به نام خداوند جان و خرد

زبان تخصصی برای مهندسی مکانیک

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Preface

Understanding and using scientific English presents many difficulties to those engineers and students who have already achieved a reasonable proficiency in conversation or literary language through the common course books. The aim of this book is to develop the necessary knowledge of how English should be used for communication in mechanical engineering field. Therefore, it is designed to help bridge the gap between such a course book and engineering text books.

The book contains verious subjects commonly utilized in mechanical engineering, which are divided into 50 units, with a variety of exercises. The exercises direct the students' attention to certain features of English which are specific to scientific and technical writing. The object is to provide the students with a better knowledge for reading more difficult engineering texts and to prepare them for making effective use of English. This book does not aim at teaching grammatical structures. It concentrates on teaching the basic technical elements of the language particulary vocabulary, and covers the technical English syllabus which is currently being practiced at Iranian universities.

Appendix 1: provides a section on the use of mathematics in English, which has been difficult for most students.

Appendix 2 : gives sample exam questions for graduate students.

Appendix 3 : provides sample exam questions for those students intending to take a ph.D course in mechanical engineering.

I do hope both the science - in - English teachers and the students of mechanical engineering will find this book useful.

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Unit 1

Friction

It is found by experience that when one body slides on other, a force is set up which resists the motion. This force is called the frictional force or more briefly the FRICTION. The direction of the friction is always opposite to the direction in which the body tends to move.

If we place a block of metal A on top of surface B, attach a string to A, Pass it over a Pulley and fix a scale pan at the lower end. Then, add weights to the pan until body A begins to move, as shown in fig (1). We can observe that the weights in the scale pan plus the weight of the scale itself equals to force F.

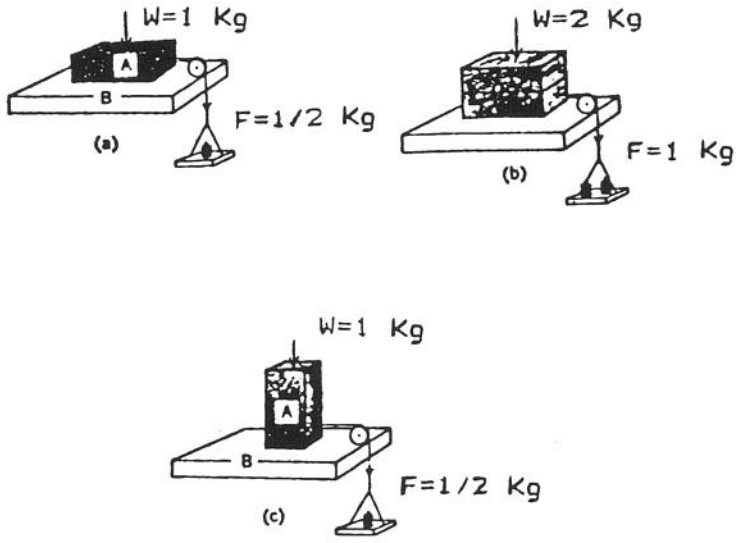
Suppose body A weighs one kilogramme(kg) and we find that the force to overcome friction is half a kg (fig 1-1a).We could then say that the frictional force F is half the normal load W. If we increase the weight of block A to two kilogrammes (fig 1-1b) then we will find that the force to slide the new weight over B is roughly one kg, that is , half the normal load. This illustrates that: FRICTIONAL FORCE IS PROPORTIONAL TO THE NORMAL LOAD.

The ratio of the friction to the load is defined as the COEFFICIENT OF FRICTION and is shown by the greek symbol μ (mu), Therefore μ=F/W, in the above case μ is 1/2. This relation shows that the value of friction depends on the nature of the two bodies contacting each other, their materials and the normal weight. We should also notice that, it is harder to start a body moving than to keep it moving.This was first pointed out by the Greek scientiest Themistius over 2000 years ago. The force to start the body moving is called the STATIC friction and the force to keep it moving. The KINETIC or SLIDING friction. Generally, the value of static friction (or LIMITING friction) is slightly greater than kinetic friction.

