CODES:

FLORIDA BUILDING CODE 2014, 5TH EDITION
ASCE STANDARD 7-2010
MIAMI DADE WIND SPEED = 186 MPH

WIND DESIGN REQUIREMENTS:

| | |
|---|---|
| ULTIMATE DESIGN WIND SPEED, Vult (3 sec. gust) | 186 mph |
| NOMINAL DESIGN WIND SPEED, Vasd | 144 mph |
| RISK CATEGORY | IV |
| HEIGHT TO CENTROID | 200 FT |
| EXPOSURE CATEGORY | D |
| ENCLOSURE CATEGORY | N/A |
| EFFECTIVE WIND AREA | N/A |
| INTERNAL PRESSURE COEFFICIENT GCPi | N/A |
| DIRECTIONALITY FACTOR Kd | 0.90 |
| TOPOGRAPHIC FACTOR Kzt | 1.00 |
| GUST EFFECT FACTOR | N/A |

WIND LOAD METHOD:

VELOCITY PRESSURE:
based on ASCE 7-10, Eq. 29.3-1
$qz = 0.00256\ Kz\ Kzt\ Kd\ V^2$ psf
Kz = 1.61
V = Vult
qz = 128.3 psf

WIND PRESSURES:
based on ASCE 7-10 Eq. 29.5.1 & FBC 1620.6
F = qh GCf Af psf Eq 29.5-2
GCp= 1.8 FOR LATERAL FORCES (ZONE 5)
GCp= 3.2 FOR VERTICAL FORCES (ZONE 3)

LOAD COMBINATIONS:

| | |
|---|---|
| POSITIVE VERTICAL FORCE: | 1.0*D + 0.6*W [FBC 1605.3.1 EQ. 16-12] |
| SLIDING & ANCHOR PULLOUT: | 0.6*D + 0.6*W [FBC 1605.3.1 EQ. 16-15] |
| OVERTURNING: | 0.67*D + 0.78*W [FBC 1605.3.2 EQ. 16-18] |

GENERAL NOTES:

1. THIS ENGINEERING REPORT DOCUMENTS THE ANALYSIS OF AC EQUIPMENT MOUNTED ON A WALL BRACKET AND THE ASSOCIATED ANCHORING SYSTEMS TO RESIST DEAD WEIGHT AND WIND LOAD FORCES.
2. THE ANALYSIS CONFORMS TO THE REQUIREMENTS OF THE FLORIDA BUILDING CODE 2014 AND ASCE 7-2010, FOR USE WITHIN & OUTSIDE HVHZ.
3. THE AC UNIT IS MOUNTED ON A METAL WALL BRACKET WHICH IS SECURED TO THE WALL. THE WALL IS DESIGNED BY OTHERS.
4. ANCHORS USED TO FASTEN THE UNIT TO THE WALL BRACKET ARE A307 OR HIGHER STRENGTH STEEL BOLTS.
5. THE WALL BRACKET IS DESIGNED AND VERIFIED BY STRUCTURAL ANALYSIS BY THIS ENGINEER.
6. ALTERNATE WALL BRACKET DESIGNS THAT ARE DESIGNED TO RESIST THE ABOVE WIND LOADS MAY BE USED AT THE CONTRACTOR'S OPTION. FOR ALTERNATE WALL BRACKET DESIGNS, PROVIDE DETAILS AND CALCULATIONS SIMILAR TO THIS SHEET AND DETAILED CALCULATIONS ON SHEET 2, STAMPED BY A PROFESSIONAL ENGINEER REGISTERED IN THE STATE OF FLORIDA.
7. THE CONTRACTOR IS REPONSIBLE FOR SAFETY, INSTALLATION, AND SPECIAL INSPECTIONS & TESTS PER FBC CHAPTER 17.

CALCULATIONS: SEE DETAILED CALCULATIONS ON SHEET 2.

LATERAL FORCES (SLIDING):

1. THE WIND LOAD ACTING ON THE SIDE AND FRONT OF THE UNIT ACTING OUTWARD.
2. THESE LATERAL FORCES MUST BE RESISTED BY THE SHEAR STRENGTH OF THE SUM OF THE ANCHORS BOTH HOLDING THE UNIT TO THE BRACKET AND THE BRACKET TO THE WALL.

