

Curved ceiling design such as this computer-rendered ticket counter area is here to stay, thanks to new design software and innovative systems technologies

USG presents

DESIGNING CURVED CEILINGS: SYSTEMS MAKE THE PROCESS EASY, EFFICIENT AND ECONOMICAL

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CURVED BUILDING DESIGN IS NOT ONLY IN VOGUE, IT'S HERE TO STAY. THANKS
to sophisticated new computer-aided design programs and innovative systems technologies,

architects, construction professionals and manufacturers are now able to collaboratively create and implement curved wall and ceiling designs that were formerly either impractical or cost-prohibitive.

The “wow” effect of curved building design is undeniable. Consider the attention that architect Frank Gehry continues to receive for his design of the Guggenheim Museum, Bilbao, Spain, and some of his other more recent projects.

Central to Gehry’s process are several important elements: unprecedented creativity, generous budgets and groundbreaking technology. To push the limits of curved building design, Gehry utilizes a powerful computer program called Catia (Computer-Aided Three-Dimensional Interactive Application). This software, originally developed to design fighter jets, is now used by Gehry’s technicians in translating the complex curves he has in mind to plans that the builder can use on the job site. Every component is accounted for and every detail confirmed as buildable before construction begins.

Unfortunately, not all design firms have the funding, staff and technology that Gehry can deliver. However even without a full-time Catia technician on staff, most architects can still incorporate exciting, innovative curves into their projects – and do it easily, efficiently and economically – thanks to two factors: advances in computer-aided design technology and a new generation of products and systems that facilitates curved building design, especially in commercial interiors.

Designers are now using flexible, 1/4-inch gypsum board panels combined with track systems to create elegantly curved walls. Bullnose paper faced metal bead and trim is taking the (90-degree) edge off wall corners. Curved modular office furniture, computers and accessories are adding energy and flow to desktops. And thanks to a combination of computer design programs and an innovative array of new integrated systems, 2-D and 3-D ceilings are lending curved dynamics, practical functionality and an expressionistic freedom to a wide range of interior spaces.

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Use the learning objectives below to focus your study as you read **A COMPARATIVE GUIDE: UNDERSTANDING AND SPECIFYING ABUSE-RESISTANT WALL SYSTEMS**. To earn one AIA/CES Learning Unit including one hour of health safety credit, answer the questions on page 157 and follow the reporting instructions on page 204 Or, use the Continuing Education self report form located at www.architecturalrecord.com.

LEARNING OBJECTIVES:

- Describe different types of materials used to form curved ceilings.
- Explain how curved ceilings are created.
- Describe where different curved ceiling systems are used.

THROWING CEILINGS A CURVE

Nowhere in the commercial interior environment is the excitement and drama of curves more pronounced than in ceilings. Gone are the days when architects were limited to horizontal suspension systems and flat infill panels. There now are several types of ceiling systems that add depth and interest to an interior's "fifth plane," provide locations for lighting and signage, indicate room transitions, guide pedestrian traffic and more – all while incorporating curves into the room design. What's more, some of these systems offer architects computer-aided design technology that delivers a complete design/build solution, assuring that the architectural plan is not only buildable, but is constructed to precise design specifications. The four primary types of curved ceiling systems that are supported by computer-aided design technology are:

- Suspension trim (for use with specialty-type ceilings, as well as flat acoustical ceilings)
- Metal accent systems
- Curved metal ceiling systems
- Drywall suspension systems

SUSPENSION TRIM was first introduced to the marketplace about 12 years ago as a way to finish the straight edges of suspension systems. Manufacturers found, however, that they could produce curved components in steel or aluminum and in different heights to interesting effect. Suspension trim systems facilitate a number of key design and performance criteria, including:



Suspension trim enables the creation of free-form island ceilings and fascia.

- The creation of free-form island ceilings or fascias that can be filled in with tile and grid to draw attention to and highlight specific areas within ceiling spaces.
- Acoustical sound control, accessibility and the use of lay-in fixtures.
- Various trim heights to create visual excitement and the illusion of varying ceiling thicknesses.
- Clean, crisp edges.

- Significant cost savings over conventional drywall soffit construction.
- Pre-engineered to design specifications, providing total design freedom for the architect and ensuring that the design is built to exacting detail.

Suspension trim can be used to create floating clouds, islands or layers of ceiling, and is often used in contemporary offices, retail stores, entertainment and gaming venues, as well as high-bay areas such as airports, lobbies and entryways.

Given the reality that standard curved components can never meet the specific design requirements for every project, manufacturers are now offering custom component design and production. This provides designers with complete design freedom. The most versatile systems are offered in custom finishes, and are pre-cut and numbered for faster installation. The ceiling contractor simply assembles the trim according to the numbered parts, which correspond to numbered instructions. Installations are typically completed using standard tools and techniques.

