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

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### References

## **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

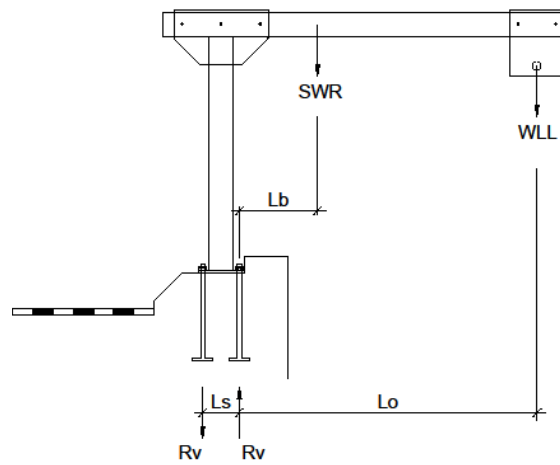
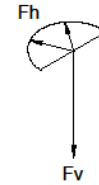


Figure 1. Davit Anchors



### Parapet Clamps

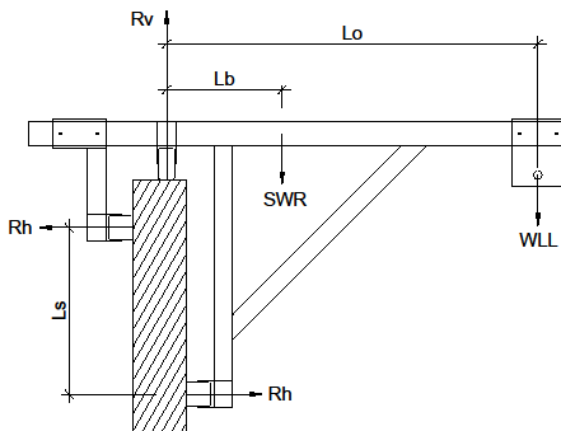
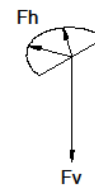


