SAEMA Document No. SDN. 14002

Guidance Note on Determining the Loads Imposed on Buildings by Equipment Designed in Accordance With BS EN 1808

Contents

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.

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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.

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3. SAEMA Position

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

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4. Purpose

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

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5. Specific Examples

Some specific examples of loads and factors applied to them have been given in BS EN 1808 as follows.

Davit Anchors

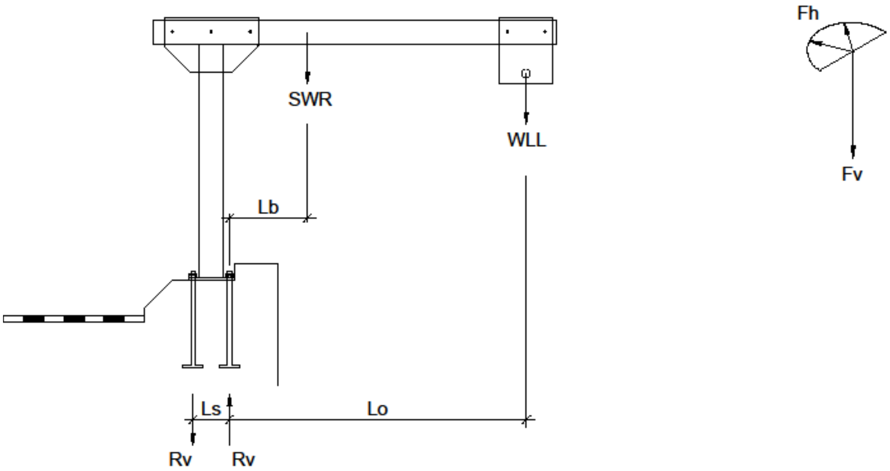

Figure 1. Davit Anchors

Parapet Clamps

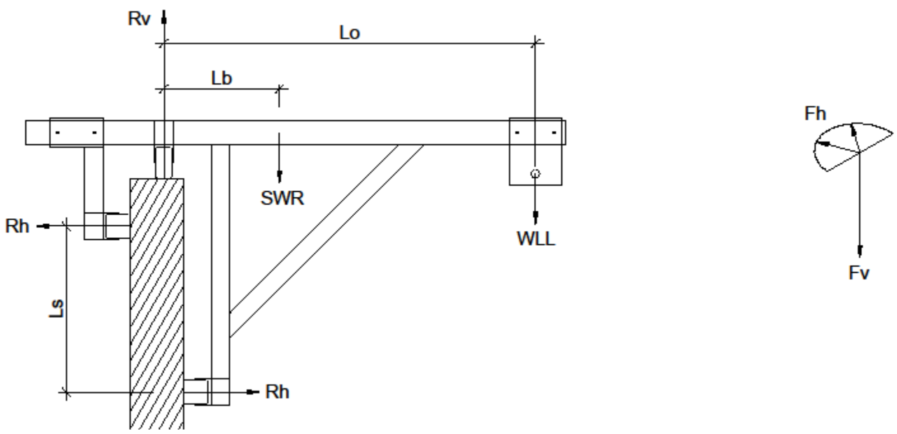

Figure 2. Parapet Clamps

Monorail Anchors

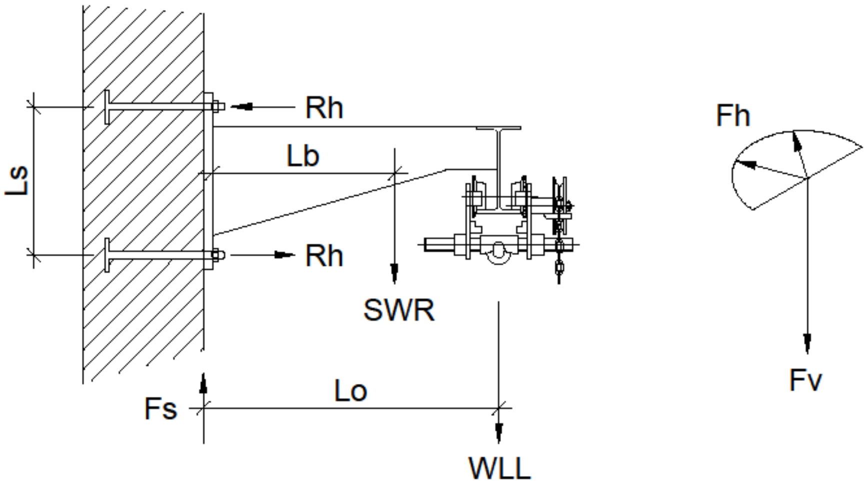

Figure 3. Monorail Anchors

Counterweight Suspension Beams

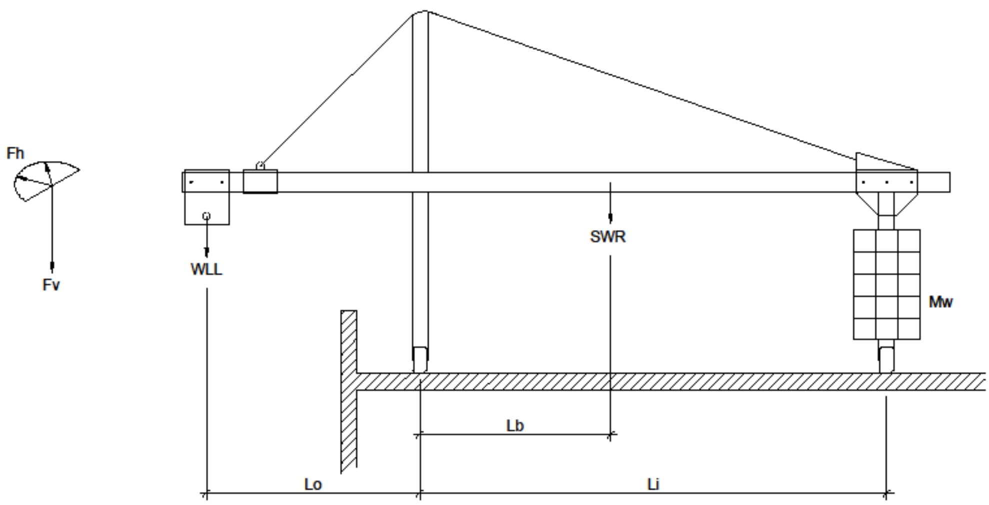

Figure 4. Typical Suspension Beam

In these cases a Factor of Safety of 3 x the Working Load Limit (WLL) 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.:

- Loads may not distribute evenly between anchors
- Concrete may not be to designed quality
- Anchors may be poorly installed
- Counterweights may become detached

Note: BS 5974: 2017 *Planning, design, setting up and use of temporary suspended access equipment – Code of Practice* has also recognised that when considering temporary SAE the Factor of Safety should be 3.

BMU Calculations

