

ART 2640, Building Systems of Interior Environments

Fall Semester 2020

Tuesdays & Thursdays 10:30-11:50

Online

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Structure in Design

Structure in the world of design

- What is 'structure'?
- A physical component that bears the weight of something beyond itself: 'load bearing'
- In the realm of design, structure can be anything from shoe laces, to sheet metal panels, to a leather belt, to a wood dowel.

- In the most basic structures there are only three forces that an object, a component, has to resist:
- Compression: think of as the weight upon the element
- Tension: think of as the pulling force on the element
- Torsion: think of as the twisting force on the element

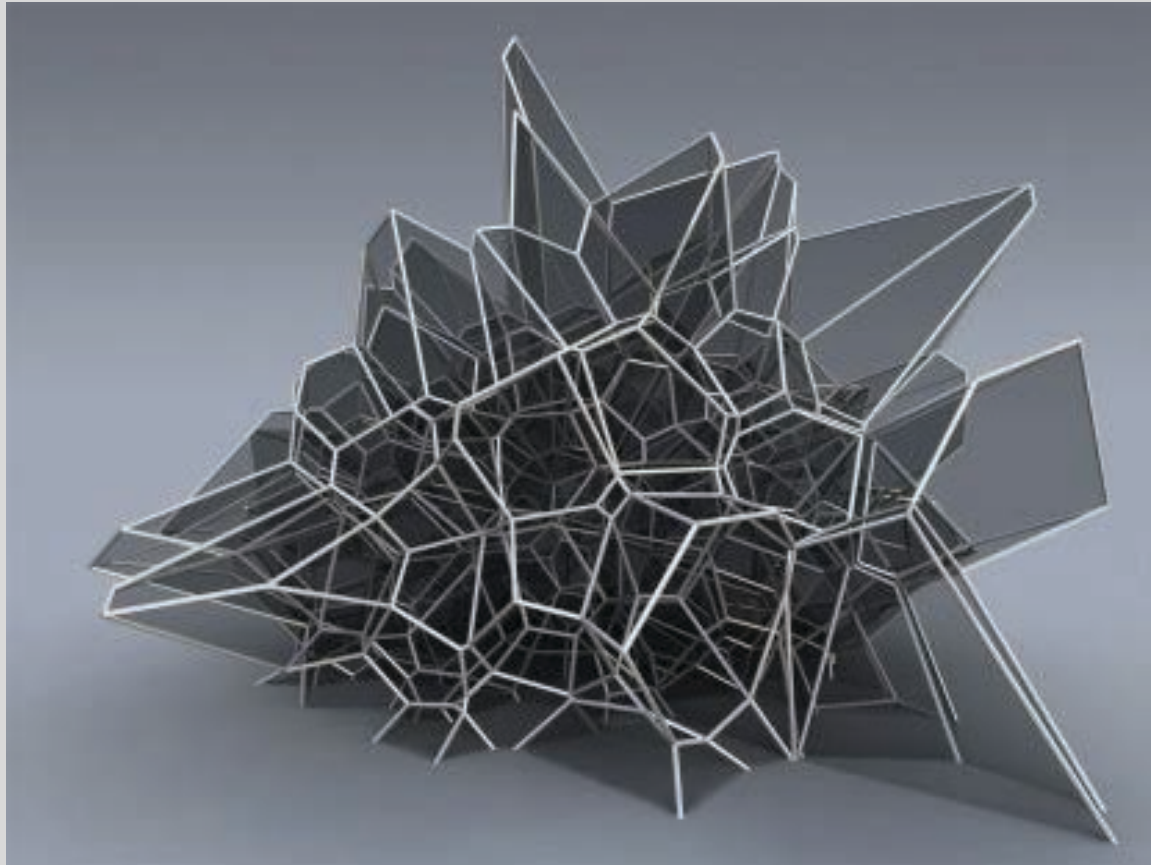
This is a structural frame system







Futuristic Cellular Structure



Canopy structure

possibly based upon the structure of a tree, and leaves



Leonardo Glass Cube building

Glaskoch Corporation

designed by 3Deluxe



Glue Laminated Beams here used as arches



Glue laminated beams are made up of small pieces of wood, glued together, to form a composite, larger piece