Figure 2. Parapet Clamps



### Monorail Anchors

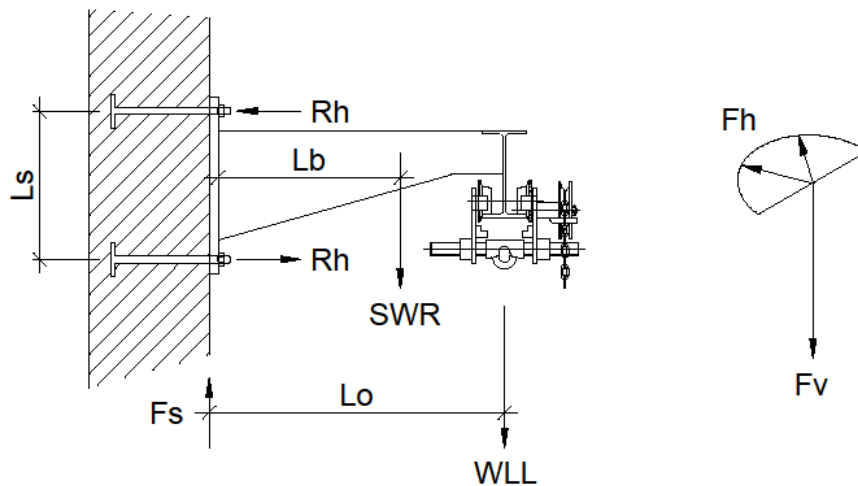


Figure 3. Monorail Anchors

### Counterweight Suspension Beams

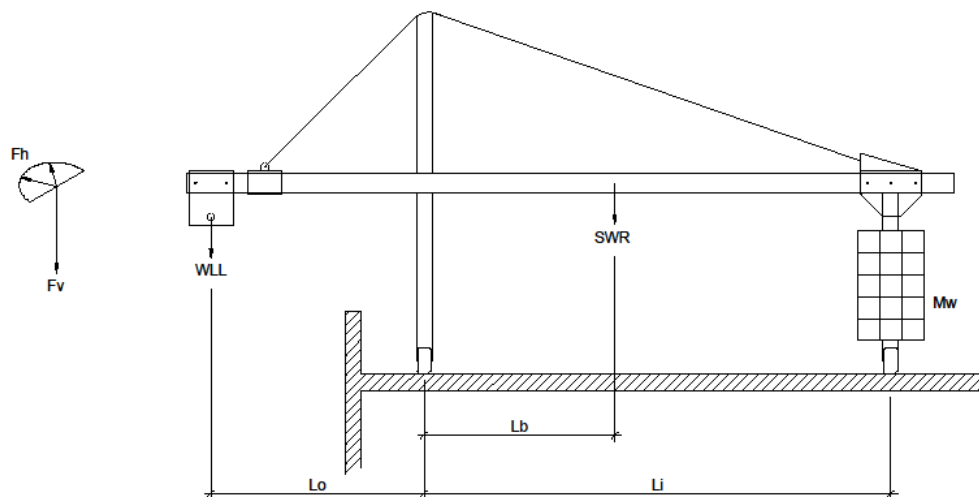


Figure 4. Typical Suspension Beam

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 m<sup>2</sup> 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	$1,25 \times \text{TSL} + 1,25 \times \text{TSHL}$	$1,25 \times \text{Mo}$ (a)	$1,25 \times \text{Mi}$ (a)	$1,25 \times \text{Fw1 Plat} + 1,25 \times \text{Fw1 Rig} + 1,25 \times \text{FwMH}$ (b) + $2 \times \text{M} \times \text{acc}$ (c)
Load case 2a (static test loads)	$1,5 \times \text{RL} + 1 \times \text{SWP} + 1,25 \times \text{HWLL} + 1 \times \text{HSW}$	$1 \times \text{Mo}$	$1 \times \text{Mi}$	0
Load case 2b – Out of service conditions	generally 0	$1 \times \text{Mo}$	$1 \times \text{Mi}$	$\text{Fw2 Plat} + 1 \times \text{Fw2 Rig}$
Load case 3 – Triggering of the secondary device	$\text{Sd} \times \text{TSL} + 1,1 \times \text{TSHL}$	$1 \times \text{Mo}$	$1 \times \text{Mi}$	0

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

(a) For static suspension rig use  $1 \times \text{Mo}$  and  $1 \times \text{Mi}$

(b) Fw1 on platform: The minimum horizontal load on the suspension points of the ropes is  $0.1 \times \text{TSL}$  in all directions

(c) Acceleration forces for traversing suspension rig (trolley) are  $2 \times \text{M} \times \text{acceleration}$  (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	$1,25 \times \text{WLL} + 1,25 \times \text{TSHL}$	$1,25 \times \text{Mo}$ (a)	$1,25 \times \text{Mi}$ (a)	$1,25 \times \text{Fw1} + 1,25 \times \text{FwMH}$ (b)
Load case 2a	$1,5 \times \text{WLL} + 1,25 \times \text{HWLL} + 1 \times \text{HSW}$	$1 \times \text{Mo}$	$1 \times \text{Mi}$	0
Load case 3 Triggering of the secondary device	$2,5 \times \text{WLL} + 1,1 \times \text{TSHL}$	$1 \times \text{Mo}$	$1 \times \text{Mi}$	0
Out of service condition	generally 0	$1 \times \text{Mo}$	$1 \times \text{Mi}$	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**

	<b>Total suspended load (N)</b>	<b>Weight of outboard portion (N)</b>	<b>Weight of inboard portion (N)</b>	<b>Horizontal force (Fh) (N)</b>
Working stability	$2 \times \text{TSL} + 1,4 \times \text{TSHL}$	$1,25 \times \text{Mo}$	$1 \times \text{Mi}$	$1,25 \times \text{Fw1 Plat} + 1,25 \times \text{Fw1 Rig}$
Parking stability	generally 0	$1 \times \text{Mo}$	$1 \times \text{Mi}$	$\text{Fw2 Plat} + \text{Fw2 Rig}$

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**

	<b>Total suspended load (N)</b>	<b>Weight of outboard portion (N)</b>	<b>Weight of inboard portion (N)</b>	<b>Horizontal force (Fh) (N)</b>
Working stability	$3 \times \text{WLL} + 1,4 \times \text{HWLL}$	$1,25 \times \text{Mo}$	$1 \times \text{Mi}$	Ignore
Parking stability	generally 0	$1 \times \text{Mo}$	$1 \times \text{Mi}$	$\text{Fw2 Plat} + \text{Fw2 Rig}$

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

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## 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:

$$(1.25 \times \text{TSL}) + (1.25 \times \text{TSHL})$$

### 6.2. Load Case 2a – Overloads Activated

As Table 9 within BS EN 1808:

$$(1.5 \times \text{RL} + \text{SWP}) + (1.25 \times \text{HWLL} + 1 \times \text{HSW})$$

