TC211-218 Workshop
MSE Walls and Reinforced Fills

Earth Pressure Distribution in the Facing Area of Geogrid Reinforced Earth Structures – Field Measurements and Design Practice

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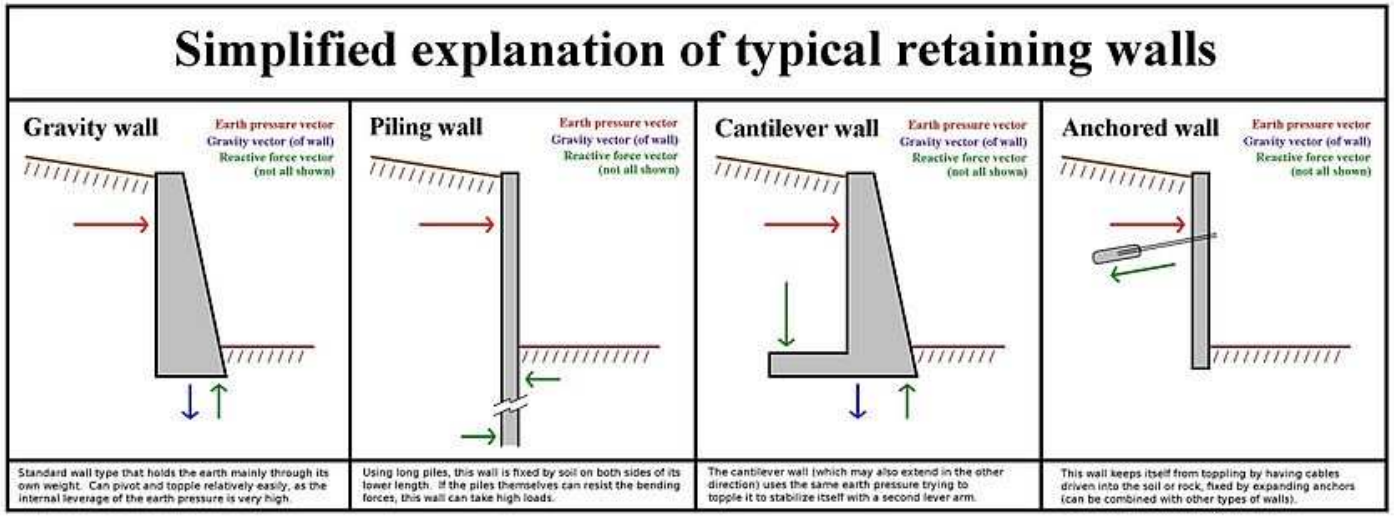
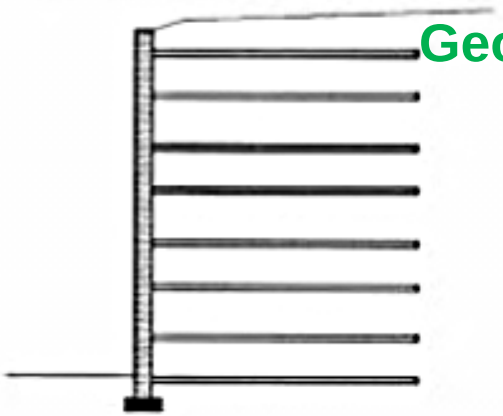
TRUE STORY ON THE EXAMPLE OF A 12M HIGH GEOGRID-REINFORCED NOISE PROTECTION WALL

There is than typical retaining walls – GEOSYNTHETIC reinforced walls

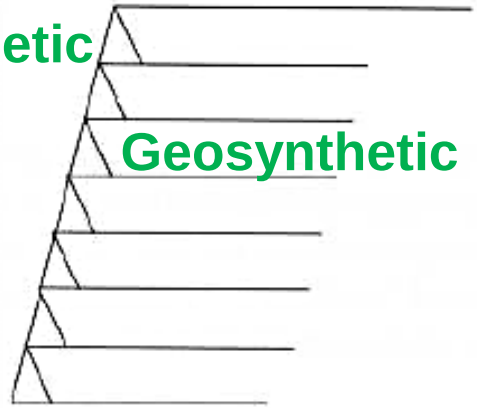


It's not only concrete

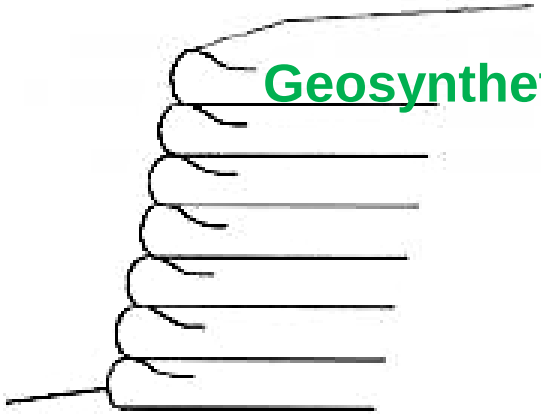
There is also something called:



