

## STUDIES REGARDING THE STRUCTURAL RESPONSE OF A 2000X100X4MM PLATE AFTER THE IMPACT WITH A 6.2KG CYLINDRICAL BODY CONSIDERING THE EQUIVALENT STRESS

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**Abstract:** The present article is included in a wider series of studies which were developed by the development team; the initial premises of the article consists in an impact analysis of a 6.2kg cylindrical body with velocity of 5 m/s on a 2000x1000x4mm plate, by using dedicated software which applies the finite element theory.

**Keywords:** vonMises 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 5m/s impact speed.

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:

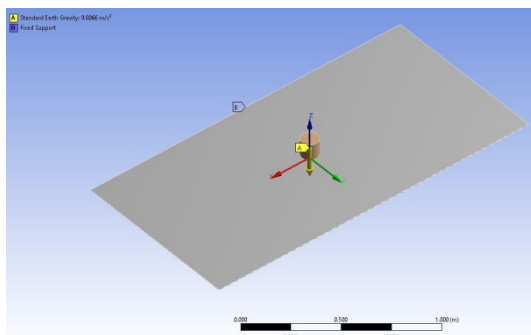


Figure 1 The geometry at the impact

Also, in Figure 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:

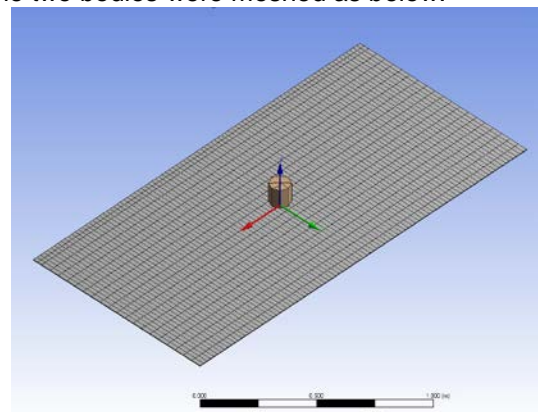


Figure 2 The meshed structure

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.

At the beginning of the simulation, the hammer is situated at 20mm above the plate.

The analysis was carried out in 80 steps, from 1 to 81, equally distributed.

The steps distributed on time are presented below:

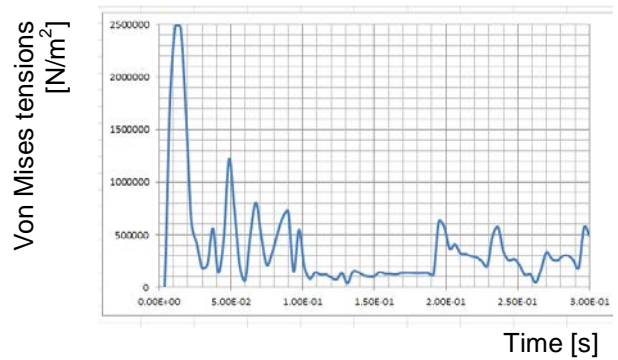
Table 1 Steps distribution on time

Step	Time [s]	Step	Time [s]
1	1.18E-38	21	7.50E-02
2	3.75E-03	22	7.88E-02
3	7.50E-03	23	8.25E-02
4	1.13E-02	24	8.63E-02

Step	Time [s]	Step	Time [s]
5	1.50E-02	25	9.00E-02
6	1.88E-02	26	9.38E-02
7	2.25E-02	27	9.75E-02
8	2.63E-02	28	0.10125
9	3.00E-02	29	0.105
10	3.38E-02	30	0.10875
11	3.75E-02	31	0.1125
12	4.13E-02	32	0.11625
13	4.50E-02	33	0.12
14	4.88E-02	34	0.12375
15	5.25E-02	35	0.1275
16	5.63E-02	36	0.13125
17	6.00E-02	37	0.135
18	6.38E-02	38	0.13875
19	6.75E-02	39	0.1425
20	7.13E-02	40	0.14625

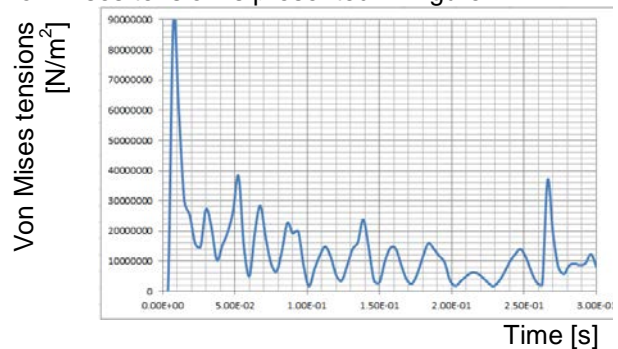
Step	Time [s]	Step	Time [s]
41	0.15	61	0.225
42	0.15375	62	0.22875
43	0.1575	63	0.2325
44	0.16125	64	0.23625
45	0.165	65	0.24
46	0.16875	66	0.24375
47	0.1725	67	0.2475
48	0.17625	68	0.25125
49	0.18	69	0.255
50	0.18375	70	0.25875
51	0.1875	71	0.2625
52	0.19125	72	0.26625
53	0.195	73	0.27
54	0.19875	74	0.27375
55	0.2025	75	0.2775
56	0.20625	76	0.28125
57	0.21	77	0.285
58	0.21375	78	0.28875
59	0.2175	79	0.2925
60	0.22125	80	0.29625
		81	0.3

The time evolution of the minimum values of the von Mises tension is presented in Figure 3



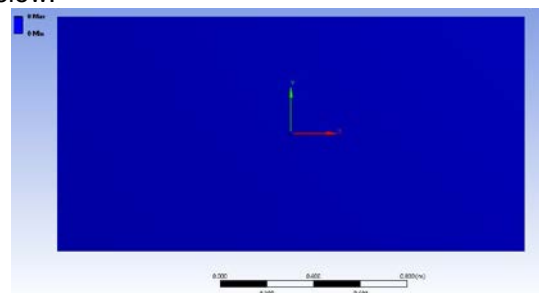
**Figure 3 Time evolution of the minimum von Mises stress**

The time evolution of the maximum values of the von Mises tension is presented in Figure 4

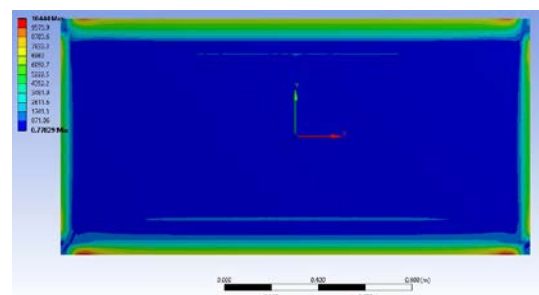


**Figure 4 Time evolution of the maximum von Mises stress**

Von Mises distribution diagrams are presented below:



**Figure 5 Equivalent stress (Von Mises) distribution diagram for step 1**



**Figure 6 Equivalent stress (Von Mises) distribution diagram for step 2**

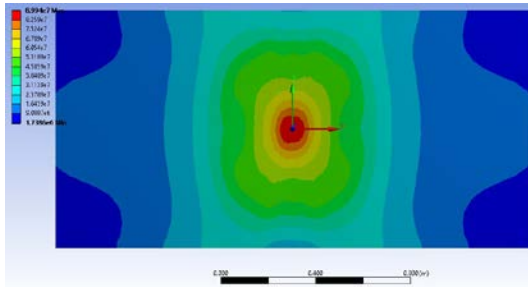


Figure 7 Equivalent stress (Von Mises) distribution diagram for step 3

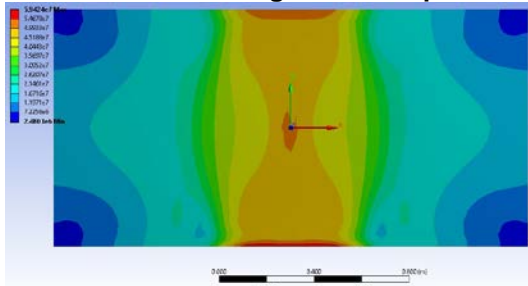


Figure 8 Equivalent stress (Von Mises) distribution diagram for step 4

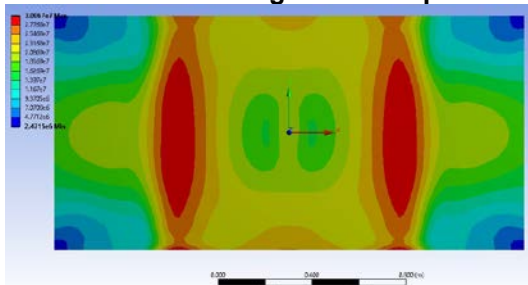


Figure 9 Equivalent stress (Von Mises) distribution diagram for step 5

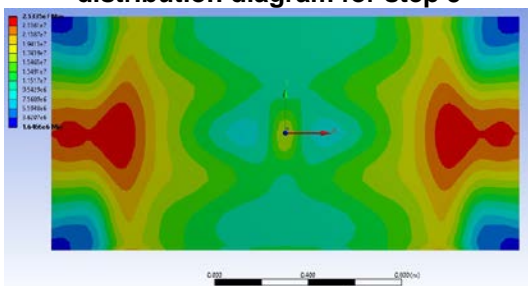


Figure 10 Equivalent stress (Von Mises) distribution diagram for step 6

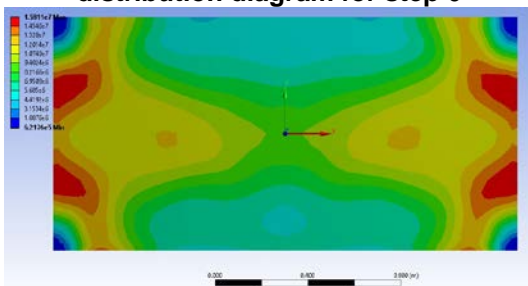


Figure 11 Equivalent stress (Von Mises) distribution diagram for step 7

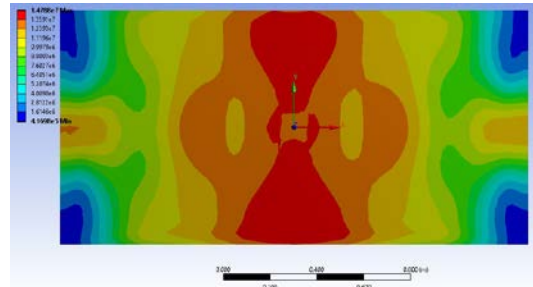


Figure 12 Equivalent stress (Von Mises) distribution diagram for step 8

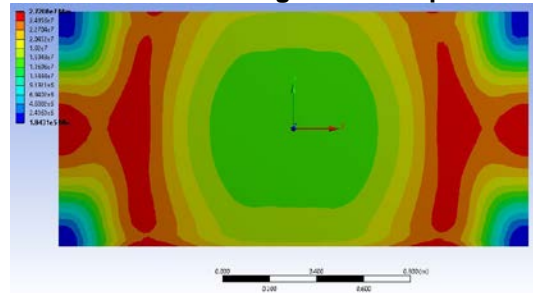


Figure 13 Equivalent stress (Von Mises) distribution diagram for step 9

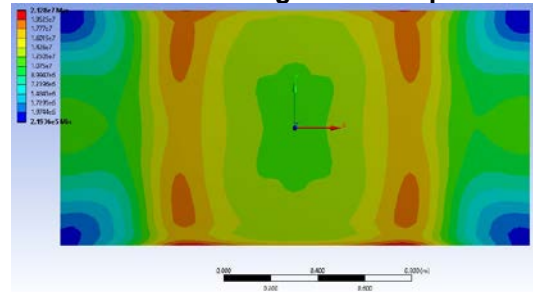


Figure 14 Equivalent stress (Von Mises) distribution diagram for step 10

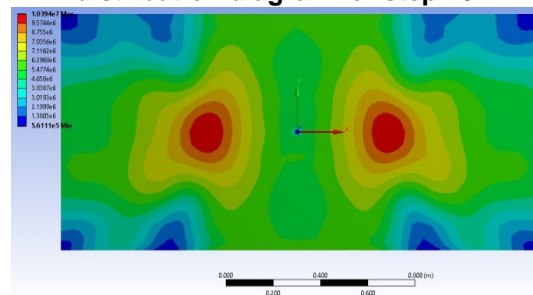


Figure 15 Equivalent stress (Von Mises) distribution diagram for step 11

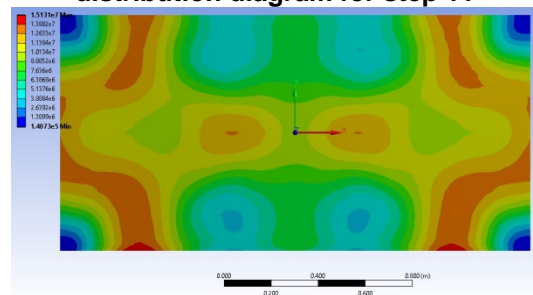


Figure 16 Equivalent stress (Von Mises) distribution diagram for step 12



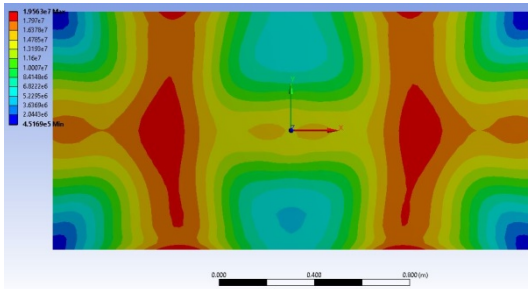


