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Resilience of educational infrastructure in Nepal: A mixed methods approach to structural and functional assessment

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ABSTRACT

Higher education institutions in developing nations are growing swiftly to address the increasing demand for quality education; however, their physical infrastructures frequently lack adequate evaluation regarding safety, functionality, and environmental performance. This study focuses on the Education and Humanities Building at Far Western University (FWU) in Nepal, two main academic structures built in the early 2010s that have been in continuous use without maintenance. A mixed-methods strategy was utilized, including visual assessments, non-destructive testing (NDT) using a rebound hammer, physical measurements, user surveys, and a review of secondary data. The results indicate moderate material strengths (14.46 MPa for masonry walls, 17.0 MPa for masonry columns, and 17.4–26.63 MPa for slabs), which are typical of older institutional buildings, but there are significant issues such as cracks, moisture infiltration, corrosion, and the lack of expansion joints. Assessments of indoor environmental quality revealed high thermal discomfort, as the temperatures of second-floor slabs exceeded 50 °C, inadequate ventilation due to low window-to-wall ratios (<20%), and insufficient daylighting. User surveys (n=50) revealed ongoing issues concerning structural cracks, congested circulation areas, leaking roofs, and poor maintenance, all of which adversely impact safety and learning environments. The results emphasize the critical necessity for preventive maintenance, structural upgrades, and functional enhancements to comply with Nepal National Building Code (NBC) standards and international guidelines for healthy educational settings. By merging technical evaluations with user feedback, this research offers evidence-based suggestions for improving the resilience, safety, and sustainability of higher education infrastructure in regions of far western Nepal that are prone to seismic activity.

Keywords: structural assessment; rebound hammer test; environmental performance; infrastructure; Far Western University

1 Introduction

Higher education institutions in developing countries like Nepal are undergoing rapid infrastructure expansion to meet the growing demand for quality education. This expansion is particularly critical in regions historically deprived of educational access due to socioeconomic, geographic, and infrastructural challenges. Among these, FWU, located in Mahendranagar, Kanchanpur, Nepal, stands as a prominent example of a public institution with a mission to provide inclusive, accessible, and equitable higher education to underserved communities in the Far Western Region of Nepal. Established under the Far-Western University Act 2067 (2010 A.D.), FWU began operating as an autonomous institution with the vision of bridging educational disparities between Nepal's central and peripheral regions. Over the past decade, several factors have contributed to their gradual deterioration. Prolonged climatic exposure marked by intense sunlight, monsoon rains, and seasonal humidity has led to material weathering, seepage, and fungal growth in damp interiors [1]. Although the Far Western Region has not been the epicenter of recent major earthquakes, its location within the seismically active Himalayan belt leaves it susceptible to moderate to strong tremors, raising concerns about structural resilience [2], [3]. Continuous high utilization, combined with budgetary and technical constraints in maintenance, has further exacerbated structural and functional wear. Additionally, design limitations such as inadequate ventilation, insufficient daylight in certain spaces, congested staircases, and the absence of expansion joints in elongated structures compromise long-term serviceability and occupant comfort [1]. Feedback from building users highlights recurring issues, including poor air circulation, leaky roofs, overcrowded lobbies and staircases, and ineffective lighting and acoustics. These deficiencies not only diminish the quality of the teaching-learning environment but also pose potential risks to occupant safety during emergencies [4]. In light of these concerns, a structured assessment is essential to verify the structural safety of load-bearing masonry and reinforced concrete elements, evaluate functional performance in terms of environmental comfort, space planning, and accessibility, and identify priority areas for maintenance, retrofitting, and compliance with the latest provisions of the NBC [4], [5], [6].

Historical evidence and geological studies confirm that the Himalayan region has endured several large-magnitude earthquakes over the centuries, each causing widespread destruction to infrastructure and significant loss of life [7], [8], [9]. The 2015 Gorkha Earthquake (magnitude 7.8) was a stark reminder of this vulnerability; although its epicenter was far from the Far Western Region, it raised nationwide concerns about the seismic resilience of public buildings, particularly schools and universities [10], [11]. The disaster revealed that many institutional structures built prior to or without compliance with updated provisions of the NBC suffered partial or complete failure, even in areas with only moderate shaking. Although the Far Western Region is less urbanized than central Nepal, it is not exempt from earthquake risk; geological studies indicate that the western segment of the Main Himalayan Thrust has not experienced a major rupture for over a century, suggesting a “seismic gap” and an elevated potential for a significant future event [12], [13], [14]. This context underscores the urgency for preventive structural health assessments in the region.

Assessment of building conditions is a critical part of maintaining safety, usability, and resilience, particularly in public and educational buildings [15]. In the context of Nepal, this has gained heightened importance following the devastating 2015 Gorkha Earthquake (2072 BS), which exposed vulnerabilities in many institutional structures. The study led to the creation of fragility curves for typical Nepali school building types, helping to quantify seismic risk and guide future resilience planning across the Himalayan region [16]. These fragility models offer valuable insights into the likelihood of damage under different intensity earthquakes and are vital tools for structural risk mapping [17]. In the broader South Asian and global context, NDT has emerged as an essential method for assessing reinforced concrete and masonry buildings [18]. On the policy front, Nepal has a codified framework through the NBC, which sets out minimum safety and structural requirements for different building types [19], [20], [21]. Although not always strictly enforced in institutional settings, the NBC provides a guideline for structural assessment, seismic design, and retrofitting interventions [14]. It encourages periodic visual inspection and structural audits, especially in buildings that house vulnerable populations like students and teachers [22], [23], [24].

Several studies across different regions have demonstrated a direct relationship between the physical condition of educational buildings and both student/teacher comfort and academic performance [25], [26]. Indoor Environmental Quality parameters including thermal comfort, lighting, ventilation, humidity, and noise play a major role in student satisfaction and performance. Similarly, in the context of Nepal, [27] reported that of surveyed students felt comfortable at an average classroom temperature of 27°C, highlighting the importance of designing learning environments that reflect local thermal preferences. NDT methods are widely employed for assessing the structural health of concrete in existing buildings due to their efficiency and minimal impact on the structure [28]. Among these, the rebound hammer test (also known as the Schmidt hammer test) is particularly popular.