Geosynthetic

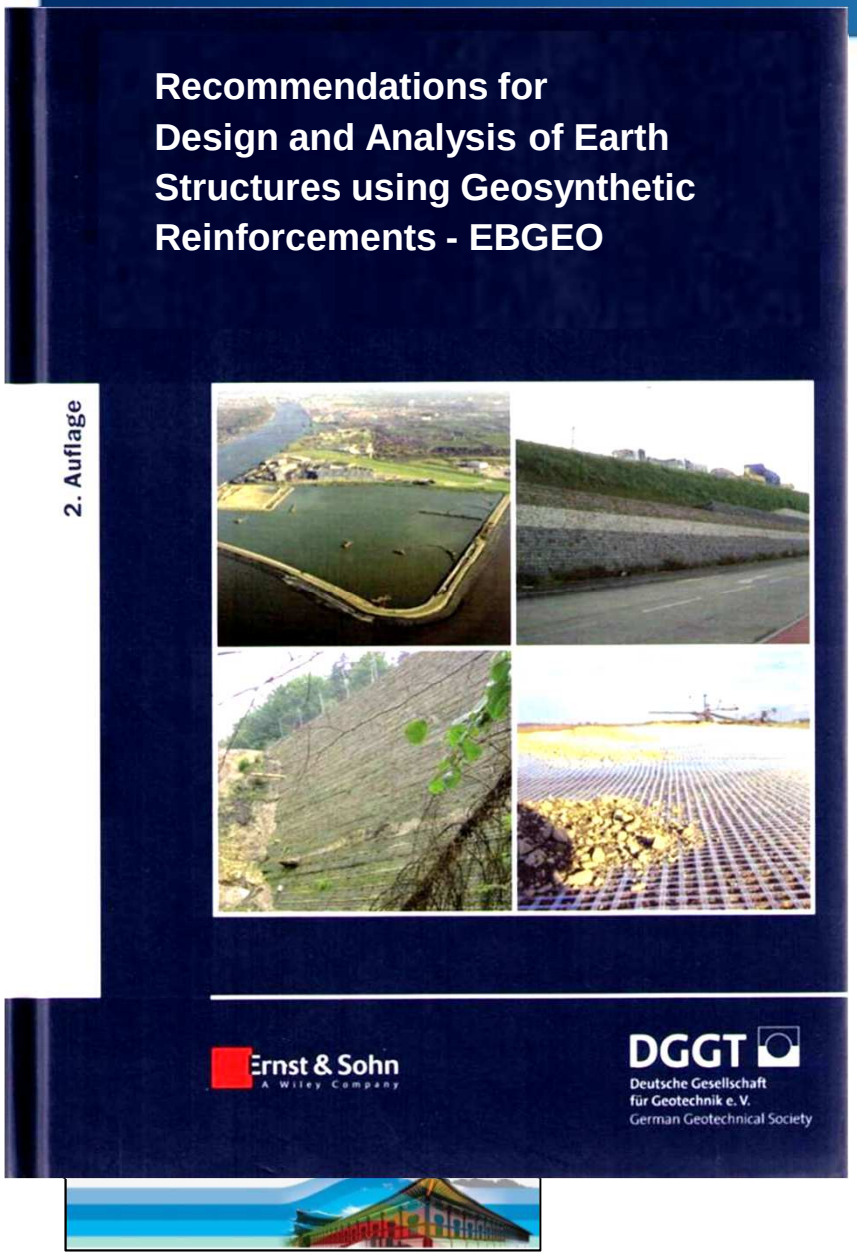


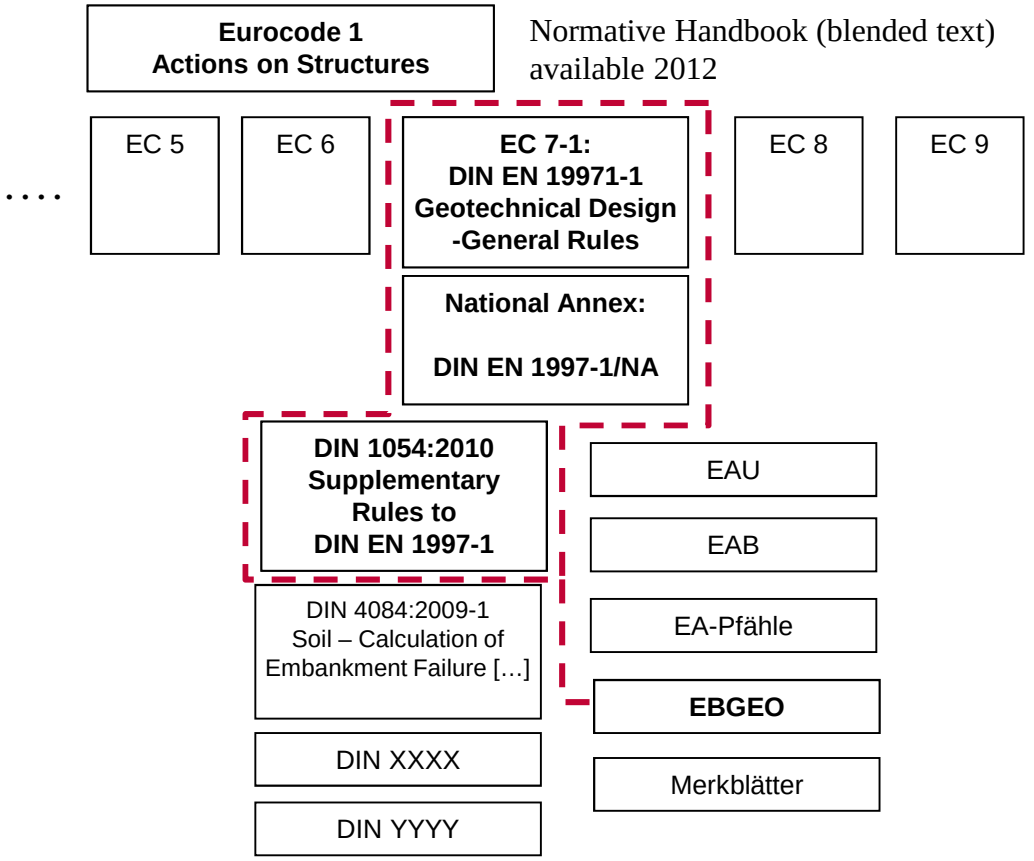
Geosynthetic



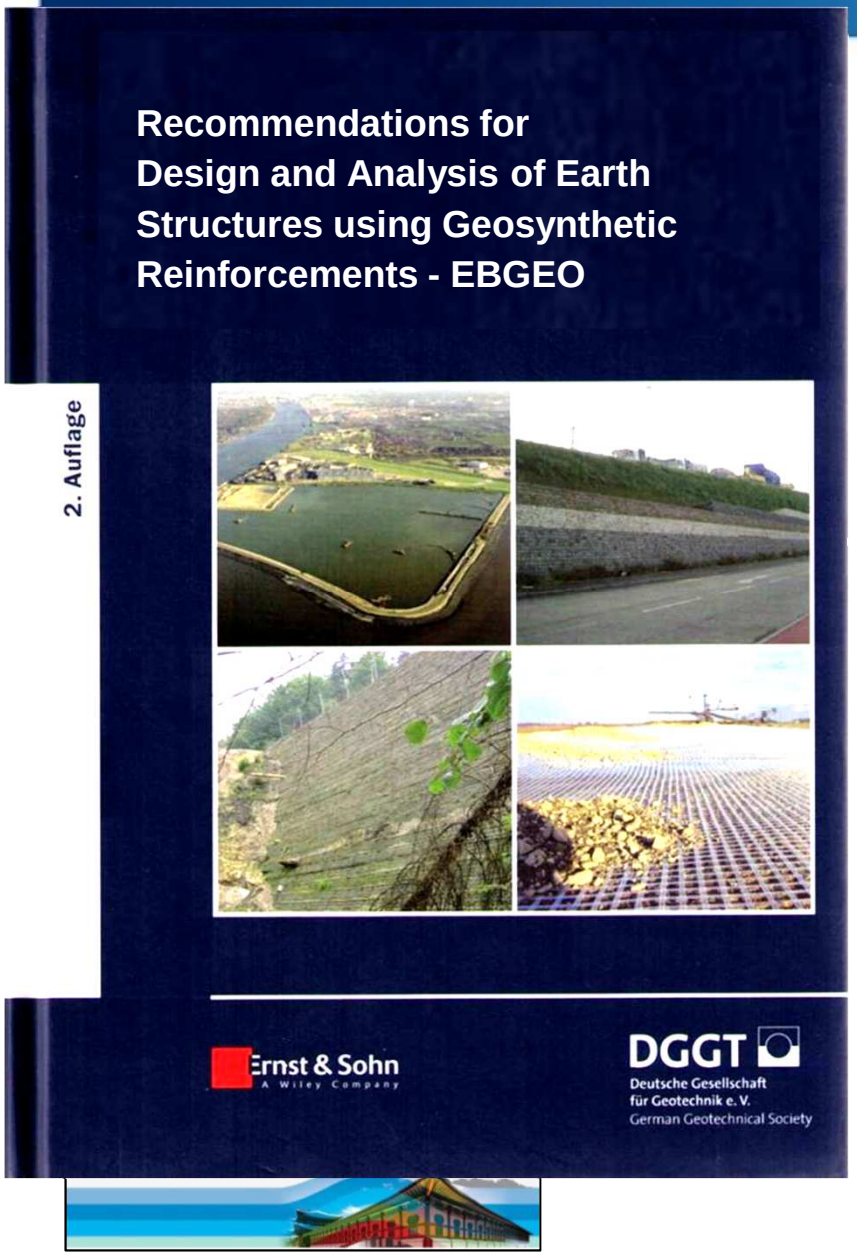
Geosynthetic

EBGEO 2010

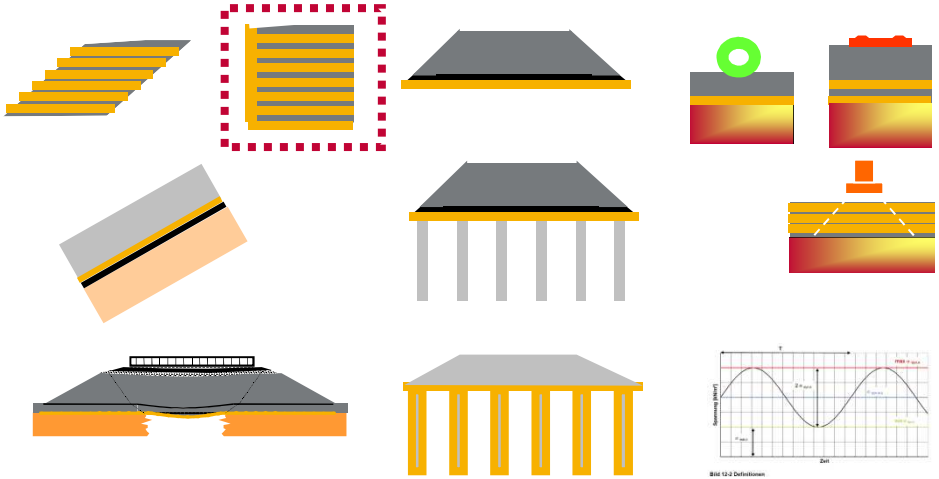

Recommendations for Design and Analysis of Earth Structures using Geosynthetic Reinforcements - EBGEO
2. Auflage
Ernst & Sohn
A Wiley Company
DGGT
Deutsche Gesellschaft für Geotechnik e. V.
German Geotechnical Society


Eurocode 1
Actions on Structures
Normative Handbook (blended text) available 2012
EC 5
EC 6
EC 7-1:
DIN EN 19971-1
Geotechnical Design
-General Rules
EC 8
EC 9
National Annex:
DIN EN 1997-1/NA
DIN 1054:2010
Supplementary Rules to
DIN EN 1997-1
EAU
EAB
EA-Pfähle
EBGEO
Merkblätter
DIN 4084:2009-1
Soil – Calculation of Embankment Failure […]
DIN XXXX
DIN YYYY