Figure 17 Equivalent stress (Von Mises) distribution diagram for step 13

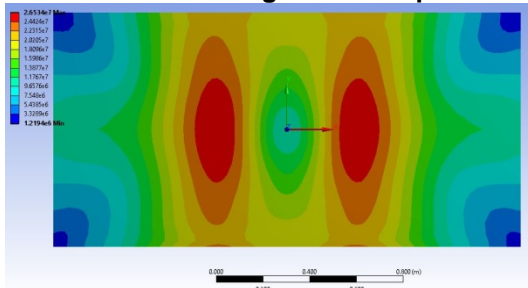


Figure 18 Equivalent stress (Von Mises) distribution diagram for step 14

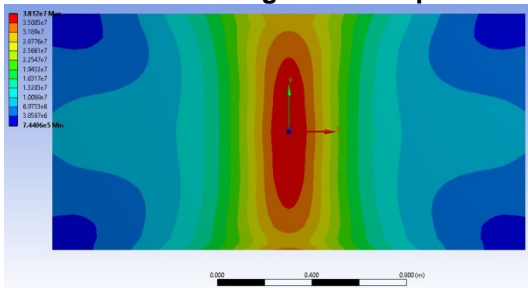


Figure 19 Equivalent stress (Von Mises) distribution diagram for step 15

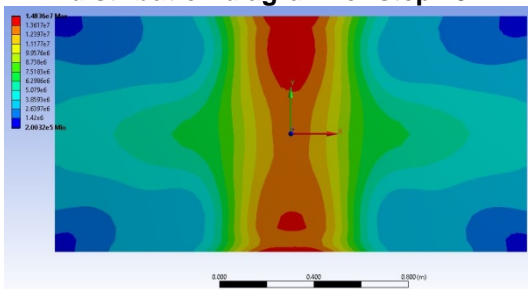


Figure 20 Equivalent stress (Von Mises) distribution diagram for step 16

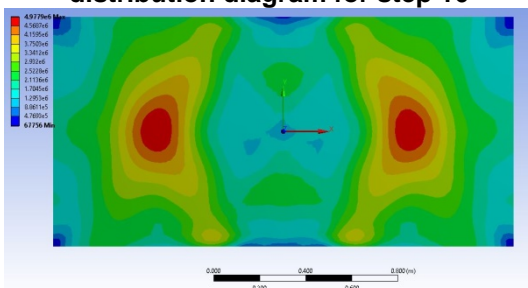


Figure 21 Equivalent stress (Von Mises) distribution diagram for step 17

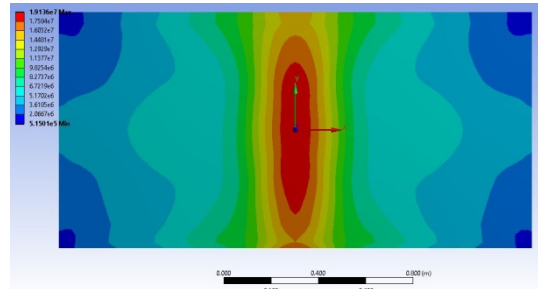


Figure 22 Equivalent stress (Von Mises) distribution diagram for step 18

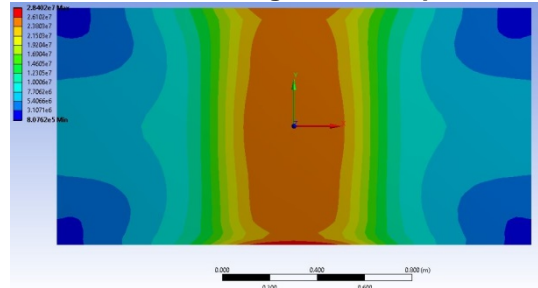


Figure 23 Equivalent stress (Von Mises) distribution diagram for step 19

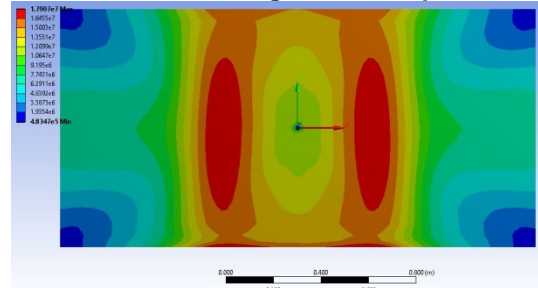


Figure 24 Equivalent stress (Von Mises) distribution diagram for step 20

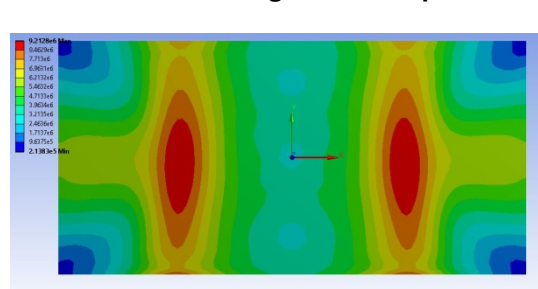


Figure 25 Equivalent stress (Von Mises) distribution diagram for step 21

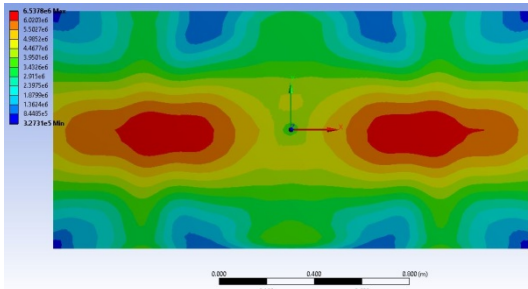


Figure 26 Equivalent stress (Von Mises) distribution diagram for step 22

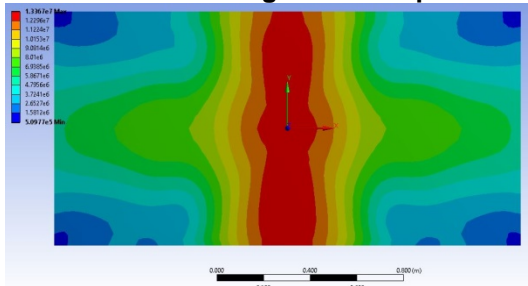


Figure 27 Equivalent stress (Von Mises) distribution diagram for step 23

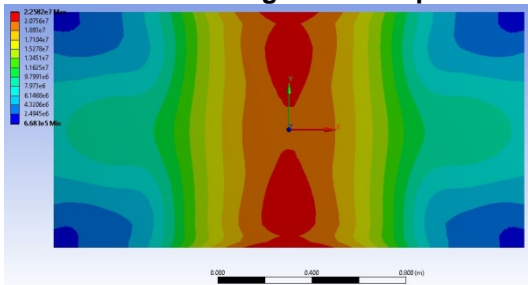


Figure 28 Equivalent stress (Von Mises) distribution diagram for step 24

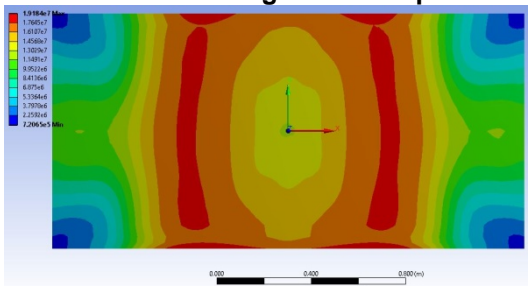


