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NATIONAL BOARD OF PUBLIC ROADS
AND WATERWAYS.

HELSINKI - TURKU MOTORWAY BETWEEN
GUMBÖLE - VEIKKOLA

ROAD CONSTRUCTION WORK: WORK DESCRIPTION

16.1.65

NATIONAL BOARD OF PUBLIC
ROADS AND WATERWAYS

MOTORWAY HELSINKI - TURKU
SECTION
GUMBÖLE - VEIKKOLA

S P E C I F I C A T I O N F O R R O A D W O R K S

1. CLASSIFICATION OF SOILS
2. CUTTING OF TIMBER AND SITE CLEARANCE
3. CONSTRUCTION OF FORMATION
4. ROAD PAVEMENT
5. SLOPES AND CENTRAL RESERVES
6. CULVERTS
7. CABLE TRENCHES AND CABLE DUCTS
8. SETTING OUT AND MEASUREMENTS
9. PROVISION FOR MAINTENANCE OF TRAFFIC DURING CONSTRUCTION
10. APPENDICES

16.1.65

TABLE OF CONTENTS

:631 Materials
:632 Procedure
:7 Borrow pits and tips

4. Road Pavement
:1 General
:2 Use of Design Charts
:3 Lower portion of road pavement
:31 Definition
:32 Choice of material
:33 Borrow pits and quarries
:34 Spreading of lower portion of road pavement
:35 Compaction
:4 Base Course
:41 General
:411 Method of construction of base course
:412 Choice of base course type
:413 Finish of the lower portion of the road pavement
:414 Surface finish of base course
:42 Base course of crushed gravel or gravel
:421 Composition
:422 Surface of base course
:43 Dry-bound macadam
:431 Quality of the crushed rock
:432 Spreading of the crushed rock
:433 Binding and blinding
:44 Gravel wearing course
:441 Composition
:442 Production
:443 Construction
:444 Dust abatement

5. Slopes and Central Reserves
:1 Construction of the slopes and central reserves
:2 Soiling and grassing of slopes
:3 Stone paving of slopes
:4 Turfing of slopes
:5 Dry stone walls

6. Culverts

:1 Foundation
:2 Laying of culverts
:21 Laying of concrete pipes
:22 Laying of corrugated iron pipes
:3 Culvert ends
:4 Backfilling
:5 Transition wedges

7. Cable Trenches and Cable Ducts

8. Setting Out and Measurements

:1 Motorway
:2 Other roads
:3 Setting-out of levels

9. Provision for Maintenance of Traffic During Construction

:1 General
:2 Temporary roads
:3 Temporary carriageways
:4 Warning and safety measures

10. Appendices

:1 TVH Soil Research Office; Determination of Frost-Susceptibility of Soils
:2-7 Parts IV[x)] 4.1; 6-11; Design Charts for Road Pavement, dated 29.1.1964
:8-15 Parts IV[x)] 4.4; 9-16; Road Pavement Layers/18.6.1964
Typical Drawings for Foundation of Culverts
:16 Foundation of Culvert on Firm Frost-Resistant Soil
:17 Foundation of Culvert on Frost-Susceptible Soil
:18 General Foundation Method for Culvert on Weak Subsoil
:19 Foundation of Culvert on Weak Subsoil, Special Case of Very Weak Subsoil

x) TVH's Standard Regulations concerning Planning, Construction and Maintenance of Roads.

1. CLASSIFICATION OF SOILS

:1 General

The classification of soils into bearing categories is to be carried out in accordance with regulations concerning the division of soils into bearing categories and notes on classification of the National Board for Public Roads and Waterways (Regulations and Notes concerning Road Construction and Maintenance dated 29.1.1964). The summary below is based on TVH's instruction.

Soils have been divided into 6 categories (A, B, C, D, E, F) with reference to bearing capacity in such a way that rock belongs to category A and soils in one of categories B-F. in accordance with their degree of frost-susceptibility. The frost-susceptibility of soils shall be investigated in each individual case as outlined below before classification into Bearing Categories. Bearing Categories are summarized in Table 1.

Table 1. Bearing Categories

Bearing Category	Soil
A	Rock
B	Frost-resistant soils whose grading curves lie within the zone for sub-base materials, or coarser, e.g. gravel.
C	Frost-resistant soils such as sand or coarser not belonging to the previous Category.
D	Frost-resistant soils such as fine sand or coarser not belonging to the previous Category.
E	Frost-susceptible soils with the exception of those in Category F. Dry crust clay, frost-susceptible fine sand and frost-susceptible moraines.
F	Weak soils. Very soft clay, peat, mud and silt.

:2 Determination of frost-susceptibility

Soils are either frost-resistant or frost-susceptible. In order to determine the frost-susceptibility of a soil, a laboratory investigation regarding its particle-size distribution must be made. The determination of frost-susceptibility is effected by comparison of the grading curve of the soil with the standard grading curves specifying the zones for frost-susceptibility. The use of the standard grading curves is specified later. As an addition to particle-size distribution the capillarity of the soil shall also be determined in borderline cases where the soil may frost-heave in certain conditions even though the particle-size distribution analysis has shown it to be frost-resistant. The soil is to be considered frost-susceptible if the capillary rise is greater than or equal to 1,0 m.

:3 Determination of Bearing Category

The following procedure is to be followed for determination of bearing capacity.

Category A: The presence of rock is to be determined either by visual inspection or by test boring.

Category B: Frost-resistant materials whose grading curves fall within the zones for sub-base material or are coarser. The zones for sub-base materials are shown in Appendices 14 and 15.

Categories C, D, E, F: Frost-susceptibility is determined by reference to the grading curves in accordance with the specifications on Appendix No. 1.

For coarse silt and coarse silty moraine the capillary rise shall also be determined. The Bearing Category shall be determined in accordance with Table 1 after the frost-susceptibility has been investigated.

2. CUTTING OF TIMBER AND SITE CLEARANCE

:1 Cutting of timber

Timber must normally be felled during the winter so that it is not damaged.

Should the owner of the land declare that he will not carry out the felling of timber himself the Contractor must himself arrange for this work to be done. The trees shall be cut as near to the ground as possible, branches and foliage removed, and the trunks stacked in a workmanlike manner outside the road working area. The road working area shall be marked before commencement of felling and clearing operations.

On the inside of curves and within junction areas felling and clearing is to be increased to such an extent that the specified clear sight distance is obtained, or the trees shall have their branches and foliage removed in this area.

:2 Clearance

Clearance comprises removal from the road working area of such growth and other objects as interfere with the construction of the road or constitute danger to traffic. Felling of timber does not form part of clerance. When timber has been removed the remaining small trees, bushes, brush-wood etc. shall be cleared from the road working area. Vegetation may to certain instances be allowed to remain. If the vegetation is to be used for grassing of slopes etc. it shall be collected after brush-wood etc. has been removed. Pulling down of fences forms part of clearance.

Stumps greater than 10 cm dia as well as clumps of grass shall be removed if they lie nearer to the completed road surface than:
100 cm in the case of roads with a gravel wearing surface
170 cm in the case of roads with surfacing.

Stumps may not project into the road pavement.

On stretches in cut stumps and clumps of grass may be removed

in conjunction with excavation provided that they are picked out from excavated soil which is marked for filling.

The material cleared away shall be removed from the road working area or burned. If the materials are stacked the piles shall be arranged in such a way that they blend into the existing landscape.

The work of clearance shall normally have been completed before excavation or filling is commenced. If this is not possible the material cleared away shall temporarily be stacked in the vicinity of the road in such a way that it does not interfere with the progress of the road works. Stacking is further to be carried out in such a manner that the material is easily accessible for final removal without damaging slopes etc. Should the materials be stacked outside the road working area even for a short time the permission of the landowner must be obtained.

Stumps and other material cleared away can be utilized for the filling of unsightly depressions at the side of the road, but in all such cases a layer of soil about 30 cm thick or vegetation removed from the road area is to be placed over the areas concerned.

Because of the danger of fire the burning of brushwood etc. may not be carried out during periods of strong winds or a drought. If burning is carried out during the spring, summer or autumn the appropriate authorities shall be advised before burning is commenced. These will decide whether burning may take place at the time desired and issue any instructions necessary. With regard to the danger of fire the work should as far as possible be planned so that burning takes place during the winter.

3. CONSTRUCTION OF FORMATION

:1 Disposal of the soil

All topsoil shall be removed in banks as well as excavations

provided this has not been forbidden in the Soil Mechanics Report in connection with construction on weak subsoils and is to be used for soiling slopes, central reserves etc. Excess soil if any may be used for landscaping in accordance with the Employer's instructions. Topsoil shall ce carted to sites approved by the Employer. Storage of the topsoil is to be carried out in such a way that future spreading and carting is facilitated and it is therefore best that soil that is to be used in a certain area is deposited in heaps alongside the road. Soil shall be doposited in such a way that it does notunnecessarily obstruct cultivation or drainage of adjoining land and agreement must be reached with the landowner concerned as regards such deposition outside the road working area. Every effort shall be made to utilize the soil available in the most economical and workmanlike manner.

In embankments for the motorway soil subject to frost heave may not be spread nearer than 1,5 m from the roads top surface. Fill shall therefore be disposed in such a manner that material not subject to frost heave and rock which are found in the road area or in a borrow pit are reserved for use in embankments.

Soft soils such as clay, very plastic clay, organic soil and peat are only suitable for evening out similar soils. They may be used for the filling of unsightly depressions next to the road and with care may even be used for the soiling of slopes.

Excavated materials with different properties shall as far as practicable be carted to embankments in such a way that materials with the greatest bearing capacity, or at least materials requiring the least thickness of road pavement, are laid at the top of the embankment.

During the course of the work regular tests shall be carried out as to the quality of the excavated materials. Should the quality of materials differ from that indicated on the drawings the thickness of the road pavement in cuttings shall be adjusted accordingly. Tests shall also be carried out to determine whether the thickness of road pavement is to be

altered as a consequence of materials being used as embankment fill being different.

:2 Excavation in soil

Before excavation is commenced all necessary work in connection with re-siting of services etc., felling of timber, clearance and removal of topsoil shall have been carried out.

During the course of excavation normally the whole section including ditches and slopes shall be removed in one operation. Cutting of ditches at the same time as the rest of the excavation is carried out will make it easier to keep the formation dry. On less stable soils the crossfall of the formation may be made greater than that indicated on the drawings so that drainage is facilitated and at the same time the surface of the formation is to be even so that formation of pockets of water is prevented. The surface of the formation shall be formed to the proper crossfall before the road pavement is deposited.

Should the formation be used by construction traffic it may be practical to stabilize this with lime or cement or temporarily strengthen it by means of a layer of gravel or crushed rock.

Material that had thus been spread on the formation may not be counted as part of the road pavement if it has become mixed with the underlying soil or become muddy owing to the action of construction traffic. In certain cases it may be necessary to lay a special road for construction traffic.

Before commencing of excavation, a back drain may be cut at the top of the excavation in order to prevent water eroding the sides of the excavation.

:3 Excavation in rock

:31 Uncovering of rock

Uncovering of rock means mechanical removal of soil overlying the rock in such a manner that there will not be soil thicker

than 10 cm on any part of the rock to be excavated. Should the resulting stone be used as material for the road pavement or for the manufacture of crushed rock the surface of the rock shall be carefully cleaned by hand. The cleanliness of the rock surface shall be approved by the Employer before blasting is carried out.

The rock shall on both sides of the road be uncovered to a width greater than the theoretical. The widening shall be carried out in accordance with the cross section, but at least to a width of 1,0 m.

If the rock is to be blasted during the winter uncovering should as far as possible take place before the soil has heaved.

In all rock cuttings, once blasting is finished, the uncovering of the rock shall be completed if necessary so that rock remaining in the sides of the cutting is exposed for a width, measured in the horizontal direction, of at least 1,0 m in order to prevent overlying soil and stone from falling down. Soil so removed shall as far as possible be placed on ledges in the sides of the cutting in order to encourage growth. Earth slopes lying above the rock shall have a normal slope and be rounded off.

:32 Blasting and disposal

:321 General

Any smaller pieces of rock found in soil excavation sections shall, once they have been uncovered, be blasted to a depth corresponding to the thickness over the surrounding soil of the road pavement but at least to a depth of 1,0 m. The stone blasted is to be removed to such an extent that at least the base course can be laid undisturbed. Transition wedges required around rock faces are to be formed in the usual manner. In the case of smaller pieces of rock or large boulders the rock is to be removed to a depth specified for the transition wedge and the excavation backfilled with the surrounding material and thoroughly compacted. Where larger rocks are encountered (normally greater than 100 m^3) the excavation is

treated as excavation in rock. Excavation in rock is carried out in accordance with cross sections with side slopes of 10:1 - 5:1 but in the case of short rock sections the side slopes are to be the same as for excavation in soil. In order that slopes may be as even as possible the sides of rock cuttings where the slopes are steeper than 1:2 are to be close-drilled and fired with a low-velocity explosive. Distances between holes shall be half the advance (distance between rows) but no greater than 0,6 m. In rock excavation with steep sides, the slope should decrease towards the ends so that a gentle transition is obtained.

:322 Deep blasting

In this method the rock is blasted down to at least 1,0 m from the finished road surface or the level indicated on the cross sections. At the ends of the cut deep blasting is to be carried out so that the portion blasted can be adequately drained. In the case of deep blasting stones need only be removed to a level such that the remaining rocks may be evened-up and blinded and the required thickness of road pavement (base and wearing courses) laid. The bottom of the cutting need not be cleaned. After the blasted rock has been removed there should be no pockets of fine grained material left in the rock surface within a distance of 0,5 m from the finished road surface. The rock surface shall be free draining.

For blinding and grading of the surface see :62.

:323 Shallow blasting

In this method the rock is blasted only to such a depth that it can be removed to a level at least 5 cm below the underside of the finished road pavement (base course). Holes are as a rule to be drilled to a depth corresponding to about half the advance. After blasting and removal of the rock the surface shall be throughly cleaned. For evening of the surface thoroughly cleaned blasted rocks shall be used which are to be laid and compacted as specified. Gravel may also be used for evening-up. A width of at least 5 m shall be ready cleaned in advance in order to facilitate proper laying.

For blinding and grading of the evened surface see :62.

:324 Surface blasting

In this case, rock below the underside of the base course shall be blasted to a depth at least 1,0 m underneath the finished road surface. Surface blasting otherwise corresponds to deep blasting with the exception that in this case the original rock surface lies below the underside of the base course. The blasted rock is to be removed only to such an extent that rock remaining in the surface may be evened up and blinded and the road pavement required constructed as specified in :322.

For blinding and grading of the surface see :62.

:325 Clearing of sides

At the time of removing the rock the sides of the cutting shall be cleared of all loose fragments that may fall down. Where this is considered necessary from the point of view of traffic safety or appearance all unsightly fragments and overhanging or projecting rock shall also be removed.

:4 Embankments

:41 Preparation of ground

Before construction of embankments is commenced the ground shall have been cleared as specified and all pipe culverts required shall have been laid and backfilled and all preparatory work shall have been carried out. Stones under embankments shall be blasted or removed if they are higher than half the thickness of a layer that may be compacted at one time. Any heaps of stone shall be spread. Should the embankment be constructed during the winter snow and ice shall be removed from the line of the embankment.

:42 Construction of embankments

:421 General

Embankments shall be constructed in such a way that any future settlement and frost heave should be as even as pos-

sible, and embankments shall therefore be built up in uniform layers.

If filling is carried out with materials which can be expected to settle or heave differentially the boundary between such materials shall be constructed in the form of a wedge. In the case of roads that are to be surfaced the slope may be no steeper than 1:20 relative to the longitudinal gradient of the road down to a depth of 2,0 - 2,5 m under the surface of the road, below which level the transition may be steeper. Flat slopes are further required between blasted rock and soil and between morains and soils having different frost-heave properties.

:422 Filling with soil

Filling shall be carried out by the "tip and spread" method unless conditions expressly require end tipping (such as filling to firm bottom). The materials for embankment filling may not contain stones with a diameter greater than half the thickness of a layer that may be compacted at one time. Layer thicknesses shall be as specified in "Compaction: Work Description". The spreading of materials shall be effected by means of a bulldozer or similar plant in such a way that the fill will be homogeneous. Slopes may not contain stones nearer than 10 cm from the surface unless gravel or stone paving is to be employed. In embankments, as a rule, soils of a lower quality shall be placed in the lowest portion with the exception of filling to firm bottom in which case the lowest portion of the embankment shall consist of materials as stony as possible.

