miyamoto. ENGINEERS + CONSTRUCTION CONSULTANTS

Aviation

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Global engineering knowledge combined with local expertise.

Our **Structural and Geotechnical** engineering teams are focused on delivering better outcomes through project tailored solutions.

We integrate structural, geotechnical and performance-based engineering to optimise the structural performance of buildings and provide sustainable solutions that reduce construction costs whilst maximising safety and investment value.

With offices across New Zealand and the strength of a global network, our integrated teams bring a multidisciplinary approach to every project, delivering design solutions that balance cost, innovation, advanced technology, and risk management.

Our clients benefit from a unified team of structural and geotechnical engineers who combine local expertise with global knowledge across a wide range of industry sectors and have a deep expertise in earthquake-resilient engineering.

We operate in over 30 strategic locations worldwide.

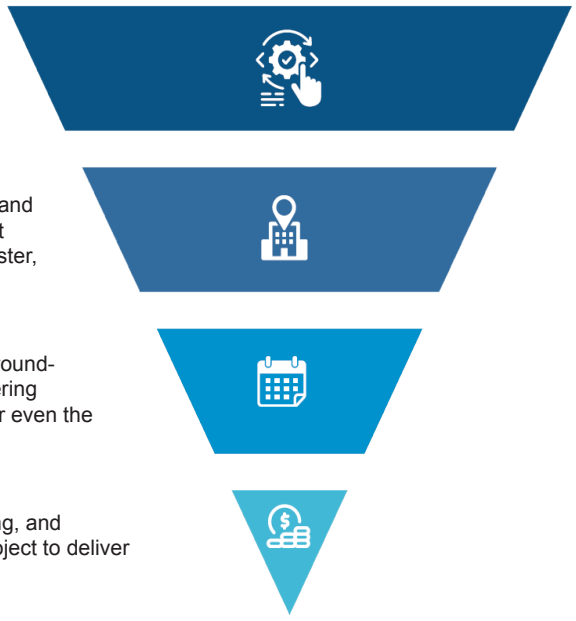
Our Approach

Comprehensive Services
Our optimised designs minimise unnecessary costs while ensuring the required structural performance is achieved.

Proven Track Record
We have access to quick testing labs and efficient numerical modelling tools that enable us to deliver retrofit designs faster, reducing overall project duration.

Reduced Project Time-lines
Our customised solutions using our ground-breaking Performance-based Engineering approach reduces the delivery time for even the most challenging of projects.

Reduced Project Costs
We combine modelling, physical testing, and design approaches unique to each project to deliver optimised, cost-effective designs.



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Technical Capabilities

- Design Optimisation.
- Advanced mathematical simulation including Non-linear Time-history analysis and Finite Element Analysis.
- Performance-based Wind Design.
- Structural health monitoring and lifecycle asset management.
- Soil-Structure Interaction.
- Carrying out experimental studies to validate the mathematical simulation.
- Low damage design to build resilient structure.

Industry Knowledge

- Aviation
- High-rise Buildings
- Commercial & Mixed-Use
- Residential
- Education Facilities
- Aged Care Facilities
- Ports, Harbours & Marinas
- Seismic Strengthening
- Building Re-purposing
- Infrastructure
- Disaster Response
- International Development
- Humanitarian Projects


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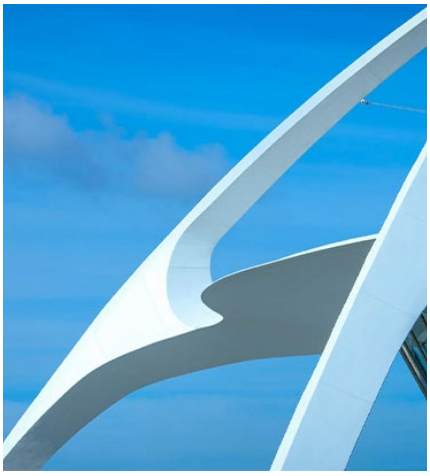
PROJECTS

Los Angeles International Airport, Theme Building, Seismic Retrofit



Location: Los Angeles, CA

Year: 2010

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

Cost: $12.3 Million

Scale: 31,000 SF

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.

