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THE INFLUENCE OF JOINT ELASTICITY ON MACHINERY OSCILLATIONS

This article describes the influence of elastic joints on the natural frequencies of the system and the influence of stiffness under the action of the moment, the type of connection and interference. The dynamic factor has been mentioned as a consolidating factor between the maximum moment and the transmitted moment. The types of the elastic joint with rubber blocks are described. The cases of axial oscillations are also mentioned. The main object of the article is to point out the role of the elastic joints in defining the individual oscillation frequencies to provide the work without resonance. In the process of machine design the elastic joints can rarely be taken into consideration because of their low cost compared to the machine in whole. The article emphasises that the special analyses based on dynamic analysis should be carried out.

General Statements. The main role of elastic joints consists of transmit of twist momentum between two mechanisms allowing thus a certain adoption. The secondary effect is setting restriction on the system eigenfrequencies. The secondary effect can happen only in case when resonance frequencies are far from the zone of critical ones; meaning the system eigenfrequencies are far from the rotating frequencies (rotating speed). If the resonance frequencies are near the rotating speed zone, their role is mentioned as secondary and becomes a very important role and as the first one [2].

There are different ways of influences caused by elastic joints on the system eigenfrequencies: the exact scheme, place and selected types. Elastic joints can provide additional types of system oscillation, determine the resonance twist frequencies for system, influence the outside frequency resonance of the system, and help the system to pass through the resonance frequency. It can even help system to face successfully the twisted over-forces on system [1, 3, 5].

The system should be accepted as a combination of different construction elements such as motor, joints, supports. The common systems contain just two mechanisms joined together with one or more elastic joint (e. g. a pump with motor, transmit system in a motor generator equipment, transmit system in ships, etc.) where each of them has its own influences on system oscillation. In this system it is normal to generate twisting oscillation, axial oscillation and sectional oscillation.

Twisted oscillation. There are two main factors which influence the twisted eigenfrequencies of system; the first one is the solidity and the second is the mass moment inertia. Those factors are varied from the constructive possibilities and changing compound elements [4].

The system solidity depends on the solidity of shafts-supports, solidity of joint plate as well as the other linear elements compound the system. If we use elastic joint in the system its solidity will vary from 50 % up to 80 % of the complete system solidity [2]. This statement is proved by series of calculation done in transmission systems in ships, pumps, etc. We can found more detailed data in the specialized literature. Despite this fact the above mentioned issues which explain the general solidity of the system and remain the most important and inclusive ones.

In the very beginning we use some empiric rules from which we derive some deviation under a specific conditions to calculate the solidity of elastic joints. The conclusion that twisted solidity in an elastic joint has a dependency form shafts support joint is proved in [1] and was used in work [3]. The shaft support joint is a function of three-factor transmitted twisted moment, joint types and interferences.

The twisted oscillation is always accompanied by a specific behavior in any concrete use. The ratio between the maximal moment in resonance and the normal moment is known as a reinforcement moment factor (or dynamic factor). This factor can be great (10–30) and small (3–4). This measure heavily depends on the period of time when system works in resonance (fast pass in resonance zone) and the amortization ability it possesses. Refer to the above mentioned facts and the characteristics of elastic joints we say that they have an important influence in the system, figure 1.

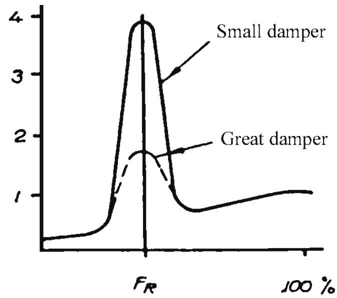

Figure 1 – Function principle of rubber rolling joints

Recommendation of ship transmit in [3] is complied with both types of joints; meantime you can see the advantages of the second in figure 2, *b*, *c*. In the [3] recommendation is stated that: “Most those with rubber elastic elements are likely to be easily constructed, have great extinction ability, greater life durability, etc. In the rubber elastic joints we can change in wide diapason the extinction ability in case we use different rubber and pre-extension“.

The elastic joint often suggested even in [3] and for specific transmit is widely used in figure 2, *b*, *c*. Rubber block (with different geometric forms) is under pressure due to the incremental twisted momentum. It is clear that rubber blocks have no remained deformation, so their volume is unchangeable. The increase of the twisted momentum will cause decrease of the whole volume and the rubber blocks occupying a greater percentage of the hole. The solidity of joint (theoretically) often goes to infinite in cases when those volumes become equal. So the solidity of joint during the twisting is going up with momentum increasing in this cause the change of the oscillation frequencies of the system itself.