### 6.3. Load Case 2b – Parking Plus Storm Winds

As Table 9 within BS EN 1808:

$$(0 \times \text{TSL}) + (\text{Storm Wind})$$

### 6.4. Load Case 3 – Extreme Condition

As Table 9 within BS EN 1808:

$$(\text{Sd} \times \text{TSL}) + (1.1 \times \text{TSHL})$$

### 6.5. BMU Stability

As Table 11 within BS EN 1808:

$$(2 \times \text{TSL}) + (1.4 \times \text{TSHL})$$

### 6.6. Parking Stability

As Table 11 within BS EN 1808:

$$(0 \times \text{TSL}) + (\text{Storm Wind})$$


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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).

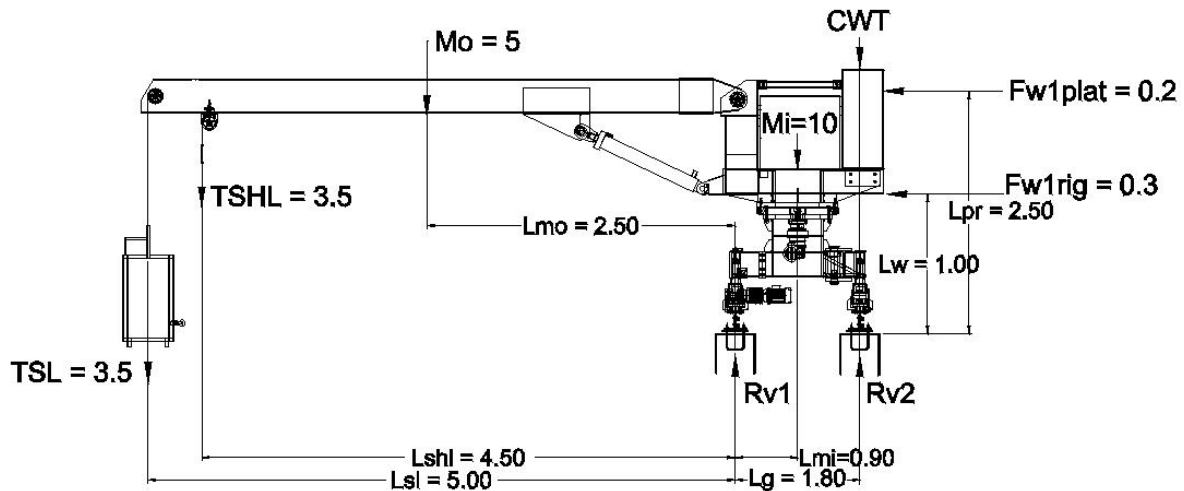
### **7.3. Stability**

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

$$\begin{aligned} & (2.00 \times TSL \times Lsl) + (1.40 \times TSHL \times Lshl) + (1.25 \times Mo \times Lmo) \\ & \quad + (1.25 \times Fw1 \text{ rig} \times Lw) + (1.25 \times Fw1 \text{ plat} \times Lpr) \\ & = (Mi \times Lmi) + (Lg \times CWT) \end{aligned}$$

$$\begin{aligned} & (2.00 \times 3.50 \times 5.00) + (1.40 \times 3.00 \times 4.50) + (1.25 \times 5.00 \times 2.50) \\ & \quad + (1.25 \times 0.30 \times 1.00) + (1.25 \times 0.20 \times 2.50) \\ & = (10.00 \times 0.90) + (1.80 \times CWT) \end{aligned}$$

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

$$CWT = 34.19kN$$


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**Calculate Reactions  $Rv_1$  and  $Rv_2$  for all load cases**

**Load Case 1 (6.1)**

For  $Rv_1$ , take moments about  $Rv_2$

$$\begin{aligned} & (1.25 \times TSL \times (Lsl + Lg)) + (1.25 \times TSHL \times (Lshl + Lg)) \\ & + (1.25 \times Mo \times (Lmo + Lg)) + (1.25 \times Mi \times Lmi) \\ & + (1.25 \times Fw1 \text{ plat} \times Lpr) + (1.25 \times Fw1 \text{ rig} \times Lw) = (Rv_1 \times Lg) \end{aligned}$$

$$\begin{aligned} & (1.25 \times 3.50 \times 6.80) + (1.25 \times 3.00 \times 6.30) + (1.25 \times 5.00 \times 4.30) \\ & + (1.25 \times 10.00 \times 0.90) + (1.25 \times 0.20 \times 2.50) \\ & + (1.25 \times 0.30 \times 2.50) = (Rv_1 \times 1.80) \end{aligned}$$

