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CONVENTIONAL FLOORING MATERIALS AND THEIR LIMITATIONS WITH SPECIAL REFRENCE TO CASTING AND PHARMACEUTICAL INDUSTRIES

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Abstract: Flooring is an important component and the largest part of the industrial structure. As in the case of the casting industry while the production is going on the intensity of forces is high and due to these impacts, it leads to cracks/damage to the flooring. They are constantly subjected to a high load due to abrasive and mechanical wear, as well as thermal, chemical, and dynamical impacts. In the case of pharmaceutical industries, the modified type of concrete floor was used by providing an overlay to make it hygienic and not allow bacteria or any kind of dust. Hence this paper deals with different types of conventional flooring materials commonly used and their limitations.

Index Terms **– Industrial Flooring, Conventional Flooring, Types of flooring materials, Concrete floor, Cracks and Loads.**

I. INTRODUCTION

As the Industrial development is at its peak since the last decade, there are many cities like Bengaluru, Pune, Coimbatore, Rajkot, Hyderabad, Chakan etc., who have become hub for various industries such as Software, Chemical, Casting, Textile, Automobile, Healthcare, etc. All these industries have different raw materials, manufacturing techniques consisting of different production processes. Considering these varieties in the production process and raw materials there is dire need of different type of flooring for every industry meeting the requirements of production process. For example, the industries subjected to heavy machinery / equipment need flooring which can resist heavy compression, impact, abrasive forces on the other hand the flooring for pharmaceutical industry need better hygienic conditions and resistant to various chemical reactions. Hence the same flooring material cannot be used for both the types of industries. However, in the olden days conventional concrete was commonly used for flooring, but it has its own limitations.

II.TYPES OF CONVENTIONAL FLOORING MATERIALS

In past depending upon the nature of the product and the processes involved various types of flooring materials were used. E.g. Mud/sand flooring is used as the flooring material mainly for the casting industries to allow high-temperature operation smoothly without causing any damage to the flooring and also to reduce the chances of an accident.

In old days conventionally, natural stones such as Kota, Marble, Granite, Mandana, etc. were used in different types of industries. Since the marble consists of calcium in it so whenever it comes in contact with the acid or any type of chemical then there is a reaction causing efflorescence leading to the formation of the cavities. This reduces the impact and abrasion resistance, and escalates the maintenance cost making it unsuitable for the casting and pharmaceutical industries.

2.1 CONVENTIONAL CONCRETE FLOORING

Due to its affordability, flexibility of placement, and durability, concrete is a versatile building material. Concrete is used extensively as a flooring material for various industries because it has many benefits, including durability, rigidity, span, fire resistance, acoustic performance, reduced maintenance, and improved durability. A concrete floor is constructed from a flat concrete slab that is either built in a foundry or poured in place. Steel bars or a mesh of steel wires are used as reinforcement steel, sometimes referred to as reinforcing steel, to strengthen concrete. Concrete has the disadvantage of being strong in compression but low tensile strength. This is fixed by using reinforcement. By being inserted into concrete, the rebar is able to withstand tensile loads and therefore improve strength. A typical cross-section of the concrete floor is shown in fig-1.

