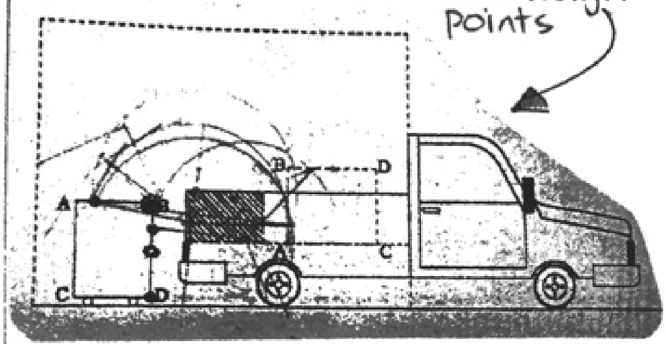
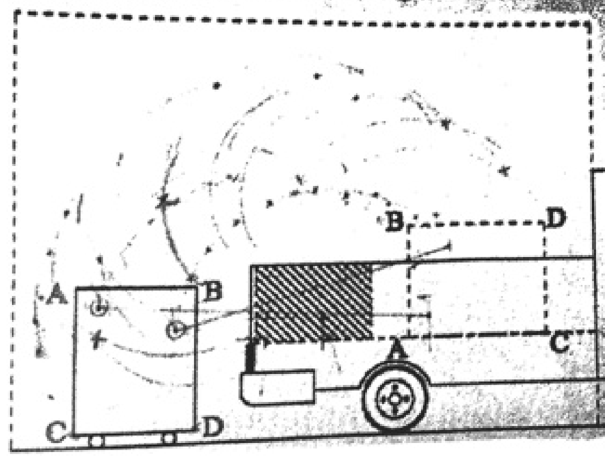
Trial Mechanisms:

Locations of trial mechanism design points





Map of link movement for earlier design

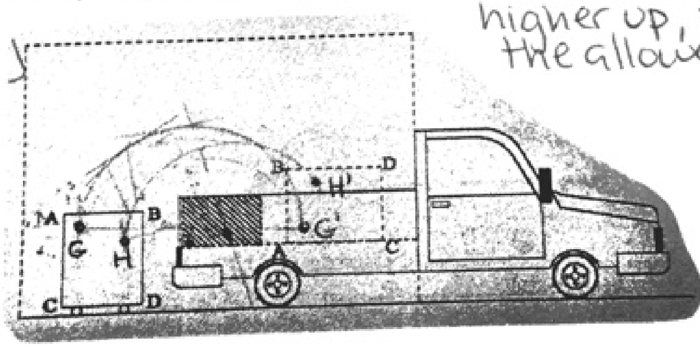
1. My first mechanism design held the container at points B & D. I decided this was a bad design choice because making the system work required one of the links to move through the truck which was not allowed.

2. I shifted the points to B and half way between B and D to fix the original issue, but when I did this the container swung too far out and went past the dotted link signifying the allowable traveling area. The links were also getting stuck because of their similar length.

3. My third attempt shifted the points to be along the edge of the container with one point being 166.5 mm from A horizontally and the second point being 166.5 mm from B vertically. This shift made the link lengths work better, but the container still travelled outside the allowable space.

↳ Final Design: To fix this issue, I moved the container points inwards towards the center of the container to have the container rotate less. The final design has point G (one of the container points) 166.5 mm from A in both the vertical and horizontal directions, and point H (the other container point) 166.5 mm horizontally from B and 333 mm vertically from B.

The points of the mechanism attached to the truck are both along the perpendicular bisector of path from the original location to the final location (G→G' or H→H'). The point linking G to the truck is lower than the point for H because this allowed for the container to rotate lower. If the H point was lower than the G point on the truck, the container rotated higher up, and in some cases it left the allowable area.



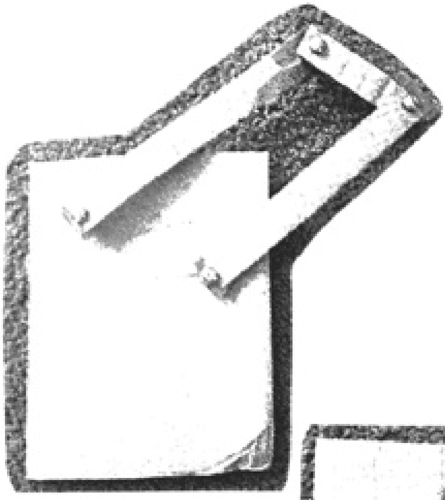
Design Process:

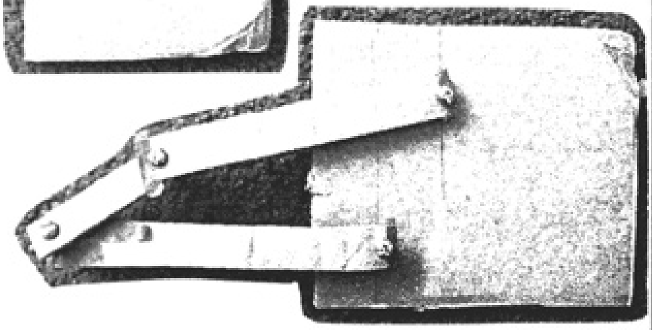
1. Attempted to conceptualize how container would move
2. Found two points on box that when connected to their final positions in the truck did not run into the truck.
3. Tested multiple locations along perpendicular bisector to see how the movement of the joints on the truck affected the movement of the container. ✓
4. Chose two specific points on truck and did iterations of the movement of the couplet link to see if the box would ever leave the allowable space.
5. After ensuring that the container would stay within the space, I used the force effect app to make sure the links wouldn't get crossed and get stuck.
6. Pre-prototype prototype build using basic found materials to figure out how to layer all of the links and bind them together (photos below).
7. Made adjustments according to issues with pre-prototype prototype.
8. Drafted materials needed for manufacture (links/container/board).
9. Chose fasteners, and eventually altered fastener size to fit mechanism better.

After this design process I had all the information I needed to manufacture and assemble the model of this mechanism. ✓

Trial Mechanism of the second [illegible] of mechanism:

An important part of the design process for me is trying out portions of my ideas, and then making alterations to the design based off of how the ideas work out. To the right are a few photos of a quick [illegible] I did to help me understand how the container would move.

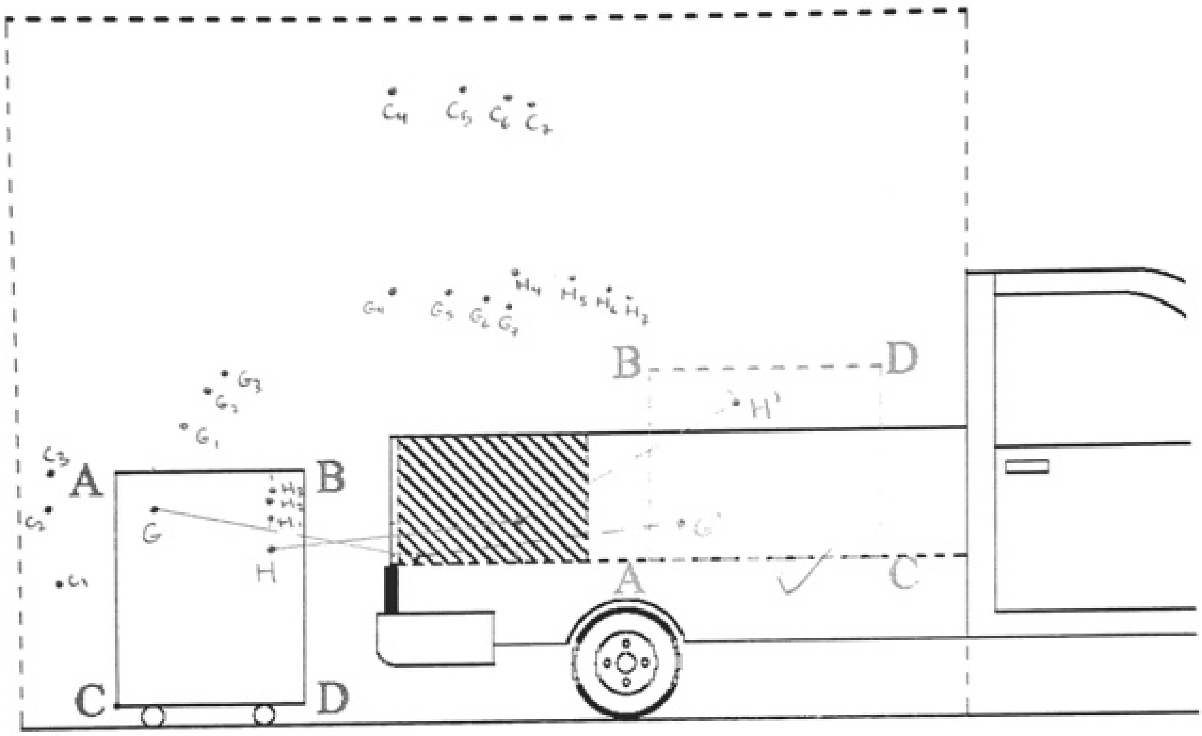




Also Briefly discuss position synthesis!

