

Advanced Floor Coatings/ Surfacing

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1.0 Introduction

During the last thirty years, the protection of concrete floors has gone from essentially nothing, to a fairly sophisticated process of some type of protective coating or surfacing. The main purpose of course, is to provide protection to the slab from deterioration or contamination, or to provide some added benefit such as aesthetics, wear, non-skid, chemical resistance, and ease of maintenance, physical performance, and a myriad of other properties. We must remember that no other surface in a building/ structure takes more abuse than floors, regardless of the type of building, whether it is domestic, industrial, or commercial.

Floors are subjected to just about every kind of abuse -impact, abrasion, chemical attack, and thermal shock. Concrete floors are not designed to take this continual abuse. Concrete floors are porous and tend to create dust from wear and abuse. They are also subject to abrasion and chemical attack. It's for this reason that all concrete needs some sort of protection regardless of where it's located. The problem, in the overall picture, is to determine that type of protective material to choose for the various conditions.

This article does not concern resilient tile, ceramic tile, carpet, or wood, which are placed on top of concrete floors. These do add a benefit, but are primarily used aesthetically for residential and highly commercial areas. This article focuses on coatings that bond directly to the surface and offer long-term protection and may or may not have some aesthetic value.

2.0 Various Types of Flooring Systems

The floorings have various kinds of traditional concrete substrate as surface with floor finishes of mosaic/terrazzo/tiles/marbles/wood/vinyl etc. However, the advancement in coating materials has led to many advance floor coatings and screedings. A typical flooring system is having substrate like concrete or mortar with primer and two coats of floor coating with top finished coating.

2.1 Epoxy Floor Coating/Screeding

Epoxy floors and epoxy coatings are becoming increasingly popular for use as commercial and industrial flooring. There are a number of different types of epoxy coatings that can be used on floors. Each of these types of epoxy coatings offers distinct advantages when compared to the others.

Epoxy flooring is chemically cured mass of polymer (bisphenol-epoxy resin with polyamine polyamides/ cycloaliphatic amines etc.). Epoxy floorings are formulated by various polymers, hardeners, and graded filler. Epoxy

coating can lengthen the life of the floor and achieve a great appearance. Epoxy flooring can be applied over many different materials, including steel, concrete, and wood. However, concrete is the best surface for laying epoxy floors. Epoxy floor coating performance is directly affected by surface preparation. The integrity and service life will be reduced significantly if the surface is improperly prepared. A proper surface preparation ensures epoxy coating adhesion to the substrate and prolongs the life of the epoxy coating system.

The constituents of an epoxy flooring is given below:

- Sub grade
- Sub base
- Slip membrane (act as a barrier to rising dampness and moisture, movement in floor slab, polyethylene and polypropylene 1.5 mm thick)
- Floor slab, reinforced, and in reinforced
- Topping layer or Protection

A schematic diagram of epoxy flooring is given in Fig. 1.

