CODES:

FLORIDA BUILDING CODE 2014, 5TH EDITION
ASCE STANDARD 7-2010
MIAMI DADE WIND SPEED = 175 MPH

WIND DESIGN REQUIREMENTS:

ULTIMATE DESIGN WIND SPEED, Vult (3 sec. gust)	175 mph
NOMINAL DESIGN WIND SPEED, Vasd	135 mph
RISK CATEGORY	II
HEIGHT TO CENTROID	15 FT max.
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 = 1.03
V = Vult
qz = 72.7 psf

WIND PRESSURES:
based on ASCE 7-10 Eq. 29.5.1 & FBC 1620.6
F = qh GCr Af psf Eq 29.5-2
GCr = 1.1 FOR LATERAL FORCES
GCr = 1.0 FOR VERTICAL FORCES

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 CONCRETE FOUNDATION PAD 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 CONCRETE FOUNDATION PAD. THE CONCRETE FOUNDATION PAD SHALL BE MIN 8" THICK AT ANCHOR LOCATIONS.
4. THE ANCHORAGE IS DESIGNED AND VERIFIED BY STRUCTURAL ANALYSIS BY THIS ENGINEER.
5. ALTERNATE DESIGNS FOR SUPPORTS WITHIN 15' OF GROUND LEVEL,THAT ARE DESIGNED TO RESIST THE ABOVE WIND LOADS MAY BE USED AT THE CONTRACTOR'S OPTION. FOR ALTERNATE DESIGNS FOR SUPPORTS WITHIN 15' OF GROUND LEVEL, 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.
6. THE CONTRACTOR IS REPONSIBLE FOR SAFETY, INSTALLATION, AND SPECIAL INSPECTIONS & TESTS PER FBC CHAPTER 17.

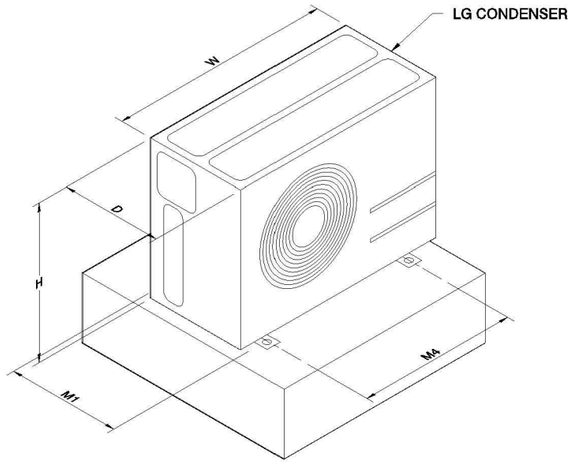
CALCULATIONS: SEE DETAILED CALCULATIONS ON SHEET 2.

WIND LATERAL AND VERTICAL FORCES:

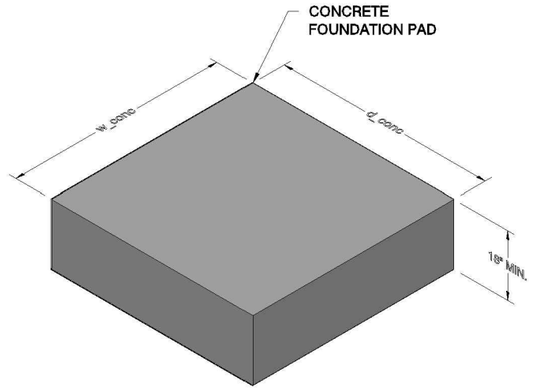
1. THE WIND LOAD ACTING NORMAL TO THE LARGE VERTICAL SIDE OF THE AC UNIT IS USED FOR WORST CASE SHEAR.
2. THE WIND LOAD ACTING ON THE TOP OF THE UNIT UPWARD AND THE HORIZONTAL WIND LOAD ARE USED TO CALCULATE UPLIFT AND MOMENT.
3. THESE FORCES MUST BE RESISTED BY THE SHEAR AND TENSILE STRENGTHS OF THE ANCHORS HOLDING THE UNIT TO THE CONCRETE FOUNDATION. THE ANCHORAGES & MOUNTING ARE VERIFIED BY THIS ENGINEER TO BE WITHIN THE ALLOWABLE STRENGTHS OF ITS ELEMENTS AND CONNECTIONS.

