2.1 GENERAL

2.1.1 The following refer to the construction of capping layer to form an appropriate formation layer for the pavement. Capping layer is required when the pavement is to be constructed on subgrade with CBR < 5%. Such cases are pavement construction on soil cuttings or native subgrade (after removing the topsoil) as well as in some cases on soil embankments.

2.1.2 The function of the capping layer is: a) to provide an adequate working surface for the proper and efficient construction of the sub-base, b) to protect weak subgrade, especially during construction, from the adverse effects of rainfall and c) to improve the strength of the subgrade.

2.1.3 The material used for the construction of the capping layer is usually selected granular material, as defined in paragraph 2.2.

2.1.4 The capping layer may also be constructed with stabilised material (stabilisation with cement or lime), as defined in paragraphs 2.3 and 2.4. In this case the capping layer may consist either of stabilised material throughout its depth, or part of the capping layer may be of stabilised material and the rest of selected granular material. In no case should the capping layer consist of more than two (2) elements of different materials.

2.1.5 When selected granular material is used (non stabilised), the weak subgrade of the cutting is removed in such a depth as is the thickness of the capping layer.

2.1.6 When cement stabilised material is used, it is usually mixed in place, for economy reasons. On the contrary, when lime is used for stabilisation, it is always mixed in place.

2.1.6.1 Depending on the depth of the capping layer constructed with stabilised material, it is decided whether the weak subgrade will be totally or partly removed and replaced by selected granular material. Material will be stabilised in layers so that the compacted thickness of each layer is not less than 130mm and not more than 250mm.

2.1.7 When capping layer is used on embankments, the material is laid on top of the embankment. Certainly the height of the embankment, during its construction, must be adjusted so as the addition of the capping layer does not change the predetermined level of the formation.
2.1.8 As for the construction of the capping layer, besides all that is mentioned in the present document, all that is included in PTP X-1 and PTP O-164 are equally in effect.
2.2 SELECTED GRANULAR MATERIAL

2.2.1 MATERIALS

2.2.1.1 The material for the construction of the capping layer is selected granular soil or other material, or combination of granular material from natural sources, streams, quarries, mines etc., the grading of which falls within the limits of Table 2A.1. Furthermore, the value of the Los Angeles test of these materials must be < 45%.

2.2.1.2 Essentially these materials fall into categories E3 and E4 of Article 2 of TSY, with the requirement the percentage passing through sieve No200 to be within the limits specified in Table 2A.1.

Table 2A.1 Grading limits

<table>
<thead>
<tr>
<th>Sieve size (mm)</th>
<th>Öype 1</th>
<th>Öype 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>125</td>
<td>100</td>
<td>-</td>
</tr>
<tr>
<td>90</td>
<td>80-100</td>
<td>-</td>
</tr>
<tr>
<td>75</td>
<td>65-100</td>
<td>100</td>
</tr>
<tr>
<td>37.5</td>
<td>45-100</td>
<td>75-100</td>
</tr>
<tr>
<td>10.0</td>
<td>15-60</td>
<td>40-95</td>
</tr>
<tr>
<td>5.0</td>
<td>10-45</td>
<td>30-85</td>
</tr>
<tr>
<td>0.600</td>
<td>0-25</td>
<td>10-50</td>
</tr>
<tr>
<td>0.063</td>
<td>0-12</td>
<td>&lt;15</td>
</tr>
</tbody>
</table>

Recommended moisture content during compaction: the optimum or maximum -2% below optimum

2.2.2 CONSTRUCTION

2.2.2.1 The capping layer may consist in its full depth of only one of the above material, or of both, in which case material Type 1 is laid first and material Type 2 follows.

2.2.2.2 Capping material is laid in layers so that the compacted thickness of each layer is not less than 110mm and not more than 250mm, provided that the appropriate mechanical equipment is available.

2.2.2.3 In all cases, the surface on which the selected material Type 1 or 2 is to be laid is trimmed and compacted with one pass of a smooth-wheeled roller having a mass per m width of roll not less than 2100 kg, or a vibratory roller having a mass per m width of roll not less than 700 kg. The capping material is laid immediately after the above mentioned compaction.
2.2.2.4 After each layer of the capping material has been laid, the capping layer is compacted with an appropriate compaction machine until the required degree of compaction has been achieved.

