



MARCH 1972

PLAINTIFF'S EXHIBIT

GP-1053

ORDER NUMBERTITLE AND DESCRIPTION

1. A Story of Human Enterprise
Booklet reviewing Georgia-Pacific history and policy, with color photographs, revised October 1971. Suitable for plant tour visitors and civic clubs, schools, etc., in connection with appearance of G-P representative on program. Free in limited quantities: 250 or more, 10 cents each.
2. Annual Report
Company sales, earnings, assets, manufacturing, timber, research, etc. Current issues available in limited quantities.
3. Vital Statistics
Insert for Annual Report containing Company sales, earnings, assets, location of plants and mills, etc.
4. Interim Financial Report
Company sales, earnings, assets, etc. Specify month and year.
5. Growth Magazine
Company magazine. Current and back issues available in limited quantities. Specify month and year.
6. Oregon Saw-Buck
Describes the forest products industry's contribution to Oregon's economy.
7. Keep America's Symbol of Freedom Flying High
Eagle protection posters, 9 x 12", and 10 x 17".
8. Seed Packets
Douglas fir or redwood available in limited quantities. 250 or more, 10 cents each. (Longleaf pine, loblolly pine and yellow poplar available from PR Manager, Augusta, Georgia.)

SGP 0025848

GENERAL CORPORATE LITERATURE CONTINUED

ORDER NUMBER

TITLE AND DESCRIPTION

9. Hunting Maps
- Current hunting maps available for Springfield, Toledo and Coos Bay, Oregon divisions showing areas open to hunters by Georgia-Pacific.
10. Building Products Catalog
- A catalog of building products manufactured by G-P with 5 categories. (A) Sheathing, underlayment and concrete forms. (B) Siding. (C) Interior paneling. (D/E) Gypsum Wallboard, Lath and Plaster. (H) Doors. Limited quantities only. Order by category.

CONSUMER LITERATURE

-
11. Imagination Package
- The right way to use wood paneling for dining rooms, recreation rooms, kitchen and family rooms, living rooms and foyers, bedrooms and dressing rooms, and storage areas. Package of six folders.
12. How to install G-P Factory Finished Paneling
- How to measure, pre-installation instructions, accessory materials, care and maintenance, design and decorating tips. With charts to show the amateur and possibly help the professional.
13. The Great Divide
- How to build fences, patio decks, storage areas out of wood. With dimensions and framing details.
14. Saw-textured Redwood
- Booklet illustrated with color photographs, showing the uses for saw-textured siding/paneling. The board with new faces for a multitude of uses.
15. Reddi-Deck
- From Georgia-Pacific, ready-to-install redwood decks take the guesswork out. Complete instructions, illustrations and charts.

RECREATION AND ENVIRONMENT
(Also see Pulp and Paper)

<u>ORDER NUMBER</u>	<u>TITLE AND DESCRIPTION</u>
16.	<u>G-P Recreation Areas In Oregon</u> Map of recreation areas in Oregon and listing of facilities at each location. Two pages, 8-1/2 x 11".
17.	<u>Public Outdoor Recreation</u> AFI survey results, 1968. 4 x 9", 8 pages.
18.	<u>Welcome to G-P Demonstration Forest</u> Guide to G-P Demonstration Forest near Trinidad, California, 4 x 9", 8 pages.
19.	<u>An Invitation to Recreation In The Redwoods</u> Illustrated folder, 4 x 8", issued by Redwood Industries Recreation Areas.
20.	<u>Georgia-Pacific and the Environment</u> A report on G-P air and water quality programs, reprinted from February 1972 GROWTH MAGAZINE.
21.	<u>The Gift</u> Six page folder covering gift of Van Duzen Redwood Groves to the public by Georgia-Pacific in 1969.
22.	<u>Boning Out Your Deer</u> Oregon State University Bulletin Number 819, 16 pages.
23.	<u>Georgia-Pacific Redwood Land Use Policy</u> One page, 8-1/2 x 13".
24.	<u>Politics, Paperwork and Pollution Control</u> An address by Matthew Gould, G-P Environmental Control Director, before the national conference of The National Environmental Health Association at Portland, Oregon, June 1971.
25.	<u>Industry Speaks Up On Pollution</u> Reprinted from INDUSTRY WEEK, April 1971. Remarks by Matthew Gould, G-P Environmental Control Director.

RECREATION AND ENVIRONMENT CONTINUED

ORDER NUMBER

TITLE AND DESCRIPTION

26. Beware: Witchdoctors in the Woods
Speech reprint of address by W. H. Hunt, President, G-P, at 62nd Pacific Logging Congress, Portland, Oregon, November 3, 1971, in which he points out that environmentalists who proceed without knowledge, particularly in field of forest management, can do more harm than good.
27. We Live Here Too
Explains relationship of gypsum industry to the environment. Produced by the Gypsum Association.

FORESTRY AND TIMBER

-
28. Better Environment Through Forestry
Four pages, 4 x 9", IFA.
29. Patch From the Blue
Six pages, 3-1/2 x 8-1/2", clearcutting, WWPA.
30. Clearcutting--Instant Plunder or Resource Renewal
Six pages, 3-1/2 x 8-1/2", AFI.
31. The Good Lord's Made all the Land He's Going to Make
Eight pages, 4 x 9", WWPA.
32. Conservation for Whom?
Sixteen pages, 3-1/2 x 8-1/2", talk by Dean Zivnuska, RRCC.
33. Want to be a Certified West Coast Tree Farmer?
Four pages, 4 x 9", IFA.
34. Emotions Aside, Clearcutting is Silviculturally Sound Concept
Four page reprint of W. D. Hagenstein talk, from FOREST INDUSTRIES MAGAZINE, December 1970.
35. A Vital Aspect to Forest Ecology
Color pamphlet, WWPA.

SGP 0025851

FORESTRY AND TIMBER CONTINUED

<u>ORDER NUMBER</u>	<u>TITLE AND DESCRIPTION</u>
36.	<u>Unwinding A Tree. . .The Story of Plywood</u> Color booklet, 8-1/2 x 11", APA.
37.	<u>Facts About Western Woods</u> Gives history, botany, uses of western trees, WWP&PA. Excellent as teachers aid and for college students.
38.	<u>ABC's of Even-Aged Management</u> Article provides understanding of even-aged forest management in the United States with particular attention to clearcutting practices, 8-1/2 x 11", reprinted with permission of The American Forestry Association from AMERICAN FORESTS, August 1971.
39.	<u>Multiple Use of Our Forests</u> Pamphlet produced by AFI, explaining term "multiple use," 3-1/2 x 8-1/2".
40.	<u>Forests USA</u> Report on the American forest and what this unique, renewable resource means to man and his environment, AFI, color, 18 pages, 8-1/2 x 11". Excellent source material for answers to questions about the forest products industry. 1971.

PULP AND PAPER

41.	<u>Environmental Protection</u> Pamphlet describing air and water quality control programs of Northwest pulp and paper mills, NWP&PA.
42.	<u>Meeting the Challenge</u> Report on pollution control by NWP&PA.

CAREER INFORMATION

<u>ORDER NUMBER</u>	<u>TITLE AND DESCRIPTION</u>
43.	<u>The Challenge of the Forest. . .Youth Looks to the Future in Wood</u> Illustrated, color booklet by NFPA.
44.	<u>Of Paper and Opportunity</u> Twelve pages, 8-1/2 x 11", illustrated, APA.
45.	<u>Schools & Colleges offering technical and Vocational Education Programs for Careers in the Forest Products Industries</u> Schools and colleges offering technical and vocational programs in preparation for careers in the forest products industries are listed, color, NFPA.

SCHOOL INFORMATION

46.	<u>A Forest Products Community</u> The City of Crossett, Arkansas, and G-P operations located there are featured in this new textbook for second graders. Prepared by the Social Science Staff of the Educational Research Council of America. Copies may be obtained from the publisher, Allyn & Bacon, Inc., Ralston Park, Belmont, California 94002, at a cost of \$1.20 each.
47.	<u>Aids to Learning</u> Pamphlet describing teaching aids that can be ordered to assist teachers in presenting basic understanding of forest management. AFI. Teaching aids include tree charts, illustrated story booklets and audio tapes.
48.	<u>Learn to Love Trees</u> Pamphlet which teaches children that forests are important and why, color, illustrated, AFI.

REDWOODS
(Also see redwood publications under Recreation)

ORDER NUMBER

TITLE AND DESCRIPTION

49. The Redwoods
Paperback pocket book, 176 pages, illustrated, CRA.
50. The Story of the Redwood Forest
Eight page brochure, 4 x 9", CRA.

-0-

AFI--American Forest Institute
1619 Massachusetts Avenue, N. W. Phone: (202) 667-7807
Washington, D. C. 20036

APA--American Plywood Association
1119 "A" Street Phone: (206) 272-2283
Tacoma, Washington 98401

CRA--California Redwood Association
617 Montgomery Street Phone: (415) 392-7880
San Francisco, California 94111

IFA--Industrial Forestry Association
1410 S. W. Morrison Phone: (503) 222-9508
Portland, Oregon 97205

NFPA--National Forest Products Association
1619 Massachusetts Avenue, N. W. Phone: (202) 332-1050
Washington, D. C. 20036

NWP&PA--Northwest Pulp & Paper Association
2633 Eastlake East Phone: (206) EA5-3277
Seattle, Washington 98102

RRCC--Redwood Region Conservation Council
224 Rosenberg Building Phone: (707) 545-9531
Santa Rosa, California 95404

WWPA--Western Wood Products Association
700 Yeon Building Phone: (503) 224-3930
Portland, Oregon 97204

ITEMS ORDERED DIRECT AS INDICATED

Redwood Vacation homes

A booklet for three types of people: beach, mountain and fresh water. Photographs of homes fashioned by thoughtful architects for comfort, beauty and permanence. And all built of redwood.

(Order direct from: California Redwood Association, 617 Montgomery Street, San Francisco, California 94111.)

Vacation Homes

A booklet showing 12 views and plans for vacation homes, and featuring Western Wood. You may order plans or blueprints by using order forms on the inside back cover.

(Order direct from: Western Wood Products Association, 700 Yeon Building, Portland, Oregon 97204.)

A Bookful of Ideas for Your New Home

Beautifully illustrated with color photographs, showing the many uses for plywood--siding, paneling, built-ins, and a section on "Hidden Values."

(Order direct from: American Plywood Association, 1119 "A" Street, Tacoma, Washington 98401.)

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March 1972

ORDER FORM

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Media Service Center
609 N. E. Schuyler
Portland, Oregon 97212

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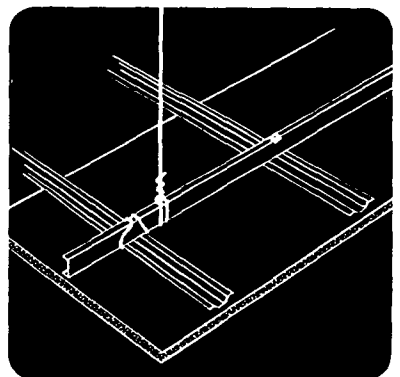
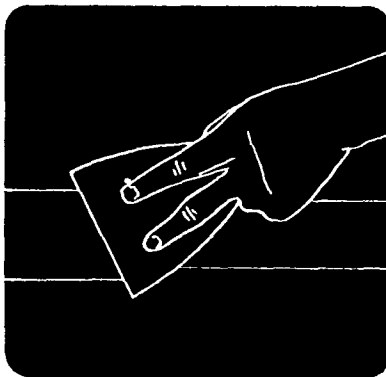
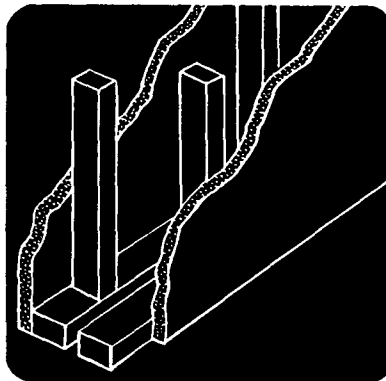
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SGP 0025856

USING
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Characteristics, properties or performance of materials or systems herein described are based on data obtained under controlled test conditions. The Gypsum Association and the member companies make no warranties or other representations as to their characteristics, properties or performance under any variation from such conditions in actual construction.

I GYPSUMBOARD CONSTRUCTION

WHAT IS GYPSUMBOARD?

GLOSSARY

Adhesive, Contact.

Bonds layers of gypsumboard. It forms a strong instantaneous bond after the two surfaces are brought in contact.

Adhesive, Laminating.

Bonds one gypsumboard to another in multiple-layer construction, or it bonds gypsumboard to suitable masonry or concrete surfaces. The bond generally develops slowly as the adhesive dries.

Adhesive, Stud.

Used for attaching single-ply gypsumboard to framing.

Back Blocking.

A single-ply installation procedure for reinforcing joints that fall between framing members with strips of gypsumboard. This helps prevent surface imperfections such as cracking and joint ridging.

Beading.

See **Ridging**.

Butt Joint.

Joints in which board ends with the core exposed are butted together.

Corner Cracking.

Cracks occurring in the joint of inside corners, between intersecting walls or at walls and ceilings.

Corner-Floating.

See **Floating Angles**.

Crimping.

A method of fastening corner beads in place or fixing metal studs in runners by pinching and deforming the metal using a special tool.

Cross Furring.

Furring members installed across, or at right angles to, framing members or runners.

Crown, Joint.

The maximum height above the surface to which treating compound is applied over the wallboard joint.

Edges.

Paper bound edges which usually run the long dimension of the board. (Fig. 1).

Ends.

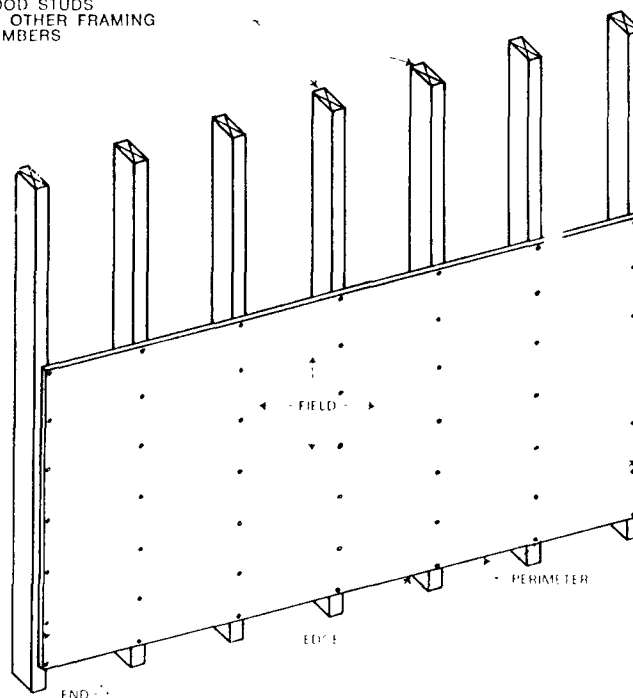
Mill or job-cut edges which expose the gypsum core. They usually run the short dimension of the board. (Fig. 1).

Gypsumboard construction for walls and ceilings is commonly called *drywall* construction because little or no moisture is required for application. Sometimes plywood, hardboard, and fiberboard are also called "drywall", but the term generally refers to gypsumboard. The major difference between gypsumboard and the various other "drywall" boards is that the gypsum product is noncombustible and fire resistant.

Gypsumboard products are flat panels which have a fire-proof gypsum core between surfaces of paper or other sheet material. Some boards also have a surface layer of plastic or aluminum foil laminated on one face.

Gypsum is a rock. It is a crystalline form of calcium sulfate combined with two molecules of water, known as hydrous calcium sulfate, $\text{Ca}(\text{SO}_4) \cdot 2\text{H}_2\text{O}$. Thus, 100 pounds of gypsum rock contains about 21 pounds, or 10 quarts, of

WOOD STUDS
OR OTHER FRAMING
MEMBERS



SGP 0025861

Fig. 1 Horizontally applied wallboard shows paper bound edges at right angles to framing members. Field, perimeter, edges, and ends are also shown.

GLOSSARY (Cont.)

Feather Edging. (Feathering.)

Tapering joint compound to a very thin edge to blend with the adjacent wallboard surface.

Fastener Treatment.

Concealing fasteners which are set below the surface of the drywall by successive application of joint compound until a smooth surface is achieved.

Field.

The surface of the board exclusive of the perimeter. (Fig. 1).

Floating Angles.

Mechanical fasteners at interior angles are omitted to relieve stresses that might otherwise cause cracking and nail popping.

Framing.

The supporting members such as wall studs, ceiling joists, and roof trusses. They may or may not bear part of the load of the building.

Furring.

Wood or metal members used to provide properly spaced, rigid, and even support for gypsumboard. These are fastened over or attached to underlying construction of framing, concrete, or masonry which is not in suitable condition for application of gypsumboard.

Fire Rating.

The time in hours that a wall, ceiling, beam, column, or roof deck will contain a fire when tested in conformance with requirements of ASTM Standard E119.

Gypsumboard.

The name for a family of non-combustible sheet products consisting of a gypsum core between paper surfaces. The core may be regular, water resistant, special fire resistant, or a combination of these.

Horizontal Application.

Horizontally applied boards have the edges at right angles to the framing members. (Fig. 1).

Joint Beading. See **Ridging.**

Joint Compound.

A material used to conceal fastener joints, and surface indentations in gypsum drywall construction.

Joint Treatment.

The method of concealing wallboard joints with tape and layers of joint compound.

Nail Popping.

A protrusion of nailhead and compound directly over the nailhead, caused by outward movement of the nail relative to the gypsumboard.

Nails, Drywall.

Nails suitable for drywall application. (See page 14.)

Nail Spotting. See **Fastener Treatment.**

Perimeter.

Surface of the board near the edges and ends (Fig. 1).

Ridging.

A linear surface protrusion along the treated joints. (See page 20.)

chemically combined water.

In processing gypsum, the rock is mined or quarried, and then crushed and ground to a powder. This is heated to about 325 F, which removes about 3/4 of the chemically combined water. The resulting material is known as calcined gypsum or hemihydrate and is also sometimes called "stucco" or "plaster of Paris." This product is used to make plaster, gypsum lath, and gypsumboard.

To make gypsumboard, the calcined gypsum is mixed with water and additives and spread between sheets of paper. The calcium sulfate then takes on the water and recrystallizes to form gypsum rock as the core of the gypsumboard.

ADVANTAGES OF GYPSUMBOARD CONSTRUCTION

Gypsumboard walls and ceilings have a number of outstanding advantages:

Some of these are:

1. Fire resistance
2. Sound isolation
3. Durability
4. Economy

Fire Resistance:

Gypsumboard is an excellent fire barrier, not only because it is noncombustible, but also because it has combined water in the gypsum core. When gypsum is exposed to fire, the water of crystallization is slowly released as steam, and this effectively retards heat transfer. Gypsumboard walls and ceilings will retard a fire for a number of hours depending on the assembly chosen (Fig. 2).

Sound Isolation:

Specially designed gypsumboard wall and ceiling systems control sound transmission between rooms. Experience shows that sound isolation cannot be adequately provided by the use of either very light, combustible panelling or acoustical surfacing materials. Thin, low-density panels transmit annoying amounts

of noise. Acoustical materials reduce the reflection of sound and the noise levels in a room, but they do not greatly reduce the noise that goes through them to the next room.

Gypsumboard walls and ceilings are effective sound barriers and are comparatively lightweight. Excellent sound isolation is obtained by techniques (Fig. 3) such as: (1) separate framing of the two sides of the wall, (2) resilient channel mounting for the gypsumboard, (3) fastening the wallboard over a sound control material, such as another gypsumboard, and (4) including sound absorbing materials in the wall cavity.

Durability

Gypsumboard makes strong high-quality walls and ceilings with good dimensional stability. The surfaces may be easily decorated and refinished during their long life.

Economy

Gypsumboard products are readily available and relatively easy to apply. They are the least expensive wall surfacing materials available which offer a structurally sound, fire-resistant interior finish. If predecorated board is used, even the cost of decorating may be saved.

GLOSSARY (Cont.)

Screws, Drywall.

Screws developed for wallboard application. (See page 14.)

Sheet Lamination.

Multi-ply construction with adhesives applied to the entire surface to be bonded. (See **Adhesive, Laminating.**)

Strip Lamination.

Multi-ply construction with adhesive applied in parallel strips usually spaced 16 in. or 24 in. apart.

Sound Transmission Class (STC)

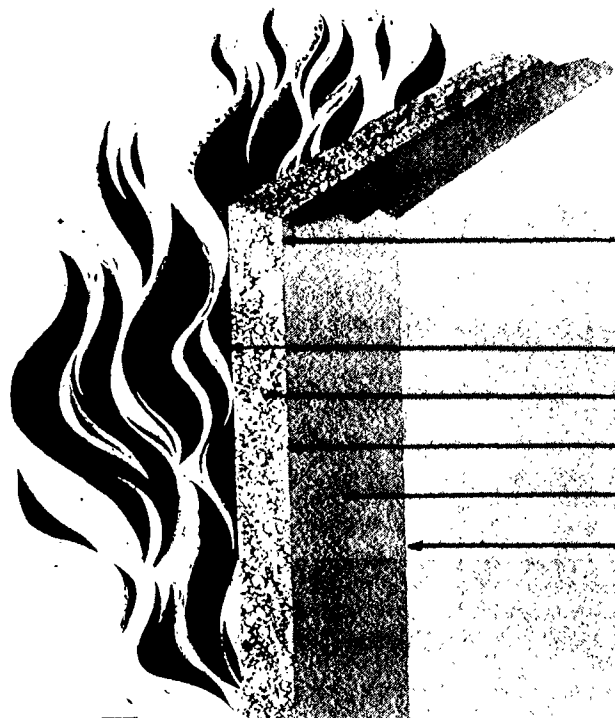
Numbers used by engineers and architects to rate resistance to airborne sound transmission.

Taping.

Embedding tape in joint compound in the process of joint treatment.

Vertical Application.

Vertically applied boards have the edges parallel to framing members.



How Gypsum Retards Heat Transmission

TWO-HOUR EXPOSURE

Vertical line represents plane of calcination at depth of about 2". Temperature never greatly exceeds 212°F. behind plane of calcination.

Temperature of exposed surface = 1900°F.

Temperature 1" from exposed face = 950°F.

Temperature 2" from exposed face = 220°F.

Temperature 4" from exposed face = 180°F.

Temperature at back surface = 130°F.

(Data from Underwriters' Laboratories, Inc.)

Fig. 2 Diagram of a six-inch thick block after two-hour fire test shows how gypsum fights fire.

Fig. 3 Sound isolating techniques improve the sound transmission class (STC) and noise reduction of gypsumboard walls

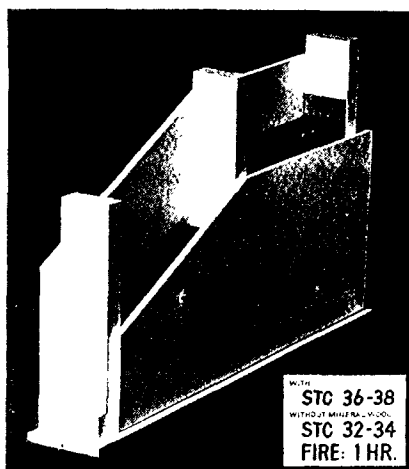


Fig. 3a Adding sound absorbing mineral wool increases the STC four points in this wall.

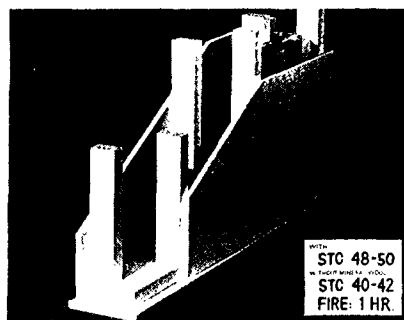


Fig. 3b Staggered studs provide partially separated framing for wall surfaces and increase STC about eight points from wall in Fig. 3a. Addition of sound absorbing material raises STC another 3 points to the 48-50 range.

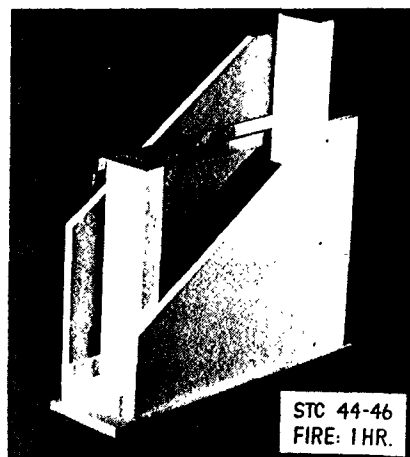


Fig. 3c Resilient mounting of gypsum-board surfaces raises STC about 12 points above that of wall in Fig. 3a.

