Mastering Movement™ Academy

Mastering Physical Movements to the Building – Expansion Joint Covers

AIA Continuing Education Provider

Mastering Movement Academy

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Learning Objectives

UPON COMPLETING THIS COURSE, YOU SHOULD BE ABLE TO:

- Describe the multiple types of building movement and the risks they pose to the building, occupants, and surrounding environments.
- Explain how architects, structural engineers, and installers can work together to plan for building movement to protect inhabitants.
- Describe how the expansion joint cover system contributes to building resiliency and occupant safety.
- Communicate the role of expansion joint covers in protecting buildings from damage such as water and fire infiltration.
- Incorporate expansion joint cover systems for performance while minimizing aesthetic disruptions.

Course Overview

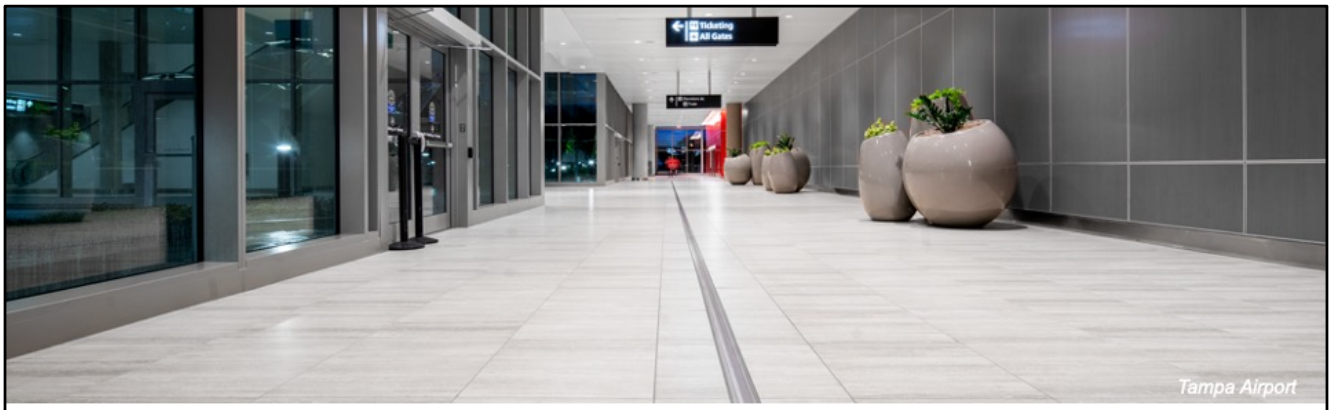
This course will provide an understanding of how to determine joint movement requirements and size joints properly based on those requirements. It will provide an overview of expansion joint cover types including floor, wall, ceiling, interior and exterior.

We will discuss fire protection and all components contained in the expansion joint cover assemblies along with applicable codes. Understanding and designing for movement regarding expansion joint covers is essential to establishing building resiliency and occupant safety.

Course Overview

This course will explore:

- The multiple types of building movement.
- How building movement impacts structural integrity (substrates/finishes) and occupant safety.
- How expansion joint cover systems work to protect buildings and occupants.
- How to integrate and specify expansion joint cover systems.



Tampa Airport

Expansion Joint Systems: Building Resilience

It would be impossible to engineer a building that could withstand every disruption or disaster, but having the proper systems in place can significantly improve building resiliency and occupant safety.

Photo by Tim Gouw on Unsplash

The Resilient Design Institute believes resilient design should be implemented in every built environment to create safer buildings and communities that advance sustainability.

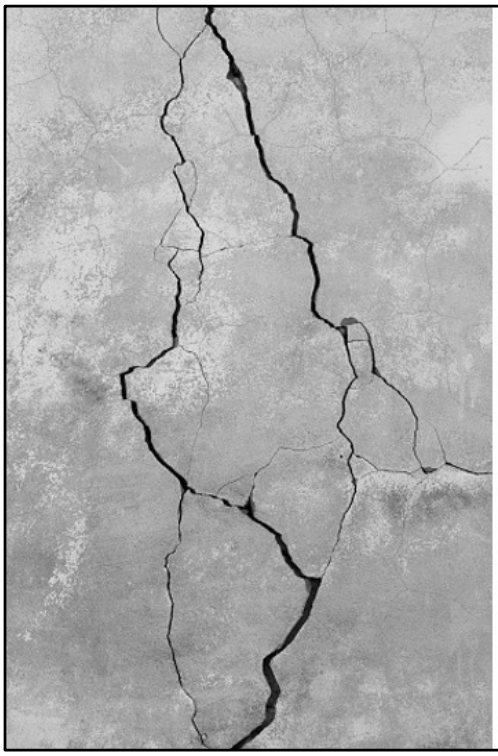
Source: https://www.resilientdesign.org/about/

Common Threats to Building Resiliency:

- Thermal movement (expansion and contraction)
- Lateral shear (perpendicular to the expansion joint gap)
- Wind sway (affects taller structures)
- Seismic events (Earthquakes)
- Building settlement (new to existing connections)
- Water intrusion (exterior expansion joint gaps, roof/exterior wall)
- Fire passage through unrated or unprotected expansion joints

Designing for resiliency ensures buildings can withstand immediate shock such as an earthquake or hurricane-force winds. It also means that the building can tolerate long-term stress such as settlement and temperature changes.


Expansion joints provide a structural gap to……
……control and absorb building and material movement.
Boise State Parking Garage



Buildings that do not integrate expansion joints will eventually find their own means of accommodating movement.

Without an expansion joint system, a building is at risk for structural damage that can lead to unsafe conditions and loss of structural integrity. This often results in material warping, cracking, breakage that could result in flooring and wall damage.

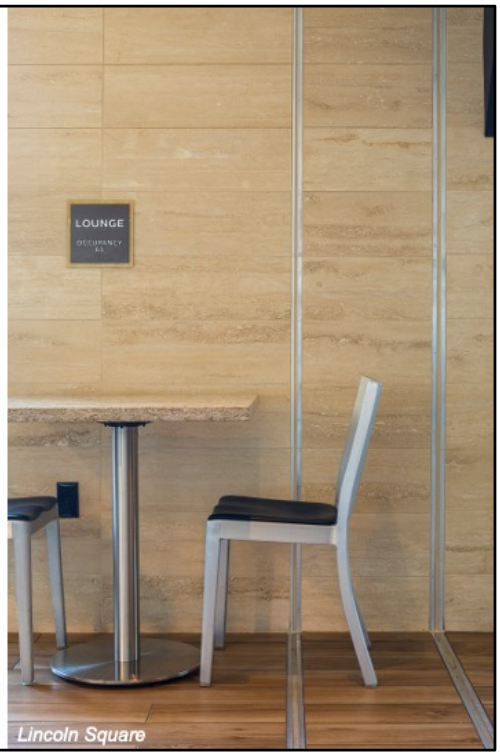
Because an expansion joint creates an actual gap within the structure, on their own they can become a threat to the building integrity and occupant safety if left uncovered.

Expansion joint covers are an integral component that provide a sealed transition over the expansion joint gap while allowing the building to function properly during movement.

