Installation of holding down bolts in structural steel frames

CM O'Gara of Euro Accessories provides an objective and informative overview of a new product called 'The Boltcracker' and its use in the installation of holding down bolts in structural steel framed buildings – as opposed to current or 'traditional' methods used.

One of the most common difficulties encountered during major construction projects is the interface between concrete and steel, as considered by Handley[1].

Current or traditional methods involve a careful and detailed programme of design, planning, expertise and skilled workmanship on-site, from an initial planning stage by the design engineer to a collaborative, multi-trade process on-site.

The most common means of connection between the structural steel frame and concrete foundation is through the use of holding down bolts, set in steel anchor plates. This consists of a wooden pattress, a wax cone and a base plate, with the holding down bolt inserted through the centre.

Common practice

Prior to setting the holding down bolts in concrete it is common practice to wrap an oil-based tape around the head of the bolt in order to cushion the bolt, creating a small void around it, the purpose of which is to allow some rotation of the bolt within the wax cone, once the bolt assembly has been cast in concrete.

This method can often be very unreliable and is dependent on several factors, one of these being the correct application of the oil-based tape around the head of the bolt, as too little will fail to create a sufficient void, thus resulting in little or no movement of the bolt within the cone. Furthermore, the time span between casting and stripping the bolt assembly is crucial to its overall viability; this should usually be no more than 24 hours, as if left for too long the strength of the structural concrete will not allow any movement of the bolt within the cone.

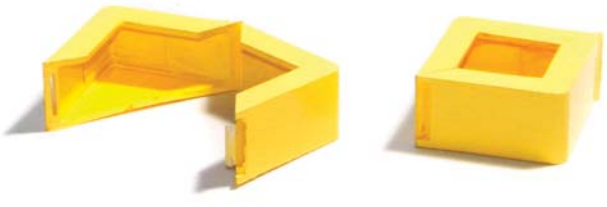

Figure 2: The Boltcracker.

Figure 1: Striking of steel wedges with sledgehammer to force bolts into correct position.

Incorrect setting

Handley[1] also considers the incorrect setting of holding down bolts to be a frequently encountered problem on-site.

The first method used as a means of remedying incorrectly set holding down bolts would be to strike the steel wedges with a sledgehammer (Figure 1) in order to force the bolts into the correct position. This process may result in shearing of the bolt from the shank. At this stage the bolt assembly may be condemned, resulting in ground-workers having to break out the structural base and then re-cast it.

Brown[2] also considers that the use of excessive force, in order to adjust holding down bolts, risks damaging the bolt threads or bolt shank.

If correct positioning cannot be achieved by force, resulting in lack of movement in the bolt shank, a specialist steel fabrication team would usually be brought to site. They would correct the problem by using one of the following two methods.

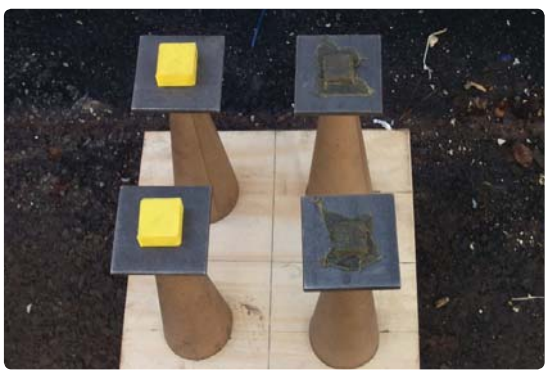

Figure 3: Boltcracker – enclosing the head of the holding down bolts (left of picture); oil-based tape (current method) attached to head of bolts (right of picture).

