

ASSESSMENT OF KNOWLEDGE AND AWARENESS REGARDING MRT OF NBC; A CASE OF TILOTTAMA MUNICIPALITY, NEPAL



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DOI: <https://doi.org/10.29121/granthaalayah.v8.i7.2020.545>

Article Type: Research Article

Article Citation: Sandeep Regmi, and Dr. Anjay Kumar Mishra. (2020). ASSESSMENT OF KNOWLEDGE AND AWARENESS REGARDING MRT OF NBC; A CASE OF TILOTTAMA MUNICIPALITY, NEPAL. International Journal of Research -GRANTHAALAYAH, 8(7), 50-66.
<https://doi.org/10.29121/granthaalayah.v8.i7.2020.545>

Received Date: 19 June 2020

Accepted Date: 25 July 2020

Keywords:
Mandatory Rule of Thumb (MRT)
Knowledge
Awareness
Compliance

ABSTRACT

The study was carried out to analyze the compliance status of NBC and Byelaws in private housing construction of Tilottama Municipality. The permitted building samples with all necessary documents is taken for research purpose to trace the compliance status of National Building Code and Byelaws in construction of private housing.

Field verification and review of approved drawings and building permits of 51 numbers of households from the total population of 323 are selected by purposive sampling method to check the compliance status of NBC and Byelaws provisions. The samples are taken from both Professionally Engineered Buildings and Mandatory rule of thumb-(NBC205) buildings constructed in the Tilottama Municipality.

From the study, it is found that after the earthquake concerned stakeholders possess good knowledge of earthquake and its consequences. Knowledge regarding the earthquake resistant design and construction process is found fairly adequate. The perspective of concerned stakeholders towards building code and byelaws are positive. Out of 51 households surveyed, only 7 of the buildings have not complied with all the technical requirements of NBC whereas the building byelaws provisions are found to be effectively implemented by 44 buildings. The adopted process and existing mechanism for the implementation of building code and byelaws by the municipality is not effective as the tracking system of building permit process is ineffective.

1. INTRODUCTION

Nepal is a mountainous country with beautiful natural and historical heritages located in the South Asia. Nepal is as prone to disaster, various natural and manmade disasters claims life and property of considerable value every year. Landslide, flood, earthquake, avalanche, windstorms, hailstorms etc. are the natural disasters while various road accidents, airplane accidents, fire, epidemics, etc. are the manmade disasters resulting the loss of life and property in Nepal. Nepal is at high risk considering the frequent occurrence of the earthquake as it lies in a seismically active zone, just on the boundary of two tectonic plate; Indian and Eurasian plate (Sangachhe, 2008). Seismic records have shown the occurrence of earthquake of magnitude greater than 8 Richter scale once every 80 years on an average in Nepal. The first earthquake recorded in history of the country was of 1255 which was followed

by numerous others, out of which the earthquake of 1934 being the greatest to strike Nepal till date with magnitude of 8.3 Richter scale (DPNET Nepal, 2017). The earthquake of 1988 was also very destructive with magnitude of 6.9 Richter scale that occurred near the Indian border. The most recent earthquake that hit the country was of 25th April 2015 magnitude 7.6 with an epicenter as Barpak, Gorkha and hypocenter at the depth of 8.2 Km. It was followed by the major aftershock on the same day with a magnitude of 6.6 & with a magnitude 7.3 on 12th May 2015 and 479 aftershocks of magnitude greater than and equal to 4 until 4th February 2017 (NSC,2017).

From the time immemorial human being has been making efforts in improving their standard of living. Development of economically and socially appropriate and environmentally comfortable shelter has been the priority of people in attempt to enhance their quality of life. Kathmandu valley is urbanizing rapidly and speeding reconstruction activities has triggered it more. It is not the earthquake that claims victims but the overcrowded, unsafe neighborhoods and collapsing weak structures that are manmade are the reason behind the loss of life and property. Consequences of earthquake are very challenging to manage which can also be seen in present scenario of Nepal. They have passed through two years of Gorkha Earthquake but the reconstruction progress seems to be very poor. If timely good step is not taken to manage these consequences Nepal will be lagging by few more years. At present the liability of government and local governing bodies has increased in conducting the reconstruction works as the peoples are still living under the temporary shelters. Thus, implementation of National Building Code can be the very first step for the effective post-earthquake reconstruction of buildings for 'Build Back Better approach'.

National building code (NBC) is the set of regulations and guidance that specifies the standards for construction of building to make them seismic resistant. The permits for construction of the building can only be obtained from the local government bodies if it satisfies the NBC and Byelaws. NBC is the only legal document fulfilling the requirements for safer construction. The London Building Act, 1844 was the first systematic national building standard. Nepal National Building Code was first drafted in 1994 after the earthquake of 1988. It was approved by the government in 2003 and since then it has been implemented as the legally binding document in all municipalities of the country. Exceeding 20 years of its existence the actual implementation still remains a critical issue. After the recent earthquake that hit the country Government of Nepal (GoN), National Reconstruction Authority (NRA) and various International/Non-Governmental Organizations (I/NGOs) are also involved in implementing the building code in reconstruction activities. Building Byelaws provides the mandatory legal framework for the building design and construction to its completion such that to minimize the urbanization effect and ensure the public health and structural safety. Building which does not adhere to building byelaws is not provided with the permit of construction by the concerned local bodies or authority. Tilottama Municipality of Rupandehi nearby Birthplace of Lord Buddha is selected to assess compliance status based of private residential buildings.

1.1. STATEMENT OF PROBLEM

NBC and Byelaws are only available legally binding document for earthquake safer construction. However, building construction in Tilottama Municipality has raised a question regarding its effective compliance. In context of Nepal, most of the buildings constructed are generally owner driven. They are constructed without the technical assistance of Engineers/Architects. But after the recent earthquake there seems to be increased level of awareness among the people regarding the construction of earthquake resistant buildings, but this awareness level is still not enough. There are several pitfalls in the effective implementation of building code and byelaws. Lack of skilled human resources, poor monitoring and evaluation techniques, weak local governing bodies and lack of technical capacities are some of the challenges for proper implementation of building codes.

After the destruction led by Gorkha earthquake questions are arising regarding the implementation procedure and status of NBC and Byelaws in various local governing bodies. This research area is widely focused in analyzing the impacts of building code and byelaws and its compliance status in construction in private housing of Tilottama Municipality.

