Dragpålar för långtidslast

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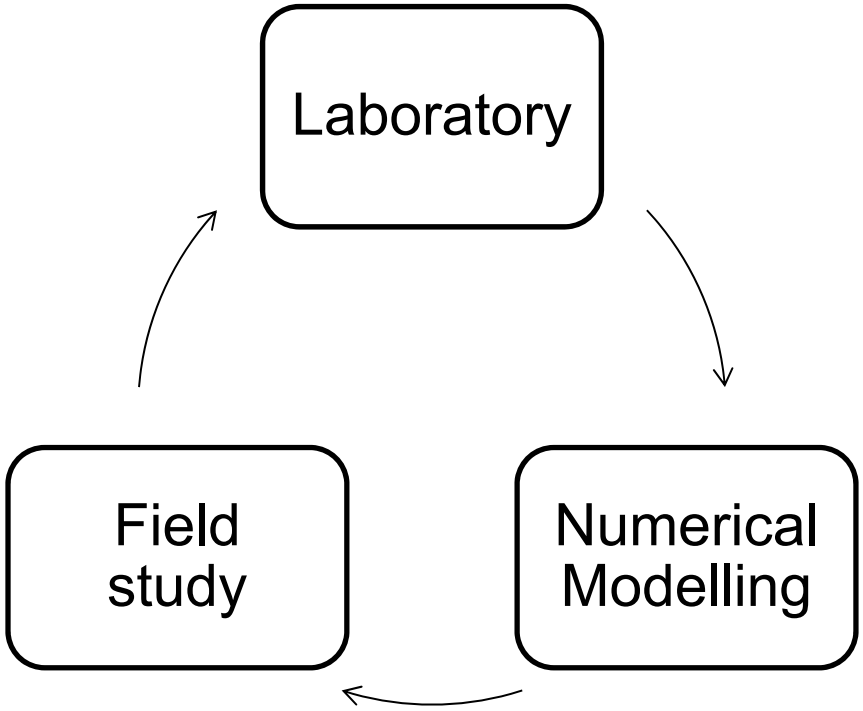
Varför långtidsbelastade dragpålar?

- Doktorandprojekt Chalmers
  - Doktorand Jorge Yannie
- Varför doktorandprojekt?
  - Behov av permanenta dragförankringar vid stora infrastrukturprojekt (i stadsmiljö)
  - Traditionell skepsis till permanenta dragförankringar
  - Funktion hos långtidsbelastad kohesionspåle?
    - Odränerad skjuvhållfasthet för långstidslast!!
- Ökad kunskap om verkningsssätt för (kohesions)pålar
  - Dragna pålar, Tryckta pålar, Negativ mantelfriktion…

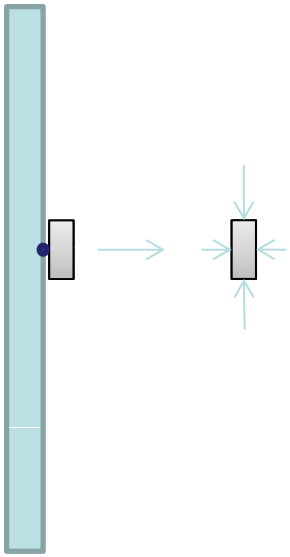
Research strategy

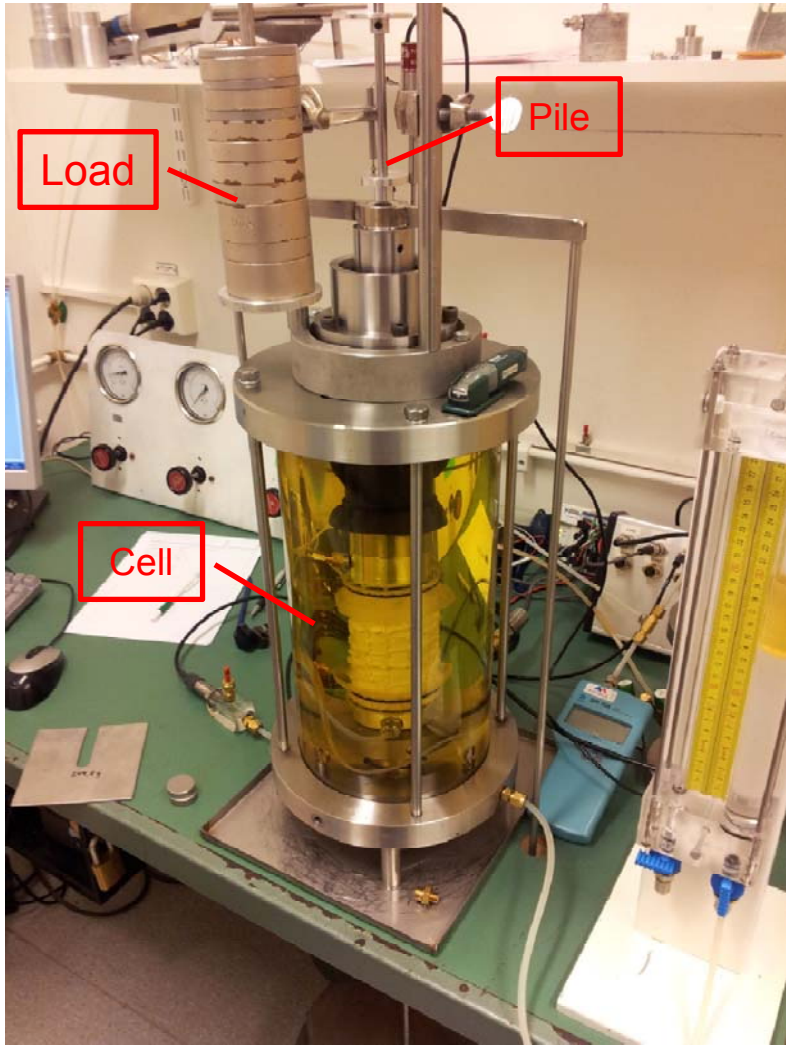


- The laboratory serve to isolate the different factors involve.
- Numerical simulations are use to model the latter factors and long term conditions.
- Real measurements of the problem. Installation effects, stress changes, time effects, group effects.

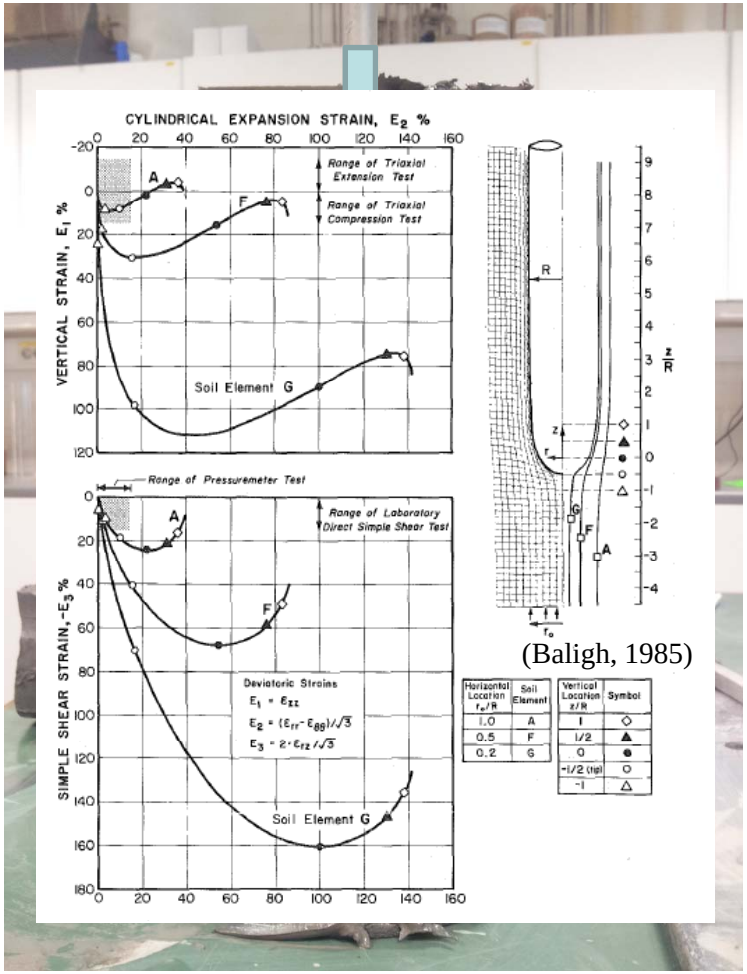
Laboratory setup

- Modified triaxial cell.
- Study the soil-pile interface behaviour for a single point along the pile shaft.

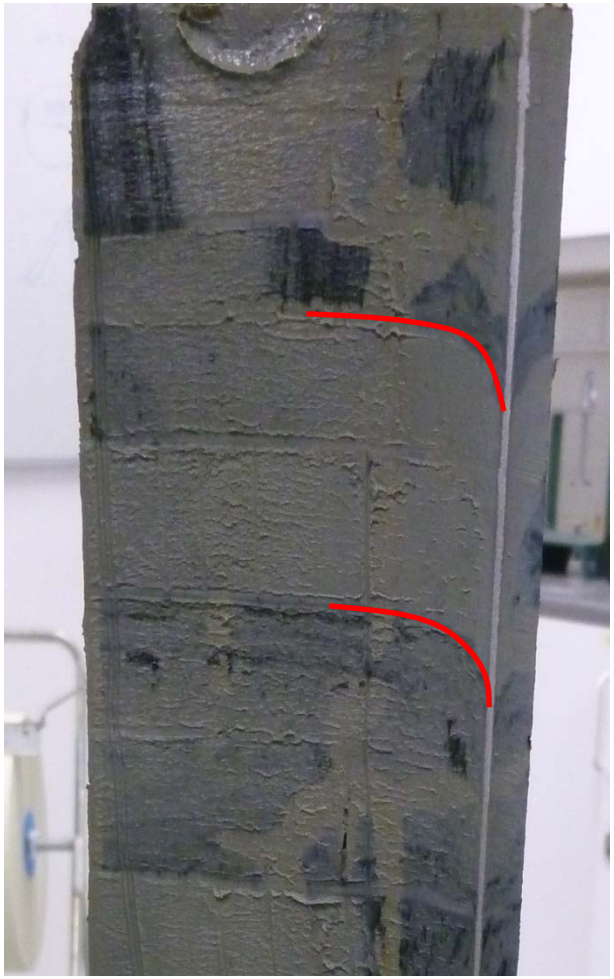




Installation effects

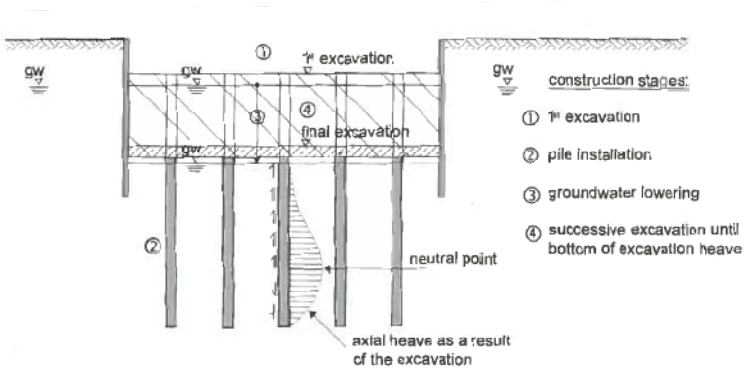


(Baligh, 1985)