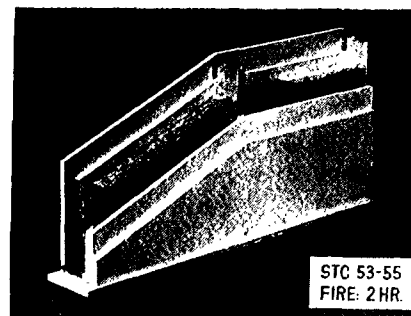


Fig. 3d Two-ply construction increases the weight of the wall surfaces and helps provide high sound resistance of wall with STC of 53-55.

SGP 0025863

TYPES OF GYPSUMBOARD PRODUCTS

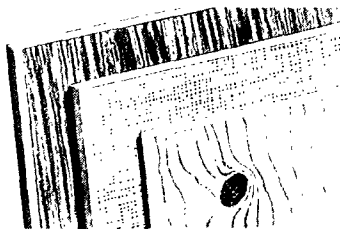
There are a number of types of gypsumboard. One of the earliest types was gypsum wallboard, and many people still refer to all gypsumboard by that term. Today however, it prevents confusion if each type is called by its correct name.

Gypsum Wallboard

Gypsum wallboard is used for the surface layer on interior walls and ceilings. *Regular gypsum wallboard* (Fig. 4) has gray liner paper on the back, but on the facing side and the edges, it has a special paper covering, generally cream colored, that provides a smooth, even surface suitable for decoration. *Insulating gypsum wallboard* has a sheet of bright-finished aluminum foil bonded to the gray liner paper on the back.

Fig. 4 Regular gypsum wallboard is shown with wallboard surface paper and both tapered and square edges.

Fig. 5 Predecorated gypsumboard is available with a variety of surface finishes



Predecorated gypsum wallboard (Fig. 5) has a decorative vinyl or paper sheet bonded to the front (exposed) surface which does not require further decorative treatment.

The various thicknesses of gypsum wallboard are used as follows:
1 4-in. — A low cost wallboard designed for covering and rehabilitation of old

wall and ceiling surfaces.

3, 8-in. — Principally used as the outer face in two-layer wall systems.

1/2-in. — Used in single layer wall and ceiling systems in new construction.

5/8-in. — Used for best quality single layer wall systems. The greater thickness provides additional fire resistance and greater control of sound transmission.

Standard gypsum wallboard is 4 ft. wide and 8, 10, 12, or 14 ft. long. The width complements the standard distances between studs or joists of 16 and 24 in.

The standard edges on gypsumboard used for walls and ceilings are rounded, beveled, tapered, square (Fig. 6) or combinations thereof.

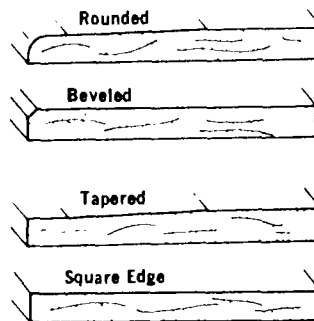


Fig. 6 Four standard edges used on gypsumboard are shown.

Gypsum Backing Board

Gypsum backing board (Fig. 7) is used as a base layer where multiple plies of gypsumboard are required for extra fire resistance, sound isolation, and strength in

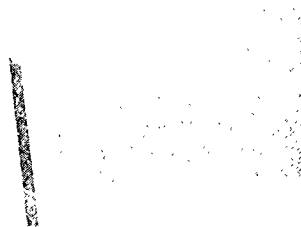


Fig. 7 Backing board has square edges and gray liner paper on both sides.

the wall. It is surfaced with gray liner paper on both sides.

Insulating backing board (Fig. 8) has a sheet of bright-finished aluminum foil bonded to the back face, which serves as a vapor barrier and reflective thermal insulation.



Fig. 8 Insulating backing board has an aluminum foil liner on one side.

Gypsum Coreboard

Gypsum coreboard is used as a base in space saving self-supporting gypsum walls erected without framing, and in demountable walls. Coreboard is made as one in. thick solid gypsum backing board (Fig. 9), or it is factory laminated from two layers of 1/2-in. thick gypsum backing board.



Fig. 9 One-inch thick coreboard shown here is solid, although coreboard may also be laminated from two sheets of backing board.

Type X Gypsumboard

Type X gypsumboard (Fig. 10) is similar in all respects to the previously mentioned boards, ex-

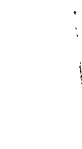


Fig. 10 Type X gypsumboards have the same appearance as other boards, such as regular wallboard here, but the core has added fire resistance.

APPLICATION OF GYPSUMBOARD

cept that the core has been made more fire resistant by the addition of glass fiber reinforcement and other materials. It may be wall-board, backing board, predecorated, or other types. Type "X" boards are used in most fire-resistance rated assemblies.

Water-Resistant Gypsum Backing Board

Water-resistant gypsum backing board has a water-resistant gypsum core and water repellent face paper. It is much more resistant to absorption of water than untreated gypsumboard. It serves as a base for application of wall tile in baths, showers, and other wet areas.

Other Gypsumboard Products

There are other gypsumboard products besides those used for interior drywall construction. These include:

Gypsum lath — used as a base for regular gypsum plaster.

Gypsum veneer base — used as a base for thin coats of very hard, high-strength, gypsum veneer plaster.

Gypsum sheathing — used to stiffen exterior frame walls against the forces of wind and vibration, and to provide fire resistance. This is covered with an exterior finish, such as siding.

Fire-Block gypsumboard — used under combustible roof coverings to protect rafters and the rest of the structure from fires started on the roof. It also serves as additional protection against fires within the structure.

Gypsum formboard — used as a support and permanent form to hold gypsum concrete in poured gypsum roof decks.

Miscellaneous — additional gypsumboard products that may be mentioned include *gypsum soffit boards* for exterior ceilings, and *gypsum planks* for floor-ceiling assemblies. New products for special needs appear regularly.

Gypsumboard is attached to framing or furring members by mechanical fasteners such as nails, screws, clips, or staples, or by special adhesives.

Gypsumboard can be applied over any firm, flat (Figs. 11 and 12) base such as wood or metal framing (wall studs, ceiling joists, and roof trusses) or furring (wood strips or metal channels supported by underlying construction). Wallboard can also be applied directly to masonry or concrete, but usually, furring is required to separate the wallboard from possible dampness in masonry walls. Self-supporting solid or semi-solid gypsumboard partitions are also built and attached to floor and ceilings by runners.¹

The most common gypsumboard used in residential construction is regular gypsum wallboard. Joints between panels and at interior corners are covered with paper tape. Exterior corners and exposed edges are reinforced or trimmed with metal or plastic bead. Joint compound is then used to hide the fasteners, tape, and trim and to give the wall or ceiling a smooth, unbroken surface. Final decoration may be completed with paint, wallpaper, tile, or panelling.

A portion of the gypsumboard

used is predecorated wallboard. This requires no paint or other decoration after installation. Joints are sometimes covered with special mouldings or battens, but often they are left exposed to give a featured joint or plank effect. Also, they may be concealed with the decorative material. Special instructions for installation of predecorated gypsum wallboard are given later under "Predecorated Wallboard Finishes."

Single vs. Multi-ply

Single-ply gypsumboard systems (Fig. 11) are commonly used in light commercial and residential construction. Generally, they are adequate to meet fire and sound resistance requirements.²

¹The proper, recognized methods of installing gypsumboard and finishes are set forth in:

American National Standard Specification for the Application and Finishing of Gypsum Wallboard, ANSI A97.1

²Single-ply gypsumboard systems achieve sound ratings from 30 to 50 STC. Fire ratings are generally limited to one hour for partitions.

Single Ply Application

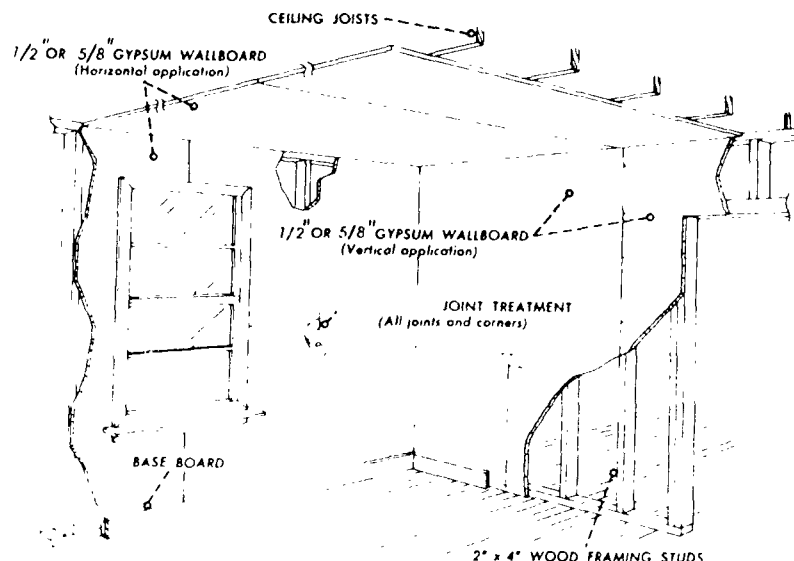


Fig. 11 Wood stud framing provides a firm, level, plumb, and even base for single-ply gypsumboard application. All joints are treated before decorating.

Double Ply Application

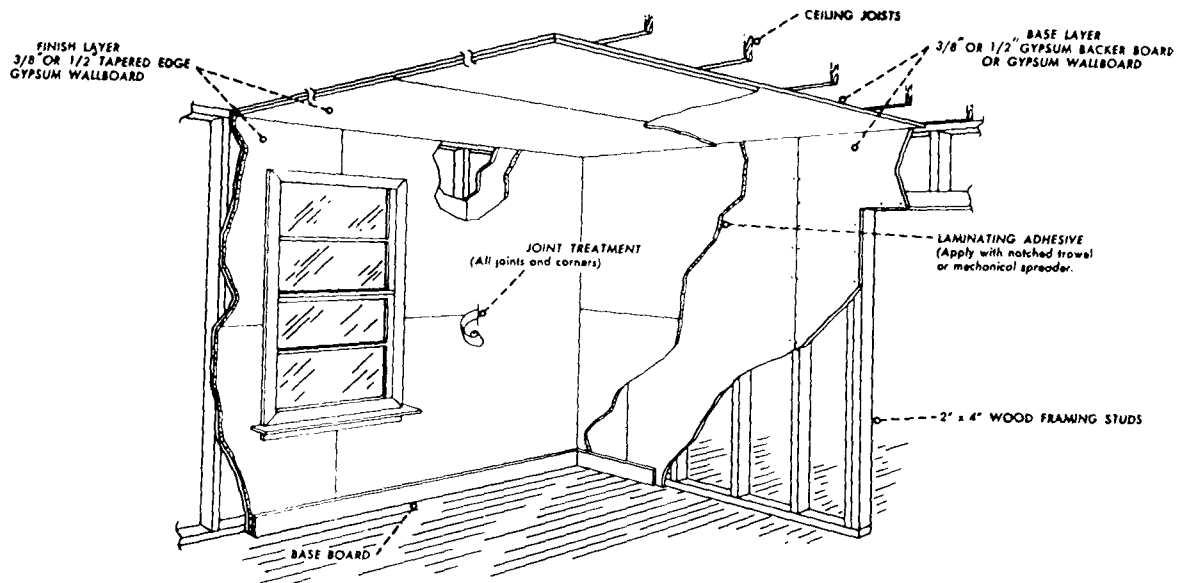


Fig. 12 Double layer multi-ply system has laminated surface layer of gypsum wallboard and base layer of gypsum backing board for greater fire resistance, sound control, and durability.

Multi-ply systems (Fig. 12) have two or more layers of gypsum-board and produce increased sound isolation and fire resistance.¹ They also provide better surface quality because face layers are often laminated and have fewer fasteners in the surface and because the surface joints are reinforced by the continuous backing layer of gypsumboard. Therefore, they are inherently resistant to problems such as nail popping and ridging, and they can provide a good finish with less perfectly aligned supports.

A high-quality job can be assured with either single-ply or multi-ply assemblies by requiring proper:

1. framing details (evenness, spacing)
2. job conditions under which the board is applied.
3. application of the board.
4. joint and fastener treatment, and
5. special requirements for sound isolation, fire resistance, thermal properties, or moisture resistance.

¹Multi-ply gypsumboard systems achieve sound ratings up to 61 STC. Three hour fire ratings are possible.

Jobsite Preparations

Job conditions such as temperature and humidity affect the performance of joint treating materials, the quality of the joint, and sometimes the adhesive bond.

During the winter season, when the temperature is less than 55 F, interior finishes should not be installed unless the building has a controlled heat of at least 55 F. This temperature should be maintained for 24 hours before installation, and until a permanent heating system is in operation.

During warm months, the building need not be completely glazed, but all materials and the installation should be protected from the weather.

Ventilation should be provided if humidity is excessive. In glazed buildings, windows should be kept open to provide air circulation. In enclosed areas without natural ventilation, fans should be used. When drying is slow, additional drying time between coats of joint compound should be allowed. During hot dry weather, or in large, open areas, drafts should be avoided so that joint compound will not dry too rapidly.

Both lumber and gypsumboard can be affected if they get wet at

the job site. Excess moisture in lumber will cause wood shrinkage and nail popping.

Lumber shrinks across the grain as it dries, and it tends to expose the shanks of nails driven into the edge (Fig. 13). If shrinkage is substantial and nails are too long, separation between the gypsumboard and its framing lumber can result. This can happen with excessively long screws also. A separation as small as 1/32 in. can result in an objectionable nail pop (protrusion of the nail head from the surface). Therefore, lumber must be kept dry during storage and installation, and nail lengths should not exceed those recommended for specific applications. Green lumber should not be used for framing and furring. Moisture content should not exceed 19 per cent.

Delivery of gypsumboard should coincide closely with the installation schedule. Boards should be stored flat and under cover at the site. Stacking long lengths on short lengths should be avoided to prevent the longer boards from breaking. Setting boards vertically against the framing with the long edges horizontal is not recommended and is sometimes a dangerous

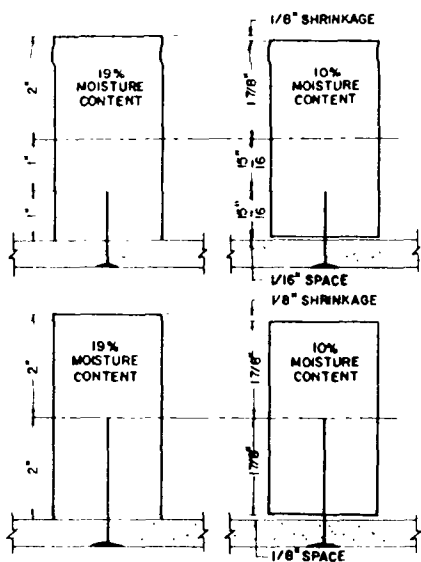


Fig. 13 Studs shrink as they dry out, and separation may occur between the stud and the gypsumboard in a wall. As studs shrink, separation may be as much as 1/16 in. when nails penetrate one in. or 1/8 in. with two-in. penetration.

practice unless safety precautions are taken. All materials should remain in their wrappings or containers until ready for use. When boards are used on the job, they should be carried, not dragged, so that the edges are not abused.

Cutting and Fitting Precautions

Gypsumboard installations should be carefully planned. Window and door frames should be of appropriate depth for the intended wall thickness. When installing mechanical and electrical equipment, consideration should be given to the thickness of the gypsumboard finish and design of

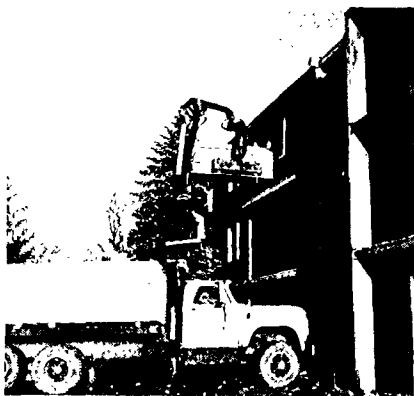


Fig. 14 A boom truck delivers gypsumboard economically to upper stories.



Fig. 15 Gypsumboard applied horizontally provides a stiffer surface finish. Measurements at each corner of framing and gypsumboard must be made carefully to assure close fit around openings.

trim components such as cover plates, registers and grilles.

Boards should span the entire length of ceilings and walls if possible, to avoid butt-end joints which are difficult to finish. Butt-end joints that do occur should be staggered; and they should be located as far from the center of the walls and ceilings as possible. Then, they will be less conspicuous. Except in face layers of two-ply construction, board ends and edges parallel to supporting members should fall on these members to reinforce the joint.

It is preferred that wallboard be installed at right angles to supporting members because a stiffer surface finish results, and there are usually less joints to treat. On long walls, boards of maximum practical length should be used to minimize the number of end joints. Scored, scratched, broken, or otherwise damaged board should not be used.

Proper measuring, cutting, and fittings are very important for successful application of gypsumboard finishes.

Measurements should be taken accurately at the correct ceiling or wall location for each edge or end of the board (Fig. 15). Accurate measuring will usually reveal

irregularity in framing and furring so that corrections can be made or allowances made in cutting.

Straight line cuts across the full length or width of gypsumboard are made by scoring through the face paper into the core (Fig. 16). The core of the board is then snapped and the back paper is cut (Fig. 17). Ragged cut ends should be smoothed with a rasp or sandpaper, or trimmed with



Fig. 16 Gypsumboard can be cut by scoring and breaking. Here, a drywall applicator scores a measured length using a straightedge as a guide.



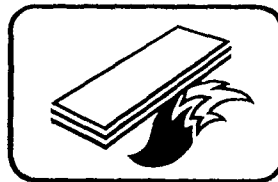
Fig. 17 Completes the break by snapping the gypsumboard away from the scored surface (left) and running a knife through the uncut paper (right). Usually, gypsumboard will be snapped as well as cut while standing as shown at the right.

a sharp knife; otherwise, burrs on the ends will form a visible ridge in the finished surface. Paper-bound edges that have been severely damaged—so that the gypsum core is fractured—should be cut back to sound board. Badly broken edges are susceptible to ridging after joint treatment is applied.

Gypsumboard can be sawn, if necessary, by making the cut from the face side to preserve a smooth paper edge.

When gypsumboard is installed, ceiling panels should be installed first, and then the walls. All panels should be cut so that they fit easily into place. Joints should

be loosely butted; boards should be in contact but should not be forced into position. Tapered edges should be placed next to tapered edges, and square cut ends should be loosely butted to square ends. Square ends should not be placed next to tapered edges because the resulting ridge is very difficult to conceal.



II SUPPORTING CONSTRUCTION

WOOD FRAMING

All wood framing and furring must be accurately aligned in the same plane so that the gypsumboard fits flat against it at all points (Fig. 18). Fastening surfaces should not vary more than 1/8 in. from the plane of adjacent supports. Furthermore, the spacing of framing should not exceed the maximum recommended for the wallboard thickness as shown in Table I for single-ply and multiple-ply construction. This support spacing provides the necessary strength and rigidity for a durable finish.

Warped or crooked studs and joists should be removed and replaced with straight lumber. Excessive moisture in wood can cause warping as the wood dries and that will have an effect on the finished surface. Therefore, the moisture content should never exceed 19 per cent.

Supports for gypsumboard should be rigid to maintain the good appearance of the finish. Headers or lintels should be provided over openings to support structural loads and special construction should be provided

IMPROPER FRAMING

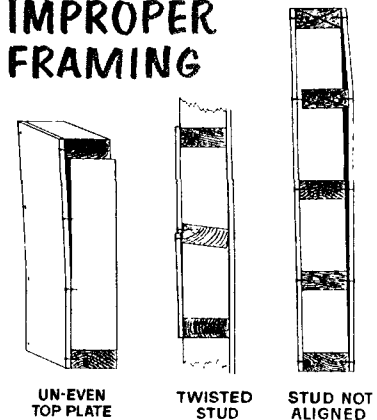


Fig. 18 Framing that is not accurately aligned can cause loose board attachment and problems in finished surfaces

TABLE I
MAXIMUM FRAMING SPACING
FOR APPLICATION OF GYPSUMBOARD

GYPSUMBOARD THICKNESS		LOCATION	APPLICATION	MAXIMUM SPACING		
BASE LAYER	FACE LAYER			ONE LAYER ONLY	TWO LAYERS FASTENERS ONLY	ADHESIVE BETWEEN LAYERS
3/8"	—	Ceilings	Horizontal	16" o.c.	16" o.c.	16" o.c.
3/8"	3/8"	Ceilings	Horizontal	NA	16" o.c.	16" o.c.
3/8"	3/8"	Ceilings	Vertical	NA	NR	16" o.c.
1/2"	—	Ceilings	Horizontal	24" o.c.	24" o.c.	24" o.c.
1/2"	—	Ceilings	Vertical	16" o.c.	16" o.c.	16" o.c.
1/2"	3/8"	Ceilings	Horizontal	NA	16" o.c.	24" o.c.
1/2"	3/8"	Ceilings	Vertical	NA	NR	24" o.c.
1/2"	1/2"	Ceilings	Horizontal	NA	24" o.c.	24" o.c.
1/2"	1/2"	Ceilings	Vertical	NA	16" o.c.	24" o.c.
5/8"	—	Ceilings	Horizontal	24" o.c.	24" o.c.	24" o.c.
5/8"	—	Ceilings	Vertical	16" o.c.	16" o.c.	24" o.c.
5/8"	3/8"	Ceilings	Horizontal	NA	16" o.c.	24" o.c.
5/8"	3/8"	Ceilings	Vertical	NA	NR	24" o.c.
5/8"	1/2" or 5/8"	Ceilings	Horizontal	NA	24" o.c.	24" o.c.
5/8"	1/2" or 5/8"	Ceilings	Vertical	NA	16" o.c.	24" o.c.
1/4"	—	Walls	Vertical	NR	16" o.c.	16" o.c.
1/4"	3/8"	Walls	NR	NA	NR	NR
1/4"	1/2" or 5/8"	Walls	Horizontal or Vertical	NA	16" o.c.	16" o.c.
3/8"	—	Walls	Horizontal or Vertical	16" o.c.	16" o.c.	24" o.c.
3/8"	3/8" or 1/2" or 5/8"	Walls	Horizontal or Vertical	NA	16" o.c.	24" o.c.
1/2" or 5/8"	—	Walls	Horizontal or Vertical	24" o.c.	24" o.c.	24" o.c.
1/2" or 5/8"	3/8" or 1/2" or 5/8"	Walls	Horizontal or Vertical	NA	24" o.c.	24" o.c.

NA—Not Applicable

NR—Not Recommended

¹ Framing spacing for two-ply, 3/8 in. gypsumboard wall may be 24 in. o.c. if adhesive is used between plies.

where required to support wall-hung equipment and fixtures.

Furring

When the spacing between framing members exceeds the maximum recommended for a particular board thickness, or when the surface of the framing members is not sufficiently flat, furring should be used. The furring surface bearing against the gypsumboard must be at least 1-1/2 in. wide for wood members and 1-1/4 in. wide for metal furring at joints of abutting edges or ends.

The wood furring strips or metal channels can be directly attached to the underlying framing or to a concrete or masonry wall. Gypsumboard is attached to the furring members.

Wood furring to which gypsumboard is to be nailed must be

rigid enough to provide firm support during the nailing. This requires at least a nominal 2 in. x 2 in. wood strip.

Where screws are used, wood furring can be a minimum of 1 in. x 3 in. nominal size, and where the furring is backed by solid construction, such as masonry, wood furring strips can be as small as 5/8 in. x 1-1/2 in.

Furring on wood-framed walls is usually metal sound control (resilient) channels, and the gypsumboard is attached with screws.

The maximum spacing between furring strips should be the same as shown for framing members in Table I.

Studs

Wood studs in load-bearing partitions should be nominal 2 in. x 4 in. or larger. In nonload-bearing partitions, 2 in. x 3 in. wood studs may be used. Studs in staggered stud, load-bearing partitions rated for one hour fire resistance may be 2 in. x 3 in. at 16 in. o.c. and staggered 8 in. o.c. in opposite rows one inch apart. For two hour fire resistance in the same type of wall, 2 in. x 4 in. studs must be used.

