

María Yazmín Abril-Fernández[✉], Yaneth Pineda-Triana[✉], Oscar Javier Gutiérrez-Junco[✉] and Juan José Alarcón^{*✉}

High-performance self-compacting concrete: A systematic review

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Abstract: High-performance self-compacting concrete (HPSCC) has emerged as an advanced cementitious material for the construction industry because it can flow, fill formwork, and consolidate under its own weight without mechanical vibration. This technology improves concrete placement in congested reinforcement and complex geometries, while reducing execution time, labour requirements, and construction costs. Nevertheless, its performance, particularly under aggressive environmental exposure and in mixtures incorporating high-range water-reducing admixtures (HRWR), still involves technical and durability challenges that require systematic assessment. This study analyses and synthesises the most relevant scientific literature on the physical, mechanical, rheological, and durability properties of HPSCC, with emphasis on the influence of HRWR admixtures. A systematic literature review was conducted in three stages: planning, execution, and reporting. The search was performed in Web of Science, Scopus, and ScienceDirect, considering peer-reviewed articles published between 2015 and 2025. Inclusion and exclusion criteria were applied to select studies addressing mix design, mechanical properties, durability performance, supplementary cementitious materials, and admixture effects. Bibliometric indicators and author collaboration networks were generated using VOSviewer. Nees Jan van Eck y Ludo Waltman (Universidad de Leiden). The results show sustained growth in HPSCC research, mainly in Asia, Europe, and North America. Five thematic clusters were identified, focused on mix design optimisation, supplementary cementitious materials,

rheological behaviour, chemical durability, and sustainable constituents. Recent studies highlight fibres, next-generation admixtures, recycled materials, and artificial intelligence for mixture optimisation. HPSCC is a promising alternative for demanding and sustainable structural applications; however, long-term durability, aggressive exposure, and fresh-hardened property interactions require further research under diverse construction conditions worldwide.

Keywords: self-compacting concrete, mechanical properties, mixed design

1 Introduction

Concrete is the most widely used construction material in the world due to its versatility, strength, and ease of production. With technological advancements in materials engineering, new developments have emerged that have optimised its mechanical properties and durability, including high-performance concrete (HPC) and self-compacting concrete (SCC). While these materials are not recent discoveries, they have gained prominence in the construction field due to their ability to flow and compact under their own weight without the need for mechanical vibration, which facilitates placement in structures with complex geometries and reduces labour costs and construction time (Shi et al. 2015; Mehdipour and Khayat 2018b). Despite the documented benefits, the design and implementation of these concretes still largely depend on information provided by manufacturers, who highlight their high mechanical strength and improved durability due to their low porosity and reduced permeability to aggressive substances, such as chlorides and sulphates (Alam et al. 2024b).

Historically, the evolution of concrete has been marked by the incorporation of chemical and mineral additives that modify its properties in both the fresh and hardened states. In the case of SCC, the use of high-range water-reducing additives (HRWR) is required to improve its

***Corresponding author: Juan José Alarcón**, Facultad de Ingeniería, Universidad Pedagógica y Tecnológica de Colombia, Av norte 5 N 4-11, Tunja 150001, Colombia, E-mail: juan.alarcon12@uptc.edu.co
María Yazmín Abril-Fernández, Yaneth Pineda-Triana and Oscar Javier Gutiérrez-Junco, Universidad Pedagógica y Tecnológica de Colombia, Sede Tunja

flowability without compromising mechanical strength, which has raised concerns about their impact on the microstructure and long-term durability of the material (Ben Aicha 2020). Unlike conventional concrete, where these additives were optional, they are essential in SCC to achieve the required properties. However, their use has raised concerns regarding potential effects on volumetric stability, drying shrinkage, and chemical resistance of the concrete, necessitating a more detailed analysis of their influence on structural behaviour and their feasibility in various environmental conditions (Wang et al. 2024b).

In this context, this systematic literature review aims to identify, analyse, and synthesise the most relevant scientific studies on the physical, mechanical, and durability properties of high-performance self-compacting concretes (HPSCC) that incorporate high-range water-reducing additives in their formulation. By collecting and evaluating specialised literature, the goal is to establish the state of the art in this research area, providing key information to optimise mix design, improve performance, and expand its application in sustainable infrastructure projects with high structural demands.

2 Methods

2.1 Scope

This study applies to a systematic literature review following the methodology proposed by Torres-Carrion et al. (2018), which consists of three main phases: planning, review development, and results reporting. The research focuses on the analysis of HPSCC, particularly on the influence of high-range water-reducing additives (HRWR) on their physical, mechanical, and durability properties. The objective is to identify the most relevant advancements in this field and provide a reference framework for future research.

