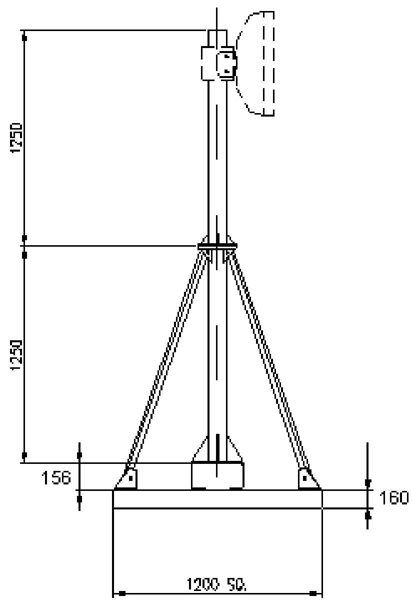
F & L Accessories Ltd 4 Chosen View Road Cheltenham Tel;01242 571409, Fax; 01242 574240	**Project** FLA, CHOSEN VIEW RD, CHELTENHAM				**Job Ref.** 7979	
	Part of Structure ROOF MOUNT FRAME				**Sheet no./rev.** 1	
	Calc. by SJB	**Date** 10/12/03	**Chck'd by**	**Date**	**App'd by**	**Date**

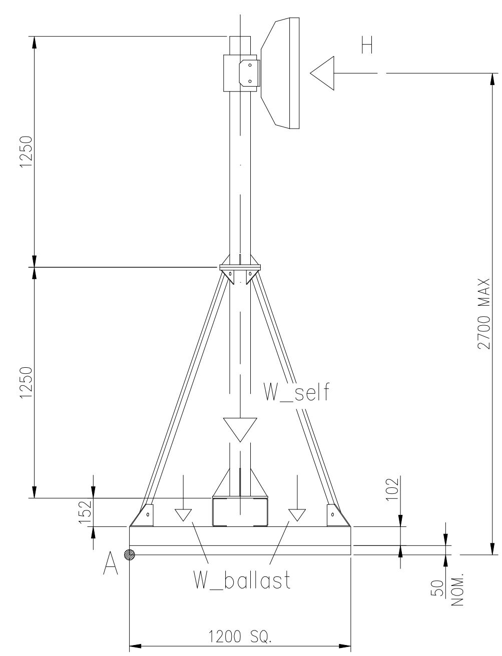
Ref.	**Calculations**	**Output**

Standard Roof Mount Frame : FLA Drg No. Pallet 2500

The following calculations are to establish the weight of ballast required to the base frame supporting 300mm & 600mm diameter microwave dishes.



Loadings



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Frame Self Weight

Dish support pole (114 dia x 5.0mm CHS – 2.5m long); W_{pole} = **0.35** kN

Base plinth (4 No.160 x 60 x 4mm channel sections – 1.2m long); W_{plinth} = **0.35** kN

Open steel flooring (2 No. trays 1.18 x 0.5m from 25 x 3mm strip); W_{floor} = **0.28** kN

Diagonal brace members (4 No. 45 x 45 x 5mm angle – 1.48m long); W_{brace} = **0.20** kN

Cross channels (2 No. 156 x 76 x 4mm channel section – 1.2m long); $W_{channel}$ = **0.22** kN

Therefore total weight of frame;

$W_{self} = sum(W_{pole},W_{plinth},W_{floor},W_{brace}, W_{channel})$ = **1.40** kN

Wind Loading on Antennas;

The following wind loads have been taken from the antenna manufacturers literature – "Andrew Corporation Catalog 38". Design wind loads of 70 mph, 100 mph, 125 mph & 150 mph have been considered for design;

70 mph wind speed

Max horizontal loads applied to the antenna;

1 ft dia (300mm) Antenna; $H_{0.3\_70}$ = **0.102** kN

2 ft dia (600mm) Antenna; $H_{0.6\_70}$ = **0.294** kN

100 mph wind speed

Max horizontal loads applied to the antenna;

1 ft dia (300mm) Antenna; $H_{0.3\_100}$ = **0.194** kN

2 ft dia (600mm) Antenna; $H_{0.6\_100}$ = **0.595** kN

125 mph wind speed

Max horizontal loads applied to the antenna;

1 ft dia (300mm) Antenna; $H_{0.3\_125}$ = **0.334** kN

2 ft dia (600mm) Antenna; $H_{0.6\_125}$ = **0.960** kN

150 mph wind speed

Max horizontal loads applied to the antenna;

1 ft dia (300mm) Antenna; $H_{0.3\_150}$ = **0.481** kN

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2 ft dia (600mm) Antenna; $H_{0.6\_150}$ = **1.382** kN

Overturning;

Assume rotation about edge of pallet, point A, as shown above.