Lateral Stress on Facings



It covers most reinforcement applications:



All chapters are in accordance to EC7

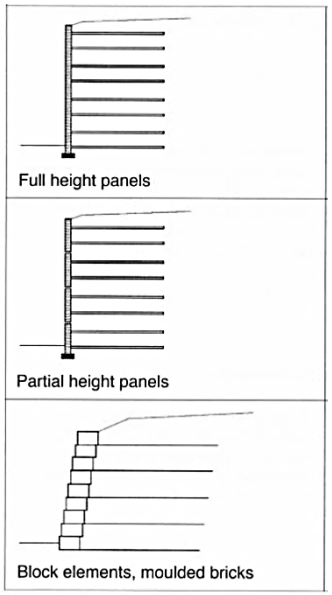
Lateral Stress on Facings

Facing Systems

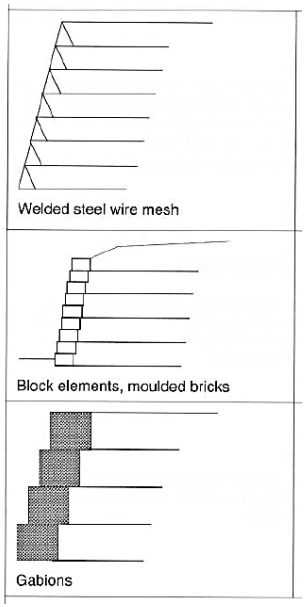
(according to *DIN EN 14475 - Execution of special geotechnical works - Reinforced fill)*

The requirements for the connections to the facings depend on the classification of facing as given in EN 14475:

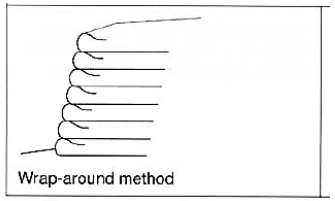
- **rigid facing** (non-deformable) (e.g. full height panels, block elements with rigid connections)
- **semi-flexible facing (partially deformable)** (e.g. gabions baskets, steel welded grid elements, block elements without rigid connections)
- **flexible facing systems (deformable)** (wrap around method)



Rigid



Semi-flexible

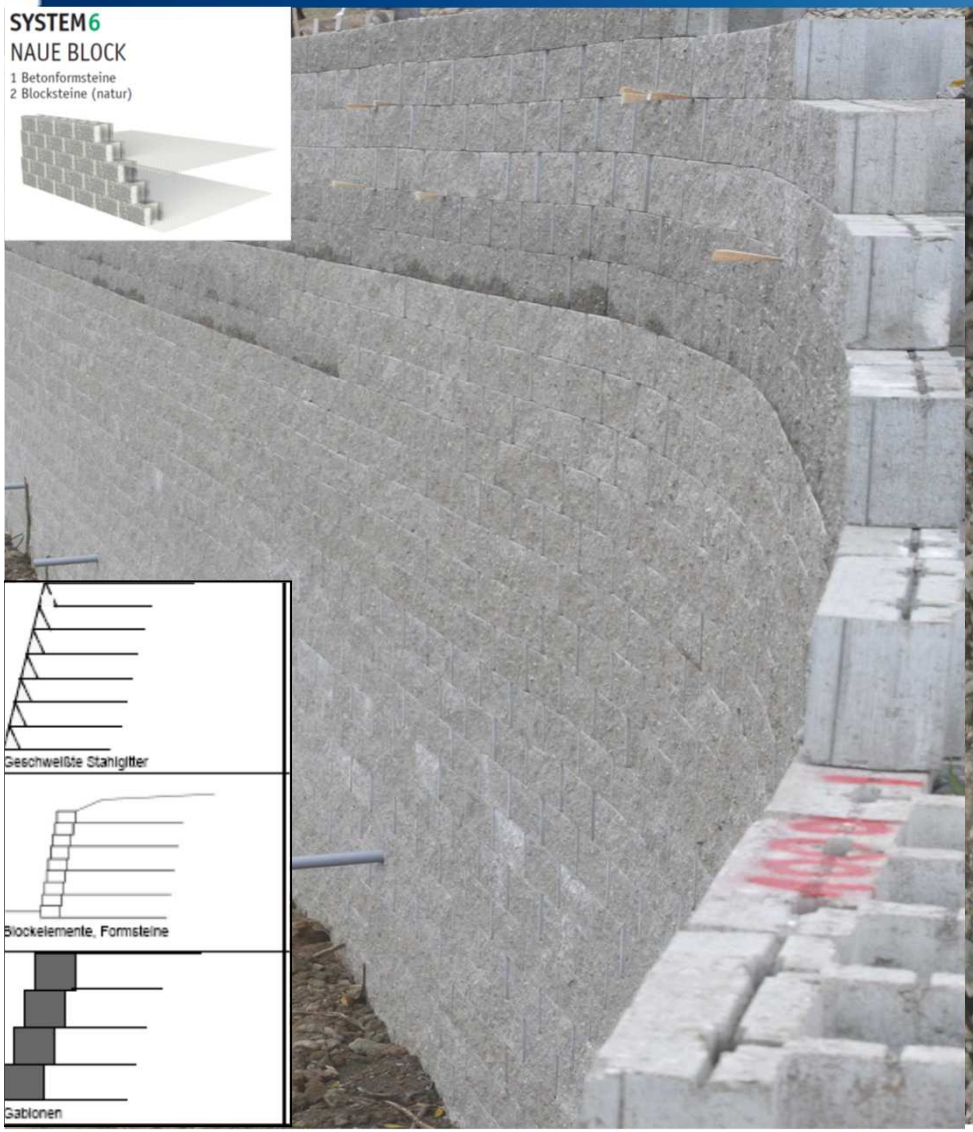


Flexible

Lateral Stress on Facings

Rigid facing system (e.g. full height panels, block elements with rigid connections)

