PROCEEDINGS

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## Faculty of Mechanical Engineering

# PROSPECTS IN MECHANICAL ENGINEERING

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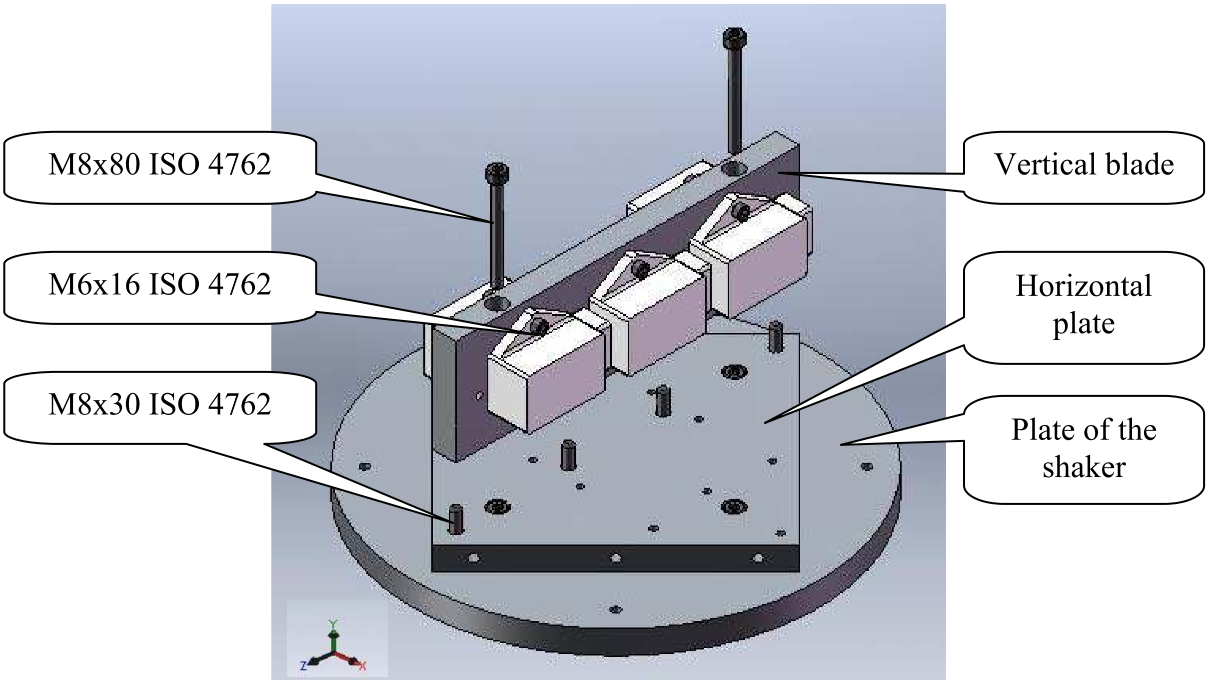
P. Madarász/ G. Por/ I. Jenei/ G. Ladányi/ L. Valenta

# Investigation on the vibration of dashboard instruments of cars

## INTRODUCTION

In our institute, Institute of Mechanics of College of Dunaujvaros permanent testing of the dashboard instruments produced by BOSCH Hungary for many of the cars are carried out under contract. Instruments and their elements are tested against the long term vibration and large temperature changes in a VITA shaker and in a Vötsch camera. Both the economy and from the scientific point of view it seemed to be reasonable to use such a instruments holder, which enables us to carry out vibration tests in all three dimension without changing the platform for their fixation. Therefore a special construction has been planed and built, that allows us to fix the elements of the instruments in horizontal and vertical directions (Figure 1). Here we present the test of that instruments-part holder for vibration and its finite element modeling.