70 mph wind speed

1 ft dia (300mm) Antenna;

Max overturning moment; $OTM_{0.3\_70} = H_{0.3\_70} \times 2.70m$ = **0.28** kNm

2 ft dia (600mm) Antenna;

Max overturning moment; $OTM_{0.6\_70} = H_{0.6\_70} \times 2.70m$ = **0.79** kNm

100 mph wind speed

1 ft dia (300mm) Antenna;

Max overturning moment; $OTM_{0.3\_100} = H_{0.3\_100} \times 2.70m$ = **0.52** kNm

2 ft dia (600mm) Antenna;

Max overturning moment; $OTM_{0.6\_100} = H_{0.6\_100} \times 2.70m$ = **1.61** kNm

125 mph wind speed

1 ft dia (300mm) Antenna;

Max overturning moment; $OTM_{0.3\_125} = H_{0.3\_125} \times 2.70m$ = **0.90** kNm

2 ft dia (600mm) Antenna;

Max overturning moment; $OTM_{0.6\_125} = H_{0.6\_125} \times 2.70m$ = **2.59** kNm

150 mph wind speed

1 ft dia (300mm) Antenna;

Max overturning moment; $OTM_{0.3\_150} = H_{0.3\_150} \times 2.70m$ = **1.30** kNm

2 ft dia (600mm) Antenna;

Max overturning moment; $OTM_{0.6\_150} = H_{0.6\_150} \times 2.70m$ = **3.73** kNm

Restoring moment;

For design purposes ignore the weight of the antenna when considering the restoring moment (conservative).

Factor of safety against overturning is taken as 1.2 for design purposes, i.e; FOS_{ot} = **1.2**

Ballast to positioned symmetrically on pallet on pallet, i.e. weight of ballast to act through the centre of pallet base.

Weight of ballast required (min 2 x 25kg bags of sand);

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70 mph wind speed

1 ft dia (300mm) Antenna;

$W_{ballast\_0.3\_70}$ = max(($FOS_{ot} \times OTM_{0.3\_70}$)/0.60m - W_{self}, 0kN) = **0.00** kN

Number of 25kg bags of sand required; $N_{sand\_0.3\_70}$ = max(2,int($W_{ballast\_0.3\_70}$/0.245 kN) + 1) = **2**

2 ft dia (600mm) Antenna;

$W_{ballast\_0.6\_70}$ = max(($FOS_{ot} \times OTM_{0.6\_70}$)/0.60m - W_{self}, 0kN) = **0.19** kN

Number of 25kg bags of sand required; $N_{sand\_0.6\_70}$ = max(2,int($W_{ballast\_0.6\_70}$/0.245 kN) +1) = **2**

100 mph wind speed

1 ft dia (300mm) Antenna;

$W_{ballast\_0.3\_100}$ = max(($FOS_{ot} \times OTM_{0.3\_100}$)/0.60m - W_{self}, 0kN) = **0.00** kN

Number of 25kg bags of sand required; $N_{sand\_0.3\_100}$ = max(2,int($W_{ballast\_0.3\_100}$/0.245 kN) + 1) = **2**

2 ft dia (600mm) Antenna;

$W_{ballast\_0.6\_100}$ = max(($FOS_{ot} \times OTM_{0.6\_100}$)/0.60m - W_{self}, 0kN) = **1.81** kN

Number of 25kg bags of sand required; $N_{sand\_0.6\_100}$ = max(2,int($W_{ballast\_0.6\_100}$/0.245 kN) +1) = **8**

125 mph wind speed

1 ft dia (300mm) Antenna;

$W_{ballast\_0.3\_125}$ = max(($FOS_{ot} \times OTM_{0.3\_125}$)/0.60m - W_{self}, 0kN) = **0.40** kN

Number of 25kg bags of sand required; $N_{sand\_0.3\_125}$ = max(2,int($W_{ballast\_0.3\_125}$/0.245 kN) +1) = **2**

2 ft dia (600mm) Antenna;

$W_{ballast\_0.6\_125}$ = max(($FOS_{ot} \times OTM_{0.6\_125}$)/0.60m - W_{self}, 0kN) = **3.78** kN

Number of 25kg bags of sand required; $N_{sand\_0.6\_125}$ = max(2,int($W_{ballast\_0.6\_125}$/0.245 kN) +1) = **16**

