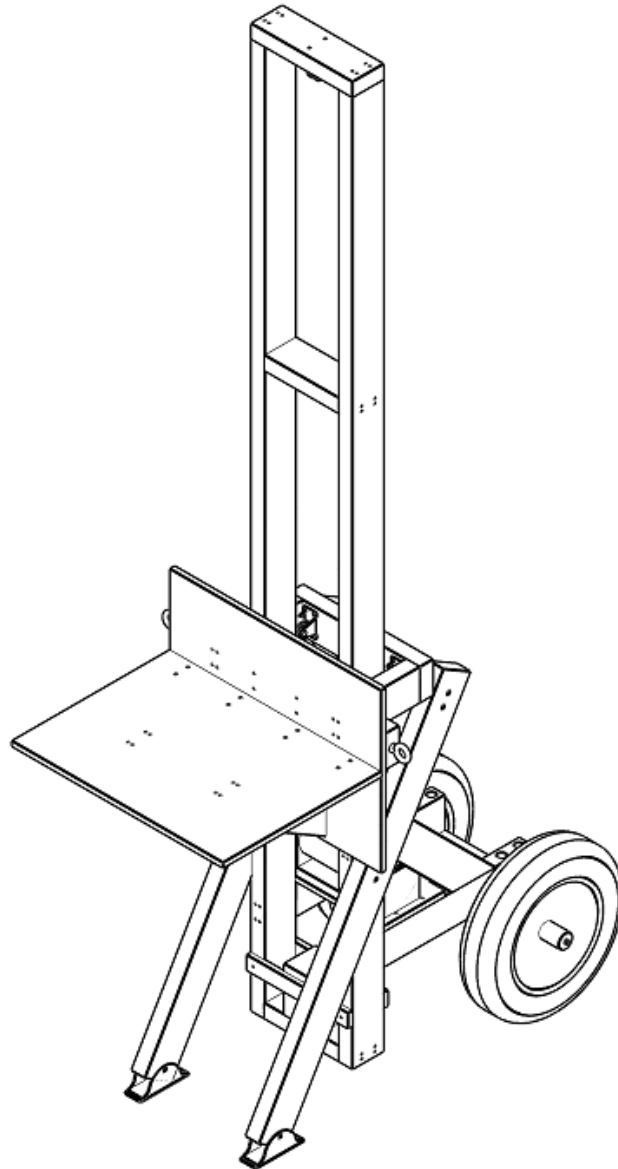


B.E.E.S.

Bee Environment Elevation System
Building Instructions



Swarm Trap Lifter

Product Information:

Name: Bee Environment Elevation System (B.E.E.S.)

Model No.: 001

Manufacturer: MSU Capstone DG29 - Amanda Jeffers, Bennett Guensche, Bradley Haskin, Brandon Roux, Daniel Staal

Date: April 2024

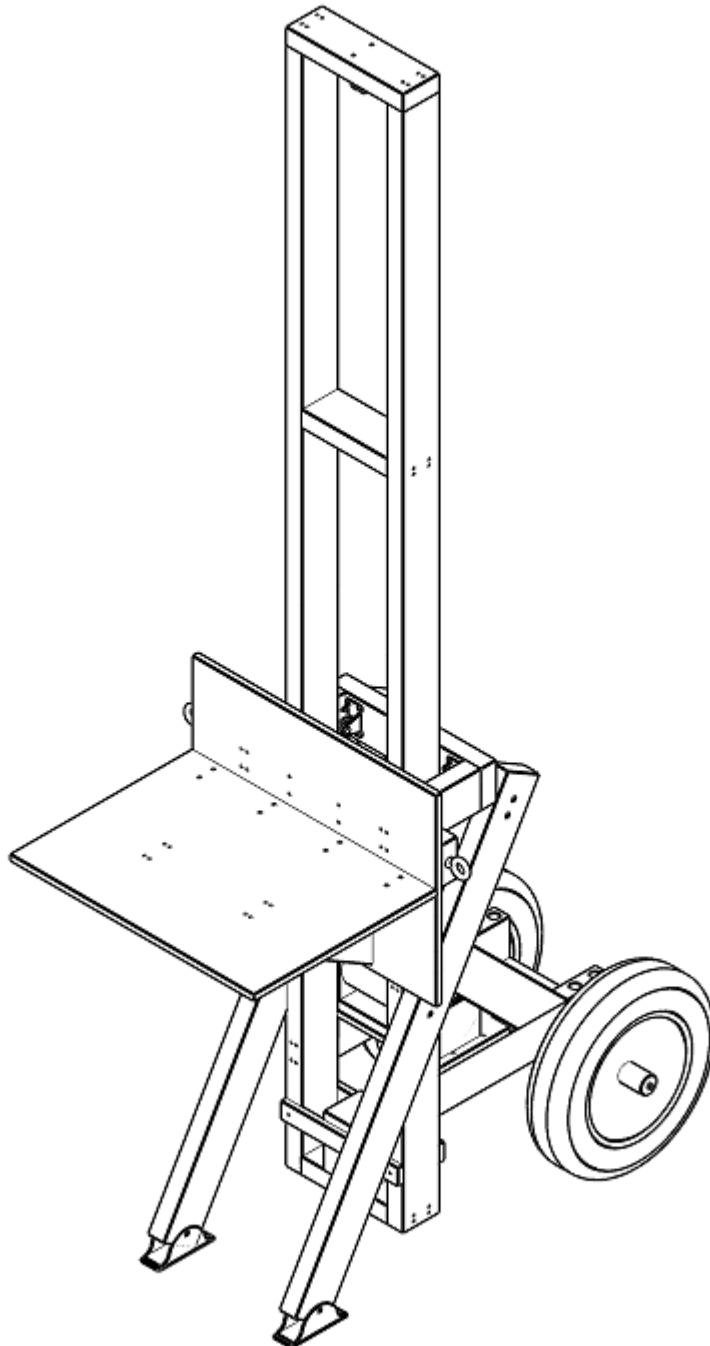
1. Introduction
 2. Supplies Needed
 3. Safety Instructions
 4. Building Instructions
 5. Operating Instructions
 6. Maintenance
 7. FAQs
-

1. Introduction:

What is B.E.E.S.?:

- The Bee Environment Elevation System (B.E.E.S.) is a lifting system designed to help beekeepers easily move swarm traps. This system was created in a way where any beekeeper should be able to purchase all the materials necessary and replicate with simple tools.

Please read all instructions before beginning to cut and build



2. Supplies Needed:

Materials:

- 6- 2x4 8' wood boards, we used pressure treated lumber. Measure all lengths before cutting to ensure you have the right amount of wood.
- 1- 1/2 inch 2' by 4' plywood sheet
- 1- 2-wheel wheelbarrow conversion kit, use the wheels and axles
- 1- 3/8" diameter eye bolt, shank length must be at least 4" and the eye should be large enough to connect to the winch hook, for this specific winch it was 1".
- 4- 2" rigid caster wheels
- 1- electric winch
- 1- atv battery, must be compatible with winch size. we used 12V 12AH battery
- 1- 2 pack of ladder shoes
- 1- pulley 5/16" diameter 7/8" wide
 - If using this specific pulley, may need to acquire a ferrule and to have it crimped to the winch cable after adding the pulley. This can be achieved in most local hardware stores. Alternatively, use a pulley with a removable axle to allow the winch cable to be connected through the pulley.
- 4- corner braces 2.5 inch
- optional: 6.5-inch gate handle

Hardware:

- 56- 5" wood screws
- 32- 1 3/4" wood screws
- 8- 3/8 by 4" bolts
- 16- 1/4-20 3/4 in bolts
- 18- #10-24 bolts
- 2- 5/16-18 bolts
- Corresponding nuts and washers for all bolts listed above

Tools:

- Drill and corresponding bits
- Saw
- Tape measure
- Square
- Pencil
- Sandpaper
- Screwdriver
- Wrench

Note: If you have a similar alternative item, feel free to use what you find best. These instructions are general and designed to be adaptable to your needs.

3. Safety Instructions:**General Precautions:**

- Use proper safety precautions and equipment while using power tools.
- Follow manufacturer safety instructions on electric winch and battery.
- Inspect product for damage before each use.
- Do not use the product if it is damaged.
- Make sure to choose wood that is not split, warped or twisted.
- Ensure all hardware is compliant with chosen materials.

Operating Safeguards:

- Keep hands away from the platform while moving.
- Do not hold onto uprights while operating the winch.
- Remain behind the platform while operating the winch.
- Do not raise the platform above 7'.

4. Building Instructions:

Cutting and Drilling:

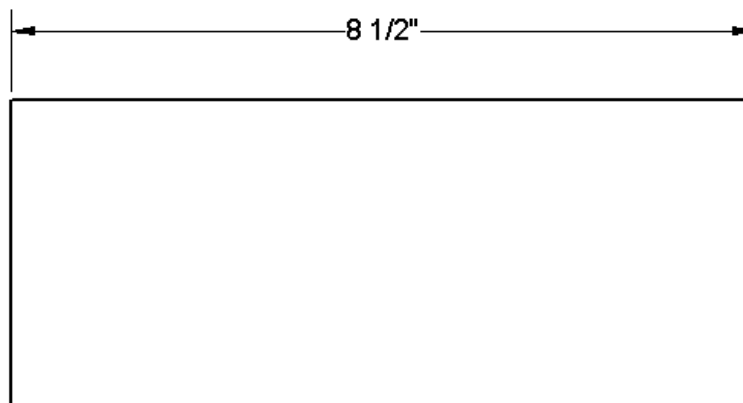
- Cut the 2x4s into the following sizes:
 - 3- 8.5" (upright bracing) [A]
 - 2- 96" (8 feet) (upright) [B]
 - 1- 11.5" (top bracing) [C]
 - 2- 17" (wheel connector) [D]
 - 2- 18" (back bracing) [E]
 - 1- 24" (lift anchor bracing) [F]
 - 2- 7" (caster support side) [G]
 - 1- 14.75" (caster support back) [H]
 - 2- 18" (platform bracing) [I]
 - 2- 42" (stabilizer) [J]
 - 1- 11.5" (wheel mounting block) [K]
- Cut the plywood sheet to the following dimensions:
 - 2- 18" x 24" (lift platform back and lift platform) [L & M]
 - 1- 10" x 11.5" (winch platform) [N]
 - 2- 1.5" x 11.5" (battery supports) [O]

Piece by Piece cutting and drilling:

Note: Given dimensions are precise. Lengths and caster hole spacings are critical. Predrilled hole dimensions are not critical but are dimensioned for even spacing, not the function of the device.

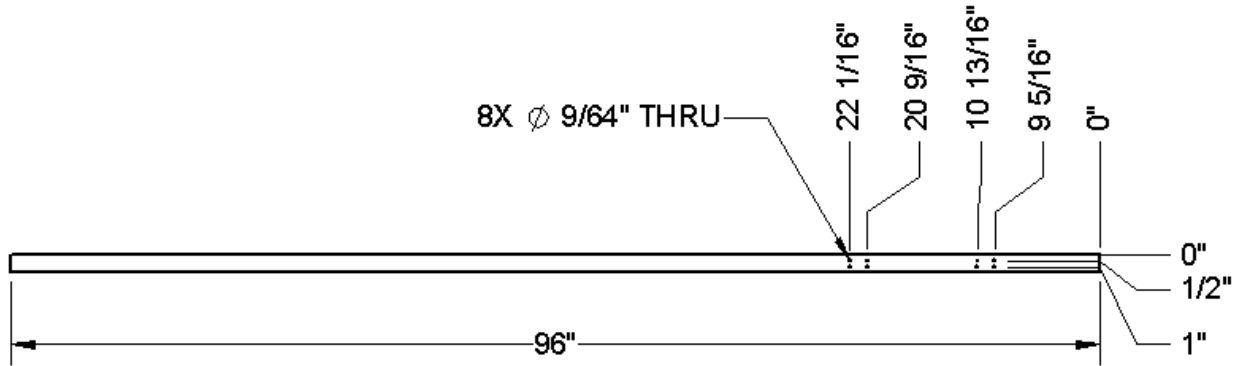
A- Upright Bracing

Cut three 2x4" to 8.5" long.

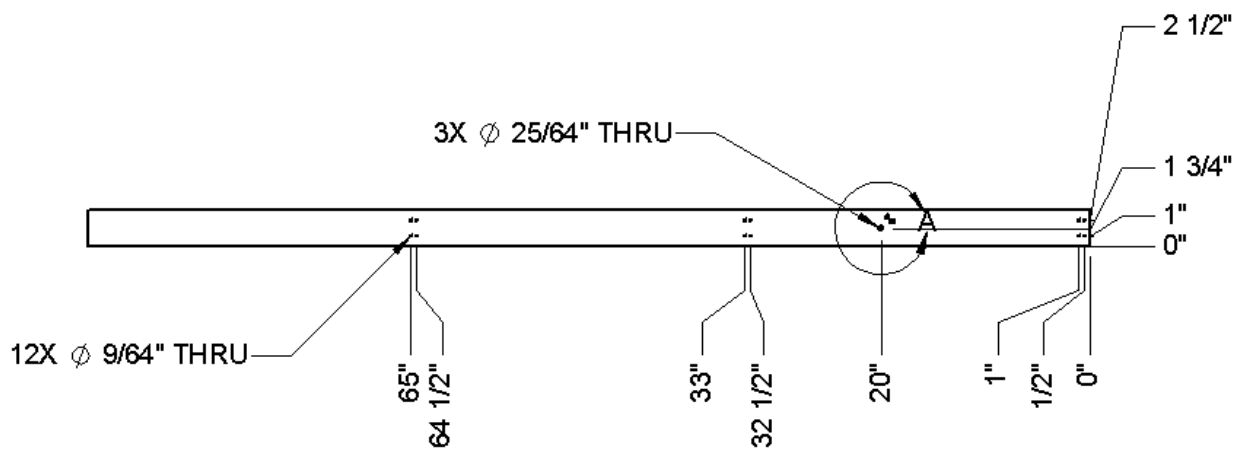


B- Uprights

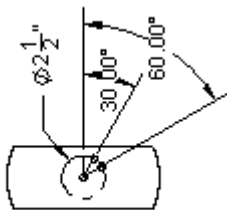
Set two 2x4" aside. Pre-drill 3x 25/64" holes through and 20x 9/64" holes through.



