

Factual Report and Design Information for Capping Replacement Ground Stabilisation using Lime and Cement

Adoptable Roads

Markham Park Bury St Edmonds

Design Information from **Norfolk Highways** in the form of highlighted lines on a SHW 600 Snippet.

643 (02/16) Lime and Cement Stabilisation to Form Capping

1 (02/16) Where capping is to consist of, either wholly or in part, lime and cement stabilised material **Class 9E or 9F**, this Clause shall apply to the construction of those parts which are stabilised with lime and cement.

2 (02/16) Material to be stabilised with lime and cement shall be **Class 6R or 7I** material all complying with **Clause 601 and Table 6/1.**

1. Clause 643 (02/16) Lime and Cement Stabilisation to Form Capping

This lays out the specification and controls that must be in place and the pre-testing required to prove the adopted mix etc. and provides Table 6/1 in regard to what testing that must be undertaken to prove both the type of materials being treated, which in turn would determine what the material classification actually is and which form of Class 9 material will actually be produced.

The **Class 6/7 material** is as such the intermediate state after the addition **Lime** and mellowing period, with the **Class 9 material** being the final state of the materials, after the initial addition of the Lime & then the **Cement**.

However, without a classification on the commencing materials it is currently unknown whether the materials at the intermediate state will be Class 6R/7F and or final state a Class 9E/9F, also without an Appendix 6/1, we cannot determine the rate of testing required and or the criteria for acceptance of these pre-treatment and post-treatment materials etc.

It is also very unclear whether the materials are being treated to provide a Capping replacement and or Subbase replacement as a full road section isn't provided. We need to understand whether the materials to be treated fall within or under the frost zone. This normally being the top 450mm of pavement construction being generally the Asphalt and Type 1 materials, and or potentially the capping material, which would then require such materials to be non-frost susceptible.

It has been mentioned that a target CBR of 30% is required, however, we would normally classify a capping layer as being 15% CBR and potentially frost susceptible (FS), a stone replacement layer (Type 1 replacement) as being 30% CBR and non-frost susceptible (NFS).

Also mentioned **2% Lime + 2% Cement** addition, however, we believe such a mix will provide a **Class 9 (NFS) material** and achieve a **30% Soaked CBR** as would generally be required for such materials.

The flinty Chalk does provide a very good base material

Undertaking the works in two layers of **150mm and 300mm, with overall depth of 450mm**, we believe it better that the works are done in **2 x 225mm** layer as this maximises both the mixing and compaction effectiveness in both layers, unless of course it is expected that the lower and upper layers are to be different in some way in terms of CBR etc.

Please note it would normally take between 45 – 50 days to get samples, undertake Total Potential Sulphate testing (TPS), classifications, Atterberg's, MDD, optimum moisture checks etc. and to then undertake appropriate mix tests with varying binder %'s to determine the correct mix to be used, traditionally initial results would be available after 7 / 10 days however the soaked CBR's take 28 days after the final tests are started. Also, once the final mix has been determined, materials also need to be sent away to 3rd party lab to undertake frost heave testing, which can take between 40 – 45 days to complete. Whilst some works may be undertaken at risk on certain projects, on an adopted highway we believe all test results will be needed before the actual mix can be signed off and the works on site allowed to proceed. This unfortunately will put the period for construction squarely in the middle of Winter.

The client also mentions the following:

1. **Cl882 testing shall be carried out on the formation to prove the short-term stiffness values of the formation are at or about the long term values**
 - JJ Mac would have **no control over this**, if the stiffness values are lower than expected what remedy is expected by the client and or design?
2. **Where lime is used, the lime will be allowed to mellow for 24hrs before the cement is added**
 - With modern mixing plant the mellowing process is generally much quicker and can be as low as 2 hours especially in granular type clays.
3. **The Cement bound materials shall be mixed, laid, and compacted within their allowable working window as laid in out in the specification of highway works or BS9227**
 - This generally equates to adding, mixing, and compacting each layer **after the final cement addition within 2 hours max.**
4. **The capping layer shall not have the next layer added till it has either been left for 7 days, or LWD measurements meet the requirements for a Capping Layer class 1**
 - This delay of being able to place one layer on top of the other will of course affect the programme of the works and needs to be allowed for in terms of potential mob & demob if insufficient works are available to provide continuity.
 - This will require a Tack Coat curing layer to be added to the top of the Stabilised layers to ensure the stabilised material cures correctly over the 7-day stand-off period.
 - It should be noted that granular stabilised soils have a very significant stiffness even after 24 hours and any additional layers are always pushed out on top of the underlying layer thereby eliminating any direct running on the treated layers, this acts as 225mm cushion / protection.
 - Also not delaying between layers ensures there is a homogeneous mix and eliminating any potential weak / porous interface between the layers.

5. ***It is proposed that Deflection testing in accordance with CL 885 of the Specification of Highway works is carried out on the capping layer before the sub-base is added***
 - *We assume from the above that the Deflection Testing can't potentially be undertaken for 7 days, as per item 4.*
 - *This will require a Tack Coat curing layer to be added on top of the top layer, prior to the Type 1 being placed.*
 - *In normal circumstances the Type 1 would be added immediately or following day to act as the curing mat.*

6. ***Cold weather working shall be carried out in accordance with CI813/13***
 - *This means the works will generally have to cease if temperatures drop to 3 degrees and below, frost is potentially forecast this coming week in some parts of the UK, so Winter Working rules will apply from now on until next spring.*

7. ***The goal is that a combination of a stabilised capping and type one place on top will achieve a class two foundation in line with Suffolk County councils' requirements before the asphalt is laid.***
 - *A Foundation Class 2 is required to achieve $\geq 100\text{MPa}$ – utilising a Capping Layer plus/or granular subbase material.*
 - *JJMac has no control over whether what they have been asked to provide will provide a bearing $>100\text{MPa}$*
 - *We assume that the depth of Asphalt and Type 1 has already been specified, though we are not in possession of this information.*
 - *Depth of construction of capping has been specified as 450mm. In two layers currently 1 x 300mm + 1 x 150mm layer. Please see my note above on alternative layer depths 2 x 225mm.*
 - *Target CBR 30% has been specified.*
 - *JJMac can only control the number of products they add to achieve whatever the agreed CBR requirement sort by their client and whether NFS is achieved or not achieved.*
 - *JJMac has no control over commencing bearing, which has direct bearing on the actual depth of Capping necessary to achieve a Foundation Class 2 @ $\geq 100\text{MPa}$.*