Swedish Geotechnical Society (SGF)

Society of Engineering Geology (BGS)

System of notations

for geotechnical investigations

List of contents

Introduction

This notation system has been developed jointly by the Swedish Geotechnical Society (SGF) and the Society of Engineering Geology (BGS). The system provides guidelines for geotechnical, geological and geo-environmental presentations in plan and section. It covers the reporting of investigations, evaluated of ground conditions, foundation structures and various measures of reinforcement.

The notation system is intended for

- those carrying out geotechnical investigations (field personnel, geotechnical engineers in charge, laboratory personnel, draughtsmen and CAD personnel)
- purchasers of geotechnical investigations, foundation and earth works
- contractors for such works
- others coming into contact with any form of geotechnical presentation.

Validity

This notation system, Version 2001:2, is valid from 2001-01-01, whereupon all previous notation sheets issued by SGF will cease to apply.

In order for the notations in this system to apply, the particular document must contain a reference to the SGF/BGS notation system and relevant version.

Structure

Compared with earlier notation sheets, this notation system has been extended with new investigation methods in geotechnics, engineering geology and environmental technology.

The notation system is divided up according to the normal sequence of work from design to production, i.e. the presentation of:

- Investigations
- Interpretation of ground conditions from investigation results
- Foundation methods and reinforcement measures
- Foundation and reinforcement

Apart from the various symbols, presentation of soundings and other investigations, grids for foundation methods and reinforcement measures, etc, the notation system sets out related description codes for symbols and attributes in accordance with “Dataformat för överföring av data från geotekniska undersökningar” (“Data format for transference of data from geotechnical investigations”; Recommended standard 1994-10-12).

Normally, the SGF’s transfer format is applied to automatic registration of field investigations result. This also enables neutral transfer of geotechnical information between different software systems.

It is possible to use the SGF/BGS notation system for selecting desired texts and symbols that are relevant to the particular report and presentation.

Availability

The notation system is available via the SGF home page on the Internet at address **www.sgf.net**. Users may download all or parts of the notation system for their own use. A guide for using the system can be downloaded from the start page for the notation system.

A hard copy version can be ordered from the SGF Secretariat, SE-581 93 Linköping, Sweden.

SWEDISH GEOTECHNICAL SOCIETY SOCIETY OF ENGINEERING GEOLOGY

Presentation in plan

General

The site of the point of investigation is marked with a circle, 3 mm in diameter, placed at its centre. The circle can be completed with several attributes, such as lines, circles and shading. The attributes tell which kind of probing, sampling or observation has been carried out.

An open circle, 3 mm in diameter, means, for example, that simple probing has been made, such as stick sounding without notation of the penetration resistance. If the lower half of the circle is filled in, static sounding has been performed, e.g. weight sounding. On the other hand, if the upper half of the circle is filled in, dynamic probing has been performed, such as ram sounding or percussion sounding. A vertical line below the circle and its ending - or the lack of a vertical line - tell how the probing has been terminated, e.g. if we have to deal with normal refusal, or if probing has been made into bedrock.

An outer circle, 5 mm in diameter, surrounding the 3-mm circle, means that sampling has been carried out. In-filling of the upper or the lower half of the circle indicates that samples can be considered as disturbed respectively undisturbed, e.g. taken by means of an earth auger or a piston sampler.

The 3-mm circle refers to soil investigation. A vertical line above the circle means some kind of hydro-geological observation. A vertical line below the circle means that probing refusal has been reached, or that probing has been carried out into, or down to, assumed bedrock.

Close to the point of investigation an identity number is given. To the left of the point, the ground surface level or some other reference level is indicated.

Inclined boreholes, common in connection with deep probing in bedrock, are indicated with a line showing the projection in plan of the borehole. Sometimes complementary information is given about the inclination, the length and the direction of the borehole.

Probing

Point of investigation (basic symbol) without attribute referring to probing and simple probing without presentation of penetration resistance (e.g. stick sounding or percussion sounding without registration of sounding resistance)

Static probing with registration of penetration resistance in soil (e.g. weight sounding and pyramid penetration test)

CPT

Dynamic probing with registration of penetration resistance in soil (e.g. ram sounding)

Addendum concerning depth and bedrock determination

Probing terminated without reaching firm bottom

Probing to assumed firm bottom, i.e. the probe cannot be forced deeper down into the soil by normal procedure without great difficulty

Probing to assumed bedrock

Drilling less than 3 m into assumed bedrock

Drilling minimum 3 m into assumed bedrock

Drilling minimum 3 m into assumed bedrock, including analysis of rock cuttings

Core drilling minimum 3 m into assumed bedrock

Inclined borehole through soil down into assumed bedrock. Plan projection indicated as well as rock surface level and ending of borehole. Information about borehole inclination and length can be given.

Sampling

Disturbed sampling
(Samples usually recovered by means of open drive sampler, helical auger or post -hole auger, thick-walled tube sampler or special sampler, e.g. ballast sampler)

Undisturbed sampling
(Samples usually recovered by means of standard piston sampler or core sampler)

Test pit. Larger test pit is presented to scale.

Superficial sampling in rock/break stone samples.
Performed sample analyses and measurements can be represented by letter notations such as:

T = other technical analysis
P = petrographical analysis, thin cut analysis
C = chemical analysis

In situ tests

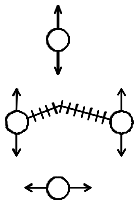

Vane test (Vb)


Dilatometer test (DMT)


Pressuremeter test (PMT)


Other investigation (method indicated with abbreviation)

Deformation and stress measurements



Observation of vertical movement in the field by means of soil-level gauges, settlement gauges, etc.

Observation of vertical movement in field, e.g. by means of hose settlement gauges.

Observation of horizontal movement in field, e.g. by means of inclinometer measurements.

Benchmark for settlement or other movement observations.

Bedrock stress or earth pressure measurements *in situ*. Presented to the right of the observation symbol.

Hydro-geological investigations


Water level observed, for example, in the sampling hole


Groundwater level determined by short-term observation in open system


Groundwater level determined by long-term observation in open system


Terminated observation


Pore pressure measurement


Test pumping or infiltration test


Water loss measurement in rock


Well (excavated, blasted or bored)

Environmental ground investigations

 Field analysis

 Laboratory analysis

Inspected/analysed media/samples are presented with supplementary notations below the triangular symbol as shown below. The soil type at the sampling level can be presented to the left of the symbol.

Supplementary notations:

G	Gas
L	Fluid (usually water)
S	Solids (usually soil)

Supplementary notations above the triangular symbol:

Rn	radon investigation

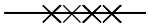
Geophysical investigations

Geophysical investigation line (profile, section).
Identity, abbreviation for applied method according to Appendix 1 and length observation presented above the end of the line

Geophysical investigation in individual point or borehole, e.g. some kind of logging. Type of investigation indicated at the borehole.

Supplementary information presented on the investigation line:

Noticed aberration. In seismic investigations: reduced wave velocity in rock. Estimated velocity can be given.



Indication of aberration. In seismic investigations: indication of reduced wave velocity in rock. Estimated velocity can be given.

Type of aberration presented e.g. in the key to the drawing symbols.

Presentation in section

Probing

General

Results of probing are presented at the side of the borehole column. This is formed into double vertical lines corresponding to the length of the borehole. Above a borehole column are noted the identity of the investigation point, observation grade according to ‘SGF:s Fälthandbok’ (‘the SGF Field Manual’) and equipment grade if also existing, ground surface level as well as performed investigations in chronological order. At the side of a borehole column are noted the results of probing, *in situ* tests and laboratory analyses. These pieces of information complete the specification of level and of methods utilised.

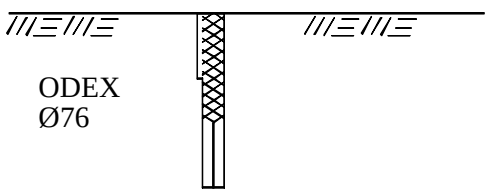
In the case of sounding, the penetration resistance is registered as a measure of the firmness of the soil. The penetration resistance can be registered as, for example, the number of half turns of the sounding rod required for every 0.2 m of penetration (hv/0.2 m (weight sounding)); as the number of blows required for every 0.2 m of penetration (sl/0.2 m (ram sounding)); as the time required for every 0.2 m of penetration (sec/0.2 m (percussion sounding)); or with notation of point resistance, sleeve friction and pore water pressure (CPT). Various types of bar charts or continuous charts—depending upon which investigation method has been used—close to the borehole column indicate the penetration resistance.

In stick sounding the penetration resistance is not usually registered. Also percussion sounding and soil/rock probing can be performed without registration of the penetration resistance.

The termination of the borehole column indicates type of refusal and is coupled with the plan symbol.

The code in the subsequent paragraphs, e.g. code HM=91, refers to the code presented in SGFs ‘Dataformat för överföring av data från geotekniska undersökningar’ (the SGF Data format for transfer of data obtained in geotechnical investigations).

Beginning of probing with preboring

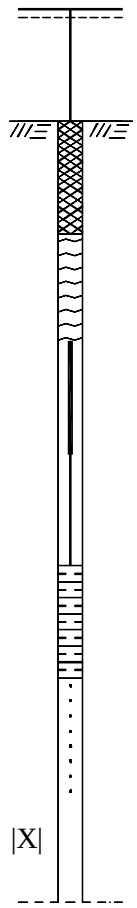


The preboring depth is indicated with enlarged column width as shown in the figure.

Method of preboring and diameter of auger is indicated, e.g. ODEX drilling.

Notations in the borehole column

Soil types evaluated in the field from sounding results are presented as follows:



Free water (code 81)

Man-made ground, fill (code 30)

Peat (code 83)

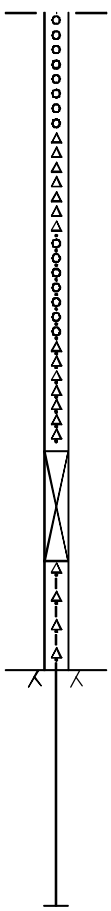
Dry-crust clay (code 31)

Clay and cohesive soil (code 37)

Silt (code 82)

Sand (code 38)

|X| (soil type not defined)



Gravelly soil (code 39)

Cobbles and boulders (code 40)

Non-cohesive soil, general (code 33-35, 37)

Till, clay till excluded (code 84)

Perforated boulder or stone (code 41)

Clay till (boulder clay) (code 85)

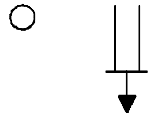
Rock surface (code 94)

Drilling in rock (code 36)

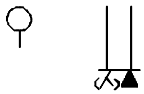
Drilling in rock terminated (code 95)

Termination of probing

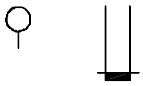
The examples shown below are presented with the plan symbol to match.



