
INTRODUCTION

CHAPTER I

INTRODUCTION

> ***"Home is where the heart can laugh without shyness. Home is where the heart's tears can dry at their own pace".***
>
> (Baker, 2005)

It is a well-established fact that grasses and foliages remove carbon dioxide from the atmosphere and act like a body of water to reduce the heat. Replacement with building materials, on the other hand, breaks this cycle and creates a hot air barrier that blocks the normal flow of winds and rains.

Earlier eco-friendly materials such as wood, clay, stones, mud, etc. have been used in construction of residential buildings (Taylor, 2000). Natural polymers such as bitumen sealants in construction activities were used for water proofing in the ancient cities of Harappa, Mohenjodaro, Lothal etc. However, buildings created since the 1950s contained plastics in applications such as piping, windows, roofing, flooring, cable sheathing, ducting and insulation (Verma, 2003).

Organic Building Materials and Housing

Organic materials are perhaps the oldest construction materials (Merritt, 1986) but recently they have been noticed by scientists and researchers. Through many generations of use, people have found ways of getting around some of the limitations of naturally organic construction materials. Organic building materials are engineering materials which are mixture of different hydrocarbons sometimes together with sulphur, nitrogen and oxygen derivatives, used in residential constructions. (Raghavan, 1996)

Wood is a versatile and widely used structural engineering material for indoor and outdoor applications (Pandey, 2003). Use of wood in building construction and decoration is still considered of higher aesthetic value than

other competing materials. Depleting forests leading to rising prices has only made alternative materials more competitive but has not taken the shine off wood (Jain and Mehta, 2003).

Polymers are organic substances and derivatives of carbon and hydrogen. They are also known as 'plastics' (Agrawal, 1988). PVC, PTFE, Polyehylene are widely used organic polymers in building industry (Raghava, 1998).

Rubbers are highly elastic and resilient polymeric materials which find wide applications in various fields. They are organic polymers that are capable of being subjected to large elastic strains without plastic yielding (Agrawal, 1988). Sponge rubber is used in sealing, heat insulating, cushioning and shock absorptions in buildings (Sastry *et al.* 1998).

Bitumen is a primary engineering material functioning as a binder in buildings and roads. It acts as a weather proofing membrane in roofing and structural applications. Its thermoplastic nature, water resistance and adhesion towards most other substances make it unique as a building material (Khursheed *et al.,* 2003).

Glues obtained from animal gelatins, vegetables and starches are widely used adhesives. Adhesives made from polymers include cellulose acetate, cellulose acetate butyrates and pyroxylin. Xanthan gum is commercially the most widely produced gum (Sastry, 1998).

Thus, organic building materials have been used from earlier days but they have been modified and protected by use of new organic substances such as plastics, rubber and other materials.

Organic Building Materials and Effects of Environment

The process of weathering is defined as the action of atmospheric elements in altering the colour, texture, composition or form of exposed objects, ultimately leading to disintegration or failure to perform a

function. The well-known elements of weather are radiation, moisture, thermal conditions and gases (Vadstrup, 2005).

Due to long-term exposure for humidity, sooner or later the decay has reached a critical limit for the service life of the materials. The decay of wood due to natural exposure is more or less predictable. Another reason for long service life of wood is the "favourable" climate (a combination of generally low precipitation and low temperature) and constructions based on long-term experience. At the same time, expanding use of surface treatment by tar products, oil paint, linseed-oil paint and stains gave further protection from humidity and prolonged the service life. "Unpredicted" or extensive decay is often due to relatively clear events/change in exposure.

Norwegian studies by Mattson and Oftedal in 2005 indicated quite clearly that the decay of wood due to natural exposure is more or less predictable. One explanation is the traditionally use of pine logs with an extensive amount of heartwood, which ensure a clear limitation regarding to growth of wood-decaying fungi and wood-boring insects.

The environmental factors collated by following five causes are responsible for most of the deterioration and damages in the organic building materials (Vadstrup, 2005):

1 **Influence of water:** and the consequences or followers of water: Moisture, ice, saltwater, acid rain. This causes dry rot and fungus in wood, salts in masonry and stones, frost damages, acid deterioration, algae, dirt etc.

