PROJECT DESCRIPTION

TOWER SCOPE OF WORK:

- REMOVE (3) RRHs PER SECTOR
- REMOVE (1) ANTENNA PER SECTOR
- REMOVE (E) PENTHOUSE STRUCTURE
- REPLACE (6) 7/8" COAX, (6) DC TRUNKS & (3) FIBER TRUNKS FOR RELOCATED SECTORS
- RELOCATE (6) ANTENNAS TOTAL
- RELOCATE (6) RRHs TOTAL
- RELOCATE (2) WCS FILTERS TOTAL (1 PER ALPHA, (1) PER BETA)
- RELOCATE (1) TMA PER SECTOR
- RELOCATE (1) SURGE SUPPRESSORS PER SECTOR
- INSTALL NEW (2) ANTENNAS PER SECTOR
- INSTALL NEW (3) RRHs PER SECTOR
- INSTALL NEW (3) CABLE TRAYS
- INSTALL NEW ROOF TOP MOUNT AND FRP SCREENING BY CALIBER ENGINEERING SOLUTIONS DATED 04/22/2020

GROUND SCOPE OF WORK:

- INSTALL NEW (2) RECTIFIERS IN (E) POWER PLANT.
- INSTALL NEW (1) FSM4 w/ (1) AMIA (1) ABIL & (1) ASIK
- INSTALL NEW (15) VERTIV POWER EXTEND CONVERTERS [NEQ. 44717] IN (E) POWER PLANT

PERMIT NUMBER: 2020-1865221 LT
RSN 1487202
ADDRESS: 1501 S. POTOMAC STREET
ELECTRICAL AND STRUCTURAL INSPECTIONS REQUIRED

City of Aurora Building Division
Reviewed for Code Compliance
Approved as Noted: *cmacy*
Date: *Sep 16, 2020*
2015 INTERNATIONAL CODES & 2020 NEC

Code violations that are found during inspection are required to be corrected. Permit issuance does not grant approval of a code violation.

Field inspection consultation is available upon request. Call 303-739-7420 to request a consultation.

Structural plan review is limited to a general survey for code compliance. No review is implied nor was undertaken to verify structural adequacy.

SCOPE OF WORK

☐ 1C ☐ 3C ☐ 5C ☒ 5G NR ☒ 4TXRX

☐ 2C ☐ 4C ☒ 6C ☐ 2ND RRH ADD

PROJECT INFORMATION

SITE ADDRESS:	1501 SOUTH POTOMAC AURORA, CO 80045	ZONING DISTRICT:	PD
		EXISTING USE:	UNMANNED TELECOMMUNICATIONS FACILITY
LATITUDE:	39° 41' 22.6602" (39.6896278)	NEW USE:	UNMANNED TELECOMMUNICATIONS FACILITY
LONGITUDE:	-104° 49' 57.4788" (-104.832633)	CONSTRUCTION TYPE:	II-B
JURISDICTION:	CITY OF AURORA	A.P.N.	1973-24-1-23-001

RF DATA SHEET

DATE ISSUED: 03/29/2019 VERSION: 2.00 RFDS ID :2983896

DRAWING INDEX

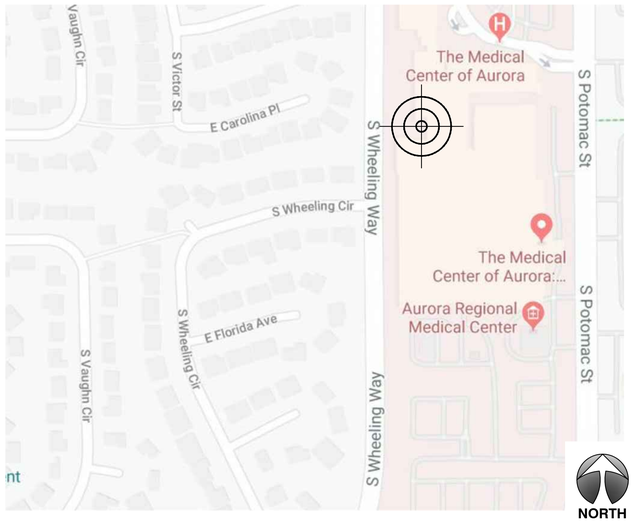
		REV
10093833-COL01176-T-1	TITLE SHEET	0
10093833-COL01176-GN-1	GENERAL NOTES	0
10093833-COL01176-A-1	OVERALL SITE PLAN	0
10093833-COL01176-A-1.1	ROOFTOP SITE PLAN	0
10093833-COL01176-A-2	EXISTING ENLARGED EQUIPMENT PLAN	0
10093833-COL01176-A-3	NEW ENLARGED EQUIPMENT PLAN	0
10093833-COL01176-A-4	EXISTING & NEW ELEVATIONS	0
10093833-COL01176-A-4.1	EXISTING & NEW ELEVATIONS	0
10093833-COL01176-RF-1	EXISTING & NEW ANTENNA CONFIGURATION	0
10093833-COL01176-RF-2	RF & EQUIPMENT DETAILS	0
10093833-COL01176-G-1	SCHEMATIC GROUNDING PLAN & DETAILS	0

FRP SCREENING DESIGN AND MOUNT DETAILS ADDED AS ADDENDUM TO DRAWING

SITE NAME: HUMANA
SITE NUMBER: COL01176
PROJECT: LTE 6C: MRUTH034610/5G NR: MRUTH034541/4T4RX: MRUTH034640
CONSTRUCTION DRAWINGS

VICINITY MAP

DIRECTIONS: (161 INVERNESS DR WEST,2ND FLOOR ENGLEWOOD, CO 80112):
161 INVERNESS DR W 2ND FLOOR ENGLEWOOD, CO 80112, USA GET ON I-25 N IN CENTENNIAL FROM INVERNESS BLVD (0.7 MI) CONTINUE ON I-25 N TO DENVER. TAKE EXIT 200 FROM I-25 N (4.8 MI) USE THE LEFT 2 LANES TO TURN LEFT ONTO SYOSEMITE ST (1.0 MI) USE THE RIGHT 2 LANES TO TURN RIGHT ONTO CO-30 E/E HAMPDEN AVE CONTINUE TO FOLLOW CO-30 E PASS BY DISCOUNT TIRE (ON THE RIGHT IN 2.4 MI) (2.9 MI) CONTINUE ON E JEWELL AVE. DRIVE TO S WHEELING WAY (2.2 MI) 1501 S POTOMAC ST AURORA, CO 80045, USA



APPLICABLE BLDG. CODES AND STANDARDS

SUBCONTRACTOR'S WORK SHALL COMPLY WITH ALL APPLICABLE NATIONAL, STATE, AND LOCAL CODES AS ADOPTED BY THE LOCAL AUTHORITY HAVING JURISDICTION (AHJ) FOR THE LOCATION. THE EDITION OF THE AHJ ADOPTED CODES AND STANDARDS IN EFFECT ON THE DATE OF CONTRACT AWARD SHALL GOVERN THE DESIGN.

BUILDING CODE:
[INTERNATIONAL BUILDING CODE (IBC), 2015 AS ADOPTED BY THE LOCAL JURISDICTION]

ELECTRICAL CODE:
[NATIONAL ELECTRICAL CODE, 2020 AS ADOPTED BY THE LOCAL JURISDICTION]

LIGHTNING PROTECTION CODE:
[NFPA 780 – 2002, LIGHTNING PROTECTION CODE]

SUBCONTRACTOR'S WORK SHALL COMPLY WITH THE LATEST EDITION OF THE FOLLOWING STANDARDS. AMERICAN CONCRETE INSTITUTE (ACI) 318, BUILDING CODE REQUIREMENTS FOR STRUCTURAL CONCRETE AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC), MANUAL OF STEEL CONSTRUCTION, ASD, THIRTEENTH EDITION ANSI/TIA 222-G, STRUCTURAL STANDARDS FOR ANTENNA SUPPORTING STRUCTURES AND ANTENNAS.

TIA 607, COMMERCIAL BUILDING GROUNDING AND BONDING REQUIREMENTS FOR TELECOMMUNICATIONS

INSTITUTE FOR ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE) 81, GUIDE FOR MEASURING EARTH RESISTIVITY, GROUND IMPEDANCE, AND EARTH SURFACE POTENTIALS OF A GROUND SYSTEM IEEE 1100 (1999) RECOMMENDED PRACTICE FOR POWERING AND GROUNDING OF ELECTRONIC EQUIPMENT

IEEE C2 NATIONAL ELECTRIC SAFETY CODE, LATEST VERSION

TELCORDIA GR-1275, GENERAL INSTALLATION REQUIREMENTS

ANSI T1.311, FOR TELECOM – DC POWER SYSTEMS – TELECOM, ENVIRONMENTAL PROTECTION

FOR ANY CONFLICTS BETWEEN SECTIONS OF LISTED CODES AND STANDARDS REGARDING MATERIAL, METHODS OF CONSTRUCTION, OR OTHER REQUIREMENTS, THE MOST RESTRICTIVE REQUIREMENT SHALL GOVERN. WHERE THERE IS CONFLICT BETWEEN A GENERAL REQUIREMENT AND A SPECIFIC REQUIREMENT, THE SPECIFIC REQUIREMENT SHALL GOVERN.

STRUCTURAL ANALYSIS OF TOWER BY AMMTEC CONSULTANTS, PLLC AND ANTENNA MOUNT ANALYSIS IS BY AMMTEC CONSULTANTS, PLLC . BOTH THE GC AND BUILDING OFFICIAL MUST ENSURE THE STRUCTURAL ANALYSIS DOCUMENTS HAVE BEEN PROVIDED BY AT&T. GC TO ENSURE THAT ANY TOWER OR MOUNT MODIFICATIONS ARE MADE PRIOR TO INSTALLATION.

SITE PROJECT PARTICIPANTS

	NAME	COMPANY	NUMBER
A/E	CHRISTIAN MUELLER	TELCYTE INFRASTRUCTURE SERVICES	720-244-6013
SAC	NATHAN MARTONE	SMARTLINK, LLC	817-287-9725
RF	ROEL SIGUE	AT&T WIRELESS	703-599-6115
LANDLORD	T.B.D	500 EAST 84TH LLC	T.B.D

DIG INFO

CALL COLORADO ONE CALL
(800) 922-1987
CALL 3 WORKING DAYS
BEFORE YOU DIG!

SCALING DRAWINGS

SUBCONTRACTOR SHALL VERIFY ALL PLANS, EXISTING DIMENSIONS & CONDITIONS ON THE JOB SITE & SHALL IMMEDIATELY NOTIFY THE ENGINEER IN WRITING OF ANY DISCREPANCIES BEFORE PROCEEDING WITH THE WORK OR BE RESPONSIBLE FOR THE SAME.

IF USING 11"x17" PLOT, DRAWINGS WILL BE AT HALF SCALE.

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SHEET TITLE
TITLE SHEET

SHEET NUMBER
T-1

GENERAL NOTES:

1. FOR THE PURPOSE OF CONSTRUCTION DRAWING, THE FOLLOWING DEFINITIONS SHALL APPLY:
   1.1. CONTRACTOR – T.B.D.
   1.2. SUBCONTRACTOR – GENERAL CONTRACTOR (CONSTRUCTION)
   1.3. OWNER – AT&T MOBILITY
   1.4. OEM – ORIGINAL EQUIPMENT MANUFACTURE

2. PRIOR TO THE SUBMISSION OF BIDS, THE BIDDING SUBCONTRACTOR SHALL VISIT THE CELL SITE TO FAMILIARIZE THEMSELVES WITH THE EXISTING CONDITIONS AND TO CONFIRM THAT THE WORK CAN BE ACCOMPLISHED AS SHOWN ON THE CONSTRUCTION DRAWINGS. ANY DISCREPANCY FOUND SHALL BE BROUGHT TO THE ATTENTION OF CONTRACTOR.

3. ALL MATERIALS FURNISHED AND INSTALLED SHALL BE IN STRICT ACCORDANCE WITH ALL APPLICABLE CODES, REGULATIONS, AND ORDINANCES. SUBCONTRACTOR SHALL ISSUE ALL APPROPRIATE NOTICES AND COMPLY WITH ALL LAWS, ORDINANCES, RULES, REGULATIONS, AND LAWFUL ORDERS OF ANY PUBLIC AUTHORITY REGARDING THE PERFORMANCE OF THE WORK. ALL WORK CARRIED OUT SHALL COMPLY WITH ALL APPLICABLE MUNICIPAL AND UTILITY COMPANY SPECIFICATIONS AND LOCAL JURISDICTIONAL CODES, ORDINANCES AND APPLICABLE REGULATIONS.

4. UNLESS NOTED OTHERWISE, THE WORK SHALL INCLUDE FURNISHING MATERIALS, EQUIPMENT, APPURTENANCES, AND LABOR NECESSARY TO COMPLETE ALL INSTALLATIONS AS INDICATED ON THE DRAWINGS.

5. THE SUBCONTRACTOR SHALL INSTALL ALL EQUIPMENT AND MATERIALS IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS UNLESS SPECIFICALLY STATED OTHERWISE.

6. IF THE SPECIFIED EQUIPMENT CANNOT BE INSTALLED AS SHOWN ON THESE DRAWINGS, THE SUBCONTRACTOR SHALL PROPOSE AN ALTERNATIVE INSTALLATION FOR APPROVAL BY THE CONTRACTOR.

7. SUBCONTRACTOR SHALL DETERMINE ACTUAL ROUTING OF CONDUIT, POWER AND T1 CABLES, GROUNDING CABLES AS SHOWN ON THE POWER, GROUNDING AND TELCO PLAN DRAWING. SUBCONTRACTOR SHALL UTILIZE EXISTING TRAYS AND/OR SHALL ADD NEW TRAYS AS NECESSARY. SUBCONTRACTOR SHALL CONFIRM THE ACTUAL ROUTING WITH THE CONTRACTOR. ROUTING OF TRENCHING SHALL BE APPROVED BY CONTRACTOR.

8. THE SUBCONTRACTOR SHALL PROTECT EXISTING IMPROVEMENTS, PAVEMENTS, CURBS, LANDSCAPING AND STRUCTURES. ANY DAMAGED PART SHALL BE REPAIRED AT SUBCONTRACTOR'S EXPENSE TO THE SATISFACTION OF OWNER.

9. SUBCONTRACTOR SHALL LEGALLY AND PROPERLY DISPOSE OFF ALL SCRAP MATERIALS SUCH AS COAXIAL CABLES AND OTHER ITEMS REMOVED FROM THE EXISTING FACILITY. ANTENNAS REMOVED SHALL BE RETURNED TO THE OWNER'S DESIGNATED LOCATION.

10. SUBCONTRACTOR SHALL LEAVE PREMISES IN CLEAN CONDITION.

11. ALL CONCRETE REPAIR WORK SHALL BE DONE IN ACCORDANCE WITH AMERICAN CONCRETE INSTITUTE (ACI) 301.

12. ALL STRUCTURAL STEEL WORK SHALL BE DONE IN ACCORDANCE WITH AISC SPECIFICATIONS.

13. CONSTRUCTION SHALL COMPLY WITH SPECIFICATION 25741–000–3APS–A0OZ–00002, GENERAL CONSTRUCTION SERVICES.

14. SUBCONTRACTOR SHALL VERIFY ALL EXISTING DIMENSIONS AND CONDITIONS PRIOR TO COMMENCING ANY WORK. ALL DIMENSIONS OF EXISTING CONSTRUCTION SHOWN ON THE DRAWINGS MUST BE VERIFIED. SUBCONTRACTOR SHALL NOTIFY THE CONTRACTOR OF ANY DISCREPANCIES PRIOR TO ORDERING MATERIAL OR PROCEEDING WITH CONSTRUCTION.

15. THE EXISTING CELL SITE IS IN FULL COMMERCIAL OPERATION. ANY CONSTRUCTION WORK BY SUBCONTRACTOR SHALL NOT DISRUPT THE EXISTING NORMAL OPERATION. ANY WORK ON EXISTING EQUIPMENT MUST BE COORDINATED WITH CONTRACTOR. ALSO, WORK MAY NEED TO BE SCHEDULED FOR AN APPROPRIATE MAINTENANCE WINDOW USUALLY IN LOW TRAFFIC PERIODS AFTER MIDNIGHT.

16. SINCE THE CELL SITE MAY BE ACTIVE, ALL SAFETY PRECAUTIONS MUST BE TAKEN WHEN WORKING AROUND HIGH LEVELS OF ELECTROMAGNETIC RADIATION. EQUIPMENT SHOULD BE SHUTDOWN PRIOR TO PERFORMING ANY WORK THAT COULD EXPOSE THE WORKERS TO DANGER. PERSONAL RF EXPOSURE MONITORS ARE REQUIRED TO BE WORN TO ALERT OF ANY DANGEROUS EXPOSURE LEVELS.

17. WIRING, RACEWAY, AND SUPPORT METHODS AND MATERIALS SHALL COMPLY WITH THE REQUIREMENTS OF THE NEC AND TELCORDIA.

18. SUBCONTRACTOR SHALL MODIFY EXISTING CABLE TRAY SYSTEM AS REQUIRED TO SUPPORT RF AND TRANSPORT CABLING TO THE NEW BTS EQUIPMENT. SUBCONTRACTOR SHALL SUBMIT MODIFICATIONS TO CONTRACTOR FOR APPROVAL.

19. CABLES SHALL NOT BE ROUTED THROUGH LADDER–STYLE CABLE TRAY RUNGS.

20. EACH END OF EVERY POWER, GROUNDING, AND T1 CONDUCTOR AND CABLE SHALL BE LABELED WITH COLOR–CODED INSULATION OR ELECTRICAL TAPE (3M BRAND, 1/2 INCH PLASTIC ELECTRICAL TAPE WITH UV PROTECTION, OR EQUAL). THE IDENTIFICATION METHOD SHALL CONFORM WITH NEC & OSHA, AND MATCH EXISTING INSTALLATION REQUIREMENTS.

21. POWER PHASE CONDUCTORS (I.E., HOTS) SHALL BE LABELED WITH COLOR–CODED INSULATION OR ELECTRICAL TAPE (3M BRAND, ½ INCH PLASTIC ELECTRICAL TAPE WITH UV PROTECTION, OR EQUAL). PHASE CONDUCTOR COLOR CODES SHALL CONFORM WITH THE NEC & OSHA AND MATCH EXISTING INSTALLATION REQUIREMENTS.

22. ALL ELECTRICAL COMPONENTS SHALL BE CLEARLY LABELED WITH ENGRAVED LAMACOID PLASTIC LABELS. ALL EQUIPMENT SHALL BE LABELED WITH THEIR VOLTAGE RATING, PHASE CONFIGURATION, WIRE CONFIGURATION, POWER OR AMPACITY RATING, AND BRANCH CIRCUIT ID NUMBERS (I.E., PLANELOAD AND CIRCUIT ID'S).

23. PANELBOARDS (ID NUMBERS) AND INTERNAL CIRCUIT BREAKERS (CIRCUIT ID NUMBERS) SHALL BE CLEARLY LABELED WITH ENGRAVED LAMACOID PLASTIC LABELS.

24. ALL TIE WRAPS WHERE PERMITTED SHALL BE CUT FLUSH WITH APPROVED CUTTING TOOL TO REMOVE SHARP EDGES. USE LOW PROFILES TIE WRAPS.

25. NONMETALLIC RECEPTACLE, SWITCH, AND DEVICE BOXES SHALL MEET OR EXCEED NEMA OS 2; AND RATED NEMA 1 (OR BETTER) INDOORS, OR WEATHER PROTECTED (WP OR BETTER) OUTDOORS.

26. THE SUBCONTRACTOR SHALL NOTIFY AND OBTAIN NECESSARY AUTHORIZATION FROM THE CONTRACTOR BEFORE COMMENCING WORK ON THE AC POWER DISTRIBUTION PANELS.

27. THE SUBCONTRACTOR SHALL PROVIDE NECESSARY TAGGING ON THE BREAKERS, CABLES AND DISTRIBUTION PANELS IN ACCORDANCE WITH THE APPLICABLE CODES AND STANDARDS TO SAFEGUARD AGAINST LIFE AND PROPERTY.

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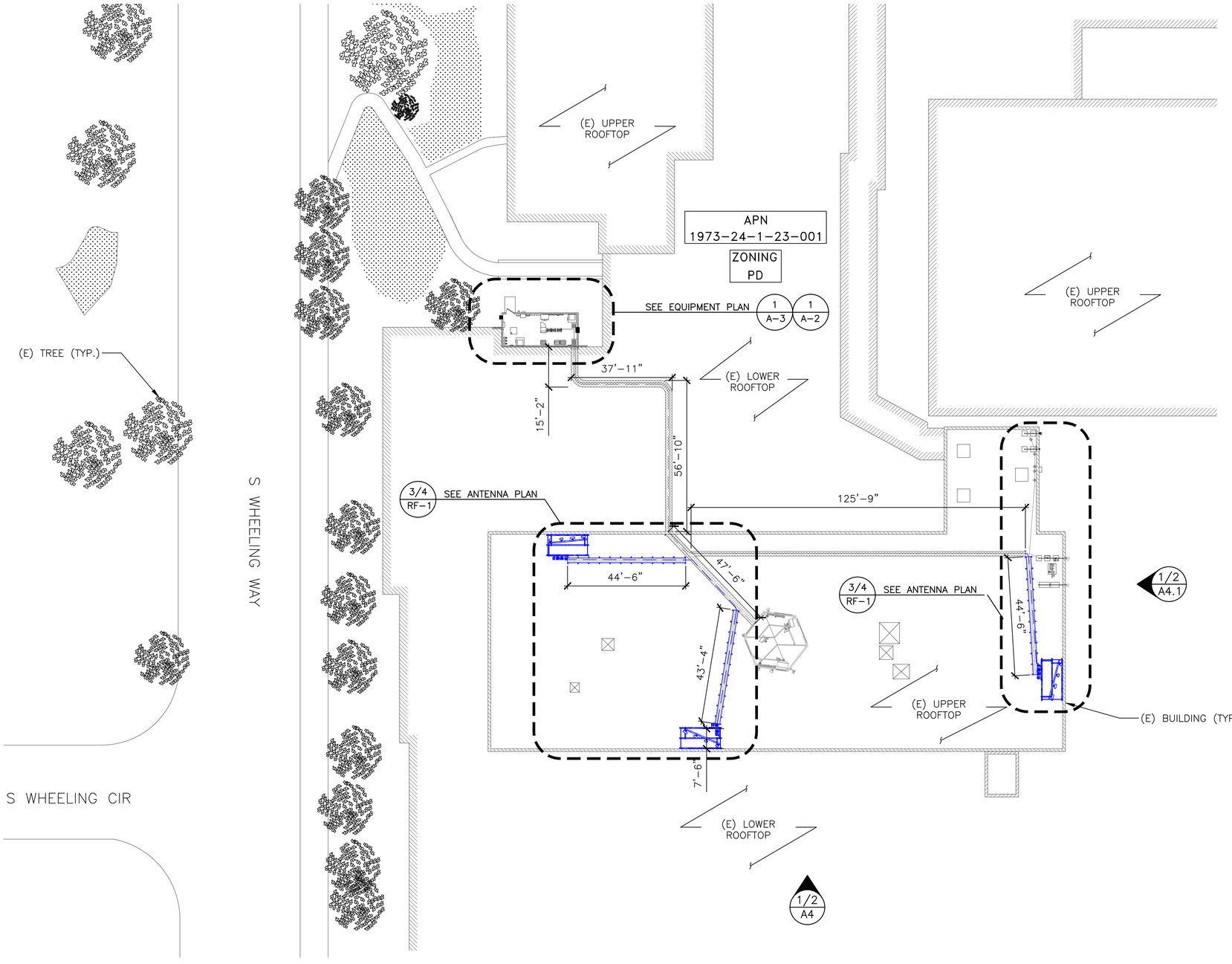

LEGEND

UTILITIES
- UGP — BURIED POWER LINE
- BURIED GAS LINE
- OHT — OVERHEAD TELEPHONE LINE
- UGT — BURIED TELEPHONE LINE
- W — W — BURIED WATER LINE
- SS — BURIED SANITARY SEWER
- SD — BURIED STORM DRAIN
- OHP — OVERHEAD POWER LINE

LANDSCAPE
- DITCH LINE/FLOW LINE
- ROCK RETAINING WALL
- VEGETATION LINE
- x — x — x — CHAIN LINK FENCE
- WOOD FENCE
- BARBED WIRE FENCE
- RAILROAD TRACKS
- EDGE OF ROAD/STREET
- CENTERLINE OF ROAD/STREET

PROPERTY
- PROPERTY LINE
- RIGHT-OF-WAY CENTERLINE
- RIGHT-OF-WAY LINE
- ADJACENT BOUNDARY LINE
- SECTIONAL BREAKDOWN LINE

AT&T SITE PROPERTY
- SUBJECT BOUNDARY LINE

SYMBOL KEY
- FIRE HYDRANT
- GATE VALVE
- WATER METER
- FIRE STAND PIPE
- CATCH BASIN, TYPE I
- CATCH BASIN, TYPE II
- TRANSFORMER
- LIGHT STANDARD
- P — POWER VAULT
- UTILITY BOX
- UTILITY POLE
- POLE GUY WIRE
- GAS VALVE
- GAS METER
- T — TELEPHONE VAULT
- TELEPHONE RISER
- SIGN
- BOLLARD
- MAIL BOX
- 234.21 — SPOT ELEVATION

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NORTH

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SHEET TITLE
OVERALL SITE PLAN

SHEET NUMBER
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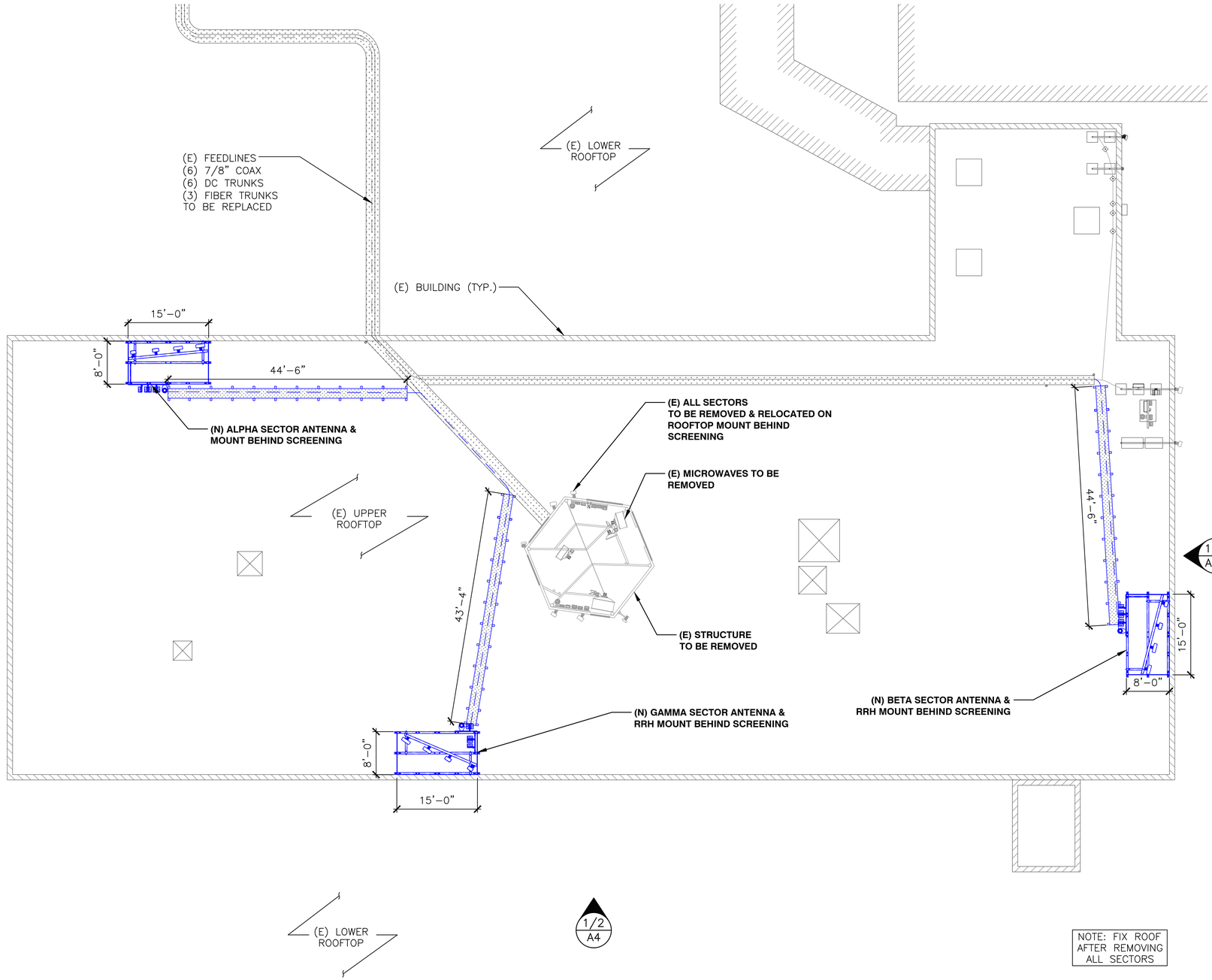

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ROOFTOP SITE PLAN | 1

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ROOFTOP PLAN

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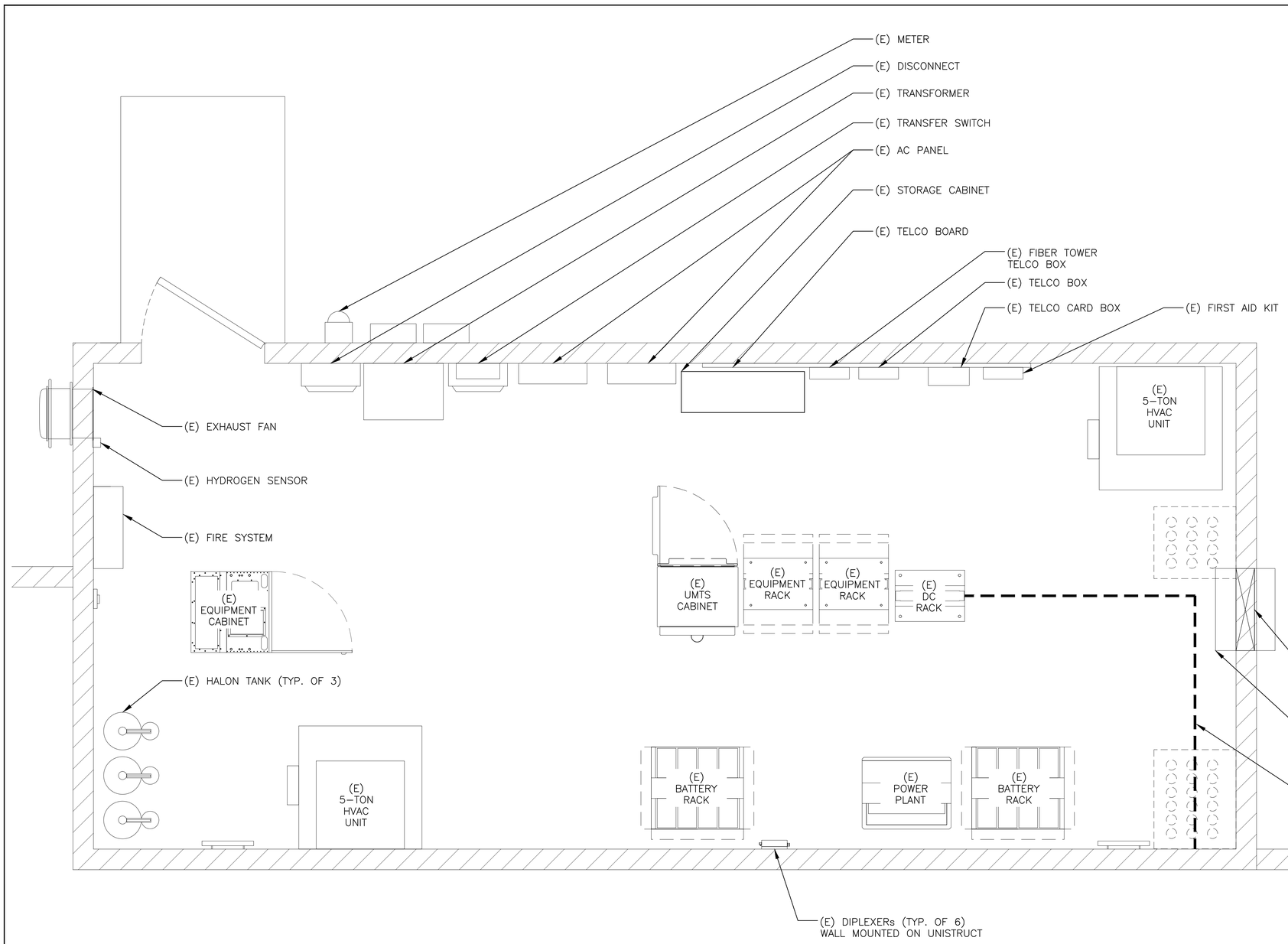
A-1.1



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4' 2' 0 1' 2' 3' 6'

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EXISTING ENLARGED EQUIPMENT PLAN 1

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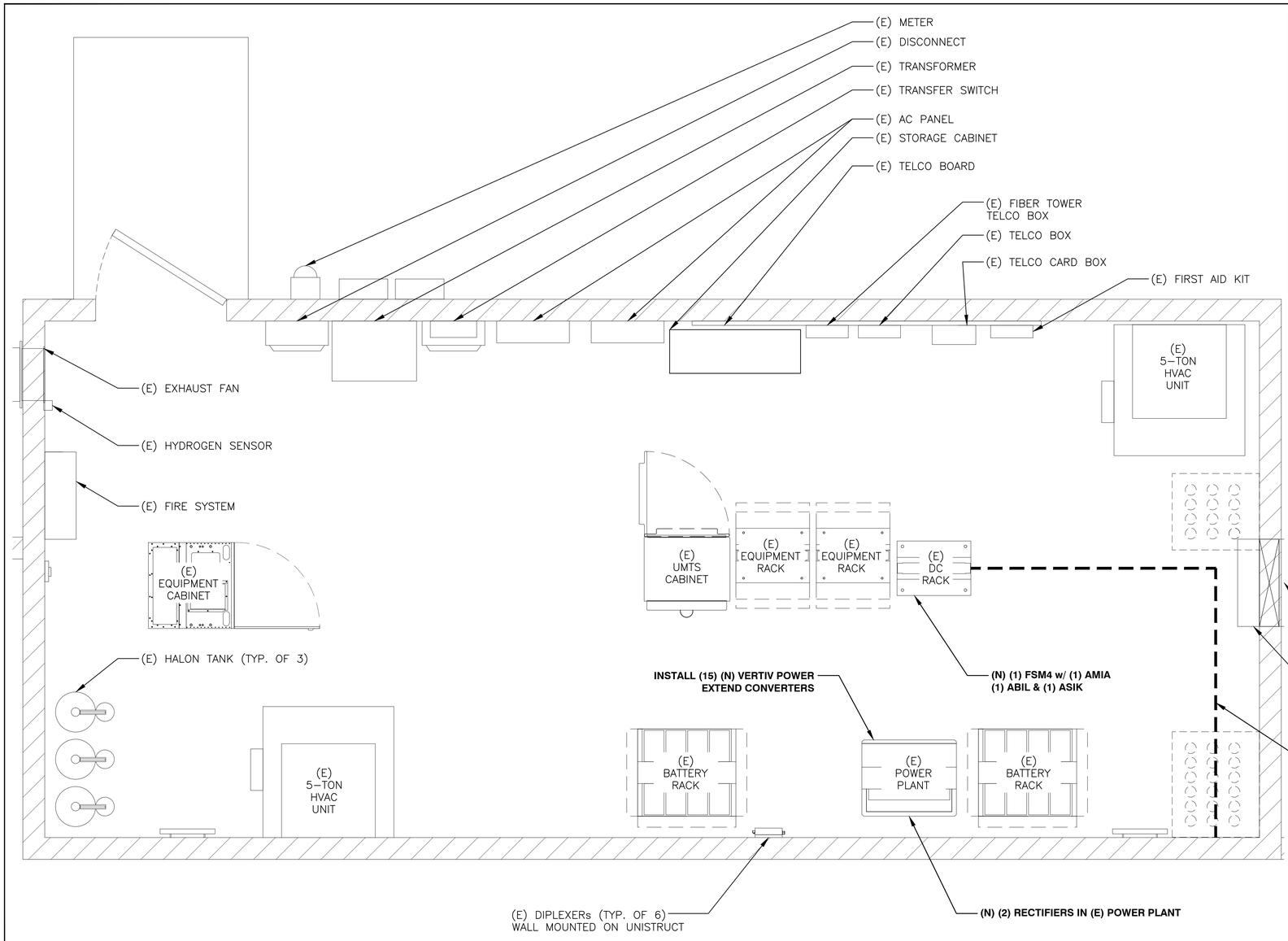
SHEET NUMBER
A-2



ELECTRICAL SOW SUMMARY (RESULTS BASED ON POWER AUDIT TOOL PROVIDED BY AT&T):

- FAILS RECTIFIER; EXISTING NETSURE 721 −48VDC POWER PLANT IS EQUIPPED WITH (14) ENERGIZED MODEL R48 2000e3 2KW −48VDC 37A RECTIFIERS. INSTALL (2) RECTIFIERS FOR A TOTAL OF (16) TO SATISFY N+1.
- PASSES CONVERTER; EXISTING NETSURE 721 −48VDC POWER PLANT IS EQUIPPED WITH (8) ENERGIZED MODEL C48/24−1500 1.5KW −48/+24VDC 63A DC CONVERTERS.
- BATTERY RESERVE CAPACITY @ 4.89 HRS, THERE ARE (40) MARATHON M12V155FT BATTERIES i.e. (10) STRING CONFIGURED @ 48VDC NOMINAL.
- PASSES HVAC TONNAGE CAPACITY; THERE ARE (2) EXISTING 5−TON HVAC UNITS.
- NOTE:
- SITE FAILS 200 AMP PANEL @ 249.33 AMPS RECOMEND LOAD STUDY OR UPGRADE TO 400 AMP

NORTH

FULL SCALE (22x34 SHEET ONLY) 3/8" = 1'−0"
4' 2' 0 1' 2' 3' 6'
HALF SCALE (11x17 SHEET ONLY) 3/16" = 1'−0"

NEW ENLARGED EQUIPMENT PLAN | 1

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smartlink
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SCOTTSDALE, AZ 85258

TELCYTE INFRASTRUCTURE SERVICES
2227 W. PECOS ROAD. SUITE 4,
CHANDLER AZ 85224

ADDRESS
1501 SOUTH POTOMAC
AURORA, CO 80045

SITE NUMBER
COL01176

SITE NAME
HUMANA

SEAL

COLORADO REGISTERED
TIM ALEXANDER
44563
EXP 10/31/21
PROFESSIONAL ENGINEER
SIGNED, 10 SEP 2020

DRAWN BY: AK | CHECKED BY: CW | APPROVED BY: CW

FA #: 10093833

REV	DATE	DESCRIPTION
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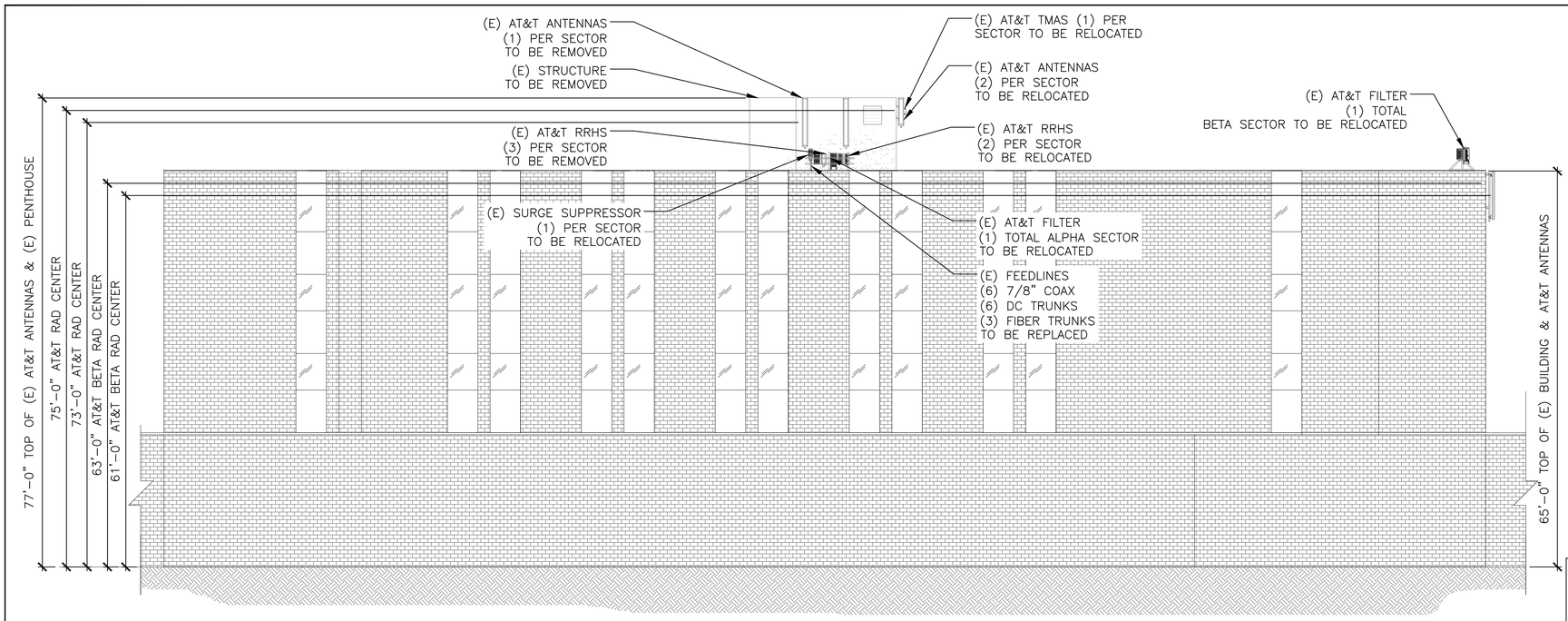
F	07/02/20	CLIENT CORRECTIONS
G	08/24/20	SCREENING REVISION
0	09/10/20	SUBMITTAL CD'S

