

Loading and Stability Report for Proposal "Hatfield Galleria - 611.1" (611.1)

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Mini Rbt

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The Design Life of the proposal is 25 years.

General Assumptions

All lengths and positions are given in mm, masses in kg, forces in kN unless otherwise stated.

Gravity is taken to be 9.81 m/s²

Assembly maximum allowed overall width = 15 m, maximum allowed overall height = 9 m.

Where appropriate, partial action factors are chosen from Design Approach 1: Combinations DC1 and DC2; PAF1 for ULS structural tests.

Foundations are sized using methodologies from Eurocode 7 and BD 94/07.

Signs with channels, have deflections tested to TDB4 (25 mm/m).

Signs without channels are not tested.

The ground and structure in this proposal have been classed as Geotechnical Category 2

Environs

This proposal is situated in the general Environs "Hatfield" whose details are given below.

Location	England
Description	Hatfield Galleria
Terrain Class	III (Town)
General Altitude	85 m
Exposure	Normal
Orography	Not significant

Local Site

Within this Environs, the assembly is to be constructed on an area whose Local Site details are as follows:

Altitude	85 m
Exposure	Normal
Orography	Not significant
Distance to Shore-line	40.0
Distance to Town Edge	0.4

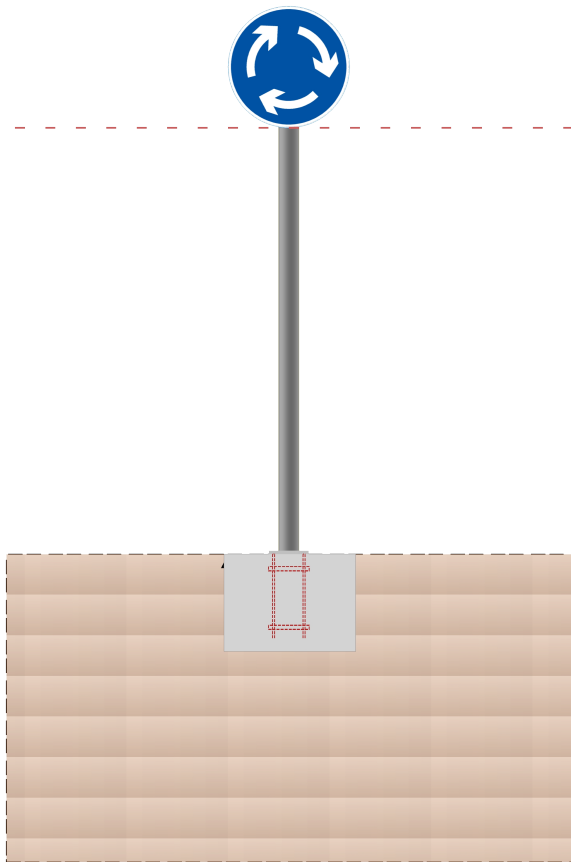
Structure and Sign Assembly

Component objects	Signs: 1	Posts: 1	Foundations: 1
Max height above ground	2700 mm		
Mounting height	2100 mm	Carriageway Clearance	2100 mm
Bearing from North	000 °		
Electrical Housings	None		

