

# Building Enclosure Material / System Options

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All Enclosures need to fulfill three categories functions of

## **Support**

### **Control**

Rain

Air

Heat

Vapor

... and often others, such as Fire, Sound, Insects, Access

### **Finish**

Inside

Outside

These functions are met by a range of different materials / sub-assemblies (numerous distinct materials non-chemically combined) in different formats. Common choices for the design of modern buildings in the Western world are listed below. While not comprehensive, the materials/systems listed probably comprise 90-95% of all buildings.

**Support** (*sometimes called structure, but building structure is often distinct from enclosure support*)

- Brick, concrete (CMU), aerated concrete & natural stone (limestone, granite, marble) masonry
- Concrete (precast, sitecast, tiltup) of various densities
- Wood (stud framing, logs, heavy timber, CLT, glue lam, nail lam)
- Steel (stud framing, hot-rolled angles & tubes)
- Aluminum extrusions (custom formed tubes, C-sections, etc.)
- Adobe, cob, rammed earth

Exterior Finish (*the component called "cladding", which may have other functions as well*)

- Brick, concrete, & Stone (limestone, granite, marble) masonry
- Concrete (precast, sitecast tiltup) panels, Ductal (UHPC)
- Ceramic / porcelain / terra-cotta tiles/panels
- Stone panels
- Metal (steel, aluminum, zinc, copper, titanium) panels or siding
- Glass panels
- Fiber-cement panels
- Stucco (cement, lime, earth)
- Synthetic stucco (polymer)
- Adhered veneers (stone, brick, concrete)
- Vinyl Siding
- Wood siding, panels, shakes
- High Pressure Laminates / Phenolic

- Paint or elastomeric over substrate (concrete, metal, wood, etc)
- Polymers / Fiberglass / Acrylic (e.g. Corian) panels
- Asphalt, PVC, EPDM, TPO etc roof membranes

### **Inside Finish**

- Paint or elastomeric (over gypsum wall board, wood, concrete)
- Wallpaper (vinyl or cellulose based)
- Plaster (gypsum, lime, cement)
- Concrete and terrazzo
- Wood and wood veneers
- Ceramics
- Stone
- Glass
- Metals
- Laminates / High Pressure Laminates
- Carpet
- Vinyl (sheet, tile)
- Linoleum
- Cork
- Ceiling tiles of cellulose, mineral fibers etc

### **Control- Heat Control** (*often called Insulation, but there is more*)

- Fiberglass (rigid , batt, blown, loose)
- Stonewool (rigid , batt, blown, loose)
- Cellulose fiber (fiberboard, blown, loose) cork
- Spray foam (open-cell low-medium density and closed-cell medium-high density)
- Extruded polystyrene boards
- Expanded polystyrene
- Polyisocyanurate boards (faced with numerous materials)
- Foamglass, AirKrete, Pumice
- Low-e coatings / radiant barriers (when in conjunction with an airspace)
- Gas-filled or vacuum gaps
- Natural fiber materials (wool, cotton, bagasse, straw, hemp)

### **Control- Water Control** (*joints usually require different or special treatment*)

- Asphalt-impregnated felt
- Asphalt-coated paper
- Polymeric housewraps, polymeric sheets with adhesive backing
- Faced (plastic, aluminum) SBS bitumen and butyl sheets
- Fluid-applied asphalts, urethanes, acrylics, silicones
- Thick layers of monolithic masonry
- 3-6" or more of high-quality reinforced concrete
- roof membranes: EPDM, TPO, fabric reinforced modified SBS, reinforced PVC, fabric reinforced asphalt

- Glass sheets
- Metal (aluminum, steel, zinc, copper) sheets
- Closed-cell plastic foams (spray or board)

**Control- Air** (*joints usually require special treatment*)

- Polymeric housewraps, polymeric sheets with adhesive backing
- Faced (plastic, aluminum) SBS bitumen and butyl sheets
- Fluid-applied asphalts, urethanes, acrylics, silicones
- Thick layers of monolithic masonry
- 3-6" or more of high-quality reinforced concrete
- EPDM, TPO, fabric reinforced modified SBS, reinforced PVC, fabric reinforced asphalt
- Glass sheets
- Metal (aluminum, steel, zinc, copper) sheets
- Closed-cell plastic foams (spray or board) and some open-cell
- Gypsum board
- Wood panel boards (OSB, plywood, MDF)

**Control-Fire**

- Gypsum board
- Cement-bonded cellulose spray
- Concrete / mortar
- Thick layers of solid wood
- Specialty polymeric coatings (intumescent)

**Control- Vapor**

- Specialty paints/coatings, such as epoxy
- All metal sheets, extrusions, films, castings
- Glass
- Asphalt butyl coatings, thick enough (e.g., over 1 mm is enough)
- Polyethylene, saran, polycarbonate, polypropylene as films, not woven or perforated
- Closed cell polyurethane foam (over 2")
- EXPS (over 1-2")
- EPS (density matters, usually over 2" or so)
- Concrete (good quality, over 2-3", lower quality porous, 6-10")
- Dense stone (few pores, over 2-4" thickness or so)
- Closely spaced perforations usually mostly eliminate vapor resistance
- Wood, depending on density, species and thickness (over 4" for softwoods)

Specialty systems that fill niches are not all included in the above: for example, air-supported and tension fabric structures (ETFE pillows, reinforced PVC, PTFE coated glass fabric tents/sails).

Almost any of these combinations can be produced in prefabricated, site built, or near site-fabricated versions.