SHEET TITLE
NEW ENLARGED EQUIPMENT PLAN

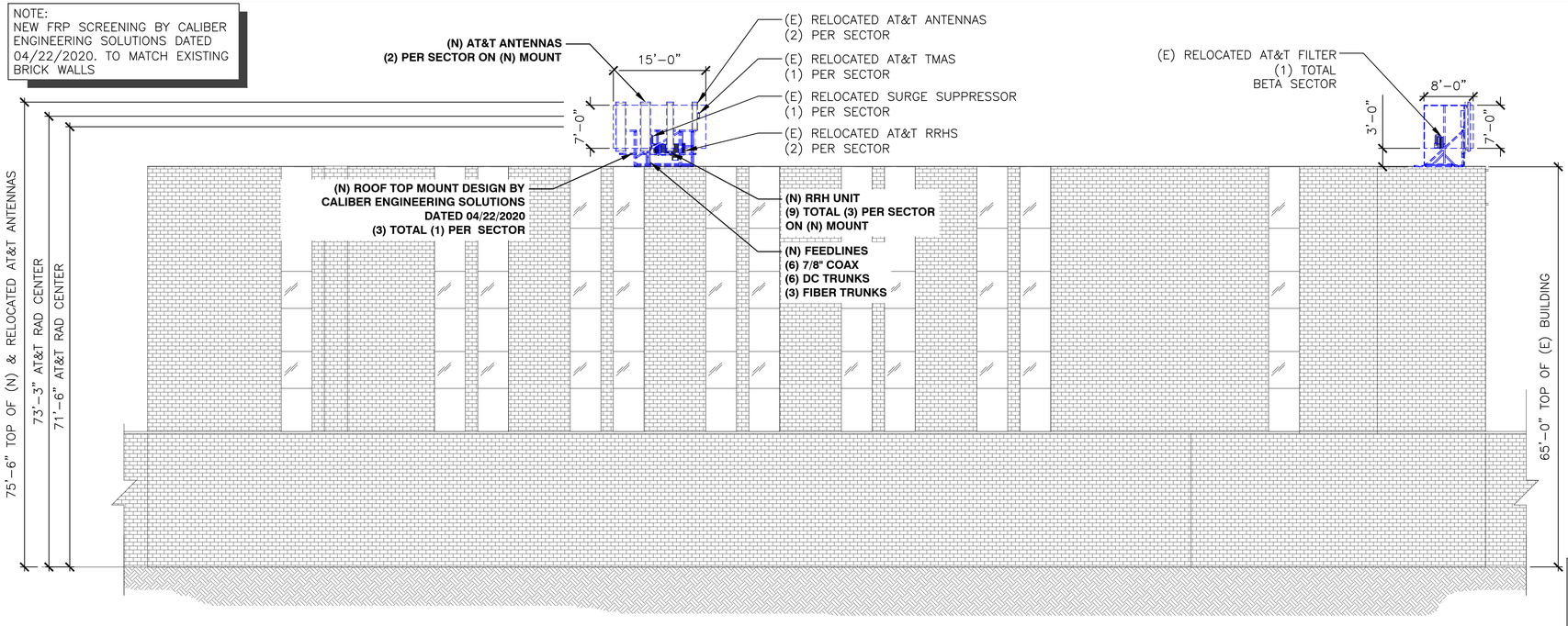
SHEET NUMBER
A-3



EXISTING SOUTH BUILDING ELEVATION | 1

FULL SCALE (22x34 SHEET ONLY) 3/32" = 1'-0"
16' 8' 0 4' 8' 12' 24'
HALF SCALE (11x17 SHEET ONLY) 3/64" = 1'-0"

NOTE:
NEW FRP SCREENING BY CALIBER ENGINEERING SOLUTIONS DATED 04/22/2020. TO MATCH EXISTING BRICK WALLS



NEW SOUTH BUILDING ELEVATION | 2

FULL SCALE (22x34 SHEET ONLY) 3/32" = 1'-0"
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HALF SCALE (11x17 SHEET ONLY) 3/64" = 1'-0"

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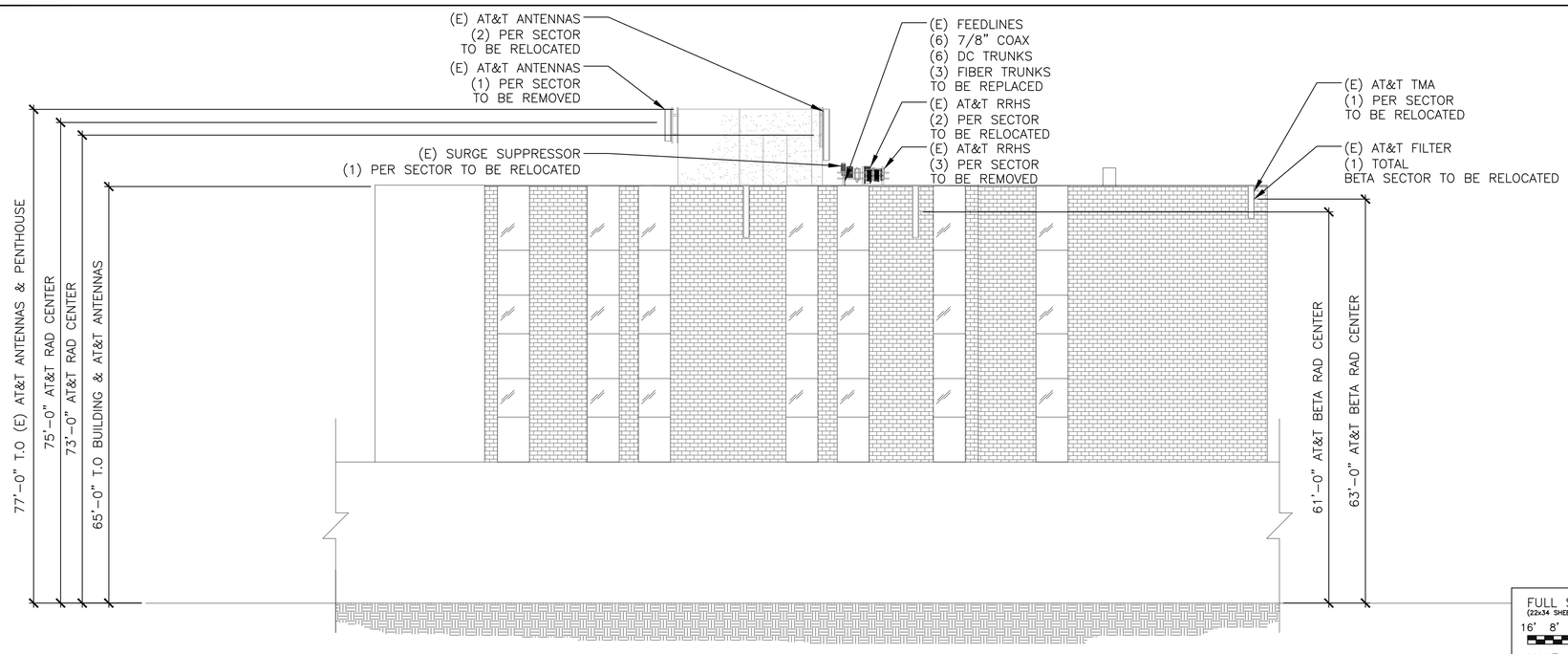
0	09/10/20	SUBMITTAL CD'S

SHEET TITLE
EXISTING & NEW BUILDING ELEVATION

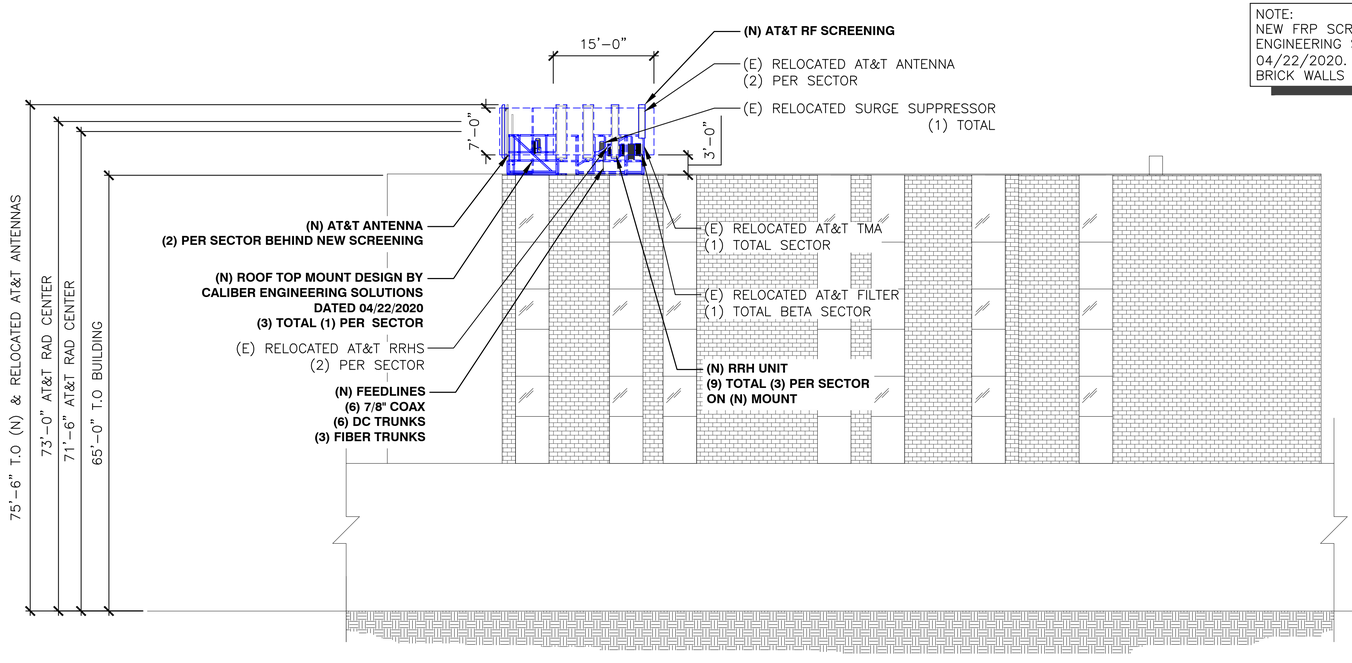
SHEET NUMBER
A-4



EXISTING EAST BUILDING ELEVATION | 1

FULL SCALE (22x34 SHEET ONLY) 3/32" = 1'-0"
16' 8' 0 4' 8' 12' 24'
HALF SCALE (11x17 SHEET ONLY) 3/64" = 1'-0"

NOTE:
NEW FRP SCREENING BY CALIBER ENGINEERING SOLUTIONS DATED 04/22/2020. TO MATCH EXISTING BRICK WALLS



NEW EAST BUILDING ELEVATION | 2

FULL SCALE (22x34 SHEET ONLY) 3/32" = 1'-0"
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HALF SCALE (11x17 SHEET ONLY) 3/64" = 1'-0"

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SHEET TITLE
EXISTING & NEW BUILDING ELEVATION

SHEET NUMBER
A-4.1

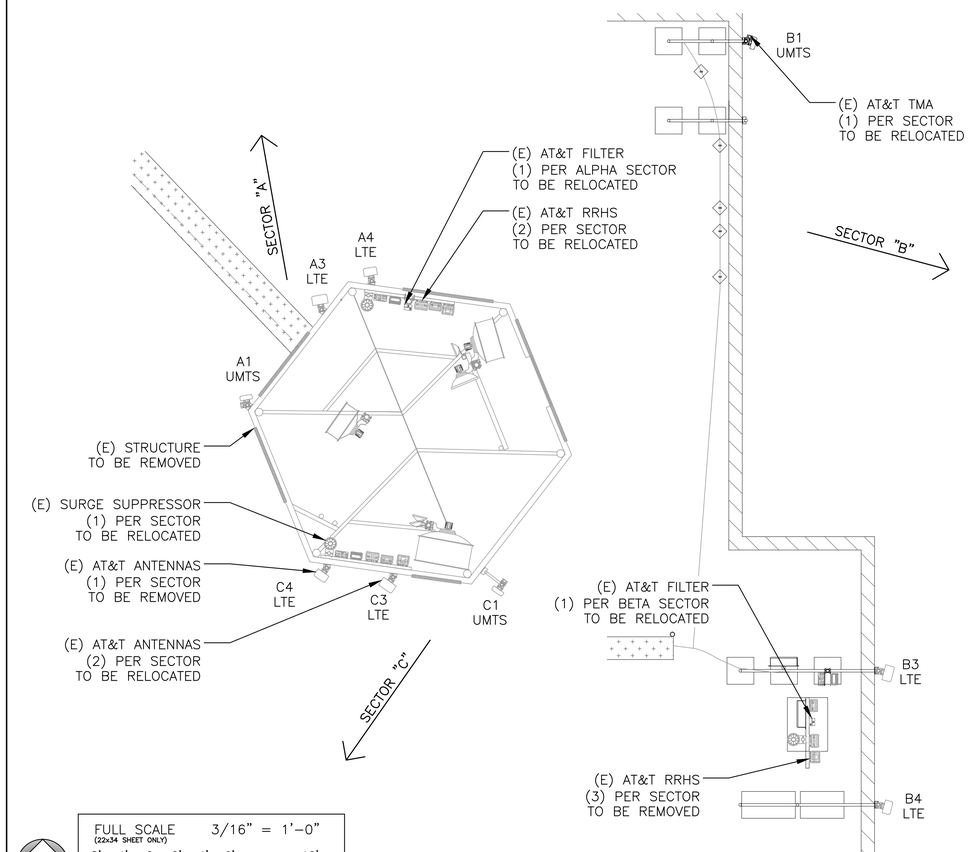
EXISTING ANTENNA SCHEDULE					
SECTOR	POSITION	TECH	ANTENNA	RRH	FEED LINE TYPE
ALPHA	1	UMTS	55" PANEL	–	(2) (E) COAX CABLES
ALPHA	2	----	–	–	–
ALPHA	3	LTE	96" PANEL	(3) LTE	EXISTING FIBER TRUNK
ALPHA	4	LTE	96.7" PANEL	(2) LTE	EXISTING FIBER TRUNK
BETA	1	UMTS	55" PANEL	–	(2) (E) COAX CABLES
BETA	2	----	–	–	–
BETA	3	LTE	96.7" PANEL	(2) LTE	EXISTING FIBER TRUNK
BETA	4	LTE	96" PANEL	(3) LTE	EXISTING FIBER TRUNK
GAMMA	1	UMTS	55" PANEL	–	(2) (E) COAX CABLES
GAMMA	2	----	–	–	–
GAMMA	3	LTE	96" PANEL	(3) LTE	EXISTING FIBER TRUNK
GAMMA	4	LTE	96.7" PANEL	(2) LTE	EXISTING FIBER TRUNK

EXISTING ANTENNAS AND COAX CONFIGURATION AND SCHEDULE | 1

NEW ANTENNA SCHEDULE						
SECTOR	POSITION	TECH	ANTENNA	RRH	FEED LINE TYPE	CABLE LENGTH
ALPHA	1	UMTS	55" PANEL	–	(2) NEW COAX CABLES	±280.8'
ALPHA	2	LTE	96" PANEL	(2) LTE	NEW FIBER TRUNK	
ALPHA	3	LTE	96" PANEL	(1) LTE	NEW FIBER TRUNK	
ALPHA	4	LTE	96" PANEL	(2) LTE	NEW FIBER TRUNK	
BETA	1	UMTS	55" PANEL	–	(2) NEW COAX CABLES	±422.4'
BETA	2	LTE	96" PANEL	(2) LTE	NEW FIBER TRUNK	
BETA	3	LTE	96" PANEL	(1) LTE	NEW FIBER TRUNK	
BETA	4	LTE	96" PANEL	(2) LTE	NEW FIBER TRUNK	
GAMMA	1	UMTS	55" PANEL	–	(2) NEW COAX CABLES	±315.6'
GAMMA	2	LTE	96" PANEL	(2) LTE	NEW FIBER TRUNK	
GAMMA	3	LTE	96" PANEL	(1) LTE	NEW FIBER TRUNK	
GAMMA	4	LTE	96" PANEL	(2) LTE	NEW FIBER TRUNK	

NOTES:
1. DO NOT USE COAX LENGTHS FOR CUT LENGTHS: ESTIMATES ONLY
2. CONFIRM THAT GENERAL CONTRACTOR IS USING LATEST VERSION OF RFDS.
* OR SIMILAR

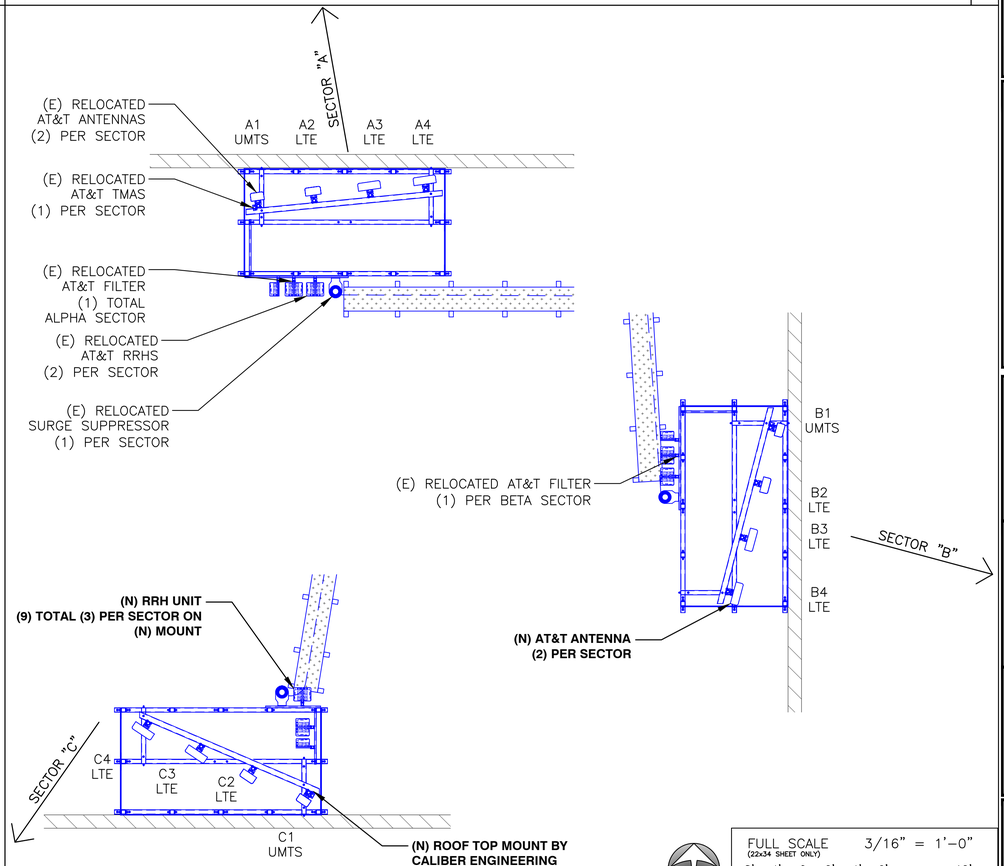
NEW ANTENNA AND COAX CONFIGURATION AND SCHEDULE | 2



NORTH

FULL SCALE 3/16" = 1'-0"
(22x34 SHEET ONLY)
8' 4' 0 2' 4' 6' 12'
HALF SCALE 3/32" = 1'-0"
(11x17 SHEET ONLY)

EXISTING ANTENNA CONFIGURATION | 3



NORTH

FULL SCALE 3/16" = 1'-0"
(22x34 SHEET ONLY)
8' 4' 0 2' 4' 6' 12'
HALF SCALE 3/32" = 1'-0"
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NEW ANTENNA CONFIGURATION | 4

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SHEET TITLE
EXISTING & NEW ANTENNA CONFIGURATION

SHEET NUMBER
RF-1

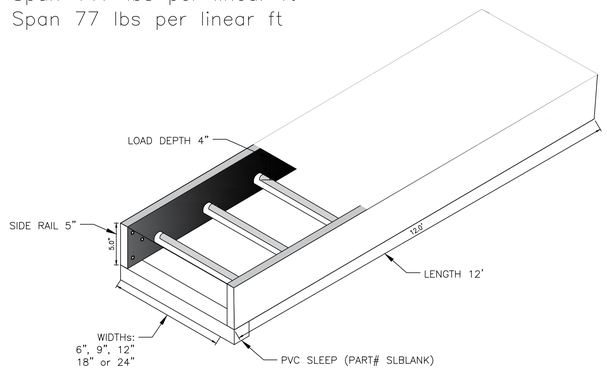
ALUMINUM COVERED CABLE TRAY | 1

Weight:

6"x12'	15 lbs
9"x12'	17 lbs
12" x12'	19 lbs
18" x12'	22 lbs
24" x12'	23 lbs

Load:

6' Span 324 lbs per linear ft
8' Span 125 lbs per linear ft
10' Span 117 lbs per linear ft
12' Span 77 lbs per linear ft



Features: Aluminum cable tray with press fit rungs. Covers and bends also available.
Construction: Constructed from extruded T-6061 aluminum.

VERTIV CONVERTERS | 2

DC INPUT

VOLTAGE RANGE	-42 VDC TO -58 VDC
MAXIMUM CURRENT	24.35 A

DC OUTPUT

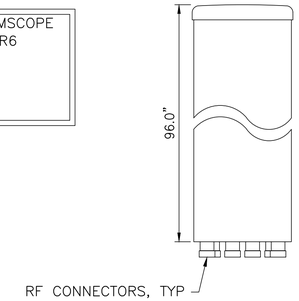
VOLTAGE	-58 VDC
MAXIMUM POWER	1000 W
MAXIMUM CURRENT	17.2 A @ -58 VDC
PEAK EFFICIENCY	98.6%

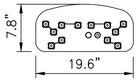
MECHANICS

DIMENSIONS (H X W X D)	107.2 X 18.5 X 109.7 MM 4.22 X 0.73 X 4.32 INCHES
WEIGHT	0.45 KG / 1.0 LBS

COMMSCOPE NNH4-65C-R6 | 3

MANUFACTURER: COMMSCOPE
PART #: NNH4-65C-R6
LENGTH: 96.0"
WIDTH: 19.6"
DEPTH: 7.8"
WEIGHT: 99.2 lbs.





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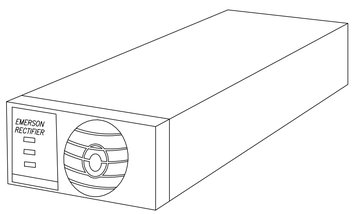
SHEET TITLE
RF & EQUIPMENT DETAILS

SHEET NUMBER
RF-2

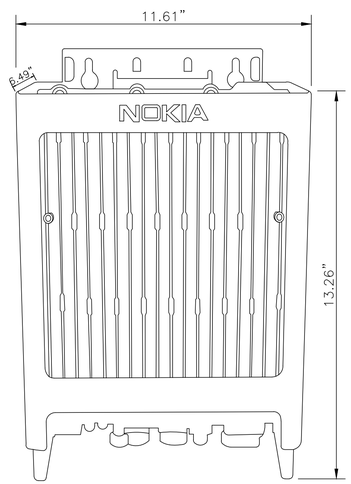
RECTIFIER DETAIL | 4



NEQ.15930 1R482000E3
RECTIFIER, NETSURE™ 512 & 721, HIGH EFFICIENCY,
-48 VDC, 40 A/2000 W, 120/208/240 VAC, SINGLE-PHASE INPUT, 4.4 LBS.

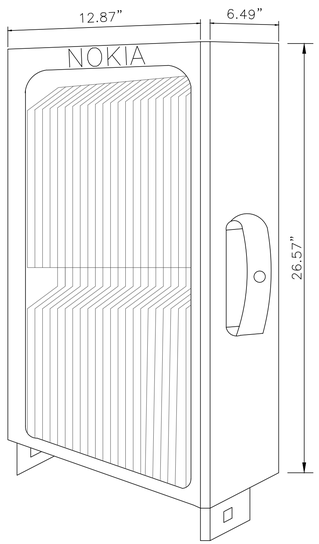
NEW AIRSCALE RRH 4T4R B5 160W AHCA | 5

MANUFACTURER: NOKIA
MODEL: AIRSCALE RRH 4T4R B5 160W
HEIGHT: 13.26" (337mm)
WIDTH: 11.61" (295mm)
DEPTH: 6.49" (165mm)
WEIGHT: 36.82 LBS (16.7KG)



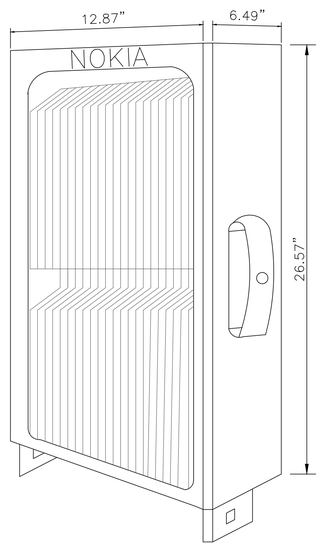
NEW AIRSCALE DUAL RRH 4T4R B25/66 320W AHFIB | 6

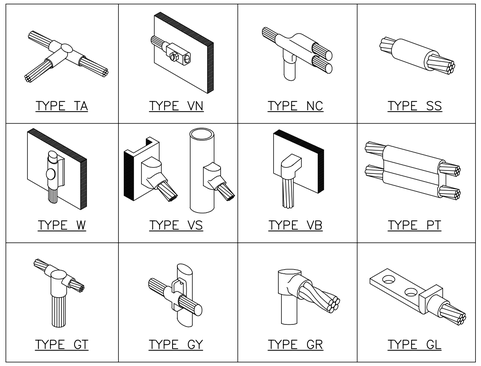
MANUFACTURER: NOKIA
MODEL: AIRSCALE RRH 4T4R B25/B66 320W
HEIGHT: 26.57" (675mm)
WIDTH: 12.87" (327mm)
DEPTH: 6.49" (165mm)
WEIGHT: <88.18 LBS (40.0KG)



NEW AIRSCALE DUAL RRH 4T4R B12/14 320W AHLBA | 7

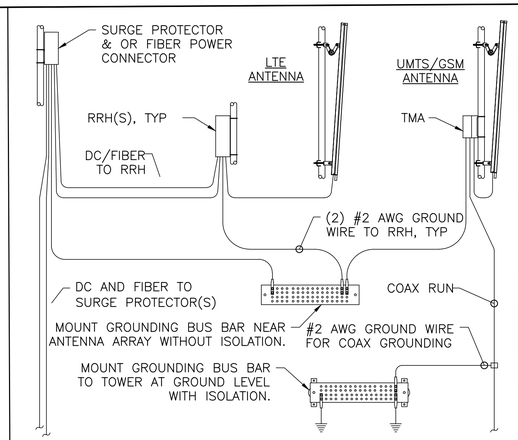
MANUFACTURER: NOKIA
MODEL: AIRSCALE RRH 4T4R B12/B14 320W
HEIGHT: 26.57" (675mm)
WIDTH: 12.87" (327mm)
DEPTH: 6.49" (165mm)
WEIGHT: <101.41 LBS (46.0KG)





NOTE: CADWELD "TYPES" SHOWN ABOVE ARE EXAMPLES – CONSULT WITH PROJECT MANAGER FOR SPECIFIC TYPES OF CADWELDS TO BE USED.

CAD WELD EXAMPLES | 1



ANTENNA GROUNDING DIAGRAM | 2

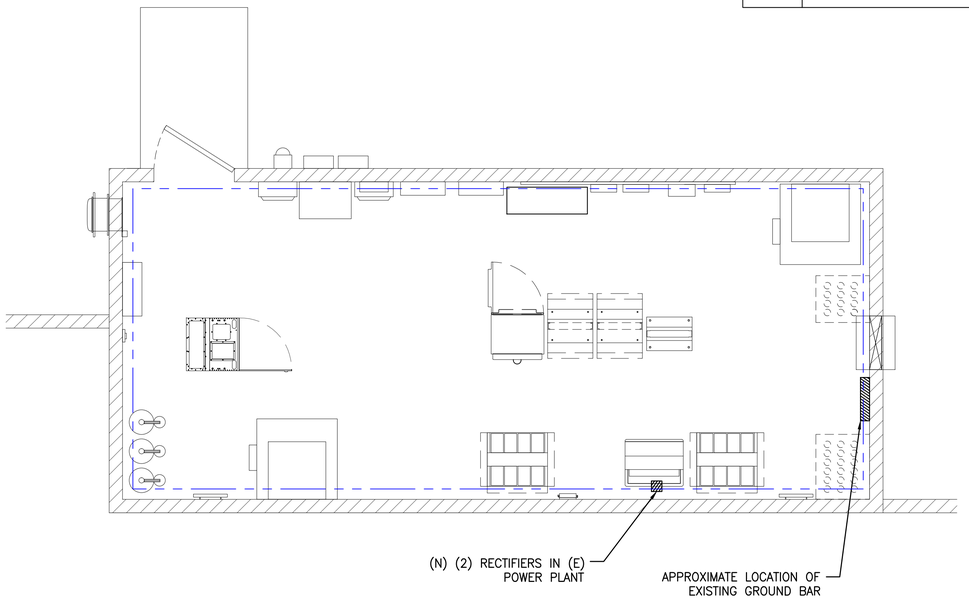
GENERAL GROUNDING NOTES:

1. ALL DETAILS ARE SHOWN IN GENERAL TERMS. ACTUAL INSTALLATION AND CONSTRUCTION MAY VARY DUE TO SITE SPECIFIC CONDITIONS.
2. GROUND ALL ANTENNA BASES, FRAMES, CABLE RUNS, AND OTHER METALLIC COMPONENTS USING GROUND WIRES AND CONNECT TO SURFACE MOUNTED BUS BARS. FOLLOW ANTENNA AND BTS MANUFACTURERS PRACTICES FOR GROUNDING REQUIREMENTS. GROUND COAX SHIELD AT BOTH ENDS AND EXIT FROM TOWER OR POLE USING MFR'S PRACTICES.
3. ALL WIRES SHALL BE COPPER THHN/THWN. ALL GROUND WIRE SHALL BE GREEN INSULATED WIRE ABOVE GROUND.
4. CONTRACTOR TO VERIFY AND TEST GROUND TO SOURCE. GROUNDING AND OTHER OPERATIONAL TESTING WILL BE WITNESSED BY AT&T REPRESENTATIVE.
5. THE SUBCONTRACTOR SHALL REVIEW AND INSPECT THE EXISTING FACILITY GROUNDING SYSTEM AND LIGHTNING PROTECTION SYSTEM (AS DESIGNED AND INSTALLED) FOR STRICT COMPLIANCE WITH THE NEC (AS ADOPTED BY THE AHJ), THE SITE-SPECIFIC (UL, LPI, OR NFPA) LIGHTING PROTECTION CODE, AND GENERAL COMPLIANCE WITH TELCORDIA AND TIA GROUNDING STANDARDS. THE SUBCONTRACTOR SHALL REPORT ANY VIOLATIONS OR ADVERSE FINDINGS TO THE CONTRACTOR FOR RESOLUTION.

GROUNDING NOTES | 3

NOT USED | 4

SYMBOL	DESCRIPTION
	CADWELD CONNECTION
	GROUND BAR
	MECHANICAL CONNECTION
	FIELD VERIFY & TIE INTO EXISTING GROUNDING SYSTEM



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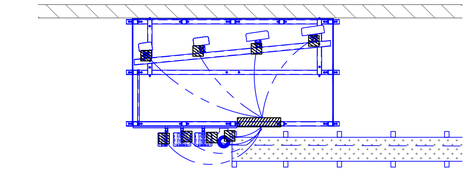
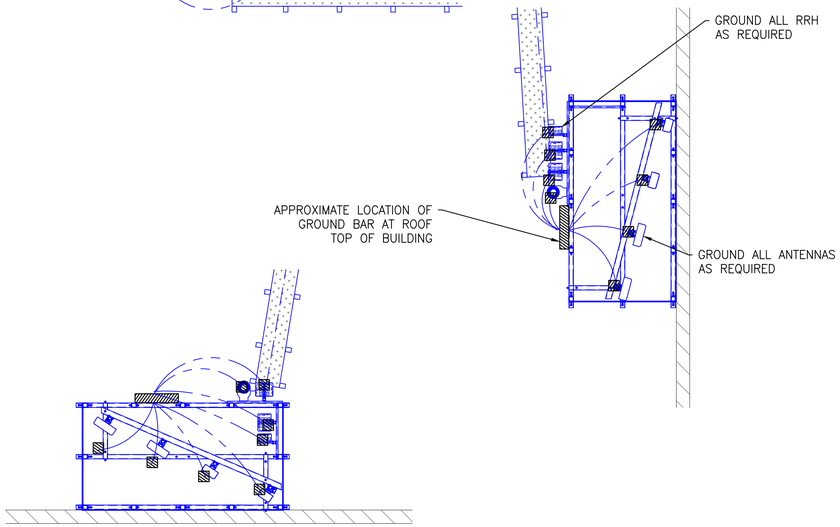
FULL SCALE (22x34 SHEET ONLY) 1/2" = 1'-0"
4' 2' 0 2' 4'
HALF SCALE (11x17 SHEET ONLY) 1/4" = 1'-0"

GROUNDING PLAN | 5





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ANTENNA PLAN | 6

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SHEET TITLE
SCHEMATIC GROUNDING PLAN & DETAILS

SHEET NUMBER
G-1

GENERAL STRUCTURAL NOTES

BUILDING CODE

2015 EDITION OF THE INTERNATIONAL BUILDING CODE
W/ CITY OF AURORA ENGINEERING DESIGN CRITERIA

LOADS

GRAVITY LOADS
ROOF SNOW, Pf = 30 PSF
ROOF LIVE LOAD, Lr = 20 PSF (REDUCIBLE)

WIND
WIND SPEED (ULTIMATE 3-SEC GUST), Vult = 115 MPH
WIND EXPOSURE CATEGORY = B
RISK CATEGORY = II

SEISMIC
S_{DS} = 0.184g
S_{D1} = 0.091g
SITE SOIL CLASS = D
SEISMIC DESIGN CATEGORY = B

STRUCTURAL STEEL

ALL STRUCTURAL STEEL CONSTRUCTION SHALL BE PER THE LATEST EDITION OF THE AISC STEEL CONSTRUCTION MANUAL. ALL STRUCTURAL MEMBERS ARE TO BE HOT DIPPED GALVANIZED ACCORDING TO THE APPLICABLE ASTM STANDARD. THE FOLLOWING STEEL GRADES SHALL APPLY UNLESS NOTED OTHERWISE.

HSS TUBE STEEL	ASTM A500	(Fy = 46 KS)
MISC STEEL	ASTM A36	(Fy = 36 KSI)
PIPE STEEL	ASTM A53	(Fy = 35 KSI)

STEEL BOLTS:
ALL STEEL BOLTS SHALL BE A307 UNLESS NOTED OTHERWISE AND UTILIZE AN AISC ACCEPTED LOCKING MECHANISM TO PREVENT THE NUTS FROM COMING OFF THE BOLT. AT CONTRACTORS OPTION, A325 BOLTS MAY BE USED IN PLACE OF A307 BOLTS. ALL BOLTS SHALL BE INSTALLED UTILIZING STEEL WASHERS AND TIGHTENED TO A SNUG TIGHT CONDITION UNLESS NOTED OTHERWISE.

WELDING:
ALL WELDING PER THE LATEST EDITION OF THE AWS STANDARD. ALL WELDING SHALL UTILIZE TYPE E70 RODS. ALL WELDING SHALL BE PERFORMED BY CERTIFIED WELDERS.

THESE PLANS DO NOT DISTINGUISH BETWEEN SHOP AND FIELD WELDING. CONTRACTOR CAN PROVIDE SHOP OR FIELD WELDING AT CONTRACTORS DISCRETION. CONTRACTOR SHALL SHOW SHOP AND FIELD WELDS ON SHOP DRAWINGS.

FIBER REINFORCED POLYMER (FRP) FRAMING

THE DESIGN AND DESIGN VALUES ARE BASED ON STRONGWELL FRP PRODUCTS AS NOTED BELOW.

STRUCTURAL SHAPES:
ALL FRP FRAMING MEMBERS ARE TO BE PER STRONGWELL EXTREN 500/525 OR 625 SPECIFICATIONS. SUBSTITUTION FOR ALTERNATIVE FABRICATORS/PROVIDERS IS NOT PERMITTED. MATERIAL PROPERTIES FOR 500/525 SERIES AS PROVIDED BY STRONGWELL:

PROPERTY	NOMINAL VALUE	ASTM TEST
TENSILE STRESS (LW)	30,000 PSI	ASTM D638
FLEXURAL STRESS (LW)	30,000 PSI	ASTM D790
FLEXURAL MODULUS (LW)	1.6×10^6 PSI	ASTM D790
MODULUS OF ELASTICITY	2.6×10^6 PSI	

FRP PANELS:
ALL FRP PANELS ARE TO BE PER STRONGWELL EXTREN PLATE 500/525, OR 625 SERIES. SUBSTITUTION FOR ALTERNATIVE FABRICATORS/PROVIDERS IS NOT PERMITTED. CONTRACTOR MUST TAKE CARE TO ORIENT PANELS AS INDICATED ON PLAN. PANELS SHALL SPAN NO MORE THAN 40" TO (LW) SUPPORTS. MATERIAL PROPERTIES FOR 500/525 SERIES AS PROVIDED BY STRONGWELL:

PROPERTY	NOMINAL VALUE	ASTM TEST
TENSILE STRESS (LW)	20,000 PSI	ASTM D638
TENSILE MODULUS (LW)	1.8×10^6 PSI	ASTM D638
FLEXURAL STRESS (LW)	24,000 PSI	ASTM D790
FLEXURAL MODULUS (LW)	1.4×10^6 PSI	ASTM D790

FRP BOLTS:
ALL FRP BOLTS WHERE NOTED ARE TO BE PER STRONGWELL FIBREBOLT SPECIFICATIONS. SUBSTITUTION FOR ALTERNATIVE FABRICATORS/PROVIDERS IS NOT PERMITTED.

ADDITIONAL CONNECTION NOTES

ADDITIONAL DIRECTION IS PROVIDED HERE FOR BOLTED CONNECTIONS.

MIN DISTANCE FROM CENTER OF BOLT TO NEAREST EDGE OF CONNECTED PARTS:
3/4" DIA. BOLTS.....1" MIN
1" DIA. BOLTS.....1.25" MIN

BOLT TYPE AT CONNECTION TYPE:
FRP TO FRP.....USE FIBREBOLTS
FRP TO STEEL.....USE FIBREBOLTS OR STEEL BOLTS
STEEL TO STEEL.....USE STEEL BOLTS

POST INSTALLED ANCHORS IN CONCRETE

ALL EXPANSION (WEDGE) TYPE ANCHORS IN CONCRETE SHALL UTILIZE HILTI KWIK BOLT-TZ TYPE ANCHORS (ESR-1917). CONTRACTOR MUST OBTAIN PRIOR APPROVAL FROM ENGINEER OF RECORD FOR ANY SUBSTITUTIONS. SEE EXISTING CONDITIONS SECTION FOR MINIMUM CLEAR DISTANCES FROM EXISTING REINFORCING.

