

**CGC**

**The Gypsum Construction**  
**Handbook**

**| Centennial Edition**

Published for the Construction Industry by  
CGC Inc.

## Important Notes to This Edition

This edition of the Gypsum Construction Handbook is a guide to construction procedures for gypsum drywall, cement board, veneer plaster and conventional plaster construction in effect in 2004.

Information, standards, products, product names, properties, application methods, procedures, etc., contained herein are subject to change. For the latest available information concerning CGC products, systems or recommended application procedures, contact your local CGC sales office or representative toll-free at 888-206-1110 (Atlantic); 800-361-1310 (Quebec); 800-387-2690 (Ontario); 800-663-1055 (Western); or see the CGC website (<http://www.cgcinc.com>).

All information, details, specifications, data, applications, procedures, etc., contained in this handbook are intended as a general guide when using CGC-manufactured or supplied products. CGC assumes no liability for failure resulting from the use of this handbook or for failure from improper application or installation of its products.

CGC products must not be used in the design or construction of any structure without a complete and detailed evaluation by qualified engineers, architects and/or acoustical consultants to verify the suitability of these products for use in any given structure. Competent supervision of component installation is recommended to achieve desired results.

Information from this publication should be used only in conjunction with CGC-manufactured products or products supplied by CGC, as physical properties among competitive products may vary.

Information about CGC products that contain recycled materials, as well as a discussion on environmental acceptability of CGC products and what steps CGC is taking to protect the environment in the future may be found on page vii.

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**Editorial Committee**

The Editorial Committee for this edition of CGC Gypsum Construction Handbook was headed by Bob Mercer and included Jeff Glancie, Trevor McGregor, Larry Dean and Yannick Devost. Carole Caron was the print production co-ordinator.

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# A Century of Building

This “Centennial Edition” of the *Gypsum Construction Handbook* recognizes not only the dawning of a new century, but also the fact that CGC is about to celebrate its 100th anniversary in supplying building materials to build Canada and the world. We intend that this new edition will be a valued companion for you for many years into the twenty-first century.

Since its earliest version in 1905, the CGC/United States Gypsum Company *Gypsum Construction Handbook* has been the best reference for gypsum products and systems in the building industry. Throughout the years it has evolved and changed as the building industry itself has evolved and changed. This edition has been reorganized to make it easier than ever to use and to find the specific information you are looking for.

- It has been printed in a larger size to make it easier to read and more pleasing to look at.
- We’ve divided the “Finishing” chapter into separate chapters on drywall finishing and veneer plaster finishing to help you find the specific information you are seeking.
- We’ve added improved photos and illustrative details to make information clearer for you.
- We’ve provided more information on subjects that readers of our previous editions have asked for, including entire chapters on acoustical ceilings and safety.
- We’ve added many new products and construction techniques concerning not only gypsum products, but cement board products as well.
- The most popular feature of previous editions has been the comprehensive key word index; we’ve further expanded and improved it to make it even more valuable.



Founded in 1902, United States Gypsum Company's concentration on quality has ensured its success in the development of gypsum plasters and cements for the construction industry. Continued research and innovation enabled the Corporation to revolutionize the industry in the early 1930s with the introduction of ROCKLATH Gypsum Lath, a paper-bound gypsum board that replaced conventional wood and metal lath as a base material for conventional plaster. Later in the same decade, advancements in production technology and research in gypsum-based compounds resulted in the development of larger gypsum panels. As the Corporation perfected systems to join the panels together, it introduced the SHEETROCK Brand Drywall Systems that have become the standard of the construction industry throughout the world.



The innovations continue to this day. In this last twenty years alone, the Corporation has pioneered major advances in DUROCK Brand Cement Board construction, lightweight SHEETROCK Brand Joint Compounds, high performance sound-control assemblies, fire-rated systems, high-strength veneer plasters and drywall surface preparations. The most recent innovations have been in the area of abuse-resistant construction, where a variety of drywall and plaster products, including FIBEROCK Brand Abuse-Resistant Panels, have been developed.

CGC Inc. was founded in 1907 as Canadian Gypsum Company by United States Gypsum Company. For nearly 100 years, it has been the name to be trusted for quality and fire/sound performance in the Canadian Construction industry. The Corporation's spirit of innovation will help us retain our reputation as construction moves into the twenty-first century and CGC's second century.

