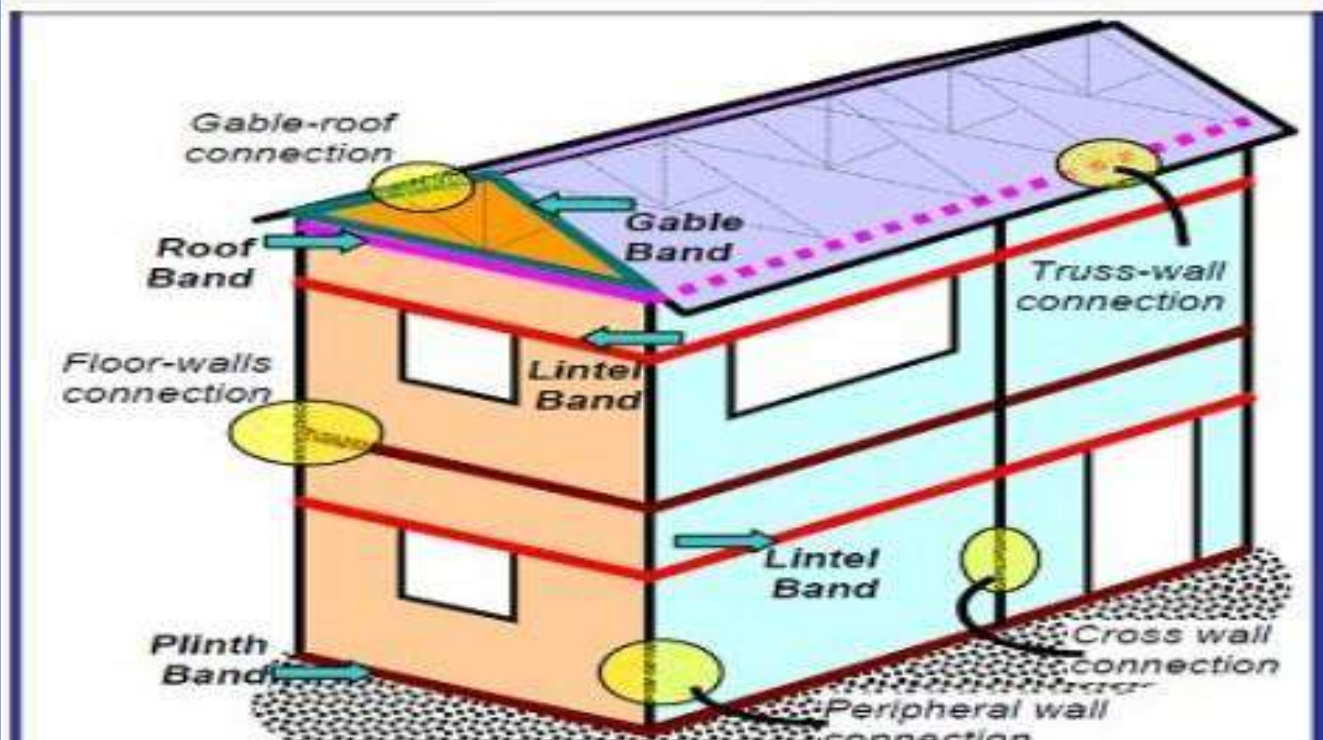




# TRAINING OF MASONS ON HAZARD-RESISTANT CONSTRUCTIONS

AT  
ATC SUNDERNAGAR, HP

## BANDS



*Organised by*  
**H.P. State Centre on Climate Change**  
**(O/o H.P. Council for Science Technology & Environment (HIMCOSTE), Bemloe, Shimla)**



*In collaboration with*  
**State Disaster Management Authority (SDMA), H.P. Secretariat, Shimla**



&

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



**Under the guidelines of National Disaster Management Authority (NDMA)**



**Compiled by**  
**Er. Kanchan Rana**  
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## **FIRST MODULE OF MASON TRAINING**

**(03-05 October, 2019)**

### **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.**

<b>Day/Sessions</b>	<b>Topic</b>	<b>Resource Person</b>
<b>Day 1- 03.10.2019 (Thursday)</b>		
<b>09:00 – 10.00</b>	<b>Registration</b>	
<b>10:00 - 11.30</b>	Inaugural Session	
	Welcomes Address	<b>Dr. S.S. Randhawa</b> , Principal Scientific Office, HIMCOSTE.
	Honoring of Chief Guest	<b>Er. NeerajUppal</b> , Principal, Govt. Polytechnic, Sundernagar.
	Introduction & Course Objectives	<b>Dr. R. Dharmaraju</b> , Sr. Principal Scientist, CSIR-CBRI, Roorkee.
	Address by Chief Guest	<b>Ar. S. K. Negi</b> , Chief Scientist, CSIR-CBRI, Roorkee.
	Vote of Thanks	Principal/ Coordinator, ATC.
<b>11:30- 13:30</b>	Good Construction Practices	<b>Er. H. K. Jain</b> , CSIR-CBRI, Roorkee.
<b>13:30- 14:00</b>	Lunch break	
<b>14:00- 15:00</b>	Examining Quality of Materials and importance of Construction Tools for Good Quality of Construction.	<b>Er. Tanmay Kapoor</b> , HOD, Civil Engineering, Govt. Polytechnic, Sundernagar.
<b>15:00- 17:00</b>	Layout of site. Construction Sample Foundation and Plinth. Construction of Plinth band. Visit to Demonstration Centre.	<b>Dr. R. Dharmaraju</b> , Sr. Principal Scientist and CSIR-CBRI, Team. <b>HIMCOSTE Team.</b>
<b>Day 2- 04.10.2019 (Friday)</b>		
<b>09:00- 09:30</b>	Recapitulating the previous Day's Learning.	<b>Er. H. K. Jain</b> , CSIR - CBRI, Roorkee.
<b>09:30- 13:30</b>	Constructing Hazard Resistant Foundations with corner vertical	<b>CSIR - CBRI, Roorkee Team and HIMCOSTE Team.</b>

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

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

<b>HIMCOSTE, Team Members</b>		
<b>S. NO.</b>	<b>Name</b>	<b>Designation</b>
<b>1.</b>	<b>Dr. S. S. Randhawa,</b>	<b>Principal Scientific Officer</b>

<b>2.</b>	<b>Sh. Gopal Jain</b>	<b>Scientific Officer</b>
<b>3.</b>	<b>Ar. Prem Lal</b>	<b>Asstt. Architect.</b>
<b>4.</b>	<b>Er. Kalit Bhardwaj</b>	<b>Sr. Tech Asstt.,</b>
<b>5.</b>	<b>Sh. Ramesh Kumar</b>	<b>Sr. Scientific Asstt.,</b>
<b>6.</b>	<b>Smt. Neena Sharma,</b>	<b>DEO, (Logistic Support).</b>
<b>7.</b>	<b>Er. Kanchan Rana</b>	<b>Jr. Research Fellow/ Master Trainer</b>
<b>8.</b>	<b>Sh. Tajender Kumar</b>	<b>Master Trainer.</b>

## **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 3<sup>rd</sup> to 5<sup>th</sup> 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 Sundernagar Distt. Mandi	96256 98383
4	Sh. Karam Singh	Sh. Khajana Ram	Chamukha	Vill. Hawali P.O. Churad Tehsil Sundernagar Distt. Mandi	98574 16351
5	Sh. Prabha 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 Thalagdhara 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. Jogal Ram	Barto	Vill. Jadron P.O. Biala Tehsil Sundernagar Distt. Mandi	--
9	Sh. Krishan Ram	Sh. Jogal 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 Distt. Mandi	86791 53195
16	Sh. Sher Singh	Sh. Narayan Singh	Samoun	Village Kunela P.O. Nalag Tehsil	98178 39234

				Sundernagar Distt. Mandi	
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 Distt. Mandi	88945 71835
19	Sh. Roop Singh	Sh. Narapat Ram	Churad	Village Bhanglar P.O. Kapahi Tehsil Sundernagar Distt. Mandi.	82191 23300
20	Sh. Sunder Singh	Sh. Soju Ram	Nalag	Village Behana P.O. Nalag Tehsil Sundernagar Distt. Mandi	98828 74823
21	Sh. Hem Raj	Sh. Ram	Barto	Village Luhanu P.O. P.O. Biala Tehsil Sundernagar Distt. Mandi	98164 34825
22	Sh. Jai Lal	Sh. Budhu Ram	Nalag	Village Behana P.O. Nalag Tehsil Sundernagar Distt. Mandi	85805 03925
23	Sh. Budhi Ram	Sh. Narayan	Nalag	Village Behana P.O. Nalag Tehsil Sundernagar Distt. Mandi	----
24	Sh. Prem Lal	Sh. Sikru Ram	Chanol	Village Chanol P.O. Taleli Tehsil Sundernagar Distt. Mandi	96252 28514
25	Sh. Niku Ram	Sh. Sant Ram	Chanol	Village Chanol P.O. Taleli Tehsil Sundernagar Distt. Mandi	78075 92241
26	Sh. Gian Chand	Sh. Mangta Ram	Barto	Village Jagroun P.O. Biala Tehsil Sundernagar Distt. 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. PremLal**, **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 course 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 session was led by **CSIR - CBRI, Roorkee Team and HIMCOSTE Team**. The plinth is constructed on site.



The bars 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 P8** 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 understand 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 also discussed.

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. 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 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 is 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.



## SECOND MODULE OF MASON TRAINING

(05-07December, 2019)

Second module of three days training programme on “Earthquake Resistant Construction Techniques” was from 5-7 December, 2019 and was focused on strengthening disaster preparedness with “built back better” concept through integration of disaster risk reduction measures. Such efforts to reduce risk and create opportunities for local development and sustainable livelihoods are made.

Localisation of disaster risk reduction will also ensure that we make the most of traditional best practices and indigenous knowledge. The training through its various learning sessions covers housing typologies hazard occurrence and impacts principles of hazard resistant construction importance of site and soil conditions specific safety features for foundation and plinth walls and roof.



## **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:**   **05-07December, 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.**

<b>Day/Sessions</b>	<b>Topic</b>	<b>Resource Person</b>
<b>Day 1- 05.12.2019 (Thursday)</b>		
<b>09:00 – 10:00</b>	<b>Registration</b>	
<b>10:00 - 11:30</b>	Inaugural Session	
	Welcomes Address	<b>Dr. S.S. Randhawa</b> , Principal Scientific Office, HIMCOSTE.
	Honoring of Chief Guest	<b>Sh. Gopal Jain</b> Scientific Officer, HIMCOSTE
	Introduction & Course Objectives	<b>Ar. PremLal</b> Asstt. Architect, HIMCOSTE
	Address by Chief Guest	<b>Sh. Gopal Jain</b> Scientific Officer, HIMCOSTE
	Vote of Thanks	Principal/ Coordinator, ATC.
<b>11:30- 13:30</b>	Recapitulating the previous Day's Learning.	<b>HIMCOSTE, Team Members</b>
<b>13:30- 14:00</b>	Lunch break	
<b>14:00- 15:00</b>	Constructing hazard resistant features	<b>HIMCOSTE, Team Members</b>
<b>15:00- 17:00</b>	Understanding the implications of hazard resistant features on cost of construction through comparative cost estimation.	<b>HIMCOSTE, Team Members</b>
<b>Day 2- 06.12.2019 (Friday)</b>		
<b>09:00- 09:30</b>	Recapitulating the previous Day's Learning.	<b>HIMCOSTE, Team Members</b>
<b>09:30- 13:30</b>	Listing various elements of construction based on the house designs.	<b>HIMCOSTE, Team Members</b>

<b>13:30- 14:00</b>	Lunch break	
<b>14:00- 15:00</b>	Quantities of materials required for each of the building elements.	<b>HIMCOSTE, Team Members</b>
<b>15:00 - 17:00</b>	Cost comparison with or without be hazard resistant materials and discussion.	<b>HIMCOSTE, Team Members</b>
<b>DAY 3 - 07.12.2019 (Saturday)</b>		
<b>9:00 – 09:30</b>	Recapitulating the previous Day's Learning.	<b>HIMCOSTE, Team Members</b>
<b>9:30- 12:00</b>	Clarifying any new questions for an answer questions on hazard resistant construction.	<b>HIMCOSTE, Team Members</b>
<b>12:00 – 13:00</b>	Trainers ask again about the situations which they face in regards to building hazard resistant homes.	<b>HIMCOSTE, Team Members</b>
<b>13:00 – 14:00</b>	Lunch break	
<b>14:00- 16:00</b>	Concluding session in which feedback of trainees is sought on the training and trainers.	Distribution of TA/DA.
<b>16:00- 17:00</b>	Certificate distribution	

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

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

<b>HIMCOSTE, Team Members</b>		
<b>S. NO.</b>	<b>Name</b>	<b>Designation</b>
<b>9.</b>	<b>Dr. S. S. Randhawa,</b>	<b>Principal Scientific Officer</b>
<b>10.</b>	<b>Sh. Gopal Jain</b>	<b>Scientific Officer</b>
<b>11.</b>	<b>Ar. PremLal</b>	<b>Asstt. Architect.</b>
<b>12.</b>	<b>Er. Kalit Bhardwaj</b>	<b>Sr. Tech Asstt.,</b>
<b>13.</b>	<b>Sh. Ramesh Kumar</b>	<b>Sr. Scientific Asstt.,</b>
<b>14.</b>	<b>Smt. Neena Sharma,</b>	<b>DEO, (Logistic Support).</b>
<b>15.</b>	<b>Er. KanchanRana</b>	<b>Jr. Research Fellow/ Master Trainer</b>
<b>16.</b>	<b>Sh. Tajender Kumar</b>	<b>Master Trainer.</b>

## **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.

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### **Training methods**

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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 5<sup>th</sup> to 7<sup>th</sup> December 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
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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 Distt. Mandi	86791 53195
16	Sh. Sher Singh	Sh. Narayan Singh	Samoun	Village KunelaP.O. Nalag Tehsil	98178 39234

				Sundernagar Distt. Mandi	
17	Sh. ChuniLal	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 Distt. Mandi	88945 71835
19	Sh. Roop Singh	Sh.Narapat Ram	Churad	Village Bhanglar P.O. Kapahi Tehsil Sundernagar Distt. Mandi.	82191 23300
20	Sh. Sunder Singh	Sh. Soju Ram	Nalag	Village Behana P.O. Nalag Tehsil Sundernagar Distt. Mandi	98828 74823
21	Sh. Hem Raj	Sh. Ram	Barto	Village Luhanu P.O. P.O. Biala Tehsil Sundernagar Distt. Mandi	98164 34825
22	Sh. Jai Lal	Sh. Budhu Ram	Nalag	Village Behana P.O. Nalag Tehsil Sundernagar Distt. Mandi	85805 03925
23	Sh. Budhi Ram	Sh. Narayan	Nalag	Village Behana P.O. Nalag Tehsil Sundernagar Distt. Mandi	----
24	Sh. PremLal	Sh. Sikru Ram	Chanol	Village Chanol P.O. Taleli Tehsil Sundernagar Distt. Mandi	96252 28514
25	Sh. Niku Ram	Sh. Sant Ram	Chanol	Village Chanol P.O. Taleli Tehsil Sundernagar Distt. Mandi	78075 92241
26	Sh. Gian Chand	Sh. Mangta Ram	Barto	Village Jagroun P.O. Biala Tehsil Sundernagar Distt. Mandi.	98171 27 694



The training methods involved theoretical sessions as well as hands on practice. This is a generic module and can be adapted to local and regional construction typologies. It is expected that ongoing training programs under PMKVY, DDU-GKY, PMAY and other such schemes shell adopt this module to build local capacities for hazard resistant housing and minimising damage and loss due to natural hazards.

P11 is a practical session which is meant to introduce participants to various other house elements where hazard resistant features need to be incorporated these elements are staircases, parapets, balconies, chajjas, verandas extra. Vulnerability due to furniture and service installations is also discussed and necessary steps are evolved by a participatory method.







P12this session introduces participants to understanding the implications of hazard resistant features on cost of construction through comparative cost estimation. Here, it is stressed that safety is a choice that the owner and Mason make along with aesthetic choices. In case of budget constraints often safety is compromised over specific choice of elements and materials. Such questioning it is hoped will help and guide the participants to make correct choices when restraint bi limited budget or other such limitation.