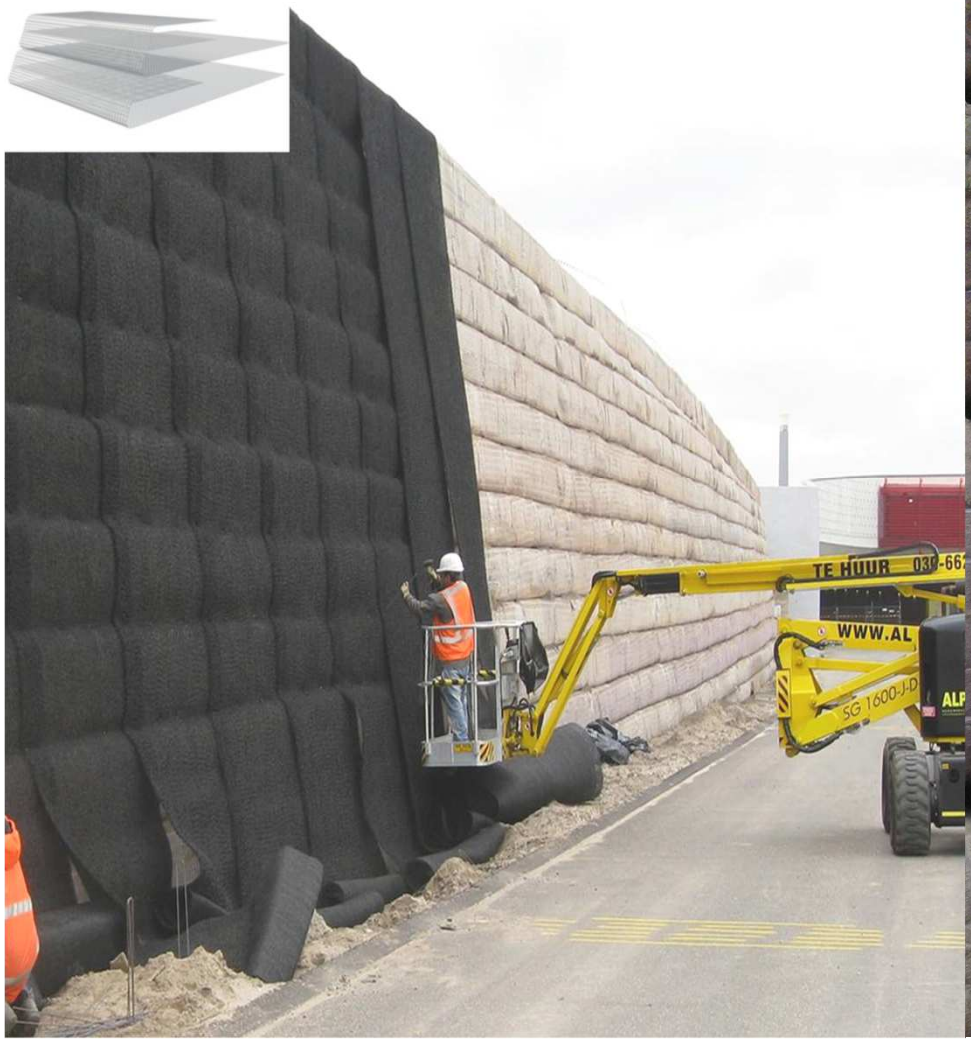
Lateral Stress on Facings

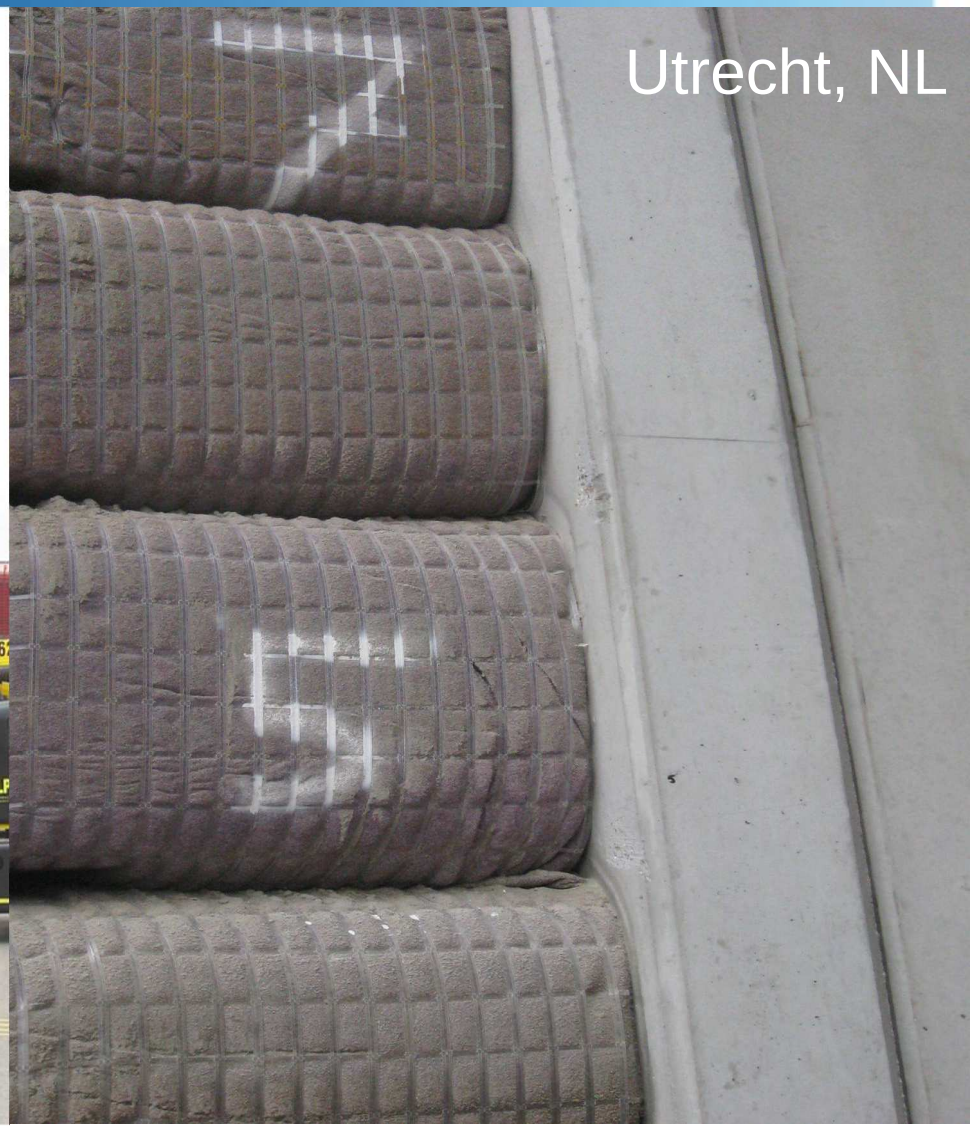


Semi-flexible Facing System(e.g. gabions baskets, welded steel grid elements, block elements without rigid connections)