DESIGN TIP: *To minimize the effect of visible hanger wires on the job site, specify that they must be installed plumb, straight and neat. The spec should include instructions for uniform wire turns and pigtailed trimmed close to the vertical wire. Alternatively, use aviation wire with a crimping sleeve. For open ceilings, try using 18 ga. hanger wire.*

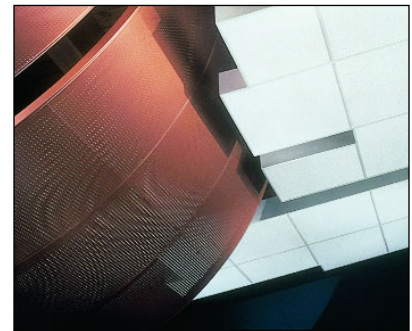
A recent twist on the suspension trim concept is the development of **metal accent** systems, which can be configured to create circles, straightaways, arcs, angles or spirals. Lighting and signage can be hung or mounted on the metal channels for way-finding and space-defining applications. The systems are available in various sizes, heights and reveals, and can be finished in any color.



Metal accent systems can be used for decorative, way-finding or space-defining applications.

Recently, suspension trim has evolved into even more sophisticated **curved metal ceiling** systems. Intended for visual impact and heightened aesthetics, these systems have made ceilings more expressive than was ever possible before. Available as a series of vaults and valleys in various radii, the range of different curved shapes and effects is nearly endless. Curved metal ceiling systems offer the following features and benefits:

- Curved main tee segments and flexible panels offer multiple variations for creating beauty and drama in interior spaces at affordable prices.
- Optional edge trim and access panels provide design versatility while meeting functional requirements.
- A broad choice of infill panels makes these systems desirable for a wide range of applications.
- They are designed and pre-engineered as a system to reduce labor costs.
- They are shipped in a kit to ensure that the design is constructed exactly as intended.



New one-directional infill panels lend a monolithic look to curved metal ceilings.

Infill panels are made from expanded metal or woven wire mesh in an anodized brass or steel finish, solid metal, perforated metal or translucent materials. Lighting can be integrated into the systems or placed behind the infills panels for transparent or luminous effects.

Some manufacturers offer curved metal ceiling systems customized to meet specific design requirements. All pieces are marked with "genetic codes" that correspond to an assembly sequence outlined in installation directions. These products install like conventional suspended ceiling systems, enabling experienced ceiling contractors to handle installation quickly and efficiently.

DESIGN TIP: For the greatest creative latitude and assurance that the envisioned design will be successfully constructed on the job site, look for a curved metal ceiling system whose manufacturer offers AutoCAD®-compatible software for the system's design and specification. This software permits three-dimensional rendering on the computer screen, incorporates custom finishes and can be exported into the architect's rendering programs to create client presentation drawings. Just as importantly, the software will notify architects when they've created a system detail that cannot be executed due to space or component limitations.

Recent line extensions to curved metal ceiling systems offer a narrow-faced, 9/16-inch profile grid with a slight reveal that provides a virtually non-interrupted ceiling plane. New, one-directional infill panels, which butt against each other to create an almost invisible seam, add further to the monolithic look.

Speaking of monolithic ceilings, it is now possible to create curved drywall ceilings easily and economically. In the past, drywall was used on either

the flat surfaces of bulkheads or painstakingly wetted, scored and bent into curved shapes, which had to be left overnight to dry. The panels then were installed using hat channel steel, black iron suspension and GRG (glass-fiber-reinforced gypsum) ceiling shapes constructed on the job site. This involved process made curved drywall ceilings very expensive to install and rather unpredictable in terms of finished results.

Thanks to recently developed **drywall suspension systems**, drywall vaults, valleys, arches and other curved elements – all cost-prohibitive only a few years ago – are now within reach for a wide range



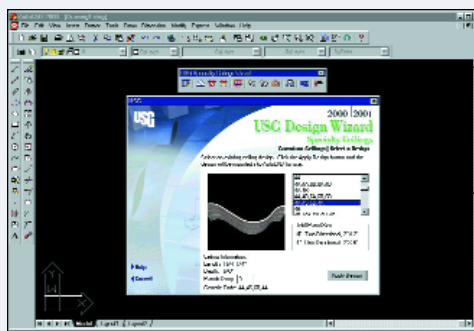
Drywall suspension systems facilitate the design construction of vaults, valleys and arches.

of projects. Like other specialty ceilings, these systems are supported by computer-aided design and pre-engineered component manufacturing. They accept 1/4-, 1/2- and 5/8-inch drywall, and deliver the following features and benefits:

- Facilitate the design of vaults, valleys, arches and other curved drywall ceiling configurations, while dramatically reducing installation time and costs.
- Pre-engineered system components ensure that ceiling designs are constructed on the job site in exacting detail.
- Enable cost-efficient construction of curved and serpentine drywall soffits and fascia.
- Transition exceptionally well from soffits, flat drywall ceilings and even acoustical ceilings.

