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Article

Adaptation of the infrastructure of the university cafeteria [Nevería], Faculty of Engineering of the Autonomous University of Campeche – Campus V

Adecuación de la infraestructura del comedor universitario [Nevería], Facultad de Ingeniería de la Universidad Autónoma de Campeche – Campus V

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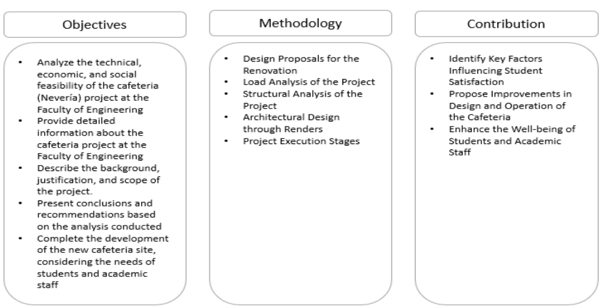
Abstract

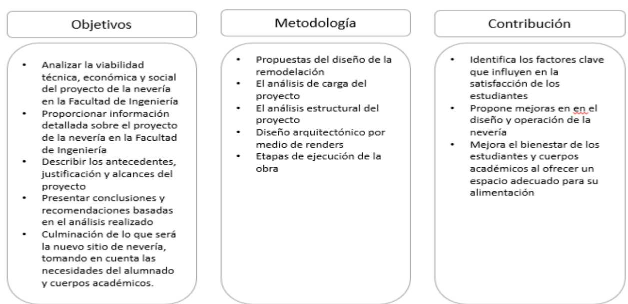
The article discusses the suitability of the cafeteria in the V Campus of the Faculty of Engineering at the Autonomous University of Campeche. It highlights the importance of properly conditioning common areas in higher education institutions, as these spaces are essential for recreation, relaxation, and food consumption by students, academics, administrative staff, and visitors. The document addresses the diagnosis and analysis needed to improve these areas, with the goal of creating an optimal and functional environment within the campus.



Common spaces, university infrastructure, student well-being.

Resumen

El artículo trata sobre la adecuación de la nevería en el Campus V de la Facultad de Ingeniería de la Universidad Autónoma de Campeche. Se destaca la importancia de acondicionar adecuadamente las áreas comunes en instituciones de educación superior, ya que estos espacios son esenciales para el esparcimiento, la recreación y la ingesta de alimentos de estudiantes, académicos, administrativos y visitantes. El documento aborda el diagnóstico y el análisis necesarios para mejorar estas áreas, con el objetivo de crear un entorno óptimo y funcional dentro del campus.



Espacios comunes, infraestructura universitaria, bienestar estudiantil

Area: Advocacy and attention to national problems

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Introduction

Institutions of higher education are the places where students in professional training spend most of their time outside their homes. They are also spaces where a large number of individuals—such as faculty members, administrative staff, and occasional visitors—interact. Therefore, for academic entities such as the Faculty of Engineering at the Autonomous University of Campeche [Campus V], it is essential to have adequately conditioned common-use areas for recreation, leisure, and food consumption. Consequently, conducting detailed studies of these areas allows us to gain a general overview for decision-making, with the aim of developing an immediate adaptation plan that will help us ensure optimal conditions in the spaces designated for such purposes. The main advantage of preparing a diagnostic assessment for adaptation is that, when done in a timely manner, it helps extend the infrastructure's lifespan, better withstand the high impact of school space occupancy levels, and—above all—enhance user safety. This aligns with broader quality assurance models in higher education, such as those proposed by Ferrari Arroyo & Gallegos Muñoz [2025], where infrastructure adaptation forms part of continuous improvement actions to meet accreditation standards.

In the specific case of the Faculty of Engineering at the Autonomous University of Campeche, the institution is subject to ongoing evaluations to ensure the quality of its academic programs. It is accredited by organizations such as the Inter-Institutional Committees for the Evaluation of Higher Education [CIEES], the Accreditation Council for Engineering Education [CACEI], among others. As part of the periodic reviews conducted by these accrediting bodies, visits have been made to Campus V to assess all essential aspects required for ensuring quality education. These include teacher training, faculty profiles, the number and academic rank of faculty members, as well as classroom and laboratory equipment, and campus infrastructure, among other elements.

