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SPECIALISTS PREPARATION FOR NEW TECHNOLOGIES DEVELOPMENT OF THE NUCLEAR INDUSTRY CONSTRUCTION COMPLEX

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Abstract

The article highlights the problem of forming the construction complex personnel readiness for industry innovations while constructing nuclear energy facilities. The authors consider this problem in the light of the Knowledge Management methodology and the modern approaches of the Nuclear Energy Agency under the auspices of the Organization for Economic Cooperation and Development (OECD - NEA) to understanding the quality of human resources as intangible assets that affect the reduction in the cost of nuclear energy construction projects. The authors promote the idea of considering advanced training and retraining programs as a mean of "soft force" in personnel management in solving organizational tasks of implementing a construction facility, since the engineering literacy of specialists and accumulated experience contribute to increasing labor productivity and reducing investment costs. The authors critically assess the content of the programs and propose to increase the methodological potential with intellectual resources developed on the basis of the experience and practice of the world modern achievements of the NPP construction, including the practice of experimental work of developing and applying self-consolidating concrete. The article provides an overview of modern publications reflecting the advantages and problems of SCC from various sides.

Keywords: Knowledge management, nuclear energy facilities, retraining programs

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1. Introduction

According to the IAEA for 2020, 52 reactors under construction have been recorded in the world. In the future, the pace of commissioning of new nuclear power units is planned to double every year, since technologically, nuclear power plants provide a transition to energy with zero greenhouse gas emissions, and nuclear generation as a whole can take a special place in the global energy balance of the future. The benefits of nuclear power outweigh the complex costs associated with the stage of NPP construction, the process of capital-intensive, technically and organizationally complex, which affects the timing and cost of NPP construction projects.

The report of the Nuclear Energy Agency under the auspices of the Organization for Economic Cooperation and Development (OECD) emphasizes that for "improving the economic performance of nuclear power requirements a holistic approach that includes both cost reductions and risk allocation and migration measures" (OECD, 2020, p. 24).

Among this kind of “mitigation measures” they remark «the importance of soft costs and the organisational dimension in nuclear power», namely, “art” of project management, which involves a blend of leadership, organisational skills, mindsets, attitudes, behaviour and organisational culture» (OECD, 2020, p. 52). Intangible by nature assets of the quality of human resources, ensure the readiness of staff to perceive and introduce innovations. This approach of the world energy industry to the issues of soft power management in the large investment projects optimization for the construction of nuclear power plants, to the assessment of the role of personnel explains the importance of updating professional retraining and advanced training programs, training employees in new technologies in the realities of the digital the industry transformation.

2. Problem Statement

Technical and economic solutions of power units construction are determined by a combination of factors, among which new technologies and materials occupy an important place, their development during construction, which is associated with a system of construction personnel training, since the engineering literacy of specialists and accumulated experience contribute to increasing labor productivity and reducing investment costs.

In order to study the best world practices of construction technologies, the Industry Capital Construction Center (ICCC) was created in the structure of the State Corporation. The expert community selected, studied, grouped materials in five directions: - modern construction and power technologies; - innovative construction materials, products; - high-performance construction mechanisms and tools; - new hi-tech services, specialized software; - perspective research and development on stages of industrial introduction and a scientific and technical reserve. As a result of large-scale expert work “The register of innovative solutions, technologies, products, materials, hi-tech services in the sphere of capital construction”, placed on industry information resources was created. Technologies included in the register are recommended for implementation. Using the achievements of world practice that meet the strategic objectives of nuclear energy development, the task of increasing the competitiveness of the nuclear industry construction complex was solved.

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During the work on the project, experts from the department of construction technology and reinforced concrete structures repair of JSC “Russian Research Institute of Hydraulic Engineering named after Vedeneeva” noted the mutual conditionality of the introduction of technical innovations and the readiness of staff to perceive innovations: "Today, many innovative developments are presented that deserve special attention and require early industrial implementation during construction. But at the same time, we need to increase the culture of production, we need highly qualified performers" (Romanova, 2017, para. 8). Among the variety of modern technological solutions in the structure of JSC RRIHE named after Vedeneeva, as a developer, a technology for high-speed construction of NPP structures with self-compacting new-generation concrete was proposed.

