Case study

Design and performance of two block-faced geogrid walls

Allen, T.M. and Bathurst, R.J. 2014. Performance of a 11 m high block-faced geogrid wall designed using the K-stiffness Method, *Canadian Geotechnical Journal* 51(1): 16-29 (2014 BEST PAPER Award)

Allen, T.M. and Bathurst, R.J. 2014. Design and performance of a 6.3 m high block-faced geogrid wall designed using the K-stiffness Method, ASCE *J Geotechnical and Geoenvironmental Engineering* 142(2): 12 p.

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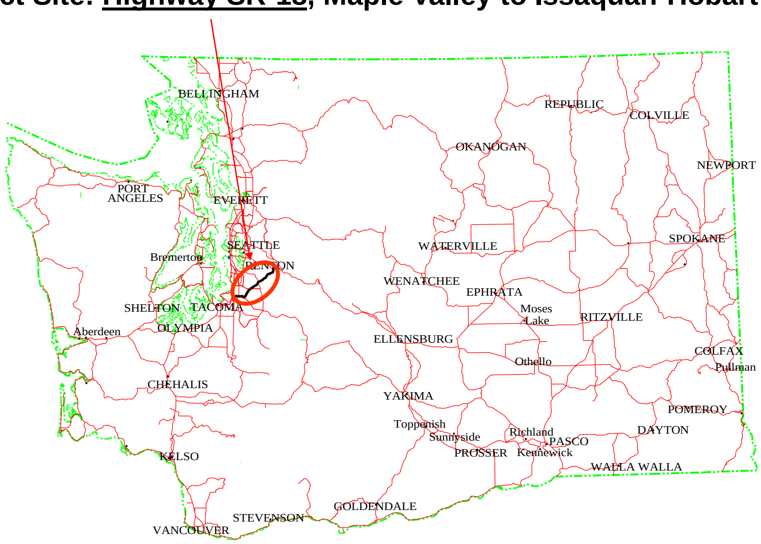
Case study

Project Site: Highway SR-18, Maple Valley to Issaquah-Hobart Road



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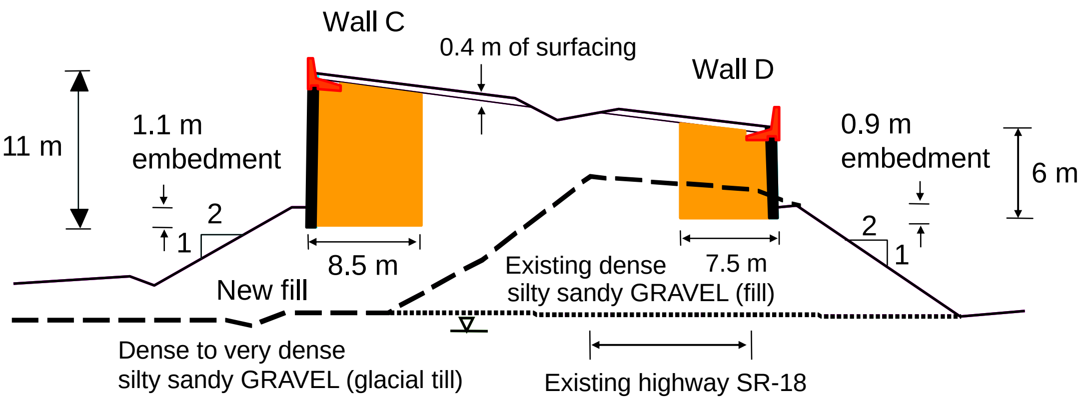
Cross-Section at Instrumented Section for Wall C (WB 1399+00)



Internal reinforcement designed using Stiffness Method

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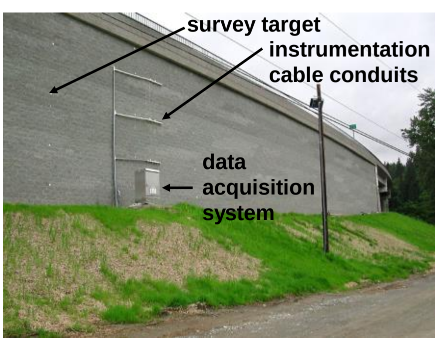