From these visits, the most recent evaluation carried out by CIEES in 2021 identified the university cafeteria—commonly known as "La Nevería"—as one of the areas with potential for improvement. This was due to the fact that it is an open-air space and is significantly affected by various climatic factors of the region, which impact its comfort and usability. The evaluation committee explicitly recommended that the necessary modifications be made to this common area to meet minimum requirements. This implies a redesign of the space to address its current shortcomings. Similar to institutional strategies adopted in other Latin American universities [Tauber, Delucchi, & Olivieri, 2025], this redesign seeks to address not only climatic exposure but also food safety and hygiene standards. Food safety, in particular, is a growing concern in public dining services and has been identified as a critical area of intervention in broader regional studies [Ramírez Montero, 2025].

Based on the above, the present work focuses on generating the necessary adaptations to the university cafeteria ["La Nevería"] of the Faculty of Engineering – Campus V, in accordance with the need to increase seating capacity and to establish a secure, enclosed structure that protects against climatic and hygienic factors. It also aims to respond to the recommendations made by accrediting bodies during evaluation visits. All these efforts are supported by structural and geotechnical studies to optimize the available space. This approach seeks to provide a comprehensive perspective that contributes to informed decision-making when planning or executing infrastructure adaptations at the Engineering Faculty.

Historical Background

The Faculty of Engineering was established in 1958, beginning with the Civil Engineering program, housed at the current Campus I. In 1998, due to the need to grow in accordance with the demands of the 21st century, the decision was made to construct new facilities and relocate the faculty to Campus V, where it has been located since July 20, 2011. Currently, the faculty offers six undergraduate programs: Civil Engineering and Management, Energy Engineering, Mechatronics Engineering, Computer Systems Engineering, Electromechanical Engineering, and Software Technology Engineering. It also offers two graduate programs: the Master's in Renewable Energy and Energy Efficiency and the Master's in Engineering with a focus on Road Infrastructure.

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Each year, an average of 350 students enroll in the Faculty of Engineering, distributed among the six undergraduate and two graduate programs.

The Faculty of Engineering holds various accreditations for its academic programs. The Computer Systems Engineering undergraduate program is accredited by CIEES, having been granted Level 1 for a period of five years, valid from June 2017 to July 2022. The Civil Engineering and Management program is also accredited by CIEES, with the same Level 1 distinction and validity period. The Mechatronics Engineering program is accredited by CACEI for five years, from December 2017 to December 2022. The Energy Engineering program is accredited by CACEI for three years, from December 2019 to December 2022. The Civil Engineering and Management program also received a separate five-year accreditation from CACEI, valid from February 2020 to February 2025.

The graduate programs hold recognition from the National Postgraduate System [Sistema Nacional de Posgrado, SNP], awarded by Mexico's Secretariat of Humanities, Science, and Technology [SECIHTI]. Additionally, the Faculty of Engineering maintains active membership in the National Association of Faculties and Schools of Engineering [ANFEI].

It is crucial for the Faculty of Engineering to maintain these accreditations in order to ensure that its academic programs meet nationally recognized quality standards. These accreditations support the pursuit of high-quality education and drive the institution to continually evaluate and improve its processes and programs. This commitment to continuous improvement benefits the entire academic community.

Social impact

To contribute to the improvement of common-use area infrastructure by creating a comfortable, functional, and suitable environment for students, faculty, and administrative staff. This will enhance the educational experience for students and provide an appropriate setting for visiting faculty and exchange students, as well as for the general public visiting the facilities of the Faculty of Engineering at the Autonomous University of Campeche [Campus V].

