ARCH 171

BANANA SPLIT

PILARTA, JAMES DANIEL
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PROF. BELGA

CONCEPT

TOWER CRANE

Tower cranes are used in construction sites to transport heavy loads, typically building materials, to the needed place at the needed height. The stability of the tower crane relies on its space truss system to transfer loads safely to its foundation. It is often loaded eccentrically, or away from the axis of its mast.

THE ACTUAL PARTS OF A

TOWER CRANE[1]

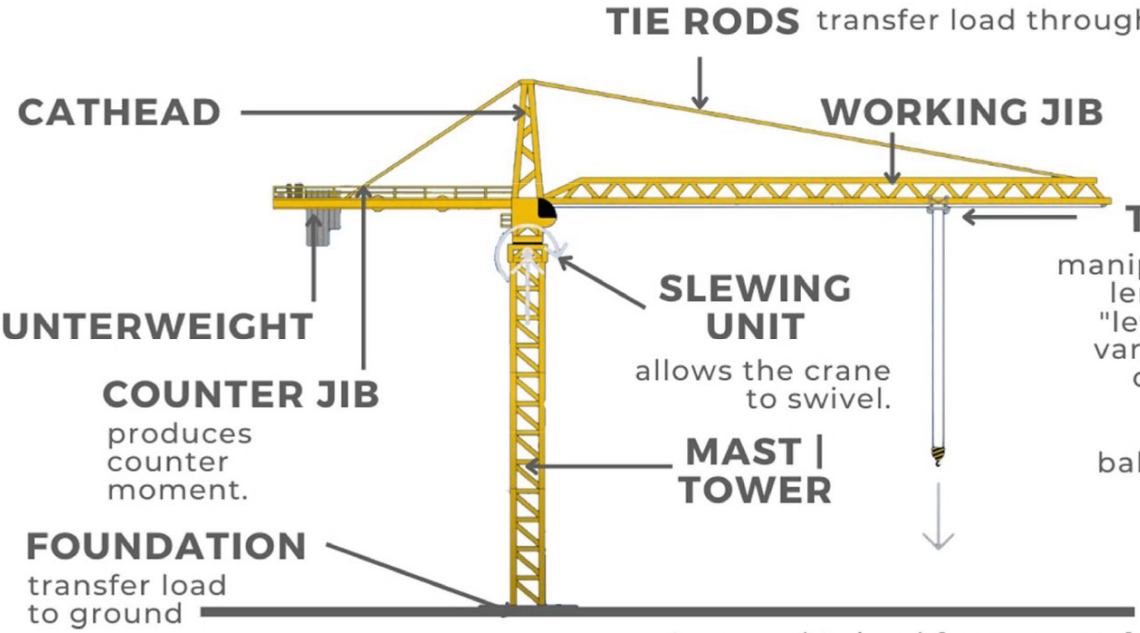
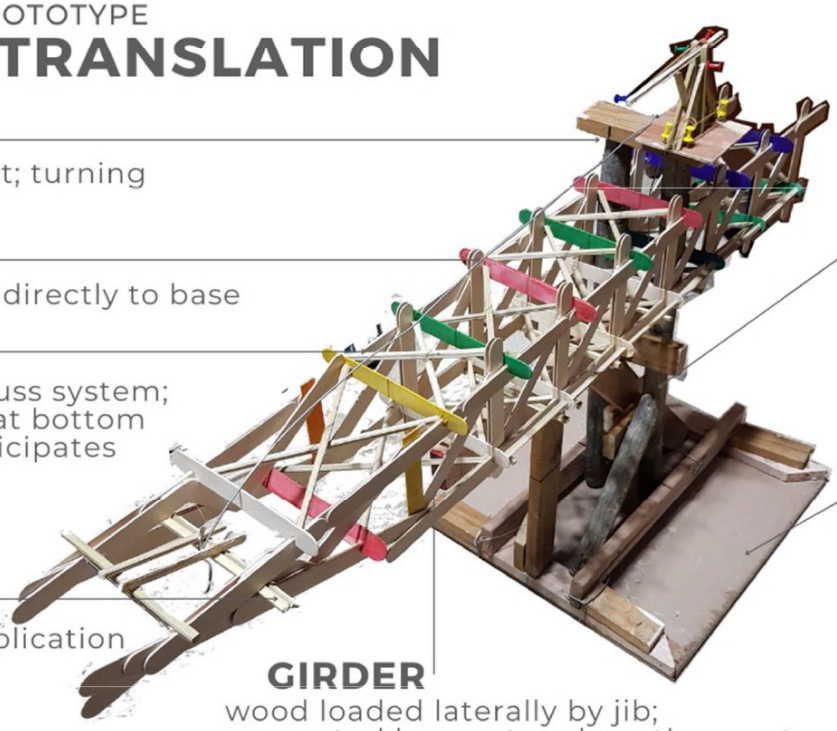


Image obtained from source[1].

STRUCTURAL PROTOTYPE

DESIGN TRANSLATION



CATHEAD
extension of mast; turning point for tie rod

TIE RODS
wires connected directly to base

JIB
popsicle-stick truss system; more members at bottom chord which anticipates compression

DOWEL
point of load application

GIRDER
wood loaded laterally by jib; supported by mast and another post

To comply with the requirement, the trolley and slewing unit were not included.

MAST
made from old *arnis* sticks with members connected by nails

FOUNDATION
400mm x 400mm ceramic tile; connected to wooden part of base by contact cement and wire

Weight of the model is 4kg.

[1]*How Tower Cranes Build Themselves. (2020, April 30). YouTube. Retrieved June 6, 2022, from https://www.youtube.com/watch?v=0SyC8pxJdeQ*

BASE: 400mm x 400mm ceramic tile

LOAD HEIGHT: Dowel 400mm from floor line

LOAD DISPLACEMENT: Dowel 400mm from base footprint

LOAD TESTING DOCUMENTATION

As can be seen from this footage, the structural prototype was able to sustain its stability when subjected to the initial loading requirement of **5 banana fingers.**

1 banana finger: ~71.4 grams

The prototype was still able to stand even after being loaded by **14 bananas**, which is **almost a kilogram in weight.** To see some failure, a different loading material was used, in two different prototype configurations.

TIE ROD-TO-DOWEL CONFIG 1

The tie rod was connected to the dowel, the point of load application, contributing significantly to load transfer to the base.

In image "A", the prototype was loaded by 5 lbs. or 2 - 2.5-lb weights. It was able to carry this loading, but image "B" shows that the jib can pivot at the mast due to the induced moment by the load. **However, failure at the members is not apparent.**

In images "C","D", and "E", the prototype was loaded by 5 lbs. and a dumbbell handle of about 2lbs. The basket holding the load was in direct contact to the floor.

1 lb = ~1.13 Kg

TIE ROD-TO-BOTTOM CHORD CONFIG 2

The tie rod was connected to the jib's bottom chord to restrict its tendency to pivot (see "1").

In image "2", the prototype was loaded by 7.5 lbs. Image "3" shows that the "beams" of the jib supported by the wood girder have started to buckle.

In images "4" and "5", the prototype was loaded by 10 lbs. Image "4" shows that the dowel where the point load is applied has collapsed from the structure, dropping the weights to the floor.

Image "5" emphasizes the failure due to torsion of the jib. It took a few seconds before it finally collapsed.

+ CONCLUSIONS

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To improve this prototype, more bracing at the jib's inner section could have resisted the torsion failure. In addition, securing the load application point at the very central axis of the jib is essential, since the offset caused cumulative failure over time. The role of the tie rod in tower cranes is also very consequential.