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Assessing Code Compliance and Mason Proficiency in Residential Construction in Birendranagar Municipality, Surkhet

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Abstract

Urbanization is rapidly increasing worldwide, and refers to the process by which rural areas transform into urban areas, where cities in Karnali Province are experiencing significant growth. However, much of this expansion is characterized by informal construction, with over 80% of housing lacking compliance with building codes, thereby increasing vulnerability to disasters like the 2015 Gorkha Earthquake and the 2023 Jajarkot Earthquake. This study evaluates building code compliance in residential RCC buildings within Birendranagar Municipality, focusing on both completed and under-construction buildings. The research adopts a qualitative approach, combining literature review, field surveys, and questionnaire administration to gather and analyze data.

Key findings reveal that among the 22 completed buildings surveyed, only 5 fully complied with the approved designs, with common issues including non-compliant staircases, beams, and room layouts. For the 22 under-construction buildings, 8 demonstrated full compliance, especially in foundation work, tie beams, and rebar sizing, although non-compliance issues like slab thickness, bar lapping positions, and staircase dimensions were identified. Additionally, 11 out of the 22 completed buildings met municipal bye-laws, especially with regard to ground coverage ratio and building height, but setbacks and floor area ratios were frequently violated. The study also found that most masons lacked formal training, with only 30% aware of earthquake-resistant design principles. Masons relied primarily on practical experience, with limited knowledge of building codes and municipal approval processes. Findings highlight the need for increased training for masons, greater awareness for homeowners, and improved municipal oversight to ensure better compliance and safer construction practices

Keywords: *Urbanization, Building Code Compliance, Residential Construction, Non-compliance, Mason Training.*

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Introduction

Urbanization marks a significant trend of the 21st century, with over half of the global population living in urban areas. This trend is also evident in Nepal, where cities increasingly draw individuals seeking enhanced economic prospects and a better quality of life. Birendranagar, located centrally in Karnali Province, serves as a prime example of this urban shift. As the city experiences rapid growth, it embodies both the challenges and opportunities of urban development within a developing country.

The urban growth rate in Nepal has been substantial, with the urban population increasing from 17% in 2011 to 24% in 2021 (CBS, 2021). However, much of this urban expansion is characterized by informal construction. Rough estimates indicate that over 80% of housing in Nepal is informal (UN-HABITAT, 2010) with limited or no application of building codes in such structures. Even within the formal sector, adherence to building codes remains limited (Bhattarai & Mishra, 2017). This widespread non-compliance significantly heightens earthquake vulnerability.

Earthquakes are relatively frequent and disastrous natural events in Nepal, emphasizing the urgent need for strict adherence to building codes to ensure structural safety. The Gorkha Earthquake of April 25, 2015, with a magnitude of 7.6, had its epicenter near Barpak village in Gorkha district, approximately 181 km northwest of Kathmandu. This catastrophic event resulted in the complete destruction of 604,930 houses and partial damage to 288,856 houses (Subedi & Poudyal, 2019). Most of the affected structures were old, non-engineered adobe and masonry buildings, although some engineered buildings also collapsed due to poor workmanship and substandard construction materials.

More recently, the Jajarkot Earthquake on November 3, 2023, with a magnitude of 6.4, further underscored the seismic vulnerability of Nepal's built environment. This event led to over 150 fatalities, hundreds of injuries, and the destruction of thousands of buildings.

It is often noted that "earthquakes do not kill people; poorly built structures do" (Bhattarai & Mishra, 2017). A case study in Karyabinayak Municipality reveals systemic deficiencies even in regulated constructions. Of the total registered building drawings, 78% were Class C buildings, requiring specifications as per Nepal Building Code (NBC): 205, while 22% were Class B buildings, necessitating detailed analysis and design (Chaulagain, Rodrigues, Spacone, & Varum, 2015). Common issues identified included inadequate stirrup spacing, improper bar anchorage, insufficient column reinforcement, and poor detailing in staircases. Configuration problems such as short-column effects, non-grid-aligned columns, and discontinuous beams were also prevalent.

The challenges of compliance are compounded by limited inspection and monitoring processes within municipalities. Municipal engineers inspect construction work primarily up to the plinth level, as noted by (Maharjan & Shrestha, 2023). The municipality's oversight occurs in three key stages: issuing a temporary construction permit (up to plinth level), providing a permanent construction permit after plinth-level completion, and granting a completion certificate upon project finalization. However, the lack of continuous inspection beyond the plinth level leads to deviations from approved plans, resulting in structural weaknesses and compromised quality.

