Seminar On Steel Fibre Reinforced Concrete (SFRC) In Concrete Slabs

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CIVIL AND STRUCTURAL ENGINEERING TECHNICAL DIVISION

THE Civil and Structural Engineering Technical Division organised a half-day seminar on Steel Fibre Reinforced Concrete (SFRC) on 2nd July 2013.

Speaker Dr Ing. Ralf Winterberg said although steel fibres are used in various construction industries such as tunnelling, slabs in ports, harbours, airport aprons, roads etc., he would be emphasising on the use of steel fibres in industrial concrete floors for the seminar.

He said adding steel fibres into the concrete increases the flexural and shear strength (increase "toughness"), abrasion and fatigue resistance as well as impact properties of the concrete. The use of steel fibres in concrete and concrete floors has been successfully carried out since the 1980s, especially in Europe and North America.

Steel fibres are able to replace traditional mesh reinforcement, providing an equal load bearing capacity, which has to be verified by an appropriate method of analysis. The traditional and most common way of designing slabs on grade is by the Elastic Design Method (Westergaard method). It provides safe but conservative results, because it significantly underestimates the real load bearing capacity of concrete slabs on ground.

In addition, the elastic design method does not allow the utilisation of the beneficial performance of steel fibres in the post cracked stage of concrete.

So new methods have been developed in order to design more closely to the real load bearing behaviour of slabs on ground, based on the Yield Line Theory (by Losberg). This method allows the designer to use the benefits of the post cracking performance of the steel fibres, resulting in a more economic and efficient design.

Another design methodology was developed jointly by Mess. Maccaferri and the University of Brescia to find the most realistic design approach while using the utmost advantage of performance potentials of the constituents (including steel fibres) and the composite. This involved the use of Non-Linear Fracture Mechanics (NLFM). Dr Winterberg showed the experimental investigations during the development of this design approach.

He explains that the technology of SFRC is more than just the equation "Concrete + Steel Fibres = SFRC". By fully understanding the composite material, an engineer will be able to design for higher performance and a more durable floor.

Design guides are available for slab-on-ground. They are:

1. TR 34 – Concrete Industrial Ground Floor
2. ACI 360 R-10 – Guide to Design of Slabs-on- Ground
3. DBV – Guide to Good Practice "Steel Fibre Reinforced Concrete".
4. fib Model Code 2010 for Concrete Structures.

He then talked about a new construction approach – jointless slabs on ground. Jointless means there are no saw-cut joints and the slab is only bound by daily construction joints. Omitting the onerous saw-cut joints not only saves time in construction, but further reduces maintenance costs and time. Pour sizes of up to 50m x 50m can be executed. However, due to the large panels in jointless floors, the stresses from long-term drying out have to be considered and superimposed with the stresses from loadings.

Pile-supported slabs are also a newer application of SFRC as the structural design differs from slabs on ground. The design considers fully suspended slabs and the methodology refers to general structural design. There is no particular design method for slabs on piles; however, a common methodology based on the Yield Line Theory is used. Successfully executed projects using SFRC in Malaysia and Thailand were shown.

Dr Winterberg then went into the construction process of the SFRC floor. He covered all aspects of the construction sequence, from planning to batching and dispersion of the fibres using pneumatic blowers. SFRC were then placed, levelled, compacted (by a truss screed) and usually finish with a power-floating machine to a smooth levelled finish.

The seminar ended with lively discussions at 12.30 p.m. The session chairman, Ir. Boone Lim, thanked Dr Winterberg and presented him with a token of appreciation for the interesting seminar. ■

Ir. Boone Lim, civil engineer (Texas, 1986) is currently Secretary/Treasurer of C&S Engineering Technical Division. He is the Past President of ACI, KL Chapter. He is involved in concrete repair and strengthening, concrete floors, airport aprons and pavements and construction chemicals.