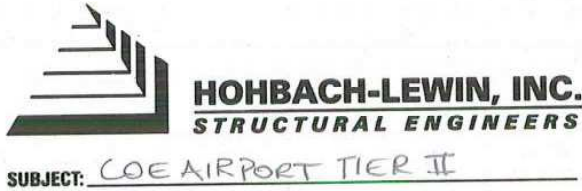
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TIER 1 DEFICIENCY: STEEL COLUMNS (BASE ANCHORAGE)

THE COLUMN BASE ANCHORAGE DOES NOT MEET THE TIER 1 REQUIREMENT FOR IMMEDIATE OCCUPANCY, WHICH REQUIRES THE ANCHORAGE TO DEVELOP THE CAPACITY OF THE COLUMN, COLUMN SPLICE, OR THE FOUNDATION UPLIFT CAPACITY.

ANALYSIS PROCEDURE

THE STEEL COLUMNS ARE EMBEDDED INTO 24"x24" SQUARE PLINTHES THAT RANGE FROM 2' TO 4' TALL. THE COLUMNS TRANSFER FORCES INTO THE PLINTHES, WHICH ARE DOWELED TO THE FOUNDATIONS BELOW. THE FRAMES ARE TO BE ANALYZED FOR THE EXPECTED LOADING.



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STEEL COLUMN ENCASEMENT

DETERMINE M-FACTOR FOR THE CONCRETE PLINTHE THAT ENCASES THE BASE OF THE STEEL COLUMNS. THE M-FACTOR FOR THE PLINTHE IS DETERMINED CONSIDERING THE PLINTHE AS A REINFORCED CONCRETE BEAM ACTING IN FLEXURE.

MIN TIE SPACING FOR CONFORMING SECTION $\leq d/3$.

$d = 24"$
 $s = 8" \therefore OK$

SEE NOTE "L" FOR C OR NC DESCRIPTION

REBAR
USE $F_y = 60 \text{ ksi}$
 $F'_c = 3000 \text{ psi}$

ASCE TBL 10-1
TRANSLATES LOWER BOUND TO EXPECTED STRENGTH.

USE $F_y = 112.5 (60 \text{ ksi})$
 $F'_c = 115 (3000 \text{ psi})$

$V_s = \frac{A_v F_y d}{s}$
 $A_v = 2 (0.2) (2 \text{ LEGS}) = 0.4 \#4$
 $V_s = 90 \text{ k}$

TIE STRENGTH MUST BE $3/4 V_u$

$V_{max} = 4/3 V_s \rightarrow 120 \text{ k}$
 $Max V = 60 \text{ k} OK$

$\therefore F_y = 75 \text{ ksi}$
 $F'_c = 4500 \text{ psi}$

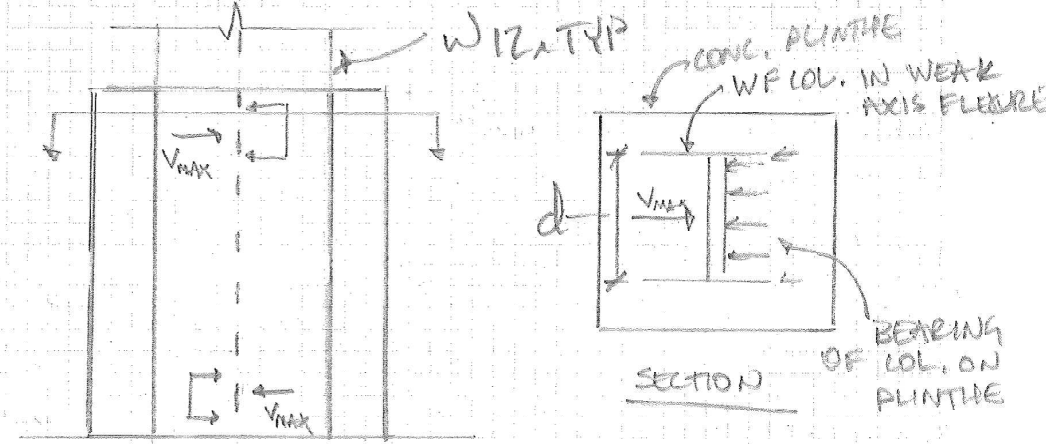
TYP FOR ENCASEMENT

TIES ARE CONFORMING, USE M-FACTOR 2.0 FOR ENCASEMENT FLEXURE.

$\therefore @ MF=3$
LINE F
 $DLR < 1.0$, ENCASEMENT CONTROLLED BY FLEXURE

STEEL COLUMN ENLASEMENT

CHECK IF THE COLUMN BEARING ON THE CONCRETE PLINTHE CAN DEVELOP THE SHEAR CAPACITY OF THE CONCRETE PLINTHE



BEARING, WF ON PLINTHE:

$$V_{max} = 0.85 f'_c d a$$

$$f'_c = 4.5 \text{ ksi}$$

$$d = 12"$$

$$V_{max} = 161 \text{ K}$$

$$\text{TRY } a = 3.5"$$

= PLINTHE SHEAR CAPACITY, SEE BELOW.

PLINTHE SHEAR CAPACITY:

$$V_s = 90 \text{ K (RECALL PREVIOUSLY)}$$

$$V_c = 2 \sqrt{f'_c} b_w d$$

$$b_w = 24" \quad d = 22"$$

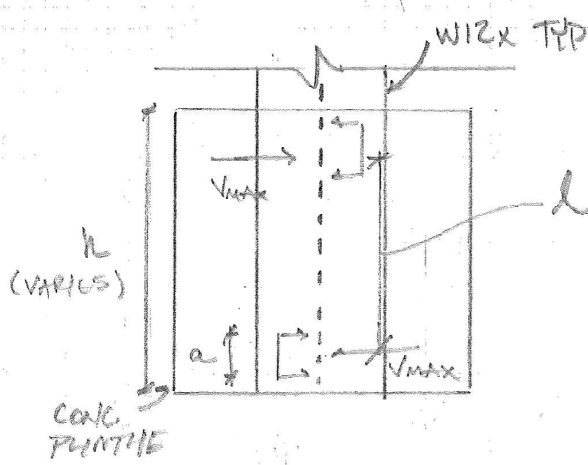
$$f'_c = 4500 \text{ psi}$$

$$V_c = 71 \text{ K}$$

$$V_{max} = V_s + V_c = 90 \text{ K} + 71 \text{ K} \rightarrow 161 \text{ K}$$

STEEL COLUMN ENLASEMENT

DETERMINE THE MOMENT THAT CAN BE TRANSFERRED TO THE PLINTHE WHEN THE PLINTHE IS AT IT'S SHEAR CAPACITY



$$l = h - a \text{ (VARIES)} \quad a = 3.5' \text{ (SEE PREVIOUS)}$$

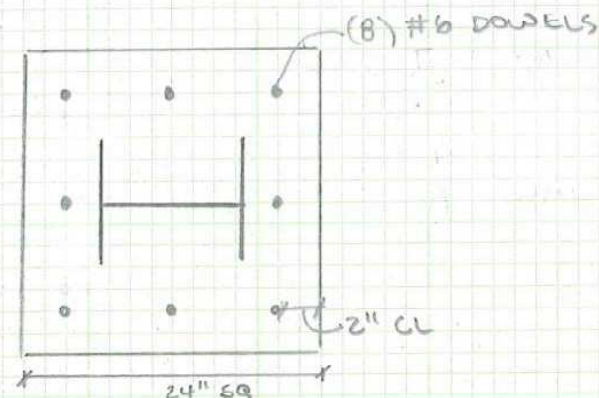
$$M_{max} = V_{max} l$$

$$V_{max} = 161 \text{ K (SEE PREVIOUS)}$$

h	M _{max}	M _{max} w/ M-FACTOR=2
2'	275 K-ft	625 K-ft
3'	436 K-ft	872 K-ft
4'	597 K-ft	1194 K-ft

STEEL COLUMN ENCASEMENT

DETERMINE FLEXURAL
CAPACITY OF COLUMN ENCASEMENT
AS A BEAM,



$$M_N = K_s F_y (j - a/2)$$
$$a = \frac{A_s F_y}{0.85 F_c' b} = \frac{(3)(0.44 \text{ in}^2)(75 \text{ ksi})}{0.85 (4.5 \text{ ksi})(24 \text{ in})} = 1.1 \text{ in}$$
$$j = 24 \text{ in} - 2 \text{ in} \rightarrow 22 \text{ in}$$

$$M_N = (3)(0.44 \text{ in}^2)(75 \text{ ksi})(22 \text{ in} - 1.1 \text{ in}/2)$$

$$M_N = 171 \text{ K-in}$$

USE M-FACTOR 2.0 $\therefore M_{ALL} = 354 \text{ K-in}$

THE FLEXURAL CAPACITY OF THE PLINTHE IS THE LIMITING FACTOR
MAXIMUM CAPACITY = 354 K-FT (FOR ALL PLINTHE HEIGHTS)

**FLEXURAL CAPACITY OF
PLINTHE PER PREVIOUS PAGE**

Column Moment Summary

Column	Mu (k-ft)	Encasement Height	M _{all} (k-ft)	DCR	Location
W12x96	237	3	354	0.67	Line D
W12x79	197	3	354	0.56	Line C
W12x79	553	2	354	1.56	Line F
W12x136	371	3	354	1.05	Terminal A Concourse

DCR OF PLINTHE SECTION TYPICALLY < 1.0, THEREFORE THE ASSUMPTION
OF FIXED-BASE IS REASONABLE.

AT (4) COLUMNS ON LINE F, THE DCR = 1.56. THESE COLUMNS WILL START
OFF ACTING FIXED-BASE, BUT AS THE MOMENT EXCEEDS THE CAPACITY OF
THE PLINTHE, THE COLUMN BASE IS ANTICIPATED TO ACT MORE PIN LIKE,
RESULTING IN INCREASED FLEXIBILITY OF THE FRAME, LEADING TO FORCE
REDISTRIBUTION TO OTHER FRAMES.

THE FOLLOWING IS ADDRESSES THE TIER 1 DEFICIENCY FOR BEAM BOTTOM FLANGE BRACING.



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STRUCTURAL ENGINEERS

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PER ASCE 41-13 SECTION 5.5.2.2.8, WHERE BEAMS DO NOT INCLUDE BOTTOM FLANGE BRACING, THEY SHALL BE EVALUATED FOR THE EFFECTS OF LATERAL TORSIONAL BUCKLING.

AS INDICATED ON PAGE 37, LATERAL TORSIONAL BUCKLING DOES NOT GOVERN THE FLEXURAL DESIGN OF THE FRAME BEAMS. THEREFORE THE LACK OF BOTTOM FLANGE BRACING IS DEEMED ACCEPTABLE.

THE FOLLOWING IS A DESCRIPTION OF MOMENT FRAME LAYOUT TO & THE TIER 1 DEFICIENCY OF REDUNDANCY.



