

Project No. 2571	Sheet	Revision P1	54 DENMARK STREET
Date Apr 26	Engineer PRH	Checked	

Introduction

Constructure have been appointed to complete the structural design for a small plant deck, which is to span between the external facade of an existing building and an existing brick retaining wall, some 4m away from it.

The location of the proposed plant deck is shown overleaf, and is intended to support two air source heat pumps (ASHPs) of circa 400kg each, over an area of circa 4m (span) x 3m (width).

The arrangement is intended to consist of 3no. galvanised hot rolled steel beams spanning between the facade and the retaining wall, spaced at 1.5m centres, with steel grating spanning the 1.5m between beams, onto which the ASHPs will sit. We understand all acoustic and anti-vibration measures will be dealt with by the contractor.

Loading

The loading will be from the 2no. ASHPs, the weight of the grating, and a live load allowance. As the weight of the ASHPs is allowed for as an individual load case, the live load allowance can be relatively modest for maintenance, etc. For this design we will assume a 1.5kN/m² live load allowance, which would also cover any snow load, etc.

The load of the ASHPs is shown in the literature (overleaf) as 348kg each. We will round that up to 400kg each to account for any additional during use. The plan area is shown as 1.75m long x 0.74m wide, which would equate to an area load of 3.1kN/m² (SLS), applied to the footprint of the unit only.

Deck/Grating Specification

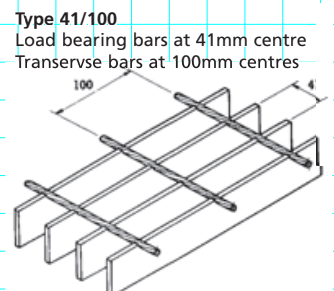
The decking needs to span 1.5m (from beam to beam), with the live loading assumed to be 1.5kN/m² throughout plus an additional 2kN/m² in the area of the ASHP (to make up the difference between the ASHP load and the 1.5kN/m² general allowance, plus some snow). The ASHP load would apply to the middle half (approx) of the span, and for ease we will simplify this to an additional 1.5kN/m² over the whole area; ie. a total live load of 3kN/m².

TYPES 41/100 and 41/50 Safe Uniformly Distributed Load in kN/m²

Load Bearing Bars mm	Mass Kg/m ² *	Clear Span in Millimetres													# Max Span mm
		600	750	900	1050	1200	1350	1500	1650	1800	1950	2100	2250	2400	
20 x 3	14.8	17.4	9.1	5.2	3.3										908
25 x 3	18.0	27.2	17.4	10.2	6.5	4.3									1141
25 x 5	27.8	45.4	29.0	17.1	10.8	7.2	5.1	3.7							1350
30 x 3	21.0	39.2	25.1	17.4	11.2	7.5	5.2	3.8							1367
30 x 5	33.0	65.0	41.8	29.0	18.6	12.5	8.5	6.4	4.8						1594
35 x 3	23.8	53.0	34.0	23.7	17.4	11.9	8.3	6.0	4.6						1570
35 x 5	37.8	89.0	57.0	39.5	29.0	19.8	13.9	10.1	7.7	5.9	4.6				1867
40 x 3	26.8	70.0	44.6	31.0	22.8	17.4	12.6	9.1	6.8	5.2	4.2				1816
40 x 5	43.0	116	74.0	52.0	37.9	29.0	20.8	15.2	11.4	8.79	6.9	5.3	4.0		2119
50 x 5	52.8	181	116	81.0	59.0	45.4	35.8	29.0	22.9	17.2	13.5	10.3	7.8	5.9	2505
60 x 5	63.0	261	167	110	85.0	65.0	52.0	41.8	34.6	28.5	23.1	17.7	13.4	10.3	2872

* For mass of Type 41/50 add 1.8 Kg/m²

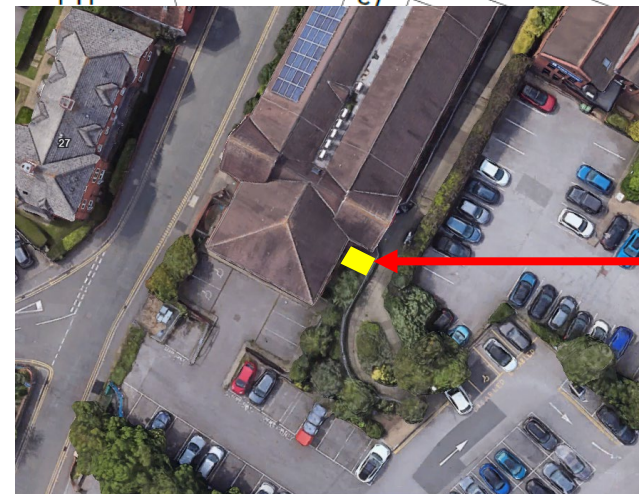
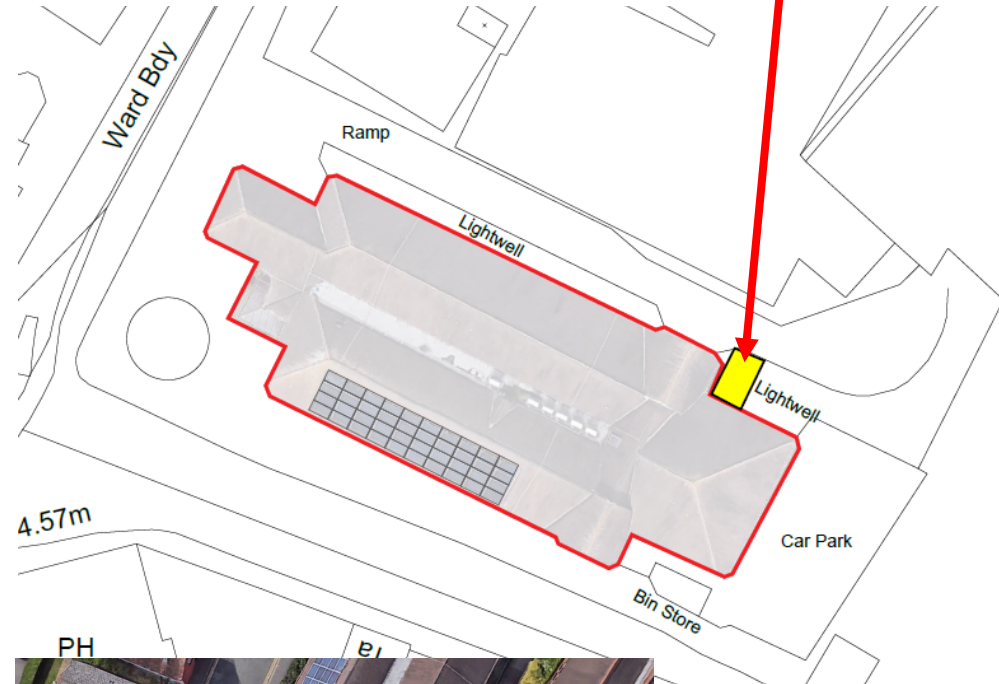
Based on the adjacent load-span table from "Steelway" the 30x3 grating @ 21kg/m² self weight, would appear appropriate.