The study examines the evolution of HPC, the materials used in its production, the environmental impact of its manufacturing process, and current trends in its

development. Additionally, the approaches adopted in different regions worldwide are analysed, emphasising the importance of sustainability and material optimisation in the concrete industry.

2.2 Instruments and techniques

For data collection, high-impact scientific databases such as Web of Science, Scopus, and ScienceDirect were used. A structured search syntax was established based on key terms extracted from the conceptual mind map of SCC to ensure the relevance and accuracy of the results. A filtering process was conducted to focus the analysis exclusively on literature reviews published between 2015 and 2025, ensuring the up-to-date nature of the collected information. Table 1 presents the search structure used in each database along with the results obtained.

2.2.1 Inclusion and exclusion criteria

To ensure the relevance of the selected studies, general and specific criteria were applied. The review included research analysing the physical, mechanical, and durability properties of HPSCC, focusing on publications in high-impact journals from 2015 onwards. Additionally, studies presenting HPSCC mix design methodologies and evaluating different families of high-range water-reducing additives (HRWR) were prioritised. Research on geopolymers and recycled concrete was excluded to maintain the focus on conventional SCC formulations.

2.3 Procedure

The development of this systematic review was structured into three fundamental stages: review planning, review execution, and results reporting, following the methodology of Torres-Carrion et al. (2018). The study focused on HPSCC and the impact of high-range water-reducing additives (HRWR) on its mechanical and durability properties. A rigorous approach was established, including a

Tab. 1: Search structure employed.

Database	Search syntax	Initial results	Filtered results
Web of Science	High-performance concrete, self-compacting properties, and durability	389	30
Scopus	TITLE-ABS-KEY (high AND performance AND concrete AND self-compacting AND properties AND durability)	170	11
ScienceDirect	High performance concrete self-compacting properties and durability AND SP AND NOT uhpc AND NOT recycled concrete AND NOT geopolymers	672	21

SP, superplasticisers.

structured search in high-impact scientific databases, bibliometric tools to analyse research trends, and the identification of collaboration networks among authors. This process helped consolidate a robust theoretical framework on the state of the art in HPSCC, providing key insights for future research in this field.

2.3.1 Planning stage

In the planning phase, research questions were defined to assess the influence of HRWR on the behaviour of HPSCC in its fresh and hardened states, as well as its long-term durability. A conceptual mind map was developed to guide the selection of key terms and the formulation of a structured search syntax. The literature search was conducted in high-impact databases, such as Web of Science, Scopus, and ScienceDirect, ensuring the relevance and up-to-date nature of the collected studies.

2.3.2 Development

During the development phase, information was collected and filtered using inclusion and exclusion criteria, prioritising studies on mixed design, mechanical properties, and durability of HPSCC. To analyse research trends and collaboration networks, VOSviewer software was used, enabling the identification of thematic clusters and the visualisation of research evolution in this field. The analysis revealed that recent studies primarily focus on cementitious material replacement, fibre reinforcement, and additive optimisation.

2.3.3 Result stage

In the results reporting phase, the main scientific journals publishing relevant research on HPSCC and HRWR were analysed, highlighting construction and building materials and cement and concrete research due to their high impact in the field. Relationship maps and term co-occurrence networks were created to identify publication patterns and gaps in the literature. The findings indicate significant growth in HPSCC research across Asia, Europe, and North America, with an increasing focus on sustainability and the use of recycled materials in its composition.

3 Results and analysis

Based on the information obtained from the systematic review, a bibliometric analysis was conducted using

VOSviewer software, which allows for the visualisation of collaboration networks and relationships between authors, reference terms, and thematic trends within the field of study. The processing of data from indexed databases revealed the existence of well-defined clusters based on the terminology used and the interconnection between studies. Figure 2a shows the distribution of documents according to the most recurrent terms, where a significant concentration of records focused on the analysis of concrete compaction, mix design, and the behaviour of its components is evident. Specifically, studies on aggregates, filler materials, and fibre inclusion in concrete production are highlighted (Elyamany et al. 2015; Jain et al. 2019).

Additionally, although with less presence in the analysed literature, studies focusing on the mechanical and durability properties of SCC were identified, highlighting aspects such as compressive strength, modulus of elasticity, and long-term performance under aggressive conditions (Zega et al. 2020; Alam et al. 2024b). The reference term analysis also identified five main thematic groups, which reflect the research trends in this field. As shown in Figure 2b, the smallest cluster consists of studies that directly refer to the abbreviation for SCC, indicating a lower frequency of use compared to other more specific technical terms. These findings provide a clear view of the knowledge structure in this area, guiding future research towards less explored areas or those with potential for development in improving the performance of SCC.