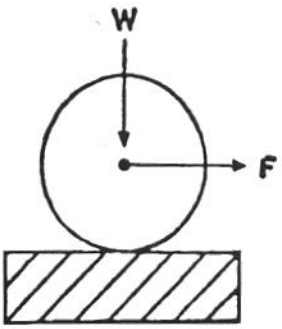
We can also find that the frictional force will not depend on which way block A is rested on surface B, whether with its small face or its large face in contact (fig 1-1c). Hence , friction does not depend on the apparent area of the contacting surfaces.

In rolling and rotating motion there is also a coefficient of friction but its value is much lower than sliding friction. In figure (1-2), if the weight of the wheel or roller is W and a force F is applied at the center to enable rolling to take place then, we can say that the ROLLING FRICTION(F_R)= μ_R W.

For a hard steel roller on a hard steel surface, μ_R may be as little as 0.001, that is , the rolling force is only one thousandth of the normal load. This situation operates in ball and roller bearings.With more deformable materials the rolling friction is higher but even for a rubber tire on a road the rolling friction is 0.05. Clearly it is advantageous to convert sliding motion into rolling motion.



Figure(1.1) A simple method of measuring the friction between body A and surface B.



Figure(1.2).A roller of weight W rest on a flat surface.

EXERCISE(1) Rewrite The Following Sentences, Replacing The Words Underlined With Those From The Passage Which Have Similar Meaning:

1) When one surface moves over another, a force is set up which opposes the movement.

2) If we set a large body on a surface and pull it , then we will perceive friction.

3) We can reduce kinetic friction by lubricating moving surfaces.

4) Connect a thiny rope to surface (A) and move it over a grooved wheel.

5) Experiment shows that the limiting friction is independent of the area of contact when the normal weight is the same.

6) The magnitude of limiting friction is higher that sliding friction.

7) The coefficient of dynamic friction between two given surfaces is less than the coefficient of static friction between the same surfaces .

8) Itis only in the last fifty years that physicists,chemists, engineers and metallurgists have tackled the problem cause by friction in a more effective way .

9) To understand friction we need to study the shape and contour of contact surfaces, the way they change size and shape , the properties of the interface and the role of surface films.

10) If we roll over an elastic solid such as rubber , no permanent groove is formed . this does not mean that rolling resistance is zero.

EXERCISE(2) Answer These Questions Without Referring To The Text :

1)What is friction ?.....

2) Distinguish between static and kinetic friction.....

3) The coefficient of static friction is the ratio of ..... .

4) The coefficient of sliding friction is the ratio ..... .

5) Rolling friction is defined as ..... .

6) The coefficient of friction between two given surfaces is ..... of the area in contact .

7) Why do you think it is desirable to convert sliding motion into rolling one ?

8) There are some situations where we need friction . Give at least two examples of these circumstances .....

9) Friction is generally considered a nuisance . Give one example.....

10) In running machinery friction is undesirable . One way to reduce it is by lubricating the surfaces with oils or greases . Can you think of any other way?

EXERCISE(3) Translate The Following Into Farsi :

if we move through a pool of water we experience a resistance to our motion .This shows that there is a frictional force in liquids. We say this is due to the VISCOSITY of the liquid . If the frictional force is comparatively low , as in water , then we say that the viscosity of the liquid is low. If the frictional force is large , as in glue or glycerine , then we say that the viscosity of the liquid is high. We can compare roughly the viscosity of two liquids by filling two measuring cylinders with each of them, and allowing identical small steel ball- bearings to fall through each liquid. The sphere falls more slowly through the liquid of higher viscosity.

Levers

The lever consists of a straight bar or rigid structure on which one point (the FULCRUM) is fixed , another is connected with the surface to be acted on , and a third is connected with the force or power to be applied . In order to understand how the lever works we must consider the principle of the moment of a force about a point . The moment of the force is equal to the product of the force and the perpendicular distance from its line of action to the point about which it rotates.

In fig (2.1) , the applied force or EFFORT (E) exerts a torque E. d_1 in a clockwise direction while the resistance or LOAD (L) exerts a torque L. d_2 in an anticlockwise direction about the FULCRUM. If it is assumed that there is no friction at the fulcrum , equilibrium exists when E. d_1 = L. d_2 . The ratio of load to effort (L/E) is known as the mechanical advantage (MA) of the machine . In this case the MA is equal to (d_1/d_2).

