

## Gypsum Board Construction

2012 International Building Code

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Gypsum board has been an important part of the construction industry for more than 100 years. Its humble beginnings started in the late 1800s as “Sackett Board,” named for Augustine Sackett, one of the inventors of the early gypsum product. Sackett Board consisted of Plaster of Paris between two layers of felt paper. The board was ¼ inch thick and 36 inches square with exposed edges. Although not suitable as a finish product as is today’s gypsum board, Sackett Board made an excellent base for gypsum plaster. In 1910 the evolution of gypsum board took another step forward when a process for wrapping the exposed edges was implemented in manufacturing. This was followed shortly by the replacement of felt paper with a true paper-based facing. Over the next 40 years other developments in gypsum board were introduced, such as air-entrainment to make the board lighter, exterior wall and roof sheathing, and Type X fire-resistant board.

Gypsum board is frequently called “drywall,” a term whose origin has been lost over time, but was likely used to differentiate it from the “wet” gypsum plaster method. Other terms have also worked their way into the gypsum board vernacular, such as “Sheetrock” (a brand name for gypsum board produced by United States Gypsum), and “plasterboard” (commonly used in Europe, Australia, and New Zealand). ASTM C 11, *Standard Terminology Relating to Gypsum and Related Building Materials and Systems*, considers *gypsum board* to be “the generic name for a family of sheet products consisting of a noncombustible core primarily of gypsum with paper surfacing”; thus, *gypsum board* will be used throughout this article.

### Gypsum Board Materials

In the *International Building Code (IBC)*, gypsum board or gypsum wallboard are mentioned numerous times—primarily regarding fire-resistive construction—but the basic requirements for gypsum board, regardless of where gypsum board is mentioned, are located in Chapter 25. Section 2506 requires that gypsum board materials comply with the material standards in Table 2506.2. For standard gypsum board products, the table lists ASTM C 1396, *Standard Specification for Gypsum Board*, which includes the following:

- *Gypsum Wallboard*: A gypsum board defined in ASTM C 11 as being “used primarily as an interior surfacing for building structures.”
- *Predecorated Gypsum Board*: A gypsum board with a factory-applied decorative surface or coating.
- *Gypsum Backing Board*: A thin, ¼-inch to ⅝-inch, gypsum board used as backing for gypsum wallboard, acoustical tiles, or other dry cladding.
- *Gypsum Core Board*: A thick, ¾-inch to 1-inch, laminated gypsum board used for solid or semi-solid partitions.
- *Gypsum Shaftliner Board*: A gypsum board, usually 1-inch-thick, used in specialized shaft assemblies.
- *Water-Resistant Gypsum Backing Board*: A gypsum board with a water-resistant core used as a backing material to ceramic and other types of tile.
- *Exterior Gypsum Soffit Board*: A gypsum board used for exterior soffits that are protected from liquid water.

- *Gypsum Sheathing Board*: A gypsum board suitable for use as a backing for exterior wall coverings and which consists of a water-resistant paper and may have a water-resistant core.
- *Gypsum Base for Veneer Plaster*: A gypsum board used as a substrate to a thin coating of specialized plaster.
- *Gypsum Lath*: A gypsum board used as a substrate for gypsum plaster in lieu of metal or board lath.
- *Gypsum Ceiling Board*: A gypsum board designed for ceiling applications where water-based finishes are applied.

The IBC Table 2506.2 also identifies other gypsum-based board materials along with the required material standards. These include:

- *Fiber-reinforced gypsum panels* per ASTM C 1278. These panels consist of gypsum with cellulose fibers for strength and have no paper facing.
- *Glass mat gypsum backing panel* per ASTM C 1178. These panels consist of a gypsum core surfaced with a fiberglass mat that is embedded or partially embedded in the core and has a water-resistant coating applied to one surface.
- *Glass mat gypsum panel* per ASTM C 1658. These panels are similar to the backing panels, but are suitable to receive a decorative finish.
- *Glass mat gypsum substrate* per ASTM C 1177. These panels are used for exterior sheathing and consist of a water-resistant gypsum core surfaced with a fiberglass mat that is embedded or partially embedded in the core.

Joint treatment materials, such as joint compound and joint tape, are required to conform to ASTM C 475, *Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board*. Joint tape may consist of paper or fiberglass mesh; self-adhered tapes are also permitted. Gypsum board accessories must comply with ASTM C 1047, *Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base*. Accessories include cornerbeads, edge trims, and control joints fabricated from zinc-coated steel, zinc, and ABS and PVC plastic. Metal accessories may include paper flanges.

