

A CONDITION ASSESSMENT OF THE PROFILE AND NON-STRUCTURAL FACTORS OF THE BUILDINGS IN THE UNIVERSITY OF EASTERN PHILIPPINES

Abstract. This study discusses on the condition assessment of the profile and non-structural factors of the buildings in the University of Eastern Philippines was undertaken to determine the level of functionality of the building as perceived by the end users, to find out the serviceability of the buildings structure, and to assess the profile and non-structural factors of the buildings in the University of Eastern Philippines. The study utilized ocular/visual inspection, data and documents review, applying the instrument made by Coronelli, survey questionnaire as perceived by the end users, and the American Concrete Institute (ACI) guidelines on the condition of the selected buildings in the University of Eastern Philippines-Main Campus. Cracking of concrete are classified into structural and non-structural cracks. Non-structural cracking was observed in the buildings inspected and the College of Nursing is the most critical building in terms of cracks of the building. Furthermore, College of Science obtained 3.07 was perceived as most functional building according to the end users. The selected school buildings which are in need of repair are the College of Education and College of Nursing buildings.

Keywords: Buildings, Condition Assessment, Level of Functionality, Serviceability, Structural Engineering

1. Introduction

Buildings are among the important aspects in our daily lives, it is used for dwelling, establishments, and it is the art or business of assembling materials into a structure, a structure with roofs and walls, such as a house, school, store, or factory. The rapid growth and development of any institution will depend on the presence of structures or buildings which is a mere indicator that there is an improvement and development of the institution.

In some cases, the occurrence of natural calamities such as earthquake, typhoon, and many others, may cause damage and different effects to the structures. Most of the damages that are visually transpired are the presence of cracks on concrete, spalling of concrete, and many others. Furthermore, not only the occurrence of calamities and other natural phenomena may cause defects to structures but also due to aging or normal wear and tear of the structure. After the occurrence of natural phenomena particularly typhoon, earthquake and the likes, assessment, and evaluation of the building and other structures in the institution, should be carried out at reasonable time and standard.

Moreover, as far as the record of monitoring, assessment, and evaluation of the structures in this institution are concerned, no studies or records on condition assessment of the buildings in the University of Eastern Philippines were done yet.

It is, therefore, imperative that this study was conducted. Stakeholders of UEP will benefit from this study, since information and other data pertaining to the condition of buildings in the University of Eastern Philippines will be available. The results of this Study may serve as the basis for the recommendations and suggestions for the implementation of regular monitoring of the structures, and for the assessment condition of other building structures in general. In view of this concern, this study was undertaken to find out the status, and implications of the condition of selected existing buildings in the University of Eastern Philippines.

2. Methodology

Guidelines and tools for the status of the buildings were used for assessing of the condition of the buildings. The profile data of the buildings were secured from the Program, Planning and Development Office (PPDO), the secretariat of the Bids and Awards Committee (BAC), Property Office, and the Municipal Engineering Office (MEO).

Level of Functionality. The level of functional of the building as perceived by the end-users.

The formula was used the weighted mean.

$$WM = \frac{WF}{N}$$

where:

WM – weighted mean

WF – summation of weighted frequency

N – total number of respondents

In order to determine level of functionality, the interpretation of the result was used in the scoring and for the interpretation.

The scoring and interpretation for the level of functionality of the Building by the end users was based on the following categorization and quantification, to wit:

The respondents are ask to indicate as to how much or how far do they satisfied the ambiance of the building that the functionality answer the need or necessity of their lives on the extent of usage or the end user of the given building. Five (5) – point scale instrument for the functionality of the building. They are asking to evaluate and rate accordingly. The 5-point scales were the following: 5- fully functional, 4-mostly functional, 3-functional, 2-barely functional, and 1-poorly functional. Individual scores were summed up and made the basis for the range and interpretation and categorical description, to wit:

| Range | Interpretation |
|-----------|---------------------|
| 4.2 – 5.0 | - Fully Functional |
| 3.4 – 4.1 | - Mostly Functional |
| 2.6 – 3.3 | - Functional |
| 1.8 – 2.5 | - Barely Functional |
| 1.0 – 1.7 | - Poorly Functional |

The respondents in this study were end users of the buildings in the University of Eastern Philippines particularly the deans/head, staff, and students of which the number of samples will be pro-rated according to the number of employee of the building in the institution, using Slovin's formula.

Research Instrument.

Survey Questionnaire that elicits responses on the functionality of the buildings as perceived by the end users that the statement on the questionnaire was adopted from the instrument made by the Accrediting Agency of Chartered Colleges and Universities in the

Philippines (AACCUP) particularly in Area VIII-Physical Plant and facilities letter B in the instrument which was refer to Building.

