

# AVIATION



**70!**  
ANNIVERSARY

**miyamoto.** EARTHQUAKE +  
STRUCTURAL  
ENGINEERS



levators / Stalre



Elevators / Stalre

# miyamoto.

save lives, impact economies

Miyamoto International is a global earthquake + structural engineering and project management company providing critical services that sustain industries and safeguard communities around the world.

We are experts in high-performance engineering that reduces lifecycle costs and produces a positive net impact on a structure's operation. We assess the performance of structures to identify specific vulnerabilities, and prioritize solutions that limit business interruption and reduce property damage.

Built on decades of earthquake and structural engineering experience in the field, our expertise supports how clients address the economic, political, social, sustainability and resiliency challenges in earthquake risk reduction and post-disaster recovery and reconstruction.

Miyamoto offices are strategically located worldwide in earthquake-hazard regions to positively impact economies and save lives.

Sacramento  
San Francisco  
San Jose  
Los Angeles  
Orange County  
San Diego  
Reno  
Washington, D.C.  
Mexico  
Costa Rica  
Colombia  
Haiti  
Liberia  
Italy  
Turkey  
India  
Nepal  
Japan  
New Zealand

**make the world a better, safer place.**



Miyamoto International was the Structural Engineer for the design phase of Bob Hope Airport's Regional Intermodal Transportation Center (RITC), the first transportation hub in Southern California to serve trains, buses, cars and bikes. The three-story concrete and corrugated steel structure is home to a consolidated rental car facility, emergency response center and terminal services for airport shuttles and transit buses. The center includes more than 1,000 parking spaces and 11 car rental companies, four times the airport's former volume.

The 520,000-SF facility was built to withstand an 8.0-magnitude earthquake, serving as an emergency nerve center for rescue agencies from across the nation. Our "beyond code" design featured triple-pendulum bearing isolators to diffuse the rolling motion and absorb seismic energy.

RITC is topped by a red steel roof with solar panels. For egress and pedestrian safety, an elevated covered walkway shuttles passengers along a moving sidewalk to the central terminal area.

## Bob Hope Airport, Regional Intermodal Transportation Center

**LOCATION:**  
Burbank, CA

**YEAR:**  
2015

**CLIENT:**  
Burbank-Glendale-Pasadena Airport Authority (Owner)  
PGAL (Prime)

**CONSTRUCTION COST:**  
\$112 Million

**SCALE:**  
520,000 SF

### AWARDS

2014 ENGINEERING NEWS RECORD (ENR), CALIFORNIA BEST PROJECT AWARDS: AVIATION



Under the scope of the Regional Intermodal Transportation Center, Miyamoto International provided structural engineering services for a consolidated rental car center, enabling rental car operators that were previously dispersed off-site to reside

in one location. Our scope involved individual rental booths for Hertz, Avis, Thrifty and Budget, as well as the primary customer service center that accommodates 11 rental car companies. The new space provides four times the former capacity.

## Bob Hope Airport, Regional Intermodal Transportation Center, Rental Car Facility

**LOCATION:**  
Burbank, CA

**YEAR:**  
2015

**CLIENT:**  
Burbank-Glendale-Pasadena Airport  
Authority (Owner)  
PGAL (Prime)



## Bob Hope Airport, Regional Intermodal Transportation Center, Elevated Walkway

**LOCATION:**  
Burbank, CA

**YEAR:**  
2015

**CLIENT:**  
Burbank-Glendale-Pasadena Airport  
Authority (Owner)  
PGAL (Prime)

Miyamoto International was the design structural engineer for Bob Hope Airport's Regional Intermodal Transportation Center, also known as RITC. The heart of the project is a three level, 300,000-SF signature structure with a consolidated rental car facility, terminals for airport shuttle and transit

bus services and visitor parking. For egress and pedestrian safety, a 1400-foot-long elevated covered walkway with a people mover was constructed. The walkway provides a dedicated passageway from the consolidated rental car facility and ground transportation center to the central terminal area.