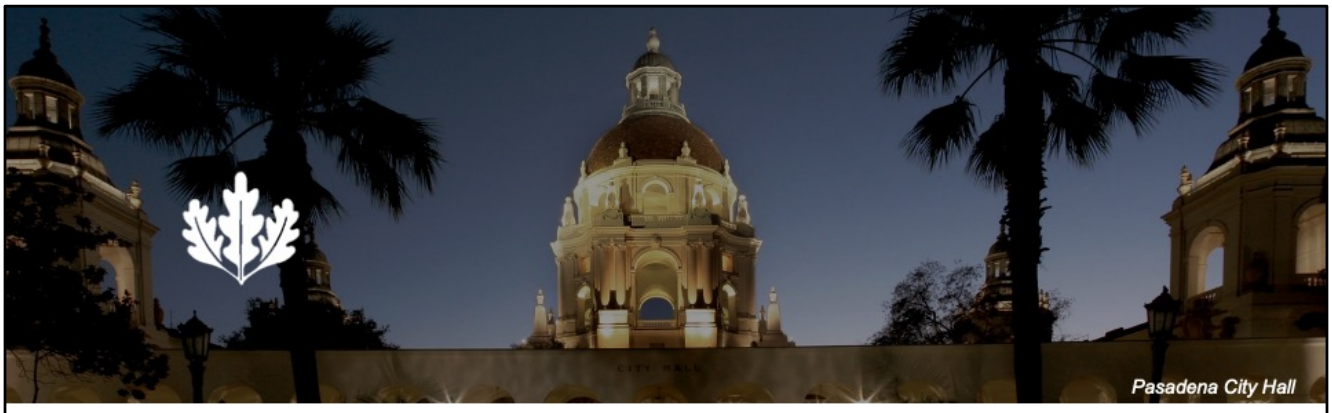
Poorly designed expansion joint cover systems can have negative impacts on substrates, energy efficiency, waterproofing, and fire rating. They also pose hazards to building occupants and facility operations.

Benefits of
Expansion Joint Cover Systems:

- Allows building to function properly under movement
- Provides flush surface over expansion joint gaps
- Reduces tripping hazards (ADA Compliant)
- Contributes to building envelop Integrity (Thermal Vapor Barrier)
- Creates a watertight seal
- Prevents bacteria and mold growth
- Blocks dust and dirt accumulation
- Reduces aesthetic design disruptions



Lincoln Square



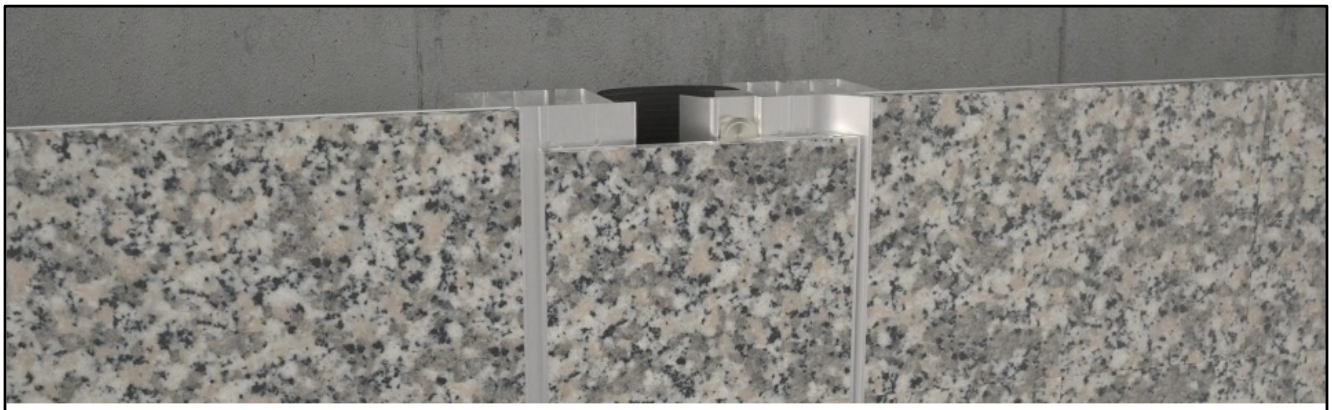
LEED Considerations

When specifying expansion joint covers, considerations to the manufacturing process and materials of the system can benefit LEED contributions.

- MR Credit 4.1 & 4.2, Recycled Content – many expansion joint covers are made from aluminum, steel, and stainless steel. Consult your manufacturer to understand recycled and post-consumer recycled content.
- EQ Credit 4.1, Low Emitting Adhesives – confirm compliancy of SCAQMD Rule #1168 as it pertains to adhesives used in interior applications.
- EQ Credit 4.2, Low Emitting Paints and Coatings: seek out environmentally friendly coatings.

Some manufacturers may also qualify for MR Credit 5.1, Regional Materials or Cradle to Cradle Certification dependent on manufacturing practices.

Photo: Pasadena City Hall East Elevation #2

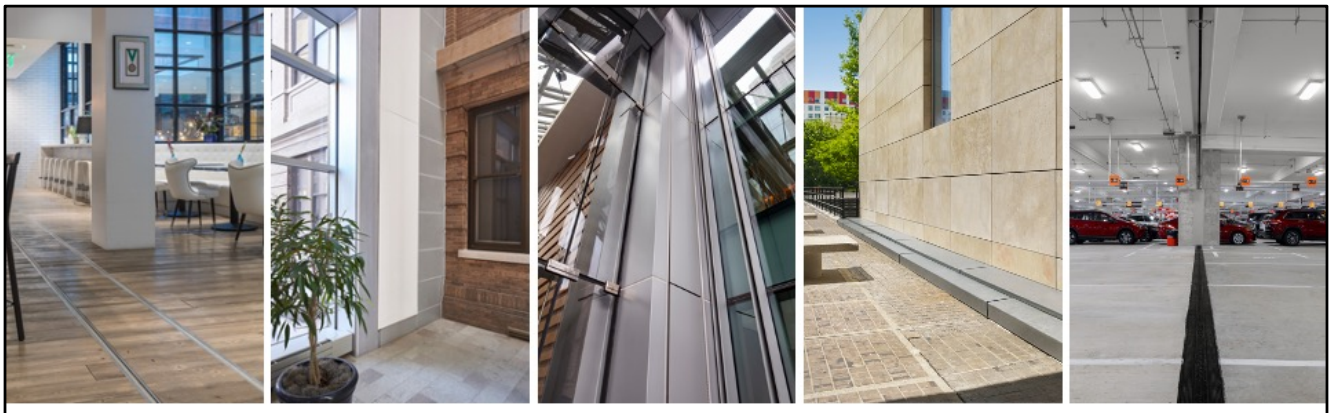


Function

Protection Meets Performance

Expansion joint systems are vital for protecting the sound, water, and fire barriers of a building. They also increase a building's resiliency to temperature changes, seismic events, and severe storms. To ensure components can withstand these varied levels of stress, extensive testing is paramount in predicting real-world performance.

EJC systems are not monitored by specific codes and therefore unique testing is required to ensure optimal performance.



