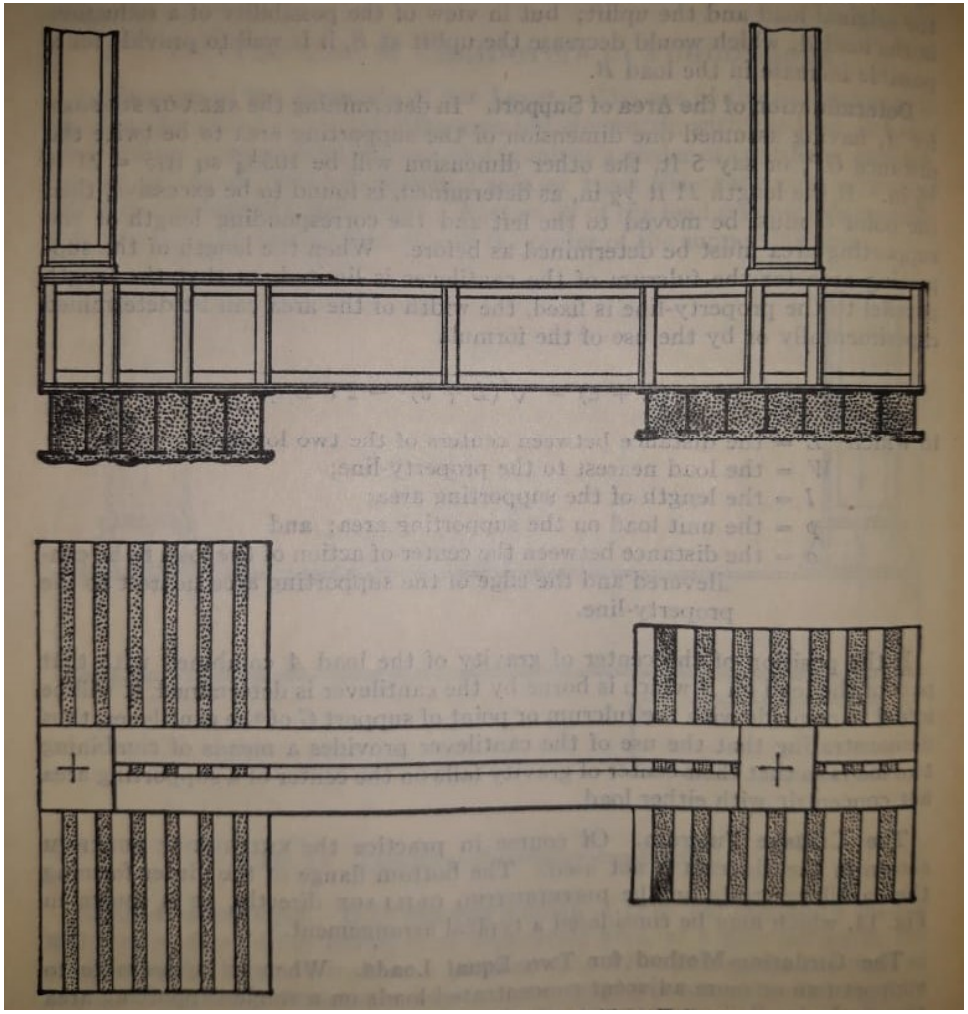
PEF 3405

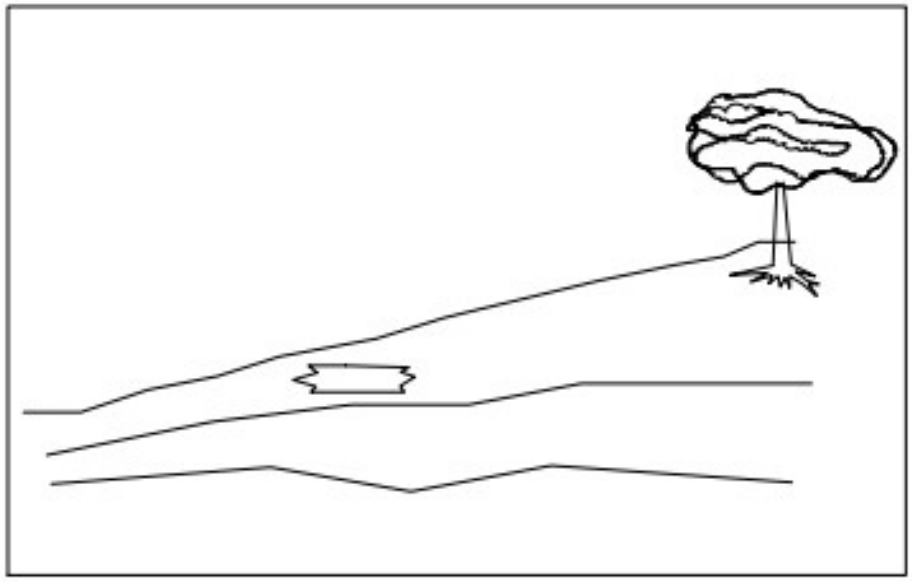
Conceitos iniciais - fundações rasas

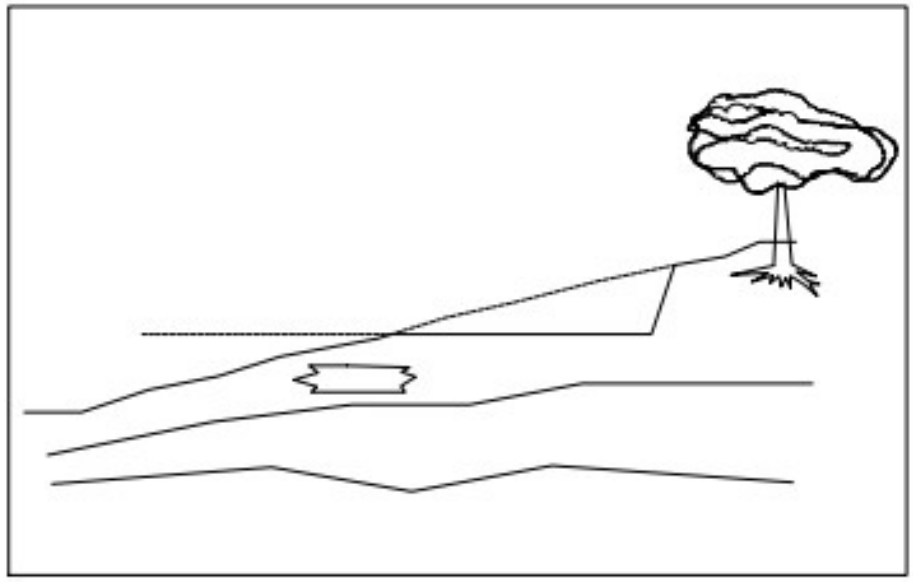


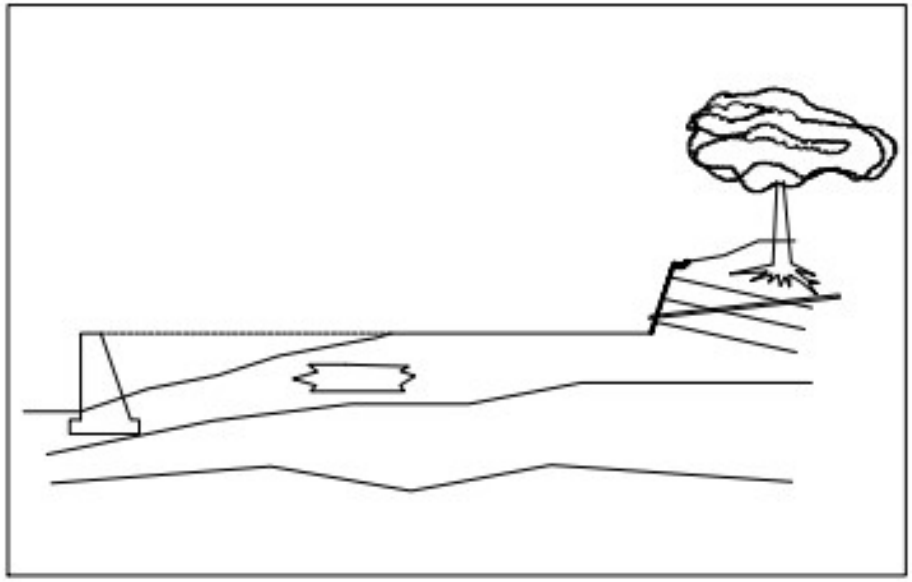
Sapatas com viga alavanca – solução com uso de vigas mistas de aço e concreto (Thomas Nolan. T. The use of cantilevers in foundations. Kidder-Parker architects and builders handbook. Wiley & Sons, 1949. 18a Ed. Cap. I, p. 170.)

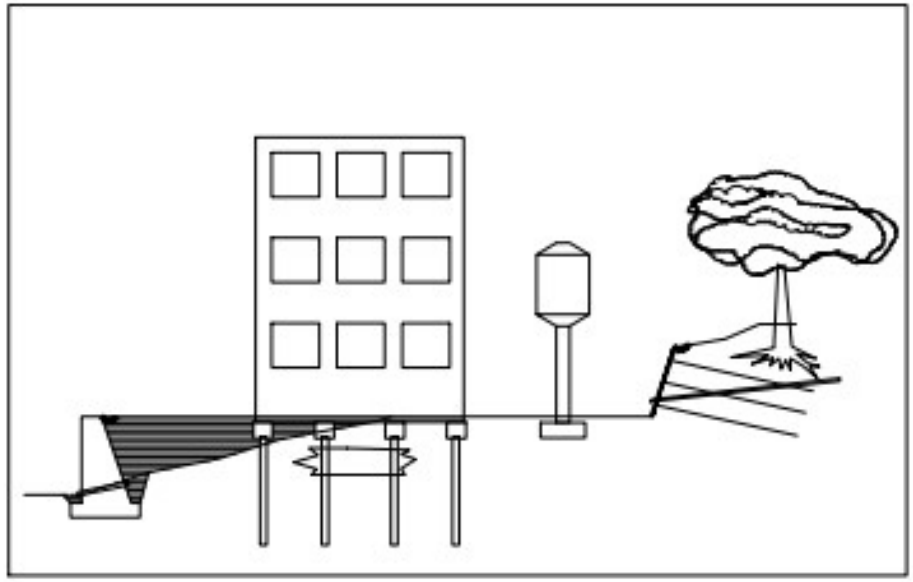
FUNDAÇÕES E CONTENÇÕES

- FUNDAÇÕES
  - Rasas (ou diretas);
  - Profundas;
  - Especiais;
- CONTENÇÕES
  - Aterros;
  - Escavações;
  - Taludes naturais;









FUNDAÇÕES RASAS

- Algumas formas usuais;
  - Sapatas isoladas e blocos;
  - Sapatas corridas;
  - Sapatas associadas;
  - Sapatas excêntricas com viga alavanca (ou viga de equilíbrio);
  - Radier;
- Transferência dos esforços para o maciço;
  - Tensões na interface entre o elemento de fundação e o solo;
  - Tensões no interior do maciço;
  - Deformações (recalques);

DESLOCAMENTOS NA SUPERFÍCIE

Teoria da Elasticidade (aplicação, com simplificações, ao caso de fundação do tipo sapata)

$$\rho = \sigma \times B \times \frac{1-\nu^2}{E} \times I_\rho$$

$$I_\rho = \frac{1}{\pi} \times \left[\ell \times \ln \frac{1+\sqrt{\ell^2+1}}{\ell} + \ln\left(\ell + \sqrt{\ell^2+1}\right) \right]$$

