



COMMUNITY GARDEN GUIDE SEASON EXTENSION

Construction and Operation of a Plant Propagation Rack

Introduction:

In 2008 the Natural Resources Conservation Service published a Community Garden Guide on seed starting. A description of a relatively inexpensive plant propagation rack was included in that Community Garden Guide document. The following is an instruction guide for building and operating a propagation rack similar to that described in the Community Garden Guide.

Tools and materials required:

The propagation rack can be assembled using a variety of power tools and hand tools. Always read and follow the operating and safety instructions for all power tools.

Recommended tools include:

Power miter saw	Table saw (or hand held circular saw)
Power drill with drill bits and screw driving bits	Framing square
Combination square	C-clamps and pipe clamps (minimum 5' long).
Measuring tape	Socket set or wrench set
Hammer or stapler	

Materials list: See Bill of Materials on page 9. A good quality waterproof sealer (ex. Thompson's Water Seal® or similar) is recommended. When purchasing wood for the propagation rack, take care to select pieces that are straight and not twisted. If straight, non-twisted 2" X 2" boards are not available find straight, non-twisted 2" X 4" boards and cut them to the appropriate width with a table saw. Plywood sheets should not have excessive curvature.

Construction screws listed in the bill of materials should be high quality exterior wood screws. Using screws with a "star" or "torx" head, with appropriate screw driving bit, will make driving screws into the wood easier than with a traditional "Phillips" screw head.

Construction notes:

- The final dimensions of the propagation rack will be 51" X 48" by 76" (depending on caster size). Complete final assembly in the room where the propagation rack will be used if the entry to that room is not large enough for the propagation rack.
- Drill pilot holes in all 2" X 2" boards and leg ends using a drill bit smaller than the screws.
- Use wood glue in addition to screws at all joints. This will improve the strength of the joints and increase stability of the propagation rack.
- Creating a jig to build the corners of the shelves will help ensure square corners and tight joints.

Step 1. Establish a solid work surface and create a jig to build square corners of the shelves.

- A solid work surface will aid in creating a jig and make constructing the propagation rack more comfortable. A heavy duty sheet of plywood or OSB supported on a table or saw horses are good choices for a work surface.
- Create a jig by securing a piece of 2" X 4" wood to the work surface. Use a framing square to determine the location of another 2" X 4" piece to be secured to the work surface. Make sure that there is about 4" between the two inside ends of the jig to allow for driving screws into the shelf unit corners (see Figures 1, 2).



Figure 1. Creating a jig to assure square corners



Figure 2. Creating a jig to assure square corners

Step 2. Construct shelf units.

- Cut 10 2" X 2" boards exactly 48" long using a miter saw.
- Cut 10 2" X 4" boards exactly 45" long using a miter saw.
- Apply glue to the edge of a 2" X 2" board and the end of a 2" X 4" board. Place the glued surfaces together in the jig built in Step 2 (see Figure 3).

- Drill two pilot holes through the 2" X 2" board and the end of the 2" X 4" board. Attach the two boards using 3" construction screws (see shelf support detail on page 11). Take care to ensure square and level corners for each shelf.
- Repeat process to construct four (4) additional shelves. Each shelf unit should measure 48" X 48" when complete.



Figure 3. Using jig to assure square and level corners for shelf support

Step 3. Install lights on shelf units.

- Four fluorescent light fixtures are to be attached to the 2" X 2" boards on four shelf units. Measure 6" from the outside edge of the shelf unit and place a mark. This will be the center location of the first light fixture. Three additional light fixtures are to be spaced 12" apart on the shelf unit (see Side View diagram on page 10).
- Orient the fluorescent lights so that all power cords are on the same side of the shelf unit.
- Fasten light fixtures directly to the shelf units using 1" self tapping metal screws.
- Apply silicone sealant to any open holes or seams on the light fixture to prevent water entry into the light fixture.
- Do not install light bulbs until after final assembly is complete.

Step 4. Attach shelf supports to legs.

