METHOD OF CALCULATING PROBLEMS OF CARVED JOINTS

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Annotation. The purpose of the article is to rely on theoretical knowledge and apply it in practice in the calculation of problems related to rhizomatous compounds.

Key words: groove, inner diameter, outer diameter, joint calculation,transverse loads, screw, stud, reserve factor, steel, number of joints in the joint.

Solving problems is usually carried out in the following order.

1) A connection calculation scheme is drawn up and the load acting on the bolt (screw, stud) is determined.

External loads affecting the grooved joint can be permanent or cyclic, depending on the condition of loading - axial, transverse or mixed, depending on the nature of the effect.

When transverse loads are applied, two types of joints are used:

— the bolt is inserted into the hole with a slot;

- the bolt is inserted into the hole without a notch.

a) When the bolt is installed with a slot, a frictional force greater than the external displacement force of the load must be created on the surface of the connection by twisting.

In this case, the force stretching the bolt (screw, stud) is determined as follows

$$F_B = \frac{K \cdot F}{f \cdot z \cdot i},$$

where FB is the force acting on the bolt; F — external displacement force; K is the reserve factor: K = 1.3...1.5 in static load, K = 1.8...2.0 in variable load; f — coefficient of friction in the connection: f = 0.15... 0.20 — for steel and cast iron (steel); f = 0.3... 0.35 — for steel (cast iron) and concrete;

f = 0,25 — steel (cast iron) and wood; z is the number of bolts; i is the number of connections in the compound.

b) When the bolt is installed without a slot (by sliding or tension fitting), the frictional force in the connection is not taken into account, since it is not necessary to tighten the bolts. In this case, the bolt rod is called according to the condition of resistance to shearing and crushing.

Before proceeding with the calculation of the connections, it is necessary to determine that these connections are affected by a transverse force tending to move the parts being attached. The displacement force is determined from the condition of the balance of the parts relative to the axis of rotation: $\Sigma T_i = \Sigma F_i \cdot \frac{D_i}{2} = 0,$

where Fi is the displacement force acting on the diameter of the location of bolts (screws, studs); Di - rotational forces acting on proportional diameters, usually this is the resistance force of the parts being moved.

This transverse force is provided by tightening the threaded joint, balancing the frictional force at the joint of the parts to be joined. In this case, the bolt (screw, stud) is stretched. In the combination shown in Fig. 1, the torque of the friction forces must be 20... 25% greater than the shearing torque for accurate transfer to the rotary saw, i.e. $T_{IK} \geq 1{,}25 \cdot T_{QIRQ.}$ or $F_{IK} \cdot (D_1 / 2) \geq 1{,}25 \, F \cdot (D / 2)$,
where FIK is the frictional force between the saw band and the puck when tightening the nut FIK = f · N; f is the coefficient of friction between the saw and the puck, we take f = 0.12; N is the compressive force in the joint resulting from the tightening tension $F_B = N$.

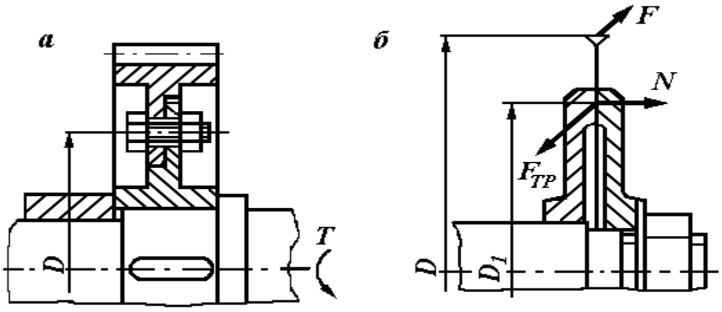

Figure 1

In the joint (Fig. 2, a), the force FB acting on the screw is determined from the condition of balance of the hammer (Fig. 2, b)

$$F \cdot (a + b) = F_B \cdot b.$$

Given an asymmetric voltage, the acting load is divided into parts and they are transferred to the center of gravity of the connection. If the number of bolts is not indicated in the problem, then their number is given.

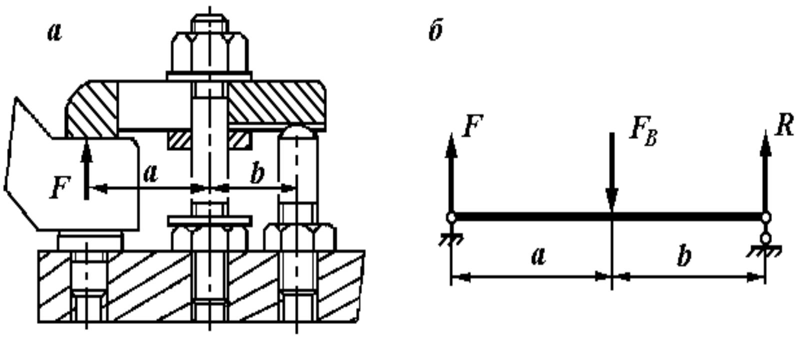

Figure 2

Let's look at the compounds in the problems (Figures 3 and 4). In these cases, the asymmetric applied load will open the circuit (and cause the details to move). Solving such issues is a mixed bag. The acting load is divided into parts - axial and transverse, and then transferred to the center of gravity of the connection. It is also possible to use the recommendations given in solving the problems of the first group.