Figure 3a illustrates the network of reference terms and the thematic links generated in the research on HPC. The bibliometric analysis reveals the presence of multiple variables involved in the formation of these materials, reflecting the complexity of their design and behaviour. The diversity of interconnected terms demonstrates the need to approach the study of SCC from different perspectives, considering aspects such as mix design, rheological properties, compaction, and optimisation of its components. This highlights the dynamism and evolution of knowledge in this field.

On the other hand, Figure 3b allows for the visualisation of the temporal evolution of publications related to these reference terms. It can be observed that more recent research has focused on concrete compaction, the substitution of filler materials and binders, and the incorporation of fibres into mixes. This trend may align with the growing concern for sustainability in the construction industry, driven by the scarcity of natural resources and the need to reduce the environmental impact of concrete. The exploration of new material alternatives responds to the search for more efficient and sustainable solutions,

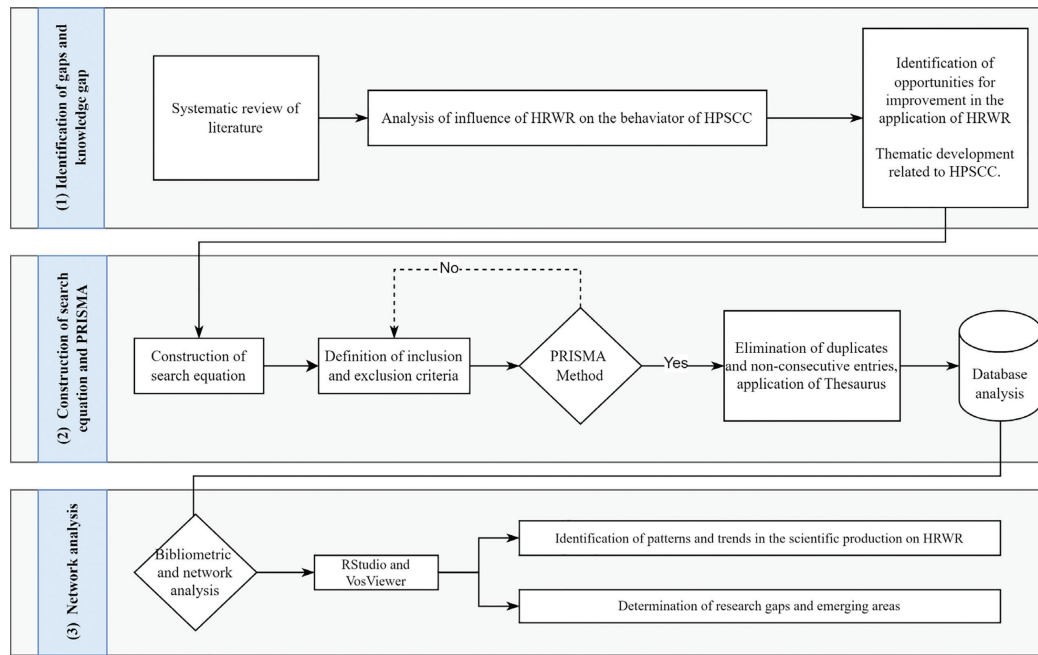


Fig. 1: Methodology. HPSCC, high-performance self-compacting concrete.

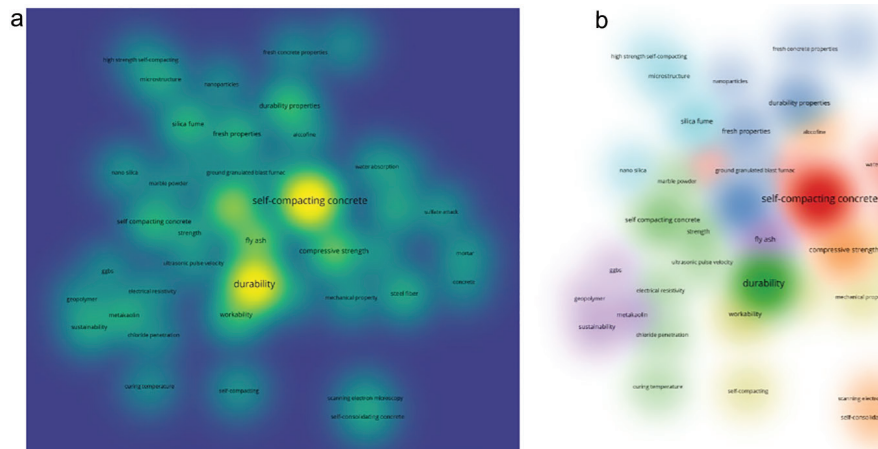


Fig. 2: (a) Concurrency and (b) concept clustering.

promoting the inclusion of industrial by-products and recycled materials as partial replacements for cement and aggregates, to optimise both the mechanical performance and durability of SCC.

