A cleaner, safer, faster alternative to Pour Strips

Ancon

Lockable Dowels
for Temporary Movement Joints in Post-Tensioned Concrete
Ancon Lockable Dowels

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Lockable Dowels
Lockable Dowels have been designed by Ancon for use at temporary movement joints, most commonly found in post-tensioned concrete frames.
These dowels allow initial shrinkage of the concrete to take place and are then locked in position with a mechanical plate and a controlled amount of epoxy resin. The locked dowels continue to transfer shear, but prevent further movement taking place.

Advantages
The use of Lockable Dowels can save a significant amount of time and materials over other construction methods. Traditionally, concrete shrinkage has been accommodated by leaving gaps in the slab called ‘pour strips’ or ‘closure strips’. These strips are filled once movement has stabilised, however until they are filled the slabs must be propped, restricting site access and delaying site progress. Gaps in the slab also create a trip hazard for site workers, use additional formwork and can leave the soffit face marked.

The Lockable Dowel improves site access, minimises formwork requirements and accelerates the rate of construction. With a Lockable Dowel, there is less requirement for the slabs to be propped or a support corbel to be constructed, as shear load is transferred by the dowel. The time saved by early removal of slab props can be significant.
A Lockable Dowel also provides many advantages over the site-assembled arrangement of carbon steel reinforcing bar, galvanised or plastic ducting, vent tubes and a non-specific grout, which is sometimes used by contractors.
In addition, engineers have found the Ancon Lockable Dowel to be the preferred design solution for pin-ended joints. Although it is customary for practical reasons to use U-bars or other rebar continuity systems at these connections, these options do not truly act as hinges and so rotation of the slab under load can induce cracking at the wall-to-slab interface with potential integrity issues.

The Lockable Dowel is closer to a true pin-ended joint and, being manufactured from stainless steel, provides additional corrosion protection over systems using carbon steel reinforcement.
The design capacities shown on page 6 are backed by independent test data and the unique void former allows inspection of the dowel before the joint is locked.
Standard Ancon systems are available for use at slab joints and retaining / core walls.

✔ Eliminate pour strips
✔ Reduce propping times
✔ Reduce formwork
✔ Improve site access
✔ Faster, safer construction
✔ Proven performance

Pour Strips restrict site access, cause a trip hazard and delay progress on site

The Lockable Dowel eliminates the need for Pour Strips, accelerating the speed of construction and improving site safety
Applications
In most cases, Ancon Lockable Dowels can be used to replace pour strips at temporary movement joints in post-tensioned concrete frames. Standard Ancon systems are available for use at slab joints and retaining/core walls.

Slab-to-Slab
Various site-assembled components
Unreliable performance, additional construction materials used and support corbel or prop required

Slab-to-Wall
Restricted access
Slabs propped for several weeks

Hybrid Construction
Pour strip at steel beam to concrete slab junction

Ancon Lockable Dowel, in conjunction with Ancon Weldable Coupler. Contact Ancon with details of your project requirements.
Ancon Lockable Dowels

Range of Lockable Dowels
A Lockable Dowel allows initial shrinkage of the concrete to take place and then, after a pre-determined time period (generally 3-4 weeks), is locked in position with a mechanical plate and a controlled amount of epoxy resin. The range comprises three products; ESDQ-L20, HLDQ-L30 and ESDQ-L20W.

Slab-to-Slab Lockable Dowels
ESDQ-L20
The dowel component is manufactured from 30mm diameter stainless steel; one end features two fixed overlapping anchor discs and the other has a series of grooves to accept the Locking Plate. The cylindrical sleeve which accepts the dowel component is contained within a box-section to allow lateral, longitudinal and some rotational movement. The epoxy resin is poured into the L-shaped void former. This product has a design capacity of up to 71kN. See pages 6-9 for full technical details.

HLDQ-L30
The HLDQ-L30 is a high load Lockable Dowel with a design capacity of up to 136kN. See pages 6-9 for full technical details.

Example Specification Clause
Delete/Amend blue text as appropriate

<Ancon ESDQ-L20 or Ancon HLDQ-L30> lockable shear load connector comprising dowel, sleeve and locking components to be installed at the temporary movement joint between two slabs. Product to be positioned at <insert centres>mm horizontal centres at <the centre line of the slab or 1000mm from the top of the slab>. The dowel is to be locked in position after <insert time period> using the locking plate and resin supplied. System should be installed in accordance with Ancon’s instructions and engineer’s drawings.
Slab-to-Wall Lockable Dowel ESDQ-L20W

The dowel component is manufactured from 30mm diameter stainless steel, but is shorter than the ESDQ-L20 dowel. One end of the dowel is designed to fix into the stainless steel Ancon SKS24 Threaded Anchor cast into the face of the concrete and the other end features a series of grooves to accept the Locking Plate. The sleeve component is the same as used in the ESDQ-L20. See pages 6-9 for full technical details.

Slab-to-Wall Application

Example Specification Clause
Delete/Amend blue text as appropriate
Ancon ESDQ-L20W lockable shear load connector comprising dowel, sleeve, threaded anchor and looking components to be installed at the temporary movement joint between slab and wall. Product to be positioned at <insert centres> mm horizontal centres at <the centre line of the slab or XXXmm from the top of the slab>. The dowel is to be locked in position after <insert time period> using the locking plate and resin supplied. System should be installed in accordance with Ancon’s instructions and engineer’s drawings.

Epoxy Resin
Each dowel is locked after a pre-determined time period (generally 3-4 weeks) with a high quality, two-part epoxy resin. The resin is mixed and poured into the L-shaped void former. Each dowel requires 1,500g of resin.
Ancon Lockable Dowels

Performance Data

ESDQ-L20 Example
Slab thickness = 240mm
Maximum width of joint = 20mm
Concrete strength = C30/37
Characteristic permanent action (dead load) = 40kN/m
Characteristic variable action (imposed load) = 50kN/m
Design load = 1.35 x 40 + 1.5 x 50 = 129kN/m
Vertical design resistance = 62.2kN (240mm slab 20mm joint)
Therefore centres for vertical load = 62.2 / 129 = 0.482m use 450mm centres
Each dowel will in addition provide a design resistance across the joint of 100kN (for slab to wall this is 80kN), therefore the total design resistance in the direction of the dowel = 100 / 0.45 = 222kN (for slab to wall 80 / 0.45 = 177kN).
If this is insufficient, the dowel centres can be reduced to a minimum of 1.5 x slab thickness to increase the design resistance across the joint, in this example it would increase to 100 / 0.36 = 277kN (for slab to wall 80 / 0.36 = 222kN).

Note to above tables:
Increasing concrete grade will not improve the tensile performance of the dowel.

Joint Filler / Fire Protection
Ancon can provide information on a suitable joint filler and also recommend fire resistant material which could be used as part of an overall fire protection system.

Reinforcement Details
Local reinforcement is required around each Ancon Lockable Dowel to guarantee that the forces are transferred between the connectors and the concrete. See page 8 for full details.

ESDQ-L20 Lockable Dowels (slab-to-slab)

<table>
<thead>
<tr>
<th>Slab Thickness (mm)</th>
<th>Tension along line of dowel (kN)</th>
<th>Vertical Design Resistance (kN) for Various Design Joint Widths (mm) in C30/37 Concrete</th>
</tr>
</thead>
<tbody>
<tr>
<td>160</td>
<td>45</td>
<td>12.0 12.0 12.0 12.0 12.0 12.0 12.0 12.0 12.0 12.0 12.0</td>
</tr>
<tr>
<td>180</td>
<td>65</td>
<td>25.0 25.0 25.0 25.0 25.0 25.0 25.0 25.0 25.0 25.0 25.0</td>
</tr>
<tr>
<td>200</td>
<td>80</td>
<td>40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0</td>
</tr>
<tr>
<td>220</td>
<td>100</td>
<td>53.6 53.6 53.6 53.6 53.6 53.6 53.6 53.6 53.6 53.6 53.6</td>
</tr>
<tr>
<td>240</td>
<td>100</td>
<td>62.2 62.2 62.2 62.2 62.2 62.2 62.2 60.6 57.8 55.2 52.7</td>
</tr>
<tr>
<td>260 and above</td>
<td>100</td>
<td>71.4 69.9 66.6 63.5 60.6 57.8 55.2 52.7 52.7</td>
</tr>
</tbody>
</table>

ESDQ-L20W Lockable Dowels (slab-to-wall)

<table>
<thead>
<tr>
<th>Slab Thickness (mm)</th>
<th>Tension along line of dowel (kN)</th>
<th>Vertical Design Resistance (kN) for Various Design Joint Widths (mm) in C30/37 Concrete</th>
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<tr>
<td>160</td>
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<td>25.0 25.0 25.0 25.0 25.0 25.0 25.0 25.0 25.0 25.0 25.0</td>
</tr>
<tr>
<td>200</td>
<td>80</td>
<td>40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0</td>
</tr>
<tr>
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<td>80</td>
<td>53.6 53.6 53.6 53.6 53.6 53.6 53.6 53.6 53.6 53.6 53.6</td>
</tr>
<tr>
<td>240</td>
<td>80</td>
<td>62.2 62.2 62.2 62.2 62.2 62.2 62.2 60.6 57.8 55.2 52.7</td>
</tr>
<tr>
<td>260 and above</td>
<td>80</td>
<td>71.4 69.9 66.6 63.5 60.6 57.8 55.2 52.7 52.7</td>
</tr>
</tbody>
</table>