Lateral Stress on Facings

SYSTEM2
NAUE WRAP

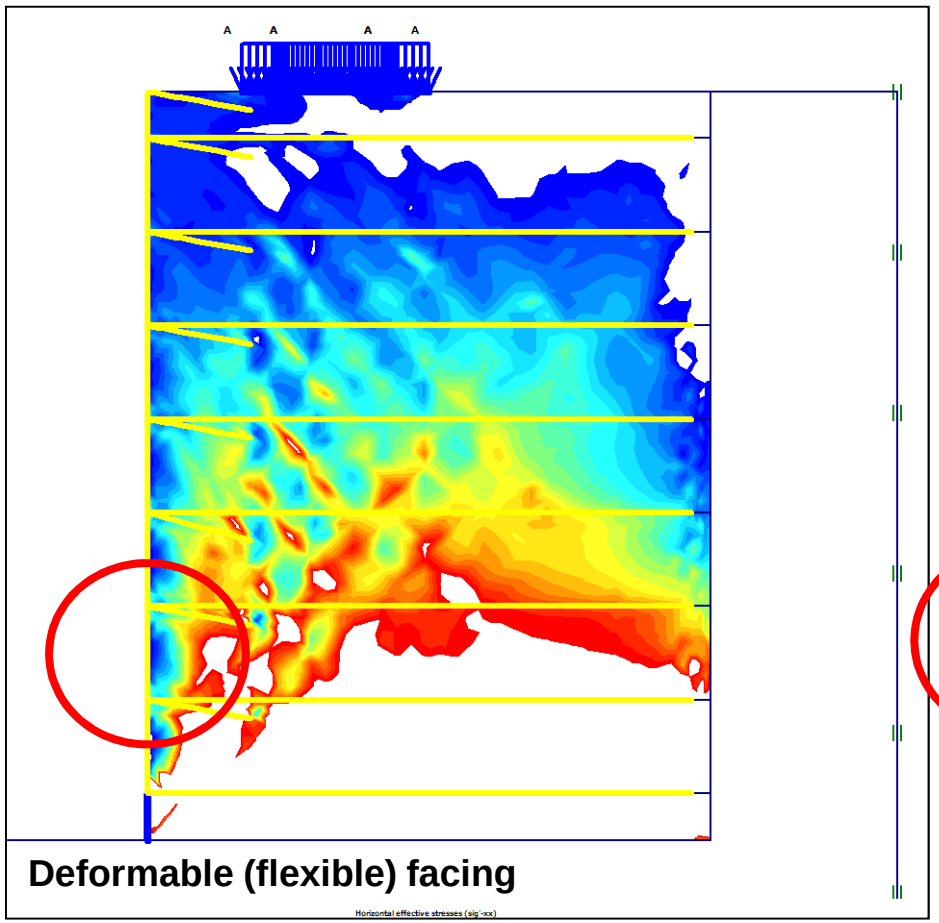


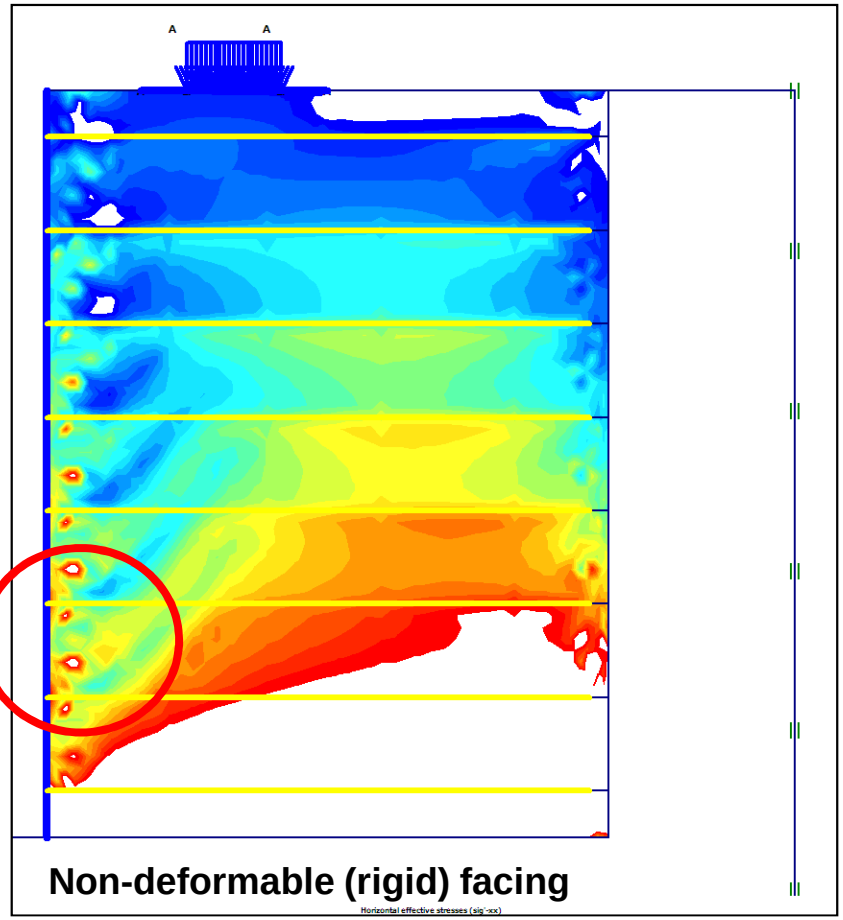


Flexible Facing System (wrap-around method)

Lateral Stress on Facings

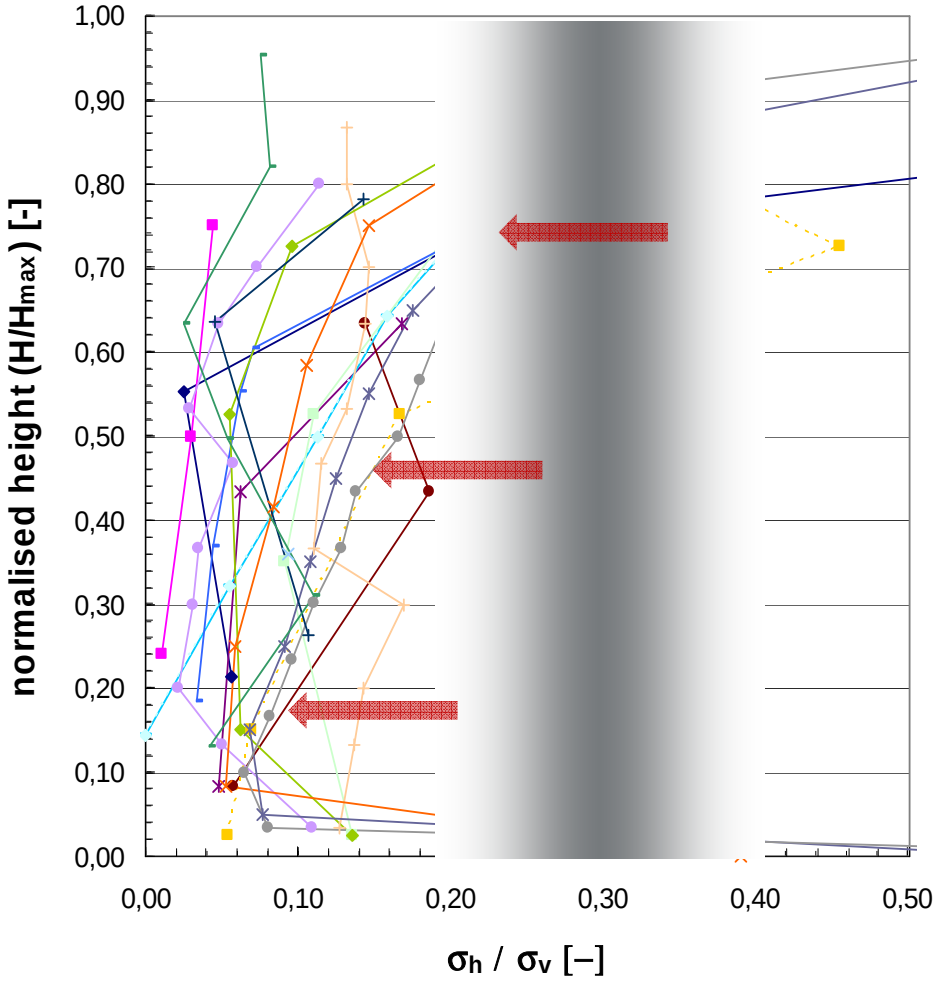
FEM – calculation according to DIN EN 14475

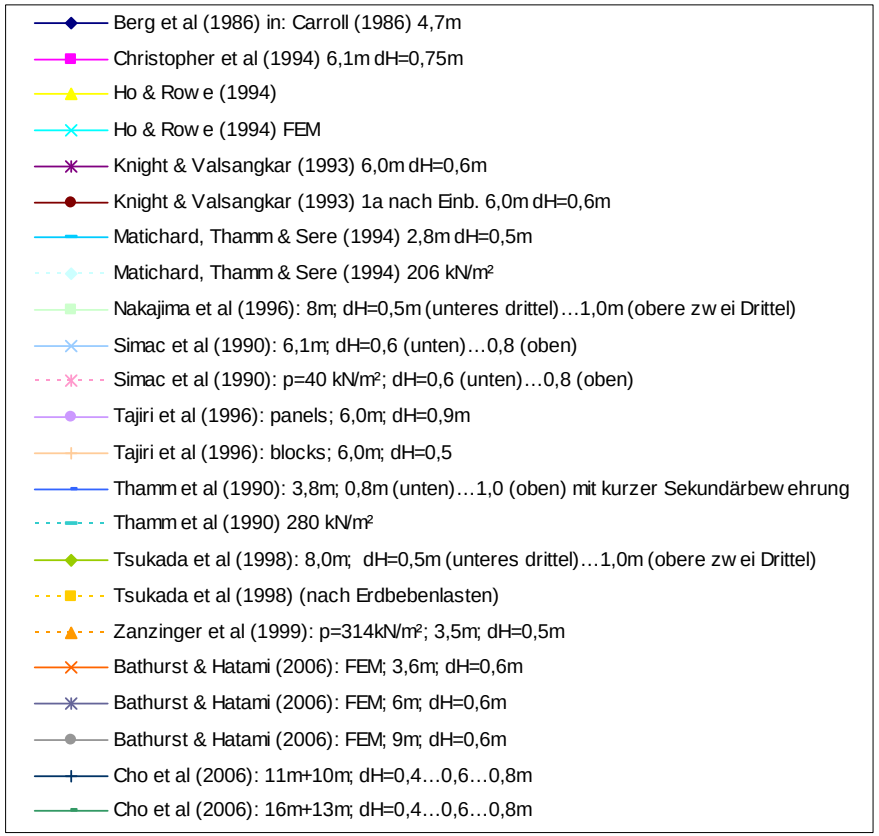




Pachomow et al. (2007)

Lateral Stress on Facings
Measurement-results from literature





Pachomow et al. (2007)