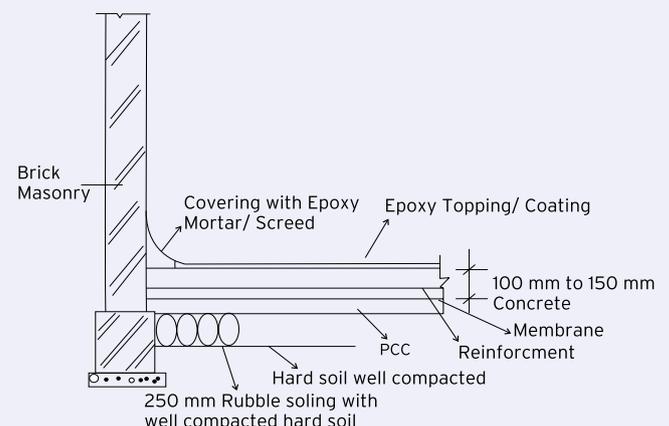


Fig. 1: Schematic diagram of epoxy flooring

The epoxy coatings are ideal for a variety of types of commercial and industrial buildings, including air plane hangars, manufacturing facilities, distribution facilities, warehouses, residential garages, commercial garages, pharmaceutical plants, and laboratories. Epoxy floorings and coatings are ideally suited for a variety of applications. It has a range of anti-skid, antistatic, anti-fungal, anti-bacterial floorings which are formulated to withstand the movement of men and material. Monolithic or specked, dark or light coloured, epoxy floorings are created in one seamless application. The application of epoxy floor plants results in the creation of a hard wearing, durable surface as well as epoxy vapour barrier application to prevent moisture penetration through concrete subfloors. The various properties of the floor coating material are given in Table 1.

Table 1. Properties of floor coating

Property	Standards	Range
Pot life (Min)		2 - 120
Tensile strength (N/mm ²)	DIN EN ISO 527	1 - 60
Elongation at break (%)	DIN EN ISO 527	6 - 100
Modulus of elasticity (N/mm ²)	DIN EN ISO 527	0.1 - 2.5
Compression strength (N/mm ²)	DIN EN ISO 604	≤ 100
Tear propagation strength (N/mm ²)	DIN ISO 34 - 1	1 - 100
Shore hardness	DIN 53 505	A 20 - D 80
Abrasion resistance(mg)	DIN EN ISO 5470-1	5 - 150

2.1.1. Self Dispersing Epoxy Coatings for Floors

This type of epoxy coating is commonly used in areas that receive frequent forklift or heavy truck traffic as it has very good mechanical strength. Another type of this durable epoxy coating is the self-dispersing epoxy with quartz sand. This type of epoxy coating is commonly used in food-processing industries or other locations where liquids are present because it has good anti-slip characteristics.

2.1.2 Self-levelling Epoxy Coatings for Floors

Self-levelling epoxy coatings are easy to install over new and old concrete floors as they level easily creating a seamless and smooth surface. Self-levelling epoxy coatings can be used in kitchens, dining rooms, storage places, garages, warehouses, office buildings, and more (Fig. 2).



Fig. 2: Epoxy flooring in a shop floor

2.1.3 Mortar Epoxy Coatings for Floors

This is the strongest of all epoxy floors. This type of epoxy coating is commonly used in heavy industries application and can also be used to repair cracks before laying other types of epoxy floors.

2.1.4 Gravelled Epoxy Coatings for Floors

Gravelled epoxy coatings are the most decorative epoxy flooring choice, and they can be used for adding logotypes, brand marks, and decorative details to floors.

2.1.5 Epoxy Terrazzo Floor Coatings

This type of epoxy flooring is very decorative (Fig. 3) and

easy to clean. Epoxy terrazzo flooring is commonly used in large areas, including hallways and entrances of commercial buildings, schools, and office buildings.



Fig. 3: View of decorative epoxy flooring

2.1.6 Epoxy Antistatic Floor Coatings

This specialized epoxy coating is designed for use where static-sensitive electronic components are in permanent use, and a static-free environment is most important such as in laboratories (Fig. 4), hospitals, and electronics equipments manufacturing plants (Fig. 5).



Fig. 4: Epoxy flooring in a Pharmaceutical laboratory



Fig. 5: Epoxy flooring in an Electrical Panel board room for antistatic properties

2.1.7 Vapour Barrier Epoxy Coatings

Liquid epoxy vapour barriers are applied directly over concrete floors to provide an impenetrable surface that reduces vapour transmission to nearly zero. These epoxy coatings are typically applied prior to adding the final flooring surface, including sheet vinyl, tile, carpet, or hardwood floors.

2.1.8 Epoxy Flaked Floor Coatings

This is not exactly a type of epoxy flooring, but rather a style of applying epoxy coatings. With this epoxy flooring technique, multi-coloured flakes, or chips are added over

the epoxy coating while it is still wet in order to provide a decorative finish or look.