Top View



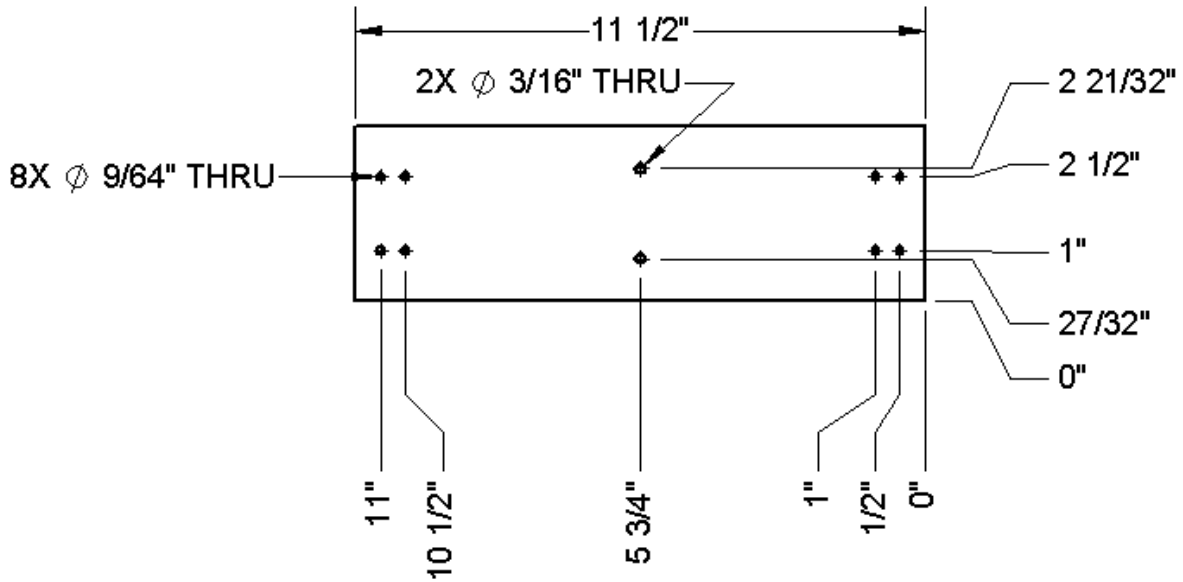
Front View



Detail View of circled portion above

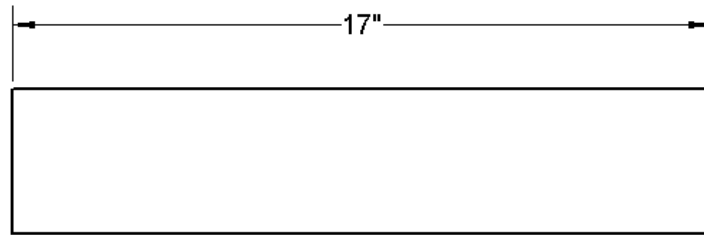
C- Top Bracing

Cut one 2x4" to 11.5" long. Pre-drill 8x 9/64" holes through and 2x 3/16" holes through. The 3/16" holes' locations and sizes may differ based on pulley used.

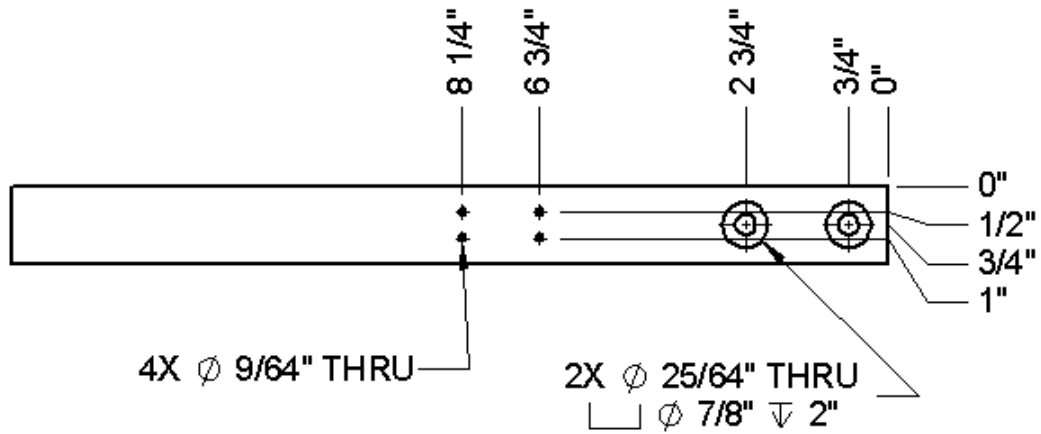


D- Wheel Connector

Cut two 2x4" to 17" long. Pre-drill 2x 25/64" through with 2" deep 7/8" counterbore. (Alternative: find a 6" bolt or other way of attaching to avoid drilling a counterbore.) Pre-drill 4x 9/64" holes through.



Front View



Top View

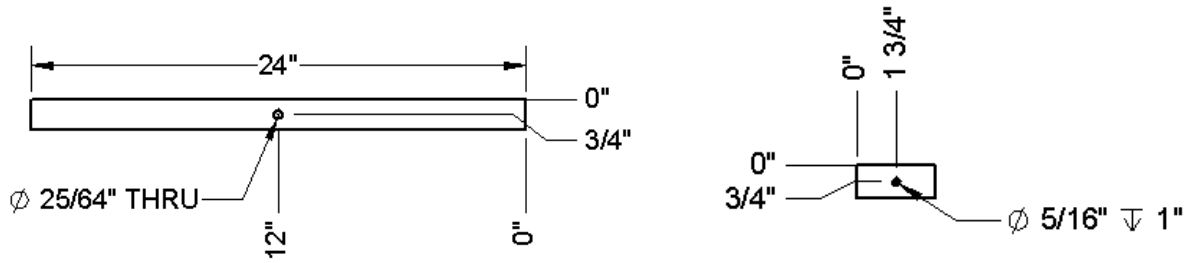
E- Back Bracing

Cut two 2x4" to 18" long. Cut a 45° angle on opposite ends in opposite directions.



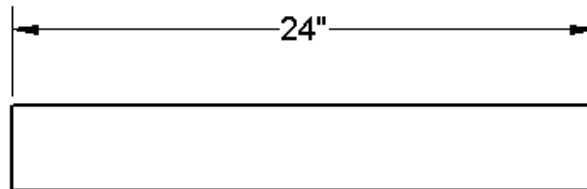
F- Lift anchor bracing

Cut 2x4" to 24" long. Pre-drill 1x 25/64" hole through the top view. Pre-drill 2x 5/16" about 1" deep, one on each side view. All three holes may differ based on eye bolts and eye screws used.



Top View

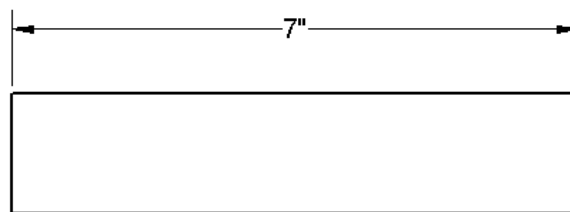
Side View



Front View

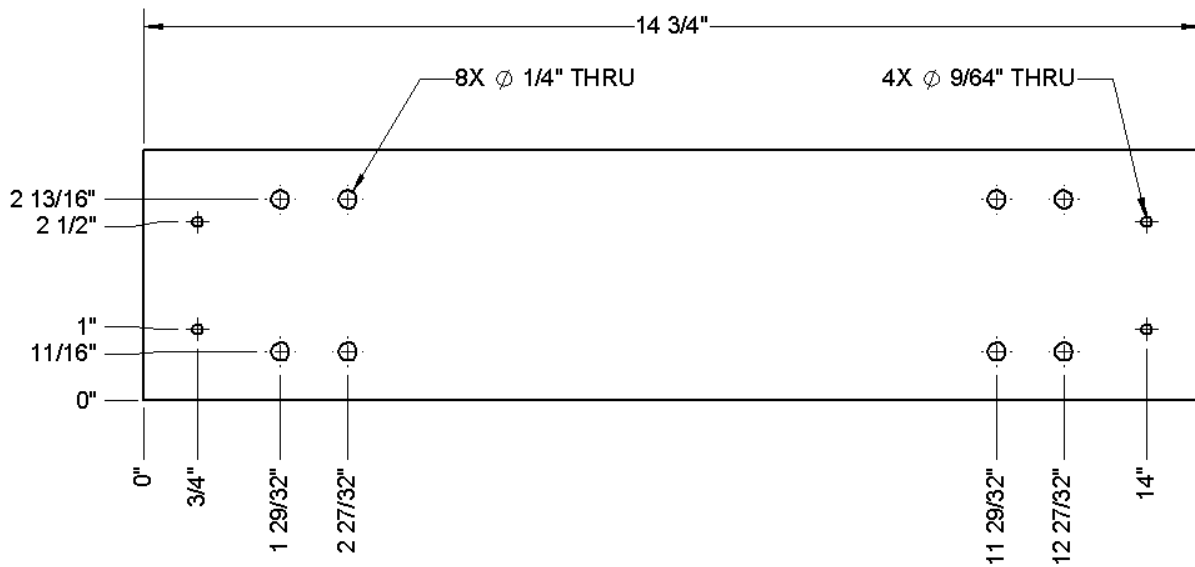
G- Caster Support Side

Cut two 2x4" to 7" long.



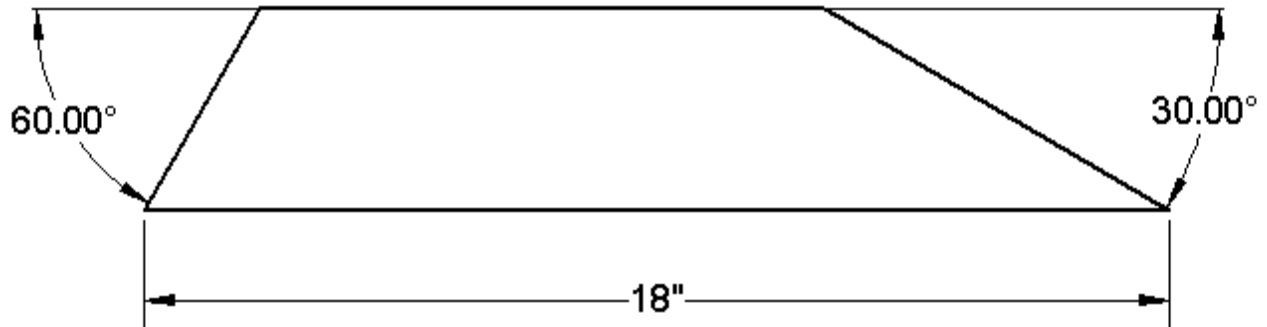
H-Caster Support Back

Cut one 2x4" to 14.75" long. Pre-drill 8x 1/4" holes through and 4x 9/64" holes through. The 1/4" holes' locations and sizes may differ based on casters used.



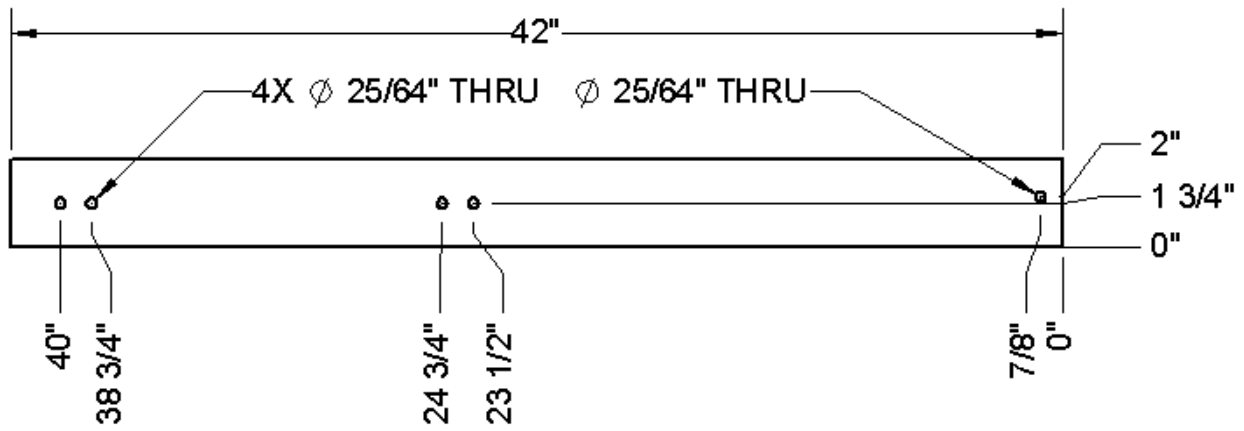
I- Platform Bracing

Cut two 2x4" to 18" long. Cut a 30° angle on one end and a 60° angle on the opposite end in opposite directions.



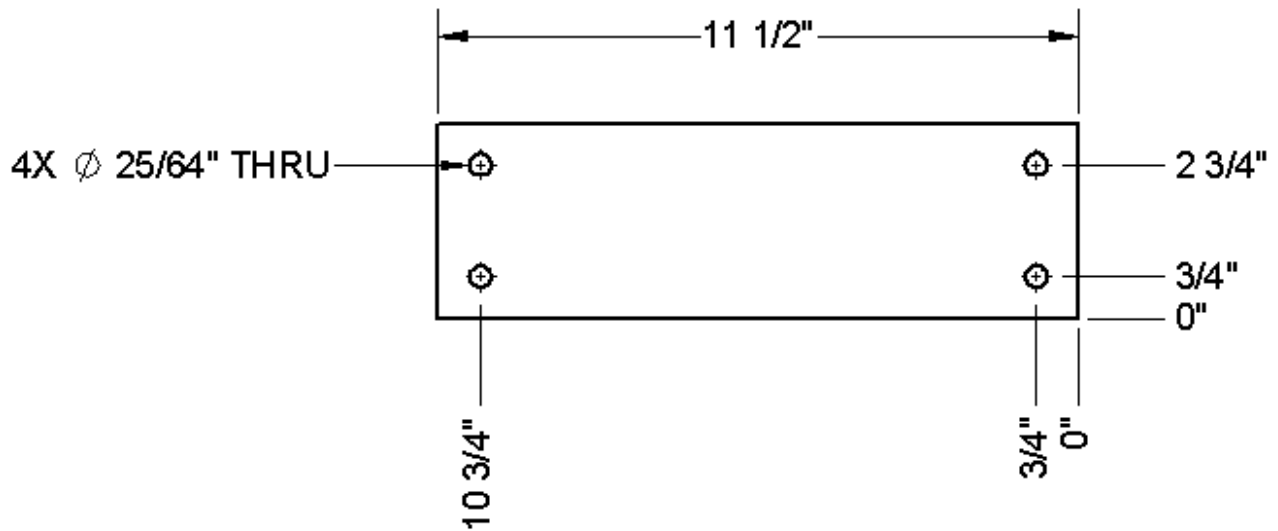
J- Stabilizers

Cut two 2x4" to 42" long. Pre-drill 5x 25/64" holes through.