2.2.2.5 As for the required degree of compaction, and generally for construction, testing and acceptance of the capping layer, all that is mentioned in PTP X-1 and Article 2 of TSY, in relation to compaction, is in effect.

2.2.2.6 After the construction of the capping layer has been completed, construction of the sub-base and base follows, in the shortest time possible. See also paragraph 2.5.

2.2.2.7 Particular emphasis must be given to the capability of the Contractor to construct the capping layer(s) in compliance with the requirements. This is ensured by the construction of a trial section. Details for the construction and testing of the trial section are given in paragraphs 2.6.1 to 2.6.2.3 and 2.6.5.

2.2.3 WEATHER LIMITATIONS

2.2.3.1 Refer to paragraph 2.7.

2.2.4 TESTS

2.2.4.1 Refer to paragraph 2.8.

2.3 CEMENT STABILISED MATERIAL

2.3.1 GENERAL

2.3.1.1 Cement stabilisation of the capping material is implemented when there is shortage of selected granular material in the vicinity of the project and when the available material may be economically treated with cement.

2.3.1.2 For economy reasons, cement stabilisation is carried out in situ. Cement stabilisation could also take place in plant, but with an increase in construction cost. Thus, in-plant-mixing is usually preferred when the material to be stabilised is brought to site.

2.3.1.3 The capping layer may consist of cement stabilised material in its full depth or in part of cement stabilised material and in part of material Type 1 or 2, as defined in paragraph 2.2.1.

2.3.1.4 For the construction of the capping layer with cement stabilised material mixed in place, all that is mentioned in PTP O-164 is in effect, as well as the following.
2.3.2 MATERIALS

2.3.2.1 Materials that are suitable for cement stabilisation, relatively economically, and used as capping layer may be selected granular soil material or selected cohesive soil material, Type ST1 or ST2, correspondingly, complying with the requirements of Table 2A.2.

2.3.2.2 If, following an economic analysis and justification, in-plant-mixing is selected, then the material to be stabilised should have maximum particle size such that all material passes through sieve size 50mm.

2.3.2.3 Cement and water to be used in stabilisation, as well as other additives possibly used, will be as defined in PTP O-164.

2.3.3 MIX DESIGN

2.3.3.1 The Contractor must submit for approval to the Authority the mix design, in which, besides the properties mentioned in Table 2A.2, the following must be determined: the required amount of cement (in no case less than 2%), the moisture content during mixing and compaction and the density that the compacted mix should have. In case other additives are used, they should be included in the mix design. After approval or the suggested modification by the Authority, the Contractor will be responsible for implementing the mix design throughout construction. The Authority preserves the right to perform periodical inspections at their discretion.

2.3.3.2 The required cement content is determined by laboratory tests, so that the absolute minimum CBR value achieved after 7 days maturing (3 days in an airtight plastic bag, or in a chamber with 100% moisture content, or continuous spraying of water, followed by 4 days of soaking) is greater than the one stated in Table 2A.2 and the expansion achieved is less than 2%.

2.3.3.3 When material Type ST1 is used, a cement content in the order of 2%-2.5% may very well achieve the required CBR value. Material Type ST2 generally requires a greater amount of cement compared to Type ST1 mix.

2.3.4 CONSTRUCTION

2.3.4.1 The equipment used for spreading and mixing the cement as well as the general way of construction are as described in the relevant articles of PTP O-164. Furthermore, the following are also in effect:
2.3.4.2 The capping material is laid in layers. The maximum permissible compacted thickness of each layer is 250mm, provided the appropriate mechanical equipment is available, while the minimum permissible compacted thickness of each layer is 130mm.