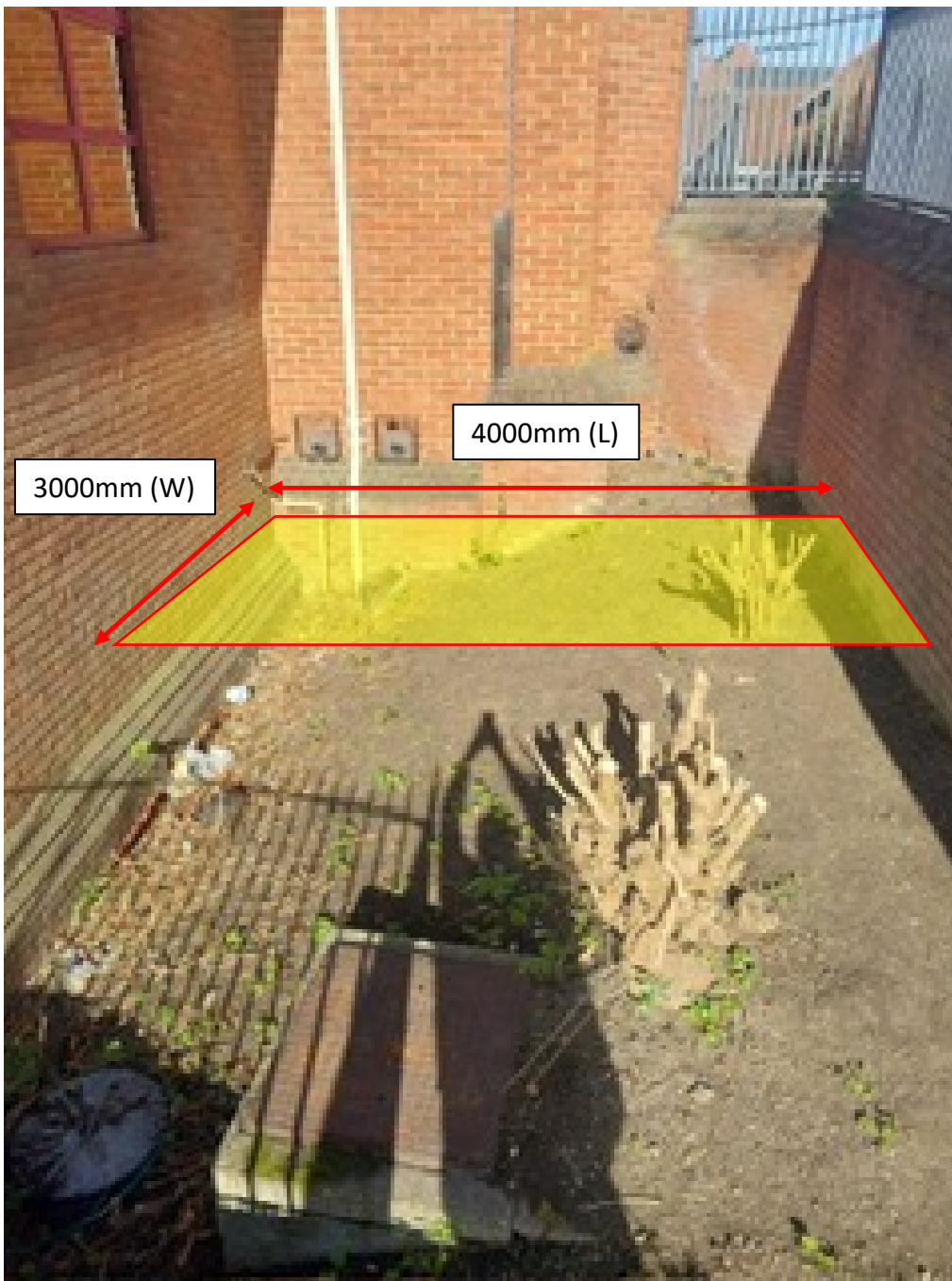
Project Title:

POST-16 SEND HUB,
DENMARK STREET,
WOKINGHAM, RG40 2BB

Location of Plant Deck



Location of Plant Deck





Outdoor Unit				PURY-EM400YNW-A1 (-BS)		PURY-EM450YNW-A1 (-BS)		PURY-EM500YNW-A1 (-BS)				
Power Source				3-phase 4-wire 380-400-415 V 50/60 Hz								
Cooling Capacity [Nominal]* ¹			kW	45.0			50.0	56.0				
			Power Input	kW	13.84		15.24		18.06			
			Current Input	A	23.3 - 22.1 - 21.3		25.7 - 24.4 - 23.5		30.4 - 28.9 - 27.9			
			EER	kW / kW	3.25		3.28		3.10			
Temp. Range of Cooling* ³			Indoor	W.B.	15.0 ~ 24.0°C		15.0 ~ 24.0°C		15.0 ~ 24.0°C			
			Outdoor	D.B.	-5.0 ~ 52.0°C		-5.0 ~ 52.0°C		-5.0 ~ 52.0°C			
Heating Capacity [Nominal]* ²			kW	50.0			56.0	63.0				
			Power Input	kW	13.88		15.77		17.45			
			Current Input	A	23.4 - 22.2 - 21.4		26.6 - 25.2 - 24.3		29.4 - 27.9 - 26.9			
			COP	kW / kW	3.60		3.55		3.61			
Temp. Range of Heating* ³			Indoor	D.B.	15.0 ~ 27.0°C		15.0 ~ 27.0°C		15.0 ~ 27.0°C			
			Outdoor	W.B.	-20.0 ~ 15.5°C		-20.0 ~ 15.5°C		-20.0 ~ 15.5°C			
Indoor Unit Connectable			Total Capacity	50 ~ 150% of outdoor unit capacity		50 ~ 150% of outdoor unit capacity		50 ~ 150% of outdoor unit capacity				
			Model / Quantity	W/WP/WL10~125/2~50 * ⁶		W/WP/WL10~125/2~50 * ⁶		W/WP/WL10~125/2~50 * ⁶				
Sound Pressure Level (Measured in Anechoic Room)* ⁴			dB <A>	65.0/69.0		65.5/70.0		63.5/64.5				
Sound Power Level (Measured in Anechoic Room)* ⁴			dB <A>	83.0/88.0		83.0/89.0		82.0/84.0				
Refrigerant Piping Diameter			High Pressure	mm (in.)		19.05 (3/4) Brazed		19.05 (3/4) Brazed				
			Low Pressure	mm (in.)		28.58 (1-1/8) Brazed		28.58 (1-1/8) Brazed				
Fan			Type x Quantity		Propeller fan x 2		Propeller fan x 2		Propeller fan x 2			
			Airflow Rate		m ³ /min		315		315		295	
					L/S		5,250		5,250		4,917	
			Control, Driving Mechanism		Inverter-control, direct-driven by motor							
			Motor Output		kW		0.46 x 2		0.46 x 2		0.92 x 2	
					External Static Press. * ⁵		0 Pa		0 Pa		0 Pa	
Compressor			Type		Inverter scroll hermetic compressor		Inverter scroll hermetic compressor		Inverter scroll hermetic compressor			
			Starting Method		Inverter		Inverter		Inverter			
			Motor Output		kW		11.1		12.7		13.8	
			Case Heater		kW		- (- V)		- (- V)		- (- V)	
External Finish				Pre-coated galvanized steel sheets (+powder coating for -BS type) <MUNSELL 5Y 8/1 or similar>								
External Dimension H x W x D			mm	1,858 (1,798 without legs) x 1,240 x 740		1,858 (1,798 without legs) x 1,240 x 740		1,858 (1,798 without legs) x 1,750 x 740				
Protection Devices			High Pressure Protection		High pressure sensor, high pressure switch at 4.15 MPa (601 psi)							
			Inverter Circuit (COMP./FAN)		Over-heat protection, over-current protection							
			Compressor				-		-		-	
			Fan Motor				-		-		-	
Refrigerant												
Type/GWP				R32/675		R32/675		R32/675				
Factory Charged		Weight	kg	8.0		10.8		10.8				
Maximum Additional Charge		Weight	kg	19.5		19.5		19.5				
Net Weight			kg	280		305		348				
Heat Exchanger				Salt-resistant cross fin & aluminium tube								
Defrosting Method				Auto-defrost mode (Reversed refrigerant cycle)								
Optional Parts				Main HBC: CMB-WM108,1016V-AA, CMB-WM500F-AA Sub HRC: CMB-WM108,1016V-BB								

Notes:

- *1 Nominal cooling conditions (subject to JIS B8615-2)
Indoor: 27°CDB./19°CWB., Outdoor: 35°CDB./24°CWB.
Pipe length: 7.5 m, Level difference: 0 m.
- *2 Nominal heating conditions (subject to JIS B8615-2)
Indoor: 20°CDB., Outdoor: 7°CDB./6°CWB.
Pipe length: 7.5 m, Level difference: 0 m.
- *3 -5°CDB./-6°CWB. to 21°CDB./15.5°CWB. with cooling/heating mixed operation.
- *4 Cooling mode/Heating mode
- *5 External static pressure option is available (30 Pa, 60 Pa, 80 Pa).
Consult your dealer about the specification when setting External static pressure option.
- *6 There are restrictions on compatible combinations among W-model, WP-model, and WL-model indoor units. Check with your dealer on compatible selections.

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Beam Design

Now the grating as been confirmed as 21kg/m² self weight, we will conservatively say 30kg/m² to allow for potential changes in specification - 0.3kN/m²

So, total live load, LL = 3kN/m² (from the 1.5kN/m² maintenance & distributed ASHP load)

& total dead load, DL = 0.3kN/m² (from the grating)

The central beam will attract circa twice the load as the two side ones, so we will look at this first.

Load width = 1.5m,

so DL = 0.45kN/m (SLS) plus say 0.3kN/m for the self weight of the beam --> 0.75kN/m (SLS)

& LL = 4.5kN/m² (SLS)

so SLS = 5.3kN/m and ULS = 8.3kN/m.

Span = 4m, plus say 0.1m to allow for bearing, so

$$M = 8.3 \times 4.1^2 / 8 = 17.5\text{kNm (ULS)}$$

To keep the beam deflection below say span/360 (= 11mm) ...

$$I > (5 \times 5.3 \times 4,100^4) / (384 \times 205,000 \times 11 \times 10^4) = 865\text{cm}^4$$

With this in mind some beam options would be :

150x90x24 PFC @ 24kg/m (I = 1,160cm⁴ ; Mb = 37kNm @ Le = 4m)

152x152x23 UC @ 23kg/m (I = 1,250cm⁴ ; Mb = 37kNm @ Le = 4m)

178x102x19 UB @ 19kg/m (I = 1,360cm⁴ ; Mb = 21kNm @ Le = 4m)

In the first instance we would recommend having the 152UC23 for the central member, giving a good 75mm of bearing for each grating, and the 150x90PFC for the edge beams as this would provide a nice vertical plate (ie. the web) onto which a handrail could be bolted.

Note: the edge beams would have circa 50% of the load as the central beam, so have some spare capacity for the torsion.