1.2. RESEARCH OBJECTIVE

The general objective of this research is to portray the status of compliance of National Building Code and Byelaws in private housing construction of Tilottama Municipality.

2. METHODS AND MATERIALS

2.1. RESEARCH APPROACH

The research approach follows both quantitative and qualitative approach. In this research quantitative approach consist of standardized structured questionnaires to address the issues arising in the building code compliance in private housing reconstruction activity. Field study, focus group discussion and observation were carried out for collection of data as qualitative approach. In the study reference were taken from previous study regarding building bylaws development in Nepal by Mishra (2019), Structural features of buildings by Mishra and Thing (2019) and Cost implecation by Mishra (2019) along with Bhattarai and Mishra (2017) for newly formed municipality.

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2.2. STUDY POPULATION

In this research the study population refers to technical professionals, administrative and technical staff of the municipality, consulting firms/designers/engineers, local contractors and masons, house owners, and general public working within the Tilottama Municipality. Building samples which had been permitted and in implementation phase after the compliance with National Building Code and Byelaws were taken for verification.

2.3. SAMPLING METHOD

Sample size refers to the part chosen from the population. Determining the sample size depends on the type of research to be conducted and form of data you intend to collect. Though with the larger sample size the accurate and closer the estimates will be, but in practice expenses of data collection and research budget governs the situation. Purposive sampling was used.

2.4. SAMPLE SIZE OF BUILDING

To trace the compliance status of National Building Code and Byelaws in the construction of the private housing constructed in Tilottama Municipality with complete required documents were taken for the research purpose. In Tilottama Municipality, till date there are only 323 houses (frame structures) with building permits and approved drawings from the total buildings of 323, only 51 buildings were taken for compliance check regarding the building code and byelaws for convenience. All the buildings sample were frame structured. Minimum of 3 buildings from each ward were chosen for the compliance check.

Questionnaire, key informant interview and focus group discussion were conducted among major stakeholders. The house owners, 51 numbers who have their house constructed were considered as sample size for the questionnaire.

- Local contractors (general and petty contractors) and masons within the municipality
All the 20 numbers of contractors/masons working in the construction of above mentioned 51 buildings were considered for questionnaire.
- Municipal engineers/ Technical professionals
All the technical personnel, engineers/sub-engineer of the municipality (i.e. total number 8) were considered for questionnaire and focus group discussion.

- Consulting firms/Consultants/designers/engineers

Out of 53 consulting firms/Consultants/designers/engineers registered in the municipality. Only 25 numbers of them were considered for the questionnaire for convenience as most of the consultants were either inactive or had their registration expired and difficult to track down.

2.5. RESEARCH MATRIX

Research matrix helps to summarize and organize the information of the study.

Table 3.1: Research Matrix

S. N	Research Objective	Data Collection Source	Analytical Tools/Method
1	To compare the level of knowledge and awareness among house owners of the house constructed in Tilottama Municipality.	Questionnaire Survey	Comparative analysis of questionnaire
2	To assess status of compliance of Nepal National Building Code and Byelaws in private housing construction in Tilottama Municipality	Study of municipal records, building codes, byelaws, legislative and other relevant documents Field study & observation Approved drawings & building permits/certificates	Field study & observation Site measurement Analysis of architectural, structural drawings and building permits

2.6. KNOWLEDGE AND AWARENESS OF STAKEHOLDERS

Level of knowledge of stakeholders is very important to trace the compliance status of NBC and Byelaws. So, to discern the level of awareness and knowledge related to NBC and Byelaws general question related to earthquake and its consequences, earthquake resistant design and construction process, building Code and MRT provisions and provisions in byelaws were enquired with concerned stakeholders.

Table 4.1: Knowledge of stakeholders about Earthquake & Earthquake Resistant Design

S. N	Description	House owner			Contractor /Masons			Consultants			Municipal Technical Personnel		
		51			20			25			8		
		I	II	III	I	II	III	I	II	III	I	II	III
1	Knowledge about earthquake and its consequences	7	34	10	3	13	4	0	5	20	0	1	7
2	Knowledge about Earthquake resistant design and Construction process	7	35	9	3	13	4	0	3	22	0	2	6

I: No knowledge II: General knowledge III: Sufficient Knowledge (Source: Field Survey, 2018)

2.7. KNOWLEDGE REGARDING EARTHQUAKE AND IT'S CONSEQUENCE

Out of 51 house owners, seven has no knowledge, 34 have general knowledge and rest 10 of them have sufficient knowledge regarding the earthquake and its consequences. Similarly among the contractors and masons, out of 20 respondents, three has no knowledge, 13 have general knowledge and remaining four has sufficient knowledge. Out of 25 respondents from consultants, 5 of them have general knowledge and rest 20 of them have sufficient knowledge about the earthquake and its consequences. Out of 8 respondents of Municipal technical personnel, one has general knowledge and rest 7 has sufficient knowledge regarding the earthquake & its consequences.

Thus after the earthquake of April 25 2015, the data portrayed that awareness level of stakeholders about the earthquake and its consequences have increased. The reason behind the increased knowledge of stakeholders is due to various public awareness related programs in mass media and grass root level.

