

# Post-Occupancy Evaluation Study of an Educational Building in Mexico:

## Occupant's perception vs. occupancy survey

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***ABSTRACT:** This paper presents the results of an assessment of a higher education building located in the city of Puebla in Mexico. The research carried out is a post-occupancy evaluation study of a building built forty years ago but still very heavily used. The building is covered by four concrete shell structures joined together by a translucent dome. A focus group and a questionnaire provided us the views of the building users regarding environmental factors, aesthetics and functionality of the building. People's perceptions have been compared with the results of an occupancy survey, which has shown how people is using the building, peak usage times and space occupancy. Improvements to the building are suggested based on the data obtained. The main aim of this research is to improve the interior environment of the building while learning from it in order to design new good quality and sustainable education buildings.*

***Keywords:** post-occupancy evaluation, comfort, education building, user's perception.*

### INTRODUCTION

People's perception regarding the built environment has been studied for the past thirty years. However, very recently these Post-Occupancy Evaluation (POE) studies have taken a new perspective and a greater importance for designers, developers and clients [1]. The reason is the increasing awareness of people towards the preservation of our natural environment, the imperative reduction of fossil fuels as energy sources, the importance of energy efficient design of buildings and users' comfort. The latter is highly important in order to design for people, minimising absenteeism, sick building syndrome symptoms and reducing energy consumption by knowing how and when people use certain spaces [2].

This paper presents the results of a POE assessment of an educational building located in the city of Puebla in Mexico. The building is called La Monja Cultural Centre and is part of the Architecture Faculty of the University of Puebla (BUAP). La Monja is covered by four concrete shells joined by a central translucent dome. This building is an iconic university structure not only for the Faculty of Architecture but also for the whole university campus. It is a place where activities such as lectures, seminars and exhibitions take place. There are also some offices, a computer room and cafe on the ground floor. Due to the shape of the roof the building is commonly known as 'la Monja' or the 'Nun building' (Fig. 1). La Monja was built in 1969 and designed by architects Miguel Pavón Rivero and Jorge Belches Landero. Even though the

building has suffered several changes in its interior design, it has always been used for educational purposes.



Figures 1 (up) and 2 (above): Exterior views of La Monja building.

La Monja is a two-storey building. It has been modified in its interior layout several times in order to adapt it to the Faculty's space needs. In 1969 the Architecture Faculty had 800 enrolled students, while today it has 2,800 students in seven different programmes, hence the lack of space is an important issue for the Faculty and space adaptations have been done quickly and without a long term plan.

## METHODOLOGY

The main objective of this research is to identify environmental factors in the building that restrict their use or make unbearable to perform certain activities in it. Furthermore, it is necessary to determine if there are certain areas underutilised and the reasons for that. This is important since the student population of the Faculty is 2800 people, there are almost 200 academic staff and 32 admin staff; therefore, the Faculty is always short of space. Moreover, economic and environmental consciousness is forcing architects and managers to consider energy efficiency of buildings obtained mainly by a better use of buildings.

A focus group with 12 people, academic staff, admin staff (who particularly work in this building), undergraduate and postgraduate students, was organised. Participants were asked to discuss the issues or characteristics of the building that influence their work when they are in La Monja. Proposals were suggested to improve the environment and functionality of the building and its surroundings. Questions used in the focus group followed a set of categories based on CABA's Design Quality Indicators: functionality, build quality and impact on its surroundings [3]. In addition, a space occupancy survey (SOS) was carried out during five working days during Summer Term in July 2008.

The survey consisted on observing every hour (from 7am to 8pm) the usage of the building recording the number of people utilising each space and the activity they were performing. Activities included: taking class, working in a group, working with a computer, talking on the phone, talking, having coffee or eating. Occupants' perception recorded during the focus group discussion plus results from a previous users' survey [4] are compared against the SOS data. Suggestions for improving the building space use and interior environment are included.

## RESULTS

**Focus Group** It was held in April 2008 during a two-hour session where people were asked 11 main questions that derived in a vast amount of comments and discussion between all of them. Participants of the focus group included people with different jobs or

responsibilities within the Faculty: 6 architecture and graphic design professors, 1 postgraduate student, 2 undergraduate students, the administrative director of the Faculty and 2 admin staff.

