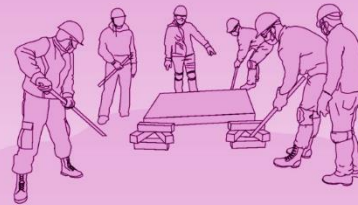


Baliyo Ghar Program

Promoting Seismic Retrofitting of Partially Damaged Buildings



Enhancing Skills of Existing Masons through 7 Days Training



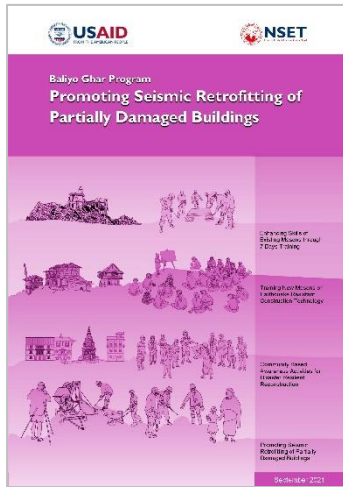
Training New Masons on Earthquake Resistant Construction Technology



Community Based Awareness Activities for Disaster Resilient Reconstruction



Promoting Seismic Retrofitting of Partially Damaged Buildings



Baliyo Ghar Program

Community Based Awareness Activities for Disaster Resilient Reconstruction

A Summary Report

Program Period:

October 1, 2015 to September 30, 2021

Reporting Period:

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Chandan Dhoj Rana Magar



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FOREWORD

National Reconstruction Authority Put forward a recovery vision allowing all the partners to align their actions with Nepal government plan and policy to build social harmony as a basis of resilience. National Society for Earthquake Technology-Nepal (NSET) found active on supporting Gorkha earthquake Reconstruction and Recovery prior to the establishment of NRA with National Planning commission. NRA is getting continuous support from NSET from the beginning of reconstruction and the technical support provided by NSET through its programme is commendable/ highly acknowledged.

Housing reconstruction program is one of the biggest challenges for NRA due to its sensitivity that it is directly related to the shelter need of affected families damaged by earthquake. The damaged was not limited to the physical losses of houses it's also impacted on socio-economic aspect of each family. The worriedness among the earthquake affected people was heightening. In such circumstances providing technical support and bringing hope to the individual family to stand with earthquake resistance house is supposed to be a nightmare which was converted into the reality now. And support of partners to the NRA is high.

NSET through USAID supported “Baliyo Ghar” program enlighten hope to about 60 thousand household with its socio-technical assistantship during house reconstruction. The capacity building trainings to masons, engineers and the policy makers are major deliverables that NSET complement on government efforts. On awareness raising component the utilization of mass media is remarkable. In specific the television program creates the opportunity to discuss the local challenges and reconstruction and recovery issues which is remains as a strong platform on advocacy as well as decisions dissemination. The technical research for innovative technology on retrofitting of houses is vital for enhancing the building resilience with minimum interventions on buildings are unique works done by NSET. The support provided by Baliyo Ghar program to draft the different type of training curricula, manuals and technical guidelines and standards are remarkable.

NRA acknowledge the technical support received during six years on reconstruction has high value and would like to express my gratitude for the NSET leadership and the working team and thankful to USAID for their support to NSET for implementation of Baliyo Ghar program.

Sushil Gyewali

Chief Executive Officer

National Reconstruction Authority

REMARKS

The housing reconstruction technical support program in a name of Baliyo Ghar designed for Gorkha earthquake housing reconstruction is strongly rooted on the NSET learnings and work experience on Pakistan housing reconstruction after 2005 earthquake. NSET engaged in **Training Support for Earthquake Resistant Reconstruction in Pakistan (TSERR)** for Earthquake Reconstruction and Rehabilitation Authority (ERRA) of the government of Pakistan for housing reconstruction. The experience of Gujrat reconstruction through the mason exchange program and the experiences working after Iran earthquake enrich the institutional experiences which is well reflected on Gorkha earthquake reconstruction and recovery through NSET different efforts. Before Gorkha earthquake NSET is engaged in different type of earthquake preparedness activities which may help to save many lives and property during gorkha earthquake. Unfortunately, the quantification of preparedness efforts and its contribution on saving life and property is not well studied so far.

Baliyo Ghar program is a one of the priority programs of NSET for housing reconstruction and recovery through which the institutional learnings and experience of NSET from around the world were systematically feed into the Nepal government reconstruction and recovery efforts. Being a professional organization the contribution of preparing PDNA with National Planning commission and engagement during preparation of PDRF are key involvement to shape the Nepal reconstruction and recovery. The technical support on development of Inspection mechanism, functions of enrollment camps and the support on developing institutional arrangement through the assign role of NRA-CEO technical advisor and the subject matter experts in a later course of NRA actions is a contribution of NSET as an institution.

Baliyo Ghar program at the field reaches to provide the socio technical support at household level. The training and capacity building of construction workforces are key contribution to create the reconstruction environment. The mass media mobilization helps NRA to understand the challenges raised during housing reconstruction which helps NRA to take a corrective measure. The local F.M stations brings the issues from the ground and discussed. The national and district level interaction conducted through the program brings synergy in reconstruction to resolve the issue at the different level of existing governance system making DLPIUs and district office more credible and accountable to the reconstruction beneficiaries.

I expressed my gratitude to the municipalities who support for the reconstruction efforts and thankful to NRA, CLPIU-Building, DLPIUs for their trust and providing us a working environment and providing the guidance. The partner organizations, HRRP and civil societies help us to be active and engaged us in different forum for discussion on reconstruction, thankful for their efforts. I acknowledge the support from USAID for providing funding and necessary guidance during program designing and implementation. And appreciate the dedication and professional work demonstrated by NSET staff during this reconstruction period.

Surya Narayan Shrestha

Executive Director

NSET-Nepal

PREFACE

Gorkha earthquake housing reconstruction is one of the successful efforts that Nepal deliberates to ensure the resilient reconstruction of private houses. Owner driven housing reconstruction adopted by Government of Nepal for such a large scale of housing reconstruction probably the largest owner driven reconstruction in the world so far. The topographical challenge of access road to supply construction materials at mountainous region is itself a complicated task. Despite all in a leadership of National Reconstruction Authority (NRA) is support from government, Nepalese people donors, I/NGO and civil societies the reconstruction of more than eight hundred thousand houses is about its completion within seven years after 2015 earthquake. However, the reconstruction of few urban settlements still has many issues and remaining reconstruction need to be completed.

The technical support provided by the partner organization is significant as mentioned by the NRA. NSET implemented Baliyo Ghar program to provide technical support to government efforts aligning with the government plan, policy, and procedures for reconstruction. The six-year Housing reconstruction technical support program begins on 1st October 2015 and ended on 30 September 2021 with the support from USAID. Most probably Baliyo Ghar program is one of the programs having longer program period almost similar life span of NRA effective life. Program support NRA in multitude of activities in three major aspects on technical support; policy, capacity building training and awareness raising for resilient reconstruction.

Baliyo Ghar program has a twofold of actions. On one aspect it has a direct reach to the reconstruction beneficiaries at household level to provide require socio-technical support on housing reconstruction through its program activities. On the other hand, the support on policy drafting and mass media activities its indirectly support to the entire beneficiaries among the earthquake affected district.