Fasteners for attaching gypsum board to steel framing shall conform to either ASTM C 954 or ASTM C 1002 for steel screws. The former standard is for screws used to attach gypsum board to steel studs having a thickness of 0.033 to 0.112 inch, which are commonly referred to as cold-formed steel framing. The latter standard applies to screws used for attaching gypsum board to nonstructural steel studs. For attachment to wood framing, screws complying with ASTM C 1002 or nails complying with ASTM C 514 are used. Standard wood fasteners complying with ASTM F 547 or ASTM F 1667 are also permitted by the IBC for attaching gypsum board to wood framing. If adhesives are used for securing gypsum board to wood framing, the adhesive must comply with ASTM C 557, *Standard Specification for Adhesives for Fastening Gypsum Wallboard to Wood Framing*.

### **Gypsum Board Installation**

The IBC provides few requirements regarding the installation of gypsum board. Instead, the IBC relies on the provisions of ASTM C 840, *Standard Specification for Application and Finishing of Gypsum Board*, or Gypsum Association's GA-216, *Application and Finishing of Gypsum Board*. The ASTM standard addresses materials and preparation in addition to the various methods of attaching gypsum board. Although both standards include provisions for stapling gypsum board to wood studs in two-ply installations, this method is not permitted by the IBC, since Section 2508.1 only permits the materials

listed in Table 2506.2, which does not include staples. On the other hand, IBC Section 2306.3 provides criteria for stabling of gypsum board used as shear walls in wood frame construction.

ASTM C 840 provides eleven different systems for application of gypsum board, including typical interior installations on wood and steel stud framing, adhesive application to interior masonry and concrete, and installation for exterior soffits and other protected areas. Curved installations are also addressed using the two methods of moistening the board or cutting the back side. GA-216 includes applications similar to those in ASTM C 840, but it also includes installations for solid gypsum panel partitions and installations over existing interior walls and ceilings.

General installation requirements common to both standards include minimum fastener length, cutting of gypsum board, location of control joints, fastener spacing, and fastener drive depth. Another commonly overlooked requirement within both standards is that the bottom edge of gypsum boards be at least ¼-inch above the floor surface—gypsum board is not permitted to be in contact with the floor surface.

The IBC requires in Section 2508.4 that gypsum board used in a fire-resistance-rated construction have the joints treated with tape and compound and that fastener heads be treated with compound. However, the treatment is not required if one of the following conditions exists:

- The joints and fasteners will be covered with a decorative treatment that would provide similar protection, such as wood paneling and acoustical finishes.
- The joints occur over wood framing members.
- Square- or V-edged gypsum board used as backing or sheathing.
- Multi-layer applications where the joints between layers are offset.
- Assemblies that are tested without treated joints.

IBC Section 2508.2 requires gypsum sheathing when gypsum panels are used as a substrate for exterior wall coverings. Installation of gypsum sheathing shall comply with ASTM C 1280, *Standard Specification for Application of Gypsum Sheathing*. According to ASTM C 1280, gypsum sheathing cannot be left exposed for more than 30 days, after which it must be covered by an exterior wall covering or water-resistive barrier. Requirements for water-resistive barriers are provided in IBC Section 1404.2. Some manufacturers advertise products that can be left exposed for much longer periods of time, but to do so may likely require approval by the building official using the manufacturer's test data or an acceptable evaluation report.

Interior and exterior gypsum board that is part of a fire-resistance-rated assembly or a shear assembly is required to be inspected by the building official per IBC Section 110.3.5. The inspection must take place after the installation of the gypsum board, but prior to the installation of any cladding or decoration, including taping and finishing of joints and fasteners.

### **Application Limitations**

In Section 2509, the IBC limits the use of certain gypsum board types in areas subject to moisture. Where wall tile is used in tub or shower areas or as wall and ceiling panels in shower areas, the only gypsum-based panel product permitted is glass mat water-resistant gypsum backing board per ASTM C 1178. Cement-based panels complying ASTM C 1288 or ASTM C 1325 are also permitted, but are not considered gypsum products.

In water closet compartments, standard water-resistant gypsum backing board per ASTM C 1396 is permitted as a base for tile while other types of gypsum board, such as gypsum wallboard, is permitted as a tile base in other wall and ceiling locations. Water-resistant gypsum backing board, however, cannot be used in areas where it will have direct exposure to water or continuous high humidity. Additionally, on ceilings, ½-inch panels cannot be used when the framing spacing exceeds 12 inches or for ⅝-inch panels when the framing spacing exceeds 16 inches. The IBC also does not permit the use of water-resistant gypsum backing board in shower and bathtub compartments when installed over a vapor retarder, which will be interpreted to mean all water-resistant board, even the glass mat type.

