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MEASUREMENTS OF STATIC AND DYNAMIC STRESSES ON IKARUS-EAG-398 BUS

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The paper describes methodology and some results of experimental investigations of IKARUS-EAG-398 coach. The experiments were performed in the range of COPERNICUS Project CP 94 0520 - "Bus-Expert-System for Dynamics Simulation, Design and Quality Control"

1. Introduction

The following consortium is solving the international research project COPERNICUS CP 94 0520 - "Bus-Expert-System for Dynamics Simulation, Design and Quality Control":

- Institut fur Mechatronik (IfM), Chemnitz, Germany,
- ŠKODA VÝZKUM, s.r.o., Pilsen, Czech Republic,
- Automotive Research and Development Company (AUTÓKUT), Budapest, Hungary,
- Institutul pentru Analiza Sistemolor (INAS), Craiova, Romania,
- IKARUS Special Coach Factory, Ltd., Budapest, Hungary.

Experimental investigations of IKARUS-EAG 398 Coach were taken in the range of solving the project. Vibration analyses were performed by AUTÓKUT and measurements of stresses were performed by ŠKODA. The IKARUS coach adapted for tests came into ŠKODA Company, where the measurements took place. The following measurements of stresses were performed.

2. Measurements at Static Loading

The static stresses were measured at 8 different loading states. Various distributions of vertical payload were modelled inside the coach interior and the luggage spaces (Fig.1).

3. Short-Time Measurements at Deterministic Dynamic Loading

To simulate an expressive unevenness of a road, artificial obstacles were used (Fig.2). The obstacles with given form (cylindrical segments having base width 500 mm and height 60 mm) were laid on smooth asphalt surface. The measurements were taken at velocity 40 km/h and carried-out with empty as well as fully loaded coach. There were measured even relative displacements between the axles and the chassis. Fig.3 shows typical stress-time histories, which were measured on a bodywork joint.

4. Long-Time Measurements at Random Dynamic Loading

The measurements were carried-out at various service conditions. The empty as well as fully loaded coach was investigated at run on real testing tracks (city roads, inter-city roads, motorway). The measured stress responses are random processes at this type of loading. Fig.4 shows whole recorded stress-time histories on the bodywork joint. Detail illustrations of parts of the stress-time histories are shown in. Fig.5.

5. Comparison of Experimental and Theoretical Data

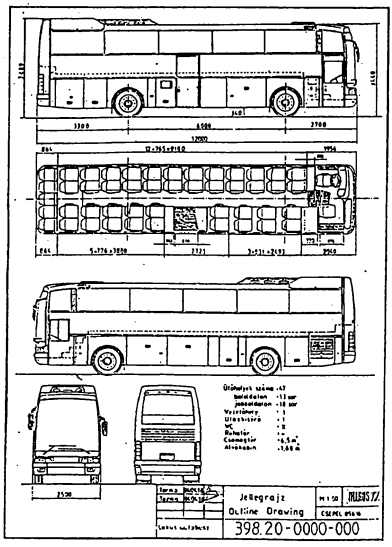
"Multi-body" model of the bus was built up in the ALASKA software environment by AUTOKUT and IfM. Passing over the artificial obstacles was simulated with the MBS-model. The measured as well as computed deformation of the front suspension are plotted in Fig.7. FEM-model was created in ANSYS software environment by INAS (Fig.8). The model was used for computer simulations of static as well as dynamic loading of the bus. A comparison of the computational and measured static stresses is given in Fig.9.

6. Fatigue Tests

Typical welded joints of bodywork profiles were manufactured by IKARUS. The specimens were tested by ŠKODA laboratories. Results of the fatigue tests will serve for fatigue life assessment of the bodywork structure. New software for the fatigue life assessment was developed by ŠKODA (Fig.10).

7. Conclusions

The following results were obtained on the base of the experimental investigations:
- improvement of both MBS-model and FEM-model of the bus,
- evaluation of both static and dynamic stresses,
- fatigue life assessment of the bodywork structure.