- Cut four 2" X 4" boards 73" long. These will be the legs for the propagation rack.
- Attach each shelf support to the legs with 6" construction screws. Make sure the shelf supports are square with the legs (see Figure 4).
 - Attach the bottom shelf support (no lights) and the top shelf support (with lights) to the legs. Install the three middle shelf supports (with lights) to the legs at 18" spacing on center between shelf supports (see front view diagram on page 9).
 - Orient all shelf supports so that the light fixture power cords are on the same side of the propagation rack (see Figure 5).



Figure 4. Attaching shelf support to legs



Figure 5. Power cords on same side of rack

Step 5. Attach castors to bottom of propagation rack.

- Install a 2" X 2" board between the legs on the bottom shelf to provide extra support for the castor assembly (see castor attachment detail diagram on page 12). Measure distance between the legs for an exact length to cut the 2" X 2" board.
- Cut $\frac{3}{4}$ " thick plywood into four pieces 5 $\frac{1}{4}$ " X 6". This will be the castor support.
- Drill and countersink holes in the castor supports. Attach castor support to the bottom of the propagation rack with 1 $\frac{1}{2}$ " construction screws (see Figure 6).
 - Plan the location of the screws on the castor support so that they will not interfere with the placement of the castor on the castor support (see Figure 7).
- Attach castors to the castor support using 1 $\frac{1}{2}$ " lag screws. Position the castor $\frac{1}{2}$ " in from the outside edges of the castor support (see Figure 7).



Figure 6. Countersink holes in castor support



Figure 7. Castor attached to castor support

Step 6. Install shelves on shelf supports.

- Cut ½" thick plywood into five pieces, each 48" X 48". These will be the shelves for the propagation rack.
- Treat plywood shelves with a waterproof sealer before installing shelves on shelf support.
- Install shelves on shelf supports. Attach plywood to shelf supports with 1" wood screws (see Figure 8).



Figure 8. Shelf attached to shelf support

- Install shoe molding to the sides of each shelf. Apply silicone sealant under each piece of shoe molding to prevent water from dripping on to the fluorescent light fixtures. Attach shoe molding to shelves with staples or brad nails (see Figures 9, 10).



Figure 9. Installing shoe molding on side of shelf



Figure 10. Shoe molding installation complete

Step 7. Connect electrical supply and install light bulbs

- Electrical supplies are to be determined by user. The circuit that will power the lights on the propagation rack should be protected by Ground Fault Circuit Interruption (GFCI) (see Figure 12).
- A suggested power supply arrangement is to have the light fixtures of each shelf connected to a power strip, and the power strips connected to a master power strip. Use clips or hooks to route the cords in an orderly manner, helping to prevent accidental un-plugging (see Figure 11).
- Install fluorescent light bulbs in each fixture.

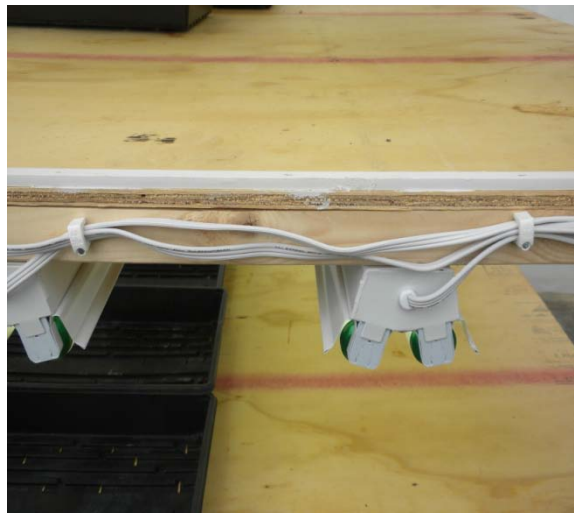


Figure 11. Electrical power cords routed to minimize accidental unplugging



Figure 12. GFCI outlet as electricity source



Figure 13. Propagation rack ready for operation

Operation and maintenance notes:



Figure 14. Various containers for plant propagation

- Place propagation rack in an area that can be easily accessed to lock casters into place.
- Plants can be propagated in this unit using a variety of containers, including flats, pots, and cones. Select containers with a low profile that can be easily moved on and off the shelves without touching the fluorescent lights (see Figure 14).
- **DO NOT WATER PLANTS ON THE SHELVES.** Remove propagation containers from the shelf before watering. Allow container to drain before placing back on shelf. This will minimize the opportunity for water to come in contact with the electrical system.

