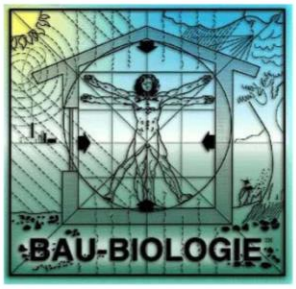
International Institute for Bau-biologie® & Ecology

IBE 207.4

IBE 207.4 Floor Systems

BRINGING TOGETHER TECHNOLOGY AND DESIGN METHODS TO PROVIDE THE INFORMATION NEEDED TO CREATE HEALTHY HOMES AND WORKPLACES



Floor Systems – IBE 207.4

Welcome

Thank you for choosing IBE for your educational needs. Current environmental realities demand a new approach to ensuring that our homes, schools and office buildings support the health and wellness of all who dwell there. We strive to provide the latest information and cutting edge methodology on the vital, complex relationship between the natural and the built environments. May you find your educational experiences enlightening, and take this knowledge out into your community for the benefit of all. **Michael Conn**, *Executive Director*, Institute for Bau-Biologie & Ecology.

Course Navigation

You will find that it is very easy to navigate through this course.

- Progress through the lessons using intuitive navigation tools. When you study, make sure to be aware of and use all supporting materials, such as pdf files, video and audio clips, links to other websites or relevant articles or papers, as well as the online forum.
- The last lesson will give you the option of downloading an electronic version (PDF) of the course. Please be aware that this information is copyright protected.
- When finished, you will be ready for the test. These tests are "open book" and are designed to help you evaluate your understanding of the subject.
- When you have finished the entire Course Pack, a Certificate of Completion is available online.

By using the Forum feature, students can share information and solve problems. We would like to see truly interactive discussions take place.

Please be advised that links to third party information may not reflect or support the Building Biology viewpoint. However, it might be of some interest to see how other people, groups, institutions, etc. argue the same subject.

Copyright

Direct all inquiries to:

General Information: **infopod@buildingbiology.net**
Technical Support: **techsupport@buildingbiology.net**

Phone:**1-866-960-0333** (toll-free in US & Canada)

Table of Contents

Lesson 1 – Introduction to Floor Systems

25 Principles of Building Biology

The following list of 25 principles were developed more than 40 years ago by Anton Schneider, PhD., Founder of the *Institut fur Baubiologie und Oekologie*. Many of these principles have been adopted by the green building movement. Other principles are either unknown, ignored or otherwise neglected in favor of a blind trust in conventional building codes. Although these principles apply to all scales of the built environment from community to the individual home, the significance of these principles as they pertain to floor systems will be made known throughout the study of this course.

1. Verify that the building site is geologically undisturbed.
2. Place dwellings away from industrial centers and main traffic routes.
3. Place dwellings well apart from each other in spaciously planned developments amidst green areas.
4. Plan homes and developments taking into consideration the human aspect and the needs of community, families, and individuals while respecting the natural environment.
5. Use natural and unadulterated building materials.
6. Use wall, floor and ceiling materials that allow the diffusion of moisture.
7. Allow natural self-regulation of indoor air humidity using hygroscopic materials.
8. Consider sorption of building materials and plants (in- and outside) which allow filtration and neutralization of toxic airborne substances.
9. Design for a balance of thermal mass and insulation in living spaces.
10. Plan for optimal surface and air temperature.
11. Use thermal radiation for heating buildings employing solar energy as much as possible.
12. Assure health-promoting humidity levels and rapid desiccation of wet construction processes in new buildings.
13. Utilize building materials which have neutral or pleasant natural scents and which do not emit toxic vapors.
14. Provide for natural light and use illumination and color in accordance with nature.
15. Provide adequate protection from noise and infrasonic vibration or sound conducted through solids.
16. Avoid building materials that have elevated radioactivity levels
17. Preserve the natural (DC) air electrical field and physiologically beneficial ion balance in space.
18. Preserve the natural (DC) magnetic field.
19. Minimize technical (AC) electric and (AC) magnetic fields.
20. Minimize the alteration of vital cosmic and terrestrial radiation.
21. Utilize physiological knowledge in furniture and space design.
22. Consider proportion, harmonic orders, and shapes in design.
23. Use building materials that do not contribute to environmental problems and high energy cost in the production process.
24. Do not support products or buildings materials that over-use limited and irreplaceable raw materials.
25. Support building activities and production of materials which do not have adverse side effects of any kind and which promote health and social well-being.

Characteristics of Earth

The earth beneath our feet is alive with micro-organisms, larger fauna and a variety of plant life. It is sometimes wet, dusty, and rocky. It can be sandy, silty, loamy or clay-rich. All of these conditions determine the kind of foundation and floor systems a builder chooses. It's important to know what the conditions are of the earth at the building site before reviewing your options.

Earth can contain a huge amount of moisture. Soil with good tilth, or "fluffiness", and a high percentage of loam can contain up to 25% water. Other soils may not be able to hold as much water, but moisture is still a characteristic to be aware of when both choosing a site and constructing a building. Because earth is part of the hydrologic cycle of water on the planet, moisture will both be moving through the earth as well as up and out of the earth as moisture evaporates from the ground. If a building is located above earth that transpires a high amount of moisture and the building has no strategies for dealing with this moisture, then the building will likely trap this moisture and experience adverse effects as a result of excess water in the environment. High humidity can lead to mold, mildew and insect problems.