2.3.4.3 In case the capping layer consists solely of stabilised soil, in order to achieve satisfactory blending of cement with the natural soil, part of the weak soil material to be stabilised is excavated and placed by the site. Stabilisation of the bottom layer of the soil material then follows, while the removed soil is gradually redeposited and stabilised in layers of compacted thickness no more than 250mm.
Table 2A.2  Gradings and required properties of materials to be stabilised with cement

<table>
<thead>
<tr>
<th>Sieve size (according to ÅS) (mm)</th>
<th>Cement stabilisation</th>
</tr>
</thead>
<tbody>
<tr>
<td>125</td>
<td>100</td>
</tr>
<tr>
<td>90</td>
<td>85-100</td>
</tr>
<tr>
<td>75</td>
<td>-</td>
</tr>
<tr>
<td>37.5</td>
<td>-</td>
</tr>
<tr>
<td>28.0</td>
<td>-</td>
</tr>
<tr>
<td>10.0</td>
<td>25-100</td>
</tr>
<tr>
<td>5.0</td>
<td>-</td>
</tr>
<tr>
<td>2.00</td>
<td>-</td>
</tr>
<tr>
<td>0.600</td>
<td>10-100</td>
</tr>
<tr>
<td>0.063</td>
<td>&lt; 15</td>
</tr>
</tbody>
</table>

Other requirements

For the soil material:
- Uniformity coefficient $D_{50}/D_{10}$
- Liquid Limit (LL)
- Plasticity Index (PI)
- Organic matter content
- Total sulphate content

For the stabilised material:
- Degree of pulverisation (before compaction)
- California Bearing Ratio
- Moisture content during mixing
- Moisture Condition Value (before compaction)

(a) According to BS 1377: Part 3
(b) Percent passing through sieve size 28mm: 95% and percent passing through sieve size 5mm: > 60%
(c) According to ASTM D-3668, after compaction for maximum density (for 100% compaction) by modified Proctor test (E 105-86), 3 days maturing of the stabilised specimen and 4 days of soaking
(d) The moisture content during mixing is determined by the mix design
(e) According to BS 1377: Part 4

2.3.4.4 In case part of the capping material consists of stabilised soil and the rest of granular material, the soil that will be replaced by the granular material is removed from site. The remaining soil material (bottom layer) is stabilised in layers of compacted thickness no more than 250mm.
2.3.4.5 The appropriate quantity of cement shall be uniformly spread on the pulverised soil material by an approved spreading machine. The total quantity of cement is in no case allowed to be spread in less than two passes of the spreading machine. The quantity of cement spread is checked by the Contractor, in the presence or not of the Authority, once for every 500 m² of cement spread. The quantity of cement spread is checked by placing an appropriate collecting tray, or a plastic membrane, or a piece of linoleum, of known weight and area, on the surface that the spreader is going to pass from.

2.3.4.6 Any additional amount of water that may be required to be added in the mix is also measured in order to avoid any adverse effect.

2.3.4.7 There should always be an overlap of 150-200mm between adjacent passes of the pulverising/mixing machine.

2.3.4.8 Each layer of processed material is compacted immediately after the whole cement quantity has been spread and adequate mixing and pulverisation (cement and natural soil) has been achieved. Compaction shall be completed within 2 hours at the maximum. In case of plant mixing the mixture is simply spread (by motor grader) and compacted.

2.3.4.9 To ensure high compaction, just before compaction commences, the Moisture Condition Value (MCV) of the processed material is checked to be no greater than what is stated in Table 2A.2. The minimum value is usually 8. Water may be added, if necessary, to enable this MCV requirement to be met. Care must be taken to spread this amount of water in a uniform manner.

2.3.4.10 The stabilised material is compacted by the usual mechanical means, until the required compacted density is achieved. The vibratory roller is usually used for compaction, while the smooth-wheeled roller should be avoided.

2.3.4.11 After compaction the layer is left to mature for 7 days. During the maturing period the surface is protected with a plastic membrane or water is periodically sprayed. The stabilised layer is also protected by suitable means, during periods when the air temperature is forecast to drop below 3 °C.

2.3.4.12 During the maturing period, no other material should be laid or deposited above the stabilised layer. Furthermore it should not be used by traffic (including construction vehicles). Refer also to paragraph 2.5.
2.3.4.13 Where a subsequent stabilised layer is placed on a layer previously stabilised, the tines or blades of the stabilising machine shall be set so that they cut into the previously stabilised layer below by at least 20mm.

2.3.4.14 Construction of the sub-base and base follows as soon as possible after construction and maturing of the capping layer have been completed. Refer also to paragraph 2.5.

