Hampshire County Council

Universal Services Directorate

Technical Guidance Note
TG6-1 - Pavement Foundation Design

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Amendments are indicated by a bar in the left hand margin

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1. Policy / approach

1.1. Overview

1.1.1. The policies adopted by Hampshire County Council look to deliver road pavement foundations that provide resilience and minimise the maintenance requirements of the entire road pavement during their design life.

1.1.2. Design Standards are used to ensure a consistent approach to pavement foundation design and future maintenance. Within Hampshire these include:

- Design Manual for Roads and Bridges (DMRB)
- Manual of Contract Documents for Highway Works
- Specification for Highway Works
- Hampshire County Council's Highway Construction Standard Details
- Notes for Guidance on the use of the County Council's Series 11 Standard Detail Drawings
- Hampshire County Council's Technical Guidance Notes (TGs)

1.1.3. The TGs identify which elements of the DMRB are to be applied within Hampshire, as well as detail any other design standards / requirements that apply. They also include wider design guidance, detail any processes to be followed and link to the County Council's Material Use and Commuted Sum Policies. The relevant TGs associated with the design of pavement foundations are detailed in section 3.

1.1.4. A design that does not comply with the Design Standards as required/detailed in this TG (this includes any cross reference to DMRB or other published standards), will require a departure from standard (DfS) in accordance with Technical Guidance Note TG17 - Departures from Standard for each element of the design that does not comply. There is no guarantee that a DfS will be granted and until the outcome is received, the design will be progressing at risk.

1.2. The design and construction of durable pavement foundations

1.2.1. The six essential elements required for the design and construction of a durable pavement foundation are:

- the nature and condition of the site through intrusive investigation
- an assessment of predicted traffic that the pavement will or has carried during its life
- the subgrade on which the pavement foundation is to be constructed
- the design of the foundation itself
- the materials from which the pavement is to be constructed
- the effective construction of the foundation and pavement

These six elements all play a part in the design and long-term life of a pavement's foundation, further details of which covered in this TG.

1.2.2. When designing pavement foundations, preference should be given to using recyclable materials with lower whole life carbon.

1.2.3. Within Hampshire, Restricted Foundation Designs are generally used rather than Performance Foundation Designs – refer to section 4.10. With Restricted Foundation Designs, the capping and subbase materials are compacted using method compaction and as such don't require to be tested for surface modulus at the top of each layer. However, where Hampshire County Council officers are not in attendance to confirm the method compaction has been undertaken effectively or where there is evidence of a lack of compaction/other concerns about the placement of the material, testing shall be undertaken on the top of the capping and/or subbase layer using either plate bearing or Dynamic Cone Penetrometer as detailed in section 7.9.

2. Definitions & abbreviations

CBGM	Cement Bound Granular Mixture
CBR	California Bearing Ratio
CSSM	Construction Subgrade Surface Modulus
DCP	Dynamic Cone Penetrometer
Departure from standard (DfS)	A non-compliance with a mandatory requirement of a standard, as set out in Hampshire County Council's Technical Guidance Notes or other policy/standard document cross-referred to from the Technical Guidance Notes.
DMRB	Design Manual for Roads and Bridges
Design organisation	Any organisation, including in-house County Council resources, undertaking the design of works that affect any part of the highway network. Such works include private and public developments.
DSSM	Design Subgrade Surface Modulus
EA	Environment Agency
Formation	Level upon which subbase is placed
Foundation	All materials up to and including subbase
FWD	Falling Weight Deflectometer
FSM	Foundation Surface Modulus
HBGM	Hydraulically Bound Granular Mixture
HBM	Hydraulically Bound Mixture
HSS	Hydraulically Stabilised Soils
IBAA	Incinerator Bottom Ash Aggregate
IDD	Intact Dry Density
Legal requirement	A statement in a standard that is associated with the words "must" or "must not". Legal requirements cannot be departed from or relaxed.
LWD	Lightweight Deflectometer
Mandatory requirement	A statement in a standard with the words "shall" or "shall not"
MCHW	Manual of Contract Documents for Highway Works
MPa	MegaPascal (unit of surface modulus)
NH	National Highways
PFD	Performance Foundation Designs

PI	Plasticity Index
RFD	Restricted Foundation Designs
SHRB	Soil treated by Hydraulic Road Binder
SHW	Specification for Highway Works. The Specification for Highway Works is published as Volume 1 of the MCHW.
TG	Technical Guidance Note - A suite of notes detailing what the adoptable standards are for Hampshire County Council's local Highway network.

3. Additional guidance

3.1. The following documents and publications are to be reviewed when preparing to design a pavement foundation:

Design Manual for Roads and Bridges

- CD 224 - Traffic Assessment
- CD 225 - Design for New Pavement Foundations
- CD 226 - Design for New Pavement Construction
- CD 227 – Design for Pavement Maintenance
- CD 229 – Data for Pavement Assessment
- CG 501 - Design of Highway Drainage Systems
- CD 524 - Edge of Pavement Details

Manual of Contract Documents for Highway Works

Guidance Document for Carriageway Surfacing Options

TRL Report - LR1132

Technical Guidance Notes

- TG5 – Geotechnical Investigation, Testing and Design
- TG6-2 - Flexible and Rigid Pavement Design
- TG6-3 - Modular Pavement Design
- ITG6-4 – Permeable Paving
- TG8-1 - Drainage - General
- TG8-2 - Drainage - Infiltration
- TG17 - Departures from Standard

Highway Construction Standard Details

Notes for Guidance on the Highway Construction Standard Details

Hampshire County Council's Commuted Sums Policy

4. Technical requirements

4.1. General

4.1.1. This TG covers the requirements for the design of new pavement foundation, as well as foundations for the widening and maintenance of existing pavements. Details of the foundation design for permeable pavements are covered within TG6-4 – Permeable Paving.

4.2. Pavement foundations

4.2.1. The main purpose of a pavement's foundation is to:

- protect the subgrade against the effects of the environment
- provide a platform on which to construct the pavement
- provide support to the overlying pavement throughout its design life by controlling traffic induced stresses within the pavement

4.2.2. A 40-year design period without structural maintenance is generally considered as being the most economical solution for all new, widened and maintained pavements. Therefore, unless a departure from standard has been agreed in advance, all pavements constructed within Hampshire shall have a design life of 40 years. The only exception to this is for maintenance schemes on evolved roads where the scheme brief/scope of works may only require resurfacing or haunching to a lesser value.

4.2.3. The failure of a pavement's foundation can be expensive to remedy because complete removal and reconstruction of the whole pavement is unavoidable. It is important to ensure that at each stage of construction the individual layers of the foundation are sufficiently robust to fulfil their purpose both during construction as a working platform, and to support all succeeding layers. This is essential in order to provide the performance that will last the life of the pavement so that maintenance operations can be confined to the surface layers only.

4.3. Subgrade surface modulus

4.3.1. Key to producing an acceptable pavement foundation is an understanding of the underlying geology and the existing ground conditions onto which the foundation is to be constructed. Determination of the subgrade surface modulus, especially at the sub-formation level in weaker soils, is crucial, with the choice of foundation materials having an influence on the overall pavement thickness.