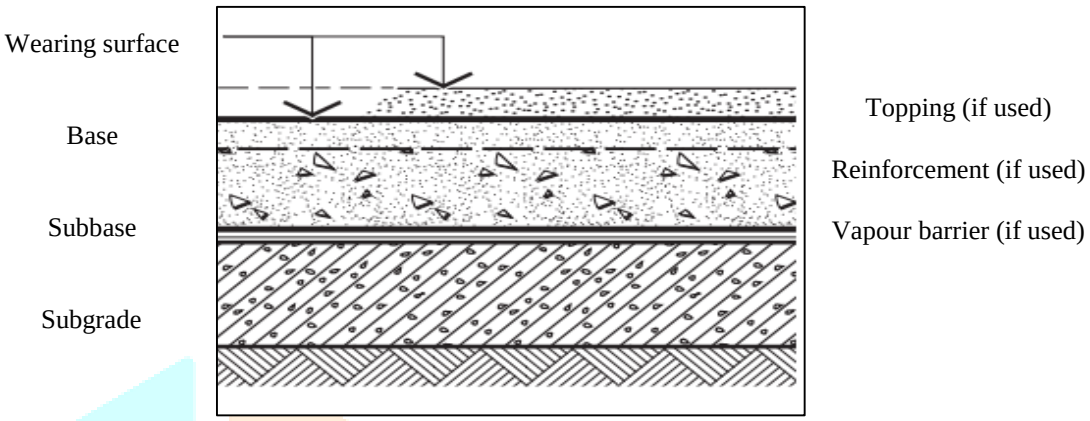

Fig-1. Typical cross-section of the concrete floor

i) Typical Characteristics of Concrete are as under

• Concrete flooring is incredibly strong, resilient, and weight-resistant. It is hard and unforgiving.
• Cement, aggregate (sand), coarse aggregate (gravel/or crushed stone), water, and other chemicals known as admixtures are used to produce concrete. The admixtures regulate the plasticity and setting time.
• Thickness: Its thickness ranges from 25 to 50 mm.
• Weight: A significant portion of concrete is dead weight.

ii) Major benefits of concrete floor are as given below

• **Cost:** It is the least expensive alternative to flooring because it doesn't require another floor covering.
• **Highly abrasion-resistant:** It won't be damaged by the equipment movements, is more abrasive resistant, and is better resistant to impact caused by falling goods and it is easy to cast/install in any position in the industry.
• **Durability:** A concrete floor that is properly sealed and maintained can last for a very long time before needing to be replaced. However, sealing or waxing is necessary every 6 to 9 months.
• **Finish:** A perfect gloss can be achieved by polishing concrete that enhances easy movement on the surface .however acrylic-based coatings cannot be applied easily.
• **Design options:** Most people envision unpleasant, grey industrial surfaces with harsh rough patterns when they think of concrete floors. Colouring concrete or applying textures, designs, machine cuts, and other techniques with the use of various components or new materials available in the market, can now breathe fresh life into this age-old material.
• **Versatile:** Concrete slabs can now be now coated with a different kind of flooring material. Since it is non-allergic and may not be appropriate for industrial uses, it is an excellent substitute for flooring.
• **Environmentally friendly:** A concrete floor is self-contained and does not require any additional flooring. Nowadays concrete can be made eco-friendly by the blending of various pozzolanic admixtures that help to reduce carbon emissions and the depletion of natural resources include fly ash and ground, granulated blast furnace slag.

iii) Limitations of concrete floor are as given below

• **Hard floor:** Concrete is a hard surface with brittle nature with less resilience hence it will lead to fracture or crack as shown in Fig-2, due to the falling of heavy objects on concrete surfaces.

Fig -2. Cracks due to heavy loading

• **Uncomfortable:** Standing on Concrete for lengthy periods of time is uncomfortable due to its hardness.
• **Artificial material:** Concrete lacks in the cosmetic look/ natural beauty of the materials like marble or granite.
• **Moisture:** If the top and bottom surfaces of the concrete floor are not correctly sealed, moisture can seep through leading to production issues.

2.2 REINFORCED CONCRETE FLOOR

` Steel bars are used in concrete as a composite material as represented in fig-3, making the plain concrete stronger. Concrete flooring with reinforcement is more resistant to tensile loads, cracking, and structural failure. Reinforcement is especially important for commercial and industrial flooring because it allows concrete to endure extreme pressure, high traffic, and years of wear and tear. Concrete flooring must be poured directly over pre-installed reinforcement bars or mesh in order to be adequately reinforced. The concrete is again allowed to set and harden around the rods or mesh, resulting in a stronger concrete flooring.