2.3.4.15 Particular emphasis must be given to the capability of the Contractor to construct the capping layer(s) in compliance with the requirements. This is ensured by the construction of a trial section. Details for the construction and testing of the trial section are given in paragraphs 2.6.1, 2.6.3 to 2.6.3.3 and 2.6.5.

2.3.5 WEATHER LIMITATIONS

2.3.5.1 Refer to paragraph 2.7.

2.3.6 TESTS

2.3.6.1 Refer to paragraph 2.8.

2.4 LIME STABILISED MATERIAL

2.4.1 GENERAL

2.4.1.1 Lime stabilisation of soil materials is a more economic alternative to that of cement stabilisation.

2.4.1.2 Lime is always added- and mixed-in-place and the required mechanical equipment is the same as used in cement in-place stabilisation, paragraph 2.3.4.1.

2.4.2 MATERIALS

2.4.2.1 Material to be stabilised with lime and used to form capping layer is cohesive soil material with high plasticity complying with the requirements of Table 2A.3.

2.4.2.2 Lime shall comply with BS 890 or DIN 19611, and when sieved (to ensure that there are no lumps and effective stabilisation shall be obtained) shall have all material passing through a sieve size 9.5 mm (3/8 in) and >95% of the material passing through a sieve size 4.76 mm (No.4).

2.4.3 MIX DESIGN
2.4.3.1 The Contractor must submit for approval to the Authority the mix design, in which, besides the properties mentioned in Table 2A.3, the following must be determined: the required amount of lime (in no case less than 2.5%), the moisture content during mixing and compaction and the density that the compacted mix should have. In case other additives are used, they should be included in the composition study. After approval or the suggested modification by the Authority, the Contractor will be responsible for implementing the composition study throughout construction. The Authority preserves the right to perform periodical inspections at their discretion.

2.4.3.2 The required lime content is determined by laboratory tests, so that the absolute minimum CBR, defined in Table 2A.3, is achieved. Along with the determination of the lime content in the mix, the required water content is also determined.
### Table 2A.3 | Gradings and required properties of materials to be stabilised with lime

<table>
<thead>
<tr>
<th>Sieve size (according to ÂS) (mm)</th>
<th>Lime stabilisation % by mass</th>
</tr>
</thead>
<tbody>
<tr>
<td>125</td>
<td>-</td>
</tr>
<tr>
<td>90</td>
<td>-</td>
</tr>
<tr>
<td>75</td>
<td>100</td>
</tr>
<tr>
<td>37.5</td>
<td>-</td>
</tr>
<tr>
<td>28.0</td>
<td>95-100</td>
</tr>
<tr>
<td>10.0</td>
<td>-</td>
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<tr>
<td>5.0</td>
<td>-</td>
</tr>
<tr>
<td>2.00</td>
<td>-</td>
</tr>
<tr>
<td>0.600</td>
<td>-</td>
</tr>
<tr>
<td>0.063</td>
<td>15-100</td>
</tr>
</tbody>
</table>

**Other requirements**

*For the natural material:*
- Plasticity Index (PI) > 10
- Organic matter content \(^{(a)}\) < 2%
- Total sulphate content \(^{(a)}\) < 1%
- Moisture Condition Value (MCV) \(^{(b)}\) > 6

*For the stabilised material:*
- Degree of pulverisation \(^{(c)}\) (before compaction) see (c)
- California Bearing Ratio \(^{(d)}\) > 5%
- Moisture Condition Value just before compaction \(^{(b)}\) 8 to 12
- Moisture content during mixing see (e)
- Lime content in the mix see (f)

\(^{(a)}\) According to BS 1377: Part 3
\(^{(b)}\) According to BS 1377: Part 4
\(^{(c)}\) When sieved, the dry mixed material shall have: percent passing through sieve size 28mm: >95% and percent passing through sieve size 5mm: > 30%
\(^{(d)}\) According to ASTM D-3668, after compaction for maximum density by modified Proctor test (E 105-86), 3 days maturing of the stabilised specimen and 4 days soaking.
\(^{(e)}\) The moisture content during mixing is determined by the mix design
\(^{(f)}\) According to ASTM D-3155 and it must be equal to or greater than the percentage determined by the composition study

### 2.4.4 CONSTRUCTION
2.4.4.1 The equipment used for spreading and mixing of lime as well as the general way of construction are as described in the relevant articles of PTP O-164. Furthermore, the following are also in effect:

2.4.4.2 Compaction of lime stabilised material is carried out in layers. The maximum permissible compacted thickness of each layer is 250mm, provided the appropriate mechanical equipment is available, while the minimum permissible compacted thickness of each layer is 130mm.

