

CONSIDERATIONS REGARDING THE SHEAR STRESS DEVELOPED ON A 2000X100X4MM PLATE DURING THE IMPACT WITH A 6.2KG CYLINDRICAL BODY

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Abstract: This article belongs to a series of papers which are covering a complex study regarding the impact of a 6.2kg cylindrical body on a 2000x1000x4mm plate using the software based on finite element theory.

Keywords: shear stress, impact body, energy impact, distortion

This paperwork belongs to a series of papers covering a complex study regarding the impact of a 6.2kg cylindrical body on a 2000x1000x4mm plate.

This study is considering the plate to be fixed on all 4 sides and a cylindrical body hits it with impact speeds from 1 to 20m/s. Also, the standard earth gravity is considered to be active.

The studies were carried out in ANSYS 12.1.

Both, plate and considered to be made from structural steel.

At the impact, the geometry is presented in below figure:

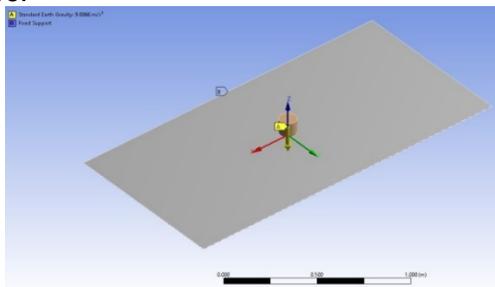


Figure 1 The geometry at the impact

Also, in Figure 1 are presented the boundary conditions and the axis of coordinate. X is the red vector, Y is the green vector and Z is the blue vector.

The origin is situated in the middle of the plate, at the intersection of the median surfaces.

The two bodies were meshed as below:

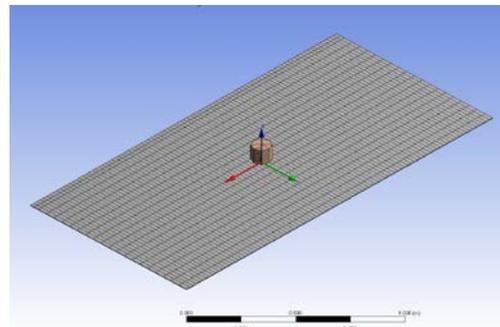


Figure 2 The meshed structure

The mesh of the plate consists in 4200 nodes and 1980 elements.

The simulations were a dynamic one, having the end time of 0.3 seconds.

For this study were considered the shear stress on the XY plane, which is the face plane of the plate.

Graphically the values of the minimum and maximum values of the shear stress on XY plane are presented below:

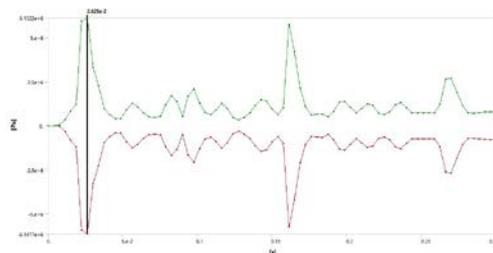


Figure 3 The variation of minimum (red line) and maximum (green line) values of the XY plane shear stress for 1m/s impact speed

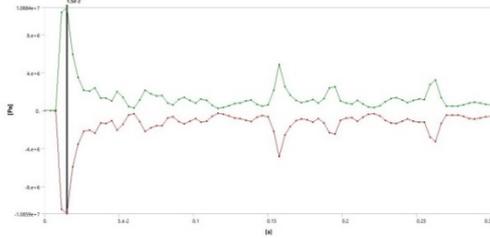


Figure 4 The variation of minimum (red line) and maximum (green line) values of the XY plane shear stress for 2m/s impact speed

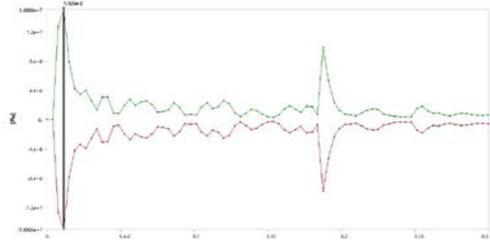


Figure 5 The variation of minimum (red line) and maximum (green line) values of the XY plane shear stress for 3m/s impact speed

