Queensland Government

Geotechnical Terms and Symbols Form

Part 1 – Geotechnical Terms and Tables

Part 2 – Geotechnical Symbols and Abbreviations

The terms and tables provided in this form shall be utilised for the geotechnical logging of materials (both naturally occurring and man-made), in conjunction with the Queensland Department of Transport and Main Roads (TMR) Guideline for Geotechnical Logging. The key reference document is Australian Standard AS 1726:2017 Geotechnical site investigations.

Soil Description and Classification

Composition of soils

Particle size definitions (after AS 1726:2017, Table 1)

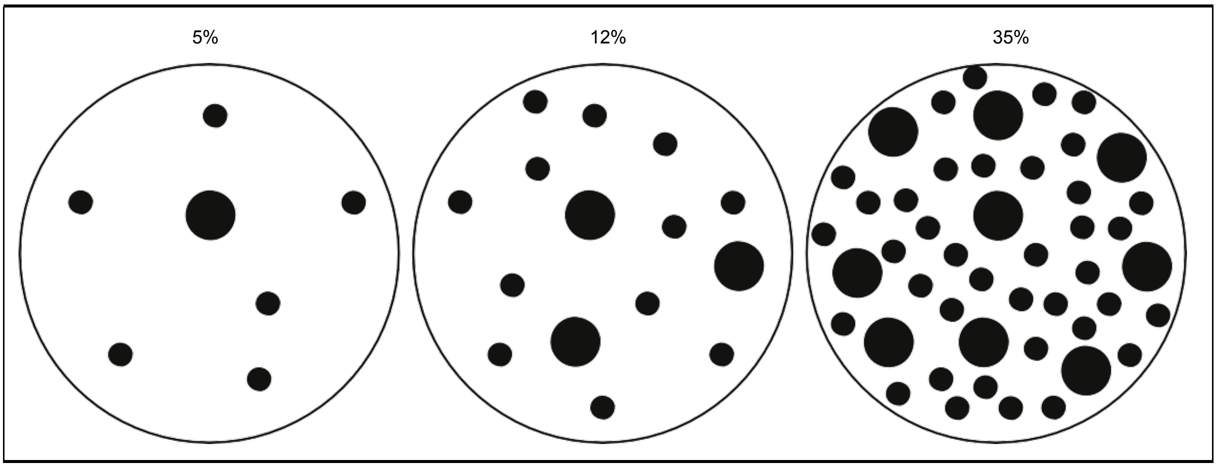
Fraction	Components	Subdivision	Size[1] (mm)
Oversize	Boulders (Bo)		> 200
	Cobbles (Co)		63 - 200
Coarse grained soils	Gravel (Gr)	Coarse (cGr)	19 - 63
		Medium (mGr)	6.7 - 19
		Fine (fGr)	2.36 - 6.7
	Sand (Sa)	Coarse (cSa)	0.6 - 2.36
		Medium (mSa)	0.21 - 0.6
		Fine (fSa)	0.075 - 0.21
Fine grained soils	Silt (Si)		0.002 - 0.075
	Clay (Cly)		< 0.002

Note: 1. Corresponding (approximately) to standard sieve sizes

Descriptive terms for accessory (secondary and minor) soil components (after AS 1726:2017, Table 2)

Designation of components	In coarse grained soils				In fine grained soils	
	% Fines	Terminology	% Accessory coarse fraction	Terminology	% Sand/ gravel	Terminology
Minor	≤ 5	Add 'trace clay/silt' to description, as applicable	≤ 15	Add 'trace sand/gravel' to description, as applicable	≤ 15	Use 'trace'
	> 5, ≤ 12	Add 'with clay/silt' to description, as applicable	> 15, ≤ 30	Add 'with sand/gravel' to description, as applicable	> 15, ≤ 30	Add 'with sand/gravel' to description, as applicable
Secondary	> 12	Prefix soil name as 'silty' or 'clayey', as applicable	> 30	Prefix soil name as 'sandy' or 'gravelly', as applicable	> 30	Prefix soil name with 'sandy' or 'gravelly', as applicable

Diagram of various percentages of grains (after AS 1726:2017, Figure 3)



Identification of organic soils using laboratory tests (after AS 1726:2017, Table 3)

Material	Organic content – % of dry mass
Inorganic soil	< 2
Organic soil	2 to 25
Peat	> 25

Descriptive terms for the degree of decomposition of peat (after AS 1726:2017, Table 4)

Term	Decomposition	Remains	Squeeze
Fibrous	Little or none	Clearly recognizable	Only water, no solids
Pseudo-fibrous	Moderate	Mixture of fibres and amorphous paste	Turbid water, < 50% solids
Amorphous	Full	Not recognizable	Paste, > 50% solids

Assessment of carbonate content (after AS 1726:2017, Table 5)

Term	Reaction to acid	Approximate carbonate content
Non-calcareous	HCl produces no effervescence	Negligible
Calcareous	HCl produces weak or sporadic effervescence	< 50%
Carbonate	HCl produces clear sustained effervescence	> 50%

Note: 10% hydrochloric acid is made by taking 10 mL of concentrated HCl acid solution (36% HCl) and making it up to 100 mL. This gives 3.6% HCl by mass which is about 1.2 molar

Descriptive Terms for Plasticity (after AS 1726:2017, Table 6)

Descriptive term	Range of liquid limit for silt	Range of liquid limit for clay
Non-plastic	Not applicable	Not applicable
Low plasticity	≤ 50	≤ 35
Medium plasticity	Not applicable	> 35 and ≤ 50
High plasticity	> 50	> 50

Terms for describing the spread of coarse grained particle sizes (afterAS1726:2017, Claus 6.1.4.11)

Term	Description
Well graded	Having good representation of all particle sizes from the largest to the smallest (*Cu* > 4 and 1 < *Cc* < 3)
Poorly graded	With one or more intermediate sizes poorly represented
Gap graded	With one or more intermediate sizes absent
Uniformly graded	Essentially of one size

Notes: Where D10, D30 and D60 are those grain sizes for which 10%, 30% and 60% of the soil grains are smaller

1. The coefficient of uniformity is given by Cu = (D60 / D10)

2. The coefficient of curvature is given by Cc = (D30)2 / (D10D60)

Particle shapes (after AS 1726:2017, Figure 4)

Note: Essentially two-dimensional particles with the third dimension small by comparison shall by described as 'flaky' or 'platy'

Identification of fine grained soils by visual - tactile methods (after AS 1726:2017, Table 8)

Soil description	Identification of inorganic fine-grained soils		
	Dry strength	Dilatancy	Toughness and plasticity
SILT	None to low	Slow to rapid	Low or thread cannot be formed
Clayey SILT–Clay/silt mixtures of low plasticity	Low to medium	None to slow	Low to medium
Silty CLAY–Silt/clay mixtures of medium plasticity	Medium to high	None to slow	Medium
High plasticity CLAY	High to very high	None	High

Visual - tactile assessment of fine grained soils (after AS 1726:2017, Table 7)

