
Photo: Buchan Precast Concrete.

Post-tensioning delivers La Tour de force

Hotel La Tour, a new 174-bedroom, four-star hotel in the centre of Birmingham, was subject to a very tight construction schedule. Its timely completion was aided, at least in part, by the post-tensioning (PT) of two floors, including a transfer-slab (Figure 1). Tom McAteer of CCL reports.

Figure 1 above: Post-tensioned slabs at Levels 2 and 3.

Figure 2 above right: First level of precast walls above Levels 2 and 3 post-tensioned slabs.

Figure 3 bottom right: Downstand beams to cantilever areas at Levels 2 and 3.

The original design of Hotel La Tour comprised two and five levels of precast concrete structure supported by two floors of reinforced concrete (RC) plates at Levels 2 and 3 (Figure 2). Level 2 was originally schemed as 300mm RC. Level 3 was a 300mm transfer-slab with a grillage of downstand beams resulting in a typical overall depth of 1250mm, although this reached 1500mm in some areas.

PT flat-slab solution

The initial RC design included several elements which would have had a considerable impact on the timescale of the project. Among these was the large number of downstand beams within the slabs, which would have made the fixing of formwork a more lengthy process, extending the programme cycles. To overcome this obstacle, post-tensioning specialist CCL designed and installed PT suspended horizontal floor plates to Levels 2 and 3. Not only did the PT slabs remove the majority of downstand beams but also the amount of reinforcement to be fixed was also significantly reduced.

A 300/220mm PT flat-slab solution was proposed for Level 2, while the overall transfer-slab depth at Level 3 was reduced from the original 1250/1500mm thickness to a typical 600/520mm depth. Downstand beams were retained in the designs for Levels 2 and 3 at cantilever locations, in order to control deflections (Figure 3). CCL's XF flat-slab system, which is designed and approved to ETAG (European Technical Approval Guide) 013 Standards, was installed using 15.7mm diameter strand.

The reduced number of downstands in both floors made a big difference to the amount of space available and to the layout of the area beneath. Longer spans gave a more open look and feel, and floor-to-ceiling space was maximised. Floor-to-floor programme cycles were accelerated because formwork placement and removal was greatly simplified.

A further benefit of the PT flat-slab solution was the easier routing of services. The remaining downstands were used to facilitate service installation. With careful

co-ordination, sleeves were cast into the PT beams to allow free passage.

The precast elements above Levels 2 and 3 included nine different types of fully fitted bathroom pods. Both the PT slabs incorporated a central 80mm recess strip to accept the precast casings (Figure 4). This method of placement reduced the amount of screed required after the units were seated, decreased installation time and kept the slab depth to a minimum. Level 2 had originally been designed as 300mm RC but with no recess for the pods. The post-tensioned slab was able to maintain the 300mm depth and introduce the 80mm recess. This could not have been achieved with the RC slab without increasing the slab depth. Large service openings were required through both the Level 2 and 3 slabs, adjacent to the bathroom units. The flexibility afforded by the PT design ensured these could be easily accommodated (Figure 5).

Crack limitation

Despite reducing the depth of the original transfer-slab from 1200 to 600mm, the final thickness still gave rise to concerns about the possibility of cracking, caused by shrinkage as the concrete cured. Concrete with additional ground-granulated blast-furnace slag (GGBS) was used, which would limit this risk. CCL also co-ordinated the size of the pours to further reduce the chance of cracking and to ensure that the separate pours could be cast in a continuous pour in a single day.

Change to loading

As the project progressed, a change was made to the loading philosophy of the precast structure which was supported by the transfer-slab. This resulted in the near doubling of the original load imposed by the precast elements on the Level 3 slab. By co-ordinating the detailed loads with the precast suppliers and the main consulting engineer, CCL was able to understand their erection and connection procedures and so accommodate the additional loadings. The dowel connection bars between the precast structure and Level 3 were easily co-ordinated and placed, thanks to the significant reduction in the amount of reinforcement within the PT transfer-slab.

The Hotel La Tour project is a valuable illustration of just some of the benefits that can be secured by incorporating post-tensioning into a building (see Figure 6).

Faster and simpler construction schedules bring significant savings in time, which translate into cost benefits. So too does the reduction in the amount of reinforcement and concrete used in the structure. Both programme speed and reduced material usage contribute to a more sustainable method of construction, as well as the flexibility which can be gained to achieve more open, expansive spaces. ●

Figure 4 top left: Starter bars for precast walls and internal recess for bathroom pods.

Figure 5 top right: Large service openings in the post-tensioned slabs.

Figure 6 above: Layout of the post-tensioned transfer-slab at Level 3.