Introduction to Building Biology

Lesson Aim

To explain the concept of healthy buildings, including its relevance to human health

BUILDING BIOLOGY

Building biology, bio-house design, biological architecture and ecological building all refer to the construction of a building along lines of more natural, renewable resources and health of the occupants. In other words buildings become more people-friendly. It aims to establish a balance between technology, culture and biology.

> *"Building Biology deals with the study of living organisms in and around the building environment which have direct or indirect effect on the health of the building fabric, its materials, structures, environments and occupants." Jagjit Singh (1993)*

To a human-being the walls of a building can be regarded as a third skin (the first is our own skin, the second is our clothing). Most buildings do not breathe like our natural skin and unfortunately in the USA this has been shown to lead to a build-up in radioactive radon gas and reduce the benefits of passive solar energy in spring and autumn. If a building is to be sealed (which most are) then it needs to be well ventilated to remove unhealthy pollutants.

Many buildings contain hazardous materials or substances without the owner's knowledge. Freshly constructed cement homes have high levels of moisture, homes built in the 1960's contain asbestos cement which is known to be carcinogenic and old piping systems are frequently painted with lead paints. In addition to the household disinfectants, fly sprays, paints, varnishes, and other fumes released from a large range of furnishings and commodities are of no benefit to the occupant's health.

Environmental costs are considered from the very first stage of planning. If products need to be transported a good distance, then they are usually rejected due to pollution, energy and costs for transportation. Even non-renewable resources are avoided.

Building Diseases

Chemical - As mentioned above due to their fumes.

Electrical - The human body is sensitive to electrical frequencies. Wiring should be minimalised, not placed closer than 1 metre to the sleeping bed, use of T.V. and other appliances should be reduced. Even static electricity from synthetic floor coverings can cause problems.

Cage - This occurs when concrete and steel buildings screen out natural radiations which help regulate life systems.

Location - This covers geobiology which is concerned with natural radiation that originate within the earth. It is a new science based on traditional principles.

Building Biology also deals with the environment in general and the climate of living. The climate of living can be determined by things such as:

- Installations and furnishings
- Noise and acoustics
- Lighting and colours
- Radiation, avoiding disturbed areas

- Radioactivity
- Space, form and proportion
- Physiology and psychology of living and working
- City planning with biological, ecological and sociological aspects.

Bio-houses and bio-settlements have been sprouting up throughout Europe over the years. They frequently contain solar temperature-control systems or insulated winter gardens for heating. Sites are surveyed with divining rods to ensure the area is free of ground water veins and other electromagnetic disturbances.

Biotechture utilizes vegetation to reverse the harsh processes caused by buildings. Plants usually intercept between 70% and 90% of incoming solar radiation. Deciduous trees can provide a 5 degree C reduction in heat in summer but allows the sun through in winter thereby reducing energy loss by up to 30%.

Many plants have characteristics that can be used for the benefit of construction. Leaves defoliate and remove air pollution, foliage that closes and opens can act like a ventilator, etc. It is advisable to use plant as much as possible to complement the house not only aesthetically but also functionally.

EUROPE

"*Bau Biologie*" is a German word, meaning building biology. This concept was developed in Germany and has spread from there throughout Europe to the USA and other parts of the world.

A course to train building biologists was written by Professor Doctor Anton Schneider in Germany; as head of the German "Insitut fuer Baubiologie und Oekologie in Neubeuern" Building Biology Institutes have now also been established in various other countries including:

- In the United States (Florida):"International Institute for Bau Biologie & Ecology"
- In New Zealand: "Building Biologie and Ecology Institute of New Zealand".

These institutes conduct courses and seminars training professionals to work as consultants, designers and inspectors in the building industry.

Opportunities to work in this industry are limited, but expanding. Legislation (particularly in parts of Europe), is leading to increasing significance being given to health issues in the way buildings are constructed.

Study of building biology factors is being included increasingly into relevant courses (e.g. Architecture) in many parts of the developed world.

Different terminology is used by different professionals, from bio-harmonic architecture or healthy buildings to sick building syndrome and building biology. These terms all refer to similar things: the impact of a building on the health of people using it.

A Summary of Environmental Law in Britain

- Government policy is to frame laws that will prevent, rather than cure, pollution.
- The polluter is to pay for the pollution generated.
- Environmental protection laws to be increased by the EC unless the controversial subsidiarity principle, referring to in the Treaty of Maastricht, is applied.
- Environmental protection will become an ever-more significant factor in town and country planning.
- New contaminated land registers under the EPA could have a significant impact on the location of commercial developments and on the availability of development finance, if the government proceeds with its proposal.
- Building regulations whilst not primarily concerned with environmental protection will give greater consideration to issues such as energy efficiency and the use of environmental friendly building materials.

- Construction operations must be carried out in such a manner so as to cause no unavoidable pollution of the air, land or water.
- Waste materials must be disposed of in accordance with the new duty of care imposed by the EPA, and only by registered contractors.
- The government plans a new, comprehensive Environmental Agency for England and Wales, but this is unlikely to be in place until 1994.

From: S. Johnson and T. E. Sutherland (1993) "Greener Buildings: Environmental impact of property".

BIOLOGY AND HEALTH OF BUILDINGS

A building is similar to a living organism. It can provide ecological niches and micro-climates for a wide range of organisms, which should be understood as a whole entity. Interrelationships exist between the building, the living organisms and the environment, many of which are very complex. Factors that cause building decay or failure are temperature, water, humidity and lack of ventilation.

Biological Damage

Dry Rot

Timber decay caused by the fungus *Serpula lacrymans* attacks mostly softwoods causing extensive damage in Britain.

The fungus causes discolouration and cracking.

Wet Rot

The fungi group of Basidiomycetes will cause wet rot. These include Coniophora puteana, Phellinus contiguus, Donkiporia expansa, Pleurotus ostreatus, Asterostroma spp., Paxillus panuoides and "Poria" fungi.

Wet rot is sometimes called white rot.

The fungus causes shrinkage, cracking and discolouration.

Soft Rot

More common in timbers in contact with the ground, this rot is caused by *Chaetomium globosum.*

Hardwoods are more susceptible to this form of rot.

Thin surface cracking and shallow decay of the wood are typical symptoms.

Moulds

Moulds have the ability to survive on masonry, brickwork, concrete, rendering, tiles and paving, plaster, wood, wallpaper and paint. They occur only on the surface as a miscoloured growth, usually green, grey or black.

Mould species include: *Cladosporium* spp., *Penicillium* spp., *Aspergillus* spp., *Trichoderma viride* and *Alternaria* spp.

Moulds reduce the strength of the wood.

Slime Moulds

Slime moulds are occasionally found growing on masonry, brickwork, rendering, tiles, paving and organic surfaces such as damp wood.

Slime moulds belong to the division of Myxomycota.

Plaster Fungi

Occasionally found in situations where damp brickwork or plaster occurs.

Stain Fungi

Most stain fungi belong to the class Hypomycetes.

Damage will occur if timber is sap moist and will only reduce the aesthetics of the timber.

Bacteria

Damage can occur to timber and stone in a building environment.

They eventually cause a slow and progressive loss of timber strength and an increase in the permeability of the wood which adds to the chance of seasonal rain wetting, thus increasing the risk of decay.

Lichens, Mosses and Algae

All three cause a chemical dissimilatory type of biodeterioration.

Damage is restricted to surface discolouration of wood, concrete, brick, asbestos-cement and asphaltic materials.

ENVIRONMENTAL CONSIDERATIONS IN A BUILDING

A building should provide a pleasant, efficient and healthy environment for its occupants. Its primary purpose should be to protect from adverse conditions found outside; but in doing so, not lose the beneficial conditions found outside. If a building is properly planned and built well, these aims can be achieved. In most situations, buildings should satisfy the following:

- Buffer the impact of adverse external conditions (e.g. extremes of temperature, wind, moisture).
- Make use of natural light during the day (with windows, skylights, reflective interior surfaces, etc).
- Provide appropriate artificial light (without glare, with appropriate intensity and wavelengths, etc).
- Maintain good air quality inside (e.g. through ventilation, indoor plants).
- Minimise pollutants/toxins (e.g. fumes, dust).
- Control acoustics (stop unwanted noise; avoid interference/distortion of desirable noise, etc)
- Provide unimpeded movement and access to all areas.
- Provide rapid response to environmental controls (e.g. ability to raise or lower temperature quickly, ventilate rapidly if necessary).

CLEAN INTERIORS

Interiors that are clean are healthier to live in. Building and interior design should be geared towards ensuring interiors are able to be kept clean without any great difficulty.

Guidelines for a Clean Building

- Smooth, even surfaces are easier to keep clean
- Areas need to be well lit if dust, grime etc is to be noticed
- Areas need to be accessible to be kept clean
- Cracks, high shelves, light fittings etc. can easily collect dust and go unnoticed
- Minimise fabrics which will collect dust/ breed pests (eg. mites, etc)
- Avoid using cleaners that contain toxins or leave undesirable residues.

Appliances

- Electric appliances will cause radiation which can be a health risk.

- By selecting low radiation appliances and placing them in appropriate places, this risk can be minimised.
- Appliances made from plastics can give off toxic fumes at a faster rate if they heat up.

Cleaning Materials

There are toxic components in many common household cleaners. Ammonia and chlorine based cleaners are common, but these can also be detrimental to health if used repeatedly over a long period of time. The following cleaning alternatives are considered safer than using synthetic chemical cleaners:

Cleaning Problem	**Safe Solution**
Laminated surfaces	Use vinegar & sodium bicarbonate on different sponges
Stainless steel	Use vinegar & sodium bicarbonate on different sponges
Oven	Cover with sodium bicarbonate paste, then wipe off Sprinkle stains with salt (in cool oven) then wipe off
Burnt saucepans	Boil water with cream of tartar for 10 minutes
Refrigerator	Rub surfaces with sodium bicarbonate and a damp cloth. Deodorise by leaving vanilla essence (open) inside.
Stained crockery	Rub with salt or sodium bicarbonate and a damp cloth
Washing dishes	Soap if using soft water. If using hard water, use soap and washing soda.
Cleaning Floors	Half a cup of vinegar in a bucket of warm water, then mop or scrub.

Aluminium in salty water acts as a magnet, drawing tarnish from metal in the kitchen or jewellery. In the kitchen sink you could add a sheet of aluminium foil with a few handfuls of salt, and immerse metal items in for a quick clean. A teaspoon of baking soda will add in the cleaning process. Lemon juice and salt work well on brass, silver, bronze, copper and steel.

Household Chemicals and Hazards

Tetrachloroethylene can enter the home on clothes that come fresh form the dry cleaners. Benzene can enter the home on clothes form self-serve petrol stations. Elevated levels of chloroform are present in every time you take a shower, if the water is chlorinated. Oven fumes, nail polish, paint thinner, and especially cigarette smoke add toxic fumes to which you may be exposed. Plants may be an effective method in removing some of the most dangerous toxic contaminants. In one experiment it was proven that the spider plant (*Chlorophytum elatum*) was capable of reducing the concentration of formaldehyde by 85% within a 24 hour period. As such, 2 or 3 spider plants per average household room should be sufficient to reduce offensive chemicals.

Ozone generators have been used by many people to reduce the chemical out gassing of new cars and other such products. These generators destroy odours caused by chemicals, tobacco, animals and fires, aerosols; they kill fungus, moulds, spores and mildew, and detoxify buildings. Unfortunately, it is toxic to humans and animals, is unstable, ages fabrics, plastics and rubber, and is believed by some to affect the ozone layer.

The following list on formaldehyde was compiled by Lovelace Biomedical & Environmental Research Institute, 5400 Gibson Boulevard, S.E., Albuquerque, NM 87105. It is a ranking of off-gassing form formaldehyde-containing products. The product and the amount of formaldehyde release per m^2 surface area per day:

Plywood Panelling	34,000

Particle Board	25,000
Particle Board	24,000
Particle Board	15,000
Particle Board	2,000
Wood panelling	1,500
Paper cups and plates	680
Ladies' dresses	570
Men's shirts	470
Fibreglass ceiling panel	460
Fibreglass insulation	450
Rigid round air duct	400
100% cotton fabric drapery	340
Paper Cups and plates	330
Paper cups and plates	260
Rigid round fibreglass duct	150
Girl's dresses – polyester/cotton	130
100% cotton drapery fabric	100
Latex-backed carpet	100
3.5% inch fibreglass	90
Foam-backed carpet	65
Plywood exterior	55
77% rayon/23% cotton drapery	50
Children's clothes – 65% polyester/35%cotton	35
Bland fabric	25
Nylon upholstery fabric	3-9
Carpet	1-2
Foam-backed carpet	1
Cotton upholstery fabric	ND (not detectable)

Research in Oregon (USA) has shown that housewives aged between 16 and 64 are twice as likely to die from cancer due to domestic exposure to carcinogenic materials found in cleaning materials such as petroleum distillates, benzene, naphtha, chlorinated hydrocarbons and ammonia.

In a comparison between indoor and outdoor air, breath and drinking water in North Carolina (USA) it was shown that at least 11 chemicals were found to be 2 to 5 times higher indoors. Some households had exposure to chemicals 70 times the outdoor rates.

The worst household dangers identified so far include smoking, living with a smoker, using air fresheners, mothballs, aerosol sprays and storing paints and solvents.

