

C27 Holdiford Road, Tixall, Staffordshire The use of FABM for road-haunch reconstruction

Introduction

Close to Stafford, Holdiford road at Tixall is a narrow, approximately 5.5m wide, rural road with field and property accesses, and canal and river Trent bridges. It is a canal bridge conservation area, which also falls with the Cannock Chase area of outstanding natural beauty.

The road required repair in Autumn 2008 consisting of structural 'edge-of-carriageway' reconstruction to a depth of 350mm utilising fly ash bound mixture (FABM) overlain with 80mm binder course (for subsequent surface dressing in 2009). Normally used for full width new or reconstruction work, this use of FABM highlights the versatility of the slow setting slow hardening mixture and its suitability for haunch repairs and other narrow works such as trench reinstatement.



The works were carried out by Enterprise Ltd using FABM from Wrekin Construction Ltd's central recycling hub at Rugeley Power Station. The FABM set-up at Rugeley is well established and is the main source of base and sub-base material for Staffordshire County Council. The FABM consists of recycled road arisings treated with fly ash (from the Power station) and lime. The arisings from the excavation works at Holdiford Road were fed into the 'aggregate' stock-pile at Rugeley.

FABM

The FABM type used at Holdiford Road was FABM 1 (T2 strength class) in accordance with the European Standard BSEN 14227-3.

FABM 1 has been used in Staffordshire since 1997 when it was first utilised for full width reconstruction works on the A52 at Kingsley Bank between Froghall and Kingsley. At that time, which was before the advent of European standards, the HBM was known as GFA (Granular material treated by Fly Ash). From that initial use, GFA went on to be utilised in 1998/99 in the Ramsgate Relief road in Kent and then in 2000, back in Staffordshire, for the Burntwood Bypass. This was Wrekin Construction's first experience of the mixture, which subsequently led to Wrekin establishing their permanent FABM facility at Rugeley Power Station in 2003. This facility, where FABM can be sourced on a ready-mixed basis, has become the first choice sub-base and base material for new-build and reconstruction works in Staffordshire. At the end of 2008, in excess of 50 works/schemes in Staffordshire had utilised the FABM from Rugeley Power Station.

The set-up at Rugeley operates as a central-recycling facility where pavement (and other) arisings from Staffordshire are taken for processing for re-use as aggregate for Wrekin's FABM 1. The mixture proportions employed at Rugeley are;

- 85% recycled aggregate + 12% fly ash + 3% quick lime (CaO).

Following 12 years of Staffordshire experience, these proportions have remained constant since performance continues to be excellent, the price is right, and the FABM meets the County's 'green agenda'. This set-up allows Staffordshire to reuse their arisings as aggregate and their local industrial by-product (fly ash ex Rugeley Power Station) as binder to produce a superior 'bound' paving material that has satisfied and continues to satisfy their county road sub-base and base requirements. This was the material that was used at Holdiford Road..



In accordance with BS EN 14227-3, Wrekin's FABM 1 realises compressive strength class C5/6 / C6/8 or tensile strength / elastic modulus class T2, which is then used for thickness design purposes utilising UKQAA recommendations (refer to Annex).

The challenge at Holdiford Road

The deterioration at Holdiford Road presented Staffordshire County Council's Area Engineer Simon Johnson with a challenging maintenance scenario, which was satisfied by the FABM 1 from Rugeley Power Station. In Simon's paraphrased words;

- The existing deteriorated road profile showed approximately 500mm of overrun of the verge with 500-700mm deterioration/breaking-up of the edge of the existing carriageway. The remainder of the carriageway was in good condition.
- From routine safety inspections, the deterioration meant that the county had regularly to carry out ad hoc patching/make-safe programs of work. Such was the frequency of this work and the continuing disruption that resulted, Staffordshire decided that a permanent solution was necessary.
- A robust approach was necessary to determine the depth of statutory undertaker's apparatus. For this scheme it had a bearing on the design depth of construction due to a cast iron gas main running longitudinally for a partial stretch of the scheme and the shallow depth of some of the service connections to properties.
- Design options considered included either conventional edge reconstruction utilising excavators/capping/type1 etc, but it was estimated for the size of scheme this operation could have taken in excess of 12 weeks to complete under a road closure, or an overlay but this would have still meant the improvement/reconstruction of the overrun verge/edge deterioration.
- It was necessary to undertake a thorough investigation of the material below the existing black layers within the proposed reconstruction depth. For this scheme, Phil Cartmail of Staffordshire's County laboratory carried out a number of cores, which classified the material below the black as a Class A fill material (sandy gravel) which Staffordshire were able to feed into the FABM aggregate stock-pile at Rugeley. If the material had been of a poorer type then there could have been a major cost incurred in its disposal but its suitability for re-use in FABM was an important factor.