4.4. Subgrade drainage

4.4.1. Excluding water from the subgrade, capping and subbase is vital both during construction and to maintain the life of the foundation and the pavement as a whole by removing and keeping water out of the road structure.

4.4.2. The subgrade (sub-surface) drainage requirements contained within previous design standards are not contained within CD 225, which focuses only on drainage paths, stressing the need for continuity of drainage within the foundation layers. However, further guidance on subgrade drainage can be found within CG 501 and CD 524.

4.4.3. Subgrade drainage is considered beneficial when the water table is high, irrespective of the nature of the subgrade. Drainage of the subbase may be omitted only if the underlying materials (capping, subgrade) are more permeable than the subbase, and the water table never approaches the underside of foundation closer than 300mm.

4.4.4. Subgrade drainage can be achieved by installing fin drains to Cl. 514 or narrow filter drains to Cl. 515. Wherever possible, the subgrade drainage should be kept separate from pavement run-off drainage. Narrow filter drains are a suitable alternative to fin drains. Unlike fin drains, they offer the opportunity for cleansing if chambers are installed at intervals, so may be more appropriate in areas of fine-grained soils.

4.4.5. Fin drains and narrow filter drains are provided to remove surface infiltration from the pavement layers, to prevent infiltration from shoulders, medians and verges into the pavement, and sometimes to cut off shallow groundwater seepage. They shall be installed contiguous with the pavement box, on each side where the carriageway is balanced and on the low side where it is superelevated.

4.4.6. Where an embankment is to be constructed on a soft subgrade, a granular aggregate drainage blanket, or starter layer, of Class 1C or 6B material (Series 600) of between 150mm and 220mm may be used. In order to stop pore clogging by fines from other adjacent layers, geosynthetic separators may be incorporated between the materials, with the drainage blanket treated as capping materials for design purposes. However, where a drainage blanket is used, the permeability shall be checked to ensure that water drains freely and does not act as a reservoir which could soften any adjacent moisture susceptible materials.

4.5. Edge of pavement details

4.5.1. The County Council's requirement is that all foundation and pavement layers are stepped at the edge on a 45-degree splay from the channel on a kerbed carriageway, and the base of the surface course layer for an un-kerbed carriageway or where the pavement has been over-widened to ensure full compaction where an extruded asphalt kerb is to be applied.

4.6. Widening of an existing pavement

4.6.1. Where widening of an existing pavement is required, the pavement and foundation of the existing carriageway adjacent to the proposed widening shall be assessed to establish the material type, condition, and the thickness of each layer. The proposed pavement may be thicker than the existing pavement, so the foundation proposals need to be carefully considered to ensure a continuity of subsurface water flow to avoid a 'sump' being created, as trapped water within the foundation could soften the subgrade leading to failure over time.

4.6.2. The design of the new foundation shall consider the following:

- use of materials to ensure lower whole life carbon emissions
- use of materials that do not inhibit the flow of subsurface water through the foundation
- layer thicknesses
- crossfalls

4.6.3. Where the existing subsurface drainage falls towards the existing pavement, the foundation within the widening shall fall in the opposite direction, away from the existing pavement, to avoid additional subsurface water contributing to the existing drainage paths. However, where the existing foundation falls towards the widening, the formation level within the widening shall either match or be lower than the existing formation level. Further information is provided within CD 225.

4.6.4. Pavement widening shall be a minimum of 1.3m wide to enable the haunch foundation to be compacted using plant indicated within Table 6/4 within SHW 600 Series. In order to place the joint between the wheel track zone, the existing surface and binder course shall be removed and formed in accordance with Cl. 903.29 to Cl. 903.41. Where a haunch narrower than 1.3m in width is proposed, part of the existing pavement may need to be removed to achieve this.

4.7. Modular pavement foundation design

4.7.1. Modular pavements will generally only be permitted where the gradient is less than 1 in 15. Where they are, the foundation shall be designed in accordance with CD 225 as a Class 2 foundation. Refer also to 4.13.

4.7.2. Where modular pavements, such as blocks or granite setts, are proposed, the proposals will need to be approved by the Highway Authority. Such proposals will attract a commuted sum. Further details on the design of modular pavements are provided within TG6-3 – Modular Pavement Design.

4.8. Design standard

4.8.1. CD 225 shall be used for the design of all flexible and rigid pavement foundations to be constructed within Hampshire.

4.8.2. CD 225 identifies two design approaches:

- Restricted Foundation Designs (RFD)
- Performance Foundation Designs (PFD)

4.9. Foundation classes

4.9.1. There are four associated foundation classes covering a range of stiffnesses, which are also used within CD 226 as part of the pavement design process. These are:

- Class 1 is a capping only design
- Class 2 either a subbase only or a subbase and capping design
- Classes 3 and 4 are designs typically incorporating cement or other hydraulically bound mixtures

4.9.2. Foundation Class 1 is not permitted for use within Hampshire.

4.10. Design approaches

4.10.1. The RFD approach offers assurance of performance. The design options are based on a limited selection of materials linked to an assumed performance which does not require verification via performance testing of the foundation. Within Hampshire, only Classes 2 or 3 are permitted for use in RFDs.

4.10.2. PFDs are only considered suitable where the proposed carriageway is to be of a sufficient length to deem it appropriate to undertake the required range of compliance testing. Finished levels are also a consideration and must be non-critical, as the remedy for a foundation that does not meet the required surface modulus (stiffness) is to increase the bound layers to compensate. This would preclude using PFDs for the reconstruction or widening of pavements within an area where maintaining existing threshold levels is essential.

4.10.3. As most new pavements constructed within Hampshire are generally small scale, of the two design approaches, the RFD is the preferred for pavement foundation designs.

4.11. Determination of Design Subgrade Surface Modulus

4.11.1. The Design Subgrade Surface Modulus (DSSM) is the stiffness modulus for foundation design within an area or length of a proposed carriageway. It is the lower of the short-term and long-term subgrade surface modulus. CD 225 states that short-term and long-term subgrade surface modulus are the estimated stiffness modulus for the subgrade during construction and then when a state of equilibrium is reached under the pavement. However, within Hampshire the DSSM shall be established by investigation. The short-term and long-term subgrade surface modulus, expressed in MPa, shall be determined for each area or length of proposed pavement. Where the desk study or site investigations identify a clay or silty subgrade, laboratory testing shall be undertaken, with the

lower value of the in-situ and laboratory testing used as the DSSM. Further advice is provided within section 5.

DSSM shall only be determined by investigation in advance of any construction commencing. The lower value of in-situ and laboratory testing results shall be used as the DSSM value.

For Information: CD 225 details that the DSSM be estimated, whereas Construction Subgrade Surface Modulus (CSSM) is to be determined by testing prior to construction works commencing. If the CSSM is found to be lower than the DSSM, then action is required by either improving the subgrade or by reviewing the DSSM with a view to redesigning using the lower value. Pavement foundation proposals could be significantly altered if the CSSM were found to be lower than the DSSM. This could lead to delays and increased cost, especially if the CSSM were to be determined to be lower than 30 MPa requiring improvements to the subgrade. If the DSSM is determined by site investigation and not estimated, this will be less likely.

