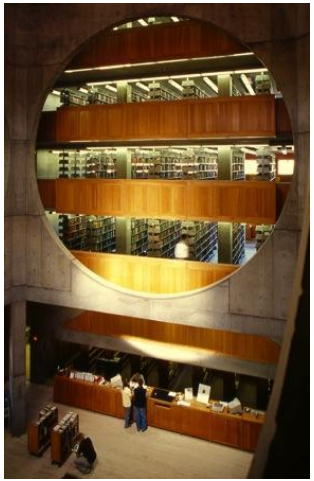
BUILDING TECH I

MATERIALS, PROPERTIES and STRUCTURAL SYSTEMS



BUILDING TECH I

MATERIALS, PROPERTIES and STRUCTURAL SYSTEMS: wood | steel | reinforced concrete

spanning systems

photo:1881
mcny collection

BUILDING TECH I

MATERIALS, PROPERTIES and STRUCTURAL SYSTEMS: wood | steel | reinforced concrete

Structural Systems --

Module 3:Structural Study

Assignment for this week

- Choose 1 of 3 structural systems
- Draw column grid to case study dimensions; determine span dimensions
- Determine beam + decking layout + dimensions based on span rating + rules of thumb [information from Ching BCI readings]
- Start axonometric of floor framing

BUILDING TECH I

MATERIALS, PROPERTIES and STRUCTURAL SYSTEMS: wood | steel | reinforced concrete

Structural Systems --

a few examples from last week...

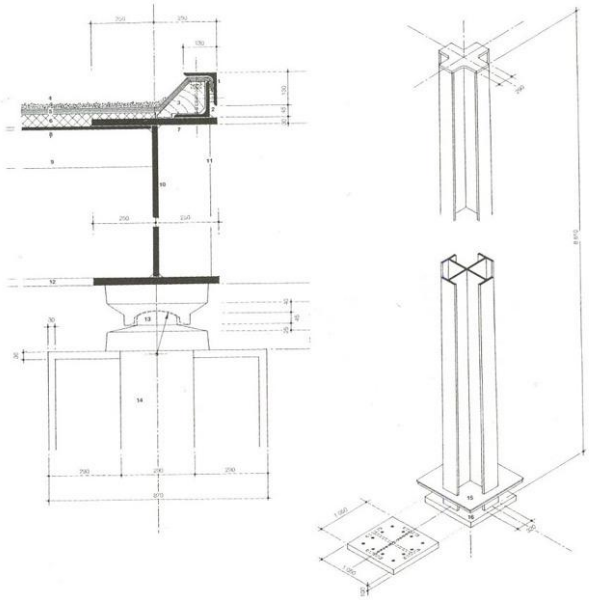
STRUCTURAL SYSTEMS

wood: heavy timber (plank + beam)

wood joist

STRUCTURAL SYSTEMS

steel: (2-way frame)