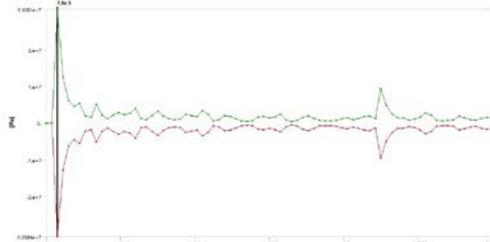


Figure 6 The variation of minimum (red line) and maximum (green line) values of the XY plane shear stress for 4m/s impact speed

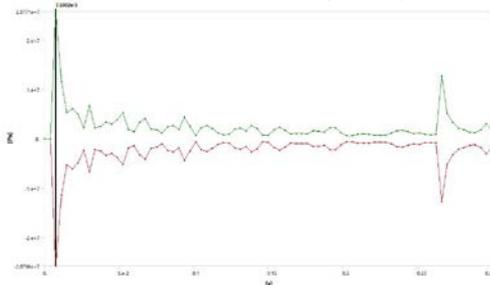


Figure 7 The variation of minimum (red line) and maximum (green line) values of the XY plane shear stress for 5m/s impact speed

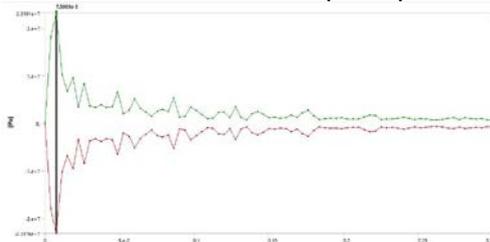


Figure 8 The variation of minimum (red line) and maximum (green line) values of the XY plane shear stress for 6m/s impact speed

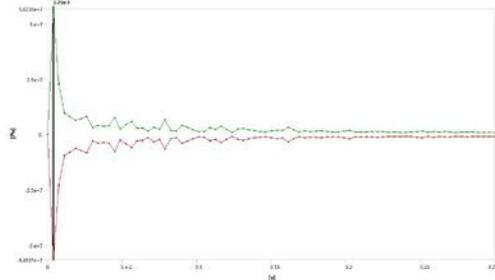


Figure 9 The variation of minimum (red line) and maximum (green line) values of the XY plane shear stress for 7m/s impact speed

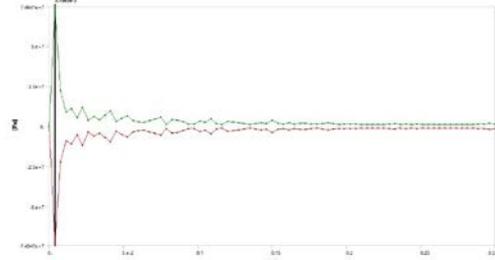


Figure 10 The variation of minimum (red line) and maximum (green line) values of the XY plane shear stress for 8m/s impact speed

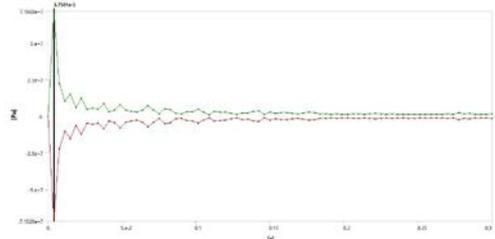


Figure 11 The variation of minimum (red line) and maximum (green line) values of the XY plane shear stress for 9m/s impact speed

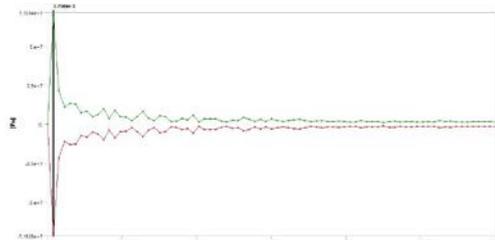


Figure 12 The variation of minimum (red line) and maximum (green line) values of the XY plane shear stress for 10m/s impact speed

