A Simulation App to Calculate Stiffness of Stabilizer Bar

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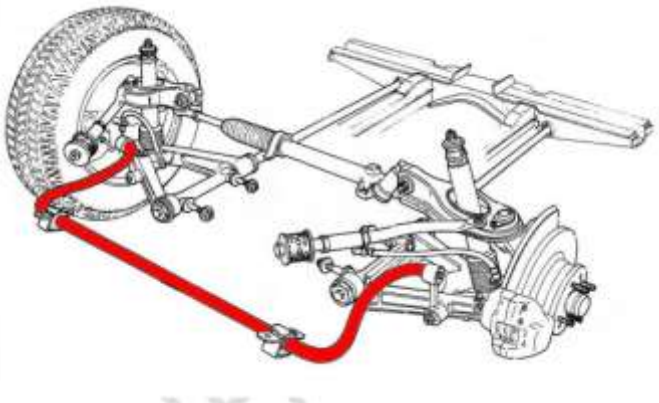
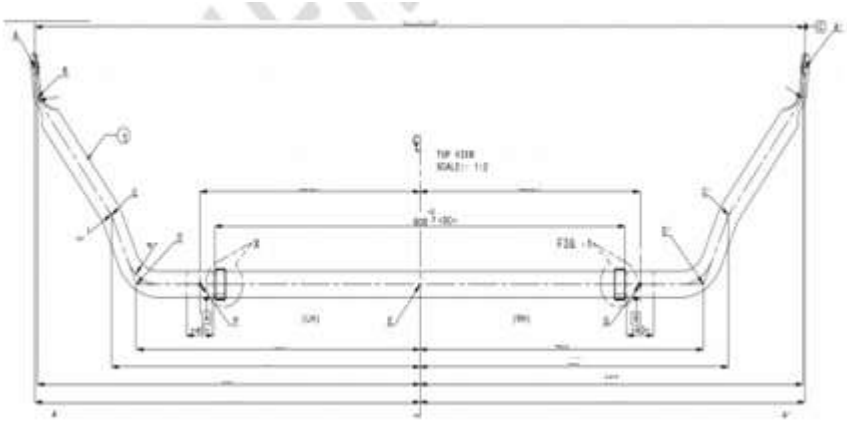
Introduction

- Anti-Roll Bars are the part of suspension system, its purpose is to resist the body roll during the cornering of the vehicle and prevent vehicle from waddling due to road surface providing ride comfort to passenger





- To achieve the required roll gradient, we have to target roll stiffness which in turn decides the Stabilizer bar stiffness

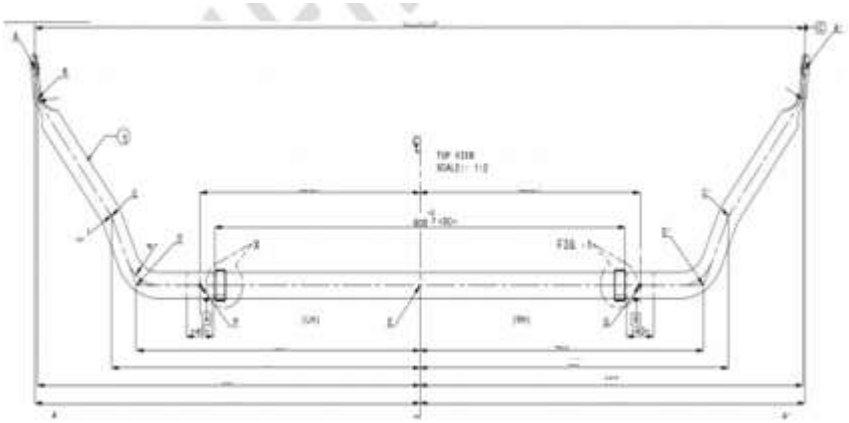
Roll gradient → Suspension Roll Stiffness → Stabilizer bar stiffness

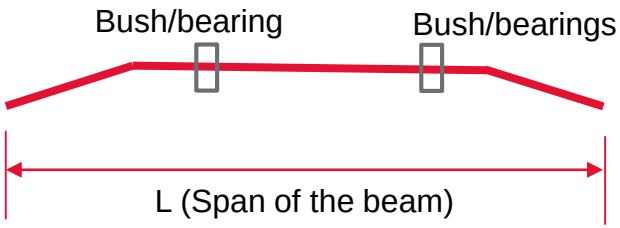
Simulation Objective

- The objective of this application is to compute the stiffness of Stabilizer Bars under different load cases with and without bushing
- To reduce the iterations in the FEM to achieve target metrics during the design at concept stage
- To design the geometrical aspect of bar with determining number of bends using parametric study during packaging
- Build a Comsol application in Mathapps web based platform using Comsol server and custom developed methods