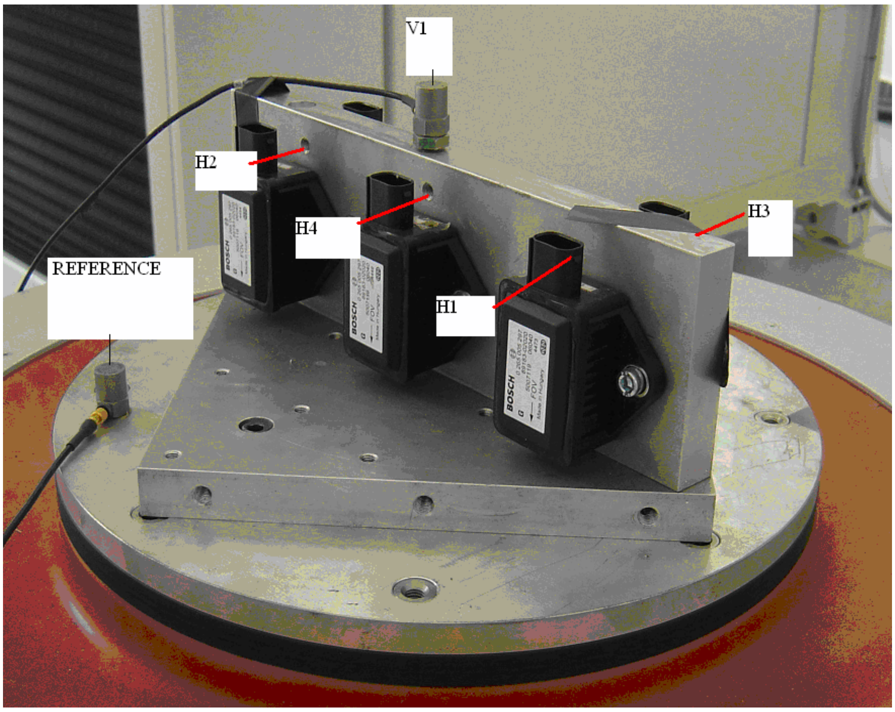
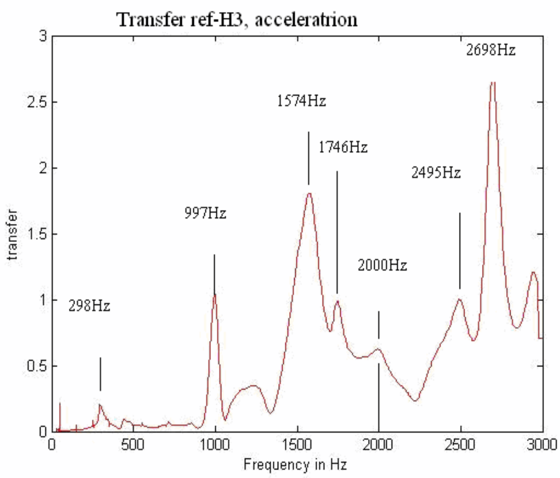
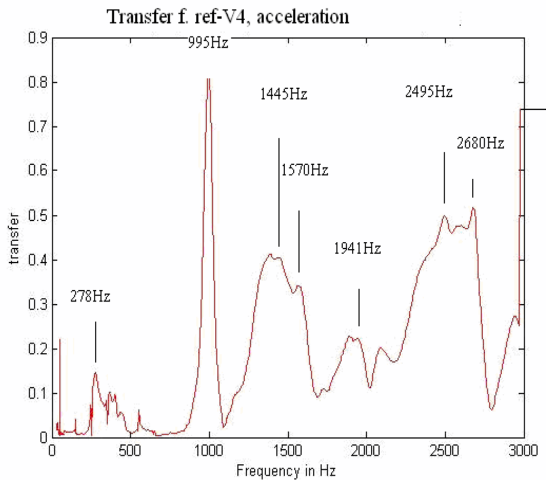



***Fig.1. The structure of the fixation under investigation and the measuring positions***

**THE MEASUREMENTS RESULTS**

We carried out the measurements using sweep sinus excitation. We placed our reference sensor on the horizontal plate fixed to the VITA shaker, while the response was measured vertically on the top of the blade (position V1), horizontally on the edge /H1/, on the other edge /H2/, on the other side /H3/ and finally horizontally in the middle of the blade /H4/ (see Figure 1.). Transfer functions between (V1-H1,2,3,4) were measured (amplitude and phase).



## ANALITICAL CALCULATION OF THE BENDING FREQUENCY

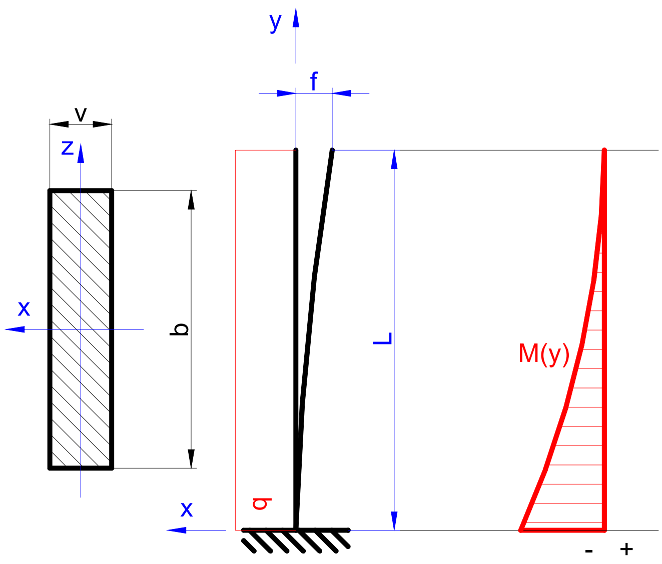



***Fig.2. The mechanical model of the cantilever (q = beam mass only).***

The mass of the beam:

$$q = \frac{13}{90}\,\frac{N}{mm}$$

The vertical displacement of the end of beam:

$$v_q'' = -\frac{M(y)}{I_z \cdot E} \rightarrow v_q' = -\frac{1}{I_z \cdot E}\int_0^L M(y)dy = -\frac{1}{I_z \cdot E}\left[M_{max} \cdot L - \frac{q \cdot L^3}{6} + C_1\right]_0^L$$

$$f_q = -\frac{1}{I_z \cdot E}\left\{\int_0^L M_{max} \cdot LdL - \int_0^L \frac{q \cdot L^3}{6}dL + \int_0^L C_1 dL\right\} = -\frac{1}{I_z \cdot E} \cdot \left[\frac{M_{max} \cdot L^2}{2} - \frac{q \cdot L^4}{24} + C_1 \cdot L + C_2\right]_0^L$$

