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	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
$q_z = 0.00256\ K_z\ K_{zt}\ K_d\ V^2$ psf
$K_z = 1.03$
V = Vult
$q_z = 82.1$ 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 12" 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.

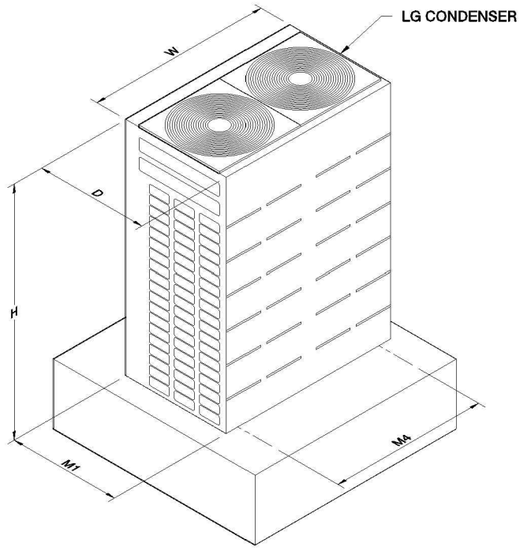
CALCULATIONS: SEE DETAILED CALCULATIONS ON SHEET 2.

WIND LATERAL AND VERTICAL FORCES:

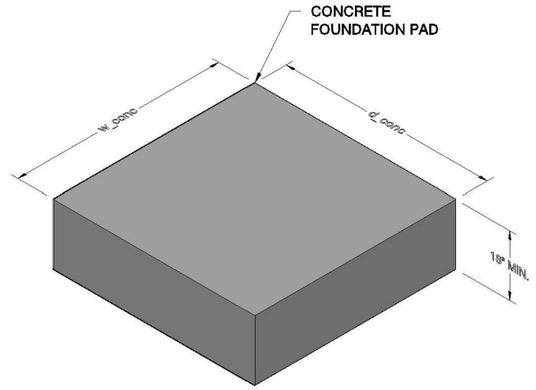
1. THE WIND LOAD ACTING NORMAL TO THE LARGE VERTICAL SIDE OF THE AC UNIT IS USED FOR WORST CASE SHEAR.
2. THE WIND LOAD ACTING ON THE TOP OF THE UNIT UPWARD AND THE HORIZONTAL WIND LOAD ARE USED TO CALCULATE UPLIFT AND MOMENT.
3. THESE FORCES MUST BE RESISTED BY THE SHEAR AND TENSILE STRENGTHS OF THE 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	0.310	KIP
MAX PULLOUT AT ANCHOR	1.090	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 = 12" MIN.
3. FOUNDATION HEIGHT AT EDGES = 18" MIN.
4. FOUNDATION SHALL EXTEND MIN. 12" BELOW GROUND.
5. w_conc = FOUNDATION WIDTH = 61" MIN, 72" MAX.
6. d_conc = FOUNDATION DEPTH = 61" 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 3/8" Ø HILTI KWIK BOLT 3 ANCHORS WITH MIN. 2" EMBED. IN CONCRETE. EACH ANCHOR CAPACITY IS COMBINED TENSION = 1090 LBS AND SHEAR = 310 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:

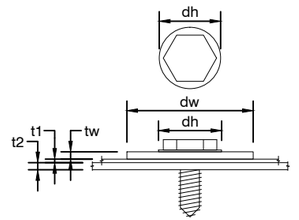
THE TABLE BELOW SHOWS DIMENSIONS, MIN FOUNDATION DEPTH & WIDTH, AND SHELL ENCLOSURE SCREWS FOR SOME MODELS OF LG ELECTRONICS USA HVAC OUTDOOR EQUIPMENT THAT MEET THE FOLLOWING ANALYSIS:

- 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: ARU_096_TE4, ARU_1___TE4										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
ARUB096BTE4 ARUB096DTE4 ARUN096BTE4 ARUN096DTE4 ARUN121BTE4 ARUN121DTE4 ARUB121BTE4 ARUB121DTE4	48.81	29.94	66.13	29.06	43.38	563	60	60	18, #10	0.98	0.89	0.40
ARUN122BTE4 ARUN122DTE4 ARUB122BTE4 ARUB122DTE4	48.81	29.94	66.13	29.06	43.38	661	60	60	18, #10	0.98	0.87	0.40
ARUN144BTE4 ARUN144DTE4 ARUB144BTE4 ARUB144DTE4 ARUN168BTE4 ARUN168DTE4 ARUB168BTE4 ARUB168DTE4	48.81	29.94	66.13	29.06	43.38	628	60	60	18, #10	0.98	0.88	0.40
ARUN145BTE4 ARUN145DTE4 ARUB145BTE4 ARUB145DTE4 ARUN169BTE4 ARUN169DTE4 ARUB169BTE4 ARUB169DTE4	48.81	29.94	66.13	29.06	43.38	660	60	60	18, #10	0.98	0.87	0.40