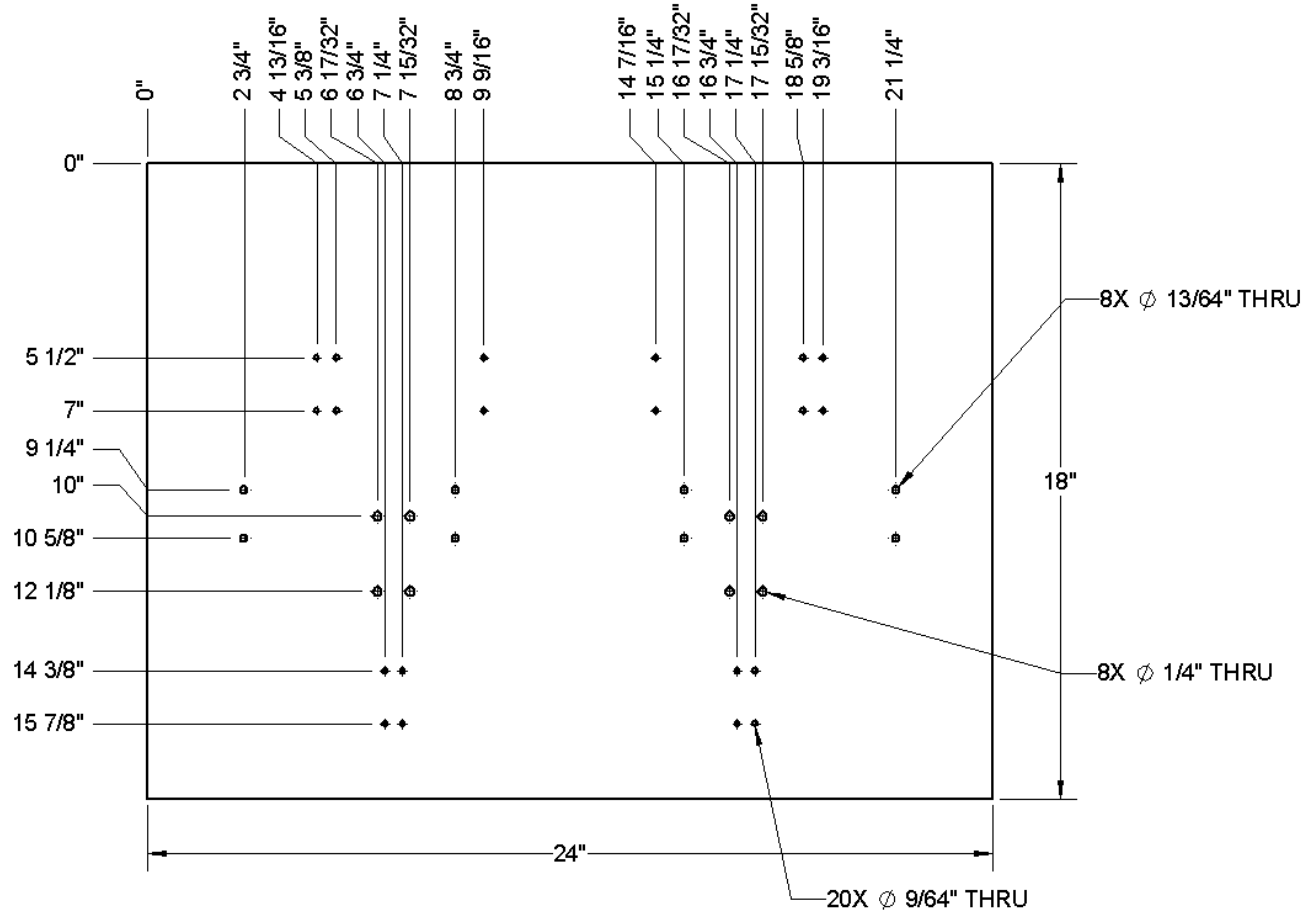
K- Wheel Mounting Block

Cut one 2x4" to 11.5" long. Pre-drill 4x 3/8" holes.



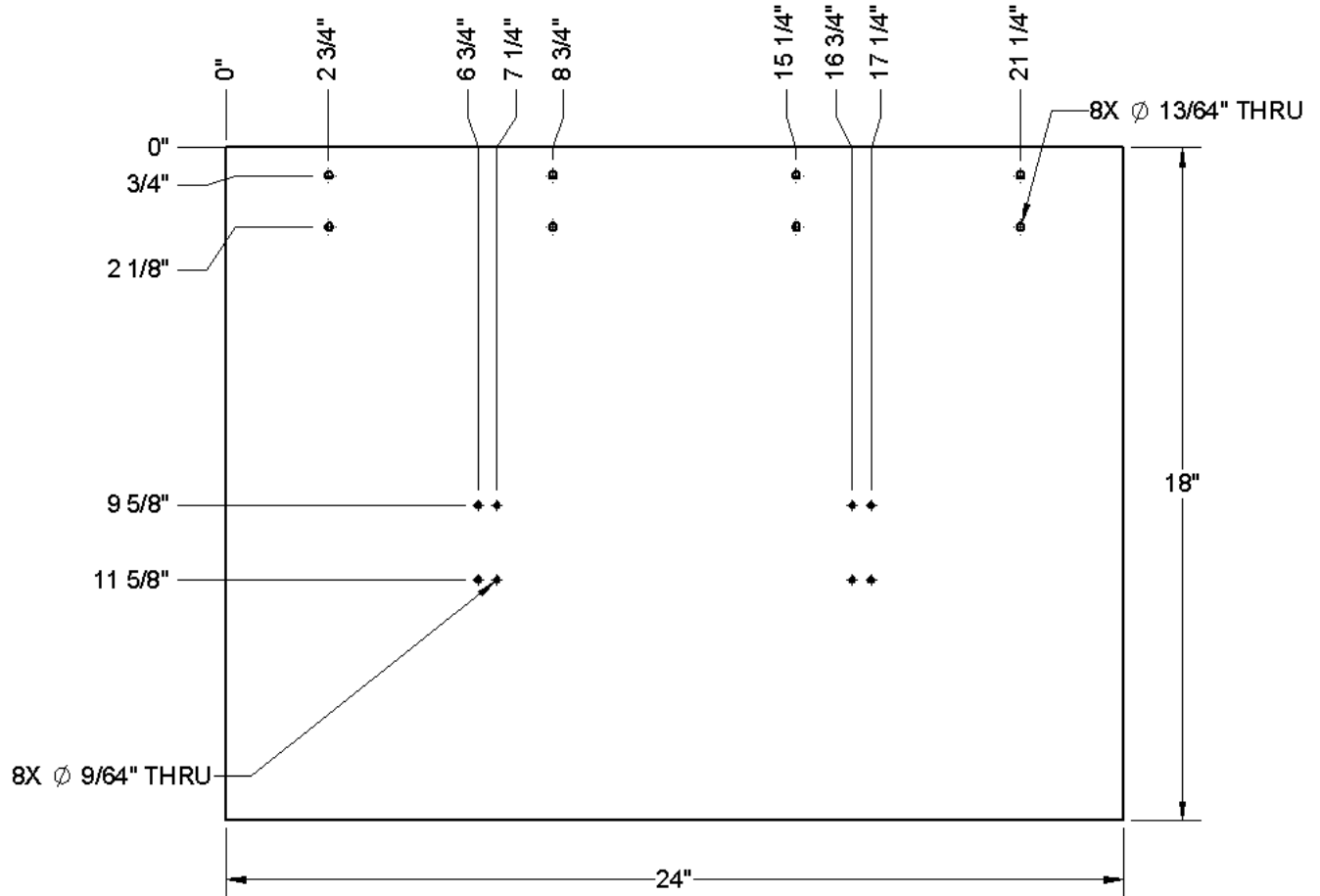
L- Lift Platform Back

Cut the plywood to 18x24". Pre-drill 8x 1/4" holes through, 20x 9/64" through, and 8x 13/64" holes through. The 13/64" holes' locations and sizes may differ based on corner brackets used. The 1/4" holes' locations and sizes may differ based on casters used.



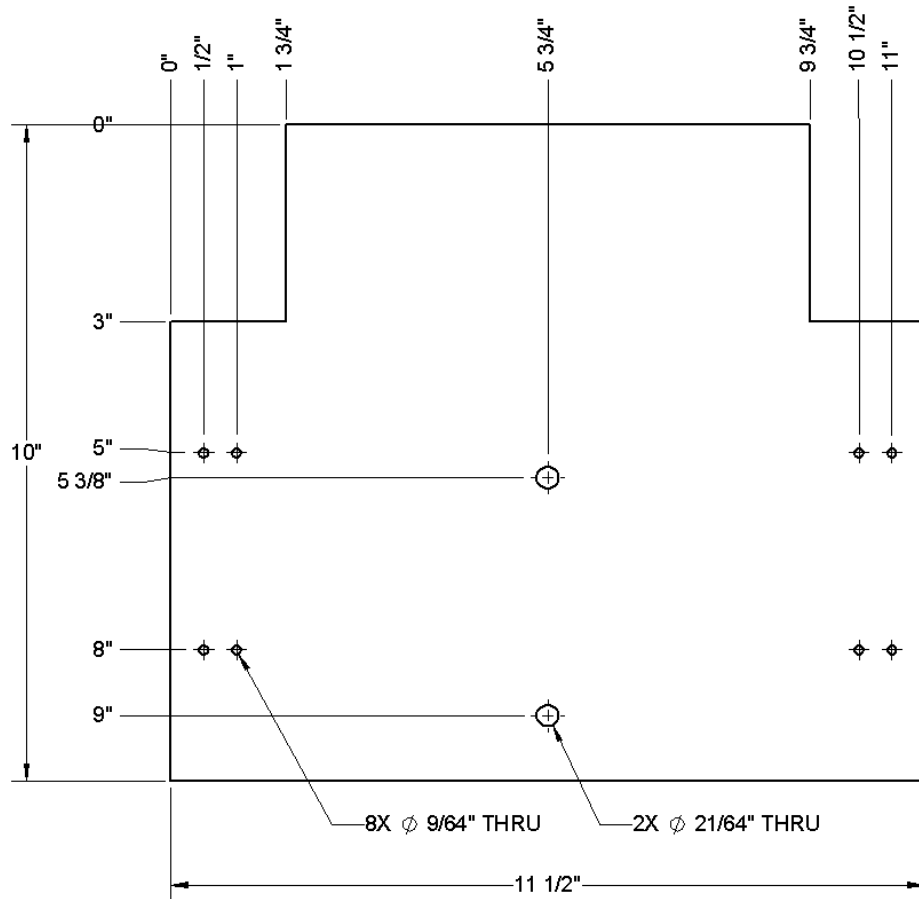
M- Lift Platform

Cut the plywood to 18x24". Pre- drill 8x 9/64" holes through and 8x 13/64" holes through. The 13/64" holes' locations and sizes may differ based on corner brackets used.



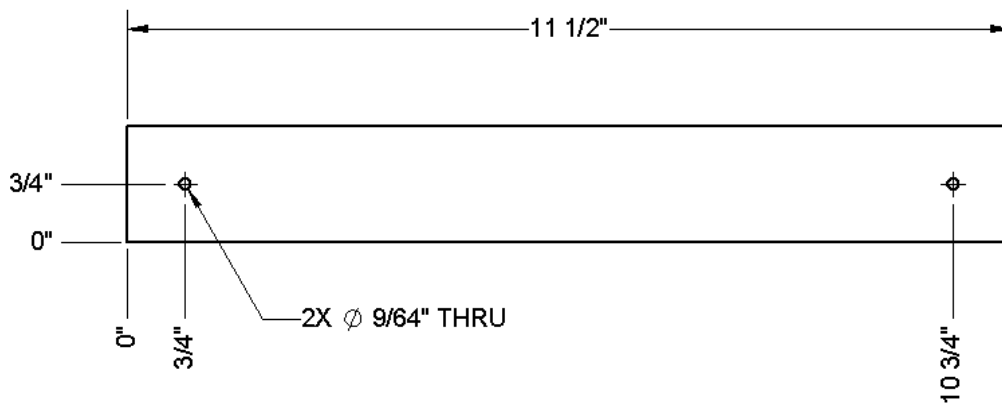
N- Winch Platform

Cut the plywood to 10x11.5". Cut out two 3" by 1.75" rectangles from the corner of the wood to form a T shape. The 3" should be marked from the 10" side of the board and the 1.75" from the 11.5" side of the board. Pre-drill 8x 9/64" holes through and 2x 21/64" holes through. The 21/64" holes' count, locations and sizes may differ based on winch used.