People gave their views according to a set of categories based on CABA's Design Quality Indicators (DQI) developed for post-occupancy evaluation of schools [3]. The following is a summary of their opinions.

### Functionality

- *Access:* No handicapped access. No emergency exits. Bad signaling outside and inside the building. No service entrance. Staff parking with pavement that allows plant grow, there are some trees. There is any physical relationship with other Faculties.
- *Spaces:* Lecture theatres, computer room, hot desks for academic staff, cafeteria, offices, storage area, and 3 terraces.
- *Use:* Conferences, lectures, seminars, degree examinations. Does not follow its original purpose: exhibition and cultural centre. Interior areas never had specific uses.

### Build quality

- *Structure:* One of the finest concrete shell structures in Puebla. The dome is an attractive structure. The central interior translucent pyramid has no purpose. "It's an untouchable structure", "it has not been possible to make changes to the structure because no one has been brave enough". The building has four identical facades that do not respond to orientation.
- *Installations and services:* No toilets on the first floor. IT installation everywhere in the building.
- *Environmental quality:* Thermal discomfort: especially in lecture theatres (high temp.). Translucent pyramid absorbs heat and radiates it to interior spaces. Thin concrete shells transmit heat to lecture theatres. Acoustics on the ground floor are bad despite the cork panels.
- *Furniture and décor:* Uncomfortable furniture does not help to use the spaces in a flexible way. Cork panels used as interior divisions on ground floor.

### Impact

- In the city and the university campus: Iconic building. Represents an important style of Mexican architecture.
- *In the Architecture Faculty:* Representative building, it is the logo of the Faculty. All important events are held in this building.
- *Shape and materials:* Unusual and attractive shape, good for acoustics. Ground floor is windowed and first floor is covered by concrete shell roofs and a polycarbonate dome.
- *Character and innovation:* It has a lot of character but it is not functional.

### Suggestions to improve the building

- 1) Include passive systems and eco-technologies.
- 2) Consider good and bad decisions over time.
- 3) Remove old windows and replace them with double-glazing openable ones.
- 4) Give users control over their environment.
- 5) Green roof for thermal control.
- 6) Use of terraces for cross ventilation and stack effect through central dome.
- 7) Introduction of natural ventilation in lecture theatres.
- 8) Landscape design.
- 9) Rescue former features like the central staircase to improve relationship between two floors and contribute to stack effect.
- 10) Improve security for exhibitions and art pieces.
- 11) Planning for future needs. Integral approach for future planning considering comfort as a top priority.
- 12) Use of air as insulation.
- 13) Different solutions for each facade according to orientation.
- 14) Use same colors as in other university buildings to integrate La Monja into the campus.
- 15) Organize education campaigns to avoid vandalism in the buildings and to promote sustainable actions.
- 16) Improve maintenance actions.
- 17) Include a peripheral porch to serve as a thermal cushion, rain protection and to provide outside views.
- 18) Include support spaces such as storage for cleaning material, vending machines, reading areas.

Overall, participants of the focus group pointed out issues that influence the performance of the activities and humors of the users of La Monja. Those issues directly correspond to the results and conclusions obtained from a **users' survey** carried out during April 2008. The main aim of the survey was to gather information regarding users' perception towards the interior environment of La Monja. A total number of 494 questionnaires were answered by students representing 17% of the total number of enrolled students, while 32 were answered by Faculty staff, which also represents 17% of the total number of academic and non-academic staff [3].

Occupants were asked to give their impressions regarding the interior environment of the building. Most students think it is neutral or bad, while most staff respondents were more critical saying that the environment of La Monja is bad and very bad (Fig. 3) [3]. One third of the staff stated that the quality of daylight is bad/very bad for the activities they perform in the building. On the other hand, users believe the acoustics of the building is not too bad while others believe it is good/very good. Most of them think the shape of the concrete shells contribute to the quality of the acoustics of La Monja, particularly in the seminar rooms which are located underneath the concrete shells.