The mobilization of social mobilizers with engineers and construction technicians as a one mobile team for one ward of municipalities for about forty wards directly supported for the reconstruction of about sixty thousand houses which helps about thirty million people to assure the safe permanent shelter. The door-to-door technical support provided by the mobile teams remains instrumental to drive the result on physical reconstruction of houses at the initial days of reconstruction when in many areas people were completely unaware and confused about the rebuild of houses, reviving settlements from the ruins is a big challenge foreseen.

During reconstruction period, Baliyo Ghar program constructed 910 technology demonstration houses which trained 5,430 new masons where 26% percentage of participants were female. Similarly, the retrofitting technology demonstration on 74 houses trained 444 masons who were capable to retrofit the houses independently. The practicing masons were trained on earthquake resistant technology of houses, about 13,474 masons were trained. 2,554 engineers and architect trained in different professional skills. The elected local representatives were trained on Disaster Risk reduction and management. The television and radio program provided the platform of reconstruction, discussion information dissemination advocacy and policy decision which realize that the concept that the mobilization of mass media is equally important to support the reconstruction and recovery efforts.

I express my gratitude to all the housing reconstruction beneficiaries, local people, municipalities, CLPIU-building, GMALI, DLPIU; Dhading, Nuwakot and Kathmandu for their guidance and support during the program implementation. My sincere acknowledgement to USAID for continuous funding and supports, the program team who employed their tireless efforts on program implementation and thankful to the NSET-Board, executive director, NSET's divisions and experts at NSET for their contribution on program to make it successful.

Dr. Ramesh Guragain

Program Director and Deputy Executive Director
NSET-Nepal

LIST OF ABBREVIATIONS

ADB	Asian Development Bank
AIN	Association of International Nongovernmental Organizations in Nepal
BCRAC	Building Code Revision Advisory Committee
CBOs	Community-Based Organizations
CDO	Chief District Officer
CLPIU	Central Project Implementation Unit
CSO	Civil Society Organizations
DACFC	Development Assistance Coordination and Facilitation Committee
DCC	District Coordination Committees
DFID	Department for International Development
DLPIU	District Level Project Implementation Unit
DOR	Department of Roads
DOLIDAR	Department of Local Infrastructure Development and Agricultural Roads
DPR	Detail Project Report
DRCN	District Road Core Network
DRRM	Disaster Risk Reduction and Management
DRSP	Disaster Resilience of Schools Project
DUDBC	Department of Urban Development and Building Construction
DWSS	Department of Water Supply and Sewerage
ECED	Early Childhood Education and Development
EEAP	Earthquake Emergency Assistance Project
EIRR	Economic Internal Rate of Return
ESRP	Emergency School Reconstruction Project
EU	European Union
EXIM Bank	Export-Import Bank of India
GESI	Gender Equity and Social Inclusion
GIZ	The Deutsche Gesellschaft für Internationale Zusammenarbeit / German Corporation for International Cooperation GmbH
GMaLI	Grant Management and Local Infrastructure
GoI	Government of India
GoN	Government of Nepal
IEE	Initial Environmental Examinations
IDA	International Development Association
INGO	International Non-Governmental Organization
JFPR	Japan Fund for Poverty Reduction
JICA	Japan International Cooperation Agency
KOICA	Korean International Cooperation Agency
KVDA	Kathmandu Valley Development Authority
LRN	Local Road Network
MDTF	Multi-Donor Trust Fund
MoE	Ministry of Education
MoFALD	Ministry of Federal Affairs and Local Development
MoHA	Ministry of Home Affairs
MoHP	Ministry of Health and Population
MoUD	Ministry of Urban Development
NEA	Nepal Electricity Authority
NFN	NGO Federation of Nepal
NGO	Non-Governmental Organization
NNBC	Nepal National Building Code
NPC	National Planning Commission
NPR	Nepalese Rupee
NRA	National Reconstruction Authority
PCU	Project Co –Ordination Unit
PDNA	Post-Disaster Needs Assessment
PDRF	Post-Disaster Recovery Framework
PIU	Project Implementation Unit
PMC	Programme Management Consultancy
POs	Partner Organizations
PRC	People's Republic of China
RC	Reinforced Concrete
SEANep	Structural Engineers' Association Nepal

SDC	Swiss Agency for Development and Cooperation
SFD	Saudi Fund for Development
SMC	School Management Committees
TOR	Terms of Reference
TVET	Technical and Vocational Education and Training
UNDP	United Nations Development Programme
UNICEF	United Nations International Children's Education Fund
USAID	United States Agency for International Development
VRCN	Village Road Core Network
WASH	Water, Sanitation & Hygiene

EXECUTIVE SUMMARY

This is a final report of Baliyo Ghar program to consolidate the learnings of socio technical assistant for housing reconstruction after gorkha earthquake 2015. National Society for Earthquake Technology-Nepal (NSET) with the funding from USAID implemented the Baliyo Ghar program from october1, 2015 until September 30, 2021, to provide the socio technical assistant on housing reconstruction in coordination with National Reconstruction Authority (NRA). Baliyo Ghar program has three-fold of actions for socio technical assistance. The policy support to prepare the technical guidelines, manuals, training Curriculum and other relevant policy document related to the housing reconstruction, Training, capacity building of construction workforce and the awareness raising for the resilient reconstruction of houses. The policy document supported Nepal government to prepare the standard policy document related to housing for all earthquake affected area. Through the policy documents, mass awareness activities aired and broadcasted from radio and television program contributed for entire housing reconstruction efforts. However, capacity building efforts and technical support for household level was focused on four districts: Dhading, Nuwakot, Dolakha and Kathmandu named as program implemented districts. Within the program coverage districts one third the housing reconstruction beneficiaries were directly taken care off. In other area different partners provided the technical support. However, in technical aspect through the district reconstruction technology center formed by Baliyo Ghar program provided support to enhance the partners capacity on technical aspect of housing reconstruction. Training to the partners technical professionals, technical discussion and sharing were the key area of collaboration among the partners.

Similarly at the national level with the Center Level Program Implementation Unit (CLPIU-Building) the National Reconstruction Technology Center (NRTC) formed by the Baliyo Ghar program contributed to develop the different technical manual, curriculum, and policy documents. The training curriculum for masons, engineers, social mobilizers, correction manuals for houses, extension guidelines are few examples of policy document developed with the involvement of experts deployed by the Baliyo Ghar program.

At the end users' level, the mobile team consisting social mobilizer, engineer, and construction technician known as a mobile team provided the door-to-door technical support at household level to provide information related to the housing reconstruction such as government grant provisions, process etc. as a part of social mobilization and provided the technical supervision of houses by the engineers and construction technician during the construction of houses, for the planning and cost-estimate of the houses engineers work with the houseowner to meet the requirement and to plan the material and budget prior to the construction of house. This process of consulting individual beneficiaries helped a lot on timely completion of reconstruction at program areas. About 63000 household were benefited from this direct approach of intervention.

In this connection, the awareness raising activities conducted by the program at program implemented areas helps to prepare a reconstruction environment at the starting period when almost all of the stakeholders including government were not clear on steps of grant disbursement, housing inspection and it interlink. The campaign of social mobilization to disseminate government decisions at local level remains instrumental to rollout the grant disbursement process. This is how NRA came to start the grant agreement with beneficiaries from the Baliyo Ghar program implemented area. The rural market center of former VDC's- Singati bazar at Dolakha was chosen and grant agreement camp was first formed and tested. The learnings of which helps NRA to take the decision that the grant agreement must be done at former VDC office intending to decrease the challenges faced by the beneficiaries. The first enrollment camp was also chosen at Baliyo Ghar program district at Dhading where program mobile team were mobilized beforehand and certain level of awareness activities were conducted by the program. Both enrollment camp provided many learnings to the NRA and involved partner organizations. Enrollment processes were revisited, standardized on procedure, and scaled up to the other part of the reconstruction areas.

