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CONSIDERATIONS REGARDING THE NORMAL STRESS (X AXIS) 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 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: *normal 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 body are considered to be made from structural steel.
At the impact, the geometry is presented in below figure:

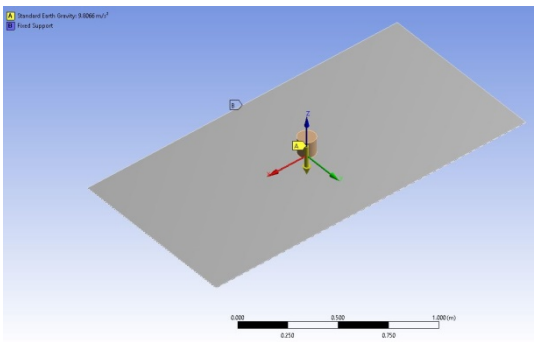

Figure 1 The geometry at the impact

Also, in Figure 1are 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:

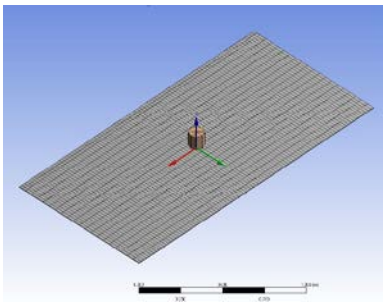

Figure 2 The meshed structure

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 paperwork were considered the normal stress (X axis).
The time variation of minimum and maximum values of normal stress (X axis) is presented in following pictures:

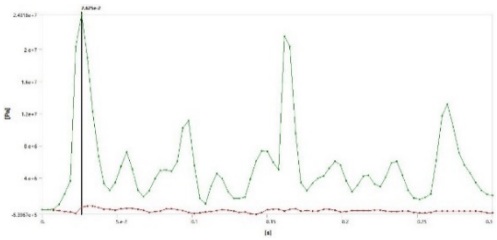

Figure 3 Time variation of minimum (red line) and maximum (green line) values of normal stress (X axis) for 1m/s impact speed

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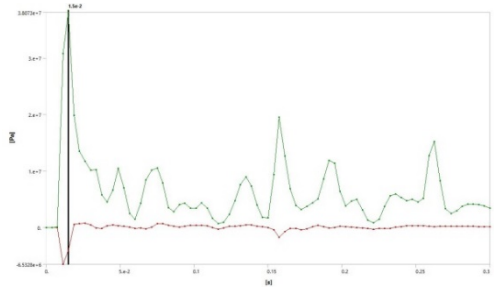

Figure 4 Time variation of minimum (red line) and maximum (green line) values of normal stress (X axis) for 2m/s impact speed

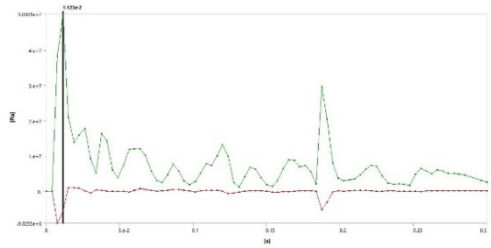

Figure 5 Time variation of minimum (red line) and maximum (green line) values of normal stress (X axis) for 3m/s impact speed

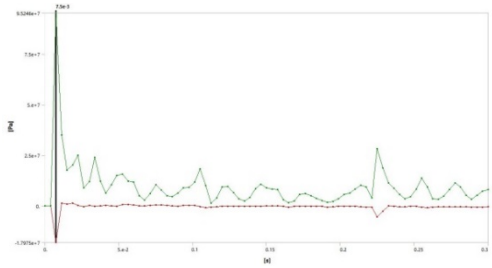

Figure 6 Time variation of minimum (red line) and maximum (green line) values of normal stress (X axis) for 4m/s impact speed