Lateral Stress on Facings

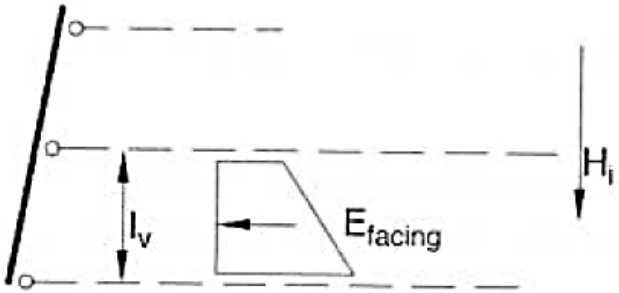


Figure 7.20 Earth pressure

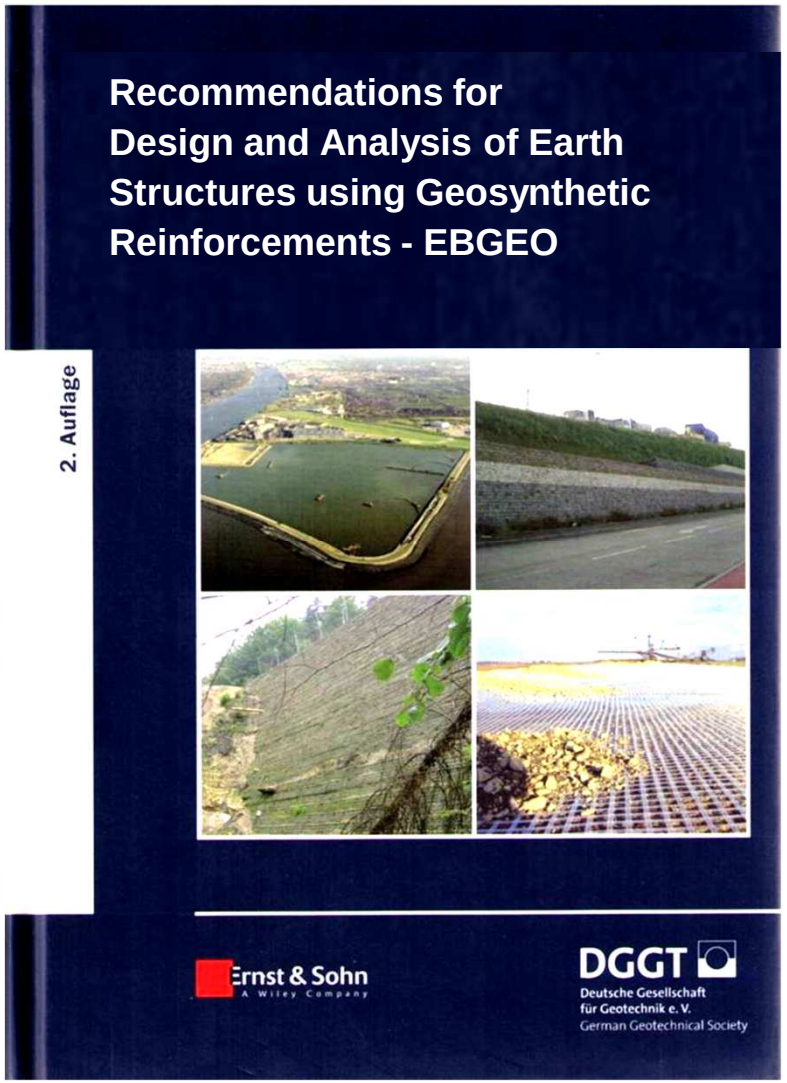
Analysis:

E_{facing} characteristic earth pressure to DIN 4085

The earth pressure on the external skin is:

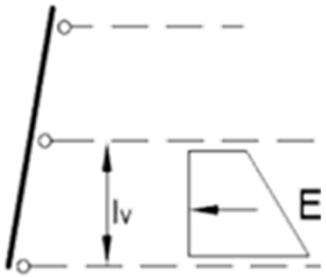
$$e_{facing} = \eta_g \cdot K_{agh,k} \cdot \gamma_k \cdot H_i \cdot \gamma_G + \eta_q \cdot K_{aqh,k} \cdot q \cdot \gamma_Q$$

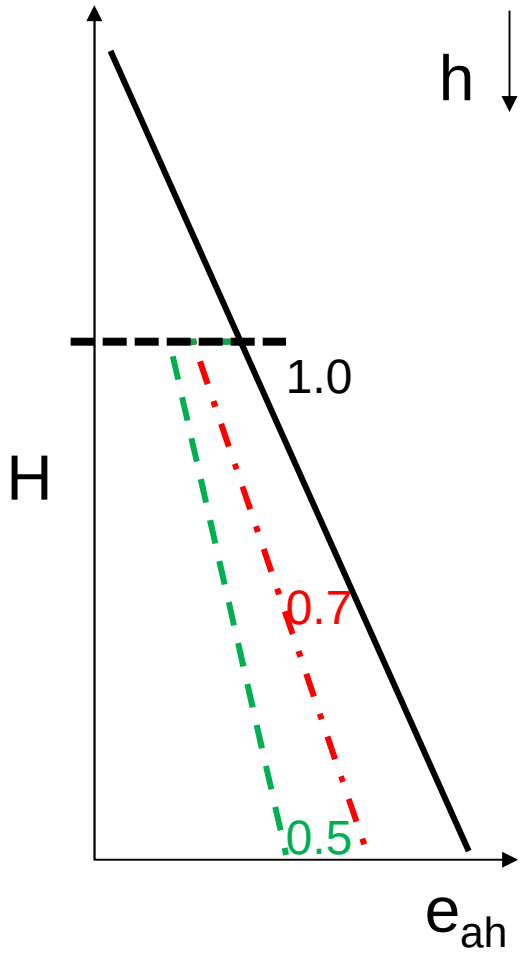
$$E_{facing} = e_{facing} \cdot l_v$$



Lateral Stress on Facings

Calculation of connection strength facing vs. geogrid

	Correction Factor		
	η_g		η_q
	0 < h ≤ 0.4 H	0.4 H < h ≤ H	
rigid ———	1.0	1.0	1.0
semi flexible – . –	1.0	0.7	1.0
flexible – – .	1.0	0.5	1.0



Based on field measurements and full-scale testing

EBGEO (2010)

Lateral Stress on Facings – in-situ measurements

Construction Phase

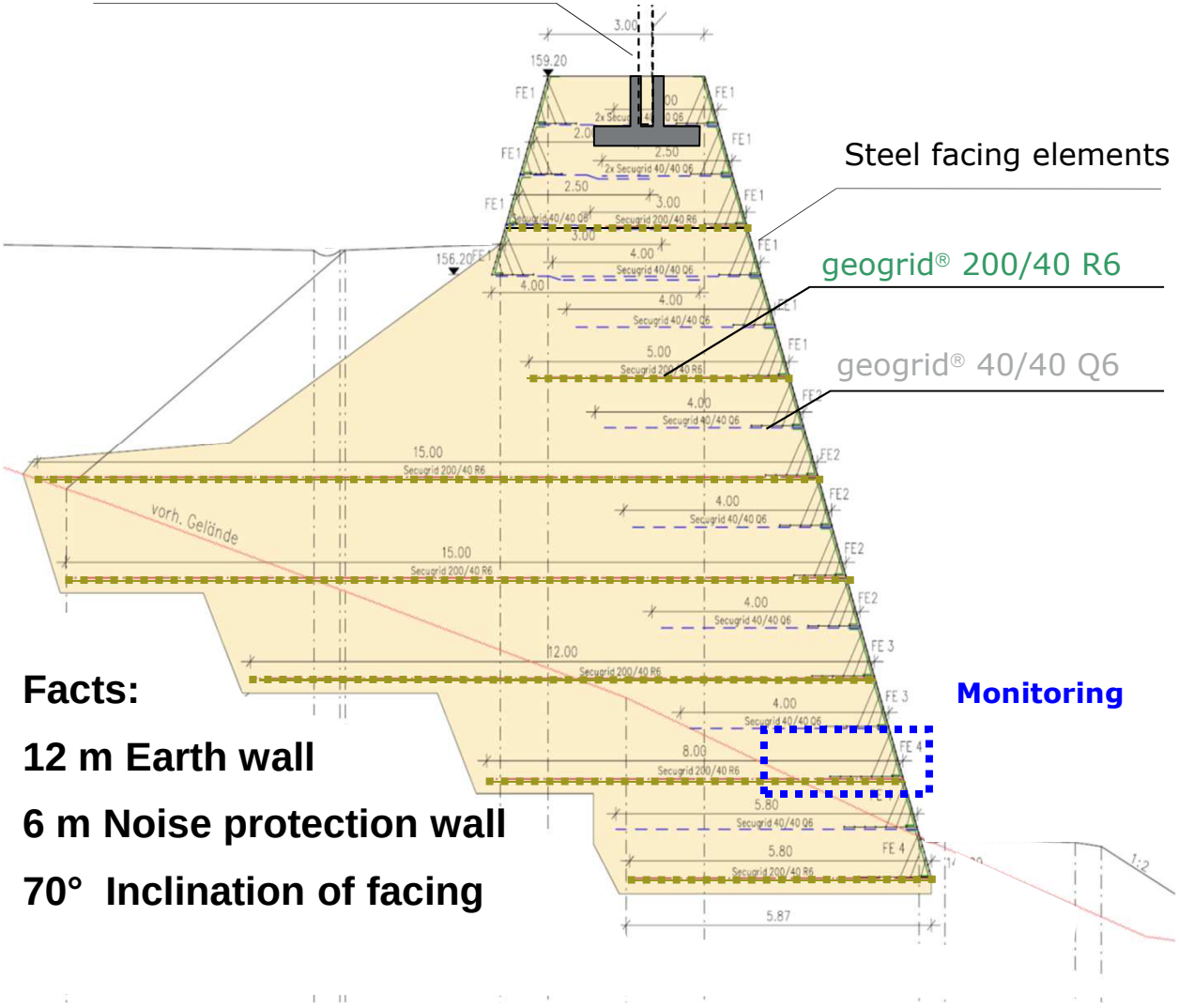
25.000m³ fill soil
2 month installation time