Ideas to reduce Hazards

Kitchen microwaves - long term exposure to low-level microwave radiation affects the central nervous system, causing insomnia, decreased sexual potency, dizziness and birth defects. If microwaves must be used, do not stand in front of it when cooking. Eastern European nations believe that the "safe exposure levels" set by western nations is far too dangerous and would prefer the rate reduced from 10 milliwatts to 10 microwatts per cubic centimetre.

Gas ovens and stoves - the toxic fumes released by poorly ventilated appliances is sufficient to make the air inside the house worse than that of Los Angeles' smoggy skies. When using gas, ensure exhaust fans are on and windows are open.

Lead - lead is a well known hazardous ingredient used in paints and soldering in tin cans. Fruit juices such as orange or any acidic product, can react with the original metal container if kept in the refrigerator. Closed glass bottles are best.

Synthetic carpets - spray on an anti-static fluid (one part fabric softener to five parts water) each month to reduce the positive ions generated by walking across it. Positive ions make you sleepy and rob you of oxygen. Replace carpet with natural thread throw rugs, non-porous ceramic tiles or sealed hardwood floors.

Freshly dry-cleaned clothes will release trichloroethylene (TCE), which are known to cause headaches. Remove newly dry-cleaned clothes out of the bedroom for safety reasons, and a good night sleep. Consider airing the clothes on the porch/veranda until smell has gone.

Reduce use of "non-iron", "permanent-press", or "crease-resistant" clothing and materials. It is believed that formaldehyde is the ingredient that makes material crease-proof, and that it is used in the cotton/polyester blends. Formaldehyde is suspected of being carcinogenic, teratogenic (causing birth defects) and mutagenic (causing genetic changes). It has also been implicated with infant death syndrome.

Electric blankets - get rid of them! The EMR so close to your body is dangerous.

Hairsprays - many contain methylene chloride which has been found to be carcinogenic to animals and is suspected to be dangerous to humans. The same substance is often found in decaffeinated coffee, and is used in spray paints and insect sprays.

Talcum powder - women using talcum powder on their genitals and sanitary napkins were three times as likely to develop ovarian cancer as women who didn't use the powder.

Toothpaste - some varieties contain formaldehyde.

Face creams - some creams use petroleum products. Avoid these: paraffin, propylene glycol, isopropyl myristate, sodium lauryl sulphate, TEA and DEA.

Laundry chemicals - avoid: naphthalene, phenol, ammonia, EDTA and dyes

SET READING

Search available material for reading that refers to the aim of this lesson – “explain the concept of healthy buildings”. This material may include textbooks, library books, journal articles and online resources such as specific website. If you have a textbook, read the first or introductory chapter. Spend 2 hours on this.

SET TASK

Activity 1

Investigate current attitudes and trends towards building biology. Talk with at least two different people involved in the building industry. Spend up to 2 hours doing this.

Remember they may or may not understand terminology such as "healthy buildings" or "building biology". For this reason, you should avoid using such jargon. Ask about things such as "environmental concerns" and "health concerns" in the way buildings are constructed or renovated, and with the materials that are used, or have been used in the past. You might talk to people such as any of the following:

- A health inspector
- A building inspector
- A builder, plumber, electrician, carpenter or other tradesperson.
- A town planner, engineer, health practitioner or other professional with concerns about healthy buildings.

You might ask questions such as:

1. What regulations/laws are in force to ensure buildings constructed do not contain health hazards?
2. Are new or additional regulations likely to be introduced?
3. Do you think our country will follow trends in other countries to regulate more and more in this area?

Assignment 1

Question 1

Explain the concept of building biology, in accordance with the international building biology institute. Write one paragraph.

Question 2

Give two examples of how building construction can affect the health of people who use those buildings. Write one paragraph for each example.

Question 3

Explain in your own words the current status of bio-harmonic architectural practices in your country. You may do this by commenting on questions such as the following (as far as your current knowledge allows).

- Are building industry professionals (builders, developers, architects, material suppliers) very sensitive to the impact of building construction on human health?
- Do home owners compromise or modify their choice of materials and methods of construction to reduce health risks in buildings?
- How much control does government exercise to reduce health impacts in buildings?

Write about one page or 500 words.

TO FIND OUT MORE ABOUT THIS COURSE VISIT

https://www.acsedu.co.uk/Courses/Permaculture-and-Self-Sufficiency/HEALTHY-BUILDINGS-CONSTRUCTION-HEALTHY-BUILDINGS-I-BSS200-417.aspx