GENERAL NOTES

ALL WORK PRESENTED WITHIN THESE DRAWINGS AND DETAILS SHALL ONLY BE PERFORMED BY A CONTRACTOR THAT IS EXPERIENCED AND KNOWLEDGEABLE IN THE TYPE OF WORK BEING PERFORMED AND HAS A HISTORY OF COMPLETING SIMILAR PROJECTS. ONLY A CONTRACTOR THAT IS LICENSED AND REGISTERED IN THE STATE WHERE THE WORK IS TO BE PERFORMED SHALL BE PERMITTED TO PERFORM THE WORK.

THE STRUCTURAL PLANS AND DETAILS DEPICT THE REQUIREMENTS FOR THE FINISHED STRUCTURAL ELEMENTS. THE PLANS AND DETAILS DO NOT PROVIDE THE CONTRACTOR WITH "MEANS AND METHODS" OF CONSTRUCTION. IT IS THE CONTRACTOR'S RESPONSIBILITY TO OBTAIN ALL REQUIRED MEASUREMENTS AND INFORMATION IN ORDER TO MEET THE STRUCTURAL REQUIREMENTS OF THESE PLANS. ANY ADDITIONAL INFORMATION NEEDED FROM THE ENGINEER OF RECORD CAN BE OBTAINED WITH A FORMAL "REQUEST FOR INFORMATION".

THE PLANS AND DETAILS DO NOT PROVIDE ENGINEERING FOR ANY SHORING, TEMPORARY BRACING, SCAFFOLDING, OR OTHERWISE. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO PROVIDE A SAFE WORK ENVIRONMENT AND TO OBTAIN ANY ADDITIONAL ENGINEERING SERVICES THAT ARE NEEDED IN ORDER TO SUPPORT TEMPORARY LOADS OR LOADS DUE TO CONSTRUCTION ACTIVITIES. THE ENGINEER OF RECORD SHALL NOT BE RESPONSIBLE FOR THE SEQUENCING, PROCEDURES, OR TECHNIQUES USED BY THE CONTRACTOR.

WEATHER PROOFING

ALL ROOF PENETRATIONS, DEMOLITION, INSTALLATION, AND ANY OTHER ACTIVITY THAT COMPROMISES THE WEATHERPROOFING OF THE EXISTING STRUCTURE SHALL BE REVIEWED, REPAIRED, AND COMPLETED BY A CONTRACTOR THAT IS EXPERIENCED IN ROOF FRAMING AND WEATHERPROOFING CONSTRUCTION. THE CONTRACTOR MUST WARRANTEE ALL WEATHERPROOFING WORK FOR A MINIMUM AMOUNT OF TIME THAT IS WITHIN INDUSTRY STANDARDS AND IS ACCEPTABLE TO ALL STAKEHOLDERS. WEATHERPROOFING WORK SHALL NOT BE PERFORMED BY A CONTRACTOR THAT DOES NOT HAVE EXPERIENCE IN THE TYPE OF WORK BEING PERFORMED AND/OR CANNOT WARRANTEE THE WORK. THESE DRAWINGS DO NOT PROVIDE DETAILS, DIRECTION, AND/OR SPECIFICATION FOR WEATHERPROOFING. WEATHERPROOFING IS THE RESPONSIBILITY OF THE CONTRACTOR. THE MEANS, METHODS, AND MATERIALS USED FOR WEATHERPROOFING ARE TO BE AS SPECIFIED BY A QUALIFIED CONTRACTOR.

EXISTING CONDITIONS

IT IS THE CONTRACTORS RESPONSIBILITY TO ENSURE THE EXISTING FIELD CONDITIONS ARE AS SHOWN IN THESE PLANS. THE CONTRACTOR MUST ENSURE THE STRUCTURAL ELEMENTS CAN BE COMPLETED AS SHOWN ON THESE PLANS IN RELATION TO THE EXISTING ELEMENTS.

THE CONTRACTOR MUST EMPLOYEE A QUALIFIED AGENCY WHO CAN GUARANTEE THE COMPLETE LOCATING OF ALL EXISTING REINFORCING, TENDONS, CONCRETE THICKNESS, AND SUPPORTING WALLS/COLUMNS/BEAMS. THE AGENCY MUST BE ABLE TO MAKE THIS GUARANTEE IN ORDER TO AVOID INTERFERING WITH THE EXISTING ELEMENTS. A COPY OF THE REINFORCEMENT LOCATE REPORT SHALL BE PROVIDED TO THE ENGINEER OF RECORD. MINIMUM CLEAR DISTANCE FROM EXISTING SLAB REINFORCING TO POST INSTALLED ANCHOR SHALL BE 3" MIN.

DESPITE THE REQUIREMENTS FOR FIELD VERIFICATION, THE CONTRACTOR MUST STILL EXERCISE EXTREME CAUTION WITH ANCHORING TO THE CONCRETE DECK. THE CONTRACTOR MUST BE EXPERIENCED AND FAMILIAR WITH THIS TYPE OF WORK. IT IS RECOMMENDED THAT THE CONTRACTOR OPERATE IN A SLOW AND CAUTIOUS MANNER AND STOP WORK WITH ANY CONCERNS FOUND WITH FIELD CONDITIONS.

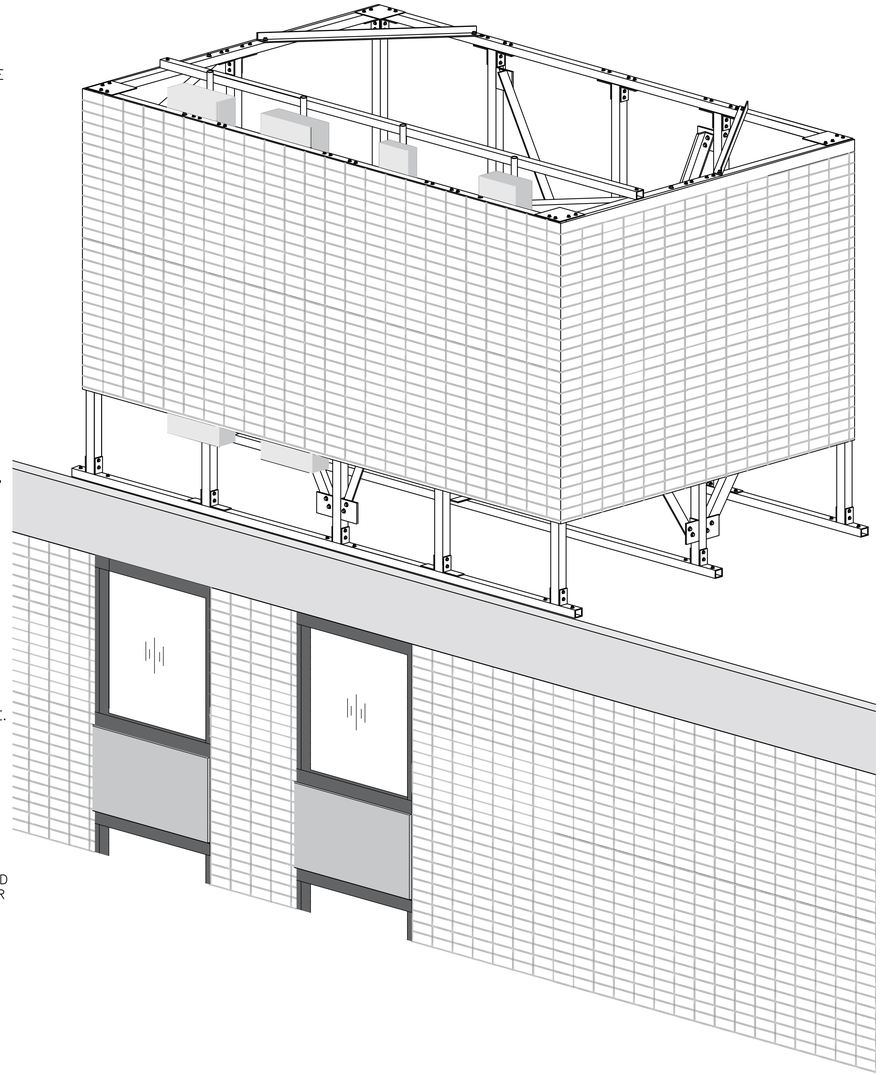
SPECIAL STRUCTURAL INSPECTIONS

THE SPECIAL INSPECTIONS LISTED BELOW ARE IN ADDITION TO THE LOCAL BUILDING INSPECTIONS AND ARE REQUIRED PER CH. 17 OF THE INTERNATIONAL BUILDING CODE.

POST INSTALLED ANCHORS
1. INSPECTION OF CLEANING USING A WIRE BRUSH AND COMPRESSED AIR.
2. INSPECTION OF CONFORMANCE TO DETAIL INCLUDING EMBEDMENT AND ANCHOR.
3. INSPECTION OF CONFORMANCE TO SPECIFIED PRODUCT AND MANUFACTURER SPECIFICATIONS.
4. VERIFY CONTRACTOR HAS LOCATED SLAB REINFORCING IN THE FIELD SO AS TO AVOID PENETRATING REINFORCING.

RESPONSIBILITIES OF THE CONTRACTOR
1. ANY DEVIATIONS MUST BE APPROVED IN WRITING FROM THE ENGINEER OF RECORD AND MUST BE ORIGINATED IN WRITING BY THE CONTRACTOR WITH A REQUEST FOR INFORMATION (RFI).
2. WHERE THE WORK IS REQUIRED TO BE COMPLETED IN THE PRESENCE OF THE SPECIAL INSPECTOR (CLEANING AND INSTALLATION), THE CONTRACTOR SHALL BE SURE TO PERFORM THE WORK UNDER THE OBSERVANCE OF THE SPECIAL INSPECTOR.
3. AREAS TO BE INSPECTED BY THE SPECIAL INSPECTOR ARE TO BE MADE SAFELY ACCESSIBLE FOR INSPECTION.
4. FOR ANY QUESTIONS REGARDING SPECIAL INSPECTIONS, CONTACT THE ENGINEER OF RECORD.

RESPONSIBILITIES OF THE SPECIAL INSPECTOR
1. THE SPECIAL INSPECTOR SHALL VISIT THE SITE AND ENSURE THE WORK PERFORMED CONFORMS TO THE DETAILS AND SPECIFICATIONS SHOWN ON THE PLANS.
2. THE SPECIAL INSPECTOR IS NOT AUTHORIZED TO APPROVE OR SUGGEST ANY DEVIATIONS FROM WHAT IS SHOWN ON THE PLANS.
3. THE SPECIAL INSPECTOR MUST BE KNOWLEDGEABLE IN THE WORK BEING PERFORMED, KNOW THE MANUFACTURER REQUIREMENTS AND UNDERSTAND ITEMS REQUIRING INSPECTION AND OBSERVATION.
4. THE SPECIAL INSPECTOR MUST PROVIDE WRITTEN INSPECTION REPORTS TO BOTH THE ENGINEER OF RECORD AND THE BUILDING OFFICIAL.
5. ANY DISCREPANCIES REQUIRING CORRECTION MUST BE BROUGHT TO THE IMMEDIATE ATTENTION OF THE CONTRACTOR FOR CORRECTION. IF LEFT UNCORRECTED, THE DISCREPANCIES MUST BE MADE KNOWN TO THE ENGINEER OF RECORD AND BUILDING OFFICIAL.



ROOFTOP STEALTH SCREEN - ISOMETRIC VIEW
NTS

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City of Aurora Building Division
Reviewed for Code Compliance
Approved as Noted: cmacy
Date: Sep 16, 2020
2015 INTERNATIONAL CODES & 2020 NEC

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ROOFTOP ANTENNA SCREEN
SITE NAME: HUMANA
ID: COL01176
1501 SOUTH POTOMAC ST.
AURORA, CO 80012

REV	ISSUED	DATE
0	ISSUED FOR PERMIT	04.22.20

COLORADO LICENSED
MATTHEW E. NIEVES
54115
04.22.20
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JOB: 20-G101	ENG: MEN

GSN & ISOMETRIC

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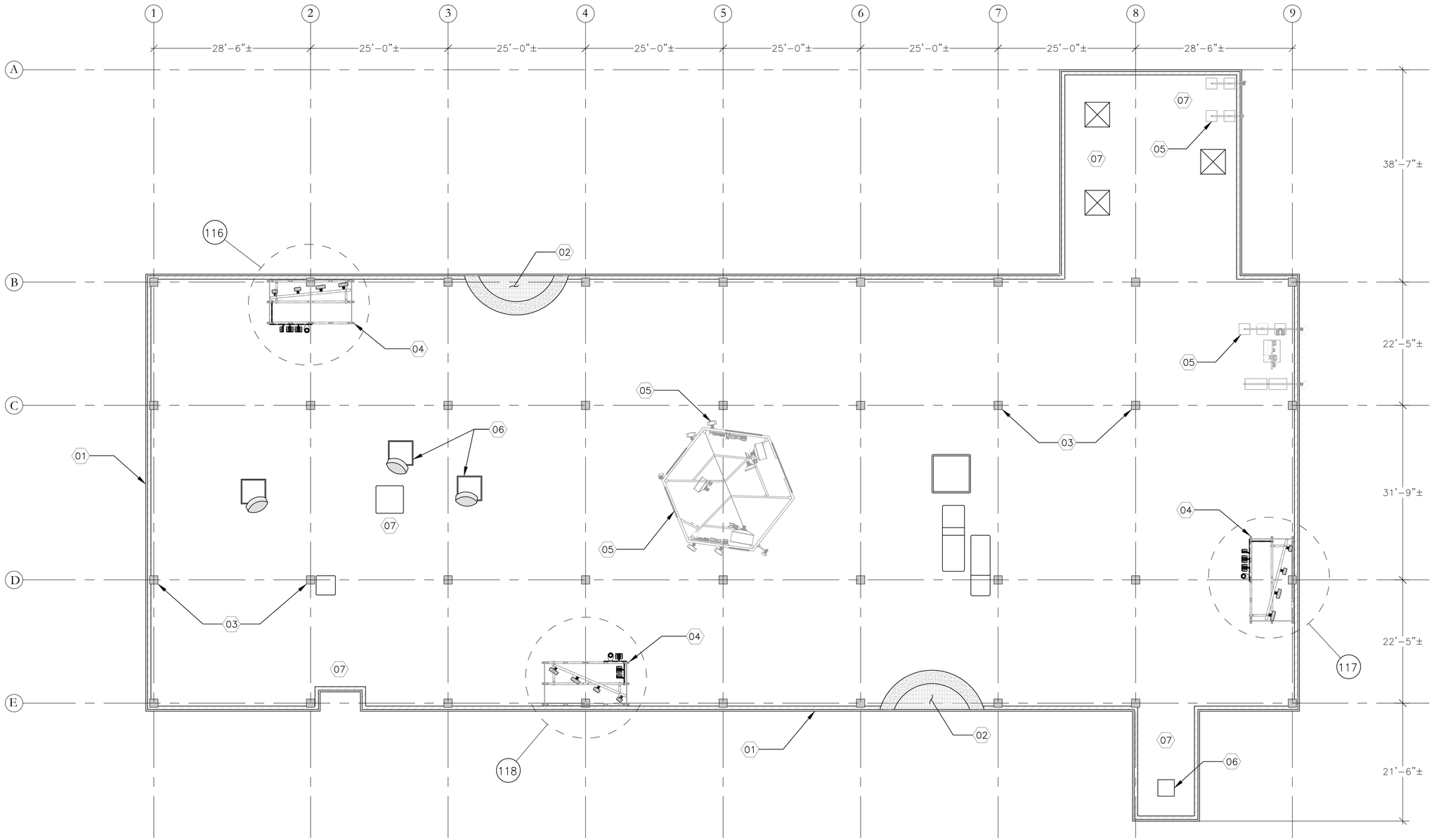

PLAN NOTES:

1. DO NOT USE THESE PLANS TO SCALE, SIZE, OR LOCATE EQUIPMENT. DO NOT ASSUME LOCATIONS OF FRAMING BELOW BASED ON GRID LINES. FRAMING AND COLUMNS BELOW THE ROOF THAT SUPPORT THE ANTENNA EQUIPMENT MUST BE FIELD VERIFIED BELOW THE ANTENNA EQUIPMENT.
2. EXISTING CONDITIONS ARE BASED ON THE BEST AVAILABLE INFORMATION AS SHOWN IN ROOF MAPPING BY SUGARLOAF TOWER COMPANY, DATED MARCH 13, 2020. EXISTING CONDITIONS ARE TO BE FIELD VERIFIED. NOT ALL CONDITIONS ARE GUARANTEED TO BE AS SHOWN. CONTACT ENGINEER OF RECORD IF ANY DISCREPANCIES WITH THESE PLANS ARE DISCOVERED.
3. THESE PLANS ARE SPECIFIC TO THIS PROJECT SCOPE FOR THIS ANTENNA INSTALLATION. FUTURE PROJECTS SHOULD EVALUATE THE ROOF FOR ANY FUTURE WORK OR ADDITIONS. NOT ALL ROOF FRAMING/CONDITIONS ARE SHOWN. FUTURE PROJECTS SHOULD REFERENCE THE ORIGINAL BUILDING DRAWINGS OR PERFORM THEIR OWN FIELD VERIFICATION.
4. MECHANICAL EQUIPMENT AND OPENINGS ARE NOT SHOWN ON THIS PLAN. CONTRACTOR MUST VERIFY THAT NO OPENINGS, MECHANICAL EQUIPMENT, OR OTHER HEAVY EQUIPMENT IS LOCATED ON THE SAME ROOF FRAMING (SLAB, BEAM, COLUMN) SUPPORTING THE ANTENNA FRAME. THIS INCLUDES EQUIPMENT ABOVE THE ROOF AND EQUIPMENT BELOW THE ROOF (SUSPENDED).
5. CONTRACTOR MUST ENSURE THE ANTENNA FRAMES ARE PLACED AS SHOWN ON THIS PLAN AND THE REFERENCED DETAILS.

KEY NOTES:

01 EXISTING EXTERIOR WALLS APPEAR TO BE MASONRY WITH SINGLE WYTHE BRICK OR BRICK VENEER ON THE OUTSIDE. GENERAL CONDITION APPEARS TO BE THAT THE WALL DOES NOT PROJECT ABOVE THE ROOF (NO PARAPET).

02 EXISTING RIGID FOAM INSULATION OVER CONCRETE SLAB ROOF.

03 EXISTING CONCRETE COLUMN SUPPORTING ROOF SLAB.

04 NEW FRP ANTENNA SCREEN BOX – PLACE OVER COLUMN BELOW AS SHOWN.

05 REMOVE EXISTING ANTENNA FRAMES, SCREEN WALLS, & EQUIPMENT. ROOFER TO PATCH AND WEATHERPROOF WHERE REQUIRED DUE TO REMOVAL. RELOCATE ANTENNAS AND RRH'S TO NEW STEALTH FRP ENCLOSURE WHERE ANTENNAS/RRH'S ARE RE-USED.

06 EXISTING ROOFTOP EQUIPMENT OR VENTILATION.

07 EXISTING STAIRWELL AND/OR ELEVATOR.

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PARTIAL ROOF FRAMING PLAN

NTS

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PARTIAL ROOF PLAN

S2 | 0

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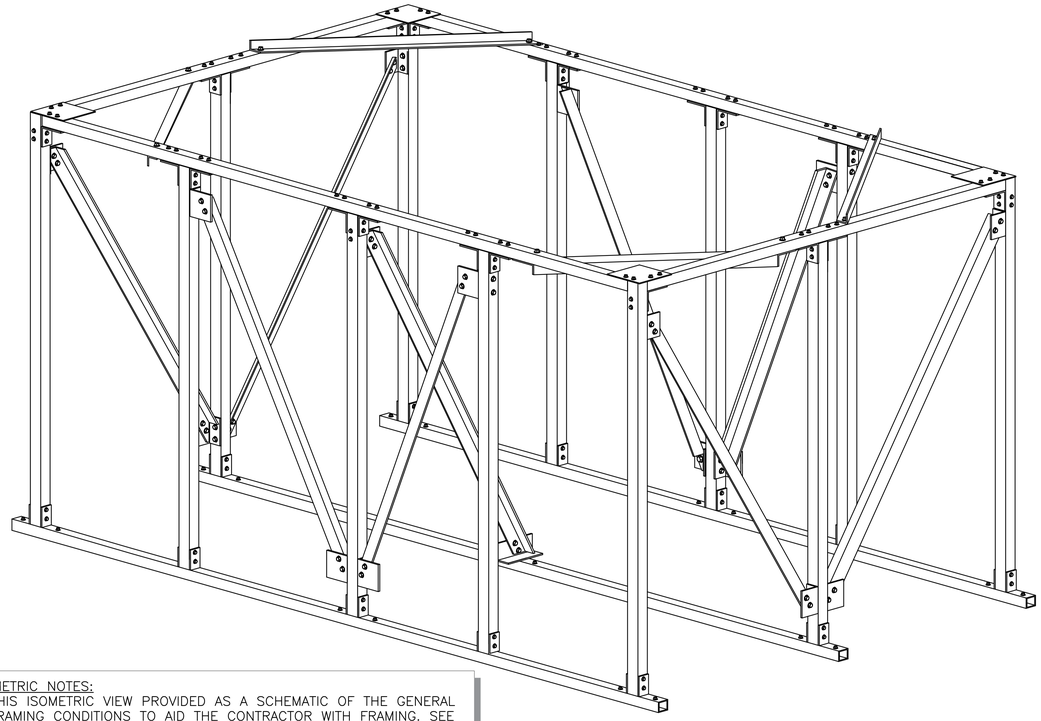
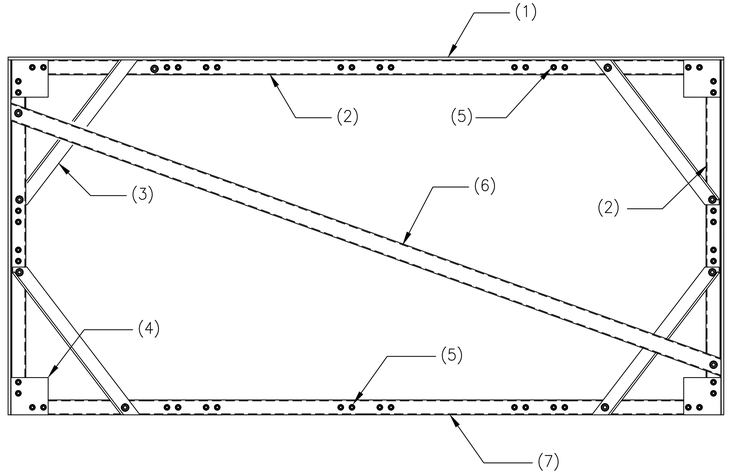


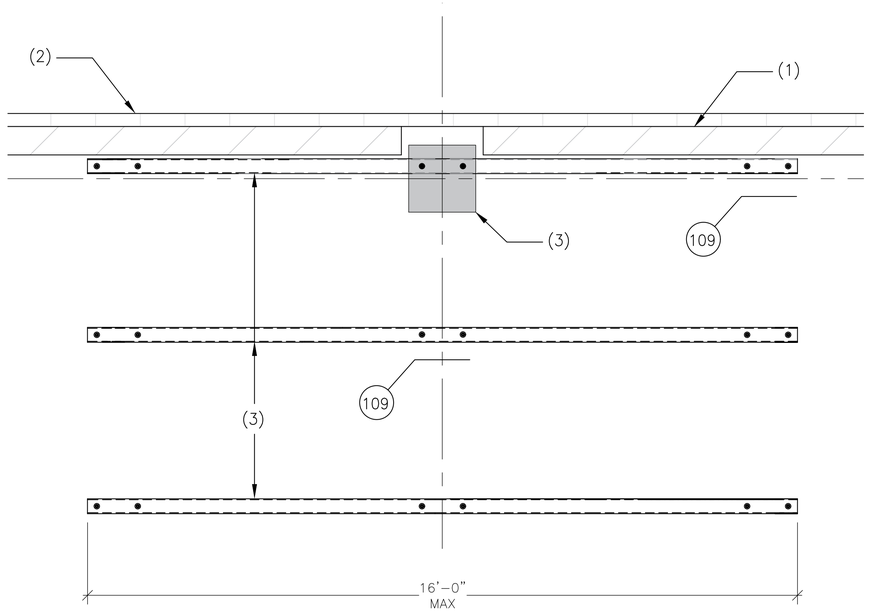
ISOMETRIC NOTES:
1. THIS ISOMETRIC VIEW PROVIDED AS A SCHEMATIC OF THE GENERAL FRAMING CONDITIONS TO AID THE CONTRACTOR WITH FRAMING. SEE PLANS, ELEVATIONS, AND DETAILS FOR SPECIFIC DIRECTION. CONTACT THE EOR WITH ANY QUESTIONS, CONCERNS, DISCREPANCIES.
2. PANEL, ANTENNA EQUIPMENT, EQUIPMENT SUPPORTS NOT SHOWN.
3. BUILDING STRUCTURE NOT SHOWN.

103 SCREEN ENCLOSURE – ISOMETRIC VIEW
NTS



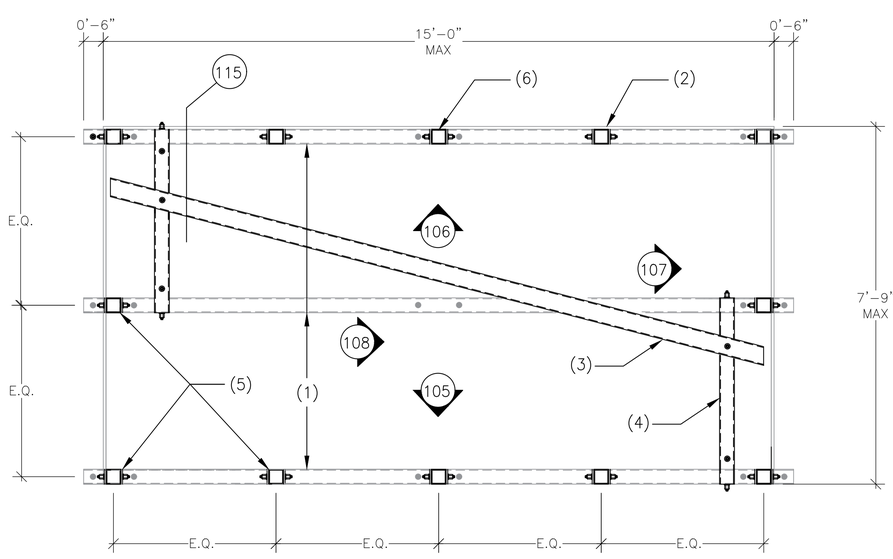
1. STRONGWELL FRP PANEL AT (3) SIDES.
2. STRONGWELL FRP 4x4x1/4 SQUARE TUBE - CONTINUOUS TOP RAIL FROM CORNER POST TO CORNER POST.
3. STRONGWELL FRP 3x3x1/4 ANGLE BRACE - LOCATE WHERE SHOWN. ATTACH TO TOP RAIL WITH (1) 1" DIA. STRONGWELL FIBREBOLT AT EACH END. THE CORNER BRACE ANGLE MAY BE LOCATED ABOVE THE TOP RAIL OR BELOW THE TOP RAIL IN ORDER TO ALLOW OTHER FRAMING CONDITIONS AS SHOWN.
4. 10x10x5/8 FRP PLATE AT CORNERS - CONTRACTOR MAY USE SCRAP CUTS FROM FRP PANEL TO MAKE PLATES
5. TOP BOLTS FROM POST CONNECTIONS - SEE WALL ELEVATIONS.
6. STRONGWELL FRP 4x4x3/8" SQ TUBE FOR ANTENNA PIPE ATTACHMENT. ATTACH TO TOP RAIL FRP WITH (1) 1" DIA. FRP STRONGBOLT AT EACH END.
7. NO FRP PANEL AT BACK SIDE - THIS SIDE LEFT OPEN TO ACCESS EQUIPMENT.

104 SCREEN ENCLOSURE TOP FRAMING PLAN – LOOKING DOWN FROM ABOVE ENCLOSURE
NTS



1. EXISTING MASONRY WALL BELOW.
2. EXISTING SINGLE WYTHE BRICK OR VENEER.
3. CONCRETE COLUMN BELOW - FIELD VERIFY AND CENTER STEEL SLEEPER LENGTH WITH COLUMN AS SHOWN SO THAT FRP POST WILL SIT ON TOP OF COLUMN.
4. CONTINUOUS STEEL HSS 4x4x1/8 SQUARE TUBE SLEEPER ANCHORED TO CONCRETE DECK.
5. ANCHOR TO CONCRETE SLAB DECK. (18) ANCHORS TOTAL. LOCATE AS SHOWN.

101 SCREEN ENCLOSURE – STEEL STAND & ANCHORAGE PLAN
NTS



1. STEEL SLEEPER ON CONCRETE DECK.
2. STRONGWELL FRP PANEL AT (3) SIDES.
3. STRONGWELL FRP 4x4x3/8 SQ TUBE FOR ANTENNA PIPE ATTACHMENT.
4. STRONGWELL FRP 4x4x1/4 SQUARE TUBE TO SUPPORT ANGLE. LOCATE AS REQUIRED IN ORDER TO ACHIEVE REQUIRED AZIMUTH.
5. STRONGWELL FRP 4x4x1/4 SQUARE TUBE POST - (12) PLACES.
6. THIS POST TO BE LOCATED OVER CONCRETE COLUMN AS SHOWN IN DETAIL 101 AND ON PLANS.

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City of Aurora Building Division
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Approved as Noted: *cmacy*
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102 SCREEN ENCLOSURE POST LAYOUT PLAN
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ROOFTOP ANTENNA SCREEN
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FRP SCREEN PLAN VIEWS

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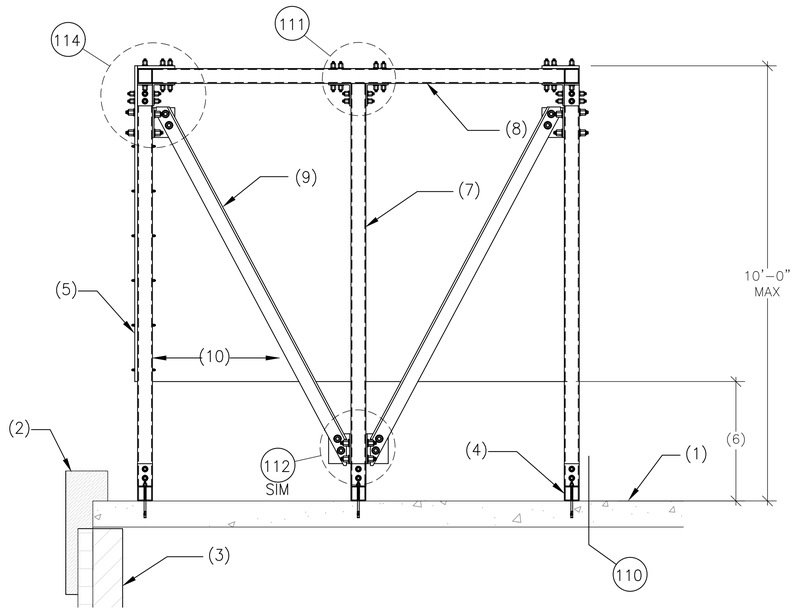
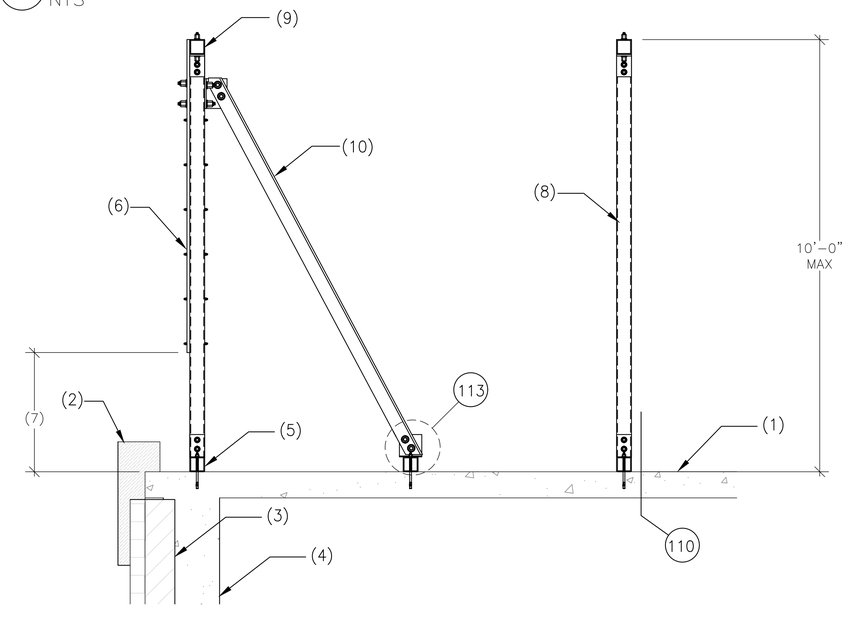


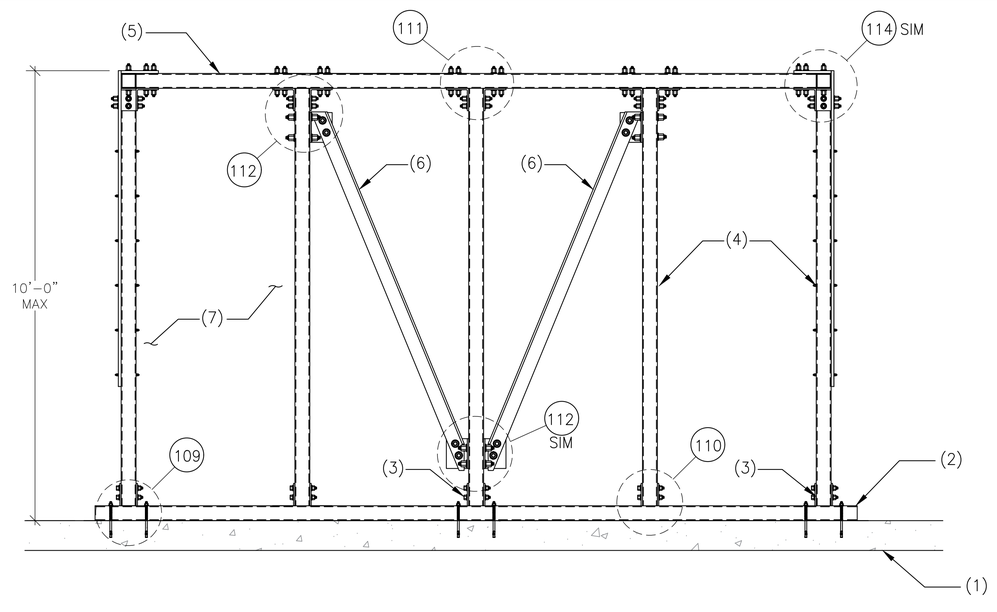
1. EXISTING CONCRETE SLAB ROOF DECK - BUILT UP ROOF/RIGID INSULATION NOT SHOWN.
2. EXISTING BUILT UP POP-OUT.
3. EXISTING MASONRY WITH SINGLE WYTHE BRICK OR VENEER.
4. CONTINUOUS STEEL HSS 4x4x1/8 SQUARE SLEEPER ANCHORED TO CONCRETE ROOF.
5. STRONGWELL FRP 5/8" THICK PANEL - ATTACH TO VERTICAL POSTS WITH 3/8" DIA. FIBREBOLTS AT 12" O.C. MAX AT EACH VERTICAL POST. PAINT PANEL TO MATCH BUILDING COLOR AND PATTERN.
6. START FRP PANEL AT 3'-0" ABOVE ROOF DECK TO PREVENT SNOW BUILD UP.
7. STRONGWELL FRP 4x4x1/4 SQUARE POST.
8. STRONGWELL CONTINUOUS FRP 4x4x1/4 SQUARE TOP RAIL.
9. STRONGWELL FRP 4x4x1/2 ANGLE BRACE WHERE SHOWN.
10. INSTALL FRP PANEL IN LENGTH-WISE (LW) DIRECTION PERPENDICULAR TO VERTICAL POSTS. LW DIRECTION WILL BE MARKED BY STRONGWELL.

107 SCREEN ENCLOSURE – WALL ELEVATION – SIDE WALL
NTS



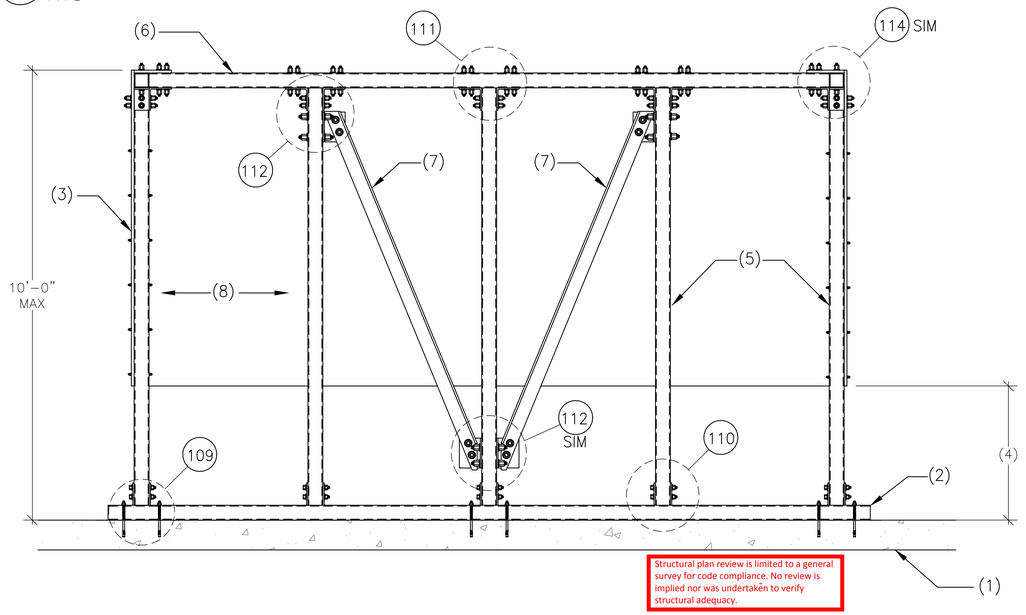
1. EXISTING CONCRETE ROOF DECK - BUILT UP ROOF NOT SHOWN.
2. EXISTING BUILT UP POP-OUT.
3. EXISTING MASONRY W/ SINGLE WYHE BRICK OR VENEER.
4. EXISTING CONCRETE COLUMN - SEE PLAN FOR DIRECTION AND LOCATION. LOCATE POST ABOVE COLUMN AS SHOWN.
5. CONTINUOUS STEEL HSS 4x4x1/8 SQUARE SLEEPER ANCHORED TO CONCRETE ROOF.
6. STRONGWELL FRP 5/8" THICK PANEL - ATTACH TO VERTICAL POSTS WITH 3/8" DIA. FIBREBOLTS AT 12" O.C. MAX AT EACH VERTICAL POST. PAINT PANEL TO MATCH BUILDING COLOR AND PATTERN.
7. START FRP PANEL AT 3'-0" ABOVE ROOF DECK TO PREVENT SNOW BUILD UP.
8. STRONGWELL FRP 4x4x1/4 SQUARE POST.
9. STRONGWELL CONTINUOUS FRP 4x4x1/4 SQUARE TOP RAIL.
10. STRONGWELL FRP 4x4x1/2 ANGLE BRACE WHERE SHOWN.

108 SCREEN ENCLOSURE – WALL ELEVATION – MID BRACE FRAME
NTS



1. EXISTING CONCRETE SLAB ROOF DECK. BUILT UP ROOF/RIGID INSULATION NOT SHOWN.
2. CONTINUOUS STEEL HSS 4x4x1/8 SQUARE TUBE SLEEPER ANCHORED TO CONCRETE DECK.
3. POST CONNECTION TO STEEL SLEEPER PER REFERENCED DETAIL.
4. STRONGWELL FRP 4x4x1/4 SQUARE POST.
5. STRONGWELL CONTINUOUS FRP 4x4x1/4 SQUARE TOP RAIL.
6. STRONGWELL FRP 4x4x1/2 ANGLE BRACE WHERE SHOWN.
7. NO FRP PANEL AT BACK WALL - THIS SIDE LEFT OPEN TO ACCESS EQUIPMENT.

105 SCREEN ENCLOSURE – WALL ELEVATION – BACK WALL
NTS



Structural plan review is limited to a general survey for code compliance. No review is implied nor was undertaken to verify structural adequacy.

