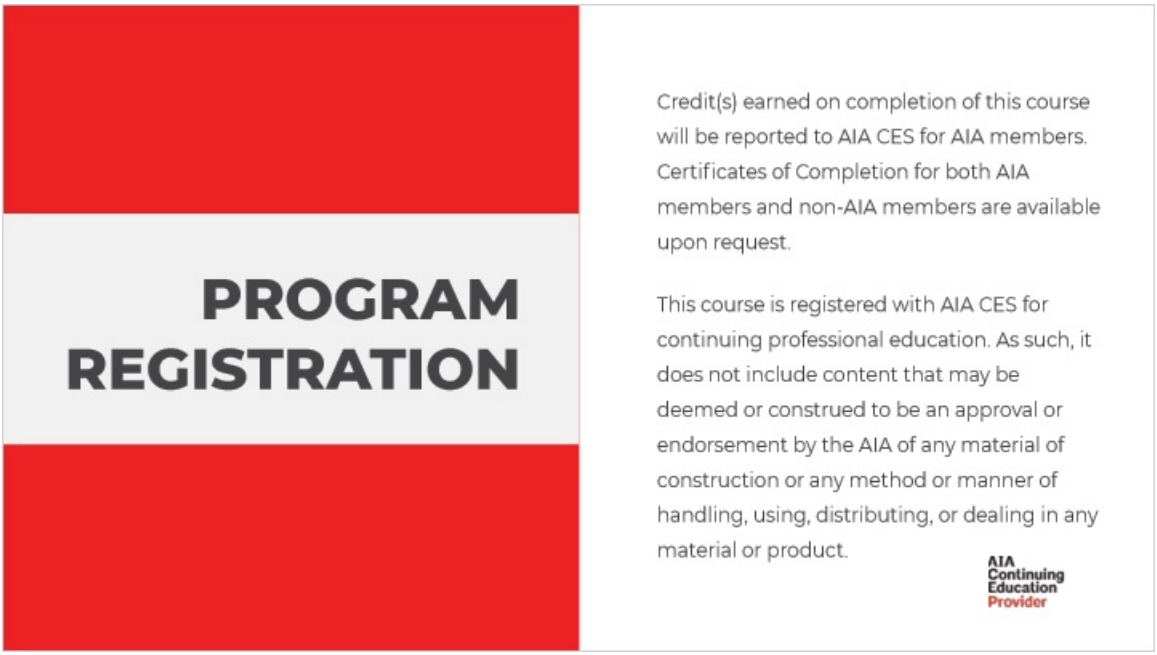
Accommodating Movement In Building Design

1.1 Accommodating Movement in Building Design

Notes:

Accommodating Movement In Building Design: Mastering the Physical Movement of Earth's Elements Around the Built Environment

1.2 Program Registration



Notes:

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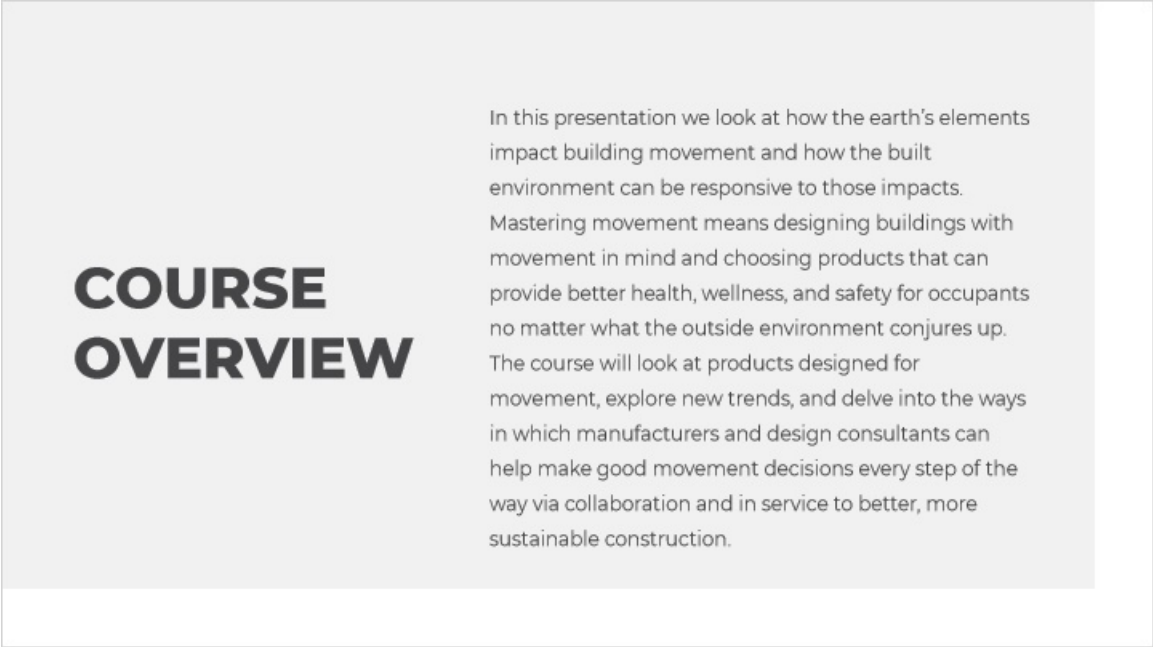
1.4 Course Overview



Notes:

In this presentation we look at how the earth's elements impact building movement and how the built environment can be responsive to those impacts. Mastering movement means designing buildings with movement in mind and choosing products that can provide better health, wellness, and safety for occupants no matter what the outside environment conjures up. The course will look at products designed for movement, explore new trends, and delve into the ways in which manufacturers and design consultants can help make good movement decisions every step of the way via collaboration and in service to better more sustainable construction.

1.5 Learning Objectives

Notes:

At the end of this presentation, attendees will be able to:

Understand how to manage movement in product specifications to protect the welfare of building inhabitants.

Discuss building science terms around movement and the ways in which emerging trends lead to occupant health and well-being.

Describe how design-assist consultants should help with early planning for better design and more efficient collaboration among all shareholders.

List ways manufacturers are offering more services to ensure their solutions meet safety standards, aesthetic preferences, and performance requirements.

1.6 Section 1

Notes:

This section will look at how the elements impact buildings and how engineers, architects, and others in the industry can work together for desired design aesthetic and building function.

1.7 A Rise in Natural Disasters

Notes:

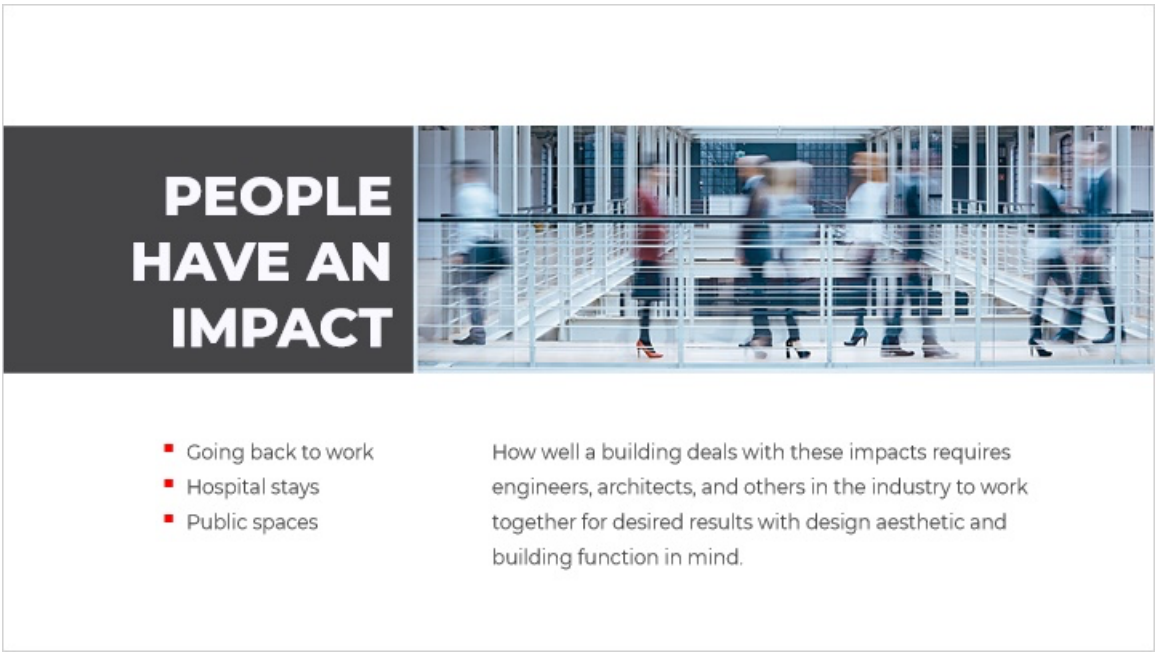
The construction industry has always had to deal with weather events. In fact, it is one of the biggest factors in determining material choices, project plans, and strategies as well as labor and construction timelines. In the past few decades, however, natural disasters have increased and intensified in significant ways.

Between 1989 and 2018 there was an average of 520 natural disasters per year. In 2019, that number jumped to 820-a nearly 58% increase. Many of these events can be tied to climate change, which is increasing the frequency and extremes of events such as hurricanes and leading to billions of dollars in damage.

Data compiled by the U.S. government's National Oceanic and Atmospheric Administration shows that the number of earthquakes per year has seen significant variation, but the overall trend shows an increasing frequency. Engineering the seismic safety of buildings requires consideration for design, construction, and location. Buildings must be able to handle both major and small-but-perpetuating traumas, whether from a natural disaster due to climate change or some other weather event born of wind, sun, water, fire, or the earth, or whether it is the impact of occupants in and around the building.

How well a building deals with these impacts requires engineers, architects, and others in the industry to work together for desired results with design aesthetic and building function in mind.

