



Reduced Carbon Concrete

A47 Tuddenham & Blofield

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Knowledge/Case Study Type:

Quality, Efficiency & Improvement



Environment, Sustainability & Carbon



Engineering & Design



Key Points:

Reduction in carbon emissions when using concrete for ancillary working

CHE MEMORANDUM 483/22 – MCHW Series 2600 Replacement of standardised prescribed ST type concrete with designated GEN/RC type concrete

Description

In 2021 National Highways set out their plan for Net Zero Highways which includes a commitment to net zero emissions from construction and maintenance activity by 2040. Galliford Try is committed to achieving this goal and is actively targeting the reduction of Carbon on all projects. Achieving this target will require significant reductions in emissions relating to the materials we use including concrete which is one of the principal materials for both construction and for carbon emissions.

On the A47 Tuddenham and Blofield projects, concrete will be used in structures and ancillary activities. There are a wide array of mix types specified in the design. This case study focusses on ancillary concrete.

Action

MCHW Clause 2602 'Concrete for Ancillary Purposes' specifies that when concrete is required for ancillary applications, a standardised prescribed concrete (ST type) shall be used that complies with BS EN 206 *Concrete. Specification, performance, production and conformity*, and BS 8500 *Concrete – Complementary British Standard to BS EN 206*.

Concrete for ancillary purposes is generally mass concrete without steel reinforcement.

ST type concretes come in five grades (ST1 to ST5) of 'set' mix design and are specified because of their ease of use. BS 8500 includes a table listing typical quantities of concrete constituents for each grade. The amount of cement in each grade of ST type concrete is higher than what would be necessary to achieve the specified strength for that grade

Since 2004, suppliers of concrete for structural and ancillary purposes have been required to be certified via product certification schemes.

References in the MCHW to 'Clause 2602' or different grades of ST concrete occur many times, e.g. in Volume 1, Specification for Highway Works, Series 300, 400, 500, 600, 1100, 1200, 1300, 1400, 1500 and 2500, MCHW Volume 3 Highway Construction Details and MCHW Volume 5 Ground Investigation.

The proposed alternative to ST concretes is BS 8500 designated GEN or RC concretes, which have a tighter mix design compared with standardised prescribed ST concretes and require comparatively less cement in the mix to achieve the same strength. There is a small associated risk of concrete not achieving the expected strength, but as the MCHW specification (sub-clause 104.12 and Appendix B) requires concrete suppliers to be certificated by a recognised product certification scheme, the probability of non-conformance is very low. On our projects Galliford Try has a specialist Subcontract testing facility which is UKAS accredited for testing of concrete which is used to verify compliance.

The preferred designated GEN/RC concretes equivalent to ST concretes listed in the table below, have been chosen to ensure durability is not adversely affected.

Galliford Try Materials team with support from our specialist Low Carbon Manager, proposed to the Project Designer, a change from ST mixes to Gen mixes for the ancillary concrete to achieve a significant reduction of carbon across the projects. Table 1 below identifies the cement reduction by equivalent mix.

Table 1: Use of preferred designated concrete mixes

Concrete for Ancillary Purposes Purpose	Preferred designated concrete	Alternative standardised prescribed concrete
1 Footings for fence posts and augered foundations for traffic sign posts	GEN 2 200	ST2/ST3 265-300 / 295-345
2 Foundations for environmental barrier posts, and planted lighting columns; foundations for non-proprietary VRS safety barrier posts and end anchorages.	RC20/25 240	ST5 375-415
3 Blinding concrete, backfill for structural foundations, overdig of post holes and preparation of formation to Clause 616	GEN1 180	ST1 230-265
4 Bedding and backing to precast concrete kerbs, channels, edgings and quadrants	GEN1 180	ST1 230-265
5 Bed to drains Type A #. Foundations, channels and benching to chambers	GEN3 220	ST4 330-380
6 Bed, haunch and surround to drains other than Type A #. Surround to chambers and gullies	GEN2 200	ST2 265-300

Notes:

- Based on BS8500-2:2015 and assuming 20mm aggregate:
- ST Concretes - Cement or Combination kg/m³. Range to cover S1/S2 – S4. Table 10
- Designated Concretes – Min Cement or Combination kg/m³. Default slump S3 – Table 6
- Highlighted in yellow are cement contents as kg/m³.



Table 2 below provides details of the environmental saving through carbon reduction and the nominal commercial benefit. Table 3 details the embodied carbon for prescribed and designated mixes.

As demonstrated, significant carbon savings and nominal cost savings can be achieved by implementing the CHE memo referenced above across the A47 National Highways schemes. This

action can be transferred across most projects.

Note that the National Highways embodied carbon factors (ECFs) and ICE database default ECFs for both ST and GEN mixes do not accurately reflect the cementitious contents in these mixes. To evidence the carbon reduction in moving to GEN mixes, the ICE ECFs based on cementitious content should be used.

Table 2 Summary of Carbon and Cost saving switching from ST to GEN mixes

	A47 Blofield	A47 North Tuddenham	A47 Wansford	total
Carbon saving (tCO2e)	170.256	429.175	172.006	755
cost saving (£)	£2,680.460	£8,036.060	£3,235.100	£13,951.620

Table 3: Embodied Carbon Factors for concrete prescribed and designated mixes

Concrete Mix (in accordance with BS 8500-2:2023)	Cement Content (kg/m3)	Embodied carbon factor (tCO2e/t)
GEN0	120	0.060
GEN1	180	0.083
GEN2	200	0.091
GEN3	220	0.099
RC20/25	240	0.106
ST1	230	0.1025
ST2	265	0.114
ST3	295	0.13
ST4	330	0.1415
ST5	375	0.161

Result

As demonstrated, significant carbon savings and nominal cost savings can be achieved by implementing the CHE memo referenced above across the A47 National Highways schemes. This action can be transferred across most projects.

To put the saving into perspective 755 tCO₂e is a huge saving, with a return flight to New York producing around 1tCO₂e.

Transfer

The design change is appropriate for most projects where ST mix design is specified for ancillary concretes. Galliford Try central resource is available to help achieve our business goals. For more details please contact:

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