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About OMICS Group Conferences

OMICS Group International is a pioneer and leading science event organizer, which publishes around 400 open access journals and conducts over 300 Medical, Clinical, Engineering, Life Sciences, Pharma scientific conferences all over the globe annually with the support of more than 1000 scientific associations and 30,000 editorial board members and 3.5 million followers to its credit.

OMICS Group has organized 500 conferences, workshops and national symposiums across the major cities including San Francisco, Las Vegas, San Antonio, Omaha, Orlando, Raleigh, Santa Clara, Chicago, Philadelphia, Baltimore, United Kingdom, Valencia, Dubai, Beijing, Hyderabad, Bengaluru and Mumbai.



Dynamic Simulation of a Cranktrain

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AVL

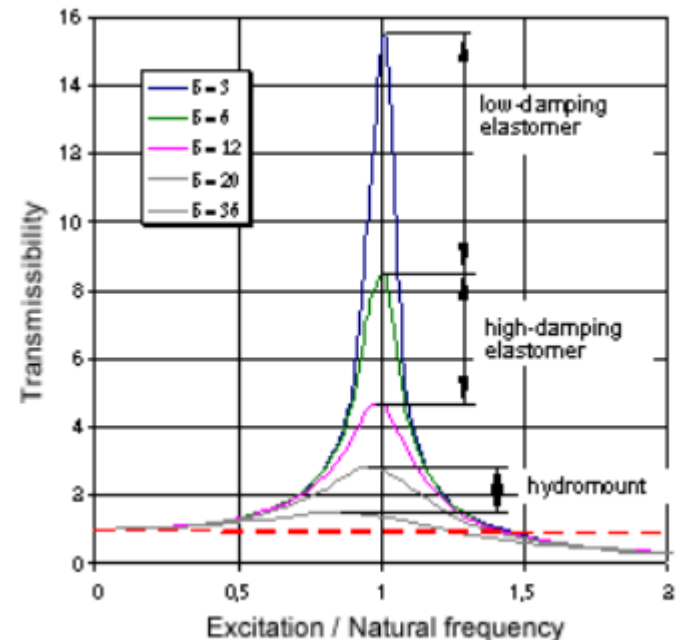


Objective

- To provide
 - Lower vibration magnitudes
 - Reduced maintenance cost and weight
 - More comfort to passengers
 - Increasing the safety

Damping of Torsional Vibration

- Damping refers to keeping the vibration deflection within acceptable limits once the resonance point has been passed as the extraction of kinetic energy by means of **thermal conversion**
- Elastomer materials exhibit greater damping than metal due to **internal material friction**.



How do we calculate damping?

$$d = \frac{c \cdot \Psi}{2 \cdot \Pi \cdot \omega}$$

- Where ;

$$\omega = \sqrt{\frac{c}{J}}$$

Damping factor d ; unit [Nms/rad]

Damping ratio Ψ ; unit [-]

Natural frequency of the TV damper ω ; unit[1/s]

Torsional stiffness of the TV damper c ; unit [Nm/rad]

Mass moment of inertia of the TV damper J ; unit [kgm²]

What is TV Damper?

● Torsional Vibration

- Designed to;
 - prevent from **fatigue failures** of crankshaft
 - Protect other driveline parts from **wear**
 - Increasing the **NVH performance** of the car
 - **AVL Excite Designer** software is used to simulate the system

AVL Excite Designer

- Leads crank train and driveline design analysis with **less set of data**
- Performs modal analysis of the system and determines its **torsional frequencies and torsional modes, as well as critical speeds**
- Results of dynamic forced response calculation include **dynamic torques, angular displacements, and dissipation power of torsional vibration damper**

Simulation Interface

- Engine Illustration

The screenshot displays the EXCITE Designer software interface for a 4-cylinder inline engine simulation. The window title is "EXCITE Designer - IL4 - Case 1 of Designer Set 1". The menu bar includes Programs, File, Edit, Element, Model, Simulation, FE Analysis, Optimization, Options, Tools, Utilities, and Help. The toolbar shows various icons for file operations, navigation, and simulation control. The main workspace is titled "2D-View" and "3D-View", with the "2D-View" tab selected. The engine model is labeled "EXCITE D v2011" and "4 Cylinder Inline engine".