Glue laminated beams joined using steel plates and bolts





Interior wood structure: ceiling/overhead plane







Wood pieces used as beams & columns



Bamboo structure



Bamboo scaffolding



Steel connector, bamboo tubes



A small geodesic dome





A tensile structure

the fabric is pulled taut, in tension, by the cables, and is held up by the steel tubes



A tensile structure



A tensile structure



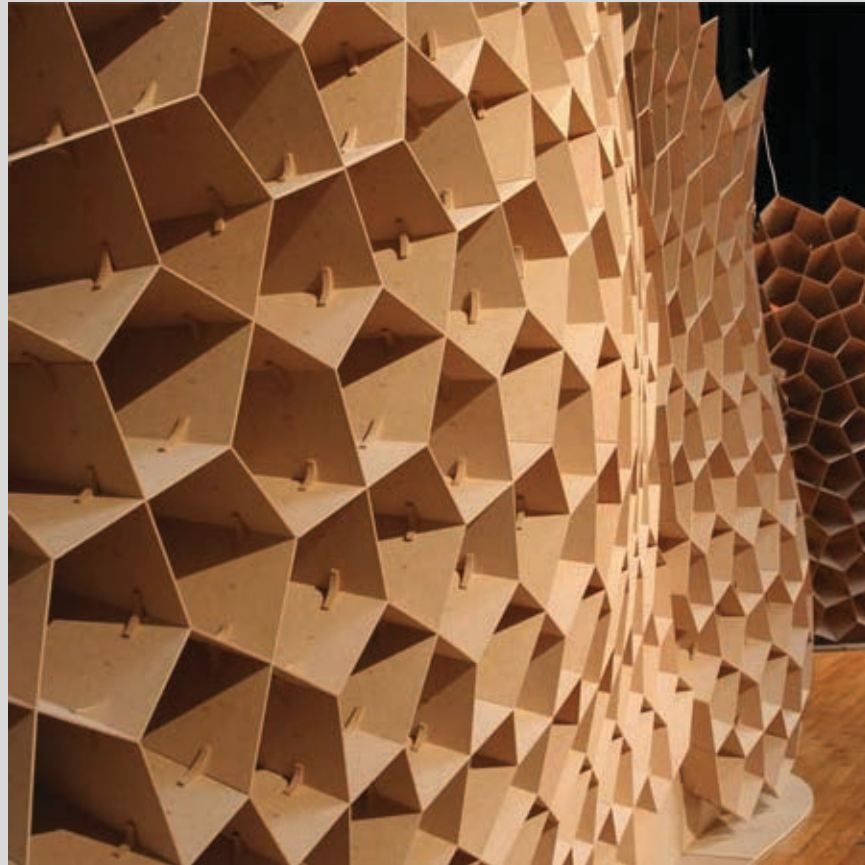
Interior tensile structure