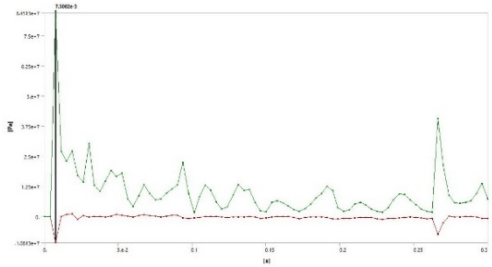

Figure 7 Time variation of minimum (red line) and maximum (green line) values of normal stress (X axis) for 5m/s impact speed

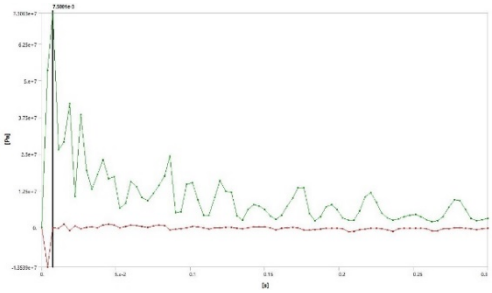

Figure 8 Time variation of minimum (red line) and maximum (green line) values of normal stress (X axis) for 6m/s impact speed

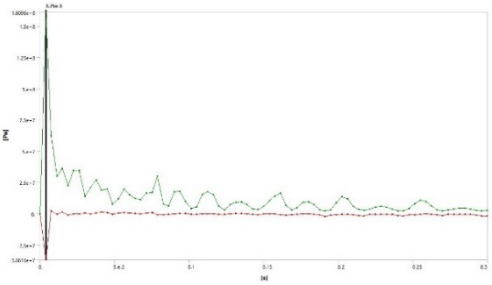

Figure 9 Time variation of minimum (red line) and maximum (green line) values of normal stress (X axis) for 7m/s impact speed

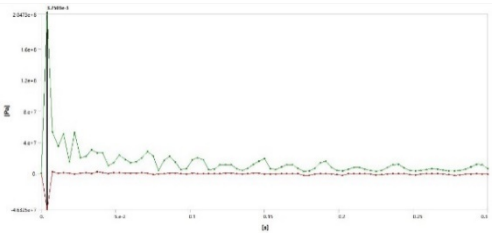

Figure 10 Time variation of minimum (red line) and maximum (green line) values of normal stress (X axis) for 8m/s impact speed

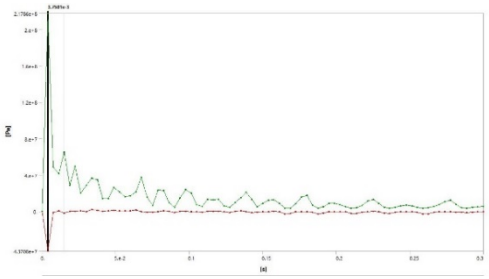

Figure 11 Time variation of minimum (red line) and maximum (green line) values of normal stress (X axis) for 9m/s impact speed

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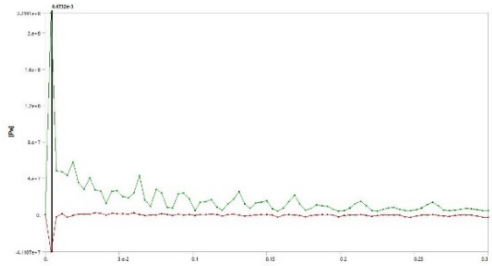

Figure 12 Time variation of minimum (red line) and maximum (green line) values of normal stress (X axis) for 10m/s impact speed

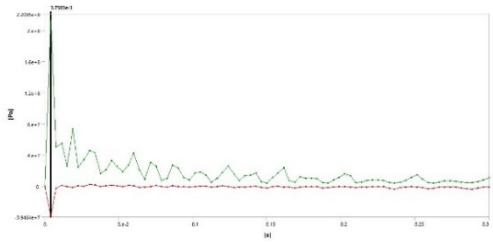

Figure 13 Time variation of minimum (red line) and maximum (green line) values of normal stress (X axis) for 11m/s impact speed