1.8 People Have an Impact



Notes:

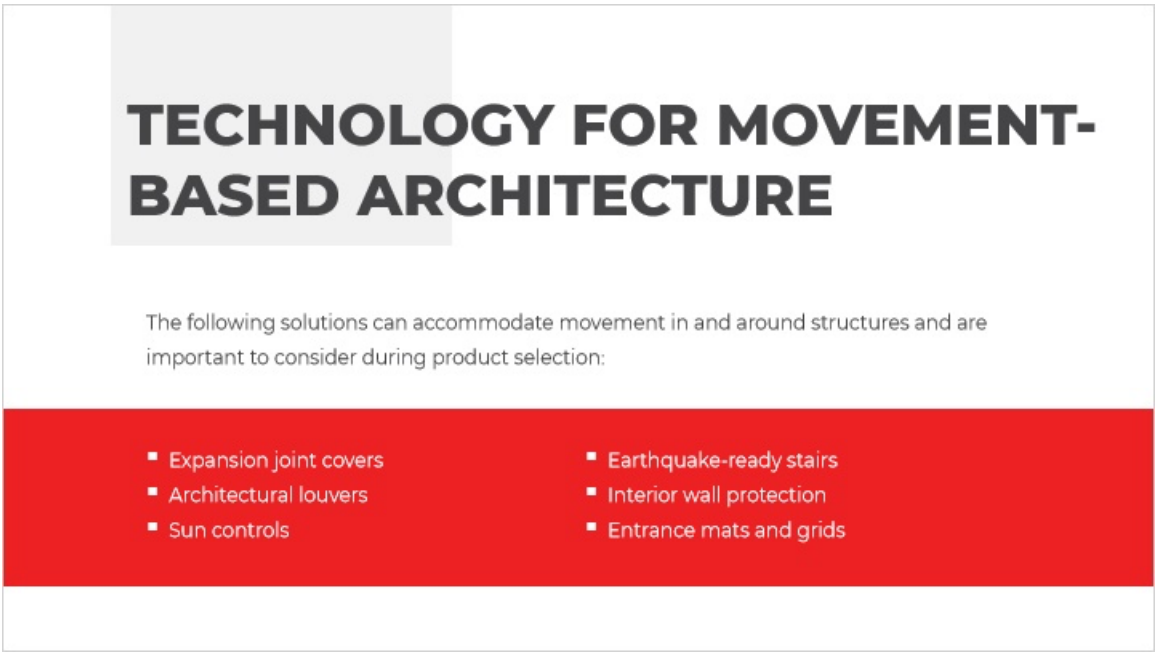
Bear in mind, too, the impact of occupants in and around the building. How well a building deals with these impacts requires engineers, architects, and others in the industry to work together for desired results with design aesthetic and building function in mind. The uncertainty of the pandemic has changed work environments with more in-home offices, but as workers return, buildings suffer the consequences of more occupants. In addition, hospital crowding during the worst of the pandemic and the current rise in the Delta variant of Covid-19 cases can lead to more abuse of hospital interiors. During lulls in the pandemic, public spaces such as event and entertainment centers have seen a rise in visitors, which could lead to more building damage.

1.9 Physical Movement of the Earth's Elements and Inhabitants

Notes:

The physical movement of the earth's elements and inhabitants, including air/wind, sun, water, fire, earth, and people, need to be addressed in building construction. These elements are the root causes of building movement.

1.10 Technology for Movement-Based Architecture



Notes:

The following solutions can accommodate movement in and around structures and are important to consider during product selection.

Architects can achieve building resilience by specifying products designed to help a building withstand natural and manmade disasters. Some of those products include: expansion joint covers, architectural louvers, sun controls, earthquake-ready stairs, interior wall protection, and entrance mats and grids.

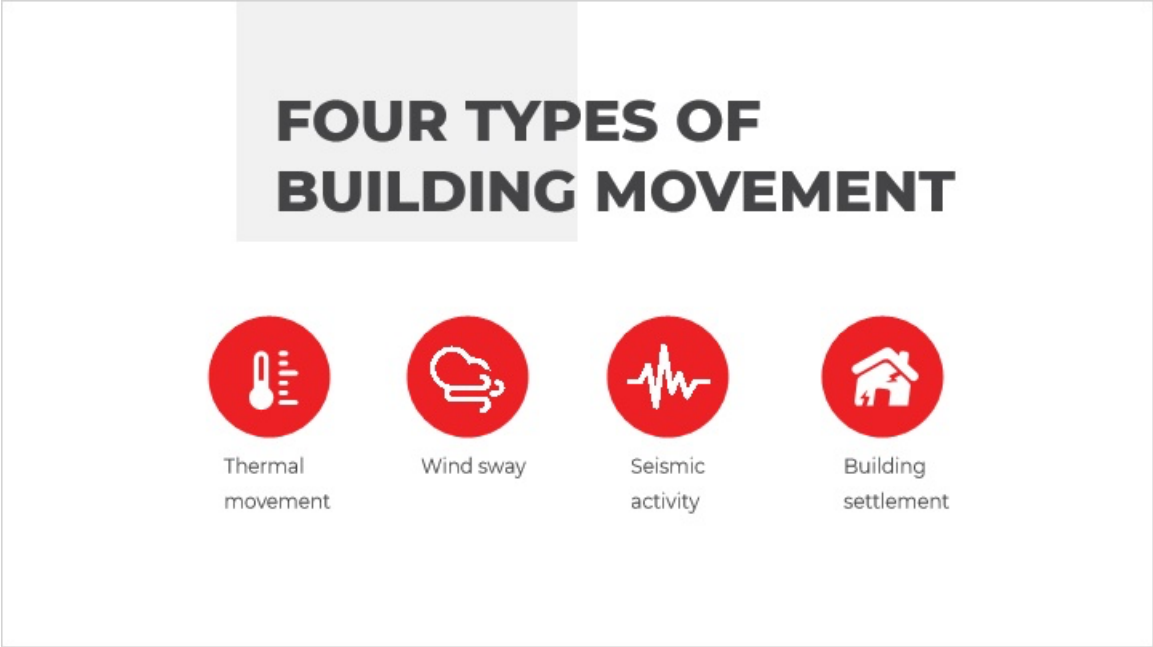
1.11 Expansion Joint Covers

Notes:

Expansion joint covers are especially necessary in areas prone to earthquakes. During an earthquake, a building might experience thermal expansion and contraction, wind sway, building settlement, and/or seismic activity.

Expansion joint covers go over the gaps where expansion occurs without interrupting the building's aesthetic and allow the building to move without damaging itself. Moat cover systems accommodate large movements around the base of structures, which is critical for safe and functional egress for occupants and ingress for first responders during and after a seismic event.

1.12 Four Types of Building Movement



Notes:

Expansion joint covers accommodate four different types of movement. Types of movement that impact a particular structure in a particular environment are one way to categorize how a building should be constructed.

Thermal movement is the most common type of movement. It is the expansion and contraction of materials-especially metal-at an atomic level, based on temperature.

Wind sway is another type of movement that buildings endure. A skyscraper, for instance, is built to move with the flow of a horizontal wind.

Seismic activity, such as during an earthquake, is a dramatic type of movement that moves buildings horizontally with the vibrations of the earth.

Finally, buildings can be affected by building settlement, which is the distortion of a building due to foundation compression, shrinkage of frames, or heavy loads being applied to the building after it has been constructed. Some settlement is normal, but unequal or differential settlement can cause significant problems.

1.13 Specifying Expansion Joint Covers

Notes:

Expansion joint covers can be chosen through a multitude of specifications for floors, walls, ceilings, and roofs to accommodate different types of movement. All expansion joint systems should accommodate thermal movement, but they can be selected to meet a project's specific thermal requirements. When it comes to wind sway, surface mounted plate systems for floors and rubber gasket systems for walls and ceilings are ideal because they do not disengage and do not pose a tripping hazard. A building in a seismic area should incorporate expansion joint covers that accommodate multi-directional movement.

Expansion joint covers can be chosen as traffic grade for parking garages and stadiums, and by joint size, fire rating, the substrate material, total movement they need to accommodate, design intention, sustainability, for retrofit projects, and for vapor barriers, among other attributes.

1.14 Specifying Expansion Joint Covers

Notes:

It is important to specify the correct expansion joint cover model based on nominal, maximum, and minimum joint size opening, which typically is determined by an engineer. Loading is also a critical component to ensuring the system functions correctly on a day-to-day basis. If these two factors are not correct in the specification, the expansion joint cover may not be installed correctly and will not function properly as needed. An expert should be secured early and often when a building is in a seismic region. It is also best to work with one manufacturer for systems to work and connect properly.

1.15 Get All Expansion Joint Covers From a Single Manufacturer

Notes:

Getting a movement architecture technology such as expansion joint covers (EJC) from a single source for roof, flooring, and all other EJC needs can alleviate issues down the road. This leads to factory-mitered products that are produced by a single company, which understands the project and can provide consistency. Onsite concoctions or a single type of product pulled from a variety of vendors can lead to mismatches and other problems.

1.16 Architectural Louvers

Notes:

Architectural louvers, which usually are found in a building's mechanical room, allow for proper airflow so that mechanical equipment can function well. At the same time, they protect equipment from wind-driven rain that is especially harmful during events such as earthquakes.

1.17 Specifying Architectural Louvers

Notes:

A more efficient specification solution is based on the needs of the building. It is therefore important to consider the following when specifying louvres:

Site location and exposure

Severity of local (site) weather conditions

Location and exposure of louvres on building

Airflow rate and direction through louvre

Maximum acceptable pressure drop

Degree and depth of water penetration acceptable

Aesthetics of the building

1.18 Sun Controls

Notes:

Sun controls play an important role in the built environment when it comes to light and energy. The ability to control glare and improve daylighting means allowing light to filter in according to specific times of day, while also allowing occupants to see out of the building without interference.