- Shelves should be treated with water sealant before the start of plant propagation. In addition to sealant, placing a plastic sheet on each shelf will further protect the shelf materials and reduce the probability of water contacting the electrical system (see Figure 15).

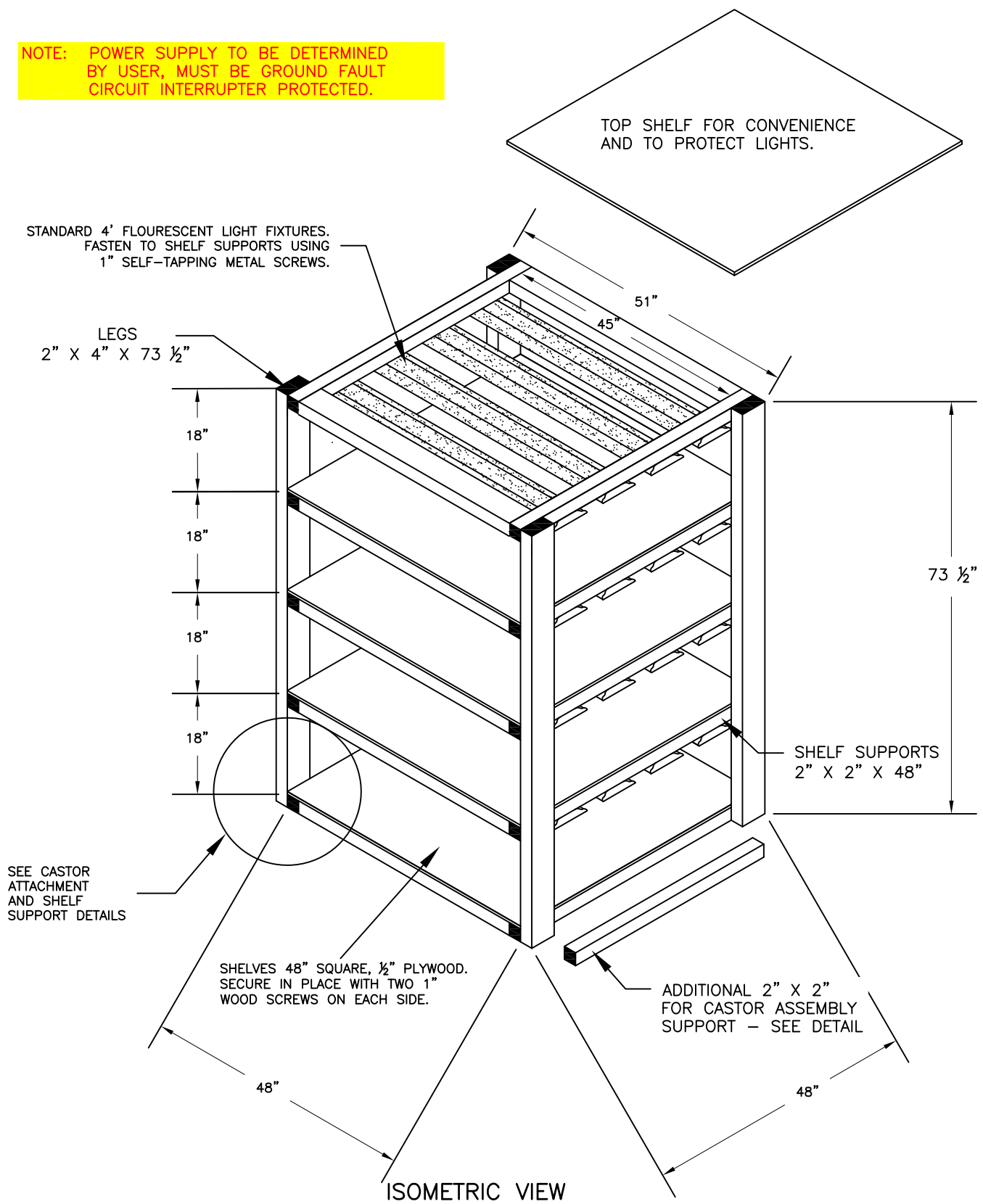


Figure 15. Plastic sheet on shelf for additional protection

The fluorescent lights are not intended to provide heat for the plants. The propagation rack should be used in an area that can maintain an appropriate temperature for plant propagation. Refer to Community Garden Guide on seed starting for temperature recommendations.

- Fluorescent lights can be controlled with timers. Select timer(s) that will handle the electrical demand of the propagation rack and is appropriate for the environment where it will be used.
