Proceedings of 12th IOE Graduate Conference
Peer Reviewed
ISSN: 2350-8914 (Online), 2350-8906 (Print)
Year: 2022 Month: October Volume: 12

Problems in Residential Space facing Occupancy Change and Developing a Template for Qualitative Risk Assessment: A Case Study of Butwal City

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Abstract
The occupancy changes in many countries including Nepal are prevalent. Residential areas are frequently vulnerable to land use changes because of local characteristics, accessibility, renting/business concerns, governmental legislation,et cetera. This study aims to explore physical and environmental problems in the building attributes and neighborhood premises associated with the conversion of residential buildings into mixed-use. It helps to identify factors associated with alterations based on functional, cultural and technical aspects of building attributes and neighborhood and risks followed by such alterations, as well as rank their impacts. For the problem exploration and findings, checklist is prepared for location and building attributes on basis of literature study and revised on basis of inspection of buildings and interviews in mixed-use settlements. The checklist prepared for the initial assessment is known as 'The Veto Criterion' and then for further assessment, the checklist prepared is known as 'The Gradual Criterion'.
The study takes sample of mixed-use residential buildings of Sukkhanagar area and it's opposite street lane of Butwal city. The inspection of total of 22 buildings is done and around 50 percent of buildings fall under the category of Risk Class 3, which is a strong impact. And, the traffic congestion and parking being the major problem. The major findings show the impact of identified problems on health and environment and provide enhancement measures for possible risks. The study concluded by recommending that there is a need of permit of a change of residential building even if no intervention is required and that government should be concerned about the planning codes, services and safety of people.

Keywords
Disaster Risk Management, Ministry of Urban Development, Environmental Impact Assessment, National Building Code

1. Introduction

A change in occupancy refers to a change in use or occupancy of any building or structure that would place it in a different division of the same group of occupancies or a different group of occupancies. The originality of space is altered by human migration, variability in human needs, and human behavior. [1]. Butwal is a city having a population around 1,95,054 as arises the center hub for the western region of Nepal, which connect terai to the different mountainous districts, with a 2.3 percent annual population change. Long recognized as one of the country's most livable cities, the city's growth began somewhat concurrently with the designation of sub-metropolitan, and it is now rapidly expanding [2].

Over time, the established part of the city has undergone a process of reconstruction and conversion associated with the conversion of residential buildings into cooperative commercial firms, which has led to an acceleration and rapid growth of economic activity. As a result, the residential area has been converted to commercial uses, bringing social and security issues. These commercial uses include banks, cooperatives, private offices, supermarkets, restaurants, pharmacies, schools, hotel accommodations, and guest houses. Urban issues like pollution, overcrowding, inadequate environmental sanitation, traffic congestion, a high crime rate, mounting demand for real estate, and a lack of parking spaces were brought on by the

reconstruction of commercial structures in residential areas. Therefore, Sukkhanagar's buildings have been taken for the research.

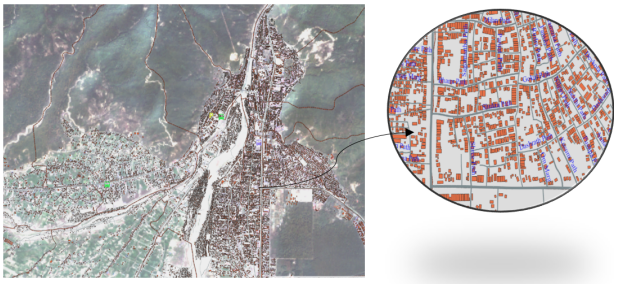

Figure 1: Butwal City and Sukkhanagar Area

1.1 Need and Importance of the Research

The need of this study is to provide a sound understanding of the risks in residential spaces of Nepal and the importance of the need for a permit to change the use of a residential building. This is necessary for confirming if the building meets all the requirements for the new use or occupancy classification. It's quite probable that serious environmental risks exist in single-family homes that are kept hidden in mixed-use neighborhoods [3]. Butwal City is in the process of urbanization and land development, and hence considering such factors is necessary when the residential buildings are rapidly converted into mixed-use buildings.