## Introduction and Contents

### The Purpose of the Handbook

This edition of the *Gypsum Construction Handbook* is a guide to good construction procedures for gypsum drywall, veneer plaster, cement board and conventional plaster construction. It contains the newest developments in products and systems including time-saving, lower-cost methods of installation to simplify and speed construction.

The book, which has become a standard handbook in the construction industry, serves as a valuable reference for those with broad experience and those who wish to learn about gypsum construction.

**Architects, Designers and Engineers** Technical information on gypsum product construction standards, including available system descriptions, fire- and sound-rated construction, limitations and installation procedures.

**Contractors, Builders and Dealers** Full data on all aspects of gypsum products and accessories, tools and equipment, and application including information for estimating and planning.

**Apprenticeship Training Schools** Well organized, easy-to-understand, illustrated directions for applying gypsum products from framing to finish.

**Journeyman** A comprehensive index to contents and clear, concise illustrated directions and techniques for applying gypsum products from framing to finish.

**Building Officials and Code Users** Fire, sound and physical test data; proper construction procedures for gypsum products to ensure compliance with performance criteria.

## How to Use the Handbook

To find the information you want, use the table of contents or the fully cross-referenced index in the back to find the applicable reference on drywall, veneer or conventional plaster, or cement board construction. The handbook is organized as follows:

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### **Drywall & Veneer Plaster Construction**

Chapter 1	Products
Chapter 2	Framing
Chapter 3	Cladding
Chapter 4	Cement Board Construction
Chapter 5	Finishing Drywall Systems
Chapter 6	Finishing Veneer Plaster Systems

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### **Conventional Lath & Plaster Construction**

Chapter 7	Conventional Plaster Products
Chapter 8	Conventional Plaster Application

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### **Suspended Acoustical Ceiling Systems**

Chapter 9	Acoustical Ceiling Design & Application
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### **General Construction**

Chapter 10	System Design Considerations
Chapter 11	Planning, Execution & Inspection
Chapter 12	Problems, Remedies & Preventive Measures
Chapter 13	Safety Considerations, Material Handling
Chapter 14	Tools & Equipment

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### **Appendix**

#### **Glossary**

#### **Key Word Index**

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#### **Alphabetical Index to Tables**

# Environmental Responsibility

CGC Inc. works hard to be as friendly to the environment as possible. The following general statement provides an overview of CGC's commitment to the environment. Specific information about percentage of recycled material in specific products or answers to other questions may be obtained by writing to Dept. 292, CGC Inc., 350 Burnhamthorpe Road West, 5th Floor, Mississauga, Ontario, L5B 3J1.

**Assurance** We recognize the importance of safeguarding the environment. We offer our customers products that are environmentally acceptable, safe and effective when used as intended. We are committed to our employees, our customers and our communities and believe that health, safety and environmental well-being can and should be compatible with economic health. We will continue to conduct our operations in compliance with applicable laws and regulations, continuously reviewing all procedures, practices and products.

**Dedication** We are a leading manufacturer/supplier of drywall, plaster, cement board, joint treatment, ceiling tile and suspension systems, and commercial life-safety systems. With plants throughout North America, USG and CGC remain dedicated to environmental issues while maintaining our high standard of product quality and service. We use recycled and sustainable raw materials in product formulation and development. Using recycled goods as raw material provides numerous environmental benefits such as reducing demands on municipal landfills, mitigating mining and logging operations, and preserving depletable natural resources.

**Leadership** CGC/USG has a long history of utilizing recycled materials in manufacturing building products. We use synthetic gypsum, a byproduct of various industrial processes, to manufacture ceiling products and wallboard, in addition to natural gypsum. In 1993, USG (as a founding member) helped establish the U.S. Green Building Council, a coalition of principal building industry groups whose mission is to promote energy, health, productivity and environmental improvement for "whole" buildings. USG is also involved in construction of recycling demonstration projects with the National Association of Home Builders (NAHB).

## CGC Inc. Metric Policy

CGC has manufactured metric sized products for many years on a special order basis. CGC will make every reasonable effort to make metric products available to the market on a special order basis.