MOMENT FORCE (OVERTURN):

3. THE WIND LOAD ACTING ON THE SIDE AND FRONT OF THE AC UNIT WILL PIVOT THE UNIT ABOUT THE SIDE. THE FRONT WIND LOAD AND THE DEAD LOAD WILL PIVOT ABOUT THE BOTTOM. A SUM OF VECTORS IS ALSO CALCULATED.
4. THIS PIVOTING FORCE MUST BE RESISTED BY THE WITHDRAWAL STRENGTH OF THE ANCHORS.

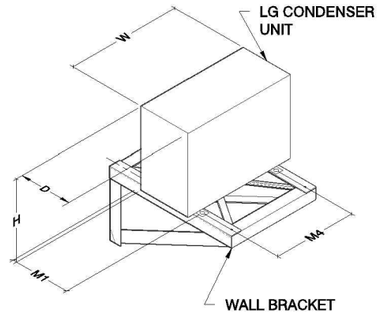
CLEARANCES:

5. ANCHORS IN BRACKET METAL MUST HAVE EDGE CLEARANCES OF 1-1/2 DIAMETERS.
6. ANCHORS IN CONCRETE BLOCK MUST BE AT LEAST 12" FROM THE EDGE OF THE WALL.

ANCHOR STRENGTH: SEE TABLE THIS DRAWING.

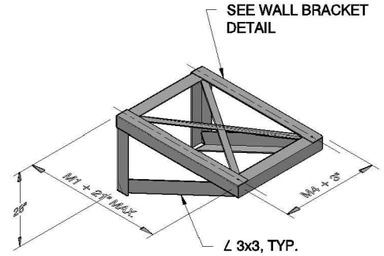
ENCLOSURE FASTENERS:

7. THE METAL SHELL FASTENERS MUST RESIST THE NEGATIVE WIND PRESSURES CAUSING TENSILE STRESS IN THE SCREWS AND PULL-OVER EFFECTS OF THE SHEET METAL.



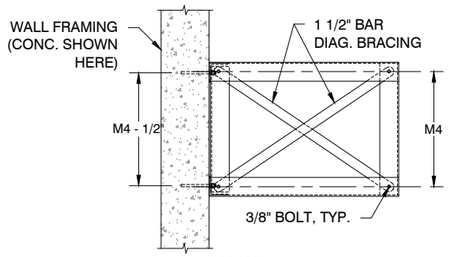

## EQUIPMENT VIEW

SCALE:

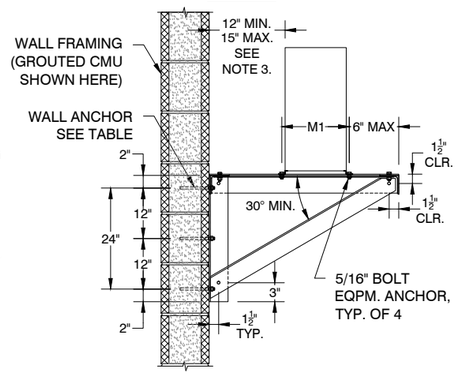



## WALL BRACKET VIEW

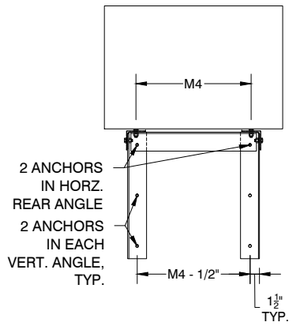
SCALE:




TOP VIEW




SIDE VIEW




FRONT VIEW

## WALL BRACKET DETAIL

SCALE: 1/2" = 1'-0"

WALL BRACKET NOTES:

1. WALL BRACKET IS DESIGNED AND VERIFIED FOR THE FORCES DESCRIBED IN THIS DOCUMENT AS SUMMARIZED IN THE ENGINEERING CALCULATIONS INCLUDED.
2. WALL BRACKET HEIGHT = 28".
3. LG HVAC UNIT SHALL BE MIN 12" CLEAR FROM EXTERIOR FACE OF FINISHED WALL.
4. WALL BRACKETS SHALL BE EITHER ALL GALV STEEL MEMBERS WITH GALV BOLTS & ANCHORS, OR ALL ALUMINUM MEMBERS WITH STAINLESS STEEL BOLTS & ANCHORS (EXCEPT GALV ISOLATION ANCHORS FOR COLD FORMED STEEL STUD WALLS AND STRUCTURAL STEEL).

