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SEATTLE PARKS AND RECREATION

MAGNUSON BUILDING 2 STRUCTURAL/SEISMIC ANALYSIS (WC2362)

Final Report

July 26, 2010

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Introduction and Scope

This report represents our findings from a limited scope structural/condition review of this building, a large former military aircraft hangar and maintenance facility, currently used for recreational and other civic and community functions. (This building was identified by the State of Washington Department of Archeology and Historic Preservation (DAHP) as a significant contributing structure to the Naval Air Station (NAS) Seattle Historic District.) Our task was to focus on the structural viability and remaining life of the facility, paying particular attention to the north side of the complex, which will soon have the only remaining tenant in the building. We were also asked to review a particular instance of structural distress at the west face of the building, where masonry is apparently pulling away from its steel support structure. Our specific scope from the original RFP reads:

> "The Consultant shall provide a structural review of Magnuson Building 2. The purpose of this review is to determine the structural integrity of the existing roof, roof diaphragm, and associated structure, identify existing structural and other hazards (if any) and assess associated risk, provide a professional opinion on whether and how long the existing roof system can continue to provide reasonably safe and secure occupancy to existing Seattle Conservation Corps (SCC) employees located in the north wing of the building, provide options for a range of corrective measures that would allow safe continuance of the existing use of the building portion occupied by the SCC for a period of at least 10 years, and provide a summary of the pros and cons associated with each option along with a budget-level cost estimate. The options shall include, but not be limited to, the use of "Carbon Fiber wrap" as an acceptable method to strengthen the structure. The structural review shall follow ASCE 31-03 Tier II guidelines.
>
> Work and Deliverables shall include but not be limited to:
>
> - Site visit(s) as necessary for report.
> - Review existing as-built drawings and records of existing structure.
> - Identify structural and seismic issues, as well as any other observable concerns (e.g. leakage, vermin, insects, hazardous materials, etc.)
> - Determine a range of renovation/retrofit options that would address seismic, structural, and other issues identified in the portion of the building occupied by the SCC.
> - Produce and submit a draft report detailing the structural status and general condition of the facility, full descriptions of options for renovation as described above, and a summary table of the options with budget level option and pros/cons briefly laid out.
> - Respond to the report comments by Parks.
> - Provide final report."

Building Envelope, Exiting, and Fire Protection

We have enlisted the expertise of our architectural consultant, Jerry Osborn from S.M. Stemper Architects, to offer guidance on exiting, envelope and fire protection issues.

Approach

Seismic Issues

A full building seismic analysis is beyond the scope of this current study. Using ASCE 31 as our guide, our experience in seismic analysis and review, and our specific experience with Magnuson/Sandpoint hangars and Magnuson Building 2 in particular, we have used the following approach to this task:

- Focus on seismic hazards on the north side of the facility.
- Focus on identifying complete "load paths" for lateral forces.
- Use simplified lateral load distribution assumptions for determining preliminary approaches to capacity analysis and schematic strengthening schemes.
- Complete ASCE 31 Tier 1 Checklists for hazards.
- Review Deficiencies in Compliance with ASCE 31 Tier 2.

The original scope discusses a ten year time frame for continued use of this facility. This time horizon is not particularly useful when thinking about seismic forces, which have a great deal of uncertainty in magnitude and occurrence frequency. We will consider a "Life Safety" level of building performance in our analysis.

Description of Building, Lateral Force Resisting System, and Assumptions

Building Description

The primary original function of this facility was the maintenance and repair of military aircraft. The building forms resulting from this use include large span hangars, and ancillary space adjacent to the hangars for maintenance and administration work. The first, northern portion of the facility was constructed approximately 1930-1931, with the second major portion to the south constructed in approximately 1940-1941. Other interior additions and remodeling were also apparent in the drawing record.

Primary structural systems include long-span steel trusses, with wood and steel beams and purlins, steel wind x-bracing in both the horizontal and vertical plane, and unreinforced masonry walls infilling steel frame construction at some locations.

In the original design, consideration was given to bracing the building for lateral forces, in the form of wind bracing. Design for wind bracing in buildings of this age and type is usually not adequate to meet seismic design criteria for existing buildings.

The foundation of the earlier, northern portion was apparently driven concrete piles, while the newer southern portion is on spread footings. In some cases, mezzanines on shallow spread footings were constructed directly adjacent to pile supported foundations. When shallow spread footings were used, they were founded 4 to 6 feet below grade, which is perhaps an indication that the near-surface soils are not competent bearing material.

Current General Condition of the Building

We have walked through (and above) this building several times and have observed the following conditions.

Roof Deterioration and Leakage

The roof membrane is past the end of its design life. Leakage has occurred in many areas, and particularly in the North Wing.

Investigation for the presence of mold in these areas is beyond the scope of this report, but mold is likely to occur in these situations.

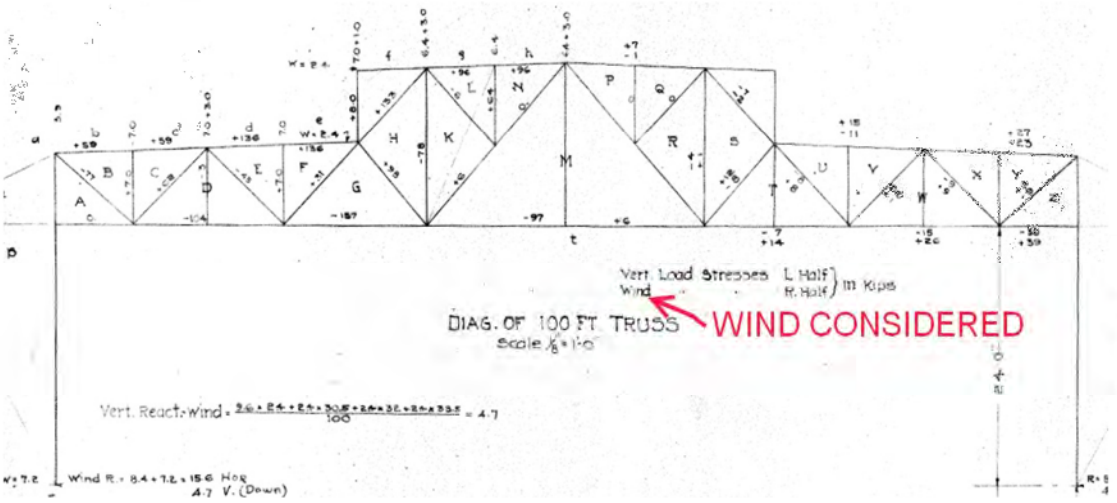
Our building envelope consultant, Jerry Osborn of S.M. Stemper, says that this building should be reroofed.

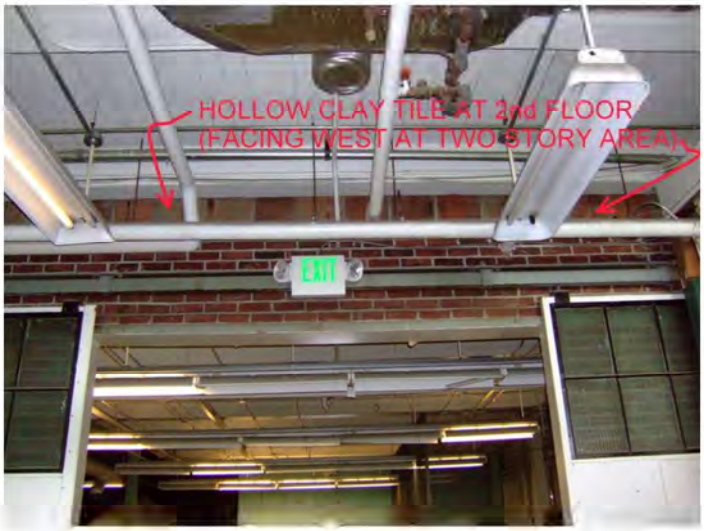
Bird Excrement

Open areas in the building allow bird nesting, leading to accumulation of bird excrement and other debris. These areas should be cleaned and secured.

Assumptions for the Lateral Force Resisting System

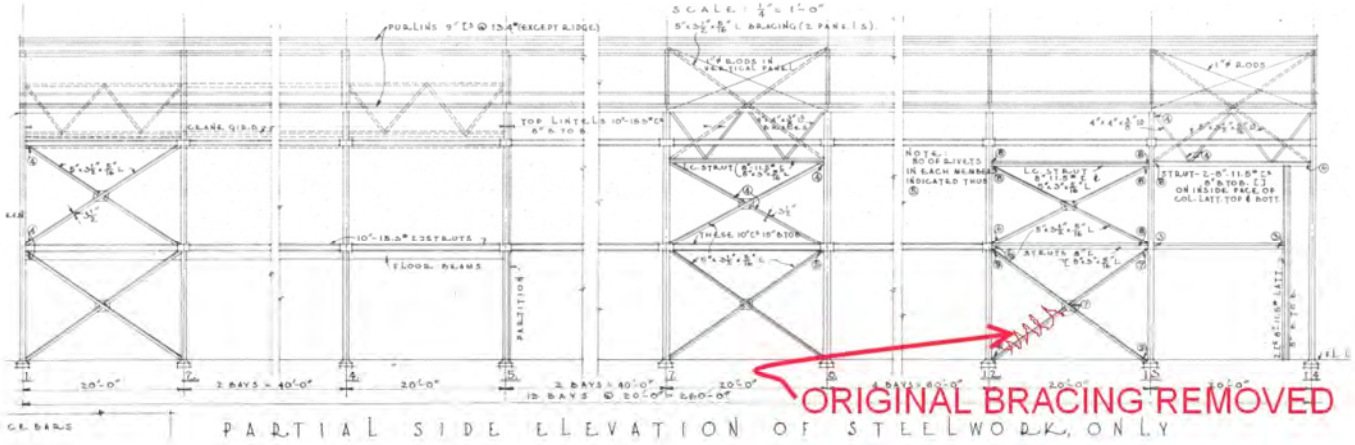
For the purposes of this brief study, our attention is focused on the north end of the building. We believe that the north and the south hangars are structurally connected. We are assuming, however, that their lateral force resisting systems are independent. For lateral forces in the north-south direction, this may be unconservative, as the higher, more flexible south hangar truss frames may shed load to the lower, stiffer north hangar truss frames. Unpredictable damage may occur, especially at the interface between the south and north hangars. This unconservative assumption is mitigated by the redundancy offered by truss moment frames at 20 feet on center. The load path, therefore, for most of the loads in the north-south direction is relatively complete. The 2nd story wings, and their low roofs, are supported by the high roof columns, and lateral loads will be dragged into the truss moment frame system as shown in the analytical section to the left, from the 1929 drawings.