Interior tensile structure



An interior divider/storage wall



Structure as form within the design of furniture



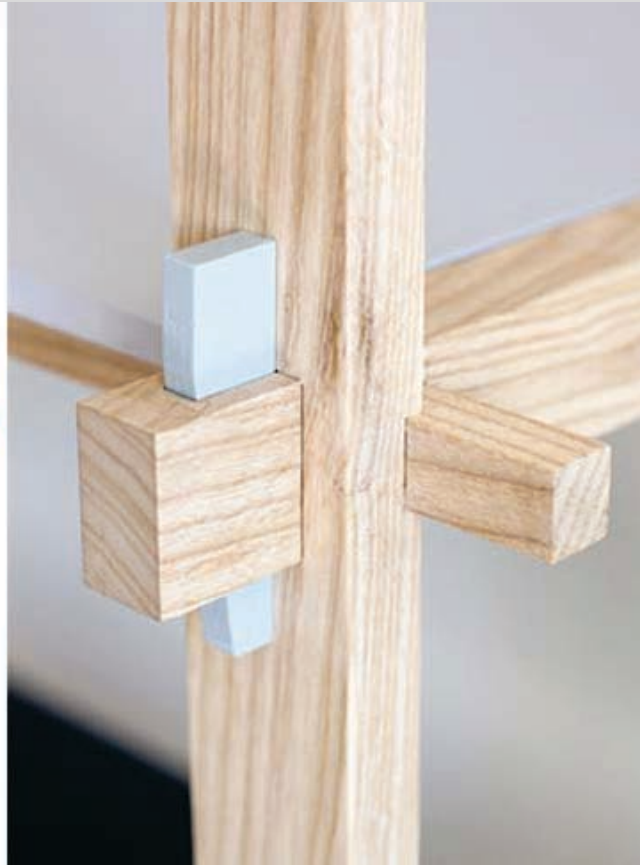
Weight bearing structures



Weight bearing structures



Structure: compression, tension
Joint condition: mortise & tenon



Triangulated corrugated cardboard used as the structure of the chair





Corrugated cardboard



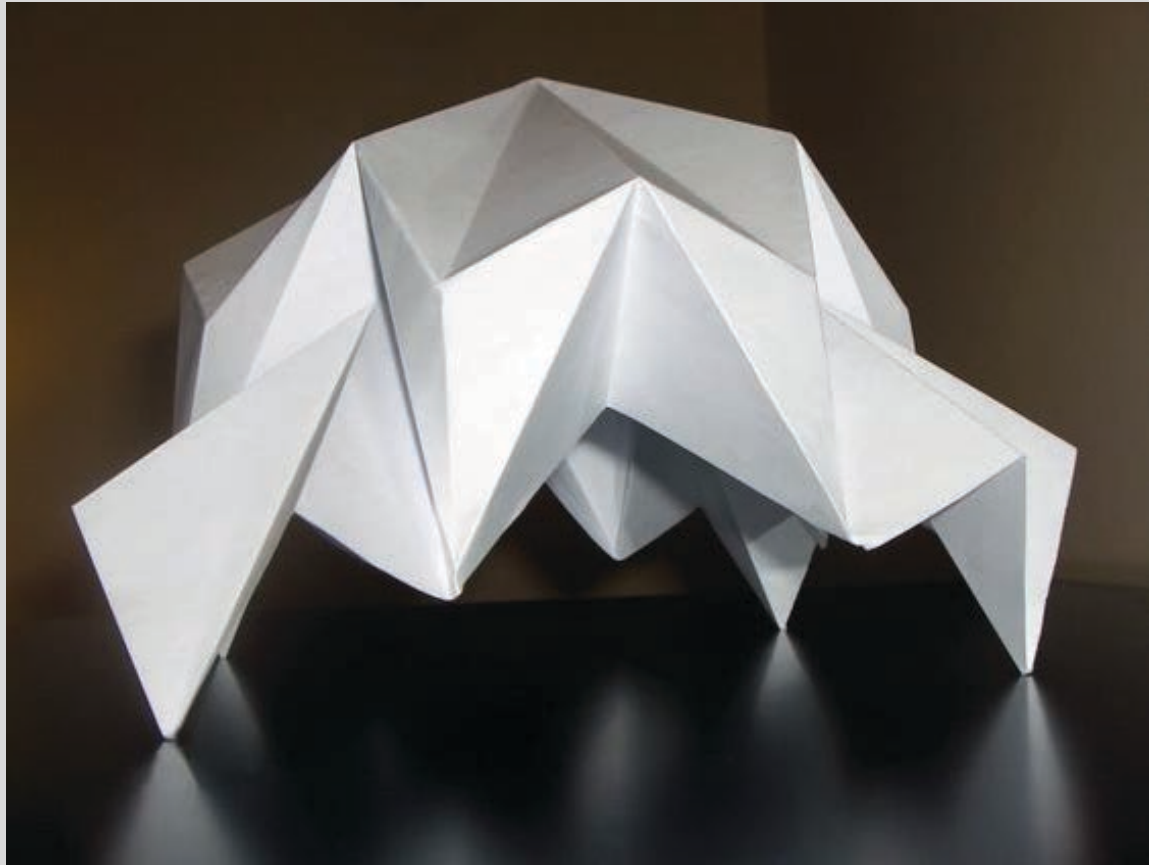


What element is bearing the weight
(compression) of the table top?

