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IMPROVING BUILDING PERMIT SYSTEM FOR BUILDING CODE ENFORCEMENT: APPLICABLE FOR MEDIUM SIZED MUNICIPALITIES

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Abstract

The experiences from past earthquakes show that effective enforcement of earthquake resistant codes can mitigate the earthquake losses significantly. This show the enforcement of building code in Nepal is crucial. Where it has 217 municipalities, among which 25% are medium sized and 70% are emerging towns. Each municipality has different building permit process as a result of which the level of building code implementation is different in different municipalities. In most of the municipalities, buildings are planned and constructed with little or no intervention for seismic safety. This has led to the increment of seismically vulnerable building stocks.

Dharan Sub-Metropolitan City, Bharatpur Sub-Metropolitan City, Dhangadi Sub-Metropolitan City and Vyas Municipality represent the municipalities from different development regions. In an average total 4,300 buildings are constructed annually in these municipalities. However, there is only one engineer and one Assistant Engineer in each municipality to look after the whole process. These municipalities are working on building code enforcement from last five to seven years and are in evolution process by learning and doing. During this period, they have upgraded the building permit system with feedback from house-owners and different stakeholders. From last one year, these municipalities have worked together to develop a simple, realistic, common and easily adaptable building permit process for effective enforcement of building code.

This paper describes the common building permit system for enforcement of building code in these municipalities. This building permit system seeks involvement of different stakeholders and third party verification at different levels and auto-mechanized monitoring system between different stakeholders. It consists of simplified flowchart allowing the completion of the whole process within short duration and with existing human resources in the municipality. This building permit process can be further replicated to other emerging towns of the country.

Keywords: Building Code; Building Permit System; Medium sized municipalities; Third party verification

1. Introduction

Nepal is going through an unplanned and haphazard urbanization. Every year the number of buildings constructed throughout the country is increasing. The majority of these buildings is poorly constructed and is extremely vulnerable to earthquakes. The recent April 25, 2015 Gorkha Earthquake and its aftershock killed 8,790 people. The injury toll climbed over 22,300. Out of 75 districts in Nepal, 31 were affected by the earthquake, 14 of which were heavily damaged. In the hardest hit districts, as much as 95 percent of the structures were destroyed. Some 3 million people were displaced and hundreds of thousands of livelihoods are lost or damaged. Over half a million houses were destroyed. The damage exposed the weaknesses of houses that did not have any seismic-resistant features or were not in accordance with the building codes. [1].

Even after the earthquake, the construction rate has not gone down. Ironically, the construction practices have not improved significantly. If the buildings do not comply provisions of building code, the risk will increase. Nepal's National Building Code (NBC) was formulated in 1994. While legislation has made compliance to building codes mandatory, municipalities lack appropriate mechanisms and capacities for building code implementation. This fact was very clearly demonstrated by a recent survey, which showed that only two engineers, on average, are available in a municipality in which an average of 400 new building permits are issued every year. Intervention to ensure safer construction is required to address these huge risks. Effective building code implementation is one of the most effective ways to decrease potential risk of earthquake casualties.

Nepal has 217 municipalities, among which around 25% are medium sized. In Nepal, municipalities are the responsible agencies to issue building permits. The current municipal building permit process does not ensure the compliance of NBC. Few municipalities in Nepal have tried to incorporate NBC into their building permit process; but these attempts have been too limited and lack the necessary verification to ensure compliance. The de facto building permit process is very superficial and subjective even though many municipalities enforce NBC compliance in theory. There is no effective mechanism for field verification of approved drawings.

Another problem of ineffectiveness of compliance enforcement is that these municipalities do not have a common building permit system. Each municipality has different building permit process as a result of which the level of building code implementation is different in different municipalities. Ironically, most of them still being, planned and constructed with little or no regard for seismic safety. This has led to the increment of seismically vulnerable building stocks. In order to overcome this risk, an effective and a common permit system which can ensure transparency and accountability in each stage is required.