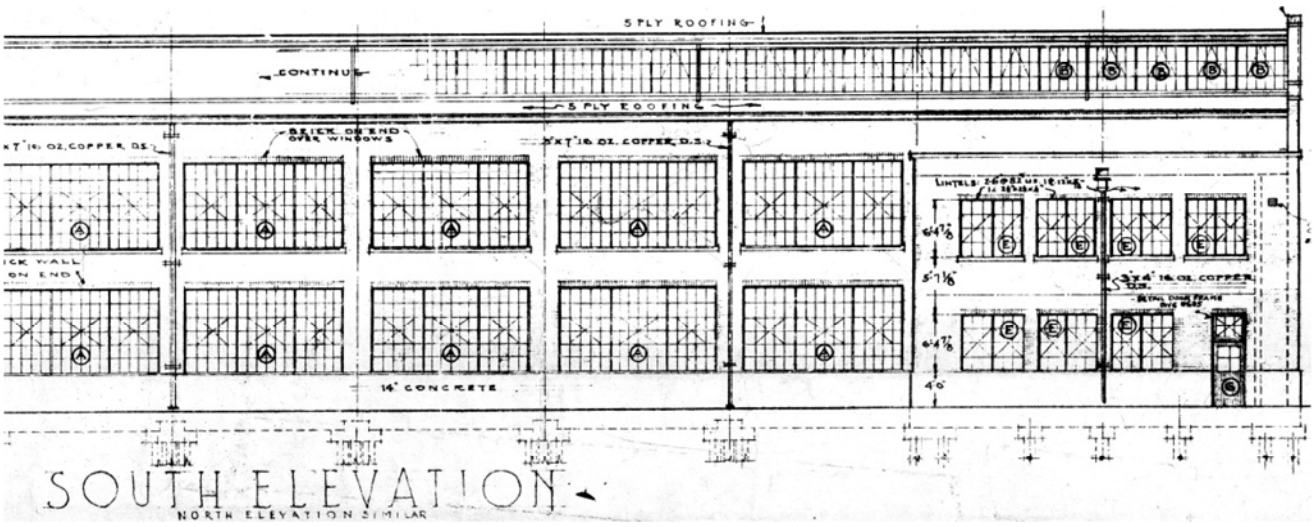


The west 80 feet of the north hangar includes a mezzanine. Lateral resistance may rely partially on unreinforced masonry walls in this area, at the east and west side of the mezzanine.

In the east-west direction, the original steel construction of the north hangar high bay had a deliberate bracing scheme on both sides for lateral forces:



Built integrally with the steel frames are brick walls, which were originally the exterior walls of the building:



Some of the openings in these walls have been enlarged, and the walls completely removed. Other openings are infilled with wood or plaster partitions. It appears that the steel bracing originally designed has been removed in some cases for convenience. (See photo.)

The high bay stability of the north hangar thus relies on an incomplete and deleteriously modified steel bracing scheme.

The north wing shown in the photo is a two story area, and will, by the end of 2010, house the building's only tenant. The floor framing in this area is concrete slab over steel beams, while the roof is framed with steel and wood decking. The walls are unreinforced brick masonry.

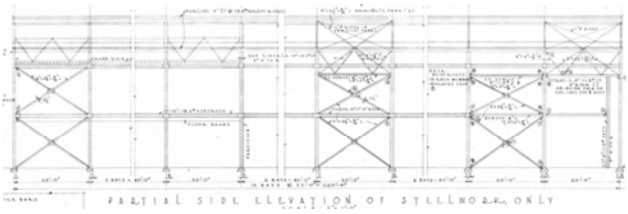
Our ASCE 31 quick check for east-west lateral forces at the north wing reveals a lack of adequate in-plane strength in the unreinforced masonry piers to resist anticipated seismic loads. Additionally, steel girders in some locations may bear directly on the north wall unreinforced masonry piers, and have minimal or no positive attachment for out-of-plane loads. Additionally, the braced frames at the hangar bay, which provide stability for this north block as well, lack adequate strength, and one brace has been removed, as described above.

Possible Solutions for Global Seismic Issues

There is currently no DPD mandate to seismically upgrade this facility. However, the building owner may want to consider addressing some of the seismic hazards apparent for occupant safety. The lateral force resisting system is not adequate to resist the large magnitude earthquakes expected in the Seattle area, but in that respect is similar to many other occupied buildings, both public and private.

East-West Direction

The north bay lacks seismic resistance in the east-west direction. The original high bay bracing is modified or missing in some cases. This bracing supports both the high bay roof and the two story occupied tenant space. Reestablishing this bracing, with new members and connections for current forces, is one option for increasing resistance at these lines. Another option is to provide concrete shear walls in some of the bays.



At the north wall, the narrow URM piers lack capacity for seismic loads. Multiple windows may have to be infilled with concrete or steel braced frames to reinforce this wall for in-plane loads. These infill walls or braced frames will need to be coordinated with the State DAHP regarding any changes to architectural character defining features.

North-South Direction

A load path apparently exists, in the form of truss moment frames designed for wind forces, and drag beams at the adjacent office/work blocks. The seismic support of the mezzanines at the west 80 feet of the north building is somewhat less certain. Existing walls are unlikely to have sufficient capacity. New walls or braced frames may be necessary for a complete load path.

Non-Structural Seismic Hazards

So-called "Non-Structural" Seismic Hazards include portions or elements of a structure that are not part of the main lateral force system, but which are vulnerable to seismic damage. Additionally, failure of "non-structural" elements may harm occupants, or make exiting a seismically damaged building difficult.

Specific hazards have been identified earlier. Other hazards are less visibly apparent, but are determined through review of the structure.

West Side Masonry Distress

On the west side of the north hangar, the brick masonry appears to be pulling away from the supporting steel frame. Solutions to this apparent failure include rebolting the masonry to the steel angle at the top of the wall, or providing a light gage steel stud strongback wall to support the URM.

Anchorage of Exterior Walls to Floor and Roof Diaphragms

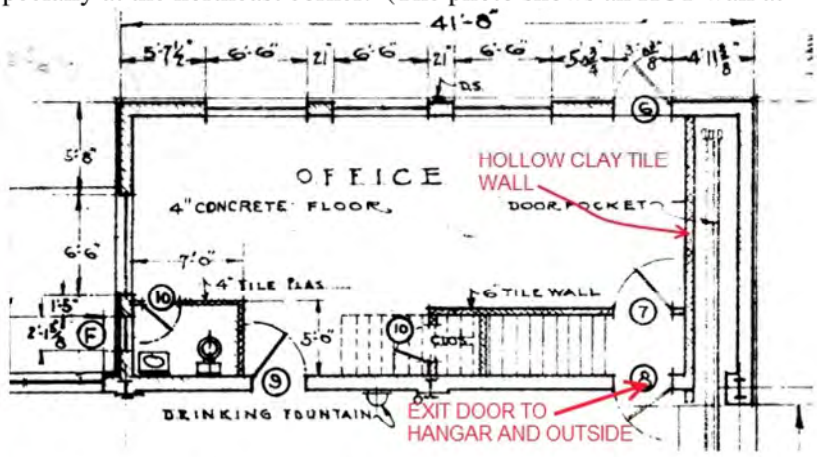
The north wall may be inadequately anchored to the floor and roof, and could be in danger of separating during an earthquake. This area above fixed ceilings is not currently accessible, and more investigation is needed. Improved anchorage, especially near building exits, should be added if the current anchorage is inadequate.

Ceiling and Mechanical Equipment Bracing

Suspended ceiling systems, especially in the 2nd floor area (see photo), most likely lack adequate seismic bracing, and could drop during an earthquake. Suspended mechanical equipment may be inadequately braced as well.

Hollow Clay Tile Walls Near Exit Paths

Hollow Clay Tile walls exist near exit paths, especially at the northeast corner. (The photo shows an HCT wall at the hangar door pocket directly adjacent to the exit stairs.) These walls are extremely



vulnerable to collapse in an earthquake. The walls should be strengthened, or the exit path changed.

Strengthening could be accomplished with carbon fiber reinforcement, or steel strongbacks.

Hazardous Material Storage

Gasoline in yard maintenance equipment may be stored in the first floor area of the north wing. This may be an unintended hazard.

Architectural Life Safety Issues

In conjunction with building seismic and functional upgrades, other upgrades to Architectural and Fire Protection Life Safety Systems may be desired or required by the local jurisdiction. Jerry Osborn of S.M. Stemper Architects suggests that consideration should be given to the following issues:

Provide Occupancy Separation

A Two Hour Fire Separation may be required or desired between occupied areas of the building and the area that Arena Sports is vacating. This would include new wall and ceiling construction, and infilling of glass windows and some doors that are not fire resistive. See plans for extent and information.