4.11.2. The proposed DSSM, subbase thickness, and where required, capping proposals shall be approved by the Highway Authority **in advance of any construction commencing**. Should construction commence without prior approval, it shall be deemed that the works are progressing at the initiators risk, which may require removal and replacement if it is determined to be in any way inadequate.

4.12. Existing subgrade

4.12.1. Determining the nature and condition of the existing subgrade is essential, as well as its surface modulus (stiffness). For the purposes of improving or maintaining an existing carriageway and for new carriageways, investigations should be targeted at identifying the following:

- subgrade: material and condition, presence of ground water
- subbase and capping: materials, thicknesses and condition, presence of ground and surface water

4.12.2. Cl. 602 requires the contractor to keep excavations free of water during construction. This can be achieved by shaping the areas adjacent to the area around the pavement box to prevent water entering the earthworks from any source, which may require the provision of temporary watercourses, drains etc. Water entering the excavation should be lowered and maintained by appropriate measures such as pumping the water level in excavations, sufficiently to enable the permanent works to be constructed, and discharged into a permanent outfall with adequate means introduced for trapping silt on temporary systems discharging into permanent drainage systems. Fin, narrow filter drains and filter drains forming part of the permanent works shall not be used for this purpose.

4.13. Subgrade improvement

4.13.1. Foundations constructed on subgrades with a surface modulus ≤ 30 MPa have the potential risk of structural rutting during construction and use. Therefore, CD 225 does not include designs for such situations as they are considered unsuitable to support a pavement foundation. Instead, CD 225 requires weak subgrades to be permanently improved using one of the three methods:

- replacing between 500 to 1000 mm of the soft subgrade with granular fill
- mechanical stabilisation (see section 4.16 on the 'Use of Geotextiles and Geogrids')
- soil stabilisation

4.13.2. Recent amendments within the 800 Series of the SHW regarding soil stabilisation have changed the designations associated with Cl. 840, from soil treated by cement (SC), by slag (SS), by fly ash (SFA) or Soil Treated by Hydraulic Road Binder (SHRB), to generic Hydraulically Stabilised Soils (HSS). Permitted binder constituents, along with minimum binder or binder constituent additions are covered within Cl. 811. Further guidance on designing stabilised capping layers, as well as for fills and embankments are provided within BS EN 16907-4:2018, Earthworks - Part 4: Soil treatment with lime and/or hydraulic binders.

4.13.3. CD 225 states that the upper limit of the DSSM for areas with an 'improved' subgrade shall be deemed to be 50 MPa.

4.14. Chalk subgrades

4.14.1. The surface modulus of all chalk subgrades shall be determined. This, the classification, and the Intact Dry Density (IDD) of the chalk shall be determined from trial pitting/boreholes and laboratory testing.

4.15. Division of the site

4.15.1. CD 225 requires that a site with differing subgrade surface moduli be divided up and the pavement foundations designed separately. However, creating small areas with differing DSSMs should be avoided. Therefore, the site should be divided into practical areas or lengths for construction purposes. Advice on what constitutes a minimum area or length for division should be sought from a geotechnical engineer and approved by the Highway Authority.

4.15.2. Where differing subgrade surface moduli, and therefore differing foundation designs are required, these shall be indicated by area on pavement foundation drawings, differentiated by shading and the use of unique reference number. The referencing identifying the foundation and pavement design shall then be included within Schedule 1B of Appendix 7/1 within the contract Specification.

4.15.3. Where a single foundation design is proposed throughout the site, specific pavement foundation drawings will not be required, as the information can be incorporated within the pavement drawings. However, the area reference and details will still need to be indicated within Schedule 1B.

4.15.4. The division of the site by subgrade surface modulus shall be sensible to avoid constantly changing capping and / or subbase thicknesses. Therefore, based on CD 225, the following bands, which allow for minor variations in subgrade surface modulus, shall be used:

< 30MPa

≥ 30MPa to < 50 MPa

≥ 50 MPa to < 65 MPa

≥ 65 MPa to < 77 MPa

≥ 77 MPa to < 100 MPa

≥ 100 MPa

4.15.5. Where the MPa value falls mid-band, foundation designs shall be based on the lower MPa value for that band.

4.15.6. As there is little difference in capping and subbase layer thicknesses between bands above 50 MPa, the designer could consider merging bands to create a wider band (for example from ≥ 50 MPa to < 77 MPa) to avoid too many incremental changes in construction thickness. Again, the foundation designs shall be based on the lower MPa value for each band.

4.15.7. The nominal thicknesses for each foundation layer shall be rounded up to the nearest 10 mm in accordance with CD 225.

4.16. Use of geotextiles and geogrids

4.16.1. Geotextiles can be woven or non-woven earthworks separators which prevent pavement foundation materials from mixing with or ‘punching’ down into a soft subgrade, or subgrade materials from migrating up into a capping or subbase layer above. Whilst they also allow the passage of moisture, they do not provide any appreciable mechanical soil stabilisation. Whilst woven separators allowing greater permeability, they are not as efficient at filtration. They can also allow finer grained materials to pass through.

4.16.2. Geogrids on the other hand are polymeric products made from materials such as polyester, high-density polyethylene or polypropylene formed into intersecting grids by first punching and then stretching. They work by producing an interlock at the base of a capping or subbase layer. Only geogrids or geocomposites (geogrids with a non-woven geotextile laminated to the underside) provide sufficient mechanical soil stabilisation to be considered suitable for subgrade improvement.

4.16.3. The use of a geogrid needs to be considered carefully. Unless approved by the Highway Authority, a geogrid shall not be used where it would be installed above any utility plant, foul or highway drainage. This is to

prevent damage to the geogrid both during the pavement foundations construction and during its serviceable life.

4.16.4. When submitting a foundation design that includes geogrids or geocomposites, calculations shall be provided for the **site specific proposal** to demonstrate the benefits and justification of geogrid inclusion for the Highway Authority to review. There is no guarantee that proposals to include a geogrid will be considered acceptable to the Highway Authority.

4.16.5. Any excavation through a geogrid has to be repaired if it is to perform the function for which it was installed. Therefore, all sites where it is has been used shall be identified by the Highway Authority as a site of '**Special Construction Needs**' (Refer to TG24 – Scheme Handover to Asset Owners). In that way Statutory Undertakers and others will be made aware of its presence and will be held accountable if deformation or failure of the pavement occurs due to inadequate repair of a geogrid when reinstating their works.

4.17. Frost protection

4.17.1. The requirements of frost susceptibility should be considered in the overall pavement design. For routine cases, in accordance with Cl. 602.19, all material within 450mm of a carriageway's surface shall be constructed using non-frost susceptible materials (SHW Series 600 and tested according to with BS 812: Part 124, amended as given in sub-Clause 801.7).

4.17.2. Where the subgrade is frost susceptible, the overall construction thickness should not generally be less than 450mm, irrespective of the subgrade surface modulus. Where a site-specific frost index evaluation has been carried out (e-mail climate@metoffice.gov.uk quoting mean annual frost index (MAFI) – a fee is payable) it may be possible to justify reducing the minimum cover to 350mm. Further information can be obtained from TRL Report RR 45 - Winter air temperatures in relation to frost damage in roads (1986).

