An Introduction to TECHNICAL THEATRE

by Tal Sanders
An Introduction to Technical Theatre
Scenery encompasses all the physical decorative elements of the stage design. It includes curtains, platforms, stairs, walls, furniture, and all of the other items a show might require for its visual environment. Scenic designs are delivered to the technical director as a set of plans for the design. The technical director drafts any additional “working drawings” necessary for construction and then distributes the scaled plans to the scene shop. Drafted plans are drawn in a “language of lines” and standard graphic symbols that are generally understood by those who need to interpret them. Each draft has a title block in one corner that tells you what the drawing represents and how to interpret its scale for construction, as well as who created it and when it was drafted or last revised.

Walls that we construct as flats and raised platforms that create levels, also referred to as decks, are the most commonly constructed elements for scenery. Of course there may be lots of other items that a scenic design utilizes or requires, but these elements are standards for set construction.

As scenery represents a large portion of the physical needs for a production, it is often the most labor intensive of the design elements and usually makes up a significant part of the budget. It stands to reason that the less you need to build from scratch, the more time and money can be saved or allocated to other production needs. Stock scenery items are those that the theatre stores between productions and can be reused, redressed, or altered for a production. Companies that have allocated space to store scenic elements such as flat walls and platforms can effectively and economically reuse them. Storage, therefore, is a premium in theatre spaces, and you usually find that something is stored in every nook and cranny of a theatre space in case it might be useful in the future. Environmentally, it also makes sense to reuse as much as possible because plays tend to have relatively short performance runs, and the art form could otherwise be seen as wasteful.

To be most useful, stock scenery should be constructed in sizes that are commonly required and can be assembled in a variety of configurations. Therefore, stock sizes of scenery are also common. Flat walls are generally constructed in 1-, 2-, 3-, or 4-foot widths. Heights are dependent on the most useful size for a given stage space.
Some flats can be 20-feet tall or taller, while the most common sizes are 8 feet, 10 feet, and 12 feet.

Flats are commonly constructed in two basic types. A **soft-cover flat** is constructed on a frame, usually of wood, but sometimes metal. A canvas is stretched over the entire plane that faces the audience. Much like a large painter’s canvas, a flat can be painted to resemble any environment. Soft-cover flats are both lightweight and portable and have been traditional elements of scenery for hundreds of years. Each of the joints of the flat’s frame is supported by a thin plywood brace. These **corner blocks** and ** keystones** help to stiffen the relatively thin flat frames. These frames, often constructed of 1-by-3- or 1-by-4-inch lumber, are economical to construct and their minimal thickness (approximately 1 inch each) reduces storage space. However, their relative delicacy due to the soft-cover makes them an unpopular choice in modern theatre. While there was a time when it was standard for performers to act in front of the scenery, modern plays require them to interact with the scenery, making canvas walls impractical.

**Hard-cover flats** are also commonly built as wooden frames, but their face is covered in a thin plywood rather than canvas. This makes them more durable, but also heavier and generally more expensive to construct. The most common version of a hard-cover flat is the “studio” or “Broadway” style flat. These frames are not only stiffer than other styles, but their depth also allows them to be easily secured to one another as well as to the floor. If your production requires actors to lean on the set’s walls or throw things against them, a hard-cover flat is your best choice.
Flats are sometimes constructed in shapes other than rectangles. If a flat is constructed to have a shaped edge profile, we refer to it as a **profile flat**. Tree shapes and arches are common profile flats. Flats can be propped up by triangular frames called **jacks** where needed for support.

Platforms are often constructed as frames that support a full sheet of plywood as their top **skin** surface, or lid. In the U.S., plywood is sold in sheets that measure 4 feet by 8 feet, and so platforms are constructed this size or smaller. Groups of stock platforms can be assembled into larger **decks** of stage levels with support legs that set their heights above the **natural stage floor**. A **facing** can be added to these platforms that hides the legs so they appear as solid block shapes to the audience.

Typical framing for a wooden theatrical platform can be constructed from either 2-by-4 or 1-by-6-inch boards. Framed on-edge, both materials provide the necessary support the plywood lid requires. Joists that span the 4-foot width of the frame need to be installed on 24-inch **centers** in order to provide the stiffness and weight distribution required for the platform to safely support scenery and performers. A stage platform is typically skinned in ¾-inch thick plywood and supported by a minimum of six legs. Metal platform frames are also common to large productions and touring shows.