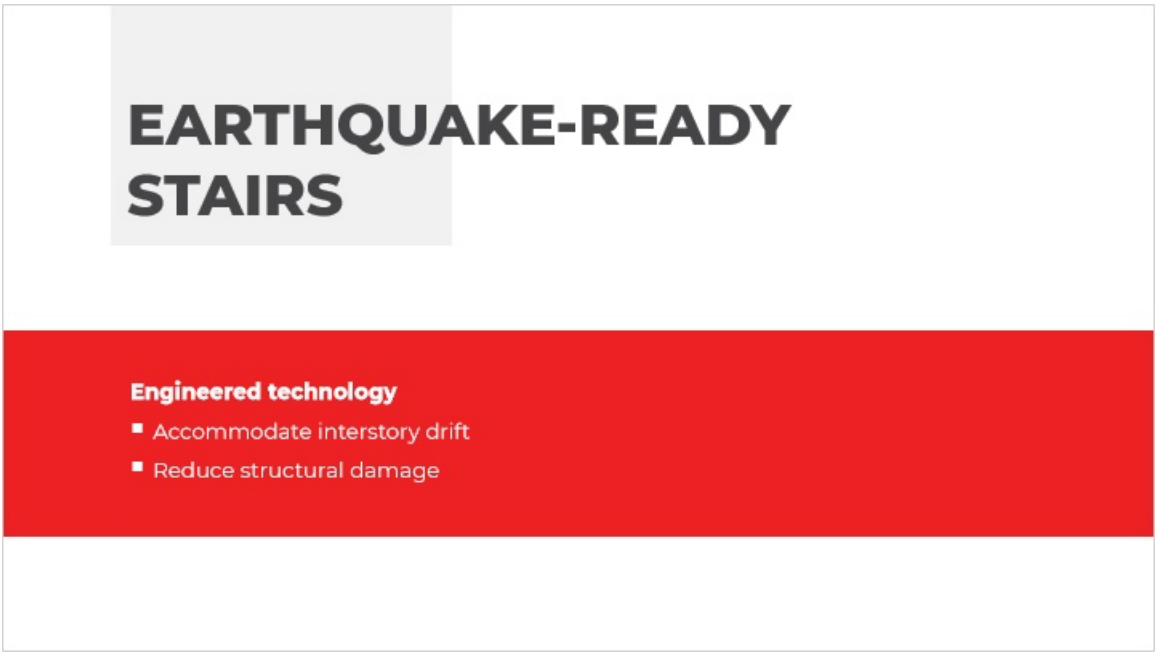
Sun controls reduce energy consumption by decreasing the need for intense cooling systems. And they can provide passive solar, which saves energy and costs. Finally, sun controls have their own unique design elements that can create texture, vivid colors, and aesthetic appeal, often through a powder-coat finish or LED lighting.

1.19 Specifying Sun Control Products

Notes:

Sun control products and attachments include a variety of blades, outriggers, fascias, and mounting options. Sun controls can be oriented horizontally or vertically, and they come in a variety of forms such as cantilevered, suspended, shadow lined, and twisted. Sometimes sun controls are specified just to add beauty to a building-a way of incorporating architectural metals with no function required.

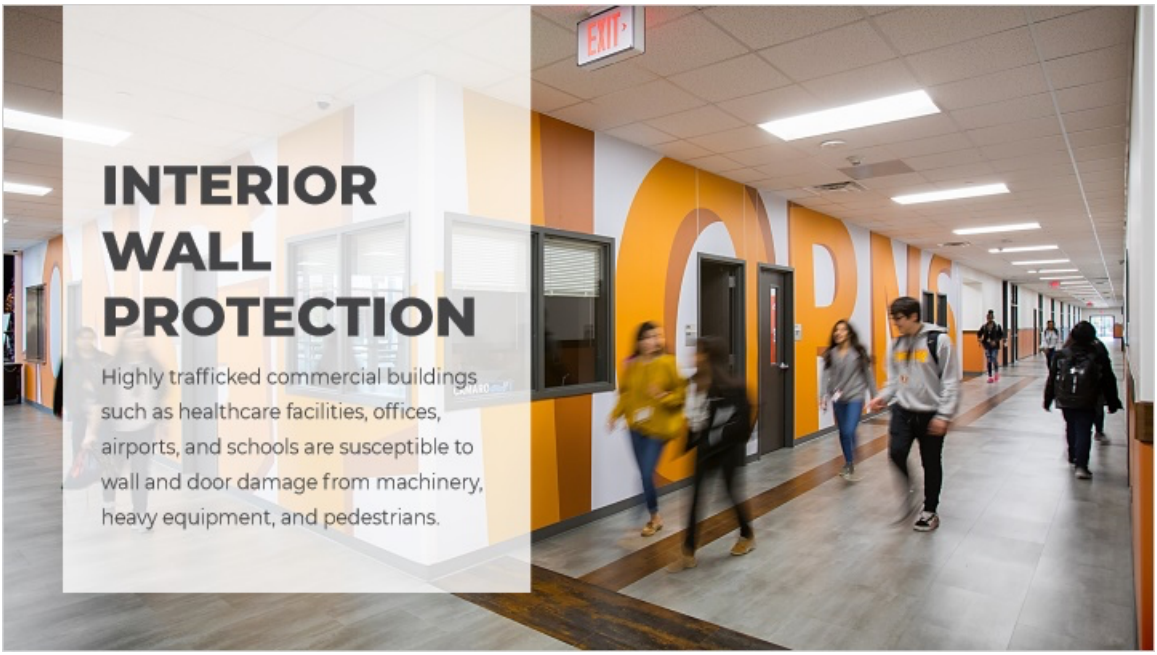
1.20 Earthquake-Ready Stairs



Notes:

Stairs can be a dangerous part of a building in the event of a seismic shift. If they collapse, they can injure occupants. Additionally, stairs are a necessary route to safety inside a building. Safe egress for occupants and ingress for emergency personnel is a critical component of a building's performance and is a matter of life safety during and after a seismic event. New trends in architectural movement focus on stairs that move with the building as the building shifts, including interstory drift.

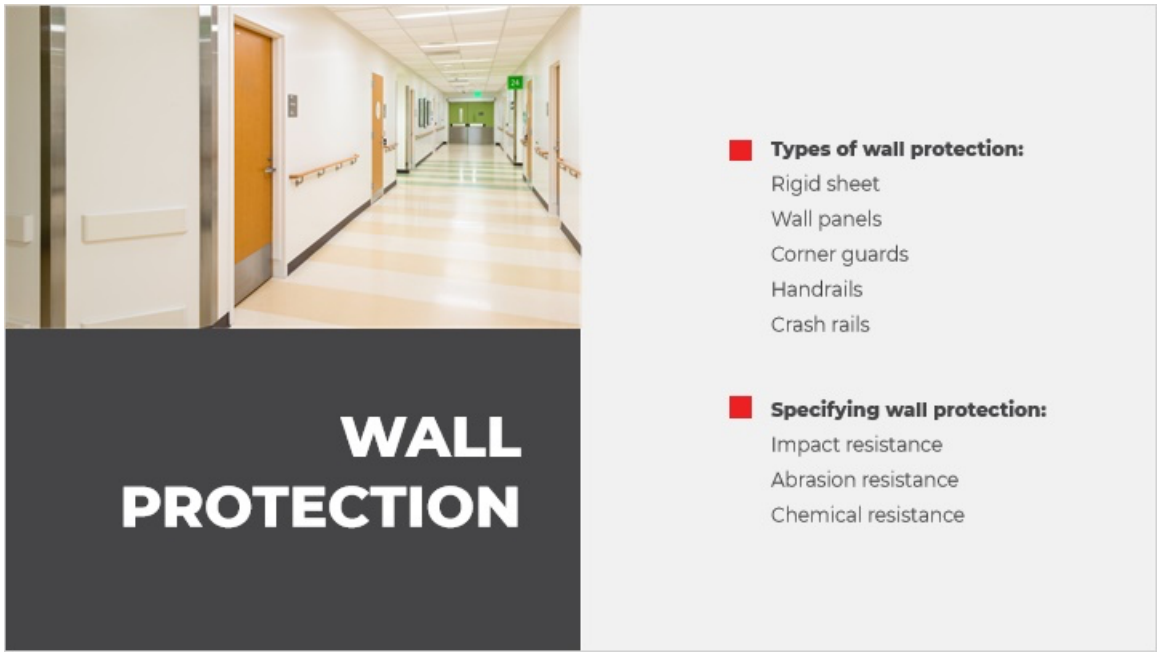
1.21 Interior Wall Protection



Notes:

Highly trafficked commercial buildings such as healthcare facilities, offices, airports, and schools are susceptible to wall and door damage from machinery, heavy equipment, and pedestrians. Walls can be protected from this type of damage by installing rigid sheet, corner guards, and bumper guards.

1.22 Wall Protection



Notes:

It is important to first consider what type of wall protection you need. Wall protection is performance-evaluated based on impact, abrasion and chemical resistance.

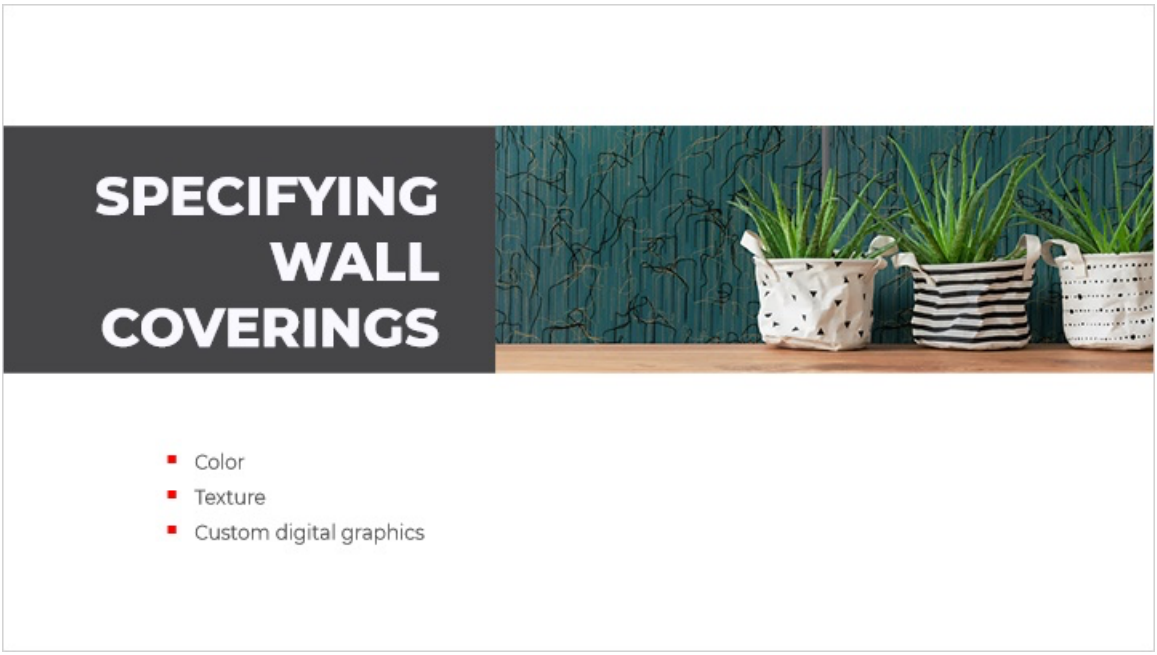
The rigid sheet is durable and prevents scuffs, dents, or cracks in a wall. Doors are another part of a building that easily can get damaged in high traffic areas. By covering the doors in the same rigid sheet as walls, the life span of a door increases dramatically.

