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THE ANALYSIS OF FIELD STRESSES OF PLATE WITH FINITE DIMENSIONS THAT IS EQUIPPED WITH HOLES

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ABSTRACT
This paper presents the study of the distributions of the field stresses of a plate with finite dimensions that is equipped with holes of different diameter. The plate was loaded with uniform pressure on exterior side.
Keywords*: Square plate, state of stresses, plate with holes.*

1. INTRODUCTION
This paper tackles with the problem of plane elasticity that is analysed using the method of finite element. There were used plane elements heaving three or four knots. It was analysed the field stresses from a square plate having finite dimensions equipped with three holes, see figure 1. The plate is loading with pressure p_x and/or p_y on out side.

2. THE DETERMINATION OF STRESSES
The analysis of the field stresses has been made for more constructive and loaded plate variants. There were analysed the following variants:

- The out side of plate was loaded with the pressure p_x=0, 1, 2, 3, 4 and p_y=0, 1, 2, 3, 4 [MPa].
- In this case we analysed more loading variants, as follows:
  - the pressure $p_x > p_y$. Between the values of the pressure p_x and pressure p_y it was chosen the following relation: p_x/p_y=(0, 0.25, 0.35, 0.5, 1, 2, 3, 4)
  - the pressure $p_y > p_x$. Between the values of the pressure p_x and pressure p_y it was chosen the following relation: p_y/p_x=(0, 0.25, 0.35, 0.5, 1, 2, 3, 4)

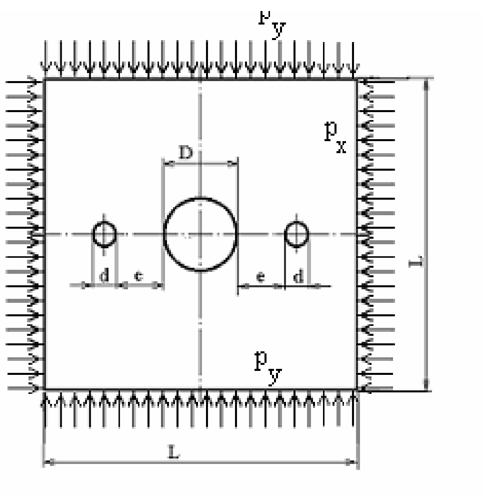

Figure 1. Plate with holes

- The outside dimension of the plate have been modified so that the ratio k=L/D

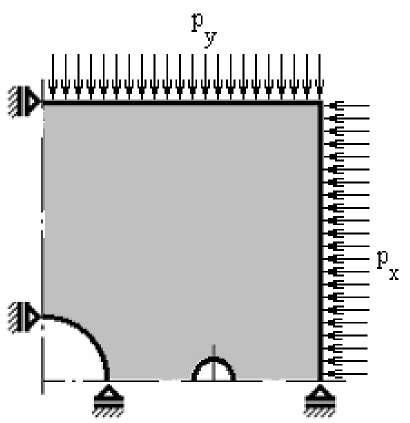

Figure 2. The connection condition and the load.

has the following values k=2.
Because the plate has two axes of symmetry we used for the analysis with finite elements a quarter of plate that has the connection condition shown in figure 2.
We have determined the equivalent stresses, that have been calculated using Tresca's criterion for all constructive and loaded variants that have been shown above.
In figures 3, 4, 5 and 6, it was shown the variation of equivalent stresses calculated using Tresca's criterion for the case when p_x=1…4 [MPa], and p_y=0.

