TG.SAG.2 : PROPOSAL OF BULLETIN WITH OUTCOMES OF FOCUS POINT 1

From Traditional to Sustainable Practices : Experience and Outlook for Concrete Structures (SotA)

Table of Contents (1st Draft)

[1] Comprehensive overview of categories of solution, emphasizing the key message that multiple approaches are not only feasible but also necessary (and can be seamlessly combined to achieve optimal benefits for the environment, economy, and society).

[2] Category to be discussed

[3] Arrangement of the cases should follow the previously defined categories of sustainable solutions, with the understanding that the examples will likely involve a combination of various solutions (e.g., the use of both RAC and non-metallic reinforcement). Therefore, they may not strictly align with a single category and some creativity in arrangement will be required

3.1.3 Future Outlook and Potential Challenges for Upscaling

3.1.4 Current Practices & Case Studies [4]

3.1.4.1 Successful Implementation of LC3 Concrete in [Application/Project Name]
3.1.4.1.1 Case description
3.1.4.1.2 Suitability Enhancement Rationale
3.1.4.1.3 Environmental Impact Evaluation incl. Comparison with Traditional Solutions
3.1.4.1.4 Economic and Societal Considerations incl. Comparison with Traditional Solutions
3.1.4.1.5 Regulatory Compliance and Standards in the Project
3.1.4.1.6 Potential for Upscaling Innovation
3.1.4.2 [Research/Case Name] Showcasing LC3 Concrete Structure in Research Project
3.1.4.2.1 Case description
3.1.4.2.2 Suitability Enhancement Rationale
3.1.4.2.3 Environmental Impact Evaluation incl. Comparison with Traditional Solutions
3.1.4.2.4 Economic and Societal Considerations incl. Comparison with Traditional Solutions
3.1.4.2.5 Regulatory Compliance and Standards in the Project
3.1.4.2.6 Potential for Upscaling Innovation
3.1.4.3 […… LC3 Concrete in Structural Application ……..]
3.1.4.4 […… LC3 Concrete in Structural Application ……..]
3.1.4.5 Successful Implementation of GGBS Concrete in [Application/Project Name]
3.1.4.5.1 Case description
3.1.4.5.2 Suitability Enhancement Rationale
3.1.4.5.3 Environmental Impact Evaluation incl. Comparison with Traditional Solutions
3.1.4.5.4 Economic and Societal Considerations incl. Comparison with Traditional Solutions
3.1.4.5.5 Regulatory Compliance and Standards in the Project
3.1.4.5.6 Potential for Upscaling Innovation
3.1.4.6 [Research/Case Name] Showcasing GGBS Concrete Structure in Research Project
3.1.4.6.1 Case description
3.1.4.6.2 Suitability Enhancement Rationale
3.1.4.6.3 Environmental Impact Evaluation incl. Comparison with Traditional Solutions
3.1.4.6.4 Economic and Societal Considerations incl. Comparison with Traditional Solutions
3.1.4.6.5 Regulatory Compliance and Standards in the Project
3.1.4.6.6 Potential for Upscaling Innovation
3.1.4.7 […… GGBS Concrete in Structural Application ……..]
3.1.4.8 […… GGBS Concrete in Structural Application ……..]
3.1.4.9 […… Other Concrete Mixtures with SCM in Structural Applications ………]
3.1.4.10 [… Other Concrete Mixtures with SCM in Structural Applications ………]

3.2 Low-carbon Concrete Mixtures with Alternative Binders in Structural Applications

3.2.1 General Characteristics and Benefits in Context of Sustainability

[… clinker substituted by alternative binders …]

3.2.2 Regulatory Compliance and Standards

3.2.3 Future Outlook and Potential Challenges for Upscaling

3.2.4 Current Practices & Case Studies

3.2.4.1 Implementation of Alkali Activated Geopolymer Concrete in Application/Research [Project Name]
3.2.4.2 […… Alkali Activated Geopolymer Concrete in Structural Application ……..]
3.2.4.3 […… Other Alternative Binders in Structural Applications ……..]