Upgrade Exiting

Revise and upgrade exiting from occupied areas of the building (without exiting through unoccupied areas of the building.) The east exit at the first floor may require a vestibule in the hangar space. A new exit door may be needed at the north side of the first floor. See attached plans.

Upgrade Fire Alarm System

The fire alarm system may need to be upgraded in the occupied areas.

Fire Sprinklers

It's not allowed to retrofit fire sprinklers to only part of a building, so the entire complex would have to be upgraded. This would be cost prohibitive. As long as the building remains occupied, and the use doesn't change, there is no requirement for this upgrade. We therefore haven't included this item in the summary table.

If all but the north wing is vacated, and separation walls are built, future reoccupancy may trigger the need for fire sprinklers.

Summary Table

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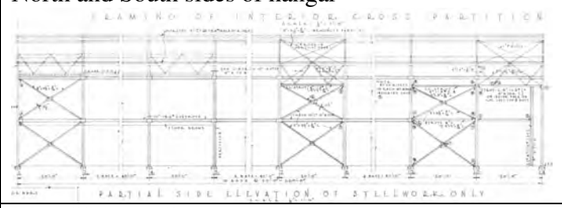
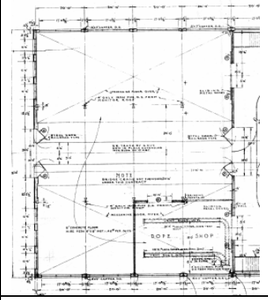
Summary Table
Sandpoint Building 2
Structural Condition Survey
July 26, 2010

Item	Category	Location	Budget	Pros	Cons	Comments
Upgrade Hangar Braced Frames	Building Seismic Mitigation	North and South sides of hangar 	$150,000	Provides overall seismic stability to the north hangar and the north two-story wing in the east-west direction.	Costly and disruptive.	*Some elements are missing. Critical to seismic performance of the hangar. Some resistance exists, but it is likely to be overwhelmed in a major seismic event.*
Add shear walls at west mezzanine area	Building Seismic Mitigation	West 80 feet of hangar 	$50,000	Provides independent seismic stability to this area.	Costly. May not be necessary. Some walls exist.	*Further analysis may show this area to be acceptable.*
Add infill shear walls at north wing	Building Seismic Mitigation	North walls at two-story block 	$30,000	Provides overall seismic stability to the north two-story wing in the east-west direction.	May compromise exterior architectural integrity of this historic structure.	*3 bays at 1st and 2nd floor windows. Coordinate with Washington DAHP.*

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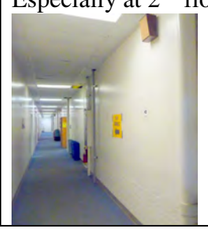
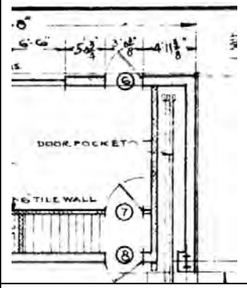
Item	Category	Location	Budget	Pros	Cons	Comments
Reroof north two story area	Building Condition	Roof 	$170,000	Prevents further damage and deterioration, extends building life, addresses occupant comfort.	None.	*Investigate for mold. Roofing options, including insulation, will affect price. Estimate shown is for no additional insulation.*
Repair West Side Masonry	Building Condition, Non-structural Seismic Mitigation	Center of North Side West wall 	$15,000	Preserves building stability.		*Use light gage steel stud backup, or reconnect steel framing to walls with new bolts.*
Clean Bird Excrement	Building Condition	West side 2nd floor (as above)	$10,000		None.	*Possible Health Hazard*
Anchor Exterior Walls to Floor and Roof Diaphragms	Non-structural Seismic Mitigation	May exist at 2nd floor roof at north wing.	$35,000	Increased exiting safety.	Some demolition and disruption required for installation.	*More investigation needed. If mitigation is undertaken, focus on exit paths from building.*
Brace Ceiling and Mechanical Equipment	Non-structural Seismic Mitigation	Especially at 2nd floor Corridor. 	$80,000	Increased exiting safety.	Costly. Construction is disruptive.	*Damaged ceilings may block exit path.*

Item	Category	Location	Budget	Pros	Cons	Comments
Strengthen Hollow Clay Tile Walls Near Exit Paths	Non-structural Seismic Mitigation	Especially at the NE Corner in the north wing. 	$25,000	Increased exiting safety.	*Cost.*	*Damaged walls may block exit paths. Consider carbon fiber wrap reinforcing.*
Provide 2 Hour Fire Separation	Architectural Life Safety	Throughout the interface.	$250,000	Provides security separation as well.	Costly. Construction may be disruptive.	*May be code issue. See attached plans. Includes vertical and horizontal separation where shown.*
Revise and upgrade exiting	Architectural Life Safety	West wall and east wall through hangar door	$25,000	Could provide additional convenience.	May compromise exterior architectural integrity of this historic structure. May cause building security issues.	*May be code issue.*
Upgrade the fire alarm system in the occupied part of the building.	Architectural Life Safety	Throughout the occupied portion of the building.	$100,000	Upgraded occupant safety.	Cost.	*May be code issue.*

NOTE: Budget Estimates shown are schematic level estimates of construction cost only, in 2010 dollars. Soft costs and inflation aren't included.

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ASCE 31 Checklists

3.7.3 Basic Structural Checklist for Building Type S1: Steel Moment Frames with Flexible Diaphragms

This Basic Structural Checklist shall be completed when required by Table 3-2.

Each of the evaluation statements on this checklist shall be marked Compliant (C), Non-Compliant (NC), or Not Applicable (N/A) for a Tier 1 Evaluation. Compliant statements identify issues that are acceptable according to the criteria of this standard, while non-compliant statements identify issues that require further investigation. Certain statements may not apply to the buildings being evaluated. For non-compliant evaluation statements, the design professional may choose to conduct further investigation using the corresponding Tier 2 evaluation procedure; corresponding section numbers are in parentheses following each evaluation statement.

C3.7.3A Basic Structural Checklist for Building Type S1A

These buildings consist of a frame assembly of steel beams and steel columns. Floor and roof framing consists of cast-in-place concrete slabs or metal deck with concrete fill supported on steel beams, open web joists or steel trusses. Lateral forces are resisted by steel moment frames that develop their stiffness through rigid or semi-rigid beam-column connections. Where all connections are moment resisting connections the entire frame participates in lateral force resistance. Where only selected connections are moment-resisting connections, resistance is provided along discrete frame lines. Columns are oriented so that each principal direction of the building has columns resisting forces in strong axis bending. Diaphragms consist of wood framings; un-topped metal deck; or metal deck with lightweight insulating concrete, poured gypsum, or similar non-structural topping, and are flexible relative to the frames. Where the exterior of the structure is concealed, walls consist of metal panel curtain walls, glazing, brick masonry, or precast concrete panels. Where the interior of the structure is finished, frames are concealed by ceilings, partition walls and architectural column furring. Foundations consist of concrete spread footings or deep pile foundations.

Building System

C **NC** LOAD PATH: The structure shall contain one complete load path for Life Safety and Immediate Occupancy for seismic force effects from any horizontal direction that serves to transfer the inertial forces from the mass to the foundation. (Tier 2: Sec. 4.3.1.1)

Load path has been deleteriously modified in the east-west direction, and lacks a complete system at the north wall.

NC ADJACENT BUILDINGS: The clear distance between the building being evaluated and any adjacent building shall be greater than 4 percent of the height of the shorter building for Life Safety and Immediate Occupancy. (Tier 2: Sec. 4.3.1.2)

Second hangar is rigidly attached to original construction withpout regard for stiffness. Load distribution is uncertain.

C MEZZANINES: Interior mezzanine levels shall be braced independently from the main structure, or shall be anchored to the lateral-force-resisting elements of the main structure. (Tier 2: Sec. 4.3.1.3)

	N/A	WEAK STORY: The strength of the lateral-force-resisting system in any story shall not be less than 80 percent of the strength in an adjacent story, above or below, for Life-Safety and Immediate Occupancy. (Tier 2: Sec. 4.3.2.1)
	N/A	SOFT STORY: The stiffness of the lateral-force-resisting system in any story shall not be less than 70 percent of the lateral-force-resisting system stiffness in an adjacent story above or below, or less than 80% of the average lateral-force-resisting system stiffness of the three stories above or below for Life-Safety and Immediate Occupancy. (Tier 2: Sec. 4.3.2.2)
	N/A	GEOMETRY: There shall be no changes in horizontal dimension of the lateral-force-resisting system of more than 30 percent in a story relative to adjacent stories for Life Safety and Immediate Occupancy, excluding one-story penthouses and mezzanines. (Tier 2: Sec. 4.3.2.3)
	NC	VERTICAL DISCONTINUITIES: All vertical elements in the lateral-force-resisting system shall be continuous to the foundation. (Tier 2: Sec. 4.3.2.4) ***Braced frames have been modified.***
	N/A	MASS: There shall be no change in effective mass more than 50% from one story to the next for Life Safety and Immediate Occupancy. Light roofs, penthouses, and mezzanines need not be considered. (Tier 2: Sec. 4.3.2.5)
C		TORSION: The estimated distance between the story center of mass and the story center of rigidity shall be less than 20 percent of the building width in either plan dimension for Life Safety and Immediate Occupancy. (Tier 2: Sec. 4.3.2.6)
C		DETERIORATION OF STEEL: There shall be no visible rusting, corrosion, cracking or other deterioration in any of the steel elements or connections in the vertical- or lateral-force-resisting systems. (Tier 2: Sec. 4.3.3.3)
C		DETERIORATION OF CONCRETE: There shall be no visible deterioration of concrete or reinforcing steel in any of the vertical- or lateral-force-resisting elements. (Tier 2: Sec. 4.3.3.4)