3. Research Questions

The construction of nuclear power facilities using new building materials and structures, advanced design and project management methods attracts the attention of engineers, technical specialists, scientists. The importance of advanced concrete and rebar solutions in the organization of construction work is also indicated by the data of the report of the Nuclear Energy Agency (NEA), noting, among other things, the advantages of self-consolidating concrete: "The latter flows into place using gravity alone, reducing defections and labor requirements dying Its use in the nuclear industry has already been reported for AP1000 projects» (OECD, 2020, p. 82). Publications with information on the world practice of experimental work with calculations and tables are useful material for the formation of a set of educational tasks for advanced training and retraining programs.

In the scientific and technical literature, the issues of the technology of self-compacting concrete mixes are widely discussed. Concept of Self-Consolidating Concrete (SCC) suggested by Okamura in 80’s in Japan is still discussed nowadays but extensively used for the construction of industrial engineering structures. A review of publications highlights key aspects of the authors' attention that address the benefits and challenges of SCC from different perspectives.

Extensive publications are presented by Indian researchers. This is not by chance, nuclear power is actively developing in India and 4 power units are being built: “Current scenario of construction industries due to demand in the construction of large and complex structures often leads to difficult concreting conditions” (Arulsivanantham & Ravindiran, 2017, p. 62). In this article there is «a review» on Self Compacting Concrete (SCC) and the reasons of the invention of new type of concrete named as self-compacting concrete (SCC). This type of concrete runs into all corners of the formwork. It’s known that to avoid voids or honeycombs without compaction by manual or by mechanical vibrators is very difficult in this situation, “when large quantity of heavy reinforcement is to be placed in a reinforcing bar”. In accordance to Indian specialists their discovery of compatibility of fourth generation superplasticisers with Indian cements allows the production of self-compacting concrete (SCC). During a long period, Indian researchers have been studying some other “marginal materials” like stone dust and zero-size grit (aggregates 2-6 mm sieve size), that to produce self-compacting concrete. Fly ash based SCC mixes with 28-day strength in the compressive strength range 50-70 MPa, have already been developed by the authors and tested structural properties in construction at Roorkee (Praveen & Kaushik, 2003). The crucial role of durability performance of self-consolidating samples (concretes and mortars)

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blended with Silica fume, natural zeolite, and limestone powder was expertise for structures located in the Persian Gulf environment. The performance of plain vibrated concrete and mortars were also compared with plain self-consolidating mixtures, and the latter resulted in a better performance than the former (Alaghebandian et al., 2020).

The functional significance of SCC is emphasized by modern authors: «self-compacting concrete (SCC) is design to achieve three functional requirements, which are filling ability, passing ability, and resistance to segregation» (Yahiab, 2020, p. 1). The action of gravity, while maintaining good homogeneity leads to fill the formwork and encapsulate reinforcing bars. Turkish authors study the dynamic stability of self-consolidating concrete and underline that there are many standard test methods and applications to determine or estimate the workability of fresh concrete mixtures, most of them are focused on highly flow able concrete mixtures. “Due to its high flow ability, self-consolidating concrete (SCC) is much more vulnerable to segregation compared to conventional concrete mixtures” (Gökçe & Andiç-Çakır, 2018). China researchers stress this specific of SCC too: conceptually, SCC should be of excellent flowability, passing ability and segregation resistance (the ability to retain homogenous distribution of coarse aggregate), “due to the highly plasticized mortar matrix and the suspended characteristic of coarse aggregate in mortar matrix, the segregation resistance of SCC is inferior to that of conventional concrete’ (Han & Yan, 2021, p. 1). Except the influence of Water-Reducing Admixture (WRA) and vibration, mix proportion parameters can also influence the segregation resistance of SCC. Higher STPVR (sand to paste volume ratio) value makes concrete to be more tolerant about the over dosage of WRA, which results in the bulk density at the lower end of cylinder specimen to be decreased and the compressive strength of cubic specimen to be impaired. So, both bulk density distribution and Coarse aggregate area ratio CAAR distribution can serve as tools for evaluating the segregate resistance of SCC (P.9). Specific properties, such as fillability, flowability, and passability of self-compacting concrete (SCC) require experimentally investigate. It also needs to resist segregation, which may be caused by increased water or superplasticizer (SP) content. In addition, long periods of mixing deteriorate the properties of fresh SCC and cause difficulty in filling structure sections. The properties of fresh concrete were assessed by seven tests, namely, slump flow, V-funnel, slump flow T50, V-funnel T5, L-box, bleeding, and segregation. Hardened concrete was assessed on the basis of compressive, indirect, and flexural strengths. The increase in dosage of superplasticizer has mitigated the negative effect for long mixing periods on the properties of concrete (Abdullah & Almalki, 2020).