Wall corners are prone to machines and people bumping into them and can be protected with corner guards. In hospitals, wheeled equipment like beds and carts can potentially rub up against a wall, but bumper guards that stick out a few centimeters from a wall's surface can handle the rubbing and abuse that wheeled equipment can cause.

Crash rails and handrails extend along the walls and prevent carts and light machinery from bumping or scraping walls.

Protecting these interior walls and doors reduces maintenance and cleaning costs.

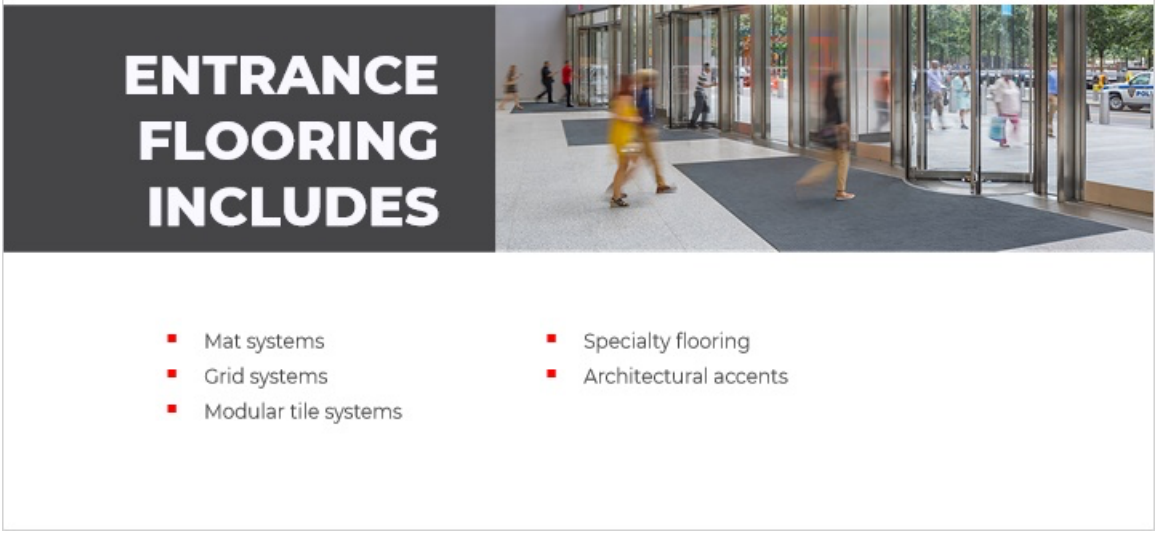
1.23 Specifying Wall Coverings



Notes:

It is important to specify wall protection first. What are you looking to cover and what are you looking to protect? Once you have made a decision about wall protection based on impact, abrasion, and chemical resistance needs, you can make decisions based on design. Wall coverings, for instance, come in a wide array of colors, textures, patterns, and custom digital photography options for logos, wayfinding, and custom wall art and décor.

1.24 Entrance Flooring Includes

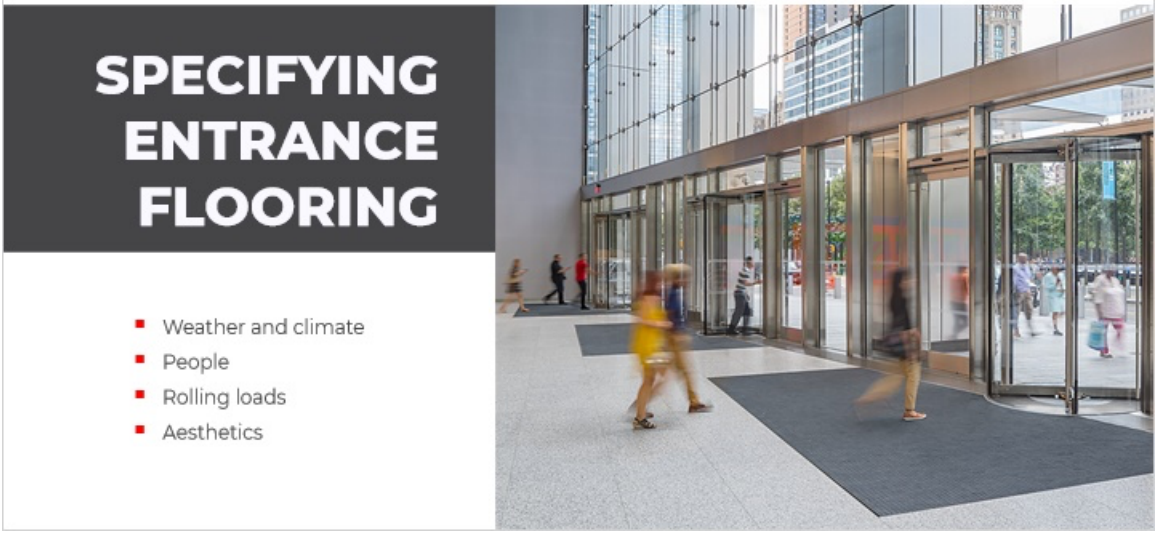


Notes:

High traffic building entrances are exposed to dirt, sand, and water tracked in by occupants. Entrance mats and grids are designed to trap the dirt, sand, and water so that the floor beyond the entrance remains safe, clean, and presentable.

Most entrance mats and grids are designed so that they easily can be lifted and cleaned underneath. In order for the system to function properly, it is important to properly clean entrance mats and grids and do so on a regular basis. These mats are durable but also can add an aesthetic element to the building.

1.25 Specifying Entrance Flooring



Notes:

When specifying entrance flooring consider the type of impact. Depending on the location, weather and climate can affect the entrance flooring. What type of building is it and what are the behaviors of its occupants coming in and out of the doors? Does the entrance way deal with heavy equipment such as gurneys rolling in and out? Once you have specified the needs for the entrance protection you can assess aesthetic needs for the entrance flooring.

1.26 Section 2

Notes:

As with many health, safety, and welfare decisions, resilient design stems from seeing how vulnerable buildings and communities have fared in different disaster situations and turning those lessons into practical solutions. This section will dig into the larger picture of why resilient design is important and cover its possibilities.

1.27 Resilient Design: A Big-Picture Concept

Notes:

Resilient design refers to buildings, landscapes, communities-and even regions-that are deliberately designed to withstand impacts that might otherwise damage or destroy the community.

1.28 Resilience-Based Building Design: Why it Matters

Notes:

For years, the architecture, engineering, and construction industry has gambled on building design when it comes to some natural disasters such as earthquakes. How often does an earthquake or other major event really happen? Is it worth the time and money to invest in movement design elements? In other words: How lucky do we feel? With the increase of climate events, a better question worth considering is: Do you want your building's welfare to be based on luck?

1.29 Resilient Building Design Solutions

Notes:

A multiyear federal study in the United States recently concluded that fixing buildings after an earthquake costs four times more than it would to initially build them with products aimed at architectural movement. In other words: If you engineer buildings with more resiliency in mind, you won't pay as much down the road. Resilient building products are trending, and the field of embracing movement in architecture is catching on in the U.S. in a couple of key areas, including stairs, expansion joint covers, and architectural louvers.

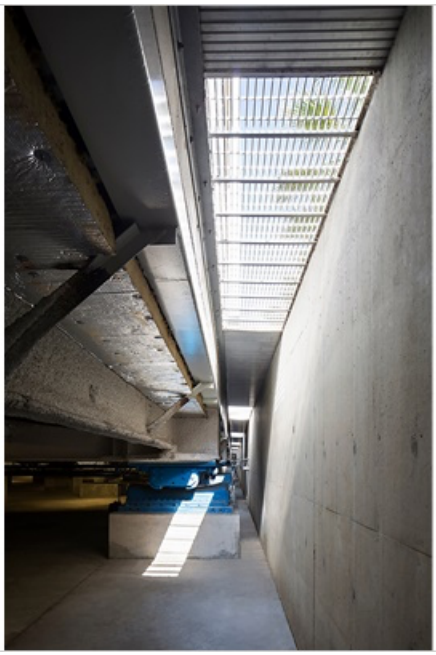
Total cost of ownership must be considered in building construction. An architectural movement system including more resilient materials and products used today will reduce costs in the future. Building owners in conjunction with architects, engineers, and constructors must consider choosing a product line that requires less updating, less replacing, and less out-of-service time when making required upgrades and updates.

1.30 Earthquake-Ready Stairs

Notes:

Stairs can be a dangerous part of a building in the event of a seismic shift. If they collapse, they can injure occupants. Additionally, stairs are a necessary route to safety inside a building. Safe egress for occupants and ingress for emergency personnel is a critical component of a building's performance and is a matter of life safety during and after a seismic event. New trends in architectural movement focus on stairs that move with the building as the building shifts.

