Development Services

From Concept to Construction

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APPEAL SUMMARY

Status: Decision Rendered - Reconsideration of ID 20424

Appeal ID: 20509	**Project Address:** 7 SE Stark St
Hearing Date: 6/12/19	**Appellant Name:** Jared Diganci
Case No.: B-013	**Appellant Phone:** (503)234-2945
Appeal Type: Building	**Plans Examiner/Inspector:** Brian McCall, Corey Stanley
Project Type: commercial	**Stories:** 10 **Occupancy:** B, M, S-2, S-1, A-3 **Construction Type:** I-B
Building/Business Name:	**Fire Sprinklers:** Yes - Entire Building
Appeal Involves: Reconsideration of appeal	**LUR or Permit Application No.:** 17-160571-CO
Plan Submitted Option: pdf [File 1] [File 2] [File 3] [File 4]	**Proposed use:** Mixed Use Development

APPEAL INFORMATION SHEET

Appeal item 1

Code Section	704.2
Requires	704.2 – Column Protection Where Columns are required to have protection to be fire-resistance rated, the entire column shall be provided individual encasement protection by protecting it on all sides for the full column length
Proposed Design	The proposed building is a Type IB, Mixed-Use 10-story, 117ft high rise core and shell development containing 6 floors of open parking garage (S-2), Ground Level Retail (M), and 4 floors of office (B). The proposed structural frame is 5 levels of long-span post-tensioned concrete frame, with 5 levels of steel frame with composite steel deck above. The top level of the parking garage has 1-HR FRR steel columns which support the composite steel deck above. Steel outriggers for cladding/cable attachment are connected to the 1-HR FRR columns. The cables are ½" diameter (Ø) galvanized steel cables tensioned to 3,100lbs and are engineered as both a vehicle barrier and guardrail. We propose wrapping the primary structure steel columns in (2) layers of ½" gypsum wallboard (Type X) to exceed the 1-HR minimum rated requirement (Refer to Exhibit 3 and Figure 722.5.1(4) "Fire Resistance of Structural Steel Columns Protected with Various Thicknesses of Type X Gypsum Wallboard"). Spray-Fireproofing at the ceiling will overlap the rated gypsum column wrap to provide continuity of fire-resistance rating. Penetrations through the gypsum board by the outriggers and vehicle barrier cable will be sealed with fire caulking. The penetration at the cables will be over-sized and filled with fire caulking that per the manufacturer allows for movement capability of 33% without compromising the efficacy of the caulking material. The structural engineer has confirmed the maximum deflection of the ½" Ø cable due from the cable's own weight at the point of penetration will be approx. 0.0105". The

structural engineer also confirmed the maximum deflection of the ½" Ø cable due to a 200lb concentrated load (IBC 1607.8.1.1) at the point of penetration will be approx. 0.277". Please Refer to Exhibit 4 for the Structural Engineers calculations. The fire caulking be installed with a 1" fire caulking joint around the cable, capable of accommodating 0.33" deflection, approximately 18% more than the expected movement.

The primary role of the cable rail is to act as a vehicle barrier and it is designed to resist a concentrated load of 6,000 lbs.The cable rails must maintain tension to satisfy this structural design capacity and provide appropriate pedestrian protection. The hole through the column fire wrap for the cables is over-sized and filled with a caulk that is resilient to and accommodates any flex from the typical movement and sagging of the cables. We propose a Maintenance schedule to measure any potential sag in the cables to monitor these cables stay within the allowable movement distance per the flexible fire caulking. We propose surveying the height of the cables per the engineered requirements upon initial installation and then establishing a maintenance schedule that will require the owner to re-survey these cable heights 1-year from installation and re-tension/repair if the cables are sagging beyond the allowed distance. After the 1st year, the cables will be re-surveyed every 5-years.

Reason for alternative Providing 1-HR FRR protection for the primary steel column was proving to have constructability problems regarding adhesion issues with spray fireproofing where the outriggers connected to the columns. Therefore, we are proposing to wrap the columns with (2) layers of ½" gypsum wallboard (Type X) and seal penetrations with fire caulking per manufacturers requirements to provide equivalency and more than the required minimum 1-HR FRR of the steel columns (Refer to Exhibit 3).

The penetration of the gypsum board at the ½" Ø cable barriers will be oversized and filled with a flexible fire caulking to accommodate the expected movement from daily use. The (2) layers of ½" gypsum wallboard (Type X) will be staggered and fastened per the OSSC Section 722.5.1.2.1 and Figure 722.5.1(3)

Please see enclosed the following exhibits including drawings and Fire Engineer's Report References:
Exhibit 1: Plan Diagram
Exhibit 2: Details + 3D Diagrams
Exhibit 3: Report from Fire Protection Engineer, David Gessert, P.E.
Exhibit 4: Structural Engineer Cable Deflection Report, DCI Engineers

