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Our Reference : PE/CH/D116285/SMR

Date: 4th April 2008

For the attention of Mr C Holloway

Dear Sir,

A27 Bridge Road, Sarisbury Green, Gas Pipeline
Long term monitoring and testing of SMR treated trench arisings

Introduction

Scott Wilson Ltd (SW) were commissioned by Sustainable Aggregates Ltd to undertake in situ performance testing of the gas pipeline trench reinstatement on the A27, Bridge Road, Sarisbury Green. The SW testing regime was specifically targeted at establishing the performance of the SMR treated trench arisings, utilised as a Non Flowable Structural Reinstatement Material (NFSMR). NFSMR are classified as an Alternative Reinstatement Material (ARM) within the Specification for Reinstatement of Openings in Highways (2002). General observations on the condition of the trench reinstatement are included for completeness.

Background

The trench reinstatement works were undertaken in August 2005. Site details, based upon information provided by Southern Gas Networks and SMR Ltd, are given in Table 1.

Table 1 Site details

Details	Site specifics
Type of trial site	Routine utility excavation
Nature of trial site	Joint evaluation exercise with Hampshire County Council
Location of site trial	A27, Bridge Road, Sarisbury Green: Type 2 Road classification
Positioning	Outside wheel path of lane 1 (westbound) – uphill section of road
ARM trialled	NFSMR in accordance with Appendix 9 of the SROH (2002), overlain by a total of 280 mm of bituminous bound materials.
ARM details	Recycled trench arisings treated with minimum of 2.5 bags of SMR per cubic metre. Compaction within 48 hours of mixing. Production and placement (including compaction) supported by a quality control process.

Details of the testing undertaken during the trench reinstatement works follow:

- The compliance testing reported by Hampshire County Council (e-mail dated 10/11/05) recorded 90 day compressive strength which classified the material as a C2 NFSMR (90 day cube value in excess of 2 N/mm^2). To achieve this on site, compaction to a minimum in situ relative density of 95% was required.
- The mean in situ compaction test data sets from site were a relative density of 95%, with individual results ranging between 90 to 101%.
- German Dynamic Plate (a measurement of surface stiffness) results ranged between 15 and 122 MPa.

The interim conclusions, based upon the 90 day strength (specification compliance testing) and in situ performance testing, was that the material appeared adequate for purpose as subbase within a Type 2 carriageway, but that performance would need to be monitored over time to give assurance of performance as a base layer. Approval of SMR treated arisings for reinstatement of utility openings, as a C2 NFSMR, was given on this basis (letter from Hampshire County Council dated 6th March 2006).

The 2008 SW investigative works were designed to assess the in situ performance of the SMR, with a view to informing the assessment of its use as a base layer within a Type 2 carriageway.

Performance monitoring in 2008

A visual assessment was undertaken to select representative sections of trench reinstatement, to be targeted by the intrusive works. The focus for the works was on the area previously assessed during the reinstatement works, where in situ performance testing was referenced from lamp posts 603 to 606.

Appendix A contains photographs taken during the site walkover (Plates 1 to 3).

This visual assessment did not comprise a full visual survey of the works, it was undertaken by a pavement engineer and the general comments noted are:

- General pavement condition:
    - Localised widely spaced (around 6 m) minor cracks noted, perpendicular to the road (Plate 2) and not extending into the trench reinstatement.
    - Localised rutting within lane 1 nearside wheel path, with associated minor cracks (Plate 3).
- Trench reinstatement:
    - Localised loss of surface sealant and associated minor cracking between surface layer of the trench reinstatement and the adjacent pavement (top right of Plate 3).
    - No rutting or settlement observed.
    - No cracking or surface deformation of the trench reinstatement material observed.

Three test locations were selected. Locations L1 and L2 were selected to be generally representative for the trench reinstatement (within the area of interest). Location L3 was selected adjacent to an area where localised loss of surface sealant was noted. Although not

an issue directly related to the performance of the stabilised material, this would give an indication of variation in performance.

At each location, the intrusive works, undertaken with appropriate traffic management in place, comprised the following operations:

1. 450 mm diameter air coring and removal of the upper bituminous bound layers.
2. Visual assessment of the exposed SMR stabilised base layer surface.
3. In situ testing directly onto the SMR stabilised base layer surface.

Coring into the SMR stabilised base layer had been provisionally allowed for; however, the permit to dig criteria could not be satisfied for safe working above the gas main. Therefore, each location was reinstated upon completion of the in situ testing.

The in situ testing comprised the following test devices:

- German Dynamic Plate (GDP) – this device was developed for testing crushed rock materials, it measures a surface stiffness modulus and was included to provide a comparison with the initial testing undertaken during the trench reinstatement works (August 2005).
- Light Weight Deflectometer (LWD) testing (utilising a Prima) – this device is similar to the GDP; however, it is capable of testing a wider range of materials and it was included since it is the test adopted by the Highway Agency guidance for performance testing of pavement foundation materials (IAN73/HD25, 2006). Testing was undertaken to target a peak stress of 100 MPa, unless the targeted deflection fell outside the range 100 to 1000 microns, in which case the applied stress was increased to achieve a measurable deflection. Surface stiffness modulus was determined in accordance with the Highway Agency guidance (IAN73/HD25, 2006) and reported in MPa. It is a direct measurement of the materials capability to support the overlying layers.
- Clegg impactor soil tester – although not a performance test, it was included to give an indication of performance related to California Bearing Ratio (CBR).