1.31 Expansion Joint Cover Trends



EXPANSION JOINT COVER TRENDS

Expansion joint moat covers work in conjunction with the base isolation system.

Notes:

We talked about expansion joint covers earlier in the presentation. One area that has taken off for architectural movement is seismic expansion joint covers that are designed as moat covers and installed around the perimeter of a building to work in conjunction with the base isolation system.

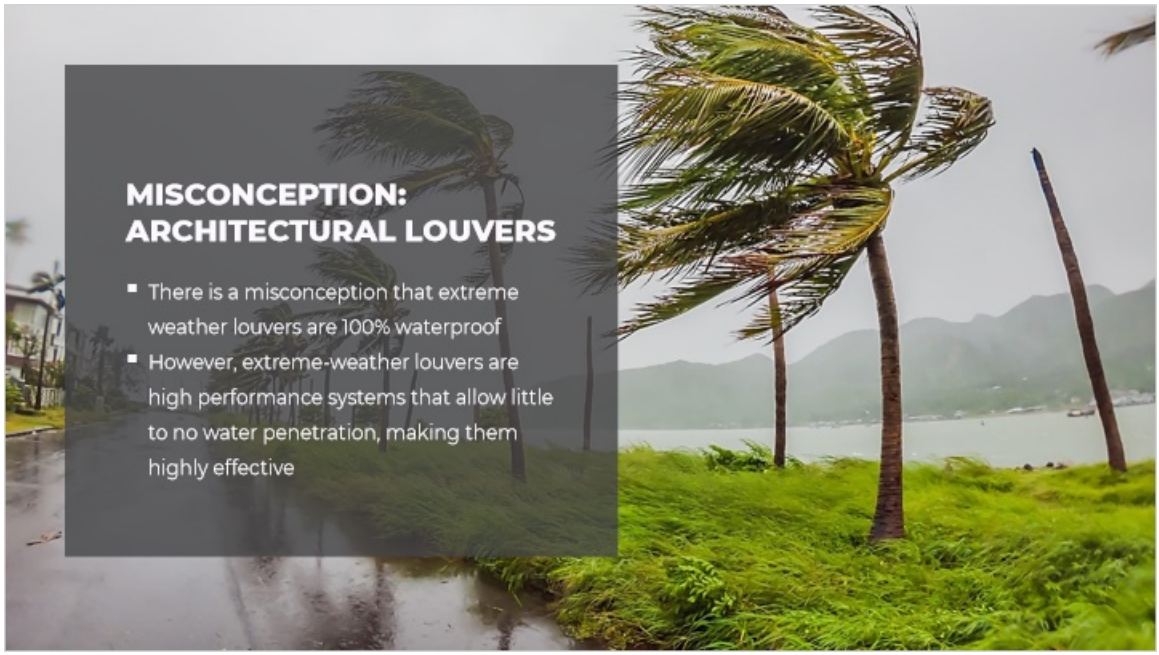
1.32 Increased Demand for Extreme Weather Louver Performance

Notes:

Over the last several years, building codes started changing to adopt louvers as part of the standard new construction requirements. Advancing the performance of these louvers for higher wind speeds and greater rainfall rates all started in the Sunshine State of Florida, where they had to specify louvers to meet the new codes going back to after Hurricane Andrew. Ever since Superstorm Sandy, though, states all up and down the Eastern Seaboard have adopted the same building codes and requirements for AMCA 540/550 louvers.

Extreme weather louvers were once only common in hurricane prone regions, such as Florida. As of 2012, heightened codes and testing (AMCA 540 and AMCA 550) have led to an expansion of extreme weather louvers to outside of Florida. They now encompass the entire east coast and all states on the Gulf of Mexico, providing durability and resiliency to a range of buildings that deal with significant wind, water, and air movement.

1.33 Misconception: Architectural Louvers



Notes:

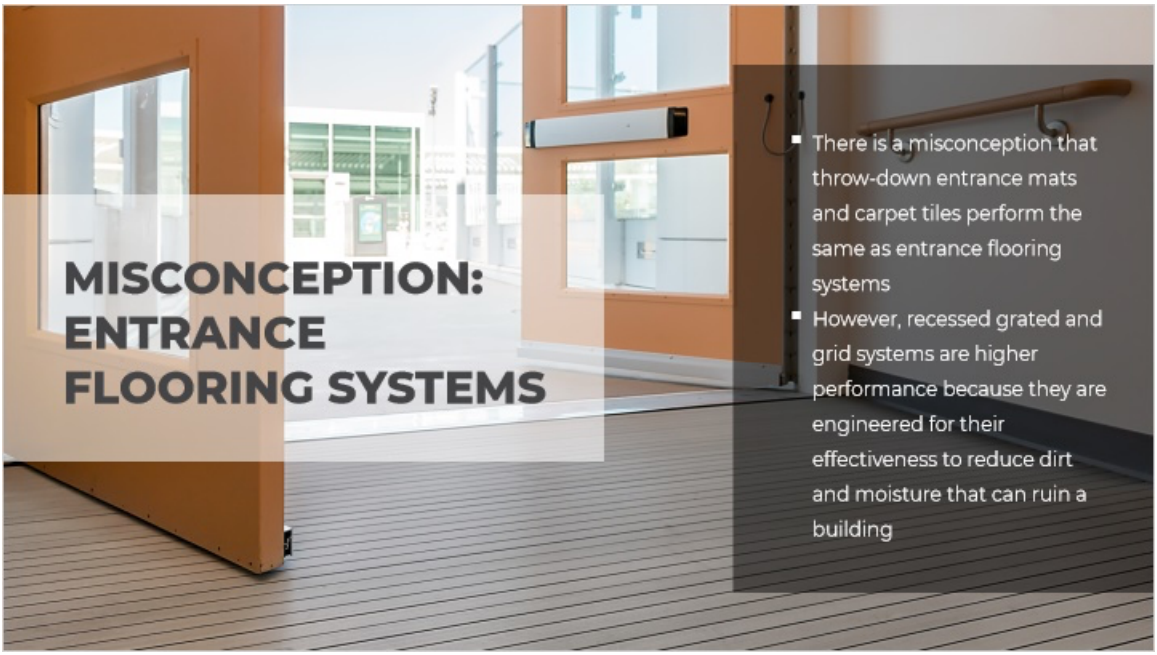
There is a misconception that extreme weather louvers are 100% waterproof, which they are not. However, extreme-weather louvers are high performance systems that allow little to no water penetration, making them highly effective. Working with a manufacturer to specify the appropriate solution for your climate will be the best way to figure out how architectural louvers best suit your needs.

1.34 Wind-Driven Rain Test

Notes:

Knowing how a louver will perform is critical to ensuring that it will stand up to real-life conditions on the job. Resiliency is tested to meet the standards of the Air Movement Control Association (AMCA), a long-established American trade body that sets standards for heating, ventilation, and air conditioning (HVAC) equipment. Tests can be performed in a test chamber. All louvers let air get into buildings, but anything that lets air in can also let in rain. Some storm-resistant louvers meet BSRIA, HEVAC, and AMCA wind driven rain test standards and appear to keep water out of a building.

1.35 Misconception: Entrance Flooring Systems



Notes:

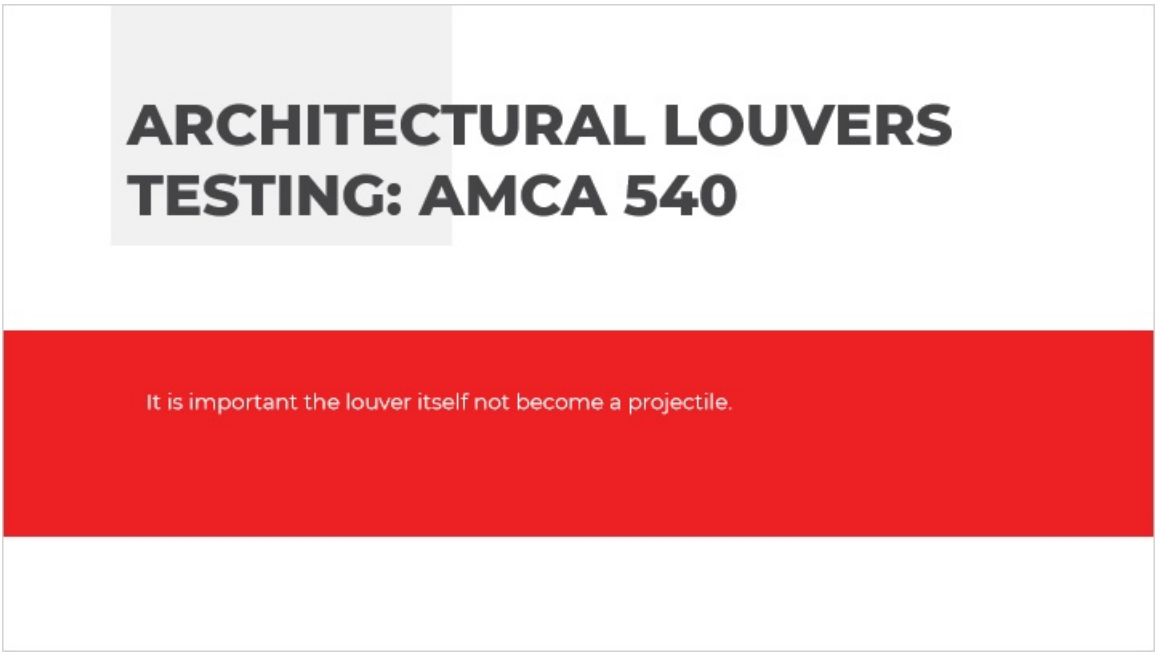
Entrance flooring systems often are underestimated as to what they can do. When designing an entrance flooring system, architects and builders sometimes believe carpet tiles or throwdown mats are equivalent to a recessed grated or grid system. However, recessed grated and grid systems are engineered for their effectiveness to reduce dirt and moisture that can ruin a building. Paying for the higher cost of these systems is worth its contributions to the lifecycle of the building since reduced maintenance will save money in the long run. Again, here is where the building owner or manager should remember total cost of ownership and the decision to invest in resilience now for future cost savings.

