Guidelines for Execution of Epoxy / PU Floorings

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1.0 Introduction

Almost all the industries in India today have epoxy/ PU floorings in their plant area in order to provide a seamless, joint-less aesthetic, chemical-resistant, hygienic, and dust-free atmosphere. An overall survey indicates that not all users are happy with the result. Many of the users express that they experience a variety of problems such as de-bonding, bubbling, scratches, uneven surfaces, and so on and also express a concern regarding its durability. This article aims to address many of these issues related to the selection, execution, and aftercare of epoxy/PU floorings, so as to minimize these instances but not eliminate them completely.

A survey in the USA on epoxy/PU floorings has indicated that about 20% of the problems were due to the wrong selection of material/thickness, 60% due to the wrong application and 20% due to the poor quality of the products. Hence it is important to divide the discussion into three parts:

- Pre-installation guide-lines and checks
- Installation procedures
- Post-installation practices

2.0 Pre-installation guidelines

2.1 Selection of Right Product

Various authors have deliberated on which kind of material to choose for which applications. This is therefore not covered here. The major difference between epoxy and PU systems is that PU is more flexible and hence is more suitable in high-impact areas.

2.2 Selection of right thickness

It is very important to arrive at the correct thickness of flooring to provide optimum service to the required traffic conditions. Higher the thickness, higher the durability and higher will be the cost. Hence, it is pertinent to calculate the right thickness.

2.3 Analysis of the requirement

This is the most important part of the process for the selection of right product as well as the right application methods. Obviously, a single product cannot meet all the requirements and hence the customer has to allot a priority for each requirement. Light duty flooring can be laid from 500 microns to 1 mm, medium duty at 1 mm to 2 mm and heavy duty varies from 3 mm to 6 mm. All the above parameters can be said to resist the following four broad categories:

- Mechanical effects : Static and dynamic loads, abrasion, impact, vibration, skidding, conductive, or antistatic etc.
- Chemical effects : Oil, grease, chemicals, soluble salts, cleaning agents, solvents
- Environmental effects : Thermal exposure such as heat or cold, UV, and other weather conditions, noise
- Biological effects : Bacterial impact

3.0 Pre-installation checks

3.1 Check List

This is a key step in ensuring that the final floor meets or exceeds the expectations of the customer. The following needs to be checked:

- The type of floor – Mosaic / Concrete / Tile / Stones / Marble (if so, check the level of polish).
- Any floor-hardener, curing agent etc. has been used if concrete is present.
- Soundness of the floor with a hammer or scratching the surface with coin etc.
- Porosity of the concrete by putting a few drops of water and check for beading etc.
- Level-difference/undulations on the floor
- Oil spillage, grease, or any other contaminants
- Moisture content preferably under plant operating conditions
- Ingress of water through roof/wall cracks and floor joints
- Any chemical/solvent spillage and its concentration, temperature etc.
- Any possibility of steam impingement
- Type of traffic envisaged and the condition of material handling equipment (type of wheel etc.)
- Understand the customer's expectations
- Estimate the job correctly by preferably measuring the area.
- Surface condition, presence, and location of cracks
- Joints and its locations, types of joints, condition of joints.
- Concrete strength
- Contamination of floor
- Moisture level/movement
- Presence of vapour/moisture barrier
- Types of abuses present
- Usage floor
- Requirement/purpose of laying epoxy toppings/screeds
- Types of industry (pharma, hospitals, engg, chemical, etc.)

3.2 Moisture Testing

Moisture in the concrete or rising moisture from subsoil has been the single most contributing factor for failure due to bubbles. Moisture doesn't just mean water droplets, it could include high humidity. Some coatings shouldn't be applied when humidity levels are high. More obvious sources of serious moisture are things like rising moisture through concrete pores, higher moisture content in a new concrete, standing water puddles on a concrete slab, or, even more likely, a damp or even saturated surface.

- Surface dry doesn't mean really dry. Surface moisture content can be measured by means of a handheld moisture meter (Fig. 1) and the thumb rule is that the moisture content should be less than 5% to allow impermeable coatings to be laid. However, surface moisture is only an indicative test and is not sufficient to test rising moisture.
- There can be (and often is) a high moisture content hidden just below the surface. The standard test is to tape a 1.2 m by 1.2 m plastic sheet to the concrete and see if visible moisture collects under the plastic. Some of the modern epoxies can be applied to wet or damp surfaces but generally a moisture rich surface means no possibility of coating.

Fig. 1: Moisture meter check of flooring

3.3. Check for Oil/Grease

Generally coatings do not stick to greasy, oily, waxy surfaces. This includes many kinds of plastic surfaces. Oily surfaces can be tricky, just grinding the surface is often not good enough, as oil within the concrete is bound to rise to the surface before the primer has the chance to stick. Even on what seems like a non-greasy surface, any coatings will 'bead-up' leaving behind hollow, coating-less circles or voids.

3.4 Check for Dust, Salts etc.

This is one of the neglected steps and can lead to disastrous consequences. Coatings may stick to the dust but not to the base floor and can lead to de-bonding. Salts and/or minerals either deposited out on the surface from the curing of fresh concrete or from the evaporation of seawater on concrete, or steel can quickly ruin a coating.

