MIDEA Heat Pumps

OUTDOOR CONDENSING UNITS

PAD MOUNT CONFIGURATION AND ANCHOR SELECTION - WIND LOAD RESISTANCE VERIFICATION

CODE: FMC and FBC 5th Ed. (2014) BLDG, ASCE 7-10

MIAMI-DADE WIND SPEED = 186 MPH

Spreadsheet designed by: B. Schwartz, PE

Bri-Ko Engineering, Inc., Structural Analysis Date data input: 21-Oct-15

Calc Sht: EC-1 Mechanical Equipment on Concrete Pad Calc

Description: Structural Analysis of concrete pad mounted mechanical equipment to resist wind forces.

Dwg Reference: ENG-1 Code: Florida Building Code 2010 and ASCE 7-10.

Design Methodology and Load Combinations:

Design Method: ASD Ω = 1.65

Load Combos: FBC Eqn. 16-6 0.6 D + 0.6 W

Wind Forces: *based on FBC 2010, 1609.8, B =h, B = L*

Ultimate Design Wind Speed, Vult (3-sec gust): **186 mph** Miami Dade

Nominal Design Wind Speed, Vasd: 144 mph

Risk Category: IV Wind Directionality Factor, Kd: 0.85

Ht to roof, h: 15 ft Topographic Factor, Kzt: 1.00

Exposure Cat.: C Vel. Pres. Exposure Coef., Kz: 0.849

Enclosure Cat. Not Applicable Gust Effect Factor, G: 0.85

Velocity Pressure $q_h = 0.00256 K_z K_{zt} K_d V^2$ (lb/ft²) qh= **63.9 psf**

$F = q_{h(GC_r)} A_f$ (GC_r) v,l = 1.0 vert. 1.1 lat. Fver = **63.9 psf** Flat. = **70.3 psf**

Limit States:

Select model # for illustration purposes: WCH848604MKA1

Verify Pad and anchor clearances:

Anchor critical edge distance is 12d = 4.5" for 0.375" dia.

Distance from pad edge to AC unit = 9.4 in. **CHECKS OK**

Dist from pad edge to anchor center = 7.4 in. **CHECKS OK**

Resistance to Pad overturn:

Use Load Combo: 0.67 D + 0.78 W *FBC 1605.3.2 Eqn. 16-18*

Concrete Pad wt: 800 lbs Moverturn = 0.78*(Wh*Area*(A+t)/2+Wv*area*(D/2)) = 14.6 k-in

Mdead wt = 0.67*(pad + unit wt*(D/2)) = 16.2 k-in **Checks OK**

Resistance to sliding: Use Load Combo: 0.60 D + 0.60 W *FBC 1605.3.1 Eqn. 16-14*

Reqd Shear = 0.60*(Wh*Area) = 283 lbs

Nominal Shear from Table A-1 *4 anchors = 1660 lbs **Checks OK**

Anchor hold down: Use Load Combo: 0.67 D + 0.78 W *FBC 1605.3.2 Eqn. 16-18*

Reqd Overtrn M = 0.78*(Wh*Area*A/2+Wv*area*E/2-Wt*E/2)= 9.4 k-in

Nominal Anchor pull-down from Table A-1 * 2 anchors = 26.6 k-in **Checks OK**

SMS in Clip to Frame hold down:

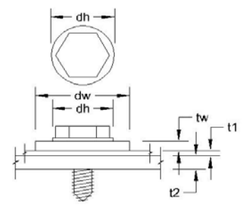
Nominal Anchor pull-down from Table A-3 * 2 anchors = 9.5 k-in **Checks OK**

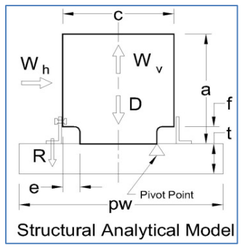
Equipment Integrity: Sheet metal cover fastener resistance: **Checks OK**

Load Combo: 0.60 D + 0.60 W *Analysis based on AISI S100-2007 "Cold Formed Steel Structural*