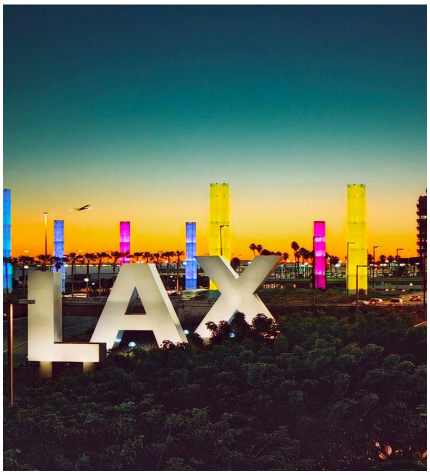
Awards:

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

Los Angeles International Airport, Police Headquarters



Location: Los Angeles, CA

Year: 2006

Client: Gin Wong and Associates

Cost: $34.6 Million

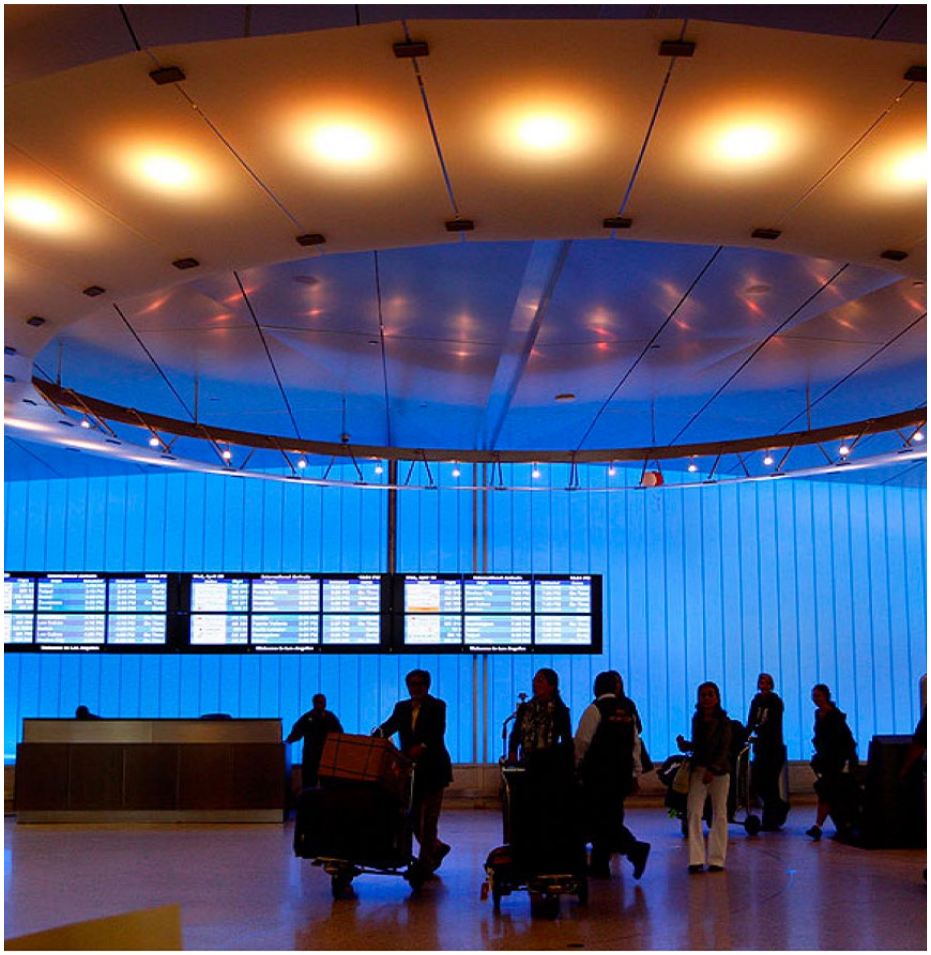
Scale: 83,300 SF

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.