2.4.4.3 The capping layer may consist of lime stabilised material in its full depth or in part of lime stabilised material and in part of material Type 1 or 2, as defined in paragraph 2.2.

2.4.4.3.1 In case the capping layer consists solely of stabilised soil, in order to achieve satisfactory blending of lime with the natural soil, part of the weak soil material to be stabilised is excavated (to the required depth), and placed by the site, and the bottom layer of the soil material is then stabilised.

2.4.4.3.2 In case part of the capping material consists of stabilised soil and part of granular material, the soil that will be replaced by the granular material is removed from site. The remaining soil material (bottom layer) is stabilised in layers of compacted thickness no more than 250mm.

2.4.4.4 The appropriate quantity of lime shall be uniformly spread by an approved spreading machine. The total quantity of lime is in no case allowed to be spread in less than two passes of the spreading machine. The quantity of lime spread is checked by the Contractor, in the presence or not of the Authority, once for every 500 m$^2$ of lime spread. The quantity of cement spread is checked by placing an appropriate collecting tray, or a plastic membrane, or a piece of linoleum, of known weight and area, on the surface that the spreader is going to pass from.

2.4.4.5 Any additional amount of water that may be required to be added in the mix is also measured in order to avoid any adverse effect.

2.4.4.6 There should always be an overlap of 150-200mm between adjacent passes of the pulverising/mixing machine.

2.4.4.7 After the lime has been spread and the mix pulverised satisfactorily (degree of pulverisation must meet the requirement of Table 2A.3), the surface is sealed with one pass of a smooth-wheeled roller having a mass per metre width of roll of not less than 2700 kg or a pneumatic tyred roller of not less than 1000 kg per wheel. Final compaction starts after not less than 24 hours and not greater than 72 hours, to be agreed by the Authority, to enable the lime to react with the soil.
2.4.4.8 At the end of this period, and before final compaction, the layer receives one further pass of the pulverising machine in order the appropriate pulverisation degree and Moisture Condition Value, as stated in Table 2A.3, to be achieved. At this stage the addition of further amount of water may be necessary. Provided that the above requirements have been met, compaction of the stabilised layer may begin.

2.4.4.8.1 If, for any reason, there is a delay following completion of the above requirements and before commencement of compaction, the surface is sealed by 2 or 3 passes of the roller, as mentioned in paragraph 2.4.4.7. On recommencement and before final compaction the layer is re-processed, as stated in paragraph 2.4.4.8, without the addition of lime.

2.4.4.9 Compaction of the stabilised mix is carried out usually with pneumatic-tyre rollers of appropriate weight, until at least 95% of the maximum dry density has been achieved. Typically, 6 passes of a roller having a mass of 2000 to 2500 kg per wheel are sufficient to compact a layer of compacted thickness 150mm. To compact a layer of compacted thickness 250mm, 16 passes of a pneumatic-tyred roller having a mass of 4000 to 6000 kg per wheel is required.

2.4.4.9.1 Equally good compaction is achieved by a tamping roller having a mass of 4000 kg per metre width of roll. In this case and for the above mentioned thicknesses, 4 and 8 passes, respectively, are required. After compaction by the tamping roller, the surface is sealed by one pass of a smooth-wheeled roller.

2.4.4.9.2 Vibratory rollers may also be used. Typically, to compact a layer of compacted thickness 150mm and 250mm, the required passes of a vibratory roller with a mass of more than 5000 kg per metre width of roll, are 6 and 12, respectively.

