Review Report of Doctoral Thesis

November 7, 2021

Author: Mr.Sunil Kumar M R

Title of Thesis:
FRACTURE TOUGHNESS ANALYSIS OF AUTOMOTIVE STEEL IN PLANE STRESS

Reviewer: Dr.Neelakantha .V. Londe

Chapter 1 mainly focuses the various industrial steels that are predominantly used in the automotive field. The problems associated with the automotive stamping and its influence by fracture toughness is discussed. The standard fracture toughness parameters determination using ASME standards and their non-suitability is explained.

Chapter 2 briefly discusses the objective and necessity of the research work. **Chapter 3** deals with the fundamentals of fracture toughness and the parameters like stress intensity factor, crack tip opening displacement and J-integral are briefly discussed.

In **Chapter 4** the fundamental theory of essential work of fracture methodology has been discussed quite extensively. The parameters like specific essential work of fracture, crack tip opening displacement and crack tip opening angle from the methodology is discussed. The author also tries to write the influence of various parameters on the methodology. The essential work of fracture methodology is compared with the standard J-integral, and various possible modes of loading is introduced.

Chapter 5 focuses on the forming limit diagram and utilization of strain data to find out the triaxility and equivalent strains in different modes. Chapter 6 mainly focuses on the methodology of the research work. Here, details about the DP450 steel and IF steel, the methodology of the experiments, standard tensile tests, sample preparations for the EWF tests, EBSD technique and hole expansion tests are explained clearly.

Chapter 7 is dedicated to the results of the experiments carried out. The essential work of fracture test results are elucidated for various test conditions like precracked and notched conditions for the DP450 steel and IF steel. Fracture toughness difference between two steels are also discussed concisely. The EWF methodology is also tried for different modes and the results are also discussed.

Chapter 8 fundamentally focuses on the microstructural influence and fractographic evaluation of the tested samples. The microstructural information is explained extensively using EBSD

data. The nature of the fracture behaviour and damage initiation is explained with help of scanning electron microscope micrographs.

Chapter 9 deals with strain during the EWF test using digital image correlation technique. The strain data is well represented for both the steels. Standard forming limit diagram and the results are compared with the EWF test results. **Chapter 10** the conclusion and future scope of work is mentioned. **Corrections in the report**

Minor error:

In page no. 136 of the thesis, under section *9.2 Fracture forming diagrams*, in the beginning it should be Figure 9.15 and Figure 9.16 instead of Figure 9.16 and Figure 9.16, similar error in 3rd row to be corrected.

Questions to the author

1. Why you have selected DP450 steel and the IF steel in your research?
2. Whether the grain orientations of test specimens affect the test results?
3. How do validate your work?

Conclusion:

To summarize my assessment, all the stated research objectives were fulfilled; the PhD thesis is well written, well organized and presented. Very comprehensive and useful scientific data has been generated through this study with carefully done experiments. The work done has very relevant practical applications. The dissertation meets all the requirements; the quality of the thesis. The intensive work done is reflected in good number of peer-reviewed international publications.

I strongly recommend the award of degree of Doctor of Philosophy to the author for his research work done.

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