Classroom temperature plays a crucial role in shaping the learning environment, directly influencing students' comfort, attention span, and overall academic performance. Research indicates that an optimal temperature range of 20–24 °C creates a thermally comfortable environment that enhances cognitive functions such as memory, concentration, and problem-solving skills [27], [29]. When classroom temperatures exceed this range, students often experience drowsiness, irritability, and reduced engagement, while excessively low temperatures can lead to discomfort, distraction, and slower reaction times [22], [23], [29]. A stable thermal environment not only promotes better on-task behavior but also reduces fatigue, creating a setting conducive to active participation and effective learning. Several studies highlight the negative impacts of thermal discomfort on academic outcomes. For example, [22] found that classrooms outside the optimal temperature range were linked to lower standardized test scores and decreased attention levels. The available literature on safety, maintenance, and emergency preparedness in Nepal's educational institutions after the 2015 Gorkha earthquake remains limited [9], [30]. However, certain studies provide relevant context and insights. Despite these positive examples, the broader post-earthquake reconstruction efforts encountered serious challenges [31], [32], [33]. Despite the growing body of literature on seismic vulnerabilities and post-2015 Gorkha earthquake reconstruction efforts in Nepal, there remains a significant research gap in comprehensive, mixed-methods evaluations of educational infrastructure, particularly in underserved peripheral regions like the Far Western Province, where studies integrating non-destructive testing (NDT), environmental monitoring, and user perceptions are scarce. This study addresses this gap by conducting an in-depth assessment of the Education and Humanities Building at Far Western University, offering novel insights into structural defects, thermal discomfort, and safety shortcomings while contributing evidence-based recommendations for enhancing resilience, compliance with NBC standards, and overall functionality in seismically active contexts. Overall, while detailed research on school-specific emergency readiness and maintenance is sparse, available programs and reports underscore the need for focused, institution-level studies in the aftermath of seismic events in Nepal

1.1 Objectives of the Study

The primary aim of this study is to assess the structural integrity and functional suitability of the Education at FWU, with a view to identifying vulnerabilities and recommending improvements. Specific objectives include:

- Structural Assessment – Using NDT and visual inspection to determine the condition of masonry walls, columns, beams, and slabs.
- Functional Performance Review – Evaluating ventilation, lighting, thermal comfort, spatial adequacy, and accessibility in relation to academic needs.
- Safety and Preparedness Audit – Reviewing the availability and effectiveness of emergency exits, fire safety equipment, and earthquake preparedness measures.

1.2 Scope and Significance

This research focuses on two key academic buildings at FWU, the Education Building serving. Its significance lies in an integrated methodology that combines technical evaluation through NDT and environmental monitoring for objective structural and environmental data, user-based feedback to capture the lived experiences and perceptions of building occupants, and code-based benchmarking to assess compliance with Nepal NBC safety and functional standards. By generating empirical evidence, the study aims to support university administrators, engineers, and policy-makers in making informed decisions on infrastructure investment, safety enhancement, and maintenance prioritization, while also contributing to the broader discourse on improving the resilience of higher education infrastructure in Nepal's seismically active context.

2 Method and data

The study was conducted at FWU, located in Mahendranagar, Kanchanpur District, Sudurpashchim Province, Nepal. Established in 2010 (2067 B.S.), FWU serves as a major higher education institution for the Far-Western Region, offering programs in Humanities, Education, Science, Management, and Technology (buildings shown in figure 1). The assessment focused on two key academic structures within the central campus the Education Building, constructed in the early 2010s and currently in continuous daily use. These buildings are among the oldest on campus and are essential to the university's teaching, learning, and administrative functions.

Figure 1. Location of Education and Humanities Building (source: Google Maps)

2.1 Research Design

A mixed-methods approach was employed, integrating technical building inspections with user perception surveys to obtain both quantitative and qualitative insights into the buildings' structural and functional performance. This approach ensured that the findings reflected both the measurable physical condition of the structures and the lived experiences of their occupants.

2.2 Data Collection Methods

A comprehensive visual assessment of the Education and Humanities Building at Far-Western University was conducted to analyze its physical and functional conditions. The walk-through evaluation revealed various signs of deterioration, such as surface cracks in both structural and non-structural components, corrosion of exposed reinforcements, water leakage at the bases and ceilings of walls, moisture in classrooms, peeling paint, and indications of general material decline due to insufficient maintenance. Functional elements of the buildings were also examined, with a specific focus on accessibility and circulation. Common issues identified included narrow lobbies, crowded staircases, and inadequate sanitary facilities, which collectively contribute to overcrowding and decreased convenience for users. Field notes and photographic evidence were meticulously gathered to document these issues and provide a solid foundation for further analysis. These findings emphasize the urgent requirement for both structural repairs and functional enhancements to guarantee safety, usability, and adherence to building standards.

The Rebound Hammer Test was performed on the masonry walls, masonry columns, beams, and slabs of the Education and Humanities Building to assess surface hardness and its corresponding compressive strength, without inflicting damage on the structural elements. A grid-based testing methodology was employed, with measurements taken at various points and orientations (+90°, -90°, and 0°, as applicable) to ensure a thorough representation of the material conditions. For each test point, 10 rebound readings were recorded and averaged to minimize variability from surface irregularities. The average rebound values were then converted to estimated compressive strength using established calibration curves provided with the Rebound hammer. Descriptive statistics, including mean, were calculated for each structural element to evaluate strength consistency and identify localized weaknesses. Interpretatively, compressive strengths were benchmarked against Nepal's National Building Code (NBC) thresholds, with values below 13 MPa categorized as indicative of potential material degradation or stress concentration, warranting further inspection or retrofitting. This non-destructive technique offered essential insights into material strength while maintaining the integrity of the components.