This research aims to assess design criteria compliance in construction practices to enhance building code adherence and improve urban safety. Insights gained will not only benefit Birendranagar but also inform similar urban areas in developing regions. Additionally, these findings can guide local authorities and policymakers in refining regulations to foster safer, more sustainable urban development.

This research, focused on Birendranagar in Karnali Province, Nepal, evaluates building code compliance and construction masons' understanding of these codes for residential RCC buildings. A basic checklist prepared during the similar research on Sisne Rural Municipality Rukum (East) prepared by (K.C, Bhattarai, &

Katuwal, 2023) were used to assess compliance. Limitations of the study that the study has been carried out for construction of residential RCC buildings, the study uses a basic compliance checklist without structural integrity testing. Despite these constraints, the study offers insights to improve construction practices and regulatory adherence, supporting safer urban development.

Research Objectives

The objective of this study is to assess the status of compliance with building codes in residential buildings within Birendranagar Municipality while also evaluating the knowledge and experiences of construction contractors and masons regarding adherence to these codes during the construction process.

Literature review

A study analyzing compliance in building construction revealed concerning trends. Out of 27 completed buildings, only one met the compliance checklist, while all 13 buildings under construction failed to comply. Common deviations included unauthorized changes to design elements like plinth areas, room sizes, and staircase positioning, alongside improper lapping of rebar in columns and beams. These issues stem largely from masons' lack of awareness of building codes and adherence to owners' instructions that often contravene compliance requirements. This highlights a pressing need for stricter enforcement and education regarding building regulations. (K.C, Bhattarai, & Katuwal, 2023)

An investigation on the level of awareness amongst Cape Town contractors of building regulations; the degree of compliance by contractors with building regulations; the perceived quality and availability of regulation documentation to contractors; and whether there are significant differences between the levels of compliance by the different levels of building contractors studied. Rigorous inspections, based on a checklist of NBR requirements, were undertaken. Out of 14 constructions, five were seen to have complied fully with NBR regulations. It was found that there is skill and knowledge gap in the South African construction industry and most of the managerial positions are held by people who, though uneducated, have extensive experience. It was also found that the level of non- compliance tends to be more significant amongst the unqualified and less experienced firms (Windapo & Cattell, 2010).

A study on the building code compliance observations on the building designs in Karya Binayak Municipality shows checklist survey was carried out on the design drawing for the collection of data. Most of the building designs of both classes have ductility related problems like stirrups spacing, anchorage of bars, number of bars in column, detailing in staircase and bar diameter. Building drawings were mostly non-compliant to ductility related checks. Strength related check was found compliant except in 15% building drawings. Configuration problems were also another parameter neglected in most of the drawings. Configuration problems were observed mainly due to irregular shape of land plot (Shrestha, Pradhan, & Shrestha, 2015).

(Bhattarai & Mishra, 2017) Studied existing scenario of building code implementation through Mandatory Rule of Thumb (MRT in newly formed Nagarjun Municipality. The result shows that the adopted process and existing institutional mechanism for the implementation of building code is not effective due to lack of building code implementation section, insufficient manpower and non-functionality of environmental section. Municipal engineers and technical manpower have academic achievements though they lack relevant trainings for effective implementation of building code and by-laws. MRT has been implemented in permitted drawings and implemented in construction also in Nagarjun Municipality. Local contractors implemented the design in construction as they have relevant trainings.

Methodology

This research targets the evaluation of compliance with approved designs in residential building construction within Birendranagar Municipality, Surkhet District. It aims to uncover the causes of non-compliance, analyze these factors, and propose actionable recommendations to enhance

construction compliance.

Research Approach: The study employs a qualitative research methodology, encompassing: i. A comprehensive literature reviews. ii. Field surveys and data collection. iii. Administration of questionnaires. iv. Data entry, analysis, and interpretation. v. Compilation of a research report detailing findings and conclusions.

This approach promises to provide insights that can significantly improve local construction practices and compliance with building codes.

Study Area

The study focused on residential buildings located in 12 out of the 16 wards of Birendranagar Municipality. These wards were selected because they contain residential buildings larger than 1,000 sq. ft constructed in the fiscal year 2079/80 BS, allowing for an analysis of compliance with building design standards.

