Effective installation of precast stairs in high-rise construction

For many years, the preferred form of stairs in high-rise construction has been precast concrete. Produced off-site, they can be delivered and installed as required by the site programme to create instant access (and egress) as the structure goes up. Additionally, as with most precast concrete, they can be manufactured with high-quality finishes, not requiring further cosmetic work. ***Cliff Billington*** *of* ***Invisible Connections*** *reports.*

The vast majority of landings are supported from the stairwell walls using one of two methods: bolted-on steel angles or proprietary telescopic connectors. These two methods are very different from each other in almost every aspect and a comparison of these differences reveals how time and money can be wasted, while either introducing or eliminating health and safety risks, according to the chosen method.

Health, safety and performance

Perhaps of the greatest concern is what happens when drilling for the angle fixings hits vertical reinforcement in the wall. To reposition the hole requires redrilling the angle, which is time consuming, costly and may not satisfy loading requirements. The temptation therefore is to simply drill at an angle to miss the bars. The result of this is fixings that do not sit squarely against the steel angle (see Figure 1). The capacity of such fixings is a matter of conjecture, but it certainly would not be as intended and must be a concern.

From a practical aspect, further problems must be faced if the angle is not exactly horizontal. Packing or bedding must be installed (see Figure 2), which entails working beneath the landing while it is still on the crane hook. This goes against all sensible health and safety advice and is only one of the drawbacks of bolted-on angles on-site. For the drilling, power is needed, creating trip hazards with trailing cables, and the drilling itself is a prime source of hand–arm vibration, dust and noise.

When using telescopic connectors, operations are carried out from the top of the landing only, and it is recommended that landings are supported by a temporary staging while this is done. No power or tools are necessary.

For both methods, edge protection should be used where falls are possible.

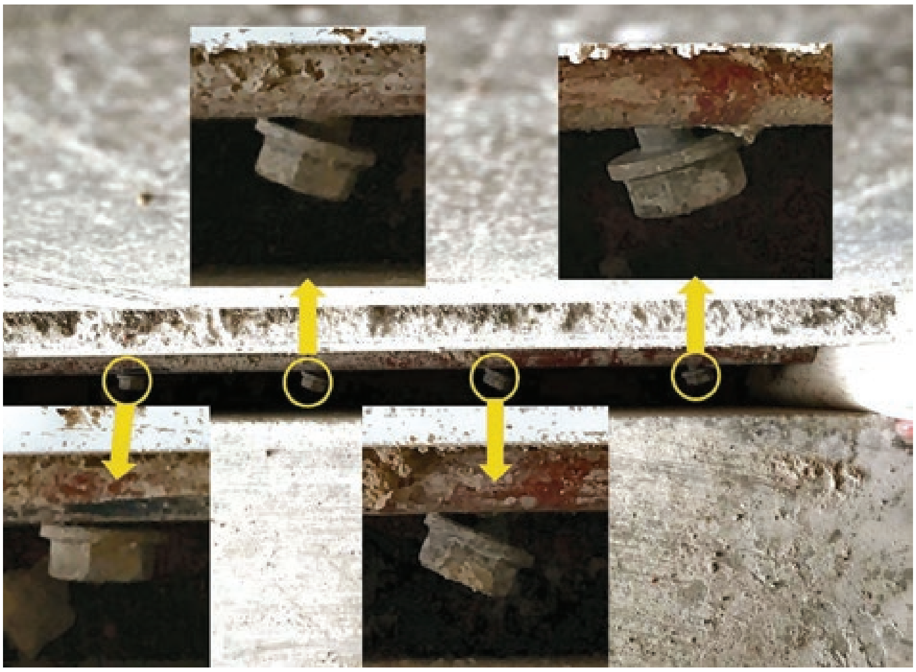

Figure 1: Badly seated fixings due to hitting steel.