16. Details of column and pin-joint.

STRUCTURAL SYSTEMS

concrete: sitecast | precast

Photo: Ezra Stoller 1949

BUILDING TECH I

MATERIALS, PROPERTIES and STRUCTURAL SYSTEMS: wood | steel | reinforced concrete

Framing and Floor Decking Systems --

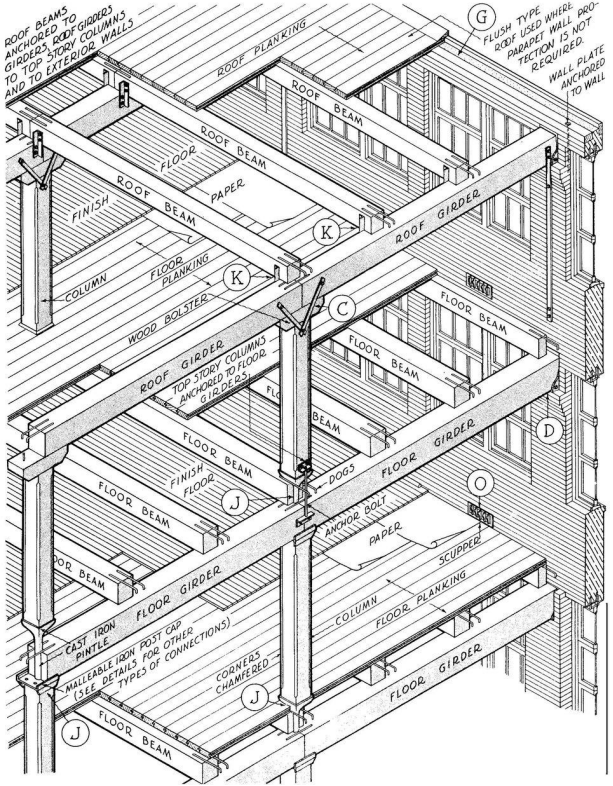
Module 3:Structural Study

Assignment 3A review from last week

- Resources - Ching book, *Building Construction Illustrated*
- Calculations + Sketches

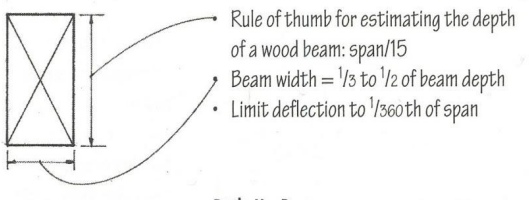
STRUCTURAL SYSTEMS

wood plank + beam | heavy timber



Solid Sawn Lumber

In the selection of a wood beam the following should be considered: lumber species, structural grade, modulus of elasticity, allowable bending and shear stress values, and the minimum deflection permitted for the intended use. In addition, attention should be paid to the precise loading conditions and the types of connections used. See Bibliography for sources of more detailed span and load tables.



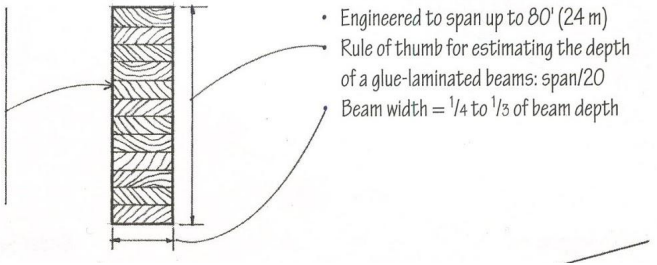
NOTE:
GIRDER (primary beam) SPANS LONGER DIMENSION; USE SECONDARY BEAM FOR SHORTER SPANS

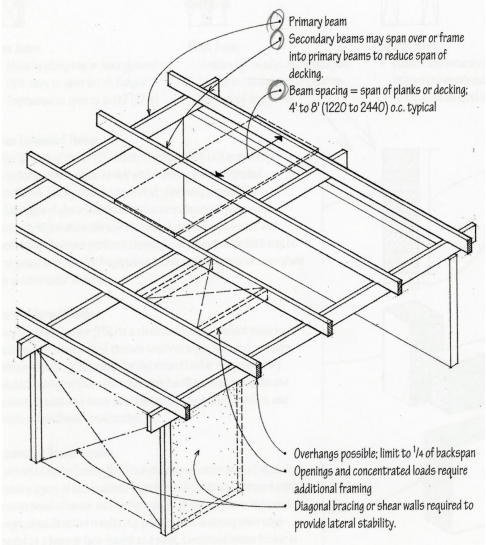
STRUCTURAL SYSTEMS

wood plank + beam | glue-laminated timber

Glue-Laminated Timber

Glue-laminated timber (CSI MasterFormat 06 18 00) is made by laminating stress-grade lumber with adhesive under controlled conditions, usually with the grain of all plies being parallel. The advantages of glued-laminated timber over dimension lumber are generally higher allowable unit stresses, improved appearance, and availability of various sectional shapes. Glue-laminated timbers may be end-joined with scarf or finger joints to any desired length, or edge-glued for greater width or depth.