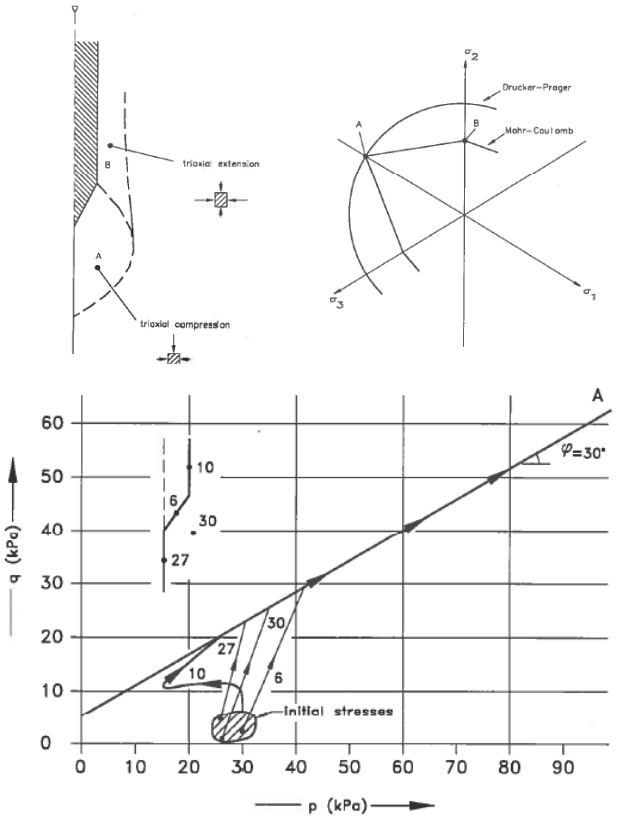


Numerical Model

- Incorporate installation effects.
- Evolution of stresses and strains.
- Change of soil fabric and time effects (creep).
- Model complex system interaction.



Heave in bottom slab in anchorage system (Kempfert, H. G.; Gebreselassie, B.; 2006).



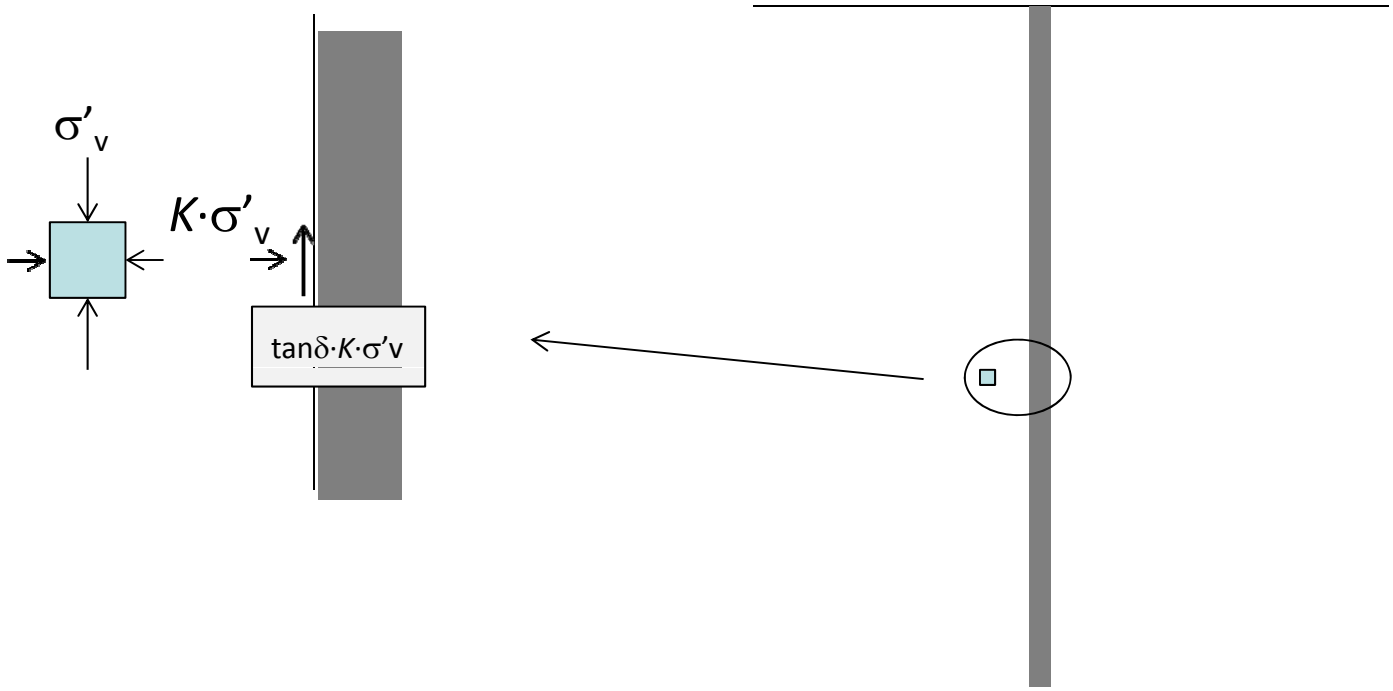
Stress path in p-q diagram for sand (Drucker-Prager) (Berg, P. van den; 1994).

Field test

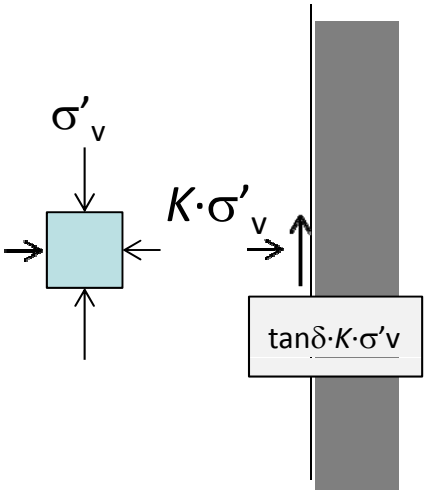
- Benchmark to numerical models.
- Static load testing.
- Dynamic load testing.

http://www.dotd.la.gov/administration/public_info/projects/i10veteranstoclearview/images/

Dränerad eller odränerad skjuvhållfasthet



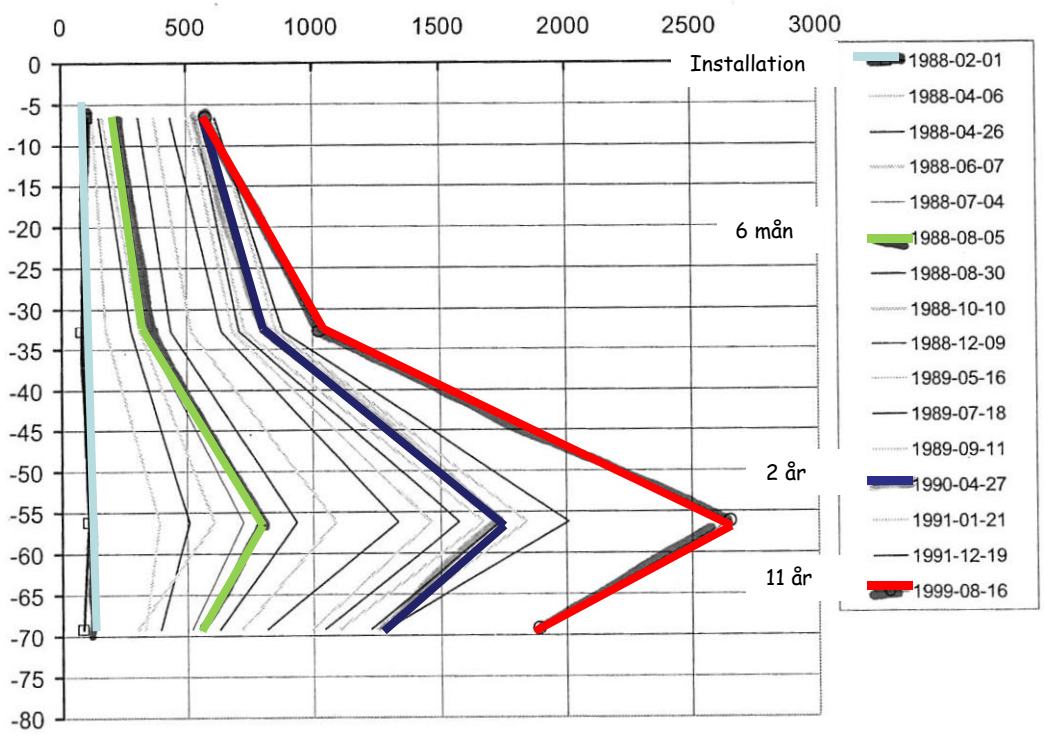
Dränerad eller odränerad skjuvhållfasthet



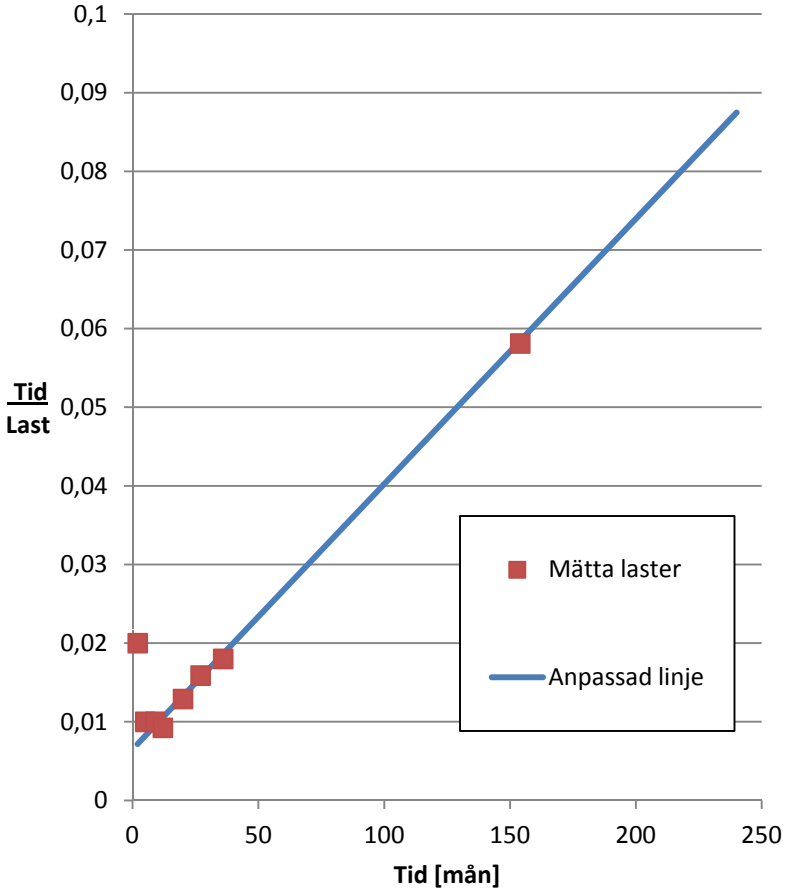
- Exempel
  - $\sigma'_c = 1{,}25 \cdot \sigma'_0$
  - $c_u = 0{,}25 \cdot \sigma'_c$
  - K=0,55
  - tan δ=tan 30°