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: 48-30-G-82 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.
48-30-G-82

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

From "29.3 Velocity Pressure"
qz = 0.00256*Kz*Kzt*Kd*V2 = 82.1 psf (Eq. 29.3-1)
From "29.5 Design Wind Loads - Other Structures"
F = qz(GCr)Af (Eq. 29.5-1)

Fvertical = 82.1 psf * (1.0) * Af = 82.1 psf x Area (ft^2)
Flateral = 82.1 psf * (1.1) * Af = 90.3 psf x Area (ft^2)

Example AC Unit:
Use ARUB096BTE4 in Table w/ dims (W, D, H, Wt)=(48.81", 29.94", 66.13", 563 lbs)

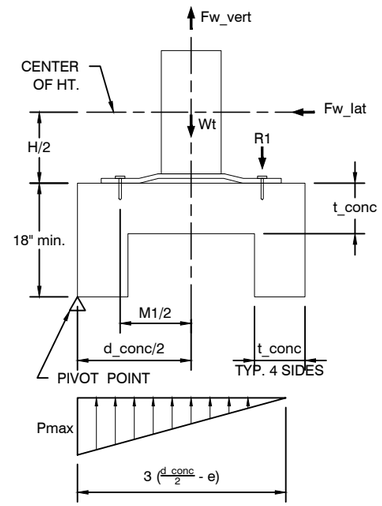
WIND LOAD FORCES:

Top Area = 29.94" * 48.81" / (144 in²/ft²) = 10.15 sf
Fw vertical (Fw_vert) = 82.1 psf * 10.15 sf = 833 lbs (unfactored)

Long side Area = 48.81" * 66.13" / (144 in²/ft²) = 22.42 sf
Fw lateral (Fw_lat) = 90.3 psf * 22.42 sf = 2024 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 * 2024 #/ 4 = 304 lbs
Pull-up R1 = [0.78 * Fw_lat * H/2 + (0.78 * Fw_vert - 0.67 * Wt) * (M1/2)] / (M1)/ 2 legs
= [0.78*2024 #*(66.13"/2)+(0.78*833#-0.67*563#)*(29.06"/2)]/(29.06")/2
= 0.966 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 *{12" * 61" * 61" + (18" - 12") * 2 * 12" * [61" + (61" - 2 * 12")]}
= 5.10 kips

P = 0.67 * (Wt + Wt_conc)- 0.78 * Fw_vert
= 0.67 * (0.563 kip + 5.10 kip) - 0.78 * 833 #
= 3.145 kip

M_ot = 0.78 * Fw_lat *(18" + H/2)
= 0.78 * 2024 # *(18" + 66.13"/2)
= 80.631 kip*in

e = M_ot/P = 80.631 kip*in/3.145 kips= 25.64"

If e=25.64" > d_conc/6 = 10.17"
then Pmax =2P/{3*w_conc*[(d_conc/2)-e]}
=2*3.145 kip/{3*61" * [(61"/2) - 25.64"]}
= 1018 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 * 2024# = 1214 lbs
Shear per anchor= 1214# / 4 = 304 lbs
Fsliding nominal = 0.310 kips
Since 0.310 kips > 0.304 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 = 0.966 kips
Max uplift at one anchor = 1.090 kips
Since 1.090 kips > 0.966 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 * 2024# = 1214 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.

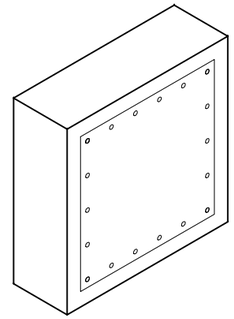
Inputs:
#10 screw, d = 0.19" with integral 0.5"-diameter washer
Thickness of metal shell, t1 = 0.043" (18 gauge)
Depth of penetration of screw into frame, tc = 0.25"
Strength of screw, Fu1 = 55 ksi

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 = 1214# / 170#/screw = 7.14 screws
Rounds up to min 8 screws per side, use 18 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:

ARUB096BTE4	ARUN145DTE4
ARUB096DTE4	ARUB145BTE4
ARUN096BTE4	ARUB145DTE4
ARUN096DTE4	ARUN169BTE4
ARUN121BTE4	ARUN169DTE4
ARUN121DTE4	ARUB169BTE4
ARUB121BTE4	ARUB169DTE4
ARUB121DTE4	
ARUN122BTE4	
ARUN122DTE4	
ARUB122BTE4	
ARUB122DTE4	
ARUN144BTE4	
ARUN144DTE4	
ARUB144BTE4	
ARUB144DTE4	
ARUN168BTE4	
ARUN168DTE4	
ARUB168BTE4	
ARUB168DTE4	
ARUN145BTE4	



SCREW PATTERN

SCALE: NTS

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DRAWING TITLE: 48-30-G-82 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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SHEET 2 OF 2

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