The bibliometric analysis allowed for the identification of the leading authors and researchers currently contributing to the study of self-compacting high-performance concrete (SCHPC). A significant increase in scientific production in recent years was observed, reflecting the growing interest in optimising this material, particularly in terms of mix design, durability, and sustainability. Figure 4a shows the temporal evolution of publications, highlighting a greater involvement of

researchers in the last 5 years, with an increase in interdisciplinary collaboration.

Furthermore, using analysis tools like VOSviewer, the formation of collaboration networks between authors was visualised, indicating a trend towards increased international cooperation in this field. Figure 4b illustrates the emerging associations between different research groups, highlighting the interconnectivity between experts from various regions of the world, particularly in Asia, Europe, and North America. Additionally, the density of scientific production by author was identified, allowing for the recognition of the most influential researchers in the field based on the number of published articles. These findings

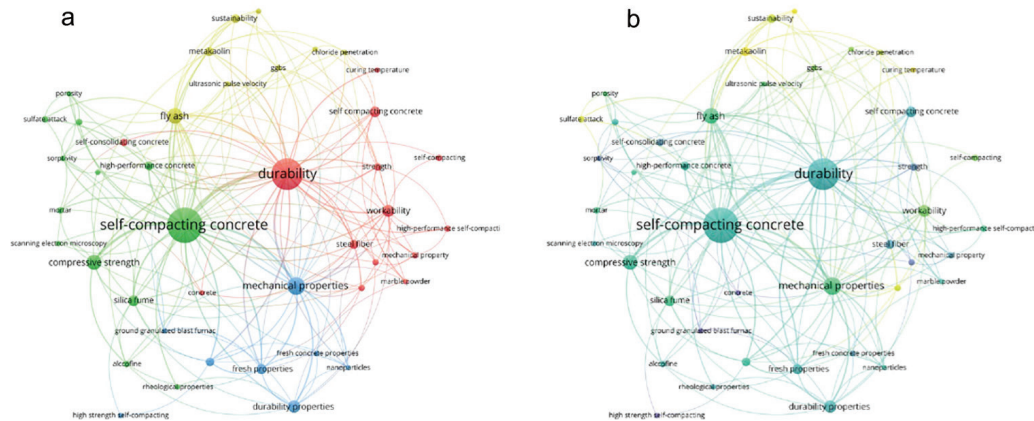


Fig. 3: (a) Relationship between concepts and (b) Concepts by year.

provide a solid foundation for establishing new collaborations and strengthening the exchange of knowledge in the development of HPSCC.

4 Discussion

HPC has experienced rapid evolution in the construction industry due to the growing demand for materials with strengths exceeding 80 MPa. These concretes have been developed to meet the structural requirements of taller buildings, innovative geometries, and slender elements, offering efficient solutions in terms of both strength and durability (Mehdipour and Khayat 2018a). Furthermore, the development of HPC has focused on reducing environmental impact by promoting the use of local raw materials and the recycling of industrial waste, although the incorporation of these materials still requires further research and regulation (Alam et al. 2024a).

In this context, various combinations of supplementary cementitious materials (SCMs) have been explored to improve the properties of concrete. Among the most used are ground granulated blast-furnace slag (GGBS), fly ash, and rice husk ash (RHA), as well as mineral additives, such as silica fume (SF), ultrafine slag (UFS), and nanosilica (nS). These materials, when combined with Ordinary Portland cement (OPC), have shown significant improvements in concrete's strength, workability, and durability (Su et al. 2022). However, while the incorporation of industrial waste represents a sustainable alternative, challenges remain regarding the homogeneity of the mixes and uncertainty about their long-term behaviour, which has led to caution in their widespread adoption (Iqbal et al. 2025). Recent studies have reported that some of these combinations can achieve strengths greater than 100 MPa at 28 days, leading to their incorporation in road and industrial infrastructure

that requires early strength to optimise construction timelines (Bhuva and Bhogayata 2022).

In addition to mechanical strength, the demand for concrete is also driven by the need to form structural elements with unconventional shapes or those that must overcome obstacles, such as high reinforcement densities, where traditional compaction methods are not feasible. In response to these challenges, HPSCC has been developed, a variant of HPC capable of flowing and compacting by itself without the need for mechanical vibration (Roussel et al. 2020). This type of concrete achieves its workability through the incorporation of chemical additives that modify viscosity and superplasticisers (SP) that improve the flow of the mix. However, its high cost has driven the search for more economical and sustainable alternatives, such as the inclusion of fibres and recycled aggregates, although certain materials, like rubber waste, may negatively affect the mechanical strength of the concrete (Gao et al. 2025).