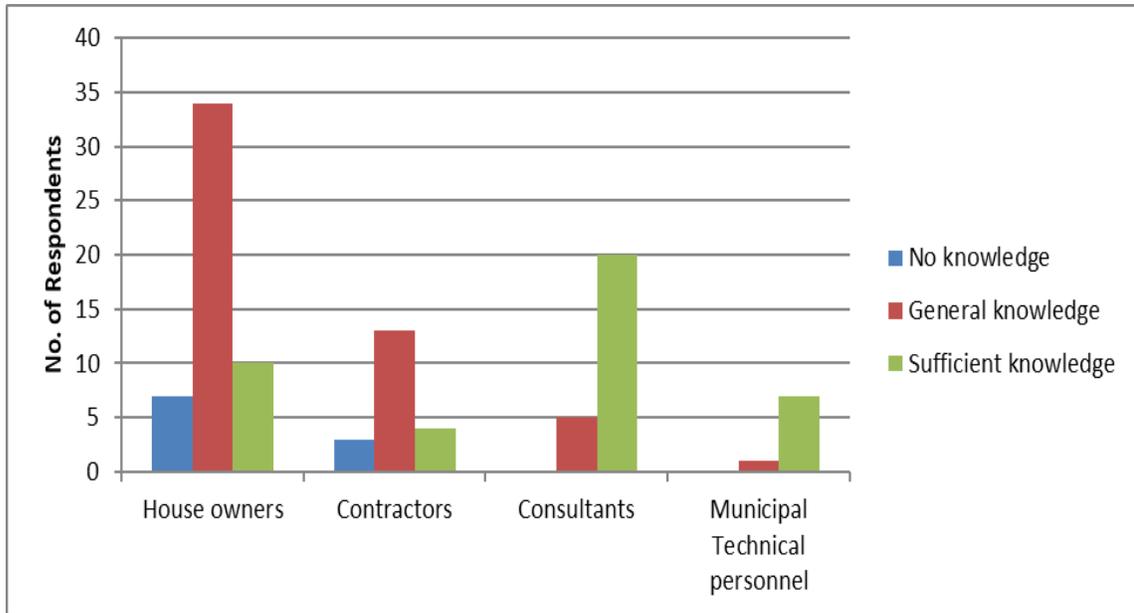


Figure 4.1: Knowledge regarding earthquake and its consequences

2.8. KNOWLEDGE REGARDING EARTHQUAKE RESISTANT DESIGN AND CONSTRUCTION PROCESS

Out of 51 respondents from house owner, 7 has no knowledge, 35 of them has general knowledge and remaining 9 have sufficient knowledge regarding the earthquake resistant design and construction process. Similarly, out of 20 contractors/masons, 3 has no knowledge, 13 have general knowledge and rest 4 contractors/masons have sufficient knowledge about the earthquake resistant design and construction process. Out of 25 consultants, 3 have general knowledge and remaining 22 has sufficient knowledge about the earthquake resistant design and construction process. And out of 8 municipal technical personnel, 2 of them have general knowledge and rest 6 of them have sufficient knowledge.

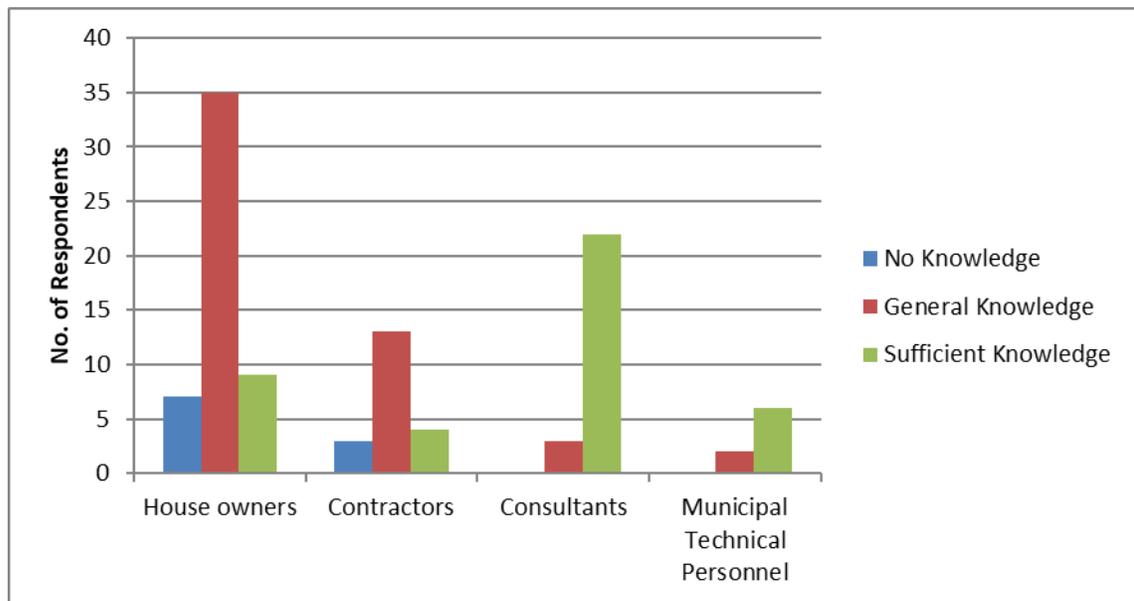


Figure 4.2: Knowledge regarding earthquake resistant design and construction process

Relevant trainings to concerned stakeholders on the earthquake safe construction practice is required and awareness campaigns to general public and house owner is needed to achieve the sufficient level of knowledge and awareness.

2.9. KNOWLEDGE OF STAKEHOLDERS ABOUT NBC AND MRT PROVISIONS

To trace the status of compliance of National Building Code (NBC) and Mandatory Rule of Thumb (MRT) provisions in the municipality, questionnaire was scheduled as the awareness level of concerned stakeholder plays the very important role in effective implementation of NBC. The questionnaire was set with an assumption that majority of private housing reconstruction follows the MRT code provisions.

Table 4.2: Level of Knowledge of stakeholders regarding the NBC

S. no	Description	Contractor/ Masons			Consultants			Municipal Technical Personnel		
		20			25			8		
		I	II	III	I	II	III	I	II	III
1	Knowledge regarding National Building Code	12	8	0	0	7	18	0	1	7
2	Knowledge regarding MRT provisions of NBC	14	6	0	0	6	19	0	1	7

I: No knowledge; II: General knowledge; III: Sufficient Knowledge (Source: Field Survey, 2018)

2.10. KNOWLEDGE REGARDING THE NATIONAL BUILDING CODE

Out of 20 contractors/masons, 12 of them have no knowledge and rest 8 of them has general knowledge regarding the National Building Code (NBC). Out of 25 consultants, 7 of them have general knowledge and remaining 18 have sufficient knowledge of NBC. Similarly out of 8 municipal technical personnel, one has general knowledge and remaining 7 have sufficient knowledge of NBC.