If we add levels to our stages, we need stairs to get from one height to another. Humans have an interesting relationship with stairs. Most of us do not need to carefully navigate each rise in a staircase, but instead have an autopilot feature that usually allows us to climb or descend them with ease. This is true until one stair is of a slightly
different rise than the rest, then we are apt to trip and fall at this step. Designers should take care to ensure, as much as possible, that all of the stairs on a given set are of the same height so the actors can traverse them easily without great concentration. Many theatres keep stock stair units as a part of their inventory.

There’s More to Know

When constructing stairs for a set, it is helpful to use the 18-inch rule for your calculations. The rise of each tread to the next and the run or depth of each tread when added together should add up to 18 inches. Therefore, if a 6-inch rise from tread to tread is required, then your run or depth of tread should be 12 inches. If your rise is 8 inches per tread, then your stairs should each have a 10-inch run depth. This will keep the natural rhythm of human movement intact.

Plywood and other sheet goods are important building materials for scenic construction. Plywood are made up of sheets of material that have been manufactured as a strata of layers, or “veneers.” These thin layers of wood have been peeled off long logs and then laid in a stack with the wood grain of each layer running perpendicular to the layer above and below. As wood is strongest along its grain fibers, crossing the grains adds strength to the ply. These layers are pressed and glued together, making for a very strong sheet of lumber. More layers add thickness to the ply, making it capable of supporting a greater load. Theatrical platforms are generally skinned with a sheet of plywood at least ¾-inch thick to support the weight of the actors and scenery. Sheet goods also include decorative items such as paneling and materials like MDF (medium density fiberboard), which are not good materials to support weight, but have other qualities that can be useful in construction. Generally, in the United States, sheet goods are sold in panels of 4 feet by 8 feet.

Plywood is graded based on both the finish of its outermost veneers and the quality of the woods that make up its inner plies. If you want a smooth sanded surface with no mars to the wood grain, you need to purchase higher-grade plywood. Low-grade plywood may have “holidays,” or holes, in their veneers, including the exterior layers.

<table>
<thead>
<tr>
<th>Interior Grade</th>
<th>Face</th>
<th>Back</th>
<th>Inner Plies</th>
<th>Use and Appearance</th>
</tr>
</thead>
<tbody>
<tr>
<td>A-A</td>
<td>A</td>
<td>A</td>
<td>C</td>
<td>Cabinet doors, furniture where both sides show. Good natural wood finish both sides.</td>
</tr>
<tr>
<td>A-B</td>
<td>A</td>
<td>B</td>
<td>C</td>
<td>Paneling, one-sided natural wood finish. Finished face; smooth, sanded back.</td>
</tr>
<tr>
<td>A-C</td>
<td>A</td>
<td>C</td>
<td>C</td>
<td>Platforms/work seen from one side only. Finish grade face, voids on back.</td>
</tr>
</tbody>
</table>

*Common plywood grade chart*
Consider This

To glue or not to glue? It is a good question. If you are constructing stock scenery that has elements that will either take abuse or have questionable safety or stability, then YES, glue. If, however, the construction is decorative, and you want to recoup the materials for later use, then glue will only make the job harder.

Modern scenery includes many of the architectural elements and details we use every day, like appliances that need to work, windows that will be opened, or a sink with running water. These are called practical. Doors are the most common practical element of scenery. They often need to function normally, but also stand up to some abuse called for by the script, which can range from hard knocking to full forced entry attempts. It can be a challenge for carpenters to support and reinforce these elements within an environment of temporarily constructed flat walls.

Many scripts call for a variety of locations to be represented within the same play. Scene designers work to find ways to transport their audience from one location to another without taking massive breaks in the action to achieve the changes. A number of rolling platform elements, known as wagons, can help streamline these transitions by transporting large props and scenery on and off the stage quickly. A variety of wagons are common to scenic design. A large turntable wagon that can spin to reveal a new setting is called a revolve. Some theatres are equipped with a built-in revolve that is permanently installed as part of their stage floor. Platform wagons that pivot onstage from a fixed point in the wings are called jackknife platforms. Straight run platform wagons roll either upstage to downstage or in and out of the wings. The wheels that these wagons operate on, known as casters, are either fixed casters or swivel casters. A fixed caster can only roll along a straight path, while swivel casters allow units to be rolled in any direction. Sometimes these wagons are guided by a track built into the stage floor.

Scenery construction methods and choice of materials vary from theatre to theatre, but standards for construction are important for every company. Standard construction methods greatly increase safety and reliability, and items built-in the same manner tend to fit together easily without modifications.