ENCLOSURE FASTENERS:

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



GROUND MOUNT CONFIGURATION



CONCRETE PAD W/ TURNDOWN EDGE

CONCRETE FOUNDATION PAD STRENGTH LIMITS		
LIMIT TYPE	AMOUNT	UNITS
MAX SHEAR AT ANCHOR	0.200	KIP
MAX PULLOUT AT ANCHOR	0.600	KIP

FOUNDATION NOTES:

1. FOUNDATION IS DESIGNED AND VERIFIED FOR THE FORCES DESCRIBED IN THIS DOCUMENT AS SUMMARIZED IN THE ENGINEERING CALCULATIONS INCLUDED.
2. t_conc = FOUNDATION SLAB THICKNESS = 8" MIN.
3. FOUNDATION HEIGHT AT EDGES = 18" MIN.
4. FOUNDATION SHALL EXTEND MIN. 12" BELOW GROUND.
5. w_conc = FOUNDATION WIDTH = 42" MIN, 72" MAX.
6. d_conc = FOUNDATION DEPTH = 24" MIN, 72" MAX.
7. TOP OF FOUNDATION PAD SHALL BE MIN. 4" ABOVE ADJACENT GRADE.
8. AC UNIT MUST BE CENTERED ON FOUNDATION.
9. AC UNIT IS ANCHORED TO CONCRETE SLAB W/ GALV 1/4" Ø HILTI KWIK BOLT 3 ANCHORS WITH MIN. 2" EMBED. IN CONCRETE. EACH ANCHOR CAPACITY IS COMBINED TENSION = 600 LBS AND SHEAR = 200 LBS.
10. MIN. REINFORCEMENT SHALL BE ONE LAYER OF #4 BARS @ 14" EACH WAY, CENTERED IN THE CONCRETE.
11. FOUNDATION SUBGRADE SHALL BE COMPACTED TO PROVIDE MIN. 1200 PSF ALLOWABLE BEARING PRESSURE.

OTHER NOTES:

- 1"± NON-METALLIC NON-SHRINK GROUT MAY BE USED UNDER THE MOUNTING PLATES.

ENGINEERING CONFORMANCE ANALYSIS:

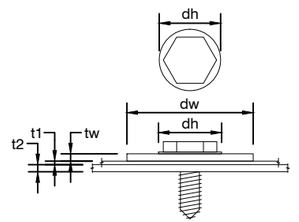
THE TABLE BELOW SHOWS DIMENSIONS, MIN FOUNDATION DEPTH & WIDTH, AND SHELL ENCLOSURE SCREWS FOR SOME MODELS OF LG ELECTRONICS USA HVAC OUTDOOR EQUIPMENT THAT MEET THE FOLLOWING ANALYSIS:

- FOUNDATION STRENGTH: STRENGTH TO RESIST UNIT WEIGHT AND WIND LOADS ON LATERAL AND VERTICAL SURFACES
- ANCHORS: PULLOUT AND SHEAR DUE TO OVERTURNING AND SLIDING FORCE IS WITHIN REQUIREMENTS
- EQUIPMENT METAL COVER FASTENERS: MIN NUMBER AND SIZE

NOTE: STAND DIMENSIONS ARE MINIMUMS. STAND SHALL BE BUILT TO SUPPORT ONE CONDENSER UNIT AS OUTLINED IN THE LG ELECTRONICS USA INSTALLATION MANUAL.