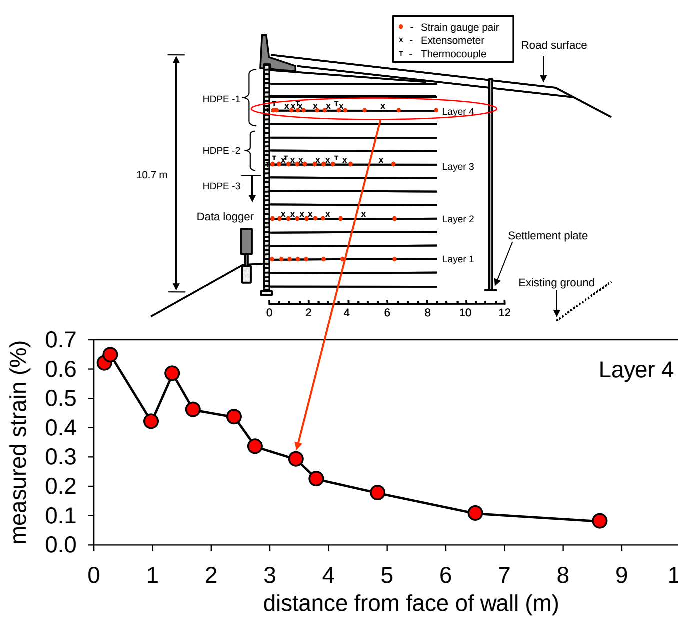

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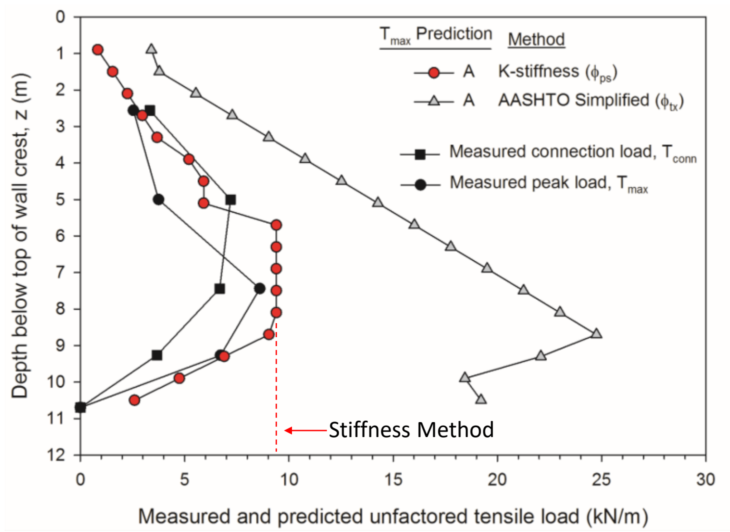
Comparison of measured loads at end of construction using Simplified strength-based design method and Stiffness Method



Allen and Bathurst (2014)

Case study

- Stiffness-based design method gave more accurate estimates of measured strains (and loads) in the reinforcement
- Less reinforcement was required
- Savings in reinforcement material covered the cost of the instrumentation program!
- Geosynthetic reinforcement strains < 3% which is consistent with working stress conditions

Limitations

Maximum reinforcement loads apply to <u>operational conditions only</u>

Calibration based on simple geometries, small uniform surcharges, competent foundations and quality reinforced backfill soils

Has not been calibrated for the case of a footing located on top of an MSE wall

Does not consider compound stability and other global stability limit states

Does not consider extreme loading events such as earthquake

Use "conventional" modified limit equilibrium slope stability methods for these conditions

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<u>Experience to date using the Stiffness Method for internal stability design</u>

- Soil failure limit – usually controls
- Connection failure – controls only if connection is very inefficient
- Pullout – may control for polymer straps

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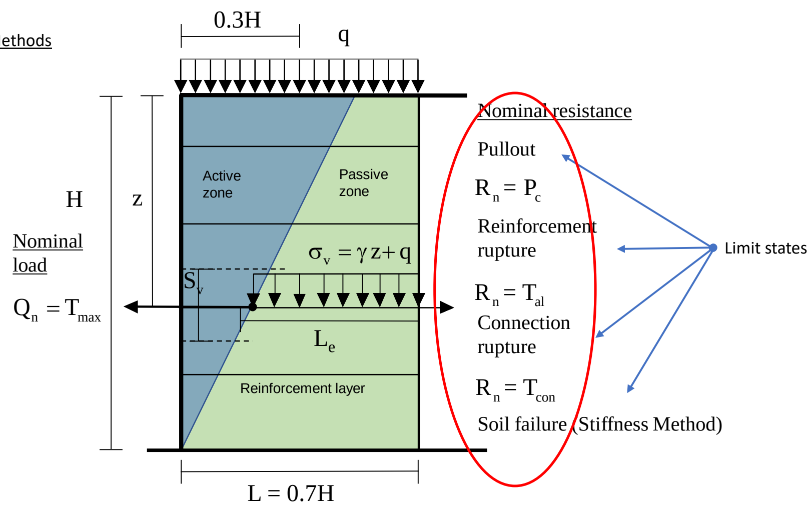
We have been focusing on the load side for internal stability design ….
Lets now focus on the resistance side