Figure 29 Equivalent stress (Von Mises) distribution diagram for step 25

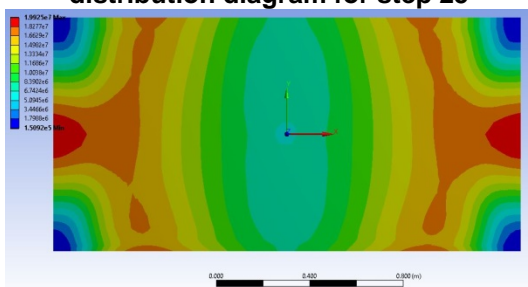


Figure 30 Equivalent stress (Von Mises) distribution diagram for step 26

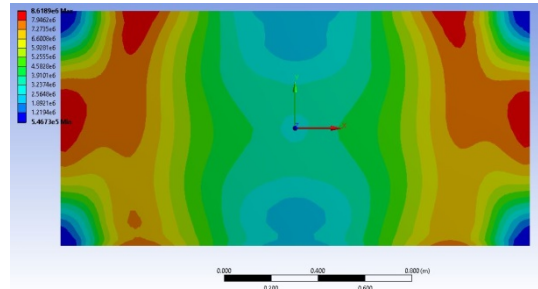


Figure 31 Equivalent stress (Von Mises) distribution diagram for step 27

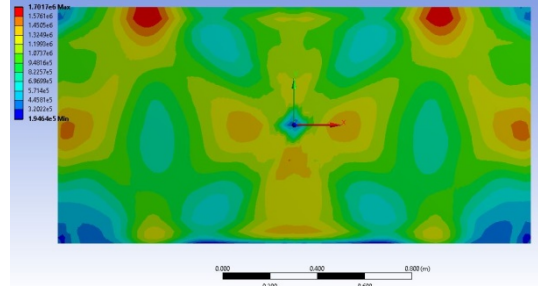


Figure 32 Equivalent stress (Von Mises) distribution diagram for step 28

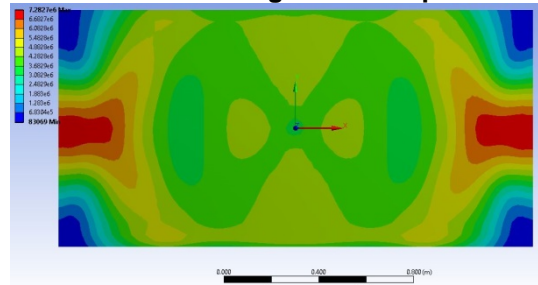


Figure 33 Equivalent stress (Von Mises) distribution diagram for step 29

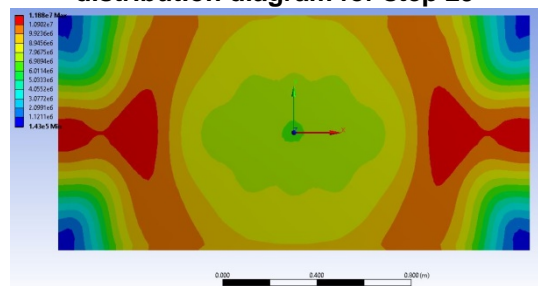


Figure 34 Equivalent stress (Von Mises) distribution diagram for step 30



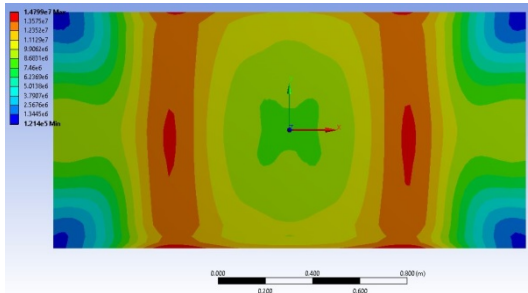


Figure 35 Equivalent stress (Von Mises) distribution diagram for step 31

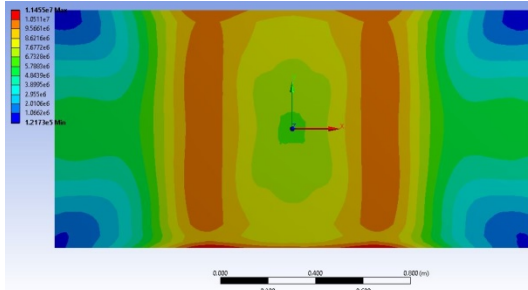


Figure 36 Equivalent stress (Von Mises) distribution diagram for step 32

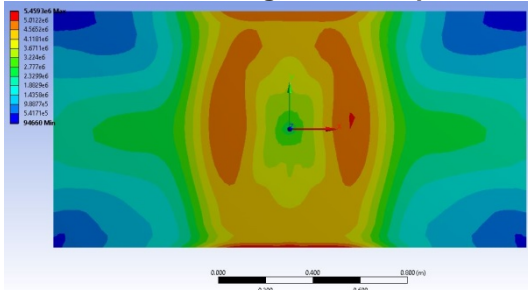


Figure 37 Equivalent stress (Von Mises) distribution diagram for step 33

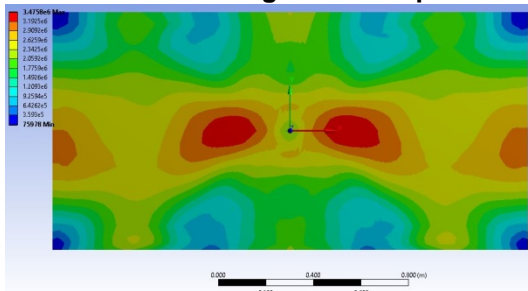


Figure 38 Equivalent stress (Von Mises) distribution diagram for step 34

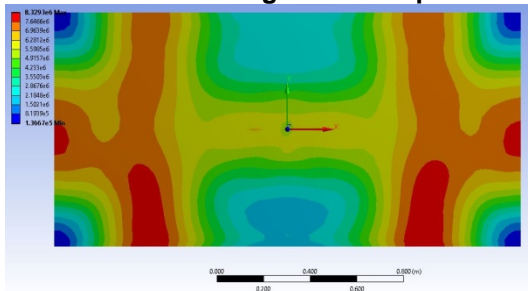


Figure 39 Equivalent stress (Von Mises) distribution diagram for step 35

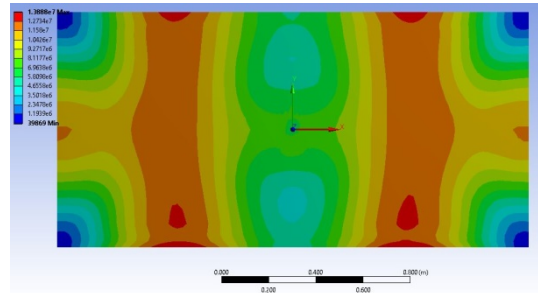


Figure 40 Equivalent stress (Von Mises) distribution diagram for step 36

