PRACTICE 1 Exercise 3

COMPUTATIONAL STRUCTURAL MECHANICS AND DYNAMICS

Marcos Boniquet Aparicio

It's chosen a problem type: *Plane_State.*

Material, self weight condition, and constraints are settled.

The particular case for the plate structure of concrete **without steel plates** is calculated, in order to compare it with the latter.

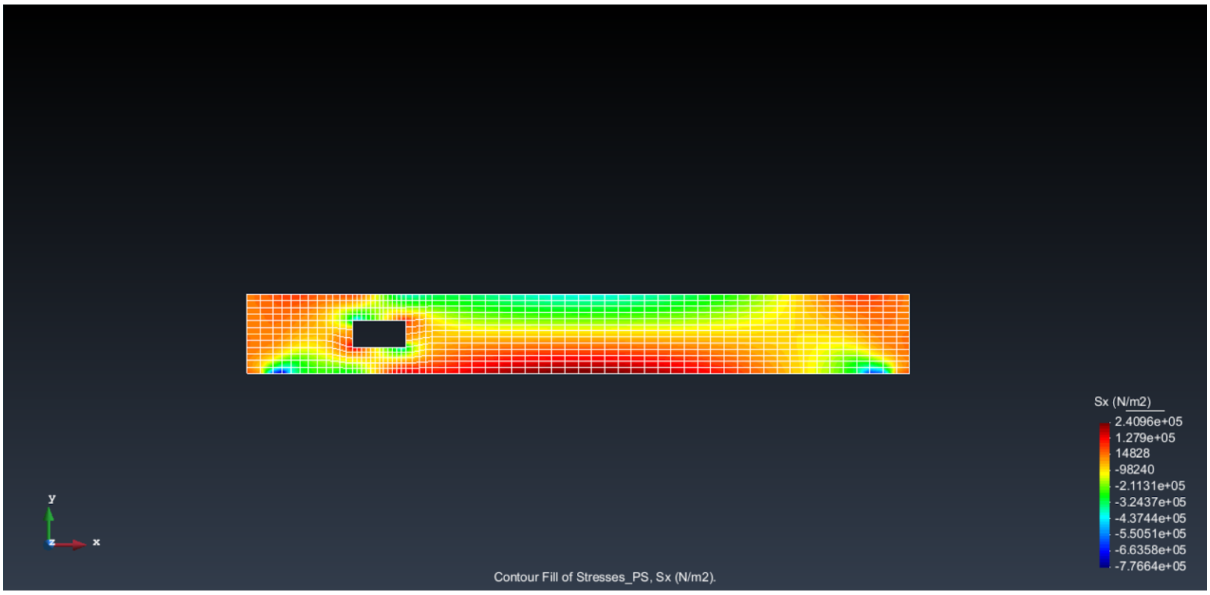
Concrete:
*E=3*10^{10} Pa*
ν=0,2
thickness=0,25 m

Steel:
*E=2,1*10^{11} Pa*
ν=0,3
thickness=0,016 m

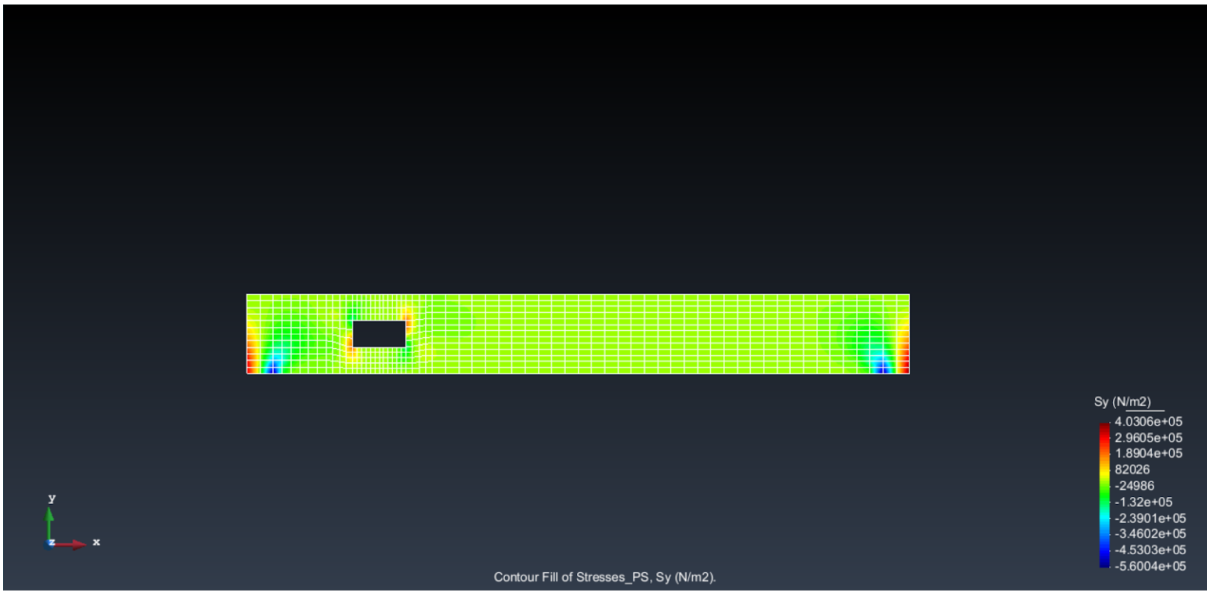
*It's been built a quadrilateral 4-node mesh 772 elements and 864 nodes, thus 864-6 fixed nodes, and two DoF by node=**1716 DOF.** Mesh is finer near the hole.*