STEEL FABRICATION NOTES (SEE WALL BRACKET NOTE 4.):

- ALL MATERIAL SHALL BE GALVANIZED A36 STEEL WITH MIN Fy = 36 KSI.
- ALL JOINTS SHALL BE BOLTED WITH 1/2" DIAMETER GALV A307 BOLTS W/ LOCK WASHERS, OR WELDED CONTINUOUS W/ 3/16" FILLET (EXCEPT USE CONTINUOUS ⅛" FILLET WELD AT ⅛" MEMBERS).
- ALL STEEL ANGLES SHALL BE GALV L4X3X1/4 LONG LEG VERTICAL.
- ALL STEEL DIAGONAL BRACING SHALL BE 1 ½" X 1/8" GALV BARS.

ALUMINUM FABRICATION NOTES (SEE WALL BRACKET NOTE 4.):

- ALL MATERIAL SHALL BE ALUMINUM ALLOY 6061-T5 OR 6061-T6.
- ALL JOINTS SHALL BE BOLTED WITH 1/2" DIAMETER STAINLESS STEEL BOLTS W/ LOCK WASHERS, OR WELDED CONTINUOUS W/ 1/4" FILLET.
- ALL ALUMINUM ANGLES SHALL BE ALUMINUM L4X3X3/8 LONG LEG VERTICAL.
- ALL ALUMINUM DIAGONAL BRACING SHALL BE 1 ½" X 1/4" ALUMINUM BARS.

OTHER NOTES:

- EQUIPMENT SUPPORT IS NOT PART OF WALL BRACKET.

ENGINEERING CONFORMANCE ANALYSIS:

THE TABLE BELOW SHOWS DIMENSIONS AND SHELL ENCLOSURE SCREWS FOR SOME MODELS OF LG ELECTRONICS USA HVAC OUTDOOR EQUIPMENT THAT MEET THE FOLLOWING ANALYSIS:

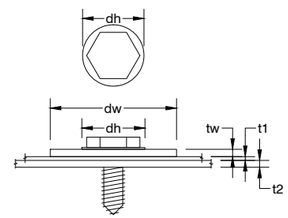
- WALL BRACKET STRENGTH: STRENGTH TO RESIST UNIT WEIGHT AND WIND LOADS ON LATERAL AND VERTICAL SURFACES
- WALL FRAME ANCHORS: PULLOUT AND SHEAR DUE TO UNIT WEIGHT AND WIND LOAD.
- EQUIPMENT METAL COVER FASTENERS: MIN NUMBER AND SIZE

