RESULT AND DISCUSSION

CHAPTER IV

RESULTS AND DISCUSSION

Findings of the research work on the organic building materials are described and discussed in this chapter. To ignore biased ness in results due to different geographical factors in the state the residential buildings in hill as well as plain region were selected and cumulative results are presented.

The findings are presented in composite frequency and percentage summary tables. These are followed by statistical applications for testing the hypotheses. Important views about the findings are discussed at the end of the chapter in order to review, correlate and justify the results. This is done under light of few studies of other researchers and supported by some other facts. The results are summarized as per the objectives of the study under following sections:

4.1 Description of the respondents and their houses

4.2 Organic Building Materials

4.3 Experimental results

- Checklist of defective symptoms in the houses
- Short term memory
- Work and Fatigue
- Attention/ Concentration
- Temperature
- Humidity

4.4 Testing of hypotheses

Section: 4.1

Description of the Respondents and Their Houses

This section includes personal characteristics of the respondents, their family characteristics, general living habits and general information of their houses. The homemakers were the key respondents for the study.

1. Personal Profile of the Respondents

Personal profile of the respondents was comprised of age, educational qualification and employment status. (Table 2)

Mean age of the respondents was 36.20 years. Therefore, little less than half i.e. 40 percent of the respondents were found to be in the age group of 31-40 years. Their age differed by a standard deviation (S.D.) of $\pm$ 9.16 years. (Figure 7)

About one third of the respondents (39.50 percent) were highly qualified having a degree or diploma and none of them was illiterate. Less than one third of the respondents (27.00 percent) were having a low level of educational qualification. (Figure 8)

About more than three fourth of the respondents were unemployed (88 percent). They were housewives, taking care of their families and spending most of the time indoors. (Figure 9)

There is no control on allocation of housing. The social scientist investigates differences in health circumstances that actually do exist in the population. By asking a range of questions concerning the respondents' social, demographic, environmental and other circumstances, the social scientist analytically remove all other factors that might be related to variations in health experiences (Burridge et. al. 1993).

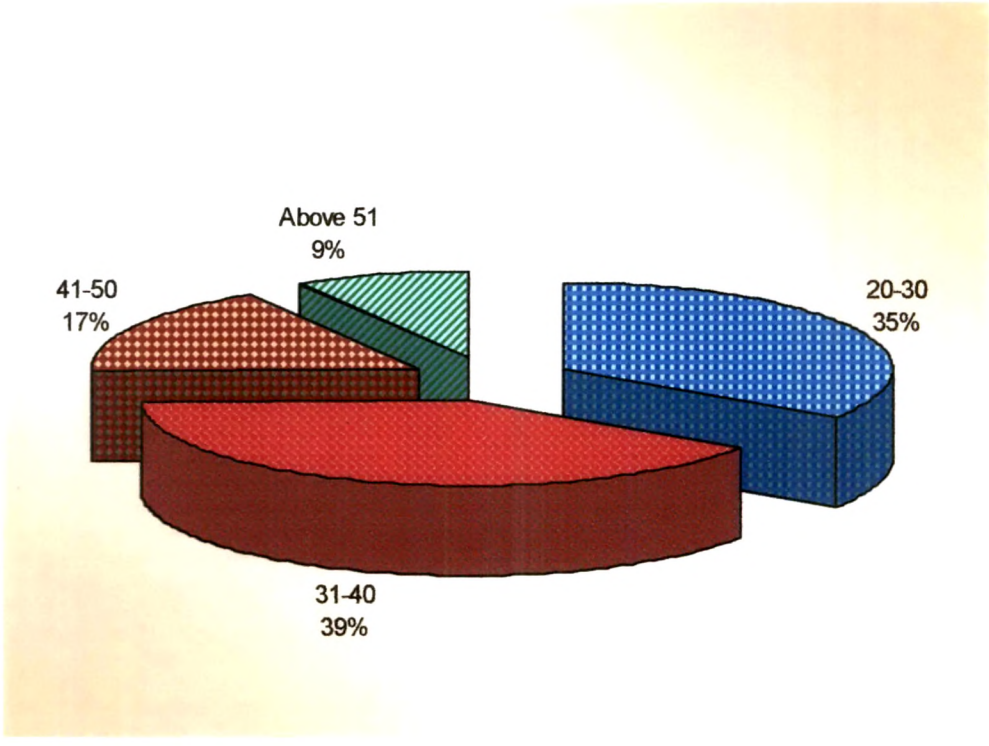


Figure 7: Personal Profile of the Respondents According to their Age (years)

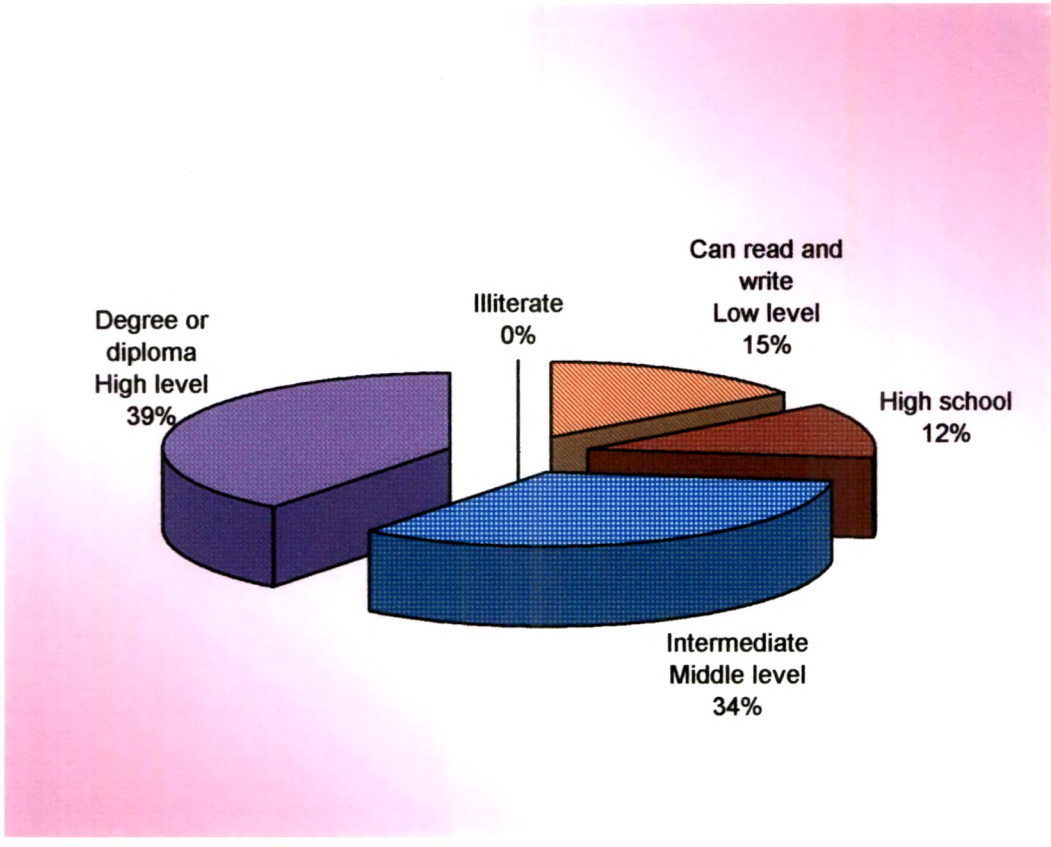


Figure 8: Personal Profile of the Respondents According to their Educational Qualification

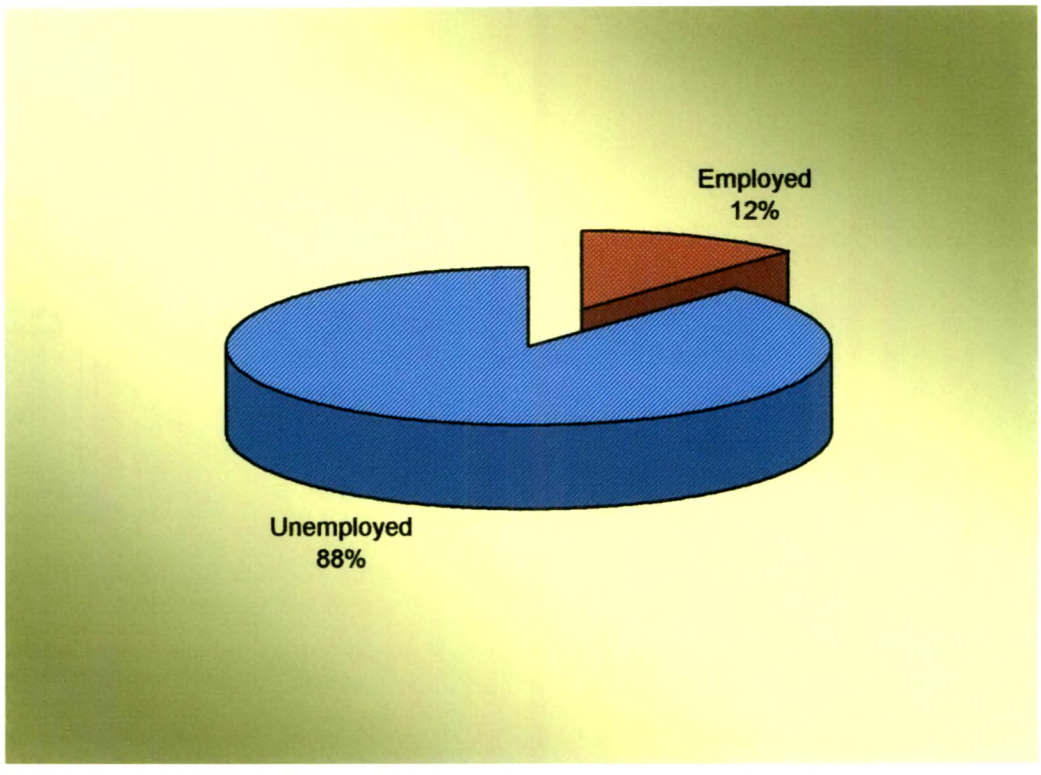


Figure 9: Personal Profile of the Respondents According to their Employment Status

Table 2: Personal Profile of the Respondents (n=200)

S. No.	Characteristics	Respondents	
		Frequency	Percentage
1	**Age (years)**		
	20-30	69	34.50
	31-40	80	40.00
	41-50	34	17.00
	Above 51	17	8.50
	Mean Age (Years)		36.20
	S.D.		±9.16
2	**Educational Qualification**		
	Illiterate	--	00.00
	Low level: Can read and write	30	15.00
	High school	24	12.00
	Middle level: Intermediate	67	33.50
	High level: Degree or diploma	79	39.50
3	**Employment Status**		
	Employed	24	12.00
	Unemployed	176	88.00

2. Demographic Profile of the Respondents

Occupational status and monthly income of the family were considered for demographic profile of the selected respondents.

Among the selected families more than a half of the families (67.50 percent) were having a medium size of the families consisting of 5-10 family members. Some of the families (13.50 percent) reported large family of more than 10 family members. (Figure 10)

About half (51.50 percent) of the respondents' families were having service as means of their income and a little less than half (42.50 percent) of the families were generating their income from business, but a few of them (5.50 percent) earned money from agriculture. (Figure 11)

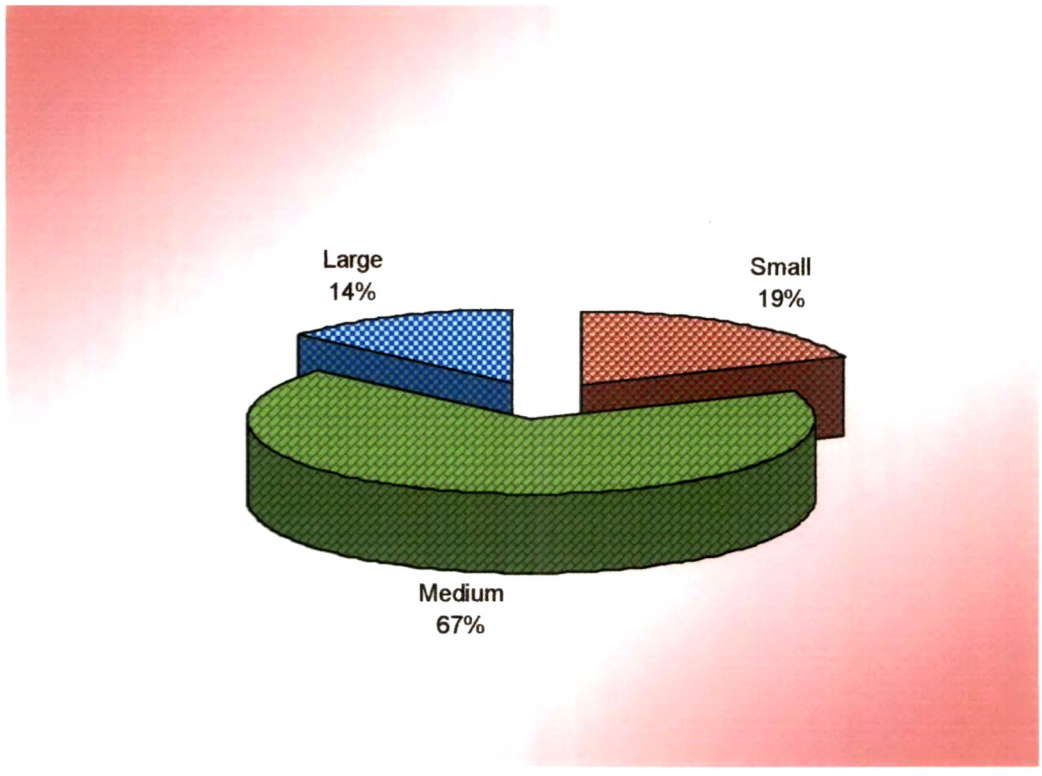


Figure 10: Demographic Profile of the Respondents according to their Family Size

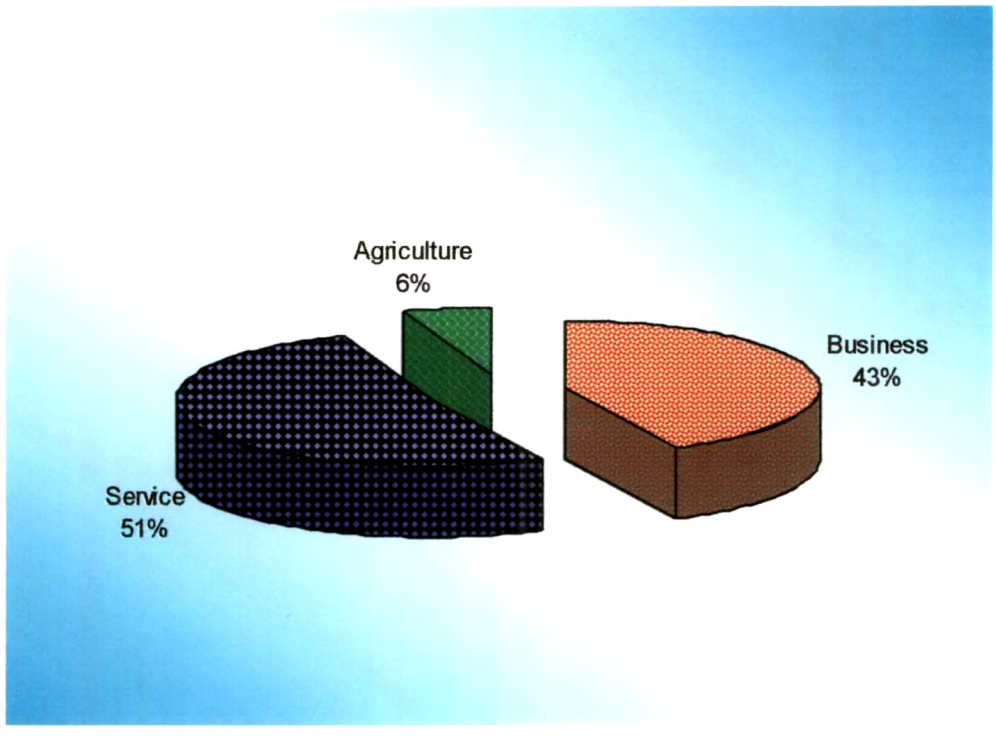


Figure 11: Demographic Profile of the Respondents According to their Occupational Status

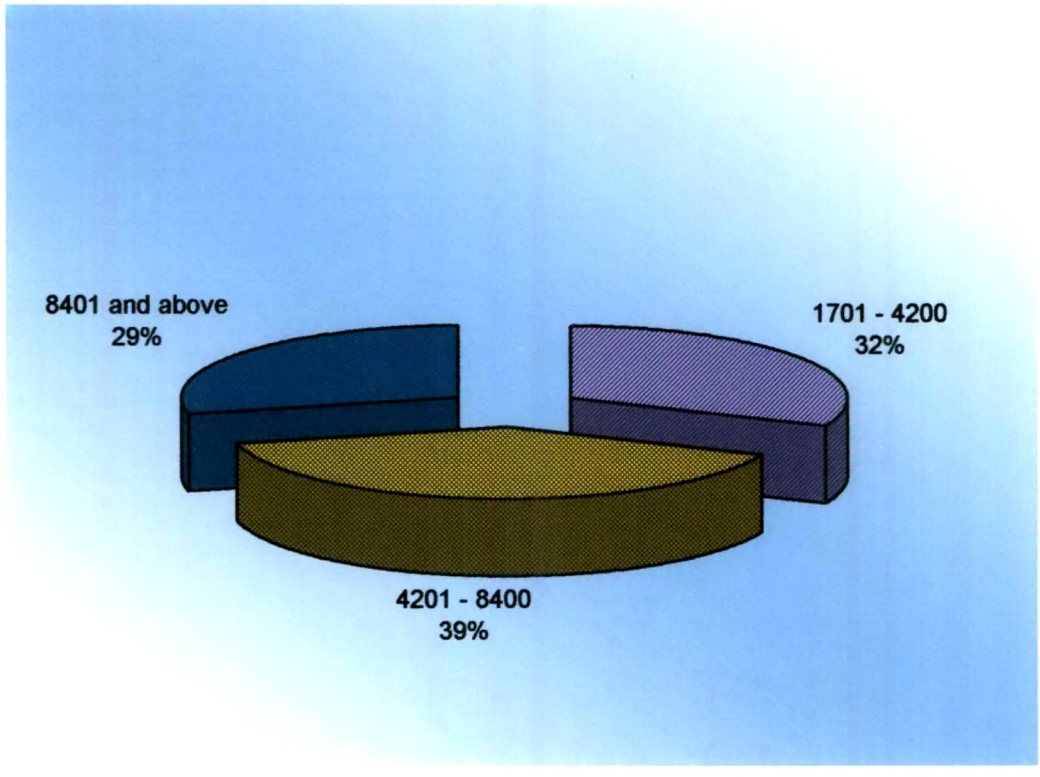


Figure 12: Demographic Profile of the Respondents According to their Monthly Income (Rupees)

The respondents were having family income of about Rs. 9,400 with a standard difference of ± Rs. 5826.92. Forty percent of them belonged to medium high level of monthly income. (Figure 12)

Thus medium size service class families were prominent with medium high income group.

Table 3: Demographic Profile of the Respondents (n=200)

S. No.	Characteristics		Respondents	
			Frequency	Percentage
1	**Family Size**			
	Small		38	19.00
	Medium		135	67.50
	Large		27	13.50
2	**Occupational Status***			
	Business		85	42.50
	Service		103	51.50
	Agriculture		11	5.50
3	**Monthly Income****			
	Medium:	1701-4200	63	31.50
	Medium high:	4201-8400	80	40.00
	High:	8401 and Above	57	28.50
	Mean Income			9400
	S.D.			±5826.92

* Figures shows multiple responses ** Taxation Inquiry Committee, 1991

3. General Information about the Houses of the Respondents

For the purpose of the study it was found important to record information about general conditions of the selected houses therefore location of the house, type of house, age of building structure and occupancy period was recorded. Therefore, fifty percent selected respondents were from hill areas and fifty percent were from plains.

Most of the houses (94.50 percent) were *pucca* houses built with stone, bricks or any building material which is durable whereas, a very few of them were built as semi *pucca* (2.50 percent) and wooden (3 percent). Through many generations of use, people have found ways of getting around some of the limitations of naturally occurring organic construction materials. In addition to improving natural materials, technologies have developed many synthetic polymers, which are important in current constructions (Merritt, 1986) and make the houses *pucca*. (Plate 5 and Plate 6)

Table 4: General Information about the houses of the Respondents (n=200)

S. No.	Characteristics	Respondents	
		Frequency	Percentage
1	**Location of House**		
	Hills	100	50.00
	Plains	100	50.00
2	**Type of House**		
	Kuchcha	--	--
	Pucca	189	94.50
	Semi *pucca*	5	2.50
	Wooden	6	3.00
3	**Age of building structure (years)**		
	Less than 5	--	--
	6-10	57	28.50
	More than 11	143	72.50
4	**Occupancy period (years)**		
	Less than 5	--	--
	6-10	163	81.50
	More than 11	37	18.50

Plate 5: A Modern Wooden House (*Pucca)*

Plate 6: A Traditional Thatched House (*Kachcha)*

Among the selected residences about three fourth of the houses (72.50 percent) were built more than ten years ago and some of them were built between 5-10 years (28.50 percent) ago.

Among the selected respondents most of them (81.50 percent) were living in the selected houses for more than ten years and some of them were residing for 5-10 years (18.50 percent).

From the Table 4 it is evident that most of the houses were *pucca* having built before more than eleven years and the respondents were residing in them for about 6-10 years which is enough time to find out relationship of building materials with the health, performance and environmental factors.

4. General Living Habits of the Respondents

Cecere et. al. (1998) reported that environmental and demographic risk factors are associated with the type of roof, presence of cracks in the walls and number of people living in the house. Thus general living habits like type of fuel used, numbers of smokers and period of occupancy per day was recorded.

Most of the selected families were using LPG (91.50 percent) as a fuel for cooking and about one third of them were using electricity (35.50 percent) as a fuel for lighting, cooking as well as heating.

Eighty percent of the respondents were not having any smoker in their families who smoked in the houses.

Housewives were the member of families spending most of the time in their houses. Most of them were spending 19-24 hours (80 percent), some of them were spending 13-18 hours (17.50 percent) and very few of them were spending 6-12 hours (2.50 percent) in their houses. Townsend et. al. in 1988 also recommended that 'Hosing conditions are associated

with health status in a variety of ways'. The conditions were found to be very much suitable to assess effect of OBM on the residents.

Table 5: General Living Habits of the Respondents (n=200)

S. No.	Characteristics	Respondents	
		Frequency	Percentage
1	**Type of fuel used***		
	Wood and dung cakes	--	--
	Kerosene	6	3.00
	LPG	183	91.50
	Electricity	71	35.50
2	**Smoker in house**		
	Yes	40	20.00
	No	160	80.00
3	**Period of occupancy per day**		
	Less than 6 hours	--	--
	7-12 hours	5	2.50
	13-18 hours	35	17.50
	19-24 hours	160	80.00

* Figures shows multiple responses

SECTION: 4.2

Organic Building Materials

This section includes information about various organic building materials and their availability, throwing a light on extent of use of various organic building materials in homes and also on their purposes for using them. It reveals results of aspects of care and maintenance of the homes and problems perceived/experienced by the residents during care and maintenance and also deals with health problems /symptoms / syndromes perceived as an effect of organic building material in the homes. The

section also discusses level of knowledge regarding OBM and satisfaction derived after using the OBM on various parameters by the respondents.

5. Building Materials and Their Sources

Source of building can be defined as the outlet of building materials from where the consumers could buy construction materials for construction and renovation purposes in their houses. The sources were categorized in to three; local market, district market and market of the other state out side the native state. After that respondents were asked to report the sources from which the materials were bought by them. (Table 6)

About more than a half of the respondents reported that they got building materials for the masonry (63.00 percent) and metals (64.50 percent) from district market. Whereas, it was also reported that a large number of the respondents (95.00 percent) preferred to buy protective/decorative finishes from district market. Just about a half of the respondents got materials like wood/plastic/glass (68.50 percent) and roofing/sealant/adhesive (59.00 percent) in the local market. Building materials for reinforcement/basic material were available in the local market, district market as well as the markets of the state and the respondents bought them as per their feasibility and convenience.

It was observed that the materials for roofing / sealants/ adhesives were available in the local market but other building materials were available within the district market and the materials for reinforcement / basic structure was found in out of state markets.

Table 6: Building Materials and Their Sources (n=200)

S. No.	Building Materials	Respondents	
		Frequency	Percentage
1	**MASONRY**		
	From local market	72	36.00
	Within the district	126	63.00
	From other state	12	6.00
2	**METALS**		
	From local market	15	7.50
	Within the district	129	64.50
	From other state	56	28.00
3	**WOOD/PLASTIC/GLASS**		
	From local market	137	68.50
	Within the district	13	6.50
	From other state	50	25.00
4	**ROOFING/SEALANT/ADHESIVE**		
	From local market	118	59.00
	Within the district	78	39.00
	From other state	4	2.00
5	**PROTECTIVE/DECORATIVE FINISHES**		
	From local market	3	1.50
	Within the district	190	95.00
	From other state	7	3.50
6	**REINFORCEMENT/BASIC STRUCTURE**		
	From local market	25	12.50
	Within the district	78	39.00
	From other state	97	48.50

* Figures shows multiple responses

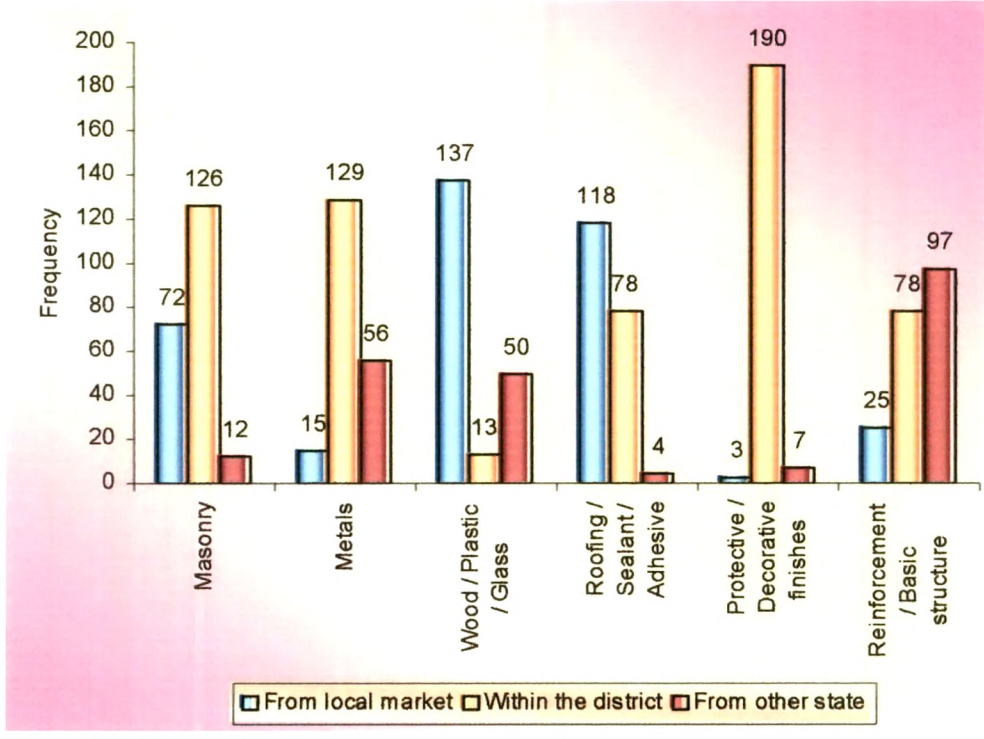


Figure 13: Building Materials and their Sources

6. Finishes/Techniques used for selected factors causing damage to the houses

Weathering is a process of disintegration of building structure as a result of environmental forces; moisture, gases, sunlight, humidity, temperature, etc. Besides, environmental forces some environmental hazards like earthquakes and factors of infestation like termite also affect durability of the building materials thus the building structure. The houses were categorized into various areas on the basis of their utility in the home then respondents were asked to report the type of finishes used specifically to withstand the hazards. Data observed in Table 7 shows the finishes / techniques used by the respondents to withstand accidents due to these environmental hazards.

a. Entire House

Among the selected residents about half (45.50 percent) of the respondents have given protective finishes to entire house to get rid of problems arising due to dampness especially during rainy season, very few gave treatment for preventing electric shock (28.50 percent) and termite (14.50 percent).

b. Specific Area

It was found that sometimes residents applied finishes or used specific material to withstand accidents. In living room some of the respondents applied finishes against termite (31.50 percent), dampness (20 percent) and very few of them for electric shock (8.50 percent). It was also reported by the respondents that 20 percent of them used termite resistance for their bed room and store room, 25.50 percent of them for kitchen and some other areas of the houses. Fire proof materials in kitchen were found only in 14.50 percent of the houses. Different architectural measures were also used by very few (2.50 percent) residents to make bed room, store room and verandah earth quake -

Table 7: Finishes/Techniques used for selected factors causing damage to the houses (n=200)

S. No.	Area	Factors causing damage									
		Termite		Fire		Earth Quake		Electric Shock		Dampness	
		F	%	F	%	F	%	F	%	F	%
1	**Entire House**	29	14.50	--	--	--	--	57	28.50	91	45.50
2	**Specific Area**										
	Living Room	63	31.50	--	--	--	--	17	8.50	40	20.00
	Bed Room	40	20.00	--	--	5	2.50	29	14.50	29	14.50
	Kitchen	51	25.50	29	14.50	--	--	23	11.50	40	20.00
	Store Room	40	20.00	--	--	5	2.50	17	8.50	29	14.50
	Bath Room	23	11.50	--	--	--	--	34	17.00	23	11.50
	Stair cases	5	2.50	--	--	--	--	11	5.50	17	8.50
	Verandah	11	5.50	--	--	5	2.50	--	--	23	11.50

resistant. Electric shock resistance was provided by the residents usually in bathroom (17 percent), kitchen (11.50 percent) and bed room (14.50 percent). Various measures were found to be important for damp proofing in living room (20 percent), bed room (14.50 percent), store room (14.50 percent) and kitchen (20 percent). (Figure 13)

It is clear from the table that finishes against dampness, electric shock and termite was a common practice among the selected respondents. Some of them also used finishes / techniques to withstand fire, termite and earthquakes. Studies by Turkulin and Sell (2002), Trajkovic et. al. (1999), Despot et. al. (1999), Razek (1998) showed the positive effect of finishes on durability of the building materials.

7. Purpose and Areas Covered By Building Materials Used In Residential Constructions

a. As Basic Material

Wood was the material used by all the residents (Plates 7-10) for doors, windows, ventilators, cupboards and half of the respondents for floors, roofs, working counters and staircases whereas, about one third of them used it for electric fitting boards (33.33 percent). Stone was also used as basic material (Plates 11, 12, 13) for roofs, cupboards, walls and working counters by about half of the respondents.

Agrawal and Jain in their study conducted in 1991, reported that there are various alternative building materials used as substitute for wood such as fibre boards, gypsum boards, PVC boards, EPS sandwich composites, FRP panels etc. Different products, particularly doors and windows are available in Indian market made of these materials and they have been generally used by the people in their homes, despite of, they have not been sufficiently tested for their suitability and performance.

Table 8: Purpose and Areas Covered by Building Materials Used In Residential Constructions (n=12)

S. No.	Material	Areas Acquired										
		Floors	Walls	Roofs	Doors	Windows	Ventilators	Cupboards	Working Counters	Electric Fittings	Plumbing	Staircases
A	AS BASIC MATERIAL											
1	Stone	--	8 66.67	6 50.00	--	--	--	6 50.00	6 50.00	--	--	1 8.33
2	Bricks	--	4 33.33	--	--	--	--	--	--	--	--	--
3	Wood	6 50.00	2 16.67	6 50.00	12 100	12 100	12 100	12 100	6 50.00	4 33.33	--	6 50.00
4	Iron	--	--	--	--	12 100	12 100	--	--	--	--	--
5	Steel	--	--	--	--	--	--	--	--	--	4 33.33	--
6	Aluminum	--	--	--	--	--	--	--	--	--	12 100	--
7	Sand	--	--	--	--	--	--	--	--	--	--	--
8	Plastic	--	--	--	--	--	--	--	--	8 66.67	--	--

Table 8 contnued.....

B	AS FINISHING MATERIAL											
1	Stone	5 41.67	--	--	--	--	--	--	--	--	--	--
2	Bricks	--	--	--	--	--	--	--	--	--	--	--
3	Wood	--	--	--	--	--	--	--	--	--	--	--
4	Iron	--	--	--	12 100	12 100	12 100	12 100	--	--	--	--
5	Steel	--	--	--	--	--	--	--	--	--	--	--
6	Aluminum	--	--	--	--	--	--	--	--	--	--	--
7	Sand	--	--	--	--	--	--	--	--	--	--	--
8	Plastic	--	12 100	--	--	--	--	--	--	--	--	--
9	Paint	--	12 100	6 50.00	12 100	12 100	12 100	12 100	7 58.33	--	--	6 50.00
10	Glass	4 33.33	--	--	--	9 75.00	10 83.33	7 58.33	--	--	--	--

Figure in parentheses are percentages of total.

Plate 7: Exterior application of OBM in the House (Source: CBRI, Roorki)

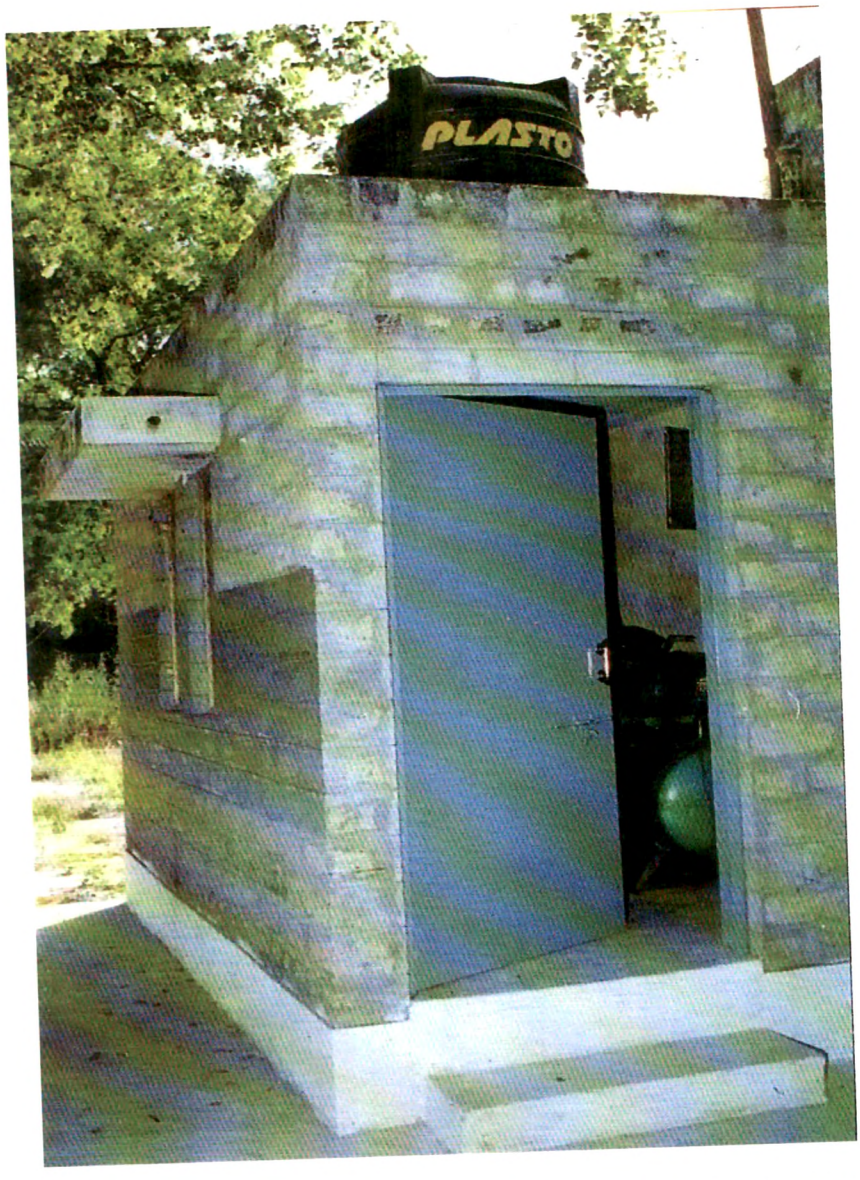


Plate 8: Interior application of OBM in the House (Source: CBRI Roorki)

Plate 9: Use of Wood in doors of the House

Plate 10: Use of Wood in roof of the House

Plate 11: Use of stone in roof of the house

Plate 12: Use of stone in stairs of the house

Plate 13: Use of stone in walls of the house

b. As Finishing Material

Some building materials were used as finishes or supporting material either to add coagulation property or aesthetics to the residences. All the houses used paints on walls, doors, windows, ventilators, cupboards and working counters, windows and ventilators. Plastic was the OBM used by all the respondents for finishing on walls.

Table 8 and corresponding plates showed that naturally occurring organic building materials are very much use in the selected area. Some synthetic OBM like polymers were also used to improve functionality, durability and aestheticity in the houses.

8. Extent of Use of Organic Building Materials in the Selected Residential Constructions

The organic building materials used by the respondents in their houses were listed and their extent of use in their houses was determined on the basis of their notations for the use of materials in all the areas, most of the areas and some of the areas. (Table 9)

A little less than half of the respondents (44 percent) reported that they used wood and its products in most of the areas of their residential constructions. Plastics and its derivatives were used by about half of the respondents in most of the areas (55 percent) and another half of the respondents in some of the areas (45 percent). Only some of the respondents reported that they used asphalt (12.50 percent) and bitumen (21.50 percent) in some of the areas of their home. Resins/adhesives being important building materials were used by all of the respondents in varying degrees, viz. in all of the areas (39.50 percent), most of the areas (13.50 percent) and some of the areas (47 percent) of the home. (Figure 14)

Table 9: Extent of Use of Organic Building Materials in the Selected Residential Constructions (n=200)

S. No.	Organic Building Materials	Extent of Use					
		All the Areas		Most of the Areas		Some of the Areas	
		F	%	F	%	F	%
1	Wood and its products	35	17.50	88	44.00	77	38.50
2	Plastics and its derivatives	--	--	110	55.00	90	45.00
3	Asphalt	--	--	--	--	25	12.50
4	Bitumen	--	--	--	--	43	21.50
5	Resins/adhesives	79	39.50	27	13.50	94	47.00

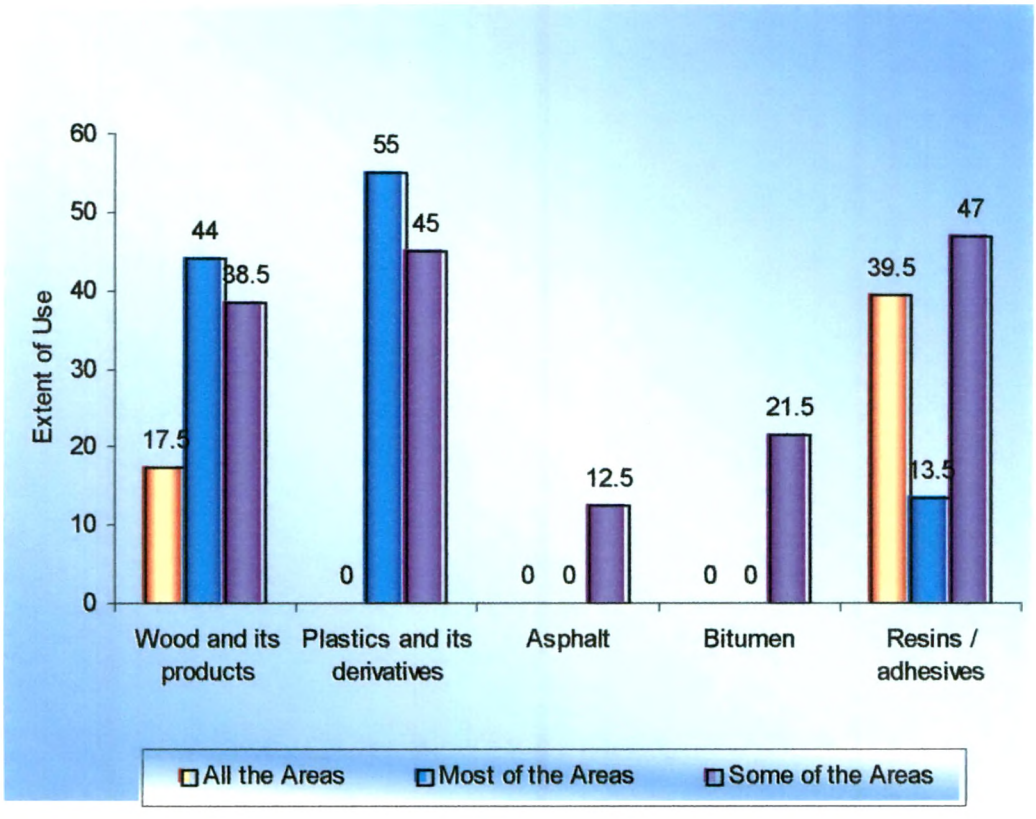


Figure 14: Extent of Use of Organic Building Materials in the Selected Residential Constructions

9. Care and Maintenance in the Residential Constructions

Data in Table 10 revealed that most of the respondents took care and maintenance of wash basins, working counters and bath tub (93.50 percent), cupboards (89.50 percent), doors, windows and ventilators (85.50 percent), roofs and walls (86.50 percent) on their own. It is clear from the data that most of the care and maintenance was done by the respondents on their own therefore it helped the investigator in finding out the effect of OBM on the health of the respondents, satisfaction of the respondents towards use of OBM and also the problems in the care and maintenance of the house.

The respondents reported that time taken for the care and maintenance of the roofs and walls (83.50 percent), doors, windows and ventilators (61.50 percent), wash basins, working counters and bath tub (91 percent) and stairs and side supports (79 percent) was 30-60 minutes. Whereas, 60-90 minutes were involved in the care and maintenance of floors (48.50 percent) and cupboards. But more than 90 minutes were reported for cleaning of cupboards by little less than of the respondents (44 percent).

It is clear from the table that floors were cleaned daily by more than a half of the respondents (69.50 percent). Care and maintenance of roofs and walls (56.50 percent), doors, windows and ventilators (72.50 percent), cupboards (64.50 percent), washbasins, working counters and bath tub (54.50 percent) done weekly by more than half of the respondents. Roofs and walls requiring least maintenance was reported by about one third of the respondents (29.50 percent).

Table 10: Details of Care and Maintenance in the Residential Constructions (n=200)

S. No.	Details	Area of the house											
		Roofs and walls		Floor		Doors, windows and ventilators		Cupboards		Wash basins, working counters and bath tub		Stairs and side supports	
		F	%	F	%	F	%	F	%	F	%	F	%
	Care and maintenance												
1	**Person involved**												
	Own	173	86.50	121	60.50	171	85.50	179	89.50	187	93.50	93	46.50
	Servant	27	13.50	79	39.50	29	14.50	21	10.50	13	6.50	107	53.50
2	**Time taken** ($min.month^{-1}$)												
	30-60 minutes	167	83.50	97	48.50	123	61.50	15	7.50	182	91.00	158	79.00
	60-90 minutes	32	16.00	103	51.50	77	38.50	97	48.50	16	8.00	1	0.50
	more than 90 min.	1	0.50	--	--	--	--	88	44.00	2	1.00	41	20.50
3	**Frequency**												
	Daily	--	--	139	69.50	21	10.50	3	1.50	32	16.00	13	6.50

	Weekly	113	56.50	61	30.50	145	72.50	129	64.50	109	54.50	87	43.50
	Monthly	28	14.00	--	--	27	13.50	62	31.00	59	29.50	48	24.00
	Yearly	59	29.50	11	--	7	3.50	6	3.00	--	--	52	26.00
4	**Cost involved**												
	Rs. 0-500	94	47.00	109	54.5	146	73.00	182	91.00	173	86.50	179	89.50
	Rs. 501-1000	87	43.50	68	34.00	43	21.50	7	3.50	27	13.50	18	9.00
	Rs. 1001 and above	19	9.50	23	11.50	11	5.50	11	5.50	--	--	3	1.50
5	**Type of Repair**												
	Own	3	1.50	7	3.50	13	6.50	--	--	--	--	--	--
	Hired	197	98.50	193	96.50	187	93.50	200	100	200	100	200	100
6	**Frequency of Repair**												
	Weekly	--	--	--	--	--	--	--	--	--	--	--	--
	Monthly	--	--	--	--	--	--	--	--	--	--	--	--
	Seasonal	200	100	200	100	200	100	200	100	200	100	200	100
7	**Cost involved**												
	Rs. 0-500 (per month)	--	--	19	9.50	39	19.50	--	--	--	--	7	3.50
	Rs. 501-1000 (-do-)	36	18.00	41	20.50	161	80.50	51	25.50	102	51.00	181	90.50
	Rs. 1001 and above	164	82.00	140	70.00	--		149	74.50	98	49.00	12	6.00

Cost involved in the cleaning and maintenance was reported least (Rs. 0-500 per month) in cupboards by 91 percent of the respondents and highest (Rs. 1001 and above) in the cleaning of the floors by 11.50 percent of the respondents. A little less than half of the respondents (43.50 percent) reported Rs. 501-1000 per month for cleaning and maintenance of the cupboards. All of the respondents hired people for repair in cupboards, washbasins, working counters and bath tubs and stairs and side supports. But few of the respondents (1.50 percent) reported that they repaired their roofs and walls on their own. The repair in the areas of the home was seasonal and involved Rs. 1001 and above for roofs (82 percent), floors (70 percent), cupboards (74.50 percent). Rs. 501-1000 reported for doors and windows and ventilators (80.50 percent), stairs and side support (90. 50 percent).

10. Physical Problems in Various Parts of the Residential Buildings Observed By the Respondents

Glasgow District Council (1989), Hunt, Martin and Platt (1986), Turkulin et. al. (1997) indicated quite clearly that various external and internal environmental as well as physical factors affects the quality of building materials and they sometimes became causal factors for physical problems in the houses. Several physical problems found generally in houses were asked to the respondents as given in Table 11.

Table 11: Physical Problems in Various Parts of the Residential Buildings Observed by the Respondents (n=200)

S.No.	Problems	Area of Residential Building											
		Walls		Roof		Doors		Windows		Floor		Cupboard	
		F	%	F	%	F	%	F	%	F	%	F	%
1	Deformity	150	75.00	45	22.50	55	27.50	40	20.00	35	17.50	25	12.50
2	Dampness	155	77.50	125	62.50	30	15.00	15	7.50	15	7.50	30	15.00
3	Flaking off	130	65.00	80	40.00	30	15.00	25	12.50	10	5.00	5	2.50
4	Shorter life of BM	25	12.50	10	5.00	50	25.00	15	7.50	5	2.50	15	7.50
5	Corrosion	15	7.50	5	2.50	60	30.00	65	32.50	5	2.50	35	17.50
6	Vegetative growth	55	27.50	25	12.50	5	2.50	10	5.00	10	5.00	5	2.50
7	Fire ignition	5	2.50	--	--	45	22.50	40	20.00	15	7.50	15	7.50
8	Dust release	75	37.50	55	27.50	90	45.00	95	47.50	90	45.00	50	25.00

Table 11 continued.....

9	Termite	5	2.50	--	--	105	52.50	75	37.50	5	2.50	60	30.00
10	Mold growth	35	17.50	15	7.50	20	10.00	25	12.50	5	2.50	30	15.00
11	Reaction with water	20	10.00	20	10.00	45	22.50	15	7.50	15	7.50	10	5.00
12	Reaction with food materials	5	2.50	--	--	--	--	--	--	15	7.50	10	5.00
13	Heating up	50	25.00	85	42.50	5	2.50	5	2.50	30	15.00	--	--
14	Noise	20	10.00	10	5.00	45	22.50	50	25.00	15	7.50	10	5.00
15	Fumes	30	15.00	25	12.50	45	22.50	60	30.00	5	2.50	15	7.50
16	Smell	30	15.00	10	5.00	15	7.50	15	7.50	15	7.50	55	27.50

Data revealed that in walls major physical problems reported by the respondents were deformity (75 percent), dampness (77.50 percent) and flaking off (65 percent). Fire ignition, termite and reaction with food materials were the problems least reported (2.50 percent) by the respondents.

Dampness in roofs was found to be a major physical problem in the houses of 62.50 percent of the respondents and corrosion (2.50 percent) and noise (5 percent) were the problems causing least problems for the respondents.

Termite was reported as a major problem in wooden doors (52.50 percent). Dust release (45 percent) and corrosion (30 percent) was also reported by about one third of the respondents. Vegetative growth and heating up were reported by 2.5 percent of the respondents only.

More or less same problems as in doors were found in the windows of the houses of the selected respondents. Termite caused deteriorative problems in about a little more than one third (37.50 percent) of the houses. Dust release (47.50 percent) and corrosion (32.50 percent) was reported by about one third of the respondents, too. The physical problems in windows least reported by the respondents was heating up.

Floors became problematic due to dust release in about half of the houses (45 percent). Shorter life of building material, fumes, termite and mold growth were also found as causal factors for deterioration in the houses by some of the respondents (2.50 percent). In the floors of the selected houses physical problems reported by some of the respondents (2.5 percent) were shorter life of building material and corrosion.

A little less than one third of the respondents reported about the termite (30 percent), dust release (25 percent) and smell (27.50 percent) in the cupboards. Whereas, the problems least reported were flaking off and vegetative growth by the 2.50 percent respondents.

Reasons for the problems reported were excessive water, air, termite in wood, smell due to water; soil, etc., rain, pollution, weeds (*gajar ghas*), garbage, etc.

11. Symptoms 0f Health Problems Perceived By Respondents in the Residential Constructions

Several studies by Strachan *et. al.* (1986); McCarthy *et. al.* (1985) and Blackman *et. al.* (1989), Boardman (1986) and Smith (1989) have found links among building materials and damp housing, the presence of mould and high rates of asthma and respiratory illness. Various health problems for which building materials found to be a causative factor were asked to the respondents.

Table12.a: Rank Order of Symptoms of Health Problems Perceived by Respondents in the Residential Constructions (n=200)

S. No.	Symptoms of Health Problems	Often	Sometimes	Never	Mean Value	Rank Order
1	Sneezing	55	100	45	0.683	IX
2	Dizziness	40	95	65	0.625	XVI
3	Cough	35	120	45	0.650	XIII
4	Headache	50	110	40	0.683	X
5	Nausea	65	75	60	0.576	XX
6	Fatigue	90	85	25	0.775	II
7	Excitement	60	100	40	0.370	XXI
8	Eye irritation	45	90	65	0.633	XV
9	Effect on hearing	90	45	65	0.708	V
10	Skin irritation	60	70	70	0.650	XIV
11	Effect on visibility	15	130	55	0.600	XVIII
12	Throat irritation	55	110	35	0.700	VII
13	Mental fatigue	80	35	85	0.658	XI

Table 12.a continued.....

14	Chest tightness	50	60	90	0.600	XIX
15	Shortness of breath	70	55	75	0.658	XII
16	Wheeze	65	35	100	0.608	XVII
17	Nose bleeds	75	65	60	0.692	VIII
18	Dry skin	70	100	30	0.733	**IV**
19	Skin rash	85	55	60	0.708	VI
20	Lethargy	90	95	15	0.792	**I**
21	Symptoms of humidifier fever	80	85	35	0.742	**III**

Table 12.a shows that lethargy was the health symptoms due to organic building materials felt by most of the respondents and thus ranked first with a mean value 0.792 among all the perceived health problems. Fatigue was ranked second (0.775) and symptoms of humidified fever ranked as third (0.742). The health problems perceived least among all were excitement (0.370), nausea (0.576) and chest tightness (0.600).

Table12.b: Extent of Symptoms of Health Problems Perceived by Respondents in the Residential Constructions (n=200)

S. No.	Extent of symptoms of health problems	Scores	Respondents	
			Frequency	Percentage
1	High	49-63	8	4.00
2	Moderate	35-48	190	95.00
3	Low	21-34	2	1.00

When the respondents were asked to report on various health problems due to organic building materials used in their houses, most of them (95 percent) reported that they have a moderate degree of health problems; some of them (4 percent) perceived the health problems to high extent and only one percent respondents perceived low extent of the health symptoms. (Table 12.b and Figure 15)

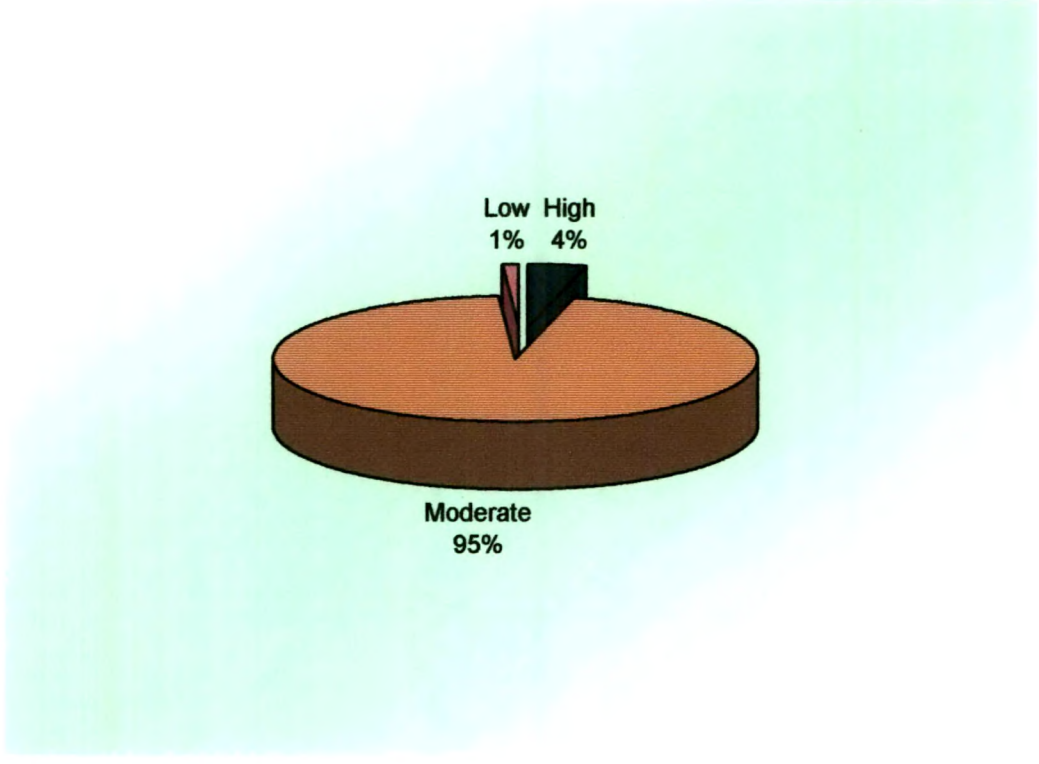


Figure 15: Level of Health Symptoms Perceived by Respondents in the Residential Construction

12. Health Syndromes Perceived By Respondents in the Residential Constructions

Syndrome is a term used to denote a health problem consisting of various symptoms of ill health. Health syndromes related to buildings were asked to the selected respondents and results are presented in the form of Table 15.

It is very much clear from the data given in Table 15 that building related health syndromes were found in the respondents residing in the houses of OBM. As far as sick building syndrome was concerned one fourth of the respondents reported symptoms of throat irritation as minor problem and symptoms of mucosa of skin as major problem. Symptoms of eye irritation were reported as major problem by none of them. Fifteen percent of the respondents perceived the mental fatigue as a minor health problem.

Among building related illness one fourth of them reported asthma like symptoms as major problem. Legionnaire's disease was also reported as a major problem by 7.50 percent of them.

Extreme dust sensitivity was reported as a major problem by 25 percent of the respondents. About one fourth of them also reported that they had extreme dust sensitivity (30 percent), chronic fatigue (22.50 percent) and headache (25 percent) as minor problems.

A study conducted by Singh, 1991 also revealed that the prime cause for a large number of fire deaths is the use of new materials, especially organic polymers in buildings both as integral parts and furnishings which are capable of producing wide variety of asphyxiant toxicants. These materials, no doubt have many advantages over inorganic traditional building materials, but some restrictions may be imposed to their use in building to reduce hazardous situations.

Table13: Health Syndromes reported by Respondents in the Residential Constructions (n=200)

S. No.	Health Syndromes	Major Problem		Minor Problem		No Problem	
		F	%	F	%	F	%
A	**SICK BUILDING SYNDROME**						
1	Symptoms of eye irritation	--	--	55	27.50	145	72.50
2	Symptoms of throat irritation	5	2.50	50	25.00	145	72.50
3	Symptoms of nose irritation	5	2.50	10	5.00	185	92.50
4	Symptoms of mucosa of skin	50	25.00	45	22.50	105	52.50
5	Mental fatigue	20	10.00	30	15.00	150	75.00
6	Arythema	5	2.50	--	--	195	97.50
B	**BUILDING RELATED ILLNESS**						
1	Asthma like symptoms	50	25.00	25	12.50	125	62.50
2	Legionnaire's disease	15	7.50	5	2.50	180	90
3	Hyper sensitivity	20	10.00	25	12.50	155	77.50
4	Humidifier fever	10	5.00	15	7.50	175	87.50
C	**MULTIPLE CHEMICAL SENSITIVITY**						
1	Extreme dust sensitivity	50	25.00	60	30.00	90	45.00
2	Chronic fatigue	20	10.00	45	22.50	135	67.50
3	Nausea	5	2.50	30	15.00	165	82.50
4	Headache	20	10.00	50	25.00	130	65.00

13. Level of Knowledge Regarding Organic Building Materials of the Respondents

The most important factor considered in collecting the items for the knowledge test was to include the various aspects of OBM like, their origin, use, constituents, utility, physiological and psychological effect and so on.

The level of knowledge of the respondents is determined in terms of whether they possess good, medium or low knowledge. This is measured by giving scores to answers for each item in the test and by addition of the scores for each respondent.

Table 14: Level of Knowledge Regarding Organic Building Materials of the Respondents (n=200)

S.No.	Level of Knowledge	Scores	Respondents	
			F	%
1	Low level	102-135	193	96.50
2	Middle level	136-170	7	3.50
3	High level	171-204	0	00.00

When respondents were asked several questions regarding OBM they scored 102-135 points and their knowledge level was found as low level by most of them (96.50 percent). Some of them (3.50 percent) scored 136-170 points and they fall under category of middle knowledge level regarding OBM. None of them showed high knowledge level. (Figure 16)

Thus need was felt to formulate a techno-kit (communication package) regarding information about knowledge. The package would enhance knowledge of the respondents thus improvement in awareness about OBM used in residential constructions.

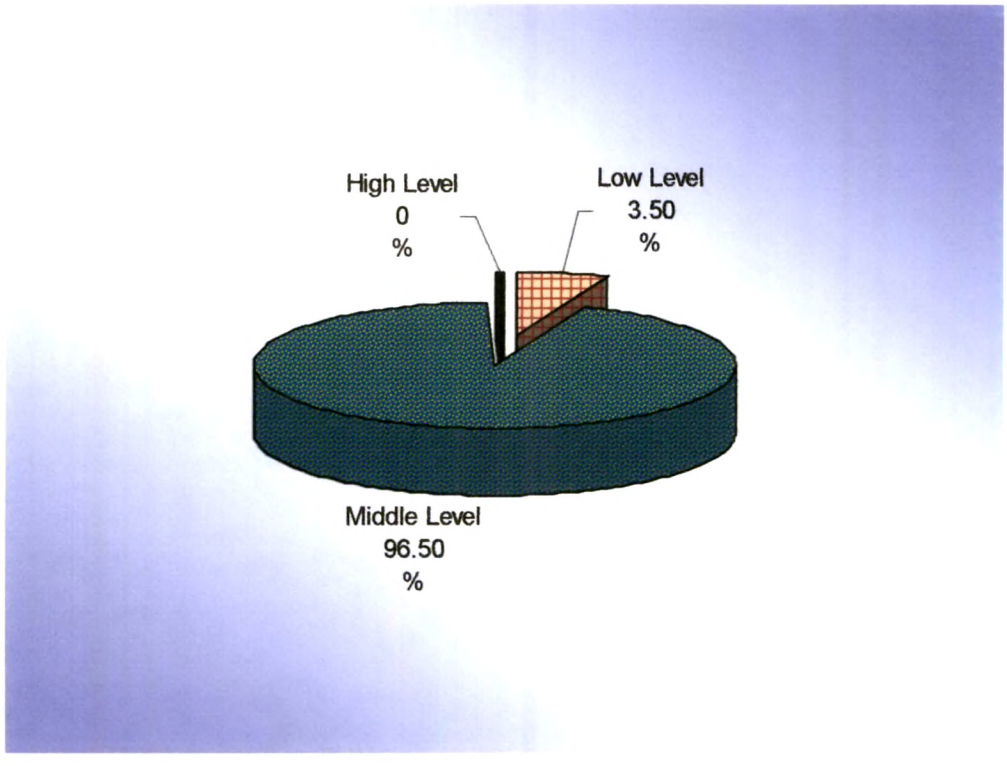


Figure 16: Level of Knowledge Regarding Organic Building Materials of the Respondents

14. Satisfaction Derived From Use of OBM in Residential Constructions

Data in Table 15.a justifies that the satisfaction derived after the use of OBM was ranked on the basis of cost, care and maintenance of house, function / purpose, safety and heath effects. The respondents were highly satisfied by safety and care and maintenance therefore ranked it first for satisfaction level. Function / purpose performed by OBM in home were ranked third. However, no health effects were ranked least.

Among different aspects taken for the satisfaction scale, cost of OBM at initial construction was ranked first and cost involved in cooling and heating were ranked lasts for aspects of costs involved in OBM constructions. For care and maintenance, the respondents were satisfied utmost with time involved in cleaning and the least satisfied with the time involved in repair. It inferred that if there was any defect in the building areas of OBM then it involved lot of money and efforts to be wasted. For functional purposes of OBM noise and light was efficiently controlled thus the respondents were satisfied with the purposes of OBM. Cooling in summers was the purpose with which the respondents were least satisfied. Among safety aspects, termite proof and damp proof were the aspects the respondents were highly satisfied.

For cost of OBM about half of the respondents (42.50 percent) were satisfied by its cost at the time of repair/ renovation. As no health effects were ranked least on the satisfaction level, about more than half of the respondents were not satisfied with no skin allergies (67 percent), no chemical reactions (66 percent), no eye irritation (64 percent), no respiratory problems (62 percent) and no fatigue or activeness (62 percent).

The results for some of the aspects reported by the respondents did not match with the problems reported earlier. The reason might be that in due course of time they got used to the problems.

Table 15.a: Satisfaction Derived From Use of OBM in Residential Constructions (n=200)

S. No.	Item/Statement	Highly Satisfactory		Satisfactory		Not Satisfactory		Mean Values	Rank Order (A)	Rank Order (B)
		F	%	F	%	F	%			
A	**COST**									
1	Cost of OBM at initial construction	64	32.00	55	27.50	81	40.50	0.64	III	II
2	Cost of OBM at time of renovation/repair	85	42.50	79	39.50	36	18.00	0.75	I	
3	Cost involved in cleaning	76	38.00	43	21.50	81	40.50	0.66	II	
4	Cost involved in heating of home	43	21.50	42	21.00	39	19.50	0.42	VI	
5	Cost involved in cooling of home	49	24.50	118	59.00	33	16.50	0.56	V	
6	Cost involved in transportation of products	37	18.50	97	48.50	66	33.00	0.62	IV	
B	**CARE AND MAINTENANCE**									

1	Number of persons needed to be involved while cleaning	46	23.00	100	50.00	54	27.00	0.65	III	
2	Frequency of care to be done	79	39.50	37	18.50	84	42.00	0.66	II	I
3	Time involved in cleaning	61	30.50	79	39.50	60	30.00	0.67	I	
4	Time involved in repair	49	24.50	73	36.50	78	39.00	0.62	IV	
C	**FUNCTION/PURPOSE**									
1	Heating in winters	34	17.00	94	47.00	72	36.00	0.60	VII	
2	Cooling in summers	43	21.50	64	32.00	93	46.50	0.59	VIII	
3	Noise control	82	41.00	76	38.00	42	21.00	0.73	I	
4	Durability	73	36.50	72	36.00	55	27.50	0.70	II	
5	Strength	55	27.50	73	36.50	72	36.00	0.64	V	III
6	Damp proofing	49	24.50	88	44.00	63	31.50	0.65	IV	
7	Light in weight	82	41.00	58	29.00	60	30.00	0.70	II	
8	Aestheticity	52	26.00	73	36.50	75	37.50	0.63	VI	
9	Fire proofing	67	33.50	58	29.00	73	36.50	0.65	IV	
10	Dust control	72	36.00	67	33.50	61	30.50	0.69	III	
D	**SAFETY**									
1	Electric shock proof	58	29.00	69	34.50	39	19.50	0.59	III	

2	Damp proof	78	39.00	97	48.50	25	12.50	0.76	I	
3	Earth quake resistant	25	12.50	78	39.00	97	48.50	0.55	IV	
4	Fire proof	34	17.00	85	42.50	81	40.50	0.59	III	I
5	Termite proof	82	41.00	81	40.50	49	24.50	0.76	I	
6	Allergy level	31	15.50	133	66.50	36	18.00	0.66	II	
7	Chemical reactions	25	12.50	145	72.50	30	15.00	0.66	II	
E	**HEALTH EFFECTS** Respondents experienced no effect regarding:									
1	Skin allergies	25	12.50	148	74	27	13.50	0.67	I	
2	Bad odors	19	9.50	129	64.50	52	26.00	0.61	V	
3	Eye irritation	28	14.00	127	63.50	45	22.50	0.64	III	
4	Respiratory problems	16	8.00	139	69.50	45	22.50	0.62	IV	
5	Fatigue or activeness	13	6.50	144	72.00	43	21.50	0.62	IV	IV
6	Throat infection	10	5.00	129	64.50	61	30.50	0.58	VII	
7	Head ache	16	8.00	138	69.00	46	23.00	0.62	IV	
8	Hypersensitivity	19	9.50	121	60.50	60	30.00	0.60	VI	
9	Chemical reactions	58	29.00	81	40.50	61	30.50	0.66	II	

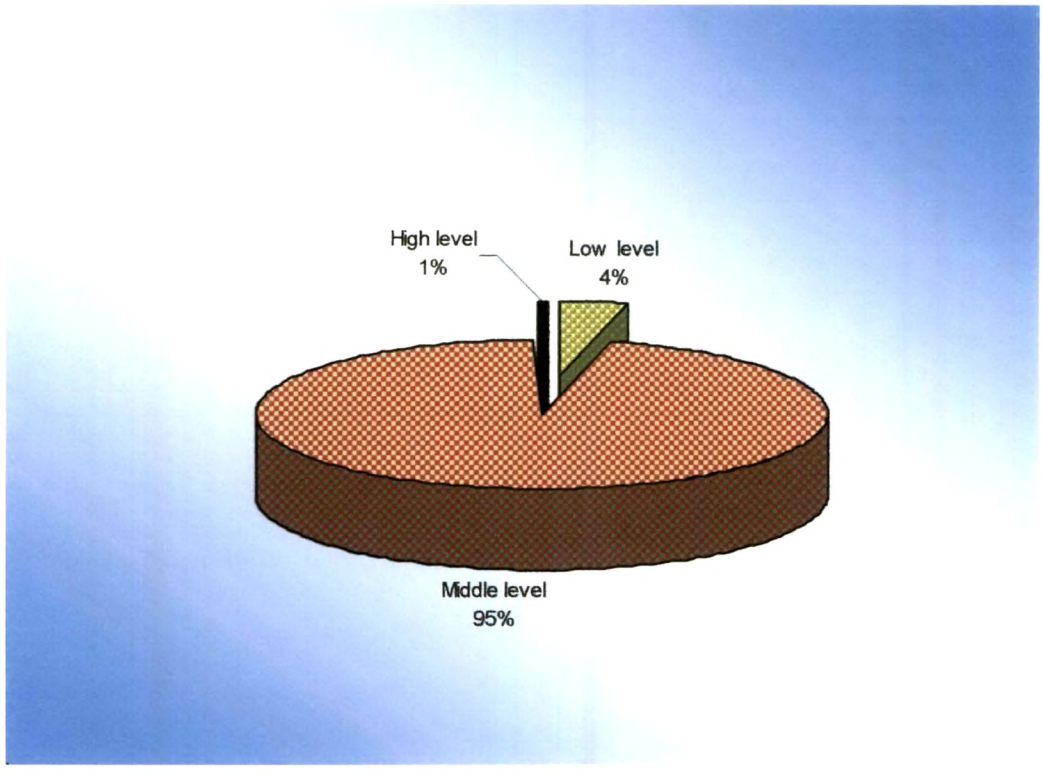


Figure 17: Extent of Satisfaction Derived from Use of OBM in Residential Construction

Table 15.b: Extent of Satisfaction Derived From Use of OBM in Residential Constructions (n=200)

S.No.	Satisfaction level	Scores	Respondents	
			F	%
1	Low level	36-60	8	4.00
2	Middle level	61-84	191	95.50
3	High level	85-108	1	00.50

Extent of satisfaction in Table 15.b showed that most of the respondents showed middle level of satisfaction (95.50 percent) scoring 61-84 points on the satisfaction scale. However, some of the respondents showed low level of satisfaction (4 percent) by scoring 36-60 points. But only 00.50 percent of the respondents showed high level of satisfaction after using OBM in the home.

SECTION: 4.3

Experimental Results

Experiments for the study were carried out on a sample of twelve respondents in the selected area. In order to find out the defects in the house and performance of the respondents living in the wooden and non wooden houses as these were the two commonly used basic materials for residential constructions. Therefore a set of six wooden and six non wooden houses was selected and the observations were recorded. Care was taken to select houses with similar age, size and orientation.

The section deals with checklist of defective symptoms / problems in the residential constructions, parameters of human performance and environment in houses constructed with OBM.

15. Checklist of Defective Symptoms / Problems in the Residential Constructions (Bowyer, 1973)

Checklist of defective symptoms in various parts of building structures given by Bowyer, 1973 was used to observe physical problems in the selected residential constructions. Observations showed that in wooden homes, roofs were showing dampness (50 percent), rot (33.33 percent), stains (33.33 percent) and splits (33.33 percent). Cracks (50 percent), dirty spots (33.33 percent), fractured areas (33.33 percent) and dampness (33.33 percent) were observed in the walls. Rot (33.33 percent) and stains (33.33 percent) were quite observable in floors and stair cases (timber) of the selected wooden houses. Deposition of dirt was observed in all of the wooden houses. When internal finishes were observed it was found that in half of the houses cracks were found and about one third (33.33 percent) of the houses were showing loss of gloss and misses in the painting. Problems like leakage (33.33 percent), smell of heating (16.67 percent), lack of temperature (16.67 percent), spots (16.67 percent) and fungus (50 percent) were also observed in the wooden houses.

Table16: Checklist of Defective Symptoms / Problems in the Residential Constructions (n=12)

S. No.	Defective symptoms / Problems	Residential Constructions			
		Wooden (n=6)		Non Wooden (n=6)	
		F	%	F	%
A	**ROOF**				
1	Rot	2	33.33	1	16.67
2	Splits	2	33.33	--	--
3	Granular surface	--	--	3	50.00
4	Crumbled on surface	1	16.67	--	--
5	Loosen paving	1	16.67	--	--
6	Dampness	3	50.00	4	66.67
7	No grating	--	--	--	--
8	Bubbles on surface	--	--	--	--
9	Dirt	6	100	--	--
10	Stains	2	33.33	1	16.67
11	Infestation	1	16.67	5	83.33
B	**WALLS**				
1	Cracks	3	50.00	1	16.67
2	Rot	--	--	--	--
3	Twisted / Curled	--	--	--	--
4	Dirty Spots	2	33.33	6	100
5	Fractured	2	33.33	--	--
6	Dampness	2	33.33	6	100
7	Dry dirty patch	--	--	--	--
8	Sagging timber lining	--	--	--	--
9	Damp rising on internal walls	--	--	--	--
C	**FLOORS AND STAIR CASES (TIMBER)**				
1	Rot	2	33.33	--	--
2	Board crack underfoot	1	16.67	--	--
3	White spongy under floor covering	--	--	--	--
4	Bay dips outward	1	16.67	--	--
5	Stains	2	33.33	4	66.67
6	Long filament growth	1	16.67	--	--
7	1st floor unstable under foot cracks	1	16.67	--	--
8	Olive green or brown fruiting body on surfaces	--	--	--	--
9	Squeaks the staircases	--	--	--	--
10	Tread fall away	--	--	--	--
11	Small holes	1	16.67	--	--
12	Dirt	6	100	6	100
13	Saw dust	1	16.67	--	--
D	**INTERNAL FINISHES** **I. PLASTER**				
1	Crack	3	50.00	3	50.00
2	Soft & Crumbly	--	--	--	--
3	Dry & crumbly	--	--	--	--

4	Dampness	1	16.67	--	--
5	Bulging	--	--	--	--
6	Pinholes in joinery	--	--	--	--
7	Blister or small crater	--	--	--	--
II	**PAINTING**				
1	Bittiness	--	--	--	--
2	Blooming	--	--	--	--
3	Cissing	--	--	--	--
4	Drying trouble	--	--	--	--
5	Grinning	--	--	--	--
6	Mould	--	--	--	--
7	Shriveling	--	--	--	--
8	Bleeding	--	--	--	--
9	Brush marks	1	16.67	1	16.67
10	Crazing	--	--	--	--
11	Efflorescence	--	--	--	--
12	Loss of gloss	2	33.33	4	66.67
13	Poor opacity	1	16.67	--	--
14	Saponification	--	--	--	--
15	Blistering	--	--	--	--
16	Chalking	--	--	--	--
17	Running	--	--	--	--
18	Flaking	2	33.33	4	66.67
19	Misses	--	--	--	--
20	Sheeriness	--	--	--	--
E	**SERVICES**				
1	Leakage	2	33.33	4	66.67
2	Noisy	--	--	--	--
3	Encrustation	--	--	--	--
4	Fungus	3	50.00	1	16.67
5	Water stain	--	--	1	16.67
6	Supply sluggish	--	--	--	--
7	Lack of temperature	1	16.67	3	50.00
8	Excessive joints	--	--	--	--
9	Spots	1	16.67	--	--
10	Smell of heating	1	16.67	1	16.67

Observations in non wooden houses showed that in roofs the major problem was infestation in about more than three fourth (83.33 percent) of the houses. Where as, granular surface in half of the houses (50 percent), dampness in a little more than a half (66.67 percent) was observed. When walls were observed dirty spots and dampness were observed —

Plate 14: Cracking in Balcony made up of Wood

Plate 15: Cracking in Floor made up of Wood

Plate 16: Cracking and flaking off due to dampness in building

in all of the houses. Dirt (100 percent) and stains (66.67 percent) were the defective symptoms observed in floors and staircases. Internal finishes were showing cracks in half of the houses and loss of gloss and flaking were problems found in 66.67 percent of the houses. Services were also hindered due to leakage (66.67 percent) and lack of temperature (50 percent).

Inference drawn from the above data is that in case of roofs, wooden houses were showing more defective symptoms than the non wooden houses. In walls of non wooden houses, the problems of dirty spots and dampness were prominent. Floors and stair cases of timber were more exposed to rot, cracking (Plate 14 and 15), stains, long filament growth and small holes. In wooden houses as well as non wooden houses, internal finishes were defective with cracks, dampness (Plate 16), brush marks, loss of gloss and poor opacity. In case of service like water supply, electricity, etc. defective symptoms were more or loss same in case of both the types of houses.

16. Parameters of Human Performance (short term memory, attention / concentration, work and fatigue in semi-simplicit activity)

Berglund *et al.* in 1987 designed to study sick building syndrome with a battery of diverse psychological tests (reaction time, short-term memory, vigilance, and steadiness) to assess human performance. The trends were found in the expected direction. Memory is considered central to all cognitive functions and it was tested with a commonly used short-term memory task (Peterson *et al.* 1959).

a. Short Term Memory of the Residents

It is a common experience that numbers are difficult to remember. It has been shown (Peterson & Peterson, 1959) that short term memory decays rapidly. A standardized test to test short term memory given by Ost, 1969

(Annexure-3) and further used by many experimentalists was used to test short term memory of the respondents living in two different types of houses.

Table 17: Short Term Memory of the Residents (n=12)

Treatment	Subject	Number of mistakes done (0-4 mistakes)						
		One digit	Two digits	Three digits	Four digits	Five digits	Six digits	Seven digits
T_1	S_1	--	--	--	1	--	3	2
	S_2	--	--	--	3	1	--	4
	S_3	--	2	--	2	--	--	3
	S_4	--	--	1	--	1	3	3
	S_5	--	--	--	1	--	2	3
	S_6	--	--	--	2	1	--	3
T_2	S_1	--	1	--	--	--	2	1
	S_2	--	-	1	--	--	2	2
	S_3	--	--	--	1	--	--	2
	S_4	--	1	--	--	--	--	3
	S_5	--	--	--	--	1	2	2
	S_6	--	--	1	--	--	3	3

* T_1: Wooden Houses T_2: Non Wooden Houses

Table 17 depicts the results of experiment carried out on twelve respondents, six each in wooden and non wooden houses. The Experimenter read a number, then a category name for example, fruits, colors, cities or animals. The subject gave three examples of the category, and then was asked to repeat the same number. The answer was scored as correct or wrong. The digits were read evenly, one each second, then the category name is given in rhythm. The subject were asked to give examples of the category immediately, with no pause to rehearse the number. Number of mistakes done by each of the respondent in one digit number to seven digit number category was recorded to find out the short term memory of the respondents.

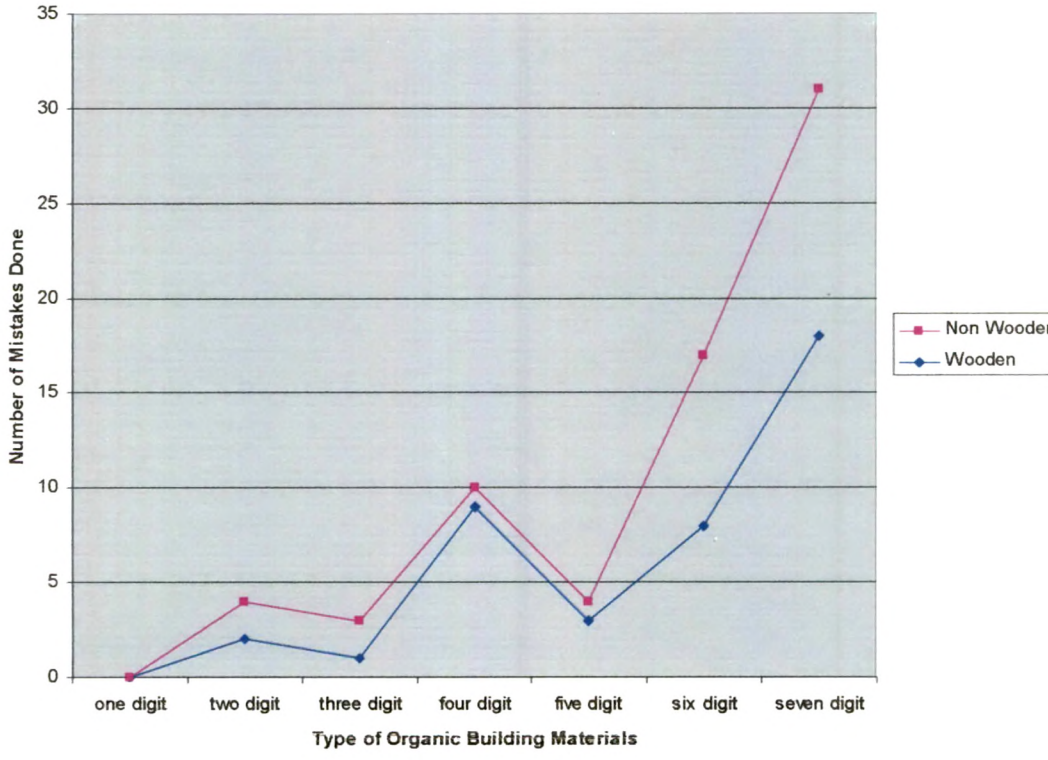


Figure 18: Number of mistakes in done by the respondents showing short term memory (N=12)

Figure 18 shows that numbers of mistakes done by the respondents living in houses completely build up of natural OBM i.e. wood was lower than the respondents living in non wooden houses.

b. Attention / Concentration of the Residents

To discover number of times attention wanders and to find out conditions which help concentration or attention, a standardized test for testing attention / concentration given by Kuppuswamy (1954) was used (Annexure-3).

Instructions were given to respondents: 'Look at your pencil. Concentrate your attention upon it for one min. when your attention

wanders from the object indicate by a movement of your left hand.' Experimenter noted down the number of times attention wandered during the one minute period.

Table 18: Attention/Concentration of the Residents (n=12)

Treatment*	Subject	Number of times attention wanders	
		Series 1	Series 2
T_1	S_1	2	3
	S_2	2	2
	S_3	3	1
	S_4	0	0
	S_5	0	1
	S_6	1	0
T_2	S_1	1	0
	S_2	0	0
	S_3	1	0
	S_4	4	0
	S_5	0	0
	S_6	0	1
Mean		1:167	0.667
S.D.		$\pm$1.348	$\pm$0.985

* T_1: Wooden Houses T_2: Non Wooden Houses

In the second series the following instructions were given. 'Look at the pencil. Think about its size, colour, material, with which it is made, flaws in the making, its uses, etc. Indicate as before when attention wanders.' Experimenter noted down the number of times attention wandered during the one minute period. The number of time attention wandered in the first series and in the second series were calculated. The difference was noted. The data for whole sample were collected. Mean and S.D. for the two series were calculated. (Table 18)

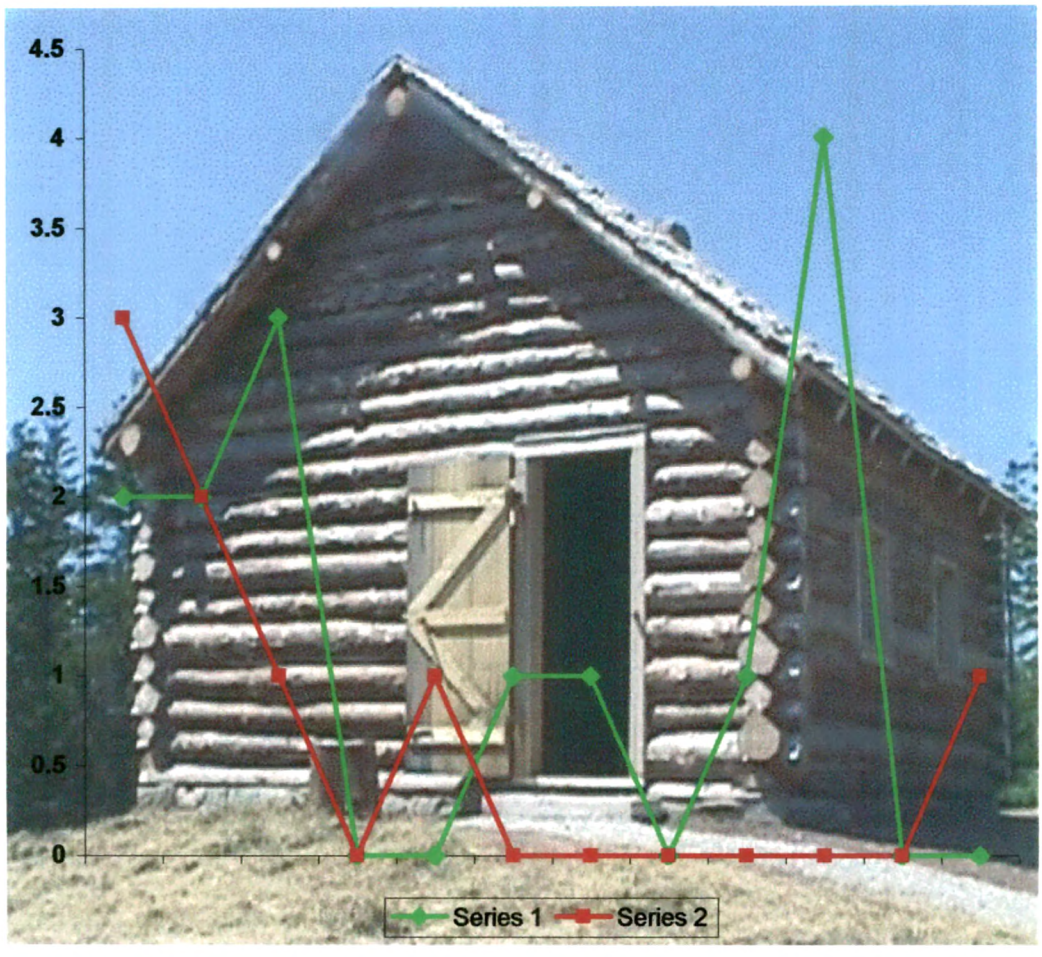


Figure 19: Attention / Concentration of the Residents

Figure 19 shows level of concentration / attention shown by the people living in houses made up of two different types of building materials. It is clear from the Figure that poor concentration level was shown by the respondents living in non wooden houses.

c. Work and Fatigue in Semi-Simplicit Activity

To measure continuous thinking work and its change, especially changes by fatigue, a standardized test for testing work and fatigue in semi-simplicit activity was used (Dashiell, 1931; Watson; Robinson; Pillsbury; Gates).

