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QATAR UNIVERSITY جامعة قطر



Fall 2017

Term Project

Design, Building and Testing of a Tower Crane

INTRODUCTION

Different types of cranes are used for different activities, such as loading or unloading freight from railroad cars or ships, or to move building materials at construction sites. A commonly seen type of crane is the tower crane, which is what we will build this term. The tower crane is a type of balance crane that uses balancing weights in order to carry heavy loads. Tower cranes offer the best combination of height and lifting capacity, and thus are typically used in the construction of large buildings.



The main parts of a tower crane are the base, mast, jib (also called the working arm), and counter-jib (see Figure 1). The base is fixed to the ground or to a nearby building. The mast, attached to the base, gives the crane its height. The jib is the part of the crane that carries the load, and the counter-jib carries a counterweight to help balance the crane. When the load and the counterweight are properly balanced with the weight of the crane's arms (so that the forces sum to zero and the torques sum to zero), the crane is in static equilibrium. To balance the torques, a heavier counterweight is used on the shorter side of the counter-jib to balance a lighter load at farther distances along the longer jib.

COMPETITION

Inspired by the actual design of a tower crane and modelled on similar lines, this competition combines the difficulties of structural design along with the complex science of construction. In this competition, the different students groups are required to build the most efficient tower crane that satisfies the following objectives:

- The tower crane shall remain in static equilibrium while carrying the largest possible load at the largest possible distance along the jib.
- The deflection at the tip of the jib shall not exceed 5% of the length of the jib.

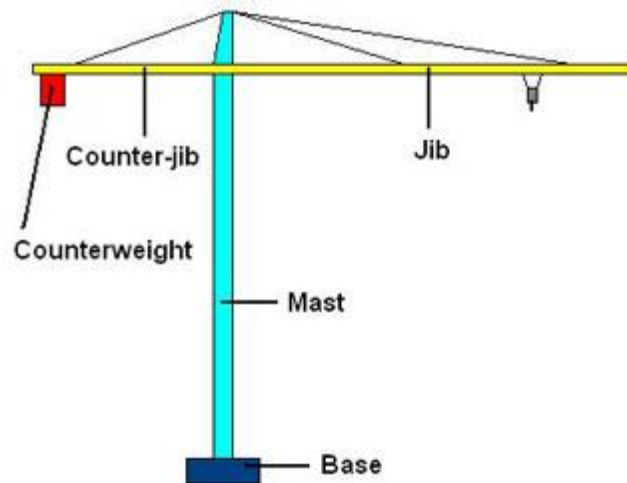


Figure 1 Parts of the tower crane.

STUDENTS GROUPS

Each team should consist of FIVE (5) students. Each team is allowed to enter only one tower, built prior to the competition.

SPECIFICATIONS

You are required to design and build a crane that remains in balance at all times (under loading as well as standing on its own). This means your crane must be structurally sound and theoretically sound (in terms of the static equilibrium equations).

- Make a tower crane, which consists of a vertical mast and a lever arm to support loads, with respect to the following dimensions:
 - The crane overall external sizes should not exceed **1m x 1m x 1m**.
 - The main mast starting from base should be vertical
 - The tower must be a single structure, with no separate or detachable pieces
 - The tower must not be braced against any edge of the base for lateral support at any time
 - The lever-arm should have an area less than 200 mm X 200 mm at any cross-section.

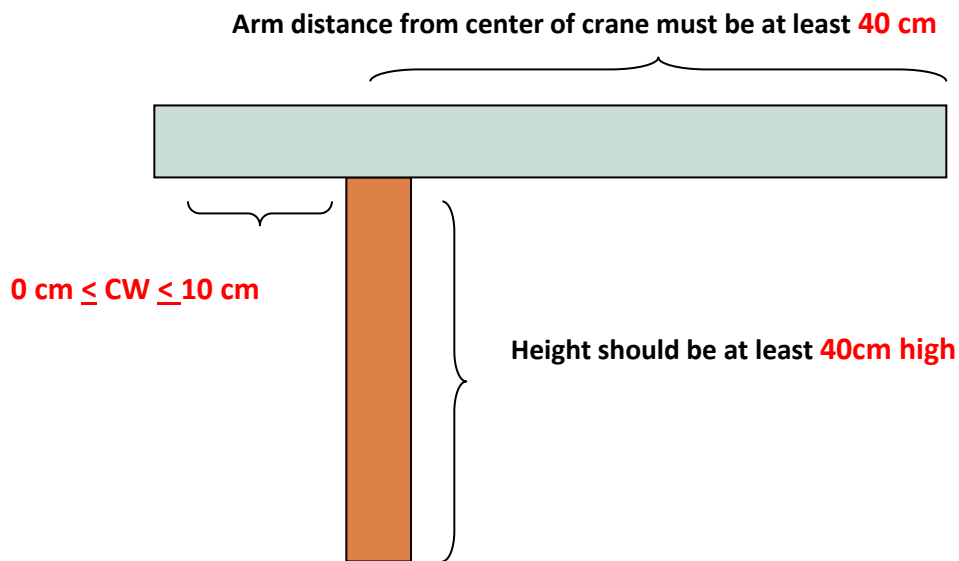


Figure 2 Dimensions of the tower crane.