Back-up or extra support members should be provided at all interior corners for support or as a nailing base for the gypsumboard.

Ceilings

Ceiling joists to which gypsumboard will be attached should be evenly spaced with all bottom faces aligned in a level plane. Excessively bowed or crooked joists should not be used. Joists with a slight crown may be used if they are installed with the crown up. Slightly crooked or bowed joists can be aligned by nailing bracing members across the joists approximately at mid span (Fig. 19).

Wood trusses to which a ceiling must be attached may have irregularities in spacing and leveling. When wide variances are found, cross furring generally is recommended to provide a plane surface for supporting gypsumboard.

With truss roof construction, the exterior walls and the ceilings

sometimes are finished before interior partitions are erected and finished. When this method is used, the roofing and all other construction elements which increase roof loads should be installed before interior partitions

are erected. If substantial roof loads are introduced after partitions are installed, the ceiling may be forced down against the partitions and may be distorted as the roof trusses deflect (Fig. 20).

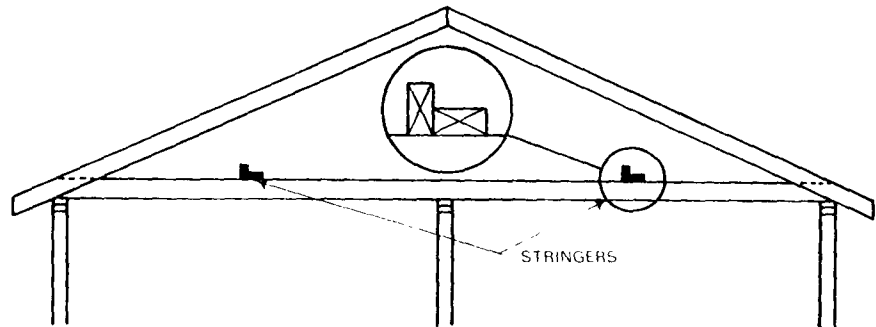


Fig. 19 Slightly crooked or bowed joists may be corrected by nailing stringers approximately at the mid spans. 2 in. x 4 in. stringers, laid flat, regulate spacing, and other stringers, set on edge, accomplish some leveling.

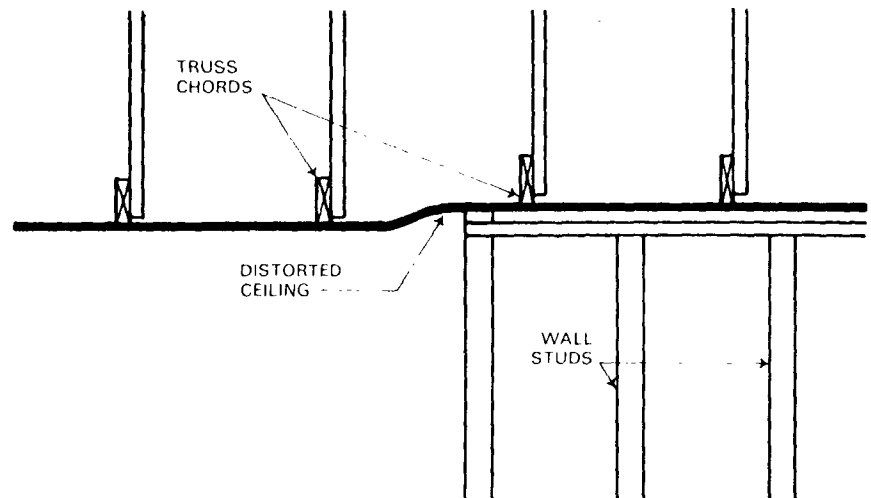


Fig. 20 Ceiling distortion can result under truss roofs where the weight of the roof forces the ceiling down and the interior partitions hold it up. Partitions may be installed only after truss roofs and ceilings are completed and the roof covering is finished.

METAL STUD PARTITIONS AND CEILING SYSTEMS

Metal stud partition systems are common in high-rise residential and other commercial buildings where noncombustible construction is required (Fig. 21), and it is becoming a factor in home building. Nonload-bearing partitions usually are framed with metal studs; ceilings usually are framed with metal furring secured to or suspended from open-web joists or light beams.¹

There are a variety of metal framing systems. Many are de-

signed for ease of erection and demountability with a minimum of waste. Many others are designed to meet requirements for sound isolation and fire resistance. The fire resistance classification and sound transmission class of

¹Detailed specifications for metal framing are given in *Gypsum Association Specifications for the Installation of Screw-Type Steel Framing Members to Receive Gypsumboard*.

several hundred systems are shown in *Design Data-Fire Resistance/Sound Control*, published by the Gypsum Association.

The advantages of metal framing are noncombustibility, stable price, freedom from rot, ease of erection, and freedom from problems caused by moisture content and nonuniformity. The elements of the system are manufactured to fit.

The spacing for metal framing to receive gypsumboard should not exceed the maximum spans recommended for single and multi-ply construction which are shown in Table I.

Studs

Typically, metal studs in non-load-bearing partition framing are "C" shaped, 25 gauge cold-formed steel, electrogalvanized,

hot-dip galvanized, or painted to resist corrosion (Fig. 22). This gauge is suitable for use with most drywall screws used for fastening gypsumboard to metal studs.

Joists

Open-web joists generally are not designed to receive wallboard directly, and they often are spaced more than 24 in. o.c. Hence, it is necessary to provide suitable furring or suspension systems at appropriate spacing for attaching the wallboard ceiling (Fig. 23).

Channels

Metal furring members may be either *cold-rolled channels*, *dry-wall furring channels*, *resilient furring channels*, or *drywall steel studs* (Fig. 24). Metal furring is used in noncombustible assemblies

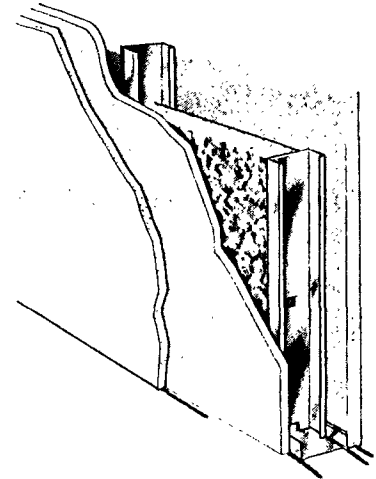


Fig. 22 "C" shaped steel studs placed in metal runners support this multi-ply, sound-insulating partition.

and for extra sound isolation in wood-framed assemblies.



Fig. 21 Metal studs go up quickly in this office building.



Fig. 23 Open-web joists are furred with a cold rolled and drywall channel suspension system to hold gypsumboard in this floor-ceiling assembly.

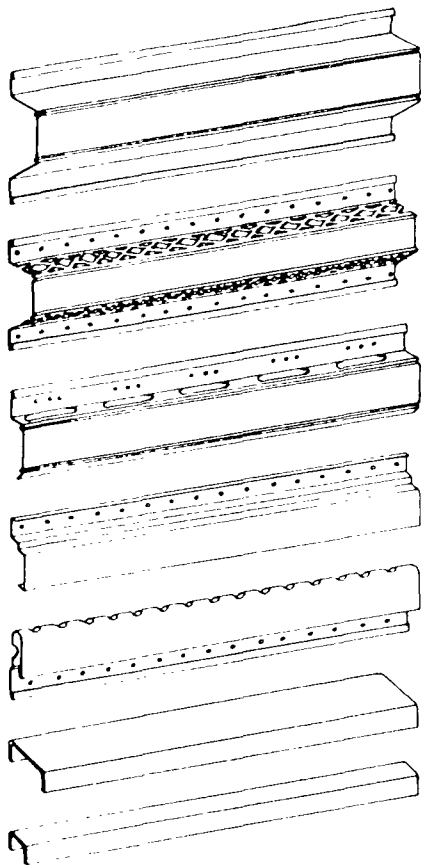


Fig. 24 Plain drywall channel (top) has a hat-shaped cross section, while resilient drywall channels (center four) come in several designs. All are of galvanized steel. Cold rolled channels (bottom two) are "C" shaped and generally of 16 gauge black asphaltum painted steel.

Cold-rolled channels may be used in furred partitions and in most types of suspended ceiling assemblies. Ordinarily, they are wire-tied in place with the furring channels tied or clipped to them. These channels usually are of 16 gauge steel with either a galvanized or black asphaltum finish. They are available in sizes ranging from 3/4 to 2 in. wide in lengths up to 20 ft.

Drywall furring channels (or plain furring channels) are cold rolled from 25 gauge electrogalvanized or hot-dip galvanized steel and are generally "hat" shaped. Standard drywall channels are designed for wallboard attachment with self-drilling and self-tapping gypsum drywall screws. The channels should be installed at right angles to framing supports. They are fastened to wood framing with a 1-1/4 in.

screw or a 5d nail, and to metal framing with wire ties or clips at each support.

Drywall furring channels over masonry or concrete surfaces may be installed horizontally or vertically, whichever is more convenient. Metal studs may also be used. The spacing should be as shown in Table 1.

Masonry and concrete walls ordinarily use plain furring channels because resilient mounting does not substantially improve the sound isolation qualities. However, most drywall channels are used in ceiling assemblies to support the wallboard (Fig. 25). If sound or vibration isolation is desired, a suspended ceiling of gyp-

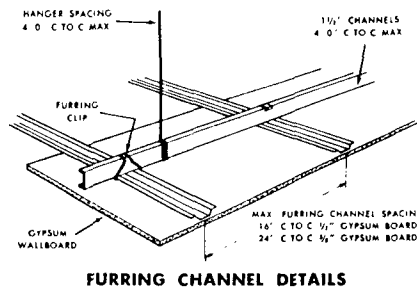


Fig. 25 In suspended gypsumboard ceilings, drywall channels are clipped to suspended cold-rolled channels rather than to framing members. Various clips are used.

sumboard is attached to drywall channels clipped or tied to a grid of cold-rolled channels supported by wire hangers.

Resilient furring channels are used over both metal and wood framing to provide a sound absorbing spring mounting for a gypsumboard surface. They not only improve sound isolation, but they also help to isolate the gypsumboard from structural movement, and help minimize the possibility of cracking.

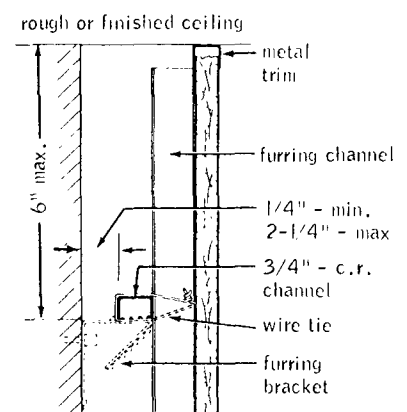
MASONRY SUPPORTS

In addition to attachment to wood or metal framing or furring, wallboard finishes can be laminated directly to above-grade, interior masonry and concrete if the surface is sufficiently dry, smooth,

clean and flat. Above-grade, exterior cavity walls also may be suitable for direct lamination if the cavity is properly insulated to prevent condensation. However, adhesive application directly to exterior masonry walls is not recommended. Also, predecorated gypsumboard with a surface which is highly resistant to water vapor generally should not be laminated directly to concrete or masonry. Moisture may become trapped within the gypsum core of the board.

The base surface should be made as flat as possible. Rough or protruding edges should be removed and large depressions may be filled with mortar. Excess mortar in joints should be trimmed

ceiling attachments



adjustable wall furring

floor attachments

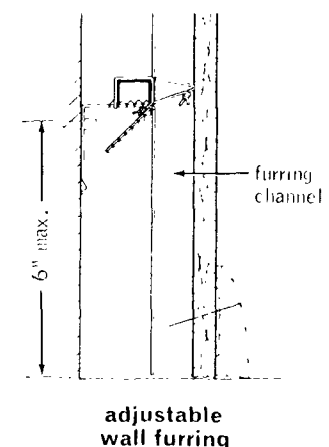


Fig. 26 Adjustable brackets make installation of furring easy over irregular masonry walls.

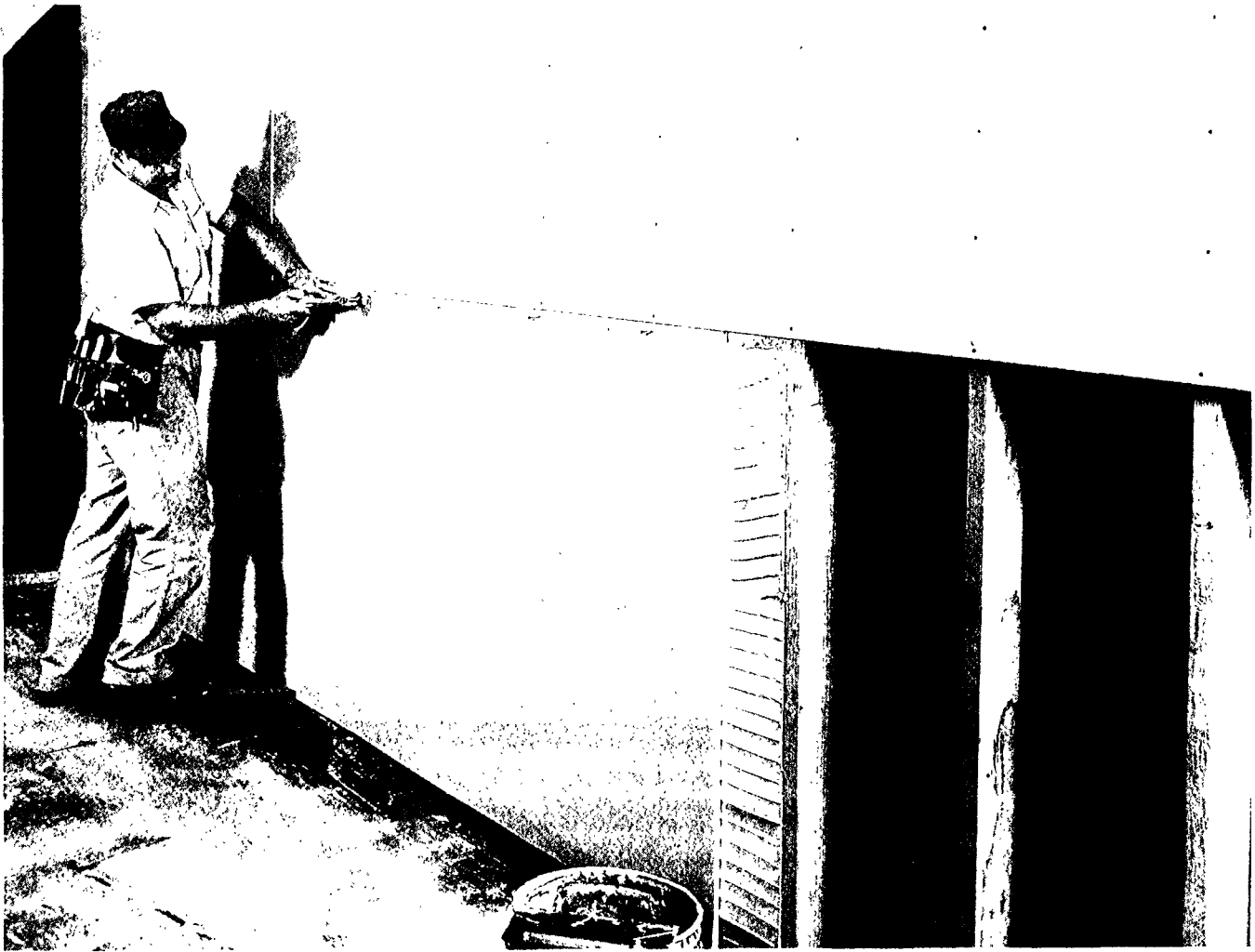


Fig 27 Nails properly driven with a crown headed hammer show a slight depression, or "dimple", around the nailhead.

flush with the face of the wall.

Base surfaces should be cleaned of form oils, curing compounds, loose particles, dust, or grease to assure adequate bond. It is essential that concrete be allowed to cure for at least 28 days before wallboard is laminated directly to it.

Exterior and below-grade walls, horizontal surfaces subject to moisture or excessive heat loss, or any surface which cannot be prepared readily for adhesive lamination should be furred to provide a suitable base for attaching the gypsumboard.

A variety of clips, runners, and adjustable brackets are available with engineered furring systems to facilitate rapid erection over irregular masonry walls. When special clips are used, manufacturers specific recommendations for installation should be followed.

ATTACHMENTS AND FASTENERS

Nails and screws are commonly used to attach gypsumboard in both single and multi-ply installations; clips and staples are used only to attach the base layer in multi-ply construction.

Special drywall adhesives can be used to secure single-ply gypsumboard to framing and furring, masonry and concrete, or to laminate a face ply to a base layer of gypsumboard, sound deadening board, or rigid foam insulation. Adhesives generally are supplemented with mechanical fasteners.

Mechanical application of gypsumboard requires special nails, staples, and screws. Ordinary wood screws, sheet metal screws, or common nails should not be

used. They are not designed to hold the board tightly and to countersink neatly.

Fasteners should be placed at least $\frac{3}{8}$ in. from board edges and ends. Fastening should start in the middle of the board and proceed outward toward the edges. Fasteners should be driven as nearly perpendicular as possible while the board is held firmly against the supporting construction. Nails should be driven with a crown headed hammer which forms a uniform depression or "dimple" not more than 1.32 in. deep around the nail head (Fig. 27). Particular care should be taken not to break the face paper or crush the core with too heavy a blow.

For Application of GYPSUM WALLBOARD

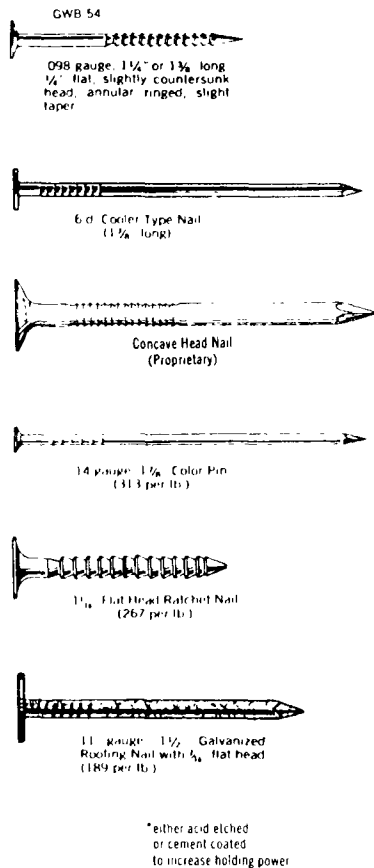


Fig. 28 Nails used in drywall construction have thin, 1/4 in. diameter heads. Small-headed nails shown are color pins for use with predecorated wallboard. These are used according to instructions of the manufacturers

Nails

Samples of nails for gypsumboard application are shown in Fig. 28.¹ Preferably, the nails should have heads that are flat or slightly concave and thin at the rim. The heads should be at least 1.4 in. diameter and not more than 5/16 in. diameter to provide adequate holding power

¹Nails suitable for gypsumboard application should conform to ASTM C-514, *Standard Specifications For Nails For the Application of Gypsum Wallboard*, although some fire rated constructions require special nails as recommended by the manufacturer.

without cutting the face paper when the nail is dimpled. Casing nails and common nails have heads too small in relation to the shank; they easily cut into the face paper and should not be used. Nail heads that are too large are also likely to cut the paper surface if the nail is driven incorrectly at a slight angle.

Nails should be long enough to go through the wallboard layers and far enough into supporting construction to provide adequate holding power. Nail penetration into the framing member should be 7/8 in. for smooth shank nails, but only 3/4 in. for annular ringed nails which provide more withdrawal resistance and require less penetration.

Screws

Drywall screws are used to attach gypsumboard to wood or steel framing or to other gypsumboards. They have cupped Phillips heads designed for use with a drywall power screwdriver. These screws pull the board tightly to the supports without damaging the board, and this minimizes fastener/surface defects due to loose boards. The specially contoured head makes a uniform depression free of ragged edges and fuzz if properly driven.

The three basic types of drywall screws: Type W for wood, Type S for sheetmetal, and Type G for solid gypsum construction, are shown in (Fig. 29) with their recommended penetrations into the framing members. Also shown are properly designed screws available for attaching wood or metal trim and Type S-12 screws for attaching wallboard to heavy gauge, load-bearing metal studs.

Type W gypsum drywall screws are designed for fastening gypsumboard to wood framing or furring. Diamond-shaped points on Type W screws provide efficient drilling action through both gypsum and wood, and a specially designed thread gives quick penetration and increased holding power. Recommended minimum penetration into supporting construction is 5/8 in. However, in two-ply construction where the

face layer is screw attached, additional holding power is developed in the base ply which permits reducing penetration into supports to 1/2 in.

Type W screws are available in several lengths. However, if the right length cannot be found, drywall sheetmetal screws, more readily available in longer sizes, may be substituted in two-ply construction.

Type S gypsum drywall screws are designed for fastening gypsumboard to metal studs or furring. They are self-drilling; they have a self-tapping thread and generally a mill-slot or hardened drill point designed to penetrate sheet metal with little pressure. Easy penetration is important because steel studs often are flexible and tend to bend away from the screws. Type S screws are made available in several lengths, from 7/8 in. to 2-1/4 in.

Screws for Application of GYPSUM WALLBOARD

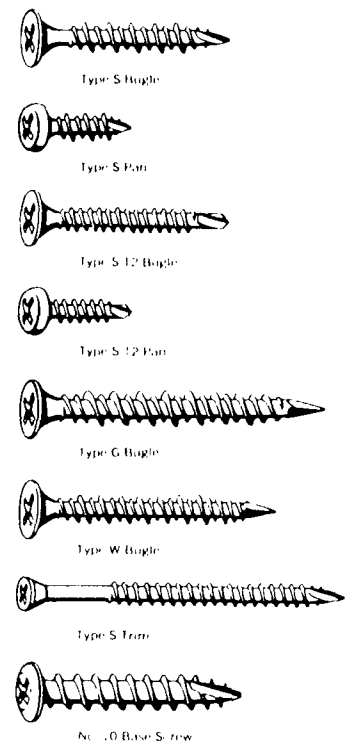


Fig. 29 Type S screws shown should penetrate at least 3/8 in. beyond gypsumboard surface to hold metal framing tightly. Type G screws should penetrate at least 3/8 in. into supporting layers of gypsumboard to hold tightly, and Type W screws should penetrate at least 5/8 in. into wood framing under gypsumboard.

Type G gypsum drywall screws are used for fastening gypsum-board panels to gypsum backing boards. Type G are similar to Type W screws, but they have a deeper special thread design. They generally are 1-1/2 in. long, but other lengths are available. Gypsum drywall screws require penetration of at least 5/8 in. of the threaded portion into the framing members.

Gypsum drywall screws should not be used to attach wallboard to 3/8 in. backing board because sufficient holding strength is not available. Nails or longer screws should be driven through both the surface layer and the 3/8 in. base ply to give the proper penetration in supporting wood or metal construction.

Staples

Staples are recommended only for attaching base ply to wood members in multi-ply construction. They should be 16 gauge, flattened, galvanized wire with a minimum 7/16 in. wide crown and spreading points. Staples should provide a minimum of 5/8 in. penetration into supports.

Adhesives

Adhesives are used to bond single layers of gypsumboard directly to framing, furring, masonry, or concrete. They can also be used to laminate wallboard to base layers of backing board, sound deadening board, rigid foam, or other insulation. They generally are used in combination with nails or screws which provide supplemental support. Adhesives for applying wallboard finishes are classed:

1. stud adhesives;
2. laminating adhesives; and
3. contact or modified adhesives.

Stud adhesives are specially prepared to attach single-ply wallboard to steel or wood supports. They should be of caulking consistency so that they bridge framing irregularities. Also they should meet rigid standards for

strength, bridging ability, aging, and other qualities necessary for long term performance.¹ They are applied with a gun (Fig. 30) in a continuous or semi-continuous bead. Solvent-base stud adhesives should not be used near an open flame, in poorly ventilated areas, or for lamination of predecorated gypsumboard.

Laminating adhesives generally are casein-base compounds in powder form to which water is added. They are used to laminate gypsumboards to each other and to suitable masonry or concrete surfaces. They are not intended for adhesive bonding to wood framing or furring. Although some stud adhesives and contact adhesives also can be used for laminating, they should not be so used unless recommended by the manufacturer.