Many theatres work primarily in wood, which is relatively inexpensive and malleable. Some shops work in metals as well, though separate working spaces are often required for metal construction due to the inherent fire danger. Simple theatrical construction does not typically involve intensive wood joinery, but instead relies on abutted joint, or butt joint, construction methods. When working with lumber, it is important to understand the “true” or actual dimensions of the lumber in order to correctly figure the lengths needed to be cut for a project. Lumber is sold by what we refer to as a nominal dimension. Nominal dimensions are the sizes to which each piece of lumber was rough cut at the mill. The lumber we buy at our local supplier has then been put through a series of finishing machines that have cut the
lumber into consistent rectangular planks and sanded away the rough edges. This process removes some of the wood and leaves us with a piece whose actual dimension is significantly smaller than its nominal dimension. Scene shops regularly work with sticks of lumber we refer to as “one-by-three” to build flat frames, but the carpenters must remember those pieces actually measure \( \frac{3}{4} \) inch by 2\( \frac{1}{2} \) inch.

<table>
<thead>
<tr>
<th>Nominal Lumber Dimensions</th>
<th>Actual Lumber Dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1X3</td>
<td>( \frac{3}{4}” \times 2\frac{1}{2}” )</td>
</tr>
<tr>
<td>1X4</td>
<td>( \frac{3}{4}” \times 3\frac{1}{2}” )</td>
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<tr>
<td>1x6</td>
<td>( \frac{3}{4}” \times 5\frac{1}{2}” )</td>
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<tr>
<td>1X8</td>
<td>( \frac{3}{4}” \times 7\frac{1}{4}” )</td>
</tr>
<tr>
<td>1x12</td>
<td>( \frac{3}{4}” \times 11\frac{1}{4}” )</td>
</tr>
<tr>
<td>2x4</td>
<td>( 1\frac{1}{2}” \times 3\frac{1}{2}” )</td>
</tr>
<tr>
<td>2x6</td>
<td>( 1\frac{1}{2}” \times 5\frac{1}{2}” )</td>
</tr>
<tr>
<td>2x8</td>
<td>( 1\frac{1}{2}” \times 7\frac{1}{4}” )</td>
</tr>
<tr>
<td>4x4</td>
<td>( 3\frac{1}{2}” \times 3\frac{1}{2}” )</td>
</tr>
</tbody>
</table>

Woodworking requires a series of cutting and assembly tools. These tools must be well-maintained and their safety recommendations upheld in order to ensure a safe working environment. All construction tools are potentially dangerous. They are loud, and to a new user, often seem scary. Before you use any construction tools, make sure you have been adequately trained and are aware of all personal safety precautions and equipment required for your task.

**Consider This**

The theatre is a potentially dangerous environment. Many factors contribute to this. We build temporary scenery, hang lighting equipment next to fabric curtains, run lots of extension cords, hang many things overhead, and then we work amongst it all in relative darkness during performances. That means we need to be extra careful to take all possible precautions to work safely. Wear provided safety equipment. Read product warnings. Keep a clean work environment and always stay aware of the work happening around you.

The woodworking tools in use at most scene shops fall into two categories. “Stationary tools,” which are permanently placed in the shop with adequate working space around them. Table saws and cut-off saws such as a tilting arbor (chop saw) or sliding arbor saw are common to most wood shops. A drill press, sanding station, lathe, and band saws are also common. The second category of tools is “hand tools.”
These are familiar tools such as hammers, wrenches, and screwdrivers, but also include hand-held power tools like circular saws, sabre saws, and reciprocating saws as well as grinders, staplers, and driver drills.

**Common shop tools**

*Table saw:* Used primarily for ripping lumber (cutting along the grain). Allows for wood to be beveled on a tilting arbor table saw.

*Cut-off saw:* Used primarily for crosscutting lumber against the grain. Can be a tilting arbor saw.

*Band saw:* A saw with a continuous loop blade. Allows for the cutting of curves along material.

*Drill press:* A stationary tool in which a drill motor can be lowered into and lifted from materials providing an opportunity for precise holes to be drilled.

*Pneumatic stapler:* An air-driven stapler. Drive staples from ½-inch lengths up to 2½-inch lengths.

*Driver drill:* A cordless, battery-driven drill that has an adjustable clutch to assist in the insertion of screws.

Unless you are constructing stock scenery, most theatrical construction is temporary. It must be safe and durable, but after the show closes, we would like to recoup as much of the material as possible for reuse. Using screws as a primary fastener allows us to construct and deconstruct with little damage to the materials. Battery-powered driver drills have made the use of screws rather than nails or staples a reasonable alternative for construction. **Drywall screws,** which are hard and sharp, have become widely used in theatre construction because they are faster to work with than woodscrews and have better adhesion than nails. However, they are brittle and can be prone to breaking.

Nuts and bolts are also heavily used for theatre construction. A wide variety of bolts are available. **Carriage bolts** and **hex bolts** are the most common to theatre.
For Further Exploration