On the basis of population, resources and other urban facilities available, Nepal has three different classifications of the urban areas- (a) Metropolitan City, (b) Sub-Metropolitan City and, (c) Municipality. Metropolitan cities have a minimum population of 300,000, Sub-Metropolitan cities 100,000 and Municipalities 20,000 in plains and 10,000 in hills [2]. Thus, the municipalities of Nepal have varying capacities in terms of resources and trained human resources. A common medicine to all the illnesses cannot be a proper solution. However, a common solution to a common group of municipalities which have similar resources, workload and human capacities can be devised. Medium sized cities as envisioned in this study are all sub-metropolitan cities and municipalities which have more than 50,000 population and enough trained human resources to deal with building code issues.

2. Past and Ongoing Efforts

NBC was formulated in 1994 but it was updated and approved by the government in 2003. Thusfar, many municipalities have started to implement building code. The city of Dharan started implementing the code in

2007. The implementation process in Dharan is of particular interest as it is the pioneer municipality in Nepal to start the process from the ground level. This municipality is a small city of around 140,000 inhabitants struggling with challenges similar to many other medium-sized Asian cities, such as low budgets and a lack of expertise and knowledge. The process in Dharan started slowly but gained speed over the years following a step-by step approach, taking implementation one step further each year. A building permit process was already in place, so the municipality started by trying to improve the quality check on the drawings submitted. Before 2007, drawings were only checked on detailing, and not on structural calculations. The idea was that a technical cell, consisting of a municipal engineer, a local consultant and an academic, would check the drawings more thoroughly. However, as there was no structural engineering expertise available, the technical cell still found it hard to check the calculations. Meanwhile, trainings on earthquake resilient building were given to masons and local builders, and they formed a Professional Association of Local Builders and Masons. In 2008, the municipality took the process outside of the city hall walls, and worked on field implementation. People were encouraged to build according to the Mandatory Rules of Thumb by conducting mobile clinics. The builders' association gave support, but the numbers of buildings complying with the building code still didn't rise significantly.
The process really took off in 2009, when the municipality introduced a licensing system for local builders and masons. Builders would only be allowed to register with the municipality once they had completed a four-day training in earthquake safe building.

Although the licensing programme was very successful in the beginning, problems arose after a few months, when builders realized that the municipality still didn't have the capacity to check all building permit applications for structural safety. Some started to ignore the building code again, which affected the builders who did comply negatively, as compliant buildings are more expensive to build. To solve this problem, the municipality introduced a reward and punishment system; builders breaking the rules could from now on be suspended or even delisted from the municipal registration. Home owners could be fined up to 100,000 rupee (approx. 1,000 USD) or would not receive a certificate of completion. Without such a certificate, it is much harder or even impossible for a homeowner to get a home loan or to receive legal titles on the property. Masons and builders who followed the rules, on the other hand, could be rewarded with cash prizes, certificates and would be announced publicly on the yearly Earthquake Awareness Day.

To improve the functioning of the technical cell, by the end of 2009 the municipality decided to simplify the Mandatory Rules of Thumb to five basic rules for reinforced concrete buildings and five rules for load bearing buildings. These rules are easier to follow for builders and easier to check for compliance for municipal staff. The rules for reinforced concrete buildings are:
1. All columns must be in grid;
2. The minimum size of a column should be 12"x12" (30x30 cm);
3. For buildings up to three floors, there should be a sill and lintel band throughout the wall;
4. The construction should be designed in a way that the short column effect and soft storey effect cannot occur;
5. There should be a strap beam in the foundation for eccentric footings.

For load bearing buildings the rules are:
1. All the load-bearing walls must be at least 10" (25 cm) thick. For three-storey buildings, the ground floor walls should be at least 15" (38 cm) thick;
2. All openings should be at least two feet away from the corners of the building;
3. There should be longitudinal reinforcement in every corner and every side of an opening;
4. There should be sill and lintel bands or top beams throughout the walls and foundation bands;
5. There should be stitches (reinforces concrete sections that prevent walls to separate from each other during earthquakes) in every corner of the building at an interval of 2 feet (61 cm).