Lateral Force Resisting System

C	**NC**	REDUNDANCY: The number of lines of moment frames in each principal direction shall be greater than or equal to 2 for Life Safety and Immediate Occupancy. The number of bays of moment frames in each line shall be greater than or equal to 2 for Life Safety and 3 for Immediate Occupancy. (Tier 2: Sec. 4.4.1.1.1) ***Minimal redundancy in the east-west direction.***
	NC	INTERFERING WALLS: All concrete and masonry infill walls placed in moment frames shall be isolated from structural elements. (Tier 2: Sec. 4.4.1.2.1)
	NC	DRIFT CHECK: The drift ratio of the steel moment frames, calculated using the Quick Check

procedure of Section 3.5.3.1, shall be less than 0.025 for Life Safety and 0.015 for Immediate Occupancy. (Tier 2: Sec. 4.4.1.3.1)

Unknown AXIAL STRESS CHECK: The axial stress due to gravity loads in columns subjected to overturning forces shall be less than $0.10F_y$ for Life Safety and Immediate Occupancy. Alternatively, the axial stress due to overturning forces alone, calculated using the Quick Check Procedure of Section 3.5.3.6, shall be less than $0.30F_y$ for Life Safety and Immediate Occupancy. (Tier 2: Sec. 4.4.1.3.2)

Connections

C TRANSFER TO STEEL FRAMES: Diaphragms shall be connected for transfer of loads to the steel frames for Life Safety and the connections shall be able to develop the lesser of the strength of the frames or diaphragms for Immediate Occupancy. (Tier 2: Sec. 4.6.2.2)

Unknown STEEL COLUMNS: The columns in lateral-force-resisting frames shall be anchored to the building foundation for Life Safety and the anchorage shall be able to develop the lesser 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, for Immediate Occupancy. (Tier 2: Sec. 4.6.3.1)

3.7.4A Basic Structural Checklist for Building Type S2A: Steel Braced Frames With Flexible Diaphragms (Partial Information)

C3.7.4A Basic Structural Checklist for Building Type S2A

These buildings consist of a frame assembly of steel beams and steel columns. Floor and roof framing consists of wood framing or untopped metal deck supported on steel beams, open web joists or steel trusses. Lateral forces are resisted by tension and compression forces in diagonal steel members. As such, this selection is not intended to explicitly address eccentrically braced frame systems. See Section 4.4.3.3 for discussion of eccentrically braced frames. Where diagonal brace connections are concentric to beam column joints, all member stresses are primarily axial. Where diagonal brace connections are eccentric to the joints, members are subjected to bending and axial stresses. Diaphragms consist of wood framing; un-topped metal deck; oriented deck with lightweight insulating concrete, poured gypsum, or similar nonstructural topping and are flexible relative to the frames. Where the exterior of the structure is concealed, walls consist of metal panel curtain walls, glazing, brick masonry, or precast concrete panels. Where the interior of the structure is finished, frames are concealed by ceilings, partition walls and architectural furring. Foundations consist of concrete spread footings or deep pile foundation.

Building System

NC LOAD PATH: The structure shall contain one complete load path for Life Safety and Immediate Occupancy for seismic force effects from any horizontal direction that serves to transfer the inertial forces from the mass to the foundation. (Tier 2: Sec. 4.3.1.1)

In the East-west (braced frame) direction, braces have been removed, and the north wall lateral system is incomplete.

C ADJACENT BUILDINGS: The clear distance between the building being evaluated and any adjacent building shall be greater than 4 percent of the height of the shorter building for Life Safety and Immediate Occupancy. (Tier 2: Sec. 4.3.1.2)

Complies in E-W direction only.

NC MEZZANINES: Interior mezzanine levels shall be braced independently from the main structure, or shall be anchored to the lateral-force-resisting elements of the main structure. (Tier 2: Sec. 4.3.1.3)

Mezzanines may not be adequately anchored.

N/A WEAK STORY: The strength of the lateral-force-resisting system in any story shall not be less than 80 percent of the strength in an adjacent story, above or below, for Life-Safety and Immediate Occupancy. (Tier 2: Sec. 4.3.2.1)

N/A SOFT STORY: The stiffness of the lateral-force-resisting system in any story shall not be less than 70 percent of the lateral-force-resisting system stiffness in an adjacent story above or below, or less than 80 percent of the average lateral-force-resisting system stiffness of the three stories above or below for Life-Safety and Immediate Occupancy. (Tier 2: Sec. 4.3.2.2)

C		GEOMETRY: There shall be no changes in horizontal dimension of the lateral-force-resisting system of more than 30 percent in a story relative to adjacent stories for Life Safety and Immediate Occupancy, excluding one-story penthouses. (Tier 2: Sec. 4.3.2.3)
	NC	VERTICAL DISCONTINUITIES: All vertical elements in the lateral-force-resisting system shall be continuous to the foundation. (Tier 2: Sec. 4.3.2.4)

Lateral Force Resisting System

	NC	AXIAL STRESS CHECK: The axial stress due to gravity loads in columns subjected to overturning forces shall be less than $0.10F_y$ for Life Safety and Immediate Occupancy. Alternatively, the axial stress due to overturning forces alone, calculated using the Quick Check Procedure of Section 3.5.3.6, shall be less than $0.30F_y$ for Life Safety and Immediate Occupancy. (Tier 2: Sec. 4.4.1.3.2)
C		REDUNDANCY: The number of lines of braced frames in each principal direction shall be greater than or equal to 2 for Life Safety and Immediate Occupancy. The number of braced bays in each line shall be greater than 2 for Life Safety and 3 for Immediate Occupancy. (Tier 2: Sec. 4.4.3.1.1)
	NC	AXIAL STRESS CHECK: The axial stress in the diagonals, calculated using the Quick Check procedure of Section 3.5.3.4, shall be less than $0.50F_y$ for Life Safety and for Immediate Occupancy. (Tier 2: Sec. 4.4.3.1.2)
	NC	COLUMN SPLICES: All column splice details located in braced frames shall develop the tensile strength of the column. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.4.3.1.5)

Connections

C		TRANSFER TO STEEL FRAMES: Diaphragms shall be connected for transfer of loads to the steel frames for Life Safety and the connections shall be able to develop the shear strength of the frames for Immediate Occupancy. (Tier 2: Sec. 4.6.2.2)
C		STEEL COLUMNS: The columns in lateral-force-resisting frames shall be anchored to the building foundation for Life Safety and the anchorage shall be able to develop the lesser 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 for Immediate Occupancy. (Tier 2: Sec. 4.6.3.1)

3.7.3S Supplemental Structural Checklist for Building Type S1: Steel Moment Frames With Stiff Diaphragms

This Supplemental Structural Checklist shall be completed when required by Table 3-2. The Basic Structural Checklist shall be completed prior to completing this Supplemental Structural Checklist.

Lateral Force Resisting System

NC MOMENT-RESISTING CONNECTIONS: All moment connections shall be able to develop the strength of the adjoining members or panel zones. (Tier 2: Sec. 4.4.1.3.3)

N/A PANEL ZONES: All panel zones shall 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. (Tier 2: Sec. 4.4.1.3.4)

C COLUMN SPLICES: All column splice details located in moment resisting frames shall include connection of both flanges and the web for Life Safety and the splice shall develop the strength of the column for Immediate Occupancy. (Tier 2: Sec. 4.4.1.3.5)

NC STRONG COLUMN/WEAK BEAM: The percentage of strong column/weak beam joints in each story of each line of moment-resisting frames shall be greater than 50 percent for Life Safety and Immediate Occupancy. (Tier 2: Sec. 4.4.1.3.6)

NC COMPACT MEMBERS: All frame elements shall meet compact section requirements set forth by the *Seismic Provisions for Structural Steel Buildings* Table 1-9-1 (AISC, 1997). (Tier 2: Sec.4.4.1.3.7)

C BEAM PENETRATIONS: All openings in frame-beam webs shall be less than 1/4 of the beam depth and shall be located in the center half of the beams. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.4.1.3.8)

N/A GIRDER FLANGE CONTINUITY PLATES: There shall be girder flange continuity plates at all moment-resisting frame joints. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.4.1.3.9)

N/A OUT-OF-PLANE BRACING: Beam-column joints shall be braced out-of-plane. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.4.1.3.10)

N/A BOTTOM FLANGE BRACING: The bottom flange of beams shall be braced out-of-plane. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.4.1.3.11)

Diaphragms

N/A PLAN IRREGULARITIES: There shall be tensile capacity to develop the strength of the diaphragm at re-entrant corners or other locations of plan irregularities. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.5.1.7)

N/A DIAPHRAGM REINFORCEMENT AT OPENINGS: There shall be reinforcing around all diaphragms openings larger than 50 percent of the building width in either major plan dimension. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.5.1.8)

Connections

NC UPLIFT PILE CAPS: Pile caps shall have top reinforcement and piles shall be anchored to the pile caps for Life Safety, and the pile cap reinforcement and pile anchorage shall be able to develop the tensile capacity of the piles for Immediate Occupancy. (Tier 2: Sec. 4.6.3.10)

3.7.4S Supplemental Structural Checklist for Building Type S2: Steel Braced Frames With Stiff Diaphragms

This Supplemental Structural Checklist shall be completed when required by Table 3-2. The Basic Structural Checklist shall be completed prior to completing this Supplemental Structural Checklist.