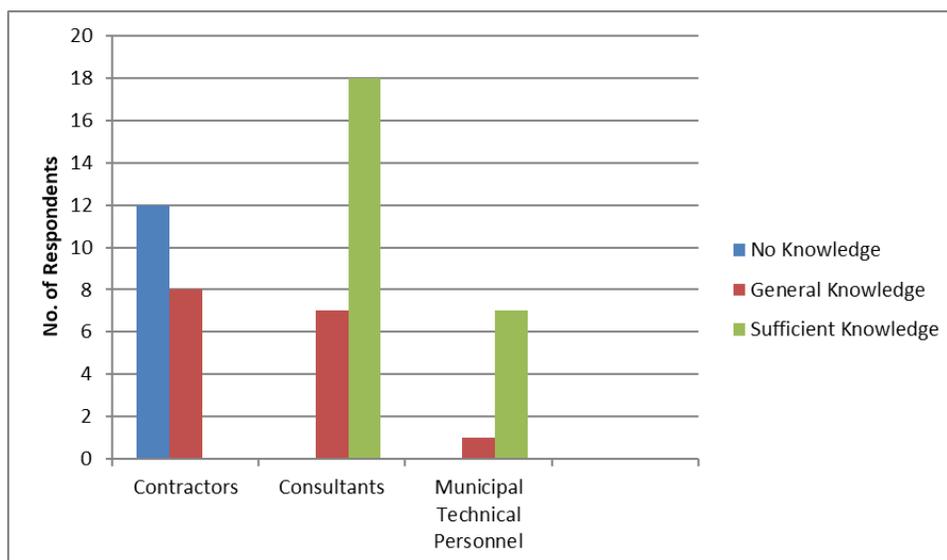


Figure 4.3: Knowledge regarding the National Building Code

The level of knowledge regarding the National Building Code among the consultants and municipal technical personnel was good and very good with NRA technical personnel as all of them had sufficient knowledge. But the knowledge of contractors/masons about the NBC was found to be poor as more than 50% had no knowledge of NBC.

2.11. KNOWLEDGE REGARDING THE MRT PROVISIONS OF NATIONAL BUILDING CODE

Out of 20 Contractors, 14 of them have no knowledge and rest 6 has general knowledge regarding about the MRT provisions of NBC. Out of 25 consultants, 6 have general knowledge and remaining 19 have sufficient knowledge. Similarly, out of 8 municipal technical personnel one has general knowledge and rest 7 of them has sufficient knowledge.

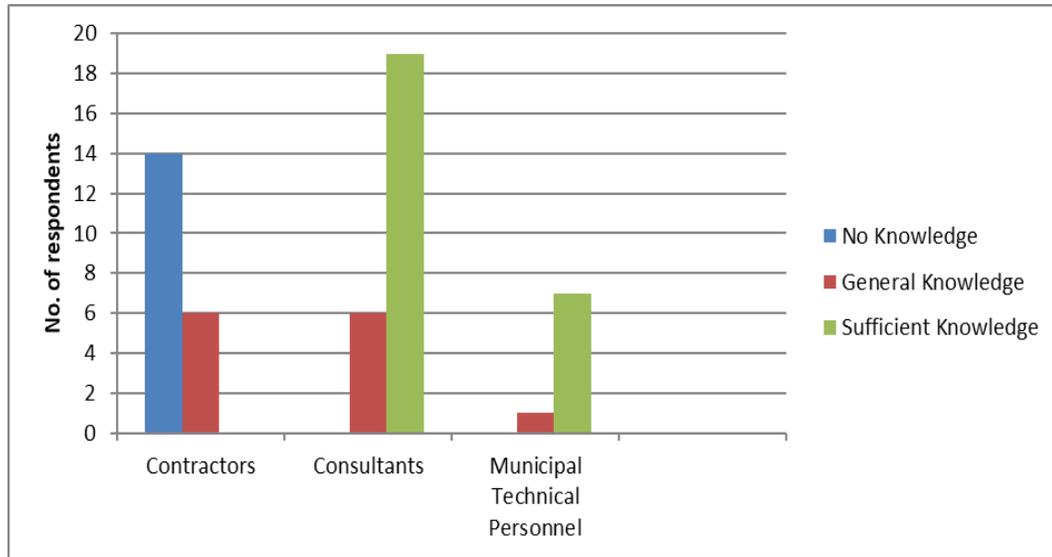


Figure 4.4: Knowledge regarding the MRT provisions of NBC

The result shows that in case of consultant, municipal engineers and NRA engineers most of them have sufficient knowledge about the MRT provisions. Thus among them knowledge level regarding the MRT provisions is very good. But with contractor 80% of them have no knowledge of MRT provisions.

Thus it can be inferred that relevant trainings, orientation programs and public education and awareness campaigns about the NBC and MRT provisions are to be conducted more often.

2.12. PERSPECTIVE OF CONCERNED STAKEHOLDERS

The perspective of concerned stakeholders is very much important to trace the compliance and effectively implementing the building code and byelaws.

2.13. HOUSE OWNER FAMILIARITY TO BYELAWS

Stakeholder's viewpoint plays the very appreciable role in upgrading and improving the building code and byelaws.

Out of 51 respondents, 44 of them (86.27%) answered that they are familiar about the Building by e laws around their surroundings and rest (13.73%) have no idea about the building byelaws and its provision. Results show that the people are more aware about the byelaws compared to NBC.

2.14. PERSPECTIVE OF HOUSE OWNER TOWARDS COMPLIANCE OF BYELAWS

The questions were asked to house owners about the effectiveness in the compliance of building byelaws provision in the municipality.

Out of 51 respondents, 44 (86.27%) house owner responded that they find the byelaws provision effectively adopted in the municipality, 2 (3.92 %) responded that the byelaws provision are not effective & remaining 5 (9.81%) were not sure about.

The results show that the house owners perspective regarding the compliance of byelaws were positive.

2.15. PERSPECTIVE OF HOUSE OWNER REGARDING ADOPTION TO BUILDING CODE AND BYELAWS

Out of 51 houseowners, 18 of the answered there a son behind the adoption to building code and byelaws is being legally enforced and rest 33 of house owner answered that they adopted the building code and byelaws for earthquake safer construction.

The results show that the house owners are aware about the earthquake safer construction which is also the main reason behind their adoption to buildings code and byelaws. But still some of them are implementing the building code and byelaws just because it is legally enforced.

2.16. CONTRACTORS/MASONS RESPONSE TOWARDS BYELAWS

Out of 20 respondents, 13 of them (65%) answered that they are familiar about the building byelaws and its provision and remaining 7 (35%) have no idea about the building byelaws and its provision. Though the awareness level is improved results shows that the contractors are not aware about the byelaws. So the awareness & training programs on byelaws needs to be provided to contractors and masons.

2.17. RESPONSE TOWARDS BUILDING PERMIT PROCEDURE

Out of 51 house owner, 32 house owners responded that the building permit procedure in the municipality is complicated and remaining 19 of them responded that the building permit process is not complicated. Out of 25 consultants, 14 of them said that the building permit process is complicated and rest 11 of them responded that the process is not complicated. Similarly out of 8 Municipal technical personnel, viewpoint of 2 of them towards building permit procedure is complicated & rest 6 replied building permit procedure is not complicated. It is presented in the figure 4.9.

