Checking Report
for
Wi Column
by
Wembley Innovation Limited

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1. Overview

Clegg Associates Ltd was requested by Wembley Innovation (WI) to carry out a Category 3 check of a technical comparison between Wi columns and Ancon WP2 windposts.

This brief report outlines the scope of checking undertaken and summarises the checking results. It is understood that WI may use this report and Certificate for the purpose of declaring that an Independent Engineer has reviewed the system and found it to be satisfactory.

2. Checking Procedure

Clegg Associates Ltd has undertaken an examination of structural design of the above mentioned system. As part of the checking procedure, an independent analytical exercise has been carried out and consequently a separate set of calculations, verifying a selected panel, has been produced to reasonable skill and care. As such, methods of analysis employed may differ from original WI calculations; however it is believed that the results are comparable. The calculations have been presented in Appendix A of this report.

3. Design Calculations and Analysis

This section summarises design codes, technical literature and software used in carrying out the verifying design calculations exercise.

a. Design Codes

- BS 5628 – 1 1992: "Code of Practice for use of Masonry"
- BS EN 1996 -1 – 1: 2005 "Eurocode 6, Design of Masonry Structures
- UK National Annexes

b. Technical / Manufacturer Literature

- Ancon Building Products – Windposts, Parapet Posts & Masonry Reinforcement
- Wembley Innovation – Wi System Design Program Manual
- Wembley Innovation – Comparison of Ancon Windposts vs Wi Columns
- http://www.wembleyinnovation.co.uk/

c. Design and Analysis Software

- CSC Tedds 2015 for Word. Template Calculations

4. Summary

The WI Comparison document uses an 11.0 metre panel to be restrained by either stainless steel windposts or Wi Columns. From the Ancon data table, the 140mm wall requires 5No Ancon windposts (130 x 70 x 6 section) which would be spaced at 1860mm. The equivalent panel restrained by Wi Columns would require only 3No columns spaced at 2413mm.

In order to satisfy the structural adequacy of the Wi Column solution, verifying calculations have been carried out to British Standard and Eurocode for the following panel configuration:

- Panel width 2750mm x Panel height 4000mm, 140mm, 7.3N/mm^2 aggregate concrete blocks, mortar M4, subject to a characteristic wind load of 1.0 kN/m^2.

5. Findings

The typical panel detailed on Sustainability Check – Calc No W140/MaxL/01 has passed the independent design checks, which are presented in Appendix A of this report. Due to methods of analysis employed or analytical approach taken some calculations may have returned slightly different (although comparable) results from WI calculations.

British BS5628 Manuf Control - Category 1 Construction Control - **Special**	Flexural Stress Allowable - 0.697 kNm/m Actual - 0.709 kNm/m	Utilisation 1.02
Eurocode 6 Manuf Control - Category 1 **Class 1**	Wall Design Moment Allowable - 0.757 kNm/m Actual - 0.705 kNm/m	Utilisation 0.930

As such, Clegg Associates have no adverse comments on the typical panel (as listed above) presented for checking by WI.

6. Conclusions

a. An independent set of calculations for the typical panel supplied for checking has been produced and is presented in Appendix A of this report.

b. Clegg Associates Ltd has made our own judgement on analysis methods therefore some results might slightly differ from the ones presented in WI calculations.

c. The calculations presented in Appendix A did not return results indicating possibility of structural failure to Eurocode under the loadings supplied and with details proposed by WI.

d. As such, Clegg Associates Ltd has no adverse comments on design calculations and comparison documents supplied for checking by WI

e. Using an 11.0m long x 4.0m high masonry panel, we can conclude that 3No Wi Columns are structurally adequate against the need for 5No Ancon Windposts to provide similar stability.