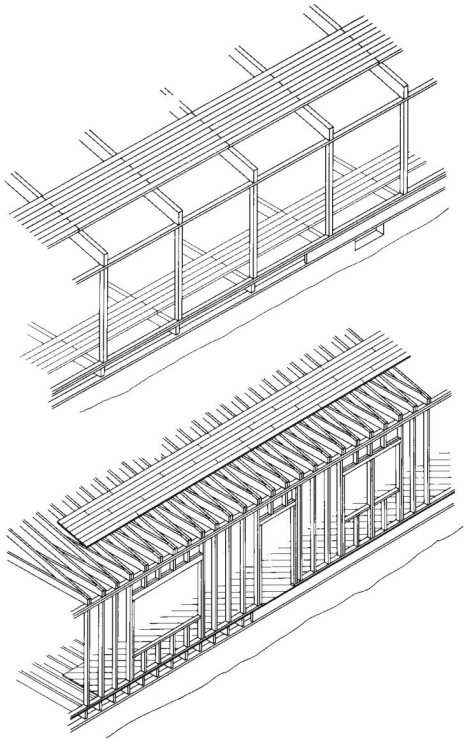


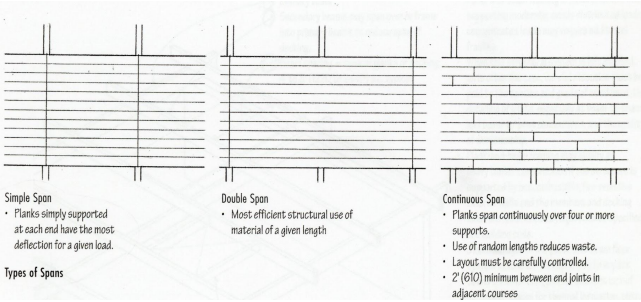


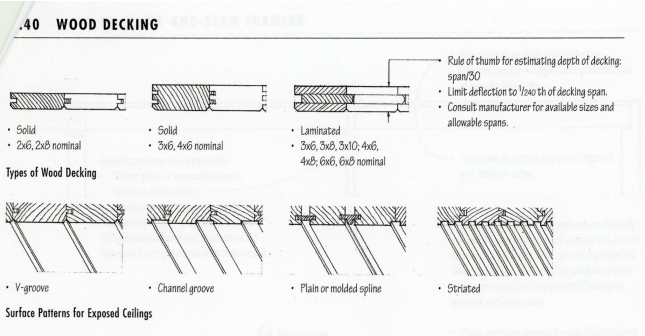
STRUCTURAL SYSTEMS

wood plank + beam | wood decking

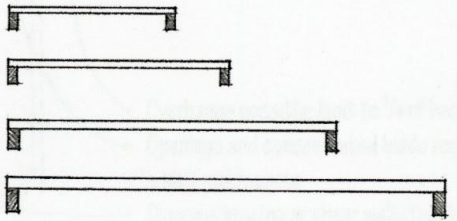
Figure 1 Comparison of Plank-and-beam System With Conventional Framing







- 2x decking can span up to 6' (1830)
- 3x decking can span 6' to 10' (1830 to 3050)
- 4x decking can span 10' to 14' (3050 to 4265)
- 6x decking can span 12' to 20' (3655 to 6095)