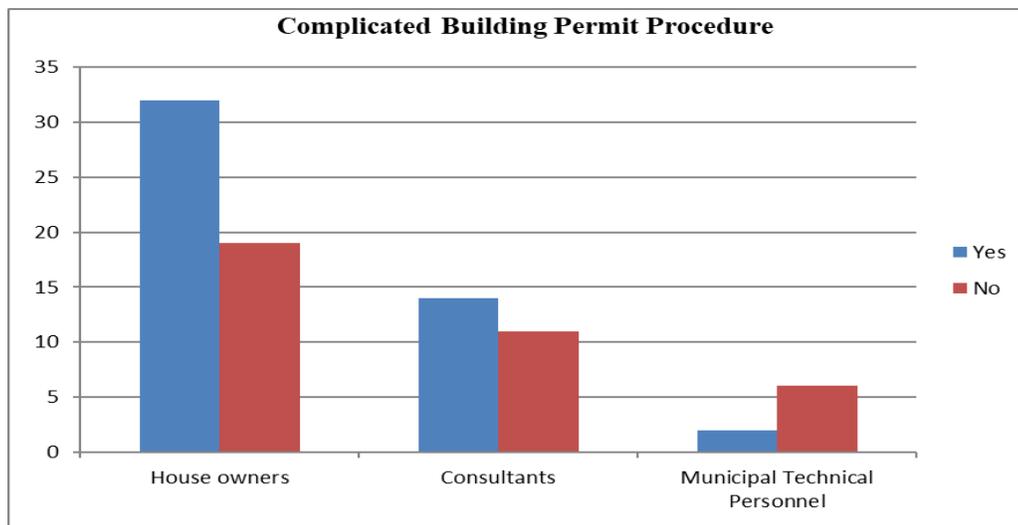


Figure 4.9: Stakeholders response towards building permit procedure complication

The main reason behind the complicated building permit procedure is the lack of adequate manpower which resulted in the administrative and technical procedure delays. To increase the effectiveness of stage wise building permit process adopted by municipality, the building permit section needs to be strengthened with adequate technical manpower for frequent and effective supervision in each stage of construction. House owner needs to be more aware of their roles and responsibilities such that to ensure proper coordination between municipal technical personnel in implementation of building code and byelaws.

The tracking system of building permit process is inefficient and often the documents under the certification process are lost and misplaced. Stakeholders suggested that the building permit process in the municipality can be improved by avoiding the slow and avoid the lengthy clumsy administrative procedure. For instance, the time frame of 15 days regarding the notice to the owners of adjacent plot can be decreased such that to building permit procedure.

2.18. PERSPECTIVE OF TECHNICAL PERSONNEL

Figure 4.10 show the viewpoint of technical personnel for effective implementation of seismic details at site.

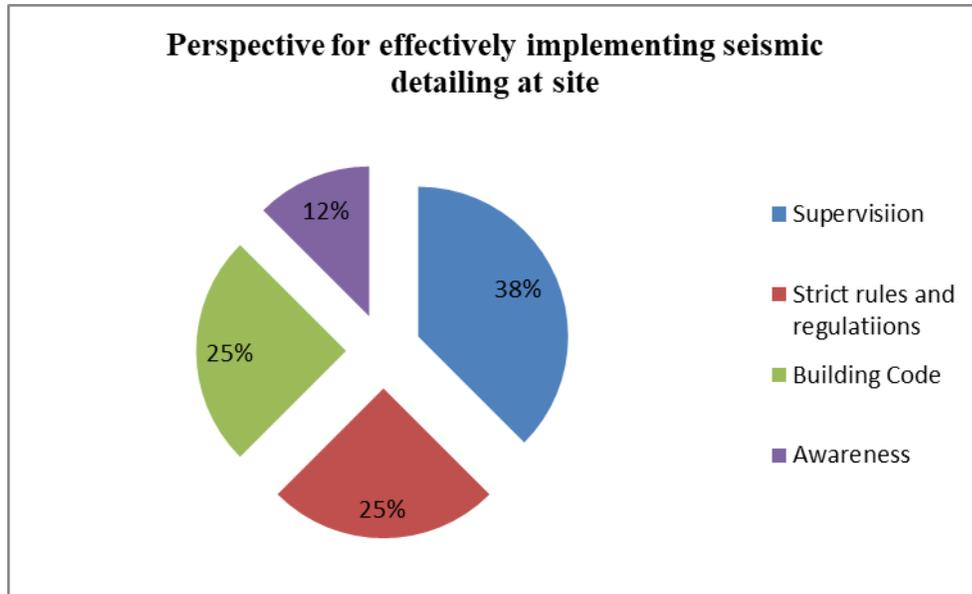


Figure 4.10: Municipal Technical Personnel Perspective

Out of 8Municipal technical personnel, 3 of them responded supervision, 2 responded strict rules and regulations, 2 responded building codes and one responded awareness to be the proper approach for implementing seismic detailing at site.

2.19. CONTRACTORS PERSPECTIVE TOWARDS CONSTRUCTION SAFETY

The purpose of National Building Code, NBC 114 is to provide reasonable degree of safety to construction related personnel in building and civil construction works. Perspective of contractors and masons are very much important for effective implementation of construction safety and labor welfare. They are the stakeholders directly involved in construction activities and exposure to occupational fatalities. It is required that they must have heard and must know about the basics of safety and labor welfare. About 80% of contractors/masons responded that they are concerned about the safety factors on their site.