2.1.9 Abrasion Resistant Epoxy Screed Floor

It is a three-component epoxy screed system designed to provide abrasion resistant, impact resistant, and chemical resistant, tough flooring. It is formulated to withstand heavy industrial traffic (Fig. 6) and is available in a variety of colours as well. It should ideally be top coated with transparent, epoxy/polyurethane sealers or with self-levelling epoxy.



Fig. 4: Epoxy flooring in an engineering industry

2.1.10 Self-levelling Epoxy Anti-skid Floor Topping

It is a four component pigmented epoxy floor topping which is laid at a thickness of 1 mm to 2 mm. It is jointless, textured, non-porous, hygienic and chemical resistant, easy to clean, and maintain. It is available in a number of colours and has sufficient strength to withstand industrial traffic with nylon and rubber wheels. It has excellent bonding with concrete and other substrates like Kota stones.

2.2 Polyurethane Floor Coatings

Polyurethane floor coatings have been in commercial use for more than 30 years. They are flexible, hard, and tough coating materials, formulated with polyurethane raw materials for application in many different market segments. Polyurethane coatings can be customized to yield property profiles that suit the individual floors.

As shown in Fig. 7 polyurethane coatings may range from highly elastic (for membranes, floors in sports facilities) to hard and highly resistant to chemicals (for chemical production plants).



Fig. 7: View of polyurethane floor coating at parking in Terminal T2 of Mumbai International Airport

2.2.1 Typical Applications of Polyurethane Coatings

- One and two component primers and sealers.
- Floor coatings for sports facility's membranes, e.g. waterproofing membranes.
- Industrial floor coatings ranging from tough yet flexible to hard depending on the requirements of construction and water protection regulations.
- One and two component synthetic resin mortars and coloured sand mortars.

Instrumental in the success of polyurethane system in these applications are the following properties.

- Curing even at low temperatures.
- Good adhesion.
- Excellent chemical resistance with hard coatings.
- Crack-bridging with elastic and tough yet flexible formulation.
- Seamless application, also with elastic and tough yet flexible membranes.

Hence PU coatings can be designed to have wide range of requirements fulfilling capacities. It features the following:

- Polyurethane floor coating with unsurpassed stain/chemical resistance
- Excellent abrasion resistance
- High wear resistance
- High gloss to stain finish
- Excellent gloss retention
- Quick turnaround time
- Variety of colours option or select your own custom colour
- UV light resistant polymer coating
- VOC compliance

Polyurethane coating is generally recommended for areas exposed to chemicals with a need for cleanability including:

- Aerospace Industries, Hangars
- Automotive Facilities, Auto Service
- Chemical Plants, Clean Rooms
- Furniture Plants, Meat Packers
- Printing Plants, Dock Areas (excellent wear non-slip floor coatings)
- Trenches, Military Facilities

2.2.2 Polyurethane Floor Coating Benefits

Like epoxy, polyurethane is a thermosetting polymer as well and is considered a high-performance coating. Of the different formulations available, aliphatic polyurethane is the desired choice for garage floors, though they are approximately 60% to 70% solids. Depending on the manufacturer, a polyurethane coating is only about 50 to 75 micron in thickness and can't be adjusted as with epoxy. However, the thinner dry film thickness is not all that it appears. Aliphatic polyurethane has more

flexibility than epoxy, and it is this flexibility that aids in absorbing impacts better. It is also far more abrasion resistant, in fact, some manufacturers claim that the wear resistance of polyurethane over epoxy is almost 3 to 1. The resistance to chemicals is better than epoxy as well and includes solvents such as methylene chloride, which is the primary ingredient in paint stripper. A comparison of various properties between epoxy and polyurethane coatings is given in Fig. 8.