Only as much laminating adhesive should be mixed as can be used within the working time specified by the manufacturer. Water used should be at room temperature and clean enough to drink. The adhesive may be applied over the entire board area with a suitable spreader, or it may be spaced in parallel ribbons or a pattern of spots as recommended by the manufacturer. Face boards require temporary support or supplemental fasteners until the adhesive develops sufficient bond strength.

Contact adhesives have a synthetic rubber base, sometimes with resins added. Contact adhesives are used to laminate gypsumboards to each other or to bond wallboard to metal studs. The adhesive is applied by roller, spray gun, or brush, in a thin, uniform coating to both surfaces to be bonded. For most contact adhesives, some drying time usually is required before surfaces can be joined and bond can be developed. To assure proper adhesion between mating surfaces, the face board should be impacted over its entire surface with a suitable tool, such as a rubber mallet.

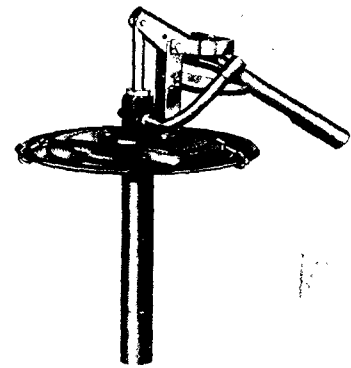


Fig. 30 Adhesive applicators (guns) are loaded with material pumped from a container.

Contact adhesives give the advantages of immediate bond, excellent long-term strength, and resistance to fatigue. Also, no temporary supports are needed while the adhesive sets and the bond forms. One disadvantage is their inability to fill in irregularities between surfaces, which leaves areas without adhesive bond. Another disadvantage is that most of these adhesives do not permit moving the boards once contact between surfaces has been made. A sheet of polyethylene film or tough building paper can be slipped between the surfaces so that gradual bonding of surfaces will occur as the slip sheet is withdrawn.

Extra care and judgment should be taken when contact adhesives are used. Manufacturer's recommendations should be followed.

Modified contact adhesives provide a longer placement time. They have an open time of up to 1/2 hour during which the board can be repositioned if necessary. They combine good long-term strength with sufficient immediate bond to permit erection with a minimum of temporary fasteners. In addition, the adhesive has bridging ability.

Modified contact adhesive is intended for attaching wallboard to all kinds of supporting construction, including framing, solid walls, other gypsumboard, and various insulating boards.

¹ASTM C-557 Tentative Specification for Adhesives to Fasten Gypsum Wallboard to Wood Framing.

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¹ASTM C-557 Tentative Specification for Adhesives to Fasten Gypsum Wallboard to Wood Framing.

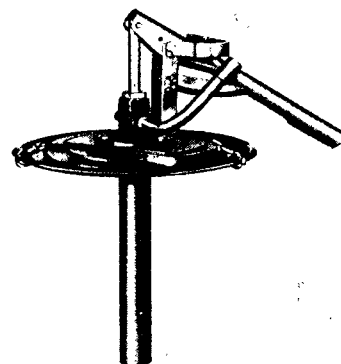


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III SINGLE-PLY APPLICATION

The quality of single-ply finishes is largely dependent on accurately aligned, solid supports. Before single-ply gypsumboard is

applied, the framing or furring members should be checked for firmness and alignment in the same plane (Fig. 18).

NAIL ATTACHMENT

Wallboard can be attached by either a single-nailing or double-nailing method. In general, space between nails is determined by requirements for fire resistance and for firmness of board-to-stud contact necessary to reduce possible surface defects. It is less dependent on the load imposed. Single nails should be spaced 7 in. o.c. on ceilings and 8 in. o.c. on walls along supports (Fig. 31).

Double nailing can produce tighter board-to-stud contact and fewer loose boards than single nailing.

In double nailing, a first set

of nails is driven 12 in. o.c. in the middle of the panel, and then a second set is driven 2 in. from each of the nails first applied. After the second set of nails is driven, the board is held tighter than before, and the first nails driven should be given an extra blow to reseal them firmly. Edges and ends falling over supports should be single-nailed 7 in. o.c. on ceilings and 8 in o.c. on walls (Fig. 32).

Loose Attachment

Loose attachment of gypsumboard will result in objectionable

nail pops. The board must be drawn tightly against framing or furring members so that it cannot move on the nail shank. Even when substantial pressure is applied properly, it still may not be possible to produce snug contact between board and supporting members. This will happen if a board is cut too large to fit and must be forced into place or if nailing is started at the perimeter (ends or edges) and finished inward. To prevent loose boards, panels should be cut to fit easily into place, pressure should be applied while nailing (Fig. 33), and the correct nailing sequence from the middle of the panel outward should be observed.

Loose Nails

Loose nails also cause loose gypsumboards. Loose nails can result when nails either miss the underlying construction or enter it at an angle near the edge (Fig. 34). These nails may eventually work loose from vibration until they protrude beyond the finish surface. To guard against loose nails: 1) the location of supporting members should be marked carefully on the wallboard prior to nailing; 2) nails should be driven perpendicular to the surface and into the member; 3) nails which do miss the supports should be removed promptly, and their holes should be dimpled and treated with compound.

Face Paper Fractures

Face paper fractures can cause loose boards and nail popping.

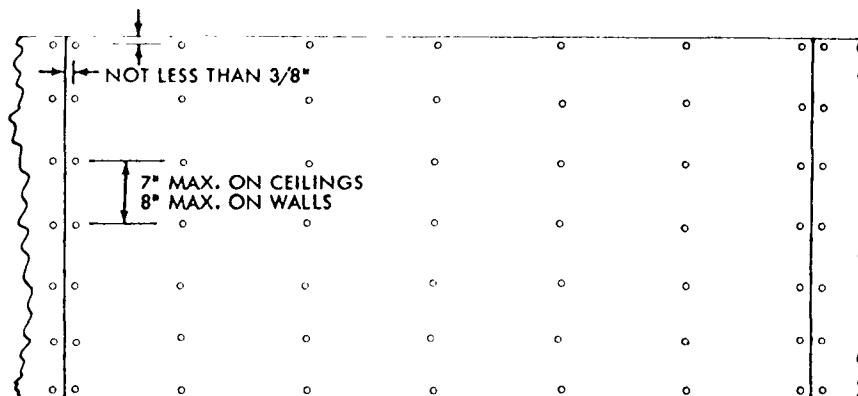


Fig. 31 In single nailed gypsumboard, nails are spaced 7 to 8 in. apart along supports and not less than $3/8$ in. from edges and ends. Nails are first driven in the middle area of the board and then out toward the edges and ends.

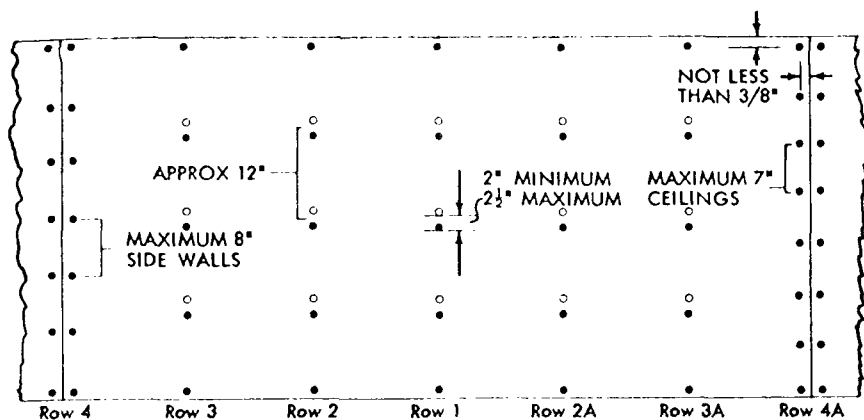


Fig. 32 In double nailing, first nails, represented by black dots, are driven starting with row 1, then row 2 and 2A, working out toward the ends. Second nails, represented by the circles, are then driven in the same sequence.

This defect can be caused by improper nailhead design, nails driven at an angle (Fig. 35), or excessive and repeated impact during nailing. The gypsum core is easily crushed where the paper is punctured, and it offers less resistance to loosening from normal impact and vibration.

Fractures caused by over-driving of nails should be corrected by driving a new nail 2 in. away from the fracture to provide firm attachment.

Other common causes of face paper fractures are misaligned or twisted supporting members and projections of improperly installed blocking or bracing (Fig. 18). These framing faults prevent solid contact between wallboard and supporting members, and hammer impact causes the board to rebound in a manner that often ruptures the paper. Defective supports should be corrected before the wallboard is erected. Protruding supporting members

should be trimmed off or re-installed. Shims can be used if necessary for receding pieces. The use of screws, adhesives, or two-ply construction will minimize problems resulting from these defects.

SCREW ATTACHMENT

Because fewer fasteners are required when screws are used to attach wallboard, the number to be treated and possible defects are reduced.

Screws should be spaced 12 in. o.c. on ceilings and 16 in. o.c. on walls where framing members are 16 in. o.c. Screws should be spaced a maximum of 12 in. o.c. on walls and ceilings where framing members are 24 in. o.c.¹ The necessary penetration for screws is given in Fig. 29.

¹For fire-rated construction, spacing may differ according to test requirements.

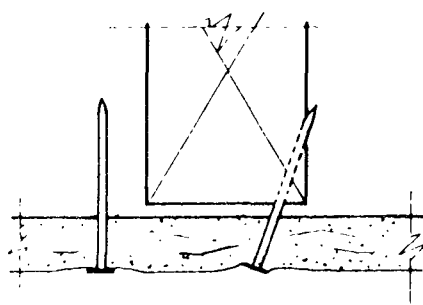
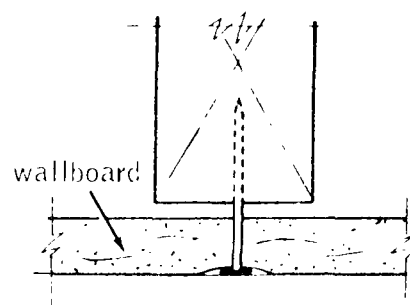


Fig. 34 Loose nails are caused by poor fit of gypsumboard to framing surface (left) or by nails missing the framing members when driven (right).



Fig. 33 Gypsumboard applicator lifts board into place with a foot lever and leans against board with his forearm to hold it firmly while nailing.

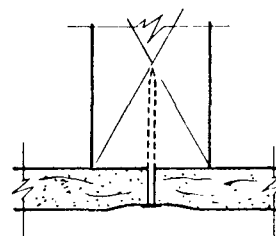
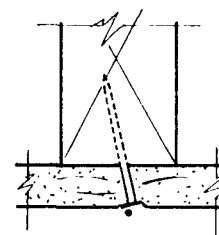
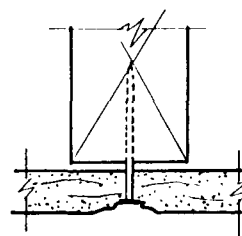


Fig. 35 Nails driven in loose board will probably fracture the face paper (top). Nails driven at an angle also usually fracture the face paper (center). Properly driven nails produce tight attachment with a slight, uniform dimple (bottom).

ADHESIVE NAIL-ON ATTACHMENT

Compared to conventional nailing, adhesive nail-on attachment has the advantage of reducing the number of nails in the middle of the panel by at least 50 percent. The tight bond between the wallboard and its supports results in a stronger, stiffer assembly with fewer fastener defects. Screws can be used in place of nails, but their use is not common because good board-to-stud contact is assured by the adhesive and the number of face fasteners is already reduced to a minimum.

Stud Adhesives

Stud adhesive should be applied with a caulking gun in accordance with the manufacturer's recommendations. A straight bead, approximately 1/4 in. diameter, is applied to the face of supports in the field of the panel (Fig. 36). Where two adjacent panels join over a supporting member, a serpentine or zig-zag bead should be applied if the joint is to be taped (Fig. 36). When a predecorated wallboard joint is to be left untreated, two parallel

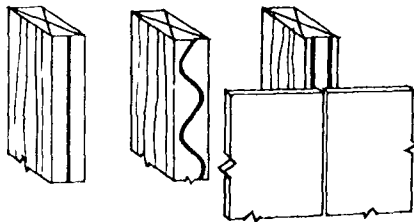


Fig. 36 Beads of stud adhesive are applied (left) straight under the field of a board, (center) zig-zag under joints to be taped, and (right) parallel under predecorated joints.

beads of adhesive should be applied, one near each edge of the member (Fig. 36). Enough adhesive should be in the bead so that, when the wallboard is pressed on, the bead will spread to an average width of 1 in. at least 1/16 in. thick.

Not so much adhesive should be applied that it will squeeze out at the joints. It should not be applied to members which are

not required for wallboard support, such as diagonal bracing, blocking and plates. The number and spacing of supplemental nails (or screws) varies, depending on the adhesive properties.

Stud adhesives require only perimeter fasteners for wall application.¹ The fasteners should be spaced 16 in. o.c. along edges or ends that fall on parallel supports, and then should be placed at each point where edges or ends cross perpendicular supports. For ceiling application, the perimeter is nailed as for walls, but additional fasteners spaced 24 in. o.c. are

required in the field (Fig. 37).

Some stud adhesives, such as those for use with metal framing, require fasteners on intermediate supports as well as at the perimeter of panels. Fastener spacing varies according to type of fastener, support spacing, and load-bearing conditions as shown in Table II.

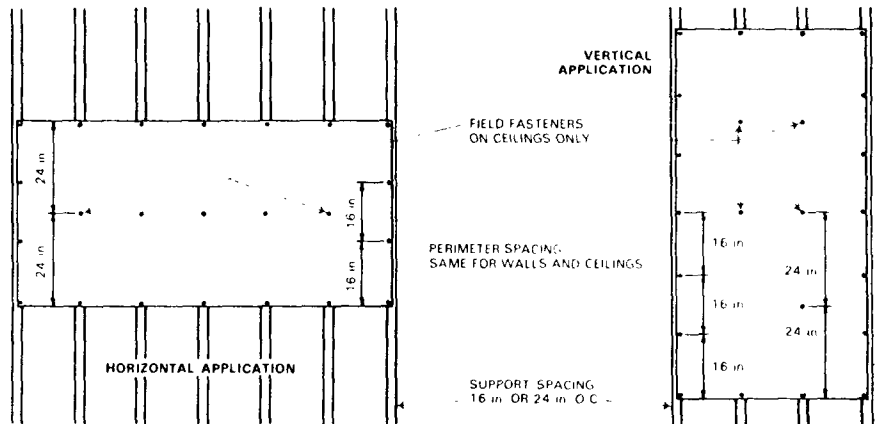


Fig. 37 Single-ply gypsumboard systems attached with stud adhesives require supplemental fasteners on the perimeter. Spacing is the same whether board edges are perpendicular or parallel to supports. Ceiling installations require supplemental fasteners in the field as well as on the perimeter.

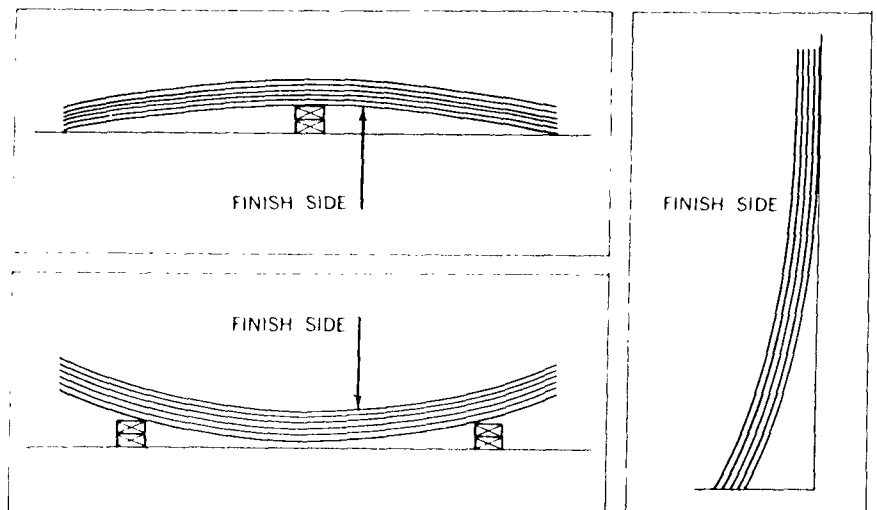


Fig. 38 Prebowing puts an arc in gypsumboard that keeps it in tight contact with adhesives after it is applied.

¹These adhesives conform to ASTM C-557. See footnote, page 15.

Bracing

Predecorated wallboard with bevelled or square edges often does not require joint treatment, and therefore, it is desirable to avoid fasteners at the joints. The board should be applied with adhesive, and prebowing, temporary bracing, or some other means should be used to ensure contact between board and adhesive until the bond develops full strength. Plain wallboard may also be attached vertically with adhesives without using fasteners at the edges if temporary nailing or bracing is used. Temporary supports for adhesive attachments should be allowed to remain in place for at least 24 hours (Fig. 39).

METAL FRAMING

Wallboards should be attached to metal framing and furring with Type S screws, spaced not more than 12 in. o.c. along supports for both walls and ceilings.¹ These screw spacings are appropriate also when wallboard is mounted on resilient furring channels over wood framing.

CONCRETE AND MASONRY

Some laminating adhesives and stud adhesives are suitable for laminating wallboard directly to concrete and masonry, but individual manufacturer's recommendations vary and should be consulted to ensure proper selection and application. While adhesive is setting, temporary support should be provided for the wallboard. Temporary bracing, threaded stub nails, or cut nails may be used.

¹ For fire and sound-rated construction, screw spacing must follow that of the system tested.

TABLE II

SPACING FOR FASTENERS USED WITH STUD ADHESIVES.

LOCATION	SUPPORT SPACING	FASTENER SPACING	
		NAILS	SCREWS
Ceiling	16 in. o.c. 24 in. o.c.	16 in. o.c. 12 in. o.c.	16 in. o.c.
Load-bearing Walls	16 in. o.c. 24 in. o.c.	16 in. o.c. 12 in. o.c.	24 in. o.c. 16 in. o.c.
Nonload-bearing Walls	16 in. o.c. 24 in. o.c.	24 in. o.c. 16 in. o.c.	24 in. o.c.

PREVENTING DEFECTS

Nail Popping

Nail popping is caused by wood shrinkage or warping, improper

framing, improper nailing or any conditions that lead to loose gypsumboards. These conditions have been shown in Fig. 13, 18, 34



Fig. 39 Temporary bracing holds gypsumboard against supporting framing until adhesive bond develops.

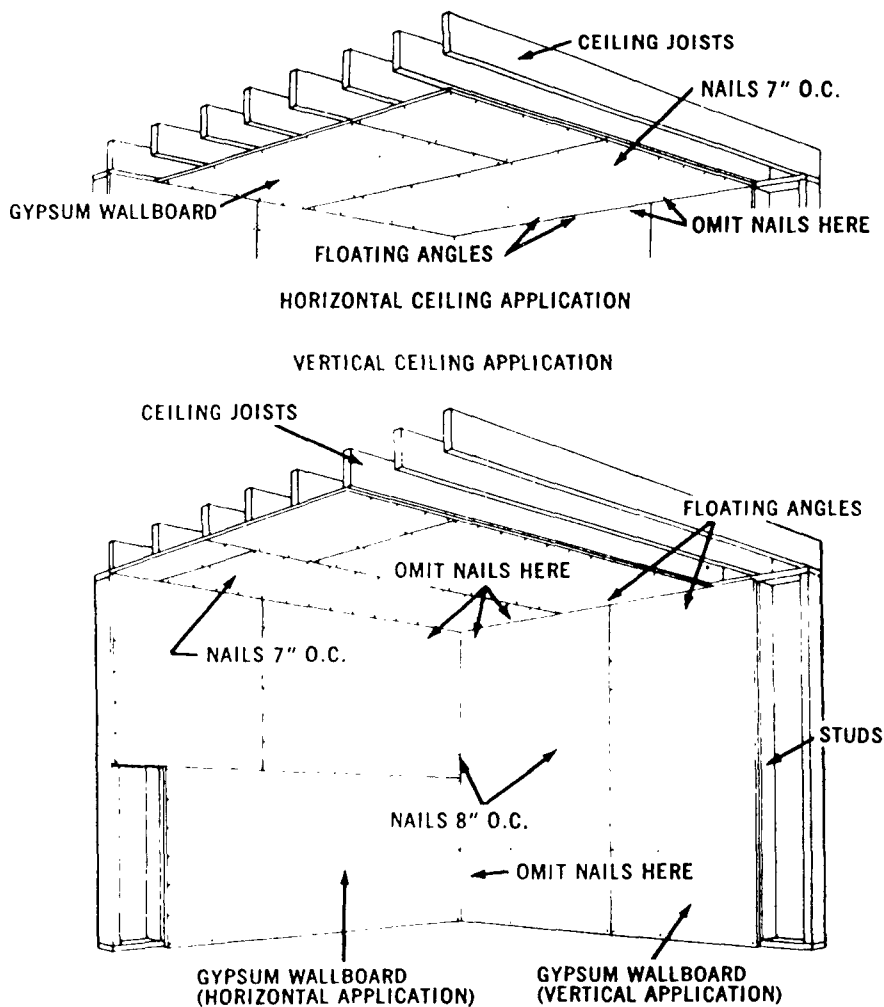


Fig. 40 Floating angle construction helps eliminate nail popping and corner cracking. Fasteners at the intersection of walls or ceilings are omitted.

and 35. Maintaining good job site storage conditions, making sure that framing is in line, and using proper nails and attachment procedures will help avoid the problem. Floating angle construction (see below) will also help avoid nailpopping caused by stresses at inside corners.

Cracking

Corner cracking may result from structural stresses at inside corners where walls and ceiling meet, although it may also result from improper joint treatment. *Floating angle construction* is intended to minimize damage from structural stresses. It consists of omitting some fasteners at interior corners (Fig. 40).

Wallboard should be applied to the ceiling first. It should be fitted snugly at the wall-to-wall and

ceiling-to-wall intersections. Framing members or blocking should be used at corners to provide solid backing, even though they may not be required to hold fasteners.

Where walls meet ceilings, the last row of fasteners on the wall should be omitted so that nails start 8 in. from the intersection. On ceilings where the joists are parallel to the intersection with a wall, nailing should start at the intersection; where joists are perpendicular, nails should start 7 in. from the intersection (Fig. 40).

For interior corners at the meeting of walls, the last row of fasteners is omitted from the board first applied only; the overlapping board on the other wall is nailed in the conventional manner. When double nailing, the same nail-free clearances at corners should be maintained as for

single nailing described above.

A source of cracking in nonbearing walls is the modern trend toward less rigid structures. Larger deflections in structural members and greater expansion and contraction of exterior columns can impose unexpected loads on nonbearing walls, and this may cause cracking. Detail designs for perimeter relief of nonbearing partitions are available to improve this condition. Several designs may be used with fire rated and sound rated partitions. One example is relief runners used to attach nonbearing walls to ceiling and column members (Fig. 41).

Ridging

Joint ridging may occur when joints are treated during cold or humid weather. It occurs more frequently when joint compound is not properly applied. Joint treatment is discussed in a later section.

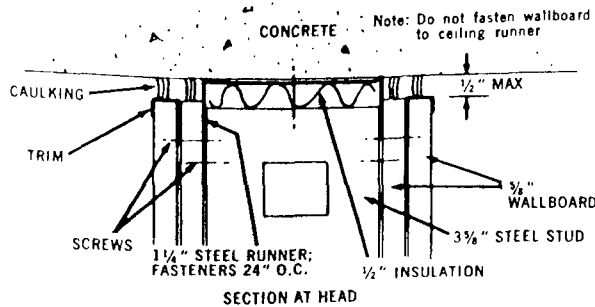
The most effective preventive is to use a multi-ply gypsumboard system which reinforces the surface joints. Other preventives are to use *back blocking* or *strip reinforcing* to reinforce joints and to prevent the stresses that cause ridging. *Special edged boards*, produced specifically to overcome ridging problems, are available from most gypsumboard manufacturers.

Back blocking is used when gypsumboard ends are located midway between framing members on walls or ceilings. Gypsumboard back-blocks spanning the distance between supports are laminated to the back of the surface wallboard to reinforce the joints and prevent flexing or movement.