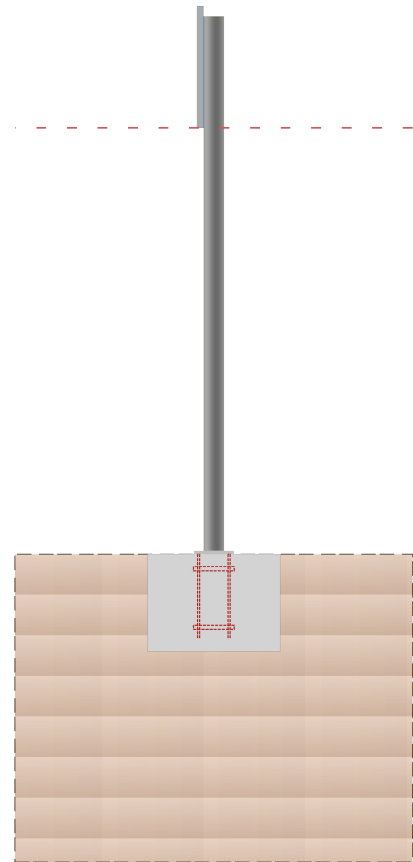
Safety Factors

Destabilising (model) $\gamma_s;d$	1.25	(Default)
Overtipping	1.50	(Default)
Sliding	1.50	(Default)
Additional Factor	1.00	(Default)
Slope Stability Factor	1.50	(Default)

Front Elevation



Side Elevation



Wind

Wind Load Method		Eurocode 1	
Based on a wind return period of		25 years	
1-year wind return factor		0.611	
Wind velocity based on location	$v_{b,map}$	21.526 m / s	
Altitude factor	c_{alt}	1.085	
Fundamental Basic Wind Velocity	$v_{b,0}$	23.356 m / s	$= v_{b,map} \times c_{alt}$
Design life exceedence probability factor	c_{prob}	0.960	
Seasonal factor	c_{season}	1.000	
Air density in storm	ρ	1.226 kg / m ³	

Wind Force on Signs

Height from Ground to centroid 2400.0 mm

Plane XY

Orography factor	c_o	1.000	
Basic Wind Velocity	v_b	22.414 m / s	
Mean Basic Velocity Pressure	q_b	307.976 kN / m ²	
Exposure factor	c_e	1.417	
Peak Velocity pressure	q_p	0.437 kN / m ²	
Basic Wind Load (Pressure)	w_b	0.437 kN / m ²	(Above WL1)

Sign# 001

Area of Sign A_{ref} 0.283 m²

Wind Force

Effective slenderness ratio	λ	1.007	
Force coefficient	c_f	1.438	(By Eurocode 1 UK NA6)
Wind Design Pressure (ULS)	$w_{e,d}$ (ULS)	0.847 kN / m ²	
Wind Design Pressure (SLS)	$w_{e,d}$ (SLS)	0.628 kN / m ²	
Total Design Wind Force (ULS)	$F_{w,d}$ (ULS)	0.237 kN	
Total Design Wind Force (SLS)	$F_{w,d}$ (SLS)	0.176 kN	
Design Wind Force (SLS) 1-year Return	$F_{w,d}$ (1 yr)	0.107 kN	


Partial Action Factors for Loads

Ultimate Limit State (ULS)	γ_{fl}	1.350
Servicability Limit State (SLS)	γ_{fl}	1.000
Additional Factor	γ_{f3}	1.000

Ground

Grid Ref point	GB: (492502.0, 247760.0)		
Slope	0.0° (XY)		
Depth to solid layer	1 m		
Ground Category	Cohesive soils (Firm clays)		
Soil Quality	Unknown (Overridden from default of: Poor)		
Friction Coeff	0.303		
Presumed Allowable Bearing Pressure	100.0 kN / m ²		
Unit Weight	18.00 kN / m ³		
Angle of Internal Friction	φ	0 °	
Cohesion	cu	40	Tested Undrained
Ground Water	Well below foundations		

Signs

Sign	Ref	Type	Shape	Zpos	W	H	D	Mass	Face	Substrate	X	Y	Area
					mm	mm	mm	kg			mm	mm	m ²
001	NS3		Cir	Front	600	600	3.00	2.29		Generic Aluminium	0	2100	0.28

Posts

Support	Ref	Type	X	Y	H	Orient	Cap	BPlt	Doors	Mass	Flange	Mount	Anchorage	Foundation
			mm	mm	mm					kg				
001		ST-A	300	0	2650	000°	N	N	0	10	Y	Anchorage	AT-A	001

Support Types

Type	Manufacturer	Model	Section	Width	Breadth	Wall	Base	Material
				mm	mm	mm	mm	
ST-A	Signpost Solutions	Optimast	CHS	102.0	-	3.2	N/A	Aluminium/606385-T6

Type	Mass/m	VMax	MuMax _x	MuMax _y	TuMax	EI _x	EI _y	JG	Passive Safety
	kg / m	kN	kN m	kN m	kN m	kN m ²	kN m ²	kN m ²	
ST-A	3.80	3.60	6.50	6.50	2.60	91.000	91.000	24.000	100NE3

Note: Use of Passively Safe post types and those deemed Passively Safe under BS EN 12767 imply restrictions on mounting height, sign array size and post separation. The relevant standard and manufacturer's data should be checked to confirm that their use is appropriate.

