**Abstract:**

The main objective of the thesis is to reduce the weight of the rear frame of a motorcycle and get the results more accurate. Due to the over design the weight of the part might increase. higher quality product but excessive cost erodes all the profits. Overdesign – wasteful of resources such as materials time and money

The project's aim is to find dynamic implicit FEM stresses in the motorcycle rear frame using experimental fatigue testing. Other main goals of the thesis include analyzing the critical stress areas in the rear-frame and improving the computation time efficiency. The simulation will be validated using the Experimental method.

**Why?**

Due to over design the weight of the part might increase, this main objective of the thesis is to reduce the weight of the part and get the results more accurate.

Design should not be close to the constraints and may choose to ensure there is extra margin. may be expensive components/extra layers results higher product cost 🡪 higher quality product but excessive cost erodes all the profits

Overdesign – wasteful of resources such as materials time and money. Does not understand the difference between something that could possible be useful vs something that would probably be useful. Something is possibly useful 🡪 majority of the peoples want it and will use it. Something is probably useful 🡪 someone might need it. Designers think lot of cases that could probably useful.

**What needs to be done to reach the goals of the thesis:**

1. Preparation of Time-Displacement-Signal based on SWITI experiment (For Fatigue relevant signal and SOE relevant Signal)

🡪*Understand the time-displacement signal and try to get the information using python/MATLAB*

*🡪Need to study about the characteristic behavior of the time displacement signal*

🡪*Normalize the s-Lenkkopf\_1 & s\_Schwinge\_1 and extract the critical points*

1. Dynamic Implicit method FEM Calculation with Abaqus (Model Spring-damping system, apply TDS as a load, Determine the output)

*🡪Dynamic Implicit method?*

*🡪How to extract data from ANSA to Abaqus*

*🡪apply TDS as a load in the load point*

1. Modal Analysis, frequency response (influence of resonance phenomena)

*🡪determine the impact of resonance*

1. Validation of FEM results with K81 SWITI experiment (validation via acceleration and DMS sensor)

*🡪validate the results in order to match with the already made experimental results (SWITI)*

1. Efficient Simulation-workflow and Output (later for damage and strength analysis)

*🡪Extract the acceleration data for the input file and extract the maximum acceleration points*

*🡪run the simulation for the maximum acceleration points*

1. Increase efficiency of calculation time (substitution of solid elements via substructures or matrices for overall structural stiffness formation)

*🡪run the python script to convert the stiffness of elements in the fixed constraint and convert it to solid elements*

*🡪convert the time domain input to frequency domain and run the simulation*

**Working package:**

1. Technical:

Dynamic Implicit method:

What is Time-Displacement-Signal:

Displacement-time graph shows the displacement of a moving object with respect to time

Slope / gradient shows the velocity

Substructure:

Hexa and Penta elements difference and How it will be integrated (Total integration with Gauss points)

Triangular and tetrahedral elements are geometrically versatile and are used in many automatic meshing algorithms. It is very convenient to mesh a complex shape with triangles or tetrahedra, and the second-order and modified triangular and tetrahedral elements (CPE6, CPE6M, C3D10, C3D10M, etc.) in Abaqus are suitable for general usage. However, a good mesh of hexahedral elements usually provides a solution of equivalent accuracy at less cost. Quadrilaterals and hexahedra have a better convergence rate than triangles and tetrahedra, and sensitivity to mesh orientation in regular meshes is not an issue. However, triangles and tetrahedra are less sensitive to initial element shape, whereas first-order quadrilaterals and hexahedra perform better if their shape is approximately rectangular. The elements become much less accurate when they are initially distorted (see [Performance of continuum and shell elements for linear analysis of bending problems](https://abaqus-docs.mit.edu/2017/English/SIMACAEBMKRefMap/simabmk-c-linbending.htm)).

First-order triangles and tetrahedra are usually overly stiff, and extremely fine meshes are required to obtain accurate results. As mentioned earlier, fully integrated first-order triangles and tetrahedra in Abaqus/Standard also exhibit volumetric locking in incompressible problems. As a rule, these elements should not be used except as filler elements in noncritical areas. Therefore, try to use well-shaped elements in regions of interest.

1. Documentation:

Report work:

1. University work

🡪Register the thesis

Get an approval letter From Kiefer

Abstract from Company

(sent to university Nov 10)

(sent to university Nov 10)

Approval from university supervisor

Forward approval letter to Student office

Project timetable:

Week 1: organization work (check One note)

Week 2-4: Ansa and Workflow document creation

Work flow

 Time displacement signal from SWITI experiment and extract the critical points

FEM Simulation for Rear frame (Spring & Damper model)

Load input

Validation with acceleration

Extract critical acceleration value and run the simulation

Final Stress and Acceleration (Output)

 Model 1 (current model where we design the spring damper) and Model 2 (in future)

Rear frame base model with high FOS 🡪 SWITI experiment

SWITI experiment 🡪 time displacement signal and acceleration signal

Time-displacement signal 🡪 extract critical points 🡪 modeling of spring damper

Give critical point time displacement signal as load in spring damper system and determine the stresses and displacements

Validate the FEM stresses and acceleration with the SWITI experiment acceleration 🡪 validation ok (not ok)🡪 result (modify the spring damper / modify the critical points of the time displacement signal)

Question:

#1 For the initial SWITI experiment 🡪 Model 1 with high FOS rear frame design

Finally, we get two design of rear frame for Model. (one with high FOS and one after the simulation)

If this FEM simulation is success, we designed spring damper mechanism for Model 1, in future for Model 2, where we will get the input time displacement signal? Again, we get this data by running Model 2 with high FOS design.

#2 Will the time displacement signal is common for all models? For each model it differs

#3 How we can set the threshold value for the time displacement graph? (we must understand the characteristics of the graph) – We have to extract the critical points (do we have to set a random threshold value / we have to do this with simulation)

#4 Can I create a random data and extract the critical points from it by writing python script must make the two data to normalize, noise clearance and finally have to extract the critical points

Future work:

For each model 🡪 run Static FEM 🡪 get stress and strains (with high margin) 🡪 run SWITI experiment and get time displacement signal and acceleration 🡪 run Dynamic simulation and validate 🡪 get final stress and acceleration 🡪 compare with Static FEM stresses 🡪 too high 🡪 design change

Task:

1. Need to apply the loads, accelerometer points, boundary conditions and mesh with the pre-existing model (complete before 27/01/2022)
2. Task for next week? Weekly task – better way to work on progress
3. What I have done? How to create Contact, Loads, Sets and what are the steps involved in the simulation
4. Flow guide Working? – Working
5. Have to run the simulation and analyze the results in META
6. Try to modify the load parameters and run the simulation
7. Spring damper application and modify the parameters and run the simulation – Excel sheet
8. Report for Mid term Review
9. Data Preparation time dis**placement signal**

Abstract and Problem statement

Introduction

Time displacement signal

Fourier Transform

STFT

Xspectrogram

Critical point

Model

Target signal

Connector

Validation

Difference btwn experiment and simulation – target signal

Damping coefficient and spring coefficient – validation

Parameter Sensitivity analysis

Different spring damper coefficient analysis

Stress estimation for critical time point

Damage estimation

Literature review – 7-9 pages (time domain, frequency domain, time frequency analysis)

Experimental setup 🡪 work flow, vibration setup, simulation model, target signal, why connector 10-12 pages

Results 🡪 critical time points stft and signal analysis, parametric study to select the k and c value, critical stress 10-12 pages

Conclusion: 2-3 pages