HLDQ-L30 Lockable Dowels (slab-to-slab)

<table>
<thead>
<tr>
<th>Slab Thickness (mm)</th>
<th>Tension along line of dowel (kN)</th>
<th>Vertical Design Resistance (kN) for Various Design Joint Widths (mm) in C30/37 Concrete</th>
</tr>
</thead>
<tbody>
<tr>
<td>240 and above</td>
<td>100</td>
<td>136.0 136.0 136.0 136.0 136.0 136.0 136.0 136.0 136.0 136.0 136.0 121.9</td>
</tr>
</tbody>
</table>

Ancon can provide information on a suitable joint filler and also recommend fire resistant material which could be used as part of an overall fire protection system.

Reinforcement Details
Local reinforcement is required around each Ancon Lockable Dowel to guarantee that the forces are transferred between the connectors and the concrete. See page 8 for full details.
**Edge Distance and Spacings**

For connectors working at or near their maximum capacity, the minimum spacing should be 1.5 times the slab thickness. Where the design load of the connector could be used in a thinner slab, a spacing of 1.5 times the thinner slab thickness can be used. The minimum end distance is always 0.5 times the spacing.

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**ESDQ-L20 Example**

- **Slab thickness**: 300mm
- **Maximum width of joint**: 20mm
- **Concrete strength**: C30/37
- **Design resistance/connector** (based on slabs 260mm and above): 63.5kN

**Spacing for max. load**

\[ 300 \times 1.5 = 450\text{mm} \]

**End distance for max. load**

\[ 450 \times 0.5 = 225\text{mm} \]

**Design resistance/metre**

\[ 63.5 / 0.45 = 141.1\text{kN/m} \]

As an ESDQ-L20 can be used in a 220mm slab for a design resistance per connector of up to 53.6kN, the spacing can be based on a 220mm slab. Therefore:

**Reduced spacing**

\[ 220 \times 1.5 = 330\text{mm} \]

**Reduced end distance**

\[ 330 \times 0.5 = 165\text{mm} \]

**Design resistance/metre**

\[ 53.6 / 0.33 = 162.4\text{kN/m} \]

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**By using these dowels we have saved at least four weeks per storey. This construction method is just more efficient. Wet trades finish sooner on site and the anticipated movement at the joints was achieved without any issues.**

Ben Ume, Director, Matthew Consultants
University Campus Suffolk phase 2, Ipswich, UK

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**The Lockable Dowel is a very clean system. If you have encountered pour strips before, the Lockable Dowel is a no-brainer.**

Mahmoud Farawi, Skanska USA
Reinforcement Details

Local reinforcement is required around each Ancon Lockable Dowel to guarantee that the forces are transferred between the connectors and the concrete. Correct detailing in accordance with appropriate design codes and the recommendations provided here will ensure the dowels attain their full capacity. The tables show the main reinforcement required, together with details of reinforcement above and below the connectors. Although only the sleeve components are illustrated, the same reinforcement is required around the dowel component.

### Options for Main Reinforcement

<table>
<thead>
<tr>
<th>Lockable Dowel</th>
<th>No. of U-bars each side</th>
</tr>
</thead>
<tbody>
<tr>
<td>ESDQ-L20</td>
<td>2</td>
</tr>
<tr>
<td>HLDQ-L30</td>
<td>4 3 3</td>
</tr>
</tbody>
</table>

### Options for Longitudinal Reinforcement

<table>
<thead>
<tr>
<th>Lockable Dowel</th>
<th>No. of bars top and bottom</th>
</tr>
</thead>
<tbody>
<tr>
<td>ESDQ-L20</td>
<td>2</td>
</tr>
<tr>
<td>HLDQ-L30</td>
<td>2 2 2</td>
</tr>
</tbody>
</table>

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**Threaded Anchor**

Reinforcement around the Ancon Threaded Anchor should be a minimum diameter of 12mm, installed at maximum 200mm vertical and horizontal centres.
Dimensions

**ESDQ-L20 Components**
- Dowel Component

**HLDQ-L30 Components**
- Dowel Component

**ESDQ-L20W Components**
- SKS24 Threaded Anchor

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**Eamonn O’Donnell, Project Manager, PJ Carey (Contractors) Ltd**

Emergency Care Centre, Aberdeen, UK

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“PJ Carey chose the lockable dowel system because it offered time and cost savings, accelerating an already fast build programme.”
**Ancon Lockable Dowels**

**Installation**

**Slab-to-Slab**

Although installation is shown for the ESDQ-L20, the procedure is the same for the HLDQ-L30.