Study Population, sample selection and sample size

The study population consists of registered residential buildings constructed after the municipality mandated compliance with building laws in 2075 BS, as recorded by the Birendranagar Municipality Office. This includes 90 under-construction buildings and 93 completed buildings with areas exceeding 1,000 sq. ft. Stratified random sampling was used to select the sample for the study.

Table 1: Ward-wise Construction Status in Birendranagar Municipality

Birendranagar Municipality (2079/80)				
Ward	**Construction status**			
	Under construction		**Completed**	
	Population	**Sample**	**Population**	**Sample**
1	5	1	3	1
2	4	1	5	1
3	22	5	26	6
4	6	2	5	1
5	5	1	5	1
6	5	1	5	1
7	5	1	8	2
8	11	3	9	2
9	3	1	6	2
10	9	2	10	2
11	6	2	6	2
12	9	2	5	1
Total	**90**	**22**	**93**	**22**

The sample sizes have been fixed using stratified random sampling, which ensures representation across different wards by dividing the population into strata (ward-wise under-construction and completed buildings). This method improves accuracy by capturing variability across different locations while maintaining a manageable sample size. Similarly, the sample size for each ward is selected proportionally based on the number of buildings in that category (under-construction or completed). This ensures that wards with more buildings have a larger sample size, maintaining representativeness.

Conducting inspections or detailed compliance assessments on every building in the population was not be feasible due to time, cost, and resource limitations. The selected sample size balances the need for comprehensive data with practical considerations. Similarly, the use of sample sizes around 20–30% of the population is common in similar municipal compliance studies by (K.C, Bhattarai, & Katuwal, 2023), (Shrestha, et al., 2022), (Maharjan & Shrestha, 2023) as it provides a balance between detailed analysis and broad generalizability.

Data Collection

Primary Data Collection

Primary data were collected for the compliance verification of approved and permitted buildings form the municipality. The data were collected using following methods:

a. Field Verification: A site investigation of sampled buildings was done, and compliance was checked based on the checklist prepared. The checklist involves: Characteristics of mason, Configuration related parameter, Strength related parameter, Ductility related parameter, Connection related parameter, Causes of non- compliance

b. Questionnaires: A set of different questionnaires were prepared for local contractor/mason. The questionnaires were related to assess the awareness, perspective and capabilities of the mason to construct the buildings to comply the provision of building code.

Secondary Data Collection

Secondary data collected for the study were from Municipal Records, Approved Drawings and Design, Building Permit Certificate, Photographs, Relevant textbooks, Prevalent acts and regulations, Published and unpublished journals, records of the related government offices.

Data Analysis and Research Matrix

The required data for this study was collected as much as possible from the targeted personnel. Data were collected, coded processed and analyzed by descriptive method using MS Excel and logically interpreted outcomes were presented in tabular and graphical forms.

Research Matrix

The research matrix for the study has been presented below (see Table 2)

Table 2: Research Matrix

Objectives	Data Required	Source of Data	Tools	Outcomes
To assess the status of compliance of building code in residential buildings of Birendranagar Municipality	The data of different parameters of building Code as per the prepared checklist in residential buildings	Field observation and measurement, checklist, Approved drawings & building permits/certificates, building codes, Municipal records, legal and other relative documents,	Descriptive statistics such as percentage, charts	Compliance of individual parameters and total compliance.

To evaluate the knowledge and experiences of construction contractors and masons regarding compliance to building codes in the construction of residential buildings of Birendranagar Municipality	Awareness, perspective and capabilities of construction contractor/ masons measured in Academic qualification, experience, relevant trainings	Primary Data collected via questionnaire	Descriptive statistics such as percentage, charts	Awareness level of the Local contractor/ Mason in complying building code while construction

Results and discussions

General Information

There was rapidly increasing in the number of houses being constructed in recent few years and it seems to be ongoing process. The wardwise status of building construction has been depicted in the above section (see Table 1).

Building Code and Byelaws Compliance in Construction of Residential Building

The compliance checklists for constructed and under-construction buildings were prepared from different sources. This approach was necessary due to the differing stages of construction and the specific compliance parameters relevant at each stage:

•**Constructed Buildings:** The compliance checklist for constructed buildings was based on the checklist used by the Municipality for issuing building construction certificates. This checklist focuses on final inspections, ensuring the entire structure complies with design, safety, and regulatory standards after completion.