2 **Mechanical causes:** from wear, ground decreases, insufficient carrying capacity and wind.

3 **Technical faults:** from insufficient constructions: Leakages, insufficient adjoints between materials, too hard and moisture tight surface treatments or finishing coats, changes in the physical balance in the constructions.

4 **Forced deterioration** of the surface materials due to leakages in the roof, joints, watertight surface on iron etc.

5 **Other causes:** incorrect use and arrangements, neglect of maintenance.

Thus, changed use (no more heating, lack of maintenance) or construction of the buildings (new materials, thermal insulation) may be the factors that provoke an accelerated rate of decay. Even small changes, such as applying a modern paint system, can be sufficient for a major change in rate of decay.

Housing and Health

Housing conditions are associated with health status in a variety of ways (Townsend *et al.*, 1988). People complain that they become sick in buildings of poor insulation, energy conservation and ventilation with symptoms of eye, throat and nose irritation, dryness of mucosa of skin, erythema and mental fatigue. Displeasures are also experienced with aversive and persistent odours and with ventilation noise (Ahlstrom *et al.* 1986 and Andersen *et al.* 1975).

Problems of sick buildings concern exposure to irritating agents in indoor air. They may affect the olfactory system, the trigeminal system, the cutaneous system as well as cognitive functions (Bergland *et al.* 1986).

Sick buildings subject the inhabitants to air which is polluted by mould spores and mould metabolites, volatile hydrocarbons, radon, asbestos particles or other agents. The reactions to air borne chemical compounds and aerosols lead to itchy eyes, dry mucous membranes, abnormal fatigue, headache, or other psychosomatic reactions (Ryd, 1991).

Damp conditions particularly condensation encourage the growth of mould. Mould is less likely to be found in conditions of penetrating or rising damp since the salts which emerge with the moisture tend to inhibit its growth. Condensation on the other hand, contains relatively pure water which is highly

conducive to the growth and proliferation of fungal spores, which live off the organic material on walls and in cavities. Fungal spores can give rise to three types of reactions; allergies, infections and toxic effects (Hunt, 1993).

The housing conditions thus have a definite impact on health of the people living in it and make a place where one seeks refuge from the anxieties and worries of the outside world.

Health and Human Behaviour

Biological status can influence psychological state, but psychological status cannot affect biological status (Keithley, 1993). It is growing awareness of the importance of individual behaviour in determining the patterns of health and disease in the population which represents perhaps the greatest single change affecting public health in recent years (Public Health in England, HMSO, 1988).

The cost of living in sick buildings is much higher than accepted if you count the psychological effects. This is more pronounced if sick building is your home. The concepts which should be studied and are studied by different people, in order to show the importance of building healthy homes' are:

1. Cognition
2. Belongingness and identification
3. Feelings, devotion and love
4. Memories
5. Sexual behaviour and social association
6. Unity and order
7. Self-identity and gender differences
8. Privacy, refuge and security

9. Social and family relationship

(RYD, 1991)

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).

Housing conditions not only have impact on physical well being but also mental well being of the people as reported by various researchers.

Rationale for the Study

> ***"Social Science should not be seen as developing a stock of knowledge about an object which is external to us, but should develop a critical self-awareness in people or subjects and indeed assist in their emancipation."***
>
> (Sayer, 1984)

Building materials are most important materials for human beings. Wood, a renewable resource is most abundantly and naturally occurring organic polymeric composite material which consists of long cellulosic fibers (Sastry *et al.* 2003). In India, the estimated demand of timber is 56.98 million cubic meter in the year 2001-2006. Limitation of plywood/timber in terms of reuse value could be effectively mitigated by the use of new polymeric materials (Singh and Gupta, 2003). Organic polymers are becoming day by day important due to their binding and insulation characteristics (Chand, 2003). Currently about 3.7 million tones of plastics are produced in India for different uses. Their consumption as building material is close to 1.35 m tones. By 2006-07, the production of plastics is expected to reach about 8 million tones in which the share of plastic for building is about 2.4 million tones (Singh & Gupta, 2003).

"Home Means refuge and security, a place to which we turn to replenish our energies. What does it mean to us if we feel threats against our health in the very place where we need to feel comfortable and at ease?"

