ABSTRACT

Building materials are most important materials for human beings. Since prehistoric times man has been using naturally available organic materials for his requirements. In India, animal (bovine) dung has been used to improve the properties of clays. Grasses have been used to provide protection from sun and rain (thatch). Naturally available bees-wax, lac and oils have been used to water proof pots and ceramics. Gradually, as the man's knowledge increased, various oils were processed to make paints and varnishes. Similarly, casein, starches were modified to obtain adhesives.

Use of wood in buildings, construction and decoration is still considered of higher aesthetic value than other competing material. With the increasing emphasis on environment protection and environment friendly technologies, it has become immensely important to work towards development of wood substitutes. In present period, a number of organic substances were synthesized many of organic substances present in nature and also produced thousands of substances that do not occur in nature and plastics/polymers are on such group of substances. Polymers are becoming day by day important as organic building materials due to their binding and insulation characteristics. Polymers are expensive materials so some filler like particulates, agro wastes, industrial wastes, fibres, whiskers are added to formulate composite building materials.

Organic building materials are widely used as structural engineering materials for indoor and outdoor applications. In exterior use, wood is subjected to varying environmental conditions resulting in physical deterioration, discolouration, surface roughening, cracking and damages of the micro structure. Weathering affects physical and mechanical properties of wood and also results in premature coating failure. Infestation of pests also results underneath clear finishes, affects coating adhesion and degradates service life of the building materials. Plastics being organic in nature are prone to attack UV present in sun light and other weathering elements such as

temperature variation, moisture, wind, dust, ozone, etc. These materials and environmental effects together make an indoor climate to be lived in a house.

Physical environment provided by a house has a profound effect on the performance of physical tasks. It can also affect mental task performance. Cold causes peripheral vasoconstriction, shivering, impaired neural conduction and poorer muscular control, all of which may have effects, such as longer reaction time, which may appear to be of psychological nature. Low relative humidity (less than 40 percent) may also increase the risk of respiratory infection. (Bredger, 1995)

There is a less or negligible documentation about the relationship among organic building materials (OBM), housing conditions in OBM houses, health and human behaviour. Therefore, a need was felt to conduct a study on residences made from organic building materials in order to search a link of the residences with physiological, physical and mental health issues.

The present study was proposed with Exploratory cum Experimental research design to describe, to correlate and to measure housing conditions due to use of organic building materials and psychological behaviour of residents. Multistage purposive cum random sampling design was adopted to select 200 residential buildings in Uttaranchal.

To record information in the interview schedule personal interview method is appropriate. An interview schedule having descriptive statements, observation charts and experiment sheets was developed to collect subjective as well as experimental data during face to face interview with residents.

To measure the level of knowledge of the respondents regarding quality of environment, an attempt has been made to develop a knowledge test in view of the fact that it plays an important role in achieving and maintaining quality of the environment in the residential constructions.

A three point Likert type scale was developed to assess satisfaction derived from use of OBM in residential constructions.

To assess level of human performance in the selected residential buildings with OBM constructions, it was felt necessary to conduct experiments on certain psychological aspects and indoor environment of the residents, in terms of short term memory, work and fatigue, attention/concentration, temperature and humidity. The parameters were recorded with standardized tests and equipments.

Descriptive as well as relational statistics were used to analyze the data in the study. Pearson's product moment coefficient of correlation, t test, regression analysis and Analysis of Variance (ANOVA) were employed to test the hypothesis formulated for the present study.

The mean age of the respondents was about 36 years with a standard deviation of $\pm$ 9 years. It revealed that they were having a settled life and living in a particular house for many years. None of them was found to be illiterate. About 88 percent were unemployed respondents, which mean they were spending most of the hours in their houses thus, having a close contact with building materials used in their homes for longer duration than other members of their families.

Among the respondents half of them belonged to service class families and a little less than half of them were from business class families having an average income of about Rs. 9,400 with a standard deviation of Rs. $\pm$ 5826.92. It implied that some of them can afford a house of their own but many of them were living in rented houses.

Houses selected for the study were in hills as well as plain topographic areas to minimize biasness of results due to geographical factors. The residences were mostly *pucca* houses and thus built of natural as well as synthetic organic building materials. 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.* The residents were selected having resided in their houses at least for five years so that effect of the OBM can better be perceived and a cause effect relationship could be established between the OBM and health of the residents. About 72 percent houses were having a life of at least ten years. It helped in assessment of defective problems/symptoms in due course of time due to degenerative changes and also minimized effect of volatile organic compounds emitting out of newly built OBM residences.

The residences were selected on the basis of use of clear fuel. Most of the selected respondents reported that they are using either LPG or electricity or both for lighting as well as cooking purposes. Smokers were found only in twenty percent of the houses. Most of the respondents were spending their 13-24 hours of time per day in their homes. Townsend et. al. in 1988 also recommended that 'Housing 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.

Building materials used in construction and during renovation were classified under six categories and then it was noted down that the materials were available in their vicinity easily or not. It was found that materials used for masonry purposes were available only in few areas and people have to bring them from far off places. OBM like wood, plastics, roofing materials, sealants, and adhesives are available in near by markets. But people are buying protective and decorative finishes and materials used for reinforcement from far off places, sometimes from other districts and states, too.

Wood was the material used by 17.50 percent residents in all the areas for doors, windows, ventilators, cupboards and half of the respondents (for floors, roofs, working counters and staircases) whereas, about 44 percent of

them used it in most of the areas and about 38.50 percent of them used it for some of the areas. Stone was also used as basic material for roof, cupboards, walls and working counters by about half of the respondents.

The data showed that most of the care and maintenance was done by the respondents on their own. More than 90 minutes per month were reported for cleaning of cupboards by little less than of the respondents (44 percent). Roofs and walls requiring least maintenance was reported by about one third of the respondents (29.50 percent) and floors were cleaned daily by more than a half of the respondents (69.50 percent).

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.

In due course of time several defective symptoms were observed in the houses like deformity, smell, dampness, flaking off, shorter life, allergy, corrosion, vegetative growth, fire ignition, dust release, noise, fumes, termite, mold growth, reaction with water, reaction with food materials and heating were the problems experienced by the residents in their homes. Among these problems mostly reported were deformity in walls by 75 percent of the respondents, dampness in walls by 77.50 percent and in roof by 62.50 percent of the respondents, flaking off in walls by 65 percent of them, dust release from doors, windows and ventilators by about 45 percent of them, problem of termite in cup boards by about one third and heating up of roof was reported by about 42.50 percent of the respondents.

Various health symptoms were highly perceived by 95 percent of the respondents as an effect of the OBM used in their houses. Among them lethargy (often felt by 45 percent respondents) was ranked first, fatigue (often felt by 45 percent respondents) second and symptoms of humidified fever (often felt by 40 percent respondents) as third.

Among building related health syndromes 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.

Among the selected respondents most of them i.e. about 96.50 percent showed a low level of knowledge regarding OBM used in their houses and a very few of them reflected middle level (3.50 percent). As per satisfaction OBM were ranked first on safety and care and maintenance, second on cost, third on function/purpose and lastly on no health effects.

The 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. The poorer concentration level was shown by the respondents living in non wooden houses than the wooden houses.

The number of sums done by the respondents living in the non wooden houses was 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.

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.

In the present study, findings of the analysis confirmed that the knowledge regarding OBM of the respondents varied significantly with age, educational qualification, employment status, occupational status and location of house, which indicated that the knowledge varied due to these variables. Family income, family size, occupancy period and age of building structure which were found to be non significant.

Extent of use of OBM in home varied significantly with age of the respondent, employment status and occupancy period and age of building structure and not found significantly associated with educational qualification, occupational status, family size, family income, location of house

Problems faced in care and maintenance of the home showed a significant variation with occupational status, family income and age of building structure and not found significant variation with age, educational qualification, employment status, family size, location of the house and occupancy period.

Significant relationship was observed between knowledge regarding OBM and extent of use of OBM in home. Whereas, relationship of 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 was found non significant.

The relationship was found significant 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. Non significant values were observed for association among 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.

Satisfaction derived from use of OBM in the home varied significantly with educational qualification, employment status and occupation of the family and did not vary with age, family size, family income, location of the house, occupancy period and age of the building structure.

Effect on health of the residents, it was observed that it varied significantly with educational qualification, employment status, occupation of

the family and occupancy period and did not vary with age, family size, family income, location of the house, and age of the building structure.

Extent of use of OBM and humidity inside houses varied significantly for the wooden houses and non wooden houses. However, it did not vary significantly for temperature inside houses.

Among human performance, work and fatigue did not vary significantly for the wooden and non wooden houses but varied for short term memory an attention/concentration.

As a follow up of the study an intervention package was administered among the respondents. There was a 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.