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THE REDUNDANCY TIER 1 DEFICIENCY IS FLAGGED IF EITHER OF THE FOLLOWING CONDITIONS OCCUR:

- (1) THE NUMBER OF MF LINES IN EACH DIRECTION IS LESS THAN 2
- (2) IF A LINE WITH MOMENT RESTISTING FRAMES CONSISTS OF LESS THAN 3 FRAMES

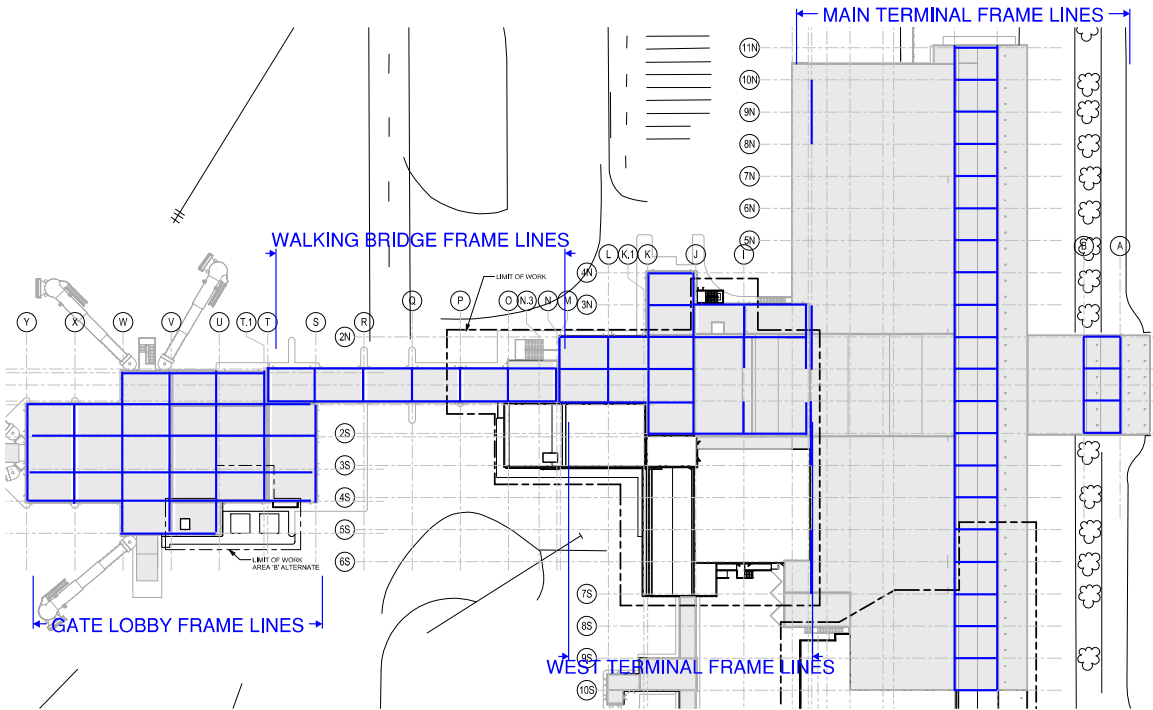
MAIN TERMINAL:
IN THE E-W DIRECTION FRAMES OCCUR AT 20' O.C. BETWEEN LINES C AND D FOR A TOTAL OF 22 FRAMES.

IN THE N-S DIRECTION, LINES C AND D HAVE FRAMES THE FULL-LENGTH OF THE BUILDING FOR A TOTAL OF 21 BAYS ON EACH LINE. LINE F HAS 3 FRAMES; 2 FRAMES WITH 2 BAYS AND 1 FRAME WITH 3 BAYS FOR A TOTAL OF 5 BAYS.

THE MAIN TERMINAL FAILS THE CRITERIA OF THE TIER 1 REDUNDANCY CHECK SINCE THERE IS ONLY 1 BAY IN EACH FRAME LINE IN THE E-W. HOWEVER, SINCE THE FRAMES OCCUR EVERY BAY (AT 20' O.C.), THE STRUCTURE HAS A LOT OF INHERENT REDUNDANCY.

WEST TERMINA, WALKING BRIDGE, GATE LOBBY:
IN THE WEST TERMINAL, WALKING BRIDGE, AND GATE LOBBY, FRAMES OCCUR IN NEARLY EVERY BAY. THE BUILDINGS FAILS THE STRICT CRITERIA OF THE TIER 1 REDUNDANCY CHECK, BECAUSE AT SOME LOCATIONS THE BUILDINGS ARE LESS THAN 3 BAYS LONG AND FAIL BY DEFAULT. (I.E. EVEN THOUGH EVERY BAY IS A FRAME, SOME LINES DON'T HAVE A MINIMUM OF 3 BAYS.)

THOUGH THE PROVIDED CRITERIA IS NOT MET, THE BUILDINGS CONSIST OF MANY FRAMES AND ARE INHERENTLY REDUNDANT.

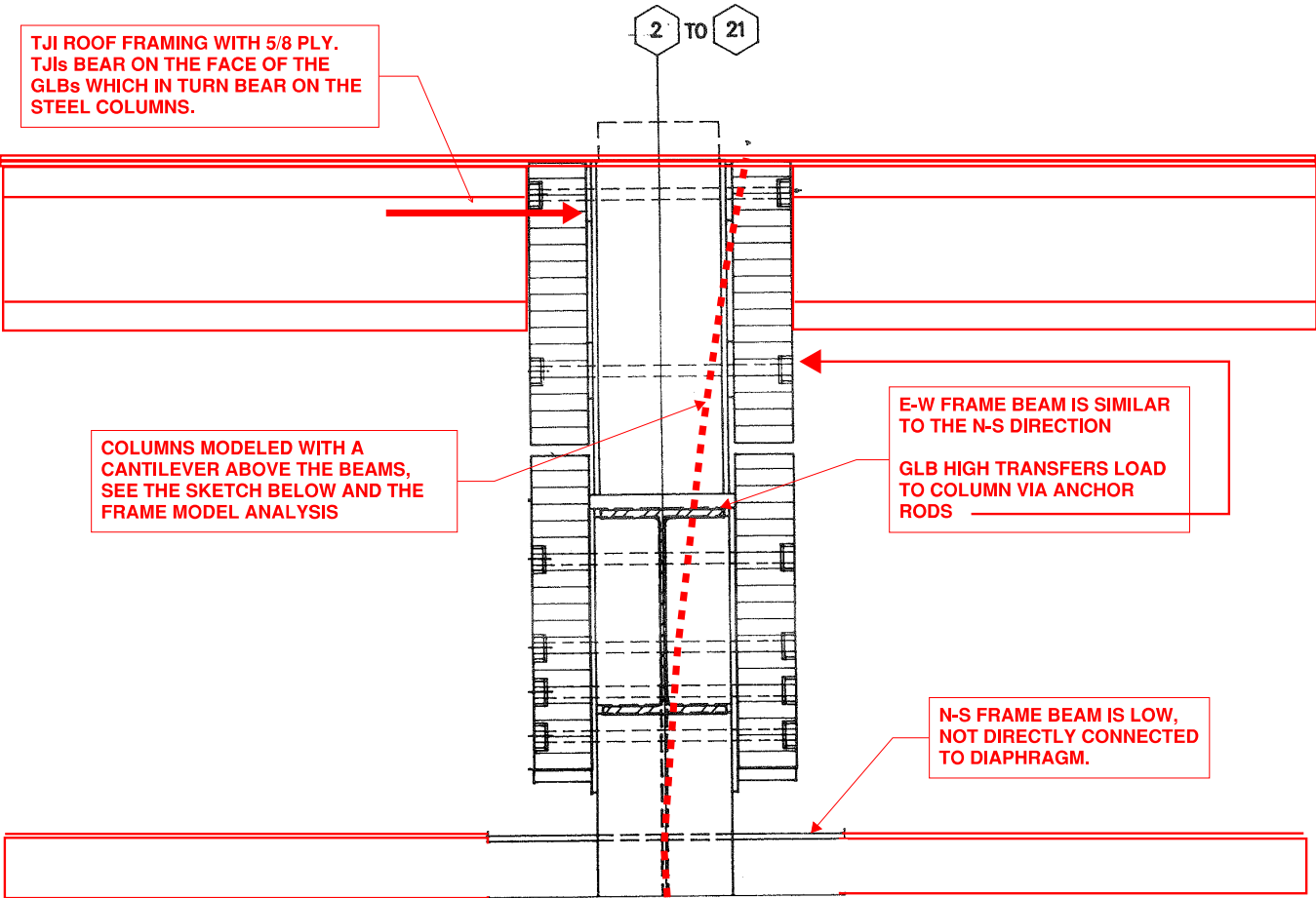


THE FOLLOWING ADDRESSES THE TIER 1 DEFICIENCY OF
TRANSFER TO STEEL FRAMES.

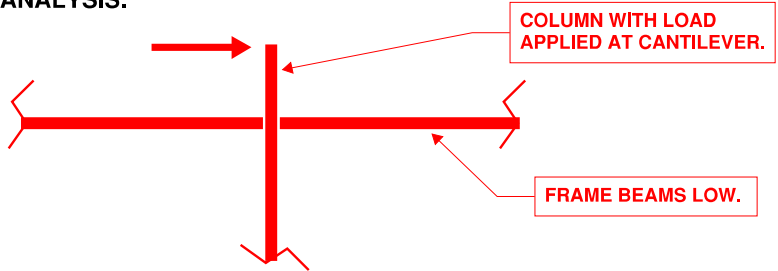


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IN THE MAIN TERMINAL, FRAMES IN THE N-S LOADING DIRECTION ARE NOT
DIRECTLY CONNECTED TO THE ROOF DIAPHRAGM. INSTEAD, GLULAM BEAMS
BEAR ON THE COLUMNS WHICH CANTILEVER BETWEEN THE GLULAM BEAMS AND
THE N-S FRAME BEAMS. SEES DETAIL BELOW:



IN THE RISA ANALYSIS MODELS, THE COLUMNS ARE MODELED CANTILEVERING
ABOVE THE FRAME BEAMS, WITH THE LATERAL LOADING APPLIED AT THE TOP OF
THE COLUMN (AS SKETCHED BELOW). THE RESULTING MEMBER STRESSES ARE
CONSIDERED IN THE ANALYSIS.



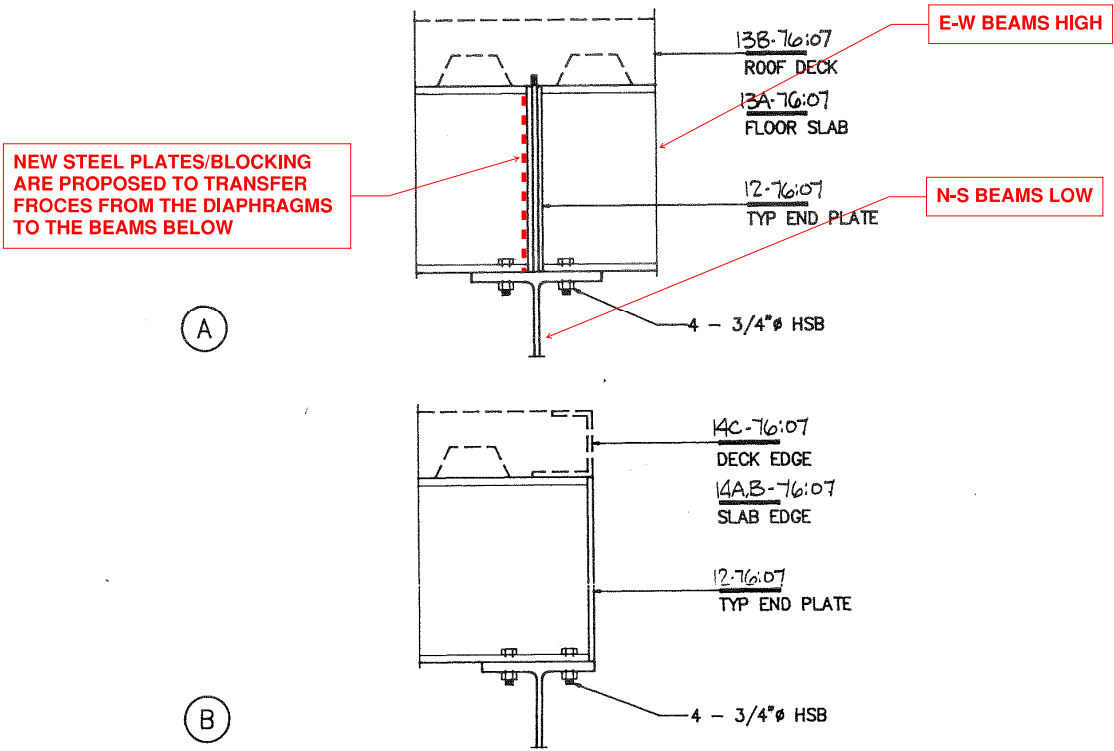
THE FOLLOWING ADDRESSES THE TIER 1 DEFICIENCY OF
TRANSFER TO STEEL FRAMES.