Types of Expansion Joint Covers

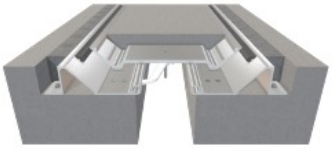
Determining the expansion joint cover that is right for your project is dependent on the joint size and movement expected. These criteria will be determined by the structural engineer and may be specified in inches or percentages to indicate minimum and maximum opening of the expansion joint gap. (Nominal, Minimum, Maximum)

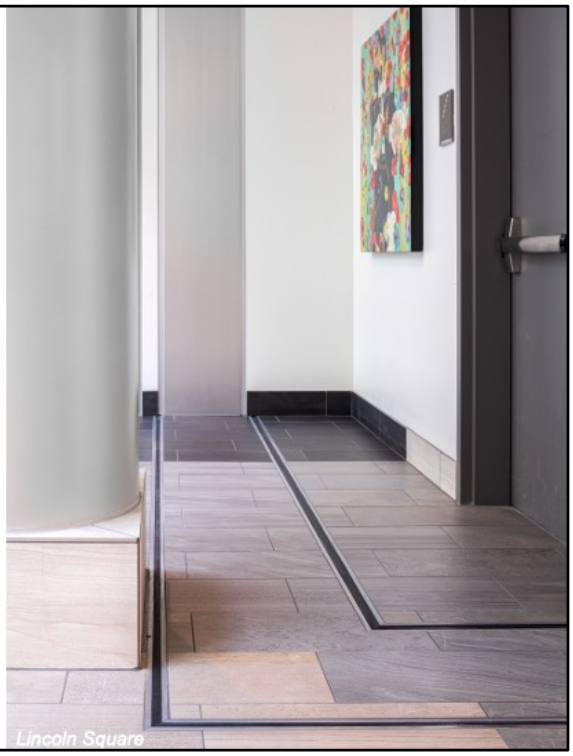
Garage Rubber Strip One Point © Seamus Payne

Floor Covers

Designed to integrate seamlessly with multiple flooring materials and ensure a smooth journey for pedestrians and equipment.

- Single gasket
- Dual gasket
- Aluminum
- Seismic (Pan Systems)
- Heavy Duty
- Infill





Interior Wall & Ceiling Covers

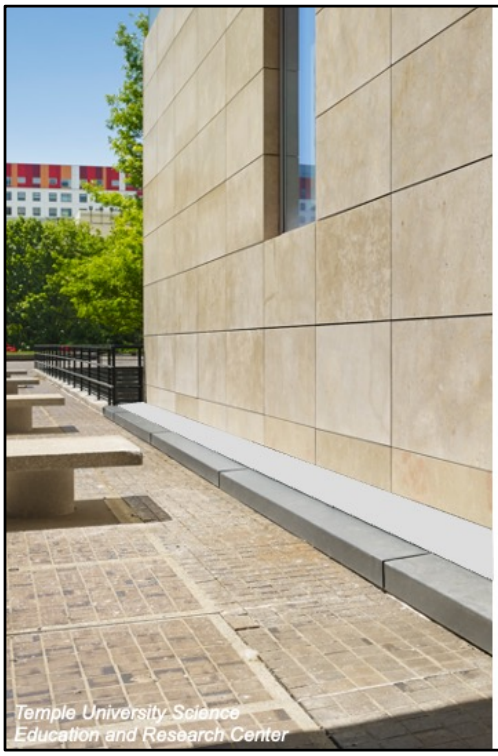
Provide a connection from vertical to horizontal locations with matching styles.

- Single gasket
- Dual gasket
- Aluminum

Exterior Wall Covers

Designed to protect against weather elements including water, dirt, and dust. Color matching is used to blend covers into surrounding exterior finishes. Infill options can be used to further conceal visibility within the building facade.

- Single gasket
- Dual gasket
- Foam
- All aluminum
- Infill



Roof Covers

Available to accommodate

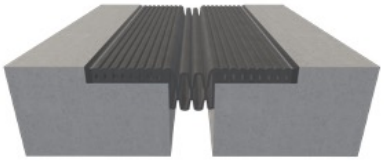
both flat and built-up rooflines.

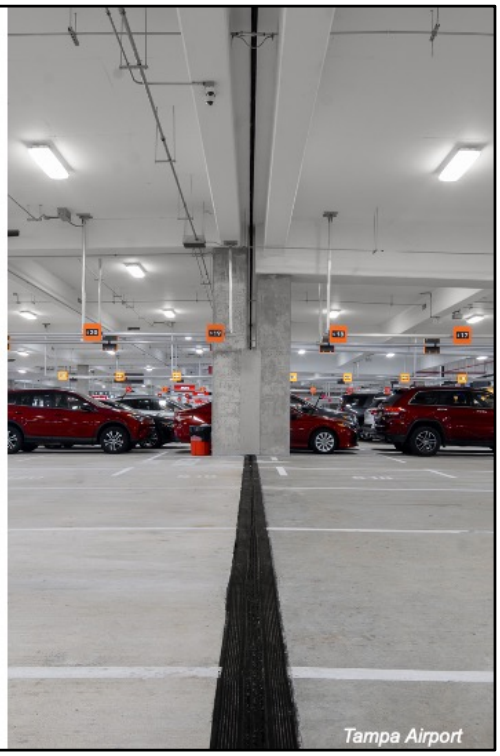
- Bellows
- Aluminum

Parking and Stadium Covers

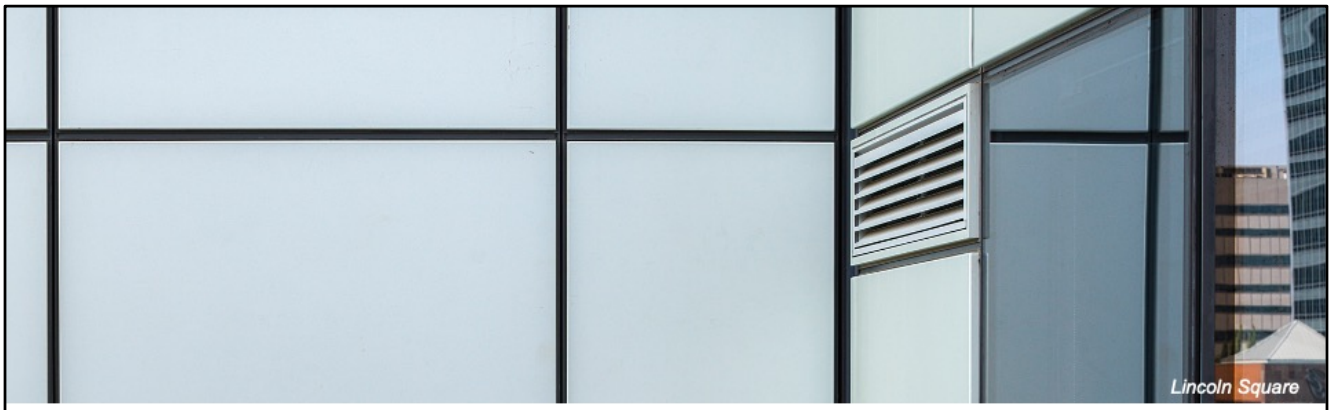
Designed for open-air facilities and can withstand constant vehicular traffic.