Los Angeles International Airport, Bradley West Enabling Projects



Location: Los Angeles, CA

Year: 2009

Client: Fentress Architects
Los Angeles World Airports

Cost: $8 Million

Scale: 800,000 SF (new terminal)

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 re-routing 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 merchandise in the Tom Bradley terminal retail shops.

Los Angeles International Airport, TWA Hangar Feasibility Study

Location: Los Angeles, CA

Year: 2009

Client: Los Angeles World Airports

Cost: $6 Million

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.

Los Angeles International Airport, Parking Garage and Terminal Elevator Replacements

Location: Los Angeles, CA

Year: 2016

Client: Base Architecture

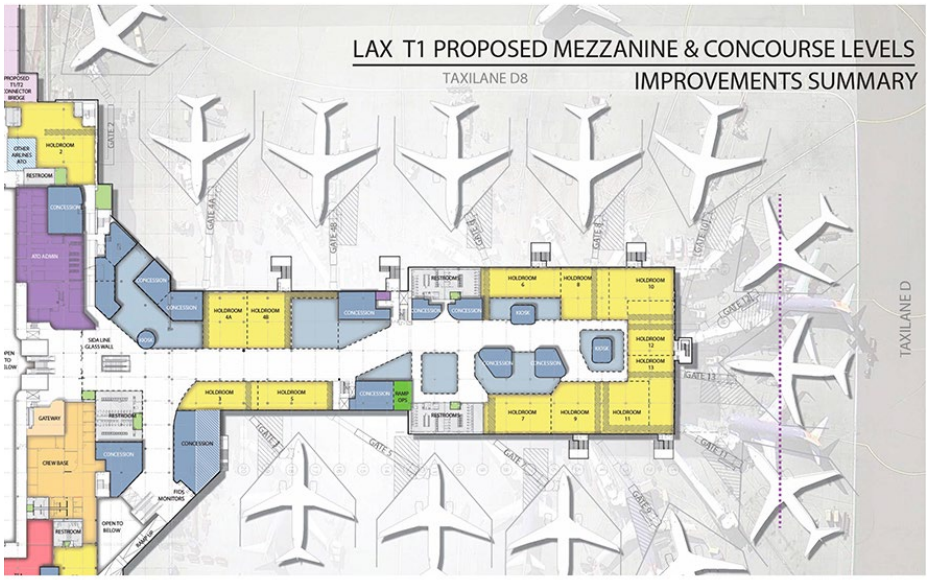
Cost: $40 Million

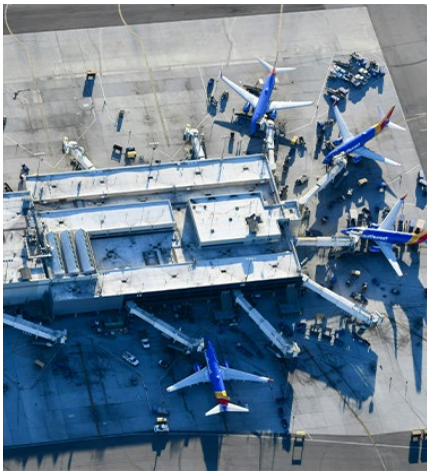
Scale: 7 Parking Garages
7 Elevator Towers
7 Exit Stairwells

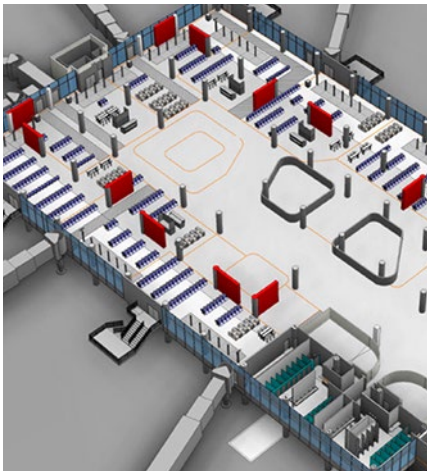
When LAWA initiated a program to rehabilitate its outdated elevators at LAX, Miyamoto's vital role in the expansion and restoration included the modernization of seven parking garages, seven parking structure elevator enclosures and seven exit stairwells and pedestrian finishes to fit the parking structure's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

The scope of work includes 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.