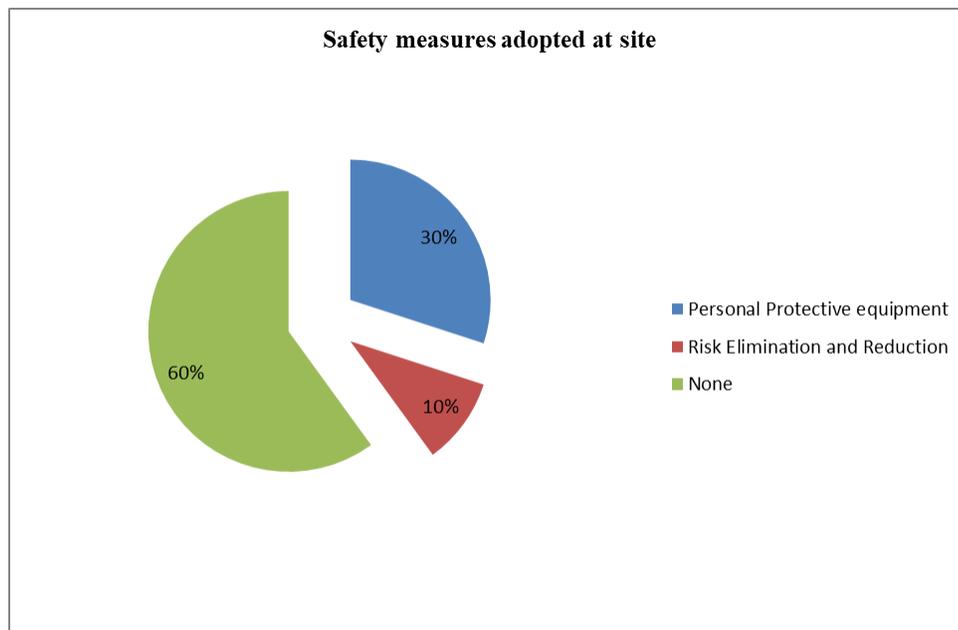


Figure 4.11: (b) Safety measures adopted at site by contractors/masons

The results shows that out of 20 contractors/masons, 6(30%) of contractors/masons use Personal Protective Equipment (PPE) as the safety measures at site. Two (10%) of contractor/mason go for risk elimination and reduction and rest 12(60%) responded that they don't use any of the safety measures at site.

Though 80% of contractors/masons are concerned about the safety, the result shows that few of them are adopting only PPE as safety measures. Among the PPE measures adopted, the contractors and masons use rubber gloves and boots only, that's also mainly in concreting works. The result shows that contractors/masons are not aware of safety issues.

So, proper occupational health and safety trainings and safety awareness activities needs to be provided to the contractors and masons.

Out of 20 respondents, 9(45%) of contractors/masons answered that they know about the labor act 1992 and rest 11(55%) answered they don't know about the labor act. The result portrays that the contractors and masons are unaware of the labor act 1992 and its chapter related to workings hours, health and safety arrangements, medical expenses and welfare provisions. Thus, awareness and education programs need to be conducted such that the contractors/masons can be aware about the labor act and rules.

2.20. APPROVAL STATUS OF BUILDING DRAWINGS

All the 51 households surveyed had their buildings drawings approved by the municipality. The buildings were approved either before or after construction.

Table 4.3: Approval of Building Drawings

S. No	Description	Before Construction	After Construction	Total Respondents
1	Municipal Technical Personnel	8	0	8
2	House owner	43	9	51

(Source: Field Survey, 2018)

Out of 8 respondents of Municipal technical personnel, all 8 of them claimed that the building drawings are approved before construction. But among the 51 house owners, 43 of them claimed that their building drawings were approved before construction and rest 9 of them claimed that their buildings were approved after construction.

The table 4.3 represents that most of the buildings took the approval prior to construction.

2.21. REQUIREMENT OF AMENDMENT OF BUILDING DRAWINGS

The buildings constructed or at the stage of under construction in the municipality needed the amendment of previously approved building drawings. Some of the buildings constructed and in under construction phase have applied for amendment of previously approved building drawings. But other buildings have not filed the application for amendment despite the changes made at site as the actual construction differs from the approved drawing. Consultants, NRA and municipality technical personnel have assessed amendment requirement of the previously approved drawings which are presented in the figure 4.14 below.

Table 4.4: Supervision from the technical team

S.N	Municipality technical personnel = 8			Consultants = 25			House owners = 51		
	I	II	III	I	II	III	I	II	III
A	2	2	4	5	11	9	15	30	6

I: Regular II: On call III: As per requirement

(Source: Field Survey, 2018)

Out of 8 respondents of Municipal technical personnel, all 8 of them claimed that the building drawings are approved before construction. But among the 51 house owners, 43 of them claimed that their building drawings were approved before construction and rest 9 of them claimed that their buildings were approved after construction.

2.22. REQUIREMENT OF AMENDMENT OF BUILDING DRAWINGS

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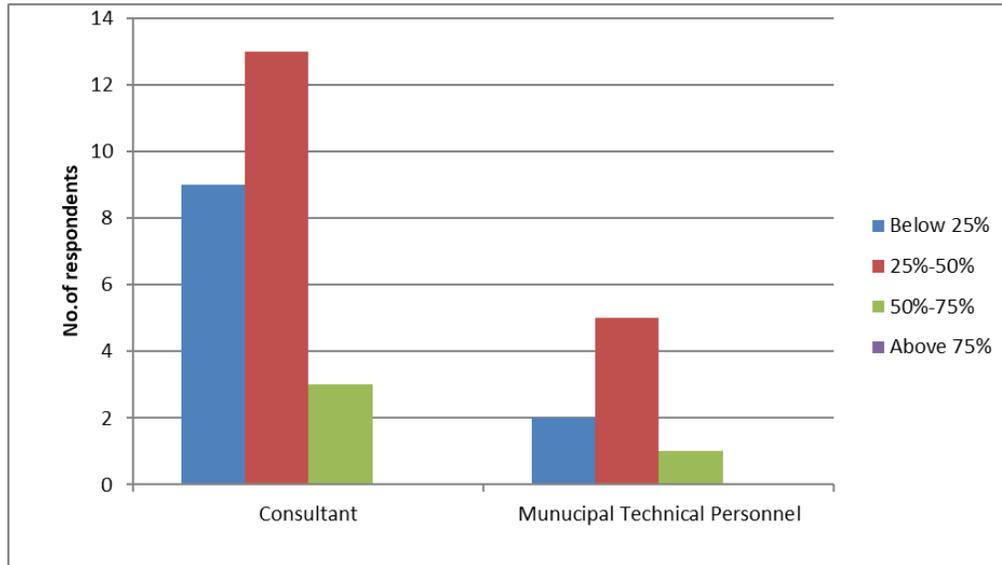


Figure 4.13: Requirement of the amendment of building drawings previously approved

Among 25 consultants, 9 of them responded that below 25% of building drawing needs amendment as the actual construction differs from drawing. 13 of them responded 25% to 50% and rest 3 of them responded 50% to 75% needs amendment. As per Municipality technical personnel out of 8, 2 responded below 25%, 5 responded 25% to 50% and one responded 50% to 75% of the building drawings needs amendment as the actual construction differs from the site. On an average 25% to 50% of buildings needs the amendment of drawings approved previously because the actual construction differs from the approved drawings.