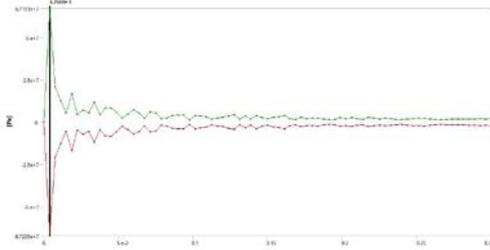


Figure 13 The variation of minimum (red line) and maximum (green line) values of the XY plane shear stress for 11m/s impact speed

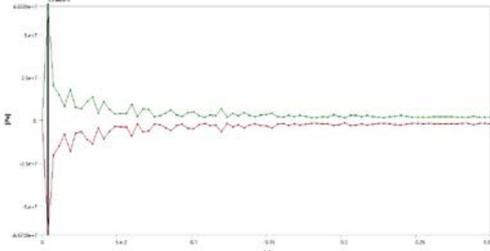


Figure 14 The variation of minimum (red line) and maximum (green line) values of the XY plane shear stress for 12m/s impact speed

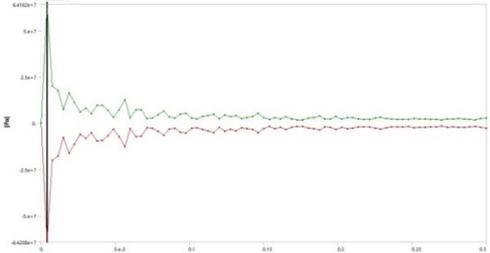


Figure 15 The variation of minimum (red line) and maximum (green line) values of the XY plane shear stress for 13m/s impact speed

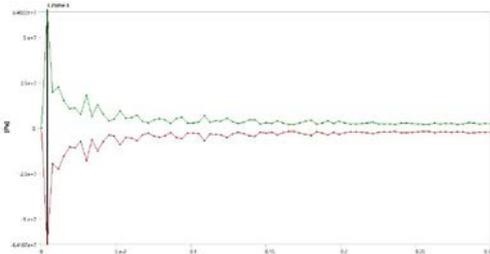


Figure 16 The variation of minimum (red line) and maximum (green line) values of the XY plane shear stress for 14m/s impact speed

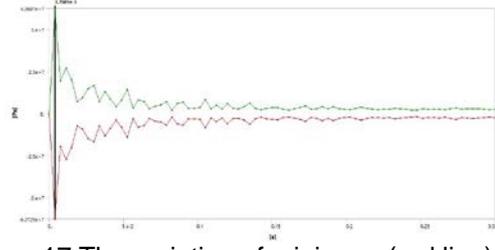


Figure 17 The variation of minimum (red line) and maximum (green line) values of the XY plane shear stress for 15m/s impact speed

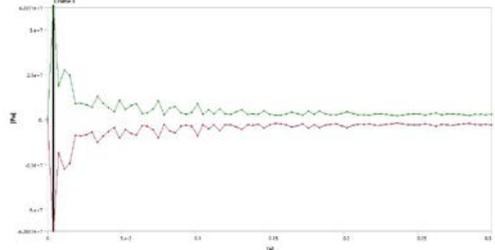


Figure 18 The variation of minimum (red line) and maximum (green line) values of the XY plane shear stress for 16m/s impact speed

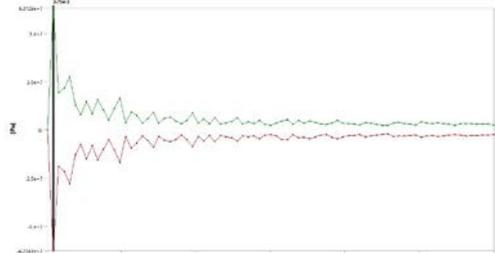


Figure 19 The variation of minimum (red line) and maximum (green line) values of the XY plane shear stress for 17m/s impact speed