Verification of design

Ingenieurbüro für Geotechnik Urbanski

IBU
Institut für textile Bau- und Umwelttechnik GmbH

Noise protection wall



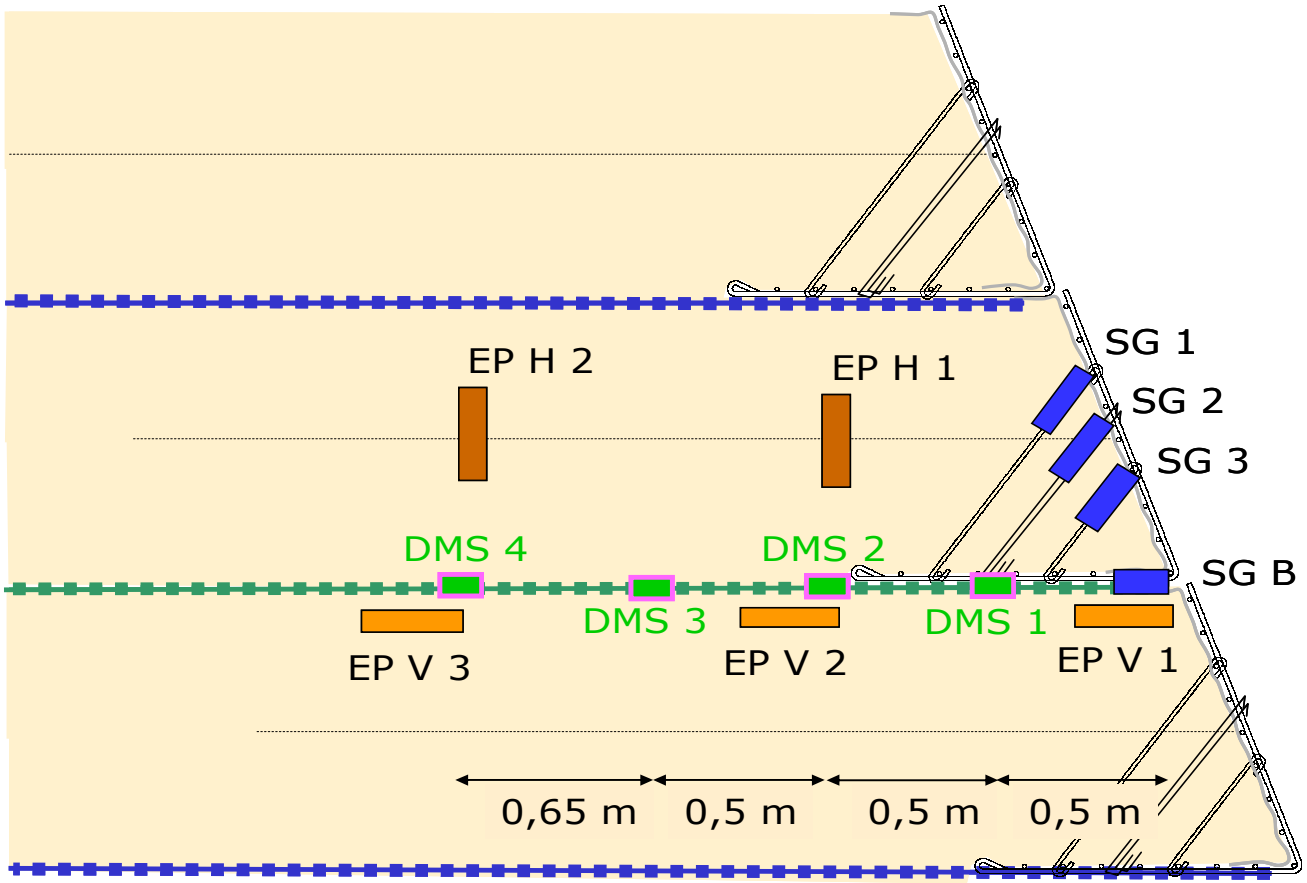
Facts:

12 m Earth wall

6 m Noise protection wall

70° Inclination of facing

Verification of design

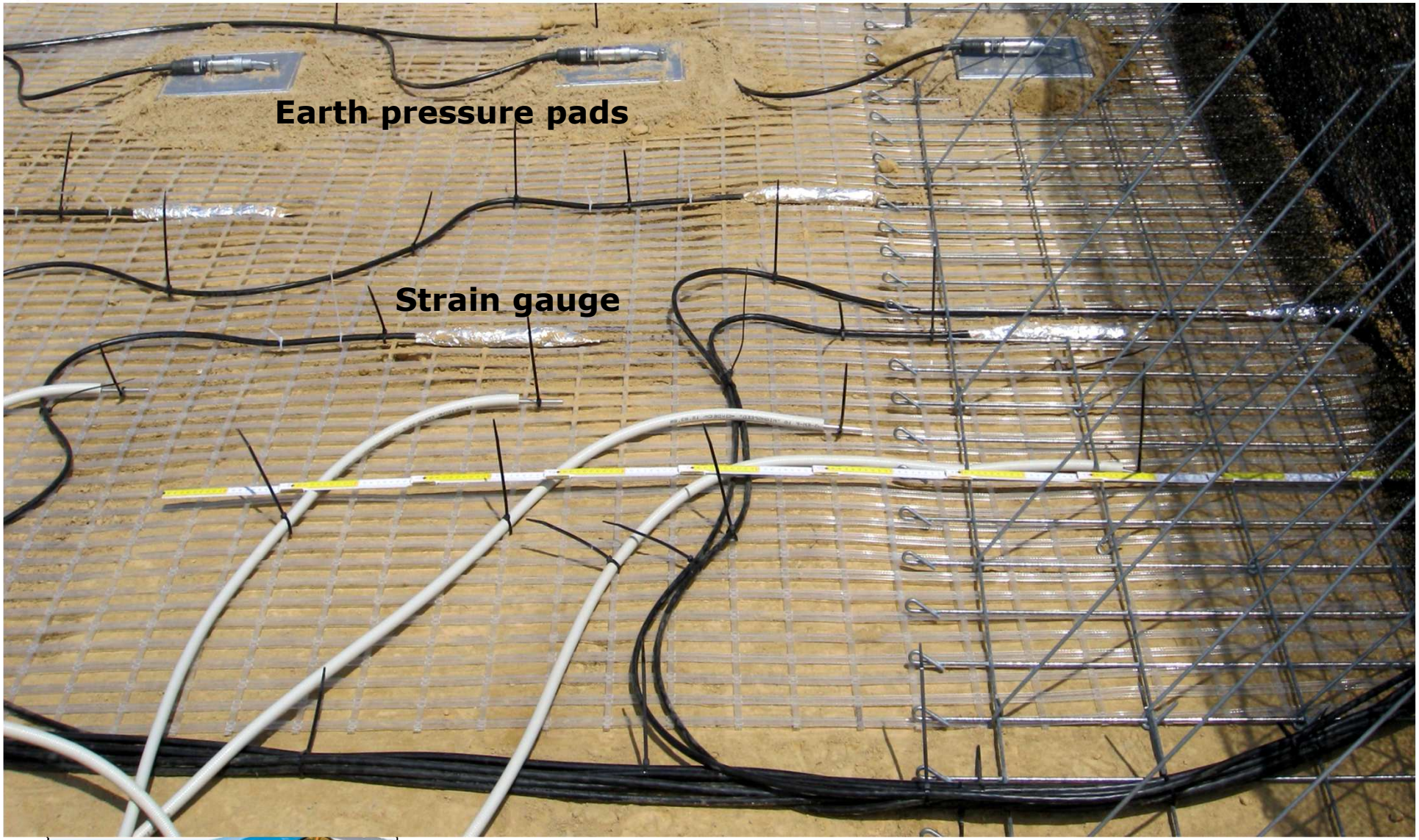


Earth pressure pad horizontal (EP H) vertical (EP V)

