1 General matters

1.1 Introduction

Structural engineering can broadly be described as the study of how the various component elements of a building act together to form a supportive structure and transmit forces down to the foundations. Determining the actual size of the members or elements is only one of the interrelated matters with which the structural engineer is concerned in the design of a building or similar structure. For the purpose of description these matters may be divided into stages and defined as follows:

Structural planning stage When a structural scheme is devised to suit both the purpose of the building and the site conditions which exist.

Structural analysis stage When the loads are determined and their dispersal through the structure is analysed by applying the principles of structural mechanics.

Structural elements design stage When the size needed for each member is calculated in relation to the material and its particular structural capacity.

Structural detailing stage When detail drawings are produced to illustrate how the structure is to be constructed on site so as to comply with the engineer's design concept.

Structural specification stage When the specification clauses are compiled to ensure that the standard of materials and workmanship to be employed in the works comply with the assumptions embodied in the structural engineer's design.

Building and civil engineering is a team effort, requiring each discipline to have some understanding of the work in others. In this context structural element design is probably the best subject to provide architects, quantity surveyors, building control officers, clerks of works and site staff with a fundamental knowledge of the structural behaviour of the different building materials.

Initially students often mistakenly believe that structural element design is just a form of applied mathematics. Some regrettably are even daunted by this belief. It cannot be denied that in order to determine the size of individual elements it is necessary to carry out calculations, but these, once understood, follow a logical sequence.

To assist us in arriving at a logical design sequence we first need a set of guidelines. These may be found in the relevant British Standards or Codes of Practice which advise on how the materials we use, that is timber, concrete, masonry and steel, behave in the form of building elements such as beams, columns, slabs and walls.

1.2 British Standards

Guidance on the design of building and civil engineering structures is given in various British Standards and Codes of Practice. These play an important role in the provision of structural designs which are both safe and economic and which comply with the Building Regulations and other statutory requirements.

To the inexperienced the standards can be seen as sets of rules restricting freedom and choice, but in the author's opinion they should be accepted as guidelines. Just as our buildings need firm foundations, so too does our knowledge of how structures behave. Engineering judgement and flair come not from taking risks but from a sound understanding of the limits to which we can take the various materials. British Standards contribute to that understanding.

In relation to their application in structural design the various standards and codes may be broadly classified into three groups:

(a) Those relating to the specification of materials and components
(b) Those relating to structural loading
(c) Those relating to the actual design of structural elements in a specific material.

Listed in Tables 1.1, 1.2 and 1.3 respectively are a selection of British Standards within each group.

Table 1.1 Standards relating to materials and components

BSI reference	Title
BS 4 Part 1 1980	Structural steel sections – specification for hot rolled sections
BS 12 1989	Specification for Portland cements
BS 882 1983	Specification for aggregates from natural sources for concrete
BS 890 1972	Specification for building limes
BS 1243 1978	Specification for metal ties for cavity wall construction
BS 3921 1985	Specification for clay bricks
BS 4360 1990	Specification for weldable structural steels
BS 4449 1988	Specification for carbon steel bars for the reinforcement of concrete
BS 4483 1985	Specification for steel fabric for the reinforcement of concrete
BS 4721 1981 (1986)	Specification for ready-mixed building mortars
BS 4978 1988	Specification for softwood grades for structural use
BS 5606 1988	Code of practice for accuracy in building
BS 5977 Part 2 1983	Lintels – specification for prefabricated lintels
BS 6073 Part 1 1981	Specification for precast concrete masonry units
BS 6073 Part 2 1981	Method for specifying precast concrete masonry units
BS 6398 1983	Specification for bitumen damp-proof courses for masonry