## Bob Hope Airport, Emergency Response Center

**LOCATION:**  
Burbank, CA

**YEAR:**  
2015

**CLIENT:**  
Burbank-Glendale-Pasadena Airport  
Authority (Owner)  
PGAL (Prime)

Within the scope of the Regional Intermodal Transportation Center, Miyamoto International was responsible for designing an Emergency Response Center (ERC), which is housed within the three-level, 520,000 SF structure. The center was built to remain elastic during an 8.0 magnitude earthquake, providing a safe location for regional emergency operations. In the event of such a cataclysmic temblor, Bob Hope Airport

is designed to become a hub for flying in, storing and distributing emergency supplies. With “seismic isolators” built like shock absorbers into its roughly 130 columns, each floor was designed to “roll” 30 inches from side to side without damaging the building. Miyamoto was specifically chosen for this project for our unmatched expertise in seismic engineering and our command of innovative technologies.



As part of the \$1.3 billion LAX Bradley West Expansion project, Miyamoto played a vital role in the design of the enabling projects. These projects needed to be completed before the new Bradley West Gates could start construction. The Miyamoto team evaluated the existing cable trays and designed new temporary emergency egress stairs.

Included in the scope was the rerouting of the fire alarm and communication systems into a separate building and the design of a temporary loading dock and bridge for easy removal of trash and replenishment of duty-free terminal retail shops.

## LAX Bradley West Enabling Projects

**LOCATION:**  
Los Angeles, CA

**YEAR:**  
2009

**CLIENT:**  
Fentress Architects  
Los Angeles World Airports

**CONSTRUCTION COST:**  
\$8 Million

**SCALE:**  
800,000 SF (new terminal)





When LAWA initiated a program to rehabilitate its outdated elevators at LAX, Miyamoto's vital role in the expansion and restoration included the modernization of seven parking garages, seven parking structure elevator enclosures and seven exit stairwells and pedestrian finishes to fit the parking structure's aesthetics. The

scope of work included completing two new elevators in the terminal areas, new shaft extensions for the elevators, new structural steel framing to provide support for the new facade at the stairs and elevator shafts and converting the existing helipad roof to parking.

## LAX Parking Garage and Terminal Elevator Replacements

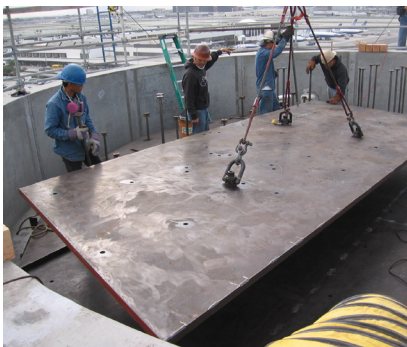
**LOCATION:**  
Los Angeles, CA

**YEAR:**  
2017

**CLIENT:**  
Base Architecture

**CONSTRUCTION COST:**  
\$40 Million

**SCALE:**  
7 Parking Garages  
7 Elevator Towers  
7 Exit Stairwells



The futuristic LAX Theme Building, a Space Age icon at Los Angeles' airport, was at one time in grave danger should a medium to large earthquake strike Los Angeles. Miyamoto engineered an innovative seismic retrofit solution by adding 1.2 million pounds of steel mass at the roof cavity, which is supported by base isolators and dampers. This approach created a tuned-mass damper to reduce seismic demand. This design eliminated the need for a conventional

seismic upgrade and preserved the historical integrity of the building. We used advanced analysis and the latest engineering technologies to implement a cost-effective and elegant seismic retrofit solution. This High-Performance earthquake engineering approach saved the airport an estimated \$4 million in construction costs over traditional seismic retrofits. Miyamoto acted as an expert structural sub-consultant to VCA Engineers.