Simplified and Stiffness Methods



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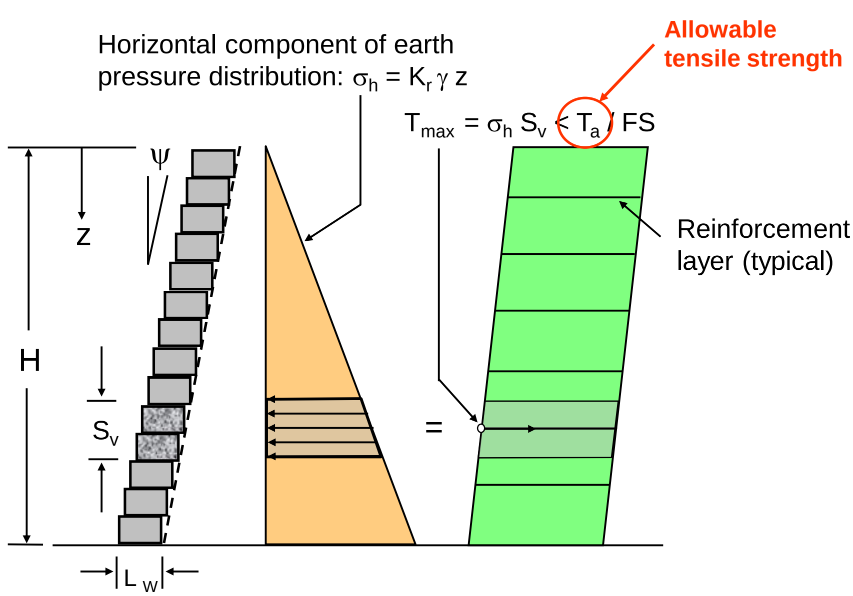

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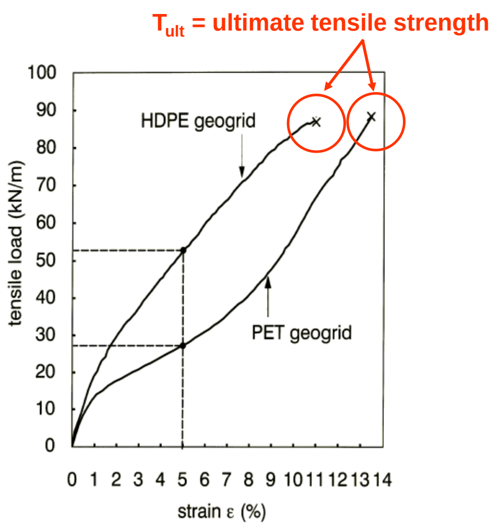
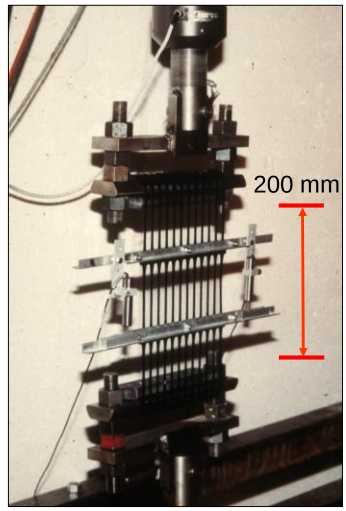
Calculated by applying reductions factors to a reference in-isolation laboratory geosynthetic tensile strength T_{ult}





10% strain/min

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- creep FS_{CR}
- installation damage FS_{ID}
- chemical degradation FS_{CD}
- biological degradation FS_{BD}
- joints (seams and connections) FS_{JNT}