Marking many benefits in terms of production and placement compared to traditional concrete, especially placement, quality control and finishing are essential for SCC. “Constructability issues may arise for specifies and contractors if related standards, guidelines or practices are not appropriately followed for production and placement” (Kashaniab & Ngoa, 2020, p. 65). So “robust quality control measures” take place as a famous aspect during the production and placement of SCC. SCC is “less tolerant to abrupt changes in aggregate moisture content”, this depends on “chemical admixtures and water content”. The type of concrete mixer, transport time and the methods of concrete placement and finishing can affect the properties of SCC. “The excellent flow ability” of SCC compared to traditional concrete makes pumping the best method of placement, but there is a threat of air entrainment due to a higher flow speed, and arise of cavity and segregation. Attention to control measures during the

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production is analyses by some other authors, who describe the “durability aspects of SCC such as carbonation and corrosion particularly chloride attack and sulphate attack” (Paratibha & Yogesh, 2020, p. 147). Carbonation in SCC is different from normal concrete and the difference is displayed in reactions and mechanisms. “Corrosion in SCC can be due to many causes but main are chloride attack and sulphate attack” and supplementary cementations materials.

A significant part of the publications is a compositional study of mixture projects in the production of SCC. Compared to conventional concrete self-consolidating concrete (SCC) has a higher cost due to the large content of cement, use of mineral fillers, and use of various chemical admixtures, resulting in relatively high material cost. The proper selection of material and mixture proportioning can enable reduction in cement and admixture contents, leading to savings in cost (Elemam et al., 2020). The stability of self-consolidating concrete (SCC) is not only the key performance controlling the workability, but also has an important impact on its mechanics and durability in the later period. However, numerous problems still exist in the study of stability. The existing evaluation methods of stability are difficult to provide accurate and useful information in the field, and there is no generally accepted evaluation method and a standard evaluation system. The relative significance of the mix proportion parameters and external disturbances on stability is not clear and the key factors controlling the stability have not been concluded (Zedi et al., 2021).

> These classes of concrete are obtained by using a low water-cementitious materials ratio (w/cm), incorporating high quantities of supplementary materials (cement and mineral admixtures, such as ground-granulated blast furnace slag, fly ash and limestone powder) and superplasticizer, increasing sand-aggregate ratio, and if needed, a viscosity-modifying admixture (Yahiab, 2020, p. 2).

Some researchers believe that the use of superplasticizers create this concrete that can meet flow performance requirements (Han et al., 2017). The investigation of the influence of incorporating fly ash at high volume level on the porosity of Self-Compacting Concrete (SCC) discovered that degradation of concrete could be triggered by the presence of aggressive agents from the environment into the body of concrete. The penetration of these agents is influenced by the pore characteristics of the concrete. Incorporating a pozzolanic material such as fly ash could modify the pore characteristic of the concrete (Kristiawan et al., 2017). The impacts of hybrid fibers on properties of high strength fiber-reinforced self-consolidating concrete (FRSCC) was investigated by group of specialists. In total, the experiment included nine mixtures with different fiber types (Polyvinyl Alcohol/PVA, and hybrid fibers) and fiber factors ($\lambda = 0 \sim 70$) were fabricated with same basic mix proportioning. And the results indicated that single PVA fibers displayed identical influences on slump flow as steel fiber with similar fiber factor, however, can result in higher viscosity. Meanwhile, PVA fibers reduced the compressive strength and displayed limited restraining effects on the specific creep. However, the positive synergetic effects of hybrid fibers can reverse the reductions in compressive strength caused by the PVA fiber and increase flexural performances with multi-scale bridge effects (Li et al., 2021).

