

connections. The books promote the use of standard design methodology and standard connection details.

Construction led⁽¹³⁾. Series of articles published in *Steel Construction Today* and *New Steel Construction* in 1993. Informative articles covering various aspects of structural steelwork design, fabrication and erection.

Design guide for circular hollow section joints⁽¹⁹⁾. Valuable design information from the international committee which deals with tubular construction. Other guides are available from the same organisation.

Constructional steel design - an international guide⁽²¹⁾. A collection of papers by various authors, providing an international view of steel and composite construction. Includes; material behaviour, element behaviour and design, dynamic behaviour, construction technology and computer applications.

Verifying the performance of standard ductile connections for semi-continuous steel frames⁽²²⁾. Describes a series of tests undertaken to establish details for a family of standard ductile connections.

A new industry standard for moment connections in steelwork⁽²³⁾. Describes the background to reference 16.

Design guidance notes for friction grip bolted connections⁽²⁴⁾. Considers analysis and design of HSFG bolted connections, including a description of bolt behaviour. The text is complemented by worked examples.

Steelwork design guide to BS 5950, vol 4, essential data for designers⁽²⁵⁾. Presents essential design data, not readily available elsewhere, that is useful to steelwork designers and fabricators.

Serviceability design considerations for low-rise buildings⁽²⁶⁾. Includes serviceability design guidance for roofing, cladding, and equipment such as elevators and cranes. Gives recommended maximum values for deflections, and considers human and machine response to vibrations.

4 SITE PRACTICE

The aim of this Section is to give the designer an appreciation of what will, or perhaps should, happen on site. Some of the information describes best *site* practice, and is therefore less directly relevant to the designer than the best *design* practice contained elsewhere in the document. Nevertheless, what will happen on site should be considered during the evolution of any design.

Careful planning of the site work is needed to ensure that a steel frame is erected to programme and within budget. The amount of work to be carried out on site should be minimised, since it is a less suitable and therefore more expensive environment for connecting members than the fabrication works (typically, work undertaken on site is between two and ten times more expensive than the same operation undertaken in the works).

It may be possible for the designer to reduce the amount of site work by specifying components such as fascia frames that are pre-assembled in the workshop. Similarly, some elements, such as components of walkways, may be connected together at ground level to form sub-frames prior to lifting into position. This reduces risk by reducing the work to be performed at height, and speeds up erection by reducing the number of lifts. The use of sub-frames may also facilitate erection, by increasing the rigidity of the items to be joined together 'in the air'. Care must be taken to ensure that sub-frames can be easily joined to other frame members.

Site work can also be reduced by eliminating the need for modifications to the steelwork on site. To achieve this it is essential that the designer supplies the necessary final design information to the steelwork contractor on time (as noted in Section 2). Late or revised information is one of the major reasons why modifications are required on site, causing projects to run late and costs to escalate.

4.1 General features of site practice

4.1.1 Delivery

The need for transportation to site leads to the imposition of certain limitations on the size of components. These limitations may be either practical, due to problems of handling or site access, or legal restrictions governing transport on public roads. Figure 4.1 provides a summary of the maximum dimensions of items which can be transported by road, with or without police notification and escort. Transport time increases considerably as requirements become more onerous; relative values are also indicated in Figure 4.1. The relative costs of the three alternatives vary in accordance with the time taken. More details are given in *Design for manufacture*⁽¹⁾