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The Use of Self-Compacting Concrete in Japan

Self-Compacting Concrete (SCC) is very familiar in the concrete industry. It is a Japanese invention whose development dates back to 1980 in response to a problem. Repairs were frequently required for concrete structures which had started to exhibit defects just 20 years after construction. This premature deterioration of concrete became a business-wide issue in Japan. The cause was traced to defective materials and construction and it provoked ongoing active research into the durability of concrete structures.

According to Mr. Okamura - former professor of Tokyo University, the most common defect in concrete products is caused by human error, particularly in concrete compacting. He considered that a fundamental solution was required to prevent this problem, which involved changing the material. Through his research into concrete workability he developed the SCC which is used today.

Precast concrete products normally have more complicated shapes and less thickness between the outer surfaces of the concrete and the re-bar compared to cast-in-place concrete structures. Strong vibration for a specific period is necessary for normal concrete to flow and fill the mould. SCC makes it possible to fill moulds easily with little or no vibration. This has a lot of advantages for the manufacturing process.

In fact not many companies use SCC because of the difficulties in designing and controlling the mix, maintaining a constant quality and because of the cost of material. In this issue we introduce an innovative Japanese concrete product manufacturer "Fuji Concrete Industry Co. Ltd." (hereinafter referred to as Fuji Concrete) which uses only SCC and provides consistently high quality products.

15 years ago Fuji Concrete switched from medium fluidity concrete to SCC.

At that time they started mixing one batch of SCC per day. Surprisingly, just one year later this had become 20 batches per day

and now SCC represents over 80 % of daily production in all Fuji Concrete factories.

However they had a long way to go before achieving this success. They had to overcome many hurdles such as:

- Establishing criteria for the appraisal of SCC.
- Finding the best pouring methods for different products or different moulds.
- Obtaining the client's approval for changing the mix.
- Adjusting the mix by using warm concrete in the winter months.
- Purchasing the material in consistent quality.
- Investment in extra equipment for better quality control, such as water regulation, mix control units which can be operated at the pouring site etc.
- "Kaizen" is carried out whenever necessary to achieve the best solution.

The advantage of using SCC is that no vibration is needed for manufacturing. This brings many advantages as below:

- It makes the mould much more durable.
- It keeps maintenance costs down
- It makes the mould more lightweight.
- No need to use rubber seals (in some cases).

Its viscosity means that the SCC does not leak even though there is little clearance in the mould and it gives products a beautiful finish.

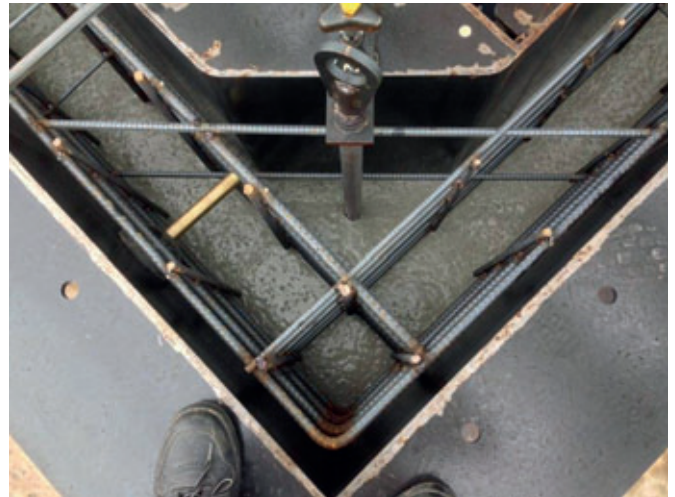
- Saves the time needed to fit/remove the vibrators.
- Saves time needed for trowel finishing
- No vibration noise. This prevents health hazards such as hearing loss. Safety is improved in an environment which permits easy communication and employees' willingness to work is enhanced.

The biggest advantage is the reduction of pouring time. Productivity has been increased dramatically at Fuji Concrete.

There follow some examples of comparisons of SCC with normal concrete:



Figs. 1&2 show the mould for manufacturing the Box Culvert with a concrete weight of 12.3 t.



Figs. 3&4 show the pouring scenario. Although the SCC is poured in one location without moving the hopper, the concrete flows evenly. This is not the case when using normal concrete.

1. One year after Fuji Concrete started using SCC they conducted a test to compare the differences between SCC and normal concrete by manufacturing a section of Box Culvert. While it took 3 operators 20 to 30 minutes using the normal concrete, it took one operator 3 minutes to complete the pouring process using SCC. In addition the normal concrete product result was less satisfactory than the one using SCC.
2. A project was carried out using products made by Fuji Concrete and other manufacturers. The same products were constructed side by side. One year later, the products made by Fuji Concrete still looked good while the others were already darkened. The reason for this was found to be the use of SCC.
3. Fuji Concrete set the design strength of their SCC product at 40N/mm². One day a client said that 30N/mm² was



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Figs. 5 & 6 show examples of Fuji Concrete' products.

sufficient for their project. The client requested that the product be produced with normal concrete with a discount for the downgrade.

However it is actually more expensive from the productivity perspective to manufacture with normal concrete. It was hard to convince the customer. Each and every product made with SCC looks good. Consistent high quality and dimensional accuracy are guaranteed. They are ideal examples of quality products at low costs.

Toyota Forms have been working with Fuji Concrete for 45 years, since its foundation, and provide moulds for precast concrete.

Nowadays this Japanese concrete technology has spread globally. SCC is not only cast-in place, it is also used also in precast concrete factories in Europe and U.S.A., The development of SCC is set to continue the acceleration of the shift from drycast to wetcast.

FURTHER INFORMATION



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