1. EXISTING CONCRETE SLAB ROOF DECK. BUILT UP ROOF/RIGID INSULATION NOT SHOWN.
2. CONTINUOUS STEEL HSS 4x4x1/8 SQUARE TUBE SLEEPER ANCHORED TO CONCRETE DECK.
3. STRONGWELL FRP 5/8" THICK PANEL - ATTACH TO VERTICAL POSTS WITH 3/8" DIA. FIBREBOLTS AT 12" O.C. MAX AT EACH VERTICAL POST. PAINT PANEL TO MATCH BUILDING COLOR AND PATTERN.
4. START FRP PANEL AT 3'-0" ABOVE ROOF DECK TO PREVENT SNOW BUILD UP.
5. STRONGWELL FRP 4x4x1/4 SQUARE POST.
6. STRONGWELL CONTINUOUS FRP 4x4x1/4 SQUARE TOP RAIL.
7. STRONGWELL FRP 4x4x1/2 ANGLE BRACE WHERE SHOWN.
8. INSTALL FRP PANEL IN LENGTH-WISE (LW) DIRECTION PERPENDICULAR TO VERTICAL POSTS. LW DIRECTION WILL BE MARKED BY STRONGWELL.

City of Aurora Building Division
Reviewed for Code Compliance
Approved as Noted: *cmacy*
Date: *Sep 16, 2020*
2015 INTERNATIONAL CODES & 2020 NEC

106 SCREEN ENCLOSURE – WALL ELEVATION – FRONT WALL
NTS

AT&T

smartlink

ROOFTOP ANTENNA SCREEN
SITE NAME: HUMANA
ID: COL01176
1501 SOUTH POTOMAC ST.
AURORA, CO 80012

REV	ISSUED	DATE
0	ISSUED FOR PERMIT	04.22.20

COLORADO LICENSED
MATTHEW E. NIEVES
54115
04.22.20
PROFESSIONAL ENGINEER

CES
CaliberEngineering Solutions
INTEGRITY. QUALITY. EXPERTISE.
2487 S. GILBERT RD. STE. 106-(607)
GILBERT, AZ 85295
480.329.0493
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JOB: 20-G101	ENG: MEN

FRP SCREEN WALL ELEVATIONS

S4	0

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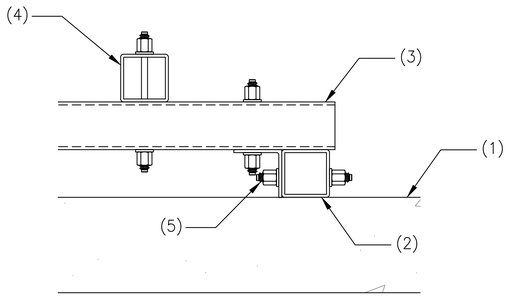
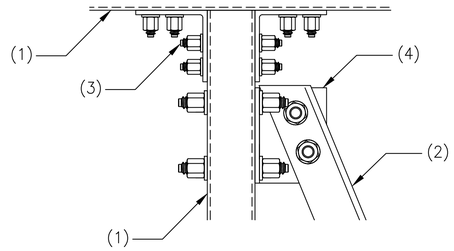


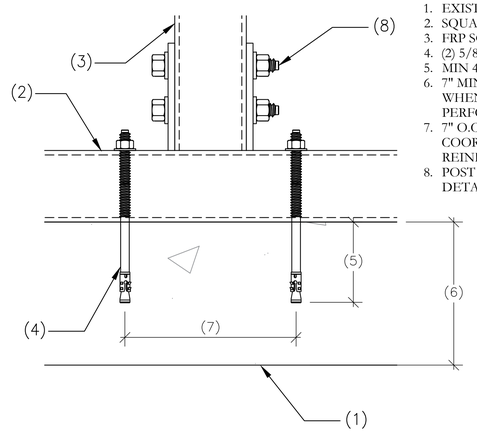
1. CONCRETE SLAB ROOF DECK.
2. STEEL SLEEPER PER PLAN.
3. FRP 4x4x1/4 SQUARE TUBE. BRIDGE BETWEEN TWO SLEEPERS IN ORDER TO PROVIDE SUPPORT FOR FRP ANGLE.
4. FRP SQ TUBE PER PLAN TO SUPPORT ANTENNAS. LOCATE WHERE REQUIRED IN ORDER TO ACHIEVE AZIMUTH AND REDUCE ANTENNA SKEW.
5. FRP 4x4x1/2 ANGLE - 4" LONG WITH 3/4" DIA. FIBREBOLT AT EACH ANGLE LEG.

115 ANTENNA SUPPORT ANGLE ATTACHMENT
NTS



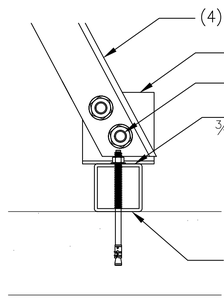
1. FRP SQUARE TUBE PER WALL ELEVATIONS.
2. FRP BRACE - LOCATION PER WALL ELEVATIONS & AS SHOWN ON PLANS.
3. ADJACENT CONNECTION WHERE OCCURS - SEE WALL ELEVATIONS & DETAILS.
4. STRONGWELL FRP 6x6x3/8 ANGLE - 8" LONG WITH (2) 1" DIA. FIBREBOLTS AT POST AND (2) 1" DIA. FIBREBOLTS AT BRACE ANGLE. WHERE BRACE OCCURS AT EACH SIDE - PROVIDE SAME CONNECTION AT EACH SIDE.

112 BRACE ANGLE CONNECTION AT FRP POST
NTS



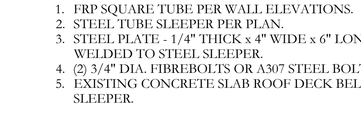
1. EXISTING CONCRETE SLAB ROOF.
2. SQUARE STEEL TUBE SLEEPER PER PLAN.
3. FRP SQUARE POST.
4. (2) 5/8" DIA. EXPANSION ANCHORS PER GSN.
5. MIN 4" EMBED.
6. 7" MIN THICK CONCRETE - FIELD VERIFY WHEN LOCATING OF REINFORCING IS PERFORMED.
7. 7" O.C. MIN, 16" O.C. MAX - CONTRACTOR TO COORDINATE IN ORDER TO CLEAR ANY REINFORCING PER GSN.
8. POST ATTACHMENT TO SLEEPER PER DETAIL 110.

109 STEEL TUBE SLEEPER ANCHORAGE TO ROOF
NTS



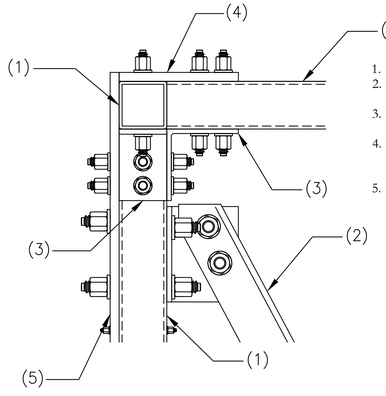
1. STEEL TUBE SLEEPER ANCHORED TO CONCRETE DECK PER PLAN.
2. STEEL 6x6x3/8 - 8" LONG, WELDED TO STEEL TUBE.
3. (2) 1" DIA. FRP FIBREBOLTS OR A307 STEEL BOLTS.
4. FRP BRACE ANGLE PER WALL ELEVATIONS.

113 FRP ANGLE BRACE AT STEEL TUBE
NTS



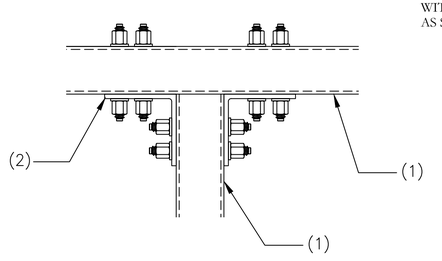
1. FRP SQUARE TUBE PER WALL ELEVATIONS.
2. STEEL TUBE SLEEPER PER PLAN.
3. STEEL PLATE - 1/4" THICK x 4" WIDE x 6" LONG WELDED TO STEEL SLEEPER.
4. (2) 3/4" DIA. FIBREBOLTS OR A307 STEEL BOLTS.
5. EXISTING CONCRETE SLAB ROOF DECK BELOW SLEEPER.

110 FRP POST AT STEEL SLEEPER
NTS



1. FRP SQUARE TUBE PER WALL ELEVATIONS.
2. FRP BRACE AND CONNECTION WHERE OCCURS - SEE DETAIL 112.
3. STRONGWELL FRP 6x6x3/8 ANGLE - 4" LONG WITH (2) 3/4" DIA. FIBREBOLTS AT EACH LEG.
4. 10x10x5/8 FRP PLATE AT CORNER POSTS. CONTRACTOR MAY USE SPARE CUTS FROM FRP PANEL TO MAKE PLATE.
5. FRP PANEL.

114 CORNER POST TOP ATTACHMENT
NTS



1. FRP SQUARE TUBE PER WALL ELEVATIONS.
2. STRONGWELL FRP 6x6x3/8 ANGLE - 4" LONG, WITH (2) 3/4" DIA. FIBREBOLTS AT EACH LEG AS SHOWN.

111 INTERIOR FRP POST AT FRP TOP RAIL
NTS

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City of Aurora Building Division
Reviewed for Code Compliance
Approved as Noted: cmacy
Date: Sep 16, 2020
2015 INTERNATIONAL CODES & 2020 NEC

AT&T

smartlink

ROOFTOP ANTENNA SCREEN
SITE NAME: HUMANA
ID: COL01176
1501 SOUTH POTOMAC ST.
AURORA, CO 80012

REV	ISSUED	DATE
0	ISSUED FOR PERMIT	04.22.20

COLORADO LICENSED
MATTHEW E. NIEVES
54115
04.22.20
PROFESSIONAL ENGINEER

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GILBERT, AZ 85295
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JOB: 20-G101 | ENG: MEN

STRUCTURAL DETAILS

S5 | 0

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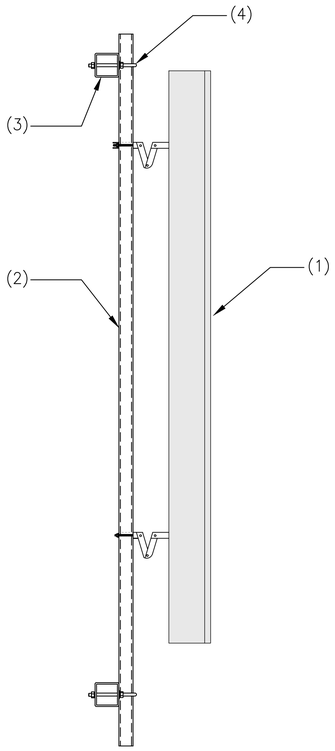
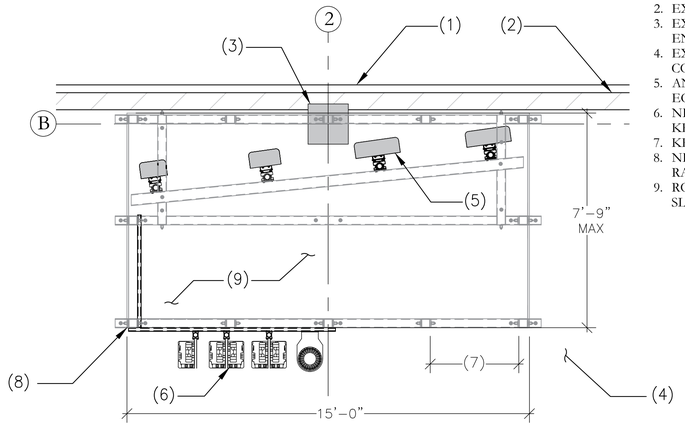


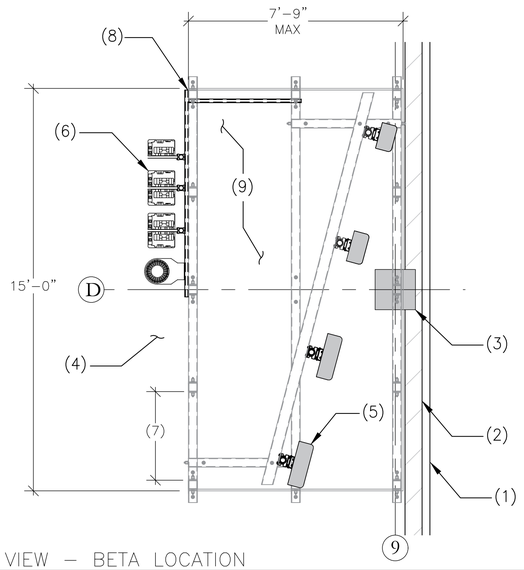
1. ANTENNA - ATTACH TO PIPE PER MFR.
2. 2" STD PIPE (2-3/8" O.D.).
3. 4"x4"x3/8" FRP SQ TUBE PER FRAMING PLANS.
4. PROVIDE 5/8" DIA. A307 U-BOLT AT TOP AND BOTTOM.

119 ANTENNA ATTACHMENT
NTS



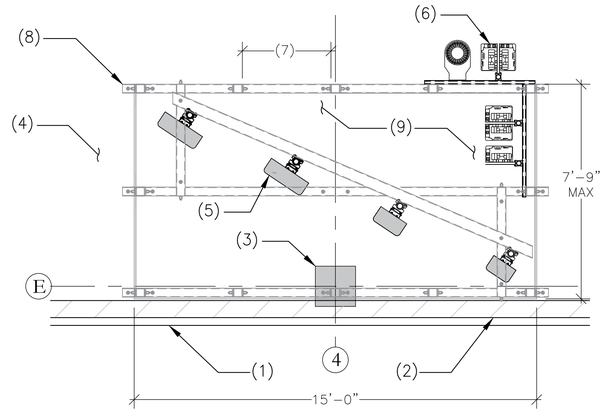
1. EXISTING SINGLE WYTHE BRICK OR BRICK VENEER FACADE.
2. EXISTING MASONRY WALL (BELOW - NO PARAPET).
3. EXISTING BUILDING COLUMN (BELOW). LOCATE NEW ENCLOSURE OVER COLUMN & WALLS AS SHOWN.
4. EXISTING ROOF DECK - RIGID INSULATION OVER CONCRETE SLAB.
5. ANTENNAS - SEE DRAWINGS BY TELCYTE FOR AZIMUTH & EQUIPMENT SPECS.
6. NEW RADIO EQUIPMENT - KEEP 3 FT ABOVE ROOF DECK TO KEEP RADIOS ABOVE SNOW.
7. KEEP CLEAR FOR ACCESS.
8. NEW FRP BOX SCREENING TO CONCEAL ANTENNAS AND RADIO EQUIPMENT.
9. ROOFER TO MAKE AREA WEATHERPROOF PER GSN AFTER SLEEPERS ARE INSTALLED.

116 PLAN VIEW – ALPHA LOCATION
NTS



1. EXISTING SINGLE WYTHE BRICK OR BRICK VENEER FACADE.
2. EXISTING MASONRY WALL (BELOW - NO PARAPET).
3. EXISTING BUILDING COLUMN (BELOW). LOCATE NEW ENCLOSURE OVER COLUMN & WALLS AS SHOWN.
4. EXISTING ROOF DECK - RIGID INSULATION OVER CONCRETE SLAB.
5. ANTENNAS - SEE DRAWINGS BY TELCYTE FOR AZIMUTH & EQUIPMENT SPECS.
6. NEW RADIO EQUIPMENT - KEEP 3 FT ABOVE ROOF DECK TO KEEP RADIOS ABOVE SNOW.
7. KEEP CLEAR FOR ACCESS.
8. NEW FRP BOX SCREENING TO CONCEAL ANTENNAS AND RADIO EQUIPMENT.
9. ROOFER TO MAKE AREA WEATHERPROOF PER GSN AFTER SLEEPERS ARE INSTALLED.

117 PLAN VIEW – BETA LOCATION
NTS



1. EXISTING SINGLE WYTHE BRICK OR BRICK VENEER FACADE.
2. EXISTING MASONRY WALL (BELOW - NO PARAPET).
3. EXISTING BUILDING COLUMN (BELOW). LOCATE NEW ENCLOSURE OVER COLUMN & WALLS AS SHOWN.
4. EXISTING ROOF DECK - RIGID INSULATION OVER CONCRETE SLAB.
5. ANTENNAS - SEE DRAWINGS BY TELCYTE FOR AZIMUTH & EQUIPMENT SPECS.
6. NEW RADIO EQUIPMENT - KEEP 3 FT ABOVE ROOF DECK TO KEEP RADIOS ABOVE SNOW.
7. KEEP CLEAR FOR ACCESS.
8. NEW FRP BOX SCREENING TO CONCEAL ANTENNAS AND RADIO EQUIPMENT.
9. ROOFER TO MAKE AREA WEATHERPROOF PER GSN AFTER SLEEPERS ARE INSTALLED.

118 PLAN VIEW – GAMMA LOCATION
NTS

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City of Aurora Building Division
Reviewed for Code Compliance
Approved as Noted: *cmacy*
Date: *Sep 16, 2020*
2015 INTERNATIONAL CODES & 2020 NEC

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ROOFTOP ANTENNA SCREEN
SITE NAME: HUMANA
ID: COL01176
1501 SOUTH POTOMAC ST.
AURORA, CO 80012

REV	ISSUED	DATE
0	ISSUED FOR PERMIT	04.22.20

COLORADO LICENSED
MATTHEW E. NIEVES
54115
04.22.20
PROFESSIONAL ENGINEER

CaliberEngineering Solutions
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2487 S. GILBERT RD. STE. 106-(607)
GILBERT, AZ 85295
480.329.0493
WWW.CALIBER-ES.COM

JOB: 20-G101 | ENG: MEN

SECTOR PLAN VIEWS

S6 | 0

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CaliberEngineering Solutions

PROJECT INFORMATION:

Subject:	New FRP Screen Antenna Enclosure & Roof Calculations
Site ID:	COL01176
Site Name:	Humana
Location:	1501 South Potomac St. Aurora, CO 80012

WIRELESS CARRIER:

AT&T

PREPARED FOR:

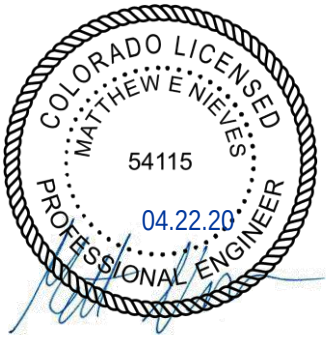
smartlink

8502 E. Via de Ventura Ste. 220

Scottsdale, AZ 85258

PREPARED BY:

Caliber Engineering Solutions
2487 S. Gilbert Rd. Ste 106-(607)
Gilbert, AZ 85295



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City of Aurora Building Division
Reviewed for Code Compliance
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Date: *Sep 16, 2020*
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Project: COL01176 – FRP Enclosure & Roof Calcs
CES Job No.: 20-G101
Eng: MEN
Date: April 21, 2020

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SECTION 3: ROOF CHECKS

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Project: COL01176 – FRP Enclosure & Roof Calcs
CES Job No.: 20-G101
Eng: MEN
Date: April 21, 2020

Basis for Design

CODE CRITERIA

BUILDING CODE:	2015 INTERNATIONAL BUILDING CODE
LOADS:	ASCE 7-10 MINIMUM DESIGN LOADS FOR BUILDINGS & OTHER STRUCTURES

GRAVITY LOADS

ROOF LIVE:	Lr = 20 PSF
ROOF SNOW:	Pf = 30 PSF

LATERAL LOADS

WIND LOADS:	WIND SPEED = 115 MPH (ULTIMATE 3-SEC GUST) RISK CATEGORY = II EXPOSURE CATEGORY = B TOPOGRAPHIC CATEGORY = 1
SEISMIC:	IMPORTANCE FACTOR = 1.0 SOIL CLASS = D S_{DS} = 0.184 g S_{D1} = 0.091 g SEISMIC DESIGN CATEGORY = B

MATERIALS

STEEL:	STEEL RECT. TUBE = A500 Gr B (Fy = 46 KSI) MISC. STEEL SHAPES = A36 (Fy = 36 KSI) PIPE STEEL = A53 Gr B (Fy = 35 KSI) BOLTS = AS NOTED	
FRP:	SHAPES = STRONGWELL EXTREN 500/525/625 BOLTS = STRONGWELL FIBREBOLT	(SEE REFERENCES) (SEE REFERENCES)

Project: COL01176 – FRP Enclosure & Roof Calcs
CES Job No.: 20-G101
Eng: MEN
Date: April 21, 2020

CaliberEngineering Solutions

Limitations & Assumptions

It is our goal to fully meet our customers engineering needs. The list below has been presented to help bring awareness to some of the limitations of this report and ensure there is no conflict with our customers intended use. Any concerns with the following limitations should be brought to the attention of the professional engineer of record.

1. This analysis report is based on information made available to Caliber Engineering Solutions in the form of a Building Structural Mapping Report by Sugarloaf Tower Company, dated March 13, 2020. Any variance found with existing field conditions should be brought to the attention of the professional engineer of record.

2. The calculations within this report should not be used for any future additions or roof calculations. Many of the calculations shown herein were used to determine influence comparisons but are not the original design capacities and therefore should not be referenced. The conclusions and methods used in this report were specifically made for the scope shown in the drawings by Caliber Engineering Solutions. Assumptions and comparisons are made in this report that are not to be taken as the original design loads. Any future work should reference the original building design or with field verification.

Project: COL01176 – FRP Enclosure & Roof Calcs
CES Job No.: 20-G101
Eng: MEN
Date: April 21, 2020

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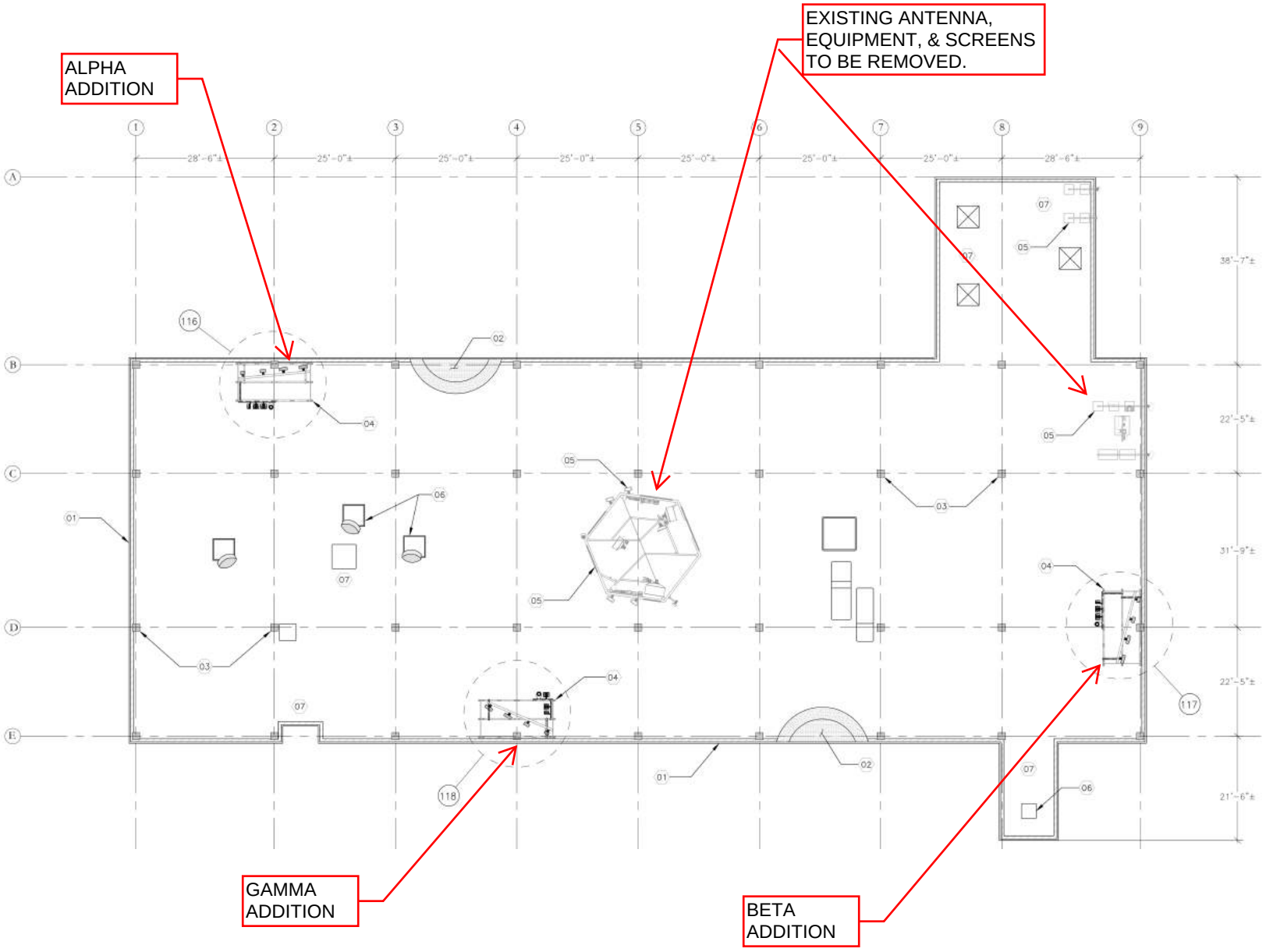
Key Plan



Project: COL01176 – FRP Enclosure & Roof Calcs
CES Job No.: 20-G101
Eng: MEN
Date: April 21, 2020

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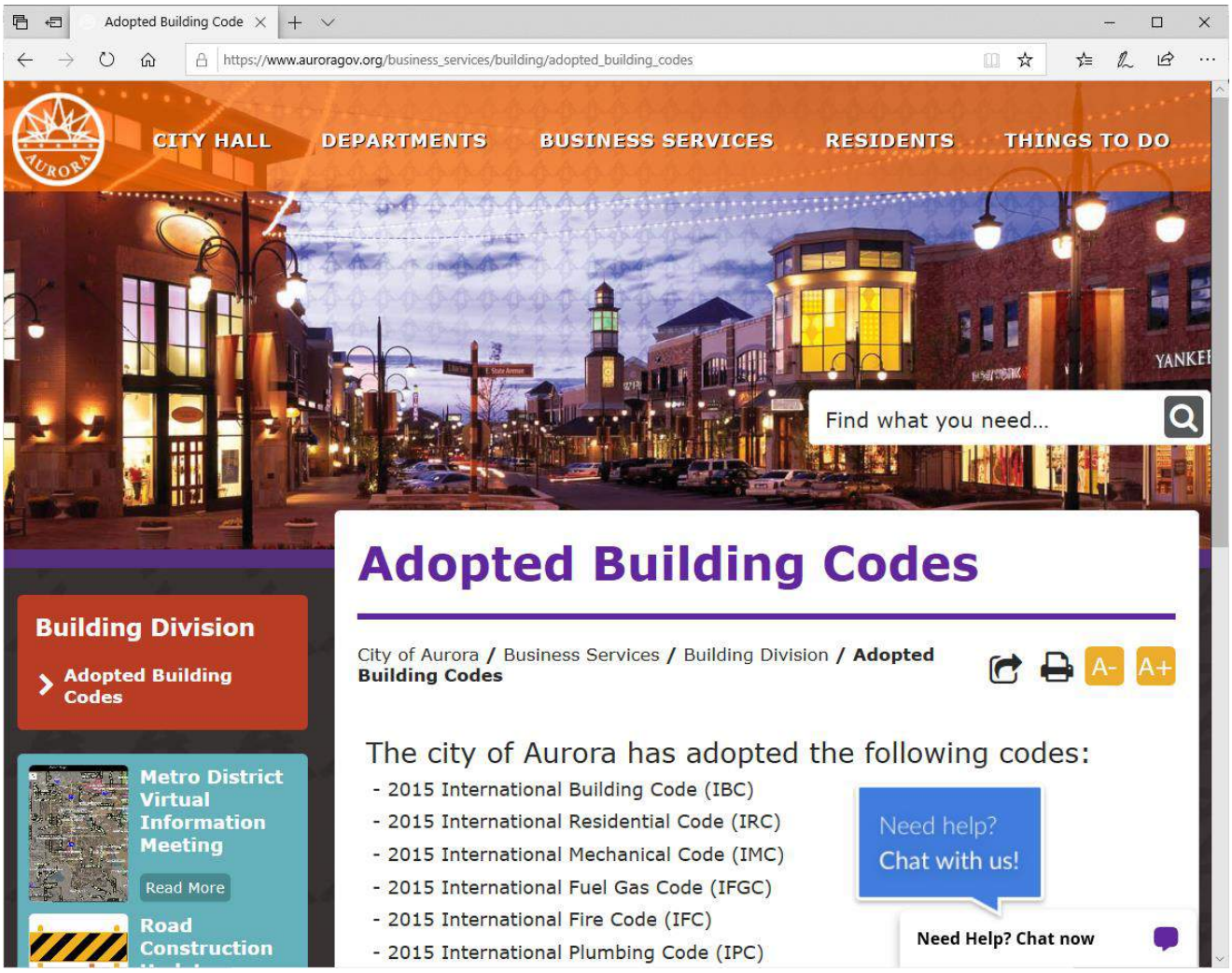
Photo of Existing Conditions

Project: COL01176 – FRP Enclosure & Roof Calcs
CES Job No.: 20-G101
Eng: MEN
Date: April 21, 2020

CaliberEngineering Solutions

Building Code



Project: COL01176 – FRP Enclosure & Roof Calcs
CES Job No.: 20-G101
Eng: MEN
Date: April 21, 2020

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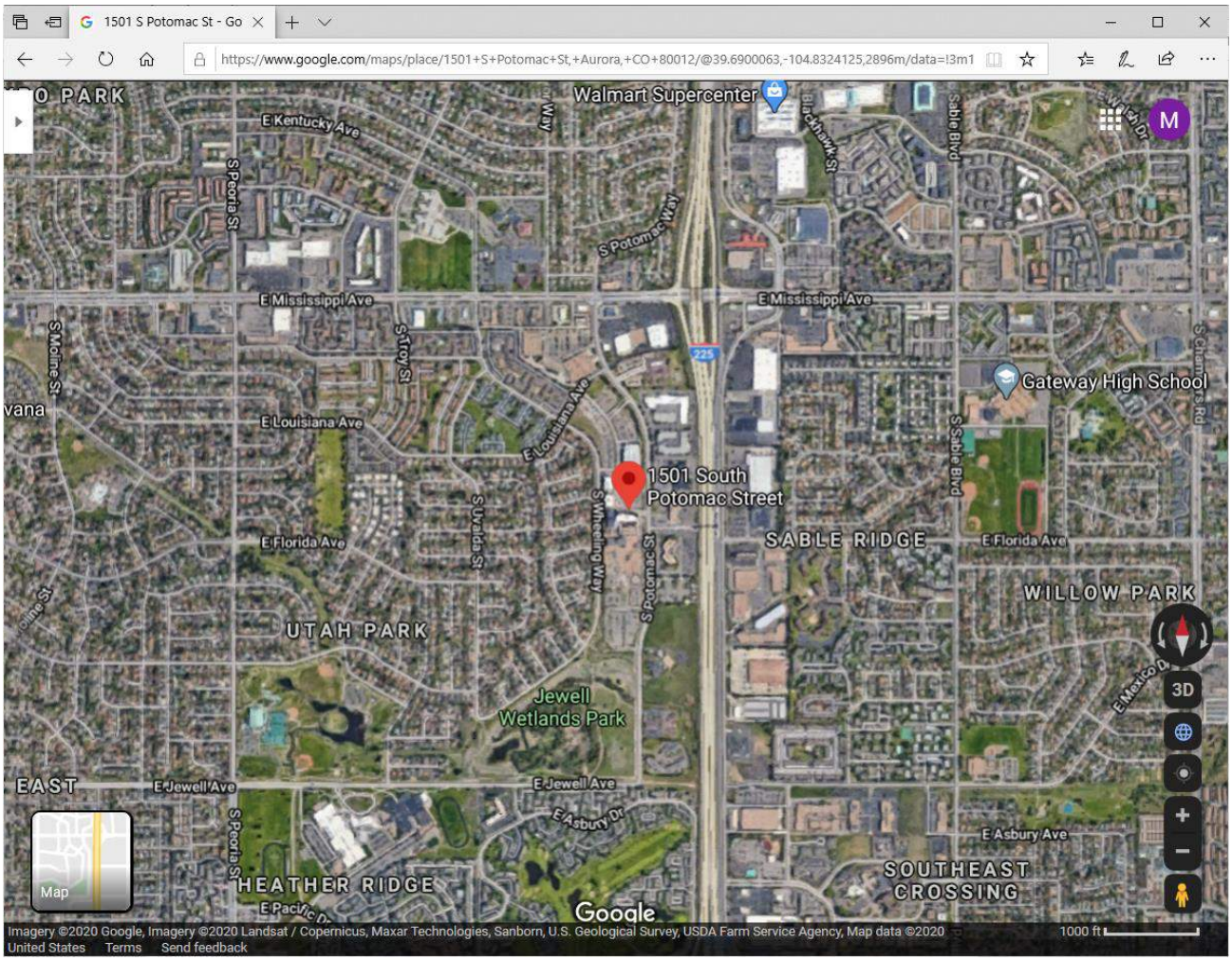
Wind Exposure

Surface Roughness: B

Wind Exposure: B

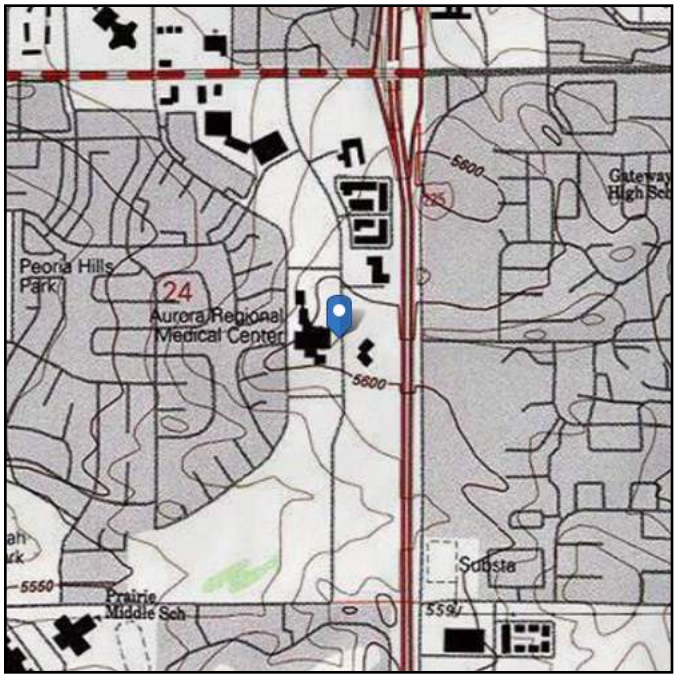


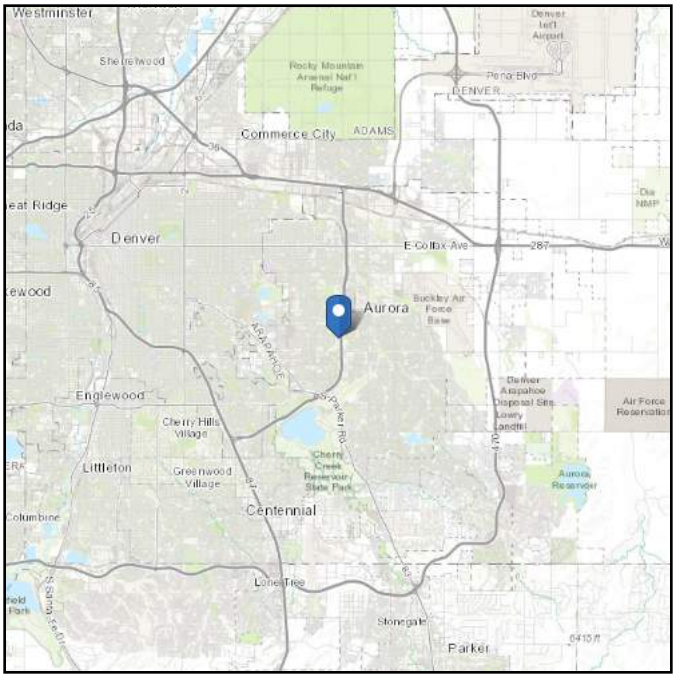
ASCE 7 Hazards Report

Address:
1501 S Potomac St
Aurora, Colorado
80012

Standard: ASCE/SEI 7-10
Risk Category: II
Soil Class: D - Stiff Soil

Elevation: 5601.6 ft (NAVD 88)
Latitude: 39.689271
Longitude: -104.831178





Wind

Results:

Wind Speed:	115 Vmph
10-year MRI	76 Vmph
25-year MRI	84 Vmph
50-year MRI	90 Vmph
100-year MRI	96 Vmph
Data Source:	ASCE/SEI 7-10, Fig. 26.5-1A and Figs. CC-1–CC-4, incorporating errata of March 12, 2014
Date Accessed:	Tue Apr 21 2020

Value provided is 3-second gust wind speeds at 33 ft above ground for Exposure C Category, based on linear interpolation between contours. Wind speeds are interpolated in accordance with the 7-10 Standard. Wind speeds correspond to approximately a 7% probability of exceedance in 50 years (annual exceedance probability = 0.00143, MRI = 700 years).

Site is not in a hurricane-prone region as defined in ASCE/SEI 7-10 Section 26.2.

Mountainous terrain, gorges, ocean promontories, and special wind regions should be examined for unusual wind conditions.

ASCE
AMERICAN SOCIETY OF CIVIL ENGINEERS

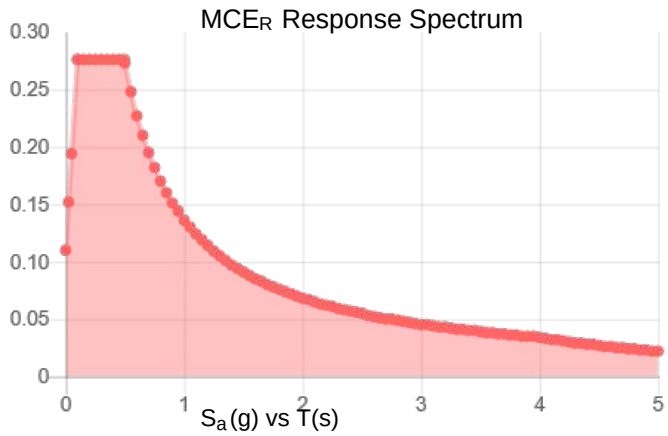
Seismic

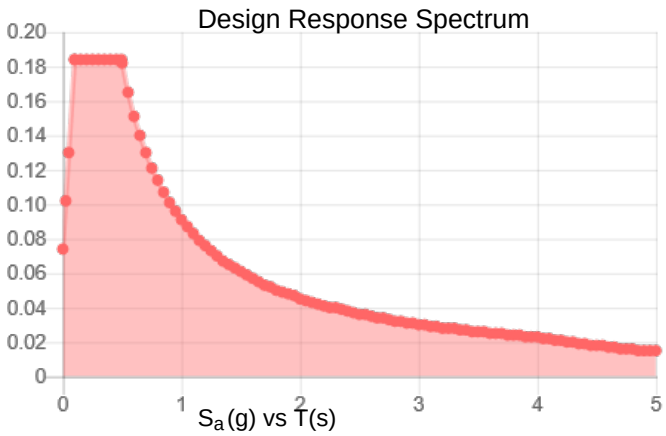
Site Soil Class: D - Stiff Soil

Results:

S_S :	0.173	S_{DS} :	0.184
S_1 :	0.057	S_{D1} :	0.091
F_a :	1.6	T_L :	4
F_v :	2.4	PGA :	0.087
S_{MS} :	0.276	PGA_M :	0.139
S_{M1} :	0.136	F_{PGA} :	1.6
		I_e :	1

Seismic Design Category B





Data Accessed: Tue Apr 21 2020

Date Source: USGS Seismic Design Maps based on ASCE/SEI 7-10, incorporating Supplement 1 and errata of March 31, 2013, and ASCE/SEI 7-10 Table 1.5-2. Additional data for site-specific ground motion procedures in accordance with ASCE/SEI 7-10 Ch. 21 are available from USGS.

Snow

Results:

Ground Snow Load, p_g:	20 lb/ft^2
Elevation:	5601.6 ft
Data Source:	ASCE/SEI 7-10, Fig. 7-1.
Date Accessed:	Tue Apr 21 2020

USE 30 PSF ROOF SNOW PER CITY STANDARDS

Values provided are ground snow loads. In areas designated "case study required," extreme local variations in ground snow loads preclude mapping at this scale. Site-specific case studies are required to establish ground snow loads at elevations not covered.