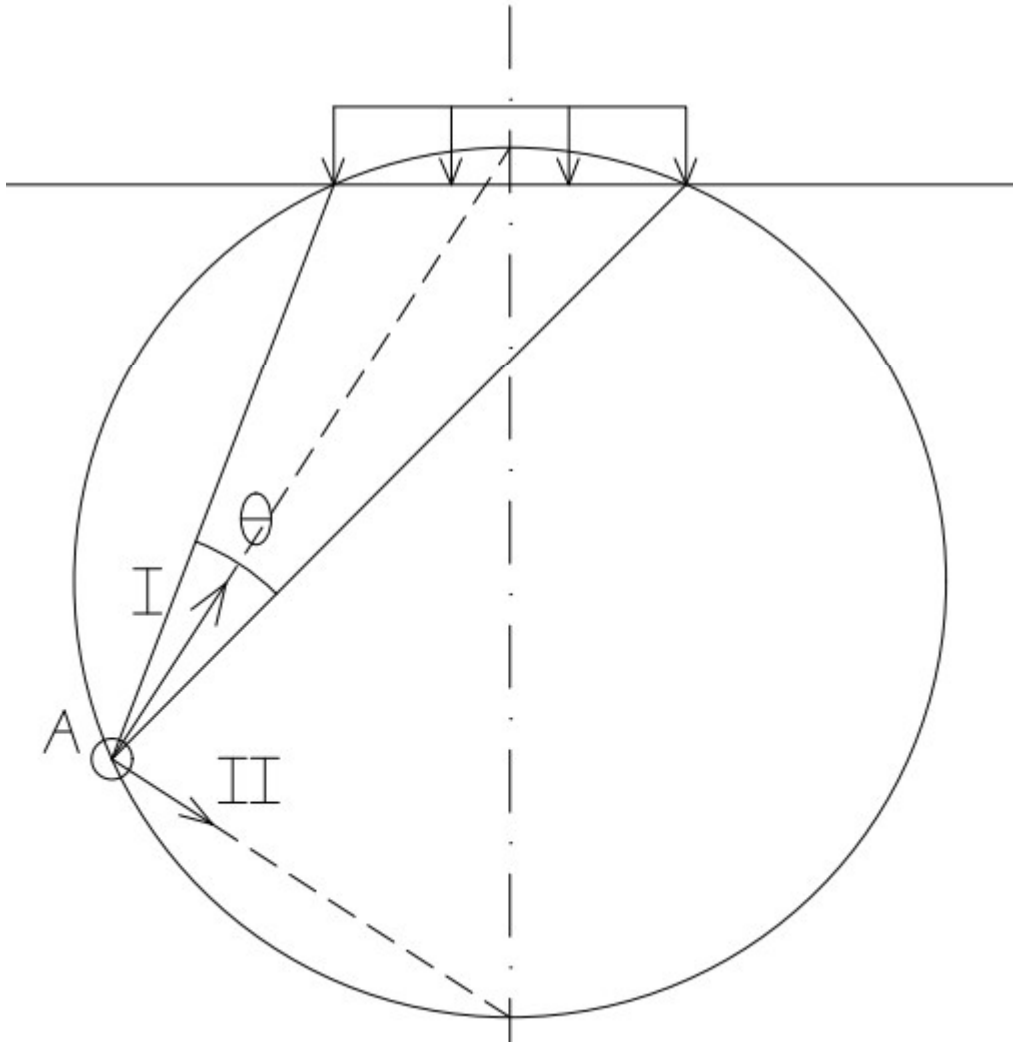
$$\ell = \frac{L}{B}$$

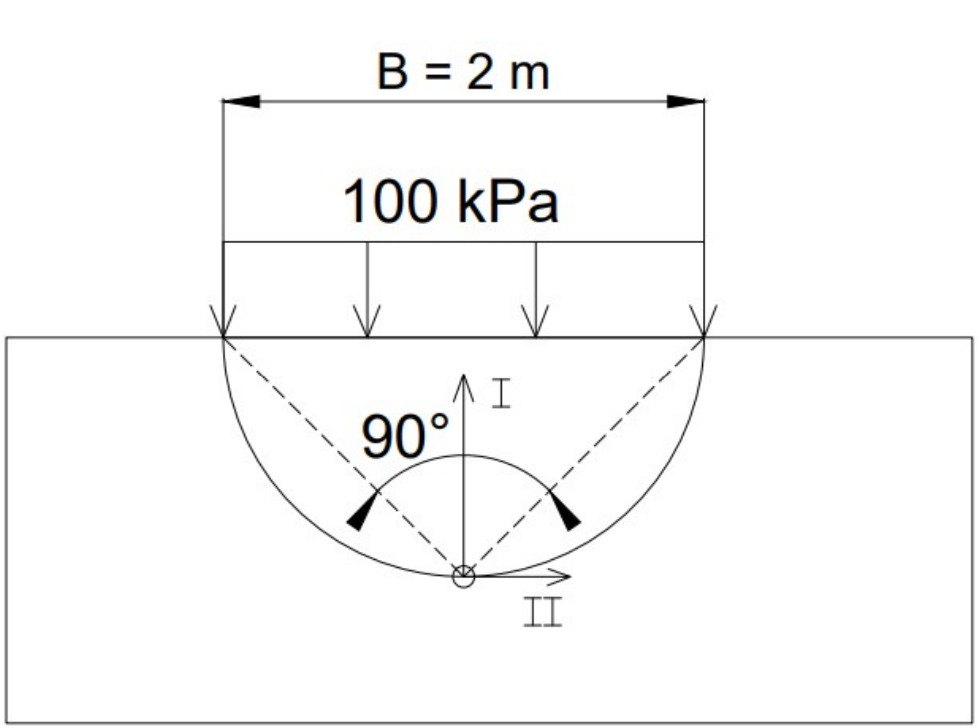
TENSÕES NO INTERIOR DO MACIÇO

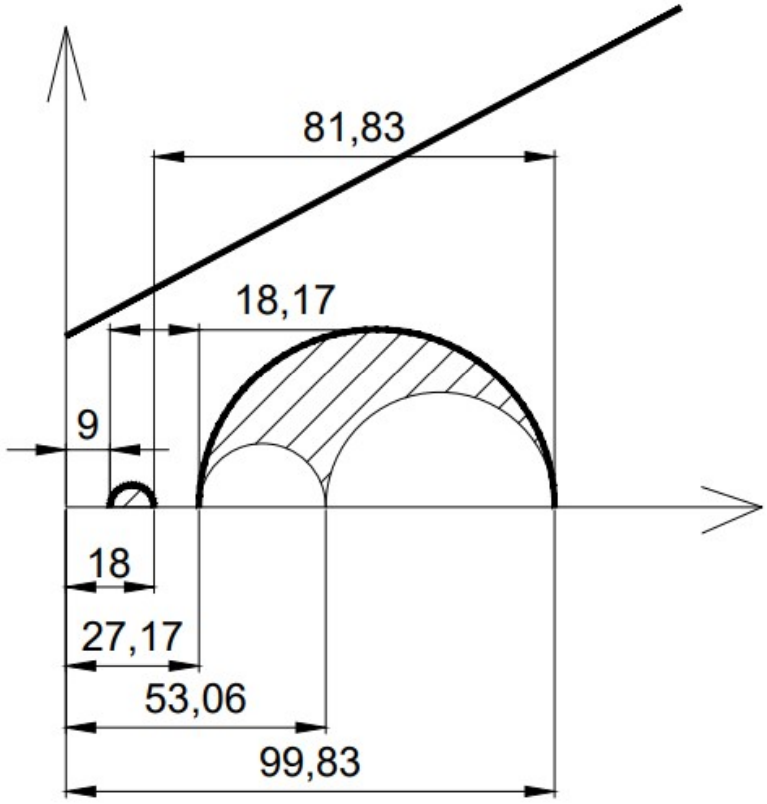
Teoria da Elasticidade (aplicação, com simplificação, ao caso de fundação corrida)

$$\sigma_{I,II} = \frac{\sigma_o}{\pi} \times (\theta \pm \sin\theta)$$

$$\tau_{máx} = \frac{\sigma_o}{\pi} \times \sin\theta$$