•**Under-Construction Buildings:** The checklist for under-construction buildings was derived from the compliance check handbook of Lalitpur Metropolitan City, as well as studies from Karya Vinayak Municipality and Sisne Rural Municipality, Rukum (East). These sources emphasize monitoring construction practices during different phases, addressing issues like material usage, structural integrity, and workmanship that can affect compliance before completion.

Using different sources ensures that each checklist is tailored to the unique inspection needs of buildings at various stages, enhancing the accuracy and relevance of compliance assessments.

Building Code Compliance in Constructed Residential Building

Among 90 construction completed buildings with municipality approval, sample of 22 buildings were considered for building code compliance. The checklists for the constructed building in field verification are as follows: Check for Column Size and Grid Position, Check for Beam Size and Grid Position, Check for Plinth Area of The Building, Check for Room Size and Orientation, Check for Staircase Size and Position, Check for Final Built-Up Area

The status of the compliance of constructed building has been depicted in the figure 1 below.

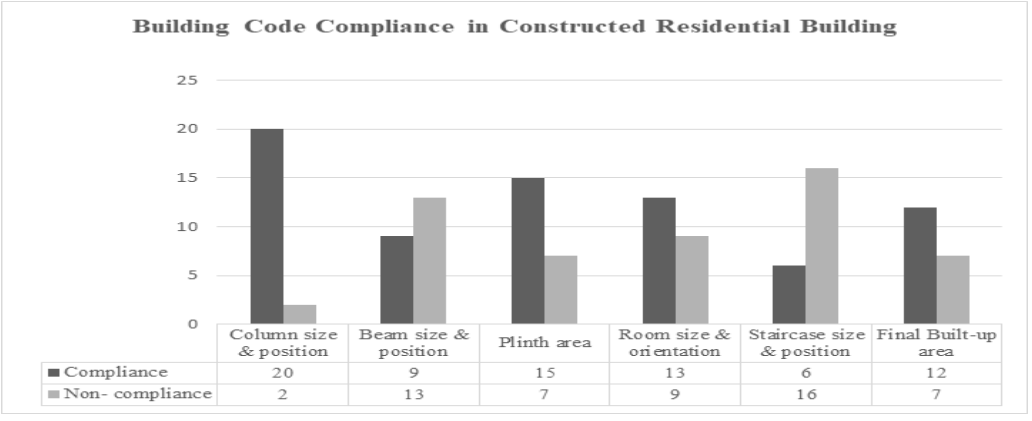

Figure 1: Building Code Compliance in Constructed Residential Building

Field observation showed that 5 out of 22 buildings fully complied with the checklist. This success was attributed to proactive house owners who were committed to constructing their buildings according to the approved designs. They ensured regular site visits and supervision by an engineer, while also closely monitoring the work of masons and contractors to maintain compliance.

Building Code Compliance in Under Construction Buildings

Among 93 construction undergoing buildings with municipality approval, sample of 22 buildings were considered for building code compliance. The major parameters considered for the checklist survey are as follows: Depth and Construction of foundation, Column size and position, Beam size and position, Floor Slab thickness, Clear cover, Reinforcement detailing, Stirrups, and Sill and lintel bands in construction.

The details of under construction buildings considered for the study are depicted in the table below (see Table 3).

Table 3: Construction status of ongoing buildings

S. No	Status of Construction	Frequency	Percentage
1	Construction of Foundation	1	4.5
2	Construction up to DPC Level	4	18.2
3	Constructed up to 1st floor	7	31.8
4	Constructed above 2nd floor	6	27.3
5	Completion works (plastering and painting)	4	18.2

Analysis of Compliance and Non-Compliance Check

Following table (see Table 4) explains the Compliance and Non-Compliance in Under Construction Building from the detail analysis of data obtained during field observation and measurement.

Table 4: Checklist of Compliance and Non-Compliance in Under Construction Building

S.N.	Description of compliance parameters	Compliance	Non-Compliance	Compliance (%)	Non-Compliance (%)	Remarks
1	Depth of Excavation in foundation	5	-	100	-	Observed on buildings constructed up to Plinth level.
2	Foundation Construction					
a	Size	5	-	100	-	Studied on buildings constructed up to Plinth level.
b	Rebar placement and Size	5	-	100	-	Studied on buildings constructed up to Plinth level.
3	Column Size and Position	20	2	90.9	9.1	Studied on all ongoing buildings
4	Beam Size and Position					
a	Tie beam	1	-	100	-	Studied on foundation Construction building
b	Plinth Beam	4	-	100	-	Studied on buildings constructed up to Plinth level.
c	Floor Beam	12	5	70.59	24.59	Studied on 1st, 2nd and completion buildings
5	Staircase size and position	9	8	52.94	47.06	Studied on 1st, 2nd and final completion buildings
6	Slab Thickness					
a	Floor Slab	11	6	64.7	35.3	Studied on 1st, 2nd and completion buildings
b	Staircase Slab	15	2	88.23	11.77	Studied on 1st, 2nd and completion buildings
7	Reinforcement detailing					