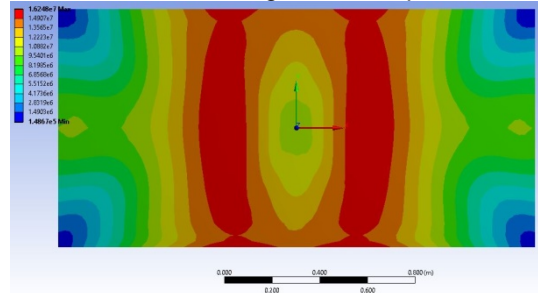


Figure 41 Equivalent stress (Von Mises) distribution diagram for step 37

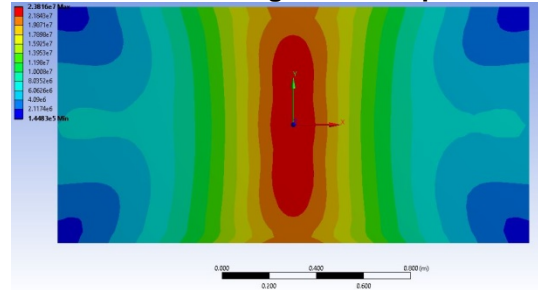


Figure 42 Equivalent stress (Von Mises) distribution diagram for step 38

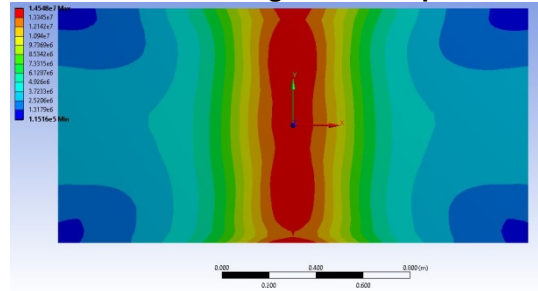


Figure 43 Equivalent stress (Von Mises) distribution diagram for step 39

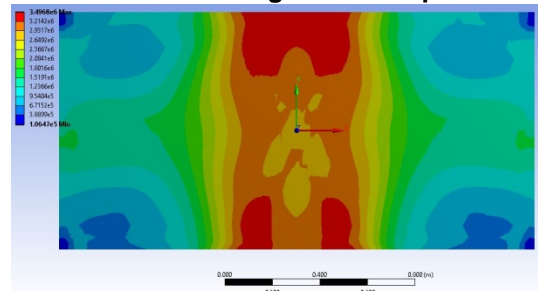


Figure 44 Equivalent stress (Von Mises) distribution diagram for step 40

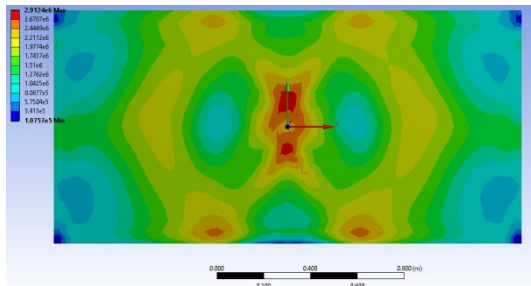


Figure 45 Equivalent stress (Von Mises) distribution diagram for step 41

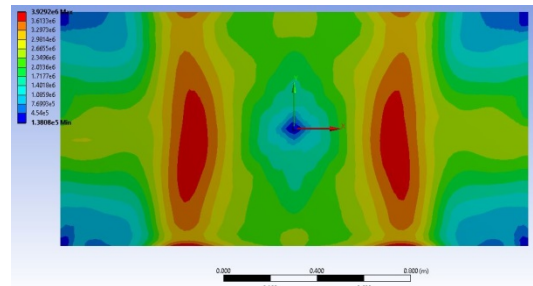


Figure 50 Equivalent stress (Von Mises) distribution diagram for step 46

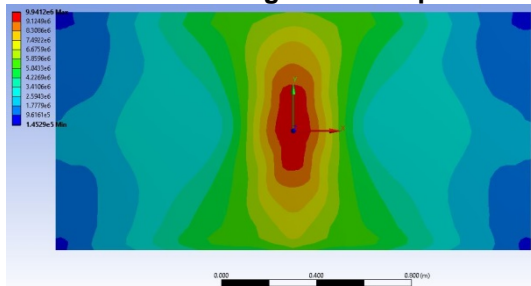


Figure 46 Equivalent stress (Von Mises) distribution diagram for step 42

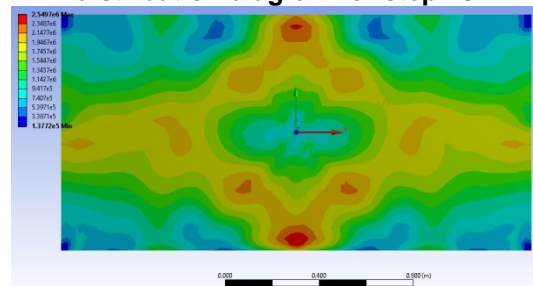


Figure 51 Equivalent stress (Von Mises) distribution diagram for step 47

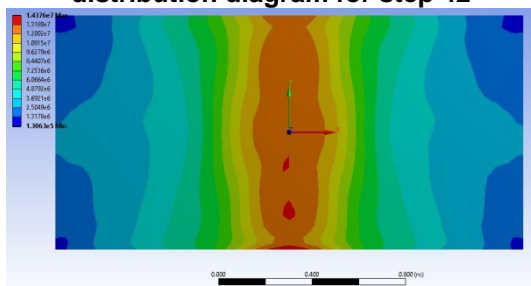


Figure 47 Equivalent stress (Von Mises) distribution diagram for step 43

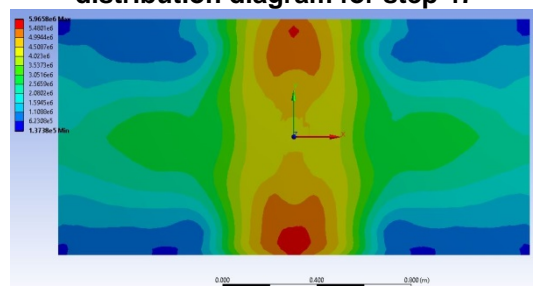


Figure 52 Equivalent stress (Von Mises) distribution diagram for step 48

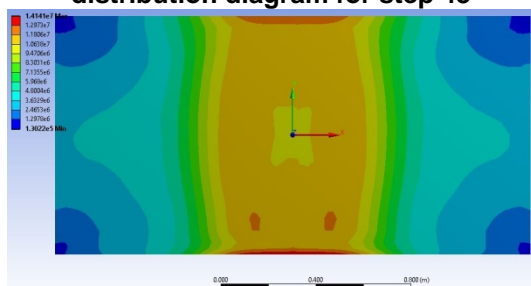


Figure 48 Equivalent stress (Von Mises) distribution diagram for step 44

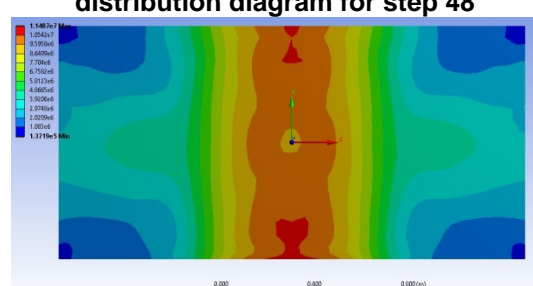


