ISO/TC 46/SC 8/WG 8 N 0199
2011-03-16 (Version 6)
Chapter 6.7 (former 12)

6.7 Floor construction and covering

6.7.1 General

The horizontal separation between habitable floors of a building is made of the following elements:

a) floor structure;

b) lower covering (ceiling);

c) upper covering (flooring).

The floor structure is the horizontal structural element that receives the load directly and transmits it to the other elements of the structure (columns and foundations).

Normally, a lower covering or ceiling is added to conceal the lower part of the floor structure; in some cases the decision may be not to cover this lower part. The type of material chosen usually depends on its aesthetic impact and acoustic features. There are two installation systems:

a) In direct contact with the floor structure.

b) Separated from the floor structure allowing an intermediate air space (false ceiling). This option allows for the installation of services (lighting, air conditioning, wiring, etc.). It is essential that hatches are installed to give access to the services.

As for the upper covering, there are three ways of installing the flooring:

a) Directly placed on the floor structure.

b) Placed over an intermediate layer which is used both for levelling the flooring and for housing the services.

c) Separated from the floor structure, leaving an intermediate air space (raised floor). This is a system of adjustable feet located on the floor structure. These support plates on which the flooring is placed. This option allows for the installation of services (air conditioning, wiring, etc.).

This chapter defines some requirements for flooring and types of flooring suitable for libraries.

6.7.2 Flooring requirements

The flooring, always visible because it is in our field of view, is an integral part of the architectural design. Different types of flooring could be used to visualize different functions in an open area. The choice of flooring can be based on different aspects: the functions of the particular library area, the traffic routes, aesthetics, durability, financing issues, etc.

Some of the requirements are:

a) Comfort and security for the public and staff. Aspects to bear in mind:

    a. The flooring should be nonslip and non-inflammable.

    b. On the stairs and ramps there should not be any kind of relief.

    c. The height difference between the outdoor flooring and the indoor flooring should not exceed 2 cm, with a rounded edge or well cut at an angle of 45º.

b) Acoustic absorption and prevention of impact noise.

c) Resistance to intensive use and to specific live loads (shelving, wheeled furniture, etc.)

d) Durability.

e) Ease of cleaning and replacement.

f) Possibility of facilitating access to installations going underneath (both fitted ductworks in the filling layer on the floor structure and raised floor). (See Chapter 13 - Wiring). Access hatches should be perfectly level with the rest of the flooring in order to avoid accidents.

Requirements for the raised floor:

a) Strength: The system of adjustable feet system supporting a raised floor should be adequate to support the weight of shelving and other items of furniture.

b) Cleaning: As the raised floor is not guaranteed to be waterproof, the recommended cleaning method is by vacuum cleaner. When the material employed for the finish requires liquid products, the cleaning should be carried out with great care in order not to damage the ductworks and connections beneath.

There might be local or national regulations concerning flooring that ought to be considered.

6.7.3 Types of flooring

The following types of floor covering are suitable for use in libraries:

a) carpet;

b) stone;

c) artificial aggregate (e. g. terrazzo);

d) ceramic tiles;

e) light flooring (e. g. linoleum);

f) wood;

g) laminate and stratified flooring;

h) continuous flooring in situ.

<table>
<tr><td>Carpet</td><td colspan="2">Types of carpet:
a) Natural.
Generally made of a single fabric which serves both the purposes of resistant support and surface finish.
b) Synthetic.
Made of a base of resistant fibres and a fabric layer of surface finish.

Carpets are supplied in rolls or as floor tiles. Placing can be done without adhesives because it is a flooring of a floating kind that settles due to its own weight.</td></tr>
<tr><td></td><td>Positive aspects:
- Thermal insulation.
- Soundproofing.
Carpets never isolate airborne sound because the mass is minimal. Their best acoustic features concentrate on absorption of inside noise and inhibition of impact noise, given that it is soft flooring.
- Safety of usage.</td><td>Negative aspects:
- Carpets retain large quantities of dust and can cause allergy problems.
- Limited service life.
The busiest areas are easily damaged. Using floor tiles allows partial substitution of the most affected parts.
- Difficulty of maintenance.
Carpets retain a lot of dirt and dust, so it is necessary to clean them repeatedly, generally with a vacuum cleaner. The presence of much furniture (shelving, service desks, tables, chairs, etc.) makes this operation more difficult.</td></tr>
<tr><td></td><td colspan="2">This flooring is recommended for the following areas:
- Auditoria
- Children’s library</td></tr>
<tr><td>Stone</td><td colspan="2">There are three types of stone:
a) igneous rocks (granite, etc.);
b) sedimentary rocks (sandstone, travertine, etc.);
c) metamorphic rocks (marble, shale, etc.).

Stones are supplied in different sizes.</td></tr>
<tr><td></td><td>Positive aspects:
- Durability.
- Hardness and ease of maintenance, especially granite.
- Possibility of designing the shape of the pieces.</td><td>Negative aspects:
- Noisy.
- Except for the granite, most of the kinds of stone need treatment to reduce porosity.
- An excessive polished finish can be slippery and make users fall. Non-polished finishes are very porous and difficult to clean and are not recommended for a public building.</td></tr>
</table>

<table>
<tr><td></td><td>This flooring is recommended for the following areas:
- Entrance areas and circulation spaces.
- Auditoria.
- User services areas.
- Open and closed stacks.
- Offices for administration.
- Storerooms (granite).
- Cleaning staff and equipment space.
- Toilets.</td></tr>
<tr><td>Artificial aggregate</td><td>There are two types of artificial aggregate:
a) Terrazzo.
Pieces made up of two different kinds of cement mortar, vibrated and pressed, which serve as base and surface finish. It is a slightly porous material, so it is desirable to protect the surface with waterproof products.
b) Compact.
Floor tiles made up by a sole compound (little fragments of marble, basaltic or granite origin) to which pigments are added. This fusion is made by means of pressure with the application of synthetic resins.
Compact is more recent than terrazzo and is notable for its resistance to wear and tear and for the low level of maintenance required.

Terrazzo and Compact are supplied in pieces of different sizes.
Continuous flooring can also be carried out in situ.</td></tr>
<tr><td></td><td><table><tr><td>Positive aspects:
- Resistance and durability.
- Ease of maintenance.
- Artificial aggregates are appropriate for the raised floor because of their own heavy weight.</td><td>Negative aspects:
- Artificial aggregates are noisy and have little acoustic absorption.</td></tr></table></td></tr>
<tr><td></td><td>This flooring is recommended for the following areas:
- Entrance areas and circulation spaces.
- User service areas.
- Open and closed stacks.
- Offices for administration.
- Storerooms.
- Cleaning staff and equipment space.
- Utility management space for air conditioning, lift machinery, etc.
- Toilets.</td></tr>
<tr><td>Ceramic tiles</td><td>There are three types of ceramic tiles:
a) Ceramics.
Pieces of fired clay that can have a glazed finish.
b) Stoneware.
The type of raw material and the high temperature firing make stoneware a harder and less porous material.
c) Porcelain stoneware.
It is appropriate due to its low porosity both for interior and exterior flooring.

Ceramic tiles are supplied in pieces of different sizes.</td></tr>
</table>

<table>
<tr><td></td><td>Positive aspects:
- Durability.
- Ease of maintenance.</td><td>Negative aspects:
- Noisy.
- Erosion by abrasion in areas of very intensive use.
- Presence of very marked joints which can accumulate dirt.
- In large spaces, the coefficient of thermal expansion necessitates provision of elastic joints.
- Since it is a dynamic market, the production runs are limited and it is difficult to find pieces with the same characteristics.</td></tr>
<tr><td></td><td colspan="2">This flooring is recommended for the following areas:
- Cleaning staff and equipment space.
- Toilets.</td></tr>
<tr><td>Light flooring</td><td colspan="2">Types of light floorings are:
a) Natural (linoleum).
Linoleum floors are elastic, they do not make noise if used with rubber soles and do not deteriorate with incisions. Moreover, they have a better environmental behaviour than the Synthetic ones.
b) Synthetic (rubber, PVC, vinyl, etc.).
Synthetics are more resistant to erosion, cheaper and easier to maintain.