CGC is prepared to offer metric sizes in most of its acoustical panel and suspension systems.

Metric width and length SHEETROCK Brand Gypsum Panel products will be available from designated manufacturing plants throughout Canada. Metric length and width DUROCK Brand Cement Board products will also be available from designated manufacturing plants. Certain minimum order quantities and up-charges may apply, as determined by local market conditions.

Bag and pail products, including CGC Brand Joint Treatment Products, spray textures, gypsum plasters and other products carry soft metric designations for size and/or weight.

**Important:** The basic CGC product line remains unchanged. Standard foot/inch/pound products previously available from CGC will still be readily available. The addition of metric length/width products will allow us to supply all job requirements, whether imperial or metric.

CGC will offer assistance to construction professionals with regard to design, specification and installation issues involving our metric products, just as we always have with our standard products.

In metric construction, many building materials, systems and documents are affected.

**Dimensions** Units have changed from feet and inches to millimeters, scales from inch fractions to feet (for example,  $1/4" = 1' 0"$ ) to true ratios (such as 1:20). Drawings are not to be dual dimensioned, in order to avoid dimensional conflicts and errors.

**Specifications** Specs call for metric linear dimensions, areas, and volumes.

**Construction Products** A majority of construction products do not change in size since they are not modular or panelized. They are simply "soft converted" or re-labeled in metric dimensions.

**Framing** Stud spacing has changed from 16" to 400 mm and 24" to 600 mm. Wood studs are now known as their actual size 38 x 89 mm (2 x 4 nom).

**Batt Insulation** Width has changed from 16" and 24" nominal to 400 mm and 600 mm nominal.

**Ceiling Systems** Grids and lay-in ceiling tile, air diffusers and lighting fixtures, from 2' x 2' to 600 mm x 600 mm and from 2' x 4' to 600 mm x 1200 mm. Grid profiles, tile thicknesses, air diffuser capacities and fluorescent tubes have not changed.

For more information and assistance on metric projects, see the current CGC literature on product sizing and availability. Information on specific metric product availability in your market area may be obtained from CGC sales or customer service representatives. They can be reached at your local sales office. See inside the back cover of this book for information on reaching your nearest CGC sales office. Also, there is more information on metric terms and a table of metric equivalents on pages 438-439 of the Appendix.





# CGC Products and Systems

CGC offers a wide variety of quality products and performance-engineered systems. These systems are designed to consider all major factors: cost, sound control, fire resistance, structural capacity, esthetics and overall utility and function.

Thin, lightweight gypsum panel drywall and cement board assemblies are noted for their fast installation and low cost. They are used in the majority of new residential buildings and have gained similar acceptance in commercial buildings.

This handbook contains the latest information about proper gypsum drywall, plaster and cement board construction available at the time of its writing. The text covers framing installation, drywall and veneer plaster construction, joint treatment and plaster finishing, interior cement board construction, and conventional plaster application, as well as the tools required for each job. It also covers special engineered systems, product application factors, problems and remedies, and various repair and remodeling techniques.

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## The Manufacture of Gypsum Products

The development of all gypsum products begins with a mined mineral rock, gray to white in color, called gypsum. The basic mineral is composed of calcium sulfate chemically combined with water of crystallization —  $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ . The combined water makes up approximately 20% of the weight of gypsum rock. This is the feature that gives gypsum its fire-resistive qualities and makes it so adaptable for construction purposes.

After gypsum rock is mined or quarried, it is crushed, dried, and ground to flour fineness, then calcined to drive off the greater part of the chemically combined water as steam. This calcined gypsum, commonly called plaster of paris, is then mixed with water and other ingredients and sandwiched between two sheets of specially manufactured paper to form various types of gypsum board or specially formulated and bagged for shipment as gypsum plaster or cement.

While mined gypsum has been the traditional raw material for drywall and plaster products, more and more “synthetic” gypsum is used in the manufacturing process. Synthetic gypsum is a material that is a byproduct of an industrial process. For example, in most power plants, the burning of coal produces undesirable emissions of sulfur, a leading cause of acid rain. A wet lime-limestone scrubber is a common method for removing this pollution from the air. It works via a device installed on the exhaust (smoke stack) of the coal-burning furnace; as the exhaust smoke rises through the scrubber, the pollutants are chemically removed. The calcium and water in the wet limestone combine with the sulfate in the exhaust to create calcium sulfate (gypsum) and water. This material is called either “synthetic” or “chemical” gypsum and can be readily used to manufacture gypsum products.