Lateral Force Resisting System

NC COMPACT MEMBERS: All frame elements shall meet section requirements set forth by the *Seismic Provisions for Structural Steel Buildings* Table I-9-1 (AISC, 1997). (Tier 2: Sec. 4.4.1.3.7)

NC CONNECTION STRENGTH: All the brace connections shall develop the yield capacity of the diagonals. (Tier 2: Sec. 4.4.3.1.4)

N/A OUT-OF-PLANE BRACING: Braced frame connections attached to beam bottom flanges located away from beam-column joints shall be braced out-of-plane at the bottom flange of the beams. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.4.3.1.6)

C K-BRACING: The bracing system shall not include K-braced bays. (Tier 2: Sec. 4.4.3.2.1)

NC TENSION-ONLY BRACES: Tension-only braces shall not comprise more than 70% of the total lateral-force-resisting capacity in structures over two stories in height. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.4.3.2.2)

N/A CHEVRON BRACING: The bracing system shall not include chevron, or V-braced bays. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.4.3.2.3)

N/A CONCENTRICALLY BRACED FRAME JOINTS: All the diagonal braces shall frame into the beam-column joints concentrically. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.4.3.2.4)

Diaphragms

C OPENINGS AT BRACED FRAMES: Diaphragm openings immediately adjacent to the braced frames shall extend less than 25 percent of the frame length for Life Safety and 15 percent of the frame length for Immediate Occupancy. (Tier 2: Sec. 4.5.1.5)

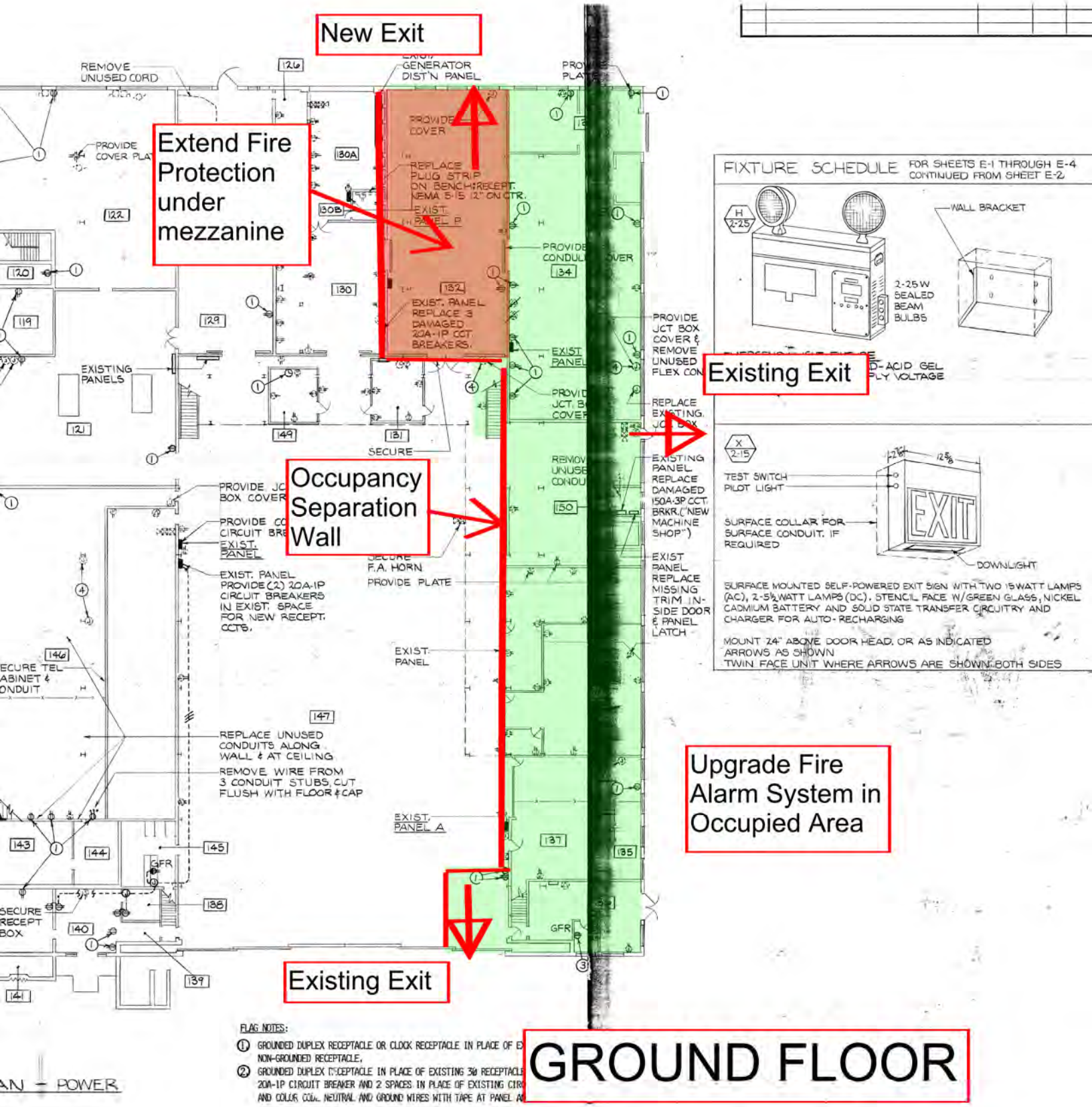
PSM

CONSULTING ENGINEERS

Architectural Life Safety

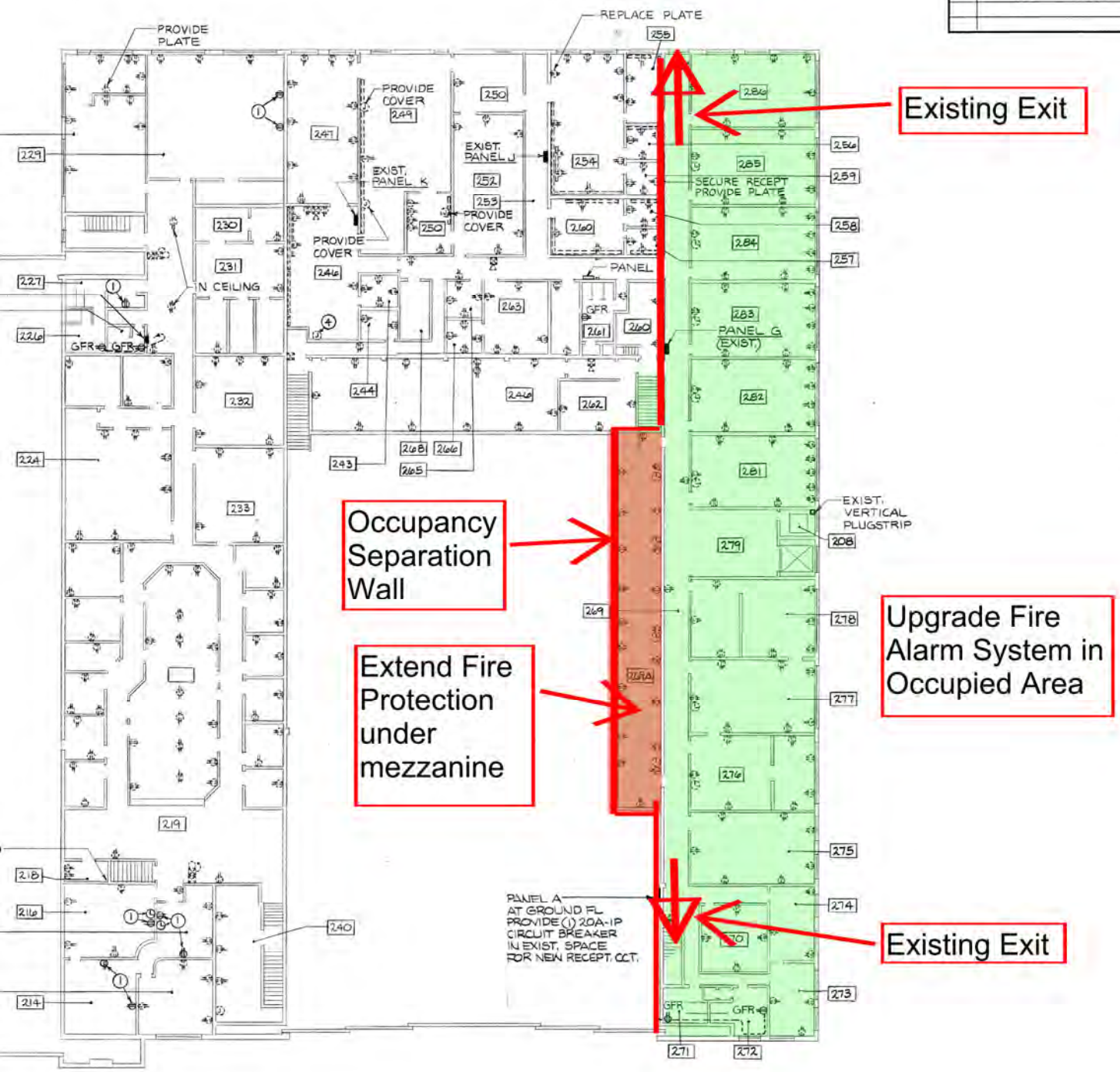
S.M. STEMPER ■ ARCHITECTS

A PROFESSIONAL LIMITED LIABILITY COMPANY



S.M. STEMPER ■ ARCHITECTS

A PROFESSIONAL LIMITED LIABILITY COMPANY



G NOTES:

GROUNDED DUPLEX RECEPTACLE OR CLOCK RECEPTACLE IN PLACE OF EXISTING NON-GROUNDED RECEPTACLE.

GROUNDED DUPLEX RECEPTACLE IN PLACE OF EXISTING 3Ø RECEPTACLE. PROVIDE 20A-1P CIRCUIT BREAKER AND 2 SPACES IN PLACE OF EXISTING CIRCUIT BREAKER AND COLOR CODE NEUTRAL AND GROUND WIRES WITH TAPE AT PANEL AND RECEPTACLE.