4.18. Consideration of trees

4.18.1. On subgrades classified as shrinkable clays (clays with a plasticity index between 20% and 40% are deemed medium shrinkable, clays with plasticity index >40% are highly shrinkable), the impact of potential volume change on a pavement's performance shall be assessed, particularly where there are existing trees or trees are to be planted within 10 metres of the carriageway or footway. Consideration should be given to planting tree species with a low water demand (avoiding elms, eucalyptus, hawthorn, oaks, poplars and willows which all have high water demand). A useful reference is NHBC's guidance on the effects of trees on shrinkable soils.

4.18.2. The removal of any mature trees within 10m of a proposed carriageway can also affect the subgrade. Whilst the water within the subgrade will not

be reduced during summer months the resultant ‘heave’ can continue for a number of years after the tree’s removal.

4.18.3. Where the risk of potential pavement damage is considered to be high, engineering measures shall be incorporated to overcome the problem. Such measures shall include tree root barriers / deflectors and / or geogrids incorporated as appropriate. All such measures shall be subject to the approval of the Highway Authority prior to the commencement of construction.

5. Investigation and testing

5.1. General

5.1.1. Undertaking adequate intrusive investigation is vital for determining the nature of the subgrade onto which a new pavement is to be constructed, or, for existing pavements, on which it has been constructed. This information will assist the designer to understand the ground conditions, and the foundation of any existing pavement, to inform design decisions. The latter is especially important for maintenance applications, as the vast majority of Hampshire's roads have evolved over time and have not been constructed using design standards.

5.1.2. Both in-situ and laboratory testing shall be undertaken by an independent UKAS or equivalent accredited body, approved by the Highway Authority.

5.2. Desk study

5.2.1. A desk study shall be undertaken to identify the likely ground-related hazards for further investigation to inform the in-situ and laboratory testing required. This, as stated in TG5, shall be undertaken in line with section 2 of BS 5930 and Appendix D of CD 622, with further guidance provided within BS EN 1997:2 – 2007.

5.2.2. For pavement foundations, amongst other things, the desk study shall determine the underlying geology by reviewing geological and other mapping. The EA's groundwater source protection zone mapping shall be reviewed, especially where infiltration is being considered as the method of drainage, and for all schemes where – unbound granular materials which include any percentage of IBAA are being considered as a foundation material (see 6.3.15 to 6.3.22 for further information).

5.2.3. Any planning conditions, including discharge requirements, should be considered as part of the desk study.

5.3. Change to the expression of subgrade strength

5.3.1. CD 225 does not include the use of CBRs as a means for expressing subgrade strength. Instead, subgrade surface modulus is now the only means, expressed in MPa. Therefore, CBR is no longer included within the design tables as a means to determine layer thickness, with MPa the only value used.

5.3.2. Where the in-situ assessment method used or laboratory testing produces result directly recorded or translated to a CBR value, the result shall then be converted into MPa using Equation 2.4 within CD 225 for design purposes (valid for CBRs in the range of 2 to 12% only). CBR is referred to within this document for these situations only.

5.4. In-situ subgrade testing

5.4.1. In-situ subgrade testing shall be undertaken using the Falling Weight Deflectometer (FWD) or Lightweight Deflectometer (LWD) as indicated in SHW Cl. 882. In addition, the Clegg hammer may also be used on smaller projects. A request to use Clegg hammer should be submitted to the Highway Authority at least two weeks before testing commences. The Dynamic Cone Penetrometer (DCP) shall not be used where the desk study predicts CBR values less than 10%, and especially where the subgrade is clay or silt, which are typically 5% (50 MPa) or less. As low strength soils are found across the majority of Hampshire, the DCP is unlikely to be suitable for subgrade measurement.

5.4.2. It should be noted that all in-situ subgrade test methods have flaws, such as user error, hitting a hard local feature such as flint or gravel which could affect the readings, or errors in interpreting the results. The season that the in-situ test takes place in can also influence results. For example, a dry summer versus a wet winter, with testing at the end of winter, when the subgrade is at its wettest, providing worst case results.

5.4.3. LWD is the preferred method of assessing subgrade surface modulus within Hampshire. The equipment shall be calibrated and tested in accordance with BS 1924-2. If a LWD is to be used, it is recommended that it shall first be calibrated against a pre-calibrated FWD on the specific site in question. However, as an alternative, a LWD that has participated in the annual correlation exercise and received a correction factor may be used, provided evidence of calibration and annual correlation is submitted to the Highway Authority prior to its use.

5.4.4. In-situ subgrade testing will require a trial pit to be excavated to the depth of the ‘assumed’ formation / sub-formation considering the proposed pavement thickness and assessed subgrade surface modulus from the desk study. The trial pits should be within the area of proposed pavement construction, and where results of ≤ 30 MPa are established for a site expected to deliver a higher value, the trial hole shall be excavated a further 250mm and retested. In addition, the material from the base of the pit shall be sampled to enable plasticity testing, as described within section 5.5.

5.4.5. The Clegg impact hammer is a portable in-situ test device which uses an accelerometer (hammer) manually dropped from a set height, recording the resultant impact value (deceleration of the hammer). It is suitable for use on clay, silt, and granular subgrades, as well as for assessing the strength of capping and subbase layers. The results can be converted to a CBR value on a material specific basis, and subsequently to MPa. This method is a proven in-situ method and has been used for assessing subgrade strength over many years within Hampshire.

5.4.6. Clegg hammer subgrade tests shall be undertaken in accordance with the manufacturer’s instructions within pits at around the anticipated formation or sub-formation level. This can be determined based on the expected finished road level when considering the proposed pavement thickness and an estimate of foundation requirements from the desk study. This also

enables a visual inspection of the subgrade and the opportunity to sample for laboratory testing. If when tested, the subgrade is determined to be ≤ 2.5% CBR, the trial pit is to be excavated a further 250mm deeper and the subgrade re-tested.

5.4.7. Whichever method is adopted, the timing is important. Testing during the wetter, winter and spring months is likely to provide more representative results than during drier summer and autumn months where subgrade conditions can lead to results that are artificially high. It is therefore recommended that, where the desk study shows clay or silt to be present, and / or in-situ test results are below 5% CBR (50 MPa), that sampling and plasticity testing of the subgrade from the proposed formation / sub-formation level be taken and equilibrium subgrade surface modulus assessed as indicated within section 5.5. The lower of the in-situ and laboratory test results shall be the DSSM.

5.4.8. Further information on Geotechnical Testing Requirements are provided within TG5 – Geotechnical Investigation Testing and Design.

5.5. Laboratory testing

5.5.1. In addition to plasticity testing, further, routine Laboratory classification tests such as, but not limited to, Particle Size Distribution (PSD) (gradings), wet sieve / sedimentations, Atterberg Limit testing, Intact Dry Density (IDD) tests, shall be undertaken on the soils as deemed appropriate by a geotechnical specialist. Where any concrete structures are proposed below the pavement, such as protection slabs or culverts, the presence of sulphates shall be tested for in accordance with BRE Special Digest 1.