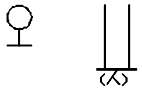
Sounding terminated without reaching refusal (code 90)



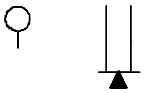
Stop against stone or boulder (code 93)



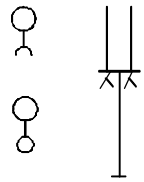
The probe cannot be driven deeper down by normal procedure (code 91)



Stop against assumed bedrock (code 94)



Stop against stone, boulder or bedrock (code 92)

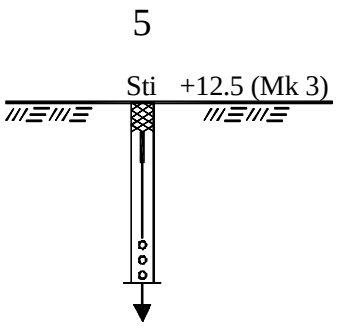


Soil-rock probing.
Drilling into assumed bedrock (code 95). When drilling has been made to a depth of minimum 3 m in bedrock, the lower-most plan symbol is shown, otherwise the upper plan symbol.

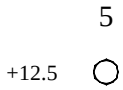
Stick sounding

Basic symbol in plan: ○

(code HM =11)



The plan symbol in the example:



Presented without showing the penetration resistance. Estimated soil type on the basis of the sounding result can be shown. In this case the grade of observation Mk3 (see appendix 1) has been applied.

Weight sounding

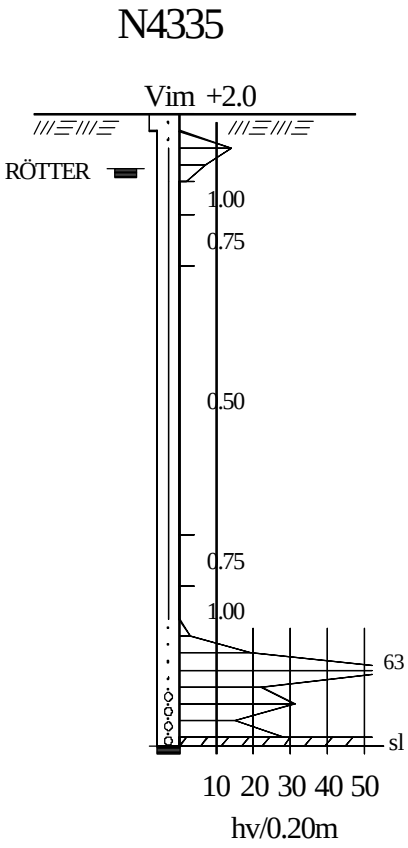
Basic symbol in plan: ◒

(code HM=01)

The penetration resistance is registered as the applied load, in kN, without or with simultaneous turning of the rod.

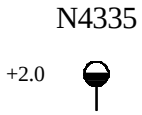
The resistance observed on self-penetration is shown with the applied load, in kN, in the depth intervals marked. In case the sounding rod is rotated, the number of half turns utilised (hv/0.2 m) is shown at the lower border of the interval. Shaded intervals and sl indicate that the probe has been driven down by means of blows.

Notations to the left of the borehole column indicate stop against local obstructions at the very bottom boulder or bedrock, on top some other obstruction (wood). Probing trials have been carried out down to the given levels. Estimated soil types in connection with the sounding operation can be shown in the borehole column.



Vim tells which method is used.
+2,0 shows the starting level of probing.
N4335 gives the identity of the borehole (the same as in plan)
0,50 shows the applied load, in kN.
63 is an example of those cases where the number of half turns do not go into the scale given.

Plan symbol in the example:



Pyramid Penetration Test (Tr)

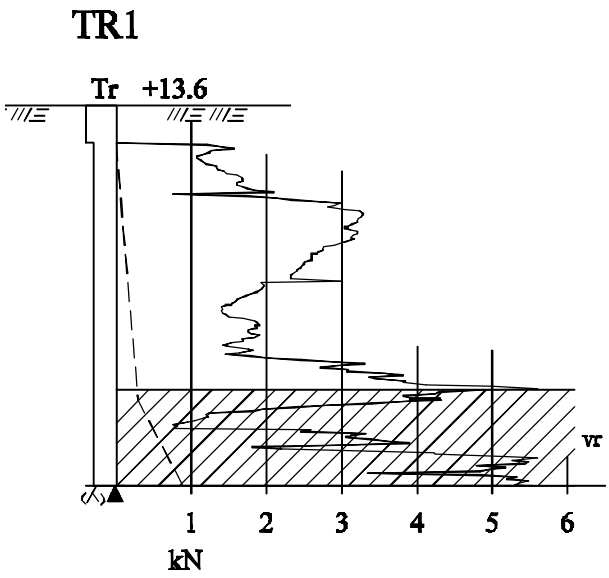
Basic symbol in plan:

(code HM=01)

The penetration resistance, in kN, obtained when a pyramid-shaped point attached to a sounding rod is pushed into the soil. The frictional resistance is measured at certain levels by the aid of a play coupling.

The registration of the penetration resistance shall be made, and indicated, every 0.05 m and the sleeve friction every second metre.

The registration of total penetration resistance and of frictional resistance is made in kN or MPa. It shall include all the levels between which turning of the sounding rod has been carried out and the estimated level of sounding refusal.



Tr indicates the method utilised.

TR1 shows the identification of the borehole.

+ 13.6 indicates the starting level of probing.

Shaded interval and vr indicates turning of the rod

Unbroken line shows sounding resistance.

Broken line shows frictionalresistance.

Plan symbol in the example. TR1 +13.6

Cone Penetration Test CPT

Basic symbol in plan: 

(code HM=07)

Applied probing grade, CPT 1, 2 or 3, is indicated. The presentation includes graphs showing the observed basic parameters: point resistance (q_T, alt. q_c), frictional resistance (f_T, alt. f_c) and, where appropriate, pore water pressure (u).

CPT 1
The penetration resistance is shown in the form of a diagram.

In the diagram, the unbroken line marks the point resistance q_c and the broken line the frictional resistance f_c observed at the point level. x indicates longer intermission in the probing operation (> 5 min.).

The graphs of point resistance and pore pressure can be shown together to the right of the borehole column and the graph of sleeve friction mirrored to the left.

CPT 2 and CPT 3
In the case of CPT 2 and 3 the pore pressure graph is also shown. Point resistance and sleeve friction are shown uncorrected (q_C, f_C). In certain cases also the graphs of the calculated parameters friction ratio (R_f) and pore pressure ratio (DPPR) are shown. Estimated soil types can be indicated in the borehole column.

The probing class in question shall be shown above the borehole column.

Drawings shall preferably be made to the following scales:

Depth	1.0 m/cm	
q_T	2 MPa/cm	(unbroken line)
f_T	50 kPa/cm	(unbroken line)
u	200 kPa/cm	(unbroken line)

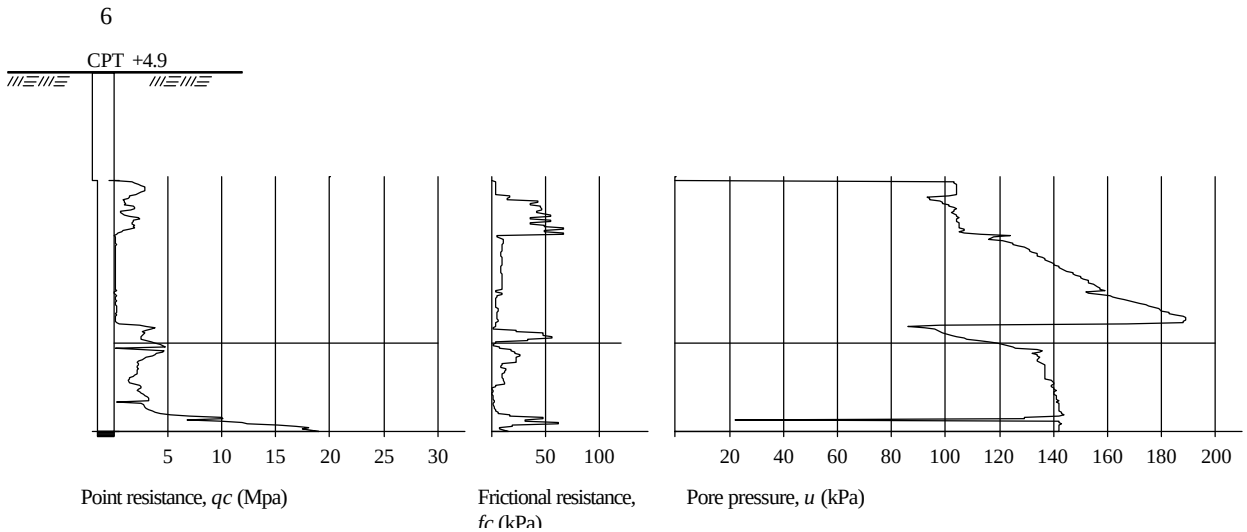
The graphs of point resistance and sleeve friction are shown to the right of the borehole column while that of the pore pressure is shown to the left.

Estimated soil types can be shown in the borehole column. Intermissions in the probing operation longer than 5 minutes are indicated with x.

In certain cases the graphs of friction ratio (R_f) and pore pressure ratio (DPPR) are also shown. The following scales shall then be used:

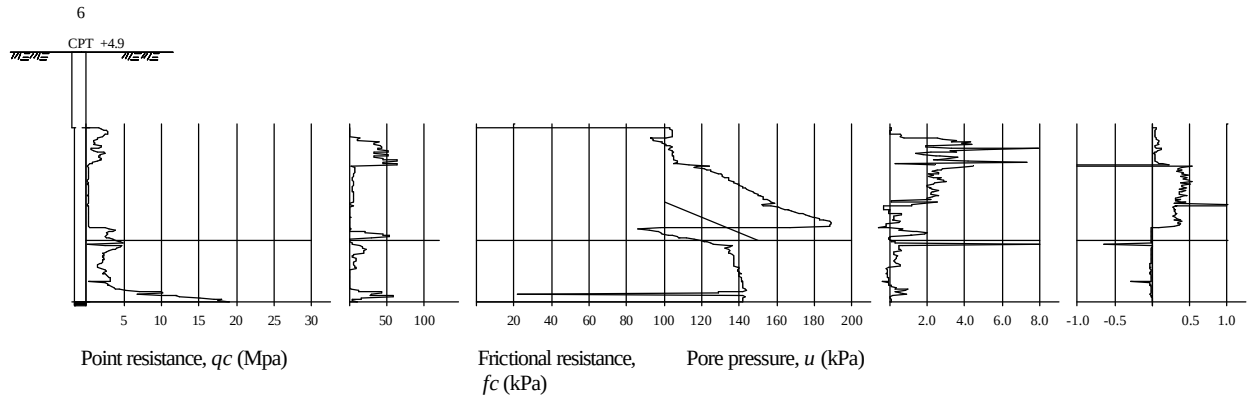
R_f	2%/cm
DPPR	0.5/cm

These calculated parameters are always presented together with the observed parameters. The presentation can either be made in the geotechnical section or separately.