Fw = 283 lbs *See above* *Members", Section E4: Screw Connections*

Number of screws Reqd, Provided:	2	10
Screw Size (d)	#8	Units
Integral washer size (dw):	0.322	in.
Thickness of metal shell (t1):	0.024	in.
Thickness of frame (t2):	0.039	in.
Depth of penetration:	0.375	in.
Screw yield strength:	55	ksi
Allowable tensile strength/screw:	257	lbs
Allowable pull-over strength/screw:	163	lbs





Structural Analytical Model

ENGINEERING CONFORMANCE ANALYSIS:

THE TABLE SHOWS PAD SIZE AND ANCHOR TYPES FOR VARIOUS MIDEA HEAT PUMP MODELS FROM FROM 2 TO 5 TONS MOUNTED ON A CONCRETE PAD VERIFYING OVERTURN, SLIDING & EQUIPMENT INTEGRITY.

TABLE A-2

Model No.	kBtu	Wt (lbs)	Length, Width, Height (C,B,A) (in.)	Recess E (in.)	Recess F (in.)	SMS Type	Anchor Type	Pad Size, minimum (in.) W, D, t	Min # screws to secure shell
WCH824364MKA1	24/36	157	29 1/8 , 29 1/8 , 24 15/16	2.76	1.57	S-1	A-1	44, 44, 4	4 #8
WCH848604MKA1	48/60	205	29 1/8 , 29 1/8 , 33 3/16	2.76	1.57	S-2	A-1	48, 48, 4	4 #8

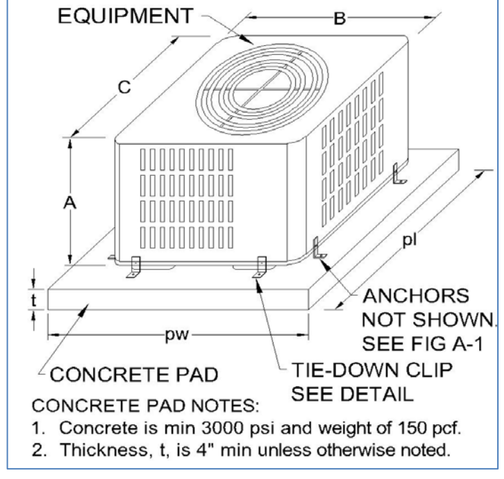
Design Check: Nomnal / Reqd ≥ 1.00 = OK

Overturn	Anchor Pullout	SMS Pullout	Anchor Sliding
1.11	3.93	1.13	7.80
1.10	2.84	1.01	5.86

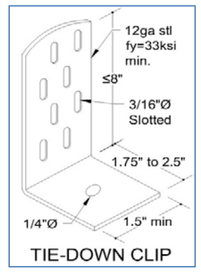
Notes: 1. Tie clips only required on two sides opposite each other. Each tie clip has one anchor at bottom leg and one SMS screw into equipment frame at vertical leg.

Input Criteria:			
Concrete Pad weight, (pcf):	150		lbs
Pad edge to anchor dist. (min):	4.50		in.
Pad edge to AC unit (min):	2.00		in.
Dist. Unit side to anchor (min,max):	0.75	2.00	in.

EQUIPMENT AND PAD

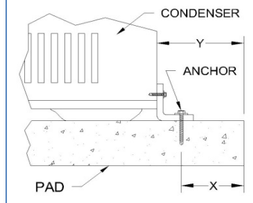


CONCRETE PAD NOTES:
1. Concrete is min 3000 psi and weight of 150 pcf.
2. Thickness, t, is 4" min unless otherwise noted.