- Aluminum
- EPDM Monolithic seal
- Foam

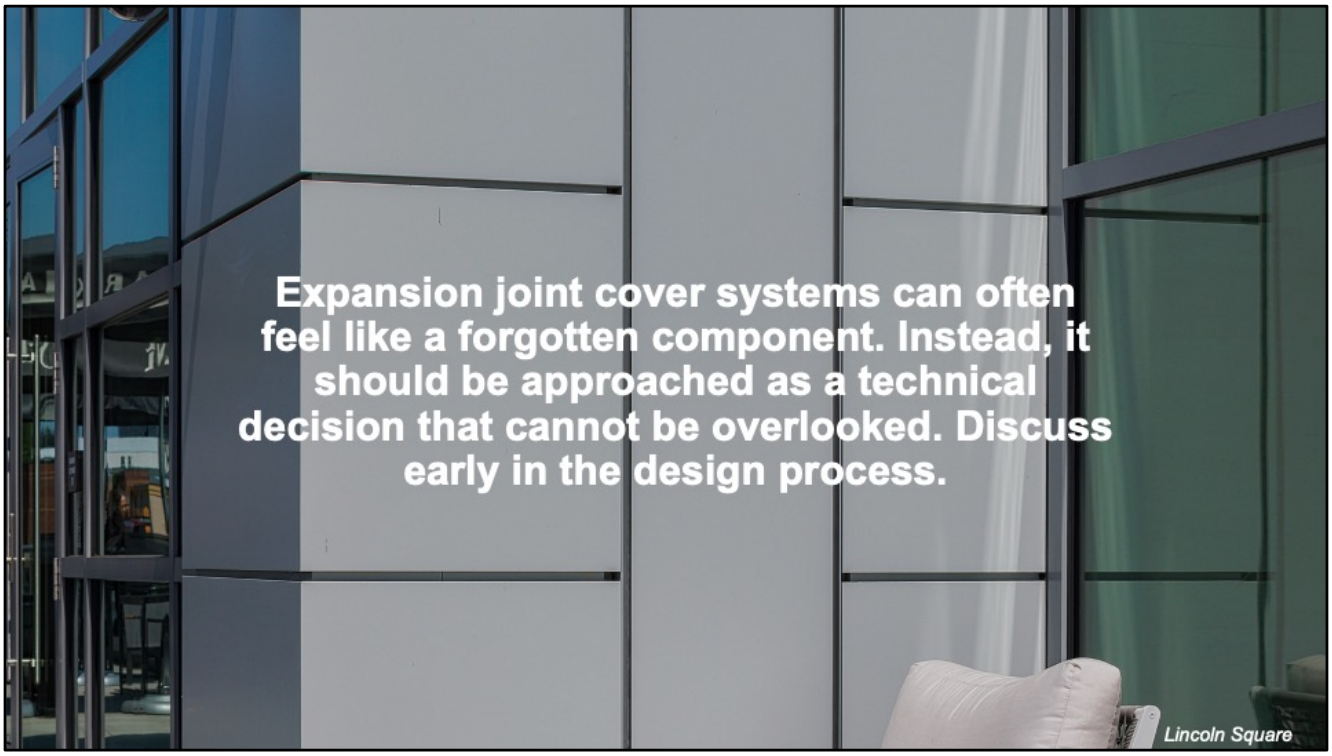




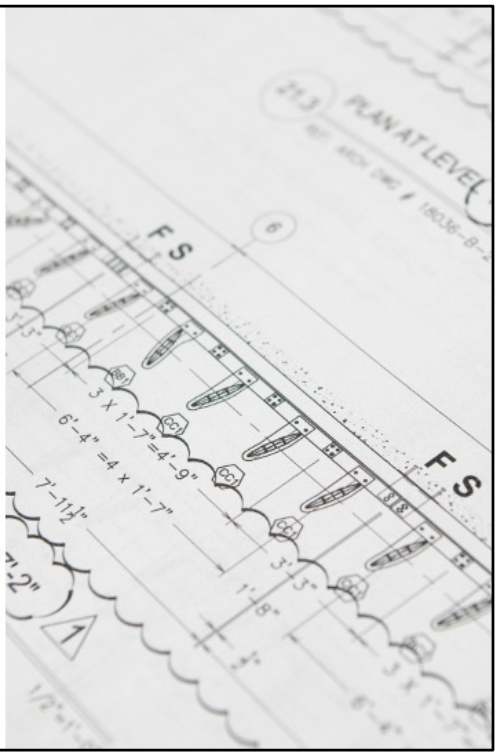
Garage Rubber Strip One Point.jpg © Seamus Payne



Integration: A System for Success

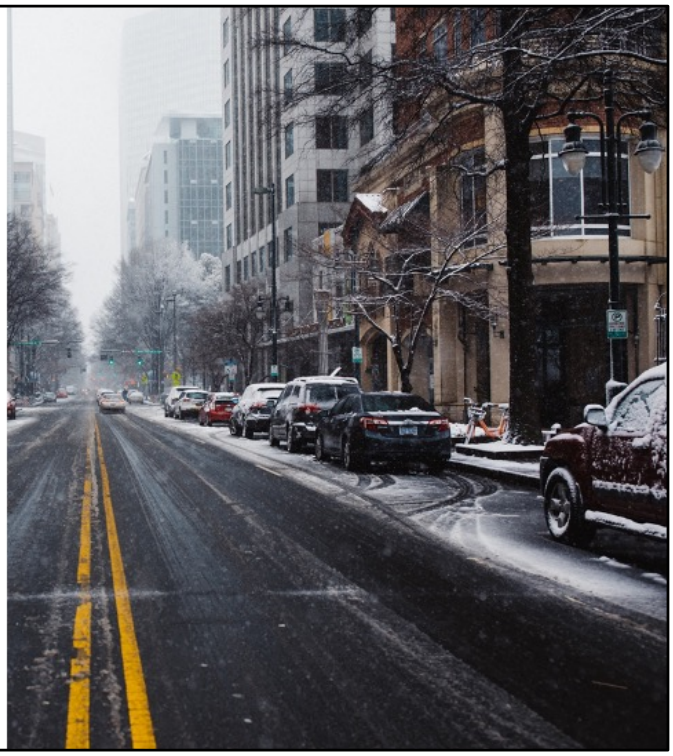

Expansion joint cover systems can often feel like a forgotten component. Instead, it should be approached as a technical decision that cannot be overlooked. Discuss early in the design process.
Lincoln Square

When selecting the appropriate expansion joint cover, start by asking yourself these questions:



1. What type of movement must the building endure?

- Thermal movement
- Wind sway
- Settlement
- Seismic movement
- Lateral movement
- Vertical movement



This will often indicate the proper expansion joint cover for the application.

Photo by Wes Hicks on Unsplash

2. Joint size as built; What are the movement expectations?

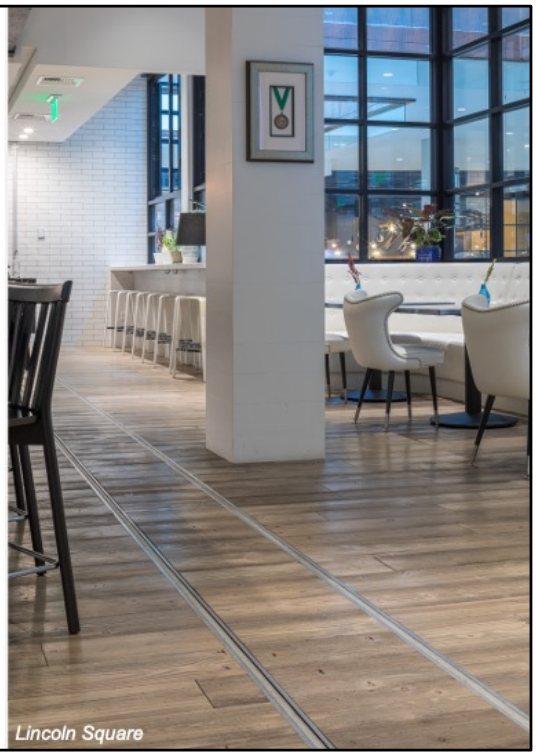
Minimum and maximum opening and in what axis. This should be determined by the structural engineer.