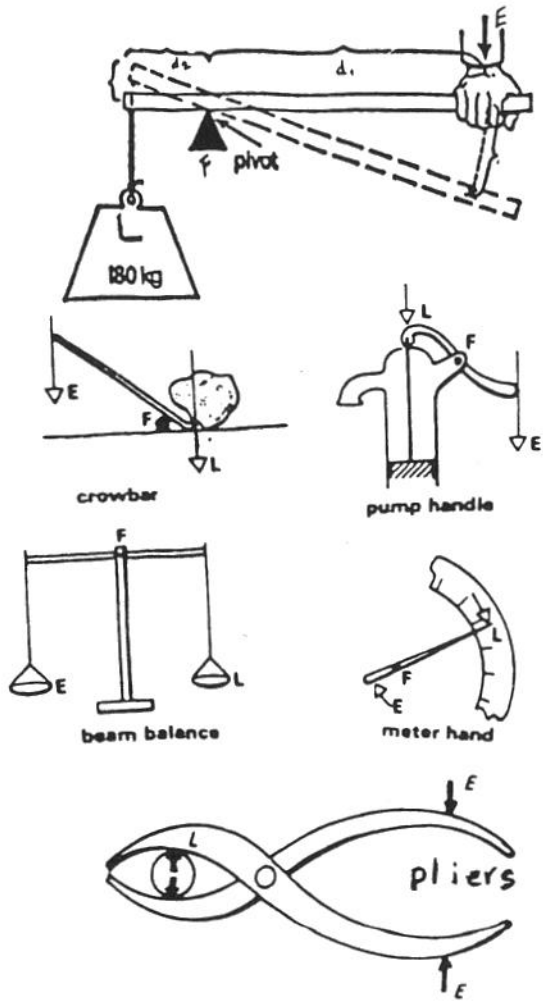


Fig (2-1) Levers of the first kind

The levers we have just examined have the fulcrum between the effort and the load. They are known as levers of the first kind, and include such things as scissors, oars, pliers, pump handles, beam balances, meter handles and crowbars.

Levers of the second kind place the load between the fulcrum and the effort (fig 2.2). Their mechanical advantage (d_1/d_2) is always greater than unity, so like levers of the first kind they too amplify the effort. Wheelbarrow and nutcracker are examples for the second kind of levers.

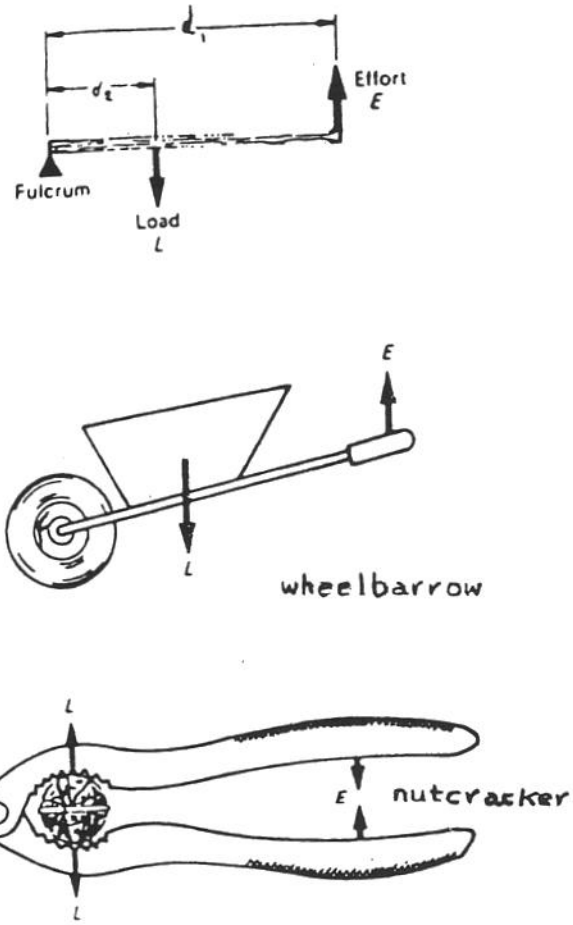


Fig (2-2) Levers of the second kind

In levers of the third kind (fig 3.3), the effort is placed between the load and the fulcrum. Such levers have a MA less than unity, but their Transmission Factor (TF) exceeds unity. The TF is defined as:

$$\left(\frac{\text{distance moved against load}}{\text{distance movsd by effort}}\right)$$

This means that levers of the third kind may be used as a means of magnifying a movement. Some examples of these levers are: the human forearm, steam saftey valve, aneroid barometer pointer and fishing rods.