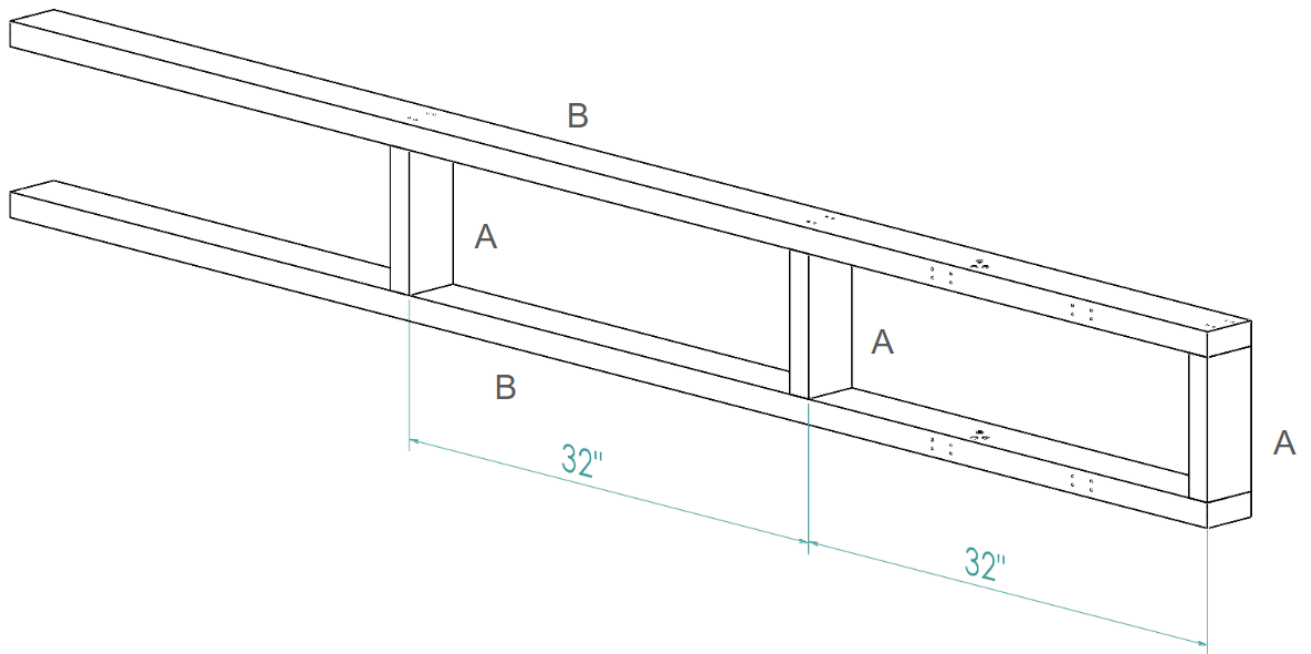
O- Battery Supports

Cut excess plywood into 2x 1.5'x11.5" strips. Pre-drill 2x 9/64" through. These pieces are used for securing the battery.

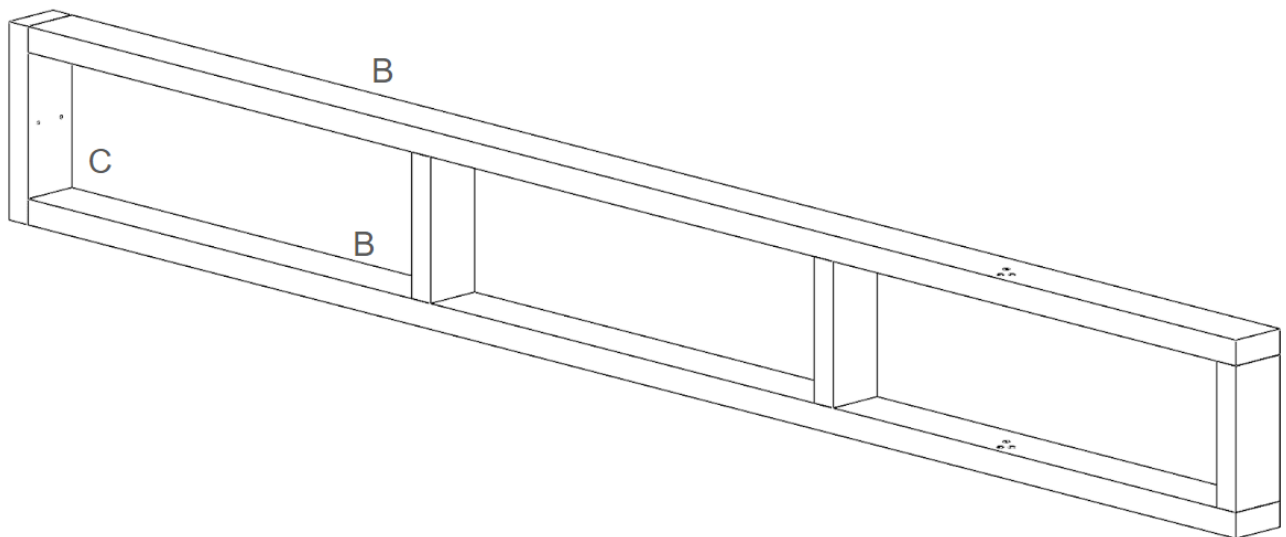


Assembling:

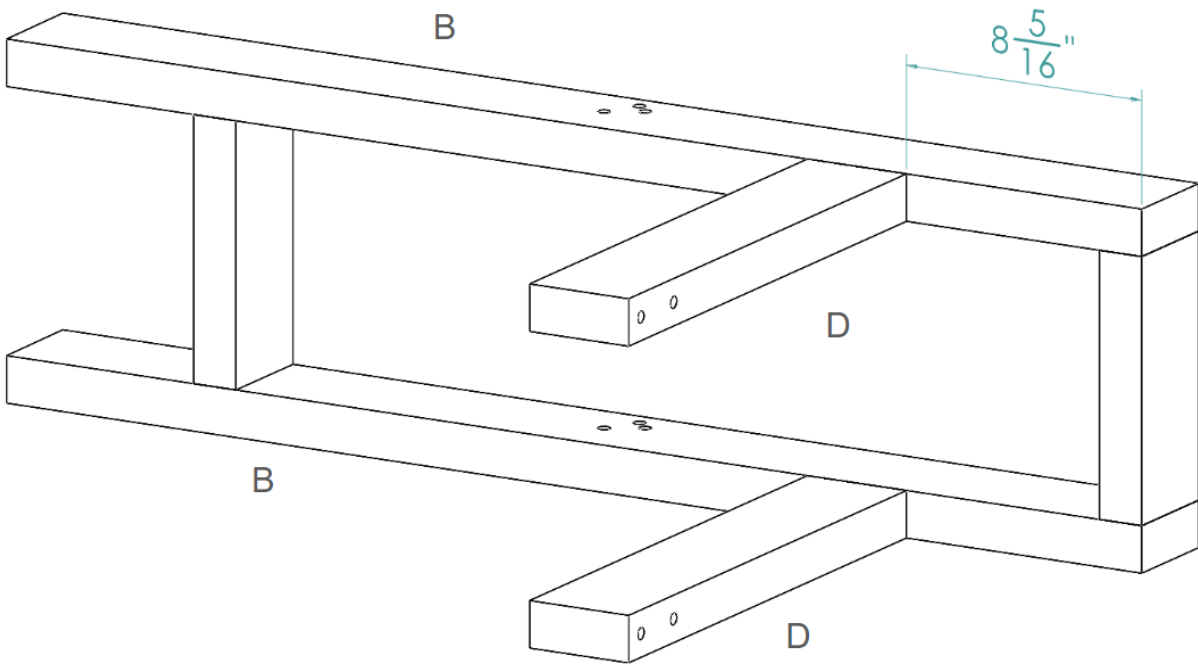
- Screw upright bracings [A] into uprights [B] with 5" wood screws.



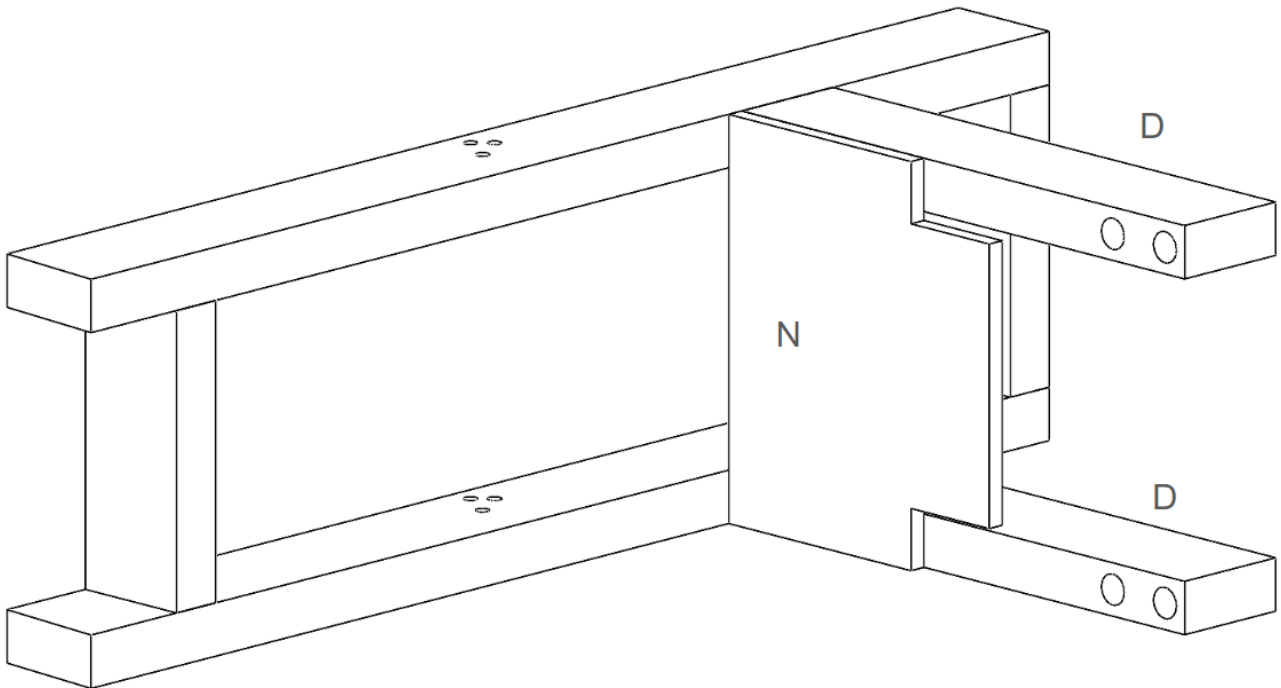
- Screw top bracing [C] on top of uprights [B] with 5" wood screws.



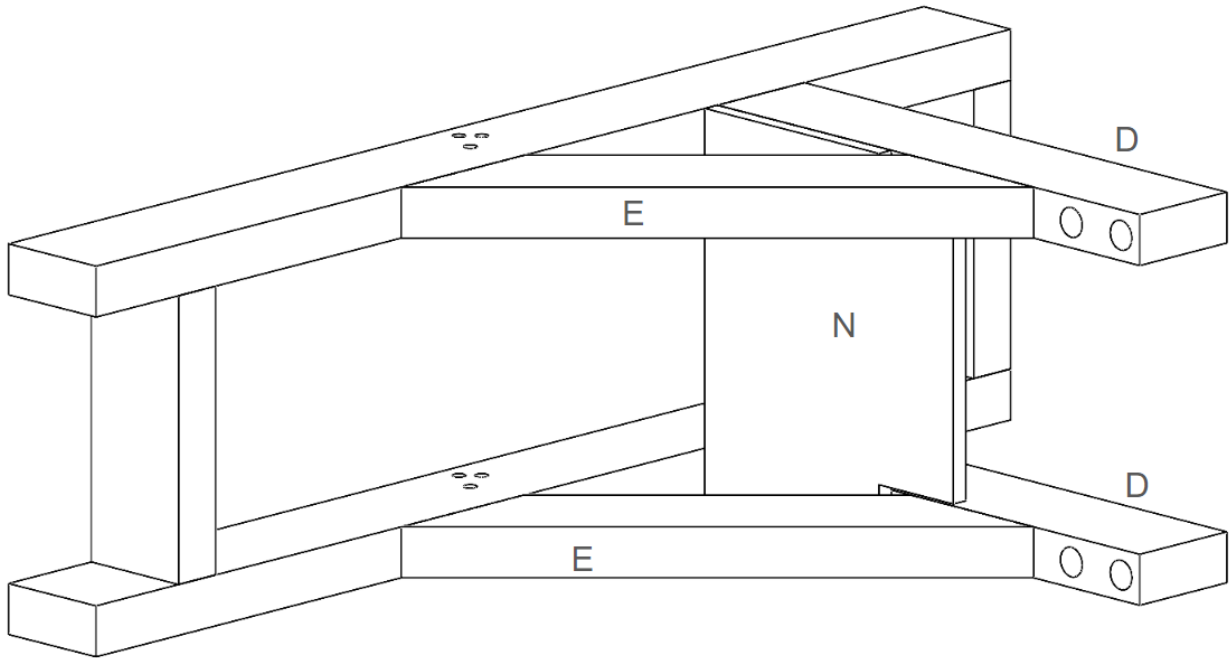
- Screw the wheel connectors [D] to the uprights [B] with 5" wood screws.



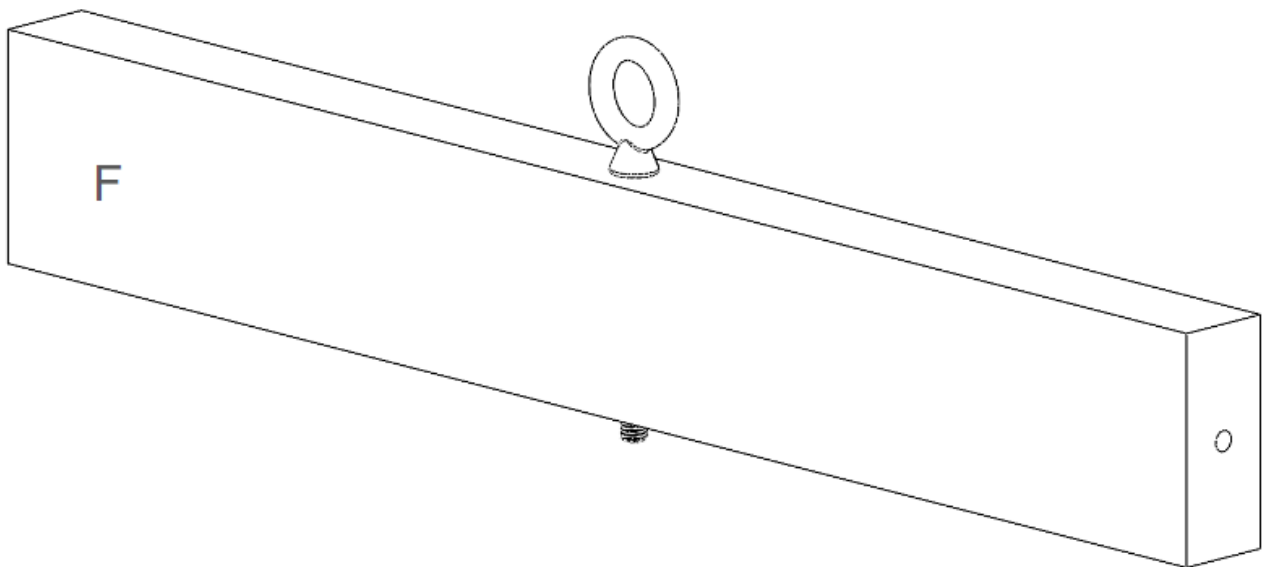
- Screw the winch platform [N] to wheel connectors [D] with $1 \frac{3}{4}$ " wood screws.