150 mph wind speed

1 ft dia (300mm) Antenna;

$W_{ballast\_0.3\_150}$ = max(($FOS_{ot} \times OTM_{0.3\_150}$)/0.60m - W_{self}, 0kN) = **1.20** kN

Number of 25kg bags of sand required; $N_{sand\_0.3\_150}$ = max(2,int($W_{ballast\_0.3\_150}$/0.245 kN) +1) = **5**

2 ft dia (600mm) Antenna;

$W_{ballast\_0.6\_150}$ = max(($FOS_{ot} \times OTM_{0.6\_150}$)/0.60m - W_{self}, 0kN) = **6.06** kN

Number of 25kg bags of sand required; $N_{sand\_0.6\_150}$ = max(2,int($W_{ballast\_0.6\_150}$/0.245 kN) +1) = **25**

Summary

Number of 25kg bags of sand required on base of roof mount pallet for various wind speeds;

	Wind Speed			
Antenna Diameter	**70 mph**	**100 mph**	**125 mph**	**150 mph**
300 mm	**2**	**2**	**2**	**5**
600 mm	**2**	**8**	**16**	**25**

Note:

The sand bags are to be positioned as evenly as possible on the base frame in order to ensure that the weight of the ballast acts through the centre of the base frame.

Bearing Pressures Under Edge of Pallet Base

Rigid insulation board is to be provided to the underside of the pallet base to protect the roof membrane therefore for design purposes consider a square continuous bearing surface to the underside of the frame; Length & breadth of pallet base; $L_{base} = B_{base} = \underline{\mathbf{1.20}}$ m

70mph wind speed

1 ft dia (300mm) Antenna;

Max vertical load; $V_{0.3\_70} = (N_{sand\_0.3\_70} \times 0.245 \text{ kN}) + W_{self} = \underline{\mathbf{1.89}}$ kN

Overturning moment; $OTM_{0.3\_70} = \underline{\mathbf{0.28}}$ kNm

Therefore eccentricity of load; $e = OTM_{0.3\_70} / V_{0.3\_70} = \underline{\mathbf{0.146}}$ m

Max bearing pressure under base;

$p_{max\_0.3\_70}$ = if(e<L_{base}/6, $V_{0.3\_70}$ /($L_{base} \times B_{base}$)+6 × $OTM_{0.3\_70}$/($B_{base} \times L_{base}^2$),2 × $V_{0.3\_70}$ /(3 × B_{base} × (L_{base}/2 - e))) = **2** kN/m^2;

2 ft dia (600mm) Antenna;

Max vertical load; $V_{0.6\_70} = (N_{sand\_0.6\_70} \times 0.245 \text{ kN}) + W_{self} = \underline{\mathbf{1.89}}$ kN

Overturning moment; $OTM_{0.6\_70} = \underline{\mathbf{0.79}}$ kNm

Therefore eccentricity of load; $e = OTM_{0.6\_70} / V_{0.6\_70} = \underline{\mathbf{0.420}}$ m

Max bearing pressure under base;

$p_{max\_0.6\_70}$ = if(e<L_{base}/6, $V_{0.6\_70}$ /($L_{base} \times B_{base}$)+6 × $OTM_{0.6\_70}$/($B_{base} \times L_{base}^2$),2 × $V_{0.6\_70}$ /(3 × B_{base} × (L_{base}/2 - e))) = **6** kN/m^2;

100mph wind speed

1 ft dia (300mm) Antenna;

Max vertical load; $V_{0.3\_100} = (N_{sand\_0.3\_100} \times 0.245 \text{ kN}) + W_{self} = \underline{\mathbf{1.89}}$ kN

Overturning moment; $OTM_{0.3\_100} = \underline{\mathbf{0.52}}$ kNm

Therefore eccentricity of load; $e = OTM_{0.3\_100} / V_{0.3\_100} = \underline{\mathbf{0.277}}$ m

Max bearing pressure under base;

$p_{max\_0.3\_100}$ = if(e<L_{base}/6, $V_{0.3\_100}$ /($L_{base} \times B_{base}$)+6 × $OTM_{0.3\_100}$/($B_{base} \times L_{base}^2$),2 × $V_{0.3\_100}$ /(3 × B_{base} × (L_{base}/2 - e))) = **3** kN/m^2;

2 ft dia (600mm) Antenna;

Max vertical load; $V_{0.6\_100} = (N_{sand\_0.6\_100} \times 0.245 \text{ kN}) + W_{self} = \underline{\mathbf{3.36}}$ kN