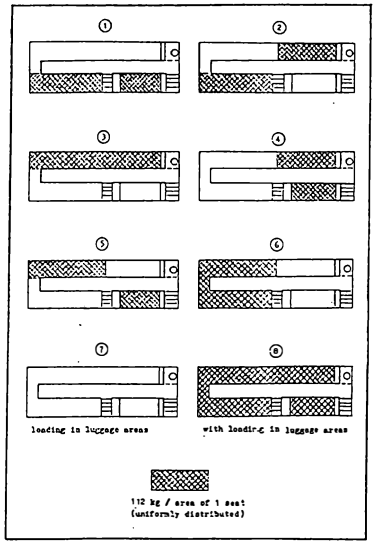


Fig.1

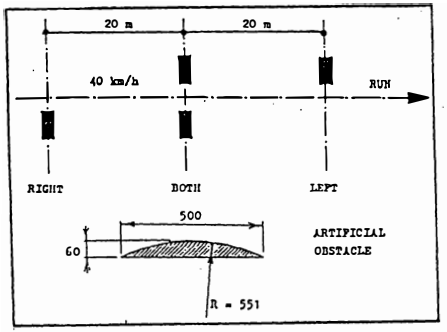


Fig.2

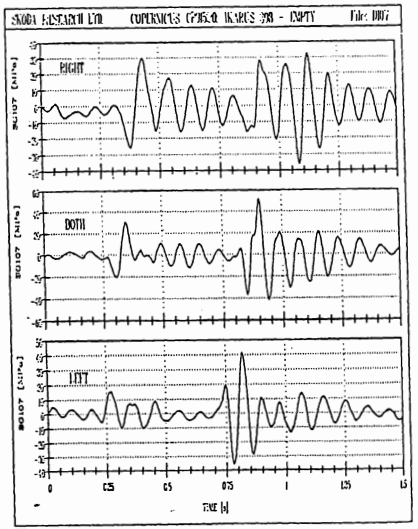


Fig.3

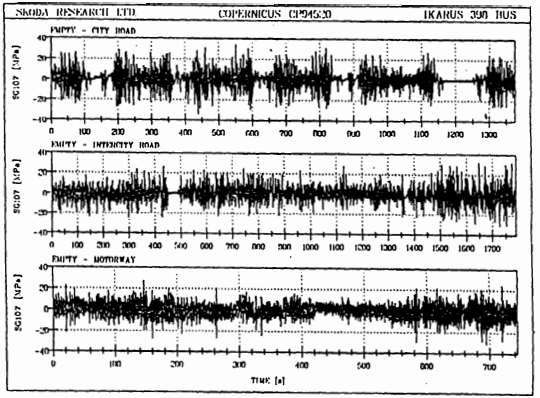


Fig.4

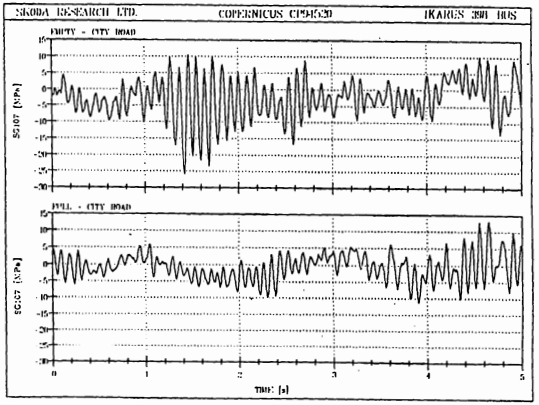


Fig.5

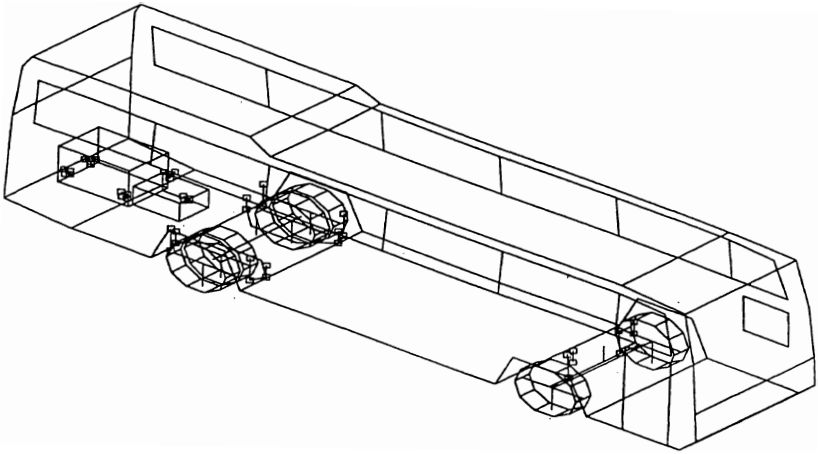
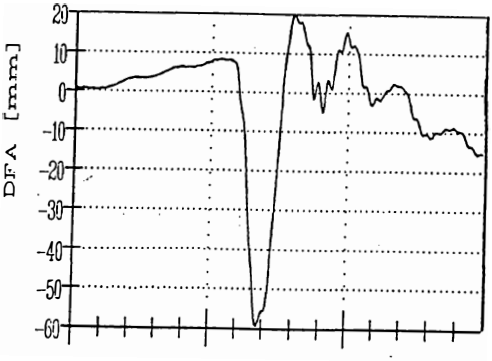


