Editorial: Precast concrete

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This precast concrete themed issue of *Magazine of Concrete Research* is to be welcomed. Precast concrete is defined as any concrete product that is made in a factory and is ready for final installation on leaving. The range of products is vast, from small bricks and roof tiles to thousand tonne caissons produced in temporary waterside plants. Precast includes structural and non-structural products, including concrete masonry – sometimes overlooked by researchers. It also includes aircrete products with a density as low as 115 kg/m^3 . Precast products and systems must deal with a huge range of environmental and physical influences above ground, on the surface and underground. Guaranteed cover to reinforcement and factory-controlled water content gives precast solutions a significant advantage in product quality assurance and therefore risk reduction.

Globally there are few industries with greater long-term growth prospects than factory made concrete. Cement consumption is growing year by year as emerging economies invest in new water and sewerage infrastructure, transport and trading links, public and private buildings and new housing. The established trend is for high market shares of site-mixed concrete to transfer to ready-mixed concrete as quality standards rise. Ready mix markets then change to precast concrete and masonry solutions in many markets where precision, speed, and control of water and cover to reinforcement are paramount. Ultimately, as seen in the Netherlands, the proportion of cement used by ready mix and precast producers is the same, at about 45% each, with the remainder mixed on site.

The trend from West to East is now well established, with China producing around 55% of world concrete in 2013, an astonishingly high proportion. Work in 2012 by the Cement Sustainability Initiative, part of the World Business Council for Sustainable Development, projected a major continuing increase in the shift of demand for concrete from mature to emerging economies by mid-century. India is forecast to overtake China in its production of concrete by 2040, and further high growth is expected in the rest of Asia, South America and Africa (WBCSD, 2013). For the research community these long term shifts in demand patterns will dictate the priorities in the nature of project themes. The climatic, topographical, seismic and cultural drivers for the future will be different from those of the past.

The drive for sustainable construction around the world is throwing up new challenging clusters of research – low- or zero-carbon cements, nanomaterials, end-of-life recycling and low carbon dioxide buildings and structures. Concrete provides a safe haven for devices such as radio-frequency identification (RFID)

that can measure and report behaviour – intelligent and smart concrete has a massive role to play.

Those Western concrete researchers that seek alliances with universities, industry and government research centres in the new economies are indeed very wise to do so. Opportunities are opening up for the knowledgeable and experienced men and women from the West to develop new research businesses and alliances. This will help to avoid the mistakes of the past and will result in feedback that will help the mature Western concrete industries to improve. These are indeed exciting times for precast concrete products.

The papers in this themed issue of *Magazine of Concrete Research* are valuable additions to the knowledge base. Italy, Turkey and New Zealand have each experienced catastrophic deadly earthquakes in recent years, with questions asked about design and construction standards. The three papers from these countries are therefore significant.

In the first paper in this issue Ozden *et al.* (2014) present a review of precast concrete structural performance in the Van, Turkey earthquake of 2011. The importance of adherence to the post-1999 earthquake codes is emphasised. Moment-resisting connections performed well. All six structures designed to Turkish Precast Concrete Association guidelines were undamaged. Next Belleri *et al.* (2014) investigate the potential for new designs of ductile connections between precast beams and roof elements. Precast roof beams for industrial buildings are the norm in Italy. In May 2012 there was significant damage to such structures in two earthquakes in the North. The next stage of this work – gaining acceptance for the new connection – will be interesting.

Corney *et al.* (2014) review the performance of precast floor systems during the 2010–2011 earthquakes in Canterbury, New Zealand. Precast has replaced in situ floors since 1980. Widespread damage was not observed. Changes to floor diaphragm design methods will result. In the next paper Kim *et al.* (2014) provide insight into the selection of jointing methods for prestressed precast hollow concrete box beams, a valuable aid for design engineers.

Elliott (2014) has produced valuable data on the transmission length and shear capacity of prestressed hollow core slabs and T-beams; information that will assist in the revision of Eurocode 2 and help ensure that industry practice is mirrored in the code. The next paper by Zhang *et al.* (2014) looks at variables governing the rate of cement hydration and presents reliable predictive models

of compressive strength and elastic modulus that will assist the growing Chinese and worldwide precast industry.

Brandão Ferreira *et al.* (2014) examine the use of a fly ash-based alkali-activated binder in the production of precast façade panels. With the support of a Portuguese cement company, the tests show the performance of the panels made with differing sodium silicate content. This is a valuable and practical contribution to the geopolymer concrete literature, with more development work needed to take it to commercial manufacture. Finally, Labib *et al.* (2014) examine the behaviour of the embedded steel plates in tilt-up concrete panels. Tilt-up panels can be made in factories or cast on site using floor slabs as the mould base. The authors found that ACI codes were too conservative and have developed an alternative finite-element model.

It is to be hoped that the next precast themed issue of *Magazine of Concrete Research* will follow soon.

REFERENCES

- Belleri A, Torquati M and Riva P (2014) Seismic performance of ductile connections between precast beams and roof elements. *Magazine of Concrete Research* **66(11)**: 553–562, <http://dx.doi.org/10.1680/mac.13.00092>.
- Brandão Ferreira LF, Sousa Costa HS, Antunes Barata II *et al.* (2014) Precast alkali-activated concrete towards sustainable construction. *Magazine of Concrete Research* **66(12)**: 618–626, <http://dx.doi.org/10.1680/mac.13.00091>.
- Corney SR, Henry RS and Ingham JM (2014) Performance of precast concrete floor systems during the 2010/2011 Canterbury earthquake series. *Magazine of Concrete Research* **66(11)**: 563–575, <http://dx.doi.org/10.1680/mac.13.00106>.
- Elliott KS (2014) Transmission length and shear capacity in prestressed concrete hollow core slabs. *Magazine of Concrete Research* **66(12)**: 585–602, <http://dx.doi.org/10.1680/mac.13.00251>.
- Kim MS, Scanlon A, Kang J and Lee YH (2014) Torsional behaviour of prestressed concrete girder with precast box segments. *Magazine of Concrete Research* **66(11)**: 576–584, <http://dx.doi.org/10.1680/mac.13.00086>.
- Labib M, Sheu W, Ayoub A and Mo YL (2014) Embedded steel plate supports in concrete tilt-up precast walls. *Magazine of Concrete Research* **66(12)**: 627–642, <http://dx.doi.org/10.1680/mac.13.00118>.
- Ozden S, Akpınar E, Erdogan H and Atalay H (2014) Performance of precast concrete structures in October 2011 Van earthquake, Turkey. *Magazine of Concrete Research* **66(11)**: 543–552, <http://dx.doi.org/10.1680/mac.13.00097>.
- WBCSD (World Business Council for Sustainable Development) (2013) *Technology Roadmap Low-Carbon Technology for the Indian Cement Industry*. IEA Publications, Paris, France.
- Zhang J, Han Y, Han J and Wang Z (2014) Cement hydration based model to predict the mechanical properties of precast concrete. *Magazine of Concrete Research* **66(12)**: 603–617, <http://dx.doi.org/10.1680/mac.13.00083>.