APPEAL DECISION

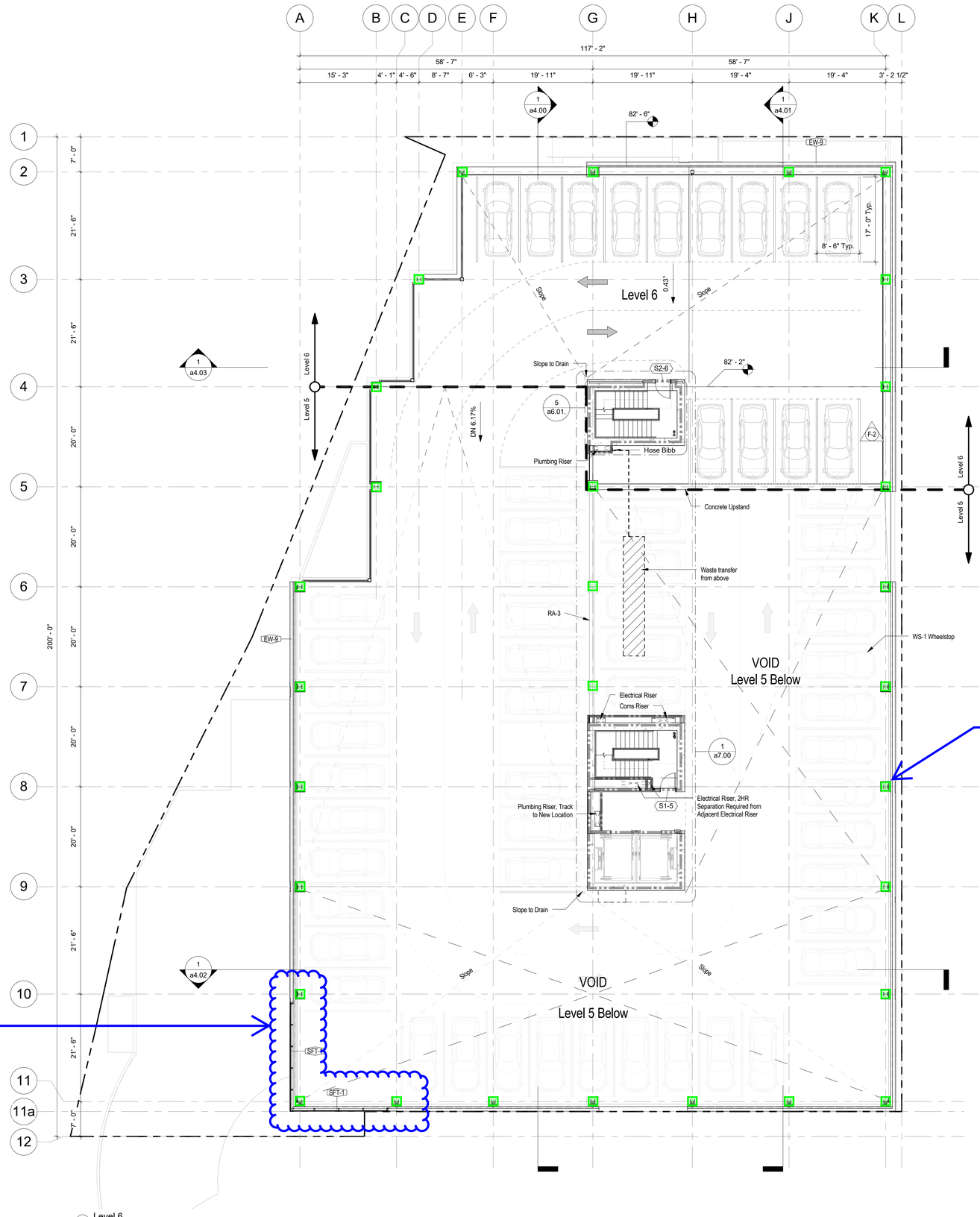
Alternate 1 hour fire rated column assembly with engineering analysis: Granted provided additional cable survey is performed at the third year.
Appellant may contact John Butler (503 823-7339) with questions.

The Administrative Appeal Board finds with the conditions noted, that the information submitted by the appellant demonstrates that the approved modifications or alternate methods are consistent with the intent of the code; do not lessen health, safety, accessibility, life, fire safety or structural requirements; and that special conditions unique to this project make strict application of those code sections impractical.

Pursuant to City Code Chapter 24.10, you may appeal this decision to the Building Code Board of Appeal within 180 calendar days of the date this decision is published. For information on the appeals process and costs, including forms, appeal fee, payment methods and fee waivers, go to www.portlandoregon.gov/bds/appealsinfo, call (503) 823-7300 or come in to the Development Services Center.

EXHIBIT 1: Plan Diagram
LEVEL 6

Locations of Rated Primary Structure Steel Columns indicated with **GREEN** Box ▢



1 Level 6
3/32" = 1'-0"

Detail A
TYPICAL Condition
See Exhibit 2

Detail B
Special Condition
See Exhibit 2

SHEET NOTES

A. Reference Sheet g0.01 for Dimensioning Standards & Abbreviations
B. Reference Sheet g0.01 for Accessibility Standards & Device Locations
C. Reference Sheets a0.01 - a0.03 For Wall Types & Ceiling Types
D. Reference Edge of Slab Plans for Opening & Additional Dimensions
E. The Emergency Generator will Provide a Minimum Fuel Supply to Accommodate at least 2-hours at Full-Demand of all Required Emergency Equipment. At least 8-hrs for Fire Pump.
F. Provide Dunnage and/or Curbs for All Mechanical Equipment
G. Shoring will be design build.
H. Provide 6-inch housekeeping pads for fire pump in Fire Pump Room
J. All Datum Levels Given are City Of Portland datum.
K. Reference schedule a9.00 and acronym sheet a9.01 for specification references.
M. Reference Sheet a0.16 for Roof Anchor Plans
N. Per Appeal ID 15506 - Intake Louver has a Water Curtain-type Sprinkler Head . Signage States "Generator Exhaust, Do Not Block". Bollards to be placed in front of this area. No Parking Allowed within 10 feet.
P. All Electrical Circuits and Junction Boxes to be located at or above the Flood Protection Elevation of 32.8ft City of Portland Datum, unless otherwise demonstrated to meet the req. of Section 7.2 of ASCE 7-05.