Modelling in Comsol

- The Anti-Roll bar is modelled in Comsol as beam with 6 combination of cases with loading at the ends, bushing/ bearing at the mid-way





- The roll gradient is formulated as:

$$\text{R.G.(deg/g)} = \frac{Mr}{Kr}$$;Mr = Roll Moment; Kr = Roll Stiffness

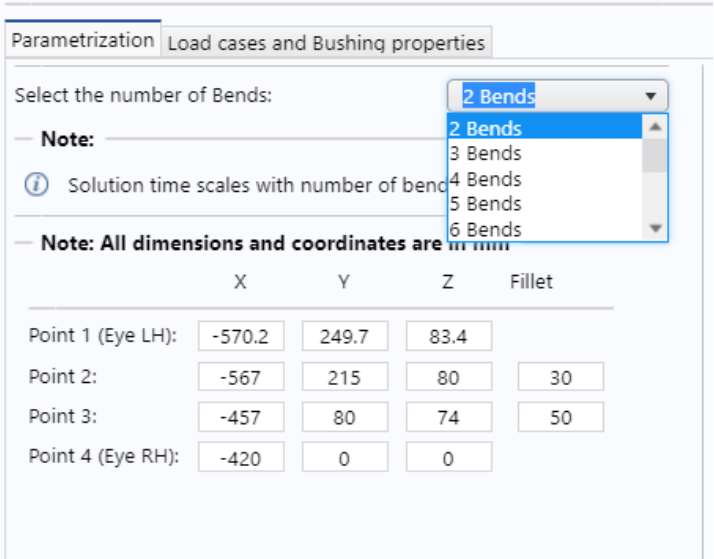
Mr = Fz*L;

- The calculated Roll gradient which is the target will be then used for further analysis

Modelling in Comsol

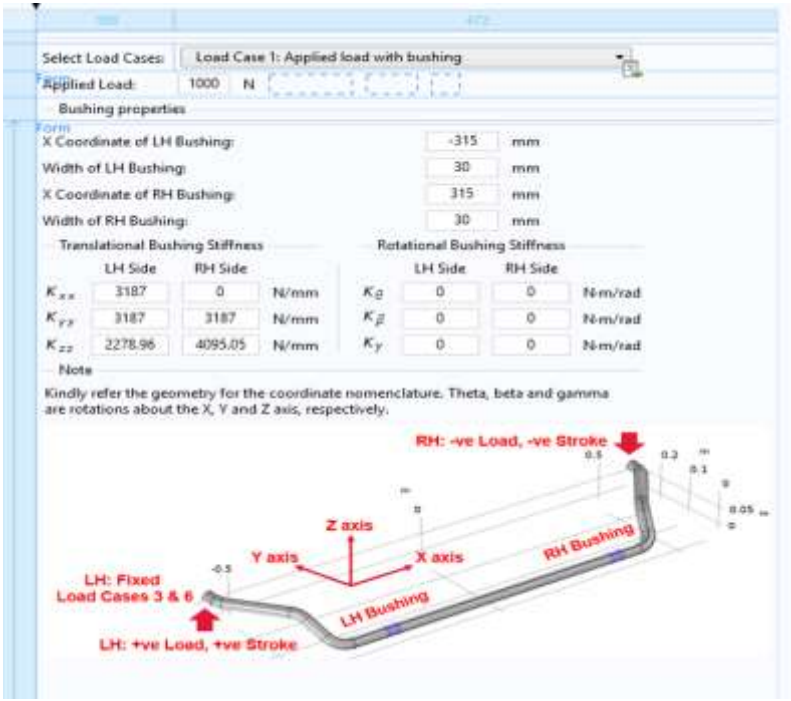
- Parametrization of Geometry

No of Bends:



The application requires the co-ordinates of the two eye point of the ARB along with the Bends