The engine model is shown in a 2D view, illustrating the internal components and their connections. The components are labeled as follows:

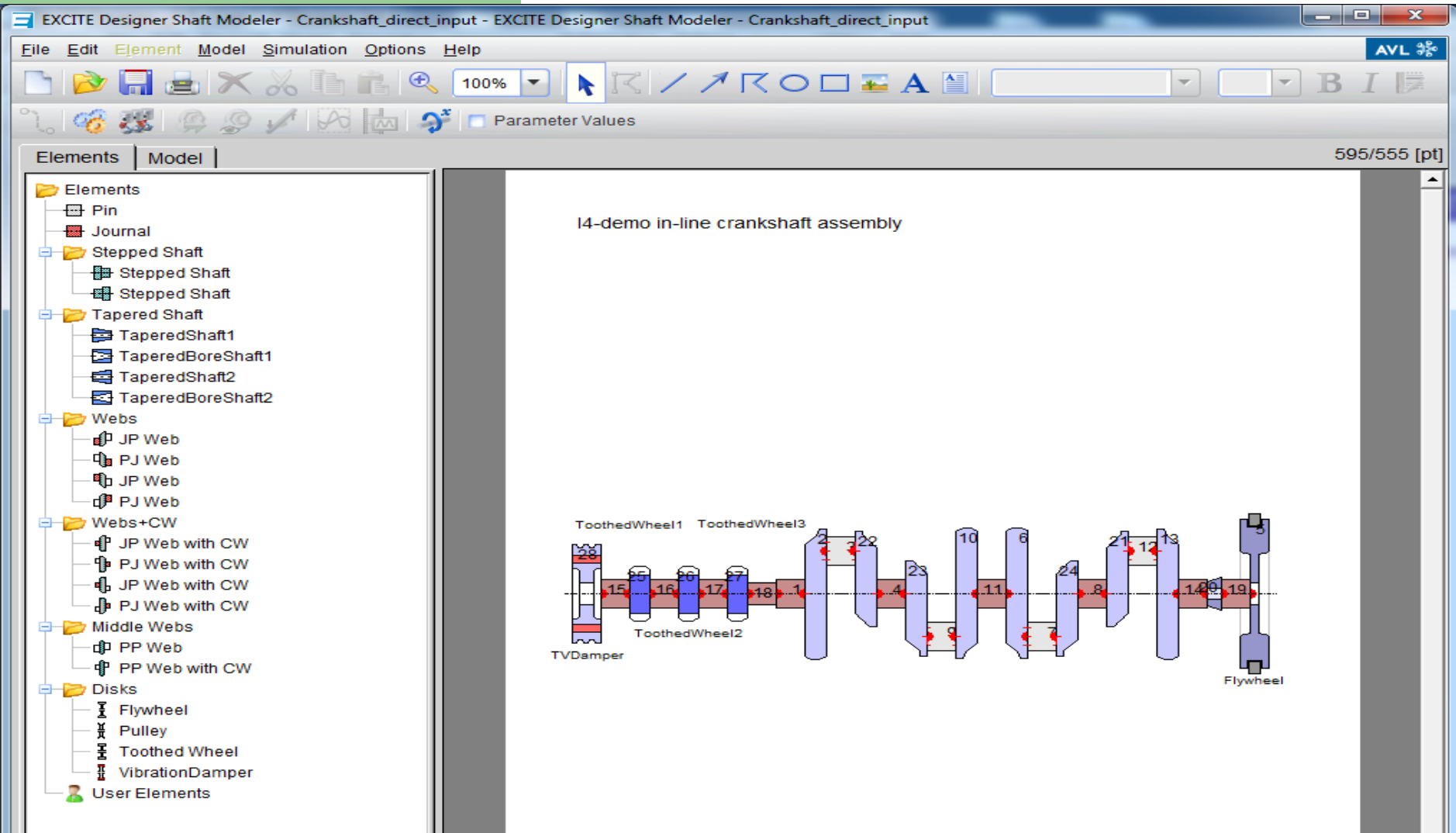
- Piston:** Piston1, Piston2, Piston3, Piston4
- Piston Pin:** PistonPin1, PistonPin2, PistonPin3, PistonPin4
- P-Pin:** P-Pin1, P-Pin2, P-Pin3, P-Pin4
- Small End:** SmallEnd1, SmallEnd2, SmallEnd3, SmallEnd4
- Conrod:** Conrod1, Conrod2, Conrod3, Conrod4
- Big End:** BigEnd1, BigEnd2, BigEnd3, BigEnd4
- Crankshaft:** Crankshaft
- Main Bearing:** MainBearing1, MainBearing2, MainBearing3, MainBearing4, MainBearing5