The round dowel and the vertical leg

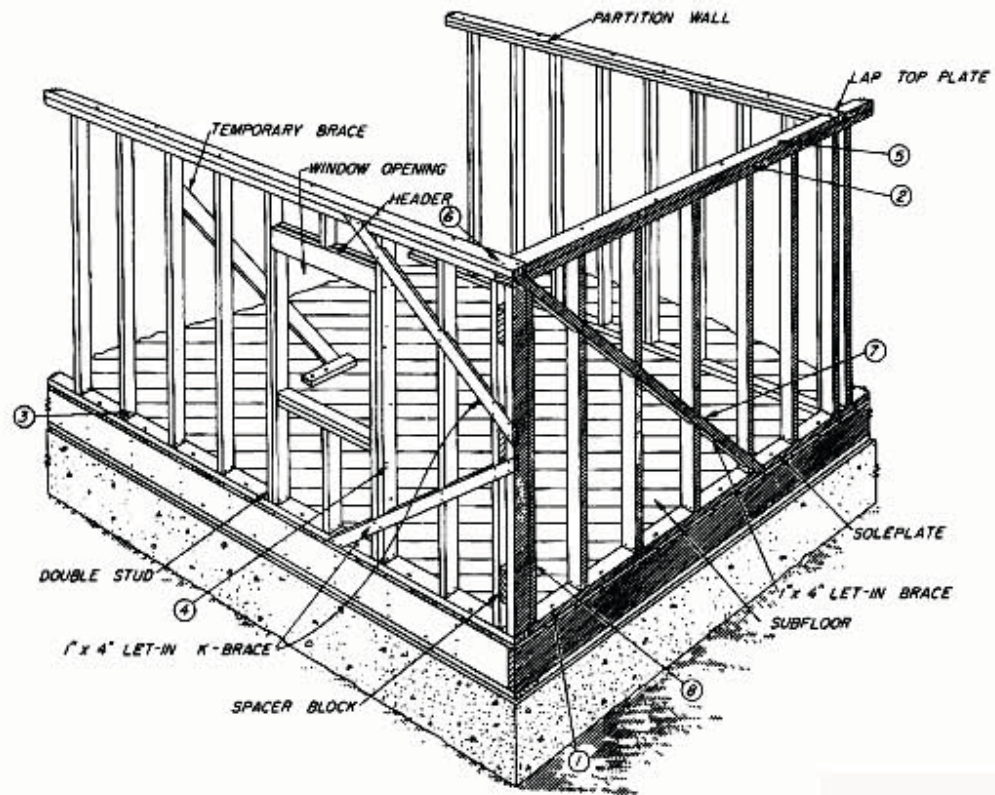


Folded paper: structure at work
How big is this?

