Part 6 Superstructure (excluding roofs)

Chapter 6.5

Steelwork

6.5 Steelwork

CONTENTS

SCOPE

This Chapter gives guidance on meeting the Technical Requirements and recommendations for steelwork to support masonry partitions, timber floors and to trim floor voids.

DESIGN STANDARDS

6.5 - D1 Design shall meet the Technical Requirements

Design that follows the guidance below will be acceptable for steelwork supporting either masonry partitions or floors.

STRUCTURAL DESIGN

6.5 - D2 Steelwork shall be designed to support and transmit loads to the supporting structure without undue movement or deflection

Steelwork (including its support and any connections) should be either:

- designed by an Engineer in accordance with Technical Requirement R5, or
- where appropriate, detailed according to the designs shown in this Chapter.

The designs shown in this Chapter are in accordance with BS EN 1993-1-1 using grade S275 steel and therefore meet statutory requirements.

It should be noted that the information given in this Chapter has been prepared primarily to assist builders in providing proper support to masonry partitions and floors. The designs given will not always be the most economic and an engineer may be able to design a smaller section beam for a particular situation.

Items to be taken into account include:

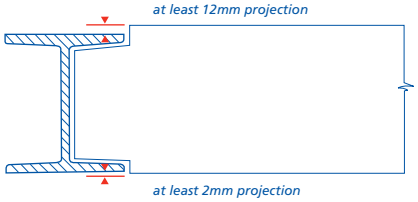
(a) support of masonry partitions
Where appropriate, masonry partitions may be supported by steelwork selected in accordance with Appendix 6.5-A.

Care should be taken during construction to avoid the problem of out-of-true masonry being only partly supported by steelwork.

(b) support of floors
Timber floors can be supported by steelwork.

Where appropriate, steelwork should be in accordance with Appendices 6.5-B and 6.5-C.

The timber floor should be in accordance with Chapter 6.4 'Timber and concrete upper floors' (each section), including proper allowance for shrinkage of timber joists supported by steelwork.



(c) support of steelwork

Steelwork may need to be supported on padstones to distribute loads safely.

Masonry should be in accordance with Chapter 6.1 'External masonry walls' (each section) or Chapter 6.3 'Internal walls' (each section), as appropriate.

(d) steelwork to steelwork connection
Connections between steel beams should be designed.

Where appropriate, steelwork beam-to-beam connections should be in accordance with Appendix 6.5-C.

Appendix 6.5-C uses bolted connections (using black bolts) or welding. Connections requiring the use of other forms of connection (such as high strength friction grip bolts) should be designed by an Engineer in accordance with Technical Requirement R5.

(e) durability
Steelwork should be given a protective coating system to ensure durability. For details, refer to Sitework clause 6.5-S3.

(f) fire resistance
Steelwork should be provided with the level of fire resistance required by Building Regulations.

PADSTONES

6.5 - D3 Padstones shall distribute point loads safely to the supporting structure

Where a steel beam is supported by masonry, a padstone may be required to spread the load over a sufficiently large area of the masonry to prevent overstressing. A padstone may be necessary (see Table 3, Appendix 6.5-A and Table 5, Appendix 6.5-B for sizes).

Where the inner leaf is used to provide a major contribution to the thermal insulation of a cavity wall, any padstone that is needed should have similar thermal properties to the masonry used for the rest of the inner leaf or precautions should be taken to prevent cold bridging.

MATERIALS STANDARDS

6.5 - M1 All materials shall:
(a) meet the Technical Requirements
(b) take account of the design

Materials that comply with the design and the guidance below will be acceptable for steelwork supporting either masonry partitions or floors.

Materials for steelwork supporting either masonry partitions or floors shall comply with all relevant standards, including those listed below. Where no standard exists, Technical Requirement R3 applies (see Chapter 1.1 'Introduction to the Standards and Technical Requirements').

References to British Standards and Codes of Practice include those made under the Construction Products Directive (89/106/EEC) and, in particular, appropriate European Technical Specifications approved by a European Committee for Standardisation (CEN).

STEELWORK

6.5 - M2 Steelwork shall be of sufficient strength and durability

Steelwork will be acceptable if it complies with Clause M1 above and is based on:

BS 4 Part 1	Structural steel sections : Specification for hot-rolled sections, or
BS 4848	Specification for hot-rolled structural steel sections.

