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 facture and load duration factor); bending stress is used to determine \( S_{reqd} \) 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

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 0.67sqrt(E/Fc)) have a transitional stress from crushing to buckling; long columns have l/d < 50

Minimum column dimension is typically braced