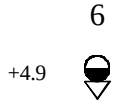


Plan symbol in the example:

N.B. Not to scale!



Plan symbol in the example:

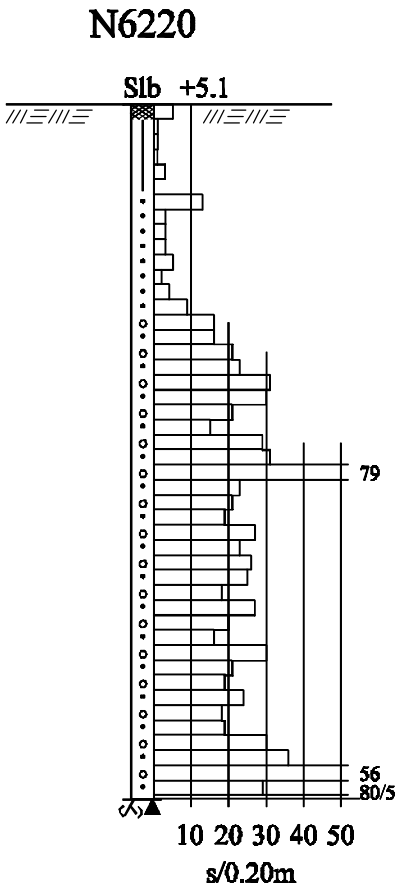


N.B. Not to scale!

Percussion sounding with registration

Basic symbol in plan:

(code HM=10)



The resistance is shown as penetration time per depth interval (sec./0.2 m) and is presented in a bar chart.

Soil types, estimated in connection with probing, can be shown in the borehole column.

Figures to the right of the bar chart indicate the number of seconds required per 0.2 m of penetration, if the number exceeds the shown scale.

80/5 means that 80 seconds have been required for 5 cm of penetration (before having met refusal).

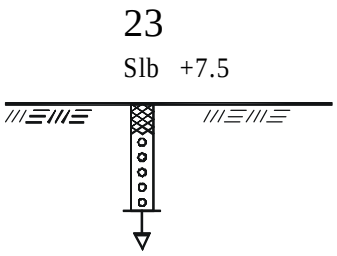
Machine type and rod diameter should be presented.

Plan symbol in the example: N6220 +5.1

Percussion sounding without registration

Basic symbol in plan:

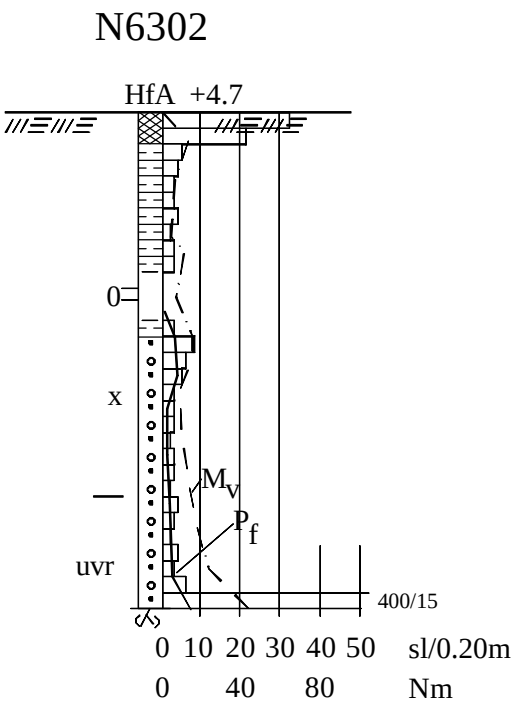
(code HM=11)



Ram sounding

Basic symbol in plan:

(code HM=09)



Is carried out according to method A or B. The penetration resistance is noted as the number of blows required per 0.2 m of penetration (sl/0.2 m) and is presented in a bar chart. Different scales can be used. The turning resistance (M_v in Nm) and calculated frictional resistance (P_f in sl/0.2 m) can be left out. Estimated soil types in connection with the sounding operation can be noted in the borehole column.

Terms to the left of the borehole column:
uvr indicates no turning of the rod below the marked level.
x indicates longer intermission of probing than 5 minutes.
0 indicates penetration without blows

N6302

Plan symbol in the example: +4.7

Soil/rock probing

Basic symbol in plan:

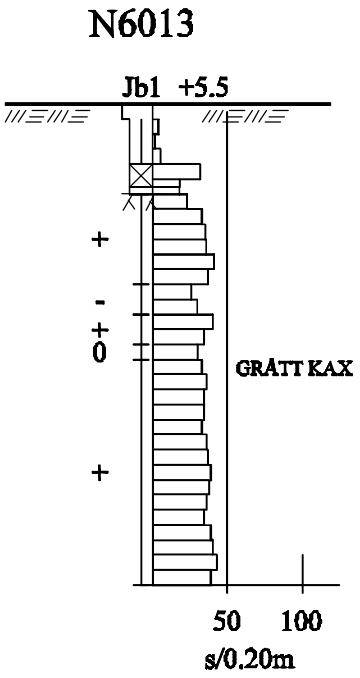
(code HM=12)

General

Soil/rock probing can be carried out in three different grades named Jb-1, Jb-2 and Jb-3.

Jb-1

The penetration resistance is given as the time required per depth interval (sec./0.2 m) and is presented as a bar chart with thick vertical lines. The plan symbol indicates registration during penetration in soil and more than 3 m of drilling into assumed bedrock. Drilling in rock shown with a single vertical line. Penetrated boulder is indicated, see example. The machine type utilised is indicated in case several different machine types have been used in the same project.
Notations to the left of the lower part of the borehole column between level indications:



+	No perceptible fractures, rate of penetration even
0	Fractured rock, perceptible apertures.
-	Highly fractured rock, difficulties in turning the rod.
--	Aperture, without or with in-filling, free penetration of drill bit.
ib	Presence of fractures not assessed.
ir	Indicates that registration has not been performed.
Jbl	Grade of execution.

N6013

Plan symbol in the example: +5.5

Jb-2

Basic symbol in plan:
(code HM=12, alt. 22)

Registration and presentation of the following parameters shall be made:

a) Depth.

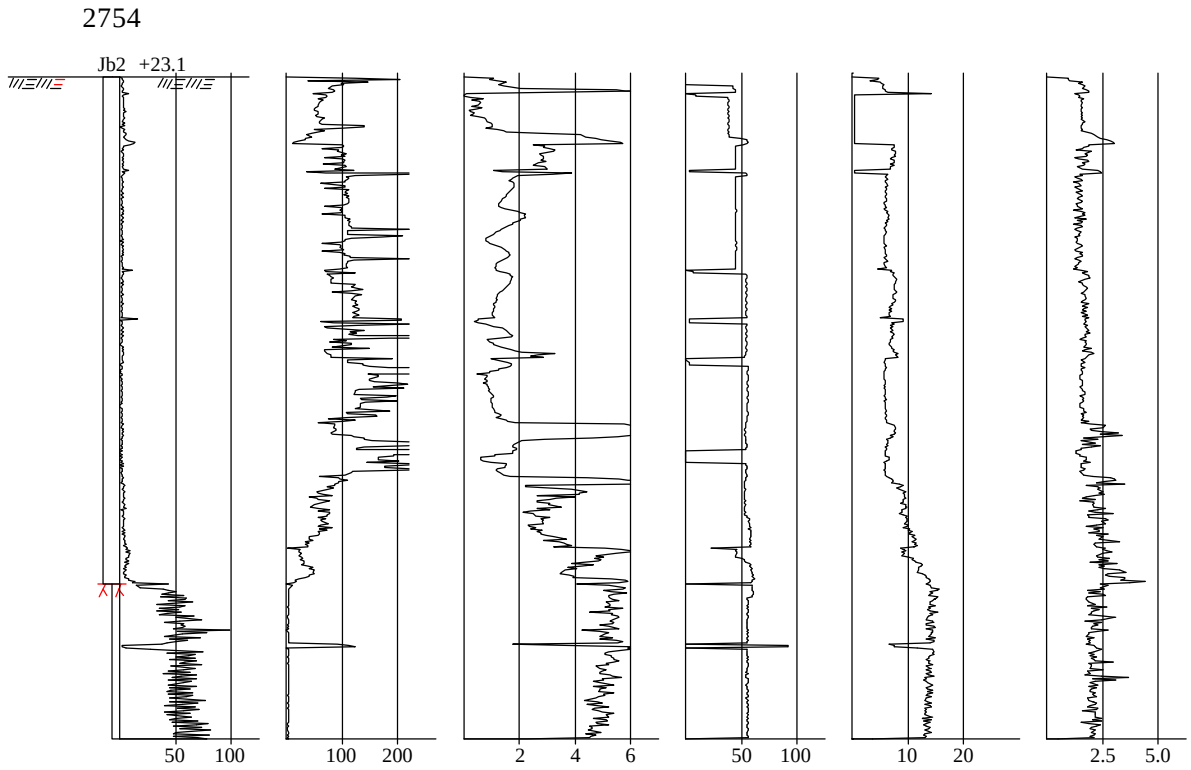
b) Penetration resistance and rate of penetration.

c) Force input.

d) Hammer pressure.

e) Rotational pressure (pressure in turning engine)

Presentation is made as shown in the example below.



N.B. Not to scale!

