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20th August 2010

Mr Paul Clarke,
Melbourne Prop Hire Pty Ltd,
45-47 Marni Street,
Dandenong South
Vic 3175

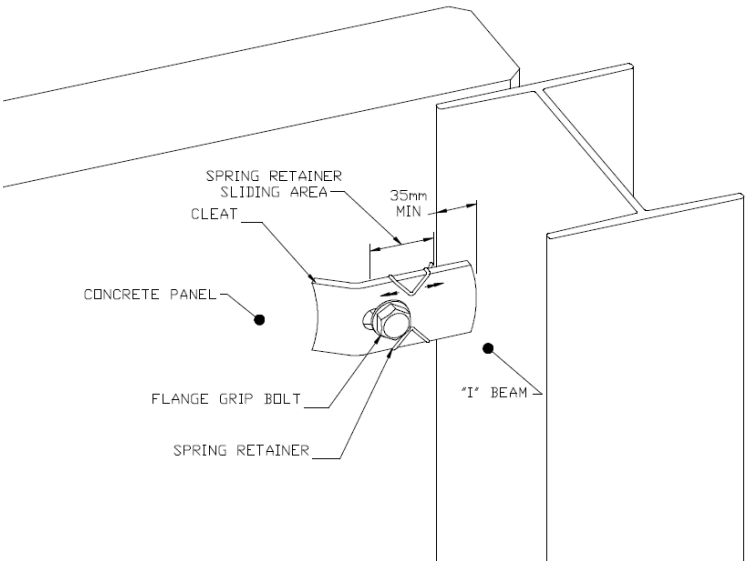
Dear Paul,

REVIEW OF PANEL CLIPS - CLAWCLIP™

As requested, we have reviewed the suitability of Clawclip connection for precast concrete panels to steel columns, based on the technical information and sample supplied by you, as follows.

- Panel Clip Info Fax Sheet
- Drawing 300-2-2001 showing the 75mm x 10mm bent plate nominally 150mm long showing the clip plate
- Report No MTS 338 by Melbourne Testing Services dated the 15th July 2002
- Information from your web site
- Our review of a Clawclip which you sent to us

We understand the general system is as shown below where precast panels are fixed to columns with the Clawclip. The two photographs following also show an actual Clawclip which we have inspected.



Typical Arrangement of the Clawclip

The Clawclip from the front

The Clawclip from the back

We note from the fax sheet information provided and our review of the Clawclip, the following comments:-

- The Clawclip system has been developed to allow movement (in the horizontal direction when fixed to a column)
- The Clawclip system is complete system with the bent cleat, stainless steel wire retainer spring and the flange grip bolt which has an integrated washer
- The scalloped end of the bent cleat provides 2 teeth to bite into the precast panel and the spring clip keeps the bent cleat in position and restricts its rotation
- The cleat plate has a minimum overlap of 35mm onto the column

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- Heavier and longer cleat plates are available for incorrectly positioned columns (or if designers require a longer overlap or heavier plate)
- The bent cleat has a 20mm x 40 mm slotted hole allowing up to 20mm movement or ± 10mm from the centre of the slot
- The normal cleat plate is hot dipped galvanised 10mm x 75mm x 150mm long (nominal)
- The flange grip bolt (grade 4.6) is 80mm overall in length and appears to be cadmium plated or similar. The bolt has an integrated washer with small serrations which allow it to be easily tightened with a "rattle gun" but much more difficult to undo because of the direction of the of the serrations
- The stainless steel wire retainer spring is fits over the straight section of the cleat plate so it can slide along its straight length but cannot slide off the plate as the bolt retrains it in one direction and in the other direction the wire retainer spring will not slide around the bent shape of the cleat plate. The retainer spring also cannot rotate or twist on the cleat plate because of the way it clips over the cleat plate top and bottom on both sides. The ends of the retainer spring have bent ends which when the complete assembly is fitted, presses against the flange of the column or into the concrete panel so the rotation of the assembly is prevented

The Test Report in 2002 by Melbourne Testing Services, which is a NATA registered laboratory, was also reviewed. Melbourne Testing Services tested a Clawclip for resistance to rotation and movement using a section of a steel column and precast panels. Melbourne Testing Services tested for simulated thermal movements of 5mm and crane movements of 2mm and concluded that after a 60 year design life based on one thermal movement per day and 1 crane movement per day for 6 day a week for 48 weeks a year, that the clip remained in the same position and the movements had worn a minimal amount from the toe of the clip due to movement.

We offer the following general comments based on our experience in precast concrete and our review of the information supplied.

- As with all fixing systems, these must be designed as necessary by the structural engineer to resist lateral loads such as wind, earthquake, soil loads etc. For the Clawclip system with the 10mm x 75mm plate, the arrangement of fixings, the number of fixings, the locations, and spacings will need to be determined by the structural engineer to suit the structural engineering design. The Precast Concrete Handbook has a design example of how such clips can be designed that designers can refer to
- For portal framed structures or similar, diagonal steel bracing will usually be provided in the line of the columns, by the designer for stability. Based on this assumption, if the precast panel is fixed to the column as shown above and assuming the precast panel is not a shear wall providing stability in the line of the wall, we cannot see any structural problems with the system as described. Indeed by not welding the Clawclip, any differential movement due to thermal movements or movements due to cranes is allowed and the precast panels do not become unintentionally shear walls
- The Building Code of Australia (BCA) in Part C, Clause 1.11, requires that in the event of a fire, that the precast or tilt-up panel must either continue to stand or if it fails, it must fall inwards. This is particularly important for steel-framed buildings, with which in an intense fire the steel frame generally buckles, twists and collapses inwards. It is fair to say this requirement is a very vexed question and it is our observation that engineers assume this is met with most connections. The only reference we are aware of and which discusses the technical issues, is the One Steel Publication, Fire Design Note No. 1, Steel Portal Frame

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Buildings: Support of External Concrete Wall Panels published in 2000. The Clawclip would be a classified as a rigid connection by that reference.

In conclusion, we believe the Clawclip is a suitable connection for fixing of precast panels to steel columns but as with all precast concrete elements, detailed design and detailing of the precast panel including the connections must always be carried out by the structural engineer to suit the design parameters and design model chosen.

We trust the above information provide an adequate assessment of the issues involved.

Yours sincerely

John Woodside

NPER, F.I.E.Aust, F.A.S.C.E, M.I.C.E, M.I.Struc.E

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