Los Angeles International Airport, Southwest Terminal 1 Modernisation







Location: Los Angeles, CA

Year: 2013

Client: Southwest Airlines, RS&H, PGAL

Cost: $400 Million (Est)

Scale: 375,000 SF

Southwest Airlines underwent a complete development program to modernize Terminal 1 at Los Angeles International Airport (LAX).

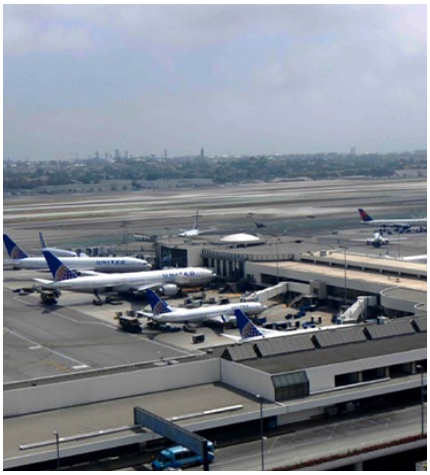
Originally constructed in 1982, the modernisation includes extensive renovation, reconfiguration and refinishing of the interior.

The program includes 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 was $400 million.

Miyamoto also provided structural engineering services to support the seismic section of the Project Definition Booklet.

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

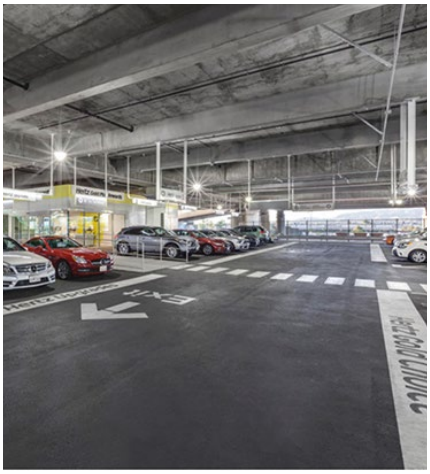
Miyamoto developed a tailored program to determine the existing risk to LAWA from earthquakes. Our risk improvement program brings expected business/service interruptions to manageable levels, therefore maximizing continuity of operations following an earthquake.

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 also developed a long-term program to be fully integrated with long-range development plans for LAWA.

Bob Hope Airport, Regional Intermodal Transportation Center



Location: Burbank, CA

Year: 2015

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

Cost: $112 Million

Scale: 520,000 SF

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.