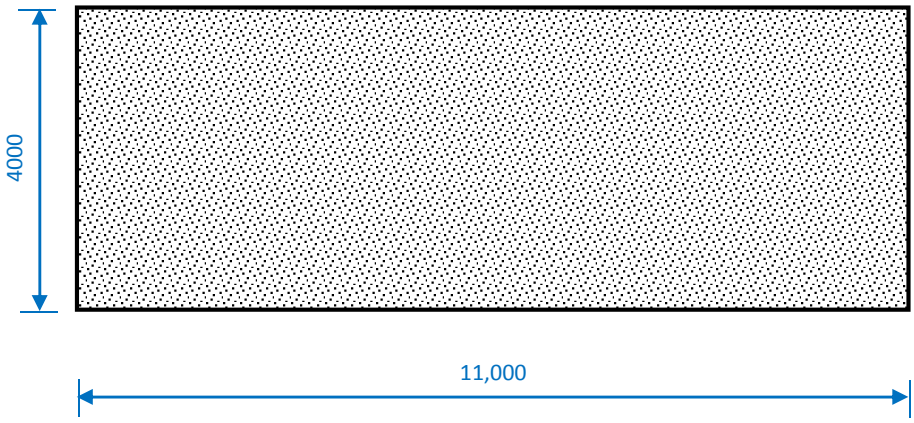
Comparison of Lateral Supports: Steel Angle Windpost vs Wi Column

Introduction

This study compares a stainless steel 130 x 70 x 6 “Angle” windpost against a Wi Column. Both members are typically adopted as structural supports for laterally loaded walls.

For this case, the windpost and Wi Column are required to support a 140mm blockwork wall 11m long and 4m high, subjected to a pressure of 1.0kPa.

Panel Design



Wall Panel Dimensions

Panel capacity calculation

Refer to CADS wall panel calculation sheet W140/MaxL/01:

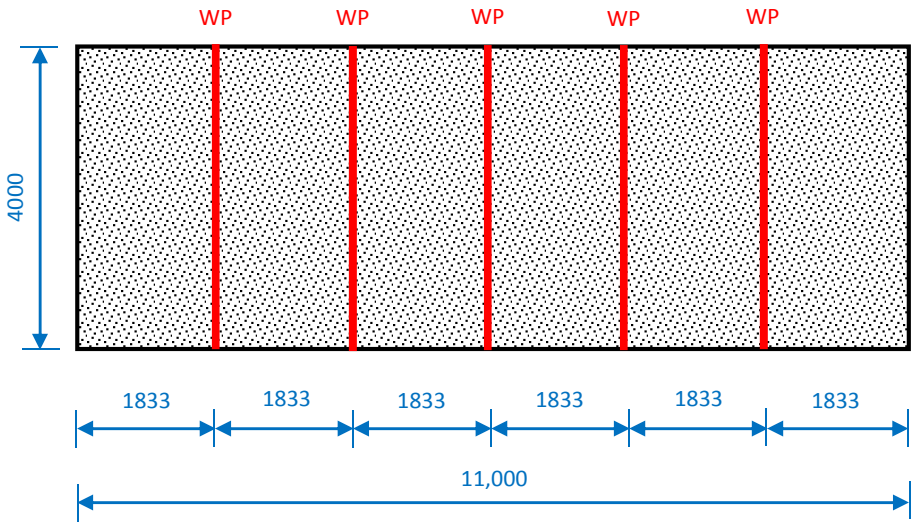
For a 140mm wall, 4m height and load pressure = 1.0kPa, the maximum panel length = **2750mm**

Windpost calculation

From Table 1, which is based on Ancon windpost load capacities, select 130 x 70 x 6 section, which is the largest capacity windpost suitable for a 140mm wall.

For a 140mm wall, 4m height and load pressure = 1.0kPa, the maximum allowable panel length = **1860mm**

Therefore, if the wall is restrained by the primary structure either end, the number of panels formed are: 11,000/1860 = 6no. with 5no. windposts, as below:



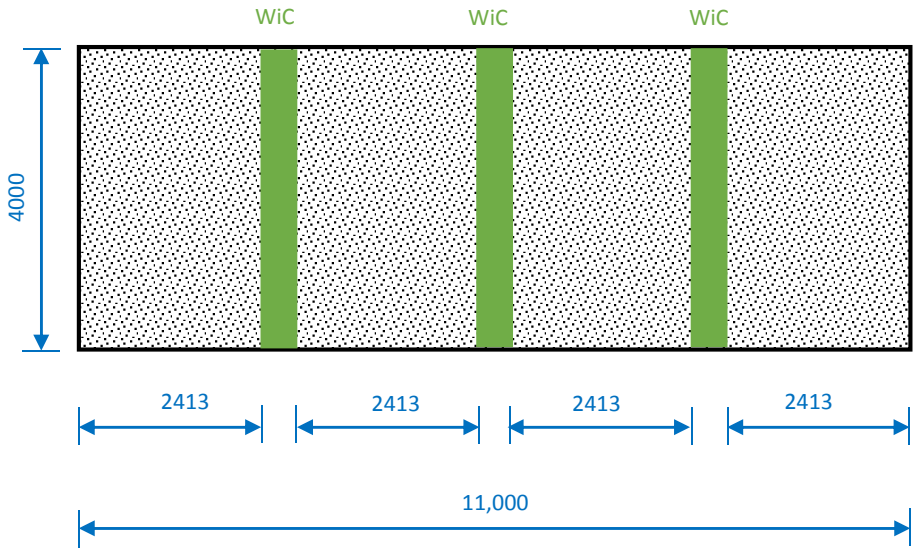
Windpost and panel layout

Wi Column calculation

Refer to Wi Design Program page WiC/01:

For 140mm wall, 4m height, load pressure = 1.0kPa and a maximum panel length = 2750, the Wi Column is satisfactory, with a **Utilisation Ratio = 0.48** (Using the "conservative approach")

Therefore, if the wall is restrained by the primary structure either end, the number of panels formed are: 11,000/2750 = 4no. with 3no. windposts, spaced 2413mm apart, face-to-face (as per design for Wi Columns) as below:

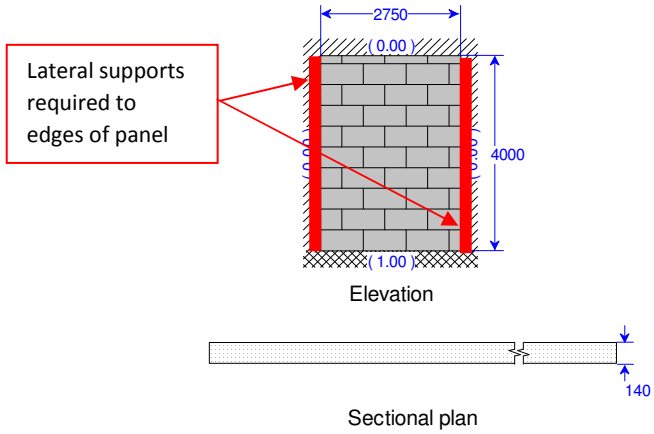


Wi Column and panel layout

Conclusions

1. For the same conditions, 5no. 130 x 70 x 6 windposts are required versus 3no. Wi Columns.
2. The 5no. windposts are at maximum capacity, whilst the 3no. Wi Columns are at a utilisation ratio of only 48%.
3. The Wi Column design is based on a "conservative" approach, which has been utilised for direct comparison with the windpost result. The Wi Column utilisation ratio can be further reduced to 43%, if the "standard approach" is adopted, which is the norm.
4. The windpost capacity is based on creating a fully mortared joint against the blockwork panels. If a movement joint is required, the capacity will be reduced.
5. The comparison is for a standard 140mm Wi Column and the highest capacity angle windpost that can be accommodated within a 140mm blockwork wall.

WEMBLEY INNOVATION™	**SUSTAINABILITY CHECK** **Wi Column vs Windpost Check** **Maximum Panel Length Calculation** **140mm Wall 4000 high x 2750 long** **Wind load = 1.0kPa**	Job No : Job Ref : Designed By : TS Checked By : Date : 20/03/15 Revision No : Calc No : W140/MaxL/01 Page No : 1



Data item	*Near*
Bed joint reinforcement	No
DPC - top	No
DPC - bottom	No

Note:
1.For details of masonry units, bed joint reinforcement and damp proof course refer to 'Material and design data'
2.For details of wall ties (if specified) refer to 'Concise' or 'Detailed' report.
3.Figures in brackets eg: (1.00) shown in elevation indicate user defined proportional fixity/continuity factor applied before allowing for openings.

