

SCC TECHNOLOGY AND CONCRETE MANUFACTURERS' ROLE

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ABSTRACT

Self-Compacting Concrete (SCC) has been known globally for over 2 decades. In some countries this technology is well established and some are going through a great deal of uncertainties. Because of its unique flow and deformation characteristics, SCC allows to substantially change the way the concreting is executed. The important difference between conventionally vibrated concrete technology and SCC is that the quality of structures made of SCC nearly entirely depends on the fresh properties of SCC, which puts the responsibility pressure on a concrete manufacturer. Self compacting concrete technology brings a new set of rules and some also paradoxes into conventional concrete construction sites. One of the most important changes taking place on concrete construction sites is a responsibility transfer from a concrete user to an SCC supplier. This responsibility transfer is a major reason for increasing the concrete manufacturers' role and raising concrete readymix industry profile within concrete construction sector. Unfortunately, in some places the role of a concrete supplier is undervalued either by concrete manufacturers themselves or by other industry members.

INTRODUCTION

Continuous intensive research to better understand the properties and behaviour of self-compacting concrete has been carried out in the last 20 years all around the world. As a result, the behaviour of plastic SCC and its main properties at hardened state are well understood and mechanisms to control them are developed.

Self compacting concrete technology has the potential to deliver many benefits to constructors, concrete product manufacturers and designers – they may enjoy new design opportunities, increase in productivity, and substantial improvement in health and safety. Readymix concrete manufacturers, on the other hand, do not seem to be gaining much advantage from the new technology. Quality of concrete structures made of SCC depends on quality of fresh concrete much more than quality of structures made with conventionally vibrated concrete (CVC). As far as concrete construction process is concerned, the major change the SCC technology brings to it is the shift in responsibility. Being partially responsible for the quality of finished structures when CVC is supplied, a concrete manufacturer becomes nearly fully responsible when SCC is used. Increase in responsibility and lack of incentive do not make SCC technology an attractive proposition for readymix concrete industry. On the other hand it provides a unique opportunity to improve the overall quality of concrete products and to lift a concrete manufacturer's profile and the whole concrete readymix industry in the concrete construction sector of building industry.

CONCRETE SUPPLIER'S RESPONSIBILITY

Concrete workability check is normally a responsibility borderline, and fresh concrete properties are expected to be maintained within specified tolerances until concrete is placed. However, it appears to be that the point at which the changeover of responsibility takes place is different for SCC compared with CVC.

Conventionally Vibrated Concrete (CVC)

The concrete manufacturers' responsibility in this case is confined to manufacturing and delivering concrete. It is expected from a concrete manufacturer to maintain required fresh concrete properties within specified tolerances during the placement of concrete, but, normally, acceptance occurs at the time of workability check. This could be either visual check or physical (usually slump) test. The actual execution of concreting is a concrete contractor's duty. The concrete contractor chooses, depending on details of a structure, placement method, weather conditions and other factors, an appropriate type and consistency of concrete and placing techniques to achieve the best possible end result. This process is well established and responsibility boundaries are quite clear: from the point of accepting delivered concrete it is up to the concrete contractor how the concrete is used. Of course some responsibility for hardened concrete properties still remain with the concrete supplier, especially strength, but this is a matter of production quality control and quality assurance and would be subjected to appropriate placing and curing methods.

Self Compacting Concrete (SCC)

Self compacting concrete technology brings a new set of rules and some paradoxes into conventional concrete construction sites. By its very nature SCC, during casting, doesn't require much effort to place, which means the contractor's role and influence in placing SCC is minimal. The quality of concrete structures depends much more on the fresh concrete properties, placing more responsibility onto concrete supplier. Although it is still the contractor's responsibility, of course, to make sure that formwork systems are suitable for SCC, i.e. formwork material, release agent and formwork bracing are properly selected for SCC, and after placing curing of concrete. Boundaries of responsibility are becoming unclear, as workability check is now supplier's internal quality assurance procedure and contractor becomes an observer rather than an active participant in placing concrete. Because of this, both concrete supplier and concrete contractor may not be fully comfortable and may try to avoid wherever possible to supply and use SCC. And here is a paradox: a contractor is reluctant to use SCC while a concrete manufacturer is not very enthusiastic about supplying it. Because of this, both are losing opportunities to learn about SCC technology and to gain necessary experience to be more comfortable with unavoidable responsibility change. At the same time, in the background, the both players clearly understand the potential value of SCC technology.

NEW OPPORTUNITIES

SCC technology offers some new opportunities and challenges for both concrete supplier and concrete contractor. Contractor can substantially reduce the amount of effort needed for concreting and remedial work, as supplier may start taking responsibility to deliver SCC directly into the formwork as it ensures more control over fresh concrete properties.

This in return offers the supplier a number of benefits, for example, an opportunity to optimise the truck fleet utilization. Depending on the concrete manufacturer's capabilities and marketing philosophies, such responsibility transition may cause opposite effects: either acceptance through challenges or rejection. New technologies are associated with the risk. When risk is properly assessed and calculated it becomes manageable and new technology development is challenged. Otherwise the fear of failure dominates and total rejection of the technology occurs.

CONCRETE SUPPLIER'S CHALLENGES

SCC Robustness and Production Quality Assurance

Thanks to SCC and other technological achievements, manufacturing of readymix concrete is becoming a highly professional industrial sector. One of the challenges concrete manufacturers are facing is an improvement of production quality control and quality assurance. The ultimate goal is to create robust SCC mixes which produce consistent properties when slight variations in production processes, including raw materials quality, occur. Robustness of SCC can be achieved by applying the following:

- (a) employing more science into mix engineering (rheology, surface chemistry, particles packing, flow modelling, etc);
- (b) improving quality and consistency of raw materials through closer co-operation, training and education of the raw material suppliers;
- (c) training and educating concrete production and delivery personnel; and
- (d) optimising concrete production process and upgrading production facilities.

