### AS 1726:2017 Geotechnical Site Investigations



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### **New Standard**



Douglas Partners

### AS 1726:2017 Geotechnical Site Investigations

- Contents of Presentation
  - So What's Different
  - Changes to DP Logging
  - Review of Universal Classification System
  - Rock Logging
  - Additional Logging Changes
  - Implications for Reporting
  - Other important changes to AS1726
  - Useful Spreadsheets for Logging
  - Take Home Message



# So what's different?

- Previous revision 1993
- Previously the delineation between a coarse material (sand,gravel) and a fine material (clay, silt) was based on the majority rule (ie. If more than 50% above 75 micron = coarse soil)
- Now new boundaries, as follows
  - >65% above 75 micron
  - >35% below 75 micron

Sand or gravel Clay or silt

Why? It only takes a relatively small amount of fines to alter the behaviour of the soil



### How does this differ from DP Logging?

No difference to boundaries from previously but slight difference to subdivision for sand

Cobble	63 - 200
Gravel	2.36 - 63
Sand	0.075 - 2.36
Silt	0.002 - 0.075
Clay	<0.002



Fraction	Components	Subdivision	Size* mm
Oversize	BOULDERS		>200
	COBBLES		63-200
Coarse	GRAVEL	Coarse	19–63
grained soil		Medium	6.7–19
5011		Fine	2.36-6.7
	SAND	Coarse	0.6-2.36
		Medium	0.21-0.6
		Fine	0.075-0.21
Fine	SILT		0.002-0.075
grained soil	CLAY		<0.002

\* These sizes correspond approximately to standard sieve sizes.



### Secondary Constituents and Naming

Term	Proportion	Example	]						
And	Specify	Clay (60%) and Sand (40%)				4			_
Adjective	20 - 35%	Sandy Clay	1 /		AS 1	72	6:20	)17	7
Slightly	12 - 20%	Slightly Sandy Clay					00	_ /	
With some	5 - 12%	Clay with some sand	-	(SE	1 DESCRIPTIVE T CONDARY AND M	ABLE 2 ERMS FOI IINOR) SC	R ACCESSOR DIL COMPON	Y ENTS	
With a trace of	0 - 5%	Clay with a trace	] —		in coarse g	rained soils		In fine	grained soils
		of sand	)n ts	% Fines	Terminology	% Accessory coarse fraction	Terminology	% Sand/ gravel	Terminology
D	P Note	Minor		≤5	Add 'trace clay/silt' to description, as applicable	≤15	Add 'trace sand/gravel' to description, as applicable	≤15	Use 'trace'
Different t	hresholds fo	r	$\rightarrow$	>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
term	inology	Seconda	ary	>12	Prefix soil name as 'silty' pr 'clayey')as applicable	>30	Prefix soil name with 'sandy' or 'gravelly', as	>30	Prefix soil name with 'sandy' or
DP notes refle	being chang ect new code	ged to				Dol	applicable	Pari	applicable

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### Secondary Constituents and Naming

- Previously a soil would become "clayey sand" for instance with 20% to 35% clay. Now only 12% clay is required to be a "clayey sand"
- Now if a soil has greater than 35% fines it is a fine soil
  - Therefore, a soil with 64% sand and 36% clay is a sandy CLAY not a clayey SAND.
  - This is to try to convey the behaviour of the soil (i.e that amount of clay is going to make it behave like a clay).



### Secondary Constituents and Naming

TADLE 1

Note: Different thresholds for secondary constituents in coarse as opposed to fine soils.

	(	In coarse gi	rained soils		In fine	grained soils
Designation of components	% 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 with 'sandy' or 'gravelly', as applicable	>30	Prefix soil name with 'sandy' or 'gravelly', as applicable

This reflects that it takes a lot more coarse material to change the behaviour of the soil (30% v 12%).



### **Minor Soil Components**

- Terms used is as follows:
- Trace (<5% fines) or (<15% coarse)
- With (>5% to 12% fines) or (>15% to 30% coarse)
- Adjective modifier (eg sandy)
   (>12% fines) or (>30% coarse)

No use of "slightly" or "some"







# Naming

- Primary Component in BLOCK LETTERS
- Secondary component included in name if over secondary threshold
- Minor components added after name

- Eg Clayey SAND with trace gravel



# **Determining Fine Content**

- If hydrometers done then use them
- If Atterberg done use the following rule

– Above A line	clay
– Below A line	silt

 If neither done then use tactile assessment for clay/silt – use water!