5.5.2. Laboratory testing shall be undertaken where the subgrade is other than sand, sandy-gravel, or chalk (that is where clay or silty subgrades are encountered). Silt / clay subgrades, where moisture and plasticity may produce significant issues, shall be sampled and laboratory tested to determine an equilibrium subgrade surface modulus, derived from the plasticity index (PI) percentage. The test procedure shall be undertaken in accordance with BS 1377-4.

5.5.3. In certain circumstances soaked CBR testing might be required. However, they do not mirror the equilibrium situation or the stress history, but they do provide an indication of worst conditions, which is important where HSSs are being considered.

5.5.4. For chalk subgrades, the IDD of chalk shall be determined in accordance with BS1377:1990.

5.5.5. Further information is included within TG5 – Geotechnical Investigation Testing and Design.

5.5.6. Testing shall always be undertaken to determine the suitability of a subgrade where infiltration is being considered as a method of drainage, as not all subgrade materials, including sands and chalk are suitable. Further details can be found within TG8-2 - Drainage – Infiltration.

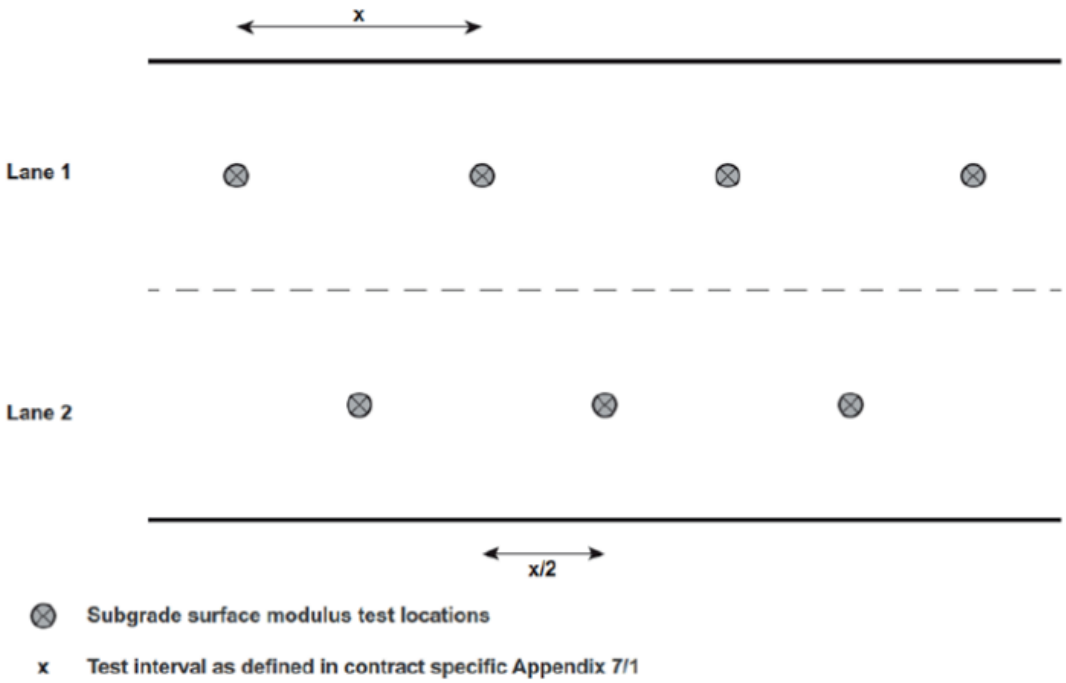
5.5.7. As described in TRL report LR1132 when determining a subgrade strength from a PI to derive a long-term subgrade surface modulus, 'average construction conditions' shall be assumed with a high groundwater level (300mm below sub-formation level), for a thick (1200mm thick, incorporating 600mm of capping) or thin (300mm thick) pavement construction as appropriate. For thicknesses in between, an equilibrium value of CBR may be interpolated. Subgrades with PI values greater than 40%(roughly 30 MPa or less) may require improvement in accordance with CD 225 (see 4.13, above, for further information). It should be noted that silt is non-plastic but reduces in strength when saturated and so has low equilibrium values (as per LR1132 table C1).

5.5.8. The provision of sub-soil drainage should be the default position where a high ground water level exists, but if it is not to be installed, then 'poor construction conditions' shall be used to determine the equilibrium subgrade surface modulus.

5.5.9. In all circumstance, laboratory tests that produce results as a CBR percentage shall be converted into MPa for design purposes. See section 5.3 for further information.

5.6. Frequency of testing

5.6.1. Subgrade surface modulus shall be determined using one of the methods mentioned above at intervals suitable for the type of subgrade material and its condition. Where the geology is expected to be consistent, the tests shall be undertaken at a maximum spacing of 60m along each lane of prepared subgrade and staggered to the mid-point between adjacent lanes, as indicated below. However, as the geology within Hampshire can be quite variable with interbedded sands and clays, for the majority of sites, testing at spacings of between 5m and 20m are likely to be required. The spacing shall be informed by the desk study and field reconnaissance and be agreed with the Highway Authority before the testing commences (for developer-led schemes, contact the County Council's Highway Development Agreement team (roadagreements@hants.gov.uk) at least two weeks prior to testing.



5.6.2. Where laboratory tests are undertaken to determine the equilibrium subgrade strength/surface modulus, they shall be undertaken at the same frequency as required for in-situ tests.

5.6.3. For smaller sites, such as for a Section 278 junction or bellmouth, a single subgrade assessment is not acceptable, and a minimum of three in-situ tests and three plasticity laboratory tests shall be undertaken per site. The exact number and position of tests to be undertaken shall be agreed with the Highway Authority in advance (for developer-led schemes, contact the County Council's Highway Development Agreement team (roadagreements@hants.gov.uk) at least two weeks prior to testing.

5.7. Ground water

5.7.1. Trial pitting, window sampling or bore holes shall be used to identify the presence of ground water close to ground level, or within 1.0m of the formation or sub-formation. Where such conditions exist, ground water levels shall be monitored seasonally to inform the need for subgrade drainage, and to assess the likely construction conditions for use in determining an equilibrium subgrade CBR/surface modulus from PI values. Monitoring shall be undertaken via the installation of boreholes preferably to enable a full year's worth of ground water level data to be collected, or as a minimum over the winter season (October to March), with water levels generally highest in March, to ensure that the highest ground water conditions are established. Refer to TG5 – Geotechnical Investigation Testing and Design for further information.

5.8. Assessment for stabilisation

5.8.1. The enhanced characteristics of stabilised materials can be used where appropriate to optimise the use of local materials. BS 1924 contains the

full range of tests required to determine the suitability of a site or an area of a site for stabilisation. The specification of hydraulically stabilised soils is covered within BS EN 14227-15, with that of cement bound granular mixtures covered within BS EN 14227-1.

5.8.2. Where sites are being considered for lime / cement stabilisation, the process to demonstrate suitability of soils shall be:

- suitability testing
- performance testing
- site trials
- verification results

5.8.3. The suitability testing shall include assessments of:

- Plastic Limit
- Liquid Limit
- Plasticity Index
- particle size distribution (wet sieve and sedimentation)
- organic matter content (BS1377: Part 3)
- water soluble sulfate content (TRL Report 447, test no 1), oxidizable sulfides content (TRL Report 447, Test no 2 and 2) and total potential sulfate content (TRL Report 447, test no 4)
- initial consumption of lime tests

5.8.4. The performance testing shall include:

- CBR : untreated and treated, with results converted to MPa (see section 5.3)
- linear swelling, untreated and treated
- Moisture Condition Value, untreated
- Moisture Condition Value, treated
- water content, untreated
- water content, treated
- OMC/MDD/MCV relationship – treated

5.8.5. Where lime treated soils are to be used within 450 mm of ground level, frost tests in accordance with BS 812-124:2009 will need to be undertaken.