Figure 53 Equivalent stress (Von Mises) distribution diagram for step 49

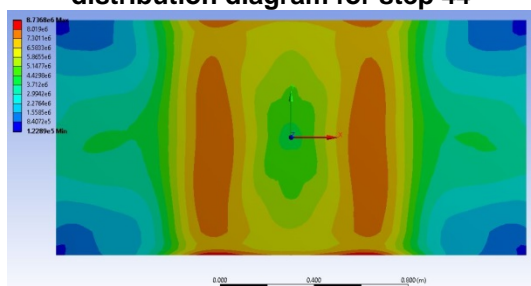


Figure 49 Equivalent stress (Von Mises) distribution diagram for step 45

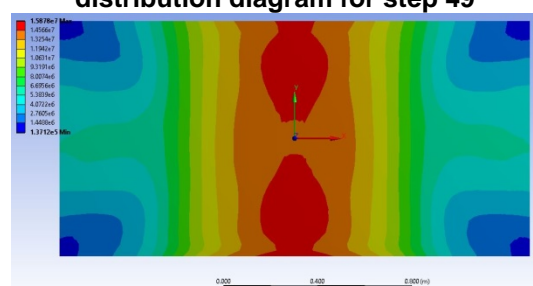


Figure 54 Equivalent stress (Von Mises) distribution diagram for step 50



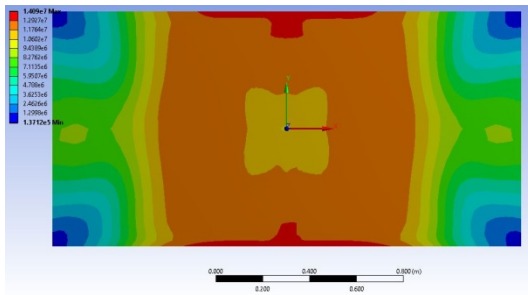


Figure 55 Equivalent stress (Von Mises) distribution diagram for step 51

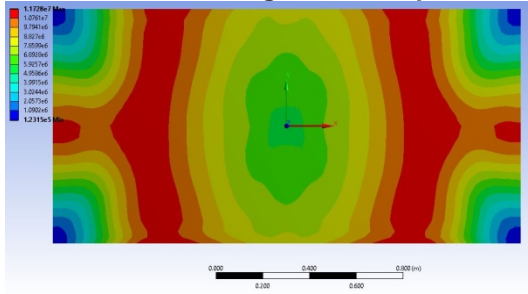


Figure 56 Equivalent stress (Von Mises) distribution diagram for step 52

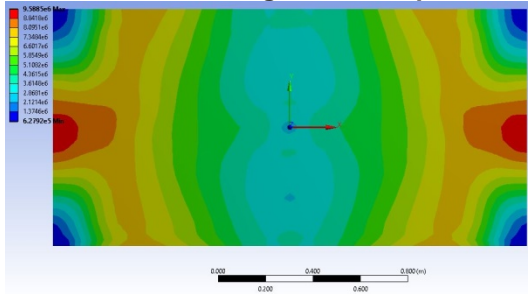


Figure 57 Equivalent stress (Von Mises) distribution diagram for step 53

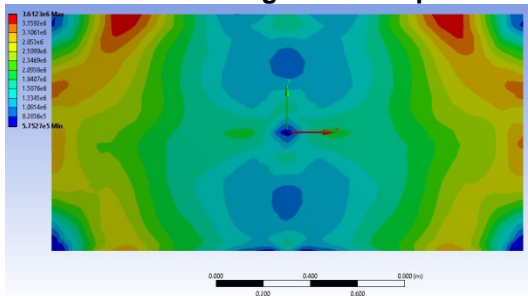


Figure 58 Equivalent stress (Von Mises) distribution diagram for step 54

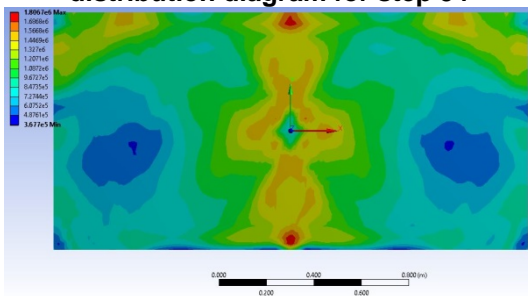


Figure 59 Equivalent stress (Von Mises) distribution diagram for step 55

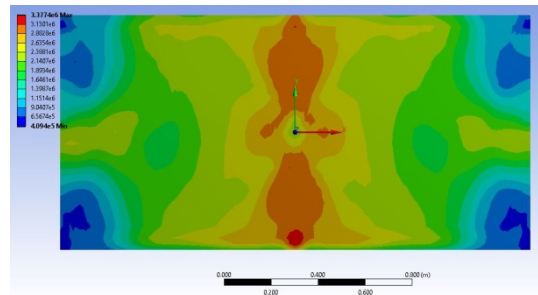


Figure 60 Equivalent stress (Von Mises) distribution diagram for step 56

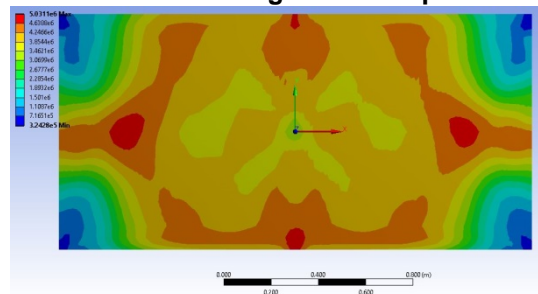


Figure 61 Equivalent stress (Von Mises) distribution diagram for step 57

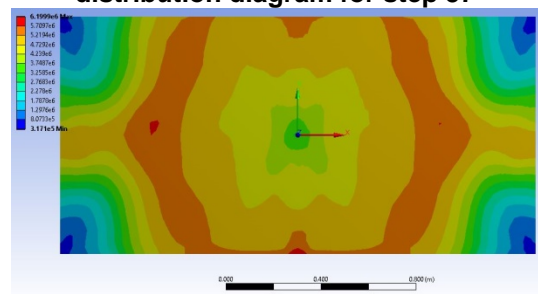


Figure 62 Equivalent stress (Von Mises) distribution diagram for step 58

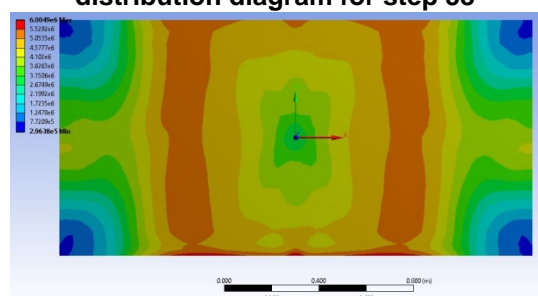


Figure 63 Equivalent stress (Von Mises) distribution diagram for step 59

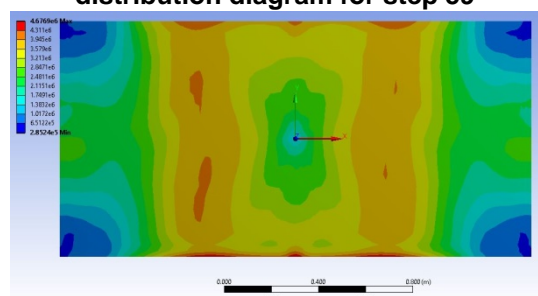


