

Urban Reconstruction Process and Challenges for Residential Building after Nepal Earthquake 2015: Case Study at Bhaktapur Municipality

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Abstract

Modern technology of reinforced cement concrete (RCC) was adopted during reconstruction of residential building after Nepal earthquake 2015 instead of adopting traditional materials and technology of brick mortar load bearing wall system. Life span of RCC buildings are expected to be fifty to sixty years. There is probability of loss in transfer of these traditional technologies of housing construction in near future. The devastating earthquake of April 25 2015 destroyed world Heritage sites in Kathmandu, Bhaktapur and Lalitpur, including the iconic Dharahara and historic Kasthamandap. Many neighborhoods of Kathmandu, Lalitpur and Bhaktapur were severely affected forcing people to take shelter in open spaces and streets. Reconstruction process was started after few years of earthquake in 2015. But even after five years of earthquake reconstruction work has not been completed. Then main reconstruction challenges are poor financial status of house owner and problem in legal inheritance of land and house among siblings. The main objective of this study is to examine process and challenges for reconstruction of residential building after Nepal earthquake 2015 at Bhaktapur Municipality. The specific objectives are to study about architectural conservation in reconstructed buildings, to study challenges faced by house owner for reconstruction, to acknowledge social changes after post-earthquake reconstruction and to study about Reconstruction Process at Bhaktapur Municipality. This study was carried out based on questionnaire survey among 25 households of different ward at Bhaktapur municipality core area and data was analyzed in IBM SPSS software. Some houses have completed its reconstruction work, some are in process and some houses have not even started for reconstruction work. There are significant efforts made by Bhaktapur municipality to conserve building architecture by making byelaws for exposing brick at façade and making slope roof at staircase cover. There have been significant social changes and improved in people's life style after reconstruction of residential buildings.

Keywords

Reconstruction, process and challenges, architectural conservation, social change

1. Background

An urban area is the region that surrounds a city, can refer to city and suburbs. Urban areas are very developed, which means that there is a density of human structures, such as houses, commercial buildings, roads, bridges and railways [1]. Urbanization refers to the increasing number of people living in urban areas. It predominantly results in the physical growth of urban areas, be it horizontal as mass housing or vertical as high rise apartments. 55% of the world's population lives in urban areas, a proportion that is expected to increase to 68% by 2050[2]. Urbanization is closely linked to

modernization, industrialization and sociological process of rationalization[3]. Therefore, the term urbanization can represent the level of urban development in relation to the general population, or can represent the rate to which urban proportion increases.

The basic function of a building is to provide a space with a healthy structure and a controllable environment for the accommodation and protection of residents and its belongings[4]. The types of residential buildings are: individual houses or private apartments and apartment building or dormitory apartments. The building sector plays an important

role in energy consumption, including space heating or cooling, hot water and electricity. The current focus is on planning and realizing attractive residential buildings that have low purchase and operating costs and are energy-efficient. It is imperative to build fast, high-quality, and environmentally friendly buildings. Like human casualties, house destruction is one of the most obvious and significant effects of major disasters. The loss of living space destroys livelihoods, protection and privacy. Effective housing reconstruction is essential to restore the dignity, social, economic, and cultural characteristics of affected communities[5]. Residential buildings should meet one of the basic human needs of housing. Due to changes in population structure and lifestyles, today's buildings are increasingly unable to meet the needs of residents[6].

2. Introduction

Bhaktapur District has long been regarded as a gem of traditional Newar architecture and has a world famous cultural heritage listed by the United Nations Educational, Scientific and Cultural Organization (UNESCO) . It was hit hard in the April 25, 2015 earthquake, which killed 333 peoples and damaged more than 30,000 private homes[7]. As of March 20, 2020 a total of 28,455 households in the area were listed as potential beneficiaries for private housing construction subsidies, of which 6,888 households were in Bhaktapur [8]. The earthquake also caused extensive damage to historic buildings, including the World Heritage Bhaktapur Durbar Square. A total of 116 historical and cultural monuments have been damaged or destroyed, including National Art Gallery, Vatsala Devi Temple, Siddhi Laxmi Temple, Tawa Sattal and Nyatapola Temple[9].