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City of Aurora Public Works Department

ENGINEERING DESIGN CRITERIA

Building Division • 15151 E. Alameda Parkway, Ste 2400 • Aurora, CO 80012
303.739.7420 • Email: permitcounter@auroragov.org

CLIMATIC AND GEOGRAPHIC CRITERIA:

Roof Snow Load	30 psf. (Pergola 20 psf.)
Ground Snow Load	34 psf.
Basic Wind Speed	115 mph Risk Category II, 120 mph Risk Category III-IV, 105 mph Risk Category I (3-second gust all categories)
Special Wind Region	No
Topographic Effects	No
Exposure Category	IRC R301.2.1.4 or IBC 1609.4.3
Seismic Design Category Residential	B
Seismic Design Category Commercial	Per IBC chapter 16
Weathering	Severe
Minimum Frost Depth for Foundations	36 inches
Winter Design Temperature	1 DEGREE (F)
Ice Barrier Underlayment Required	Yes
Flood Hazard	Varies – See City Code Chapter 70
Air Freezing Index	712
Mean Annual Temperature	50 DEGREES (F)

Project Title: Col.01176 - Humana
Project No.: 20-G101
Eng: MEN Date: 4.18.20

CaliberEngineering Solutions

Wind Pressure On Screen Enclosure

Screens are Located at Building Edge & Corner. Therefore, Use parapet Wind Pressure in accordance w/ industry Standards & Design Guidelines.

Velocity Pressure

$$q_z = 0.00256 K_z K_{zt} K_d V^2 \qquad \text{(ASCE 7 Eq 30.3-1)}$$

$K_z = 0.93$
$K_{zt} = 1.0$
$K_d = 0.85$
$V = 115$ MPH

$= 0.00256 (0.93)(1.0)(0.85)(115 \text{ MPH})^2$

$= 26.8$ PSF

Screen (Parapet) Pressure Coefficients (Long Sides)

Load Case	GC_{p1}	GC_{p2}
A. Windward	+0.75	-2.6
B. Leeward	+0.75	-1.25

Screen Wall Pressure (Long Sides)

Wind Ward

$P_w = q_p (GC_p - GC_{pi}) = 26.8 \text{ PSF} (0.75 - (-2.6))$
$= 89.8$ PSF

$0.6 P_w = 53.9$ PSF (ASD)

Leeward

$P_L = 26.8 \text{ PSF} (0.75 - (-1.25)) = 53.6$ PSF

$0.6 P_L = 32.2$ PSF (ASD)

Caliber Engineering Solutions

Wind Pressure on Screen Enclosure Cont'd

Screen (Parapet) Pressure Coefficients (Short Sides)

Load Case	GC_{p1}	GC_{p2}
A. Windward	+0.8	-2.75
B. Leeward	+0.8	-1.5

Screen Wall Pressure (Short Sides)

Windward

$P_W = 26.8\ PSF\ (0.8 - (-2.75)) = 95.1\ PSF$

$0.6 P_W = 57\ PSF$

Leeward

$P_L = 26.8\ PSF\ (0.8 - (-1.5)) = 61.6\ PSF$

$0.6 P_L = 37.0\ PSF$

Project Title: CoL01176 - Humana
Project No.: 20-6101
Eng: MEN Date: 4.18.20

CaliberEngineering Solutions

FRP Panel Check

Clear Span Between Framing = 40 in (LW)

Design Wind Pressure (ASD)

$0.6 P_w = 57.0$ PSF

Allowable Uniform Load

$$P_{allow} = 45 \text{ PSF} + \frac{(84 \text{ PSF} - 45 \text{ PSF})}{3}$$

$$= 58 \text{ PSF}$$

Design Results

Use Strongwell 500/525/625 Extren Series 5/8" Thick Panel

PLATE

Allowable Loads

EXTREN® 500, 525 and 625

Plate spanning in Lengthwise Direction
For allowable loads when plate is spanning in crosswise direction, multiply table values by 0.70

I = 0.244 in^4/ft. of width
S = 0.781 in^3/ft. of width.

LOAD/DEFLECTION TABLE

Span Inches		*5/8" Thickness Wt/ft^2 = 5.79 lbs									MAX LOAD AT Δ = l/100 OR t/2
12"	u	100	200	300	400	500	1000	1500	2000	2500	2600
	Δ u	.005	.009	.014	.018	.023	.046	.069	.092	.115	.120
	c	50	100	150	200	250	500	750	1000	1250	1622
	Δ c	.004	.007	.011	.015	.018	.037	.055	.074	.092	.120
18"	u	100	200	300	400	500	600	700			768
	Δ u	.023	.047	.070	.093	.117	.140	.163			.180
	c	75	150	225	300	375	450	525			723
	Δ c	.019	.037	.056	.075	.093	.112	.131			.180
24"	u	20	40	100	200	300					326
	Δ u	.015	.030	.074	.148	.221					.240
	c	20	40	100	200	300					407
	Δ c	.012	.024	.059	.118	.177					.240
30"	u	20	40	60	100	150					167
	Δ u	.036	.072	.108	.180	.270					.300
	c	25	50	75	125	188					260
	Δ c	.029	.058	.086	.144	.216					.300
36"	u	20	40	60	80						84
	Δ u	.075	.149	.224	.299						.312
	c	30	60	90	120						157
	Δ c	.060	.120	.179	.239						.312
42"	u	10	20	30	40						45
	Δ u	.069	.138	.208	.277						.312
	c	18	35	53	70						99
	Δ c	.055	.111	.166	.221						.312
48"	u	10	20								27
	Δ u	.118	.236								.312
	c	20	40								66
	Δ c	.094	.189								.312
54"	u	10									17
	Δ u	.189									.312
	c	23									47
	Δ c	.151									.312
60"	u	10									11
	Δ u	.288									.312
	c	25									34
	Δ c	.231									.312

c IS CONCENTRATED LOAD LBS/FT WIDTH
Δ c IS DEFLECTION UNDER CONCENTRATED LOAD
u IS UNIFORM LOAD LBS/FT^2
Δ u IS DEFLECTION UNDER UNIFORM LOAD

* Non-stock size subject to mill run requirement.

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CaliberEngineering Solutions

Loads On Screen Wall Frame

Load Path

FRP Panel → Vert Posts → Braced Frames → Anchors
(Lateral)

Dead Load

Use 6 PSF Where Panel is Attached to Frame

Use Weight of Framing Members

For Radio Equipment:

1) Neglect Radio Equipment For Screen Wall Calcs since Radio Equipment will resist Uplift Anchorage (Conservative)

2) Add Radio Equipment in for Roof Calcs.

Wind Load

Trib Width = 44 in (Vert Post Spacing)

On Long Face

Windward

$W_w = 89.8\ PSF\ (44in/12) = 329\ PLF$

Leeward

$W_L = 53.6\ PSF\ (44in/12) = 197\ PLF$

On Short Face

Windward

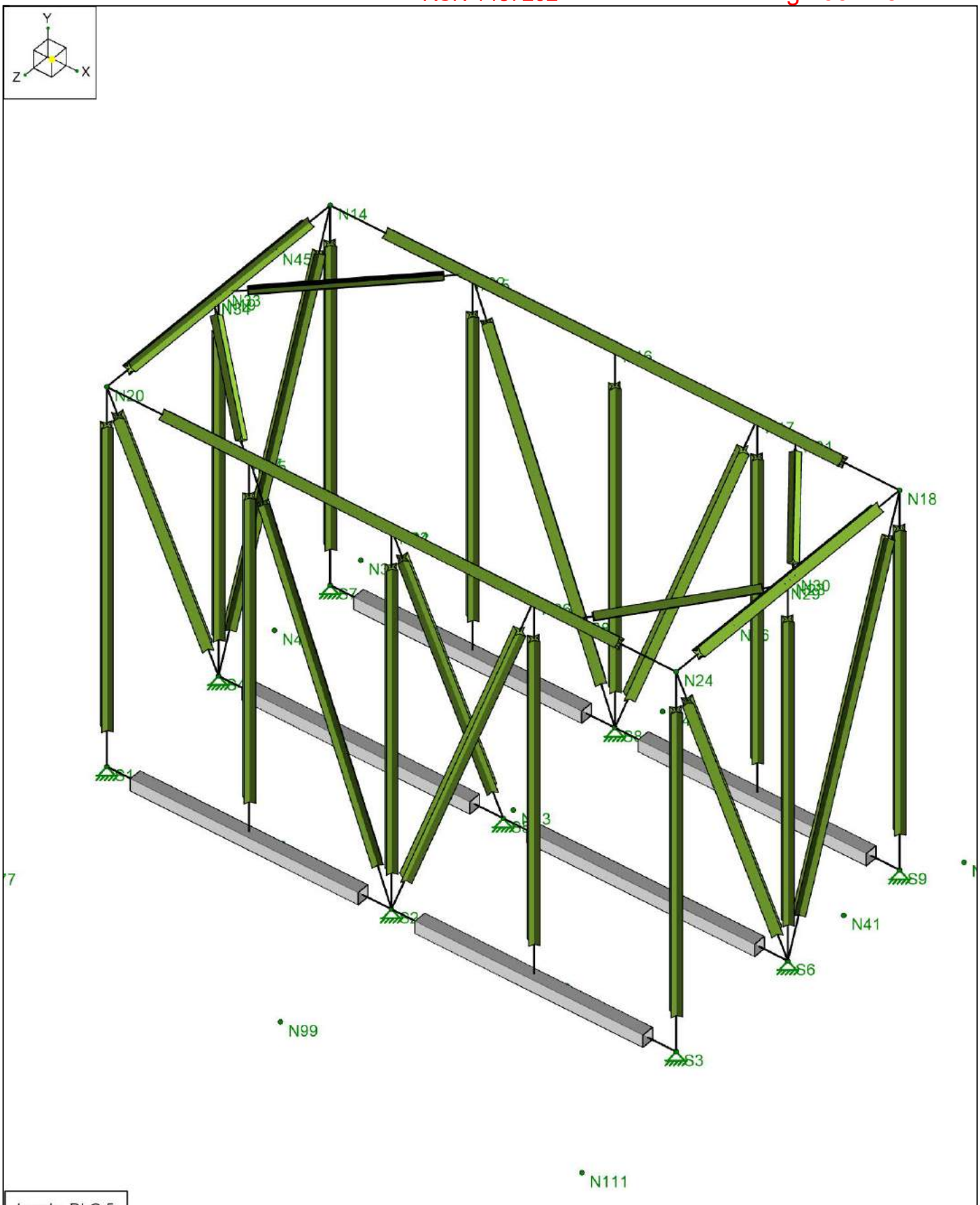
$W_w = 95.1\ PSF\ (44in/12) = 349\ PLF$

Leeward

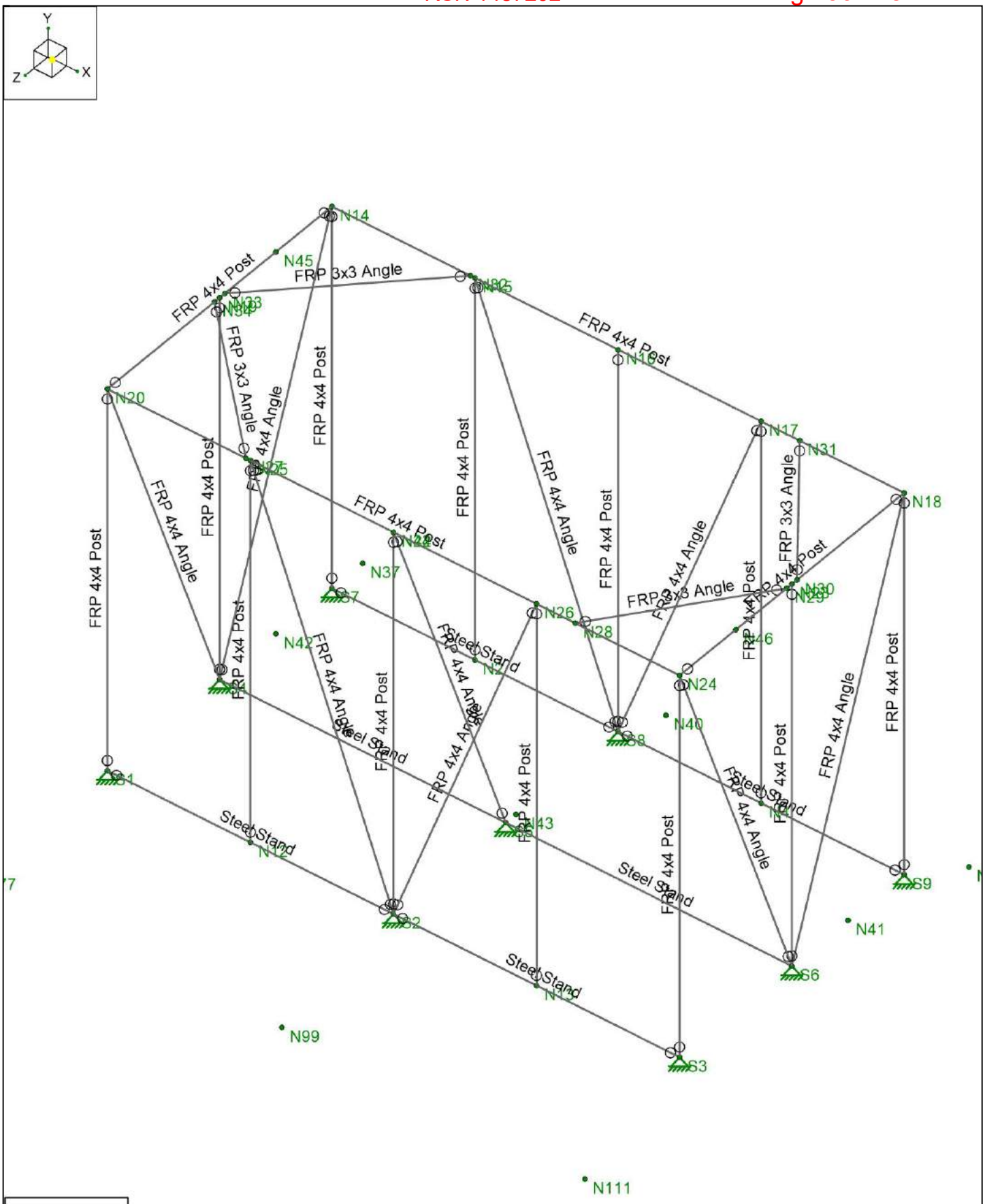
$W_L = 61.6\ PSF\ (44in/12) = 226\ PLF$

For Radio Equipment:

Apply Wind Load Across Equipment Zone

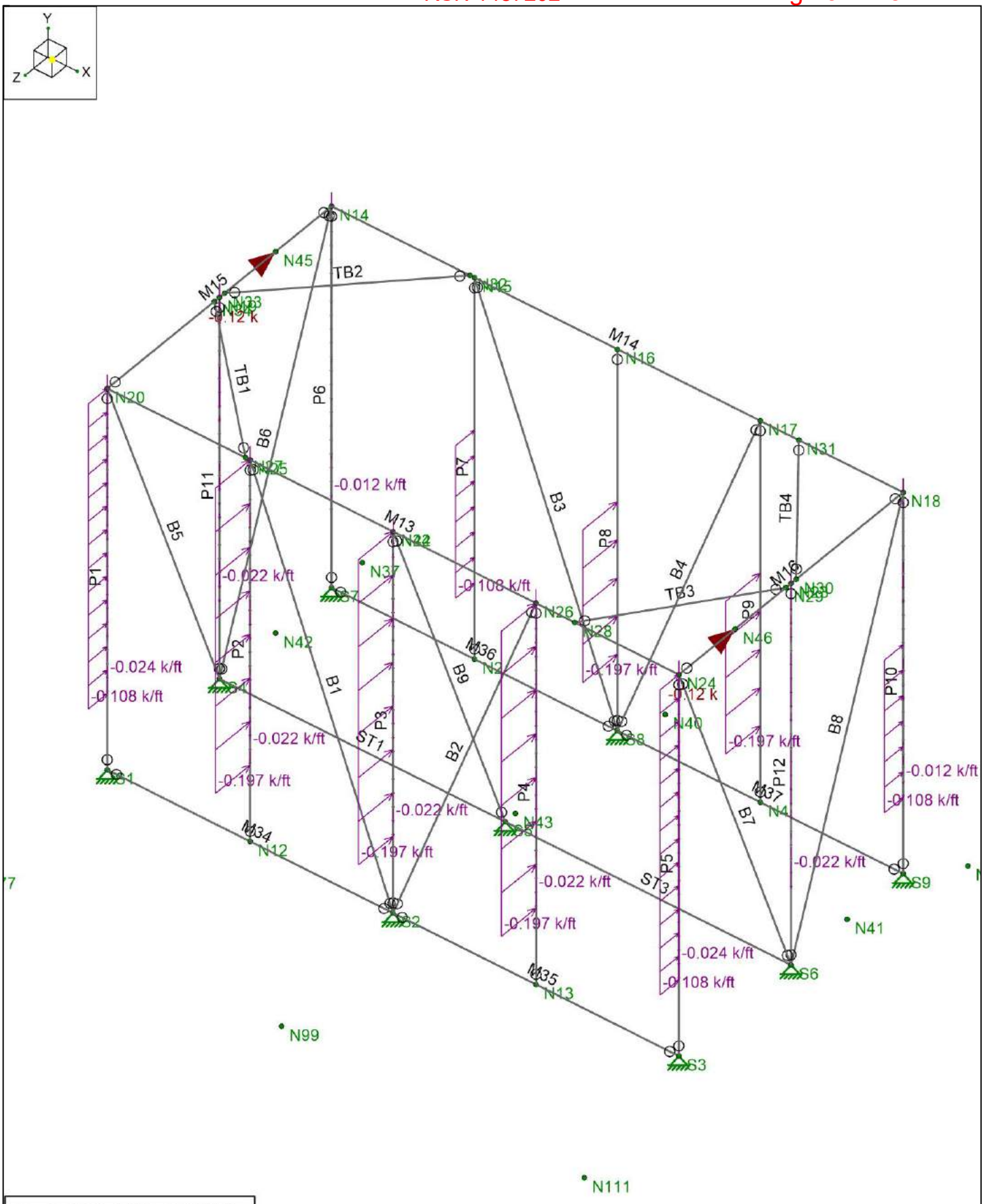


		SK-1
		Apr 21, 2020
		Risa.r3d



Loads: BLC 5,

		SK-3
		Apr 21, 2020
		Risa.r3d



		SK-4
		Apr 21, 2020
		Risa.r3d

RISA A NEMETSCHEK COMPANY

Company :
Designer :
Job Number :
Model Name :

4/21/2020
11:09:02 AM
Checked By : _____

General Properties

	Label	E [ksi]	G [ksi]	Nu	Therm. Coeff. [1e…	Density [k/ft³]
1	gen_Conc3NW	3155	1372	0.15	0.6	0.145
2	gen_Conc4NW	3644	1584	0.15	0.6	0.145
3	gen_Conc3LW	2085	906	0.15	0.6	0.11
4	gen_Conc4LW	2408	1047	0.15	0.6	0.11
5	gen_Alum	10100	4077	0.3	1.29	0.173
6	gen_Steel	29000	11154	0.3	0.65	0.49
7	gen_Plywood	1800	38	0	0.3	0.035
8	RIGID	1e+06		0.3	0	0
9	FRP	2600	425	0.33	0	0.112

Hot Rolled Steel Properties

	Label	E [ksi]	G [ksi]	Nu	Therm. C…	Density [k…	Yield [ksi]	Ry	Fu [ksi]	Rt
1	A992	29000	11154	0.3	0.65	0.49	50	1.1	65	1.1
2	A36 Gr.36	29000	11154	0.3	0.65	0.49	36	1.5	58	1.2
3	A572 Gr.50	29000	11154	0.3	0.65	0.49	50	1.1	65	1.1
4	A500 Gr.…	29000	11154	0.3	0.65	0.527	42	1.4	58	1.3
5	A500 Gr.…	29000	11154	0.3	0.65	0.527	46	1.4	58	1.3
6	A53 Gr.B	29000	11154	0.3	0.65	0.49	35	1.6	60	1.2
7	A1085	29000	11154	0.3	0.65	0.49	50	1.4	65	1.3

General Section Sets

	Label	Shape	Type	Material	Area [in²]	Iyy [in⁴]	Izz [in⁴]	J [in⁴]
1	GEN1A	RE4X4	Beam	gen_Conc3NW	16	21.333	21.333	31.573
2	RIGID		None	RIGID	1e+06	1e+06	1e+06	1e+06
3	FRP 4x4 Post	FRP SQ 4x4…	Column	FRP	3.74	8.82	8.82	13.183
4	FRP 4x4 Angle	FRP 4x4x1/2…	HBrace	FRP	3.75	5.56	5.56	0.312
5	FRP 3x3 Angle	FRP 3x3x1/4…	HBrace	FRP	1.42	1.18	1.18	0.03

Hot Rolled Steel Section Sets

	Label	Shape	Type	Design List	Material	Design Rule	Area [in²]	Iyy [in⁴]	Izz [in⁴]	J [in⁴]
1	Steel Stand	HSS4X4X2	Beam	Tube	A500 Gr.…	Typical	1.77	4.4	4.4	6.91

Basic Load Cases

	BLC Desc…	Category	X Gravity	Y Gravity	Z Gravity	Nodal	Point	Distributed	Area(Me…	Surface(P…
1	DL	None		-1				9		
2	WLX	None				2		6		
3	WLZw	None				2		9		
4	WLZl	None				2		9		

Load Combinations

	De…	So…	PD…	SR…	BLC	Fa…	BLC	Fa…	BLC	Fa…	BLC	Fa…	BLC	Fa…	BLC	Fa…	BLC	Fa…	BLC	Fa…	BLC	Fa…	BLC	Fa…
1	DL	Yes	Y		1	1																		
2	0.6…	Yes	Y		1	0.6	2	0.6																
3	DL…	Yes	Y		1	1	2	0.6																
4					1																			
5	0.6…	Yes	Y		1	0.6	3	0.6																
6	1.0…	Yes	Y		1	1	3	0.6																
7																								
8	0.6…	Yes	Y		1	0.6	4	0.6																
9	1.0…	Yes	Y		1	1	4	0.6																
10																								
11	0.9…		Y		1	0.9	2	1																
12	1.2…		Y		1	1.2	2	1																
13																								
14	0.9…		Y		1	0.9	3	1																
15	1.2…		Y		1	1.2	3	1																

Load Combinations (Continued)

	De...	So...	PD...	SR...	BLC	Fa...	BLC	Fa...	BLC	Fa...	BLC	Fa...	BLC	Fa...	BLC	Fa...	BLC	Fa...	BLC	Fa...	BLC	Fa...	BLC	Fa...
16																								
17	0.9...		Y		1	0.9	4	1																
18	1.2...		Y		1	1.2	4	1																

Node Loads and Enforced Displacements (BLC 2 : WLX)

	Node Label	L, D, M	Direction	Magnitude [(k, k-ft), (...	Inactive [(k, k-ft), (in,...
1	N45	L	X	0.2	Active
2	N46	L	X	0.2	Active

Node Loads and Enforced Displacements (BLC 3 : WLZw)

	Node Label	L, D, M	Direction	Magnitude [(k, k-ft), (...	Inactive [(k, k-ft), (in,...
1	N45	L	Z	-0.2	Active
2	N46	L	Z	-0.2	Active

Node Loads and Enforced Displacements (BLC 4 : WLZl)

	Node Label	L, D, M	Direction	Magnitude [(k, k-ft), (...	Inactive [(k, k-ft), (in,...
1	N45	L	Z	0.2	Active
2	N46	L	Z	0.2	Active

Member Distributed Loads (BLC 1 : DL)

	Member Label	Direction	Start Magnitud...	End Magnitude...	Start Location [...	End Location [(...	Inactive [(k, k-f...
1	P1	Y	-0.024	-0.024	24	%100	Active
2	P2	Y	-0.022	-0.022	24	%100	Active
3	P3	Y	-0.022	-0.022	24	%100	Active
4	P4	Y	-0.022	-0.022	24	%100	Active
5	P5	Y	-0.024	-0.024	24	%100	Active
6	P6	Y	-0.012	-0.012	24	%100	Active
7	P10	Y	-0.012	-0.012	24	%100	Active
8	P11	Y	-0.022	-0.022	24	%100	Active
9	P12	Y	-0.022	-0.022	24	%100	Active

Member Distributed Loads (BLC 2 : WLX)

	Member Label	Direction	Start Magnitud...	End Magnitude...	Start Location [...	End Location [(...	Inactive [(k, k-f...
1	P1	X	0.19	0.19	24	%100	Active
2	P5	X	0.19	0.19	24	%100	Active
3	P6	X	0.19	0.19	24	%100	Active
4	P10	X	0.19	0.19	24	%100	Active
5	P11	X	0.349	0.349	24	%100	Active
6	P12	X	0.349	0.349	24	%100	Active

Member Distributed Loads (BLC 3 : WLZw)

	Member Label	Direction	Start Magnitud...	End Magnitude...	Start Location [...	End Location [(...	Inactive [(k, k-f...
1	P1	Z	-0.18	-0.18	24	%100	Active
2	P2	Z	-0.329	-0.329	24	%100	Active
3	P3	Z	-0.329	-0.329	24	%100	Active
4	P4	Z	-0.329	-0.329	24	%100	Active
5	P5	Z	-0.18	-0.18	24	%100	Active
6	P10	Z	-0.18	-0.18	24	72	Active
7	P7	Z	-0.18	-0.18	24	72	Active
8	P8	Z	-0.329	-0.329	24	72	Active
9	P9	Z	-0.329	-0.329	24	72	Active

Member Distributed Loads (BLC 4 : WLZI)

	Member Label	Direction	Start Magnitud...	End Magnitude...	Start Location [...	End Location [(...	Inactive [(k, k-f...
1	P1	Z	0.107	0.107	24	%100	Active
2	P2	Z	0.197	0.197	24	%100	Active
3	P3	Z	0.197	0.197	24	%100	Active
4	P4	Z	0.197	0.197	24	%100	Active
5	P5	Z	0.107	0.107	24	%100	Active
6	P10	Z	0.107	0.107	24	72	Active
7	P7	Z	0.107	0.107	24	72	Active
8	P8	Z	0.197	0.197	24	72	Active
9	P9	Z	0.197	0.197	24	72	Active

Maximum Member Section Forces

	Me...		Axi...	Loc...	LC	y S...	Loc...	LC	z S...	Loc...	LC	Tor...	Loc...	LC	y-y...	Loc...	LC	z-z...	Loc...	LC
1	P1	max	1.89	0	9	0.365	23.75	3	0.346	23.75	6	0	120	9	1.244	62.5	6	0	120	9
2		min	-2.778	120	6	-0.547	120	2	-0.518	120	5	0	0	1	-0.74	62.5	8	-1.313	62.5	2
3	P2	max	1.2	0	9	0	120	9	0.632	23.75	6	0.052	120	3	2.274	62.5	6	0	120	9
4		min	-2.126	120	3	0	0	1	-0.948	120	5	-0.076	0	5	-1.362	62.5	8	0	0	1
5	P3	max	2.255	0	9	0	120	9	0.632	23.75	6	0	120	5	2.274	62.5	6	0	120	9
6		min	-3.278	120	5	0	0	1	-0.948	120	5	-0.001	0	3	-1.362	62.5	8	0	0	1
7	P4	max	2.489	0	3	0	120	9	0.632	23.75	6	0.008	120	5	2.274	62.5	6	0	120	9
8		min	-1.056	120	6	0	0	1	-0.948	120	5	-0.005	0	9	-1.362	62.5	8	0	0	1
9	P5	max	1.898	0	9	0.365	23.75	3	0.346	23.75	6	0	120	9	1.244	62.5	6	0	120	9
10		min	-2.775	120	6	-0.547	120	2	-0.518	120	5	0	0	1	-0.74	62.5	8	-1.313	62.5	2
11	P12	max	0.237	0	3	0.67	23.75	3	0	120	9	0.012	120	5	0	120	9	0	120	9
12		min	0.01	120	5	-1.005	120	2	0	0	1	-0.011	0	9	0	0	1	-2.412	62.5	2
13	P10	max	2.72	0	6	0.365	23.75	3	0.259	23.75	6	0	120	9	0.829	52.5	6	0	120	9
14		min	-1.648	120	9	-0.547	120	2	-0.173	72.5	5	0	0	1	-0.493	52.5	8	-1.313	62.5	2
15	P9	max	2.391	0	2	0	120	9	0.474	23.75	6	0.02	120	5	1.516	52.5	6	0	120	9
16		min	-0.282	120	6	0	0	1	-0.316	72.5	5	-0.016	0	9	-0.908	52.5	8	0	0	1
17	P8	max	0.1	0	3	0	120	9	0.474	23.75	6	0.001	120	2	1.516	52.5	6	0	120	9
18		min	-0.034	120	5	0	0	1	-0.316	72.5	5	0	0	6	-0.908	52.5	8	0	0	1
19	P6	max	2.79	0	6	0.365	23.75	3	0	120	9	0	120	9	0	120	9	0	120	9
20		min	-1.702	120	9	-0.547	120	2	0	0	1	0	0	1	0	0	1	-1.313	62.5	2
21	P11	max	0.229	0	6	0.67	23.75	3	0	120	9	0.024	120	9	0	120	9	0	120	9
22		min	0.014	120	8	-1.005	120	2	0	0	1	-0.033	0	5	0	0	1	-2.412	62.5	2
23	P7	max	0.245	0	5	0	120	9	0.259	23.75	6	0.013	120	9	0.829	52.5	6	0	120	9
24		min	-2.492	120	3	0	0	1	-0.173	72.5	5	-0.016	0	5	-0.493	52.5	8	0	0	1
25	M13	max	0.836	44	3	0.31	88	3	0.973	44	6	0	42....	2	0.844	132	5	0.301	132	5
26		min	-1.071	132	2	-0.317	143	3	-0.729	132	6	0	132	5	-0.552	132	9	-1.119	132	3
27	M16	max	0.911	88	5	0.017	44	3	0.615	45....	3	0.01	22	5	0.125	41.25	8	0.011	44	3
28		min	-0.577	46.75	9	-0.015	43....	3	-0.398	42....	2	-0.029	0	3	-0.749	44	3	-0.005	22	6
29	M15	max	1.042	22	5	0.015	44....	6	0.619	44	2	0.049	22	3	1.243	44	3	0.003	44	9
30		min	-0.661	0	9	-0.013	44	3	-0.7	42....	6	-0.02	42....	5	-1.125	45....	5	-0.006	24.75	3
31	TB1	max	1.422	59....	5	0.003	0	9	0	59....	9	0	59....	9	0	59....	9	0	59....	9
32		min	-0.826	0	9	-0.003	59....	1	0	0	1	0	0	5	0	0	1	-0.003	29....	1
33	TB3	max	0.868	52....	6	0.002	0	3	0	52....	9	0	52....	3	0	52....	9	0	52....	9
34		min	-0.472	0	8	-0.002	52....	6	0	0	1	0	0	5	0	0	1	-0.003	26....	3
35	TB4	max	0.395	52....	8	0.002	0	6	0	52....	9	0	52....	5	0	52....	9	0	52....	9
36		min	-0.706	0	3	-0.002	52....	3	0	0	1	0	0	3	0	0	1	-0.003	26....	6
37	TB2	max	0.511	59....	2	0.003	0	9	0	59....	9	0	59....	8	0	59....	9	0	59....	9
38		min	-0.644	0	6	-0.003	59....	1	0	0	1	0	0	3	0	0	1	-0.003	29....	1
39	B1	max	2.452	0	3	0.005	0	3	0	127...	9	0	127...	3	0	127...	9	0	127...	9
40		min	-1.089	127...	8	-0.005	127...	6	0	0	1	0	0	5	0	0	1	-0.014	63....	3
41	B2	max	1.327	0	6	0.005	0	9	0	127...	9	0	127...	3	0	127...	9	0	127...	9
42		min	-3.114	127...	2	-0.005	127...	6	0	0	1	0	0	5	0	0	1	-0.014	63....	9
43	M14	max	1.283	44	3	0.353	88	3	0.378	176	3	0	132	2	0.722	42....	2	1.089	44	3
44		min	-1.041	132	3	-0.54	176	3	-0.427	132	6	0	133...	3	-0.722	143	3	-1.242	132	3
45	B3	max	3.297	127...	3	0.005	0	3	0	127...	9	0	127...	6	0	127...	9	0	127...	9
46		min	-0.274	0	5	-0.005	127...	6	0	0	1	0	0	2	0	0	1	-0.014	63....	3

RISA A NEMETSCHEK COMPANY

Company :
Designer :
Job Number :
Model Name :

4/21/2020
11:09:02 AM
Checked By : _____

Maximum Member Section Forces (Continued)

	Me...		Axi...	Loc...	LC	y S...	Loc...	LC	z S...	Loc...	LC	Tor...	Loc...	LC	y-y...	Loc...	LC	z-z...	Loc...	LC
47	B4	max	0.481	127...	6	0.005	0	9	0	127...	9	0	127...	6	0	127...	9	0	127...	9
48		min	-3.488	0	2	-0.005	127...	1	0	0	1	0	0	2	0	0	1	-0.014	63....	9
49	ST1	max	0	88	9	0.049	0	9	0.015	88	9	0.013	88	3	0.15	0	2	0.174	0	9
50		min	0	0	1	-0.083	88	3	-0.032	0	2	0.006	0	5	-0.089	0	9	-0.44	0	2
51	ST3	max	0	88	9	0.048	0	6	0.039	88	2	0.013	88	3	0.201	88	3	0.563	88	3
52		min	0	0	1	-0.099	88	3	-0.002	0	9	0.006	0	5	-0.086	0	2	-0.072	88	5
53	M34	max	0.013	88	2	1.001	44	2	0.316	43....	5	0	88	9	1.236	44	5	3.643	44	2
54		min	-0.013	0	2	-1	43....	2	-0.337	44	5	0	0	1	-0.701	44	8	-2.243	44	9
55	M35	max	0.019	44	3	1.268	0	3	0.319	44	5	0	88	9	1.17	44	5	1.645	44	5
56		min	-0.019	44....	3	-1.268	88	3	-0.317	44....	5	0	0	1	-0.692	44	8	-4.607	44	3
57	M36	max	0.019	88	3	1.231	44	3	0.127	43....	6	0	88	9	0.482	44	5	4.472	44	3
58		min	-0.019	0	3	-1.231	43....	3	-0.131	44	5	0	0	1	-0.29	44	9	-0.476	44	5
59	M37	max	0.018	44	3	1.219	0	3	0.24	44	5	0	88	9	0.88	44	5	0.428	44	5
60		min	-0.018	44....	3	-1.219	88	3	-0.235	44....	6	0	0	1	-0.528	44	9	-4.427	44	3
61	B9	max	3.422	127...	5	0.005	0	1	0	127...	9	0	127...	9	0	127...	9	0	127...	9
62		min	-2.099	0	9	-0.005	127...	3	0	0	1	0	0	5	0	0	1	-0.014	63....	1
63	B6	max	1.839	127...	9	0.005	0	3	0	127...	9	0	127...	9	0	127...	9	0	127...	9
64		min	-2.819	0	5	-0.005	127...	1	0	0	1	0	0	2	0	0	1	-0.014	63....	3
65	B5	max	2.94	0	6	0.007	0	3	0.102	127...	2	0.001	127...	9	0.622	127...	2	0.013	0	3
66		min	-1.745	127...	8	-0.004	127...	6	-0.032	0	9	-0.002	0	5	-0.469	0	2	-0.01	74....	6
67	B8	max	1.847	127...	9	0.004	0	6	0.018	127...	5	0	127...	5	0.803	0	3	0.013	127...	3
68		min	-2.845	0	5	-0.007	127...	3	-0.132	0	3	0	0	3	-0.6	127...	3	-0.01	53....	6
69	B7	max	2.914	0	6	0.005	0	6	0	127...	9	0	127...	5	0	127...	9	0	127...	9
70		min	-1.718	127...	8	-0.005	127...	9	0	0	1	0	0	9	0	0	1	-0.014	63....	6

MAX COMP IN BRACE (ASD)

Node Reactions

	Node...		X [k]	LC	Y [k]	LC	Z [k]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
1	S2	max	0.135	9	1.64	9	1.265	5	0	9	0	9	0	9
2		min	-1.914	3	-1.339	5	-0.765	8	0	1	0	1	0	1
3	S1	max	0	1	2.514	9	0.669	5	0	9	0	9	0	9
4		min	-0.375	2	-3.434	5	-0.381	8	0	1	0	1	0	1
5	S3	max	0.018	5	2.296	9	0.67	5	0	9	0	9	0	9
6		min	-0.345	2	-3.072	5	-0.39	8	0	1	0	1	0	1
7	S6	max	0.006	5	0.897	3	1.967	6	0	9	0	9	0	9
8		min	-0.792	2	0.177	5	-1.21	8	0	1	0	1	0	1
9	S9	max	0	1	2.617	6	0.487	6	0	9	0	9	0	9
10		min	-0.34	2	-1.488	8	-0.296	8	0	1	0	1	0	1
11	S8	max	0.242	5	0.294	6	0.844	5	0	9	0	9	0	9
12		min	-2.323	3	-0.088	2	-0.506	9	0	1	0	1	0	1
13	S7	max	0	1	2.931	6	0.12	6	0	9	0	9	0	9
14		min	-0.39	3	-1.678	8	-0.078	8	0	1	0	1	0	1
15	S4	max	0.045	9	0.414	9	1.947	6	0	9	0	9	0	9
16		min	-0.772	2	-0.029	2	-1.204	8	0	1	0	1	0	1
17	S5	max	0.005	2	3.328	6	1.186	5	0	9	0	9	0	9
18		min	-0.018	5	-1.942	8	-0.738	9	0	1	0	1	0	1
19	Totals:	max	0	9	2.518	9	9.149	6						
20		min	-7.238	2	1.511	2	-5.563	8						

Project Title: COLO1176 HUMANA
Project No.: 20-G101
Eng: MEN Date: 4.22.20

CaliberEngineering Solutions

FRP Square Tube Check - Side Post

Design Loads (ASD)

Compression

$P = 0.5\ k$ Max (w/ Concurrent Wind)

Moment

$$R_1 = \frac{(0.6 \times 349\ PLF)(7.7\ ft)}{2(9\ ft)}(2 \times 9\ ft - 7.7\ ft) = 923\ lbs$$

$$M_{Max} = \frac{R_1^2}{2w} = \frac{(923\ lbs)^2}{2(0.6 \times 349\ PLF)} = 2034\ lb \cdot ft$$

Allowable Loads

Compression

$P_{allow} = 16.6\ K$

Moment

$$M_{allow} = \frac{(223\ PLF)(9\ ft)^2}{8} = 2258\ lb \cdot ft$$

Demand to Capacity Ratio

$$P/P_{allow} + M/M_{allow} = 0.5\ K/16.6\ K + 2034\ lb \cdot ft/2258\ lb \cdot ft$$

$$= 0.93 < 1.0 \rightarrow OK$$

Design Results

Use Strongwell Extren 500/525/625 Series
FRP SQ 4x4x1/4

Caliber Engineering Solutions

FRP Square Tube Check - Windward Post

Design Loads (ASD)

Compression

$P = 2.3\ K$ Max (w/ Concurrent Wind)

Moment

$$R_1 = \frac{(0.6 \times 329\ PLF)(7.7\ ft)}{2(9\ ft)}(2 \times 9\ ft - 7.7\ ft) = 870\ lbs$$

$$M_{Max} = \frac{R_1^2}{2w} = \frac{(870\ lbs)^2}{2(0.6 \times 329\ PLF)} = 1917\ lb \cdot ft$$

Allowable Loads

Compression

$P_{allow} = 16.6\ K$

Moment

$$M_{allow} = \frac{(223\ PLF)(9\ ft)^2}{8} = 2258\ lb \cdot ft$$

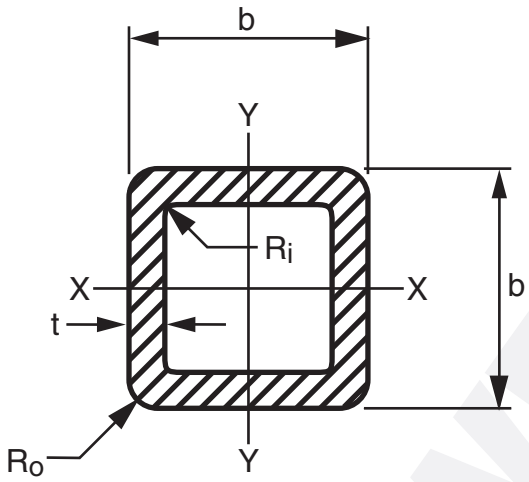
Demand to Capacity Ratio

$$P/P_{allow} + M/M_{allow} = 2.3\ K/16.6\ K + 1917\ lb \cdot ft/2258\ lb \cdot ft$$

$$= 0.99 < 1.0 \rightarrow OK$$

Design Results

Use Strongwell Extren 500/525/625 Series
FRP SQ 4x4 x 1/4



EXTREN® SQUARE TUBES

PHYSICAL PROPERTIES						SECTION PROPERTIES				DESIGN PROPERTIES	
SIZE		A	NOM. Wt/ft	RADII		I	S	r	A_w 2 Webs	b/t	J
b	t			R_o	R_i						
in	in	in^2	lbs	in	in	in^4	in^3	in	in^2		in^4
1	1/8	0.43	0.36	5/32	1/32	0.06	0.11	0.36	0.19	8.00	0.060
1-1/4	1/8	0.56	0.47	5/32	1/32	0.12	0.19	0.46	0.25	10.00	0.178
1-1/2	1/8	0.68	0.57	5/32	1/8	0.22	0.29	0.56	0.31	12.00	0.325
1-1/2	1/4	1.24	1.04	5/32	1/32	0.34	0.45	0.52	0.50	6.00	0.488
1-3/4	1/8	0.81	0.68	5/32	1/32	0.36	0.41	0.67	0.38	14.00	0.536
1-3/4	1/4	1.49	1.25	5/32	1/32	0.58	0.66	0.62	0.63	7.00	0.844
2	1/8	0.93	0.78	5/32	1/8	0.55	0.55	0.77	0.44	16.00	0.824
2	1/4	1.74	1.46	5/32	1/8	0.91	0.91	0.73	0.75	8.00	1.339
2-1/2	1/4	2.25	1.89	5/32	1/32	1.92	1.54	0.92	1.00	10.00	2.848
3	1/8	1.43	1.20	5/32	1/8	1.98	1.32	1.18	0.69	24.00	2.970
3	1/4	2.74	2.30	5/32	1/8	3.50	2.33	1.13	1.25	12.00	5.199
3	3/8	3.90	3.28	5/32	1/8	4.53	3.02	1.08	1.69	8.00	6.780
3-1/2	1/4	3.25	2.73	5/32	1/8	5.86	3.35	1.34	1.50	14.00	8.582
4	1/4	3.74	3.14	5/32	1/8	8.82	4.41	1.53	1.75	16.00	13.183
4	3/8	5.48	4.60	5/32	1/8	11.90	5.95	1.48	2.44	10.67	17.860
6	3/8	8.16	6.85	5/8	1/4	42.41	14.14	2.28	3.94	16.00	66.740

NOTE: Telescoping of square tubes cannot be guaranteed due to thickness tolerances.