Figure 64 Equivalent stress (Von Mises) distribution diagram for step 60



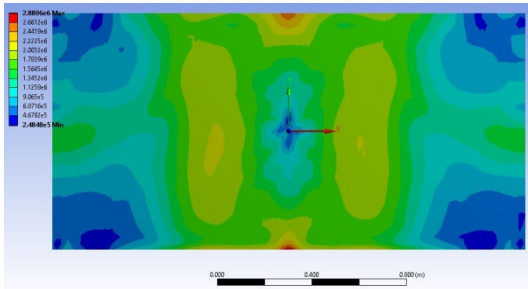


Figure 65 Equivalent stress (Von Mises) distribution diagram for step 61

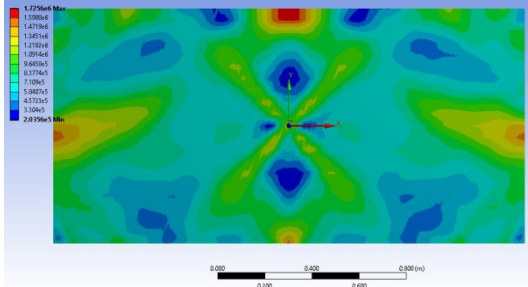


Figure 66 Equivalent stress (Von Mises) distribution diagram for step 62

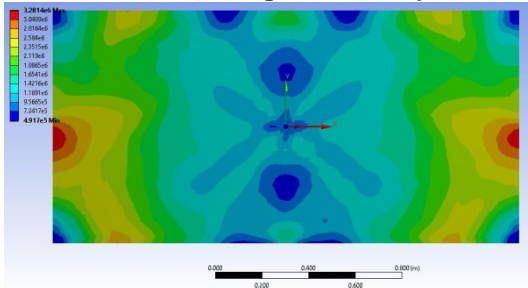


Figure 67 Equivalent stress (Von Mises) distribution diagram for step 63

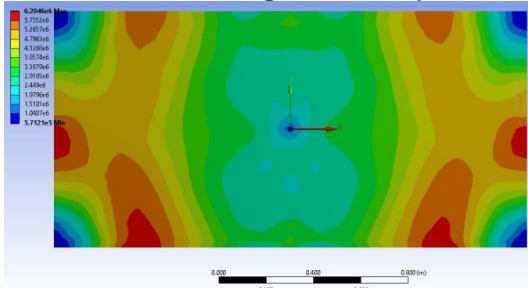


Figure 68 Equivalent stress (Von Mises) distribution diagram for step 64

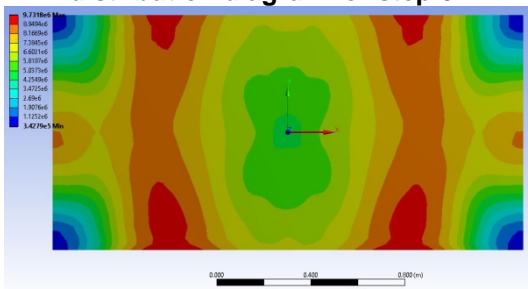


Figure 69 Equivalent stress (Von Mises) distribution diagram for step 65

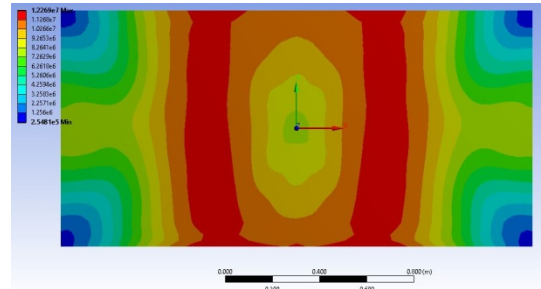


Figure 70 Equivalent stress (Von Mises) distribution diagram for step 66

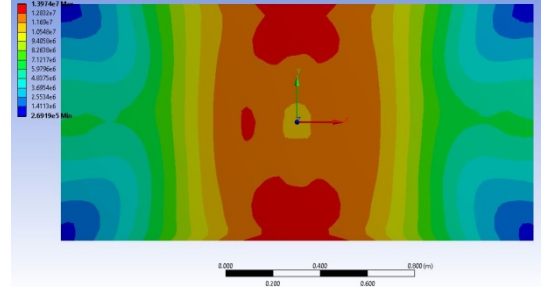


Figure 71 Equivalent stress (Von Mises) distribution diagram for step 67

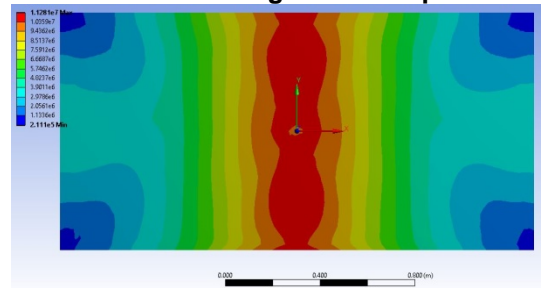


Figure 72 Equivalent stress (Von Mises) distribution diagram for step 68

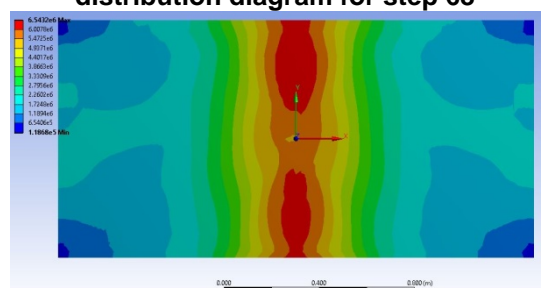


Figure 73 Equivalent stress (Von Mises) distribution diagram for step 69

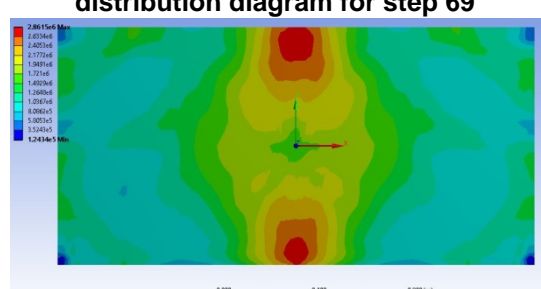


Figure 74 Equivalent stress (Von Mises) distribution diagram for step 70

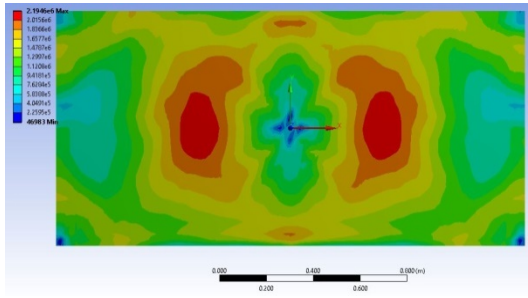


Figure 75 Equivalent stress (Von Mises) distribution diagram for step 71