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IN THE WEST TERMINAL, GATE LOBBY AND WALKWAY BRIDGE, BEAMS IN THE N-S
DIRECTION ARE DROPPED BELOW THE BEAMS IN THE E-W DIRECTION. THERE IS
NO DIRECT CONNECTION BETWEEN THE DIAPHRAGM AND BEAMS IN THE N-S
DIRECTION. SEE DETAIL BELOW.

TO ADDRESS THE DEFICIENCY, STEEL PLATES, STEEL BLOCKING, OR SIMILAR CAN
BE ADDED TO TRANSFER LOAD BETWEEN THE DIAPHRAGMS AND THE DROPPED
BEAMS.



THE FOLLOWING IS ADDRESSES THE TIER 1 DEFICIENCY
FOR OUT-OF-PLANE BRACING BRACING.



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APPENDIX C
COST ESTIMATE

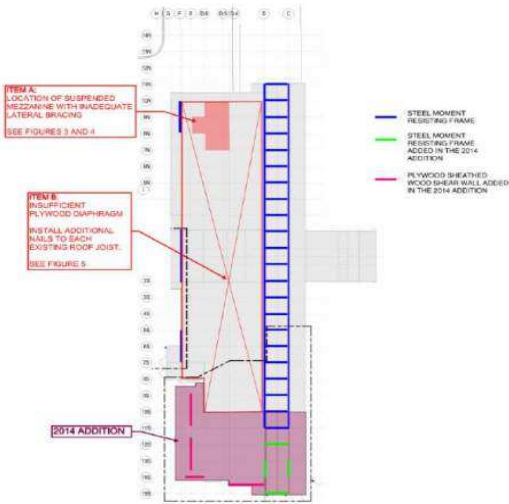
THE TIER 1 DEFICIENCY IS TRIGGERED DUE TO LACK OF BRACING AT
BEAM/COLUMN JOINTS, WHICH OCCURS AT THE FRAME BEAMS THAT ARE
DROPPED BELOW THE ROOF.

PER ASCE 41-13 5.5.2.7 THE LACK OF OUT-OF-PLANE BRACING IS JUSTIFIED
WHERE THE COLUMN IS ADEQUATE TO SPAN BETWEEN POINTS OF BRACING.
BECAUSE THE DROPPED BEAMS OCCUR NEAR THE TOP OF THE COLUMNS, THE
LACK OF BRACING IS DEEMED ADEQUATE.



January 18, 2019
Revision #0

CITY OF EUGENE
AIRPORT TERMINAL SEISMIC RETROFIT



STATEMENT OF PROBABLE COST

Prepared for:
Hohbach-Lewin, Inc
Eugene, OR

Prepared by:
Steve Gunn

Steve Gunn
President
Construction Focus, Inc.

CITY OF EUGENE
AIRPORT TERMINAL SEISMIC RETROFIT
Statement of Probable Cost

LOC	ITEM	DESCRIPTION	QNTY	UNIT	\$/UNIT	TOTAL \$
BUILDING AREAS						
Seismic Retrofit Gross Area			67,700	SF		
I. Main Terminal (Mezz) Gross Area			2,775	SF		
I. Main Terminal Roof Gross Area			35,000	SF		
II. West Terminal Gross Area			11,450	SF		
III. Walkway Bridge Gross Area			4,100	SF		
IV. Gate Lobby Gross Area			14,375	SF		
MAIN MEZZANINE						
I. Main	Figure 4: Shear Walls					43,344
	Demo wall finish	x_gyp bd	1,125	SF	2.50	2,813
	Salvage ceiling	r/r_suspended ceiling	2,775	SF	1.94	5,384
	Wall framing	D-Fir_2x4 @ 16 o.c.	1,125	SF	7.03	7,909
	Blocking	D-Fir_2x4	266	LF	5.52	1,468
	Steel connectors	angles/plates	266	LF	9.38	2,495
	Wall sheathing	1/2" APA rated	1,125	SF	4.57	5,141
	Gypsum bd: wall	type: X LVL 4_5/8"	1,125	SF	6.82	7,673
	Paint: walls	prime/2 top ct on gypbd	1,125	SF	1.30	1,463
	Temp. floor protection	allowance	1	LS	2,000.00	2,000
	Remove/reinstall electrical	allowance for wall mt items	1	LS	3,000.00	3,000
	Temp. dust barriers	allowance	1	LS	4,000.00	4,000
	Pedestrian traffic control	allowance	1	LS		
MAIN MEZZANINE HARDCOST						43,344
MAIN ROOF						
I. Main	Figure 5: Re-Nail Sheathing + Roofing					957,289
	Demo roofing	x_mod-bit or BUR/ins	37,680	SF	1.85	69,708
	Demo sht mtl	x_flashing	450	LF	3.21	1,445
	Remove/reinstall roof equip.	r/r_mech units	14	EA	900.00	12,600
	Roofing	tpo/cvr bd	37,680	SF	15.40	580,272
	Insulation	R-20 rigid w/ crickets	37,680	SF	4.18	157,502
	Vapor barrier		37,680	SF	0.60	22,608
	Walkway pads	30" tpo	800	LF	23.00	18,400
	Renail roof ply	10d/staples edge/field	37,680	SF	1.74	65,563
	Curb framing	PT 2x12	200	LF	9.58	1,916
	Counter flashing	steel_Kynar_24 ga	225	LF	10.91	2,455
	Coping	steel_Kynar_24 ga	225	LF	17.69	3,980
	Dust catching at decking	allowance	1	LS	2,000.00	2,000
	Temporary roofing for weather	allowance	37,680	SF	0.50	18,840
MAIN ROOF HARDCOST						957,289

CITY OF EUGENE
AIRPORT TERMINAL SEISMIC RETROFIT
Statement of Probable Cost

2/4

LOC	ITEM	DESCRIPTION	QNTY	UNIT	\$/UNIT	TOTAL \$
SEISMIC FLOOR RETROFIT						
II. West	Figure 9: Floor Beam to Decking					196,422
	Salvage ceiling	r/r_suspended ceiling	11,450	SF	1.94	22,213
	Fasteners into dkg	1/4" titen HD	432	EA	14.20	6,134
	Stl plate (horiz)	1/4" x 2'-3" x 3'-0"	2,481	LB	8.15	20,220
	Stl plate (vert)	3/8" x 1'-6" x 3'-0"	2,482	LB	11.34	28,144
	Temp. floor protection	allowance	36	LOC	336.16	12,102
	Remove/reinstall utilities	allowance for conflicts	36	LOC	400.00	14,400
	Temp. dust barriers	allowance	36	LOC	2,116.80	76,205
	Pedestrian traffic control	allowance	36	LOC	472.32	17,004
III. Walkway	Figure 9: Floor Beam to Decking					75,702
	Salvage ceiling	r/r_suspended ceiling	4,100	SF	1.94	7,954
	Fasteners into dkg	1/4" titen HD	168	EA	14.20	2,386
	Stl plate (horiz)	1/4" x 2'-3" x 3'-0"	965	LB	8.15	7,863
	Stl plate (vert)	3/8" x 1'-6" x 3'-0"	965	LB	11.34	10,945
	Temp. floor protection	allowance	14	LOC	336.16	4,706
	Remove/reinstall utilities	allowance for conflicts	14	LOC	400.00	5,600
	Temp. dust barriers	allowance	14	LOC	2,116.80	29,635
	Pedestrian traffic control	allowance	14	LOC	472.32	6,612
IV. Gate	Figure 9: Floor Beam to Decking					226,318
	Salvage ceiling	r/r_suspended ceiling	14,375	SF	1.94	27,888
	Fasteners into dkg	1/4" titen HD	624	EA	14.20	8,861
	Stl plate (horiz)	1/4" x 2'-3" x 3'-0"	3,584	LB	8.15	29,207
	Stl plate (vert)	3/8" x 1'-6" x 3'-0"	3,585	LB	11.34	40,653
	Temp. floor protection	allowance	36	LOC	336.16	12,102
	Remove/reinstall utilities	allowance for conflicts	36	LOC	400.00	14,400
	Temp. dust barriers	allowance	36	LOC	2,116.80	76,205
	Pedestrian traffic control	allowance	36	LOC	472.32	17,004
SEISMIC FLOOR RETROFIT HARDCOST						498,442
SEISMIC ROOF RETROFIT						
II. West	Figure 10: Roof Beam to Decking					137,858
	Salvage ceiling	r/r_suspended ceiling	11,450	SF	1.94	22,213
	Stl flat plate	54mil x 1'-4" x 9'-0"	234	LF	30.32	7,095
	Fasteners	#12 screws	1,404	EA	3.89	5,462
	Custom stl track (vert)	54mil x 1'-4" x 9'-0"	234	LF	40.16	9,397
	Stl plate	3/16" x 3" x 9'-0"	450	LB	16.06	7,234
	Temp. floor protection	allowance	26	LOC	336.16	8,740
	Remove/reinstall utilities	allowance for conflicts	26	LOC	400.00	10,400
	Temp. dust barriers	allowance	26	LOC	2,116.80	55,037
	Pedestrian traffic control	allowance	26	LOC	472.32	12,280

