**Fig. 4. Two-storey-high circular columns in self-compacting, high-strength concrete**

requires more connections. With self-compacting concrete, it became possible to cast circular columns in closed horizontal moulds via the openings left for the corbels. Hence, the problem of limited column height at manufacture is solved.

Prestressing is often applied in precasting because of the possibility of using prestressing beds and tendons anchored by bond. This technique does not only offer all the constructional advantages of prestressed concrete but also economical manufacture because of the low labour input and the absence of the expensive anchorage devices needed in post-tensioning.

The major difference with cast in-situ concrete is that the planning around the units to be precast has to start at an earlier stage. Both the architect and services engineer must be ready to define their requirements in time for the precaster to prepare his/her drawings. However, with the introduction of BIM, this difference starts to disappear.

## Opportunities in prefabrication

Compared with traditional construction methods and other building materials, prefabrication as a construction method and concrete as a material have several positive features. Prefabrication is an industrialized construction technique with inherent advantages.

**Factory-made products.** The only way to industrialize the construction business is to shift the work from the site to modern, permanent factories. Factory production means rational and efficient manufacturing processes, skilled workers, repetition of actions and lower labour costs per square metre due to the automation of the production process, as is the case, for example, with the manufacture of hollow-core floors and the activity of quality surveillance. Factory products are process-based and lean manufacturing principles are used in manufacturing. Competition and the social environment are forcing the industry to continuously strive for greater efficiency and better working conditions through the development and innovation of products, systems and processes. Automation is gradually being implemented. Examples already exist in the domain of reinforcement preparation, the assembly of moulds, concrete casting, the surface finishing of architectural concrete, and so forth. Other operations will follow.

**Prestressing.** The pretensioning of steel tendons is often applied in precasting because of the possibility of using prestressing beds and tendons anchored by bond, as shown in Fig. 5. Besides the constructional advantages, this technique offers an economical way of manufacturing because of low labour input and the absence of the expensive anchorage devices as used in post-tensioning.

**Fig. 5. Prestressing methods use long-line casting beds of between 100 – 180 metres in length**

**Optimum use of materials.** Prefabrication has much greater potential for economy, structural performance and durability than cast in-situ construction because of the higher potential and optimal use of the materials. This is obtained through modern manufacturing equipment and carefully studied working procedures. Precasting works use computer-controlled batching and mixing equipment. Additives and admixtures are used in the mix design to obtain the specific mechanical performances needed for each product. The casting and compaction of the concrete are performed in indoor working conditions, with optimum equipment. The water content can be reduced to a minimum and curing is also carried out in controlled circumstances. As a result, the grade of concrete used can be exactly suited to the requirements of each type of element in order to eliminate the use of more expensive and exhaustible materials. In addition, the mix efficiency is better than in cast in-situ concrete.

**Architectural freedom.** The design of buildings is not limited to the application of rigid precast elements and almost every building can be adapted to the requirements of the builder or the architect (Fig. 6). Architectural elegance and variety on the one hand and increased efficiency on the other are not mutually exclusive. The days are gone when industrialization led to large numbers of identical units; an efficient production process combined with skilled workmanship allows for modern architectural design within a budget.

**Structural efficiency.** Precast concrete offers considerable scope for improving structural efficiency. Longer spans and shallower construction depths can be obtained by using precast prestressed concrete for beams and floors. For industrial and commercial halls,


**Fig. 6. Strand Apartment building, London (a); Apartment building, South Street London (b)**