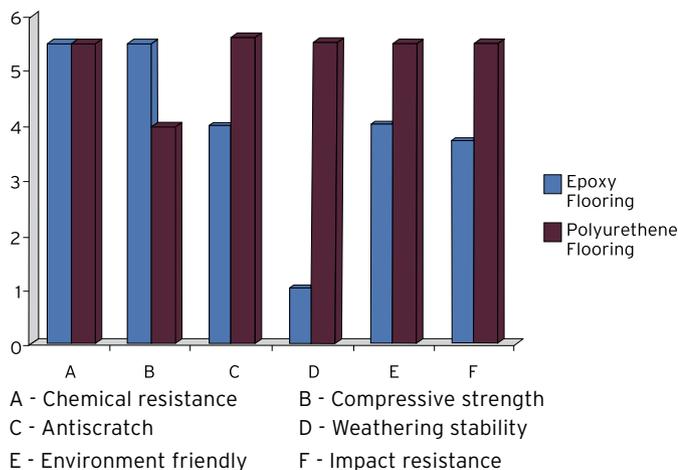


Fig. 8: Comparison of various properties between epoxy and polyurethane coatings

Another advantage of polyurethane over epoxy is that it is UV stable. This means that it won't get yellow like epoxy does when exposed to small amounts of sunlight. The surface of polyurethane is not as hard as epoxy, but it is far more scratch resistant, can tolerate larger temperature swings and handles humidity much better. It is also available in different finishes from satin to very glossy. Though polyurethane has many advantages over epoxy, it does have less bond strength to concrete and its thin dry film thickness will not work well as a self-levelling coating to fill in small cracks in the surface.

2.3 Cementitious Flooring Systems

This is yet another type of flooring system available for floor protection. As the name suggests, one of the binders of flooring product is cement, with one or more than one other resins included into the product. These products are normally more economical comparable to epoxy and PU floor products. Cementitious flooring comes in: A. self-levelling flooring (underlayment and topping) B. screed C. floor repairing product.

Self-levelling underlayment gives smooth, flat surface-ready for floor goods fast. Its level-top can turn a rough, irregular surface into one that is perfect for carpet, wood, ceramic tiles, vinyl virtually any floor covering. Efficient application and fast drying time keep you on schedule. The level top provides a level surface on otherwise out-of-level

concrete slabs in apartments, commercial buildings, and homes worldwide.

Cementitious screed is manufactured in single component, or in two components, all products based on cement, fillers, and resins. Under floor hardners, there are dry shake floor hardness in powder form, meant for application in green concrete floor, and liquid form, used for existing concrete floors. Decorative concrete system is yet another type of flooring systems, well famous in advanced countries. In India, now many flooring specialities have stated using the above concept.

3.0 Advantages of Self-levelling Floors

- **Attractive appearance:** They have beautiful gloss, smooth surface, quite a wide colour range and may be textured, matt or glossy, with decorative effects which expand the original design solutions capabilities.
- **Hygienic and easy treatment:** Self-levelling floors are often chosen for placements that has high sanitary-hygienic requirements since seamless surfaces are easier to clean and polymer materials themselves are protected from fungi, bacteria and other microorganisms.
- **Durability:** Right choice of a polymer material and adherence to technologies of floor filling provides for its long service life - up to 40 years, which is considerably larger than the standard service life of any other flooring material.
- **Fire safety:** Polymer materials used for self-levelling floors are flame retardant and don't release toxic combustion product.
- **Resistance to moisture, UV and chemically aggressive environments**
- **Self-levelling floors don't fade in sunlight, are not damaged by gasoline, oil, acids, alkalis, solvents (the latter can be used to clean highly fouled self-levelling floors).**
- **High adhesion:** Possibility of a good adhesion with various type of base: concrete surface, wooden underfloor, ceramic tile.
- **Simplicity of installation:** Following the rules of installation, listed by a producer, almost any person can create a self-levelling floor by himself.

The major disadvantages are quite a labour-intensive process of preparation and difficult to un-install.

4.0 Conclusion

The thorough process for selecting a coating or topping system, the writing of a detailed specification and the preparation of detailed application procedures and final acceptance criteria will give the owner a basis for choosing the right system. One has to consider proper material application and long-term performance, thereby reducing the long-term cost of floor maintenance.