a	Foundation	1	-	100	-	Studied on foundation construction building
b	Column	18	-	100	-	Studied on buildings except completion stage
c	Beam	13	-	100	-	Studied on 1st, and 2nd floor constructed building
d	Slab	13	-	100	-	Studied on 1st, and 2nd floor constructed building
e	Staircase Slab	13	-	100	-	Studied on 1st, and 2nd floor constructed building
7	Stirrups	16	2	88.89	11.11	Studied on buildings except completion stage
8	Lapping Position of Bar					
a	Column	7	11	38.89	61.11	Studied on buildings except final completion stage
b	Beam Top Bar	10	3	76.92	23.08	Studied on 1st, and 2nd floor constructed building
c	Beam Bottom Bar	10	3	76.92	23.08	Studied on 1st, and 2nd floor constructed building
9	Sill and Lintel Band	11	2	84.62	15.38	Studied on 1st, and 2nd floor constructed building

Key Findings

Building Code Compliance:

o Of the 22 completed buildings surveyed, only 5 fully complied with the approved designs and drawings. Common issues included non-compliance in staircase dimensions, beam depth, plinth area, and room layout. However, column specifications generally met the standards.

o Among the 22 buildings under construction, 8 showed full compliance. They adhered well to standards in foundation work, tie beam and plinth constructions, and rebar sizing. Main compliance issues were related to bar lapping positions, slab thickness, and the dimensions and placement of staircases.

Bye-Law Compliance:

o The study showed better results in bye-law adherence, with 11 out of 22 constructed buildings fully meeting municipal regulations. Full compliance was noted in ground coverage ratios and building heights, whereas setbacks and floor area ratios were the most common points of non-compliance.

Mason Characteristics:

o Analysis of 16 lead masons from active construction sites highlighted a deficit in formal training and education, with most relying primarily on hands-on experience. Only about 30% of masons were familiar with earthquake-resistant design principles and building codes, though over half understood the municipal approval process for drawings. Many masons struggled with implementing earthquake-resistant practices, interpreting drawings, and fully grasping construction methodologies and material specifications.

Discussions

Field observation showed full compliance of building codes in parameters for foundation excavation and construction, Tie beam and plinth size and position with adequate size of reinforcement. As mentioned earlier, this success was attributed to quality of engineers, contractors/ masons and mainly proactive house owners who were committed to constructing their buildings according to the approved designs who ensured regular site visits and supervision by an engineer, while also closely monitoring the work of masons and contractors to maintain compliance.

The major non-compliance parameters identified were lapping position of bar, thickness of slab, staircase size and position and spacing of stirrups. Staircase size was a common issue in Municipality with alteration in dimensions, changes in the riser, tread and width sizes. In case of floor slab was primarily driven by the owners' preference to adjust the slab slope to direct rainwater flow in a specific direction. Similarly, for sill and lintel band, inadequate band thickness and improper placement of reinforcement were observed. These deviations were primarily attributed to poor workmanship, owners' preference as well as their passiveness and not frequent inspection of municipality technical personnel.

Building Byelaw Compliance in Completed Buildings

The study revealed that 11 out of 22 constructed buildings fully compliant to the municipality building by-laws. The compliance status of setbacks, floor area ratio, coverage and building height were assessed. Ground coverage ratio and building height were the parameters that were fully adhered, and the most common area of non-compliance included side, back and front setbacks along with floor area ratio. The details have been depicted in figure 2 below.

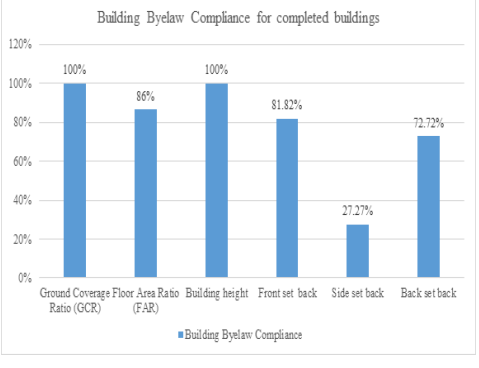

Figure 2: Building Byelaw Compliance for construction completed buildings

Characteristics, Awareness and Capabilities of Construction Contractor/Masons

This objective defines the existing level of awareness and capabilities of construction contractor and masons involved in building construction in Birendranagar Municipality. This also helps to trace the reasons behind non-compliance of building code.

