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VERIFICATION OF TRUCK CABIN FEM-MODEL

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The contribution describes methodics and main results of experimental verification of FEM - cabin skeleton model for trucks.

1. Introduction

The ŠKODA LIAZ Ltd. has developed a new type of cabin for its series of trucks. The carrying part of the cabin is formed by a skeleton made from complicated profiles from aluminium alloys. When proposing and optimising the design solution of cabin skeleton, also the central research institute ŠKODA VÝZKUM s.r.o. (Ltd.) collaborated, namely in the field of calculations by method of final elements and of experimental stress analysis. Both these methods were combined in such a way, that the proposed FEM - cabin skeleton model might describe the real skeleton as authentically as possible [1].

2. Verifying the FEM - Model by a Static Test

The FEM - cabin skeleton model was compiled in the COSMOS programme packet. Description of design has been carried-out by shell elements of type SHELL 4, which made it possible to precisely describe complicated shapes of skeleton profiles. The model proper has been described by approx. 25 000 elements. From the point of view of the stiffness matrix order, it dealt with a large model (Fig.1). One testing sample of cabin skeleton has been delivered by the producer for verifying the FEM - model.

The cabin proper was firmly fixed to the grate of the floor at the testing stand. For fastening, those cabin holders were utilized, which secure its position at the undercarriage frame of the vehicle. In the calculation the same boundary conditions were defined, i.e. preventing from shifting and swivelling in places of position supports.

31 strain gauges of type HBM6/120LY11 were installed on the testing cabin skeleton. Measuring places were selected on the base of experiences and preliminary calculations. Stress measurements were taken with the aid of the HBM-UPM60 measuring central unit.

The verification of the FEM-model was carried-out on the base of static tests. The loading proper was simulated by the device with screw mechanism. Magnitude of loading force was measured by the dynamometer. Besides this, even the deformation (shift) was measured in the direction of affecting force.

For comparison of calculation and measuring, 3 loading states were chosen (see Fig. 1).

A - The force affect the column of cabin skeleton at upper corner of front window under an angle of 15° from the direction of run.

B - The force affect the column of cabin skeleton at lower corner of front window under an angle of 15° from the direction of run.

C - The side force affect the upper corner of cabin skeleton rear wall.

Comparison of measured and calculated values of stresses is graphically demonstrated on Figs. 2, 3 and 4.

Good conformity of calculation and measuring has been achieved at loading states A and B. The stress values conformed with signs and correspond to one another even with sizes. Accommodating conformity was foud-out at calculated and measured deformations in places of affecting forces, as well.

At loading state C, the influence expressively appeared regarding the way of cabin rear wall modelling. This wall is formed by honeycombed plate from alucobond (2 x 0,5 mm thick outside aluminium metal-sheets + inside filling from lightening plastic material).

First way of rigidity description of this plate originated from documents delivered by the producer. It was demonstrated, that the influence of this plate is in fact far smaller, than it was presumed. This appeared namely at judging the loading state C. The calculated deformation of cabin skeleton at place of affecting force was multiply smaller than the real one. Also the calculated and measured stress values did not conform - see diagram on Fig. 4.

Therefore, this plate has been neglected during the further calculation. At this way of simplification the difference between the calculated and measured deformation of cabin skeleton at the place of the affecting force is approx. 30%. Calculated values of stresses at places of strain gauges coincided both in sign and size. From the point of view of further calculations, is was necessary to consider the honeycombed rear wall of the cabin as an yielding plate.

3. Global Evaluation of the Results

With regard to our experiences with results of calculation verifications and of measuring the complicated constructions, the FEM - cabin skeleton model has been declared as satisfying one, provided the wall rigidity and the co-operation of rear wall from alucobond are not overestimated. This assertion is based on results of calculations and stress measurings of cabin skeleton and on comparison of deformations in places affected by loading forces.

Results gained by calculation and experimental realisation of loading states A and B can be considered as valuable ones even from such reason, that they simulate (even if only very approximately) conditions of loading at the test according to the R29.EHK prescription [3].

The experimentally verified FEM - cabin skeleton model was then used for calculations of following loading states [2], which were not possible to be carried-out experimentally:

- Load by cabin equipment and crew,
- Regime of cabin lifting,
- Static overload of the roof.

4. Conclusion

Development of a new cabin for trucks from ŠKODA LIAZ Ltd. was intensively supported by application of experimental stress analysis and of method of final elements. Success of the development work is also confirmed by the fact, that the prototype of the new cabin complied with accelerated test of fatigue life, in course of which the operating dynamic loading within the range of 2 millions of km run was simulated on a special test stand of TATRA Kopřivnice.

References

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[2] Zámečník, Š. - Študent, J. - Martinec, P. - Adlerová, J.:
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[3] Uniform regulations for homologing the trucks from the point of view of crew protection inside the truck cabin R29.EHK.