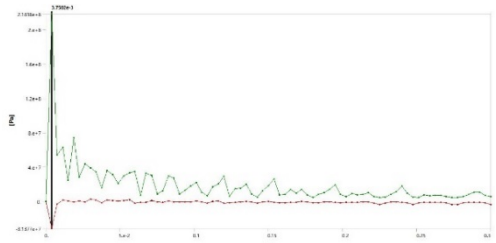

Figure 14 Time variation of minimum (red line) and maximum (green line) values of normal stress (X axis) for 12m/s impact speed

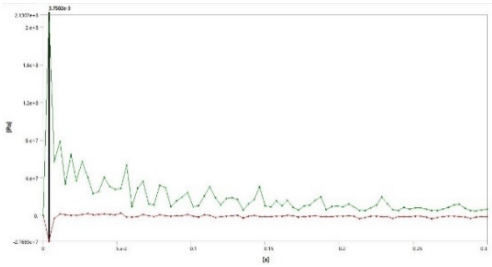

Figure 15 Time variation of minimum (red line) and maximum (green line) values of normal stress (X axis) for 13m/s impact speed

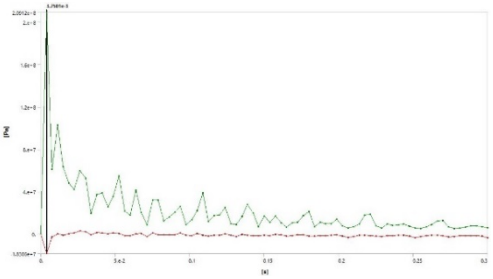

Figure 16 Time variation of minimum (red line) and maximum (green line) values of normal stress (X axis) for 14m/s impact speed

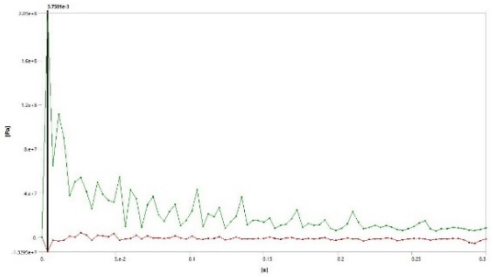

Figure 17 Time variation of minimum (red line) and maximum (green line) values of normal stress (X axis) for 15m/s impact speed

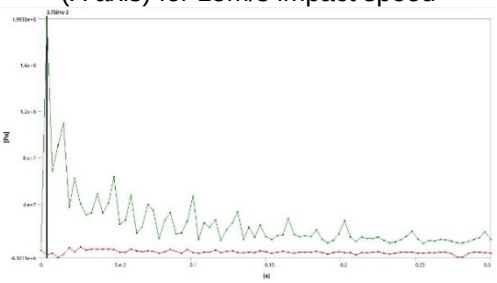

Figure 18 Time variation of minimum (red line) and maximum (green line) values of normal stress (X axis) for 16m/s impact speed

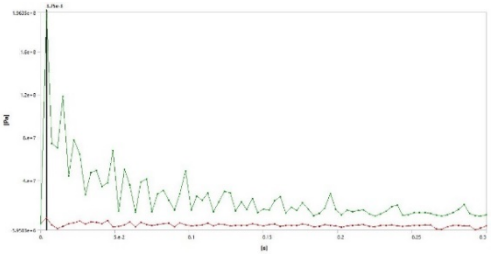

Figure 19 Time variation of minimum (red line) and maximum (green line) values of normal stress (X axis) for 17m/s impact speed

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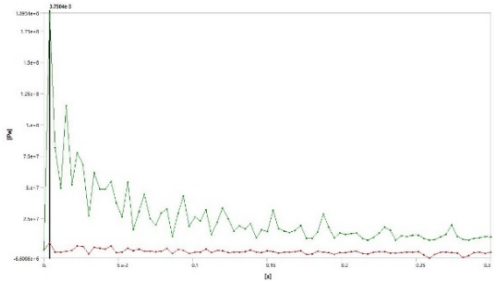