The stiffness:

$$c = \frac{f_q}{q \cdot L} = \frac{L^3}{8 \cdot I_z \cdot E} = \frac{90^3 mm^3}{8 \cdot \frac{20^3 mm^3 \cdot 290\ mm}{12} \cdot 69000 \frac{N}{mm^2}} = 6{,}8 \cdot 10^{-6}\,\frac{mm}{N}$$

The bending frequency:

$$\alpha = \sqrt{\frac{1}{c \cdot m}} = \sqrt{\frac{1}{6{,}83 \cdot 10^{-9}\frac{m}{N} \cdot 2\,N\frac{m}{s^2}}} = 10611\,\frac{rad}{sec}$$

$$\nu = \frac{\alpha}{2 \cdot \pi} = \frac{10611 \frac{rad}{sec}}{2 \cdot \pi} = 1689 \text{ Hz}$$

## FINITE ELEMENT (FEA) SIMULATION

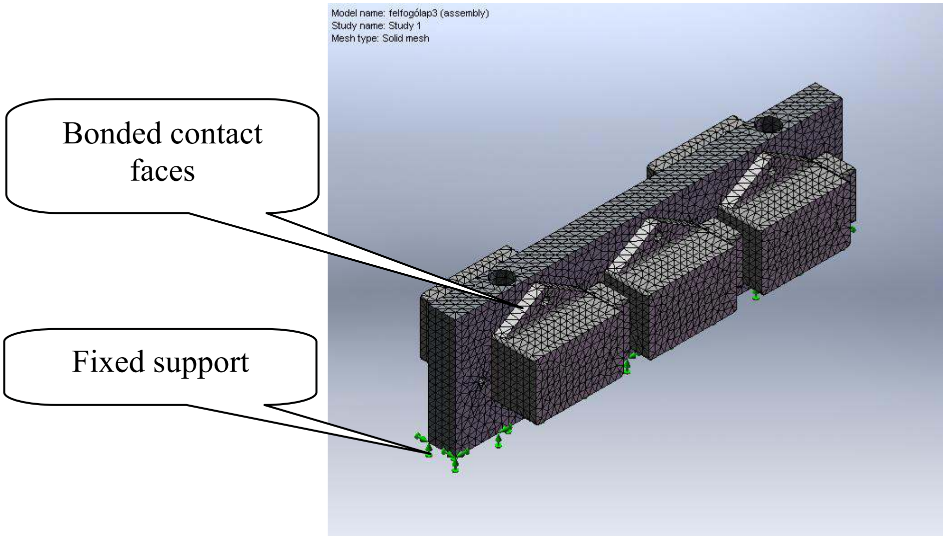
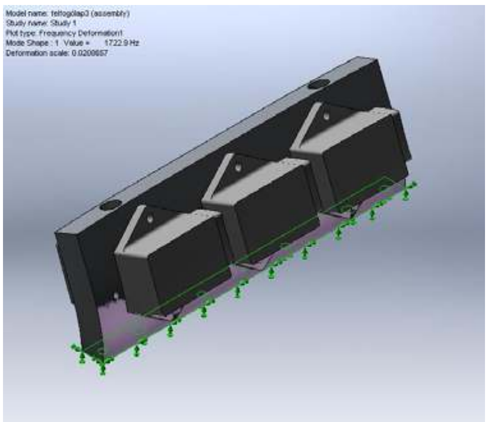
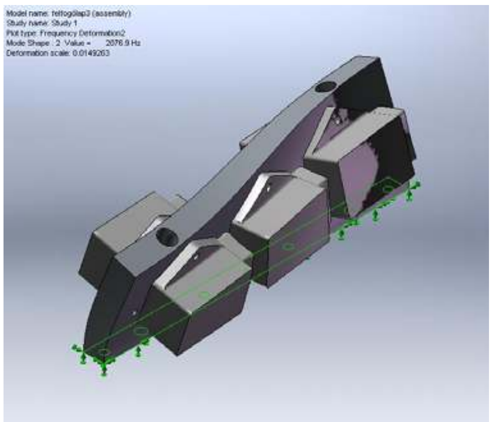



***Fig.3. The FEA model.***




***Bending frequency at 1723 Hz***




***Twisting at 2077Hz***

Finite element simulation was carried out using COSMOS program, the first two bending frequencies were found at 1723 and 2077 Ht, which is in good agreement with measured data. Further bending frequencies are higher then 3000Hz (out of measuring range.

**References:**


[1] Frischherz D. et al: Fémtechnológia táblázatok. B + V Lap- és Könyvkiadó Kft. Budapest 1996.
[2] Tom Irvine: Bending frequencies of beams, rods, pipes (Revision K)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