Design Calculations

Site Supplies Direct Ltd
Slot Block Stability Calculation

Drawing	Issue	Description

Revision	**Description**	**Created**	**Checked**	**Date**
A	Initial issue	RJC	MG	01.04.15

Introduction

Slot Block, manufactured by Site Supplies Direct Ltd is a water filled barrier designed to hold a standard 'Heras' fence panel.
Site Supplies Direct Ltd have stated that the barrier has been wind tested by MIRA to 'withstand 57 mph'.

This calculation has been commissioned to establish the maximum wind speed mathematically and to compare it to the experimental value.

The calculation will be carried out to :
BSI Code of Practice CP3 - Code of Basic data for the design of buildings, Chapter V - Loadings, Part 2 - Wind.

General assumptions

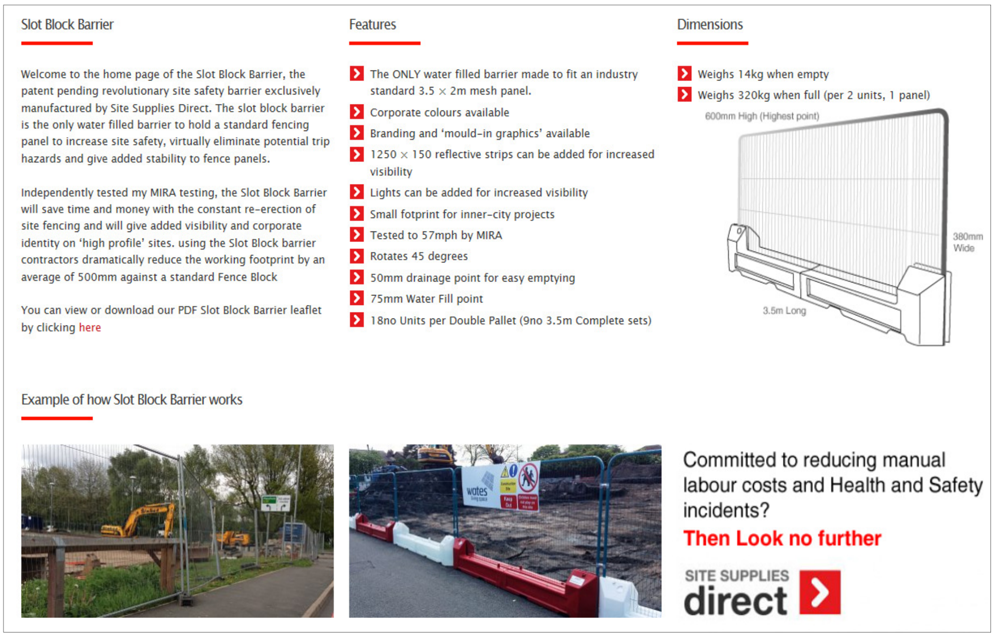
Weights and dimensions of the Slot Block base are taken from the Site Supplies Direct Ltd website and have been confirmed from detailed drawings of the base.
Weights and dimensions of the fence panels are taken from information supplied by Heras. See Appendix.
Note: the difference in fence weight and construction has a negligible effect on the design wind speed calculation.
A round top panel has been considered in this calculation as this is shown in the images from MIRA wind tunnel tests. See Appendix.
Panels are installed vertically upright on firm ground.
The calculation assumes a single panel but applies equally to multiple panels in a straight line configuration.

Design wind speed factors & constants (in accordance with CP3:Chapter V:Part2)

g	Acceleration due to gravity	9.81	m/s^2

The calculation is used to establish a design wind speed, V_s.

Calculate stabilising moment



m_{base} :	Mass of 'Slot Block' water filled base	*From 'Slot Block' website* =	160	kg
		=	1570	N
m_{panel} :	Mass of Heras panel	*From Heras drawing* =	17	kg
		=	167	N
n :	Number of 'Slot Block' bases per panel	=	2	
w :	Width of base	*From 'Slot Block' website* =	0.38	m
$M_{stabilising}$:	Stabilising moment	$(nm_{base} + m_{panel})\ .\ w/2$ =	628.13	Nm

Calculate frame areas for Heras panels

h :	Height of panel	*From Heras drawing* =	2000	mm
s :	Offset at base of panel	*From Heras drawing* =	158	mm
b :	Breadth of panel	*From Heras drawing* =	3450	mm
x :	Pitch of vertical mesh bars	*From Heras drawing* =	41.5	mm
y :	Pitch of horizontal mesh bars	*From Heras drawing* =	261	mm
A :	Total area enclosed by the panel	$(h\text{-}s)b$ =	6354900	mm^2
		=	6.355	m^2
n_v :	Number of vertical mesh bars per panel	*From Heras drawing* =	81	
n_h :	Number of horizontal mesh bars per panel	*From Heras drawing* =	6	
A_1 :	Area of tubular frame	$2[h+(b-2D_{frame})] \times D_{frame}$ =	409484	mm^2
		=	0.409	m^2
A_2 :	Area of horizontal mesh bars	$(b-2D_{frame}) \times n_h \times D_{mesh}$ =	60728	mm^2
		=	0.061	m^2
A_3 :	Area of vertical mesh bars	$[(h-s-2D_{frame}) - (n_h \times D_{mesh})] \times n_v \times D_{mesh}$ =	424715	mm^2
		=	0.425	m^2
A_e :	Effective area of the frame	$A_1 + A_2 + A_3$ =	0.895	m^2