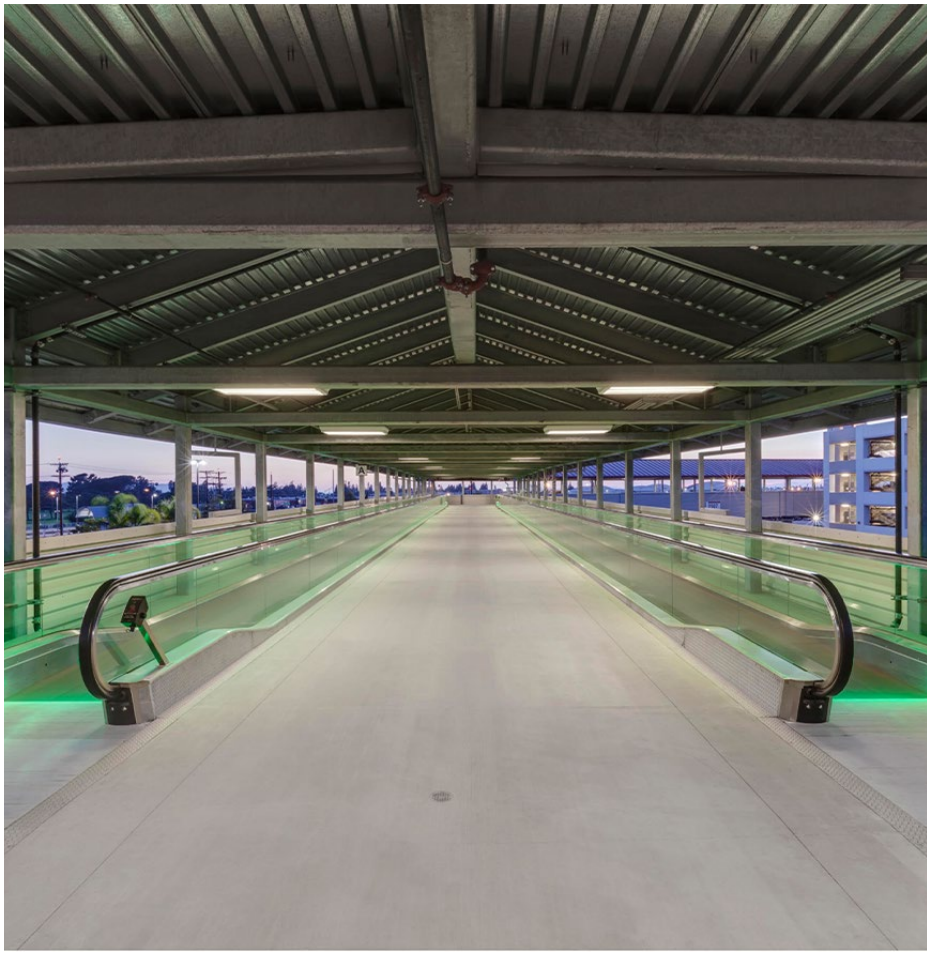
The three-storey concrete and corrugated steel structure is home to a consolidated rental car facility, emergency response center and terminal services for airport shuttles and transit buses. The center includes more than 1,000 parking spaces and 11 car rental companies, four times the airport's former 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.

Awards

2014 Engineering News Record (ENR), California best project awards: aviation

Bob Hope Airport, Regional Intermodal Transportation Center, Elevated Walkway



Location: Burbank, CA

Year: 2015

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

Miyamoto 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)

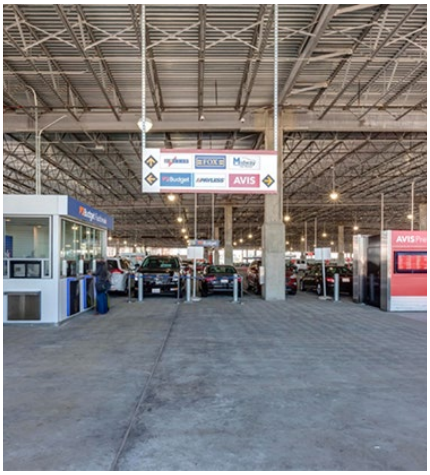
Within the scope of the Regional Intermodal Transportation Center,

Miyamoto 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 withstand an 8.0 magnitude earthquake, providing a safe location for regional emergency operations. In the event of such a cataclysmic temblor, Bob Hope Airport could 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.

Miyamoto was specifically chosen for this project for our unmatched expertise in seismic engineering and our command of innovative technologies.

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



Location: Burbank, CA

Year: 2015

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

Under the scope of the Regional Intermodal Transportation Center,

Miyamoto 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.

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 the building.

Toussant Louverture International Airport

Location: Port Au Prince, Haiti

Year: 2012

Client: Autorite Aeroportuaire National

Cost: $7.5 Million (Est.)