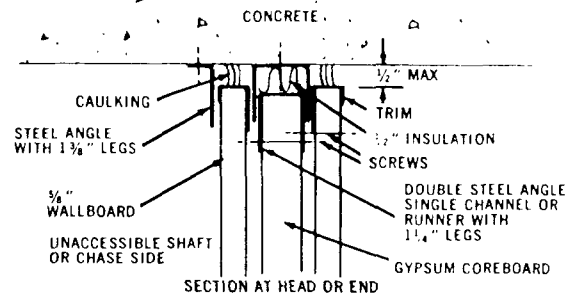
Joints between square ends need a high crown and wide feathering which may cause ridging when they are treated under adverse weather conditions. A procedure which reduces the need for high crowns is end joint tapering, shown in Fig. 42. Used in conjunction with back blocking, end joint tapering produces a shallow depression which is easier to treat than the square end joint.

Back blocking and associated constructions are used most often

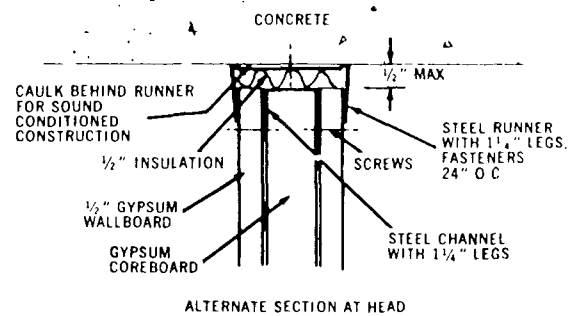
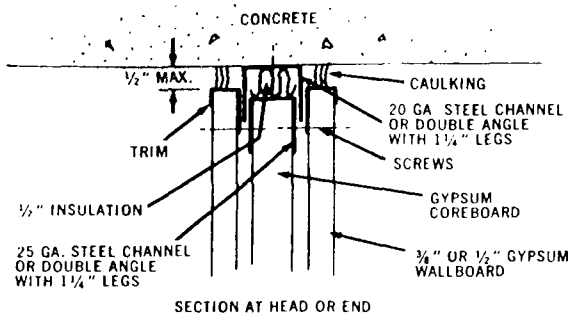
STEEL STUD PARTITION



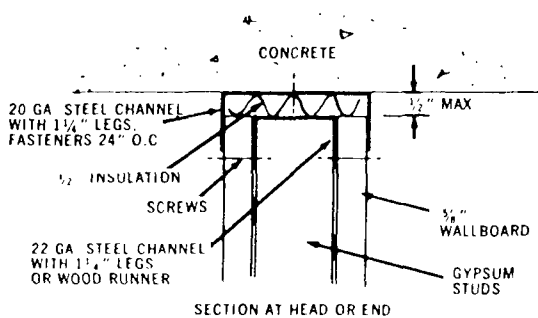
SOLID CORE GYPSUM PARTITION



SOLID OR LAMINATED GYPSUM CORE PARTITION



SEMI-SOLID GYPSUM CORE PARTITION



DOUBLE WALL GYPSUM STUD PARTITION

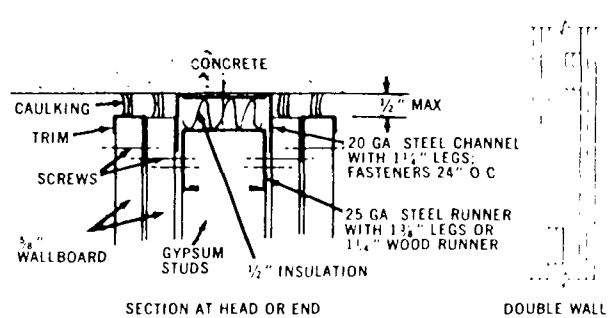


Fig. 41 Detail designs show fire-rated perimeter relief systems to eliminate stress cracking in gypsumboard.

on ceilings because imperfections are more conspicuous on such large, unobstructed, obliquely lighted surfaces.

Strip reinforcing offers many of the advantages of two-ply construction at reduced cost. Combining adhesive lamination with mechanical fastening reduces the number of nails in the face-ply. Although it results in thicker assemblies than does back blocking, strip reinforcing accomplishes the same results positively and in

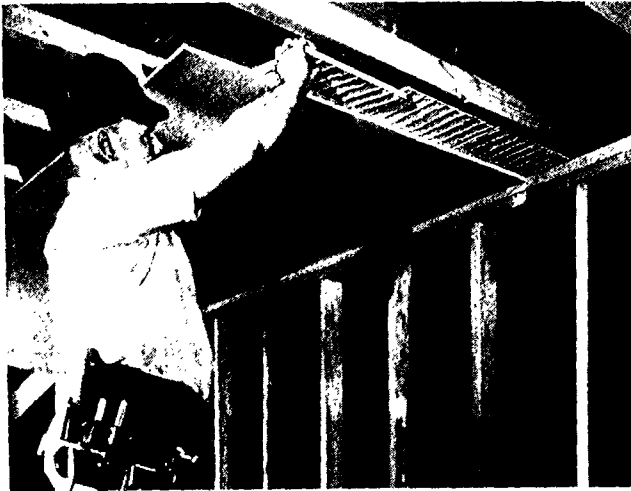
less time.

Strips of 3/8 in. backing board or scrap wallboard, 8 in. wide, are installed 24 in. o.c. perpendicular to framing members in the same way as cross furring. Strips should be 4 in. wide along the base of the partition and along the partition-ceiling intersection. This cross stripping supports the edges and provides intermediate support in the field.

To support the butt ends, additional short strips are secured

directly over the supporting members between the cross-stripping. All strips except those parallel to studs are nailed about 1 in. from the edge.

Laminating adhesive is applied to the strips with a strip-laminating head in parallel beads. Wallboard should be 1/2 in. or thicker and must be installed perpendicular to framing members so that long edges fall on the cross-stripping and ends are supported on the short intermediate strips.



Backing blocks, 8 in. wide and long, enough to fit loosely between joists, are placed along the floated ends of a ceiling wallboard.

Top cross section shows how wood strip along joint and temporary braces depress the end joint while adhesive bond sets. Bottom shows joint after removal of strip and braces.

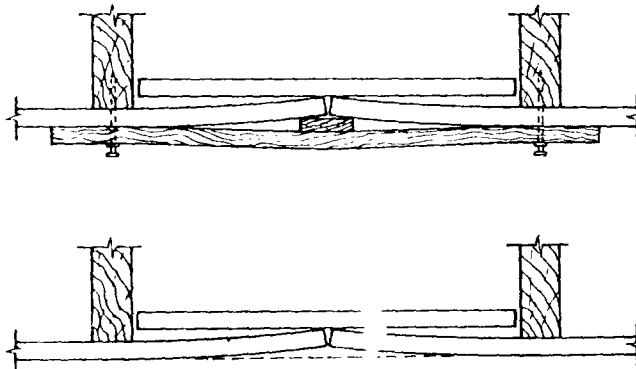
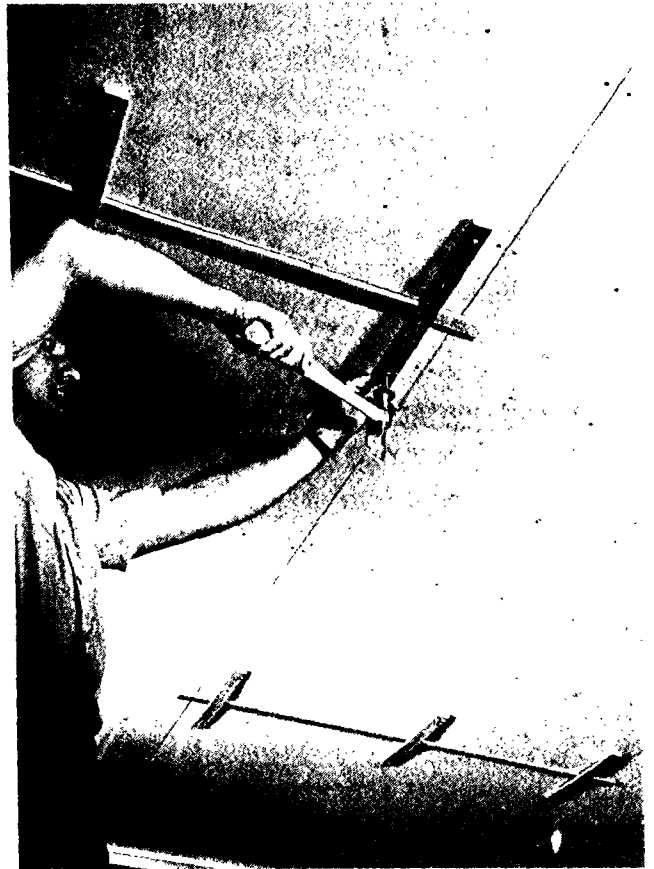


Fig. 42 Back blocking and tapering butt joints on ceilings reduces the need for high crowns and strengthens the joint against ridging. After wood strips are removed, tapered joint remains depressed.

Workman use double-headed nails in temporary bracing for end joint tapering.

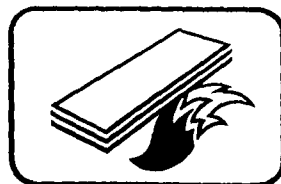


When supporting members in walls are spaced 16 in. o.c., 1-1/2 in. Type G drywall gypsum screws are required through the surface layer to the gypsumboard strips midway between framing members for both walls and ceil-

ings. Appropriate drywall nails providing generally recommended penetration are used to attach both stripping and wallboard to the framing.

Special-edged wallboards are one widely recommended solution for the problem of joint ridging

in single-ply finishes proposed by manufacturers today. These have beveled or rounded tapered edges specifically developed to overcome joint ridging. A special fast-setting joint compound is used to prefill the joints.



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IV MULTI-PLY APPLICATION

Multi-ply constructions have two or more layers of gypsumboard. Face layers usually are laminated to a base layer of wallboard, backing board, or sound deadening board. Only a limited number of fasteners are used to assure adhesive bond. Multi-ply construction is used on ceilings, framed wall assemblies, and self-supporting all-gypsum partitions.

The maximum support spacing for multi-ply finishes depends mainly on the base-ply thickness and placement. It is the same for both wood and metal framing and furring, and it is shown in Table I.

BASE-PLY ATTACHMENT

The base-ply of gypsumboard multi-ply systems may be wallboard, but more often, backing board is used for economy. Special gypsumboard is used for increased sound isolation, and other sound deadening boards are also

found as a base ply.

Nails, staples, or screws are used to attach the base-ply to supporting framing or furring. Fastener spacing is shown in Table III.

WOOD FRAMING AND FURRING

When a multi-ply system with a laminated face layer is to be used over wood supports, the base ply should be single-nailed as recommended for single-ply construc-

tion. Double nailing is not used because nailheads will be covered by the face ply and fastener treatment is not a consideration.

TABLE III

BASE-PLY FASTENER SPACING ON WOOD FRAMING ¹

Location	NAIL SPACING		SCREW SPACING		STAPLE SPACING	
	Laminated Face Ply	Nailed Face Ply	Laminated Face Ply ²	Screwed Face Ply	Laminated Face Ply	Nailed or Screwed Face Ply
Walls	8 in. o.c.	16 in. o.c.	16 in. o.c.	24 in. o.c.	7 in. o.c.	16 in. o.c.
Ceilings	7 in. o.c.	16 in. o.c.	16 in. o.c.	24 in. o.c.	7 in. o.c.	16 in. o.c.

¹ Fastener size and spacing for applying sound deadening boards vary for different fire and sound-rated constructions. The manufacturer's recommendations should be followed.

² 12 in. o.c. for both ceilings and walls when supports are spaced 24 in. o.c.

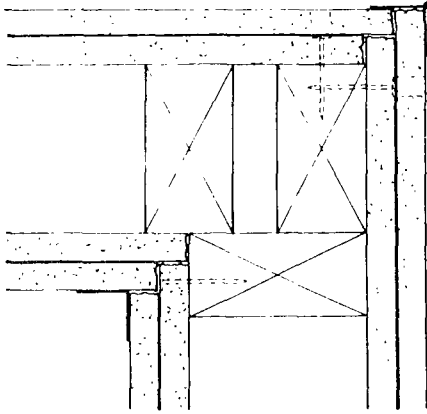


Fig. 43 Floating angle construction for multi-ply systems has overlapping side of base ply only nailed at interior corner.

The base-ply on multi-ply finished walls may be installed parallel or at right angles to framing members. Support spacings are given in Table I. On ceilings, it is preferred that the base-ply be perpendicular to the framing members.

At inside corners, it is recommended that only the overlapping base ply be nailed or screwed and that fasteners be omitted from the face ply. The floating corners created are more capable of resisting structural stress (Fig. 43).

The base ply generally does not need fasteners at exterior corners because support will be provided when the face ply and corner trim is added.

Staples used to fasten base plys should be driven with the crown perpendicular to the edges of the board, except that where edges fall over supports, they should be driven parallel to the edges (Fig. 44). Crowns of driven staples should bear tightly against the board without breaking the face paper.

METAL FRAMING AND FURRING

Base layers of multi-ply construction on metal framing or furring are attached with Type S drywall sheet metal screws. Screw spacing in the base-ply should be 12 in. o.c. in the field and at

edges where the face-ply will be laminated, and 16 in. o.c. throughout when the face ply will be attached with screws.

FACE PLY ATTACHMENT

Joints in the face-ply should be offset from joints in the base-ply by at least 10 in. Wallboard can be applied either horizontally or vertically, whichever results in the least waste of materials. On walls, horizontal application usually results in fewer joints and therefore

is preferred. However, predecorated wallboard that is to be left with joints untreated or wallboard that is to be trimmed with battens is installed vertically.

NAIL AND SCREW ATTACHMENT

When the face-ply is attached with mechanical fasteners and there is no adhesive between plys, the maximum spacing and minimum penetration recommended for nails and screws should be the same as for single-ply ap-

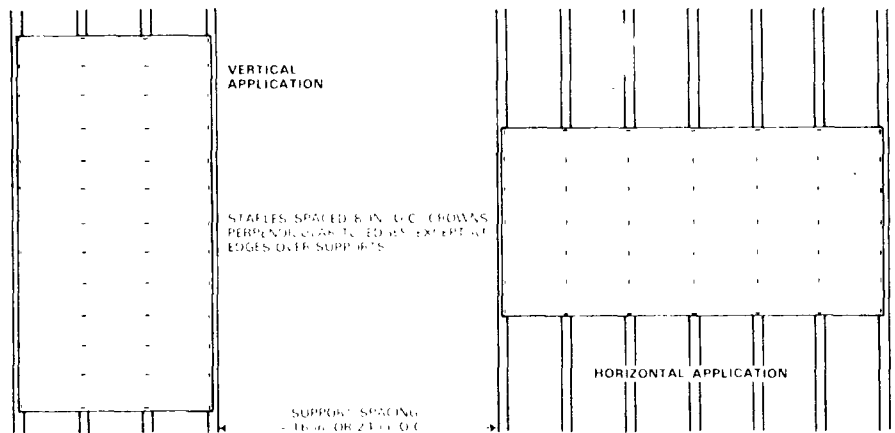


Fig. 44 Staples are driven with crowns perpendicular to gypsumboard edges except where edges fall along supporting members.

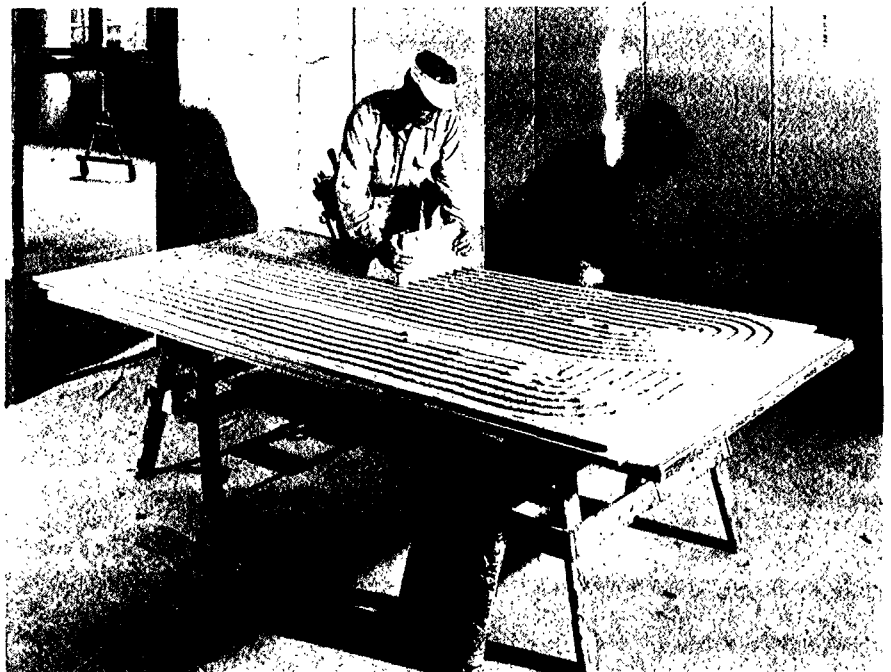


Fig. 45 Notched spreaders apply adhesive for sheet lamination.

plication. These have been given in the *Single Ply Application* chap-

ter under "Nail Attachment" and "Screw Attachment".

ADHESIVE ATTACHMENT

Typical multi-ply construction may employ *sheet lamination*, *strip lamination*, or *spot lamination* to attach the face-ply to the base-ply.

Sheet lamination involves covering the entire back of the face-ply with laminating adhesive from a notched spreader, box spreader, or other suitable tool (Fig. 45). Size and spacing of the notches varies with the adhesive. The wallboard should be erected using moderate pressure, and any adhesive squeezed out at the joints should be promptly removed.

Strip lamination and *spot lamination* are preferred to sheet lamination in sound rated partitions because the sound control is improved. In strip lamination, adhesive is applied with a special spreader in ribbons normally spaced 16 in. to 24 in. o.c. (Fig. 46). In spot lamination, spots of adhesive (Fig. 47) are brushed or daubed on in a pattern.

Temporary Fasteners

Supplemental mechanical fasteners or temporary bracing (Fig. 39) are required to hold the face ply against the base ply, and to assure satisfactory adhesive bond.

Temporary fasteners may be used to hold a face ply in place while the adhesive sets if a fire rating is not required. These fasteners may be double-headed nails (Fig. 48), stucco furring nails, or drywall nails, generally spaced approximately 24 in. o.c. in each direction. Drywall nails should be driven through gypsumboard washers or other rigid material for easy removal without damage to the face ply. After nails are removed, nail holes should be dimpled and finished with compound, like permanent nails.

Permanent Fasteners

Permanent fasteners generally are required in the field as well as in the perimeter of the face

ply of fire-rated assemblies. Nail spacing varies depending on the tested assembly construction and is not related to whether adhesive is used between plies. The spacing is given in the report of the fire tests and is available either in the manufacturer's literature or Gypsum Association literature.

In sound-rated partitions where fire resistance is not a consideration, the most common practice is to attach the face ply vertically over sound deadening board or other board with permanent mechanical fasteners at the top and bottom. Intermediate fasteners are omitted along vertical joints and in the field, and temporary bracing is provided until adhesive has developed sufficient bond strength.

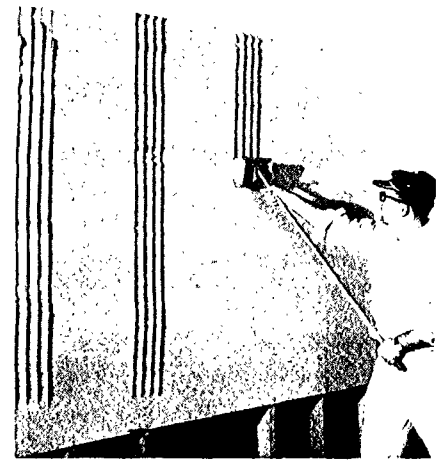


Fig. 46 Strips of adhesive for laminating can be applied to base ply on the wall or to the back of gypsumboard to be mounted.

Some permanent mechanical fasteners should be used in each laminated gypsumboard panel, particularly on ceilings. On side walls these can be placed at the perimeter of the board where they will be concealed by joint treatment or trim.



Fig. 47 Spot lamination using dabs of adhesive provides better resistance to sound transmission in laminated gypsumboard assemblies.



Fig. 48 Double-headed temporary nails are easily removed. A metal plate is used to protect the wallboard surface.

SELF-SUPPORTING GYPSUM PARTITIONS

These are nonload-bearing, non-combustible, multi-ply partitions. They are fabricated on the job, almost entirely from gypsum-board. Inner plies are backing-board ribs or sheets, and wallboard face plies are laminated to these. Unlike the framed ceiling and wall assemblies which depend on wood, metal or other construction to support the surface finish, gypsum partitions are entirely self-supporting, and they require only floor and ceiling runners to stabilize the partition. Runners should be attached securely to ceilings and floors with fasteners

spaced not over 24 in. o.c.

Self-supporting gypsum partitions are classed as:

1. *semi-solid*, utilizing backing-board ribs between face plies,
2. *solid* with a coreboard (thicker backing board) inner ply, or
3. *double solid and triple solid*, with two or three solid walls placed parallel to provide increased fire resistance and sound control.

All gypsumboard components such as ribs, coreboard, backing board and wallboard are installed in vertical position.

Semi-Solid Partitions

Semi-solid partitions provide vertical interior passages for mechanical services. They consist of single or two-ply faces of gypsum-board separated by vertical gypsum ribs, 6 in. wide and preferably 1-5/8 in. thick.¹ The panels are set vertically in place (Fig. 49). In single-faced partitions, the face ply is attached directly to the ribs. Partitions with two-ply faces consist of gypsum ribs, a backing-board base ply and wallboard face ply.

Semi-solid walls may be pre-laminated or laminated in place. Gypsum ribs, cut 6 in. shorter than wallboard, are laminated to the face ply on one side of the partition either before or after it is erected. (Edges of door and window openings should be reinforced with wood or steel). Adhesive is spread on the erected face ply or on the ribs, keeping it 1 in. from the rib edges, and the rib is pressed in place. The rib-reinforced panels are secured to wood or metal runners at top and bottom with appropriate drywall screws spaced 12 in. o.c.

The ribs on the erected panels then are spread with adhesive, and facing panels are installed by

¹ If one in. thick ribs are used, care must be taken to make sure proper outlet boxes are used.

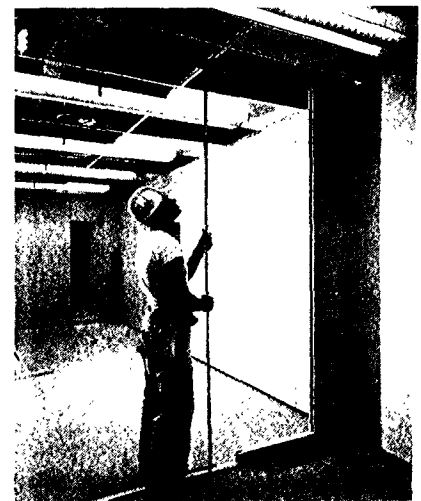


Fig. 49 A workman mounts pre-laminated semi-solid partition panels on floor and ceiling runners.