Baliyo Ghar program consider the theory of change (TOC) that if guidelines are standardized, local capacity and awareness increased the house owner will be able to reconstruct their houses to be disaster resilient. TOC further defined through the program goals which is to contribute to sustainable earthquake reconstruction. The program objectives to support disaster-resilient reconstruction of houses through standardized training, awareness, and demonstration in built with three intermediate results (IR) with its clear output level activities. The IR-1 improved policy and standardization of training, guidelines, and manuals for disaster-resilient construction technologies priorities its output level activities as curricula for awareness and training (including instructor development). The IR-2 Enhanced local capacity to apply disaster resilient construction methods and techniques designed with instructors' development trainings, construction workforce training, social mobilizers training, training to the government officers and support made for engaging local authorities in a process of institutionalization of safer building practices. The IR-3 increased awareness on disaster resilience construction in Nepal designed with the formal orientation sessions, Door-to-Door technical support, construction of demonstration models, Information Education and Communication (IEC) material designing and printing, radio program and dedicated television program on reconstruction are the key activities for achieve the attainment of desire outcomes under IR-3.

Targeting to the end users most of the activities were focused on program implemented districts which is one third part of Dhading, Nuwakot and Dolakha district were considered as a focused program areas where each house owners receive the technical support for their reconstruction not limiting to the reconstruction beneficiaries only. The provision of blanket technical support to each homeowner who were constructing their houses were the target groups.

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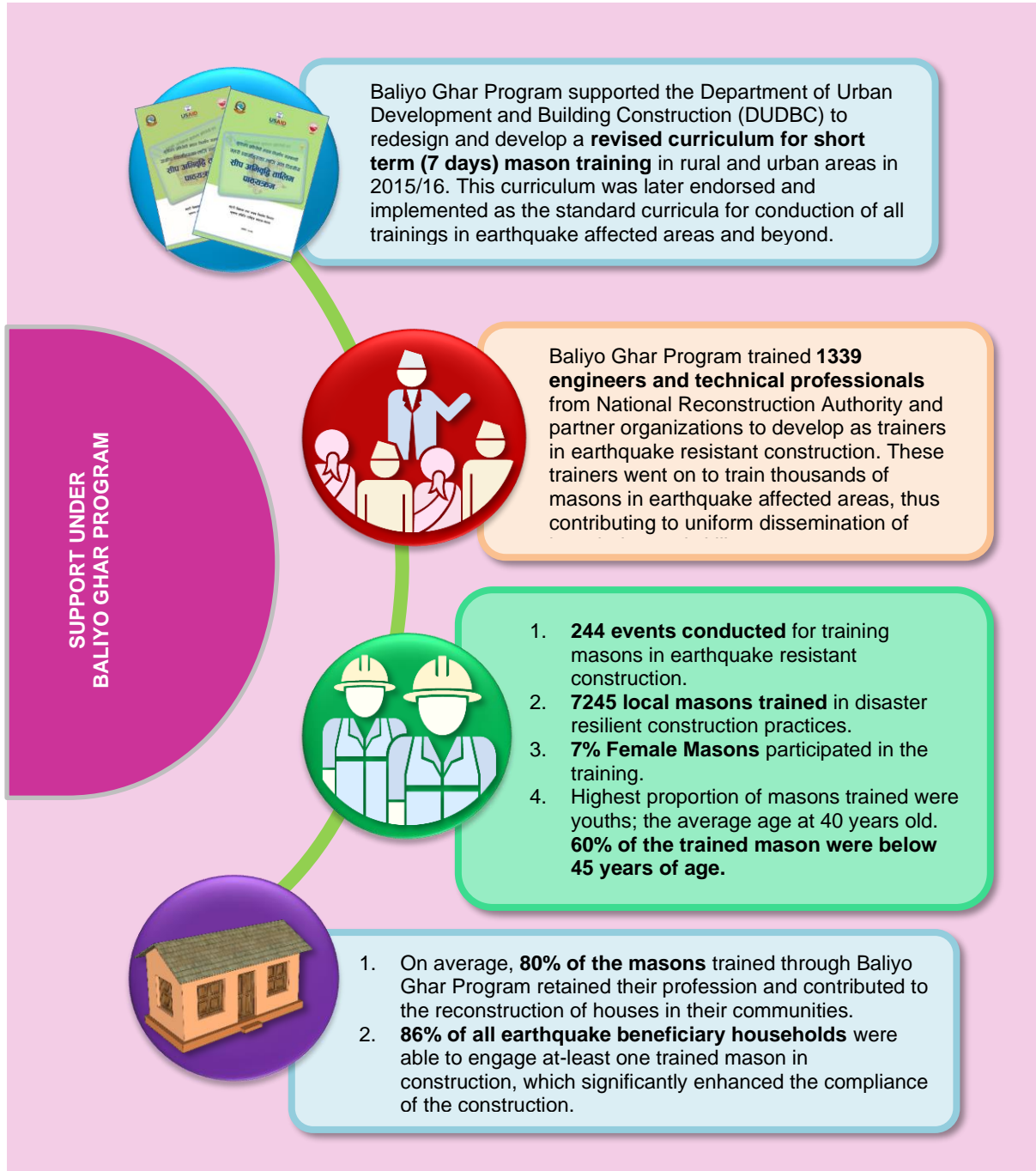
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PROMOTING SEISMIC RETROFITTING OF PARTIALLY DAMAGED BUILDINGS

KEY HIGHLIGHTS



I SUMMARY

With an aim of supporting the Government of Nepal's owner driven approach for the reconstruction of private houses damaged during the 2015 Gorkha Earthquake, NSET has been implementing the "Baliyo Ghar Program" as a key part of the reconstruction portfolio of USAID/Nepal under the cooperative agreement AID-367-A-15-00005. Baliyo Ghar Program is providing comprehensive technical support to the GoN's reconstruction project, by empowering and supporting communities to "Build Back Better". The program primarily imparts knowledge, skills and awareness regarding disaster resilient construction techniques to earthquake affected communities in four of the most affected districts in Nepal. Further, the program assists the government in developing policies, guidelines, norms and training curricula to standardize the entire process of reconstruction under the leadership of the Government of Nepal (GoN) National Reconstruction Authority (NRA) and its project implementation units.

Baliyo Ghar Program conducted various capacity building activities targeted to home owners, masons, engineers, social mobilizers and government officials which formed the backbone of socio-technical assistance in the earthquake-affected communities, enhancing the speed of recovery as well as ensuring the compliance of the constructed buildings to prescribed technical norms. In October 2018, three and a half years since the earthquake and three years into the implementation of Baliyo Ghar Program, 36% of the fully damaged houses had already completed their construction, and another 30% had started. Reconstruction was progressing at a satisfactory rate and was assumed to be completed within the NRA's mandated timeframe.

Contrary to this, partially damaged buildings, enlisted by the NRA as "retrofitting beneficiaries" in the housing reconstruction program were in a limbo. Of the 53,000 beneficiaries enlisted by NRA at that period, only about 360 (<1%) had completed the repair and retrofitting of their houses. Furthermore, where 90% of the reconstruction beneficiaries were already enrolled in the program, only 20% of the retrofitting beneficiaries had done so. Dissatisfaction, confusion, discontent and misinformation were rampant among the homeowners, masons, engineers, local representatives and government officials alike. Despite the NRA having developed the retrofitting manual in 2017, implementation in the field was severely lacking. An intensive intervention was hence, of paramount importance to address the issues.