1.2 Problem Statement

The change of use or occupancy of buildings can cause alterations to the originality of space and alterations to the exterior of the buildings. The occupant load increases after the space are commercialized, which simultaneously decreases the life of the building. Butwal Municipality is facing the same changes. Due to urbanization and building conversion, existing mixed-use communities frequently suffer the negative health effects of toxic and hazardous pollutants. These include high rates of stress, lack of sleep, hearing loss, asthma, birth defects, asthma, and respiratory disorders. [4].

The risk to the health and safety of people arises, as the need for fire safety, proper accessibility, entry and exit routes, emergency exit, openings of the façade, etc. changes accordingly. Nepal is at risk of potential hazards, and the alteration of the structural load of the building creates a major problem. There are many cases of uncertain fire (like restaurant spaces), death due to improper planning (lack of proper ventilation in bathrooms of School/College dormitories), inaccessibility for handicapped people, degradation of the authentic exterior of the buildings, lack of proper parking and hence the cause of traffic, alterations to the space used for the certain purpose and creation of awkward space which is not user friendly.

1.3 Research Objective

The objective of the research is:

- To explore the physical and environmental problems in the building attributes and neighborhood premises associated with conversion of Residential Buildings into mixed-use.
- To identify factors associated with alterations and evaluate with functional, cultural and technical aspects of building attributes and risks followed by such alterations, as well as rank their impacts.
- To create a template for qualitative risk assessment

1.4 Research Questions

- What are the ranges of building and neighboring attributes that are likely to accompany the change?
- What can be changing in building space, form and function of mixed-use buildings in the study area?
- What will be the framework/template of Qualitative Risk Assessment for mixed-used Residential Buildings in Nepalese Environment?

1.5 Scope and Limitations of the Study

The inspection of buildings consists of two areas; structural part analysis and non-structural(qualitative) analysis. The structural analysis is not included in my study as buildings inspected in this study have already failed on the building code rule due to conversion without building code consideration, and study covers only the qualitative analysis of buildings. The research is confined to the physical, and

environmental analysis due to change and ultimately creating a template for qualitative risk assessment. The study incorporates functional, cultural, and technical attributes.

2. Literature Review and Theoretical Framework

2.1 Concept and Definitions

2.1.1 Mixed-use Residential Space

A mixed-use building is defined as any building that accommodates multiple uses. It integrates a variety of uses, such as residential, commercial, cultural, institutional, or entertainment, into a single area to a certain extent, both physically and functionally, and creates pedestrian connections [5].

Type of Mixed-Use Residential [5]

- Office/Residential
- Hotel/Residence
- Commercial/Residence
- Hospital/Residence
- Industry/Residence

2.1.2 Risk in Housing

Risk is an unfavorable occurrence that can be recognized and quantified according to its significance and likelihood of occurring [6].

2.1.3 Factors of Risk

Hazard, Vulnerability and Exposure

The term ”hazard” refers to the potential for future natural or human-caused physical events that could be harmful to exposed and sensitive elements [7].

The term “vulnerability” is referred as the potential of exposed elements, such as people, their livelihoods, and assets, to incur negative consequences when touched by hazard events [7].This includes the physical components, the population, the necessary infrastructure, the socioeconomic factors, the transportation infrastructure, the economic activities, the life lines, and the environmental components.

The term ”exposure” describes the list of components in a space where risk occurrences could occur [7].

2.1.4 Relation of Occupancy Change and Risk and Impacts

Housing conditions have a significant impact on both individual and collective health [7]. The risk factors considered for occupancy change consists of five categories [1].

a) Functional Risk
b) Cultural Risk
c) Technical Risk
d) Legal Risk
e) Financial Risk

It outlines the effects on urban planning based on the following factors: environmental, economic, social, physical, and policy consequences [8].

2.1.5 Risk Exploration and Checklist

A risk analysis checklist is essential for developing and accessing risks. Depending on the reference system, risks could, among other things, relate to a loss of money (economic system), power (political system), solidarity (social system), health (health care system), or legal security (legal system). [5].

