INVESTIGATION OF OSCILLATION PROCESS OF THE SHELL ELEMENT BY METHOD OF FINITE ELEMENTS

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At it is well known, during the exploitation of a passenger automobile the carrying body of an automobile is under the influence of dynamic loads. Under the influence of irregularities of road an automobile body is under the forced oscillation. As the carrying body of a passenger automobile consists most of shell elements, so it is interesting to investigate the oscillation process of it. Above mentioned investigation, done by traditional analytic methods, relates with huge complexity, so this work is devoted to the investigation of mentioned process by method of finite elements. The road irregularities are exerting randomly and it is important to take into account all the cases of the oscillation in order to avoid resonances during the exploitation.

The above mentioned calculations, if they are done by traditional methods, require a lot of assumptions, which influence on the accuracy of the obtaining data. Especially, here the carrying body of an automobile is introduced as a material particle which is connected with the car suspension by the solid connection.

It doesn’t make an opportunity to completely calculate and to assess the designing automobile's driving evenness.

Driving evenness is one of the operational attributes of an automobile, which describes the ability of an automobile to move on the unequal road by the given interval of velocities.

The engine generates some vibrations too. But these vibrations are too small comparison with above mentioned vibrations. Vibrations have huge influence upon not only driving evenness, but also the technique-operational attributes of an automobile.

In general, the basis of oscillation investigation is the following equation

(1) $[M]\{u''\}+[C]\{u'\}+[K]\{u\}=\{F(t)\}$ Where

$[M]$ - Mass matrix, $[C]$ -Damping matrix, $[K]$ - Stiffness matrix, $\{\ddot{u}\},\{\dot{u}\},\{u\}$ are accordingly nodal acceleration, velocity and displacement vectors, (t) – time.

Above mentioned matrices are formed automatically. The density and volume have to be entered, which are the calculation starting points of the mass of each finite element.

During modal analysis the above mentioned equation has the following view.

(2) $[M]\{u''\}+[K]\{u\}=0$

During Harmonic analysis the loads are changing their influence by harmonic type. The basis equation has the same view, but in compare with the following.

(3) $\{F(t)\}=\{F_0(\cos(\omega t+\varphi)+i\sin(\omega t+\varphi))\}$

The modal analysis gives us an opportunity to obtain the own oscillation frequencies in the most possible directions. In this case the first five directions which are most possible are remarkable. The other ones are not actual. The results are introduced in the Table1.

Sub step	Oscillation frequency	Measure
1	12141	[Hz]
2	30593	[Hz]
3	70655	[Hz]

4	81472	[Hz]
5	87277	[Hz]

Table1. The results of calculated own oscillation frequency

These results are obtained by the calculation of the shell element, which is welded on the one side. On the other side an external force is acting by sinusoidal principle. This case is more usual in carrying body automobiles and represents more interest.

The described model is shown on the Figure1

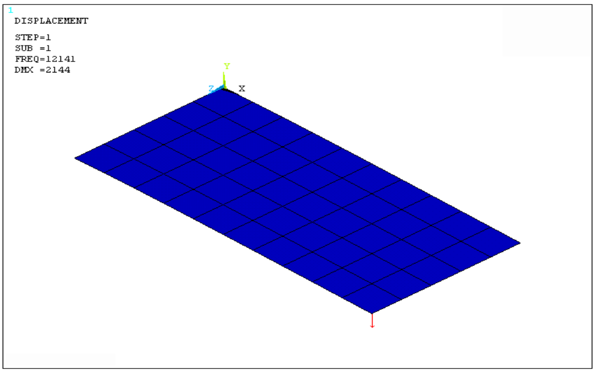

Figure1. The designed model of shell element

After above mentioned calculations, the interval of the external force frequency is given in that case, that the value of own oscillation in the according node is the mentioned interval.

The result is given the Figure2, where we can easily see the function of oscillation amplitude and frequency.

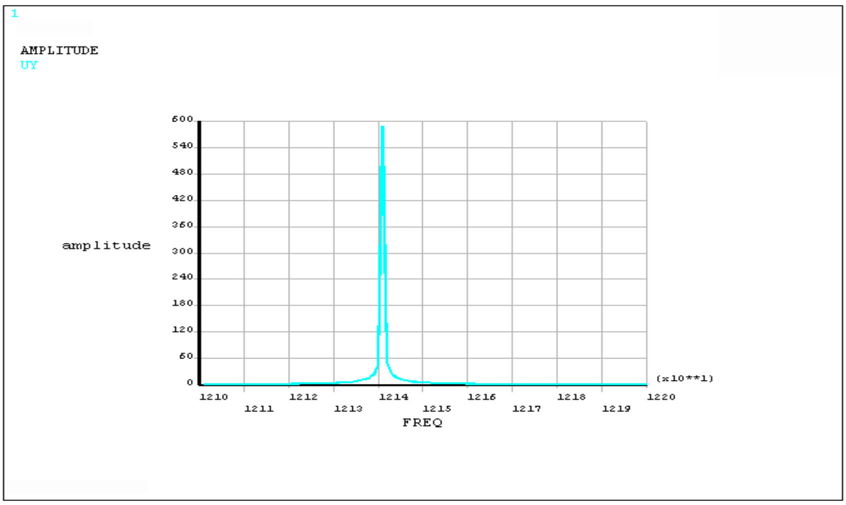

Figure2. Function of oscillation amplitude and frequency

The case of resonance is evident here.

References

[1] G.V.Musayelyan, *Utilization of Method of Finite Elements in Transporting Systems,* SEUA, Yerevan 2003-289p.

[2]Pippert H. *Karosserietechnik*: Vogel Verlag, 1998.- 303 s.

[3] Müller G. *FEM für Praktiker*, Expert Verlag, 1997.- 859 s.