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The result of using SCC is “a substantial reduction in labor cost”, “construction time”, “a better working environment by eliminating the impact of vibration”- there are some social aspects of improvement of the properties of SCC.

The technology of high-speed construction of NPP structures with self-compacting concrete of a new generation is being developed by Russian specialists of the Rosatom State Corporation. Self-compacting concrete blends, as examples of technological solutions, have great advantages over traditional technologies. Their main components are new generation hyperplasticizing additives and micro-fillers, including based on polymer boxylates, which reduce the water content in concrete, but at the same time significantly increase its mobility. Such mixtures are characterized by high fluidity, self-sealing - they fill the entire concreted space of the structure. Reducing labor costs is one of the main attractive characteristics of self-compacting concrete. The use of self-compacting concrete mixtures allows to ensure high strength and monolithic properties of constructed structures with low cement content. Today, experts are working on the release of domestic additives. High-speed concreting technology with self-compacting concrete mixtures has already been used in the construction of radiation protection structures for the sealed volume of the reactor building of NV NPP-2 and L NPP-2, as well as in the construction of the Lakhtacentra and the bridge across the Bosphorus Vostochny Strait (Vladivostok).

It is planned to apply it when implementing the VVER-TOI project at the Kursk NPP-2 site. Light high-strength concrete with self-sealing properties is also being developed. It cannot be cracked, has high operational reliability and strength (class V40 and above) on light aggregates (expanded clay, ash gravel, waste from industrial enterprises, thermal stations, etc.). As a result of the use of light high-strength concretes, the mass of building structures will be significantly reduced without loss of load capacity and operational reliability. Light concrete is in demand in various sectors of construction, including the construction of structures, bridge structures, high-rise buildings and the development of the offshore shelf (floating platforms, floating pontoons), etc. At these facilities, concrete will work under the influence of ice loads and aggressive sea water. In the nuclear industry, use is possible in the construction of cooling towers, administrative buildings, auxiliary structures.

4. Purpose of the Study

Principles of knowledge management and ideas of soft approach to organizational dimension in nuclear power let us formulate the purpose of the study: analysis of the potential of retraining and development programs as a source of soft power in the management of construction projects. Achievement of the goal was ensured by setting the following tasks: - review of publications of SCC study and experience; - study of the cognitive component in the content of programs for advanced training and retraining of personnel for the nuclear power facilities construction; - streamlining of methodological developments of training specialists for working with innovative materials.

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5. Research Methods

Based on the approach of OECD-NEA, the following research methods were used: review of scientific literature, streamlining and systematization of discussion materials on professional competencies in the context of the emerging digital culture practice, logical analysis of the problems of increasing rationalization, division of labor and specializations in the producing of SCC or integration and synergy of professional functions and the emergence of new types of constructive materials and design. A lot of information was obtained by research of leading professional journals, as “Journal of Materials Research and Technology”, “Construction and Building Materials”, “International Journal of Chem. Tech Research”, “The Indian Concrete Journal”, “Journal of Building Engineering”, “Civil and Structural Engineering”. Some other source is conferences’ articles; for example, IOP Conference Series: Materials Science and Engineering, Self-Compacting Concrete: Materials, Properties and Applications/ Wood head Publishing Series.

The empirical data of the study was formed by observation methods, surveys and questionnaires of program participants, teachers, and instructors. The synthesis of the results was carried out by logical methods of analysis and synthesis, comparison, extrapolation, systematization and ordering of information of scientific publications. Due to the emergence of new materials and constructions, professional groups with the spread of new technologies in production, there are an objective need to study the creative component of professional competencies in additional engineering education. This is manifested in the growth of intellectualization of labor, the development of cognitive abilities, heuristic skills, communicative skills and behavioral experience in the focus of alternative approaches in choosing promising educational technologies in connection with the intensive implementation of information resources and electronic media technologies into professional education.