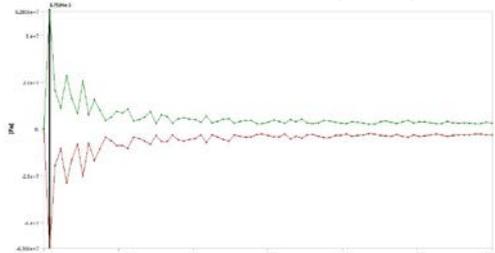


Figure 20 The variation of minimum (red line) and maximum (green line) values of the XY plane shear stress for 18m/s impact speed

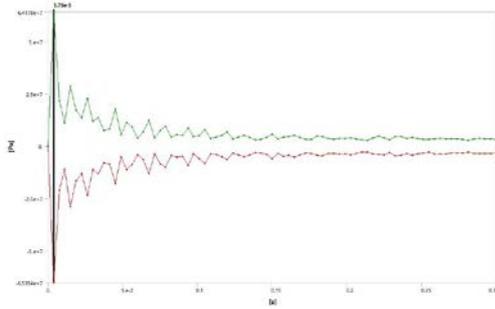


Figure 21 The variation of minimum (red line) and maximum (green line) values of the XY plane shear stress for 19m/s impact speed

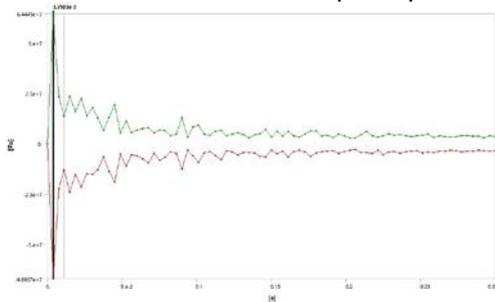


Figure 22 The variation of minimum (red line) and maximum (green line) values of the XY plane shear stress for 20m/s impact speed

Table 1 Maximum values of the shear stress (XY Plane)

Speed [m/s]	Shear stress (XY Plane) [N/mm ²]	Speed [m/s]	Shear stress (XY Plane) [N/mm ²]
1	6.132	11	67.151
2	10.88	12	66.589
3	14.999	13	64.162
4	31.081	14	64.022
5	25.771	15	62.601
6	23.191	16	62.271
7	56.726	17	63.129
8	74.641	18	62.856
9	71.868	19	64.178
10	71.514	20	64.449

The value of the maximum shear stress variation is presented below:

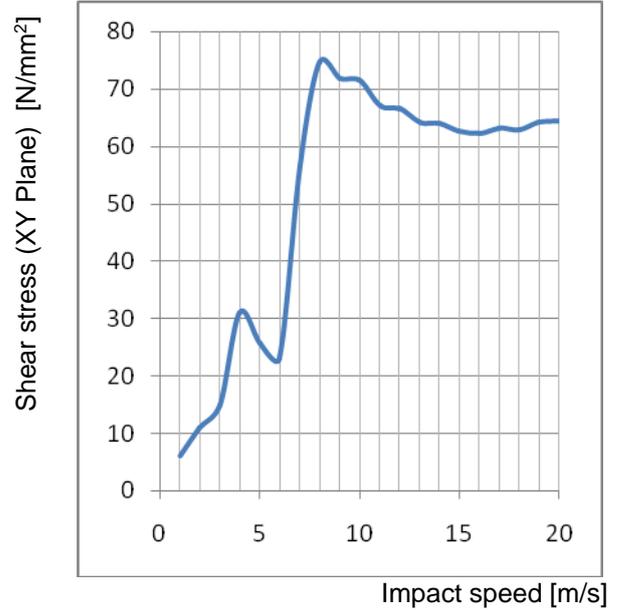


Figure 23 Maximum values of the shear stress (XY Plane) for different impact speeds

As it can be seen, the maximum value of the shear stress (XY plane) reaches a maximum value, and, after that, stays around these values. To understand this phenomenon, we need to see the repartition diagrams of the shear stress (XY Plane).