2754

Plan symbol in the example: +23.1

Jb-3

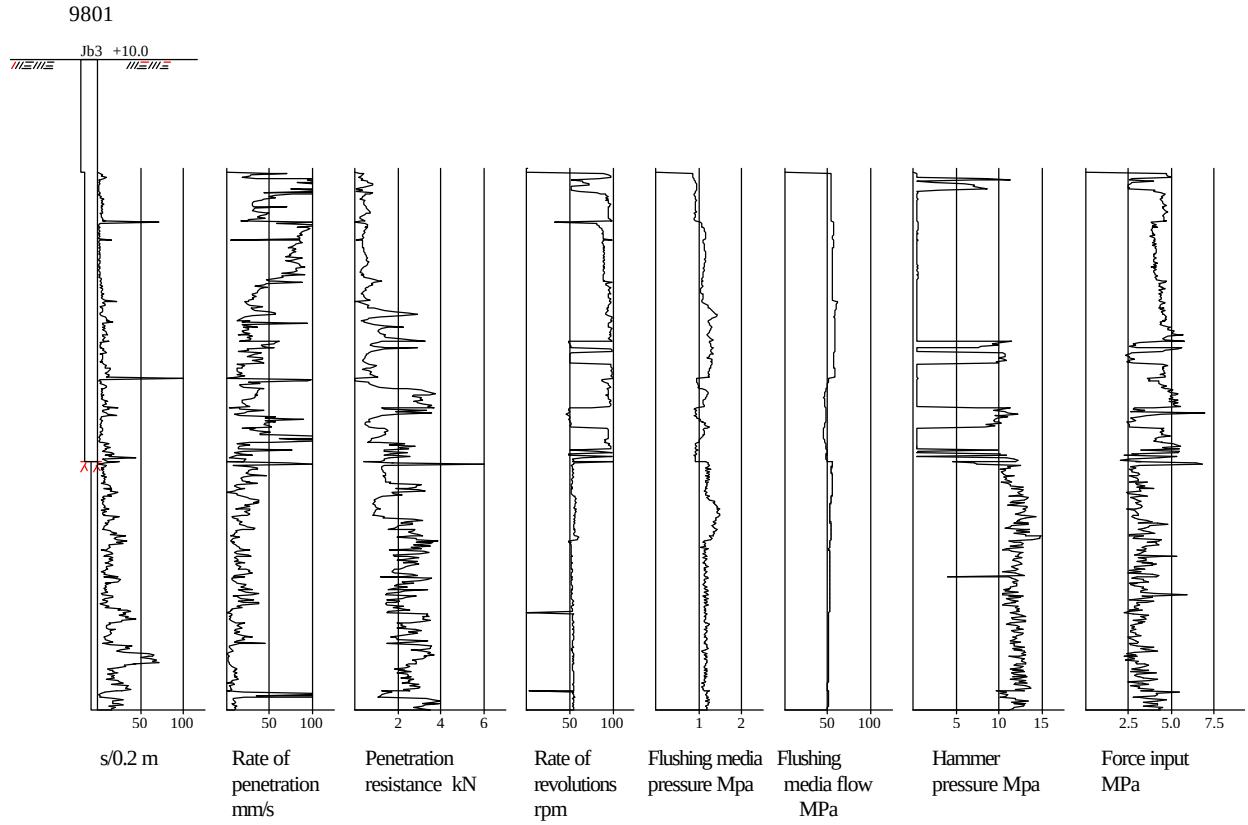
Basic symbol in plan:

(code HM=12, alt 80)

Registration and presentation of the following parameters shall be made:

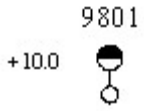
a) Depth
b) Penetration resistance and rate of penetration.
c) Force input
d) Rate of revolutions
e) Hammer pressure
f) Rotation pressure (pressure in turning engine)
g) Flushing media pressure
h) Flushing media flow

The presentation shall be made according to the example given below.



N.B. Not to scale!

Plan symbol in the example:



Sampling

General

Sampling is presented to the left of the sounding column in another, adjacent column, 1 mm in width, with text to the left. The length of the column represents the depth of sampling and is shown to scale. Above the column the identity of the investigation point is given. Above and to the right of the column the level of the ground surface is given. Above and to the left of the column the investigations carried out, in due order, are given. In-filled column represents undisturbed sampling and shaded column disturbed sampling. Soil types presented at horizontal marks represent the centres of the samples tested in the laboratory. Soil identification presented at the probing column represents the estimation made by the field personnel. Generally speaking, the identification made by the laboratory personnel is used.

Results of laboratory investigations of water content, density, preconsolidation pressure, etc. are presented to the right of the sounding column.

A system is developed which defines how the names of various soil types should be abbreviated. Thus, for example, (si)Le<u>saf</u> means “somewhat silty clay with layers of fine sand”, see Appendix 1. Modifiers are placed before the main term, with the modifying soil fractions being placed in due order with regard to their respective quantity (the larger the closer to the main term). Terms representing layers are placed behind the main term. Mineral soils can be divided into fine, mean and coarse (f, m and g), e.g. Saf = fine sand.

Soil sampling

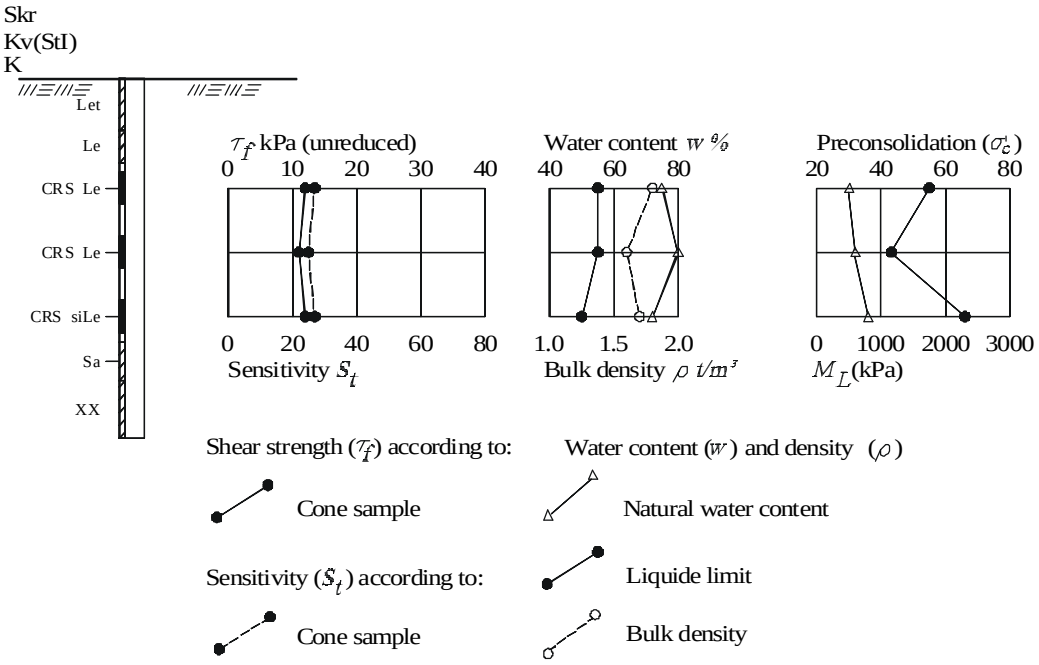
Disturbed sampling, basic symbol in plan:

(code HM=26, 27, 31, 32, 33, 34)

Undisturbed sampling, basic symbol in plan:

(code HM=25, 28, 29, 30)

Sampling is presented in a column, 1 mm in width, to the left of the sounding column. Parts of the column filled in represent undisturbed samples and shaded parts disturbed samples. Horizontal mark indicates that the sample has been investigated in the laboratory. Soil type is presented with abbreviation to the left of the sampling column. xx means lost sample.



In the diagrams are presented uncorrected shear strength (t_k) and sensitivity (S_{tk}), water contents (natural w_N, liquid limit w_L) and bulk density (r), preconsolidation pressure (s'_c) and compression modulus M_L, determined by means of oedometer tests, in this case CRS tests.

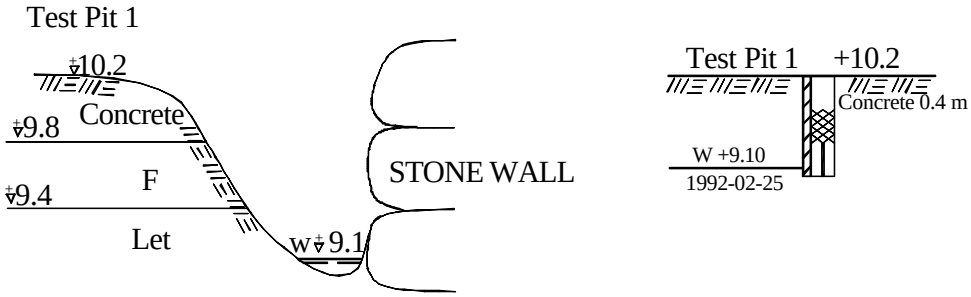
Plan symbol in the example:

Sampling in test pit

Basic symbol in plan: □

(code HM=34)

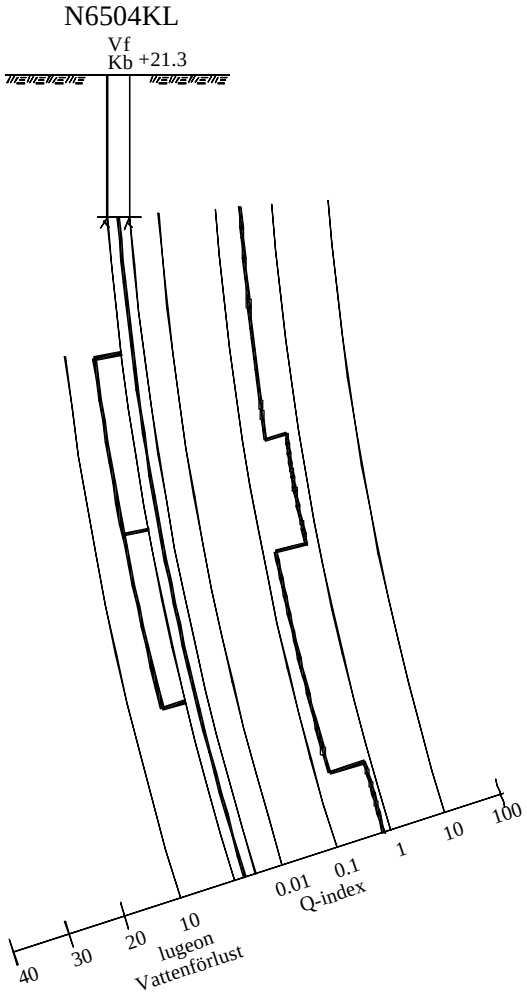
If possible, the test pit is presented the way it is executed.



SCALE 1:50 SCALE 1:100

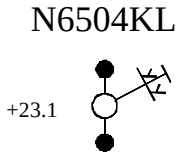
Sampling in rock

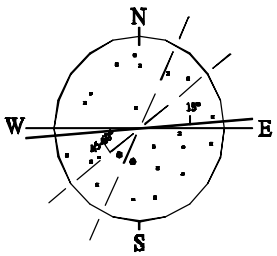
Plan symbol: 



Results of core drilling can be presented in a simple or detailed way. In simple presentation in section drawings, the situation of the borehole is shown together with the values of RQD, Vf and Q/RMR. The borehole column can be utilised to illustrate the rock type. In detailed presentation there is a possibility to describe every observation made along the rock core, and for orientated core the strike and dip of individual fractures can be noted.

Plan symbol in the example:





Presentation of fractures in a so-called stereo net (Schmidt diagram). The plan of the fracture is shown with a point, the pole of which is a projection of the point where a normal to the plan intersects the lower hemisphere. The observations can be brought together to form interpreted main directions represented by the broken lines in the fracture diagram.

In situ tests

General

In situ tests are presented either in section drawings (field vane and pressuremeter tests) or individually (dilatometer tests).