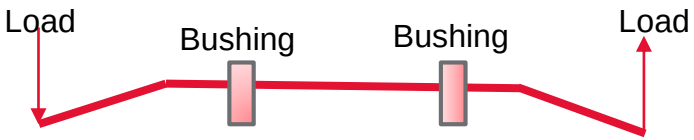
- Load Cases and Bushing



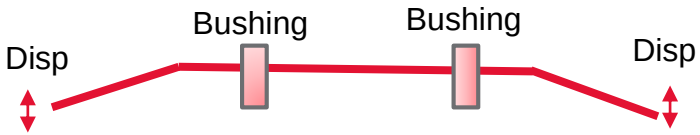
Several Load Cases and Bushings properties are defined to set boundary condition

Load Cases and Bushing

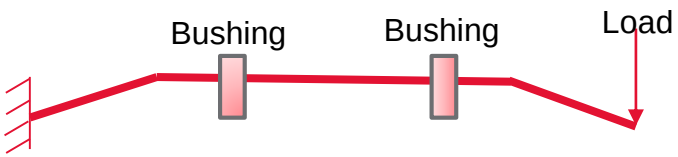
1. Load at both the ends and bushing applied



2. Displacement at both the ends and bushing applied

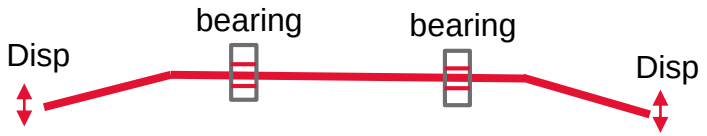


3. Load applied at one end, one end fixed and bushing applied

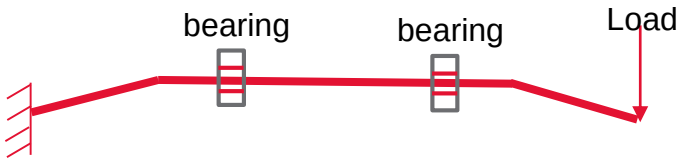


4. Load applied at both the end without bushing

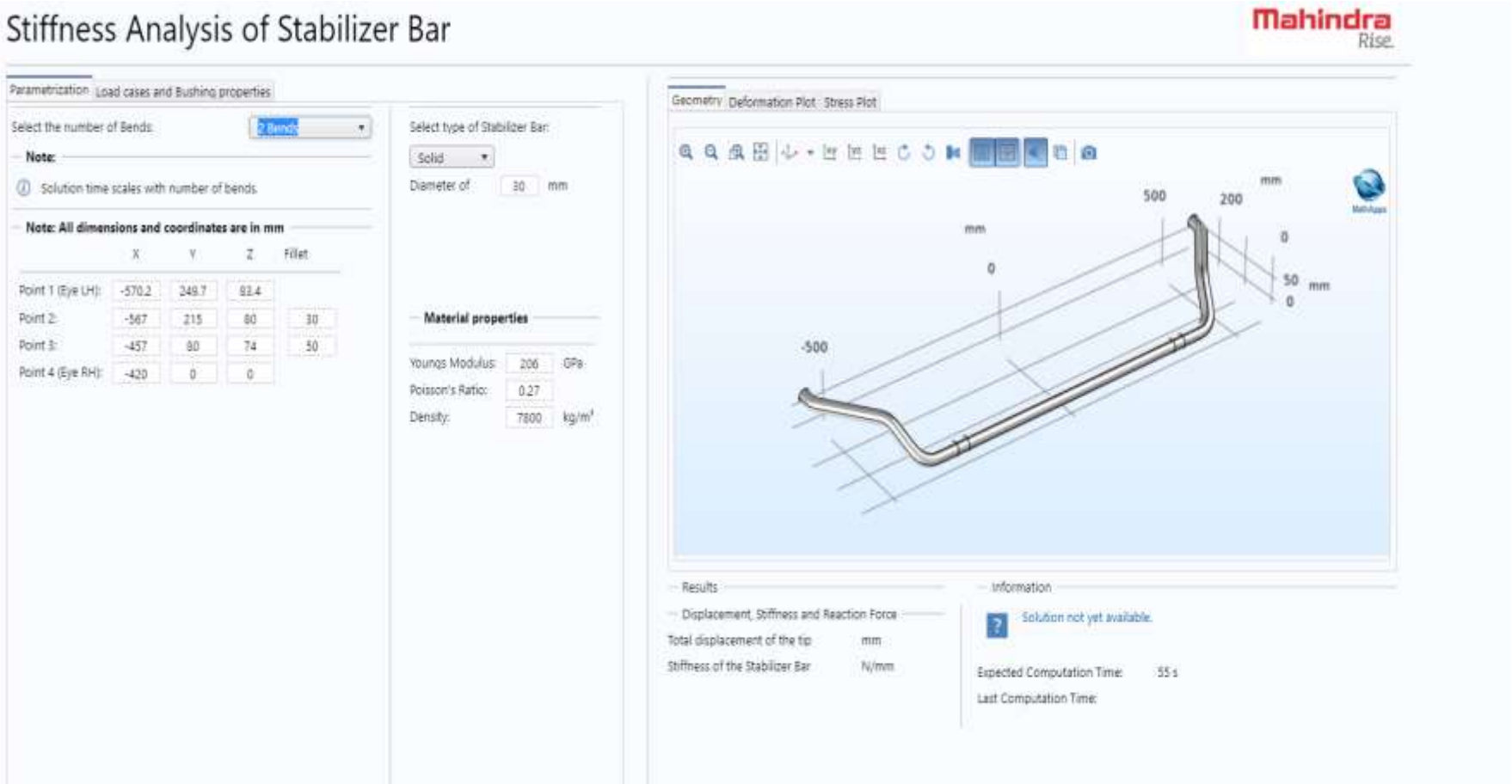
5. Displacement applied at both the ends without bushing