6. Findings

NPP construction is an organizationally complex capital project in which the parties participate, the coordination and interaction of which is labor-intensive and costly. The harder the skills and skills of technical personnel and the formed technological competencies, the more consistent and effective will be the management of the construction process. «Tacit knowledge is the result of experience, trial and error, human interactions and work practices. Most of the knowledge capital accumulated at the end of a project is tacit knowledge» (OECD, 2020, p. 80). And the threats caused by the completion of work and the loss of skills, staff turnover, uncertainty of orders for the construction of new nuclear power plants increase the risks of reducing the effectiveness of projects. Therefore, it is so important to maintain staff skills in a timely manner and improve retraining and advanced training programs in accordance with new technological innovations in the focus of the knowledge management methodology.

In the structure of "Rosatom Technical Academy", a training program "Construction of concrete and reinforced concrete monolithic structures during the construction of facilities for the use of atomic energy" for 40 hours with full-time training was developed. The strength of this program is its strong reliance on the STO "Facilities for the use of atomic energy. Basic Requirements for Self-Compacting Mixtures" and a list of legislative and regulatory acts, primarily GOST documents and IAEA

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requirements. However, this relatively recent document does not meet the requirements of the knowledge management methodology, much less focus on achieving digital transformation. 36 hours out of 40 hours are lecture classes. The program does not reflect design work or other types of creative classes. The program does not have a set of tasks such as case-study, STEM exercises, etc. The type of control of the training process offers only one form - "oral interview." The program announces modern technical means (- office equipment and personal computers; - multimedia projectors; - flipcharts, wall screens and magnetic marker boards), but they are not reflected in the content of the program and how the teacher works is not obvious.

Digital transformation is the strategic line of Rosatom since 2018. The introduction of a dual operating system that combines traditional hierarchies with network-like structures can be a way to address this shortcoming. Of course safety is at the core of nuclear activities and processes, but a well-balanced safety and high-performance culture may be beneficial. Need to find the right balance between hierarchical and network-like structures to minimize soft costs and hence maximize safe performance. “Digital transformation is the organizational process of using digital solutions to enhance the performance of existing business processes, and its adoption in the nuclear industry, particularly for design and construction, could provide a range of benefits:

- the higher degrees of automation, simplification and streamlining that can be achieved with digital tools may offer significant cost savings;
- digitally enabled to accommodate more simulations, analyses and verification in the early stages of design, thus reducing reworking risks;
- allows for greater unification, synchronization and traceability of information;
- explores processes characterized by higher collaboration, reactivity, agility and innovative thanking.

The applied aspects of digital transformation were investigated by "Rosatom Technical Academy" specialists as part of improving retraining and advanced training programs and tested in the open press (Filatova et al., 2020). Digital technologies make it possible to experience the physical and functional characteristics of various buildings and components of nuclear power plants.

The passive form of training does not form skills and competencies, knowledge is formed in interaction with collective efforts, setting and solving a creative task. For the most promising technologies and processes», which include «advanced manufacturing & advanced concrete and rebar solutions», need to revise the program in accordance of a “holistic approach” of OECD – NEA Org.

A review of publications on a problem relevant to this program - mastering the application of SCC - allows us to propose a set of methodological material that reflects modern research in the field of SCC, using figures, tables, the results of experimental work and formulating a problem task for studying the material: analysis of Indian or Chinese experience in the construction of nuclear energy facilities.

7. Conclusion

A review of world practice publications on the study and application of SCC showed the variety of examples of experimental creative work that can and should be used in the educational process on the topics "Materials and Technologies" in the development of methodological sets of classes. Design types

of work with analysis of results, data comparison and comparison operations, identification of special characteristics of the experiment will make it possible to strengthen the intellectual potential of workers, develop their cognitive abilities, creative skills, and in general the competence of personnel of high-tech production of digital transformation. Our research is driven by the approach to staff in the logic of Knowledge Management ideas promoted by the Nuclear Energy Agency (NEA) under the auspices of OECD. Personnel retraining and development programs acquire the status of a soft force component in the management of projects for the construction of nuclear facilities. “These innovations represent incremental improvements rather than disruptive or revolutionary changes. The objective, similar to design optimization, is to preserve the learning effect from previous constructions as much as possible” (OECD, 2020, p. 77).

References

Abdullah, M. Z., & Almalki, A. (2020). Influence of mixing time and superplasticizer dosage on self-consolidating concrete properties. *Journal of Materials Research and Technology, 9, 3,* 6101-6115.