5.8.6. Following the results of performance testing a method statement for stabilisation will need to be produced by a specialist. This should set out a site trial.

5.8.7. An earthworks specification may also need to be produced and include the relevant earthwork classes.

5.8.8. Site trials:

A Highway Authority inspector shall be present for all site trials on S278 and S38 schemes. For County Council designed and implemented schemes, the investigation shall be undertaken in conjunction with the County Council's Geotechnical team.

5.8.9. Verification results:

All results shall be provided along with any other site investigation within an interpretive report to the Highway Authority.

5.9. Interpretive report

5.9.1. An interpretive report shall be produced for all in-situ and laboratory test results, trial pits, window samples and boreholes, and made available to the Highway Authority along with the pavement and foundation design approval request. Failure to provide an interpretive report will delay the review of the pavement and foundation design.

5.10. Other issues

5.10.1. It is expected that by determining the DSSM via testing, the chances of the CSSMs being lower will be significantly reduced, but the requirement for the CSSM to be determined by testing prior to construction works commencing still remains. However, if this were found not to be the case, then the requirements within section 7.2 shall be followed.

5.10.2. Where infiltration is being considered for drainage purposes, testing shall be undertaken in accordance with TG8-2 - Drainage – Infiltration.

5.10.3. The presence of utilities should be considered, especially those that are shallow and potentially within or just beneath a pavement's construction. It is recommended that they are surveyed beforehand for health and safety reasons to help avoid potential strikes during investigation and / or construction works.

6. Materials

6.1. General

6.1.1. The SHW provides details of acceptable capping and subbase materials within the 600 Series and 800 Series, respectively. However, additional guidance and restrictions on the materials permitted for pavement foundation within Hampshire are specified below.

6.1.2. In choosing materials for capping and subbase, designers should consider the whole life carbon emissions, including those associated with transportation of materials and end of life treatment. In-situ treatment/recycling should be considered where appropriate. Also, consideration needs to be given to the time of year construction is proposed, in respect of the laying, compaction **and** the protection required. In addition to not exceeding the permitted subbase tolerance stated in Cl. 702, the cumulative tolerances of the bound pavement layer shall not be exceeded, nor a reduction in the thickness of the bituminous surface course by more than 5 mm from that specified, in order to achieve the proposed finished levels.

6.1.3. Where unbound granular materials which include any percentage of IBAA are being considered, refer to 6.3.15 to 6.3.20.

6.2. Capping

6.2.1. Class 2 and 3 foundations can be produced with or without a capping layer depending on the subgrade surface modulus.

6.2.2. Capping materials are required when the subgrade surface modulus proves inadequate to provide a suitably strong platform to support the subbase layer and to distribute the commercial vehicle loading to the underlying sub-formation. For lower subgrade surface moduli a layer of capping material brings practical benefits by providing a working platform and a good base for compaction of the overlying layers.

6.2.3. As mentioned above, it is generally expected that within Hampshire, pavement foundations shall be designed using the RFD approach. However, Class 1, which is an option for RFDs as a capping-only option, shall not be used.

6.2.4. Capping materials shall comply with the permitted constituents and requirements for Class 6F materials (6F1 to 6F5) as stated in Table 6/1 of Series 600 of SHW. It should be noted that Class 6F1 and 6F2 are site-won materials and that Class 6F4 and 6F5 are their imported equivalents. Where possible and subject to the suitability of the materials, site-won materials should be used to minimise construction traffic, import and export of materials and hence minimise the associated carbon emissions.

6.2.5. For sites with subgrades of 50 MPa or lower only Class 6F5 materials shall be used, as Class 6F4 materials are generally finer, and can inhibit the flow of subsurface drainage through the foundation which can more easily lose strength and stiffness when saturated.

6.2.6. A Class 6S granular filter layer material may be used beneath the subbase where permanently improving a wet, weak subgrade is proposed. Classes 9A, 9B, 9D, 9E and 9F are all cement and / or lime HSS capping materials.

6.2.7. The compaction of capping materials shall conform to the requirements of Table 6/4 of Series 600 of SHW.

Stabilised capping

6.2.8. Due to the cost of excavation and disposal of surplus soil from excavations, the need to transport dwindling mineral resources and the need to reduce embodied carbon, hydraulic stabilisation of the existing subgrade in place of imported capping materials should be considered. Alternatively, a lower stabilised layer overlain with unbound Class 6F granular capping making up the required depth could be considered. The materials that are suitable for stabilisation are stated within Table 6/1 of the SHW 600 Series.

6.2.9. Stabilised capping shall conform with the requirements of the SHW 600 Series, with the use of either cement, lime, or both in accordance with Clauses 614, 615 and 643 as appropriate.

6.2.10. In all cases, the subgrade to be stabilised shall be sampled and a design produced. The frequency of sampling shall be at a minimum 50m centres for proposed carriageways of up to 250m in length, subject to a minimum of 3 No. samples, and not less than 100m centres for a site of greater length. The sampling information and stabilisation design shall be submitted as part of the design approval process.

6.2.11. Further guidance on stabilisation to form capping material is provided within BS EN 16907-4:2018, Earthworks - Part 4: Soil treatment with lime and/or hydraulic binders.

6.3. Subbase

6.3.1. The objective of a subbase layer is to provide a suitably strong platform to support the bound pavement layers above and distribute the commercial vehicle loading to the underlying capping layer or formation.

6.3.2. Traditional unbound mixtures are generally used as subbase materials for flexible pavements. However, bound subbase materials may be used instead for flexible pavements, and always for rigid pavements.

6.3.3. Subbase-only designs will only be permitted where the DSSM is greater than 50 MPa, as subgrades of a lower modulus are almost exclusively soils containing clays or silts and therefore carry the potential risk of structural rutting during construction and use.

6.3.4. To ensure that compaction requirements are achieved, the maximum layer thickness of Cl. 807 (Type 4) asphalt arisings to be permitted within Hampshire is 200mm.

6.3.5. Cement Bound Granular Mixtures (CBGM) complying to Cl. 821 and 822 may also be used. It should be noted that CBGMs should not be trafficked for 7 days after laying unless the layer complies with the requirements of Cl. 813.17. Material to Cl. 823 shall not be used.

6.3.6. To maximise the life of rigid pavements, the subbase shall be constructed of bound materials such as Hydraulically Bound Mixtures (HBM) a minimum of 150mm thick. This is to help prevent erosion of the subbase should joint sealants fail, as bound subbases are less water susceptible than unbound subbase materials.

Hydraulically Stabilised Subbase

6.3.7. The use of hydraulic stabilisation techniques often gives environmental and economic benefits by minimising the excavation and disposal of unsuitable subgrade materials and the importation of dwindling mineral resources.