## LAX Theme Building, Seismic Retrofit

**LOCATION:**  
Los Angeles, CA

**YEAR:**  
2010

**CLIENT:**  
Los Angeles World Airports  
Tower General Contractors  
Gin Wong and Associates  
VCA Engineering

**CONSTRUCTION COST:**  
\$12.3 Million

**SCALE:**  
31,000 SF

**AWARDS:**  
2010 TRUSTEES AWARD FOR EXCELLENCE IN HISTORIC PRESERVATION  
2010 CALIFORNIA PRESERVATION FOUNDATION AWARD IN PRESERVATION TECHNOLOGY CATEGORY  
2010 STRUCTURAL ENGINEERS ASSOCIATION OF CALIFORNIA, AWARD OF EXCELLENCE IN ALTERATION/RETROFIT CATEGORY



Miyamoto provided services for a feasibility report regarding partial demolition and seismic analysis of an existing American Airlines hangar. The structure is frequently referred to as the TWA hangar and it is located at Los Angeles International Airport. The study and concept design provides options for the removal of the east half of the

hangar and retrofit for the remainder of the building. The primary user of the west hangar and central concrete core is Qantas, who performs daily maintenance on its Boeing 747 fleet. The specific locations of the retrofit in the west hangar allowed Qantas to remain operational during the retrofit construction.

## LAX Airport, TWA Hangar Feasibility Study

**LOCATION:**  
Los Angeles, CA

**YEAR:**  
2009

**CLIENT:**  
Los Angeles World Airports

**CONSTRUCTION COST:**  
\$6 Million



## LAWA Earthquake Business Interruption Loss Control Program

**LOCATIONS:**

Los Angeles International Airport  
 LA/Ontario International Airport  
 Van Nuys Airport

**YEAR:**

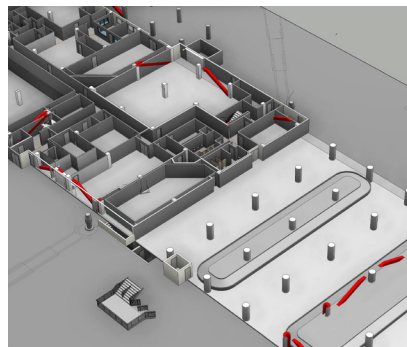
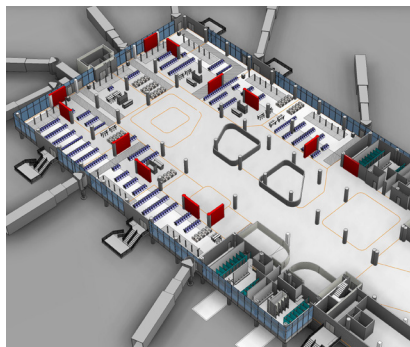
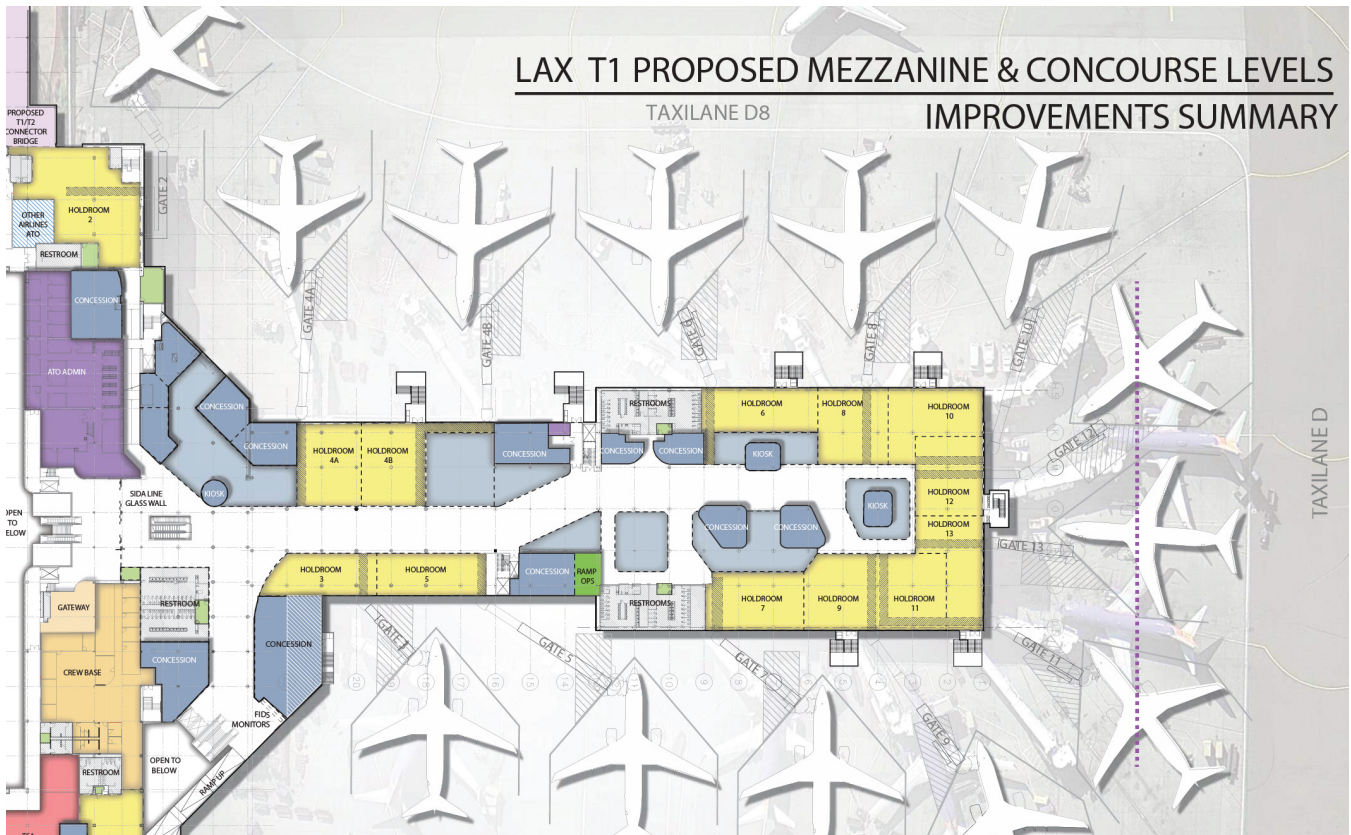
2012