Masonry characteristic strengths

Description	*Near*	*Units*	*Description*	*Near*	*Units*
Design code	EN 1996-1-1:2005		Shear		
Compression			Shear without compression	0.15	N/mm²
Factor for collar joint	1.00	-	Shear friction coefficient	0.40	-
Compression on bed joints	5.73	N/mm²	Limiting shear	0.65	N/mm²
Compression // bed joints	5.73	N/mm²	Vertical shear- bonded		N/mm²
Flexure			Elastic modulus		
Horizontal span	0.53	N/mm²	Short term	5.73	kN/mm²
Vertical span	0.22	N/mm²	Long term	2.29	kN/mm²

Characteristic vertical loads

Load category name	Near	
	Load (kN/m)	Ecc. mm

Characteristic lateral wind pressure

Category name	Dyn. pr. kN/m²	Coeff. Near	Coeff. Far	Net coeff.	Res. pr. kN/m²
Wind near	1.000	0.700	-0.300	1.000	1.000

Characteristic lateral line load

Category name	Load kN/m	Height from bottom mm

Note: For details of more than two loads please refer detailed report

Summary results (critical load combinations)

Description	*Wall*	*Status*	*Units*	*Description*	*Near*	*Status*	*Units*
Lateral load capacity	1.610		kN/m²	Max. slenderness ratio	27		
Design uniform load	1.500		kN/m²	Actual	9.821		
Utilisation	**0.932**	**Pass**		Utilisation	0.364	Pass	
Load combination	0.90D+1.50Wn						
Limiting dimension / area							
Allowable	90		mm				
Actual	140		mm				
Utilisation	0.643	Pass					

Notes:

- **This is an example calculation to determine the maximum panel length for a 140mm block wall 4m in height and 11m in overall length , subject to a wind load of 1.0kPa**
- **The maximum panel length is 2750 and will require structural supports to its edges if it is an internal panel to a continuous wall**

Comparison of Ancon Windposts vs Wi Columns

TABLE 1

Note: Values will be based on full restraint of long leg of angle i.e. no provision of movement joint. If MJ is required, values are likely to be considerably reduced

Design spacings of windposts

	Max Total Design UDL (kN) per Post (from Ancon Tables)							
130x70x6	15.83	11.93	9.3	7.42	6.03	4.98	4.17	3.53
	Height (m)							
Wind kPa	**2.50**	**3.00**	**3.50**	**4.00**	**4.50**	**5.00**	**5.50**	**6.00**
0.25	25.33	15.91	10.63	7.42	5.36	3.98	3.03	2.35
0.50	12.66	7.95	5.31	3.71	2.68	1.99	1.52	1.18
0.75	8.44	5.30	3.54	2.47	1.79	1.33	1.01	0.78
1.00	6.33	3.98	2.66	**1.86**	1.34	1.00	0.76	0.59
1.25	5.07	3.18	2.13	1.48	1.07	0.80	0.61	0.47
1.50	4.22	2.65	1.77	1.24	0.89	0.66	0.51	0.39
1.75	3.62	2.27	1.52	1.06	0.77	0.57	0.43	0.34
2.00	3.17	1.99	1.33	0.93	0.67	0.50	0.38	0.29
2.25	2.81	1.77	1.18	0.82	0.60	0.44	0.34	0.26
2.50	2.53	1.59	1.06	0.74	0.54	0.40	0.30	0.24
2.75	2.30	1.45	0.97	0.67	0.49	0.36	0.28	0.21
3.00	2.11	1.33	0.89	0.62	0.45	0.33	0.25	0.20

Figure in red used to compare against Wi Column design

Figures in grey are uneconomic / impractical spacings

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Ancon WP2 vs Wi Col		Job No:	
		Revision	
Prepared By:	**TS**	Page:	**WiC/01**
Wall Ref.: **Comparison with Ancon 130x70x6 WP2**	Checked By:	Date:	**13/03/2015**

GENERAL DATA

Element type:	**Wi Column**
Design approach:	**Conservative**

SUMMARY OF RESULTS

Wi Column utilisation ratio = 0.48

...ADOPT: 140mm thk Wembley Innovation Wi Column

ELEMENT ARRANGEMENT

Wi Column width:	**Single**
Left side construction type:	**Standard**
Right side construction type:	**Standard**
Wall thickness 't' *[mm]* =	**140**
Panel height 'H' *[m]* =	**4.00**
Distance to left column's face 'w_1' *[m]* =	**2.41**
Distance to right column's face 'w_2' *[m]* =	**2.41**