B = 2 m
100 kPa
90°
I
II


81,83
18,17
9
18
27,17
53,06
99,83

CAPACIDADE DE CARGA
Equação de Terzaghi para sapata corrida em situação drenada

$$\sigma_u = c' \times N_c + q' \times N_q + \frac{1}{2} \times \gamma' \times B \times N_\gamma$$

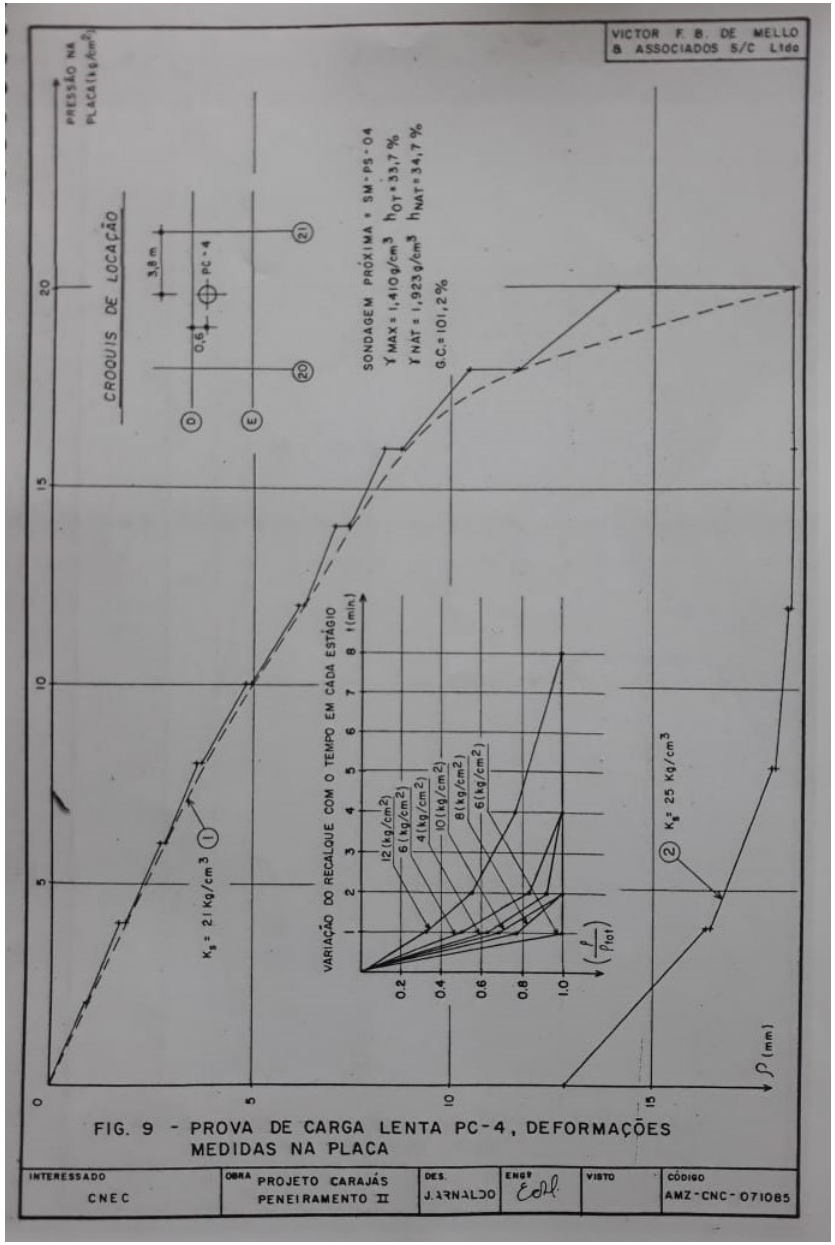
$$N_q = N_\varphi \times e^{\pi \times \tan \varphi}$$

