MODELLING AND SIMULATION OF MR DAMPER USING COMSOL

Mr.Y.M.Khedkar1, Prof.S.B.Joshi2, Prof.Dr.P.M.Pawar3, Prof.Dr. B.P.Ronge4

1.Assistant Professor, Mechanical Engineering Department, SVERI's College of Engineering, Pandharpur, District Solapur, Maharashtra, India
2.Principal,Brahmdevdada Mane Polytechnic,Belati, Solapur, Maharashtra, India
3.Dean, Research and Development, SVERI's College of Engineering, Pandharpur, District Solapur, Maharashtra, India
4.Principal, SVERI's College of Engineering,Pandharpur, District Solapur, Maharashtra, India

Introduction: Vibration amplitude reduction can be achieved by improving the old technique of suspension by bringing in application of Magnetorheological fluid in it. Due to the controllable characteristics of the material used in the classical hydraulic damper, the design and application of such devices has been area of recent interest. Considering this requirement, classical damper was modified into MR damper by using an external magnet arrangement without any changes in the internal design of the classical damper. The MR damper was modeled using COMSOL and under varying magnetic and excitations, the results were observed using simulations.

Computational Methods: In order to estimate the effect of gap and effect of magnetic field on viscosity of MR fluid behavior of the system, a multi physics FEM model has been developed in the Comsol FemlabTM environment(2). In this model non-Newtonian behavior of the MR fluid has been used. In order to get a smoother characteristic the Carreau model has been used .(1)

$$\eta = \eta_\infty + (\eta_0 - \eta_\infty)\left[1 + (\lambda_y)^2\right]^{\frac{n-1}{2}}$$

n = value of viscosity [Pa × s]

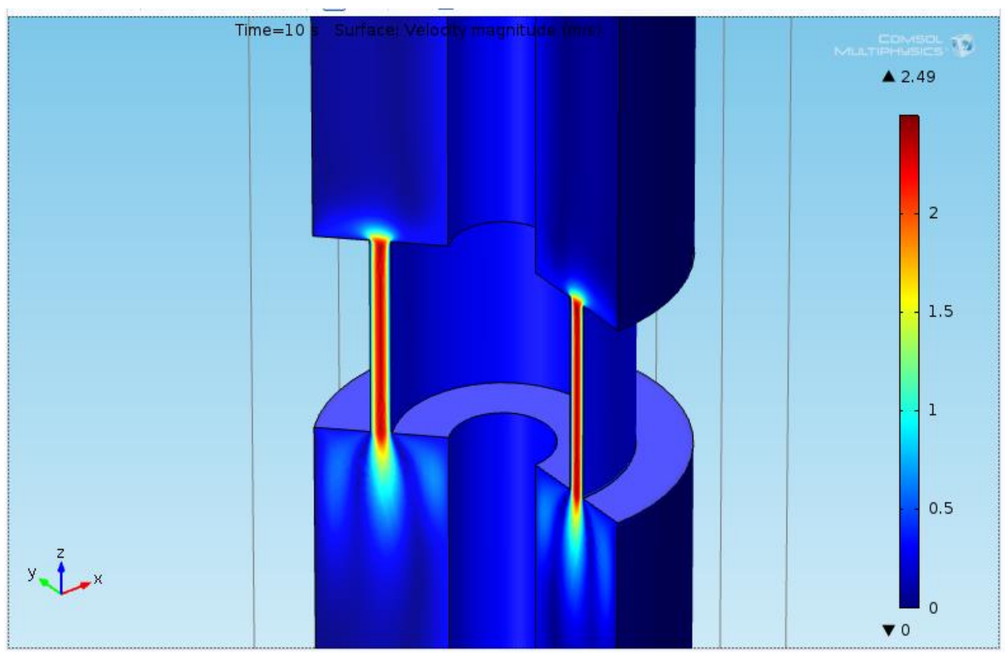


Figure 1 : 3D axisymmetrical model of fluid gap In MR damper

Results: MR fluid gap is increased to study the effect of gap on viscosity of MR Fluid. As magnetic field is increased it is observed that viscosity is also increased.