Physical measurements were conducted to evaluate the spatial and environmental performance of the Education and Humanities Building. The sizes of specific classrooms, office rooms, staircases, and lobbies were documented to analyze circulation space and spatial adequacy based on user needs. The ratio of door and window openings to wall area was calculated to assess natural lighting and ventilation, then compared to the minimum standards set by the Nepal (NBC). Furthermore, indoor and outdoor thermal conditions were recorded by measuring temperature and relative humidity at three different times during the day (10:00, 13:00, and 15:00) using a handheld infrared thermometer and digital hygrometer, yielding important data regarding indoor comfort levels.

User perception was evaluated through structured questionnaires distributed to 50 participants, comprising students, faculty, and administrative personnel, chosen through purposive sampling. Survey data were cleaned for completeness and analysed using Excel software and Google Sheets. Descriptive statistics (frequencies, percentages, and means) were calculated for closed-ended questions, providing insights into user perceptions such as the prevalence of structural issues and comfort levels. This analytical approach facilitated a comprehensive understanding of the building's condition from both quantitative and qualitative perspectives.

The purpose of the survey was to gather opinions on essential elements of the building environment, including classroom comfort, ventilation, lighting, accessibility, safety preparedness, and the frequency of maintenance tasks. Respondents were also requested to share their overall satisfaction with building conditions and to identify any structural problems they had noticed, such as cracks, dampness, or material degradation. Additional queries focused on issues like overcrowding in hallways and the sufficiency of emergency preparedness measures, providing important insights for enhancements.

The review of secondary data included analyzing existing records concerning the construction history, maintenance efforts, and previous inspections of the Education and Humanities Building at Far-Western University. These documents delivered valuable background on the buildings' ages, the materials used, and the types of repair or maintenance work undertaken over the years. Nevertheless, the records were not exhaustive for all timeframes, indicating gaps in systematic documentation. Despite these shortcomings, the data provided key context for understanding the present physical state of the buildings and reinforced the findings from the field assessment.

3 Results and Discussion

3.1 Structural Condition

(Pathirana & Savitha, 2023; Wickramathilake & Hemachandra, 2025)NDT using the Rebound Hammer method and visual inspections provided quantitative and qualitative insights. Rebound Hammer Test results showed average compressive strengths of 14.46 MPa for masonry walls (range: 12–18 MPa), 17.0 MPa for masonry columns (12–24 MPa), and 17.4–26.63 MPa for reinforced concrete slabs and beams shown in Figures 2 to 9. These values indicate adequate capacity for current occupancy but fall short of the robustness needed for high seismic zones. Localized low readings (below 13 MPa) suggest material degradation or stress concentration. Visual inspections identified critical distress, including longitudinal cracks near beam supports and slab joints, indicating poor bonding between structural and non-structural elements, which compromises lateral stability. Diagonal shear cracks around window and door openings signal seismic vulnerability shown in figure 10. Additional defects include moisture seepage, corroded window frames, rotting wooden doors (see figure 10), peeling paint, and ceiling stains, reflecting environmental exposure and poor maintenance these types of similar study also suggested in [34], [35]. A significant compliance issue is the absence of expansion joints, despite the building's elongated footprint exceeding the length-to-width ratio per NBC 205:1994, Clause 7.5 [20]. The combination of adequate but variable material strength, environmental deterioration, irregular plan shape, and non-compliance with expansion joint requirements necessitates immediate intervention

[14], [36]. Also building's shape is L shape, which leads to the vulnerability of the structure, and careful design is required for such of structure to resist earthquakes [37]. Recommended measures include introducing expansion joints, implementing moisture control (e.g., drainage systems, waterproof coatings), and establishing a proactive maintenance program to address early-stage deterioration. Without these interventions, crack expansion and stiffness reduction could heighten seismic risks, compromising the building's long-term safety and functionality.

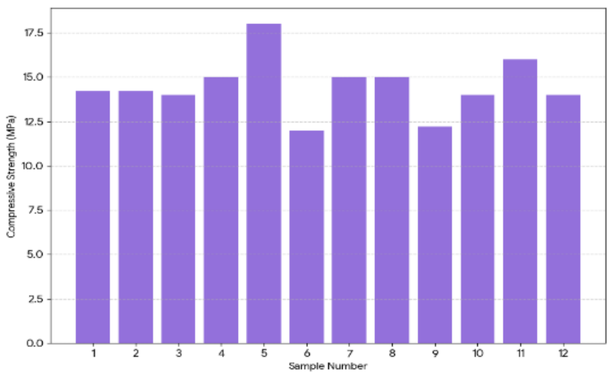

Figure 2. Compressive strength of wall 1 by Rebound test

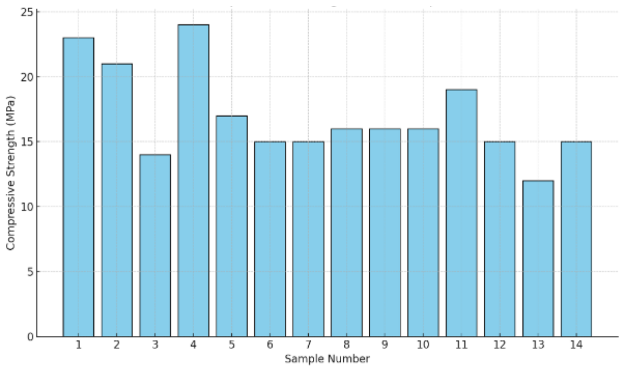

Figure 3. Compressive strength of masonry column by Rebound test

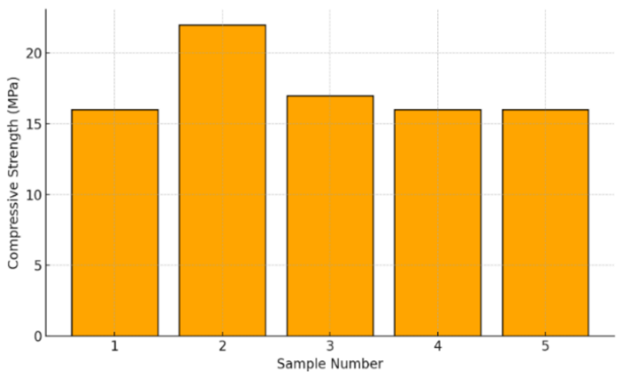

Figure 4. Compressive strength of Slab by Rebound test (2nd Floor, -90°)