1.36 Testing for Other Movement-Based Architecture

Notes:

Movement-based architecture goes through a variety of testing and labeling processes. Interior wall protections are fire rated, labeled, and installed according to building codes. For example, entrance mats and grids are most often tested for load capacities.

1.37 Architectural Louvers Testing: AMCA 540



Notes:

Architectural louvers are tested and certified by the Air Movement and Control Association (AMCA), which is a third-party testing agency for the louver industry that tests and certifies louvers for air, water, and impact performance. AMCA 540 is a test method for louvers impacted by wind-borne debris to ensure the louver cannot become dislodged from the opening. It is important that the louver itself does not become a projectile. Other tests focus on high velocity wind and water.

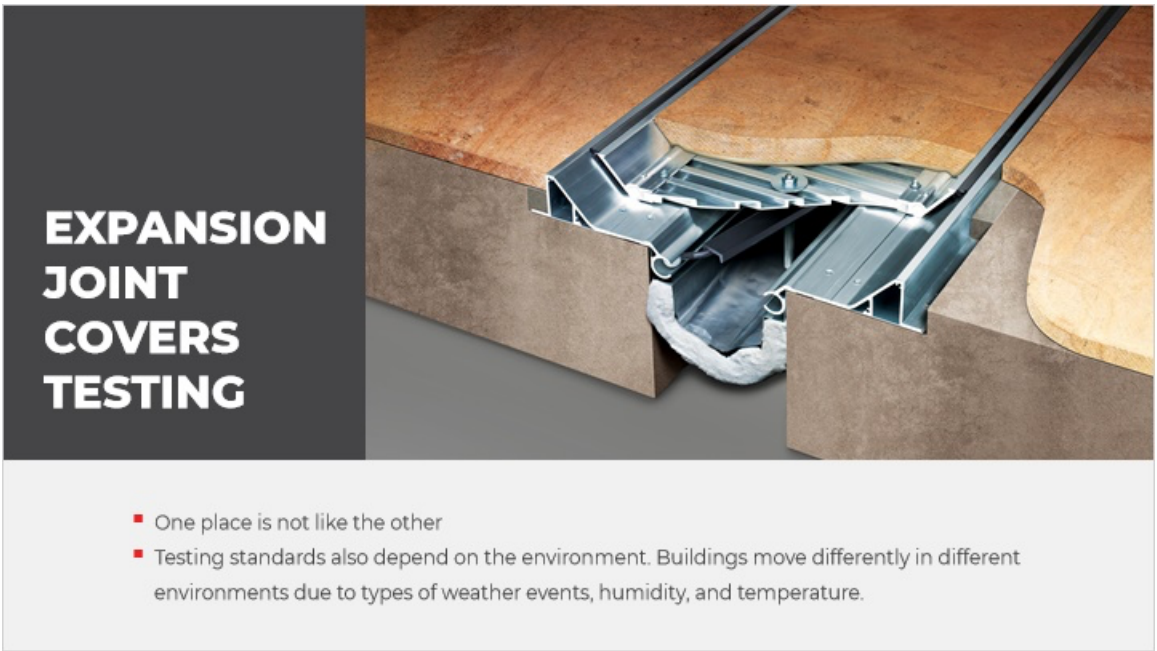
1.38 Expansion Joint Covers Testing: U.S. Resiliency Council

Notes:

Expansion joint covers are tested to ensure they will perform in a seismic event. The U.S. Resiliency Council (USRC) has established a building ratings system that assigns one to five stars based on dimensions, safety, monetary damage, and recovery time to regain basic functionality after an event.

The USRC Building Rating System describes the expected impacts of an earthquake or other natural disaster on buildings. It considers the performance of a building's structure, mechanical, electrical, and plumbing systems, and architectural components such as cladding, windows, partitions, and ceilings.

1.39 Expansion Joint Covers Testing



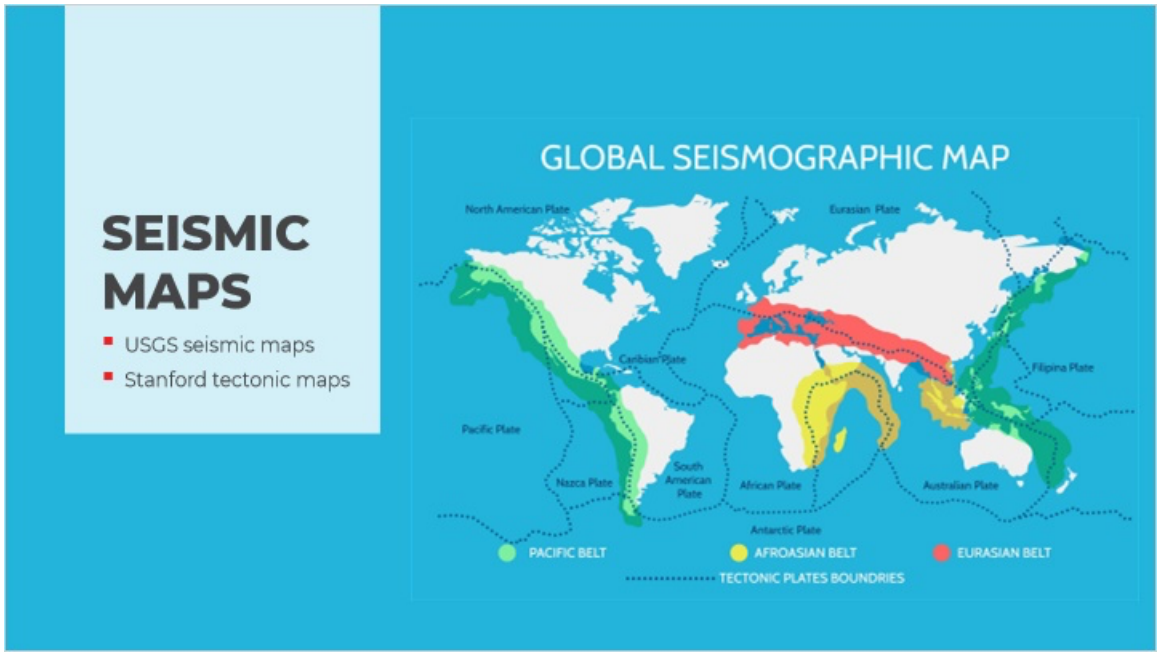
Notes:

Testing standards also depend on the environment. Buildings move differently in different environments due to types of weather events, humidity, and temperature. Miami-Dade County in Florida demands more stringent testing for louvers than anywhere in the Northeast.

Expansion

Expansion joint covers are needed on every building, no matter the location, but a building dealing with more seismic activity requires specific EJC treatment. Buildings that experience sand (such as in the southwest) or snow load in the north or Midwest, must consider those factors when specifying entrance flooring.

1.40 Seismic Maps



Notes:

Architects and engineers have map resources to use as a guide for predicting the types of movement in architecture products they might need. Stanford University researchers have come up with a new, expanded map of the tectonic stresses acting on North America-mostly human-made.

Additionally, a suite of National Seismic Hazard Maps for the U.S. was updated recently by the United States Geological Survey (USGS). The hazard component of the current AIR Earthquake Model for the United States is updated roughly every six years to ensure they incorporate the most accurate and up-to-date information.

1.41 Section 3

Notes:

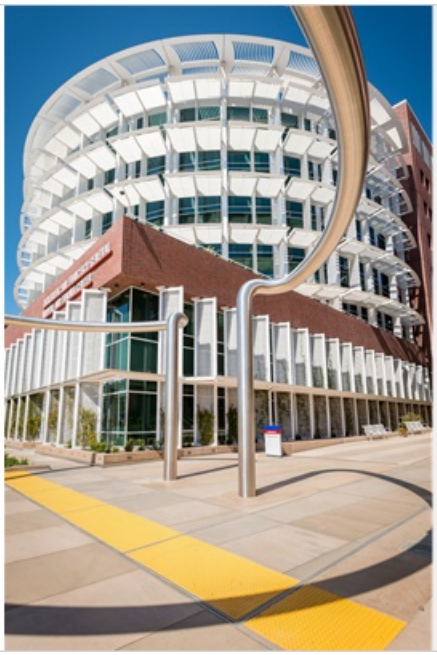
This section explores new attitudes about building construction, including a focus on health, wellness, and safety. It shows how many building owners, employers, and working inhabitants now have safety and comfort (and health) at the forefront of their minds when designing commercial structures today. It investigates the ways movement-based architecture plays into these goals.

1.42 Unexpected Disasters and Shapeshifting Spaces

Notes:

Buildings built for movement are buildings built with flexibility. That concept applies as well to how a space can be designed for flexible use during unpredictable disasters. In the midst of the pandemic, for instance, some hospital parking lots were turned into waiting rooms and at times even checkup rooms. Because these “black swan” events are unpredictable, a building can’t always be designed with a particular black swan makeover in mind, but it can provide certain elements that give it a shapeshifting quality.