6.3.8. Clause 840 details the requirements for HSSs, with details of permitted binders covered within Cl. 811. The mixture proportions used for production shall be based on a laboratory mixture design procedure in accordance with Cl. 880.

6.3.9. Within Hampshire, soil treated by cement is accepted. However, SHRBs have the potential to reduce the amount of cement clinker required thereby making it more cost effective and better for the environment than other types of HSS. Additionally, the SHRB treated materials are slower at setting and hardening, thereby providing improved workability.

6.3.10. As with stabilised capping materials, the soil to be stabilised shall be sampled and a design produced. The frequency and other requirements shall as a minimum be as detailed within 6.2.10. It is also essential that the surface modulus of the stabilised layer is not too strong and accepted by the Highway Authority before any materials are placed on top.

6.3.11. Further information can be found within HA 74/07, which although withdrawn, provides useful information regarding sulfate and sulfide minerals which could affect the stabilisation process, the occurrence of which in the UK are summarised within Appendix B of HA 74. A suite of documents providing further advice on soil stabilisation have been produced by Britpave, the British Cementitious Paving Association, which can be obtained from www.britpave.org.uk

Hydraulically bound subbase materials

6.3.12. HBMs have been used in Hampshire for some time, originally to the County Council's bespoke Cl. 894AR. Cl. 894AR has now been removed from the County Council's Model specification in favour of using materials conforming to SHW Cls 821, 822 known as Hydraulically Bound Granular Mixtures (HBGM). Both of these are Cement Bound Granular Mixtures (CBGM), which as their name implies, principally use cement as the hydraulic binder.

6.3.13. Typically, foundation Class 3 or 4 materials, incorporating cement or other Hydraulically Bound Mixtures (HBM), are to be used for performance foundation designs and rigid pavements. The SHW indicates that materials contaminated with tar or tar-bitumen binders, as well as Incinerator Bottom Ash Aggregates (IBAA), shall be excluded from inclusion within SHW HBMs. However, Hampshire County Council, together with Milestones and OCL, have developed a process at the Micheldever materials recycling plant that enables tar bound materials derived from only Hampshire's network to be used as a primary feed source for HBM products used within Hampshire. This reduces the requirement for the disposal of these materials in a licensed tip, providing considerable cost savings and reducing the demand on dwindling aggregate sources.

6.3.14. HBMs are covered within the 800 Series and are therefore generally used as subbase materials. HBM to Cl. 821 (C5/6) is permissible for use as foundations within footways and to Cl. 822 (C8/10) for use within carriageways.

Incinerator Bottom Ash Aggregates (IBAA)

6.3.15. Where IBAA is used, either as a pure product or as part of a blended capping or subbase material, the requirements stated below shall apply.

6.3.16. A minimum of 200mm cover to the material shall be provided.

6.3.17. A site-specific risk assessment by IBAA supplier shall be undertaken for the developer to deem if the material is suitable for use on the specific site. This will include an assessment to determine the water table level during the winter period, as the material shall not be used in areas of high-water table, or over principal aquifers or in the vicinity of other environmentally sensitive areas without consideration of the potential for leachability. Therefore, it shall only be used subject to the satisfactory outcome of a site-specific environmental assessment to be carried out by the supplier in accordance with protocols agreed with the Environment Agency (EA). In addition, it shall be demonstrated to the Highway Authority that the use of IBAA products comply with the EA's regulatory position statement RPS 247 - Using unbound incinerator bottom ash aggregate (IBAA) in construction activities, or any subsequent revision to BS EN 13242: 2002+A1:2007 (which is the current BS EN after the 2013 revision was withdrawn).

Any proposal to use material containing any quantity of IBAA shall be notified to Hampshire County Council using the e-form "IBAA – Hampshire County Council Requirements - Delivery and Installation Register"

6.3.18. The grading requirements and all other criteria shall comply with Series 0600 and 0800 accordingly. Once delivered to site, the RPS requires that unbound IBAA must be stored securely, and it must be at the place of final

use for no longer than 6 months before its use. Also, that the activity must not endanger human health or the environment, or:

- cause a risk to water, air, soil, plants or animals,
- cause a nuisance through noise or odour, or
- adversely affect the countryside or places of special interest.

6.3.19. It is incumbent on the design organisation to check that its proposed use on a site does not contravene any of the above restrictions before specifying its use.

6.3.20. There are further restrictions in respect of conditions on its use, which requires the keeping of records of the material and where it has been used, but which also prevents the storage or use of IBAA within:

- a groundwater source protection zone 1 or 2, or
- 50 metres of any spring or well, or of any borehole used to supply water, including private water supplies.

6.3.21. Further information on the Environment Agency's approach to groundwater protection, especially in respect of Transport developments (Section C4), can be accessed via the following link:

Environment Agency's approach to groundwater protection

7. Construction

7.1. General

7.1.1. All pavements shall be constructed in accordance with the relevant series of the SHW as amended by Hampshire County Council's model specification, ensuring adequate drainage to achieve good long-term pavement performance, foundation strength, stiffness and the integrity of the pavement. These considerations are to be reflected in both design and construction, as failure to do so in one or both will have implications on the life expectancy of the pavement. Testing requirements are to be detailed in Appendix 1/5 of the works specification.

7.2. Pre-construction testing

7.2.1. Prior to construction commencing, the subgrade CSSM shall be checked by the contractor at the top of the exposed subgrade using an LWD in accordance with Cl. 882.14, Procedure A or an FWD in accordance with Cl. 882.11 and the test results shall be compiled and supplied to the Highway Authority.

7.2.2. The frequency of testing shall be as indicated in Cl. 882.2, Figure 8/1, with a minimum of ten tests carried out for each prepared foundation area. For smaller sites, or where the subgrade stiffness is deemed to be consistent across the site, the number of tests may be reduced by agreement with the Highway Authority. However, where the subgrade is considered variable the number of CSSM tests may need to be increased, with the exact testing locations to be agreed with the Highway Authority.

7.2.3. Where pre-construction in-situ testing indicates the CSSM to be lower than the DSSM the design shall be reassessed, and the foundation proposals amended as required. Any change to the approved foundation design will require the approval of the Highway Authority before construction commences.

7.2.4. If the in-situ testing indicates a CSSM ≤ 30 MPa, the proposals for permanently improving the subgrade shall be submitted to the Highway Authority's original approver for review, with no works permitted to commence until approval of the proposals have been granted. Should works continue without prior approval, this shall be deemed to be at the initiators risk and may require removal and replacement if it is determined to be in any way inadequate.

7.3. Division of the site

7.3.1. The pavement foundation shall be constructed at the depths indicated for each area as identified within the approved design, or as amended following pre-construction testing.

7.4. During construction

7.4.1. During construction the following information, covered by the SHW, is to be collected of the pavement foundation:

- the actual thickness for each foundation layer
- compliance with the relevant material specifications from the SHW 600 and 800 Series as appropriate

7.4.2. The subgrade, sub-formation and formation shall, in accordance with Cl. 701, be protected from deterioration due to the ingress of water, the adverse effects of weather and the use of construction plant to prevent damage due to weather or trafficking during the progress of the works. This may involve shaping to shed water and, subject to the agreement of the Highway Authority, the provision of specialised subgrade drainage.

