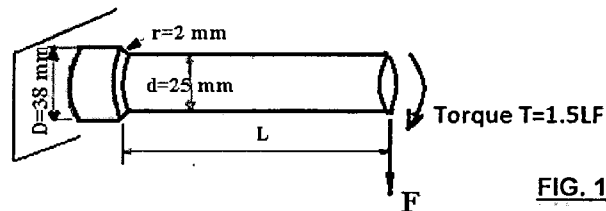
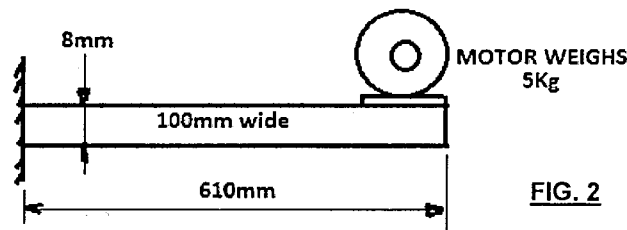


Instructions: Answer all FOUR questions which are of equal credits. Any data, if not furnished, may be assumed.

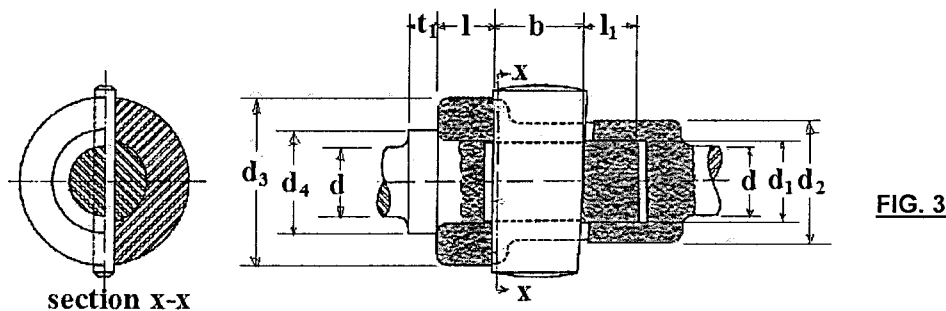
1. The cantilever beam is to be designed, with the dimensions as shown in Fig.1, with a factor of safety of 1.5 and 90% reliability. How large can L be for infinite life at the step in the shaft if the force F fluctuates between a minimum of 800 N and a maximum of 1900 N and the fluctuating end torque is given by $T=1.5LF$. The shaft material is an alloy steel with $\sigma_u = 1.26$ GPa and $\sigma_y = 1.17$ GPa. The shaft has a machined finish.



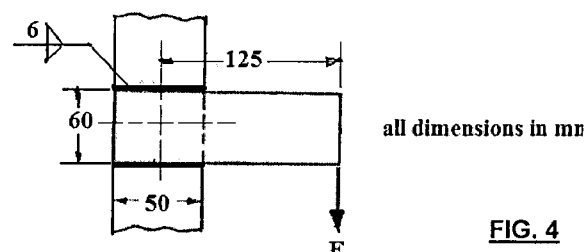
2. When the motor mounted at the end of the cantilever beam shown in Fig.2 rotates, the beam has a total up and down displacement of 6mm. The beam is made of a steel with $\sigma_u = 635$ MPa, $\sigma_y = 545$ MPa and modified $\sigma_e = 180$ MPa. Find the factor of safety at the wall.



3. The cotter joint shown in Fig.3 supports an axial load of 28 kN. Assume that the allowable stresses in tension, compression and shear of the rod, socket and the cotter are the same and they are $\sigma_t = 150$ MPa, $\sigma_c = 160$ MPa, $\tau_y = 80$ MPa respectively. Determine the values of the dimensions d , d_1 , d_2 , d_4 and l_1 .



4. The beam shown in Fig.4 is 10 mm thick and welded to a support using two 6-mm fillet welds. Find the safe value of F if the permissible shear stress in the weld is 135 MPa.



Some Useful Design Charts

