Fixing Tests for Multi-Core block
27-Feb-02

Dear Sirs

**Fischer Fixing Systems**

We confirm that the tests detailed in your document titled 'Fixings Test Report for Topblock' were carried out at Artur fischer UK and that the tests were carried out into single Topcrete multi-core 7N blocks, and the results are a true record of the tests.

Therefore we recommend that the fixings described are suitable for use with the fore mentioned Topblock product up to the safe working loads stated.

Yours faithfully

T.V Holl
Technical Advisor.
Testing on Topcrete Multicore Block

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2 Test Parameters

fischer fixings have been working alongside Tarmac Topblock to discover what type of fixings and what kind of loads would be suitable for their new Topcrete multicore block. The block is manufactured using dense aggregates and has preformed circular voids. The face size is 440 x 215mm and a thickness of 140mm and is of 7Nmm² compressive capability. The block is available in three grades, standard, paint quality and fair faced; and we tested the paint quality grade, which were single units not in a wall arrangement.

Fischer initially introduced six fixings ranging from lightweight to heavy-duty fixings, the fixings range from the simplest lightweight SX nylon plug to a more complex heavy-duty resin anchor. All the fixings were tested in the centre of the preformed circular voids, where the web thickness was at its minimum being just 25mm.

The test results for all the fixings tested show a good variation in ultimate loads. This allows the engineer/architect/end user to have a broad range of anchor to choose from depending on both function and load performance.

The test were carried out at: fischer Fixings (UK) Limited
Hithercroft Road
Wallingford
Oxfordshire
OX10 9AT

All tests were carried out using a Hydrajaws calibrated tensile tester with a 0-5KN AND 0-20KN gauge, in conjunction with an aluminum 150mm load spreading bridge and M8, M10, and M12 open ended test adapters. To conform to CFA (construction fixing association) guidelines each fixing was tested six times.

As part of the project we also manufactured three demonstration blocks high lighting the six fixings we would be testing, these were distributed to the three Tarmac regional offices around the U.K. for presentation. See appendix A.
3 Fixing Products Tested

3.1 fischer FIS V 360 S & FIS net with steel Threaded rod

**Material:**
Resin: Vinyl ester hybrid resin
Rod: M10 Zinc plated grade 5.8
Sleeve: Plastic Frame with flexible nylon netting

**Range:** M8-M30

The fischer FIS V injection anchor contains a styrene-free, quick setting, high quality hybrid resin mortar, which is characterized by its universal suitability for many applications. This resin can be used solo or in conjunction with an anchor sleeve dependent on application and substrate. When fully cured this resin produced a form type locking in hollow material and friction type locking in solid material, allowing the application to be a stress free fixing.
3 Fixing Products Tested

3.2 fischer FHY Expansion Anchor

Material: Metal, bright zinc plated or stainless steel
Range: M6 – M10

The fischer FHY expansion anchor is the newest anchor from the fischer range. The FHY is designed specifically for hollow-ceiling slabs. The taper section has a continuous internal thread, which permits use with both bolts and threaded rod. The high expansion capacity of the anchor makes it suitable for both solid and hollow-ceiling slabs with a thickness greater than 25mm. The shield of the anchor is 40mm long with sections cut from the shield 21mm from the anchor collar allowing maximum expansion; it is at this point where the anchor is in contact with the concrete. The shield is divided into four segments so that the load is evenly distributed onto the walls of the hollow section. It is with these characteristics that the anchor expands creating friction and form locking.
3 Fixing Products Tested

3.3 fischer Nylon M Unit M10

Material:  Glass reinforced nylon (polyamide 6) with brass cone
Range:  M5 – M16

The fischer M Unit is a glass reinforced nylon expansion anchor with an integral internally threaded brass cone. The M Unit expands like a conventional ‘Wall Bolt,’ but due to the walls of the M Unit being glass reinforced nylon the expansion forces are less aggressive preventing the substrate from crushing during installation. The glass reinforced nylon also reduces noise caused by vibration of pipes, for Mechanical & Electrical applications.
3 Fixing Products Tested

3.4 fischer FFS Self Tapping Screw

Material: Metal zinc plated, passivated to 5 microns
Range: 7.5mm Diameter

The fischer FFS allows a stress free ‘through fixing’ into most substrates. A pre-drilled 6mm hole is required into the concrete; the FFS is then driven into the concrete with ease this is due to the tapered lead-in thread which has a smooth hardened screw surface and slim thread pitch. The minimum embedment into concrete is 20mm, which is perfect when fixing into multi core hollow blocks as the web thickness is 25mm.