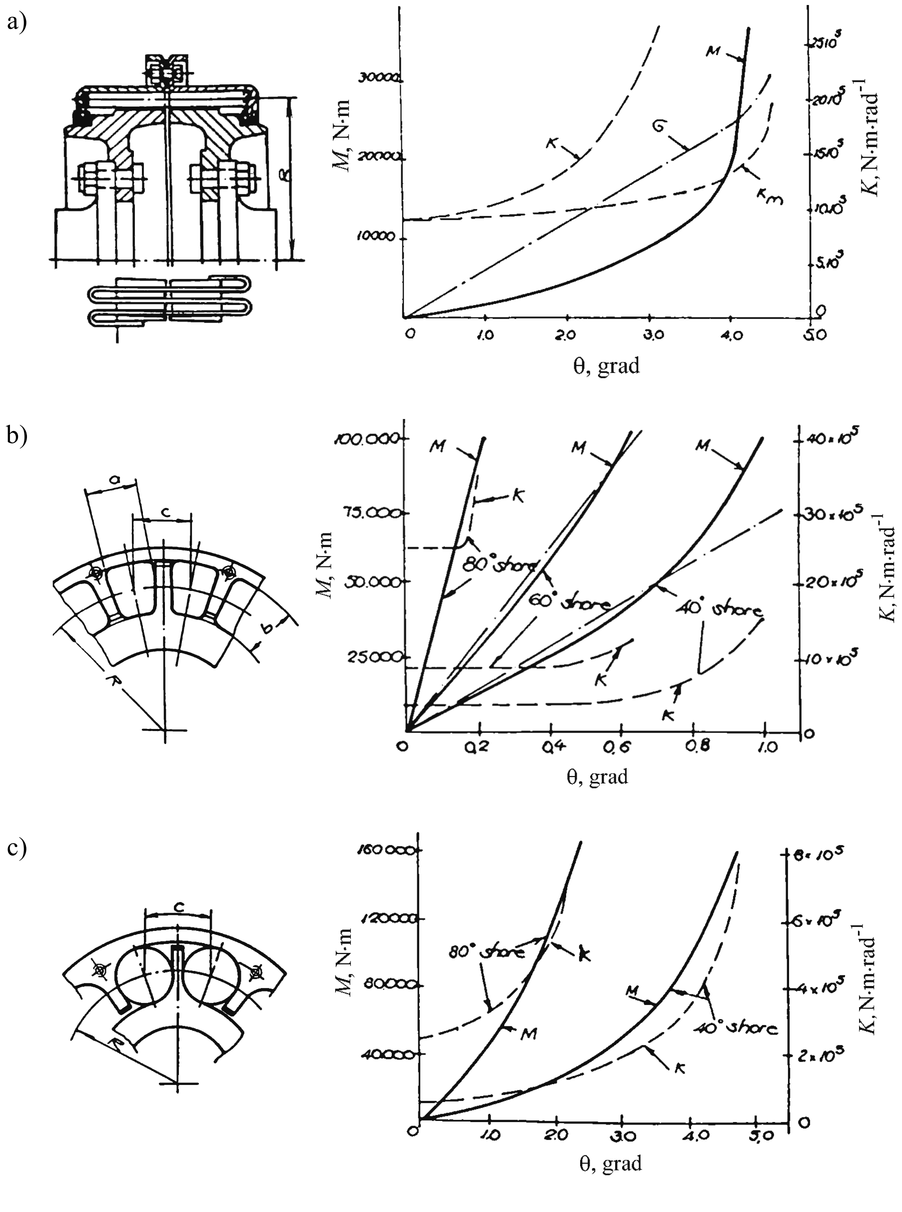

Figure 2 – Elastic Joints:
a – with the spring; b – with the wedge roller; c – with the cylindrical roller

The function curve form for rotating moment acting and rotating solidity, dependent on geometric rubber block and the joint hole as well as the hardness of rubber shown in figure 2, *b*, *c*.

Incremental solidity of the joint is based on twist accompanied with resonance frequency dependency from the acting moment.

The presence of elastic joint of this type within the system makes the impossible decision of the resonance zone and the dynamic factor reach suitable values [3, 4].

Due to the above mentioned reasons derived the conclusive recommendation in [3] is that using such joint will postpone the resonance zone and decrease the amplitude in this postponed zone.

Thus, initiated from system characteristics and the results we want to achieve, we can select the best and the most suitable elastic joints. Lets take an example of analyses for the ship cases: based on nominal moment we want to transmit, solidity we want to achieve as well as the twisted angle predictable we can realize refer to the dependence graphics of those measures for a concrete case as it is shown in figure 3.

