WORK INSTRUCTIONS FOR ENGINEERS

Compiled by : LCL

Checked by : NHB

Approved by : TYC

OP-018. DESIGN OF GEOGRID FOR PILED EMBANKMENT TO BS8006

18.0 DESIGN OF GEOGRID FOR PILED EMBANKMENT TO BS8006

18.1. INTRODUCTION

1) Refer to Section 8.3.3 (Pg. 104) of BS8006.
2) Use the Partial Factors in Table 27.
3) Check for both Ultimate Limit States (**ULS**) and Serviceability Limit States (**SLS**).
4) The maximum limit state tensile load, T_r per metre 'run' :
   (i) Along the embankment to transfer the vertical embankment load onto pile caps, T_{rp} (Sec. 8.3.3.6)

   $$T_r = T_{rp}$$

   (ii) Across the embankment is the sum of load to transfer the vertical embankment load onto pile caps, T_{rp} (Sec. 8.3.3.6) & T_{ds} to resist lateral sliding (Sec. 8.3.3.7)

   $$T_r = T_{rp} + T_{ds}$$

   (iii) Need to check $T_D/f_n \geq T_r$. T_D is the design strength (Sec. 5.3.3), f_n from Table 3. For most critical case, f_n = 1.1.

   Two stages need to be checked, namely :
   (a) During Construction
   (b) Final (long term)

   (iv) In total there is minimum of 4 Nos. of T_r obtained for each stage :
   (v) Along the Embankment, Ultimate Limit State T_r
   (vi) Along the Embankment, Serviceability Limit State T_r
   (vii) Across the Embankment, Ultimate Limit State T_r
   (viii) Across the Embankment, Serviceability Limit State T_r

18.2. Ultimate Limit States (ULS) should check for following :

1) Pile Group Capacity (Section 8.3.3.4 + Fig 67a)
2) Pile Group Extent (Section 8.3.3.5 + Fig 67b)
3) Vertical load shedding onto pile caps (Section 8.3.3.6 + Fig 67c)
4) Lateral sliding stability of the fill (Section 8.3.3.7 + Fig 67d + Fig 71)
5) Overall stability of piled embankment (Fig 67e)

Note: For Ultimate Limit States (ULS) the suggested **strain** to be used to be based on Manufacturer's **strain at ultimate tensile strength** (e.g. Fortrac is about 12% as from Isochronous creep curves)

18.3. Serviceability Limit States (SLS) should check for following :

1) Excessive Stain in reinforcement (Fig 68a)
2) Settlement of Piled Foundation (Fig 68b)

18.4. Maximum allowable strain

Maximum allowable strain in reinforcement, e_{max} (Section 8.3.3.10) $\Rightarrow$ to control differential settlement (Serviceability Limit State) :

1) The long term strain (due to creep) of reinforcement should be kept to minimum ⇒ A maximum creep strain of 2% over the design life should be allowed. **MORE CRITICAL**.
2) 6% is the practical upper limit (Serviceability Limit State)

(Note : can check for "mushroom" effects)

18.5. Polymeric Reinforcement

For the design of Polymeric Reinforcement (e.g. Fortrac), the following clause shall be followed :

1) Use Clause 5.3.3.3 (Pg 34) and Annex A (A.1.3)(Pg.142)
2) T_D = T_{CR}/f_m or T_{CS}/f_m which ever is smaller :

