Maintaining Protection of Gypsum Assemblies

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Agenda

• Gypsum Mineral
• Types of Gypsum Cores and Their Applications
• Test Standards for Wall and Ceilings
• Common UL Designs and Acceptable Variations
• Repairs of Gypsum Wallboard
Gypsum Mineral

- Calcium Sulfate Dihydrate
  - CaSO$_4$·2H$_2$O
- 20% water by weight
- Two forms
  - Natural
  - Synthetic (Recycled)
Natural Gypsum
Synthetic (Recycled) Gypsum

- Recaptured Gypsum from Flue Gas Desulphurization

\[ \text{CaCO}_3 + 2\text{SO}_2 + 2\text{H}_2\text{O} = \text{CaSO}_4 + 2\text{H}_2\text{O} + \text{CO}_2 \]

- Reduced Acidification (SO₂)
- Reduced Transportation
- Renewable raw material
- Reduce Extraction (Energy, Pollution)
- Increased GHG (CO₂)
Gypsum Calcination

Dihydrate (Rock)
CaSO$_4$ - 2H$_2$O

Heat

Water

Hemi-hydrate (Plaster)
CaSO$_4$ - 1/2H$_2$O
Gypsum Properties

- ASTM E 119
- 2 hours of exposure equals 1850°F
Gypsum Properties

1” back 950°F
Gypsum Properties

2” back 220°F
Gypsum Properties

4” back  180° F
Gypsum Properties

6” back 130° F
System Fire Rating

• The system of components determines the fire rating!

• A single piece of gypsum has no rating!
Gypsum Core Types

- Regular (ASTM C1396 Defined)
- Type X (ASTM C1396 Defined)
- Proprietary Enhanced (Non-defined, often called Type C)
Panel Core Comparison

- Simple Test @ 1850°F
- 13” x 13” x 5/8” Panels
- Regular, Type X & Type C Panels
- 12lb - 9oz. loading
Test specimen
Significance of Test

• Regular \(\neq\) Type X \(\neq\) Type C

• Specify panel type per the published design

• Panels **MUST** be installed per the published design
Passive Protection - Compartmentalization
Wall Fire Test

• ASTM Test Procedures (E119)

• Aspects of fire test
  1) Heat transfer
  2) Structural integrity
  3) Hose stream – structural integrity

• A single piece of gypsum has no fire rating
Wall Testing Furnace
Standard Time-Temperature Curve

Temperature, Degree F

Time, Minutes

ASTM E119
Wall Assembly Prior to Test
– Fire Exposed Side
Wall Assembly After Test – Fire Exposed Side
Hose Stream Test
Ceiling Fire Test

• ASTM Test Procedures (E119)

• Aspects of fire test
  1) heat transfer
  2) structural integrity
Floor/Ceiling Test Furnace
Floor Ceiling System
- Prior to Test
Floor Ceiling System
- After Test
Gypsum Assemblies

U419 - 1 Hour (U465)
Gypsum Assemblies

U419 - 2 Hour (U411)
Gypsum Assemblies

U419 - 3 Hour
Gypsum Assemblies

U419 - 4 Hour
5. **Gypsum Board** — Gypsum panels with beveled, square or tapered edges, applied vertically or horizontally. Vertical joints centered over studs and staggered one stud cavity on opposite sides of studs. Vertical joints in adjacent layers (multilayer systems) staggered one stud cavity. Horizontal joints need not be backed by steel framing. Horizontal edge joints and horizontal butt joints on opposite sides of studs need not be staggered. Horizontal edge joints and horizontal butt joints in adjacent layers (multilayer systems) staggered a min of 12 in. Horizontal edge joints and horizontal butt joints in adjacent layers (multilayer systems) with Type ULIX need not be staggered. The thickness and number of layers for the 1 hr, 2 hr, 3 hr and 4 hr ratings are as follows:

### Gypsum Board Protection on Each Side of Wall

<table>
<thead>
<tr>
<th>Rating, Hr</th>
<th>Min Stud Depth, in. Items 2, 2C, 2D, 2F, 2G, 2O</th>
<th>No. of Layers &amp; Thkns of Panel</th>
<th>Min Thkns of Insulation (Item 4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3-1/2</td>
<td>1 layer, 5/8 in. thick</td>
<td>Optional</td>
</tr>
<tr>
<td>1</td>
<td>2-1/2</td>
<td>1 layer, 1/2 in. thick</td>
<td>1-1/2 in.</td>
</tr>
<tr>
<td>1</td>
<td>1-5/8</td>
<td>1 layer, 3/4 in. thick</td>
<td>Optional</td>
</tr>
<tr>
<td>2</td>
<td>1-5/8</td>
<td>2 layers, 1/2 in. thick</td>
<td>Optional</td>
</tr>
<tr>
<td>2</td>
<td>1-5/8</td>
<td>2 layers, 5/8 in. thick</td>
<td>Optional</td>
</tr>
<tr>
<td>2</td>
<td>3-1/2</td>
<td>1 layer, 3/4 in. thick</td>
<td>3 in.</td>
</tr>
<tr>
<td>3</td>
<td>1-5/8</td>
<td>3 layers, 1/2 in. thick</td>
<td>Optional</td>
</tr>
<tr>
<td>3</td>
<td>1-5/8</td>
<td>2 layers, 3/4 in. thick</td>
<td>Optional</td>
</tr>
<tr>
<td>3</td>
<td>1-5/8</td>
<td>3 layers, 5/8 in. thick</td>
<td>Optional</td>
</tr>
<tr>
<td>4</td>
<td>1-5/8</td>
<td>4 layers, 5/8 in. thick</td>
<td>Optional</td>
</tr>
<tr>
<td>4</td>
<td>1-5/8</td>
<td>4 layers, 1/2 in. thick</td>
<td>Optional</td>
</tr>
<tr>
<td>4</td>
<td>2-1/2</td>
<td>2 layers, 3/4 in. thick</td>
<td>2 in.</td>
</tr>
</tbody>
</table>
4. Batts and Blankets* — (Required as indicated under Item 5) — Mineral wool batts; friction fitted between studs and runners. Min nom thickness as indicated under Item 5.

See Batts and Blankets (BKNV or BZIZ) Categories for names of Classified companies.

4A. Batts and Blankets* — (Optional) — Placed in stud cavities, any glass fiber or mineral wool insulation bearing the UL Classification Marking as to Surface Burning Characteristics and/or Fire Resistance.

See Batts and Blankets (BKNV or BZIZ) Categories for names of Classified companies.

4B. Fiber, Sprayed* — (Optional, for use with Type ULIX) Where insulation is required - Spray applied granulated mineral fiber material. The fiber is applied with adhesive at a minimum density of 4.0 pcf to completely fill the wall cavity in accordance with the application instructions supplied with the product. See Fiber, Sprayed (CCAZ).

AMERICAN ROCKWOOL MANUFACTURING, LLC — Type Rockwool Premium Plus

6. Fasteners — (Not Shown) — For use with Items 2 and 2F - Type S or S-12 steel screws used to attach panels to studs (Item 2) or furring channels (Item 7). Single layer systems: 1 in. long for 1/2 and 5/8 in. thick panels or 1-1/4 in. long for 3/4 in. thick panels, spaced 8 in. OC when panels are applied horizontally, or 8 in. OC along vertical and bottom edges and 12 in. OC in the field when panels are applied vertically. Two layer systems: First layer - 1 in. long for 1/2 and 5/8 in. thick panels or 1-1/4 in. long for 3/4 in. thick panels, spaced 16 in. OC. Second layer - 1-5/8 in. long for 1/2 in. 5/8 in. thick panels or 2-1/4 in. long for 3/4 in. thick panels, spaced 16 in. OC with screws offset 8 in. from first layer. Three-layer systems: First layer - 1 in. long for 1/2 in. 5/8 in. thick panels, spaced 24 in. OC. Second layer - 1-5/8 in. long for 1/2 in. 5/8 in. thick panels, spaced 24 in. OC. Third layer - 2-1/4 in. long for 1/2 in. 5/8 in. thick panels or 2-5/8 in. long for 5/8 in. thick panels, spaced 24 in. OC. Screws offset min 6 in. from layer below. Four-layer systems: First layer - 1 in. long for 1/2 in. 5/8 in. thick panels, spaced 24 in. OC. Second layer - 1-5/8 in. long for 1/2 in. 5/8 in. thick panels, spaced 24 in. OC. Third layer - 2-1/4 in. long for 1/2 in. thick panels or 2-5/8 in. long for 5/8 in. thick panels, spaced 24 in. OC. Fourth layer - 2-5/8 in. long for 1/2 in. thick panels or 3 in. long for 5/8 in. thick panels, spaced 12 in. OC. Screws offset min 6 in. from layer below.
Fire Resistance and Sound Control Design Manual

Gypsum Systems

GA FILE NO. WP 1058

PROPRIETARY

Gypsum Panels, Steel Studs, Insulation

Fire Design:
One layer 5/8" proprietary type X gypsum panels applied parallel or at right angles to each side of 3.5/8", 18 mil steel studs 24" o.c. with 1" Type S screws 8" o.c. at the edges and 12" o.c. at intermediate studs when applied parallel to framing or 8" o.c. at the ends and intermediate studs when applied at right angles to framing. 3/16" glass fiber insulation in stud cavity. Vertical joints centered over studs and staggered one stud cavity on OPPOSITE SIDES. Horizontal joints need not be staggered or backed (NFB).

