ISSMGE TC 218 - GROUP 3 - CONSTRUCTION BEST PRACTICES

COMPARISON OF THE EXISTING CODES AND GUIDELINES

		USA							
		AASHTO & FHWA				National Concrete Masonry Association			
TOPIC	SUB-TOPIC	RELEVANT CODES	REFERENCE	ADVISORY/OBLIGITARY	COMMENTS/BEST PRACTICE	RELEVANT CODES	REFERENCE	ADVISORY / OBLIGITARY	COMMENTS/BEST PRACTICE
1. SOIL INVESTIGATION	1.1. VALUES TO BE TESTED PRIOR DESIGN	AASHTO & FHWA	1988 Manual on Subsurface Investigations & NHI 2001/2009 Manuals	Advisory	Staggered borings at 30 to 45 m intervals. Closer in poor subsurface conditions. Soil/rock sampling, lab testing & design recommendations	bearing and infill soil properties, water table	NCMA SRW Best Practices	ADVISORY	
	1.2. GLOBAL STABILITY	AASHTO & FHWA	LRFD Bridge Design, Latest Edition and NHI 2001/2009 Manuals	Advisory	Evaluation of both global and compound stability	If steep slope, tiered walls, bad soils or toe slope	NCMA SRW Best Practices	ADVISORY	
	1.3 VALUES TO BE TESTED PRIOR START OF INSTALLATION	AASHTO & FHWA	LRFD Bridge Design, Latest Edition & NHI 2001/2009 Manuals	Advisory/Obligatory	Bearing resistance, backfill gradation & strength, backfill proctor criteria and electrochemical testing (as required by reinforcement type)	c, phi, gamma, soil type, PI, bearing capacity	NCMA SRW Best Practices	ADVISORY	
2. FILL SELECTION	2.1. SUITABLE FILL TYPES FOR WALLS/SLOPES	AASHTO & FHWA	LRFD Bridge Design, Latest Edition & NHI 2001/2009 Manuals	Advisory/Obligatory	Sands and gravels	Granular soils with less than 35% fines. Finer soils could be used for short walls with extra care	NCMA SRW Best Practices	ADVISORY	
	2.2. PROHIBITED MATERIALS	AASHTO & FHWA	LRFD Bridge Design, Latest Edition & NHI 2001/2009 Manuals	Obligatory	Compressible materials, < 1% organics	Peats, organic soils, MH, CH	NCMA SRW Best Practices	ADVISORY	
	2.3. REQUIRED STRENGTH VALUES/LIMITS (c',Φ', PSD, FINES etc)	AASHTO & FHWA	LRFD Bridge Design, Latest Edition & NHI 2001/2009 Manuals	Advisory/Oblgatory	c' = 0 psf (Usual), Φ= 34°, < 15% Fines Passing #200 Sieve, Max Dia < 100 mm, Plastic Index ≤ 6	35% fines and PI<20, for taller applications 15% fines and PI<6%	NCMA SRW Best Practices	ADVISORY	
	2.4. SPECIFIC REQUIREMENTS FOR ELECTROCHEMICAL CONDITIONS (pH, SALTS, etc)	AASHTO & FHWA	LRFD Bridge Design, Latest Edition & NHI 2001/2009 Manuals	Obligatory	Steel : ≤100 ppm Cl, ≤200 ppm Sulfates, ≥3000 ohm-cm Resistivity & 5≤pH≤10. Geosyn: 5≤pH≤9 (PET) & pH > 3 (PP & HDPE)	NA			
	2.5. SPECIFIC REQUIREMENTS FOR MARGINAL/COHESIVE SOILS	AASHTO & FHWA	LRFD Bridge Design, Latest Edition & NHI 2001/2009 Manuals	Obigatory - Not Allowed in AASHTO and Advisory - With Caution in NHI (FHWA)	Use of NHI (FHWA) and NCMA Standards for Segmental Walls also allows wider use of marginal/cohesive soils up to and 35% fines	35% fines and PI<20, for taller applications 15% fines and PI<6%	NCMA SRW Best Practices	ADVISORY	

3. FILL TESTING	3.1. VALUES TO BE TESTED FOR APPROVAL	AASHTO & FHWA	LRFD Bridge Design, Latest Edition & NHI 2001/2009 Manuals	Advisory	Gradation, Atterberg Limits, Proctor Testing, Electrochemical	density at least 95% standard proctor or 92% modified proctor	NCMA SRW Best Practices	ADVISORY	
	3.2. FREQUENCY OF COMPLIANCE TESTING	Not Specifically stated in MSE & RSS Codes; typically relegated to State DOTs	Not Specifically Stated in MSE & RSS Codes; typically relegated to State DOTs	Advisory	Typically indicated at changes in material type or per volume of placed material during construction.	1 compaction test for each soil lift, (not exceeding 8 in. (203 mm)) but not less than one test for every 50 cubic yards (38 cubic meters) of compacted fill at a spacing not to exceed 100 ft (30 m).	NCMA SRW Best Practices	ADVISORY	
	3.3. SPECIFIC REQUIREMENTS FOR MARGINAL/COHESIVE SOILS	AASHTO & FHWA	LRFD Bridge Design, Latest Edition & NHI 2001/2009 Manuals	Obigatory - Not Allowed in AASHTO and Advisory - With Caution in NHI (FHWA)	Use of NHI (FHWA) and NCMA Standards for Segmental Walls also allows wider use of marginal/cohesive soils up to and 35% fines	density at least 95% standard proctor or 92% modified proctor	NCMA SRW Best Practices	ADVISORY	
4. FILL PLACEMENT	4.1. PREPARATION OF THE BEARING SURFACE / GROUND STABILIZATION IF REQUIRED	Not specifically stated in AASHTO codes but addressed in NHI and NCMA Standards	NHI 2001/2009 Manuals & NCMA Segmental Wall Stds	Advisory	Remove unsuitable material (organic material, vegetation, slide debris and undesireable soils). Proof roll base.	compact leveling pad. If required stabilization, get the advice from the geotechnical engineer	NCMA SRW Best Practices	ADVISORY	
	4.2. METHOD OF PLACEMENT	Not specifically stated in AASHTO codes but addressed in NHI and NCMA Standards	NHI 2001/2009 Manuals & NCMA Segmental Wall Stds	Advisory	Manual and lightweight equipment placement within 1 m of fascia. Standard means beyond 1 m; minimum 5 passes of compaction equipment. Spread fill from mid-width location.	6 to 8 inch lifts	NCMA SRW Best Practices	ADVISORY	
	4.3. TRAFFICKING OVER REINFORCEMENT	Not specifically stated in AASHTO codes but addressed in NHI and NCMA Standards	NHI 2001/2009 Manuals & NCMA Segmental Wall Stds	Advisory	No equipment directly on reinforcements. At least 75 mm fill between overlapping reinforcements. At least 300 mm fill over reinforcement before crossing with construction equipment.	6 inches of soil over reinforcement	NCMA SRW Best Practices	ADVISORY	
	4.4. STOCKPILING OF FILL	Not Specifically stated in MSE & RSS Codes; typically relegated to State DOTs	Not Specifically Stated in MSE & RSS Codes; typically relegated to State DOTs	Advisory	N/A	NA			
	4.5. MANAGEMENT OF MOISTURE CONTENT	Not specifically stated in AASHTO codes but addressed in NHI and NCMA Standards	NHI 2001/2009 Manuals & NCMA Segmental Wall Stds	Advisory	Maintain moisture within 2% of optimum for standard backfill and within 3% for free draining soils with less than 5% fines.	As a general rule, the moisture of the soil should be within +/- 2% points of the soil's optimum moisture. Best information from the geotechnical engineer.	NCMA SRW Best Practices	ADVISORY	
	4.6. SPECIFIC REQUIREMENTS FOR MARGINAL/COHESIVE SOILS	Not specifically stated in AASHTO codes but addressed in NHI and NCMA Standards	NHI 2001/2009 Manuals & NCMA Segmental Wall Stds	Advisory	Reduced fill lifts.	identical requirements	NCMA SRW Best Practices	ADVISORY	

5. FILL COMPACTION	5.1. SELECTING METHOD OF COMPACTION	Not specifically stated in AASHTO codes but addressed in NHI and NCMA Standards	NHI 2001/2009 Manuals & NCMA Segmental Wall Stds	Advisory	Portable equipment within 1 m of fasicia. Smooth roller equipment more than 1 m from facing; no use of sheepsfoot equipment.	NA			
	5.2. VERIFICATION OF COMPACTION AND TEST FREQUENCY	Not specifically stated in AASHTO codes but addressed in NHI and NCMA Standards	NHI 2001/2009 Manuals & NCMA Segmental Wall Stds	Advisory	Typically at compaction of at least 95% of maximum dry density per AASHTO T99. Frequency of testing typically State-by_State.	1 compaction test for each soil lift, (not exceeding 8 in. (203 mm)) but not less than one test for every 50 cubic yards (38 cubic meters) of compacted fill at a spacing not to exceed 100 ft (30 m).	NCMA SRW Best Practices	ADVISORY	
	5.3. REQUIREMENTS / ADVICE GIVEN	Not specifically stated in AASHTO codes but addressed in NHI	NHI 2009 Manual	Advisory	Key to good performance is consistent placement & compaction. Loose lift thickness should not exceed 12 inches. Fill should be placed at rear and middle of reiforcements and bladed to front face.	Similar to NHI criteria	NCMA Manual	Advisory	Fill placed in reinforced zone should have lift thickness of 8 inches. In the retained fill beyond the reinforced zone can go with 8 to 12 inches.
	5.4. SPECIFIC REQUIREMENTS FOR MARGINAL/COHESIVE SOILS	Not specifically stated in AASHTO codes but addressed in NHI	NHI 2009 Manual	Advisory	Marginal fills have been used in MSEW but careful consideration of design issues is needed for the walls to perform well. Issues to be examined include drainage, corrosion, wall alignment, reinforcement pullout (direct testing), constructability and long term performance. NCHRP 24-22 has confirmed up to 35% fines (passing No. 200 sieve) of low plasticity may be successfully used. However, perceived savings in lower cost fills may be inversely offset by the costs needed to successfully install it. Better to limit fines to less than 15% with low plasticity and higher internal friction.	Similar to NHI criteria	NCMA Manual	Advisory	Similar considerations as given in NHI manual. However, use of reinforced fill with up to 35% fines (passing No. 200 sieve) is more commonly accepted with proper consideration of drainage and wall alignment.
6. DRAINAGE	6.1. REQUIREMENTS / ADVICE GIVEN	General guidelines in AASHTO & FHWA	LRFD Bridge Design, Latest Edition & NHI 2001/2009 Manuals	Advisory	Base drainage and cutoff drainage behind wall volume recommended. NHI & NCMA go further for Segmental Retaining Walls to incorporate free draining gravel at 300 mm width behind fascia blocks.	Always include a drainage pipe behind the bottom block or in the leveling pad and either daylighting or tied to a sewer. If three are water sources in the wall add swale above the wall, grade the site, etc	NCMA SRW Best Practices	ADVISORY	
	6.2. VERIFICATION OF INSTALLATION	General guidelines in AASHTO & FHWA	LRFD Bridge Design, Latest Edition & NHI 2001/2009 Manuals	Advisory	Field inspector responsibility.	yes	NCMA SRW Best Practices	ADVISORY	
7. REINFORCEMENT - Duplicate for different types (geogrid, geotextile, polymer strip, steel strip, steel ladder, welded wire fabric etc) if regulations/recommendations differ	7.1. APPROVAL OF REINFORCEMENT TYPE , REINFORCEMENT EXTERNAL APPROVAL SYSTEM?	General guidelines in AASHTO & FHWA	LRFD Bridge Design, Latest Edition & NHI 2001/2009 Manuals	Advisory	Owner's agency at time of design.	Defined by designer. NTPEP approved reinforcements	NCMA SRW Best Practices	ADVISORY	
	7.2. COMPLIANCE TESTING AND FREQUENCY	General guidelines in AASHTO & FHWA	LRFD Bridge Design, Latest Edition & NHI 2001/2009 Manuals	Advisory	Product approval at time of design. Delivered materials reviewed by field inspector.	NA			
	7.3. INSTALLATION MONITORING (GRADE, TENSION etc)	Not specifically stated in AASHTO codes but addressed in NHI and NCMA Standards	NHI 2001/2009 Manuals & NCMA Segmental Wall Stds	Advisory	Field inspector responsibility.	With backfilling	NCMA SRW Best Practices	ADVISORY	

8. FACING SELECTION	8.1. APPROVED FACING TYPES WALLS, LIMITING ANGLES etc	Not specifically stated in AASHTO codes but addressed in NHI and NCMA Standards. Also State DOTs have specific acceptance.	NHI 2001/2009 Manuals & NCMA Segmental Wall Stds	Obligatory on State-by-State basis for DOTs	State regulatory agencies typically establish approved facings. The FHWA does have a clearing house approval basis called IDEA, but	NA			
	8.2. APPROVED FACING TYPES SLOPES, LIMITING ANGLES etc	General guidelines are found in AASHTO and NHI. Specific approvals are by individual State DOTs or other authorities.	NHI 2001/2009 Manuals & NCMA Segmental Wall Stds	Obligatory on State-by-State basis for DOTs	State regulatory agencies typically establish approved facings. The FHWA does have a clearing house approval basis called IDEA, but	NA			
	8.3. FACING SYSTEM EXTERNAL APPROVAL SYSTEM	FHWA IDEA program followed by State DOTs or other local government or owner authority	FHWA IDEA program (Innovations, Development, Enhancement and Advancements)	Advisory	Government (State DOT) or local owner has final approval	NA			
	8.4. UV PROTECTION OF EXPOSED REINFORCEMENT	AASHTO & FHWA	Exposed geosynthetics as a facing slection are discouraged when exposed to UV	Advisory	Temporary applications only.	This is already part of the appropriate ASTM standards	NCMA SRW Best Practices	ADVISORY	
9. FACING CONNECTION	9.1. FACING/CONNECTION REQUIREMENTS	AASHTO & FHWA	LRFD Bridge Design, Latest Edition & NHI 2001/2009 Manuals	Obligatory	Tension and embedment criteria sepparately addressed by code.	Use system with the appropriate ASTM testing	NCMA SRW Best Practices	ADVISORY	
	9.2. TESTING AND APPROVAL SYSTEM & ON SITE	AASHTO & FHWA	LRFD Bridge Design, Latest Edition & NHI 2001/2009 Manuals	Obligatory	Tension criteria and other mechanisms specifically addressed in codes.	ASTM D6638 - 18, Standard Test Method for Determining Connection Strength Between Geosynthetic Reinforcement and Segmental Concrete Units (Modular Concrete Blocks)	NCMA SRW Design Manual	ADVISORY	
10. MOVEMENT JOINTS	10.1. ADVICE AND FREQUENCY OF MOVEMENT JOINTS	AASHTO & FHWA	LRFD Bridge Design, Latest Edition & NHI 2001/2009 Manuals	Obligatory	Size of fascia addressed as well as differential settlements	NA			
	10.2. REQUIREMENTS FOR PADS OR SPACERS FOR JOINT SEPARATION	FHWA & Local State DOT requirements	NHI 2001/2009 Manuals give general guidance and State DOTs more specific	Advisory	In addition to FHWA general gudelines, the FHWA IDEA program is used to address specific pads to the associated panel system.	NA			
	10.3. MINIMUM EMBEDMENT, FROST HEAVE , OVERDIG REQUIREMENTS etc	AASHTO & FHWA	LRFD Bridge Design, Latest Edition & NHI 2001/2009 Manuals	Obligatory	Embedment for frost and near slopes indicated	6 inches min. more based on the project, toe slope and global stability requirements (if applicable)	NCMA SRW Best Practices	ADVISORY	
11. VEGETATION	11.1. ADVICE AND RECOMMENDATIONS	FHWA & Local State DOT requirements	NHI 2001/2009 Manuals give general guidance and State DOTs more specific	Advisory	Mostly addresses RSS rather than MSE. Specifics on types of vegetation , placement, development and design provided in NHI manuals	Landscape the top of the wall to avoid erosion	NCMA SRW Best Practices	ADVISORY	
	11.2. RESTRICTIONS ON VEGETATION	FHWA & Local State DOT requirements	NHI 2001/2009 Manuals give general guidance and State DOTs more specific	Advisory	Mostly addresses RSS rather than MSE. Specifics on types of vegetation , placement, development and design provided in NHI manuals	NA			

12. INSPECTION AND MAINTENANCE	12.1. REQUIREMENTS	FHWA & Local State DOT requirements	NHI 2001/2009 Manuals give general guidance and State DOTs more specific	Obligatory	State DOT criteria are specific and obligatory while FHWA NHI is advisory.	Post construction tolerances.	NCMA SRW Best Practices	ADVISORY	
	12.2. FREQUENCY	FHWA & Local State DOT requirements	NHI 2001/2009 Manuals give general guidance and State DOTs more specific	Obligatory	State DOT criteria are specific and obligatory while FHWA NHI is advisory.	For tall walls and for critical structures, annual or bi-annual inspections of the wall may be warranted, and if conducted, should be performed by a qualified firm. Similar inspections should also be performed following extreme events.	NCMA SRW Best Practices	ADVISORY	
13. OTHER	13.1. ANY OTHER ITEM NOT SPECIFICALLY ADDRESSED IN THE PRECEDING ITEMS	AASHTO & FHWA	LRFD Bridge Design, Latest Edition & NHI 2001/2009 Manuals	Advisory	Geotextile at panel joints addressed as well as concrete top treatments such as coping and traffic barriers.	NA			

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COMPARISON OF THE EXISTING CODES AND GUIDELINES

ITALY
[1] RELEVANT CODE FOR GEOTECHNICAL STRUCTURES: DM 17-01-2018. Aggiornamento delle «Norme tecniche per le costruzioni». Usually called NTC2018. Published in: Gazzetta Ufficiale Della Repubblica Italiana. Supplemento ordinario N. 8, Serie generale n. 42 del 20 febbraio 2018.
[2] RELEVANT CODES FOR REINFORCED SOIL STRUCTURES: NONE.
[3] RELEVANT PUBLICATION: Massimo Comedini and Pietro Rimoldi (2013). Terre rinforzate. Applicazioni - Tecnologie – Dimensionamento. Dario Flaccovio Publisher, Palermo, Italy. 463 pages.
[4] SOIL CLASSIFICATION, USE OF SOIL IN CIVIL ENGINEERING PROJECTS: UNI 11531-1:2014. Costruzione e manutenzione delle opere civili delle infrastrutture - Criteri per l'impiego dei materiali - Parte 1: Terre e miscele di aggregati non legati. (Includes instructions for use of EN ISO 14688, EN 13242, EN 13285)
[5]CE MARKING: EN 13251:2016. Geotextiles and geotextile-related products. Characteristics required for use in earthworks, foundations and retaining structures
[6] CONSTRUCTION: EN 14475. Execution of special geotechnical works. Reinforced fill
[7] EN 1997-2:2007 Eurocode 7: Geotechnical design - Part 2: Ground investigation and testing

TOPIC	SUB-TOPIC	RELEVANT CODES	REFERENCE	ADVISORY / OBLIGATORY	COMMENTS/BEST PRACTICE
1. SOIL INVESTIGATION	1.1. VALUES TO BE TESTED PRIOR DESIGN	[3], [7]	φ' and c' for frictional soil; c_u for coehsive soils; site investigation in accordance with the requirements of EN 1997-1	ADVISORY	Design Engineer can ask for other parameters to be investigated
	1.2. GLOBAL STABILITY	[3], [7]	as above + water content for insitu soils	ADVISORY	as above
	1.3 VALUES TO BE TESTED PRIOR START OF INSTALLATION	[3], [7]	as above + water content for insitu soils	ADVISORY	as above
2. FILL SELECTION	2.1. SUITABLE FILL TYPES FOR WALLS/SLOPES	[4], [6]	All type of soils from A1 to A7	ADVISORY	Soils in classes A1, A2-4, A2-5, A3 are considered as frictional; all other soils are considered cohesive - frictional or purely
	2.2. PROHIBITED MATERIALS	[4]	Organic soils A8	ADVISORY	
	2.3. REQUIRED STRENGTH VALUES/LIMITS (c',Φ', PSD, FINES etc)	[3], [6]	Up to Design engineer judgement	ADVISORY	
	2.4. SPECIFIC REQUIREMENTS FOR ELECTROCHEMICAL CONDITIONS (pH, SALTS, etc)	[3], [6]	Folow recommendations in Annex B of EN 14475. With steel reinforcement : only soils in classes A1-a, A1-b, A3, A2-4, A2-5 should be used; resistivity should be > 1000 Ohm·cm for dry walls and > 3000 Ohm·cm for walls in contact with water, pH should be between 5 and 10; Cl^- ions < 200 mg/kg for dry walls and < 100 mg/kg for walls in contact with fresh water; SO_4 ions < 1000 mg/kg for dry walls and < 500 mg/kg for walls in contact with fresh water;	ADVISORY	Other specific requirements can be imposed by the Design engineer
	2.5. SPECIFIC REQUIREMENTS FOR MARGINAL/COHESIVE SOILS	[3]	The Design engineer should consider an internal drainage system to lower the pwp; specific compaction procedures should be applied	ADVISORY	

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<tr>
<td rowspan="15">3. FILL TESTING</td>
<td>3.1. VALUES TO BE TESTED FOR APPROVAL</td>
<td>[4]</td>
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<table>
<tr><th colspan="2" rowspan="2">Miscele non legate
di aggregati naturali e artificiali</th><th colspan="6">Impieghi</th></tr>
<tr><th colspan="2">Strato anticapillare</th><th colspan="2">Fondazione
non legata</th><th colspan="2">Base non legata</th></tr>
<tr><th>Caratteristica</th><th>Norma di prova</th><th>Requisito</th><th>Frequenza minima di prova in fase di stesa</th><th>Requisito</th><th>Frequenza minima di prova in fase di stesa</th><th>Requisito</th><th>Frequenza minima di prova in fase di stesa</th></tr>
<tr><td>Designazione</td><td>UNI EN 13242 /13285</td><td>2 / 31,5</td><td></td><td>0 / 31,5</td><td></td><td>0 / 31,5</td><td></td></tr>
<tr><td>Sopravaglio della miscela</td><td>UNI EN 933-1</td><td>-</td><td></td><td>OC_{75}</td><td>1000 m³</td><td>OC_{85}</td><td>1000 m³</td></tr>
<tr><td>Contenuto massimo dei fini</td><td>UNI EN 933-1</td><td>UF_3</td><td>1000 m³</td><td>UF_9</td><td>1000 m³</td><td>UF_9</td><td>1000 m³</td></tr>
<tr><td>Contenuto minimo dei fini</td><td>UNI EN 933-1</td><td>-</td><td></td><td>LF_2</td><td>1000 m³</td><td>LF_2</td><td>1000 m³</td></tr>
<tr><td>Granulometria</td><td>UNI EN 933-1</td><td>$G_C85/15$</td><td>1000 m³</td><td>G_A</td><td>1000 m³</td><td>G_A</td><td>1000 m³</td></tr>
<tr><td>Appiattimento dell'aggregato grosso</td><td>UNI EN 933-3</td><td>FI_{35}</td><td>10000 m³</td><td>FI_{35}</td><td>10000 m³</td><td>FI_{35}</td><td>10000 m³</td></tr>
<tr><td>Qualità dei fini</td><td>UNI EN 933-9</td><td>-</td><td></td><td>MB_2</td><td>1000 m³</td><td>$MB_{1,5}$</td><td>1000 m³</td></tr>
<tr><td>Qualità dei fini (alternativo)</td><td>UNI EN 933-8</td><td>SE_{70}</td><td>1000 m³</td><td>SE_{30}</td><td>1000 m³</td><td>SE_{50}</td><td>1000 m³</td></tr>
<tr><td>Resistenza alla frammentazione</td><td>UNI-EN 1097-2</td><td>LA_{40}</td><td>10000 m³</td><td>LA_{30}</td><td>10000 m³</td><td>LA_{30}</td><td>10000 m³</td></tr>
<tr><td>Percentuale di particelle frantumate/arrotondate</td><td>UNI-EN 933-5</td><td>-</td><td></td><td>-</td><td></td><td>$C_{90/3}$</td><td>10000 m³</td></tr>
<tr><td>Resistenza all'usura</td><td>UNI-EN 1097-1</td><td>-</td><td></td><td>-</td><td></td><td>$M_{DE}20$</td><td>10000 m³</td></tr>
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<tr>
<td>3.2. FREQUENCY OF COMPLIANCE TESTING</td>
<td>[4]</td>
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<tr><td>Massa volumica max con energia Proctor modificata</td><td>EN 13286-2</td><td>-</td><td></td><td>√</td><td>2000 m³</td><td>√</td><td>2000 m³</td></tr>
<tr><td>Portanza CBR dopo 4 gg di imbibizione su provini costipati con umidità ±2% dell'ottimo al 95% della massa volumica massima all'energia Proctor mod.</td><td>EN 13286-47</td><td>-</td><td></td><td>≥ 30</td><td>20000 m³</td><td>-</td><td></td></tr>
<tr><td>Portanza CBR dopo 4 gg di imbibizione su provini costipati con umidità ±2% dell'ottimo al 100% della massa volumica massima all'energia Proctor mod.</td><td>EN 13286-47</td><td>-</td><td></td><td>-</td><td></td><td>≥ 80</td><td>20000 m³</td></tr>
<tr><td>Rigonfiamento CBR</td><td>EN 13286-47</td><td>-</td><td></td><td>≤ 1 %</td><td>20000 m³</td><td>≤ 1 %</td><td>20000 m³</td></tr>
<tr><td>Perdita di resistenza dopo cicli di gelo e disgelo (*)</td><td>EN 1367-1</td><td>-</td><td></td><td>$\Delta S_{LA} \leq 30$</td><td>50000 m³</td><td>$\Delta S_{LA} \leq 30$</td><td>50000 m³</td></tr>
<tr><td>Sonnenbrand del basalto (**)</td><td>UNI-EN 1097-2</td><td>SB_{LA}</td><td>50000 m³</td><td>SB_{LA}</td><td>50000 m³</td><td>SB_{LA}</td><td>50000 m³</td></tr>
<tr><td>Stabilità volumetrica (**)</td><td>UNI EN 1744-1 19.3</td><td>$V_{3,5}$</td><td>10000 m³</td><td>$V_{3,5}$</td><td>10000 m³</td><td>$V_{3,5}$</td><td>10000 m³</td></tr>
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<tr>
<td>3.3. SPECIFIC REQUIREMENTS FOR MARGINAL/COHESIVE SOILS</td>
<td>[4]</td>
<td>Other specific requirements can be imposed by the Design engineer</td>
<td>ADVISORY</td>
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<tr>
<td rowspan="6">4. FILL PLACEMENT</td>
<td>4.1. PREPARATION OF THE BEARING SURFACE / GROUND STABILIZATION IF REQUIRED</td>
<td>[3], [6]</td>
<td>Smoothing and rolling of the bearing surface; soft soil stabilisation or basal reinforcement with geogrids or woven geotextiles. Follow recommendations in Section 8.3 of EN 14475</td>
<td>ADVISORY</td>
<td></td>
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<tr>
<td>4.2. METHOD OF PLACEMENT</td>
<td>[3]</td>
<td>Maximum 300 mm lifts</td>
<td>ADVISORY</td>
<td></td>
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<tr>
<td>4.3. TRAFFICKING OVER REINFORCEMENT</td>
<td>[3]</td>
<td>Not allowed</td>
<td>ADVISORY</td>
<td></td>
</tr>
<tr>
<td>4.4. STOCKPILING OF FILL</td>
<td>[3]</td>
<td>Only in adjacent areas</td>
<td>ADVISORY</td>
<td></td>
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<tr>
<td>4.5. MANAGEMENT OF MOISTURE CONTENT</td>
<td>[3]</td>
<td>Moisture should be corresponding to 95 % Standard Proctor (EN 13286-2)</td>
<td>ADVISORY</td>
<td></td>
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<tr>
<td>4.6. SPECIFIC REQUIREMENTS FOR MARGINAL/COHESIVE SOILS</td>
<td>[3]</td>
<td>Usually sheepfoot rollers are required</td>
<td>ADVISORY</td>
<td>Other specific requirements can be imposed by the Design engineer</td>
</tr>
</table>

5. FILL COMPACTION	5.1. SELECTING METHOD OF COMPACTION	[4]	Static or vibratory rollers. Follow recommendations in Section 8.5.4 of EN 14475	ADVISORY	
	5.2. VERIFICATION OF COMPACTION AND TEST FREQUENCY	[4]	Soil density test every 2000 m^3; compaction test site if overall volume > 100,000 m^3	ADVISORY	
	5.3. REQUIREMENTS / ADVICE GIVEN	[3], [4]	Soil density after compaction should be higher than 95 % maximum density from Standard Proctor (EN 13286-2) or higher than 90 % maximum density from Modified Proctor (EN 13286-2)	ADVISORY	
	5.4. SPECIFIC REQUIREMENTS FOR MARGINAL/COHESIVE SOILS	[3], [4]	Evaluate to use sheepfoot rollers for compaction	ADVISORY	
6. DRAINAGE	6.1. REQUIREMENTS / ADVICE GIVEN	[3], [6]	When using drainage geosynthetics the drainage and filtration properties of the geosynthetic shall be compatible with the selected fill. For marginal soils the Design engineer should consider an internal drainage system to lower the pwp. Follow recommendations in Section 8.4 of EN 14475	ADVISORY	
	6.2. VERIFICATION OF INSTALLATION	[6]	Follow recommendations in Section 8.4 of EN 14475		
7. REINFORCEMENT - Duplicate for different types (geogrid, geotextile, polymer strip, steel strip, steel ladder, welded wire fabric etc) if regulations/recommendations differ	7.1. APPROVAL OF REINFORCEMENT TYPE , REINFORCEMENT EXTERNAL APPROVAL SYSTEM?	[5]	CE Marking	OBLIGATORY	
	7.2. COMPLIANCE TESTING AND FREQUENCY	[5]	According to CE Marking Certificate	OBLIGATORY	
	7.3. INSTALLATION MONITORING (GRADE, TENSION etc)	[6]	Follow recommendations in Section 10 of EN 14475	ADVISORY	
8. FACING SELECTION	8.1. APPROVED FACING TYPES WALLS, LIMITING ANGLES etc	[6]	No limits	ADVISORY	
	8.2. APPROVED FACING TYPES SLOPES, LIMITING ANGLES etc	[6]	No limits	ADVISORY	
	8.3. FACING SYSTEM EXTERNAL APPROVAL SYSTEM	[5]	CE Marking	OBLIGATORY	
	8.4. UV PROTECTION OF EXPOSED REINFORCEMENT	[5]	According to EN 13251 requirements		
9. FACING CONNECTION	9.1. FACING/CONNECTION REQUIREMENTS	[6]	Follow recommendations in Annex C and Annex F of EN 14475.		
	9.2. TESTING AND APPROVAL SYSTEM & ON SITE	[5]	CE Marking	OBLIGATORY	
10. MOVEMENT JOINTS	10.1. ADVICE AND FREQUENCY OF MOVEMENT JOINTS		According to supplier specification		
	10.2. REQUIREMENTS FOR PADS OR SPACERS FOR JOINT SEPARATION		According to supplier specification		
	10.3. MINIMUM EMBEDMENT, FROST HEAVE , OVERDIG REQUIREMENTS etc		According to supplier specification		
11. VEGETATION	11.1. ADVICE AND RECOMMENDATIONS		Follow recommendations in Section 8.5.5 of EN 14475. When green face is required, hydroseeding is recommended		
	11.2. RESTRICTIONS ON VEGETATION		Only grass and willows should be allowd on face		
12. INSPECTION AND MAINTENANCE	12.1. REQUIREMENTS	[6]	Follow recommendations in Section 9 of EN 14475		
	12.2. FREQUENCY	[6]	Follow recommendations in Section 9 of EN 14475		
13. OTHER	13.1. ANY OTHER ITEM NOT SPECIFICALLY ADDRESSED IN THE PRECEDING ITEMS				

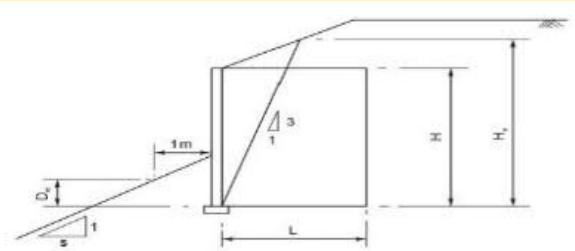
ISSMGE TC 218 - GROUP 3 - CONSTRUCTION BEST PRACTICES

COMPARISON OF THE EXISTING CODES AND GUIDELINES

			HONG KONG		
			[1] Geoguide 1 - Guide to Retaining Wall Design		
			[2] Geoguide 2 - Gudie to Site Investigation		
			[3] Geoguide 5 - Guide to Slope Maintenance		
			[4] Geoguide 6 - Guide to Reinforced Fill Structure and Slope Design		
TOPIC	SUB-TOPIC	RELEVANT CODES	REFERENCE	ADVISORY/OBLIGITARY	COMMENTS/BEST PRACTICE
1. SOIL INVESTIGATION	1.1. VALUES TO BE TESTED PRIOR DESIGN	[2]	ϕ' and c' of soil, water table, bearing capacity	ADVISORY	
	1.2. GLOBAL STABILITY	[2]	as above	ADVISORY	
	1.3 VALUES TO BE TESTED PRIOR START OF INSTALLATION	[2]	as above	ADVISORY	
2. FILL SELECTION	2.1. SUITABLE FILL TYPES FOR WALLS/SLOPES	[4]	Table A.1 – Properties of Selected Fill Material Material Type / Requirement: Type I: Maximum Size (mm) 150; % Passing 10 mm BS Sieve Size 25 – 100; % Passing 600 microns BS Sieve Size 10 – 100; % Passing 63 microns BS Sieve Size 0 – 10; % Smaller than 2 microns -; Coefficient of Uniformity ≥ 5; Liquid Limit (%) Not applicable; Plasticity Index (%) Not applicable Type II: 150; - ; 10 – 100; 0 – 45; 0 – 10; ≥ 5; ≤ 45; ≤ 20 Notes: (1) No dispersant shall be used in the determination of particle size distribution. (2) BS Sieve Sizes are in accordance with BS 410-1:2000, ISO 3310-1:2000. [Amd GG6/01/2017]	ADVISORY	
	2.2. PROHIBITED MATERIALS			ADVISORY	have to use selected fill or comply with the specification of Geoguide 6
	2.3. REQUIRED STRENGTH VALUES/LIMITS (c',Φ', PSD, FINES etc)	[4]	Based on the selected fill material	ADVISORY	

<table>
<tr><td></td><td>2.4. SPECIFIC REQUIREMENTS FOR ELECTROCHEMICAL CONDITIONS (pH, SALTS, etc)</td><td>[4]</td><td>Table A.2 – Allowable Electrical and Chemical Limits of Selected Fill and Granular Filter
<table><tr><th rowspan="2">Fill Property</th><th colspan="2">Allowable Limits</th></tr><tr><th>Submerged</th><th>Non-Submerged</th></tr><tr><td>pH</td><td>5 – 10</td><td>5 – 10</td></tr><tr><td>Resistivity (ohm m)</td><td>≥ 30</td><td>≥ 10</td></tr><tr><td>Organic Content</td><td>≤ 0.2</td><td>≤ 0.2</td></tr><tr><td>Redox Potential (volts)(3)</td><td>≥ 0.40 (Type I)
≥ 0.43 (Type II)</td><td>≥ 0.40 (Type I)
≥ 0.43 (Type II)</td></tr><tr><td>Microbial Activity Index(3)</td><td>≤ 5</td><td>≤ 5</td></tr><tr><td>Chloride Ion Content (% by weight)</td><td>≤ 0.01</td><td>≤ 0.02</td></tr><tr><td>Total Sulphate Content (% by weight)</td><td>≤ 0.10</td><td>≤ 0.20</td></tr><tr><td>Sulphate Ion Content (% by weight)</td><td>≤ 0.05</td><td>≤ 0.10</td></tr><tr><td>Total Sulphide Content (% by weight)</td><td>≤ 0.01</td><td>≤ 0.03</td></tr></table></td><td>ADVISORY</td><td></td></tr>
<tr><td></td><td>2.5. SPECIFIC REQUIREMENTS FOR MARGINAL/COHESIVE SOILS</td><td>[4]</td><td>1. Organic content shall be carried out for clayey soils where more than 15% passes a 63 micron BS Sieve Size
2. Measurement of either redox potential or microbial activity index shall be carried out for clayey soil with an organic content in excess of the specified limit</td><td>ADVISORY</td><td></td></tr>
<tr><td>3. FILL TESTING</td><td>3.1. VALUES TO BE TESTED FOR APPROVAL</td><td>[4]</td><td>The insitu dry density of the compacted fill material shall be 95% of the maximum dry density</td><td></td><td></td></tr>
<tr><td></td><td>3.2. FREQUENCY OF COMPLIANCE TESTING</td><td>[4]</td><td>For the PSD, at least 3 samples shall be taken from each batch of fill material and, where the volume of the batch exceeds 3,000m2, 1 additional sample shall be taken for each additional 1,000m2 or part thereof. For SRT, 3 samples shall be taken from each batch of fill material and, where the plan area of the structure or slope exceeds 800m2, 3 additional samples shall be taken for each additional 800m2 or part thereof.</td><td></td><td></td></tr>
<tr><td></td><td>3.3. SPECIFIC REQUIREMENTS FOR MARGINAL/COHESIVE SOILS</td><td>[4]</td><td>Not specify for the marginal/cohesive soil, testing shall be followed section 3.2</td><td></td><td></td></tr>
<tr><td>4. FILL PLACEMENT</td><td>4.1. PREPARATION OF THE BEARING SURFACE / GROUND STABILIZATION IF REQUIRED</td><td>Code of practice for foundation</td><td>98% compaction for the foundation</td><td></td><td>Based on different contract</td></tr>
<tr><td></td><td>4.2. METHOD OF PLACEMENT</td><td>[4]</td><td>each layer 300mm</td><td></td><td></td></tr>
<tr><td></td><td>4.3. TRAFFICKING OVER REINFORCEMENT</td><td>[4]</td><td>At least 150mm fill on top</td><td></td><td>min. layer of 150mm fill will be spread on top of the strips</td></tr>
<tr><td></td><td>4.4. STOCKPILING OF FILL</td><td>[4]</td><td>Fill material shall not be handled or stored in a manner which will result in segregatoin, deterioration, erosion or instability of the material</td><td>ADVISORY</td><td>Depend on site situation</td></tr>
<tr><td></td><td>4.5. MANAGEMENT OF MOISTURE CONTENT</td><td>[4]</td><td>The tolerance on the optimum moisture content shall be +/- 3% provided that the fill material is capable of being compacted in accordance with the specified requirement to form a stable mass of fill</td><td>OBLIGATORY</td><td></td></tr>
<tr><td></td><td>4.6. SPECIFIC REQUIREMENTS FOR MARGINAL/COHESIVE SOILS</td><td>-</td><td>-</td><td></td><td></td></tr>
</table>

5. FILL COMPACTION	5.1. SELECTING METHOD OF COMPACTION	[4]	Sand replacement test	ADVISORY	
	5.2. VERIFICATION OF COMPACTION AND TEST FREQUENCY	[4]	Compaction level does not exceed 300mm	OBLIGATORY	
	5.3. REQUIREMENTS / ADVICE GIVEN	[4]	The insitu dry density of the compacted fill material shall be 95% of the maximum dry density. Cobbles, bouders, rock or waste fragments whose largest dimension in greater than two-thirds of the loose layer thickness shall not be incorporated into the fill.		
	5.4. SPECIFIC REQUIREMENTS FOR MARGINAL/COHESIVE SOILS	[4]	Not specify for the marginal/cohesive soil, testing shall be followed section 5.3		
6. DRAINAGE	6.1. REQUIREMENTS / ADVICE GIVEN	General Specification for Civil Engineering Works (2006), [1]	Table 17 - Design Criteria for Granular Filters Rule Number / Filter Design Rule(1) / Requirement 1: $D_{15}F_c < 5 \times D_{85}S_f$ — Stability (i.e. the pores in the filter must be small enough to prevent infiltration of the material being drained) 2: Should not be gap-graded (i.e. having two or more distinct sections of the grading curve separated by sub-horizontal portions) — Stability 3: $D_{15}F_f > 5 \times D_{15}S_c$ — Permeability (i.e. the filter must be much more permeable than the material being drained) 4: Not more than 5% to pass 63μm sieve and that fraction to be cohesionless — Permeability 5: Uniformity Coefficient $4 < \frac{D_{60}F}{D_{10}F} < 20$ — Segregation (i.e. the filter must not become segregated or contaminated prior to, during, and after installation) 6: Maximum size of particles should not be greater than 50 mm — Segregation Notes: (1) In this Table, $D_{15}F$ is used to designate the 15% size of the filter material (i.e. the size of the sieve that allows 15% by weight of the filter material to pass through it). Similarly, $D_{85}S$ designates the size of sieve that allows 85% by weight of the base soil to pass through it. The subscript c denotes the coarse side of the envelope, and subscript f denotes the fine side. (2) For a widely graded base soil, with original $D_{60}S > 2$ mm and $D_{10}S < 0.06$ mm, the above criteria should be applied to the 'revised' base soil grading curve consisting of the particles smaller than 5 mm only. (3) The thickness of a filter should not be less than 300 mm for a hand-placed layer, or 450 mm for a machine-placed layer. (4) Rule 5 should be used to check individual filter grading curves rather than to design the limits of the grading envelope. (5) The determination of the particle size distributions of the base soil and the filter should be carried out without using dispersants.		based on each contract
	6.2. VERIFICATION OF INSTALLATION	-			
7. REINFORCEMENT - Duplicate for different types (geogrid, geotextile, polymer strip, steel strip, steel ladder, welded wire fabric etc) if regulations/recommendations differ	7.1. APPROVAL OF REINFORCEMENT TYPE , REINFORCEMENT EXTERNAL APPROVAL SYSTEM?	[4]	-	ADVISORY	
	7.2. COMPLIANCE TESTING AND FREQUENCY	[4]	Tensile test and galvanization test before the start of the construction	OBLIGATORY	
	7.3. INSTALLATION MONITORING (GRADE, TENSION etc)	[4]	-		
8. FACING SELECTION	8.1. APPROVED FACING TYPES WALLS, LIMITING ANGLES etc	From client's requirement	no limit	ADVISORY	
	8.2. APPROVED FACING TYPES SLOPES, LIMITING ANGLES etc	From client's requirement	no limit	ADVISORY	
	8.3. FACING SYSTEM EXTERNAL APPROVAL SYSTEM	-	-	ADVISORY	
	8.4. UV PROTECTION OF EXPOSED REINFORCEMENT	-	-	ADVISORY	
9. FACING CONNECTION	9.1. FACING/CONNECTION REQUIREMENTS	[4]	Method of testing shall be in accordance with NCMASRWU-1 or other test method as approved by Engineer		
	9.2. TESTING AND APPROVAL SYSTEM & ON SITE	[4]	Method of testing shall be in accordance with NCMASRWU-1 or other test method as approved by Engineer	ADVISORY	

10. MOVEMENT JOINTS	10.1. ADVICE AND FREQUENCY OF MOVEMENT JOINTS	-	-	ADVISORY	
	10.2. REQUIREMENTS FOR PADS OR SPACERS FOR JOINT SEPARATION	-	-	ADVISORY	Requirement of bearing pad is based on our own standard A461
	10.3. MINIMUM EMBEDMENT, FROST HEAVE , OVERDIG REQUIREMENTS etc	[4]	 (1) For Initial Sizing, $L \geq 0.7H_e$ for walls $L \geq (0.6H_e + 2)$ for abutments (2) For Embedment depth, $s = 3$, $D_m \geq H_e / 10$ $s = 2$, $D_m \geq H_e / 7$ $s = 1.5$ $D_m \geq H_e / 5$	ADVISORY	
11. VEGETATION	11.1. ADVICE AND RECOMMENDATIONS	[3],[4]	Regular pruning should be speified in the maintenance manual if soft landscape treatment is employed	ADVISORY	
	11.2. RESTRICTIONS ON VEGETATION	[3],[4]	Planting of trees should not be premitted behind the facing units	ADVISORY	
12. INSPECTION AND MAINTENANCE	12.1. REQUIREMENTS	[3]	Routine Maintenance Inspection (Cat 1 and 2, once a year; Cat 3 Once every two year)	ADVISORY	
	12.2. FREQUENCY	[3]	Routine Maintenance Inspection (Cat 1 and 2, once a year; Cat 3 Once every two year)	ADVISORY	
13. OTHER	13.1. ANY OTHER ITEM NOT SPECIFICALLY ADDRESSED IN THE PRECEDING ITEMS	-	-		

ISSMGE TC 218 - GROUP 3 - CONSTRUCTION BEST PRACTICES

COMPARISON OF THE EXISTING CODES AND GUIDELINES

		UK			
TOPIC	SUB-TOPIC	RELEVANT CODES	REFERENCE	ADVISORY/OBLIGATORY	COMMENTS/BEST PRACTICE
1. SOIL INVESTIGATION	1.1. VALUES TO BE TESTED PRIOR DESIGN	BS8006:2010 BS EN 16907:2018 BS ISO 11277:2020 BS ISO 22477:2020 BS ISO 17892:2019	Highways Works Specifications	ADVISORY	Index properties, Particle size distribution , Grading, Friction angle, cohesion, unit weight , PH soil
	1.2. GLOBAL STABILITY	BS8006:2010 BS EN 16907:2018 BS 8004 2015: 2020	Highways Works Specifications	ADVISORY	Geometry, end use, foundation conditions, State of stress, degree of saturation, drainage
	1.3 VALUES TO BE TESTED PRIOR START OF INSTALLATION	BS8006:2010 BS EN 16907:2018 BS ISO 22476:2018 BS 5975:2019	Highways Works Specifications	ADVISORY	Bearing capacity, degree of saturation, Undrained conditions, temporary works
2. FILL SELECTION	2.1. SUITABLE FILL TYPES FOR WALLS/SLOPES	BS8006:2010 BS EN 16907:2018	Highways Works Specifications	ADVISORY	Selected granular soils, selected cohesive soils, LWA, PFA, EPS, others as per designer specifications
	2.2. PROHIBITED MATERIALS	BS8006:2010	Highways Works Specifications	ADVISORY	Organic soils, peat, topsoil
	2.3. REQUIRED STRENGTH VALUES/LIMITS (c',Φ', PSD, FINES etc)	BS8006:2010 BS1377: Part4, Part8	Highways Works Specifications BS EN 16907:2018 BS6006:2010 - Clause 4.2.2 Mobilized soil shear strength	ADVISORY	f' = max 42o C' = max 5 kPa PSD: depending on applications Fines: passing sive 63mm max 30% (or depending on application) When using site won/cohesive fill to be cautious to decide if to use peak or cv strength values.
	2.4. SPECIFIC REQUIREMENTS FOR ELECTROCHEMICAL CONDITIONS (pH, SALTS, etc)	BS1377: Part3	BS EN14475	ADVISORY	pH limits depending on type of reinforcement
	2.5. SPECIFIC REQUIREMENTS FOR MARGINAL/COHESIVE SOILS	BS1377: Part2, Part4	HA 44/95	ADVISORY	Plasticity Index: max 25 Optimum moisture content : + - 3%
3. FILL TESTING	3.1. VALUES TO BE TESTED FOR APPROVAL	BS1377	Highways Works Specifications	ADVISORY	f', C', density, PSD, OMC, PI
	3.2. FREQUENCY OF COMPLIANCE TESTING	No codes in UK	Hong Kong Geoguide 6	ADVISORY	Determine f' & C' for each source of fill material along with PSD, OMC and Density. Verify PSD and density at a rate of 3 tests per 800sqm plan area of structure at 3 intermediate heights. Compaction testing carried out at every fill lift with 1 test per 800sqm of plan area.
	3.3. SPECIFIC REQUIREMENTS FOR MARGINAL/COHESIVE SOILS	No codes in UK	Hong Kong Geoguide 6	ADVISORY	Include PI in testing as per 3.2 and verify along with PSD and density.

4. FILL PLACEMENT	4.1. PREPARATION OF THE BEARING SURFACE / GROUND STABILIZATION IF REQUIRED	BS8006:2010 - Clause 8.5.2.5		ADVISORY	Levelled subgrade, no soft spots, no organic materials
	4.2. METHOD OF PLACEMENT			ADVISORY	Max layers of 300mm, end tipped (rather than pushed)
	4.3. TRAFFICKING OVER REINFORCEMENT			ADVISORY	Min 150mm, no slewing on tracks
	4.4. STOCKPILING OF FILL		Highways Works Specifications: Series 600, Series 800	ADVISORY	Cover material if it's weather susceptible Safe height and angle and suitable bearing strata
	4.5. MANAGEMENT OF MOISTURE CONTENT			ADVISORY	Cover material if it's weather susceptible and test moisture content if material exposed after significant weather events
	4.6. SPECIFIC REQUIREMENTS FOR MARGINAL/COHESIVE SOILS			ADVISORY	Cover material if it's weather susceptible and test moisture content if material exposed after significant weather events
5. FILL COMPACTION	5.1. SELECTING METHOD OF COMPACTION		Highways Works Specifications: Series 600, Series 800	ADVISORY	Select method according to Highways Specification Series 600 Table 6.4 Validated Intelligent Compaction (VIC)
	5.2. VERIFICATION OF COMPACTION AND TEST FREQUENCY	BS1377:Part 9		ADVISORY	In-Situ CBR: Plate Bearing test / Nuclear density test / Dynamic Cone Penetrometer Test: - When using on-site won material: tests every layer. Number of tests per layer Average: 1 test every 50m of running length. Minimum four (4) tests per layer - When using imported granular material (e.g. Class 6l, 6J), tests every 2 to 3 layers. (Number of tests per layer tested Average: 1 test every 50-80m of running length). - Hand Vane Shear test for cohesive soils: minimum three (3)
	5.3. REQUIREMENTS / ADVICE GIVEN		Highways Works Specifications: Series 600, Series 800	ADVISORY	Minimum CBR: 15% Note: CBR requirement can be higher according to specific application Relative Compaction: minimum 95% of maximum dry density (maximum 5% air voids at a dry density equal to 95% of the maximum dry density from 4.5kg hammer compaction test)
	5.4. SPECIFIC REQUIREMENTS FOR MARGINAL/COHESIVE SOILS			ADVISORY	For cohesive/marginal soils CBR of 15% and relative compaction of 95% may not always be achievable but needs to be assessed according to the specific soils and application. If test results are below the minimum requirements, the layer needs to be removed completely and replaced with site-won material from a different batch and retested. When this procedure is not working, to replace the layer with granular material or cement/lime stabilised soil and retest the compacted layer.
6. DRAINAGE	6.1. REQUIREMENTS / ADVICE GIVEN	BS8006:2010		ADVISORY	Drainage systems at the back, base and front face of the reinforced wall as per BS8006 Clause 6.10.5.2-Drainage of the wall and Figures 50 and 51. To leave min 500mm from the top of the wall to the end of the vertical drainage (front and behind of the reinforced soil)
	6.2. VERIFICATION OF INSTALLATION			ADVISORY	Ideally horizontal collector drain to be in front of the reinforced wall After main storm events, to check that the drain system is running clear

7. REINFORCEMENT - Duplicate for different types (geogrid, geotextile, polymer strip, steel strip, steel ladder, welded wire fabric etc) if regulations/recommendations differ	7.1. APPROVAL OF REINFORCEMENT TYPE , REINFORCEMENT EXTERNAL APPROVAL SYSTEM?	BS8006:2010		ADVISORY	BS8006: 2010 - Figure 8. Selection of materials for reinforcement, connections and facings for reinforced soil structures
	7.2. COMPLIANCE TESTING AND FREQUENCY			ADVISORY	As per manufacture Quality Control Systems
	7.3. INSTALLATION MONITORING (GRADE, TENSION etc)	BS8006:2010	PD ISO/TR 20432	ADVISORY	BS8006:2010 Clause 4.3.5- Tests for polymeric reinforcements and 4.3.6- Reinforcement samples
8. FACING SELECTION	8.1. APPROVED FACING TYPES WALLS, LIMITING ANGLES etc	BS8006:2010		ADVISORY	Types: modular blocks, discrete panels, full-height panels, wrap-around (Figure 16) and Gabion face
	8.2. APPROVED FACING TYPES SLOPES, LIMITING ANGLES etc	BS8006:2010		ADVISORY	up to 70 deg: wrap-around, segmental blocks, gabion face up to 45deg : open face with erosion control mats
	8.3. FACING SYSTEM EXTERNAL APPROVAL SYSTEM			ADVISORY	Modular Blocks: BBA certificate or external approval
	8.4. UV PROTECTION OF EXPOSED REINFORCEMENT			ADVISORY	If geogrids are likely to be exposed, to be UV stabilised
9. FACING CONNECTION	9.1. FACING/CONNECTION REQUIREMENTS	BS8006:2010		ADVISORY	Table 20. Connection loads for the ultimate and serviceability limit states
	9.2. TESTING AND APPROVAL SYSTEM & ON SITE			ADVISORY	As per manufacturers advice. Tests on site are not common practice
10. MOVEMENT JOINTS	10.1. ADVICE AND FREQUENCY OF MOVEMENT JOINTS			ADVISORY	When change in foundation conditions and at interface with a different structure. When significant difference in height For panels, typically every 20m
	10.2. REQUIREMENTS FOR PADS OR SPACERS FOR JOINT SEPARATION			ADVISORY	For discrete panel systems: typically 2 pads per panel Pads should be designed according to the specific system used
	10.3. MINIMUM EMBEDMENT, FROST HEAVE , OVERDIG REQUIREMENTS etc	BS8006:2010		ADVISORY	Min 450mm for frost heave. Min embedment: Table 15. Minimum embedment as a funtion of the Height and the factord bearing pressure
11. VEGETATION	11.1. ADVICE AND RECOMMENDATIONS	BS8006:2010 - Clause 7.5.7		ADVISORY	Clause 7.5.7 Vegetation on slope faces
	11.2. RESTRICTIONS ON VEGETATION			ADVISORY	Large bushes and trees should be avoided from the face of slopes and behind slope depending on root penetration.
12. INSPECTION AND MAINTENANCE	12.1. REQUIREMENTS	BS8006:2010		ADVISORY	Clause 6.10.7 Maintenance Excessive settlements , horizontal displacements of the facings, damage to the facings, evidence of drainage problems, opening of facing joints, cracking within the earthworks adjacent to the stucture Any vegetation between joints to be removed
	12.2. FREQUENCY		The Inspection Manual for Highway structures	ADVISORY	As per client's requirements
13. OTHER	13.1. ANY OTHER ITEM NOT SPECIFICALLY ADDRESSED IN THE PRECEDING ITEMS				