Fig-3. Reinforced concrete floor

Regular concrete could be less strong and have lower tensile strength than reinforced concrete. Concrete floors are kept protected from damage such as cracking, bending, and rusting by the use of reinforced concrete. Any internal stress is avoided since steel and concrete respond to heat variations identically. Compared to traditional plain concrete, reinforced concrete flooring is more resilient and has a higher compression strength. A reinforced concrete floor can hold more weight than normal concrete because any stress placed on it is transferred to the steel rods.

i) The following are the major advantages of reinforced concrete:

- Reinforced concrete has a higher compressive strength than other materials like wood, steel, and so on. Reinforcing improves the tensile strength of concrete, which may not have as much tensile strength as other building materials.
- Reinforced concrete is not as complex as other artificial flooring materials because it is made of stone, sand, cement, water, reinforcement, and other ingredients.
- The most appealing aspect of reinforced concrete is the connection between the components. Contrary to other materials, reinforced concrete rapidly binds to itself to form a composite material that may overcome the weaknesses of the individual components.
- Reinforced concrete is far more affordable and lasting when compared to other sources like steel.
- Abrasion resistance is higher in reinforced concrete.
- It has the ability to withstand moderate impact loads.
- It has the ability to resist flexural bending stresses than other conventional flooring material.

ii) Major Limitations of reinforced concrete flooring are as under:

- To repair concrete structures, extensive formwork, centering, and shuttering are needed. As a result, it calls for a sizable quantity of site space and labour.
- Concrete takes some time to fully develop its strength. It cannot therefore be utilized immediately after casting.
- The three main steps in using reinforced concrete are combining, casting, and curing. The final strength is impacted by everything.
- Casting RC shapes are much more expensive.
- As a result of shrinkage, cracks develop and the material loses strength, making work challenging.

2.3. VACUUM DEWATERED FLOORING/TIMEX METHOD

As seen in fig. 4, the Vacuum Dewatered (VD)/Tremix flooring method is a highly efficient way for installing high-quality concrete flooring. Concrete must be vacuum-dewatered in order for this approach to work. After placement and vibration, excess water from the concrete is removed, bringing the water-to-cement ratio to a desirable level. By using the VD flooring technology, concrete can be used more easily than is often possible.

Fig-4. The Vacuum Dewatered (VD) flooring

By vacuum-treating the concrete, it is feasible to lower the water content by 15% to 25%, considerably enhancing the compressive strength. The likelihood of shrinkage and subsequent cracking is significantly reduced by lowering the water-to-cement ratio. Concrete with a significant initial slump can be poured because vacuum dewatering reduces the water-cement ratio.

i) Laying Procedure: The method involves placing concrete in the following sequence:

• Concrete prepared in the conventional manner, but with a larger slump to ensure optimal workability and quick pouring and spreading.
• For floors with a thickness of 100 mm or more, poker vibration is always necessary (particularly on the both side of the panel).
• Double Beam Surface Vibrator Surface Vibration
• Using a straight edge to level the vibrating surface.
• Vacuum dewatering with a vacuum pump, suction mat top cover, and filter pads.

• Using Skim floaters to flog and trowel the concrete flooring.

ii) The vacuum-treated flooring or pavement demonstrates the following intrinsic benefits.

• Pavers that are monolithic and shrinkage-free.
• Each panel up to 100 square metres without joints (Depending on the design requirements)
• Extremely strong splitting ability.
• Consistent and controlled surface finish.
• Extremely high output of between 100 and 200 square metres. one day (Dependent to Vacuum Dewatering System setup and other site conditions, such as mixing concrete and pouring pace.)

iii) Major Limitations of Vacuum dewatered flooring

- **Initial Investment Costs are Higher**

VDF flooring has a greater initial cost due to the usage of heavy machinery such as a vacuum pump, grouting blades, surface vibrators, and so on.

- **Requirement for Skilled Labor**

VDF flooring is a complex process that must be conducted by trained workers under adequate supervision, or the floor may end up being defective.

- **Not Recommended for Small Spaces**

VDF flooring is not ideal for smaller places since it would be prohibitively expensive; therefore, it is primarily utilized in areas with a vast floor area.

2.4. KOTA STONE FLOORING

Kota Stone is a fine-grained, naturally occurring limestone. It is the most widely utilized material in industrial locations due to its attractive natural look, durability and low cost. Kota is noted for its glossy appearance and appealing shades, and it ages gracefully. It comes in a variety of forms and sizes. In reality, because of its unique properties, the material is a valuable asset in the construction industry.