Table 19: Work and Fatigue in Semi-Simplicit Activity (n=12)

Treatment*	Subject	Number of sums done	Number of mistakes occurred (30 sets)
T_1	S_1	271	12
	S_2	253	10
	S_3	213	9
	S_4	109	5
	S_5	268	11
	S_6	213	7
T_2	S_1	277	18
	S_2	252	16
	S_3	217	14
	S_4	128	8
	S_5	262	17
	S_6	217	14

* T_1: Wooden Houses T_2: Non Wooden Houses

Subject (S) was comfortably seated in a quiet room. Experimenter (E) pronounced aloud a number. S was immediately asked to add 2 to this number aloud, then asked to add 3 to this new number aloud, then 4 to that,

then 5 and then again 2,3,4,5, etc., in rotation. For instance, if the number given was 9, the consecutive sums would be: 11, 14, 18, 23, 28, 32, 37, 39, etc. Every thirty seconds E was to announce a new number with which S was to start at once a new number keep adding through out at your maximum speed.

Taking first some column of numbers, E offered S a trial by speaking aloud the number at the top, and checked her accuracy in the adding by following down the column. If a mistake was made the correct number was called out and at the same time made a dot opposite it on the page.

For the formal experiments, E used the columns in their order from left to right. The numbers announced every thirty seconds to S were the ones at the top of the columns. As S added aloud, E followed down each column and corrected and marked errors. At the end of each thirty seconds he drawn a line under the last number given by S to indicate how many numbers were added and at the same time announces aloud the new number of the next column.

One person as S was to work constantly in one single bodily position until he had been taken over twenty columns three times – a total of 30 minutes of adding time. She seated looking at a point on the wall and through out his work she did not vary her bodily posture, but kept the same sitting position, both feet flat on the floor, head and arms in the same pose, etc. This was important. The number of sums done and the mistakes were recorded for each of the respondents as given in Table 19.

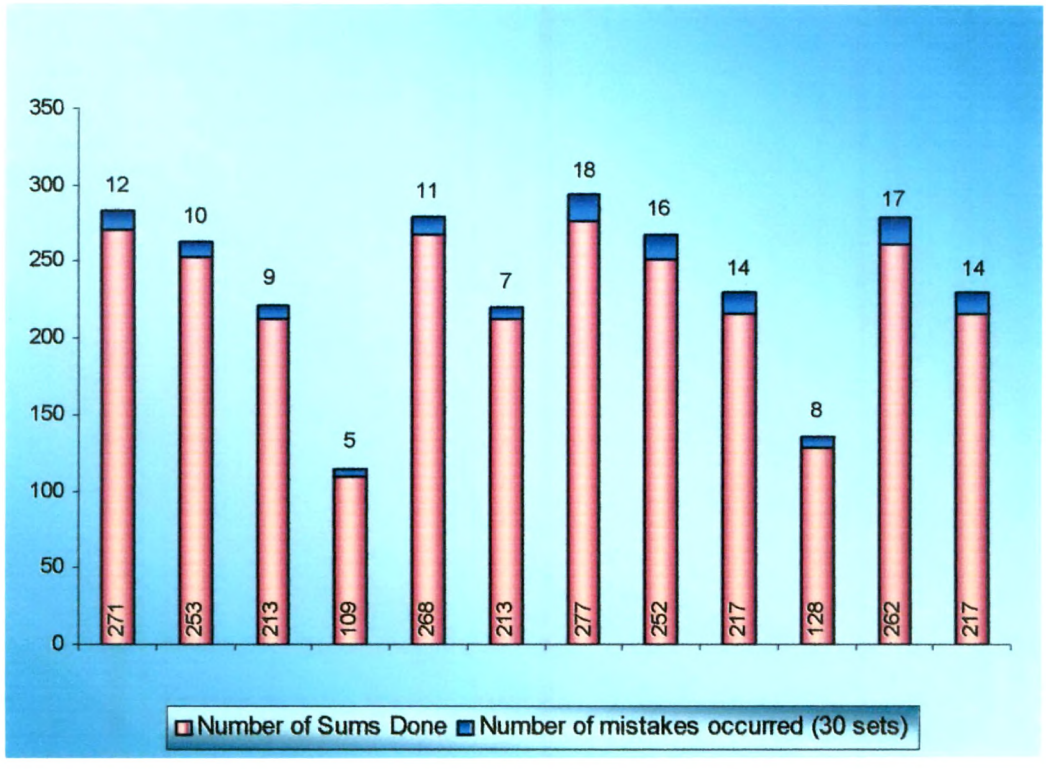


Figure 20: Work and fatigue of the respondents

Figure 20 revealed that number of sums done by the respondents living in the non wooden houses were more than the sums done by the respondents living in wooden houses. But, number of mistakes performed by the respondents was more by the respondents living in the wooden houses were more than the sums done by the respondents living in non wooden houses. It shows that level of fatigue was reflected more by the respondents living in non wooden houses.

17. Parameters of Indoor Environment

Azer, *et al.* (1972) provides more evidence that hot conditions have significant affects on performance only when they cause a rise in body temperature. Relative humidity seemed to be a key determinant of performance in a variety of tasks. Studies conducted by Allen and Fischer (1978), Barros (1993), I. I. D. A. (1993) also supported the same view point that temperature and humidity are the key determinants of the human performance of the people living in residential unit. Symptoms of poor health also reported if the environmental conditions persist for a longer time.

Data in Table 20 shows temperature and humidity values recorded with standardized Thermo hygro clock during morning, noon, evening and midnight simultaneously in wooden and non wooden houses. The data were further analyzed to find out the difference in the parametric values, thus to estimate evidences of effect of building materials on indoor environment in the selected houses.

There were two types of treatment and six subjects under each treatment. Three sets of temperature values and humidity values were recorded at the same point of time in each of the set of houses. Then values were summed up and average values were quoted so that error could be eliminated. The process was repeated in each set of the houses for morning, noon, evening and midnight. It was checked that any variation in the data is not due to the cooling or heating devices, prospect of the houses and error in

noting down the readings. From the data a clear difference was found in the temperature and humidity in the selected group of houses.

Table 20: Temperature and Humidity of the Selected Residences (n=12)

Treatment*	Subject	Temperature					Humidity				
		Outdoors	Indoors				Outdoors	Indoors			
		^{0}C	M	N	E	MN	%	M	N	E	MN
T_1	S_1	13-22	15.3	14.8	15.4	17.1	53	49	41	47	49
	S_2	12-22	15.4	15.5	15.3	15.4	25	49	42	47	48
	S_3	12-22	15.4	16.5	15.3	15.3	24	46	43	49	49
	S_4	12-22	14.8	16.9	16.2	15.5	25	42	38	37	41
	S_5	12-22	14.6	17.2	15.9	15.8	24	43	37	37	40
	S_6	12-23	14.6	15.9	15.7	15.7	23	43	37	40	43
Mean			15.0	16.1	15.6	15.8		45	40	43	45
T_2	S_1	13-22	20.0	20.1	20.0	20.0	53	43	33	41	45
	S_2	12-22	20.0	20.1	20.0	20.0	25	43	33	43	50
	S_3	12-22	20.0	20.1	20.0	20.0	24	43	33	45	51
	S_4	12-22	20.0	20.0	20.0	20.0	25	50	44	34	41
	S_5	12-22	20.0	20.0	20.0	20.0	24	50	45	35	41
	S_6	12-23	20.0	20.0	20.0	20.0	23	50	42	40	43
Mean			20.0	20.1	20	20		47	38	40	45

* T_1: Wooden Houses T_2: Non Wooden Houses

In Table 18 a clear difference was found in the temperature and humidity in the selected group of houses. The percentage increase in temperature from outdoor to indoor environment was more in non wooden houses than the wooden houses. But the results were viceversa for the relative humidity.

SECTION: 4.4

Testing of Hypotheses

A number of hypotheses were formulated on the basis of objectives of the study. For the purpose of statistical analysis the hypotheses were formulated in null form.

To test the hypotheses statistically Analysis of Variance, Pearson's Product Moment Coefficient of Correlation, 't' Test and regression analysis were applied.

Analysis of variance was computed to find out the variation due to personal variables, family variables and situational variables towards knowledge regarding OBM, extent of use of OBM in home, problems faced in care and maintenance of the house, satisfaction derived from use of OBM and effect on health of the residents.

To find the variation between the different groups of respondents according to environmental and psychological parameters of performance of the residents 't' test was performed.

Pearson's Product Moment Coefficient of Correlation was computed in order to find degree of relationship among knowledge regarding OBM, extent of use of OBM in home and problems faced in its care and maintenance. Their association with satisfaction derived from use of OBM and effect on health of the residents was also computed.

NH_{0-1}: Knowledge regarding OBM, extent of use of OBM in home and problems faced in care and maintenance do not vary with personal variables, family variables and situational variables.

- **Personal Variables**
    - Age
    - Educational qualification
    - Employment status
- **Family variables**
    - Family size
    - Occupational status
    - Family income
- **Situational Variables**
    - Location of the house
    - Occupancy period
    - Age of building structure

Analysis of Variance was computed to test this hypothesis.

a. Knowledge regarding OBM of the selected respondents

Analysis of Variance was computed and results showed that, the knowledge regarding OBM of the respondents varied significantly with age (F=2.70), educational qualification (F=4.75), employment status (F=5.75), occupational status (F=5.04) and location of house (F=5.09), which indicated that the knowledge varied due to these variables. Family income, family size, occupancy period and age of building structure which were have no significant impact on knowledge of the respondents. (Table 21)

Table 21: Analysis of Variance for Knowledge regarding OBM of the selected respondents

Source of Variation	Degree of freedom	Sum of Squares	Mean of Squares	F Value	Significance level
Personal Variables					
Age	3.00	893.46	297.82	2.70	0.05
	196.00	21300.00	108.67		
Educational Qualification	2.00	1169.63	584.81	4.74	0.01
	197.00	24300.41	123.35		
Employment Status	1.00	3134.14	3134.14	5.75	0.01
	198.00	107833.68	544.61		
Family Variables					
Family Size	2.00	28.00	14.00	0.74	N.S.
	197.00	373.00	18.90		
Occupational Status	2.00	2631.30	1315.65	5.04	0.01
	197.00	51391.52	1315.65		
Family Income	2.00	667.19	333.59	0.43	N.S.
	197.00	197.00	151528.63		
Situational Variables					
Location of house	1.00	67.28	67.28	5.09	0.05
	198.00	2616.54	13.21		
Age of Building Structure	1.00	45.98	45.98	1.37	N.S.
	198.00	6637.84	33.52		
Occupancy Period	1.00	14.78	14.78	0.44	N.S.
	198.00	6669.04	33.68		

Thus the hypothesis was rejected for the association of the knowledge regarding OBM of the respondents with age, educational qualification, employment status, occupational status and location of house and accepted for family income, family size, occupancy period and age of building structure.

b. Extent of use of OBM in the homes of the selected respondents

Further, analysis of variance for extent of use of OBM in home was computed and it was found that it varied significantly with educational qualification (F=6.33), occupational status (F=17.00), family size (F=10.12), family income (F=4.67), location of house (F=5.91) and age of building structure (F=10.00). Extent of use of OBM was not found significantly associated with age of the respondent, employment status and occupancy period. (Table 22)

Table 22: Analysis of Variance for extent of use of OBM in the homes of the selected respondents

Source of Variation	Degree of freedom	Sum of Squares	Mean of Squares	F Value	Significance level
Personal Variables					
Age	3.00	8.40	2.80	0.16	N.S.
	196.00	3472.62	17.72		
Educational	2.00	0.38	0.19	6.33	0.01
Qualification	197.00	6.33	0.03		
Employment	1.00	0.40	0.40	0.45	N.S.
Status	198.00	176.32	0.89		
Family Variables					
Family Size	2.00	0.33	0.165	10.12	0.01
	197.00	3.21	0.0163		
Occupational	2.00	1.02	0.51	17.00	0.01
Status	197.00	5.70	0.03		
Family	2.00	0.29	0.14	4.67	0.01
Income	197.00	06.43	0.03		

Table 22 continued.....

Situational Variables					
Location of house	1.00 198.00	5.12 171.60	5.12 0.87	5.91	0.05
Age of Building Structure	1.00 198.00	10.00 0.72	10.00 0.00	10.00	0.01
Occupancy Period	1.00 198.00	0.41 196.98	0.41 0.99	0.42	N.S.

Therefore, the hypothesis was rejected for extent of use of OBM in home with educational qualification, occupational status, family size, family income, location of house and age of building structure and accepted with age of the respondent, employment status and occupancy period.

c. Problems faced in care and maintenance of the home by the selected respondents

Analysis of variance was applied for problems faced in care and maintenance of the home and the values of the F test showed a significant variation with age (F=4.83), educational qualification (F=4.75), employment status (F=23.34), family size (F=19.26), location of the house (F=32.89) and occupancy period (F=234.50). Non significant variation was found with the variable; occupational status, family income and age of building structure.

The hypothesis was rejected for problems faced in care and maintenance of the home with age, educational qualification, employment status, family size, location of the house and occupancy period. It was accepted for occupational status, family income and age of building structure.

Table 23: Analysis of Variance for problems faced in care and maintenance of the home by the selected respondents

Source of Variation	Degree of freedom	Sum of Squares	Mean of Squares	F Value	Significance level
Personal Variables					
Age	3.00	41.67	13.89	4.83	0.05
	8.00	23.00	2.875		
Educational Qualification	2.00	32.67	16.33	4.75	0.05
	9.00	31.00	3.44		
Employment Status	1.00	22.17	22.17	23.34	0.01
	10.00	9.50	0.95		
Family Variables					
Family Size	2.00	1.04	0.52	19.26	0.01
	9.00	5.30	0.027		
Occupational Status	1.00	22.87	22.87	2.10	N.S.
	10.00	108.80	10.88		
Family Income	2.00	35.33	17.67	1.65	N.S.
	9.00	96.33	10.70		
Situational Variables					
Location of house	1.00	147.00	147.00	32.89	0.01
	10.00	44.67	4.47		
Age of Building Structure	1.00	0.11	0.11	1.83	N.S.
	10.00	0.56	0.06		
Occupancy Period	1.00	4.69	4.69	234.50	0.01
	10.00	0.22	0.02		

NH_{0-2}: There is no inter relationship among knowledge regarding OBM, extent of use of OBM in home and problems faced in its care and maintenance.

Pearson's Product Moment of correlation coefficient was calculated to test this hypothesis. Significant relationship was observed between extent of use of OBM in home and problems faced in its care and maintenance; knowledge regarding OBM and problems faced in its care and maintenance. Whereas, relationship of knowledge regarding OBM and extent of use of OBM in home was found non significant. (Table 24)

Thus, hypothesis was rejected for extent of use of OBM in home and problems faced in its care and maintenance; knowledge regarding OBM and problems faced in its care and maintenance and accepted for relationship of knowledge regarding OBM and extent of use of OBM in home.

Table 24: Correlation Coefficient showing relationship among knowledge regarding OBM, extent of use of OBM in home and problems faced in its care and maintenance by the selected respondents

Variables	r-values	Degree of freedom	Significance Level
Knowledge regarding OBM and extent of use of OBM in home	0.054729	199	N.S.
Extent of use of OBM in home and problems faced in its care and maintenance	0.99764	199	0.01
Knowledge regarding OBM and problems faced in its care and maintenance	0.72698	199	0.01

NH_{0-3}: Knowledge regarding OBM, extent of use of OBM in home and problems faced in care and maintenance of the houses do not vary with satisfaction derived from use of OBM and effect on health of the residents.