To address this issue, in its fourth year of implementation, Baliyo Ghar Program implemented several activities focused on the promotion of retrofitting. A comprehensive approach, with interventions at local, district as well as national levels in policy development, capacity building and awareness was utilized. Subsequently, the program provided capacity building trainings to engineers, supervisors and designers and trained local masons in retrofitting of masonry buildings. Additionally, demonstration models were constructed where more than stakeholders visited to observe retrofitting first-hand, and which has tremendously contributed to changing perceptions and enhance confidence on the technique and its benefits. These interventions fueled the

national initiative in retrofitting, and a total of more than 2000 houses have been successfully retrofitting through the concerted efforts, a small but significant progress achieved considering the widespread challenges and issues.

The retrofitting of partially damaged buildings during the Earthquake Housing Reconstruction Program is not only an immediate need for the earthquake recovery process, but also has significant correlation to the earthquake risk management initiatives in the future. The lessons from the interventions provide key insights into the challenges in promoting and scaling up the retrofitting efforts and prospective strategies and approaches that might be most effective. The national institutional capacity, knowledge and skills enhanced during this process, the research conducted on various techniques and field implementation point to the need of comprehensive programs alongside incentive-based promotion mechanism from local, provincial and central governments will develop a congenial environment for implementing retrofitting at a much larger scale.

2 BACKGROUND

In the aftermath of the 2015 Gorkha earthquake, the housing reconstruction program was implemented in an owner driven approach, with financial and technical assistance to ensure “Build Back Better”. The reconstruction program, in fact, comprised to two facades: Reconstruction & Retrofitting. The buildings which are damaged to an irreparable extent were classified under the reconstruction genre, the homeowners enlisted as “reconstruction beneficiaries” and were provided with NRs 300,000 grant support for rebuilding their damaged houses. On the other hand, houses with partial damages, and lying the lower categories of damage (DG 2,3) were enlisted as “retrofitting beneficiaries” and were provided with NRs. 100,000 cash grants alongside technical support for undertaking repair and retrofitting of their houses.

Retrofitting is the judicious modification of the strength, stiffness and ductility of structural members or of the structural system to improve the structure's performance in future earthquakes. Retrofitting generally includes increasing the strength or ductility of individual members or introducing new structural elements to significantly increase the lateral force resistance of the structure. There are several approaches and techniques for the retrofitting of existing buildings currently in application all over the world.

The seismic retrofitting of buildings as an earthquake risk mitigation measure is not an entirely new concept in Nepal. More than two decades ago, in late 1990s, the technique was first implemented through the strengthening of a school building in Nangkhel, Bhaktapur as part of the Kathmandu Valley Earthquake Risk Management Project. The retrofitting was implemented as a demonstration of the feasibility of the technique in masonry buildings in Nepal and to understand it's impacts in our communities and institutions. Coincidentally, NSET was at the forefront of its implementation and other stakeholder engagement activities during that period. Since that initiative, over the period of more than one and a half decades until 2015, the retrofitting of schools was largely taken up by the Government of Nepal as its School

Earthquake Safety Program, supported by a number of different donors and partner organizations. Until 2015, nearly 300 schools and hundreds of other private and public buildings had been retrofitted, and were undamaged during the earthquake; a testament to the effectiveness of the technique. The experience gained in implementing these initiatives were crucial in shaping the retrofitting of partially damaged buildings in the aftermath of the 2015 Gorkha earthquake, in policy development, capacity building as well as awareness.

3 INTRODUCTION

With an aim of supporting the Government of Nepal’s owner driven approach for the reconstruction of private houses damaged during the 2015 Gorkha Earthquake, NSET has been implementing the “Baliyo Ghar Program” and is providing comprehensive technical support to the owner driven model of housing reconstruction by promoting disaster resilient construction standards and design and empowering and supporting earthquake-affected communities to “Build Back Better”.

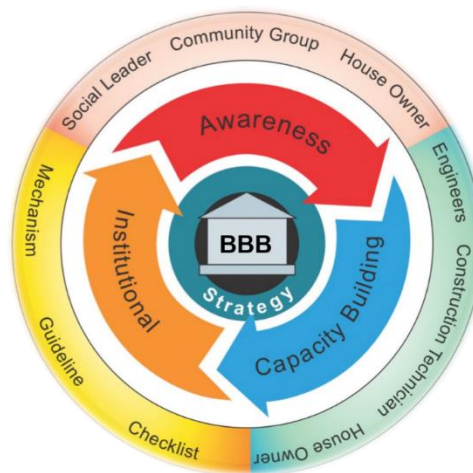


Figure 1. Baliyo Ghar Program strategy, key areas of interventions and relevant stakeholders

The program primarily imparted knowledge, skills and awareness regarding disaster resilient construction techniques to earthquake-affected communities in four of the most affected districts in Nepal. Further, the program assisted the government in developing policies, guidelines, norms and training curricula to standardize the entire process of reconstruction under the leadership of the Government of Nepal (GoN) National Reconstruction Authority (NRA) and its project implementation units. The program covered a wide range of stakeholders targeted through its comprehensive technical assistance for awareness, capacity building and institutional improvements.

After the successful implementation of various activities to support house owners in reconstruction of houses, Baliyo Ghar Program initiated support to homeowners with partially damaged buildings in the later half of 2018. Following the program’s principle, the interventions and technical assistance also covered a comprehensive approach, supporting in policy development,

institutional mechanisms, capacity building and awareness. Several trainings and awareness campaigns for various stakeholders were implemented using mass media, printed media and digital channels. Similarly, government institutions were supported through national and regional discourses in workshops and active inputs in various working groups.

4 SOCIO TECHNICAL ASSISTANCE IN RETROFITTING

Baliyo Ghar Program implemented socio-technical assistance to support the repair and retrofitting of partially damaged buildings. The assistance was primarily focused on the program’s housing reconstruction areas, in four districts; Dhading, Dolakha and Nuwakot and Kathmandu. As the highest proportion of partially damaged buildings in these areas were masonry buildings, the assistance, especially trainings for masons were done in masonry buildings built using stone or bricks in mud or cement mortar.

The following section discusses the key activities and interventions implemented by Baliyo Ghar Program to promote retrofitting and their key outputs.

4.1 Study on Key Issues

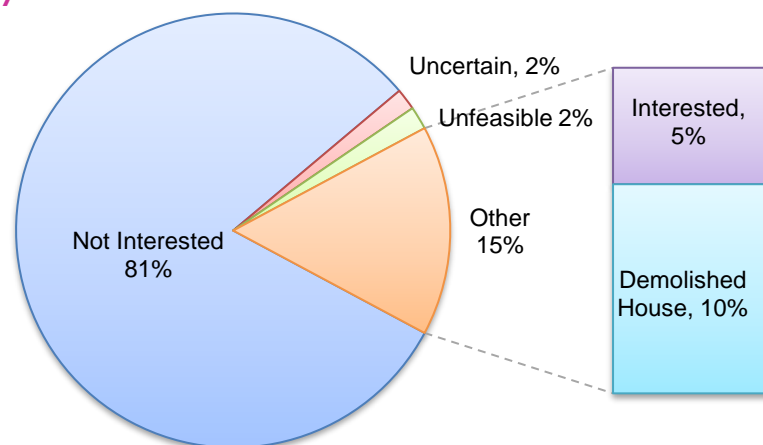


Figure 2. Perception of beneficiaries towards retrofitting

Before the implementation of the program activities, a thorough study was conducted among more than 1300 houseowners enlisted as “retrofitting beneficiaries” in the program coverage wards. The study not only provided the program with key insights into the challenges and issues and their degree, but also helped the program in advocacy with the relevant government institutions in planning adequate assistance measures.