The manufacturing of SCHPC has been accompanied by advances in third-generation SP, such as high-range water reducers (HRWR), which have shown greater efficiency in particle dispersion within the mix. These additives not only optimise the flow and cohesion of SCC but have also been applied in the development of self-healing concretes, which can self-repair through the formation of cementitious compounds in microcracks. Due to their impact on reducing water consumption and improving workability, ARAAR continues to be the subject of numerous studies aimed at enhancing the sustainability and performance of SCHPC in various construction applications (Wang et al. 2024a).

The development and evolution of SCC have been extensively analysed in scientific literature. Since its origin in Japan in the 1980s, this type of concrete has revolutionised materials engineering due to its ability to flow and consolidate without the need for mechanical vibration.

4.2 Sustainability and use of alternative materials in SCC

The sustainability of SCC is an increasing concern in the scientific community, given the need to reduce the environmental impact of construction. In this context, studies such as those by Barroqueiro et al. (2020), Sun et al. (2020), Kelechi et al. (2022), and Jasim et al. (2023) have explored the potential of incorporating recycled materials and industrial by-products in the production of SCC. One of the most promising approaches is the use of recycled concrete aggregates, which have been widely studied by Evangelista et al. (2019), Tang et al. (2020), Yuliani et al. (2020), Cárdenas et al. (2021), and Steinman et al. (2022). Although recycled aggregates can affect the workability and strength of SCC, the use of surface modification agents and chemical treatments has allowed for improvements in its properties. Another significant development in the sustainability of SCC is the evaluation of its life cycle (life cycle assessment [LCA]), a method that quantifies the environmental impact from material production to the demolition of structures. Authors such as Kurda et al. (2018), Abokersh et al. (2020), and Marinković et al. (2023) have applied this methodology to compare SCC with conventional concrete, concluding that the reduction in energy consumption and CO₂ emissions justifies its implementation in sustainable infrastructure projects.

SCC has been used in a wide variety of structural applications, ranging from high-rise buildings to bridges and tunnels. Research by Gebremariam et al. (2021) and Alarab et al. (2022) has analysed its performance in structural elements subjected to extreme loads, highlighting its ability to improve construction quality and reduce maintenance costs. Recent studies have explored the use of metallic and synthetic fibres in SCC to enhance its flexural strength and crack resistance. Authors such as Yalçınkaya and Yazıcı (2016), Yazıcı and Tanacan (2020), and Cappellesso et al. (2023) have demonstrated that the addition of steel, polypropylene, and basalt fibres increases the ductility of SCC, making it ideal for applications in pavements and structures subjected to repetitive impacts.

5 Conclusions

SCHPC has been extensively studied in scientific literature, with numerous articles analysing it from various perspectives. Among the most frequently addressed approaches are those related to mixed design, where the proportions

of constituent materials are optimised to improve flowability and strength, as well as the analysis of their physical and mechanical properties, both in the fresh and hardened states. Furthermore, research has been developed on its internal structure and microstructural behavior, evaluating the influence of components such as aggregates, filler materials, and the inclusion of fibers in its production—factors that have been shown to enhance its performance in terms of strength, ductility, and controlled deformation capacity (Zega et al. 2020; Gao et al. 2025). However, despite these studies providing greater knowledge of the material, gaps remain in the research, particularly regarding its long-term durability, behaviour in aggressive environments, and interaction with structures subjected to extreme conditions, highlighting the need to continue exploring these aspects in future investigations (Alam et al. 2024a).

Currently, the largest scientific production related to SCHPC comes from Asia, followed by Europe and North America. This suggests a strong research activity in countries such as China, Japan, and India, where the development of advanced technologies and the need to optimise materials in infrastructure have driven its study and application (Bhuva and Bhogayata 2022). In these countries, efforts have focused on the use of SCM and the integration of artificial intelligence for mixed optimisation. In Europe and North America, while research on this material is also significant, authors tend to be more dispersed, which has made it challenging to consolidate collaborative networks. However, in recent years, interdisciplinary research groups have begun to emerge, aiming to establish standardised methodologies and expand knowledge on its structural and sustainable applicability (Roussel et al. 2020). This scenario reflects the need to strengthen international cooperation and promote studies that not only improve the performance of SCHPC but also ensure its viability and durability in different construction contexts.

References

- Abokersh, M. H., Vallès, M., Cabeza, L. F., & Boer, D. (2020). A framework for the optimal integration of solar assisted district heating in different urban sized communities: A robust machine learning approach incorporating global sensitivity analysis. *Applied Energy*, 267, p. e114903. doi: 10.1016/j.apenergy.2020.114903
- Alam, M. F., Pratap, B., Azhar, M., Kumar, S., & Srivastava, A. K. L. (2024a). Microstructure and durability properties of high strength self-compacting concrete using micro silica and nano silica. *Asian Journal of Civil Engineering*, 25(7), pp. 5547-5557. doi: 10.1007/s42107-024-01128-3