To ensure durability, steelwork should be given a protective coating system. For steelwork which is to be bolted (using black bolts) or not connected, an acceptable coating system is one coat of high build zinc phosphate primer and one coat of bituminous paint. Where welding is to be carried out, use the protective coating system specified by the designer.

PADSTONES

6.5 - M3 Padstones shall distribute point loads safely to the supporting structure

Details of padstones are given in Table 3, Appendix 6.5-A and Table 5, Appendix 6.5-B. For the design of padstones see Design section, clause D2.

CONNECTIONS

6.5 - M4 Connections shall be chosen to be capable of supporting and transmitting the intended loads

Connections should comply with the design. Bolts will be acceptable if they comply with the design and are based on the relevant British Standards, including:

BS 4190	Specification for ISO metric black hexagon bolts, screws and nuts
BS 4395	Specification for high strength friction grip bolts and associated nuts and washers for structural engineering
BS 4604	Specification for the use of high strength friction grip bolts in structural steelwork.

Welded connections should comply with:

BS 5135	Specification for arc welding of carbon and carbon-manganese steels.

SITEWORK STANDARDS

6.5 - S1 All sitework shall:
(a) meet the Technical Requirements
(b) take account of the design
(c) follow established good practice and workmanship

Construction that follows the design and the guidance below will be acceptable for steelwork supporting either masonry partitions or floors.

STEELWORK

6.5 - S2 Steelwork shall be installed to achieve the required structural performance

Items to be taken into account include:

(a) the section size and grade detailed in the design
When materials are delivered to site, check that they conform with either:
- the Engineer's design, or
- the steelwork sizes given in the Appendices to this Chapter.

(b) bearings
Bearings for steelwork should be:
- at least 100mm, and
- clean, dry and level.

Padstones may be required in accordance with:
- the Engineer's design, or
- the guidance given in Table 3, Appendix 6.5-A and Table 5, Appendix 6.5-B.

(c) connections
Where steelwork-to-steelwork connections are required, follow either:
- the Engineer's design, or
- the guidance given in Appendix 6.5-C.

Only weld, cut or drill steelwork if it is required by the design.

6.5 - S3 Steelwork shall be protected to achieve the required durability

To ensure durability, steelwork should be given a protective coating system.

For steelwork which is to be bolted (using black bolts), or not connected, an acceptable coating system is one coat of high build zinc phosphate primer and one coat of bituminous paint.

Where steelwork is to be protected by intumescent paint for fire purposes, manufacturers' recommendations should be followed.

STEELWORK - UNGALVANIZED
Internal and external steelwork that has not been galvanized should be protected with at least:
- two coats of zinc phosphate primer, and
- a suitable decorative finish where required.

STEELWORK - GALVANIZED
Unless steelwork is galvanized to a rate of 460g/m^2, it should be protected as described for ungalvanized.

APPENDIX 6.5-A

DESIGN TABLES FOR SUPPORT OF MASONRY PARTITIONS (no floor loads)

Steel beams in accordance with the Tables 1, 2 and 3 in this Appendix will be acceptable to NHBC for the support of masonry partitions, if:

- the masonry partition is not more than 2.7m in height, ***and***
- steel beams only support the weight of the masonry partition and self weight, ***and***
- steel beams span no more than 4.0m, ***and***
- the masonry partition is built centrally on the steelwork beam, ***and***
- the masonry partition is of one of the types detailed in Table 1, ***and***
- padstones are provided, where required, ***and***
- the masonry supporting the steel beam is of at least 2.8N/mm2 blockwork (workface size 440mm x 215mm) or brickwork and the beam supports do not occur over a door or window opening.

If ***any*** of the above limitations are not met, steelwork should be designed in accordance with Technical Requirement R5.

Method of applying tables

1 Check that the situation is within all the limitations detailed above.
2 Identify the masonry partition construction and thickness.
3 Use Table 1 to establish the load per metre run.
4 Check the span of the beam(s).
5 Use Table 2 to determine a suitable steel section size.
6 Check whether padstones are required - see Table 3.