With these simplified rules, with the reward and punishment system and with the trainings for local builders and masons, the licensing and permit system was up and running in 2010. The only stakeholder that hadn't been addressed extensively yet was the home owners. Therefore, the municipality started to organize monthly

orientation meetings for house owners who had recently applied for a building permit. Home owners now also had to be physically present when registering the building permit, so municipal staff could give a short briefing on requirements under the building code. During the building process, the home owner, like the builder, the designer and the supervisor, have to sign for compliance with the rules to proceed to the next level: before start of construction, after construction of the plinth and after completion. A permit to proceed with construction will only been given after a municipal technician has verified compliance at the building site. This process ensures that home owners are involved in all steps, and cannot state that they didn't know better when non-compliance is discovered in later stages of construction [3].

At present, about 80% of newly constructed buildings in Dharan follow the building code. Dharan attained this success with the concept of "Learning by doing." However, this experience of Dharan has been well understood and most of the municipalities that are implementing NBC at present have been following the same path as Dharan has done. Bharatpur enforced the code in 2013, Dhangadi in 2014 and Vyas in 2011 [4]. These four municipalities have now developed a common building permit system applicable to all the municipalities for enforcement of building code. There are 217 municipalities in Nepal but the question arises "why only 4 municipalities are together?" The answer is quite simple. It is because the interest and understanding level of these four municipalities is same. Dharan was the first to implement the code effectively. Later on, Vyas, Bharatpur and Dhangadhi followed the way of Dharan. This led to common understanding that collective approach for different municipalities will lead to effective implementation of building code. Now, these four municipalities represent the success icon in effective implementation of building code. Moreover the populations, building construction trend of these four municipalities are also of similar nature. Bharatpur has approximately 1600-1800 newly constructed buildings every year. Dharan has about 1000, Dhangadhi about 700-1000 and Vyas about 500 newly constructed buildings every year [5]. This common sizing has also triggered these four municipalities to work together for the betterment of building code enforcement.

National Society for Earthquake Technology- Nepal (NSET-Nepal) has implemented a project called Building Code Implementation Program in Nepal (BCIPN) from October 2012 with the main aim to enhance earthquake resilience of urban settlements in Nepal. It has focused on assisting the municipal governments in Nepal in enhancing their capacities to develop and administer the building permits and control system properly for ensuring improved seismic performance of all new building construction in those urban and urbanizing areas of Nepal. It has also enhanced earthquake awareness of the residents and technical knowledge of the municipal official on aspects of earthquake risk management including earthquake-resistant design and construction. It has conducted a series of training courses for technical personnel including the contractors and mason and has conducted earthquake orientation and other awareness activities. This effort of developing a common building permit system has also been triggered by this project.

3. Challenges and lessons learned

The major challenges that were faced while implementing the building code and the lessons learnt from the efforts that were put are summarized as follows:

☐ **Accountability and Enforcement framework:** There is no specific enforcement framework in the municipalities. So, some municipalities have done well while some are still struggling. Moreover, the accountability of the municipal staff involved in building permit system also varies from municipality to municipality and from person to person.

☐ **Lack of coordination between authorities:** Coordination between concerned stakeholders is lacking in case of Nepalese development partners. It has been found that many municipalities are working in isolation. They have not mobilized the masons/ contractors and owners.

☐ **Lack of political will:** The Municipality does not have the Peoples' representatives at the present and is being run by the Administrative Officer who belongs to bureaucratic stream. A case of Birendranagar Municipality in Surkhet is an interesting one. It had implemented Building Code during the period of Royal governance. Later

on after the establishment of Federal Democratic Republic system, the local parties canceled the decision saying that it was being decided during King Gyanedra's autocracy which in itself explains the lack of political vision and political will [6].