Case study description

The adaptation study was conducted at the facilities of CAMPUS V [Faculty of Engineering], located in the northeastern part of the city of San Francisco de Campeche, in the Ex-Hacienda Kalá neighborhood [19.8456° N, 90.4774° W], covering an area of 39,949.19 m². Figure 1 illustrates the spatial layout of the Faculty of Engineering facilities, where the architectural plan begins with a concentric organizational core represented by Building A, aligned along a north–south axis defined by Building B. From this axis, Buildings E and F extend westward, and Buildings C and D extend eastward in a staggered arrangement, with the main entrance serving as the pivot point.

Box 1

Figure 1
Layout Plans of the Faculty of Engineering
Source: Authos' own work

Within this complex, the university cafeteria known as La Nevería is located to the west of Buildings E and F, occupying a surface area of 183.83 m². An interior comfort adaptation is proposed for this space.

In its current condition, the cafeteria consists of a steel structure with a polycarbonate sheet roof, and its sides are open to the elements.

This configuration makes the space unsuitable for prolonged occupancy due to high temperatures and the intrusion of dust and debris carried by the wind.

Current state of the building

Currently, the cafeteria is comprised of a steel structure and a polycarbonate sheet roof [Figure 2].

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Polycarbonate, when exposed to UV light due to its molecular structure, undergoes degradation and becomes brittle over time. Similarly, part of the cafeteria is open to the elements on its sides, which prevents comfortable use of the space due to high temperatures, dust and debris carried by the wind, as well as heavy rains combined with strong winds, making the cafeteria unusable during certain times of the year.

Box 2

Figure 2

Current status of the building at the Faculty of Engineering

Source: Authors' own work

During the field visit to the existing university cafeteria, surveys were conducted to confirm the project dimensions and carry out the necessary adjustments. Observations were made for the proposed renovations, which include: maintenance of the masonry structure and concrete columns in the kitchen area [kitchen storage, service area, and breakfast room]; use of the existing building as structural support for the new construction; modification of the slab and the retaining wall to allow for the expansion of the university cafeteria; inclusion of special installations [such as the placement of solar panels on the roof] in the load analysis; consideration of a potential expansion of the building; and the proposal to apply the same structural system criteria used in the classrooms adjacent to the cafeteria.

Adaptation proposal

A rectangular-shaped space is proposed to optimize the distribution of service tables, using the same existing area and accommodating up to 60 consummers. A ceiling height of 3.6 m is considered to enhance thermal comfort, featuring a skylight for natural ventilation, oriented north to capture prevailing winds from that direction.

The integration of floor-to-beam window walls is also proposed to take advantage of cross ventilation during winter and to ensure natural lighting throughout the year [on the east and south sides].

On the west-facing side, a blind wall with small openings near the ceiling is proposed to allow natural extraction of warm air from space. On the east side, the façade design includes a cantilevered slab that covers more than 90% of the glass walls to help mitigate solar heat gain. On the south façade, a vertical green wall is planned to reduce solar radiation while also creating a refreshing ambiance through vertically arranged vegetation.

The interior layout includes a service counter where students can work with their electronic devices. The proposal also includes electrical outlets and voice and data service points. To ensure a comfortable environment, air conditioning vents with grilles are designed along the central axis of the cafeteria, as well as indirect lighting concealed within a false ceiling, adding dynamism to the interior design composition. The exterior design aligns with the overall minimalist architecture of the campus complex [Figure 3].

Box 3

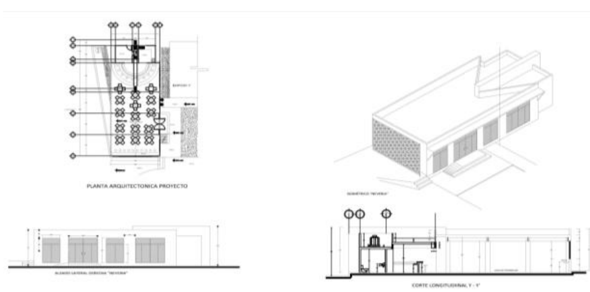

Figure 3

Architectural design proposal for the schoolar cafeteria

Source: Authors' own work

The energy department, having already obtained approval for the architectural plans, proceeded with the analysis of artificial lighting and environmental conditioning needs through vents and the air conditioning system. This included the development of calculation reports and the preparation of the corresponding technical drawings.