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Padstone Check

The loading arrangement covered thus far would result in an end reaction of:

$$\begin{array}{lcl}
 \text{DL} = 0.75\text{kN/m} \times 2.1\text{m} = 1.6\text{kN (SLS)} & \left. \vphantom{\begin{array}{l} \text{DL} \\ \text{LL} \end{array}} \right\} & \text{SLS} = 11\text{kN} \\
 \text{LL} = 4.5\text{kN/m} \times 2.1\text{m} = 9.4\text{kN (SLS)} & & \text{ULS} = 17.3\text{kN}
 \end{array}$$

We will check if having the ASHPs closer to the end support would increase this reaction ...

General UDL is $\text{DL} = 0.3\text{kN/m}^2$ and $\text{LL} = 1.5\text{kN/m}^2$, so the beam reaction (for the central beam) would be these multiplied by $1.5\text{m} \times 2.1\text{m}$ (3.15m^2), so ...

$$\text{DL} = 0.95\text{kN} ; \text{LL} = 4.8\text{kN}$$

If we then effectively added a full 4kN (from $2 \times 50\%$ of the ASHP load) this would bring the LL reaction up to 8.8kN (SLS)

This is seen to be less than the previous figures, so we will use the previous figures to check the padstone requirements.

With a bearing width of 150mm (from the 152UC) and an embedment of 100mm we get a bearing area of $15,000\text{mm}^2$. With a ULS reaction of 17,300N this results in a brick stress of 1.15N/mm^2 . This is likely to be acceptable, but we will double check using TEDDS (overleaf).

For the building end there is also circa two storeys of brick over, however given the 150mm distance we have here this is not considered critical.

The TEDDS results overleaf indicate no padstone is required for the central beam, and if we prorata 50% of the load on the outer beams that are 60% of the width this would also be ok.

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MASONRY BEARING DESIGN TO BS5628-1:2005

TEDDS calculation version 1.0.06

Masonry details

Masonry type

Clay or calcium silicate bricks

Compressive strength of unit

$p_{unit} = 20.0 \text{ N/mm}^2$

Mortar designation

iii

Category of masonry units

Category II

Category of construction control

Normal

Partial safety factor for material strength

$\gamma_m = 3.5$

Thickness of load bearing leaf

$t = 100 \text{ mm}$

Effective thickness of masonry wall

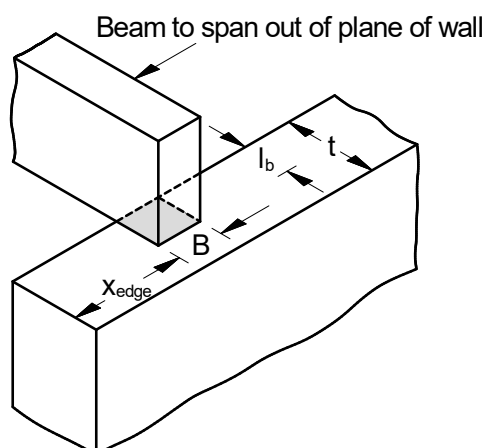
$t_{ef} = 100 \text{ mm}$

Height of masonry wall

$h = 1000 \text{ mm}$

Effective height of masonry wall

$h_{ef} = 1000 \text{ mm}$



Bearing details

Beam spanning out of plane of wall

Width of bearing

$B = 150 \text{ mm}$

Length of bearing

$l_b = 100 \text{ mm}$

Edge distance

$x_{edge} = 500 \text{ mm}$

Compressive strength from Table 2 BS5628:Part 1 - Clay or calcium silicate bricks

Mortar designation

Mortar = "iii"

Brick compressive strength

$p_{unit} = 20.0 \text{ N/mm}^2$

Characteristic compressive strength

$f_k = 5.00 \text{ N/mm}^2$

Loading details

Characteristic concentrated dead load

$G_k = 2 \text{ kN}$

Characteristic concentrated imposed load

$Q_k = 9 \text{ kN}$

Design concentrated load

$F = (G_k \times 1.4) + (Q_k \times 1.6) = 17.3 \text{ kN}$

Characteristic distributed dead load

$g_k = 0.0 \text{ kN/m}$

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Characteristic distributed imposed load

$$q_k = 0.0 \text{ kN/m}$$

Design distributed load

$$f = (g_k \times 1.4) + (q_k \times 1.6) = 0.0 \text{ kN/m}$$

Masonry bearing type

Bearing type

Type 2

Bearing safety factor

$$\gamma_{\text{bear}} = 1.50$$

Check design bearing without a spreader

Design bearing stress

$$f_{ca} = F / (B \times l_b) + f / t = 1.152 \text{ N/mm}^2$$

Allowable bearing stress

$$f_{cp} = \gamma_{\text{bear}} \times f_k / \gamma_m = 2.143 \text{ N/mm}^2$$

PASS - Allowable bearing stress exceeds design bearing stress

Check design bearing at $0.4 \times h$ below the bearing level

Slenderness ratio

$$h_{ef} / t_{ef} = 10.00$$

Eccentricity at top of wall

$$e_x = 0.0 \text{ mm}$$

From BS5628:1 Table 7

Capacity reduction factor

$$\beta = 0.99$$

Length of bearing distributed at $0.4 \times h$

$$l_d = 950 \text{ mm}$$

Maximum bearing stress

$$f_{ca} = F / (l_d \times t) + f / t = 0.182 \text{ N/mm}^2$$

Allowable bearing stress

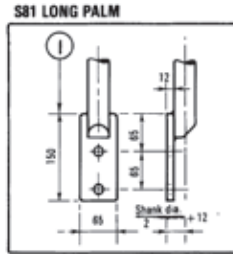
$$f_{cp} = \beta \times f_k / \gamma_m = 1.414 \text{ N/mm}^2$$

PASS - Allowable bearing stress at $0.4 \times h$ below bearing level exceeds design bearing stress

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Handrails

If the height of the platform above the ground dictates the requirement for a handrail we assume this will take the form similar to that shown overleaf (extracted from the Steelway brochure), with a higher and lower rail, and 3-4 standards per side, side fixed into the PFCs with something like this ...