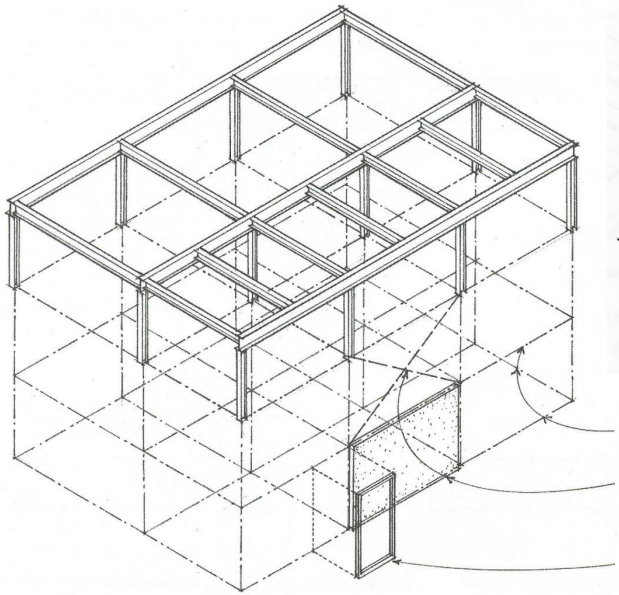
Span Ranges

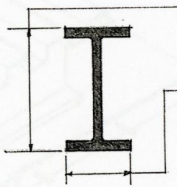
CSI MasterFormat 06 15 00 Wood Decking

STRUCTURAL SYSTEMS

steel beam | metal deck | concrete slab

4.14 STRUCTURAL STEEL FRAMING



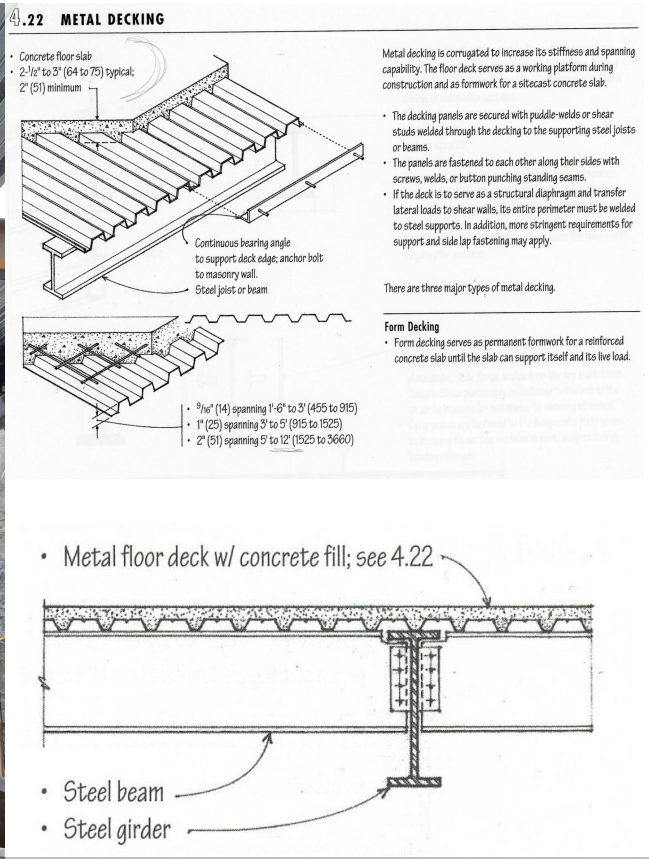


- More structurally efficient wide-flange (W) shapes have largely superseded the classic I-beam (S) shapes. Beams may also be in the form of channel (C) sections, structural tubing, or composite sections.
- Rules of thumb for estimating depth:
  beams: span/20
  girders: span/15
  Width = 1/3 to 1/2 of depth
- The general objective is to use the lightest steel section that will resist bending and shear forces within allowable limits of stress and without excessive deflection for intended use.
- In addition to material costs, also consider the labor costs required for erection.

Steel framing is most efficient when the girder and beam supports are laid out along a regular grid.
Resistance to lateral wind or earthquake forces requires the use of shear walls, diagonal bracing, or rigid framing with moment-resisting connections.
For nonbearing or curtain wall options, see 7.24.

STRUCTURAL SYSTEMS

steel beam | metal deck | concrete slab



4.22 METAL DECKING

- Concrete floor slab
- 2-1/2" to 3" (64 to 75) typical; 2" (51) minimum

Continuous bearing angle to support deck edge; anchor bolt to masonry wall.