2.4.4.10 After compaction, the surface is left for some time to mature. This period is necessary in order the mix to develop the required bearing ratio (CBR>15%, when tested in natural moisture content). No other material is compacted or deposited above the stabilised layer, until such time as the required bearing ratio has been achieved. During this maturing period, no vehicular traffic is allowed on the stabilised layer, except for the vehicles used for construction of the stabilised layer. Operation of other construction vehicles may be permitted after 2 or 3 days, provided they are not channeled through one lane and do not cause obvious surface distortion (wheel rutting or/and corrugations).

2.4.4.11 Maturing time of the mix depends on local conditions. Stabilisation is not carried out during rainfall or when the shade temperature is below 7 °C. Furthermore, it is recommended that the surface is protected, in order to avoid drying. Surface
protection from drying is usually achieved by spraying water. When the surface is exposed to high temperatures for long periods of time, cationic bituminous emulsion KE-5 may also be sprayed, approximately 1 kg/m².

2.4.4.12 Where a subsequent layer of stabilised material is placed on a layer previously stabilised, the tines or blades of the stabilising machine are set so that they cut into the previously stabilised layer below at least 20mm.

2.4.4.13 After stabilisation of the lower layer has been completed and the required bearing ratio has been achieved, the construction of the next layer, either stabilised or of granular material Type 1 or 2 (when a mixed capping layer is being constructed), is recommended to start as soon as possible.

2.4.4.14 Construction of the sub-base and base follows as soon as possible after construction and maturing of the capping layer have been completed. Refer also to paragraph 2.5.

2.4.4.15 Particular emphasis must be given to the capability of the Contractor to construct the capping layer(s) in compliance with the requirements. This is ensured by the construction of a trial section. Details for the construction and testing of the trial section are given in paragraphs 2.6.1, 2.6.4 to 2.6.4.2 and 2.6.5.

2.5 PROTECTION OF CAPPING LAYER

2.5.1 The sub-base/base layer is constructed immediately, or as soon as possible, after construction of the capping layer has been completed and the required bearing ratio has been achieved, in case stabilised material is used.

2.5.2 In the meantime, until the sub-base/base layer is laid, traffic on the capping layer must be limited and permitted only to the vehicles required for construction of the capping layer. Operation of other construction vehicles on the capping layer must be minimal since the capping layer is not designed to receive continuous traffic loading of such vehicles, but to form an appropriate surface to lay the sub-base and base layers.

2.5.3 When construction of the sub-base and base is delayed for long periods of time, although this is not recommended, the capping layer surface must be protected against the adverse effects of rain and high temperatures (in case stabilised material is used). The contractor should submit to the Authority the suggested method of protection for approval.

2.6 TRIAL SECTION
2.6.1 Before commencement of construction of the capping layer, a trial section, not less than 700m$^2$, will be constructed using the method, materials, equipment and personnel that will be used in the main construction. The objective of this trial section is for the Contractor to demonstrate his ability to construct the capping layer satisfactorily and in accordance with the requirements, using a specific method, type of materials and equipment.

2.6.2 In the trial section and provided the capping layer consists solely of granular soil material the following shall be determined: a) aggregate grading, b) optimum moisture content to achieve optimum density, c) moisture content during compaction, d) degree of compaction, e) layer thickness, f) evenness and g) level of the final surface.

2.6.2.1 Determination of (a) to (f) is carried out according to the relevant paragraphs of PTP X-1.

2.6.2.2 As for the level of the final surface of the capping layer, which follows the longitudinal and crossfall gradient of the road, the permissible tolerances are +20mm and -30mm from the appropriate pavement formation level.

2.6.2.3 If the surface level of the capping layer is above the permissible tolerance, the surface is corrected (removal of extra material and compaction) appropriately. If the surface level of the capping layer is below the permissible tolerance the surface is restored by adding and compacting suitable material. This material may be the same as the one used in the construction of the capping layer (provided the size of the maximum grain in relation to the remaining thickness allows it) or other suitable material, usually sub-base material, at the expense of the Contractor.

2.6.3 In the trial section and provided the capping layer consists solely of cement stabilised material, the following shall be determined: Before stabilisation: a) grading of soil material, b) uniformity coefficient ($D_{60}/D_{10}$), in case material Type ST2 is used, c) Liquid Limit (LL), d) Plasticity Index (PI), e) organic matter content and f) total sulphate content. Furthermore, after stabilisation: g) degree of pulverisation prior to one pass of the roller and prior to full compaction, h) California Bearing Ratio, i) moisture content during mixing, j) Moisture Condition Value just before compaction, k) degree of compaction, l) layer thickness, m) evenness and n) final surface level.

