HIGHER TECHNICAL INSTITUTE

MECHANICAL ENGINEERING DEPARTMENT

DIPLOMA PROJECT

DESIGN OF A LARGE LIFTING BLOCK

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BY

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Project report

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CHAPTER 4

SUMMARY

Design of a large lifting block

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The aim of this project is to design and calculate dimensions of a block that would be able to lift weights up to 100kN

For making easier the decision upon the optimal design to be more detailed drawn and calculated is necessary to lied down different ideas and from those to decide which one drawing will serve some standards.

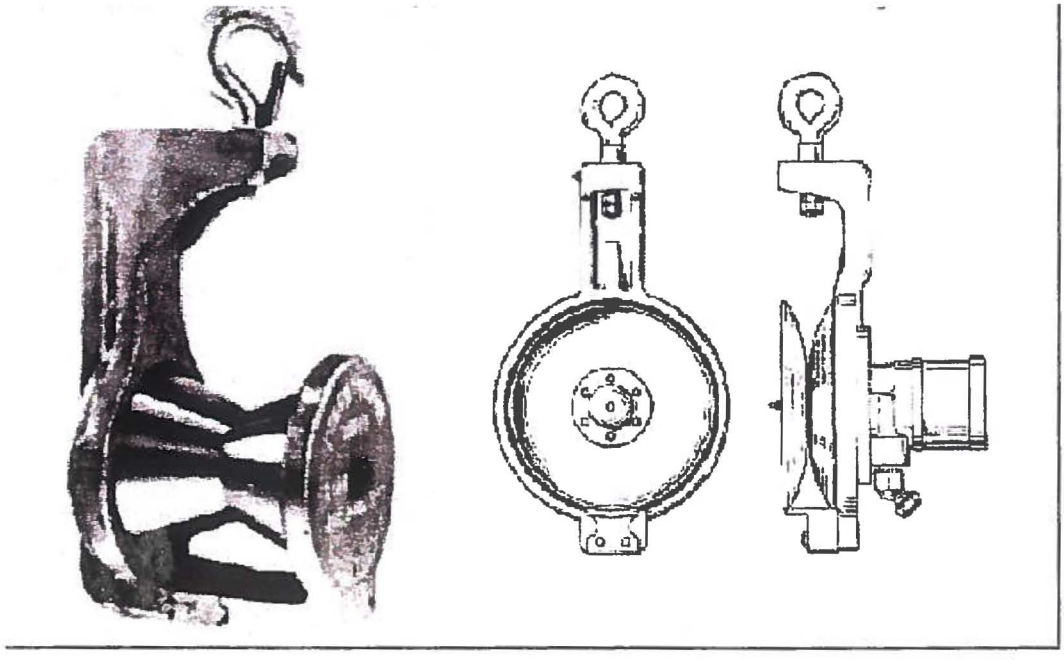
For one to be able to decide and design this kind of blocks needs to have some experience on how they are used in the industry and what improvements are needed to make the use of this more wide and easier.

AutoCAD R14 is the main program used for the designs of the blocks.

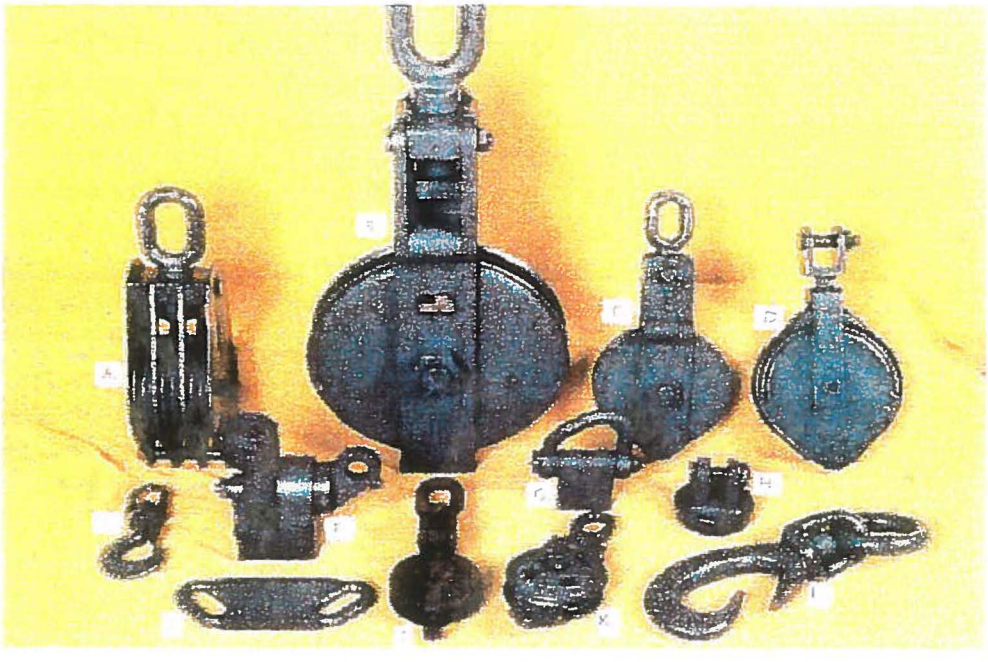
The equations used in calculations were retrieved from different books (H.T.I library) and the use of the Internet was indeed very helpful.

