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Drainage

Control of Sub-surface Water Management by Draining with Pipes, Open-ditch Drainage and Amelioration of the Subsoil

General Instructions and Special Cases

DIN 1185 Part 1

Dränung; Regelung des Bodenwasser-Haushaltes durch Rohrdränung, Rohrlose Dränung und Unterbodenmelioration; Allgemeine Hinweise und Sonderfälle

Since publication of the 8th edition of "Dränanweisung" ("Drainage Instructions") in 1959, there have been developments in the fields of drainage techniques and soil science. Machines have almost entirely replaced manual labour. Machinery has become heavier and more efficient. The consequence has been increased stress on the soil which, especially in the cases of structurally unstable and waterlogged soils, leads to unfavourable results. The danger of this is enhanced by the urge, motivated by considerations of economics and the saving of time, to continue the tilling of the ground even under unfavourable weather conditions.

Today, where sub-surface water management is concerned, a distinction is drawn between soil containing ground water and waterlogged or binding-wet soil. In recognition of the fact that it is better to combat the cause rather than the effect, an assessment of the local situation (see DIN 4220 Part 1 to Part 4, Preliminary Standards) is taken as the basis for the choice of technical measures for drainage systems. The greatest possible improvement in the structure of the soil and its stabilization are considered to be an important aim of the drainage.

It follows that it is no longer possible to speak of "drainage instructions" in the earlier sense of the term. Indeed, this Standard is to be regarded more as a directive. The intention is that the engineer responsible for planning and construction should, to a greater extent than heretofore, be given not only the freedom to take, but also the responsibility for taking decisions in the light of detailed study of conditions on the site.

It therefore appeared both desirable and necessary to incorporate into the Standard those methods of subsoil amelioration (deep loosening and deep ploughing) in the soil which have only recently been scientifically developed but not yet conclusively tried out. These methods are recommended to the extent where this is possible in the light of current knowledge.

Inevitably, this led to a new concept for this Standard. It proved possible to omit all questions of soil science and those of local significance because they are dealt with in detail in DIN 4220 Part 1 to Part 4 (Preliminary Standards), DIN 19 680, DIN 19 681, DIN 19 682 Part 1 to Part 13, DIN 19 683 Part 1 to Part 19 and DIN 19 684 Part 31 to Part 41 (at present still in draft form).

As a result of the revision of DIN 18 308, all details of the technical requirements for a drainage project must be positively dealt with and defined in this Standard, because the nature of the execution of the work is to be the subject of technical Standards in accordance with the provisions of the Deutscher Verdingungsausschuss (German Contracts Committee). Finally, account had to be taken of the fact that, in almost every building project, modifications to plans become necessary. Thus, the contractor should be in a position to inform himself on the spot of the more important details for planning and designing the drainage system. In consequence, it became desirable to divide the Standard into several Parts, according to the various aspects and requirements:

Part 1 Drainage, control of sub-surface water management by drainage with pipes, open-ditch drainage and amelioration of the subsoil; general instructions and special cases
Part 2 —; Important data for planning and dimensioning
Part 3 —; Construction
Part 4 —; Design
Part 5 —; Maintenance work

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1 Scope

This Standard applies to methods for the control by drainage of sub-surface water management of areas used for agricultural purposes.

The choice of method is determined by conditions on the site, especially the soil characteristics and the causes of wetting. The question of whether pipe drainage, open-ditch drainage, subsoil amelioration of combined methods (see Fig. 1) are appropriate and economic is to be examined. In every case, the aim should be to keep foreign water away from the drainage area. In the case of sufficiently permeable soil, a check is to be made of whether, where the ground water levels are too high, control of the water management can be achieved by an improvement in the outfall of gravitational water. To this end, the area is to be investigated for permeable strata by exhaustive exploratory drilling. If the improvement in the outfall of gravitational water is insufficiently effective, consideration should be given to further technical measures.