Figure 20 Time variation of minimum (red line) and maximum (green line) values of normal stress (X axis) for 18m/s impact speed

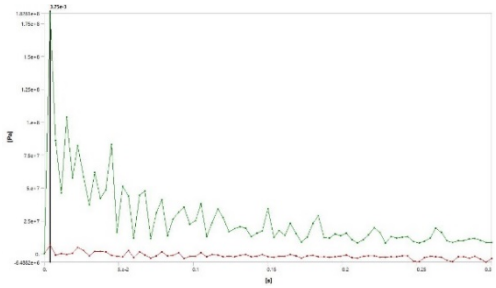

Figure 21 Time variation of minimum (red line) and maximum (green line) values of normal stress (X axis) for 19m/s impact speed

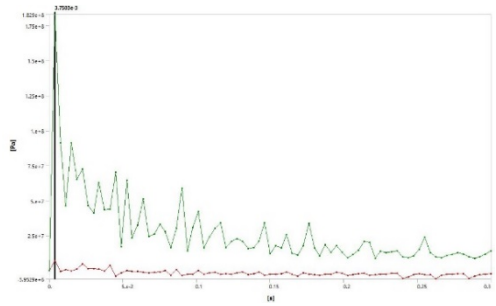

Figure 22 Time variation of minimum (red line) and maximum (green line) values of normal stress (X axis) for 20m/s impact speed

The maximum values for the normal stress (X Axis) for each impact speed, are presented below:

Table 1 Maximum values for the normal stress (X Axis) for different impact speed

Speed [m/s]	Normal stress (X Axis) [N/mm^2]	Speed [m/s]	Normal stress (X Axis) [N/mm^2]
1	24.31	11	220.95
2	38.07	12	218.18
3	50.301	13	213.07
4	95.246	14	209.12
5	84.513	15	203
6	73.063	16	199.38
7	160.96	17	196.35
8	204.73	18	189.34
9	217.86	19	182.81
10	221.91	20	182.9

A graphic variation of the maximum values for Normal stress (X Axis) is presented below:

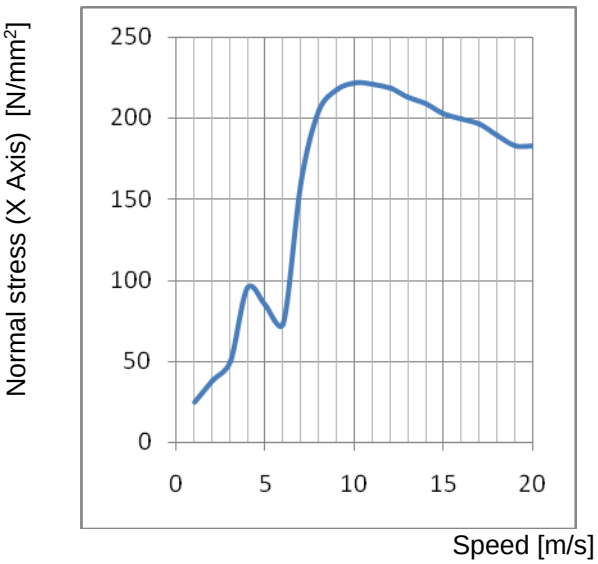

Figure 23 Variation of the maximum values for Normal stress (X Axis) depending on impact speed

It can be seen, at the impact speed of 8m/s it is reached a maximum value, and after that the values stays around this value.