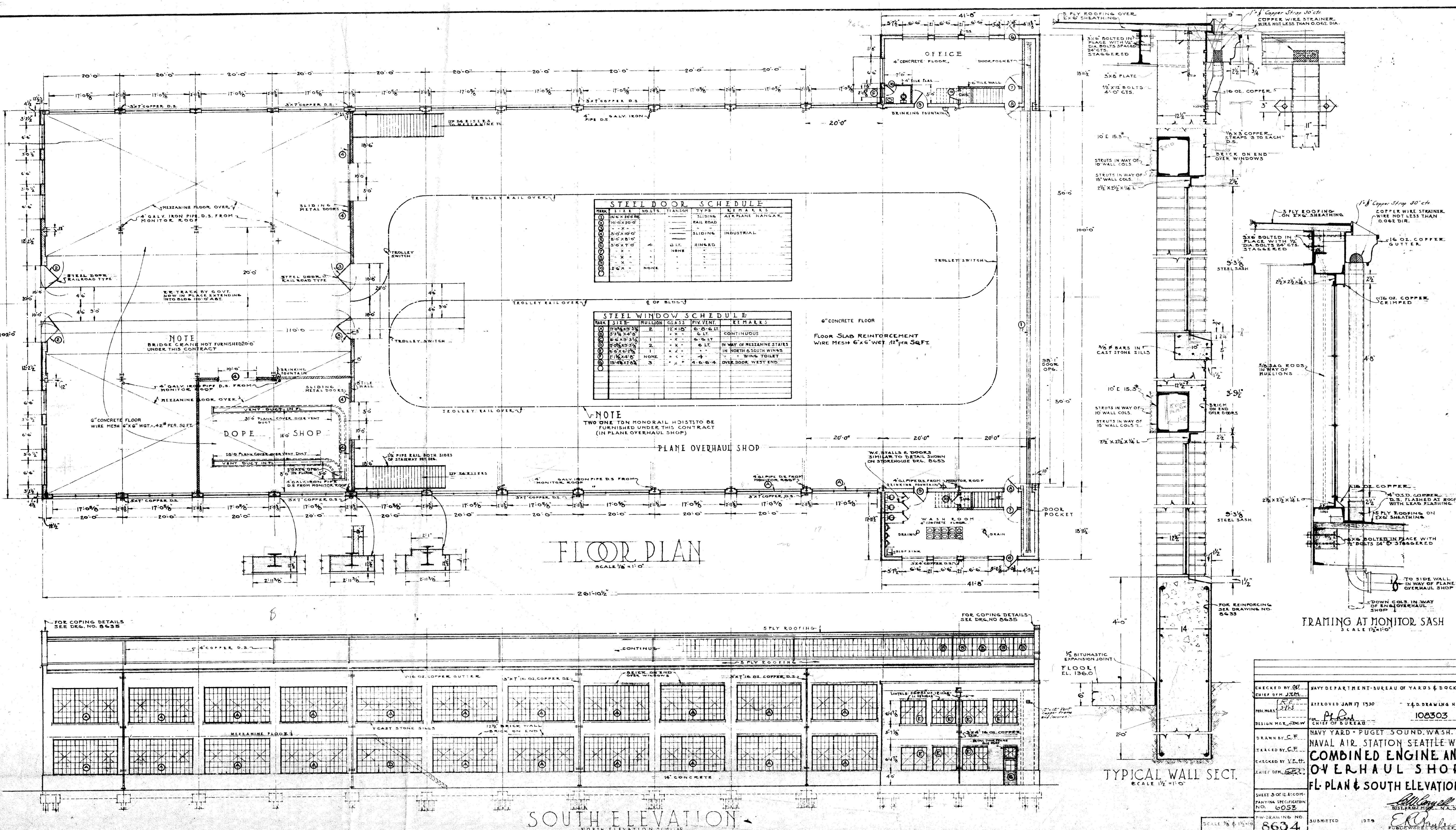
NEW GROUND FAULT CIRCUIT INTERRUPTING RECEPTACLE IN PLACE OF EXISTING RECEPTACLE.

MEZZANINE

PSM

CONSULTING ENGINEERS

Selected Original Drawings



STEEL DOOR SCHEDULE

MARK	SIZE	NO. LTS.	TRANSOM	TYPE	REMARKS
1	16'-6" x 24'-0" Adj.		—	SLIDING	AIRPLANE HANGAR
2	10'-0" x 20'-0"		—	RAIL ROAD	
3	" " x " "		—	" "	
4	5'-0" x 10'-0"		—	SLIDING	INDUSTRIAL
5	8'-0" x 8'-0"		—	"	
6	3'-0" x 7'-0"	4	6 LT.	HINGED	
7	" x "	"	NONE	"	
8	" x "	"	"	"	
9	" x "	"	"	"	
10	2'-6" x "	NONE	"	"	

STEEL WINDOW SCHEDULE

MARK	SIZE	MULLION	GLASS	PIV. VENT.	REMARKS
A	17'-0 3/8" x 9'-3 1/8"	2	12" x 18"	6-8-6 LT.	
B	5'-2 3/4" x 4'-8"		" x "	6 LT.	CONTINUOUS
C	5'-6" x 9'-3 1/8"	1	" x "	6-6 LT.	
D	17'-0 3/8" x 9'-3 1/8"	2	" x "	6 LT.	IN WAY OF MEZZANINE STAIRS
E	6'-6" x 6'-2 3/8"	1	" x "	" "	IN NORTH & SOUTH WINGS
F	2'-1 5/8" x 4'-8"	NONE	" x "	4 "	" " WING TOILET
G	19'-4 1/4" x 7'-8 3/4"	3	" x "	4-6-6-4	OVER DOOR WEST END

CHECKED BY C.W.
CHIEF DFM. J.T.M.
PROJ. MGRS. R.E.T. / J.N.S.
DESIGN MGR. DCW

NAVY DEPARTMENT - BUREAU OF YARDS & DOCKS
APPROVED JAN 17 1930
Y. & D. DRAWING NO. 108303
FOR [signature] CHIEF OF BUREAU

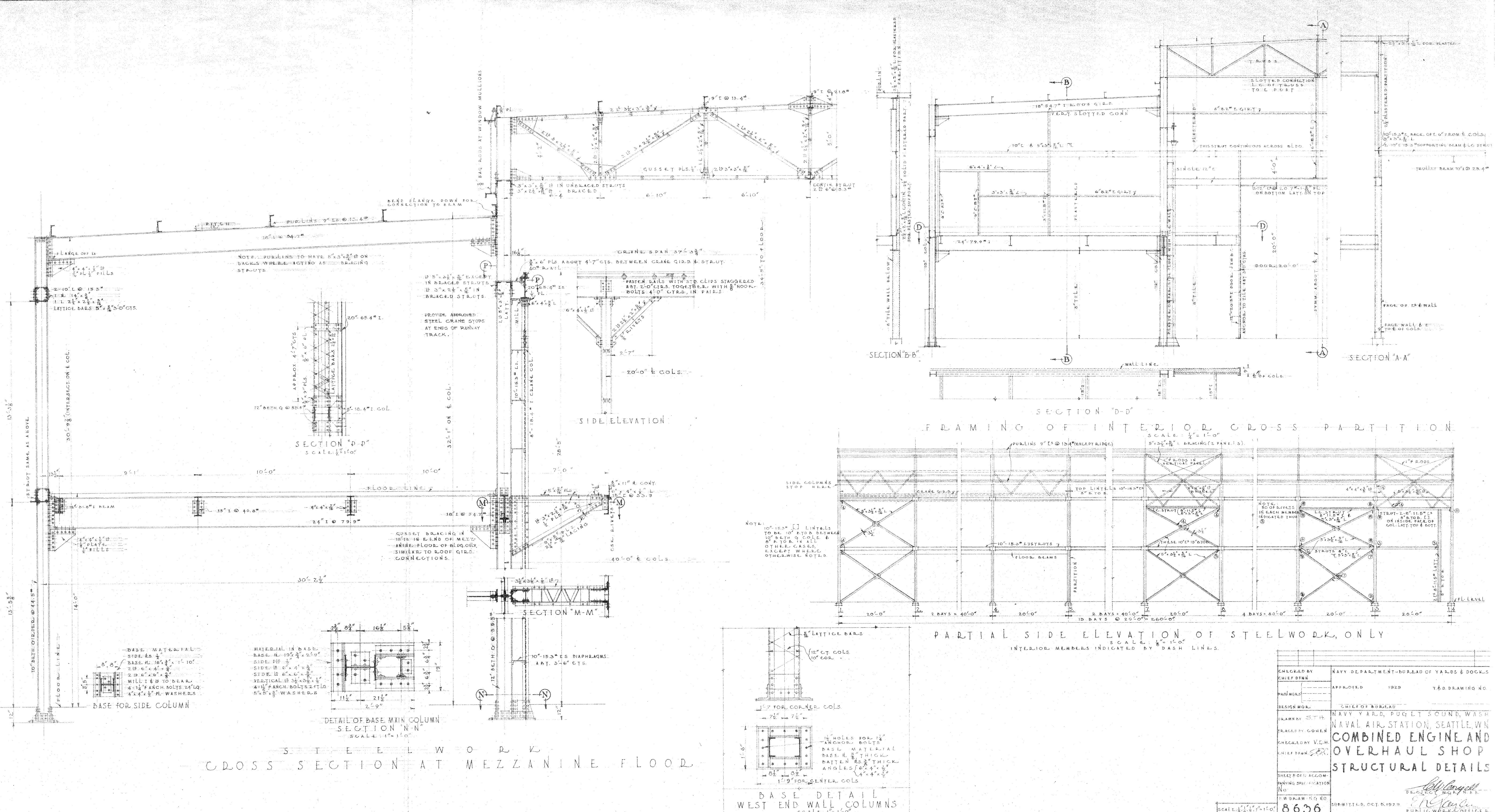
DRAWN BY C.F.
TRACED BY C.F.
CHECKED BY V.E.H.
CHIEF DFM. [signature]

NAVY YARD - PUGET SOUND, WASH.
NAVAL AIR STATION SEATTLE WN.
COMBINED ENGINE AND OVERHAUL SHOP
FL. PLAN & SOUTH ELEVATION

[signature] DIST. PROJ. MGR. N.A.S.