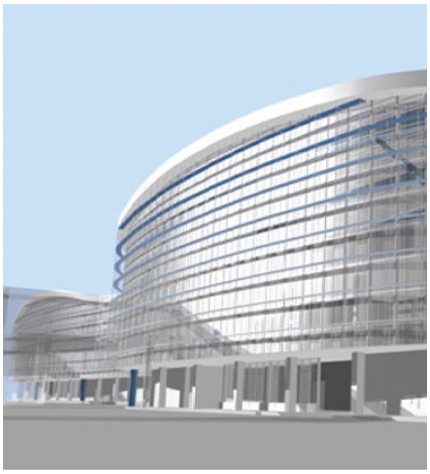
Scale: 16,338 Square Meters
175,860 SF

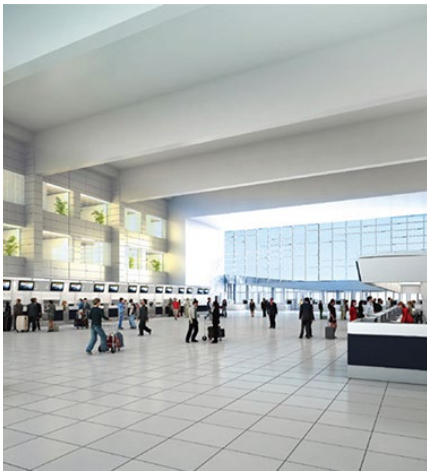
Miyamoto provided the structural investigation and developed the repair and retrofit strategy for this essential transportation facility for the country of Haiti. Fully funded and supported by the Haitian government, this iconic project serves as a significant milestone to the country's recovery efforts.

Miyamoto partnered with MTPTC (Ministry of Public Works, Transportation, and Communications) and Panexus to develop and implement the structural retrofit of the airport as 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.

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.

Structural Design Consultant:
Ing. Boerio, Miyamoto, Milan

Cost: 60 Million (EUR)

Scale: 17,000 Square Meters

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.

Awards:

ECCS European Steel Design Award 2011.

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STRATEGIC LOSS CONTROL PROGRAM
AIRPORT RISK ASSESSMENT

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Airport Earthquake Risk Assessment & Business Continuity Control Program

Project Overview

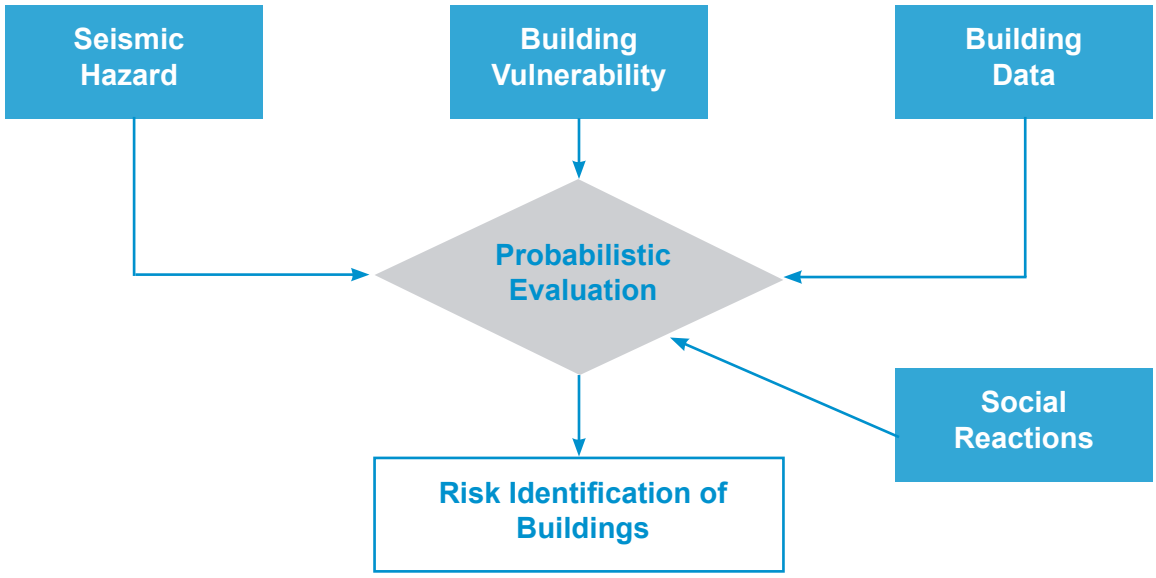
Building codes address life safety only they do not systematically address earthquake risk, operational performance, continuity of operation nor functionality of critical systems.

