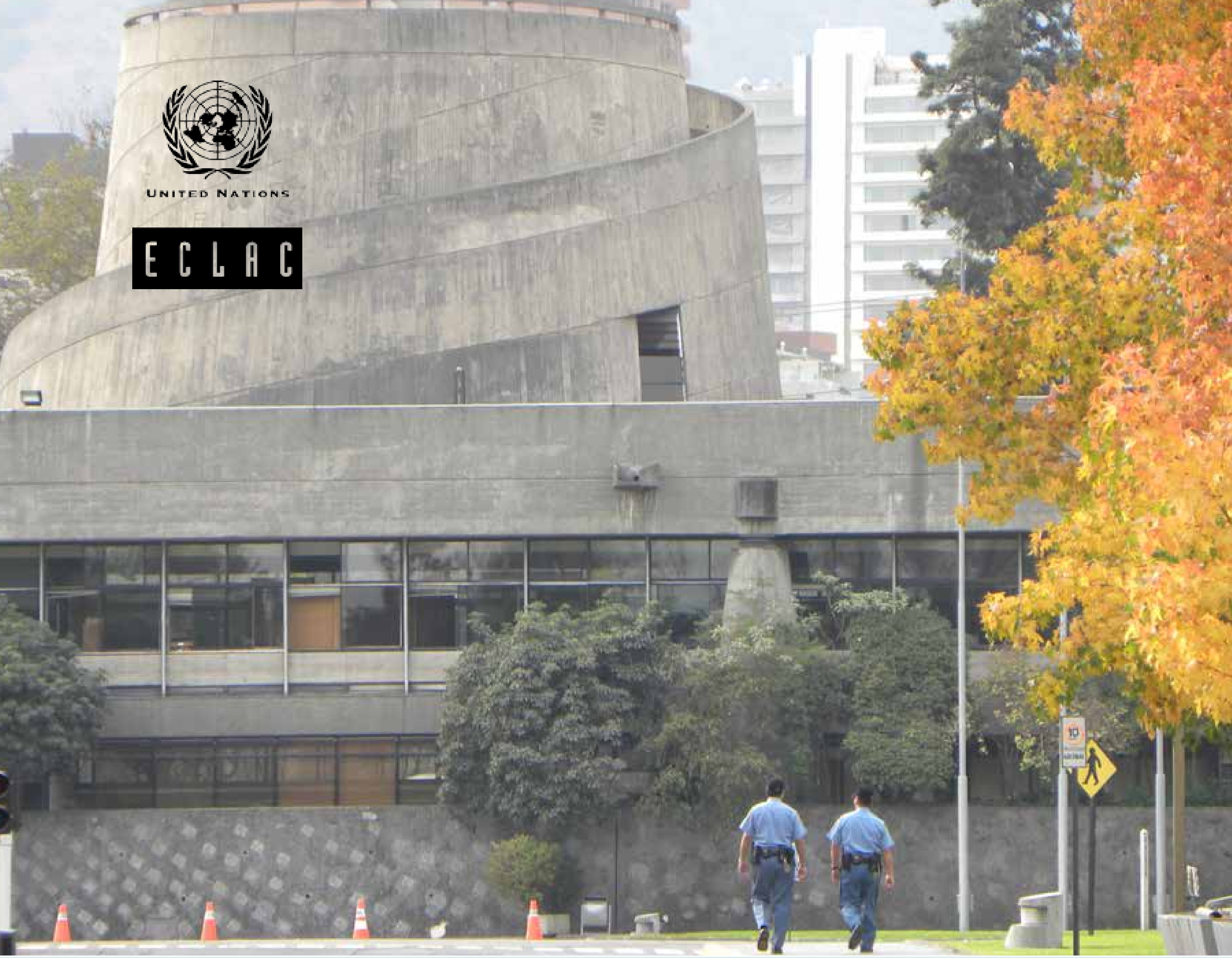

A SUSTAINABLE AND INTEGRATED BUILDING RENOVATION

A United Nations Earthquake Recovery Initiative in Chile

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UNITED NATIONS

ECLAC

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ACKNOWLEDGEMENTS

ECLAC'S reconstruction team would like to acknowledge the support provided by Ban Ki-moon, Secretary-General, United Nations, and Alicia Bárcena, Executive Secretary, United Nations Economic Commission for Latin America and the Caribbean, who led ECLAC thhroughout the reconstruction, as well as to all staff members of the Organization here in Chile, New York and overseas, who provided unconditional support to all the ECLAC's staff affected by the 2010 earthquake in Chile.

We would also like to thank Regina Pawlik, former Director of Administration at ECLAC, and Andrea Henrichsen, current Director of Administration and former Chief of General Services at ECLAC, for providing active support in the logistics and activities necessary to effectively implement the Earthquake Recovery Plan. We wish to specially thank all the Sections and Units in ECLAC's Administration Division that made possible the successful work performed during such a difficult time and acknowledge in particular the work performed by the General Services Section, Finance, Information Communication Technology Sections, and the Procurement Unit. Last but not least we wish to recognize the leadership provided by the Facilities Management Unit and the resilience of all ECLAC's staff members who faced the challenge and kept on delivering their daily work under strenuous conditios throughout the construction works.

This publication compiles the multiple strategies contained in the Earthquake Recovery Plan and the works and activities developed to implement those strategies.

FOREWORD

The headquarters building of the United Nations Economic Commission for Latin America and the Caribbean – UN ECLAC – is located in Santiago, Chile. Its main building -conceived and built in the 1960's- is considered an emblematic landmark of Modern Architecture and included in the DOCOMOMO's (International Committee for the documentation and conservation of buildings, sites and monuments of the Modern movement) watch-dog's list, as heritage of this architectural movement in view of its innovative design concepts and novel structural model. The building in itself reinforces the structural and formal beliefs of modern architecture by blending its structure, volumes and concrete texture with the surrounding Andes mountains, using the "piano nobile" as open space for public gatherings, and promoting open and fluid functional office spaces. The above-mentioned characteristics of this building call for a special approach when requiring architectural intervention in the context of past and future renovations.

ECLAC's main building was greatly damaged during the earthquake that hit Chile on February 27th, 2010. The affected areas corresponded to one third of the total usable office space of the compound. More than 300 staff members required relocation in order to accommodate all Divisions and continue business as usual. Additional areas other than the main building's office space were also damaged: the third floor of the central core housing two conference rooms, the cafeteria and the conference rooms on the ground floor, as well as the four stairwells and major infrastructure and structural elements of the main building. All areas affected by the earthquake required demolishing, redesign and reconstruction responding to current industry and local codes. Infrastructure, structure and relocation of former functional areas were required to be upgraded in order to comply with the current safety and construction regulations.

Our in-house team of Architects and Engineers developed a comprehensive reconstruction logistic plan that included procurement and implementation schedules, as well as a swing space planning and a detailed budget as requested by ECLAC's Executive –Secretary, Ms. Alicia Barcena, and for the assessment of the Secretary-General, Mr. Ban Ki-Moon upon his visit to Chile to evaluate the damages and to offer his full support to the United Nations staff members and the Chilean people, days after the earthquake.

ECLAC's reconstruction after the earthquake was developed and implemented in less than two years and within the estimated original budget. The preservation and upgrading of the building's original design concept while meeting the present Commission's programmatic and space requirements that has changed over time, bringing the building to comply with international safety, HVAC and sustainability standards and Codes, while removing architectural barriers for persons with disabilities -providing adequate accessibility and safety egress- and the re-stacking of functional areas achieved a renovated, safe, healthy, sustainable and efficient working environment.

THE ECLAC BUILDING

The building is a modern architectural heritage case based on its strong institutional character as a building representing an international organization in Latin America. Its innovative layout in formal and structural design has allowed it to remain in time with a particular, widely recognized architectural value within the discipline.

Its architectural resolution has long been a reference and considered as a paradigmatic work, synthesizing modern aspirations based on the functionality of an administrative complex while having an open spatial resolution and a daring structural design, which has defied the gravity of its architectural elements.

The United Nations ECLAC headquarters building was constructed from the project that won the architectural competition held for that purpose in 1960. The project was awarded to the architect Emilio Duhart and his team of associated partners, Christian De Groote and Roberto Goycolea.

The groundbreaking ceremony was held in 1961, the construction was started in 1963 and the building was inaugurated three years later, in 1966. The ECLAC building was designed in a suburban and peripheral city context and its purpose was to impact as a landmark building of institutional and international character. Therefore, its layout strategy was based on developing a stand-alone building. A square of 95.66 meters per side surrounds a square patio of 66.38 meters side that lay within the perimeter square structure. In this yard, two volumes–two stories-high each–are developed:
a rectangular core and a spiral shell.

The perimeter structure that encircles these courts is suspended on four pyramidal pillars that support a wide beam that crowns the building and hold the structural iron tensors from which hang the main slabs of the first and only level of the building. This floor, best known as “the ring,” houses the main office space, which covers an open and permeable “Piano Nobile” that allows wide views towards the courtyard and the surrounding context. The construction was performed in exposed reinforced concrete, which most notably highlights the long-span structural system.

The ECLAC building proposes a whole unit based on a quadrangle with an interior courtyard into which functional and formally autonomous elements are freely included. These two volumes are represented by two different structures: the core and the spiral shell. These are linked to the surrounding square volume by exempt elements, bridges, which hold onto it while allowing for free circulation.

The quadrangle is composed of an upper structure supported by 16 large pillars from which hangs a continuous floor, containing the offices designed originally for ECLAC and ILPES. Beneath it and among other items located in the courtyard, gardens and intermediate areas are found to link the building with its immediate context.

The access is characterized by an oval pond that builds the arrival atrium, and the large tile-form deck marks the main entrance to the complex. Both interventions are unquestionably situated for the most stunning view of this building marked by its own particular character. The Economic Commission for Latin America (ECLA) was established by resolution 106 (VI) of the Economic and Social Council, on February 25th 1948, and started to work that same year. The scope of the Commission's work was later broadened to include the countries of the Caribbean, and by resolution 1984/67 of 27 July 1984, the Economic Council decided to change its name to the Economic Commission for Latin America and the Caribbean (ECLAC); the Spanish acronym, CEPAL, remains unchanged.

ECLAC, which is headquartered in Santiago, Chile, is one of the five regional commissions of the United Nations. It was founded with the purpose of contributing to the economic development of Latin America, coordinating actions directed towards this end, and reinforcing economic ties among countries and with other nations of the world. The promotion of the region's social development was later included among its primary objectives.

In June 1951, the Commission established the ECLAC subregional headquarters in Mexico City, which serves the needs of the Central American subregion, and in December 1966, the ECLAC subregional headquarters for the Caribbean was founded in Port-of-Spain, Trinidad and Tobago. In addition, ECLAC maintains country offices in Buenos Aires, Brasilia, Montevideo and Bogotá, as well as a liaison office in Washington, D.C. The Executive Secretariat of UN ECLAC is led by Alicia Bárcena since 1 July, 2008.

