Simulated Study of Coupled Field Analysis and Investigation of Bolt Behaviour under Engine Operating Loads

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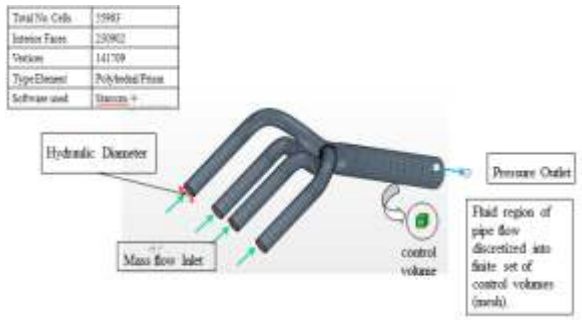
Abstract:

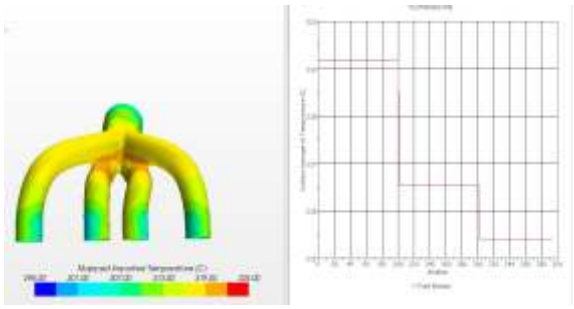
The exhaust manifold is exposed to high temperature exhaust gas, sometime it exceeds the 1000 ^{0}C. The metal temperature varies rapidly from the sub-zero to as high as 1000 ^{0}C and thus it develops a large thermal gradient. Therefore, the early modelling of the component behavior and its reliability is important part of the development. Since the temperature and fluid solved with the different solvers software, there is a need to establish the link between the these solvers. This project work is aimed at developing the coupling methodology to established link between the STAR CCM+(CFD) and ABAQUS (Structural)

The above approach investigated is best approach for possible solution of FVM and FEM coupled problem. The basic model was generated by using the HYPERMESH preprocessor software. Flow and temperature field was solved using the CFD software STAR CCM+ and resulting film coefficient and the ambient temperature was interpolated to corresponding mesh of the solid surfaces in ABAQUS. The iteration has been done up to temperature between consequent step should be 10% of total temperature.

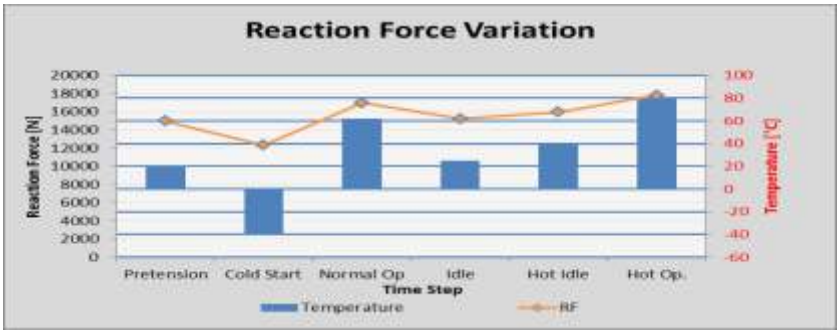
In the second part, the bolt behavior was analysed under various operative conditions. Here, for analysis maximum temperature of the each cycle was taken and was applied on the exhaust manifold. The basic load was assembly load and the result of this analysis has been arrested, and over that temperature and the pressure load has been applied. The bolt force pattern and gas leakage from the exhaust pipe was studied.



Methodology study



Temperature difference in iterative steps



Bolt force varies due to temperature variation