Clause 6.5 of BS EN 1808: 2015 states 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 (Appendix A1).

For strength calculations use Tables 9 and 10.

For stability Calculations use Tables 11 and 12.

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 BS EN 1808, 2015 *Safety requirements for suspended access equipment – Design calculation, stability criteria, construction – Examinations and tests.*

For Permanent SAE use tables 9 and 11.

For Temporary SAE use tables 10 and 12.

The following abbreviations and symbols are used throughout Tables 9, 10, 11 and 12 within BS EN 1808: 2015.

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
M = Total mass (Mi + Mo)
Mi = Weight of inboard portion
Mo = Weight of outboard portion
RL = Rated load
SWP = Self weight of platform
Sd is the shock load co-efficient of the secondary safety device.
TSHL = Total suspended hoist load (TSHL = HWLL + HSW)
TSL = Total suspended load
WLL = Working load limit of platform winch

BS EN 1808:2015 Table 9 – Load cases to be considered for strength of the BMU suspension rig itself

Table 9 — Load cases for BMU suspension rig

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 × TSHL	1,25 × Mo (a)	1,25 × Mi (a)	1,25 × Fw1 Plat + 1,25 × Fw1 Rig + 1,25 × FwMH (b) + 2 × M × acc (c)
Load case 2a (static test loads)	1,5 × RL + 1 × SWP + 1,25 × HWLL + 1 × HSW	1 x Mo	1 × Mi	0
Load case 2b – Out of service conditions	generally 0	1 × Mo	1 × Mi	Fw2 Plat + 1 × Fw2 Rig
Load case 3 – Triggering of the secondary device	Sd × TSL + 1,1 × TSHL	1 × Mo	1 × Mi	0

The most unfavourable combination of the forces shall be considered for the calculation.

