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Guidance on Determining the Loads imposed on buildings by equipment designed in accordance with BS EN 1808

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Guidance on Determining the Loads used in BS EN 1808

Disclaimer:
Whilst every effort has been made to provide reliable and accurate information, we would welcome any corrections or information provided by the writer which may not be entirely accurate, therefore for this reason, SAEMA cannot accept responsibility for any misinformation posted.

1. Introduction

This document has been prepared to assist various people in the Façade Access Industry (Consultants, Main Contractors, Structural Engineers CDM Co-ordinators, etc) with the interpretation of the loadings that will be imposed onto the building by equipment designed to BS EN 1808

2. Regulations and Standards

BS EN 1808 is a 'factory gate' standard and provides the manner in which the Suspended Access Equipment (SAE) should be designed.

However, BS EN 1808 does not provide clear information on what loads the SAE will transmit to the building or how the structural engineer should treat those loads.

3. SAEMA Position

3.1. Due to the variety of interpretations that have been encountered, SAEMA considers it necessary to develop this document to clarify the situation

3.2. SAEMA has produced this guide to provide an interpretation of the load cases that are found in BS EN 1808 and their effect on the building. This guide represents SAEMA'S interpretation of BS EN 1808 with respect to loading to buildings and does not deal with the design of the equipment itself.

4. Purpose

4.1. The principal aim of this document is to provide guidance to designers of SAE, Permanent and Temporary, in the production of information to those involved in designing the structure of the building.

4.2. It will also help structural engineers understand the loadings factored or otherwise that should be considered when designing the building.

5. Specific Examples

Some specific examples of loads and factors applied to them have been given in BS EN 1808 and are as follows: (**See Appendix A**)

1	Davit anchors	Fig 12
2	Parapet clamps	Fig 13
3	Monorail anchors	Fig 14
4	Counterweight suspension beams	Fig 15

In these cases a Factor of Safety of 3 is to be used.

The high factor of safety is provided in these instances because of the possibility of errors in the installation I.e.

1 Loads may not distribute evenly between anchors
2 Concrete may not be to designed quality
3 Anchors may be poorly installed
4 Counterweights may become detached

It is recognised that in the above instances the Factor of Safety should be 3 x WLL (Working Load Limit).

Note 1:

1. **BS 5974 (Code of practice for the planning, design, setting up and use of temporary suspended access equipment, 2010) has also recognised that when considering temporary SAE the Factor of Safety should be 3.**

Monorails Loading

Table 12 deals with the rail and bracket

Figure 14 deals with the monorail brackets anchors.

BMU Calculations

Clause 6.5.1 last paragraph state the reactions that should be given to the structural engineer,
This information should include the results of Load cases 1 and 2b and the stability calculations.

Clause 6.5.2 SAE incorporating auxiliary hoist
Stability and strength calculations of the machine, including the materials hoist to be performed in accordance with Table 8 or Table 9 and Table 10 or Table 11

Strength calculations use Table 8 or 9

Stability Calculations use Table 10 or 11

There is no distinction between SAE that have platform mounted hoists and SAE with roof mounted hoists**.** They are either Permanently or Temporarily Installed cradle systems, as defined in the definitions in BSEn 1808.

For Permanent SAE use tables 8 and 10 (Appendix B and C of this document)

For Temporary SAE use tables 9 and 11

6. LOADS CASES (PERMANENT)

There are 6 Load cases for consideration for Permanent BMU's suspending platform

6.1. Load Case 1 Working position
As table 8 BS EN 1808 (1.25 X TSL) + (1.25 x TSHL)

7.2. Load Case 2a - Overloads activated
As table 8 BS EN 1808 (1.5 X RL + SWP) + (1.25 x HWLL + 1 x HSW)

6.2. Load Case 2b - Parking plus storm winds.
As table 8 En 1808 (0 x TSL)+(Storm wind)

7.4 Load Case 3 - Extreme Condition
As Table 8 BS EN 1808 (Sd x TSL) + (1.1 x TSHL)

Where Sd is a factor when the secondary device is triggered.