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Design criteria

The design was divided into two stages: [i] the first involved conducting the corresponding load analyses; [ii] the second involved performing the structural analysis. The structural project was governed by the following codes:

- Complementary Technical Standards on Criteria for Structural Design of Buildings. Official Gazette of Mexico City [2017a].

- Complementary Technical Standards for the Design and Construction of Concrete Structures. Official Gazette of Mexico City [2017b].

- Complementary Technical Standards for the Design and Construction of Masonry Structures. Official Gazette of Mexico City [2017c].

The design was complemented by local research literature on materials and construction procedures.

Structural load analysis

Two categories of loads were considered based on the duration during which they act on the structures at their maximum intensity: permanent loads and variable loads. The final use of the structure was taken into account to define the variable loads.

The combinations of DEAD LOAD + LIVE LOAD and DEAD LOAD + SELF-WEIGHT were used to check the Serviceability Limit States in accordance with the Complementary Technical Standards on Criteria and Actions for Structural Design of Buildings Official Gazette of Mexico City [2017a]..

The load analysis for the mezzanine is shown below [see Table 1], as well as the loads considered for the rooftop [see Table 2].

Box 4

Table 1

Mezzanine slab loads

Beam-and-block slab [12-5 beam and 15x25x56 block] Loads on mezzanine slab [kg/m²]	
Self-weight of slab with length = 4 m	291
Additional live load according to RECDMEX-2017	40
Installations	20
Ceiling finishes with 2 cm thickness	42
Mortar for ceramic tile bonding with 3 cm thickness	42
Ceramic tile floor	25
Partition walls and special installations	100
Total dead load	**560**
Live load according to NTC & DC. [2017a] [kg/m²]	**350**
Service loads	910
Amplified loads 1.3 x dead load + 1.5 x live load [kg/m²]	1253

Source: Authors' own work

Box 5

Table 2

Rooftop slab loads

Load on rooftop slab [kg/m²] Beam-and-block slab [12-5 beam and 15x25x56 cm block]	
Self-weight of slab with length = 4 m	291
Additional live load according to NTC & DC. [2017b]	40
Top finish of calcrete [filling and waterproofing]	264
Installations	20
Mortar ceiling	42
Total dead load	657
Live load according to NTCDMX 2017	100
Service load	767
Amplified loads 1.3 × dead load + 1.5 × live load	1004

For the mezzanine slab, it is proposed to use 12-5 beams with blocks measuring 15 cm x 25 cm x 56 cm, topped with a 5 cm thick compression layer. Table 1 details the specific loads calculated for the mezzanine, including the slab's weight and other elements, to ensure that the cafeteria is a safe and functional building.

For the rooftop slab, it is proposed to use 12-5 beams with blocks measuring 15 cm x 25 cm x 56 cm, also with a 5 cm thick compression layer.

Table 2 refers to the loads supported by the rooftop slab, which is located at the top of the building. It mentions the loads involved, as well as installations such as pipes or electrical systems that may be present.

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Table 3 helps to understand how much weight the mezzanine slab can support and how these loads are properly distributed, so the slab is not affected by factors such as the type of material, its thickness, or the way it is supported.

Box 6

Table 3

Rooftop slab loads

Mezzanine slab loads [kg/m²] Loads on mezzanine slab in reinforced concrete slab	
Self-weight of slab with length = 4 m	384
Additional live load according to NTC & DC. [2017c]	40
Installations	20
Ceiling finishes with 2 cm thickness	42
Mortar for ceramic tile bonding with 3 cm thickness	42
Ceramic tile floor	25
Partition walls and special installations	100
Total dead load	**653**
Live load according to NTCCDMX 2017 [kg/m²]	**350**
Service loads	1003
Amplified loads 1.3 × dead load + 1.5 × live load [kg/m²]	1373

Source: Authors' own work

To carry out all this design and calculation, it was essential to perform a structural analysis to ensure that the construction can withstand the loads without compromising its strength. Figure 4 highlights the area covered with a reinforced concrete slab; for this reason, the building will have two slab systems for construction purposes.