Legend

1 Hour Fire Barrier
2 Hour Fire Barrier
3 Hour Fire Barrier

Accessible Parking Space Calculation (per OSSC Table 1106.1)

Total Parking in Lot	Minimum Number of Accessible Spaces	"Wheelchair User Only" Spaces
201-300	7	2

7 SE Stark
Permit # 17-160571-CO
Appeal # 20424
RECONSIDERATION
6/10/2019

W.PA
works progress architecture LLP
811 SE Stark Street, Suite 210 Portland, OR 97214
503.234.2945 tel
503.234.6583 fax
worksarchitecture.net

HARSCH INVESTMENT PROPERTIES

7 SE Stark
7 SE Stark Street
Portland OR, 97214
W.PA job number: 1196

Revisions

No.	Date	Description
1	09.28.17	GMP Contract Set
		Conformed Set A 12.20.17

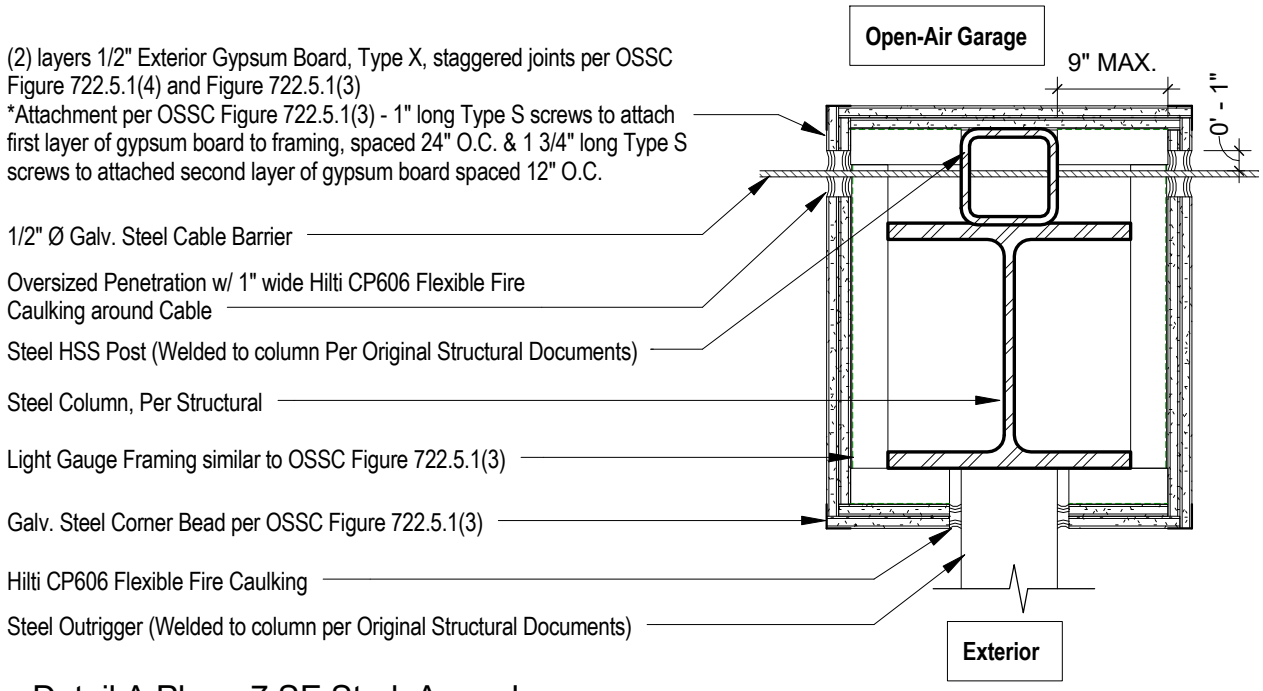
STAMP

REGISTERED ARCHITECT
CARRIE STRICKLAND
PORTLAND, OR
4952
STATE OF OREGON

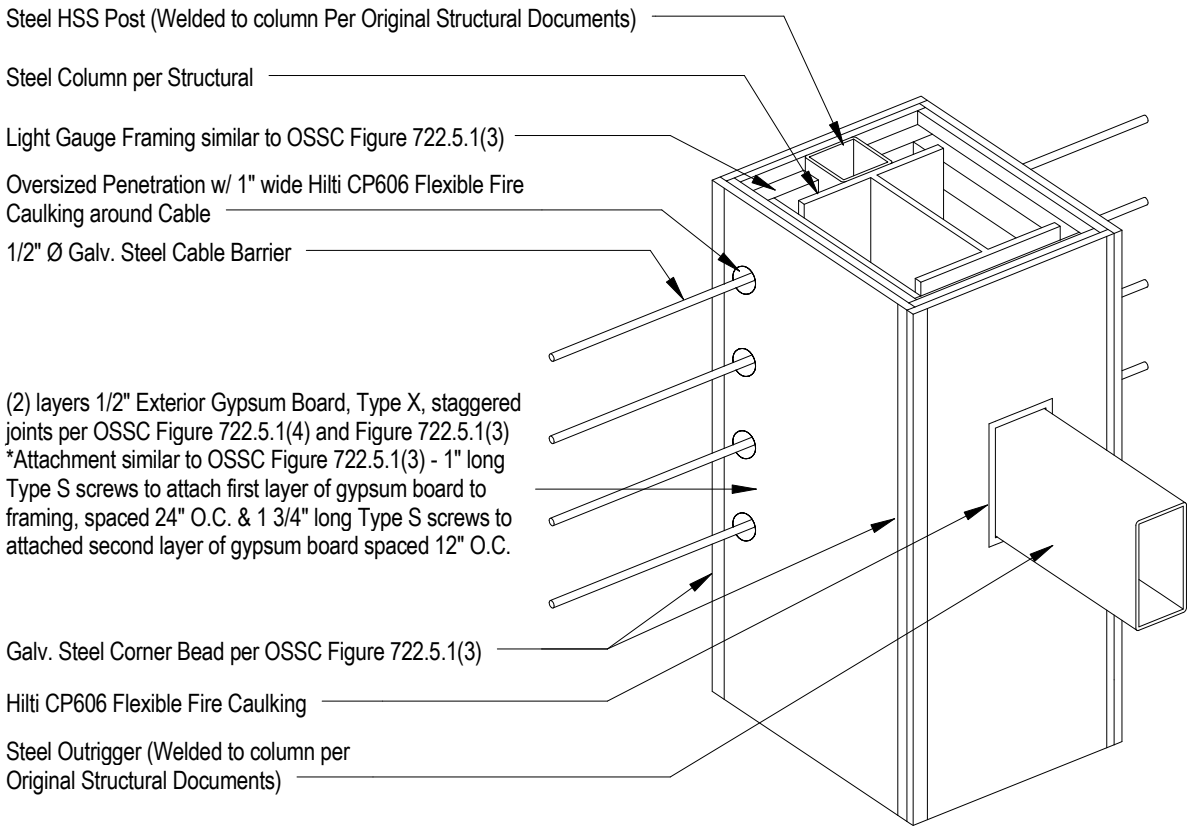
Sheet Title: Level 6
SCALE: As indicated