TIE-DOWN CLIP

ANCHOR CLEARANCES



X: PAD EDGE TO ANCHOR CENTER
Y: PAD EDGE TO EQUIPMENT. SET TO 2.0" MIN
FIG "A-1"

GENERAL NOTES:

1. THIS ENGINEERING REPORT DOCUMENTS THE ANALYSIS OF THE PERFORMANCE OF HVAC MECHANICAL EQUIPMENT TO MEET WIND LOAD OVERTURN AND ANCHOR STRENGTH.
2. THE ANALYSIS CONFORMS TO THE REQUIREMENTS OF THE 2014 FLORIDA BUILDING CODE (HIGH VELOCITY HURRICANE ZONE) AND ASCE 7-10 DESIGN WIND LOADS - OTHER STRUCTURES SECTION 29.5. NOTE: GCf FOR BOTH LATERAL AND VERTICAL DIRECTIONS ARE SET TO THE MINIMUM AS THE CONCRETE PAD AND AC UNIT ARE NOT SET ON A ROOFTOP BUT ACT AS A STAND-ALONE STRUCTURE.
3. THE LOAD PATH VERIFIED IS FROM THE EQUIPMENT AS A SINGLE UNIT, ENCLOSURE FASTENERS, TIE-DOWN CLIP ANCHORS TO CONC SLAB.
4. PADS ARE EITHER POURED IN PLACE OR PRE-FABRICATED NORMAL WEIGHT CONCRETE WITH A MINIMUM STRENGTH OF 3000 PSI AND ARE LOCATED AT GROUND LEVEL.
5. ANCHORS USED TO FASTEN THE CONDENSER FEET TO THE CONCRETE PAD ARE DEFINED IN TABLE A-1 AND TABLE A-3. THESE ANCHORS ARE TYPICALLY MANUFACTURED FROM HEAT-TREATED STEEL AND HAVE CORROSION RESISTANCE AS SPECIFIED BY THE MANUFACTURER.
6. TIE-DOWN CLIPS MUST HAVE MINIMUMTHICKNESS AND WIDTH AS SHOWN IN SKETCH.
7. AC UNIT MUST BE CENTERED ON PAD WITH OPPOSITE SIDES HAVING EQUAL CLEARANCE.

CALCULATIONS:

OVERTURN:

1. THE CRITICAL WIND LOAD IS ON THE LONG FACE OF THE CONDENSER.
2. THE MOMENT CREATED BY THE WIND LOAD MUST BE RESISTED BY THE MOMENT CREATED FROM THE WEIGHT OF THE PAD AND THE CONDENSER.

CLEARANCES:

3. DISTANCE FROM THE EDGE OF THE PAD TO THE CONDENSER SIDE (Y IN FIG.) MUST BE GREATER THAN 2.0 INCH.
4. DISTANCE FROM THE EDGE OF THE PAD TO THE CENTER OF THE ANCHOR MUST BE GREATER THAN THAT SPECIFIED IN THE INPUT CRITERIA.

ANCHOR STRENGTH:

5. THE SLIDING RESISTANCE IS TRANSFERRED TO THE PAD BY THE SHEAR STRENGTH IN THE ANCHORS.
6. THE OVERTURN RESISTANCE IS TRANSFERRED TO THE PAD BY THE ANCHORS. CONFIGURATION AND ANCHOR STRENGTH BASED ON MINIMUM EDGE DISTANCE YIELD MOMENT RESISTANCE.

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.

TABLE A-1 ANCHOR TYPE AND STRENGTH

SYM	ANCHOR DESCRIPTION & MANUFACTURER	EMBED	STRENGTH AT MIN EDGE DISTANCE PULL OUT (LBS)	SHEAR (LBS)
A-1	1/4" TAPCON	1-3/4"	505	415

Notes: 1. Strengths are for poured concrete min 3000 psi from manufacturer's specs with min. safety factor of 4.
2. Each anchor includes a 1"Ø fender washer.

Table A-3 SMS from Clip to Frame (lbs)

SYM	Description	Pull	Shear
S-1	#8 ASTM C1513 Self Tapping	145	335
S-2	#10 ASTM C1513 Self Tapping	180	535

Note: Safety factor of 3 applied.