| MODELS: LSU___HLV, LAU180HYV1, LAU240HYV1, LSU180HSV4, LAU240HSV_, LSU240HSV3, LSU243HLV, LSU___HV3, LSU240HEV1, LMU18CHV, LMU24CHV | CONDENSER DIMENSIONS | | | | | | WALL FRAME | SHELL SCREWS | DESIGN CHECK W/ NOM/REQ'D >= 1.00 = OK: STRENGTH | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MODEL # | W | D | H | M1 | M4 | Wt | WALL BRACKET HEIGHT (IN) | ON LONG SIDE, QTY. & SIZE | BOLT SHEAR | WALL ANCHOR SHEAR | WALL ANCHOR PULLOUT | BOLT TENSION | METAL SHELL |
| LSU240HLV | 34.25 | 12.63 | 31.50 | 14.19 | 21.50 | 124.6 | 28 | 8, #10 | 0.27 | 0.96 | 0.96 | 0.63 | 0.76 |
| LSU300HLV | 34.25 | 12.63 | 31.50 | 14.19 | 21.50 | 124.6 | 28 | 8, #10 | 0.27 | 0.96 | 0.96 | 0.63 | 0.76 |
| LSU360HLV | 34.25 | 12.63 | 31.50 | 14.19 | 21.50 | 124.6 | 28 | 8, #10 | 0.27 | 0.96 | 0.96 | 0.63 | 0.76 |
| LAU180HYV1 | 34.25 | 12.63 | 31.50 | 14.19 | 21.50 | 132.3 | 28 | 8, #10 | 0.27 | 0.96 | 0.96 | 0.63 | 0.76 |
| LSU180HSV4 | 34.25 | 12.63 | 31.50 | 14.19 | 21.50 | 120.2 | 28 | 8, #10 | 0.27 | 0.96 | 0.96 | 0.63 | 0.76 |
| LAU240HSV2 | 34.25 | 12.63 | 31.50 | 14.19 | 21.50 | 132.3 | 28 | 8, #10 | 0.27 | 0.96 | 0.96 | 0.63 | 0.76 |
| LAU240HYV1 | 34.25 | 12.63 | 31.50 | 14.19 | 21.50 | 132.3 | 28 | 8, #10 | 0.27 | 0.96 | 0.96 | 0.63 | 0.76 |
| LAU240HSV3 | 34.25 | 12.63 | 31.50 | 14.19 | 21.50 | 127.8 | 28 | 8, #10 | 0.27 | 0.96 | 0.96 | 0.63 | 0.76 |
| LSU240HSV3 | 34.25 | 12.63 | 31.50 | 14.19 | 21.50 | 127.8 | 28 | 8, #10 | 0.27 | 0.96 | 0.96 | 0.63 | 0.76 |
| LSU243HLV | 34.25 | 12.63 | 31.50 | 14.19 | 21.50 | 127.8 | 28 | 8, #10 | 0.27 | 0.96 | 0.96 | 0.63 | 0.76 |
| LSU307HV3 | 34.25 | 12.63 | 31.50 | 14.19 | 21.50 | 127.8 | 28 | 8, #10 | 0.27 | 0.96 | 0.96 | 0.63 | 0.76 |
| LSU360HV3 | 34.25 | 12.63 | 31.50 | 14.19 | 21.50 | 127.8 | 28 | 8, #10 | 0.27 | 0.96 | 0.96 | 0.63 | 0.76 |
| LSU240HEV1 | 34.25 | 12.63 | 25.81 | 13.38 | 21.50 | 94.6 | 28 | 8, #10 | 0.22 | 0.94 | 0.78 | 0.52 | 0.63 |
| LMU18CHV | 34.25 | 12.63 | 25.78 | 13.38 | 21.50 | 99.2 | 28 | 8, #10 | 0.22 | 0.94 | 0.78 | 0.52 | 0.63 |
| LMU24CHV | 34.25 | 12.63 | 25.78 | 13.38 | 21.50 | 99.2 | 28 | 8, #10 | 0.22 | 0.94 | 0.78 | 0.52 | 0.63 |

| WALL ANCHOR TYPE AND STRENGTH (ASD LOADS) | | | | | |
|---|---|---|---|---|---|
| WALL STRUCTURE | ANCHOR DESCRIPTION | EMBEDMENT LENGTH | MANUFACTURER | PULLOUT (LBS) | SHEAR (LBS) |
| CONCRETE | 5/8" HILTI KWIK BOLT 3 | 5 1/2" EMBED | HILTI | 2740 | 200 |
| GROUTED CONCRETE MASONRY UNITS | 1/2" HILTI HAS RODS W/ HIT-HY 200 ADHESIVE ANCHORAGE | 5" EMBED | HILTI | 2910 | 375 |
| WOOD STUDS | NOT PERMITTED FOR THIS CASE | | | | |
| COLD-FORMED STEEL STUDS 14 GA. (68 MILS) | (11) #12 SCREWS @ 3/4" X 3/4" | MIN 3 EXPOSED THREADS | ANY | 2875 | 8169 |
| COLD-FORMED STEEL STUDS ≤ 16 GA.(54MILS) | NOT PERMITTED FOR THIS CASE | -- | -- | -- | -- |
| STRUCTURAL STEEL | 1/2" A307 BOLT | NOT APPLICABLE | ANY | 4418 | 2651 |

WALL ANCHOR NOTES:

1. Poured concrete wall is min. 3000 psi. Concrete block is medium weight, or lightweight, with f'g=2500 psi normal weight grout and max. one anchor per half block.
2. Wood stud wall is nominal 2"x4" with anchor centered in stud.
3. Anchors for steel wall brackets shall be galvanized. Anchors for aluminum wall brackets shall be stainless steel (except at steel studs and structural steel, use galvanized isolation screws that prevent direct contact between the aluminum and the galvanized anchors).
4. Install anchors per manufacturer's recommendations.




| ENCLOSURE FASTENERS | | |
|---|---|---|
| DESCRIPTION | SIZE | UNITS |
| SCREW SIZE (d) | #10 | |
| INTEGRAL WASHER SIZE (dw) | 0.50 | IN |
| THICKNESS OF SHEET METAL (t1) | 0.043 | IN |
| MIN. THICKNESS OF FRAME (t2) | 0.07 | IN |
| DEPTH OF PENETRATION | 0.25 | IN |
| SCREW YIELD STRENGTH | 55 | KSI |
| ALLOWABLE TENSILE STRENGTH/SCREW | 321 | LBS |
| ALLOWABLE PULLOVER STRENGTH/SCREW | 371 | LBS |
| ALLOWABLE PULL-OUT STRENGTH/SCREW | 170 | LBS |

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DRAWING TITLE: 34-12-W-128-Z5 INFORMATION & DIAGRAMS

PROJECT TITLE: LG ELECTRONICS USA HVAC OUTDOOR CONDENSING UNIT WALL MOUNT CONFIGURATION

REVISIONS

| NO. | DATE | BY | DESCRIPTION |
|---|---|---|---|

| SCALE | DATE |
|---|---|
| NTS | 11/11/16 |
| DRAWN BY | PROJECT MGR |
| JDP | PCP |
| PROJECT NO. | FLAT FILE |
| 160387 | |

DRAWING NO.
34-12-W-128
Z5

SHEET 1 OF 2


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# ENGINEERING CALCULATION DETAIL SHEET

Outdoor Condensor Units on Wall Bracket - Suitability Verification
Designed by: Paul C. Perrin, PE, SE

| THE CALCULATIONS ON THE DRAWING ARE REPRESENTATIVE OF THE FOLLOWING LG ELECTRONICS OUTDOOR CONDENSING UNITS: |
|---|
| LSU240HLV |
| LSU300HLV |
| LSU360HLV |
| LAU180HYV1 |
| LSU180HSV4 |
| LAU240HSV2 |
| LAU240HYV1 |
| LAU240HSV3 |
| LSU240HSV3 |
| LSU243HLV |
| LSU307HV3 |
| LSU360HV3 |
| LSU240HEV1 |
| LMU18CHV |
| LMU24CHV |

SINCE THIS DESIGN IS BASED ON WIND PRESSURE, qz, THIS DESIGN IS ALSO SUITABLE FOR THE FOLLOWING CASES:

- MIAMI DADE WIND SPEED = 186 MPH, RISK CATEGORY IV, EXPOSURE CATEGORY C, HEIGHT UP TO 320 FT.
- MIAMI DADE WIND SPEED = 186 MPH, RISK CATEGORY II, EXPOSURE CATEGORY D, HEIGHT UP TO 398 FT.
- BROWARD WIND SPEED = 180 MPH, RISK CATEGORY IV, EXPOSURE CATEGORY D, HEIGHT UP TO 289 FT.

DESIGN METHODOLOGY: ASD

OBJECTIVE:
Determine Wind Load on AC unit mounted on wall bracket using ASCE 7 (2010), Section 29.5. Confirm stability, wall bracket strength, anchor configuration and strength, and equipment envelope fastening.

WIND LOAD: (See also "Wind Design Requirements" on Sheet 1)

Vult = 186 mph (FBC 2014 1620.2) for Miami-Dade, Risk Category IV

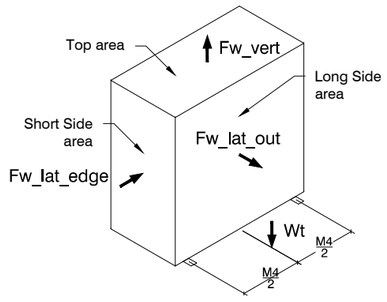
From "29.3 Velocity Pressure" for Building Height = 200'
qz = 0.00256*Kz*Kzt*Kd*V2 = 128.3 psf (Eq. 29.3-1)
From ASCE 7 Chapter 30 "Wind Loads - Components & Cladding"
Table 30-6.1 for Building h > 60 ft.
F = qz(GCp)Af
Fvertical (uplift) = 128.3 psf * (3.2) * Af = 411 psf x Area ($ft^2$)
Fvertical (down) = 128.3 psf * (1.8) * Af = 231 psf x Area ($ft^2$)
Flateral = 128.3 psf * (1.8) * Af = 231 psf x Area ($ft^2$)