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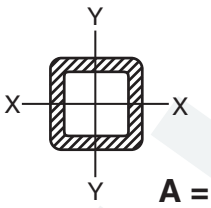
COLUMN

SQUARE TUBE
4 x 1/4
Allowable Axial Stresses and Loads



b/t = 16.0 **r = 1.53 in.** **A = 3.74 in²**

EFFECTIVE COLUMN LENGTH (ft.)	Kl/r	EXTREN® 500/525 E = 2.6 x 10⁶ psi		EXTREN® 625 E = 2.8 x 10⁶ psi		
		F_a(psi)	P_a(lbs)	F_a(psi)	P_a(lbs)	
0.5	3.9	5131	19190	5526	20667	SHORT
1.0	7.8	5131	19190	5526	20667	
1.5	11.8	5131	19190	5526	20667	
2.0	15.7	5131	19190	5526	20667	
2.5	19.6	5131	19190	5526	20667	
3.0	23.5	5131	19190	5526	20667	
3.5	27.5	5131	19190	5526	20667	
4.0	31.4	5131	19190	5526	20667	
4.5	35.3	5131	19190	5526	20667	
5.0	39.2	5131	19190	5526	20667	
5.5	43.1	5131	19190	5526	20667	
6.0	47.1	5131	19190	5526	20667	
6.5	51.0	5131	19190	5526	20667	
7.0	54.9	5131	19190	5526	20667	
7.5	58.8	5131	19190	5526	20667	
8.0	62.7	5131	19190	5526	20667	
		F_a' (psi)	P_a(lbs)	F_a' (psi)	P_a(lbs)	
8.5	66.7	4791	17918	5159	19295	LONG
9.0	70.6	4450	16643	4792	17922	
9.5	74.5	4149	15519	4469	16712	
10.0	78.4	3883	14523	4181	15640	
10.5	82.4	3646	13613	3920	14660	
11.0	86.3	3428	12819	3691	13805	
11.5	90.2	3236	12103	3485	13034	
12.0	94.1	3063	11455	3298	12336	
12.5	98.0	2905	10866	3129	11702	
13.0	102.0	2758	10315	2970	11108	
13.5	105.9	2627	9824	2829	10580	
14.0	109.8	2506	9373	2699	10094	
14.5	113.7	2395	8957	2579	9646	
15.0	117.6	2292	8573	2469	9232	
15.5	121.6	2195	8208	2364	8840	
16.0	125.5	2106	7878	2268	8484	
16.5	129.4	2024	7571	2180	8153	
17.0	133.3	1948	7284	2097	7844	
17.5	137.3	1874	7010	2018	7549	
18.0	141.2	1807	6759	1946	7279	
18.5	145.1	1744	6524	1878	7025	
19.0	149.0	1685	6303	1815	6787	
19.5	152.9	1630	6094	1755	6563	
20.0	156.9	1576	5893	1697	6346	

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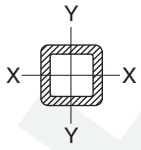
BEAMS

SQUARE TUBES — EXTREN® 500 & 525
E = 2.6 x 10^6 psi



Allowable Uniform Loads in Pounds Per Foot

SPAN IN FEET			LATERALLY SUPPORTED--GOVERNED BY: Stress	Deflection			
			*F_b or F_v	l/100	l/150	l/180	l/240	l/360
3 x 3 x 1/4								
w =	2.2 lb/ft	3	1,250	—	885	738	553	369
b_f/t_f =	12.0	4	*763	633	422	352	264	176
F_b =	7,863 psi	5	*489	345	230	192	144	96
A_w =	1.25 sq. in.	6	*339	207	138	115	86	57
I =	3.5 $in.^4$	7	*249	133	89	74	55	37
S_x =	2.33 $in.^3$	8	*191	90	60	50	38	25
J =	5.913 $in.^4$	9	*151	64	43	36	27	18
		10	*122	47	31	26	20	13
** **3-1/2 x 3-1/2 x 1/4**								
w =	2.57 lb/ft	3	1,500	—	1,343	1,119	839	560
b_f/t_f =	14.0	4	*963	—	663	552	414	276
F_b =	6,898 psi	5	*616	552	368	307	230	153
A_w =	1.5 sq. in.	6	*428	335	223	186	140	93
I =	5.86 $in.^4$	7	*314	217	145	121	91	60
S_x =	3.35 $in.^3$	8	*241	149	99	83	62	41
J =	8.582 $in.^4$	9	*190	106	71	59	44	29
		10	*154	78	52	43	32	22
4 x 4 x 1/4								
w =	3.08 lb/ft	5	*724	—	531	442	332	221
b_f/t_f =	16.0	6	*503	489	326	272	204	136
F_b =	6,158 psi	7	*369	320	213	178	133	89
A_w =	1.75 sq. in.	8	*283	219	146	122	91	61
I =	8.82 $in.^4$	9	*223	157	105	87	65	44
S_x =	4.41 $in.^3$	10	*181	116	77	64	48	32
J =	14.937 $in.^4$	11	*150	88	59	49	37	24
		12	*126	68	45	38	28	19
		13	*107	54	36	30	22	15

** Non-stock size subject to mill requirements.

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Project Title: COLO1176 HUMANA
Project No.: 20-G101
Eng: MEN Date: 4.22.20

Caliber Engineering Solutions

FRP Brace Angle

Unbraced Length = 9.5 ft

Design Load (ASD)

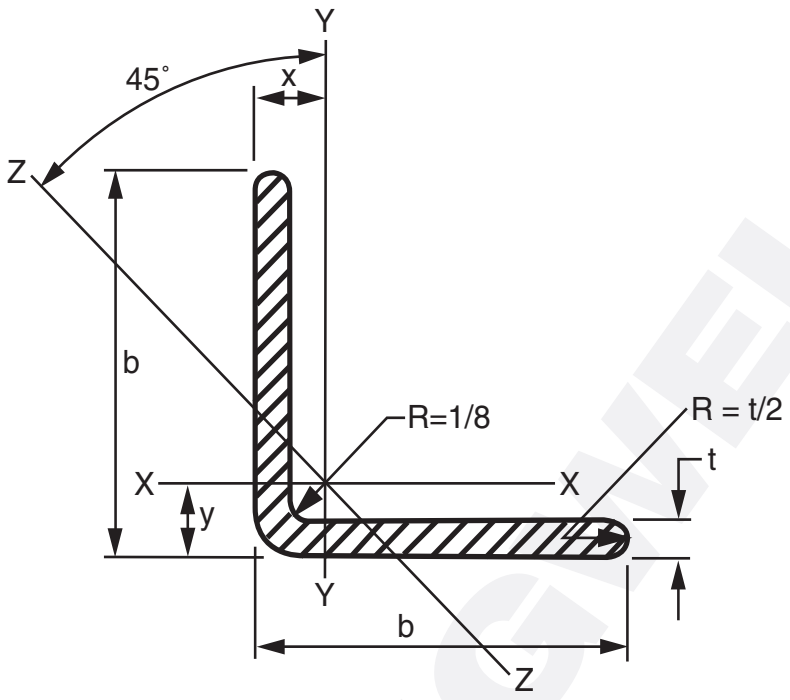
$P = 3.4$ K

Allowable Load

$P_{allow} = 3.7$ K

Design Results

Use Strongwell Extren 500/525/625
FRP 4x4x1/2 Angle



EXTREN® EQUAL LEG ANGLES

PHYSICAL PROPERTIES				SECTION PROPERTIES						DESIGN PROPERTIES	
SIZE		A	NOM. Wt/ft	AXIS X—X OR Y—Y				AXIS Z—Z		b/t	J
b	t			I	S	r	x or y	I	r		
in	in	in^2	lbs	in^4	in^3	in	in	in^4	in		in^4
1	1/8	0.22	0.18	0.02	0.03	0.30	0.29	0.01	0.19	8.00	0.001
1-1/4	1/8	0.29	0.24	0.04	0.05	0.37	0.35	0.02	0.24	10.00	0.002
1-1/4	3/16	0.42	0.35	0.06	0.07	0.37	0.37	0.03	0.24	6.67	0.005
1-1/2	1/8	0.35	0.29	0.07	0.07	0.45	0.41	0.03	0.29	12.00	0.002
1-1/2	3/16	0.51	0.43	0.11	0.10	0.45	0.44	0.04	0.29	8.00	0.006
1-1/2	1/4	0.67	0.56	0.13	0.13	0.44	0.46	0.06	0.29	6.00	0.007
2	1/8	0.48	0.40	0.19	0.13	0.63	0.55	0.08	0.46	16.00	0.002
2	3/16	0.70	0.59	0.27	0.19	0.61	0.56	0.11	0.39	10.67	0.008
2	1/4	0.92	0.77	0.34	0.24	0.60	0.58	0.14	0.39	8.00	0.020
3	1/4	1.42	1.19	1.18	0.54	0.91	0.82	0.49	0.58	12.00	0.030
3	3/8	2.09	1.76	1.70	0.80	0.90	0.87	0.70	0.58	8.00	0.090
4	1/4	1.92	1.61	2.94	1.00	1.23	1.07	1.21	0.79	16.00	0.040
4	3/8	2.84	2.39	4.26	1.48	1.22	1.12	1.75	0.78	10.67	0.134
4	1/2	3.75	3.15	5.56	1.97	1.22	1.18	2.29	0.78	8.00	0.312
5	1/2	4.71	3.96	11.34	3.35	1.55	1.61	4.87	1.02	10.00	0.390
6	1/4	2.94	2.47	10.70	2.43	1.91	1.59	4.36	1.22	24.00	0.061
6	3/8	4.34	3.65	14.85	3.38	1.85	1.60	6.07	1.18	16.00	0.204
6	1/2	5.72	4.80	19.38	4.46	1.84	1.66	7.92	1.17	12.00	0.480

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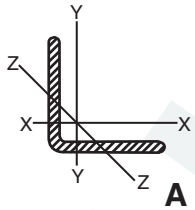
PERMIT 2020-1865221 LT
RSN 1487202

COLUMN

EQUAL LEG ANGLES
4 x 4 x 1/2
Allowable Axial Stresses and Loads



b/t = 8.0 **r_z = 0.78 in.** **A = 3.75 in²**

EFFECTIVE COLUMN LENGTH (ft.)	$\frac{KL}{r}$	EXTREN® 500/525 E = 2.6 x 10^6 psi		EXTREN® 625 E = 2.8 x 10^6 psi		
		F_a(psi)	P_a(lbs)	F_a(psi)	P_a(lbs)	
0.5	7.7	4451	16691	4793	17976	SHORT
		F_a' (psi)	P_a(lbs)	F_a' (psi)	P_a(lbs)	
1.0	15.4	3440	12899	3704	13892	LONG
1.5	23.1	2752	10320	2964	11114	
2.0	30.8	2349	8810	2529	9488	
2.5	38.5	2078	7793	2238	8393	
3.0	46.2	1879	7049	2023	7591	
3.5	53.8	1728	6482	1861	6981	
4.0	61.5	1606	6023	1729	6486	
4.5	69.2	1505	5644	1620	6078	
5.0	76.9	1420	5326	1529	5736	
5.5	84.6	1347	5054	1450	5443	
6.0	92.3	1284	4817	1382	5187	
6.5	100.0	1229	4609	1323	4963	
7.0	107.7	1180	4425	1270	4765	
7.5	115.4	1136	4261	1223	4589	
8.0	123.1	1096	4112	1180	4428	
8.5	130.8	1060	3977	1141	4283	
9.0	138.5	1027	3853	1106	4149	
9.5	146.2	997	3740	1073	4027	
10.0	153.8	970	3638	1044	3918	
10.5	161.5	944	3542	1016	3814	
11.0	169.2	920	3452	990	3717	
11.5	176.9	898	3369	967	3625	
12.0	184.6	877	3290	944	3543	
12.5	192.3	857	3217	922	3464	
13.0	200.0	839	3148	903	3390	

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Project Title: COLO1176 HUMANA
Project No.: 20-G101
Eng: MEN Date: 4.22.20

Caliber Engineering Solutions

Brace Angle Connection

Max Axial Load in Brace = 3.4 k (ASD)

Allowable Load

For 1" Fibrebolt

Vallow = 15,000 lbs / 4 = 3750 lbs

2 bolts × Vallow = 7.5 k

Design Results

Use (2) 1" Dia Strongwell Fibrebolt at Brace and Tube Connections

FIBREBOLT® STUDS AND NUTS

STANDARD COLOR–BROWN

SHAPE–HEX

For structural applications where mechanical fasteners must not only be strong, but also non-corrosive and/or non-conductive, **FIBREBOLT®** fiberglass studs and nuts can be used in place of steel or other metal fasteners.

FIBREBOLT® is being utilized in chemical process equipment, air and water pollution control equipment, marine applications electrical equipment and in general industry.

FIBREBOLT® is available in diameters of 3/8", 1/2", 5/8", 3/4" and 1" with nuts for immediate delivery. Four foot lengths are standard. Other lengths are available on request. Custom partial length threading is also available on request.

	TEST METHOD	3/8" - 16	1/2" - 13	5/8" - 11	3/4" - 10	1" - 8
Ultimate tensile load using Strongwell fiberglass nut (lb.) ①		1,050	2,000	3,100	4,500	6,500
Ultimate tensile load using two (2) Strongwell fiberglass nuts (lb.) ①		1,470	2,800	4,340	6,300	9,700
Transverse shear on threaded rod - double shear (min. load lb.) ①	ASTM-B-565	3,000	5,000	7,500	12,000	22,000
Transverse shear on threaded rod - single shear (min. load lb.) ①		1,600	2,600	3,800	6,200	15,000
Compressive strength - longitudinal, without nuts (min. psi)	ASTM-D-695	60,000	60,000	60,000	60,000	60,000
Flexural strength (min. psi) ①	ASTM-D-790	50,000	50,000	50,000	50,000	50,000
Flexural modulus (min. psi x 10^6) ①	ASTM-D-790	2.00	2.00	2.00	2.50	2.75
Dielectric strength ASTM-D-149 (kv/in.)		35	35	35	35	35
Water absorption 24 hr. immersion - threaded	ASTM-D-570	1%	1%	1%	1%	1%
Coefficient of thermal expansion - longitudinal (in./in./°F)		5 x 10^{-6}	5 x 10^{-6}	5 x 10^{-6}	5 x 10^{-6}	5 x 10^{-6}
Max recommended operation temperature - based on 50% retention of ultimate thread shear strength °F		203°F	203°F	203°F	203°F	203°F
Flammability	ASTM-D-635	Self-Extinguishing on All				
Stud weight (lb./ft.)		0.07	0.12	0.18	0.28	0.50
Thickness of nut and washer in inches		3/4"	7/8"	1-1/8"	1-1/4"	1-5/8"
Diameter of washer in inches		1"	1-1/8"	1-5/16"	1-1/2"	2"

① Strength values are minimums derived from multiple production sample testings.

NOTES
- All test results are for bolts with single nuts only unless otherwise specified.
- Appropriate safety factors must be applied.
- Properties above do not apply when fiberglass stud is used with metal nut. No data has been generated for metal nuts. If metal nuts are used, strengths will be reduced because of less thread engagement. If metal nuts are used, extreme care should be taken to assure that the threads match and that a snug fit is achieved.
- Threads do not meet Class 1, 2 or 3 ANSI/ASME standard.

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RISA A NEMETSCHEK COMPANY

Company :
Designer :
Job Number :
Model Name :

LRFD REACTIONS FOR ACHORS

4/21/2020
11:21:33 AM
Checked By : _____

Node Reactions

	Node...		X [k]	LC	Y [k]	LC	Z [k]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
1	S2	max	0.229	18	2.459	18	2.097	14	0	18	0	18	0	18
2		min	-3.202	12	-2.262	14	-1.278	17	0	11	0	11	0	11
3	S1	max	-0.042	17	4.029	18	1.137	14	0	18	0	18	0	18
4		min	-0.636	11	-5.808	14	-0.628	17	0	11	0	11	0	11
5	S3	max	0.051	14	3.688	18	1.127	14	0	18	0	18	0	18
6		min	-0.555	11	-5.158	14	-0.646	17	0	11	0	11	0	11
7	S6	max	0	15	1.329	12	3.273	15	0	18	0	18	0	18
8		min	-1.309	11	0.256	14	-2.018	17	0	11	0	11	0	11
9	S9	max	-0.004	17	4.291	15	0.804	15	0	18	0	18	0	18
10		min	-0.539	11	-2.497	17	-0.497	17	0	11	0	11	0	11
11	S8	max	0.426	14	0.373	15	1.407	14	0	18	0	18	0	18
12		min	-3.878	12	-0.202	11	-0.843	17	0	11	0	11	0	11
13	S7	max	-0.004	17	4.856	15	0.191	15	0	18	0	18	0	18
14		min	-0.678	12	-2.803	17	-0.134	17	0	11	0	11	0	11
15	S4	max	0.085	18	0.511	18	3.247	15	0	18	0	18	0	18
16		min	-1.289	11	-0.072	11	-2.007	17	0	11	0	11	0	11
17	S5	max	0.014	11	5.539	15	1.97	14	0	18	0	18	0	18
18		min	-0.052	14	-3.237	17	-1.227	18	0	11	0	11	0	11
19	Totals:	max	0	18	3.022	18	15.248	15						
20		min	-12.064	11	2.267	11	-9.272	17						

www.hilti.us

Profis Anchor 2.8.0

Company:		Page:	1
Specifier:		Project:	
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	4/21/2020
E-Mail:			

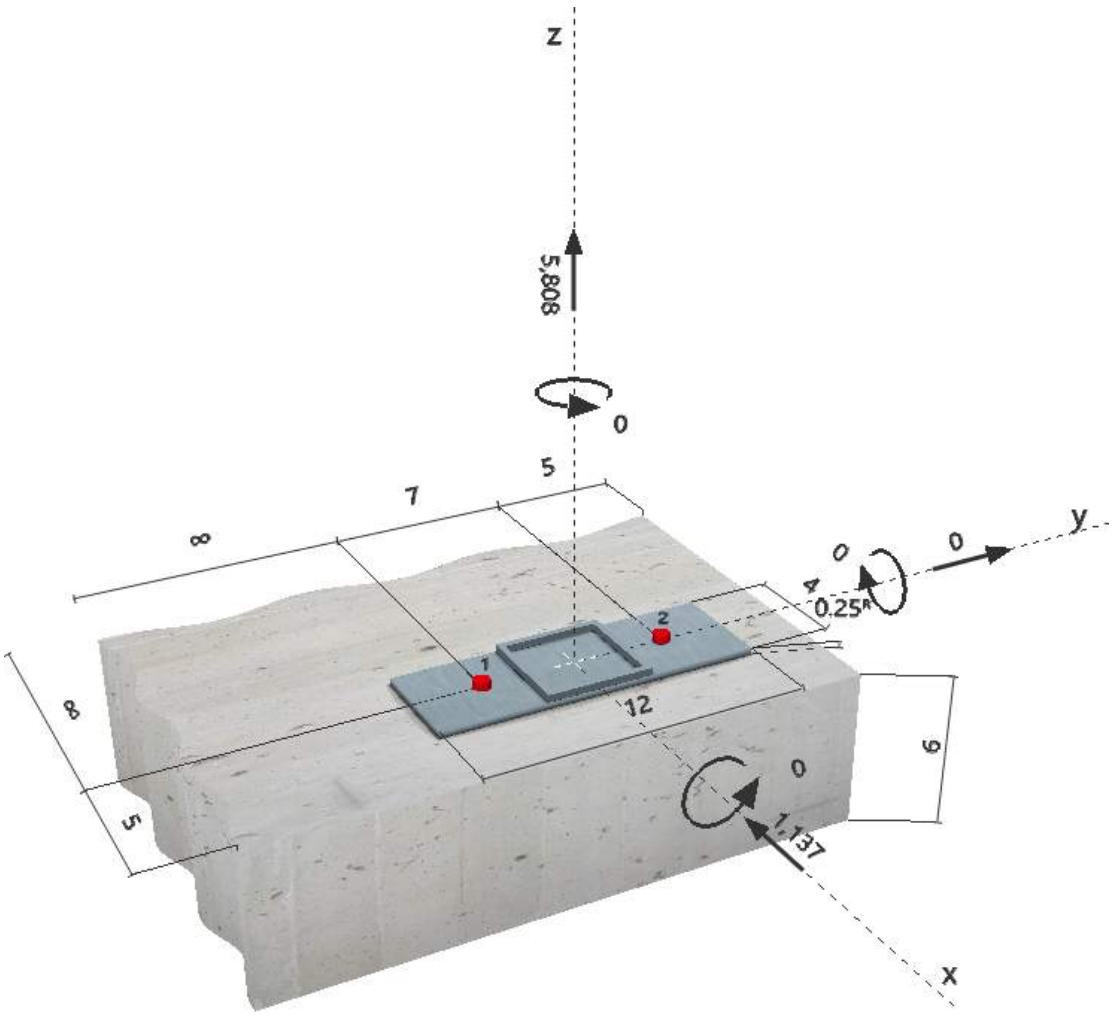
Specifier's comments:

1 Input data

Anchor type and diameter:	**Kwik Bolt TZ - CS 5/8 (4)**
Effective embedment depth:	$h_{ef,act}$ = 4.000 in., h_{nom} = 4.438 in.
Material:	Carbon Steel
Evaluation Service Report:	ESR-1917
Issued I Valid:	4/1/2018 | 5/1/2019
Proof:	Design method ACI 318-14 / Mech.
Stand-off installation:	e_b = 0.000 in. (no stand-off); t = 0.250 in.
Anchor plate:	l_x x l_y x t = 4.000 in. x 12.000 in. x 0.250 in.; (Recommended plate thickness: not calculated
Profile:	Square HSS (AISC); (L x W x T) = 4.000 in. x 4.000 in. x 0.250 in.
Base material:	cracked concrete, 3000, f_c' = 3,000 psi; h = 6.000 in.
Installation:	**hammer drilled hole, Installation condition: Dry**
Reinforcement:	tension: condition B, shear: condition B; no supplemental splitting reinforcement present edge reinforcement: none or < No. 4 bar

R - The anchor calculation is based on a rigid baseplate assumption.

Geometry [in.] & Loading [lb, in.lb]



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Company:		Page:	2
Specifier:		Project:	
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	4/21/2020
E-Mail:			

2 Proof I Utilization (Governing Cases)

		Design values [lb]		Utilization	
Loading	**Proof**	**Load**	**Capacity**	**β_N / β_V [%]**	**Status**
Tension	Concrete Breakout Strength	5,808	6,325	92 / -	OK
Shear	Concrete edge failure in direction y+	1,137	5,126	- / 23	OK

Loading	**β_N**	**β_V**	**ζ**	**Utilization $\beta_{N,V}$ [%]**	**Status**
Combined tension and shear loads	0.918	0.222	5/3	95	OK

3 Warnings

- Please consider all details and hints/warnings given in the detailed report!

Fastening meets the design criteria!

4 Remarks; Your Cooperation Duties

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CaliberEngineering Solutions

Antenna Support Tube For Antenna Attachment

Span = 15 ft Max

Design Loads

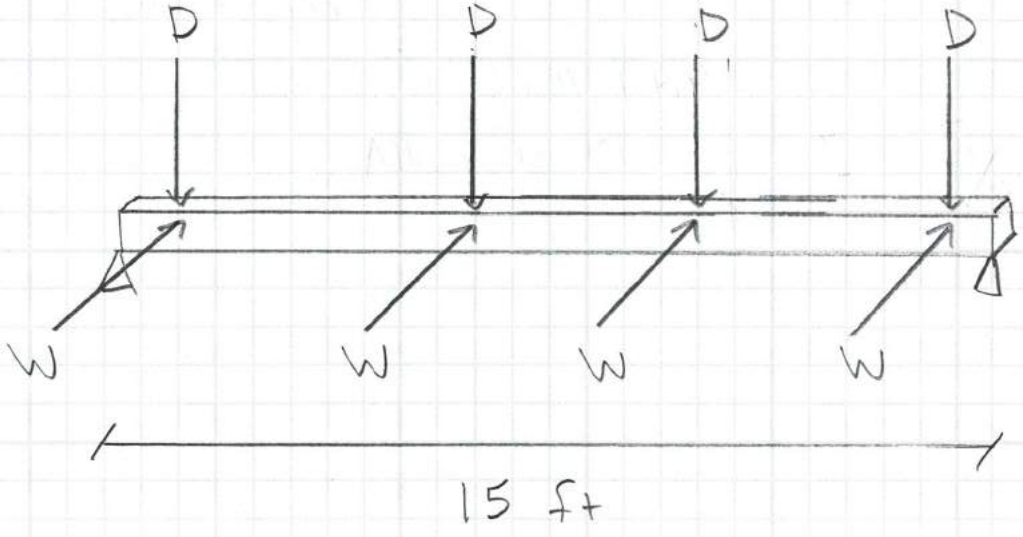
Wind Load (Unfactored)

Antennas are Well Shielded From Wind on Windward Side of Building.

Use W = 300 lbs Max at each antenna Location (Per SQ Tube - Conservative)

Dead Load

Use D = 150 lbs Max at each Antenna Location (Per Sq Tube - Conservative)



CaliberEngineering Solutions

Max Applied Moments

$M_W = 1.146 \text{ k·ft}$

$M_D = 0.573 \text{ k·ft}$

Allowable Moment

$$M_{allow} = \frac{(153 \text{ PLF})(15 \text{ ft})^2}{8} = 4.303 \text{ k·ft}$$

Demand to Capacity Ratio

$$\frac{M_W}{M_{allow}} + \frac{M_D}{M_{allow}} = \frac{1.146 \text{ k·ft}}{4.303 \text{ k·ft}} + \frac{0.573 \text{ k·ft}}{4.303 \text{ k·ft}}$$

$$= 0.4 < 1.0 \rightarrow \text{OK}$$

Use Strongwell 4x4x3/8 SQ Tube For Antenna Support

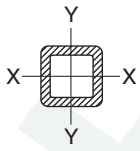
Bolted Connection to Tube

5/8" Dia Steel U-bolts are Sufficient

PERMIT 2020-1865221 LT
RSN 1487202

BEAMS

SQUARE TUBES — EXTREN® 500 & 525
E = 2.6 x 10^6 psi



Allowable Uniform Loads in Pounds Per Foot

SPAN IN FEET		LATERALLY SUPPORTED--GOVERNED BY:					
		Stress	Deflection				
		*F_b or F_v	l/100	l/150	l/180	l/240	l/360
3 x 3 x 3/8							
w = 3.09 lb/ft	3	1,690	—	1,159	966	724	483
b_f/t_f = 8.0	4	1,268	825	550	458	344	229
F_b = 11,099 psi	5	*894	448	299	249	187	125
A_w = 1.69 sq. in.	6	*621	268	179	149	112	75
I = 4.53 $in.^4$	7	*456	173	115	96	72	48
S_x = 3.02 $in.^3$	8	*349	117	78	65	49	33
J = 6.780 $in.^4$	9	*276	83	55	46	35	23
	10	*223	61	41	34	25	17
	11	*185	46	31	26	19	13
	12	*155	36	24	20	15	10
	13	*132	28	19	16	12	8
4 x 4 x 3/8							
w = 4.28 lb/ft	3	2,440	—	—	2,099	1,575	1,050
b_f/t_f = 10.7	4	1,830	—	1,277	1,064	798	532
F_b = 8,689 psi	5	*1,379	1,081	721	601	450	300
A_w = 2.44 sq. in.	6	*957	663	442	368	276	184
I = 11.9 $in.^4$	7	*703	433	288	240	180	120
S_x = 5.95 $in.^3$	8	*539	297	198	165	124	82
J = 17.860 $in.^4$	9	*426	212	141	118	88	59
	10	*345	157	104	87	65	43
	11	*285	119	79	66	49	33
	12	*239	92	61	51	38	26
	13	*204	73	49	40	30	20
	14	*176	59	39	33	24	16
	15	*153	48	32	27	20	13
	16	*135	39	26	22	16	11
	17	*119	33	22	18	14	9
	18	*106	28	19	15	12	8
	19	*95	24	16	13	10	7
	20	*86	20	14	11	8	6

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Engineer:
Project ID:
Project Descr:

Printed: 22 APR 2020, 5:48PM

General Beam

File: 1.ec6

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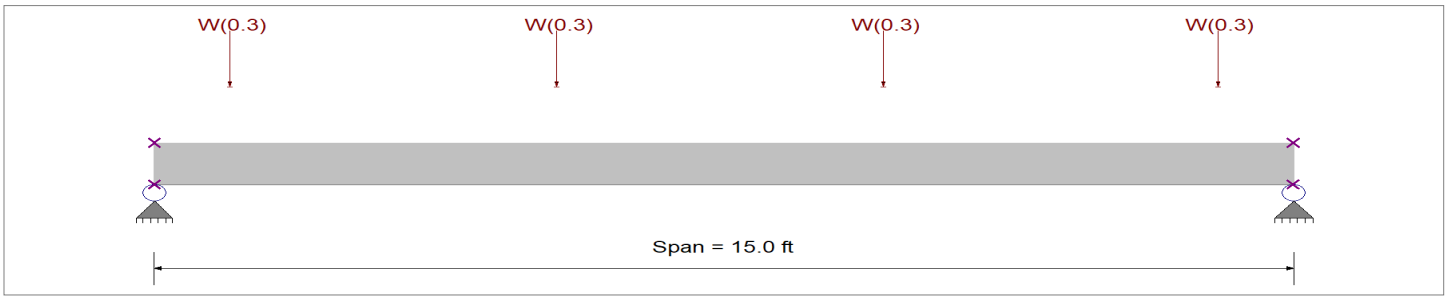
Lic. # : KW-06012569 — Caliber Engineering Solutions

DESCRIPTION: Antenna Tube Support - Wind Reactions

General Beam Properties

Elastic Modulus 2,600.0 ksi

Span #1 — Span Length = 15.0 ft — Area = 5.480 in^2 — Moment of Inertia = 11.90 in^4



Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Load(s) for Span Number 1

Point Load : W = 0.30 k @ 1.0 ft

Point Load : W = 0.30 k @ 5.30 ft

Point Load : W = 0.30 k @ 9.60 ft

Point Load : W = 0.30 k @ 14.0 ft

DESIGN SUMMARY

Maximum Bending =	1.146 k-ft	Maximum Shear =	0.3612 k
Load Combination	+D+0.60W+H	Load Combination	+D+0.60W+H
Span # where maximum occurs	Span # 1	Span # where maximum occurs	Span # 1
Location of maximum on span	9.600 ft	Location of maximum on span	0.000 ft

Maximum Deflection

Max Downward Transient Deflection	2.583 in	69
Max Upward Transient Deflection	0.041 in	4359
Max Downward Total Deflection	1.550 in	116
Max Upward Total Deflection	0.019 in	9687

Maximum Forces & Stresses for Load Combinations

Load Combination / Segment Length	Span #	Max Stress Ratios M	Max Stress Ratios V	Summary of Moment Values (k-ft) Mmax +	Mmax -	Ma - Max	Mnx	Mnx/Omega	Cb	Rm	Shear Values (k) Va Max	Vnx	Vnx/Omega
Overall MAXimum Envelope													
Dsgn. L = 15.00 ft	1			1.15		1.15					0.36		
+D+H													
Dsgn. L = 15.00 ft	1										-0.00		
+D+L+H													
Dsgn. L = 15.00 ft	1										-0.00		
+D+Lr+H													
Dsgn. L = 15.00 ft	1										-0.00		
+D+S+H													
Dsgn. L = 15.00 ft	1										-0.00		
+D+0.750Lr+0.750L+H													
Dsgn. L = 15.00 ft	1										-0.00		
+D+0.750L+0.750S+H													
Dsgn. L = 15.00 ft	1										-0.00		
+D+0.60W+H													
Dsgn. L = 15.00 ft	1			1.15		1.15					0.36		
+D+0.70E+H													
Dsgn. L = 15.00 ft	1										-0.00		
+D+0.750Lr+0.750L+0.450W+H													
Dsgn. L = 15.00 ft	1			0.86		0.86					0.27		
+D+0.750L+0.750S+0.450W+H													
Dsgn. L = 15.00 ft	1			0.86		0.86					0.27		
+D+0.750L+0.750S+0.5250E+H													
Dsgn. L = 15.00 ft	1										-0.00		

General Beam

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DESCRIPTION: Antenna Tube Support - Wind Reactions

Load Combination / Segment Length	Span #	Max Stress Ratios M	Max Stress Ratios V	Summary of Moment Values (k-ft) Mmax +	Mmax -	Ma - Max	Mnx	Mnx/Omega	Cb	Rm	Shear Values (k) Va Max	Vnx	Vnx/Omega
+0.60D+0.60W+0.60H													
Dsgn. L = 15.00 ft	1			1.15		1.15					0.36		
+0.60D+0.70E+0.60H													
Dsgn. L = 15.00 ft	1										-0.00		

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
W Only	1	2.5825	7.500		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	0.602	0.598
Overall MINimum		
+D+H		
+D+L+H		
+D+Lr+H		
+D+S+H		
+D+0.750Lr+0.750L+H		
+D+0.750L+0.750S+H		
+D+0.60W+H	0.361	0.359
+D+0.70E+H		
+D+0.750Lr+0.750L+0.450W+H	0.271	0.269
+D+0.750L+0.750S+0.450W+H	0.271	0.269
+D+0.750L+0.750S+0.5250E+H		
+0.60D+0.60W+0.60H	0.361	0.359
+0.60D+0.70E+0.60H		
D Only		
Lr Only		
L Only		
S Only		
W Only	0.602	0.598
E Only		
H Only		

Title Block Line 1
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Project Title:
Engineer:
Project ID:
Project Descr:

Printed: 22 APR 2020, 5:48PM

General Beam

File: 1.ec6

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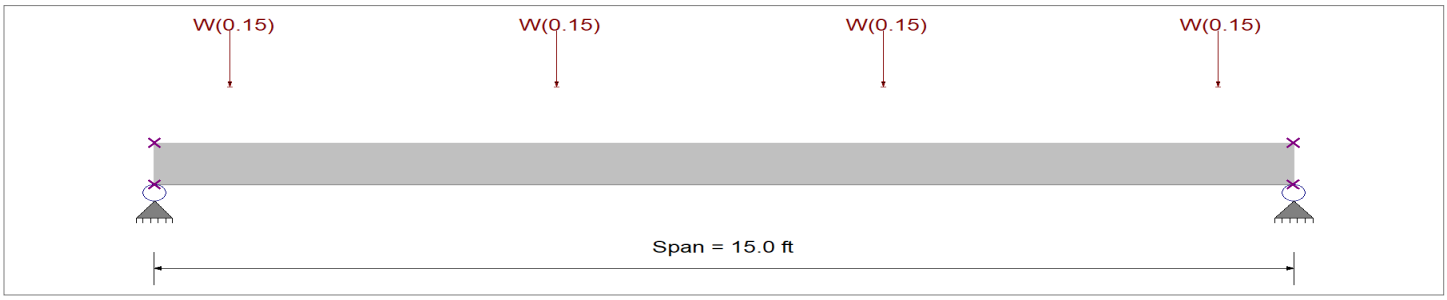
Lic. # : KW-06012569 — Caliber Engineering Solutions

DESCRIPTION: Antenna Tube Support - Dead Reactions

General Beam Properties

Elastic Modulus 2,600.0 ksi
Span #1 Span Length = 15.0 ft Area = 5.480 in^2 Moment of Inertia = 11.90 in^4



Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Load(s) for Span Number 1
Point Load : W = 0.150 k @ 1.0 ft
Point Load : W = 0.150 k @ 5.30 ft
Point Load : W = 0.150 k @ 9.60 ft
Point Load : W = 0.150 k @ 14.0 ft

DESIGN SUMMARY

Maximum Bending =	0.573 k-ft	Maximum Shear =	0.1806 k
Load Combination	+D+0.60W+H	Load Combination	+D+0.60W+H
Span # where maximum occurs	Span # 1	Span # where maximum occurs	Span # 1
Location of maximum on span	9.600 ft	Location of maximum on span	0.000 ft

Maximum Deflection

Max Downward Transient Deflection	1.291 in	139
Max Upward Transient Deflection	0.021 in	8718
Max Downward Total Deflection	0.775 in	232
Max Upward Total Deflection	0.009 in	19374

Maximum Forces & Stresses for Load Combinations

Load Combination / Segment Length	Span #	Max Stress Ratios M	Max Stress Ratios V	Summary of Moment Values (k-ft) Mmax +	Mmax -	Ma - Max	Mnx	Mnx/Omega	Cb	Rm	Shear Values (k) Va Max	Vnx	Vnx/Omega
Overall MAXimum Envelope													
Dsgn. L = 15.00 ft	1			0.57		0.57					0.18		
+D+H													
Dsgn. L = 15.00 ft	1										-0.00		
+D+L+H													
Dsgn. L = 15.00 ft	1										-0.00		
+D+Lr+H													
Dsgn. L = 15.00 ft	1										-0.00		
+D+S+H													
Dsgn. L = 15.00 ft	1										-0.00		
+D+0.750Lr+0.750L+H													
Dsgn. L = 15.00 ft	1										-0.00		
+D+0.750L+0.750S+H													
Dsgn. L = 15.00 ft	1										-0.00		
+D+0.60W+H													
Dsgn. L = 15.00 ft	1			0.57		0.57					0.18		
+D+0.70E+H													
Dsgn. L = 15.00 ft	1										-0.00		
+D+0.750Lr+0.750L+0.450W+H													
Dsgn. L = 15.00 ft	1			0.43		0.43					0.14		
+D+0.750L+0.750S+0.450W+H													
Dsgn. L = 15.00 ft	1			0.43		0.43					0.14		
+D+0.750L+0.750S+0.5250E+H													
Dsgn. L = 15.00 ft	1										-0.00		

Title Block Line 1
You can change this area using the "Settings" menu item and then using the "Printing & Title Block" selection.
Title Block Line 6

Project Title:
Engineer:
Project ID:
Project Descr:

Printed: 22 APR 2020, 5:48PM

General Beam

File: 1.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.2.28
Lic. # : KW-06012569
Caliber Engineering Solutions

DESCRIPTION: Antenna Tube Support - Dead Reactions

Load Combination / Segment Length	Span #	Max Stress Ratios M	Max Stress Ratios V	Summary of Moment Values (k-ft) Mmax +	Mmax -	Ma - Max	Mnx	Mnx/Omega	Cb	Rm	Shear Values (k) Va Max	Vnx	Vnx/Omega
+0.60D+0.60W+0.60H													
Dsgn. L = 15.00 ft	1			0.57		0.57					0.18		
+0.60D+0.70E+0.60H													
Dsgn. L = 15.00 ft	1										-0.00		

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
W Only	1	1.2913	7.500		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	0.301	0.299
Overall MINimum		
+D+H		
+D+L+H		
+D+Lr+H		
+D+S+H		
+D+0.750Lr+0.750L+H		
+D+0.750L+0.750S+H		
+D+0.60W+H	0.181	0.179
+D+0.70E+H		
+D+0.750Lr+0.750L+0.450W+H	0.135	0.135
+D+0.750L+0.750S+0.450W+H	0.135	0.135
+D+0.750L+0.750S+0.5250E+H		
+0.60D+0.60W+0.60H	0.181	0.179
+0.60D+0.70E+0.60H		
D Only		
Lr Only		
L Only		
S Only		
W Only	0.301	0.299
E Only		
H Only		

Project: COL01176 – FRP Enclosure & Roof Calcs
CES Job No.: 20-G101
Eng: MEN
Date: April 21, 2020

Roof Checks – Method & Approach

Available Information:

1. The original design drawings are not available. Original design loads are not available.
2. The general roof geometry was made available in the Building Structural Mapping Report by Sugarloaf Tower Company.