ENG: Hohbach-Lewin, Inc.
DWG DATE: 12/7/18
DESIGN LEVEL: Concept

CONSTRUCTION FOCUS, INC.
541-686-2031
EUGENE, OREGON

ESTIMATE DATE: Jan. 18, 2019
REVISION #: 0
CONST. START: 3 QTR_19

CITY OF EUGENE
AIRPORT TERMINAL SEISMIC RETROFIT
Statement of Probable Cost

3/4

LOC	ITEM	DESCRIPTION	QNTY	UNIT	\$/UNIT	TOTAL \$
III. Walkway	Figure 10: Roof Beam to Decking					110,128
	Salvage ceiling	r/r_suspended ceiling	4,100	SF	1.94	7,954
	Stl flat plate	54mil x 1'-4" x 9'-0"	126	LF	30.32	3,820
	Fasteners	#12 screws	756	EA	3.89	2,941
	Custom stl track (vert)	54mil x 1'-4" x 9'-0"	126	LF	40.16	5,060
	Stl plate	3/16" x 3" x 9'-0"	243	LB	16.06	3,895
	Temp. floor protection	allowance	26	LOC	336.16	8,740
	Remove/reinstall utilities	allowance for conflicts	26	LOC	400.00	10,400
	Temp. dust barriers	allowance	26	LOC	2,116.80	55,037
	Pedestrian traffic control	allowance	26	LOC	472.32	12,280
IV. Gate	Figure 10: Roof Beam to Decking					172,721
	Salvage ceiling	r/r_suspended ceiling	14,375	SF	1.94	27,888
	Stl flat plate	54mil x 1'-4" x 9'-0"	468	LF	30.32	14,190
	Fasteners	#12 screws	2,808	EA	3.89	10,923
	Custom stl track (vert)	54mil x 1'-4" x 9'-0"	468	LF	40.16	18,795
	Stl plate	3/16" x 3" x 9'-0"	901	LB	16.06	14,468
	Temp. floor protection	allowance	26	LOC	336.16	8,740
	Remove/reinstall utilities	allowance for conflicts	26	LOC	400.00	10,400
	Temp. dust barriers	allowance	26	LOC	2,116.80	55,037
	Pedestrian traffic control	allowance	26	LOC	472.32	12,280
SEISMIC ROOF RETROFIT HARDCOST						420,707
HARDCOST TOTAL						1,919,783
The above HARDCOST TOTAL does not include typical general contractor markups. Those plus contingencies are listed below as part of a Low-High Range. Variables include fluctuations in market conditions, material selections, and design considerations. The Cost Estimate Range will be consolidated as we move closer to the actual Bid Date.						
LOW RANGE				HIGH RANGE		
10.00%	191,978	Markups:		20.00%	383,957	
7.00%	147,823	Contingency		7.00%	161,262	
6.00%	135,575	General Conditions		6.00%	147,900	
1.20%	28,742	Profit & Overhead		1.20%	31,355	
3.00%	72,717	Performance Bond:		6.00%	158,655	
		Escalation				
576,836				Markup Subtotals:	883,129	
2,496,618				BASE BID TOTAL	2,802,911	
Refer to the "Project Narrative" for more detailed information.						

ENG: Hohbach-Lewin, Inc.
DWG DATE: 12/7/18
DESIGN LEVEL: Concept

CONSTRUCTION FOCUS, INC.
541-686-2031
EUGENE, OREGON

ESTIMATE DATE: Jan. 18, 2019
REVISION #: 0
CONST. START: 3 QTR_19

CITY OF EUGENE
AIRPORT TERMINAL SEISMIC RETROFIT
Statement of Probable Cost

NOTES
Wage rates: BOLI
This estimate assumes competitive bidding by local contractors
Use of a CMGC or special selection process for bidders will increase the estimated cost

EXCLUSIONS
Design fees, permit fees, system development fees, utility hookup charges, testing, BOLI fee.
Hazardous materials abatement, moving expenses, anti-graffiti coating, fireproofing.
Roof substrate replacement.

ALLOWANCES HAVE BEEN INCLUDED FOR:
Temporary waterproof covering until roofing is complete.
Ceiling repair as part of retrofit work.
Interior plastic sheeting to catch debris during roofing demolition.

ABBREVIATIONS

EA= Each	SF=Square Feet	BCY=Bank Cubic Yard
LF= Linear Feet	LS=Lump Sum	TN=Ton
SY=Square Yard	OPNG=Opening	LB=Pounds
PR=Pair	HT=Height	

THE ECONOMIC IMPACTS OF EUGENE AIRPORT ON THE LOCAL AND REGIONAL ECONOMY, 2024



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August, 2024

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 THE ECONOMIC IMPACTS OF EUGENE AIRPORT ON THE LOCAL AND REGIONAL ECONOMY, 2024

EXECUTIVE SUMMARY

Eugene Airport (EUG) is 9 miles northwest of downtown Eugene, Oregon. It is the second largest airport, in terms of passengers, in Oregon.¹ The Airport Administration within the City of Eugene is responsible for commercial passenger activity and cargo activity at Eugene Airport. In calendar year (CY) 2023, Eugene Airport handled 1.7 million passengers and 1.0 million pounds of freight.

In (CY) 2023, seven commercial airlines offer non-stop service between Eugene Airport and 17 domestic airports/destinations with Southwest Airlines and United Airlines carrying almost 50% of these passengers. Other domestic airlines include Alaska/Horizon Airlines, Allegiant, American, Avelo, and Delta.

Nearly 1.0 million pounds of freight moved through the Eugene Airport in CY 2023. Roughly 87 percent of air freight was handled by dedicated cargo companies AirPac, Ameriflight, and Empire. Mail and air cargo is also carried in the belly of commercial passenger aircraft.

Eugene Airport operates three parking lots in close proximity to the airport. Airport customers also have several airport access options including taxi, transportation network companies, and several point-to-point shuttles. All Eugene Airport rental car counters are located in the terminal lower level by baggage claim.

The Eugene area generates a large demand for O&D passengers, passengers who begin or end their trip in the Eugene Area and Willamette Valley, and the region's growing economy provides strong potential for continued growth. The 1.7 million commercial airline passengers and 1.0 million pounds of cargo activity at the Eugene Airport impact the local and regional economy on a large scale. Airline employees such as ramp and ground crew, customer service agents, and management, are hired to help move passengers in and out of Eugene Airport on commercial aircraft. Concessions and retail shops hire employees to sell goods and products as well as cook and serve food and beverages to passengers. Rental Car companies need employees to service and wash rental cars and run rental car facilities. Government agencies such as TSA and FAA, ensure safety of passengers as well as the movement of aircraft on the ground and in the air.

The Eugene Airport retained the services of Martin Associates to estimate the economic impacts of Eugene Airport (EUG). The purpose of the study is to quantify the economic impacts generated by passenger and cargo activity at Eugene Airport. In order to measure the impacts in the most defensible manner possible, the methodology utilized is based on interviews, local economic data, and airport statistics. The impacts are quantified in terms of:

¹ Bureau of Transportation Statistics, Airport Rankings, 2022.

THE ECONOMIC IMPACTS OF EUGENE AIRPORT ON THE LOCAL AND REGIONAL ECONOMY, 2024

- Jobs
- Employee earnings
- Business revenue
- State and local taxes and federal airport-specific taxes

The impacts are estimated for total airport activity for calendar year 2023. In addition to the baseline impacts, an economic impact model has been developed which can be used to estimate the impacts associated with capital construction and expansion projects. Furthermore, the model can be used for annual updates of the impacts as well as to test the sensitivity of impacts to changes in:

- Passenger levels
- Domestic versus international passengers
- Passenger trip purpose
- Peak hour flight levels and mix of aircraft
- Labor productivity and work rules
- Freight levels

The methodology used in this 2023 Eugene Airport analysis has been used by Martin Associates to estimate the economic impacts generated by airport activity at numerous airports. In addition to the impact studies conducted for Eugene Airport, Martin Associates has conducted similar economic impact studies for the following airports: Hartsfield-Atlanta International Airport, San Francisco International Airport, Washington DC's Ronald Reagan National Airport and Dulles International Airport, Sea-Tac International Airport, Minneapolis International Airport, Sacramento International Airport, Miami International Airport, Baltimore/Washington International Airport, Oakland International Airport, Milwaukee International Airport, San Jose International Airport, Nashville International Airport, Bellingham International Airport, Maui's Kahului Airport and Portland International Airport. This same methodology has also been used by Martin Associates to quantify the economic impacts of numerous general aviation airports throughout the United States including the 34-general aviation and commercial airports in the state of Maryland, the four general aviation/limited commercial service airports in the Miami-Dade County Aviation System, Capital City Airport and Carlisle Airport near Harrisburg, PA, Milwaukee's Lawrence J. Timmerman Airport, and Lancaster (PA) Airport.

1. IMPACTS CREATED BY EUGENE AIRPORT ACTIVITY IN CY 2023

In CY 2023, 1,719,629 passengers and 1.0 million pounds of air freight were handled at Eugene Airport. This passenger and air freight activity generated the following economic impacts in the Eugene area economy:

 THE ECONOMIC IMPACTS OF EUGENE AIRPORT ON THE LOCAL AND REGIONAL ECONOMY, 2024

- 1,226 direct, induced, and indirect jobs were generated by residents of the Eugene area. Of the 1,226 jobs, 771 were direct jobs, while 366 jobs were induced throughout the region to support the purchase of goods and services by the 771 directly dependent employees. An additional 90 indirect jobs were generated in the local economy due to \$19.5 million of local purchases by firms directly dependent on the airport.
- \$89.3 million of direct, induced, and indirect personal income and consumption expenditures were generated in the Eugene area as a result of the airport activity in CY 2023.
- Nearly \$475 million of business sales were generated by airport activity.
- The federal government received \$39 million in airport-specific taxes from activity at Eugene Airport.
- State and local governments received \$10 million in tax revenues from airport activity.

In addition to these airport-generated impacts, it is estimated that 9,157 direct, induced, and indirect jobs were supported in the Eugene area visitor industry due to expenditures by the 607,731 million visitors to the region who arrived via Eugene Airport. The impacts of the visitors are estimated from the results of a visitor survey conducted at by Travel Oregon. These visitors, spent about \$712.9 million on area hotels, restaurants, retail stores and entertainment establishments, which in turn supported the jobs in the Eugene area visitor industry. As the result of visitors arriving via the airport, \$32.9 million of state and local tax revenues were generated.

In CY 2023, 943,041 pounds of air freight were enplaned at Eugene Airport. It is estimated that the total value of air freight shipped via Eugene is about \$132.7 million, which supports nearly 1,992 jobs in the region with the firms producing the air freight and the firms' providing services and parts to those producing firms.

 THE ECONOMIC IMPACTS OF EUGENE AIRPORT ON THE LOCAL AND REGIONAL ECONOMY, 2024

I. INTRODUCTION, OVERVIEW AND SUMMARY OF RESULTS

The Eugene Airport retained the services of Martin Associates to measure the economic impact of airport activity generated by Eugene Airport (EUG) in CY 2023. The economic impacts created by the airport are measured in terms of jobs, personal income, state and local taxes, and revenue generated directly by airport activity, including the impact of visitors to the Eugene area who used Eugene Airport, as well as the air cargo handled at the airport.

In order to measure the impacts in the most defensible manner possible, the methodology utilized is based on interviews, local economic data, and airport statistics. An operational model of the airport was also developed to use in updating the impacts on a short-term basis as well as to measure the incremental changes in airport generated impacts due to changes in such factors as total passenger and air freight levels, the number of flight operations, domestic and international passenger levels, and work rules by airlines. Also, the model can be used to test the economic impacts of various capital investment and airport expansion projects.

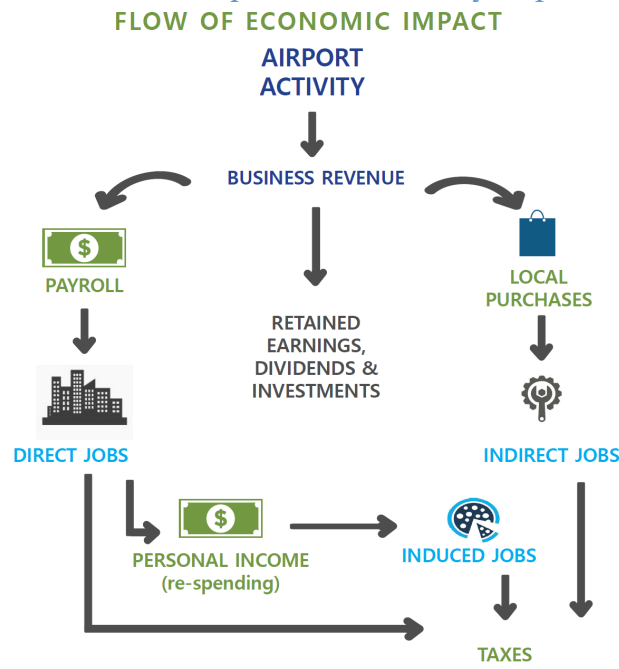
The remainder of this chapter summarizes the methodology, highlights key assumptions, and summarizes the major findings.