(To help in applying the tables, a worked example is given at the end of this Appendix.)

Table 1 - Load of partition to be supported

Type of masonry for supported partition (not more than 2.7m high and plastered both sides)	**Maximum masonry density** [kg/m^3]	**Structural thickness** [mm]		
		100	90	75
		Load [kN/m run]		
Dense masonry	2000	6.8	6.2	5.4
Medium masonry	1400	5.1	4.8	4.2
Lightweight masonry	800	3.5	3.3	2.9

Table 2 - Size of steel beam supporting partition

Partition load (from Table 1) [kN/m run]	**Clear span of beam** [m]	**Smallest suitable Universal Beam size** [mm x mm x kg/m]
Less than 3	up to 4 over 4	127 x 76 x 13 see Note 2
3 to 5	up to 3 3 to 3.5 3.5 to 4 over 4	127 x 76 x 13 152 x 89 x 16 178 x 102 x 19 see Note 2
5 to 7	up to 2.5 2.5 to 3 3 to 4 over 4	127 x 76 x 13 152 x 89 x 16 178 x 102 x 19 see Note 2

Notes to Table 2
1 For spans up to 4m, Universal Column 152mm x 152mm x 23kg/m, which is the smallest size available, may be used.
2 For spans over 4m, beams should be designed by an Engineer in accordance with Technical Requirement R5.

Table 3 - Size of padstone

Type of masonry for supported partition (not more than 2.7m high and plastered both sides)	Thickness of wall supporting beam [mm]						Minimum depth of padstone [mm]
	100	125	140	150	190	215	
	Min length of padstone [mm]						
Dense masonry	215	190	185	180	165	155	150
Medium masonry	155	140	135	130	120	110	150
Lightweight masonry	95	85	80	75	70	70	150

Notes to Table 3

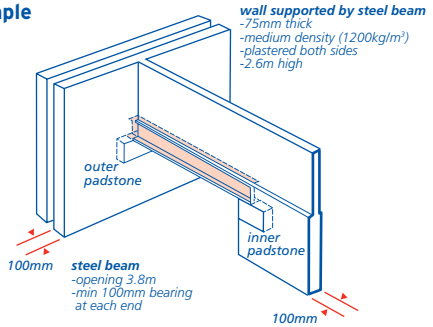
1 Padstones are not necessary where the flange dimension of the beam exceeds the length of the padstone given in this table.
2 When steelwork is in line with the wall supporting it (ie when acting as a lintel over an opening):
- the flange dimension of the beam should not be more than 50mm greater than the thickness of the supporting wall, ***and***
- the minimum length of padstone should be 200mm, ***and***
- the padstone depth should match the coursing of adjacent masonry, ***and***
- the web of the beam should be over the centre of the wall.

3 The minimum length of steel bearing onto padstone should be 100mm.
4 Padstones can be formed from:
- in-situ concrete
- precast concrete
- concrete blocks
- clay bricks.

Padstones should be formed in one unit with a minimum compressive strength of 10N/mm^2.

For padstone sizes less than 215mm x 100mm, engineering bricks will be suitable.

Worked Example



Procedure

1 Using information about the supported wall and Table 1:
- load per metre run = 4.2kN/m.

2 Using the load per metre run, the span of the beam and Table 2:
- suitable section size = 178 x 102 x 19 UB (The alternative 152 x 152 x 23 UC is not suitable as it is too wide for the inner padstone/wall.)

3 Using information about the wall supporting the beam (100mm thick), the walls supported by the beam (medium density block) and Table 3:

- minimum padstone size = 155mm long
  = 150 mm deep
- outer padstone (beam at right angles to wall):
  - minimum length = 155mm

  (as this is greater than the flange dimension of the steel section obtained in **2** above - 102mm - a padstone is required to distribute the load)
  - minimum depth = 150mm
  - thickness = 100mm, to match blockwork

  (The actual length and depth of a padstone could be greater to suit masonry coursing.)
- inner padstone (beam in line with the wall):
  - minimum length = 200mm (see Note 2 to Table 3)
  - minimum depth = 150mm
  - thickness = 100mm, to match blockwork.