(a) For static suspension rig use 1 x Mo and 1 x Mi

(b) Fw1 on platform: The minimum horizontal load on the suspension points of the ropes is 0.1 x TSL in all directions

(c) Acceleration forces for traversing suspension rig (trolley) are 2 x M x acceleration (acc).

BS EN 1808:2015 Table 10 – Load cases to be considered for strength of the TSP suspension rig itself

Table 10 — Load cases for TSP suspension rig

Load case	WLL of the hoist(s)	Weight of outboard portion	Weight of inboard portion	Horizontal force (Fh)
Load case 1 Working load	1,25 × WLL + 1,25 × TSHL	1,25 × Mo (a)	1,25 × Mi (a)	1,25 × Fw1 + 1,25 x Fw_{MH} (b)
Load case 2a	1,5 × WLL + 1,25 × HWLL + 1 × HSW	1 × Mo	1 × Mi	0
Load case 3 Triggering of the secondary device	2,5 × WLL + 1,1 x TSHL	1 × Mo	1 × Mi	0
Out of service condition	generally 0	1 × Mo	1 × Mi	Fw2

BS EN 1808:2015 Table 11 – Load cases to be considered for stability of the BMU suspension rig itself

Table 11 — 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 × TSHL	1,25 × Mo	1 × Mi	1,25 × Fw1 Plat + 1,25 × Fw1 Rig
Parking stability	generally 0	1 × Mo	1 × Mi	Fw2 Plat + Fw2 Rig

The most unfavourable combination of the forces shall be considered for the calculation.

BS EN 1808:2015 Table 12 – Load cases to be considered for stability of the TSP suspension rig itself

Table 12 — Stability coefficients for TSP suspension rigs

	Total suspended load (N)	Weight of outboard portion (N)	Weight of inboard portion (N)	Horizontal force (Fh) (N)
Working stability	3 × WLL + 1,4 × HWLL	1,25 × Mo	1 × Mi	Ignore
Parking stability	generally 0	1 × Mo	1 × Mi	Fw2 Plat + Fw2 Rig

The most unfavourable combination of the forces shall be considered for the calculation.

6. Load Cases (Permanent)

There are six load cases for consideration for Permanent BMU's suspending platforms, as follows. Worked examples are given in Appendix A1.

These load cases apply when determining the strength of the BMU design only. Load Case 3 does not transfer the reaction loads onto the structure.

6.1. Load Case 1 – Working Position

As table 9 within BS EN 1808:

(1.25 x TSL) + (1.25 x TSHL)

6.2. Load Case 2a – Overloads Activated

As Table 9 within BS EN 1808:

(1.5 x RL + SWP) + (1.25 x HWLL + 1 x HSW)

6.3. Load Case 2b – Parking Plus Storm Winds

As Table 9 within BS EN 1808:

(0 x TSL) + (Storm Wind)

6.4. Load Case 3 – Extreme Condition

As Table 9 within BS EN 1808:

(Sd x TSL) + (1.1 x TSHL)

6.5. BMU Stability

As Table 11 within BS EN 1808:

(2 x TSL) + (1.4 x TSHL)

6.6. Parking Stability

As Table 11 within BS EN 1808:

(0 x TSL) + (Storm Wind)

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7. Conclusions

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

7.1. 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 BS EN 1808:2015)

7.2. Load Class 2b Parking Plus Storm Winds

The load that the building will be expected to resist from the BMU during storm conditions. (Structural Engineer to apply a 1.33 factor as Annex D BS EN 1808:2015).