**CLIENT:**

Los Angeles World Airports

Miyamoto developed a tailored program to determine the existing risk to LAWA from earthquakes. Our risk-improvement program brings expected business/service interruptions to manageable levels, therefore maximizing continuity of operations following an earthquake. The scope of work included the three airports owned and operated by LAWA, the Los Angeles International Airport

(LAX), the LA/Ontario International Airport (ONT) and the Van Nuys Airport (VNY). Miyamoto conducted a rapid risk assessment of all key facilities, examining and ranking all on-site and off-site facilities in order of decreasing risk and importance to operations. We will also develop a long-term program to be fully integrated with long-range development plans for LAWA.



Southwest Airlines underwent a complete development program to modernize Terminal 1 at Los Angeles International Airport (LAX). Originally constructed in 1982, the modernization will include extensive renovation, reconfiguration and refinishing of the interior. The program will include a complete interior renovation to improve security checkpoints, refresh

passenger waiting areas, refurbish the baggage claim area, construct new passenger boarding bridges, renovate the terminal lobby, and seismic renovation to the current code. The estimated construction cost is \$400 million. Miyamoto also provided structural engineering services to support the seismic section of the Project Definition Booklet.

## LAX Airport, Southwest Terminal 1 Modernization

**LOCATION:**  
Los Angeles, CA

**YEAR:**  
2013

**CLIENT:**  
Southwest Airlines  
RS&H  
PGAL

**CONSTRUCTION COST:**  
Est. \$400 Million

**SCALE:**  
375,000 SF



## Los Angeles International Airport, Police Headquarters

**LOCATION:**  
Los Angeles, CA

**YEAR:**  
2006

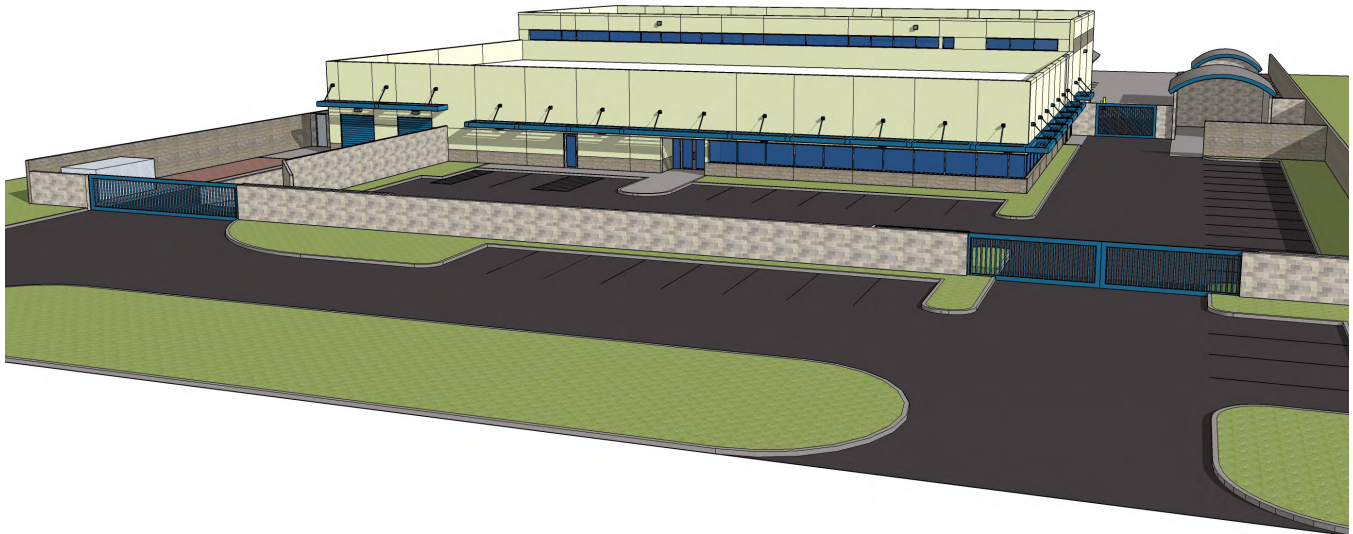
**CLIENT:**  
Gin Wong Associates

**CONSTRUCTION COST:**  
\$34.6 Million

**SCALE:**  
83,300 SF

Miyamoto provided Los Angeles World Airports (LAWA) with a series of options to retrofit the existing Delta Airlines office and hangar structure. This included adding 83,300 SF of office space in the existing hangar, currently unusable as a hangar facility. Miyamoto brought value to the client by using performance-based engineering to upgrade this essential

facility building to performance level. Some of the latest technologies, such as buckling restrained brace frames or fluid viscous dampers (shock absorbers), were options provided. These options allowed for minimally invasive retrofit work in the office space and excellent performance in an earthquake, at a cost of \$144 per square foot for an essential facility.



## John Wayne Airport Maintenance Building, Design Build

**LOCATION:**  
Costa Mesa, CA

**YEAR:**  
2013

**CLIENT :**  
Ware Malcomb

**SCALE:**  
24,882 SF

Miyamoto designed a new maintenance facility for John Wayne Airport. This structure is a 24,882-SF single-story concrete tilt-up building with high low bays. Within this facility

there is a vehicle wash station, trash enclosure structure, parking canopies, CMU fence walls and a concrete ramp to building.