The FFS has many advantages over other fixings:

- Drill hole diameter is only 6mm
- Installation using a machine with torx 30 bit is very quick
- Immediate loading
- Through fixing, easy for numerous fixing points i.e. battens or insulation
- Cover caps available for aesthetic finish
3 Fixing Products Tested

3.5 fischer SX10 with 7mm Safety screw

Material: Nylon (polyamide 6)
Metal screw grade 5.8

Range: SX4 to SX16

The fischer SX plug has a fourfold nylon plug expansion which form locks with the substrate. This action guarantees maximum load bearing characteristics. The area of application ranges from solid materials through to hollow or perforated materials.
3 Fixing Products Tested

3.6 fischer FU Universal Plug with 7mm Safety Screw

Material: Nylon (polyamide 6)
         Metal screw grade 5.8

Range:   FU6 to FU10

This all round fixing can be installed into almost any kind of substrate, its unique design allows the fixing to expand or to be permanently deformed dependant on the substrate, when installing into a cavity. The rim at the head of the fixing is to prevent it from falling through; the plug is suitable for wood and or chipboard screws.
4 Test Results
4.1 FISV 360 S & FIS H 18x85 N with M10 Threaded rod

Material: 
Resin: Vinylester hybrid resin
Rod: M10 zinc plated grade 5.8
Sleeve: plastic frame with nylon netting

<table>
<thead>
<tr>
<th>Test No</th>
<th>Free Edge</th>
<th>Axial Space</th>
<th>Load Achieved KN</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>110</td>
<td>220</td>
<td>12KN</td>
<td>bridge used concrete fail around fixing</td>
</tr>
<tr>
<td>2</td>
<td>110</td>
<td>220</td>
<td>11KN</td>
<td>bridge used concrete fail around fixing</td>
</tr>
<tr>
<td>3</td>
<td>110</td>
<td>220</td>
<td>11KN</td>
<td>Bridge used block split in one third</td>
</tr>
<tr>
<td>4</td>
<td>110</td>
<td>220</td>
<td>13KN</td>
<td>Bridge used block split in one third</td>
</tr>
<tr>
<td>5</td>
<td>220</td>
<td>220</td>
<td>12.5KN</td>
<td>Bridge used block split in half</td>
</tr>
</tbody>
</table>

Average ultimate load = **11.9KN**
Using a global safety factor of 4, safe working load in tension = **3KN**
4 Test Results

4.2 FHY M10 Expansion Anchor

Material: Metal bright zinc plated

<table>
<thead>
<tr>
<th>Test No</th>
<th>Free Edge</th>
<th>Axial Space</th>
<th>Load Achieved KN</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>40</td>
<td>70</td>
<td>1.6KN</td>
<td>Tensile slip</td>
</tr>
<tr>
<td>2</td>
<td>110</td>
<td>70</td>
<td>1.8KN</td>
<td>Tensile slip</td>
</tr>
<tr>
<td>3</td>
<td>170</td>
<td>70</td>
<td>1.2KN</td>
<td>Tensile slip</td>
</tr>
<tr>
<td>4</td>
<td>170</td>
<td>70</td>
<td>1.4KN</td>
<td>Tensile slip</td>
</tr>
<tr>
<td>5</td>
<td>110</td>
<td>70</td>
<td>1.2KN</td>
<td>Tensile slip</td>
</tr>
<tr>
<td>6</td>
<td>40</td>
<td>70</td>
<td>1.2KN</td>
<td>Tensile slip</td>
</tr>
</tbody>
</table>

Average ultimate load = 1.4KN
Using a global safety factor of 4, safe working load in tension = 0.35KN
4 Test Results