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Dwg Size:	11x 17	
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VALID ONLY WITH ENGINEER'S SIGNATURE AND SEAL

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MIDEA Heat Pumps — OUTDOOR CONDENSING UNITS

ROOF STAND CONFIGURATION AND ANCHOR SELECTION - WIND LOAD RESISTANCE VERIFICATION

CODE: FMC, FBC 5th Ed.(2014) and ASCE 7-10
MIAMI-DADE WIND SPEED = 186 MPH

Bri-Ko Engineering, Inc., Structural Analysis

Spreadsheet designed by: B. Schwartz, PE
Date data input: 21-Oct-15

Calc Sht: EC-1 Mechanical Equipment on Roof Stand Calc

Description: Structural Analysis of mechanical equipment mounted on a roof stand designed to resist wind forces.

Dwg Reference: ENG-1

Code: Florida Building Code 5th Ed. (2014) and ASCE 7-10.

Design Methodology and Load Combinations:

Design Method: ASD Ω = 1.65

Load Combos: FBC Eqn. 16-15 0.60 D + 0.60 W Eqn. 16-18 0.67 D + 0.78 W

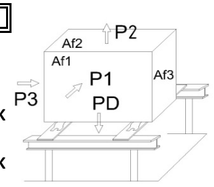
Wind Forces: *based on FBC 2014, 1620.6, A_f <0.1Bh, Af<0.1BL*

Ultimate Design Wind Speed, Vult (3-sec gust):	**186 mph**	Miami Dade	
Nominal Design Wind Speed, Vasd:	144 mph		
Risk Category:	IV	Wind Directionality Factor, Kd:	0.85
Ht to centroid, h:	60 ft	Topographic Factor, Kzt:	1.00
Exposure Category:	C	Vel. Pres. Exposure Coef., Kz:	1.137
Enclosure Cat.	Not Applicable	Gust Effect Factor, G:	N/A
Velocity Pressure	qh = 0.00256 $K_z K_{zt} K_d V^2$ (lb/ft²)	qh=	**85.6 psf**
F = $q_{h(GC_r)A_f}$	(GC_r) v,l = 1.5 vert. / 3.1 lat.	(GC_r) ver. = **128.3 psf**	(GC_r) lat. = **265.2 psf**

Limit States: Select model # for illustration purposes --> **WCH824364MKA1**

Loads, (lbs): P1= 1338 | P2= 756 | P3= 1338 | PD= 157

FBC 1605.3.1 Eqn. 16-14



Resistance to Sliding by stand legs: Load Combo: 0.60 D + 0.60 W

Shear per leg = 284 lbs Nominal Shear per leg: 850 lbs **Checks OK**

Resistance to Sliding by 1/4" bolts:

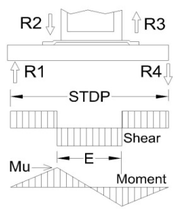
Reqd. Shear per anch.: 284 lbs Nom Shear per bolt: 646 lbs **Checks OK**

Resistance to Moment & Uplift: Use Load Combo: 0.67 D + 0.78 W *FBC 1605.3.2 Eqn. 16-18*

Moverturn = 0.78*(P1+P2)*(A/2+STHT)) -0.67*PD*(A/2+STHT)) 13.3 k-in

Uplift at each leg = 968 lbs

Maximum allowable uplift = 2930 lbs **Checks OK**



Verify Tie down Clip and bolt:

Overturn Mom,Mu = 7.6 k-in Clip Hold-down Strngth: 319 lbs

Moment Resist from Clip Hold down: 37.8 k-in **Checks OK**

Verify strength of support bar: Use Load Combo: 0.67 D + 0.78 W

Mu = 1.2 k-in Required Section Modulus = 0.08 in³

Therefore use: CS6x2.83 AL Channel w Sy=0.896 in³ **Checks OK**

Note: 6" wide channel required to provide support for recessed base pan and for tie down clip.