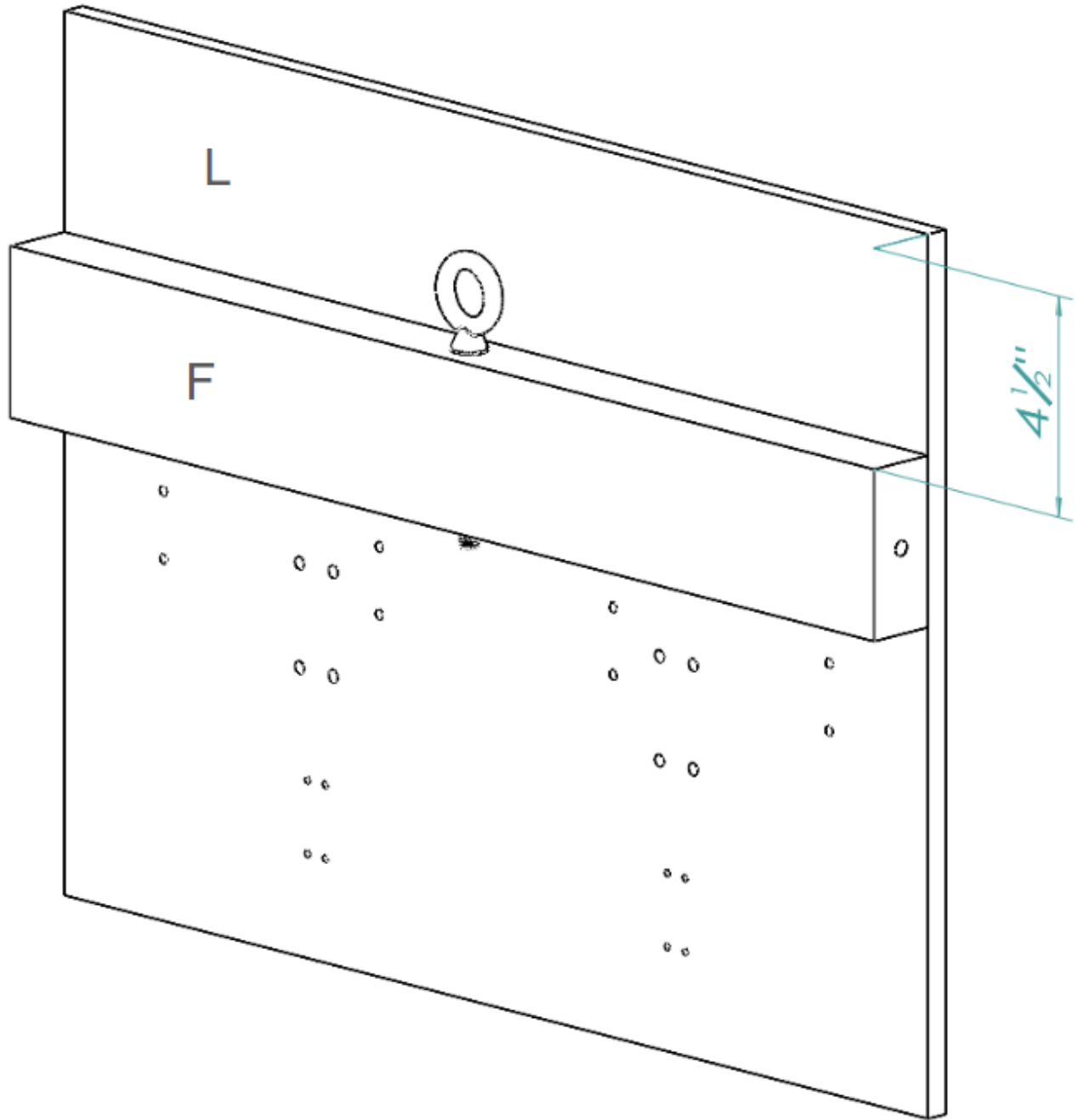
- Attach back bracing [E] to wheel connectors [D] and uprights [B] with 5" wood screws.



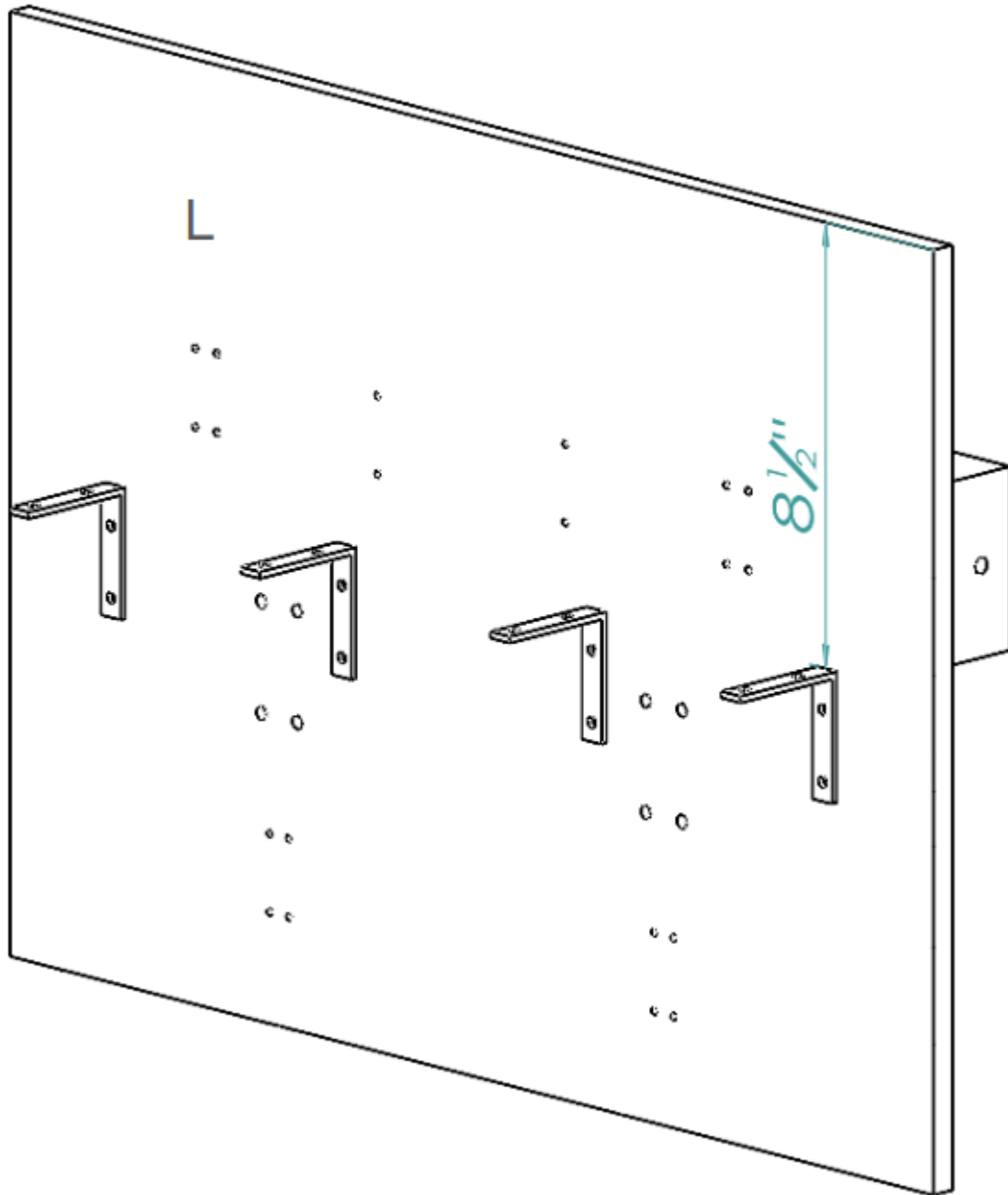
- Add the eye bolt to lift anchor bracing [F]. We used extra washers and spacers based on the size of our eyebolt.



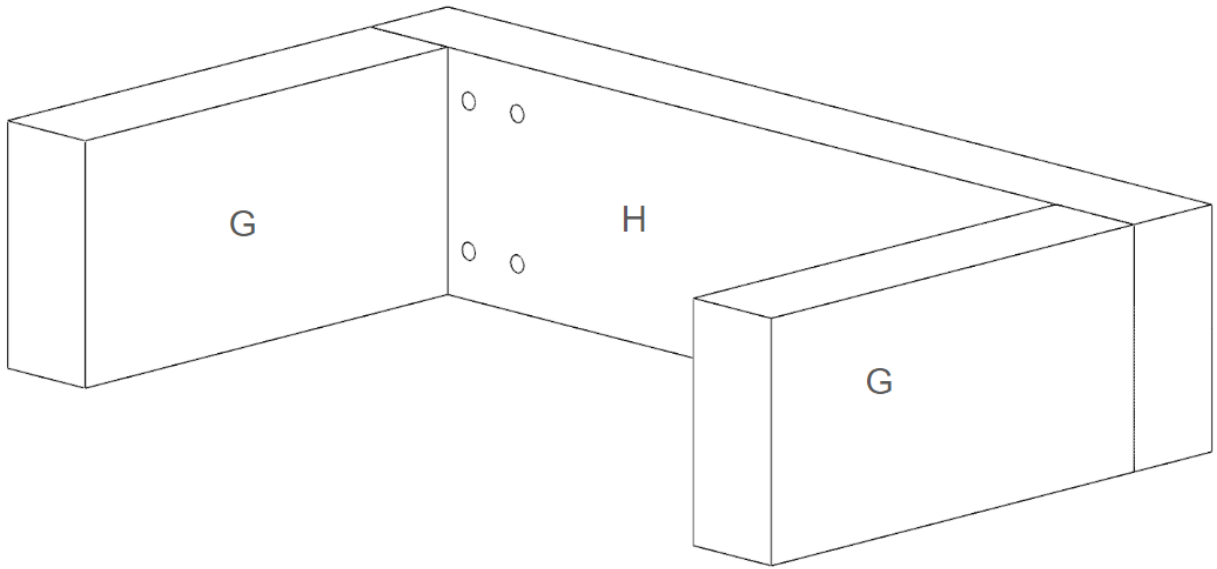
- Attach lift anchor bracing [F] into lift platform back [L] with 1 $\frac{3}{4}$ " wood screws.



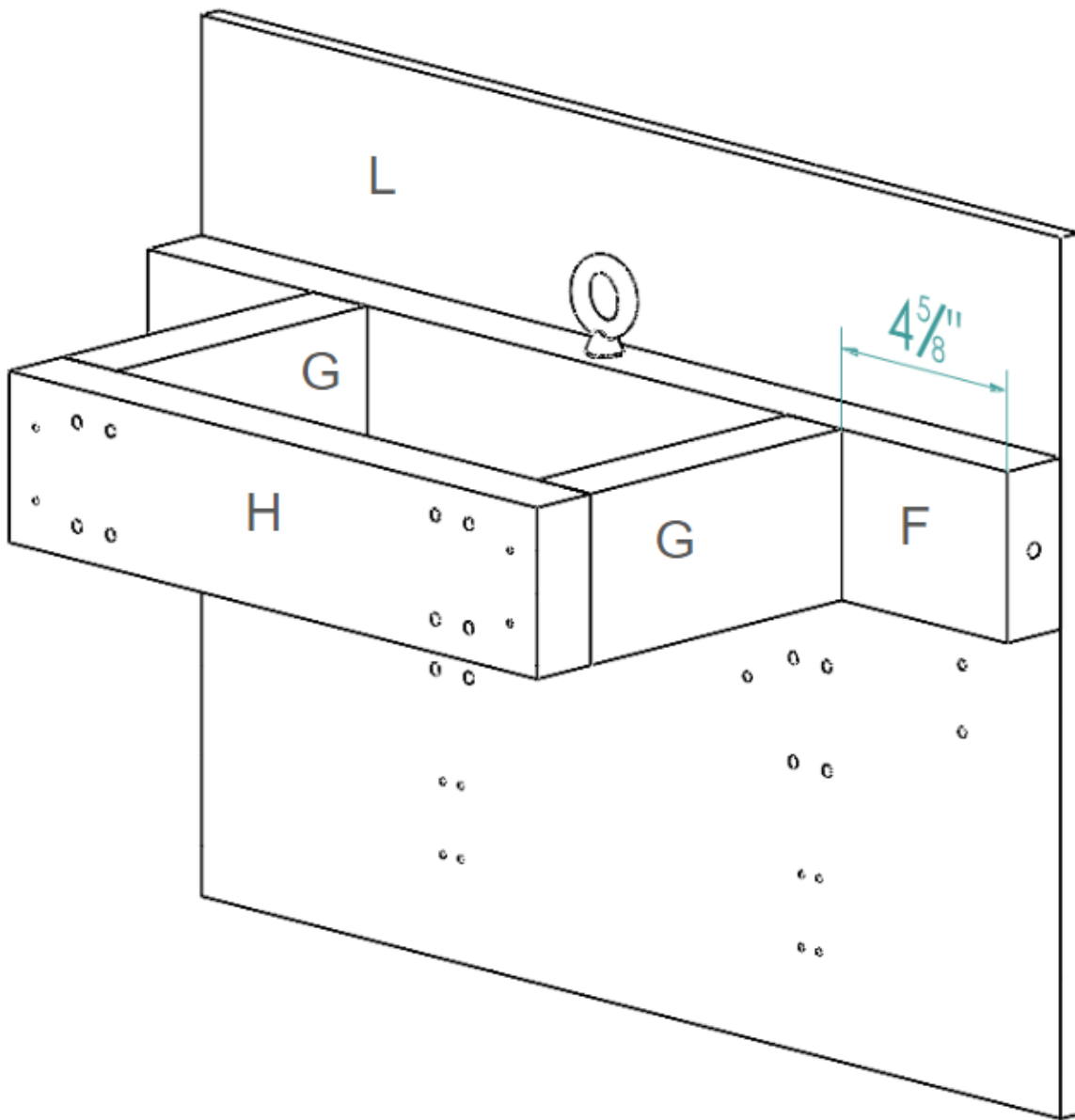
- Use corner braces to connect the lift platform back [L] and the lift platform [M] with #10-24 bolts.