SHEET 3 OF 12 ACCOMPANYING SPECIFICATION NO. 6053
SCALE 1/8" & 1 1/2"=1'-0"
P.W. DRAWING NO. 8634
SUBMITTED 1929 [signature] PUBLIC WORKS OFFICER

50003



NAVY DEPARTMENT-BUREAU OF YARDS & DOCKS

APPROVED 1929 Y.&D. DRAWING NO.

CHIEF OF BUREAU

CHECKED BY CHIEF DFMN

PROJ. MGRS.

DESIGN MGR.

DRAWN BY S.T.H.

TRACED BY COHEN

CHECKED BY V.E.H.

CHIEF DFMN.

SHEET 5 OF 12 ACCOMPANYING SPECIFICATION No.

P.W. DRAWING NO. 8636

SCALE $\frac{1}{8}$", $\frac{1}{4}$", $\frac{1}{2}$", 1" = 1'-0"

NAVY YARD, PUGET SOUND, WASH

NAVAL AIR STATION, SEATTLE, WN

COMBINED ENGINE AND OVERHAUL SHOP

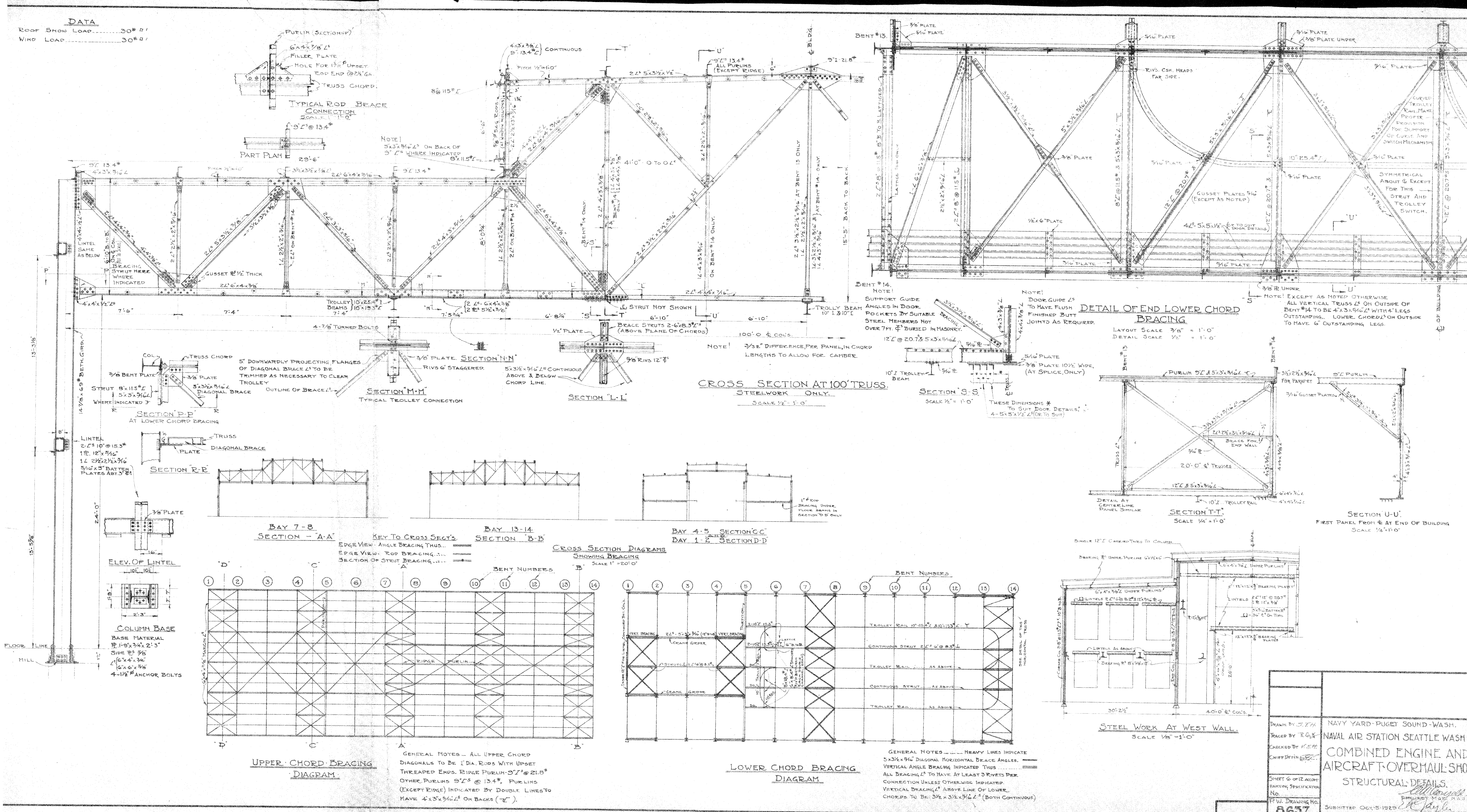
STRUCTURAL DETAILS

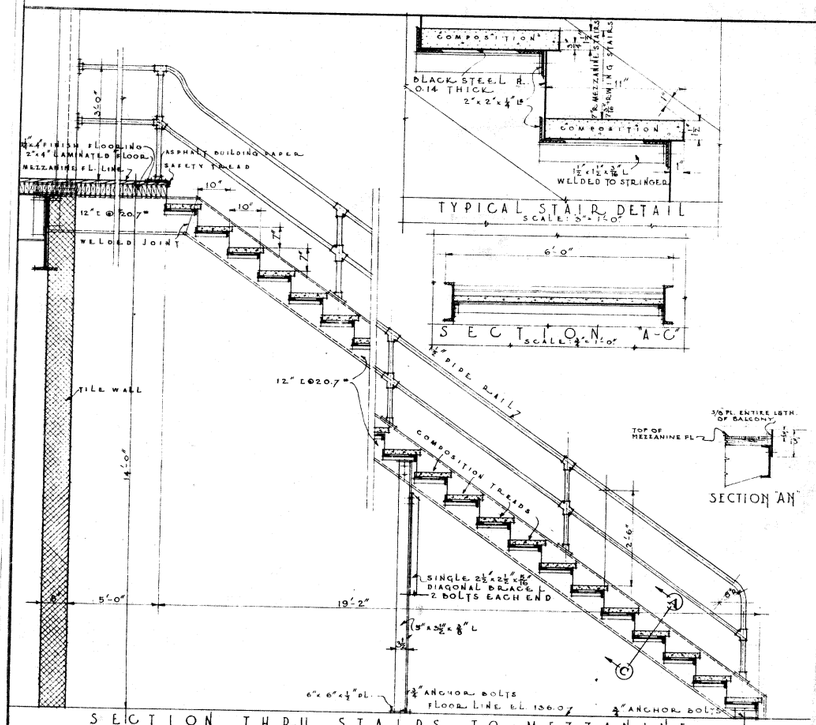
PROJECT MGR. N.A.S.