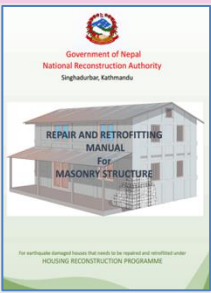
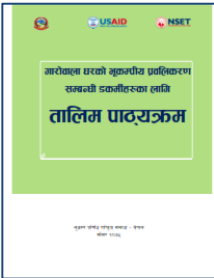
Of the total 866 beneficiaries surveyed, 81% stated that they were not interested in retrofitting at all and would like to be transferred into reconstruction beneficiaries or had already applied to do so. About 10% of the beneficiaries had already demolished their house while another 2% houses were found technically unfeasible and pointed to the issues with damage assessment. More

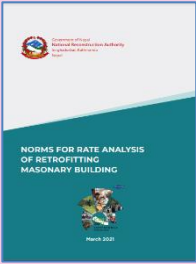
concerningly, only 5% of the homeowners were interested in retrofitting, but were still skeptical of the costs associated and other processes.

A deeper analysis of the issues pointed out to a number of issues, most prominently due to lack of adequate awareness on retrofitting measures. Until then, with more than 92% of all beneficiaries listed for reconstruction, the focus of technical assistance and inspection was largely towards the reconstruction beneficiaries. Furthermore, a delay or absence of adequate information to the local stakeholders, especially local government representatives had aggravated the situation.

4.2 Support in preparation of manuals, curricula and guidelines

To ascertain the uniform dissemination of knowledge and skills on retrofitting techniques, process and administrative provisions, the NRA led the process of formulating the technical guidelines, curricula and manuals. As such, in July 2017, with the aid of different partner organizations, the "Repair and Retrofit Manual" was published which included detail information on the philosophy and concept of repair and retrofit and detailed technical information on design and construction sequences of retrofitting masonry buildings using Splint and Bandage technique using reinforced concrete, welded wire mesh or wooden elements as reinforcements. The technique was selected based on its structural performance, suitability and cost effectiveness for rural masonry buildings. The manual is the key document to aid the engineers deployed in the earthquake affected communities to provide designs and supervise the retrofitting of the buildings. Similarly, NSET also worked in standardizing the training for masons and engineers on retrofitting, by developing modular curricula for on-site training for masons and engineers. As such, the following key policy documents have been developed with support from Baliyo Ghar Program.

SN	Document Title	Description
1	 <p>Repair and Retrofitting Manual for RC Frame and Masonry Buildings (June 2017) Stage: Approved and Published by NRA Contribution: Significant as part of technical team</p>	<ul style="list-style-type: none"> This manual supports the engineers responsible for the compliance inspection process. The engineers use this manual to provide advice and guidance to households for the implementation of required repair and retrofitting strategies. The design of retrofitting of masonry buildings implemented by Baliyo Ghar Program were primarily based on these guidelines.
2	 <p>Curriculum for the 25 Day Training of Masons on Retrofitting of Masonry Buildings (November 2018) Stage: Endorsed (Provisional approval for implementation) Contribution Developed by Baliyo Ghar Program and submitted to NRA for endorsement</p>	<ul style="list-style-type: none"> With lessons from implementing 50 day On the Job Training for new masons including curricula development, Baliyo Ghar Program also developed a standard curriculum for 25 Day Training on Retrofitting of Masonry Buildings. The curriculum was not only developed to support the implementation of trainings in Baliyo Ghar Program but also to standardize the capacity building and information dissemination process across the earthquake affected areas and beyond. The curriculum was largely implemented by the program after provisional approval from NRA.

SN	Document Title	Description
3	 <p>Norms for Rate Analysis of Retrofitting Masonry Buildings Stage: Published by NRA as part of ICNR2021 Contribution: Significant contribution as part of the technical working group</p>	<ul style="list-style-type: none"> One of the key issues hindering the standardization of retrofitting of masonry buildings in Nepal was the absence of a formal government procedure for estimation of costs. This hindrance was largely felt by the Baliyo Ghar Program as well as other partner organizations supporting the NRA on retrofitting promotion during the housing reconstruction program. Hence, Baliyo Ghar Program contributed to the development and publishing of the norms for rate analysis of retrofitting in masonry buildings.

4.3 Training local masons on retrofitting of partially damaged masonry buildings

Even when the reconstruction of completely damaged buildings was booming, retrofitting was severely lagging behind in the housing reconstruction program. One of the major reasons for this delay was attributed to the fact that these communities did not have the required level of awareness and skills of communities to undertake retrofitting of houses. Although the short training for masons was in practice for more than a decade, a formal training program for retrofitting of masonry buildings was not practiced. Understanding the need for local skilled human resource to expedite the retrofitting process, Baliyo Ghar Program conceptualized, developed and implemented the “Training for Masons on Retrofitting of Masonry Buildings” in its program areas. The learnings gathered by the program during the implementation of the 7 Day Mason Training and the 50 Day On the Job Training provided crucial lessons during this implementation.

The major objectives of the retrofit training are as follows:

- To enhance the capacity of skilled masons working in the field of housing construction to undertake the retrofitting of partially damaged stone and brick masonry buildings.
- To enhance understanding of local communities and stakeholders in increasing the seismic capacity of existing damaged and undamaged building, thus driving towards disaster resilient communities.
- To evaluate the effectiveness of the curriculum developed and make it a standard curriculum for training on retrofitting of masonry buildings.

To enhance the transfer of knowledge and skills in the trainee masons, these trainings were conducted on a full-scale demonstration model houses, selected from among the partially damaged masonry houses within the same community that were enlisted as “retrofitting beneficiaries”. This approach in training masons not only helped the trainee masons in learning all the required skills and knowledge in retrofitting a full building, but also helped develop demonstration models across the training implemented communities for awareness as discussed in later sections.

The outputs achieved in terms of number of events and the number of masons trained through the training program in different program wards is shown in the figure below.