CHILE'S EARTHQUAKE

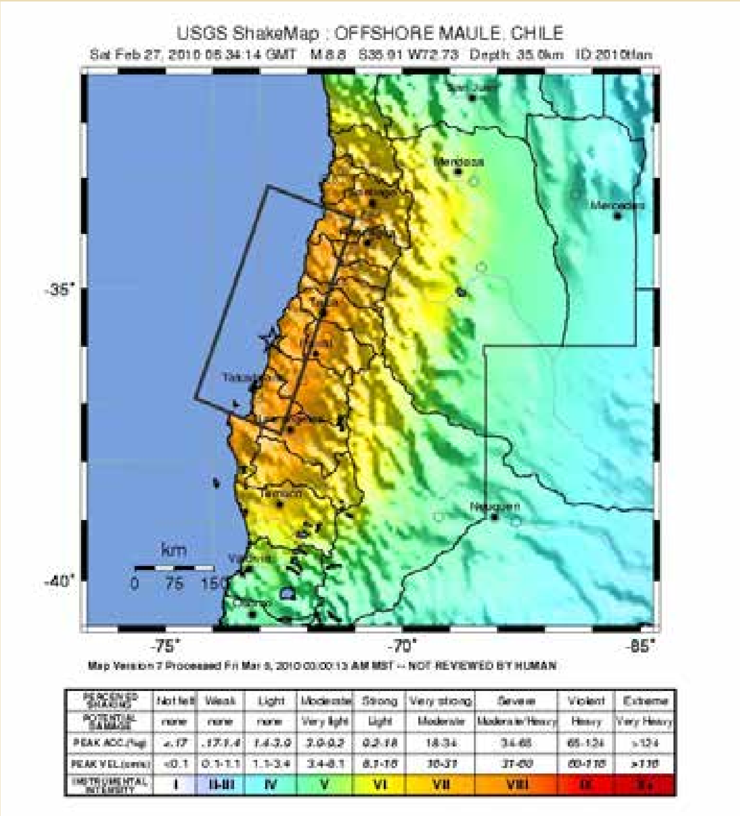
The 2010 Chile earthquake occurred off the coast of either the Maule Region or the Biobío Region of Chile on February 27th, 2010, at 03:34 local time (06:34 UTC), ranking a magnitude of 8.8 on the Richter scale, with intense shaking lasting for about three minutes. It ranks as the sixth largest earthquake ever to be recorded by a seismograph.

On March 10th, Swiss Reinsurance Co. estimated that the Chilean quake would cost the insurance industry between 4 and 7 billion dollars. This is the same estimate made by the rival German-based Munich Re AG—the earthquake's losses to economy of Chile are estimated at US$15-30 billion.

The earthquake was felt strongly in six Chilean regions (from Valparaíso in the north to Araucanía in the south), that together make up about 80 percent of the country's population. According to the United States Geological Survey (USGS) the cities experiencing the strongest shaking—VIII (Destructive) on the Mercalli intensity scale (MM)—were Arauco and Coronel. According to Chile's Seismological Service, Concepción experienced the strongest shaking at MM IX (Violent). The earthquake was felt in the capital city of Santiago at MM VII (Very Strong) or MM VIII. Tremors were felt in many Argentine cities, including Buenos Aires, Córdoba, Mendoza and La Rioja. Tremors were felt as far north as the city of Ica in southern Peru (approx. 2400 km). The earthquake triggered a tsunami which devastated several coastal towns in south-central Chile and damaged the port at Talcahuano. Tsunami warnings were issued in 53 countries, and the wave caused minor damage in the San Diego area of California as well as the Thoku region of Japan, where damage to the fisheries business was estimated at ¥6.26 billion (USD $66.7 million). The earthquake also generated a blackout that affected 93 percent of the country's population and which went on for several days in some locations.

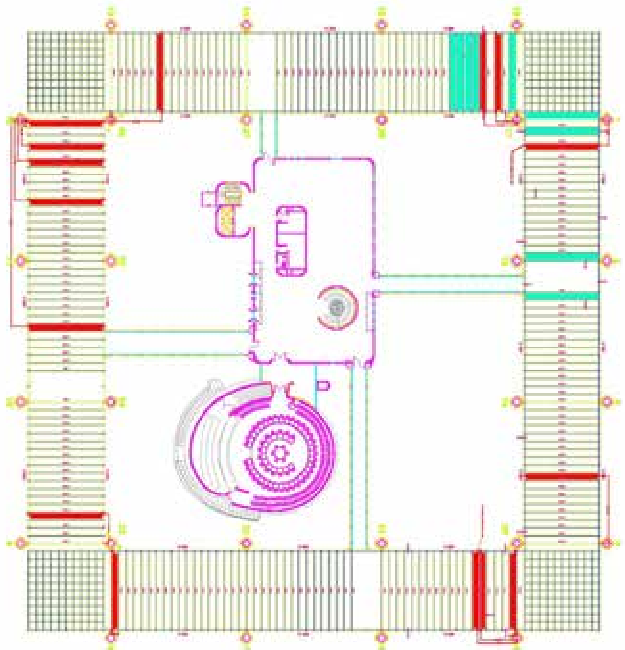
President Michelle Bachelet declared a “state of catastrophe” and sent military troops to take control of the most affected areas.

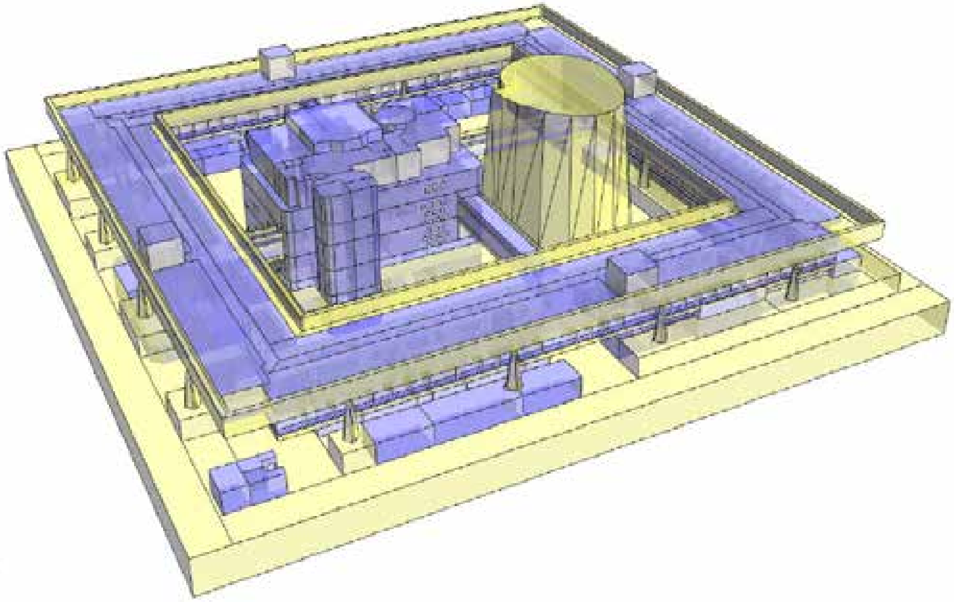
The death toll was 562 victims (down from early reports on March 3 of 802). According to the USGS the epicenter of the earthquake was about 3 km (1.9 miles) off the coast of Pelluhue commune in the Maule Region. This is about 6 km (3.7 miles) west of the village of Chovellén, 15 km (9.3 miles) southwest of the town of Pelluhue and at a point approximately 100 km (62 miles) away from the following four provincial capitals: Talca (to the north-east), Linares (to the east), Chillán (to the south-east) and Concepción (to the south). Chile’s Seismological Service located the quake’s epicenter at about 34 km (21 miles) off the coast of the Ñuble Province in the Biobío Region. This is 60 km (37 miles) north of Concepción and 170 km (110 miles) south-west of Talca.

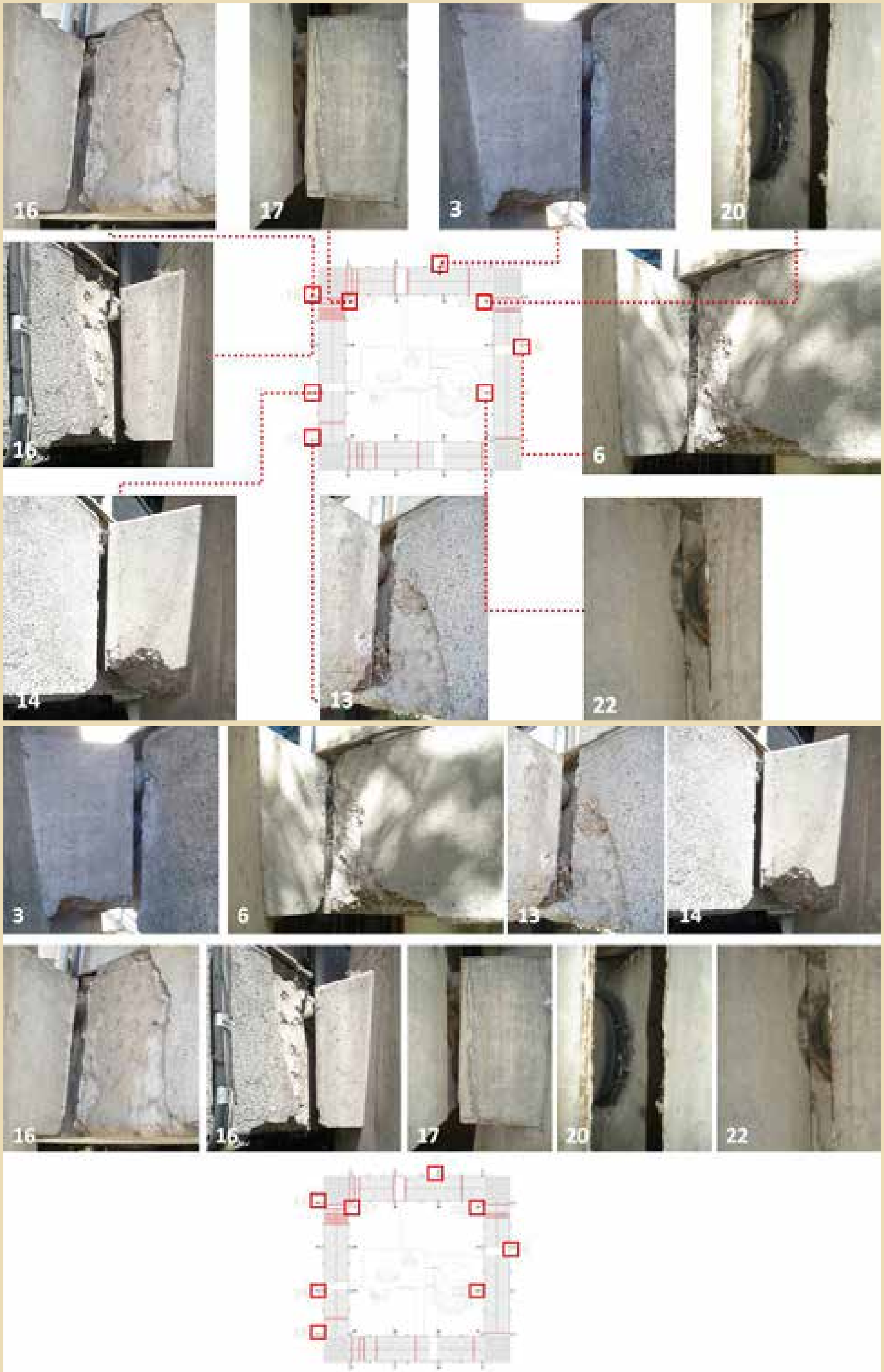


BUILDING DAMAGES EVALUATION

After the earthquake an initial visual building evaluation considered a potential structural failure due to material stressed to its strength limit, attributable to visible fracture and deformations of reinforced concrete and steel structures. Afterwards three independent structural reports were requested; various types of failures were observed in the structural inspection and a general structural failure was discarded. Failures that do not compromise the overall condition of the building were identified as follows: main structural components– fractures including staircases, columns, main beams and slabs; displacement of hanging structures which accommodate main office space of the Commission; structural failure of connecting bridges' fasteners and bumpers; structural steel bar fatigue; buildings' envelope damages including fracture and collapse of steel and aluminum façade frames, numerous broken windows. In addition ECLAC's main building presented extensive interior damages including but not limited to: collapse of ceiling structure and ceiling tiles; office partitions system collapse and/or damage due to torsion of main structural frames; floor coverings damage due to flooding caused by piping breakage. Several subsystems were damaged resulting in: lighting fixtures collapse; access control system PACT equipment failure. Finally, mechanical systems resulted with damage as a result of water, HVAC ducts, and gas piping breakage.