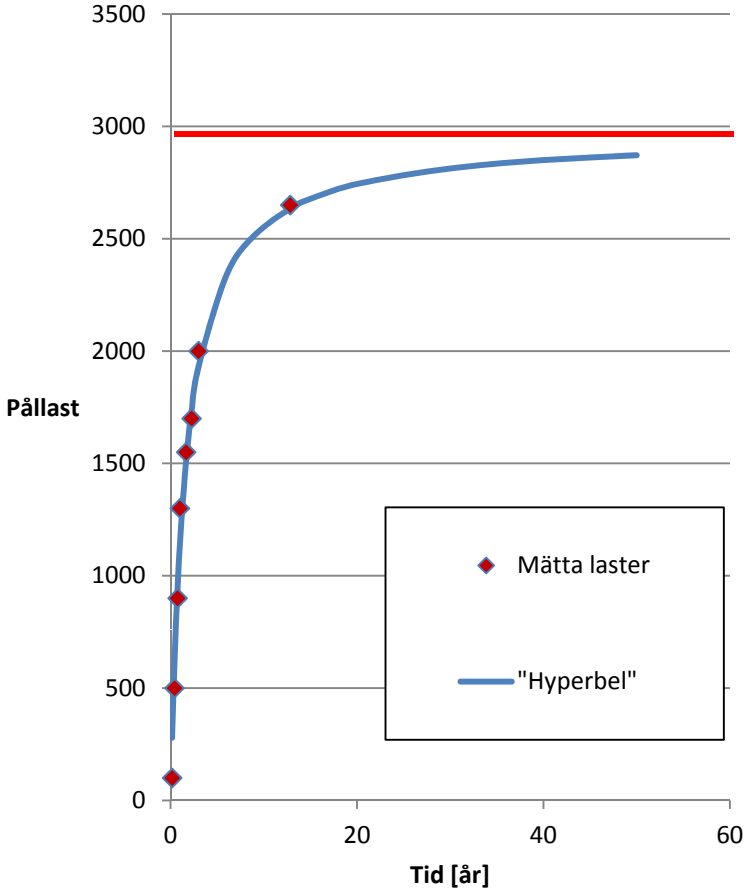
$$\tau_{mantel} = \frac{\tan(30^0) \cdot 0{,}55}{0{,}25 \cdot 1{,}25} c_u = 1{,}0 \cdot c_u$$

Långtidslast, Påle 731 , Läppstiftet

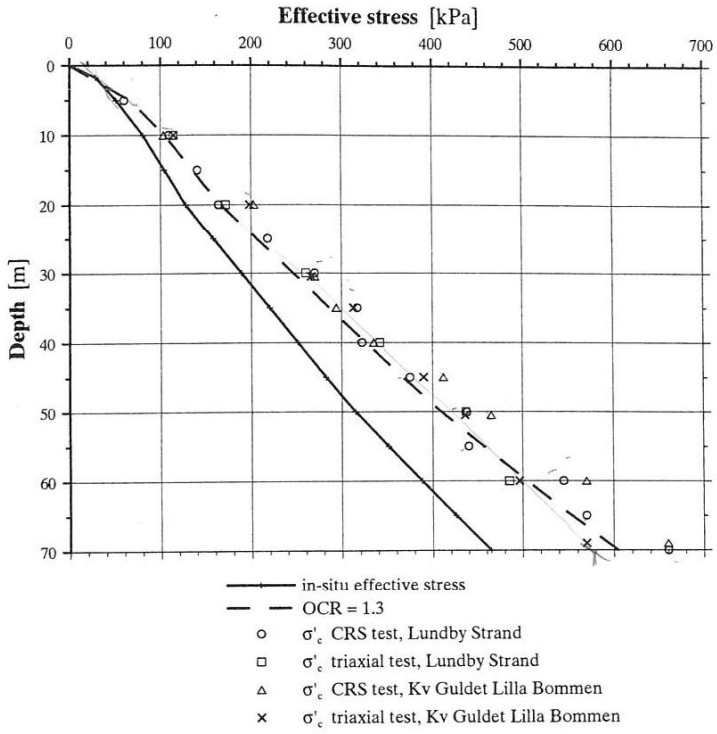


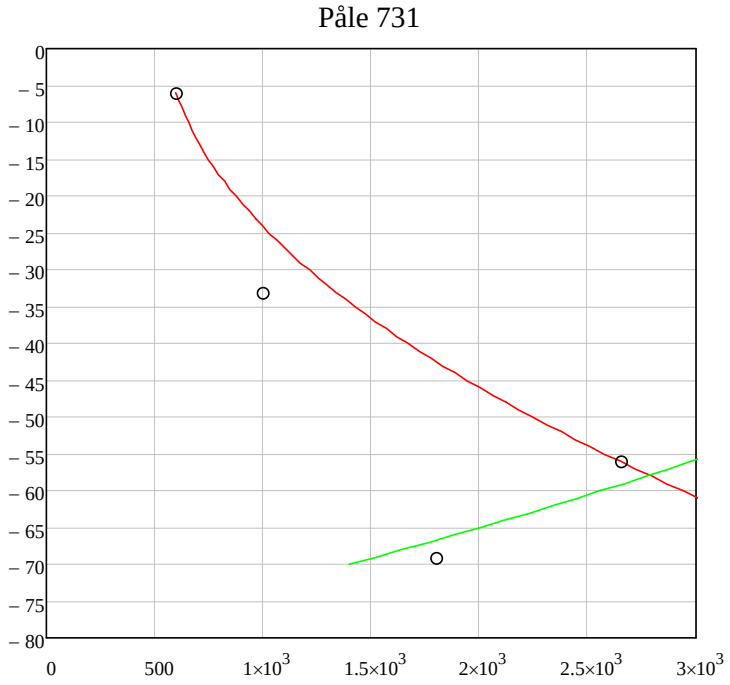
Utvärdering långtidslast – cirka 3000 kN



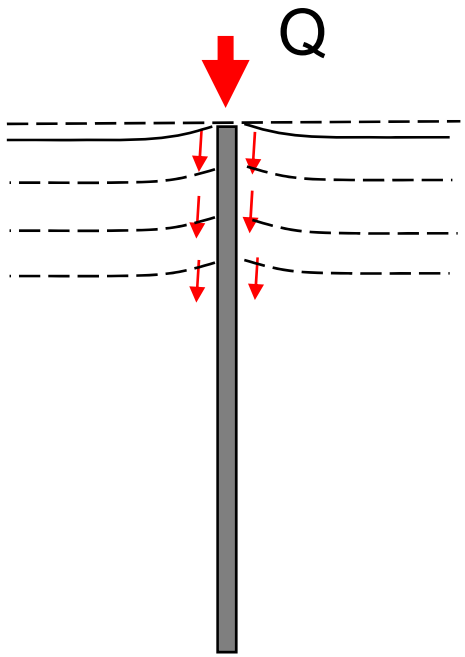


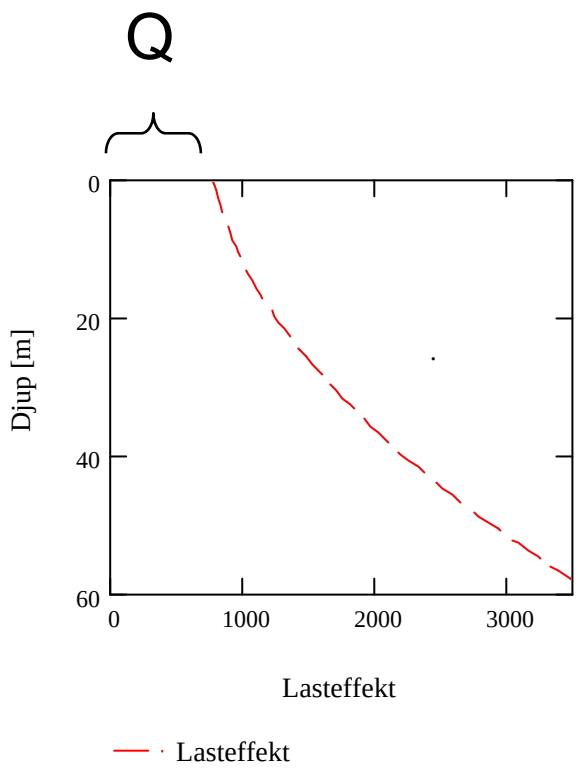
Krypdeformationer I jorden + $\alpha \cdot c_u = 0{,}25 \cdot \sigma'_c$