1. IMPACT STRUCTURE

Activity at a major airport contributes to the local and state economy by generating business revenue to local and national firms providing air passenger service, freight service and support services to the airport and the airlines. These firms, in turn, provide employment and income to individuals, and pay taxes to state and local governments. Exhibit I-1 illustrates how air traffic activity at Eugene Airport generates impacts throughout the local, state, and national economy. As this exhibit indicates, the impact of an airport on a local, state, or national economy cannot be reduced to a single number, but instead, airport activity creates several impacts. These are the revenue impact, employment impact, personal income impact, and tax impact. These impacts are not additive. For example, the income impact is a part of the revenue impact and adding these impacts together would result in double counting. Exhibit I-1 shows how activity at Eugene Airport generates the four impacts.

THE ECONOMIC IMPACTS OF EUGENE AIRPORT ON THE LOCAL AND REGIONAL ECONOMY, 2024

Exhibit I-1
Flow of Economic Impacts Generated by Airport Activity



1.1 Revenue Impact

At the outset, activity at the airport generates business revenue for firms which provide air passenger service, freight service and ground support services. This business revenue impact is dispersed throughout the economy in several ways. It is used to hire people to provide the services, to purchase goods and services, to pay for the use of airport facilities and to make federal, state, and local tax payments. The remainder is used to pay stockholders, retire debt, make investments, or is held as retained earnings. It is to be emphasized that the only portions of the revenue impact that can be definitely identified as remaining in the Eugene area are those portions paid out in salaries to direct employees, in state and local taxes, and in payments to the airport itself. Landing fees and terminal rentals paid by airlines provide for some of the costs of operation of the airport and capital costs of new construction.

1.2 Employment Impact

The employment impact of aviation activity consists of four levels of job impacts:

- Direct employment impact - jobs directly generated by airport activity which would vanish if activity at Eugene Airport were to cease

 THE ECONOMIC IMPACTS OF EUGENE AIRPORT ON THE LOCAL AND REGIONAL ECONOMY, 2024

- Induced employment impact - jobs created throughout the Eugene area economy because individuals directly employed due to airport activity spend their wages locally on goods and services such as food and housing
- Indirect employment impact - jobs generated due to the purchase of goods and services by firms dependent upon airport activity
- Related employment impact - jobs with firms in the Eugene area economy. These firms use Eugene Airport for air freight shipments and receipts. Related jobs are not directly dependent upon the airport as are the direct and induced jobs but reflect the importance of Eugene Airport as a catalyst for economic development. At some level of reduced air service, this employment could be lost to other areas.

1.3 Income Impact

The income impact is the measure of personal income received by individuals directly employed due to airport activity. This direct personal income is re-spent throughout the Eugene area by those that are directly employed. This re-spending effect in turn generates additional jobs -- the induced employment impact. This re-spending throughout the region is estimated using a regional personal income multiplier, which reflects the percentage of purchases that are made within a region. The re-spending effect varies by region: a larger re-spending effect occurs in regions that produce a relatively large proportion of the goods and services consumed by residents, while lower re-spending effects are associated with areas that import a relatively large share of consumer goods and services (since personal income "leaks out" of the region for these purchases).

1.4 Tax Impact

State and local tax impacts are tax payments to the state and local governments by both firms and individuals involved in providing services in support of airport activity. State and local tax impacts include tax revenue from all types of state and local taxes and are measured for both the states and local jurisdictions in Oregon. Also included in the tax impact are federal aviation-specific taxes generated by air passenger and air cargo activity at the Airport.

The four types of impacts outlined above are estimated for CY 2023 passenger and air cargo activity at Eugene Airport.

 THE ECONOMIC IMPACTS OF EUGENE AIRPORT ON THE LOCAL AND REGIONAL ECONOMY, 2024

2. ECONOMIC IMPACT SECTORS

An airport is a diverse economic system. The businesses that have employees at Eugene Airport cover a spectrum of trade and service sectors. For the purposes of this study, the airport system is divided into five sectors:

- Airline/airport service
- Freight transportation
- Passenger ground transportation
- Contract construction/consulting services
- Visitor industry services

Each of these sectors covers a variety of activities. A discussion of these five categories is provided below, with a description of the major participants in each.

2.1 Airline/Airport Service Sector

Airline/airport service sector consists of airlines providing passenger services, general aviation, and firms providing support services to the airlines, passengers, and to the airport. This group consists of the following participants:

- Passenger Airlines
- General Aviation, (i.e., corporate hangars and business aircraft, not-for-profit aviation services, flying clubs, etc.)
- Ground Handling
- Airport Administration
- Aviation Service Firms (including fixed base operators)
- Airport Retail Tenants (i.e., newsstands, retail shops, and food and beverage concessions)
- Federal Government Agencies (i.e., F.A.A., TSA)
- Miscellaneous

Jobs in this category are typically located on the airport property.

2.2 Freight Transportation Sector

Freight transportation includes freight airlines, freight forwarders, and trucking firms involved in transporting air freight. The air cargo consists of air freight and mail transported on dedicated freight airlines and in the cargo section of passenger airlines. Included in this group are air couriers

THE ECONOMIC IMPACTS OF EUGENE AIRPORT ON THE LOCAL AND REGIONAL ECONOMY, 2024

and freight forwarders located throughout the Eugene area. Jobs in this category are located both on and off the airport.

2.3 Passenger Ground Transportation Sector

Passenger ground transportation consists of car rental firms and other ground transportation modes, such as buses, taxis and transportation network companies, and limousines. This group covers all transportation of individuals to and from Eugene Airport and includes both drivers and supporting reservation and maintenance employees.

2.4 Contract Construction and Consulting Sector

Individuals employed in this group include those providing construction and remodeling work at Eugene Airport, as well as architects and engineers providing planning and design services.

2.5 Visitor Industry Services Sector

Passengers arrive in the Eugene area via the Eugene Airport for several purposes, including business, pleasure, and conventions. As a result of these out-of-town residents purchasing lodging, food and entertainment, jobs are created in the service and retail industries in Eugene and neighboring areas. To evaluate the impacts of visitors in the Eugene area, the results of a survey of visitors by Travel Oregon was used to develop expenditure data by visitors.

3. DATA COLLECTION

Impacts were estimated on the basis of interviews with firms in the economic impact categories described above. Impacts are calculated for the Eugene area. The Eugene Airport administration provided a contact list of businesses and service providers at Eugene Airport. A total of 18 companies provide air base activities at Eugene Airport. In addition to commercial aviation activity several businesses keep business aircraft at Eugene Airport. These businesses hire corporate pilots who are based at Eugene Airport.

4. SUMMARY OF FINDINGS

The key economic impacts generated by Eugene Airport are presented in Exhibit I-2. It is to be emphasized that these measures are separate and distinct economic impacts generated by airport activity at Eugene Airport and are not additive.

THE ECONOMIC IMPACTS OF EUGENE AIRPORT ON THE LOCAL AND REGIONAL ECONOMY, 2024

Exhibit I-2
Summary of Impacts Generated by the Eugene Airport, CY 2023

	Airport Generated	Visitor Industry	Total Impact
Jobs			
Direct	771	5,934	6,705
Induced	366	2,013	2,379
Indirect	<u>90</u>	<u>1,209</u>	<u>1,299</u>
Total Jobs	1,226	9,157	10,383
Personal Income (millions)			
Direct	\$40.6	\$160.0	\$200.6
Induced	\$42.4	\$144.8	\$187.2
Indirect	<u>\$6.2</u>	<u>\$47.6</u>	<u>\$53.8</u>
Total	\$89.3	\$352.3	\$441.6
Business Revenue (millions)	\$474.2	\$712.9	\$1,187.1
Local Purchases (millions)	\$19.5	\$85.6	\$105.2
State & Local Taxes (millions)	\$10.0	\$32.9	\$42.9
Federal Government Aviation-Specific Taxes (millions)	\$39.0	NA	\$39.0

Totals may not add due to rounding

 THE ECONOMIC IMPACTS OF EUGENE AIRPORT ON THE LOCAL AND REGIONAL ECONOMY, 2024

II. EMPLOYMENT IMPACTS

In this chapter, the employment generated by air cargo and passenger activity at Eugene Airport is estimated. The chapter is organized as follows:

- First, employment that is totally or partially dependent on the activities at Eugene Airport is estimated
- Second, the subset of total employment that is judged to be totally dependent on airport activity is analyzed in the following ways:
 - Jobs are estimated in terms of the four economic impact sectors and for job classifications within these categories. Visitor industry sector impacts are addressed separately in Chapter IV
 - Jobs are estimated by type of airport activity, i.e., passenger, air cargo activity, and ground transportation
 - Job impacts are allocated to counties and cities within the Eugene area based on the residence of those directly dependent upon airport activity
- Induced and indirect jobs are estimated.

1. TOTAL JOB IMPACTS

As a result of airport activity in CY 2023, 10,383 Eugene area residents held jobs that were supported by activity at the Eugene Airport. Of these residents:

- 771 direct jobs are dependent upon activity at Eugene Airport. These jobs would be discontinued immediately if airport activity ceased. Also, these jobs would be impacted as a result of changes in the number of flights and passenger levels.
- 366 induced jobs are created in the region due to the purchases of goods and services within the region by those 771 directly dependent upon activity at Eugene Airport.
- 90 indirect jobs are generated in the local economy due to the \$19.5 million of local purchases for office supplies, maintenance and repair work, communications and utilities, professional services, fuel, etc., by those firms completely dependent upon the airport.
- 9,157 visitor industry jobs are created in the region as a result of visitors arriving via Eugene Airport. Of these visitor industry jobs, 5,934 jobs are created with hotels, restaurants, retail outlets, entertainment, and recreational establishments due to direct expenditures by visitors in the Eugene area who have arrived via the airport. In addition, 2,013 induced jobs are

THE ECONOMIC IMPACTS OF EUGENE AIRPORT ON THE LOCAL AND REGIONAL ECONOMY, 2024

supported by the regional purchases of the 5,934 individuals holding jobs directly created due to expenditures by visitors using Eugene Airport. Finally, another 1,209 jobs are indirect jobs supported by \$85.6 million of local purchases by the hotels, restaurants and other visitor industry firms impacted by the visitors arriving via Eugene Airport.

Chapter IV presents a more detailed discussion of the job impacts created due to visitor expenditures.

2. DIRECT JOB IMPACTS

As Exhibit II-1 shows, 58 percent of the 771 jobs directly generated by airport activity are concentrated in the airline/airport service category. Ground transportation makes up the second largest percentage of jobs directly generated at Eugene Airport. Construction and freight transportation account for the balance of the direct jobs.