4.3 Nylon M Unit M10

Material: Glass reinforced nylon (polyamide 6) with brass cone

<table>
<thead>
<tr>
<th>Test No</th>
<th>Free Edge</th>
<th>Axial Space</th>
<th>Load Achieved KN</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>40</td>
<td>70</td>
<td>2.3KN</td>
<td>Cone failure</td>
</tr>
<tr>
<td>2</td>
<td>110</td>
<td>70</td>
<td>3.0KN</td>
<td>Cone failure</td>
</tr>
<tr>
<td>3</td>
<td>170</td>
<td>70</td>
<td>2.6KN</td>
<td>Cone failure</td>
</tr>
<tr>
<td>4</td>
<td>40</td>
<td>70</td>
<td>3.1KN</td>
<td>Cone failure, block cracked</td>
</tr>
<tr>
<td>5</td>
<td>110</td>
<td>70</td>
<td>3.0KN</td>
<td>Cone failure</td>
</tr>
<tr>
<td>6</td>
<td>40</td>
<td>70</td>
<td>2.2KN</td>
<td>Cone failure</td>
</tr>
</tbody>
</table>

Average ultimate load = 2.7KN
Using a global safety factor of 7, safe working load in tension = 0.38KN
4 Test Results

4.4 FFS Self Tapping Screw

Material: Metal zinc plated, passivated to 5 microns

<table>
<thead>
<tr>
<th>Test No</th>
<th>Free Edge</th>
<th>Axial Space</th>
<th>Load Achieved KN</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>40</td>
<td>70</td>
<td>0.1KN</td>
<td>Tensile Slip</td>
</tr>
<tr>
<td>2</td>
<td>110</td>
<td>70</td>
<td>0.1KN</td>
<td>Tensile Slip</td>
</tr>
<tr>
<td>3</td>
<td>170</td>
<td>60</td>
<td>0.2KN</td>
<td>Tensile Slip</td>
</tr>
<tr>
<td>4</td>
<td>170</td>
<td>60</td>
<td>0.2KN</td>
<td>Tensile Slip</td>
</tr>
<tr>
<td>5</td>
<td>110</td>
<td>70</td>
<td>0.1KN</td>
<td>Tensile Slip</td>
</tr>
<tr>
<td>6</td>
<td>40</td>
<td>70</td>
<td>0.1KN</td>
<td>Tensile Slip</td>
</tr>
</tbody>
</table>

Average ultimate load = 0.13KN
Using a global safety factor of 4, safe working load in tension = 0.03KN
4 Test Results

4.5 SX10 with 7mm safety screw

Material: Glass reinforced nylon (polyamide 6)
          Metal screw grade 5.8

<table>
<thead>
<tr>
<th>Test No</th>
<th>Free Edge</th>
<th>Axial Space</th>
<th>Load Achieved KN</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>40</td>
<td>70</td>
<td>2.0KN</td>
<td>Tensile slip</td>
</tr>
<tr>
<td>2</td>
<td>110</td>
<td>70</td>
<td>2.3KN</td>
<td>Tensile slip</td>
</tr>
<tr>
<td>3</td>
<td>170</td>
<td>70</td>
<td>1.8KN</td>
<td>Tensile slip</td>
</tr>
<tr>
<td>4</td>
<td>170</td>
<td>70</td>
<td>2.3KN</td>
<td>Tensile slip</td>
</tr>
<tr>
<td>5</td>
<td>110</td>
<td>70</td>
<td>2.3KN</td>
<td>Tensile slip</td>
</tr>
<tr>
<td>6</td>
<td>40</td>
<td>70</td>
<td>2.7KN</td>
<td>Tensile slip</td>
</tr>
</tbody>
</table>

Average ultimate load = 2.2KN
Using a global safety factor of 7, safe working load in tension = 0.31KN
4 Test Results

4.6 FU Universal plug with 7mm safety screw

Material: Glass reinforced nylon (polyamide 6)  
Metal screw grade 5.8

<table>
<thead>
<tr>
<th>Test No</th>
<th>Free Edge</th>
<th>Axial Space</th>
<th>Load Achieved</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>40</td>
<td>70</td>
<td>3.2KN</td>
<td>Tensile slip</td>
</tr>
<tr>
<td>2</td>
<td>110</td>
<td>70</td>
<td>3.4KN</td>
<td>Tensile slip</td>
</tr>
<tr>
<td>3</td>
<td>170</td>
<td>70</td>
<td>3.8KN</td>
<td>Tensile slip</td>
</tr>
<tr>
<td>4</td>
<td>170</td>
<td>70</td>
<td>3.8KN</td>
<td>Tensile slip</td>
</tr>
<tr>
<td>5</td>
<td>110</td>
<td>70</td>
<td>3.1KN</td>
<td>Tensile slip</td>
</tr>
<tr>
<td>6</td>
<td>40</td>
<td>70</td>
<td>2.8KN</td>
<td>Tensile slip</td>
</tr>
</tbody>
</table>

Average ultimate load = 3.3KN  
Using a global safety factor of 7, safe working load in tension = 0.47KN
5 Results summary

The table below shows the safe working loads of all the anchor tested into Topcrete multi-core block a product of Tarmac Topblock. The Topcrete multi-core block has a concrete web thickness of 25mm and a minimum compressive strength of 7Nmm².