Equipment Integrity: Sheet metal cover fastener resistance:

Load Combo: 0.60 D + 0.60 W Analysis based on AISI S100-2007 "Cold Formed Steel Structural

Fw = 1135 lbs *See above* Members", Section E4: Screw Connections

Min number of screws per long side = 7

Number of screws provided: 10 **Checks OK**

Screw Size (d) #8 Washer size (dw): 0.322

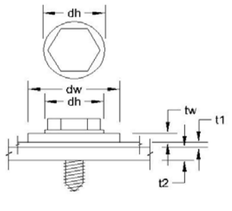
Thkness of mtl shell, frame (t1, t2): 0.024 in. 0.024 in.

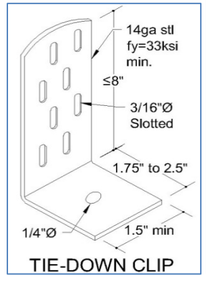
Depth of penetration: 0.375 in.

Screw yield strength: 55 ksi

Allowable tensile strength/screw: 257 lbs

Allowable pull-over strength/screw: 163 lbs





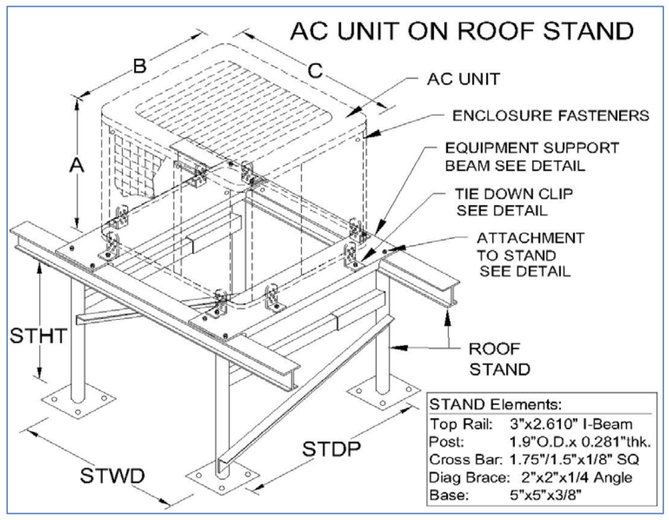
ENGINEERING CONFORMANCE ANALYSIS:

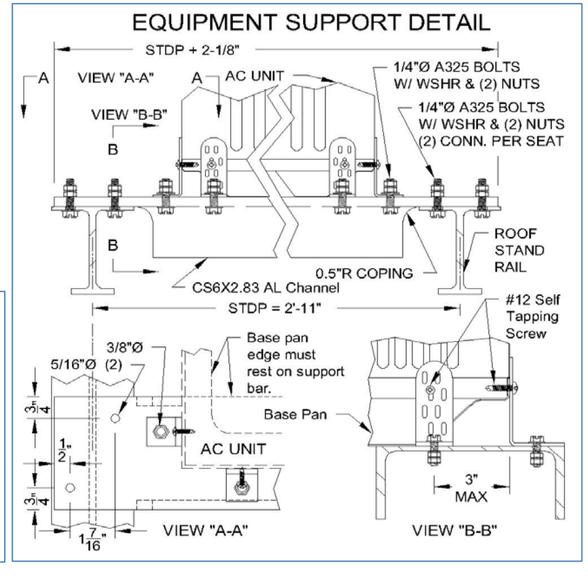
THE TABLE SHOWS ROOF STAND CHARACTERISTICS AND ANCHOR TYPES FOR VARIOUS MIDEA HEAT PUMP MODELS FROM 2 TO 5 TONS THAT ARE SUITABLE FOR THE REFERENCED ROOF STAND VERIFYING OVERTURN, SLIDING & EQUIPMENT INTEGRITY.