# Plasticity

- Terms
  - Non plastic
  - Low plasticity
  - Medium plasticity
  - High plasticity

Note: Medium not Intermediate





M denotes Silt

### **Moisture Condition**

### Coarse Soils

- Only three terms used, as follows:
  - Dry
  - Moist
  - Wet
- No use of "humid" or "saturated"

### • Fine Soils

- Moist, dry of plastic limit (w<PL)</li>
- Moist, near plastic limit (w≈PL) <</li>
- Moist, wet of plastic limit (w>PL)
- Wet, near liquid limit (w ≈LL)
- Wet, wet of liquid limit (w>LL)
- Use textural test in the field (i.e roll a 7 mm long thread)

DP will use description in brackets only



## **Group Symbol Classifications**

- Two characters system
- Primary Classifier (i.e. first letter)
   (G,S,M or C for Gravel, Sand, Silt or Clay)
- Secondary Classifier (i.e. second letter)
  - (Coarse Soils)
    - Reflect grading (W or P for well or poorly graded)
    - Or Fine content (C, M or O for clay, silt or organic)
- Secondary Classifier (i.e. second letter)
  - (Fine Soils)
    - Reflect plasticity (L, I or H for low, intermediate or high)
    - Note silt only uses L or H (no I)



#### TABLE 9

CLASSIFICATION OF COARSE GRAINED SOILS

Major (	livisions	Group ymbol	Typical names	Field classification of sand and gravel	Laboratory	classification
Coarse grained soil (more than 65% of soil excluding oversize fraction is	GRAVEL (more than half of coarse fraction is larger than 2.36 mm)	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
greater than 0.075 mm)		G₽	Gravel and gravel-sand nixtures, little o' 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	G avel-silt m xtures and gravel-sand-silt m xtures	'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 mxtures and gravel-sand-clay mxtures	'Dirty' materials with excess of plastic fines, medium to high dry strength	≥12% fines, fines are clayey	Fines behave as clay
	SAND (more than half of coarse fract on is smaller than 2.36 mm)	sw	Sand and grivel-sand mxtures, 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	$C_u \ge 6$ $1 < C_c < 3$
		SP	S nd and g avel-sand nixtures, little c'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	
		sc	Sand-clay mixtures	'Dirty' materials with excess of plastic fines, medium to high dry strength	≥12% fines, fines are clayev	Note

#### NOTE: Where the grading is determined from laboratory tests, it is defined by coefficients of curva uniformity $C_u$ derived from the particle size distribution curve, as specified in Clause 6.1.4.11.

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.

Soils that are dominated by boulders, cobbles or peat (Pt) are described separately and are not classified.

## Classifications Coarse Soils

Gravel Dominated Soils GW – well graded gravel GP – poorly graded gravel GM – gravel-silt mixture GC – gravel-clay mixture

Sand Dominated Soils SW – well graded sand SP – poorly graded sand SM – sand-silt mixture SC – sand-clay mixture

Note: Fines contents between 5% and 12% to have dual classification – eg GP-GM



Malan		(	Group	Territori	Field clas	sification of si	lt and clay	Laboratory classification
Major o	1111510115	s	mbol	Typical names	Dry strength	Dilatancy	Toughness	% < 0.075 mm
Fine grained soils (more than 35% of soil excluding oversize fraction is	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
less than 0.075 mm)		(	CL, CI	horganic clay of low to medium plasticity, gravelly clay, 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		MH	lnorganic silt	Low to medium	None to slow	Low to medium	Below A line
	(high plasticity)		СН	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	-	-	—	-

#### CLASSIFICATION OF FINE GRAINED SOILS

# Classifications Fine Soils

Silt Dominated Soils ML – low plasticity silt MH – high plasticity silt OH – organic silt

Clay Dominated Soils CL – low plasticity clay CI – medium plasticity clay CH – high plasticity clay OH – organic clay of medium to high plasticity

Pt – peat



### **Rock Classification**

- Changes in strength characterisation
  - Removal of extremely low strength
  - Material with a strength less than very low should be described as a soil but any rock structure noted.
  - UCS categories included (using a ratio of 20:1 with point load index)
- Classification Symbols same as used by DP (without EL)





### **Rock Weathering**

#### CLASSIFICATION OF MATERIAL WEATHERING

Term		Abbre	viation	Definition	XW?
Residual Soil (Note 1)		R	us	Material is weathered to such an extent that it has soil properties. Mass struc and fabric of original rock the soil has not been signi	
Extremely Weathered (Note	1)	x	w	Material is weathered to stand and fabric of original rock	
Highly Weathered (Note 2)	Distinctly Weathered (Note 2)	нw	DW	The whole of the rock mat usually by iron staining of that the colour of the origin recognizable. Rock streng changed by weathering. So have weathered to clay ministrate to clay minist	
Moderately Weathered (Note 2)		MW		The whole of the rock matusually by iron staining or that the colour of the original rock is not recognizable, but shows little or no change of strength from fresh rock.	SW?
Slightly Weathered		s	w	Rock is partially discoloured with staining or bleaching along joints but shows little or no change of strength from fresh rock.	
Fresh		F	R	Rock shows no sign of decomposition of individual minerals or colour changes.	