<table>
<tr><th colspan="2">Dry strength</th><th colspan="2">Dilatancy (reaction to shaking)</th><th colspan="2">Toughness (consistency near plastic limit)</th></tr>
<tr><td colspan="2">Mould a pat of soil to the consistency of putty, adding water if necessary. Allow the pat to dry completely by oven, sun or air drying, and then test its strength by breaking and crumbling between the fingers. This strength is a measure of the character and quantity of the colloidal fraction contained in the soil. The dry strength increases with increasing plasticity. High dry strength is characteristic for clays of the CH group. A typical inorganic silt possesses only very low dry strength. Silty fine sands and silts have about the same dry strength, but can be distinguished by feel when powdering the dried specimen. Fine sand feels gritty whereas a typical silt has the smooth feel of flour.</td><td colspan="2">Prepare a pat of moist soil with a volume of about 10 cm3. Add enough water, if necessary, to make the soil soft but not sticky. Shake the pat horizontally in the palm of the hand, striking vigorously against the other hand several times. A positive reaction consists of the appearance of water on the surface of the pat which changes to a livery consistency and becomes glossy. When the sample is squeezed between the fingers, the water and gloss disappear from the surface. The pat stiffens, and finally it cracks or crumbles. The rapidity of appearance of water during shaking and its disappearance during squeezing assist in identifying the character of the fines in the soil. Very fine clean sands give the quickest and most distinct reaction whereas a plastic clay has no reaction. Inorganic silt, such as a typical rock flour, shows a relatively rapid reaction.</td><td colspan="2">Mould a pat of soil to the consistency of putty. If too dry, add water, and if sticky, the specimen should be spread out in a thin layer and allowed to lose some moisture by evaporation. Then, roll a thread of the soil by hand on a smooth surface or between the palms until it is about 3 mm in diameter. The thread is then folded and re-rolled repeatedly. During this manipulation the moisture content is gradually reduced, the specimen stiffens, finally loses its plasticity, and crumbles. When the thread crumbles, the pieces should be lumped together with a kneading action. The plastic limit has been reached, when the soil crumbles at about 3 mm thickness. The tougher the thread near the plastic limit and the stiffer the lump when it finally crumbles, the more potent is the colloidal clay fraction in the soil. Weakness of the thread at the plastic limit and rapid loss of coherence of the lump below the plastic limit indicate either inorganic clay of low plasticity, or materials such as kaolin-type clays and organic clays which plot below the A-line. Highly organic clays have a very weak and spongy feel at the plastic limit.</td></tr>
<tr><th colspan="2">Criteria for describing dry strength</th><th colspan="2">Criteria for describing dilatancy</th><th colspan="2">Criteria for describing toughness</th></tr>
<tr><td>None</td><td>The dry specimen crumbles into powder with mere pressure of handling.</td><td>None</td><td>No visible change in the specimen.</td><td rowspan="2">Low</td><td rowspan="2">Only slight pressure is required to roll the thread near the plastic limit. The thread and the lump are weak and soft.</td></tr>
<tr><td>Low</td><td>The dry specimen crumbles into powder with some finger pressure.</td><td rowspan="2">Slow</td><td rowspan="2">Water appears slowly on the surface of the specimen during shaking and does not disappear or disappears slowly upon squeezing.</td></tr>
<tr><td>Medium</td><td>The dry specimen breaks into pieces or crumbles with considerable finger pressure.</td><td>Medium</td><td>Medium pressure is required to roll the thread to near the plastic limit. The thread and the lump have medium stiffness.</td></tr>
<tr><td>High</td><td>The dry specimen cannot be broken with finger pressure. Specimen will break into pieces between thumb and a hard surface.</td><td rowspan="2">Rapid</td><td rowspan="2">Water appears quickly on the surface of the specimen during shaking and disappears quickly upon squeezing.</td><td rowspan="2">High</td><td rowspan="2">Considerable pressure is required to roll the thread to near the plastic limit. The thread and the lump have very high stiffness.</td></tr>
<tr><td>Very High</td><td>The dry specimen cannot be broken between the thumb and a hard surface.</td></tr>
</table>

Soil classification

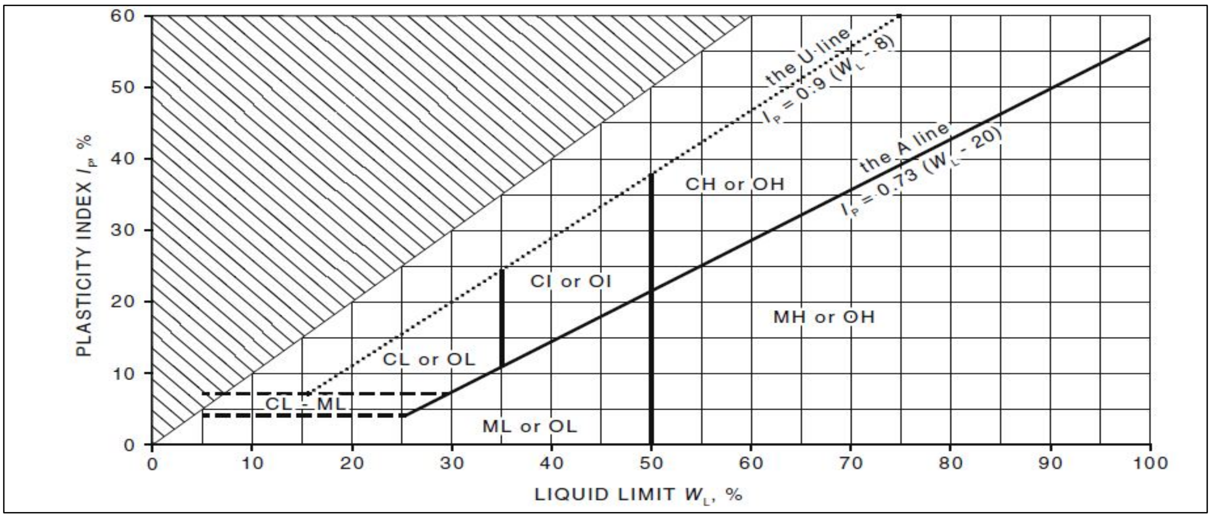
Classification of coarse grained soils (after AS 1726:2017, Table 9)

Major divisions		Group symbol	Typical names	Field classification of sand and gravel	Laboratory classification	
Coarse grained soil (more than 65% of soil excluding oversize fraction is greater than 0.075mm)	GRAVEL > 50% of coarse fraction is larger than 2.36mm	GW	Gravel and gravel-sand mixtures, little or no fines	Wide range in grain size and substantial amounts of all intermediate sizes, not enough fines to bind coarse grains, no dry strength	≤ 5% fines	$C_u > 4$ $1 < C_c < 3$
		GP	Gravel and gravel-sand mixtures, little or no fines, uniform gravels	Predominantly one size or range of sizes with some intermediate sizes missing, not enough fines to bind coarse grains, no dry strength	≤ 5% fines	Fails to comply with above
		GM	Gravel-silt mixtures and gravel-sand-silt mixtures	'Dirty' materials with excess of non-plastic fines, zero to medium dry strength	≥ 12% fines, fines are silty	Fines behave as silt
		GC	Gravel-clay mixtures and gravel-sand-clay mixtures	'Dirty' materials with excess of plastic fines, medium to high dry strength	≥ 12% fines, fines are clayey	Fines behave as clay
	SAND > 50% of coarse fraction is smaller than 2.36mm	SW	Sand and gravel-sand mixtures, little or no fines	Wide range in grain size and substantial amounts of all intermediate sizes, not enough fines to bind coarse grains, no dry strength	≤ 5% fines	$C_u > 6$ $1 < C_c < 3$
		SP	Sand and gravel-sand mixtures, little or no fines	Predominantly one size or range of sizes with some intermediate sizes missing, not enough fines to bind coarse grains, no dry strength	≤ 5% fines	Fails to comply with above
		SM	Sand-silt mixtures	'Dirty' materials with excess of non-plastic fines, zero to medium dry strength	≥ 12% fines, fines are silty	NA
		SC	Sand-clay mixtures	'Dirty' materials with excess of plastic fines, medium to high dry strength	≥ 12%, fines are clayey	

Notes:

1. Where the grading is determined from laboratory tests, it is defined by coefficients of curvature Cc and uniformity Cu derived from the particle size distribution curve, as specified in AS1726:2017, Clause 6.1.4.11
2. For fines contents between 5% and 12%, the soil shall be given a dual classification comprising the two group symbols separated by a dash, e.g. for a gravel with between 5% and 12% silt fines, the classification is GP-GM
3. Soils that are dominated by boulders, cobbles or peat (Pt) are described separately and are not classified

Modified Casagrande chart for classifying silts and clays according to their behaviour (after AS 1726:2017, Figure 5)



Note: The U line is an approximate upper bound for most natural soils. Data which plot above the U line may represent unusual / problem soil behaviour, or unreliable data and should be considered carefully.

Classification of fine grained soils (after AS 1726:2017, Table 10)

Major divisions		Group symbol	Typical names	Field classification of silt and clay			Laboratory classification
				Dry strength	Dilatancy	Toughness	% < 0.075mm
Fine grained soil (more than 35% of soil excluding oversize fraction is less than 0.075mm)	SILT and CLAY (low to medium plasticity)	ML	Inorganic silt and very fine sand, rock flour, silty or clayey fine sand or silt with low plasticity	None to low	Slow to rapid	Low	Below A line
		CL,CI	Inorganic clay of low plasticity to medium plasticity, gravelly clay and sandy clay	Medium to high	None to slow	Medium	Above A line
		OL	Organic silt	Low to medium	Slow	Low	Below A line
	SILT and CLAY (high plasticity)	MH	Inorganic silt	Low to medium	None to slow	Low to medium	Below A line
		CH	Inorganic clay of high plasticity	High to very high	None	High	Above A line
		OH	Organic clay of medium to high plasticity, organic silt	Medium to high	None to very slow	Low to medium	Below A line
	Highly organic soil	Pt	Peat, highly organic soil	–	–	–	–

Colour of soils and rocks

Soil and rock colour terms and abbreviations (after AS 1726:2017, Clauses 6.1.5, 6.2.3.3)

Term	Abbreviation	Modifier	Abbreviation
Black	bk	Pale	pl
White	wh		
Grey	gy		
Red	rd	Dark	dk
Brown	br		
Orange	or		
Yellow	yl	Mottled	mtld
Purple	pu		
Green	gr		
Blue	bl		

Condition of soils (moisture condition, consistency / relative density, and cementation)

Moisture Condition of a soil (after AS 1726:2017, Claus 6.1.7)