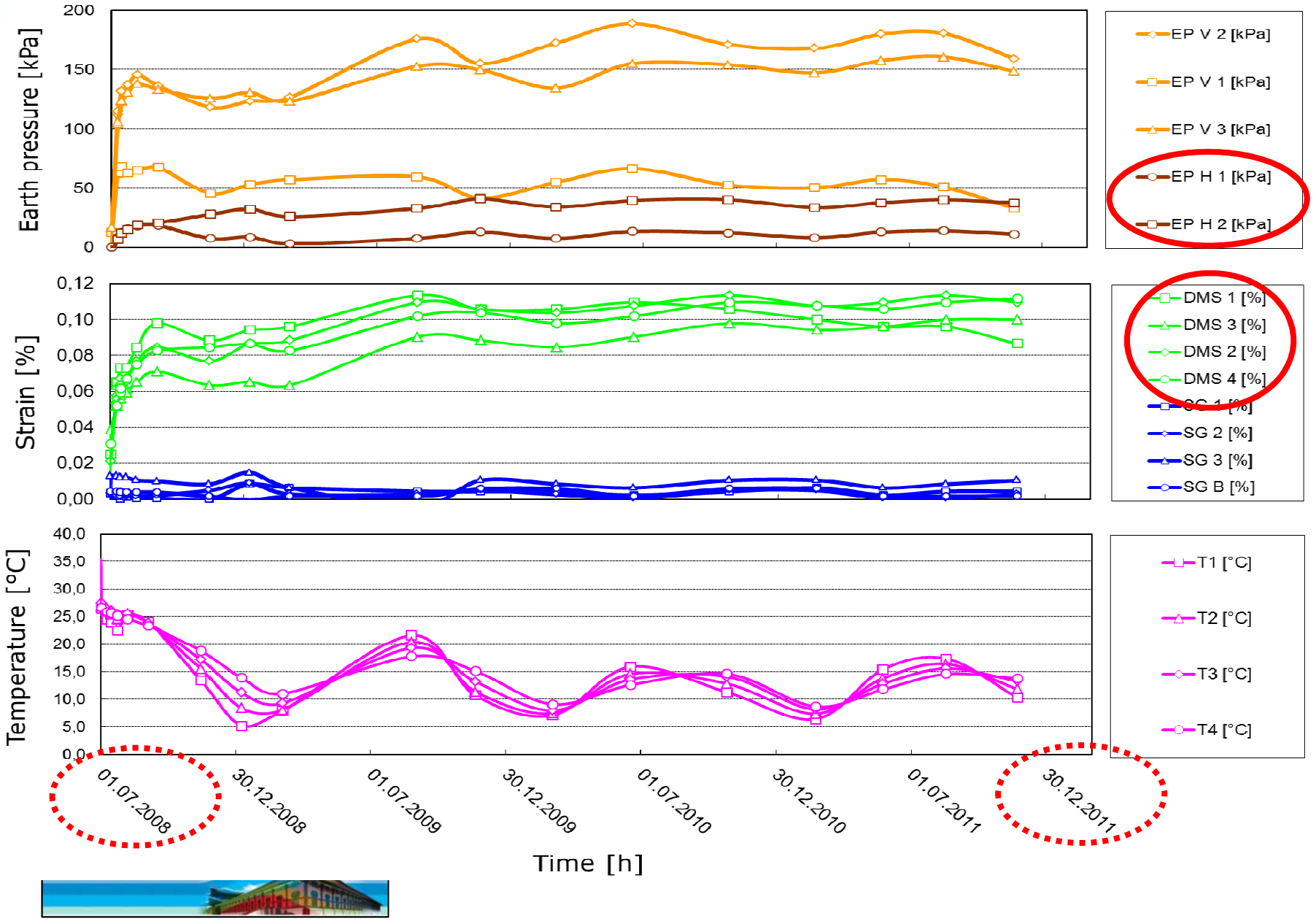
Strain gauge on steel (SG)

Strain gauge on geogrid (DMS), Temperature measurement (T)

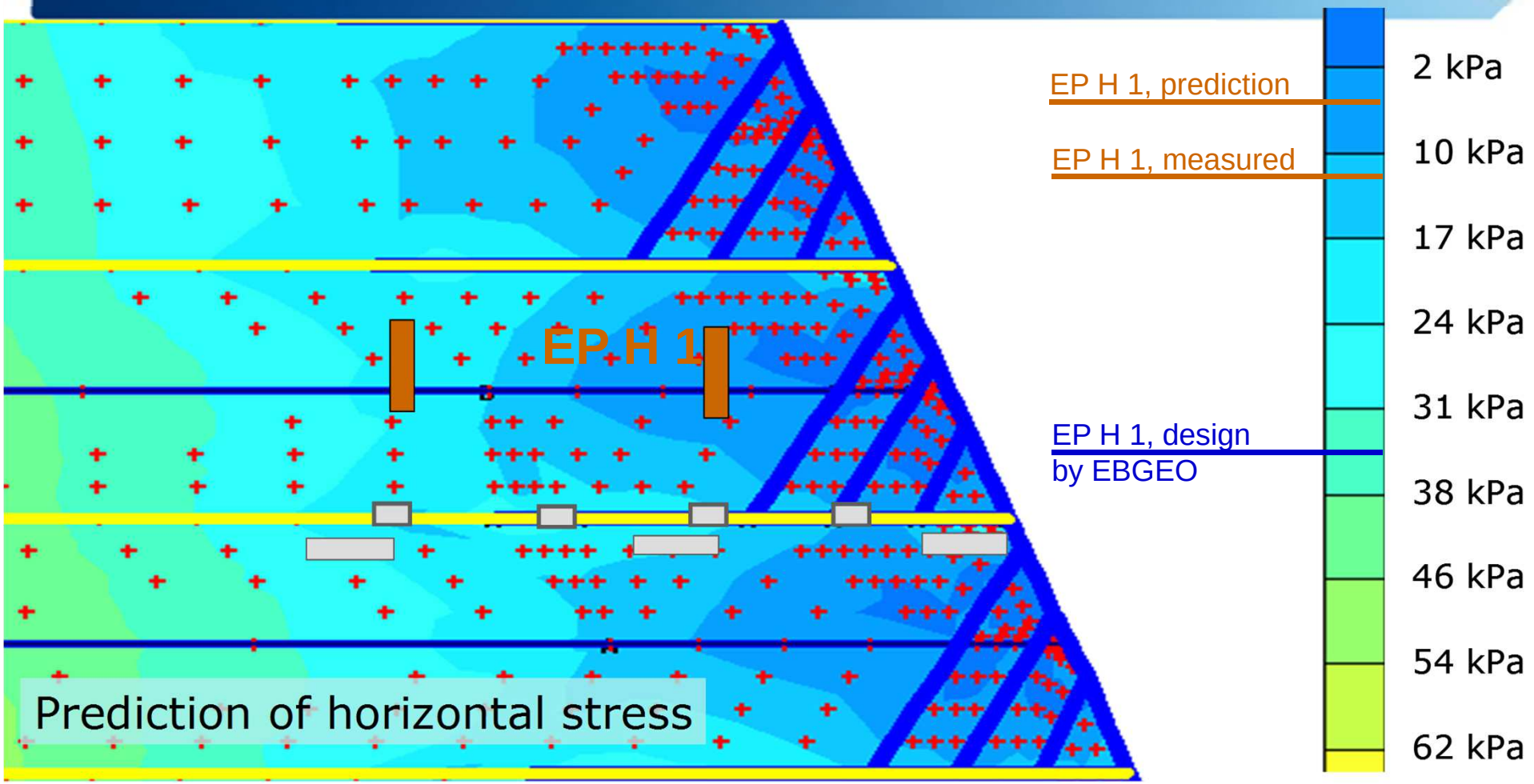
Verification of design



Verification of design



Verification of design



Summary – Lessons Learned

- **Lateral earth pressure on facing depends on the stiffness of the facing**
- **EBGEO 2010 allows for reduced lateral earth pressure stress on semi-flexible and flexible facings**
- **Design approach of EGBEO found to be on the safe side for construction stage**
- **Robust and economic solutions possible by using EBGEO 2010 in accordance with EC7**

Verification of design

Thank you for your kind attention !

Kent P. von Maubeuge

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