The number of rails should be confirmed as suitable, and the contractor should assess the requirement for any access steps and/or gates.

Point to Check on Site:



Before fabricating any steelwork the contractor should investigate the corbelled area of brickwork to check and ensure that the brickwork over (on to which we are proposing to bear the three steels) is suitably supported. They are to advise Constructure is a sound bearing is not found.

Handrail & Guardrails

General Application

As a general rule, any unprotected edge of a walkway, platform, staircase or other raised area from which a person may fall more than 0.5m must be fitted with a guardrail. Steelway handrails and guardrails are designed to provide safety and give reassurance for users of staircases and walkways. They may be of tubular or solid construction or a combination of both. We supply handrails not only to complement our staircases, platforms, and other similar structures, but also as completely independent items to fit customers own equipment or civil engineering work etc.

All component parts are tailor-made in easy to handle lengths and clearly marked for assembly on site. Drawings are provided for customers' use where they wish to undertake the site erection themselves. Alternatively, we can provide a speedy and efficient site installation service.

Design

Our designs follow the recommendation of BS 6399; Part 1, BS 5395 and BS 6180. There are at least two horizontal rails - a top rail (handrail) and an intermediate rail (knee rail) at approximately mid-height. For step (companion) ladders and staircases in close proximity to, or bounded by a wall, a single handrail only is required with a minimum clearance for the hand of 75mm** (EEUA recommend minimum 65mm). If glazed areas occur adjacent to a walkway, platform, balcony or staircase, they should be guarded by a secure handrail or balustrade.

Wherever possible, handrails should be continuous and follow the exposed edge of raised platform areas and staircases. Sharp changes of direction in the vertical plane should be avoided in runs of handrail.

The minimum height of handrails for platforms walkways and landings is 1.1m above the walking surface; for staircases the handrail height should be between 0.9m and 1m above the pitch line.

Handrails should terminate in a swept end, either to the wall or to the knee rail, or return to the standards.

Note: Sharp corners, protrusions and stop ends should be avoided since these may catch clothing and cause accidents. Return bends ('U' bends) should not extend more than 350mm from the centre line of the standards. At the foot of staircases, 'U' bends should extend to the point of maximum extension of the stringer.

Loadings

BS 5395: Part 3 recommends the following minimum design imposed lateral loads that should be used for handrails in industrial situations:

Light duty. Access limited to one person. —0.36 kN/m
General duty. Regular two-way pedestrian traffic. —0.36 kN/m
Heavy duty. High density pedestrian traffic: escape routes. —0.74 kN/m
Potentially crowded areas over 3m wide. —3.00 kN/m

If there is any possibility of vehicular impact, the recommendations in appendix C of BS 6180 should be followed.

For light access stairs, gangways etc., which are not more than 600mm wide, a minimum design load of 0.22 kN/m may be used (BS 6399: Part 1).

Protective Treatments

Steel can be supplied in the following finishes:

- Self colour.
- Red oxide metal primer.
- Hot dipped galvanized to BSENISO 1461. Recommended for exposed or corrosive conditions. Decorative paint finishes can be applied by the customer on top of galvanized materials, but a suitable priming system must be used prior to painting.
- Nylon/Plastic coated. Not recommended for exposed conditions.
- Chrome plated, polished and powder coated finishes are available to special order.

** BS 5395

Aluminium alloy and stainless steel do not normally require protective treatment. However, where additional protection or improved appearance is thought necessary, then aluminium can be anodised and stainless steel polished.

Note: Some discolouration may occur on Aluminium bends and heat affected areas when anodised.

Handrails

Tubular and Solid mild steel handrails are available in a range of sizes

Tubular: 26.9 o/d x 3.2mm wall minimum, (1.87kg/m)
33.7 o/d x 3.2mm wall minimum, (2.41kg/m)
42.4 o/d x 3.2mm wall minimum, (3.10 kg/m)
48.3 o/d x 4.0mm wall minimum, (4.39kg/m)

Solid: 25mm dia. solid bar (3.85kg/m)
32mm dia. solid bar (6.31 Kg/m)

Stainless steel handrails are available with ball type standards, but all welded construction can also be accommodated.

Aluminium tubular handrail is also available on request in a range of sizes.

Handrail Standards

Tubular and Solid ball type mild steel standards are available in a variety of types and sizes. For further details, including types of base fittings, see page 13, 14 & 15. A handrail system may be tubular or solid, or a combination of both e.g. tubular handrails with solid standards. However, it is important to select a standard with adequate ball size to be compatible with the diameter of handrail to be used, as illustrated below.

	Specification of Standard Shank Size x Ball Size	Max Dia. of Handrail to suit Ball Size
TUBULAR	33.7mm o/d x 3.2mm wall x 60mm dia. ball 42.4mm o/d x 3.2mm wall x 75mm dia. ball 48.3mm o/d x 4.0mm wall x 90mm dia. ball 60.3mm o/d x 4.0mm wall x 90mm dia. ball	33.7mm o/d 42.4mm o/d 48.3mm o/d 48.3mm o/d
SOLID	32mm dia. Solid x 60mm dia. ball 38mm dia. Solid x 70mm dia. ball	33.7mm o/d 42.4mm o/d

Note: All standards are compatible with 25mm and 32mm Solid Handrails.

Details regarding the spacing between Standards at different Loadings are given on page 13.

Aluminium tubular Standards are also available to complement the Aluminium tubular handrailing.