2 Purpose of drainage

Drainage eliminates soil wetness, which is harmful to crops and to the working of the soil, improves aeration of the soil, opens up deeper sections of soil for plant roots, makes better use of nutrients, reduces organic acids and encourages the activities of soil bacteria. The possibility of earlier planting prolongs the growth period. Cultivation is made easier and damage due to mechanization (compaction of the soil) is reduced or eliminated. Pastures become firmer underfoot and better use can be made of precipitation during the growth period. In consequence of the enhanced storage capacity, waterlogged and binding-wet soil, in particular, can, as a result of drainage, make use of considerably more effective soil humidity during drying times.

Technical installations can be properly and economically constructed and maintained only if they are based on a design drawn up according to accepted technical principles.

3 Application of drainage methods

Before any decision is taken on technical measures for improving the area, it is necessary to ascertain whether soil containing ground water, waterlogged soil or binding-wet soil (hitherto generally designated as barely permeable) is present.

3.1 Soil containing ground water

Soil is said to contain ground water if, although the water in the soil can move freely, the ground water surface is undesirably high for crops and for working the soil. Optimum sub-surface water management can be achieved by lowering the ground water surface to a favourable level below the ground elevation. The effect of the capillary fringe is to be taken into account.

If an improvement in the outfall of gravitational water does not suffice, soil containing ground water is, in principle, to be drained systematically by means of pipe drainage (system drainage). In this case, it can be advantageous to combine pipe drainage with open-ditch drainage, because this results in an improved structure, an increase in the spacing of the pipe drains and consequently greater economy.

The drain spacing is designed according to the permeability to water of the soil k_{fb} (see DIN 19 682 Part 8 "Determination of Permeability to Water by the Drill Hole Method").

Areas lying so low that an improvement of their soil would call for an uneconomic increase in the cost of provision of an outfall of gravitational water or of pumping stations should not be drained. In the case of small areas, however, a case can be made out for permitting exceptions to the recommended normal depth of branch drains (minimum depth = 70 cm).

3.2 Waterlogged soil

Soil is waterlogged when vertical movement of the water in the soil is inhibited by an impounded water level and an accumulation of water forms which, from time to time, is harmful to crops and to working the soil.

The wetness is to be eliminated by means of pipe drainage, open-ditch drainage, subsoil amelioration or combined drainage. It has been found that, in the case of consolidated soil, subsoil amelioration (deep loosening or deep ploughing), in addition to open-ditch drainage, is frequently the most suitable means of improving the area. With this method, harmful accumulations of water can be led away to lower areas or taken up by improved storage capacity. Excess water is to be led away through a widely-spaced drainage net-work, according to the gradient of the ground, the ground relief and precipitation. In the case of steeper gradients the risks of silting-up and erosion are to be taken into account in the light of scientific investigation of the soil.

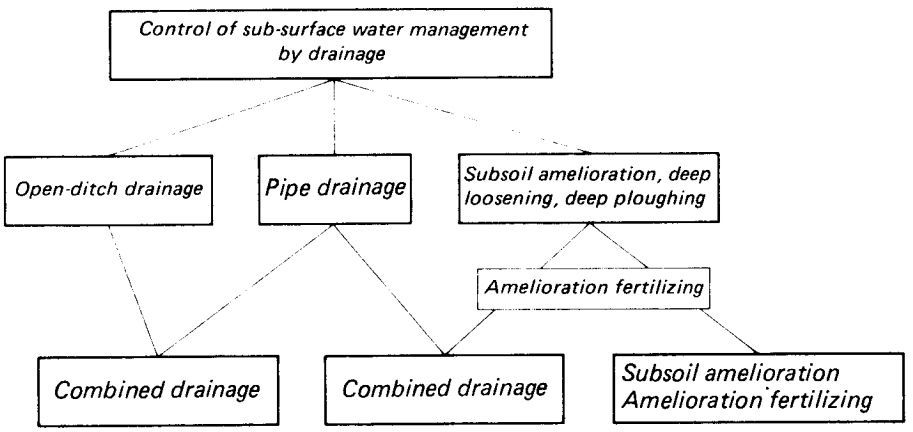

Figure 1. Possibilities of control of the sub-surface water management by drainage