Steel joist or beam

- 9/16" (14) spanning 1'-6" to 3' (455 to 915)
- 1" (25) spanning 3' to 5' (915 to 1525)
- 2" (51) spanning 5' to 12' (1525 to 3660)

Metal decking is corrugated to increase its stiffness and spanning capability. The floor deck serves as a working platform during construction and as formwork for a sitecast concrete slab.

- The decking panels are secured with puddle-welds or shear studs welded through the decking to the supporting steel joists or beams.
- The panels are fastened to each other along their sides with screws, welds, or button punching standing seams.
- If the deck is to serve as a structural diaphragm and transfer lateral loads to shear walls, its entire perimeter must be welded to steel supports. In addition, more stringent requirements for support and side lap fastening may apply.

There are three major types of metal decking.

Form Decking

- Form decking serves as permanent formwork for a reinforced concrete slab until the slab can support itself and its live load.

STRUCTURAL SYSTEMS

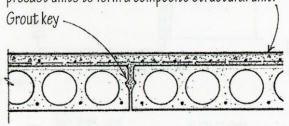
precast concrete

PRECAST CONCRETE FLOOR SYSTEMS 4.11

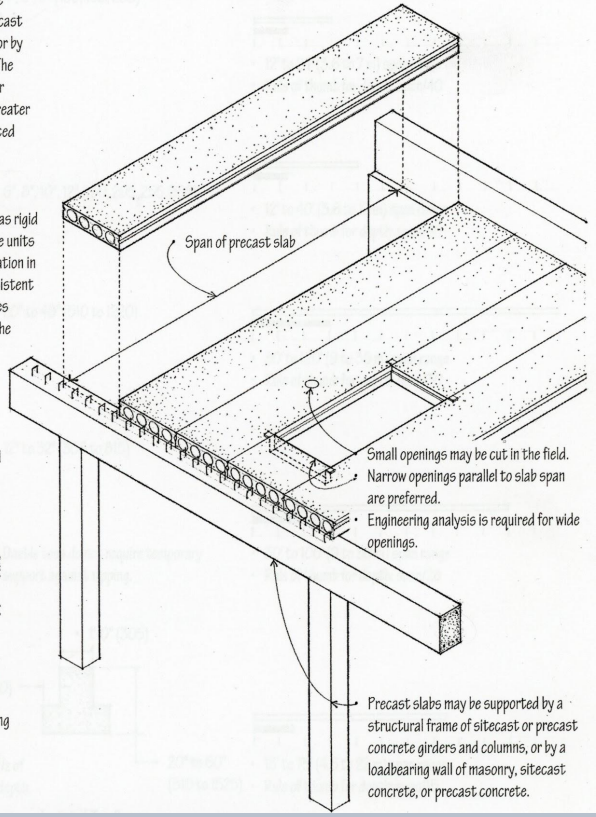
Precast concrete slabs, beams, and structural tees are one-way spanning units that may be supported by sitecast concrete, precast concrete, or masonry bearing walls, or by steel, sitecast concrete, or precast concrete frames. The precast units are manufactured with normal-density or structural lightweight concrete and prestressed for greater structural efficiency, which results in less depth, reduced weight, and longer spans.

The units are cast and steam-cured in a plant off-site, transported to the construction site, and set in place as rigid components with cranes. The size and proportion of the units may be limited by the means of transportation. Fabrication in a factory environment enables the units to have a consistent quality of strength, durability, and finish, and eliminates the need for on-site formwork. The modular nature of the standard-sized units, however, may not be suitable for irregular building shapes.