In conclusion, structural damages affecting ECLAC's buildings are summarized as follows:

Structural Fissures: Main Building slabs presented structural fissures in multiple locations. These cracks are caused during concrete curing when shrinkage exists and later were amplified with the earthquake; in areas in where reinforcing bars are overlapped the appearance of these cracks is much lower (for reference see images).

Structural Displacements: Some of the structural columns showed displacements with values of 8-12 mm from the west to the east and 4-8 mm from the north to the south (data according survey report). Displacements are due to structural design since these columns are of the sliding type; the above implies that due to the earthquake the building was left with a residual deformation at these points.

Fall of Large Pieces of Concrete: Four main staircases received structural damage due to a lack of buffer space necessary to accommodate seismic movement; during a seismic event the main slab structure impacted the staircase structure and caused structural damage, leaving reinforcing steel bars exposed.

Connecting Bridge Fasteners: Reinforced concrete expansion fasteners included rubber bumper absorbers and were located in each of the four connecting bridges which provide access to the main floor. All of these sustained severe damages due to the slab's excessive oscillation and its correspondent impact on these elements. Far from the bridges' total collapse as happened in previous seismic events, the connecting bridges remained in place, even though due to inadequate anchoring and poor adherence the fasteners failed and resulted with severe displacement and consequential damage.

Perimeter Beams Minor Fissures: Several cracks were noticed and inspected in post-tensioned concrete perimeter beams. These damages were especially visible in those beams which run from the north to south axis due to seismic movement of west to east– perpendicular to the beams' major axis.

Material Fatigue Steel Bars: Steel bars that support secondary beam structure were visually inspected and presented normal aspects. A more thorough inspection was recommended and will be executed in the near future according to availability of funds.

Failure of Glazing Structures: Similarly, there was damage to the metallic frames holding windows due to the lack of adequate space and expansion joints– crevices and chinks occurred.

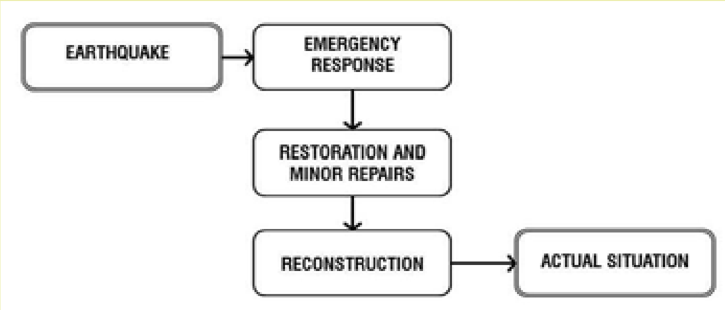
Fourth Floor Fajnzylber Auditorium: Built as an extension on the third floor covering the roof of the amphitheater, the Auditorium suffered severe damage on both its ends and in the raised steel structure, which is considered inadequate as a seismic behavior. An independent structural report was requested and various failures types were observed in the structure, not compromising lower floors. Such failures include:

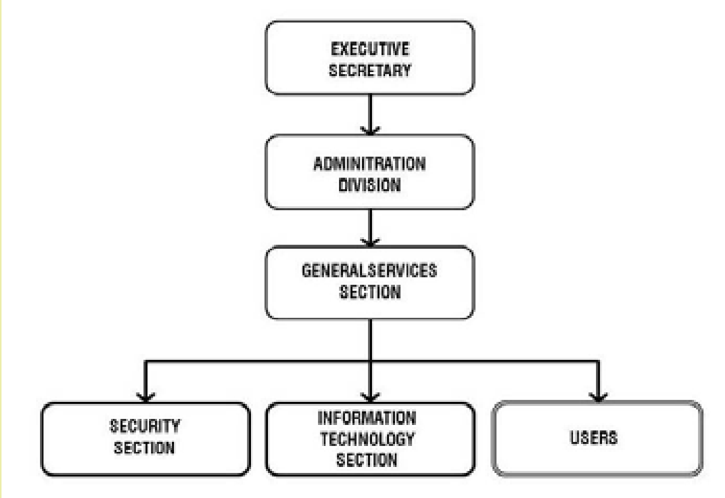
- Partition walls with large fissures in several sectors due to excessive deformation;
- False ceiling system collapse leaving most of the conference room covered in debris;
- Possible structural damage in several components (evaluation consisted of limited visual inspection– later after demolition serious structural damages were confirmed);
- Possible failures of structural column joints due to large displacements (limited by visual inspection– afterwards structural damage to columns was verified).

According to the structural report, complete structure demolition and replacement was indicated due to the lack of rigidity against lateral movement.

EARTHQUAKE RECOVERY PLAN

As immediate response to an earthquake effects ECLAC's property, the Administration Division and General Services Section devised the Earthquake Recovery Plan. The immediate priority was to recover some state of normalcy and stability in ECLAC's operations. In accordance, the Business Continuity Plan (BCP) provided support to recover critical business functions up to the point where the normal operations level was reached. The plan was conceived and implemented in three different stages: a first phase denominated Emergency Response; a second stage defined as Restoration and Minor Repairs; and a final stage designated as Reconstruction. Following is a brief description of each of the stages:





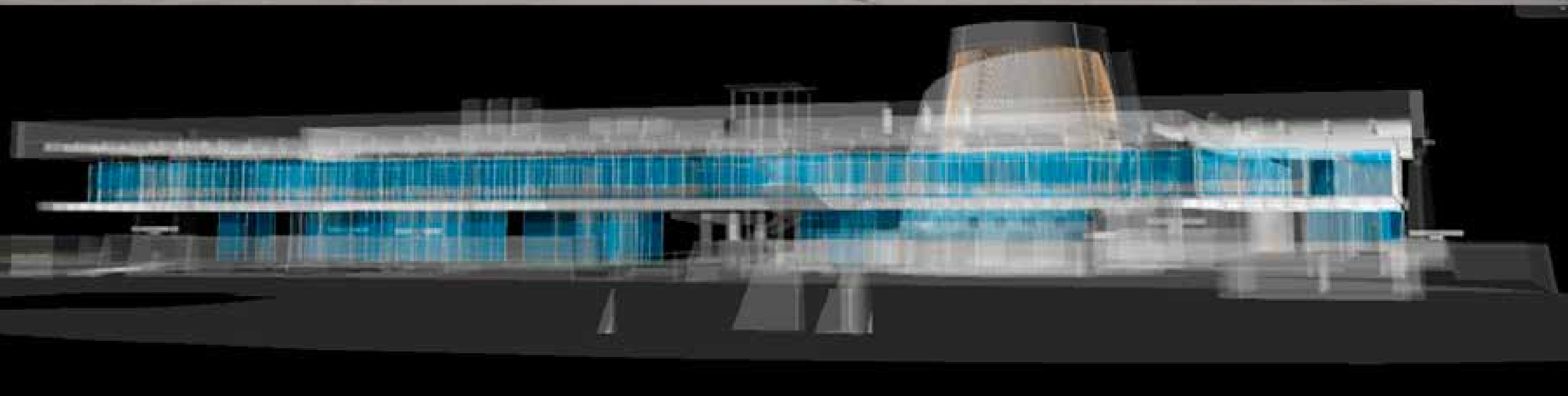
EMERGENCY RESPONSE (Business Continuity Plan): In this initial phase the main objective was to re-establish normal operations of ECLAC as quickly as possible and to prepare activities for the following two stages. Main activities were space habilitation and debris removal. It was necessary to clean up and remove debris from usable workspace. Some loose parts and stucco from affected buildings required demolition, cleaning, and debris removal. In parallel, a thorough damage assessment work was performed not only by ECLAC's engineering team but also by external consultants. The assessment consisted of: structural evaluation from three independent structural engineers; diagnosis and space usability evaluation; and infrastructure inspection and utilities evaluation. Along with the previous, some urgent repairs were performed by both internal staff and external companies. Last but not least, an insurance notice was emitted and insurance claim filed. During this phase a complete space reallocation and workspace re-assignment was performed, including computer and furniture moves, storage of damaged assets, and storage of staff personal belongings. This stage also included several associated bidding processes for food services including the implementation of a temporary cafeteria in a tent, rental of a prefabricated office building, reconstruction of meeting rooms, and procurement of containers for temporary storage.

RESTORATION (Minor Repairs): At this stage the emergency was controlled and operations at ECLAC stabilized, but 30% of existing workspace was unusable. Facilities Management Staff resumed normal work procedures and started scheduling and prioritizing the incoming projects associated with this phase. Major objectives were to execute minor repairs to habilitate workspace. Disassembly and demolition of damaged areas were executed, including Fajnzylber auditorium, the main working floor, and four staircases located at the main building, along with execution of structural repairs to damaged areas. In addition, the window system in the first floor that sustained serious damage was replaced. The temporary cafeteria was implemented and started providing food services and the temporary office building was installed on an open parking area and began to be used as swing space to move staff during renovation of workspace. Several containers were installed to provide temporary storage rooms. Associated bidding processes included execution of the demolition work related to Fajnzylber auditorium and main building workspace, including the replacement of HVAC equipment and the provision of an energy efficient façade. Architecture and engineering staff started the development of the new cafeteria project.

RECONSTRUCTION (Construction projects): This stage was the final step to recover pre-earthquake conditions and consisted of all major construction projects to be executed including complete reconstruction of the main working floor at ECLAC, which represents one third of the total office space. In addition a new building for food services was executed. The complete project including architecture and engineering was developed internally by ECLAC staff. A special emphasis was given to the fourth floor Fajnzylber Auditorium. Due to the patrimonial condition of the building and the understanding that our building is an icon of Latin American Modern Architecture, the Committee for Documentation and Conservation of Buildings, Sites and Neighborhoods of the Modern Movement (DOCOMOMO) expressed its interest to the United Nations ECLAC in participating in the renovation works by calling for an academic forum – a seminar – that allowed for a gathering of innovative and informed project ideas. This cooperation between ECLAC, the DOCOMOMO International and DOCOMOMO Chile was agreed as an academic venture established as a central experience within the field of the modern heritage intervention. The seminar resulted in an international call for ideas where three projects were selected out of fifteen presented. The final selection was awarded to a local architecture firm and executed accordingly.