2.6.3.1 Determination of the above, except (h), (j) and (n) is conducted according to the relevant paragraphs of PTP O-164. For (g) note ‘b’ of Table 2A.2 also applies.

2.6.3.2 Determination of (h) is done according to ASTM D-3668, of (j) according to BS 1377:Part 4, while for (n) the contents of paragraph 2.6.2.2 apply.
2.6.3.3 If the surface level of the capping layer that consists of stabilised material is above the permissible tolerance, the surface is corrected appropriately (removal of extra material and compaction). If the surface level of the capping layer is below the permissible tolerance, the surface is restored by pulverisation and addition of suitable material. Pulverisation is carried out in such depth that the compacted layer thickness (after the extra stabilised material has been added) is 150mm.

2.6.4 In the trial section and provided the capping layer consists solely of lime stabilised material, the following will be determined: Before stabilisation: a) grading of soil material, b) Plasticity Index (Pl), c) organic matter content and d) Moisture Condition Value of the natural soil. Furthermore, after stabilisation: e) degree of pulverisation prior to one pass of the roller and prior to full compaction, f) California Bearing Ratio, g) moisture content during mixing, h) lime content by mass of dry mix, i) Moisture Condition Value just before compaction, j) degree of compaction, k) layer thickness, l) evenness and m) final surface level.

2.6.4.1 Determination of the above, except (d), (f), (h), (i) and (m) is conducted according to the relevant paragraphs of PTP O-164. For (e) note ‘c’ of Table 2A.3 also applies.

2.6.4.2 Determination of (d) and (i) is done according to BS 1377:Part 4, of (f) according to ASTM D-3668, and of (h) according to ASTM D-3155. For (m) the contents of paragraph 2.6.2.2 apply.

2.6.5 The results and the acceptance or not of the material and construction by the Authority will be issued within 10 days at the maximum. In case of the material and construction been accepted, the area of the trial section is added to the project. In case the material and construction is not accepted, recommendation will be given and the trial section removed by the Contractor at his expense.

2.7 WEATHER LIMITATIONS

2.7.1 Capping layer should not be constructed during rainfall or when air temperature is below 0, except when stabilised materials are used. For these cases refer to the relevant paragraphs.

2.7.2 Furthermore subgrade excavation should not commence when rain is expected shortly and the meantime is not enough for completion of the capping layer construction.

2.8 TESTS
2.8.1 In order to ensure the quality of construction during and after completion of construction works, the tests as mentioned in Table 2A.4 should be carried out for each type of material. The recommended frequency of execution of each test is also given in Table 2A.4, nevertheless it may be modified, depending on the case, by the Authority.

2.8.2 Sampling and testing are carried out by laboratories of the public or private sector authorised and recognised from the Authority.

2.9 BILL OF QUANTITIES

2.9.1 The quantities will be measured by cubic metre of full construction (materials and construction).

2.9.2 In case the capping layer consists solely of selected granular material, the total thickness of the capping layer is determined by surveying the excavated surface level and the final surface level. In case of in-place soil stabilisation, without the removal of the soil, the total capping layer thickness is determined combinedly, i.e. as the sum of the thickness of the bottom stabilised layer and the rest stabilised or not layers, up to full construction of the capping. The thickness of the bottom stabilised layer is determined by an appropriate stick. The thickness of the other layers is determined by surveying the surface level on which the rest of the layers will be laid and the surface level of the completed capping layer.

2.10 PAYMENT

2.10.1 Payments will be made by cubic metre of full construction of compacted layer measured in accordance with the previous paragraph and include every expense for full construction. Such expenses are the purchase, transportation and laying of all the appropriate materials, water spraying, pulverisation (as many times as required), one pass of the roller and full compaction, protection of the surface (as it is decided and approved), transportation of equipment, all testing required, as well as any other expense which, even though not specified, is required for full completion of construction.