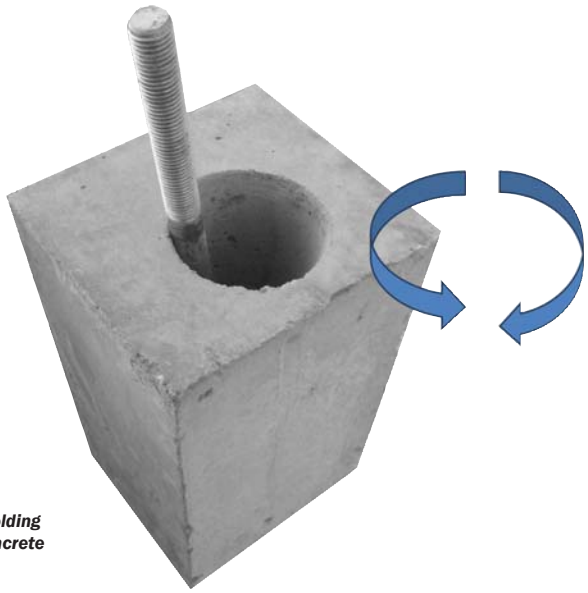

Figure 4 (above): Holding down bolt set in concrete showing rotational movement.

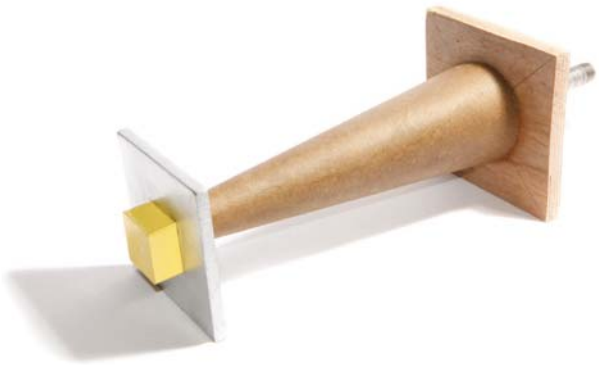

Figure 5: Three-dimensional view of Boltcracker.

Method 1

- They may initially 'burn off' the bolts that have been cast, down to the concrete level.
- The cone would be then filled with concrete or grout.
- The concrete/grout would then be drilled to the correct positions.
- The bolts would then be resin anchored back into the concrete in the correct positions.

Method 2

- The holes in the structural steel plate may be elongated using oxyacetylene burning or drilling methods.

This elongation of the holes in the structural steel plate has implications for the overall strength and integrity of the plate. If the holes are elongated, this results in a structural engineer having to calculate an appropriately sized, additional piece of steel, which then has to be welded onto the weakened side of the steel plate, to return it to its former integrity.

The numerous problems that can occur as a result of incorrectly positioned holding down bolts have implications in terms of cost; these include increased man-hours on-site, additional time spent attempting to remedy the problem, further costs incurred bringing additional trades on-site, but most importantly the possible delay in overall project schedules.

Figure 6 (right): Picture showing setting out of holding down bolts.

Figure 7 (far right): Section through the bolt cone showing The Boltcracker in position.

Benefits of 'The Boltcracker'

'The Boltcracker' (Figure 2) is comprised of a square, plastic enclosure, incorporating a plastic hinge, which clamps shut. It also incorporates a square hole, which matches that of the square key on the bolt head.

The Boltcracker should be attached to the head of the holding down bolt, enclosing the head of the bolt under the anchor plate (Figure 3). This process should occur after the holding down bolts have been assembled, prior to setting in concrete.

Once correctly positioned, it provides a small void surrounding the bolt head. This void then provides adequate space for rotational movement of the bolt head, after it has been positioned and the concrete has set (Figure 4).

This then allows for easy repositioning and alignment of steel, avoiding the need for additional costs, manpower and resources on-site.

The benefits of using The Boltcracker as opposed to current methods seem clear. It could be considered a more economical, robust and time-saving method in the process of holding down bolt installation (Figure 5). ●

References

1. HANDLEY, P.H. The structural steel-to concrete interface. *The Structural Engineer*; Vol.72, No. 17, 6 September 1994.
2. BROWN, G. *Engineers Report*. Thomasons Consulting & Structural Engineers, Available at: *www.boltcracker.com/engineer.html*, 2011.