[4] Two categories are proposed for consideration : (i) successful implementation in practice and (ii) showcasing in research study

3.3 Non-traditional Reinforcing Materials in Structural Applications

3.3.1 General Characteristics and Benefits in Context of Sustainability

[… dematerialisation with lightweight materials / non-corrosive / bio-based …]

3.3.2 Regulatory Compliance and Standards

3.3.3 Future Outlook and Potential Challenges for Upscaling

3.3.4 Current Practices & Case Studies

3.3.4.1 Implementation of FRP Reinforcement in Application/Research [Project Name]
3.3.4.2 […… FRP Reinforcement in Structural Application ……..]
3.3.4.3 […… Bio-based Reinforcing Materials in Structural Application ……..]
3.3.4.4 […… High Strength Reinforcing Steel Structural Application ……..]
3.3.4.5 […… Other Non-traditional Reinforcing Materials in Structural Applications ……..]

3.4 High-Performance Concrete in Structural Applications

3.4.1 General Characteristics and Benefits in Context of Sustainability

[… dematerialisation with high-performance materials & materials with enhanced durability …]

3.4.2 Regulatory Compliance and Standards

3.4.3 Future Outlook and Potential Challenges for Upscaling

3.4.4 Current Practices & Case Studies

3.4.4.1 Implementation of FRC in Application/Research [Project Name]
3.4.4.2 […… FRC in Structural Application ……..]
3.4.4.3 […… UHPC in Structural Application ……..]
3.4.4.4 […… Other Types of High-Performance Concrete in Structural Applications ……..]

3.5 Design Optimisation in Structural Applications

3.5.1 General Characteristics and Benefits in Context of Sustainability

[… dematerialisation with structural & material design optimization …]

3.5.2 Regulatory Compliance and Standards

3.5.3 Future Outlook and Potential Challenges for Upscaling

3.5.4 Current Practices & Case Studies

3.5.4.1 Implementation of risk-based structural design approach in Application/Research [Project Name]
3.5.4.2 […… Risk-based Structural Design Approach in Structural Application ……..]
3.5.4.3 […… Design Optimization Supported by FEA in Structural Application ……..]
3.5.4.4 […… Other Design Optimisation Concepts in Structural Applications ……..]

3.6 Recycling and Reuse Practices in Structural Applications

3.6.1 Sustainable Practices in Material Reuse and Benefits in Context of Sustainability

[… reuse of materials, components and structural parts …]

3.6.2 Regulatory Compliance and Standards

3.6.3 Future Outlook and Potential Challenges for Upscaling

3.6.4 Current Practices & Case Studies

3.6.4.1 Implementation of RAC in Application/Research [Project Name]
3.6.4.2 […… RAC in Structural Application ……..]
3.6.4.3 […… Reuse of Reclaimed Elements in Structural Application ……..]
3.6.4.4 […… Other Types of Circular Solutions in Structural Applications ……..]

3.7 Sustainable LCM, Maintenance, Renovation and Adaptation Practices in Structural Applications

3.7.1 Sustainable Practices in Service Life Extension and Efficient Use of Existing Textures and Benefits in Context of Sustainability

[… service life extension, efficient use through sustainable LCM, maintenance, renovation and adaptation of existing structures…]

3.7.2 Regulatory Compliance and Standards

3.7.3 Future Outlook and Potential Challenges for Upscaling

3.7.4 Current Practices & Case Studies

3.7.4.1 Implementation of RAC in Application/Research [Project Name]

3.7.4.2 […… Data Informed Assessment and Condition-Based Maintenance ……..]

3.7.4.3 [……Renovation and Adaptation in Structural Application ……..]

3.7.4.4 […… Other Examples of Sustainable LCM Practices for Structural Applications ……..]