- When changing light bulbs turn off the power to the light fixture. Make sure the area around the light fixture is clean and dry before changing light bulbs.
 - Inspect the electrical system periodically. Replace or adjust electrical system components as necessary.
 - Inspect and oil casters periodically. Replace any non-functioning casters.

NOTE: POWER SUPPLY TO BE DETERMINED BY USER, MUST BE GROUND FAULT CIRCUIT INTERRUPTER PROTECTED.



PLANT PROPAGATION RACK

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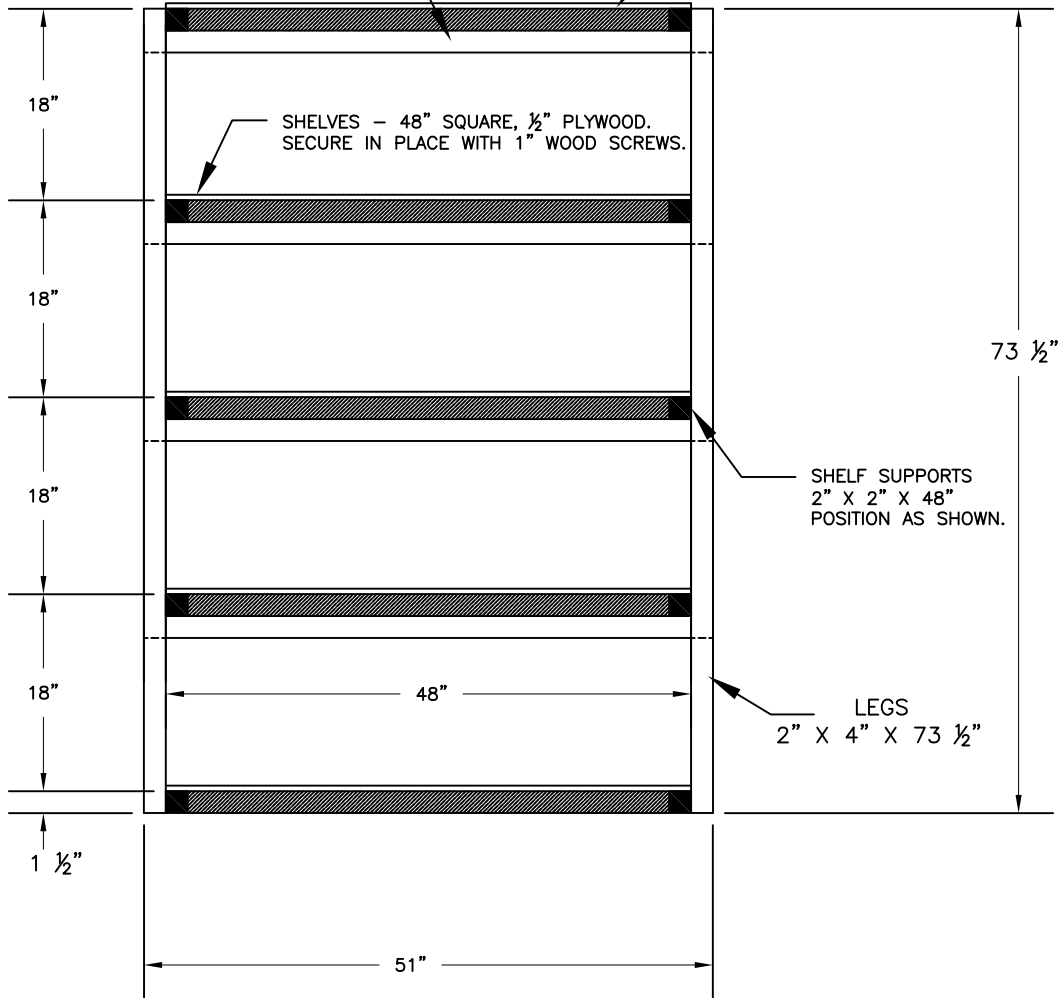
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STANDARD 4' FLOURESCENT LIGHT FIXTURES.
FASTEN TO SHELF SUPPORTS USING
SELF-TAPPING 1" METAL SCREWS.

