ARCH 631. Study Guide for Exam 1

This guide is not providing “answers” for the conceptual questions. It is a list of topical concepts and their application you should be familiar with. It is an aid to help prepare for the mid-term exam.

Covers material of Lectures 1, 2, 3, 4, 5, & 6

**Statics & Mechanics**

- Vectors and scalars
- Parallelogram law
- Tip-to-tail method
- Internal vs. external forces
- Tension and compression
- Resultant of a force
- Component of a force
- Moment of a force
- Moment of a distributed load
- Moment Couple
- Equivalent Force Systems
- Concurrent vs non-concurrent force systems
- Equilibrium
- Newton’s First Law
- Direction and type of force in a cable with relation to geometry
- Free Body Diagram
- Reactions at a support and relationship to motion prevented
- Statically Determinate vs. Indeterminate
- Two-force bodies and relationship to loads
- Three-force bodies
- Fixed-end moment reactions
- Pin connections
- Method of Joints
- Method of Sections
- Actions vs. reactions
- Internal shear, axial force & bending moment
- Inflection point on moment diagram
- Effect of forces on shear diagram
- Effect of moments on moment diagram
- Location of zero shear (x) and relation to maximum moment
- Slope relationships with integration
- Normal stress (compression & tension)
- Shear stress (non beams)
- Bearing stress
- Bending & shear stress (beams)
- Torsional (shear) stress (with respect to shape and where maximum occurs)
- Relation of strain to stress & Modulus of Elasticity
- Brittle, Ductile & Semi-brittle material behavior
- Yield strength (or point & proportional limit)
- Elastic vs. plastic range
- Ultimate strength
- Strength vs. stress
- Rupture / Fatigue behavior
- Creep
- Orthotropic vs. Isotropic vs. Anisotropic materials
- Stress concentration
- Thermal vs. elastic strains
- Geometric constraints
- Serviceability
- Buckling
- Deflections & elongation
- Stiffness (relative to EI/L through Δ, or AE/L through δ)
- Superpositioning
- Single vs. double shear
**General: Design**

- Allowable Stress Design
- Load and Resistance Factor Design
- Factored loads
- Resistance Factors
- “Design” values vs. “Capacity”
- Factor of Safety
- Density of materials and relation to weight
- Load types (and directions) *(like D, L, S ...)*
- Minimum loads (building codes)
- Load combinations
- Serviceability and limits (ex. ponding)
- Live load reduction

- Building codes vs. standards vs. structural codes
- Stability of systems & members
- Design vs. analysis
- Efficiency
- Load tracing & (con)tributary width (vs. area)
- Static vs. dynamic loads
- Equivalent static wind load & pressure
- Concentrated loads
- Distributed loads – uniform / non-uniform
- Result of acceleration on a mass and Weight
- Period of vibration, frequency, damping & resonance

**General: Systems**

- One-way vs. two-way systems
- Truss configurations and assumptions for analysis
- Zero-force member
- Special truss member configurations at joints and conditions
- Basis of graphical truss analysis (aka Maxwell’s diagram)
- Compound truss
- “Cable” truss members

- “Shear & Moments” in parallel chord trusses
- Lenticular truss
- Vierendeel “truss”
- Catenary shape, sag
- Cable-stayed
- Pinned arches (2 vs. 3) & rigid arches
- “Thrust”
- Types and purpose of bracing
- Bearing, shear, curtain walls ...

**General: Columns**

- Stability
- Buckling vs. crushing
- Slenderness
- Critical Buckling and Euler’s Formula
- Effective length, K & bracing (end conditions)
- Beam-Columns (eccentric loading)

- Combined bending and compression – *interaction equations or diagrams*
- P-Δ effect
- Eccentricity
- Kern

**General: Beams**

- Simply supported
- Overhang
- Cantilever
- Continuous
- w vs. W
- Equivalent center of load area
- Built-up shape

- Centroid, moment of inertia, $Q$, radius of gyration
- Neutral axis, section modulus, extreme fiber
- Negative area method
- Parallel axis theorem
- Maximum bending stress (& location along length and in cross section)
General: Beams (Continued)

- Maximum shear stress (& location along length and in cross section)
- Maximum shear stress by beam shape (proper equations)
- Shear flow and shear center
- Lateral buckling (and bracing)
- Torsion stresses and cross section shape
- Stress types in beams
- Self-weight
- Deflections & superpositioning (+ units)

- Use of Beam Diagrams and Formulas
- Principal stresses
- Efficient cross-section shapes
- Shaping a beam along the length for efficiency
- Location of supports and efficiency
- “Effective length” and points of inflection
- Methods for analysis of statically indeterminate beams
- Support settlements and stress redistribution
- Loading patterns for spans