Sheet Number:

a2.06



1 Detail A Plan - 7 SE Stark Appeal
1 1/2" = 1'-0"



2 Detail A Axonometric Section - 7 SE Stark Appeal
1" = 1'-0"

W.PA
works progress architecture
811 SE Stark Street, Suite 210
Portland OR, 97214 (503) 234-2945

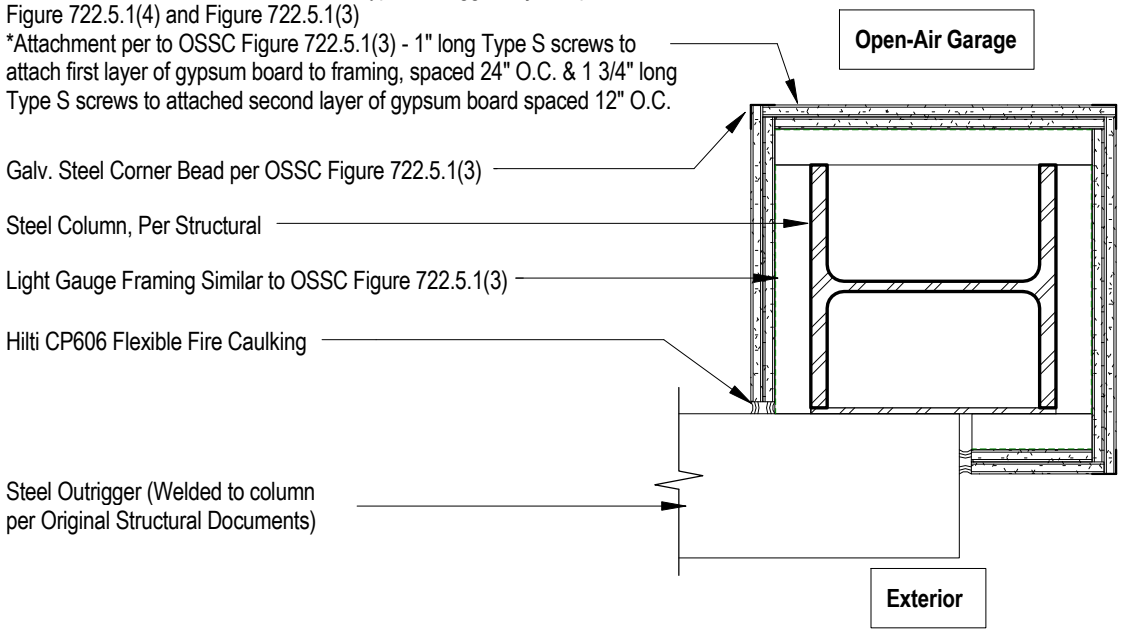
Sheet:
Issue: 7 SE Stark - 704.2 Appeal EXHIBIT 2
RE:
Date: 06/03/19
By: Author