JOB LAMINATING OF PANEL ASSEMBLIES

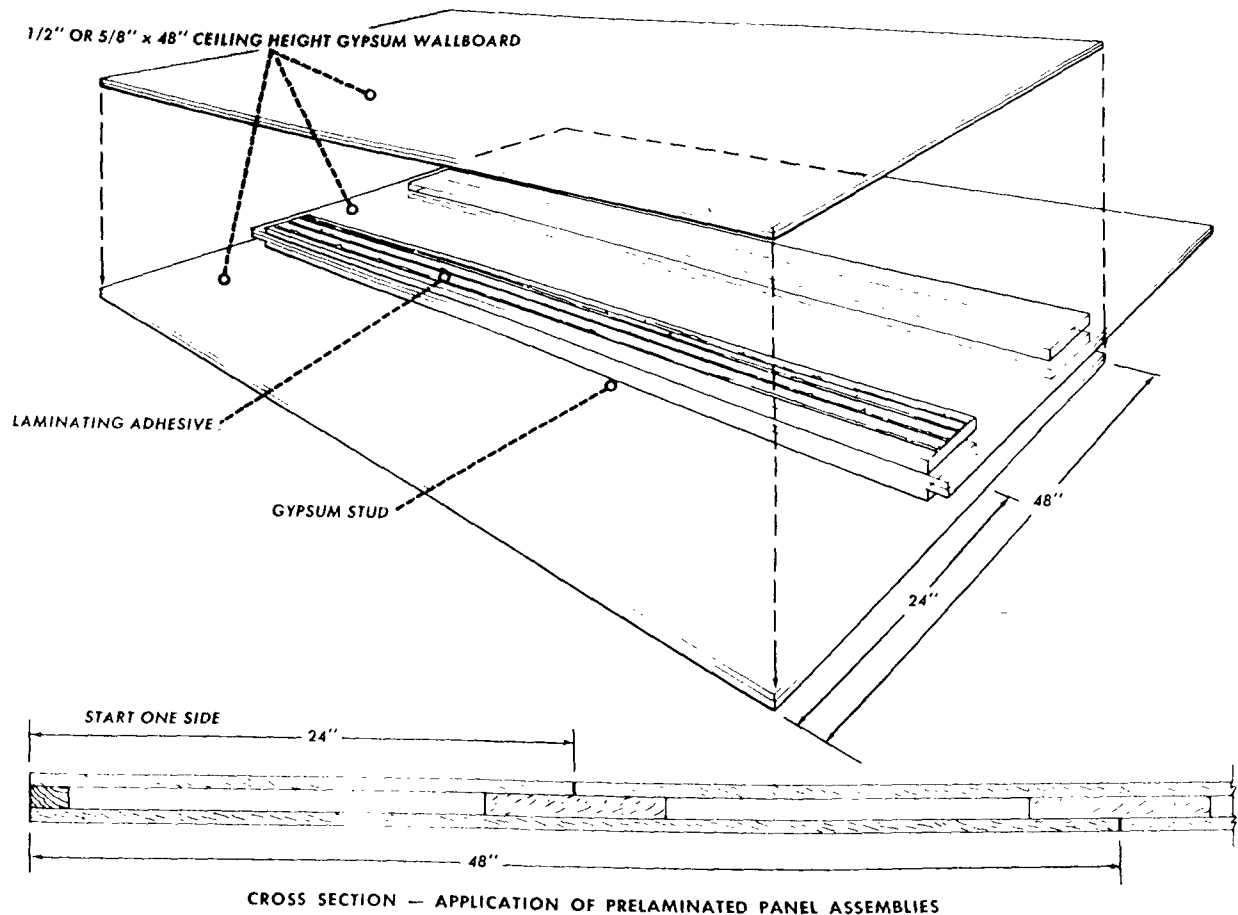


Fig. 50 An efficient method of attaching gypsum ribs to face panels for semi-solid partitions is:

- STEP 1** - Place two pieces (one bundle) of face layers (plain or predecorated gypsum wallboard) with finish surfaces together on a smooth, level surface;
- STEP 2** - Spread adhesive on one side each of two gypsum ribs, using a spreader;
- STEP 3** - Place one rib, adhesive face down, in the middle of the top face sheet about 3 in. from each end,
- STEP 4** - Set the second rib flush with the edge, adhesive side up, about 3 in. from each end;
- STEP 5** - Place a second bundle on top of the ribs with the edge flush with the edge of the uncoated stud, again spread two ribs with adhesive and repeat the procedure until the required number of panels are laminated. Place an extra bundle on the top assembly to provide pressure while the adhesive dries.

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screw-attaching them to the runners with screws spaced 12 in. o.c. Adequate bond to the ribs is assured by 1-1/2 in. Type G dry-wall gypsum screws placed along each rib 12 in. from the top and

bottom and spaced not more than 36 in. o.c.

A more rapid method for adhering ribs to panels is shown in Fig. 50. After this procedure is carried out, panels with ribs

attached are erected with adhesive spread on the outer face of the ribs. The erected panel edges are kept in contact with the ribs by temporary fasteners until the adhesive dries.

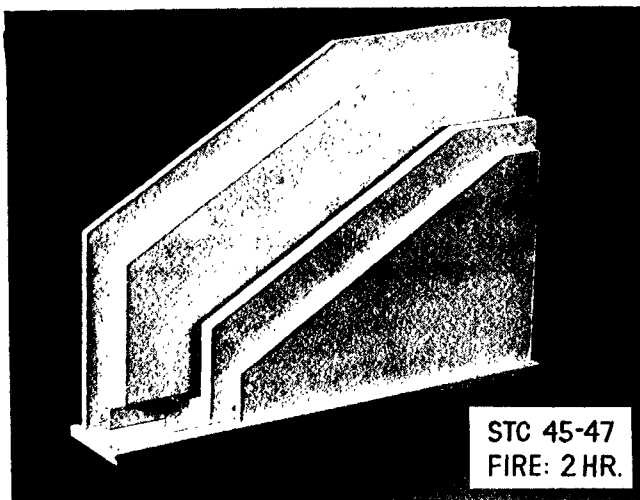


Fig. 51 Double solid gypsumboard partitions have parallel courses attached to two runners separated by an air space. Courses are coreboard faced with wallboard

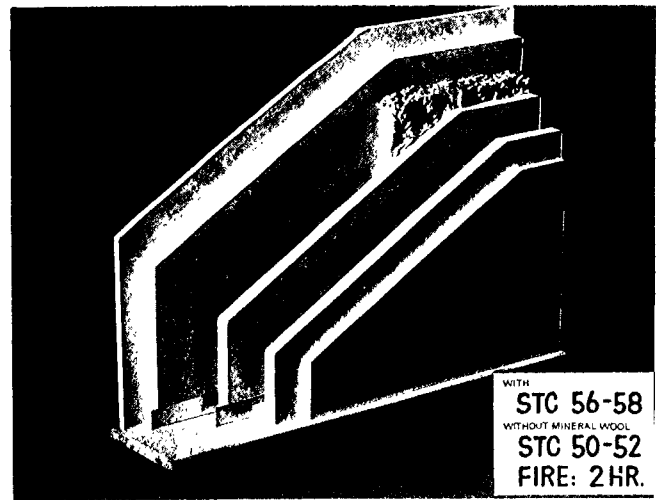


Fig. 52 Triple-solid gypsumboard partitions have three parallel courses and provide superior sound control when a mineral wool or glass fiber blanket is added.

For partitions with two-ply faces, the ribs and backing-board base plies are assembled and installed as previously mentioned. The face plies are sheet laminated as described for two-ply supported partitions using supplemental drywall gypsum screws. (Screw spacing should be according to manufacturer's recommendations for fire rated partitions.)

Separated rib construction to improve sound isolating effectiveness can be provided in either single or two-ply ribbed partitions. Installation is essentially the same as for ordinary ribbed partitions, but twice as many ribs are required. These are spaced 12 in. o.c. and staggered on opposite sides of the partition.

Solid Partitions

Solid gypsum partitions have wallboard faces laminated to each

side of a coreboard. Vertical joints in the face ply should be offset at least 3 in. from joints in the coreboard. The face ply typically is attached by sheet lamination

with supplemental drywall gypsum screws. Double and triple solid partitions separated by air spaces are shown in Figs. 51 and 52.

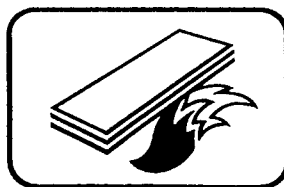
RESURFACING EXISTING CONSTRUCTION

Wallboard may be used to provide a new finish on existing walls and ceilings of wood, plaster, masonry or wallboard. If the existing surface is structurally sound and provides a sufficiently smooth and solid backing without shimming, 1/4 in. wallboard can be applied with adhesives, nails or screws.

Existing surfaces which are too irregular to receive wallboard should be furred and shimmed to

provide a suitable base. Minimum wallboard thickness for various support spacings and installation methods should be as recommended for new construction over furring.

Surface trim for mechanical and electrical equipment such as switch plates, outlet covers, and ventilating grilles should be removed and saved for reinstallation. Electrical boxes should be reset prior to the installation of new wallboard.



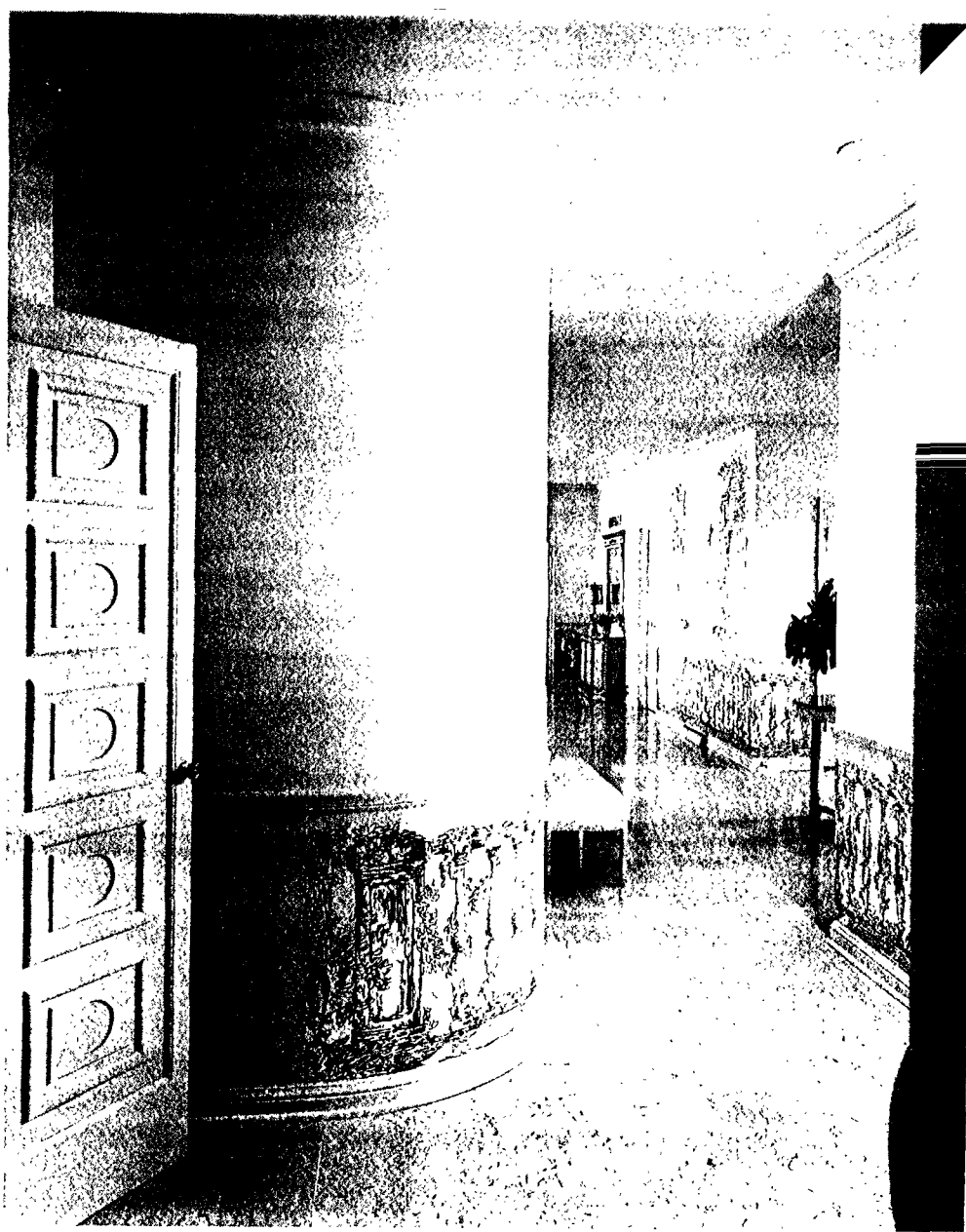


Fig. 53 Gypsumboard walls and ceilings usually have joints treated with tape and compound to give a smooth, monolithic appearance, as in this foyer.

V JOINT AND FASTENER TREATMENT

After wallboard is erected, it is necessary to make joints either inconspicuous or decorative to give the wall or ceiling a desirable appearance (Fig. 53). Panel joints in the same plane and interior corners are usually covered with paper tape and joint compound.¹ Exterior corners and exposed edges require metal or other corner and edge trim for appearance

and protection. Both taped and trimmed areas, as well as fasteners, require finishing with compound to achieve a smooth, monolithic look.

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¹Joint tape and joint compound used to produce a smooth finish should conform to ASTM C-475 *Joint Treatment Materials for Gypsum Wallboard Construction*.

Where joints are decorated instead of taped, battens or mouldings are generally used (Fig. 54).



Fig. 54 Some gypsumboard joints, such as these on predecorated panels, are decorated with metal battens. Vinyl inserts are used to hide fasteners.

JOINT TREATMENT PRODUCTS

Tape used for joint reinforcement typically is strong-fibered paper with feathered edges. The special paper used resists tensile stresses across the joint as well as longitudinally.

Joint treatment products include:

1. *Taping or joint compound* for embedding and bonding the joint tape;
2. *topping or finishing compound* for final smoothing and leveling over joints and fasteners; and
3. *all-purpose compound*, which combines features of both taping and topping compounds.

These compounds either are packaged in powder form to be mixed with water on the job, or are premixed by the manufacturer.

Dry, powdered compounds generally are casein products which shrink as they dry. They require several applications to cover properly, but each application must be thoroughly dry before the succeeding coat is applied. Dry, powdered, vinyl-resin compounds are also available. When mixed with water, these have working characteristics very similar to factory premixed material.

Most joint compounds harden

by evaporation of the water. They have a long wet, or working, life, and they can be kept as wet mixes for several days. They should be covered with a moist cloth or a film of water to prevent drying, and they should be protected against freezing during storage. Preservatives have been added to prevent putrefying.

There are also setting types of dry, powdered compound which can be used for filling joints, for embedding tape, or for both. Setting compounds generally have a gypsum base that sets in a fixed position and holds it when dry. Setting compounds have a short wet life; they must be used within the time limits marked on the container.

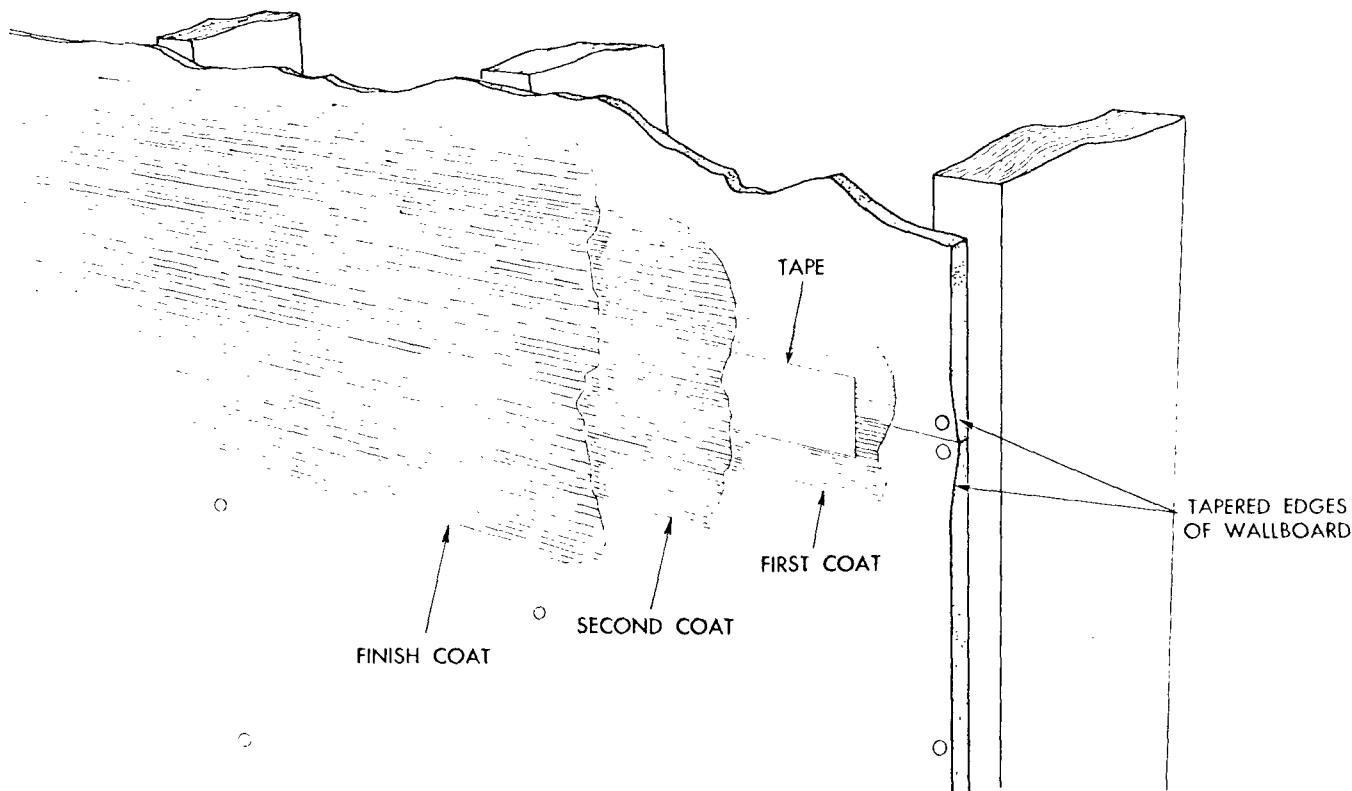


Fig. 55 Reinforcing joints with tape prevents cracks from appearing at filled gypsumboard joints. The joint fill and first coat may be joint compound or all purpose compound.

The second and third coats should be finishing compound or all-purpose compound.

Regular casein or vinyl resin based compounds may be used as second or final topping coats over setting compounds. However, setting compounds and drying compounds must be kept separated until they are applied. They must be mixed in clean containers and applied with clean tools. If the materials are accidentally mixed, they will set too fast to be used properly.

Taping Compound

Taping or joint compounds fill depressions, bond tape over joints, and serve as a first coat for concealing fasteners and edge and corner trim. These materials are sometimes referred to as "embedding" compounds. Usually, taping compound requires at least overnight drying before following coats can be applied. Setting compounds, discussed above, harden in two to four hours. These permit

up to three applications of compound in one day.

Topping Compound

Topping or finishing compound is primarily a surface filler used to conceal and smooth over embedded tape, fasteners, and trim. It is a ready-mixed or powder formulation that bonds well with taping compound, gypsumboard, and fasteners. Also, it sands easily and provides a surface with sufficient "tooth" and "suction" for painting.

Do not use topping compounds

as laminating adhesives.

All Purpose Compound

All-purpose compound, available from some manufacturers, serves as both taping and topping material. This convenient formulation is available in powder or ready-mixed form, in either a machine or hand-tool consistency. All-purpose compound can be used for embedding tape, topping over tape, finishing over metal trim, and concealing fasteners. It may also be used to texture surfaces. However, it should not be used for laminating gypsumboard.

TAPING AND FINISHING

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At least three coats of joint compound are recommended for all taped joints—an embedding coat to bond the tape and two finishing or topping coats over the

tape. Each coat should be allowed to dry thoroughly before the next coat is added so that it can complete its maximum shrinkage before it is covered.



Fig. 56 Filling and taping are the first steps in finishing a gypsumboard joint. (left) The depression at the joint is filled with compound. (right) Tape is centered over the joint and smoothed and pressed into the compound. Excess compound is smoothed over the tape and feathered out with a wide knife.

Depending on atmospheric conditions, joint compound may need 12 to 24 hours for each successive coat to dry unless a setting com-

pound is used. Temperature and ventilation at the job site should be controlled as discussed under "job site preparations".

FLUSH JOINTS

To treat a flush joint, taping compound is spread into the depression formed by the tapered edges of adjacent boards and over all butt-end joints. Then tape is centered over the joint and smoothed to avoid wrinkling. The tape is pressed into the compound by drawing a broad knife along the joint with enough pressure to squeeze out excess compound. If

too much compound is forced out, ridging can occur. The excess should be redistributed as a skim coat over the tape (Fig. 56).

When the embedding coat is dry, it may be sanded if the surface is too rough. Then a second coat of compound is applied and the edges are feathered 2 in. to 4 in. beyond the tape edges. After this coat dries, it



Fig. 57 Top coat edges are feathered out till the treatment appears flush with the wall surface. The use of wider knives helps in feathering top coats.

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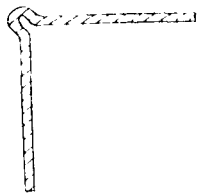
Fig. 58 An automatic taping machine rapidly fills joints and places the tape in one operation.



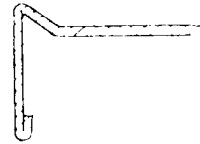
Fig. 59 An automatic treating machine rapidly dispenses an even top coat of compound and does most of the leveling.

METAL ACCESSORIES

Cornerbead - (Numbers indicate width of flanges
i.e.—118 is 1-1/8 in. W.
Flange)



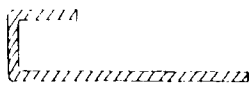
ANSI-CB- 1 x 1
ANSI-CB- 118 x 118
ANSI-CB- 114 x 114
ANSI-CB- 1 x 114
ANSI-CB-PF (Paper Flange,
Steel corner
bead)



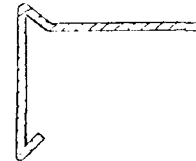
ANSI-LS-38, LB-38
ANSI-LS-12, LB-12
ANSI-LS-58, LB-58
ANSI-LS-34, LB-34

"LK" Bead - (For use with Kerfed jamb) ("S"
indicates square nose, "B" Bull
or Round Nose)

"U" Bead - (Numbers indicate thickness of
board to be used) "S" indicates
square nose, "B" Bull or Round
Nose)

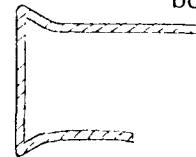


ANSI-US-38, UB-38
ANSI-US-12, UB-12
ANSI-US-58, UB-58
ANSI-US-34, UB-34



ANSI-LK-S
ANSI-LK-B

"LC" Bead - (Numbers indicate thickness of
board to be used)



ANSI-LC-38
ANSI-LC-12
ANSI-LC-58
ANSI-LC-34

"L" Bead - (Number indicate thickness of board
to be used) ("S" indicates square
nose, "B" Bull or Round Nose)

Fig. 60 Cornerbeads, CB, protect outside corners of gypsumboard walls. UL, LK, and LC beads are used where boards end at door and window frames. Flared angles at corners provide space for joint treating compound.

is sanded if necessary, and a third coat of compound is spread with edges feathered 2 in. to 4 in. beyond the second coat to blend smoothly with the wallboard surface (Fig. 57). When joint treatment is done skillfully, sanding of successive coats is unnecessary. If sanding is done, care should be taken to avoid scratching the base paper because this raises the fibers and contributes to poor appearance after decorating.

Figs. 58 and 59 show automatic taping and treating machines that can speed joint treatment.

INTERIOR CORNER JOINTS

At interior corners, compound is applied to both sides of the joint; then tape is folded along the center crease and embedded snugly in the corner to form a right angle. Excess compound is removed, and the surfaces are finished as described for flush joints. Hand tools or machines can be used for corner finishing.

EDGE AND CORNER TRIM

Exposed wallboard corners need the protection of wood or metal trim. Wood casings are often used for decorative effect at window and door frames, and a baseboard is used to protect wallboard edges at the floor. Metal trim, such as corner beads and casing beads, is used when inconspicuous edge protection is desired.

The standard shapes for metal trim¹ are illustrated in Fig. 60. On outside corners, metal cornerbeads protect the wallboard from damage and provide neat, slightly rounded corners which are difficult to obtain with tape and joint compound alone. Metal flanged beads such as CB, L, LC, and LK generally are nailed or screwed to supporting construction approximately 6 in. o.c. (CB can also be crimped for attachment as in Fig. 61).

All trim shapes except metal U-bead are installed after the wallboard is erected. Trim shapes require at least three-coat finishing with joint compound to obtain a smooth surface and to conceal fasteners.

SGP 0025894



Fig. 61 Various tools are used to crimp cornerbead at the outside corner of gypsumboard facings on a column.

¹Taken from *American National Standard Specifications for the Application and Finishing of Gypsum Wallboard*, ANSI A97.1.

Unlike other trims, U-bead is fastened through the back flange first, then the wallboard is erected, with edges inserted in the trim. Finishing with compound is not required because fasteners are concealed. *The drywall applicator must make sure that the U-bead is in place before the wallboard is fastened down, or the board will have to be removed and replaced. Also, if LC bead is used, the board edges to be protected should not be fastened until the bead is in place.*



Fig 62 The dimpled depressions from fasteners must be treated with compound before gypsumboard is decorated. More than one coat is often necessary.