Sound Design:
Sound tested with resilient channels 24" o.c. on ONE SIDE with the gypsum panels applied at right angles to channels.

PROPRIETARY GYPSUM PANEL

United States Gypsum Company...5/8" Sheetrock® Brand EcoSmart Panels Firecode® X

Thickness:
4-7/8" (Fire)
5-3/8" (Sound)

Approx. Weight:
3.8 pf (Fire)
3.9 pf (Sound)

Fire Test:
UL R1319, 1766834899, 4-16-15
4786545484, 1-30-15;
4787806679, 8-22-15;
UL Design U419

Sound Test:
USG-151202, 12-1-15
Shaft Walls

Classified by UL
- Can be used in any assembly where SLX panels are listed

UL Assemblies
- U415 1-4 hour rated shaftwall assemblies
- Unsupported horizontal butt joints
- U336 2 hour rated area separation wall

Cross-Section of Elevator Shaft Assembly
Area Separation Walls

Multi-Family Fire Resistance

- Designed for townhouses that share a common wall
- Up to 4 stories
- Allows for collapse of fire-exposed construction while maintaining integrity of unexposed side
UL Design No. U493

- Unique Chase Wall Design
- No connection of opposite studs
- Acoustically better
Influencing Factors

**Framing Material Depth**

**Fire**
- Fire Resistance
  - 1-5/8 in.
  - 6 in.
- Stud Depth

**Sound**
- STC
  - 1-5/8 in.
  - 6 in.
- Stud Depth
Influencing Factors

Framing Material Thickness

FIRE

- 25 ga. (18 mil)
- 20 ga. (33 mil)
- 16 ga. (54 mil)

FIRE RESISTANCE

SOUND

- 25 ga. (18 mil)
- 20 ga. (33 mil)
- 16 ga. (54 mil)

STC

Stud Gauge
Influencing Factors

Framing Spacing

FIRE

- FIRE RESISTANCE
- Stud Spacing: 12 in., 16 in., 24 in.

SOUND

- STC
- Stud Spacing: 12 in., 16 in., 24 in.
Influencing Factors

SCREW SPACING

FIRE

FIRE RESISTANCE

Screw Spacing

Fewer Screws

More Screws

SOUND

STC

Screw Spacing

Fewer Screws

More Screws
Influencing Factors

GYPSUM PANEL LAYERS

FIRE RESISTANCE

FIRE

SOUND

STC

Gypsum Panel Layers

1 2 3

Gypsum Panel Layers

1 2 3
Dos & Don’ts

DO
- Add layers of gypsum
- Add fibrous insulation to walls
- Add resilient channels to walls
- Add materials on top of the flooring system
- Add sheathing (e.g. plywood) within walls

DON’T
- Don’t add insulation to floor- and roof-ceilings without consulting published design
- Don’t add spray foam insulation to walls or ceilings without consulting published design
- Don’t construct steel stud chase walls with a common runner
Repairs

• Simply covering a hole or damaged area is not a repair
• Repair procedure must take into consideration:
  – Size of the affected area
  – Hourly rating of assembly
  – Framing: type, size and spacing
  – Gypsum: type, number of layers and orientation
  – Accessibility: Can the repair be made from both sides?
  – Other: fastening method, location of repair, etc.
• NFPA 1:
  – 12.3.3.2 Where required, fire-rated gypsum wallboard walls or ceilings that are damaged to the extent that through openings exist, the damaged gypsum wallboard shall be replaced or returned to the required level of fire resistance using a listed repair system or using materials and methods equivalent to the original construction.
• Must contact manufacturer to verify listed repair method
Repairs

• GA-225 – Repair of Fire-Rated Gypsum Panel Product Systems
Repairs – Small Surface Patch

6" by 6" (min.) SHEETROCK Brand FIRECODE C Gypsum Panels

Line of opening in existing layer of gypsum panels

4" by 4" (max.) hole

3/8" min.

1-1/2" Type G screws
Repairs – Small Flush Patch

- Cut-out Max. 6" x 6"
- Existing gypsum panel
- Stud

- Type "B" Screw
- Runner
- Patch
- Existing gypsum panel

- Tape & Finish with USG joint finish system
- Section A-A
Repairs – Large Flush Patch

1. Remove existing gypsum panel along the line of patch removal.
2. Install a metal runner for blocking.
3. Use type G screws to secure the patch.
4. Tape and finish joints.
5. Use type S screws to attach to the stud.
Questions??
Thanks for Attending!!!

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