## Jorge Chavez International Airport

**LOCATION:**  
Lima, Peru

**YEAR:**  
Estimated 2019

**CLIENT:**  
Jorge Chavez International Airport

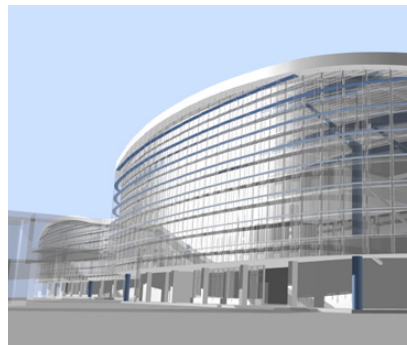
**CONSTRUCTION COST:**  
\$900 Million

**SCALE:**  
250,000 Square Meters

Miyamoto provided expert consultancy services related to the design of the new terminal at the Jorge Chavez International Airport in Lima, Peru. Miyamoto's services included peer review of the schematic structural design of the base-isolated terminal performed by RS&H and Cosapi Consortium. Upon completion of the review, Miyamoto presented its

findings to Lima Airport Partners (LAP) in Lima, Peru. Following Miyamoto's recommendation, the conceptual design was considered complete by LAP. The airport is located in an area of high seismicity. The objective of the base-isolation project is immediate/continued occupancy after a design-level earthquake.





Built in a seismically active area, this new terminal at the Otopeni Airport in Bucharest is a sophisticated combination of a 3,500-ton steel structure and concrete bracing walls. The upper level is covered with 41-metre-span undulating box section girders supported by tubular volutes resting on solid steel columns. The

efficiency achieved with precise works prefabrication of the large components permitted completion of the entire structure in less than four months. The design clarity of this white painted structure provides a calm and friendly atmosphere at this busy location. The project earned the ECCS Steel Design award in 2011.

## The Finger Building at Otopeni International Airport

**LOCATION:**

Bucharest, Romania

**YEAR:**

2010

**CLIENT:**

Technical S.P.A.

**GENERAL CONTRACTOR:**

Romairport SRL (Astaldi Group)

**GENERAL DESIGN:**

Technital S.P.A.

**CONSULTANT FOR STRUCTURAL DESIGN:**

Ing. Boerio, Miyamoto International, Milan

**CONSTRUCTION COST:**

60 Million €

**SCALE:**

17,000 Square Meters

**AWARDS:**

EUROPEAN STEEL DESIGN AWARDS 2011



## Breda Hangar at Milan Linate Airport Vulnerability Assessments

**LOCATION:**  
Milano, Italy

**YEAR:**  
2010

**CLIENT:**  
SEA - Aeroporti Milanesi, S.P.A.

**COST:**  
1.8 Million Euro

Miyamoto provided the seismic assessment for the “Breda” hangar a steel structure built in 1936, that is considered to be one of the best steel-style buildings in Italy. The roof is supported by two 120-meter truss beams, which are supported by four columns. Although Milan is considered a low-risk seismic area, this building is pivotal in civil protection in case of

an earthquake and therefore a seismic assessment had to be performed. During the first phase, the steel structure was studied, with the second phase being the assessment of the steel structure and the two RC frames. The testing of the materials and dynamic identification were performed for the computer model that carried out the assessment.



## Multi-Story Car Park at Milan Linate International Airport

**LOCATION:**  
Milan, Italy

**YEAR:**  
2010

**CLIENT:**  
SEA -- Aeroporti di Milano

**CONSTRUCTION COST:**  
14.000.000 €

This preliminary structural design of a multi-story carpark inside located at the Milan Linate International Airport spreads over six floors. It is the biggest

car park in Milan and is directly connected to the terminal by two steel bridges.



## Delhi Airport ATC Tower

**LOCATION:**  
New Delhi, India

**YEAR:**  
2015

**CLIENT:**  
Delhi Airport

**CONSTRUCTION COST:**  
\$50 Million

**SCALE:**  
101.9 Meters Tall

The new ATC tower at Indira Gandhi International Airport is unique in more ways than one and has already become an icon for the people in Delhi. It stands 101.9 meters tall with a slenderness ratio of nearly 1:14. It is the first project in India to have a Tuned Mass Damper, which is positioned at approximately 91 meters high. What makes the Delhi ATC the most unique in the world is that it has a constantly changing shape as it rises from the ground all the way to the roof. While the tower outline moves inwards

along the X-direction, it simultaneously moves outwards in the Y-direction. The top two levels of the tower are steel; the rest of the tower is built using high-strength reinforced concrete. The tower rests on a raft 3.0 meters deep and is supported by 32 piles 1.5 meters in diameter thick. A glass lift located at the center of the tower provides a 360-degree view of the Delhi skyline. The design team was responsible for the entire design and also post-contract services.