7 SE Stark

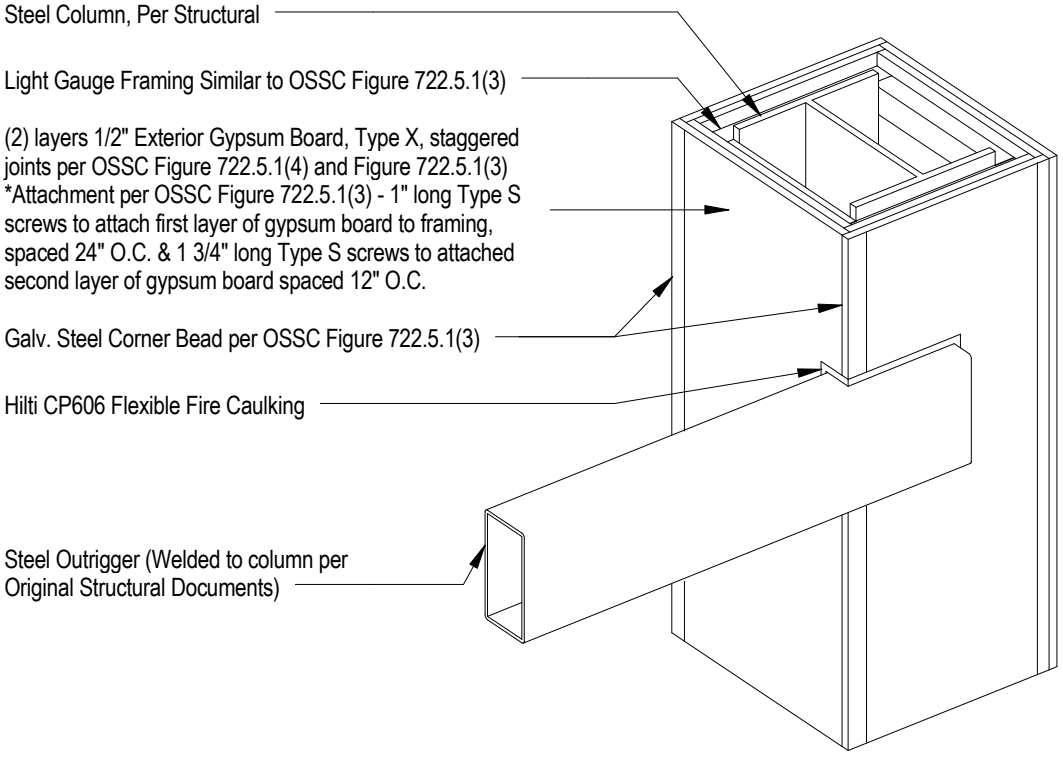
7 SE Stark
Portland, OR 97214
#1196

SK-39.0

7 SE Stark
Permit # 17-160571-CO
Appeal #20424
6/10/2019
RECONSIDERATION



1 Detail B Plan - 7 SE Stark Appeal
1 1/2" = 1'-0"



2 Detail B Axonometric Section - 7 SE Stark Appeal
1" = 1'-0"

W.PA
works progress architecture
811 SE Stark Street, Suite 210
Portland OR, 97214 (503) 234-2945

Sheet:
Issue: 7 SE Stark - 704.2 Appeal EXHIBIT 2
RE:
Date: 06/03/19
By: Author

7 SE Stark

7 SE Stark
Portland, OR 97214
#1196

SK-39.1

7 SE Stark
Permit # 17-160571-CO
Appeal #20424
6/10/2019
RECONSIDERATION

FIRE PROTECTION CONSULTING
3115 NW 132nd Place, Portland, OR 97229-7037
Phone 503-531-8717 email djgessert@gmail.com

Letter

Date:	June 4, 2019
To:	Works Progress Architecture 811 SE Stark Street, S210 Portland, OR 97214
Attention:	Jared Diganci
From:	David Gessert, P. E. Fire Protection Engineer
Subject/Project:	7 SE Stark Fire Protection of Selected Columns Alternate Design
Job No.:	2019-22

Total Pages: 6

Introduction/Executive Summary

Oregon Structural Specialty Code (OSSC), 2014 Edition 704.2 requires the subject columns to be provided with individual encasement protection the full column length. More than the code required fire resistance gypsum wallboard wrap compensates for steel cable barrier and Hollow Steel Section (HSS) outrigger penetrations of the encasement.

7 SE Stark Selected Column Protection – Alternate Design

Approximately 30 primary structure, wide-flange, steel columns will be wrapped with two layers of ½-inch Type X gypsum wallboard. This 1-inch thickness Type X gypsum wallboard provides more than 1-hour of fire resistance for the steel columns. See drawings SK-39.0 and SK-39.1

This greater than the code minimum fire resistance of the steel columns compensates for the following:

- Penetration of barrier cable of the column protection. This is a reoccurring condition where barrier cable is attached to the columns.
- Penetration of steel outriggers of the column protection. This condition occurs a maximum of one per column and only on selected columns.

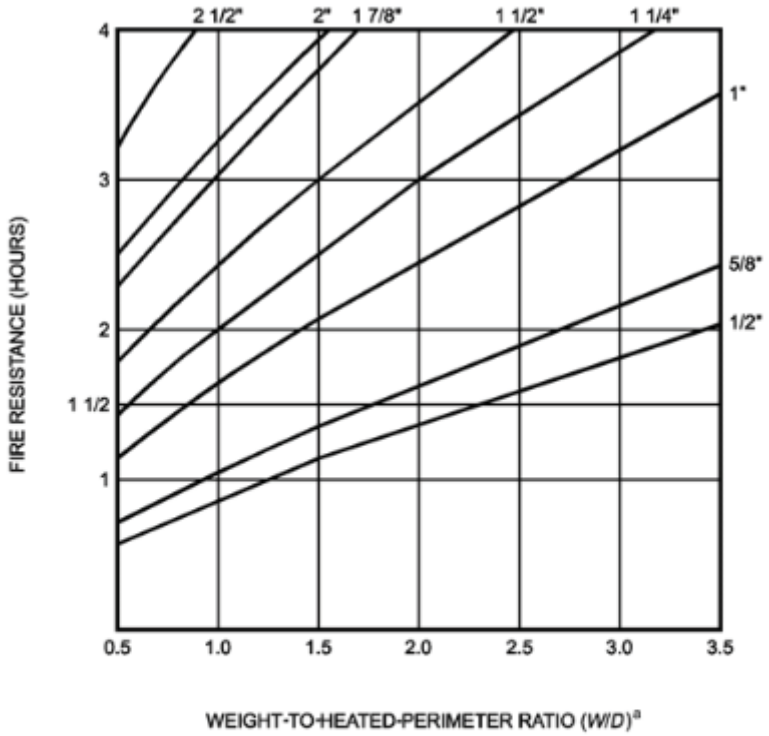
Top 4 of 11 barrier cables

Outrigger to column attachment

Column Fire Resistance Analysis

For structural steel members the W/D ratio is the weight of steel section (lb/ft) divided by the heated perimeter of section in inches.

OSSC (2014) Figure 722.5.1(4) provides the fire resistance of the steel column protected with gypsum wallboard.



For SI: 1 inch = 25.4 mm, 1 pound per linear foot/inch = 0.059 kg/m/mm.

FIGURE 722.5.1(4)
FIRE RESISTANCE OF STRUCTURAL STEEL COLUMNS PROTECTED WITH VARIOUS THICKNESSES OF TYPE X GYPSUM WALLBOARD

The following table shows the wide-flange steel column shapes that are included in the alternate design and their corresponding fire resistance provide by 1-inch of Type X gypsum wallboard. Fire resistance values are read from Figure 722.5.1(4) above.