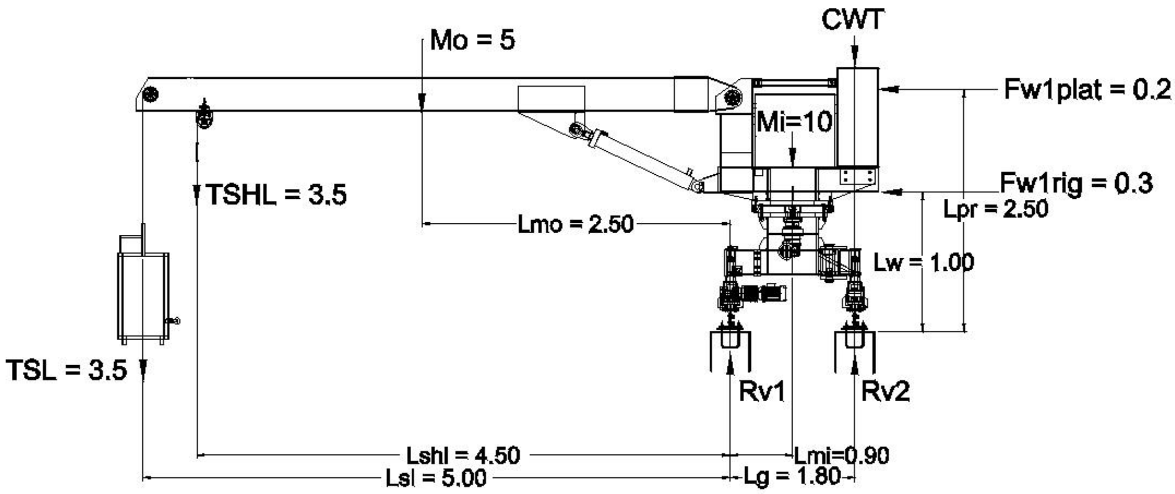
7.3. Stability

The load the building will be expected to resist from the BMU system to consider the system stable. (SAEMA recommend that a Structural Engineer applies a minimum factor of 1.1).

Appendices

A1: Worked Example of a Trolley Unit Stability Calculation

Please note that this is a basic example calculation and does not take into account all factors which a designer may need to consider. For example, wind loadings on materials have not been considered.



Assumed Loadings
TSL = 3.5kN
TSHL = 3kN
Mo = 5kN
Mi = 10kN
Fw1 Plat = 0.2kN
Fw1 Rig = 0.3kN
FwMH = 0.625kN
Lg = Track gauge = 1.8m
CWT is directly over the rear track

Calculate required counterweight for stability using Table 11 BS EN 1808

$$(2.00\ x\ TSL\ x\ Lsl) + (1.40\ x\ TSHL\ x\ Lshl) + (1.25\ x\ Mo\ x\ Lmo) + (1.25\ x\ Fw1\ rig\ x\ Lw) + (1.25\ x\ Fw1\ plat\ x\ Lpr) = (Mi\ x\ Lmi) + (Lg\ x\ CWT)$$

$$(2.00\ x\ 3.50\ x\ 5.00) + (1.40\ x\ 3.00\ x\ 4.50) + (1.25\ x\ 5.00\ x\ 2.50) + (1.25\ x\ 0.30\ x 1.00) + (1.25\ x\ 0.20\ x\ 2.50) = (10.00\ x\ 0.90) + (1.80\ x\ CWT)$$

$$35.00 + 18.90 + 15.63 + 0.38 + 0.63 = 9.00 + (1.8\ x\ CWT)$$

$$\boldsymbol{CWT = 34.19kN}$$

Calculate Reactions Rv_1 and Rv_2 for all load cases

Load Case 1 (6.1)

For Rv_1, take moments about Rv_2

$$\big(1.25\ x\ TSL\ x\ (Lsl + Lg)\big) + \big(1.25\ x\ TSHL\ x\ (Lshl + Lg)\big) + \big(1.25\ x\ Mo\ x\ (Lmo + Lg)\big) + (1.25\ x\ Mi\ x\ Lmi) + (1.25\ x\ Fw1\ plat\ x\ Lpr) + (1.25\ x\ Fw1\ rig\ x\ Lw) = (Rv_1\ x\ Lg)$$

$$(1.25\ x\ 3.50\ x\ 6.80) + (1.25\ x\ 3.00\ x\ 6.30) + (1.25\ x\ 5.00\ x\ 4.30) + (1.25\ x\ 10.00\ x\ 0.90) + (1.25\ x\ 0.20\ x\ 2.50) + (1.25\ x\ 0.30\ x\ 2.50) = (Rv_1\ \ x\ 1.80)$$