<table>
<thead>
<tr>
<th>Product tested</th>
<th>Average ultimate load</th>
<th>Safe working load</th>
<th>Characteristics Axial spacing</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>FISV 360 S Injection resin with net</td>
<td>11.9KN</td>
<td>2.9KN</td>
<td>220</td>
<td>Tendency to crack the block if high loads applied</td>
</tr>
<tr>
<td>FHY M10 Metal expansion anchor</td>
<td>1.4KN</td>
<td>0.35KN</td>
<td>70</td>
<td>Very difficult to set, substrate too soft</td>
</tr>
<tr>
<td>M UNIT M10 Nylon expansion anchor</td>
<td>2.7KN</td>
<td>0.38KN</td>
<td>70</td>
<td>Slightly better than FHY, more safety factor required as the fixing is nylon</td>
</tr>
<tr>
<td>SX Plug Nylon plug with safety screw</td>
<td>2.2KN</td>
<td>0.31KN</td>
<td>70</td>
<td>Quick, easy and cheap. A good around fixing</td>
</tr>
<tr>
<td>FU 10 Nylon plug with safety screw</td>
<td>3.3KN</td>
<td>0.47KN</td>
<td>70</td>
<td>Also quick, easy and cheap. Capable of high loads than the SX Plug</td>
</tr>
</tbody>
</table>
6 Conclusion

Six fixings were selected for their potential suitability in these types of blocks and the test results collated into a summary table see section 5. All the fixings were installed in accordance with the manufacture guidelines.

**FIS V 360 S**
The application was very simple and the Topcrete block easy to drill, with the resin cured the fixing is stress free. There was no visible slip before block failure occurred. As block failure was observed it would be safe to assume that the loads achieved were limited by the strength of the block, therefore this is the max load attainable in these blocks.

**FHY Expansion Anchor**
The second fixing tested was the fischer FHY expansion anchor, where the larger M10 was used. Although the anchor only works well in material of a wall thickness of 25mm and above the Topcrete block was too soft and produced great difficulty in setting the anchor. We found that the inner collar could be pulled through the body of the anchor. This fixing could be used but there would always be an inherent risk with over tightening and crushing the block during installation.

**M Unit**
The third fixing tested was the nylon M Unit, this glass reinforced nylon expansion anchor has similar fixing properties than the FHY and like the FHY anchor there can be some problems when setting the anchor. We noticed that due to the large hole diameter required to install the anchor, the substrate was not robust enough to prevent the anchor from turning in the hole when a torque loading was applied making collapsing the anchor very difficult. Fixing performed well in tension but there was some problem involved with the functioning of the anchor.

**FFS Self Tapping Screw**
The fourth fixing tested was the FFS self-tapping screw. Due to the substrate being too soft the course thread was unable to cut a deep enough thread into the substrate, so when a load was applied the screw could be pull straight out. Therefore we would only suggest this fixing be used in a shear application.

**SX Plug**
The fifth fixing tested was the SX plug; this is a universal fixing and works well in most substrates. Although this fixing is not capable of high loads it is still a reasonable option due to its size and axial spacing.

**FU Universal Plug**
The sixth fixing tested was the FU universal plug. This, like the SX plug, is a universal fixing and works well in majority of substrates. We found this fixing gave us high loads compared with the price, resulting in a light –mid weight solution with a good safety margin.

As you can see from the test result, this substrate is rather unique. This is due to the use of dense aggregates in a thin walled block configuration, which could potentially cause problems when fixing. Additional testing of the other product ranges may be required to bridge the gap between the fischer FU and FISV.
Appendix A
Presentation Blocks

Plate 1

Plate 2
Presentation Blocks

Plate 3

Plate 4