The left sidebar shows a tree view of the model elements, including:

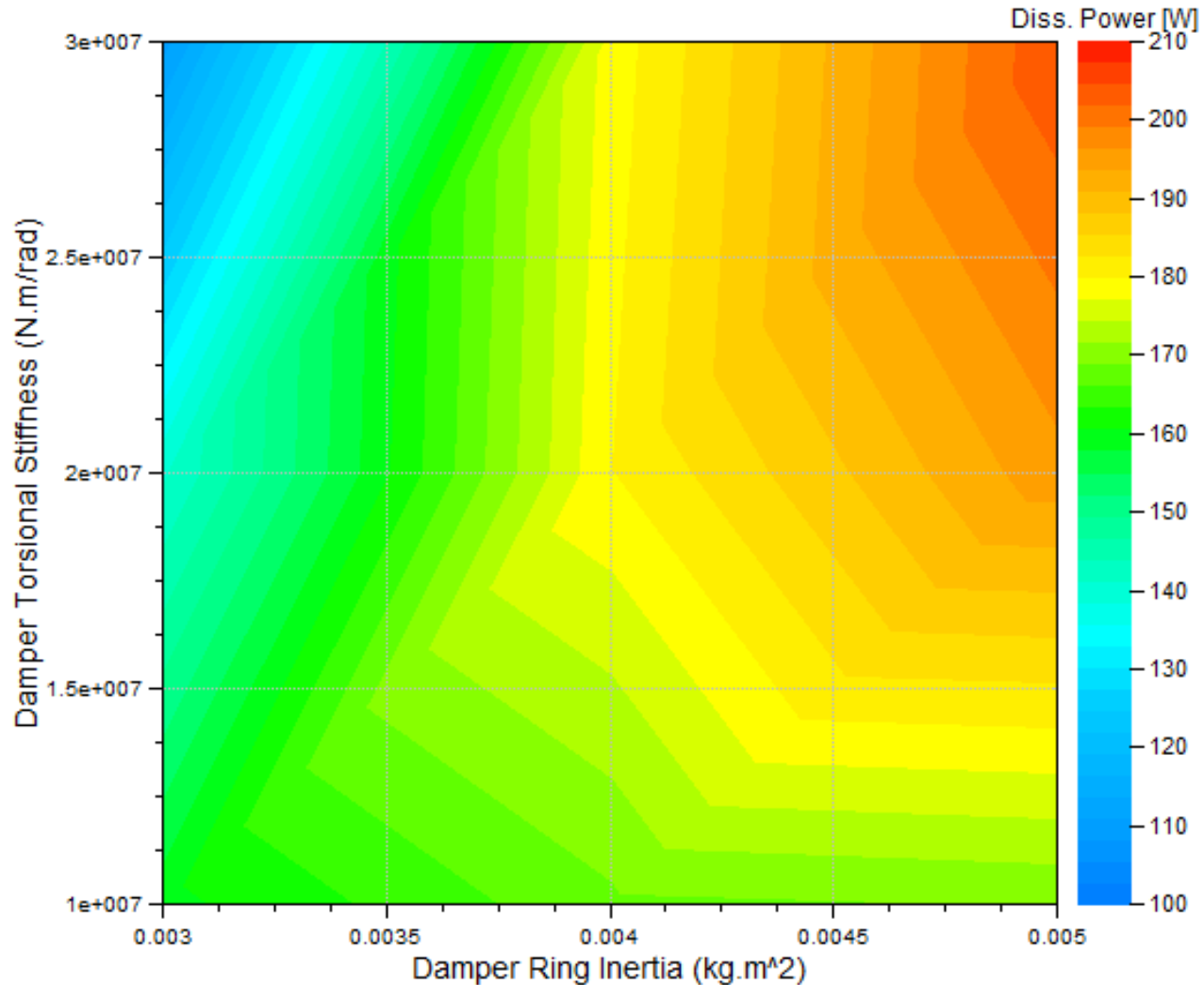
- Generic Body
- Piston
- ConRod
- Cross Head
- Crankshaft
- Balancer Shaft
- Engine/Power Unit
 - Engine
 - Power Unit
- Drive Train
- Miscellaneous
 - Piston Pin
 - Shaft
- Wind Turbine
- Generic Joint
- Radial Slider Bearing
 - Radial Bearing C-C
 - Radial Bearing C-S
 - Radial Bearing S-S
- Rolling Elements Bearing
- Thrust Bearing
- Oil Supply Line
- Transmission
- Electromechanic Coupling
- User Elements

The bottom of the interface features a "Data Checker" panel, which is currently empty. The status bar at the bottom indicates the file path: "c:\Program Files (x86)\AVL\EXCITE\2011.2\examples\121_Designer_IL4\excite\IL4.ex loaded".