PVC is prohibited in some countries for environmental reasons. Light floorings are thin and concentrate all features in little space. Uniform coloured finishes are not recommended since they make stains and erosion very visible.
Light floorings are supplied in floor tiles and rolls. A continuous flooring can also be made in situ.
Light floorings can include a layer to improve soundproofing and reduce impact noise. Likewise, dust and liquid repellent products, antistatic products and other protections can be applied.</td></tr>
<tr><td></td><td>Positive aspects:
- Good acoustic absorption.
- Impact and rolling resistance, very similar to the ceramic tiles and terrazzo.
- Capacity of elastic deformation avoids permanent deformations due to impact.
- Due to its low weight, this flooring is adequate for structures where increases in load are not contemplated.
- Ease of maintenance.</td><td>Negative aspects:
- As it is a flooring of little thickness, the final appearance is bound to the surface where it is installed, which has to be levelled if there is no guarantee of flatness.
- Contact with solar light can alter the surface finish and cause aging and increase dust absorption.</td></tr>
</table>

<table>
<tr><td></td><td colspan="2">This flooring is recommended for the following areas:
- Auditoria.
- User services areas.
- Children’s library.
- Open and closed stacks.
- Offices for administration.
- Storerooms for computer and magnetic material (rubber and other light floorings with an antistatic treatment).</td></tr>
<tr><td rowspan="3">Wood</td><td colspan="2">Types of wood for flooring are:
a) Solid.
b) Chipboard.
This type is made by combining small fragments of wood with resins, fused with glue under pressure.
c) Plywood.
This type is manufactured by superimposing panels with their fibres in different directions to compensate their behaviour and obtain a more stable material.
d) Chipboard at high pressure.
This type combines the characteristics of chipboard and plywood. High pressures in the manufacturing process produce materials of great hardness, high density and low water absorption in comparison with other wood types.</td></tr>
<tr><td>Positive aspects:
- Low thermal conductivity (useful in cold regions).</td><td>Negative aspects:
- Fragile.
- Noisy.
- Little resistance (variable depending on the type of wood).
- Wood can distort or dilate because of humidity.
- Difficulty of maintenance (cleaning, sanding, varnishing, etc.).
- Wood floors need fire treatment, treatment against insects and fungus and treatment to avoid the change of colour when they are exposed to direct solar radiation.</td></tr>
<tr><td colspan="2">This flooring is recommended for the following areas:
- Children’s library.
- Offices for administration (in cold regions).</td></tr>
<tr><td>Laminate and stratified floorings</td><td colspan="2">Laminate and stratified floorings are made of a transparent surface layer of high resistance to wear and to ultraviolet rays which overlies a decorated paper, on a wood sheet or on a thin decorative element. All this is bonded to a board with high-density wood fibres and finally, to a stabilisation layer, suitable for absorbing surface irregularities.
They can be bonded to a base or with a floating system. Joints are of the tongue and groove type.</td></tr>
</table>

	Positive aspects: - Impact and rolling resistance, very similar to the ceramic tiles and terrazzo. - Ease of assembly. - Aesthetic diversity depending on the decorative sheet.	Negative aspects: - Noisy. - Presence of very marked joints which can accumulate dirt.
	This flooring is recommended for the following areas: - Offices for administration.	
Continuous flooring in situ	There is also the possibility of carrying out continuous floorings in situ with a great variety of materials (mortar, fibreglass, resins, paint, rubber, vinyl, etc.). The main advantage is that the flooring composition can be chosen according to the requirements it should satisfy (soundproofing, waterproofing, abrasion resistance, etc.). Likewise, finishing treatments can be applied to give certain textures and colours. Therefore, flooring in situ can be seen as personalised flooring. The main disadvantage is the difficulty of carrying out the work, which is greater when flooring spaces of little dimensions and corners or sharp angles.	

If noisy materials are used, it will be especially necessary to use acoustic absorption by the structure and materials of walls and ceiling.

For rare book areas and long-time preservation material, materials of a high thermal capacity should be used and they should not cause chemical reactions in the collections (See Chapter 9 - Storage conditions).

In exterior zones around the building stable flooring should be used in order to avoid dirt being carried to the interior.

In the area immediately outside the access doors it is advisable to use flooring that acts as a filter for dust, mud and water. It is recommended to use metallic grille, natural or synthetic doormat and exterior carpet. The existence of a small eave gutter on top of the entrance doors will facilitate cleaning and preservation.