If the expansion joint cover is under-designed (often to save budget) it will limit joint movement capabilities and can result in system failure.

Insulation, sound, fire, and water proofing can all be built into the expansion joint to ensure proper building enclosures, performance, and safety. It is important to understand that these added materials require added space and cannot accommodate 0" closure without damage.

Photos:
EJC_Joint_Spacing_Minimum_with_barrier

4. What is the function of the facility?

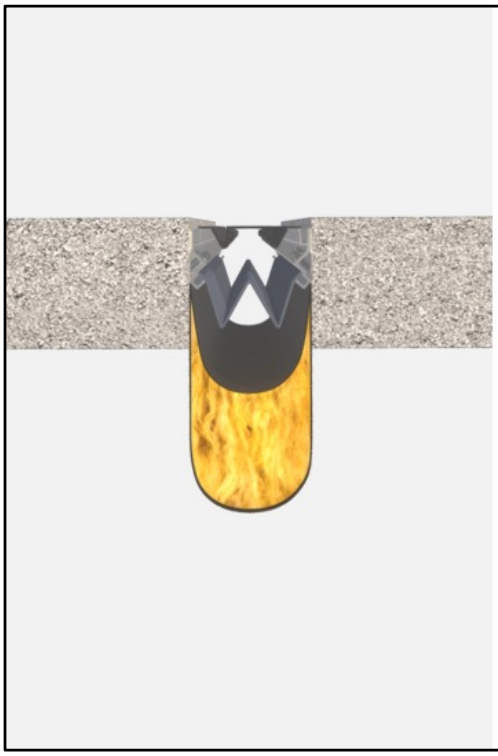


Different building functions will dictate different expansion joint cover finishes. Considerations of hygienic requirements, equipment load capacities, and most importantly occupant safety should be made. For example, an elegant upscale hotel lobby EJC requirement would be something that might incorporate inset of tile, ceramic etc… to be visually more pleasing to the eye.

Expansion joints, while necessary, can interfere with water proofing and fire safety barriers.

If the wrong cover system is used, the expansion joint becomes a passage for water and moisture intrusion and a dangerous disruption in fire containment systems.

Photo by Alexandre Guimont on Unsplash



Waterproofing

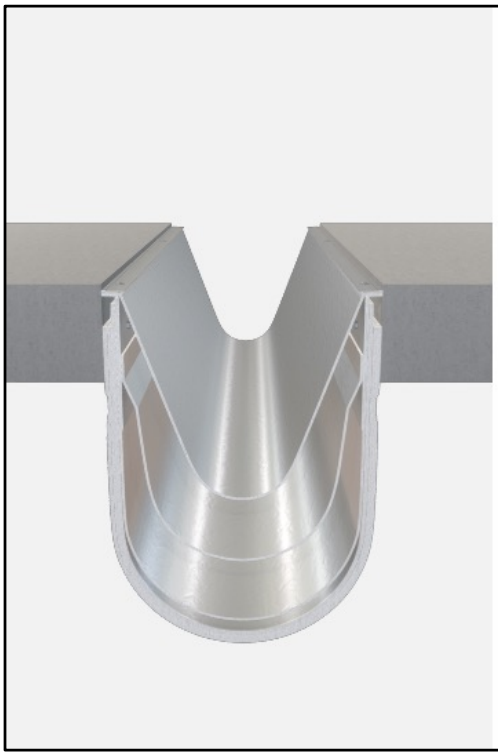
On the exterior, expansion joint covers are a critical component in sealing the building envelope. Systems with secondary seals or vapor barrier accessories can prevent moisture including condensation, fog, rain, and wind-driven rain that accompanies severe storms such as hurricanes and typhoons.

Waterproofing is particularly important when addressing rooflines and exterior walls. Selection of the proper cover type and accessories is critical to sealing the system. Factory-fabricated sealed transitions are highly recommended to ensure watertightness.

Waterproofing

As the system moves from horizontal to vertical planes, joints are required to maintain sealed transitions. Errors in transitions can often become points of water intrusion and can cause severe damage.

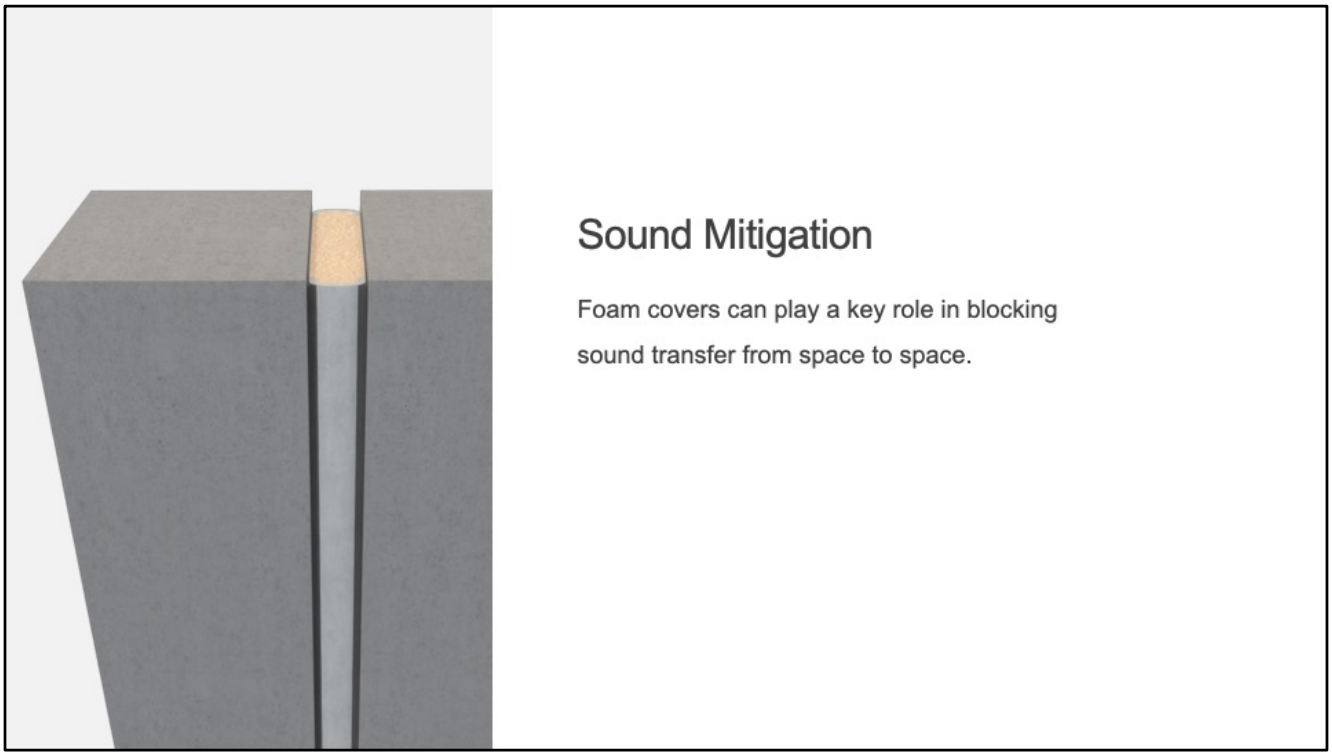
Often times when transitions are done in the field, without factory mitered transitions to provide a clean connection, the result can be messy and subject to the interpretation and skill level of the subcontractor for field fix. Selecting a "sole source supplier" ensures that all system components work together from design to installation.