7 SE Stark Fire Resistance of Selected Columns

Steel Column Shape	W/D Ratio[1]	Fire Resistance Hours[2]
W10x33	0.661	1:15
W10x39	0.780	1:25
W10x45	0.888	1:30
W10x49	0.840	1.25
W10x54	0.922	1:35
W10x60	1.01	1:40
W10x68	1.15	1:45
W10x77	1.28	1:50
W10x88	1.45	2:00
W12x65	0.925	1.35
W12x136	1.86	2:20

Table Notes:

1. Weight of steel section (lb/ft) divided by the heated perimeter of section in inches. Values are from Carboline publication, see References.
2. Fire resistance rounded to 5 minutes.

Both the barrier cable and HSS outrigger penetrations of the gypsum wallboard fire wrap provide conduction paths for heating of the steel columns. This is a negative attribute of the design. However the overdesign of the fire wrap slows heat transfer to the columns. This is a positive attribute. From a surface area standpoint the overdesigned fire wrap is more than an order of magnitude greater than the area of the non-compliant penetrations. The area of the penetrations of the column encasement is substantially smaller than the area of the gypsum wallboard encasement which provides greater fire resistance than required by OSSC (2014). The better than code column encasement compensates for the penetrations.

Light gauge steel framing will be inside the gypsum wallboard fire wrap for the selected columns. This framing will be attached to the selected columns. In turn the framing will support the fire wrap. OSSC (2014) 722.5.1.2.1 provides direction for the support of gypsum wallboard. This design is similar to the light gauge steel framing and gypsum wallboard shown in OSSC (2014) Figure 722.5.1(3).

The SE Stark design allows for more air movement within the gypsum wallboard fire wrap than the OSSC design. This is a positive attribute since it will delay the development of any “hot

spots" on the steel column. Failure of the ASTM E119 test for columns occurs if the average temperature on the steel at any one of the four levels exceeds 1000°F or rises above 1200°F at any one of the measured points.

Additional Considerations

Vehicle Fires – The primary if not sole fire hazard in the space of the subject columns are vehicles. Vehicles are specifically designed to minimize the probability of a fire and if a fire were to occur to minimize the size and severity of the fire. The most common cause of a vehicle fire is a collision with another moving vehicle or stationary object. The probability of a post-collision vehicle fire increases as the severity of the crash increases. Since this is a parking garage the vehicles speeds are moderate and severity of crashes is less than on the open road. Hence the rate incidence and severity of fires will be less.

Fire incidents of parked vehicles are low and propagation to adjacent vehicles is rare. In a space with code compliant fire protection sprinklers further reduces the severity of fires.

Open-Air Fires – The ASTM E119 fire test that the gypsum wallboard wrap of the columns is required to pass takes place in an enclosed furnace. All of the subject columns are in a space that is partially open to atmosphere. In actual fire conditions much of the heat from a fire will be lost to the outside. Additionally since part of the space does not have walls, there is no mass to heat up and radiate heat back to intensify the fire.

Location of Steel Outrigger – Secondary Structural Member – These HSS steel shapes are attached to the outside face of the columns. At this location it will be less likely that the column will be exposed to a fire with the intensity of the ASTM E 119 test.

Conclusion

For all the primary structure, wide-flange, steel columns two layers of ½-inch (1-inch total thickness) Type X gypsum wallboard provides more than one-hour of fire resistance. This fire resistance above 1-hour compensates for cable barrier and HSS penetrations of the column protection required by OSSC (2014) 704.2.

References

ASTM E119: *Standard Test Methods for Fire Tests of Building Construction and Materials*, American Society for Test and Materials, West Conshohocken, Pennsylvania

Drawing s2.06, Structural Mild Reinforcing Plan – Level 6, Revision 6, 10.14.17, DCI Engineers, Portland, Oregon

Drawings SK-39.0 and SK39.1, 7 SE Stark, 05/16/19 & 05/17/19, Works Progress Architecture, Portland, Oregon

Oregon Structural Specialty Code, 2014 Edition, International Code Council, Country Club Hills, Illinois

W/D, M/D, A/P Tables, Carboline Fireproofing Division, Issued: June 7, 2007, Carboline, St. Louis, Missouri

White Paper – *Evaluation of Motor Vehicle Fire Initiation and Propagation, Vehicle Crash and Fire Propagation* Test Program, 98-S4-0-04, Jack Jensen and Jeffery Santock, General Motors Corporation, USA

UL Design No. 534, October 24, 2017, UL, Northbrook, Illinois

End of Report

Project # : 16031-0120 Page # :
Proj. Name : 7 SE Stark
Engineer : PW Date : 6/7/2019
Subject : Deflection of a cable in Tension

Deflection of a cable in tension

E = 29000 ksi
Cable Dia. = 0.5 in
Length = 20 ft

Using Cable as a beam analogy: See attached report for reference

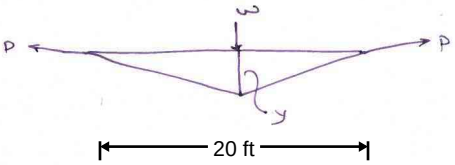
a simply supported beam of length "ℓ", loaded by a concentrated load of magnitude "w" with an axial load in tension of "P" has a deflection "y" at the center of the beam given by the following:

$$y = \frac{w}{P}\left(\frac{\ell}{4} - \frac{1}{2}\, j \tanh \frac{1}{2} U\right) \qquad \text{where}$$

$$U = \frac{\ell}{j}$$

$$j = \sqrt{\frac{EI}{P}}$$

tanh = hyperbolic tangent



$$y = \frac{\omega}{P}\left(\frac{\ell}{4} - \frac{1}{2}\, j \tanh \frac{1}{2} U\right)$$

$$U = \frac{\ell}{j} \quad ; \quad j = \sqrt{\frac{EI}{P}}$$

TENSION IN CABLE → $P = 3100$ lbs ; $\omega = 200$ lbs. ; $\ell = 20$ ft.