2.1.6 Checklist of risks at building and Neighbourhood Level

The given table 1 illustrates the possible areas which includes the checklist for three different criterias for analysis in the case of Building Attributes.

And, table 2 illustrates the possible areas for analysis in the case of Location and Neighbourhoos premises of building.

Table 1: Checklist of Risk at Building Level

Building	Risk
Functional	Space and Service Analysis, and Possible Risks
Technical	Building Service, Defects and Possible Risks
Cultural	Authenticity and Cultural Impact Analysis

2.2 Theoretical Framework

The framework in figure 2 consists of mainly 3 steps. First is checklist preparation which consists of preparation of questionnaire through literature and survey. The second is Qualitative Risk Assessment, which consists of a process of Veto Criterion Assessment and Gradual Criterion Assessment.

Table 2: Checklist of Risk at Neighborhood and Location Level

Neighborhood	Risk
Functional	Based on accessibility and routes
Technical	Possibility of noise and odour pollution
Cultural	Cultural authenticity of community

The Veto Criterion assessment is done of the building which is only mixed use after the inspection. And gradual assessment is done after the need for further assessment after the veto criterion. The third is risk analysis, which is the analysis done on overall analysis and categorized analysis.

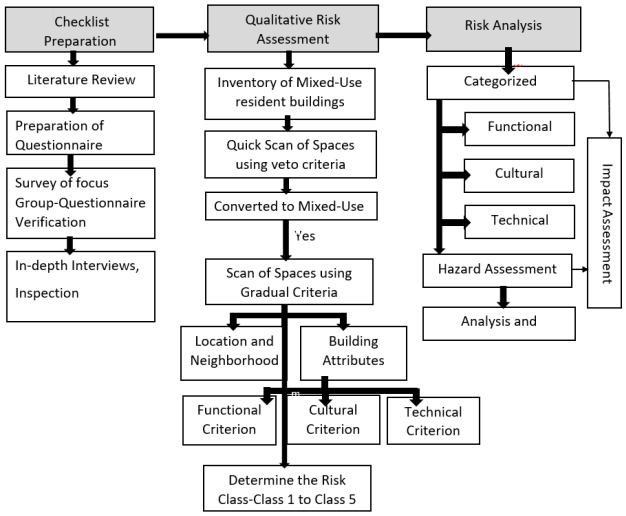

Figure 2: Framework for Research Process

2.3 Focus groups and Methods

The first section of the survey is housing quality, which identifies the functional qualities and condition of the dwelling to assess the residents' quality of life. These include the size of the housing unit, the features, and conditions of the dwelling, the services, the setting, the cleanliness, the amount of usable space, etc (physical alterations and environmental characteristics).

The second area is focused on neighborhood characteristics. On parameters including the state of the road's surface, nearby playgrounds, parking, security, landscaping, pollution, drainage facilities, cleanliness, waste disposal facilities, social relations, and more, data is gathered. This can be done to gauge both community facility satisfaction and the degree of degradation in the housing estates.

3. Methodology

The nature of the research is as an exploratory and descriptive research based on qualitative and quantitative research approaches. Figure 3 explains the overall process of workflow of research from research visualization to preparation checklist to assessment and discussions.