- A 2" to 3-1/2" (51 to 90) concrete topping reinforced with steel fabric or reinforcing bars bonds with the precast units to form a composite structural unit.
- Grout key

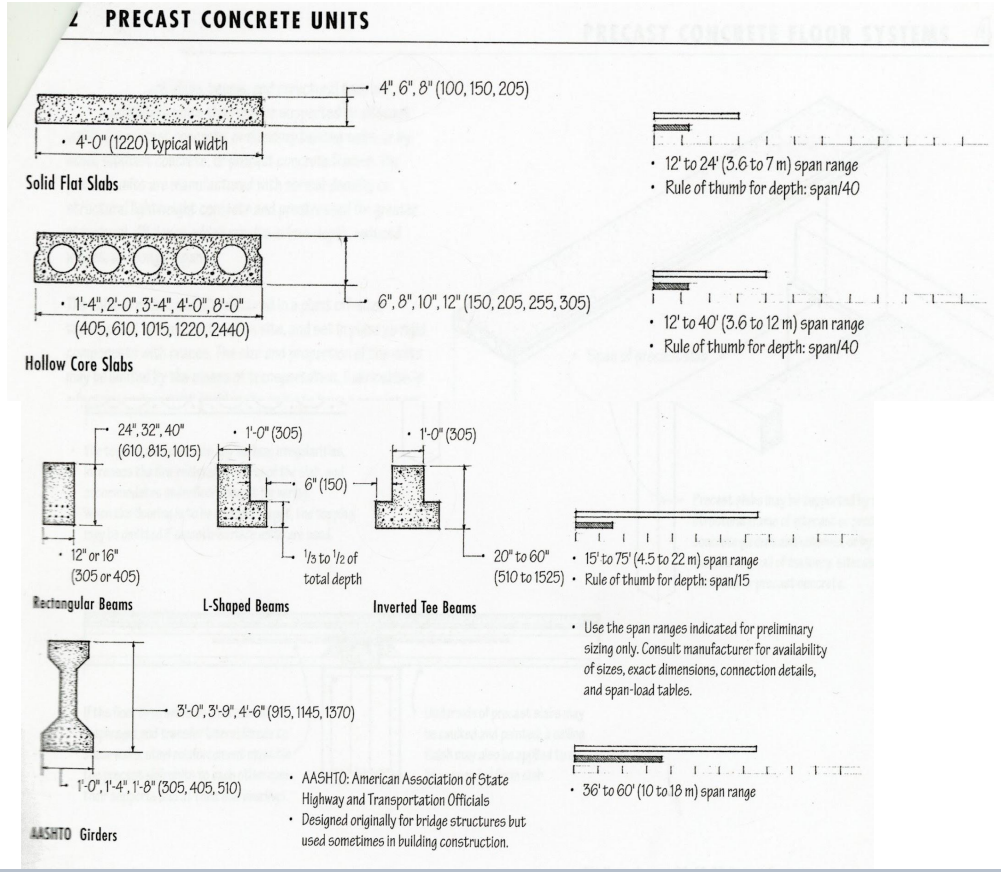


- The topping also conceals any surface irregularities, increases the fire-resistance rating of the slab, and accommodates underfloor conduit for wiring.
- When the flooring is to be pad and carpet, the topping may be omitted if smooth-surface units are used.