Overturning moment; $OTM_{0.6\_100} = \underline{\mathbf{1.61}}$ kNm

Therefore eccentricity of load; $e = OTM_{0.6\_100} / V_{0.6\_100} = \underline{\mathbf{0.478}}$ m

Ref.	Calculations	Output

Max bearing pressure under base;

$p_{max\_0.6\_100}$ = if(e<L_{base}/6, $V_{0.6\_100}$ /($L_{base} \times B_{base}$)+6 × $OTM_{0.6\_100}$/($B_{base} \times L_{base}^2$),2 × $V_{0.6\_100}$ /(3 × B_{base} × (L_{base}/2 - e))) = **15** kN/m^2;

125mph wind speed

1 ft dia (300mm) Antenna;

Max vertical load; $V_{0.3\_125}$ = ($N_{sand\_0.3\_125}$ × 0.245 kN) + W_{self} = **1.89** kN

Overturning moment; $OTM_{0.3\_125}$ = **0.90** kNm

Therefore eccentricity of load; e = $OTM_{0.3\_125}$/ $V_{0.3\_125}$ = **0.477** m

Max bearing pressure under base;

$p_{max\_0.3\_125}$ = if(e<L_{base}/6, $V_{0.3\_125}$ /($L_{base} \times B_{base}$)+6 × $OTM_{0.3\_125}$/($B_{base} \times L_{base}^2$),2 × $V_{0.3\_125}$ /(3 × B_{base} × (L_{base}/2 - e))) = **9** kN/m^2;

2 ft dia (600mm) Antenna;

Max vertical load; $V_{0.6\_125}$ = ($N_{sand\_0.6\_125}$ × 0.245 kN) + W_{self} = **5.32** kN

Overturning moment; $OTM_{0.6\_125}$ = **2.59** kNm

Therefore eccentricity of load; e = $OTM_{0.6\_125}$/ $V_{0.6\_125}$ = **0.487** m

Max bearing pressure under base;

$p_{max\_0.6\_125}$ = if(e<L_{base}/6, $V_{0.6\_125}$ /($L_{base} \times B_{base}$)+6 × $OTM_{0.6\_125}$/($B_{base} \times L_{base}^2$),2 × $V_{0.6\_125}$ /(3 × B_{base} × (L_{base}/2 - e))) = **26** kN/m^2;

150mph wind speed

1 ft dia (300mm) Antenna;

Max vertical load; $V_{0.3\_150}$ = ($N_{sand\_0.3\_150}$ × 0.245 kN) + W_{self} = **2.63** kN

Overturning moment; $OTM_{0.3\_150}$ = **1.30** kNm

Therefore eccentricity of load; e = $OTM_{0.3\_150}$/ $V_{0.3\_150}$ = **0.495** m

Max bearing pressure under base;

$p_{max\_0.3\_150}$ = if(e<L_{base}/6, $V_{0.3\_150}$ /($L_{base} \times B_{base}$)+6 × $OTM_{0.3\_150}$/($B_{base} \times L_{base}^2$),2 × $V_{0.3\_150}$ /(3 × B_{base} × (L_{base}/2 - e))) = **14** kN/m^2;

2 ft dia (600mm) Antenna;

Max vertical load; $V_{0.6\_150}$ = ($N_{sand\_0.6\_150}$ × 0.245 kN) + W_{self} = **7.53** kN

Overturning moment; $OTM_{0.6\_150}$ = **3.73** kNm

Therefore eccentricity of load; e = $OTM_{0.6\_150}$/ $V_{0.6\_150}$ = **0.496** m

Max bearing pressure under base;

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$p_{max\_0.6\_150}$ = if(e<L_{base}/6, $V_{0.6\_150}$ /($L_{base} \times B_{base}$)+6 × $OTM_{0.6\_150}$/($B_{base} \times L_{base}^2$),2 × $V_{0.6\_150}$ /(3 × B_{base} × (L_{base}/2 - e))) = **40** kN/m^2;

Summary: Bearing Pressures Under Edge of Base - **kN/m^2**

Figures in brackets denote number of 25kg sand bags to be placed on frame base

	Design Wind Speed			
Antenna Diameter	**70 mph**	**100 mph**	**125 mph**	**150 mph**
300 mm	**2 (2)**	**3 (2)**	**9 (2)**	**14 (5)**
600 mm	**6 (2)**	**15 (8)**	**26 (16)**	**40 (25)**