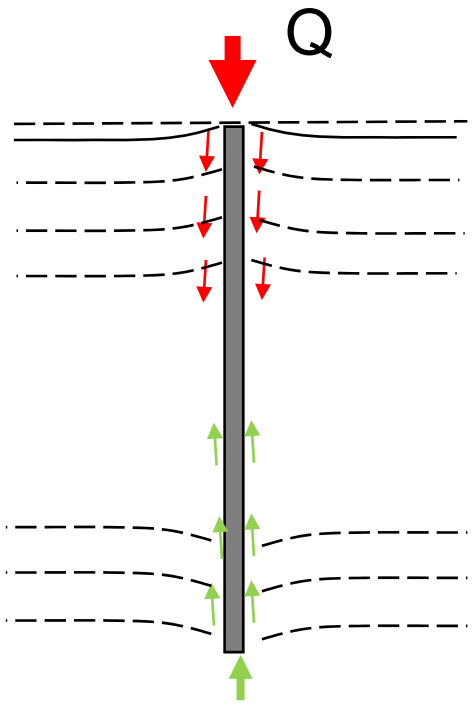


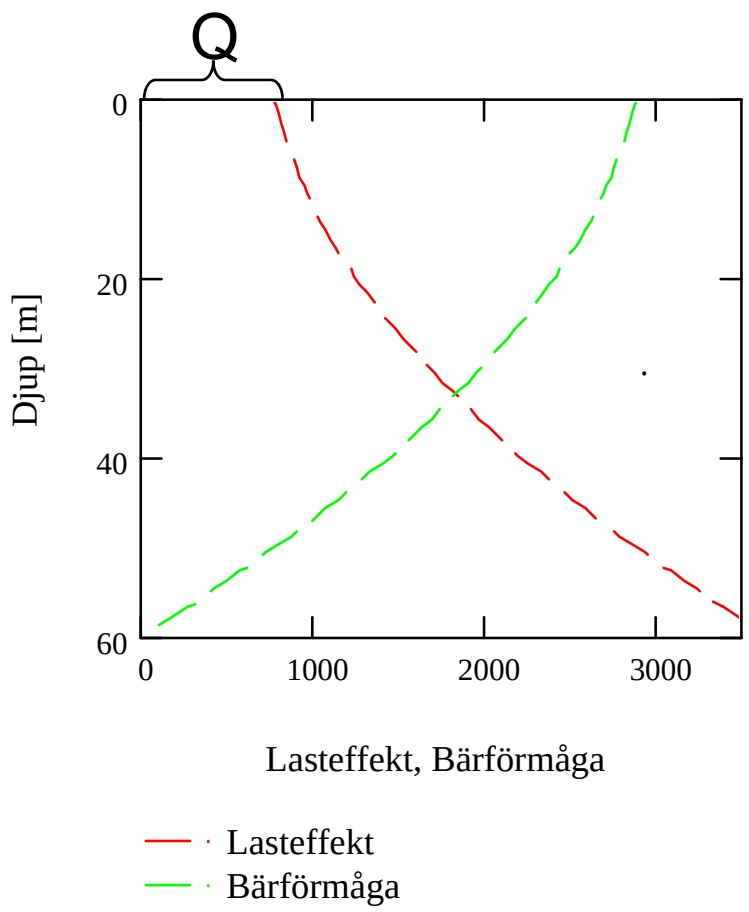
Lasteffekt påle



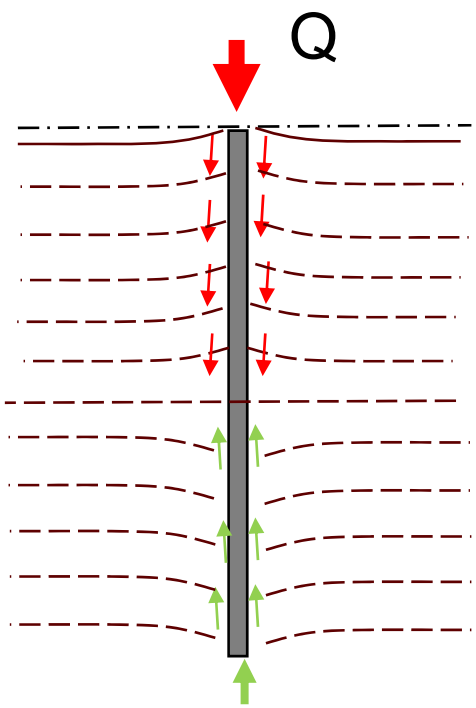


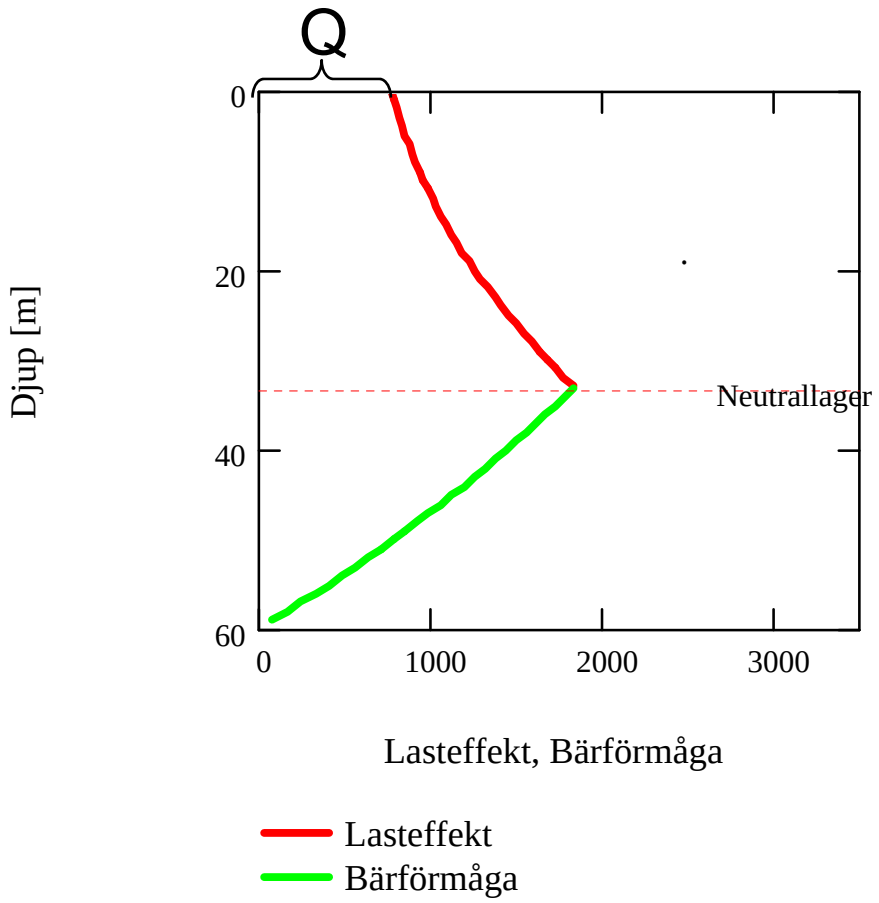
Geoteknisk bärförmåga



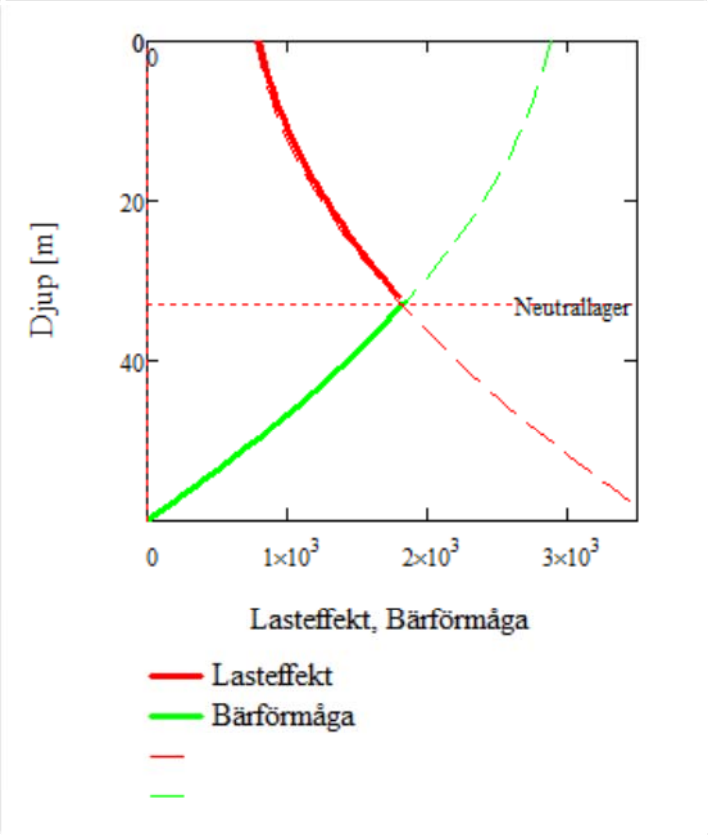


Neutrala lagret

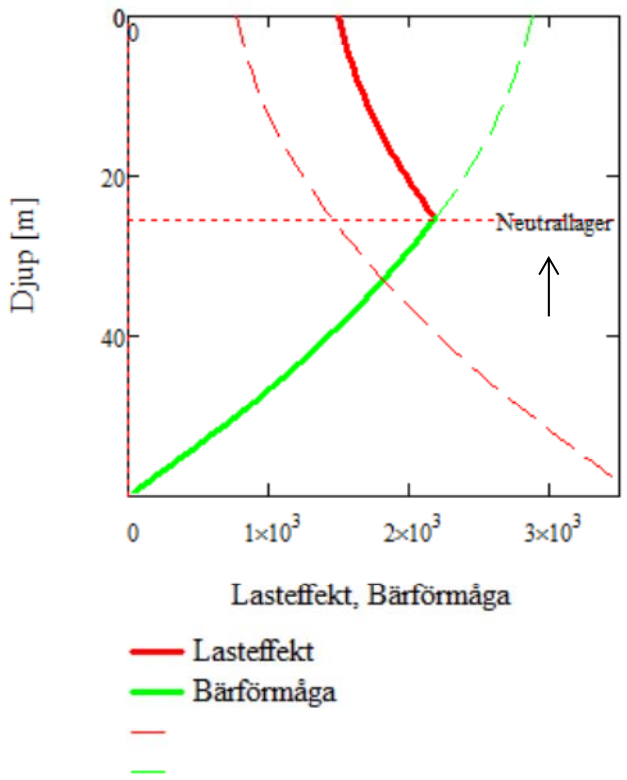




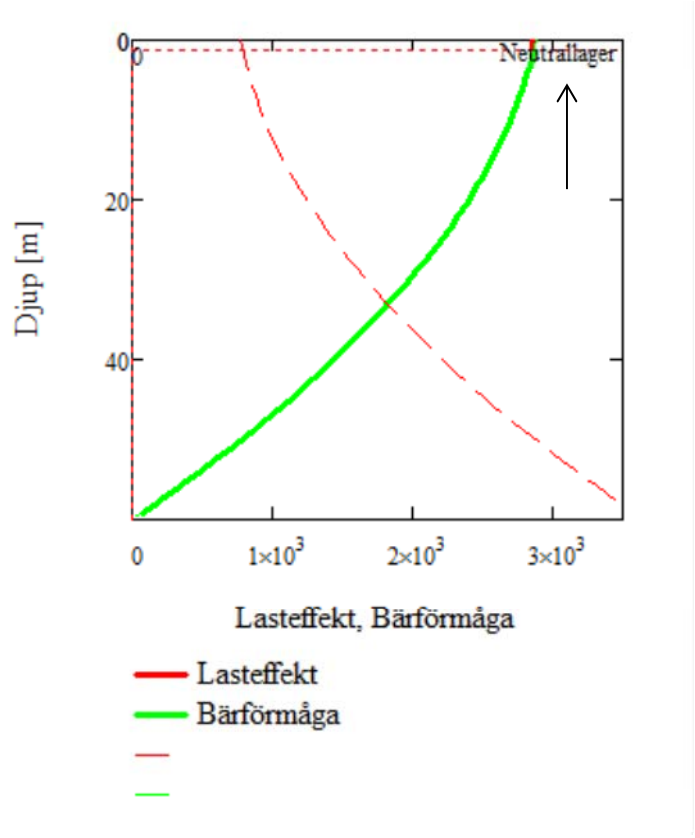
”Normal” pållast



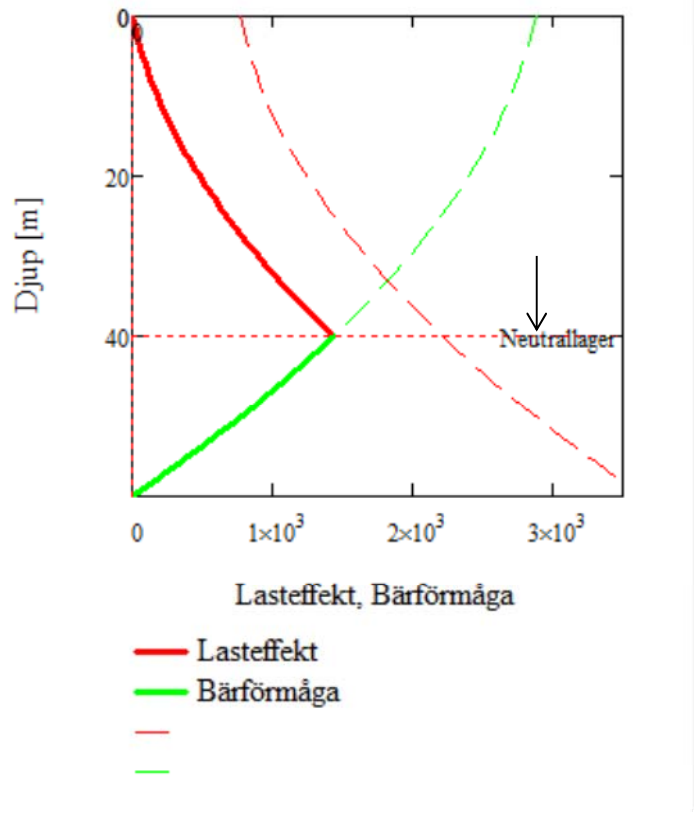
Ökad pållast



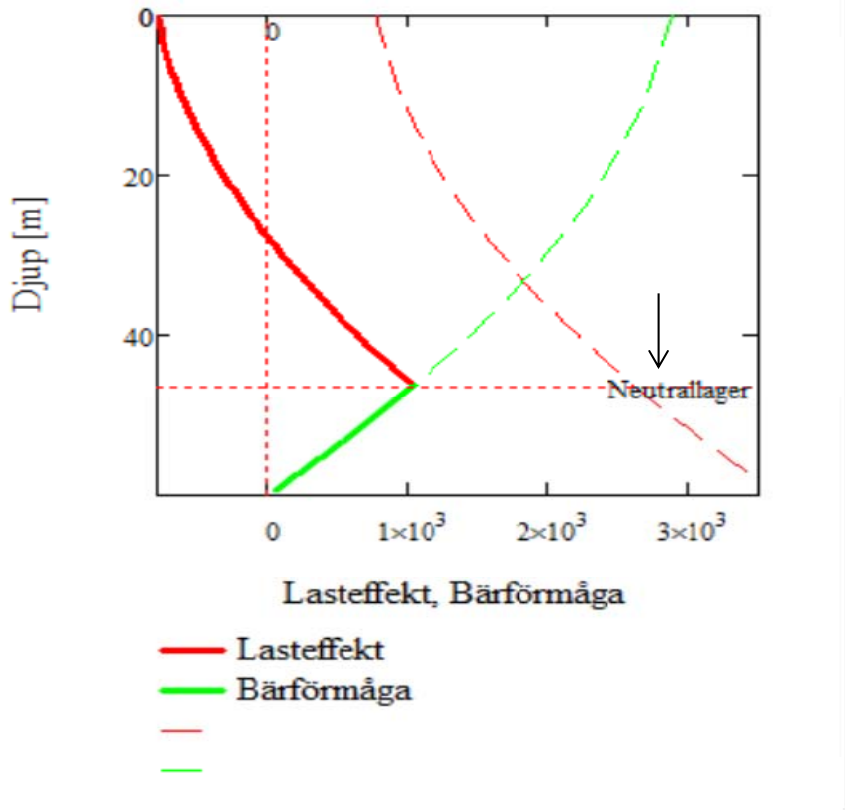
Helt utnyttjad bärförmåga