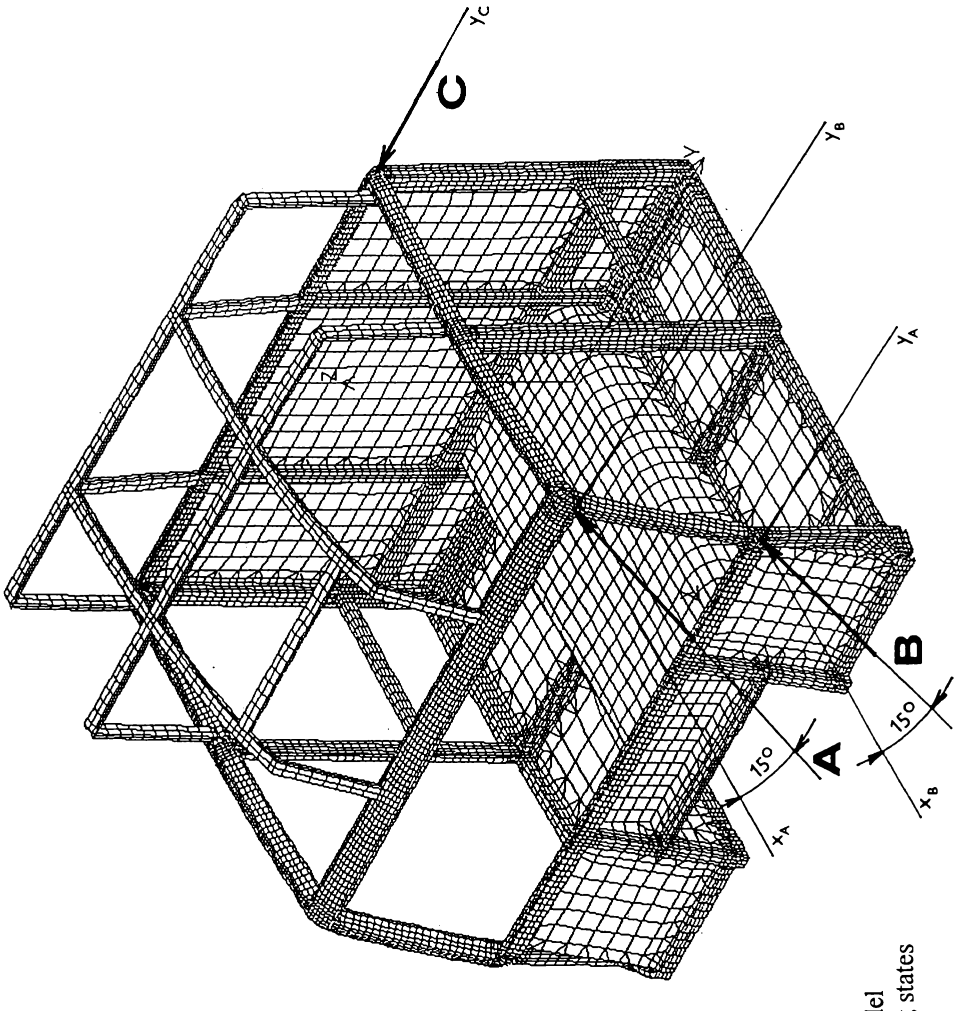

Fig. 1 - FEM - model
and loading states

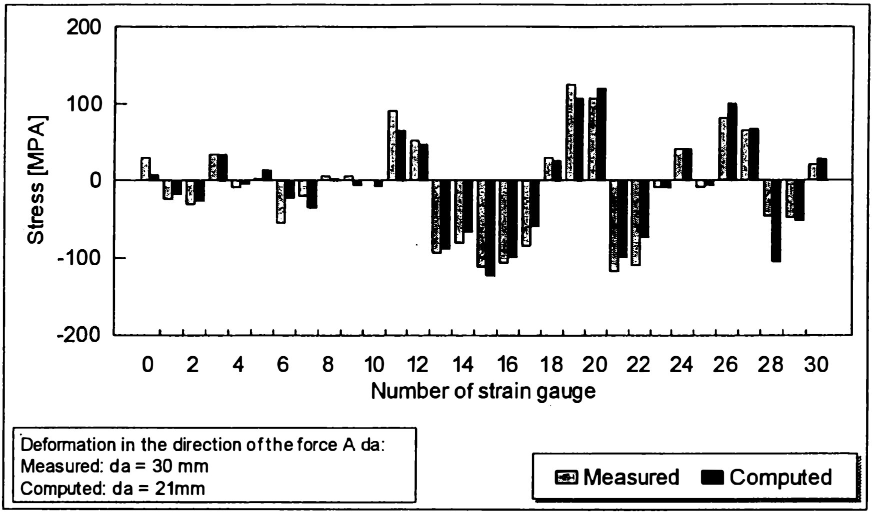

Fig. 2 The loading state A.