AN INTEGRATED AND SUSTAINABLE APROACH

ECLAC's Architecture and Engineering team proposed to explore new ways to integrate knowledge of sustainability into building operations and maintenance. Through the use of the Building Information Modeling (BIM) concept, and looking at relations between its potential application in building renovation and its implementation using different data collection techniques and multiple analysis tools, the team implemented multiple or federated BIM models that integrate different building aspects to achieve a sustainable building renovation. Moreover, ECLAC's approach was to extend the use of BIM along the complete building lifecycle using the approach known as Building Lifecycle Management (BLM). BLM, based on BIM, comprises a set of integrated design and analysis software tools and new workflows. BIM forces interdisciplinary teams to adopt nontraditional ways of working together - change is challenging. It enables all the players in the lifecycle of a building to create, manage, and share information about built capital assets from concept to demolition or reuse. This methodology provides means to support a very accurate three-dimensional integrated model to assist the building design and analysis. Additionally, production management is supported through material tracking and production management software. With this integration, one-of-a-kind products can be produced with similar efficiencies as mass products. Nevertheless, the building lifecycle includes at least three stages: first, building production; second, building operations and maintenance; and third, building recycling. Building operations and maintenance correspond to 65% of the entire building lifecycle cost and few implementations have occurred up to now.



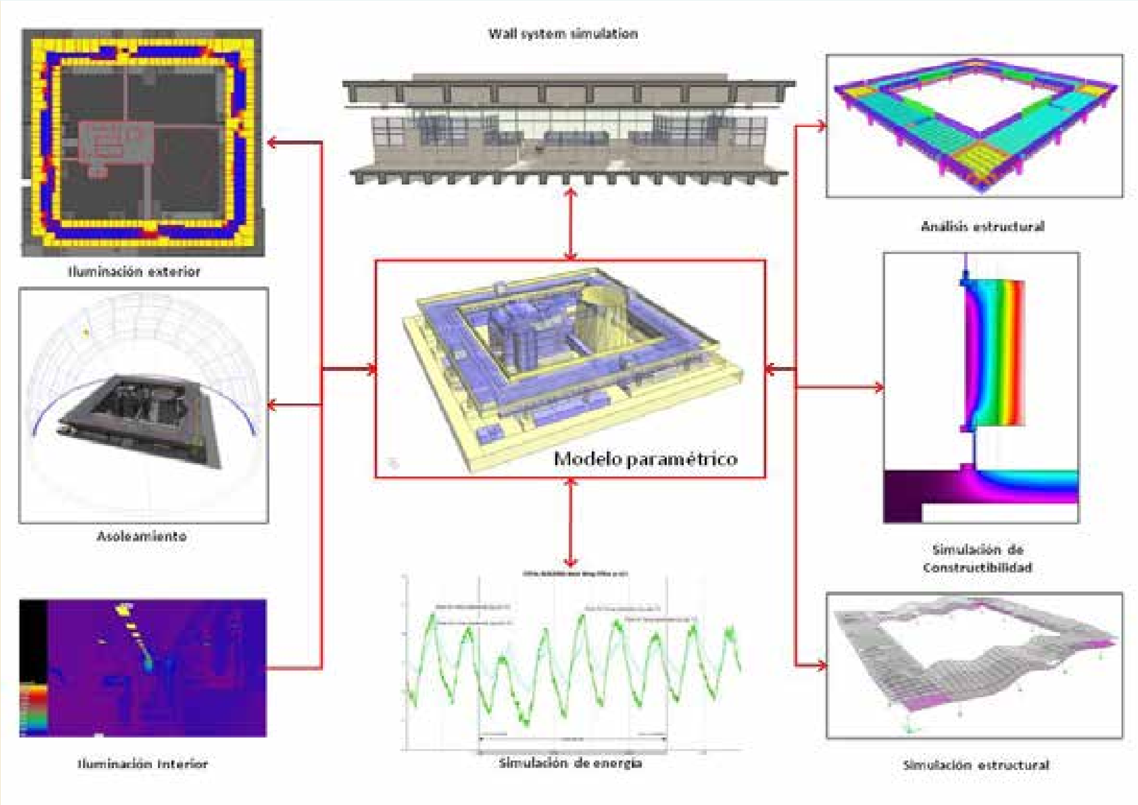
ENERGY CONSERVATION

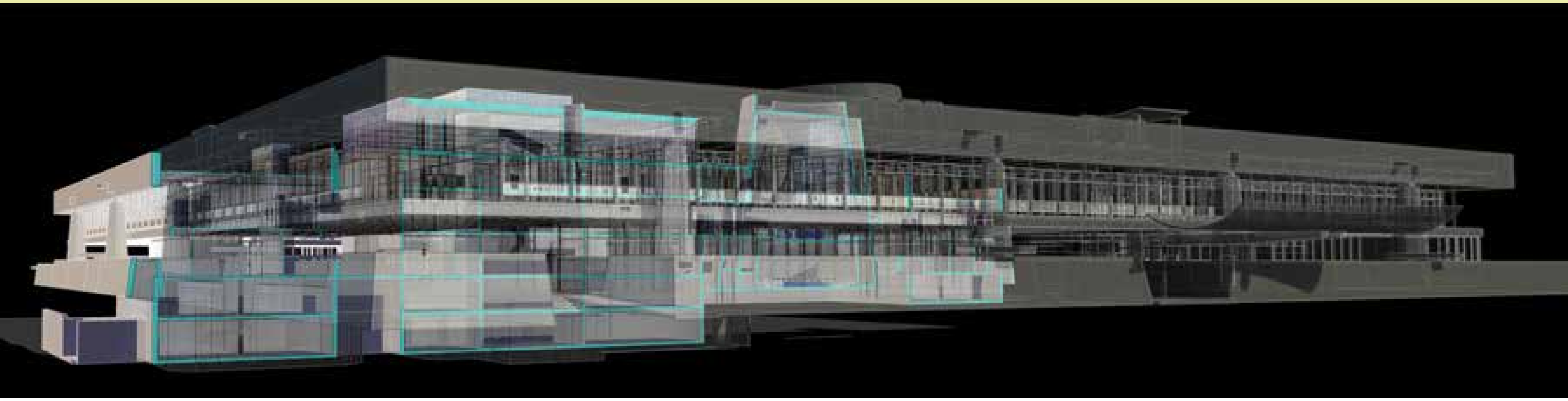
In the first stage, several building conditions surveys were performed, including data logger installation, FDR images capture, and luminance analysis; simultaneously a BIM energy model was developed and further explored to detect relevant issues. Environmental aspects such as lighting and thermal comfort were analyzed. Data collection was programmed to measure interior and exterior temperature (ºC); interior and exterior relative humidity (%), and luminance (lux) every 10 minutes. Measurements have shown the following results:

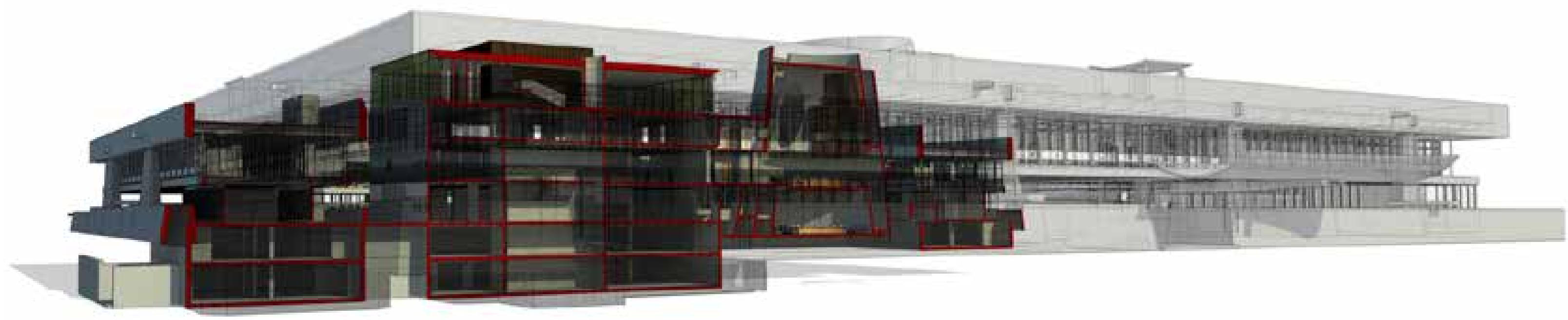
In relation to thermal comfort: Existing HVAC equipment was not capable of providing a cooling temperature within the required thermal comfort range. This situation was due either to the obsolescence of the approximately twenty year old equipment or to insufficient cooling power capabilities from existing equipment. The major issue was on the second floor which is the main office space in ECLAC– not only the biggest workspace in ECLAC but also the most demanding space at the building regarding cooling.

In relation to lighting requirements: There are an important number of offices with neither provision of natural light nor adequate artificial light provision. In addition, there is a complete wing with glare problems.

In relation to energy demands: Since there is no metering by building at the ECLAC compound, energy demand was calculated from energy consumption simulations. Nevertheless, high energy consumption is due to a deficient artificial lighting system, an inefficient envelope, and an aged HVAC system.







BUILDING ENERGY EFFICIENCY OPTIMIZATION PROCESS

The goal of the optimization process was to compare different strategies to improve the building's energy efficiency and indoor environmental quality with the building's actual performance. All the proposals have been considered bearing in mind that the building is an architectural patrimony, therefore is important to maintain its aspect. All input data was provided by ECLAC. For the purposes of this study the building was divided in four parts: the ground, the working floor, the core building, and the bellow grade floors. It should be noted that this analysis is appropriated for the comparison of different passive and active strategies, and it is not intended to provide absolute energy performance of the building.

The analysis was carried out using IESVE® for the thermal simulation and Radiance® for the daylight simulation.