3. Literature Review

The main features of the reconstruction of public housing after the 2002 Hanshin Awaji Earthquake in Kobe, Japan are: First one is it provides rental housing. The public sector provides rental apartments for victims after the disaster. Provide rental apartments and affordable housing for low-income people of a disaster. Providing affordable public housing is a unique method in the post-disaster housing reconstruction plan. There are many residential units provided by the public sector. Second one is victims were provided or lend funds to rebuild

their home using existing house stock and electricity from the private sector. The public sectors are reluctant to directly repair damaged houses as individual properties. Many housing units have been provided by public sectors for those who were unable to reconstruct their houses or unable to acquire rental housing by themselves[10].

Five different ways for housing reconstruction was employed in Gujarat after the massive earthquake on January 26, 2001. First one is owner-driven housing approach in which house owners are responsible to carry out reconstruction work on their own with external financial, material and technical support[5]. Second one is subsidiary housing approach. Through this approach, agencies do not directly participate in the reconstruction of homes, but provide additional material and technical assistance. Similar in participatory housing approach the agency plays a leading role in housing reconstruction while involving house owners in the planning, design, and reconstruction of the house. In the same way, in contractor-driven in-situ housing approach professional contractors are hired to plan and build houses. In-situ means that houses will be rebuilt on the same site as before the disaster. In contractor-driven ex-nihilo housing approach professional construction company are heir and village is rebuilt in a new location.

The Gorkha earthquake on April 25, 2015 caused severe damage and destruction to the central part which severely affect the lives of the Nepalese people and the overall economy of Nepal (Gyawali, 2020). Government provides only three lakhs rupees as grant for reconstruction of private housing was a major challenge for housing reconstruction. Although the government has prepared many model houses to support and guide rural houses, the price of design model houses is more expensive than the amount provided by the government. Even the cheapest model requires more than three lakhs construction costs. The Nepalese government announced that it will provide three lakhs rupees to earthquake victims in three phases. At the same time, the guidelines set by the Nepal reconstruction authority (NRA) are very strict and may not apply to rural areas. This is why the beneficiaries cannot receive payments on time. The main reason for not being able to get the 2nd and 3rd installments is that the houses built do not meet the requirements of the NRA (Gyawali, 2020). The main requirement of NRA is use of reinforcement for

concreting of RCC buildings and completion of concreting work to get final installment. The government established guidelines but failed to provide enough skills to build cheap and earthquake-resistant houses. The difficult topography of Nepal with hills and mountains is another obstacle for reconstruction. As rural roads are not accessible during the monsoon season, it is difficult to transport and transport materials to the affected areas.

After almost couple of years of reconstruction, there does not seem any effective plan and action to address future casualties. Local participation is not involved in designing and planning has been identified as one of the major flaws in reconstruction. Top-down planning approach failed to identify ground level demand of people in terms of housing and livelihood. Lack of local government followed by bureaucratic hassle in the planning and implementation leads to difficulties in smooth running of reconstruction process. However, government somehow managed to get aid and loan from international platform, which made it possible for planning and mobilization of engineers, logistics and other necessary manpower and equipment. These small welcoming steps can be considered as the positive aspect for functioning of reconstruction process (Gyawali, 2020).

Nepali architecture also called 'Newar' style is very different from those found in neighboring Asian countries with similar cultures, traditions and religions[11]. A distinguishing factor of the style as a whole is the way in which the two principal materials, wood and brick with mud mortar are used for load bearing wall system. They are used to make up building elements using technological processes that have evolved over many centuries to create a distinctive style of architecture. Whereas reinforce cement concrete contains embedded steel bars, plates or fibers reinforcing the material. Such materials magnify the load bearing capacity, because of this unique property reinforce cement concrete construction is commonly used in any buildings. Indeed it has become the most frequently used building material. It is one of the major developments of last decade's real estate technology in the field of construction technology (Homes 247 guide, 2021).

4. Methodology

Questionnaires were prepared on the basis of various research parameters and variables supporting research