STRUCTURAL SYSTEMS

precast concrete



BUILDING TECH I

MATERIALS, PROPERTIES and STRUCTURAL SYSTEMS: wood | steel | reinforced concrete

Framing and Floor Decking Systems --

Module 3:Structural Study

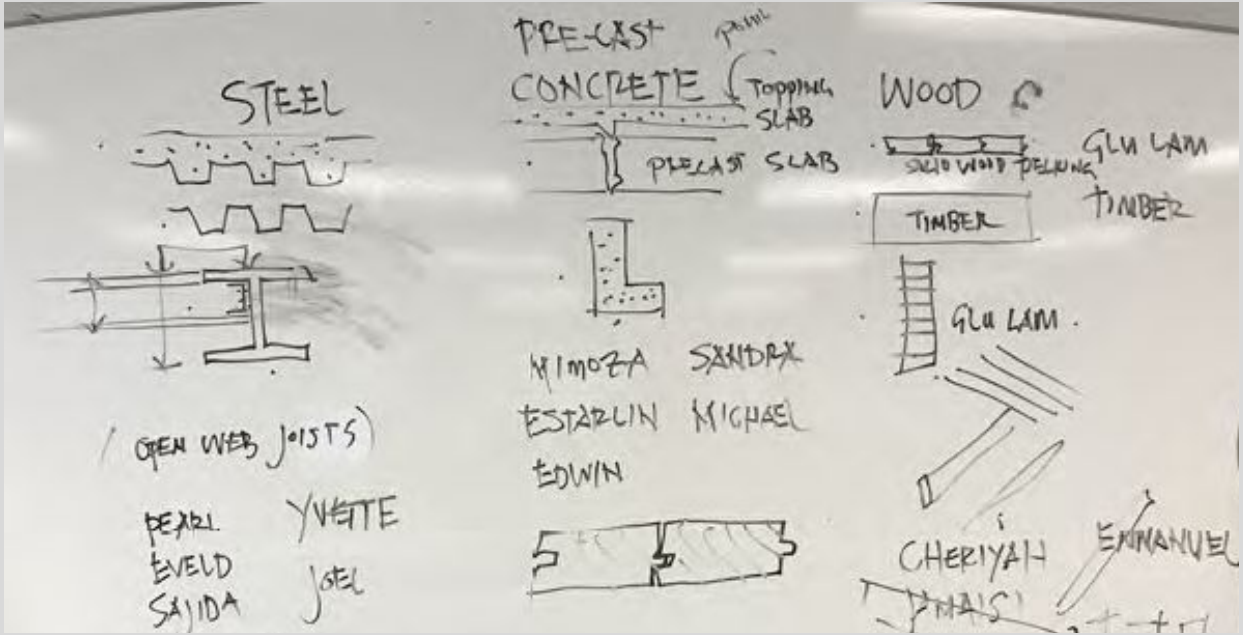
Assignment this week

- Choose 1 of the 3 structural systems
- Draw column grid to case study dimensions; determine span dimensions
- Determine beam + decking dimensions based on span rating + rules of thumb [information from Ching BCI readings]
- Start axonometric of floor framing

BUILDING TECH I

MATERIALS, PROPERTIES and STRUCTURAL SYSTEMS: wood | steel | reinforced concrete

Structural Study -- Choose one system



BUILDING TECH I

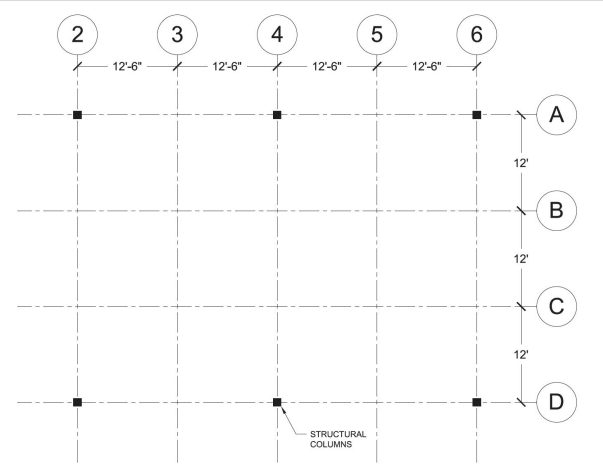
MATERIALS, PROPERTIES and STRUCTURAL SYSTEMS: wood | steel | reinforced concrete

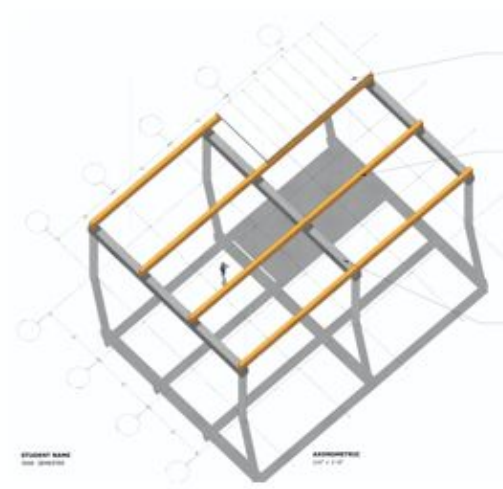
Structural Study -- scale: ⅛”=1’-0”