☐**Engagement of the Municipality Engineers in the preparation of the drawings**

The Municipal Engineers are themselves found to design the buildings. The implementation of Building code will give additional burden to the designers cum municipal technicians. So, they are not motivated to implement the code. Moreover, the conflict of interest will arise is such case.

☐**Employment of the untrained Mason and untrained designer**

- Many masons have not got any formal training. But they are still continuing to construct the buildings. So, they are unaware of the need to follow the Building Code. Not all the engineers have received training about Building Code. As a result, the drawings are not prepared accordingly.

☐**Lack of awareness on the part of the owner**

- People are less aware on the earthquake resistant construction techniques.

☐**Lack of Monitoring during the construction**

- In most of the municipalities, the drawings are prepared as required by the Building Code. But the checking is not done effectively. This is said to be due to the lack of sufficient manpower in the Municipality but it is more due to the lack of will to do so.

Lessons learnt from these challenges are:
☐ Accountability of the municipal officials, supervisors and masons/ contractors need to be improved by preparing an Enforcement framework.

☐ Municipality should mobilize all the stakeholder.

☐Municipality Engineers should not be engaged in the preparation of the drawings

☐Only trained mason should be engaged in the construction work.

☐ Owners need to be made aware.

☐ ProperMonitoring mechanism during the construction should be made.

It has been found that all these challenges could be addressed if a well coordinated common building permit system is introduced.

4.Improved Building Permit System

The four municipalities already had their own building permit system. But the problem was some were quite liberal and the rest were quite stringent. Thus the implementation level was also varying. Therefore with the support of NSET's BCIPN program, these four municipalities were able to sit together and make necessary changes, additions and omissions on their existing building permit system and were able to come up with a common building permit system. The major changes that have been made are:

1. The Building Permit Form has been proposed to be divided into two separate parts- One that contains all the related information will remain with the house owner and the other that contains all the legal forms and certificates will remain in the municipality. Previously, there was only one form where the related information regarding building code and other procedural information targeted for the owners to read was kept in the municipality.
2. Following minimum qualification for the designers has been assigned by this system.

- For Category 'A' building, the designer should be a civil engineer with15 years of building design experience or a structure engineer or an earthquake engineer.
- For Category 'B' building, the designer should be a graduate in civil engineering with 2 years of related experience
- For Category 'C' building, the designer should be a sub-engineer having received an earthquake resistant construction training
- For Category 'D' building, the designer should be an assistant sub-engineer having received an earthquake resistant construction training.

3. The agreement between the house owner and the technical supervisor has been made mandatory while applying for the permit. This has increased the involvement of technical person in construction of even an ordinary building. In Nepal, it is a trend that buildings are built under the supervision of a mason and contractor who in most cases are untrained. The technical supervisor has to submit subsequent reports on the basis of their field visit with photographs of the ongoing work. The supervisor has to visit at least 14 times for a single storied building and 5 times each for each subsequent upper floors. The owner is also given a call schedule so that the owner shall know when to call the supervisor to check the ongoing work. Punishment system has also been introduced to demoralize those supervisors who gives false report.
4. To check buildings which fall under Category "A" and "B" as per the code, third party verification or recommendation of "Technical Committee" composed of the subject experts has been introduced. This has made the design checking mechanism more transparent and accountable.
5. The building permit fee has been charged on the basis of land-use zoning to guide the development as per planning in a safe place. Different municipalities have different way of charging the permit fee. Some charge on the basis of floors; some on the basis of structure type.
6. The building permit deposit which most of the municipalities are taking from the owners has been removed in this system. The deposit amount is very less and the service takers have to go through cumbersome process to get back the deposited amount after receiving the construction completion certificate. Instead, the building permit fee has been increased so that the municipality could receive a handsome revenue and can use it for the infrastructure development of that area.
7. Pre information regarding earthquake resistant construction has been given to the owner and involved mason/ contractor by the municipality during file registration time. This is done in different ways – short orientation, frequently asked questions booklet, fliers and a documentary video show.
8. A system of licensing the contractors/ masons has been introduced. It is mandatory that the practicing contractor/ mason receive a four days earthquake resistant construction training organized by the municipality or other agreed agencies and that they receive a working license. These licensed contractors/ masons have to fill up the affidavit during the file registration process and be involved in signatories during each process of the permit system. Reward and Punishment system is applied to these masons/ contractors. Two stage punishment system – Blacklisting and Delisting has been practiced.
9. Layout and foundation check by the municipal building officers is ensured by this system. Previously, municipal check was only on three stages – at plinth level, superstructure and completion thus neglecting the foundation aspect, which is the important part of the building. Now, the municipal building officer has to visit the site in four stages – Foundation level, plinth level, superstructure level and after completion.
10. Supplementary Monitoring of the construction is given to Ward level disaster risk management committee. They are first being trained on their jobs and are given authority to inspect and give timely information about the compliance situation. The necessary actions will then be taken by the municipality. These committees have helped by serving as an information collector to the municipality thus fulfilling the deficiency of required human resources in the municipality.
11. To facilitate the design checking for the municipal officials, a simple checklist has been developed. The checklist consists of assessing the vulnerability level of the design regarding configuration (column layout, beam layout, soft storey and redundancy), strength, ductility, joint detailing etc. The designers are required to fill up the checklist and the design should obtain certain minimum point to be approved. If they do not obtain the minimum point, the design is subjected to re-designing.