Table 2A.4 Typical tests and suggested frequency for the construction of capping layer

<table>
<thead>
<tr>
<th>Material</th>
<th>Test</th>
<th>Suggested frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Selected granular material Type 1 and 2</td>
<td>-Gradation</td>
<td>Once per 400 tons</td>
</tr>
<tr>
<td></td>
<td>-Moisture content</td>
<td>Once per 400 tons</td>
</tr>
<tr>
<td></td>
<td>-Optimum moisture content</td>
<td>Once per 400 tons</td>
</tr>
<tr>
<td></td>
<td>-Moisture during compaction</td>
<td>Once per 400 tons</td>
</tr>
</tbody>
</table>
### Once in every source

<table>
<thead>
<tr>
<th>Material to be stabilised with cement</th>
<th>-Los Angeles</th>
<th>Once in every source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material to be stabilised with lime</td>
<td>-Gradation</td>
<td>Once per 400 tons</td>
</tr>
<tr>
<td>-------------------------------------</td>
<td>--------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>Material to be stabilised with lime</td>
<td>-Plasticity Index (Pl)</td>
<td>Once a day</td>
</tr>
<tr>
<td>-------------------------------------</td>
<td>--------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>Material to be stabilised with lime</td>
<td>-Organic matter content</td>
<td>Once a week</td>
</tr>
<tr>
<td>-------------------------------------</td>
<td>--------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>Material to be stabilised with lime</td>
<td>-Total sulphate content</td>
<td>Once a week</td>
</tr>
<tr>
<td>-------------------------------------</td>
<td>--------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>To the cement or lime stabilised material</td>
<td>-Gradation</td>
<td>Once per 400 tons</td>
</tr>
<tr>
<td>-------------------------------------</td>
<td>--------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>To the cement or lime stabilised material</td>
<td>-Plasticity Index (Pl)</td>
<td>Once a day</td>
</tr>
<tr>
<td>-------------------------------------</td>
<td>--------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>To the cement or lime stabilised material</td>
<td>-Organic matter content</td>
<td>Once a week</td>
</tr>
<tr>
<td>-------------------------------------</td>
<td>--------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>To the cement or lime stabilised material</td>
<td>-Total sulphate content</td>
<td>Once a week</td>
</tr>
<tr>
<td>-------------------------------------</td>
<td>--------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>To the cement or lime stabilised material</td>
<td>-Moisture Condition Value</td>
<td>Once per 400 tons</td>
</tr>
<tr>
<td>-------------------------------------</td>
<td>--------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>To the cement or lime stabilised material</td>
<td>-Degree of pulverisation</td>
<td>Once per lane spread 200m long</td>
</tr>
<tr>
<td>-------------------------------------</td>
<td>--------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>To the cement or lime stabilised material</td>
<td>-California Bearing Ratio</td>
<td>Once in every 500 m²</td>
</tr>
<tr>
<td>-------------------------------------</td>
<td>--------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>To each compacted layer</td>
<td>-Moisture content during mixing</td>
<td>Once per 400 tons from at least 3 samples (at least 6 if a nuclear density meter is used for compaction)</td>
</tr>
<tr>
<td>-------------------------------------</td>
<td>--------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>To the final surface level of the capping layer</td>
<td>-Layer thickness</td>
<td>Once after construction is completed</td>
</tr>
<tr>
<td>-------------------------------------</td>
<td>--------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>To the final surface level of the capping layer</td>
<td>-Evenness</td>
<td>Once after construction is completed</td>
</tr>
<tr>
<td>-------------------------------------</td>
<td>--------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>To the final surface level of the capping layer</td>
<td>-Surface level</td>
<td>Once after construction is completed</td>
</tr>
</tbody>
</table>

(1) Depending on the material
(2) From 3 random samples
(3) From 3 random samples, CBR and expansion. No value should be lower or greater, respectively, than the recommended in Tables 2A.2 and 2A.3
(4) Pulverisation depth will be checked continuously by an appropriate metal stick
(5) The mean value should be not less than 100% of the standard Proctor compaction test and no individual value should be less than 98%
(6) No greater than the maximum and no lower than the minimum permissible, depending on the material, refer to the relevant paragraphs 2.2.2.2, 2.3.4.2 and 2.4.4.2.