Gypsum manufacturers are increasingly using this material as a substitute for mined gypsum. The U. S. Bureau of Mines estimates that

roughly 20 million tonnes of synthetic gypsum were generated in 1993 by electric utilities equipped with wet lime-limestone scrubbers. CGC and other gypsum manufacturers have worked with utilities on sourcing synthetic gypsum for wallboard production.

Gypsum boards are formed in a highly automated continuous process. After the gypsum core has set, the boards are cut to length, dried, pre-finished if required, and packaged for shipment. All processing is in strict accordance with specifications to meet quality standards.

Cement board products have some of the same characteristics as gypsum boards, but without the disadvantage of being sensitive to water. Cement boards are manufactured from strong, water-durable portland cement, formed in a continuous process of aggregated portland cement slurry with polymer-coated, glass-fiber mesh completely encompassing edges, back and front surfaces, in a patented process. The ends are square cut. The most-popular use for cement board is as a substrate for ceramic tile on walls and floors, because of its durability. A wide variety of sizes are available for floors, walls, ceilings, counter-tops and as a wall shield for solid-fuel room heaters and fireplace stoves.

The continued advancement of gypsum construction depends on maintaining quality while reducing construction time and costs. CGC has consistently been at the forefront of this effort. New products for broader uses and new cost-saving systems with improved fire and sound resistance are continually being developed and tested at the USG Research Center. Once quality is ensured, strategically located operating plants produce and/or stock the building materials described here.

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## Advantages of Gypsum Product Construction

**Life Safety Protection** Fire resistance is inherent in gypsum or cement board construction. Systems provide permanent fire resistance not subject to loss of water pressure or other malfunctions and problems that may occur in sprinkler systems.

**Fire Resistance** Neither gypsum nor portland cement panels will support combustion. When attacked by fire, the chemically combined water in the gypsum crystal is released and turns to steam to help retard the spread of flame and protect adjacent constructions. Cement board, too, is an effective fire barrier. Both constructions meet fire resistance and flame spread requirements of all model building codes. Fire resistance ratings up to four hours are available with specific gypsum partition, wall, floor-ceiling, beam and column fireproofing assemblies.

**Sound Control** Gypsum and cement board constructions offer excellent resistance to airborne and impact sound transmission without excessive bulk or weight. Resilient attachment of gypsum panels or bases and sound insulating blankets further improve sound ratings, making partitions ideally suited for party walls. Walls and floor-ceiling assemblies are available which meet STC (Sound Transmission Class) and IIC (Impact Insulation Class) requirements of applicable building codes, and tenant/owner needs.

**Durability** Veneer plaster combines the best features of drywall and conventional plaster. The high-strength and abrasion-resistant features of veneer finishes offer the durability needed in high-traffic areas. Conventional plaster surfaces are highly resistant to impact and abuse. Finished with a CGC joint system, gypsum panels form walls and ceilings that are better able to resist cracking resulting from minor movement and variations in temperature and humidity than other, more rigid materials. Cement board is an exceptionally durable substrate that does not deteriorate in water.



**Light Weight** Gypsum and cement board constructions weigh much less than masonry assemblies of the same thickness. They reduce material-handling expense and may permit the use of lighter structural members, floors and footings. Veneer plaster construction compares with the weight of gypsum drywall and is considerably lighter than conventional plaster.

**Low Installed Cost** Gypsum and cement board systems offer lower installed costs than more massive constructions. The lighter weight systems reduce material-handling costs. The hollow-type constructions provide an ample cavity for thermal and sound insulation, simplify fixture attachment and permit routing of utilities in walls. Low material cost and large, quickly erected panels combine to provide a lower cost for gypsum drywall, cement board and veneer plaster systems than for conventional plaster or masonry. Fast veneer plaster finish application plus savings in decorating time make veneer systems competitive to gypsum drywall in many instances.