However, some people reported bad acoustics on the multiple use area on the ground floor, regardless of the cork panels; particularly when it is divided into smaller rooms and all are used at the same time.

Finally, thermal control (temperature) and ventilation are the environmental aspects that were rated by most staff and students as being very bad and bad.

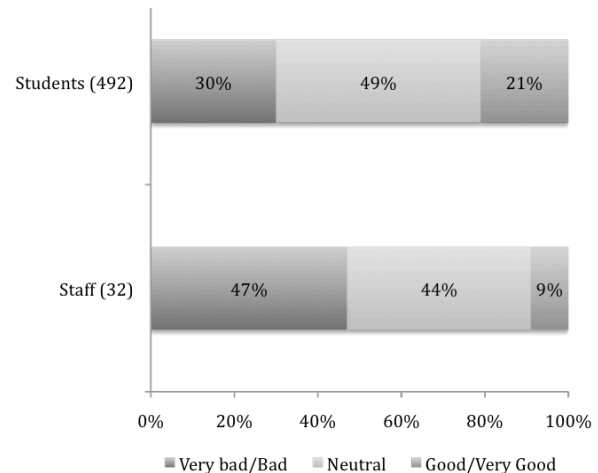


Figure 3: Users perception of the interior environment (source: 3).

**Space Occupancy Survey (SOS)** Results from the SOS showed some interesting considerations that need to be taken into account in order to preserve La Monja in good conditions and as an iconic building. This basically means: improving its environmental approach as well as increasing users' comfort. During the 5 working days of the SOS observations were made by four people. They followed two different routes registering every hour the number of people present in each space of the building and the activity they were performing at that moment. Results are presented in the tables below (Tables 1 and 2).

Table 1: Space Occupancy of La Monja Cultural Centre during five working days of the Summer Term (2008 data).

No. of people	TOTAL	HOT DESKS FOR LECTURERS	COMPUTER ROOM	OTHER AREAS (corridors, halls, waiting area, spare chairs, storage, kitchen)
<b>TOTAL SPACE CAPACITY</b>	<b>802</b>	<b>9</b>	<b>23</b>	<b>60</b>
Total number of visitors (5 days)	<b>3261</b>	66	258	558
Average no. people observed/day	<b>652</b>	13	52	112
Maximum capacity within 70 observ. (no. of people)	<b>56140</b>	630	1610	4200
<b>% of Occupancy</b>	<b>6</b>	<b>10</b>	<b>16</b>	<b>13</b>
% of visitors vs. total no. of staff and students of the Architecture Faculty	<b>21%</b>			

Table 2: Space Occupancy of La Monja Cultural Centre during five working days of the Summer Term (2008 data).

No. of people	TOTAL	OFFICES	4 LECTURE THEATRES	TERRACES (1st floor)	CAFETERIA	MULTIPURPOSE AREA
<b>TOTAL SPACE CAPACITY</b>	<b>802</b>	<b>16</b>	<b>469</b>	<b>30</b>	<b>95</b>	<b>100</b>
Total number of visitors (5 days)	<b>3261</b>	100	1686	17	414	162
Average no. people observed/day	<b>652</b>	20	337	3	83	32
Maximum capacity within 70 observ. (no. of people)	<b>56140</b>	1120	32830	2100	6650	7000
<b>% of Occupancy</b>	<b>6</b>	<b>9</b>	<b>5</b>	<b>1</b>	<b>6</b>	<b>2</b>
% of visitors vs. total no. of staff and students of the Architecture Faculty	<b>21 %</b>					

From the above tables it is possible to identify the occupancy percentage of the case study building, which is 6%. This figure was obtained considering the total capacity of La Monja (maximum number of people that can use the building at the same time) and the total number of people observed in the building at the same time (average no. of people per hour) during the SOS. This shows a low occupation of the building, although the total number of people observed during the five days of observation sounds shocking: 3,261 people used the building.

The least utilized areas according to this study are the three terraces located on the first floor (Fig. 4, 5), with only 1% occupancy. These terraces lack of proper exterior furniture, are not integrated into the main hall and corridor of that floor and the main problem is that the doors that communicate the hall with the terraces are most of the time locked. This problem was also raised by the focus group and through the questionnaire, where people pointed out this as one of the reasons of having bad ventilation on that floor.