objective. The research design of this study was random sampling survey with replacement techniques as houses without reconstruction after earthquake were not selected for study. Questionnaires survey was carried out at different wards of Bhaktapur municipality randomly. Pilot Survey was carried out within 5 reconstructed houses at Byasi and necessary improvement was made on questionnaire. 25 households i.e. 2% houses were selected among 2015 reconstructed houses after Nepal Earthquake 2015 for questionnaire survey. Data from questionnaire survey was entered and analyze on IBM Statistical Package for Social Sciences (SPSS v.25) software. Three houses were analyzed in detail – one post reconstructed house, one pre-reconstructed house and one house during reconstruction were studied in detail. Findings were based on data analysis collected from questionnaire survey and detail study was based on site visit, observation and AutoCAD drawings. Data regarding destructed houses at Bhaktapur Municipality during Nepal Earthquake 2015 was collected. Out of 7656 destructed houses 5681 houses received agreement with Nepal Reconstruction Authority Bhaktapur for reconstruction. Out of 5681 household 2015 household receive 3rd Phase of Financial support i.e. one lakh rupees after completing all concreting work as per approved drawing. The total Number of damaged houses were 7656 by earthquake and total number of reconstructed houses were 2015 i.e. 26.31% (NRA, Bhaktapur) and 2% of 2015 i.e. 25 houses were sample size was selected this study.

5. Data analysis and findings

5.1 Architectural conservation

In context to Architectural conservation, all the houses are of 4 story and staircase cover with brick exposed façade at core area of bhaktapur. A total of 25 surveyed houses 16 houses were of more than 4 stories before earthquake and they were brick exposed. 13 houses had flat and slope roof before earthquake and slope roof was covered by zinc corrugated sheet. 4 Houses with building completion certificate has slope roof at staircase cover and flat roof at floor level and slope roof was covered by jingati tiles. The houses within road width of 10 feet are facilitating with balcony in that elevation. All the houses before reconstruction were of load bearing wall system where as all the houses after reconstruction RCC Frame structure.



Figure 1: Elevation of approved building drawing

5.2 Challenges faced by house owner

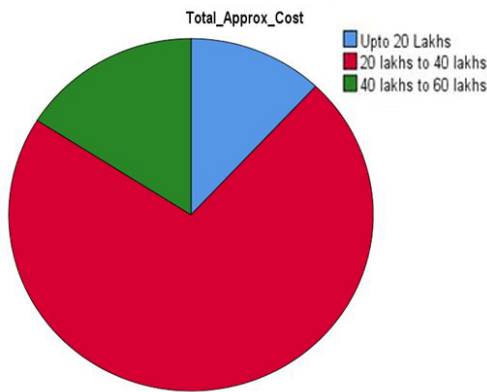


Figure 2: Reconstruction Cost of residential buildings

Among 25 houses the construction cost of 72% houses is 20 lakhs to 40 lakhs and 16% houses cost 40 to 60 lakhs for reconstruction. All the houses received financial aid by NRA Rs. 3 Lakhs which cover up to 3% to 10% construction cost. Average reconstruction period is 1 year as there is urgency to shift from temporary living to permanent living place. 3 houses completed its construction in more than 2 years because they made partial construction and began to live there. 20 house owners' heir professional contractor for construction of their houses. Only 4 houses get building completion certificate out of 25 houses because most of other houses do not follow

approved building drawing during construction like some of these houses made space for overhead water tank instead of slop roof at staircase cover. Most of house owner face issue like multiple rejection of building drawing and time consuming process from submission of drawing to approval of drawing. Most of the houses in core area of bhaktpaur municipality owned limited space about 200 sq.ft to 500 sq.ft. and concrete staircase occupy more space than single flight wood ladder. These houses are with only 1 or 2 rooms in each floor.

5.3 Social Changes

There have been significant social changes and in people's life style after reconstruction of residential buildings. Among 25 houses 72 % houses are used for residential purpose only and 28% houses are used for both residential and commercial purpose. A house within the buffer zone of road width of more than 10 feet has residential and commercial purpose. Among 25 houses 7 houses have shops at ground floor which contribute in financial gain of household and other floor are used for residential purpose. 24 houses has underground water tank after reconstruction but 4 houses do not have underground water tank because they reconstructed their houses earlier before getting aware about necessity of underground water tank. None of the houses had underground water tank at their house before earthquake. Most people are able to design and construct their house as per their wish and need within their available space. They got opportunity to make update on sanitary and electrical settings. 6 houses have more than 3 toilets and other houses have more than one toilet after reconstruction and most of them are well furnished with updated sanitary and electrical fittings. All these houses had only one or two toilets before earthquake. 56% sampled households has more than 3 taps based on overhead water tank and other houses has one or more than one taps. Very few houses had one taps and most of houses do not have any taps before earthquake and use community taps or wells. Out 25 surveyed houses 19 households have modern kitchen appliances like refrigerator after reconstruction and other houses has other kitchen appliances like rice cooker, induction, water boiler etc. Only 4 houses do not have any of these kitchen appliances even after reconstruction. Very few houses had modern kitchen appliances like refrigerator before earthquake. Most of houses are reconstructed only after approval of building drawing at municipality and implementations of byelaws has

mitigate the problems like narrow road, dark and poorly ventilated room etc.