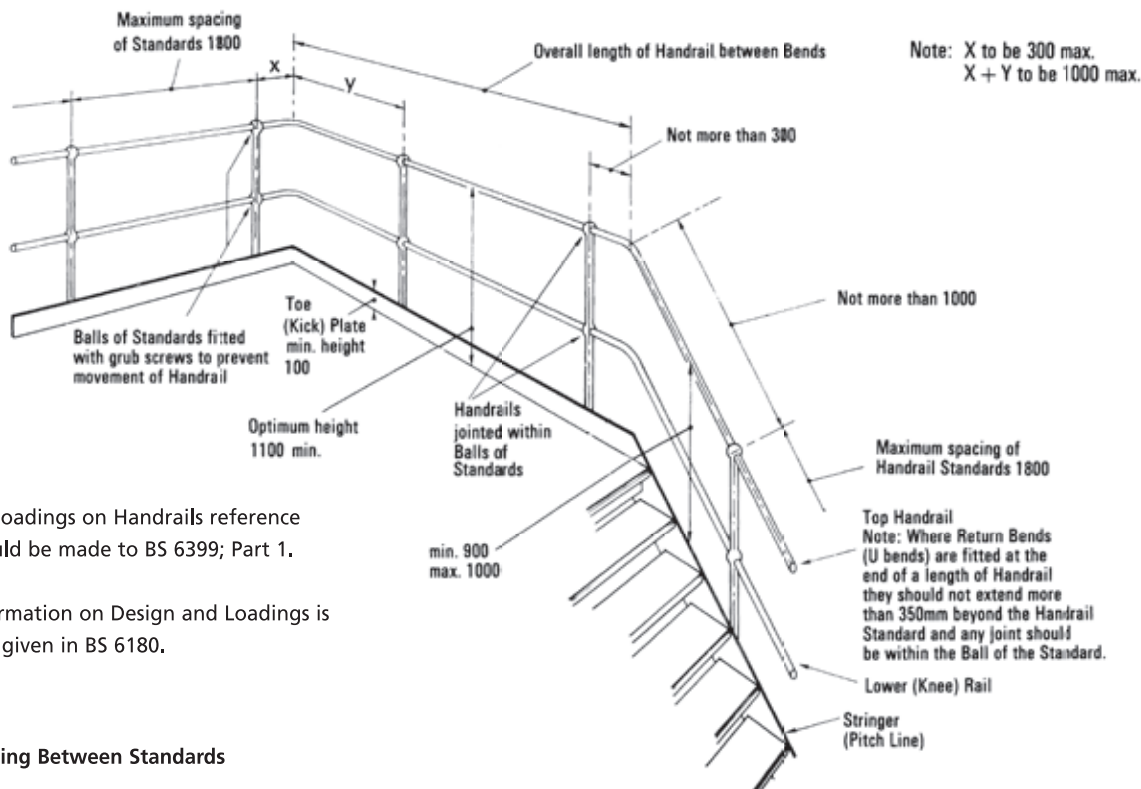
Gates and Safety Chains

Where loading access is required for a mezzanine floor, or for protection across openings at the head of stairs and ladders, we can supply gates of tubular construction to match the design of adjoining handrails. Alternatively, safety chains can be provided. Chains are galvanized mild steel, smooth welded to BS4942 and supplied with hooks, split rings, shackles, eye bolts and snap fasteners as required.

Infill Panels and Mesh Guards

Where a two line system of handrail is preferred or for existing handrails where the need arises for additional protection, we can provide infill panels. These panels consist of 50mm sq. welded mesh constructed from 3.25mm dia. wire with heavy gauge wire frame surrounds and supplied complete with fixing clips for securing to handrails.

Typical arrangement of Handrails for Stairs, Platforms and Walkways



For loadings on Handrails reference should be made to BS 6399; Part 1.

Information on Design and Loadings is also given in BS 6180.

Spacing Between Standards

Tables A and B take into account the limiting stress for the grade of steel specified. The horizontal displacement of any part of the barrier should not exceed 25mm. Allowance has been made for the combined deflection of handrails and standards.

In order to select a suitable size of handrail standard from the above tables one must first decide:

- the horizontal loading requirement
 - the handrail diameter to be used
- Having decided the handrail dia. and loading:

- select from table A or Table B a suitable standard
Note: Height should be taken from fixing point (1) see base details page 15.
- check that the handrail dia. is compatible with the size of handrail standard selected. See page 12.

TABLE A

Max. Spacing in mm of Mild Steel Handrail Standards where Intensity of Horizontal Loading = 0.36 kN/m									
	Specification of Standards	Height of Standards							
		900	950	1000	1050	1100	1150	1200	1250
M.S. TUBULAR	33.7mm o/d Shank x 60mm dia. ball	1090	1030	N/A	N/A	N/A	N/A	N/A	N/A
	42.4mm o/d Shank x 75mm dia. ball	1800	1800	1795	1710	1630	1560	1495	1300
	48.3mm o/d Shank x 90mm dia. ball	1800	1800	1800	1800	1800	1800	1800	1800
	60.3mm o/d Shank x 90mm dia. ball	1800	1800	1800	1800	1800	1800	1800	1800
M.S. SOLID	32mm dia. Solid x 60mm dia. ball	1635	1550	1473	1405	1245	N/A	N/A	N/A
	38mm dia. Solid x 70mm dia. ball	1800	1800	1800	1800	1800	1800	1800	1800

TABLE B

Max. Spacing in mm of Mild Steel Handrail Standards where Intensity of Horizontal Loading = 0.74 kN/m									
	Specification of Standards	Height of Standards							
		900	950	1000	1050	1100	1150	1200	1250
M.S. TUBULAR	33.7mm o/d Shank x 60mm dia. ball	THIS PATTERN NOT SUITABLE							
	42.4mm o/d Shank x 75mm dia. ball	THIS PATTERN NOT SUITABLE							
	48.3mm o/d Shank x 90mm dia. ball	1800	1800	1763	1685	1545	1330	1010	N/A
	60.3mm o/d Shank x 90mm dia. ball	1800	1800	1800	1800	1800	1800	1800	1800
M.S. SOLID	32mm dia. Solid x 60mm dia. ball	THIS PATTERN NOT SUITABLE							
	38mm dia. Solid x 70mm dia. ball	1333	1265	1200	1143	830*	N/A	N/A	N/A

* By using 42.4mm o/d tube handrails, spacing of standards in this particular instance could be increased to 1090mm. When fixed to concrete or other building materials, the maximum spacing of standards for 0.74kN/m loading should be no greater than 1250mm

Handrail Standards

Steelway tubular and solid ball type standards are made in varying heights to suit single, double and multi-line handrails. Balls are drilled to suit handrails or can be fitted with eyes for chains. Grub screws are a standard fitment in balls to secure handrails against movement.