Without steel plates

Stresses:

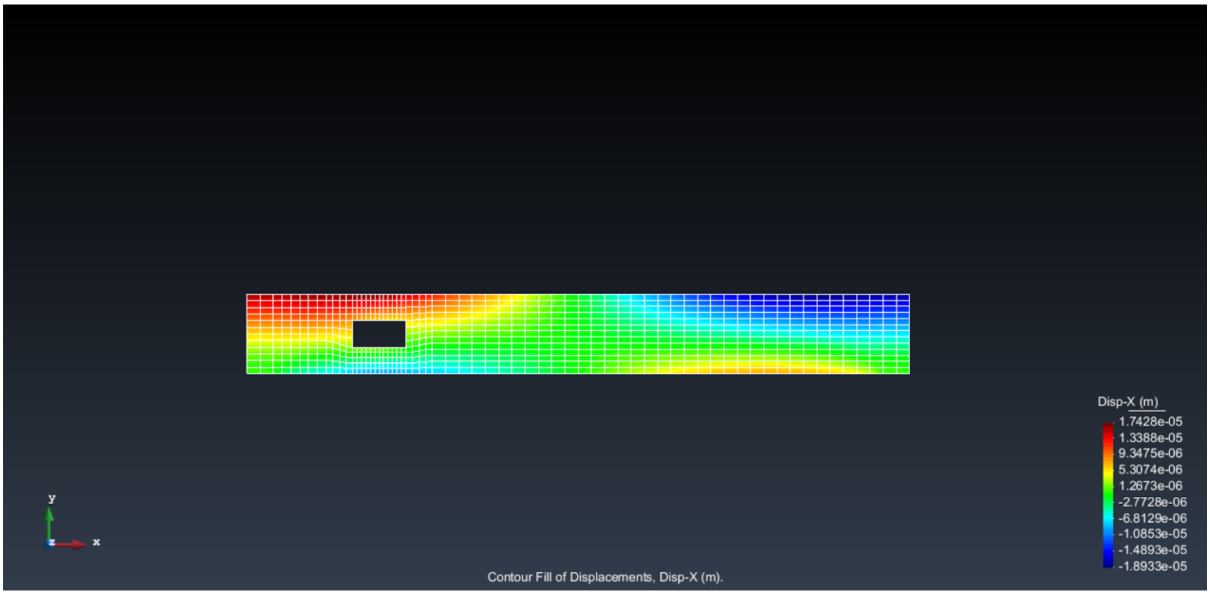


Sx [N/m2]



Sy [N/m2]

Displacements:



x-Displacement [m]