Coarse grained soil	
Term	**Field appearance and feel**
Dry	Non-cohesive and free running
Moist	Feels cool, darkened in colour - tends to stick together
Wet	Feels cool, darkened in colour - tends to stick together, free water forms when handling
Fine grained soil	
Description	**Relative to the plastic limit (or liquid limit for soils with higher moisture contents)**
Moist, dry of plastic limit	Hard and friable and powdery (or ‘w < PL’)
Moist, near plastic limit	Soils can be moulded at a moisture content approximately equal to the plastic limit (or ‘w ≈ PL’)
Moist, wet of plastic limit	Soils usually weakened and free water forms on hands when handling (or ‘w > PL’)
Wet, near liquid limit	(or ‘w ≈ LL’)
Wet, wet of liquid limit	(or ‘w > LL’)

Consistency terms for cohesive soils (after AS 1726:2017, Table 11)

Consistency[1]	Field guide to consistency	Indicative undrained shear strength s_u (kPa)[2]	Approximate range of SPT *N* values
Very Soft (VS)	Exudes between the fingers when squeezed in hand	≤ 12	0 - 2
Soft (S)	Can be moulded by light finger pressure	> 12 and ≤ 25	2 - 4
Firm (F)	Can be moulded by strong finger pressure	> 25 and ≤ 50	4 - 8
Stiff (St)	Cannot be moulded by fingers	> 50 and ≤ 100	8 - 15
Very Stiff (VSt)	Can be indented thumb nail	> 100 and ≤ 200	15 - 30
Hard (H)	Can be indented with difficulty by thumb nail	> 200	> 30
Friable (Fr)	Can be easily crumbed or broken into small pieces by hand	-	-

Notes:

1. Consistency is affected by the moisture content of the soil at the time of measurement

2. Often su = qu / 2 (where qu is the unconfined compressive strength, Foundation Analysis and Design, 5th ed., J.E. Bowles, 1997)

Relative density of non-cohesive soils (after AS1726:2017, Table 12)

Term	Density Index %	Approximate range of SPT *N* values
Very Loose (VL)	≤ 15	0 - 4
Loose (L)	> 15 and ≤ 35	4 - 10
Medium Dense (MD)	> 35 and ≤ 65	10 - 30
Dense (D)	> 65 and ≤ 85	30 - 50
Very Dense (VD)	> 85	> 50

Note: The moisture content may influence the inferred relative density

Reporting of SPT results (after AS1289.6.3.1-2004)

Test Report	Penetration Resistance (N)	Explanation / Comment
4, 7, 11	N = 18	Full penetration; N is reported on engineering borehole log
18, 27, 32	N = 59	Full penetration; N is reported on engineering borehole log
4, 18, 30/15 mm	N is not reported	30 blows causes less than 100 mm penetration (3rd interval) – test discontinued
30/80 mm	N is not reported	30 blows causes less than 100 mm penetration (1st interval) – test discontinued
rw	N < 1	Rod weight only causes full penetration
hw	N < 1	Hammer and rod weight only causes full penetration
hb	N is not reported	Hammer bouncing for 5 consecutive blows with no measurable penetration – test discontinued

Cementation of soils (after AS 1726:2017, Claus 6.1.7)

Term	Definition
Weakly cemented	Easily disaggregated by hand in air or water
Moderately cemented	Effort is required to disaggregate by hand in air or water

Mass properties of soils (zoning and defects)

Zoning in soils (after AS 1726:2017, Claus 6.1.8)

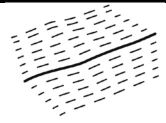
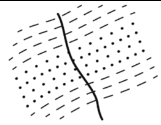
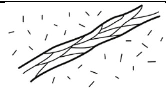
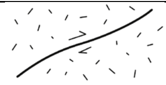
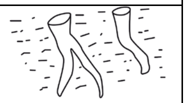
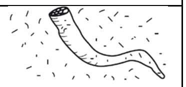
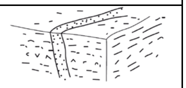
Term	Definition
Layer	A continuous zone across the exposure or sample
Lens	A discontinuous layer of different material, with lenticular shape
Pocket	An irregular inclusion of different material
Intermixed	Two or more soil types arranged in an irregular manner

Notes:

1. The thickness, orientation and any distinguishing features of the zones shall be described. The boundaries between zones shall be described as gradational or distinct

2. ‘Interbedded’ or ‘interlaminated’, shall be used if layers of alternating soil types are too thin to describe individually. The maximum/mean/minimum thickness of the beds/laminations should be given

Soil defect types (after AS 1726:2017, Table 13)

Term	Definition	Diagram
Parting	A surface or crack across which the soil has little or no tensile strength. Parallel or sub parallel to layering (for example, bedding). May be open or closed	
Fissure	A surface or crack across which the soil has little or no tensile strength but which is not parallel or sub parallel to layering. May be open or closed. May include desiccation cracks	
Sheared seam	A zone in clayey soil with roughly parallel near planar, curved or undulating boundaries containing closely spaced, smooth or slickensided, curved intersecting fissures which divide the mass into lenticular or wedge shaped blocks	
Sheared surface	A near planar, curved or undulating smooth, polished or slickensided surface in clayey soil. The polished or slickensided surfaces indicates that movement (in many cases very little) has occurred along the defect	
Softened zone	A zone in clayey soil, usually adjacent to a defect in which the soil has higher moisture content than elsewhere	
Tube	Tubular cavity. May occur singly or as one of a large number of separate or interconnected tubes. Walls often coated with clay or strengthened by denser packing of grains. May contain organic matter. Origins include root holes, animal burrows, tunnel erosion	
Tube cast	An infilled tube. The infill may be uncemented or weakly cemented soil or have rock properties	
Infilled seam	Sheet or wall like body of soil substance or mass with roughly planar to irregular near parallel boundaries which cuts through a soil mass. Formed by infilling of open defects	

Note: Where practical, the surface of the defects shall be described in terms of shape, (planar, stepped, curved, irregular), surface roughness (rough, smooth, polished, slickensided), and coating

Soil Origin

Geological and anthropogenic origins of soils (after AS 1726:2017, Claus 6.1.9)

Description	Definition
FILL	Any material which has been placed by anthropogenic processes. 'FILL' should be emphasised on logs by the use of BLOCK LETTERS
TOPSOIL	Mantle of surface and/or near surface soil often defined by high levels of organic matter. 'TOPSOIL' should be emphasised on logs by the use of BLOCK LETTERS
Extremely weathered material	Formed directly from *in situ* weathering of geological formations. Although of soil strength it retains the structure and/or fabric of the parent rock material
Residual soil	Formed directly from *in situ* weathering of geological formations. No longer retaining any visual structure or fabric of the parent soil or rock material
Alluvial soil	Deposited by streams and rivers
Estuarine soil	Deposited in coastal estuaries, and including sediments carried by inflowing rivers and streams, and tidal currents
Marine soil	Deposited in a marine environment
Lacustrine soil	Deposited in freshwater lakes
Aeolian soil	Carried and deposited by wind
Colluvial soil	Soil and rock debris transported down slopes by gravity, with or without the assistance of flowing water and generally deposited in gullies or at the base of slopes. Formed from landslides.
Slopewash	Thinner and more widespread colluvial deposits that accumulate gradually over longer geological timeframes than colluvial soils from landslides

Note: Soils should be assigned to a stratigraphic unit. Where there is doubt, the terms 'possibly' or 'probably shall be used

Definitions of FILL types (after AS1726:2017, Claus 6.1.11 and Appendix D)

FILL type	Definition
Controlled	Fill placed in accordance with AS 3798 or other controlled method, as demonstrated by construction documentation
Uncontrolled FILL	Fill for which no construction documentation is available

Typical characteristics and descriptive terms for FILL materials (after AS 1726:2017, Table 14, and Clause 6.1.11)

Some typical characteristics of FILL
Uncontrolled / non-engineered fill may settle variably, have poor bearing capacity
Very distinct changes in soil profile, unusually variable range of colours
Presence of foreign objects such as glass, plastic, slag
Buried organic matter
'Cloddiness' of clay soil indicating previous disturbance by excavation

Generalised terms	Typical descriptions
Organic matter	Fibrous peat
	Charcoal
	Wood fragments
	Roots (greater than 2mm diameter)
	Root fibres (less than 2mm diameter)
	Night soil, putrescible waste
Artificial materials	Oil, bitumen
	Masonry, concrete rubble, fibrous plaster, plasterboard, asbestos, fibre cement
	Timber pieces, wood shavings, sawdust, leather
	Iron filings, drums, steel bars, steel scrap
	Slag, chitter, ash, tailings
	Rubber tyres, bottles, broken glass

Problematic Soils (after AS 1726:2017, Appendix D)