In the case of an embankment constructed of silt or similar soil types, each filling layer 1,0 m thick shall have laid on top a blinding layer for the purpose of draining off water (sandwich construction). In embankments acting as a stabilising counterweight any mineral soil may be used. Even for roads of a lower classification embankments shall as far as practicable be constructed by the "tip and spread" method.

On less stable soils where construction traffic is to use the

formation without there being a special road for this traffic the top surface should unless it has been stabilised by means of lime or cement be constructed with a steeper crossfall than the final one so that drainage is facilitated. Should any wheeltracking occur this shall afterwards be evened up so that pockets of water cannot form.

:423 Filling with rock material

Rock material for all types of road may be spread by means of end tipping but at least to a depth of 1,5 m below finished road level stones shall be spread by means of a bulldozer and no stones larger than 0,5 m may occur in this layer. Stones in the embankment shall generally be smaller than half the height of the embankment or half the thickness of each individual layer.

Stone embankments shall at least for a depth of 0,5 m below finished road surface be free draining (see clause :322). Should the rock be of a poor nature or the soil content be very large (but frost-resistant) filling may not be carried out higher than this level. After construction traffic has ceased a special road pavement is to be laid as specified.

Should stone filling be laid on clayey subsoil (this does not apply to filling to firm bottom) there shall be laid on top of the clay a sand layer at least 30 cm thick in order to counteract penetration of the clay into the stone fill.

The top surface of the embankment shall be blinded and graded in accordancew with :62.

:424 Filling on weak subsoils

In the case of embankments on weak subsoils the instructions given in the Soil Mechanics Report shall be followed.

:5 Transition Wedges

Transition wedges shall be constructed in accordance with the Special Drawings and very carefully and accurately. Where no Special Drawing is available the transition is to be constructed in accordance with Typical Drawings enclosed.

:51 Transition wedge at transition between rock and soil.

In order to prevent differential settlement at the interface of soil and rock a certain portion of the soil shall, before the road pavement is constructed, be replaced by such material and in such a way as is specified on the Drawings.

Should in a section of road, in soil subject to frost heave, rock lie nearer than 170 cm from the road surface the soil in the whole width of the road shall be removed to this depth. The transition wedge shall be drained if this is necessary. The line of slope of the wedge must be parallel with the road.

:52 Transition wedge between soil excavation and fill sections

Transition between soil excavation and fill sections may not be abrupt in order that differential settlement or frost heave may be prevented. If the ground has a slope steeper than that of the wedge the ground shall be excavated to this slope. At the interface of cut and fill sections the ground shall be thoroughly cleared of vegetation etc.

:53 Transition wedge at interface of soils with different bearing capacities

If the road is constructed on subsoils which abruptly change in their susceptibility to frost heave or in their bearing capacity or if any locally waterbearing strata are encountered which cannot be removed and there is a probability that differential frost heave will occur, transition wedges shall be formed to the same depths as in the case of rock. Should the frost-susceptible soil occur in localised pockets it shall if possible be totally removed down to the depth of the transition and replaced by frost-resistant material.

:6 Preparation of Formation

:61 General

Before the road pavement is laid the formation shall be even and have the specified longitudinal and crossfalls, and have

If the soil is so wet that it is not possible to carry out adequate compaction any pockets of water shall first be drained after which the surface shall be graded so that good drainage is possible. The area should then lie without traffic being permitted on it until such time as it has sufficiently dried out and final grading and compaction have been carried out.

On fine-grained soils the completely dry surfaces may be protected from becoming wet by means of bitumen spraying after which the surface is blinded with sand or covered with fine crushed stone in approximately the same way as in the case of surface dressing. The surface may in some instances be covered with plastic sheeting instead but in this case no traffic is to be allowed on it.

Should the embankment contain fine-grained soils it may be of advantage to stabilise the surface with lime which treatment will render the soil firmer and more resistant to wetting, thereby facilitating the spreading of the road pavement. Lime stabilization of clayey soils may also be used in order to provide roadways for construction traffic.

Other soils rich in fine-grained material can similarly be stabilised with cement.

:62 Blinding and grading of rock formation

On rock embankments or in rock cuttings as well as in other cases when the formation is constructed of lumps of rock or spalls the surface is first blinded and roughly graded as necessary with further spalls. In order to prevent the road pavement material running down into the interstices, the surface is to be blinded and graded with crushed rock, or sub-base gravel as required.

In order that grading of the surface to the specified level may be carried out by means of a grader the maximum stone size in the crushed rock or sub-base gravel used for blinding shall be 30 mm. The smoothness of the surface shall on completion be such that the greatest irregularity in a length of 5 m is 15 mm if the surface is to have a base course laid on

it, and 12 mm in a length of 5 m if bitumen macadam is to be laid on the surface direct or if it is to be surface dressed.

If the original grading is carried out by means of gravel the surface must previously have been blinded very thoroughly otherwise the grading material once it has dried out may run down into the interstices in the material below resulting in settlement. Rough grading with blasted rock, spalls and crushed rock shall be carried out in such a manner that the grading gravel is normally nowhere thicker than 15 cm.

Blinding and grading of rock base or rock embankment shall unless the Employer otherwise directs be carried out immediately since otherwise there is a risk that unsuitable soil may be carried on to the rock by construction traffic.

If too much unsuitable soil is carried on to the road pavement by construction traffic it shall be provided with an additional layer of at least 5 cm gravel which shall then be bulldozed off when the unsuitable material is removed.

If the rock material used for the construction of embankments is poor it is advisable to omit the last 0,5 m of the road pavement or embankment until construction traffic is largely over, and similarly in cuttings in rock of poor quality it is advantageous to remove the rock to a depth of 0,5 m below the finished road level to start with.

:63 Lime Stabilization

:631 Materials

In order that a homogeneous final muxture of soil and lime may be obtained the stone content should be low. Stone size should not exceed 50 mm.

Either slaked or unslaked lime may be used for stabilization. Slaked lime is to be used when the water content of the soil does not appreciably exceed the optimum. Unslaked lime which has a greater propinquity to chemically bind water and in addition generates heat when slaked, which results in evaporation of water, is to be used when the weather is unfavour-

able or when the soil has a very high water content. Should the water content, however, be too high no stabilising effect is obtained and this method is unsuitable.

In order that sufficient stabilization may be obtained and that stabilization may have a lasting effect it is necessary that the lime content required be determined in advance. The required lime content is normally 5% by weight of the dry soil when the lime is high-quality technical lime. Lime intended for agricultural use is often not suitable for stabilization.

:632 Procedure

In order that stabilization may give a good result the work should be carried out when weather conditions are favourable. To attain the required degree of reaction between the lime and soil the stabilization should be carried out during the spring and summer. The accumulation of pockets of water on the surface to be stabilized shall be prevented during and after stabilization.

The lime is to be spread evenly over the surface either mechanically or manually. If unslaked lime which has corrosive properties is used the supervisory staff is to ensure that operators follow safety specifications.

The lime is mixed by means of a cultivator uniformly and to a depth of at least 15 cm finished thickness. Since lime facilitates the breaking down of the soil it is more advantageous to have several fast passes with the cultivator. Should the soil contain a high proportion of caly it is best to suspend mixing of the lime after one or two passes of the cultivator and to compact the soil lightly. When the lime has after a day had time to loosen up the soil the passes with the cultivator are continued until uniform mixing has been attained, after which the soil is compacted.

The water content is to be kept approximately at the optimum value during stabilization. Water may be sprayed on the surface from a tanker. When work is suspended overnight or in the event of rain the surface should be graded and if nec-

essary lightly rolled.

When stabilization has been completed the surface is graded and well compacted by means of suitable plant, e.g. a rubber-wheeled roller. Compaction equipment shall be chosen in view of the properties of the stabilized layer and the underlying layer. Grading and compaction shall be carried out immediately after stabilizing operations have finished, which will reduce the risk that the water content of the soil is increased through the action of rain.

When the stabilized layer is completed it is to be covered by a sub-base material layer at least 10 cm thick. The stabilized layer should if possible not bear any traffic for at least a week.

:7 **Borrow pits and tips**

The Employer shall approve borrow pits and tips. Regard shall be paid when choosing sites to appearance. A contract shall be drawn up with the owners concerned in connection with the sites. Excess excavated materials may in accordance with the Employer's instructions be used for the construction of storage areas, reduction of side slope gradients or other filling operations for landscaping in the immediate vicinity of the road working area.

4. ROAD PAVEMENT

:1 General

The construction of formation comprises the taking-out of excavations or the building of embankments so that the formation is obtained on which the road pavement is to be laid.

All materials that are laid after the formation has been constructed form part of the road pavement, i.e. blinding layer, sub-base, transition wedges, base course and surfacing.

The function of the road pavement is to support and distribute to the formation the stresses due to traffic without there being any appreciable permanent deformation in either

the road pavement or the soil thereunder.

Bearing capacity and stability depend besides the thickness of the layer on the composition of the material and also on water content and compaction. Since the stresses are greatest at the surface and reduce with depth, the nearer a material lies to the surface the higher the requirements as to bearing capacity and stability. The composition of the road pavement is determined by the loading on the road and the bearing capacity of the subsoil. Design procedures are laid down in standard regulations prepared by TVL and in instructions for the planning, construction and maintenance of roads, Part IV 4.1 pages 6-11, dated 29.1.1964. Requirements for materials in the layers of the road pavement and instructions for their laying are specified in the same instructions, Part IV 4.4 dated 18.6.1964. In the case of compaction, however, the provisions of the Work Description for Compaction are to be followed and transition wedges are to be constructed in accordance with Special Drawings.

:2 Use of Design Charts

The design charts indicate the required minimum thickness of the road pavement as well as different construction alternatives. When choosing the type of road pavement the directions of the Design Instructions shall be observed. Should there be a number of suitable materials available for construction of the lower portion of the road pavement, this should as far as practicable be constructed in such a way that fine-grained, low-bearing capacity material is laid nearest to the formation and the coarser material nearest to the base course. The layers in the road pavement shall be laid in such order and at such a slope as is specified on the drawings and supplementary figures.

The thickness of the construction may not be reduced for short stretches even if this is allowed by design considerations.

:3 Lower portion of road pavement (sub-base, isolating and filter courses)

:31 Definition

The formation as a rule consists of materials of such bearing capacities that a layer of better material must be laid before the base course is placed.

:32 Choice of material

The materials are to be chosen so that they conform to the quality requirements laid down in the Design Instructions of the TVL.

The sub-base may be constructed of crushed rock or spalls. The diameter of stone for this layer may not exceed 200 mm or half the thickness of the layer that is to be compacted. The surface of the layer constructed of coarse material shall be carefully blinded with Class B material, crushed rock or similar. The sub-base may be constructed in one or more layers. When the lower portion of the road pavement consisting of coarse-grained material is laid on a formation of fine-grained material, there is a danger of the fine-grained material penetrating into the road pavement. The filter layer to be used in this case shall confirm to the requirements for isolating sand (sand or fine gravel) and pay regard to the quality of the subsoil.

No special lower portion to the road pavement is as a rule required in rock excavation or on rock embankments. Steps shall, however, be taken to ensure that the stone fill is stable and well compacted and that to a level of at least 0,5 m below finished road surface the filling material is free draining and does not contain too much fine-grained material. Stone material obtained from excavations in poor rock may contain a high proportion of soil or be so poor that it breaks down into fine particles as a result of blasting or further working and therefore in such poor rock all loose rock shall be removed to a depth of 0,5 m below finished road surface and replaced by Class B material. The same applies to rock embankments constructed of similar material. Material used in the lower portion of the road pavement may not disintegrate or be crushed by the action of traffic.

:33 Borrow pits and quarries

When considering the choice between different possible sites the Contractor shall pay regard to the influence they will have on the landscape. Should it appear that the choice of a site has a detrimental effect on the landscape efforts shall as far as possible be made to obtain the materials at a different site. If this is not possible the site shall be worked in such a way that it will be noticed as little as possible e.g. by going in from a side that is most suitable, or by leaving standing or erecting a protecting screen. Before the site is abandoned the tops of slopes shall be rounded off and tidied up and the faces should be grassed (method IV). Safety devices such as fences shall be erected if required. A plan should be prepared before work is commenced of the measures that are to be taken to preserve the landscape.

Sites may not be worked in such a way that there is a risk for ground water used for water supply being polluted. This is especially to be observed in the case of gravel ridges which often must be utilized as sources of water. In addition, steps shall be taken to ensure that pollution of ground does not occur by storing teheron fuel oil, bituminous materials etc. In case of doubt the authorities shall be consulted.

:34 Spreading of lower portion of road pavement

Before the road pavement is constructed the formation is to have the proper shape and conform to specifications as to evenness, compaction etc. If the formation is so firm that it can be trafficked without the risk of wheel-tracking or other deformation the material for the lower portion of the road pavement may be delivered and spread on the prepared formation direct.

If the material is not uniform spreading shall be carried out in several thin layers so that it will be well mixed. If the material is very stony it may not be tipped in heaps since the material may then segregate.

Should it be necessary to spread the lower portion of the road

pavement on a formation that is so unstable that it can not be trafficked without wheeltracks being formed the material shall be tipped onto the formation. The material shall then be spread onto the formation by means of a light tracked bulldozer or similar plant.

Should there be a danger that part of the road pavement material may become mixed with the formation the thickness of the road pavement is to be increased to such an extent that it is certain that at least the specified minimum thickness of clean material is obtained over the whole area.

Traffic is not to use the lower portion of the road pavement in such a way that there is a risk of the formation being deformed. If the formation has been constructed of saturated fine-grained soils no construction traffic may use this surface except when it is frozen. A special construction road is to be built by the lower portion of the road pavement not being spread in the first place to its full thickness over the whole width (but normally at least to 15 cm thick) but instead spread thicker than normal over the part to be used by construction traffic. The material for lower portion of the road pavement shall be spread on the part to be trafficked to at least a thickness corresponding to the total depth specified for the road pavement. It may be spread even thicker if especially heavy vehicles will use the construction road. When the actual base course is to be spread the lower portion of the road pavement is to be spread over the whole width. If unsuitable material has been carried onto the surface of the construction road by traffic or if the surface has been crushed the unsuitable material shall first be removed.

:35 Compaction

The lower portion of the road pavement shall be thoroughly compacted and compaction shall be carried on until no appreciable settlement can be observed behind the roller. The provisions of the Work Description for Compaction shall be observed in connection with compaction.

:4 Base Course

:41 General

:411 Method of construction of base course

The choice of base course type and thicknesses have been tabulated in Appendices 2-7. In accordance with these the base course in flexible road pavements 1, 2 and 3 is generally to be carried out in two parts which are different in construction. The lower portion may be constructed of crushed rock, dry-bound macadam or crushed gravel and the upper portion of bituminous gravel, bitumen macadam or similar. The construction of the various bituminous layers has been specified in the Work Description of Paving Work. When making the choice as to type, supplies of materials are to be taken into account. In connection with the construction of the lower portion of the base course, the standard regulations for the planning, construction and maintenance of roads dated 18.6.64 prepared by the TVL shall be followed.

:412 Choice of base course type

The lower portion of the base course for road pavements 1, 2 and 3 is to be constructed of crushed gravel, crushed stone or crushed rock or dry-bound macadam. The surface of the lower portion of the base course is to be impregnated as specified in the Work Description of Paving Work. The whole base course for road pavements types 4, 5 and 6 as well as 3 may be constructed of crushed gravel. Natural instead of crushed gravel may be used for the base course in road pavement type 5.

Traffic may use a gravel base course before surfacing is laid. In order that traffic may use a base course of crushed material the surface is usually impregnated, either completely or partially although traffic may also use a base course of crushed material after it has been bound with sand and the surface blinded with crushed gravel.

:413 Finish of the lower portion of the road pavement

Before the base course is laid the underlying surface, i.e. the sub-base and in the case of Classes A and B the formation,

shall conform to specifications as to evenness of surface, compaction and bearing capacity and have the proper levels and cross falls.

If unsuitable material nas been carried on to the lower portion of the road pavement by construction traffic or the surface has been crushed to a great extent, the unsuitable material shall be removed and replaced by approved materials before the base course is laid.

:414 Surface finish of base course

The finished base course shall have the required thickness and have the proper levels and cross-falls specified on the drawings. The greatest permitted deviation from the proper level is 20 mm for unbound base courses and 15 mm for bound base courses. The finish of the surface shall be checked during the course of the work, and the greatest permitted deviation from true in a length of 5 m will be 20 mm for unbound surfaces and 15 mm for bound surfaces. Should the road, however, be provided with a gravel wearing course a deviation from true of 20 mm may be permitted.