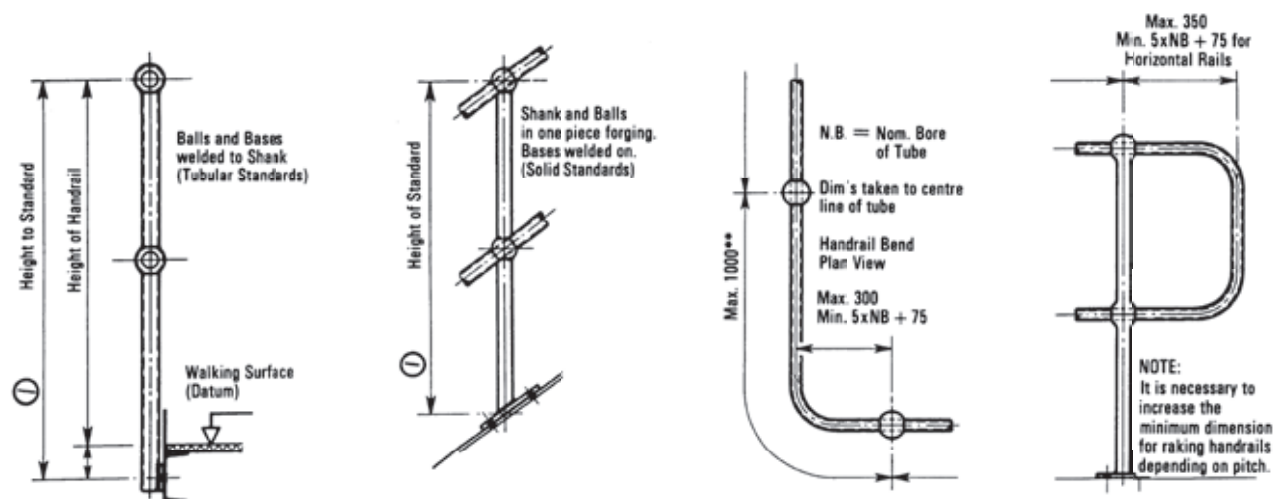
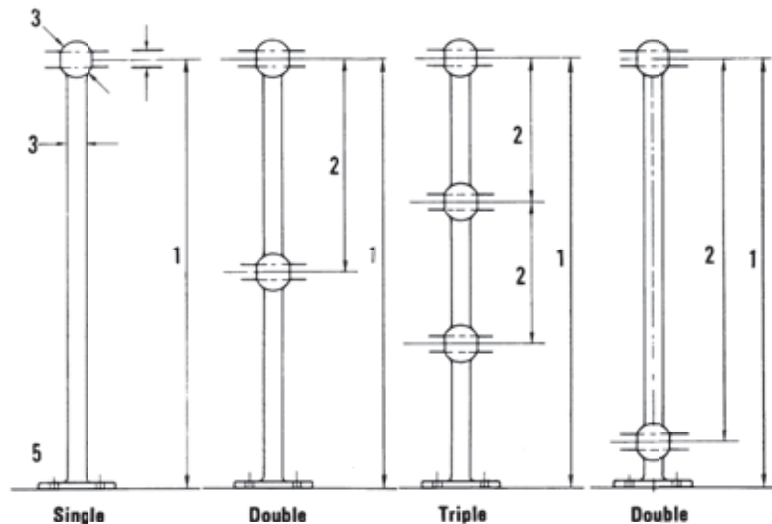
Note: Handrail standards must not be supported from toe plates, unless it can be shown that the toe plates are structural members.

When ordering please indicate whether solid type or tubular type standards are required, and state:

- 1) Height.
- 2) Ball centres.
- 3) Diameter of ball/shank.
- 4) Outside diameter of handrail.
- 5) Type of base (state reference). See page 15.
- 6) Angle of rake/pitch (if side fixing type base state handing L.H. or R.H. side of stair when ascending).
- 7) Material and finish. See page 12.

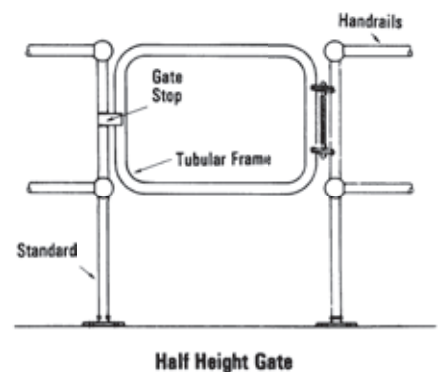
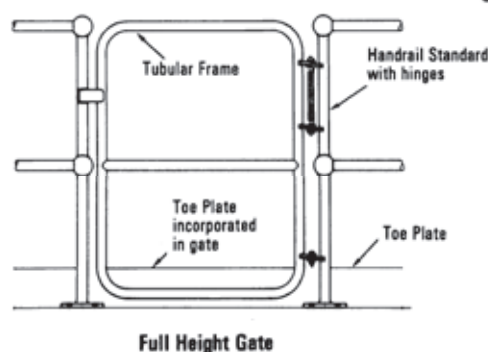
A full range of available bases are illustrated on page 15. The type of base should be chosen with care to ensure it will be suitable for attaching to the structure in question. A larger size of base is more suitable when fixing to materials which have a lower density than steel e.g. concrete,

brickwork, block work. The size and spacing of fixing bolts into concrete or other low density materials requires careful consideration. There is an optimum requirement for fixings, and exceeding this may weaken rather than strengthen the attachment.