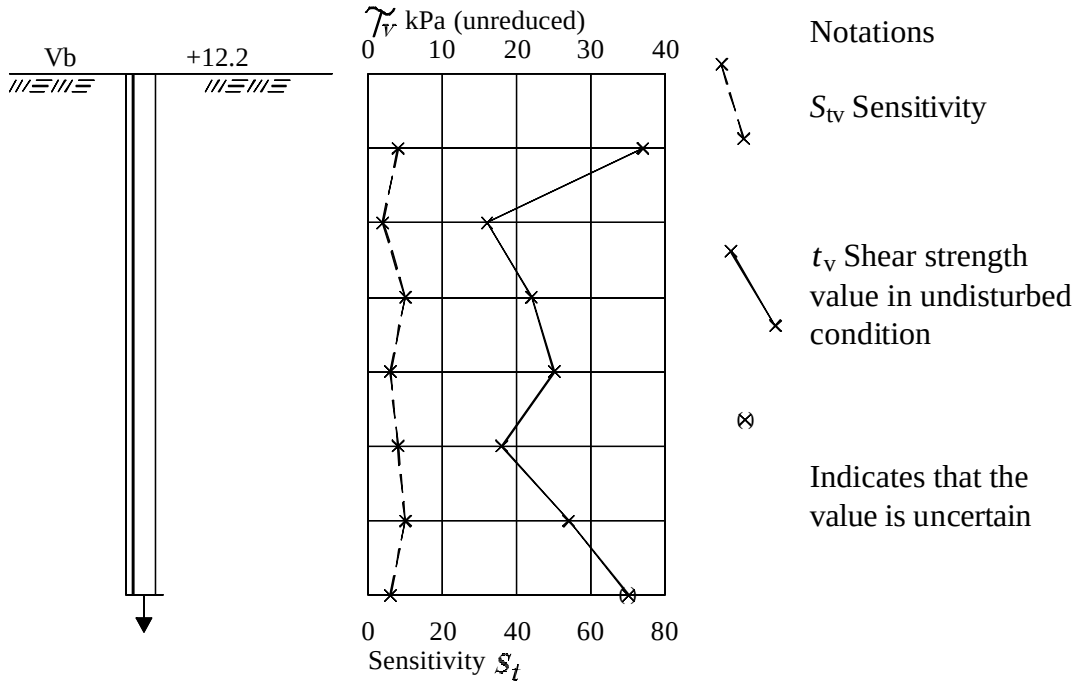
The tests are presented with a column to the left of the sounding column and with a filled mark, 2 mm in length, at the investigation level in question.

Vane tests

Basic symbol in plan:

(code HM=13

Vane tests are carried out at different levels in the soil, on one hand for determination of the uncorrected shear strength t_v in undisturbed condition and on the other for determination of the shear strength after remoulding. The quotient of the shear strength values in undisturbed and remoulded state is defined as sensitivity S_t. The values of t_v and S_t are presented in a diagram, often together with the results of routine laboratory investigations of undisturbed samples taken by means of piston samplers.



Plan symbol in the example: +12.2

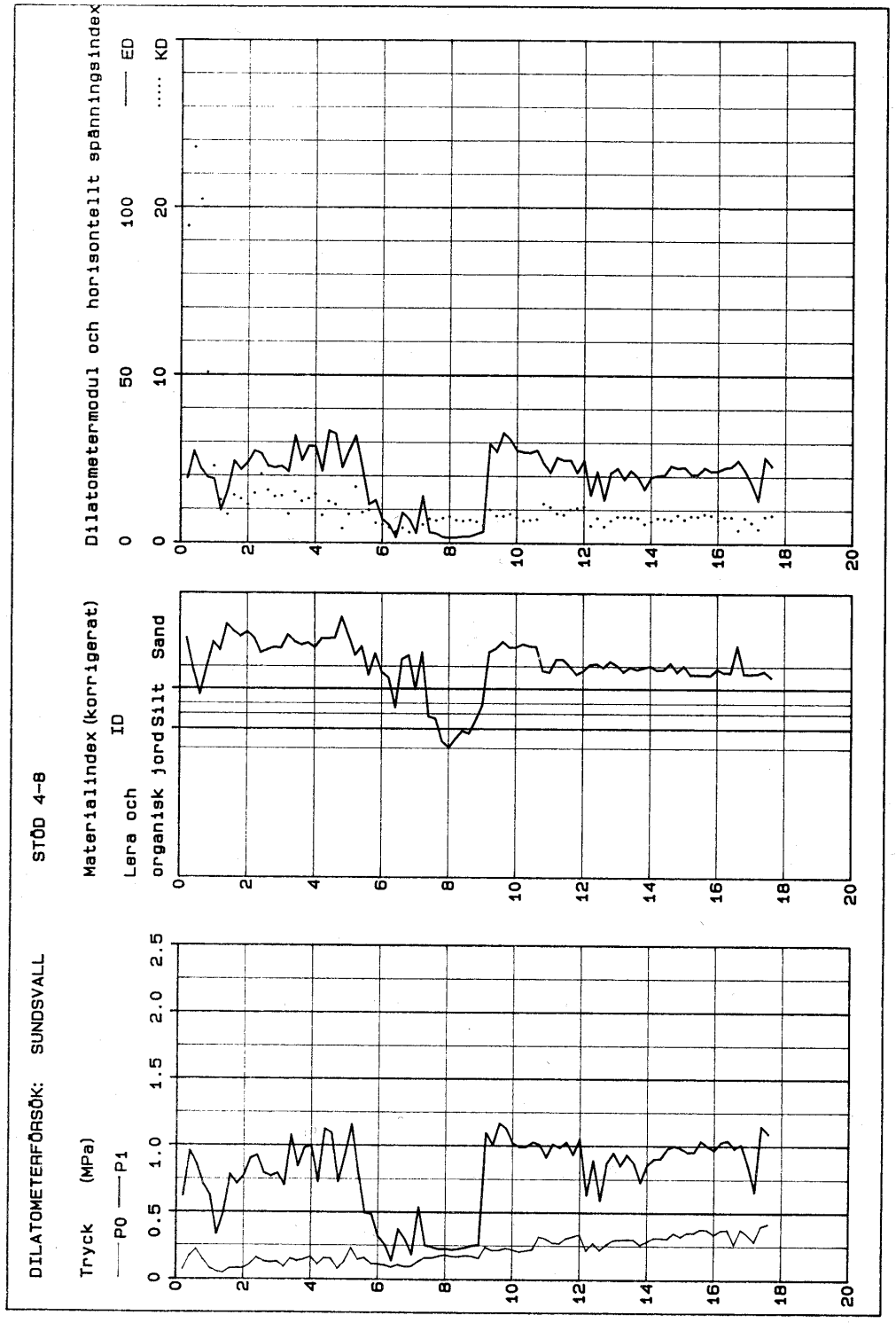
Dilatometer tests

Basic symbol in plan: 

(code HM=14)

The dilatometer tests include determination of the contact pressure p_0 and the expansion pressure p_t at normally every 0.2 m of depth. Direct observations and interpreted parameters at the respective levels are presented in a diagram.

The presentation comprises the pressures p_0 and p_t, the material index I_D, the horizontal stress index K_D and the dilatometer modulus E_D.



Plan symbol in the example: ±0.0

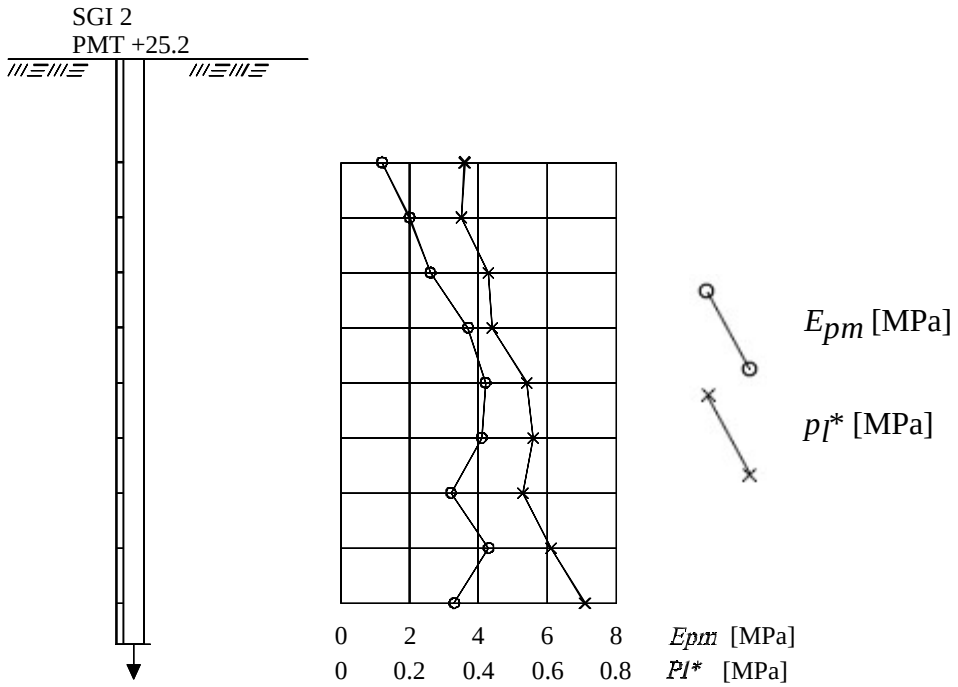
Pressuremeter tests

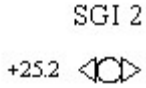
Basic symbol in plan: 

(code HM=16)

During the insertion of the pressuremeter probe the initial cell volume V_0, the creep volume V_f, the initial cell pressure p_{0M} and the creep pressure p_f are registered. These primary data form the basis for determination of the limit pressure p_l, the pressuremeter modulus E_{pm} and the net limit pressure p_l^*.

Evaluated net limit pressure p_l^* (MPa) and pressuremeter modulus E_{pm} (MPa) are presented with respectively cross and circle in a diagram.