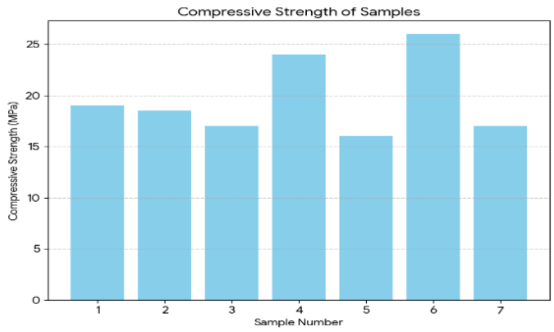

Figure 5. Compressive strength of Beam by Rebound test (-90°)

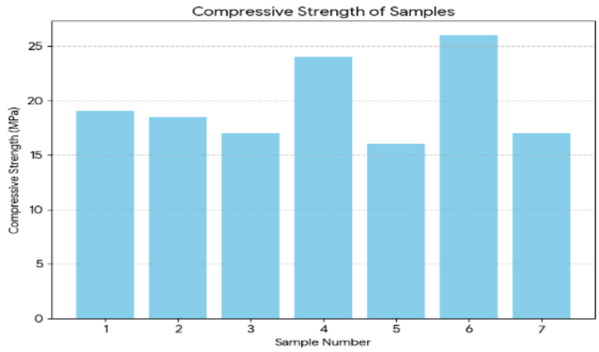

Figure 6. Compressive strength of Main Slab by Rebound test (1st Floor, +90°)

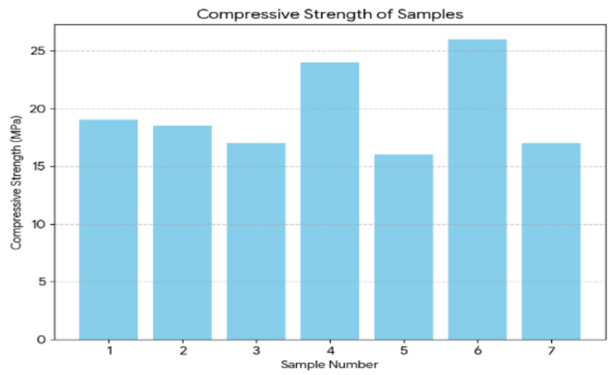

Figure 7. Compressive strength of Corridor Slab by Rebound test (+90°)

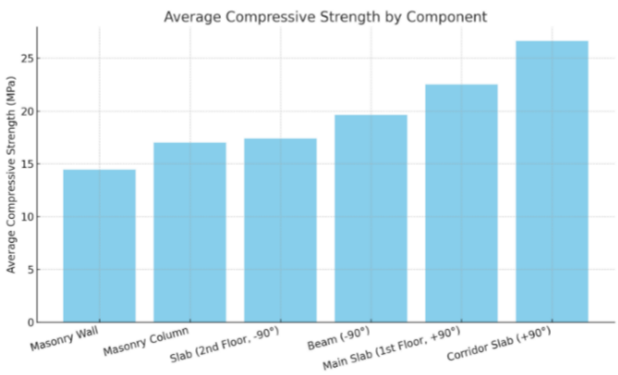

Figure 8. Graphical representation of strength of different part by Rebound test

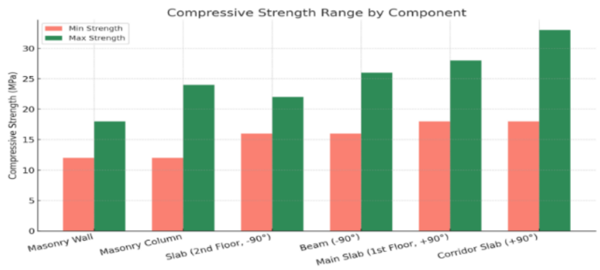

Figure 9. Variation in compressive strength for each member

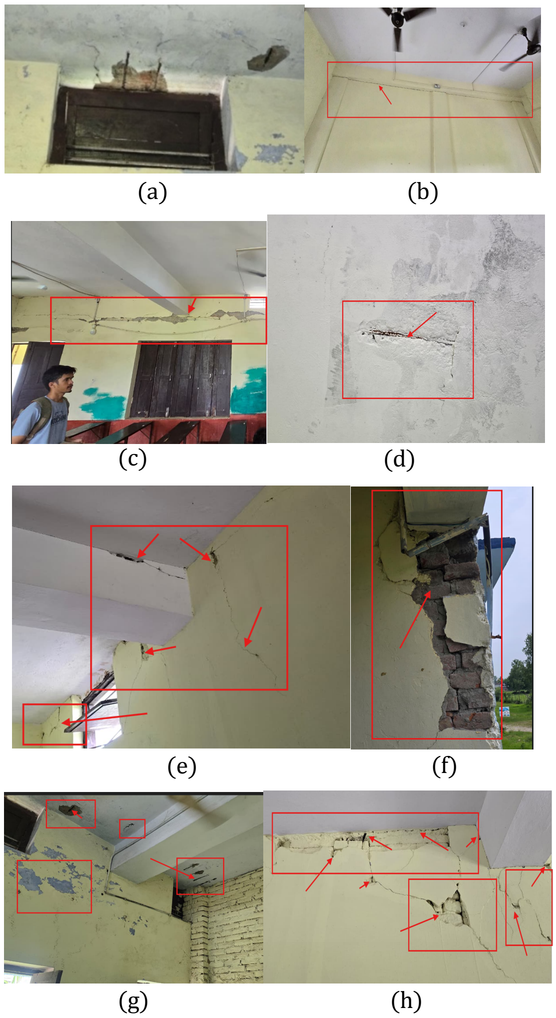

Figure 10. Defects observed in the building: (a), (d), (g) Accelerates deterioration of reinforcements and finishes; reduces durability and aesthetic quality; often due to environmental exposure and lack of protective coatings; (b) Longitudinal cracks near beam supports and slab joints (indicating poor bonding between structural and non-structural elements): (c), (e), (g), (h) Diagonal shear cracks around beam, wall corners, window and door openings (Signaling seismic vulnerability).