Magnetic Field in Gauss	Dynamic Viscosity in centi poisse
0	6650
100	8340
250	12010
550	16000
700	22050
1000	22700

Table No. 1 Dynamic viscosity and magnetic field

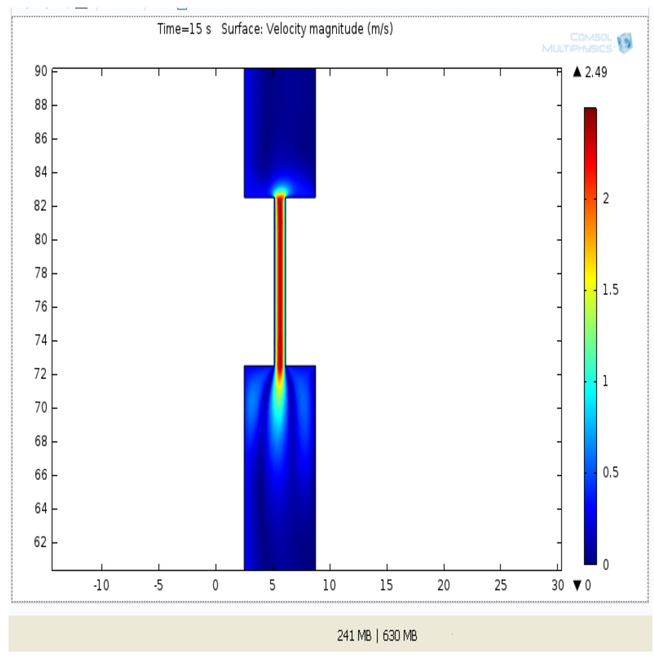
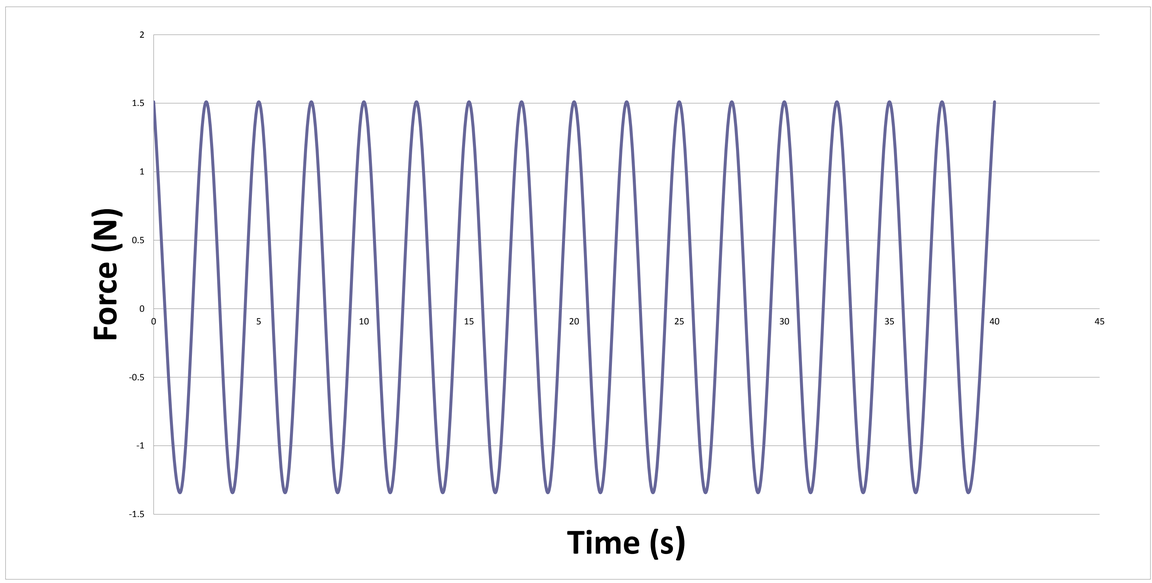


Figure 2: Velocity Vs time plot



Conclusions: It becomes convenient to estimate damping force at different viscosities which are changed under magnetic field due to simulation in COMSOL. It also makes it correct to simulate various configuration of dampers

References:

1.Peel .J., Stanwa, R., Bullough W.A., "Design Optimization of a Controllable Vibration Damper for Vehicle Suspension Applications" *Active Control of Vibration and Noise, American Society of Mechanical Engineers, Design Engineering Division Publication, DE-Volume* 93, 1996, pp. 205-214.

2. Y.K. Lau e W.H. Liao, "Design and analysis of magneto-rheological dampers for train suspension" *Journal of Rail and Rapid Transit,219 (2005), pag. 261-276.*