Typical Laying of Kota stone flooring is shown in fig-5.

Fig-5. Typical Laying of Kota stone flooring

As seen in fig-6, Kota Brown stone is available in a variety of hues, including yellow, green, and brown. In places with strict cleanliness requirements, such dairy, pharmaceutical, and food industries. These areas' nooks are dust-gathering hotspots. It comes in the following dimensions: 22inch (L) x62mm (W) x62mm (H).

Fig-6. Types of Kota stone

i) Main Advantages of the Kota stone flooring are as under

- It is the most suitable and hygienic flooring for humid environments since it is not water absorbing and anti-slip.
- It is a firm, non-porous, and uniform material that can be used in a number of applications. It is extremely durable and long-lasting.
- Kota is resistant to many types of weather, including dry, humid, and cold.
- When compared to other natural stones, it is the most economical, easily accessible, and durable stone. It is also a strong heat reflector, allowing it comfortable to walk on. It is available in blocks and tiles and is relatively affordable.

ii) Major Limitations of the Kota stone flooring are as under

- It is not offered in big block sizes like marble or granite. Kota is a very fragile variety of stone that is only sometimes encountered.
- Kota is neither acid nor chemical resistance and is easily stained.
- The use of Kota stone on a regular basis may cause cracking. However, flaking of the stone may be avoided if it is thoroughly maintained and polished on a regular basis.
- It does not have the same glossy polish as marble or granite.

2.5. MANDANA STONE

Mandana stone is a type of sandstone. Typically comes in dark crimson or chocolate shades, giving flooring and furnishings a stunningly ominous appearance as shown in fig-7.Red Mandana is a chemical-resistant stone that is therefore preferred for industries like pharmaceutical, chemical process flooring, dairy plant, etc. where it is bedded and jointed with acid-proof cement. It offers floor strength and power.

Fig-7. Mandana stone flooring

Mandana stone flooring benefits are as given below:

- Red Mandana Stone is resistant to acids and simple to clean.
- Since it is not moisture absorbent and is anti-slip, Red Mandana Stone is perhaps the most appropriate and hygiene flooring for humid environments.
- The most long-lasting and easily accessible natural stone is the Red Mandana Stone, which is also quite affordable.
- It has high chemical resistance and fewer leakage problems.

III.CONCLUSION

It is important to select appropriate flooring that is long-lasting, having higher resistant, and low-maintenance to have uninterrupted running of the industry. Many times application of the conventional concrete flooring may not give the right result. But there are something called as fibres and if these fibres are mixed in the right proportion /quantity, the concrete flooring becomes durable and hence there is a wide scope for the application of fibre reinforced concrete flooring that makes the floor more durable and sustainable.

REFERENCES

[1] Ballim, Y. and Basson, J. 2001. Durability of Concrete, in Fulton's Concrete Technology, 8th ed. Editors: Addis, B, and Owens, G. Concrete and Cement Institute, Midrand.

[2] Indian Standard code of practice for laying in-situ cement concrete flooring (First Revision) Sixth Reprint, February 1999 IS: 2571 – 1970.

[3] International Journal of Energy and Environmental Research Vol.8, No.2, pp.11-19, June 2020 Published by ECRTD-UK ISSN 2055-0197(Print), ISSN 2055-0200.

[4] Marais, L. R. and Perrie, B. D. 1993. Concrete Industrial Floors on the Ground. Portland Cement Institute, Midrand

[5] Marlena Rajczyk, Paweł Rajczyk, "Multilayer Concrete Industrial Flooring Solutions Analysis." Architecture and Engineering Journal, Volume 2, Issue 4, 2017, ISSN: 2500-0055, P.P 48–55, October 2017.

[6] Neha Meshram, Prof. Dilip Budlani, "Solid Flooring by using Tremix Method-Literature Review." International Research Journal of Engineering and Technology (IRJET) Volume 7, Issue 3, ISSN: 2395-0056, P.P 75 – 77, March 2020.

[7] Petr Mynarcik, "Technology and Trends of Concrete Industrial Floors." Procedia Engineering 65, ISSN: 1877-7058, 2013, P.P 107 – 112, September 2013.