To understand the phenomenon we need to check the distribution diagrams for Normal stress (X axis) which are presented below:

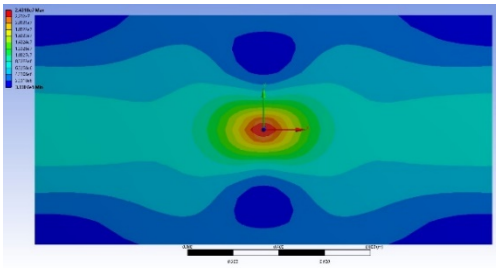

Figure 24Distribution diagram for Normal stress (X Axis) when the maximum value is reached, for 1m/s impact speed

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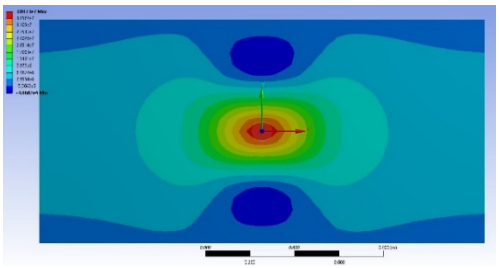

Figure 25 Distribution diagram for Normal stress (X Axis) when the maximum value is reached, for 2m/s impact speed

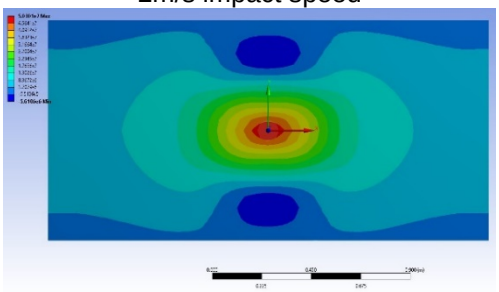

Figure 26 Distribution diagram for Normal stress (X Axis) when the maximum value is reached, for 3m/s impact speed

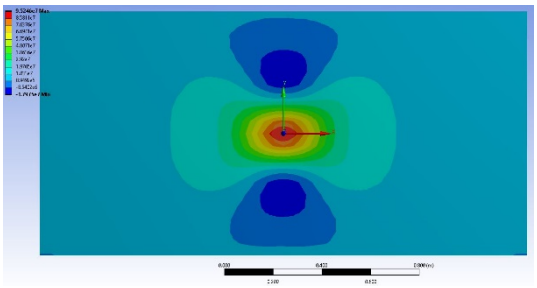

Figure 27 Distribution diagram for Normal stress (X Axis) when the maximum value is reached, for 4m/s impact speed

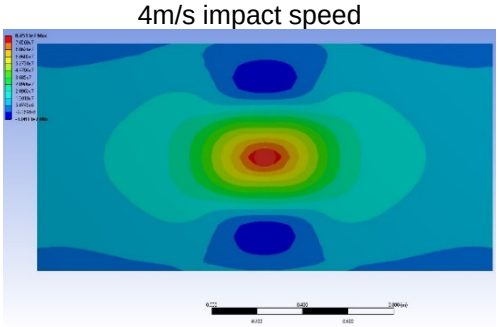

Figure 28 Distribution diagram for Normal stress (X Axis) when the maximum value is reached, for 5m/s impact speed

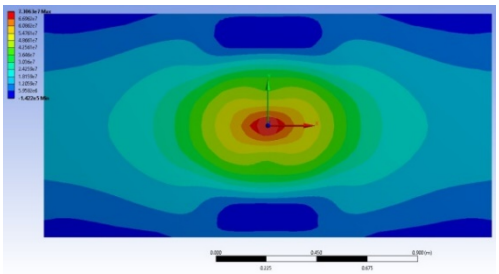

Figure 29 Distribution diagram for Normal stress (X Axis) when the maximum value is reached, for 6m/s impact speed

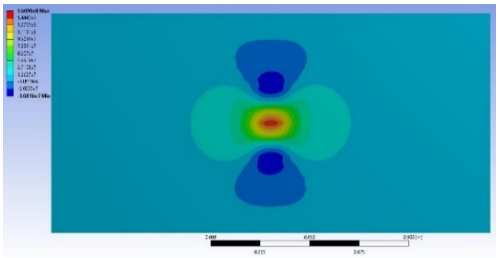

Figure 30 Distribution diagram for Normal stress (X Axis) when the maximum value is reached, for 7m/s impact speed