Note 2: *The above load cases apply when determining the strength of the BMU.*

7.5 BMU Stability

As Table 10 EN 1808 (2 x TSL)+(1.4 x TSHL)

7.6 Parking Stability

As Table 10 EN 1808 (0 x TSL)+(Storm wind)

(SEE APPENDIX 'D' FOR CALCULATIONS)

8 Table of Results

		Rv1 kN	Rv2 kN
7.1	Load Case 1	**52.47**	**10.77**
7.2	Load Case 2a	**58.32**	**2.3**
7.3	Load Case 2b	**11.44**	**32.74**
7.4	Load Case 3	**68.16**	**-5.18**
7.5	Stability	**59.40**	**0**
7.6	Parking	**11.44**	**32.34**

9. Conclusions

From the information given in EN 1808 and explained above. SAEMA considers that the following loads should be considered by the Structural Engineer for Building Design.

9.1. Load Case 1 Working Load

The load that the building will be expected to resist from the BMU in everyday use. (Live Load)(Structural Engineer to apply a 1.5 factor as Annex D EN 1808)

9.2. Load Case 2b (Note: Same as Parking Stability)

The Load that the building will be expected to resist from the BMU during storm conditions.

9.3. Stability

The Load the building will be expected to resist from the BMU system to consider the system stable.)(Structural Engineer to apply a 1.1 factor as Annex D EN 1808)

Appendix A

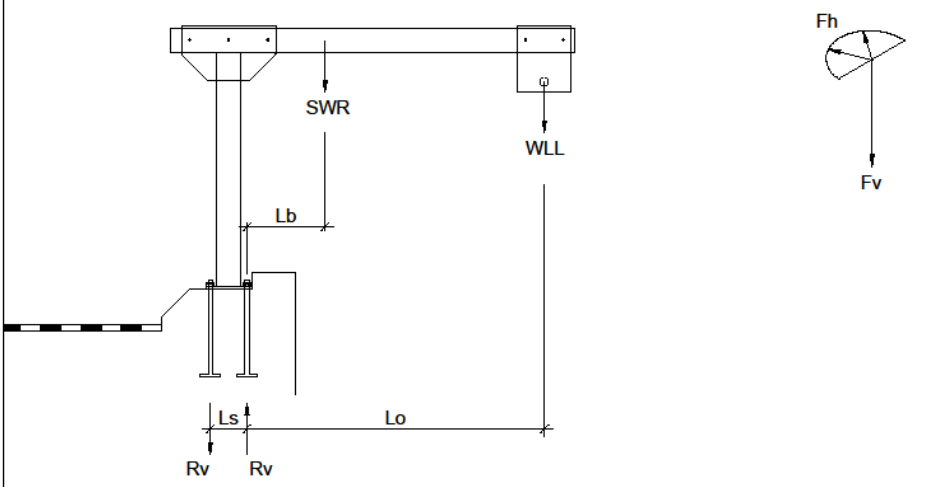


Figure 12 - Davit

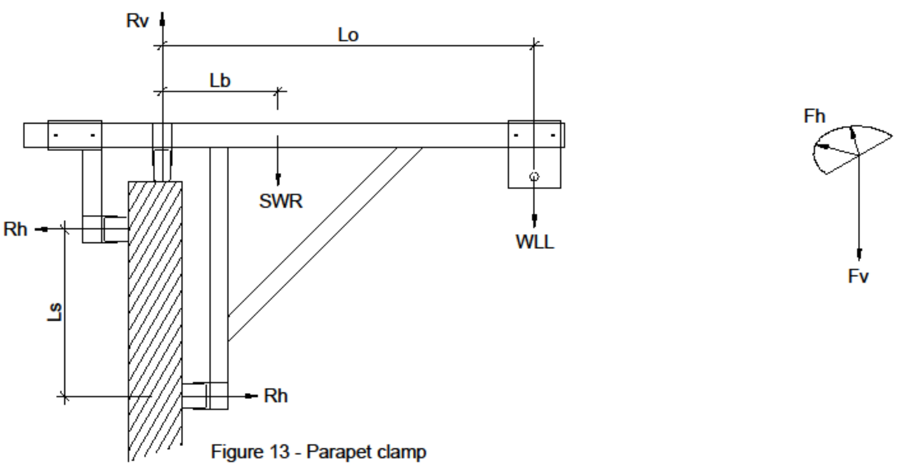


Figure 13 - Parapet clamp

Appendix A (cont)