1.43 Case Study



CASE STUDY:

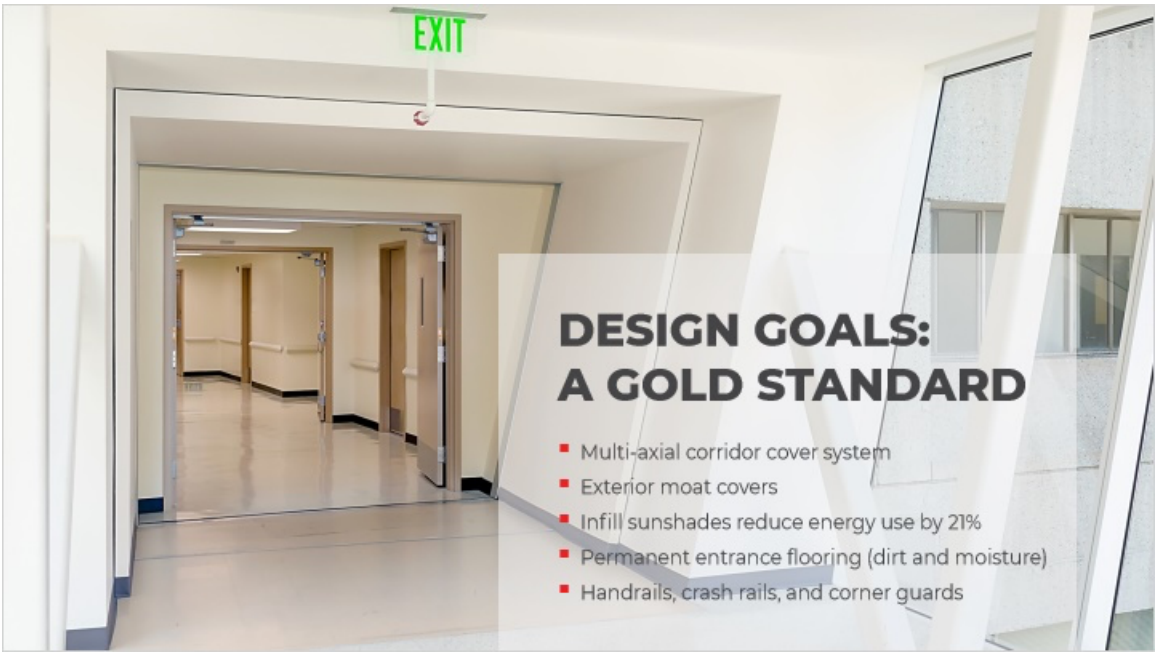
Zuckerberg San Francisco General Hospital, Location: San Francisco, CA

Notes:

In the medical field, movement-based architecture serves as a way to protect the welfare of medical staff and patients. In this case study: The Zuckerberg San Francisco General Hospital and Trauma Center, known as "The General," has been serving the city and Northern San Mateo counties for decades, and it is the area's only Level 1 Trauma Center.

The hospital serves over 100,000 patients annually and is a top medical training and research facility. The new nine-story acute care hospital connects to the existing hospital, making this a feat of construction, design, and creativity.

1.44 Design Goals

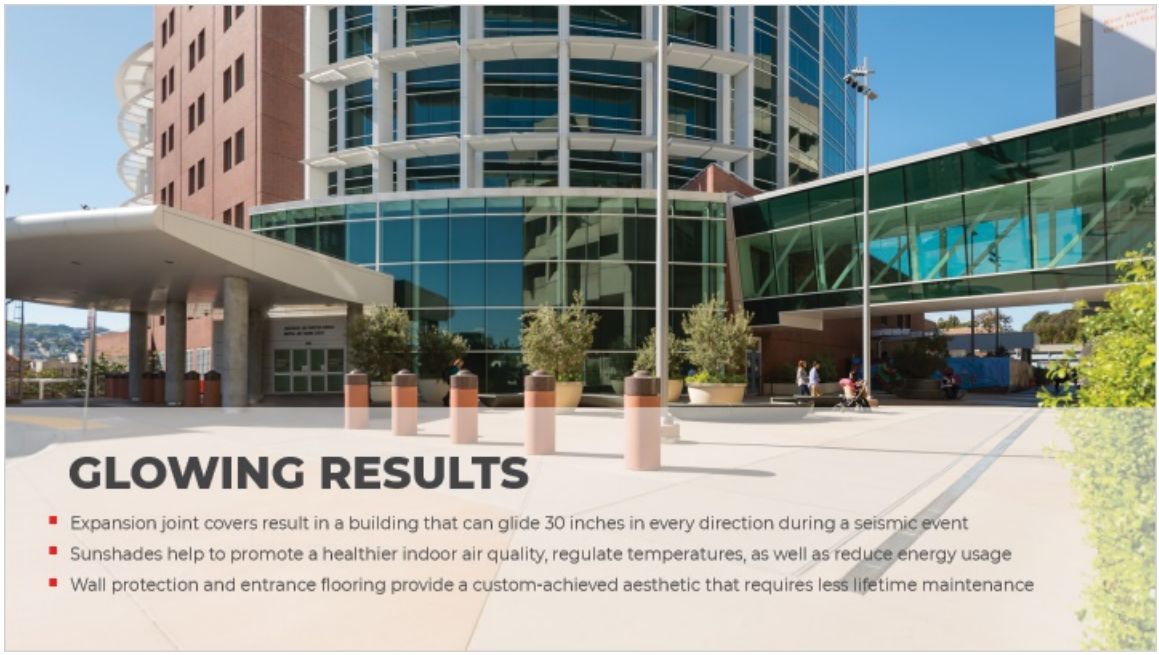


Notes:

California Building Codes mandate strict seismic standards to ensure the hospital remains operational should an earthquake occur, particularly due to its location on the San Andreas fault line. The architects selected environmentally responsible products to benefit the building's occupants and achieve the goal of becoming a LEED® Gold Certified structure.

That includes a multi-axial corridor cover system and exterior moat covers to accommodate expansion during an earthquake. The entrance flooring system allows for easy dirt and moisture removal, which would be necessary during an earthquake event. Finally, handrails, crash rails, and corner guards were installed to protect the interior of the building in the event of disaster.

1.45 Glowing Results



Notes:

These building movement products create durable yet aesthetic interiors, promote healthy indoor air quality, and reduce energy usage while providing protection for seismic events.

Expansion joint covers result in a building that glides 30 inches in every direction during a seismic event. The sunshades help to promote a healthier indoor air quality, regulate temperature, and reduce energy usage. Wall protection and entrance flooring result in a custom-achieved aesthetic that requires less lifetime maintenance.

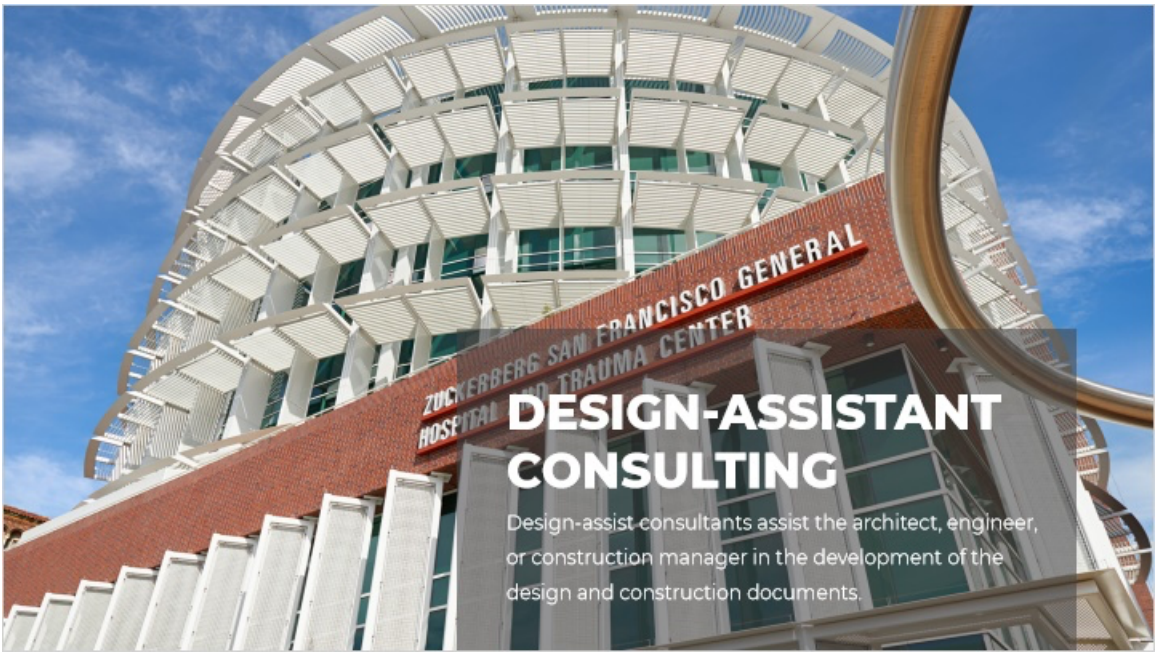
The overall result? The General is now one of the largest base-isolated hospitals in the United States and can glide 30 inches in every direction during a seismic event.

1.46 Section 4

Notes:

This section looks at how design-assistant consultants and manufacturers can play key roles in start-to-finish design and construction in a collaborative way.

1.47 Design-Assistant Consulting



Notes:

Design-assist (DA) is a procurement method where one or more subcontractors are retained prior to the completion of a design to assist the architect, engineer, or construction manager in the development of design and construction documents. Design-assistant consultants are willing to take on some of the coordination with other trades on behalf of the architect, which can be extremely beneficial for a project's schedule and risk factor overall. There are several advantages to incorporating all movement design elements from the beginning.

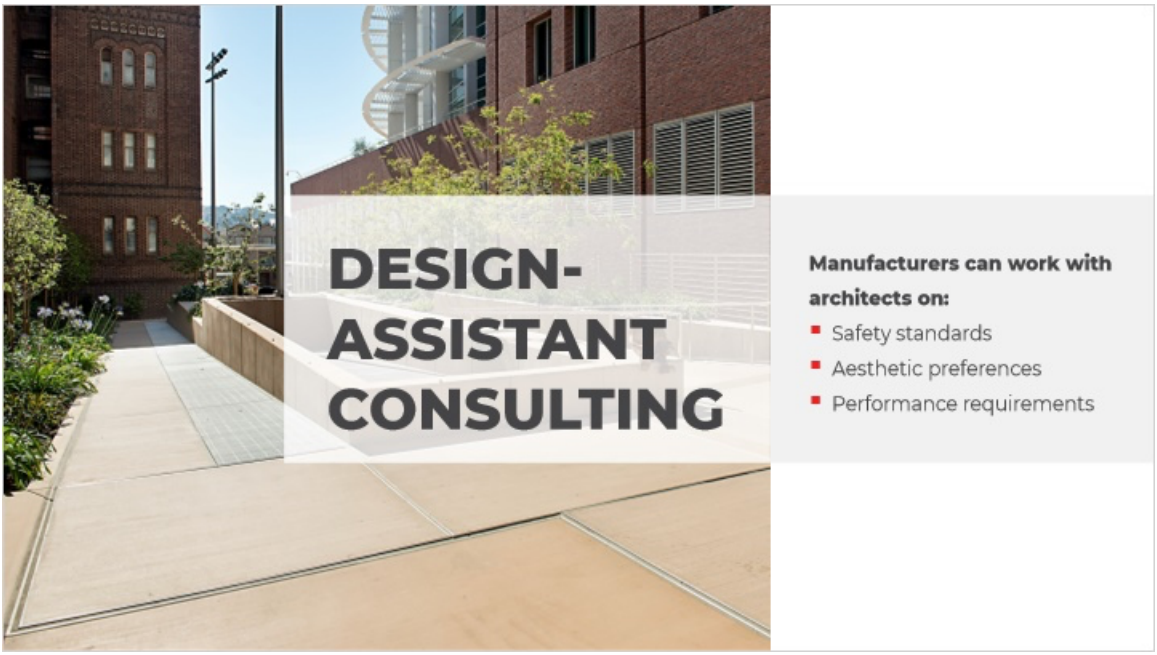
1.48 Design-Assistant Consulting

Notes:

Early collaboration increases the opportunity for innovation and prefabrication by incorporating constructability recommendations based on subcontractors' expertise.