The earth is also thermal mass. There is a uniform temperature of between 55F and 60F below frost line not too far down. What this means for a building on the surface of the earth is that access to a stable temperature is possible, but that temperature is below the comfort range for humans. In the summer, this could be an advantage when cooler temperatures are wanted. In the winter, this temperature can be tapped into with another 15 to 20 degree of heat needing to be added.

Apart from the moisture and temperature aspects, the earth below a building may also contain radon, a gas produced by the decay of radium. For buildings sited above granitic or shale composed bedrock, testing is necessary to determine the extent of the gas emissions and the risks to humans associated with this.

The composition of the soil will determine what the foundation system will need to be. If a floor is to be set on the earth, these conditions will also inform the design for the floor system. Sandy, silty and aggregate rich soils will drain well and compact tightly. They are not expansive. These soils are best for foundations and will not need as much separation of a floor from the moisture within the earth because of the high draining rate, or percolation, of the earth. Clay soils are expansive when wet and contracting when dry. Because of this potential for movement, clay soils are not good for foundations. However, when combined with fiber and other additives, it does make for good floor material and plasters. If clay is found on site, it can be harvested for these purposes with a very efficient situation being that clay is excavated for the foundation and then used for the aforementioned systems in the building.

Basic Concepts of Floor Finishes and Systems

Guidelines for Finish Selection

The floor is one of the largest surface areas in a home. Because of the prominence of this interior element, it's important to choose a finish that will satisfy aesthetic, health and functional requirements. As with all considerations for a healthy natural house, there are two main rules for material selection:

1 use the most natural product possible
2 use the most local material possible

Type of construction

Floors may or may not be built on the earth. If made of concrete directly on the ground, they are called slab-on-grade floors systems. If not built on the ground, they are referred to as raised floors and span over a space and thus need to transfer weight from their span to their bearing points on beams or bearing walls.

Materials of Construction

Conventional floor systems are made of wood, steel or concrete. Wood and steel floor systems can be made with a series of joists or trusses joined together with a decking material. Concrete floor systems are either homogenous slabs of reinforcing steel and concrete or pre-cast panels.

If the floor system is a series of joists or trusses, the spacing and depth are related to the distance of the span, the spacing of the joists and the strength of the spanning materials themselves.

Load

Floors are the horizontal planes, usually within the building envelope, that support both live and dead loads. Live loads are those gravity force loads generated by people, furnishings and equipment. They are referred to as “live” loads because the loads can be moved and changed in weight. Dead loads are static gravity loads that are usually the total combined weight of the construction systems themselves.

Raised floors may also be built rigid enough that they can transfer any lateral loading movement from wind or seismic action to shear walls. In this way they function as diaphragms connecting opposing walls to each other. The connection to the supporting foundation and wall systems is part of the structural integrity of the building as well as its aesthetic appeal.

Deflection

A certain amount of deflection, or the degree to which a material is displaced under load, is allowable and should be no greater than the length of the span divided by 180. Deflection should be minimized to maintain the optimal function and appearance of the finish materials that would otherwise be adversely affected by excessive deflection.

Lesson 2 – Evaluation of Floor Systems

Benefits of Raised Floor System

Accessibility

A raised floor separates the floor from the earth. A shallow area under the floor is called a crawl space; a deeper space is called a basement. It is this space between the floor and the earth, as opposed to no space, that constitutes the first advantage: that is, access to the underside of the floor. This is important when utilities run under the floor and into the interior of the building envelope. Having near complete ability to inspect every component of the house is a disadvantage in diagnosing many problems. This is especially crucial with the floor and foundation systems.

Basement

If the space beneath the floor is deep enough, another room for storage or mechanical systems is possible. By elevating the floor above grade, the basement then has light and air access through the space afforded by the height of the floor above the surface of the surrounding earth.

Flood Avoidance

With enough height above grade, a raised floor keeps the house off the ground and possibly avoids water damage due to flood. Spending extra money during construction to raise the floor off the ground in flood-prone areas will more than pay for itself should a flood occur. Without the benefit of height to avoid flood-waters, a home will incur thousands of dollars in damage as the water invades every part of the home.

Ventilation

A raised floor allows for the possibility of air circulation below the floor. This can be especially helpful in areas where radon is present allowing those gases to be carried away by air movement. Air circulation also helps to keep the structure dry avoiding mold and mildew problems. In areas that experience freezing temperatures, the floor structure will have to be insulated to maintain comfortable interior temperatures and to avoid damage to plumbing and mechanical systems.

Clay soils

In areas with clay-rich soils, a raised floor system can be combined with a pier and beam structural system. Such foundations excavate only where the piers will be set, minimizing the amount of ground to be excavated and the cost to do so. This kind of foundation system necessitates a raised floor system which is built on top of the beams which bear directly onto the piers.

Protecting mature vegetation

As with the situation described above where a raised floor system coordinates with the foundation system, if there are mature trees or bushes that need to be protected from the impact of building, a pier and beam system can be used to minimize or avoid damage to their roots systems.

Benefits of On-Grade Floor System

Earth coupling

Earth coupling is the joining of the floor system with the earth below it. This is accomplished through the direct contact of the mass floor with the mass of the earth. As was mentioned in Lesson 2, Characteristics of Earth, the constant temperature of the earth is between 55°F and 60°F. Through direct contact with this constant temperature, the mass floor can be cooler than air temperature in the summer and warmer than air temperature in the winter. Although this could be seen as a disadvantage in the winter when the floor temperature at 55°F may be too cold for most people, it should be remembered that this temperature is