Miyamoto International provided the structural investigation and developed the repair and retrofit strategy for this essential transportation facility for the country of Haiti. Fully funded and supported by the Haitian government, this iconic project serves as a significant milestone to the country's recovery efforts. Miyamoto partnered with MTPTC (Ministry of Public Works, Transportation, and Communications) and Panexus to develop and implement the structural retrofit of the airport per the 2009 International

Building Code to comply with essential facility requirements. The project includes extensive new engineered reinforced concrete shear walls and collector elements throughout the entire facility to provide seismic resistance. To ensure quality of work Miyamoto provided 24-hour on-site continuous construction surveillance. The existing airport structures posed unique construction challenges; Miyamoto worked closely with Panexus to provide construction sequencing and guidance.

## Toussant Louverture International Airport

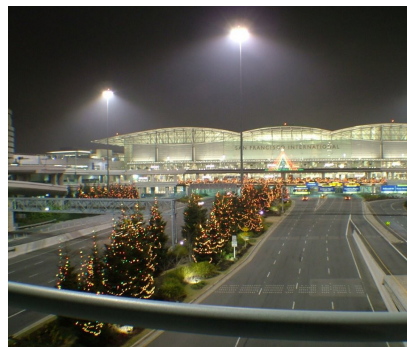
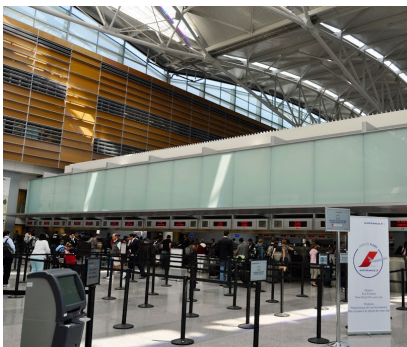
**LOCATION:**  
Port-Au-Prince, Haiti

**YEAR:**  
2012

**CLIENT:**  
Autorite Aeroportuaire National

**CONSTRUCTION COST:**  
Approximately \$7.5 Million

**SCALE:**  
16,338 Square Meters  
175,860 SF



As the centerpiece of San Francisco International Airport's expansion project, the International Terminal is a striking symbol of the city, considered the West Coast's "Gateway to the Pacific Rim." The five-story structure has expansive interiors, 80-foot-tall columns and 700-foot-long roof trusses—all while engineered to the highest seismic-safety requirements ever imposed on an American airport terminal to keep it operational in the event of a major earthquake. The design incorporated long-span double cantilever roof trusses with lower floors supported on a base-isolation system

incorporating 267 friction pendulum isolators designed by structural engineer Dr. Navin Amin. When built, it was the largest isolated building in the world. The friction pendulum bearings will provide a three-second isolated period and reduce earthquake force demands on the building by 70 percent. Each bearing can displace up to 20 inches in any horizontal direction while supporting building and seismic loads of up to 6 million pounds. Seismic isolation was the most cost-effective solution for the desired seismic performance.