$$N_c = (N_q - 1) \times \cot \varphi$$

$$N_\gamma = 2 \times (N_q - 1) \times \tan \varphi$$

$$N_\varphi = \frac{1 + \sin \varphi}{1 - \sin \varphi}$$

PROVA DE CARGA EM PLACA



Experimento numérico - Plaxis

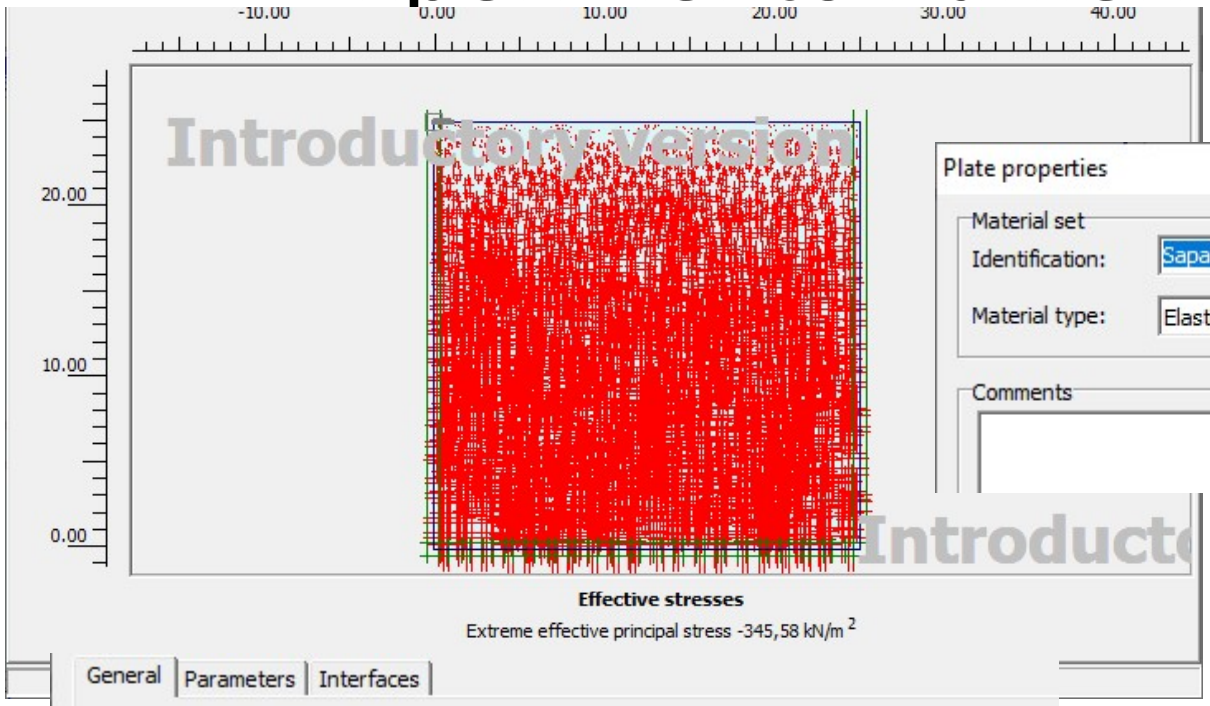


Plate properties

Material set
Identification: Sapata
Material type: Elastic

Comments

Properties
EA : 1,200E+07 kN/m
EI : 3,600E+05 kNm 2/m
d : 0,600 m
w : 15,000 kN/m/m
ν : 0,200

General | Parameters | Interfaces

Material set
Identification: solo
Material model: Mohr-Coulomb
Material type: Drained

General properties
γunsat 18,000 kN/m 3
γsat 20,000 kN/m 3

Mohr-Coulomb - Solo

General | Parameters | Interfaces

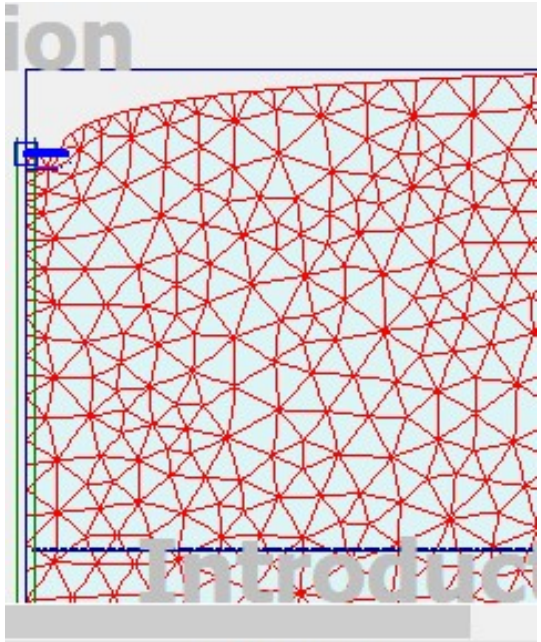
Strength
Rigid
Manual
R_{inter} : 1,000

Real interface thickness
δ-inter : 0,000

General | Parameters | Interfaces

Stiffness
E_{ref} : 4,000E+04 kN/m 2
ν (nu) : 0,350

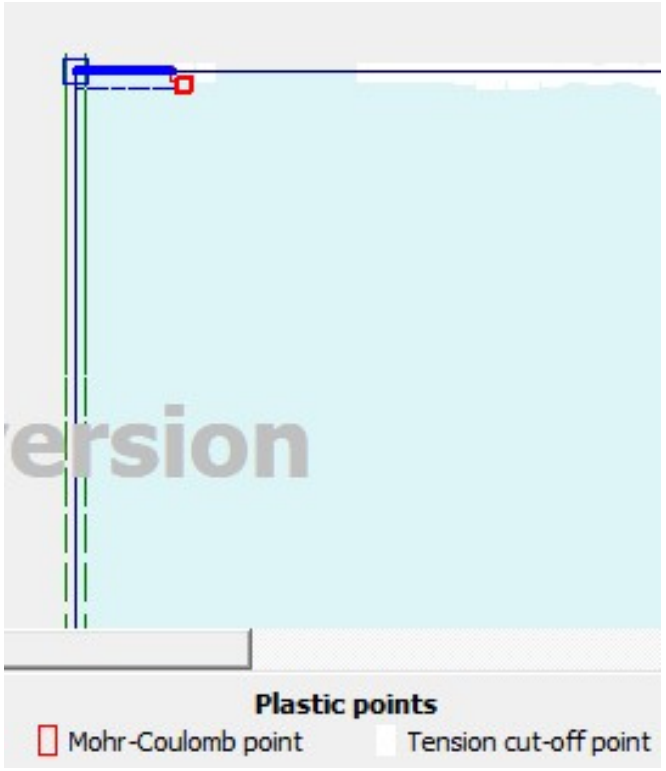
Strength
c_{ref} : 30,000 kN/m 2
φ (phi) : 28,000 °
ψ (psi) : 0,000 °