Miyamoto has developed a tailored program to determine the potential risk that a large metropolitan airport could face from a major seismic event.

Purpose

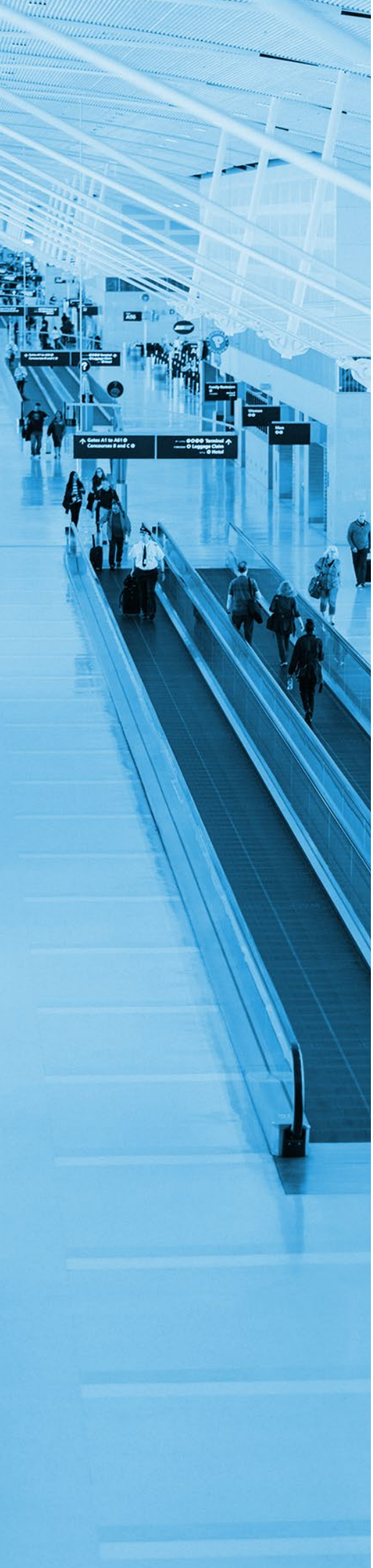
The overall goal of this program is to reduce damage and minimise business interruption following the next major earthquake, and to mitigate risk and bring expected business and service interruptions to a manageable level.

Seismic Risk Identification



Risk Options

1. Do Nothing
2. Transfer the risk through insurance
3. Reduce the risk to an acceptable level
4. Balance 1,2,3



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Scope

Task 1 – Initial Assessment

To gather essential information and identify areas requiring immediate attention and perform a rapid visual assessment of all on-site and associated offsite facilities that would impact the operations if rendered redundant. Important steps include:

1. **Establish expectations regarding:**
   - Acceptable losses and disruption.
   - Acceptable earthquake risk.
   - Required performance during and after an event.
2. **Identify the ranking of all issues related to operations and safety during and after a seismic event:**
   - Post event recovery and interactions with the local infrastructure and urban environment.
   - Identify a back-up airport (commercial or military).
3. **Conduct a rapid risk audit of the airport:**
   - Examine off-site and on-site issues.
   - Identify critical operations and the facilities they require.
   - Perform critical systems and infrastructure audit.
   - Identify and prioritise major vulnerabilities.

Task 2 – Risk Audit

- Establish a priority list that ranks critical and important facilities and structures.
- Perform detailed risk audits and loss estimates of selected critical/ priority operations and facilities.
- Collect additional information for critical offsite utilities.
- Identify major vulnerabilities and prioritise.
- Implement design and construction for the short-term B.I. Loss-Control Program to fix the most vulnerable and critical operations and facilities.