Box 7

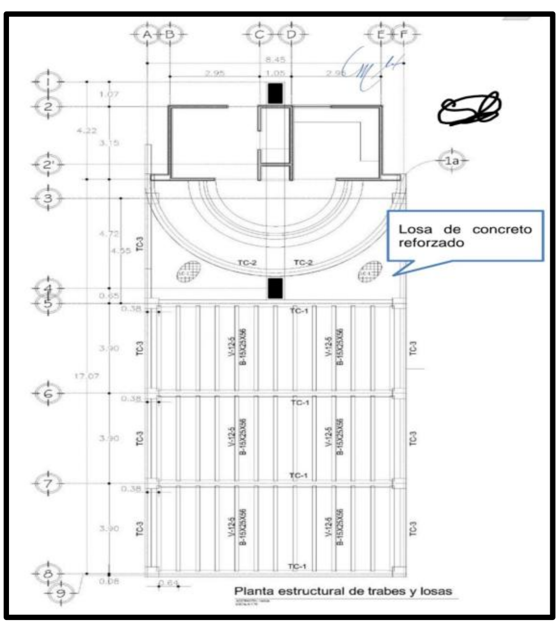

Figure 4

Structural plans of beams and slabs

Source: Authors' own work

Structural analysis for building improvement

Foundation

The bearing conditions of the supporting subsoil were determined based on previous geotechnical studies conducted near the site by a local company. These studies indicate an allowable bearing capacity of 20.0 Ton/m² at a depth of 1.50 m, from the natural ground level to the resistant stratum.

For the column loads, concentric spread footings type Z-1 made of reinforced concrete were designed, along with their respective foundation pedestals. These footings are connected by tie beams of type CT-1. These must include a leveling course built from hollow vibro-compacted concrete blocks, filled with concrete and reinforced with a 3/8" rebar embedded every 60 cm, plastered on both faces, and topped with a 15x30 cm foundation beam reinforced with four 3/8" rebars and ¼" stirrups every 15 cm [Macgregor, 1997].

For wall loads, continuous stone masonry footings are provided, topped with a 15x20 cm foundation beam reinforced with four 3/8" rebars and ¼" stirrups spaced every 15 cm. Additional requirements [González Cuevas, O., & Femández Villegas, F., 2013]:

- A 5 cm thick plain concrete blinding layer [f'c = 100 kg/cm²] must be provided under all footings to support the rebar framework.
- All reinforcement bars must be bent or hooked at their ends for proper anchorage.
- Rebars for columns and wall piers must be bent and tied to the main reinforcement of the footings.
- Reinforcement steel must be corrugated bars with a yield strength of fy = 4200 kg/cm² in the specified diameters.
- A minimum concrete cover of 5 cm must be maintained for all main reinforcement.
- All foundation elements must be waterproofed.
- The structural concrete for footings, pedestals, and foundation beams must have a compressive strength of f'c = 250 kg/cm² and should be poured dry.

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Slabs

For the foundation, roof and intermediate floor slabs are designed using precast prestressed concrete joists, type 12-5, combined with vibro-compacted hollow concrete blocks measuring 15 cm x 25 cm x 56 cm, both commercially available in the area. Specifications regarding depth and spacing indicated in the structural plans must be strictly followed. A 5 cm thick hydraulic concrete topping layer with a compressive strength of f'c = 200 kg/cm² is placed over the surface, reinforced with welded wire mesh 6-6/10-10 for thermal cracking control, with a minimum concrete cover of 1.5 cm.

Beams

The beams will carry the loads from the concrete slabs, for which three types of beams were designed: TC-1, TC-2, and TC-3. All beams shall be made of reinforced concrete with a compressive strength of 250 kg/cm².

Columns

The columns transfer the loads from the concrete beams. They are designed as type C-1 columns with dimensions of 45 cm x 45 cm, using hydraulic concrete.

The top of the columns must be level with the bottom face of the slab or beam to be supported. It is preferable to chip off a portion of the column for proper bearing of the beam or slab, rather than adding a segment during casting.

