sustainability

MDPI

Editorial

Innovative Structural Applications of High Performance Concrete Materials in Sustainable Construction

Fausto Minelli [1,*], Enzo Martinelli [2] and Luca Facconi [1]

[1] DICATAM—Department of Civil, Environmental, Architectural Engineering and Mathematics, University of Brescia, 25123 Brescia, Italy; luca.facconi@unibs.it
[2] Department of Civil Engineering, University of Salerno, 84084 Fisciano, Italy; e.martinelli@unisa.it
* Correspondence: fausto.minelli@unibs.it

It is well-known that concrete is the most widely utilised construction material in the world. Therefore, any action intending to enhance sustainability of the construction industry cannot help but consider the supply chain, production, distribution demolition and eventual disposal, landfilling or recycling of this intrinsically composite material. The use of High-Performance Concrete, although it may sound counterintuitive at first, can be one of the most effective, though technologically challenging, options to make the construction sector more sustainable. Indeed, high-performance should not only be intended in terms of mechanical properties, but also in terms of durability and capacity of the materials to cope with harsh environmental exposure conditions.

In this light, even the use of Recycled Concrete Aggregates (RCAs) in the production of Recycled Aggregate Concrete (RAC), which is generally accepted as the most realistic solution to reduce the environmental impacts of concrete productions, should guarantee a sufficiently high-performance, regardless of the origin of RCAs [1]. To this end, specific processing procedures and mix-design formulations are requested with the aim to obtain limited loss in performance when RAC is exposed to severe environmental conditions, like water immersion [2] or freeze-thaw cycles [3].

Similarly, the partial replacement of Ordinary Portland Cement (OPC), which is notoriously the most environmentally harmful among concrete constituents, with other Supplementary Cementitious Materials (SCMs) or Alternative Binders (ABs) should undergo careful research work intended at assessing the actual performance of the resulting cementitious composites. In this respect, promising results have been obtained by considering several SCMs or ABs, such as Municipal Solid Waste Incinerator Bottom Ash [4], Belitic Calcium Sulfoaluminate Cement [5] or Steel Slag [6], the latter consisting of either ground granulated blast furnace slag (GGBFS) or unprocessed ladle furnace slag (LFS).

Moreover, the use of High-Performance Cementitious Composites requires further investigations into their mechanical behaviour, especially in the cases where they are supposed to be almost perfectly bonded to other materials, such as normal-strength concrete of existing RC members [7,8] or masonry walls [9], also considering their use with the twofold objective of structural (and, specifically, seismic) and energy retrofitting of buildings. In this respect, retrofitting existing buildings can oftentimes be more cost-effective than constructing a new facility. In fact, besides the reduced energy consumption due to the adoption of energy conservation retrofits, existing buildings can take advantage from innovative seismic retrofitting interventions due to their efficient design, minimal maintenance and disruption for installation. Therefore, when sustainability initiatives, such as those described above, are taken into consideration in designing renovations and retrofits for existing buildings, operation costs and environmental impacts are reduced, thus leading to increased building adaptability, durability, and resiliency.

The challenge of enhancing sustainability by raising durability of concrete structures is particularly relevant in those applications where maintenance is particularly expensive

check for updates

Citation: Minelli, F.; Martinelli, E.; Facconi, L. Innovative Structural Applications of High Performance Concrete Materials in Sustainable Construction. *Sustainability* **2021**, *13*, 12491. https://doi.org/10.3390/su132212491

Received: 20 October 2021
Accepted: 21 October 2021
Published: 12 November 2021

Publisher's Note: MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Copyright: © 2021 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (https://creativecommons.org/licenses/by/4.0/).

and impactful, in terms of both direct intervention costs and indirect costs deriving from downtime, like in the case of Geothermal Power Plants [10].

The present Special Issue, entitled "Innovative Structural Applications of High-Performance Concrete Materials in Sustainable Construction", aims at providing readers with the most recent research results on the aforementioned subjects and further fostering a collaboration between the scientific community and the industrial sector on a common commitment towards sustainable concrete constructions.

Author Contributions: Data curation, writing—original draft preparation, writing—review and editing, supervision, F.M., E.M. and L.F. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Pani, L.; Francesconi, L.; Rombi, J.; Mistretta, F.; Sassu, M.; Stochino, F. Effect of Parent Concrete on the Performance of Recycled Aggregate Concrete. *Sustainability* **2020**, *12*, 9399. [CrossRef]
2. Sharaky, I.; Issa, U.; Alwetaishi, M.; Abdelhafiz, A.; Shamseldin, A.; Al-Surf, M.; Al-Harthi, M.; Balabel, A. Strength and Water Absorption of Sustainable Concrete Produced with Recycled Basaltic Concrete Aggregates and Powder. *Sustainability* **2021**, *13*, 6277. [CrossRef]
3. Santana Rangel, C.; Amario, M.; Pepe, M.; Martinelli, E.; Toledo Filho, R.D. Durability of Structural Recycled Aggregate Concrete Subjected to Freeze-Thaw Cycles. *Sustainability* **2020**, *12*, 6475. [CrossRef]
4. Faleschini, F.; Toska, K.; Zanini, M.A.; Andreose, F.; Settimi, A.G.; Brunelli, K.; Pellegrino, C. Assessment of a Municipal Solid Waste Incinerator Bottom Ash as a Candidate Pozzolanic Material: Comparison of Test Methods. *Sustainability* **2021**, *13*, 8998. [CrossRef]
5. Markosian, N.; Tawadrous, R.; Mastali, M.; Thomas, R.J.; Maguire, M. Performance Evaluation of a Prestressed Belitic Calcium Sulfoaluminate Cement (BCSA) Concrete Bridge Girder. *Sustainability* **2021**, *13*, 7875. [CrossRef]
6. Rubio-Cintas, M.D.; Parron-Rubio, M.E.; Perez-Garcia, F.; Bettencourt Ribeiro, A.; Oliveira, M.J. Influence of Steel Slag Type on Concrete Shrinkage. *Sustainability* **2021**, *13*, 214. [CrossRef]
7. Javidmehr, S.; Empelmann, M. Shear Bond between Ultra-High Performance Fibre Reinforced Concrete Overlays and Normal Strength Concrete Substrates. *Sustainability* **2021**, *13*, 8229. [CrossRef]
8. Nishiwaki, T.; Mancinelli, O.; Fantilli, A.P.; Adachi, Y. Mechanical and Environmental Proprieties of UHP-FRCC Panels Bonded to Existing Concrete Beams. *Sustainability* **2021**, *13*, 3085. [CrossRef]
9. Facconi, L.; Lucchini, S.S.; Minelli, F.; Grassi, B.; Pilotelli, M.; Plizzari, G.A. Innovative Method for Seismic and Energy Retrofitting of Masonry Buildings. *Sustainability* **2021**, *13*, 6350. [CrossRef]
10. Al-Obaidi, S.; Bamonte, P.; Animato, F.; Lo Monte, F.; Mazzantini, I.; Luchini, M.; Scalari, S.; Ferrara, L. Innovative Design Concept of Cooling Water Tanks/Basins in Geothermal Power Plants Using Ultra-High-Performance Fiber-Reinforced Concrete with Enhanced Durability. *Sustainability* **2021**, *13*, 9826. [CrossRef]