The technology used to develop drywall suspension systems is now being applied to systems that permit precise and economical construction of domes. Domed suspension systems are usually covered with plasters or plastics, but the end result is the same: versatile design capabilities, time-saving installation and exact reproduction of designs on the job site. ■

ADVANCED SOFTWARE MAKES ARCHITECTS WIZARDS AT CEILING DESIGN



USG Design Wizard for Ceilings

While not all architectural firms can invest the money and time required to utilize robust design software programs such as Catia, manufacturers and software designers do offer a variety of highly useful and time-saving computer-aided design systems.

A leading application is USG's Design Wizard for Ceilings. While the program is intended primarily for use with USG's ceiling products (both acoustical and specialty), it serves as an example of the powerful design tools currently available. The plug-in application integrates seamlessly with AutoCAD®

14, AutoCAD 2000 and AutoCAD 2000i to create accurate 3-D renderings and specifications within the architect's own drawings.

The software enables architects to start from scratch in designing a specialty ceiling or they may choose from and/or modify existing designs from a database of specialty ceilings. The resulting renderings are ideal for client presentations. The software also produces instant schematic drawings, providing contractors with a construction reference guide.

The USG Design Wizard is offered as a free download on the USG Web site.

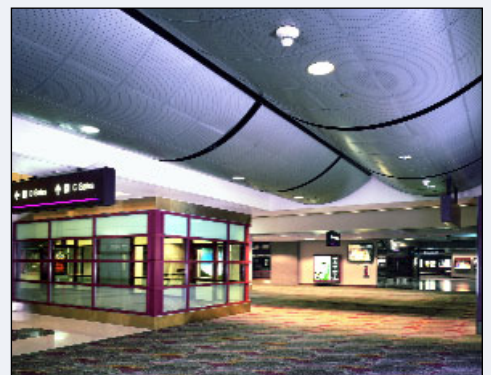
CURVED CEILINGS MAKE AIRPORT A DRAMATIC DESTINATION

Like much of Las Vegas, the new Satellite D Terminal at the city's McCarran International Airport is all about atmosphere.

Dramatic ceiling heights, broad concourse walkways, vaulted skylights and a 58-foot-tall glass wall are highlights of the 684,000-square-foot facility. To define space and add visual drama, project architect Tate & Snyder Architects of Las Vegas made extensive use of USG's CURVATURA™ 3-D Ceiling System.

Making the CURVATURA ceiling design a reality required intimate collaboration between Tate & Snyder Architects, ceiling contractor M&H Building Specialties, Inc., and USG.

"We supplied 175 different custom components for this project," said Greg Ahren, market development manager for USG's Specialty Solutions Group. "That included computer-designing, forming and custom laser-cutting all the transitional and trim components that enabled the design team and the contractor to pull this off."



The CURVATURA 3-D Ceiling System from USG adds drama and visual interest to the McCarran International Airport, Las Vegas, Nev.

NEW CEILING DOME SYSTEM DELIVERS SPECTACULAR RESULTS



The USG Drywall Suspension System saved hundreds of man-hours and ensured perfect results on the construction of 19 domes in Regent Auditorium, Pensacola.

The Regent Auditorium, a new \$90-million educational facility located in Pensacola, Fla., has set a high standard for creativity and engineering excellence in domed ceiling construction.

Designed by Strobel & Hunter, Inc., the 300,000 sq. ft. auditorium features an amazingly complex ceiling treatment, incorporating domes, curved barrel vaults and a huge saw-tooth suspended ceiling.

The ceiling elements were created using USG's Drywall Suspension System. Custom-engineered tees and crosspieces were developed by USG's Specialty Solutions Group to meet the exact specifications created by Strobel & Hunter. The components were shipped to the job site, where Acousti Engineering of Florida handled installation.

Steven Capps, project manager/estimator for Acousti Engineering, estimates that the efficiency of the USG system shaved 72 man-hours off the installation of each of the 10 18-foot-diameter domes, and 37 man-hours off the installation of each of the nine 12-foot domes.

"I've never seen domes that look this good," said Capps.

WALLS THAT FLOW

Creating curved gypsum board walls has been greatly facilitated by the development of flexible, 1/4-inch-thick drywall panels. Typically applied in double layers, the thinner, flexible panels eliminate the scoring and wetting procedures usually required to create curved walls using conventional gypsum panels.