- Alam, M. F., Shubham, K., Kumar, S., & Srivastava, A. K. L. (2024b). Enhancing high-strength self-compacting concrete properties through Nano-silica: analysis and prediction of mechanical strengths. *Journal of Building Pathology and Rehabilitation*, 9(1), pp. 1–15. doi: 10.1007/s41024-024-00386-7
- Alarab, A., Hamad, B., & Assaad, J. J. (2022). Strength and durability of concrete containing ceramic waste powder and blast furnace slag. *Journal of Materials in Civil Engineering*, 34(1), p. e04021392. doi: 10.1061/(ASCE)MT.1943-5533.0004031
- Barroqueiro, T., da Silva, P. R., & de Brito, J. (2020). High-performance self-compacting concrete with recycled aggregates from the precast industry: Durability assessment. *Buildings*, 10(6), p. 113. doi: 10.3390/buildings10060113
- Ben Aicha, M. (2020). The superplasticizer effect on the rheological and mechanical properties of self-compacting concrete. *New Materials in Civil Engineering*, Vol. 146. Elsevier, pp. 315-331. doi: 10.1016/B978-0-12-818961-0.00008-9
- Bernal, S. A. (2016). Advances in near-neutral salts activation of blast furnace slags. *RILEM Technical Letters*, 1, pp. 39-44. doi: 10.21809/rilemtechlett.2016.8
- Bhuva, P., & Bhogayata, A. (2022). A review on the application of artificial intelligence in the mix design optimization and development of self-compacting concrete. *Materials Today: Proceedings*, 65, pp. 603-608. doi: 10.1016/j.matpr.2022.03.194
- Cappellesso, V., di Summa, D., Pourhaji, P., Prabhu Kannikachalam, N., Dabral, K., Ferrara, L., et al. (2023). A review of the efficiency of self-healing concrete technologies for durable and sustainable concrete under realistic conditions. *International Materials Reviews*, 68(5), pp. 556-603. doi: 10.1080/09506608.2022.2145747
- Cárdenas, M. L., Wilde, V., Hagen-Zanker, A., Seifert-Dähnn, I., Hutchins, M. G., & Loisel, S. (2021). The circular benefits of participation in nature-based solutions. *Sustainability (Switzerland)*, 13(8), p. e4344. doi: 10.3390/su13084344
- Chinchón-Payá, S., Aguado, A., Nugterenc, H. W., & Chinchón, S. (2015). External sulfate attack in dam concretes with thaumasite formation. *Materiales de Construcción*, 65(317), p. e042. doi: 10.3989/mc.2015.10513
- Chinè-Polito, B., Cuevas-Kauffmann, R., Jiménez-Salas, R., & Ortiz-Quesada, G. (2019). Estudio experimental de la carbonatación del concreto. *Revista Tecnología En Marcha*, 32, 68-81. doi: 10.18845/tm.v32i2.4350
- Elyamany, H. E., Abd Elmoaty, A. E. M., & Mohamed, B. (2015). Effect of filler types on physical, mechanical and microstructure of self compacting concrete and Flow-able concrete. *Alexandria Engineering Journal*, 53(2), pp. 295-307. doi: 10.1016/j.aej.2014.03.010
- Evangelista, A. C. J., Tam, V. W. Y., & Santos, J. (2019). Recycled ceramic fine aggregate for masonry mortar production. *Proceedings of Institution of Civil Engineers: Construction Materials*, 172(5), pp. 225-234. doi: 10.1680/jcoma.16.00063
- Gao, F., Ge, Z., Yuan, H., Zhang, H., & Zhang, H. (2025). Influence of aggregate characteristics on workability and rheology of self-compacting concrete. *Case Studies in Construction Materials*, 22, p. e04595. doi: 10.1016/j.cscm.2025.e04595
- Gebremariam, A. T., Vahidi, A., Di Maio, F., Moreno-Juez, J., Vegas-Ramiro, I., Łagosz, A., et al. (2021). Comprehensive study on the most sustainable concrete design made of recycled concrete, glass and mineral wool from C&D wastes. *Construction and Building Materials*, 273, p. e121697. doi: 10.1016/j.conbuildmat.2020.121697
