Government of Nepal
National Reconstruction Authority
Singhadurbar, Kathmandu
Nepal

NORMS FOR RATE ANALYSIS OF RETROFITTING MASONARY BUILDING

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PREAMBLE

The National Reconstruction Authority (NRA), as a 'Special Purpose Vehicle' (SPV), has been mandated with the coordination and implementation of Nepal's recovery and reconstruction after the devastating Gorkha Earthquake of 2015. Together with a number of partners – Government line agencies, earthquake affected households, donors, Nepal Rastra Bank, commercial banks, and international and local NGOs – NRA has achieved huge successes, whilst overcoming numerous challenges faced along the way, during its five years tenure to date. More recently, the Government of Nepal (GoN) extended NRA's time period for an additional one year.

NRA intends to capture and document its experiences, learning, and best practices. NRA has and continues to compile and expand a comprehensive Institutional Memory, and, in recent months, as part of the process of ensuring a sustained legacy of its contribution to Nepal's post-disaster history, published its own 'NRA Experience Paper on Retrofitting of Private Housing'. These initiatives maintain and sustain the dialogue around post-disaster retrofitting, engage all interested parties including both practitioners and academics, show a clear drive towards continued learning and sharing of knowledge, and promote the accumulation and compilation of these into documentary form that can play a valuable role – not just for Nepal but for other countries that like ours, suffer from naturally-triggered disasters.

The retrofitting norms for rate analysis was inspired by reflection and discussion with numerous stakeholders – both in and outside of government – and has been supported equally in its elaboration by these actors. It was also essentially driven due to NRA's own experience of facing the post-earthquake retrofitting without having such an all-encompassing set of information, guidance, and practices on which it had to base its own intervention; thus, it was felt imperative to provide this for future generations.

We believe that readers of this paper will not just take away ideas, but in addition, expand on them and apply the learning that they acquire from this. We also trust that through further dissemination – in professional networks around the globe, we can all benefit from our experiences and learning in Nepal, and be better prepared for facing all future disasters, together. My thanks to you all.

Sushil Gyewali
Chief Executive Officer
National Reconstruction Authority

ACKNOWLEDGEMENTS

I would like to express most profound gratitude to NSET, Build Change, UNDP, and HRRP – Nepal for their initiation and continuous involvement during the preparation of this norms for rate analysis of retrofitting masonry building.

NRA CEO Mr. Sushil Gyawali deserves a special thanks for encouraging such kind of retrofitting norms for rate analysis with tireless energy and commitment. Without his leadership to NRA over the past five years, this kind of solidarity and smooth operation of the activities and knowledge sharing would not have been possible.

A special note of cordial thanks to Mr. Jhapper Singh Vishwokarma, Mr. Bipin K Gautam, Ms. Liva Shrestha, Ms. Pragya Pradhan, Dr. Ramesh Guragain, Mr. Ranjan Dhungel, Ms. Bhubaneswari Parajuli for their support and suggestions during the discussions on critical issues which were required to finalize retrofitting norms for rate analysis.

My sincere thanks to Mr Deepak Saud, Mr Laxmi Prasad Bhatta, Mr Dev Raj Paudel, Mr Binaya Paudel, Mr Jnananjan Panda, Ms Nitisha Kafle, Mr Ayush Baskota and Mr Manish Raj Gouli for their continuous work on preparation of retrofitting norms for rate analysis and to Mr Manohar Ghimire, NRA's Under Secretary & ICNR Secretariat's Member Secretary and Mr Sandeep Gurung, the Assistant Conference Expert for facilitating and expediting the process.

I would hereby, make most of the opportunity by expressing sincere thanks to all personnel involved, both directly and indirectly, for their valuable contribution to the preparation of this paper. I am confident that this manual will be a valuable resource for all the practitioners of Nepal's retrofitting activities.

Mani Ram Gelal
Secretary
National Reconstruction Authority

FOREWORD

I would sincerely like to congratulate everyone involved in the development of the 'Norms for Rate Analysis of Retrofitting Masonry Building' which has been published by the National Reconstruction Authority. This norms for rate analysis document will further support the implementation of the interventions of vulnerable houses that need seismic retrofitting.

Every effort from technical personnel, expertise, and the government sector is required to support households to retrofit unsafe structures so that partially damage houses constructed by different typology could be safe and budget friendly. This retrofitting norms for rate analysis has been developed for technical staff to support them in the retrofitting cost analysis of masonry structures which would support general public to guide households through the retrofit process.

I look forward to seeing the retrofitting implemented across the earthquake affected districts and all vulnerable houses in the country and to seeing the impact that it will have. This represents another positive step forward in the construction process, and will support households to retrofit their home so that it is safe, compliant, and resilient in the face of future disasters. Additionally, I trust that this retrofitting norms for rate analysis contributes to the build-up and sharing of knowledge and continues to pave the way forward toward the safe housing, and to the consolidation of NRA's documented legacy for Nepal.

Dr Chandra Bahadur Shrestha
NRA Executive Member & ICNR Convener
National Reconstruction Authority

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INTRODUCTION

The 'Norms for Rate Analysis of Retrofitting Masonry Building' is prepared by the Retrofitting Technical Working Group (R-TWG) led and facilitated by Housing Recovery and Reconstruction Platform (HRRP) and comprising reconstruction stakeholders working in the area of retrofitting in March 2020. The document serves as a standard for the calculation of labor, materials and tools that are required for different items of retrofitting of load-bearing masonry structures. The implementation of retrofitting works during Gorkha Earthquake housing retrofitting scaled with the retrofitting works before 2015 Gorkha earthquake are the basis of standardizing processes which adopt the empirical method for the study. Further, the existing items for new construction as mentioned in Government norms are also considered while detailing on item works.

Background

The 2015 Gorkha Earthquake had widespread damages, especially in the private housing sector; more than half the total losses was incurred in private houses. Nearly 900,000 houses have been identified by the National Reconstruction Authority as beneficiaries of the national reconstruction program, 78,033 of whom are retrofitting beneficiaries. To fulfill the need for technical assistance to such beneficiaries, the National Reconstruction Authority (NRA) led the process and collaborated with several partner organizations for conduction of various awareness and capacity building activities.

One of the key aspects that need to be considered while undertaking a retrofitting activity is the cost of the interventions. A general understanding states that any retrofitting activity would only be feasible if the cost of retrofitting falls under 30% of the total construction cost of the building (except in cases of buildings of historic, cultural or religious values). Furthermore, as most of the damaged buildings are situated in the rural areas, the cost of retrofitting is much more significant, owing to the economic condition of the target beneficiaries. As such, a crucial step in implementing a retrofitting process is the cost estimation for retrofitting works.

A R-TWG was formed on December 20, 2019 in close coordination with the NRA, CLPIU Building to speed up retrofitting of buildings in earthquake affected areas through standardization of technical documents, solutions and approaches related to retrofitting. This group consisted of partner organizations, namely,

National Society for Earthquake Technology (NSET), Build Change, UNDP and HRRP who were actively working in retrofitting in the earthquake affected districts of Nepal with occasional engagement of NRA, CLPIU Building officials and other partners organisations such as Earthquake Safety Solutions (ESS), CRS. Retrofitting Norms for Rate Analysis is one of the main documents prepared by the R-TWG

Objective of the Study

This document is prepared to support the retrofitting cost analysis of masonry structures. This is intended to be used by engineers and mid-level technicians for cost calculation of retrofitting works. Moreover, this document could also support the NRA, CLPIU Building and the Department of Urban Development and Building Construction (DUDBC) to speed up retrofitting of buildings, both in post-earthquake recovery as well as earthquake risk mitigation beyond reconstruction across the country.

Rationale

The process of strengthening buildings using retrofitting is not new in Nepal. Retrofitting of buildings started in Nepal in the late 1990s, with school buildings. More than 25 years later, 300 or more schools have been retrofitted. Over the course of time, the technology slowly proliferated into the public as well as private sector, with several hundreds of institutional, government and private houses being retrofitted. However, many of these retrofitting interventions were largely carried out in RC frame or brick cement buildings in the urban cities in Kathmandu Valley. Retrofitting of rural buildings, typically of stone masonry buildings was not a major priority until the 2015 Gorkha Earthquake. This led to a serious gap in knowledge, as no standardized norms or analysis of rates were available for retrofitting interventions. Particularly rates for more specialized tasks in retrofitting such as plaster scraping, placement of GI wire mesh and GI wires, anchorage and repair works were not standardized, and thus used randomly, though rates for works like brick soling, reinforcements, concreting and plastering were generally adopted from new construction. This created an inconsistency in rate analysis and estimation of retrofitting interventions across the country, and created confusion among engineers eventually resulting delay in urban reconstruction in the absence of a national standardized norm.

