NEW QUITO INTERNATIONAL AIRPORT

CANADIAN CONSULTING ENGINEERING AWARDS 2014

CATEGORY – TRANSPORTATION

MMM GROUP

MMM Group Limited was prime consultant for the Phase 1 development of the New Quito International Airport.

Located on a 1,400-hectare plateau sitting 350 m above surrounding rivers, within the Andes Mountains, and in one of the most seismically-active areas in the world, many design challenges were encountered. As a result of careful planning, due diligence, best practice strategies, and dedication to detail the project was successfully completed on time and on budget.

Photo: Aecon AG Constructores S.A., Fausto Hidalgo

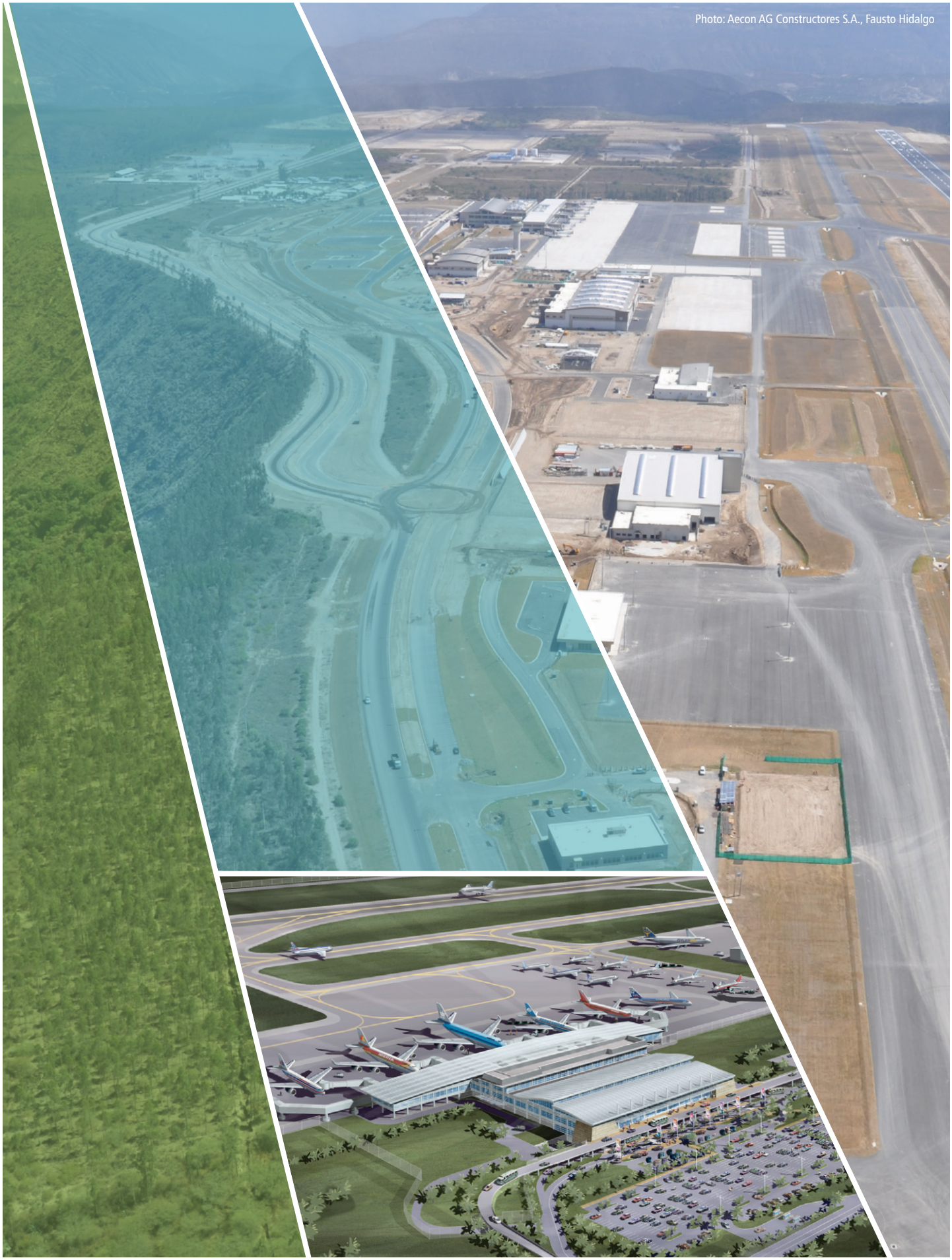


Photo: Aecon AG Constructores S.A., Fausto Hidalgo

INNOVATION

MMM Group Limited (MMM) undertook all of the engineering design for the 1,400 hectare Phase 1 development of the New Quito International Airport (NQIA), with the exception of the architectural and geotechnical design. This project's initial phase included a 38,000 m^2 four-level passenger terminal, landside and airside infrastructure, an air traffic control tower, airport / airline support facilities, a stormwater management facility, and water treatment and sanitary treatment plants.