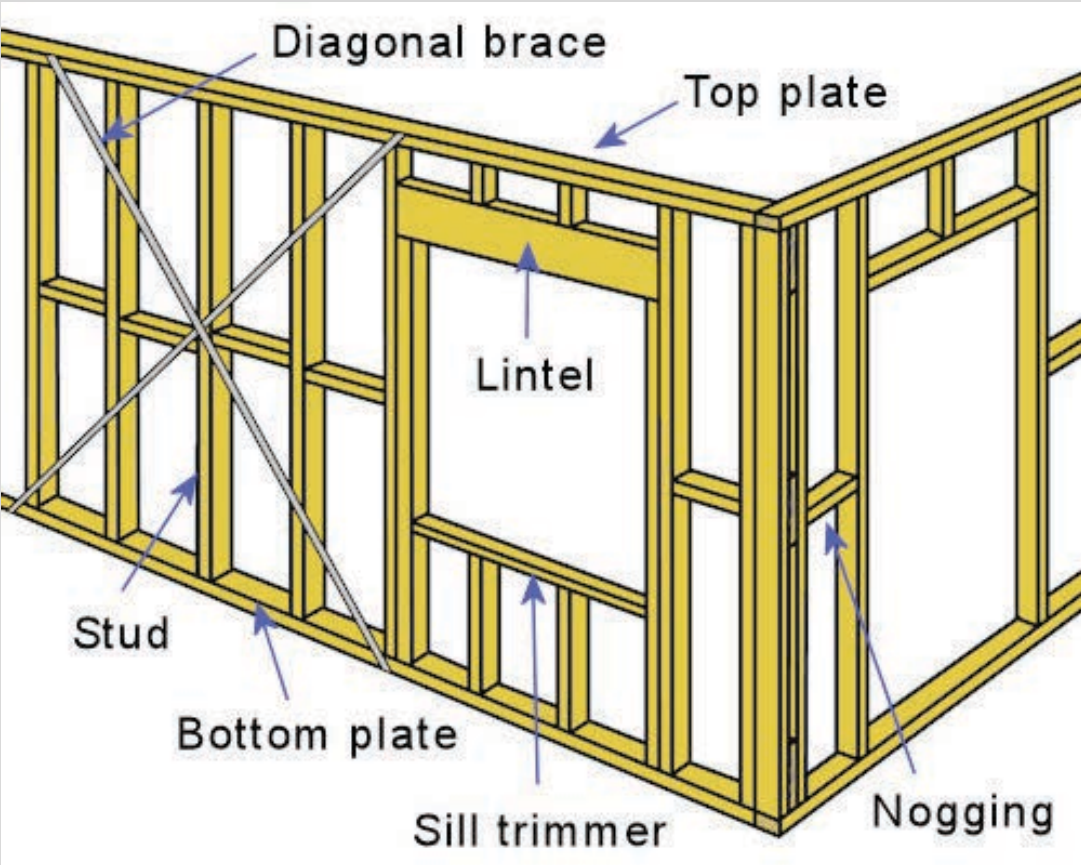


Walls

- Framing Systems:
 - stud walls
 - masonry or concrete bearing walls
 - column and beam structural frame walls with infill
 - structural panel walls







- Stud Walls:
 - built from either wood or light gauge steel
 - studs come in industry standard sizes
 - 2 x 4' s are actually 1 1/2" x 3 1/2"