REMEMBER: RMS (NSW) has its own weathering classification system



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



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3	œ	Poorly graded gravets and gravel sand mistares, little or no fines.		1	POC	Precionwrantly one size or range of sizes	nes to bind coarse grains)	- mone	62	DENSE	by a special of value and	taura berna			_			
100.00	GM	Sitty playets, gravel sand sitt minitures	1	50	60	0 -Didy' materials	Fines are non plastic (1)	None to medium	GM			SAND	,					
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101.0			1	1	E	1	SAND			VERT LOOSE	Easily penetrated with 13m	m remlacing rod pushed	I by hand	05	0 15	0	12	0
25	SW	Well graded sands and gravely sands, title	1	01	1 GX	ID Wide range in grain size	"Clean" materials (not enou	n Nore	SW	LOCSE SAND	Easily penetrated with 13m	m revolucing rod pushed	6 by hand Can be	5.10	15.35			
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100	СН	Inerganic clays of high plasticity, fat clays		1	-	High to very high	None	High	СН	SHW	Slight impression by thurst model with linger	cannot be		46	8 15	50.100	100 200	1
38	011	Organic clays of medium to high plasticity		1.		Medium to high	Nose to any slow Lo	e la reduca	06.	VERY STEP	Very lough Readily indente	d by thumbnall		7.12	15 30	100 200	200 4/10	
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#### DATA FOR DESCRIPTION AND CLASSIFICATION OF SOILS

### **Reporting Implications**



Figure 8: Slope stability analysis results



# **Other Changes**

- New Code has a whole section of material alteration (extremely, highly, moderately and slightly) with abbreviations. This is based on visual assessment
- It has good guidance on description of defects
  - Situation by situation. Some circumstances it is important to describe each joint/defect (ie. Unfavourable joints in excavation face)
  - Other circumstances generalisation of defects may be better to provide geotechnical model (eg foundation design)
  - Terms such as "joint spacing is typically 100 mm to 300mm and most joints traces less than 100 mm"



# **Other Changes**

- Has a more geological approach to jointing with good descriptions around dip, dip direction and strike
- Roughness (with roughness counts, waviness, etc)



### Soil Classification Spreadsheet

Co to Results

	%									
	Bore/Pit	3006	4002	1	4008	SP1	SP2	SP3		
nter details	Depth (r	0.3	0.5-0.8	1.2 - 1.5	0.4	1	1	0.5		
liter details	Sieve Si				Perce	ntage P	assing		 	 Ē
and copy	75.000	100%	100%	100%	100%	100%	100%	100%		
and copy	53.000	100%	100%	100%	98%	100%	100%	100%		Ī
ercentage	37.500	100%	100%	100%	35%	100%	100%	100%		
ereentage	26.500	97%	100%	33%	34%	100%	100%	100%		
assing from	19.000	94%	100%	97%	92%	100%	100%	100%		
	13.200	32%	100%	88%	89%	100%	100%	100%		
ab results	9.500	89%	100%	76%	87%	100%	100%	100%		
abresults	6.700	86%	100%	71%	84%	100%	100%	100%		
	4.750	84%	100%	67%	81%	100%	99%	33%		
	2.360	79%	100%	51%	77%	100%	98%	98%		
	1.180	74%	61%	40%	76%	100%	96%	96%		
	0.600	70%	54%	31%	75%	94%	93%	90%		
	0.425	67%	50%	28%	67%	92%	90%	85%		
	0.300	63%	45%	25%	64%	86%	86%	75%		
	0.150	51%	38%	21%	54%	85%	62%	50%		
	0.075	42%	32%	14%	33%	83%	38%	23%		
	0.045	38%	30%	12%		80%				
	0.033	36%	28%	10%		75%				
	0.023	35%	28%	8%		70%				
		• •		72		65%				
inter Atteberg	g result:	s, it a	any	52		64%				
		, 	<b>,</b>	5%		63%				
	0.006	29%	24%	4%		45%				
	0.005	27%	23%	3%		40%				
	0.003	25%	20%	3%		35%				
	0.002	24%	18%	1%		34%				
	0.001	212	18%			33%				-
	h		e ol	<b>A</b> 10	tterberg	Testing	E OI			
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		30	10 50	- IJ 			20			
	PI	30	50	6			20			_

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### Soil Classification Spreadsheet