FASTENER TREATMENT

Joint compound usually is applied over fastener heads at the same time joints are taped. Fasteners may be treated (spotted) using an automatic spotter or a finishing knife (Fig. 62) to fill in depressions or to blend in protrusions. The knife should be pressed against the surface to

make the finish level and to remove excess compound. Second and third coats of compound generally are applied over fasteners when similar coats are applied to taped joints, edges and corners. The procedure is the same as previously described under "Joint Taping and Finishing".

REMEDYING DAMAGE

The prevention of surface damage to gypsumboard finishes has been discussed. Prevention is more effective than repair because these problems cannot always be corrected by finish treatment. Nevertheless, if problems do occur, there are some remedies available.

Nailpopping

The usual repair for a nail pop (Fig. 63) is to drive a new nail of the proper size about 1-1/2 in. from the popped nail, while holding the board tight against the framing. Then the popped nail is reseated and again treated with joint compound. If punctured facepaper is the reason for the loose attachment and nail popping, the board should be

nailed tight or screws should be used 1-1/2 in. from the defective fastenings. The old nail should be removed from the broken area, and the damaged part should be filled smoothly with compound.

Ridging

If ridging occurs due to strains caused by expansion and contraction of the framing, let the condition develop fully before making repairs. Six months or one heating season should be sufficient.

Sand ridges down to the reinforcing tape without cutting through the tape, and fill the concave areas on both sides of the ridges with topping compound. After the fill is dry, blend in the repaired area with a light film of topping compound.

After the repair is made, a

strong sidelight will show whether the ridge has been eliminated or whether additional coats of compound are necessary. When the repair is satisfactory, redecorate.

Shadowing

Fastener head shadowing is simply a surface discoloration, but it may appear similar to nail popping when viewed at a distance. Shadowing is an accumulation of dust or dirt caused by increased thermal conductivity and moisture condensation over the fastener head. It occurs commonly on roof/ceiling or exterior wall assemblies in regions with great indoor-outdoor temperature variations. Shadowing can be remedied by periodic washing or decorating; it can be avoided by installing adequate insulation and using laminated, two-ply construction. Where a permanent ventilating system is employed, air filtration and humidity control will be helpful.

Joint shadowing is the joint showing darker when viewed from an angle. Texture variation or low or high joints are the causes.

Cracking

Cracks may be filled, but if they are caused by excessive movement in the framing, they will have to be refilled and redecorated periodically.

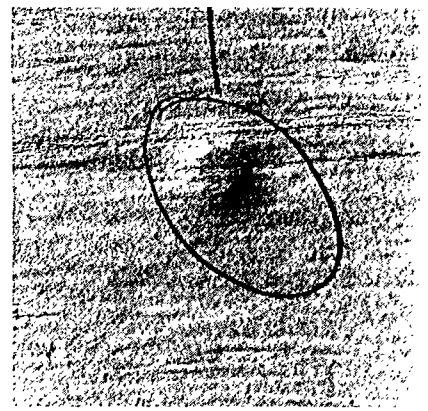
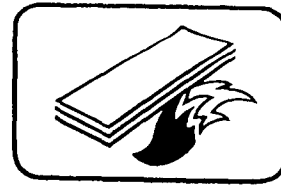


Fig. 63 Nail pops are repaired by either driving the protruding nail beneath the surface or removing it entirely and using additional fasteners, 1-1/2 inches away, to securely hold the board if necessary. The damaged area and the additional fastener heads are then treated with compound and redecorated.



VI DECORATING

Regular Gypsum Wallboard

Gypsum wallboard finishes should be reinspected prior to decorating, particularly at joints and fasteners. Any imperfections should be sanded or repaired. Before the decoration is applied, joint compound must be thoroughly dry. Depending on temperature and humidity, 24 hours or more of good drying time is generally required.

Wallboard surfaces can be decorated with emulsion or oil-base paints or with paper, fabric, or vinyl wall coverings. Always seal or prime the wallboard surface before decorating. An emulsion sealer will block the pores and lay the fibers in the paper surface so that suction and texture differences between paper and joint compound will be equalized. A good primer will provide uniform texture and conceal color or surface variations. Some coatings

both seal and prime with one application.

For best results when decorating with oil-base paints, lacquers, and enamels, wallboard should be sealed. Also, sealers are used under wall coverings so that the coverings can be later removed without marring the surface and an adequate base will be left for redecorating.

Most emulsion paints such as latex, resin, and casein do not raise the fibers in the face paper. High quality latex paints often have inherently good sealing and priming properties and require no special preparation of the wallboard. A pigmented emulsion sealer applied as a first coat or at least two coats of emulsion paint will be durable and attractive if the wallboard has been properly installed and treated. Glue size, shellac, and varnish are not suitable sealers or primers.

Predecorated Wallboard

Patterns or colors on some kinds of predecorated gypsum wallboard may vary slightly from lot to lot. All the board used in a room should be from the same lot, but when this is not possible, the joint between two different lots should be in a corner.

Care should be taken to match the patterns on adjacent pieces of predecorated wallboard. One procedure is to simply stand the boards in the places they are to occupy. Boards that do not match well are shifted. If joints are to be covered with metal trim, plan the layout of walls and ceilings in advance so that a balanced layout of joints is obtained. Avoid the appearance of two metal trimmed joints close together in a corner. If the stud spacing is not proper to allow an attractive arrangement of joints, furring strips may be necessary so that joint locations may be shifted.

Cut edges that are to be covered with trim (moldings or battens—see Fig. 64) can be sawed or scored and snapped the same as regular wallboard. If cut edge joints are to be exposed however, the face material should be cut approximately 1 in. wider than the gypsum core. The core should then be snapped and removed from the fabric — not the fabric from the core. The core should be trimmed straight and bevelled on the face side under the flap, and the overlapping face material should be pulled around the edges and fastened to the back with adhesive (see Fig. 65). Then when the panels are butted together, they will form a good looking joint.

Other joint treatments for pre-decorated board include using tape matching the face material or adhering a flap of the face material from one board onto the face of the other (Fig. 66). These methods form seams much like wallpaper seams; and when they are skillfully done, the seams are well hidden.

NOTE: When using adhesives for the application of vinyl covered gypsum board, read and follow the wallboard manufacturer's instructions. Improperly applied, or incompatible adhesives, can damage vinyl finishes.

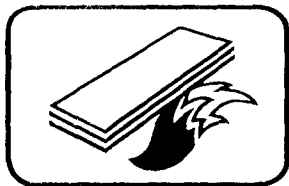
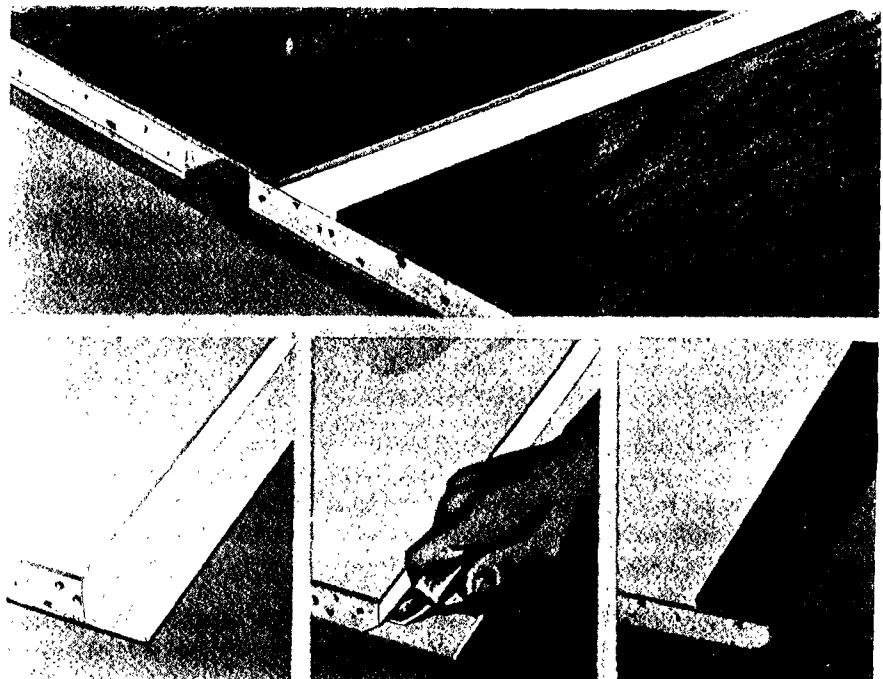


Fig. 65 For butt joints without covering trim, decorated surface is cut 1 inch longer than the exposed gypsum core (top) or the gypsum core is cut back 1 inch from the surface end (bottom left). Then the core is bevelled on the face side (center), and the decorative material is pulled around and adhered to the back. This gives a finished end which makes an attractive exposed butt joint.



Fig. 64 Screws holding predecorated wallboard are concealed with vinyl strips in battens which cover joints.





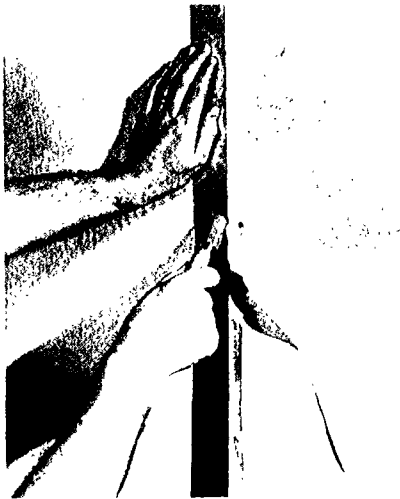
Drywall applicator fills joints with quick-setting compound. Flaps of vinyl facing are folded out of the way.



When the joint compound sets, the area is coated with wheat paste.



The right hand flap is pasted down and smoothed; then the left flap is pasted over the right hand flap.



A straight-edge and a sharp wallboard knife are used to cut through both layers of the overlapping vinyl.

Cut-off strips are removed. The overlapped right hand flap that was cut is pulled out from under the left flap.



The two flaps are now smoothed into a perfectly fitting butt joint.

Rolling the joint eliminates bubbles and excess wheat paste under the vinyl covering.

Finally, the excess wheat paste is sponged off, and the joint is dried.

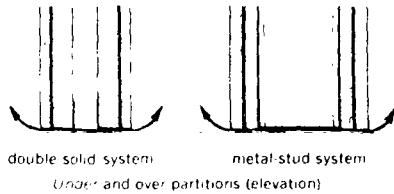


SGP 0025898

Fig. 66 Smooth, flat and carefully butted joints in vinyl coverings on wallboard are difficult to see.

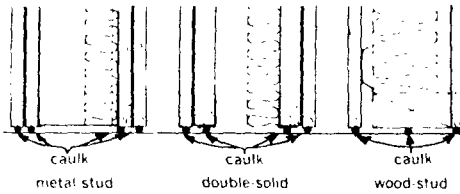
"NORMAL" CONSTRUCTION...

Arrows show flanking paths



"SELECT" CONSTRUCTION...

Caulking of relief detail at perimeter of partition to prevent sound leakage



"PRE-DESIGN" CONSTRUCTION...

Simulating laboratory conditions

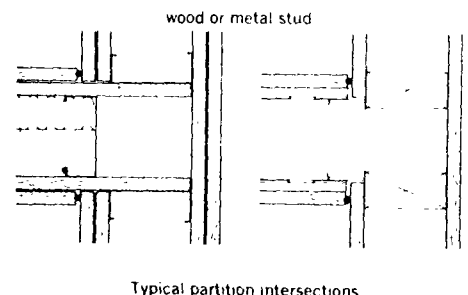
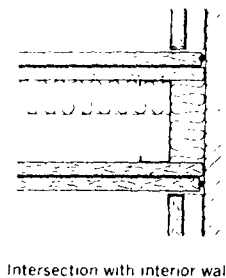
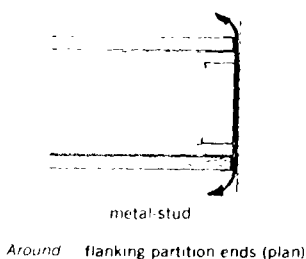
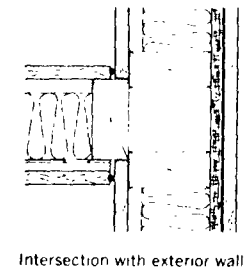
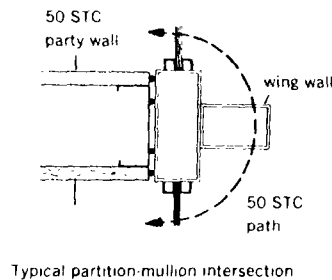
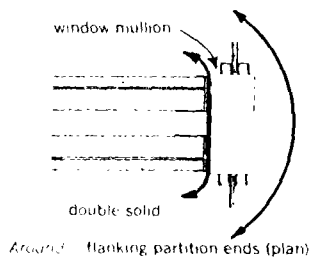
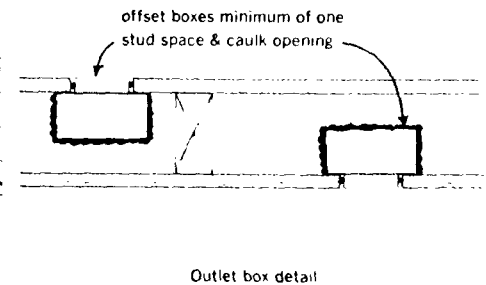
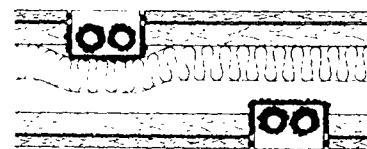
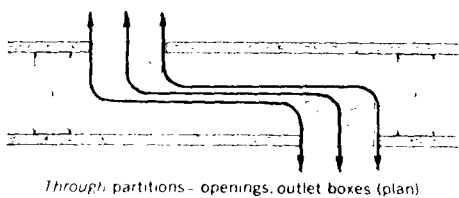
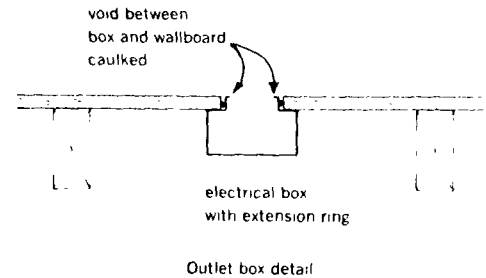
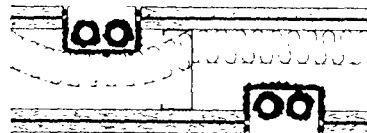
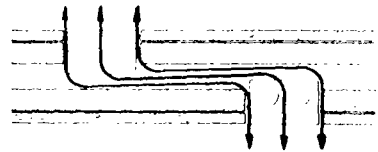
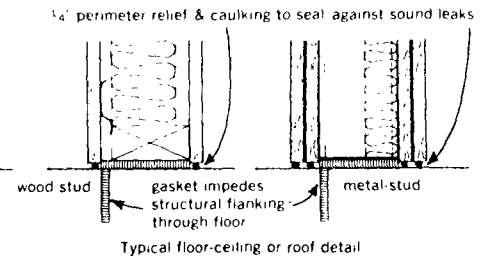
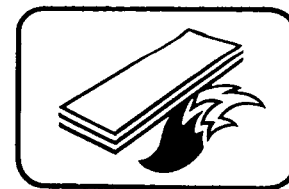


Fig. 67 Plan views show typical caulking to close off flanking paths for sound transmission.

SGP 0025899



VII SPECIAL CONSTRUCTION

Most special constructions intended to provide improved sound, fire, moisture and thermal control require a gypsumboard assembly with complete joint treatment and panel caulking. The caulking

should be a nonhardening, non-shrinking, nonbleeding, nonstaining, resilient sealant. In each case, the manufacturer's specific installation recommendations should be followed for individual systems.

walls—through nonsound proof ceilings above them, around walls—through windows and doors adjacent to them, or under walls—through nonsound proof floors and crawl spaces below.

SOUND ISOLATING CONSTRUCTION

The first essential for airborne sound isolation by any assembly is to close off air leaks and flanking paths by which noise can go around the assembly. Hair-line cracks or small holes in an assembly will reduce resistance to sound transmission by several decibels.¹ Failure to observe special construction and design precautions can destroy the effectiveness of the best sound control methods that can be built into an assembly.

Assemblies should be airtight. Recessed wall fixtures such as medicine cabinets, or electrical,

telephone, television and intercom outlets which perforate the gypsumboard surface should not be located back-to-back or in the same stud cavity. In addition, any opening for such fixtures and piping outlets should be carefully cut to proper size and caulked. The entire perimeter of a sound isolating partition should be caulked around wallboard edges and on both sides of runners to make it airtight (Fig. 67). Details of caulking needed will be given for various wall assemblies by the manufacturers of the gypsumboard used.

Assemblies intended for sound isolation should not contain heating ventilating, or air conditioning ducts. They should be designed so that airborne sound will not go over, around, or under the assembly. Noise can travel over

Separated Construction

Separated construction systems can raise the resistance to noise transmission considerably. These have the two wall surfaces on separate sets of supports so that vibrations are not transmitted through the framing to the other side. Studs may be tagged on the same top and bottom plates (Fig. 3b), but for best results they should be placed on separate plates with a space between the plates. Simply increasing the distance between the finished surfaces of the wall increases the Sound Transmission Class (STC). Doubling the distance between the walls can increase the STC about five points in some cases.

Separated walls without framing are made from all-gypsum double-solid and semi-solid partitions.

Resilient Mounting

Resilient attachments act as "shock absorbers" to reduce

¹A 0.14 sq. in. opening will reduce the STC of a sound barrier from 50 to 47, or from 60 to 48. A 1.4 sq. in. opening will reduce an STC of 50 to 39 and an STC of 60 to 40 (D. Harris, *Decibels Per Dollar*).



Fig. 68 Paper-faced insulating blankets should have flanges stapled to inside surface of studs. Stud faces to receive gypsumboard should be left free.

sound passage. Gypsumboard surfaces mounted on resilient channels or over sound deadening board are isolated from their framing, and thus transmit lesser amounts of vibration. The same is true for base plies mounted with resilient clips in multi-ply walls. Resilient mounting can raise an STC rating as much as seven points.

Kitchen cabinets, lavatories, ceramic tile, medicine cabinets and other fixtures should not be supported on resiliently mounted walls because the added weight

and fastenings may "short out" the construction acoustically. Separated walls are recommended.

Resilient furring channels generally are attached across the framing members (Fig. 3c). Nails used to attach channels to wood joists in ceiling assemblies may work loose as the framing lumber dries and cause floor squeaking; therefore, screw attachment is preferred for ceilings.

Some resilient channels can support only limited loads without losing their acoustical effective-

ness. The manufacturer's recommendations should be followed.

Resilient clips can be used to attach the base ply of two-ply finishes to wood studs, but they are not recommended for ceiling application. Special nail-on clips designed for use with auxiliary 1 in. thick wood furring are available for single-ply gypsumboard ceilings.

Sound Deadening Board

Sound deadening board used in gypsumboard construction includes:

1. gypsumboard sound deadening panels,
2. wood or cane based organic fiber board,
3. mineral (including glass) fiber board, and
4. rigid (plastic) foam board.

Sound deadening boards are manufactured from 1/2 in. to 5/8 in. thick, 4 ft. wide, and 8 ft. to 12 ft. long. They are used as base layers and they are often set parallel to supporting members with joints staggered on alternate studs.

Gypsum wallboard face layers are generally laminated over sound deadening board. However, if a fire rating must be obtained, nailing or screwing through the sound deadening board into the framing is required. This will reduce the sound isolating effectiveness of the sound deadening board.

Fiberboard and foamboard can be used over wood construction or where noncombustible materials are not required. Gypsumboard sound deadening panels are used with metal framing where noncombustible materials are required.

SGP 0025901

Sound Absorbing Materials

Mineral wool or glass fiber insulating batts and blankets may be used in assembly cavities to absorb airborne sound within the cavity.

The full height of the cavity should be filled, and batts or blankets should be carefully fitted

behind electrical outlets, around blocking and fixtures, and around cutouts necessary for plumbing lines.

Insulating batts and blankets may be faced with paper or a vapor barrier and may have flanges or be friction fit types. They are installed by stapling or fitting to the inside surfaces of studs (Fig. 68). Stapling flanges across the stud face before applying gypsumboard is not recommended because it prevents proper board-to-stud contact. In metal-stud-framed and in laminated all-gypsumboard partitions, the blankets are attached to the back of the gypsumboard. Batts and blankets without facings are required in noncombustible construction. They are installed and held by friction fit within the stud space.

FIRE-RESISTANT CONSTRUCTION

Fire resistance ratings of gypsumboard assemblies can be improved by:

1. using Type X gypsumboard,
2. increasing the gypsumboard thickness, and
3. filling the stud cavity with mineral wool or glass fiber.

Unless all of the materials used in the tested assembly classify as noncombustible, the term combustible is used after the assigned hourly classification.

Nominal 2 in. x 4 in. wood stud partitions finished with 5/8 in. Type X wallboard on both sides and installed as specified, receive a one-hour rating. Wood stud partitions have been rated two-hours when two layers of

5/8 in. Type X board are fastened on each side. Metal stud partitions receive 2 hour ratings with two-ply faces of 1 2 in. Type X board installed as recommended by the manufacturer.

Wood-joint floor/ceiling assemblies with single-layer wallboard finishes generally are limited to one-hour ratings although two hour, two layer assemblies are available. Steel and concrete assemblies protected by a suspended gypsumboard ceiling generally achieve higher ratings.

Details of many fire rated assemblies are given in *Design-Data-Fire Resistance/Sound Control* published by the Gypsum Association. Beside the ability to

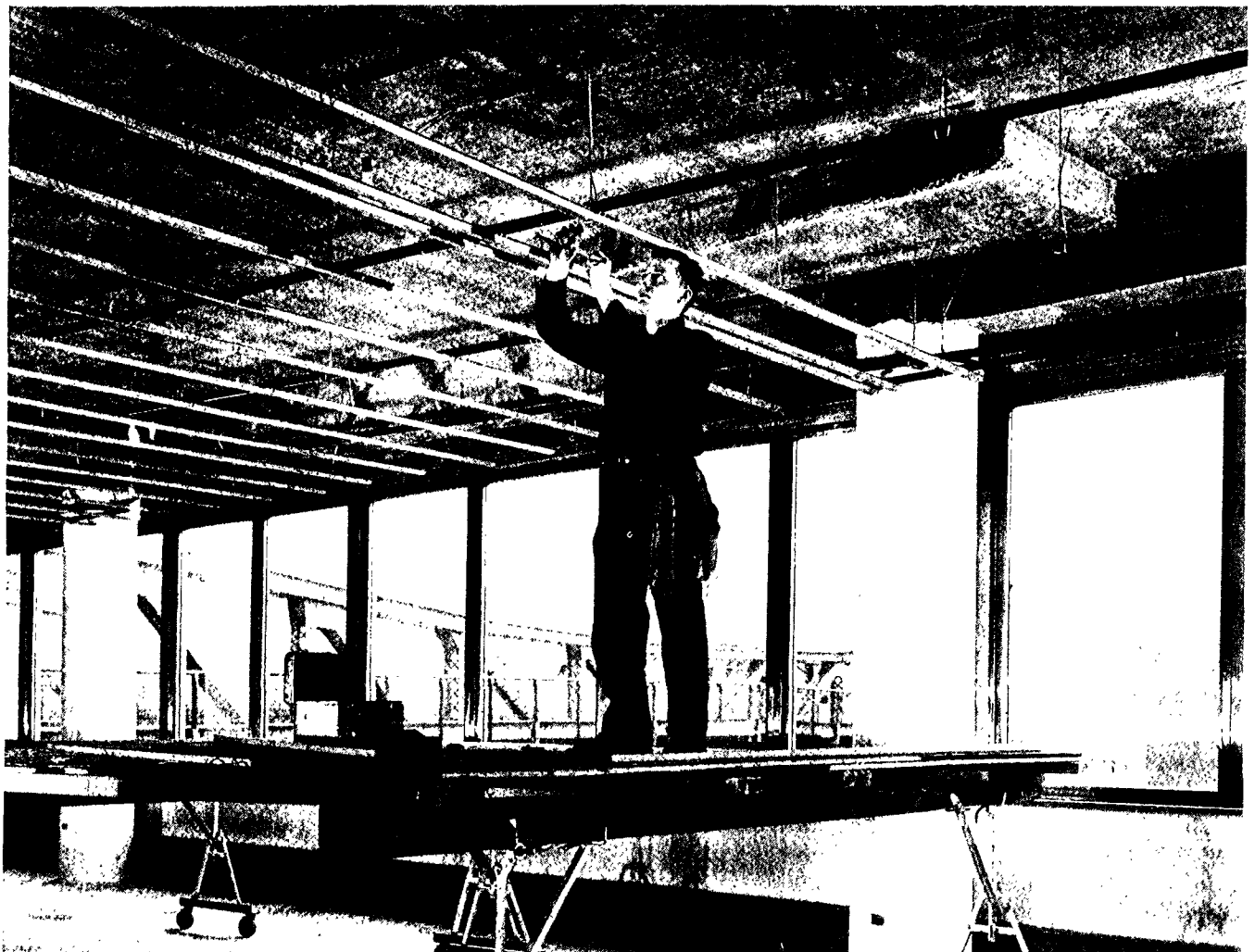


Fig. 62 A steel and concrete upper floor is protected from fire by a suspended gypsumboard ceiling membrane. The workman is tying a spliced drywall channel to a suspended cold rolled channel.