$$29.75 + 23.63 + 26.88 + 11.25 + 0.63 + 0.38 + 0.94 = 1.80Rv_1$$

$$\boldsymbol{Rv_1 = 51.92kN}$$

For Rv_2, take moments about Rv_1
(please note that for the worst case, the wind loads are reversed from the diagram)

$$(1.25\ x\ TSL\ x\ Lsl) + (1.25\ x\ TSHL\ x\ Lshl) + (1.25\ x\ Mo\ x\ Lmo) - (1.25\ x\ Mi\ x\ Lmi) - (1.25\ x\ Fw1\ plat\ x\ Lpr) - (1.25\ x\ Fw1\ rig\ x\ Lw)\ - (CWT\ x\ Lg) = (Lg\ x\ Rv_2)$$

$$(1.25\ x\ 3.50\ x\ 5.00) + (1.25\ x\ 3.00\ x\ 4.50) + (1.25\ x\ 5.00\ x\ 2.50) - \ (1.25\ x\ 10.00\ x\ 0.90) - (1.25\ x\ 0.20\ x\ 2.50) - (1.25\ x\ 0.30\ x\ 1.00) - (34.19\ x\ 1.80) = (1.80\ x\ Rv_2)$$

$$21.88 + 16.88 + 15.63 - 11.25 - 0.63 - 0.38 - 61.54 = 1.80Rv_2$$

$$\boldsymbol{Rv_2 = -10.78kN}$$

Load Case 2a (6.2)

For Rv_1, take moments about Rv_2
Where HWLL = 2.50kN
HSW = 0.50kN

$$(1.50\ x\ RL\ x\ (Lsl + Lg)) + (1.00\ x\ SWP\ x\ (Lsl + Lg)) + (1.25\ x\ HWLL\ x\ (Lshl + Lg)) + (1.00\ x\ HSW\ x\ (Lshl + Lg)) + (Mo\ x\ (Lmo + Lg)) + (Mi\ x\ Lmi) = (Lg\ x\ Rv_1)$$

$$(1.50\ x\ 2.40\ x\ 6.80) + (1.00\ x\ 1.10\ x\ 6.80) + (1.25\ x\ 2.50\ x\ 6.30) + (1.00\ x\ 0.50\ x\ 6.30) + (1.00\ x\ 5.00\ x\ 4.30) + (1.00\ x\ 10.00\ x\ 0.90) = (1.80\ x\ Rv_1)$$

$$24.48 + 7.48 + 19.69 + 3.15 + 21.50 + 9.00 = 1.80Rv_1$$

$$\boldsymbol{Rv_1 = 47.39kN}$$

For Rv_2, take moments about Rv_1

$$(1.50\ x\ RL\ x\ Lsl) + (1.00\ x\ SWP\ x\ Lsl) + (1.25\ x\ HWLL\ x\ Lshl) + (1.00\ x\ HSW\ x\ Lshl) + (Mo\ x\ Lmo) - (Mi\ x\ Lmi) - (CWT\ x\ Lg) = (Lg\ x\ Rv_1)$$

$$(1.50\ x\ 2.40\ x\ 5.00) + (1.00\ x\ 1.10\ x\ 5.00) + (1.25\ x\ 2.50\ x\ 4.50) + (1.00\ x\ 0.50\ x\ 4.50) + (5.00\ x\ 2.50) - (10.00\ x\ 0.90) - (34.19\ x\ 1.80) = (1.80\ x\ Rv_2)$$

$$18.00 + 5.50 + 14.06 + 2.25 + 12.50 - 9.00 - 61.54 = 1.80Rv_2$$

$$\boldsymbol{Rv_2 = -10.13kN}$$

Load Case 2b (6.3)

Wind pressure q is 1.1kN/m^2, Rig 4m^2, plat 2m^2
So Fw2 plat = 2 x 1.1 = 2.2kN
Fw2 rig = 4 x 1.1 = 4.4kN