Per IBC Section 403.2.3, interior exit stairways and elevator hoistways constructed of gypsum board in high rise buildings in Risk Category III or IV per IBC Section 1604.5, or all high rise buildings more than 420 feet in height, must meet certain structural integrity requirements. Assemblies surrounding stairways and elevator hoistways must conform to Classification Level 2 for Soft Body Impact per ASTM C 1629, *Standard Classification for Abuse-Resistant Nondecorated Interior Gypsum Panel Products and Fiber-Reinforced Cement Panels*. The face of these assemblies not exposed to the interior of the assemblies is required to be constructed according to one of the following assemblies:

- A minimum of two layers of impact-resistant board complying with Classification Level 2 for Hard Body Impact per ASTM C 1629.
- A minimum of one layer of impact-resistant board complying with Classification Level 3 for Hard Body Impact per ASTM C 1629.
- Multiple layers of any material when tested together complying with Classification Level 3 for Hard Body Impact per ASTM C 1629.

### Gypsum Board Myths

There are many myths surrounding gypsum board, but the most common that this author has encountered are the following two:

**Myth #1** – *Gypsum board is considered a combustible material because of the paper facing.*

Chapter 7 of the IBC establishes the minimum criteria that must be met for a material to be considered noncombustible. Gypsum board is considered a composite material, thus it is required to meet the testing requirements indicated in Section 703.5.2. Per that section, the structural base (*i.e.* gypsum core) must pass the test of established in ASTM E 136, *Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C*, which it does.

In a composite material, the structural base may be covered with a surfacing not more than ⅛-inch thick which has a flame spread index of not more than 50 when tested per ASTM E 84, *Standard Test Method for Surface Burning Characteristics of Building Materials*, or UL 723, *Test for Surface Burning Characteristics of Building Materials*. The paper facing or other facing type on gypsum board has flame spread indices that vary but are less than 50, since the ASTM standard for gypsum board requires a flame spread index of 25 or less. Thus, gypsum board products are considered noncombustible materials per the IBC.

**Myth #2** – *The color of the gypsum board facing indicates the type of gypsum board.*

The facings used on gypsum board products are not part of a standardized identification system for gypsum board. Some products are referred to as “greenboard” (for mold- or moisture-resistance) or

“blueboard” (for plaster base) because of the specific characteristics of the board facings, but this is not typical of all gypsum-based products. For the most part, the color is a branding initiative on the part of manufacturers to make their products readily identifiable as their products on a project site.

## Conclusion

There are many gypsum board products available that have not been mentioned in this article, mainly because the building code does not require or regulate them beyond the minimum requirements discussed. These products include:

- *Type X gypsum board* has a special core that gives 5/8-inch board a 1-hour fire-resistance rating or 1/2-inch board a 3/4-hour fire-resistance rating, when applied parallel to wood studs at 16 inches on center and tested per ASTM E 119, *Standard Test Methods for Fire Tests of Building Construction and Materials*.
- *Type C gypsum board* has improved fire-resistance over Type X board, but is manufactured with a proprietary core that differs with each manufacturer and has varying levels of performance. Assemblies using this type of board are tested per ASTM E 119 or UL 263, *Fire Tests of Building Construction and Materials*.
- *Foil-backed gypsum board* has a foil backing which functions as a vapor retarder.
- *Flexible gypsum board* is a 1/4-inch-thick panel specifically designed for application to curved surfaces.
- *Abuse-resistant gypsum board* is used in areas not previously discussed where the board is frequently subject to damage from abrasion or impact, such as in corridors of schools and factories.
- *Mold-resistant gypsum board* is board complying with the basic requirements of ASTM C 1396, but is also tested for mold growth per ASTM D 3273, *Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber*. A rating of 10 (“totally absent of disfigurement by particulate matter”) per ASTM D 3274, *Standard Test Method for Evaluating Degree of Surface Disfigurement of Paint Films by Fungal or Algal Growth, or Soil and Dirt Accumulation*, is reported by manufacturers that provide these panels.
- *Acoustically enhanced gypsum board* (also called “acoustic” or “sound-deadening” gypsum board) provides improved resistance to sound transmission. These products typically consist of a viscoelastic membrane sandwiched between two gypsum board layers.

Many of the gypsum board products available on the market provide more than one of the gypsum board characteristics listed above. For example, some acoustically enhanced gypsum boards also provide mold resistance. Manufacturers will continue to improve their products and devise new gypsum products as building science expands. The building code may also evolve after these new products hit the market, but in the meantime, the basic requirements of the building code apply. However, the IBC does allow installation of *approved* materials as provided for in Section 2501.1.3.

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