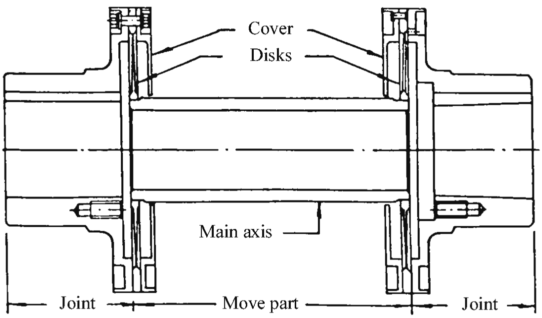

Figure 3 – Elastic joints with inflected disks

Axial Oscillation. Axial oscillation is present in machines equipped with axial rolling bars such as electric motors, generators etc. Elastic joints used in those cases are elastic joints with inflected discs in the axial direction, as you can see in figure 3.

In the figure there is one of the types of joints used for this purpose. They are dry and have two discs – axially elastic and very steady radials.

The solidity of the metallic disc is variable and depends on the axial placing. Resonance frequencies varied from minimum to maximum depend on disc movement that’s why we should pay attention to the fact the work speed should never pass through this zone [2].

The possibilities of working within the resonance zone must be controlled very carefully not only to foresee any potential damage but to prevent even the motor interfering.

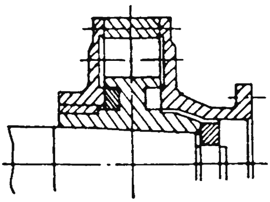

Figure 4 – Elastic joints with pressure rings

For this reason when the elastic joint needs to transmit considerable axial forces such as the shafts of ships rotating pushing helices, we use elastic joints equipped with pressing rings to face successfully the axial loads as it is shown in figure 4 [1, 3].

Side oscillation. Elastic joints in some cases might have very important influence in the side oscillations on machines. Their influence is obvious especially in the shafts located between the rolling ball and the elastic joint [2].

In order to have precise calculation, we should take into consideration even the shaft solidity and the weights of elements included in that part of shafts which are considered for studying.

Conclusion. In the article we draw attention to the fact that specific analysis must be done on the elastic joints initiated from dynamics consideration as well as emphasizing the elastic joints role in the decision of the eigenfrequencies of the system and the potential possibilities they create to eliminate the work under the resonance conditions.

Between the elastic joints the most preferable should be the ones with rubber elements due to the easy construction, life durability and the greater ability to diminish oscillation.

When an elastic joint is required or recommended in the transmission, its selection and setting should be done after respective calculations based on results we suppose to achieve.

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ВЛИЯНИЕ УПРУГОСТИ СОЧЛЕНЕНИЙ НА КОЛЕБАНИЯ МЕХАНИЧЕСКОГО ОБОРУДОВАНИЯ

В статье рассмотрены влияние упругости сочленений на собственные частоты колебаний системы, а также влияние жесткости на функцию момента, тип соединения и

люфт. Коэффициент динамичности рассмотрен в качестве определяющего фактора между максимальным и передаваемым моментом. Описаны типы упругих соединений с резиновыми подкладками, а также случаи, при которых возникают осевые колебания. Задача статьи – выявить влияние упругости сочленений на значения частот колебаний, чтобы обеспечить работу без резонанса. При проектировании упругие сочленения могут не приниматься во внимание из-за их низкой цены по сравнению со всей машиной. В статье подчеркнуто, что необходимы специальные исследования, основанные на динамическом анализе.

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THE ENERGETIC PERFORMANCE IN THE ALUMINUM AND GLASS CONSTRUCTION

The efficiency of energy use is determined by the technological application of energy rate reduction (e.g.: preservation of desired temperature in cutting down energy costs on heating/cooling by using effective thermal insulation or devices, profitable installation, etc.). Essentially it refers to the rapport between the amount of energy consumed in practice and the initial amount of energy used.

Energy conservation

Diminution of energetic consumption. People get a considerable impact to energetic consumption, when they use the aluminum cover layers in the buildings.

Practically, the energy conservation should be assumed as the process of using less energy in order to reach the required results. We should agree that the efficient energy use means efficient technological implementation in order to fulfill all energetic needs. From this point – it is to maintain the desirable temperature at the same level by periodically decreasing the warming energy or to keep fresh through the thermal insulation efficiency using special apparatus, rentable installation etc. It is a ratio between the practical amounts of energy consuming and inputs of energy.

Energetic efficiency for actual products in constructive elements and especially in aluminum construction such as cases, frame, facade, buildings and apparatus, including all characteristic influences on energy consumption.