of window design with branches of physics, psycho-physics and psychology all being relevant. This is indeed a complex array of concepts to lay before an architect. Most courses in architecture attempt to teach most of this scientific material. However, the methods of science are perhaps surprisingly unhelpful to the designer. Modern building science techniques have generally only provided methods of predicting how well a design solution will work. They are simply tools of evaluation and give no help at all with synthesis. Daylight protractors, heat loss or solar gain calculations do not tell the architect how to design the window but simply how to assess the performance of an already designed window.

## Sub-optimising

Chris Jones (1970) summarises how John Page, a professor of building science, proposes that designers should adopt what he calls a cumulative strategy for design in such a situation. This would involve setting carefully defined objectives and criteria of success for the performance of the window on all the dimensions we have identified. Page's strategy then calls for the designer to collect a variety of what he calls sub-solutions for each criterion and then discard the solutions which fail to satisfy all the criteria. Thus the window designer would produce a succession of designs, some intended to achieve a good view, others to avoid solar gain or good daylighting and so on. We are told that this strategy is intended to increase the amount of time spent on analysis and synthesis and reduce the time spent on the synthesis of bad solutions.

It is interesting that this strategy, suggested by a scientist, resembles the behaviour of the science students in the experiment described in the last chapter. Such an approach, however, does not seem born of a clear understanding of the true nature of design problems. Because design problems are so multi-dimensional they are also highly interactive. Enlarging our window may well let in more light and give a better view but this will also result in more heat loss and may create greater problems of privacy. It is the very interconnectedness of all these factors which is the essence of design problems, rather than the isolated factors themselves. In this respect designing is like devising a crossword. Change the letters of one word and several other words will need altering necessitating even further changes. Modify the dish of George Sturt's cartwheel and it may fail to support its load and the lateral thrusts unless

the angle of toe-in and axle mounting are also changed. After this the cart may not fit the rutted roads unless the length of the axle and shape of the body are changed. As we have seen, the cartwheel was the result of many years of experience rather than theoretical analysis.

## The integrated solution

Until the advent of modern building science this is just how windows were designed. Perhaps the finest period for window design in England was the eighteenth century. The vertical proportions of Georgian windows positioned near the outer edge of the wall and with splayed or stepped reveals gave excellent daylight penetration and distribution (Fig. 4.3). The vertical sliding sash was reasonably weatherproof and gave much more flexible ventilation configurations than the hinged casement which was to replace it.

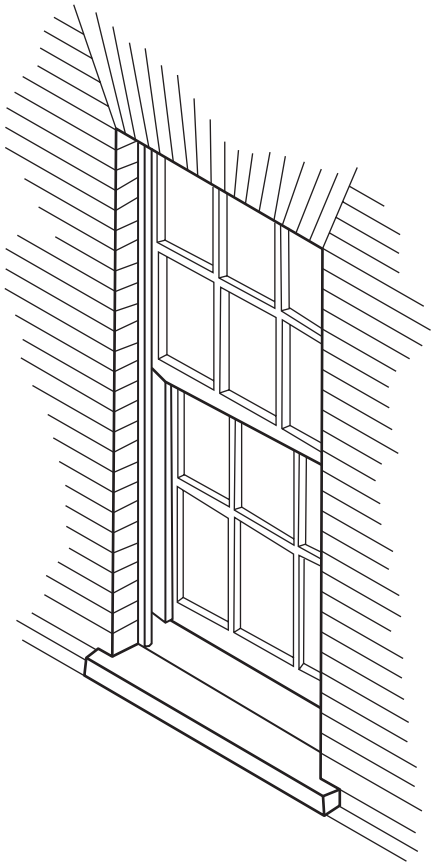

**Figure 4.3**
The Georgian window offers a beautifully integrated solution