Status of the Selected Buildings in Terms Serviceability. The Rapid Condition Assessment Tool adopted from Coronelli (2007) was used to assess the condition of the buildings in terms of serviceability on whether the building needs renovation, rehabilitation, and repair.

Assessment of the Selected Buildings. The Assessment of the buildings included preliminary survey and detailed investigation using the Rapid Condition Assessment Tool. The preliminary investigation dealt with the initial assessment of the concrete structure's behavior, condition and existing performance. It involved the following tasks:

- a. Documents review;
- b. Site inspection; and
- c. Preliminary analysis

The researcher of this study conducted visual assessment of the selected buildings through photographic recordings of images on distress areas that are visible with the naked eye. Photographic images of the distress areas within the selected buildings were captured using digital cameras during the in-site assessment to gather information needed for this study.

Detailed specification focused on specific building elements for condition evaluation. The elements primarily include columns, slab, and beams. Walls were also included even if it is non-load bearing in nature because it is involved in the overall rating of the structure. The component tools of the detailed investigation were divided into six aspects: plan frame, critical areas, visible deterioration, building component, condition rating, and the recommendation part.

The buildings and other vertical structures in UEP-Main Campus were based on the structures which has merely two-storey buildings beyond 15 years of age from the date of acquisition/completion were all included for sampling procedure corresponding to the condition of the buildings.

Rapid Tool Assessment Instrument of the buildings was used to assess the status of the selected building in the University of Eastern Philippine in terms of serviceability. Serviceability. The structural factor, as adopted for the study of Coronelli, gives the relative importance of each structural element, is shown below. After examining the structural component, damage of each individual element will be rated.

Table 1: Structural Element Factor values for Framed Buildings (Adopted from Coronelli, 2007)

| Structural Element Factor | |
|---------------------------|-----|
| Columns | 1.2 |
| Beams | 1.1 |
| Slabs | 0.3 |
| Walls | 0.0 |

Condition Rating. The condition rating is a numerical score given to the structure relative to its most deteriorated case. The score can range from 0 to 100 % with 100% representing the worst case scenario or the case in which all members are deteriorated. A brief description of each of the deterioration case is shown below.

Table 2: Condition rating and corresponding deterioration class with description

| Deterioration Class | Description of the condition | Rating |
|---------------------|--|---------|
| I | No defect, Only construction deficiencies | 0-5 |
| II | Low degree deterioration, which only after a long period of time might be the cause for reduced serviceability or durability of the affected structural component, if not repaired in proper time | 6 – 10 |
| III | Medium degree deterioration, which can be the cause for reduced serviceability and durability of the affected structural component, but still not requiring any limitation of use of the structure | 11 – 15 |
| IV | High degree deterioration, reducing the serviceability and durability of the structure, but still not requiring serious limitation of use | 16 – 25 |
| V | Very heavy deterioration, requiring limitation of use, propping of most critical components, or other protective measures | 26 - 35 |
| VI | Critical deterioration, requiring immediate propping of the structure and | > 36 |

strong limitation of use, for example, closing

The form included two condition ratings as follows:

LOCAL Condition Rating (LCR)

The local condition rating or LCR was the rating for each of the building component.

This included individual ratings for beams, columns, floor slabs and walls.

The LCR was computed as:

$$LCR = \frac{\sum B_1 K_2 K_3 K_4}{72} \times 100\%$$

where:

- B1 is the basic value of ith damage type, expressing its potential effect on the safety and durability of the structural component under observation; values range 1–4;
- K1 is the structural element factor characterizing its importance for the safety of the whole structure or one of its parts;
- K2 is the intensity factor for the ith damage, determined by qualitative visual criteria and experimental measurements in a scale of four degrees, with the corresponding numerical values $K_2 = 0.5, 1, 1.5, 2$;
- K3 is the extension factor for the ith damage within the elements under consideration, defined uniquely by descriptive criteria and applied in a scale of $K_3 = 0.5-1.0-1.5-2$;
- K4 is the urgency of intervention factor for the ith damage, with values varying from 1 to 5, grouped into four classes on the basis of direct consequences of the deterioration type on the safety of the structure and the users, and related to an indication of time for intervention.

