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Leaders in super-basement and bulk platform construction

INFORMATION SHEET **2a**

GRAVEL

Information sheet on the classification of natural materials as used in earthworks.

INTRODUCTION

Zero Group has successfully completed numerous high profile Bulk Excavation & Platform contracts across Gauteng and has gained extensive insight and experience on the various Gravel types encountered and most commonly required in fill operations. The objective of this information sheet is to provide clarity regarding gravel material classification.

Materials classification

The classification of construction materials is a complicated field. In this article the classification of natural materials as used in earthworks will be discussed. The general classification is done in terms of a "G" notification, like G5, G6, G7, G8, G9 and G10. Generally a G5 and G6 type of material is classified as natural gravel and the G7 to G10 type of material as a gravel-soil. The lower the number (5 for example) the better quality material it is.

Types of classification used in South Africa:

1. TRH 14 (1985) Road Construction Materials

Of importance are the following test methods and specifications:

- GRADING ANALYSIS
  (Test Method TMH1; A1(a) and A1(b))

Sieves utilised in grading analysis

Natural Gravel (G5 and G6) should have a maximum aggregate size of 63mm or two-thirds of the compacted layer thickness, whichever is smaller. A minimum grading modulus of 1.5 (G5) or 1.2 (G6) should be obtained.

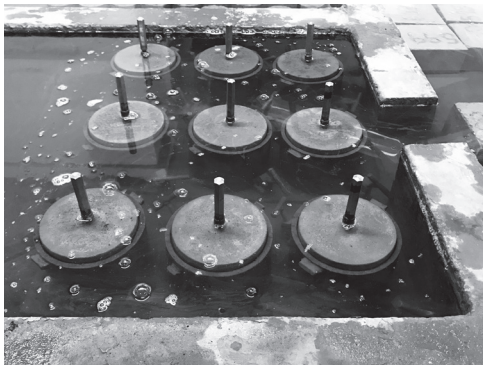
Gravel-soil (G7) should have a maximum size, in place, after compaction, not greater than two-thirds of the compacted thickness of the layer. A minimum grading modulus of 0.75 should be obtained.

Gravel-soil (G8, G9 and G10): no grading requirements.

The Grading Modulus or GM is given by GM = (P2,00 mm + P0,425 mm + P0,075 mm) / 100 where P2,00 mm, etc., denote the percentage retained on the indicated sieve size.

- BEARING STRENGTH AND SWELL
  (Test Method TMH1; A8)

Execution of Modified AASHTO density test in order to determine Maximum dry density (MDD) and Optimum moisture content (OMC)



Soaking of samples from the Modified AASHTO test in order to execute the CBR test

Material G5 should have a CBR after soaking of not less than 45 percent at 95 percent of Mod AASHTO density and a maximum swell of 0.5 percent at 100 percent Mod AASHTO density.

CBR and swell requirements for gravel and gravel-soil (G6, G7, G8, G9 and G10)

PROPERTY	MATERIAL TYPE				
	G6	G7	G8	G9	G10
Minimum CBR at 93 percent Mod AASHTO density (%)	25	15			
Minimum CBR at in-situ density (%)			10	7	3
Maximum Swell at 100 percent Mod AASHTO density (%)	1.0	1.5	1.5	1.5	1.5

- ATTERBERG LIMITS
  (Test Method TMH1; A2 and A3)

Apparatus utilised to determine the Atterberg limits

The Atterberg limits apply to the soil fines (<0.425mm)

INFORMATION SHEET **2b**

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Atterberg Limits for natural gravel and gravel-soil

PROPERTY	MATERIAL TYPE		
	G5	G6	G7
Liquid limit (max)	30		
Plasticity index (max)	10	12 or 3 GM** +10	12 or 3 GM** +10
Linear shrinkage (%)(max)	5		
Linear shrinkage x (%) passing the 0,425mm sieve (max)*	170		

*Only applicable to nodular calcrete / ** GM = Grading Modulus

2. Colto Standard Specifications for Road and Bridgeworks

The following is a shortened version of the Colto specification. Properties like additional fines, durability and soluble salts are not discussed and can be found in the specification.

PROPERTY	TYPE OF MATERIAL				
	G5	G6	G7	G8	G9
Description of material	Natural Gravel or natural gravel boulders which might require crushing or crushed rock	Natural Gravel or natural gravel boulders which might require crushing or crushed rock	Natural material (soil, sand or gravel)	Natural material (soil, sand or gravel)	Natural material (soil, sand or gravel)
Nominal maximum size	(i) Uncrushed material – 63mm (ii) Crushed material – 53mm	(i) Uncrushed material – two thirds of the compacted layer thickness (ii) Crushed material – 63mm before compaction	(i) Uncrushed material – two thirds of the compacted layer thickness (ii) Crushed material – 75mm	Two thirds of the compacted layer thickness	Two thirds of the compacted layer thickness
Grading Modulus (GM)	2,5 ≥ GM ≥ 1,5	2,6 ≥ GM ≥ 1,2	2,7 ≥ GM ≥ 0,75	2,7 ≥ GM ≥ 0,75	2,7 ≥ GM ≥ 0,75
Atterberg limits	LL shall not exceed 30 PI shall not exceed 10 LS shall not exceed 5%	PI shall not exceed 12 or 2 x GM + 10, whichever is the higher value	PI shall not exceed 12 or 3 x GM + 10, whichever is the higher value	PI shall not exceed 12 or 3 x GM + 10, whichever is the higher value	PI shall not exceed 12 or 3 x GM + 10, whichever is the higher value
Strength (CBR)	CBR at 95% of Modified AASHTO density shall not be less than 45%	CBR at 95% of Modified AASHTO density shall not be less than 25%	CBR at 93% of Modified AASHTO density shall not be less than 15%	CBR at 93% of Modified AASHTO density shall not be less than 10%	CBR at 93% of Modified AASHTO density shall not be less than 7%
Swell (maximum)	Swell at 100% of Modified AASHTO density shall not exceed 0,5%	Swell at 100% of Modified AASHTO density shall not exceed 1,0%	Swell at 100% of Modified AASHTO density shall not exceed 1,5%	Swell at 100% of Modified AASHTO density shall not exceed 1,5%	Swell at 100% of Modified AASHTO density shall not exceed 1,5%

Conclusion

In general fill material only have a CBR specification of at least 3% at 93% of Modified AASHTO density. The higher quality the material used the easier it will compact, the higher the bearing strength will be and there will be less swell and it will be less prone to cracking. If one has to choose a material utilised in earthworks and there is a small price difference in choosing a better quality material it is well worth the additional outlay.