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Tech Note Two- Materials for Production
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Data on Common Theatrical Beams, Geared Toward Platform Framing Design

Tabulated below is structural data for several common theatrical beams- that is, standard lumber sizes- and several less traditional steel members. This beam related data is particularly relevant for a common theatrical problem: framing 4'X8' platforms.

The information below comes from analyzing the "stile" member of a platform frame as a beam. For Dexion and Unistrut load values are based on manufacturer's published ratings for uniformly distributed loads. For wood and steel tubing load ratings are based on a deflection criteria of l/240 (.4 inches for the platform) and uniformly distributed loads. Total framing weight is calculated based on a 3-toggle frame.

| Member | Max distributed load (lbs/ft) | Max platfrom load (lbs/sqft) | weight/linear foot (lbs) | total frame weight (lbs) |
|-------------------------|-------------------------------|------------------------------|--------------------------|--------------------------|
| 2X4 (douglas fir) | 16 | 8 | 1.09 | 39.24 |
| 1X6 (southern pine) | 24 | 12 | 1 | 36 |
| 1X8 (southern pine) | 35 | 17.5 | 1.32 | 47.52 |
| "Unistrut" | 23 | 11.5 | 1.9 | 68.4 |
| "Dexion" | 68 | 34 | 0.78 | 28.08 |
| 1" X 3" 15 ga. steel | 65 | 32.5 | 1.69 | 60.84 |

Everything compiled here is based on looking at a single section as a beam (see Dexion note under definitions). Any platform frame is much more complicated than this: a platform acts, to some degree, as a "stressed skin" panel with only one face. Also, beam characteristics may depend on complicated failure modes such as folding or other local failure, that will dramatically change when part of a platform. Data for Dexion, particularly, should be taken with a grain of salt for this reason.

Comparing load values above to experience immediately shows that a deflection criteria less strict than l/240 may be used in many community theatres in specific cases. In fact, personal experience shows that criteria less strict than l/180 can be often be used in non-critical situations. Even a large visually apparent deflection may be acceptable (and even aesthetically desired in a few specific situations) for small theatre groups when budgets are small. Another chart could show that the actual breaking strength (including appropriate safety factors) of any of the framing methods listed above (excluding Dexion) would be much, much higher than the load ratings arrived at through using deflection criteria.

Definitions:

“Dexion” is used as a generic term for 14 gauge steel 1.6725’X2.375” slotted angle. Data comes from the manufacturer “B-Line”, based on a “single piece with stiffener” rather than “single piece” due to approximately continuous attachment to a platform lid. It is based on ultimate strength and not deflection criteria.

“Unistrut” is used to indicate a generic 12 gauge steel 1.675” U-shaped section. Data, however, comes directly from Unistrut Corp documentation for P1000 channel. It is based on a deflection criteria of 1/240.

Weights of wood are based on Douglas Fir (~30lbs/cuft) and Southern Pine (~35lbs/cuft)

E (Elasticity) of woods are based no Douglas Fir-South (1,200,000) and Southern Pine (1,500,000), each “construction grade”.

“15 gauge” steel is thickness of 0.065 in.

References:

B-Line Slotted Angle catalog (available at www.b-line.com)

Unistrut Corp catalog (available at www.unistrut.com)

Holden, Sammler. *Structural Design for the Stage*.

Carter, Paul. *Backstage Handbook*.