The test data sets are given in Table 2. The following observations were made during the works:

- The bond between the SMR and bottom of bituminous bound layer in Location L1 required a mechanical breaker to facilitate removal of the core.
- The bituminous bound layers displayed no evidence of deformation or voids (related to inadequate compaction).
- The SMR surface layers did not display any evidence of cracking, heave or deterioration.
- No free water was evident in any of the core holes.
- The SMR exposed in Location 3 displayed evidence (the material was darker in colour) of having higher water content than Locations L1 and L2. This may be related to the localised loss of surface sealant.

Table 2 Site data sets

Test location	In situ test			Plates
	GDP (MPa)	LWD (MPa)	Clegg CBR (%)	
L1	Stiffness exceeded the GDP test apparatus working range*	970	140 (123 to 163)	
L2		2700	>237 (237 to abort*)	
L3		310	45 (43 to 46)	

Key: * = materials were outside the working range (too stiff) for the test device. Duplicate Clegg testing was undertaken, the range, minimum and maximum, data sets are shown in brackets underneath the mean value.

Conclusions

The visual performance of the SMR as a base layer (with 280 mm of bituminous overlay) appears acceptable. No visual defect related to the SMR were observed and the location of the trench reinstatement, within the wheel path of what appears to be a relatively heavily trafficked up hill section of road, gives confidence in the mechanical performance of the material.

Confirmatory testing indicates a significant improvement, as would be expected from a material which gains strength/stiffness over time, from the initial testing undertaken in 2005. Comparative long term surface modulus values (assuming the material is durable) for a C4 NFSMR (90 day cube value in excess of 4 N/mm^2) and Type 1/GSB1 would respectively be around 400 MPa and 120 MPa. These values are guidance only as testing and environmental conditions will influence performance. Where the SMR recorded a surface modulus value of below 400 MPa (310 MPa was recorded in L3), evidence of increased water content was observed (given an indication of a worse case scenario). The absence of slurifcation or any other sign of deterioration indicates that the SMR has proved durable and that rectification of the surface defect would ensure subsequent performance as a base.

In short, the SMR has performed adequately as base layer within a Type 2 road. The output from this site trial, in terms of application to another site, must be taken in the context of the associated production and placement control. Aspects such as material compaction are critical to ensuring durability and long term performance.

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APPENDIX A

Plate 1: View uphill (east bound)

Plate 2: View down hill (west bound)

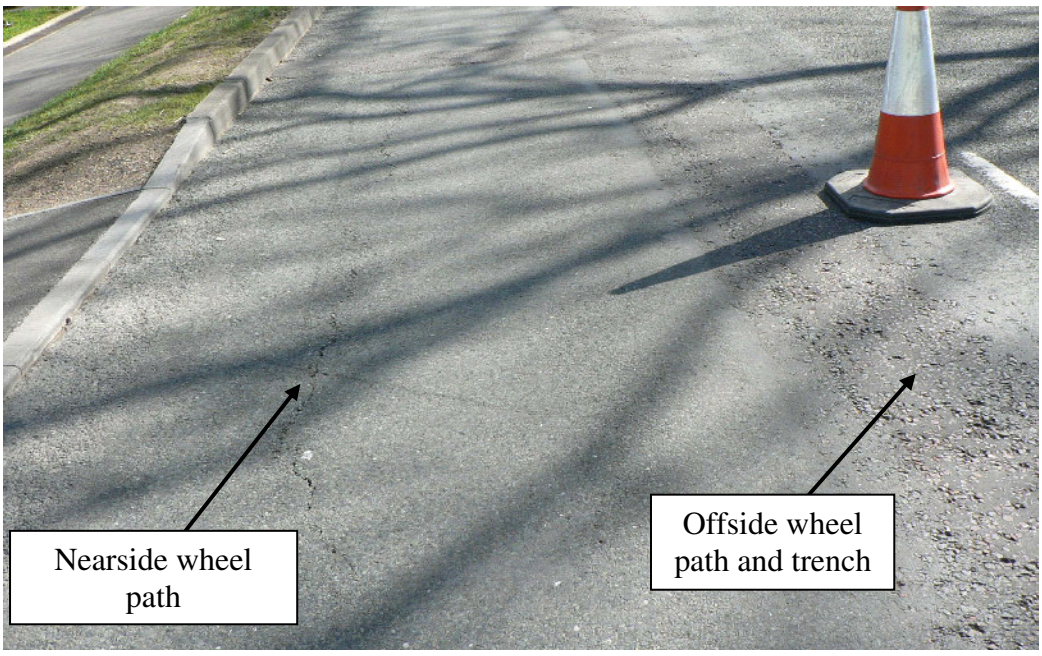

Plate 3: Close up view of rutting and minor cracking in nearside wheel path