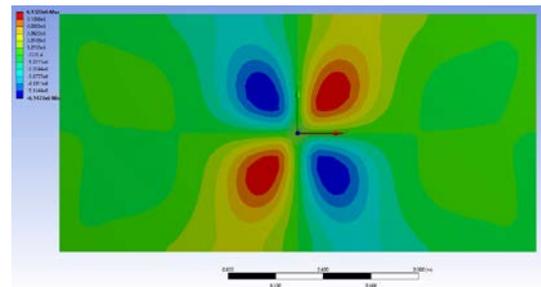


Figure 24 Shear stress (XY Plane) diagram for 1m/s impact speed

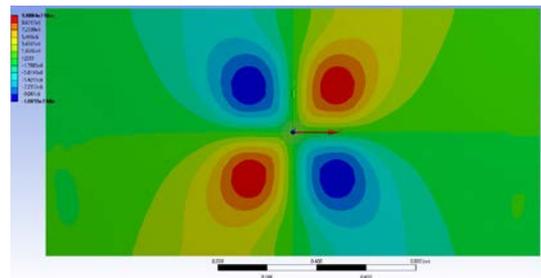


Figure 25 Shear stress (XY Plane) diagram for 2m/s impact speed

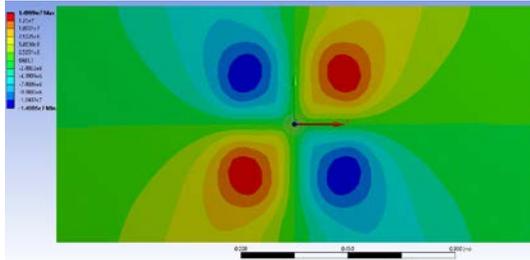


Figure 26 Shear stress (XY Plane) diagram for 3m/s impact speed

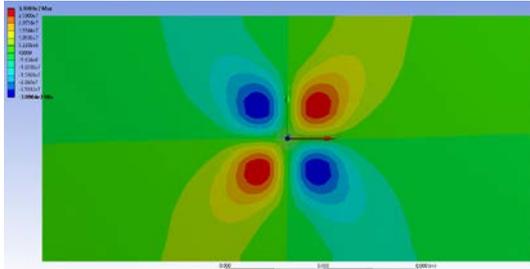


Figure 27 Shear stress (XY Plane) diagram for 4m/s impact speed

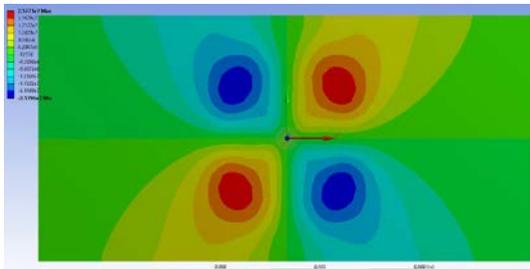


Figure 28 Shear stress (XY Plane) diagram for 5m/s impact speed

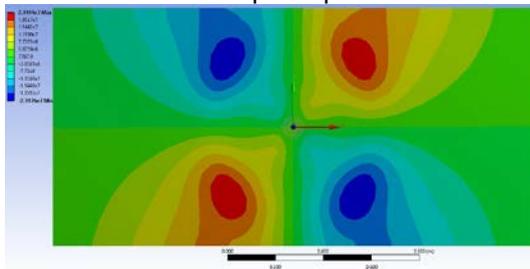


Figure 29 Shear stress (XY Plane) diagram for 6m/s impact speed

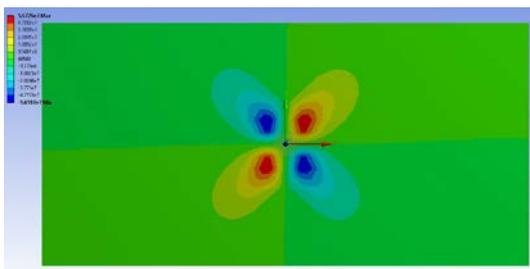


Figure 30 Shear stress (XY Plane) diagram for 7m/s impact speed

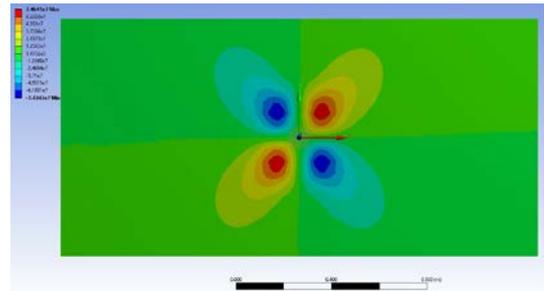


Figure 31 Shear stress (XY Plane) diagram for 8m/s impact speed