Checking of positions:

Below is a map of the link movement tracking points G, H and C (C because it is the most linkely to leave the traveling space for the majority of the movement). As shown on the map, the container will not leave the allowable area, and the points never get close enough to truck to touch the body of the truck. Seven intermediate points have been recorded to show that the container will not leave the required area.



Procedure to move Mechanism

To move the container from the ground one must simply hold link #2 (the top link holding the container to the truck) and move it in a clockwise direction until the ~~gr~~ container is sitting on the truck.

Assumptions:

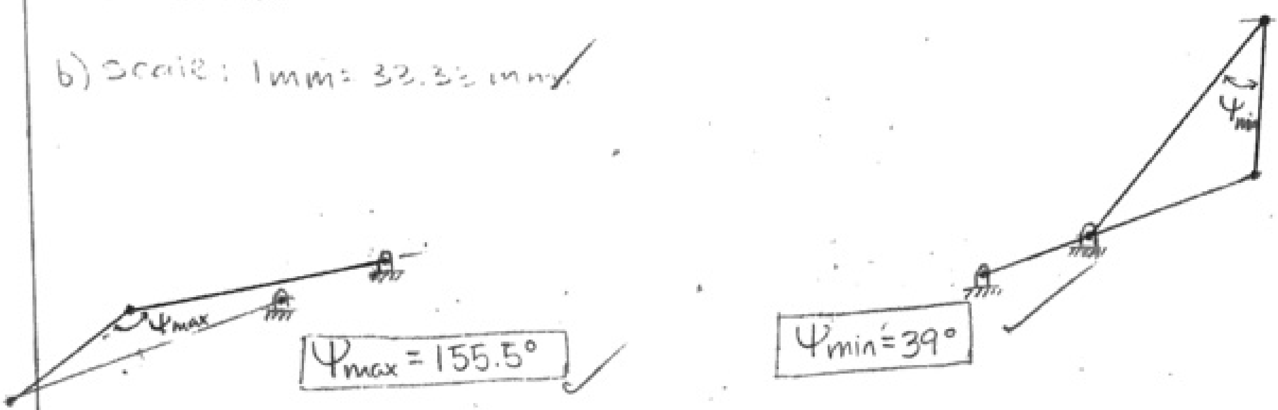
For this assignment I assumed that the body of the truck would stop the container when it reached that point and the container would rest on it, thus relieving tension in the links. In addition, I assumed we could put a clasp on the container so none of the items inside would fall out while on the trip to ~~the~~ truck.

Lab Questions:

a) The motion of the links does not interfere with the smooth operation of the truck because the box system, if installed correctly, only comes into contact with the truck where it is attached.

what if box is too heavy for links to lift?

b) Scale: 1mm = 33.33 mm



c) Yes, this mechanism does meet Grashof's criteria because: the longest link is 38.89 mm and the shortest link is 14.28 mm and those combined are less than the sum of the other two links (34.93 mm and 18.65 mm).

$s + l \leq q + p$

$14.28 + 38.89 \leq 34.93 + 18.65$

$53.17 \leq 53.58$ ✓

d) The mechanism will not need to be locked in the truck and it will be held from both sides in its same configuration. Of course, thinking practically, it is always good to lock down all loose or moving parts, but assuming that the box is latching enough weight to hold the box down and the material chosen for the links is strong and not brittle, there should not be much concern with it remaining unlocked.

e) Before applying this design on a large-scale system I would like to do some stress and failure analysis on the links to ensure their capability of supporting the box at the worst points, as well as looking into which industries this design will be used (different industries will have different requirements as far as safety and stability go). In addition, I would like to look into the pivots being used on the truck and see how they will be attached to the truck and make sure they will only be installed where the box weight will not cause the pins to move thusly causing damage to the truck itself. As an additional helpful measure, I would also add a locking mechanism to the box top (along AE) so nothing being stored inside is able to fall out.

f) It is up to the user what they choose to put in the box, but as I stated before it is important to realize how much weight the system can withstand, and depending on the material chosen for the links of the system the box will be able to complete the movement with differently weighted items. If all the users want lifted is thumb tacks, then sure the prototype will work, but otherwise new materials need to be chosen.

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My concern in safety with this mechanism is at the joints. I want them to be able to rotate the links without breaking, and be able to support the shear stress on them. I also have a concern about the links and their ability to support the load without failing. Any motor issues?

Once the container is on the truck it is unable to move upwards as the weight of the box will hold it down on the truck which will support it, and the two four bar links will hold the container from moving side to side.

i) There will always be cost issues. If we made this mechanism really well and only used the best materials the cost of the project would be astronomical. It is important to realize the cost of a design as it is being thought of, and think of where design changes could be made if it is necessary to make changes to make the device work without spending too much money.