3.2 Thermal Comfort

Temperature monitoring indicated that indoor conditions frequently matched or exceeded outdoor air temperatures, with peak readings reaching 37.5 °C during hot periods. On the second floor, slab surface temperatures exceeded 50 °C, highlighting significant solar heat gain through the uninsulated roof slab shown in Table 1. These findings align with [27], who observed that poorly insulated concrete roofs in Nepal's Terai region can cause prolonged overheating, particularly on upper floors. High thermal mass without adequate insulation traps and radiates heat well into the afternoon, creating discomfort that extends beyond peak outdoor temperatures. According to ASHRAE Standard 55 [38] and NBC 206:2020 [19] thermal comfort guidelines, such indoor conditions fall well outside the optimal range for educational spaces, increasing fatigue and impairing student cognitive performance.

Ventilation performance was sub-optimal in several classrooms due to window-to-wall ratios below the NBC-recommended minimum of 20% and the presence of obstructed or non-operational openings. Inadequate cross-ventilation, particularly in buildings with elongated footprints, results in stagnant air zones and reduced air change rates. [39] noted that this is a common issue in Nepalese educational buildings that lack climate-responsive design, leading to increased concentrations of indoor pollutants and elevated CO_2 levels during peak occupancy

Temperature and relative humidity were recorded at three-time intervals (10:00, 13:00, and 15:00) in three sample rooms on August 24, 2025 (2082/04/09). The results revealed a clear diurnal heating trend, with all building elements warming steadily throughout the day. On the second floor, indoor slab temperatures peaked at 51.43 °C (Sample 2) and 51.13 °C (Sample 3) by 15:00, indicating extreme heat gain from the roof. First-floor slabs remained significantly cooler, peaking at 35.5 °C shown in Figure 11. Relative humidity showed an inverse trend, starting higher in the morning (63–67%), dropping by midday, and reaching a low of 56% in the hottest second-floor room. The temperature humidity relationship confirmed that as indoor temperatures rose, air moisture content declined, resulting in a hotter and drier environment conditions that exacerbate occupant discomfort. This effect was most pronounced in upper-floor classrooms, where ceiling proximity to the uninsulated roof amplified heat gain [27], [38].

Table 1. Summarizing maximum room temperature, the maximum slab temperature, and minimum humidity for three sampled locations

Floor Sample	Max Room Temp (°C)	Max Slab Temp (°C)	Min Humidity (%)
Sample 1 (1st Floor)	33.3	35.5	65
Sample 2 (2nd Floor)	35.9	51.43	59
Sample 3 (2nd Floor)	35.5	51.13	56

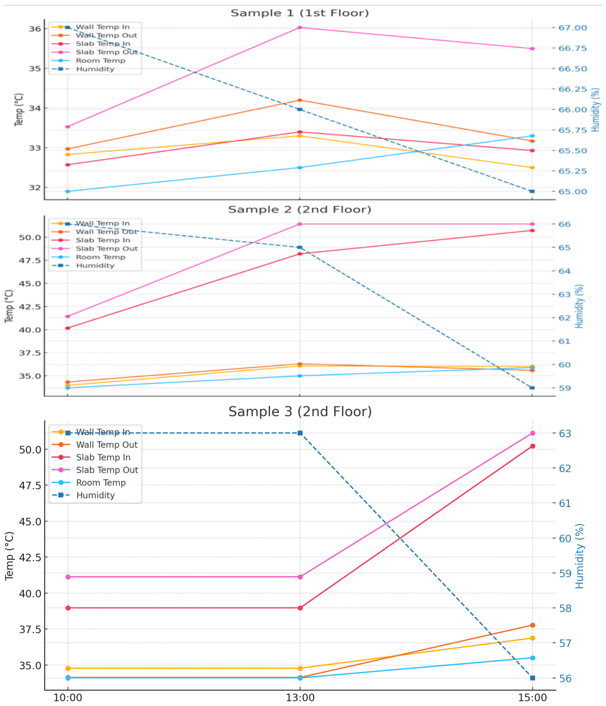

Figure 11. Temperature, Humidity and Time Graph (Diurnal Variation of Temperature and Relative Humidity in Sample Rooms)

3.3 Space and Accessibility

Measurements indicated that the lobby width is only 1.13 m, which is significantly below common circulation space standards for educational buildings. According to NBC 206:2020 [19] and international guidelines such as NFPA 101 Life Safety Code, primary circulation corridors in public buildings should generally provide a minimum clear width of 1.5–1.8 m to safely accommodate two-way pedestrian movement and allow for efficient evacuation during emergencies. The narrow lobby width in this building likely contributes to congestion during class transitions, particularly given the high daily occupancy.

3.4 Staircase Location and Flow

The staircases are positioned in a single corner of the building, creating a circulation bottleneck. Survey data revealed that 62% of respondents reported crowding on the stairs during peak class changeover periods. This design choice violates NBC recommendations, which encourage centrally located or multiple staircases to ensure even distribution of occupant movement and reduce congestion risk.

Toilets are located only on the ground floor, which is inconvenient for upper-floor users and increases unnecessary foot traffic in circulation areas. Research on school facilities by UNICEF has highlighted that inadequate distribution of sanitary facilities negatively affects student comfort, time-on-task, and hygiene compliance. For female students in particular, the absence of nearby facilities can lead to reduced attendance during certain periods of the month, impacting learning equity.