Foundations

End	Shape	X	Y	W	L	H	Concrete/Material	Density	Type	Vol	Mass	Wgt
		mm	mm	mm	mm	mm		kg/m ³		m ³	tonnes	kN
001	Cir	-20	-480	650	650	480	Designated GEN1; S3; C25/30	2000.00	Custom Block	0.16	0.32	3.13

Anchorage Types

Type	Manufacturer	Model	Shape	Width	Breadth	Height	Style	Bolts	Sep
				mm	mm	mm			mm
AT-A	Signpost Solutions	Signpost Cradle (2510)	Square	200.0	200.0	412.5	Cradle	4	150

Results

Total Mass of Structure	0.331 tonnes
Total Weight of Structure	3.246 kN
Total Volume of added Concrete	0.159 m ³

Plane: XY

Signs

Deflections, where shown, are the approximate maximum across the sign. Wind Loads are distributed. Only signs with a sign thickness ≤ 10 mm and with channels are included in deflections.

Sign# 001

Deflection

(This Sign has no Channels so deflection is not considered)

Supports

For shear and bending, ULS wind force is applied. For temporary deflections, SLS (1 year) wind force is applied.
Max Temp. Deflection Class 50.0 mm / m (TDB5)

Post# 001

Ground Cover	0.000 mm		
Partial Material Factor	1.150		
Wind Load Applied (ULS)	0.237 kN	Wind Load Applied (SLS 1-yr)	0.107 kN

Ultimate Effects

Shear

Max Shear	P_v	3.600 kN
Partial Material Factor	Y_m	1.150
Ultimate Shear Capacity	P_v / Y_m	3.130 kN

Point Load

Wind Load

Basic Load	F_k	0.150 kN (PL1)	0.176 kN
Partial Action Factor	Y_F	1.35	1.35
Applied Load	F_d	0.203 kN	0.237 kN
Ultimate Design Shear	V_d	0.203 kN	0.237 kN
Shear Capacity used		6.5 % PASS	7.6 % PASS

Bending

Max Bending Moment	M_c	6.500 kN m
Partial Material Factor	Y_m	1.150
Ultimate Bending Capacity	M_c / Y_m	5.652 kN m

Point Load

Wind Load

Dead Load

Basic Load	F_k	0.150 kN (PL1)	0.176 kN	0.022 kN
Partial Action Factor	Y_F	1.35	1.35	1.20
Applied Load	F_d	0.203 kN	0.237 kN	0.027 kN
Total Bending Moment (inc. Dead Load)				
	V_v	M	-0.012 kN m	-0.001 kN m
	H_v	M	-0.548 kN m	-0.571 kN m
Bending Capacity used	V_v	Λ	0.2 % PASS	0.0 % PASS
	H_v	Λ	9.7 % PASS	10.1 % PASS

Overall Torsion of Post

For Point Loads, the worst case. For Wind Loads the worst case and the resultant.
Capacities have been checked against the Torsion on the Worst Side.

Max Torsion Moment	T_c	2.600 kN m
Partial Material Factor	γ_m	1.150
Ultimate Torsion Capacity	T_c / γ_m	2.261 kN m

		<u>Point Load</u>	<u>Wind Load</u> <u>(Worst Side, Left)</u>	<u>Wind Load</u> <u>(Whole)</u>
Basic Load	F_k	0.150 kN (PL1)	0.088 kN	0.176 kN
Applied Load	F_d	0.203 kN	0.119 kN	0.237 kN
Resultant Torque		0.060 kN	0.015 kN	0.000 kN
Maximum Design Torque	T_d	0.060 kN m	0.015 kN m	0.000 kN m
Torsional Capacity used		2.7 % PASS	0.7 % PASS	0.0 %

Combined Effects

This section lists the results of any interaction formulae used for combined effects.
Resultant Torque is used in the formulae.