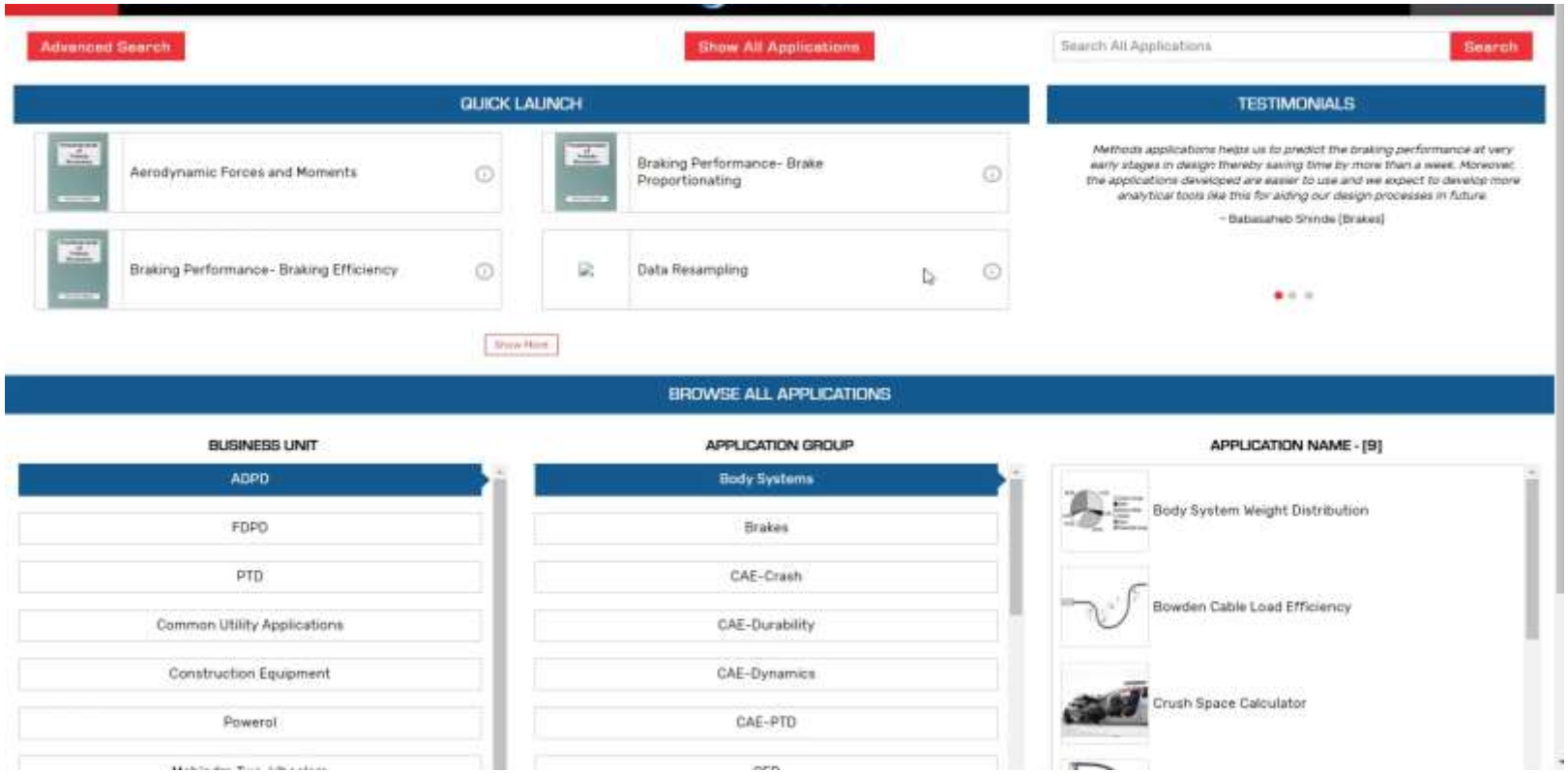
6. Load applied at one end, one end fixed and without bushing