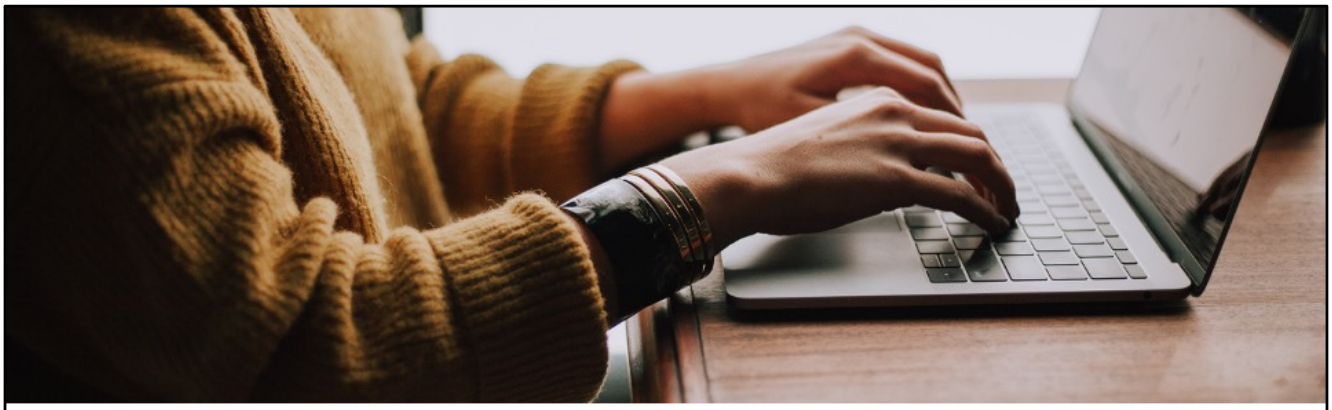
Fire Barrier Protection

Expansion joint covers by themselves in most cases are not fire-rated (the exception being fire-rated foam). You must incorporate an approved third party listed barrier into the assembly to meet your rating, accommodate movement, and protect occupants. Stainless steel foil can be used to achieve L rating (smoke).

Fire barrier testing should be certified through a reputable third-party certification agency such as Underwriter Laboratories (UL). For example, the assembly will have a specific number associated with it for floor or wall. Example - UL #FF-D-1055/ UL# WW-D-1067 (G.W.B.)/ UL# WW-D-1068 (C.M.U.)



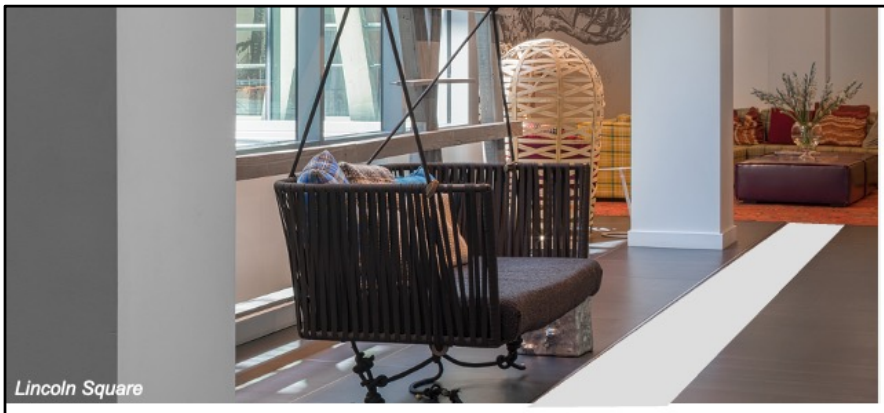
Sound mitigation is important for both building interiors and outdoor spaces such as parking garages and stadiums.

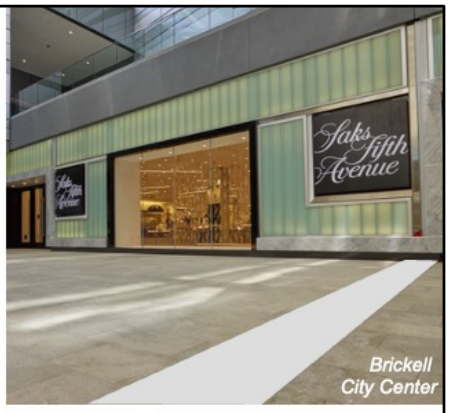


Early Specification for Success

Expansion joints and covers that are misaligned will cause malfunction and limit movement that can result in loss of building integrity and occupant safety risks. Early specification can ensure all areas of the project are working in harmony.

Expansion joint cover systems can be integrated into modeling software to help map out placement, integrate cover finishes into the overall project design, and establish workflow.





Expansion joint covers can be designed to blend in with their surrounding creating minimal sightlines. They can also incorporate many color and finish types to match the overall building design.

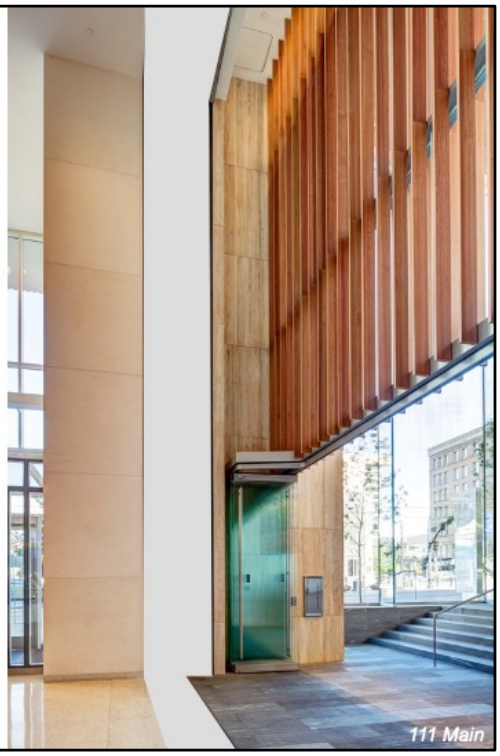
Design Considerations

Loading | Placement/Mounting | Movement | Custom

Finish and color options can be specified on the gasket and cover, however some cover materials may limit the availability of coating selections. Some covers can be flush mounted to enhance concealment. Most manufacturers offer a range of coatings and finishes, and custom matching can often be used for exact integration.