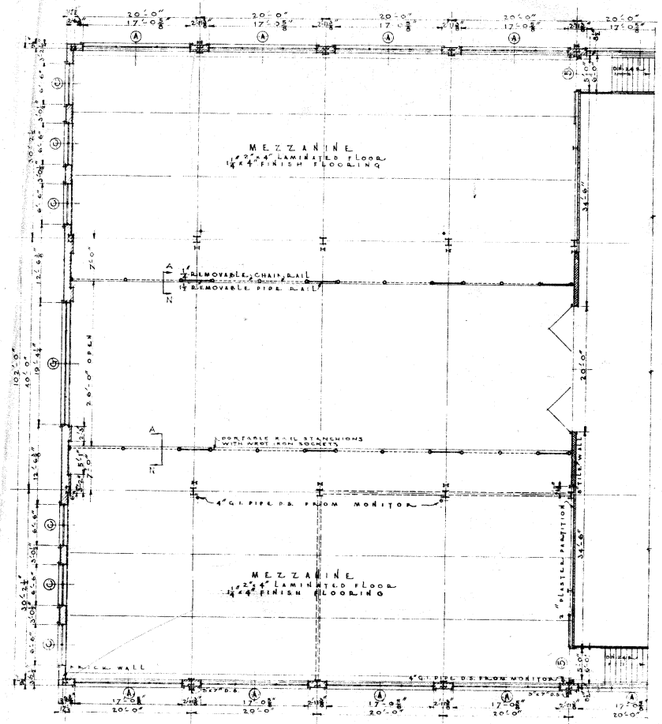
SUBMITTED, OCT. 5, 1929

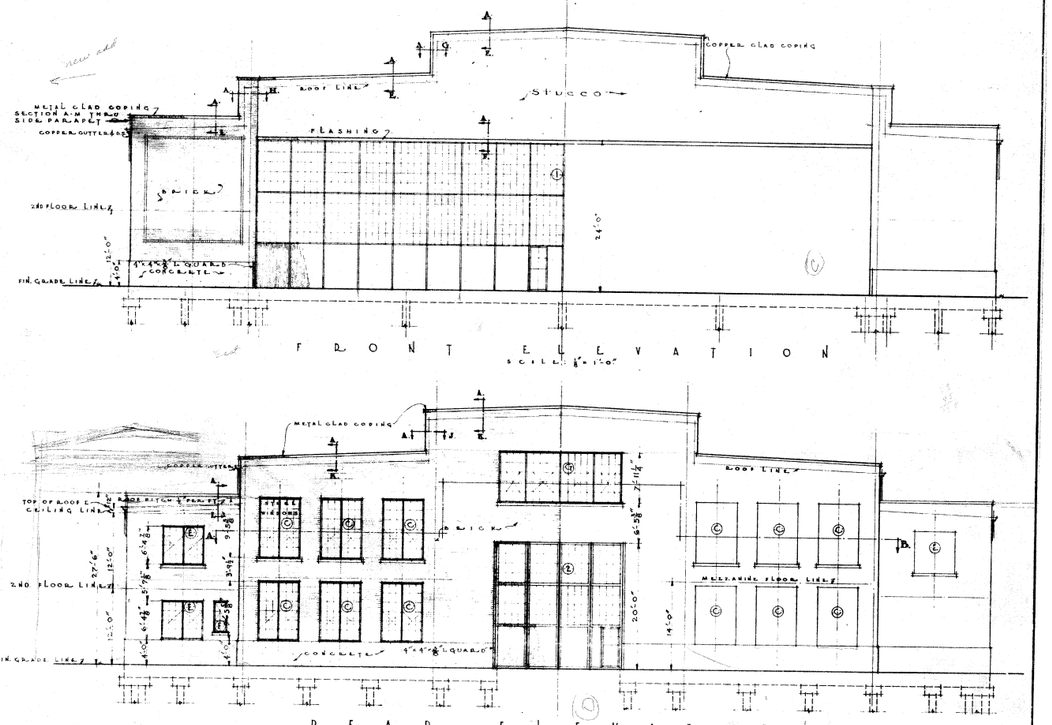
PUBLIC WORKS OFFICER.

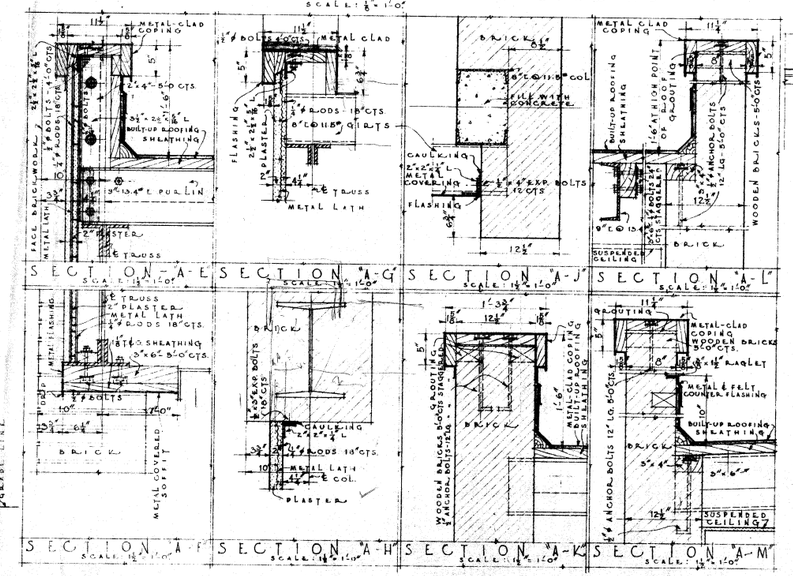
50005

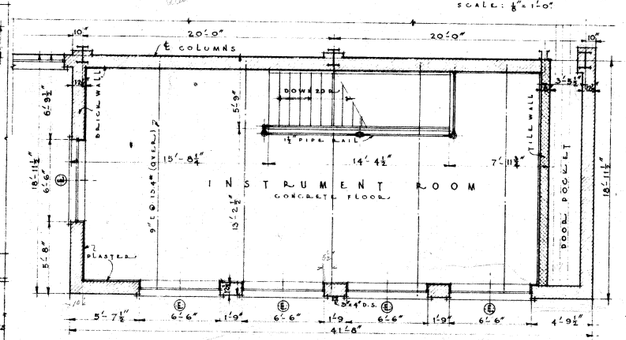

DATA
ROOF SNOW LOAD .... 30# □'
WIND LOAD .... 30# □'
TYPICAL ROD BRACE CONNECTION
PART PLAN
CROSS SECTION AT 100' TRUSS
STEELWORK ONLY.
SCALE 1/2" = 1'-0"
NOTE! 3/32" DIFFERENCE, PER PANEL, IN CHORD LENGTHS TO ALLOW FOR CAMBER.
100'-0 ℄ COL'S.
SECTION "M-M"
TYPICAL TROLLEY CONNECTION
SECTION "L-L"
SECTION "P-P"
AT LOWER CHORD BRACING
SECTION "R-R"
SECTION "S-S"
DETAIL OF END LOWER CHORD BRACING
LAYOUT SCALE 3/8" = 1'-0"
DETAIL SCALE 1/2" = 1'-0"
NOTE! EXCEPT AS NOTED OTHERWISE ALL VERTICAL TRUSS ∠S ON OUTSIDE OF BENT #14 TO BE 4×3×5/16 ∠ WITH 4" LEGS OUTSTANDING. LOWER CHORD ∠S ON OUTSIDE TO HAVE 6" OUTSTANDING LEGS.
SECTION T-T
SCALE 1/4" = 1'-0"
SECTION U-U
FIRST PANEL FROM ℄ AT END OF BUILDING
SCALE 1/4" = 1'-0"
ELEV. OF LINTEL
COLUMN BASE
BASE MATERIAL
BAY 7-8
SECTION "A-A"
KEY TO CROSS SECT'S.
EDGE VIEW - ANGLE BRACING THUS
EDGE VIEW - ROD BRACING
SECTION OF STRUT BRACING
BAY 13-14
SECTION "B-B"
CROSS SECTION DIAGRAMS SHOWING BRACING
SCALE 1" = 20'0"
BAY 4-5 SECTION C-C
BAY 1-2 SECTION D-D
BENT NUMBERS
UPPER CHORD BRACING DIAGRAM
GENERAL NOTES — ALL UPPER CHORD DIAGONALS TO BE 1" DIA. RODS WITH UPSET THREADED ENDS. RIDGE PURLIN - 9"[S @ 21.8# OTHER PURLINS 9"[S @ 13.4#. PURLINS (EXCEPT RIDGE) INDICATED BY DOUBLE LINES TO HAVE 4×3×5/16 ∠S ON BACKS.
LOWER CHORD BRACING DIAGRAM
GENERAL NOTES — HEAVY LINES INDICATE 5×3 1/2×5/16 DIAGONAL HORIZONTAL BRACE ANGLES. VERTICAL ANGLE BRACING INDICATED THUS. ALL BRACING ∠S TO HAVE AT LEAST 3 RIVETS PER CONNECTION UNLESS OTHERWISE INDICATED. VERTICAL BRACING ∠ ABOVE LINE OF LOWER CHORDS TO BE 3 1/2×3 1/2×5/16 ∠S (BOTH CONTINUOUS).
STEEL WORK AT WEST WALL
SCALE 1/8" = 1'-0"
NAVY YARD - PUGET SOUND - WASH.
NAVAL AIR STATION SEATTLE WASH.
COMBINED ENGINE AND AIRCRAFT-OVERHAUL SHOP
STRUCTURAL DETAILS.
SHEET 6 OF 12 ACCOMPANYING SPECIFICATION No.
P.W. DRAWING No. 8637
SUBMITTED OCT. 5. 1929
PUBLIC WORKS OFFICER
50006

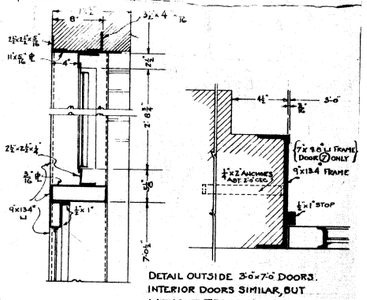












CHECKED BY OIC CHIEF DRAFTSMAN	NAVY DEPARTMENT–BUREAU OF YARDS & DOCKS
PROJ. NOS.	APPROVED JAN 17 1930. Y&D DRAWING NO. 108304
DESIGN NOS.	FOR CHIEF OF BUREAU
DRAWN BY FOOTE & CONER	NAVY YARD, PUGET SOUND, WASH
TRACED BY: GOHLE	NAVAL AIR STATION, SEATTLE, WN
CHECKED BY: S.T.H.	COMBINED ENGINE AND OVERHAUL SHOP
CHIEF DFTMN	MEZZANINE, FRONT & REAR ELEVATIONS & DETAILS
SHEET 4 OF 12 ACCOMPANYING SPECIFICATION No. 6053	PROJECT MGR. N.A.S.
P.W. DRAWING NO. 8635	SUBMITTED, OCT. 5, 1929. PUBLIC WORKS OFFICER.

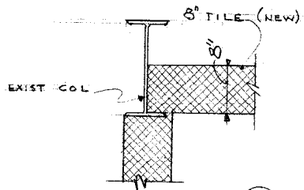
SCALE: 1/8" 1/4" 1/2" 1" 1 1/2"

50004

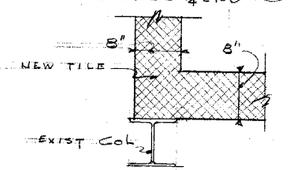
13-34-772

NOTE.

SASH TO BE OBTAINED FROM EXIST'G PARACHUTE LOFT ON MEZZANINE FLOOR. VERIFY SIZE & TYPE AT JOB. SEE DRWG# 1359



DETAIL 1
SCALE 3/4"=1'-0"



DETAIL 2
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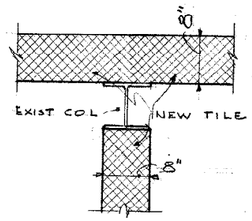

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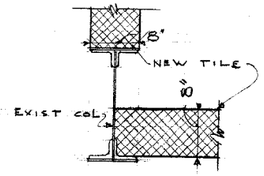

DETAIL 4
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