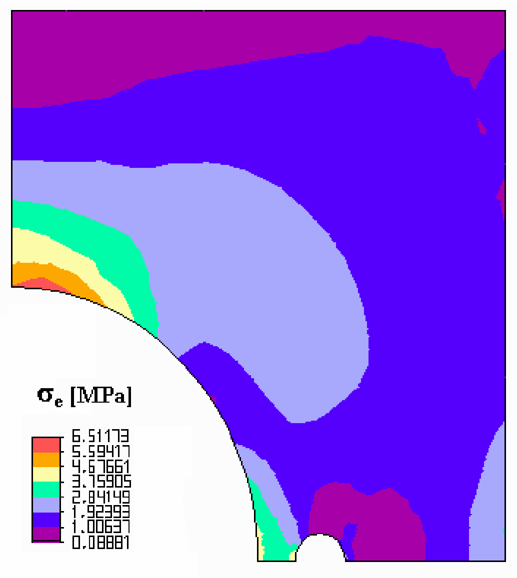

Figure 3. Equivalent stresses for (p_x=1, p_y=0 [Mpa],)

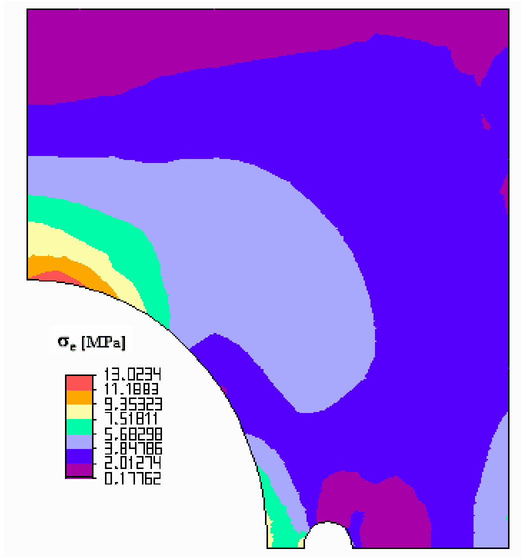

Figure 4. Equivalent stresses for (p_x=2, p_y=0 [Mpa],)

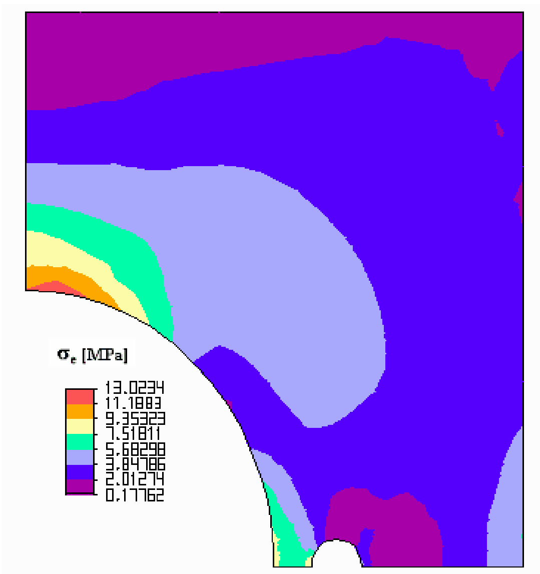

Figure5. Equivalent stresses for (p_x=3, p_y=0 [Mpa],)

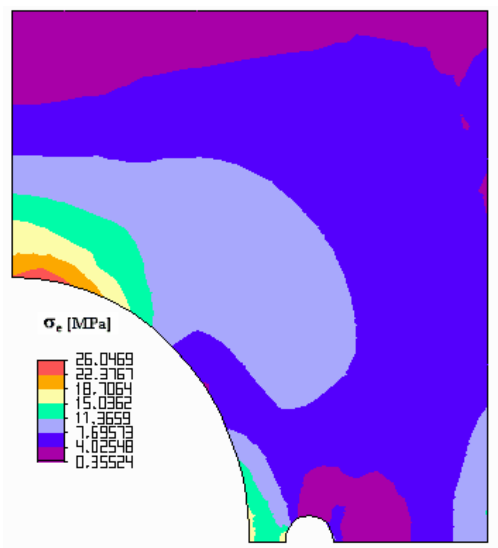

Figure 6. Equivalent stresses for (p_x=4, p_y=0 [Mpa],)

In figures 7, and 8, it was shown the variation of equivalent stresses calculated using Tresca's criterion for the case when p_x= p_y =1 and respective 4 [MPa].