OBJECTIVES:

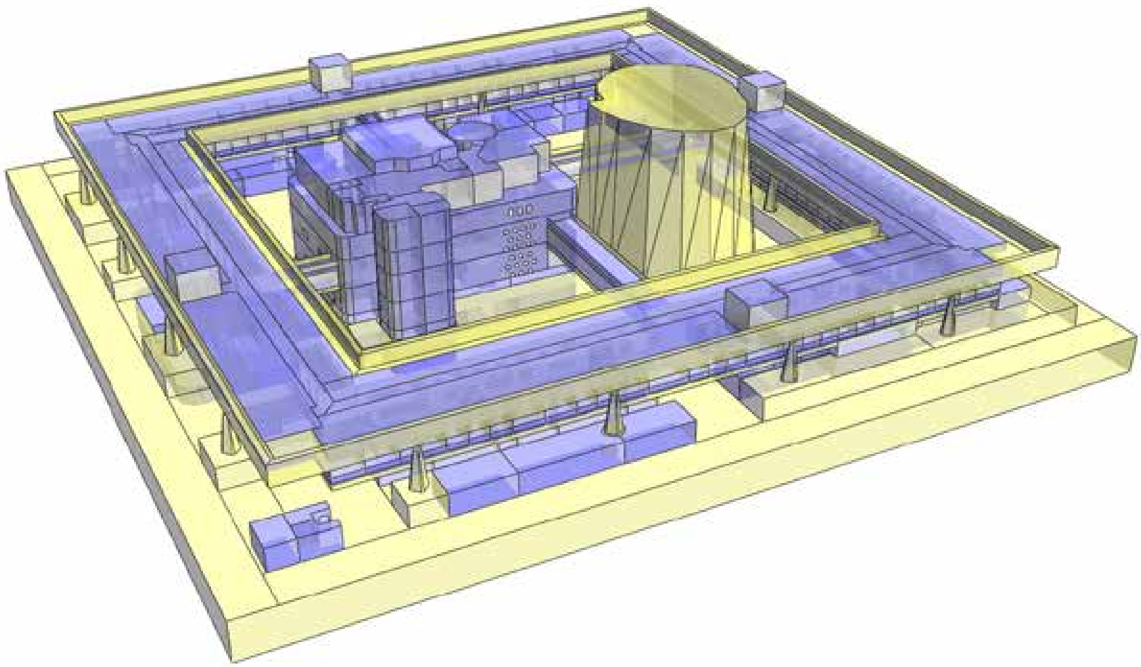
- To assess the building's actual energy performance and indoor environmental quality.
  The assessment considered dry bulb temperatures, luminance and illuminance levels.
- To compare different passive strategies with the existing building. Passive strategies such as insulation levels, glazing replacements, solar control and natural ventilation were considered to reduce the building's energy consumption.
- To compare different active strategies with the existing building. Active strategies such as plant and lighting efficiency were incorporated and the building's energy consumption reduction was evaluated.
- To compare different passive strategies to improve the building's indoor environmental quality. Passive strategies such as partition replacement and solatube® introduction were proposed to improve interior illuminance and luminance levels. The results were evaluated and compared against the existing building.
- To determine the most cost effective strategy of each kind, Life Cycle Assessments (LCA) were conducted.

The methodology of this study is based on energy and daylight simulation models. The first step is to model the existing building which represents, as close as possible, the actual building. This existing building model developed in Revit® will be used for both thermal and daylight analysis. The thermal analysis will be conducted on IESVE® computer software and the daylight analysis will be conducted on Ecotect® and Radiance® computer softwares.

Simulation Parameters:

Existing building– this model represents the actual building. The savings achieved by the different proposals are compared against this model. The existing building takes into account the following considerations:

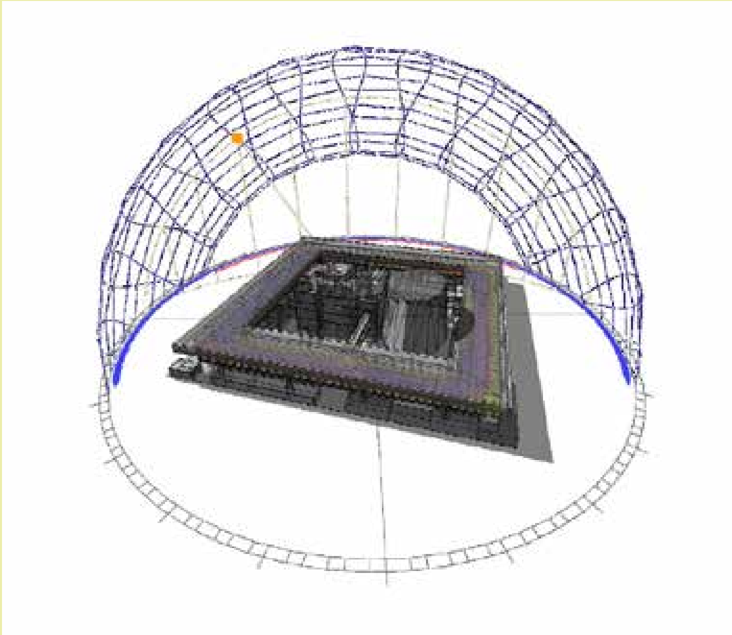
- The geometry has been modelled according to the actual state of the building;
- HVAC efficiencies are in accordance with main installed system (minor installed systems such as split systems were not considered in this analysis);
- Due to their bad condition, the shading devices have been not modelled;
- The constructions (materials) of the envelope are listed along with the respective U-values.

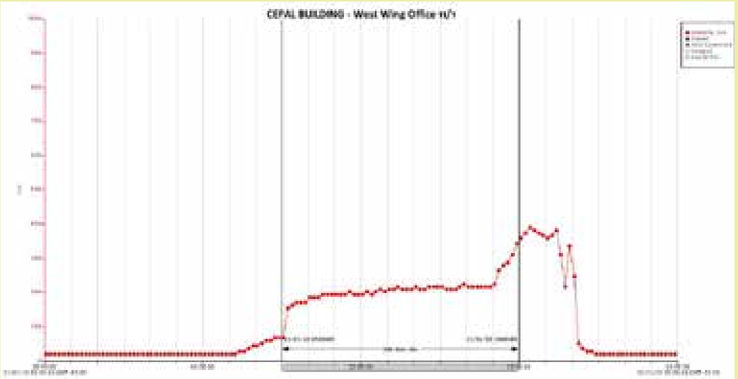


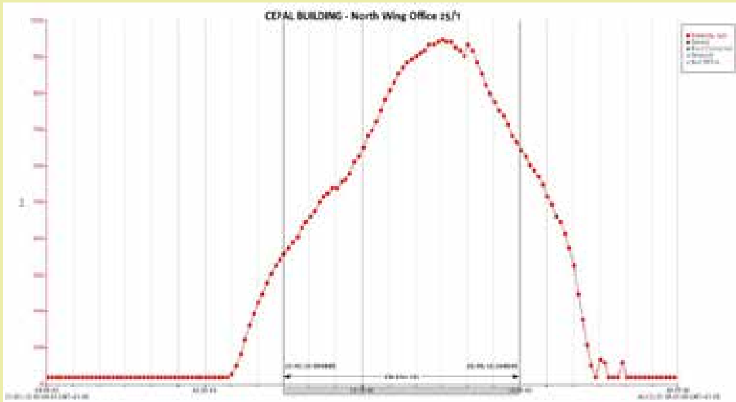
INDOOR ENVIRONMENTAL QUALITY OPTIMIZATION PROCESS

EXISTING BUILDING DAYLIGHT ANALYSIS

The methodology to study daylight was based on energy and daylight simulation models. The first step was to model the existing building which represents, as close as possible, the actual building. This existing building model in Revit® was used for both thermal and daylight analysis. The daylight analysis was conducted on Ecotect® and Radiance® computer software. In addition, data loggers were located in different offices of the working floor. First on a west wing office, then in a north wing office, and finally in a interior open plan office. The data logger had been set to measure illuminance (lux) and other parameters every 10 minutes. The red dots plotted on the working floor plan show the data logger locations. Additionally, daylight analysis used a number of photographs taken with an HDR camera. There are two images of the same view. The first picture shows the actual situation with the contour lines showing the luminance levels. The second shows the luminance levels in false colour indicating both the maximum and minimum luminance levels. Luminance is defined as: “The luminous intensity of any surface in a given direction per unit or projected area of the surface as viewed from that direction. The unit is candela per square meter (cd/m²).” (EULEB)



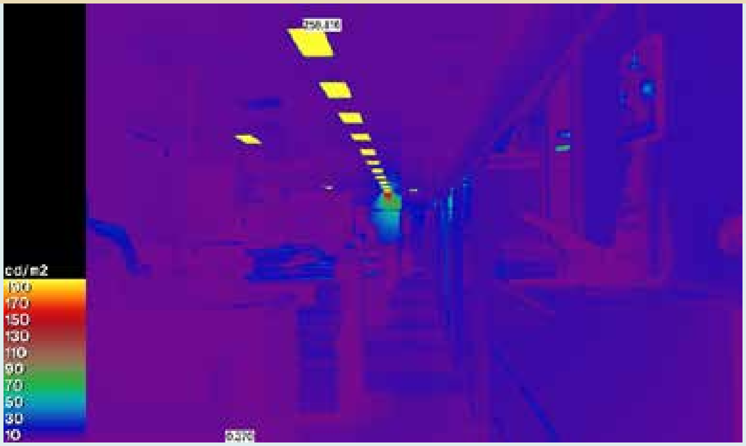




HDR IMAGES ANALYSIS

High Dynamic Range (HDR) images allow a greater dynamic range of luminance between the lightest and darkest areas of an image than standard digital photographs. Information stored in high dynamic range images typically corresponds to the physical values of luminance that can be observed in the real world. The objective of the use of HDR images in this study is to know the illuminance levels in a particular situation in order to identify the glare risk and surfaces which present high or low values of luminance. The glare is a “visual condition which results in discomfort, annoyance, interference with visual efficiency, or eye fatigue because of the brightness of a portion of the field of view (lamps, luminaires, or other surfaces or windows that are markedly brighter than the rest of the field). Direct glare is related to high luminance in the field of view. Reflected glare is related to reflections of high luminance. High contrasts in the field of view can cause glare as well, e.g. reflections on a screen” (EULEB).

The HDR images analysis presented some typical luminance situations in a west wing office, a north wing office and an interior open plan office. These situations are most representative of the original building luminance situation.