Deformed mesh

Extreme total displacement $10{,}57 * 10^{-3}$ m

(displacements scaled up 200,00 times)

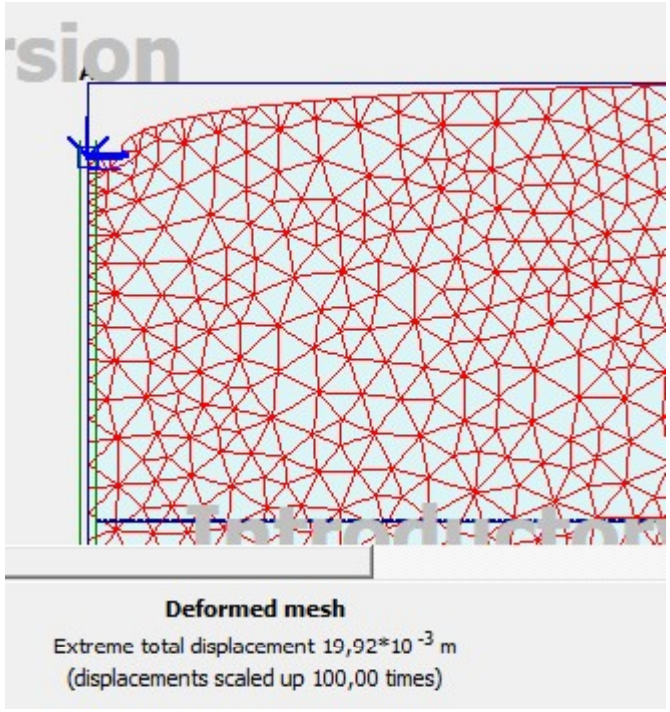


Plastic points

Mohr-Coulomb point Tension cut-off point

Effective normal stresses

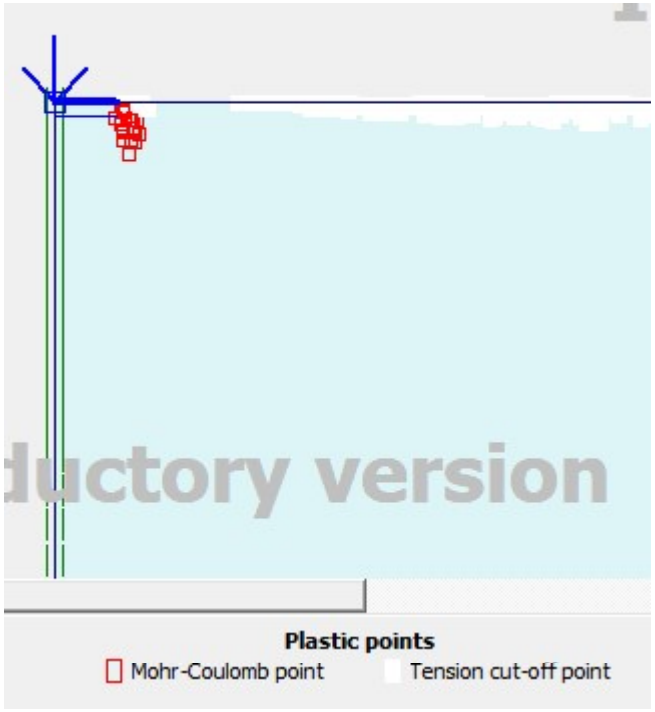
Extreme effective normal stress 530,91 kN/m^2



Deformed mesh

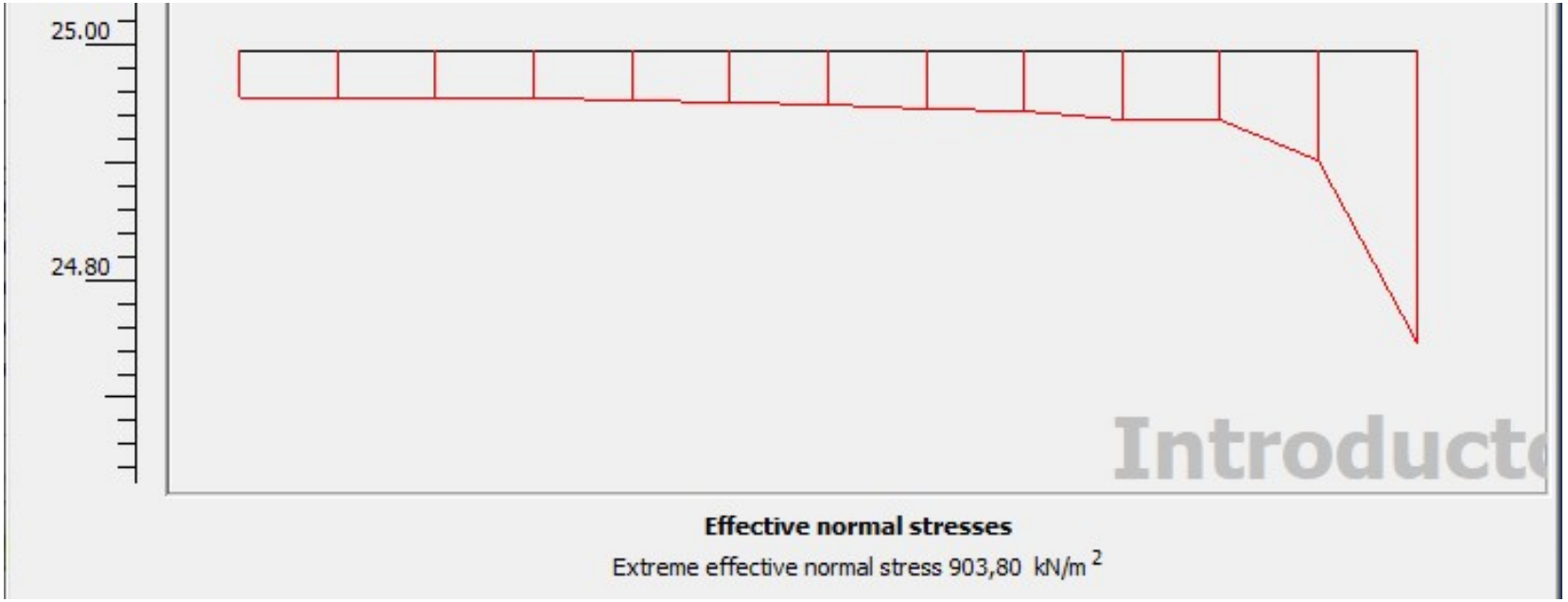
Extreme total displacement 19,92*10 $^{-3}$ m

(displacements scaled up 100,00 times)