Characteristics of Mason

This table examines key characteristics of 16 lead masons from under-construction sites, focusing

on their experience, construction training, and academic qualifications. The data helps understand the background and expertise level of the workforce involved in the building construction.

Experience of Mason

Below listed table (see Table 5) categorizes masons by their years of experience in the construction field, highlighting a diverse range of experience from less than 5 years to more than 15 years. It shows a majority has experience between 5 to 10 years, indicating a moderately experienced workforce.

Table 5: Experience of Masons

S. No	Experience in Years	Frequency	Percentage
1	Up to 5 Years	4	25
2	5 to 10 Years	7	43.75
3	10 to 15 Years	2	12.5
4	More than 15 Years	3	18.75

Relevant Training of Mason

Below listed table (see Table 6) shows the proportion of masons who have participated in formal training programs. A significant 81.25% have not received formal training, emphasizing a reliance on practical experience over structured educational programs.

Table 6: Training of Masons

S. No	Involved in Training	Frequency	Percentage
Yes	3	18.75	
No	13	81.25	

Academic Qualification

It details the educational background of the masons, showing that most have limited formal education, with 50% having less than secondary level education (SLC). This underscores the need for skill-based training to enhance construction quality. The details are depicted below (see Table 7).

Table 7: Academic qualification of mason

S. No	Academic Qualification	Frequency	Percentage
1	Literate	5	31.25
2	Under SLC	8	50
3	SLC	2	12.5
4	Intermediate	1	6.25

Level of Awareness of Construction Contractor/Mason

Table (See table 8) assesses the masons' awareness of critical construction-related knowledge areas such as earthquake-resistant design, building codes, and municipal approval processes. The relatively low awareness levels indicate gaps in essential knowledge that could impact construction safety and compliance.

Table 8: Level of Awareness of Construction Contractor/Mason

S. N	Description	No		Yes	
		Frequency	%	Frequency	%
1	General Concept on Earthquake Resistant Design and Construction	12	75	4	25
2	General Concept on Building Code and its Provisions	11	68.75	5	31.25
3	General Concept on Approval Process of Drawings from Municipality	7	43.75	9	56.25

This suggests that masons having knowledge of municipal approval processes, awareness of earth-quake-resistant construction and building codes is relatively low, emphasizing the need for targeted training in these critical areas.

Capabilities of Construction Contractor/Mason

Below listed table (see Table 9) evaluates specific skills and capabilities of masons, including their ability to follow earthquake-resistant construction practices, read technical drawings, understand material specifications, and grasp construction methodologies. The data reveals significant skill gaps, particularly in technical areas, highlighting the need for enhanced training to improve construction practices.

Table 9: Capabilities of Construction Contractor/Mason

S. N	Description	No		Yes	
		Frequency	%	Frequency	%
1	To Follow Earthquake Resistant Construction	12	75	4	25
2	To Read the Architectural and Structural Drawings and Detailing	13	81.25	3	18.75
3	To Understand the Material and Its Test Specification	9	56.25	7	43.75
4	To Understand the Construction Methodology	10	62.5	6	37.5

Perspective of Mason towards Non-Compliance

The table listed below (see Table 10) presents masons' perspectives on compliance with building designs, showing a significant influence of owners in driving non-compliance. Most masons attribute design modifications to owner instructions, which simplifies work or adheres to the owners' specific demands. This suggests a critical need for raising awareness among both masons and owners about the importance of compliance for safety and structural integrity.

Table 10: Perspective of Mason towards Non-compliance

S. N	Perspective	Frequency	Percentage
1	Compliance	1	6.25
2	Non-Compliance-Modify the design to make work easy	2	12.5
3	Non-Compliance-Modify the design as instructed by owners	13	81.25

Conclusions

This study underscores significant gaps in compliance with building codes in residential buildings within Birendranagar Municipality, revealing the pressing need for systemic improvements. While partial compliance with building codes is evident in aspects such as material selection and basic structural elements, critical deficiencies persist in areas related to seismic safety, proper load distribution, and structural design—key factors in ensuring building resilience in earthquake-prone regions like Nepal. These lapses not only jeopardize the safety of residents but also undermine the overall sustainability of urban development in the municipality.