:42 Base course of crushed gravel or gravel

:421 Composition

The composition of the gravel shall be such that its grading curve everywhere lies within the zone indicated on Appendix 15. The largest grain size shall be 35-65 mm but no greater than half the thickness of the layer that may be compacted at any one time. It is important that the base course material does not contain a higher proportion of fine fraction material (grain size under 0,074 mm) than that permitted by the boundary curves. It shall further be ensured that the material does not segregate on spreading.

:422 Surface of base course

Should the roads be provided with a wearing course of oil gravel or gravel, a 5 cm thick layer of crushed gravel with the maximum grain size 18-25 mm is laid on top of the base course. The crushed gravel shall contain a high proportion of

crushed material, and should not in general contain more than 60 % by weight of uncrushed material of grain size larger than 6 mm.

:43 Dry-bound macadam

:431 Quality of the crushed rock

The minimum grain size of the crushed rock shall be 25-35 mm and the maximum 55-65 mm. The largest grain size may, however, not exceed two-thirds of the thickness of the layer. Instead of crushed rock, gravel and crushed rock may also be used. This may in general not contain more than 20 % by weight of uncrushed material. The layer shall be bound by means of sand whose least grain size is 0,5 mm and greatest grain size 4-6 mm. The sand may be replaced by crushed stone material fulfilling the above requirements. Instead of dry-bound macadam crushed rock may be used, whose largest grain size may not exceed 65 mm. As regards construction of the layer the appropriate parts of the following shall be observed.

:432 Spreading of the crushed rock

The crushed rock is generally laid in one layer by means of a special spreader and is then rolled. During rolling more material shall be added onto depressions if required. Spreading and rolling shall be carried out in such a way that the layer is homogeneous and that it fulfils the requirements for the finish of the completed surface.

:433 Binding and blinding

Sand for binding is to be laid in several layers and each layer is to be compacted by means of vibration. Should traffic be allowed to use the surface or if it is to be impregnated the binding sand is to be added only in such a quantity that the interstices of the crushed stone layer are filled to a depth about 2-3 cm below the surface, after which crushed gravel with largest grain size 18-25 mm is to be spread on in such a way that a layer of crushed gravel about 3 cm deep is left on the surface. Instead of crushed gravel crushed rock may be used. If the surface is not to be impregnated and no

appreciable traffic is to use it the amount of binding sand is to be such that it comes up to the top surface of the crushed rock layer. Any excess sand shall be removed from the surface.

:44 Gravel wearing course

:441 Composition

The wearing course to road pavement type 6 can be constructed of crushed gravel or gravel. Other types of road pavement may also be provided with a temporary wearing course of gravel or crushed gravel e.g. to allow traffic during construction. If it is not intended to provide the road at a later stage with oil gravel or a surfacing of higher class, clay or a clayey material can be used for binding the wearing course on road pavement type 6. The use of clay or similar other material is forbidden in wearing courses on road pavement types 1-5.

:442 Production

The stone material for a wearing course for which no clay binder is to be used shall have such a grain-size distribution that the grading curve lies within the zone shown on Appendix 15 and that it is parallel to the boundary curves. The largest grain size shall be 16-18 mm. The stone material used may generally contain no more than 60% by weight uncrushed material reckoned from grains > 6 mm.

A wearing course of clayey gravel is usually a mixture of clay and gravel or crushed gravel or a mixture consisting of moraine and gravel or crushed gravel. The finished mixture shall have such a grain-size distribution that the grading curve lies within the zone shown on Appendix 15 and that it is parallel to the boundary curves. The largest stone size shall be 16-18 mm. The binding capacity of the clay used in a wearing course depends on the proportion of the clay fraction (0,002 mm) which shall be at least 25% by weight but preferably over 50%.

:443 Construction

The wearing course is generally to be 5 cm thick. Gravel or

crushed gravel is spread as one layer and the clay for binding may be deposited in heaps on the sides of the road. When the heaps have dried they are crushed and mixed into the stone material by means of grader or similar plant. Moraine used for binding is generally spread in one layer and is then mixed into the other stone material. Water is added to the materials during mixing, and mixing is continued until the materials have become fully homogeneous. Care shall be taken that during mixing the base course material is not mixed into the wearing course material.

After spreading and any mixing required the surface is to be graded and compacted. The finished wearing course shall have the right thickness and cross-fall. The greatest permitted deviation from the right level is 1,5 cm and the greatest permitted deviation from true 1,5 cm in a length of 5 m.

:444 Dust abatement

For the abatement of dusting of wearing courses calcium chloride, sulphite lye or similar material may be used. Treatment is carried out in accordance with special instructions.

5. SLOPES AND CENTRAL RESERVES

:1 Construction of the slopes and central reserves

Slopes and central reserves should be constructed as specified on the drawings and with regard to the stability of the slope. They should blend in well with the surrounding countryside. In soil excavations the top of the slope shall be rounded off with a radius of at least 5 m, and at the transition between cut and fill sections the gradient of the slope is to be slowly reduced towards the transition point so that the change-over will be gentle.

Larger stones and unsightly or dangerous pieces of rock which are left in side slopes of excavation in soil are to be blasted off level with the surface of the slope or completely removed.

:2 Soiling and grassing of slopes

Ledges formed in the sides of cuttings through rock should be filled with soil so that growth of vegetation may take place. Open textured stone embankments shall have their slope surfaces blinded and covered with a layer of fine moisture-retaining soil about 20 cm thick before being sown; the sloping sides of the road pavement, however, should not be blinded so that water therein cannot be drained away.

Three different methods of soiling and grassing slopes are used. A fourth method is used for the final covering of gravel pits, borrow pits etc.

Method I is used for large refuges, areas around buildings and for most level grassed areas. The thickness of topsoil is generally 15-20 cm and protective seeding is used.

Method II is used on roundabouts, high bridge embankments and around parking areas. The thickness of topsoil is generally 3-5 cm and protective seeding is used. On very steep slopes diagonal ribbing may be used in conjunction with grassing.

Method III includes all large roadside slopes where in general no topsoil is laid but grassing is carried out by spreading fertilizer and seed onto the smoothed surface of the soil direct.

Method IV is used for grassing of abandoned borrow pits and storage areas. The seed mixture may be varied to a great extent and contain e.g. tree and weed seeds depending on local conditions.

Protective layer

Where slopes may easily become eroded or dry out a protective layer is placed immediately after sowing. The layer may consist of leaves, cut-off foliage, straw, peat straw or bitumen or resin emulsion. Straw and peat shall always be treated with bitumen.

Table of Materials

	Method I	II	III	IV
Topsoil cm	15-20	3-5	-	-
Lime kg/ha	3000	2000	-	-
Fertilizer kg/ha	1000	1000	1000	500
Protective seeding "	100	150	-	50
Seed mixture "	200	150	100	50
Protective layer				
a) straw	about 4-5 cm			
b) peat straw	about 4-5 mm			
c) bituminous emulsion	about 0,6 kg/m^2 + 0,6 kg/m^2 water			
d) resin emulsion	about 0,25 kg/m^2 + water			
e) cut-off foliage				
f) leaves				

Lime: agricultural lime
Fertilizer: Oulu Y-fertilizer (or normal Y-fertilizer)
Protective seeding: in winter oats
in autumn rye (from 15 August)
Seed mixture: TVH standard mixtures Nos 1, II and III.

:3 Stone paving of slopes

Paving shall be constructed of blasted rock as specified in the Specifications for Bridge Works.

:4 Turfing of slopes

Turfing is to be carried out with meadow or forest turves or "turf bricks". Turves are to be pegged if required, and may also be supported by diagonal ribbing. Open joints between turves are to be filled with topsoil.

:5 Dry stone walls

Stones are to be well bonded and laid in such a way that the bottom faces of stones in joints in the surface of the wall are sufficiently wide and at right angles to the surface of the wall. The wall is to be constructed in courses and the

stones in the surface should have a depth at least equal to their height. Up to half the number of stones are to be headers with a depth equal to one and a half times that of the stretchers. Stretchers and headers should alternate in both the horizontal and vertical directions. In the case of slender walls the headers are to extend across the whole width of the wall. The back of the wall should consist of stones well bonded with the stones in the front surface. All stones should be laid on their largest faces. Openings in joints in the back of the wall may be filled with stone of the appropriate size so that no wedging action arises due to the weight of the portions of the wall lying on top.

6. CULVERTS

:1 Foundation

Special Drawings have been prepared for culverts on the motorway which show the type of foundation to be used. Should there be no Special Drawing for a culvert the foundation is to be constructed in accordance with the Typical Drawings appended to this Specification. In frost-resistant soils the width of the culvert foundation is to be equal to at least the inside diameter of the culvert + 100 cm, and in frost-susceptible or weak soils to at least the inside diameter + 150 cm. The gravel bed for the culverts shall be in accordance with the Typical Drawings and be well compacted. In the case of coarse fill and weak subsoil a blinding layer 10 cm thick shall be laid at the bottom of the excavation.

:2 Laying of culverts

:21 Laying of concrete pipes

Concrete pipes shall conform to the requirements laid down in the appropriate concrete pipe standards, and the pipes shall be laid in accordance with the provisions of the Work Description of Sewerage and Drainage Works. The pipe joints shall be as tight as possible and be protected by strips of bitumen

impregnated cardboard 20 cm wide. Should there be a risk of settlement the centre portion of the culvert is to be raised. Bedding planks are to be used to facilitate laying of the pipes.

:22 Laying of corrugated iron pipes

The quality of materials of the pipes used shall conform to the Work Description of Sewerage and Drainage Works. Assembly is to be carried out in accordance with the manufacturers instructions.

:3 Culvert ends

Culvert ends shall be constructed in accordance with the Typical Drawings.

:4 Backfilling

Gravel shall be laid in layers 15-30 cm thick and thoroughly compacted simultaneously on both sides. Backfill material even underneath the culvert shall be thoroughly compacted so that no water can flow underneath the culvert resulting in scour.

Concrete pipe culverts shall be backfilled with frost-resistant material up to a level 60 cm above the top of the pipe above which level the filling material shall be that used for the embankment. There must be no stones larger than 10 cm in the lowest part of the backfilling material. The fill is to be particularly well compacted around the whole of the culvert; normally the degree of compaction obtained shall be at least that corresponding to the natural compaction of the material in order that uneven settlement be prevented. Vibratory equipment shall be used with care in the vicinity of culverts.

Corrugated iron pipe culverts shall normally be backfilled with gravelly, frost-resistant material of 10 cm max. stone size. The material may not be frozen. or contain frozen lumps, ice or snow. Before backfilling of the excavation is commenced this shall be well cleared of snow, ice and any frozen lumps, and may not be frozen in the case of frost-susceptible or

weak soils. Filling shall up to about 90% of the height of the culvert be carried out in layers not exceeding 20-40 cm in thickness depending on the efficiency of the compacting equipment.

Should the corrugated iron pipe culvert lie partly above natural ground level (such as underpasses etc.) the backfilling shall, once the excavated portion has been backfilled as specified above, be carried on in layers up till about 90% of the height of the culvert and with a width at least 1 m on each side of the culvert. When the embankment has been completed, the portions next to the corrugated pipe are to be particularly well compacted so that uneven settlement does not occur. Compaction of the material directly above the culvert, however, may not be commenced until 0,5 m thickness has been added since otherwise the culvert may be damaged. Before construction traffic may pass over the culvert at least the minimum thickness of fill permitted for the culvert shall have been placed and well compacted.

:5 Transition wedges

Transitions in connection with culverts on the motorway shall be carried out in accordance with the Drawings. Should there be no Special Drawings for culverts, the transition wedge shall be constructed according to the enclosed Typical Drawings. The material for transition wedges shall fulfil the requirements for sub-base material.

7. CABLE TRENCHES AND CABLE DUCTS

Cable trenches are to be constructed with the bottom widths and depth (80 cm) specified by the respective cable owner. Trenches should be excavated in such a manner that at changes of direction the cable may be laid with a radius corresponding to 15 times the cable diameter unless specified differently. The Contract includes soil and rock excavation and drainage thereof, carting away of excess materials, backfilling and compaction of the excavation as well as tidying-up of the

ground surface. The backfilling material shall consist of frost-resistant material which can be dug out by spade and may not contain stones larger than 10 cm. The Contract does not include provision of steel tubes and ducts which will be delivered to the Site by the cable owners. The provision of cables, their laying, backfilling next to the cable and the covering of the cable with bricks or planks also do not form part of the Contract.

8. SETTING OUT AND MEASUREMENTS

:1 Motorway

For the purposes of measurement and for setting out in the field a traverse has been laid the co-ordinates of whose stations have been calculated. The station points have been sited outside the road working area in such a way that they will not be destroyed during the construction. Setting-out calculations for the centre line of the road have been carried out by computer, and the road will be set out on the basis of these calculations. Additional setting-out calculations have been prepared which may be used when setting-out from the traverse is not possible owing to excavations or embankments. Setting-out calculations have been prepared for intervals of 20 m and should it prove necessary to use a different interval the Contractor is to carry out all necessary calculations and measurements. The Contractor is responsible for the safety of the traverse stations during the time of construction. The Contractor is responsible for all setting out and for the preservation of the line set out. Any additional setting out and calculations therefor, that may be necessary, will be carried out by the Contractor in such a way that the road line may be accurately determined during construction and checked afterwards.

An index of traverse stations in the field has been prepared, on which the positions of the stations are given in relation to features on the ground. Calculations have an accuracy of

1 cm which is also the requirement for the accuracy of setting out.

The centre line of the road has been used as the reference line. Dimensions of the cross-section, positions of test points and other measurements in connection with the road have been given in relation to this line.

The setting-out principle is shown on a special setting-out drawing.

:2 Other roads

The highway from the existing Helsinki - Turku main road to Veikkola interchange and the old Helsinki - Turku highway at Hista and at Gumböle, are tied to the system of co-ordinates in the same way as the motorway, and setting out of and measurements for these roads is to be carried out in the same way as for the motorway.

Other roads are to be set out from their intersection points which have been set out on the ground. Should these come within the working area the Contractor is to tie them in to existing ground features so that the line can be checked during and after construction.

:3 Setting-out of levels

All levels for the road are to be determined with reference to the traverse stations and actual bench marks, the positions of which are shown on the setting-out drawings and on longitudinal sections.

Cross sections are given at intervals of 20 m and the levels have an accuracy of 1 cm. The Contractor is to ensure that bench marks are not obliterated and that they are not displaced either horizontally or vertically. Any additional bench marks are to be established by the Contractor and their level is to be related to bench marks shown on the drawings or to national bench marks in the area.

9. PROVISION FOR MAINTENANCE OF TRAFFIC DURING CONSTRUCTION

:1 General

Work on roads carrying traffic shall be carried out in such a way that the traffic is not interfered with any more than necessary. The work therefore cannot always be carried out in the cheapest possible way, a fact which must be taken account of when tendering.

Before work is commenced it shall be carefully planned so that traffic is interfered with as little as possible. The Contractor shall consult the Employer with regard to stages of the Works where traffic may experience difficulties.

On heavily-traficked roads, no work which interferes with traffic shall if possible be carried out during the times when traffic is heaviest. It may sometimes be convenient or even absolutely necessary to carry out certain work when traffic is light, e.g. at night. Work which constitutes an obstacle for or danger to traffic shall if possible be completed before work is finished for the day and must in no circumstances be left unfinished over the weekend or holidays. Thus e.g. excavation of the road for the laying of culverts etc. shall be planned so that the road can be tidied up before dark, unless work is to be carried on during the night.

:2 Temporary roads

In certain instances it may be necessary to divert the traffic from the road. These for public roads are to be built with a width of 7 m so that two-lane traffic is possible.

Temporary roads shall be provided with any road signs, meeting places etc. necessary.

:3 Temporary carriageways

Temporary roads shall be kept in a condition suitable for the traffic using them. The requirement in this connection is dependent upon the volume of traffic and the length of time during which traffic is compelled to use the temporary road.

The condition of temporary roads shall thus be such that traffic can without appreciable inconvenience pass over it at a reasonable speed depending on the circumstances.

If during snow-free periods more than 5000 vehicles per day shall use a temporary carriageway, it shall be porvided with a temporary surface. This may for instance consist of bitumen macadam. If the traffic is between 3000-5000 vehicles per day and the temporary road shall be used for longer than about 5 weeks, similar surfacing as above is to be considered or possibly only impregnation. The same applies to traffic between 1000-3000 vehicles per day in intensity for more than about 7 weeks. Temporary surfacing shall be laid as soon as possible.