Formula	<u>Point Load</u>	<u>Wind Load</u>
Linear: $M_d/M_c + T_d/T_c$	12.4 % PASS	10.1 % PASS

Deflections

In all cases, the SLS one year return Wind Load is applied.

Support Deflection due to Bending

The sum of the temporary deflections at the top.

		<u>Wind Load</u>
Applied Load	F_d	0.107 kN
Deflection	δ	6.289 mm
Deflection per metre	δ'	2.373 mm / m
Deflection Limit		50 mm / m (TDB5)
Deflection Capacity used		4.7 % PASS

Torsion

This section gives the maximum temporary torsion moment created by each sign.

Only signs on single posts are included. Wind Loads are applied to the whole Sign Assembly.

Sign# 001

		<u>Wind Load</u>
Applied Load	F_d	0.107 kN
Torsion Moment (sign v. centroid)		0.000 kN m
Angle of twist (at top of sign)		0.000 °
Deflection at edge, generated by this angle		0.000 mm

Overall Temporary Torsion of Post

For Point Loads, the worst case. For Wind Loads the resultant on the whole Assembly.
Capacities have been checked against the Resultant Torsion.

Wind Load

Applied Load	F_d	0.107 kN
Resultant Torque		0.000 kN m
Maximum Design Torque	T_d	0.000 kN m
Maximum Angle		0.000 °
Max Angle per metre		0.000 ° / m
Torsion Angular Defl. Class		0.29 ° / m (TDT4)
Torsional Deflection Capacity used		0.0 % PASS

Total Temporary Deflections due to Wind Load

Deflections are based on Wind Load acting on the sign assembly as a whole.

Sign # 001

Support deflection		6.487 mm
Sign deflection		N/A
Torsional resultant deflection		N/A
Total deflection		6.487 mm

Foundations and Stability

Foundation# 001 (Individual,Spread)

Destabilising

Unfactored Horizontal Load	F_{rep}	0.176 kN
Destabilising Moment	$M_{dst;k}$	0.506 kN m
Partial Factor	$\gamma_{G;dst}$	1.500
<u>Total Design Destabilising Effect</u>	$E_{dst;d}$	0.759 kN m
Restoring Moment	$M_{stb;k}$	1.054 kN m
Partial Factor	$\gamma_{G;stb}$	0.900
<u>Total Design Stabilising Effect</u>	$E_{stb;d}$	0.948 kN m
Capacity used	λ_{equ}	80.1 % PASS

Sliding

		<u>Design Combination 1</u>	<u>Design Combination 2</u>
Unfactored Horizontal Load	H_k	0.176 kN	0.176 kN
Partial Factor	$\gamma_{Q;unf}$	1.500	1.300
<u>Design Sliding Force</u>	H_d	0.264 kN	0.228 kN
Unfactored Resistance	R_k	13.273 kN	13.273 kN
Design Friction Angle	δ_d	N/A °	N/A °
Cohesion Factor	c_d	40.0 kN	28.6 kN
<u>Design Sliding Resistance</u>	R_d	13.273 kN	9.481 kN
Capacity used	$\lambda_{sliding}$	2.0 % PASS	2.4 % PASS

Bearing Pressure

		<u>Design Combination 1</u>	<u>Design Combination 2</u>
Total Design Horizontal Action	H_d	0.3 kN	0.2 kN
Design destabilising moment	$M_{dst;d}$	0.8 kN m	0.7 kN m