3.5 Overall Implications

The combination of narrow lobbies, corner-staircase placement, and insufficient sanitary facility distribution compromises both functional efficiency and safety. In normal operation, these constraints cause crowding, noise, and delays; in emergency scenarios, they could severely hinder evacuation speed, increasing risk to occupants.

3.6 Questionnaire-based Analysis

To complement the physical assessment of the Education and Humanities Building at FWU, a structured questionnaire was distributed among building users to gather perceptions regarding structural safety, comfort, accessibility, and maintenance. A total of 50 individuals participated, including students, faculty, administrative staff, and visitors.

3.7 Respondent Demographics

A total of 50 respondents participated in the survey to understand user perceptions of the Education and Humanities Building. The majority were students (76.4%), followed by teachers (10.9%), visitors and administrative staff (9.1%), and non-teaching staff (3.6%) as shown in Figure 12. This response distribution reflects the actual user population and ensures that the feedback primarily represents those who use the building daily for academic purposes.

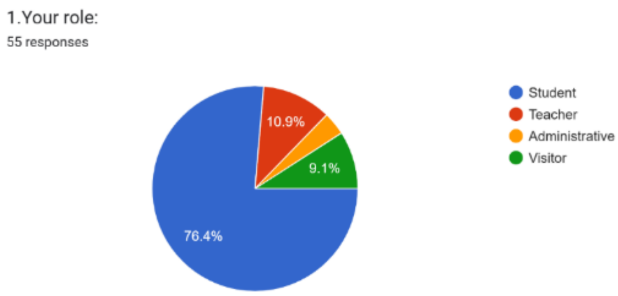

Figure 12. Respondent Roles Distribution

3.8 Faculty-wise Distribution of Respondents

In terms of academic affiliation, 54.5% of respondents were from the Education faculty, followed by 29.1% from Humanities, 10.9% from General Science, and smaller representations from BSc CSIT (1.8%), CSIT (1.8%), and Science and Technology (1.8%) Figure 13. This distribution suggests that the majority of respondents are regular users of the building, especially from Education and Humanities, which aligns with the primary purpose of the building under study.

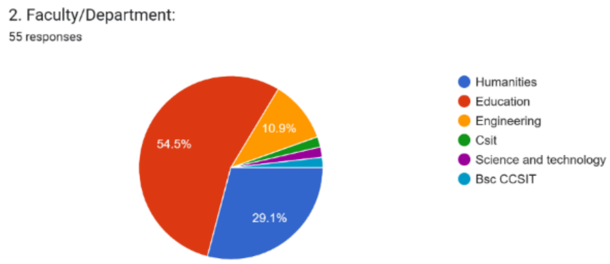

Figure 13. Faculty/Department-wise Respondent Breakdown

3.9 Duration of Building Use

When asked about how long they had been using the building, the largest proportion of respondents (50.9%) reported using it for 1 to 3 years. About 22.6% had been using the building for 3 to 5 years, while 17% had more than 5 years of usage experience Figure 14. A smaller group (9.4%) had used the building for less than one year. This shows that most participants had sufficient exposure to the building to provide meaningful feedback on its condition and functionality.

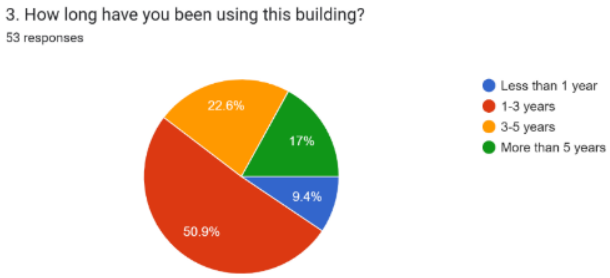

Figure 14. Duration of Building Use by Respondents

3.10 Observed Structural and Maintenance Issues

Analysis of the responses to Question 4 revealed that most users of the building have encountered considerable structural and maintenance issues in the Education and Humanities Building at Far-Western University. Cracks in the walls and beams were the most frequently noted problem, reported by 90% of participants Figure 15. This high proportion raises urgent concerns regarding the building's structural stability since such cracks may indicate underlying weaknesses in masonry or reinforced concrete elements, especially in an area prone to seismic activity. If these issues are not addressed, they could jeopardize the long-term durability of the structure and heighten its susceptibility during seismic events. Furthermore, 83% of respondents noted issues such as peeling paint and rust on metal components, which strongly suggests environmental exposure and a lack of regular maintenance. The corrosion of metal parts not only detracts from the building's appearance but can also hasten the deterioration of reinforcement, compromising the structural system. Similarly, paint deterioration often points to deeper issues like moisture ingress or inferior quality finishes. Functional issues within the building were also reported. Roughly 40% of participants indicated overcrowding in staircases and corridors, highlighting inadequate circulation space. This situation not only causes inconvenience during busy times but also presents safety risks, as crowded escape routes can impede evacuation during emergencies. Additionally, 26% of respondents mentioned experiencing water leaks during rain, indicating flaws in the roofing systems, drainage design, or waterproofing applications. Ongoing leaks can lead to moisture-related complications such as dampness, mold growth, or long-term material deterioration. Other problems, including damaged stairs, uneven flooring, and specific defects, were reported less often but still deserve focused attention. Altogether, these findings underscore the critical necessity for a thorough structural assessment, waterproofing interventions, and enhanced space planning. Establishing routine maintenance schedules and ensuring prompt repairs will be vital for maintaining user safety, functional efficiency, and the lasting usability of the university's academic facilities.