TABLE A-2

								Roof Stand			Forces			Design Check: Nomnal / Reqd ≥ 1.00 = OK		
Model No.	kBtu	Weight (lbs)	Length C (in.)	Width B (in.)	Height A (in.)	Recess E (in.)	Recess F (in.)	Num of Leg Frames	# Tiedown Clips	Min # screws to secure shell	Shear/Leg (lbs)	Moment/Leg (k-in)	Uplift/Leg (kips)	Lateral Shear	Compression	Uplift
WCH824364MKA1	24/36	157	29.13	29.13	24.94	2.76	1.57	2	8	7 #8	284	13.3	0.968	2.99	3.10	3.03
WCH848604MKA1	48/60	205	29.13	29.13	33.19	2.76	1.57	2	8	10 #8	378	18.6	1.343	2.25	2.23	2.18

Other Notes: Hold-down clips must be located within 3" of the corner of the unit.





ROOF STAND NOTES:

1) ROOF STAND IS "AIR CONDITIONING ALUM. STAND" ASBLY NO. 1 WITH (4) LEGS, AS BY R.M. ENTERPRISES, PER ENGINEERING DRWG DATED 03-09-2012 SIGNED AND SEALED BY P.E.#56902 2) STHT = STAND HEIGHT WITH MIN 18", MAX 33". 3) STWD = STAND WIDTH = 24" MIN, 36" MAX. 4) STDP = STAND DEPTH = 28" MIN, 36" MAX. 5) SUPPORT ANGLE AND FASTENERS OF SUPPORT TO STAND AND SUPPORT TO AC UNIT ARE DEFINED IN DETAIL BELOW.
6) AC UNIT MUST BE CENTERED ON THE EQUIPMENT SUPPORT BEAM DEFINED IN THE DETAIL.
ROOF STAND LIMITS.) MAX COMPRESSION PER FOOT = 6000 LBS. MAX UPLIFT PER FOOT = 5860 LBS. MAX SHEAR PER TWO FEET = 1700 LBS.

GENERAL NOTES:

1. THIS ENGINEERING REPORT DOCUMENTS THE ANALYSIS OF AC EQUIPMENT MOUNTED ON A ROOF STAND AND THE ASSOCIATED ANCHORING SYSTEMS TO RESIST DEAD WEIGHT AND WIND LOAD FORCES .
2. THE LOAD PATH VERIFIED IS FROM THE EQUIPMENT AS A SINGLE UNIT, ENCLOSURE FASTENERS, UNIT LEG ANCHORS, ROOF STAND CROSS SUPPORT TO ROOF STAND.
3. THE AC UNIT IS MOUNTED ON A METAL ROOF STAND WHICH IS SECURED TO THE ROOF.
4. ANCHORS USED TO FASTEN THE UNIT TO THE ROOF STAND ARE A325 OR HIGHER STRENGTH STEEL BOLTS.
5. THE ROOF STAND IS SUPPLIED BY THE MANUFACTURER INDICATED IN THIS DOCUMENT AND IS INSTALLED IN CONFORMANCE WITH THE ENGINEERING DOCUMENT REFERENCED.

CALCULATIONS:

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 IS USED TO CALCULATE UPLIFT AND MOMENT.
3. THESE FORCES MUST BE RESISTED BY THE SHEAR AND TENSILE STRENGTH OF THE ANCHORS BOTH HOLDING THE UNIT TO THE SUPPORT BAR AND THE SUPPORT BAR TO THE ROOF STAND. THE FORCES MUST BE WITHIN THE LIMITS OF THE STATED ROOF STAND ENGINEERING DOCS.
SUPPORT BAR STRENGTH:
4. THE MOMENT AND SHEAR MUST BE TRANSFERRED FROM THE AC UNIT TO THE ROOF STAND BY A SUPPORT BAR AS THE AC UNIT DEPTH IS LESS THAN THE ROOF STAND DEPTH.
5. MAX MOMENT AND SHEAR TO THE SUPPORT BAR DETERMINE SELECTION OF THE SUPPORT BAR.
ANCHOR STRENGTH:
6. STAINLESS STEEL BOLTS WITH MINIMUM DIAMETER OF 1/4" ARE USED.
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.

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