Type	Physical properties	Associated risks and engineering problems
Acid sulfate soils	**(1) Undisturbed** - blue-grey, sometimes green-grey, always wet, generally soft, may contain shells and/or organic matter, may have associated 'rotten egg' H_2S gas smell. **(2) Oxidised** - brown or mottled yellow and brown, moist to dry, generally soft to hard.	When the soils are disturbed or exposed to air during earthworks construction and dewatering, oxidation of sulphides can occur, thus producing acid and other environmental contaminants. They pose a risk of causing the corrosion of buried structures (concrete and steel).
Arid soils	High voids ratios, variable mechanical and chemical weathering, may contain precipitated salts.	May have unusual engineering properties, and can be prone to accelerated disintegration and lithification.
Tropical soils	Commonly contain iron and aluminium oxides (sesquioxides), which may increase soil stiffness and strength, and may limit soil reactivity.	Fines content of the soils may permanently aggregate under oven or even air drying, which may result in misleading laboratory test results.
Collapsible soils	Possess an open, metastable structure which is developed via suction or cementation.	May collapse under applied load or upon saturation.
Dispersive soils	Fines include dispersive clays such as montmorillonite (highly dispersive) and illite (moderately dispersive). Dispersivity is directly related to clay mineralogy.	Highly erodible when exposed to air and/or water. Risk of piping when subjected to internal water flow.
Expansive soils	Fines include expansive clays such as smectite. Recognisable by development of cracks during dry period	Prone to changes in volume with changes in moisture content (shrink-swell behaviour) that may be seasonal, or induced by human activity. Often initiated by altered site drainage conditions.
Glacial soils	Variably graded, often poorly sorted.	Highly variable nature makes geotechnical characterisation difficult.
Liquefiable soils	Sands and coarse silts of low relative density.	Loss of shear strength under conditions of high water table, and usually under cyclic loading.
Sensitive soils	Clay rich soils with high moisture content, low bulk density and high porosity, which lose a portion of their strength and stiffness when remoulded.	Prone to liquefaction. Contribute to instability and progressive slope failure.
Organic peat soils	Low bulk density and low undrained shear strength.	Highly compressible and exhibit creep behaviour.

Rock Description and Classification

Rock name

Guide to the naming of sedimentary rocks (after AS 1726:2017, Table 15)

Grain size (mm)		Deposited rock type		At least 90% of rock is carbonate[3]		Ejected from a volcano
				Low porosity, indurated	Porous, core can be broken by hand	
Coarse (> 2)		CONGLOMERATE (larger rounded grains in a finer matrix) BRECCIA (angular or irregular rock fragments in a finer matrix)		LIMESTONE or DOLOMITE[4]	CALCIRUDITE	AGGLOMERATE (rounded grains in a finer matrix VOLCANIC BRECCIA (angular fragments in a finer matrix)
Medium (0.06 - 2)		SANDSTONE[1,2]			CALCARENITE	TUFF
Fine (<0.06)	0.002 - 0.06	MUDSTONE[5]	SILTSTONE		CALCISILTITE	Fine grained TUFF
	< 0.002		CLAYSTONE		CALCILUTITE	

Notes:

1. Including ARENITE, ARKOSE (feldspathic arenite), QUARTZITE (quartzose arenite), and GREYWACKE (poorly sorted, lithic arenite)
2. Sandstone may be described as fine (comprising 0.06 - 0.2mm grains), medium (0.2 - 0.6mm grains), or coarse (0.6 - 2.0mm grains)
3. Where carbonate content is 50 - 90% the names provided should be preceded by the word IMPURE
4. LIMESTONE (predominantly $CaCO_3$) should be distinguished from DOLOMITE (predominantly $CaMgCO_3$) where possible
5. SHALE is a fissile mudstone with preferential weakness parallel to bedding
6. BRECCIA is any sedimentary rock composed of angular fragments in a finer matrix
7. COAL is a mostly organic rock that consists of indurated accumulations of plant debris
8. The term carbonaceous may be added to the names in the table where a rock is assessed to contain a significant carbon content
9. EVAPORITES are rocks that consist mainly of salts such as halite, anhydrite or gypsum
10. FLINT and CHERT are amorphous or cryptocrystalline quartz, from any origin
11. Cements may be, for example, siliceous, calcareous, limonitic, carbonaceous, clay, or zeolite and where identified this should be noted

Guide to the naming of igneous rocks (after AS 1726:2017, Table 16)

Grain size (mm)	Massive crystalline		
	Much quartz, pale (felsic) ⟷ Little quartz, dark (mafic)		
Coarse (> 2)	GRANITE	DIORITE	GABBRO
Medium (0.06 - 2)	MICROGRANITE	MICRODIORITE	DOLERITE
Fine (< 0.06)	RHYOLITE	ANDESITE	BASALT

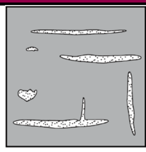
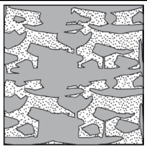
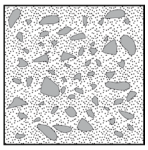
Notes:

1. PEGMATITE is intrusive igneous rock of very coarse grainsize (with crystal sizes generally > 3cm), often of granitic composition
2. OBSIDIAN and VOLCANIC GLASS are extrusive igneous rocks with no definite crystal structure (amorphous texture)
3. PORPHYRY is hypabyssal (near surface), intrusive igneous rock with larger, coarse-grained crystals (phenocrysts) set in a matrix (groundmass) of fine to medium grain size

Guide to the naming of metamorphic rocks (after AS 1726:2017, Table 17)

Grain size (mm)	Foliated (formed by regional metamorphism)	Non-foliated (formed by contact or thermal metamorphism)
Coarse (> 2)	GNEISS (well developed, but often widely spaced foliation sometimes with schistose bands)	MARBLE (crystalline calcium carbonate) QUARTZITE (fused quartz grains) SERPENTINITE (usually grey and green rock formed by hydrothermal alteration of mafic igneous rocks HORNFELS (usually fine grained rock formed by thermal metamorphism)
Medium (0.06 - 2)	SCHIST (well developed foliation with much mica, some micas > 2mm)	
Fine (< 0.06)	PHYLLITE (slightly undulose foliation) SLATE (well developed planar cleavage)	

Guide to the naming and classifying of duricrust rocks (after AS 1726:2017, Tables 18 and 25)

Name[1]	Duricrust mass grade			
	Grade[2]	Structural term	Description	Graphic
FERRICRETE (Iron oxides and hydroxides) SILCRETE (Silica) CALCRETE[3] (Calcium carbonate) GYPCRETE (Gypsum)	DI	Massive or hardpan	More than 90% of the ground consists of duricrust rock material which forms a continuous framework	
	DII	Vuggy[4] or patchy	Between 50% and 90% of the ground consists of duricrust rock material which forms a continuous framework around soil material (vuggy) or rock materials (patchy)	
	DIII	Nodular or fragmental	Less than 50% of the ground consists of gravel and cobble sized nodules (rounded or subrounded) or fragments (angular or subangular) of duricrust rock material and it is described as soil	

Notes:

1. Name (based on dominant cementing mineralogy)
2. Duricrust rocks shall be assigned a Duricrust Grade (DI, DII or DIII), rather than a weathering class
3. Field differentiation of LIMESTONE and CALCRETE should be based on observations of textures, fabric and defects with LIMESTONE being dominated by sedimentary features and CALCRETE being dominated by replacement features
4. Cavities or vugs within the rockmass should be described in terms of size, frequency and continuity

Rock texture, fabric, features and durability (after AS 1726:2017, Clauses 6.2.3.4, 6.2.3.5, 6.2.3.7)

Some rock texture terms	**Texture of a rock describes the arrangement of, or the relationship between, the grains and/or crystals that make up the rock**
Crystalline	Consisting of interlocking crystals having a distinctive colour and habit
Porphyritic	Larger crystals (phenocrysts) set in a finer groundmass
Amorphous	Having no definite crystalline structure
Glassy	Looking like manufactured glass
Some rock fabric terms[1]	**A rock possesses a fabric where the arrangement of grains shows an alignment, a preferred orientation or a layering that is visible at the scale of outcrop or core.**
Sedimentary rocks	
(1) Bedding	Layering produced by changes in sedimentation, which may be defined by grain size, colour, or other features
(2) Lamination	Similar to bedding but developed in layer thicknesses of less than 20 mm
Metamorphic rocks	
(1) Foliation	The parallel arrangement of minerals due to metamorphic processes
(2) Cleavage	A type of foliation developed in fine grained metamorphic rocks such as slates
Igneous rocks	
(1) Flow banding	Layering produced during flow of a partially solidified igneous rock that causes crystals to become oriented. Sometimes called a trachytic fabric
Features, inclusions and minor components	**Features, inclusions and minor components within the rock material shall be described where those features could significantly influence engineering behaviour.**
Gas bubbles (igneous rocks)	Vesicles if empty; amygdules or amygdales if mineralised - typical diameters shall be measured in (mm)
Veins	Described in terms of thickness (mm), orientation, cross cutting relationships, and mineralogy
Nodules	Described in terms of mineralogy. Typical diameters shall be measured in (mm)
Durability	**Tendency to develop cracks, break into smaller pieces or disintegrate with time and/or in contact with water**

