BUILDING ENGINEERING AT AECOM

In addition to comprehensive structural and MEP services, AECOM's building engineers provide specialty expertise in high-performance buildings, fire protection, IT/communications/security, blast protection, commissioning, seismic resilience and sustainability. Through integrated practice, holistic thinking, and a fresh approach to each project, we find innovative solutions to the complex technical challenges of buildings that serve exceptionally demanding functional requirements.

Our work reflects a primary commitment to making advances in sustainability that also reduce operational costs over the lifecycle of a building. Our designs are informed by an array of analytical tools and processes as well as the cost and construction knowledge available to us through the AECOM network. We serve our clients from the development of building concepts, through design to ensuring that a building operates as it was designed to.

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CASE STUDY

Seismic Resilience and Sustainability

INLAND EMPIRE TRANSPORTATION MANAGEMENT CENTER (IETMC), FONTANA, CALIFORNIA

The IETMC is an essential services facility managing highway and freeway conditions for Riverside and San Bernardino Counties in California.

BENEFITS

- **Ability to withstand a magnitude 7.5 earthquake**
- **LEED Gold minimum; target LEED Platinum**

Classified as an essential services facility by the California Building Design Code, the new Inland Empire Transportation Management Center must be able to continue operating during and after a catastrophic natural disaster—a serious challenge for a building located in the vicinity of three major seismic faults, one of which, the San Andreas, can subject it to an earthquake as high as magnitude 7.5 without warning.

AECOM's building engineers and architects undertook this challenge in concert, as well as the additional goal of designing the first LEED Platinum critical operations facility in the U.S. A high-performance building during normal operations, the resilient traffic management center will become the county's command post in the event of a major catastrophe.

The new 43,000 square-foot facility will replace two existing buildings that do not meet the requirements of California's Essential Services Facilities Act. The center will serve Caltrans District 8, the Inland Division of the California Highway Patrol (CHP) and the CHP's 9-1-1 Inland Communications Center.

The center manages highway and freeway conditions throughout the vast area of Riverside and San Bernardino Counties, stretching in the east to the Arizona and Nevada state lines, and to the west bordering Los Angeles and Orange Counties. Riverside and San Bernardino Counties are the fastest growing counties in the state, and the need to relieve traffic congestion is rapidly mounting.

A facility that can operate during and after a magnitude 7.5 earthquake

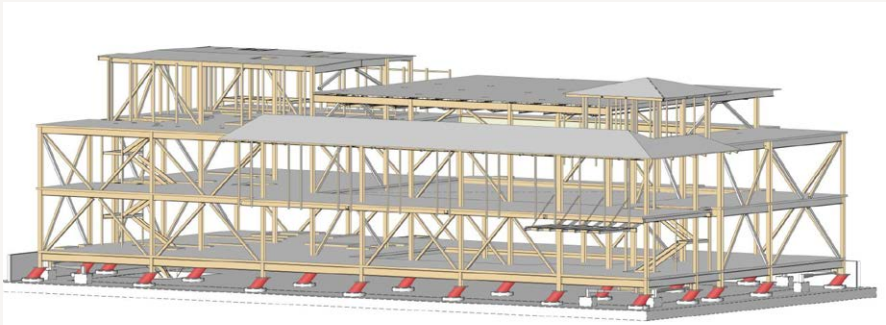
A base isolation system would provide the facility with seismic resilience by allowing the building to move on top of its foundation, absorbing seismic energy without sustaining structural damage or interruption of its utilities and complex telecommunications systems.

The first step in designing a base isolation system was to determine the site-specific seismic demand through a response spectra developed using a probabilistic seismic hazard approach. While this was underway, the structural team worked with other disciplines and client to determine the building layout that would satisfy the client's requirements and allowed for effective base isolation. An isolator layout was selected to balance the structural gravity loads accordingly.

