**Experiment 7: LOAD LIFTING MACHINE LAB**

**WESTON DIFFERENTIAL PULLEY BLOCK**

**BACKGROUND:** A [differentialpulley](https://en.wikipedia.org/wiki/Differential_pulley), also called "Weston differential pulley", sometimes "[chain hoist](https://en.wikipedia.org/w/index.php?title=CM_Lodestar_electric_chain_hoist&action=edit&redlink=1)" or colloquially "chain fall", is used to manually lift very heavy objects like car engines. It is operated by pulling upon the slack section of a continuous chain that wraps around pulleys. The relative size of two connected pulleys determines the maximum weight that can be lifted by hand. The load will remain in place (and not lower under the force of gravity) until the chain is pulled.

**History:** The differential pulley was invented in 1854 by Thomas Aldridge Weston from King's Norton, England.

The pulleys were manufactured in collaboration with Richard and George Tangye. According to Richard Tangye's autobiography, the Weston differential pulley evolved from the Chinese windlass, with an endless chain replacing the finite length of rope. He claimed that many engineering firms conceded on the difficulty of efficiently disengaging the chain from the teeth as the pulleys turned, but his firm developed a "pitch" chain which solved the issue. Marketed as "Weston Differential Pulley Blocks with Patent Chain Guides", the pulley had good sales, namely, 3000 sets in 9 months. It was displayed in 5 sizes — from 10 long hundredweight (510 kg) to 3 long tons (3,000 kg) — at the 1862 International Exhibition in [London](https://en.wikipedia.org/wiki/London) and received a medal for "original application, practical utility and success".

**AIM OF STUDY:** To determine the machine law and efficiency of a Weston Differential Pulley.

**LABORATORY EQUIPMENT:** It has two blocks: the upper block has two pulleys of different radii (R and r) that form the rigid block and the lower block carries a pulley, which bear the load W. The closed chain that connects all the pulleys is pulled – via a spring balance – with effort P. Slotted masses, hanger and meter rule are provided.

**EXPERIMENTAL PROCEDURE:** Place a load W on the load hanger. Note the initial position of the base of the load hanger (XW1) and the initial position of the hook of the spring balance (XE1). Draw gradually on the spring balance until the load starts moving upward while the effort moves downwards. At this point note the effort P as read from the load balance. Pull the spring through the maximum displacement and note the final position of the base of the load hanger (XW2) and the final position of the hook of the spring balance (XE2). This is done for several values of W.

**RESULTS AND CALCULATIONS:** XW1 = 225.5, XE1 = 41.4, XW2 = 86.5 and XE2 = 50.0

|  |  |  |  |
| --- | --- | --- | --- |
| W | P | M.A | μ |
| 5.5 | 2.6 | 2.115 | 18.28 |
| 10.5 | 3.4 | 3.088 | 26.69 |
| 15.5 | 4.6 | 3.370 | 29.13 |
| 20.5 | 5.8 | 3.534 | 30.51 |
| 25.5 | 7.2 | 3.542 | 30.61 |
| 30.5 | 8.2 | 3.720 | 32.15 |
| 35.5 | 8.8 | 4.034 | 34.87 |
| 40.5 | 10.0 | 4.05 | 35.00 |
|  |  | Mean= | 29.66 |
|  |  | Std. Dev.= | 5.37 |
| When | =2.828 | Uncertainty= | 1.9 |

From graph, Slope (S) = 3.7639 and Graphically, efficiency (*μ*) =

*μ* =

**OBSERVATIONS:**

**PRECAUTIONS:**

**CONCLUSION**