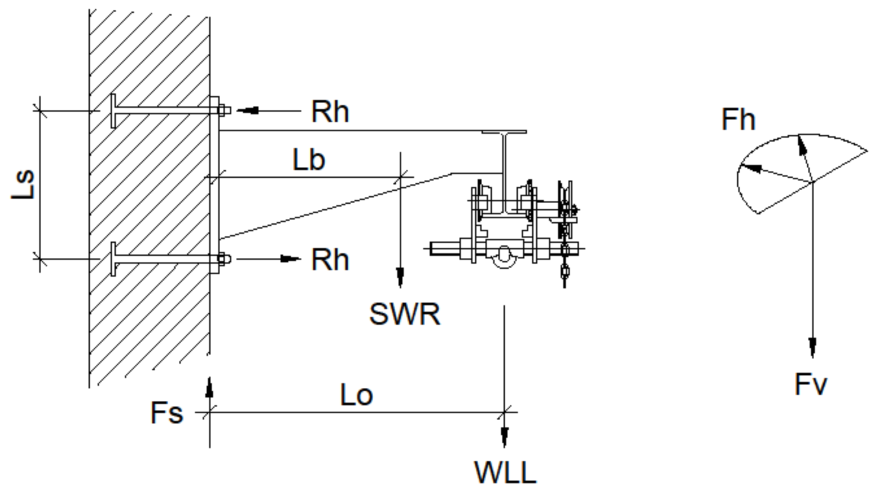


Figure 14 - Monorail

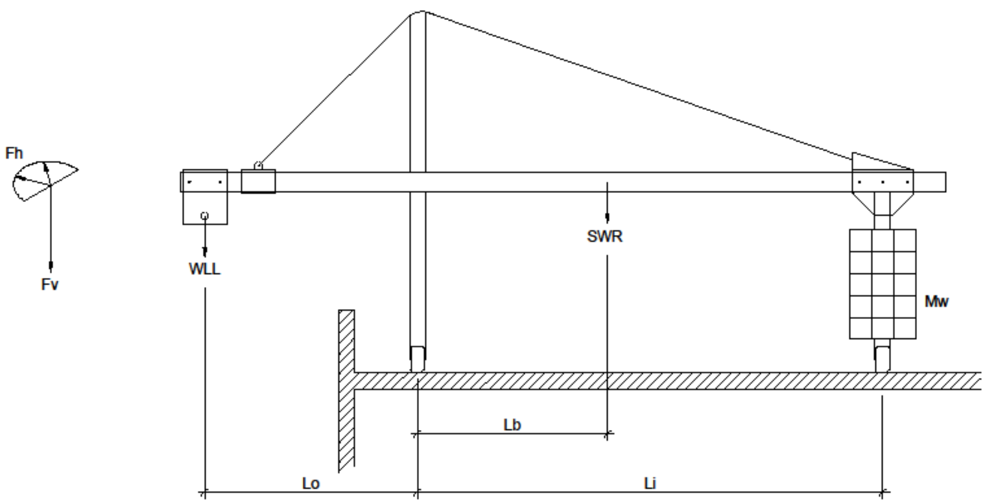


Figure 15 - Typical suspension beam

Appendix B

BMU Suspension Rig Table 8 – Load Cases for				
Load case	**Total Suspended Load (TSL)**	**Weight of outboard portion**	**Weight of inboard portion**	**Horizontal force (Fh)**
Load case 1 Working load	1,25 × TSL + 1,25 x TSHL	1,25 × Mo (a)	1,25 × Mi (a)	1,25 × Fw1 Plat + 1,25 x Fw1 Rig + 1,25 x FwMH (b) + 2 x M x acc (c)
Load case 2a	1,5 × RL + 1 x SWP + 1,25 x HWLL + 1 x HSW	1 x Mo	1 × Mi	0
Load case 2b - Out of service conditions	generally 0	1 × Mo	1 × Mi	Fw2 Plat + 1 x Fw2 Rig
Load case 3 - Triggering of the secondary device	Sd × TSL + 1,1 x TSHL	1 × Mo	1 × Mi	0

Fw1 = In-service wind force

FwMH = In-service wind force on material (assumed minimum 5 m2 and a minimum of 625 N)

Fw2 = Out-of-service storm wind force

HWLL = Working load limit of materials hoist

HSW = Mass of all suspended materials hoist items

TSHL = Total suspended hoist load (TSHL = HWLL + HSW)

Sd is actual value in accordance with test B.1.4 or B.1.5.

The worst combination of the forces shall be considered for the calculation.