The research also highlights the limited knowledge and expertise of construction contractors and masons regarding building codes. Many contractors and masons lack formal training and are unaware of recent updates to the codes, which results in suboptimal construction practices. This knowledge gap is further compounded by inadequate access to technical resources and a lack of emphasis on continuous professional development within the construction sector.

Weak enforcement mechanisms and insufficient monitoring by municipal authorities emerge as significant contributors to the non-compliance. Existing regulatory frameworks lack the necessary rigor to ensure strict adherence to building codes, while inconsistent inspection practices allow deviations to go unchecked. Additionally, the absence of public awareness campaigns about the importance of building

code compliance means that homeowners often prioritize cost and time over safety.

In conclusion, addressing these challenges requires a multifaceted approach that includes capacity building, stricter regulatory oversight, enhanced public awareness, and collaborative efforts among stakeholders. Only through concerted efforts can Birendranagar Municipality achieve safe, sustainable, and resilient urban development.

Recommendation

To address the challenges identified in this study, a comprehensive and multifaceted approach is essential. First, capacity-building initiatives should be prioritized by providing regular and accessible training programs for contractors and masons to enhance their understanding and application of building codes. These programs should focus on practical skills, seismic safety, and updated regulatory requirements. Simultaneously, municipal authorities must strengthen enforcement mechanisms by conducting frequent inspections and ensuring strict adherence to building codes at every stage of construction. Establishing penalties for non-compliance and rewarding code-compliant practices through incentives such as tax rebates or certifications can encourage adherence. Public awareness campaigns should also be launched to educate homeowners, developers, and other stakeholders about the importance of building codes for safety and resilience, emphasizing the long-term benefits of compliance over short-term cost savings. Additionally, fostering collaboration between government bodies, private sectors, and educational institutions can help create a shared commitment to promoting code-compliant construction. Finally, the municipality should ensure the availability of updated technical resources and guidelines to all stakeholders and support ongoing research to identify and address emerging challenges. By implementing these measures, Birendranagar Municipality can promote safer, more sustainable construction practices and enhance the resilience of its residential infrastructure.

References

Bhattarai, S. K., & Mishra, A. (2017). Existing Scenario of Building Code Implementation in Newly Formed “Nagarjun Municipality”. Asian Journal of Science and Technology, 6751-6762.

CBS, N. (2021). National Population and Housing Census 2021. Kathmandu: Central Bureau of Statistics (CBS, Nepal), Government of Nepal.

Chaulagain, H., Rodrigues, H., Spacone, E., & Varum, H. (2015). Seismic response of current RC buildings in Kathmandu Valley. Structural Engineering and Mechanics, 791-818.

K.C, K., Bhattarai, S. K., & Katuwal, K. (2023). Compliance of Building Code in Construction of Residential Buildings in Sisne Rural Municipality Rukum (East). Kathmandu: International Conference on Engineering and Technology, Kantipur Engineering College.

Maharjan, N., & Shrestha, S. K. (2023). Compliance of Concrete Strength Used in Low Rise Residential Buildings with NBC 205: A Case Study of Lalitpur Metropolitan City-28, 29, Harisiddhi. KEC Conference 2023 (pp. 101-105). Lalitpur: Kantipur Engineering College.

Shrestha, P., Mandal, B., Bhujel, R., Katuwal, K., K.C, S., & Lamsal, S. (2022). Construction Compliance Of Residential Building With Design and MRT In lalitpur Metropolitan City. KEC Conference 2022 (pp. 96-102). Kakthmandu: Kantipur Engineering College.

Shrestha, S., Pradhan, S., & Shrestha, S. (2015). Status of Building Code Compliance: A case study in Karyavinayak Municipality. International Symposium on New Technologies for Urban Safety of Mega Cities in Asia (USMCA).

Subedi, S., & Poudyal, M. B. (2019). Impacts of the 2015 Gorkha Earthquake: Lessons Learnt from Nepal.

UN-HABITAT. (2010). Nepal Urban Housing Sector Profile. Nairobi: United Nations Human Settlements Programme.

Windapo, A., & Cattell, K. (2010). A study of building contractors’ compliance with national building regulations in Cape Town. COBRA 2010.