Simple Machines: A legacy of human invention

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A simple machine, or a machine in general is any device that aids in the multiping of the amount of work being done by a force, over a period of time. Physics describes this relationship in classical mechanics, as:

Work = Force x Distance

These devices are fundamental in physics, and necessary information for anyone planning to be entering the engineering field. As a result humans have been using and creating simple machines through their history. Simple machines are devices that are largely considered today to be, for the most part, fairly crude and rudimentary constructions. However, some simple machines have implication for more complicated applications. Such as: the construction of the wheel and the lever. Both are distinctive devices, with their own physical implications and uses. For example, the *lever* is a simplistic machine, which can be used to the multiple the work done by a certain amount of force over a certain amount of time. There are two critical points in a lever: two critical points, one at which force is being supplied, and a side which uses the force to do work on an object. The second critical point, is the pivot point on the device, which physicists refer to as the fulcrum. The device accomplishes its function by working against the mass and any gravitational resistance of the object, by the extending the force on one end, and by levering across the fulcrum. The device has been used often by the humanity, sometimes for entertainment, as the principle of levering action are used on the playground toy the teeter-totter for example. This simple machine has a variety of forms, all with their own mechanical advantages. But the basic physical principle is what a physicist would call a “simple” machine.

Other examples of simple machines are as previously mentioned, the *wheels*. Two simple machines such as wheels and axles can work together, both adding to the multiplication of productive work being done in accordance with a force or over time. Wheels are fairly simple; able to make circular

rotations. Wheels are always connected to some axis of rotation, this device is called an *axle*. As the wheel rotates, it rotates, and can either rotate, or stay in place. Both uses of the two devices will yield a different outcome. This is essentially the relationship of a bicycle, which uses a rotating axle, which is propelled forwarded using a lever (pedals,) to rotate the wheel to which it is attached. The result is the rider of the bicycle for a small amount of physical effort and energy, with a small degree of force, is propelled forward faster. More work is being done. Combining these three simple machines, we're able to create a fairly complex device.

Humans have been utilizing their intelligence to accomplish incredible feats, throughout their history. It's is commonly thought that the ancient Britons constructed stonehenge, using a system of simple machines: Such as pulleys, levers, and so forth. (Maz 2013) While this is highly controversial, and very little evidence of such tools or devices is found in the actual archeological record. For the conceived process that scientists imagine these ancient people to have taken, the machines seem as if they might have been useful. Research teams often engage in reconstructions of stonehenge, using simple machines. For these ancient people primitive and ancient people to have been able to construct stone monuments, the stone of which, some weighing up to "25," to "35" tons each. (Sienkewicz 2015) Is a testament to the power of simple machines, in aiding in seemingly impossible tasks.

A *pulley* acts in the same way as a lever in many ways: here like levers, a pulley comes in a variety of forms (fixed, moveable, ext.) the distinctive characteristics of a pulley is to change the direction to which a force is being applied to a given load. The key characteristics of a pulley, are that a rope (or other similar object) is connected to a moving wheel (which can achieve a rotation) this point of rotation is often referred to as a block. The force then needed to do work pulling the object on the other end is dramatically diminished. The user of the pulley is effectively allowed to change the direction that force is applied: conserving energy. One could see how this simple design would be able to aid the peoples of early state-making projects in the construction of large and sophisticated buildings and structures. It's

notable that a simple machine such as a pulley, is constructed using a variety of separate machines. For example, a wheel is instrumental in allowing a pulley to effective perform it's function. Each demonstrates a principle in physics, and classical mechanics.

The Mesopotamian Civilization is often thought to have give birth to the invention of the wheel. (Mesopotamia 2016) As grain production became more of a necessity for the progression of the ancient city state, to provide food for a now thousands of inhabitants; the work (energy) that one would have to put into to perform work would need to improve dramatically. The evolutionarily, man's intelligence would inevitably ensure them their propagation across earth. The role of simple machines throughout human history has been to make humans able to utilize and manipulate their environment more efficiently.

A particular example comes from an early human civilization, referred to as the Minoan Civilization, which used a simple machine in an interesting and revolutionary way. Developing a system of channels, it was possible for the civilization to have a system of indoor plumbing that used *inclined planes*, to move waste water which flowed along an inclined plane. This was the foundation for the creation of irrigation and advanced agriculture. The incline we all know as the simple machine used in Galileo's famous experiments, which were fundamental in establishing of Newton's Laws of Motion. This simple machine demonstrates certain principles of the physical world, such as: Gravity, Momentum, and Friction. The inclined plane uses gravitational pull, while utilizing kinetic energy to move an object more effectively along a varying slope. The device is based on the principle that an object will stay in a constant state of motion, unless acted on by an equal and opposite outside force. Understanding these forces, humans have been able to construct even more complex devices, and to perform massive amounts of work as a result. The example of the Minoan Civilization which thrived around the same time as the Mesopotamian Empire (approximately 3200-2350 BC.) All the while humans were using simple machines in a vast system of commerce and trade. From young sea-faring men using pulleys to navigate

ships across the Tigris and Euphrates Rivers, to urban residence using heated public bath houses, running the water through a complex system of inclined surfaces. One can't help from being taken back in awe, while looking at the accomplishments of humans, all aided by simple mechanical devices of our own design.

Every modern human living in a city hub, like Tokyo, will drift past simple and complex machines everywhere, which have become the life-blood of the urban civilization that we live in. Working up a hill on a hot day on a bicycle, using: levers, wheels, Fulcrums and Axles. Gliding down a constructed incline plane, applying their intuitive understanding of gravity and motion. All of it happening at once to achieve a multiplication of the work gotten from a force over time. It's a history of accomplishing complexity, suddenly a teeter-totter doesn't seem that simple. But these Simple Machines have been with humanity ever since we immerged 200,000 thousand years ago. They've been using them for the propagation of our species, and in the development of a variety of social and political structures. As well as in adding to the wealth of scientific knowledge that humans have been able to glean from the very complex universe.

Citations

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