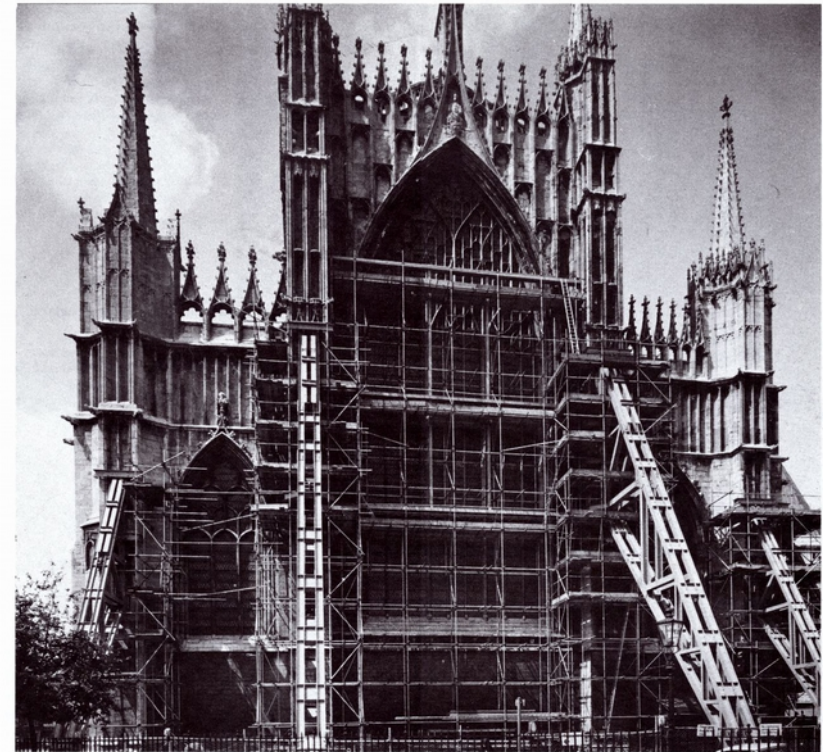


**Figure 21.6** Scaffolding, nave, York Minster, England  
(Courtesy: Shepherd Building Group Ltd)

The scaffold itself is designed for economy, using a central and two side towers linked and braced together. The scaffolding is being moved horizontally from east to west two bays at a time, since a 'rolling programme' is far more efficient than an 'up-and-down programme'. The amount of work in erecting and dismantling scaffolding should not be under-estimated, as in fact one is building a temporary building within a building to gain access to all surfaces. Note the system of bracing which is essential for stability and the toe-boards for safety. Verticals are nearly 2 m (7 ft) apart because this is a light-duty scaffold. The cleaning has exposed local faults which have to be corrected by the masons, while quite serious defects, which had been kept under observation during the consolidation of the foundations, were rectified in the bays immediately adjacent to the central tower

well. When shoring is erected, it is not stressed and consequently some movement must occur before it can carry its load. Because this movement will induce cracks or may cause other damage and in extreme cases may even be quite dangerous, it is

highly desirable to tighten up or prestress shoring to its calculated loading. This can be done by jacks of suitable type, either screw or hydraulic. Care must be taken to avoid damaging a tender old building by over-tightening the wedging or over-prestressing.



**Figure 21.7** Shoring, east end, York Minster, England  
(Courtesy: Shepherd Building Group Ltd)

Raking shores support the wall which is leaning outwards and near collapse. Flying shores act as horizontal struts between the raking shores. The whole wall had to be kept intact in order to avoid damage to the famous early fifteenth century Alpha and Omega window which is as large as a tennis court

#### Jacking shoring: an example

A refinement of jacking was devised at York Minster where flat-jacks were placed under the bases of 26 m (85 ft) long steel raking shores. These jacks were linked to a constant pressure mechanism which applied a horizontal force of 20.3 t (20 tonf). The shores were able to accommodate movement in the building and the jacks also absorbed the thermal movements in the shores themselves with a total expansion and contraction of about 30 mm (1.2 in). When inserting shores, needles are necessary to transfer the stresses to the masonry, and as has been said it is often useful to find the original

putlog holes, if they exist. Shores should always be removed carefully; if they have prestressing jacks, the procedure is greatly simplified as the pressure in the jacks can be lowered in stages.

#### Hydraulic jacks

A building contractor with wide experience can greatly assist the architect by suggesting the most up-to-date equipment and plant for any particular project; for example, many uses for hydraulic jacks are being found in restoration works. Post-tensioning of reinforcement and extraction of lining tubes to holes