Scope and Basis of Work

The document covers stone and brick masonry buildings (both with mud and cement mortar) typology for splint and bandage, containment reinforcement (CR) system / local failure jacketing and strong back method being implemented by partner organizations. Moreover, the results are based upon observation of individual line items in a certain time frame from partner organizations (Build Change, NSET, UNDP and ESS). The retrofitting components which are common as in the new construction such as excavation, pcc, brick work, etc have been adopted from standard governmental norms for new construction. Further, this document has followed the same format of the Government Standard Norms documents.

Figure 1: Splint and bandage

Figure 2: Strong-back method

Figure 3: Containment Reinforcement (CR) system

(Photo credit: NRA)

DEVELOPMENT PROCESS

With the dire need to speed up reconstruction in earthquake affected areas, a Retrofit - Technical Working Group (R-TWG) was formed to consolidate and develop various documents and resource materials to support the NRA CLPIUs and all partner organizations in retrofitting interventions. Among various objectives and tasks of the R-TWG was to standardize norms for retrofitting of masonry buildings using techniques as prescribed in the NRA Repair and Retrofit Manual and retrofitting techniques adopted and implemented by partner organizations.

METHODOLOGY

The series of activities that carried out during the consolidation process are in the following sequence:

- Collection and compilation of norms and rate analysis used by different organizations in estimation of retrofitting interventions.
- Study of government's existing norms and standards for new construction.
- Detail review of collected materials.
- Discussion and consensus building on the various line items pertaining to retrofitting of masonry buildings and standardized formats.
- Collection and compilation of actual human resources used for different specialized tasks in retrofitting from several sample retrofit sites.
- Averaging of rates (human resources, materials) based on actual field scenario in reference to previous retrofitting works done in Nepal before 2015 earthquake.
- Conducting several internal meetings with partner organizations to discuss and get feedback on the document.
- Sharing sessions with CLPIU-Building and other stakeholders for wider consultation.
- Shared with technical experts for their opinions and comments

Figure 4: Interaction meeting with CLPIU buildings

Figure 5: Discussion during working session

(Photo credit: HRRP/CRS)

WAY FORWARD

As norms are formulated after a series of trails, the document further needs to be sent to the engineers and mid-level technicians at local level for its degree of reliability. Further, there is a need of a formation of core working group of experts for its continuous review, wider coverage and dissemination. Also, the government department needs to take initiation in the approval process of norms.

Figure 6: Way Forward
(Photo credit: NRA)

Draft Retrofitting Norms for Rate Analysis

Norms Table of Content

Norms Table of Content

C	Work Group C : Shoring works				
	Items	**Page No.**	**Rate Analysis**		**Unit**
1	Providing Wooden Props for Shoring purpose	21	NRs.		cum
2	Providing Wooden while Shifting of Openings	22	NRs.		cum
D	**Work Group D : Masonry works**				
	Items	**Page No.**	**Rate Analysis**		**Unit**
1	Laying of stone mud mortar masonry wall	22	NRs.		cum
2	Laying of brick mud mortar masonry wall	23	NRs.		cum
3	Laying of masonry wall of stone in cement mortar 1:6	23	NRs.		cum
4	Laying of masonry wall of brick in cement mortar 1:6	24	NRs.		cum
5	Flat Brick soling	24	NRs.		sqm
6	Stone soling	25	NRs.		sqm
E	**Work Group E : Concrete & Rebar Works**				
	Items	**Page No.**	**Rate Analysis**		**Unit**
1	Providing, mixing and laying P.C.C. in 1:2:4 ratio	25	NRs.		cum
2	Providing, mixing and laying R.C.C. in 1:2:4 ratio	26	NRs.		cum
3	Providing, mixing and laying R.C.C. in 1:1.5:3 ratio	26	NRs.		cum
4	Providing high strength deformed bars (HYSD) of grade Fe:415	27	NRs.		metric ton
F	**Work Group F : Formwork**				
	Items	**Page No.**	**Rate Analysis**		**Unit**
1	Providing, fitting and fixing standard formwork	27	NRs.		sq.m

G	Work Group G : Wiremesh Works				
	Items	**Page No.**	**Rate Analysis**		**Unit**
1	Cutting and laying SWG10 welded wire mesh and mesh size 50mmx50 mm	28	NRs.		sq. m
2	Cutting and laying SWG10 welded wire mesh and mesh size 25mmx25 mm	28	NRs.		sq.m
3	Cutting and laying SWG12 welded wire mesh and mesh size 50mmx50mm	29	NRs.		sq.m
4	Cutting and laying SWG14 welded wire mesh and mesh size 31 mmx31 mm	29	NRs.		KG
5	Cutting and laying SWG12 welded wire mesh and mesh size 25mmx25mm	30	NRs.		sq.m
6	Cutting and laying SWG15 welded wire mesh and mesh size 20mm x 20mm	30	NRs.		sq.m
H	**Work Group H :Plaster Works**				
	Items	**Page No.**	**Rate Analysis**		**Unit**
1	Cement plaster works over on walls, with cement sand mix (1:4) and 12.5 mm thick	31	NRs.		sq.m
2	Cement plaster works over GI wire mesh / chicken wire mesh on Stone Masonry walls, with cement sand mix (1:3) and 30 mm thick	31	NRs.		sq.m
3	Cement plaster works over GI wire mesh / chicken wire mesh on Stone Masonry walls, with cement sand mix (1:3) and 20 mm thick	32	NRs.		sq.m
4	Cement plaster works over GI wire mesh / chicken wire mesh on Stone masonry walls, with cement sand mix (1:3) and 35 mm thick	32	NRs.		sq.m
5	Cement plaster works over GI wire mesh / chicken wire mesh on Stone masonry walls, with cement sand mix (1:3) and 40 mm thick	33	NRs.		sq.m
I	**Work Group I : Containment/Jacketing**				
	Items	**Page No.**	**Rate Analysis**		**Unit**
1	Providing 12G GI Wire @ 100mm c/c	33	NRs.		sq.m
2	Fixing 4mm dia G.I wire in specified location attached with each corss link hook placed at specified interval	34	NRs.		Rm

J	Work Group J :Anchorage Works				
	Items	**Page No.**	**Rate Analysis**		**Unit**
1	Throughout anchoring of SWG 10 (3.15) mm wire at 600 mm c/c with staggered layout for connection of jacketing mesh on both sides of wall	34	NRs.		nos
2	Anchorage of 4.75 mm bar with staggered layout at 600 mm c/c for connecting splints and bandages on both sides of wall	35	NRs.		nos
3	Cast In-situ Concrete Shear Connector for all belts in 450 mm thick wall with 8mm TOR rod and infill of Concrete 1:2:4	35	NRs.		
K	**Work Group K :Through Concrete, Dowel Works and Timber Splicing**				
	Items	**Page No.**	**Rate Analysis**		**Unit**
1	Providing 150mm thick and 450mm deep Through concrete	36	NRs.		1 no.
2	Providing 150mm thick and 450mm long dowel	36	NRs.		1 no.
3	Providing the timber splicing	37	NRs.		cum
L	**Work Group L :Replacement of Heavy Gable with Light Material**				
	Items	**Page No.**	**Rate Analysis**		**Unit**
1	Providing wooden frames as light gable	37	NRs.		cum
2	Providing and fixing 24 Gauge CGI Sheet as light material.	38	NRs.		sq.m
M	**Work Group M :Roof and connection Improvement**				
	Items	**Page No.**	**Rate Analysis**		**Unit**
1	Connection of Rafter and Purlin	38	NRs.		per connection
2	Connection of sill plate with ring beam	39	NRs.		per connection
3	Connection of Ridge Beam and Timber Post	39	NRs.		per connection

A 1	**Providing and fixing the 500 gauge polythene sheet with adhesive tape and nail for protection of door/ window frame with its fixtures of (on which shutter has removed) by covering it, including removing it after completion of the work and cleaning thoroughly all complete as original condition or as per instruction by the Engineer.**						
	Rate Analysis for 1 sq.m						
	Resources	**Particulars**	**Unit**	**Quantity**	**Unit Price**	**Total**	**Resources Total**
	Manpower	Skilled	Md	0.05			
		Unskilled	Md	0.05			
	Material	Polythene Sheet (500 gauge)	sq.m	1.1			
		Nails	Ls				
	Damage recovery (30%)						
	Tools (3% labor)						
					Actual Cost		
					Overhead Cost (...%)		
	Rate per 1 sq.m				Total Cost		
Rs.							

A 2	**Removing of existing door or window shutters and its fixtures (not frame) , its safe storage before construction and reinstate it after retrofitting including cleaning and fixing, all complete as original condition or as per instruction by the Engineer.**						
	Rate Analysis for Nos						
	Elements	**Particulars**	**Unit**	**Quantity**	**Unit Price**	**Total**	**Elements Total**
	Manpower for removing & safe storage	Skilled	Md	0.25			
		Unskilled	Md	0.25			
	Labor for reinstate & cleaning	Skilled	Md	0.5			
		Unskilled	Md	0.5			
	Damage recovery (30%)						
	Tools (3% labor)						
					Actual Cost		
					Overhead Cost (...%)		
	Rate per 1 Nos				Total Cost		
A 3	**Demolition of the existing brick masonry wall in cement mortar and disposing debris including , transportation of debris, cleaning the site etc. all complete as per drawing details, specification and instruction by the Engineer.**						
	Rate Analysis for 1 Cum						
	Resources	**Particulars**	**Unit**	**Quantity**	**Unit Price**	**Total**	**Resources Total**
	Manpower for demolition and disposing	Skilled	Md	0			
		Unskilled	Md	2.12			
	Damage recovery (30%)						
	Tools (3% labor)						
					Actual Cost		
					Overhead Cost (...%)		
	Rate per 1 cum				Total Cost		
Rs.							

A 4	**Demolition of the existing brick masonry wall in mud mortar and disposing debris including , transportation of debris, cleaning the site etc. all complete as per drawing details, specification and instruction by the Engineer.**						
	Rate Analysis for 1 Cum						
	Resources	**Particulars**	**Unit**	**Quantity**	**Unit Price**	**Total**	**Resource Total**
	Manpower	Skilled	Md	0			
		Unskilled	Md	1.06			
	Damage recovery (30%)						
	Tools (3% labor)						
					Actual Cost		
					Overhead Cost (...%)		
	Rate per 1 cum				Total Cost		
Rs.							
A 5	**Demolition of the existing stone masonry wall in mud mortar and disposing debris including , transportation of debris, cleaning the site etc. all complete as per drawing details, specification and instruction by the Engineer.**						
	Rate Analysis for 1 Cum						
	Resources	**Particulars**	**Unit**	**Quantity**	**Unit Price**	**Total**	**Elements Total**
	Manpower	Skilled	Md	0			
		Unskilled	Md	1.06			
	Damage recovery (30%)						
	Tools (3% labor)						
					Actual Cost		
					Overhead Cost (...%)		
	Rate per 1 Cum				Total Cost		
Rs.							

A 6	**Demolition of the existing stone masonry wall in cement mortar and disposing debris including , transportation of debris, cleaning the site etc. all complete as per drawing details, specification and instruction by the Engineer.**						
	Rate Analysis for 1 cum						
	Resource	**Particulars**	**Unit**	**Quantity**	**Unit Price**	**Total**	**Resource Total**
	Manpower	Skilled	Md	0			
		Unskilled	Md	2.12			
	Damage recovery (30%)						
	Tools (3% labor)						
					Actual Cost		
					Overhead Cost (...%)		
	Rate per 1 cum				Total Cost		
Rs.							
A 7	**Demolition of existing P.C.C. slab in perfect line, level and disposing the debris including transportation of debris, cleaning the site all complete as per drawing, specification and instruction by the Engineer.**						
	Rate Analysis for 1 Cum						
	Resource	**Particulars**	**Unit**	**Quantity**	**Unit Price**	**Total**	**Resource Total**
	Manpower	Skilled	Md	0			
		Unskilled	Md	4			
	Damage recovery (30%)						
	Tools (3% labor)						
					Actual Cost		
					Overhead Cost (...%)		
	Rate per 1 Cum				Total Cost		
Rs.							

A 8	**Demolition of existing R.C.C. slab in perfect line, level and disposing the debris including transportation of debris, cleaning the site all complete as per drawing, specification and instruction by the Engineer.**						
	Rate Analysis for 1 Cum						
	Resource	**Particulars**	**Unit**	**Quantity**	**Unit Price**	**Total**	**Resource Total**
	Manpower	Skilled	Md	0			
		Unskilled	Md	11			
	Damage recovery (30%)						
	Tools (3% labor)						
					Actual Cost		
					Overhead Cost (...%)		
	Rate per 1 Cum				Total Cost		
Rs.							
A 9	**Dismantel of existing roof truss with CGI sheet, surface cleaning and disposing the debris including transportation, etc all complete as per drawing details, specification and instruction by the Engineer.**						
	Rate Analysis for 1 sq.m						
	Elements	**Particulars**	**Unit**	**Quantity**	**Unit Price**	**Total**	**Elements Total**
	Manpower	Skilled	Md	0.03			
		Unskilled	Md	0.04			
	Damage recovery (30%)						
	Tools (3% labor)						
					Actual Cost		
					Overhead Cost (...%)		
	Rate per 1 sq.m				Total Cost		
Rs.							

A 10	**Dismantel of existing tile roofing , surface cleaning and disposing the debris including transportation, etc all complete as per drawing details, specification and instruction by the Engineer.**						
	Rate Analysis for 1 sq.m						
	Resource	**Particulars**	**Unit**	**Quantity**	**Unit Price**	**Total**	**Resource Total**
	Manpower	Skilled	Md	0.054			
		Unskilled	Md	0.081			
	Damage recovery (30%)						
	Tools (3% labor)						
					Actual Cost		
					Overhead Cost (...%)		
	Rate per 1 sq.m				Total Cost		
Rs.							
A 11	**Stripping off the existing mud plaster on the masonry wall, raking out the mud mortar to a depth of 10 mm at joint, surface cleaning and disposing the debris including transportation, etc all complete as per drawing details, specification and instruction by the Engineer.**						
	Rate Analysis for 1 sq.m						
	Resources	**Particulars**	**Unit**	**Quantity**	**Unit Price**	**Total**	**Resource Total**
	Manpower for scrapping	Unskilled	Md	0.06			
	Manpower for raking & cleaning	Unskilled	Md	0.06			
	Damage recovery (30%)						
	Tools (3% labor)						
					Actual Cost		
					Overhead Cost (...%)		
	Rate per 1 sq.m				Total Cost		
Rs.							

A 12	**Stripping off the existing cement plaster on the Masonry wall, raking out the cement mortar to a depth of 10 mm at joint, surface cleaning and disposing the debris including transportation, etc all complete as per drawing details, specification and instruction by the Engineer.**						
	Rate Analysis for 1 sq.m						
	Resources	**Particulars**	**Unit**	**Quantity**	**Unit Price**	**Total**	**Elements Total**
	Manpower for scrapping	Unskilled	Md	0.108			
	Manpower for raking & cleaning	Unskilled	Md	0.108			
	Damage recovery (30%)						
	Tools (3% labor)						
					Actual Cost		
					Overhead Cost (...%)		
	Rate per 1 sq.m				Total Cost		
Rs.							
B 1	**Earthwork in excavation in ordinary to mixed/hard soil in foundation including dressing of sides and proper compaction to trench bed, disposing of excess soil all complete as per drawing, specification and instructions by the Engineer.**						
	Rate Analysis for 1 Cum						
	Resources	**Particulars**	**Unit**	**Quantity**	**Unit Price**	**Total**	**Elements Total**
	Manpower	Skilled	Md	0			
		Unskilled	Md	0.8			
	Damage recovery (30%)						
	Tools (3% labor)						
					Actual Cost		
					Overhead Cost (...%)		
	Rate per 1 Cum				Total Cost		
Rs.							

B 2	**Backfilling Works**						
	Rate Analysis for 1 Cum						
	Resources	Particulars	Unit	Quantity	Unit Price	Total	Elements Total
	Manpower	Skilled	Md	0			
		Unskilled	Md	0.5			
	Damage recovery (30%)						
	Tools (3% labor)						
					Actual Cost		
					Overhead Cost (...%)		
	Rate per 1 Cum				Total Cost		
Rs							
C 1	**Providing Wooden Props for Shoring of Walls and Floors (Raker =100mmx100mm@3.3m spacing, Wall plate=100mmx100mm@3.3m spacing, Cleat=300mmx100mmx75mm)**						
	Rate Analysis for 1 Cum						
	Resources	**Particulars**	**Unit**	**Quantity**	**Unit Price**	**Total**	**Elements Total**
	Manpower	Skilled	Md	7.5			
		Unskilled	Md	3.8			
		Timber	cum	1.1			
	Tools (3% labor)						
					Actual Cost		
					Overhead Cost (...%)		
	Rate per cum	Note: One element will be used for 3 times.			Total Cost		

C 2	**Providing Timber shoring while Shifting of Openings (125*125 sq mm horizontal wooden posts with vertical support @ 1 m spacing, Vertical Posts @ 100 *100 sq mm)**						
	Rate Analysis for 1 cum						
	Resources	**Particulars**	**Unit**	**Quantity**	**Unit Price**	**Total**	**Elements Total**
	Manpower	Skilled	Md	4.9			
		Unskilled	Md	4.9			
		Timber	cum	1.1			
		Nails (2 inches)	kg	1.2			
	Tools (3% labor)						
					Actual Cost		
					Overhead Cost (...%)		
	Rate per cum	Note: One element will be used for 3 times.			Total Cost		
Rs.							
D 1	**Stone masonry work in mud mortar including supply of hard stone blocks preparing mud mortar and construction of the wall upto 5m high haulage distance upto 30m**						
	Rate Analysis for 1 cum						
	Resources	**Particulars**	**Unit**	**Quantity**	**Unit Price**	**Total**	**Elements Total**
	Manpower	Skilled	Md	1			
		Unskilled	Md	2.25			
	Material	Block Stone	cum	1			
		Bond Stone	cum	0.1			
		Soil	cum	0.42			
		Water	litre	70			
	Tools (3% labor)						
					Actual Cost		
					Overhead Cost (...%)		
	Rate per 1 cum				Total Cost		

D 2	**Good quality local chimney made brick work in mud mortar in perfect line, level and finishing including , curing, raking out green mortar from joints and cleaning the brick face before stopping the work and proper bonding with existing masonry all complete as per drawing, specification and instruction by the Engineer.**						
	Rate Analysis for 1 cum						
	Resources	**Particulars**	**Unit**	**Quantity**	**Unit Price**	**Total**	**Elements Total**
	Manpower	A)Skilled	Md	1			
		B)Unskilled	Md	1.7			
		C)Unskilled	Md	0.2			
	Material	Brick	nos	560			
		Soil	cum	0.42			
		Water	littre	100			
	Tools for Scaffolding	3% of C)					
	Tools (3% labor)						
					Actual Cost		
					Overhead Cost (...%)		
	Rate per 1 cum				Total Cost		
Rs.							
D 3	**Stone masonry work in cement mortar including supply of hard stone blocks preparing mud mortar and construction of the wall upto 5m high haulage distance upto 30m**						
	Rate Analysis for 1 cum						
	Resources	**Particulars**	**Unit**	**Quantity**	**Unit Price**	**Total**	**Elements Total**
	Manpower	Skilled	Md	1.95			
		Unskilled	Md	2.06			
	Material	Cement	MT	0.07			
		Sand(river)	cum	0.3			
		Block stone	cum	1.1			
		bond stone	cum	0.1			
		Water	litre	150			
	Tools (3% labor)						
					Actual Cost		
					Overhead Cost (...%)		
	Rate per 1 cum				Total Cost		
Rs.							

D 4	**Good quality local chimney made brick work in cement sand mortar (1:6) in perfect line, level and finishing including , curing, raking out green mortar from joints and cleaning the brick face before stopping the work and proper bonding with existing masonry all complete as per drawing, specification and instruction by the Engineer.**						
	Rate Analysis for 1 cum						
	Resources	**Particulars**	**Unit**	**Quantity**	**Unit Price**	**Total**	**Elements Total**
	Manpower	A) Skilled	Md	1.5			
		B) Unskilled	Md	2.2			
		C) Unskilled	Md	0.7			
	Material	Cement	bags	1.4			
		Brick	nos	560			
		Sand	cum	0.3			
		water	litre	100			
	Tools for Scaffolding (3% of C)						
					Actual Cost		
					Overhead Cost (...%)		
	Rate per 1 cum				Total Cost		
Rs.							
D 5	**Dry flat brick soiling**						
	Rate Analysis for 10 sq.m						
	Resources	**Particulars**	**Unit**	**Quantity**	**Unit Price**	**Total**	**Elements Total**
	Manpower	Skilled	Md	0.5			
		Unskilled	Md	1			
	Material	Brick	nos	420			
		Sand(river)	cum	0.71			
	Tools (3% labor)						
					Actual Cost		
					Overhead Cost (...%)		
	Rate per 1 sq.m				Total Cost		
Rs.							

D 6	**Dry stone laying (soling)**						
	Rate Analysis for 1 cum						
	Resources	**Particulars**	**Unit**	**Quantity**	**Unit Price**	**Total**	**Elements Total**
	Manpower	Skilled	Md	1			
		Unskilled	Md	3.5			
	Material	Stone	cum	1.1			
		Sand	cum	0.25			
	Tools (3% labor)						
					Actual Cost		
					Overhead Cost (...%)		
	Rate per 1 cum				Total Cost		
Rs.							
E 1	**Providing, mixing and laying P.C.C. in 1:2:4 ratio for foundation, beam with stone aggregate(10/ 20mm) down with proper compaction and completion to perfect line, level and finishing including proper curing all complete as per drawing, specification and instruction by the Engineer.**						
	Rate Analysis for 1 cum						
	Elements	**Particulars**	**Unit**	**Quantity**	**Unit Price**	**Total**	**Elements Total**
	Manpower	Skilled	Md	1			
		Unskilled	Md	4			
	Material	Cement	Bags	6.4			
		Aggregate	cum	0.86			
		Sand	cum	0.445			
		Water	ltr	150			
					Actual Cost		
					Overhead Cost (...%)		
	Rate per 1 cum				Total Cost		
Rs.							

E 2	**Providing, mixing and laying R.C.C. in 1:2:4 ratio for foundation, beam with stone aggregate(10/ 20mm) down with proper compaction and completion to perfect line, level and finishing including proper curing all complete as per drawing, specification and instruction by the Engineer.**						
	Rate Analysis for 1 cum						
	Resources	**Particulars**	**Unit**	**Quantity**	**Unit Price**	**Total**	**Elements Total**
	Manpower	Skilled	Md	0.8			
		Unskilled	Md	7			
	Material	Cement	Bags	6.4			
		Aggregate	cum	0.86			
		Sand	cum	0.445			
		Water	ltr	150			
					Actual Cost		
					Overhead Cost (...%)		
	Rate per 1 cum				Total Cost		
Rs.							
E 3	**Providing, mixing and laying R.C.C. in 1:1.5:3 ratio for foundation, beam with stone aggregate(10/ 20mm) down with proper compaction and completion to perfect line, level and finishing including proper curing all complete as per drawing, specification and instruction by the Engineer.**						
	Rate Analysis for 1 cum						
	Resources	**Particulars**	**Unit**	**Quantity**	**Unit Price**	**Total**	**Elements Total**
	Manpower	Skilled	Md	0.8			
		Unskilled	Md	7			
	Material	Cement	Bags	8			
		Aggregate	cum	0.86			
		Sand	cum	0.43			
		Water	ltr	200			
	Tools (3% labor)						
					Actual Cost		
					Overhead Cost (...%)		
	Rate per 1 cum				Total Cost		
Rs.							

E 4	**Providing high strength deformed bars (HYSD) of grade Fe:415 approved reinforcement confirming to IS: 1786 - 1985 for R.C.C work and approved bar bending schedule including straightening, cutting, bending, placing and binding in position by binding wires all complete as per drawing, specification and instruction by the Engineer.**						
	Rate Analysis for 1 metric ton						
	Elements	Particulars	Unit	Quantity	Unit Price	Total	Elements Total
	Manpower	Skilled	Md	12			
		Unskilled	Md	12			
	Material	TMT Rod	Metric ton	1.05			
		Binding Wire	kg	10			
					Actual Cost		
					Overhead Cost (...%)		
	Rate per 1 metric ton				Total Cost		
Rs.							
F 1	**Providing, fitting and fixing standard formwork of shuttering local wood including all necessary metal/wooden props, bracing, wedges and nails etc. and careful removal of form works at approved time for all type of R.C.C. works all complete as per specification and instruction by the Engineer.**						
	Rate Analysis for 1 sq.m						
	Resources	**Particulars**	**Unit**	**Quantity**	**Unit Price**	**Total**	**Elements Total**
	Manpower	Skilled	Md	0.267			
		Unskilled	Md	0.4			
	Material	Wooden Form	cum	0.07			
		Nails	kg	0.25			
	Damage recovery (30%)						
	Tools (3% labor)						
					Actual Cost		
					Overhead Cost (...%)		
	Rate per 1 sq.m				Total Cost		
Rs.	0						

G 1	**Providing, cutting and laying SWG10 welded wire mesh and mesh size 50x50 mm including anchoring it on the wall with 4.75mm bar by drilling and fixing with cement slurry as per drawing details, specification and instruction by the Engineer.**						
	Rate Analysis for 1 sq.m						
	Elements	**Particulars**	**Unit**	**Quantity**	**Unit Price**	**Total**	**Elements Total**
	Manpower	Skilled	Md	0.09			
		Unskilled	Md	0.12			
	Material	Wiremesh	sq.m	1.1			
	Tools (3% labor)						
					Actual Cost		
					Overhead Cost (...%)		
	Rate per 1 sq.m				Total Cost		
Rs.							
G 2	**Providing, cutting and laying SWG10 welded wire mesh of mesh size 25x25m as per drawing details, specification and instruction by the Engineer.**						
	Rate Analysis for 1 sq.m						
	Resources	**Particulars**	**Unit**	**Quantity**	**Unit Price**	**Total**	**Elements Total**
	Manpower	Skilled	Md	0.09			
		Unskilled	Md	0.12			
	Material	Wiremesh	sq.m	1.1			
	Tools (3% labor)						
					Actual Cost		
					Overhead Cost (...%)		
	Rate per 1 sq.m				Total Cost		
Rs.							

G 3	**Providing, cutting and laying SWG12 welded wire mesh and mesh size 50x50 mm including anchoring it on the wall with 4.75mm bar by drilling and fixing with cement slurry as per drawing details, specification and instruction by the Engineer.**						
	Rate Analysis for 1 sq.m						
	Resources	**Particulars**	**Unit**	**Quantity**	**Unit Price**	**Total**	**Elements Total**
	Manpower	Skilled	Md	0.09			
		Unskilled	Md	0.12			
	Material	Wiremesh	sq.m	1.1			
	Tools (3% labor)						
					Actual Cost		
					Overhead Cost (...%)		
	Rate per 1 sq.m				Total Cost		
Rs.							
G 4	**Providing, cutting and laying SWG14 (2.03mm) welded wire mesh of mesh size 31mmx31mm as per drawing details, specification and instruction by the Engineer**						
	Rate Analysis for 1 sq.m						
	Resources	**Particulars**	**Unit**	**Quantity**	**Unit Price**	**Total**	**Elements Total**
	Manpower	Skilled	Md	0.12			
		Unskilled	Md	0.23			
	Material	Wiremesh	sq.m	1.1			
	Tools (3% labor)						
					Actual Cost		
					Overhead Cost (...%)		
	Rate per 1 sq.m				Total Cost		
Rs.							

G 5	**Providing, cutting and laying SWG12 welded wire mesh of mesh size 25mmx25mm as per drawing details, specification and instruction by the Engineer**						
	Rate Analysis for 1 sq.m						
	Resources	Particulars	Unit	Quantity	Unit Price	Total	Elements Total
	Manpower	Skilled	Md	0.09			
		Unskilled	Md	0.12			
	Material	Wiremesh	sq.m	1.1			
	Tools (3% labor)						
					Actual Cost		
					Overhead Cost (...%)		
	Rate per 1 sq.m				Total Cost		
Rs.							
G 6	**Providing, cutting and laying SWG15(1.83mm) welded wire mesh of mesh size 20x20m as per drawing details, specification and instruction by the Engineer.**						
	Rate Analysis for 1 sq.m						
	Resources	**Particulars**	**Unit**	**Quantity**	**Unit Price**	**Total**	**Elements Total**
	Manpower	Skilled	Md	0.09			
		Unskilled	Md	0.12			
	Material	Wiremesh	sq.m	1.1			
	Tools (3% labor)						
					Actual Cost		
					Overhead Cost (...%)		
	Rate per 1 sq.m				Total Cost		
Rs.							

H 1	**Cement plaster works over on walls, with cement sand mix (1:4) and 12.5 mm thick or as per existing plaster thickness in perfect line, level and plumb, making grooves on boundary of existing plaster and new plaster including cleaning and wetting the surface and curing all complete as per specification and instruction by the Engineer.**						
	Rate Analysis for 100 sq.m						
	Resources	**Particulars**	**Unit**	**Quantity**	**Unit Price**	**Total**	**Elements Total**
	Manpower	Skilled	Md	12			
		Unskilled	Md	16			
	Material	Cement	bags	10.8			
		Sand	cum	1.5			
	Tools (3% labor)						
					Actual Cost		
					Overhead Cost (...%)		
	Rate per 1 sq.m				Total Cost		
Rs.							
H 2	**Cement plaster works over GI wire mesh / chicken wire mesh on Brick walls, with cement sand mix (1:3) and 30 mm thick**						
	Rate Analysis for 100 sq.m						
	Resources	**Particulars**	**Unit**	**Quantity**	**Unit Price**	**Total**	**Elements Total**
	Manpower	Skilled	Md	16			
		Unskilled	Md	16			
	Material	Cement	bags	30			
		Sand	cum	3			
	Tools (3% labor)						
					Actual Cost		
					Overhead Cost (...%)		
	Rate per 1 sq.m				Total Cost		
Rs.							

H 3	**Cement plaster works over GI wire mesh / chicken wire mesh on Brick walls, with cement sand mix (1:3) and 20 mm thick**						
	Rate Analysis for 100 sq.m						
	Resources	**Particulars**	**Unit**	**Quantity**	**Unit Price**	**Total**	**Elements Total**
	Manpower	Skilled	Md	15			
		Unskilled	Md	15			
	Material	Cement	bags	20			
		Sand	cum	2			
	Tools (3% labor)						
					Actual Cost		
					Overhead Cost (...%)		
	Rate per 1 sq.m				Total Cost		
Rs.							

H 4	**Cement plaster works over GI wire mesh / chicken wire mesh on Stone masonry walls, with cement sand mix (1:3) and 35 mm thick**						
	Rate Analysis for 100 sq.m						
	Resources	**Particulars**	**Unit**	**Quantity**	**Unit Price**	**Total**	**Elements Total**
	Manpower	Skilled	Md	0.391			
		Unskilled	Md	0.781			
	Material	Cement	bags	0.437			
		Sand	cum	0.046			
	Tools (3% labor)						
					Actual Cost		
					Overhead Cost (...%)		
	Rate per 1 sq.m				Total Cost		
Rs.							

H 5	**40mm (Double Layer) Plastering work @ 1:3 Cement Mortar at the location of welded wiremesh and GI Wire jacketing (First layer of 25mm and second layer of 15mm.)**						
	Rate Analysis for 100 sq.m						
	Resources	**Particulars**	**Unit**	**Quantity**	**Unit Price**	**Total**	**Elements Total**
	Manpower	Skilled	Md	16			
		Unskilled	Md	35			
	Material	Cement	bags	42			
		Sand	cum	4.29			
	Tools (3% labor)						
					Actual Cost		
					Overhead Cost (...%)		
	Rate per 1 sq.m				Total Cost		
Rs.							
I 1	**Providing 12G GI Wire @ 100mm c/c for prevention of local failure**						
	Rate Analysis for 1 sqm area						
	Resources	**Particulars**	**Unit**	**Quantity**	**Unit Price**	**Total**	**Elements Total**
	Manpower	Skilled	Md	0.06			
		Unskilled	Md	0.06			
	Material	12G GI Wire	kg	1.012			
	Tools (3% labor)						
					Actual Cost		
					Overhead Cost (...%)		
	Rate per 1 sq.m				Total Cost		
Rs.							

I	**Fixing 4mm dia G.I wire in specified location attached with each corss link hook placed at specified interval**						
2							
	Rate Analysis for 10 rm						
	Resources	**Particulars**	**Unit**	**Quantity**	**Unit Price**	**Total**	**Elements Total**
	Manpower	Skilled	Md	0.179			
		Unskilled	Md	0.357			
	Material	4mm GI Wire	kg	1			
	Tools (3% labor)						
					Actual Cost		
					Overhead Cost (...%)		
	Rate per 1 rm				Total Cost		
Rs.							
J	**Throughout anchoring of SWG 10 (3.15) mm wire at 600 mm c/c with staggered layout for connection of jacketing mesh on both sides of wall**						
1							
	Rate Analysis for 1 nos.						
	Resources	**Particulars**	**Unit**	**Quantity**	**Unit Price**	**Total**	**Elements Total**
	Manpower	Skilled	MD	0.017			
		Unskilled	MD	0.017			
	Materials	SWG 10(3.15) mm wire	kg	0.09			
	Tools	Drilling Machine					
		Drill bit					
					Actual Cost		
					Overhead Cost (...%)		
	Rate per 1 no.				Total Cost		
Rs.							

J 2	**Anchorage of 4.75 mm bar with staggered layout at 600 mm c/c for connecting splints and bandages on both sides of wall**						
	Rate Analysis for 1 nos.						
	Resources	Particulars	Unit	Quantity	Unit Price	Total	Elements Total
	Manpower	Skilled	MD	0.025			
		Unskilled	MD	0			
	Material	Cement	Bags	0.002			
		Sand	cum	0.000			
		4.75 mm rebar	kg	0.03			
	Tools (3% labor)	Drilling Machine					
		Drilling Bit					
					Actual Cost		
					Overhead Cost (...%)		
	Rate per 1 no.				Total Cost		
Rs.							
J 3	**Cast In-situ Concrete Shear Connector for all belts in 450 mm thick wall with 8mm TOR rod and infill of Concrete 1:2:4 (Include making hole of 4"*4")**						
	Rate Analysis for 10 nos.						
	Resources	**Particulars**	**Unit**	**Quantity**	**Unit Price**	**Total**	**Elements Total**
	Manpower	Skilled	MD	0.056			
		Unskilled	MD	0.083			
	Material	Steel -8mm dia.	Kg	0.16			
		Cement	Bag	0.011			
		Sand	cum	0.001			
		Aggregate	cum	0.002			
					Actual Cost		
					Overhead Cost (...%)		
	Rate per 1 no.				Total Cost		
Rs.							

K 1	**150mm thick and 450mm deep Through concrete placed in existing wall to prevent wall delamination**						
	Rate Analysis for 10 nos.						
	Resources	**Particulars**	**Unit**	**Quantity**	**Unit Price**	**Total**	**Elements Total**
	Manpower	Skilled	Md	0.5			
		Unskilled	Md	2.5			
	Material	Cement	bags	0.7			
		Sand	cum	0.04			
		Aggregate	cum	0.08			
		Rebar (7mm)	kg	2			
					Actual Cost		
					Overhead Cost (...%)		
	Rate per 1 no.				Total Cost		
Rs.							

K 2	**Providing 150mm thick and 450mm long dowel for anchoring the new element with the existing element using rebar and concrete**						
	Rate Analysis for 10 nos.						
	Resources	**Particulars**	**Unit**	**Quantity**	**Unit Price**	**Total**	**Elements Total**
	Manpower	Skilled	Md	0.6			
		Unskilled	Md	2.5			
	Material	Cement	bags	1			
		Sand	cum	0.04			
		Aggregate	cum	0.08			
		Rebar (12mm)	kg	11			
					Actual Cost		
					Overhead Cost (...%)		
	Rate per 1 no.				Total Cost		
Rs.							

K 3	**Providing the timber splicing for the wooden posts with splicing member**						
	Rate Analysis for 1 cum						
	Resources	**Particulars**	**Unit**	**Quantity**	**Unit Price**	**Total**	**Elements Total**
	Manpower	Skilled	Md	31			
		Unskilled	Md	3			
	Material	Soft Wood	cum	1.1			
		12 mm bolt/ Threaded rod	kg	183			
		Nuts and washers each	nos.	610			
	Drilling Works (1% of total cost)						
					Actual Cost		
					Overhead Cost (...%)		
	Rate per cum				Total Cost		
Rs.							

L 1	**Providing wooden frames as light gable**						
	Rate Analysis for 1 cum						
	Resources	**Particulars**	**Unit**	**Quantity**	**Unit Price**	**Total**	**Elements Total**
	Manpower	Skilled	Md	16.82			
		Unskilled	Md	5.61			
	Material	Timber	cum	1.1			
		Nails	kg	16.82			
	Tools (3% labor)						
					Actual Cost		
					Overhead Cost (...%)		
	Rate per 1 cum				Total Cost		
Rs.							

L 2	**Providing and fixing 24 Gauge CGI Sheet as light material.**						
	Rate Analysis for 10 sq.m						
	Resources	**Particulars**	**Unit**	**Quantity**	**Unit Price**	**Total**	**Elements Total**
	Manpower	Skilled	Md	1.1			
		Unskilled	Md	1.25			
	Material	CGI Sheet (24 Gauge)	sqm	12			
		Nails	kg	0.5			
		Washer	nos	55			
	Tools (3% labor)						
					Actual Cost		
					Overhead Cost (...%)		
	Rate per 1 sq.m				Total Cost		
Rs.							
M 1	**Connection of rafter and purlin with 12G GI Wire**						
	Rate Analysis for 40 connections						
	Resources	**Particulars**	**Unit**	**Quantity**	**Unit Price**	**Total**	**Elements Total**
	Manpower	Unskilled	Md	1			
	Material	12G GI Wires	kg	1.2			
	Tools (3% labor)						
					Actual Cost		
					Overhead Cost (...%)		
	Rate per connection				Total Cost		
Rs.							

M 2	**Connection of sill plate with ring beam (1000mm x 75mm double folded 24 Gauge Plain GI Sheet)**						
	Rate Analysis for 30 connections						
	Resources	**Particulars**	**Unit**	**Quantity**	**Unit Price**	**Total**	**Elements Total**
	Manpower	Skilled	Md	1			
		Unskilled	Md	2			
	Material	Plain GI Sheet	sqm	4.5			
		Nails (1.5”)	kg	1.5			
	Tools (3% labor)						
					Actual Cost		
					Overhead Cost (...%)		
	Rate per connection				Total Cost		
Rs.							
M 3	**Connection of Ridge Beam and Timber Post with Plain GI Strap (24 Gauge)**						
	Rate Analysis for 3 connections						
	Resources	**Particulars**	**Unit**	**Quantity**	**Unit Price**	**Total**	**Elements Total**
	Manpower	Skilled	Md	0.25			
		Unskilled	Md	1			
	Material	Plain GI Sheet	sqm	0.412			
		Nails (1.5”)	kg	0.5			
	Tools (3% labor)						
					Actual Cost		
					Overhead Cost (...%)		
	Rate per connection				Total Cost		
Rs.							

CALCULATION/OBSERVATION FOR NORMS CALCULATION

H3	**20mm (Double Layer) Plastering work @ 1:3 Cement Mortar at the location of welded wiremesh and GI Wire jacketing**					
	Area (sq.m)	100				
	Thickness (mm)	20				
	Ratio	1:3				
	Plaster volume (cum)=	2				
	Increasing plaster volume by 30% for dry volume					
	Total volume=	2.6				
			cum	kg	bags	
	Cement =	0.65	0.65	936	19	
	Adding 10% for slurry and wastage				21	
	Sand=	1.95	cum			
	Adding 10% for wastage	2.145	cum			
	Skilled Manpower	16	On observation it was found that one mason in a day can plaster a wall panel of height 7 feet and width 10 feet, which is equal to around 68 sq ft(6.25 sq m). Hence, for 100 sqm 16 MDs are required.			
	Unskilled Manpower	16	The unskilled manpower is required to support the skilled one in carrying and preparing 1:3 rich cement mortar using cement, sand, water and necessary tools like spade. Further, the manpower is also resposible for spraying slurry and supplying/hauling of prepared material to the skilled one.			
H2	**30mm (Double Layer) Plastering work @ 1:3 Cement Mortar at the location of welded wiremesh and GI Wire jacketing**					
	Area (sq.m)	100				
	Thickness (mm)	30				
	Ratio	1:3				
	Plaster volume (cum)=	3				
	Increasing plaster volume by 30% for dry volume					
	Total volume=	3.9				
	Cement =	0.975	0.975	1404	29	
	Adding 10% for slurry and wastage				32	
	Sand=	2.925	cum			
	Adding 10% for wastage	3.218	cum			