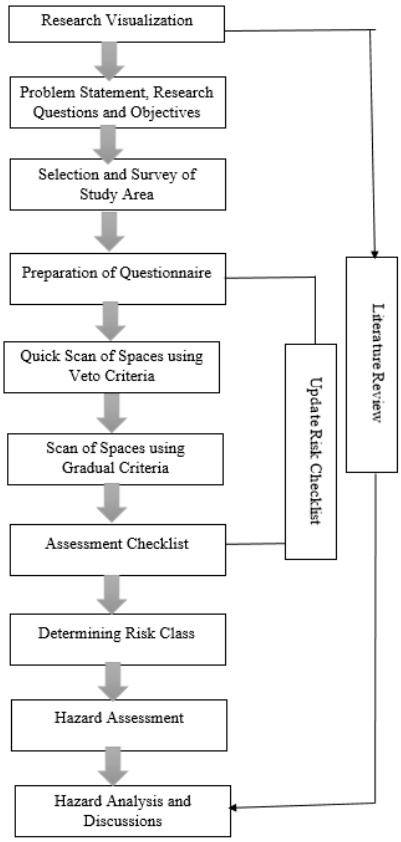

Figure 3: Organizational chart of Workflow

4. Checklist Preparation

Step 1: Veto Criterion

Table 3: Veto Criterion Table

Veto Criterion	Remark
Comfortable to live in the present mixed-use space?	Yes/No
Do people have willingness to live in the neighborhood?	Yes/No
Does the size and character of building meet the criteria of mixed-use buildings?	Yes/No
Unaffected Health due to conversion	Yes/No

Firstly, a questionnaire is asked if there is the

conversion of the residential building for public purpose, and if the answer is yes. The table 3 shows few quetionnaire that are prepared to be asked to residentials living in same buildings. If the answer to any questions is No, then further gradual assessment is done.

Step 2: Gradual Criterion

There are questionnaire prepared one for Neighborhood and Location, and another for Building Attributes which contains four different categories i.e; Functional, Cultural, Technical and Additional Space Requirements.

The Questionnaire for Additional Categories are divided according to the type of Case Studies. Four Different Cases are taken; Educational, Commercial/Office, Hospital/Clinic, and Industries/Storage. The fulfillment of each criteria ranks as 1 and 0 if not fulfilled. The overall ranking is done percentage wise. The tabular checklist for Gradual Assessment is on detail report. The total scoring criteria is around 15 percentage for location and neighborhood and around 75 percentage for building attributes.

Step 3: Determination of Potential Class of Severity

The table 4 shows the ranking level of potential severity on the basis of level of precentage obtained from checklist assessment.

Table 4: Risk Classification

Class	Effects	Score in Percentage
Class 1	Less Impact	81-100
Class 2	Moderate Impact	61-80
Class 3	Strong Impact	41-60
Class 4	Very Strong Impact	21-40
Class 5	Extremely Strong Impact	0-20

5. Results and Findings

5.1 Case Study

The buildings are taken from the Sukkhanagar area, where rapid commercialization is happening. Altogether, 22 mixed-use Residential Buildings were surveyed for the analysis of spaces on average. And, individuals categorized 5 buildings were done a detailed survey of which buildings were used for commercial, college, bank, hospital, and small industry. In the report, only one sample of a Residential building with a College is shown.

5.1.1 Selection of Mixed-Use Buildings

The sample survey of settlements of Sukkhanagar, Butwal City is done for finding the mixed-use settlements through the veto-criterion checklist created on kobotoolbox for finding the buildings for study and also through the interview of people. The Yes/No checklist has been created and the mixed-use buildings with 'No' answers are chosen for the survey. After the survey, a few buildings have been inspected with buildings used for different public purposes like a bank, educational purpose, health, and cafeteria.

5.1.2 Case Study 1-Residence and College

Figure 4: Images of Case Study

Present Building Type: Mixed-use (Residential and College)

Number of Storey at present: 4 and half

Number of Storey when Constructed: 3 and half

Present Scenario: The 4-and-a-half-story building consists of LITS (Lumbini Institute of Technology and Science) College along with the residents living on the third floor of the building. The Ground Floor Consists of Office Space and administration and one classroom. The First Floor Consists of 3 classrooms and one staff room. The second floor consists of two classrooms and half a portion of the floor is used for residential purposes. The Third Floor is used for residential purposes and half of the floor is a terrace. The fourth floor, which previously was a terrace is transformed into labs for the college.

Condition of Maintenance: Services like proper toilets, lighting in the classroom, open lobbies for discussion, and green areas are lacking for the college premises. Whereas, for the Residents living in the building the disturbance and homely environment are lacking. Figure 4 shows the pictures of the condition

of classroom and painting conditions.