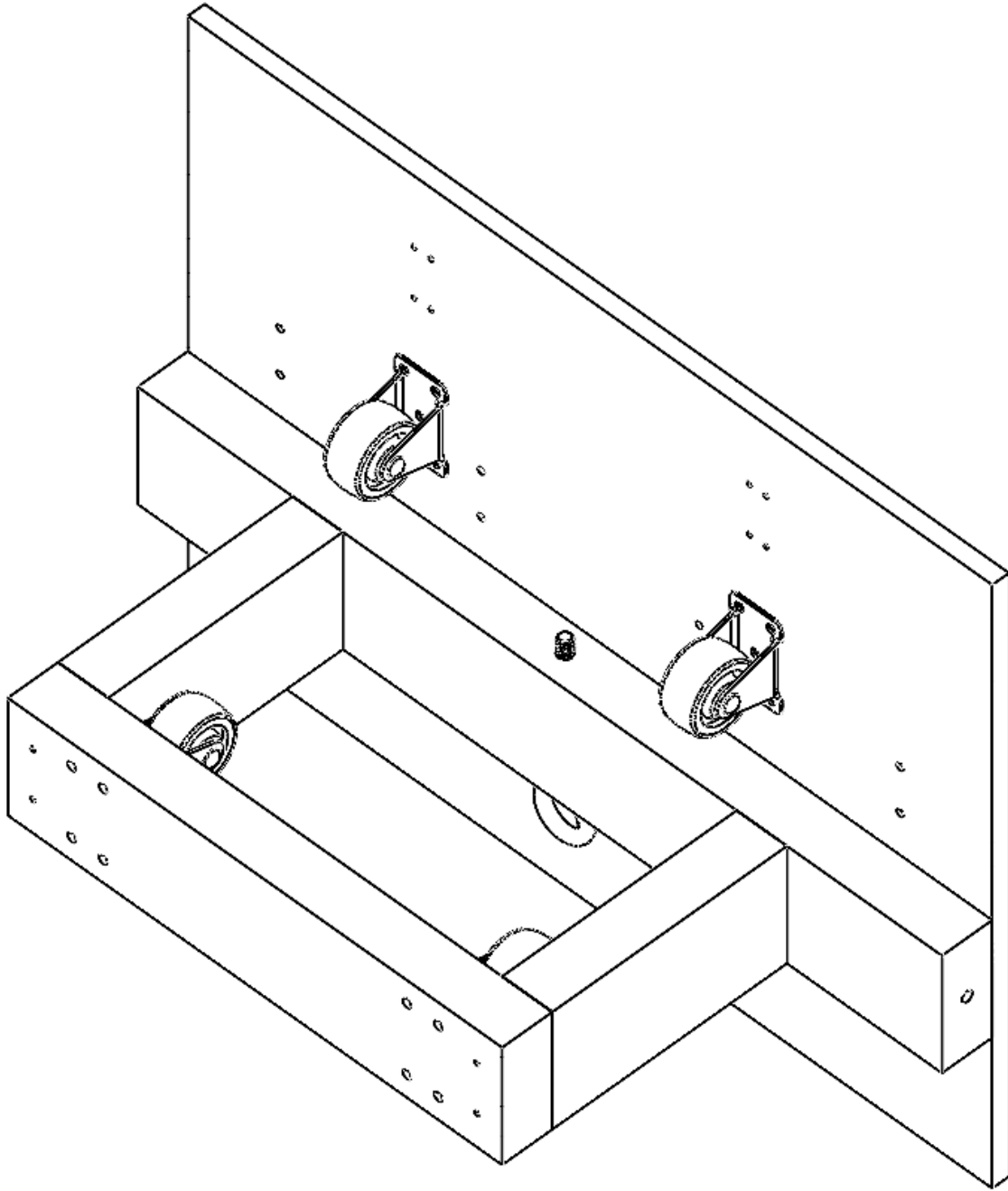
- Attach caster support sides [G] to caster support back [H] with 5" wood screws.



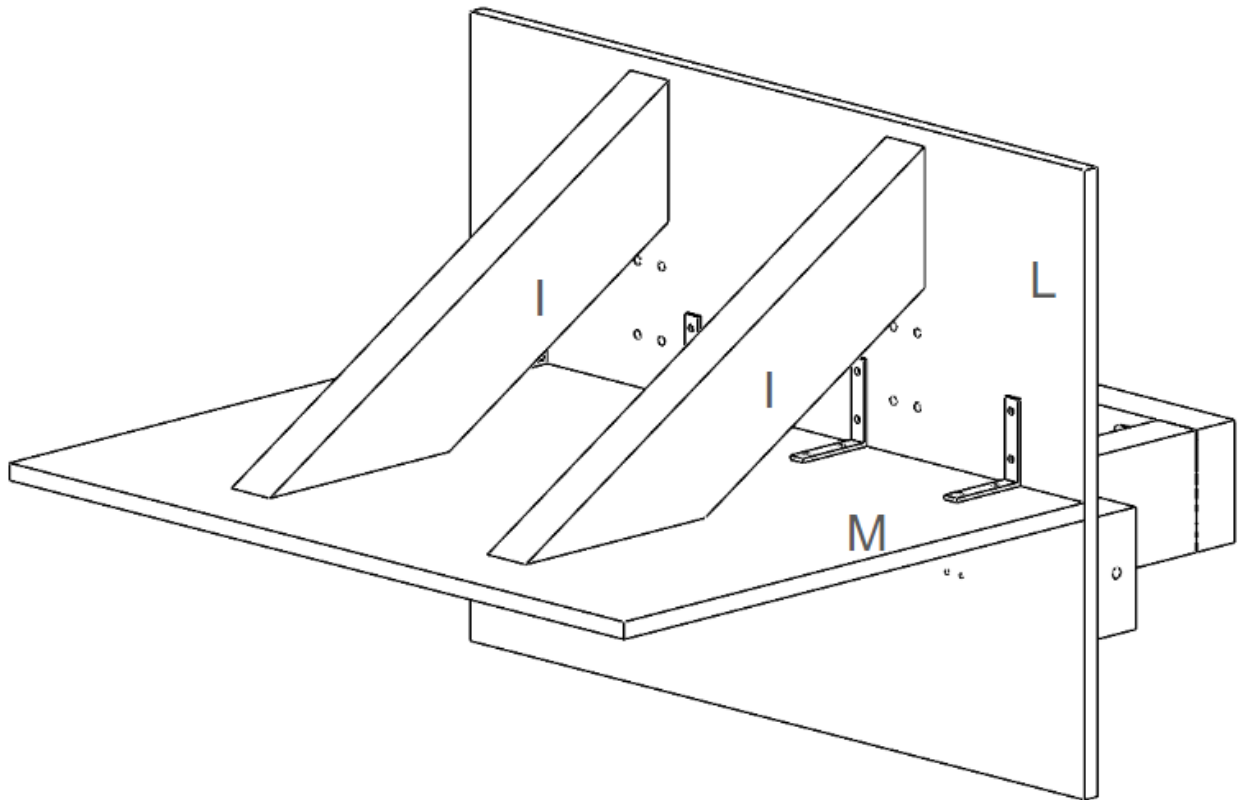
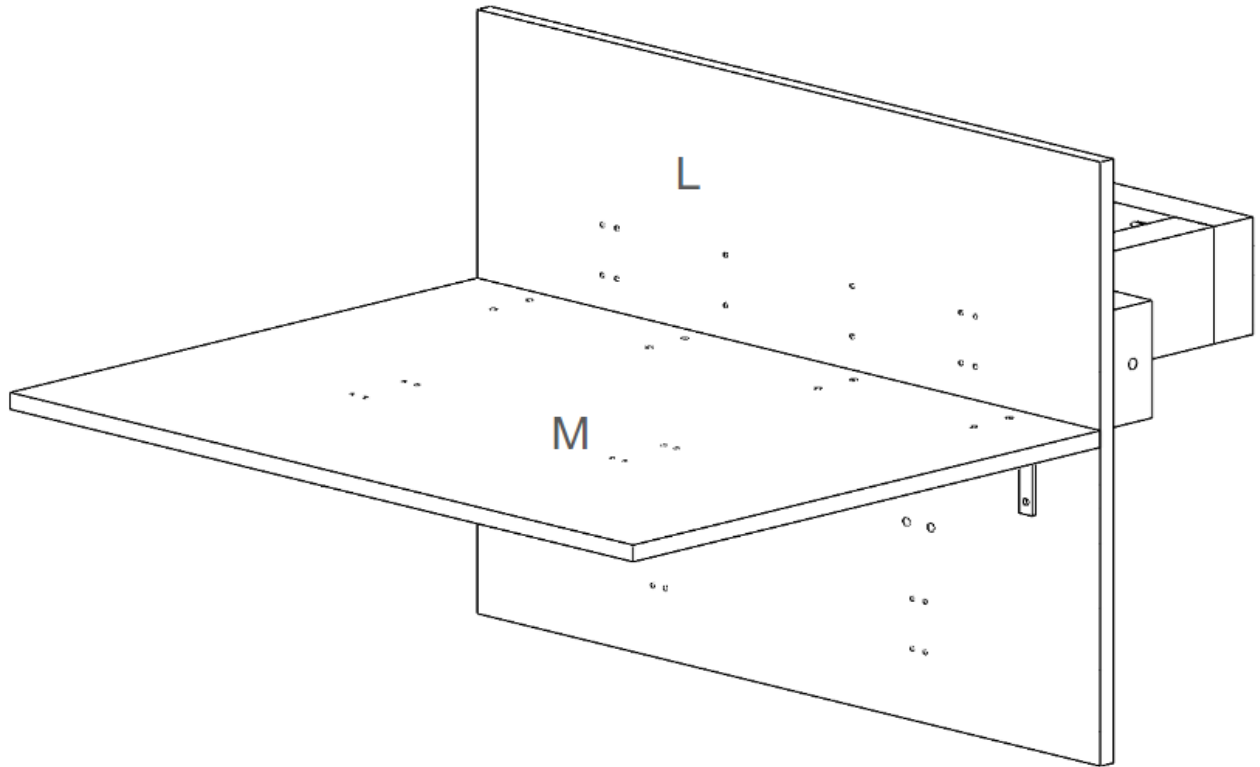
- Attach caster support sides [G] into lift anchor bracing [F] through the front of the lift platform back [L] with 5" wood screws.



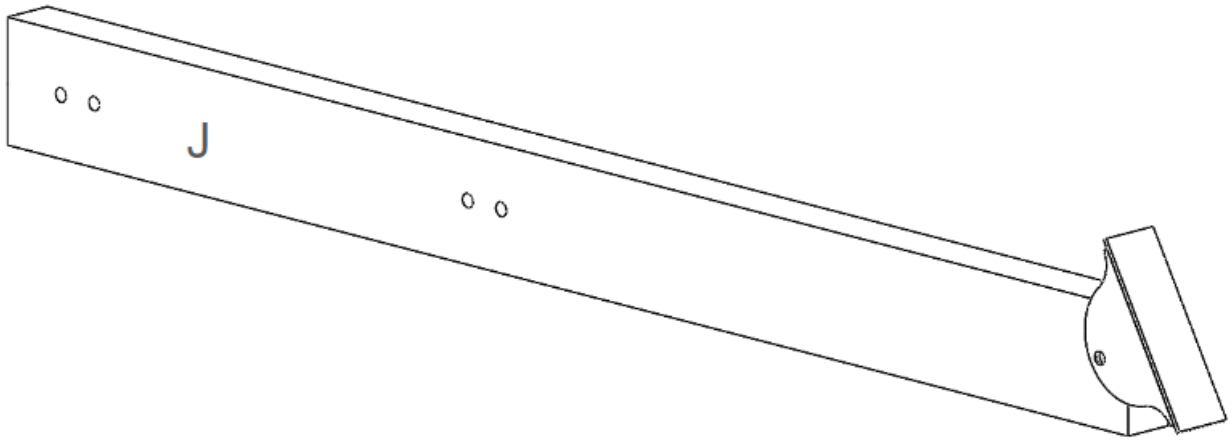
- Attach casters to lift platform back [L] and caster support back [H] with ¼-20 bolts.



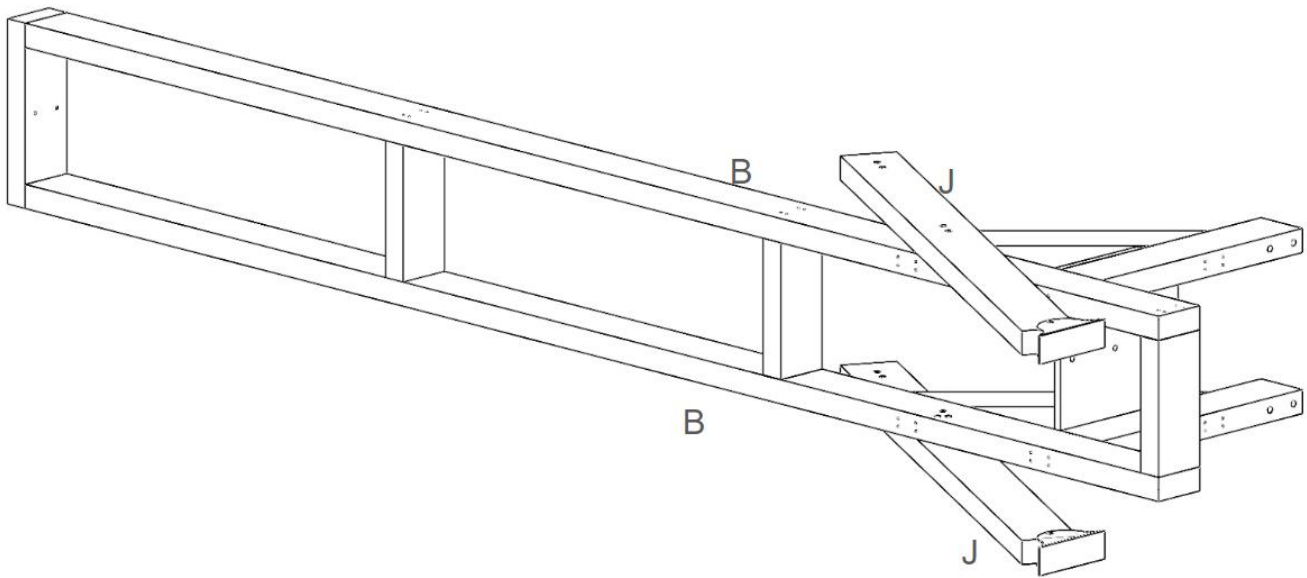
- Attach lift platform [M] to the corner bracings with #10-24 bolts, then attach platform bracings [I] to lift platform [M] and lift platform back [L] with 1 3/4" wood screws.