POWER SUPPLY TO BE DETERMINED
BY USER, MUST BE GROUND FAULT
CIRCUIT INTERRUPTER PROTECTED.

END SUPPORTS
2" X 4" X 45" - FASTEN
INSIDE SHELF SUPPORTS.
SEE SHELF SUPPORT DETAIL.



BILL OF MATERIALS

FRONT VIEW

CONSTRUCTION NOTES:

LEGS - 4 EACH - 2" X 4" X 73 1/2"
END SUPPORTS - 10 EACH - 2" X 4" X 45"
SHELF SUPPORTS - 12 EACH - 2" X 2" X 48"
WOOD GLUE - WATERPROOF - AS NEEDED.
SHELVES - 5 EACH - 1/2" PLYWOOD, 48" SQUARE
LIGHT FIXTURES- 16 EACH - STANDARD 4' FLOURESCENT
LIGHT BULBS - 32 EACH - 4' FLOURESCENT GROW LIGHTS
FASTENERS - 50 EACH - 3" CONSTRUCTION SCREWS
FASTENERS - 40 EACH - 6" CONSTRUCTION SCREWS
FASTENERS - 16 EACH - 1 1/2" LAG SCREWS WITH WASHERS
FASTENERS - 16 EACH - 1 1/2" WOOD SCREWS
FASTENERS - 40 EACH - 1" WOOD SCREWS
FASTENERS - 32 EACH - 1" SELF-TAPPING METAL SCREWS
ELECTRICAL SUPPLIES - TO BE DETERMINED BY USER.
HEAVY DUTY PLATE CASTORS - 4 EACH - 3" WITH BRAKES.
PLASTIC SHOE MOLDING - 24 LINEAL FEET

1. DRILL PILOT HOLES IN ALL 2" X 2" MEMBERS AND LEG ENDS TO AVOID SPLITTING.
2. USE WOOD GLUE IN ADDITION TO SCREWS AT ALL JOINTS.
3. FASTEN LIGHT FIXTURES DIRECTLY TO LIGHT SUPPORTS USING SELF-TAPPING 1" METAL SCREWS.
4. APPLY A SILICONE SEALANT TO ANY OPEN HOLES OR SEAMS IN LIGHT FIXTURES.
5. APPLY EXTERIOR WATERPROOF SEALER TO PLYWOOD PRIOR TO ASSEMBLY.