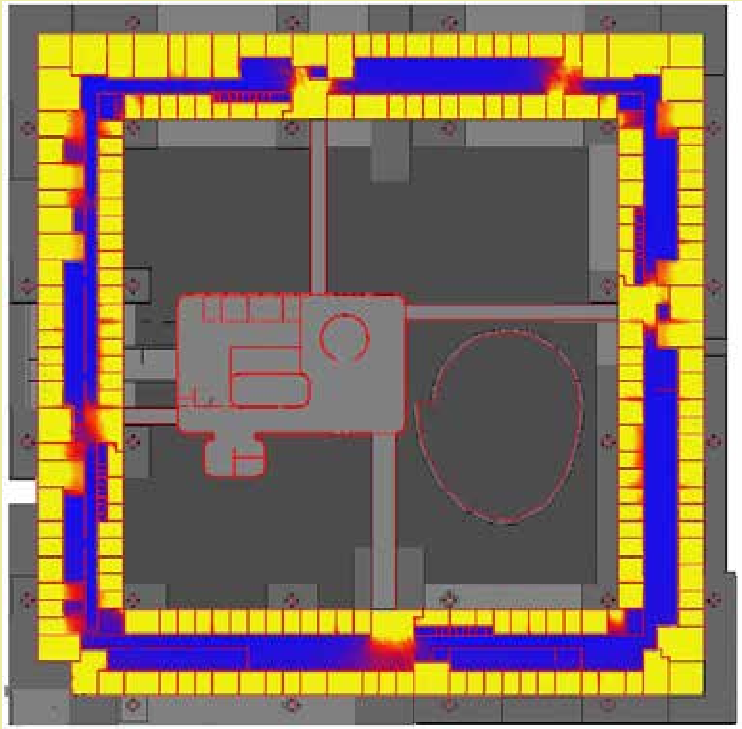
DAYLIGHT ANALYSIS

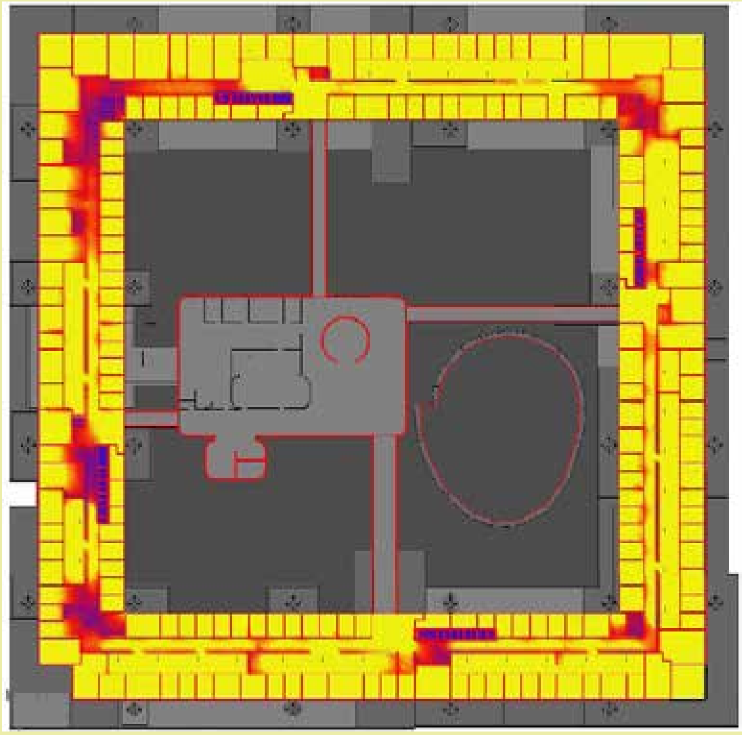
To measure and verify that daylight levels are within comfort parameters an illuminance analysis was conducted. The objective was to achieve adequate illuminance levels over the working plan (80 cm) for the different tasks. For purposes of this study, LEED parameters of minimum and maximum illuminance were taken. To obtain a point for the credit daylight and views: daylight– it is necessary that more than 70% of illuminance levels of the working areas have illuminance levels between 280 and 5380 lux at 9, 12 and 15:00 o'clock during September 21st .

In terms of illuminances the most difficult task was to provide daylight in the interior open plan offices which have no relation with the outside. On the other hand, direct radiation control on the west facade was the second objective regarding illuminance levels.

Daylight Availability: Illuminance Levels Simulations

The image shows the baseline building illuminance floor plan with a 0 - 280 lux scale. It shows minimum LEED requirements fulfilment on the perimeter cellular offices. Nevertheless, the internal open plan offices illuminance levels were not sufficient to meet the minimum LEED daylight requirements. A daylight optimization was required to increase the internal open plan offices; Solatube® incorporation strategy ensures LEED minimum illuminance levels. Nevertheless, circulation areas where Solatubes® were not installed may require artificial lighting throughout the entire year. Due to the fact that the corridors are not usually occupied spaces, is not critical but desirable to have daylight in such spaces to increase the environmental quality and





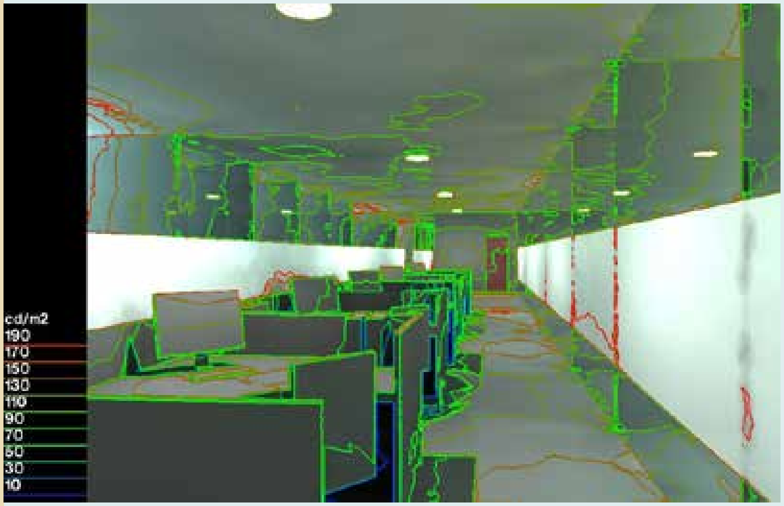
to reduce the energy consumption of lighting.

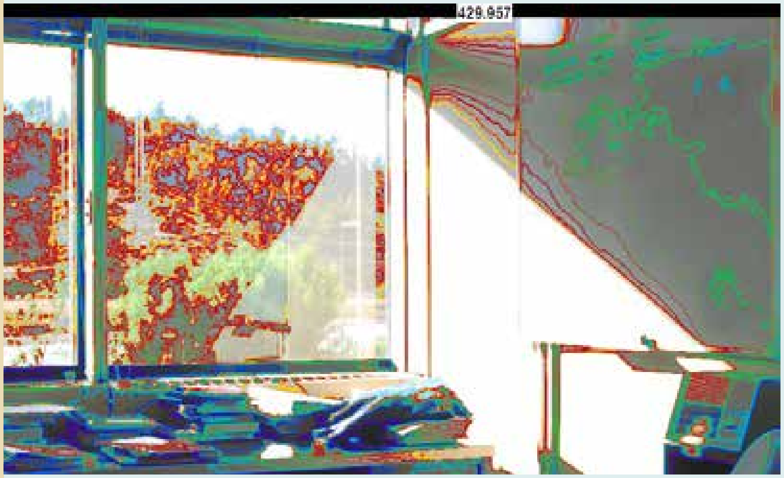
Visual Comfort: Luminance Levels

Luminance levels are evenly distributed and do not exceed 870 cd/m2 in the interior. In the bottom image it is possible to observe great luminance level improvements when glazing partitions were incorporated into the simulations. The luminance picture below shows a good distribution of luminance on surfaces, into the depth of the room. Lighting is also maximized by the presence of Solatubes®.

CONCLUSIONS

The high savings potential lighting replacement was an important strategy implemented. Mainly due to the internal partition configuration which makes the internal space dark and unlinked with the exterior, the ECLAC building had poor indoor environmental quality. This situation was overcome utilizing strategies such replacement of internal partitions and Solatube® installation. Finally, due to the actual indoor environmental conditions, there is a great potential to improve and make the ECLAC building not only a great building for all those who admire it but also for the people who work within the space.





MAIN BUILDING RECONSTRUCTION

AFTER EARTHQUAKE

Due major damage after the earthquake all furniture, interior partitions, windows, ceilings, illumination and HVAC systems, electrical installations, network and telephone lines, as well as pavement and carpets where dismantled.

No interior elements remained and original structure was cleaned up with posterior elements allowing for a full structural assessment and repair process.

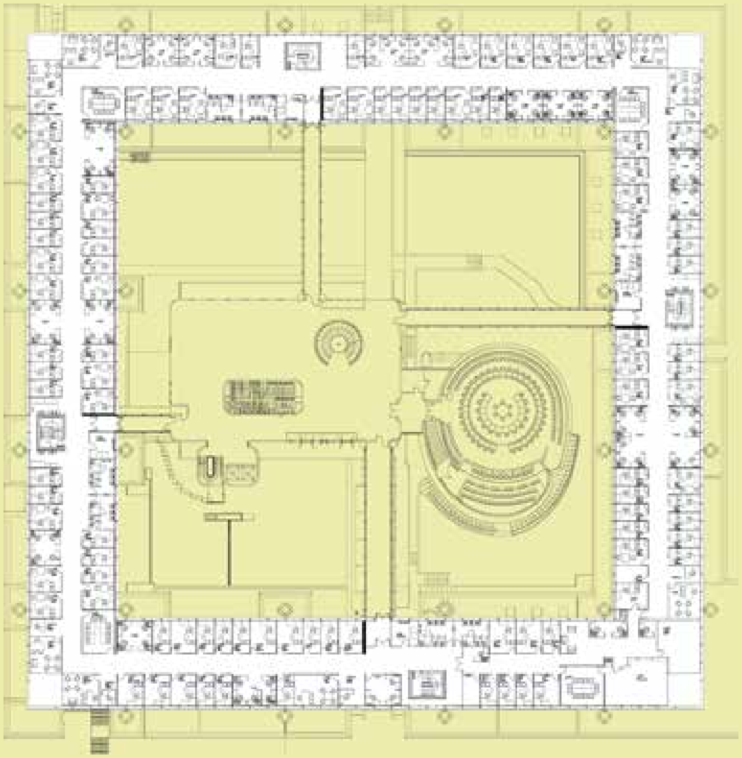
WORK FLOOR RE-DESIGN PHASE

The renovation and redesign of the work floor was based on general criteria to improve spatial working conditions, create a healthier and more enjoyable work area, and make a productive and transparent space. Private spaces were maintained but with a close relationship with public spaces through use of constant visual contact.

Space assignment standards correspond primarily to the requirements of each of the divisions which must be incorporated in the work floor: private spaces for Directors, semi-private spaces for International Officers, shared spaces for local Staff and open spaces for interns in the center of every wing, which are shared by different divisions.

The inclusion of glass walled meeting rooms, controlled centrally by conference service, gives access to all Staff and adds new public life to the work floor area.

The construction project involves balancing a historical building with environmentally friendly technologies, energy efficient lighting and HVAC systems.



STRUCTURAL REPAIRS PROCCESS

Structural repairs were made where required according to the inspection report issued by local engineers, and included work on various vertical and horizontal supporting elements as well as slab repairing and dismantling of additional elements that affect the original structural concept. The work also included demolition of existing elements as well as a steel bar structure reinforcement and repair with special mortars and concrete.

All sectors were inspected in detail and processes were reviewed step-by-step by the engineers responsible for the project.










INTERIOR CONSTRUCTION PHASE

Once structural repair work was executed and there was complete clearance of the area to be reconstructed (4000 m2), the program of work was separated into three stages, progressively advancing with the installations of each system, new wiring, installation of trays, electrical systems and network installing.

The construction then continued with all supporting elements of the HVAC equipment, civil works, dry wall construction and sanitary facilities reconstruction according to architectural project.

Quality control and proper execution of the works were supervised directly by the team of architects and engineers from ECLAC, with external technical inspection of the work.

The construction phase presented no delays and complied in full with the time requested.

FACADE WINDOW REPLACEMENT

The installation of new windows while maintaining the original modulation of the building was performed following technical specifications including Thermopanel glass and, according to a bioclimatic study performed, with high solar radiation control level and aluminum with thermal bridge break, allowing a better performance on each of the four different orientations which the building faces.

