Building Category

WINNER

Figure 1: Level 31 crane height 150m.

Figure 2: Level 18 hotel section.

Figure 3: Level 26 with 4m cantilever from Level 23.

Beetham Hilton Tower, Manchester

The Beetham landmark is the tallest concrete frame ever constructed in the UK. The project is a mixed-use development consisting of a 279-bed Hilton hotel, public bar and 219 apartments, all housed within its 47 storeys. The building itself is over 170m in height above ground level.

The lower levels of the Beetham Hilton Tower are made up of a two-storey basement car park, the ground floor reception area and hotel restaurant, the Level 1 ballroom and bar. At Level 2 there is a health spa with swimming pool. The hotel rooms are situated over Levels 4 to 22 inclusive. The public bar is situated at Level 23, with the apartments above on Levels 25 to 47 inclusive.

Figure 4: View from below.

The structure of the building is made up of two vertical cores, with post-tensioned slabs being used to maintain minimal slab depths and give greater spans between columns. Concrete was used to construct the frame due to its superb acoustic resistance and good fire protection.

The tower is founded on a 2.5m-thick raft slab, which sits directly upon the sandstone strata approximately 9m below existing ground level; there are no piles supporting the tower. The first post-tensioned slab is at Level -1 within the basement. All other slabs on the tower are post-tensioned with the exception of Level 49, the roof slab, which is a conventional metal deck construction.

There are five elliptical reinforced concrete columns (1800 × 900mm) that are situated within the reception area, rising up through the building to Level 2, where the internal columns become shear walls that run up through the tower to full height. The elliptical columns are rectangular through Levels -2 to 00, so these columns were reinforced elliptically, while maintaining a rectangular shape.

Of the five elliptical columns, the western feature columns are 10m high and were constructed in one pour. These columns were to have no additional finish on them, so a very high standard of finish as cast was required. At Level 3 the building cantilevers out approximately 1.8m at the top of the western elliptical columns, requiring a complex transfer structure to be constructed at the top of each column. These transfers contain over 2000 bars in each. These transfer structures are tied back to the main core via the post-tensioned slab, at Levels 3 and 4, thus reducing the amount of reinforcement required at these locations.

At Level 23, the cantilever level, the building cantilevers out to the north by approximately 4m. A transfer load system was devised using a combination of two-storey 'walking columns' along the two sides and four 2m-long concrete cantilever beams projecting from the concrete shear walls. The cantilevered beams work together with a 300mm-thick post-tensioned slab, with the tendons running north to south to support the extended cantilever slab from the core face, providing the stiffness required. This slab required designing to ensure the deflections were tightly controlled.

The reinforced concrete frame had to be constructed to

Figure 5 above: Level 21 and Level 3 external swimming pool structure.

Figure 6 above: 11m in-situ elliptical concrete columns in the Reception.

Figure 7 below: Beetham Hilton Manchester.

Figure 8 below: Exposed elliptical columns.

Figure 9 above: Beetham Hilton nightshift.

Figure 10 right: View of elliptical columns.

close tolerances due to the glazing system, which is fixed to the slab by means of cast-in Halfen channels. The tolerance on these channels was 5mm, and was required to ensure that glazing units maintained their design joint of 14mm between the panels in their vertical joint. As the deflections of slab edges could impact on the curtain wall, a slab with minimal deflections had to be designed. The post-tensioning system was considered the best solution to this problem.

As there are also residential lifts running from Level -2 up to 47, the verticality of the shafts was critical in order for the lifts to be installed. The building is also subject to axial shortening, requiring the cores and slab edge columns to be super-elevated at construction stage. This means in effect that the slab edges had to be installed at a higher level than designed, with the edges coming down to level once the shortening had taken place.

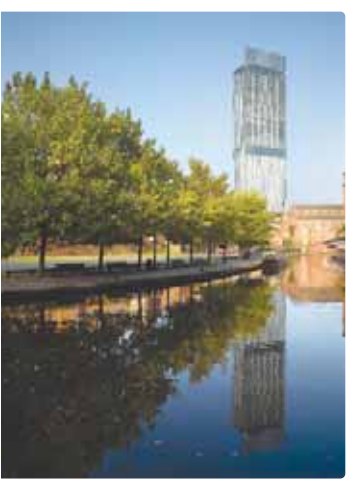

Figure 11: The completed Beetham Hilton Tower on the Manchester landscape.

Efficient use of concrete

Concealed beneath the glass façade are the twin concrete cores and post-tensioned floor slabs, delivering a very efficient use of horizontal and vertical space. The design delivered 200mm-thick concrete floor slabs without the need for supporting columns, which would have restricted the floor layout. The tower was built using a self-climbing jump form technique achieving 3.5m height per lift and at one lift per week. A striking feature of the building is the 4.5m oversail at the Sky bar on Level 23, with windows set into the floor to show the street below.

Concrete made the building possible in many ways, even though the design is based on concealing how it is done:

- 200mm post-tensioned slabs minimise storey heights and give big bays; they also allow apartment owners to cut through and join floors
- oval columns in the base are fair-faced concrete and sleekly done
- cladding to the podium block is in a precast polished concrete with a dark, terrazzo-like finish, matching the glazing in sophistication.

The construction process used pump-placed high-strength concrete (80 and 60MPa) for all floors. An innovative idea, with over $2m^3$ in the pump line, was to discharge the concrete at the end of the day's pour into formwork to make precast stairs for the works, which avoided waste.

Regarding the design, the building seeks to be sensational in several ways:

- its slender profile and asymmetrical widening part-way up (the apartments have a deeper floor plate than the hotel) makes it highly memorable and noticeable
- its publicly accessible, double-storey Sky bar in the cantilever Level 23 draws crowds
- its height, glamorous finish and style are attracting celebrity buyers. ■

Judges' comments

The Beetham Hilton Tower lives up to its billing as an excellent example of concrete construction. It has become the latest in a line of new buildings to raise the architectural and commercial level of the centre of Manchester. By putting a high-ambition building on a low-cost but strategic site, the city's commercial geography has been shifted decisively.

While much of the concrete is now concealed behind the glass cladding, concrete is used to good effect in the lobby and conference reception on Level 1, with exposed elliptical concrete columns lining the lobby area. The tower structure proved efficient, with great design and construction skill used to achieve the step-out at the 23rd floor. Floor windows in the Sky Bar are typical of the design's gymnastics. The tower is more in harmony with its surroundings than indicated by the submission photos, given the redevelopments underway, and the tower uses the flexibility and high strength of concrete in the design and construction, particularly the modifications following Building Control changes. Overall, the Beetham Tower is a great example of integrated design and construction skills.

Beetham Hilton Tower, Manchester

Owner:	**Beetham Organisation**
Architect:	**Ian Simpson Architects**
Consulting engineer:	**WSP Group**
Contractor:	**Carillion Building**
Concrete contractor:	**MPB Structures Limited**
Reinforcement supplier:	**BRC**
Concrete supplier:	**Tarmac Concrete**