Example AC Unit:
Use LSU180HSV4 in Table w/ dims (W, D, H, Wt)=( 34.25", 12.625", 31.50", 120.2 lbs)

Example Anchors:
5/8" HILTI KWIK BOLT 3 with 5 1/2" embedment with capacity of combined pullout load of 2740# and shear load of 200#.

WIND LOAD FORCES:

Top Area = 34.25" * 12.625" / (144 $in^2/ft^2$) = 3.00 sf
Fw vertical (Fw_vert) = 411 psf * 3.00 sf = 1233 lbs (unfactored)
Fw vertical downward (Fw_vert_down) = 231 psf * 3.00sf = 694 lbs (unfactored)
Long Side Area =34.25" * 31.50" / (144 $in^2/ft^2$)) = 7.49 sf
Fw lateral (Fw_lat_out) = 231 psf * 7.49 sf = 1731 lbs (unfactored)
Short Side Area = 12.625" * 31.50" / (144 $in^2/ft^2$) = 2.76 sf
Fw lateral (Fw_lat_edge) = 231 psf * 2.76 sf = 638 lbs (unfactored)

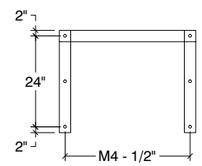



LOAD COMBINATIONS:

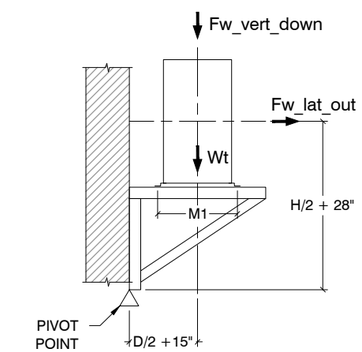
0.67D + 0.78W for overturning FBC 1605.3.2 Eq. 16-18
0.6D + 0.6W for sliding and anchors FBC 1605.3.1 Eq. 16-15

VERIFY BOLT SHEAR RESISTANCE TO AC UNIT SLIDING:
Shear Vbolt = 0.6 * $\sqrt{}$ ( $Fw_lat_out^2$ + $Fw_lat_edge^2$ ) = 277 lbs
Rn / Ω =1035# * 4 bolts = 4140 lbs > 277 lbs
Resistance to Bolt Shear Checks OK

VERIFY WALL ANCHOR SHEAR RESISTANCE:
Shear Vwall = 0.6 * $\sqrt{}$ [ ( Fw_vert - Wt )$^2$ + $Fw_lat_edge^2$ ] = 192 lbs
Wall Anchor Shear Capacity = 200# * 4 bolts = 800 lbs > 192 lbs
Resistance to Wall Anchor Shear Checks OK




CHECK ANCHOR PULLOUT FROM MOMENT ABOUT BOTTOM OF BRACKET:
Consider downward vertical wind load with equal pressure to lateral suction wind load on wall.
Moment Mbot =
= 0.78 * Fw_lat_out * (H/2 + 24" + 4") + (0.67 * Wt + 0.78 * Fw_vert_down) * (D/2 + 15")
= 70.957 kip*in
Wall Anchor Pullout Capacity = 2740 lbs > Mbot / [ 2 anchors * (24" + 2") ] =1365 lbs
Resistance to Wall Anchor Pullout Checks OK