If no surface is laid the temporary carriageway shall be constructed if required with the help of crushed gravel of 18 mm largest stone size. The gravel road shall if necessary have an anti-dusting agent added. Dust abatement is to be carried out with calcium chloride and water or possibly with sulphite lye. The surface of the carriageway shall be raking or otherwise be kept free of stones larger than 30 mm. Grading or patching of the road shall be carried out as soon as the carriageway becomes so uneven that it causes difficulties for the traffic.

:4 Warning and safety measures

The instruction and regulations issued by the National Board for Public Roads and Waterways shall be observed as regards any safety measures and warning signs necessary.

TVH MAATUTKIMUSTOIMISTO Soil research office	Determination of frost susceptibility **Maalajien routivuusarvostelu** of soils	Appendix 1 LIITE 1

Kaikki maalajit, joiden rakeisuuskäyrät ovat alueella 1, ovat routivia.

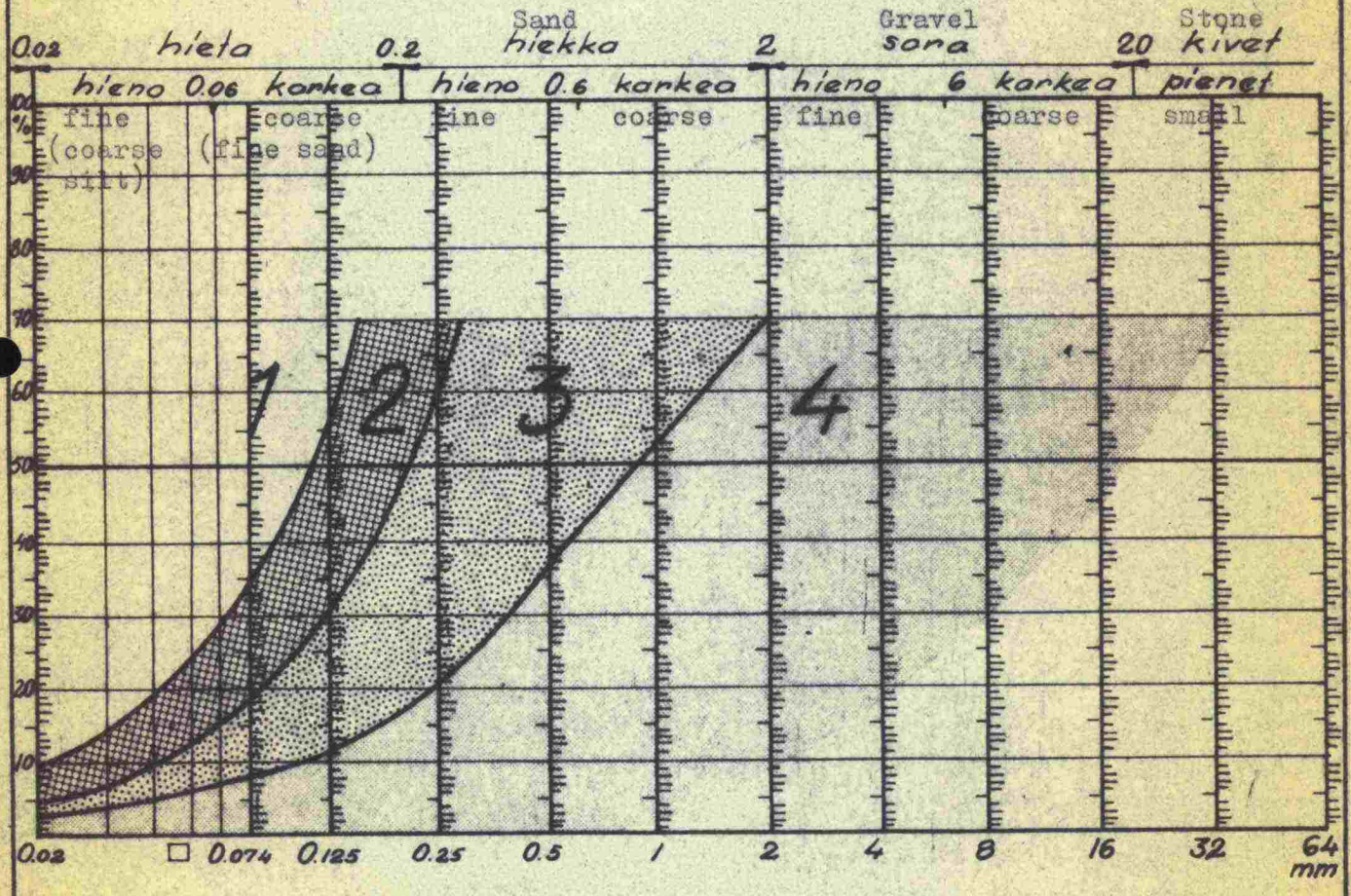
Ne maalajit, joiden rakeisuuskäyrät sijaitsevat alueella 2, 3 tai 4, ovat routimattomia edellyttäen, että käyrien alapäät eivät pääty kyseisen alueen vasemmanpuoleisen rajakäyrän yläpuolelle.

Maalajien routivuutta voidaan myös arvostella kapillaarisuuden perusteella sen ollessa routimattomilla maalajeilla pienempi kuin 1,0 m.

All soils whose grading curves lie within Zone 1 are frost-susceptible.

All soils whose grading curves lie within Zones 2,3 or 4 are frost-resistant, provided that the lower portion of the grading curve does not lie above the curve firming the left-hand boundary of the Zone in question.

The degree of frost-susceptibility of a soil can also be determined by



reference to its capillarity, soils whose capillarity is less than 1,0 m being frost-resistant.

1.2.65

FLEXIBLE PAVEMENT STRUCTURE 1 — NUMBER OF LOAD APPLICATIONS > 4 x 10^6 — TABLE 1

Bearing category	Type of subgrade	Filter course cm	Insulating course cm	Sub-base cm	Total-minimum thickness of filter insulating courses ans sub-base cm		Base course cm		Pavement cm			Minimum thickness of the pavement structure cm	
									Binder course		Wearing course		
					cut	bank	lower layer	upper layer	I	II		cut	bank
A	Rock	-	-	-	-[1]		15[2] a,b,d	6[3]	5[5]	4[6] a	3[6] a	33	(28)
							13[2] a,b,d	8[4]	5[5]	4[6] a	3[6] b		
							10[2] c,d	6[3]	5[5]	4[6] a	3[6] b		
B	Non-frost-susceptible soils, whose grain size curve is inside the design area of the sub-base or which are coarser. For ex. gravel	-	-	-	-		-"-	-"-	-"-	-"-	-"-	-"-[7]	
C	Non-frost-susceptible soils, which are sand or coarser and which do not belong to the former category	-	-	10	10		-"-	-"-	-"-	-"-	-"-	43[7]	
D	Non-frost-susceptible soils, which are fine sands or coarser and which do not belong to the above categories	-	0...10	10...32	32[8]		-"-	-"-	-"-	-"-	-"-	65[7]	
		0...10	-	20...32									
		10...12	10...12	10...12									
E	Frost-susceptible soils expect for those mentioned in category F Dry crust clay, frost-susceptible fine sand and frost-suspectible moraines 9), 10)	-	10...57	10...57	67[8]	52[8]	-"-	-"-	-"-	-"-	-"-	100	85[12]
		10...47[11]	-	20...57									
		10...47[11]	10...47	10...47									
F	Weak soil Very weak clay, peat, mud and silt 10), 13)	-	10...82	10...82	92[8]	72[8]	-"-	-"-	-"-	-"-	-"-	125	105[12]
		10...72[11]	-	20...82									
		10...72[11]	10...72	10...72									

FLEXIBLE PAVEMENT STRUCTURE 1 NUMBER OF LOAD APPLICATIONS $>4.1 \times 10^6$

1) The minimum depth of rock excavation must be one meter from the grade level, and rock fill shall be left under the bearing course for levelling of rock surface. The surface of the excavation must be sealed with small blockstones or chips and the surface must be finished with soil type B. In special cases, the rock surface can be levelled with concrete. In this case, the upper layer of the base course can be placed directly on the concrete layer.

2) a. Crushed gravel with maximum grain size # 35...65 mm.
   b. Alternatively, the lower layer of the base course can be made as vibrated macadam using mineral aggregate # 25 (35)...55 (75) mm, which is sealed with aggregate # 0.5...4 (6) mm.
   c. In special cases, the lower layer of the base course can be made of soil cement, in which case for example sandy gravel can be used as mineral aggregate. Then, the sub-base of bearing categories C...F must be thickened by 5 cm, and the minimum thickness of the upper layer of the pavement structure will consequently be 28 cm.
   d. The upper layer of crushed gravel or vibrated macadam must be grouted and the surface of soil cement must be treated with bitumen emulsion, cut back bitumen or road tar.

3) Bituminous gravel (Bsk 20...35/150) or asphalt concrete (Ab 20...35/150). The layer can alternatively be made of bitumen macadam (AAb). In stage construction of the pavement structure, the bitumen macadam surface must be treated before it is opened to traffic.

4) Grouted macadam (# 25...55 (40) mm) either bound with mix or surface treated, if necessary.

5) Asphalt concrete (Ab 18...25/120) or gravel asphalt concrete (SAb 18...25/120).

6) a. Asphalt concrete (Ab 12...20/100).
   b. Asphalt concrete (Ab 8...15/70) or Topeka (Top), sand asphalt (HA), mastic asphalt (VA) or some corresponding pavement type.

7) If a frost-resistant or frost-active embankment fill with smaller bearing capacity is used on frost-resistant native subgrade, the thickness of the pavement structure is determined by filling earth.

8) The thickness of the insulating and/or filter courses and sub-base is varying depending on available soil types. However, the total thickness mentioned in the table must be achieved. If the mineral aggregate available meets the quality requirements of both the insulating course and the sub-base, the courses may be made of the same aggregate.

9) If difficulties in drainage are observed and if it is to be feared that there will be excessive softening in the subgrade during construction, or that there will be uneven frost action later, the pavement structure F must be used, if necessary, and/or the subgrade must be stabilized with lime for example.

10) If dry crust under one meter thick is observed on clayey soil (normal sounding rods sink when loaded with 100 kg or when screwed) the pavement structure must be made according to the requirements of category F.

11) If the embankment (in special cases) is made of soil types belonging to category B or of such soil type of category C that is coarser than filter sand, a filter course must be used in banks lower than 1.5 meters.

12) When non-frost-active bank fill is used on frost-active native subgrade, the thickness of the pavement structure is determined by filling earth only in cases where the height of bank is greater than the pavement thickness required for the subgrade in a cut.

13) Special instructions will be given of possible consolidation of the subgrade.

General remarks:

- Attempts must be made to keep frost-active soil as deep as possible from the grade line.
- Pavement design is generally based on the number of load applications and not on the number of vehicles as such. In preliminary design, the estimate can yet be made that 20 years after the completion of the road, the number of heavy vehicles on pavement structure 1 will be over 1 300 vehicles per day.

FLEXIBLE PAVEMENT STRUCTURE 2 — NUMBER OF LOAD APPLICATIONS $1.7 \times 10^6 \ldots 4.1 \times 10^6$ — TABLE 2

Bearing category	Type of subgrade	Filter course cm	Insulating course cm	Sub-base cm	Total minimum thickness of filter-, insulating courses and sub-base cm		Base course		Pavement cm		Minimum thickness of the pavement structure cm	
					cut	bank	lower layer	upper layer	Binder course	Wearing course	cut	bank
A	Rock	-	-	-	- [1]		15 [2] a,b,d	6 [3]	5 [5]	4 [6]	30	(25)
							13 [2] a,b,d	8 [4]	5 [5]	4 [6]		
							10 [2] c,d	6 [3]	5 [5]	4 [6]		
B	Non-frost-susceptible soils, whose grain size curve is inside the design area of the sub-base or which are coarser. For ex. gravel	-	-	-	-		-"-	-"-	-"-	-"-	-"-	7)
C	Non-frost-susceptible soils, which are sand or coarser and which do not belong to the former category	-	-	10	10		-"-	-"-	-"-	-"-	40	7)
D	Non-frost-susceptible soils, which are fine sands or coarser and which do not belong to the above categories	-	0...10	10...30	30 [8]		-"-	-"-	-"-	-"-	60	7)
		0...10	-	20...30								
		10	10	10								
E	Frost-susceptible soils expect for those mentioned in category F Dry crust clay, frost-susceptible fine sand and frost-susceptible moraines 9), 10)	-	10...50	10...50	60 [8]	50 [8]	-"-	-"-	-"-	-"-	90	80 [12]
		10...40 [11]	-	20...50								
		10...40 [11]	10...40	10...40								
F	Weak soil Very weak clay, peat, mud and silt 10), 13)	-	10...80	10...80	90 [8]	75 [8]	-"-	-"-	-"-	-"-	120	105 [12]
		10...70 [11]	-	20...80								
		10...70 [11]	10...70	10...70								

FLEXIBLE PAVEMENT STRUCTURE 2 NUMBER OF LOAD APPLICATIONS $1.7 \times 10^6 \ldots 4.1 \times 10^6$

1) The minimum depth of rock excavation must be one meter from the grade level, and rock fill shall be left under the bearing course for levelling of rock surface. The surface of the excavation must be sealed with small blockstones or chips and the surface must be finished with soil type B. In special cases, the rock surface can be levelled with concrete. In this case, the upper layer of the base course can be placed directly on the concrete layer.

2) a. Crushed gravel with maximum grain size # 35...65 mm.
   b. Alternatively, the lower layer of the base course can be made as vibrated macadam using mineral aggregate # 25 (35)...55 (75) mm, which is sealed with aggregate # 0.5...4 (6) mm.
   c. In special cases, the lower layer of the base course can be made of soil cement, in which case for example sandy gravel can be used as mineral aggregate. Then the sub-base of bearing categories C...F must be thickened by 5 cm, and the minimum thickness of the upper layer of the pavement structure will consequently be 25 cm.
   d. The upper layer of crushed gravel or vibrated macadam must be grouted and the surface of soil cement must be treated with bitumen emulsion, cut back bitumen or road tar.

3) Bituminous gravel (Bsk 20...35/150) or asphalt concrete (Ab 20...35/150). The layer can alternatively be made of bitumen macadam (Aab). In stage construction of the pavement structure, the bitumen macadam surface must be treated before it is opened to traffic.

4) Grouted macadam (# 25...55 (40) mm) either bound with mix or surface treated, if necessary.

5) Asphalt concrete (Ab 18...25/120) or gravel asphalt concrete (SAb 18...25/120).

6) Asphalt concrete (Ab 12...15/100) or Topeka (Top), sand asphalt (HA), mastic asphalt (VA) or a corresponding pavement type.

7) If a frost-resistant or frost-active embankment fill with smaller bearing capacity is used on frost-resistant native subgrade, the thickness of the pavement structure is determined by filling earth.

8) The thickness of the insulating and/or filter courses and sub-base is varying depending on available soil types. However, the total thickness mentioned in the table must be achieved. If the mineral aggregate available meets the quality requirements of both the insulating course and the sub-base, the courses may be made of the same aggregate.

9) If difficulties in drainage are observed and if it is to be feared that there will be excessive softening in the subgrade during construction, or that there will be uneven frost action later, the pavement structure F must be used, if necessary, and/or the subgrade must be stabilized with lime for example.

10) If dry crust under one meter thick is observed on clayey soil (normal sounding rods sink when loaded with 100 kg or when screwed) the pavement structure must be made according to the requirements of category F.

11) If the embankment (in special cases) is made of soil types belonging to category B or of such soil type of category C that is coarser than filter sand, a filter course must be used in banks lower than 1.5 meters.

12) When non-frost-active bank fill is used on frost-active native subgrade, the thickness of the pavement structure is determined by filling earth only in cases where the height of bank is greater than the pavement thickness required for the subgrade in a cut.

13) Special instructions will be given of possible consolidation of the subgrade.

General remarks:

- Attempts must be made to keep frost-active soil as deep as possible from the grade line.
- Pavement design is generally based on the number of load applications and not on the number of vehicles as such. In preliminary design, the estimate can yet be made that 20 years after the completion of the road, the average number of heavy vehicles on pavement structure 2 will be 600... 1 300 vehicles per day.