This system allows the municipality to issue the Plinth Level Permit within 17-29 days of application registered by the owner thus giving an opportunity to be more accountable and transparent.

5. Way Forward

A system in itself is never perfect. Constant changes need to be made. So, some of the things that still need to be addressed in future is proposed as below:

1. Formation of central portal for listing of designers and supervisors has been proposed. At present, designers/ supervisors have to register their business firm in individual municipality. So, if a building complex, which is to be constructed in smaller cities, is being designed by a competent designer in big cities like Kathmandu, the design will be registered in the name of local designer as they are the only registered designers in that particular city. By doing so, the credit and the responsibility of the design goes upon that designer who, in fact, has not designed the building. The central portal system allows the designer to design any building in any cities of Nepal. They can be listed in any municipality and deposit their security bond in that particular municipality. Every individual municipality can see the portal and can accept the designer even though the designer is not listed in that particular municipality. If the designer/ supervisor with unsatisfactory performance is blacklisted in any municipality, it is automatically updated in the central portal and thus the black listed designer/ supervisor is not allowed to work at any municipality inside the country. The designer/ supervisor is expected to be more responsible with wider opportunity to work throughout the country.

6. Conclusion

This system is in use in four municipalities in question. Almost 1000 building permits have been issued using this system in these four municipalities. The result is magnificent. The compliance rate has increased and the municipal officials have found this system more result oriented and easy to follow. Other municipalities have started to learn this system and are in the process of following it. So, it is sure to be replicated in other municipalities of Nepal in days to come.