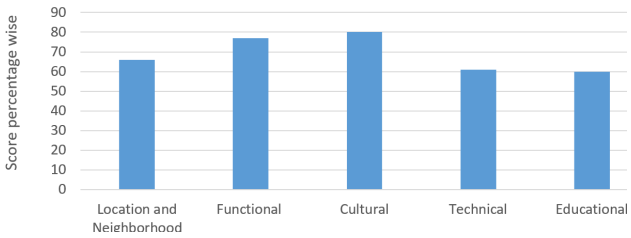

Figure 5: Score of Categorized Aspects

From the figure 5, the major problem is seen on the technical aspects of building and the criteria for additional space i.e, educational purpose is only fulfilled to sixty percentage.

Risk Class: The total percentage of score obtained is 58 percentage and it falls on Risk Class 3, which is strong impact on residents and living, due to unsatisfactory style of living.

5.2 Major Problems faced by mixed use housing

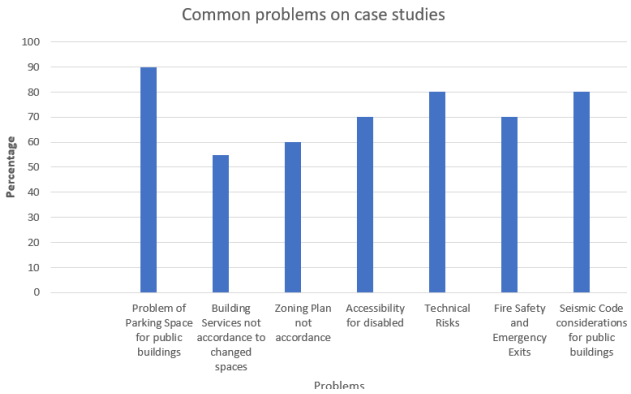

Figure 6: Problem Identification from findings

The figure 6 explains that the major problem seen is the lack of parking spaces needed for the occupants of Building. As the building originally used for around 10 people are used for hundreds, then certainly problem for parking arises. Around 90 percent of surveyed buildings were facing the problem. And mostly, technical aspects of buildings were lacking along with consideration for potential hazards.

5.3 Findings from Categorized Case Studies

Mixed-use Building: Residence with College

The major problem is functional spaces for the college such as adequate space, breakout open spaces, proper canteen, and spacious library and maintenance of the building. As the building is built originally for residence, occupying many students can cause mass irregularity and ultimately create risk as a seismic consideration.

Mixed-use Building: Residence with Cafeteria

The major problem is the degradation of the authenticity of the neighborhood. The occupancy of the cafeteria creates a crowd within the spaces and unmanaged street parking.

Mixed-use Building: Residence with Bank/Commercial

The major problem observed is legal problems such as fire safety considerations, spacious entrance, and no building code considerations for use as a bank purpose.

Mixed-use Building: Residence with Hospital

The major problem observed for residential space is the unhealthy lifestyle due to the hospital. It could affect people with the risk of getting exposed to diseases.

Mixed-use Building: Residence with Industry

The major problem observed for residential space is the noise produced by machines and chemicals that could affect the health of residents.

5.4 Enhancement Measures for Location and Neighborhood

The following mentioned points are the measures for the control of possible problems occuring in neighborhood premises of the mixed-use buildings.

- Allocation of parking spaces within locality for proper street management and traffic.
- Hard and soft landscaping, to enhance the aesthetic and provide fresh air and good environment to urban settlements.
- Training and awareness in construction health, safety and environmental management.
- Promote public knowledge of environmental pollution, and their relationship to health and hygiene. Butwal municipality needs to run awareness campaigns in conjunction with the local organization.
- Stopping the commercialization on the potential hazard zone i.e,landslide and flood risk zone.

5.5 Enhancement Measures for Building Attributes

The following mentioned points are the measures for the control of possible problems occuring in building premises of the mixed-use buildings.