General Specifications

Regarding additional structural considerations: the spacing between reinforcement bars in structural elements must not be less than 1 inch. When parallel reinforcement is arranged in two or more layers, the bars must be aligned vertically with a minimum clear spacing of 1 inch between layers.

Anchorage hooks or bends must be formed cold, with a minimum length of twelve times the diameter of the bar, unless otherwise specified. Splicing and lap lengths must be at least forty times the bar diameter.

A pre-mixed permeable concrete blend was used to achieve uniform mixtures; in all cases, appropriate dosage for the design strengths must be ensured. Quality control of the concrete should be maintained by sampling for compressive strength testing at 7, 14, and 28 days.

For structural elements with cross-sections greater than 20 cm, a minimum concrete cover of 5 cm is required; for sections less than 20 cm, a minimum of 3 cm cover is required from the surface to the reinforcement. Mortars must have a mix proportion that ensures a minimum direct compressive strength of f'c = 40 kg/cm² at 28 days. The specifications above must be complemented by Official Gazette of Mexico City [2017a]. and the Construction Regulations for the Municipality of Campeche [Ayuntamiento de Campeche, 2015].

Architectural Design and Construction Process

The render prepared for the cafeteria renovation offers a clear and realistic vision of the project, highlighting its spaciousness and functionality [Figure 5]. With a design tailored to meet the needs of the large student population of the engineering faculty, the space is intended to be welcoming and efficient. The wide entrance and large windows ensure good natural lighting and ventilation, creating a comfortable environment. Additionally, the integration of solar panels reflects a commitment to sustainability, enabling more environmentally friendly operation of the facility. This not only benefits the environment but may also help reduce long-term operational costs.

The project focuses on creating a recreational space that invites students to enjoy pleasant moments. This place will not only serve as a food service area, but will also provide a comfortable space to rest and socialize with friends. Moreover, it addresses the need for shelter during hot or rainy days, ensuring the space remains functional under various weather conditions. With a cozy and attractive design, the project aims to foster community and student well-being, turning the cafeteria into a key meeting point for the faculty.

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Box 8

Figure 5
Rendered Design Proposal of the Building
Source: Authors' own work

Results

First Stage

Before beginning construction, it was essential to prepare the site to ensure a stable foundation. The existing structure was dismantled, and debris and objects that could affect the construction were removed [Figure 6]. The ground was leveled to prevent issues with unevenness in the foundation. Layout work was carried out, marking the exact location of walls and structural axes [Figure 7]. Trenches for the foundation were excavated according to the structural plans.

Box 9

Figure 6
Dismantling of Existing Structure
Source: Authors' own work

Box 10

Figure 7
Layout, Leveling, and Excavation for Adaptations
Source: Authors' own work

Box 11

Figure 8
Foundation
Source: Authors' own work

For this project, an allowable bearing capacity of 20 Ton/m² was specified for the supporting soil stratum, with a depth of 1.50 m from the natural ground level to the resistant layer.

Concentric footings of type Z-1 made of reinforced concrete were designed, along with their corresponding foundation pedestals [Figure 8].

These footings were connected by tie beams. Reinforcing steel was placed according to the structural plans, formwork was installed to contain the concrete, which was then poured and allowed to cure properly.

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Second Stage

Reinforced with rebar and concrete, beams and girders were installed to support the slab. The slab was assembled with reinforcing steel, formwork was placed, and concrete was poured. Ducts and pipes for electricity, water, and drainage were embedded in the walls and slabs [Figure 9].

Box 12

Figure 9

New structure of the building

Source: Authors' own work

After completing the structure, the finishes that provide both aesthetics and functionality to the building are carried out [Figure 10]. Layers of cement and sand are applied to the walls for a uniform finish. Ceramic flooring is installed, with coatings applied in the bathrooms and kitchen to protect against moisture. Door and window frames are installed in the required areas. A paint layer is applied to walls and ceilings, along with waterproofing of the roof to prevent water infiltration.