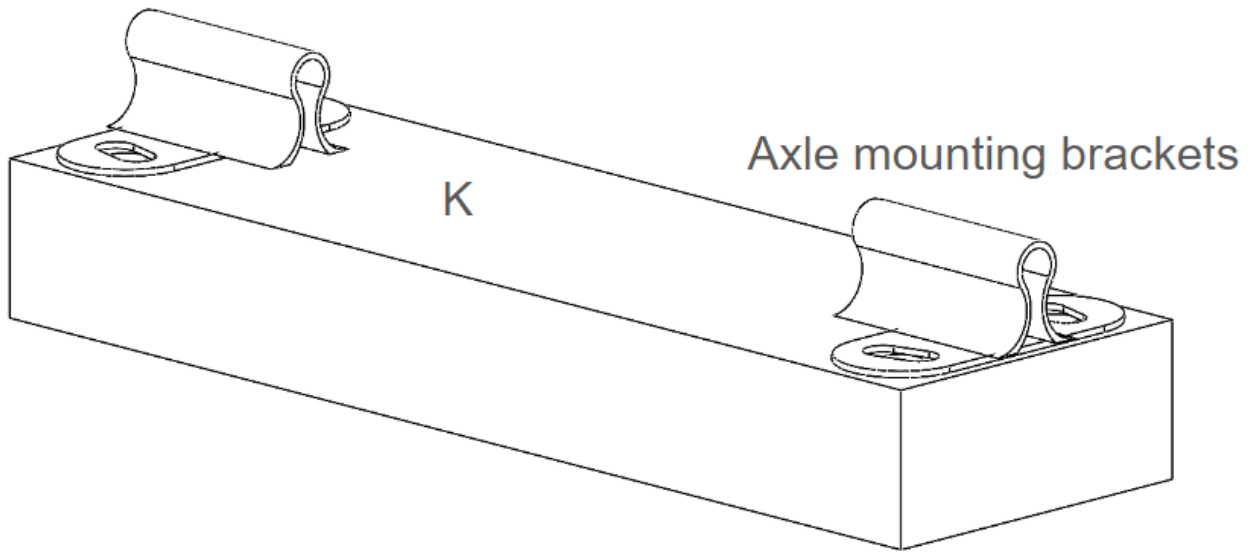
- Add ladder feet to stabilizers [J]. Follow instructions in the kit.



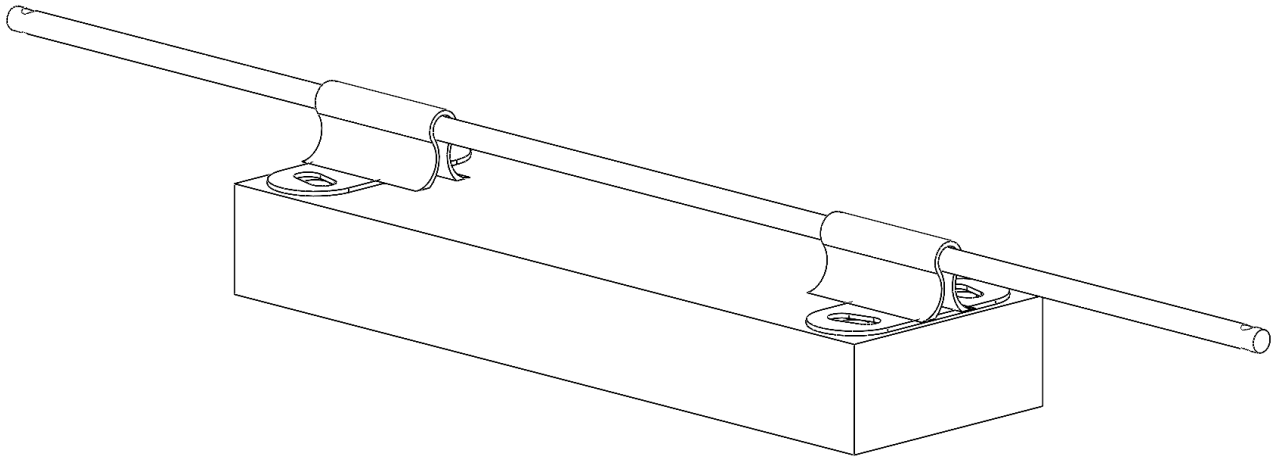
- Bolt stabilizers [J] into the uprights [B] with $\frac{3}{8}$ " bolts.



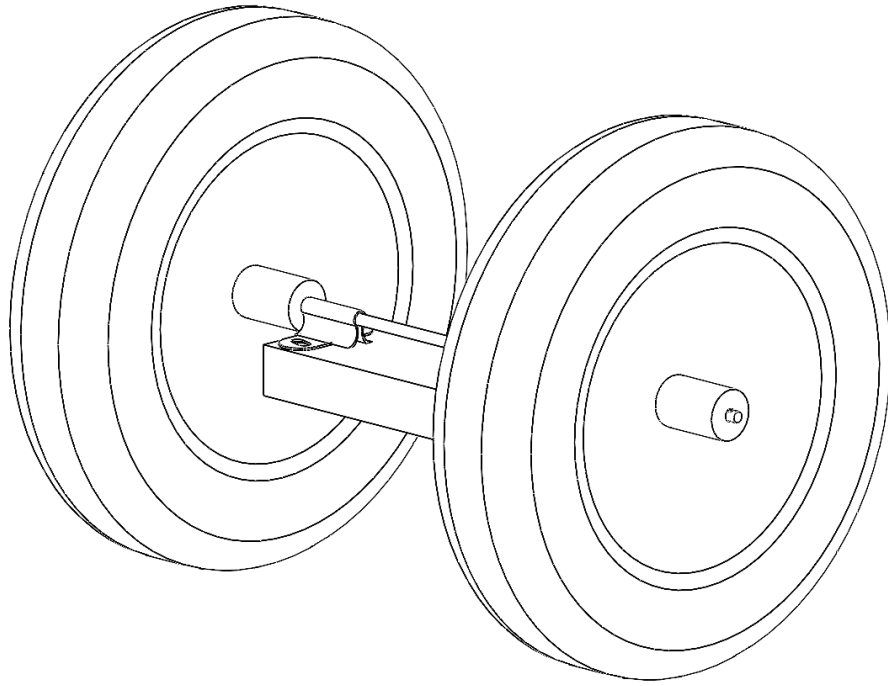
- Bolt together the wheel connectors [D], the wheel mounting block [K], and the axle mounting brackets together with $\frac{3}{8}$ " bolts.

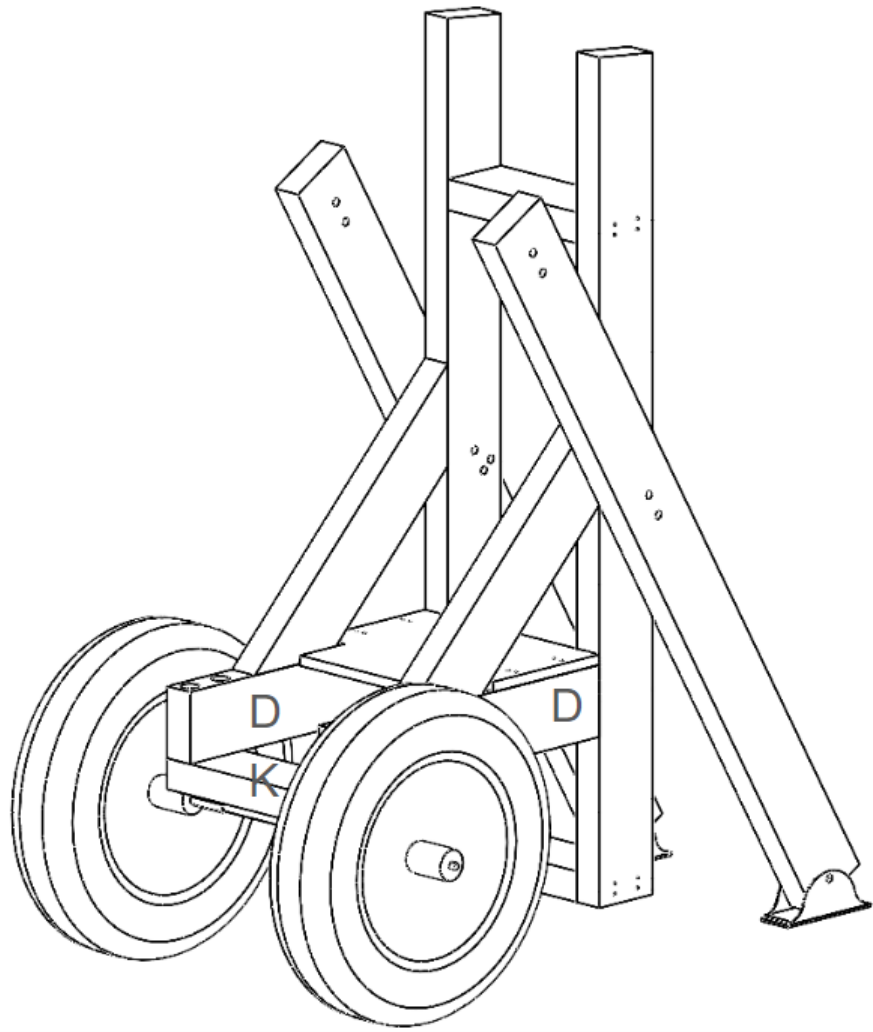


- Put the axle through the brackets.

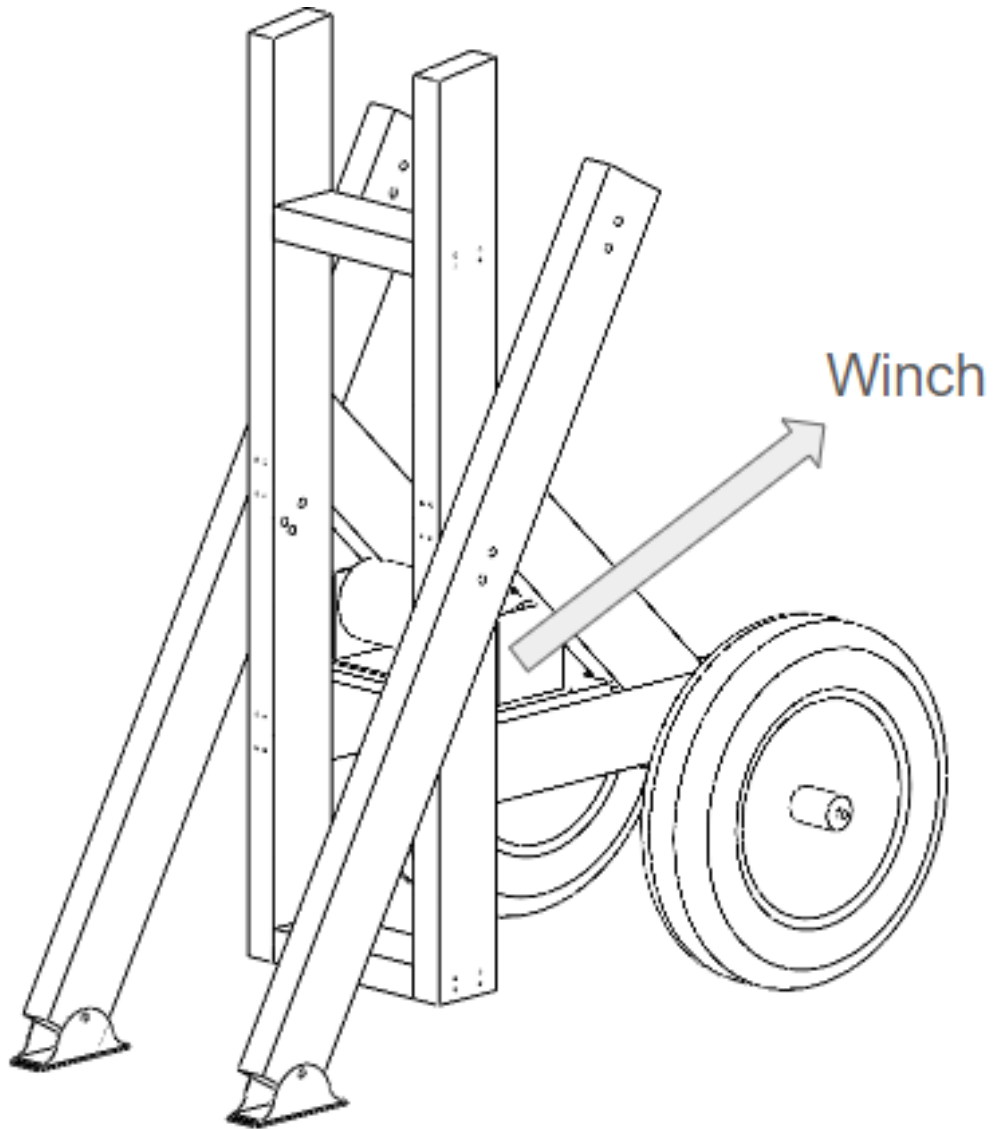


- Add the wheels on each end. Secure the cotter pins around the ends of the axle.