GLOBAL Condition Rating (GCR)

The global condition rating gave the condition index of the structure as a whole considering all the structural components. It was the condition rating for the whole building. It was computed as:

$$GCR = \frac{(1.2 * LCR \text{ Column} + 1.1 LCR \text{ Beams} + 0.3 LCR \text{ Slabs})}{2.6}$$

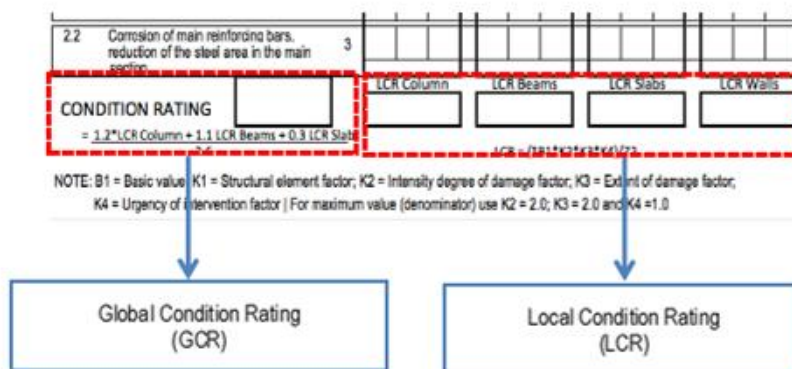


Fig 1: Global and Local Condition Ratings

Cut-off Score and Making Recommendations

Three recommendations were made upon computation of the condition rating of the building such as:

- a. No further investigation required;
- b. Detailed local investigation; and
- c. Overall detailed investigation or Level 2 assessment

This recommendation was based on the computation of local and global condition rating. If the condition rating was greater than 15%, a detailed investigation is recommended. This value was based on the fact that at 15% deterioration condition, a building is already considered medium to high degree deteriorated (Coronelli, 2007).

3. Results and Discussions

Level of Functionality of the Building as Perceived by the End Users

The respondents under surveyed emphasized that almost all the sources of the distress area of the buildings was the effect of the natural calamities, then followed the Non-periodic regular maintenance of the buildings, improper implementation of the designed engineering plan and specification, change of uses/functions of the building, and man-made calamities.

Furthermore, the functionality condition of the building encountered in the present condition were absence of equipment for an assessment of the building, failure of immediate conduct of distress area for proper and security measures of the building, lack of funds for the maintenance of the condition of the building, and inadequacy of dissemination and information of the construction worker in relation to the assigned work.

However, half of the 180 respondents indicated “mostly functional” on the following statements: the building meets all requirement of the Building Code; the Building is properly constructed and well-planned; the building is safe for the end user; structural elements of the buildings are designed for excessive calamities; and the buildings are constructed according to their uses. While the respondents responded “functional” on the statements: the building has a Certificate of Occupancy; the building is fully equipped and functional. Furthermore, “barely functional” were indicted by the end users on: the buildings are periodically checked by the competent authority/local building official; the rooms are properly lighted, well-ventilated/ air-conditioned and conducive to the end-user; and the buildings undergo proper periodic maintenance.

This implies that the school buildings in the institution were constructed according to their respective uses, the building meets all requirement of the Building Code, and structural elements of the buildings were designed for excessive calamities which greatly contributed to the quality of condition of the buildings

Table exemplifies the summary of the frequency distribution regarding of the end users perceptions on the level of functionality of the building.

Table 3: Frequency Distribution on the Level of Functionality of the Building as Perceived by the End Users

| STATEMENT | | FF | | MF | | F | | BF | | PF | | Weighted Mean | Interpretation |
|-----------|--|----|-------|----|-------|----|-------|----|-------|----|-------|---------------|-------------------|
| | | f | % | f | % | f | % | f | % | f | % | | |
| 1. | The Building meets all requirement of the Building Code | 25 | 13.89 | 57 | 31.67 | 75 | 41.67 | 18 | 10.00 | 5 | 2.78 | 3.54 | Mostly Functional |
| 2 | The Building has a Certificate of Occupancy. | 3 | 1.67 | 22 | 12.22 | 50 | 27.78 | 69 | 38.33 | 36 | 20.00 | 2.76 | Functional |
| 3 | The Building is properly constructed and well-planned | 36 | 20.00 | 61 | 33.89 | 52 | 28.89 | 17 | 9.44 | 14 | 7.78 | 3.49 | Mostly Functional |
| 4 | The building is periodically checked by the competent authority/Local Building Official. | 3 | 1.67 | 5 | 2.78 | 25 | 13.89 | 76 | 42.22 | 71 | 39.44 | 1.85 | Barely Functional |
| 5 | The Building is safe for the end user | 53 | 29.44 | 49 | 27.22 | 63 | 35.00 | 11 | 6.11 | 5 | 2.78 | 3.76 | Mostly Functional |
| 6 | The Building is fully equipped and functional. | 22 | 12.22 | 54 | 30.00 | 73 | 40.56 | 18 | 10.00 | 13 | 7.22 | 3.30 | Functional |
| 7 | The rooms are properly lighted, well-ventilated/air-conditioned and conducive to the end-user. | 8 | 4.44 | 27 | 15.00 | 56 | 31.11 | 61 | 33.89 | 28 | 15.56 | 2.59 | Barely Functional |
| 8 | Buildings are undergo proper periodic maintenance | 3 | 1.67 | 7 | 3.89 | 46 | 25.56 | 70 | 38.89 | 54 | 30.00 | 2.08 | Barely Functional |
| 9 | Structural elements of the buildings are designed for an | 33 | 18.33 | 48 | 26.67 | 63 | 35.00 | 31 | 17.22 | 5 | 2.78 | 3.41 | Mostly Functional |