To create rounded drywall corners, paper faced metal bullnose tape-on corner bead offers a simple solution. Joint compound is used to adhere the tape-on style bead to wall surfaces, so nailing – and nail pops – are eliminated. The paper tape covering the metal bullnose profile ensures excellent adhesion of joint compounds, textures and paints for a strong, smooth finish. USG backs its SHEETROCK™ Brand Paper Faced Metal Drywall Bead and Trim with a lifetime warranty against edge cracking.



Flexible 1/4-inch-thick SHEETROCK Brand Gypsum Panels facilitate curved drywall applications.

TABLE: MINIMUM BENDING RADII FOR FLEXIBLE 1/4-INCH GYPSUM BOARD PANELS

Application	Condition	Lengthwise Bend Radii	Max. stud spacing	Widthwise Bend Radii	Max. Stud Spacing
Inside (concave)	Dry	32"	9" o.c.	20"	9" o.c.
Inside (concave)	Wet	20"	9" o.c.	10"	9" o.c.
Outside (convex)	Dry	32"	9" o.c.	11"	6" o.c.
Outside (convex)	Wet	15"	6" o.c.	7"	6" o.c.

NOTE: Bending specifications are for USG's SHEETROCK® Brand 1/4 Inch Flexible Gypsum Panels tested at 65 degrees Fahrenheit and 45 percent relative humidity.

MORE TO COME

The four basic curved ceiling systems described above are, no doubt, just the beginning of things to come. As clients continue to ask for curves and architects can more freely add them to their plans, manufacturers and computer design software developers will continue to push the curved ceiling envelope.

Curved ceilings may soon become a focal point in and of themselves, much like Michelangelo's painted barrel vaults were more than 400 years ago. And that would bring curves around full circle, so to speak, as a crucial element in ceiling design. The big difference however, is that today's curved ceilings are no longer relegated to Sistine Chapel-type construction. Thanks to computer design technology and the systems approach, curves can flow everywhere.

ABOUT USG

USG is a Fortune 500 company with subsidiaries that are market leaders in their key product groups: gypsum wallboard, joint compound and related gypsum products; cement board; gypsum fiber panels; ceiling tile and grid; and building products distribution.

For more information about the company's ceiling systems, write USG at P.O. Box 806278, Chicago, IL 60680-4124, call USG's Customer Service Department at 1-800-USG-4YOU or visit the company's Web site at www.usg.com.

LEARNING OBJECTIVES

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INSTRUCTIONS:

Refer to the learning objectives above. Complete the questions below. Then turn the page upside down and check your answers. Fill out the self report form on page 204 and submit it or use the Continuing Education self report form on *Record's* web site - www.architecturalrecord.com - to receive one AIA/CES Learning Unit including one hour of health safety welfare credit.

QUESTIONS:

1. Where are suspension trim ceilings used?

2. What are the benefits of using curved metal ceilings?

3. What type of designs use drywall suspension systems?

4. What ceiling type is used to create a monolithic look?

5. How can computer software aid architects in designing curved ceilings?

1. Suspension trim ceilings are normally used in places with high ceilings where visual effects are desirable. These are usually lobbies or entryways in commercial venues. Installations are typically in retail stores, entertainment areas, gaming halls and airports. Suspension trim is used to create floating clouds or layers of ceiling to draw attention and highlight specific areas within ceiling spaces.

2. Curved metal ceiling systems offer benefits in installation and design. The installation benefits are that they are shipped in a kit to ensure that the design is constructed exactly as intended and they are designed and pre-engineered as a system to reduce labor costs. The design benefits are that they offer flexible panels and curved main tee segments, as well as optional edge trim and access panels for creating design versatility. The infill panels can be made of solid or perforated metal or translucent materials, allowing lighting to be integrated into the system.

3. Drywall suspension systems are used to create vaults, valleys, arches and other curved elements. They transition well from soffits, flat drywall ceilings and even acoustical ceilings.

4. In the past, monolithic looks were created from drywall that was wetted, scored and bent into curved shapes. This was time consuming, with unpredictable results. Now, the smooth monolithic look can be created using drywall suspension system ceilings. These use standard thicknesses of drywall with pre-engineered components. Another way to create monolithic looks is from a narrow profile metal ceiling grid with a slight reveal. One-directional infill panels butted against each other create an almost invisible seam, adding to the monolithic look.

5. Using computer software, an architect can select a ceiling design from a database of specialty ceilings or sketch a curved element on the computer screen, selecting grid size and suspension profiles. The software program then generates a precise design and corresponding specifications, schematic drawing, renderings and a construction reference guide.

ANSWERS:



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