1. Nail the sleeve to the formwork either central in the slab or for slab depths over 300mm so the top of the void former is level with the top of the slab. Do not remove the label over the nailing plate as this prevents ingress of concrete into the sleeve. Fix the local reinforcement, as specified on engineer’s drawings.

2. Pour the concrete, and when of sufficient strength, strike the formwork. Puncture the label to reveal the cylindrical sleeve only and insert the dowel until it is approximately 20mm from the back of the void former.

3. Fix the local reinforcement around the dowel component and pour the concrete.

4. After a predetermined time period (generally 3-4 weeks), when movement between the slabs has stabilised and the joint between the slabs has been filled, the dowel is ready to be locked.

5. Mix the two-part epoxy resin and pour into the void former. It is essential the resin flows along the stainless steel box section towards the joint and reaches the notches on the locking plate, which indicate minimum resin depth. Joint must be filled before resin is installed.

6. After 24 hours the void former can be filled with cementitious material, level with the top of the slab, to complete the installation. The locked dowel continues to transfer vertical load between the slabs, but movement can no longer take place.

**Slab-to-Wall**

1. Nail the threaded anchor to the formwork so the dowel will be central in the adjoining slab or within 150mm of the top of slabs over 300mm. Fix the local reinforcement as specified on engineer’s drawings and cast the concrete.

2. When concrete reaches sufficient strength, strike the formwork and remove nailing plate. Screw the dowel into the anchor.

3. Puncture the label of the sleeve to reveal the cylindrical sleeve only. Push the sleeve over the dowel until it is flush with the concrete. Tie sleeve to reinforcement and pour concrete.

See Steps 4 to 6 above to complete installation.

**Notes:** Where deep concrete pours are proposed, the installation will require further consideration. More robust fixing of the sleeve and dowel components will be necessary, to avoid displacement during casting of the concrete.
### Project References

200 Lockable dowels were installed on the James Hehir Building (University Campus Suffolk phase 2) in Ipswich, UK 'Highly Commended' in the 2010 CONSTRUCT award for innovation and best practice for its use of the Lockable Dowel.

5,000 Lockable dowels were installed on the Royal Children’s Hospital in Melbourne, Australia

500 Lockable dowels were installed on the Emergency Care Centre in Aberdeen, UK

### Other Ancon Products

#### DSD/Q Shear Load Connectors
Ancon DSD and DSDQ double-dowel connectors are used to transfer shear across movement joints in suspended concrete slabs. They are more effective at transferring load and allowing movement than standard single dowels and can be used to eliminate double columns at structural movement joints in buildings. The Q version features a rectangular box section to allow lateral and some rotational movement.

#### Plate Dowel Systems
Ancon MultiJoint is a plate dowel system for use in ground bearing concrete floor slabs. It is an all-in-one solution to load transfer, concrete contraction, armoured edge protection and formwork. Individual plate dowels are also available.

#### Punching Shear Reinforcement
Ancon Shearfix is used within a slab to provide additional reinforcement from punching shear around columns. The system consists of double-headed steel studs welded to flat rails and is designed to suit the load conditions and slab depth at each column using free calculation software from Ancon.

#### Reinforcing Bar Couplers
The use of reinforcing bar couplers can provide significant advantages over lapped joints. Design and construction of the concrete can be simplified and the amount of reinforcement can be reduced. The Ancon range includes parallel-threaded, tapered-threaded and mechanically-bolted couplers.

#### Reinforcing Continuity Systems
Ancon Eazistrip is approved by UK CARES and consists of bent bars housed in a galvanised steel casing. Once installed, the protective cover is removed and the bars are straightened, ready for joining to the slab reinforcement. Alternatively, Ancon KSN Anchors are cast into the wall and, when the formwork and thread protection are removed, Bartec Plus threaded rebars are simply screwed into the anchors.

#### Insulated Balcony Connections
Ancon’s thermally insulated connectors minimise heat loss at balcony locations while maintaining structural integrity. They provide a thermal break and, as a critical structural component, transfer moment, shear, tension and compression forces. Standard solutions are available for concrete-to-concrete, steel-to-concrete and steel-to-steel interfaces.
The construction applications and details provided in this literature are indicative only. In every case, project working details should be entrusted to appropriately qualified and experienced persons.

Whilst every care has been exercised in the preparation of this document to ensure that any advice, recommendations or information is accurate, no liability or responsibility of any kind is accepted in respect of Ancon.

With a policy of continuous product development Ancon reserves the right to modify product design and specification without due notice.