- Although the process of edge reconstruction is a relatively expensive operation per linear metre, for this scheme the process using FABM was probably the only viable option for rectifying the problem. The approach adopted not only reduced disruption time to the public - the works took 18 days to complete - but also envisaged to be, per linear metre, cheaper than the conventional approach to edge reconstruction. In short this approach was the correct “horses-for-courses” treatment at this location.



- Design details for the pavement design are shown in Annex A.

Construction

Using Staffordshire's records;

- The works were undertaken during September and October 2008.
- The main edge of carriageway reconstruction works were carried out under a road closure, with some minor kerbing works prior to closure, under traffic signals.
- The existing construction was removed using a 1m wide planer, which entailed 4 cuts (2 for the removal of the existing black/verge to a depth of 80mm and approximate width of 1.35m, and 2 cuts for the removal of the rest of the depth for the new construction to a width of approximately 1.2m).
- The minimum width of treatment of 1.35m for the asphalt and 1.2m for the FABM for the remainder of the reconstruction, allowed for a 150mm joint between the asphalt and FABM. The 1.2m width was arrived at as the minimum width for a mini-paver to be able to work in and also to gain the best ride quality on the asphalt surface. The paver was loaded utilising 5t dumpers.
- The scheme was carried out in approximately 300 to 400m bay length's, completing one side of the road prior to commencing on the other side, the asphalt was generally laid either the second or third day after the FABM was laid. The road was not opened to full trafficking until the works were completed, although access was allowed for local residents and site traffic.
- The 270mm FABM was laid in two equal lifts.
- The length of the scheme was approximately 1050m long with both sides of the road requiring edge reconstruction to the majority of this length.
- There were areas where the depth of the reconstruction was reduced due to statutory undertakers apparatus (cast iron gas main) and some minor areas where patching only to a depth of 80mm was possible due to service connections to properties and near to the structures over the canal and river.
- The works aimed for plane-out and lay of approximately 100-150t per day.
- The works took 18 days to complete.

- On a couple of occasions, the 1m-tracked planer got stuck on the deeper cuts, which on one occasion required a crane to aid its removal. Dependant upon sub-grade material, a tracked type planer would be preferable when planning to these depths for edge reconstruction. No other problems were experienced.



ANNEX A: Staffordshire design details

Traffic count details:

24 hr 2 way count = 3100 all vehicles, total commercial vehicles = 67
 Thus commercial vehicles/lane/day = 35
 Assumed growth factor for 30 year design = 1.4
 Thus design commercial vehicle/lane/day = 49

Intranet mapping:

Maintenance category/traffic group = 4 (75-250 commercial vehicle/lane/day)
 This is equivalent to 1 – 3 million standard axles.
 From the traffic count data, 1 msa was assumed for design purposes.

In Staffordshire, the FABM pavement design was carried in accordance with UKQAA Technical data sheet 6.6 (2006)* (www.ukqaa.org) as follows;

For traffic category 0.5 – 2 msa and assuming 50 MPa stiffness on top of sandy gravel sub-grade, required design is:

- 80mm asphalt surfacing on 270mm FABM 1 (T2 class) •

There are service connections in the area being reconstructed.

At their locations, the depth of edge reconstruction was reduced to a depth of 80mm for a distance of 2m either side of the service.

* Note that designs have been updated although the 2006 recommendations are still relevant.

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In general usage the term 'fly ash' is used for pulverized coal ash but it can also cover ash from burning other materials. Such 'fly ash' may have significantly differing properties and may not offer the same advantages as ash from burning pulverized coal. UKQAA datasheets only refer to PFA / fly ash produced from the burning of predominantly coal in power stations.

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