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CE 250 (STATICS)

FINAL EXAM PROBLEM I

GROUP N° 3

Problem Statement:

When a rug is in direct contact with a bare surface, it can slip relative to that surface. According to their manufacturers, rug pads are created and used to prevent such slipping.

You work for a supply chain that wants to purchase and sell large quantities of rug pads. You are given a piece of material that is purported to prevent slippage. Your assignment is to test and evaluate the claim that the material of which the rug pads are made prevents slipping.

Tests:

To evaluate the quality of rug pad, we first need to test a material that doesn't prevent slippage. The material that we decided to use for this experiment was a piece of carpet. Then, we designed three different tests. For all this tests we had a standard set up: placing a pulley on the edge of a table with a string going though it which is connected on one side to the material being tested (with and without rug pad) and on the other side we will attach weight thereby producing a horizontal force, through means of a pulley, on the material.

Test 1: for our first test, we took a piece of carpet and tested it without any pad or load on the carpet. In other words, we used a piece of carpet that we positioned on the table connected to a pulley. Then we used different weight load until we obtained the smallest weight load that caused the slipping (change of position/movement) of the carpet.

Test 2: for the second test. We tested the same rug with pads under it, but without other loads on the pad than the weight of the "rug". This test is similar to test 1, but besides only using the piece of rug by itself, we used also the pad. That we put below the piece of rug. Then, we used different weight load to find the lowest load that caused the carpet to slip.

Test 3: for test 3, we used a similar testing procedure as in test 2, however, we added different loads on the on the piece of the carpet. This was done with the utilization of five different magnitudes of loads as illustrated in the figure below.

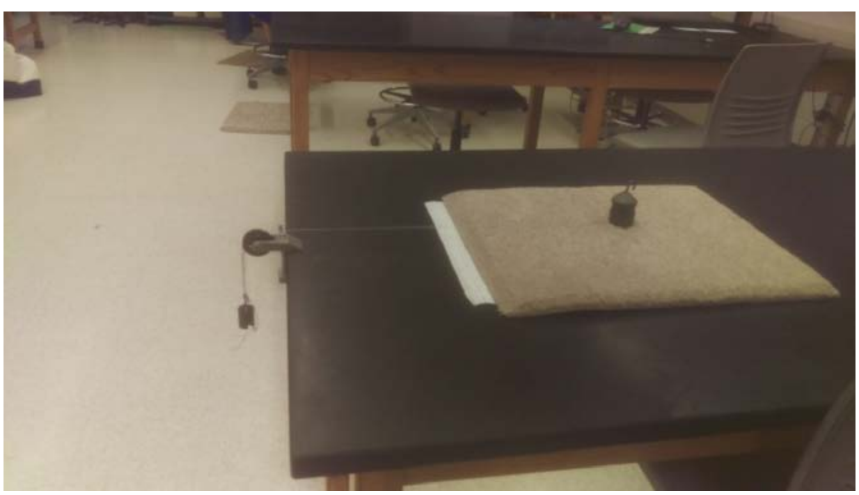

Figure 1: Illustration of test 3

Collection of Data

The assignment is to identify if the rug pad can prevent slippage. So, we need to determine the coefficient of friction based on different situation. From our formula, we know that the coefficient of friction can be determine using the weight of the mass of the material being used in addition to the adding load. Divide this value from the mass required for slippage of each test. To obtain the desire values, we need to draw a free body diagram for all the tests that we conducted as illustrated in the figure 2 below:

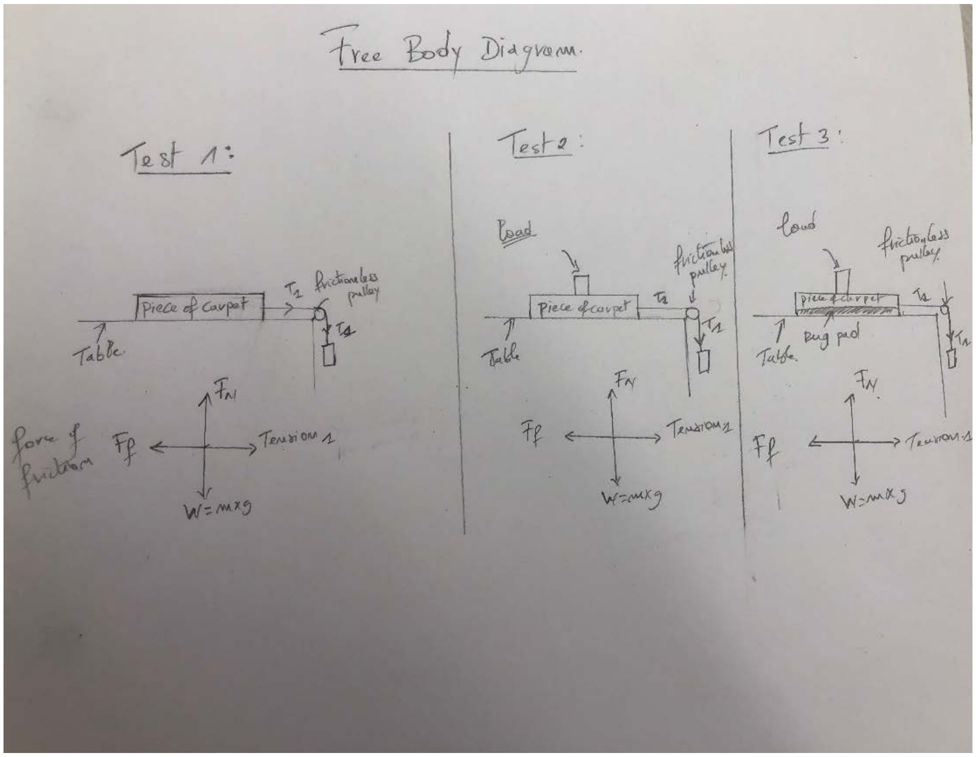

Figure 2: Free Body Diagram for test 1, test 2, and test 3

Table 1: Data Collected

Carpet (kg)	Mass Added (kg)	Force to Move (N)	Carpet with Mat (kg)	Mass Added (kg)	Force to Move (N)
No Weight	0.19	1.862	No Weight	0.9	8.82
0.2	0.26	2.548	0.2	1.2	11.76
0.4	0.33	3.234	0.4	1.4	13.72
0.6	0.39	3.822	0.6	1.72	16.86
0.8	0.45	4.41	0.8	1.86	18.228
1	0.555	5.439	1	1.95	19.11

Interpretation of the Data

In our free body diagram, we assumed that the pulley was frictionless. Also, we consider the tension T_1 to be the same as the load is pulling the carpet to cause it to slip. By analyzing our free body diagram we notice that for test 1, test 2, and test 3:

- In the vertical direction, the weight and the normal force cancelled out due to newton's third law which states that: When one body exerts a force on a second body, the second body simultaneously exerts a force equal in magnitude and opposite in direction on the first body.
- In the horizontal direction, since the tension cause the carpet to slip, a force of friction is generated to prevent the slippage of carpet and this force of friction can be calculated using the sum of force as follow:

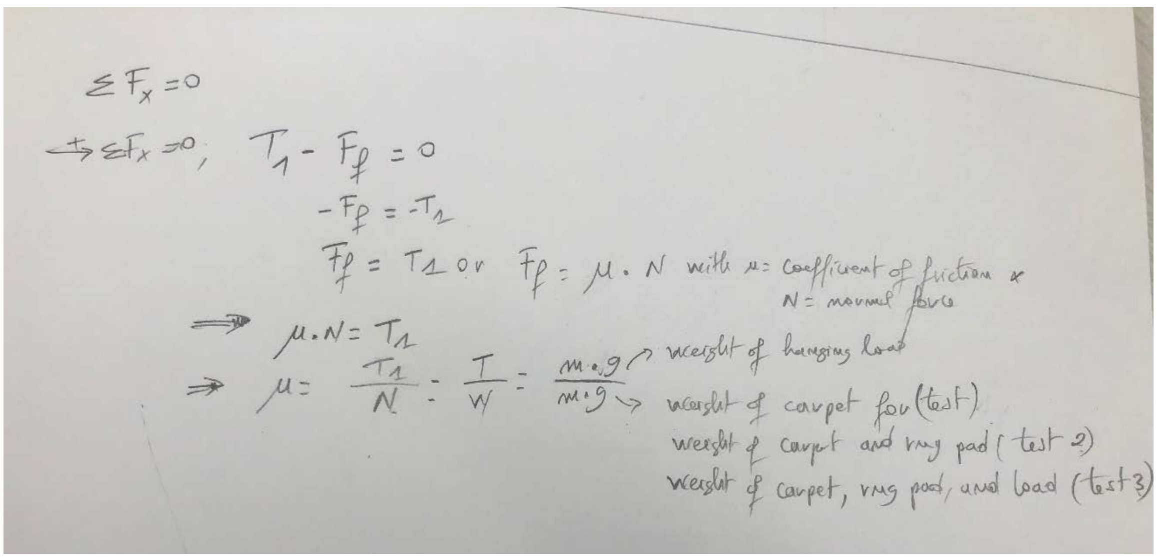

Figure 3: Calculation formula for the coefficient of friction

Table 2: Result of coefficient of Friction obtain

mass of carpet	friction of carpet	friction with pad	with mass added
0.581	0.327022375	1.549053356	1.536491677
			1.427115189
			1.456392887
			1.346850109
			1.233396584

Evaluation of the claim

The rug pad used for our experiment does hold true to the claim; the reason for that is because from our determination of the coefficient of friction, we noticed that the coefficient of friction obtained just using the plain carpet is lower than the coefficient of friction with the pad. Consequently, the Rug pad is effective to prevent slippage. However, from our collected data, we noticed that the more mass we added the easier the pad slipped. We believed this is because the mass was placed in the center of the rug, and consequently this causes the corner of the carpet to have a lowest coefficient of friction. Nevertheless, if we were to put some loads at the corner of the carpet, the carpet with the pad will be more likely to resist to friction.