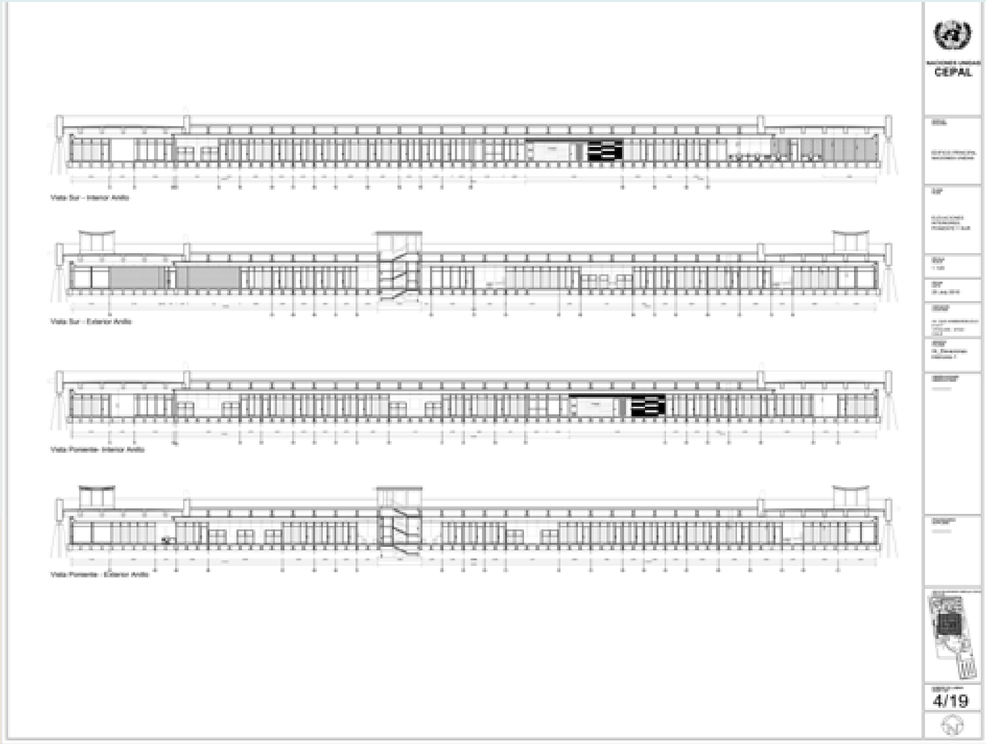
HVAC SYSTEM

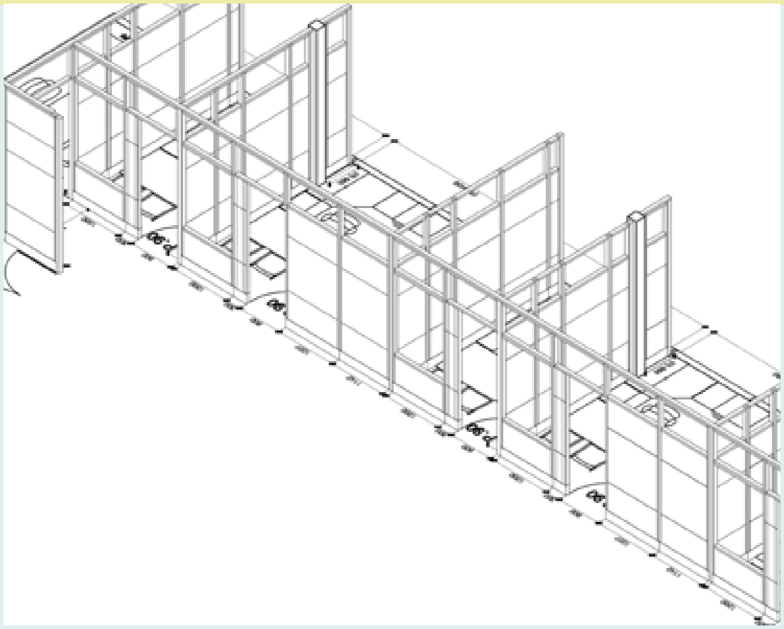
The incorporation of new HVAC technologies considered the replacement of old air handlers and chillers that worked with Gas R22 by a last generation VRV ecological system with individual control and incorporated into a central control system via software that enables constant monitoring and increased system performance.

The interior equipment corresponds to hidden systems above ceiling and individual thermostats connected to pipelines. The energy consumption of this equipment is about 30% of the previous system’s allowing for significant savings.

INTERIOR PARTITIONS AND FINISHES

A system of modular acoustic sky was included in the overall project that allows significant sound levels and rebound control in open spaces as well as in office areas. Vinyl flooring was installed in public hallways and low fire rating carpet inside offices and workspaces. High-performance low-consumption T5 lamps were installed that allow dimming control according to the intensity of the ambient light.





The modular office partitions were considered as a complementary system for the Steelcase ECLAC furniture, allowing direct coupling to walls. Design of walls was done following the original modulation of the pieces of furniture.

Acoustic insulation system FONAC BARRIER and antiblast film on top and front glasses are included.

FURNITURE ENSEMBLE

The furniture incorporated into the project corresponds to modular workstations divided in two different systems, a standard model for open spaces and another which includes meeting tables in office space.

Due to seismic safety reasons, cabinets and shelves are weight restricted, as is furniture height, which cannot exceed 1.2 meters high.

FINAL RESULT









BEFORE


AFTER

EXECUTIVE SECRETARY OFFICES

After the destruction of the Executive Secretary's office during the 2010 earthquake, it was necessary to restudy the location of this space in the new distribution plan of the work floor. New offices were moved next to the building's main access. New spaces were added to the original program as exclusive meeting spaces for visiting authorities. Concepts such as transparency were used in advisors' offices, favoring the use of natural light in all spaces. An open pool of secretaries connects the offices of the Executive Secretary and the Deputy Executive Secretary. Wooden panels with double acoustic insulation were installed to create a warm space optimal for diplomatic functions.






MEETING ROOMS RECONSTRUCTION

The conference rooms located on the ground floor were severely damaged, necessitating their complete reconstruction. Cellular concrete walls were replaced by higher seismic resistance dry walls. Installation of a modular acoustic ceiling with higher resistance to movement and an independent structural system from the floor above makes these spaces resistant to a high magnitude earthquake.

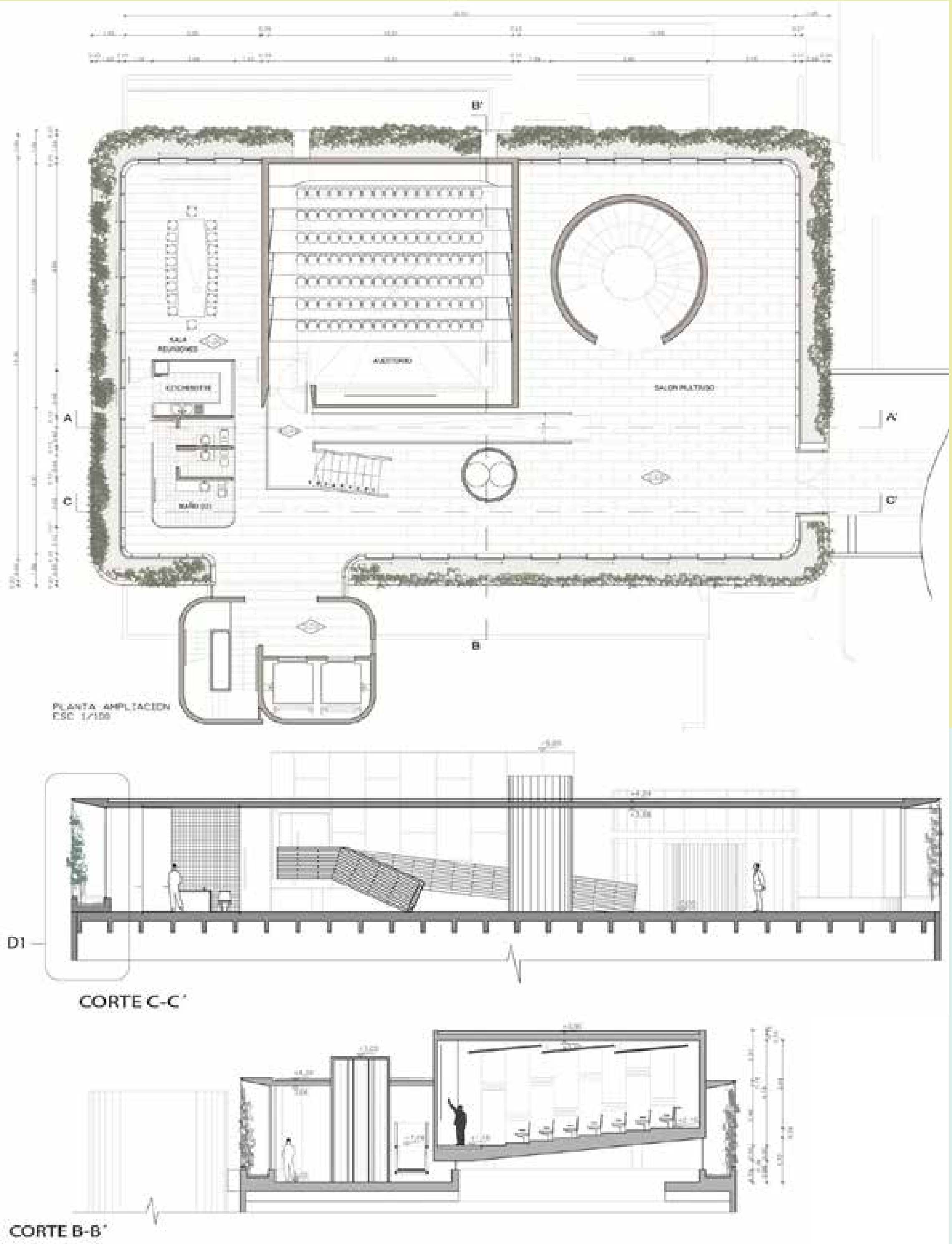
Acoustic insulation of rooms was improved by installing insulating membranes inside walls, allowing their use as videoconference rooms.

CONFERENCE ROOM RECONSTRUCTION

The conference room on the fourth floor suffered major structural damage during the 2010 earthquake, making necessary its complete demolition and reconstruction.

The reconstruction project was the result of an architectural competition organized by DOCOMOMO, resulting in an architectural project which uses a simple geometry, high transparency and defined geometric volumes, making a respectful solution to the original building, but maintaining a clear separation between the two complementary architectural works.

The acknowledgment of surrounding landscape and the use of perimeter vegetation generate an open space that can be used in various ways, making it ideal for ceremonies and meetings at the highest diplomatic level.


B'
A
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SALA REUNIONES
AUDITORIO
SALON MULTIUSO
PLANTA AMPLIACION
ESC 1/100
D1
CORTE C-C'
CORTE B-B'

DEMOLITION PROCESS

The demolition included all structural elements which were not part of the original building such as concrete structures, steel and partitions.

Sanitary facilities, flooring and electrical installations were removed and the demolition of the stairs and ramp connecting the old conference room was necessary.

CONSTRUCTION PHASE

The new structure is formed by a steel frame with a steel structured roof, giving a light and transparent effect. The original elements such as the circular staircase and ventilation chimney of the building were repaired. Interior partitions and stairs to the room were steel framed.

All floors were leveled to install new flooring. Ecological VRV HVAC systems were added on the new floor hidden in the ceiling. SIP panels with high thermal insulation were installed on the roof and glass Thermopanels were considered for the facades.