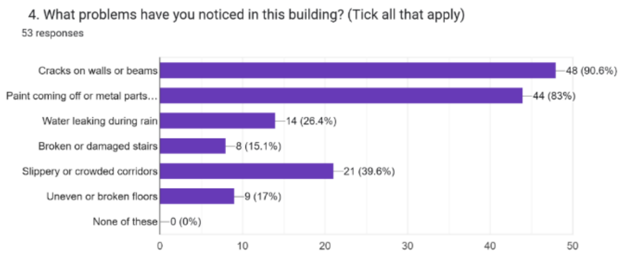

Figure 15. Problems Observed in the Building

3.11 Frequently Affected Areas in the Building

In addressing Question 5 Figure 16, participants pointed out particular building zones that face recurring issues, demonstrating that problems with deterioration and maintenance are not evenly distributed. Classrooms were mentioned by 60% of respondents as the areas most frequently affected, which has a direct impact on learning and user satisfaction. Ground floor spaces were noted by 41%, likely due to significant foot traffic and extended exposure to environmental factors like water, dust, and general wear. Lobbies and corridors were identified by 36%, which is noteworthy as these areas are crucial for movement and emergency evacuation, influencing both convenience and safety. Other zones, such as stairs, restrooms, and labs, were mentioned less often, implying fewer prominent issues, although they still warrant attention in future maintenance considerations.

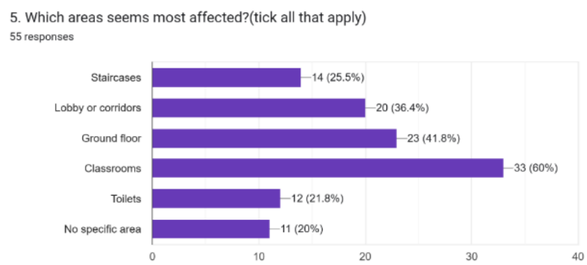

Figure 16. Most Affected Areas of the Building

3.12 Comfort Level of Classrooms

When participants were asked to rate the comfort level of the classrooms or rooms they use, a significant 57.4% of respondents stated that the spaces were uncomfortable, while only 34% felt they were comfortable Figure 17. Alarmingly, 8.4% rated the rooms as very poor, indicating serious dissatisfaction with the learning or working environment. These results highlight the urgent need for improvements in classroom conditions, particularly in terms of seating, ventilation, lighting, and spatial comfort.

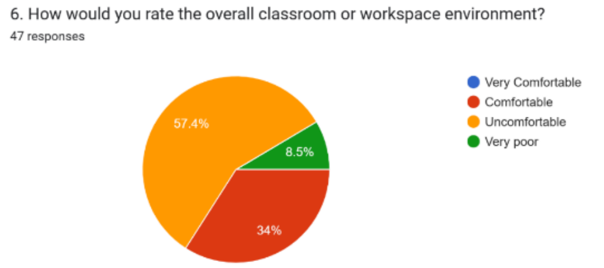

Figure 17. Respondents' Rating of Classroom Comfort

3.13 Factors Affecting Study or Work Conditions

Respondents were asked to identify the main factors that negatively impact their ability to study or work effectively within the building. A large majority (83%) pointed out that walls are dusty or cracked, while 78% reported that rooms are too hot or too cold, making thermal discomfort a significant concern (see Figure 18). Furthermore, 45% mentioned crowded stairs or corridors as a challenge during movement, and 34% cited excessive noise as another issue affecting concentration. Other factors such as poor lighting and unclear communication were marked by fewer respondents, indicating they were of lesser concern in comparison.

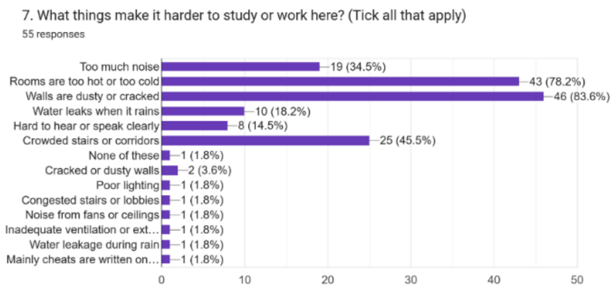

Figure 18. Factors Affecting Study and Work Environment

3.14 Staircase Condition During Busy Hours

When asked about the condition and usability of staircases during peak times, 62% of respondents reported that the stairs were slightly crowded but manageable, indicating a moderate level of congestion. However, 20% stated that the stairs were frequently congested and hard to pass through, while 16% described them as very crowded and unsafe, especially during class changes or emergencies as shown in Figure 19. These findings suggest a need for improved circulation space and better crowd management during busy periods.

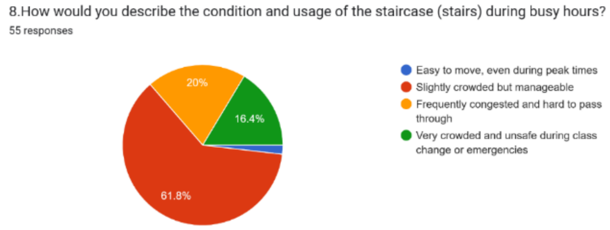

Figure 19. Crowding in Staircases During Peak Hours

3.15 Lobby and Corridor Conditions

Regarding the condition of lobbies and corridors, 45.5% of respondents reported that these spaces are sometimes crowded, especially during breaks. Additionally, 29.1% stated that the areas are often overcrowded and difficult to move through, while 23.6% believed that the corridors are poorly designed or maintained, contributing to discomfort and potential safety concerns as shown in Figure 20. These responses highlight the need for better spatial planning and regular upkeep to improve circulation and safety in common areas.

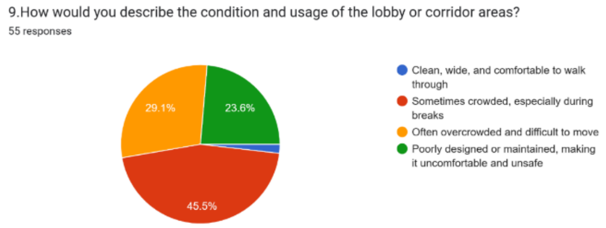

Figure 20. Conditions and Usage of Lobby/Corridor Areas

3.16 Perception of Indoor Air and Temperature Conditions

When asked about the air and temperature conditions inside classrooms and offices as shown in Figure 21, 52.7% of respondents described it as "somewhat okay", while 36.4% felt it was "uncomfortable". Additionally, 7.3% rated it as "very uncomfortable", indicating thermal discomfort and ventilation issues in many rooms. Only a small percentage considered the indoor environment to be very comfortable. These findings suggest a need for improved thermal regulation and ventilation systems to enhance comfort levels.