- The Crankshaft Model

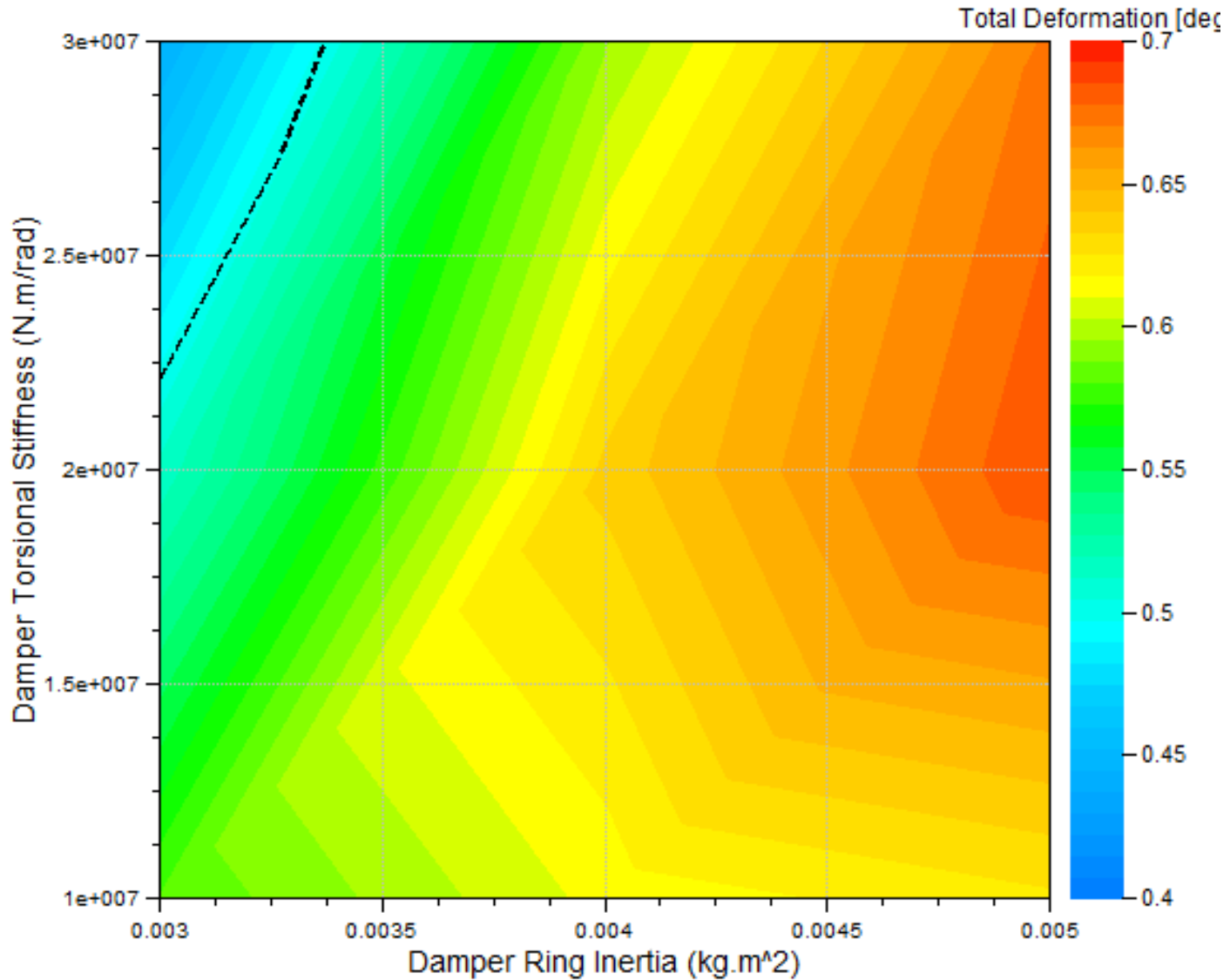


Maximum Dissipated Power @ Damper1



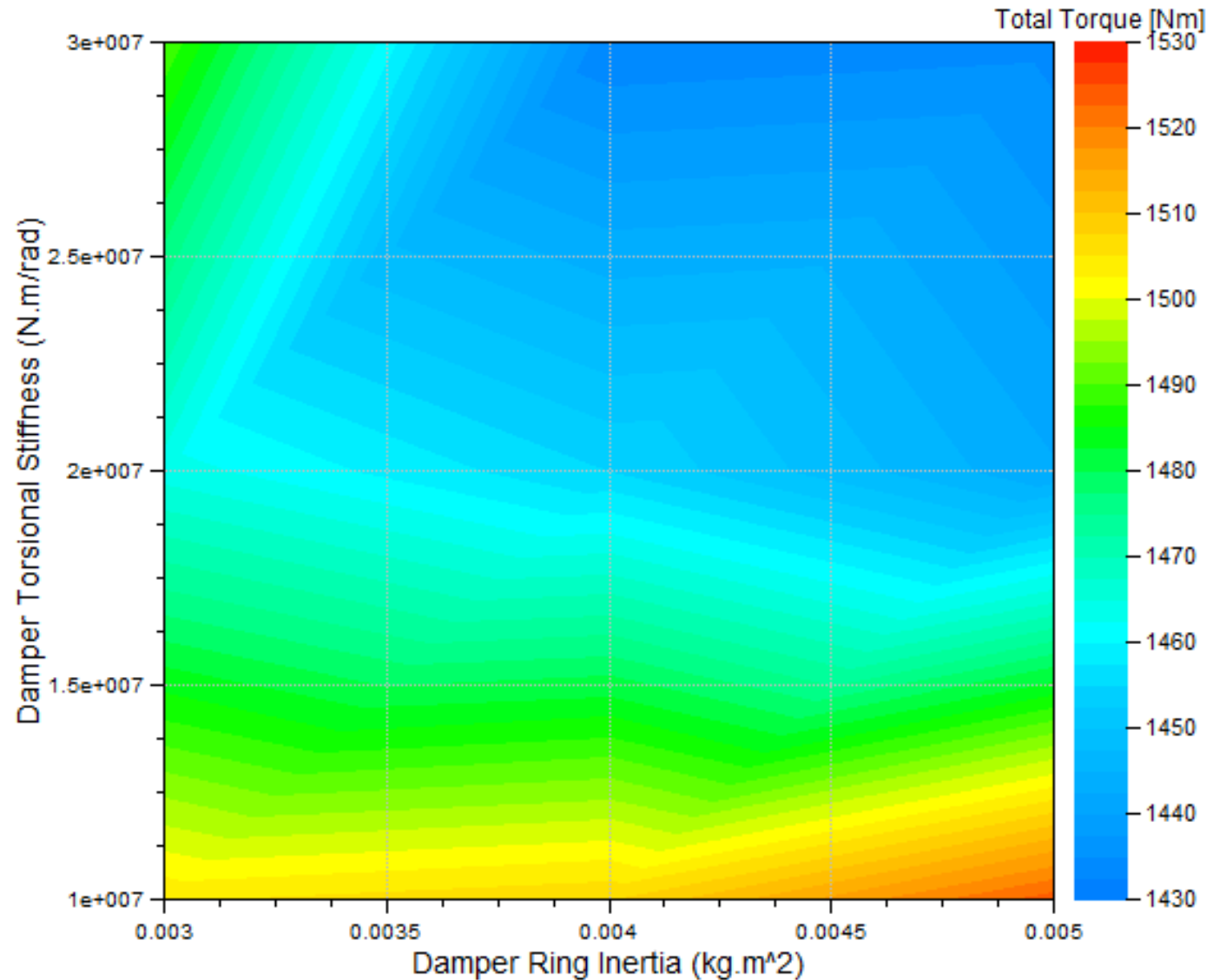
The biggest power dissipation (210 W) occur at right and upper side. Too much dissipated power **can wear elastomer material of TV damper.**