Fig. 1- Flowchart of Modified Building Permit Process

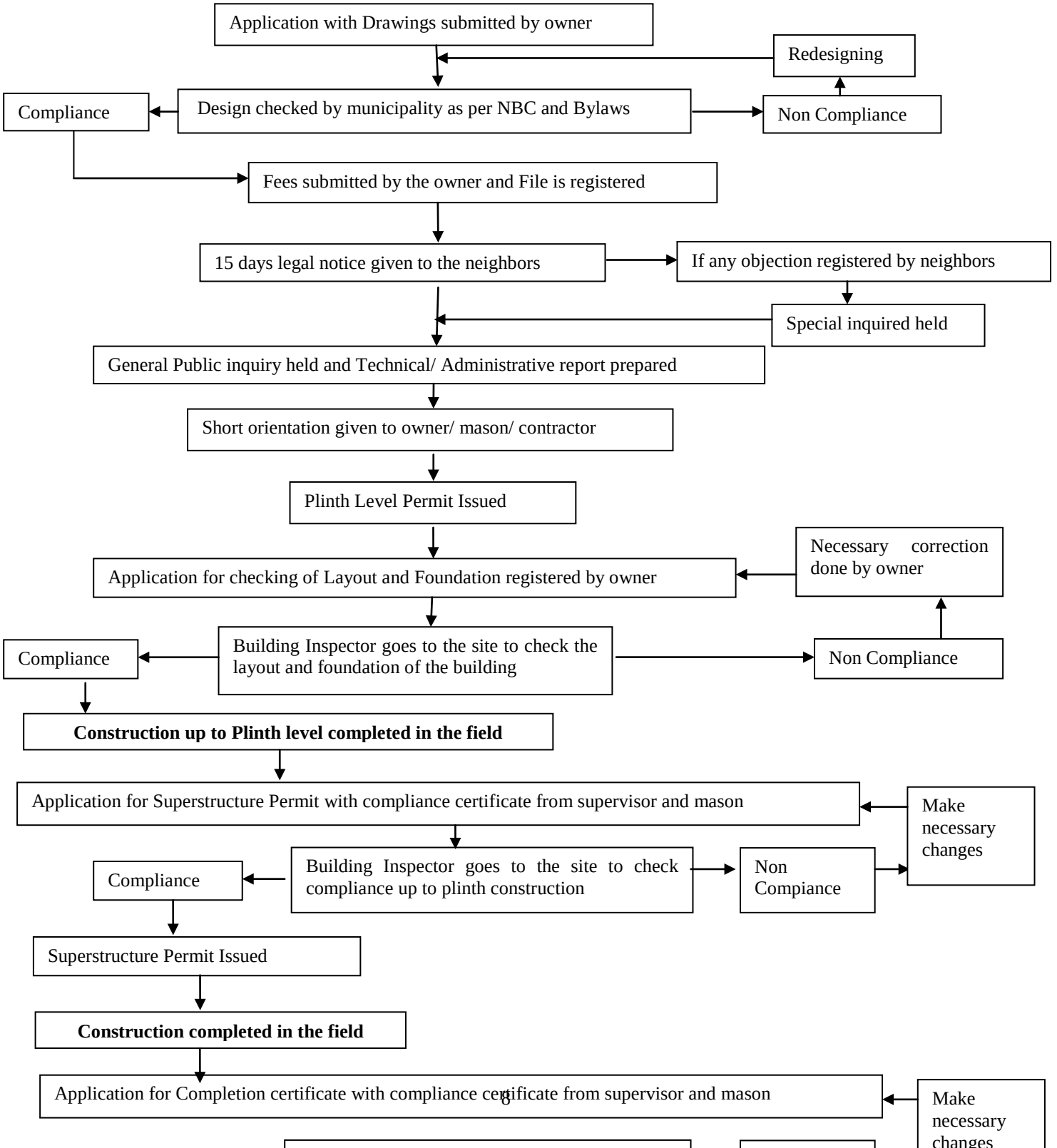

Table 1 - Compliance Checklist to Evaluate Building Design and Drawings

House Owner Name:

Address: Registration Nos.:

Contact No: Date:

Note: 1) All the provisions need to be assessed using architerctural as well as structural drawings with some quick calcualtions wherever applicable.

2) The specific condition for assessed building in corresponding provision need to be highlighted.