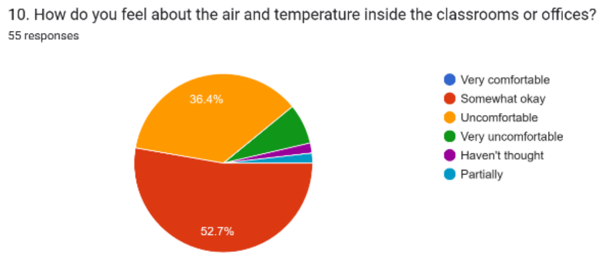

Figure 21 Perception of Indoor Air and Temperature Comfort

3.17 Safety and Emergency Preparedness

Survey results reveal significant shortcomings in the safety and emergency preparedness of the building. A substantial majority (87.3%) indicated that emergency exits are either difficult to find or blocked, while 9.1% were uncertain about their existence. The situation concerning fire safety is even more alarming: 92.7% of respondents mentioned they had not seen fire extinguishers or alarms, and 7.3% were unsure of their existence or operational status. Issues related to earthquake safety also surfaced as a major concern. Almost half (49.1%) of the participants indicated they felt unsafe staying inside during an earthquake, with 30.9% uncertain, and only 18.2% believing the building to be somewhat safe. These findings highlight the pressing need for clear emergency signage, effective fire safety measures, and better communication regarding earthquake preparedness. Tackling these issues is crucial for enhancing user confidence, protecting occupants, and ensuring the building adheres to fundamental safety and preparedness standards typically required in high-risk areas.

3.18 Frequency of Maintenance Activities

Survey findings reveal a concerning lack of clarity and uniformity in maintenance practices. Almost half of the respondents (49.1%) indicated they were not informed about the frequency of maintenance, pointing to inadequate communication or documentation. Around 32.7% claimed that maintenance is never performed, highlighting a significant shortfall in building maintenance. Only 16.4% reported having annual maintenance, with very few noticing more frequent interventions. This insufficient focus on regular upkeep not only hastens deterioration but also raises issues regarding safety, functionality, and the long-term viability of the building. Implementing consistent and clear maintenance schedules is crucial for ensuring user comfort and the structural integrity of the building.

3.19 Areas Needing Improvement

The survey findings highlight several pressing priorities for enhancing the building. The most pressing issue, noted by 98.1% of participants, was the need to repair the walls, stairs, or roof, indicating significant structural deterioration. Similarly, 69.8% pointed out the necessity for increased space in stairways and corridors, along with appropriate fire and emergency equipment, emphasizing concerns for safety and evacuation as shown in Figure 22. A total of 45% of respondents stressed the importance of cleanliness and hygiene, pointing to inadequacies in regular maintenance. Furthermore, 43% indicated a demand for additional classrooms or laboratories, suggesting that current facilities are either lacking or outdated. Collectively, these insights highlight the critical need for extensive improvements.

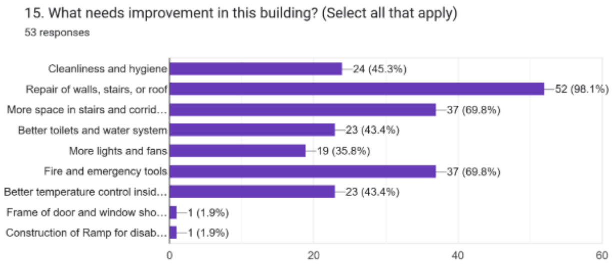

Figure 22. Areas Identified for Improvement

3.20 Perception of University's Commitment to Building Safety and Maintenance

When asked whether they believe the university authorities take building safety and maintenance seriously, nearly half of the respondents (49.1%) expressed no confidence in the university's commitment. Additionally, 47.3% were not sure about the university's efforts, indicating uncertainty or lack of visible action. Only a small fraction, 3.6%, felt that the university is indeed serious about ensuring the building's safety and upkeep. This suggests a widespread perception of inadequate attention to building maintenance and safety by the university management, highlighting the need for improved communication and visible efforts to reassure building users.

4 Conclusion

The assessment of the Education and Humanities Building at FWU reveals several critical insights into its structural integrity, environmental performance, user experience, and safety preparedness. From a structural standpoint, the building shows moderate strength in its load-bearing elements. The average rebound hammer test results indicate compressive strengths of 14.46 MPa for masonry walls, 17 MPa for masonry columns, and 17.4 to 19.6 MPa for slab sections—suggesting that while the structure is generally sound, there are localized weaknesses, especially in moisture-exposed areas. Visual observations of cracks and material wear support this assessment. Indoor environmental conditions are far from ideal. Temperature readings and user feedback confirmed poor thermal comfort, mainly due to inadequate ventilation and lack of temperature control systems. This directly affects student concentration, classroom comfort, and academic performance. Space and accessibility are also problematic. The narrow 1.13-meter-wide lobby, corner-located stairs, and absence of toilets above the ground floor make movement inconvenient and time-consuming especially during class changeovers. Crowding in classrooms and circulation spaces adds to discomfort and limits functional efficiency. The building lacks emergency preparedness. The absence of visible fire safety tools, no designated emergency exit, and the long, narrow circulation path pose serious risks during fire or earthquake scenarios. User responses confirm that 49.1% have never received any safety drills, and many are unaware of evacuation procedures. Lastly, the lack of routine maintenance is evident. Issues such as cracked walls, poor sanitation, and insufficient lighting persist, along with no structured efforts to improve ventilation or cleanliness.

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