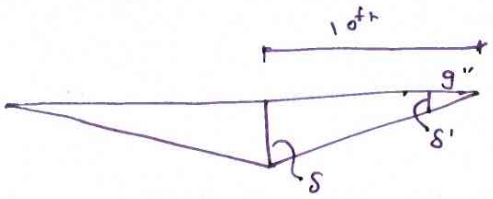
$$j = \sqrt{\frac{EI}{P}} = \sqrt{\frac{29000 \text{ ksi} \times 1000 \text{ lb/k} \times 0.0491 \times (0.5)^4}{3100 \text{ lbs}}}$$

$$j = 5.36 \quad ; \quad U = \frac{20 \text{ ft} \times 12 \text{ in/ft}}{5.36} = 44.78$$

$$y = \frac{200}{3100}\left(\frac{20 \text{ ft} \times 12 \text{ in/ft}}{4} - \frac{1}{2} \times 5.36 \times \tanh\left(\frac{44.78}{2}\right)\right)$$

$$y = 3.698''$$

Project # : 16031-0120 Page # :
Proj. Name : 7 SE Stark
Engineer : PW Date : 6/7/2019
Subject : Deflection of a cable in Tension



BY SIMILARITY of TRIANGLES —

$$\frac{\delta}{10^{ft} \times 12^{in/ft}} = \frac{\delta'}{9"}$$

$$\delta' = \frac{3.698" \times 9}{120}$$

$$\delta' = 0.277 \text{ in} \quad \text{at } 9 \text{ in.}$$

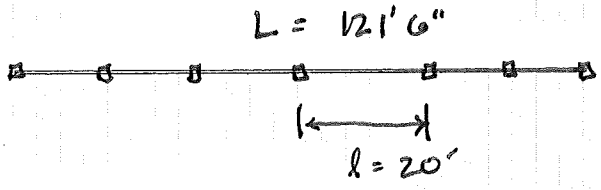
2) See attached page from Permit calculations for sag in a 20 ft cable.

Sag at 9" = 0.0105 in..... (by similarity of triangles)

EDCI ENGINEERS	Project No. 16031-0120	Sheet No.
Project: 8 SE Stark		Date: 5/17/17
Subject: Cable Barrier		By: CM

1. Prestressing to eliminate cable sag:

Grid 11:



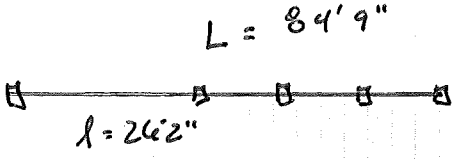
$w = 0.52$ plf for galvanized 7-wire strand

Limit sag to 0.007"/ft per PTI P-T Manual

$$F_c = \frac{l^2 w}{(0.007l)/12} \quad / 8 = 2229^{lb}$$

$s = 0.14"$ over 20'

Grid 2:



$F_c = 2916^{lb}$

↳ use initial $F_c = 3000^{lb}$

2. Impact Force

PTI vehicle force:

Cables — 250 ksi

$A = 0.153$, $E = 28{,}500{,}000$

Vehicle — 5000^{lbs}, 6' wide, 5 mph = 7.34 $\frac{ft}{s}$

mass = $5000/32.2 = 156^{lb\text{-}s^2/ft}$

$F_c = 3000$

Load spread over N=3 cables @ 4" apart

$$T = \sqrt{\left(\frac{EA}{L}\right)\left(\frac{MV^2}{N}\right) + F_c^2} = \sqrt{\left(\frac{28500000 \cdot 0.153}{121.5'}\right)\left(\frac{156 \cdot 7.34^2}{3}\right) + 3000^2}$$

$= 10466^{lb}$ @ grid 11

(12)

RADC-TR-81-392
In-House Report
January 1982

METHODS OF MEASURING AND ESTABLISHING CABLE TENSIONS IN GUYED STRUCTURES

William J. Bocchi
Nicholas G. Forlenza

ROME AIR DEVELOPMENT CENTER
Air Force Systems Command
Griffiss Air Force Base, New York 13441

ANALYTICAL METHOD:

The analytical approach is to determine tension by force resolution. This requires knowledge of the geometry of the deflected cable. In all cases, prior to attaching the tensiometer, we will assume a short segment of the cable under tension to be straight. Since we are using a relatively small deflection compared to the test length of the cable, we can also assume the cable remains straight a small distance outside the end clamps of the tensiometer. Between the clamps, the cable can take the shape of a string or a beam depending upon the bending strength of the cable. Once the geometry is known, the forces are resolved about either end point of the tensiometer (Figure 10). Neither the magnitude nor the direction of the end forces are known; however, we do know the vertical component would be equal to $\frac{P}{2}$. With the assumption that the cable is perpendicular to the central applied force, a critical parameter is the angle θ (Figure 10). θ is directly dependent on the cable properties and eventually will result in a major error consideration for the analytical method of tensiometer calibration.

Error Analysis When Using the Analytical Method To Measure Cable Tension

It is strongly emphasized that the most accurate measurements of cable tensions with a clamp on deflection tensiometer are obtained when the device has been calibrated with the exact size and type of cable under known tensions. If direct calibration is not possible, then the analytical method of resolving forces at one of the end clamps of the tensiometer may be used. As previously indicated, the amount of beam-like properties of the short length of cable between the end clamps of the tensiometer will effect the accuracy of the force resolution. Referring to Figure 10, the angle θ for a fixed deflection would be larger for a stiff cable as compared to a cable behaving like a string. Also, it has been observed that clamping the tensiometer on a length of stiff cable that was completely untensioned results in a large meter reading.