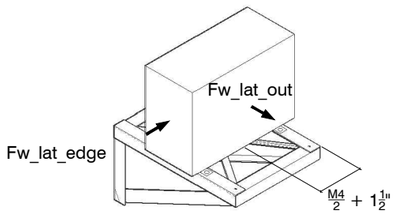



DESIGN METHODOLOGY: ASD

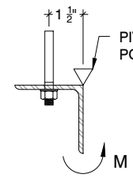
CHECK ANCHOR PULLOUT FROM MOMENT ABOUT SIDE OF BRACKET:
Moment Mside = 0.78 * Fw_lat_edge * (D/2 + 15") + 0.78 * Fw_lat_out * (M4/2 + 1.5")
= 27.142 kip*in
Wall Anchor Pullout Capacity = 2740 lbs > Mside / M4 = 27.142 kip*in / 21.50" = 1262 lbs
Resistance to Wall Anchor Pullout Checks OK

CHECK ANCHOR PULLOUT FROM COMBINED MOMENTS:
Mbot / [ 2 anchors * (24" + 2") * R_pullout ] + Mside / (1 anchor * M4 * R_pullout) = .959 < 1.00
Resistance to Wall Anchor Pullout Checks OK

CHECK MOMENT AND BOLT TENSION OF BRACKET BOLT:
Moment Mot = 0.78 * Fw_lat_out * H/2 + (0.78 * Fw_vert - 0.67 * Wt) * M4 / 2
= 30.736 kip*in
Bolt Tension Capacity = 1726lbs > Mot / (2 bolts * M1) = 30.736 kip*in / ( 2 * 13.375" ) = 1083 lbs
Resistance to Overturning Checks OK




CHECK DIAGONAL BRACING:
Mside / 1.5" = 27.142 kip*in / 1.5" = 18095 lbs > R_pullout = 2740 lbs
Therefore, horizontal diagonal bracing is required at the top angles of the bracket.
Use X-brace with 1/8" x 1.5" bars.
Tension capacity R_bar = 1.5" * 0.125" * 36 ksi / Ω
= 1.5" * 0.125" * 36 ksi / 1.67
= 4.04 kip
Bar Tension = 0.6 * Fw_lat_edge * (M1/2 + 15") / (M1 + 15") * $\sqrt{}$ [ $M4^2$ + (M1 +15")$^2$ ] / M4
= 0.489 kip < 4.04 kip
Diagonal Bracing Resistance to Tension Checks OK

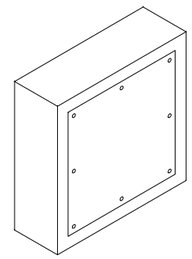



CHECK SHEET METAL ENVELOPE FASTENER RESISTANCE :
Analysis based on AISI S100-2007 "Cold Formed Steel Structural Members" Section E4:Screw Connections
Use Load Combination FBC 1605.3.1 Eq. 16-15
0.6D + 0.6W
On long side worst case
0.60 * Fw_lat_out = 0.60 * 1731# = 1039 lbs

Resistance to the metal shell pull-off is the minimum of the tensile strength of the screw and the pull-over strength of the sheet metal.

Inputs:
#10 screw, d = 0.19" with integral 0.5"-diameter washer
Thickness of metal shell, t1 = 0.043" (18 gauge)
Depth of penetration of screw into frame, tc = 0.25"
Strength of screw, Fu1 = 55 ksi

Based on the above data:
Allowable tensile of the screw, Pts/Ω = 321 lbs per screw (where Ω = 3.0)
Allowable Pull-out strength, Pnot/Ω = 170 lbs per screw
Allowable Pull-over strength, Pnov/Ω = 371 lbs per screw
Therefore the min number of screws per long side = 1039# / 170#/screw = 6.11 screws
Rounds up to min 7 screws per side, use 8 screws for symmetry and spacing.
Anchor Resistance to Metal Enclosure Pull-Off Checks OK.



**SCREW PATTERN**
SCALE: NTS

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DRAWING TITLE: 34-12-W-128-Z5 CALCULATIONS
PROJECT TITLE: LG ELECTRONICS USA HVAC OUTDOOR CONDENSING UNIT WALL MOUNT CONFIGURATION

REVISIONS

| NO. | DATE | BY | DESCRIPTION |
|---|---|---|---|

| SCALE | DATE |
|---|---|
| NTS | 11/11/16 |
| DRAWN BY | PROJECT MGR |
| JDP | PCP |
| PROJECT NO. | FLAT FILE |
| 160387 | |

DRAWING NO.
34-12-W-128
Z5

SHEET 2 OF 2


11/18/2016 1:28 PM Jonathan Peel
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