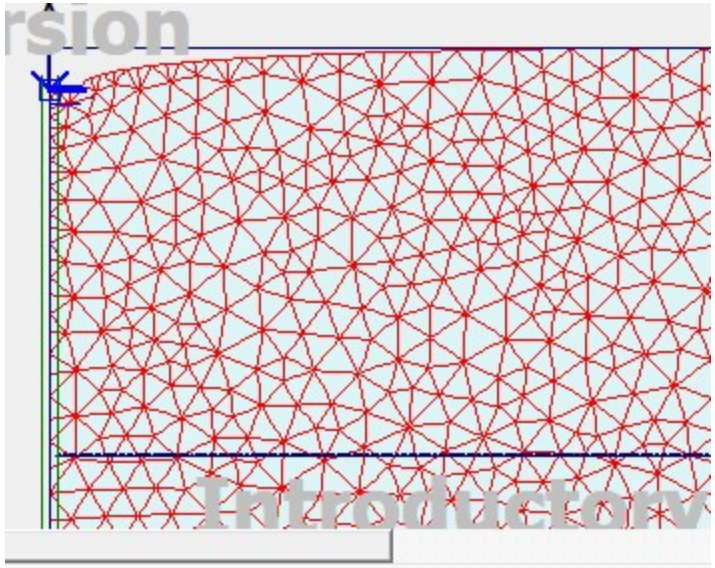
Plastic points

Mohr-Coulomb point Tension cut-off point



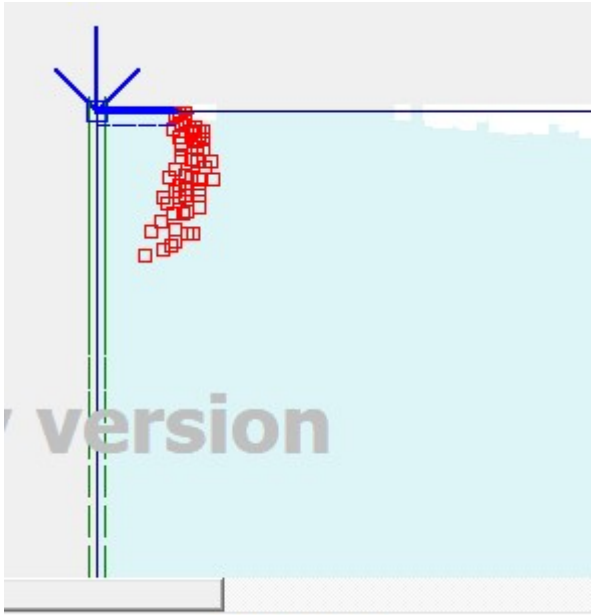
Effective normal stresses

Extreme effective normal stress 903,80 kN/m ^{2}



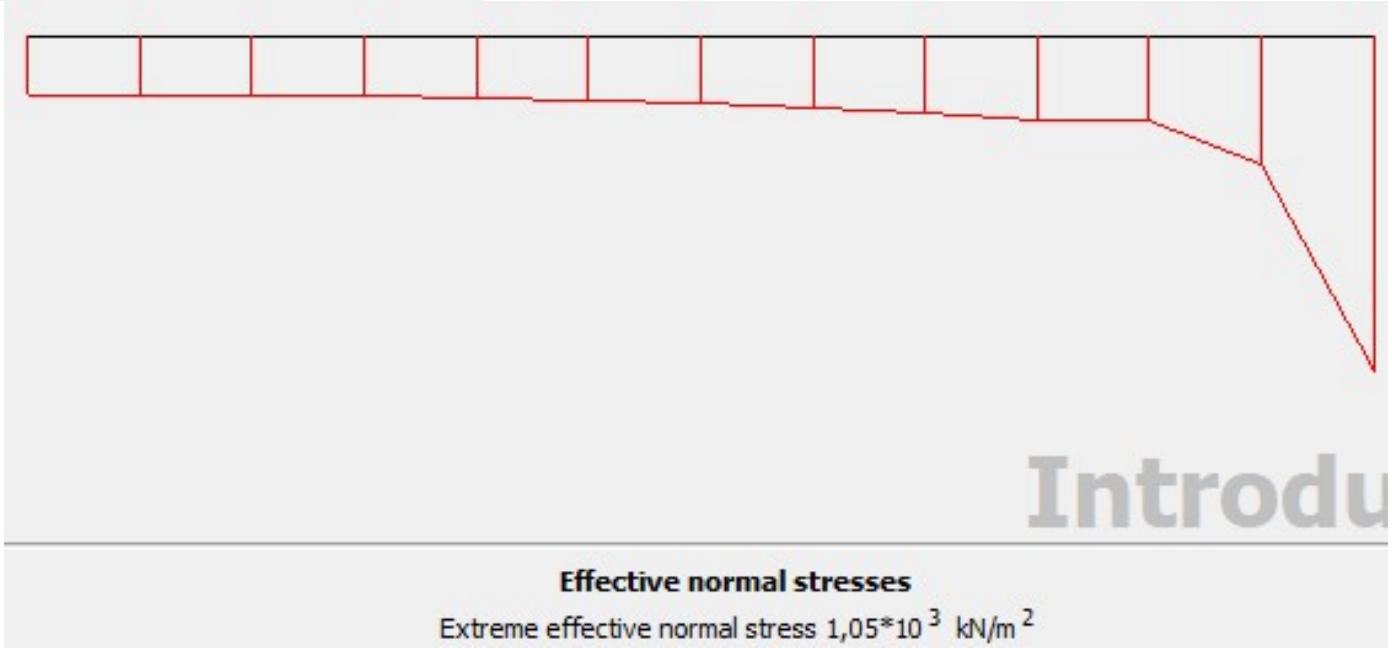
Deformed mesh

Extreme total displacement 24,87*10 $^{-3}$ m
(displacements scaled up 50,00 times)