To test this hypothesis Pearson's Product Moment of correlation coefficient was computed. The relationship was found significant for extent of

use of OBM in home and effect on health, problems faced in care and maintenance of the houses and satisfaction derived from use of OBM and problems faced in care and maintenance of the houses and effect on health. Non significant values were observed for association among knowledge regarding OBM and satisfaction derived from use of OBM, knowledge regarding OBM and effect on health and extent of use of OBM in home and satisfaction derived from use of OBM.

Table 25: Correlation Coefficient showing relationship among knowledge regarding OBM, extent of use of OBM in home and problems faced in its care and maintenance by the selected respondents

Variables	r-values	Degree of freedom	Significance Level
Knowledge regarding OBM and satisfaction derived from use of OBM	0.03477	199	N.S.
Knowledge regarding OBM and effect on health	0.00952	199	N.S.
Extent of use of OBM in home and satisfaction derived from use of OBM	0.032274	199	N.S.
Extent of use of OBM in home and effect on health	0.848201	199	0.01
Problems faced in care and maintenance of the houses and satisfaction derived from use of OBM	0.968512	199	0.01
Problems faced in care and maintenance of the houses and effect on health	0.888242	199	0.01

Therefore, hypothesis was rejected for extent of use of OBM in home and effect on health, problems faced in care and maintenance of the houses and satisfaction derived from use of OBM and problems faced in care and maintenance of the houses and effect on health and it was accepted for knowledge regarding OBM and satisfaction derived from use of OBM, knowledge regarding OBM and effect on health and extent of use of OBM in home and satisfaction derived from use of OBM.

NH_{0-4}: Satisfaction derived from use of OBM and effect on health of the residents does not vary with personal variables, family variables and situational variables.

- **Personal Variables**
    - Age
    - Educational qualification
    - Employment status
- **Family variables**
    - Family size
    - Occupational status
    - Family income
- **Situational Variables**
    - Location of the house
    - Occupancy period
    - Age of building structure

a. Satisfaction derived from use of OBM in the home by the selected respondents

On analysis of variance it was observed that satisfaction derived from use of OBM in the home, it varied significantly with age (F=42.83), family size

(F=49.09), family income (F=9.68), location of the house (F=14.41), occupancy period (F=9.38) and age of the building structure (F=31.52). It was found that satisfaction derived not varied significantly with educational qualification, employment status and occupation of the family.

Table 26: Analysis of Variance for Satisfaction derived from use of OBM in the home by the selected respondents

Source of Variation with knowledge	Degree of freedom	Sum of Squares	Mean of Squares	F Value	Significance level
Personal Variables					
Age	3.00	268.57	89.52	42.83	0.01
	196.00	409.19	2.09		
Educational	2.00	2.09	1.05	0.55	N.S.
Qualification	197.00	375.66	1.91		
Employment	1.00	9.49	9.49	0.28	N.S.
Status	198.00	6668.26	33.68		
Family Variables					
Family Size	2.00	23.07	11.54	49.09	0.01
	197.00	46.31	0.24		
Occupational	2.00	12.47	6.23	0.18	N.S.
Status	197.00	6665.29	33.83		
Family Income	2.00	60.60	30.30	9.68	0.01
	197.00	617.15	3.13		
Situational Variables					
Location of	1.00	453.01	453.01	14.41	0.01
house	198.00	6224.75	31.44		
Age of Building	1.00	3.00	3.00	9.38	0.01
Structure	198.00	63.19	0.32		
Occupancy	1.00	92.99	92.99	31.52	0.01
Period	198.00	584.76	2.95		

Therefore, hypothesis was rejected for age, family size, family income, location of the house, occupancy period and age of the building structure and accepted for educational qualification, employment status and occupation of the family.

b. Effect on health of the residents by the selected respondents

Further analysis of dependent variable; effect on health of the residents, it was observed that it varied significantly with age (F=4.92), family size (F=53.65), family income (F=2.8), age of the building structure (F=4.56 and location of the house (F=12.46). It was found that satisfaction derived not varied significantly with educational qualification, employment status, occupation of the family and occupancy period.

Table 27: Analysis of Variance for effect on health of the residents by the selected respondents

Source of Variation with knowledge	Degree of freedom	Sum of Squares	Mean of Squares	F Value	Significance level
Personal Variables					
Age	3.00	54.47	18.16	4.92	0.01
	196.00	724.41	3.69		
Educational	2.00	1.49	0.74	0.19	N.S.
Qualification	197.00	775.39	3.94		
Employment	1.00	0.00	0.00	0.00	N.S.
Status	198.00	2778.88	14.03		
Family Variables					
Family Size	2.00	69.21	34.61	53.65	0.01
	197.00	127.15	0.65		
Occupational	2.00	4.34	2.17	0.15	N.S.
Status	197.00	2769.16	14.06		

Table 27 continued.....

Family Income	2.00 197.00	21.52 757.36	10.76 3.84	2.80	0.05
Situational Variables					
Location of house	1.00 198.00	6.48 103.15	6.48 0.52	12.46	0.01
Age of Building Structure	1.00 198.00	21.18 918.00	21.18 4.64	4.56	0.05
Occupancy Period	1.00 198.00	0.53 757.70	0.53 3.83	0.14	N.S.

Therefore, hypothesis was rejected for age, family size, family income, location of the house, and age of the building structure and accepted for educational qualification, employment status, occupation of the family and occupancy period.

NH_{0-5}: Temperature and humidity inside the home do not associated with extent of use of OBM in the residential constructions.

t value (Table 28) revealed that there was significant difference at 1% level between temperature inside the wooden and non wooden houses. Thus, hypothesis was rejected. It could be inferred that there is difference in temperature of houses made up of wood and materials other than wood.

It was observed that t value calculated was not significant between extent of Use of OBM in home for the wooden and non wooden houses. Thus, hypothesis was accepted. It could be inferred that there is no difference in extent of Use of OBM in houses made up of wood and materials other than wood, both were organic building materials varying in their sources, composition, properties and structures. (Table 28)

Table 28: t- values showing difference between homes with OBM and without OBM for selected variables

Variables	Mean	t- values	Degree of freedom	Significance level
Extent of Use of OBM in home	5.33 5.17	0.360413	10	N.S.
Temperature inside house	15.65 20.01	4.31352	10	0.01
Humidity inside house	43.21 42.42	0.314427	10	N.S.

It was also observed that t value calculated (Table 28) was not significant between humidity inside house for the wooden and non wooden houses. Thus, hypothesis was accepted. It could be inferred that there is no difference in humidity inside house in houses.

Further, on regression analysis it is clear from Figure 21 that temperature inside the houses changes linearly with extent of use of OBM in wooden as well as non wooden houses. But the temperature range is higher in wooden houses than the non wooden houses. It could be inferred that wood is a better OBM to be used in the hill areas where in winters, outside temperature decreases to a greater extent.

Figure 22 revealed the regression analysis of humidity inside the houses with extent of use of OBM in wooden and non wooden houses. It had been shown that in wooden houses, the humidity changes in increasing order linearly with the change in extent of use of wood in the houses. But the reverse happened in the case of non wooden houses. It could be concluded that the problem of dampness persists more in wooden houses.

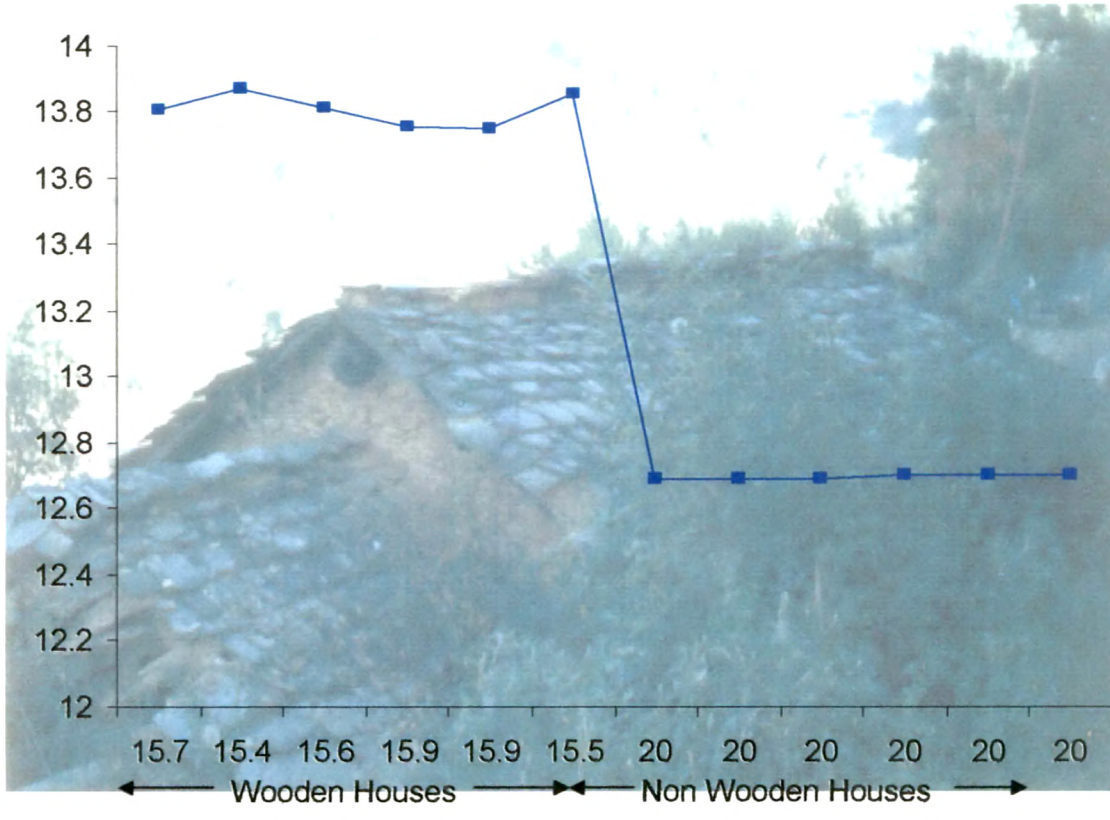


Figure 21: Regression Analysis of Extent of Use of OBM with Temperature inside the House

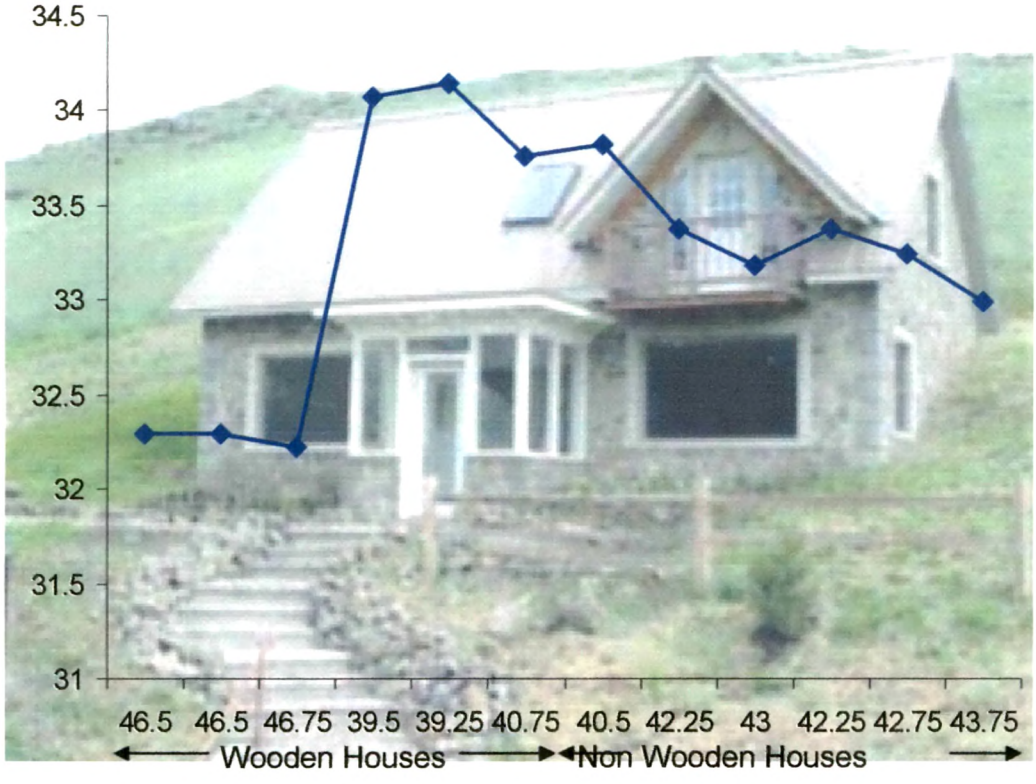


Figure 22: Regression Analysis of Extent of Use with Humidity inside the House

$NH_{0.6}$: Human performance in terms of short term memory, attention/concentration and work & fatigue do not have association with temperature and humidity inside the home.

It was observed that t value calculated was not significant short term memory between the respondents in homes of the wood and non wooden. Thus, hypothesis was accepted. It could be inferred that there is no difference in short term memory of people in houses made up of wood and materials other than wood. (Table 29)

On the basis of the t value calculated, no significant difference between attention / concentration of the respondents in the wooden and non wooden houses. Thus, hypothesis was accepted. It could be inferred that there is no difference in attention / concentration in houses made up of wood and materials other than wood. (Table 29)

Table 29: t- values showing difference between homes with OBM and without OBM for selected variables

Variables	Mean	t- values	Degree of freedom	Significance level
Short Term Memory	0.976191 0.666667	0.020528	10	N.S.
Attention/Concentration	1.25 0.583333	0.168513	10	N.S.
Work and Fatigue	9 14.5	9.53782	10	0.01

t value (Table 29) revealed that there was significant difference at 1% level between work and fatigue inside the wooden and non wooden houses.

Thus, hypothesis was rejected. It could be inferred that there is difference in work and fatigue level of respondents in houses made up of wood and materials other than wood.

Figure 23 and 24 show regression analysis of short term memory and attention / concentration values recorded for the respondents. Trend was same for the short term memory as well as attention / concentration. Values changed linearly with the temperature changes. But a clear difference was noted in the values for the selected performance parameters in wooden and non wooden houses. The respondents residing in wooden houses performed better than the respondents living in the non wooden houses.

Figure 24 showed the same trend between the relationship of temperature and work & fatigue. It meant the linear relationship between the performance and environment. But the case was vice versa for the relationship in the performance of the respondents living in wooden and non wooden houses. The respondents of non wooden houses felt fatigue more than the fatigue felt by the respondents of wooden houses.