Stud wall made with steel studs



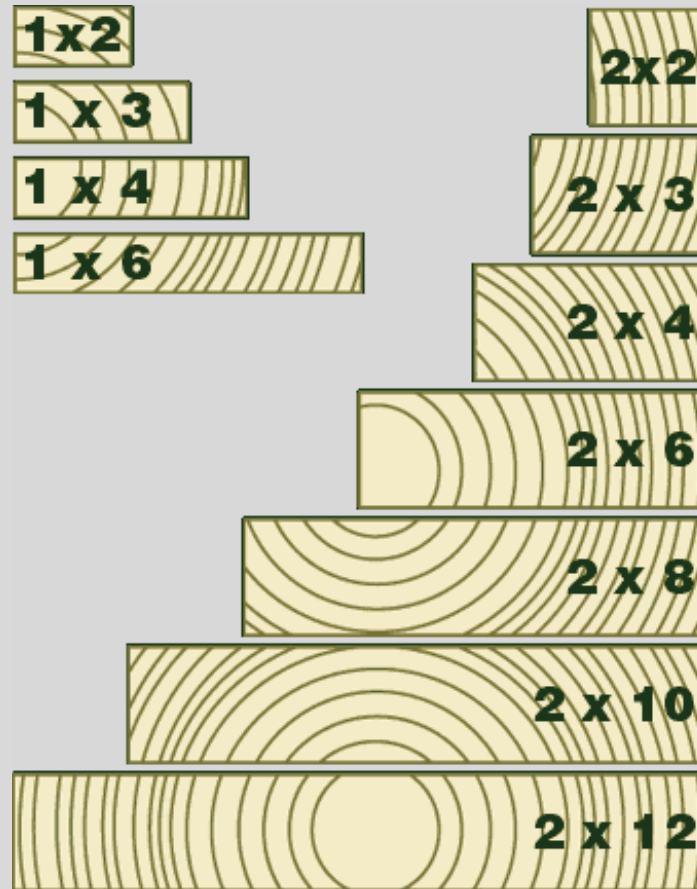


Standard Sizes of Construction Lumber

New and Old Standard Lumber Sizes

Lumber Classification	Nominal Size		Actual S4S Size		Old S4S Size	
	Thickness	Width	Thickness	Width	Thickness	Width
Dimension	2"	4"	1½"	3½"	1⅝"	3⅝"
	2"	6"	1½"	5½"	1⅝"	5⅝"
	2"	8"	1½"	7¼"	1⅝"	7½"
	2"	10"	1½"	9¼"	1⅝"	9½"
	2"	12"	1½"	11¼"	1⅝"	11½"
Timbers	4"	6"	3½"	5½"	3⅝"	5⅝"
	4"	8"	3½"	7¼"	3⅝"	7½"
	4"	10"	3½"	9¼"	3⅝"	9½"
	6"	6"	5½"	5½"	5⅝"	5⅝"
	6"	8"	5½"	7¼"	5⅝"	7½"
	6"	10"	5½"	9¼"	5⅝"	9½"
	8"	8"	7¼"	7¼"	7½"	7½"
10"	10"	9¼"	9¼"	9½"	9½"	
Common Boards	1"	4"	¾"	3½"	25/32"	3⅝"
	1"	6"	¾"	5½"	25/32"	5⅝"
	1"	8"	¾"	7½"	25/32"	7⅝"
	1"	10"	¾"	9¼"	25/32"	9½"
	1"	12"	¾"	11¼"	25/32"	11½"

Standard Construction Lumber Sizes



- Standard spacing for wall studs does vary between 12", 16", and 24", but the vast majority of walls are built using spacing of 16" on center.
- After stud walls are framed (the skeleton of studs put together) they are sheathed to make them stable.
- Sheathing materials include those used for interior and those used for exteriors, the main difference being durability and weather resistance.
- Sheathing materials include: plywood, OSB (oriented strand board) particle board, gypsum board, cementitious boards, masonite, various plastics, and even sheet metals.

Concrete and Masonry Bearing Walls

- Poured concrete, pre-cast concrete, concrete masonry units (CMU) brick, and stone.
- Walls made using these materials are more difficult to cut, or drill through, making the placement of electrical wires, duct work, and plumbing difficult.
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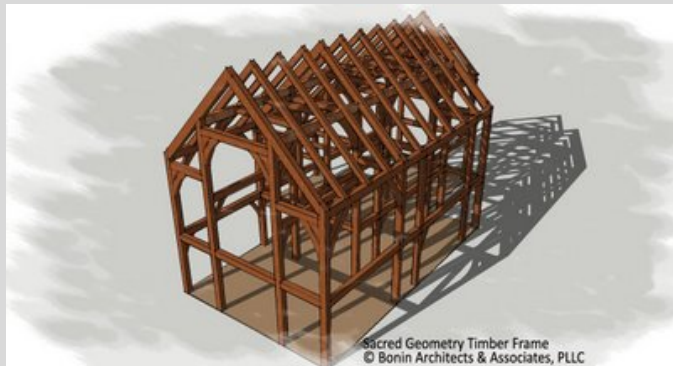
Brick bearing walls
Stone bearing walls

(The thickness of the walls is the visual clue to bearing or non-bearing)