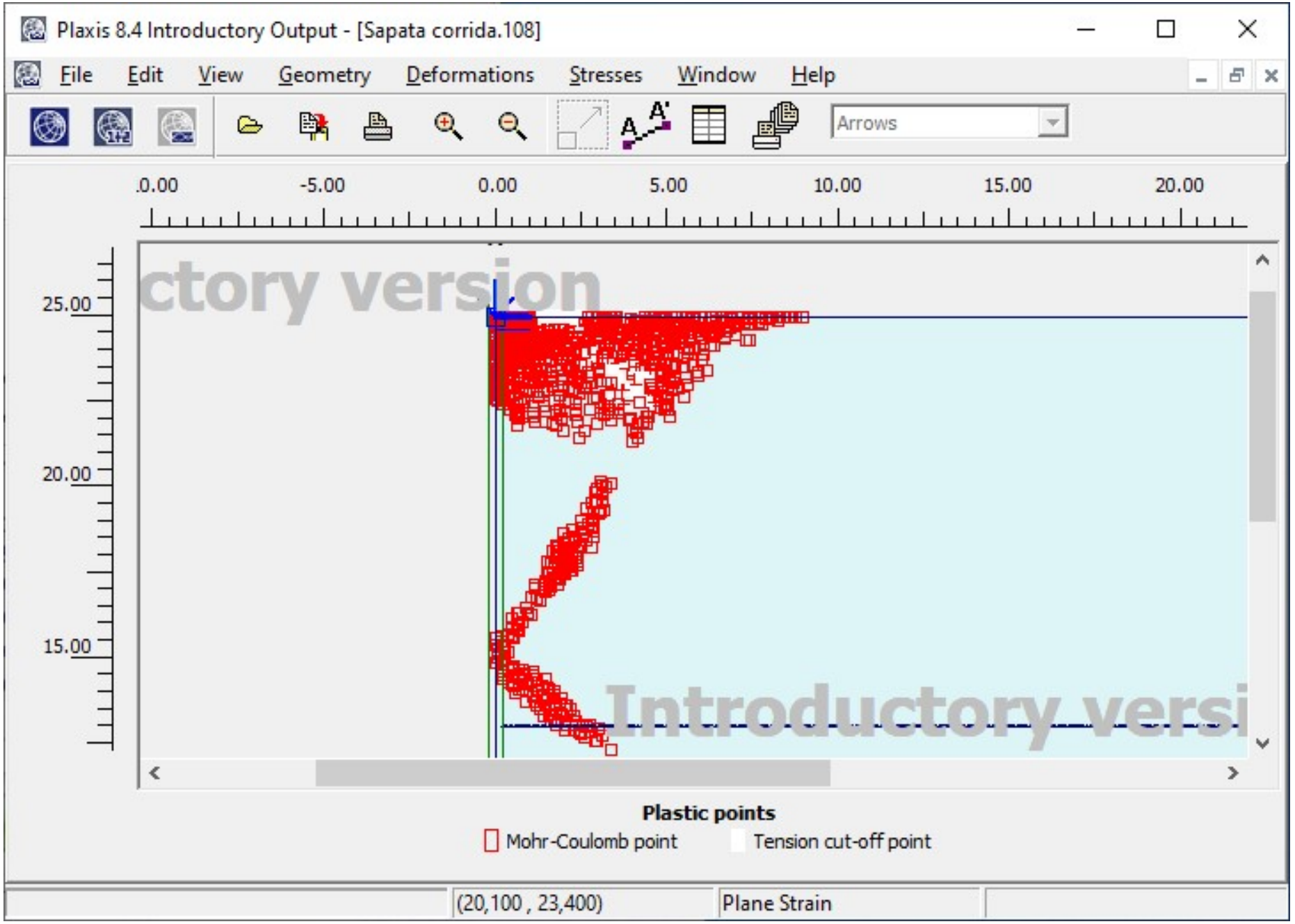
Plastic points

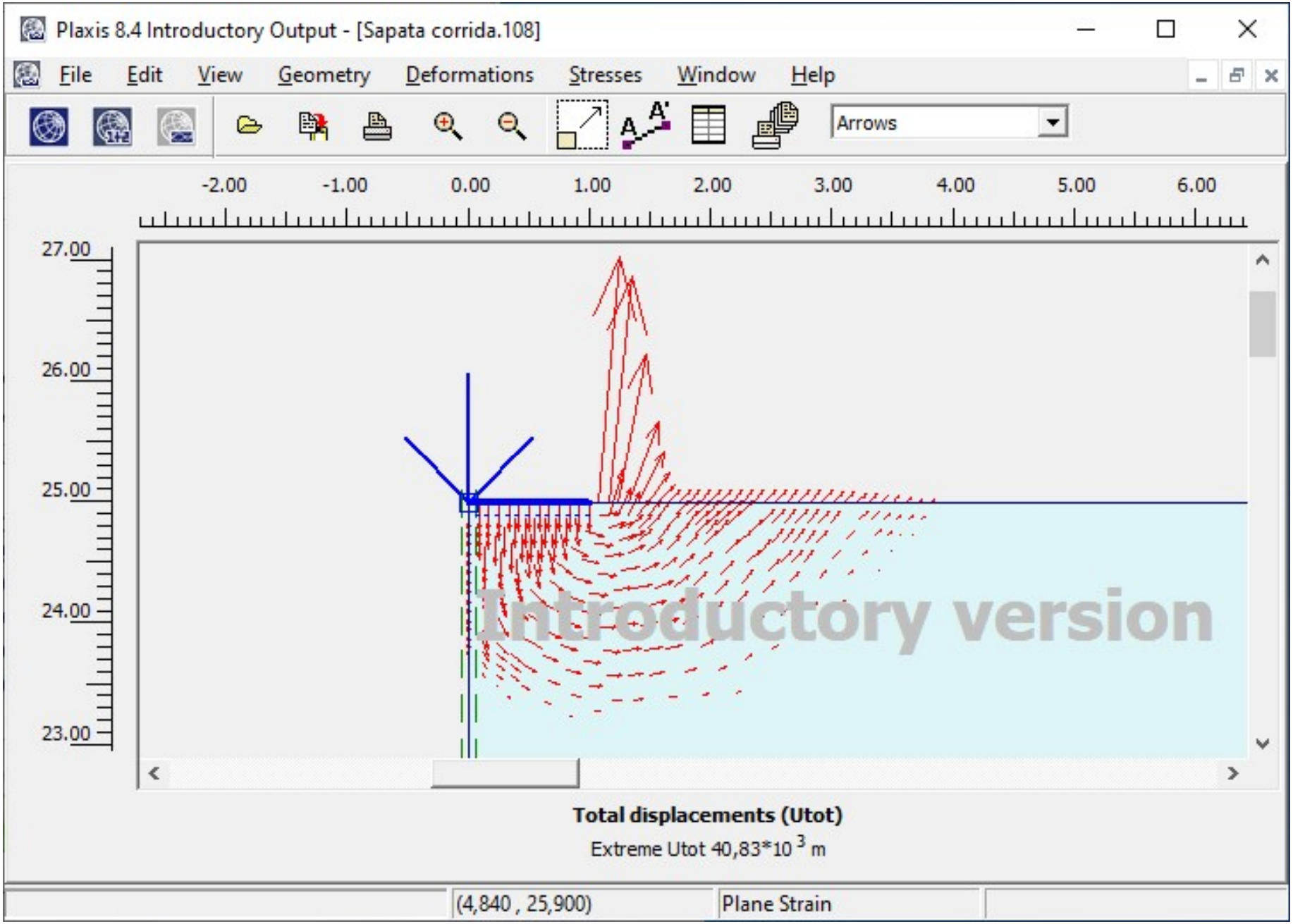
Mohr-Coulomb point Tension cut-off point