Plan symbol in the example: 

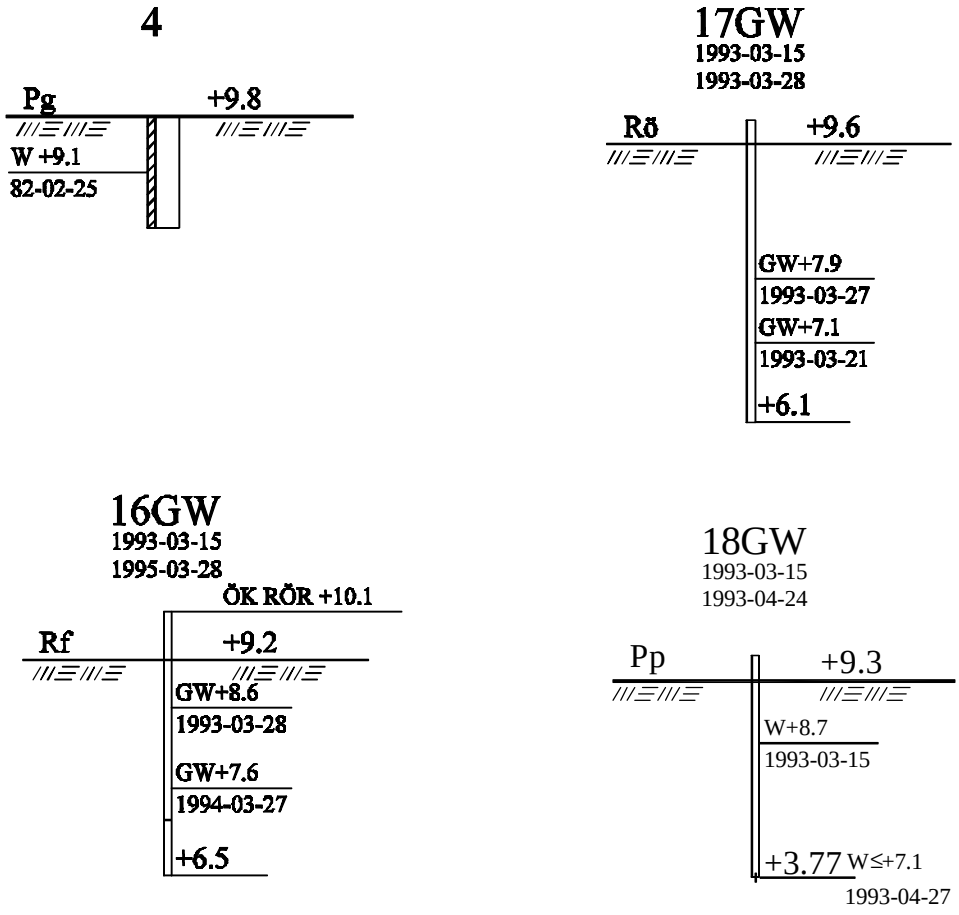
Hydro-geological investigations

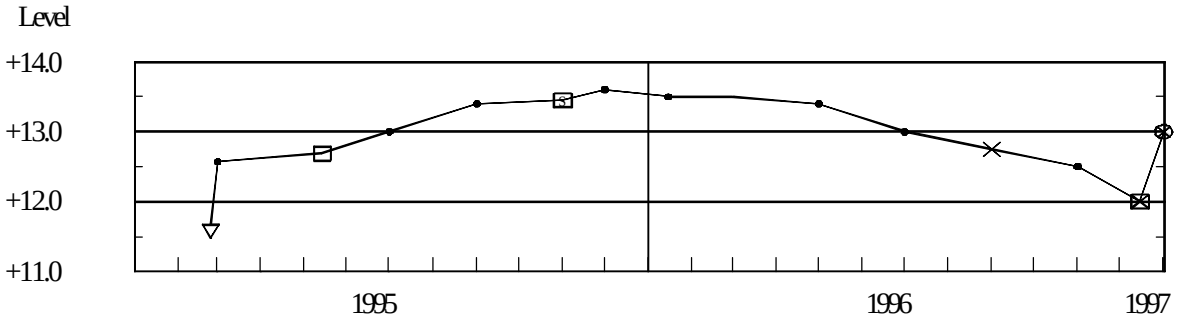
Groundwater tubes and piezometers are presented with a column, 1 mm in width. The filter tip is indicated with its real length. The piezometer tip is indicated with a filled column, 1 mm in length. The tip level of a tube and the level of filter or piezometer are indicated. Above the observation column the period of observation is given.

Water, groundwater and piezometric levels are presented along the observation column with a horizontal line together with the date of observation. The highest and lowest levels are presented as follows:

GW	groundwater surface or level
W	other water levels and pore pressures
Rö	open tube
Rf	filter tip
Pp	piezometer

If no water is observed in the tube, “dry”, alternatively “< level” is noted.





Observational comments in connection with presentation of groundwater diagrams are made with the symbols shown below.

EXPLANATIONS

▽	Dry
○	Replaced
□	Function control ok
×	Hindrance
▬	Frozen
↑	Flowing
⊗	Terminated
⊠	Function control not ok
S	Flushed

Environmental ground investigations

Plan symbols: 

General

Environmental ground investigations are presented with an isosceles triangle at the test level, in-filled in the case of laboratory analysis and open in the case of field analysis, supplemented with an explanatory abbreviation. Test results are shown in adjoining diagram or in attached record.

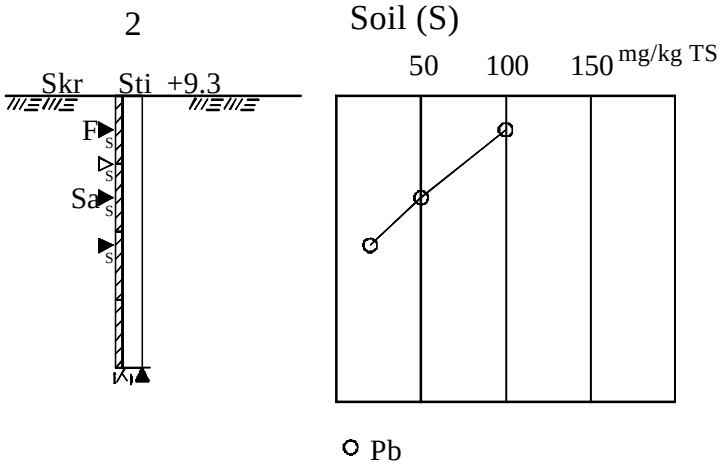
Environmentally tested/analysed media/samples are presented with letter notations below the symbol as follows:

G	Gas
L	Liquid (usually water)
S	Solid phase (usually soil)

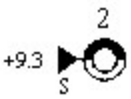
Supplementary term for analysed matter/group of matters is presented above the symbol, e.g.

Rn	Radon

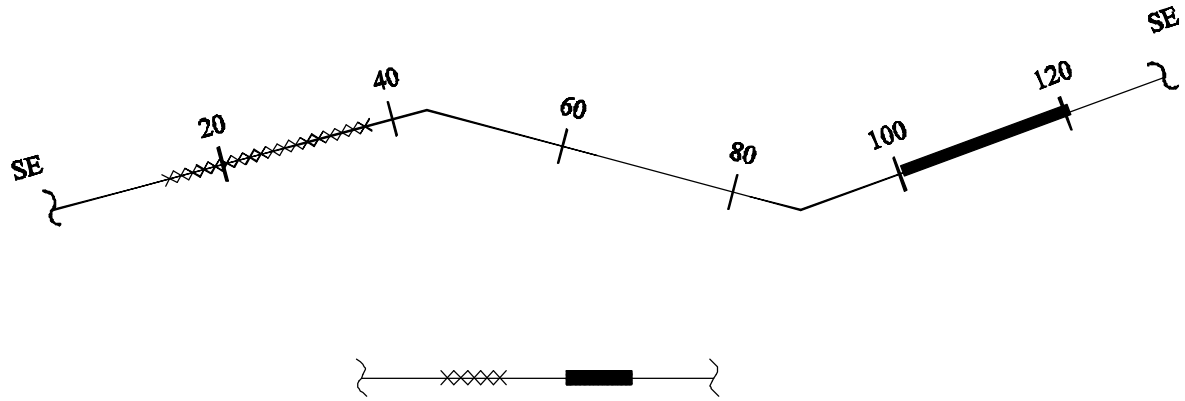
The results of the analysis can be presented in connection with the account of sampling. Results of the analysis are presented with optional symbol, filled for laboratory analysis and open for field analysis. Different scales can be used in the same diagram. The method of analysis applied to the presented parameter is indicated. Also methods of analysis used for other results, not presented, can be indicated.



Units and explanations:
Soil (S): mg/kg TS
TS = dry substance,
alternatively Vv = wet weight
Pore gas (G): ppm
(B_q/m^3)
Water (L): µg/l (mg/l)
Pb = lead
XRF = X-ray fluorescence detector
IR = infrared spectrophotometry

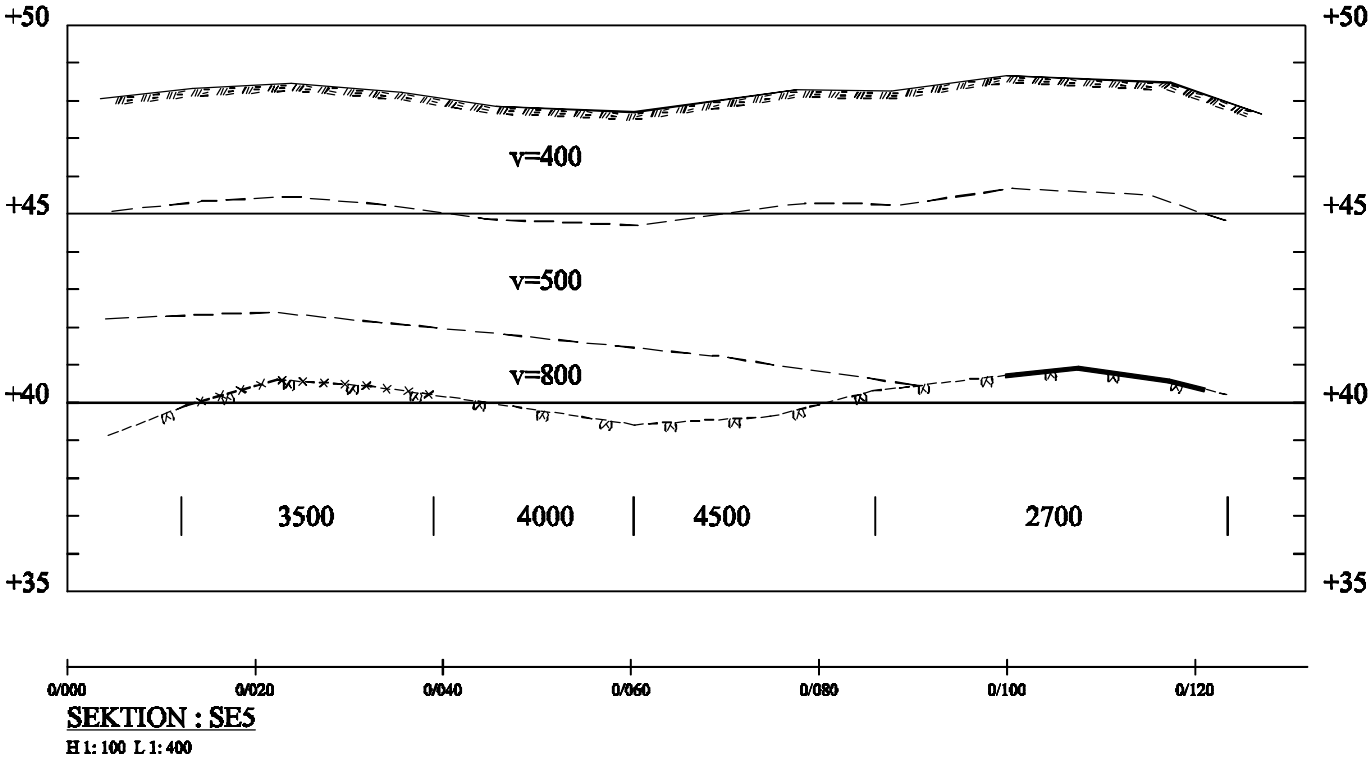
Plan symbol in the example: 

Geophysical investigations



Plan symbol:

Society of Engineering Geology Society of Engineering Geology Geophysical investigation profiles are marked to scale along the investigated area with abbreviation representing the investigation method on the line. The results are given with evaluated deviations, in the profile drawings. These can also be shown in a plan drawing. Abbreviations representing utilised investigation methods are shown in Appendix 1.