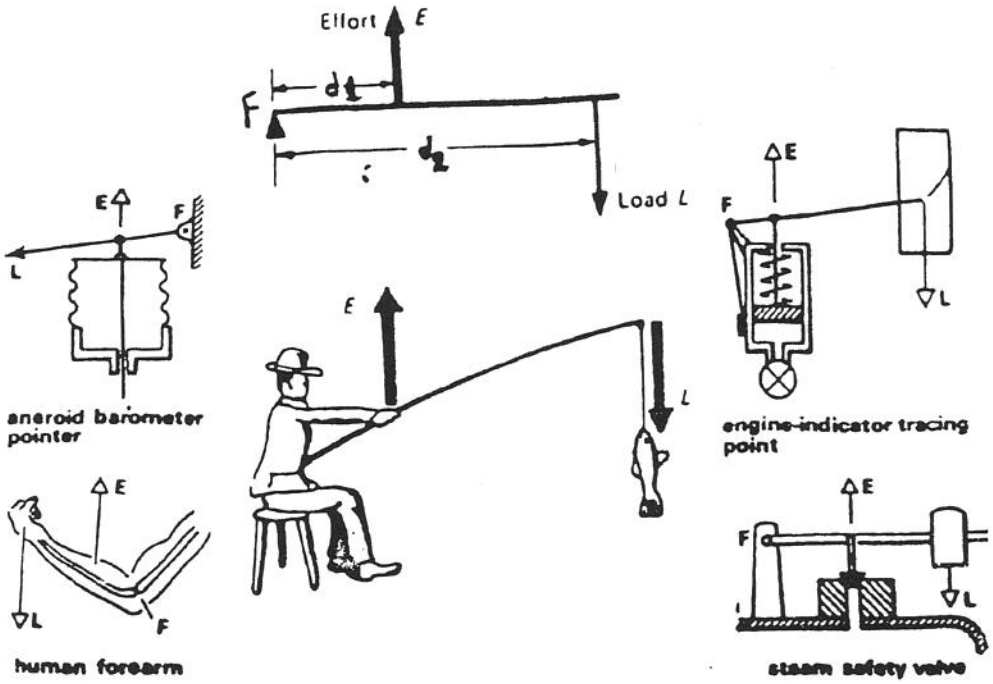


Fig (2-3) Levers of the third kind

EXERCISE(1) Fill In The Blanks In Each Sentence With Correct Words From The List:

fulcrum	perpendicular	effort	load
torque	magnifying	hinge	lift
rotates	equilibrium	moment	crowbar
forearm	wheelbarrow	nutcrackers	lever

Aneroid barometer pointer

1) The effectiveness of a force to produce rotation is called the .....of the force.

2) A hinge is a .....

3) If we push against the handle side of a door it will turn on its .....and open.

4) The moment of the force is its .....

5) We measure the .....distance between the force's line of action and its fulcrum.

6) Levers are used to .....heavy blocks.

7) The hinge is the point about which the door .....

8) A third order lever such as .....may be used for .....a movement.

9) A.....is a first order lever.

10) The human .....is a .....in which the .....is provided. by the muscle joining the upper arm to the forearm.

11) Lever which have the .....between the fulcrum and the effort are known as second order levers.

12) A .....and .....are examples of a second kind levers.

13) The system is in .....when the sum of all the torques about the fulcrum is zero.

EXERCISE(2) Translate The Following Sentences Into Farsi:

1) The fulcrum is the heel of the crowbar.

.....

2) The hinge forms a fulcrum for the door.

.....

3) All levers belong to a particular order.

.....

4) If you push a revolving door with your hand the door will rotate on its hinge.

.....

5)The turning effect of a force is given by multiplying the amount of the force by the distance from the pivot point to the line of the force.

.....