Task 3 – Summarise Results

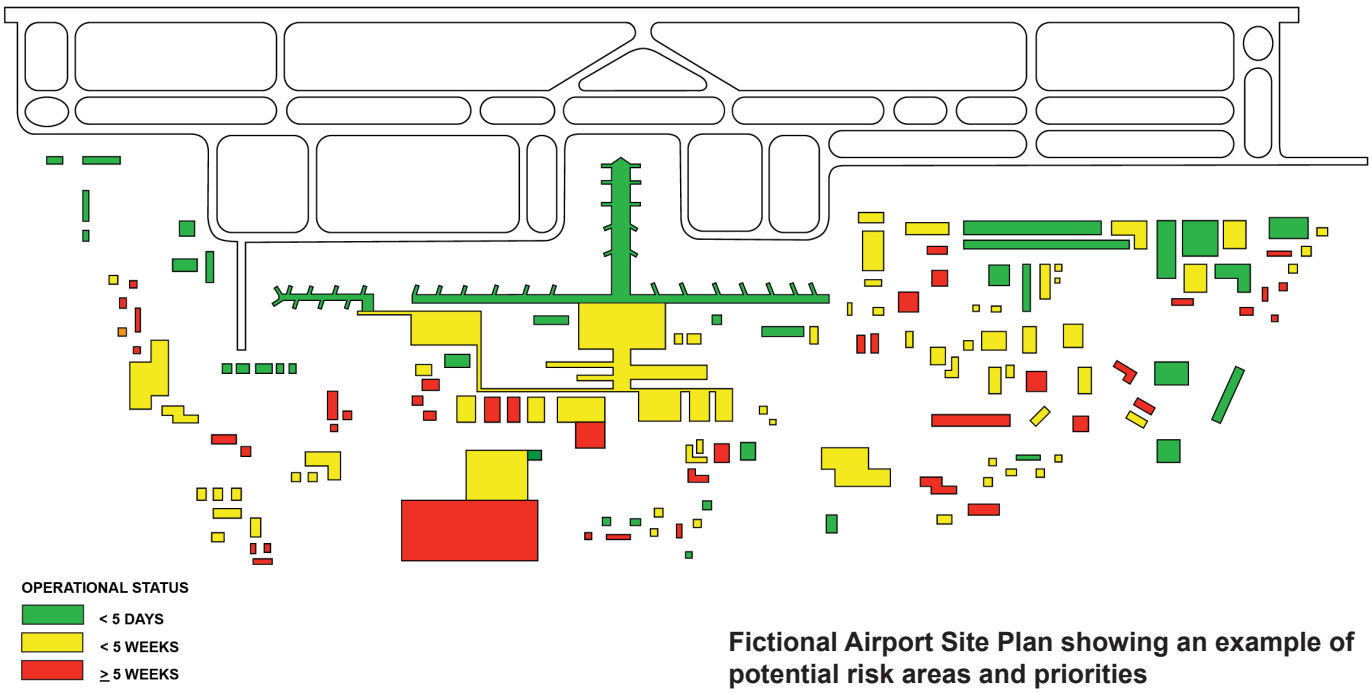
- Recommend and outline Long-Term Risk Improvement Program.
- Recommendations for earthquake response planning and safety assessment program.
- Implement an airport Seismic Improvement Strategy in all future construction projects.

Task 4 – High Benefit Critical Infrastructure Implementation

- Implementation program for priority and high cost benefit opportunities.

Loss Control Program Site Plan

This is an example of a Loss Control Program Site Plan (based on a fictional airport). It is used to identify areas of operational, property and financial risks and priorities to assist airport management with effecting improvements.



Fictional Airport Site Plan showing an example of potential risk areas and priorities

Facilities:

An in-depth analysis is performed to identify how the facilities are expected to perform and their level of resilience:

- Runways (Airside Operations)
- Terminals Other critical buildings

Infrastructure:

The analysis includes how the airport would respond if critical infrastructure was no longer operational:

- Communications (such as Telecom, IT, Security)
- Fuel
- Transportation
- Water
- Power

Overall Findings:

The output from the program identifies:

- How prepared the airport is for a significant seismic event.
- Observed strengths and weaknesses.
- Potential risks and issues against business continuity.
- Level of potential business interruptions and financial impact.
- Operational, property and financial risks are identified and prioritised to assist airport management with effecting improvements.

Ready to optimise your next project?

By combining our global knowledge base with local expertise, we deliver unparalleled structural engineering solutions tailored to your specific needs and local conditions.

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