Calculate solidity ratio and determine force co-efficient

ϕ : Solidity ratio	A_e / A =	0.14	
C_f : Effective force co-efficient	*From Table 20* =	1.2	

Calculate the wind force required to overturn the panel

At the point where the frame looses stability, the overturning moment equals the stabilising moment.

a : Lever arm	*150mm 'Slot Block' base + (h/2)* =	1150	mm
	=	1.15	m
F : Force at point of instability	$M_{stabilising} / a$ =	546	N

Calculate the wind speed to generate overturning force

q : Dynamic wind pressure to generate wind force	$F / C_f . A_e$ =	407	N/m^2
One mile	=	1609.344	m
k : Factor for SI units	=	0.613	
V_s : Design wind speed	√ (q/k) =	25.8	m/s
	=	57.7	mph

Calculate DV_s values for panel members to confirm that it is acceptable to use values from Table 20

D_{frame} : Diameter of frame members	=	38.1	mm
	=	0.0381	m
DV_s value for frame members	$D_{frame} \times V_s$ =	0.982	m^2/s
D_{mesh} : Diameter of mesh members	=	3.0	mm
	=	0.0030	m
DV_s value for mesh members	$D_{mesh} \times V_s$ =	0.0773	m^2/s

Since DV_s is less than 6 m^2/s for all circular members, force co-efficients from Table 20 may be used.

Conclusion:

There is a good correlation between the theoretical calculation and the experimental result.

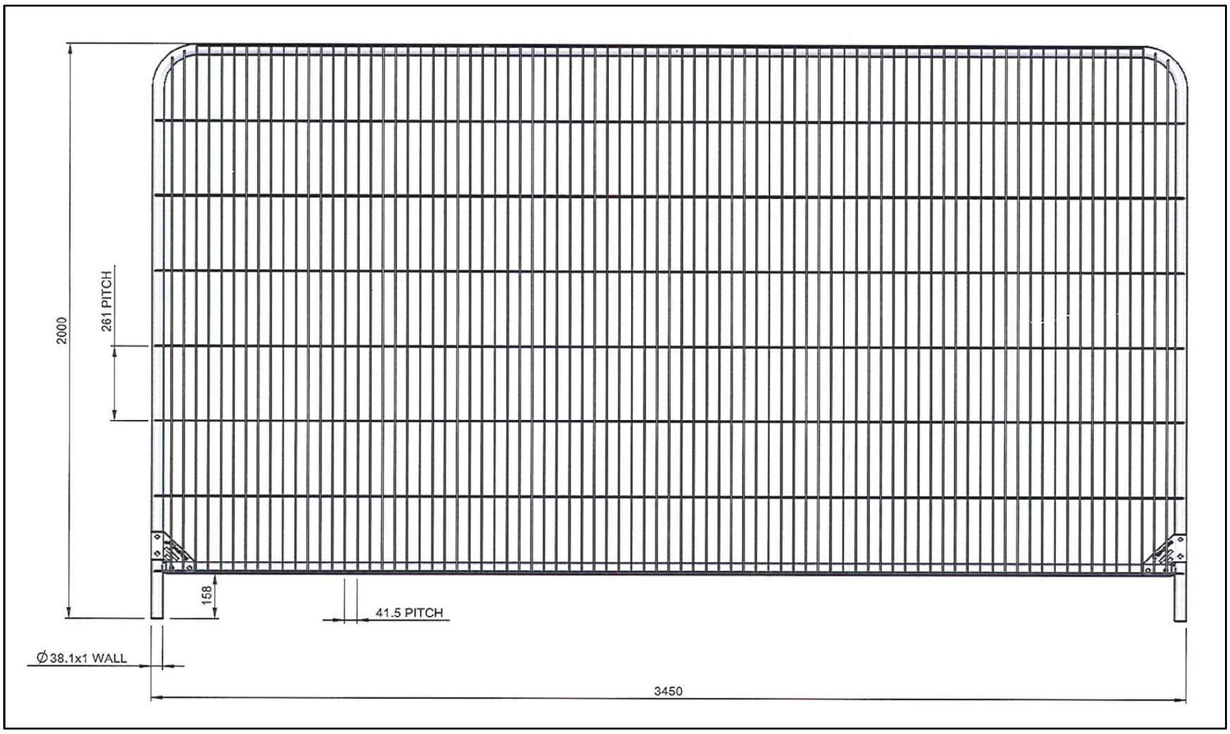
Our calculation has estimated that the barrier will fall over at a design wind speed of 58mph.

It is our understanding that the tests conducted at MIRA showed the panels to blow over at 57mph.

From these calculations and the wind tunnel tests it has been demonstrated that the supports, when installed as per the general assumptions on page 2, will remain standing in constant wind speeds upto 57mph.

Appendix

Fence panel:



Wind tunnel test: