

TRAINING OF MASONS ON HAZARD-RESISTANT CONSTRUCTION

AT
ATC SUNDERNAGAR, HP



Organised by

H.P. State Centre on Climate Change

(O/o H.P. Council for Science Technology & Environment (HIMCOSTE), Bemloe, Shimla)

&

State Disaster Management Authority (SDMA), H.P. Secretariat, Shimla

In collaboration with

CSIR-CBRI (Central Building Research Institute) Roorkee, Uttarakhand

EXECUTIVE SUMMARY

WORK SCHEDULE FOR THREE DAYS TRAINING ON “EARTHQUAKE RESISTANT CONSTRUCTION TECHNOLOGY FOR RURAL MASONS”

VENUE: **Appropriate Technology Centre, HP Council for Science Technology and Environment, at Govt. Polytechnic, Sundernagar.**

PROGRAMME: **03-05 October, 2019.** **PARTICIPANTS : 26 No.**

Organised by : **HP Council for Science, Technology and Environment (HIMCOSTE).**

In Collaboration with: **State Disaster Management Authority, Shimla.**
 Central Building Research Institute, Roorkee.

Day/Sessions	Topic	Resource Person
Day 1- 03.10.2019 (Thursday)		
09:00 – 10:00	Registration	
10:00 - 11:30	Inaugural Session	
	Welcomes Address	Dr. S.S. Randhawa , Principal Scientific Office, HIMCOSTE.
	Honoring of Chief Guest	Er. Neeraj Uppal , Principal, Govt. Polytechnic, Sundernagar.
	Introduction & Course Objectives	Dr. R. Dharmaraju , Sr. Principal Scientist, CSIR-CBRI, Roorkee.
	Address by Chief Guest	Ar. S. K. Negi , Chief Scientist, CSIR-CBRI, Roorkee.
	Vote of Thanks	Principal/ Coordinator, ATC.
11:30- 13:30	Good Construction Practices	Er. H. K. Jain , CSIR-CBRI, Roorkee.
13:30- 14:00	Lunch break	
14:00- 15:00	Examining Quality of Materials and importance of Construction Tools for Good Quality of Construction.	Er. Tanmay Kapoor , HOD, Civil Engineering, Govt. Polytechnic, Sundernagar.
15:00- 17:00	Layout of site. Construction Sample Foundation and Plinth. Construction of Plinth band. Visit to Demonstration Centre.	Dr. R. Dharmaraju , Sr. Principal Scientist and CSIR-CBRI, Team. HIMCOSTE Team.
Day 2- 04.10.2019 (Friday)		
09:00- 09:30	Recapitulating the previous Day's Learning.	Er. H. K. Jain , CSIR - CBRI, Roorkee.
09:30- 13:30	Constructing Hazard Resistant Foundations with corner vertical bars.	CSIR - CBRI, Roorkee Team and HIMCOSTE Team.
13:30- 14:00	Lunch break	

14:00- 15:00	Principal of Hazard Resistant Construction. Hazard Resistant Features for House size and Configuration. Importance of Site and Soil Conditions.	Er. Garima Sharma , Lecturer, Govt. Polytechnic, Sundernagar.
15:00 - 17:00	Hazard Resistant Feature construction: Foundation and Plinth.	HIMCOSTE Team.
DAY 3 - 05.10.2019 (Saturday)		
9:00 – 09:30	Recapitulating the previous Day's Learning.	Er. Kalit Bhardwaj , ATC, Sundernagar.
9:30- 12:00	Constructing Earthquake resistant feature Plinth Band.	Ar. Prem Lal Thakur and HIMCOSTE TEAM.
12:00 – 13:00	Estimation of Quantities and Costs	Er. Anita Joshi, HOD , Continuing Education, Govt. Poly., Sundernagar.
13:00 – 14:00	Lunch break	
14:00- 15:00	Hazard Resistant Feature for other Construction Elements.	Er. Adit Rana, Lecturer , Govt. Poly., Sundernagar
15:00- 16:00	Importance of Earthquake resistant feature Plinth Band.	Er. Kanchan Rana, Jr. Research Fellow HIMCOSTE, Shimla.
16:00- 17:00	Feedback from Participants. Valediction.	Distribution of TA/DA.

***Sessions were continued until the activities of the day are complete.**

****Tea was served at 11:30 and 15:30.**

CSIR – CBRI, Roorkee, Team Members		
S. NO.	Name	Designation
1.	Ar. S. K. Negi	Chief Scientist,
2.	Dr. R. Dharmaraju	Sr. Principal Scientist,
3.	Er. H. K. Jain	Sr. Technical Officer,
4.	Er. Manoj Tyagi	Sr. Scientist,

HIMCOSTE, Team Members		
S. NO.	Name	Designation
1.	Dr. S. S. Randhawa,	Principal Scientific Officer
2.	Sh. Gopal Jain	Scientific Officer
3.	Ar. Prem Lal	Asstt. Architect.
4.	Er. Kalit Bhardwaj	Sr. Tech Asstt.,
5.	Sh. Ramesh Kumar	Sr. Scientific Asstt.,
6.	Smt. Neena Sharma,	DEO, (Logistic Support).
7.	Er. Kanchan Rana	Jr. Research Fellow/ Master Trainer
8.	Sh. Tajender Kumar	Master Trainer.

Introduction

Training Objective: - The objective of this training curriculum is to strengthen the practicing Masons on Hazard Resistant Construction Techniques and features through theoretical and practical sessions. This training made them aware not only of the critical principles of hazards resistant construction but also provide some practical skills in appropriate and relevant details of Rural Housing Technologies that people use in different regions of India.

This training is meant to guide Masons on construction of engineered houses up to two stories and does not cover construction of engineered buildings with reinforced concrete frame for multi storey buildings.

Training methods

This training module is envisaged to be for 3 days. Each training day is designed such that there is ample time for hands-on training of Masons. The classroom sessions are plant using participatory methods with discussions, audio visual presentations models etc. Sessions provide enough time and scope for the trainees to discuss their concerns, questions and issues. The practical construction sessions were to get hands-on experience of hazard resistant features and details used in construction work.

A maximum of 26 Masons were trained at one time with three resource persons training them.



Registration of masons of three days training programme on “Earthquake Resistant Construction Techniques’ at Appropriate Technology Centre, HIMCOSTE, Govt. Polytechnic Sundernagar Distt. Mandi. H.P. from 3rd to 5th October 2019.

S. N.	Name	Father Name	Panchayat	Address	Ph.No.
1	Sh. Virender Singh	Sh.Nank Chand	Chamukha	Vill. Dhar, P.O. Churad Tehsil Sundernagar Distt. Mandi	82190 90282
2	Sh.Vijay Thakur	Sh. Krishan Chand	Chambi	Vill Jawala P.O. Chambi Tehsil Sundernagar Distt. Mandi	82199 79692
3	Sh. Hira Lal	Sh. Kundan Ram	Chamukha	Vill. Hawali P.O. Churad Tehsil Sundernagr Distt. Mandi.	96256 98383
4	Sh. Karam Singh	Sh. Khajana Ram	Chamukha	Vill. Hawali P.O. Churad Tehsil Sundernagr Distt. Mandi.	98574 16351
5	Sh. Prabh Dayal	Sh. Bansi Ram	Churad	Vill. Arankothi P.O. Churad Tehsil Sundernagar Distt. Mandi.	94596 79469
6	Sh. Karam Singh	Sh. Mani Ram	Churad	Village Thalagdhar P.O. Churad Tehsil Sundernagar Distt. Mandi.	88944 44851
7	Sh. Sarvan Kumar	Sh. Moti Ram	Barto	Vill. Jadron P.O. Biala Tehsil Sundernagar Distt. Mandi.	88944 91663
8	Sh. Munshi Ram	Sh. Jugal Ram	Barto	Vill. Jadron P.O. Biala Tehsil Sundernagar Distt. Mandi.	--
9	Sh. Krishan Ram	Sh. Jugal Ram	Nalag	Vill. Dhar P.O. Nalag Tehsil Sundernagar Distt. Mandi	86791 31799
10	Sh. Lal Chand	Sh. Mani Ram	Nalag	Vill. Dhar P.O. Nalag Tehsil Sundernagar Distt. Mandi	98575 52838
11	Sh. Laxman Singh	Sh. Gurbax	Kapahi	Vill. Dodhwan P.O. Bhojpur, Tehsil Sundernagar Distt. Mandi.	98170 40524
12	Sh. Karam Chand	Sh. Puran Chand	Kapahi	Vill. Dodhwan P.O. Bhojpur, Tehsil Sundernagar Distt. Mandi.	88945 59823
13	Sh. Ramesh Kumar	Sh. Krishan Ram	Dehar	VPO Dehar Tehsil Sundernagar Distt. Mandi	98178 22631
14	Sh. Raghu Ram	Sh. Masadi Ram	Dehar	Village Alsu P.O. Dehar Tehsil Sundernagar Distt. Mandi	98165 37083

15	Sh. Achhar Singh	Sh. Dhani Ram	Samoun	Village Khanokhar P.O. Salwana Tehsil Sundernagar Mandi	86791 53195
16	Sh. Sher Singh	Sh. Narayan Singh	Samoun	Village Kunela P.O. Nalag Tehsil Sundernagar Mandi	98178 39234
17	Sh. Chuni Lal	Sh. Sukh Ram	Samoun	Village Masog, P.O. Nalag , Tehsil Sundernagar	98052 99168
18	Sh. Basant Ram	Sh. Khajan Ram	Samoun	Village Ghour P.O. Salwana Tehsil Sundernagar Mandi	88945 71835
19	Sh. Roop Singh	Sh. Narapat Ram	Churad	Village Bhanglar P.O. Kapahi Tehsil Sundernagar Mandi.	82191 23300
20	Sh. Sunder Singh	Sh. Soju Ram	Nalag	Village Behana P.O. Nalag Tehsil Sundernagar Mandi	98828 74823
21	Sh. Hem Raj	Sh. Ram	Barto	Village Luhanu P.O. Biala Tehsil Sundernagar Mandi	98164 34825
22	Sh. Jai Lal	Sh. Budhu Ram	Nalag	Village Behana P.O. Nalag Tehsil Sundernagar Mandi	85805 03925
23	Sh. Budhi Ram	Sh. Narayan	Nalag	Village Behana P.O. Nalag Tehsil Sundernagar Mandi	----
24	Sh. Prem Lal	Sh. Sikru Ram	Chanol	Village Chanol P.O. Taleli Tehsil Sundernagar Mandi	96252 28514
25	Sh. Niku Ram	Sh. Sant Ram	Chanol	Village Chanol P.O. Taleli Tehsil Sundernagar Mandi	78075 92241
26	Sh. Gian Chand	Sh. Mangta Ram	Barto	Village Jagroun P.O. Biala Tehsil Sundernagar Mandi.	98171 27 694

Training Sessions

Inaugural Session

The opening speech is given by **Er. Kalit Bhardwaj**, ATC, Sundernagar. The esteemed dignitaries present were, **Ar. S. K. Negi**, Chief Scientist, **Er. H. K. Jain**, Sr. Technical Officer, **Dr. Dharamaraju**, Sr. Principal Scientist, **Er. Manoj Tyagi** Sr. Scientist, **Dr. S. S. Randhawa**, Principal Scientific Officer,



HIMCOSTE, **Sh. Gopal Jain**, **Ar. Prem Lal**, **Er. Neeraj Uppal**, Principal, Govt. Polytechnic, Sundernagar, **Er. Kalit Bhardwaj**, **Sh. Ramesh Kumar** and the audience. While inaugurating the training lauded that such trainings may help in adoption of suitable Earthquake Resistant Technologies and serve the larger interest of the Himalayan State, which falls in Zone IV & V by the norms of the earthquake definitions.

Welcome Address



At the outset of the Programme, **Dr. S. S. Randhawa**, Principal Scientific Officer, HIMCOSTE welcomed the CBRI Team of esteemed dignitaries and the entire audience. Setting the Programme's premise. He highlighted the growing concern

around hazard resistant techniques. **Er. Neeraj Uppal**, Principal, Govt. Polytechnic, Sundernagar honoured the chief guest. The chief guest appreciated the joint effort of HIMCOSTE and CBRI, Roorkee for taking up an interesting societal programme. He advised the trainee participants to learn appropriate techniques with full dedication and a commitment in order to take and transfer them further for field implementations in all future construction activities. The Chief Guest also suggested for inclusion of a discussion on suitable retrofitting techniques in the training curriculum so as to help and get them implemented in the improvement of the existing houses and making them earthquake resistant.

The training comprises of 13 sessions, consisting of 10 theory classroom and 3 practical sessions. These sessions were conducted in 48 hours over 3 days. The sessions are named in sequence of 1 to 13 and the prefix letter indicates the nature of session i.e. “C” for classroom session and “P” for practical exercises.

Session C1 was introductory classroom session where **Dr. R. Dharmaraju, Sr. Principal Scientist, CSIR-CBRI, Roorkee** discussed about the coarse objective. The participants interacted with each other and with the trainers. Their expectations from this training program were defined in this session. The participants were encouraged to discuss the role the artisan play in influencing the choices



of the house owners and promoting hazard resistant specifically in context of self build of self build houses.

Session C2 In this session, **Er. H. K. Jain, CSIR-CBRI, Roorkee,** introduced the participants to good construction practices in the country. He focused on regional context of the trainees.



This establish linkages between the building typologies and materials available as well as construction skills in the region. This session led discussion on important role artisans have played in evolving these typologies.

Session C3 In this session, **Er. Tanmay Kapoor, HOD, Civil Engineering, Govt. Polytechnic, Sundernagar** discussed about how to examine quality of materials and importance of



construction tools for good quality of construction. He also discussed different natural hazards and focused on the locally experienced hazards, their severity, frequency and their impact on

buildings. The natural hazards covered under different topics are earthquake, flood, cyclone, tsunami and landslides. There is flexibility to include other local hazards that may affect the particular region. The session gives conceptual understanding of different hazard zones that the country is divided into and the impact a particular region would have certain hazards. A specific discussion was initiated in the session on multiple hazards striking a particular region. Further impact of the above hazards on buildings is discussed.

Session P4 was a practical session which is meant to instil the importance of good quality materials and workmanship in construction. In this session, masons visited the Demonstration Centre with **CSIR-CBRI Team** and



HIMCOSTE Team. Layout and Construction of Sample Foundation was done. Simple steps,



rules and techniques were expected to be performed by participants to know their understanding of basics of construction. The session helped the trainers to know the skill levels of the participants so as to customise future instructions.

Session C5 was a classroom session given by **Er. H. K. Jain, CSIR - CBRI, Roorkee**. This session was focused on Recapitulation of previous Day's Learning on the principles of hazard resistant construction.



While discussing various hazards that induced damage, this session identified the characteristics that help buildings survive earthquake forces. Basic structural principles were discussed in this session with simple and often day to day life examples.

Session P6 was a practical session which was meant to construct the Hazard Resistant Foundations with corner vertical bars. This sessions was led by **CSIR - CBRI, Roorkee Team and HIMCOSTE Team**. The plinth is constructed on site.





The bar are provided at the corners of walls to make the building earthquake resistant.

Session C7 was a classroom session in which House size and shape and damage due to hazards was discussed. **Er. Garima Sharma**, Lecturer, Govt. Polytechnic, Sundernagar, made all masons aware about size, shape, scale and proportions of building and its elements that play important role in determining whether or not the building is prone to damage during hazards.



Session C8 was a discussion session in which **HIMCOSTE** team talked about Hazard Resistant Features and construction of Foundation and Plinth. The masons are made familiar with the good construction practices, directions of windows, slab thickness, steps to be followed in stone masonry



and brick masonry, techniques of shuttering, positions of windows and doors, construction of staircases.

Session C9 was a classroom session given by **Er. Kalit Bhardwaj**, ATC, Sundernagar.

This session was focused on Recapitulation of previous Day's Learning, meant to apply the theoretical



knowledge gained in earlier classroom sessions in the construction exercises. Participants understands how to construct foundations incorporating hazard resistant features. The foundations chosen in these exercises were selected from the locally practiced typologies. Also, participants were exposed to the basics of reinforced concrete footings and details of horizontal bands.

Session P10 was a practical session in which construction of earthquake resistant plinth band was done. **Ar. Prem Lal Thakur** and **HIMCOSTE TEAM** also discuss facts of building site, different soil types and hazard resistant features of the house.





Specific soil conditions like house on black cotton or Sandy soils as well as special incidents like liquefaction are discussed in this section.

Specifications of foundation for hilly Terrain and landslide prone

regions are discussed in this session. Junction of vertical reinforcement and horizontal bands.

Session C11 was a classroom session given on Estimation of Quantities and Costs by **Er. Anita Joshi, HOD, Continuing Education, Govt. Poly., Sundernagar.** She told participants about the importance and role of money, material and



manpower. She told what the specifications of buildings is and how to find the item rates of materials. The participants understood how to calculate the rate of construction materials.

Session C12 was a classroom session given on Hazard Resistant Feature for other Construction

Elements by **Er. Adit Rana, Lecturer, Govt. Poly., Sundernagar.** He discussed about the parapets, balconies, chajjas, staircases, veranda and overhead tanks.



He told that Parapets must be light weight, veranda should have columns that are properly braced up.

Session C13 was a classroom session discussed on Importance of Earthquake resistant feature using Plinth Band by **Er. Kanchan Rana, Jr. Research Fellow HIMCOSTE, Shimla.** She



discussed importance of selecting right type of foundation and plinth for specific conditions which may help in hazard resistance. Specifications of foundation for hilly Terrain and landslide prone regions are discussed in this session. Junction of vertical reinforcement and horizontal bands. Damp Proofing course, installing vertical reinforcement are discussed. The details of bands and vertical reinforcement are discussed. The participants are made aware of

the requirement of wire benders and carpenters they work with. Participants understand critical concepts of siting and details of construction of foundation and plinth.

The Major Things learned from this workshop:-

1. Construct CL stubs and mark CL and level. Protect stubs from damage. Protect stubs from damage.



2. Always check dimensions and corners by 3-4-5 method or equal diagonal method.



3. Check the level of construction at different levels.



4. Check that the course are in level.



5. After checking the level plumb the bob.



6. Apply mortar to brick face before putting it in the course and fill all the mortar joints.



7. Consume mortar within 30-60 minutes of adding water.



8. Ensure perfect bond.



9. Provide RC band and corner steel as per design and detail



The final structure made is shown in the following picture.

The same group of masons will be invited and construction of earthquake resistant building will be done up to roof level including the walls and openings in the structure.



Feedbacks

1. They like the Training programme because they learned new techniques for hazard resistant construction.
2. They don't use the horizontal and vertical bands in the construction of buildings, now they said they will use.
3. They commit that they will use centre line method and will use stubs in construction.
4. They said that they will teach other masons these techniques.
5. In village they don't use bands in load bearing structures, but now will use.
6. They said that they have learned 50% new techniques.