Note: 1. Rock fabric shall be described as either **'indistinct'**, where the fabric has little effect on intact rock strength; or 'distinct', where rock may break more easily parallel to the fabric

Rock classification

Classification of material weathering (after AS1726:2017, Table 20)

Term	Abbreviation	Definition
Residual Soil[1]	RS	Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are no longer visible, but the soil has not been significantly transported.
Extremely Weathered[1]	XW	Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are still visible.
Highly Weathered	HW	The whole of the rock material is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognizable. Rock strength is significantly changed by weathering. Some primary minerals have weathered to clay minerals. Porosity may be increased by leaching, or may be decreased due to deposition of weathering products in pores.
Moderately Weathered	MW	The whole of the rock material is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognizable, but shows little or no change of strength from fresh rock.
Slightly Weathered	SW	Rock is partially discoloured with staining or bleaching along joints but shows little or no change of strength from fresh rock.
Fresh	FR	Rock shows no sign of decomposition of individual minerals or colour changes.

Notes:

1. The term 'Extremely Weathered rock' is misleading as the material has soil properties. The word 'rock' should be replaced with the name of the original rock in lower case or the word 'material', e.g. Extremely Weathered granite or Extremely Weathered material. Residual soil and Extremely Weathered material should be described using soil descriptive terms

2. A 'specific rockmass unit (RMU)' may be defined as a significant zone (generally of > 1m length downhole in a borehole) dominated by one rock type with one dominant weathering grade, for example 'GRANITE (MW)'. RMU's may locally contain lesser zones of other materials or weathering grades, including seams, veins, dykes etc.

Rock material strength classification (after AS1726:2017, Table 19)

Term	Abbreviation	Uniaxial compressive strength[2] (UCS) MPa	Guide to strength[1]	
			Point load strength index[2] ($I_{s(50)}$) MPa	Field assessment
Very Low Strength	VL	0.6 to 2	0.03 to 0.1	Material crumbles under firm blows with sharp end of pick; can be peeled with knife; too hard to cut a Triaxial sample by hand. Pieces up to 30 mm thick can be broken by finger pressure.
Low Strength	L	2 to 6	0.1 to 0.3	Easily scored with a knife; indentations 1 mm to 3 mm show in the specimen with firm blows of the pick point; has dull sound under hammer. A piece of core 150 mm long by 50 mm diameter may be broken by hand. Sharp edges of core may be friable.
Medium Strength	M	6 to 20	0.3 to 1	Readily scored with a knife; a piece of core 150 mm long by 50 mm diameter can be broken by hand with difficulty
High Strength	H	20 to 60	1 to 3	A piece of core 150 mm long by 50 mm diameter cannot be broken by hand but can be broken by a pick with a single firm blow; rock rings under hammer.
Very High Strength	VH	60 to 200	3 to 10	Hand specimen breaks with pick after more than one blow; rock rings under hammer.
Extremely High Strength	EH	> 200	> 10	Specimen requires many blows with geological pick to break through intact material; rock rings under hammer

Notes:

1. Material with strength less than 'Very Low' shall be described using soil characteristics. The presence of an original rock structure, fabric or texture should be noted if relevant

2. The method for measuring the uniaxial compressive strength and shall be in accordance with AS4133.4.2.1

3. The method for measuring the point load strength index shall be in accordance with AS4133.4.1

4. Any correlation between UCS and $I_{s(50)}$ implied in the above Table shall not be relied upon for design purposes without supporting evidence

Classification of material alteration (after AS1726:2017, Table 21)

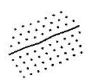
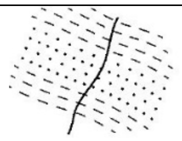
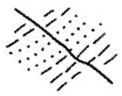
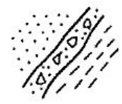
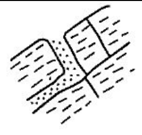
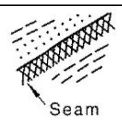
Term	Abbreviation	Definition
Extremely Altered[1]	XA	Material is altered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are still visible.
Highly Altered	HA	The whole of the rock material is discoloured, usually by staining or bleaching to the extent that the colour of the original rock is not recognizable. Rock strength is changed by alteration. Some primary minerals are altered to clay minerals. Porosity may be increased by leaching, or may be decreased due to deposition of minerals in pores.
Moderately Altered	MA	The whole of the rock material is discoloured, usually by staining or bleaching to the extent that the colour of the original rock is not recognizable, but shows little or no change of strength from fresh rock.
Slightly Altered	SA	Rock is slightly discoloured but shows little or no change of strength from fresh rock.

Notes:

1. The term 'Extremely Altered rock' is misleading as the material has soil properties. The word 'rock' should be replaced with the name of the original rock or the word 'material', e.g. Extremely Altered basalt or Extremely Altered material. Extremely Altered material should be described using soil descriptive terms

Description of defects in a rock mass

Rock defect types (after AS1726:2017, Table 22)

Type	Sub-type	Definition	Diagram
Parting		A surface or crack across which the rock has little or no tensile strength. Parallel or sub-parallel to layering (e.g. bedding) or a planar anisotropy in the rock material (e.g. cleavage). May be open or closed.	
Joint		A surface or crack with no apparent shear displacement and across which the rock has little or no tensile strength, but which is not parallel or subparallel to layering or to planar anisotropy in the rock material. May be open or closed.	
Sheared surface[1]		A near planar, curved or undulating surface which is usually smooth, polished or slickensided and which shows evidence of shear displacement.	
Sheared zone[1]		Zone of rock material with roughly parallel near planar, curved or undulating boundaries cut by closely spaced joints, sheared surfaces or other defects. Some of the defects are usually curved and intersect to divide the mass into lenticular or wedge-shaped blocks.	
Seams	Sheared seam[1]	Seam of soil material with roughly parallel almost planar boundaries, composed of soil materials with roughly parallel near planar, curved or undulating boundaries cut by closely spaced joints, sheared surfaces or other defects. Some of the defects are usually curved and intersect to divide the mass into lenticular or wedge-shaped blocks.	
	Crushed seam[1]	Seam of soil material with roughly parallel almost planar boundaries, composed of disoriented, usually angular fragments of the host rock material which may be more weathered than the host rock. The seam has soil properties.	
	Infilled seam	Seam of soil material usually with distinct roughly parallel boundaries formed by the migration of soil into an open cavity or joint, infilled seams less than 1 mm thick may be described as a veneer or coating on a joint surface.	
	Extremely weathered seam	Seam of soil material, often with gradational boundaries. Formed by weathering of the rock material in place.	

Note:

1. Sheared surfaces, sheared zones, sheared seams and crushed seams are generally faults in geological terms

Rock defect angle of incidence[1] (un-orientated drill core)

Angle of incidence (group range)[2]	Descriptor
0° - 15°	sub horizontal
15° - 30°	gentle
30° - 45°	moderate
45° - 60°	steep
60° - 75°	very steep
75° - 90°	sub vertical

Note:

1. Angle measured between defect and the normal to the core-axis (the horizontal plane for vertical boreholes)

2. For a specific rockmass unit (RMU), defects may be grouped according to the above ranges (or to more narrow ranges where appropriate). The number of defects within a group range shall be recorded per metre of core. (Note that such groupings are not necessarily defect sets, and a group frequency is not same as the 'Fracture Index', as defined in AS1726:2017, Clause 6.2.9.3

Rock defect surface description (after AS1726:2017, Claus 6.2.5.4)

Surface Roughness	Abbreviation	Definition	Surface Shape[1]	Abbreviation	Definition
Very rough	VRo	Many large surface irregularities (amplitude generally more than 1 mm). Feels like, or coarser than very coarse sand paper.	Planar	Pln	The defect does not vary in orientation
Rough	Ro	Many small surface irregularities (amplitude generally less than 1 mm). Feels like fine to coarse sand paper.	Curved	Cvd	The defect has a gradual change in orientation
Smooth	Sm	Smooth to touch. Few or no surface irregularities.	Undulating	Und	The defect has a wavy surface
Polished	Po	Shiny smooth surface.	Stepped	Stp	The defect has one or more well defined steps
Slickensided	Sl	Grooved or striated surface, usually polished.	Irregular	Irr	The defect has many sharp changes of orientation

Notes:

1. Although the surface roughness of defects can be described at all scales of observation, the overall shape of the defect surface can usually be observed only at medium and large scale. For example, a defect which appears planar in a 50 mm diameter drill core may be described as curved, undulating or stepped when observed in outcrop where more of the defect is visible.

2. At the medium scale of observation (100mm to 1m), description of the roughness of the surface shall be enhanced by description of the shape of the defect surface using the terms in the above Table, and as illustrated in AS1726:2017, Figure 7

3. For medium scale (100mm to 1m) and large scale (1m to 10m) exposures, defect wavelength and amplitude of asperities should be measured appropriately in (mm) or (m) as per AS1726:2017, Figure 8. Surface roughness may be alternatively characterised by the joint roughness coefficient (JRC), using the profiles provided in AS1726:2017, Figure 9

4. For large scale exposures, measurements of defect waviness for may be made as per AS1726:2017, Figure 10

Rock defect aperture and infill descriptors (after AS1726:2017 Claus 6.2.5.2 and Claus 6.2.5.5)

Defect Aperture			Defect Infill		
Term	**Abbreviation**	**Definition**	**Term**	**Abbreviation**	**Definition**
Open[1]	OP	Defects with visible aperture, with or without infill	Clean	Cn	No visible coating
Filled	FL	Open defects with infill of less than 1mm thickness	Stained	Stn	No visible coating, but surfaces are discoloured
Tight	TI	Defects with no appreciable aperture or measurable asperity	Veneer	Vr	A visible coating of soil or mineral, too thin to measure; may be patchy
Healed[2]	HD	Tight defects that have been re-cemented by minerals such as calcite and chlorite	Coating[3]	Ct	A visible, measureable coating of up to 1mm thickness

Notes:

1. Aperture of open defects shall be measured in millimetres
2. Healed defects generally possess some tensile strength across the defect surface, but the re-cemented strength is less than that of the rockmass
3. Where possible the mineralogy of the infill shall be identified. Soil material thicker than 1mm shall be described using defect terms (for example, infilled seam). Rock material thicker than 1mm shall be described as veins

Detailed rock core logging

Detailed Weathering, Intact Strength and Defect Spacing[1]

TMR Core Logging Data Input Sheet (Form *F:GEOT199*) shall be used to collate detailed downhole data for weathering, intact strength and defect spacing. This data informs the detailed weathering column and the intact strength and defect spacing histograms on the GEOTECHNICAL BOREHOLE LOG.

Detailed rock defect spacing description (after ISO14689:2017(E) and BS5930:1999

Defect Spacing Descriptors[1]			Rock Fabric Thickness Descriptors[2] (Stratification)	
Spacing/Width (mm)	Descriptor	Symbol	Descriptor	Spacing/Width (mm)
			Thinly Laminated	< 6
<20	Extremely Close	EC	Thickly Laminated	6 – 20
20 – 60	Very Close	VC	Very Thinly Bedded	20 – 60
60 – 200	Close	C	Thinly Bedded	60 – 200
200 – 600	Medium	M	Medium Bedded	200 – 600
600 – 2000	Wide	W	Thickly Bedded	600 – 2000
2000 – 6000	Very Wide	VW	Very Thickly Bedded	> 2000

Notes:

1. Rock defects are termed as ‘discontinuities’ in ISO14689:2017(E) and BS5930:1999. A distinction is drawn in BS5930:1999 between ‘mechanical discontinuities’, which are already open and present in the rock, and ‘integral discontinuities’, which are built-in potential planes of weakness. Rock fabrics are essentially integral discontinuities, either distinct or indistinct depending on the extent of their effect on intact rock strength
2. The terms ‘laminated’ and ‘bedded’ are rock fabric descriptors applicable to sedimentary rock. For igneous and metamorphic rock fabrics, use the above listed defect spacing descriptors
3. The above listed defect spacing descriptors should be used to define the frequency of defects, i.e. the spacing between successive defects, (or the mean defect spacing for zones of relatively broken rock); Alternatively, defect frequency should be measured by the ‘Fracture Index’, which is the number of defects per metre of core (AS1726:2017, Clause 6.2.9.3)
4. Defect set spacing is applicable to defects of similar orientation and nature, and shall be measured perpendicular to the particular defect set, and recorded as a mean average. Defect sets may be discerned visually in outcrop, orientated core, or by use of borehole imaging techniques

Detailed Defect Description

TMR Detailed Defect Description Log (Form *F:GEOT533*) shall be used to collate descriptions for individual defects, (when the project requires).

Defect persistence (length) and nature of terminations (after AS1726:2017, Claus 6.2.5.6)

Defect end condition
Defect starts and / or ends outside the extent of the exposure
Defect terminates within the rock mass
Defect terminates at an intersecting defect

Note: Rock defect persistence shall be measured in millimetres and metres as appropriate to the project requirements and scale of observation

Parameters related to core drilling (TCR and RQD)

Total core recovery (TCR) %
TCR = (Length of core recovered) / (Length of core run) x 100%

Rock quality designation (RQD) %
RQD $_{(per\ RMU)}$ = (Σ Length of intact core pieces > 100 mm in length) / (Length of specific rockmass unit) x100%
RQD $_{(per\ CR)}$ = (Σ Length of intact core pieces > 100 mm in length) / (Length of core run) x100%

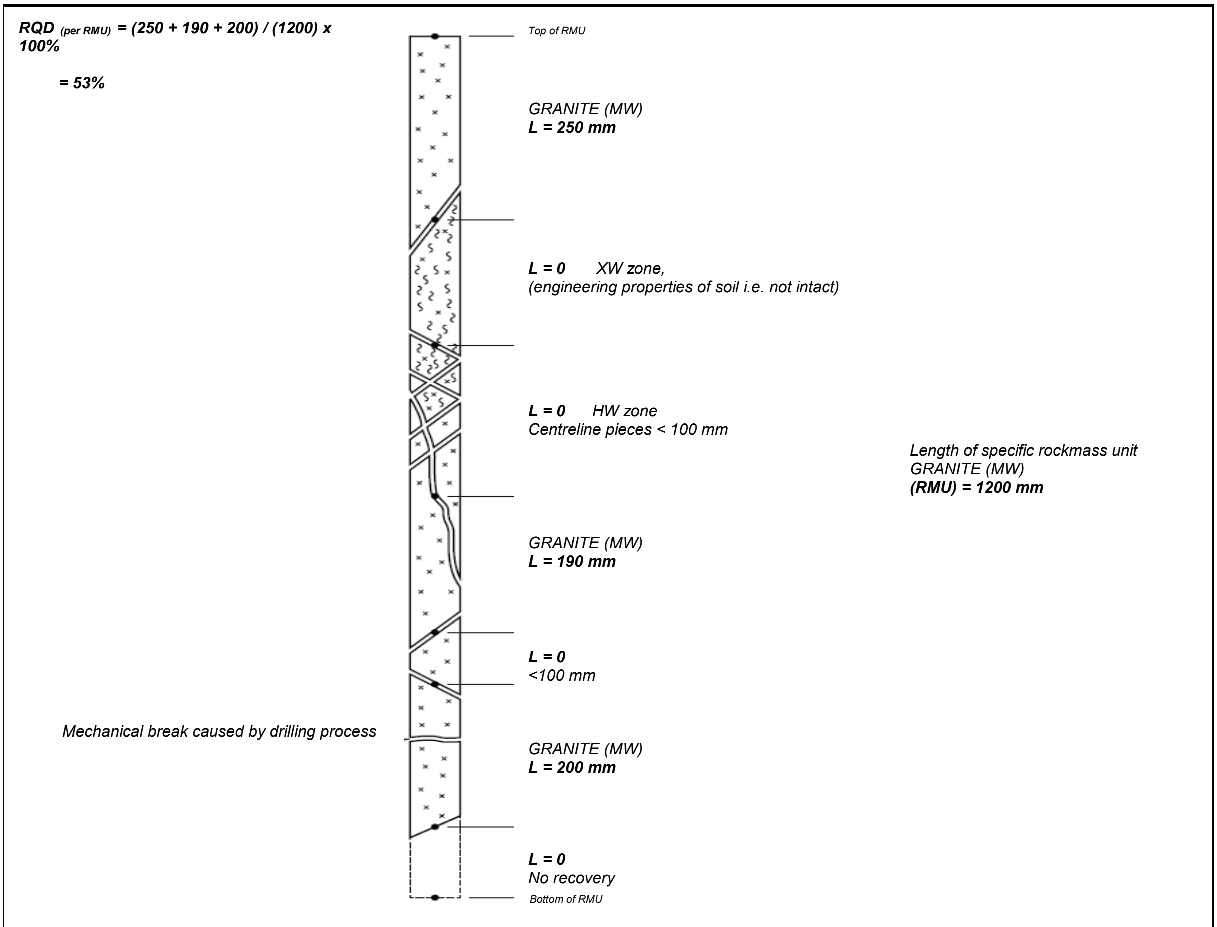
Notes:

1. RQD calculation should be employed only for core of 'N' size (i.e. about 50mm diameter or greater). Only lengths of intact core delineated by natural defects shall be measured, and measurements shall be taken along the central axis of the core as shown in the following Figure

2. Wherever practical, RQD calculation shall be made per length of specific rockmass unit (RMU) as encountered downhole in addition to the traditional RQD calculation made per length of core run (CR)

3. The borehole log report shall clearly show the method of calculating RQD, by designating as RQD $_{(per\ RMU)}$ or RQD $_{(per\ CR)}$

RQD $_{(per\ RMU)}$ measurement procedure per specific Rock Mass Unit, (adapted from AS1726:2017, Figure13)



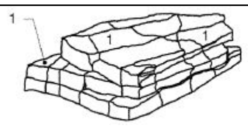
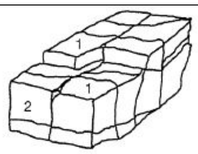
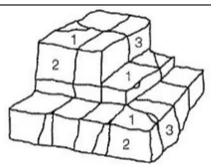
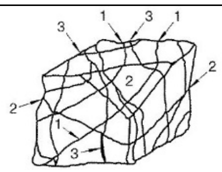
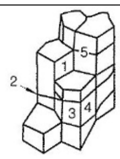
Rockmass Characterisation

Rockmass weathering grades (after AS1726:2017, Table 24)

Grade	Descriptive term
IA	Fresh; no visible sign of rock material weathering
IB	Fresh except for staining on major defect surfaces
II	Some to all of the rock mass is discoloured by slight weathering
III	Less than 35% of the mass is weathered to an engineering soil
IV	More than 35% of the mass is weathered to a soil with rock present as a discontinuous framework or corestones
V	Virtually all of the rock mass is weathered to a soil but the original mass structure still largely intact

Note: If an alternative rockmass weathering scheme is used to classify the weathering degree in an outcrop or excavation, it shall be documented.

Block shape terms, for rockmass description (after AS1726:2017, Table 23 and ISO14689:2017(E))

Term	Figure	Description
Polyhedral blocks		Irregular discontinuities without arrangement into distinct sets and of small persistence
Tabular blocks		One dominant set of parallel discontinuities (1), for example bedding planes, with other non-continuous joints; thickness of blocks much less than length or width
Prismatic blocks		Two dominant sets of discontinuities (1 and 2), approximately orthogonal and parallel, with a third irregular set; thickness of blocks much less than length or width
Equidimensional blocks		Three dominant sets of discontinuities (1,2 and 3), approximately orthogonal, with occasional irregular joints, giving equidimensional blocks
Rhomboidal blocks		Three (or more) dominant, mutually oblique sets of joints (1,2 and 3) giving oblique-shaped, equidimensional blocks
Columnar blocks		Several, usually more than three sets of continuous, parallel joints (1,2,3,4 and 5) usually crossed by irregular joints; lengths much greater than other dimensions

Block size terms, for rockmass description (after ISO14689:2017, Tables 9 and 10)

Term	Average length of block sides (mm)	Block volume
Very Small	< 60	< 1 dm^3
Small	60 to 200	< 1 dm^3 to 30 dm^3
Medium	200 to 600	0.03 m^3 to 1 m^3
Large	600 to 2000	1 m^3 to 30 m^3
Very Large	> 2000	> 30 m^3

Note: The size of rock blocks can be determined by the length of the sides or by the volume.

Department of Transport and Main Roads (TMR)
Geotechnical Symbols and Abbreviations

Queensland Government

The symbols and abbreviations provided in this form shall be utilised for the geotechnical logging of materials (both naturally occurring and anthropogenic), in conjunction with the Queensland Department of Transport and Main Roads (TMR) Guideline for Geotechnical Logging. This form is also intended to assist in the interpretation of logs and reports issued by or for TMR. More detailed information relating to the execution of geotechnical site investigations and specific test methods can be found within the relevant Australian Standards. The key reference document is Australian Standard AS 1726:2017 Geotechnical site investigations.

Colour terms for the description of soil and rock materials

Term	Symbol	Term	Symbol	Term	Symbol	Term	Symbol
Black	bk	Red	rd	Yellow	yl	Pale	pl
White	wh	Brown	br	Purple	pu	Dark	dk
Grey	gy	Orange	or	Green	gr	Mottled	mtld
Blue	bl						

Moisture terms for the description of soil and rock materials

Term	Symbol	Term	Symbol	Term	Symbol
Dry	D	Moist	M	Wet	W

Particle size definitions for soil

Term	Symbol	Term	Symbol
Boulder	Bo	Sand	Sa
Cobble	Co	Coarse sand	cSa
Gravel	Gr	Medium sand	mSa
Coarse gravel	cGr	Fine sand	fSa
Medium gravel	mGr	Silt	Si
Fine gravel	fGr	Clay	Cly

Relative density / consistency of soil

Relative Density of non-cohesive Soils		Consistency of cohesive Soils	
Term	**Symbol**	**Term**	**Symbol**
Very Loose	VL	Very Soft	VS
Loose	L	Soft	S
Medium Dense	MD	Firm	F
Dense	D	Stiff	St
Very Dense	VD	Very Stiff	VSt
		Hard	H
		Friable	Fr

Soil group symbols

Coarse grained soils	Group symbol	Fine grained soils	Group symbol
Gravel and gravel-sand mixtures, little or no fines	GW	Inorganic silt and very fine sand, rock flour, silty or clayey fine sand or silt with low plasticity	ML
Gravel and gravel-sand mixtures, little or no fines, uniform gravels	GP	Inorganic clay of low plasticity to medium plasticity, gravelly clay and sandy clay	CL[2]
Gravel-silt mixtures and gravel-sand-silt mixtures	GM	Inorganic clay of low plasticity to medium plasticity, gravelly clay and sandy clay	CI[2]
Gravel-clay mixtures and gravel-sand-clay mixtures	GC	Organic silt	OL
Sand and gravel-sand mixtures, little or no fines	SW[1]	Inorganic silt	MH
Sand and gravel-sand mixtures, little or no fines	SP[1]	Inorganic clay of high plasticity	CH
Sand-silt mixtures	SM	Organic clay of medium to high plasticity, organic silt	OH
Sand-clay mixtures	SC	Peat, highly organic soil	Pt

Notes:

1. Differentiated via laboratory classification, refer to AS1726:2017, Table 9

2. Differentiated via laboratory classification, refer to AS1726:2017, Table 10 and Figure 5

Intact rock strength

Term	Symbol	Term	Symbol	Term	Symbol
Very low	VL	Low	L	Medium	M
High	H	Very high	VH	Extremely high	EH

Degree of weathering, alteration or duricrust grade

Degree of weathering		Degree of alteration		Duricrust grade	
Term	**Symbol**	**Term**	**Symbol**	**Term**	**Symbol**
Residual soil	RS				
Extremely weathered rock	XW	Extremely altered rock	XA		
Highly weathered rock	HW	Highly altered rock	HA	Massive or hardpan	DI
Moderately weathered rock	MW	Moderately altered rock	MA	Vuggy or patchy	DII
Slightly weathered rock	SW	Slightly altered rock	SA	Nodular or fragmental	DIII
Fresh rock	FR				

Terms for rock discontinuity and defect description

Rock fabric type (integral discontinuities)		Lamination / bedding spacing descriptors	Rock defect type		Defect spacing descriptors	
Term	**Symbol**		**Term**	**Symbol**	**Term**	**Symbol**
Lamination[1]	LAM[1]	Thinly Laminated	Joint, joints	J, Js	Extremely close	EC
Bedding[1]	BED[1]	Thickly Laminated	Sheared surface	SS	Very close	VC
Foliation / cleavage[2]	FOL[2]	Very Thinly Bedded	Seared zone	SZ	Close	C
Lineation[2]	LIN[2]	Thinly Bedded	Sheared seam	Ss	Medium	M
Flow banding[2]	FLB[2]	Medium Bedded	Crushed seam	Cs	Wide	W
		Thickly Bedded	Infilled seam (generally soil)	Is	Very wide	VW
		Very Thickly Bedded	Extremely weather seam	Xs		
			Bedding parting[1]	BP[1]		
			Lamination parting[1]	LP[1]		
			Foliation / cleavage parting[2]	FP[2]		

Notes:

1. Use lamination / bedding rock fabric thickness descriptors

2. Use defect spacing descriptors

Defect surface aperture and infill descriptors

Defect surface roughness		Defect surface shape[1]		Defect aperture		Defect infill	
Term	**Symbol**	**Term**	**Symbol**	**Term**	**Symbol**	**Term**	**Symbol**
Very rough	Vro	Planar	Pln	Open	OP	Clean	Cn
Rough	Ro	Curved	Cvd	Filled	FL	Stained	Std
Polished	Po	Undulating	Und	Tight	TI	Veneer	Vr
Slickensided	SI	Stepped	Stp	Healed (cemented)	HD	Coating	Ct
		Irregular	Irr			Vein	Vn