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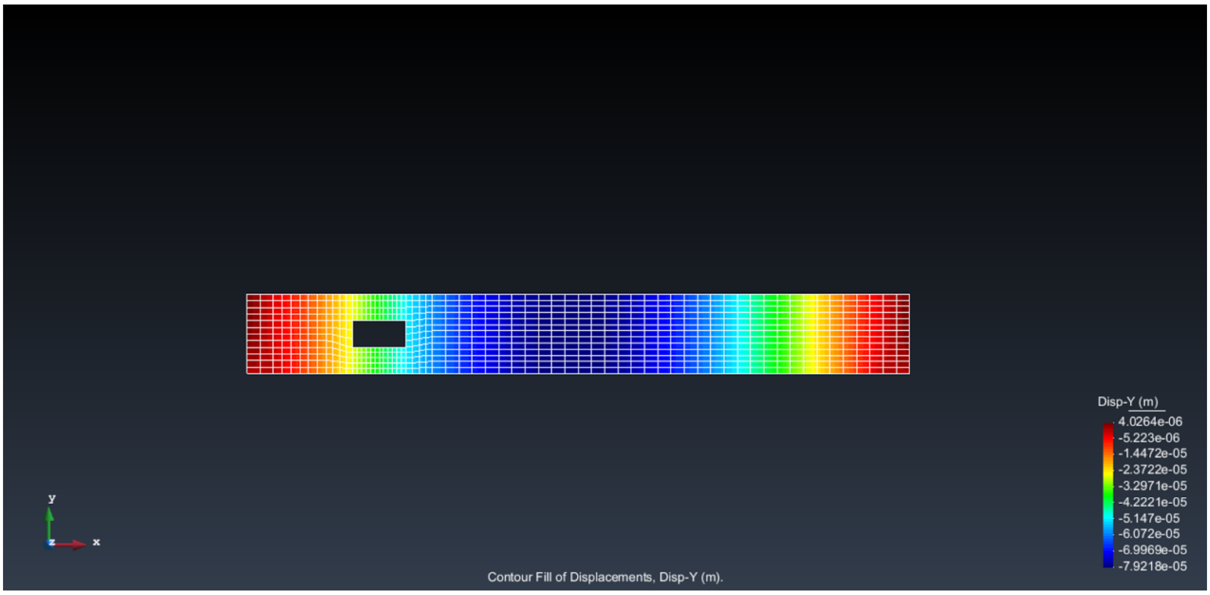
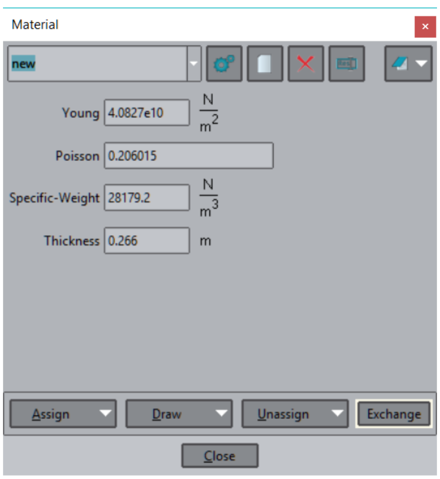


y-Displacement [m]

Summarizing, for ALL-concrete assumption:

S_x^{max}=**$2{,}41*10^5$** N/m^2 and **$7{,}77*10^5$** N/m^2 at the bottom-center of the plate and at the *fixed* elements respectively, corresponding to the compression and traction respectively.
S_y^{max}=**$4{,}03*10^5$** N/m2 and **$5{,}6*10^5$**N/m2 , compression and traction at the fixed elements.
δ_x^{max}=**$1{,}74*10^{-5}$** m and **$1{,}89*10^{-5}$** m, at left and right top corners.
δ_y^{max}=**$7{,}92*10^{-5}$** m at the bottom-center of the plate.

Now it's time to consider **both steel plates.** The problem is focused as plane-stress problem. We consider a new material in the zone where the plates are, with properties which belong to the weight (width) of each material. This is 96% concrete and a mere 4% (aprox.) of steel.



New mat. assumption

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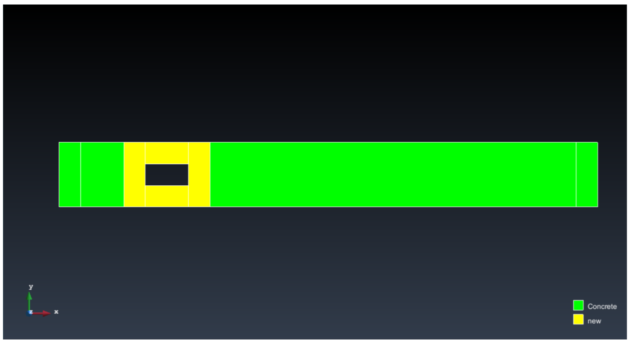
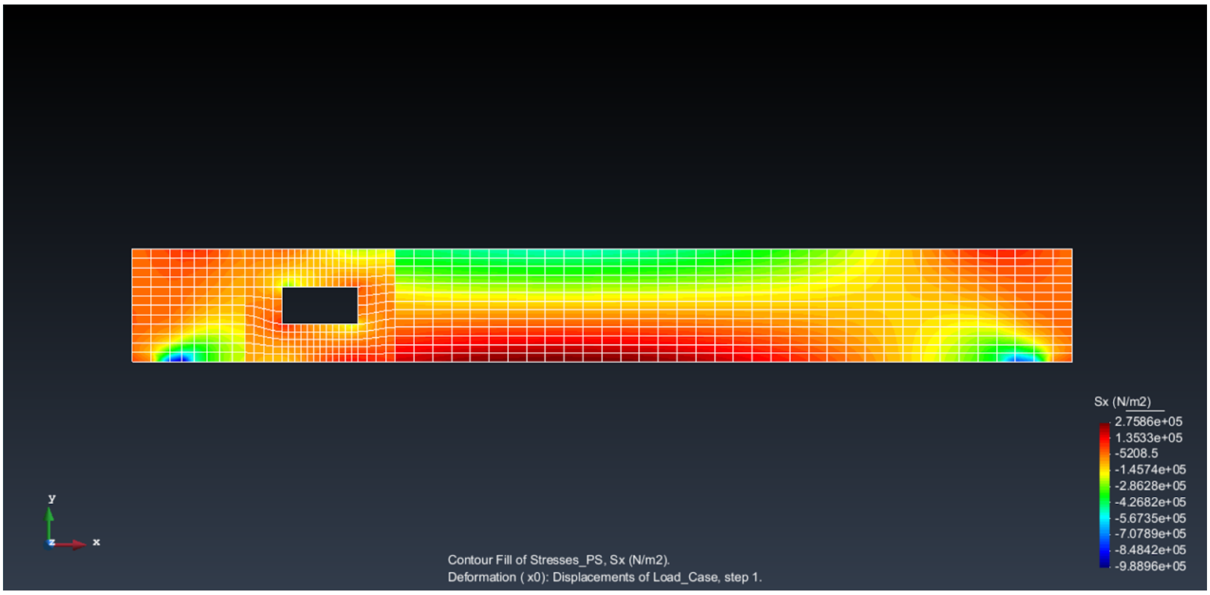
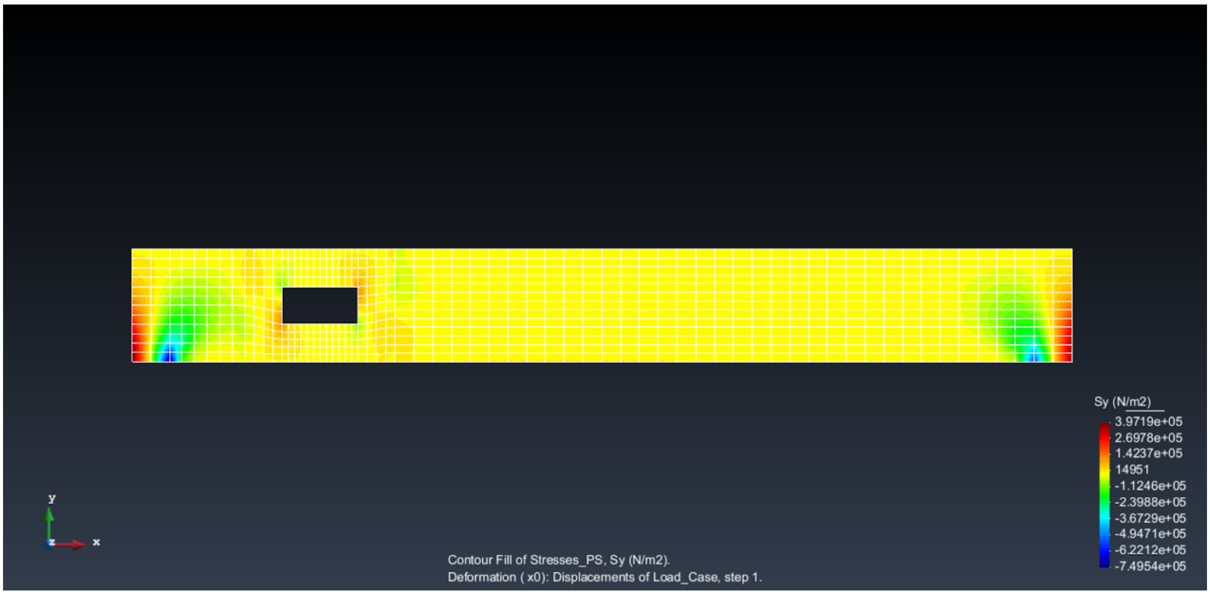


Material distribution

Stresses:

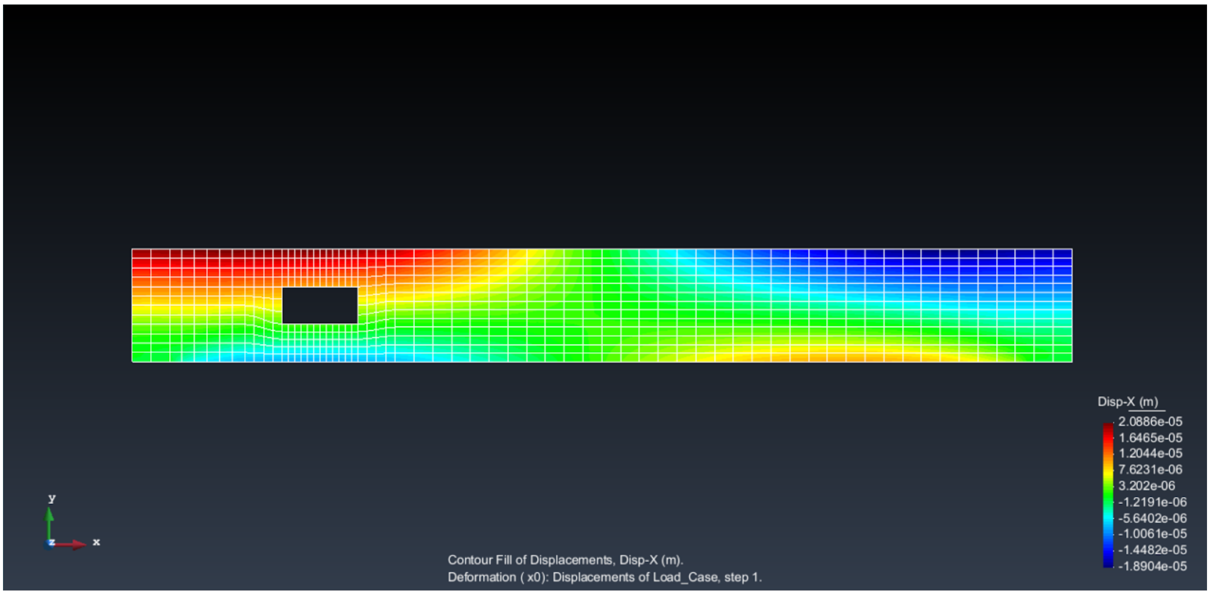


Sx [N/m2]

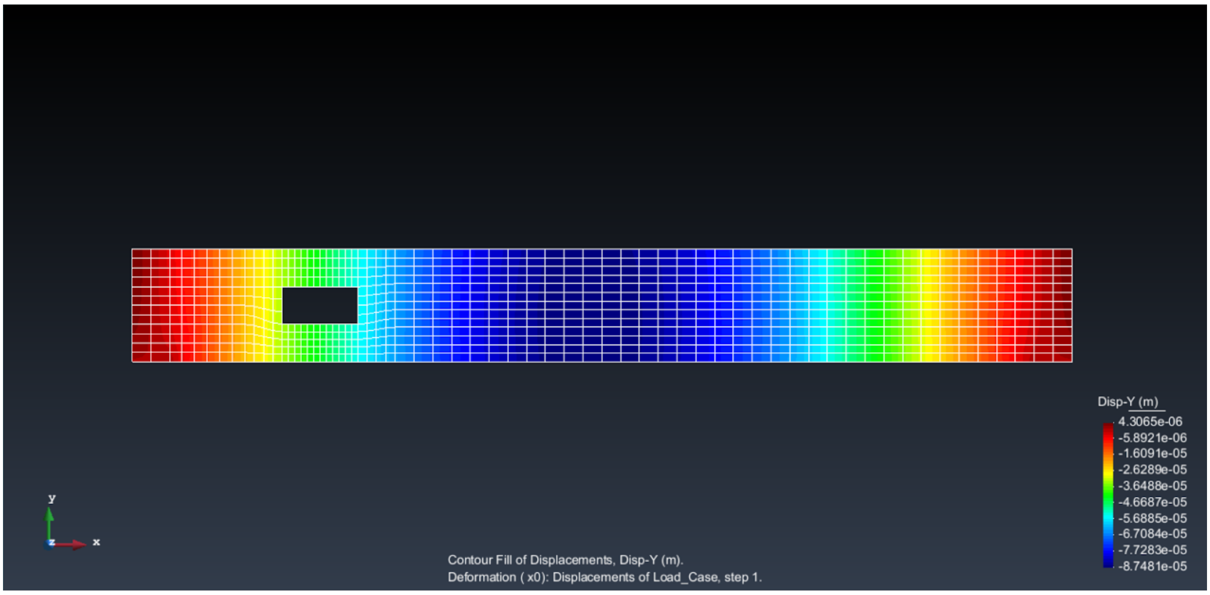


Sy [N/m2]

Displacements:



x-Displacement [m]



y-Displacement [m]

Summarizing, for case with steel plates attached:

S_x^{max}=**$2,76*10^5$** N/m^2 and **$9,89*10^5$** N/m^2 at the bottom-center of the plate and at the *fixed* elements respectively, corresponding to the compression and traction respectively.
S_y^{max}=**$3,97*10^5$** N/m2 and **$7,49*10^5$**N/m2 , compression and traction at the fixed elements.
δ_x^{max}=**$2,08*10^{-5}$** m and **$1,89*10^{-5}$** m, at left and right top corners.
δ_y^{max}=**$8,748*10^{-5}$** m at the bottom-center of the plate.

So the overall global values do not vary so much. However, if a more detailed analysis is taken into the steel plates part, higher changes are seen. The comparison takes into account, as demanded, the particular case for stresses (absolute values):

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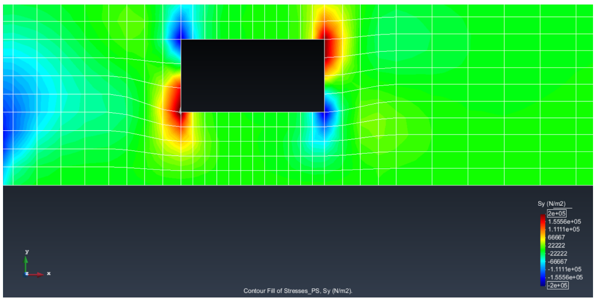
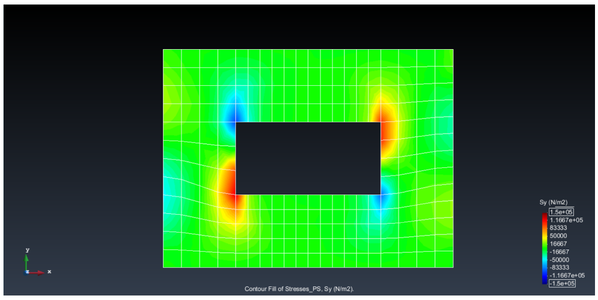
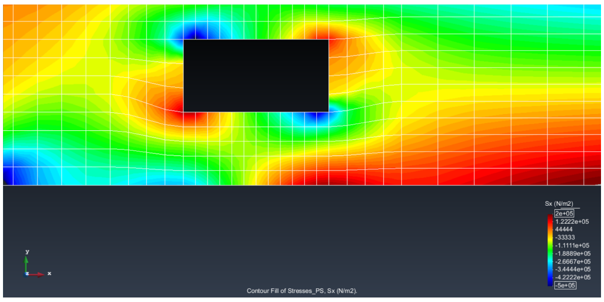
Sx*[N/m2]*:

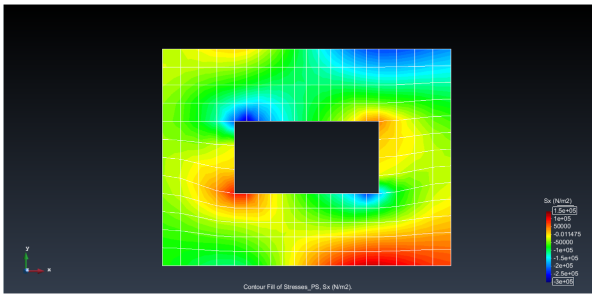

All concrete


With Steels plates

Diminishes from $2*10^{-5}$ to $1,5*10^{-5}$ both in compression and traction. (*-25%*)

Sx*[N/m2]*:


All concrete


With Steels plates

Diminishes from $2*10^{-5}$ to $1,5*10^{-5}$ in compression (*-25%*)
and
Diminishes from $5*10^{-5}$ to $3*10^{-5}$ in traction. (-40%)