3.8 Sustainable production and construction technologies for Structural Applications

3.8.1 Sustainable Practices in Production and Construction Technologies and Benefits in Context of Sustainability

[… reducing on-site waste, minimizing energy consumption, enhancing energy-efficiency of e.g. curing, decreasing construction time, …]

3.8.2 Regulatory Compliance and Standards

3.8.3 Future Outlook and Potential Challenges for Upscaling

3.8.4 Current Practices & Case Studies

3.8.4.1 Implementation of Precast and Modular Construction in Application/Research [Project Name]

3.8.4.2 […… Precast and Modular Construction in Structural Application ……..]

3.8.4.3 […… Additive Manufacturing in Structural Application ……..]

3.8.4.4 […… CCS for Cement Production Facilities ……..]

3.8.4.5 […… Other Examples of Sustainable Production and Construction technologies ……..]

4. Decision-Making Perspectives

4.1 Factors Influencing Adoption of Sustainable Practices [5]

4.2 Role of Regulatory Compliance and Standards in Upscaling Innovative Solutions [6]

5. Conclusions and Outlook

5.1 Recommendations on Implementing Sustainable Practices

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[5] This Section ought to emphasizes the importance of a balanced and inclusive decision-making process that considers multiple dimensions, practical constraints, and the perspectives of different stakeholders, e.g. :

- include a broad discussion on adoption that encompasses environmental, societal, and economic considerations, to ensure that decisions are made with a holistic view, taking into account the impact on the planet, the well-being of society, and economic viability.
- consider practical constraints during the decision-making process, acknowledging and addressing limitations in resources, technology, and logistics that may impact the feasibility and implementation of chosen strategies.
- reflect of decisions from the perspectives of various stakeholders involved in the project., recognizing the diverse interests and concerns of stakeholders, including community members, industry partners, and regulatory bodies, ensures a well-rounded approach that aligns with broader goals and values.

[6] This Section ought to emphasize the need to navigate regulatory complexities, viewing standards as facilitators, and promoting collaboration between industry and regulatory bodies to effectively upscale innovative solutions

- emphasize the importance of aligning innovative solutions with existing regulatory frameworks. Ensure that upscaling efforts comply with established laws and standards to guarantee safety, quality, and ethical considerations.
- highlight the role of standards not just as compliance measures but as facilitators for upscaling. Standards can provide a common ground for industry players, fostering interoperability and a shared understanding of best practices.
- recognize the importance of global harmonization of standards. Discuss efforts to align standards internationally, facilitating the global adoption of innovative solutions and promoting a cohesive approach to addressing common challenges

5.2 Research and Development Opportunities
5.3 Future Outlook and Potential Challenges

INVENTORY OF SOLUTIONS AND SPECIFIC EXAMPLES TO BE INCLUDED IN THE BULLETIN

Categories of solutions		Name of contributor Type of innovation Type of structural application
Low-carbon concrete mixtures with substitution of standard Portland cement		
	Clinker substitutes / supplementary cementitious materials (SCMs) e.g.: ○ pozzolanic SCMs e.g.: - fly ash - silica fume - calcined clays (metakaolin) - burnt rice husk - natural pozzolans ○ hydraulic SCMs e.g.: - ground granulated blast-furnace slag (GGBS) - burnt shale oil ○ limestone ○ other	
	Alternative binders e.g.: ○ alkali-actived binders (or geopolymers) ○ reactive belite-rich Portland cement (RBPC) ○ belite calcium sulfoaluminate (BCSA) cement ○ wollastonite-based cement ○ prehydrated calcium silicate cement ○ magnesium silicate cement ○ biomineralisation ○ other	
	Recovered Portland cement	
	Other low-carbon concrete mixtures	
Non-traditional reinforcing materials		
	FRP-based embedded reinforcement e.g.: ○ 1D (bars) - carbon (CFRP) - glass (GFRP) - basalt (BFRP) ○ 2D (textile, grid, laminate) ○ 3D (3D grids)	
	Bio-based reinforcing materials (natural fibre reinforcement)	
	High strength reinforcing steel	
	Other low-carbon reinforcing materials	
High-performance concrete		
	Fibre reinforced concrete e.g.: ○ steel fibre reinforced concrete (SFRC) ○ polymer fibre reinforced concrete (PFRC) ○ UHPC ○ other	
	High performance fibre reinforced cementitious composites (HPFRCC) ○ reactive powder concrete (RPC) ○ engineered cementitious composites (ECC) ○ other	
	Other types of high-performance concrete	
Design optimisation		
	Structural design optimisation e.g.: ○ sustainability in the conceptual design phase ○ risk-based structural design approach ○ design optimization supported by FEA	