5.4 Reconstruction Process

The common reconstruction process was followed by all the surveyed houses as this process was set by Bhaktapur Municipality for reconstruction of residential buildings. Firstly house owner had to get building drawing following all the byelaws prepared certified civil engineer or architect. Necessary documents were submitted and registered at Municipality along with 6 copies of building drawing, blue print, land ownership, citizenship of house owner, payment bill at malpot, legal documents if any. After registration at municipality, file forwarded at ward office. Ward provide 15 days date to neighbor at 4 direction at East, West, North and South. After 15 days, if there is no any complain by neighbor, civil engineer technician from ward office came to verify building drawing as per site and provided documents. After verification from ward office, building drawing and documents are forward to Bhktapur Municipality for approval. Then Bhktapur municipality asks for structural drawing and analysis of building. After some process municipality give official permission for construction work. House owner heir contractor for construction work. Construction work started form layout of foundation, excavation and concreting of Foundation, foundation tie beam and plinth tie beam. After concreting plinth tie beam, owner apply application for concreting first floor at Bhktapur Municipality. The technician from municipality visits the site to check plinth tie beam as per drawing. After verification municipality provide permission for concreting first floor. Technician from Nepal Reconstruction authority also visit at site and verify then provide financial aid of 50,000. After concreting first floor, NRA provides financial aid of 1 lakh 50 thousand. After completing all concreting work NRA provide remaining 1 Lakh. After completion of building construction Bhktapur municipality provide building completion certificate if building was constructed as per building drawing approved by bhktapur municipality

6. Discussion

As (Tiwari, 2009) states, the primary building construction materials for the traditional style of architecture in the Kathmandu valley included brick,

mud and wood. In bhaktapur as well, residential building before reconstructions were of brick wall with thickness of 19” to 22” with mud mortar and act as load bearing structure. And floors and pillars are of wood like: Nila, dalin, than etc. Tiwari (2009) also terms these materials as “very weather sensitive materials” that needed to sever modification to achieve a perfect balance between its function, aesthetics and resistance against weathering. Supporting this statement all people from sampled household has experience that traditional houses before earthquake had more thermal and weather comfort than existing RCC house.

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According to [10] after earthquake disaster at Kobe City japan in 2002 for reconstruction of houses was carry out by lending money resource and by supplying rental housing units for the victims after disasters. Whereas as in Nepal, 3 lakh financial aid was provided by Nepal Reconstruction Authority. Average construction cost is 20 to 40 lakhs which is not affordable to most of house owner with lower economic status. So lower economic status of house owner is the major challenge for reconstruction work in bhaktapur.

As argue by (Gyawali, 2020)for reconstruction of private housing at gorkha after 2015 earthquake government proposed model houses the prototype houses do not match in the rural context of Nepal and there is no local participation in designing and planning. Here in Bhaktapur, NRA also has reconstruction responsibility. But government do not purpose prototype of houses and house owner are free to make design according to their owned space and following prevailing byelaws of bhaktapur

municipality.

According to [5] after earthquake in gujrat in 2006, five different housing reconstruction approaches were employed there are: Owner-driven approach, Subsidiary housing approach, Participatory housing approach, Contractor-driven approach in situ, Contractor-driven approach ex nihilo. In bhaktapur it is mainly owner driven reconstruction approach. Owner has full control on design and construction of house along with all the financial and material management. Technical assistance was providing by professional contractor for construction work and engineer provides assistance for design work.

According to [12] planning documents indicate that development activities are geared towards futuristic jump, but often forgetting reference to own past culture and available knowledge. This was proved at reconstruction work of residential building at bhaktapur as the entire houses adopt RCC for reconstruction as futuristic jump. And the old cultural knowledge of brick wall system is in state of being forgotten soon by coming generation.