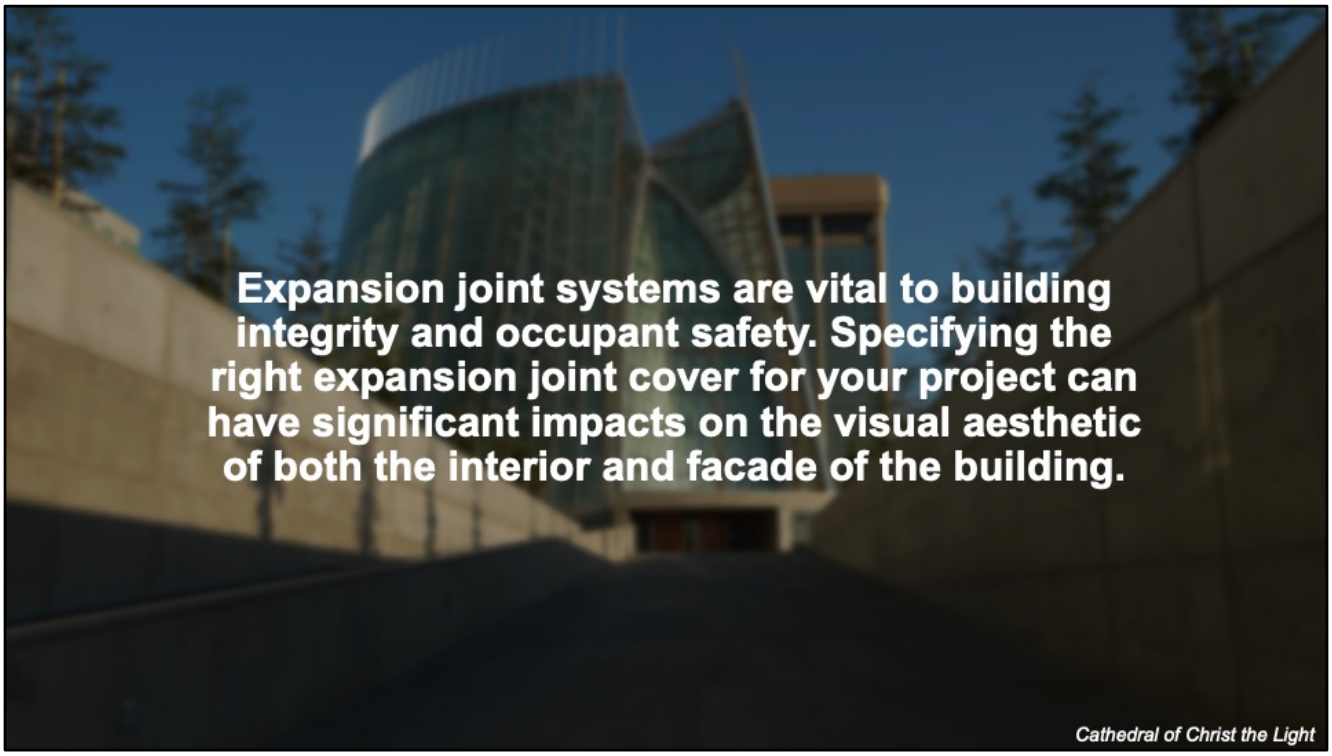
Custom Covers

Every project has its own special movement or aesthetic criteria. When a standard design does not work with the project, a custom option can be created to meet the specific building requirements.



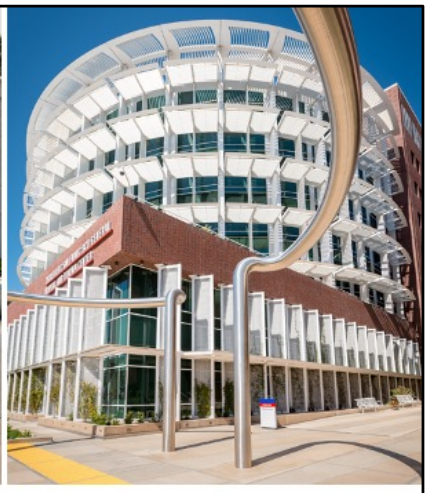
Selecting a manufacturer who can provide real-world testing is critical for custom designs. Ensuring how the custom cover will perform in real-life conditions is vital to sustained occupant safety and building integrity.

Inspiration: Seamless Design



These projects are a few examples of how expansion joint systems can be integrated to deliver unmatched safety, performance, and design.

Zuckerberg San Francisco General Hospital and Trauma Center



Zuckerberg San Francisco General Hospital and Trauma Center

San Francisco | FL
Fong & Chang Architects

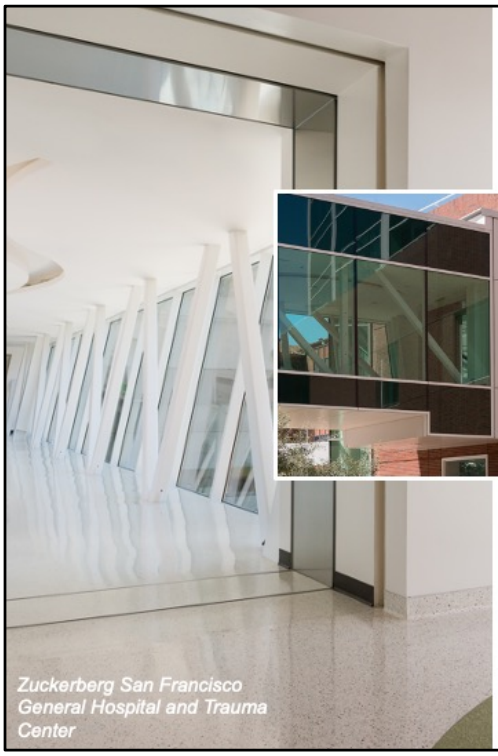
Known as "The General," the hospital serves over 100,000 patients annually and is a top medical training and research facility. A nine-story expansion was made possible because of a significant donation from Facebook founder, Mark Zuckerberg, and his wife, Priscilla Chan.

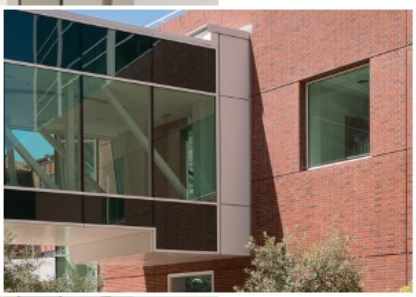
Challenge:

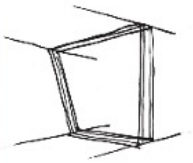
California Building Codes mandate strict seismic standards. Because of its location on the San Andreas fault line, extraordinary measures were required to ensure the hospital would remain operational should an earthquake occur.

Graphic: Map_of_California_highlighting_Alameda_County.svg: User:Babbage derivative work: Babbage, Public domain, via Wikimedia Commons.

Photography Credit: Construction Specialties®
Photo by Clem Onojeghuo on Unsplash



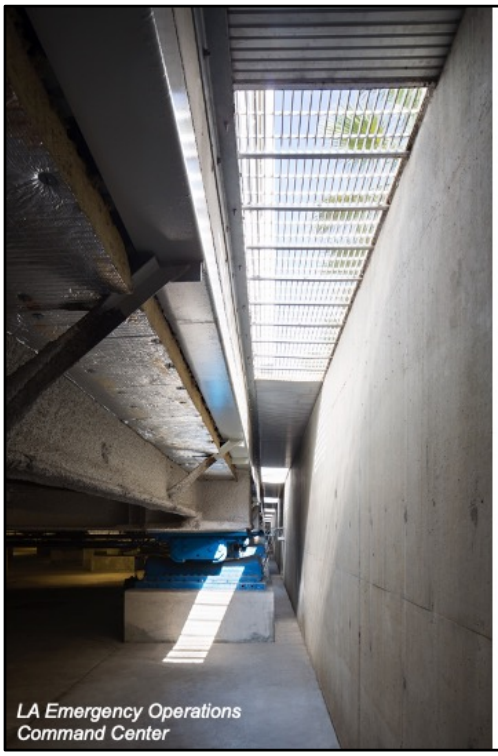




Zuckerberg San Francisco General Hospital and Trauma Center

Solution:

An expansion joint cover system was designed to accommodate extreme seismic activity. That system consisted of multiple axial covers which connect the new hospital to the existing structure and exterior moat covers to unite the landscape and sidewalk with the structure. 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.