Note

Beam supports should not occur above window or door openings

APPENDIX 6.5-B

DESIGN TABLES FOR SUPPORT OF FLOORS
(no masonry partition loads)

Limitations

Steel beams in accordance with Tables 4 and 5 in this Appendix will be acceptable to NHBC for the support of floors, if:

- the floor construction is of decking (softwood boarding, chipboard, oriented strand board or plywood) on timber joists with a plasterboard ceiling underneath which is given either a plaster skim coat or a plastic finish (Artex or similar), ***and***
- allowance has been made of 0.5kN/m^2 for self weight (floor and ceiling load) ***and***
- the floor does not support masonry partitions, ***and***
- any lightweight partition (such as plasterboard on timber studwork or proprietary product) is non-loadbearing, ***and***
- padstones are provided, where required, ***and***
- clear span of beam does not exceed 4.4m, ***and***
- connections between steelwork beams are in accordance with Appendix 6.5-C or are designed by an Engineer, ***and***
- the floor support is one of the methods shown in Figure 1.

If ***any*** of the above limitations are not met, steelwork should be designed by an Engineer in accordance with Technical Requirement R5.

Method of applying tables

1 Check that the situation is within all the limitations detailed above.
2 Using Figure 1, determine the area supported by the beam(s).
3 Check the span of the beam(s).
4 Use Table 4 to determine a suitable steel section size.
5 Check whether padstones are required by Table 5.
6 If steel beam-to-steel beam connections are required, use Appendix 6.5-C.

Figure 1 - Effective areas supported by steel beams

If any area shown as 'void' contains a staircase, add 2m² to the effective area supported by any beam which supports (partially or fully) that staircase.