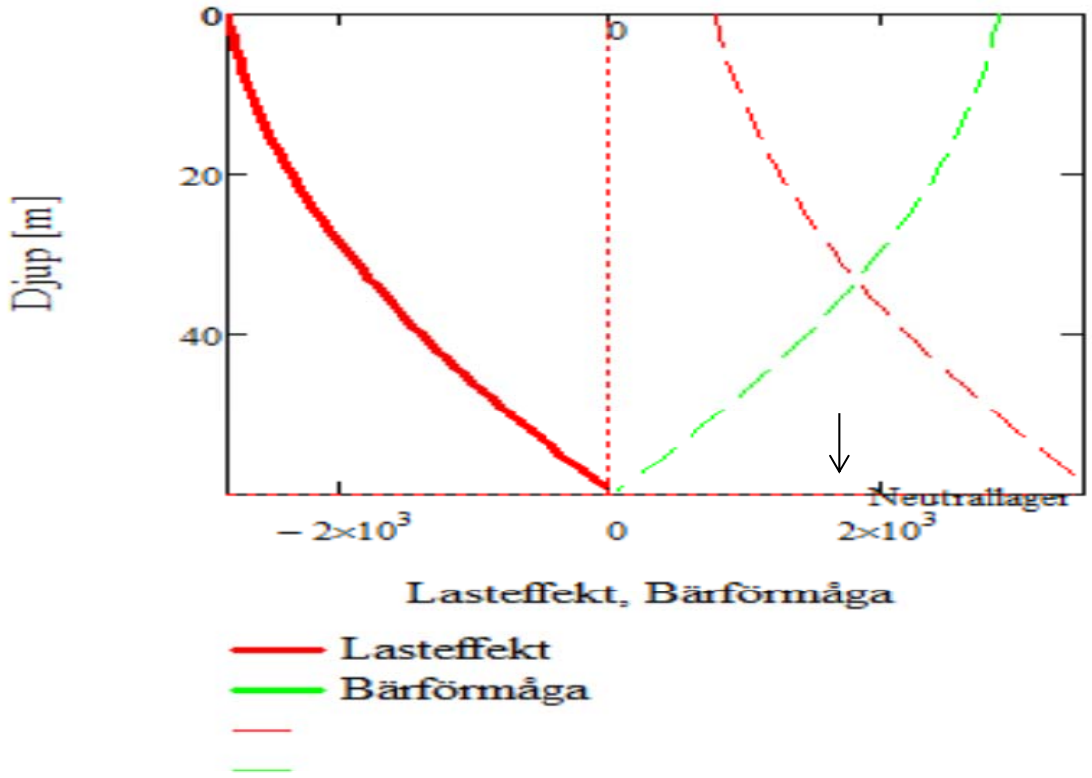
Avlastning


0
20
40
Djup [m]
Neutrallager
0
1×10^3
2×10^3
3×10^3
Lasteffekt, Bärförmåga
Lasteffekt
Bärförmåga

Dragbelastning



Fullt utnyttjad bärförmåga drag



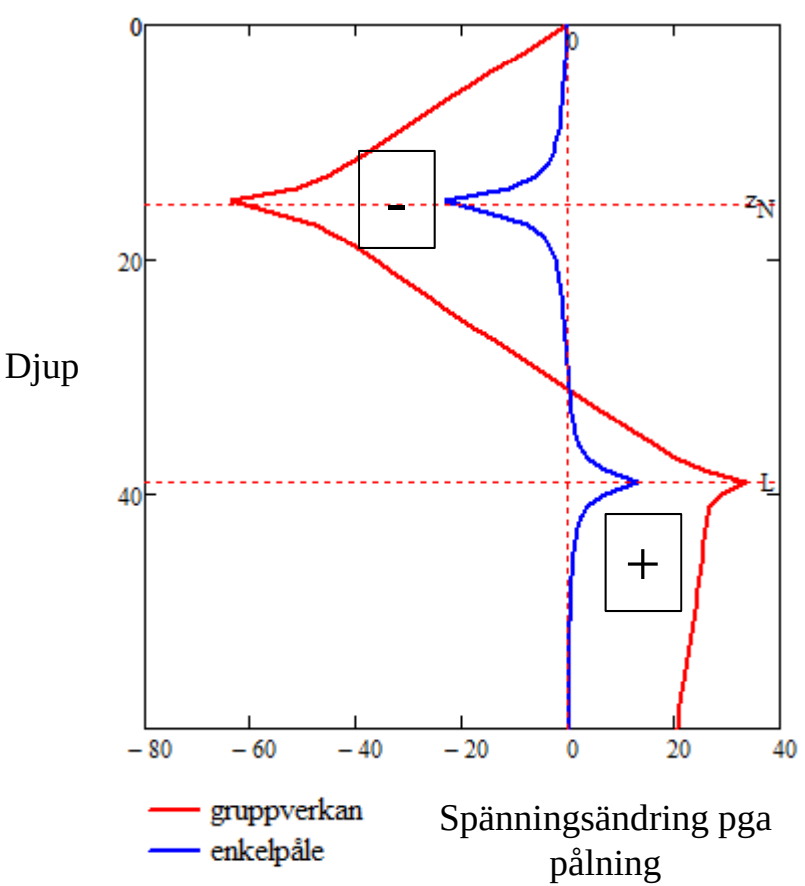
Exempel – Spänningsändrig jord av pålning

- Pålad bottenplatta 60m x 60m

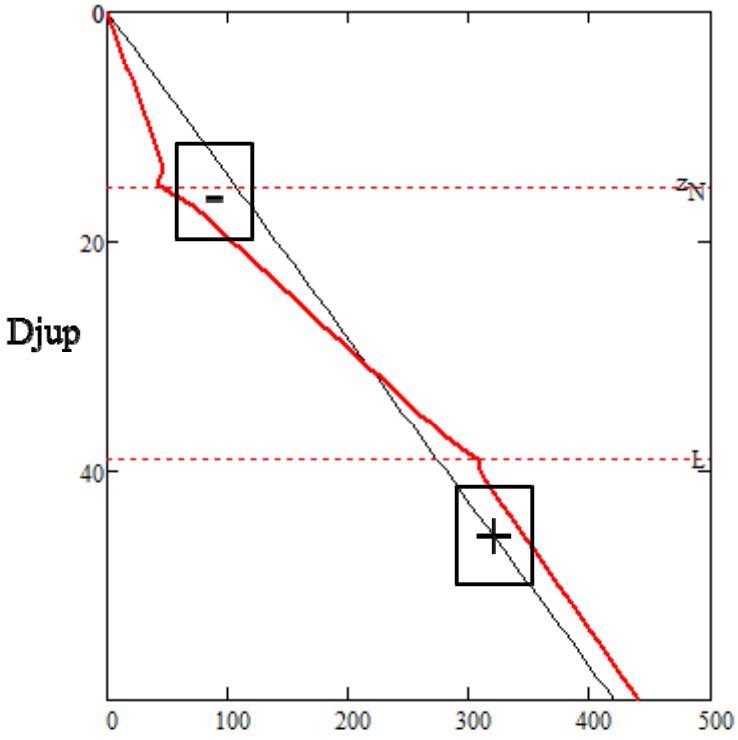
- 60m lätt överkonsoliderad lera – ”Göteborgslera”
- Pållängd 39m
- Pålavstånd 4m

- Stort antal pålar
- Inverkan av gruppeffekt
- Jämförelse tryckta och dragna pålar