Total Design Vertical Action	V_d	3.2 kN	3.2 kN
Design stabilising moment	$M_{stb;d}$	1.1 kN m	1.1 kN m
Resultant Vertical Action	$R_{v;d}$	3.2 kN	3.2 kN
Eccentricity of resulting force	e	234.3 mm	203.1 mm
Distance to 'middle third'		108.3 mm	108.3 mm
Effective Area of Foundation		0.056 m ²	0.086 m ²
<u>Maximum bearing pressure</u>	q_{max}	214.2 kN / m ²	63.8 kN / m ²
<u>Maximum bearing Force</u>	V_d	12.0 kN	5.5 kN
Design angle of shear resistance	φ_d	N/A °	N/A °
Cohesion Factor	c_d	40.0 kN	28.6 kN
<u>Bearing Pressure Resistance</u>	q'	323.0 kN / m ²	231.4 kN / m ²
<u>Bearing Resistance</u>	R_d	18.2 kN	19.9 kN
Capacity used		66.3 %	27.6 %

PASS

PASS

Settlement Check: GEO, SLS

Design destabilising moment	$M_{dst;d}$	-0.5 kN m	
Design Restoring Vertical Action	$V_{stb;d}$	3.2 kN	
Design stabilising moment	$M_{stb;d}$	1.1 kN m	
Eccentricity of resulting force	e	156.3 mm	
Distance to 'middle third'		108.3 mm	
Effective Area of Foundation	A'	0.137 m ²	
Maximum bearing pressure	q_{max}	33.6 kN / m ²	
<u>Maximum bearing Force</u>	V_d	4.6 kN	
Bearing Pressure Resistance	q'	305.3 kN / m ²	
<u>Bearing Resistance</u>	R_d	41.8 kN	
Settlement Test		9.1	No settlement calculations required

Reinforcement Check

Design Concrete Strength	$f_{ct;d}$	957.6 kN / m ²	
Design Ground Pressure	$\sigma_{g;d}$	323.0 kN / m ²	
Reinforcement Test		1.0	Reinforcement is not required

Reinforcement is not required

Plane: ZY

Supports

For shear and bending, ULS wind force is applied. For temporary deflections, SLS (1 year) wind force is applied.

Max Temp. Deflection Class 50.0 mm / m (TDB5)

Post# 001

Ground Cover	0.000 mm		
Partial Material Factor	1.150		
Wind Load Applied (ULS)	0.003 kN	Wind Load Applied (SLS 1-yr)	0.000 kN

Ultimate Effects

Shear

Max Shear	P_v	3.600 kN
Partial Material Factor	γ_m	1.150
Ultimate Shear Capacity	P_v / γ_m	3.130 kN

		<u>Point Load</u>	<u>Wind Load</u>
Basic Load	F_k	0.150 kN (PL1)	0.002 kN
Partial Action Factor	γ_F	1.35	1.35
Applied Load	F_d	0.203 kN	0.003 kN
Ultimate Design Shear	V_d	0.203 kN	0.003 kN
Shear Capacity used		6.5 % <input type="text" value="PASS"/>	0.1 % <input type="text" value="PASS"/>

Bending

Max Bending Moment	M_c	6.500 kN m
Partial Material Factor	γ_m	1.150
Ultimate Bending Capacity	M_c / γ_m	5.652 kN m

		<u>Point Load</u>	<u>Wind Load</u>	<u>Dead Load</u>
Basic Load	F_k	0.150 kN (PL1)	0.002 kN	0.022 kN
Partial Action Factor	γ_F	1.35	1.35	1.20
Applied Load	F_d	0.203 kN	0.003 kN	0.027 kN
Total Bending Moment (inc. Dead Load)				
	<u>V.</u>	M	-0.061 kN m	0.000 kN m
	<u>H.</u>	M	-0.547 kN m	-0.006 kN m
Bending Capacity used	<u>V.</u>	Λ	1.1 % <input type="text" value="PASS"/>	0.0 % <input type="text" value="PASS"/>
	<u>H.</u>	Λ	9.7 % <input type="text" value="PASS"/>	0.1 % <input type="text" value="PASS"/>