| | | | | | | | | | | | | | | |
|-------------------|---|----|-------|----|-------|----|-------|----|------|---|------|-------------|-------------------|--|
| | excessive calamities. | | | | | | | | | | | | | |
| 10 | The Buildings are constructed according to their respective uses. | 38 | 21.11 | 69 | 38.33 | 56 | 31.11 | 12 | 6.67 | 5 | 2.78 | 3.68 | Mostly Functional | |
| GRAND MEAN | | | | | | | | | | | | 3.05 | Functional | |

Legend:

| | | |
|----|---------------------|-----------------|
| FF | - Fully Functional | (4.2 - 5.0 pts) |
| MF | - Mostly Functional | (3.4 - 4.1 pts) |
| F | - Functional | (2.6 - 3.3 pts) |
| BF | - Barely Functional | (1.8 - 2.5 pts) |
| NF | - Not Functional | (1.0 - 1.7 pts) |

Serviceability

The status of building in terms of serviceability was assessed using Coronelli's (2007) instrument or the Rapid Condition Assessments Tool, in which, the College of Nursing Building was found to be the most critical. Based on the Coronelli's instrument it is recommended that detailed local investigation is required for the areas such columns, beams, slabs, and walls, if the computed global condition rating is beyond 15%.

The College of Nursing Building reached a global rating of 20.66%. This implies that the College of Nursing needs detailed local investigation required particularly the beams which are very much affected by the corrosion of reinforcing steel bars or the corrosion of embedded metals. Other school buildings did not exceed 15% global condition rating.

Table 4: Status of Building in Terms of Serviceability

| Category (Name of the Buildings) | LOCAL CONDITION RATING | | | | Global Condition Rating | REMARKS |
|-------------------------------------|------------------------|-------|-------|-------|-------------------------|---|
| | C | B | S | W | | |
| School Buildings | | | | | | |
| CAFNR | 4.17 | 24.06 | 9.32 | 13.02 | 13.18 | No further action required |
| CBA | 4.17 | 24.06 | 10.34 | 13.02 | 10.08 | No further action required |
| COED | 4.17 | 24.06 | 12.23 | 18.02 | 14.12 | No further action required |
| CL | 4.17 | 24.06 | 11.36 | 13.02 | 11.15 | No further action required |
| CN | 4.17 | 40.64 | 13.33 | 13.02 | 20.66 | Detailed local investigation required for the following areas |
| CS | 4.17 | 24.06 | 9.87 | 13.03 | 11.59 | No further action required |

Building or Structure in the University of Eastern Philippines which Needs Renovation, Rehabilitation, and Repair

Based on the results of the visual assessment, description from the distress area of the selected buildings, functionality of the building as perceived by the end users, and other factors affecting the condition of the building in terms of the number of times that building/s have survived calamities, the building that needs immediate action for repair is the College of Nursing

4. Conclusions

The following conclusions and implication are drawn on the basis of the findings of the study, to wit:

1. The buildings that are exposed to more calamities are buildings which suffered and were recorded to have more distress areas. It entails that the institution particularly the concerned department/unit must undergo proper periodic monitoring of the buildings.
2. The College of Nursing and College of Education buildings have more distress areas compared to the other buildings. This implies that these buildings need immediate action repair for it to be safe for use.
3. The findings of the study revealed that the majority of the selected buildings has no building permit, no data en banc for the profile of the buildings, and no proper periodic monitoring and assessment. Nevertheless, the physical appearance of the selected buildings of this study found out that most of the distress areas in terms of concrete cracks were classified as non structural cracks which are the early thermal contraction.
4. The serviceability of the selected buildings revealed that only the College of Nursing needs detailed local investigation for the slab, column, beam, and wall. The findings revealed that the selected school buildings, administration buildings, landmarks/historical landmarks, and other two-story buildings were functional to the end users.
5. It was also found out that the College of nursing and the College of Education that there is a dire need for immediate repair.

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