Tillskottsspänningar – tryckta pålar

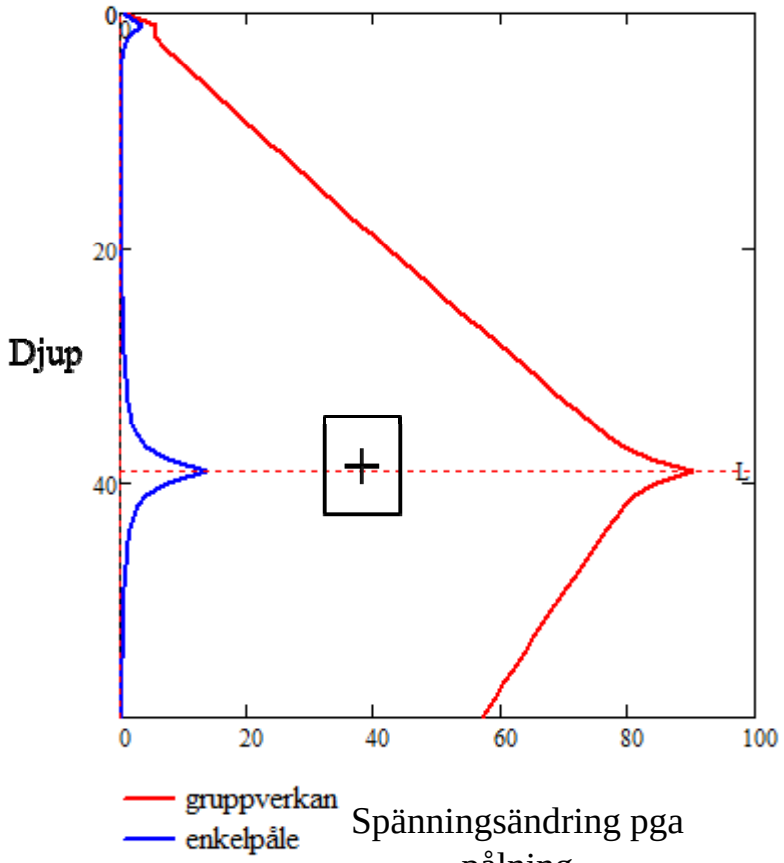


Spänningsändring pga pålning

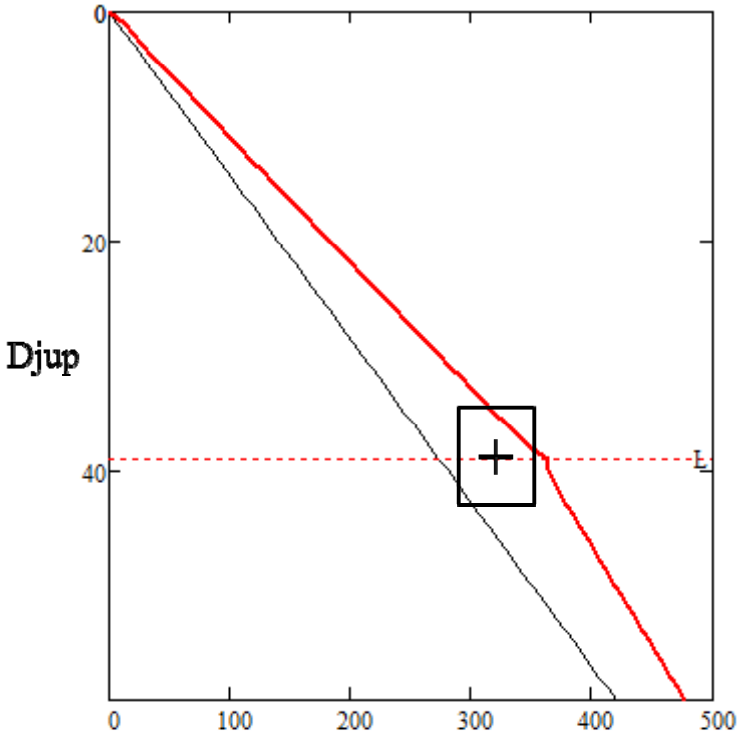


Spänning inkl egenvikt jord

Fullt utnyttjad tryckt påle

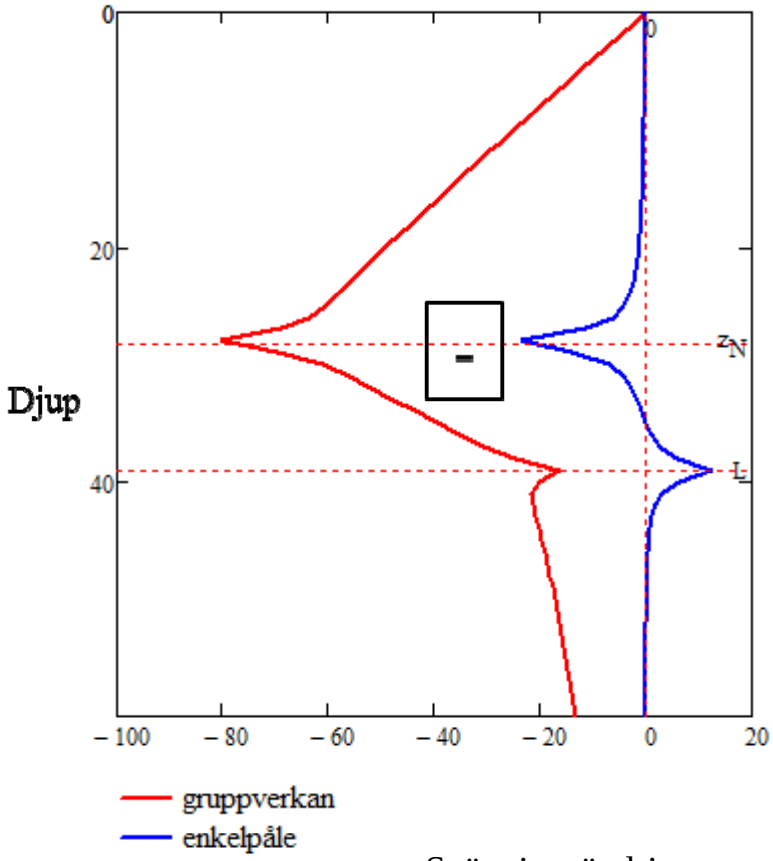


Spänningsändring pga pålning

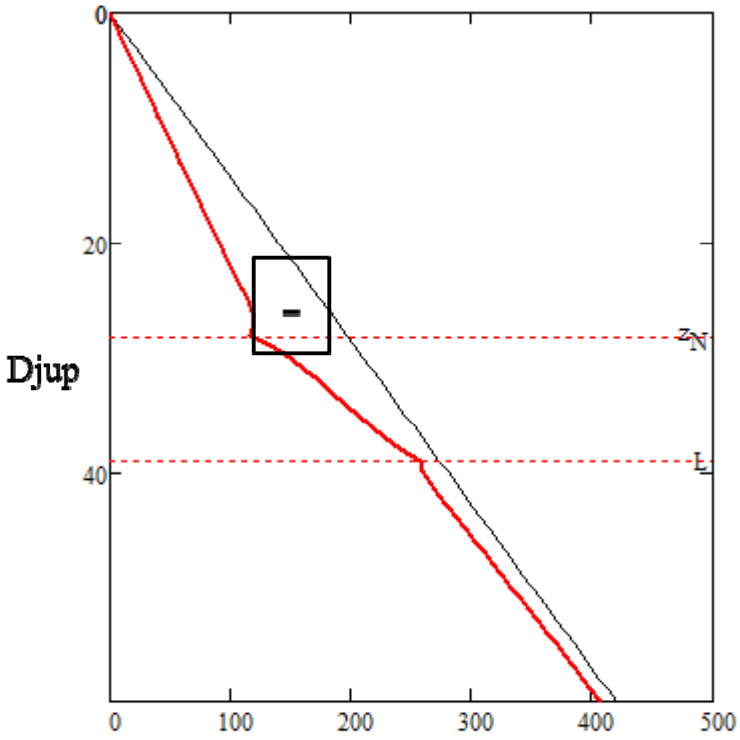


Spänning inkl egenvikt jord

Tillskottsspänningar -Dragna pålar

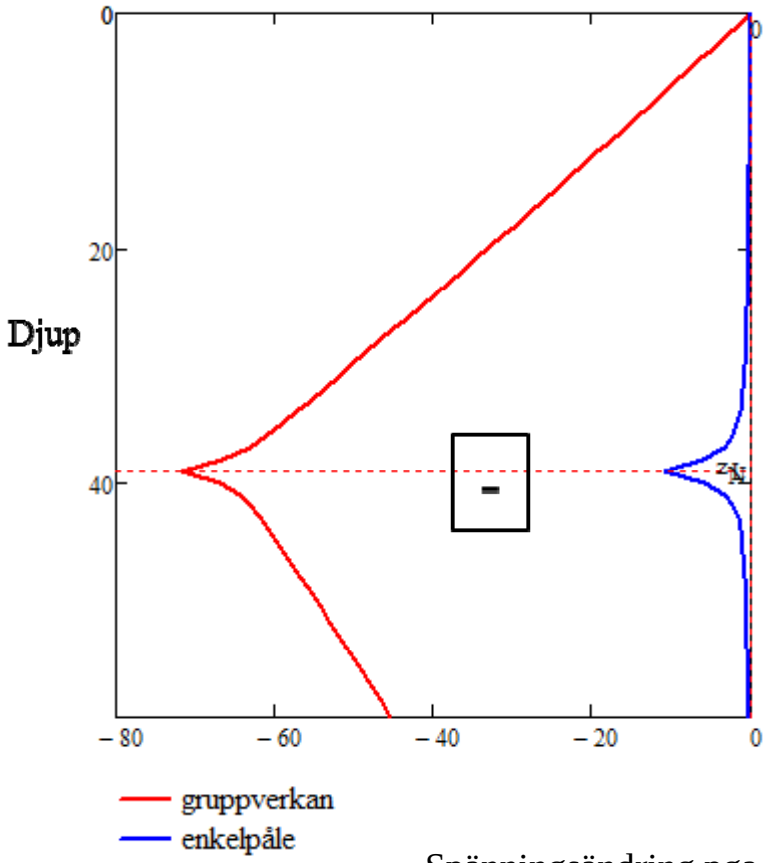


Spänningsändring pga pålning