   T_D = Design Tensile Strength

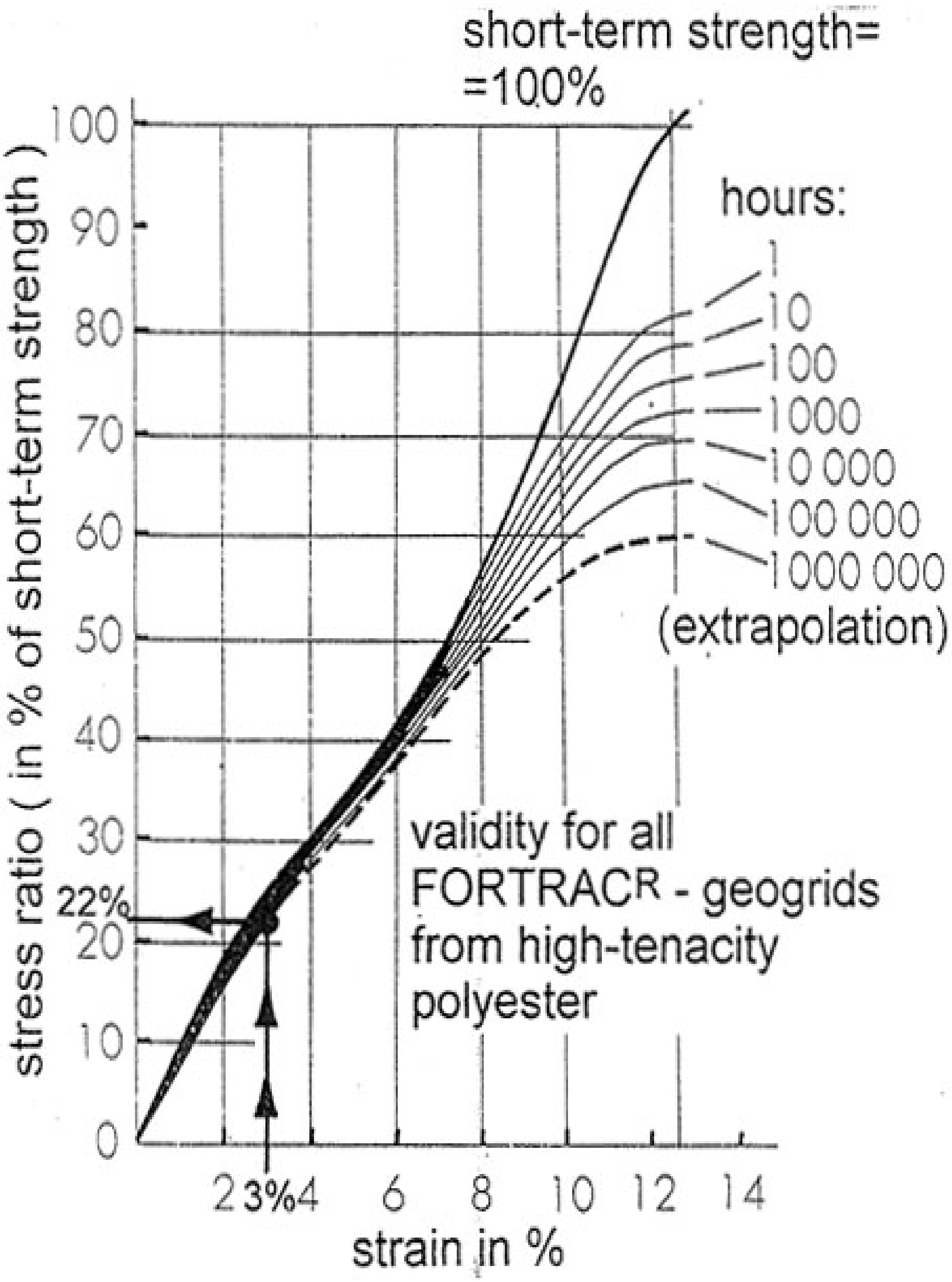
   T_{CR} = Extrapolated tensile creep rupture strength at the end of the selected design life and at the maximum operational temperature. (Annex A).

   - The peak tensile creep rupture strength at the appropriate temperature (Cl. 5.3.3.3)
   - Generally to be used for ***Ultimate Limit State***
   - Can use 1million hours strength (e.g. for Fortrac use 60% of the Short Term Strength)

   T_{CS} = Extrapolated tensile load which gives rise to a creep strain, between the end of construction and the end of the design life, which does not exceed prescribed serviceability limit strains.

   - The average tensile strength based on creep strain considerations at the appropriate temperature.
   - Generally to be used for ***Serviceability Limit State***
   - Based on stress ratio in % of short-term strength obtained from serviceability strain (e.g. 2% to 6% refer to Cl.8.3.3.10) (e.g. for Fortrac about 18% of the short term strength)

3) Generally f_m can be taken as 1.0


short-term strength=
=100%
hours:
1
10
100
1000
10 000
100 000
1000 000
(extrapolation)
validity for all
FORTRACR - geogrids
from high-tenacity
polyester
stress ratio (in % of short-term strength)
100
90
80
70
60
50
40
30
22%
20
10
0
2
3%
4
6
8
10
12
14
strain in %