MODELS: LAU___HVP, LSU___HSV4, LAU090HYV1, LAU120HYV1, LUU___HV, LSU180HEV1										DESIGN CHECK W/ NOM/REQ'D >= 1.00 = OK		
	CONDENSER DIMENSIONS						CONCRETE PAD		SHELL SCREWS	ANCHOR STRENGTH		
MODEL #	W	D	H	M1	M4	Wt	MIN d_conc	MIN w_conc	ON LONG SIDE, QTY. & SIZE	SHEAR	UPLIFT	METAL SHELL
LAU090HVP	30.31	11.31	21.50	13.00	22.00	81.6	24	42	6, #10	0.27	0.23	0.21
LAU120HVP	30.31	11.31	21.50	13.00	22.00	81.6	24	42	6, #10	0.27	0.23	0.21
LSU090HSV4	30.31	11.31	21.50	13.00	22.00	75	24	42	6, #10	0.27	0.23	0.21
LSU120HSV4	30.31	11.31	21.50	13.00	22.00	75	24	42	6, #10	0.27	0.23	0.21
LAU090HYV1	30.31	11.31	21.50	13.00	22.00	76.9	24	42	6, #10	0.27	0.23	0.21
LAU120HYV1	30.31	11.31	21.50	13.00	22.00	76.9	24	42	6, #10	0.27	0.23	0.21
LUU097HV	30.31	11.31	21.50	13.00	22.00	76.9	24	42	6, #10	0.27	0.23	0.21
LUU127HV	30.31	11.31	21.50	13.00	22.00	76.9	24	42	6, #10	0.27	0.23	0.21
LSU180HEV1	30.31	11.31	21.50	13.00	22.00	75.4	24	42	6, #10	0.27	0.23	0.21

NOTE: THE CONCRETE PAD DIMENSIONS ARE MINIMUMS. CONCRETE PAD MAY BE BUILT TO SUPPORT MORE THAN ONE CONDENSER UNIT AS OUTLINED IN THE LG ELECTRONICS USA INSTALLATION MANUAL.



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: 30-11-G-73 INFORMATION & DIAGRAMS

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

REVISIONS

NO.	DATE	BY	DESCRIPTION

SCALE	DATE
NTS	10/28/16
DRAWN BY	PROJECT MGR
JDP	PCP
PROJECT NO.	FLAT FILE
160387	

DRAWING NO.
30-11-G-73

SHEET 1 OF 2

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ENGINEERING CALCULATION DETAIL SHEET

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

DESIGN METHODOLOGY: ASD

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

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

Vult = 175 mph (FBC 2014 1620.2) for Miami-Dade, Risk Category II

From "29.3 Velocity Pressure"
qz = 0.00256*Kz*Kzt*Kd*V2 = 72.7 psf (Eq. 29.3-1)
From "29.5 Design Wind Loads - Other Structures"
F = qz(GCr)Af (Eq. 29.5-1)

Fvertical = 72.7 psf * (1.0) * Af = 72.7 psf x Area (ft^2)
Flateral = 72.7 psf * (1.1) * Af = 79.94 psf x Area (ft^2)

Example AC Unit:
Use LSU120HSV4 in Table w/ dims (W, D, H, Wt)=(30.31", 11.31", 21.5", 75 lbs)

WIND LOAD FORCES:

Top Area = 11.31" * 30.31" / (144 in²/ft²) = 2.38 sf
Fw vertical (Fw_vert) = 72.7 psf * 2.38 sf = 173 lbs (unfactored)

Long side Area = 30.31" * 21.5" / (144 in²/ft²) = 4.53 sf
Fw lateral (Fw_lat) = 79.94 psf * 4.53 sf = 362 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

CALCULATE REACTION FORCES ON CONCRETE FOUNDATION:

Shear V1 = 0.6 * Fw_lat / 4 anchors = 0.6 * 362 #/ 4 = 54 lbs
Pull-up R1 = [0.78 * Fw_lat * H/2 + (0.78 * Fw_vert - 0.67 * Wt) * (M1/2)] / (M1)/ 2 legs
= [0.78*362 #*(21.5"/2)+(0.78*173#-0.67*75#)*(13.00"/2)]/(13.00")/2
= 0.138 kips

SOIL BEARING PRESSURE AT CONCRETE FOUNDATION:

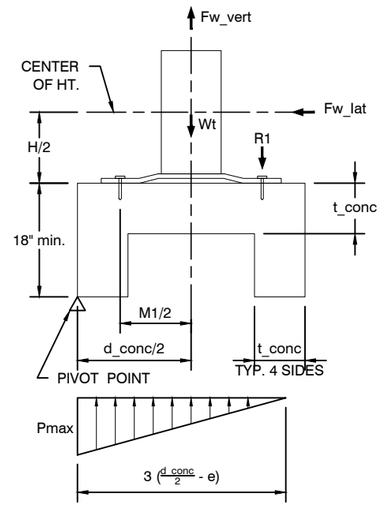
Wt conc = 150 pcf * {t_conc * w_conc * d_conc + (18" - t_conc)* 2 * t_conc * [w_conc + (d_conc - 2 * t-conc)]}
= 150 pcf *{8" * 42" * 24" + (18" - 8") * 2 * 8" * [42" + (24" - 2 * 8")]}
= 1.39 kips

P = 0.67 * (Wt + Wt_conc)- 0.78 * Fw_vert
= 0.67 * (0.075 kip + 1.39 kip) - 0.78 * 173 #
= 0.85 kip

M_ot = 0.78 * Fw_lat *(18" + H/2)
= 0.78 * 362 # *(18" + 21.5"/2)
= 8.113 kip*in

e = M_ot/P = 8.113 kip*in/0.85 kips= 9.55"

If e=9.55" > d_conc/6 = 4.00"
then Pmax =2P/{3*w_conc*[(d_conc/2)-e]}
=2*0.85 kip/{3*42" * [(24"/2) - 9.55"]}
= 792 psf



DESIGN METHODOLOGY: ASD

VERIFY ANCHOR SHEAR RESISTANCE TO SLIDING:
Use Load Combination FBC 1605.3.1 Eq. 16-15
0.6D + 0.6W = 0.6 * Fw_lat = 0.6 * 362# = 217 lbs
Shear per anchor= 217# / 4 = 54 lbs
Fsliding nominal = 0.200 kips
Since 0.200 kips > 0.054 kips

Resistance to Sliding Checks OK.

CHECK OVERTURNING ANCHOR PULLOUT/UPLIFT RESISTANCE:
Use Load Combination FBC 1605.3.1 Eq. 16-15
0.6D + 0.6W
On one anchor
Pull-up R1 = 0.138 kips
Max uplift at one anchor = 0.600 kips
Since 0.600 kips > 0.138 kips

Anchor Resistance to Overturning 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 = 0.60 * 362# = 217 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.

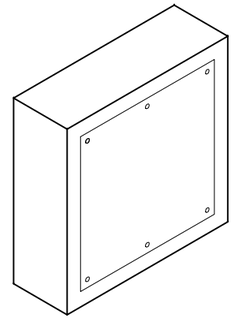
Inputs:
#10 screw, d = 0.19" with integral 0.5"-diameter washer
Thickness of metal shell, t1 = 0.043" (18 gauge)
Depth of penetration of screw into frame, tc = 0.25"
Strength of screw, Fu1 = 55 ksi

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 = 217# / 170#/screw = 1.28 screws
Rounds up to min 2 screws per side, use 6 screws, spaced 12" O.C. minimum.

Anchor Resistance to Metal Enclosure Pull-Off Checks OK.

THE CALCULATIONS ON THE DRAWING ARE REPRESENTATIVE OF THE FOLLOWING LG ELECTRONICS OUTDOOR CONDENSING UNITS:

LAU090HVP
LAU120HVP
LSU090HSV4
LSU120HSV4
LAU090HYV1
LAU120HYV1
LUU097HV
LUU127HV
LSU180HEV1



SCREW PATTERN
SCALE: NTS

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DRAWING TITLE: 30-11-G-73 CALCULATIONS
PROJECT TITLE: LG ELECTRONICS USA HVAC OUTDOOR CONDENSING UNIT GROUND MOUNT CONFIGURATION

REVISIONS

NO.	DATE	BY	DESCRIPTION

SCALE	DATE
NTS	10/28/16
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DRAWING NO.
30-11-G-73

SHEET 2 OF 2

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