General Approach:

Since the original design documents are not available, a rigorous analysis of the building roof structure cannot be performed. Therefore, the approach will be to show that the influence due to the addition of the screen wall and antenna equipment remains within the limits permitted by the 2015 International Existing Building Code.

1. The rooftop screens & equipment are not expected to result in an increase in the demand to capacity ratio of the Lateral Force Resisting System by more than 10%.
2. The rooftop screens & equipment are added weight to the roof. The influence of the additional gravity load should be examined in order to determine if the demand to capacity of the gravity resisting members would result in an increase of more than 5%.
    a. Primary concern is to ensure that the influence in the bending of the roof slab does not result in an increase in the demand to capacity ratio of more than 5% and does not result in a notable shift in the moment profile.

Method:

1. Perform a plate analysis over sections of the roof using the geometry provided and code required loads.
    a. These loads will not be the design loads and should not be assumed as such or used in any analysis The loads will only used for comparison to determine the influence of adding a load.
    b. A section of the building geometry will be used to create a plate analysis at the antenna sector locations. There will not be a complete analysis of the roof and it is expected that the continuity will differ than the original design. However, this is expected to be sufficient for determining influence.
2. Add the gravity loads due to the additional equipment.
3. Limit the screen walls to a max dimension of 15ft and start the screening above the balanced snow load height in order to avoid snow drift and corresponding load requirements.
4. By means of comparison, draw a conclusion regarding the influence due to the additional equipment and the expected impact on the demand to capacity ratio of connected elements.

Project Title: COLO1176 HUMANA
Project No.: 20-G101
Eng: MEN Date: 4.22.20

CaliberEngineering Solutions

Screen Wall / Framing DL

(15 ft + 8 ft + 8 ft)(7 ft)(5.79 PSF)	1256 lbs	(Panel)
[4] x (5 ft)(2.3 PLF)	46 lbs	(Top Br)
(15 ft + 15 ft + 8 ft + 8 ft)(3.14 PLF)	144 lbs	(Top SQ)
[12] x (9 ft)(3.14 PLF)	339 lbs	(Post)
[9] x (9.5 ft)(3.15 PLF)	269 lbs	(Brace)
[3] x (16 ft)(6.5 PLF)	312 lbs	(Stand)
Misc	200 lbs	

Total 2566 lbs
Use 2570 lbs

Project Title: COLO1176 HUMANA
Project No.: 20-G101
Eng: MEN Date: 4.22.20

CaliberEngineering Solutions

Dead Load Added to Roof Due to Screen & Equip

Additional Dead Loads

Screen Wall / Frame	2570	lbs
(4) 2" Std Pipes	150	lbs
Antennas	350	lbs
Radios / Surge	425	lbs
Total	3495	lbs
Use	3500	lbs

At (3) Sided Equipment Screen

Distribute Over Frame Stand / Sleeper Area

DL_{add} = 3500 lbs / (15 ft × 8 ft)

= 29 PSF

At (2) Sided Equipment Screen

DL_{add} = (3500 lbs - 300 lbs) / (15 ft × 8 ft)

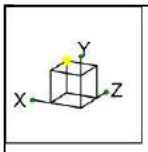
= 27 PSF

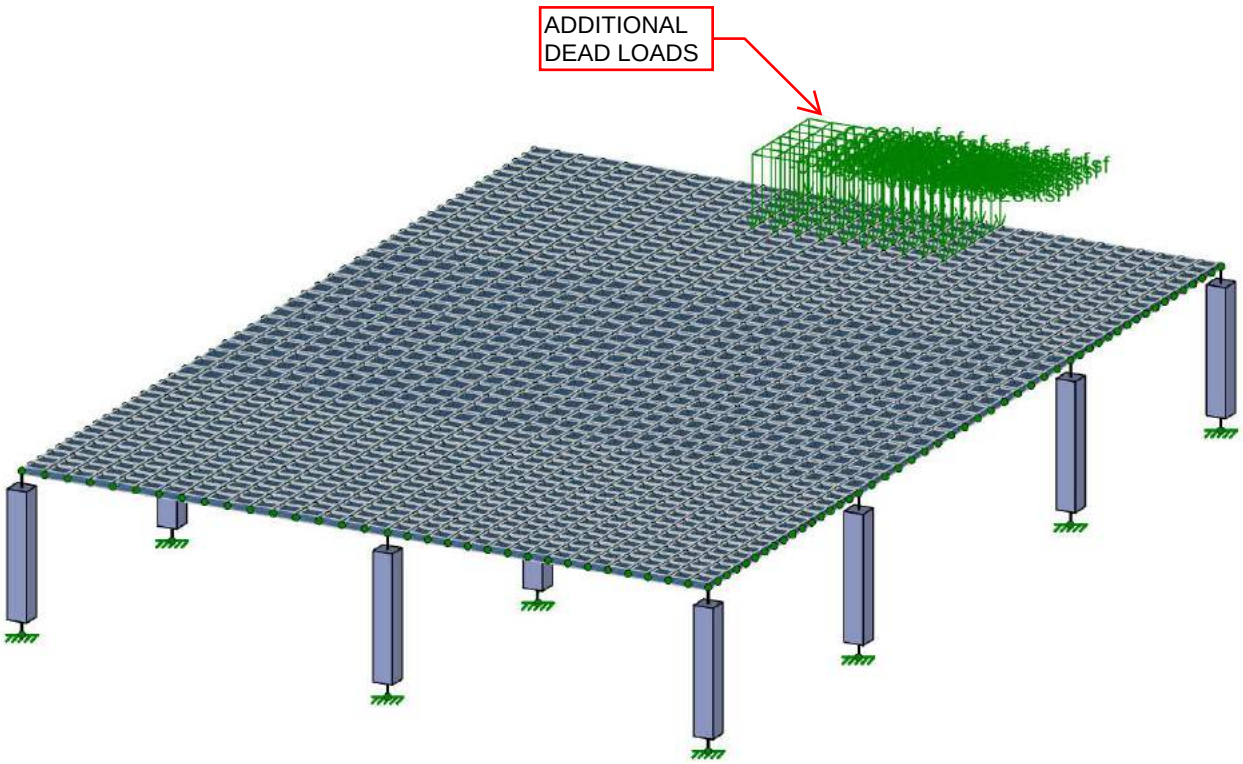
Note:

For Plate Analysis Verify Area of Plates is 8×15 = 120 sq ft and Adjust DL_{add} as required if Mesh'd area is Different

PERMIT 2020-18652211
RSN 1487202

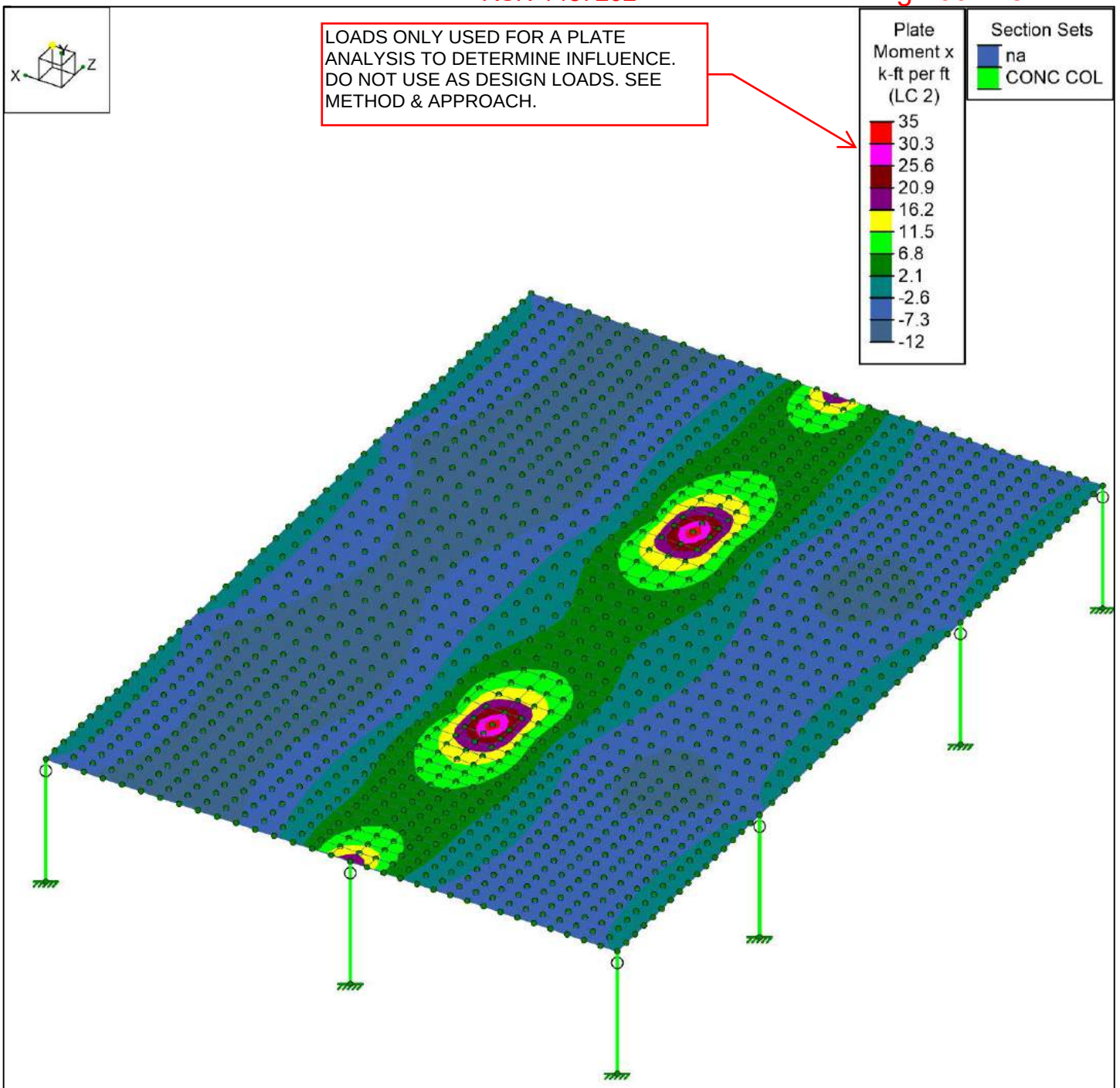
ALPHA LOCATION ON BUILDING





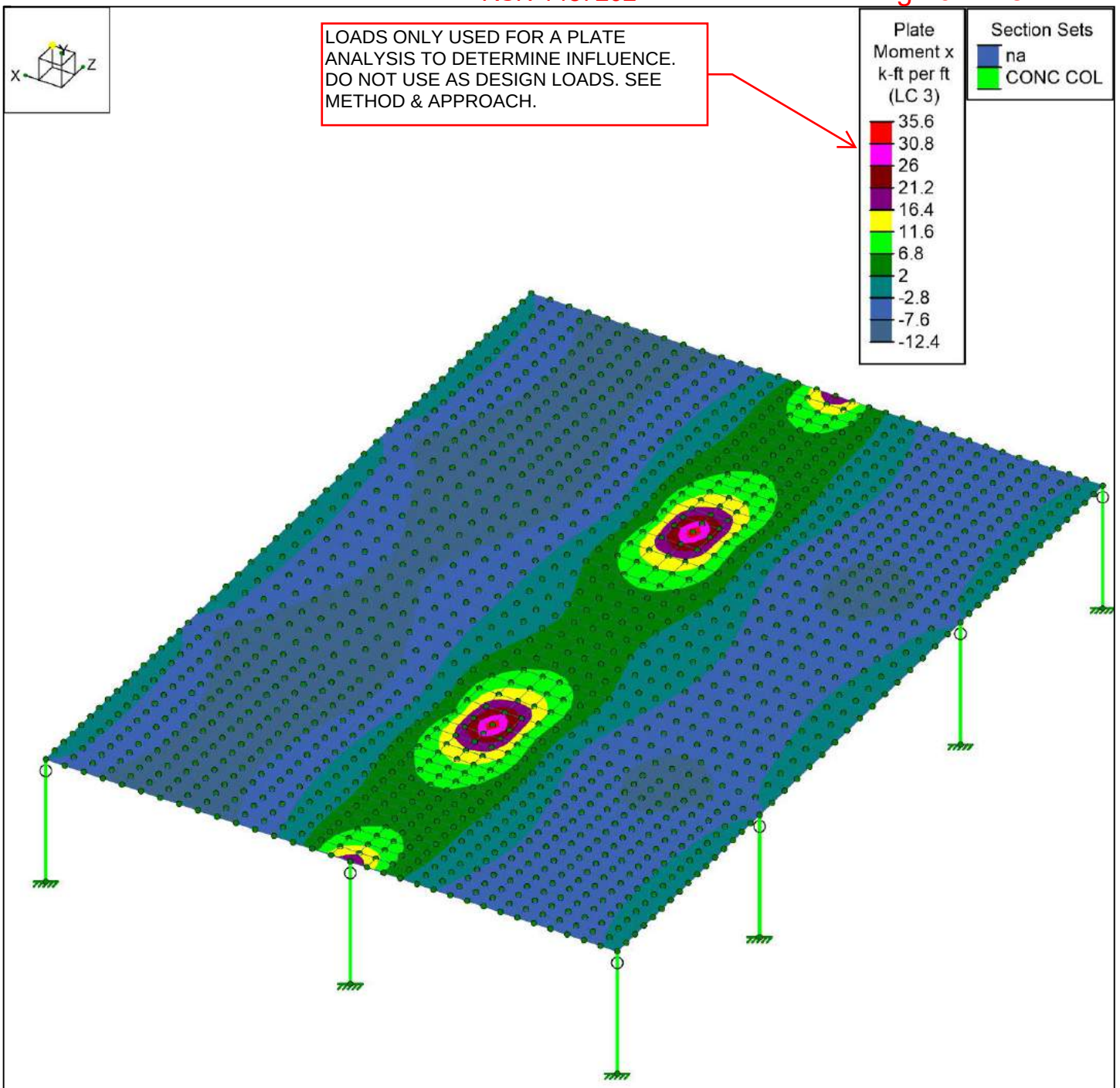
Loads: BLC 2, DL(EQ)

Caliber Engineering Solutions		SK-1
		Apr 21, 2020
		Plate Analysis - Alpha 1B - Cont.r3d



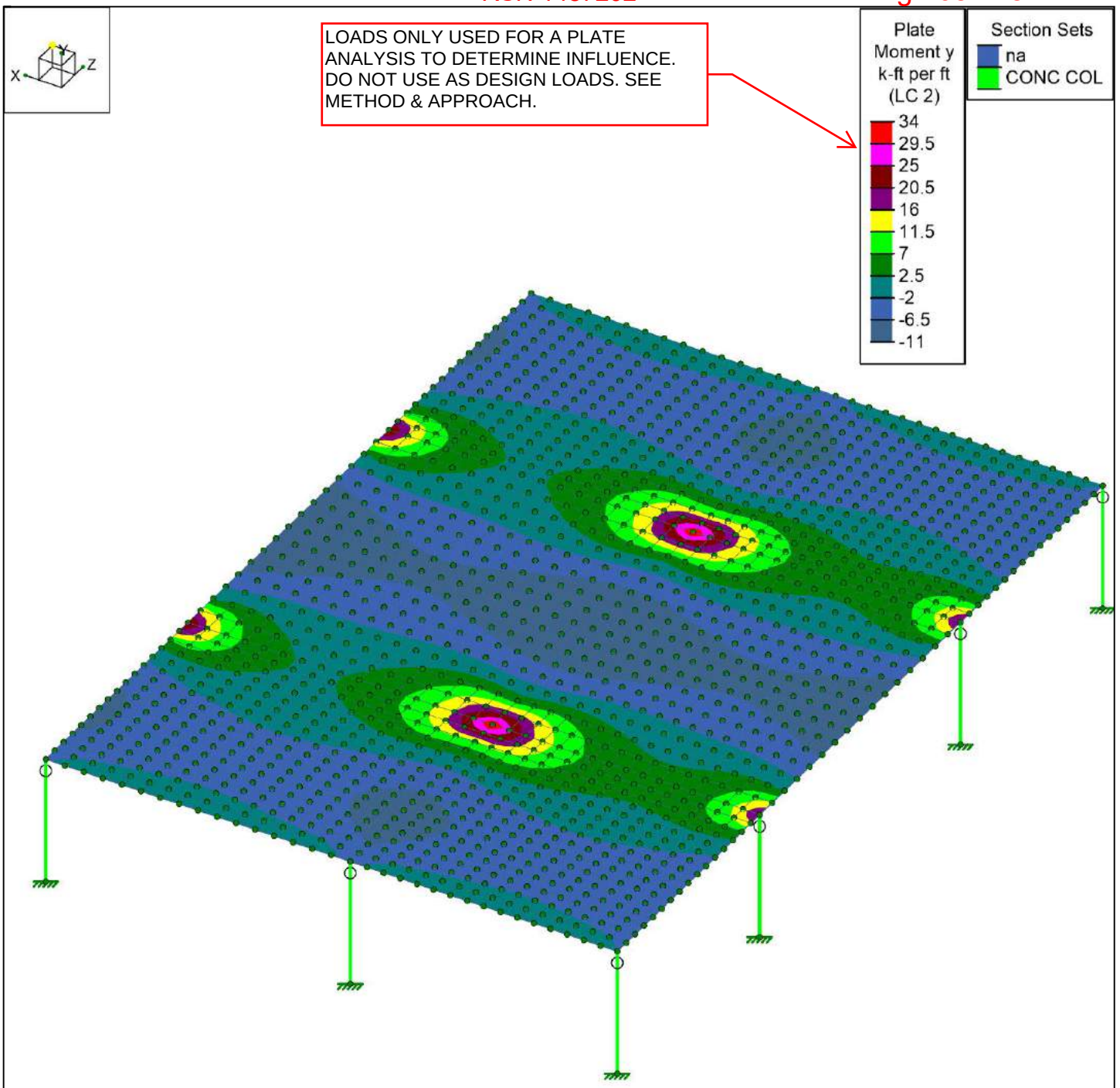
Results for LC 2, 1.2DL + 1.6SL

Caliber Engineering Solutions		SK-3
		Apr 21, 2020
		Plate Analysis - Alpha 1B - Cont.r3d



Results for LC 3, 1.2DL + 1.2DL(EQ) + 1.6SL

Caliber Engineering Solutions		SK-4
		Apr 21, 2020
		Plate Analysis - Alpha 1B - Cont.r3d



Results for LC 2, 1.2DL + 1.6SL

Caliber Engineering Solutions		SK-6
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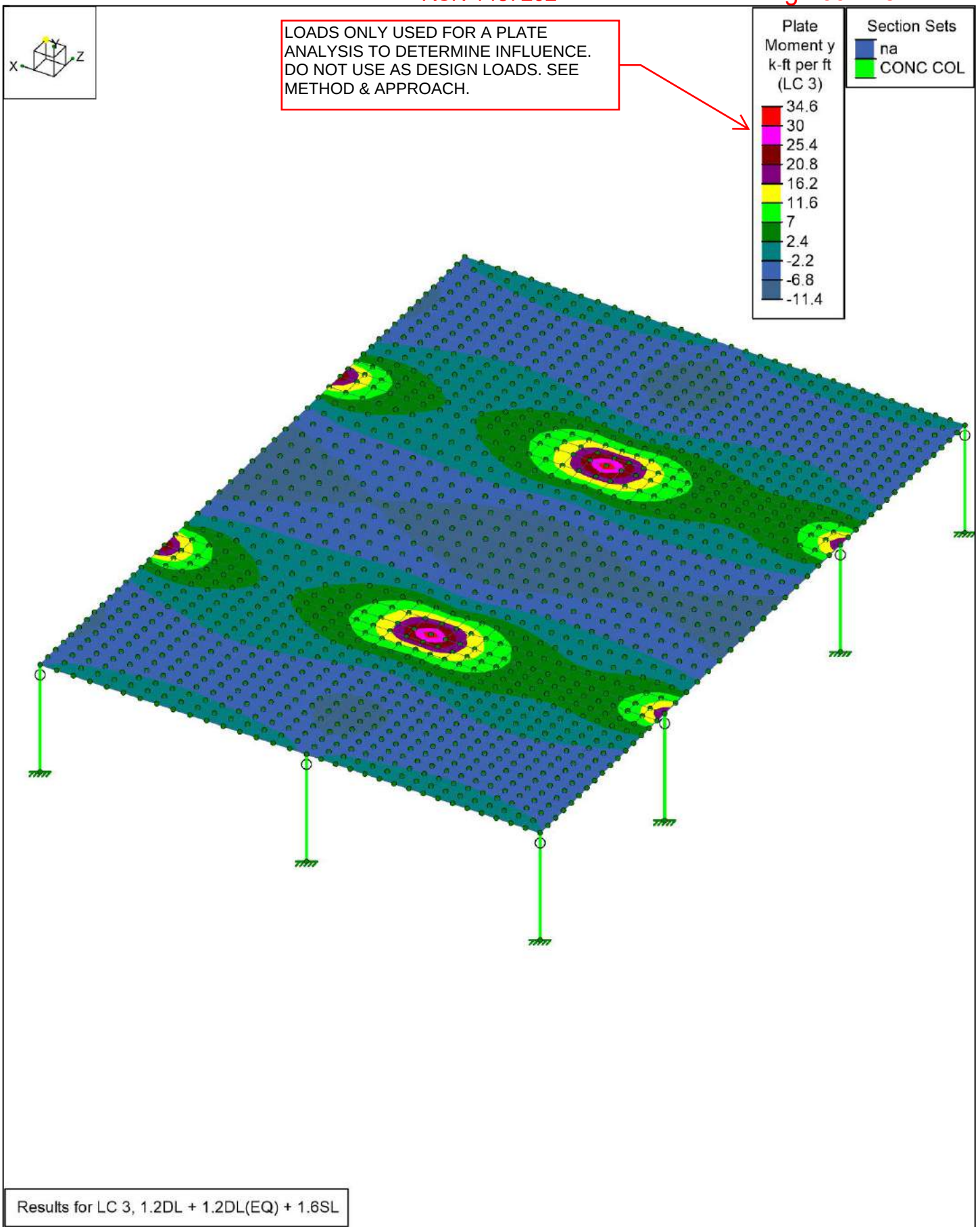
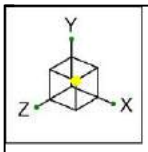


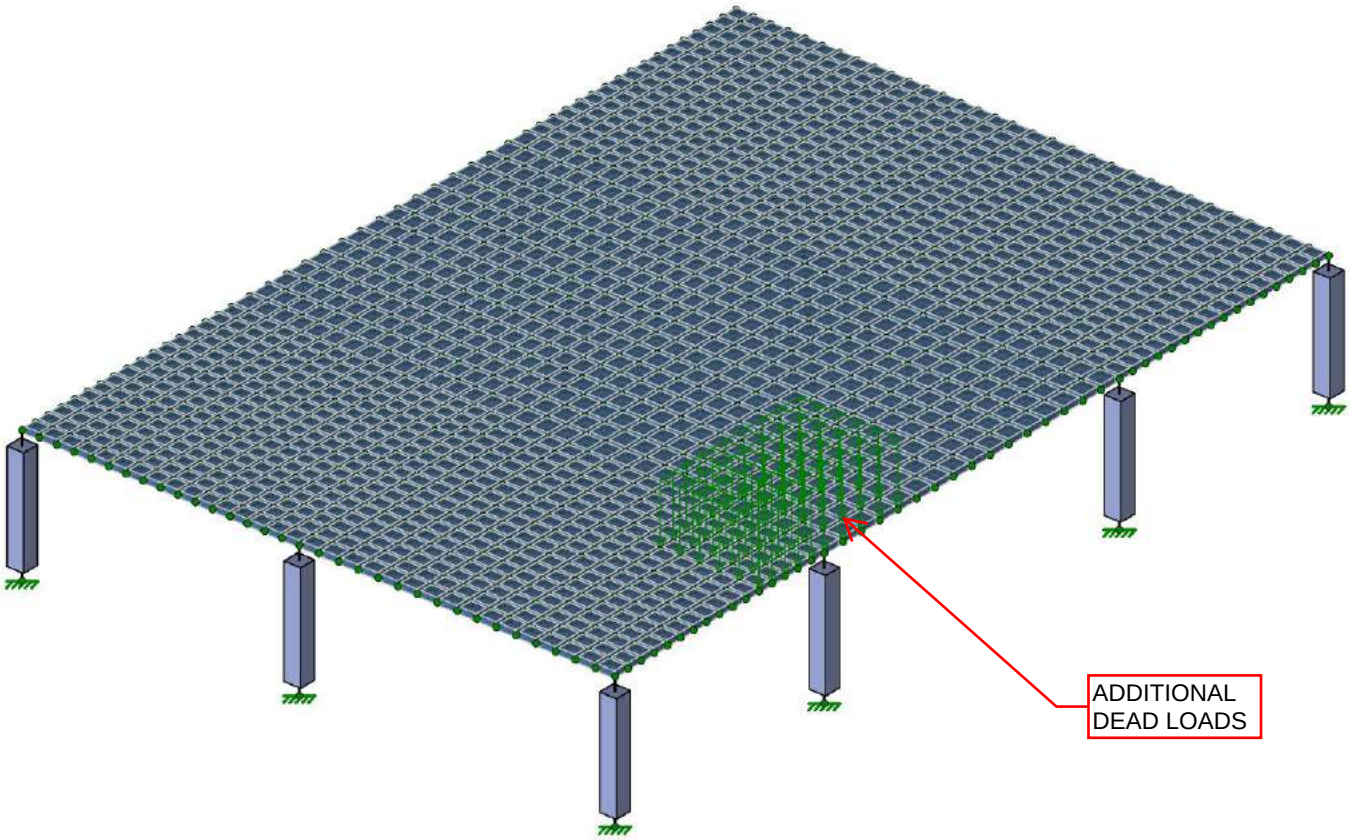
Results for LC 3, 1.2DL + 1.2DL(EQ) + 1.6SL

Caliber Engineering Solutions		SK-5
		Apr 21, 2020
		Plate Analysis - Alpha 2B - Cont.r3d

BETA LOCATION ON BUILDING

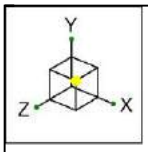
PERMIT 2020-18652211 I
RSN 1487202



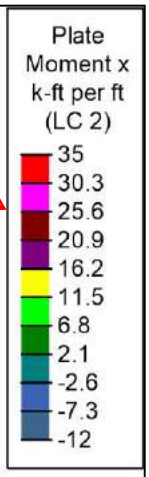


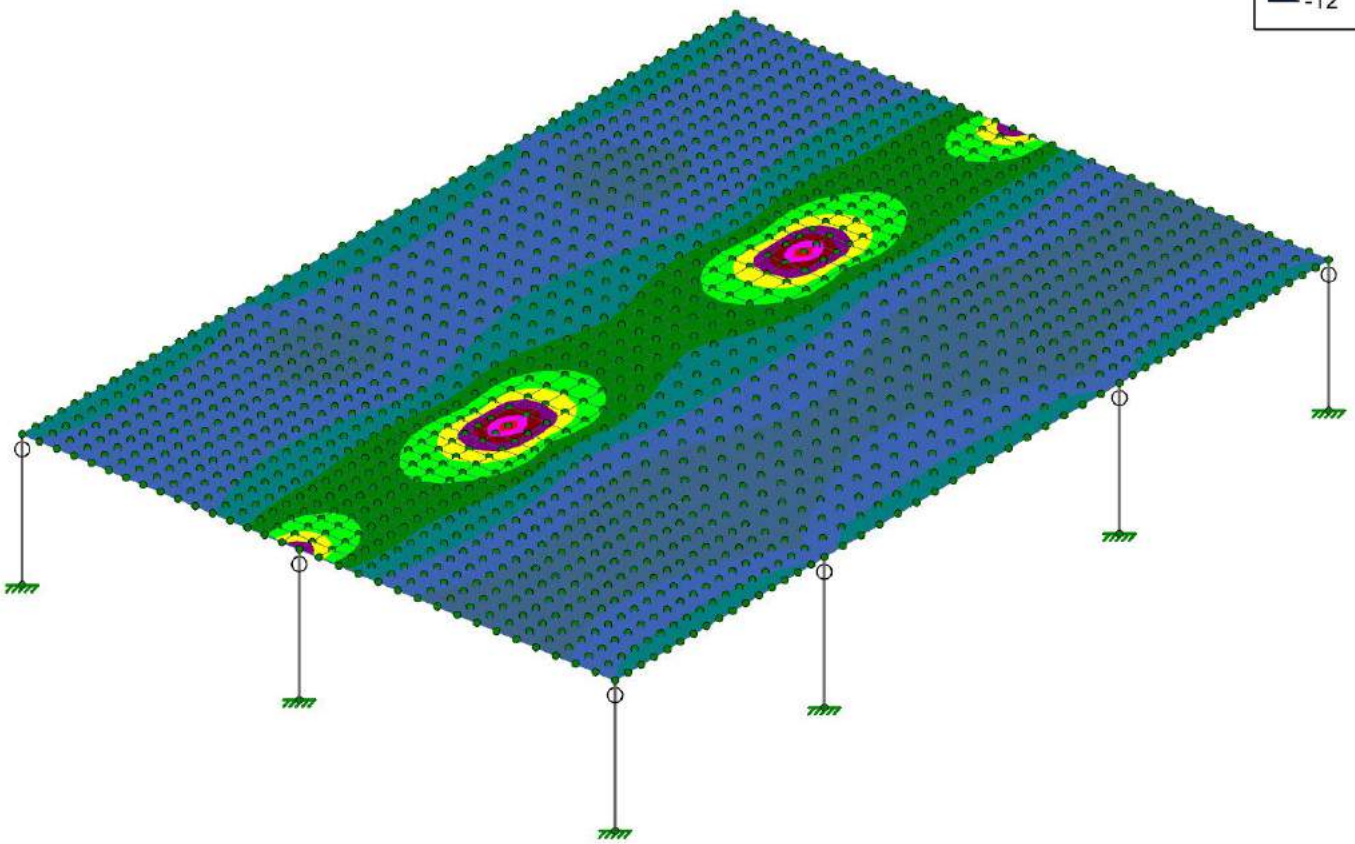
Loads: BLC 2, DL-EQ

Caliber Engineering Solutions		SK-1
		Apr 21, 2020
		Plate Analysis - E9 - Cont.r3d



LOADS ONLY USED FOR A PLATE ANALYSIS TO DETERMINE INFLUENCE. DO NOT USE AS DESIGN LOADS. SEE METHOD & APPROACH.





Results for LC 2, 1.2DL + 1.6SL

Caliber Engineering Solutions		SK-2
		Apr 21, 2020
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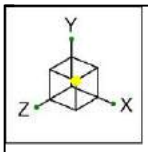
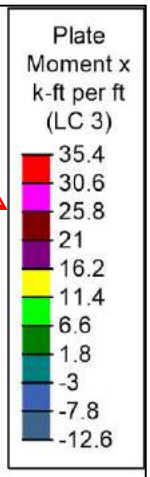
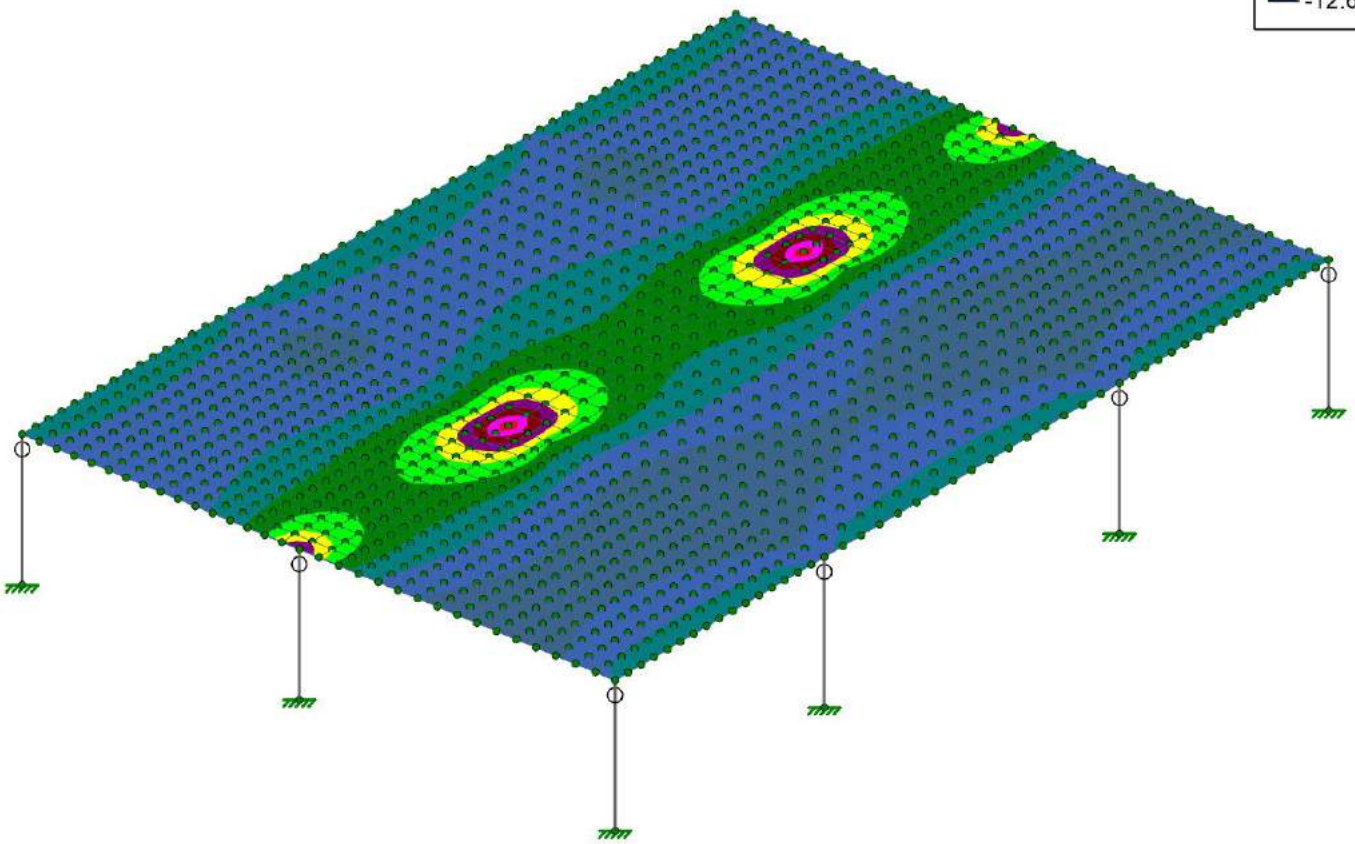


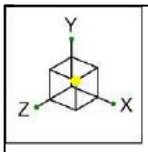
LOADS ONLY USED FOR A PLATE ANALYSIS TO DETERMINE INFLUENCE. DO NOT USE AS DESIGN LOADS. SEE METHOD & APPROACH.



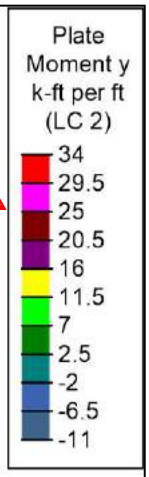


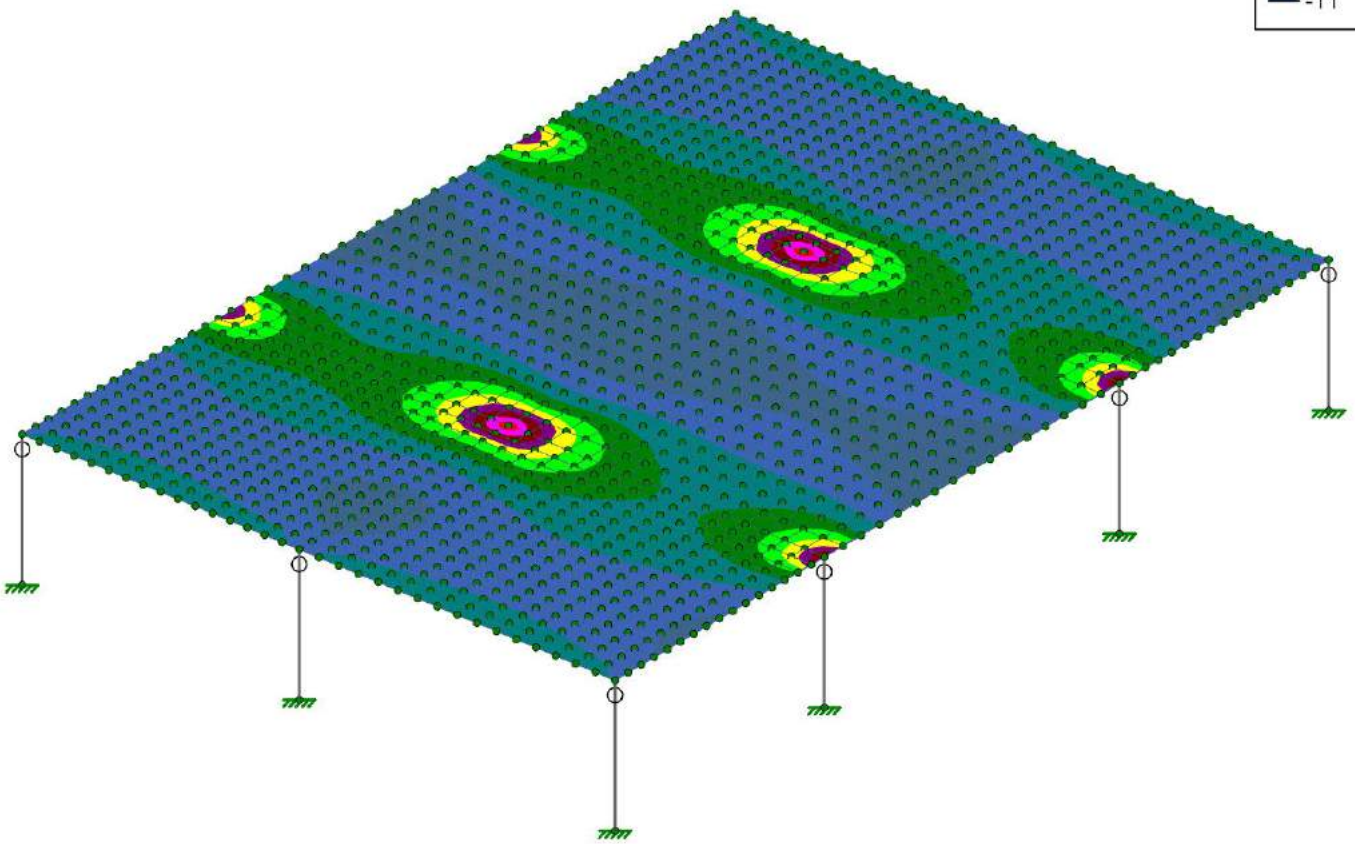
Results for LC 3, 1.2DL + 1.2DL(EQ) + 1.6SL

Caliber Engineering Solutions		SK-3
		Apr 21, 2020
		Plate Analysis - E9 - Cont.r3d



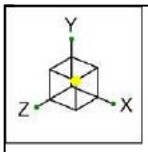
LOADS ONLY USED FOR A PLATE ANALYSIS TO DETERMINE INFLUENCE. DO NOT USE AS DESIGN LOADS. SEE METHOD & APPROACH.