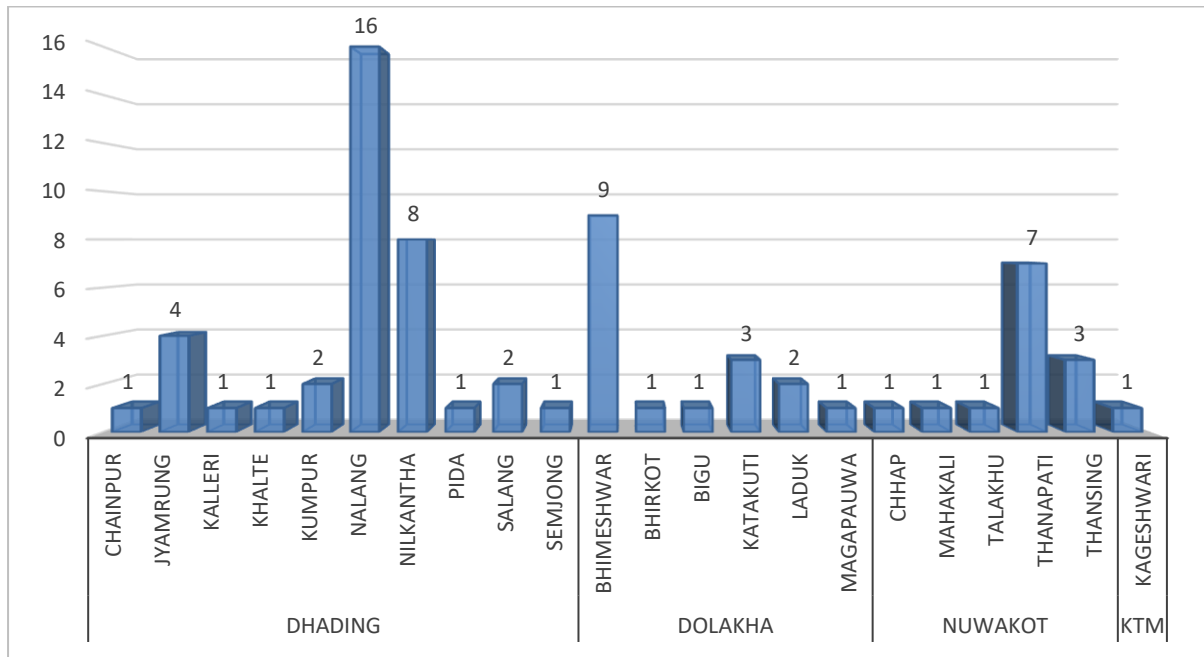


Figure 3. Number of retrofit training events and trained masons in different program wards

4.4 Community awareness campaigns through construction of demonstration models

To compliment the awareness campaigns and capacity building process, Baliyo Ghar Program also constructed demonstration models in the program implemented communities. Houses that were partially damaged by the 2015 Gorkha earthquake and enlisted by the National Reconstruction Authority as “retrofit beneficiaries” were prioritized in selection as demonstration model houses, in recommendation from the local governments. These model houses not only served as hands-on sites for the training of local masons, but also worked to demonstrate the procedure of retrofitting in the communities. House owners, masons, engineers, local and national stakeholders alike visited these demonstration model houses to observe the procedure of retrofitting and analyze the cost-benefits of the techniques. Baliyo Ghar Program focused on retrofitting a wide range of houses based on size, socio-economic condition of households and geographical locations to portray the suitability of the technique in different aspects.

In total, more than 1000 stakeholders; house owners, masons, engineers, local government representatives and officials from National Reconstruction Authority and other government institutions visited these demonstration model sites. The demonstration of the technique, and its subsequent impacts on the community further enhanced national confidence and consensus on the viability of the process, and helped ignite the national campaign in retrofitting the partially damaged buildings.



Figure 4. Local community people including house owners, local government representatives and others visiting a demonstration construction site on retrofitting to learn about the technique. Such demonstration visits were facilitated by Baliyo Ghar Program through awareness campaigns or trainings.

4.5 Training engineers on design, construction and supervision of retrofitting

Although local masons were equipped with the hands-on implementation of retrofitting through the trainings, they required further technical support in design and supervision of the process to ensure that standards of quality construction were met. Although the guidelines on retrofitting published by the Government of Nepal were a major step in enhancing knowledge, the relative complexity of the technique with regards to various other technical factors in a building demanded that designers and supervising engineers were adequately trained on the process. Similarly, training engineers was also paramount to ensure that retrofitting beneficiaries were provided with ample technical assistance to implement the process.

Hence, as part of the comprehensive approach, Baliyo Ghar Program trained a total of engineers, architects and designers on the process of retrofitting design, construction, supervision and inspection through various training programs. The training programs were catered to the needs and level of expertise of the training participants and focused largely on hands-on skills through practical exercises and demonstrations. The following table highlights the major outputs of these trainings.

#	Description of Training	# Trained
I	Training on Basics of Repair and Retrofitting of Buildings: This training provided basic knowledge and skills in prevalent repair and retrofitting techniques in Masonry and RC Frame buildings. Theoretical knowledge were complimented with demonstration; participants observed the retrofitting of masonry buildings under construction at the demonstration model sites to enhance practical learning. The training also included use of NRA manuals and guidelines to provide technical assistance to house owners and masons on retrofitting.	239 Engineers trained from 9 events

#	Description of Training	# Trained
2	Training on Inspection of Retrofitting of Masonry Buildings: Specifically targeted to the Inspection Engineers from National Reconstruction Authority, this training provided basic knowledge on repair and retrofitting as well as the use of the NRA manuals and guidelines to provide technical assistance and undertake inspection of the retrofitted houses for grant disbursement process.	186 Engineers trained from 7 Events
3	Training on Design of Retrofitting of Masonry Buildings: An advanced training course was implemented for designers and structural engineers to undertake the structural analysis and design of retrofitting of masonry buildings.	119 Designers trained from 4 Events.



Figure 5. Engineers participating in training on design of retrofitting (left) and a field demonstration on construction process of retrofitting for participating engineers (right)

4.6 Generating mass awareness through digital and printed media channels

In addition to various trainings and awareness programs, Baliyo Ghar Program comprehensively used the mass media platform; Local and National Radio and TV programs to cover, develop and broadcast awareness materials on retrofitting targeted to a wide coverage of audience.

The use of mass media was especially advantageous to create an atmosphere of curiosity among the beneficiaries regarding the process and disseminate important information regarding technical as well as administrative aspects of retrofitting and increase confidence among stakeholders through documentation of case stories depicting success of retrofit implementation. In the end, the TV program alone was able to motivate a number of beneficiaries to initiate the process of retrofitting. In the later stages of implementation by Baliyo Ghar, the TV programs largely focused on the successes of approaches and actions done by the program in promoting retrofitting across the earthquake affected areas. Similarly, testimonials from the beneficiaries, local government representatives, engineers and local and national stakeholders were broadcasted, in an attempt to increase confidence among other stakeholders. The coverage of the issues, challenges, approaches, strategies, actions and lessons will also be valuable for developing earthquake risk mitigation programs and actions in the future.

The following table highlight the program’s interventions in awareness raising in retrofitting through mass media channels.

SN	Description	Achievement
1	Number of Radio Programs developed and broadcasted through four local radio partners on retrofitting	66 programs developed and broadcasted 132 times
2	Number of TV episodes developed and broadcasted through Baliyo Ghar TV Program focused on retrofitting	8 episodes developed and broadcasted 16 times

4.7 Developing national consensus through workshops

Creating awareness among stakeholders is crucial for appropriate planning and prompt implementation. Keeping this in mind, NSET conducted numerous talk programs, seminars, workshops and conferences at local, district and central levels in collaboration with the government of Nepal. Such activities provided very good platform for sharing experiences among the professionals; local, provincial and central government officials, engineers, media personnel, academicians, partner organizations, donors etc. Sharing of challenges, successes, failures and learnings provided ample opportunity to develop appropriate solutions and strategies. Further, discourse on retrofitting also helped in developing national/ international linkages with similar agencies, improve coordination mechanism among the stakeholders and keeping updated with the recent global achievements in the field, enabling stakeholders to learn from local and global knowledge for effective strategy planning and implementation.