The airport was designed to the International Building Code (IBC 2000) and other codes that were mandated by contract but not followed in Ecuador. Strict adherence to these codes created a high-quality facility, designed and built to North American standards which helped educate local affiliates and construction personnel on best practices for future projects.

Surrounded by volcanoes, many eruptions have occurred in the site vicinity over the years. The plateau on which the NQIA is situated is comprised of layers of volcanic ash. The existing soil in its natural state is loose and weak. As found, the soil was not suitable for construction, so a rigorous testing process was undertaken to establish the best solution to this issue. The addition of water and load causes the soil to collapse; however, adding water to disturbed soil and placing it as engineered fill turns the soil into what many have described as "water resistant concrete."

Several trials were undertaken to determine the exact process (equipment type, number of passes with the compactor, and thickness of each lift of soil) and materials composition (soil to water ratio) to determine the optimum solution – unique to the New Quito International Airport site.

Ultimately the following optimum process was developed:

- Excavate the existing loose ash soil
- Deposit it into "mixing bowls" which were large rectangular bermed areas created on the airport site
- Add the prescribed amount of water and mix to achieve the optimum water content
- Re-excavate the water-treated soil and place it on the site in (exactly) 22 cm lifts
- Compact the treated soil with six passes (exactly) with the roller

A 1 m thick layer of this "engineered" fill was placed beneath the runway pavement structure to stabilize it. The structural design of the airport buildings, including the Passenger Terminal Building and Air Traffic Control Tower (post-disaster buildings), took into account the unique soils conditions. In total, approximately 8 million m^3 of earthworks were required for the airport development.

COMPLEXITY

Located on the equator high within the Andes Mountains, the NQIA is situated on a 1,400-hectare plateau sitting 350 m above the rivers below, surrounded by mountainous terrain (volcanoes), and in one of the most seismically-active areas in the world, creating numerous significant design and site challenges.

These challenges and the need for the new airport to be within reasonable proximity to the City of Quito resulted in very limited viable options. The new site location was recommended for its size, orientation with respect to prevailing winds, location in proximity to the City of Quito, and potential for future expansion. Even with this, the runway approach and take-off "shoots the gaps" between existing volcanoes. One challenge was to orientate the primary runway, so that its length could be maximized, take advantage of the prevailing wind conditions, and accommodate take-offs and landings within the challenging terrain.

The site is also located in one of the highest seismic zones in the world. This required extensive architectural and engineering measures to ensure a safe and secure development. Structures were designed to resist the high seismic loads using a combination of steel braced frames and reinforced concrete moment frames.

Early in the construction of the project, a significant archaeological find was discovered. The design-build team worked quickly, cooperatively and seamlessly with the Archaeology team that was brought in to carefully extract the precious artifacts (dating back to 300 BC) that were buried beneath the surface where the terminal and groundside parking facility now sit.

Photo: Aecon AG Constructores S.A., Fausto Hidalgo

SOCIAL AND/OR ECONOMIC BENEFITS

The original Mariscal Sucre International Airport was located in the heart of the City of Quito, nestled in the valley of surrounding mountains, and engulfed by existing urban development.

Site constraints made expansion of the existing facilities virtually impossible. The runway was limited to its existing length which could not accommodate the larger aircraft in use today. Furthermore, there has been significant growth in air traffic over the years. These factors combined with numerous accidents that have occurred confirmed the need for a new airport away from the congested city centre.

With increased capacity of more than 1.2M annual passengers and expansion capability of 3.8M more, the City of Quito and Ecuador as a whole have a new international airport that provides a variety of economic benefits. The NQIA opens a new era for the progress of air transportation, tourism and urban development in the region. The airport development created numerous employment opportunities at the airport itself both during construction and after opening, and has generated development in the surrounding areas. Benefits also include improved air travel safety via a world-class airport in keeping with the progressing development of the country and improved safety within Quito's city centre with the existing airport now decommissioned. The NQIA will also enhance export capabilities of one of the country's principal commodities – roses.

In addition to winning several prestigious international environmental, corporate responsibility, and airport design awards, the project has the potential to catalyze the local economy and increase the accessibility of the region.

ENVIRONMENTAL BENEFITS

Building a greenfield airport to current environmental standards in a developing country required the team to overlay an international standard of sustainability and environmental stewardship. The New Quito International Airport is the principal gateway to the Galapagos Islands and as such ecology and sustainability were critical issues considered during design and construction.

