

## ARCH 631. Topic 19 Reading Notes

- Timber construction commonly has linear one-way spanning elements, with 2 to 3 levels in the horizontal system
- Light framing construction is defined as floor systems with light occupancy loads and simply supported joists with transverse decking on a load bearing wall of masonry or studs sheathed in plywood; height restriction of 3-4 stories for fire safety
- Heavy timber construction is defined as large beams (commonly glue laminated) with transverse planking; larger spans; commonly simply supported on bearing walls or timber columns; shear walls provide lateral stability or knee braces with column; moment resistant joints possible, but not common
- Types of timber elements:
  - stressed-skin member – plywood sheathing on one or both side of stringers; plates used for carrying bending loads; usually constructed off site and placed on site; can be used for folded plates
  - box beams – built up with plywood and beams; good for long spans (more efficient than solid or laminated beams with less material)
  - folded plates and arch panels – flat or curved that span one way; usually constructed with plywood
  - arches – laminated (bent or curved) very common; good for long spans and useful as roofs with light uniform loads; most are two or three hinged (not fixed) at base supports
  - lamellas – singly or doubly curved surfaces made from short pieces of wood; typically for roofs
- Approximate span ranges for timber chart is for TYPICAL lengths and corresponding depths for USUAL use (that means common loadings and tributary widths) – *use with care and THEN design using another method*; typical thickness to height (cross section dimension) for beams range from 1:25 to 1:10; typical slenderness ratios for walls are 1:30 to 1:15
- Appendix 17, Table A.17.2 lists common allowable stress ranges for douglas fir, southern pine and glued-laminated lumber made from these woods along with common load duration factors
- Design usually starts with finding tabulated values of stresses and multiplying by adjustment factors (shown in the second example with the shape factor and load duration factor); bending stress is used to determine  $S_{req'd}$  or the size of  $b \times d$  determined knowing  $S = bd^2/6$  for a rectangle; shear stress is determined from  $3V/2A$  (for a rectangle); bearing stress is found from  $P/A$ ; deflection is determined using a formula and must be calculated for both the total and just the live load deflection which must not exceed limits described by the span (L) over a unit-less number (like  $L/240$ ); **if at any time, the stress or deflection criteria is not satisfied, a new section must be chosen with larger S, A or I**
- Beams with constant rectangular cross section (prisms) are not structurally efficient because they provide extra cross section where it isn't needed for the maximum moment; because the part of the cross section seeing the maximum stress is at the top or bottom-most fibers, so the rest sees less stress

- Modulus of elasticity and allowable stress values are dependent upon the type and grade of wood and how it is used, if it is wet or dry – wet glulam needs the modulus of elasticity ( $E$ ) reduced – what direction the loading is to the grain, the load duration, and many other adjustment factors ( $C_{\text{sub something}}$ )
- Laminated timber is made of gluing layers of wood to build up a composite whole; can be large with higher strength, usually with high strength layers on the exterior
- Timber column allowable stress equations are based on Euler's buckling stress equation with a factor of safety and slenderness in the form of  $L/d$ ; short columns are designed to the compression strength; intermediate length columns ( $l/d > 11$  but less than  $0.67\sqrt{E/F_c}$ ) have a transitional stress from crushing to buckling; long columns have  $l/d < 50$
- Minimum column dimension is typically braced