FINAL RESULT

Separation between different elements and uses is divided by textures and the use of materials. The meeting room is surrounded by a wood face, sanitary rooms are covered in white glass, and the stairs are covered by a black painted metal surface which gives a clear volumetric architectural game.

Floors were covered with travertine marble and cables were installed on the outside perimeter to allow vegetation to climb, making a green facade.




BUILDING'S CORE REFURBISHMENT

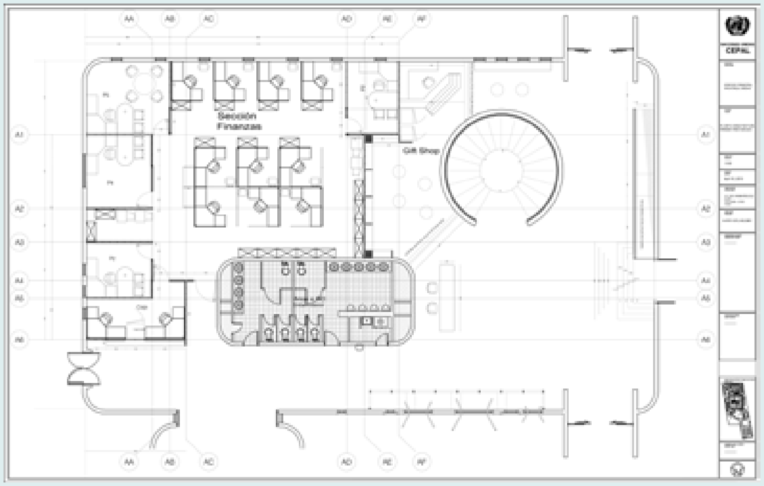
The ECLAC building core refurbishment responds to an effort to keep the essence of the building while rehabilitating public spaces and providing the possibility for the spaces to be used in various ways according to the requirements of ECLAC and its public events.

The open areas and use of colors and textures create distinct spaces framed within a larger open space.

The office spaces were redesigned favoring natural light and ventilation, using colors from the original Le Corbusier palette, separating the solid volumes of transparency of the buildings.

New HVAC technology and high performance, low consumption lightning systems were designed for a healthier work environment.

The entire project was designed by the ECLAC architectural team.





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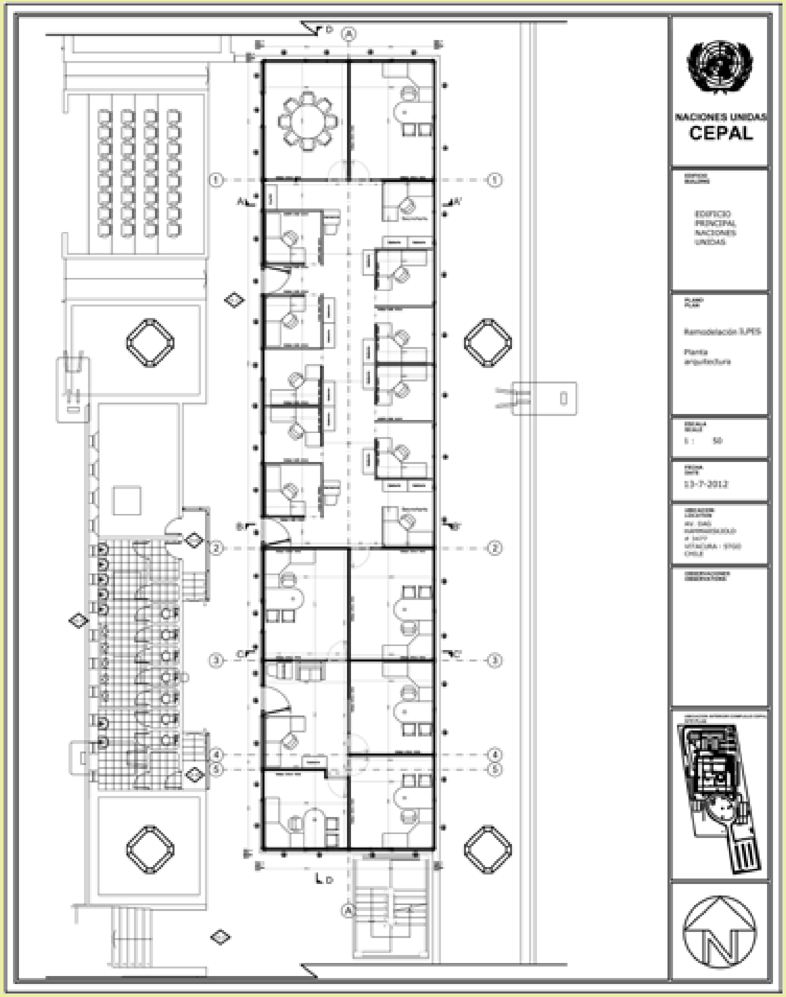
GROUND FLOOR OFFICE SPACE REFURBISHMENT

The refurbishment of the buildings was based on the recovery of public spaces in the hall of the first and second floor, establishing suitable spaces for events related to Conference Service. Substantial improvements were implemented in the surrounding offices areas favoring natural light and ventilation of open space. In the central hall a corporate gift shop was included. A system of color usage based on the original palette of Le Corbusier was used on all walls and wood finishing was installed in the second floor hall to visually separate spaces. New systems of efficient low consumption lighting and improved VRV HVAC were implemented. This project was entirely developed by ECLAC's architects.



CAFETERIA BUILDING CONSTRUCTION

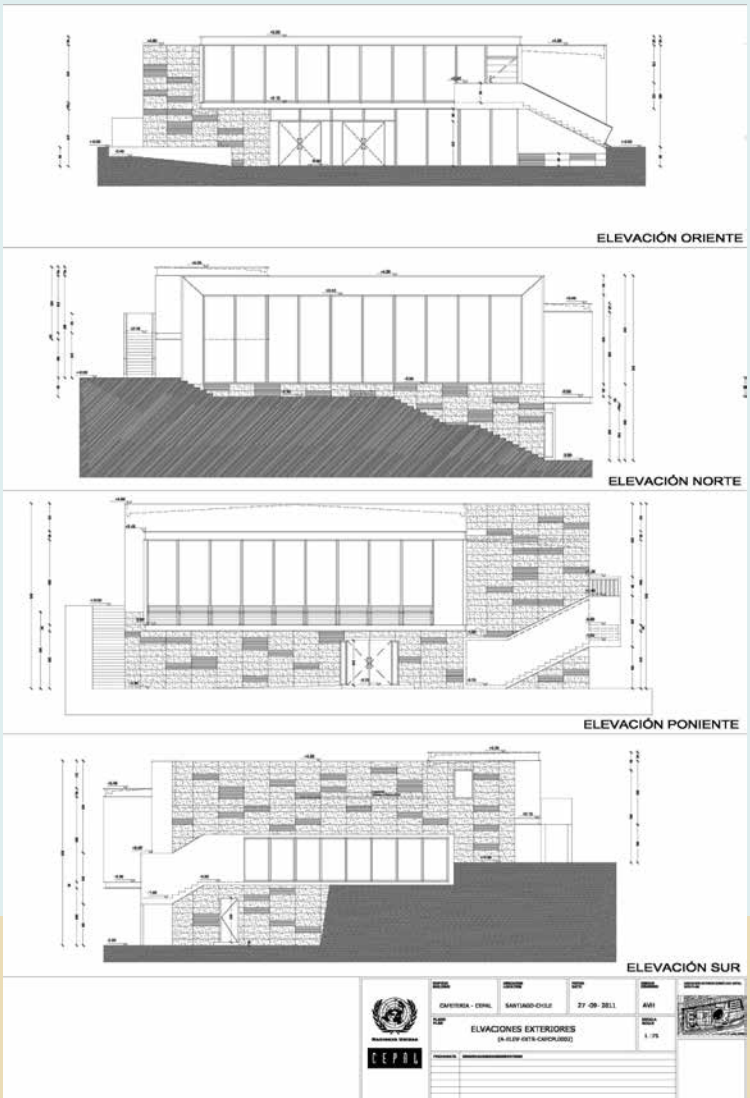
CAFETERIA BUILDING DESIGN PHASE

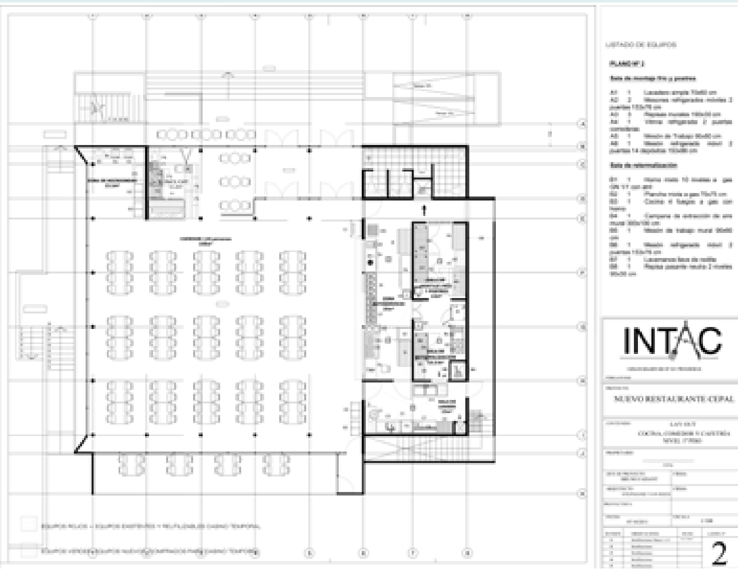
The challenge of establishing a new location for the cafeteria building that met the technical and architectural requirements needed was approached by the team of architects of ECLAC, requesting the support of experts in industrial kitchen design.

The building was divided into three floors, with the lower level including storage and services of exclusive use to the food service contractor. Second floor is a mixed area which includes the kitchen, a 120 person dining room, public restrooms, and a coffee shop. The upper floor has a VIP Dining room and kitchen with a separate entrance.

The structural model is based on a mixed structure of reinforced concrete in the lower level and steel frame for second and third floor, focusing on these two higher floors on the fairness and transparency of the facades.

Stairs were built as separate elements attached to the facade and a terrace was built that looks directly to the surrounding park. Use of a ventilated clay facade promotes economy of HVAC systems.





CONSTRUCTION PHASE

The stages for the construction of the cafeteria building started with the excavation and leveling of land for the construction of the first floor of the reinforced concrete structure. The reinforcement and construction of retaining walls ensured the proper anchoring of the building.

Once the formwork was placed for slabs and walls, along with the reinforcement mats, all the elements for piping and electrical systems were installed and then filled with concrete.

According structural calculations, steel structures were anchored directly to the concrete structure and welded on site.

The walls and roof were made with SIP panels improving the thermal insulation of the building. All openings correspond to large thermo glass windows. Lamps that were installed correspond to T5 low consumption lighting systems.

FINAL RESULT

A colorful building that easily tells the visitor what is its function, with bright and comfortable spaces that promote human relations in a building that does not overlap with surrounding buildings but allows for a free relationship between them and the landscapes around it.




BEFORE

AFTER

UNITED NATIONS

ECLAC

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