Tractor Stabilizer Bar Mounting Bracket Durability Analysis & Failure Correlation.

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Abstract: - *Tractor stabilizer mounting bracket supports stabilizer bar and it is mounted on rear axle carrier using three bolts. Failure has been observed in the field. CAE was to simulate the failure & propose new design using ABAQUS. The bracket & bolts were meshed using solid elements. As stabilizer bar is the part of three point linkage mechanism & it was challenge for CAE to simulate mechanism joints in ABAQUS. Nonlinear material properties were used. Contacts & bolt pretension load was assigned. Field failure location was matched with CAE results. Initial proposal was to add one additional mounting hole in the bracket to mitigate the stresses but it would have meant adding cost and assembly process change. Further after analysis of this proposal it was found that it doesn't help in reducing stresses in the failure region.*

Another proposal was tried at CAE end and keeping three mounting holes only without requiring assembly change. This design mitigated the stresses in the failure region, saved cost of adding extra bolts, material & development time. This design was then tested in the lab and it met the acceptance criteria.

Body of Paper

Non-linear contact simulation of tractor stabilizer bar mounting bracket was done using ABAQUS/standard. Need of this analysis was to correlate the field failure with CAE hot spot and to modify bracket design with minimum weight & cost. Figure 1 shows tractor three point linkage assembly. Failure occurred on the base plate & rib welding area. Bracket base plate, vertical plate, ribs and welding modeled using second order solid elements as shown in Figure 2. Rear axle carrier and bolts modeled using 1st order solid elements. The three point linkage mechanism links and joints modeled using 1D element. Nonlinear material properties were used for bracket. Bolt pretension and contact between base plate and rear axle carrier were defined for lateral load case. Von Mises Stresses found in the weld area were not within the acceptance criteria. CAE hot spot matched with the field failure location as shown in Figure 3.

Four holes mounting bracket design was proposed and if implemented it would have added two extra bolts, rear axle carrier design modification, development cost and increase in assembly time. But this proposal did not work and welded area Von Mises Stress was again not within the acceptance criteria as shown in Figure 4. Then CAE proposed another bracket design by keeping only existing three mounting holes and without any assembly change. CAE proposed design successfully met the von Mises stress criteria as shown in Figure 5. This design was then tested and validated in the lab. Weight reduction was 4.8% per tractor with respect to proposed design.

In Linear Static Analysis, CAE failure location did not match with the field failure location.

ABAQUS used to simulate

- Material Non-Linearity
- Contact Non-Linearity

That's Why ABAQUS/Standard used and CAE failure location exactly matched with the field failure location as shown in Figure 3.

Conclusions

ABAQUS has proven to be a valuable tool for the design evaluation of stabilizer bar mounting bracket at MAHINDRA SWARAJ division. The program is also used for Non-linear static analysis of tractor components.

ACKNOWLEDGEMENT

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References

ABAQUS 6.12 documentation.

