i3P Workshop – Obstacles to Use of Cement Replacement Types

1. Code and Standards Development Obstacles

- We can only specify new materials when we have a body of evidence of performance. Inclusion in standards updates is the simplest way to do this. For instance BS8500 recent update (issued 2019) specifically allows the use of some new cement replacements, natural and calcined pozzolans. Much well-meaning and sound academic research into alternative cementitious materials never makes it as far as the standardization process.

- Cement EN standards already allow 27 types of cementitious material (EN197) but UK industry practice required a new product standard, BS 8615, and a BS8500 update.

- Standards updates are usually driven by industry interest groups and do not always reflect a broader view of sustainable development. We need focussed R&D effort to get new materials accepted with levels of evidence sufficient for major infrastructure client asset engineers and experts to accept.

- If the designers go beyond standards, then there are problems with risk acceptance. Few design engineers will have the relevant detailed technical knowledge.

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2. Designer Training and Awareness Obstacles

- Designers do not always understand the drivers for specification of cement replacements. We have come across cases of over-specification through lack of knowledge of the options.

- Similar problems occur with emerging materials issues such as problems with galvanized steel cracking, which are only recently being publicised and should be addressed through better specification.

- GGBS may appear to be a panacea for cement replacement but if the transport carbon is factored in for shipping it from Asia, a substantial part of the carbon saving could be negated. We need carbon metrics that do not obscure these factors. The origin of materials such as ggbs is typically not declared by the supplier.

i3P Workshop – Opportunities for Cement Replacement

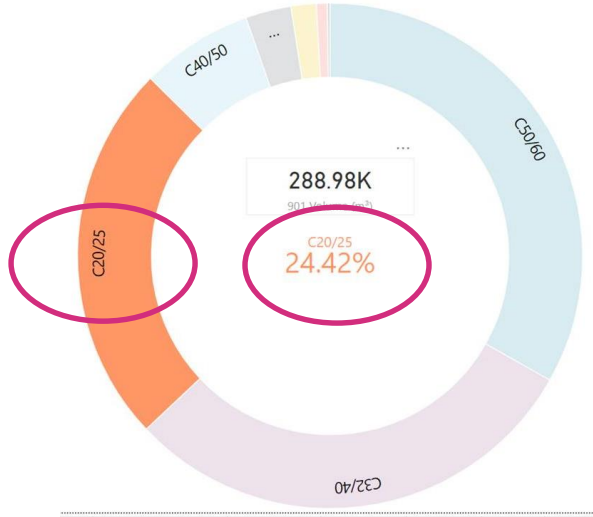
3. HS2 Example: picking up where Crossrail left off

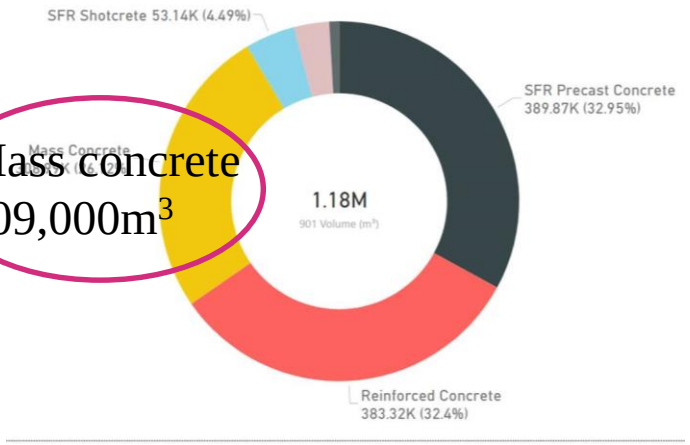
- Attempts to use calcined clay from excavated spoil to produce a cement replacement have not yet been shown to meet structural concrete standards.

- Although London Clay is known to be relatively low-kaolin content, not all infrastructure concrete is high strength. An HS2 innovation project proposed by SCS with DH seeks to trial the use of London Clay TBM spoil to make calcined product on site with a portable production facility. If successful this will demonstrate feasibility at local scale for grade C16/20 concrete and will minimise transport carbon costs for site-batching.

- HS2 MWCC contract requires 309,000m^3 of mass concrete. Therefore we are targeting cement replacement based on prototype tests of MASS CONCRETE produced LOCALLY.

BIM Quantities Report HS2 MWCC from SCS / Design House team





Mass concrete 309,000m^3

REAL Re-purposed Excavation Arisings Loop

Phase 1

Material feasibility study

- *Calcined clay as cementitious material and cement substitute*
- *Clay Light Weight Aggregate(LWA)*

Production of material samples and appropriate testing

Main activities/work packages

- Acquisition of excavated material (London Clay): as dug, conditioned, post-treated
- Preliminary raw material preparation/characterisation
- Set out material production process
- Set out & agree testing methodology
- Set up material production facility
- Material fabrication
- Chemical, physical & further technical testing
- Collation & assessment of testing results / compliance with relevant standards

Phase 2

Concrete feasibility study

- *Different concrete mixes containing the calcined clay and/or LWA produced from spoil*

Concrete prototype fabrication and testing

Main activities/work packages

- Specify mix designs to be produced & tested
- Set up concrete prototype facility
- Calcined clay and/or LWA production to sufficient quantities
- Fabrication of concrete prototypes
- Chemical, physical & further technical testing
- Batching plant / site testing for workability, etc.
- Collation & assessment of testing results / compliance with relevant standards

Phase 3

Concrete trialling

- *Pilot application in structures*

Incorporate and monitor the novel concrete mixes into low risk assets/works

Main activities/work packages

- Identify areas of potential application for the concrete mixes produced within SCS works
- Engage with Arup & SCS delivery team to design in and de-risk the novel concrete mixes
- Production of sufficient amounts of novel concrete mixes to be trialled
- Incorporate novel concrete into the selected structures/components; also precast elements to be considered
- Set up framework for monitoring and data collection over time
- Collation & assessment of monitoring results