	Skilled Manpower	15	On observation it was found that one mason in a day can plaster a wall panel of height 7 feet and width 10 feet, which is equal to around 72 sq ft(6.66 sq m). Hence, for 100 sqm 15 MDs are required.			
	Unskilled Manpower	15	The unskilled manpower is required to support the skilled one in carrying and preparing 1:3 rich cement mortar using cement, sand, water and necessary tools like spade. Further, the manpower is also resposible for spraying slurry and supply-ing/hauling of prepared material to the skilled one.			
G1	**Providing, cutting and laying SWG10 welded wire mesh and mesh size 50x50 mm as per drawing details, specification and instruction by the Engineer.**					
	Skilled Manpower	0.09 MD	While cutting and installing a GI Welded Wire Mesh over surface of wall, it has been observed that skilled manpower is necessary to intially place, temporarily anchor and help other unskilled masons. For all these works total time taken for 1 sqm area is 44 minutes.			
	Unskilled Manpower	0.12 MD	Unskilled Manpower are required to remove the existing internventions like joist, roofing materials, nailing wire mesh over walls and other purposes. For all these works total time taken for 1 sqm area is around 58 to 60 minutes.			
J2	**Anchorage of 4.75 mm bar with staggered layout at 600 mm c/c for connecting splints and bandages on both sides of wall**					
	Total time required for preparation, placing and fixing of anchorages.					
	For preparation of an-chorage bar	4	min-utes			
	For drilling of holes	2	min-utes			
	For placing and tamper-ing rich cement mortar inside the hole	6	min-utes			
	Total time required	12	min-utes			
	Hence, converting it into man days, as skilled manpowers are used:					
	Skilled manpower re-quired	0.025	MD			
	Drilling Works					

	Drilling Machine	3		Rate of renting each drilling machine is around NPR 500 per day. Such machines are used for around 8-10 days and their are around 1000 anchorage holes in an average Nepali building. Hence ((500*8)/1000) gives about Npr 3 per hole for drilling machine. Likewise, for drilling bit, an average bit when made locally from rods will cost NPR 800. Since 3-4 such bits are sufficient for a building in normal cases, per hole cost for 1000 holes is around NPR 2.		
	Drilling Bit	2				
J1	**Throughout anchoring of SWG 10 (3.15) mm wire at 600 mm c/c with staggered layout for connection of jacketing mesh on both sides of wall**					
	Total time required for preparation, placing and fixing of anchorages.					
	For drilling of holes	8	minutes	In General this is done by 2 set of masons who sit at inner and outer side of walls.		
	For placing and tampering rich cement mortar inside the hole	8	minutes			
	Total time required	16	minutes			
	Hence, converting it into man days, as skilled manpowers are used:					
	Skilled manpower	0.017	MD	Divided the number into a skilled and unskilled masons		
	Unskilled manpower	0.017	MD			
	Drilling Works					
	Drilling Machine	3		Rate of renting each drilling machine is around NPR 500 per day. Such machines are used for around 8-10 days and there are around 1000 anchorage holes in an average Nepali building. Hence ((500*8)/1000) gives about Npr 3 per hole for drilling machine. Likewise, for drilling bit, an average bit when made locally from rods will cost NPR 800. Since 3-4 such bits are sufficient for a building in normal cases, per hole cost for 1000 holes is around NPR 2.		
	Drilling Bit	2				
I1	**Providing 12G GI Wire @ 100mm c/c for prevention of local failure**					
	Skilled Manpower	0.06	While cutting and installing a GI wire over surface of wall, it has been observed that skilled manpower is necessary to intially place, wind and help other unskilled masons. For all these works total time taken for 1 sqm area is 30 minutes.			

	Unskilled Manpower	0.06	Unskilled Manpower are required to remove the existing internventions like binding and tying up of the wire mesh. For all these works total time taken for 1 sqm area is around 30 minutes.			
	For quanity of material for which wire is placed at 100 mm c/c a sq m area the length is 23 m. (1 extra m is for binding works)					

C1	**Providing Wooden Props for Shoring of Walls and Floors**		
	Assuming elevation area of shoring = (10m x 5m i.e 10m length of building and 5m height of building)		
	No. of Raker (100mmx100mmx2440mm)	4	no.
	Wall Plate (100mmx100mmx3962mm)	4	no.
	Cleat(75mmx100mmx300mm)	4	no.
	Total volume of timber	0.27	cum
	Skilled	2	Md
	Unskilled	1	Md
	For 1 cum of timber shoring	1	cum
	Timber	1.1	cum
	Skilled	7.5	Md
	Unskilled	3.8	Md
C2	**Providing Wooden while Shifting of Openings (125*125 sq mm horizontal wooden posts with vertical support @ 1 m spacing, Vertical Posts @ 100 *100 sq mm)**		
	Assuming length of shoring = 4m and height of floor = 2m		
	Vertical Member (100mmx100mmx2000mm)	8	no.
	Horizontal Member (125mmx125mmx4000mm)	4	no.
	Total volume of timber	0.41	cum
	Skilled	2	Md
	Unskilled	2	Md
	Nails	0.5	kg
	For 1 cum of timber shoring	1	cum
	Timber	1.1	cum
	Skilled	4.9	Md
	Unskilled	4.9	Md
	Nails	1.2	kg

G2	**Providing, cutting and laying SWG10 welded wire mesh and mesh size 25x25 mm as per drawing details, specification and instruction by the Engineer.**					
	Skilled Manpower=	0.09	While cutting and installing a GI Welded Wire Mesh over surface of wall, it has been observed that skilled manpower is necessary to intially place, temporarily anchor and help other un-skilled masons. For all these works total time taken for 1 sqm area is 44 minutes.			
	Unskilled Manpower	0.12	Unskilled Manpower are required to remove the existing interventions like joist, roofing materi-als, nailing wire mesh over walls and other pur-poses. For all these works total time taken for 1 sqm area is around 58 to 60 minutes.			
G6	**Providing, cutting and laying SWG15 welded wire mesh and mesh size 20x20 mm as per drawing details, specification and instruction by the Engineer.**					
	Skilled Manpower	0.09	While cutting and installing a GI Welded Wire Mesh over surface of wall, it has been observed that skilled manpower is necessary to intially place, temporarily anchor and help other un-skilled masons. For all these works total time taken for 1 sqm area is 44 minutes.			
	Unskilled Manpower	0.12	Unskilled Manpower are required to remove the existing interventions like joist, roofing materi-als, nailing wire mesh over walls and other pur-poses. For all these works total time taken for 1 sqm area is around 58 to 60 minutes.			
H1	**Cement plaster works over on walls, with cement sand mix (1:4) and 12.5 mm thick**					
	Area (sq.m)	100				
	Thickness (mm)	12.5				
	Ratio	1:4				
	Plaster volume (cum)=	1.25				
	Increasing plaster vol-ume by 35% for dry volume					
	Total volume=	1.688				
			cum	kg	bags	
	Cement =	0.338	0.338	486	9.72	
	Adding 10% for slurry and wastage				10.692	
	Sand=	1.35	cum			
	Adding 10% for wastage	1.485	cum			
	Skilled Manpower	12	On observation it was found that one mason in a day can plaster a wall panel of height 9 feet and width 10 feet, which is equal to around 90 sq ft(8.36 sq m). Hence, for 100 sqm 12 MDs are required.			

	Unskilled Manpower	16	The unskilled manpower is required to support the skilled one in carrying and preparing 1:4 rich cement mortar using cement, sand, water and necessary tools like spade. Further, the man-power is also resposible for spraying slurry and supplying/hauling of prepared material to the skilled one.			
H5	**40mm (Double Layer) Plastering work @ 1:3 Cement Mortar at the location of welded wiremesh and GI Wire jacketing**					
	Area (sq.m)	100				
	Thickness (mm)	40				
	Ratio	1:3				
	Plaster volume (cum)=	4				
	Increasing plaster vol-ume by 30% for dry volume					
	Total volume=	5.2				
			cum	kg	bags	
	Cement =	1.3	1.3	1872	38	
	Adding 10% for slurry and wastage				42	
	Sand=	3.9	cum			
	Adding 10% for wastage	4.29	cum			
	Skilled Manpower	16	On observation it was found that one mason in a day can plaster a wall panel of height 7 feet and width 10 feet, which is equal to around 70 sq ft(6.51 sq m). Hence, for 100 sqm 16 MDs are required.			
	Unskilled Manpower	35	The unskilled manpower is required to support the skilled one in carrying and preparing 1:3 rich cement mortar using cement, sand, water and necessary tools like spade. Further, the man-power is also resposible for spraying slurry and supplying/hauling of prepared material to the skilled one.			
K1	**150mm thick and 450mm deep Through concrete placed in existing wall to pre-vent wall delamination**					
	Concrete Work For one no.					
	Volume (cum)	0.01				
	Ratio (Mix=M20)	1:1.5:3				
	Skilled	0.01	Md			
	Unskilled	0.06	Md			
	Cement	0.06	bags			
	Sand	0.003	cum			

