Triscuits

1 The design

The triscuit is a type of panel for use in decking, developed by the Yale School of Drama. Its stress-skin design gives it several advantages over the traditional platform decking. This note presents the basic design and the structural rationale behind it, a brief comparison to other designs, and some notes on common variations.

The triscuit is a stress-skin platform. In the Yale design, the dimensions are four feet by four feet square, with a thickness of 2 $\frac{3}{8}$ inches. A frame is constructed from $\frac{5}{4}$ nominal pine lumber, as in Figure 1. The $\frac{5}{4}$ boards are laid flat (i.e. in their weak direction), and glued and stapled or screwed together. Five *stringers*, pieces of $\frac{5}{4} \times 2''$ (true) are used as the structural elements of the frame (three at $3'7\frac{7}{8}''$ and two at $3'9\frac{7}{8}''$), and two pieces of $\frac{5}{4}'' \times 1$ (true) serve as endcaps, holding the others together but otherwise non-structural..

The two faces are constructed of $\frac{5}{8}''$ plywood, generally CDX, cut to $3'11\frac{7}{8}''$ square. The triscuits are assembled at slightly under their $4' \times 4'$ nominal dimensions in order to allow for a $\frac{1}{8}''$ gap between adjacent panels in a deck that prevents squeaking during use. The faces must be carefully attached by covering the entire frame surface with a glue coat, then attaching the plywood with nails or screws.

The strength of this platform comes from its stressed-skin design. When the platform is loaded, it has a natural tendency to bend under the applied force. Because the top and bottom skins are securely attached to each other through the stringers, the top skin must contract and the bottom skin must expand in order to bend. The result is that the top skin resists compressive stresses, the bottom skin tensile stresses, and the stringers shear stresses. The wood effectively resists these stresses, and therefore the panel as a whole can withstand greater loads with minimal deflection than any of the individual pieces could alone. With this design, the platforms can support a load of at least 50 psf. However, it is critical that the plywood faces are carefully attached to the lumber stringers. Moreover, the plywood must be oriented such that the face grain is parallel to the $2''$ framing members. If these conditions are not met, the result will not have the strength of a stress-skin platform.