## San Francisco International Airport - International Terminal \*

**LOCATION:**

San Francisco, CA

**YEAR:**

2000

**CLIENT:**

San Francisco International Airport

**CONSTRUCTION COST:**

\$550 Million

**SCALE:**

1.8 Million SF

\*Staff Experience

**AWARDS:**

2003 GRAPHIC DESIGN AWARD, GRAPHICS INTERNATIONAL

2002 EXCELLENCE IN STRUCTURAL ENGINEERING: AWARD OF MERIT, STRUCTURAL ENGINEERS ASSOCIATION OF ILLINOIS

2002 NATIONAL HONOR AWARD FOR ARCHITECTURE, AMERICAN INSTITUTE OF ARCHITECTS (AIA)

2002 NATIONAL HONOR AWARD FOR INTERIOR ARCHITECTURE, AMERICAN INSTITUTE OF ARCHITECTS (AIA)



Photo courtesy of San Diego International Airport

The San Diego International Airport Rental Car Center is a state-of-the-art rental car facility and is the largest concrete building in San Diego. This massive 4-story structure includes a multi-floor quick turnaround facility, rental car ready return, open customer service center with atriums and restaurant space. The building is approximately 1,400 feet long and includes eight seismically separate buildings. The construction involved placement of approximately 100,000 cubic yards of concrete and 25 million pounds of rebar in a 12-month period.

The rental car center allows the airport to consolidate rental car operations, including 16 rental car brands to a

single location. The project greatly reduces traffic congestion on Harbor Drive by reducing the number of shuttles and providing transportation to the airport on an internal road with alternative fuel shuttles. The project also includes three public art displays and bio-swale ponds.

Lisa Bridge was a member of the design team that provided the seismic design of the biaxial special reinforced concrete moment frame system and structural steel penthouse, and regularly participated in structural observations that were performed up to four times per week during the fast-paced construction schedule.

## San Diego International Airport, Rental Car Center\*

**LOCATION:**  
San Diego, CA

**YEAR:**  
2016

**CLIENT:**  
San Diego County Regional Airport Authority  
Demattei Wong Architecture  
WSP|Parsons Brinckerhoff

**CONSTRUCTION COST:**  
\$316 Million

**SCALE:**  
2 Million SF  
5,400 rental car capacity

\*Staff experience

## AVIATION EXPERIENCE

**Burbank Airport, Regional Intermodal Transportation Center (RITC)**  
Burbank, CA

**Burbank Airport, Rental Car Facility**  
Burbank, CA

**Burbank Airport, Elevated Walkway**  
Burbank, CA

**Burbank Airport, Emergency Response Center**  
Burbank, CA

**Delhi Airport, ATC Tower**  
New Delhi, India

**Fresno Air Terminal**  
Fresno, CA

**John Chavez**  
Lima, Peru

**John Wayne Airport, Maintenance Building, Design-Build**  
Costa Mesa, CA

**LAWA, Earthquake Business Interruption Loss Control Program**  
Los Angeles, CA

**LAWA, LAX Theme Building, Seismic Retrofit**  
Los Angeles, CA

**LAX Bradley West Enabling Projects**  
Los Angeles, CA

**LAX Airport, Parking Garage & Terminal Elevator Rehabilitation**  
Los Angeles, CA

**LAX Airport, Southwest Terminal I Modernization**  
Los Angeles, CA

**LAX Airport, TWA Hangar Feasibility Study**  
Los Angeles, CA

**LAX Airport, Police Headquarters**  
Los Angeles, CA

**LAX People Mover System, Maintenance Facility Stations**  
Los Angeles, CA

**Madera Municipal Airport Tee Hangar Buildings**  
Madera, CA

**Otopeni International Airport, Finger Building**  
Bucharest, Romania

**Milan Linate Airport, Breda Hangar**  
Bucharest, Romania

**Milan Linate Airport, Car Park**  
Bucharest, Romania

**Toussaint Louverture International Airport**  
Port-au-Prince, Haiti



LAX Airport Theme Building  
Los Angeles, CA



Toussaint Louverture International Airport  
Port-au-Prince, Haiti





[miyamotointernational.com](http://miyamotointernational.com)

© 2018 Miyamoto International, Inc.

Sacramento | San Francisco | San Jose | Los Angeles | Orange County | San Diego | Reno | Washington, D.C.  
Mexico | Costa Rica | Colombia | Haiti | Liberia | Italy | Turkey | India | Nepal | Japan | New Zealand