7.5. Subgrade drainage

7.5.1. The proposed subgrade drainage shall be installed to assist the drainage of the pavement foundation both during and after construction. During construction, every effort should be made to protect the subgrade by placing aggregate before rain can soften it. Therefore, capping / subbase materials shall be placed and compacted as soon as practical after the subgrade drainage has been installed.

7.5.2. There should always be a downslope route for water to drain from the foundation towards the subgrade drainage system. Especially in reconstruction and widening projects it is necessary to maintain the continuity of drainage from existing capping and subbase materials to adjacent new materials, using appropriate thicknesses and crossfalls (refer to section 4.4 and 4.6).

7.5.3. Details of fin and narrow filter drains, and their installation are provided within SHW Highway Construction Details F18 and F19. They shall not be used for draining the site during construction, which in accordance with Cl. 602.15 and 16, is the responsibility of the contractor.

7.5.4. Where water is to be discharged from the site during construction, the measures required to protect receiving waters shall be agreed with the Environment Agency where it affects a Main River, or Hampshire County Council in the case of Ordinary Water Courses. Failure to do so shall be at the initiators risk, and the responsibility for any required remediation shall rest with them.

7.6. Sub-formation and formation

7.6.1. Preparation of sub-formation and formation within existing subgrades or on fill materials shall be undertaken in accordance with clauses 613 to 616. This shall be followed immediately by the construction of the full thickness of capping or subbase as appropriate.

7.7. Capping

7.7.1. The sub-formation shall be prepared, and capping installed in accordance with clauses 613 to 617 and 643, with compaction requirements of Tables 6/1 and 6/4 of Series 600 of the SHW.

7.7.2. Method compaction is to be used for capping materials with Hampshire County Council's inspector/site supervisor team in attendance. Should there be concerns that suitable compaction has not been achieved, unless identified as a soft spot and treated as such, the Highway Authority may require the area to be tested. Any area found to be lower than the minimum value shall be remediated as required to achieve the minimum value at the initiators expense.

7.7.3. Where a performance design has been used, performance assessment shall be in accordance with Cl 884 and 886.

7.7.4. Further guidance on the treating, compacting, curing, and the subsequent testing, plus the trafficking of stabilised materials used to form capping layers are provided within BS EN 16907-4:2018, Earthworks - Part 4: Soil treatment with lime and/or hydraulic binders.

7.7.5. Failure to address weak areas of capping may affect the overlaying layers and it will be deemed that the works are progressing at risk.

7.8. Subbase

7.8.1. The transportation, laying and compaction of all unbound mixtures shall be undertaken in accordance with Cl. 802 and Table 8/5, with cement and other Hydraulically Bound Mixture (HBM) subbases covered by the requirements of Cl. 810 to Cl. 822, with material to Cl. 823 not permitted for use within Hampshire. Further requirements may be as detailed in the scheme specific Appendix 7/1.

7.8.2. Method compaction shall also be used for subbase materials with Hampshire County Council's inspector/site supervisor team in attendance. Should there be concerns that suitable compaction has not been achieved, unless identified as a soft spot and treated as such, the Highway Authority may require the area to be tested. Any areas found to be lower than the required value shall be remediated to achieve the minimum value at the initiators expense.

7.8.3. The specified strength mechanical performance requirements for Cl. 821 and 822 CBGM subbases shall be assessed by testing in accordance with Cl. 870.

7.9. Inspections and testing

7.9.1. Inspections of the capping and subbase materials shall be undertaken, and where deemed inadequate they shall be removed by the initiator and replaced at their cost, with the costs of undertaking the initial and any subsequent testing also borne by the initiator.

7.9.2. Capping materials shall meet the requirements of grading, optimum moisture content (site-won material) or water content (imported materials), with unbound subbase mixtures, meeting the requirements of Cl. 801 for

the Type proposed for the specific site. For stabilised capping materials, BS 1924 contains the full range of tests required after treatment. It also provides guidance for the testing of hydraulically bound granular mixtures detailed in BS EN 14227-1 to BS EN 14227-5, and hydraulically stabilised soils in BS EN 14227-15.

7.9.3. Where the compaction of the capping materials has been undertaken without Hampshire County Council's inspector/site supervisor present, or where there is evidence of a lack of compaction/other concerns about the placement of the material, testing shall be undertaken on the top of the capping layer using either plate bearing or DCP to demonstrate 15% CBR has been achieved.

7.9.4. Where the compaction of the subbase materials has been undertaken without the County Council's inspector/site supervisor present, testing shall be undertaken on the top of the subbase layer using either plate bearing or DCP to demonstrate 30% CBR has been achieved.

7.9.5. Where a performance design has been used, performance assessment shall be in accordance with Cl 884 and 886

7.9.6. Notwithstanding the tolerances permitted in surface levels of pavement course, in accordance with Cl. 616.1, the surface level tolerance of the formation shall be within +20 mm and -30 mm, or other level of tolerance defined in contract specific Appendix 6/7. Other than under concrete pavement surface slabs, the tolerance of a subbase shall be +10 – 30mm (Table 7/1, SHW 700 Series).

7.10. Trafficking trial

7.10.1. A trafficking trial may be specified as a requirement within Appendix 7/1 or instructed by the Highway Authority where there are concerns over a capping or subbase materials potential performance. The location and duration of the trafficking trial shall be agreed with the Highway Authority a minimum of two weeks prior to the proposed use of the material and undertaken at the initiators expense.

7.10.2. The trial shall be undertaken in accordance with Cls 802.12 to 802.18, with a maximum of 30mm deformation permitted. In accordance with Cl. 802.14, the trial area shall be at least 60m long, and of sufficient width that when trafficked, the wheel paths of the test vehicle shall be at least 1.0m from either edge of the top of the unbound mixture layer. Where the total length of subbase to be laid is less than 60m long, the initiator shall propose to the Highway Authority for approval the extent over which they propose that the trafficking trial be undertaken.

7.10.3. The formation shall extend for a further 1.0m either side of the unbound mixture layer, and the unbound mixture layer shall be compacted to the thickness specified within the approved specification prior to the commencement of the trafficking trial.

7.10.4. Where permitted in Appendix 6/7, the trafficking trial may be undertaken on an area of the proposed carriageway. Provided that the materials and

compaction meet the requirements of the approved design, and the maximum deformation requirement is not exceeded, the trial area may be incorporated within the permanent works.

8. Further support

8.1. Should you have a specific query or feedback about any of the content of this Technical Guidance Note, please send an e-mail to: Technical.Guidance@hants.gov.uk.

8.2. Should you have a query about applying this to your particular project, please contact:

- the design check engineer dealing with your S278 or S38 application (if you are a developer or developer's consultant)
- the Technical Guidance Note Specialist(s) (if you are a working within Hampshire County Council).

8.3. Associated Technical Guidance Notes

TG5 - Geotechnical Investigation, Testing and Design

TG6-2 - Flexible and Rigid Pavement Design

TG6-3 - Modular Pavement Design

TG6-4 - Permeable Paving

TG8-1 - Drainage - General Items

TG8-2 - Drainage - Infiltration

TG17 - Departures from Standard