- Timely consultation with local authorities regarding proper planning and safety.
- Involvement of key stakeholders in - planning, design, reconstruction is necessary for successful implementation according to bylaws and improving environment, health and hygiene of the people in sustained way.
- Analyze the building's condition (with reference e.g. to design and condition of structure, finish, maintenance).
- Renovation if needed after detailed analysis(extra reinforcement, shotcrete,interior courtyard for more daylight, etc.)
- Analyze different access possibilities (entrance hall, central corridor, central access).
- Analyze expansion possibilities for parking(combine with other buildings; rent open spaces, etc.)

5.6 Template for Potential Risk Meter

The table 5 illustrates the template for potential risk meter, which is basically a template for the process of qualitative assessment of mixed use spaces for problem findings and analysis.

5.7 Data Interpretation and Analysis

Table 6 illustrates the physical problems that were frequently noticed during the survey of buildings, on which building services is the area mainly seen having problems in buildings. Housing facilities are ranked as the second major physical impact as 11 among 22 buildings had a problem. Based on this, we can deduce that building services need more attention on buildings that are facing conversion.

Table 7 illustrates the environmental problems that are identified on site and among them, 16 houses faced the problem of traffic congestion making it the first rank for creating a major impact. Noise hindrance and high population are the second and third major environmental problems from the study.

Step	Action	Outcome
Step 0	Inventory of mixed use settlements	Selection of mixed use spaces for analysis
Step 1	Quick Scan: Initial Appraisal using veto criteria	Selection or Rejection of building for further study; YES/NO decision
Step 2	Further Appraisal: Gradual Criteria	Detailed assessment on potential risk
Step 3	Determination of Risk Class	Indicates risk on 5 point scale from low to extremely strong impact
Step 4	Potential Hazard and Impact Assessment	Highlights categorized risks with potential hazard
Step 5	Risk Analysis, Evaluation and Measures	Highlights areas of concern in mixed sue settlements

Table 5: Template for Potential Risk Meter

Physical Problems	Frequency of occurrence	Rank from survey
Building Services	17	1st
Condition of Maintenance	7	5th
No Habitable Residential Space	10	3rd
Housing Facilities	11	2nd
Finishes and Materials	8	4th
Lighting and Ventilation	6	6th

Table 6: Physical Problems found from case studies and their rank according to the impact

The impact on different categorized buildings and its indication on basis of rank of low, moderate, and high on attributes of different types of mixed-used buildings are done. Hospitals and Clinics are affected severely in terms of cultural and technical aspects. And Industrial Mixed-use Residential buildings are affected severely in terms of functional and cultural aspects.

The different types of mixed-use residential buildings and their results of impacts on basis of rank classification are done. Among the inspected 22 buildings, around 50 percent of buildings had a strong

Environmental Problems	Frequency of occurence	Rank from survey
Traffic Congestion	17	1st
Noise Hindrance	12	2nd
Poor Sanitation	8	4th
Crime	4	7th
House Pollution	7	5th
Poor Drainage	5	6th
High Population	11	3rd

Table 7: Environmental problems examined in study area and their rank according to the impact

impact due to conversion and fall on Class 3 of the risk classification category.

6. Conclusion

Physical problems such as lack of ventilation and lighting, affected functionality of buildings, street parking, condition of building components, etc. are found. The major physical impact is the lack of building services found on 17 buildings out of 22 surveyed buildings. The major impact on the environment is created due to traffic congestion which was found problematic in 16 surveyed buildings out of 22. From the risk assessment of buildings, around 50 percent of buildings fall on Risk Class 3 which is having a strong impact. Common health problems are found such as gastroenteritis, diarrhea, and mental health issues. The qualitative risk assessment template is formulated after the study, case studies, and analysis of specific problems. It has five steps for qualitative risk assessment.

Butwal is a city with rapid urbanization and in the present scenario, the concern of necessary authority can create the proper planning of the city along with the minimization of underlying risks such as sudden accidents due to fire, lack of ventilation in bathrooms, earthquake hazards, heat waves, etc. Also educating residents about better living styles and health awareness can contribute to the management of residential spaces. This study serves as a start to the need for exploration within a residential space in the rapidly developing cities and commercialization happening, which has not been given priority to date in the case of Nepal.

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