Early reliability of the design decisions allows the team to direct their energy toward improving constructability issues. For example, if a supplier for expansion joint covers is brought into the equation late in the process after design and construction already have taken place, the expansion joint covers might become more of an add-on, and that approach can end up ruining the desired visual aesthetic.

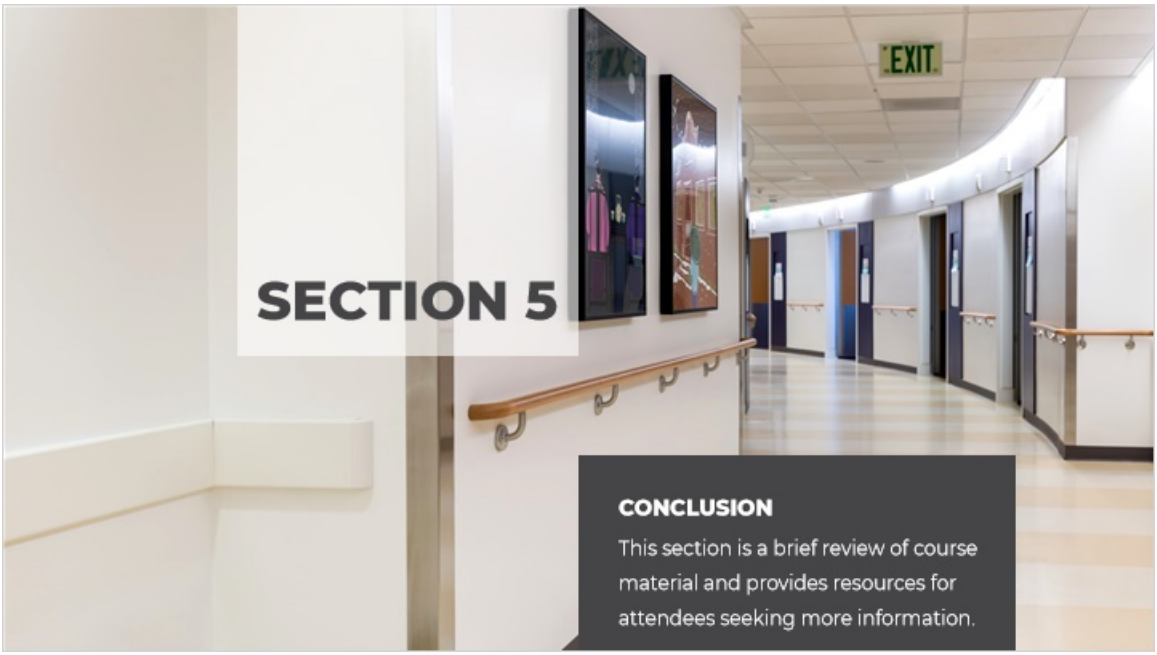
1.49 Design-Assistant Consulting



Notes:

More and more, manufacturers are offering services to ensure their solutions meet safety standards, aesthetic preferences, and performance requirements. That includes ensuring safety testing. In the best circumstances, the relationship between manufacturer and architect should be a collaboration, not just a transactional relationship. In the end, it is this collaboration and the sharing of expertise that leads to better custom solutions.

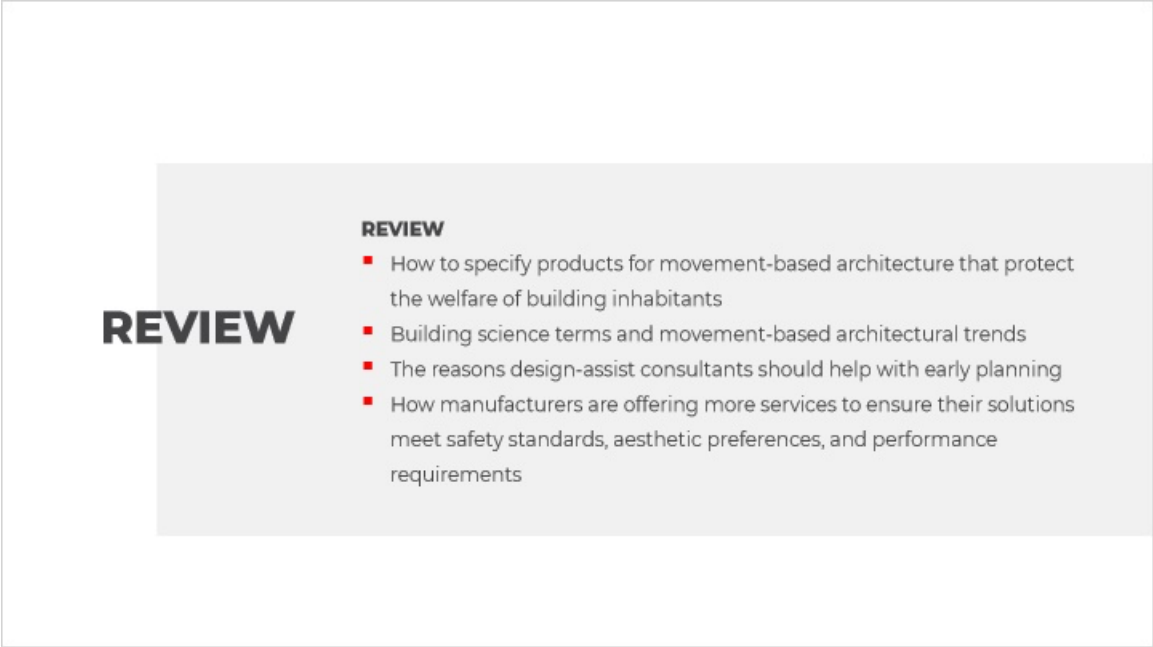
1.50 Section 5



Notes:

This section is a brief review of course material and provides resources for attendees seeking more information.

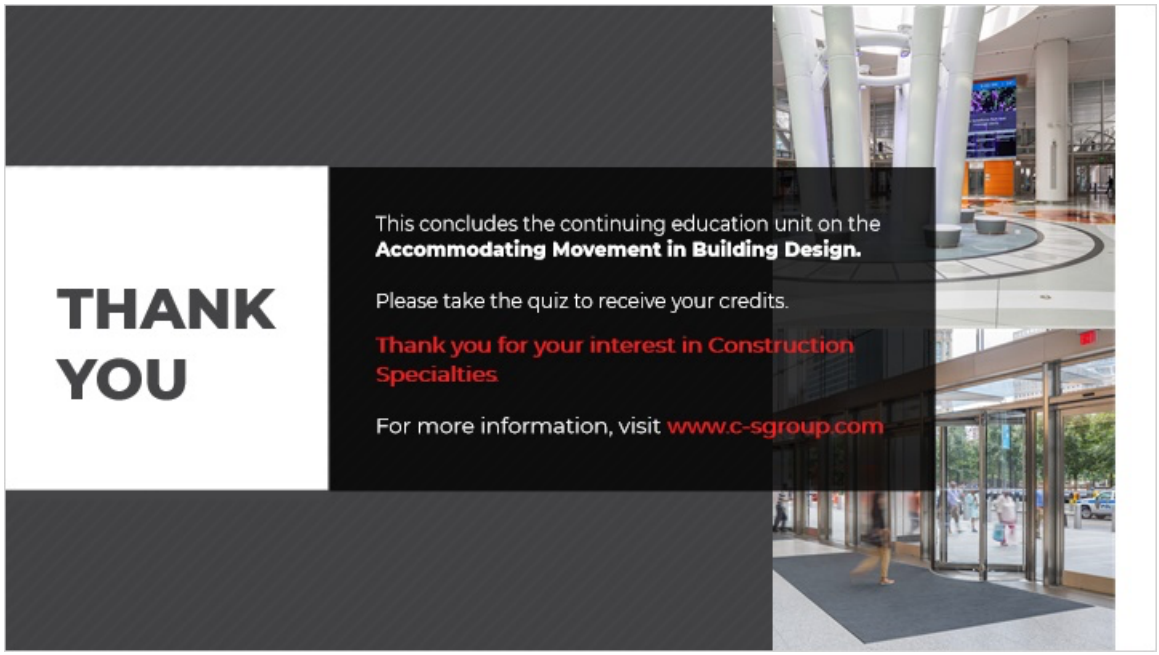
1.51 Review



Notes:

Over the course of this presentation, you have learned how to specify products within movement-based architecture that protect the welfare of building inhabitants. You have heard several building science terms and concepts about how earth and buildings interact and what architectural trends address those issues. You also have learned reasons for design-assist consultants and early planning strategies. Finally, you now understand how manufacturers and other industry players work together to meet safety standards, aesthetic preferences, and performance requirements.

1.52 Thank You



Notes:

This concludes the continuing education unit on the Accommodating Movement in Building Design: Mastering the Physical Movement of Earth's Elements Around the Built Environment.