Exhibit II-1
Direct Job Impacts by Sector
Eugene Airport

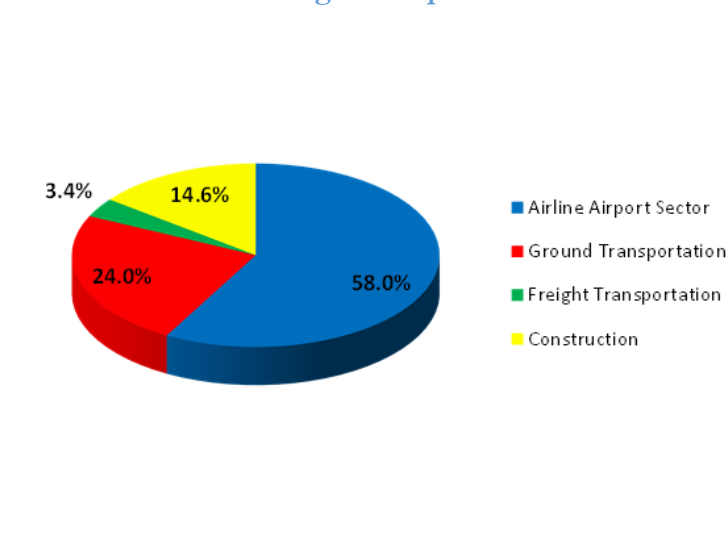


Exhibit II-2 shows the distribution of employment within each major sector. Roughly fifty percent, or 226, of the 447 jobs in the airline/airport sector are with passenger airlines and fixed based operators. Passenger airline jobs include management, ticket agents, ramp employees, and maintenance workers. In addition to jobs with passenger airlines, the airline/airport sector includes jobs with government agencies such as TSA and the FAA tower, retail and concession vendors located at Eugene Airport, and the airport administration.

THE ECONOMIC IMPACTS OF EUGENE AIRPORT ON THE LOCAL AND REGIONAL ECONOMY, 2024

Exhibit II-2
Direct Job Impacts by Category

	Direct Jobs
Airline/Airport Sector	
Passenger Airlines	114
Federal Government	85
Eugene Airport Administration	69
Retail Concessions	43
Fixed Base Operators/GA	112
Miscellaneous	<u>25</u>
Subtotal	447
Freight Transportation Sector	
Freight Airlines, Couriers and Freight Forwarders	
Subtotal	26
Ground Transportation	
Rental Cars	84
TNC/Taxis	72
Limos/Bus/Vans	<u>28</u>
Subtotal	185
Construction	113
Total	771

Totals may not add due to rounding

 THE ECONOMIC IMPACTS OF EUGENE AIRPORT ON THE LOCAL AND REGIONAL ECONOMY, 2024

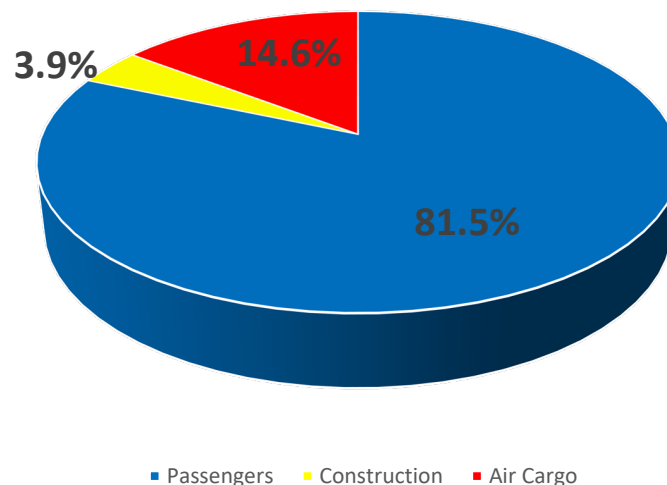
2.1 Direct Job Impacts by Type of Activity

The direct jobs are next allocated to types of activity at Eugene Airport:

- Passenger Activity on Commercial Air Carriers
- Air Cargo
- Construction

Exhibit II-3 shows the distribution of the direct jobs by type of activity.

Exhibit II-3
Distribution of Direct Jobs by Type of Airport Activity



2.1.1 Direct Jobs Dependent Upon Passenger Activity

A total of 447 direct jobs were generated by commercial airline passenger activity. Of these 447 direct jobs, 114 jobs are with the airline passenger activity. These airline jobs include ticket agents, dispatchers, ramp and ground crew, and airline management and clerical jobs. It is clear from this diverse set of jobs with airlines that certain jobs are dependent upon the number of flights at Eugene Airport, others are dependent upon the number of passengers at the airport.

As a result of this diversity in the types of jobs with airlines and their dependency upon the airport activity, changes in the level of airport activity will not have a proportionate impact on the level of total direct airline jobs. For example, the airline flight attendants living in the Eugene area, and not

THE ECONOMIC IMPACTS OF EUGENE AIRPORT ON THE LOCAL AND REGIONAL ECONOMY, 2024

based out of the Eugene Airport, as well as system maintenance facilities, are not necessarily dependent upon the level of flights in and out of the Eugene Airport, but instead on the growth in the specific airline system of which they are employees. In contrast, certain jobs are directly dependent on the number of flights at Eugene Airport, such as the equipment service technicians, ramp and ground crew, ticket agents and dispatchers.

Because of this diversity in the types of airline employees at Eugene Airport, it is critical to emphasize that an increase or decrease in flight activity at Eugene Airport will not result in a proportional change in the number of airline employees. For example, if flights are decreased at Eugene Airport, airline employment could actually increase. This would be the case if the passenger load factor increased for the aircraft still using Eugene Airport, or if the size of planes increased (while number of flights declined).

2.1.2 Air Cargo Job Impacts

In CY 2023, 1 million pounds of air freight moved on commercial air carriers and dedicated air cargo carriers at Eugene Airport. Of the 771 jobs directly generated by airport activity, 26 jobs are directly generated as a result of air cargo activity.

2.1.3 Construction Jobs

As the result of \$39.2 million capital expenditures by Eugene Airport in CY 2023, 113 direct jobs were created in the local construction industry.

3. GEOGRAPHIC DISTRIBUTION OF DIRECT JOBS

In order to estimate the local economic impact created by airport activity, data on residency of employees was collected from the interviews with airport tenants, Eugene Airport employee records, and interviews with the leading airlines serving the Eugene Airport. The direct job impact, 771 jobs, was then allocated based on city and county of residence. Exhibit II-4 shows the distribution of job impacts by city of Eugene and surrounding counties.

THE ECONOMIC IMPACTS OF EUGENE AIRPORT ON THE LOCAL AND REGIONAL ECONOMY, 2024

Exhibit II-4
Distribution of Job Impacts by Jurisdiction of Residence

Jurisdiction	Percent	Expanded
Eugene	54.2%	418
Other Lane County	40.8%	315
Linn County	3.6%	28
Other OR	1.3%	10
Total	100%	771

Totals may not add due to rounding

As this exhibit indicates, approximately 95 percent of all directly dependent airport employees reside in Lane County. Of the 95 percent, 54 percent live in the city of Eugene.

4. INDUCED JOB IMPACT

A portion of the income received by those 771 directly employed due to airport activity is saved, another portion is used to pay federal, state and local taxes, while another portion is used to purchase goods and services from firms located in the Eugene area, as well as firms outside the region. The purchase of goods and services from Eugene area firms creates induced jobs for area residents in the firms supplying the goods and services. Furthermore, those individuals supplying the goods and services also receive income from their employers and use a portion of it for additional purchases from firms located in the area. This "trickledown" effect of an initial income expenditure results in a multiplier effect throughout the Eugene area economy known as the personal income multiplier. As a result of this re-spending, 366 additional jobs in other sectors of the regional economy are supported. These jobs are with state and local government agencies (excluding those state and local government jobs included as direct impacts), financial/business and educational services, retail, housing/construction, transportation services (including service stations, auto parts suppliers, automobile dealers, body shops, etc.), entertainment/recreational services, apparel, and healthcare services.

5. INDIRECT IMPACTS

In addition to these induced jobs created from purchases by the 771 individuals directly employed due to activity at Eugene Airport, more jobs in the Eugene area economy will be created indirectly as a result of the purchase of goods and services by the firms involved in airport activity. For example, airlines purchase such items as fuel, catering services, parts, and office supplies from local firms, thereby creating jobs in these supplying industries. Similarly, the airport itself purchases such services as contract construction, utilities, and maintenance services from local suppliers, also creating jobs in the local economy. The jobs resulting from such purchases are included in the direct

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job impacts. For example, the 112 jobs with suppliers of aircraft services, (including fixed based operators, fuel handlers, and parts suppliers & maintenance), and the 113 jobs with contract construction and consulting firms are all included as direct job impacts. In some studies, impacts in these supplying industries are included as indirect jobs and measured using a regional input/output model. For the purposes of this study, a more detailed assessment of jobs in the supplying industries was more appropriate since many are located on the airport facility and these impacts are considered direct job impacts.

Another \$19.5 million of local purchases were made by the firms' dependent upon the airport in addition to these other purchases. These local purchases include purchases for goods, maintenance and repair services, utilities and communications, transportation and fueling. The \$19.5 million of local purchases supported the 90 indirect jobs.

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III. REVENUE, INCOME AND TAX IMPACTS

The movement of passengers and freight via Eugene Airport generates revenue for firms in each of the four categories of airport-related activity. For example, in the airline/airport service category, revenue is received by airport tenants who sell retail merchandise to passengers in the airport. In the freight transportation category, airlines receive revenue from moving the air cargo to and from the airport and freight forwarders receive revenue from arranging air transportation for the cargo. Similarly, the rental car agencies and the firms providing ground transportation receive revenue from transporting passengers to and from the airport, while contract construction receive revenue from the airport and airlines that have contracted these services. In the hotel/restaurant/visitors' service category, local service and retail firms receive revenue from passengers staying overnight in the Eugene area.

Revenue generated by airport activity is dispersed throughout the economy in several ways. For example, gross revenue is used to pay employee salaries and the whole range of taxes, it is distributed to stockholders, and it is used for purchases of goods and services (as described in the discussion of indirect job impacts in the last chapter). Only part of this revenue can be traced geographically with any degree of accuracy, the portion of the revenue paid out in salaries and state and local taxes. These impacts are addressed in separate sections of this chapter.

1. REVENUE IMPACT

It is useful to estimate the revenue received by each category of firms involved with airport activity because the distribution is quite different from that of employment. However, only a portion of the revenue can be traced to uses within the Eugene area economy. The portion of revenue paid in salaries and re-spent within the Eugene area economy or paid in taxes by individuals, and state and local taxes paid by firms, represents an impact that can be traced as remaining in the regional economy. In addition, airline user fees paid to the airport represent local impacts.

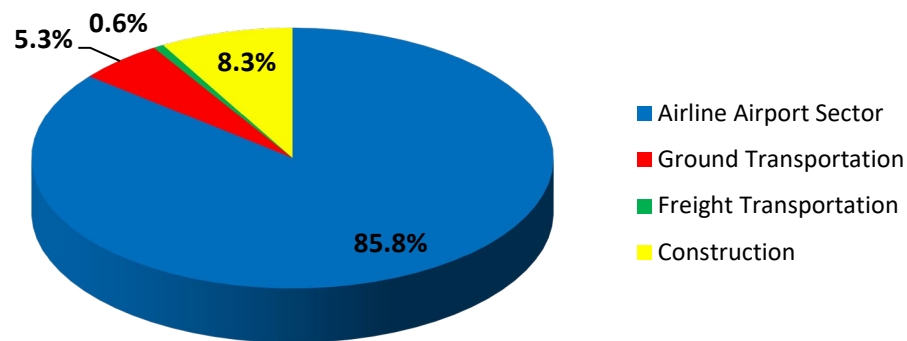
As explained in Chapter II in relation to the indirect job impact, it is unlikely that a large portion of a firm's expenditures on goods and services takes place within the Eugene area economy. Although to the extent that local products and services are purchased, this represents an additional impact. For example, the majority of air carrier purchases of major equipment are made out of the region. Thus, there is little spin-off effect, and the use of an expenditure multiplier would overstate the revenue impact.