Alaghebandian, N., Mirvalad, S., & Shirzadi Javid, A. A. (2020). Durability of self-consolidating concrete and mortar mixtures containing ternary and quaternary cement blends exposed to simulated marine environment. *Construction and Building Materials, 259,* 119767. https://doi.org/10.1016/j.conbuildmat.2020.119767

Arulsivanantham, P., & Ravindiran, G. (2017). A Review on Self Compacting Concrete. *International Journal of ChemTech Research, 10*(11), 62-68.

Elemam, W. E., Abdelraheem, A. H., Mahdy, M. G., & Tahwia, A. M. (2020). Optimizing fresh properties and compressive strength of self-consolidating concrete. *Construction and Building Materials, 249*, 118781. https://doi.org/10.1016/j.conbuildmat.2020.118781

Filatova, O., Khoroshavina, G., Gordeev, M., Chibirev, S., & Pozdnyakov, V. (2020). Innovative potential of "digital methodology" in the training of personnel of nuclear industry enterprises. *E3S Web of Conference, 210,* 22005. https://doi.org/10.1051/e3sconf/202021022005

Gökçe, H. S., & Andiç-Çakır, O. (2018). A new method for determination of dynamic stability of self-consolidating concrete: 3-Compartment sieve test. *Construction and Building Materials*. https://doi.org/10.1016/j.conbuildmat.2018.02.087

Han, B., Zhang, L., & Ou, J. (2017). *Self-Compacting Concrete. In: Smart and Multifunctional Concrete Toward Sustainable Infrastructures.* Springer, Singapore. https://doi.org/10.1007/978-981-10-4349-9_2

Han, J., & Yan, P. (2021). Influence of segregation on the permeability of self-consolidating concrete. *Construction and Building Materials, 269,* 121277. https://doi.org/10.1016/j.conbuildmat.2020.121277

Kashaniab, A., & Ngoa, T. (2020). Production and placement of self-compacting concrete. Self-Compacting Concrete: Materials, Properties and Applications, *Wood head Publishing Series in Civil and Structural Engineering,* 65-81.

Kristiawan, S. A., Sunarmasto, E. A., & Murti, G. Y. (2017). Porosity of Self-Compacting Concrete (SCC) incorporating high volume fly ash. *IOP Conf. Ser.: Mater. Sci. Eng., 176*, 012043

Li, K. F., Yang, C. Q., Huang, W., Zhao, Y. B., Wang, Y., Pan, Y., & Xu, F. (2021). Effects of hybrid fibers on workability, mechanical, and time-dependent properties of high strength fiber-reinforced self-consolidating concrete. *Construction and Building Materials, 277,* 122325. https://doi.org/10.1016/j.conbuildmat.2021.122325

OECD (2020). *Unlocking Reductions in the Construction Costs of Nuclear: A Practical Guide for Stakeholders, No.7530. NEA Org. Pub.* Retrieved on 20th of April 2021 from https://www.oecd-nea.org/jcms/pl_30653/

Paratibha, A., & Yogesh, A. (2020). Carbonation and corrosion of SCC. Self-Compacting Concrete: Materials, Properties and Applications, *Wood head Publishing Series in Civil and Structural Engineering,* 147-193. https://doi.org/10.1016/B978-0-12-817369-5.00007-6

Praveen, K., & Kaushik, S. K. (2003). Some trends in the use of concrete: Indian scenario. *The Indian Concrete Journal,* 1503-1508.

Romanova, S. (2017). *Transfer as a means of saving*. https://atomicexpert.com/page776793.html

Yahiab, M. S. A. (2020) Mix design procedure, tests, and standards// Self-Compacting Concrete: Materials, Properties and Applications. *Wood head Publishing Series in Civil and Structural Engineering,* 1-3. https://doi.org/10.1016/B978-0-12-817369-5.00001-5

Zedi, Zh., Xiao, J., Zhang, Q., Han, K., Wang, J., & Hu, X. (2021). A state-of-the-art review on the stability of self-consolidating concrete. *Construction and Building Materials, 268,* 121099. https://doi.org/10.1016/j.conbuildmat.2020.121099