Moreover, the multipurpose area located on the ground floor (Fig. 6) is also under-utilized with only 2% of its capacity. Originally, all the ground floor was a big open plan area for exhibitions. Currently, the floor has been divided to host the cafeteria, office space, storage space and one computer room. A central area with access through the main entrance of La Monja is considered to be a "flexible" space where special events take place, students work exhibitions, seminars and workshops. Furniture can be arranged to suit the event. However, there seems to be too few activities taking place in this area, or the activities that are held there are performed by only a few people. Hence, the space is not utilized to its full capacity.

On the other hand, the area of the building with a highest utilization rate is the computer room (16%). This room is used by graphic design students. Two main reasons have been identified as causes of this effect: it is the only computer room with Mac computers in the Faculty running special software for the graphic design college, and computer lectures are taught in this room forcing people to use it.



Figure 4: Interior view of the door and windows that communicate to one of the terraces.



Figure 5: Exterior view of one terrace, 1<sup>st</sup> floor La Monja building.



Figure 6: Multipurpose room with movable partitions (ground floor).

In general, the peak utilization times of La Monja are between 10am to 5pm. Lecture theatres are mainly occupied from 10am to 2pm, and from 5 to 10 pm. Office areas are occupied from 8 and 9am. The busiest time of the cafeteria is from 12 to 5 pm. Although Summer Term at the University of Puebla is a regular and compulsory term for students, it seemed necessary to carry out a second SOS during the Autumn Term in order to have a wider picture of the use of La Monja building. This study

was then repeated during a week of the Autumn Term in 2008. Comparisons of results from both studies are still in process but it is clear that the building needs to be refurbished in a very sensible way considering: comfort, furniture, materials, its place and relevance within the Faculty and other university buildings and new ways of teaching and learning.

## CONCLUSION

This paper is a short version of the POE study carried out in an iconic university building. It is part of the Faculty of Architecture and it is probably the most representative building of the university campus, it clearly shows the architectural style from the sixties when the university campus was built. The building is covered by four thin concrete shell structures that were allegedly calculated by Felix Candela.

The building has suffered several interventions mainly due to the rapid growth of the number of enrolled students in the faculty. Once again, La Monja does not meet the minimum requirements of comfort and functionality for a higher education building. And what is more worrying, the building does not meet the needs of the new education system of the University that demands flexible, comfortable, healthy spaces that people could adapt to the needs of each lecture, and where it would be possible for everyone to stay virtually communicated.

This POE study is to be translated into an architectural and organisational proposal for the building. According to some authors [5] POEs allow us to “diagnose the causes of specific building, organisational or individual (e.g. health) problems; to inform organisational change and...the future running of the building; to feed into the design process of future similar buildings... to inform the design process of that type of building in general”. As a conclusion it is possible to list the factors that need to be addressed in the refurbishment proposal:

- 1) Lighting, ventilation, thermal and acoustics design according to the climate of Puebla and the function of the building;
- 2) Removal of old air conditioning systems in computer room and lecture theatres;
- 3) Replacement of old windows and opening of new ones;
- 4) Furniture and décor need to lift the spirit and be comfortable and modern;

- 5) Rearrangement of areas going back to its original open plan area on the ground floor but considering the use of: natural light, natural ventilation and outside views.
- 6) Passive solutions and the use of technology such as Photovoltaic panels to reduce the energy consumption of the building;
- 7) Organisational change to increase the use of the building;
- 8) Improve the relationship between La Monja and other faculty buildings, and inside La Monja between entrance halls, corridors, terraces, etc.
- 9) Landscape design.

Finally, the refurbishment of the building will set precedent for other university buildings, in terms of converting it into a sustainable building, not demolishing but transforming a beautiful construction with three priorities: users comfort, adequate space utilization and energy efficiency. Future work with this case study includes field measurements of light, temperature, humidity and noise. Furthermore, it is intended to establish a database of higher education buildings in Mexico with information from other POEs.

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