- The base must be a solid level surface, with the following specifications:
 - ✓ The base must be square of 32 cm x 32 cm.
 - ✓ It must incorporate 4 holes of 30 mm diameter each with 25 cm distance as shown, to allow fixing the base to the bench.

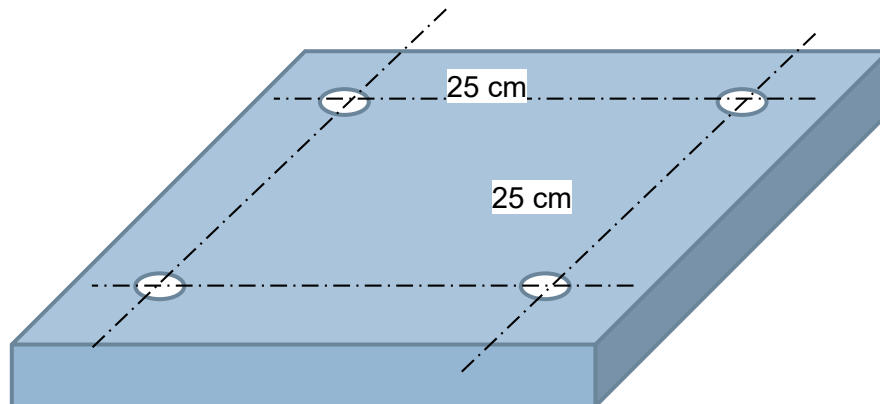


Figure 3 Base of the crane and its dimensions.

- Hooks must be provided at the ends of the lever arm to support the load where the structure would be loaded.
- The structure could be of any shape (truss or beam). Use your knowledge gained in the lectures and your imagination! For example, different shapes could be considered for the vertical mast.
- Failing to abide by above terms will lead to marks loss.

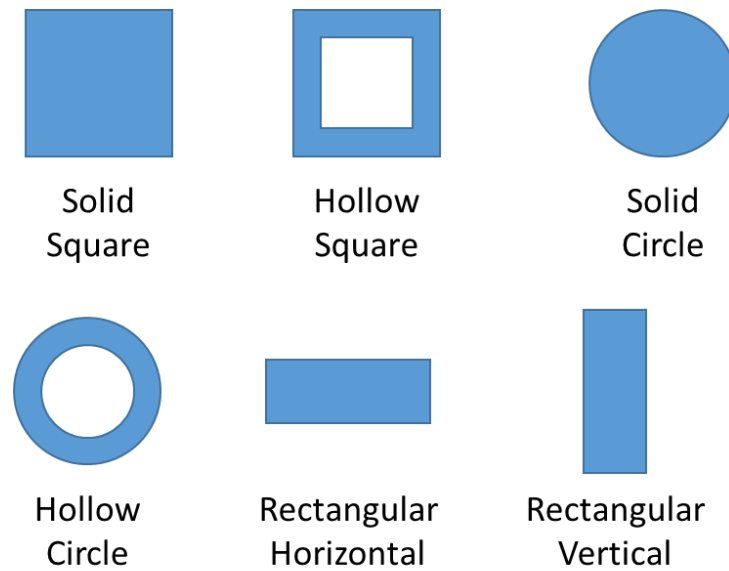


Figure 4 Possible shapes of the vertical mast.

MATERIALS

The tower crane can be constructed from any material. However, heavy material will lead to severe loss of marks (since the weight is being taken into consideration).

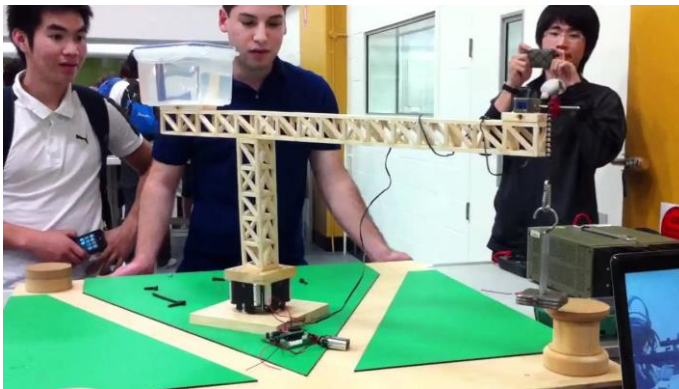


Figure 5 Possible designs of the tower crane.

GRADING CRITERIA

The scoring will depend on:

- The scientific content of the report
- The self-weight of the crane
- The maximum load (during the contest) applied at the greatest distance from the center of the crane
- The lowest deflection of the crane arm
- The artistic quality of the design
- The quality of manufacturing

IMPORTANT DATES

Please adhere to the deadlines below:

Date	Task	Action
19/10/2017	Form the Group	To be done through Blackboard – Group Self Enrollment
26/10/2017	Prepare Project Plan	Submit project plan through Blackboard
23/11/2017	Project Review	Submit project update through Blackboard
21/12/2017	Report Submission	Submit the final report via Blackboard
24/12/2017	Competition	Bring your designs to the Student's Activities Building