Application GUI in Comsol server



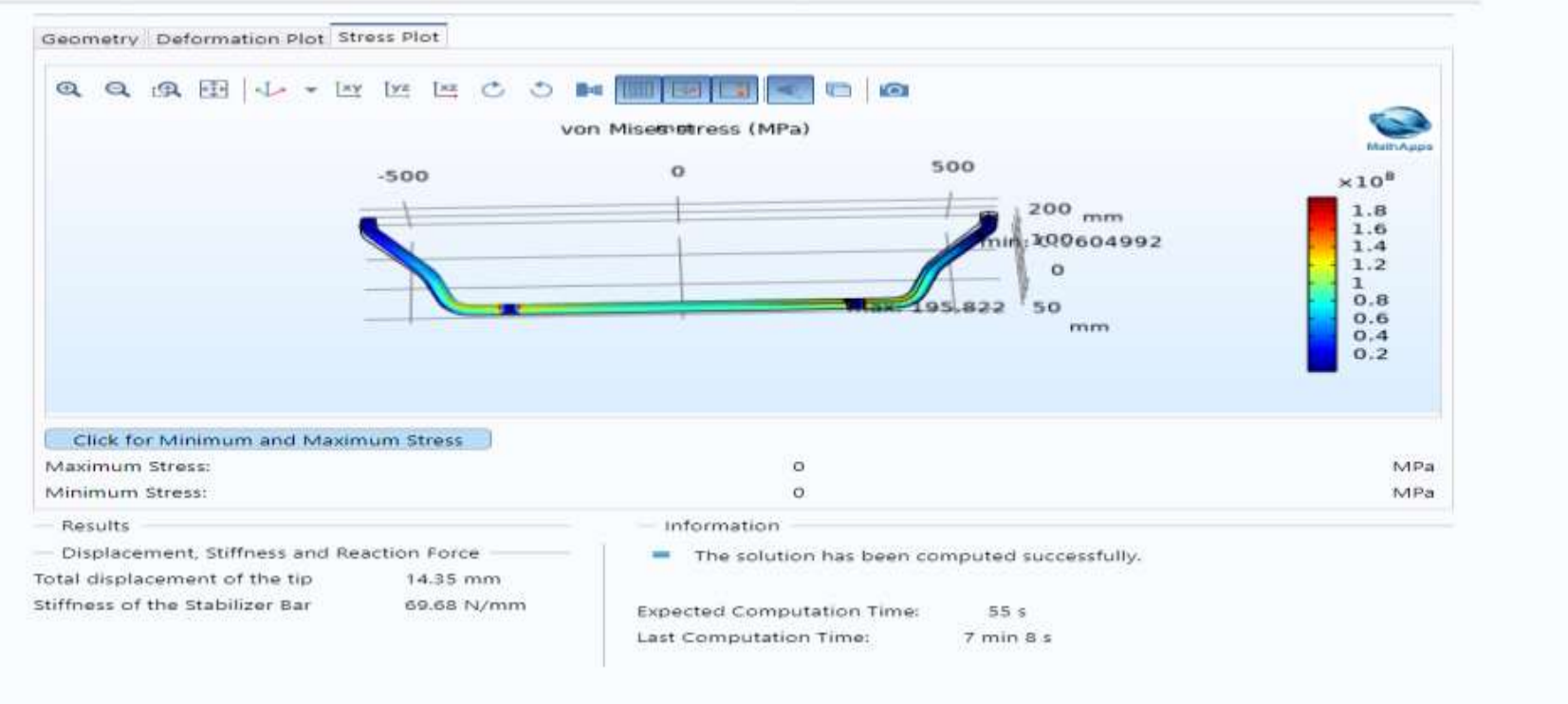
Application GUI in Comsol server



Results

After computation the below results values can be analysed

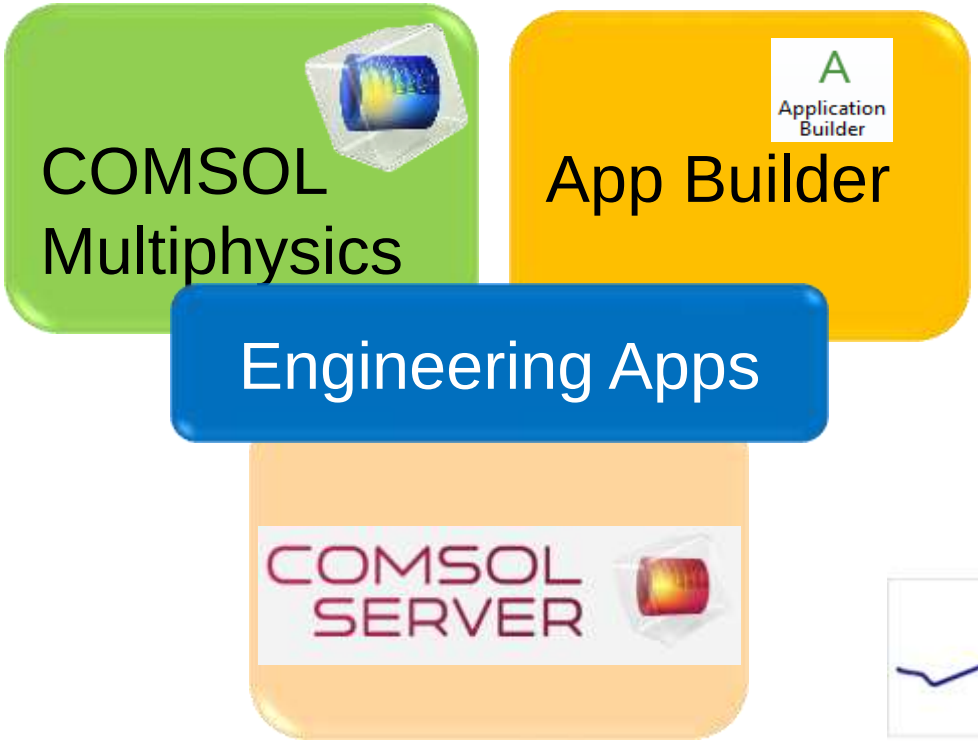
- Displacement at eye of the Stabilizer Bar
- Stiffness of the Stabilizer Bar

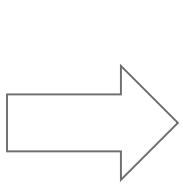


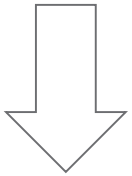
The results form this application give about 95% of correlation along with the success in mesh sensitivity analysis with the FEA

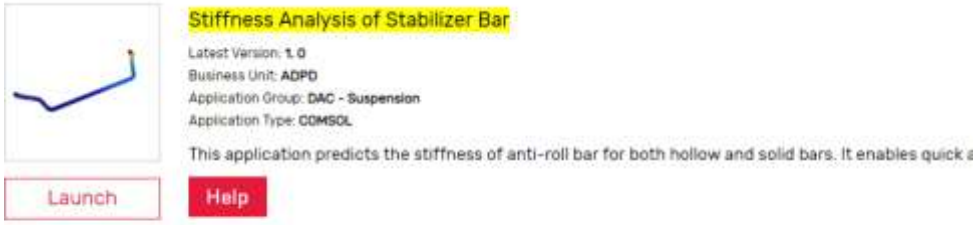
Web Based Mathapps GUI

- Deployment of the application on our web based portal across our organization “Mathapps”









Summary

- COMSOL App builder can be used to prepare the customize applications (GUI) based on user requirement
- The Roll stiffness of the vehicle Stabilizer Bar can be evaluated and compared with the target without relying fully to FEA simulation
- The designer can quickly evaluate the stiffness of stabilizer bars just by entering the coordinates, bushing locations, bushing stiffness, stabilizer diameter and thickness, material properties and choose from a pre-defined load cases which is beneficial in decisions related to packaging
- The web based portal deployment via COMSOL server gives access to any of the user across different locations in the organisation

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Thank you

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