Appendix C

Table 10 – Stability coefficients for BMU Suspension Rigs				
	Total suspended load (N)	**Weight of outboard portion (N)**	**Weight of inboard portion (N)**	**Horizontal force (Fh) (N)**
Working stability	2 × TSL + 1,4 x TSHL	1,25 × Mo	1 × Mi	1,25 × Fw1 Plat + 1,25 x Fw1 Rig
Parking stability	generally 0	1 × Mo	1 × Mi	Fw2 Plat + Fw2 Rig

Fw1 = In-service wind force

FwMH = In-service wind force on material (assumed minimum 5 m2 and a minimum of 625 N)

Fw2 = Out-of-service storm wind force

HWLL = Working load limit of materials hoist

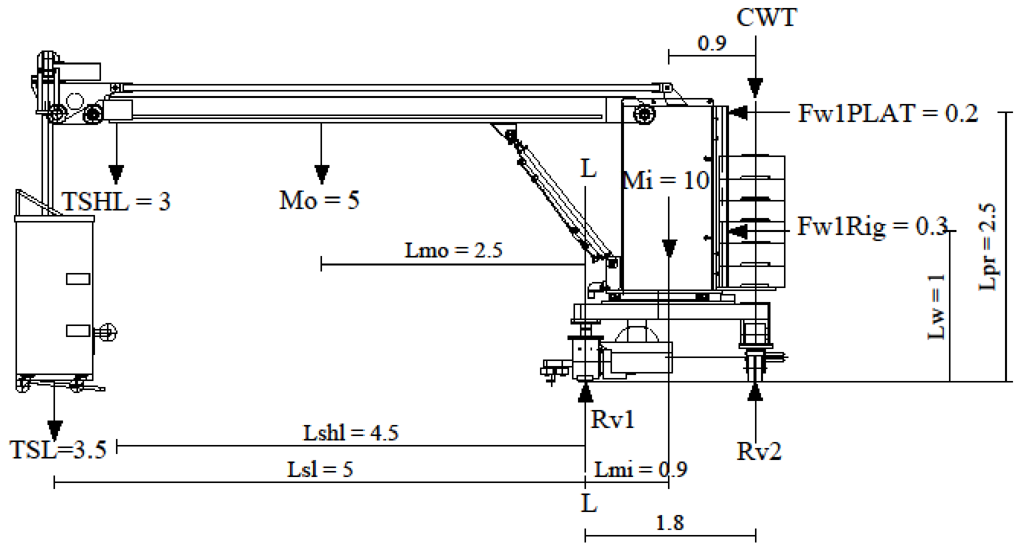
HSW = Mass of all suspended materials hoist items

TSHL = Total suspended hoist load (TSHL = HWLL + HSW)

Sd is actual value in accordance with test B.1.4 or B.1.5.

The worst combination of the forces shall be considered for the calculation.

Appendix D



Trolley unit stability calculation

Assumed Loadings

TSL = 3.5kN,
TSHL = 3Kn,
Mo = 5kN,
Mi = 10kN
Fw1Plat = 0.2kN,
Fw1rig = 0.3kN,
Fwmh = 0.625kN
Track gauge = 1.8m,
CWT is directly over the rear track

Calculate required counterweight for stability using Table 10 BS EN 1808

TSL + Mo + Fw1 rig + TSHL + Fw1 plat =

(2x3.5x5)+(1.25x5x2.5)+(1.25x0.3x1)+(1.4x3x4.5)+(1.25x0.2x2.5) =

Mi + CWT = (10x0.9)+CWT x1.8 =

35 + 15.625 + 0.375 + 18.9 + 0.625 = 9 + 1.8xCWT

CWT = 34.18 kN

Calculate Reactions Rv_1 and Rv_2 for all load cases

7.1 LOAD CASE 1

For Rv_1take moments about Rv_2

TSL + TSHL + Mo + Mi + Fw1plat

(1.25x3.5x6.8)+(1.25x3x6.3)+(1.25x5x4.3)+(1.25x10x0.9)+(1.25x0.2x2.5)

+ Fw1rig + Fwmh

+(1.25x0.3x1)+(1.25x0.625x2.5)= Rv_1x1.8.

