REVIEWER'S OPINION OF FINAL THESIS

I. IDENTIFICATION DATA

Thesis name:	**Virtual design of powertrain components under consideration of construction space and NVH requirements**
Author's name:	**Helen Hedrichová**
Type of thesis :	master
Faculty/Institute:	Faculty of Mechanical Engineering (FME)
Department:	Department of Automotive, Combustion Engine and Railway Engineering
Thesis reviewer:	Ing. Václav ZOUL, CSc.
Reviewer's department:	Centre of Vehicles for Sustainable Mobility

II. EVALUATION OF INDIVIDUAL CRITERIA

Assignment	**extraordinarily challenging**

Evaluation of thesis difficulty of assignment.

The thesis concerns the latest methods of design of automotive drivelines and simulation of their functions already in their prototype stadium. The topic requires an overview about the current development of automotive aggregates, knowledge of new computational methods and their application to specific calculations. The scope of the assignment was very broad, requiring extensive research activities to be followed by a number of simulation calculations and an evaluation of their results to achieve an optimal solution.

Satisfaction of assignment	**fulfilled**

Assess that handed thesis meets assignment. Present points of assignment that fell short or were extended. Try to assess importance, impact or cause of each shortcoming.

All points of the assignment were fulfilled and, also in the opinion of the experts who assigned this theme, the work brought knowledges which could be well used in solving similar problems.

Method of conception	**correct**

Assess that student has chosen correct approach or solution methods.

The student has chosen correct approach and solution methods, corresponding to current trends and state of research.

Technical level	**B - very good.**

Assess level of thesis specialty, use of knowledge gained by study and by expert literature, use of sources and data gained by experience.

The student used well the sources and data gained from study and expert literature and also from experiences of colleagues.

Formal and language level, scope of thesis	**B - very good.**

Assess correctness of usage of formal notation. Assess typographical and language arrangement of thesis.

The thesis are sufficiently good structured, even if, the next to last chapter (Nr.6.) could be better arranged. Also the pictures taken from the computer printers could be larger and described in larger fonts to be more transparent.

To describe the features of DMF could certainly be used more illustrative schemas that is surely, among other things, possible to find in literature.

A report written in English can be easily understood. However, some terms are used that are not common in description of the themes related to vibration (angular velocity - engine speed;excitement - high values of acceleration or vibration, high stresses, resonance amplitudes; wheel-floor – wheel-ground). But this cannot be considered as a large deficiency.

Somewhat confusing (Chapter 6) is the use (not every time) of the term "2-cylinder engine", when a 4-cylinder engine with two deactivated cylinders is meant.

Selection of sources, citation correctness	B - very good.

Thesis is prepared in a comprehensive, careful and diligent manner. The data taken-off from external materials are properly labeled and documented in the list of literature. The used sources are recent and actual. Perhaps only that the bibliography numbers within the text should be written in square brackets ([]).

Additional commentary and evaluation

In every case the goals of the thesis were achieve. The presented results show how the basic problems associated with the driveline simulation can be solved and gave a basis for developing these and similar simulations. The problematik is obviously much greater than was possible to master in a given time frame. It is a bit pitty that the scope of assigment was so broad that no more time left for the simulation, even if the student tried to work very intensive.

III. OVERALL EVALUATION, QUESTIONS FOR DEFENSE, CLASSIFICATION SUGGESTION

Even if the work is well done, there are several questions that could be clarified.

Characteristic (Torque/twist angle) of the MDF:

Explain, please the Fig.3.2.6. concerning the slope of the lines depicted there ($k_1+k_2+k_3<k_1+k_3$).

Natural Frequencies:

I assume that the calculation of the natural frequencies was done for the system without considering damping.

When the drive line operates at one of the gears, in the full scope of the engine speeds at this gear the engine can operate producing a different torque, also from a very low to very high. It means for the DMF a different load and corresponding to this, different torsional stiffness. Did you notice an influence of this fact on the position of the natural frequencies.

Influence of the hybrid EM. Do you have also calculation of the NF for the drive line without EM (conventional driveline)? With another words, did you observed a difference between conventional and hybrid driveline NF.

As you have mentioned the modal analysis is an important part of the calculation. I miss the same calculation as that described in the Chapter 5.3 also in Chapter 6.

Excited vibration:

Fig. 5.2.3. In the Journal 1 -5 you have inertia, stiffness and damping (according the Tab. 5.2.2). What inertia it is? Usually the inertia of the crankpin is already included in the rotating masses (see the Frahm's formula).

Are in the cylinder excitation except the gas pressure forces included also forces caused due to reciprocating masses?

Why is on the 2nd cylinder "Curve 3D3", when the firing angle is controlled probably by the block "Firing angle 2".

Clutching:

Explain, please, the clutching process of the K0-EM, the 1st paragraph of the Chap. 5.4.2 in detail.

Test bench:

The term "test bench" is in fact somehow clarified in the report, nevertheless it is misleading. The term is used for a real test bench (Chap.5.2) and for a block in the Simulink schema, which regulate or keep the vehicle speed (Chap.5.4.1).

DMF Optimization, Chap.6:

The problem of cylinder deactivation is in principle problem of misfiring, not (or less) the problem of NF position. Therefore it is not easy to solve it only trying to optimize the DMF. The results from the Chap.6 had this moreover proved. Do you know another method how to eliminate torsional vibration caused due to the deactivation?

The task was not simple. Therefore also so many question. But nevertheless, the student has shown a good knowledge and hard effort and it can be estimated that she will be a good engineer.

I evaluate handed thesis with classification grade **B - very good.** Depending on the results of defense a better classification is not excluded.

Date: **26.8.2018**   Signature: Ing. Václav ZOUL, CSc.