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1.1 Revenue Impact by Sector

In CY 2023, passenger and air freight activity at Eugene Airport generated \$474.2 million of business revenue to firms providing services at the airport which is illustrated by economic impact sector in Exhibit III-1.

Exhibit III-1
Distribution of Revenue by Sector



Most of the revenue generated, nearly 86 percent, of revenue is concentrated in the airline airport sector. While 8.3 percent of the revenue impacts are concentrated in the construction sector. Ground transportation and freight transportation make up the balance of the revenue impacts by sector

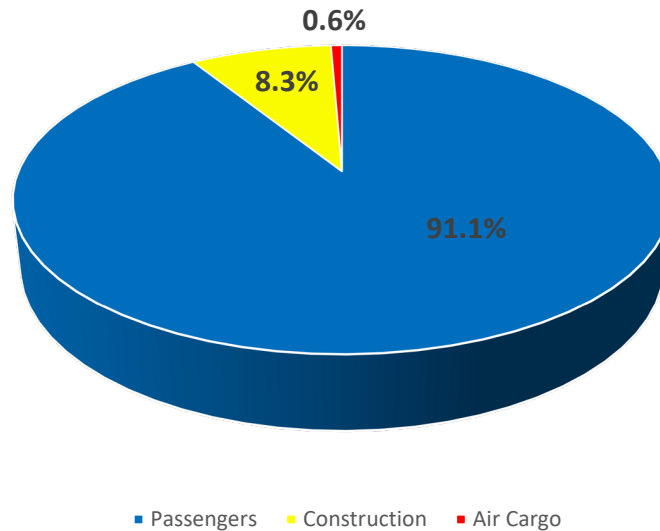
1.2 Revenue Impact by Type of Activity

The \$474.2 million revenue impact is allocated by type of airport activity:

- Passenger Activity
- Air Cargo Activity
- Construction/Consulting

Exhibit III-2 shows the distribution of the revenue impacts by type of airport activity.

Exhibit III-2
Distribution of the Revenue Impact by Airport Activity



1.2.1 Revenue Impact Generated by Passenger Activity

Passenger activity at Eugene Airport generated \$431.9 million of revenue to businesses providing services to passengers on commercial airlines. Most of this revenue was received by the airlines from passengers enplaning at Eugene. This is based on estimated revenue per enplaning passenger provided to Martin Associates during the airline interviews.

1.2.2 Revenue Impacts Generated by Air Cargo Activity

The 943,041 pounds of air freight loaded at Eugene Airport generated \$3.1 million of revenue to the airlines moving the air cargo, the freight forwarders arranging for the freight transportation, and the trucking companies and couriers carrying the freight. The revenue impact for the air cargo is based on estimated revenue per pound of enplaned air freight as derived from the airlines and freight forwarders.

1.2.3 Revenue Impacts Generated by Construction Activity

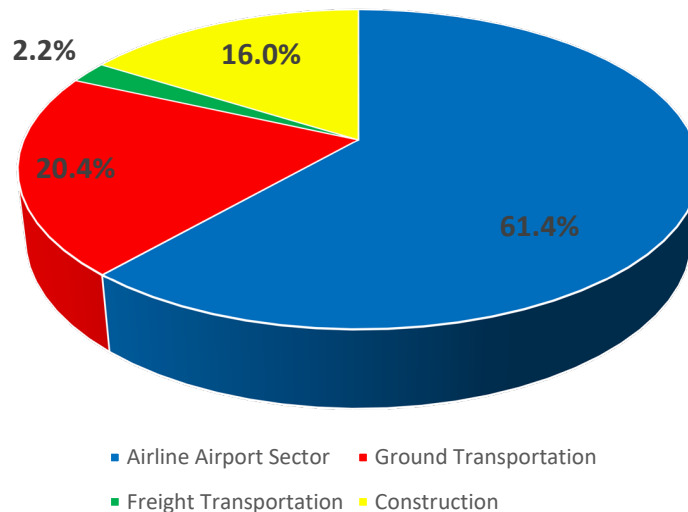
A total of \$39.2 million was spent on construction activity at Eugene Airport in calendar 2023.

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2. PERSONAL WAGE AND SALARY IMPACTS

A total of \$89.3 million of direct, induced, and indirect wages and salaries were generated in the Eugene area as a result of airport activity in CY 2023. Of this total wage and salary impact, \$40.6 million was paid in wages and salaries to the 771 direct employees. This income impact is estimated based on the average wage and salaries for each job category multiplied by the corresponding job impact in that category. In addition, \$42.4 million of induced income and local consumption expenditures and \$6.2 million of indirect income was generated by activity by Eugene Airport in CY 2023.

Exhibit III-3
Distribution of Direct Personal Income by Sector



The distribution of the direct income reflects the relatively higher paying jobs with airlines, as 61.4 percent of the income payroll by sector is generated by the airline airport sector.

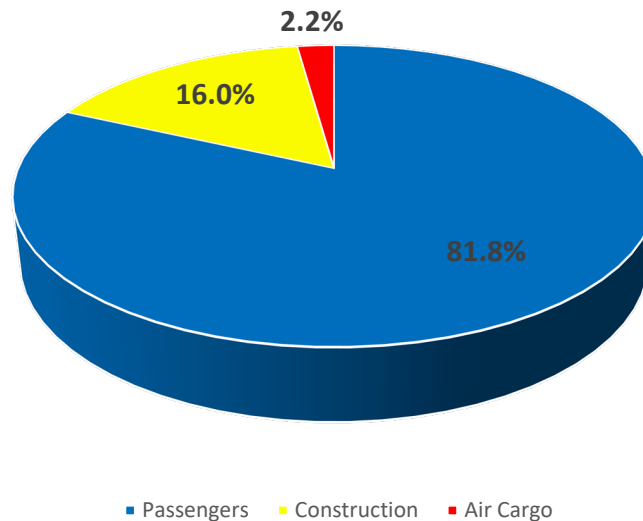
2.1 Distribution of the Direct Income Impact by Type of Activity

The distribution of the \$40.6 million direct wage and salary impact by type of activity is presented in Exhibit III-4.

2.1.1 Income Impact of Passenger Activity

Passenger activity generated 771 direct jobs. These direct employees in turn received about \$40.6 million of personal income.

Exhibit III-4
Distribution of the Direct Personal Income Impact
by Type of Airport Activity



2.1.2 Income Impact Created by Air Cargo Activity

Air cargo activity at Eugene Airport created 30 direct jobs including the jobs with air express and air cargo carriers and the dedicated air cargo jobs with the passenger airlines. These directly employed individuals in turn received about \$894.8 thousand in annual salaries and wages.

2.1.3 Income Impact Created by Construction and Consulting Activity

The CY 2023 construction activity at Eugene Airport generated 113 jobs who received \$6.5 million in wages and salaries.

2.2 Induced and Indirect Personal Income Impacts

The spending of the \$40.6 million personal income within the Eugene area creates the additional employment estimated as induced jobs in Chapter II, which results in an additional \$42.4 million of personal income and consumption purchases. Re-spending of income within a region is measured by a regional income multiplier. The size of the multiplier varies by region depending on the proportion of regional goods and services purchased by individuals. The higher this percentage, the lower the income leakage out of the region. Based on data provided by the Bureau of Economic Analysis, for every one dollar earned by individuals in the Eugene area, another \$1.04 is generated in the region. It

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is to be emphasized that this re-spending effect measures the total re-spending impact in the Eugene area. The induced jobs, which are generated by this re-spending of the direct income, only include jobs generated at the retail and wholesale level due to consumer purchases, since it is assumed that these jobs will occur in the Eugene area. In addition to these induced retail and wholesale jobs, there are also induced, and indirect jobs created to support purchases by those induced jobs in the wholesale and retail sectors, i.e., a second round of induced and indirect jobs. These second level induced, and indirect jobs are not estimated, since it is not possible to identify the geographic location where these second round induced, and indirect jobs are created with any degree of defensibility. Because the total number of induced and indirect jobs (second, third and fourth levels, etc.) generated by airport activity is not estimated, it is not possible to divide the induced income (\$42.4 million) by the estimated induced jobs to estimate the salary and wage income associated with the estimated induced jobs (366). To do so would result in a gross overestimation of the personal income associated with the induced jobs.

In addition to the induced income, the 90 indirectly employed workers received \$6.2 million of indirect wages and salaries.

3. TAX IMPACTS

Airport activity in CY 2023 generated government revenue through an assortment of tax payments by airport businesses and employees. The tax impacts are estimated at the state and local government levels, and the state of Oregon. Federal aviation-specific taxes are estimated for domestic passengers boarding flights at Eugene Airport and for air cargo loaded on planes at the airport. The federal aviation-specific taxes on cargo and domestic passengers are paid to the Federal Aviation Trust Fund, which is in turn used to finance airport development throughout the U.S.

To estimate the state and local tax impact, the share of income paid in state and local taxes was developed from data supplied for Oregon by the Tax Foundation. These per income tax burdens were multiplied by the respective direct, induced, and indirect wage and salary personal income generated in Oregon as the result of airport activity in CY 2023.

Using these state and local tax indices, it is estimated that activity at Eugene Airport generated about \$10 million of state and local tax revenues.

Federal aviation-specific taxes were estimated based on the appropriate tax formulas. These taxes include taxes collected based on passengers as well as air cargo. The taxes collected on passengers include domestic passenger tax and a federal security tax is also included. The Federal Air Cargo Tax is based on a tax levy on the value of enplaned air cargo. Based on these tax levies, air passenger and cargo activity generated \$39 million in federal aviation specific tax revenue. The breakdown of the state and local taxes and federal aviation taxes are shown in Exhibit III-5.

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Exhibit III-5
Tax Impacts of Eugene Airport Activity CY 2023

State & Local Taxes (millions)	
State	\$6.4
Local	\$3.5
Total State & Local Taxes	\$10.0
Federal Aviation Specific Taxes (millions)	\$39.0

Totals may not add due to rounding

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IV. VISITOR INDUSTRY IMPACTS

The impact of visitors on the local and regional economy is measured in terms of jobs, income, revenue, and taxes created in the hotels, retail establishments, entertainment activities, and transportation service firms.

Individuals visit the Eugene area for a variety of reasons, including business, pleasure, and for participation in conventions. These visitors purchase hotel rooms, pay for meals and entertainment, and make retail purchases while in the Eugene area. These purchases of goods and services stimulate the local economy, in turn generating jobs with hotels, restaurants, retail outlets, and local entertainment establishments. Those individuals employed in the Eugene visitor industry due to visitors' purchases receive income. This income is re-spent in the local economy generating induced jobs in the regional economy.