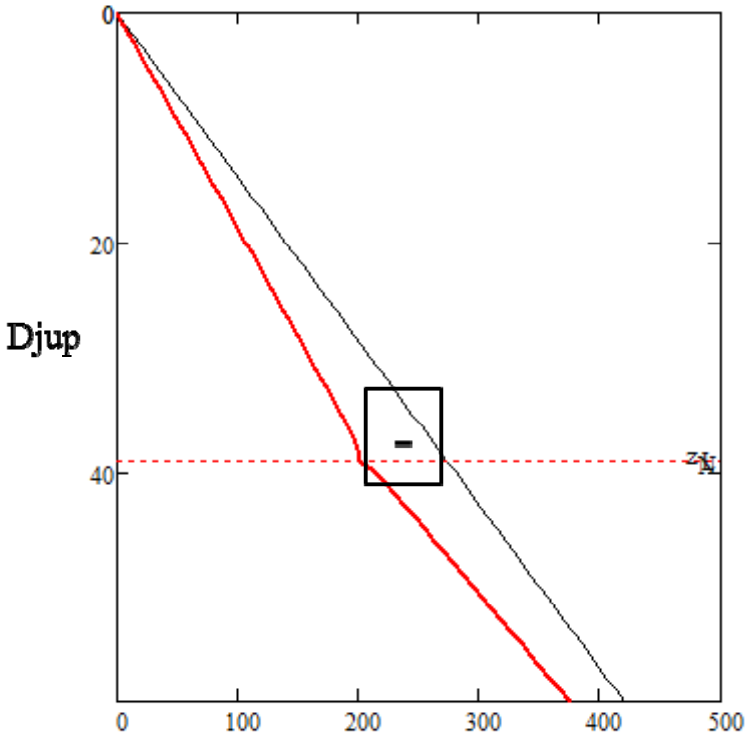


Spänning inkl egenvikt jord

Fullt utnyttjad dragen påle

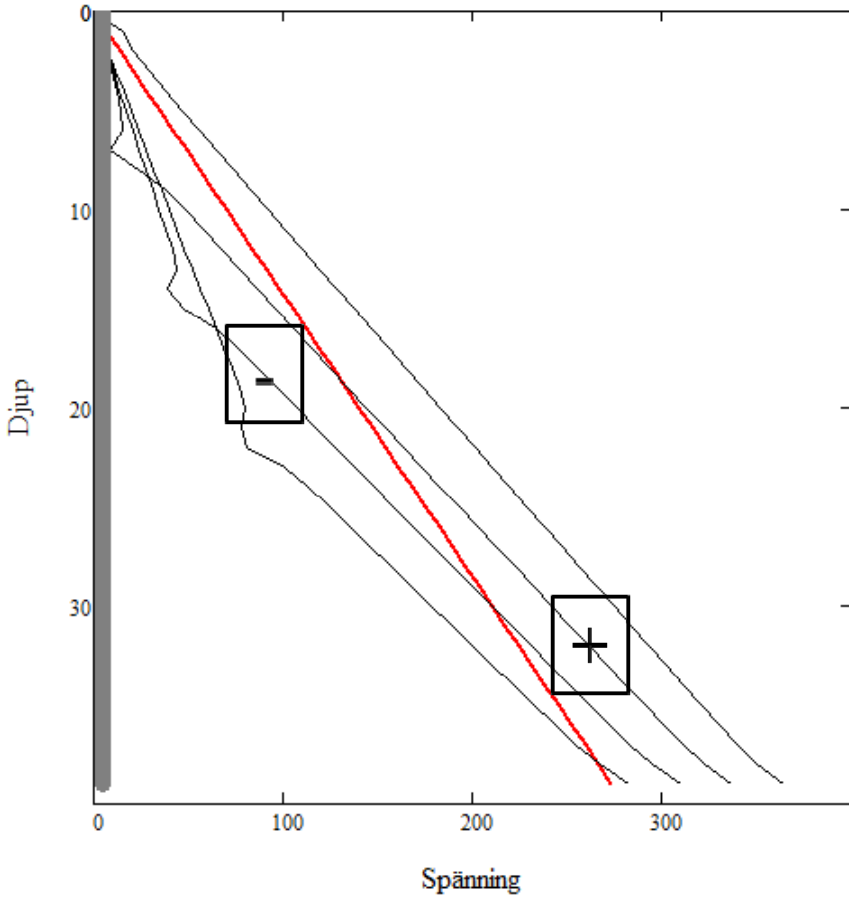


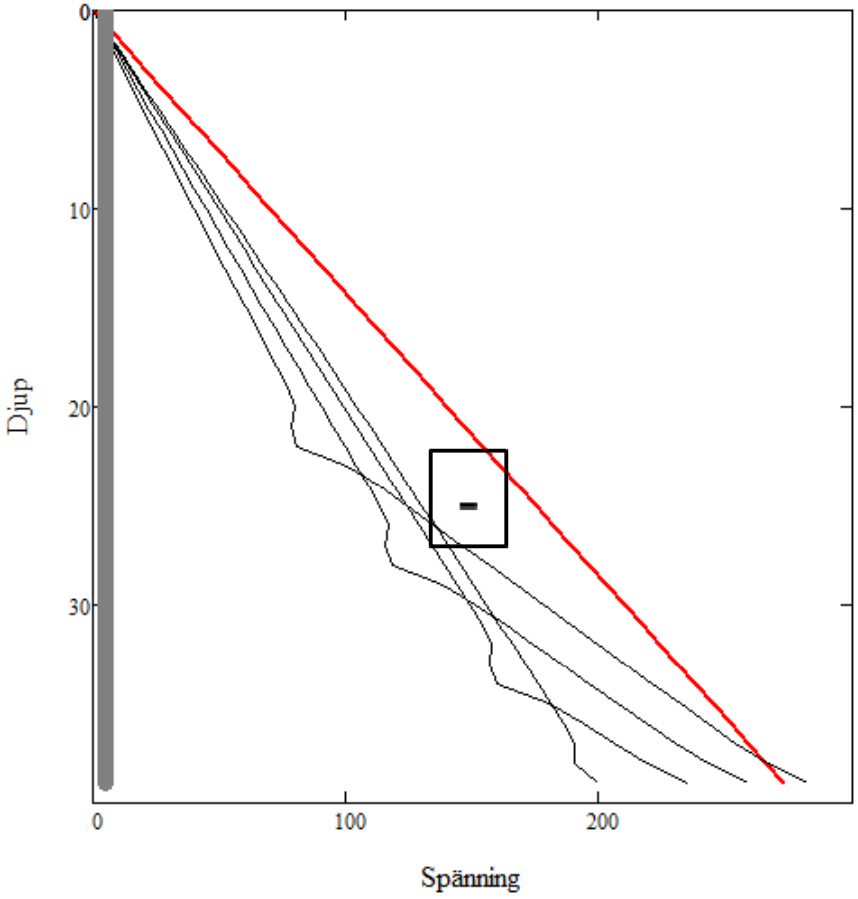
Spänningsändring pga pålning



Spänning inkl egenvikt jord

Tryckta resp dragna pålar





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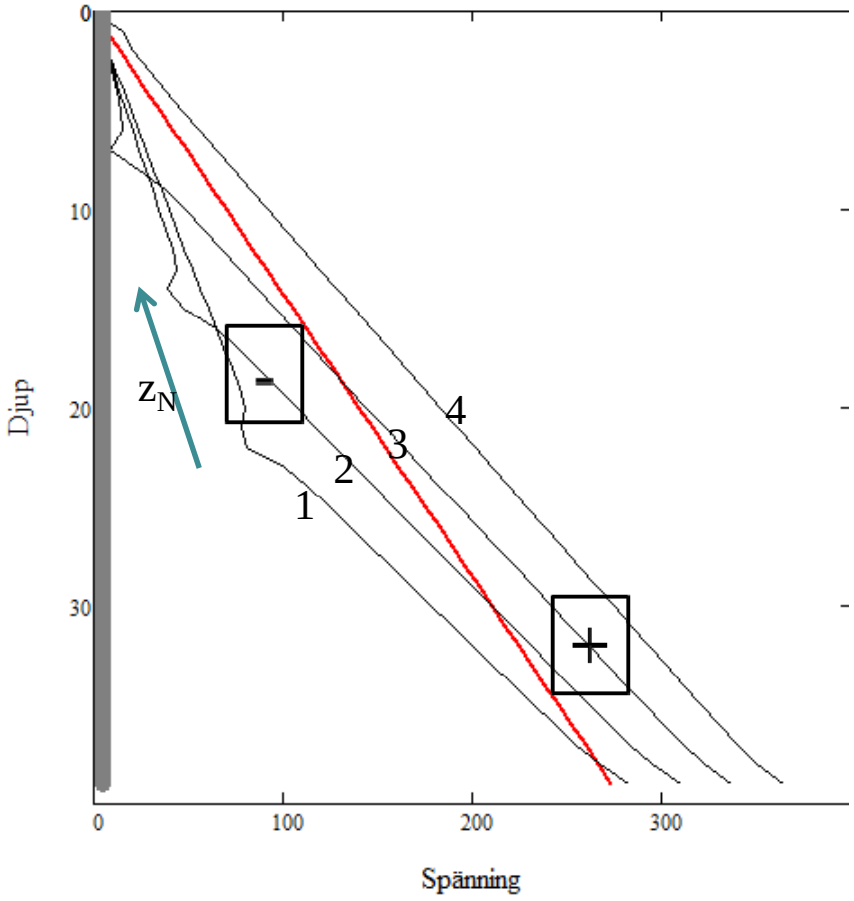
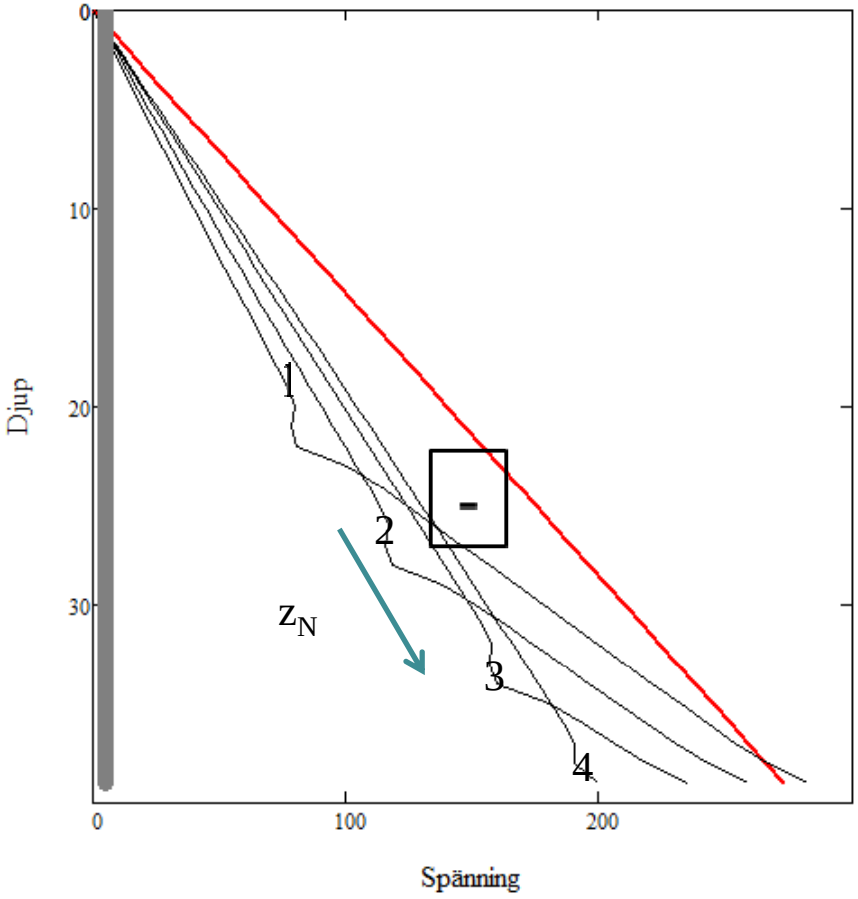
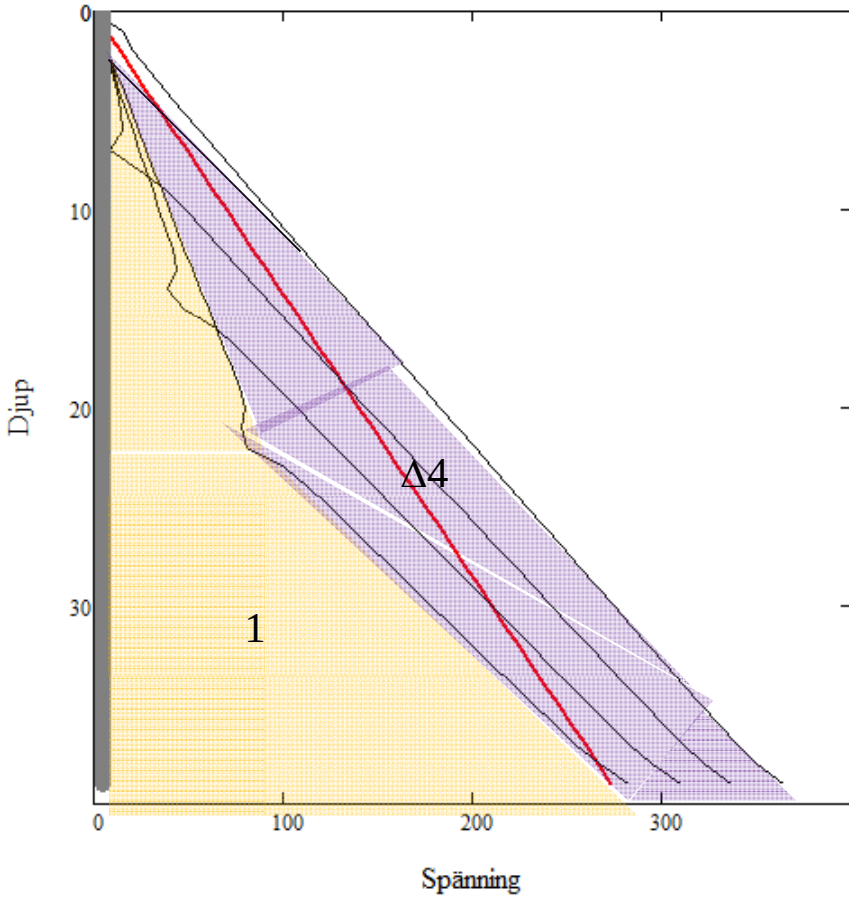
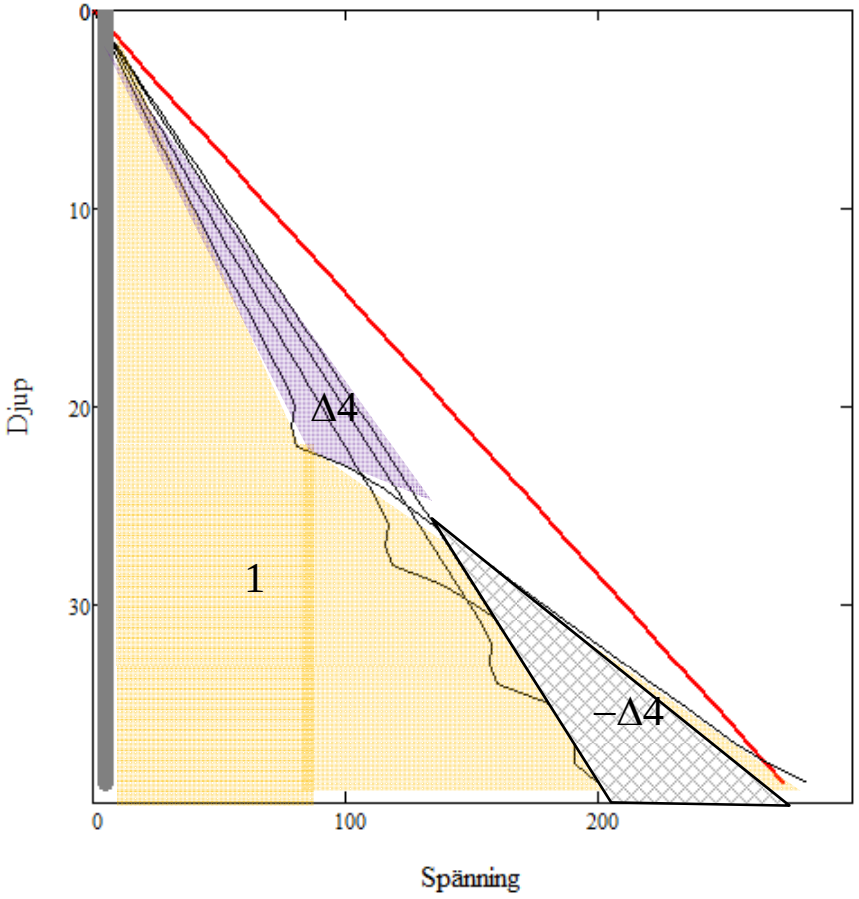