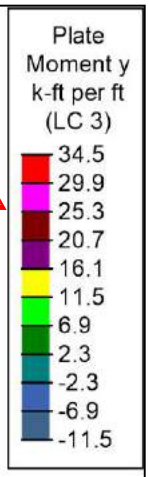


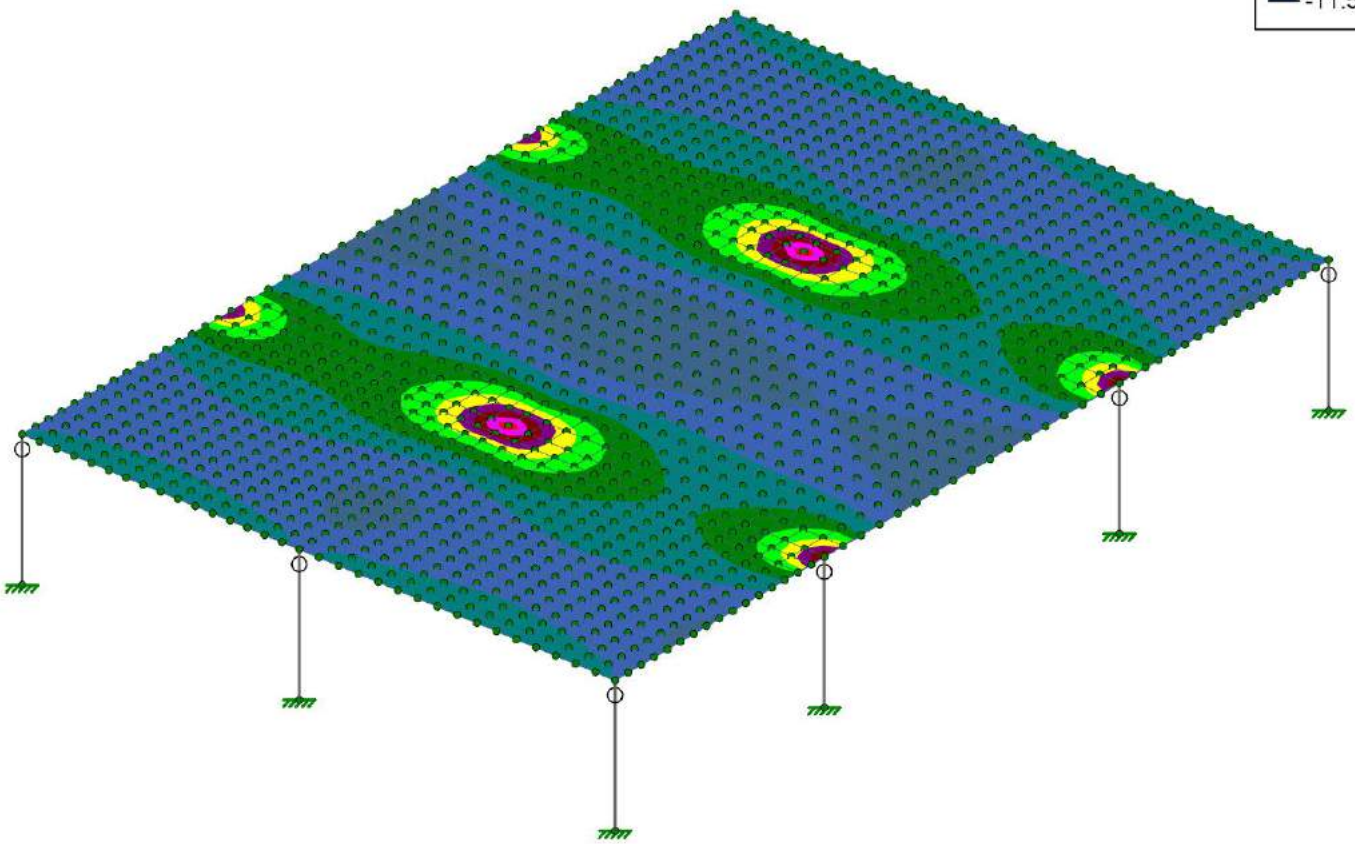
Results for LC 2, 1.2DL + 1.6SL

Caliber Engineering Solutions		SK-4
		Apr 21, 2020
		Plate Analysis - E9 - Cont.r3d



LOADS ONLY USED FOR A PLATE ANALYSIS TO DETERMINE INFLUENCE. DO NOT USE AS DESIGN LOADS. SEE METHOD & APPROACH.



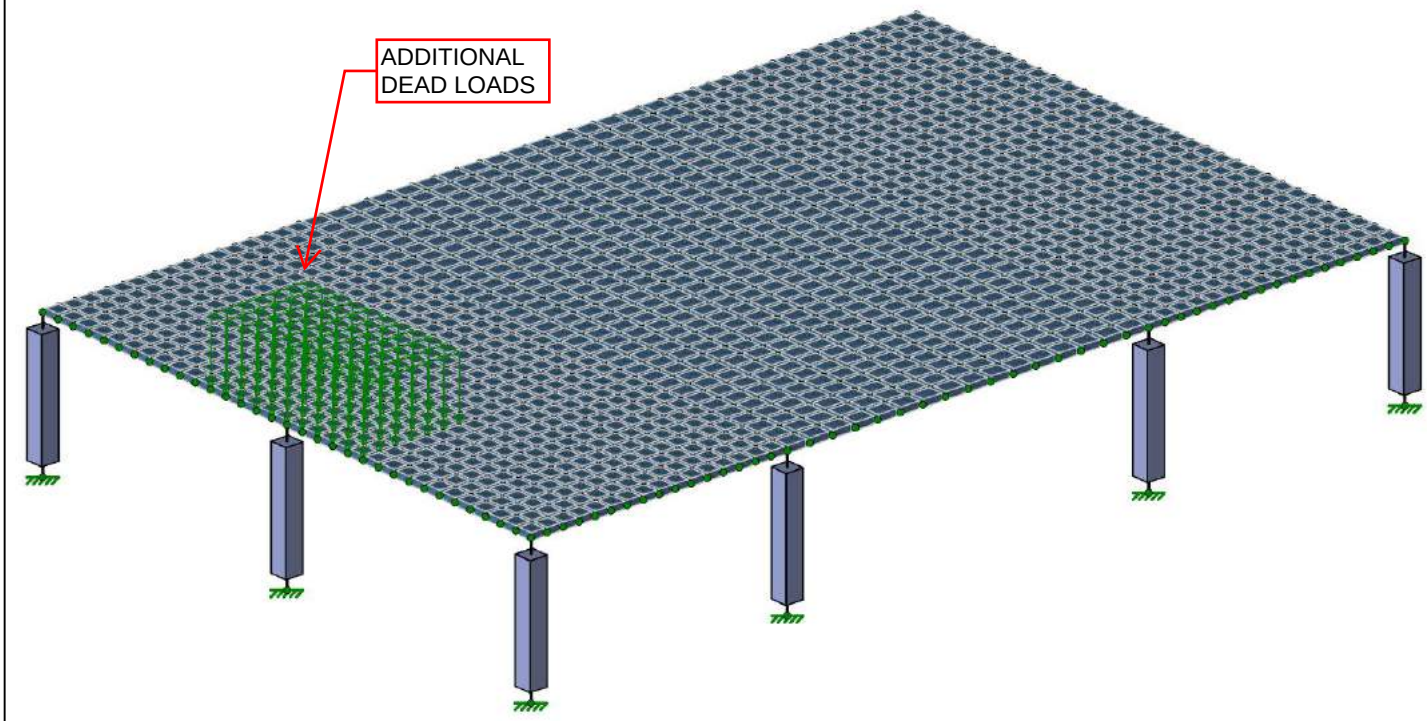


Results for LC 3, 1.2DL + 1.2DL(EQ) + 1.6SL

Caliber Engineering Solutions		SK-5
		Apr 21, 2020
		Plate Analysis - E9 - Cont.r3d

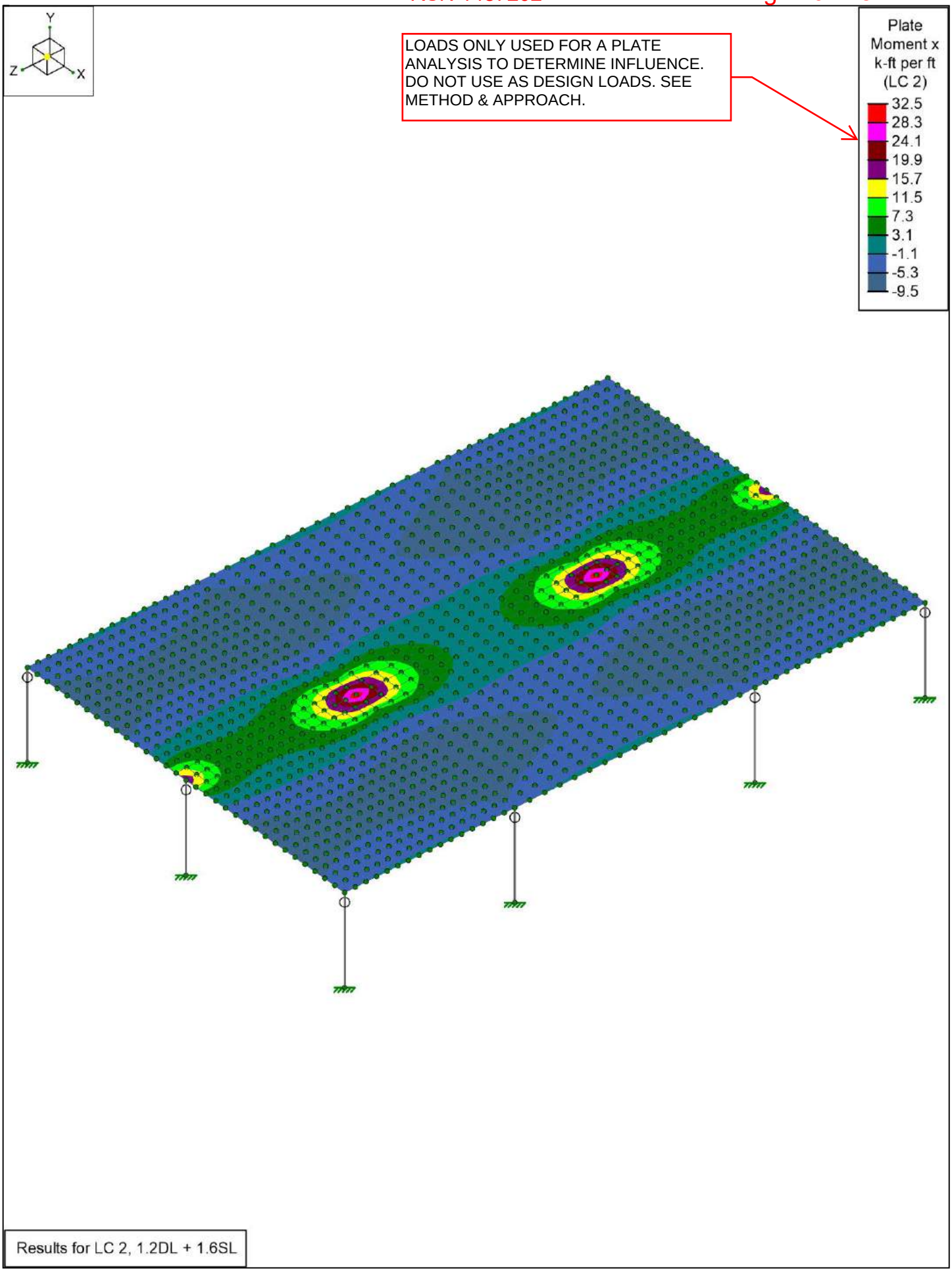
PERMIT 2020-18652231 LL
RSN 1487202

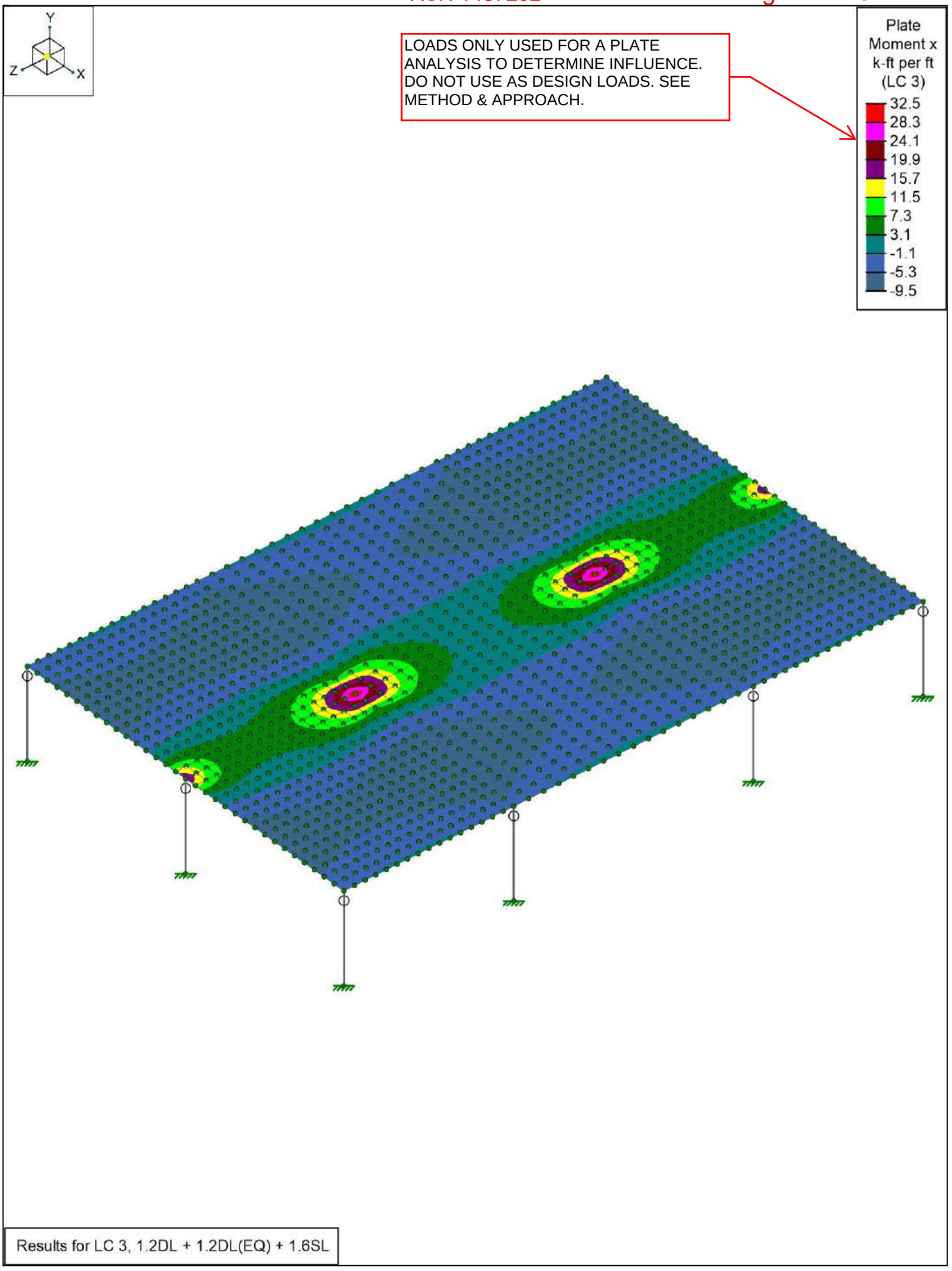
GAMMA LOCATION ON BUILDING

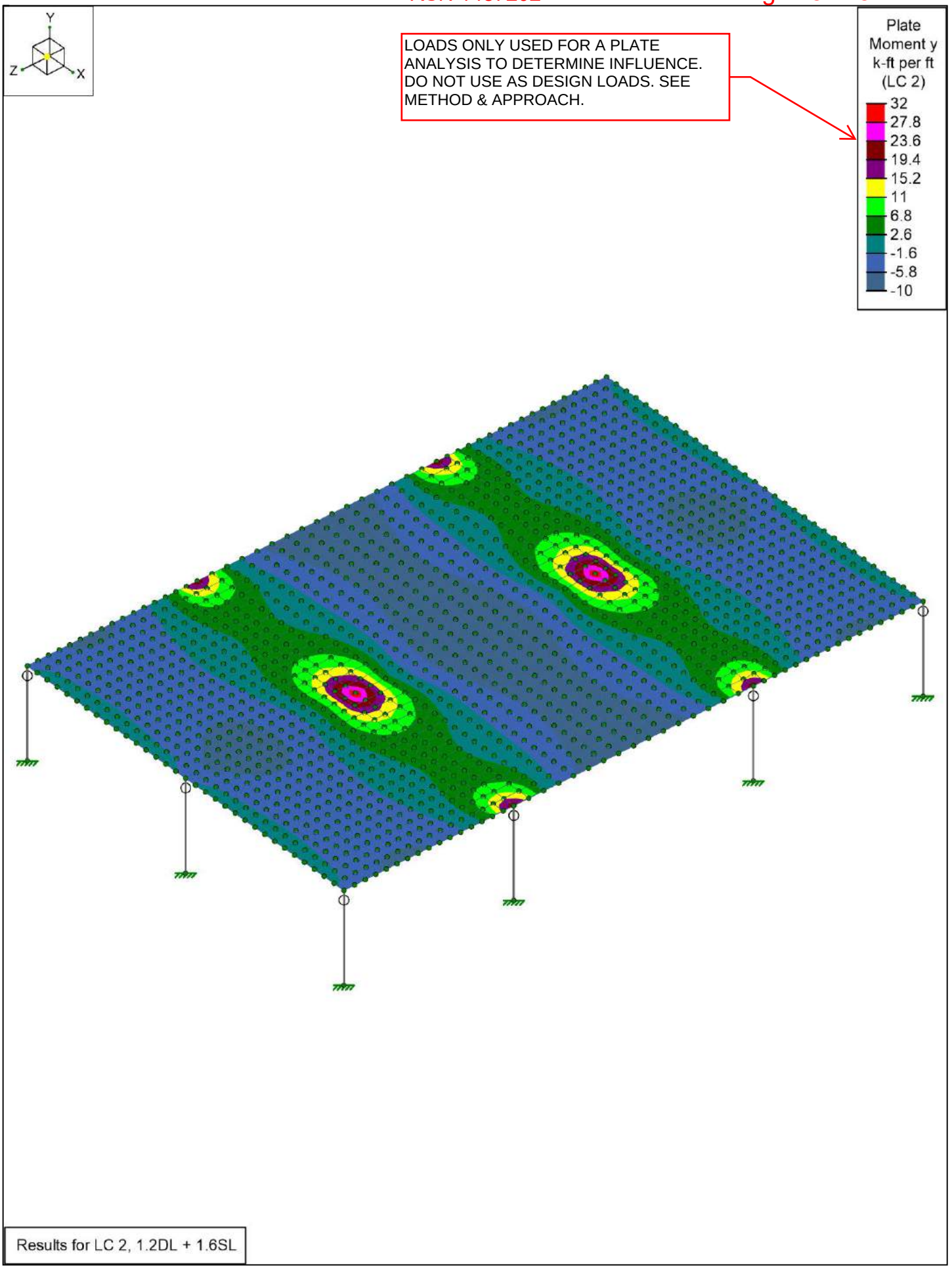


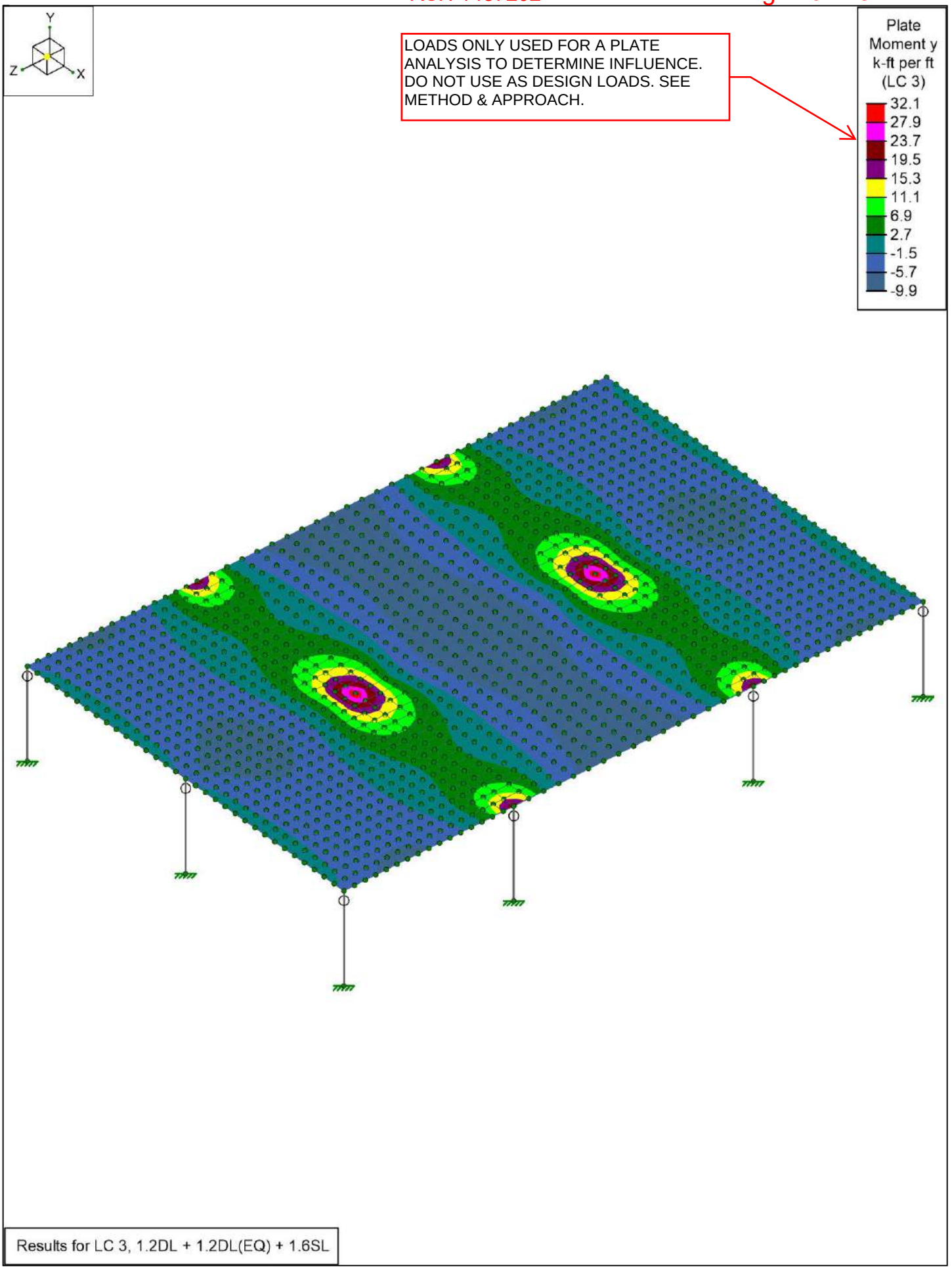
Loads: BLC 2, DL(EQ)

Caliber Engineering Solutions		SK-1
		Apr 21, 2020
		Plate Analysis - Gamma - 4E.r3d


Y
Z
X
LOADS ONLY USED FOR A PLATE ANALYSIS TO DETERMINE INFLUENCE. DO NOT USE AS DESIGN LOADS. SEE METHOD & APPROACH.
Plate Moment x k-ft per ft (LC 2)
32.5
28.3
24.1
19.9
15.7
11.5
7.3
3.1
-1.1
-5.3
-9.5
Results for LC 2, 1.2DL + 1.6SL


Y
Z
X
LOADS ONLY USED FOR A PLATE ANALYSIS TO DETERMINE INFLUENCE. DO NOT USE AS DESIGN LOADS. SEE METHOD & APPROACH.
Plate Moment x k-ft per ft (LC 3)
32.5
28.3
24.1
19.9
15.7
11.5
7.3
3.1
-1.1
-5.3
-9.5
Results for LC 3, 1.2DL + 1.2DL(EQ) + 1.6SL


Y
Z
X
LOADS ONLY USED FOR A PLATE ANALYSIS TO DETERMINE INFLUENCE. DO NOT USE AS DESIGN LOADS. SEE METHOD & APPROACH.
Plate Moment y k-ft per ft (LC 2)
32
27.8
23.6
19.4
15.2
11
6.8
2.6
-1.6
-5.8
-10
Results for LC 2, 1.2DL + 1.6SL


Y
Z
X
LOADS ONLY USED FOR A PLATE ANALYSIS TO DETERMINE INFLUENCE. DO NOT USE AS DESIGN LOADS. SEE METHOD & APPROACH.
Plate Moment y k-ft per ft (LC 3)
32.1
27.9
23.7
19.5
15.3
11.1
6.9
2.7
-1.5
-5.7
-9.9
Results for LC 3, 1.2DL + 1.2DL(EQ) + 1.6SL

Project: COL01176 – FRP Enclosure & Roof Calcs
CES Job No.: 20-G101
Eng: MEN
Date: April 21, 2020

CaliberEngineering Solutions

Roof Checks – Conclusion

Findings:

1. The extreme values for the plates w/ highest moments did not increase by more than 5% due to the addition.
2. Some moments at certain plate locations increased by approximately 5% - 6%.
3. In order to ensure the moments do not increase by more than 5% at all of the meshed plate locations, the center post can be placed over a column in order to transfer some of the weight directly to the column below. This will reduce the weight that creates bending moment on the slab.
4. Based on a review of the influence of the additional loads, it is expected that the addition will not result in an increase in the demand to capacity ratio of more than 5%.

Recommendations:

1. Ensure the windward center post for the screen walls is located directly over a concrete column.
2. Limit the max dimension of the screen wall to 15 ft and start the screen wall above the balanced snow height.

SERIES 500/525/625 STRUCTURAL SHAPES ULTIMATE COUPON PROPERTIES

Below are the test results for the **minimum** ultimate **coupon** properties of **EXTREN®** structural shapes as per the referenced ASTM procedures. The properties of plate as well as thermal cure rod and bar are found elsewhere in this section. Designers should refer to Section 8 — **FLEXURAL MEMBERS** and Section 9 — **COMPRESSION MEMBERS** for the recommended design equations for **EXTREN®**. The actual geometry and application of the structural shape will determine its ultimate usability. Additionally, WF / I-Beam ASTM properties may vary due to location in the part but the modulus of elasticity will not be affected.

PROPERTY	ASTM TEST	UNITS	SERIES 500/525	SERIES 625
MECHANICAL				
Tensile Stress, LW	D638	psi	30,000	30,000
Tensile Stress, CW	D638	psi	7,000	7,000
Tensile Modulus, LW	D638	10^6 psi	2.5	2.6
Tensile Modulus, CW	D638	10^6 psi	0.8	0.8
Compressive Stress, LW①	D695	psi	30,000	30,000
Compressive Stress, CW	D695	psi	15,000	16,000
Compressive Modulus, LW	D695	10^6 psi	2.5	2.6
Compressive Modulus CW	D695	10^6 psi	0.8	0.8
Flexural Stress, LW②	D790	psi	30,000	30,000
Flexural Stress, CW	D790	psi	10,000	10,000
Flexural Modulus, LW②	D790	10^6 psi	1.6	1.6
Flexural Modulus, CW	D790	10^6 psi	0.8	0.8
Modulus of Elasticity ③	full section	10^6 psi	2.6	2.8
Modulus of Elasticity (W and I Shapes > 4") ③	full section	10^6 psi	2.5	2.5
Shear Modulus, LW ④⑧	—	10^6 psi	0.425	0.425
Short Beam Shear, LW ⑦⑧	D2344	psi	4,500	4,500
Ultimate Bearing Stress, LW	D953	psi	30,000	30,000
Poisson's Ratio, LW⑧	D3039	in/in	0.33	0.33
Notched Izod Impact, LW	D256	ft-lbs/in	25	25
Notched Izod Impact, CW	D256	ft-lbs/in	4	4
PHYSICAL				
Barcol Hardness⑤	D2583	—	45	45
24 hr. Water Absorption⑥	D570	% Max	0.6	0.6
Density	D792	lbs/in^3	.062-.070	.062-.070
Coefficient of Thermal Expansion, LW ⑧	D696	10^{-6} in/in/°F	7	7
Coefficient of Thermal Expansion, CW ⑧	D696	10^{-6} in/in/°F	16	16
Thermal Conductivity ⑧	C177	BTU-in/ft^2/hr/°F	4	4
ELECTRICAL				
Arc Resistance, LW ⑧	D495	seconds	120	120
Dielectric Strength, LW ⑧	D149	KV/in	35	35
Dielectric Strength, PF ⑨	D149	volts/mil	200	200

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PROPERTY	TEST	VALUE
FLAMMABILITY (Only Series 525 and 625)		
Flammability Classification (1/8")	UL 94	VO
Tunnel Test	ASTM E84	25 Max
NBS Smoke Chamber	ASTM E662	650-700 (Typical)
Flammability	ASTM D635	Self Extinguishing
UL Thermal Index	Generic	266°F
British Fire Test	BS 476-7	Class 1

LW — lengthwise
CW — crosswise
PF — perpendicular to laminate face

NOTES:

① Refer to Section 9 — **COMPRESSION MEMBERS** for the recommended allowable stresses for **EXTREN®** columns.

② Refer to Section 8 — **FLEXURAL MEMBERS** for the recommended allowable stresses for **EXTREN®** beams. LW results are for the flange only.

③ This value is determined from full section simple beam bending of **EXTREN®** structural shapes and will be used in Sections 8 and 9 for design.

④ The Shear Modulus value has been determined from tests with full sections of **EXTREN®** structural shapes. Less precise values are occasionally estimated for pultrusion by using an equation for isotropic materials, $G=E/[2(1+\nu)]$. For example, if **EXTREN®** pultrusions are assumed to be isotropic with a Poisson's Ratio (ν) of 0.33 and a Modulus of Elasticity of 2.6×10^6 psi, then G = 977,000 psi, which exceeds the listed tested value. **EXTREN®** shapes are mat/roving composites and anisotropic.

⑤ Strongwell incorporates a synthetic surfacing veil routinely on the surface of all **EXTREN®** structural shapes. This has the effect of lowering the measured Barcol Hardness and does not reflect an absence of cure. Other additives incorporated into the composite for corrosion protection and surface improvements may also reduce Barcol Hardness to a typical value of 45. A surface unprotected by a surfacing veil without additives would have a minimum value of 50.

⑥ Measured as a percentage maximum by weight.

⑦ Span to depth ratio of 3:1; **EXTREN®** angles will have a minimum value of 4000 psi and the I/W shapes are tested in the web.

⑧ Typical values.

⑨ This is a typical value which varies with composite thickness.

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THERMAL CURE ROD AND BAR ULTIMATE COUPON PROPERTIES

Below are the test results for the **minimum** ultimate **coupon** properties of thermal cure rod and bar as per the referenced ASTM procedures. Rod and bar stock contain longitudinal reinforcements only – no mat. Coupon testing provides a proof test for the composite, but the actual geometry and application of the structural shape will determine its ultimate usability.

PROPERTY	ASTM TEST	UNITS	THERMAL CURE CLEAR
MECHANICAL			
Tensile Stress, LW	D3916	psi	100,000
Tensile Modulus, LW	D3916	10^6 psi	6.0
Compressive Stress, Axial, LW	D695	psi	60,000
Flexural Stress, LW	D790	psi	100,000
Flexural Modulus, LW	D790	10^6 psi	6.0
Notched Izod Impact, LW	D256	ft-lbs/in	40
Short Beam Shear, LW	D4475	psi	5,500
PHYSICAL			
Barcol Hardness	D2583	—	50
24 hr. Water Absorption ①	D570	% Max	0.25
Density	D792	lbs/in^3	.072-0.76
Coefficient of Thermal Expansion ②	D696	10^{-6} in/in/°F	5
ELECTRICAL			
Dielectric Strength, LW ②	D149	KV/in	35

LW — lengthwise or parallel to the roving

NOTE: All thermal cure rod and bar are not normally produced with a fire retardant resin. Thermal cure rod and bar were not designed to be machined. Machining may cause splintering or other issues due to the lack of off-axis reinforcements.

① Measured as a percentage maximum by weight.
② Typical values.

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SERIES 500/525 PLATE ULTIMATE COUPON PROPERTIES

Below are the test results for the minimum ultimate coupon properties of **EXTREN®** Series 500/525 plate as per the referenced ASTM procedures. Designers should refer to Section 10 — **PLATE** for the recommended design equations for **EXTREN®**. The actual geometry and application of the plate will determine its ultimate usability.

PROPERTY	ASTM TEST	UNITS	THICKNESS 1/8"	3/16"-3/8"	1/2"-1"
MECHANICAL					
Tensile Stress, LW	D638	psi	20,000	20,000	20,000
Tensile Stress, CW	D638	psi	7,500	10,000	10,000
Tensile Modulus, LW	D638	10^6 psi	1.8	1.8	1.8
Tensile Modulus, CW	D638	10^6 psi	0.7	0.9	1.0
Compressive Stress, Edgewise, LW	D695	psi	24,000	24,000	24,000
Compressive Stress, Edgewise, CW	D695	psi	15,500	16,500	20,000
Compressive Modulus, Edgewise, LW	D695	10^6 psi	1.8	1.8	1.8
Compressive Modulus, Edgewise, CW	D695	10^6 psi	0.7	0.9	1.0
Flexural Stress, Flatwise, LW	D790	psi	24,000	24,000	24,000
Flexural Stress, Flatwise, CW	D790	psi	10,000	13,000	17,000
Flexural Modulus, Flatwise, LW	D790	10^6 psi	1.1	1.1	1.4
Flexural Modulus, Flatwise, CW	D790	10^6 psi	0.8	0.8	1.3
Ultimate Bearing Stress, LW	D953	psi	32,000	32,000	32,000
Poisson's Ratio, LW ②	D3039	in/in	0.31	0.31	0.31
Poisson's Ratio, CW ②	D3039	in/in	0.29	0.29	0.29
Notched Izod Impact, LW	D256	ft-lbs/in	15	10	10
Notched Izod Impact, CW	D256	ft-lbs/in	5	5	5
PHYSICAL					
Barcol Hardness	D2583	—	40	40	40
24 hr. Water Absorption ①	D570	% Max	0.6	0.6	0.6
Density	D792	lbs/in^3	.060-0.68	.060-0.68	.060-0.68
Coefficient of Thermal Expansion ②	D696	10^{-6} in/in/°F	8	8	8
ELECTRICAL					
Dielectric Strength, LW ②	D149	KV/in	35	35	35
Dielectric Strength, PF ②	D149	volts/mil	200	N.T.	N.T.

LW — lengthwise
CW — crosswise
PF — perpendicular to the laminate face
N.T. — not tested

NOTES:
① Measured as a percentage maximum by weight.
② This is a typical value which varies with composite thickness.

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SERIES 625 PLATE ULTIMATE COUPON PROPERTIES

Below are the test results for the minimum ultimate coupon properties of **EXTREN®** Series 625 plate as per the referenced ASTM procedures. Designers should refer to Section 10 — **PLATE** for the recommended design equations for **EXTREN®**. The actual geometry and application of the plate will determine its ultimate usability.

PROPERTY	ASTM TEST	UNITS	THICKNESS 1/8"	THICKNESS 3/16"-1/4"	THICKNESS 3/8"-1"
MECHANICAL					
Tensile Stress, LW	D638	psi	20,000	20,000	20,000
Tensile Stress, CW	D638	psi	7,500	10,000	10,000
Tensile Modulus, LW	D638	10^6 psi	1.8	1.8	1.8
Tensile Modulus, CW	D638	10^6 psi	1.0	1.0	1.0
Compressive Stress, Edgewise, LW	D695	psi	24,000	24,000	24,000
Compressive Stress, Edgewise, CW	D695	psi	16,500	17,500	17,500
Compressive Modulus, Edgewise, LW	D695	10^6 psi	1.8	1.8	1.8
Compressive Modulus, Edgewise, CW	D695	10^6 psi	1.0	1.0	1.0
Flexural Stress, Flatwise, LW	D790	psi	24,000	24,000	24,000
Flexural Stress, Flatwise, CW	D790	psi	10,000	13,000	17,000
Flexural Modulus, Flatwise, LW	D790	10^6 psi	1.1	1.1	1.4
Flexural Modulus, Flatwise, CW	D790	10^6 psi	0.8	0.9	1.3
Ultimate Bearing Stress, LW	D953	psi	32,000	32,000	32,000
Poisson's Ratio, LW ②	D3039	in/in	0.32	0.32	0.32
Poisson's Ratio, CW ②	D3039	in/in	0.24	0.24	0.24
Notched Izod Impact, LW	D256	ft-lbs/in	15	10	10
Notched Izod Impact, CW	D256	ft-lbs/in	5	5	5
PHYSICAL					
Barcol Hardness	D2583	—	40	40	40
24 hr. Water Absorption ①	D570	% Max	0.6	0.6	0.6
Density	D792	lbs/in^3	.060-0.68	.060-0.68	.060-0.68
Coefficient of Thermal Expansion ②	D696	10^{-6} in/in/°F	8	8	8
ELECTRICAL					
Dielectric Strength, LW ②	D149	KV/in	35	35	35
Dielectric Strength, PF ②	D149	volts/mil	250	N.T.	N.T.

LW — lengthwise
CW — crosswise
PF — perpendicular to the laminate face
N.T. — not tested

NOTES:
① Measured as a percentage maximum by weight.
② This is a typical value which varies with composite thickness.

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SAFETY FACTORS

Safety factors are defined as the ratio of the ultimate stress to the working or allowable stress.

$$\text{SAFETY FACTOR (S.F.)} = \frac{\text{ULTIMATE STRESS (U.S.)}}{\text{ALLOWABLE STRESS (A.S.)}}$$

$$\text{therefore, A.S.} = \frac{\text{U.S.}}{\text{S.F.}}$$

Safety factors compensate for:

- allowable tolerances of the part
- uncertainty of the anticipated loading (magnitude, type or placement)
- assumptions in methods of analysis
- fabrication tolerances (squareness of cuts, normal tolerances, etc.)

In Section 3 - **PROPERTIES OF EXTREN®**, Strongwell lists the **minimum** ultimate values for stresses obtained from coupon or full section testing. Typical property values are generally 20% -25% higher than those listed. Even though these are minimum ultimate stresses, these values **should not** be utilized for design purposes before dividing them by the appropriate safety factor.

The safety factors used in the various design tables were chosen to prevent first deformation of the part. First deformation is defined as the first visible deformation including local flange or web buckling, twisting, crushing, etc. The recommended safety factors used for design are:

	RECOMMENDED SAFETY FACTORS ①
Flexural members, beams	2.5 ②
Compression members, columns	3.0 ②
Shear	3.0
Connections	4.0
Modulus of Elasticity	1.0 ③
Shear Modulus	1.0 ③

NOTES:

① The safety factors given are for **static load conditions only**. Safety factors for impact loads and dynamic loads are typically **two times** the static load safety factor, see *Mechanics of Materials*, Reference 7. Long term service loads which result in creep deformations will require higher safety factors to insure satisfactory performance. For creep effects, see *Structural Plastics Design Manual,* Reference 2.

② Strongwell has developed empirical equations which calculate the allowable stresses for **EXTREN®** when used as compression members (columns) and as flexural members (beams). These equations, used to generate the allowable load tables found in this design manual, are the result of full section testing. This testing more accurately reflects the performance of the column or beam and should be used instead of coupon properties. The designer should use the allowable load found in the appropriate table, which includes a safety factor of 3.0 for columns and 2.5 for beams.

It must be noted that these equations are applicable only for **EXTREN®** and are a function of the proprietary resins and glass placement in the **EXTREN®** composite plus the size and shape of the part. The use of these empirical equations for pultruded products other than **EXTREN®** is not recommended and could result in a structural failure.

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SAFETY FACTORS

③ The moduli reported in Section 3 - **PROPERTIES OF EXTREN®** is the minimum value obtained from tests of full size sections of **EXTREN®** structural shapes which allows a safety factor of 1.0. **CAUTION:** If deflections are critical and unexpected temperature variations occur, problems may arise due to loss of stiffness. Refer to "Temperature Effects" in Section 3 for safety factors for the moduli at elevated temperatures.

These recommended safety factors, as well as the safety factors used in the generation of allowable load tables for beams and columns, are not the only safety factors that may be used in design. The designer may choose to adjust the safety factors based on particular applications and considerations including margin of safety, costs, confidence of loads or materials, etc.

Ultimately, the final selection of a safety factor is the designer's privilege as well as responsibility.

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