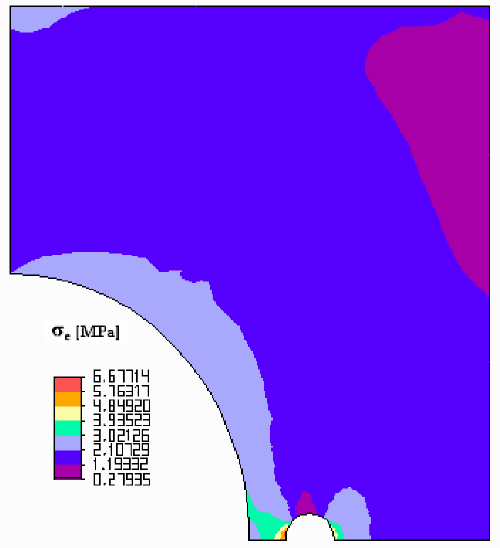

Figure 7. Equivalent stresses for (p_x=1, p_y=1 [Mpa],)

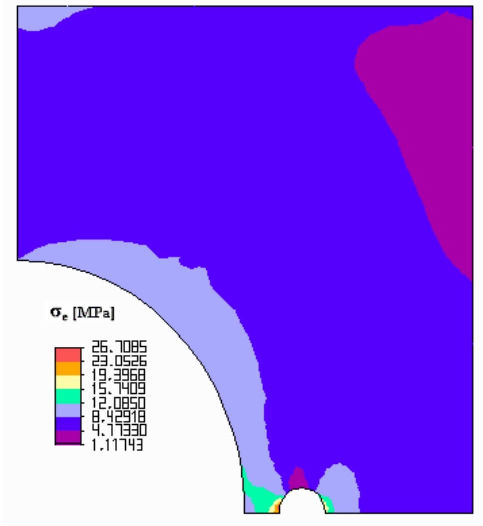

Figure 8. Equivalent stresses for (p_x=4, p_y=4 [Mpa],)

In figures 9, 10, 11 and 12, it was shown the variation of equivalent stresses calculated using Tresca's criterion for the case when p_y=1…4 [MPa], and p_x=0.

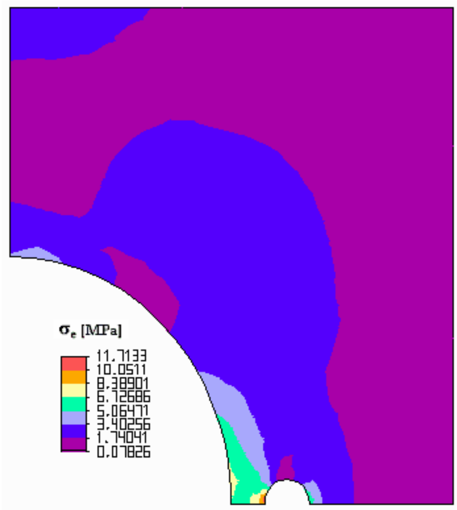

Figure 9. Equivalent stresses for (p_x=0, p_y=1 [Mpa],)

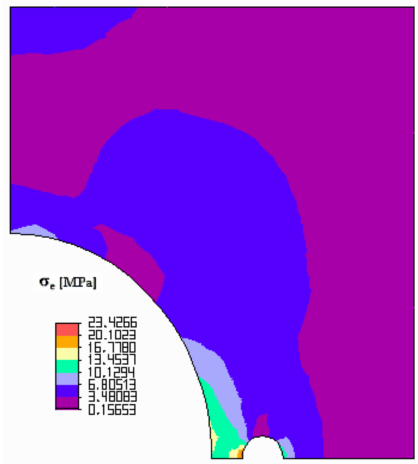

Figure 10. Equivalent stresses for (p_x=0, p_y=2 [Mpa],)