FLEXIBLE PAVEMENT STRUCTURE 3 NUMBER OF LOAD APPLICATIONS 6.8×10^5 ... 1.7×10^6 TABLE 3

Bearing category	Type of subgrade	Filter course cm	Insulating course cm	Sub-base cm	Total minimum thickness of filter-, insulating courses and sub-base cm		Base course cm		Pavement cm		Minimum thickness of the pavement structure cm	
					cut	bank	lower layer	upper layer	Binder course	Wearing course	cut	bank
A	Rock	-	-	-	- [1]		15 [2] a,b,d	-	5 [4]	4 [5]	24	(19)
							7 [2] a,b,d	8 [3]	5 [4]	4 [5]		
							10 [2] c,d	-	5 [4]	4 [5]		
B	Non-frost-susceptible soils, whose grain size curve is inside the design area of the sub-base or which are coarser. For. ex. gravel	-	-	-	-		-"-	-"-	-"-	-"-	-"-	6)
C	Non frost-susceptible soils, which are sand or coarser and which do not belong to the former category	-	-	10	10		-"-	-"-	-"-	-"-	34	6)
D	Non-frost-susceptible soils, which are fine sands or coarser and which do not belong to the above categories	-	0...21	10...31	31 [7]		-"-	-"-	-"-	-"-	55	6)
		0...11	-	20...31								
		10...11	10...11	10...11								
E	Frost-susceptible soils expect for those mentioned in category F Dry crust clay, frost-susceptible fine sand and frost-susceptible moraines 8), 9)	-	10...46	10...46	56 [7]	46 [7]	-"-	-"-	-"-	-"-	80	70 [11]
		10...36 [10]	-	20...46								
		10...36 [10]	10...36	10...36								
F	Weak soil Very weak clay, peat, mud and silt 9), 12)	-	10...76	10...76	86 [7]	76 [7]	-"-	-"-	-"-	-"-	110	100 [11]
		10...66 [10]	-	20...76								
		10...66 [10]	10...66	10...66								

Appendix 4 A
TABLE 3

FLEXIBLE PAVEMENT STRUCTURE 3 NUMBER OF LOAD APPLICATIONS
$6.8 \times 10^5 \ldots 1.7 \times 10^6$

1) The minimum depth of rock excavation must be one meter from the grade level, and rock fill shall be left under the bearing course for levelling of rock surface. The surface of the excavation must be sealed with small blockstones or chips and the surface must be finished with soil type B. In special cases, the rock surface can be levelled with concrete. In this case, the upper layer of the base course can be placed directly on the concrete layer.

2) a. Crushed gravel with maximum grain size # 35...65 mm.
   b. Alternatively, the lower layer of the base course can be made as vibrated macadam using mineral aggregate # 25 (35)...55 (75) mm, which is sealed with aggregate # 0.5...4 (6) mm.
   c. In special cases, the lower layer of the base course can be made of soil cement, in which case for example sandy gravel can be used as mineral aggregate. Then, the subbase of bearing categories C...F must be thickened by 5 cm, and the minimum thickness of the upper layer of the pavement structure will consequently be 19 cm.
   d. The upper layer of crushed gravel or vibrated macadam must be grouted and the surface of soil cement must be treated with bitumen emulsion, cut base bitumen or road tar.

3) Grouted macadam (# 25...55 (40) mm) either bound with mix or surface treated, if necessary. Alternatively, the layer can be made of bituminous gravel (Bsk 20...35/150) with the thickness of 6 cm, while the thickness of the lower layer of the bearing course must be 9 cm.

4) Asphalt concrete (Ab 18...25/120) or gravel asphalt concrete (SAb 18...25/120).

5) Asphalt concrete (Ab 12...15/100).

6) If a frost-resistant embankment fill with smaller bearing capacity is used on frost-resistant native subgrade, the thickness of the pavement structure is determined by filling earth.

7) The thickness of the insulating and/or filter courses and sub-base is varying depending on available soil types. However, the total thickness mentioned in the table must be achieved. If the mineral aggregate available meets the quality requirements of both the insulating course and the sub-base, the courses may be made of the same aggregate.

8) If difficulties in drainage are observed and if it is to be feared that there will be excessive softening in the subgrade during construction, or that there will be uneven frost action later, the pavement structure F must be used, if necessary, and/or the subgrade must be stabilized with lime for example.

9) If dry crust under one meter thick is observed on clayey soil (normal sounding rods sink when loaded with 100 kg or when screwed) the pavement structure must be made according to the requirements of category F.

10) If the embankment (in special cases) is made of soil types belonging to category B or of such soil type of category C that is coarser than filter sand, a filter course must be used in banks lower than 1.5 meters.

11) When non-frost-active bank fill is used on frost-active native subgrade, the thickness of the pavement structure is determined by filling earth only in cases where the height of bank is greater than the pavement thickness required for the subgrade in a cut.

12) Special instructions will be given of possible consolidation of the subgrade.

General remarks:

- Attempt must be made to keep frost-active soil as deep as possible from the grade line.
- Pavement design is generally based on the number of load applications and not on the number of vehicles as such. In preliminary design, the estimate can yet be made that 20 years after the completion of the road the average number of heavy vehicles on pavement structure 3 will be 250...600 vehicles per day.

PAVEMENT STRUCTURE 4 NUMBER OF LOAD APPLICATIONS $2.8 \times 10^5 \ldots 6.8 \times 10^5$ TABLE 4

Bearing category	Type of subgrade	Filter course cm	Insulating course cm	Sub-base cm	Total minimum thickness of filter, insulating courses and sub-base cm		Base course	Pavement cm	Minimum thickness of the pavement structure cm	
					cut	bank			cut	bank
A	Rock	-	-	-	- [1]		15 [2]	5 [3]	20	
B	Non-frost susceptible soils, whose grain size curve is inside the design area of the sub-base or which are coarser. For ex. gravel	-	-	-	-		-"-	-"-	-"- [4]	
C	Non-frost-susceptible soils, which are sand or coarser and which do not belong to the former category	-	-	10	10		-"-	-"-	30 [4]	
D	Non-frost-susceptible soils, which are fine sands or coarser and which do not belong to the above categories	-	0...20	10...30	30 [6]		-"-	-"-	50 [4]	
		0...10	-	20...30						
		10	10	10						
E	Frost-susceptible soils expect for those mentioned in category F Dry crust clay, frost-suspectible fine sand and frost-susceptible moraines 8), 9)	-	10...45	10...45	55 [6]	45 [6]	-"-	-"-	75	65 [7]
		10...35 [5]	-	20...45						
		10...35 [5]	10...35	10...35						
F	Weak soil Very weak clay, peat, mud and silt 9), 10)	-	10...70	10...70	80 [6]	70 [6]	-"-	-"-	100	90 [7]
		10...60 [5]	-	20...70						
		10...60 [5]	10...60	10...60						

PAVEMENT STRUCTURE 4 NUMBER OF LOAD APPLICATIONS
$2.8 \times 10^5 \ldots 6.8 \times 10^5$

1) a. Rock excavation must be made so deep that the base of the cut can be carefully levelled using small blockstones and/or chips and finished with soil type B to the level of the lower layer of the pavement structure. In special cases, the rock surface can be levelled with concrete.
   b. If the road will be paved, rock excavation must be performed as for pavement structures 1...3.

2) a. Crushed gravel with maximum grain size # 35...65 mm.
   b. Alternatively, the lower layer of the base course can be made as vibrated macadam using mineral aggregate # 25 (35)...55 (75) mm, which is sealed with aggregate # 0.5...4 (6) mm.

3) Oil gravel (Ös 18/90), cut-back bitumen gravel (Bls 18/100...120), gravel asphalt concrete (SAb 12...25/100...120), asphalt concrete (Ab 12...25/100...120) or a corresponding pavement type. Instead of oil gravel and cut-back bitumen gravel the wearing course can be made of macadam (Is, Es, Ts) or using the grouting and surface treatment method of gravel roads (IPk). In this case the thickness of the base course must be 18 cm.

4) If a frost-resistant or frost-active embankment fill with smaller bearing capacity is used on frost-resistant native subgrade, the thickness of the pavement structure is determined by filling earth.

5) If the embankment (in special cases) is made of soil types belonging to category B or of such soil type of category C that is coarser than filter sand, a filter course must be used in banks lower than 1.5 meters.

6) The thickness of the insulating and/or filter courses and sub-base is varying depending on available soil types. However, the total thickness mentioned in the table must be achieved. If the mineral aggregate available meets the quality requirements of both the insulating course and the sub-base, the courses may be made of the same aggregate.

7) When non-frost-active bank fill is used on frost-active native subgrade, the thickness of the pavement structure is determined by filling earth only in cases where the height of bank is greater than the pavement thickness required for the subgrade in a cut.

8) If difficulties in drainage are observed and if it is to be feared that there will be excessive softening in the subgrade during construction, or that there will be uneven frost action later, the pavement structure F must be used, if necessary, and/or the subgrade must be stabilized with lime for example.

9) If dry crust under one meter thick is observed on clayey soil (normal sounding rods sink when loaded with 100 kg or when screwed) the pavement structure must be made according to the requirements of category F.

10) Special instructions will be given of possible consolidation of the subgrade.

General remarks:

- Attempts must be made to keep frost-active soil as deep as possible from the grade line.
- Pavement design is generally based on the number of load applications and not on the number of vehicles as such. In preliminary design the estimate can yet be made that 20 years after the completion of the road the average number of heavy vehicles on pavement structure 4 will be 100...250 vehicles per day.

PAVEMENT STRUCTURE 5 NUMBER OF LOAD APPLICATIONS $1.1 \times 10^5 \ldots 2.8 \times 10^5$ TABLE 5

Bearing category	Type of subgrade	Filter course cm	Insulating course cm	Sub-base cm	Total minimum thickness of filter-, insulating courses and sub-base cm		Base course cm	Pavement cm	Minimum thickness of the pavement structure cm	
					cut	bank			cut	bank
A	Rock	-	-	-	- [1]		10 [2]	5 [3]	15	
B	Non-frost-susceptible soils, whose grain size curve is inside the design area of the sub-base or which are coarser. For ex. gravel	-	-	-	-		-"-	-"-	-"- [4]	
C	Non-frost-susceptible soils, which are sand or coarser and which do not belong to the former category	-	-	10	10		-"-	-"-	25 [4]	
D	Non-frost-susceptible soils, which are fine sands or coarser and which do not belong to the above categories	-	0...20	10...30	30 [6]		-"-	-"-	45 [4]	
		0...10	-	20...30						
		10	10	10						
E	Frost-susceptible soils expect for those mentioned in category F Dry crust clay, frost-susceptible fine sand and frost-susceptible moraines 8), 9)	-	10...30	10...40	50 [6]	40 [6]	-"-	-"-	65	55 [7]
		10...30 [5]	-	20...40						
		10...30 [5]	10...30	10...30						
F	Weak soil Very weak clay, peat, mud and silt 9), 10)	-	10...65	10...65	75 [6]	65 [6]	-"-	-"-	90	80 [7]
		10...55 [5]	-	20...65						
		10...55 [5]	10...55	10...55						

PAVEMENT STRUCTURE 5 NUMBER OF LOAD APPLICATIONS
$1.1 \times 10^5 ... 2.8 \times 10^5$

1) Rock excavation must be made so deep that the base of the cut can be carefully levelled using small blockstones and/or chips and finished with soil type B to the level of the lower layer of the pavement structure. In special cases, the rock surface can be levelled with concrete.

2) a. Crushed gravel with maximum grain size # 35...65 mm.
   b. Alternatively, the lower layer of the base course can be made as vibrated macadam using mineral aggregate # 25 (35)...55 (75) mm, which is sealed with aggregate # 0.5...4 (6) mm.

3) Oil gravel (Ös 18/90), cut-back bitumen gravel (Bls 18/100 ...120) or a corresponding pavement type. Alternatively, the wearing course can be made of macadam (Is, Es, Ts) or using the grouting and surface treatment method of gravel roads (IPk). In this case, the thickness of the base course must be 13 cm.

4) If a frost-resistant or frost-active embankment fill with smaller bearing capacity is used on frost-resistant native subgrade, the thickness of the pavement structure is determined by filling earth.

5) If the embankment (in special cases) is made of soil types belonging to category B or of such soil type of category C that is coarser than filter sand, a filter course must be used in banks lower than 1.5 meters.

6) The thickness of the insulating and/or filter courses and sub-base is varying depending on available soil types. However, the total thickness mentioned in the table must be achieved. If the mineral aggregate available meets the quality requirements of both the insulating course and the sub-base, the courses may be made of the same aggregate.

7) When non-frost-active bank fill is used on frost-active native subgrade, the thickness of the pavement structure is determined by filling earth only in cases where the height of

bank is greater than the pavement thickness required for the subgrade in a cut.

8) If difficulties in drainage are observed and if it is to be feared that there will be excessive softening in the subgrade during construction, or that there will be uneven frost action later, the pavement structure F must be used, if necessary, and/or the subgrade must be stabilized with lime for example.

9) If dry crust under one meter thick is observed on clayey soil (normal sounding rods sink when loaded with 100 kg or when screwed) the pavement structure must be made according to the requirements of category F.

10) Special instructions will be given of possible consolidation of the subgrade.

General remarks:

- Attempts must be made to keep frost-active soil as deep as possible from the grade line.
- Pavement design is generally based on the number of load applications and not on the number of vehicles as such. In preliminary design the estimate can yet be made that 20 years after the completion of the road the average number of heavy vehicles on pavement structure 5 will be 35...100 vehicles per day.

PAVEMENT STRUCTURE 6 NUMBER OF LOAD APPLICATIONS $< 1.1 \times 10^5$ TABLE 6

Bearing category	Type of subgrade	Filter course cm	Insulating course cm	Sub-base cm	Total minimum thickness of filter-, insulating courses and sub-base cm		Base course cm	Pavement cm	Minimum thickness of the pavement structure cm	
					cut	bank			cut	bank
A	Rock	-	-	-	- [1]		10 [2]	5 [3]	15	
B	Non-frost-susceptible soils, whose grain size curve is inside the design area of the sub-base or which are coarser. For ex. gravel	-	-	-	-		-"-	-"-	-"- [4]	
C	Non-frost-susceptible soils, which are sand or coarser and which do not belong to the former category	-	-	10	10		-"-	-"-	25 [4]	
D	Non-frost-susceptible soils, which are fine sands or coarser and which do not belong to the above categories	0...10	-	15...25	25 [6]		-"-	-"-	40 [4]	
		-	10...15	10...15						
E	Frost-susceptible soils expect for those mentioned in category F Dry crust clay, frost-susceptible fine sand and frost-susceptible moraines 8), 9)	-	10...35	10...35	45 [6]	35 [6]	-"-	-"-	60	50 [7]
		10...25 [5]	-	20...35						
		10...25 [5]	10...25	10...25						
F	Weak soil Very weak clay, peat, mud and silt 9), 10)	-	10...35	10...55	65 [6]	55 [6]	-"-	-"-	80	70 [7]
		10...45 [5]	-	20...55						
		10...45 [5]	10...45	10...45						

PAVEMENT STRUCTURE 6 NUMBER OF LOAD APPLICATIONS $< 1.1 \times 10^5$

1) Rock excavation must be made so deep that the base of the cut can be carefully levelled using small blockstones and/or chips and finished with soil type B to the level of the lower layer of the pavement structure. In special cases, the rock surface can be levelled with concrete.

2) a. Crushed gravel, meeting the quality requirements of the base course, or very well graded native gravel, the upper layer of which is finished with crushed gravel.

b. Alternatively the lower layer of the base course can be made as vibrated macadam using mineral aggregate # 25 (35)...55 (75) mm, which is sealed with aggregate # 0.5...4 (6) mm.

3) Oil gravel (Ös 18/90) or gravel. Alternatively the wearing course can be made of macadam (Is, Es, Ts) or using the grouting and surface treatment method of gravel roads (IPk). In this case the base course must be made 13 cm thick.

4) If a frost-resistant or frost-active embankment fill with smaller bearing capacity is used on frost-resistant native subgrade, the thickness of the pavement structure is determined by filling earth.

5) If the embankment (in special cases) is made of soil types belonging to category B or of such soil type of category C that is coarser than filter sand, a filter course must be used in banks lower than 1.5 meters.

6) The thickness of the insulating and/or filter courses and sub-base is varying depending on available soil types. However, the total thickness mentioned in the table must be achieved. If the mineral aggregate available meets the quality requirements of both the insulating course and the sub-base, the courses may be made of the same aggregate.

7) When non-frost-active bank fill is used on frost-active native subgrade, the thickness of the pavement structure is determined by filling earth only in cases where the height of

bank is greater than the pavement thickness required for the subgrade in a cut.