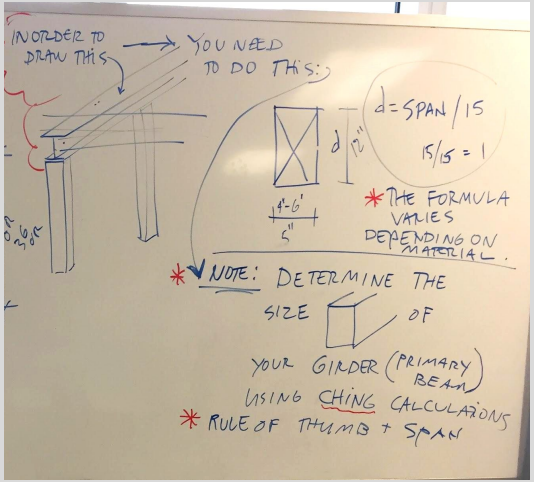
- Draw column grid + columns to case study dims.
- Column size: 18”x18”
- Determine span dimensions
- Calculate primary beam size - see next slide

Axonometric drawing - see next slide

- Calculate decking spacing - rules of thumb
- Calculate secondary beam span + size
- Start axonometric





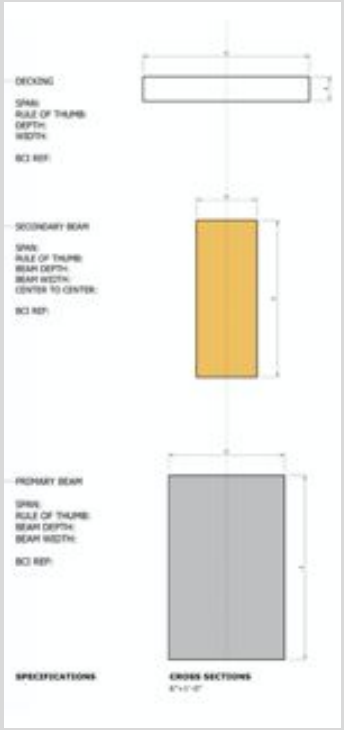


BUILDING TECH I

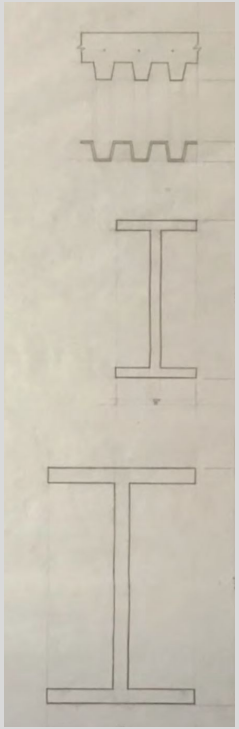
MATERIALS, PROPERTIES and STRUCTURAL SYSTEMS: wood | steel | reinforced concrete

Structural Study

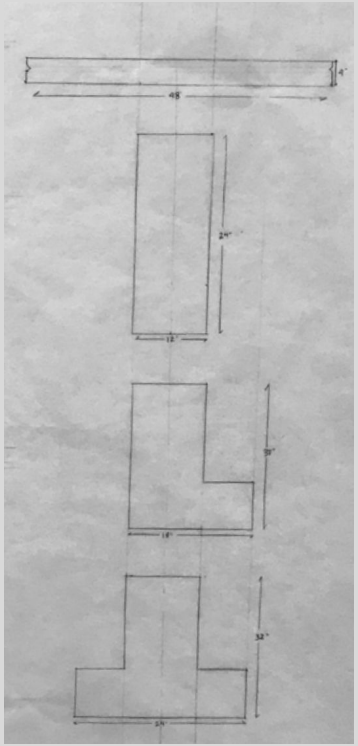
Calculate beam and deck dimensions based on span rating/rules of thumb [BCI]



WOOD



STEEL



PRECAST CONCRETE