ARCH 631. Topic 7 Reading Notes

- Rigid frame is defined by rigid connections (no relative rotations); resists lateral loads well
- Joint restraint reduces rotation and redistributes bending moment; moment on columns means they are beam-columns
- Amount of rotation depends on relative stiffnesses of the beam and column
- Rigid frame base supports will see horizontal force as well as vertical; foundations not as simple
- Lateral loads can result in large moments at the joints, making the member sizes there bigger
- Rigid frame structures are statically indeterminate and require advanced analysis – typically computer based – although there are approximate methods which assume the locations of points of zero internal moment (inflection points)
- Equilibrium of members (separated from the rigid joints) is useful to find reactions and values to construct shear and bending moment diagrams and find axial forces
- Moment distribution is dependent on relative stiffnesses of the beams and columns
- Sidesway is the lateral deflection of a rigid frame under a non-symmetrical vertical load
- Rigid frames are sensitive to differential support settlements because a change in deflection means a change (and usually increase) in the moment; unexpected changes in moment can lead to failure
- Critical loading may be partial loading (like a continuous span) and all patterns need to be tried to find the "envelope" of maximum moments, shear, and axial load for design
- One approximate analysis method for multistory frames is the cantilever method which assumes under lateral load a point of inflection at the midspan of each beam and at mid height of each column, and that the axial force in ach column is proportional to the horizontal distance from the centroid of all the columns
- Vierendeel structures are frames that are used horizontally and are often called trusses even though there are no diagonal members; they are much less inefficient than trusses because of the bending moments; they can be analyzed with the approximate method that assumes the location of the inflection points
- Rigid frames are not efficient to use if lateral loading conditions are high; common design objectives are minimizing design moments and increasing stiffness, along with suitability for foundation and constructability
- Member end conditions influence forces and moments in frames; moment redistribution refers to the distribution of negative and positive moment that when summed equals the moment without the fixed end conditions;
- Superpositioning is required to look at the combined effect of lateral load and gravity (vertical) load to determine the maximum moments for design; partial loadings can create higher moments than primary or full loadings
- Members can be sized based on moment or all sized the same based on maximum moment in the frame (inefficient)

- An optimum frame design based on bending moment is nearly impossible to achieve when multiple loading conditions must be considered
- Frame members must be designed for combined bending and axial load in addition to shear
- Moment resisting joints in steel are welded or bolted to flanges with stiffening plates; reinforced-concrete frames have monolithically cast joints or can use posttensioning; making rigid joints in timber is extremely difficult – knee bracing will help stiffen the joints
- Bracing a rigid frame also reduces the member sizes because of the reduction in bending moment caused by lateral load
- Lateral load analysis of an unbraced frame can be done using the Portal Method of Note Set 7.1 (without having to know the member sizes or stiffnesses); earthquake loads are not considered
- The Portal Method considers a two-dimensional frame of columns and beams for the full height where each frame is considered to be a portal unit
- Wind load is divided equally between portal units (so that interior columns see twice as much shear at the base)
- Column moments are found from multiplying the column shear by half the column height