DESIGNER'S NOTES

Normally Wi Column would be checked with Standard approach
"Standard" approach UR = 0.43
Check is for panel length = 11000 - (3 x 450) = 2413mm
Comparison is for a 140mm block wall

Wi Column is considerably stronger than the WP2 section
Colour coding not required colour coding

UNFACTORED LOADING

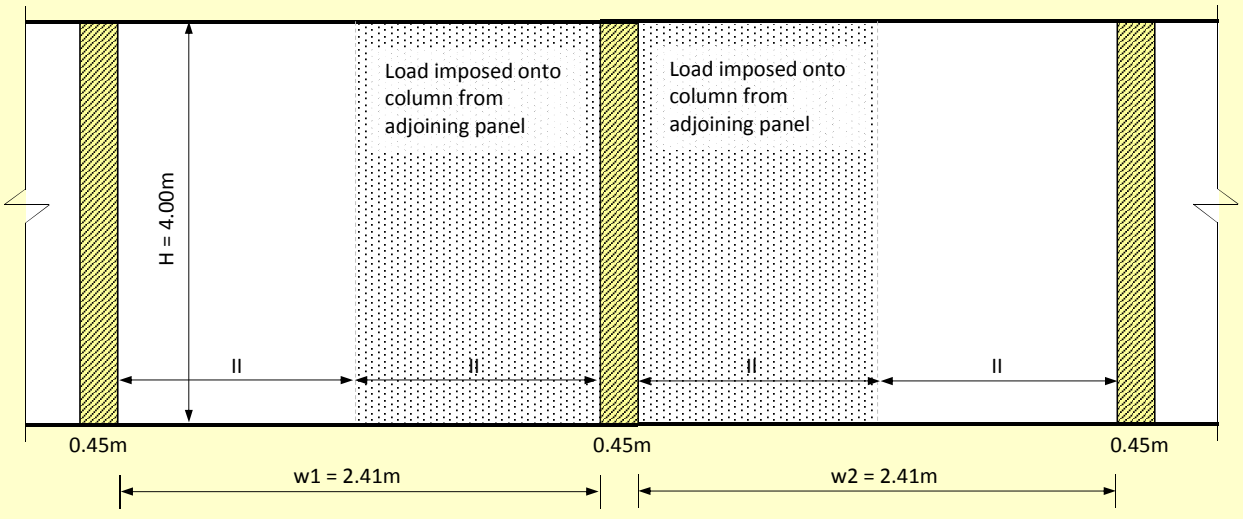
Lateral wind load 'W_k' *[kN/m^2]* =	**1.00**
Barrier distributed load 'W_{b_UDL}' *[kN/m^2]* =	**0.00**
Barrier line load 'W_{b_line}' *[kN/m]* =	**0.00**
Barrier height 'h_b' *[m]* =	**0.00**
Partial load factor for wind load 'γ_f' =	**1.50**
Partial load factor for barrier load 'γ_f' =	**1.50**
Partial material factor 'γ_M' =	**2.00** (?)

CALCULATIONS

Unfactored reaction btm / top 'R' *[kN]* =	5.73 / 5.73
Unfactored moment: wind load *[kNm]* =	5.73
Unfactored moment: barrier distributed *[kNm]* =	0.00
Unfactored moment: barrier line load *[kNm]* =	0.00
Total applied factored moment 'M_{Ed}' *[kNm]* =	8.59
Moment of resistance 'M_{Rd}' *[kNm]* =	18.00

...ADOPT: 140mm thk Wembley Innovation Wi Column

DIAGRAM



NOTE: This diagram is indicative only. It is not to scale.

NOTES:

1. Clear span between columns is edge-to-edge of columns (not centre-to-centre);
2. Panel is assessed as having simple support conditions to all 4 sides;
3. Classic "back of envelope" failure of the panel is assumed to occur with 45° yield lines at corners;
4. Sub-panels to be designed according to BS EN1996-1.1.