Based on the building's massing, which was in part modeled in 3D BIM, it was determined that the base isolation system should consist of 31 natural rubber base isolators mounted in a crawl space beneath the building, in conjunction with eight viscous fluid dampers at the building's corners. The isolators allow the building to move horizontally up to 26 inches in any direction. The dampers mitigate movement of the building under normal conditions and absorb the force of a major seismic event.

Because each isolator was a uniquely designed component and the design process involves material property assumptions, it was necessary to have a prototype production and testing program that would meet the requirements set out by the California Building Code. The dampers were tested as well, and both components of the system proved that the design solution should be able to withstand a seismic event within the range predictable for the building's location.

One of the challenges faced by the design team was to accommodate seismic movement in the electrical cables, gas pipes, sewer pipes and other complex systems. For instance, the operations center employs computer and communications technology to gather and process real-time data from permanently placed sensors and cameras along the state highway system. The building's complete 3D BIM model helped the team to design a solution for the movement within all of these systems.



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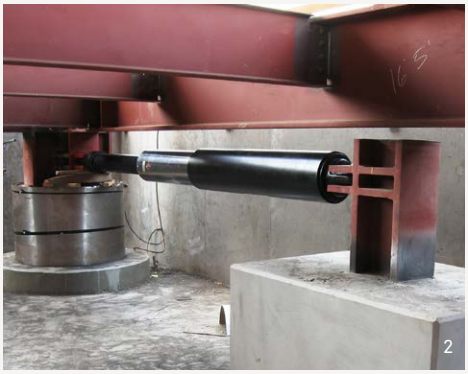

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ENGINEERING SERVICES

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- MEP
- Seismic
- Fire protection
- IT/Communications
- High-performance buildings group

OTHER SERVICES

- Architecture
- Landscape architecture
- Interior design
- Programming
- LEED consulting

The first LEED Platinum critical operations facility

The IETMC will achieve a LEED Gold certification at minimum. LEED Platinum is a possibility that could be achieved by the installation of a 500kW solar array adjacent to the building.

The natural rubber base isolators—a key part of the seismic system—contributed significantly to the sustainable performance of the building by providing over six percent of the total construction material cost from rapidly renewable sources.

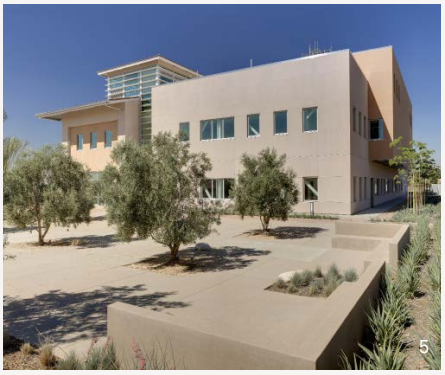
The building achieved construction waste management of over 75 percent and utilized construction material that was over 24 percent recycled content, 11 percent of it from regional sources.

The facility achieves a 45 percent potable water reduction through the use of low-flow plumbing fixtures and native plants. The site's 100 percent retention of stormwater reduces any risk of flash flooding during heavy rains.

The IETMC achieves a 16 percent reduction in energy use. Due to the high energy demand of the essential services facility, this reduction (32 kBtu/sf/yr) equates to roughly 30 percent of the average energy consumed by a Southern California commercial office building.

Dimmable solartubes provide daylight within the main command center during non-critical periods. This is a first, as daylight is usually eliminated so that occupants can view monitors and other equipment. Under-floor air conditioning is used within the command center, with local control at each of the control desks.

A packaged, evaporative chiller is used as a robust, cost-effective solution that finds an optimal balance between the efficiency of a water-cooled system and the reduced weight of an air-cooled system, which is extremely important given the requirement to move up to two feet in any direction.



1 A prototype production and testing program verified that the building's structure could withstand the seismic energy absorbed by the base isolation system.

2 31 base isolators work in conjunction with eight viscous fluid dampers.

3 The building's design accomodates complex technological systems in a safe and comfortable workplace environment.

4 The facility becomes the county's command post in the event of a major catastrophe.

5 100 percent on-site stormwater retention is part of the building's sustainability program.