Natural Resources Conservation Service
United States Department of Agriculture

PLANT PROPAGATION RACK

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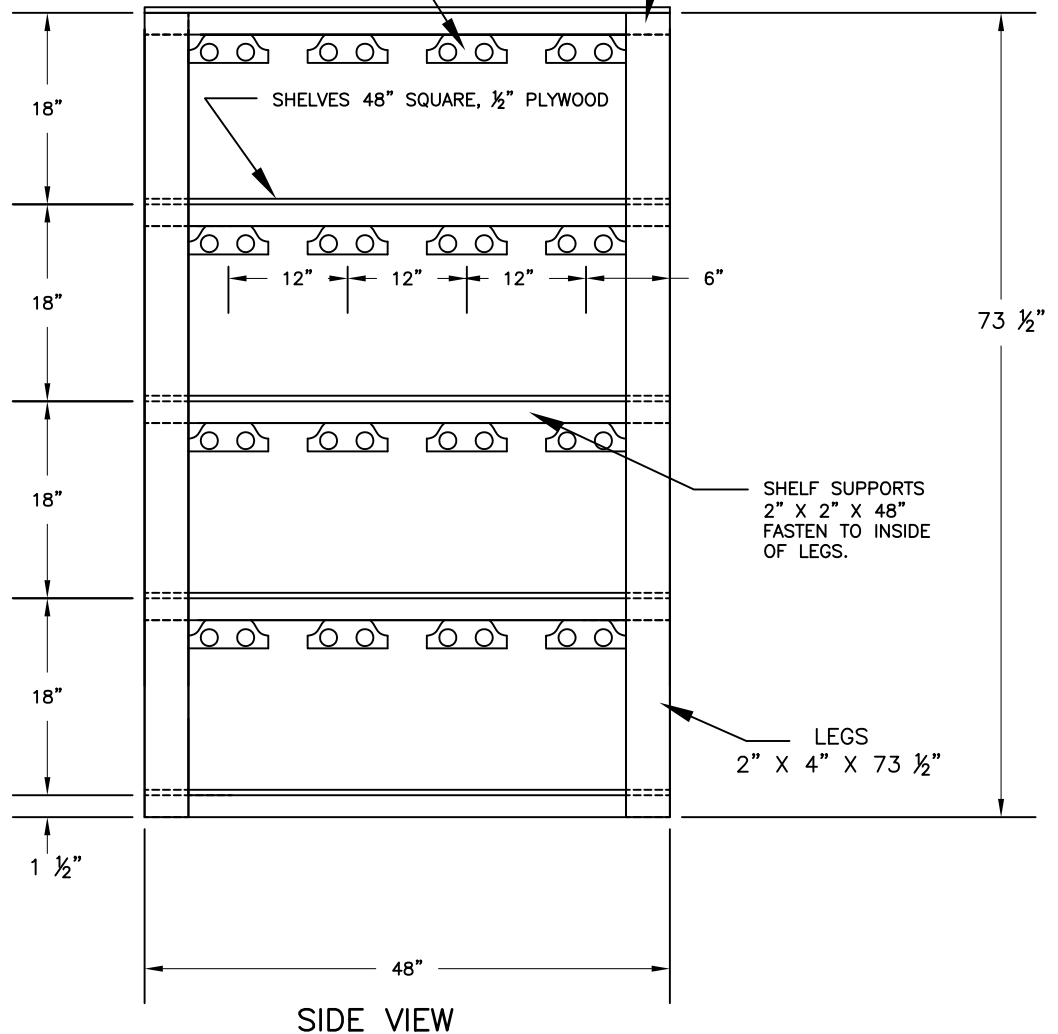
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STANDARD 4' FLOURESCENT LIGHT FIXTURES.
FASTEN TO LIGHT SUPPORTS USING
1" SELF-TAPPING METAL SCREWS.

POWER SUPPLY TO BE DETERMINED
BY USER, MUST BE GROUND FAULT
CIRCUIT INTERRUPTER PROTECTED.

END SUPPORTS
2" X 4" X 45"
FASTEN INSIDE SHELF SUPPORTS.
SEE SHELF SUPPORT DETAIL.