7. Conclusions and Recommendation

Reconstruction of residential buildings after Nepal earthquake 2015 has made significant contribution in architectural conservation of building by following the cultural of exposing brick façade at reconstructed houses. All the houses before reconstruction were of load bearing wall system and brick exposed while all the houses after reconstruction are of Reinforce cement concrete Frame structure and brick exposed. Slope roofs were covered by zinc corrugated sheet before earthquake. The houses have slope roof at staircase cover which was covered by jingati tiles and flat roof at floor level which got building completion certificate after reconstruction.

Only 40% reconstruction of residential building were carried out as mentioned in Bhaktapur municipality 10th district conference even after 5 years of earthquake from 2015 to 2021. Reconstruction process is in slow pace, the main reason is costly reconstruction cost. Average reconstruction cost is from 20 to 40 lakhs; it is difficult to afford for medium economic class people. Financial aid by NRA is Rs. 3 Lakhs which cover only 3% to 10% construction cost. Another difficulty for reconstruction process is problem of inheritance of landownership among siblings. They tend to have

problems with few inches of land which create difficulty in further process for reconstruction.

Reconstruction work brings significant social change in people's life style. Resident tends to have comfort in using spaces like staircase, corridor and rooms at reconstructed house. There are significant opportunities after Earthquake for reconstruction. Most people are able to design and construct their house as per their wish and need within their available space. There is opportunity to make update on sanitary and electrical settings. People tend to have more comfortable life style and living standard than before earthquake with use of modern appliances and technology. Implementation of Bhaktapur municipality byelaws contributes in mitigating problems like poor light and ventilations.

Reconstruction process involves the joint effort and coordination of all actors like: house owner, engineer, municipality, ward office, contractor. Significant and crucial part of reconstruction process is financial management by house owner. All other processes are guided by financial status of house owner. Building drawing was prepared by engineer as per requirement by house owner remaining within byelaws. It was then registered at municipality along with all the documents related to land and house. Then file forwarded to ward office and ward office verify at site as per drawing and documents. After verification file forwarded to municipality and drawing get approved for construction. And then house owner heir professional contractor for construction work until its completion.

Scenario of reconstruction at Bhaktapur municipality shows there has been significant work done for reconstruction of residential buildings. This reconstruction work can be still more effective and efficient with greater pace if there made some improvement in some reconstruction aspect. Here are some recommendations provided to Nepal government, municipality, local bodies and house owner so that reconstruction work can have some better impact on society and people's life.

It is recommended to Nepal Government to provide soft loan to people with lower financial status, as financial status has crucial role in reconstruction process. Reconstruction work cannot be carried out without strong financial support of house owner. There should be joint effort of Government and local bodies to provide rental housing with minimum cost

or if possible free of cost to earthquake affected people until they manage their own house. Bhaktapur Municipality should provide courses to engineer before giving registration regarding latest byelaws and about the required drawing to avoid multiple rejection of drawing. There should be possible short duration from submission of drawing to approval of drawing from municipality. Bhaktapur municipality is recommended to digitalize the process for reconstruction work like registration from online platform and processed file to ward by online medium. So that this process can be carried out in less time with better efficiency and transparency.

Local Bodies like ward office plays a significant role in quality control of reconstruction work. Technician of ward office should make regular monitoring during foundation work and concreting work according to approved drawing. These Technicians has power and authority to make house owner to work as per building drawing by making regular and strict monitoring during construction work. House owner should construct their building as per approved building drawing from municipality. House owner should understand that byelaws are for betterment of people in municipality and should follow sincerely while constructing their houses. House owner should not start construction before approving drawing from bhaktapur municipality otherwise it would invite unwanted problems. There should be proper mutual understanding among siblings regarding legal inheritance of land and house.

For Future Research, Financial management by house owner for reconstruction is to be studied. Financial status of house owner has most important contribution in reconstruction process of residential building. It has to be studied in detail and recommend practical solution at government level so that house owner can improve financial status to carryout reconstruction process. Health impact on residence by reinforces cement concrete houses after reconstruction is to be studied. It is currently seen that number of health issues regarding joint pain and respiration has risen as people start of live in RCC houses. These health issues on people living in residential building are to be studied in detail so that necessary precaution could be followed on time. The environmental impact of reconstruction is to be studied. The reconstruction work has a significant environmental impact because reinforce cement concrete structure uses steel in large

quantity and carbon emission during steel production is high and has a negative impact on the environment. Other materials that are uses for reconstruction work like: cement, aggregate, sand, paint, etc. also has an environmental impact during its production and use, these elements are to be studied in detail.

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