29.75 + 23.625 + 26.875 + 11.25 + 0.625 + 0.375 + 1.95 = 1.8 Rv_1

Rv_1 = 52.47kN

For Rv_2 take moments about Rv_1

(1.25x3.5x5)+(1.25x3x4.5)+(1.25x5x2.5)+(1.25x10x0.9)-(1.25x0.2x2.5)-(1.25x0.3x1)-(34.18x1.8)+(1.8xRv_2)=0

21.875+ 16.875 + 15.625 – 11.25 -0.625 – 0.375 – 61.52 + 1.8 Rv_2

54.375-73.77+ Rv_2 = 0

Rv_2 = 10.77kN

7.2 LOAD CASE 2a

For Rv_1 Take Moments about Rv_2

Where HWLL = 5kN

HSW = 0.5kN

RL + SWP + HWLL + HSW + Mo +Mi

[(1.5x2.4x6.8)+(1x1.1x6.8)+(1.25x5x6.3)+(1x0.5x6.3)**]** + (1x5x4.3)+(1x10x0.9)-(1.8xRv_1) = 0

24.48+7.48+39.375+3.15+21.5+9 = 1.8Rv_1

Rv_1 = 58.32kN

For Rv_2 take moments about Rv_1

(1.5x2.4x5)+(1x1.1x5)+(1.25x5x4.5)+(1x0.5x4.5))+(1x5x2.5)-(10x0.9)-(34.18x1.8)+1.8xRV_2=0

18 + 5.5 + 28.125 + 2.25 + 12.5 – 9.0 - 61.525 + 1.8Rv_2 = 0

Rv_2 = 2.3kN

7.3 LOAD CASE 2b

Wind pressure q is 1.1 kN/m^2, Rig 4m^2, plat 2m^2

So Fw2plat = 2x1.1 = 2.2kN

Fw2 rig = 4x 1.1 = 4.4kN

For Rv_1 take moments about Rv_2

(0) +(5x4.3)+(10x0.9)-(2.2x2.5)-(4.4x1) = 1.8 Rv_1

0 + 21.5 + 9 – 5.5 – 4.4 = 1.8 Rv_1

Rv_1 = 11.44 KN

For Rv_2take moments about Rv_1

(5x2.5)-(34.18x1.8)-(2.2x2.5)-(4.4x1)-1.8xRv_2=0

Rv_2 = 32.74kN

7.4 LOAD CASE 3

Sd = 3

For Rv_1 take moments about Rv_2

(3x3.5x6.8)+(1.1x3x6.3)+(5x4.3)+(10x0.9) = 1.8xRv_1

Rv_1= 68.16kN

For Rv_2 take moments about Rv_1

(3x3.5x5)+(1.1x3x4.5)+(5x2.5)-(10x0.9)-(34.18x1.8) = 1.8xRv_1

52.5+14.85 + 12.5 – 9 - 61.52 = 1.8Rv_1

79.85 – 70.52 =1.8Rv_1

Rv_1 = -5.18kN (Uplift)

7.5 STABILITY

For Rv_1 take moments about Rv_2
TSL + Mo + Fw1rig + TSHL +Fw1plat
(2x3.5x6.8) + (1.25x5x4.3) + (1.250.3x1) + (1.4x3x6.3) + (1.25x0.2x2.5)+Mi - Rv_1 = 0
+(10x0.9)-(1.8x Rv_1)=0
47.6 + 26.875 + 0.375 + 26.46 + 0.625 + 9.0 = 1.8 Rv_1
Rv_1 = 59.40kN

For Rv_2 take moments about Rv1
TSL + Mo + Fw1rig + TSHL + Fw1plat - Mi
(2x3.5x5)+(1.25x5x2.5)+(1.25x0.3x1)+(1.4x3x4.5)+(1.25x0.2x2.5)-(10x0.9)-CWT - Rv_2 = 0
-(1.8x34.18)- (1.8xRv_2) = 0
35 + 15.625 + 0.375 + 18.9 + 0.625 - 9.0 – 61.524= 1.8 Rv_2
Rv_2 = 0kN

7.6 PARKING STABILITY

Wind pressure q is 1.1 kN/m^2, Rig 4m^2, plat 2m^2
Therefore:
Fw2plat = 2x1.1 = 2.2kN
Fw2 rig = 4x 1.1 = 4.4kN

For Rv_1 take moments about Rv_2
(0)+ (5x4.3)+(10x0.9)-(2.2x2.5)-(4.4x1) = 1.8 Rv_1
0 + 21.5 + 9 – 5.5 – 4.4 = 1.8 Rv_1
Rv_1 = 11.44 KN

For Rv_2 take moments about Rv_1
(5x2.5)-(34.18x1.8)-(2.2x2.5)-(4.4x1)-1.8xRv_2=0
Rv_2 = 32.74kN