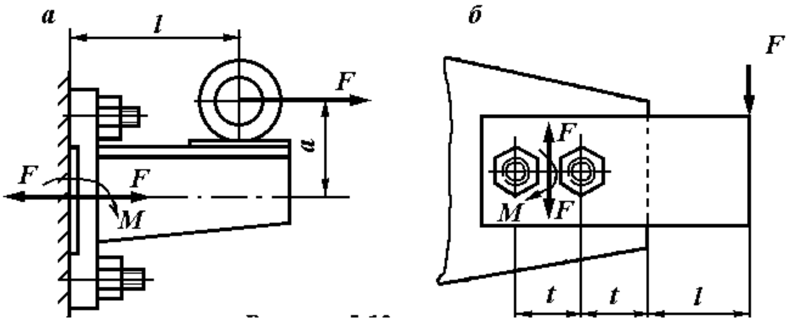

Figure 3

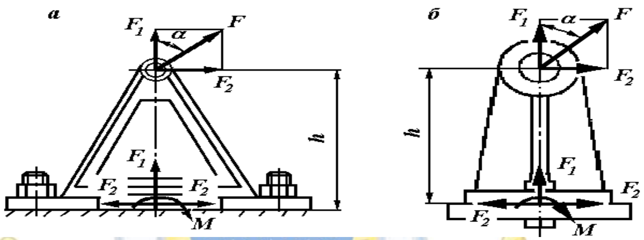

Figure 4

As a result, the joint is given, in general, axial and transverse forces that are equally received by all threaded parts and a moment that tends to open the connection. From the equation of balance - the equation of moments relative to the center of gravity of the connection - additional forces acting on the bolts (screws, studs) in the axial direction are determined.

The internal diameter of the thread is calculated based on the maximum value of the axial (breaking) force from the condition of resistance to stretching of the bolt (screw, stud).

The joint (Fig. 5) is pre-screwed with bolts, which ensures that the joint is closed by gypsum. The external force FB acting on the bolted joint reflects the internal pressure force of compressed air inside a container of diameter D:

$F_B = P \cdot (\pi \cdot D^2 / 4)$

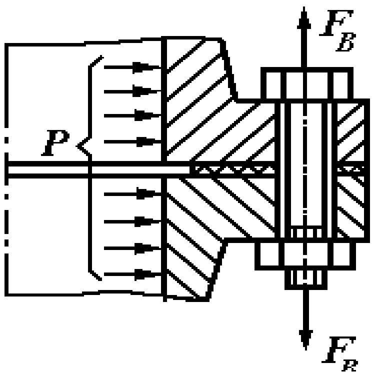

Figure 5

2) The material of the bolt (screw, stud) and, if necessary, the material of the parts to be attached are also selected. General purpose fasteners are made from low and medium carbon steels such as 10 steel ... 35 steel.

3) Depending on the working conditions of threaded parts, the permissible stress of screwing, crushing or shearing is found.

Permissible stress of screw fastening for bolted joints [σ_p] found in the absence of plastic deformations. It is the yield strength of the screw material σ_T depends on and [σ_R]= σ_T / [s_T]is equal to. Here [sT] is the strength reserve coefficient. It is recommended to choose the quantitative value of the reserve coefficient [sT] depending on the collection technology. If such an assembly is performed with a dynamometric key that allows strict control of the tightening tension, then [sT]=1.3…1.5. Screw fastening in this type of assembly is called controlled. However, in most cases, torque wrenches are used for torque control does not have, as a result, the tightening force remains uncertain. Collection performed with such a key is considered uncontrolled. In this case, it is advisable to increase the value of the reserve coefficient and take it as [sT] = 1.5... 4.0. In addition, the largest values in the specified range should be selected for small diameters of screws (d ≤ 10 mm), since the probability of wear is much higher in them.

The permissible shear stress can be determined according to the following relationship: [τ_{SR}] = (0,2… 0,3) σ_T ,

The permissible crushing stress is: [σ_{SM}] = (0,35… 0,45) σ_T.

4) The internal diameter of the thread is d1, the bolt (screw, stud) with the largest internal diameter of the thread is selected.

5) A checking account is made.

6) If necessary, the connection can be checked for the absence of displacement on the base, in which the displacement part is compared with the frictional force created when turning the bolt (screw, stud).

If the base material is not strong enough compared to the bolt material, for example: a cast iron bracket is fixed to a concrete wall (base), then the wall is tested for maximum compressive stress.

$$\sigma_{CM} = \frac{\Sigma F_i}{A_{CT}} \le [\sigma_{CM}]'$$

here SFi is the total load on the bolt compressing (crushing) the foundation; AST is the surface of the base, [? SM] is the permissible crushing stress for the lower part of the strength of the threaded pair.

Permissible compressive stress at the joint for a brick wall built in a mortar mixture — 0.7...1.0 N/mm2; for a brick wall built in a cement mixture — 1.5...2.0 N/mm2; for concrete — 2...3 N/mm2; for wood — 2...4 N/mm2.

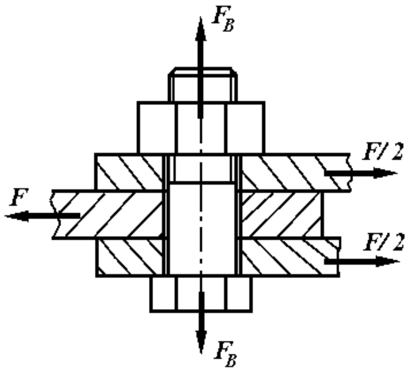

Figure 6

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