Photo: Aecon AG Constructores S.A.; Fausto Hidalgo

At the onset of the project, the New Quito International Airport team embraced an environmental policy that included a commitment to implement recommended best practices to ensure a continual improvement of environmental performance and reduction or mitigation of potential environmental impacts arising from airport-based operations. Design and construction of the NQIA was carried out in an environmentally-responsible manner, ensuring that regulatory and policy requirements were clearly understood and met.

An international Environmental Impact Assessment was completed in advance of design and construction, followed by the development of Environmental Management Plans. These documents formed the guidelines relating to the environmental and social impacts of the NQIA including aviation operations, natural environment, archaeology and heritage, and social factors. The end-design was a durable, energy efficient facility that incorporated local and recycled materials.

In July 2009, NQIA was selected by CIFAL (United Nations) as the best practice on environmental sustainability in the Americas noting that it was “selected as a best practice on how to design and build a green mega project, not only in the Americas but in the world as we are aware that no other airport of this magnitude is being built with such a high environmental focus.”

MEETING CLIENT'S NEEDS

The primary goals of the NQIA project were to:

1. Provide a world-class international airport
2. Implement the highest global standards for design and construction
3. Develop a facility that provides economic and social benefits
4. Minimize environmental impact
5. Complete on time and on budget

These goals were accomplished while dealing with extremely challenging geologic and site issues in a challenging political landscape.

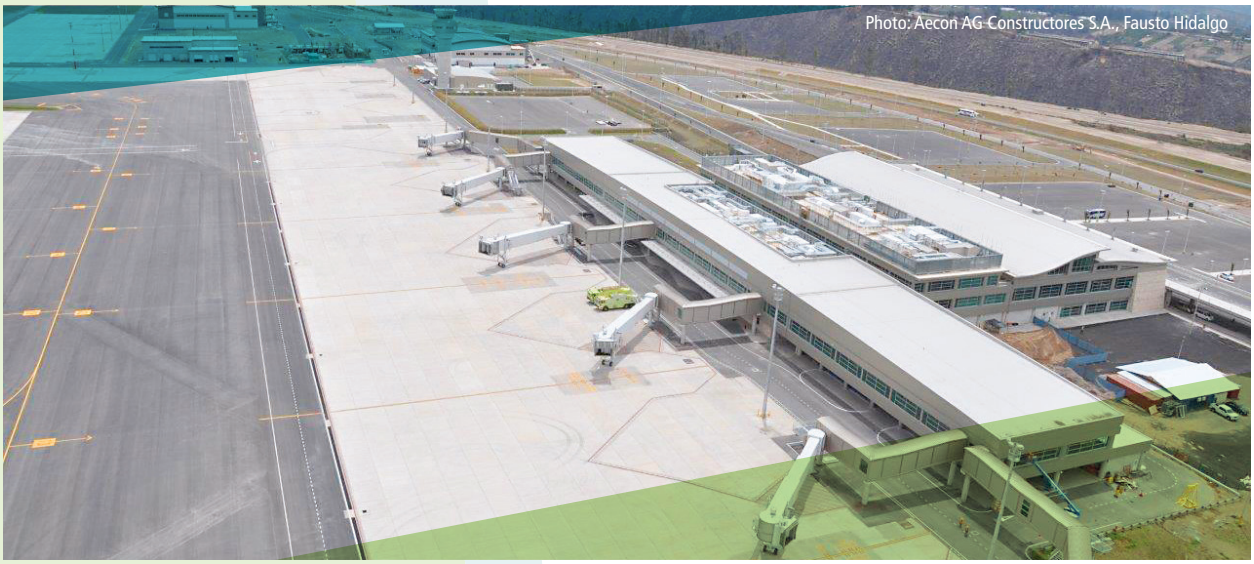
The first step in providing a new world-class international airport was to identify a viable site within reasonable proximity to Quito. Once identified, the design team prepared the Master Plan for the airport which capitalized on the shape and orientation of the site. The airport facilities were strategically situated to maximize efficiency and capture the airport's spectacular setting amongst an avenue of volcanoes.

The project was designed to North American standards (IBC, ICAO, FAA, etc.); perceived to be the best in the world. To ensure quality, an established design-review protocol was strictly followed.

A free trade zone, located within the airport site, allows the import of materials and export of finished products – further enhancing social and economic benefits of the project.

Environmental management was undertaken throughout design and construction. The design-build team worked quickly and cooperatively with the archaeology team who were brought in to extract artifacts of the significant archaeological find, discovered early in construction.

NQIA Phase 1 was completed on budget but slightly behind schedule due to an 18-month hiatus incurred for political reasons and beyond the control of the design-build team.



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