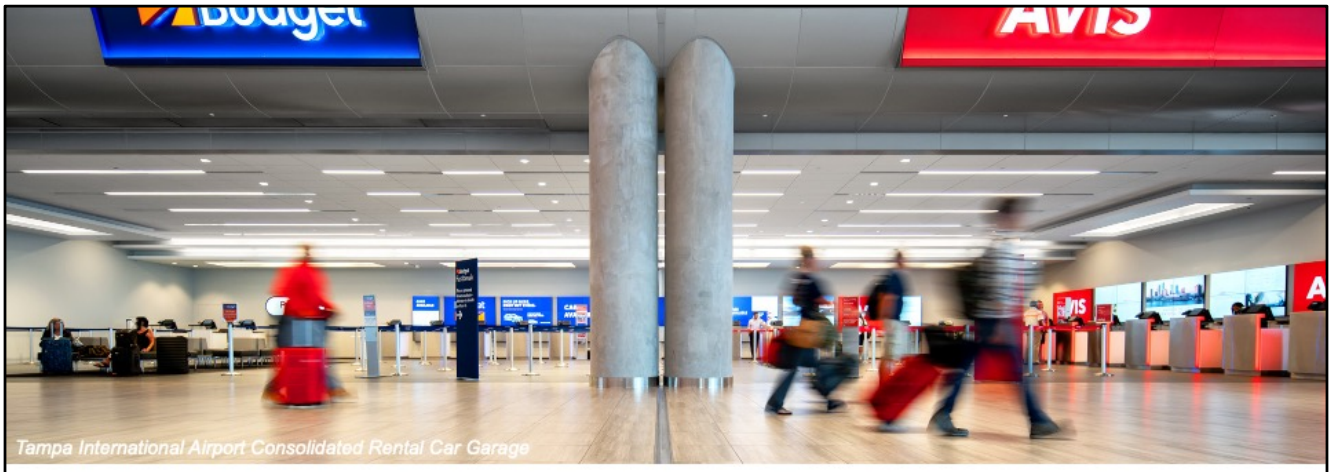


LA Emergency Operations Command Center

What is a base isolation system:

One of the most popular means of protecting a structure against earthquake forces.

It is a collection of structural elements which should substantially decouple a superstructure from its substructure that is in turn resting on the shaking ground, thus protecting a building or non-building structure's integrity.



Tampa International Airport Consolidated Rental Car Garage

Tampa | FL
Gresham Smith Partners

20 million visitors drive through the Tampa International Airports parking garages.

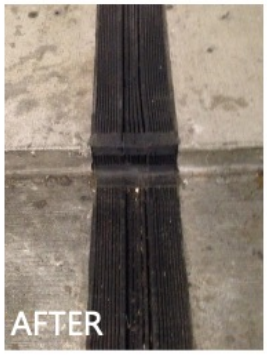
Challenge:

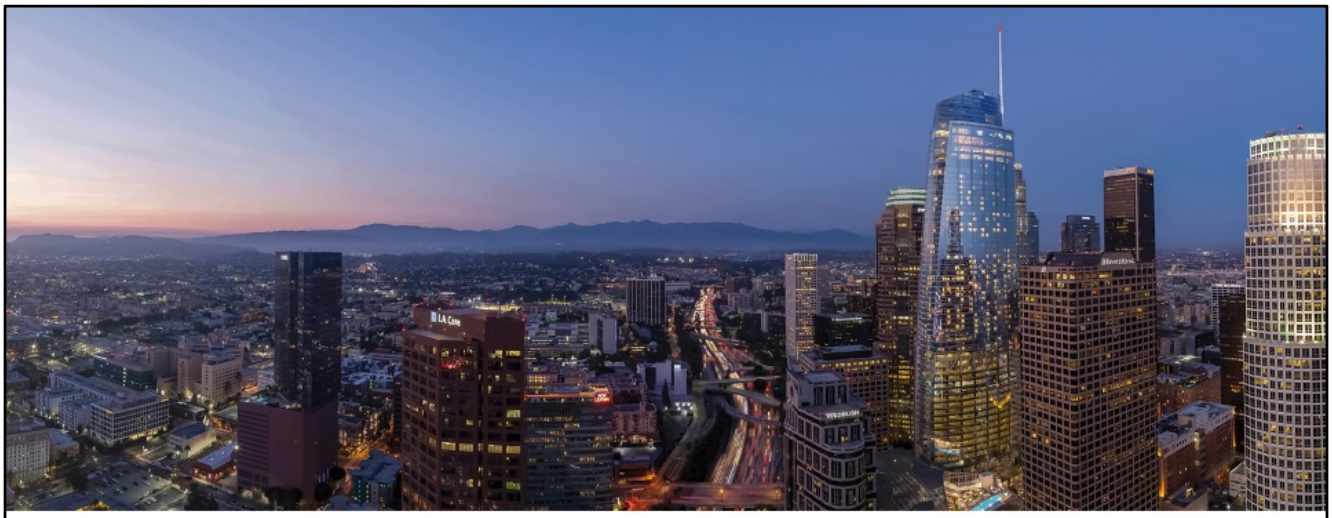
Overtime, the parking garage expansion joint covers failed due to material breakdown because of continued heavy traffic.

Solution:

Tampa International Airport
Consolidated Rental Car Garage

For this retrofit project, a one-piece parking expansion joint cover was used to accommodate material movement and eliminate the need for elastomeric concrete. Durability was further enhanced using a high-strength epoxy bedding sealed on each side with a urethane sealant. The result was a durable and watertight system that can withstand extensive wear.





Wilshire Grand Center

Los Angeles | CA
AC Martin

At 1,100 feet tall, the Wilshire Grand Center is the tallest building in California. With 73 stories, it features a 900-room InterContinental hotel, five restaurants, and multifloor, Class A office space. Confirmed WGC still holds tallest building title as of Aug 14, 2021.

Source: https://constructionreviewonline.com/biggest-projects/wilshire-grand-center-the-tallest-building-in-california-usa/

Photos:
WG-01Panorama_2017-0809-SMALL-ACMartin_edited

Challenge:

With unprecedented height built on such seismically sensitive ground, design challenges were considered insurmountable. Structural integrity could not waver to ensure this visually stunning building would withstand a potential seismic event.

Solution:

Floor-to-ceiling glass panels, a cascade glass skylight above the entrance, and a curved glass atrium were part of the captivating design that required extensive engineering. Collaboration between design, engineering, and local regulatory agencies was required to master this feat of performance, beauty, and safety.

The expansion joint selected was one that could accommodate that kind of movement and incorporate infills to achieve the design intent of the architect.

A seismic expansion joint system was custom fabricated to meet the project's complex design requirements and support unpredictable structural shifts.

Conclusion

- Expansion joint cover systems are a vital component to building resiliency and occupant safety.
- Size, material, and placement are dependent on the movement criteria of each unique building determined by the structural engineer.
- Early selection/specification with the manufacturer and collaboration with the structural engineer and installer can contribute to proper system integration.
- Faults within the expansion joint cover system can pose risks to occupant safety, allow moisture intrusion, and disrupt fire containment systems. Some scenarios – especially those associated with seismic events and extreme weather – can contribute to structural failure.

Salesforce Transit Center

Construction Specialties

Acrovyn® Wall Protection + Doors I Acrovyn® Wall Covering + Panels

Architectural Louvers I Architectural Grilles + Vision Barriers I Cubicle Curtains + Tracks I Entrance Mats + Grids

Expansion Joint Covers I Explosion + Pressure Relief Vents I Fire + Smoke Vents I Sun Controls