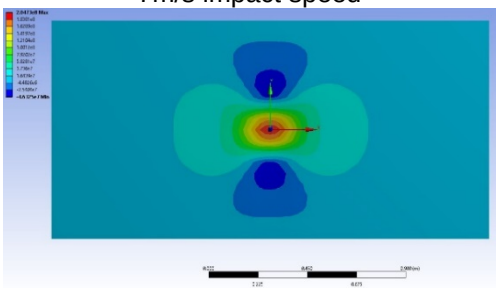

Figure 31 Distribution diagram for Normal stress (X Axis) when the maximum value is reached, for 8m/s impact speed

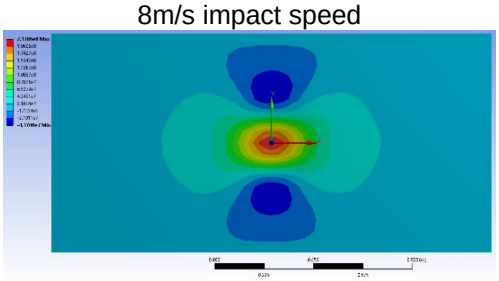

Figure 32 Distribution diagram for Normal stress (X Axis) when the maximum value is reached, for 9m/s impact speed

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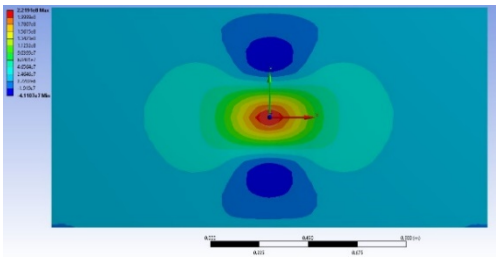

Figure 33 Distribution diagram for Normal stress (X Axis) when the maximum value is reached, for 10m/s impact speed

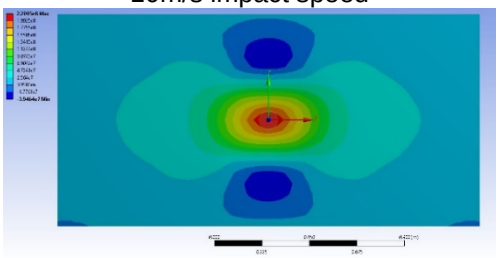

Figure 34 Distribution diagram for Normal stress (X Axis) when the maximum value is reached, for 11m/s impact speed

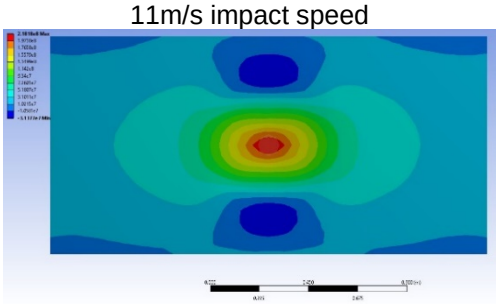

Figure 35 Distribution diagram for Normal stress (X Axis) when the maximum value is reached, for 12m/s impact speed

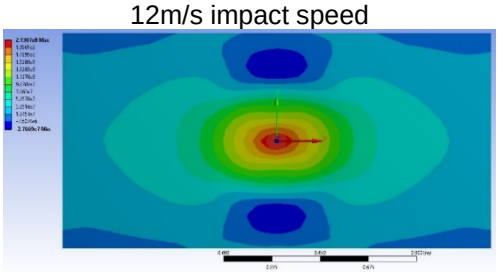

Figure 36 Distribution diagram for Normal stress (X Axis) when the maximum value is reached, for 13m/s impact speed

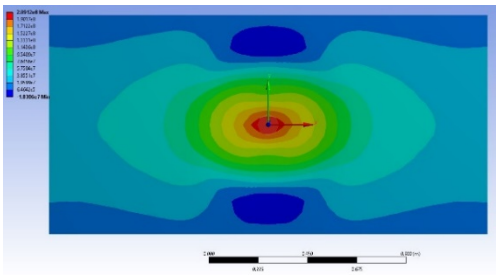

Figure 37 Distribution diagram for Normal stress (X Axis) when the maximum value is reached, for 14m/s impact speed