INTRODUCTION

Blocks are simple machines use to help lifting objects. The term block refers to the case that houses the pulleys side by side and holds the axle of the **pulley** in place. The design of the block gives the ability to attach on the end of the housing hooks or other connecting links in this cases the housing connects the axle of the pulleys and the axle of the connecting link thus creating a mechanism for lifting objects.



There are various types of blocks and each one of it is for serving a different purpose. The classification of the blocks is done by the material that they are made, the kind of work they perform, the weight they can lift, the number of pulleys that they are in use, the bearing used for the pulleys and the kind of rope they work with.



A single fixed pulley changes the direction of the force applied to the end of the rope. A common example of a pulley can be found at the top of a flagpole. Pulling down on the rope causes the flag to go up because the pulley changes the direction of the forced applied to the flag. Multiple pulleys can change both the direction of the applied force and the amount of the force, so that less force is needed to lift an object. Construction cranes use multiple pulley systems to reduce the amount of force needed to lift heavy loads.

The pulley is one of the four simple machines (along with the *lever*, the *wheel and axle*, and the *inclined plane*) used to do work. Work is defined in physics as the result of a force, such as the effort of pulling on a rope, that moves an object across a distance. Pulleys reduce the effort to lift an object by increasing the distance over which the effort is applied.

To lift any object, a person or any other mechanical element must do some work. Work is the product of the effort, or force, applied to an object multiplied by the distance the force is applied. The relation of work to force and distance can be show as an equation:

Work = Force X Distance

A pulley makes work easier by increasing the distance over which the effort is applied. Pulleys increase distance by requiring additional rope to be pulled to lift an object. Increasing the distance reduces the amount of force needed for the job. By changing the direction of a force, pulleys make it easier to apply the force because it is more convenient to pull down that to pull up. Combining pulleys increases the amount of rope needed to lift an object, so heavy loads can be lifted even less effort.

Mechanical advantage (MA) is a term that describes how much a machine magnifies effort. The greater the MA, the less the effort needed to lift a given load. There are two types of MA: theoretical and actual. Theoretical MA is the MA most commonly referred to. It is the MA a machine would have if it were perfect. The actual MA, who is always less than the theoretical MA, takes into account imperfections in simple machines. The main source of imperfection is friction, the result of two bodies rubbing against each other. Friction always opposes motion.and is present to some degree in almost every machine. Friction is a major problem in pulleys because of the weight on the rope and the movement of the rope on the pulley. Lubricants and bearings are often used in pulleys to reduce friction.

MA is generally determined by dividing the distance the effort travels by the distance the load travels. The higher the MA, the easier it is to do work. A single fixed pulley, such as the top of a flagpole, has a theoretical MA of 1, which means for each distance of rope the user pulls in, the flag rises the same distance. Effort is not magnified in this case. The primary benefit of a single pulley is to change the direction of the force or to move a load to a point (such as the top of a flagpole) that cannot be reached by the user. In reality, the actual MA is slightly less than 1 because of the friction of the rope against the pulley and the friction between the pulley and the axle on which it turns.

Pulleys can offer MAs of greater than 1 if they are moveable. A moveable pulley is one that is attached to the load to be lifted and therefore moves with the load as the rope is pulled. Even a single pulley, when placed on the object to be moved, provides an MA of 2, meaning that twice the load can be lifted with the same amount of effort. The MA of moveable pulley (or a system of pulley with a moveable part) equals the number of strands of rope coming from the moveable part (the load being lifted).

A moveable pulley can be used to lift a heavy load from the bottom of a cargo ship up to the deck. For a single moveable pulley to work, one end of the rope is tied to a fixed anchor on the deck. The rope leads from the anchor down through the pulley (which is attached to the load), and back up to the user. Since both strands of rope coming from the pulley equally support the load, any effort applied is doubled. Since a pulley system with an MA of 2 increases the force by a factor of 2, the pulley system must also double the distance the effort travels. Therefore, in order to raise a load a given distance, the user must pull and take in twice as much rope.

A block is combination of moveable pulleys put in order to make the MA bigger the possible thus needing less work to lift an object. Blocks combine pulleys in order turning around an axle, the axle is fitted on the housing, the same housing holds the various links for the loads to be attach on them either by rope or directly.