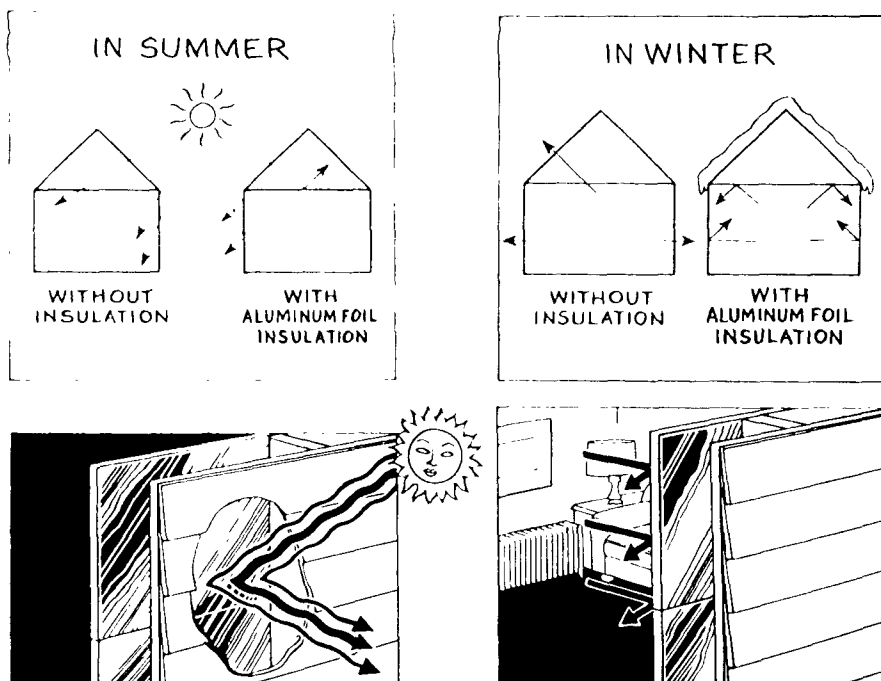


Fig. 70 Foil surfaces on gypsumboard reflect heat rays in summer and reduce radiation in winter.

contain a fire, indicated by fire resistance ratings, another criterion for fire hazard of exposed surface materials is the rate of surface flame spread. This rating for gypsumboard is under 15 based

on a flame spread of 0 for asbestos-cement board and 100 for red oak. This low flame spread rating meets the requirements for most interior finishes.

THERMAL INSULATING CONSTRUCTION

In certain regions of the country, exterior wall and ceiling assemblies may require thermal insulation to minimize heat gain or loss through the assembly. Typical means used to increase thermal resistance of gypsumboard assemblies include:

1. flexible fiber insulation (batts and blankets),
2. loose fill insulation,
3. rigid foam insulation,
4. reflective foil insulation with 3-4 in. minimum still airspace, or
5. air spaces provided by furring over solid materials such as masonry and concrete.

In addition, vapor barriers are commonly required to retard passage of moisture and condensation within the assembly.

Vapor control can be provided as an integral part of the gypsumboard or as part of the insulation. Insulating (foil-backed)

gypsumboard may provide some insulating value, equivalent to 1/2 in. fiber board, as well as an effective vapor barrier, and it can be used with or without other insulation materials. It is popular in the areas where minimum insulation is required (Fig. 70).

Rigid plastic foam and reflective foil insulation are materials with very low vapor permeability and they generally do not require a separate vapor barrier. Insulating batts and blankets are available with or without vapor barriers. Loose fill insulation requires either a separate vapor barrier, such as foil or polyethylene film, or an integral barrier provided by insulating gypsumboard.

Vapor barriers should be located on the warm side of the insulation. When reflective foil is used, it should face an air space of at least 3/4 inch to be effective.

Rigid foam insulation is intended primarily for exterior and below-grade concrete or masonry walls. Insulating foam-boards are made from expanded polystyrene or polyurethane in panels 1/2 in. to 3 in. thick and up to 4 ft. wide by 12 ft. long.

Foamboards are generally adhesive-bonded to the masonry or concrete surface. (Methods and adhesives should be specifically recommended by the insulation manufacturer.) They should be fitted together so that no gaps between the boards create cold spots or allow moisture migration. Gypsumboard can then be attached to the rigid foam insulation as recommended by the foamboard manufacturer. The use of furring channels and mechanical fasteners is recommended. Screw attachment to special channels provided with the foamboard can be used. If the gypsumboard is laminated, it should be held in place by temporary bracing or double-headed nails which can be removed after sufficient bond strength develops.

SGP 0025903

MOISTURE-RESISTANT CONSTRUCTION

Most gypsumboard is affected by prolonged contact with moisture and should not be used in locations subject to direct wetting or continuous high humidity. However, it can be used in exterior locations such as eave soffits and porch or carport ceilings when properly protected from direct contact with water. Also, it is suitable for wet or humid interior locations when special precautions are taken.

Exterior Locations

Regular or water-resistant wallboard used on horizontal surfaces in exterior locations should be at least 1/2 in. thick. Facia boards protecting wallboard soffits should have a drip edge that prevents water runoff across the wallboard (Fig. 71). In addition, edges and ends at the perimeter

of the board should be protected by metal edge trim or wood mouldings. Wallboard edges without metal trim or other water stop should be spaced at least 1/4 in. from abutting masonry. Exposed wallboard surfaces and metal trim should be sealed with two coats of exterior paint. Adequate ventilation of eaves, ceilings and attic spaces must be provided.

Interior Locations

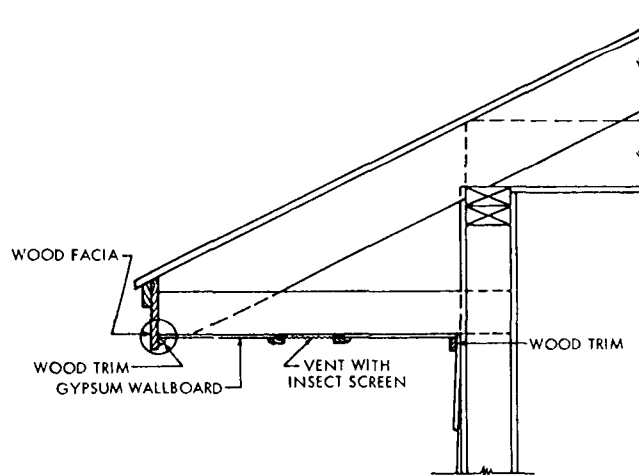
Water-resistant gypsumboard, rather than regular gypsum wallboard is recommended for all interior areas subject to high humidity. These areas include bathrooms, laundries, and utility rooms. Water-resistant board gives definitely superior performance in these areas, although regular wallboard is successful when properly installed, sealed, and protected.

Furthermore, insulating (foil-backed) wallboard should not be used in high-humidity interior areas. The foil backing may trap moisture in the board core. Because condensation is a particular problem where the high humidity area is located on an exterior wall, a separate vapor barrier on the warm side of the wall and adequate insulation are necessary. Otherwise, moisture will collect in the cavity.

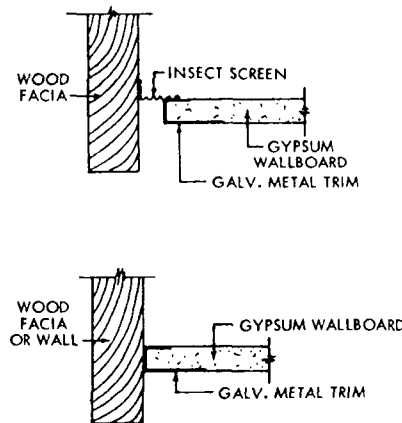
Bath-Shower Areas

Most of the wall tile installed today is applied over gypsumboard. Water-resistant gypsumboard is particularly recommended as a backing for wall tile in bath-shower areas, and proper adhesives for the service should be used with it.¹

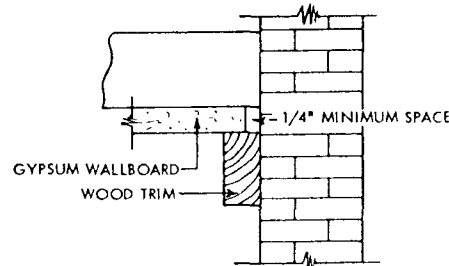
Gypsumboard around the tubs and showers should be at least 1/2 in. thick. Stud spacing should



FRAME WALL



ALTERNATE FACIA DETAILS



MASONRY WALL

SGP 0025904

¹ Ceramic wall tile application to gypsumboard should meet *American National Standard Specifications for Ceramic Tile Installed With Water-Resistant Organic Adhesives*, ANSI A108.4-1968. The adhesives used should meet the specifications of the *American National Standard for Organic Adhesives for Installation of Ceramic Tile*, ANSI A136.1-1967.

Fig. 71 Gypsumboard should be protected from wetting in outdoor locations by facia boards with drip edges. Gypsumboard edges should be separated from possible dampness by metal edge trim or by a 1/4 in. space. Spaces enclosed by gypsumboard must be adequately vented.

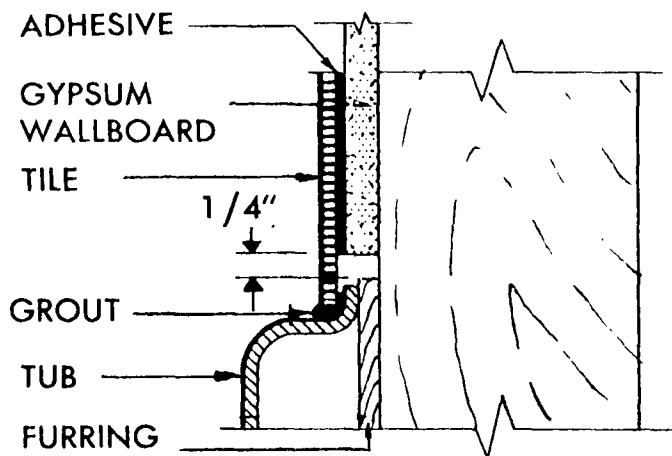


Fig. 72 Details show installation of wall tile on gypsumboard around tubs and showers. The gypsumboard must be separated from the tub, receptor, or pan by at least 1/4 in. gap to prevent moisture seepage.

not exceed 24 in. o.c.; if stud spacing exceeds 16 in. o.c., blocking should be installed not more than 4 ft. o.c. between all studs. The first row of blocking should be approximately 1 in. above the top of the tub or shower receptor. Soap dishes, hand-hold bars, and other fixtures must be backed with blocking. The gypsumboard should be applied perpendicular to framing members with paperbound edges parallel to the top of the tub or shower receptor. The board must not touch on the tub or receptor; at least 1/4 in. space should be maintained (Fig. 72). Generally, gypsumboard should be fastened with nails spaced not more than 8 in. o.c. or screws spaced not more than 12 in. o.c. However, when ceramic tile over 5/16 in. thick is intended, nails should be spaced 4 in. o.c. and screws 8 in. o.c.

When water-resistant gypsumboard is used, any special recommendations made by the manufacturer of the board should be followed. All cutouts for plumbing fixtures should be sealed with water-resistant, nonhardening compound or vinyl tape before wall tile is applied, to prevent water from seeping into the core (Fig. 73).

When regular wallboard is used, joints between adjacent boards, including those at corners, should be treated in the regular fashion.

A water-resistant sealer should be applied to the entire wallboard surface, including treated joints and corners before tile is installed. When tile adhesive is used as a sealant, the sealing coat should be spread over the entire surface and allowed to dry before the bonding coat is applied. A continuous, uniform coating, approximately 1/16 in. thick, covering all cut ends and all cutouts for fixtures is necessary.

The tile finish should cover the area illustrated in Fig. 75. Application should be according to tile manufacturers' recommenda-

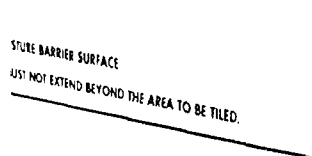


Fig. 73 Clear tape around cutouts helps keep moisture from soaking the board over a period of time.

tions. The space between tile and tub trim, shower receptor, or subpan top should be caulked (Fig. 72). To prevent the caulked joint from opening as settling occurs, it is recommended that the tub be supported at the walls on metal hangers or vertical blocking nailed to the studs. Shower receptor pans or subpans should have an upstanding leg or flange. This should at least be 1 in. higher than the water dam or threshold in the entry to the shower, so that wallboard edges may be placed above the level where leakage might reach them.

ELECTRIC PANEL HEATING

Electric heating panels in ceilings can be constructed with gypsum backing board, electric heating cables, a special, noninsulating, nonshrinking filler material, and gypsum wallboard.

Wiring

The backing board base layer should be attached perpendicular to supports with nails, screws, or staples spaced 7 in. o.c. Clearance of at least 1-1/4 in. free of cable on either side of the joint centerline, and 4 to 6 in. around the perimeter of the ceiling at the walls (Fig. 76), should be maintained by the cable installer.

Filling

A specially formulated filler, mixed according to the manufacturer's recommendations, is used to completely embed the heating cables. It should be applied to a 1/4 in. thickness and levelled to a smooth surface ready for the finish layer. All inspection and testing of the electrical installation should be performed before the face layer is applied. Finally, a finish coat of compound or a face layer of gypsum wallboard is applied. When wallboard is used, care must be taken that the nails do not cut the cables.

All filler material should be completely dry before decorating.

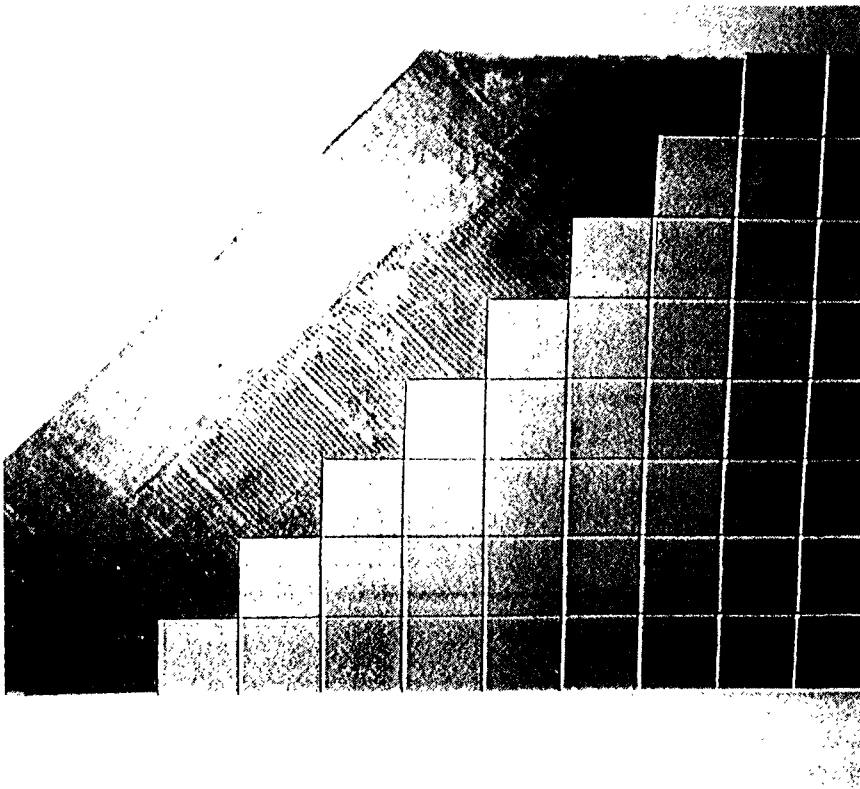


Fig. 74 Regular gypsum wallboard (light area) is covered with a skim coat of adhesive (smooth area) which is allowed to dry before the bonding adhesive (ridged area) and wall tile are applied.

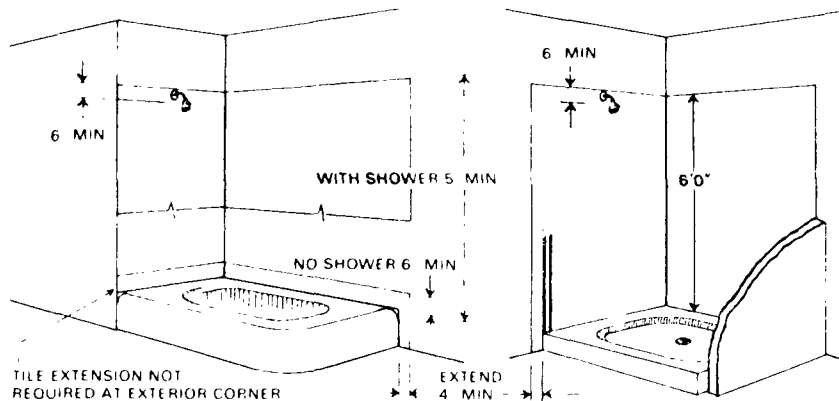
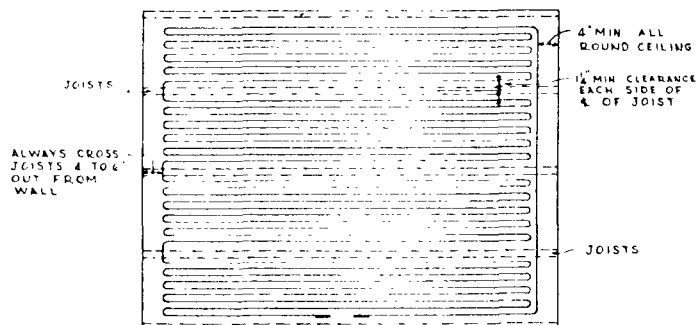


Fig. 75 Tile in baths and showers should be brought up to the levels shown.



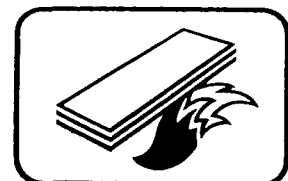
TYPICAL CEILING LAYOUT PATTERN

Fig. 76 Electric heating panel is formed from cable fastened to gypsumboard and covered with a filling compound.

Proper insulation is important for economy in electric panel heating. Unfaced, friction-fit, mineral wool or glass fiber insulating batts may be used in the ceiling above the panel heating system.

Other electrical radiant heating systems with special wallboard panels are also available. The manufacturer's application recommendations should be followed.

SGP 0025906



VIII SUMMARY

A GUIDE FOR HIGH QUALITY

Before gypsumboard is applied, check that it is the type specified for the job and in good condition after storage. Check for any cracked or edge-damaged board.

Check the job drawings and specifications (or manufacturer's recommendations if they are the guides). Make sure of application details such as direction (horizontal or vertical), fasteners, and caulking required.

Check the framing. Make sure it is installed as specified and firmly in place. Find and remedy uneven top plates, twisted studs, and studs out of alignment. No support for the gypsumboard should be more than 1/8 in. from the plane of the board, and no blocking or bracing should project out from the plane. Trim all projections and either use shims or reposition framing members to correct other defects.

Check the moisture content of wood framing with a moisture meter. If necessary, delay gypsumboard application until the moisture content meets the job specifications.

Check that window and door frames and that all electrical and other fixtures are set for the wallboard thickness used. Verify that there is caulking beneath runners if required.

When metal framing is used, check that all joints and splices are securely fastened and that runners are securely attached. (Details of metal framing are given in *Gypsum Association Specifications For the Installation of Screw-Type Steel Framing Members To Receive Gypsumboard*.)

When inspecting a base ply, check that boards are horizontal or vertical as specified and that they are fastened as specified. Test for loose board by pushing adjacent to the fasteners. Check

that face paper is not broken where fasteners are driven.

Check caulking for proper seal behind electrical boxes, medicine cabinets and other recessed fixtures. Make sure that required insulation is properly fitted and attached in wall cavities.

In face ply application, make sure exposed surfaces are free from defects. Check to see that boards are tightly attached and applied in the right direction. Joints must be correctly butted and staggered. See that specified procedures for application of adhesive and fasteners are carried out. On single ply applications, see that backing blocks or strip reinforcing is used if specified.

Suspended ceiling application should comply with component manufacturer's recommendations and job specifications. Details of grillage framing may also be obtained from the Gypsum Association Specifications (for steel framing members) previously mentioned. Measure spacing of hangers, channels, and studs to assure compliance. Runners and

furring channels should extend to within six inches of abutting walls, but they should not touch the walls. Ends should clear by at least 1 inch and sides should clear by at least 1/8 in.

Certify that mechanical equipment is independently supported and does not rest on the grillage. Also make sure that reinforced channel support is provided around light fixtures and openings.

Check that furring channel clips are alternated and that furring channel splices are secure.

After wallboard is applied, inspect trim at corners and around partition perimeters. It must be installed as specified and securely attached.

Check that no boards are loose and that all fastener heads are seated below the surface of the wallboard. Fastener heads which have broken the face paper should be replaced.

Make sure that caulking is in place and that voids are completely sealed.

Before treating joints and fasteners, make sure that temperature, humidity, and ventilation are proper to assure good drying of treating materials. In cold weather, temperatures should be maintained between 55 F. and 70 F. In hot, dry weather, drafts should be avoided. In very humid weather, ventilation may be necessary to provide drying.

In joint treatment, use proper compounds and be certain they dry completely between coats. Avoid heavy fills.

Check that finished joints and all fastener and trim coverings are smooth and dry before decorating. Sand if necessary.

Careful application and inspection of gypsumboard construction will assure smooth walls and ceilings that should remain free from defects for many years.



Fig. 77 When applying a base ply of gypsumboard to a steel stud, grasp the flange and gypsumboard firmly to prevent movement.

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BIBLIOGRAPHY

These Gypsum Association publications give additional details on the use of gypsumboard in walls and ceilings:

Design Data-- Fire Resistance/ Sound Control

American National Standard Specifications for the Application of Gypsum Wallboard and Backing Board, Including Finishing ANSI A97.1

Gypsum Association Specifications for the Installation of Screw-Type Steel Framing Members to Receive Gypsumboard

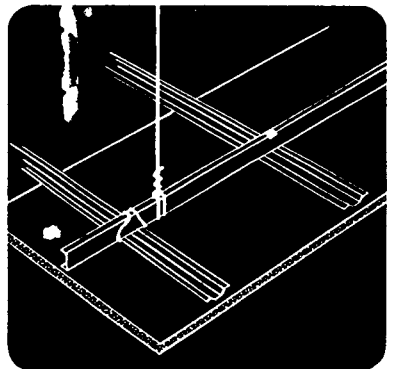
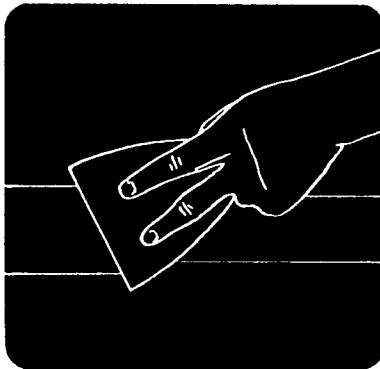
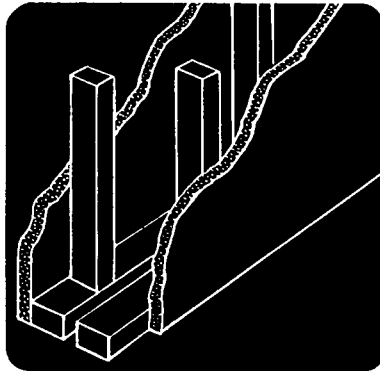
Design Data-- Gypsum Wallboard

Recommended Guide for Gypsum Drywall Construction

SGP 0025908

USING GYPSUM BOARD

FOR WALLS AND CEILING



GYPSUM ASSOCIATION

201 North Wells Street Chicago, Illinois 60606

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LITERATURE

SGP 0025847