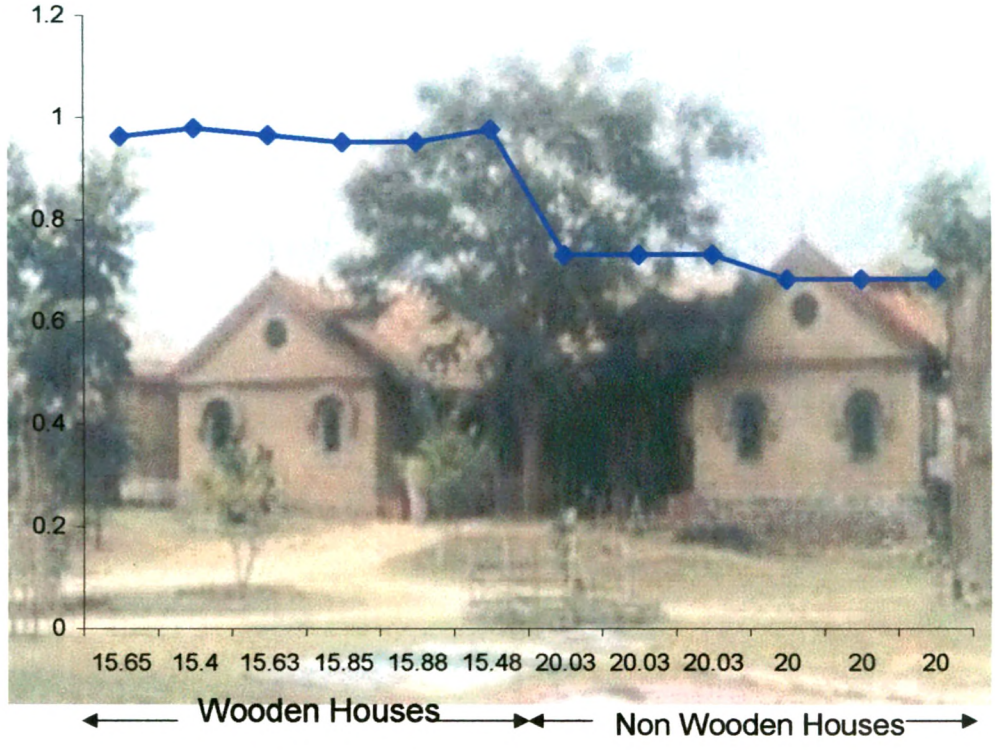


Figure 23: Regression Analysis of Short Term Memory in an Association with Temperature inside the House

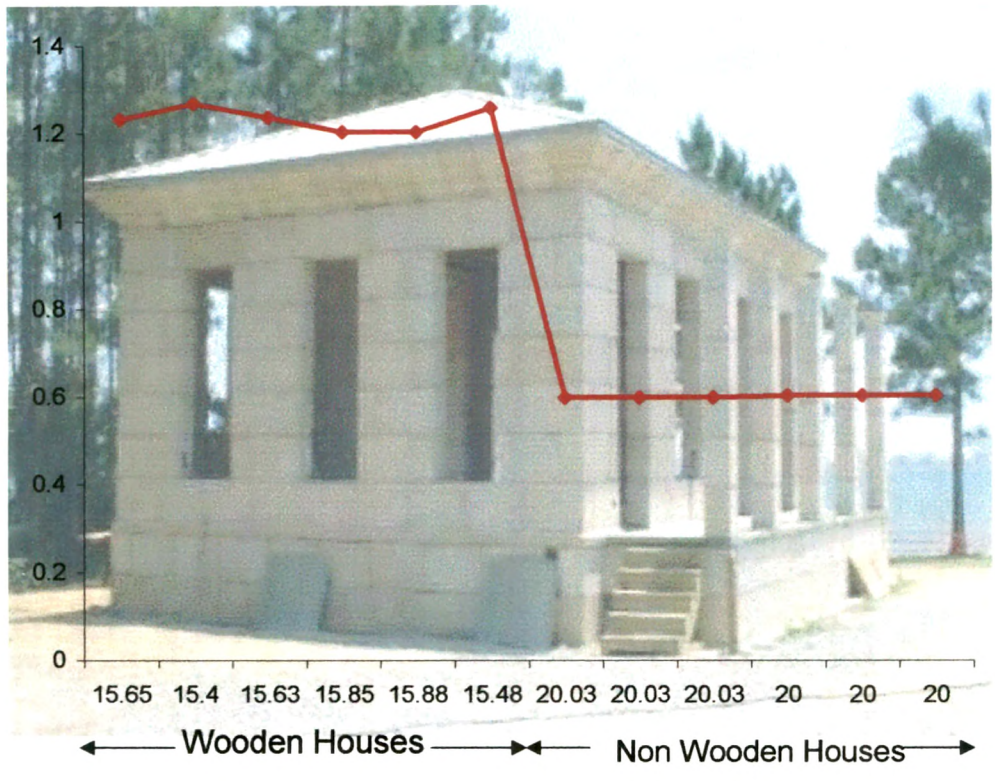


Figure 24: Regression Analysis of Attention / Concentration in an Association with Temperature inside the House

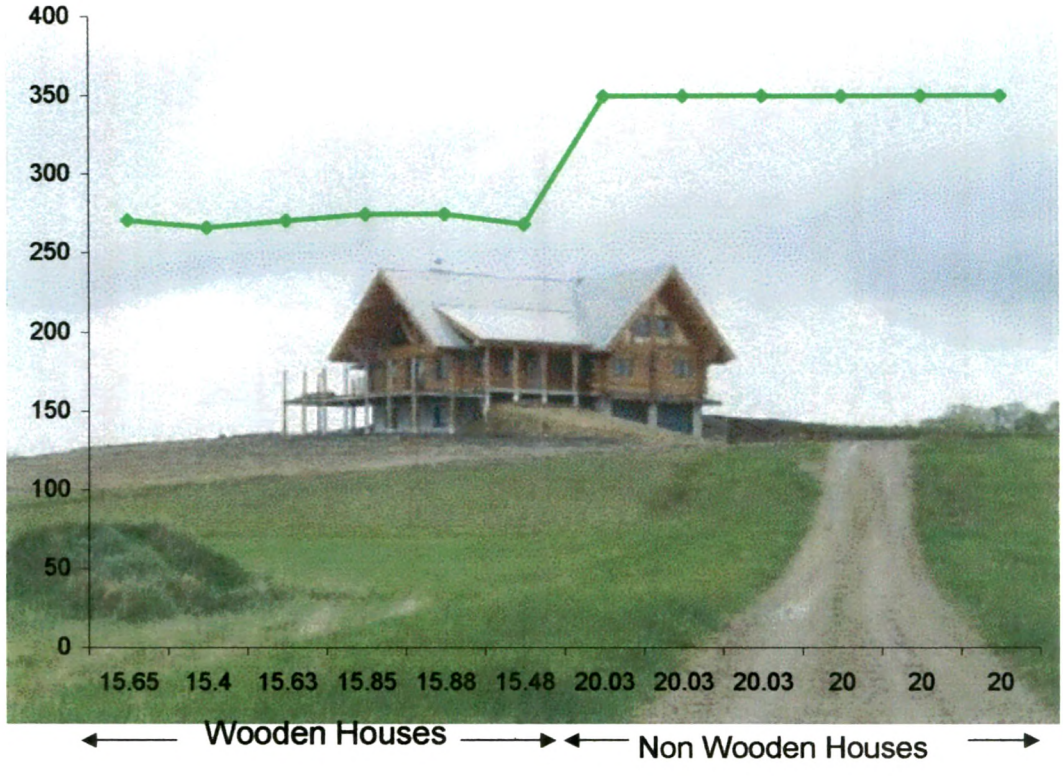


Figure 25: Regression Analysis of Work & Fatigue in an Association with Temperature inside the House

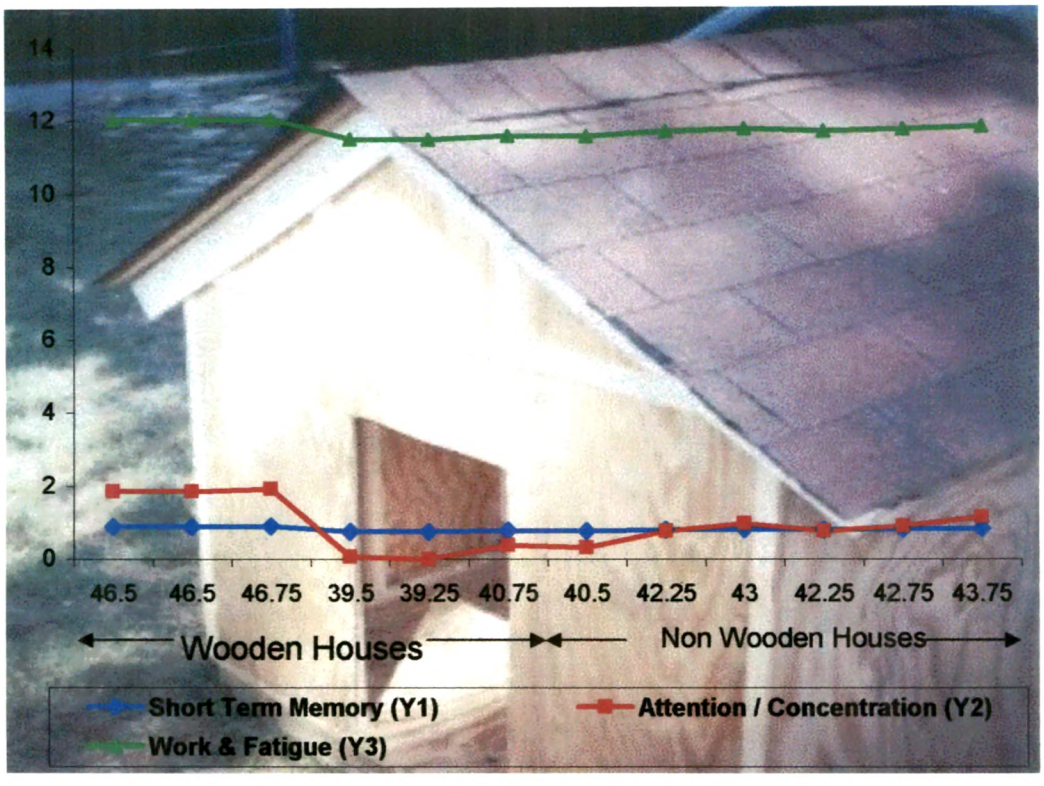


Figure 26: Regression Analysis of Short Term Memory, Attention / Concentration and Work & Fatigue in an Association with Humidity inside the House

Results depicted in Figure 26 showed regression analysis of parameters of human performance (short term memory, attention / concentration and work & fatigue) in association with parameter of environment (humidity) inside the wooden and non wooden houses. it could be concluded from the graph that short term memory changed linearly in relation to humidity. The values were constant for all the respondents and no marked difference was found in the short term memory of the respondent living in two different types of home.

In case of attention / concentration of the respondents living in two different types of houses, difference was observed among the respondents on the basis of the construction material used. The attention level of the respondents was lower than the attention level of the respondents living in the wooden houses.

Work and fatigue values recorded for the respondents showed that there was not a much difference in the level of fatigue but the values were lower for the respondents living in the non wooden houses.

FOLLOW UP ACTION

Knowledge refers to acquaintance with the facts and range of awareness or understanding. In other words, it implies a clear perception of something.

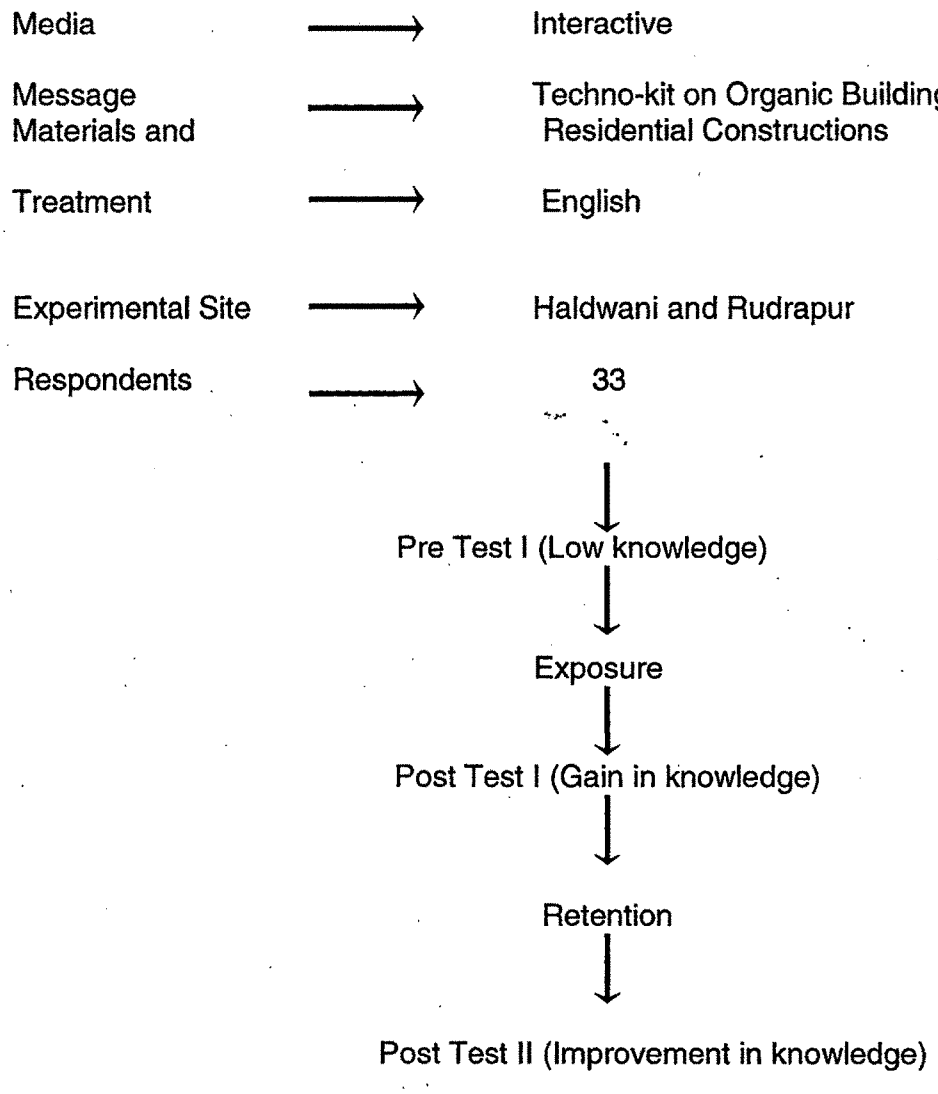
During the investigation it was found that among the selected respondents most of them had low level of knowledge regarding organic building materials (Table 14), which might hinder in living a safer and healthier life. Therefore a techno-kit on OBM was prepared by the investigator for disseminating knowledge regarding OBM and residential constructions, impact on the buildings and the health of the people living in these houses. Remedial measures to safeguard against the negative effects of OBM were also included. A sample of 33 respondents from the same population was selected to assess the efficacy of techno-kit on OBM prepared by the investigator.

Contents of the Techno-Kit (Communication Package)

- Organic Building Materials
- Environmental Factors Affecting Indoor Housing Conditions
- Traditional Residential Constructions / State Of Art In Uttaranchal
- Health Problems Due To Indoor Environment In Residential Buildings
- Identification Of Defective Symptoms / Deterioration In Residential Constructions
- Remedial Measures To Safeguard Organic Building Materials
- Measures To Control Indoor Problems In Residential Constructions

Figure 27: Development of Techno-Kit

(Communication Package)



Part A: Pre-Exposure

The knowledge tool was given to the respondents and they were asked to write 'T' for true and 'F' for false answers. Thirty minutes time was given to each respondent to complete the tool. After thirty minutes it was collected back and scored to find out the pre-test score of each individual.

Table 30: Level of Knowledge Regarding Organic Building Materials before exposure (n=33)

S.No.	Level of Knowledge	Scores	Respondents	
			F	%
1	Low level	102-135	30	90.91
2	Middle level	136-170	3	9.09
3	High level	171-204	00	00.00

Table 30 showed a poor level of knowledge by majority of the respondents (90.91 percent) and high level of the knowledge by none of them.

Part B: Intervention programme

An intervention programme was organized for the respondents. The respondents were given knowledge regarding "Organic Building Materials and Residential Constructions" in the form of booklet. Besides this, html document was also used to impart the knowledge to the selected respondents. All the respondents were grouped in pairs. Total two hours of instruction was given to them, which started from the definition of the OBM. The level of understanding was checked by cross-questioning method with the participants. Their queries were satisfied with the help of suitable examples.

Part C: Gain in Knowledge (Post Exposure)

Gain in Knowledge

Knowledge is the total amount of information understood by an individual; it can be defined as a body of understood information as possessed by an individual. Gain in knowledge is any pre-post test change in person's cognitive learning behaviour resulting from a specific learning experience. In the present study gain in knowledge refers to the extra knowledge gain by the respondents after exposure to media. It was calculated by deducting pre test scores from post test scores.

Soon after the exposure of the respondents to intervention programme, second set of the knowledge test containing same questions was distributed and they were asked to write true or false for the answer. Thirty minutes time was given to them. After thirty minutes questionnaire was collected back and gain in knowledge was calculated.

Table 31: Level of Knowledge Regarding Organic Building Materials after Exposure (n=33)

S.No.	Level of Knowledge	Scores	Respondents	
			F	%
1	Low level	102-135	00	00.00
2	Middle level	136-170	26	78.79
3	High level	171-204	7	21.21

Table 31revealed that there was an increase in the knowledge of the respondents. Some of the respondents having poor level of knowledge regarding OBM moved up to middle level of the knowledge and those having middle level of knowledge moved up to higher level of knowledge after the intervention programme. Hence after about three fourth of the respondents (78.79 percent) showed middle level and 21 percent showed higher level of the knowledge. None of them was in the category of poor level of the knowledge.

Part D: Post exposure II or Retention of message

The retention of message is the net amount of message remembered or recalled out of total message communicated at a particular time and situation. In this study retention was measured after 15 days of exposure. It was computed by deducting post test I score from post test score II.

Further, analysis of the scores was done by applying paired t test and t values shows a significant difference in the scores of the respondents during pre exposure, after intervention programme and post exposure (after a gap of 15 days). Hence it was concluded that the developed techno-kit helped in improvement of knowledge regarding OBM.

Table 32: Level of Knowledge Regarding Organic Building Materials showing retention level of the message (n=33)

S.No.	Level of Knowledge	Scores	Respondents	
			F	%
1	Low level	102-135	01	3.03
2	Middle level	136-170	32	96.97
3	High level	171-204	00	00.00

It is clear from the Table 32 that majority of the respondents possessed middle level of the knowledge after the gap of 15 days. It meant that there was retention of knowledge in the respondents.

Table 33: Values of paired t-test showing difference between knowledge level of the selected respondents before and after exposure (retention) to the techno kit developed

Variables	Mean	t- values	Degree of freedom	Significance level
Knowledge level				
Before exposure	113.05	8.57	64	0.01
After exposure	142.97			

Table 33 showed t- test with a highly significant values for before and after exposure of techno kit developed for the enhancement in knowledge level of the respondents regarding organic building materials. It could be concluded from the significant relationship that there was a definite gain in knowledge of the respondents after using the techno-kit developed for the purpose of increasing awareness among the people about OBM and their proper uses in residential constructions.