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

$$Rv_1 = 51.92kN$$

For  $Rv_2$ , take moments about  $Rv_1$

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

$$\begin{aligned} & (1.25 \times TSL \times Lsl) + (1.25 \times TSHL \times Lshl) + (1.25 \times Mo \times Lmo) \\ & - (1.25 \times Mi \times Lmi) - (1.25 \times Fw1 \text{ plat} \times Lpr) \\ & - (1.25 \times Fw1 \text{ rig} \times Lw) - (CWT \times Lg) = (Lg \times Rv_2) \end{aligned}$$

$$\begin{aligned} & (1.25 \times 3.50 \times 5.00) + (1.25 \times 3.00 \times 4.50) + (1.25 \times 5.00 \times 2.50) \\ & - (1.25 \times 10.00 \times 0.90) - (1.25 \times 0.20 \times 2.50) \\ & - (1.25 \times 0.30 \times 1.00) - (34.19 \times 1.80) = (1.80 \times Rv_2) \end{aligned}$$

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

$$Rv_2 = -10.78kN$$


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**Load Case 2a (6.2)**

For  $Rv_1$ , take moments about  $Rv_2$

Where HWLL = 2.50kN

HSW = 0.50kN

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

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

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

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

For  $Rv_2$ , take moments about  $Rv_1$

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

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

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

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

**Load Case 2b (6.3)**

Wind pressure  $q$  is  $1.1\text{kN/m}^2$ , Rig  $4\text{m}^2$ , plat  $2\text{m}^2$

So  $Fw2\text{ plat} = 2 \times 1.1 = 2.2\text{kN}$

$Fw2\text{ rig} = 4 \times 1.1 = 4.4\text{kN}$

For  $Rv_1$ , take moments about  $Rv_2$

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

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

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

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

For  $Rv_2$ , take moments about  $Rv_1$

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

$$(0.00 \times TSL \times Lsl) + (0.00 \times TSHL \times Lshl) + (1.00 \times Mo \times Lmo) \\ - (1.00 \times Mi \times Lmi) - (1.00 \times Fw2\text{ plat} \times Lpr) \\ - (1.00 \times Fw2\text{ rig} \times Lw) - (CWT \times Lg) = (Lg \times Rv_2)$$

$$0.00 + 0.00 + (5.00 \times 2.50) - (1.00 \times 10.00 \times 0.90) - (1.00 \times 2.20 \times 2.50) \\ - (1.00 \times 4.40 \times 1.00) - (34.19 \times 1.80) = 1.80Rv_2$$

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

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

**Load Case 3 (6.4)**

Sd = 3

For  $Rv_1$  take moments about  $Rv_2$

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

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

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

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

For  $Rv_2$ , take moments about  $Rv_1$

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

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

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

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

### Working Stability (6.5)

For  $Rv_1$  take moments about  $Rv_2$

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

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

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

$$Rv_1 = 61.64kN$$

For  $Rv_2$ , take moments about  $Rv_1$

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

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

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

$$Rv_2 = 0.00kN$$



### Parking Stability (6.6)

Storm wind pressure  $q$  is  $1.1\text{kN/m}^2$ , rig  $4\text{m}^2$ , plat  $2\text{m}^2$

Therefore:  $Fw2plat = 2.00 \times 1.10 = 2.20\text{kN}$

$Fw2rig = 4.00 \times 1.10 = 4.40\text{kN}$

For  $Rv_1$ , take moments about  $Rv_2$

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

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

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

$$\mathbf{Rv_1 = 22.44\text{kN}}$$

For  $Rv_2$ , take moments about  $Rv_1$

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

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

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

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

$$\mathbf{Rv_2 = -37.74\text{kN}}$$

**Table of Results**

*Table 1. Results of worked examples in Appendix A1*

		<b>Rv<sub>1</sub> kN</b>	<b>Rv<sub>2</sub> kN</b>
<b>6.1</b>	Load Case 1	51.92	-10.78
<b>6.2</b>	Load Case 2a	47.39	-10.13
<b>6.3</b>	Load Case 2b	22.44	-37.74
<b>6.4</b>	Load Case 3	68.16	5.17
<b>6.5</b>	Stability	61.64	0.00
<b>6.6</b>	Parking	22.44	-37.74