	○ other	
Recycling and reuse		
	Reuse of materials, components and structural parts harvested from deconstruction and demolition of existing concrete structures e.g.: ○ RAC ○ reuse of reclaimed elements/components/systems - with (reinforcement) detailing conform current regulations and without deterioration and/or damage - with (reinforcement) detailing not conform current regulations	
	Reuse of materials from other residual waste streams	
	Circular use of materials and components in multi-life cycle structures	
	Other solutions for recycling and reuse	
Sustainable LCM, Maintenance, Renovation and Adaptation		
	Service life extension of existing concrete structures e.g.: ○ sustainable life cycle management ○ data informed assessment and condition-based maintenance ○ renovation and adaptation practices for service life extension ○ other solutions for service life extension and efficient use	
Sustainable production and construction technologies		
	○ precast and modular construction ○ additive manufacturing ○ CCS for Cement Production Facilities ○ other sustainable production and construction technologies	
CO2 capture & sequestration (category under discussion)		
	○ CO2 uptake in concrete structures ○ CO2 storage in concrete structures ○ Other solutions	

REQUIRED INFORMATION TO BE PROVIDED FOR EACH EXAMPLE (MAX 4 PAGES)

1 **Case description**
- Opening statement : outline the specific role of innovative solution in achieving project goals, include relevant images and relevant details such as project name, type of application, timeline, budget, and any unique features incl. environmental, economic and social benefit highlighs.
- Detail overview of the project, including relevant details such as:
  - objectives, location, and key stakeholders
  - scope of the project, including primary objectives of the project and the type of structure (e.g., bridge, building, infrastructure)
  - relevant demands such as sustainability goals and structural performance requirements
  - information on the structural configuration of the project, including key engineering considerations, load-bearing requirements, and any unique design challenges addressed by the choice of innovative solution.

2 **Suitability Enhancement Rationale**
- specific role of innovative solution in achieving project goals incl. explanation on how innovative solution is integrated into the structural design (or construction) of the project.
- specify the unique characteristics of the innovative solution selected for the project and explain how these characteristics enhance the suitability for the specific application.
- provide evidence, such as test results or industry benchmarks, supporting the choice of innovative solution.

3 **Environmental Impact Evaluation incl. Comparison with Traditional Solutions**
- provide information regarding environmental impact assessment (including scope and methodology of the analysis), considering factors such as embodied carbon, resource depletion, and water usage (if relevant) and highlighting specific environmental benefits or drawbacks
- compare the environmental performance of innovative concrete with that of traditional solutions, if possible supported by (reference to) quantitative data and metrics to support the assessment.

4 **Economic and Societal Considerations incl. Comparison with Traditional Solutions**
- analyze the economic implications of using innovative solution, considering factors like material costs, construction efficiency, and long-term maintenance.
- assess societal benefits, such as improved aesthetics, hindrance reduction, health and safety etc.
- compare the costs and benefits of innovative solutions with traditional alternatives if possible supported by (reference to) case studies.

5 **Regulatory Compliance and Standards in the Project**
- provide a detailed account of how the project complies with local, national, and international regulations.
- identify any regulatory challenges faced during the implementation and describe the strategies employed for compliance.
- specify any deviations from standard industry practices and the rationale behind them.

6 **Potential for Upscaling Innovation**
- explore the scalability of the innovative solution beyond the current project
- identify potential applications in similar or different application and articulate the advantages and challenges
- discuss strategies for overcoming obstacles to upscaling