Presentation of evaluated geo-information

General

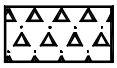
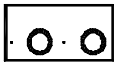
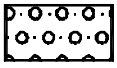
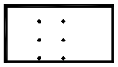
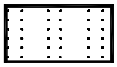
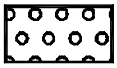
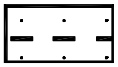
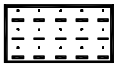
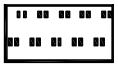
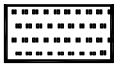
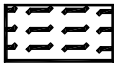
The presentation can be made as so-called detailed plan presentation. On the basis of sounding results and sampling an evaluation is made of the soil profile. In the plan, adjacent to the point symbol of soil investigation method, the ground surface level is indicated and underneath the different soil layers - in due order from the ground surface downwards - with indication of the depth below ground surface of the bottom of the soil layer in question, alternatively the levels of the layer borderlines.

The presentation concerns the most optimal judgement that can be made on the basis of collected data. The agreement between evaluated and real conditions depends on many factors, e.g. the extent of the investigation, pre-knowledge about the area in question, judgement of the field engineer, geological history.

Evaluated conditions can also be shown in section drawings. The borderlines between different soil layers are marked and the layers are coloured or screened. The classification of the different soil layers is generally rough, normally with division between fill, clay, non-cohesive soil and rock. The building geology map is an example of a simplified one. More detailed information can be presented in a similar way with extended set of screens, symbols and abbreviations. The screens used for various soil types can be combined, for instance to show clay on silt.

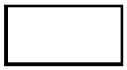
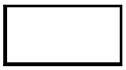
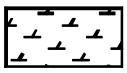
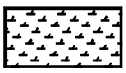
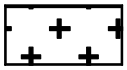
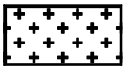
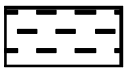
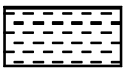
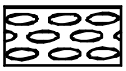
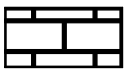
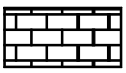
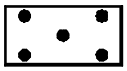
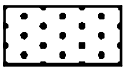
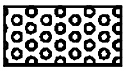
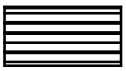
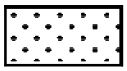
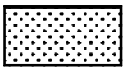
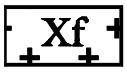
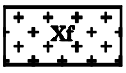
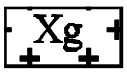
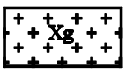
Rock types and zones of weakness are shown with standardised screens and abbreviations. For presentation of rock structures - the way they have been evaluated from the results of borings, core samples or mapping - standardised symbols are used. When evaluating rock conditions in connection with, for example, tunnelling, a so-called rock prognosis is often established. The rock prognosis normally includes an interpretation of geological and geo-hydrological conditions and a rock engineering judgement of the need of reinforcement or injection of the tunnel. The rock mass is often classified according to some international system, generally the Q-index or RMR.

Types of soil — presentation in plan

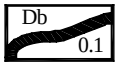
Scale: Detailed	General	*Description:*		*Code of colour according to SIS 03 14 11*
		Soil type not evaluated		
		Mn	Till	103
		LeMn	Clay till	-
		Fr	Non-cohesive soil	104
		Sa	Sand	201
		Gr	Gravel	104
		Le	Clay	101
		Let	Dry-crust clay	101
		Si	Silt	101
		GyLe	Gyttja-clay	309
		T, Gy, D	Peat, Gyttja, Dy	204
		F	Fill	-

Types of rock — presentation in plan

Scale: *Description:*

Detailed	General		
			Type of rock not evaluated
		Db	Dolerite
		Gg	Gneissic granite
		Gn	Gneiss, veined gneiss, migmatite, etc.
		Gr	Granite and other massive, grey to red rocks
		Gö	Greenstone, gabbro, diorite, amphibolite and other dark rock types
		Kg	Conglomerate
		Ks	Limestone and dolomite (crystalline and layered)
		Kv	Quartzite
		Lt	Leptite, porphyry, hälleflinta
		Sk	Shale, slate, schist, e.g. mica schist, phyllite, chlorite schist
		Ss	Sandstone
		Xf	Term for fine-granular structure, mainly granite
		Xg	Term for coarse-granular structure (inclusive augen structure), mainly in granite

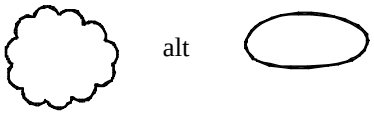
Remark: Screens can be oriented in the direction of foliation



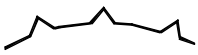
Hypabyssal rock (is noted with abbreviation for rock type), not to scale, width in m is noted

Border line of water (lake, etc.)

Border line of rock

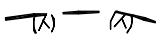


Rock at shallow depth, alternatively visible bedrock



Blasted rock slope

Small flat piece of rock, rock observation



Presentation of evaluated rock surface in section drawings

Presentation of visible rock in section drawings

Rock structure

Plane parallel structure (foliation, schistosity, etc.), with measured angle of dip

Plane parallel structure (foliation, schistosity, etc.), steep angle of dip (60°–85°)

Plane parallel structure (foliation, schistosity, etc.), vertical dip (85°–90°)

Plane parallel structure (foliation, schistocity, etc.), horizontal dip (0°–10°)

Plane parallel structure (foliation, schistosity, etc.), angle of dip unknown

Fold axis, with dip reading

Lineation, with dip reading

Lineation, vertical and horizontal dip, respectively

Lineament

Fracture = discontinuity the width of which < 10 cm
Fractured zone = discontinuity the width of which > 10 cm
Only fractures longer than about 3 m are normally marked in the drawings

Lineament (elongated, conspicuous structure in the landscape, possible fractured zone or some other discontinuity). Lineament can be topographic or indicated by geophysics.

Fracture with observed dip

Fracture with steep angle of dip (60°–85°)

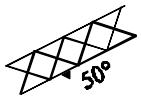
Fracture with vertical dip (85°–90°)

Fracture with horizontal dip (0°–10°). Inclusive sheeting

Fracture with unknown angle of dip

In-filled aperture (width in mm)

Fractured zone not to scale, and other discontinuities (gouge, crushed zone, shear zone, metamorphic zone, fault zone) with angle of dip



Fractured zone to scale, and other discontinuities (gouge, crushed zone, shear zone, metamorphic zone, fault zone) with angle of dip

Fault, fault zone with mainly horizontal movement (size of movement in m)

Fault, fault zone with mainly vertical movement (size of movement in m)

	Water	*Fracture roughness*
	Running	R = rough surface
	Drip	S = smooth surface
	Humidity	H = slickenside
		U = waving surface

Degree of weathering

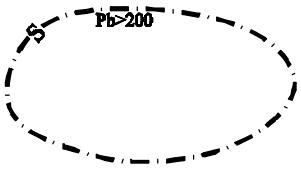
Degree	*Denomination*
1	fresh, not weathered
2	poorly weathered
3	slightly weathered
4	weathered, moderately weathered
5	strongly weathered
6	fully weathered, completely turned into soil

Geo-hydrology

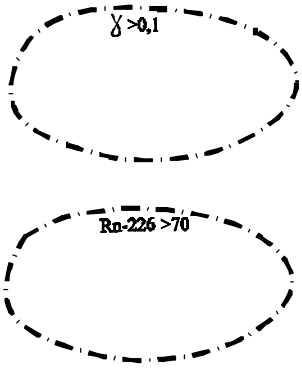
Groundwater divide
Flow direction

Environmental engineering terms

Contamination:



Demarcation of observed contamination is made by a demarcation line () combined with the abbreviated term in question and the concentration limits. Alternatively the line can be provided with abbreviations for contaminated media as shown below:
—S— contaminated soil, sediment
—L— contaminated water
—G— contaminated pore gas



Radiation	*Quantity*
Rn-222	Bq / m^3
γ	µSv / h
Rn -226	Bq / Kg
Th -232	Bq / Kg
K -40	Bq / Kg

The text shall be placed in the area/point concerned.

The amount of contamination (alternatively radium or gamma index) can also be indicated as shown below:

Radium index	Ra
Gamma index	Ga
Point information	*1.1

Report on foundation and soil and rock reinforcement methods

General

The foundation map can complete the geotechnical and engineering geological reports. On this map, buildings and other objects are screened, indicating existing and projected foundation methods.

The various types of screens can also be utilised as an illustration of the foundation conditions and of planned or existing means of reinforcement.

In connection with tunnelling in rock, means of reinforcement such as shotcrete, rock bolting, injection and drains are indicated. During the period of projection this is normally done by indicating the evaluated need of reinforcement in rock prognosis drawings, see also chapter 3. As relation data, the presentation is usually made on a so-called gatefold tunnel scanned from above. The outer dimensions of the tunnel are generally equal to its theoretical normal section. The bottom of the tunnel is normally omitted.

From a general point of view, the screens in drawings are used with advantage for elucidation of given information in a way that can be accepted in relation to other pieces of information in the drawings. The scale of the various screens can be considered as standard. Deviation from the standard is justified if it leads to better readability.
If screening is omitted, the means suggested are instead indicated in the respective part area.