Lack of regular supervision from engineers and house owners unaware of legal implications they have to face because of code violation is the reason behind the actual construction differing from the approved drawings.

2.23. SUFFICIENT MANPOWER WITH MUNICIPALITY TO IMPLEMENT NBC

For conducting the effective and efficient compliance check of National Building Code and byelaws provision in residential building, municipality should have sufficient technical manpower. Out of 6 Municipal technical personnel, 75% of them responded that there is the lack of technical manpower in the municipality for effectively implementing the building code and byelaws. Out of 51 house owner, 7 of them said that there is sufficient technical manpower within the municipality and rest 44 responded that the municipality lacks the technical manpower. Tilottama Municipality lacks the sufficient manpower for the effective implementation of building code and byelaws. Building permit section of the municipality should be well strengthened with recruitment of structural engineers.

2.24. ROLES AND RESPONSIBILITIES FOR EFFECTIVE IMPLEMENTATION OF NBC

The roles and responsibilities of the stakeholders may be different but equally important in effectively implementing and tracing the compliance of National Building Code (NBC) and Byelaws. Some of the roles and responsibilities are discussed here under.

2.25. SUPERVISION IN EACH STAGE OF CONSTRUCTION FROM THE MUNICIPALITY

According to byelaws and building code there is the provision of supervision in various stages of the construction from the Municipal engineers. The building permits in each stage are to be provided only after the supervision. Generally the supervision from the technical personnel is carried out on 3stages.

- First Stage: Temporary permit up to plinth level
- Second stage: Permanent building permit, for the superstructure
- Third stage: Issuance of the building completion certificate

Table 4.4: Supervision from the technical team

S.N	Municipality technical personnel = 8			Consultants = 25			House owners = 51		
	I	II	III	I	II	III	I	II	III
A	2	2	4	5	11	9	15	30	6

I: Regular; II: On call; III: As per requirement (Source: Field Survey, 2018)

From the total respondents of Municipal technical personnel, 2 of them claimed they carry out the supervision of construction site on regular basis, 2 of them responded about conducting the supervision on call and rest 4 of them said as per requirement. Among 25 consultants 5 claimed about conducting the regular supervision, 11 responded on call supervision and rest 9 of them said about supervision as per requirement. Similarly as per the view of 51 house owners, 15 of them said that the municipal technical team visits the site for supervision purpose on regular basis, 30 answered supervision on call and remaining 6 responded supervision was conducted as per requirement. From the analysis of the result it was found that the supervision of construction site from technical personnel was not effective and sufficient. The construction site lacks the frequency of supervision from the technical personnel in each stage of construction. Municipal technical personnel responded that high workload and limited number of engineers are the reason behind the inconsistency in supervision procedure.

2.26. TECHNICAL PERSONNEL TRAININGS ON NBC

Trainings help to develop the skills and knowledge. For the effective implementation of building code and byelaws relevant trainings to the technical personnel are necessary.

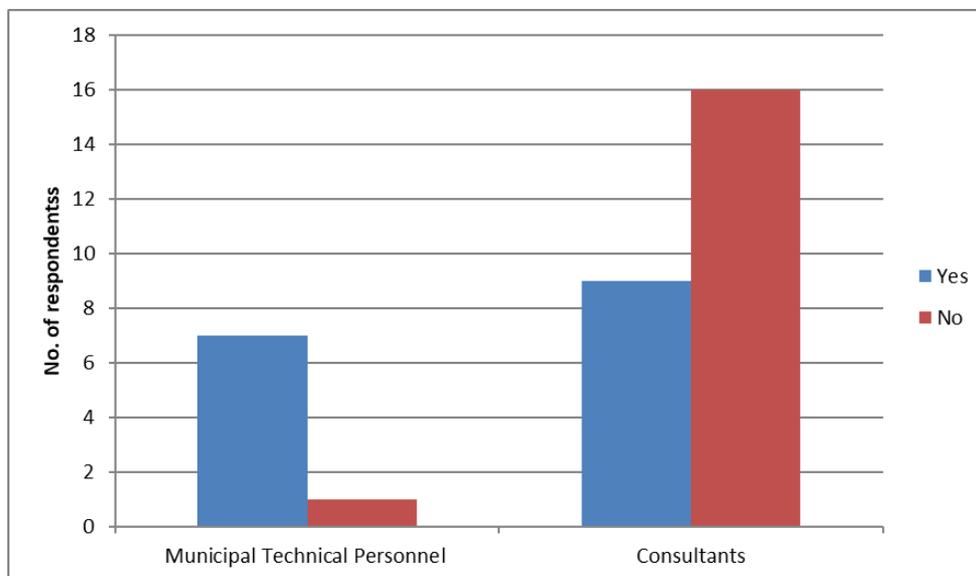


Figure 4.15: Technical personnel with trainings on NBC

The figure 4.16 represents that out of 8 municipal technical personnel 7 of them have received trainings related to NBC. Similarly, out of 25 consultants only 9 of them have received trainings on NBC. Few respondents have

received TOT trainings for earthquake safer construction and orientation trainings related to NBC. The result shows the technical personnel/engineers lacks the adequate trainings related to NBC.

3. CONCLUSION AND RECOMMENDATIONS

3.1. CONCLUSION

The research was carried out to trace the status of compliance of National Building Code and Byelaws in private housing of Tilottama Municipality. The buildings constructed in 2075 B.S. were taken for research purpose to check the compliance status of building code and byelaws in the construction. The research was carried out through questionnaire survey, key informant interview, field observation, design review of approved drawings and building permit, secondary data and relevant literature reviews.

The study shows that although building codes were developed to regulate building construction and building use in order to protect the health, safety and welfare of the occupants there were several snags with the design and implementation of the codes. But the provisions of building byelaws were found to be effectively implemented in majority of the buildings. Based on the research findings following conclusion were drawn:

3.2. KNOWLEDGE, PERSPECTIVE, ROLES AND RESPONSIBILITIES AND CHALLENGES

Following conclusion were drawn regarding the knowledge, perspective, roles and responsibilities of concerned stakeholders and challenges in effective implementation of building code and byelaws.

3.3. KNOWLEDGE LEVEL OF CONCERNED STAKEHOLDERS

- Stakeholders possess good knowledge regarding the general concept of earthquake and its consequences. Majority of stakeholders are aware about earthquake and its consequences after the earthquake of 2015.
- The knowledge regarding the earthquake resistant design and construction process among the stakeholders are fairly adequate. Relevant trainings to concerned stakeholders contractor/masons, consultant and municipal technical personnel are required. Awareness campaigns to general public and house owner is needed to achieve the sufficient level of knowledge and awareness.
- Consultant/designers and municipal engineers most of them have sufficient knowledge about the National Building Code and its MRT provisions. But 80% of contractor/masons have no knowledge of National Building Code- MRT provisions.