To properly evaluate these errors, three cases are to be considered:

1. The cable behaves like a perfect string.
2. The cable behaves like a beam.
3. The cable behaves like a string with varying amounts of beam properties.

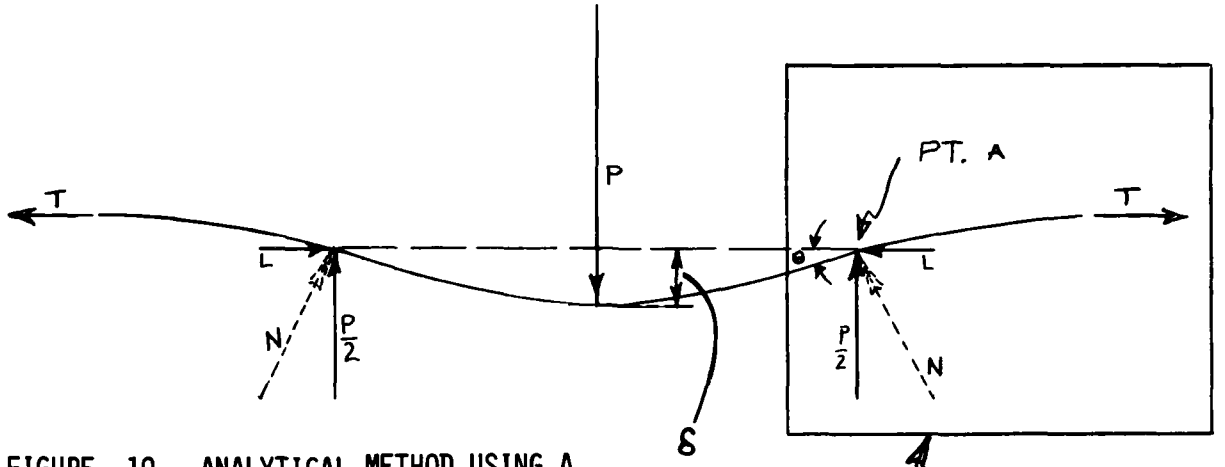


FIGURE 10 ANALYTICAL METHOD USING A TENSIOMETER

RESOLVED SECTIONS

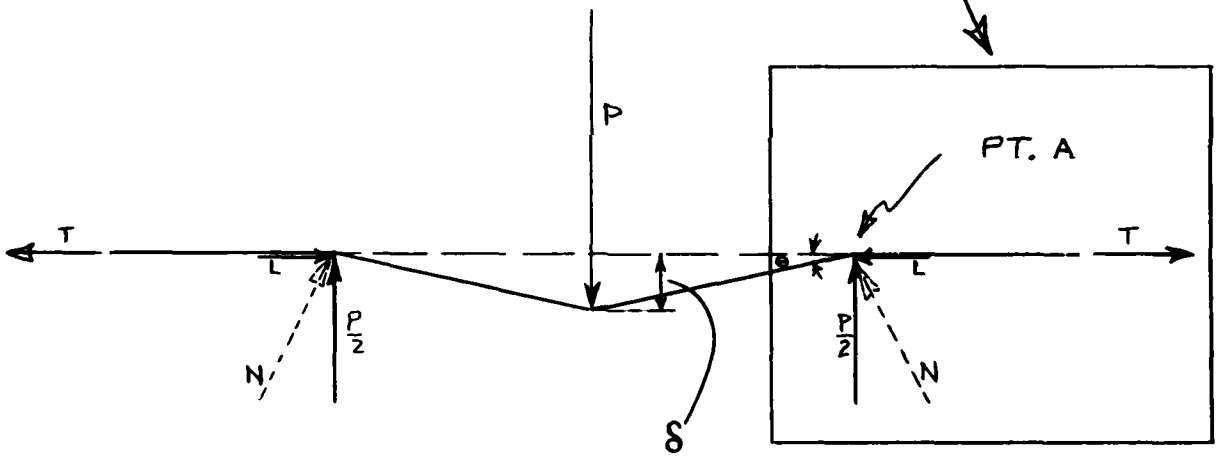


FIGURE 11 PERFECT STRING CASE

1. The Perfect String

Since a perfect string supports no bending moment, the cable will be straight between points of force application, as shown in Figure 11. This simplification eliminates all curves from the diagram and allows θ to be calculated from the geometry of the included right triangle.

$$\theta = \tan^{-1} \frac{\alpha}{L}$$

As previously stated, once θ is known the tension can be found by force resolution by the equation:

$$T = \frac{P}{2\sin\theta}$$ (Figure 12)

2. Cable As A Beam

In the case of assuming the cable to behave as a beam, the angle θ becomes much more difficult to evaluate. Consider a beam on simple end supports with a concentrated center load. Without an axial load, the angle θ can be evaluated by the well known beam deflection equation:

$$\theta = \frac{w\ell^2}{16EI}$$

However, with an axial load applied, the relationships between deflections and lateral load become very complicated and include the unknown axial force as well. For example, a simply supported beam of length "ℓ", loaded by a concentrated load of magnitude "w" with an axial load in tension of "P" has a deflection "y" at the center of the beam given by the following:

$$y = \frac{w}{P}\left(\frac{\ell}{4} - \frac{1}{2}\, j \tanh \frac{1}{2} U\right)$$ where

$$U = \frac{\ell}{j}$$

$$j = \sqrt{\frac{EI}{P}}$$

tanh = hyperbolic tangent

Thus, since "P" is an unknown (the desired value of the cable tension), force resolution of a clamp on tensiometer becomes difficult for finding the axial tension in a beam. It should further be noted that "I", the bending moment of inertia, cannot be computed for a stranded cable because the cross section material is not homogeneous.