P13 This session includes listing

various elements of construction based on the house designs provided by the trainers with brick and stone walls using appropriate foundation. Based on local construction practices more material options may be taken up.







P14 This session also includes quantities of materials required for each of the building elements like foundation walls bands roofs roofing materials vertical reinforcements and openings.

Rates of materials collected from local market and participants and

trainers

knowledge.

Cost estimation for each elements of the house and overall cost of the house in absolute and per square metre terms.

P15 is session which includes Cost comparison with or without be hazard resistant materials in absolute and per square metre terms. In this session the method included was finding and identifying various house



elements material requirements quantities of those materials rates based on question answers and consensusbuilding through participative discussion.





P16 it is meant for clarifying any new questions for an answer questions on hazard resistant construction that participants may have. This gives opportunity to discuss the questions and understand correct answers.

P17 In this session the trainer ask again about the situations which they face

in regards to building hazard resistant homes which has not been dealt with in the training program. Other participants encouraged to answer these questions and the trainers clarify the unanswered questions. Questions by trainees was first attempted by other trainees.





P18 the training culminates with concluding session in which feedback of trainees is sought on the training and trainers.

Trainer's feedback on the entire group of participants is sought in this session. Further

any unanswered questions for participants are be clarified in this session. To conclude the training missions handbook and participation certificate are distributed.

**Training feedback:** Looking back from the first day in up cards and assessing if the objectives and expectations of each person have been met.

**Trainer feedback:** The trainers ask the trainees to share their experience weather their expectations we met and also elaborate on the parts of the training that will help them in their future engagement in construction.

**Trainee feedback:** Trainers talk about the response of the trainees. The part of the training the trainer responded well and part where the trainers expectations were not met well and where the trainees can further improve through training hand out.

**Distribution of hand-out:** explanation of how Masons main use it in their daily work. Distribution of trainees hand out booklet and presentation by trainers explaining how to use it.



**Certificate distribution:** Certificate distribution was done in the End Session.



The participants understand relevant variety of housing typology in the region traditional and conventional. They also know different materials, construction systems and template on the relevance of the



choice of materials to make his are resistant houses. Participants understand role play by using

available materials and help evolve the typologies in the region and its importance in adding hazard resistance to houses. Participants understand different hazards their currencies and frequency in the region. They also know about celebrity of disasters and methods of measuring there intensity.



Participants discuss different zones of hazards and locate their own region to relay with the intensity of possible hazards. Trainers evaluate the existing knowledge of the participants in using different tools.

### **Contextualizing the vulnerability in local construction:**

Anchoring: to ensure the entire house is well and curd the joinery between plinths and was between adjoining walls falls and roof and between different roof elements must be secured safely to ensure that they do not get damaged during an earthquake or a cyclone. Plasticity this is the property of a material to be able to come back to its original position.

For practical purposes these cannot be the only materials used in the building and therefore it becomes important to design buildings well to ensure that elastic materials are at the right place and in the right quantity.



A house should be able to come back to its original position after a hazard. The final structure is shown as follows.



Also materials that are elastic but which break suddenly when their limit of elasticity is crossed need to be used carefully in the construction.

Materials like Timber bamboo and steel are more elastic than materials like concrete blocks and earthen materials. Homes made of plastic materials may be able to come back to original positions more easily.

**Earthquake-resistant construction**, the fabrication of a building or structure that is able to withstand the sudden ground shaking that is characteristic of earthquakes, thereby minimizing structural damage and human deaths and injuries. Suitable construction methods are required to ensure that proper design objectives for earthquake-resistance are met.



Construction methods can vary dramatically throughout the world, so one must be aware of local construction methods and resource availability before concluding whether a particular earthquake-resistant design will be practical and realistic for the region. The Earthquake resistant opening (window) should be like this.



## **Feedbacks**

1. They said that they will teach other masons these techniques.
2. In the villages they don't use bands in load bearing structures, but now will use.
3. They said that they have learned 70% new techniques.
4. They committed that they will use these techniques in the construction and aware other masons also about this technique.