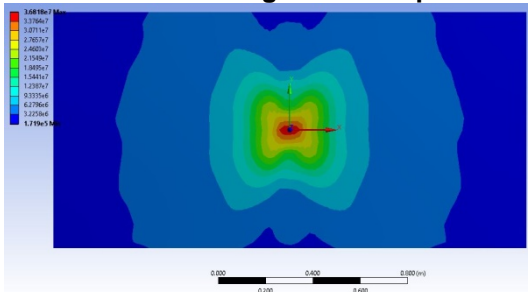


Figure 76 Equivalent stress (Von Mises) distribution diagram for step 72

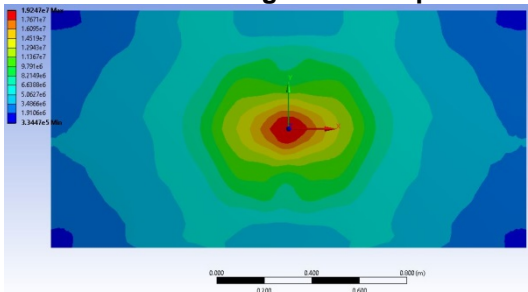


Figure 77 Equivalent stress (Von Mises) distribution diagram for step 73

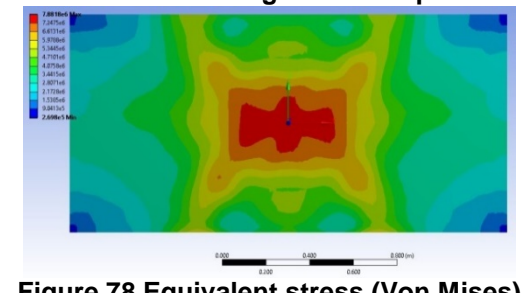


Figure 78 Equivalent stress (Von Mises) distribution diagram for step 74

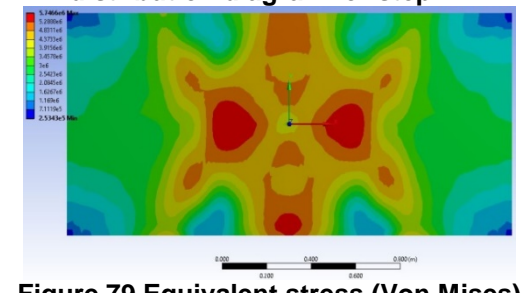


Figure 79 Equivalent stress (Von Mises) distribution diagram for step 75

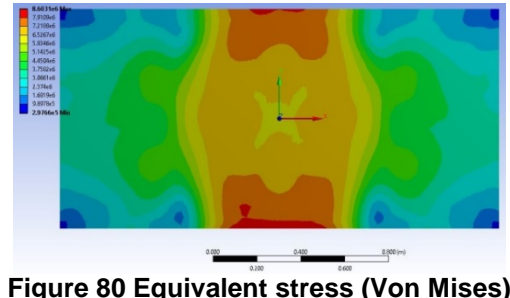


Figure 80 Equivalent stress (Von Mises) distribution diagram for step 76

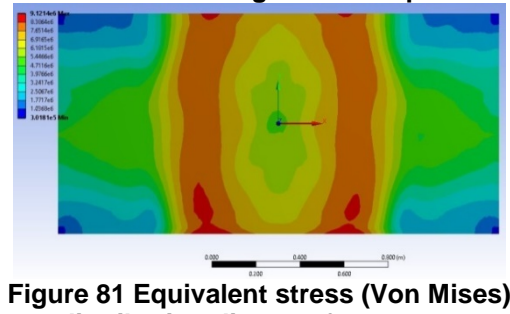


Figure 81 Equivalent stress (Von Mises) distribution diagram for step 77

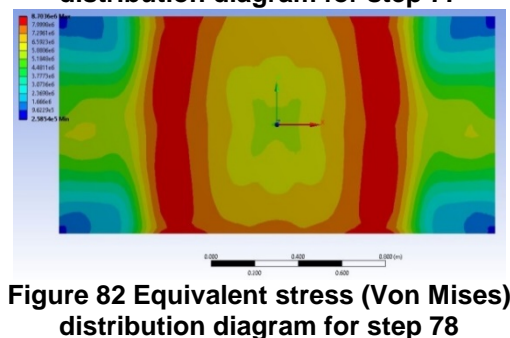


Figure 82 Equivalent stress (Von Mises) distribution diagram for step 78

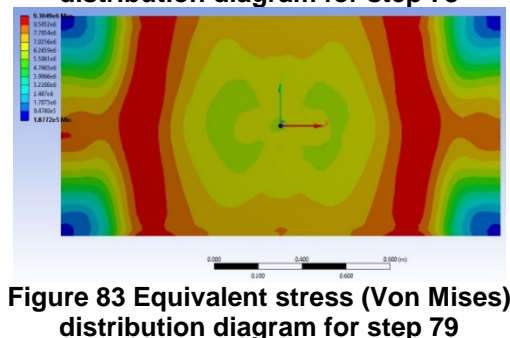


Figure 83 Equivalent stress (Von Mises) distribution diagram for step 79

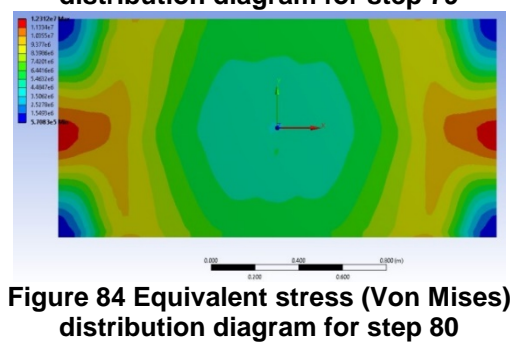
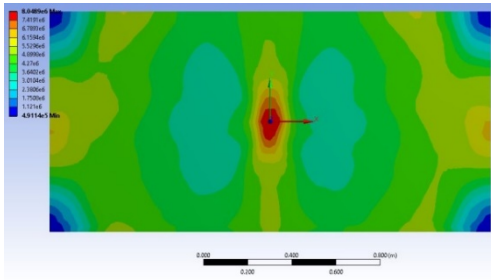


Figure 84 Equivalent stress (Von Mises) distribution diagram for step 80



**Figure 85 Equivalent stress (Von Mises) distribution diagram for step 81**

## **CONCLUSIONS**

The maximum value of von Mises tensions are reach at step 3 (7.5ms) with a value of  $8.99E7 \text{ N/m}^2$  ( $89.9\text{N/mm}^2$ ).

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