Foundation

Pile foundation

Scale:
Detailed General

Description:

Steel piles, point bearing

Concrete piles, point bearing

Wooden piles, point bearing

Bored piles

Steel piles, friction piles

Concrete piles, friction piles

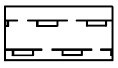
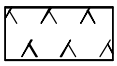
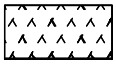
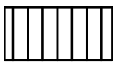
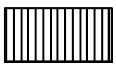
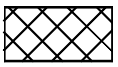
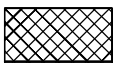
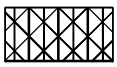
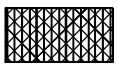
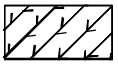
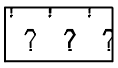
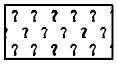
Wooden piles, friction piles

Composite piles

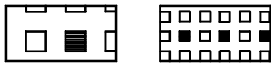
Piles of unknown type

Embankment piles

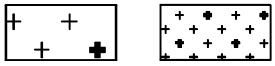
Spread foundation

Scale:		*Description:*
Detailed	General	
		Foundation on firm bottom
		Foundation on rock
		Foundation on clay
		Foundation on man-made ground
		Foundation on filled-up ground above clay
		Foundation on mattress
		Information about foundation method missing

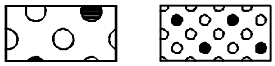
Spread foundation, continuation



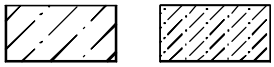
Foundation
reinforced by concrete piles



Foundation
reinforced by steel piles

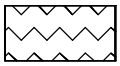
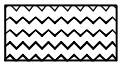
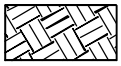
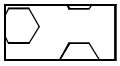
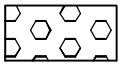
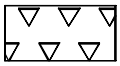
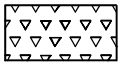
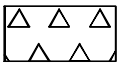
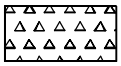
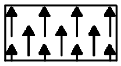
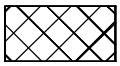
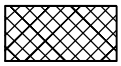
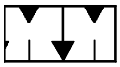
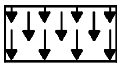
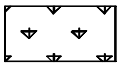
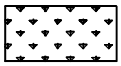


Foundation
reinforced by wooden piles



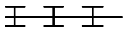
Concrete structure, general symbol
(tray, tunnel, pile deck, wall, plinth).

Soil improvement, filling — presentation in plan

Scale:		*Description:*
Detailed	General	
		Light fill material
		Soil reinforcement
		K/C columns, deep stabilisation
		Loading berm
		Excavation
		Vertical drainage
		Fill, overload
		Enforced displacement
		Deep compaction

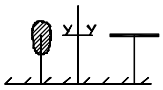
Retaining structures — presentation in plan

Sheet pile wall, temporary (watertight)

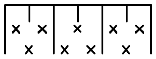


Sheet pile wall, temporary (beam wall)

Sheet pile wall, permanent

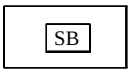
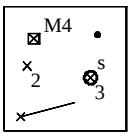
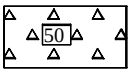
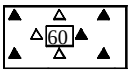
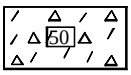
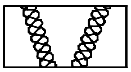
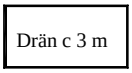
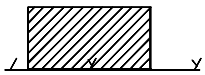
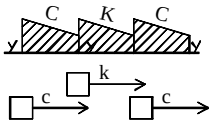


Anchorage in soil, rock respectively sheet pile anchors/plate anchors



Reinforcement by soil nailing

Reinforcement of rock

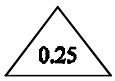
Symbol	*Description:*
	Area reinforced with system bolts (SB). The name and the extent of the system reinforcement can also be indicated along the section in question.
	Embedded dead bolt is shown with a cross. Bolt length indicated in m. Washer shown by adding a ring ⊗. Prestressed bolt shown by adding a square ☒. Pre-bolting shown with horizontally projected bolt direction. Permanence grade deviating from M2 is indicated. Swellex bolt is indicated by adding S. Bolt for interior assemblage, building construction etc. is presented with a small filled circle.
	Shotcrete, plain—possible covering thickness shown in mm. Alternatively, merely the text 050 indicates the part of the area covered by plain shotcrete, 50 mm in thickness
	Shotcrete, reinforced—possible covering thickness shown in mm. Alternatively, merely the text A60 indicates the part of the area covered by reinforced shotcrete, 60 mm in thickness.
	Fibre concrete, covering thickness is indicated in mm. Alternatively, merely the text F50 indicates the part of the area stabilised by fibre concrete, F50 in thickness.
	Drain in measured position.
	Drain system, with general spacing between the drains, not measured.
	Drain, in schematic system.
	Reinforcing arch, concrete structure.
	Zone of injection, schematic presentation. Injection material indicated by C for cement, K for chemical, PU for polyurethane and KC for mixed mortar.
	Zone of injection, real situation of pre-injection trumpets, possibly completed by information about injection material, consumption, etc..

Presentation of acceptable vibrations in plan

Acceptable levels of vibration are indicated with reference to a distance of 10 m from the source of vibration. For further information regarding acceptable vibrations during blasting see SIS 460 48 66.

[mm/s] Maximum permitted frequency of oscillation due to piling and sheet piling activities

[mm/s] Maximum permitted frequency of oscillation due to blasting



[m/s^2] Maximum permitted acceleration due to piling, sheet piling and blasting activities

Appendix 1

Abbreviations

Probing

CPT	Cone Penetration Test
Hf	ram sounding (e.g. HfA)
Jb-1, Jb-2, Jb-3	soil/rock drilling
Slb	percussion sounding
Sti	stick sounding
Tr	static sounding
TrP	pore pressure sounding
TrS	point pressure sounding
Vi	weight sounding
Vim	weight sounding, machine driven

In situ testing

DMT	dilatometer test
Kb	core drilling
PMT	pressuremeter test
Pp	pore pressure measurement
Vb	vane test

Sampler

Fo	foil sampler
Groundwater sampling in open tube:	
Ba	-collected up
Gl	-gas lift (blowing, mammoth pump)
M	-mechanical pump (centrifugal, bladder, etc.)
Sl	-Suction pump
Has	hollowstem auger
Js	scraper bucket
K	spoon sampler
Kr	core sampler
Kv	piston sampler
Ps	tube sampler
Sgs or Plp	pore gas sampler
cSgs	continuous pore gas sampler
Skr	helical auger
Sp	post-hole auger

Methods of analysis

AAS	atomic absorption spectrophotometry
DT	detector tubes
FID	flame ionisation detector
GC	gas chromatography
HPLC	liquid chromatography
ICP	inductively coupled plasma spectrometry
IR	infrared spectrophotometry
MS	mass spectrometry
PID	photo ionisation detector
TK	other test kits for field usage
XRF	x-ray fluorescence detector

Special methods

γ	gamma radiation
γ_s	gamma radiation when observed by means of gamma spectrometer
EL	electrical
EM	electromagnetic
GM	gravimetric
GPR	ground penetrating radar
Ikl	inclinometer observations
MG	magnetic
Pg	test pit
Pu	test pumping
Rf	tube with filter tip
Rö	open tube, casing
SE	seismic
Vfm	water loss observation (falling respectively constant head or well test)

Mineral and fracture filling

an	andalusite	kl	chlorite
co	cordierite	kv	quartz
ep	epidote	ky	kyanite
Fe	iron	Le	clay
fs	fluorite	of	no filling
ga	garnet	ore	ore mineral
gf	graphite	plag	plagioclase
ho	hornblende	si	sillimanite
jo	soil	su	sulphides
ka	calcite	ta	talc
kfsp	potassium feldspar		

Hypabyssal rock

A	amphibolite	Gö	greenstone
Ap	aplite	M	mylonite
B	breccia	P	pegmatite
Db	dolerite	Pf	porphyry

Rock and soil

Main term		**Modifier**		**Layer**	
B	rock				
Bl	boulders	bl	boulder-bearing		
Br	fragmented rock				
Cs	suspected contamination	cs	local contamination(routine field evaluation)	cs	contaminated layer
Dy	dy	dy	dy-bearing	dy	dy layer
F	fill, refuse, man-made soil				
Gr	gravel	gr	gravelly	gr	gravel layer
Gy	gyttja	gy	gyttja-bearing	gy	gyttja layer
Gy/Le	contact gyttja and clay (gyttja above, clay below)	( ) (sa)	somewhat, e.g. somewhat sandy	( )	thin layer
J	soil				
Le	clay	le	clayey	le	clay layer
Mn	till				
BlMn	boulder and cobble till				
StMn	cobble till				
GrMn	gravel till				
SaMn	sand till				
SiMn	silt till				
LeMn	clay till				
Mu	humus, topsoil	mu	humus-bearing	mu	humus layer
Sa	sand	sa	sandy	sa	sand layer
Si	silt	si	silty	si	silt layer
Sk	shells	sk	shell-bearing	sk	shell layer
Skgr	shell gravel				
Sksa	shell sand				
St	cobbles	st	cobble-bearing	st	cobble layer
Su	sulphide soil	su	sulphide-bearing	su	sulphide layer
T	peat			t	peat layer
Tl	fibrous peat				
Tm	pseudo-fibrous peat				
Th	amorphous peat				
Vx	plant (wood) remains	vx	containing plant remains	vx	layer of plant remains

T	after main term, e.g. Let and Sit = dry crust of clay and silt
v	varved, e.g. vLe = varved clay (the term should be reserved for glacial deposits)

The modifiers are placed before the main term. If there are several modifiers the name of the fraction which gives the soil its most characteristic properties is placed closest to the main term. The further the modifier is placed from the main term, the less the importance of the fraction in question. Layer designations are placed behind the main term. Example: sisaLesi = silty, sandy clay with silt layers. Mineral soils can be divided into the fractions fine, medium and coarse, respectively f, m and g, e.g. Saf = fine sand.

Rock and soil parameters

E_D	dilatometer modulus
E_M	pressuremeter modulus
σ'_c	preconsolidation pressure (effective)
σ'_k	characteristic effective stress
f_T	sleeve friction (area corrected (CPT))
I_D	material index
τ_{fu}	undrained shear strength
τ_{RV}	remoulded (horizontal) shear strength (Vb)
τ_v	not corrected shear strength (Vb)
K_D	horizontal stress index (DMT)
M_L	compression modulus
p_0	contact pressure (DMT)
p_{0m}	pressure (PMT)
p_l	limit pressure (PMT)
p_l*	net limit pressure (PMT)
q_T	point resistance (area corrected (CPT))
S_t	sensitivity
u	pore pressure
w	water content
w_L	liquid limit
w_N	natural water content
w_P	plastic limit
V_f	creep volume (PMT)
V_0	initial volume (PMT)

Generic terms

Fr	non-cohesive soil
Ko	cohesive soil
O	organic soil
P	mineral or organic cohesive soil (used when it is impossible to differ between these soils)
X	used when the soil type is not determined or when soil is not evaluated.

Fr, Ko and O are used when the soil type cannot be evaluated on the basis of penetration resistance or hearing impression (or by sampling nearby). Can also be used as generic terms in connection with sampling.

Remarks:

Soil	loose surface part of the Earth's crust (not more closely defined)
Soil type	classified soil (according to different classification systems)

Other abbreviations

A	analysis
fb	pre-boring
GW	groundwater level
MkA, MkB, MkC	measurement grade A, B and C according to HMK-BA2
My	ground surface
Ro	rotatory boring (previously Rt)
Sb	drop hammer boring
W	free water level, pore pressure level