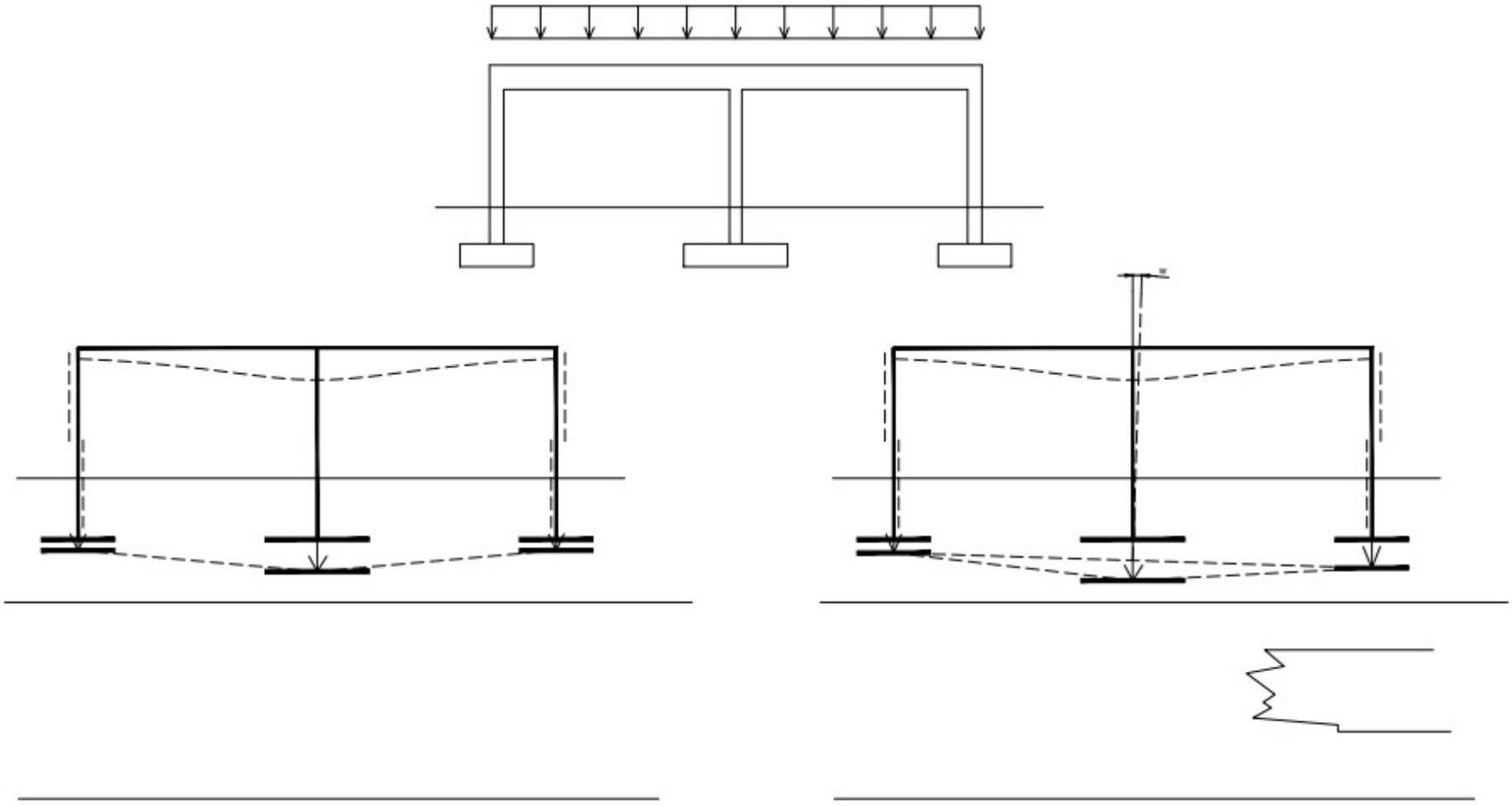
Effective normal stresses

Extreme effective normal stress 1,05*10 ^{3} kN/m ^{2}

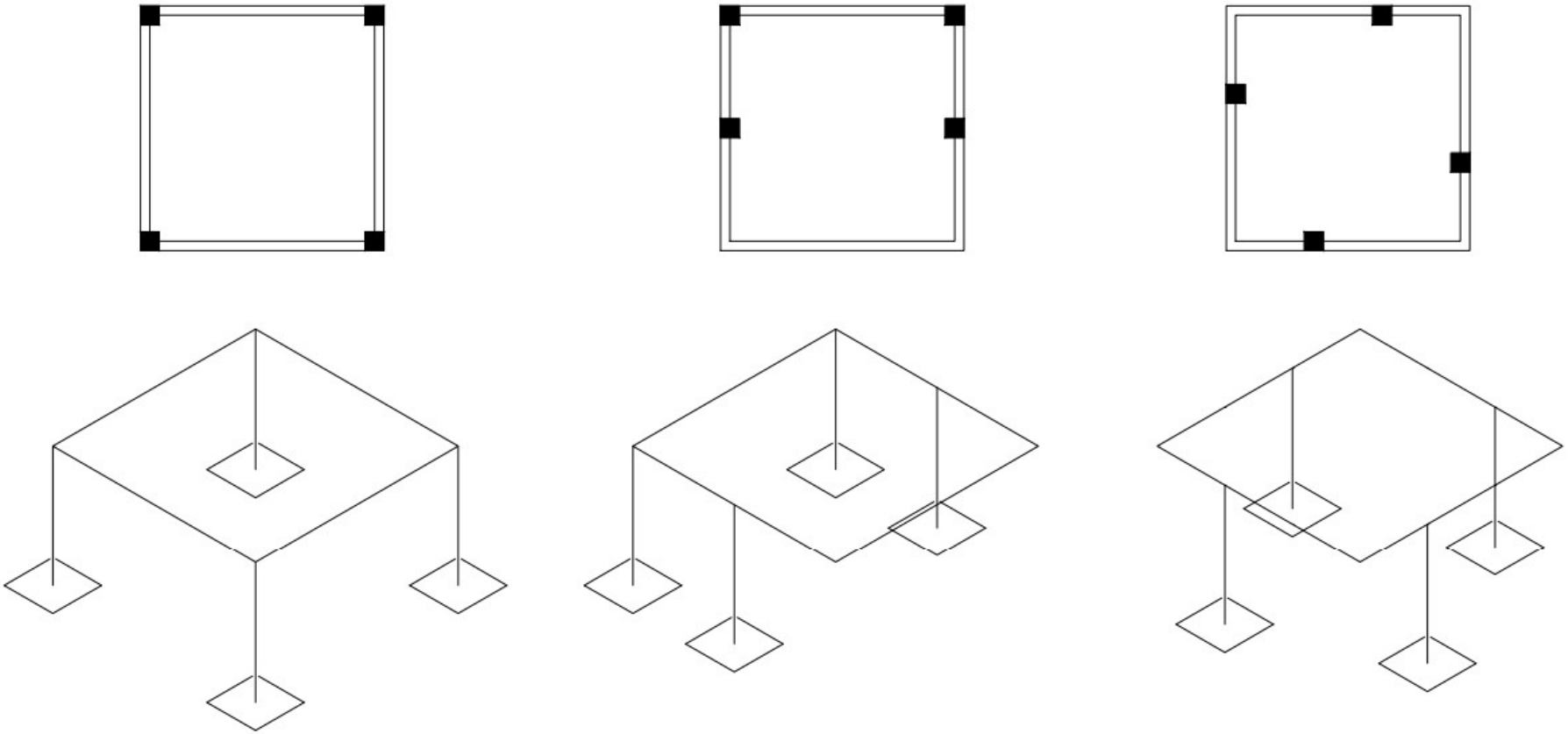

Plaxis 8.4 Introductory Output - [Sapata corrida.108]
File
Edit
View
Geometry
Deformations
Stresses
Window
Help
Arrows
.0.00
-5.00
0.00
5.00
10.00
15.00
20.00
25.00
20.00
15.00
ctory version
Introductory versi
Plastic points
Mohr-Coulomb point
Tension cut-off point
(20,100 , 23,400)
Plane Strain


Plaxis 8.4 Introductory Output - [Sapata corrida.108]
File
Edit
View
Geometry
Deformations
Stresses
Window
Help
Arrows
-2.00
-1.00
0.00
1.00
2.00
3.00
4.00
5.00
6.00
27.00
26.00
25.00
24.00
23.00
Introductory version
Total displacements (Utot)
Extreme Utot 40,83*10 3 m
(4,840 , 25,900)
Plane Strain

INTERRELAÇÃO ENTRE SOLO, FUNDAÇÃO E ESTRUTURA



Regularidade da estrutura



ELU / ELS

- Estados limites são estados a partir dos quais a estrutura apresenta desempenho inadequado às finalidades da construção;
- E. L. Último: associados com perda de equilíbrio, ruptura, instabilidade;
  - Determinam paralisação do uso;
- E. L. Serviço: associados com danos ligeiros, deformações, vibrações;
  - Impedem o uso normal ou comprometem a durabilidade;

CARGAS USUAIS NAS FUNDAÇÕES

- Ações a considerar no projeto:
  - Permanentes;
  - Variáveis;
  - Excepcionais;
- Alguns exemplos:
  - Edifícios: residenciais, comerciais, etc.;
  - Galpões para diversas finalidades;
  - Obras de arte especiais: galerias, pontes e viadutos;
  - Reservatórios;
  - Torres para diversos fins;
  - Outros;