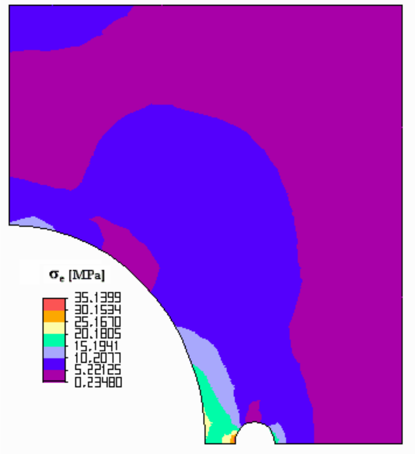

Figure 11. Equivalent stresses for (p_x=0, p_y=3 [Mpa],)

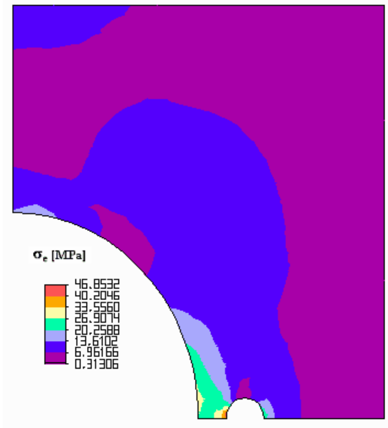

Figure 12. Equivalent stresses for (p_x=0, p_y=4 [Mpa],)

3. RESULTS AND CONCLUSIONS

In figures 13 it was shown the variation of equivalent stresses, calculated using Tresca's criterion, for the case in which p_x takes values [1..4], and p_y=0, and p_y takes values [1..4], and p_x=0. For comparison I shown the variation of equivalent stresses for the case when p_x/p_y=1 and p_x= 1…4 [MPa].

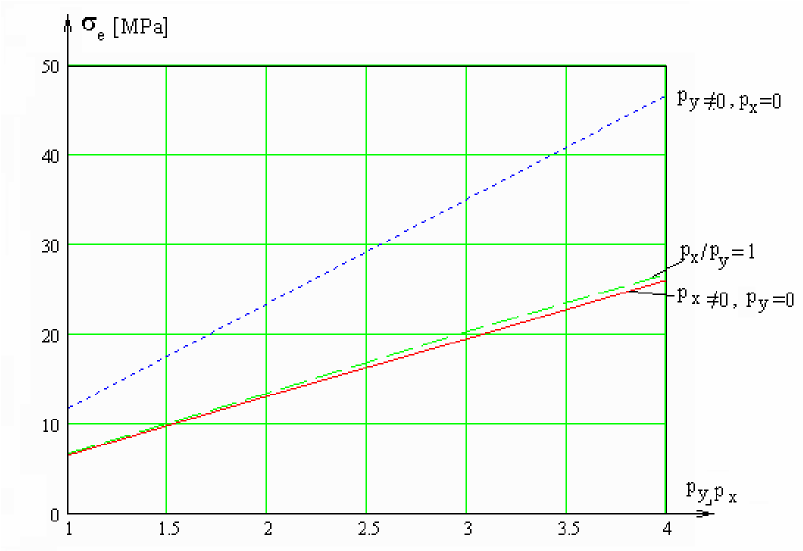

Figure 13. Equivalent stresses

The dangerous zone is at the little hole, for the case when $p_y \neq 0$ and p_x=0.
The dangerous zone is at the big hole, for the case when $p_x \neq 0$ and p_y=0, and $p_{x/}$ p_y=1.

4. REFERENCES

[1] Frățilă M. – "Deteminarea analitică a tensiunilor la un bloc prismatic străbătut de un canal circular de diametru variabil, solicitat la presiune interioară constantă", TENSOMETRIE 7, vol. II, pag. 21-32, Suceava, 17-19 octombrie 1996.
[2] Ponomariov S. D., şa., - "Calculul de rezistenţã în construcţia de maşini", vol. II, EDITURA TEHNICÃ Bucureşti.