Structural Frame Walls

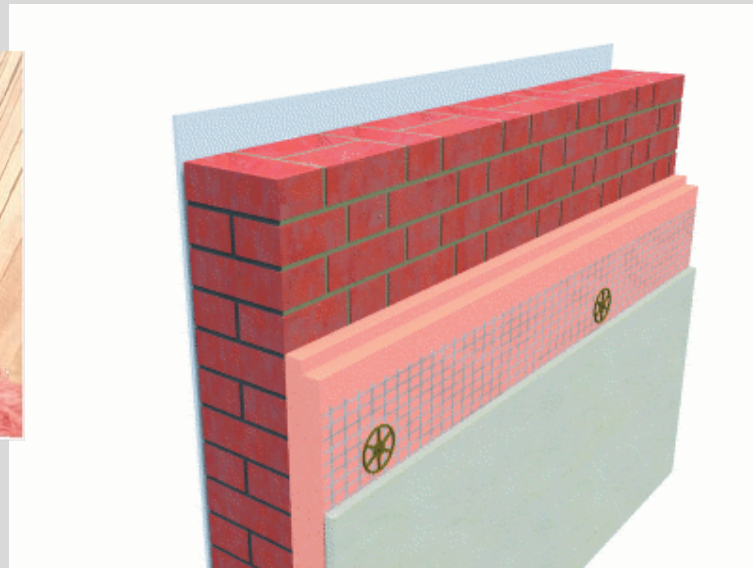
- A structural frame can be made using concrete, steel, or wood.



Most exterior walls, and many interior walls contain some form of insulation.

- Four main types of insulation are:
 - batt insulation
 - rigid board insulation
 - cellulose insulation
 - spray foam insulation
- Insulation can be made from recycled paper pulp, or other natural fibers to reduce environmental impact.
- Many types of insulation are made using plastics and chemicals that may or may not contain toxins, and may be extremely flammable.

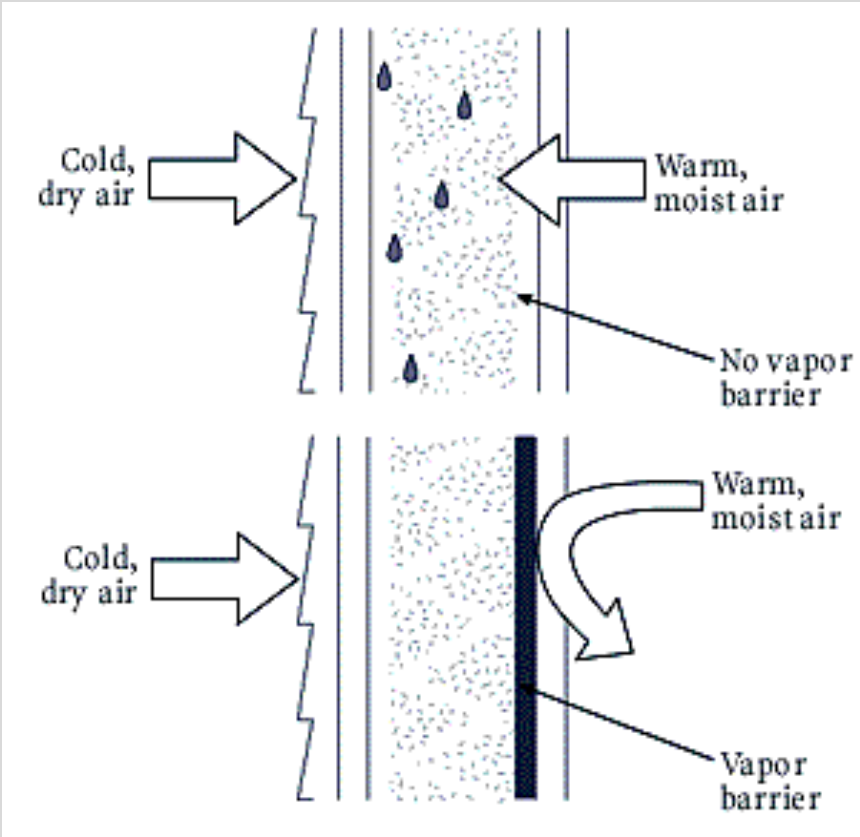
Batt insulation, rigid foam board insulation, blown cellulose insulation



Vapor Retarders

- Condensation within the wall cavity occurs when there is a substantial difference in temperature between the inside and the outside.
- The vapor retarder (vapor barrier) is installed in the wall towards the warmer side.
- This can vary depending on the climate zone.
- In cold climates the vapor retarder is installed toward the inside; in hot and humid climates, toward the outside.