8) If difficulties in drainage are observed and if it is to be feared that there will be excessive softening in the subgrade during construction, or that there will be uneven frost action later, the pavement structure F must be used, if necessary, and/or the subgrade must be stabilized with lime for example.

9) If dry crust under one meter thick is observed on clayey soil (normal sounding rods sink when loaded with 100 kg or when screwed) the pavement structure must be made according to the requirements of category F.

General remarks:

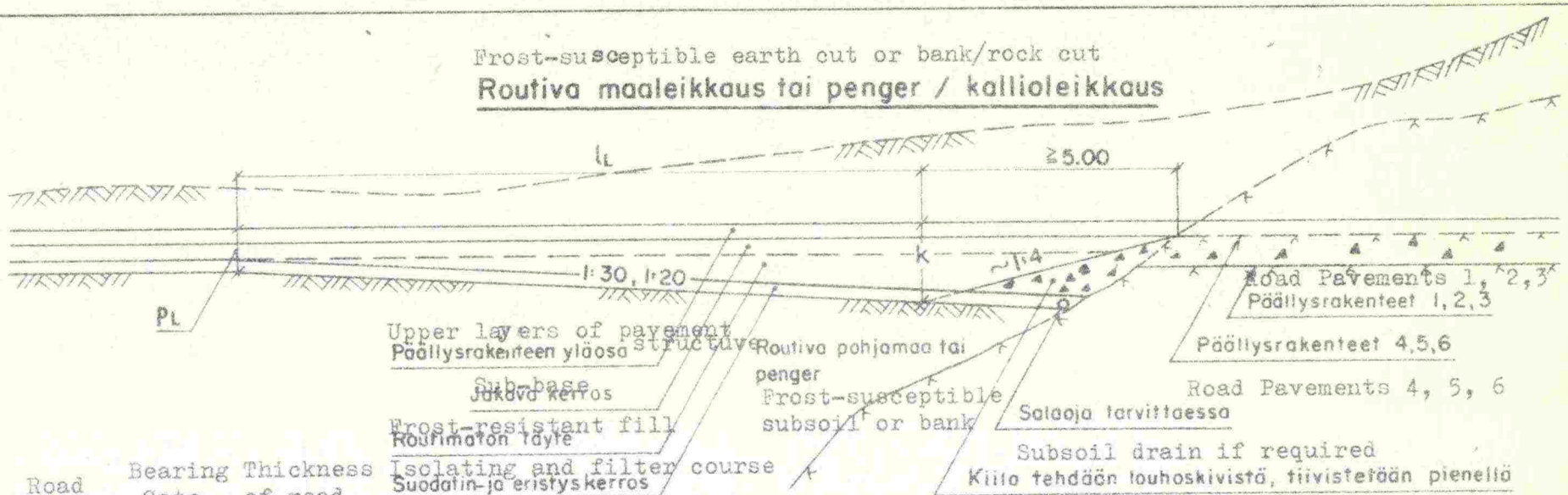
- Attempts must be made to keep frost-active soil as deep as possible from the grade line.
- Pavement design is generally based on the number of load applications and not on the number of vehicles as such. In preliminary design, the estimate can yet be made that 20 years after the completion of the road the average number of heavy vehicles on pavement structure 6 will be under 35 vehicles per day.

Päällysrakennekerrokset Road Pavement layers

Siirtymäkiila Transition Wedge

Frost-susceptible earth cut or bank/rock cut

Routiva maaleikkaus tai penger / kallioleikkaus



The wedge is constructed of blasted rock, the surface is blinded with spalls and finished with Soil Class B. If the slope of the rock is flatter than 1:4, no wedge is required.

Fig. 1.
Kuva 1

Road Pavement Päällysrakenne	Bearing Category Kantavuusluokka	Thickness of road pavement Päällysrakenteen paksuus P_L cm	Length of wedge Kiilan pituus l_L m: k = 1.60, Kiilan kaltevuus 1:30	k = 1.60, Kiilan kaltevuus 1:20	k = 1.80, Kiilan kaltevuus 1:30	k = 1.80, Kiilan kaltevuus 1:20	k = 2.00, Kiilan kaltevuus 1:30	k = 2.00, Kiilan kaltevuus 1:20
1	E	100	18.00	12.00	24.00	16.00	30.00	20.00
	F	125	10.50	7.00	16.50	11.00	22.50	15.00
2	E	90	21.00	14.00	27.00	18.00	33.00	22.00
	F	120	12.00	8.00	18.00	12.00	24.00	16.00
3	E	80	24.00	16.00	30.00	20.00	36.00	24.00
	F	110	15.00	10.00	21.00	14.00	27.00	18.00
4	E	75	25.50	17.00	31.50	21.00	37.50	25.00
	F	100	18.00	12.00	24.00	16.00	30.00	20.00
5	E	65	28.50	19.00	34.50	23.00	40.50	27.00
	F	90	21.00	14.00	27.00	18.00	33.00	22.00
6	E	60	30.00	20.00	36.00	24.00	42.00	28.00
	F	80	24.00	16.00	30.00	20.00	36.00	24.00

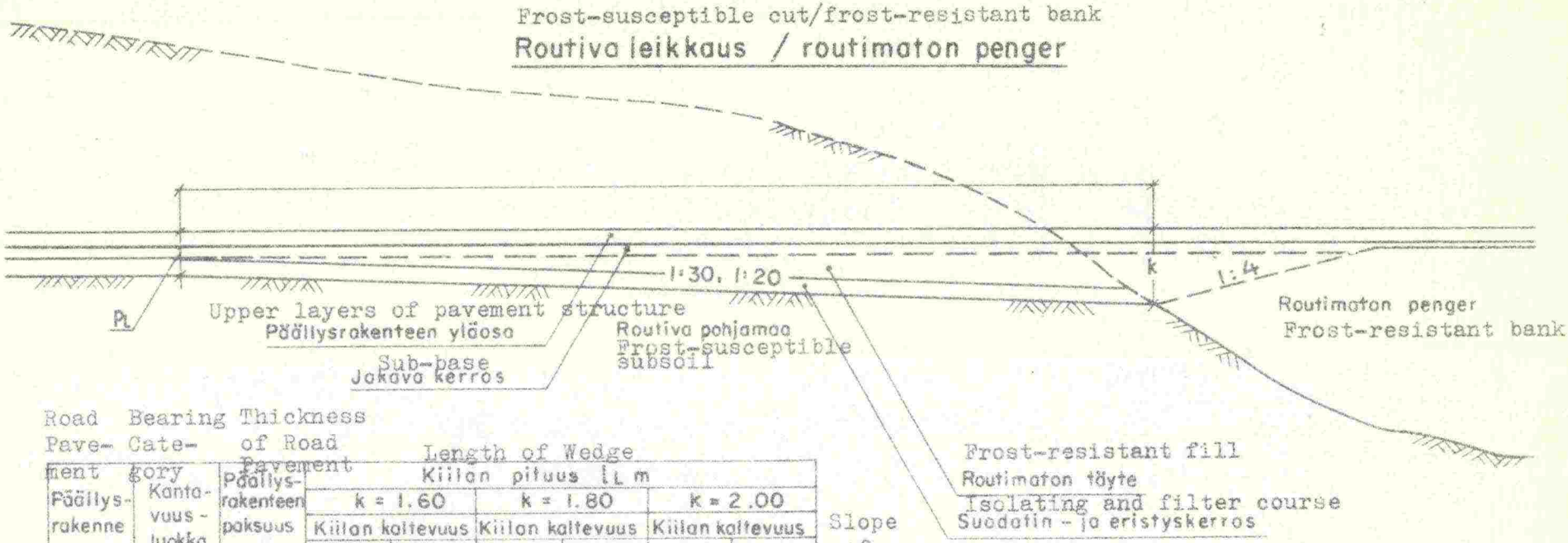
Slope of Wedge

Päällysrakennekerrokset Road Pavement Layers

Siirtymäkiila Transition Wedge

Frost-susceptible cut/frost-resistant bank

Routiva leikkaus / routimaton penger



Road Pavement Päällysrakenne	Bearing Category Kantavuusluokka	Thickness of Road Pavement Päällysrakenteen paksuus p_L cm	Length of Wedge Kiilan pituus l_L m						Slope of Wedge
			k = 1.60		k = 1.80		k = 2.00		
			Kiilan kaltevuus		Kiilan kaltevuus		Kiilan kaltevuus		
			1:30	1:20	1:30	1:20	1:30	1:20	
1	E	100	18.00	12.00	24.00	16.00	30.00	20.00	
	F	125	10.50	7.00	16.50	11.00	22.50	15.00	
2	E	90	21.00	14.00	27.00	18.00	33.50	22.00	
	F	120	12.00	8.00	18.00	12.00	24.00	16.00	
3	E	80	24.00	16.00	30.00	20.00	36.00	24.00	
	F	110	15.00	10.00	21.00	14.00	27.00	18.00	
4	E	75	25.50	17.00	31.50	21.00	37.50	25.00	
	F	100	18.00	12.00	24.00	16.00	30.00	20.00	
5	E	65	28.50	19.00	34.50	23.00	40.50	27.00	
	F	90	21.00	14.00	27.00	18.00	33.00	22.00	
6	E	60	30.00	20.00	36.00	24.00	42.00	28.00	
	F	80	24.00	16.00	30.00	20.00	36.00	24.00	

Siirtymäkiila voidaan tehdä pengertäytteenä käytettävästä kiviaineksesta. Jos kiila kuitenkin rakennetaan kantavammasta kiviaineksesta kuin penger, tehdään kiilan penkereellä oleva osa kuvassa katkoviivalla esitetyllä tavalla kaltevuuteen 1:4.

Transition wedge may be constructed of the stone Material used for the bank, If the wedge is constructed of stronger stone however the portion of wedge whithin the bank is to be laid at a slope of 1:4 as shown with broken lines.

Kuva 2
Fig. 2

Päällysrakennekerrokset — Road Pavement Layers
Siirtymäkiila — Transition Wedge

Frost-resistant earth cut or bank/rock cut

Routimaton maaleikkaus tai penger / kallioleikkaus

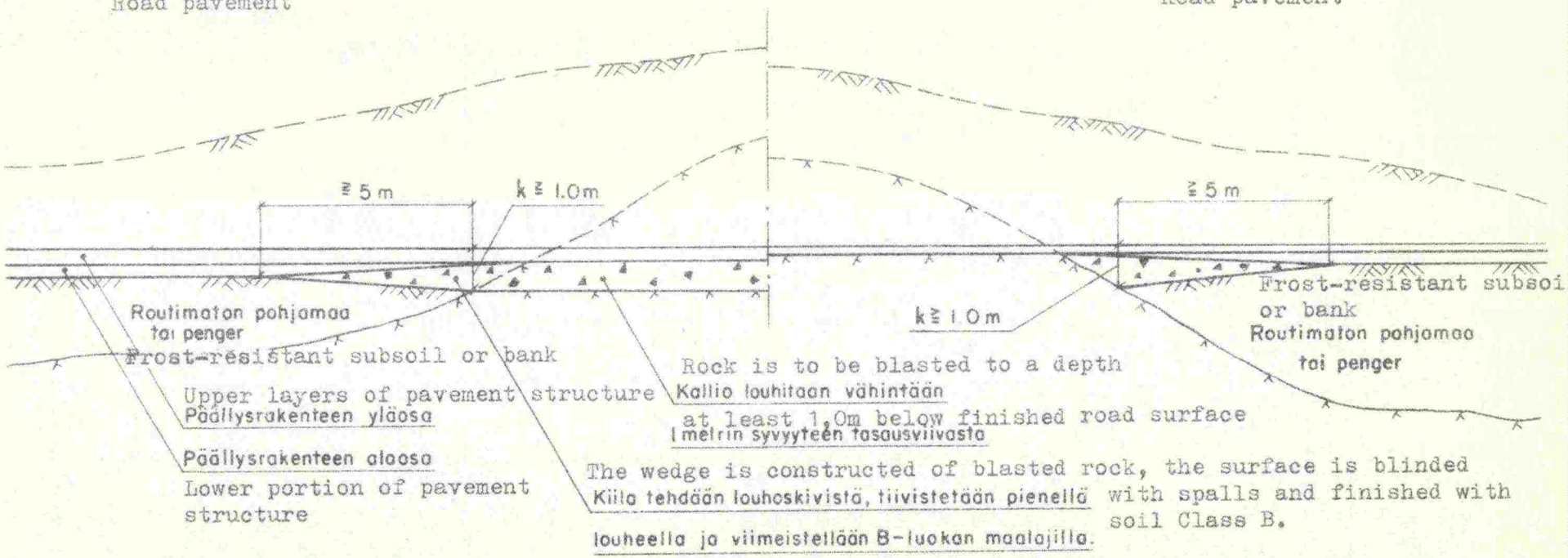


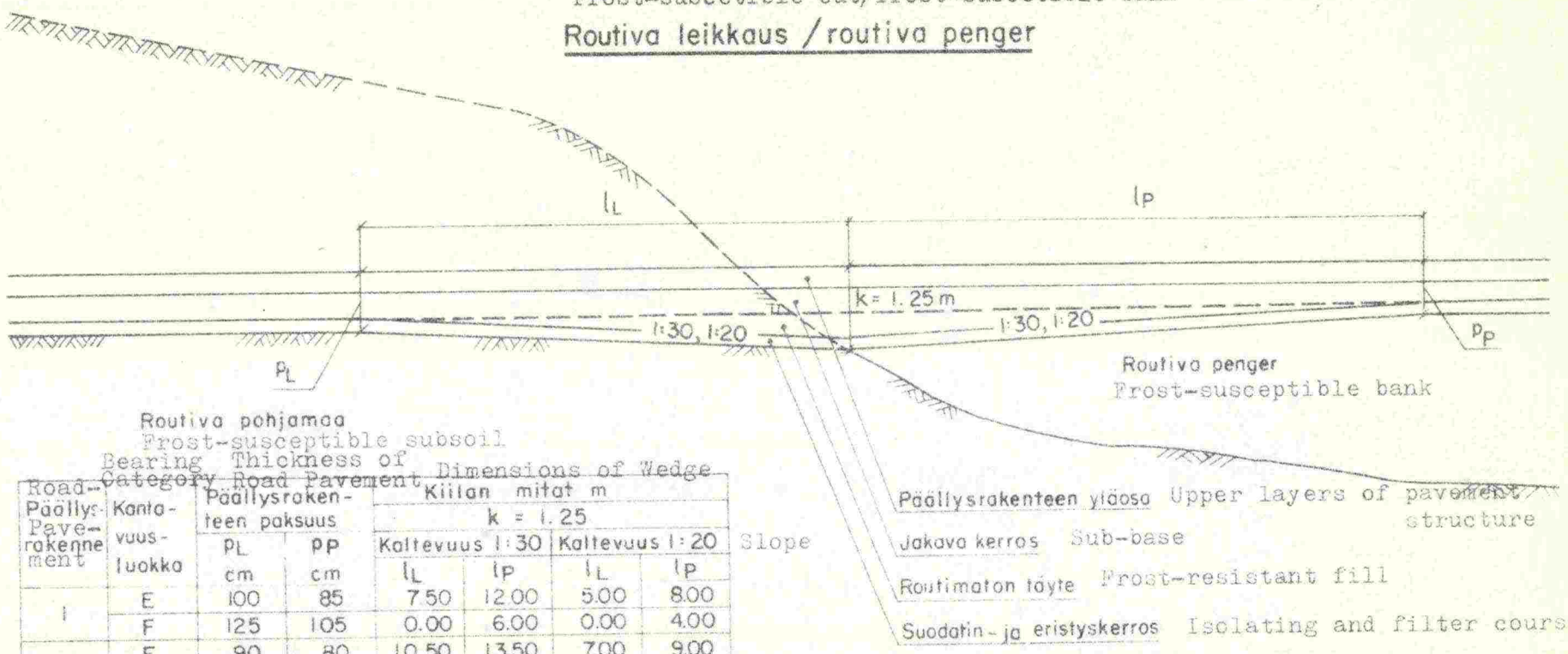
Fig. Kuva 3

Päällysrakennekerrokset Road Pavement Layers

Siirtymäkiila Transition Wedge

Frost-suscetible cut/frost-suscetible bank

Routiva leikkaus / routiva penger



Road-Päällys-Pave-rakenne ment	Bearing Category	Thickness of Road Pavement		Dimensions of Wedge			
	Kanta-vuus-luokka	Päällysraken-teen paksuus		Kiilan mitat m k = 1.25			
		p_L	p_P	Kaltevuus 1:30		Kaltevuus 1:20	Slope
		cm	cm	l_L	l_P	l_L	l_P
1	E	100	85	7.50	12.00	5.00	8.00
	F	125	105	0.00	6.00	0.00	4.00
2	E	90	80	10.50	13.50	7.00	9.00
	F	120	105	1.50	6.00	1.00	4.00
3	E	80	70	13.50	16.50	9.00	11.00
	F	110	100	4.50	7.50	3.00	5.00
4	E	75	65	15.00	18.00	10.00	12.00
	F	100	90	7.50	10.50	5.00	7.00
5	E	65	55	18.00	21.00	12.00	14.00
	F	90	80	10.50	13.50	7.00	9.00
6	E	60	50	19.50	22.50	13.00	15.00
	F	80	70	13.50	16.50	9.00	11.00