All the above pre-installation steps are very important activities that should not be ignored to ensure a long lasting epoxy/flooring solution.

4.0 Installation procedures

Once it has been established that the base floor is capable of receiving epoxy/PU topping the installation sequence is to be set in motion. The installation procedure is broadly classified into three important steps:

- Surface preparation
- Application of primer and underlay
- Application of topping

4.1 Surface Preparation

This is the single most important step that determines the life of the flooring. Any slack in this step will adversely affect the quality and durability of the flooring.

The purpose of the surface preparation is to:

- Create a surface profile so as to create a mechanical key which increases adhesion strength
- Create a clean and dry base and remove loose particles
- Improve the penetration of primer
- Removal of oil, grease, and other contaminants that will impede bonding
- Remember the word "DCS": Dry, clean, and sound surface

Some of the questions that need to be answered before commencing the surface preparation are the following:

What is the basic surface on which epoxy/PU topping needs to be applied?

- Vacuum de-watered concrete (power-trowelled)
- Manually trowelled PCC
- Cotta stone/Shabbat stone/Granite/Kadappa/Marble
- Ceramic tile/vitrified tile

What is the status of the base floor?

- Clean or oil soaked
- Existence of cracks, powdery surface etc.
- Soundness of the base floor and porosity etc.

What is the thickness of the topping proposed as the surface profile to be created is directly proportional to the thickness of the coating?

The answers to the above questions will lead you to the following decisions:

- Proper equipment to be used
- Floor grinding equipment
- Mechanical scarification
- Shot-blasting equipment
- Acid etching
- Extent of surface profile required
- Abrasion resistance (Fig. 2)
- Thermal surface preparation (Fig. 3)

The thermal surface preparation is required for following

- Recommended for oil soaked floors
- Application involves burning of oil through special torch by flame.
- Primer application should take place in hot condition only for better penetration.

Fig. 2: Checking abrasion resistance of epoxy flooring

Fig. 3: Thermal surface preparation for epoxy flooring

4.2 Priming

After the surface preparation, the second step is to ensure that the surface is primed properly. The application of priming is as important as that of surface preparation in ensuring the longevity of flooring and is most likely to be ignored by most of the contractors. As may already be known, concrete consists of micro-pores that typically do not allow penetration of filler-rich epoxy coatings. Hence, it is essential that the initial bonding is achieved by an epoxy primer that contains only resin and hardener and is of such viscosity so as to penetrate the pores of concrete thus creating a bond equivalent to that of spiked shoe on a soft floor. Thus, the concrete pores that are opened up by surface preparation get filled by a proper epoxy primer and increase the durability of the topping multi-fold.

Depending on the porosity of the concrete, viscosity of the primer shall be properly chosen. The normally available epoxy primers will not agree with vitrified tiles, polished marble/ granite etc., these call for specially formulated primers.

Once the primer layer is cured, which typically can take 4 to 12 h, depending on temperature and humidity, screed underlay has to be applied. It is strongly advised that screed underlay is applied over primer not later than 24 h. Once the primer layer is hardened, the inter-phase bond between screed and primer can diminish. In case of delay in screed application, it is advisable to wipe the primed surface with solvents like Xylene, MIBK etc.

When the total thickness of the floor topping exceeds 3 mm, it is preferable to do a 2 mm self-levelling screed underlay followed by 1 mm self-levelling topping instead of 3 mm topping together. Though this concept is being questioned by many, the argument in favour of doing a screed underlay has the following merits:

- The function of screed underlay is to provide a strong base with excellent compressive strength and bond-strength, while the function of topping is to provide abrasion resistance, chemical resistance, aesthetics etc. Thus, it is prudent to formulate two different products to optimize the properties.
- Levelling of undulated floors is much easier.
- In essence, it can also reduce the overall price of the system.

4.3 Topping

Execution of topping is very similar to that of execution of self-levelling underlay except the fact that topping contains a forth component i.e. pigment. Pigment needs to be added to component A (resin part); mixed well and component B & C are to be added sequentially.

Proper mixing machines need to be used to ensure homogeneity of the system and consequent development of desired properties. Do not allow mechanical movement for 48 h and chemical exposure for 7 days.

5.0 Post-installation practices

Some do's and dont's

- Clean the floor regularly with a mop at least once a day.
- Do not allow any loose sharp particles to be strewn on the floor and ensure to remove the same immediately.
- Check the wheels of the vehicles regularly to ensure that there are no sharp particles adhering on the wheels.
- Rectify the leaking pipes and joints immediately (e.g. Oil carrying pipes in machines).
- Avoid dragging heavy loads like machinery, wooden crates etc.
- Periodically inspect the areas and rectify damaged areas immediately.
- Do not clean epoxy floors with acid.

6.0 Conclusion

Epoxy / PU floorings have been found to give an excellent service in various industries such as pharmaceuticals, food, automobile/auto ancillaries, textile, electronic, and electrical industries, light engineering, chemical industries, etc. However, it is important to ensure that the execution and maintenance has been done as per various standard procedures and hope that this article helps in an in-depth understanding of the same.