Fig.6


DFA [mm]
20
10
0
-10
-20
-30
-40
-50
-60

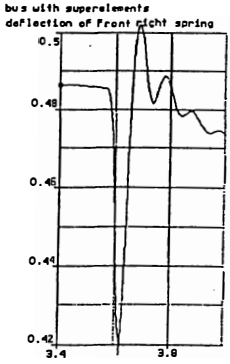

bus with superelements
deflection of Front right spring
0.5
0.48
0.46
0.44
0.42
3.4
3.8

Fig.7

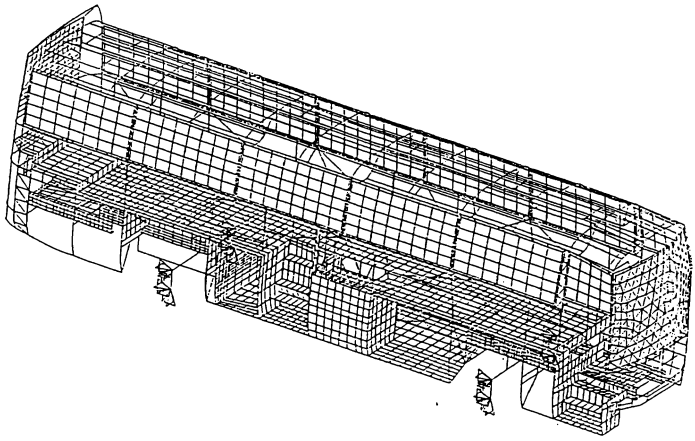


Fig.8

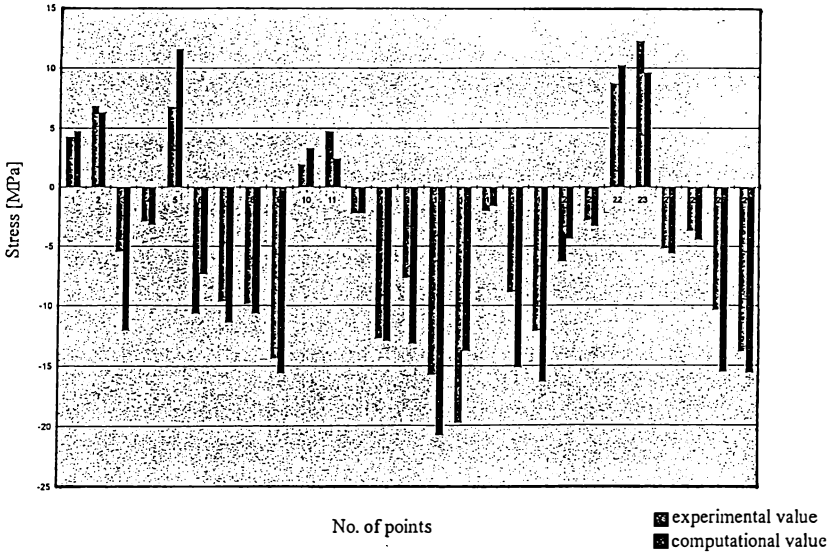

Stress [MPa]
15
10
5
0
-5
-10
-15
-20
-25
No. of points
experimental value
computational value

Fig.9

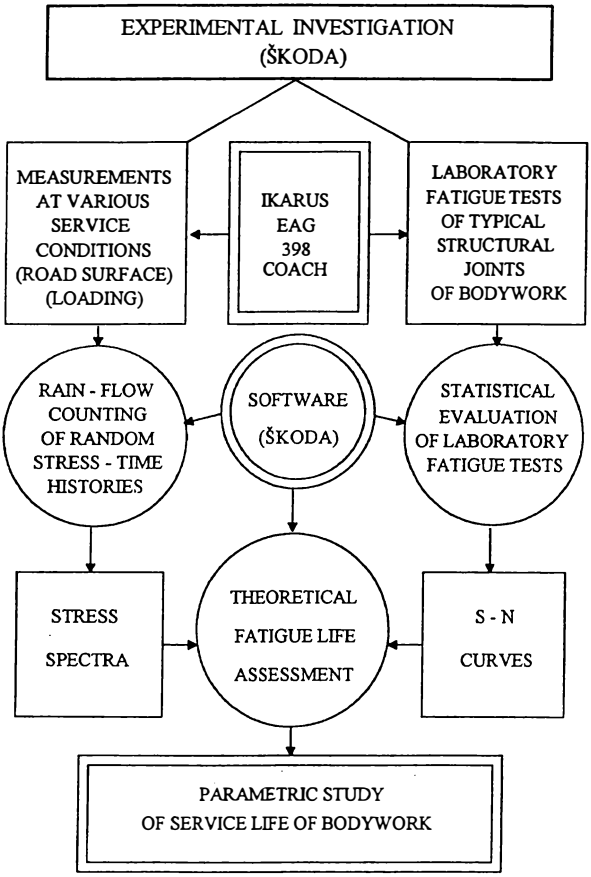


Fig.10

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