Fig. 4

Kuva 4

Päällysrakennekerrokset Road Pavement Layers
Siirtymäkiila Transition Wedge

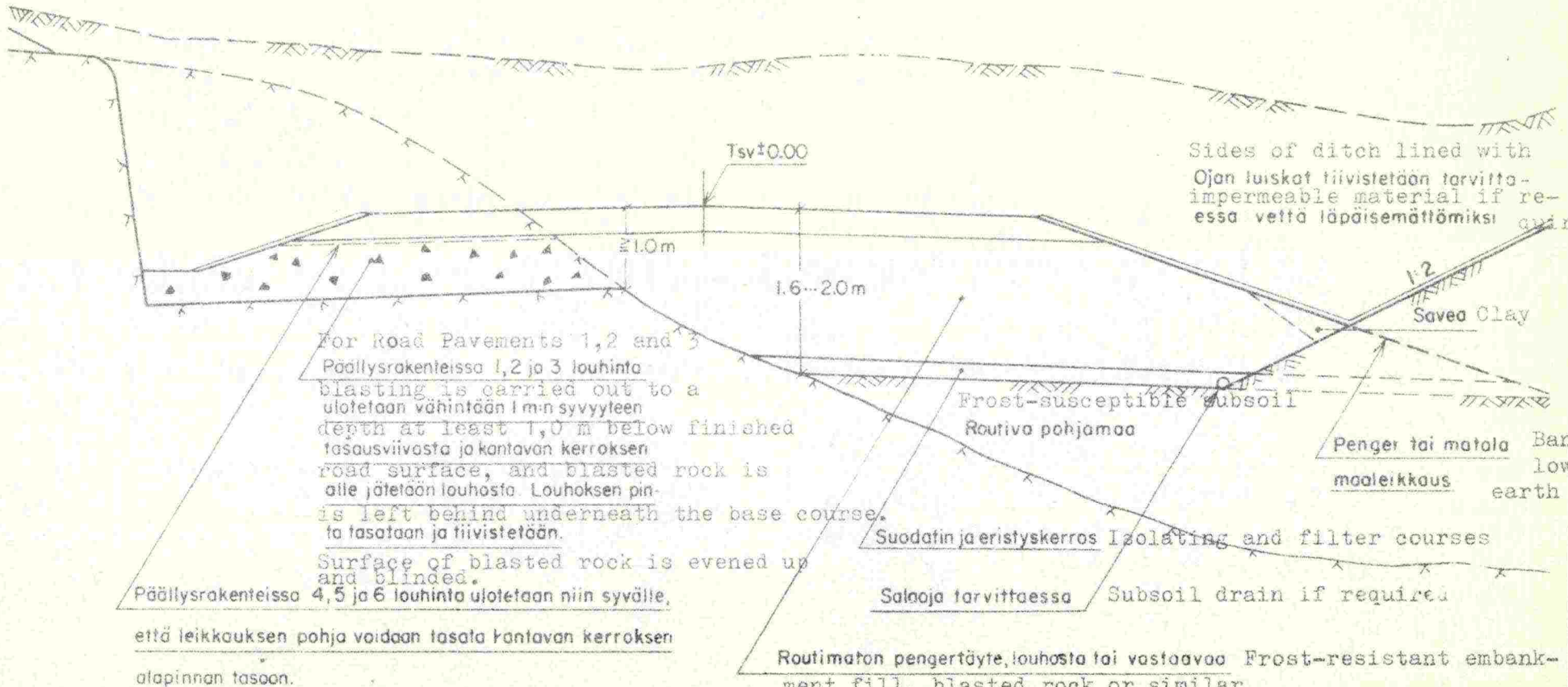


Fig. 5
Kuva 5

Päällysrakennekerrokset — Road Pavement Layers

Siirtymäkiila — Transition Wedge

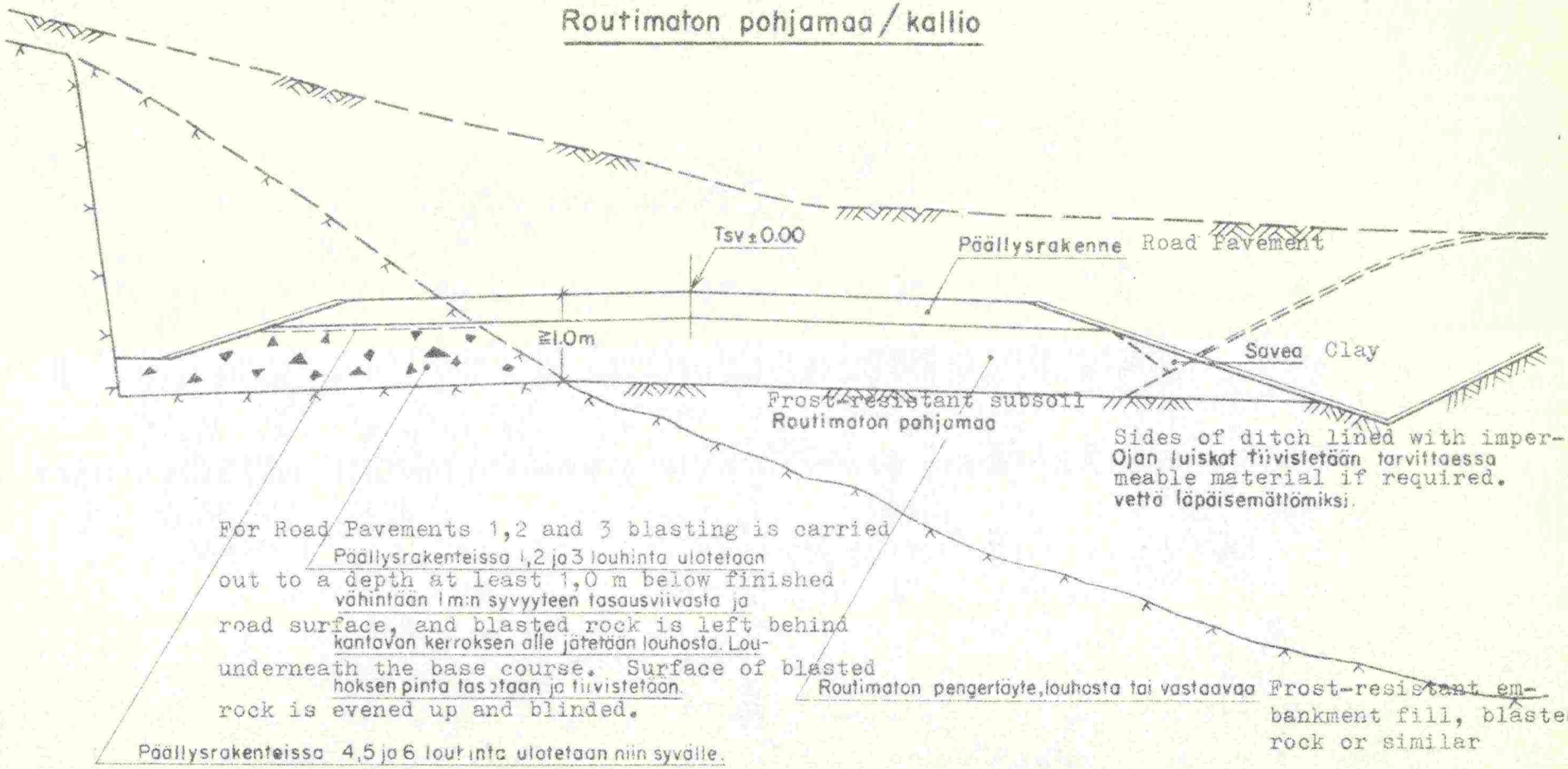
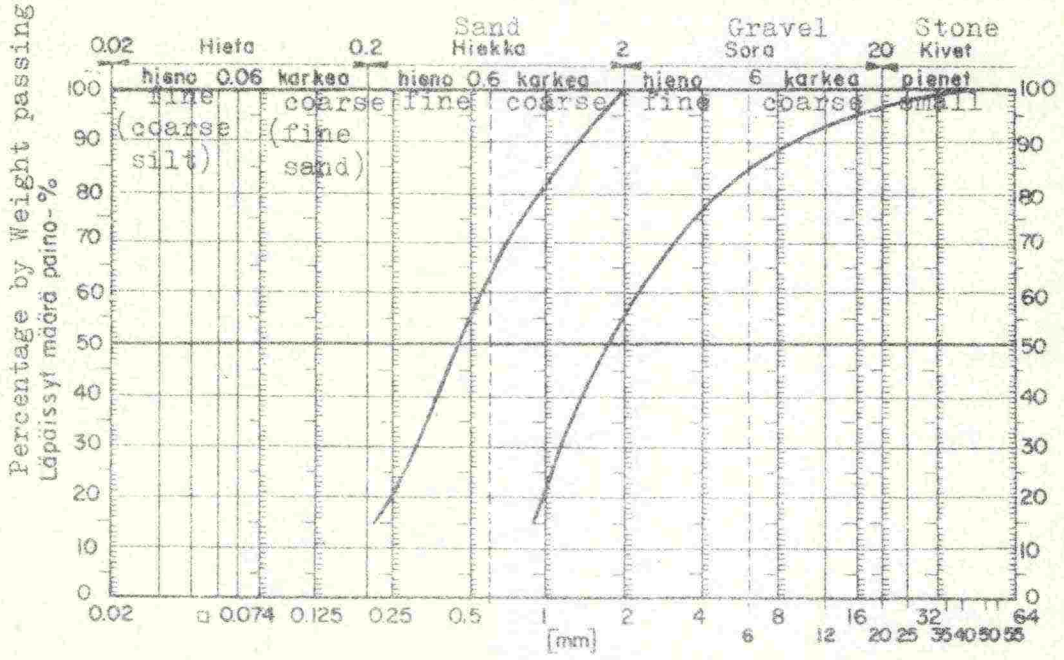


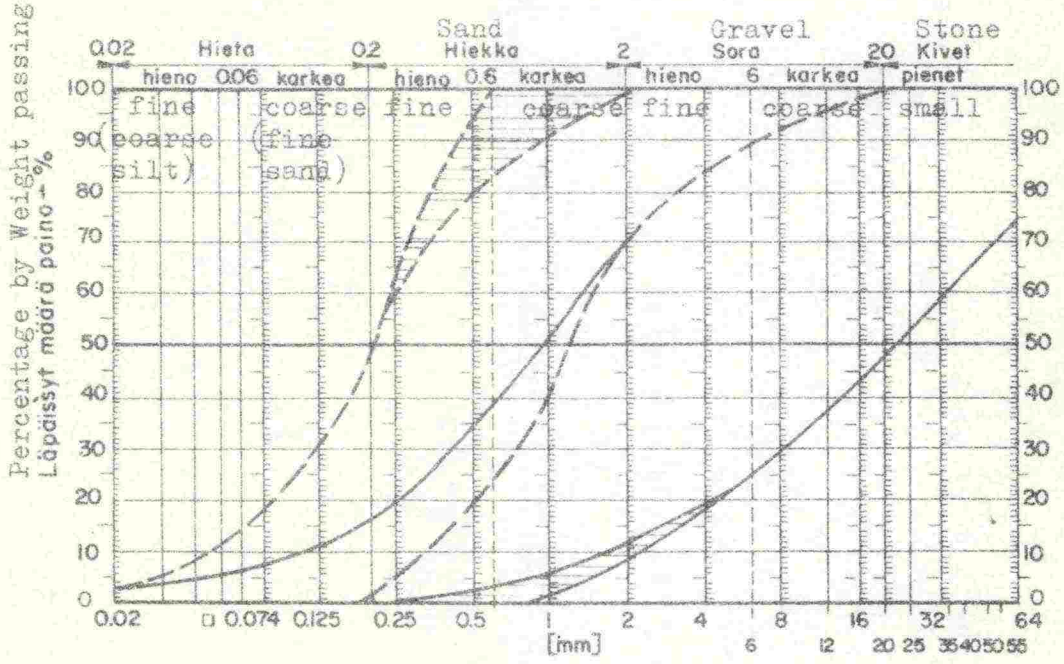
Fig. 6
Kuva 6

Road Pavement Layers
Päällysrakennekerrokset
Stone Fractions
Kiviaineksen rakeisuus

Isolating Course
Eristyskerros



Filter Course
Suodatinkerros – – –
Sub-base
Jakava kerros ———

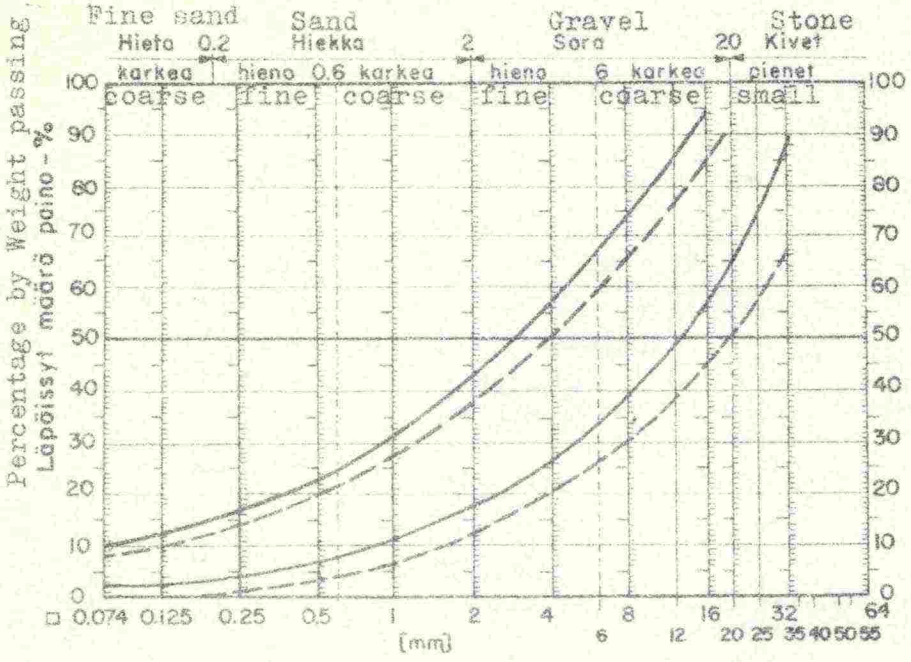


The finest filter sand may not be used underneath the coarser sub-base (shaded area).
Hienointa suodatinhiekkaa ei saa käyttää karkeimman jakavan kerroksen alla (viivoitetut alueet).