Box 13

Figure 10

Masonry Work and Facade Finishes of the Building

Source: Authors' own work

Third Stage

Once the finishes were completed, the building's functional systems were installed [Figure 11]. Switches, outlets, and lamps were installed through conduit piping, along with an electrical panel equipped with proper protections and connections. All wiring was concealed behind drywall panels mounted on an internal framework made of metal profiles. Installations were also made for the kitchen area, including piping for the stove and other gas appliances, potable water connections, as well as drainage and sewer lines. Cabinets were installed in the sink area.

Box 14

Figure 11

Electrical and Plumbing Installations in the Renovated Building

Source: Authors' own work

Conclusions

The development and execution of the adaptation project for the cafeteria at Campus V of the Faculty of Engineering have yielded substantial and measurable improvements, both in functional terms and in the quality of the built environment.

One of the most significant outcomes was the expansion of the usable area, which directly translated into an increased capacity to serve a greater number of users simultaneously. This improvement not only addresses a longstanding need within the faculty but also enhances the daily experience of students, who now benefit from a safer, more hygienic, and more pleasant space for dining and social interaction.

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From a technical perspective, the construction adhered strictly to the structural plans and local building regulations. Reinforced concrete footings, beams, and slabs were implemented using high-quality materials and following standardized procedures, ensuring the building's long-term structural stability. Every phase of construction—from site clearance and excavation to the placement of reinforcement, formwork, pouring of concrete, and controlled curing—was carefully supervised to comply with the required specifications and performance criteria.

The project also included essential finishes that contributed to both durability and aesthetics. Smooth plastering of walls, the installation of ceramic flooring and wall tiles, and high-quality waterproofing of the roof collectively enhanced the building's functionality and resilience to environmental conditions. Moreover, the integration of aluminum doors and windows, electrical and hydraulic systems, and gas and drainage lines was executed efficiently to ensure the comfort and safety of future users.

Architecturally, the cafeteria was designed with sustainability and user well-being in mind. The inclusion of large windows improves natural ventilation and lighting, while the installation of solar panels reflects a commitment to environmentally responsible design. These features not only reduce the ecological footprint of the facility but also align with global trends in sustainable construction and energy efficiency. In this regard, the project resonates with broader academic perspectives that emphasize the role of universities in promoting sustainability through their physical and educational environments. As highlighted in the case of the Universidad Católica de Manizales, the construction and adaptation of campus spaces must integrate academic, physical-spatial, and institutional dimensions to foster sustainable development in higher education institutions [Hernández-Araque, 2016].

Overall, the project met its objectives by delivering a high-quality, multi-functional space that reflects the academic and social values of the Faculty of Engineering. The cafeteria now stands as a vital communal space where students can gather, relax, and recharge.

Additionally, the building was structurally prepared for potential future vertical expansion, demonstrating foresight and adaptability in its design. This project is a clear example of how thoughtful planning and professional execution can significantly enhance the campus infrastructure, contributing to a better educational environment.

Declarations

Conflict of interest

The authors declare no interest conflict. They have no known competing financial interests or personal relationships that could have appeared to influence the article reported in this article.

Authors' Contribution

The contribution of each researcher in each of the points developed in this research, was defined based on:

Yx-Sonda, Andrés: was responsible for drafting the manuscript and preparing the technical reports related to each construction phase.

Flores-Chinchilla, Mariela: contributed to the writing of the original version of the manuscript and documented the project through photographic records.

May-Tzuc, Oscar: collaborated in the writing of the final version of the manuscript and participated in the development of the methodological framework.

Cruz y Cruz, Andrea del Rosario: supervised the overall project development and verified the accuracy and execution of structural calculations.

Barrera-Lao, Francisco Javier: served as the project leader and principal investigator, overseeing the initiative and securing the necessary funding for its implementation.

Availability of data and materials

The structural and architectural plans used in the project are available upon request from the Faculty of Engineering at the Autonomous University of Campeche. Photographic records and construction reports were generated directly by the project team and are available from the corresponding author upon reasonable request.

No proprietary or third-party data were used in this work.

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Antecedents

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