1 INTRODUCTION

There is a common misconception that the lowest cost solution for a steel-framed building will be the structure containing the least tonnage of steel. However, in the current climate of relative material and labour costs this is not normally true. Minimum weight usually equates to complexity, involving extensive local stiffening, and stiffeners have a large influence on the cost of fabrication and erection. As a rule-of-thumb, for every fabrication hour saved, 100 kg of steel could be added to the frame without any cost increase (based on average 1996 UK prices).

Complexity also lengthens fabrication and erection periods. Longer construction periods may delay the return on a client's investment. Design decisions which affect construction time are just as important as those directly related to material costs.

In a design and build situation, the steelwork contractor may well take advantage of the commercial benefits of rationalising and simplifying the steel frame. However, in the more common fabricate and construct contract, critical decisions on the basic form of the steel frame often need to be taken before the steelwork contractor is involved. Programme constraints usually preclude the possibility of introducing design changes after awarding the steelwork contract, so the designer should take account of construction aspects from the outset.

The principal designer is in the strongest position to influence the project, firstly because he is involved from a very early stage, and secondly because he has a global overview. He must, as far as is possible, take account of the implications for construction of aspects such as the building services, even though these are not directly related to the building frame for which he is responsible.

This publication presents an overview of the information that a designer requires in order to produce a 'buildable' design, to the overall benefit of the project. At the end of each Section, ***Further Reading*** lists provide the reader with details of potential sources of further information on particular topics. References are listed formally in Section 9.

A formal list of relevant codes and standards, some of which are referred to in the text, is given in Section 10.

Two types of "boxes" appear throughout the publication. The shaded "Actions" boxes highlight the principal actions on the designer, and the "Key Points" boxes summarise the points on a given subject.

Produced as a part of the Eureka CIMsteel project, this guide is a companion document to the *Design for manufacture guidelines* [1] produced under phase 1 of the project.

2 PLANNING FOR CONSTRUCTION

2.1 The need to plan for construction

There is often a great temptation to jump immediately into the detailed design of a project. Little time is spent on planning the design, in the belief that this will improve productivity. However, time spent on planning can nearly always be justified; shorter programmes, reduced uncertainty and overall cost savings can be achieved.

In planning the design to best satisfy the client's needs in terms of the building required, its cost, and the available timescale, it is essential to consider construction. By doing so it will be possible to produce a design that facilitates construction. Such an approach is sometimes called *construction led* design. The following aspects of the project are affected by this approach:

- basic design decisions (without violating other constraints)
- flow of information at the design and construction stages
- sequencing of work both on and off-site.

It should be noted that the consideration by the designer of how his design could be put into practice is also a requirement of the CDM regulations[2] , since such consideration facilitates safe construction (see Section 5).

2.2 General principles

When planning for construction, a designer should follow the five principles given below:

- carry out a thorough investigation
- plan for essential site production requirements
- plan for a practical sequence
- plan for simplicity of assembly
- plan for logical trade sequences.

These principles are taken from CIRIA guide SP26[3] , selecting those specifically relating to planning from a general list. Their relevance to the design of steelwork is highlighted in the Sections that follow.

2.2.1 Thorough investigation

A thorough and complete investigation of the site is needed before commencement of design, and the information obtained must be clearly presented. This is an essential starting point for avoiding costly modifications at a later date. The investigation should provide the designer with information concerning the following:

- ground conditions
- ground levels
- access to and throughout the site
- particulars of adjacent structures affecting or affected by the works