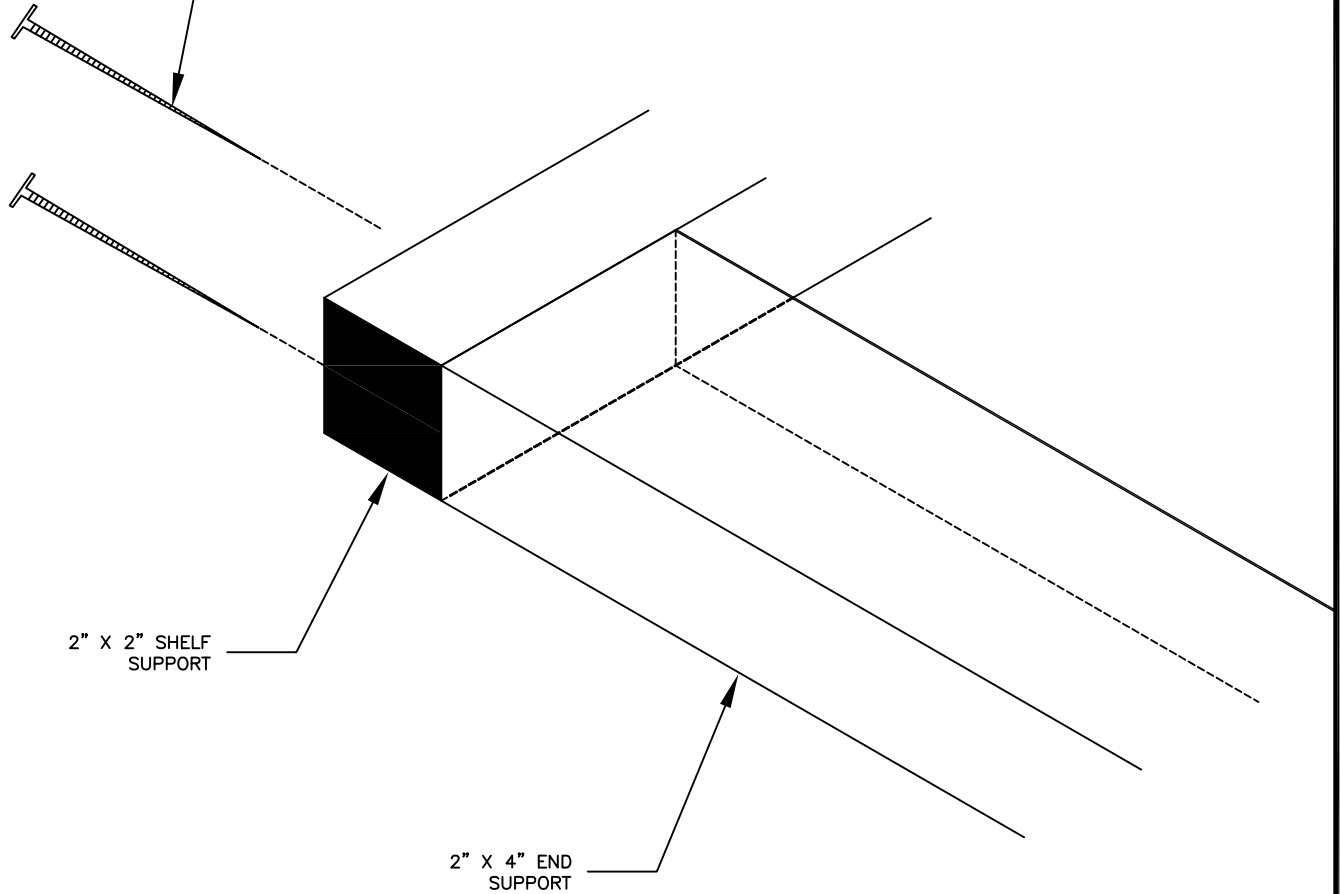
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3" CONSTRUCTION
SCREWS



2" X 2" SHELF
SUPPORT

2" X 4" END
SUPPORT

CONSTRUCTION NOTES:

1. APPLY WOOD GLUE TO JOINT PRIOR TO SETTING SCREWS.
2. DRILL PILOT HOLES IN SHELF SUPPORTS TO AVOID SPLITTING.
3. PREPARE SHELF SUPPORT ASSEMBLY AND SECURE LIGHTS IN PLACE PRIOR TO FINAL ASSEMBLY OF RACK.