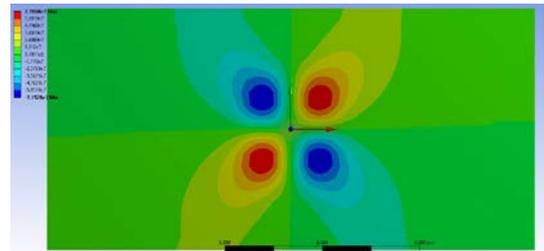


Figure 32 Shear stress (XY Plane) diagram for 9 m/s impact speed

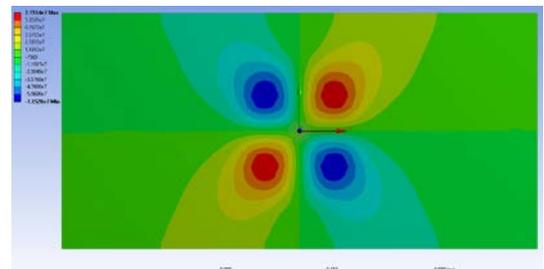


Figure 33 Shear stress (XY Plane) diagram for 10m/s impact speed

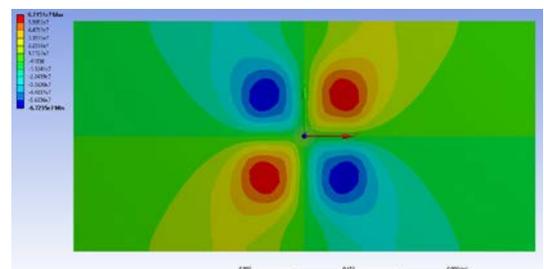


Figure 34 Shear stress (XY Plane) diagram for 11m/s impact speed

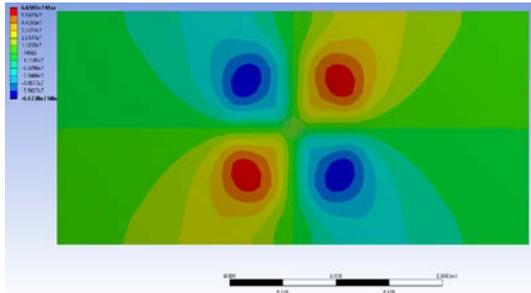


Figure 35 Shear stress (XY Plane) diagram for 12m/s impact speed

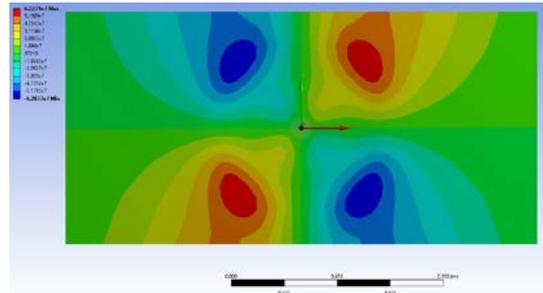


Figure 39 Shear stress (XY Plane) diagram for 16m/s impact speed

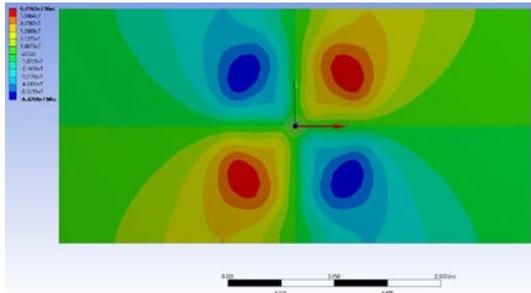


Figure 36 Shear stress (XY Plane) diagram for 13m/s impact speed

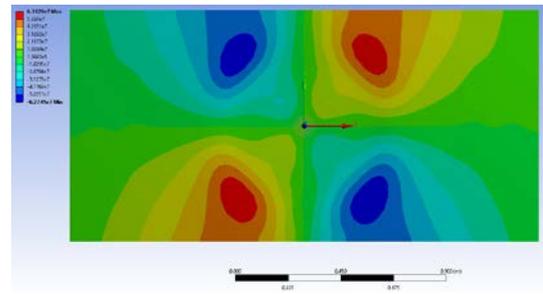


Figure 40 Shear stress (XY Plane) diagram for 17m/s impact speed

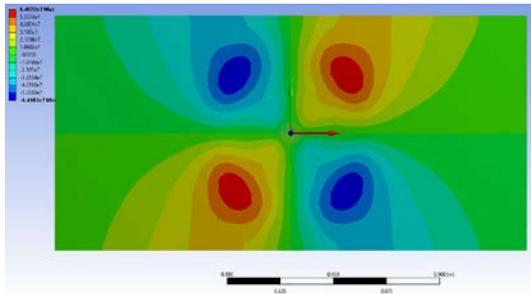