Notes:

1. Defect surface shape descriptors are applicable at medium and large scales of observation (where > 100 mm of the defect surface is observable)

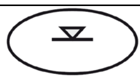
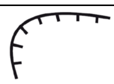
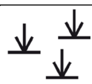
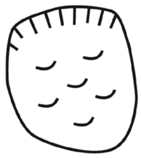
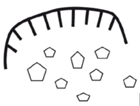
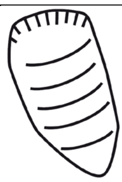
Geological mapping symbols (after AS1726:2017, Figure E1)

Mapping symbols for geological boundaries and structures			
————————————		Observed geological boundary, position known	
— — — — — — — — — — — — — —		Observed geological boundary, position approximate	
—?—?—?—?—?—?—?—?—?—?—		Geological boundary, interpreted or inferred	
~~		Fault zone or shear zone	
–U–U–U–U–U–U–U–U–U–U–U–U–U–U–U–		Unconformity	
25 Bedding	25 Cleavage	25 Plunge of fold[1]	Anticline, F1
25 Foliation	25 Joint	25 Plunge of lineation on plane	Syncline, F2

Notes:

1. Order and type of fold indicated with appropriate symbol

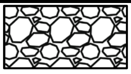
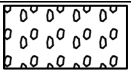
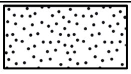
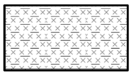
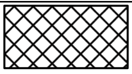
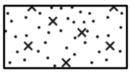
Geomorphological mapping symbols (after AS1726:2017, Figure E3)

Suggested geomorphological mapping symbols	
Sharp, concave break of slope	Intermittent flow
Rounded, concave break of slope	Continuous flow
Sharp, convex break of slope	Outflow
Rounded, convex break of slope	inflow
10 Slope angle of facet	Spring
-T- - - -T- Tension crack	 Standing water
 Scarp	 Damp reeds
 Cliff	 Landslide
 Rockfall	 Mudslide

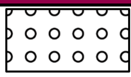
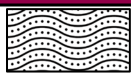
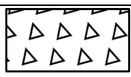
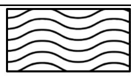
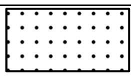
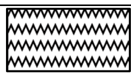
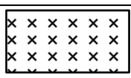
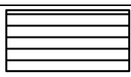
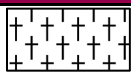
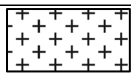
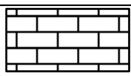
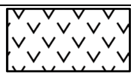
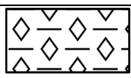
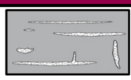
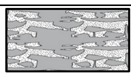
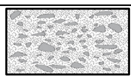
Groundwater symbols

Symbol	Definition
31/01/2020 ▼	Standing groundwater level on the date shown
▶	Water inflow
◁	Water outflow

Geological mapping symbols for soils (after AS1726:2017, Figure E2)

Fine grained soils		Coarse grained soils	
Name	**Symbol**	**Name**	**Symbol**
SILT		BOULDERS / COBBLES	
CLAY		GRAVEL	
PEAT		SAND	
Modern or Anthropogenic (Man Made) Soils		**Composite soils**	
TOPSOIL		Note: Composite soils may be signified by combined symbols, for example,	
FILL		Silty SAND	

Geological mapping symbols for rocks (after AS1726:2017, Figure E2)

Sedimentary rocks		Metamorphic rocks	
Name	**Symbol**	**Name**	**Symbol**
CONGLOMERATE[1]		Coarse grained	
BRECCIA[2]		Medium grained	
SANDSTONE		Fine grained	
SILTSTONE		**Igneous rocks**	
MUDSTONE		Coarse grained (plutonic rocks)	
COAL		Medium grained (hypabyssal rocks)	
LIMESTONE[3]		Fine grained (volcanic rocks)	
EVAPORITE		Pyroclastic rocks[4]	
Duricrust rocks		Notes: 1. Use same symbol for Volcanic AGGLOMERATE 2. Use same symbol for Volcanic BRECCIA 3. Use same symbol for all carbonate rocks (where > 90% of rock is carbonate, both low porosity and porous) 4. Use same symbol for Tuffaceous sedimentary rocks.	
Massive or hardpan (Grade DI)			
Vuggy or patchy (Grade DII)			
Nodular or fragmental (Grade DIII)			

Frequently used symbols in geotechnical engineering

Symbol	Definition	Symbol	Definition
AASS	Actual acid sulfate soil	PASS	Potential acid sulfate soil
BH	Bore hole	PI or I_{P}	Plasticity index
BS	Bulk distrusted sample	PL or w_p	Plastic Limit
c	Cohesion of a soil	PS	Piston sample
c'	Effective cohesion	PP	Pocket Penetrometer Test
c_v	Coefficient of consolidation	PQ	85mm diameter drill core (double tube wireline)
C_c	Coefficient of curvature	PQ3	83.1mm diameter drill core (triple tube wireline)
C_u	Coefficient of uniformity	q	Overburden pressure
CPT	Cone Penetration Test	q'	Effective overburden pressure
CPTu	Cone Penetration Test with pore pressure measurement (piezocone)	q_c	Cone resistance
D_{10}	Grain sizes for which 10% of the soil grains are smaller	q_d	VEDCP (PANDA) cone resistance
D_{30}	Grain sizes for which 30% of the soil grains are smaller	q_u	Unconfined compressive strength
D_{60}	Grain sizes for which 60% of the soil grains are smaller	Q	Wet density
DS	Disturbed sample (small)	Q_d	Dry density
DCP	Dynamic Cone Penetrometer Test	rw	Full penetration over any 150mm interval is achieved by SPT rod weight only
DMT	Flat Plate Dilatometer Test	R_D	Dry density ratio
e	Void ratio	RMU	Significant zone dominated by one rock type with one dominant weathering grade
E	Young's modulus (ratio of axial stress to axial strain)	RQD (per CR)	Rock quality designation (ratio calculated per length of core run)
E_s	Modulus of elasticity	RQD (per RMU)	Rock quality designation (ratio calculated per length of specific rock mass unit)
ES	Environmental Sample	s_u	Shear strength of a soil, (often $s_u = q_u / 2$)
ECN	Emerson Class Number	S	Degree of saturation
f_s	Cone skin friction	SPT	Standard Penetration Test
F_R	Cone friction ratio	TP	Test pit
FVS	Field Vane Shear Test	TCR	Total core recovery (%)
GSL	Ground surface level	u	Pore water pressure
hb	No measurable penetration, or the SPT hammer is bouncing for five consecutive blow	u_c	Pore water pressure measured at the tip of a piezocone (CPTu)
hw	Full penetration over any 150mm interval is achieved by SPT hammer and rod weight only	UCS	Uniaxial compressive strength test
HQ	63.5mm diameter drill core(double tube wireline)	U50	Undisturbed 50mm diameter tube sample
HQ3	61.1mm diameter drill core(triple tube wireline)	U75	Undisturbed 75mm diameter tube sample
I_D	Density index (cohesionless soil)	U100	Undisturbed 100mm diameter tube sample
I_{s50}	Point load strength index	VC	Vibro core
$I_{s50\,(A)}$	Axial point load strength index	VEDCP	Variable Energy Cone Penetration Test (PANDA)
$I_{s50\,(D)}$	Diametral point load strength index	w	Moisture content of a soil
$I_{s50\,(L)}$	Irregular (lump) point load strength index	w_o	Optimum moisture content (OMC)
k	Coefficient of permeability	WS	Water sample
K	Ratio of lateral to vertical stress	WLS	Weighted linear shrinkage
K_a	Active earth pressure	WPI	Weighted plasticity index
K_p	Passive earth pressure	z	Depth of interest from ground surface level (GSL)
LL or W_L	Liquid Limit %	**Greek symbol**	**Definition**
LS	Linear Shrinkage	γ	Unit weight of material
m_v	Coefficient of volume decrease	γ'	Effective unit weight of material
MDD	Maximum dry density	ε	Strain
n	Porosity	ν	Poisson's ratio
N	SPT Penetration Resistance, (blows per final 300mm penetration)	ρ	Density
N_p	DCP Penetration Resistance, (blows per 300mm penetration, depth recorded at centre of interval)	σ	Pressure or stress
NQ	47.6mm diameter drill core (double tube wireline)	σ'	Effective pressure or stress
NQ3	45.1mm diameter drill core (triple tube wireline)	τ	Shear stress
NMLC	51.9 mm diameter drill core (triple tube wireline)	φ	Angle of internal friction
OCR	Overconsolidation ratio	φ'	Effective angle of internal friction