SHELF SUPPORT DETAIL

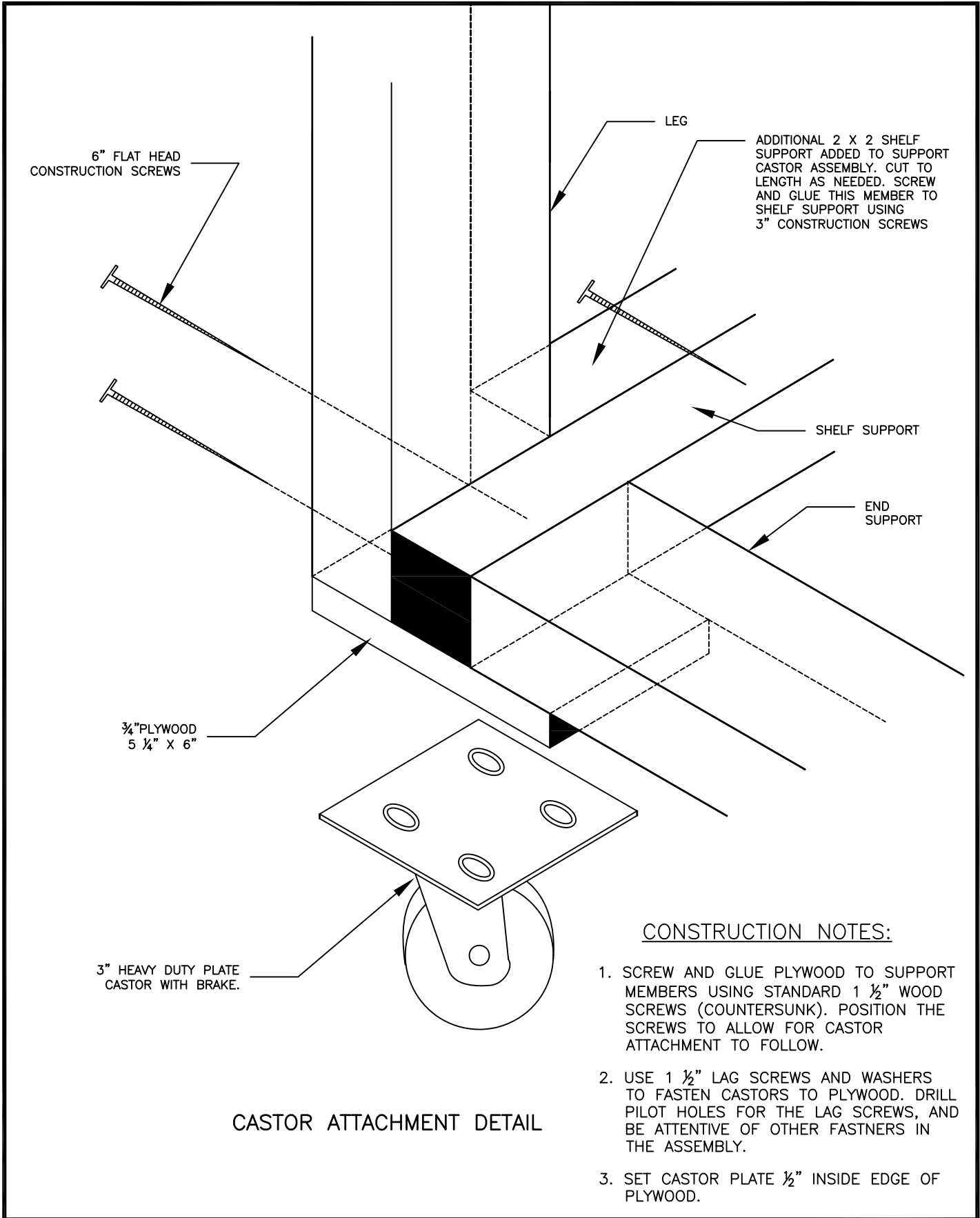


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