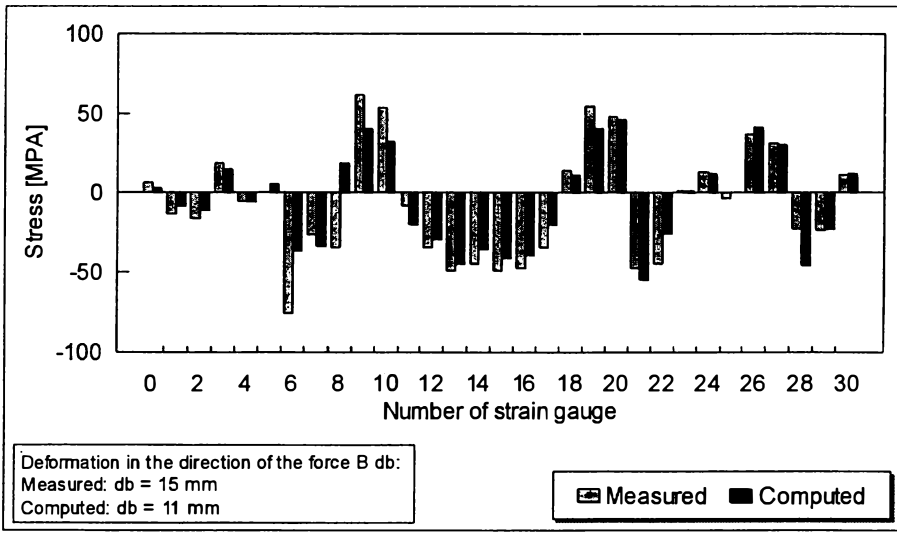

Fig. 3 The loading state B.

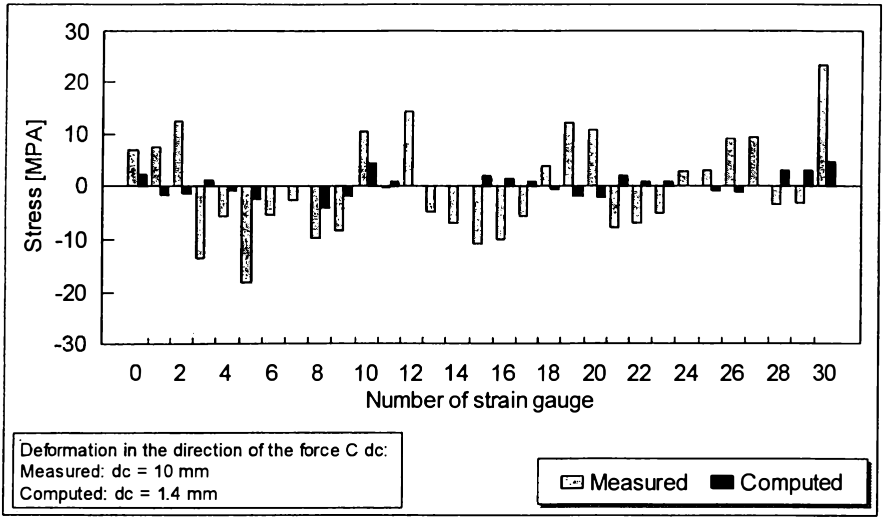

Fig. 4a The loading state C - rear wall is described from documents delivered by producer.

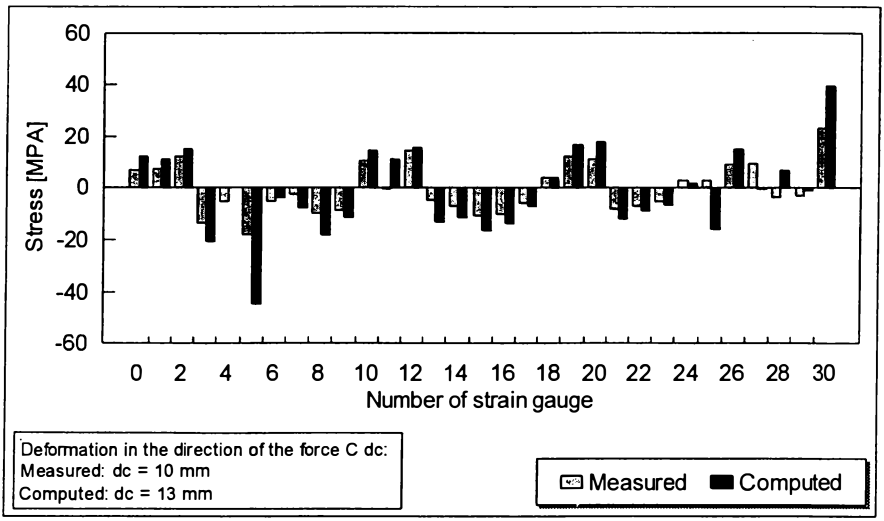

Fig. 4b The loading state C - rear wall is considered as an yielding plate.

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