These measures will not simply improve the quality of SCC - ultimately, the quality and consistency of all readymix products is improved. Thus, a concrete manufacturer can establish a reputation of a producer who is capable of manufacturing a great range of high quality both SCC and other high performance readymix products.

Science and Practice

SCC manufacturer is a source of the technology knowledge and he maintains and strengthens this from project to project. The manufacturer is not only a materials expert but also a technical advisor to the constructors and designers.

Concrete readymix industry is mastering a new cutting edge technology, which assumes a good co-operation and understanding between science and practice. The industry practitioners strive to find the answers to the millions questions they have, and the scientists and researchers working on different aspects of the SCC technology are providing the necessary solutions. In return, the scientists and researchers are getting feedback from the industry, which helps them to fine-tune their models and to promote new research. The science offers tools to reliably control properties of concrete. Concrete industry adopts a very special used-to-be-only-for-scientists terminology in its daily communication, such as rheology, thixotropy, surface chemistry, and other. Because of all these the concrete manufacturers are using a scientific approach to develop SCC mixes targeting specific properties, providing technical support to their customers, and to exploring opportunities for wider use of SCC.

Education and Training. Investment into knowledge

SCC technology necessitates the demand for well qualified and well trained people. SCC is still concrete, but is very sensitive to any wrong doings. The human impact on quality of concrete structures made of SCC during concreting is almost eliminated, so the quality of SCC remains in hands of people who make it. Their skills and abilities are vital to achieve desired quality of concrete structures. This applies not only to upskilling the frontline production staff, but also technical people: engineers, technicians, and laboratory staff, sales representatives, and managers at all levels. All staff categories require different training and knowledge compilation, but it should be specific to their job requirements. No doubts that technical staff should be getting the most comprehensive and detailed training. A concrete manufacturer who invests into knowledge wins, although not necessarily immediately.

Customers

Unlike users of SCC, an SCC manufacturer does not directly gain substantial economical benefits from simply supplying SCC to construction sites. SCC is normally sold at premium price, mainly to cover higher production costs. Neither customer is expected to pay 'normal' price for an advanced product. But product cost sometimes is not the governing factor for selection. Customers are more comfortable with a new technology or product when they are receiving a professional technical support. And that is where a confident SCC manufacturer, a knowledge and expertise holder, provides a useful and most needed assistance. With the time such assistance will hopefully be developed into a true partnership. At the beginning not every time the use of SCC is a success but not so successful applications are not a technology failure, but rather true and valuable experience for both the supplier and the user. Applying SCC technology into practice methodically is the recipe to minimise problems occurring. The true business partnership is built on trust and the trust opens the opportunities for easy responsibility shift.

Designers and architects approach the readymix industry more often these days to get advice on design options with SCC and SCC specifications.

It seems that SCC technology helps to fade away the boundaries between concrete suppliers and customers as the traditional "customer – supplier" relationship is moving towards true business partnership, when specialist expertise is invited to contribute at design stage of a project and to assist with concreting processes. This simply means utilising specialist expertise to estimate and prevent problems rather than fixing them afterwards. It may be seen by some as unnecessary expense adding to the cost to rather expensive self-compacting concrete, but in actual fact it might be much more economical doing it this way as the most expensive concrete is the one needed to be replaced. Concrete producer needs to be seen by designers (project owners) and contractors (project developers) as an equal business partner, not just as a concrete supplier.

NEW OPPORTUNITIES FOR BUSINESS RELATIONS

It is a fact that SCC technology is very successful in concrete precast factories, but only those factories where a precaster makes his own concrete. Why? Because his ultimate goal is quality and value of finished product, that is a precast article, not fresh concrete. In order to achieve desired quality and value of precast products, the precaster invests

into SCC technology, including batching plant. The precaster owns and controls the whole process from raw materials to finished products. He is fully and solely responsible for every stage of the process where production of self-compacting concrete is just one part of it. There is no responsibility transfer here. Many precast operators who elected for SCC are replacing the old machineries and equipment and changing the whole technological processes, because they know that old methods do not work with new technologies.

It is not possible, of course, to fully apply 'Precast Operation' scheme to a construction site, although there are some very successful experiences in Scandinavia where a contractor manufactures SCC and places it into a mould at his convenience. But at least some effort to break painful responsibility transfer should be seeing more and more. Business partnerships and full contracts seem to be obvious solutions. Until then SCC will not be selected for economical reasons and will remain a very special concrete and not a preferred choice for concreting, but rather as the technological solution to some construction problems like congested reinforcement and limited access for vibration. Even then, the responsibility barrier will remain the greatest obstruction.

SCC IS AN OPPORTUNITY FOR CONCRETE MANUFACTURERS TO EXCEL

The potential of SCC technology is great and one can only imagine what the technology's full capabilities are. Apart from the technological advances and economical and work environmental benefits, SCC also provides a unique opportunity to upgrade the concrete readymix industry to a whole new level of sophistication. Phenomenon of responsibility shift on construction sites demands enhancement in all aspects of concrete design, manufacture, delivery, placing, and business relations. SCC producers meet the responsibility challenge by investing into knowledge, people, and concrete production facilities and by developing business partnerships with constructors and designers. Return on such investment is a higher overall quality of concrete readymix products, well trained and qualified staff, and a position of a well recognised concrete technology expert in a concrete construction market.