Figure 37 Shear stress (XY Plane) diagram for 14m/s impact speed

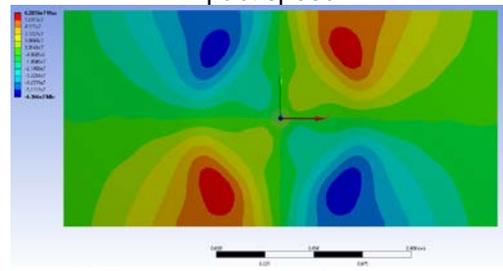


Figure 41 Shear stress (XY Plane) diagram for 18m/s impact speed

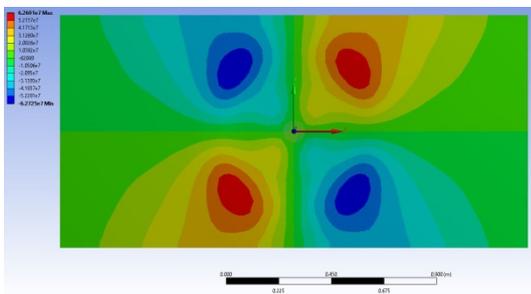


Figure 38 Shear stress (XY Plane) diagram for 15m/s impact speed

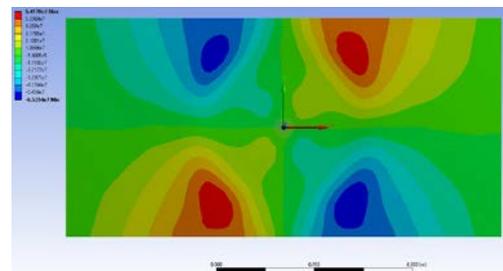


Figure 42 Shear stress (XY Plane) diagram for 19m/s impact speed

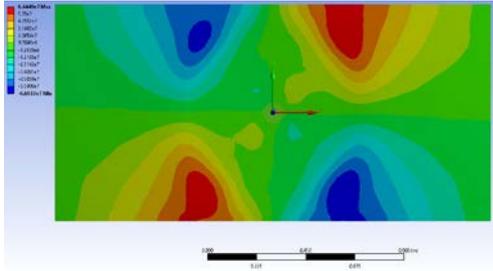


Figure 43 Shear stress (XY Plane) diagram for 20 m/s impact speed

CONCLUSIONS

The shear stress on XY plane maximum values reaches a maximum at an impact speed of 8m/s.

After that, maximum values are lower on higher impact speed

This occurs because the energy dissipation area is increasing, and the maximum values are met on a higher surface.

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