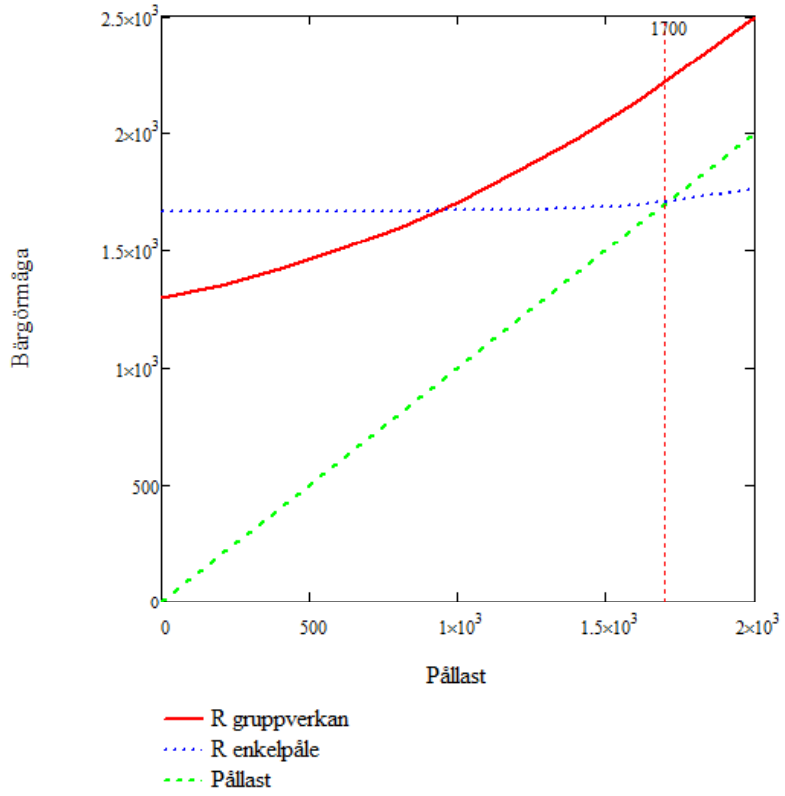
Tryckta resp dragna pålar



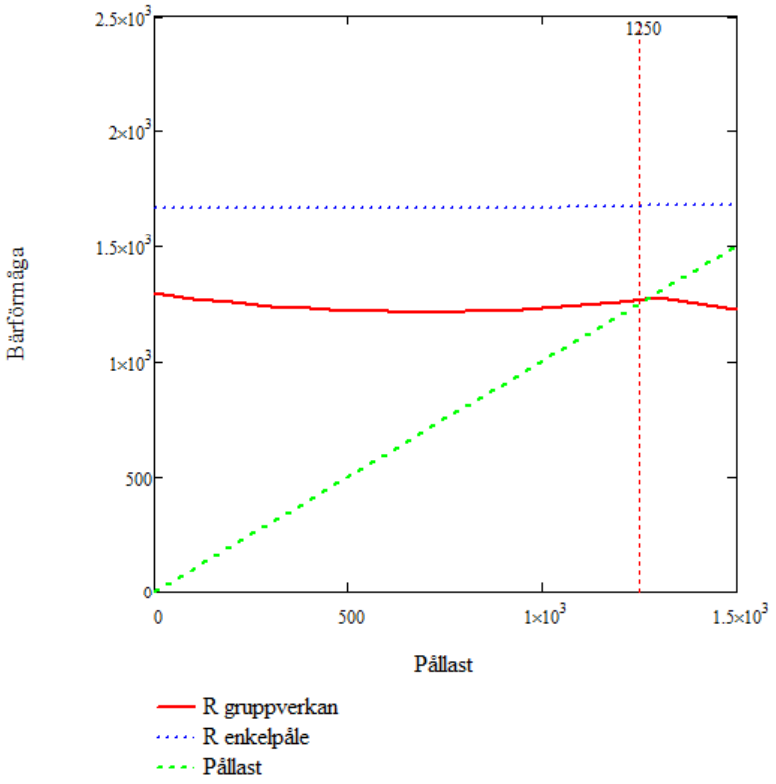


Bärförmåga = funktion(pållast)

Tryckta pålar

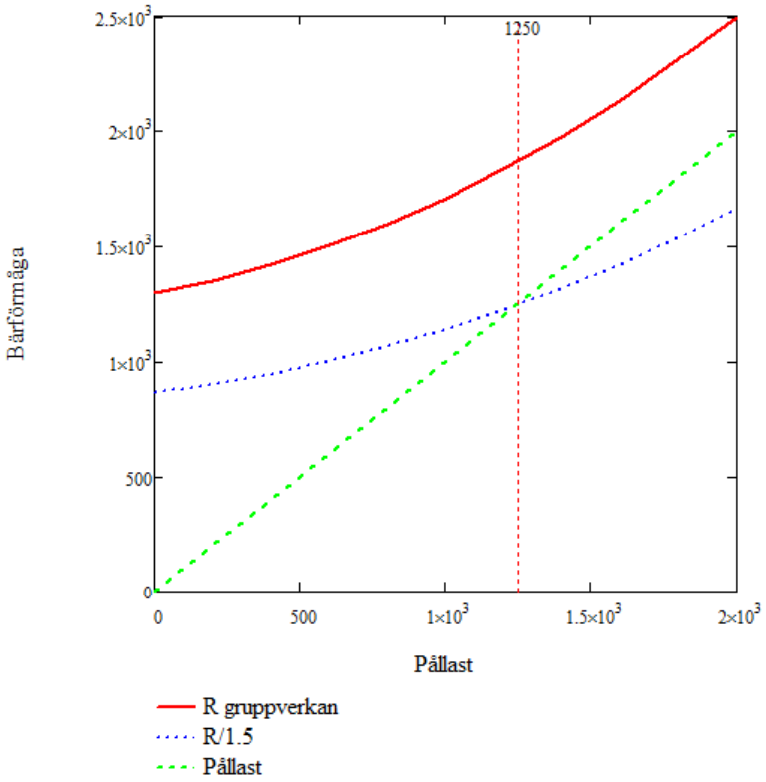


Dragna pålar

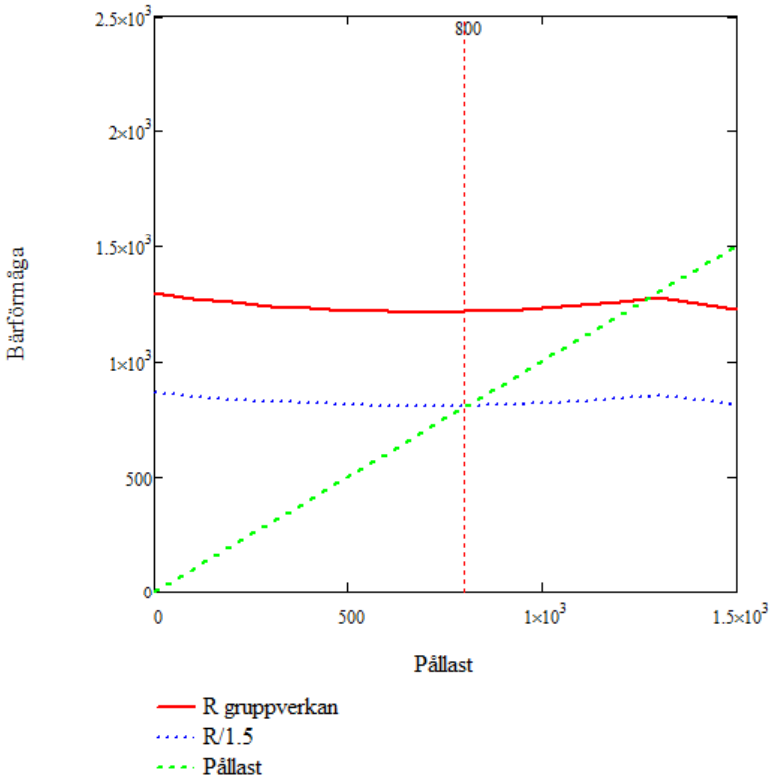


Bärförmåga = funktion(pållast)
”Säkerhetsfaktor” = 1,5

Tryckta pålar



Dragna pålar



Hypoteser

- Dimensionering mht odränerad skjuvhållfasthet empiriskt OK
- Dimensionering mht odränerad skjuvhållfasthet återvändsgränd för kunskapsutveckling
- Krypeffekter i lera signifikant
- Inverkan av gruppeffekt på spänningsändring i jord signifikant
- Bärförmåga tryckta pålar ≥ Bärförmåga dragna pålar
- Långtidseffekter och gruppeffekt går endast delvis att studera med fält- och labförsök
- Kunskapsutveckling kräver kombination av
  - Labförsök
  - Fältförsök
  - Numerisk modellering