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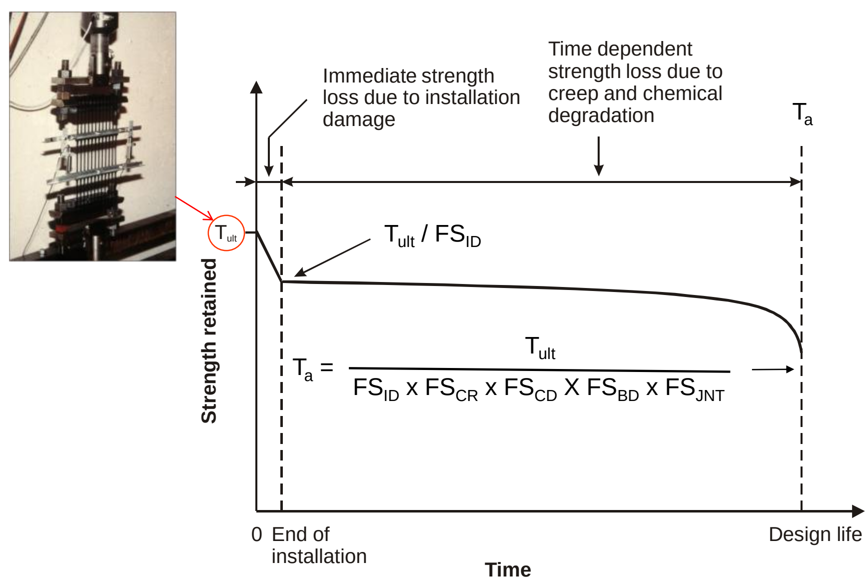
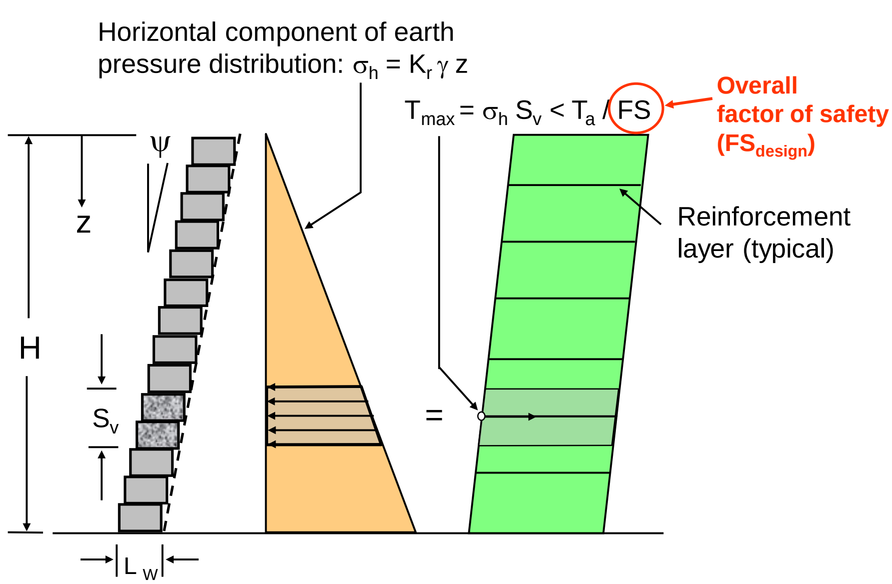

Immediate strength loss due to installation damage
Time dependent strength loss due to creep and chemical degradation
T_a
T_ult
T_ult / FS_ID
Strength retained
T_a = T_ult / (FS_ID x FS_CR x FS_CD X FS_BD x FS_JNT)
0
End of installation
Design life
Time

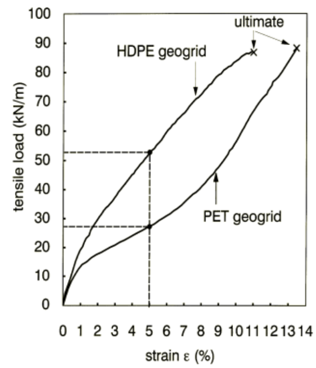

Horizontal component of earth pressure distribution: σ_h = K_r γ z
T_max = σ_h S_v < T_a / FS
Overall factor of safety (FS_design)
Reinforcement layer (typical)
ψ
z
H
S_v
L_w
=

$T_{design} = T_{LTDS} = T_a / FS_{design}$

where

FS_{design} = 1.25 to 1.5 (typical)

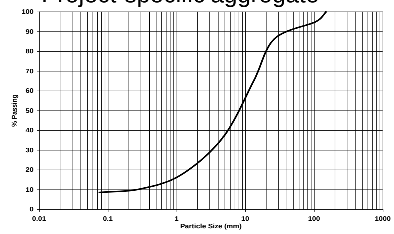
$T_{design} << T_{ult}$



installation damage FS_{ID}

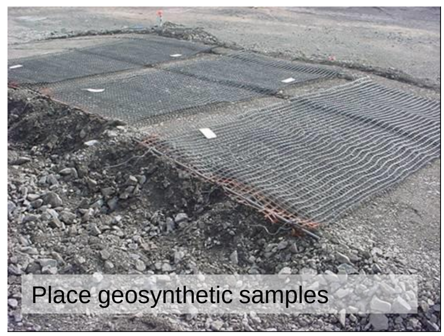
Installation damage testing

Project-specific aggregate



Place steel plates

Place aggregate base layer



Place geosynthetic samples

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Installation damage testing

Place cover aggregate

Compact aggregate using project-specific compaction equipment

Exhume samples

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