Grad	ling R	esu	lts	and L	oggiı	ng to	AS17	26:2	0	17 Doug	Presents dat	a with
											comments on la	ab testing
Bore/ Pit	Depth	Hydrometer	Atterberg	%Silt and clay	%Clay	% silt	%Sand	%Grave	ł	Description to AS1726:2017	Classification	
3006	0.3	Yes	Yes	42%	24%	19%	36%	21%		Sandy/Silty Clay with gravel	СН	1
4002	0.5-0.8	Yes	Yes	32%	18%	14%	68%	0%		Clayey SAND	SC	D. D.
1	1.2 - 1.5	Yes	Yes	14%	1%	13%	37%	49%		Silty/Sandy GRAVEL with trace clay	GM	1
4008	0.4	No	No	33%	-	-	44%	23%	·	Silty/Clayey SAND with gravel	SM/SC	1
SP1	1	Yes	No	83%	34%	49%	17%	0%		Clayey Silt with sand	ML or MH - see note 2	
SP2	1	No	Yes	38%	-	-	60%	2%		Sandy/Clayey Silt with trace gravel	MH	
SP3	0.5	No	No	29%	-	-	69%	2%		Silty/Clayey SAND with trace gravel	SM/SC	
										4		1

### Provides Soil portions Inde cobbles



**Douglas Partners** Geotechnics | Environment | Groundwater

**Plasticity Curve** 

		Ρ	oint Lo	ad t	o UC	S and Pi	ile Desigr	Parame	eters	4				iners Broundwater
	Pro	oject:	:		Maitl	and Hosp	ital					Project	Number Bore	81719.09 3001
Enter UCS/PL rationadopted multiplie (guidance in box)	o and r	ted f ted r	Multiplier fo multiplier for	r end be r UCS/IS	earing 50 ratio		4.8 17	Lower bound Upper bound Mean	$(\sigma_{n})^{0.0}$ $(\sigma_{n})^{0.0}$ $(\sigma_{n})^{0.0}$				21.4 /150 ratio	
Innut donth linit	De	pth	Elevatior	Unit	Rock Type	Axial Value	Diametral Value	Estimat	ed UCS	Ultimate End		E	stimated	UCS
input depth, Unit,		20	10.00	-			0.04	Sendrtune 0.66	Siltrane	Dearing 2 90		12	15	20
Rock Type and PL			19.02	1	1	- 0.07	0.04	1 14		5.30		0.5	10	13
values		46	18.94	1	1	-	0.05	0.79		4.27		0.6	0.7	0.9
		.46	18.94	1	2	0.14	-	0.10	2,38	7.40		1.7	2.1	2.8
		.53	17.87	1	2	-	0.23		3.96	9.55		2.8	3.5	4.7
	3	.53	17.87	1	2	0.18	-		3.04	8.37		2.1	2.7	3.6
	4	.03	17.37	1	1	-	0.21	3.63		9.14		2.6	3.2	4.3
	4	.03	17.37	1	1	0.10	-	1.73		6.32		_ · -		
	5	.37	16.03	2	1	-	0.24	4.02		9.63		🛛 Prov	ide ran	ge of
	5	.37	16.03	2	1	0.15	-	2.48		7.55		estin	nated I	ICS based
	6	.56	14.84	2	1	0.12	-	2,12		6.98				
	- 7	.03	14.37	2	1	-	0.39	6.59		12.33		on co	ommor	n ratios
	7	.03	14.37	2	1	0.17	-	2.93		8.21		Z. 1	Z.6	3.4
	7	.69	13.71	2	1	-	0.22	3.69		9.22	K_	26	33	4.3
	7	.69	13.71	2	1	0.33		5.61		11.37	$\square$	Calci	ulates e	estimated
	6	3.14	13.26	2	1	-	0.57	9.69		14.94			and ult	imate enc
	8	3.14	13.26	2	1	1.03	-	17.47		20.07				
					Hock 1 2	Lype Sandstone Siltstone L	aminite	LEGEND	Class V San	dstone		bear	ing	
			Cold		odoc	rockola			Class IV San	dstone				
				Jur C	oues	TUCK Cla	122		Class III San	dstone				
			(bas	sed c	on Pe	lls et al)	and		Class II Sand	dstone				
			usin	ng sti	rengt nside	h only -	-		Class I Sand	stone				
			defe	ects/	sean	ns				4	D	Dou	igla	s Par

### Take Home Message

- It doesn't take a lot of fines to make a soil "fine grained". This reflects soil behaviour
- Extremely low strength rock should be logged as soil or 'extremely weathered (name of parent rock)'
- Pay attention to gradings and PIs (roll threads in field take spray bottle)
- DP logging sheets and DP Field Procedure Log section of Company Manual being changed (out soon)
- New Code is a good recourse for Geo/Env Engineers



### That's all!

Thanks to the following people who are driving and assisting in the innovations to our procedures:

Grahame Wilson Will Wright Tim Swavley Heidi Sirianni