**Fast Installation** Gypsum and cement board construction eliminates costly winter construction delays, permits earlier completion and occupancy of buildings. Cement board and gypsum panels and bases are job-stocked ready for use; they are easily cut and quickly applied. For high-volume applications, conventional plasters are readily pumped and spray-applied. Veneer plasters, which set in approximately one hour, eliminate drying delays and are usually ready for next-day decorating or painting with breather-type paints.

**Easily Decorated** Gypsum construction offers smooth surfaces that readily accept decoration with paint, wallpaper, vinyl coverings or wall tile and permit repeated decoration throughout the life of the building. Plain or aggregated textures are easily applied to gypsum panels or produced during finish coat plastering. The smooth, hard surfaces obtained with veneer finishes and conventional plasters are more sanitary and easier to maintain than exposed concrete block. Cement board can be finished with ceramic tile, thin brick or synthetic stucco finish.

**Versatility** Gypsum and cement board constructions are suitable as divider, corridor and party walls; pipe chase and shaft enclosures; exterior walls and wall furring; and membrane fire-resistant constructions. Adaptable for use in every type of new construction—commercial, institutional, industrial and residential—and in remodeling. They produce attractive joint-free walls and ceilings; and they easily adapt to most contours, modules and dimensions.



*This drywall ceiling attractively houses the building's structural systems, mechanical and electrical services.*

**Abuse Resistance** The variety of CGC products available allows for wall construction to be done with high abuse resistance relative to weight and cost. Specially manufactured gypsum and gypsum-fiber panels, combinations of gypsum panels and veneer plaster, and combinations of cement board and veneer plasters have added an entire new series of solutions to low-cost abuse-resistant systems.

## **The Manufacture of Ceiling Products**

CGC is also a leading manufacturer/supplier of ceiling tile and suspension systems, relocatable wall systems, and commercial life-safety systems. As the nation's largest producer of ceiling suspension systems and second in manufacturing ceiling tile, USG/CGC operates 11 ceiling product plants in North America.

One of the principal raw materials used in CGC ceiling tile is slag, a byproduct of iron-ore reduction. Nearly 150,000 tonnes of slag per year are used in manufacturing mineral wool for ceiling panels. In certain processes, corn starch is used as a binder in manufacturing CGC's ceiling tile and drywall products. Since this material comes from renewable agricultural resources, it is less demanding on the environment than many chemicals typically used for binding that are derived from non-renewable petroleum reserves.

In addition, CGC/USG uses large amounts of pre-consumer and post consumer waste paper (newspaper, phone books, old corrugated containers, cartons and cuttings from cardboard manufacturing) in the production of ceiling panels and various other products. This reduces manufacturing costs while utilizing materials that would otherwise be a landfill burden.

As the largest North American user of synthetic gypsum, CGC/USG uses more than 2.75 million tonnes annually in the production of acoustical ceiling panels, wallboard, and other gypsum products. Synthetic gypsum is a byproduct of the flue gas desulfurization (FGD) process, which removes sulfur dioxide from the emissions of coal-burning electrical power plants.

As for CGC suspension systems, light gauge carbon steel is roll-formed into grid components. These products can be 100 percent recycled by melting and salvaging the metal. Currently, two-thirds of all scrap metal is recycled into new steel products. The metal coil stock that CGC purchases from vendors for its grid operations contains about 25 percent re-melted scrap steel.

Overall, CGC offers ceiling and gypsum products that are manufactured to be environmentally acceptable, safe, and effective when used as intended. For more information regarding the recycled content of CGC ceiling products, call 800-387-2690.

## Other CGC Products and Systems

CGC supplies a wide range of products and systems beyond the scope of this book. Unless otherwise noted, information about any of the following quality products can be easily obtained by calling 888-206-1110 (Atlantic); 800-361-1310 (Quebec); 800-387-2690 (Ontario); 800-242-4428 (Western); or looking us up on our website (<http://www.cgcinc.com>).

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### Exterior Construction Products

**CGC EXTERIOR™ Products and Systems** Substrates available include high-strength DUROCK Brand Cement Board and FIBEROCK Brand Sheathing with AQUA-TOUGH, as well as more conventional SHEETROCK Brand Gypsum Sheathing.