Fig. 7
Kuva 7

Road Pavement Layers
Päällysrakennekerrokset
Stone Fractions
Kivigineksen rakeisuus

Base Course of Crushed Gravel or Gravel
Kantava kerros murskesorasta tai sorasta - - -
Base Course of Bituminous Gravel
Kantava kerros bitumisorasta ——



Wearing Course of Crushed Gravel or Gravel
Kulutuskerros murskesorasta tai sorasta ——
Clayey Gravel or Moraine
Savisoramassa tai moreeni - - -

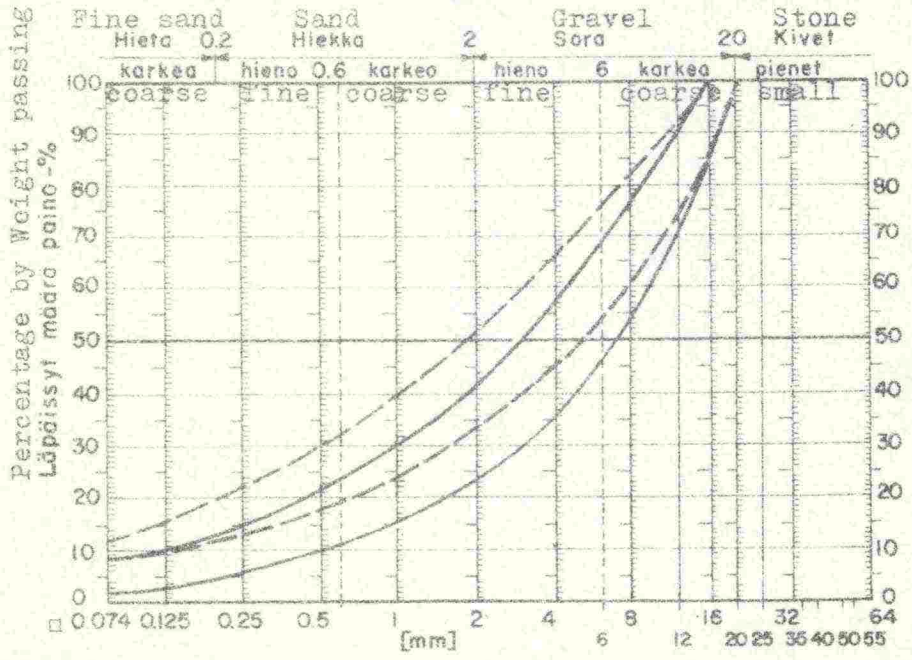
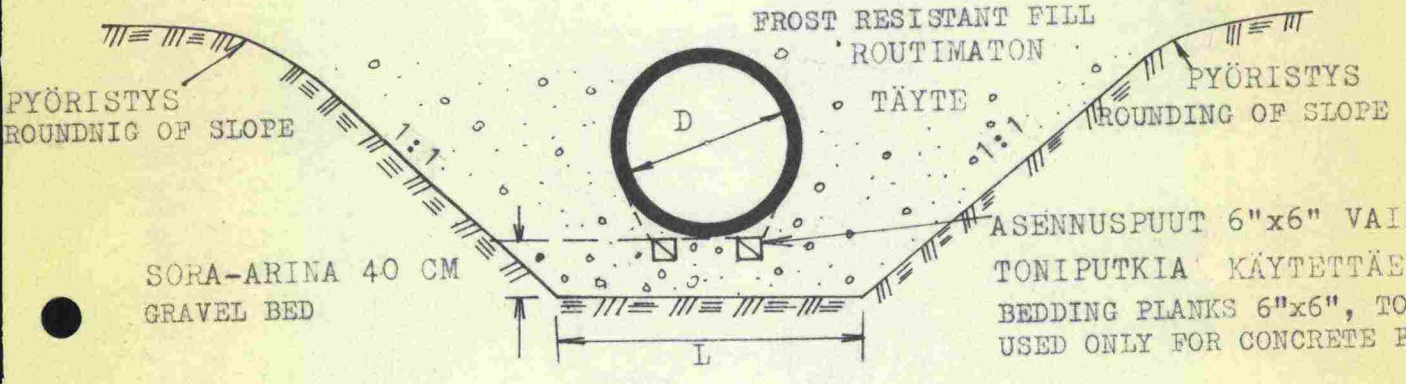


Fig. 8
Kuva 8

1

RUMMUN PERUSTAMINEN KANTAVALLE ROUTIMATTOMALLE MAALLE.

FOUNDATION OF CULVERT ON FIRM FROST-RESISTANT SOIL



IF JOS	D	<	200 CM	IS ON	L = D + 100	CM
IF JOS	D	≥	200 CM	IS ON	L = D + 150	CM

TVH/Soil Research Office

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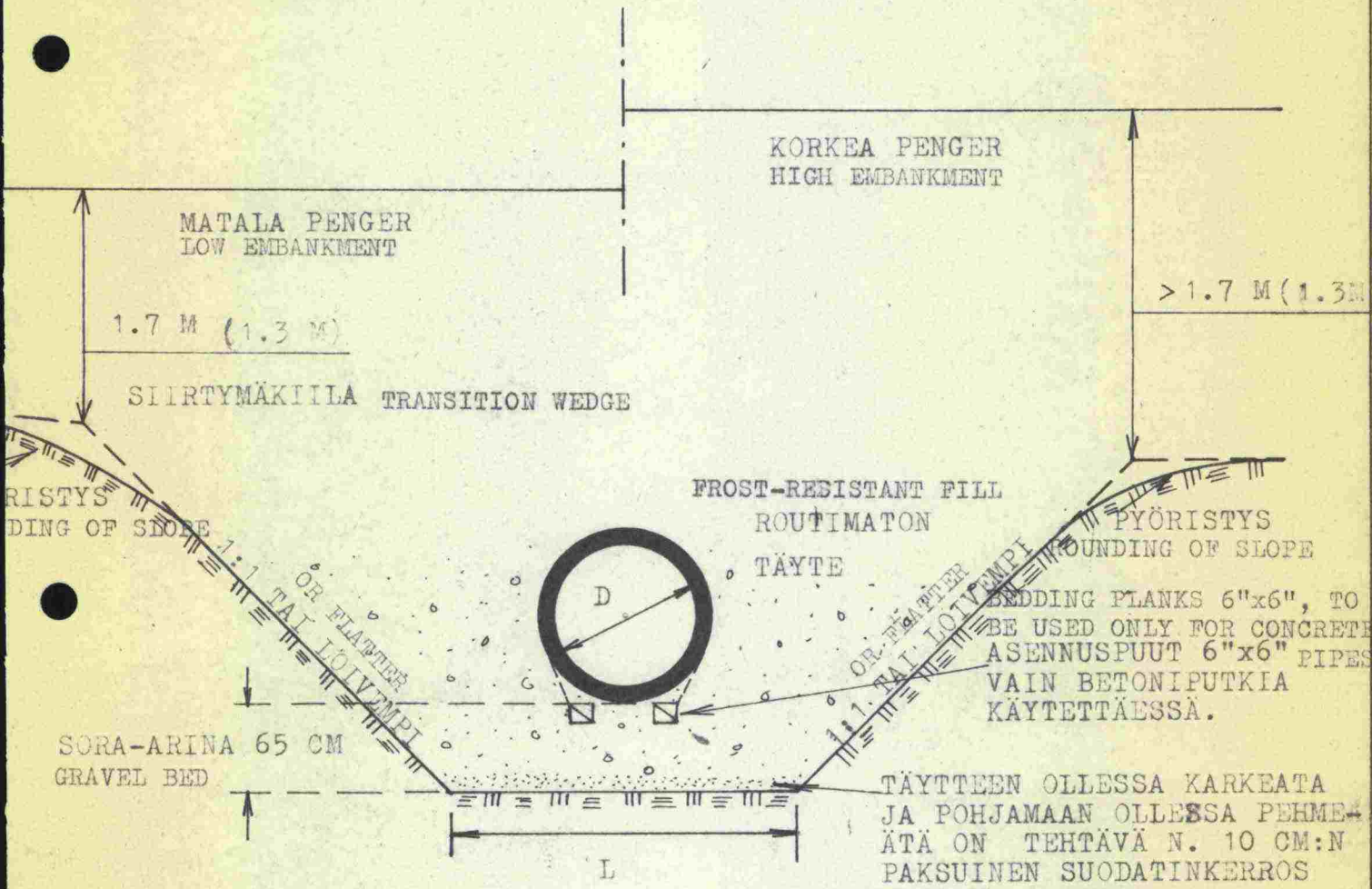
2

RUMMUN PERUSTAMINEN ROUTIVALLE MAALLE.

FOUNDATION OF CULVERT ON FROST-SUSCEPTIBLE SOIL



IF JOS	D < 200 CM	IS ON	L	=	D +	150	CM
IF JOS	D ≧ 200 CM	IS ON	L	=	D +	200	CM

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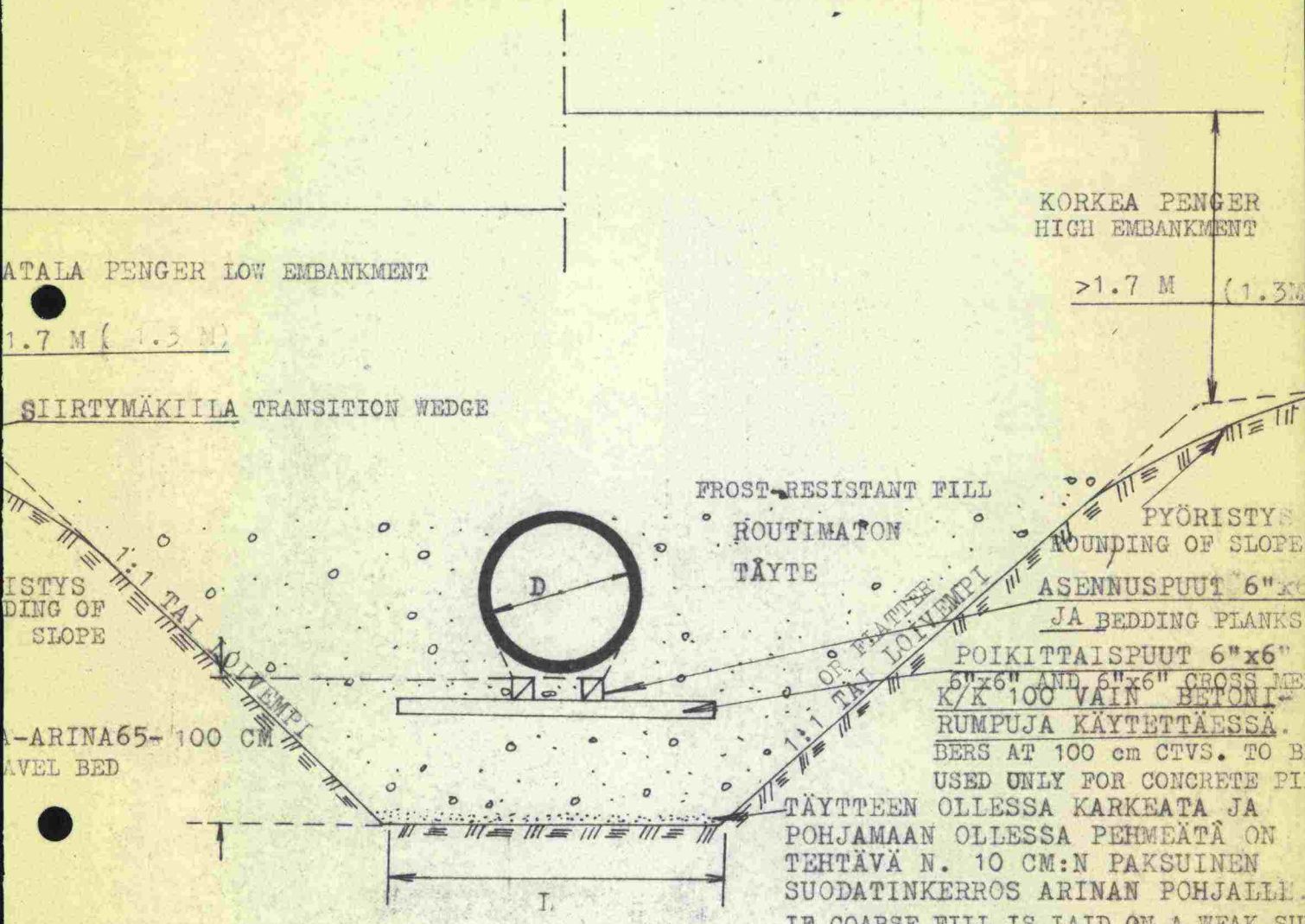
3

RUMMUN YLEINEN PERUSTAMISTAPA PEHMEIKÖLLÄ.

GENERAL FOUNDATION METHOD FOR CULVERT ON WEAK SUBSOIL



TÄYTTEEN OLLESSA KARKEATA JA POHJAMAAN OLLESSA PEHMEÄTÄ ON TEHTÄVÄ N. 10 CM:N PAKSUINEN SUODATINKERROS ARINAN POHJALLE.

IF COARSE FILL IS LAID ON A WEAK SU SOIL, A FILTER COURSE 10 cm THICK I TO BE LAID ON THE BOTTOM OF THE EX- CAVATION.

IF / JOS	D < 200	CM	IS / ON	L	=	D	+	150	CM
IF / JOS	D ≧ 200	CM	IS / ON	L	=	D	+	200	CM

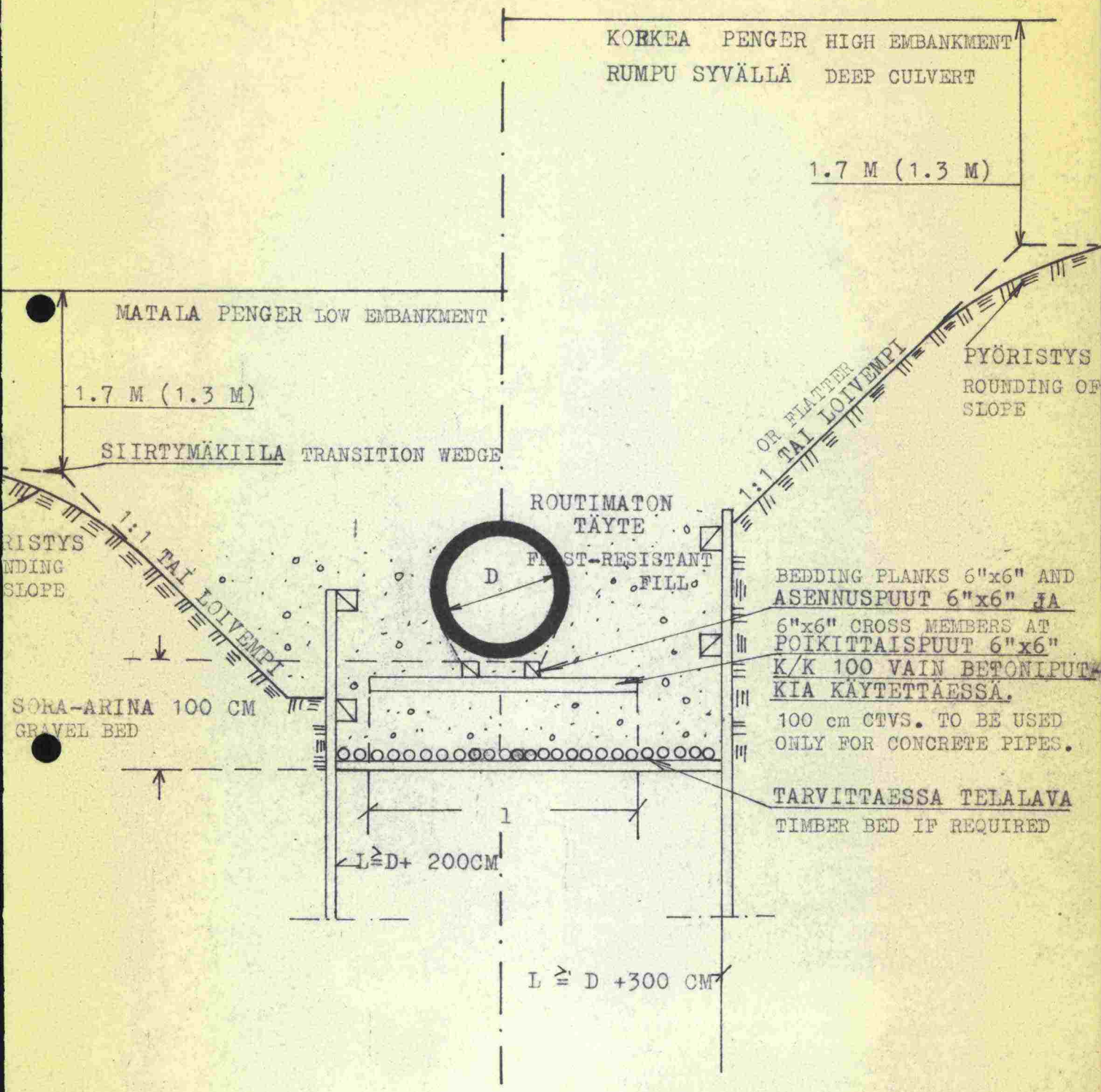
TVH/Soil Research Office

TVH/Maatutkimustoimisto 17.1.1964

4

RUMMUN PERUSTAMINEN PEHMEIKÖLLE ERIKOISTAPAUKSISSA, KUN POHJA ON ERITTÄIN PEHMEÄ.

FOUNDATION OF CULVERT ON WEAK SUBSOIL.
SPECIAL CASE OF VERY WEAK SUBSOIL.



IF JOS	D < 200 CM	IS ON	l	=	D	+	150 CM
IF JOS	D ≧ 200 CM	IS ON	l	=	D	+	200 CM

L = PONTTISEINIEN VÄLI DISTANCE BETWEEN SHEETING

TVH/Soil Research Office
TVH/Maatutkimustoimisto 17.1.1964