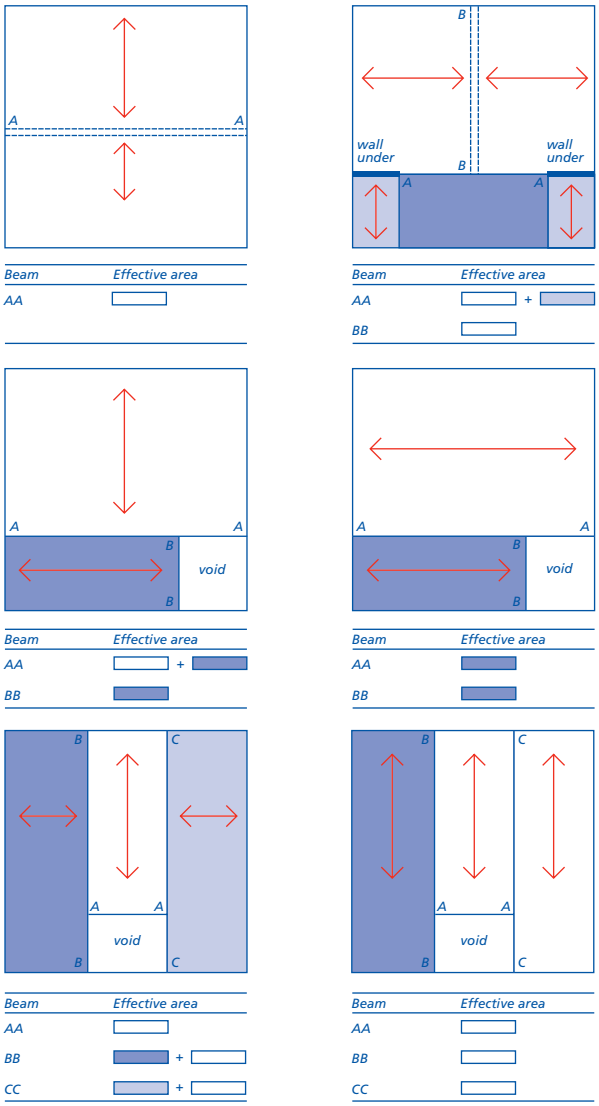


Table 4 - Size of steel beam supporting floor

Effective area supported (m^2)	**Effective trimmer span = clear span + 100mm** (m)	**Smallest suitable steel section size** (mm x mm x kg/m)	
		Universal beam	**Universal column**
0 to 20	0 to 2.0	127 x 76 x 13	152 x 152 x 23
0 to 20 20 to 30	2 to 2.5	127 x 76 x 13 152 x 89 x 16	152 x 152 x 23 152 x 152 x 23
0 to 10 10 to 20 20 to 30	2.5 to 3	127 x 76 x 13 152 x 89 x 16 178 x 102 x 19	152 x 152 x 23 152 x 152 x 23 152 x 152 x 23
0 to 10 10 to 30 30 to 40	3 to 3.5	127 x 76 x 13 178 x 102 x 19 203 x 133 x 25	152 x 152 x 23 152 x 152 x 23 152 x 152 x 30
0 to 10 10 to 20 20 to 30 30 to 40 40 to 50	3.5 to 4	152 x 89 x 16 178 x 102 x 19 203 x 102 x 23 203 x 102 x 30 see Note 1	152 x 152 x 23 152 x 152 x 23 152 x 152 x 23 152 x 152 x 30 152 x 152 x 37
0 to 10 10 to 20 20 to 30 30 to 40 40 to 50	4 to 4.5	203 x 102 x 23 203 x 133 x 25 203 x 133 x 30 see Note 1 see Note 1	152 x 152 x 23 152 x 152 x 23 152 x 152 x 30 152 x 152 x 37 203 x 203 x 46

Note to Table 4

1 Beams should be designed by an Engineer in accordance with Technical Requirement R5.

Table 5 - Size of padstone

Effective area supported (as used in Table 4) [m^2]	**Minimum padstone size** [mm]					
	Thickness of wall supporting steel beam [mm]					
	Up to 105		**105 to 155**		**156 to 216**	
	length	**depth**	**length**	**depth**	**length**	**depth**
Up to 10	95	150	80	150	70	150
10 to 20	185	150	160	150	140	150
20 to 30	275	150	240	150	210	150
30 to 40	365	215	320	150	280	150
40 to 50	455	300	400	215	345	215

Notes to Table 5

1 See limitations listed at the beginning of this Appendix.
2 Padstones are not necessary where the flange dimension of the beam exceeds the length of the padstone given in this table.
3 Where the steelwork is in line with the wall supporting it (ie acting to form a lintel over an opening):
- the steel flange dimension should not be more than 50mm greater than the thickness of the supporting wall, ***and***
- the minimum length of padstone should be 200mm, ***and***
- the padstone depth should match the coursing of adjacent masonry, ***and***
- the web of the beam should be over the centre of the wall.

4 Padstones can be formed from:
- in-situ concrete
- precast concrete
- concrete blocks
- clay bricks.

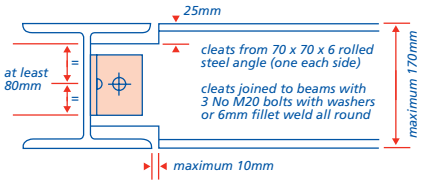
Padstones should be formed in one unit with a minimum compressive strength of 10N/mm².

For padstone sizes less than 215mm x 100mm, engineering bricks will be suitable.

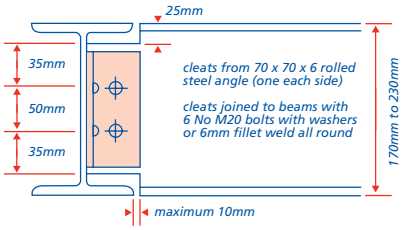
APPENDIX 6.5-C

Connection of beams supporting floors

The connection methods shown in this Appendix (determined using Appendix 6.5-B) are suitable for connecting steel beams used to support floor loads



JOINT BETWEEN BEAMS OF SIMILAR SIZE (neither beam deeper than 170mm)



JOINT BETWEEN BEAMS OF SIMILAR SIZE (beams 170mm to 230mm deep)

Limitations

Limitations on the use of this method are:

- neither beam is to support masonry partitions, ***and***
- both beams have been chosen from Table 4 of Appendix 6.5-B, ***and***
- beams do not differ in depth by more than 40mm.

The following connections should be designed by an Engineer in accordance with Technical Requirement R5:

- between steel sections which differ in depth by more than 40mm, or
- between steel sections, one of which carries floor loads and one of which carries a masonry partition, or
- between steel sections which have not been derived using Appendix 6.5-B, or
- between steel sections which both carry masonry partitions.

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