Economics

It is only possible to make economic comparisons when the whole operation is taken into account. For steel angles, most of the cost is for the angles and fixings, along with a relatively high site labour element. For telescopic connectors, the main item is the cost of the connectors, but with fairly low site costs. The actual cost of the connectors is borne by the precaster, thus inflating the

Figure 2: Bedding between precast and angle.

Figure 3: Stairwell clear of obstructions.

apparent cost of the stairs. This is a false view, however, since the overall cost of connectors, when labour and finishing works are included, can be in the region of £300 per landing less than using angles.

Once installed, steel angles must be concealed and fire-protected. This operation is frequently not included in anyone's work package, leading to potential disputes. Similarly, operations such as checking bolt torques, and indeed the design of both angle and fixings, are often not included in costs.

Erection operations

When erecting landings, particularly in a high-rise structure, it is beneficial that the stairwell is free from obstructions that would impede the lowering in of precast elements. If angles are used then these cause obstructions, requiring different lifting techniques.
The alternative is to fix angles piecemeal, working off the landing below. For telescopic connectors, the stairwell is completely free of any obstructions (see Figure 3), thus allowing a free route for the crane. This is achieved by seating the connectors into recesses in the wall. Forming these recesses used to be a drawback in itself, but now, preformed recess formers make the task easy, even with slipformed walls (see Figure 4).

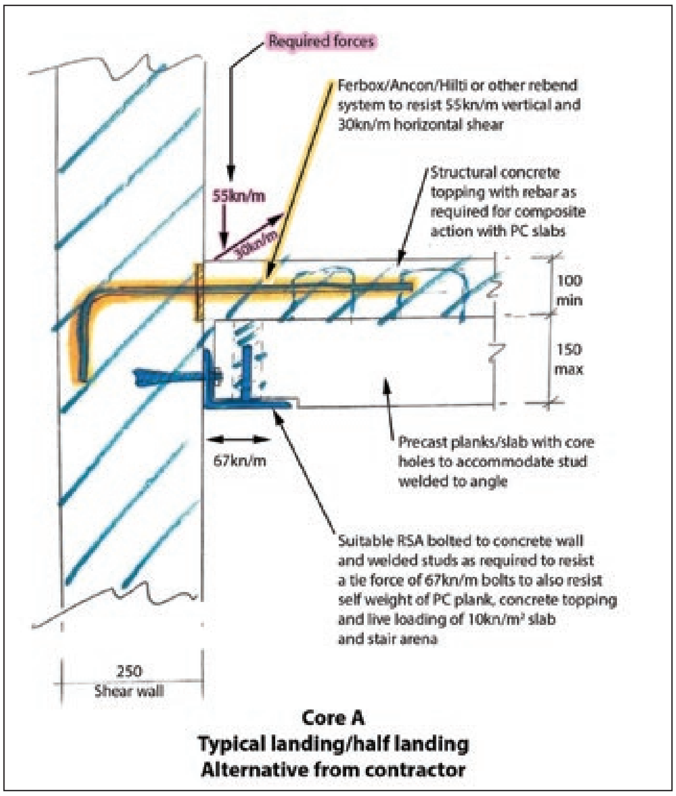

Figure 5: Impractical tying detail.