Maximum Total Deformation @ Damper1



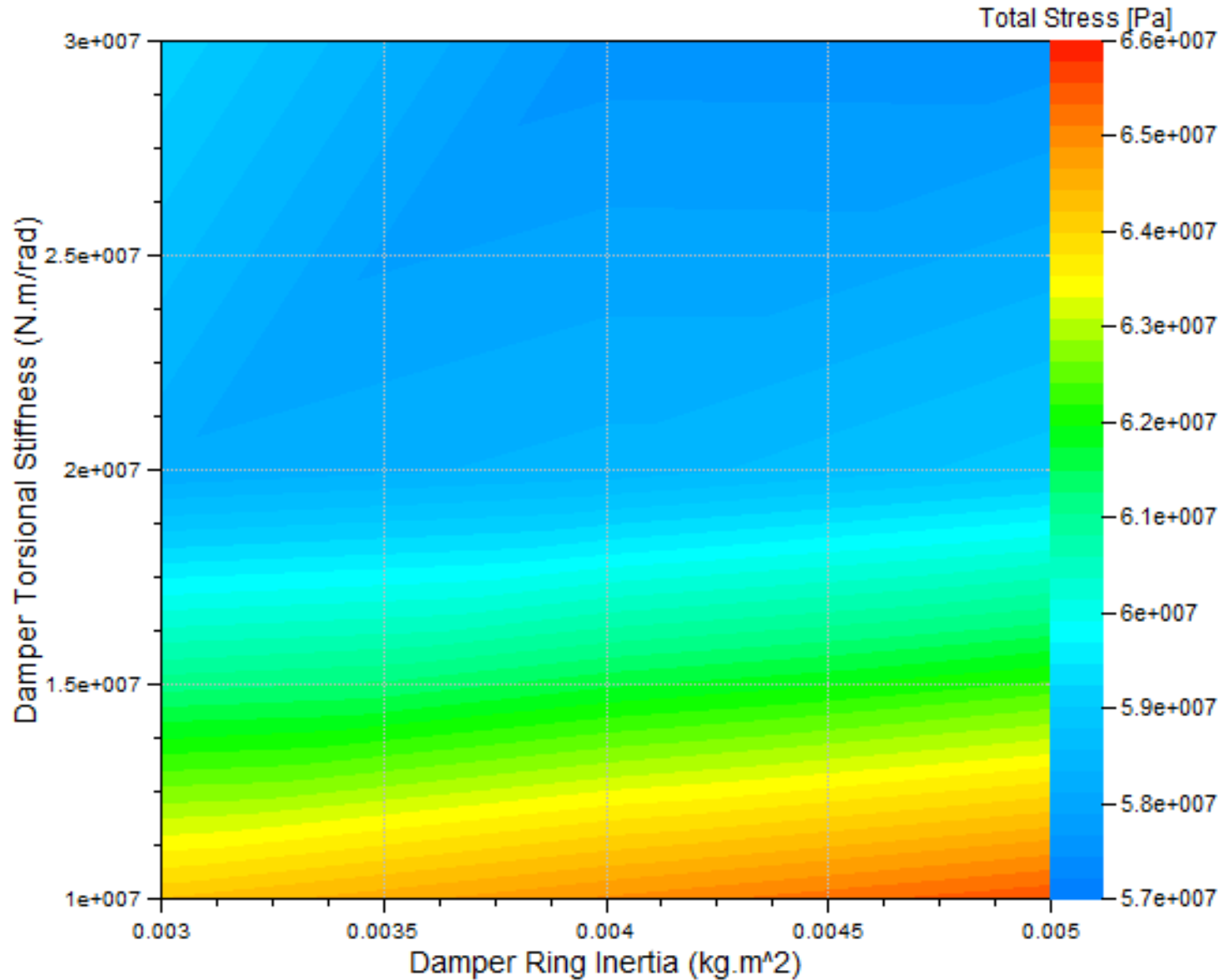
The most deformation on TV damper occurs at $2 \cdot 10^7$ stiffness and 0.005 inertia value as similar with dissipated power graph

Maximum Total Torque @ Web8



The highest magnitude of torsional torque occurs at **fillet of web8** . it can reach more than 1500 N.m

Maximum Total Stress in System



The total stress values graph of the system is in **parallel** with the graph of web8.

Conclusions

- Damper inertia and stiffness have a big impact on maximum torsion torque on the system.
- **Lower stiffness values** increase the torsional torque on the system.
- **Decreasing the inertia** of the damper can eliminate deformation and dissipated power on the TV damper

Acknowledgement

The authors acknowledge AVL-AST, Graz, Austria for providing us AVL-Excite Designer under the AVL-Çukurova University Partnership Program.

Thanks for Listening



Any questions?