S.N	Mandatory Attributes	Specific Conditions	Recommendation		
1	**Grade of Concrete**	Compliance			
		Non-Compliance			
2	**Size of Column**	Compliance			
		Non-Compliance			
3	**Soft Storey**	Compliance			
		Non-Compliance			
S.N	**Attributes**	**Specific Conditions**	**Vulnerability Factor (v)**	**Weightage (w)**	**Vulnerability Score(v*w)**
A	**Configuration Related Attributes**				
1	**Overall Dimension Ratio**	L/B≤3	0	3	
		3<L/B≤5	0.5		
		L/B>5	1		
2	**Length of Wings**	Ratio≤0.15	0	3	
		0.15<Ratio≤0.3	0.5		
		Ratio>0.3	1		
3	**Setbacks**	Compliance	0	4	
		Not Compliance	1		
4	**Redundancy**	Nos. of bays in both direction≥2	0	6	
		Nos. of bays in one direction is ≥2 and other direction is <2	0.75		
		Nos. of bays in both direction < 2	1		
5	**Column Layout**	All columns are in grid line	0	7	
		upto 15 % of column out of grid line	0.25		
		16% to 50% of column out of grid line is between	0.5		
		more than 50% of column out of grid line	1		
6	**Beam Discontinuity**	All beams are continuous	0	7	
		upto 15% of beams are discontinuous	0.25		
		16% to 50% of beams are discontinuous	0.5		
		More than 50%of beams are discontinuous	1		
7	**Vertical Discontinuity**	Compliance	0	4	
		Non-Compliance	1		
8	**Cantilever Projection**	Projection ≤1m and no walls in projection	0	2	
		Projection ≤1m and full brick wall in projection	0.5		
		Projection>1 and no walls in projection	0.25		
		Projection >1 and full brick wall in projection	1		
9	**Short Column**	None columns has short column effect	0	6	
		15% columns has short column effect	0.25		
		16%-50% internal column has short column effect OR upto 15% peripheral columns has short column effect	0.5		
		More than 50% column has short column effect	1		
10	**Torsion**	Eccentricity ≤ 10%	0	6	
		10% <Eccentricity ≤ 20%			
		20% <Eccentricity ≤ 30%	1		
11	**Adjacent Building**	The building have adequate seismic gap	0	2	
		One side is attached	0.25		
		Two adjacent side is attached	0.75		
		Two opposite sides are attached	0.5		
		Three Side is attached	1		
		Configuration Related Vulnerability Score (A)		**50**	
B	**Strength Related Attributes**				
12	**Size of Beam**	Compliance	0	4	
		Non-Compliance	1		
13	**Strong Column Weak Beam**	ΣMc≥1.1ΣMb	0	6	
		ΣMc<1.1ΣMb	1		
14	**Shear Stress In Column**	Compliance	0	5	
		Non-Compliance	1		
		Strength Related Vulnerability Score (B)		**15**	

C	**Ductility Related Provisions**				
15	**Minimum Number of Bars in Column**	Compliance	0	4	
		Non-Compliance	1		
16	**Stirrups in Column**	Compliance	0	5	
		Non-Compliance	1		
17	**Column Bar Splices**	Compliance	0	3	
		Non-Compliance	1		
18	**Column stirrups Spacing**	Compliance	0	3	
		Non-Compliance	1		
19	**Beam Column Joint**	Compliance	0	3	
		Non-Compliance	1		
20	**Beam Bar Splices**	Compliance	0	3	
		Non-Compliance	1		
21	**Beam Stirrup Spacing**	Compliance	0	3	
		Non-Compliance	1		
22	**Joint Reinforcement**	Compliance	0	3	
		Non-Compliance	1		
23	**Stirrup**	Compliance	0	3	
		Non-Compliance	1		
		Ductility Related Vulnerability Score (C)		**30**	
D	**Connection Related Attributes**				
24	**Wall Connection**	Compliance	0	5	
		Non-Compliance	1		
		Connection Related Total Vulnerability Score (D)		**5**	
		Total vulnerability score out of 100 (A+B+C+D)		**100**	

E Final Evaluation

S.N	Building Category	Criteria	Conclusion
1	**Good**	Total Vulnerability Score≤20	Compliance (Building can be forwarded for permit
2	**Average**	20<Total Vulnerability Score≤30	Non Comliance (Building can be forwarded for
3	**Poor**	Total Vulnerability Score>30 Or/ And Non-Compliance of any one Mandatory Statement OR have not information of any statements	Non Compliance (Re-submit for permit process after modification according to recommend action)

F Recommended Action

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