(Ryd, 1991)

In Uttaranchal, the spatial organization of a typical house is rather simple, functional and linear. Timber is used in conjunction with brick or stonewalls to create a composite structure. A wooden frame of joists and columns is made to support the building. Other building materials predominantly used for the construction purposes are composites of organic and inorganic materials, synthetic polymers or plastics, finished stones, marbles, etc. Typologically, in the urban *pols* they are deep wall-to-wall houses with a narrow frontage that opens onto a street. The houses create a dense built environment, as each narrow plot is 100% built up as a result of which a sense of security gets developed. It is basically a deep house-plan with three or four sequential rooms one behind the other. There is typically a small courtyard in the center that brings in light and ventilation. Basements are used for storage and water collection and also for passive cooling in the hot summer months. The optimized and ornate courtyard at the center is an important socio-cultural as well as existential space as a center of household activities. The wooden facades, a dominating element of the house form, have an intricate ordering mechanism, articulated elements and profuse carvings. They are often an expression of the socio-economic status of the owners. The aesthetic vocabulary of I making is created with horizontal bands and vertical fenestrations. There is composite construction in brick and wood. At times, burnt brick was used with mud mortar. Wooden structure is evolved through the beam and joist system with made-up floors. The internal courtyard is also a spatial aesthetic experience with the woodwork contributing a great deal. The finely carved columns, brackets and balconies are predominant elements.

The state has declared itself as an organic state. People are carefully choosing to produce organic foods and fibers to feed and clothe their families, but they should not forget to regard the construction and furnishing of their home by the same standards. Deterioration of building materials due to

exposure of environmental conditions is more or less unpredictable, which affect indoor housing environment. Housing conditions are among the primary determinants of an individual's health (Foster, 1992; Ineichen, 1993; Krieger, 2002; Xavier *et. al.* 2003). There is a substantial body of evidence on the health impacts (Fuller *et. al.* 2000; Braubach *et. al.* 2001; Ranson 1991; Xavier *et. al.* 2003) and human behaviour (Berglund *et. al.* 1986; Ryd, 1991) due to the housing environment. An increased number of bad houses and an accelerated deterioration of housing stock are on an increase (UNECE, 2002; Hunger, 1994).

There is a less or negligible documentation about the relationship among organic building materials (OBM), housing conditions in OBM houses, health and human behaviour. In home management we are very much concerned with housing for family living. The quality of housing can enhance or diminish the well being of individual and families as that of the entire community. There is a need to understand the impact of building materials on indoor environment and health of families. 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 environmental and psychological health issues.

Objectives

1. To make an inventory of organic building materials (OBM) available and their use in residential constructions.

2. To find out extent of use of OBM in residential constructions.

3. To assess problems experienced in care and maintenance in the selected residential constructions.

4. To find out the health problems perceived by the residents due to use of OBM.

5. To ascertain the knowledge and satisfaction level of residents regarding OBM.

6. To assess level of human performance in the selected residential buildings with OBM constructions.

7. To develop an educational material on increasing awareness regarding proper use of OBM.

Delimitations

1. The study will be limited to two districts of Uttaranchal, namely :

   (a) Nainital

   (b) Udham Singh Nagar.

2. The study will be limited to 200 residents comprising 100 residents in each district.

3. The experiment will be limited to assess :

   (a) Human performance (memory, attentions & mental fatigue)

   (b) Indoor environment (temperature and humidity)

Hypotheses

H_1: Knowledge regarding OBM, extent of use of OBM in home and problems faced in care and maintenance are associated with personal variables, family variables and situational variables.

H_2: There is an inter relationship among knowledge regarding OBM, extent of use of OBM in home and problems faced in its care and maintenance.

H_3: Knowledge regarding OBM, extent of use of OBM in home and problems faced in care and maintenance of the houses are associated with satisfaction derived from use of OBM and effect on health of the residents.

H_4: Satisfaction derived from use of OBM and effect on health of the residents has an association with personal variables, family variables and situational variables.

H_5: Temperature and humidity inside the home is associated with extent of use of OBM in the residential constructions.

H_6: Human performance in terms of short term memory, attention/concentration and work & fatigue has an association with temperature and humidity inside the home.

Assumption

A variety of organic building materials are used in residential constructions.