4.8 Market Facilitation

One of the key challenges during the implementation of retrofitting was the absence of retrofit materials, especially welded wire meshes in local markets in rural areas. As most retrofitting materials are not widely used for new construction, they are not locally available, even in district headquarters. Thus, market facilitation was seen as a crucial step towards supporting house owners in access to retrofit materials at a reasonable rate. Similarly, the facilitation also helped local vendors understand the scope of retrofitting in their communities and provided congenial atmosphere to increase stock of materials, thus helping in reducing the associated costs. This was altogether very essential as cost effectiveness was one of the primary concerns of the house owners.

5 LESSONS

Although small in scale, Baliyo Ghar Program’s technical assistance in retrofitting was crucial in enhancing national consensus on retrofitting and establishing it as an effective earthquake risk mitigation technique in rural buildings. The comprehensive approach in implementation of the assistance activities not only helped gain immediate impacts during reconstruction but also provided key lessons on the overall retrofitting process during the Gorkha earthquake housing reconstruction program.

5.1 Lesson 1: Selection of Appropriate Techniques and Materials in Retrofitting

There have been several research and studies on the retrofitting of masonry buildings using various techniques and materials. However, it was learnt that selection of appropriate techniques and materials, owing to a number of factors including the building typology, cost of materials and its transportation and the economic status of the beneficiary is very important. As such, the splint and bandage technique using welded GI wire mesh was found to be most cost effective during comparative estimation. However, as this technique requires that the mesh be covered with plaster, communities without access to roads and where sand is not locally available, such as higher hilly and Himalayan regions in Nepal, are not attracted towards the technique. Similarly, the locally available material, wood is not of good quality so as to be used as splints and bandages in the outer face of the walls. As such, people are deterring away from retrofitting. Furthermore, in some communities, the designs prescribed in the manuals does not conform, as the dimensions and typologies of the houses are different, and unique.

5.2 Lesson 2: Comprehensive promotion campaign is necessary

One of the major challenges in retrofitting is the negative response of house owners, local representatives and even technical personnel on the concept of retrofitting, especially on the increase of strength and the cost-benefit of retrofitting a damaged masonry building. Hence, Baliyo Ghar Program identified and prioritized several areas with high number of retrofitting beneficiaries for carrying out the assistance. As such, integrated and comprehensive social awareness campaigns were conducted in these areas, with orientation programs, video demonstration, door to door campaigns, and coordination and orientation meetings with elected representatives, participation of elected representatives in district and national workshops and conferences etc. so as to create an atmosphere of positivity towards retrofitting. As a result, in some earthquake affected communities, even house owners who are enlisted for rebuilding and full grant support have opted to retrofit their damaged houses.

5.3 Lesson 3: Retrofitting of partially damaged and undamaged masonry buildings is feasible, both technically as well as economically

As learnt during the construction of demonstration models, the cost of retrofitting is a key aspect in the decision-making process of both the house owners and designers. In terms of materials, after required analysis of strength and comparison of cost, it was found that for similar strength, cost of retrofitting using Welded GI mesh splint and bandage is 25% lesser than using RC splint and bandage. Similarly, per unit built up area cost of retrofitting of a masonry building varied from \$4 to \$8. Retrofitting per unit cost varied with the number of floors, with smaller houses costing much more in unit built up area than larger

houses. Therefore, a much more accurate index of calculating the cost of retrofitting would be through wall area calculations, which lies around \$2, irrespective of the number of floors of the building.

6 RECOMMENDATIONS

As discussed earlier, one of the key objectives of Baliyo Ghar Program's interventions in retrofitting of partially damaged buildings was also to test the approaches and strategies that would be most effective in promotion and scale up of retrofitting. From the lessons and experiences gained above, the following recommendations can be made to ensure sustainability and wide-spread promotion of the techniques in future earthquake recovery and risk mitigation programs.

Importance must be given to comprehensive awareness campaign on retrofitting including meeting and workshops with elected representatives and showcase of retrofitting success stories through audio visuals and media. Similarly, demonstration houses must be built across all earthquake affected areas to increase confidence of communities in the technique.

Establishment of Market Hubs to facilitate the transportation of materials: Although prescribed in the NRA Repair and Retrofitting Manual, the materials for retrofitting are not easily available. For example, Welded GI wire mesh, in the specification and standard mentioned in the manual and as prescribed during design are not readily and easily available in earthquake affected areas. Market facilitation for transport of these materials, at a competitive price must be done so as to decrease the cost of retrofitting.

Study on other suitable retrofitting options: In higher settlements untouched by roads, cost of transportation of retrofitting materials like cement, sand and wire mesh is not a feasible option. Similarly, the locally available material, wood is not of good quality so as to be used as splints and bandages in the outer face of the walls. As such, people are deterring away from retrofitting. Similarly, in some communities, the designs prescribed in the manuals does not conform, as the dimensions and typologies of the houses are different, and unique. Hence, several other designs on retrofitting must be studied and prescribed so as to cater to the needs of different communities.

Scrutiny of damage assessment: Damage assessment plays a significant role in determining whether or not a house is suitable for repair, retrofitting or reconstruction. As such, errors during damage assessment can create huge confusion among earthquake affected communities, as seen in the current scenario. Scrutiny of the damage assessment is necessary, and surveyors must be well trained and oriented regarding the proper recommendation after an assessment.

Baliyo Ghar Project Team:

Ramesh Guragain
Ranjan Dhungel
Ayush Baskota
Pramod Khatiwada
Bishnu Hadkhale
Pranav Dahal
Achyut Poudel
Manish Raj Gouli
Hari Ram Pathak
Prakash Shrestha
Prabhat Khanal
Bigyan Thapa
Subash Dhakal
Vishma Basnet
Manoj Sharma Chapagain
Santosh khadka
Santosh Nepal
Govind Raj Bhatta
Sagar Chandra Adhikari
Lila Bahadur Bhujel
Sangib Shrestha
Manoj Adhikari
Geeta Bhandari
Shyam Baniya
Parbati Motra
Achyut Paudel
Arjun Ghimire
Gopal Gautam
Ram Shrestha
Bhimsen Nepal
Sujan Bhusal
Manoj Sharma Wagle
Mabin Panday
Suman Kumar Dahal
Suman Khanal
Samir B.K.
Bikesh Kasula
Naresh Sayaju
Resuna Koju
Sunil Lamichhane
Sujal Niroula
Anupam Kumar
Balkrishna Shiwakoti
Milan Shrestha
Aabiskar Timilsina
Santosh Shrestha
Puspa Kumar Bista
Kiran Shrestha
Bijesh Kaiti
Prabin Shrestha
Aashis K C
Kamal Hari Dulal
Laxman Khatri
Ganesh Prasad Acharya
Arjun Adhikari
Bikram Prasad Poudel
Kamalendra Mallik

Raj Lamichhane
Ganesh Prasad Pandey
Krijan Maharjan
Nawin Deo
Anand Prashad Pant
Dhruba Devkota
Aasish Tiwari
Tara Lama
Anuj Shrestha
Jenish Sharma
Binod Dahal
Ek Raj Gautam
Ranjan Basnet
Anil Bhattarai
Bipin Sapkota
Anisha Khatri
Saroj Kandel
Saroj Adhikari
Prajwal Sanjel
Aarjan Adhikari
Aashish Khadka
Santosh Kumar Shrestha
Nishkarsha Koirala
Ujjwal Niraula
Manoj Shrestha
Nischal Parajuli
Santosh Regmi
Kshitij Rai
Dundu Ram B.K
Bikesh Kila Shrestha
Manas Thapa
Shekhar Mahat
Sujeet Gurung
Dwaipayana Sharma
Suyog Bhandari
Dipesh Ray
Rajati Dahal
Dipesh Tiwari
Nilesh Rawal
Sabin Chand
Hemraj Bogati
Neeraj Upadhyaya
Sakar Maskey
Narayan Prasad Kharel
Manoj Bista
Aavash Ghimire
Keyur Pradhan
Bimarsha Kaphle
Jayesh Singh Gurung
Ramesh Dhimal
Dinesh Pradhan
Shreeram Lawaju
Summit Pokhrel
Sushil Kumar Shrestha
Kishan Adhikari
Sanjit Wagle
Jhalak Man Basnet

