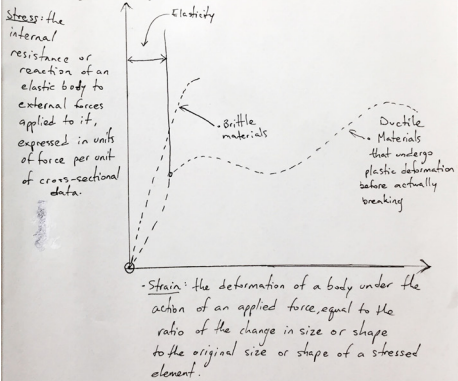


Structural Typology - Le Corbusier - Mies Van der Rohe -
 Point Load v. Wall-bearing - Facilitating Transparency -
 Gothic aspiration (light, and height).

12.02 Building Materials
 -12.03



Elasticity is the ability to deform under stress and return to its original shape when the applied stress is removed.

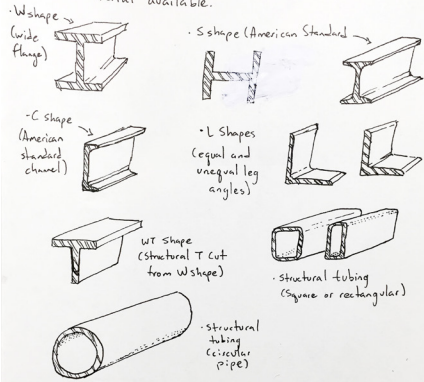
Ductile materials deform then break

Brittle materials rupture easily under loads. Unsuitable for structures.

Stiffness measures resistance. Depends on shape + elasticity.

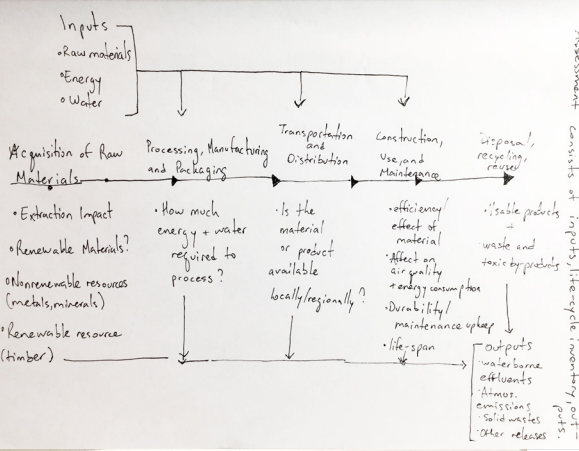
12.08 Steel

Steel = any iron-based alloy with carbon content less than cast iron and more than wrought iron. Combines strength with elasticity. Strongest low-cost material available.



Carbon steel is unalloyed. Carbon, manganese, phosphorus, sulfur, and silicon are controlled. Carbon increases strength, but reduces ductility and weldability.

Alloy steel contains various elements such as chromium, cobalt, copper, manganese, molybdenum, nickel, tungsten, or vanadium added for particular physical or chemical properties.



12.04 Concrete

Can be formed into almost any shape.

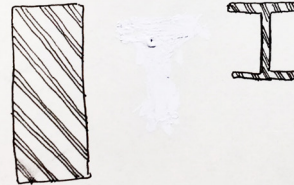


- Cement**
 - Portland Cement made by burning clay and limestone.
 - Type I normal general construction (not distinguished)
 - Type II gen. cons. where resistance to sulfate is required (large piers, heavy retaining walls)
 - Type III high-early strength cures faster + gains strength earlier. used in cold-weather, or in quick removal of formwork.
 - Type IV low-heat generates less heat used in massive concrete structures (dams).
 - Type V sulfate-resisting
 - Air-entraining is Types I-III. Sulfic A.
- Water**
 - free of organic material.
 - Cement paste
- Aggregate**
 - Sand + gravel added to cement paste. 60% - 80% of concrete volume
 - Fine aggregate sand > 1/4"
 - Coarse aggregate crushed stone, gravel or blast-furnace slag < 1/4"
 - Admixtures
 - Air-entraining agents: less cracking, scaling, produce insulating concrete in large amounts.
 - Accelerators, retarders
 - Surface-active agents/surfactants: reduce surface tension of mixing water.
 - Aid in dispersion of other additives.
 - Water-reducing agents: superplasticizers, lower water-cement ratio.
 - Coloring agents.

12.09 Nonferrous Metals - contain no iron.

Aluminum, copper, and lead are commonly used.

Aluminum is ductile, malleable, silver-white. Used in hard, light alloys. Has natural resistance to corrosion. Used in extruded and sheet forms for secondary building elements such as windows, doors, roofing, flashing, trim, and hardware. In structural framing, high strength aluminum alloys are available in shapes similar to those of structural steel.

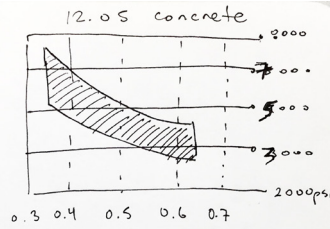


Water-cement ratio.

For most applications, ratio should range from .45 - .60.

Too much water = weak and porous.

Too little water (not enough) = dense but difficult to place and work.



| Material | Embodied Energy Btu/lb.* |
|----------------------|--------------------------|
| Sand/gravel | 18 |
| Wood | 185 |
| Lightweight Concrete | 940 |
| Gypsum Board | 1830 |
| Brickwork | 2200 |
| Cement | 4100 |
| Glass | 11,100 |
| Plastic | 18,500 |
| Steel | 19,200 |
| Lead | 25,900 |
| Copper | 29,600 |
| Aluminum | 103,500 |



Reinforced Concrete Slab
 Reinforcing steel must be protected by the surrounding concrete against corrosion and fire.

American Concrete Institute (ACI) Building Code Requirements for Reinforced Concrete according to the concrete's exposure, and size of coarse agg. + steel used.