For Rv_1, take moments about Rv_2

$$(0.00\ x\ TSL\ x\ (Lsl + Lg)) + (0.00\ x\ TSHL\ x\ (Lshl + Lg)) + (1.00\ x\ Mo\ x\ (Lmo + Lg)) + (1.00\ x\ Mi\ x\ Lmi) + (1.00\ x\ Fw2\ plat\ x\ Lpr) + (1.00\ x\ Fw2\ rig\ x\ Lw) = (Lg\ x\ Rv_1)$$

$$0.00 + 0.00 + (1.00\ x\ 5.00\ x\ 4.30) + (1.00\ x\ 10.00\ x\ 0.90) + (1.00\ x\ 2.20\ x\ 2.50) + (1.00\ x\ 4.40\ x\ 1.00) = 1.80Rv_1$$

$$21.50 + 9.00 + 5.50 + 4.40 = 1.80Rv_2$$

$$\boldsymbol{Rv_1 = 22.44kN}$$

For Rv_2, take moments about Rv_1
(please note that for the worst case, the wind loads are reversed from the diagram)

$$(0.00\ x\ TSL\ x\ Lsl) + (0.00\ x\ TSHL\ x\ Lshl) + (1.00\ x\ Mo\ x\ Lmo) - (1.00\ x\ Mi\ x\ Lmi) - (1.00\ x\ Fw2\ plat\ x\ Lpr) - (1.00\ x\ Fw2\ rig\ x\ Lw) - (CWTxLg) = (Lg\ x\ Rv_2)$$

$$0.00 + 0.00 + (5.00\ x\ 2.50) - (1.00x10.00x0.90) - (1.00\ x\ 2.20\ x\ 2.50) - (1.00\ x\ 4.40\ x\ 1.00) - (34.19\ x\ 1.80) = 1.80xRv_2$$

$$12.50 - 9.00 - 5.50 - 4.40 - 61.54 = 1.80Rv_2$$

$$\boldsymbol{Rv_2 = -37.74kN}$$

Load Case 3 (6.4)

Sd = 3

For Rv_1 take moments about Rv_2

$$(3.00\ x\ TSL\ x\ (Lsl + Lg)) + (1.10\ x\ TSHL\ x\ (Lshl + Lg)) + (1.00\ x\ Mo\ x\ (Lmo + Lg)) + (1.00\ x\ Mi\ x\ Lmi) = (Lg\ x\ Rv_1)$$

$$(3.00\ x\ 3.50\ x\ 6.80) + (1.10\ x\ 3.00\ x\ 6.30) + (1.00\ x\ 5.00\ x\ 4.30) + (1.00\ x\ 10.00\ x\ 0.90) = 1.80\ x\ Rv_1$$

$$71.40 + 20.79 + 21.50 + 9.00 = 1.8Rv_1$$

$$\boldsymbol{Rv_1 = 68.16kN}$$

For Rv_2, take moments about Rv_1

$$(3.00\ x\ TSL\ x\ Lsl) + (1.10\ x\ TSHL\ x\ Lshl) + (1.00\ x\ Mo\ x\ Lmo) - (1.00\ x\ Mi\ x\ Lmi) - (CWT\ x\ Lg) = (Lg\ x\ Rv_2)$$

$$(3.00\ x\ 3.50\ x\ 5.00) + (1.10\ x\ 3.00\ x\ 4.50) + (1.00\ x\ 5.00\ x\ 2.50) - (1.00\ x\ 10.00\ x\ 0.90) - (34.19\ x\ 1.80) = 1.80\ x\ Rv_2$$

$$52.50 + 14.85 + 12.50 - 9.00 - 61.54 = 1.80Rv_1$$

$$\boldsymbol{Rv_2 = 5.17kN}$$

Working Stability (6.5)

For Rv_1 take moments about Rv_2

$$(2.00\ x\ TSL\ x\ (Lsl + Lg)) + (1.4\ x\ TSHL\ x\ (Lshl + Lg)) + (1.25\ x\ Mo\ x\ (Lmo + Lg)) + (1.00\ x\ Mi\ x\ Lmi) + (1.25\ x\ Fw1plat\ x\ Lpr) + (1.25\ x\ Fw1rig\ x\ Lw) = Lg\ x\ Rv_1$$

$$(2.00\ x\ 3.50\ x\ 6.80) + (1.40\ x\ 3.00\ x\ 6.30) + (1.25\ x\ 5.00\ x\ 4.30) + (1.00\ x\ 10.00\ x\ 0.90) + (1.25\ x\ 0.20\ x\ 2.50) + (1.25\ x\ 0.30\ x\ 1.00) = 1.80Rv_1$$