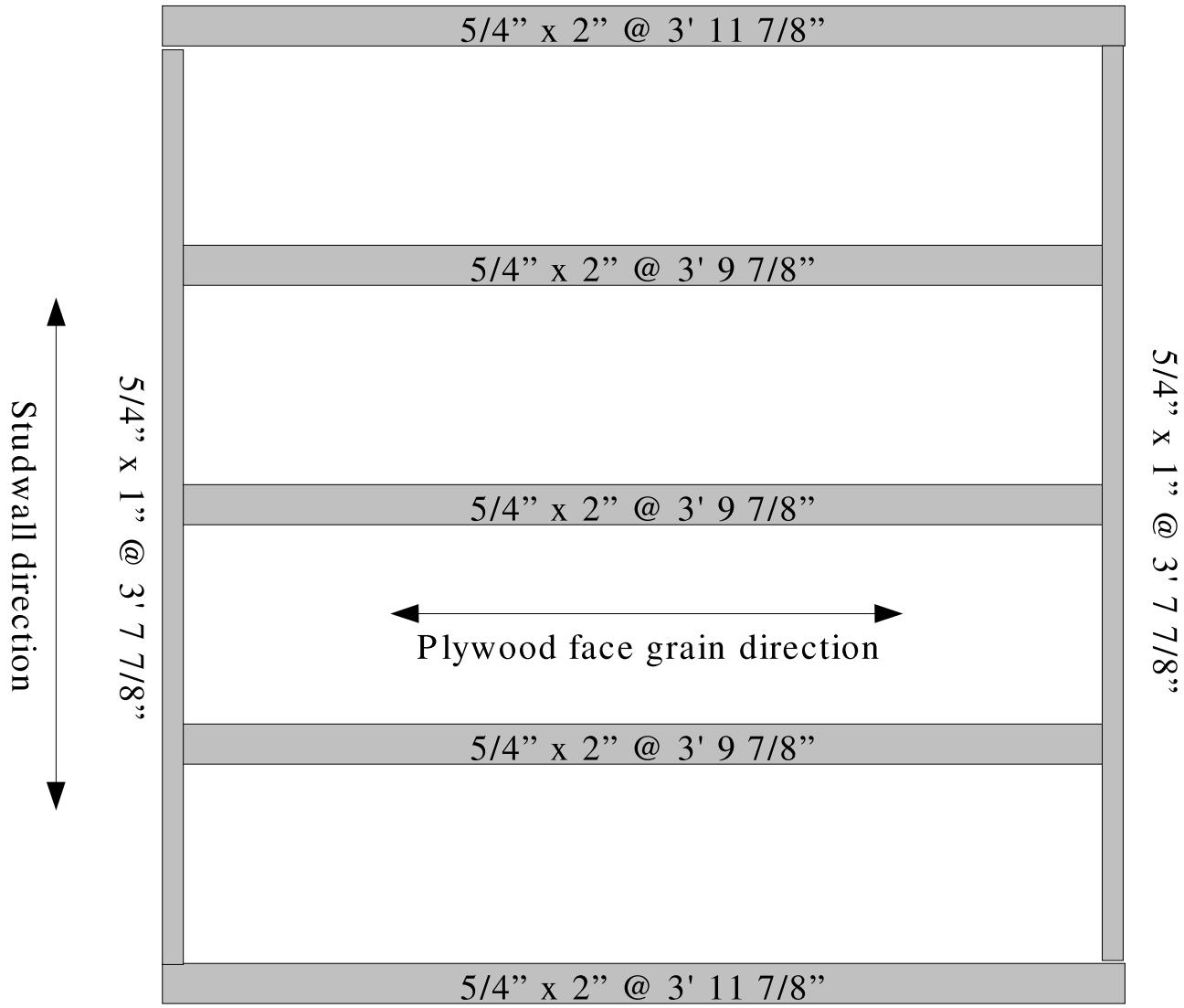

Figure 1: Frame construction layout

A triscuit deck must be supported by a system of studwalls, typically made from cheap, readily-available 2×4 lumber. The studwalls are placed $2'$ apart. Unlike standard platform legs, the studwalls allow the platform to be evenly supported along its length. It is essential to ensure that the studwalls are placed perpendicular to the surface grain of the plywood, as in Figure 1. Since the endcaps are only $1''$ wide, if properly oriented all five of the stringers will be placed over the studwall's top plate; if oriented incorrectly, not all of the framing members will be able to bear directly on the studwall, weakening the platform considerably. Holes are drilled in the triscuit at each corner, and four bolts or lag bolts are used to secure it to the studwall.

2 Advantages and disadvantages

As mentioned above, the triscuit can support a large load with a small amount of materials used, relative to a traditional platform design. This is its principal advantage: its high strength-to-size ratio.

This translates into several practical advantages. Listed briefly:

- Each triscuit unit is small and light enough to be handled by one person.
- It takes less space to store a set of triscuits than a set of 2×4-framed platforms of equivalent area.
- The limited materials required make triscuits cost-effective.
- Triscuits are thin. This has obvious design advantages. In particular, the visual effect of a projecting overhang is magnified when the deck is so thin.

One disadvantage, however, is that each unit is more complex to build than a standard platform. Two faces must be attached to the frame, and they must be glued as well as screwed on. Moreover, the deck must be supported using a studwall; the normal 4×4 or 1×3 L legging cannot be used. Fortunately, however, it is straightforward to attach the panels to the studwall.

3 Some variations

A common problem encountered when building triscuits is the unavailability of $\frac{5}{4}''$ lumber. This has led various technical designers to develop alternatives.

A simple variation uses standard $2\times$ stock instead. The $2\times$ lumber is ripped down to the $1''$ thickness of the $\frac{5}{4}$ lumber, to match any other triscuit platforms. The quality of the

lumber is important: the cuts must be made avoiding any knots in the wood. The $1.5''$ true dimension of the $2\times$ nominal lumber is used in place of the $2''$ true dimension of the $\frac{5}{4} \times 2''$ in the original triscuit design.

Since the load is resisted by the skin, it is also possible to create a stress-skin platform using foam in place of the stringers. At Penn State, a $1''$ thick panel of extruded polystyrene was used, laminated to OSB skins. A plastics manufacturing company created similar platforms by injecting A/B foam between two panels. This must be done very carefully in order to ensure that the foam is distributed evenly throughout the platform and at a consistent thickness, in addition to all the usual safety issues involved in working with foams. The advantage is that the resulting platform has impressive strength and weight properties, and a truly uniform internal structure.

The Texas triscuit is a variation introduced at Trinity University. The design has similar advantages in terms of strength and weight. However, though the layout is similar, it has some important differences structurally. Most obviously, it uses a frame made from $1\frac{1}{2}''$ 16-gauge steel tube, in essentially the same shape as Figure 1. More significantly, it is not a stress-skin platform, as it has no bottom skin. This means the stress-skin structural analysis mentioned before does not apply; instead it relies upon the strength of the steel used. Helpfully, it also means that it is possible to attach a normal compression leg to the frame, instead of using a studwall.

4 References

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