developers in that city. The city of York, including its great Minster, is built of Yorkstone, while Edinburgh, like the rock that supports its castle, rises in grey granite from a Pre-Cambrian foundation. The reason for the use of local building materials is not difficult to see. At a time when travel was difficult and transportation costs high in relation to other costs, it would seem reasonable to build with those materials close to hand. Within the structural limits of local materials the latest style in architecture was freely and imaginatively interpreted. Special or non-local materials were sometimes used but, being scarce and therefore precious, they were kept for ornamental work (Moughtin *et al*., 1995). Brick became the common structural material used throughout this country, particularly for domestic work; nevertheless, local brickworks supplied local markets. Nottingham with its bright red, almost vermilion, hard-pressed brick, or the ubiquitous of the softer brown brick in London, are evidence of a regional variation and use of this common material. Clearly, a green approach to the choice of building material for urban developments would be conditioned by a strong preference for materials originating in the local region: it would tempered by other considerations such as the availability of suitable local materials and the balance of capital energy inputs from transportation as opposed to the energy content from manufacture. In a more fully developed sustainable society than exists today – and one which may be some way in the future – regional markets in building materials may become a possibility, so stimulating a regional pattern of architecture (Amourgis, 1991).

Materials such as stone – and to some extent brick – require labour to form, dress and erect them. This often labour-intensive work involves entirely renewable energy, and furthermore extends work and remuneration to additional numbers in society, fulfilling one aim of a sustainable society, which is to pursue more equitable policies: 'A fundamental Green principle is that labour is a renewable source of energy. It follows that its substitution in the form of craftsmanship for high-energy expenditure on materials and manufacturing processes, is environmentally desirable. Another principle is that energy should be expended as closely as possible to its need. The original village or noble estate supplied its own blacksmith, farrier, dressmaker, hairdresser, carpenter, joiner . . . and so on, and a great deal of its own food'. (Fox and Murrell, 1989).

A return to the feudal system is not being advocated here. Nevertheless, the model for a sustainable building industry may have more in common with the scale and structure of the black building economies currently responsible for the massive expansion of Third World cities than the Developed World's corporate engineering industry which in this country has been responsible for, and is still engaged in, the expansion of the motorway system. Clearly, the sustainable building industry of the future is unlikely to be engaged in the mass construction of those high-rise housing estates typical of the last century.

Because of the need to minimize carbon dioxide emissions, it is most appropriate to invest in new buildings with a long life and low energy use. There are a growing number of such buildings throughout Europe, a good precursor for a green future. Many such buildings are, in themselves exciting, architectural statements (see for example The

Queens Building, School of Engineering and Manufacture, De Montfort University, Leicester and NMB Bank Headquarters in Amsterdam; Figures 2.17–2.21). Buildings such as these make great savings in the energy used during the lifetime of the building, which offsets the one-off investments in materials with a high embodied or capital energy cost. Since trees take up carbon dioxide from the atmosphere, then to some extent the capital energy content of the building, that is, some of the damage done to the environment by it, could be defrayed or mitigated by the planting of trees. By balancing the planting of trees, in sufficient numbers, with the estimated emission of carbon dioxide during manufacture of materials for development, it would be possible in theory to develop a sustainable building industry. For example, 'A typical three-bedroom house has materials with a capital energy content equivalent to the generation of 20 tonnes of carbon dioxide and would need about 20 trees to offset this over a 40-year period'. (Vale and Vale, 1993). The linking of the planning of new development with tree planting would be, in effect, an environmental tax and would be a valuable move in the direction of sustainable development as, indeed, would a labour-intensive building industry dependent upon regional building materials.

Reducing or minimizing embodied energy in a building, together with its operating energy, has considerable environmental benefits. However, energy consumption is only one of the environmental impacts of building materials. Ecological sustainability involves a more holistic evaluation of the environmental impacts of building materials. Sustainable natural processes are characterized by their cyclical nature and by

Figure 2.17 Queen's Building, School of Engineering and

Figure 2.18 Queen's Building, School of Engineering and Manufacture, De Montfort University, Leicester

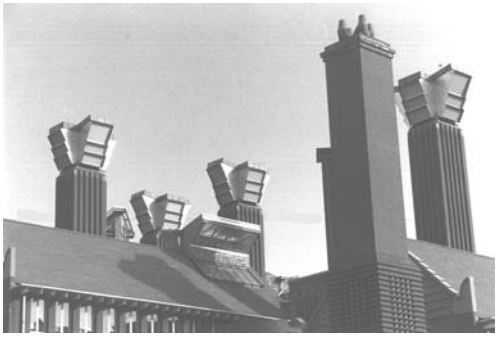

Figure 2.19 Queen's Building, School of Engineering and Manufacture, De Montfort University, Leicester