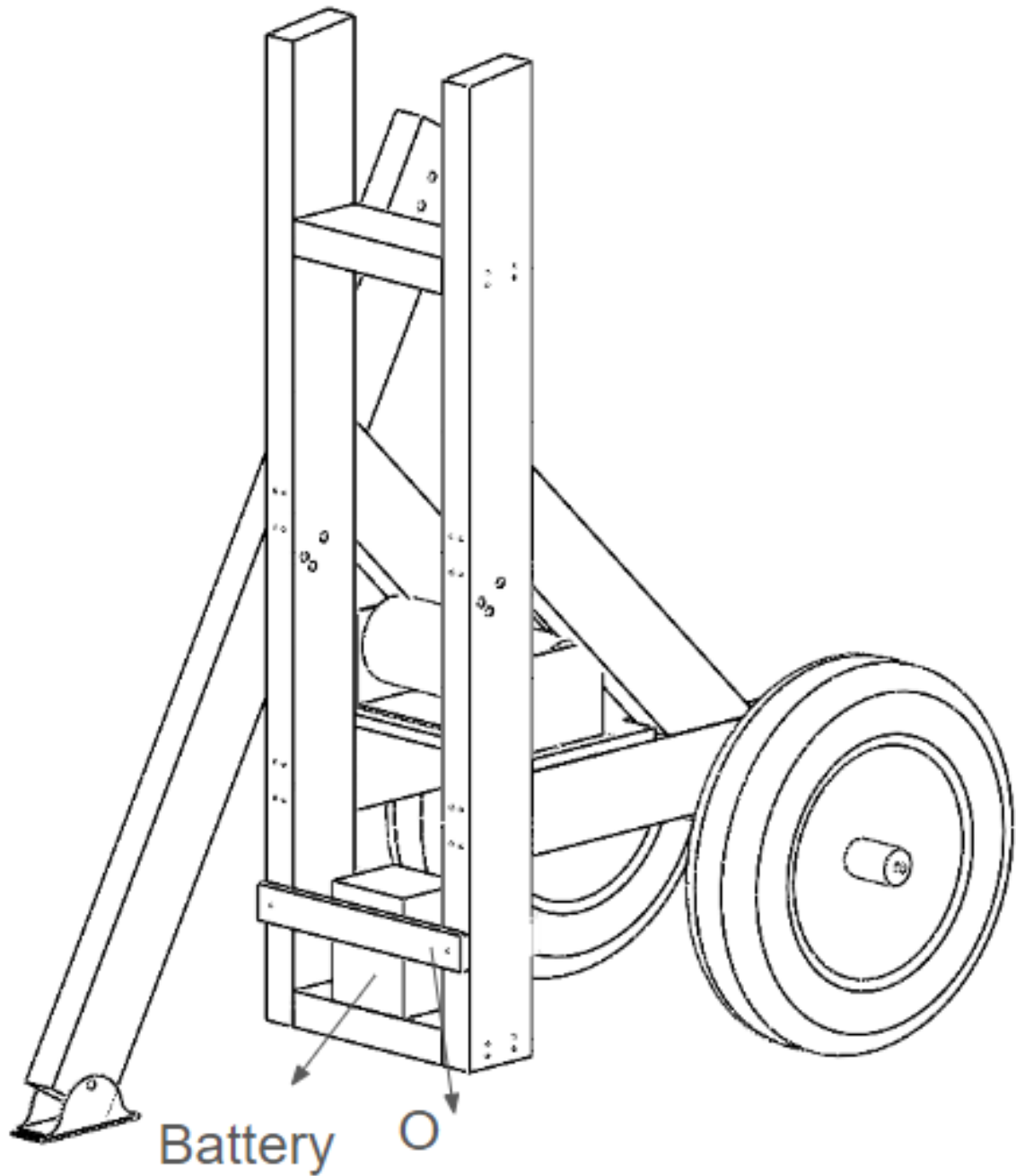




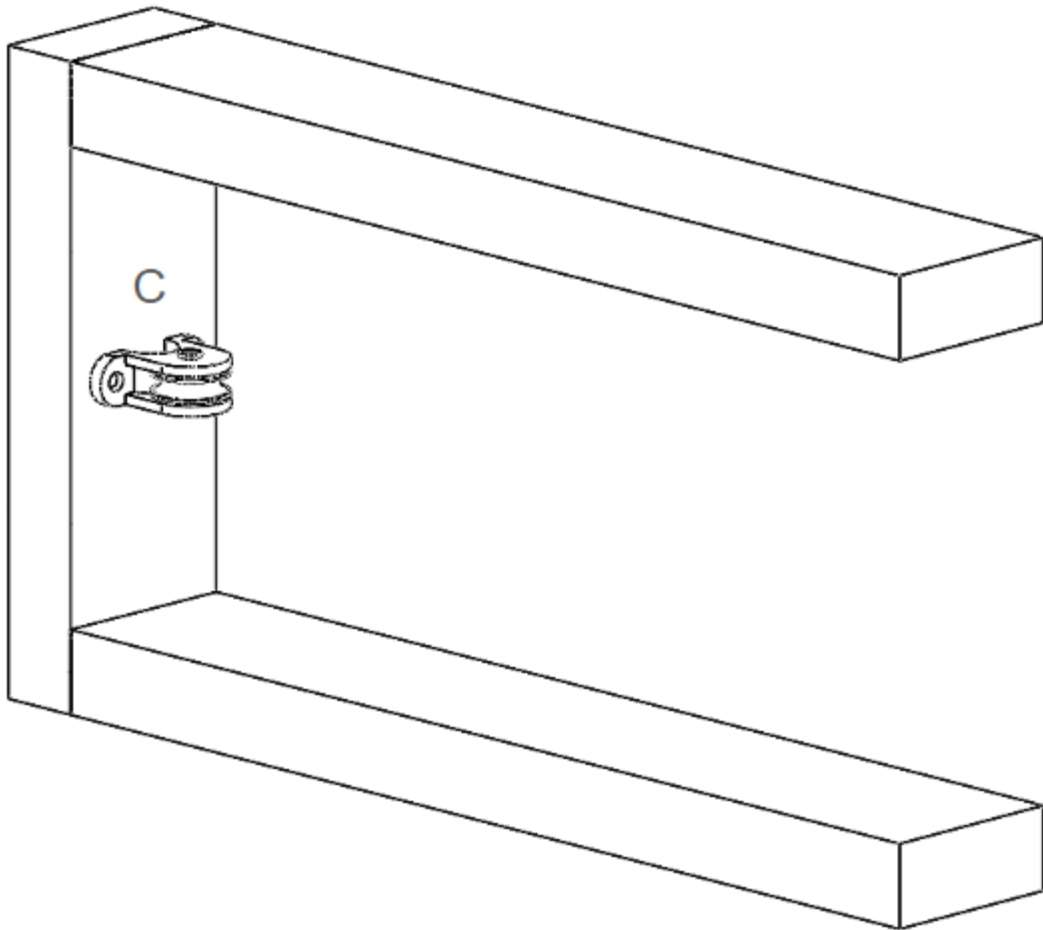
- Mount the electric winch to the winch platform [N] with 5/16"-18 bolts.



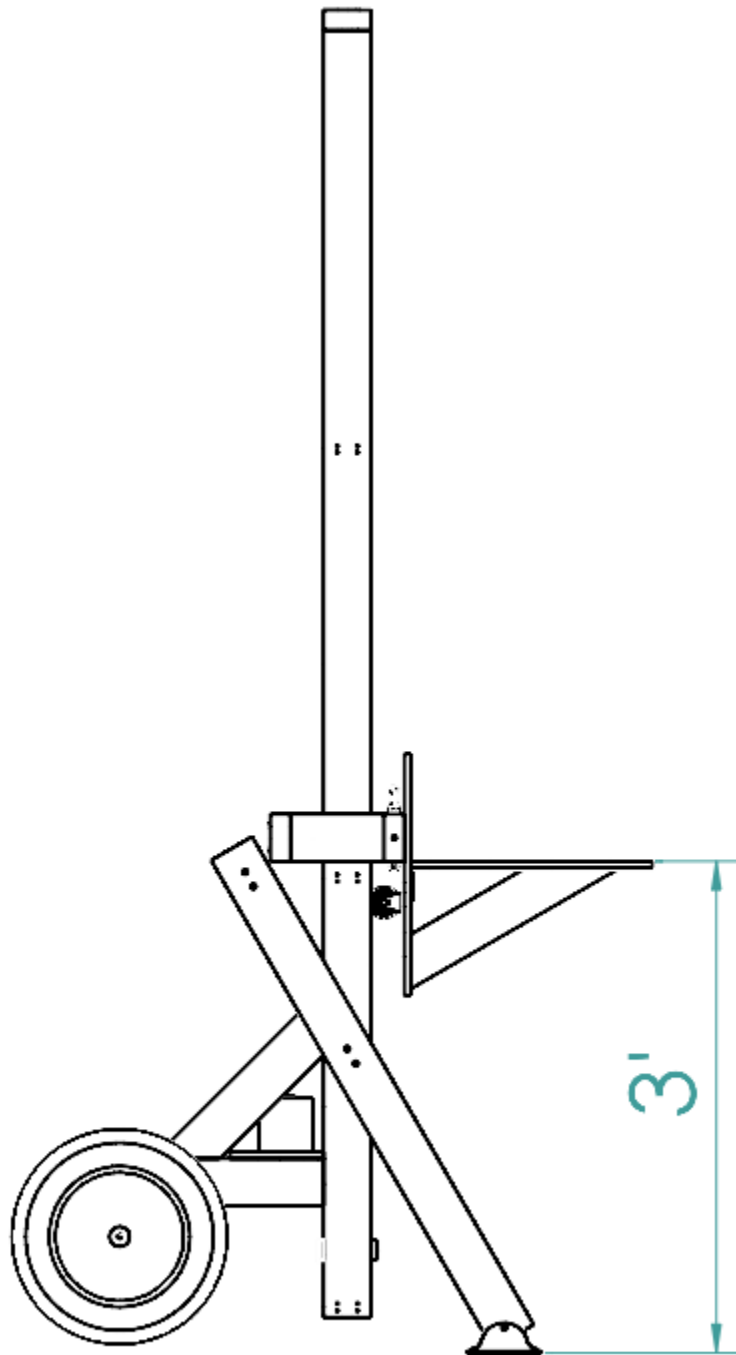
- Attach battery braces [O] onto both sides across the uprights [B] with 1 ¾" wood screws. Place the battery on the bottom upright bracing [A] between them.



- Screw in pulley to top bracing [C] with #10-24 bolts.



- Place the platform over the uprights and hook the winch hook to the eyebolt on the lift anchor brace. The platform should sit at a height of approximately 3' when connected.



- Optional: Screw handle to top of top bracing.
- Optional: draw markings on uprights for upper and lower limits to not exceed them while operating.

5. Operating Instructions:

How to use:

- 1) Secure stabilizers at desired angle
- 2) Set platform to appropriate height for loading
- 3) Secure swarm trap to platform
- 4) Lift platform to desired height
- 5) Fasten swarm trap to tree
- 6) Lower platform

6. Maintenance:

Ensure to follow all manufacturer specified guidelines for maintaining individual components.

Make sure the battery is charged before operating.

Check the device for wear or cracks before and after each use. Replace any components that are broken or exhibiting signs of excessive wear

7. FAQs:

Q: Do I have to use an electric winch and battery?

A: No, you can get a hand winch and attach it the same way as the electric one.

Q: Can I store the B.E.E.S. outside?

A: It is not recommended but, if necessary, remove all electrical equipment from the device and cover with a tarp.

Q: Do I have to make it 8' tall?

A: No, the length of part B can be changed to make the maximum lifting height lower or higher. It is not recommended to extend the height of the device due to potential instability.

Michigan State University Extension and AgrAbility are not responsible for loss of property, personal injury, death, or other damages caused by this product.

Below is a list of the items we used to create this swarm trap lifter. The following links are provided for informational purposes only and do not constitute endorsement by Michigan State University or MSU Extension.

- 2x4s
 - <https://www.homedepot.com/p/2-in-x-4-in-x-8-ft-2-Pressure-Treated-Above-Ground-Southern-Pine-Lumber-218458/100077807>
- Wheelbarrow axle kit
 - <https://www.menards.com/main/outdoors/gardening/garden-landscaping-tools/wheelbarrows-carts/truper-reg-2-wheel-wheelbarrow-parts/33827/p-1444445285224-c-13262.htm>
- Eyebolt
 - [Everbilt 3/8 in. x 7 in. Stainless Steel Eye Bolt with Nut 803604 - The Home Depot](#)
- Caster wheels
 - <https://www.homedepot.com/p/Everbilt-2-in-Black-Soft-Rubber-and-Steel-Rigid-Plate-Caster-with-90-lbs-Load-Rating-49481/203661068>
- Electric winch
 - <https://www.harborfreight.com/2000-lb-utility-trailer-winch-with-steel-rope-57365.html>
- ATV battery 12V 12AH
 - https://www.amazon.com/Mighty-Max-Battery-YTX14-BS-Gel/dp/B00UYRDZ06/ref=sr_1_3?c=ts&dib=eyJ2IjojMSJ9.49xVh-I05iCf5JQeqvZTDrWhMehwlgGWcjnylPKdV9y6sB5mbiL751o5SScKOYJWGCPngVDLsVpC04w0gGn5y5ypQ_2k2F98K08gUIkvdDACs3wfPBh0-UseGuDheGttAqW5D0HY0fbKmbWFAuHrdd11jbOYDSEr4tWK1PxswXfa4AKYSPntpnG3URolxeegxmBrVHsz2LKjO72-IY7UFhNitni0AU3-fgPolbKPTRBK9Bcetw4WMFauj90wTtBobDqx1BEVj8-A1TX9RZVv8N4uTUencyv8_Ayeo6WJJPQI.3ILFzh3uwW3nU1wldUfX0Yq9o5JeAT9WEUIRwr6Qnk4&dib_tag=se&keywords=Powersports%2BBatteries&gid=1710181913&refinements=p_n_feature_keywords_browse-bin%3A2911131011&s=automotive&sr=1-3&ts_id=404722011&th=1
- Ladder shoes
 - https://www.amazon.com/Extension-Ladders-Anti-Skid-Replacement-Aluminum/dp/B0C64JCF4F/ref=sims_dp_d_dex_ai_speed_loc_mtl_v4_d_sccl_2_6/134-9522148-7421812?pd_rd_w=luth7&content-id=amzn1.sym.f8b81522-706a-46d3-a585-5fc6e1682ebe&pf_rd_p=f8b81522-706a-46d3-a585-5fc6e1682ebe&pf_rd_r=N89XK3BZE81WC0D98BJX&pd_rd_wg=LNaN3&pd_rd_r=c4f045ed-d806-41b6-95a8-aaf247c4860a&pd_rd_i=B0C64JCF4F&psc=1
- Plywood sheet
 - <https://www.homedepot.com/p/Handprint-1-2-in-x-2-ft-x-4-ft-Pressure-Treated-Pine-Plywood-Project-Panel-205959/205603721>

- Pulley
 - <https://www.mcmaster.com/3071T1/>
- Corner braces
 - <https://www.homedepot.com/p/Everbilt-2-1-2-in-Zinc-Plated-Corner-Brace-4-Pack-15306/202033901>
- Handle (optional)
 - <https://www.homedepot.com/p/Everbilt-6-1-2-in-Galvanized-Door-Pull-15276/202034227>

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