The magnitude of the economic impact generated by visitors using Eugene Airport varies directly with the volume of out-of-town visitors and length of time the visitors stay in the Eugene area. Also, the impacts depend upon the amount of money spent by visitors on a daily basis, as well as the types of purchases made. The volume of air visitors to the area depends upon the number of origin and destination passengers compared to connecting passengers, as well as the number of out-of-town airport users versus the number of local resident users of the airport. The length of time visitors stays in the Eugene area, as well as how they spend their money, further depends upon the purpose of the trip to Eugene. For example, domestic business travelers tend to spend more per day on hotels and restaurants than a visitor on a pleasure trip, but the business traveler may spend less time in the Eugene area and less on retail purchases and entertainment than the vacationer.

To estimate the economic impact of visitors arriving via Eugene Airport, the results of a visitor survey by Travel Oregon was used to develop expenditure data and length of stay data for visitors using Eugene Airport. Passenger characteristics, including area residents versus visitors, and connecting passengers versus origin/destination passengers was developed using similar airports since this was not part of the Travel Oregon survey nor does the Eugene Airport Administration track this data.

In CY 2023, 859,414 passengers boarded commercial aircraft at Eugene Airport. Of the 859,414 enplaning passengers, about 71 percent of the enplaning passengers were not residents of the Eugene area. Eugene Airport has very little connecting passengers, approximately 1 to 2 per day. Therefore, of the 859,414 enplaning passengers at Eugene Airport, about 607,731 passengers were not residents of the Eugene area and were not connecting to other flights at Eugene Airport. It is the travel and spending characteristics of these 607,731 visitors that will contribute to the local and state economy through lodging, retail purchases, eating in restaurants, and local transportation services. Exhibit IV-1 shows the purpose of the trip of these 607,731 non-resident visitors arriving via air.

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Exhibit IV-1
Estimated Non-Resident Visitors by Purpose of Trip
(Enplanements)

Trip Purpose	Enplanements	Percentage
Business	100,276	16.5%
Pleasure	507,456	83.5%
Total	607,731	

Totals may not add due to rounding

Exhibit IV-2 shows the average length of stay and total trip expenditures by purpose of trip. As this table indicates, domestic business travelers generate the greatest dollar value in terms of local purchases per day. Pleasure travelers spend the greatest number of days in the Eugene area.

Exhibit IV-2
Visitor Characteristics

Trip Purpose	Days Spent	Dollars/Trip
Domestic Business	4.9	\$1,528.80
Domestic Pleasure	5.2	\$1,170.00

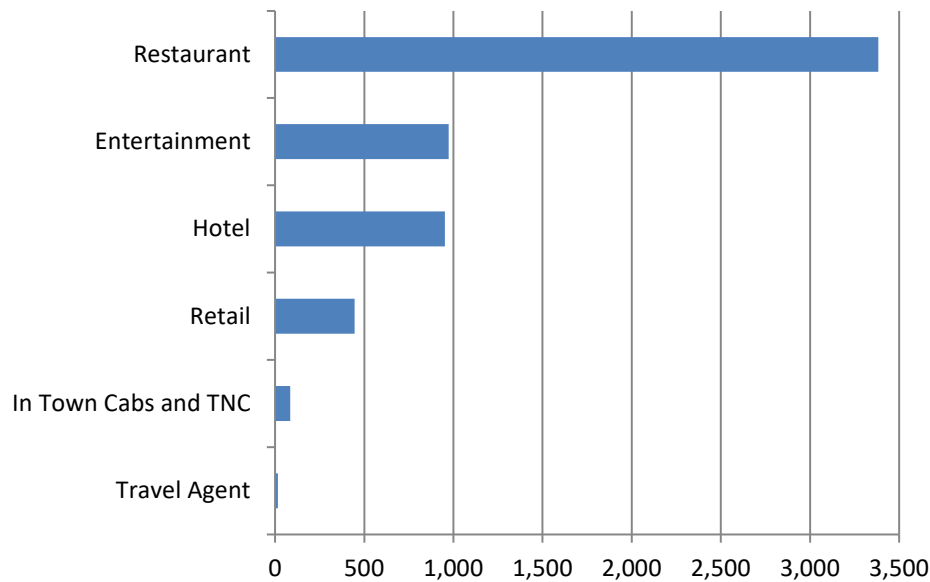
Totals may not add due to rounding

1. VISITOR INDUSTRY JOB IMPACT

Using the results of the passenger survey, the 607,731 visitors arriving via Eugene Airport are estimated to have spent about \$712.9 million in the Eugene area for lodging, food, entertainment, and transportation. This spending supported 5,934 direct jobs in the Eugene area. Exhibit IV-3 summarizes these direct visitor industry impacts.

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Exhibit IV-3
Direct Job Impacts Due to Visitors Arriving Via the Airport



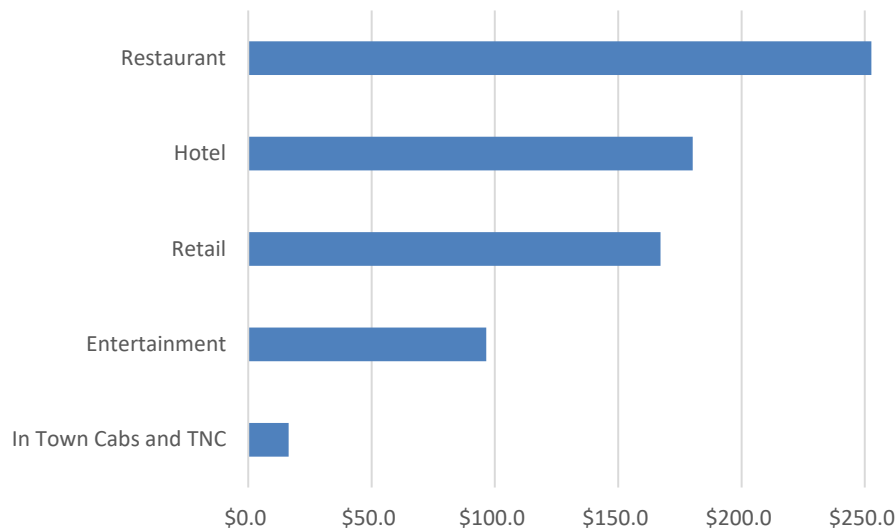
Most of the impacts are generated in restaurants, 3,384 jobs, followed by jobs with local entertainment, recreational and tourism establishments (including movie theaters; amusements; sporting events and facilities such as health clubs, country clubs, golf, skiing, basketball; national and state parks; museums; escorted tours; city festivals; etc.) 973 jobs, and 952 jobs with hotels. There were 446 jobs with local retail stores and 85 jobs with local transportation, including cabs and transportation network companies, supported by these visitors. Jobs with travel agents is minimal.

2. BUSINESS REVENUE IMPACT

The purchases made by air visitors to the Eugene area in CY 2023 generated \$712.9 million dollars of business revenue to hotels, restaurants, retail outlets, entertainment establishments and local transportation firms. The distribution of the business revenue by visitor sector industry is shown in Exhibit IV-4. As this exhibit demonstrates, local restaurants received \$252.6 million of revenue due to visitors using the airport, while hotels received \$180.2 million in sales as a result of visitors using Eugene Airport.

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Exhibit IV-4
Distribution of Visitor Industry Purchases
(\$Millions)



3. PERSONAL INCOME AND TAX IMPACTS

The 5,934 individuals directly employed in the Eugene visitor industry as the result of expenditures by the 607,731 million visitors to the area received \$160 million in wages and salaries. A portion of this personal income is also used for regional purchases of goods and services, which creates induced jobs. Applying a personal income multiplier for the tourism industry in the Eugene area, as developed by the Bureau of Economic Analysis Regional Input Output Modeling System, results in an additional \$144.8 million of re-spending and local consumption made in the local economy. These local purchases by the 5,934 directly employed in the visitor industry support an additional 2,013 induced jobs.

The local hotels, restaurants, and retail outlets supported by the visitors made \$85.6 million of local purchases for supplies and support activities. These local purchases supported 1,209 indirect jobs and received \$47.6 million of indirect income.

Finally, as a result of the visitors arriving via Eugene Airport, \$32.9 million of state and local taxes are supported, including local hotel tax receipts.

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V. RELATED JOBS

In this chapter, jobs related to, but not dependent upon Eugene Airport, are estimated. These related jobs should be viewed only as an indicator of the importance of Eugene Airport to the local business community. It is to be emphasized that the level of defensibility of the related jobs is lower than for the direct and induced jobs, primarily due to the fact that a sample of users and the results of other published studies are used rather than a 100% survey of all current, past and potential users of the Airport. Such a 100% survey would require resources not in the scope of the current study. Furthermore, since related jobs are not based on a 100 percent survey of all users, Martin Associates does not recommend that related jobs be considered when using the airport impact model to evaluate planning decisions. With these caveats in place, the remainder of the chapter provides an overview of the airport related jobs.

Related jobs are with air freight users of Eugene Airport. These shippers use Eugene Airport as well as other airports for air cargo shipments. Therefore, these shippers are not directly dependent upon Eugene in the same sense as are the firms that supply direct services to the airlines and/or passengers. However, the use of Eugene Airport by these shippers is important in stimulating economic activity in the region.

To estimate related jobs, the composition of the types of enplaned air freight loaded at Eugene Airport was estimated from the U.S. Bureau of the Census, USA Trade On-Line data for air freight loaded in the Portland Customs District. Using this data, the types of industries in the Eugene area associated with the production of the types of air freight enplaned at Eugene Airport were identified. Using data from the U.S. Bureau of Economic Analysis, Regional Income Modeling System, jobs to value of output multipliers were developed for the specific air cargo producing industries. Next, the value per pound of air freight enplaned at Eugene Airport was estimated from USA Trade On-Line data.² To estimate related jobs with air freight shippers, a weighted value per pound of all enplaned air freight at Eugene Airport was developed and multiplied by the average jobs to value of output ratio developed for the air freight producing industries.

Using this methodology, it was estimated that the average value of air freight shipments at Eugene Airport is about \$140.71 per pound. Multiplying this value per pound estimated by the 943,041 pounds of air freight enplaned at Eugene Airport in CY 2023, it is estimated that the total value of air freight shipped via Eugene is about \$132.7 million. Using the jobs to value of output ratio developed from the Bureau of Economic Analysis for the Eugene area, it is estimated that about 1,992

² It is recognized that the USA Trade On-Line data base, published by the U.S. Bureau of the Census, represents international cargo statistics. However, this data base it is used only as a proxy for the type and value of air cargo loaded at Eugene Airport since domestic data is not available.

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jobs are related to air freight shipments via Eugene Airport. These related job holders received \$78.5 million of personal income and supported \$8.5 million of related state and local taxes.

In conclusion, it is to be emphasized that these jobs are related to, not dependent upon, Eugene Airport. The level of employment with these users is determined by the demand for the firms' products instead of the use of Eugene Airport.

SUMMARY

This analysis illustrates the importance of the Eugene Airport in the local and regional economy as a major source of job creation, particularly of direct jobs with an average annual salary of \$52,659, as well as a major catalyst in the greater Willamette Valley region, the state of Oregon, the Pacific Northwest and national economies. In order to sustain this growth as an economic engine, it is critical that the Eugene Airport continues to invest in infrastructure to meet future demand, and to continue to attract businesses to stimulate further economic development in the region. This economic study suggests that the continued growth and investment in the airport, such as the planned Concourse C Development, will result in further jobs, income and tax growth for the greater Eugene region, the state of Oregon, as well as the Pacific Northwest.