- Iqbal, N., Ali, S., Ajmal, M., Nimra, Sial, N., & Chaudhry, A. H. (2025). A comprehensive review on supplementary cementitious materials – progress, environmental impact, and future sustainability challenges. *Scientific Inquiry and Review*, 9(03), pp. 80-104. doi: 10.32350/sir.93.05
- Jain, A., Gupta, R., & Chaudhary, S. (2019). Performance of self-compacting concrete comprising granite cutting waste as fine aggregate. *Construction and Building Materials*, 221, pp. 539-552. doi: 10.1016/j.conbuildmat.2019.06.104
- Jasim, A. M. D. A., Wong, L. S., Kong, S. Y., Al-Zand, A. W., & Midhin, M. A. K. (2023). An evaluative review of recycled waste material utilization in high-performance concrete. *Civil Engineering Journal (Iran)*, 9(11), pp. 2927-2957. doi: 10.28991/CEJ-2023-09-11-020
- Kantamaturapoj, K., McGreevy, S. R., Thongplew, N., Akitsu, M., Vervoort, J., Mangnus, A., et al. (2022). Constructing practice-oriented futures for sustainable urban food policy in Bangkok. *Futures*, 139, p. e102949. doi: 10.1016/j.futures.2022.102949
- Kaya, Y., Beytekin, H. E., & Mardani, A. (2024). Effect of variations in aggregate ratios on the fresh, hardened, and durability properties of self-compacting concrete. *Materials*, 17(22), p. e5639. doi: 10.3390/ma17225639
- Kelechi, S. E., Adamu, M., Mohammed, A., Ibrahim, Y. E., & Obianyo, I. I. (2022). Durability performance of self-compacting concrete containing crumb rubber, fly ash and calcium carbide waste. *Materials*, 15(2), pp. 1-17. doi: 10.3390/ma15020488
- Kurda, R., Silvestre, J. D., de Brito, J., & Ahmed, H. (2018). Optimizing recycled concrete containing high volume of fly ash in terms of the embodied energy and chloride ion resistance. *Journal of Cleaner Production*, 194, pp. 735-750. doi: 10.1016/j.jclepro.2018.05.177
- Kuzmenko, K., Ducoulombier, N., Feraille, A., & Roussel, N. (2022). Environmental impact of extrusion-based additive manufacturing: Generic model, power measurements and influence of printing resolution. *Cement and Concrete Research*, 157, p. e106807. doi: 10.1016/j.cemconres.2022.106807
- Lambrechts, W., Ghijsen, P. W. T., Jacques, A., Walravens, H., Van Liedekerke, L., & Van Petegem, P. (2018). Sustainability segmentation of business students: Toward self-regulated development of critical and interpretational competences in a post-truth era. *Journal of Cleaner Production*, 202, pp. 561-570. doi: 10.1016/j.jclepro.2018.07.303
- Marinković, S., Josa, I., Braymand, S., & Tošić, N. (2023). Sustainability assessment of recycled aggregate concrete structures: A critical view on the current state-of-knowledge and practice. *Structural Concrete*, 24(2), pp. 1956-1979. doi: 10.1002/suco.202201245
- Mehdipour, I., & Khayat, K. (2018a). Understanding the role of supplementary cementitious materials on the performance of self-consolidating concrete. *Cement and Concrete Composites*, 92, pp. 116-128. doi: 10.1016/j.cemconcomp.2018.06.011
- Mehdipour, I., & Khayat, K. H. (2018b). Understanding the role of particle packing characteristics in rheo-physical properties of cementitious suspensions: A literature review. *Construction and Building Materials*, 161, pp. 340-353. doi: 10.1016/j.conbuildmat.2017.11.147