$$47.60 + 26.46 + 26.88 + 9.00 + 0.63 + 0.38 = 1.80Rv_1$$

$$\boldsymbol{Rv_1 = 61.64kN}$$

For Rv_2, take moments about Rv_1

$$(2.00\ x\ TSL\ x\ Lsl) + (1.4\ x\ TSHL\ x\ Lshl) + (1.25\ x\ Mo\ x\ Lmo) - (1.00\ x\ Mi\ x\ Lmi) - (CWT\ x\ Lg) + (1.25\ x\ Fw1plat\ x\ Lpr) + (1.25\ x\ Fw1rig\ x\ Lw) = Lg\ x\ Rv_2$$

$$(2.00\ x\ 3.50\ x\ 5.00) + (1.40\ x\ 3.00\ x\ 4.50) + (1.25\ x\ 5.00\ x\ 2.50) - (1.00\ x\ 10.00\ x\ 0.90) - (34.19\ x\ 1.80) + (1.25\ x\ 0.2\ x\ 2.50) + (1.25\ x\ 0.3\ x\ 1.00) = 1.80Rv_2$$

$$35.00 + 18.90 + 15.63 - 9.00 - 61.54 + 0.63 + 0.38 = 1.80Rv_2$$

$$\boldsymbol{Rv_2 = 0.00kN}$$

Parking Stability (6.6)

Storm wind pressure q is 1.1kN/m^2, rig 4m^2, plat 2m^2

Therefore: $Fw2plat = 2.00\ x\ 1.10 = 2.20kN$

$Fw2rig = 4.00\ x\ 1.10 = 4.40kN$

For Rv_1, take moments about Rv_2

$$(0.00\ x\ TSL\ x\ (Lsl + Lg)) + (0.00\ x\ TSHL\ x\ (Lshl + Lg)) + (1.00\ x\ Mo\ x\ (Lmo + Lg)) + (1.00\ x\ Mi\ x\ Lmi) + (1.00\ x\ Fw2plat\ x\ Lpr) + (1.00\ x\ Fw2rig\ x\ Lw) = Lg\ x\ Rv_1$$

$$0.00 + 0.00 + (1.00\ x\ 5.00\ x\ 4.30) + (1.00\ x\ 10.00\ x\ 0.90) + (1.00\ x\ 2.20\ x\ 2.50) + (1.00\ x\ 4.40\ x\ 1.00) = 1.80Rv_1$$

$$21.50 + 9.00 + 5.50 + 4.40 = 1.80Rv_1$$

$$\boldsymbol{Rv_1 = 22.44kN}$$

For Rv_2, take moments about Rv_1

(please note that for the worst case, the wind loads are reversed from the diagram)

$$(0.00\ x\ TSL\ x\ Lsl) + (0.00\ x\ TSHL\ x\ Lshl) + (1.00\ x\ Mo\ x\ Lmo) - (1.00\ x\ Mi\ x\ Lmi) - (CWT\ x\ Lg) - (1.00\ x\ Fw2plat\ x\ Lpr) - (1.00\ x\ Fw2rig\ x\ Lw) = Lg\ x\ Rv_2$$

$$0.00 + 0.00 + (1.00\ x\ 5.00\ x\ 2.50) - (1.00\ x\ 10\ x\ 0.9) - (34.18\ x\ 1.80) - (1.00\ x\ 2.20\ x\ 2.50) - (1.00\ x\ 4.40\ x\ 1.00) = (1.80\ x\ Rv_2)$$

$$12.50 - 9.00 - 61.54 - 5.50 - 4.40 = 1.80Rv_2$$

$$\boldsymbol{Rv_2 = -37.74kN}$$

Table of Results

Table 1. Results of worked examples in Appendix A1

		Rv_1 kN	Rv_2 kN
6.1	Load Case 1	51.92	-10.78
6.2	Load Case 2a	47.39	-10.13
6.3	Load Case 2b	22.44	-37.74
6.4	Load Case 3	68.16	5.17
6.5	Stability	61.64	0.00
6.6	Parking	22.44	-37.74