	Aggregate	0.01	cum			
	Rebar Work For one no.					
	7mm rebar length required	0.565	m			
	Unit weight (kg/m)	0.30				
	Total kg	0.17	kg			
	Skilled	0.002	Md			
	Unskilled	0.002	Md			
	Rebar (7mm)	0.18	kg			
	Creating Holes in existing wallls for placing through concrete					
	Skilled	0.04	Md			
	Unskilled	0.19	Md			
	Total Material and Labour Required			For 10 no.	Factor	
	Skilled	0.05	Md	0.50	1.00	0.50
	Unskilled	0.25	Md	2.50	1.00	2.50
	Cement	0.06	bags	0.64	1.10	0.70
	Sand	0.003	cum	0.03	1.10	0.04
	Aggregate	0.01	cum	0.07	1.10	0.08
	Rebar (7mm)	0.18	kg	1.79	1.10	1.97
K2	**150mm thick and 450mm long dowel for anchoring the new element with the existing element using rebar and concrete**					
	Concrete Work For one no.					
	Volume (cum)	0.01				
	Ratio (Mix=M20)	1:1.5:3				
	Skilled	0.01	Md			
	Unskilled	0.06	Md			
	Cement	0.06	bags			
	Sand	0.003	cum			
	Aggregate	0.01	cum			
	Rebar Work For one no.					
	12mm rebar length required	0.99	m			
	Unit weight (kg/m)	0.89				
	Total kg	0.88	kg			
	Skilled	0.011	Md			
	Unskilled	0.011	Md			
	Rebar (12mm)	0.92	kg			

	Creating Holes in existing wallls for placing dowels					
	Skilled	0.04	Md			
	Unskilled	0.18	Md			
	Total Material and Labour Required			For 10 no.	Factor	
	Skilled	0.06	Md	0.60	1.00	0.60
	Unskilled	0.25	Md	2.50	1.00	2.50
	Cement	0.06	bags	0.64	1.10	0.70
	Sand	0.003	cum	0.03	1.10	0.04
	Aggregate	0.01	cum	0.07	1.10	0.08
	Rebar (12mm)	0.92	kg	9.24	1.10	10.16
K3	**Timber splicing for the wooden posts with splicing member**					
	Soft Wood (730mm x 150mm x 75mm x 2)					
	Volume	0.016	cum			
	12mm bolt/threaded rod	3.00	kg	According to site experience		
	Nut/Washer	10.00	Nos.			
	Skilled	0.500	Md			
	Unskilled	0.04	Md			
	For 1 cum of Timber					
	Volume	1.1	cum			
	12mm bolt/threaded rod	183	kg			
	Nut/Washer	610	nos			
	Skilled	31	Md			
	Unskilled	3	Md			
L1	**Providing wooden frames as light gable**					
	Creating timber light gable frame (50mmx-100mm)					
	Vertical(50mmx100mmx750mmx6no.)	0.023	cum			
	Horizontal(50mmx-100mmx2500mmx3no.)	0.038	cum			
	Inclined(50mmx100mmx2920mmx2no.)	0.029	cum			
	Total on two sides	0.178	cum			
	Skilled	3	Md			
	Unskilled	1	Md			
	Nails	3	kg			
	For 1 cum of Timber					

	Timber	1.1	cum			
	Skilled	16.82	kg			
	Unskilled	5.61	nos			
	Nails	16.82	Md			

H5	**40mm (Double Layer) Plastering work @ 1:3 Cement Mortar at the location of welded wiremesh and GI Wire jacketing**					
	Area (sq.m)	100				
	Thickness (mm)	40				
	Ratio	1:3				
	Plaster volume (cum)=	4				
	Increasing plaster volume by 30% for dry volume					
	Total volume=	5.2				
			cum	kg	bags	
	Cement =	1.3	1.3	1872	38	
	Adding 10% for slurry and wast-age				42	
	Sand=	3.9	cum			
	Adding 10% for wastage	4.29	cum			
G4	**Providing, cutting and laying SWG10 welded wire mesh and mesh size 31x31 mm as per drawing details, specification and instruction by the Engineer.**					
	Skilled Manpower	0.06 MD	While cutting and installing a GI Welded Wire Mesh over surface of wall, it has been observed that skilled manpower is necessary to intially place, temporarily anchor and help other unskilled masons. For all these works total time taken for 1 sqm area is 28 to 30 minutes.			Vertical seismic strap 200 mm (8" approx) wide
	Unskilled Manpower	0.18 MD	Unskilled Manpower are required to remove the existing internventions like joist, roofing materials, nailing wire mesh over walls and other purposes. For all these works total time taken for 1 sqm area is around 88 to 90 minutes.			

Annex 1: Volume of work referred for determination of retrofitting norms

S.N.	Line Items	Unit	TOTAL
1	Labor for removing and Safe Storage	LS	16
2	Demolition of the staircase and disposing debris including , transportation of debris, cleaning the site etc. all complete as per drawing details, specification and instruction by the Engineer.	LS	12
3	Demolition of existing P.C.C. Floor in perfect line, level and disposing the debris including transportation of debris, cleaning the site all complete as per drawing, specification and instruction by the Engineer.	cum	14.29
4	Stripping off the existing mud plaster on the wall, raking out the mud mortar to a depth of 10 mm at joint, surface cleaning and disposing the debris including transportation, etc all complete as per drawing details, specification and instruction by the Engineer.	sqm	3222.06
5	Earthwork in excavation in ordinary to mixed/hard soil in foundation including dressing of sides and proper compaction to trench bed, disposing of excess soil all complete as per drawing, specification and instructions by the Engineer.	cum	60.75
6	Backfilling works after completion of concreting works	cum	38.46
7	Providing and laying flat stone soling with voids filled with sand in foundation in line and level all complete as per drawing, specification and instruction by the Engineer.	sqm	80.95
8	Providing, mixing and laying P.C.C. in 1:1.5:3 ratio for foundation, flooring, beam with stone aggregate 20mm down with proper compaction and completion to perfect line, level and finishing including proper curing all complete as per drawing, specification and instruction by the Engineer.	cum	17.248
9	Providing, fitting and fixing standard formwork of shuttering local wood including all necessary metal/wooden props, bracing, wedges and nails etc. and careful removal of form works at approved time for all type of R.C.C. works all complete as per specification and instruction by the Engineer.	LS	16
10	Providing, cutting and laying SWG12 welded wire mesh and mesh size 50x50 mm including anchoring it on the wall with 4.75mm bar by drilling and fixing with cement slurry as per drawing details, specification and instruction by the Engineer.	sqm	455.82
11	Providing, cutting and laying SWG10 welded wire mesh and mesh size 50x50 mm including anchoring it on the wall with 4.75mm bar by drilling and fixing with cement slurry as per drawing details, specification and instruction by the Engineer.	sqm	1822.35
12	Providing high strength deformed bars (HYSD) of grade Fe:415 approved reinforcement confirming to IS: 1786 - 1985 for R.C.C work and approved bar bending schedule including straightening, cutting, bending, placing and binding in position by binding wires all complete as per drawing, specification and instruction by the Engineer.	MT	1.96

S.N.	Line Items	Unit	TOTAL
13	SWG 12 Wire mesh making and jackting with mesh size 100mm *100mm	sqm	1439
14	4.75mm anchorage rod	kg	995.219
15	SWG 10(3.24mm)G.I wire @600 c/c for connecting inner and outer mesh.	MT	1.22
16	Cement plaster works over GI wire mesh and jacketing part of whole outer surface of wall with cement sand mix (1:3) and 30 mm thick or as per existing plaster thickness in perfect line, level and plumb, making grooves on boundary of existing plaster and new plaster including cleaning and wetting the surface and curing all complete as per specification and instruction by the Engineer.	sqm	1599.25
17	Cement plaster works over GI wire mesh and jacketing portion of inner wall with cement sand mix (1:3) and 20 mm thick or as per existing plaster thickness in perfect line, level and plumb, making grooves on boundary of existing plaster and new plaster including cleaning and wetting the surface and curing all complete as per specification and instruction by the Engineer.	sqm	1623.785
18	75 mm thick PCC(1:2:4) for floor finish in the excavated part on floor for tie beam	sqm	102.44
19	Addition of cross walls according to necessary design conditions	cum	8.57
20	Scaffolding Works	No.	16

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