- Mohseni, E., Tang, W., & Cui, H. (2017). Chloride diffusion and acid resistance of concrete containing zeolite and tuff as partial replacements of cement and sand. *Materials*, 10(4), p. 372. doi: 10.3390/ma10040372
- Roussel, N., Oestere, B., & Marchon, D. (2020). Bibliometric analysis of research production on self-compacting concrete (SCC), 2015–2024. *Architecture, Structures and Construction*, 7(6). doi: 10.1007/s44150-026-00189-z
- Sahlol, D. G., Elbeltagi, E., Elzoughiby, M., & Abd Elrahman, M. (2021). Sustainable building materials assessment and selection using system dynamics. *Journal of Building Engineering*, 35, p. e101978. doi: 10.1016/j.jobe.2020.101978
- Scrivener, K., Snellings, R., & Lothenbach, B. (2018). In: CRC Press (ed.), *A Practical Guide to Microstructural Analysis of Cementitious Materials*. CRC Press. <https://www.taylorfrancis.com/books/edit/10.1201/b19074/practical-guide-microstructural-analysis-cementitious-materials-karen-scrivener-ruben-snellings-barbara-lothenbach>
- Shi, C., Wu, Z., Lv, K., & Wu, L. (2015). A review on mixture design methods for self-compacting concrete. *Construction and Building Materials*, 84, pp. 387–398. doi: 10.1016/j.conbuildmat.2015.03.079
- Steinman, A. D., Uzarski, D. G., Lusch, D. P., Miller, C., Doran, P., Zimnicki, T., et al. (2022). Groundwater in crisis? Addressing groundwater challenges in Michigan (USA) as a template for the Great Lakes. *Sustainability (Switzerland)*, 14(5), p. e3008. doi: 10.3390/su14053008
- Su, A., Chen, T., Gao, X., Li, Q., & Qin, L. (2022). Effect of carbonation curing on durability of cement mortar incorporating carbonated fly ash subjected to Freeze-Thaw and sulfate attack. *Construction and Building Materials*, 341, p. 127920. doi: 10.1016/j.conbuildmat.2022.127920
- Sun, C., Chen, Q., Xiao, J., & Liu, W. (2020). Utilization of waste concrete recycling materials in self-compacting concrete. *Resources, Conservation and Recycling*, 161, p. 104930. doi: 10.1016/j.resconrec.2020.104930
- Tangadagi, R. B., Manjunatha, M., Seth, D., & Preethi, S. (2021). Role of mineral admixtures on strength and durability of high strength self compacting concrete: An experimental study. *Materialia*, 18, p. e101144. doi: 10.1016/j.mtl.2021.101144
- Tang, Z., Li, W., Tam, V. W. Y., & Yan, L. (2020). Mechanical performance of CFRP-confined sustainable geopolymeric recycled concrete under axial compression. *Engineering Structures*, 224, p. e111246. doi: 10.1016/j.engstruct.2020.111246
- Tanyildizi, H. (2023). Durability of concrete exposed to combined freeze-thaw, sulfate, and acid attacks after two years. *Revista de La Construcción*, 22(1), pp. 102–121. doi: 10.7764/RDLC.22.1.102
- Torres-Carrion, P. V., Gonzalez-Gonzalez, C. S., Aciar, S., & Rodriguez-Morales, G. (2018). Methodology for systematic literature review applied to engineering and education. In: *IEEE Global Engineering Education Conference, EDUCON, 2018-April*, pp. 1364–1373. doi: 10.1109/EDUCON.2018.8363388
- Walraven, J., Droogné, D., Grünewald, S., Taerwe, L., Cotovanu, B., & Rovers, J. (2022). Self-compacting high-performance fiber concrete for foundations: Part 1 -experimental verification and design considerations. *Structural Concrete*, 23(1), pp. 172–186. doi: 10.1002/suco.202000440
- Wang, X.-H., Fang, Z.-C., & Zheng, L. (2024a). Effect of dose and types of the water reducing admixtures and superplasticizers on concrete strength and durability behaviour: A review. *Journal of Civil Engineering and Management*, 30(1), pp. 33–48. doi: 10.3846/jcem.2024.20145
- Wang, X., Ma, Z., Wang, X., Xue, S., Shen, W., Wu, D., et al. (2024b). Design of self-compacting ultra-high performance concrete (SCUHPC) towards to the cementitious materials packing optimization. *Cement and Concrete Composites*, 148, p. e105443. doi: 10.1016/j.cemconcomp.2024.105443
- Xia, D., Yu, S., Yu, J., Feng, C., Li, B., Zheng, Z., et al. (2023). Damage characteristics of hybrid fiber reinforced concrete under the freeze-thaw cycles and compound-salt attack. *Case Studies in Construction Materials*, 18, p. e01814. doi: 10.1016/j.cscm.2022.e01814
- Yalçınkaya, Ç., & Yazıcı, H. (2016). Effect of early-age freeze-thaw exposure on the mechanical performance of self-compacting repair mortars. *Science and Engineering of Composite Materials*, 23(3), pp. 335–344. doi: 10.1515/secm-2014-0006
- Yazıcı, S., & Tanacan, L. (2020). Material-based computational design (MCD) in sustainable architecture. *Journal of Building Engineering*, 32, p. e101543. doi: 10.1016/j.jobe.2020.101543
- Yuliani, S., Hardiman, G., & Setyowati, E. (2020). Green-roof: The role of community in the substitution of green-space toward sustainable development. *Sustainability (Switzerland)*, 12(4), p. e1429. doi: 10.3390/su12041429
- Zega, C. J., Santillán, L. R., Sosa, M. E., & Villagrán Zaccardi, Y. A. (2020). Durable performance of recycled aggregate concrete in aggressive environments. *Journal of Materials in Civil Engineering*, 32(7), p. e03120002. doi: 10.1061/(ASCE)MT.1943-5533.0003253
- Zeyad, A. M., & Almalki, A. (2020). Influence of mixing time and superplasticizer dosage on self-consolidating concrete properties. *Journal of Materials Research and Technology*, 9(3), pp. 6101–6115. doi: 10.1016/j.jmrt.2020.04.013
- Zhu, H., Fan, J., Yi, C., Ma, H., Chen, H., Shi, J., et al. (2021). Characterization of freeze-thaw resistance of new-to-old concrete based on the ultrasonic pulse velocity method. *Journal of Testing and Evaluation*, 49(1), pp. 270–283. doi: 10.1520/JTE20190639