Vapor Barrier/Retarder placement in a wall depends on the climate: hot humid vs. cold



Vapor Retarder from CertainTeed “MemBrain”



CertainTeed
MEMBRAN[™]
Vapor Retarder Film



CertainTeed 
Quality made certain. Satisfaction guaranteed.[™]

Product information from the Certain Teed Company about Mem Brain vapor retarder

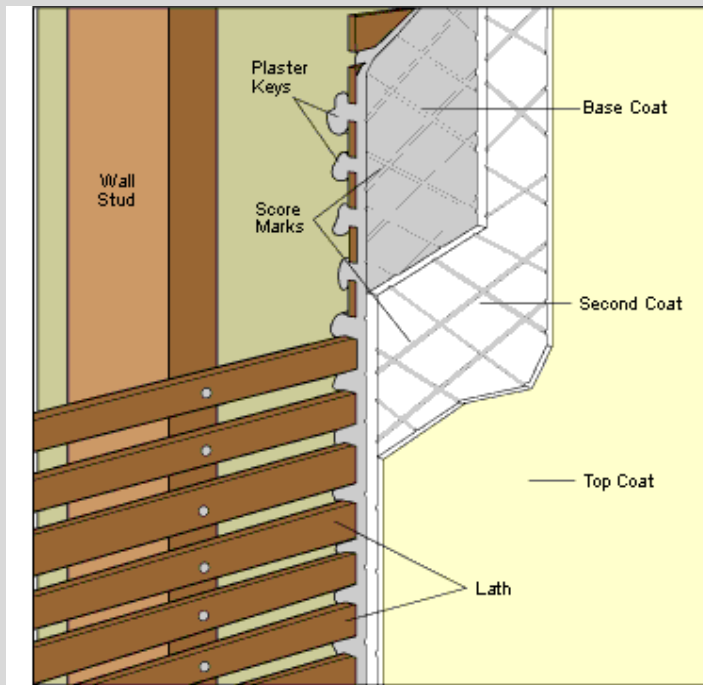
- MemBrain was designed on an ingenious principle: If you can't escape the possibility of moisture entering a wall, why not let the moisture in the wall escape?
- Made from an advanced material that changes its permeability with the ambient humidity condition, MemBrain acts like a traditional vapor retarder to protect wall cavities, but also allows closed building envelope systems to dramatically increase their drying potential with seasonal climatic changes.
- Designed to be applied over unfaced fiber glass insulation, loose-fill applications and spray foam, MemBrain looks similar to typical polyethylene sheeting, but is actually a polyamide-based material that gives MemBrain its unique ability to adapt its permeability depending on the climatic conditions.
- With a high resistance to water vapor in winter or low humidity, MemBrain behaves like a moisture vapor retarder such as poly sheeting. When the relative humidity increases, as in the summer season, its water vapor permeability increases dramatically. This allows water vapor to escape the wall cavity easily.

Interior Substrate Materials

- The selection of interior finish materials for wall surfaces is a substantial environmental impact decision.
- A traditional plaster wall is more environmentally ‘clean’ than gypsum board.
- Traditional plaster walls are made using a three coat system:
 - scratch coat: the thickest, (about 3/4” thick) base layer of rough plaster
 - brown coat: a thinner, (about 1/2” thick) less rough layer of plaster
 - finish coat: a thinner (about 1/4” thick) fine, white plaster.

Traditional Plaster Walls

Face of wall, back of wall with plaster squeezed through the lath.





Bearing Walls

- Interior designers cannot legally change the structure of a building in any way.
- If an interior designer believes that a partition is bearing loads, or has any doubt about that, they must contact an architect, or an engineer.
- General rules of thumb for dealing with structural matters:
 - never remove a column
 - in wood construction, the flooring generally runs perpendicular to the structural frame below
 - window openings should not be enlarged without consulting an architect or engineer.
 - do not remove interior partitions until it is determined that they are non-load bearing, or until alternative support has been constructed.