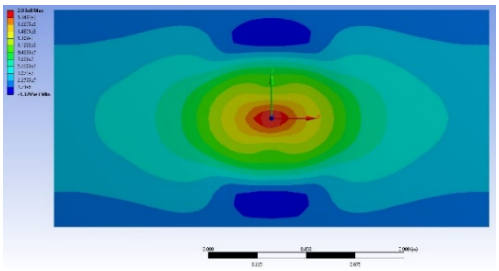

Figure 38 Distribution diagram for Normal stress (X Axis) when the maximum value is reached, for 15m/s impact speed

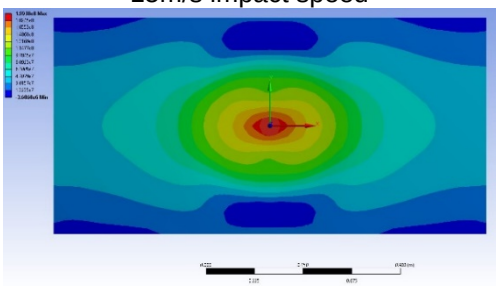

Figure 39 Distribution diagram for Normal stress (X Axis) when the maximum value is reached, for 16m/s impact speed

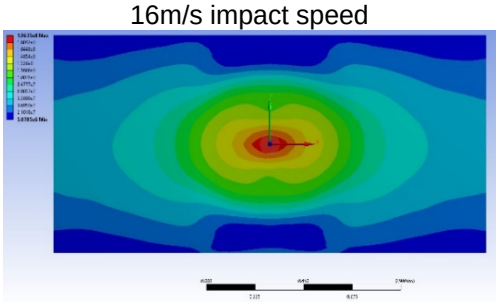

Figure 40 Distribution diagram for Normal stress (X Axis) when the maximum value is reached, for 17m/s impact speed

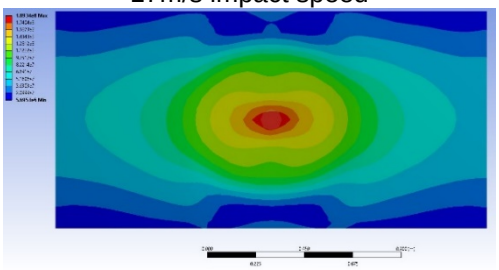

Figure 41 Distribution diagram for Normal stress (X Axis) when the maximum value is reached, for 18m/s impact speed

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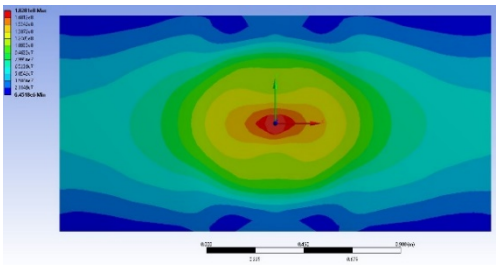

Figure 42 Distribution diagram for Normal stress (X Axis) when the maximum value is reached, for 19m/s impact speed

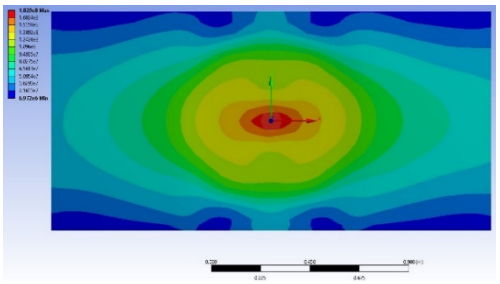

Figure 43 Distribution diagram for Normal stress (X Axis) when the maximum value is reached, for 20m/s impact speed

CONCLUSIONS

As it can be seen, the surface were the maximum values are distributed is increasing with the impact speed. This means the impact energy is distributed on bigger surface, and that's why the maximum values of the normal stress (X axis) are topped around a value.

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