Sudip Karna
Kirti Chandra Joshi
Sasit Shah
Pratiksha Thani
Prakriti Paudel
Binaya Nepal
Santa Bahadur Jirel
Manisha Maharjan
Bipin Simkhada
Ram Prasad Acharya
Ved Prakash Chaudhary
Nirman Devkota
Hari Prasad Aryal
Shrawan Dhakal
Krishna Prasad Dhakal
Biwash Kafle
Ashok Dhungana
Sudip Raj Adhikari
Prakash Kumar Shrestha
Bipin Kumar Chand
Ganesh Bhattarai
Arunachal Pokharel
Ramesh Poudel
Janaki Somare
Nirmala Nepali
Surina Kayastha
Dirge Tamang
Ramesh Shah
Jagadish Shiwakoti
Laxmi Baniya
Sharada Kumari Joshi
Rojeena Timilsina
Sabitri Khatiwada
Dipak Kumar K.C
Bhabana Dhakal Bhantana
Ram Bahadur Nepali
Hemraj Itani
Dhan Bahadur Basnet
Subhash Tamang
Binata Bhurtel Paudel
Ganesh Gautam
Binita Silwal
Kaushila Shrestha
Janaki Sapkota
Dipendra Karki
Chiranjibi Bhusal
Susma Adhikari
Samjhana Lama
Arbin Adhikari
Shova Koirala
Indira Kumari Thapa
Tika Kumari Budhathoki
Bijay Kumar Baruwal
Nabina Dulal
Nita Bhandari
Sanu Maiya Shrestha
Sabita Wosti

Srijana Tiwari
Bimala Adhikari
Rajendra Bhattarai
Reshma Rai
Ranju Dhungana
Sujan Rai
Dewan Sing Maden
Dorje Lama Tamang
Krishna Bahadur Moktan
Rabindra Dhakal
Min Kumar Thapa
Kamala Aryal
Narendra Bahadur Shahi
Dipak Raj Ojha
Bhim Bahadur Nepali
Shambhu Ram
Niraj Bahadur Ayadi
Ishwor Dutt Joshi
Sushil Pandit

Utsav Rai
Simon Thapa (Tamang)
Sushila Bhandari
Bijay Tamang
Sushil Kumar Gurung
Mek Bahadur Tamang
Dhruba Neupane
Susmita Puri
Rikesh Maharjan
Bhuvan Khanal
Puskar Basnet
Nabin Raj Ruwali
Parbati Thapaliya
Yam Kumari Uchai
Pratima Parajuli
Sajaya Shrestha
Duni Ram Saru
Nimesh Bogati
Summit Maharjan

Mahendra Acharya
Sanita Sainju
Ronak Bikram Thapa
Puspa Khadka
Yeknath Acharya
Sachin Chaudhary
Sishir Khatri
Bighnesh Regmi
Milan Hadkhale
Anita Rajlawot Khatri
Arati Shrestha
Hridaya Man B K
Rammaya Silwal (Upadhyay)
Aang Dorje Lama
Yogesh Khatri
Chitra Bahadur Lama
Bikash Paudel
Subarna Thapa Kshetri

Experts

Amod Mani Dixit
Surya Narayan Shrestha
Shree Ram Singh Basnet
Bijay Krishna Upadhyay
Surya Bhakta Sangachhen
Bhubaneswari Parajuli

Nisha Shrestha
Rabindra Kumar Suwal
Kashyap Kumar Sharma
Hikmat Adhikari
Pradip Sedhain
Anjali Silakar

Khadga Sen Oli
Chandan Dhoj Rana Magar
Ram Krishna Sharma
Mahananda Timalisina

Niva Upreti
Adutiya Narayan Kanth
Dhirendra Kumar Dawadi
Mamata Banskota

Sumit Shrestha
Nischal Sedhain
Ashwash Akash Parajuli
Kundan Kumar Sah
Nirmala Rai

Dammar Singh Pujara
Kuber Bogati
Aditi Dhakal
Jyoti Mani Bhattarai
Sumit Maskey
Om kala Khanal
Ichcha Ram Parajuli

Hima Shrestha
Rajani Prajapati
Kirty Tiwari Jaisi
Rachana Kansakar
Rabin Chaulagain
Prayash Malla
Vibek Manandhar



NSET

Earthquake Safe Communities in Nepal

National Society for Earthquake Technology-Nepal (NSET)

About NSET

National Society for Earthquake Technology-Nepal (NSET) was founded on June 18, 1993, with the vision "Earthquake Safe Communities in Nepal by 2020". NSET was conceptualized with main objective "to foster the advancement of science and practice of earthquake engineering and technology for mitigating the earthquake risk and increasing the seismic safety, and to enhance professionalism, professional engineering and scientific ethics. Bringing "substantial change in the application of technology to the many facets of earthquake disaster management for saving the lives of the people" has remained the guiding philosophy of NSET ever since its inception.

Today, NSET is considered as one of the major contributors in the field of earthquake risk management. Its seismic risk reduction approaches are now being replicated beyond the borders of Nepal. Consolidating the experience, knowledge, learning in disaster vulnerability reduction and preparedness to policy drafting and strategy development, and working with variety of stakeholders for more than two and half decades, NSET has now realized the need and decided, as stipulated by global thoughts, to expand its scope and works to managing multi-hazard situations, climate change adaptation and risk management, and integration of this synthesis of DRM and CRM into economic development efforts.

Vision

"Disaster Resilient Communities in Nepal by 2050"

Mission: "To contribute in enhancement of disaster resilience of the communities through development and implementation of appropriate technologies, inclusive and collaborative approaches in order to minimize and manage disaster risks."

Strategic Objectives

- SO1: Develop and implement integrated and inclusive interventions related to Multi- Hazard Disaster and Climate Risk Management through development and enhancement of understanding, capabilities and resources of communities in Nepal and region
- SO2: Assist in Institutionalization and Integration of validated understanding, approaches and technologies related to Disaster and Climate Risk Management into the laws, regulations, policies, initiatives and mechanisms in order to strengthen Disaster Risk Governance in Nepal.
- SO3: Devise and integrate innovative, cost- effective and appropriate methods and measures in order to increase involvement and investment of public and private sector in Disaster and Climate Risk Management
- SO4: Develop and promote effective and inclusive collaboration in order to enhance and scale-up innovation and R&D in the area of Disaster Risk Management.
- SO5: Be a dynamic, sustainable and learning organization through enhancement of capabilities, networks and collaborations.



NSET
Disaster Resilient Communities in Nepal

National Society for Earthquake Technology-Nepal (NSET)

House 65, CR-13, Sainbu Awas, Bhainsepati

Lalitpur Metropolitan City-25, Nepal

P.O.Box No.: 13775, Kathmandu, Nepal

Tel: (977-1) 5591000, Fax: (977-1) 5592692, 5592693, E-mail: nset@nset.org.np

Get Involved ! Visit the NSET website: www.nset.org.np; Follow us at



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