3.4. PERSPECTIVE OF CONCERNED STAKEHOLDERS

- Perspective of house owners towards building byelaws was positive. 86.27% answered that they are familiar about the building byelaws provisions around their surroundings. But most of the contractors/masons were found not familiar to byelaws provision.
- Perspective of house owner regarding the adoption of building code and byelaws after earthquake was found to be positive. After the Gorkha earthquake that hit the country, houseowners are aware about the earthquakes after construction which is also the main reason behind their adoption to building code and byelaws. But still some of them are implementing the building code and byelaws just because it is legally enforced and others to meet the requirement of grant provision.
- Majority of house owners and technical personnel (Engineers) responded that the building Permit procedure in the municipality after the enactment of byelaws 2015 is complicated and cumbersome.
- As per the perspective of municipal engineers, supervision and building code update is needed for the effectively implementation of seismic detailing at site. But the majority of National Reconstruction Authority engineers responded that awareness is required for the effective implementation of seismic detailing.

3.5. CONTRACTORS/MASONS PERSPECTIVE TOWARDS CONSTRUCTION SAFETY

- Though 80% of contractors/masons are concerned about the safety, the result shows that few of them are adopting only PPE as safety measures. Among the PPE measures adopted, the contractors and masons use rubber gloves and boots only, that's also depending upon the nature of work. The result concludes that contractors/masons are not aware of safety issues related to the occupational hazards.
- Knowledge level of contractors/masons regarding the labor act 2017 was found to be poor. 55 % answered they don't know about the labor act. The result conclude that the contractors and masons are unaware of the labor act 2017 and its chapter related to workings hours, health and safety arrangements, medical expenses and welfare provisions.

3.6. ROLES AND RESPONSIBILITIES IN EFFECTIVE IMPLEMENTATION

- In each stage of construction, supervision of construction site from the municipal technical personnel is not sufficient and effective.
- There is inconsistency in supervision procedure due to increased work load and limited number of technical personnel.
- Technical personnel/engineers lacks the adequate trainings related to NBC and most of the contractors/masons working in construction of residential buildings within the municipality area has not received mason trainings yet.

3.7. COMPARISON REGARDING KNOWLEDGE LEVEL OF HOUSE OWNERS

- The level of knowledge regarding the earthquake and its consequences, earthquake resistant design and construction process and perspective regarding the byelaws were found to be better among the house owners who have their houses constructed or are under construction after earthquake in comparison to house owners of the houses constructed before earthquake.

3.8. STATUS OF COMPLIANCE OF NATIONAL BUILDING CODE AND BYELAWS

- Though the architectural and structural drawings of the buildings had been approved, most of the buildings have not met all the criteria of the NBC provisions. Mainly the provision of Floor area of largest habitable room was found to be exceeded by the buildings both in the design and construction phase.
- During the compliance check it was found that 7 out of 51 buildings failed to comply the requirements of National Building Code.
- The main reason behind the violation of NBC was due to the lack of trained masons/contractors working on the construction site, consultants/designers unaware about the building code provisions and not monitoring the construction activities frequently or on regular basis, lack of supervision from municipal engineers and house owners unaware of technical details and legal implications regarding the violation of building code.
- During the compliance check it was found that 44 out of 51 buildings comply the requirements of building byelaws.
- Difference in Construction Procedure/Techniques - Before and After Earthquake
- The construction procedure and techniques implemented in the construction was found to be different and improved after the Gorkha earthquake. The provisions of lintel and sill band, foundation beam, strap beam and increased size of structural members are some examples of difference in construction procedure/techniques adopted after earth quake.
- Majority of the buildings has effectively implemented the building byelaws during design and implementation/construction phase.
- House owners are more concerned about the quality of construction materials and procedure of construction adopted at site.

3.9. Recommendation

3.9.1. RECOMMENDATION TO TILOTTAMA MUNICIPALITY

Following are the recommendation of the study for the effective implementation of building code and byelaws in the Tilottama Municipality.

Public Awareness Programs

- Community awareness raising campaigns to general public and house owner is needed to achieve the sufficient level of knowledge and awareness regarding the earth quake safety.
- The approach of conducting street dramas, audio visuals, distribution of earthquake safer construction brochures, etc. can be fruitful in the effective implementation of NBC and Byelaws.
- Promoting culture of safety through approach of word of mouth and storytelling.
- Construction camps incorporated with training, exhibition, motivational speech, art and comedy events related to awareness on earthquake safer construction with involvement of engineers, contractors, masons, house owners and general public is to be conducted.
- Construction of demonstration model of frame structure and load bearing structure in every ward office such that to impart the ideas and knowledge to stakeholders regarding the earthquake safer construction.

Database

- The information of trained masons/contractors and registered consultants/designers are to be published in the notice board and municipality booklet throughout the year.

Capacity Building of Concerned Stakeholders

- Relevant trainings and orientation programs regarding the earthquake resistant designs and National Building Code and Byelaws to concerned stakeholders contractor/masons, consultant and municipal technical personnel should be provided.
- Mason trainings and on the job trainings are to be provided to the masons/contractors for their skill enhancement.

Capacity Building of Municipality

- Enough technical competence in providing the building permit and site supervision.
- Recruitment of structural engineers is of utmost importance for the effective implementation of building code. The void regarding the expertise of structural and geotechnical engineering should be fulfilled immediately.
- Establishment of effective coordination mechanism between municipal engineers regarding the permit process and field inspection and monitoring.
- Establishment of well strengthened Building Permit Section with adequate technical personnel.
- The adopted stage wise building permit process needs to be effectively implemented by eliminating the prevailing flaws. The issues relating to time frame, frequency of supervision in each stage, adequacy of technical manpower for inspection of construction site, flow of information and coordination with house owners needs to be addressed as soon as possible.
- As the current municipal building permit process does not ensure the compliance of NBC, implementation of National Building Code through Electronic Building Permit System is recommended.
- At national level, timely update of National Building Code is of utmost importance.

SOURCES OF FUNDING

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

CONFLICT OF INTEREST

The author have declared that no competing interests exist.

ACKNOWLEDGMENT

None.

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