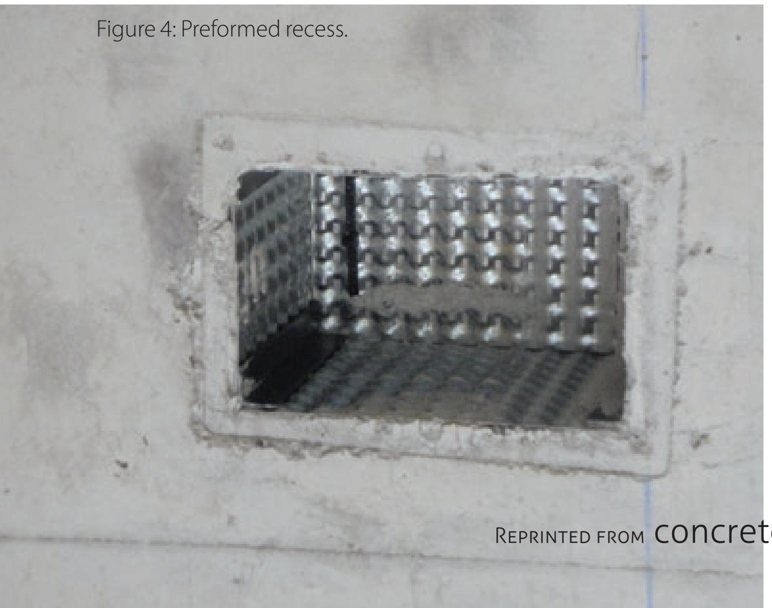

Figure 4: Preformed recess.

Design

Angles and their fixings are a safety-critical element and should be designed by a competent engineer. Too often, drawings vaguely show an angle with the note 'design by others'. This design element and that of the fixings should be clearly defined in contract documents, spelling out who is

Figure 6: Making good required where angles are used.

Figure 7: Clean soffit achieved with telescopic connectors.

Figure 8: Southbank Place, currently under construction, uses over 2000 telescopic connectors.

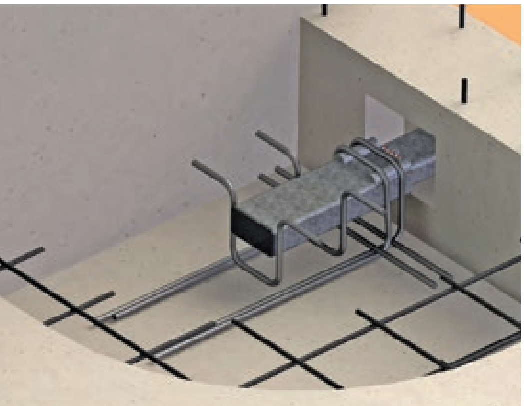

Figure 9: View of a TSS telescopic insert.

"With telescopic connectors, recent developments in design allow robustness to be achieved without recourse to additional fixings into the wall."

responsible for ensuring that the support can perform.

Telescopic connectors are normally of specific capacities, with the substantiating design being provided by the manufacturers. It is still necessary however to calculate the load being carried by each connector in order for correct selection to take place. Usually the connector supplier will provide this calculation.

Robustness

If the stair is required to provide a means of escape, there should be a reasonable probability that it will retain sufficient integrity for this purpose if the building becomes damaged by accidental loads. To achieve this, UK regulations require that all precast concrete stair landings are anchored to the main structure, ie, tied to the stairwell walls. Historically, methods used were often quite complex, time consuming, and costly, as well as relying on many site skills. Some were, and remain, totally impractical (see Figure 5). In particular, ensuring the correct level of pull-out bars from the wall into a screed is difficult to achieve, especially with slipformed walls. Such connections may be used, but design responsibility must be spelled out.

With telescopic connectors, recent developments in design allow robustness to be achieved without recourse to additional fixings into the wall. Positioning connectors on three sides of the landing allow justification that they provide anchorage in all three axes, thus satisfying requirements. Where geometry prevents this, it is possible to achieve anchorage by using factory-modified connectors with a factory-modified recess and a dowelled connection.

Appearance

Where angles are used, they normally are exposed, or even protrude below the soffit. This entails making good and fire protection, thus spoiling the line and the appearance of the high-quality concrete (see Figure 6). Again, it should be decided at the outset whose package this work falls into. With telescopic connectors, there is nothing on show on the soffit, so architectural intent is maintained (see Figure 7).

Huge benefits

For smaller or low-rise projects, angles may (if only for planning reasons) be the easiest solution. For high-rise however, the overall savings in time and cost from using telescopic connectors show huge benefits. It is important however that the use of such connectors is agreed at the outset so that all parties can build in their element of costs and that wall recesses are suitably incorporated. Large projects in particular can benefit massively from their use (see Figure 8), where programme gains, on-the-job practicalities and improved aesthetics will provide most benefit. ■