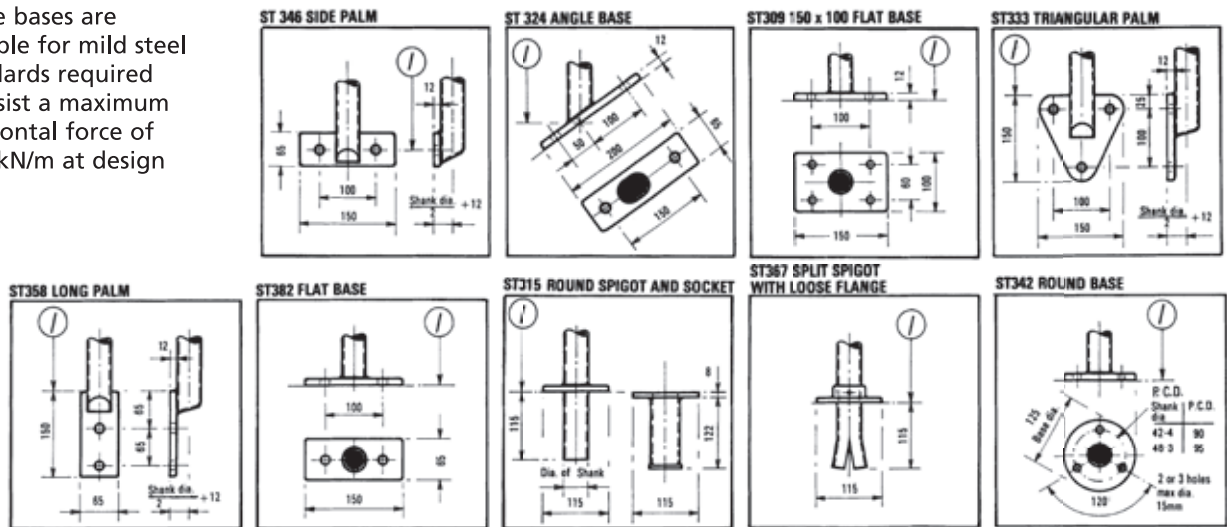
SELF CLOSING HINGED TUBULAR GATE

Should be fitted in preference to safety chains.



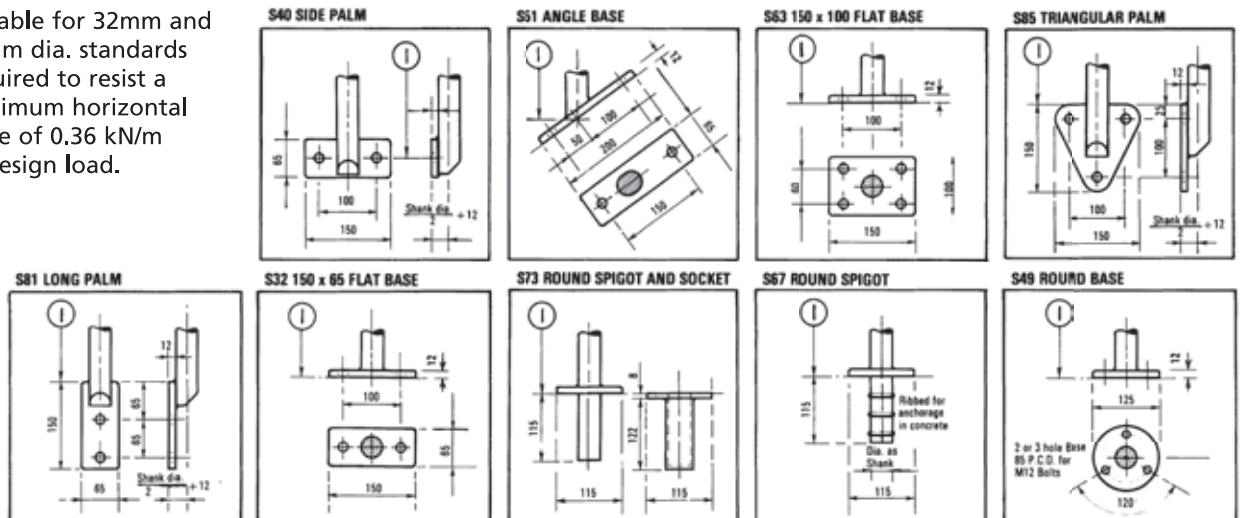
Bases for Tubular Standards Type 'ST'

These bases are suitable for mild steel standards required to resist a maximum horizontal force of 0.36 kN/m at design level.



Bases for Solid Standards Type 'S'

Suitable for 32mm and 38mm dia. standards required to resist a maximum horizontal force of 0.36 kN/m at design load.



Heavy Duty Bases Type 'HS'

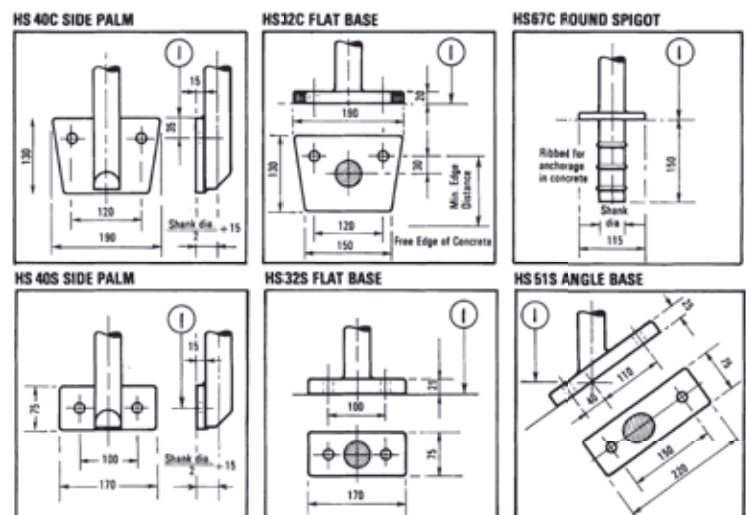
Suitable for both Solid and Tubular Standards required to resist a maximum horizontal force of 0.74 kN/m at design level.

High Tensile Bolts should be used.

Types with suffix 'C' are designed for fixing to concrete at an optimum spacing of 1.25m nominal assuming concrete to be unreinforced with a minimum compressive strength of 25 N/mm².

Types with a suffix 'S' are designed for fixing to steelwork at spacings of up to 1.8m.

Designers should ensure that the adjacent construction acting as support for handrails and balustrades is of adequate strength and stability to sustain all applied loads safely without excessive strain, deflection or distortion.



Note: Bases are drilled 19mm dia. holes for M16 bolts. Non standard drilling can be accommodated and bolts supplied on request.

Project No. 2571	Sheet	Revision P1	54 DENMARK STREET
Date Apr 26	Engineer PRH	Checked	
			Project