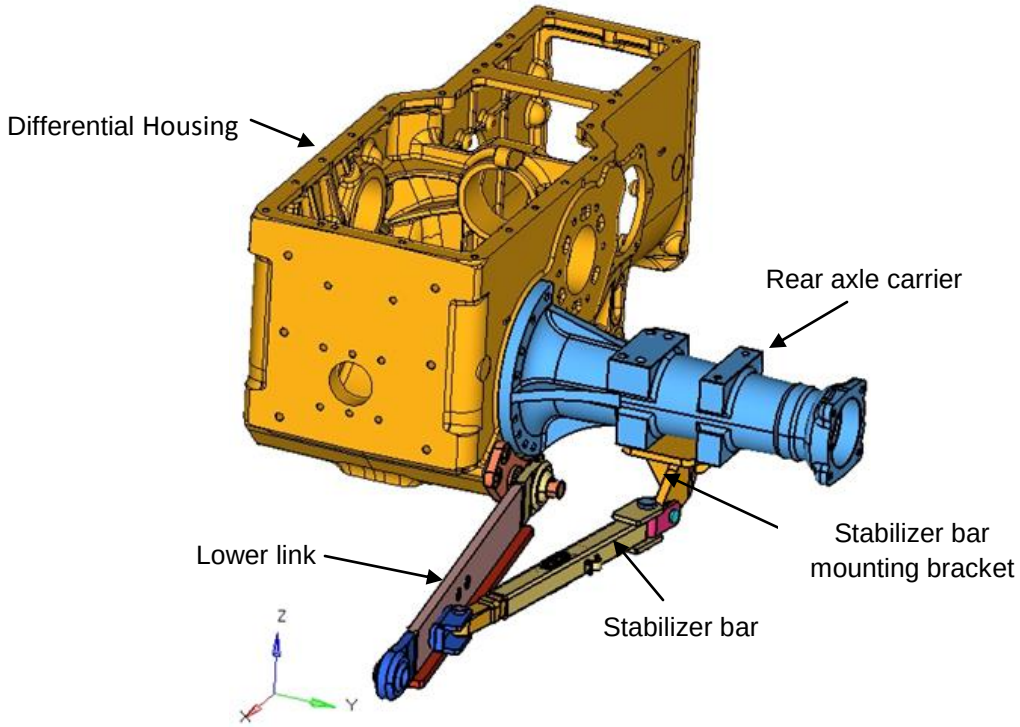

Figure 1. Tractor three point linkage assembly

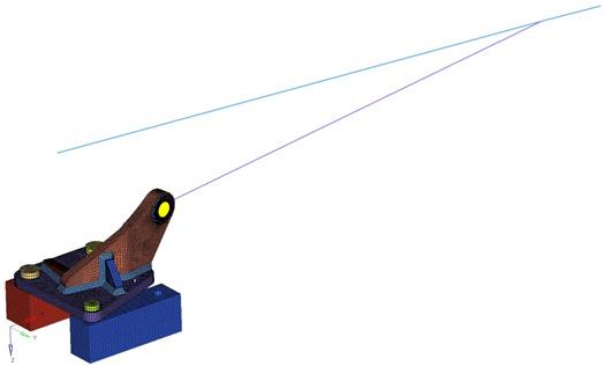

Figure 2. Stabilizer mounting bracket and three point linkage FE model

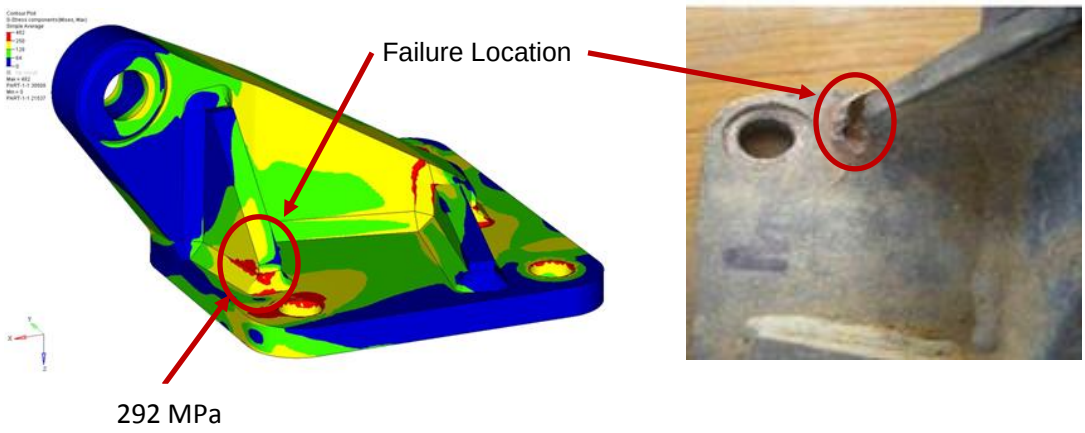

Figure 3. Baseline design von Mises Stress plot and field failure location

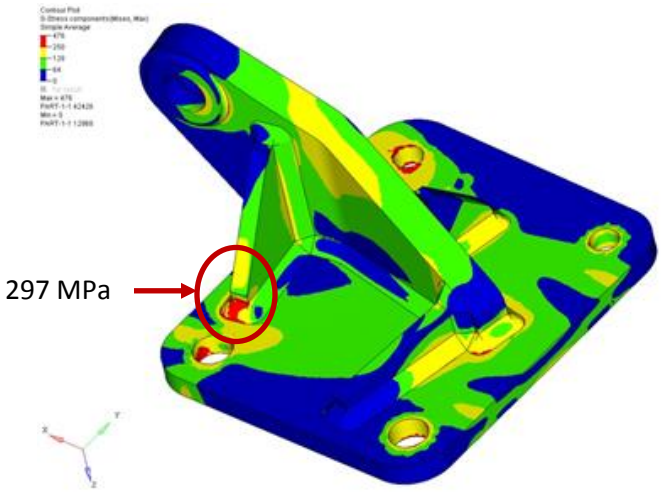

Figure 4. Proposed design von Mises Stress plot

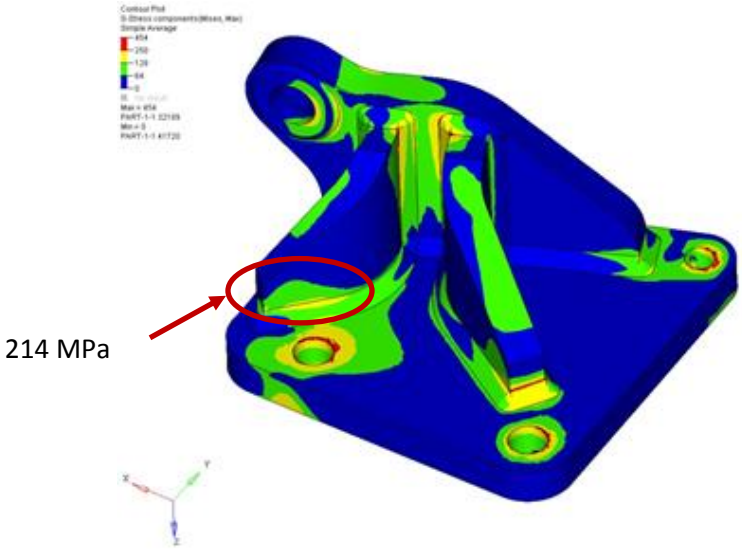

Figure 5. CAE design von Mises Stress plot