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### Security Walls

**STRUCTOCORE Security Walls** This wall system consists of specially formed steel sheets that provide continuous reinforcement for monolithic, high-strength, fire-resistant plaster finish applications. STRUCTOCORE Security Walls are ideal for use in lieu of reinforced concrete or concrete block. Applications include jails, prisons, correctional centers, vaults and storage rooms for valuable items. Tests show these walls are capable of ultimate load for fixture support of 2200 kg (4850 lbs.) Partitions are 76 mm (3"), 100 mm (4") and 115 mm (4-1/2") thick and can weigh as little as 170 kg/m<sup>2</sup> (35 psf).

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### Industrialized Construction

**Manufactured Housing and Industrialized Construction Products** CGC has a whole assortment of products specifically designed for use in manufactured housing and industrialized construction environments, including gypsum board products, joint treatment products, metal beads and trims, special sealants, primers, cement board and texture products. All are under the SHEETROCK MH Brand.

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### Industrial Products

**LEVELROCK Brand Floor Underlayment** Poured gypsum floor underlayment systems provide an economical way to achieve lightweight, fire-resistant, sound-rated, self-leveling floors in residential and light-commercial construction. Gypsum floor underlayment can be applied to a variety of substrates. This product is excellent for new construction as well as providing solutions for rehab flooring. Typical applications are less labor intensive than many other types of construction and provide the high fire ratings and sound isolation, for which gypsum systems are well known. Gypsum floor underlayments currently offer a range of benefits unmatched by other commonly specified underlayment. Some of these benefits include:

- LEVELROCK Brand Floor Underlayments provide compressive strengths up to 34.5 MPa (5,000 pounds per square inch). They can be applied at thicknesses of only 19 mm (3/4") over plywood.
- Gypsum floor underlayments provide crack-free surfaces. In addition, the slight expansive nature of gypsum underlayments seals openings around pipes and other penetrations to enhance sound control.
- Gypsum underlayments install quickly allowing for up to 3,000 m<sup>2</sup> (30,000-sq. ft.) to be installed in a day. Fast setting allows for the return of light construction trade traffic within hours.

To learn how gypsum floor underlayments can save you money and provide solutions for your next project, call our toll free hot-line at 800-387-2690.

**Plaster Casting and Glass-Fiber Reinforced Gypsum Products**

CGC Moulding Plaster and HYDROCAL Brand White Gypsum Cement are ornamental plasters for specialized cast work, such as ornamental trim, running cornices and castings. HYDROCAL Brand FGR-95 Gypsum Cement is designed to be used with chopped glass fibers or glass fiber mat for fabricating lightweight fire-resistant decorated shapes, architectural elements, column covers, cornices and trims.

**Agricultural and Landscaping Products**

CGC Industrial Gypsum Division has many other specialty products for agricultural and landscaping use, as fillers in the manufacture of products as diverse as brake linings and plastics and for food and pharmaceutical uses. A small sampling includes BEN FRANKLIN Agricultural Gypsum, AIRTROL Plaster (erosion control), CGC Terra Alba and SNOW WHITE Filler (both calcium sulfate fillers for food and pharmaceutical applications), FIRECODE CT Gypsum Cement for fire stop applications and DURACAL Cement for patching roads and highways.

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**Retail Products**

Many of CGC's products are sold in retail outlets. They are the same high quality products used by construction professionals. Examples are SHEETROCK Brand Gypsum Panels, DUROCK Brand Cement Board, FIBEROCK Brand Abuse Resistant Panels and SHEETROCK Brand Joint Compounds. Many of the joint treatment products are packaged in smaller packages that are more appropriate for retail sales. Certain products, including many ceiling products and remodel/repair products, are produced especially for retail sales.

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**Framing**

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**Drywall and Veneer Plaster Cladding**

Detailed instructions for installing drywall and veneer bases in single and multiple layer configurations. Also covers predecorated panels, water resistant panels, sheathing, insulation, fixtures and specialty materials. Provides information on fastener requirements and special constructions such as curved surfaces, arches, soffits, etc.

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**Finishing Drywall Systems**

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Describes full line of conventional plasters, laths and accessories for successful completion of plaster systems. Helps evaluate specific situations and end-use requirements to match plaster products to needs. Includes gypsum and plaster laths, beads and trims, clips and screws, framing components and specialty plasters.

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