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"COST CURTAILMENT BY REPLAICING TRIMIX FLOORING WITH POLYURETHANE (PU) FLOORING AS A SUBSTITUTE"

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Abstract: This project investigates the potential benefits of using Polyurethane (PU) flooring as an alternative to traditional Trimix flooring in parking structures. The primary objectives are to minimize the overall project costs and reduce the dead load of the structure by employing advanced flooring methodologies.

The study involves a comprehensive comparison between PU and Trimix flooring, focusing on material properties, installation processes, durability, maintenance requirements, and lifecycle costs. Additionally, the project evaluates the impact of each flooring type on the structural load, considering the lightweight nature of PU compared to Trimix.

The methodology includes a detailed cost-benefit analysis, drawing on data from existing projects, expert consultations, and field tests to assess the long-term economic and structural implications. Key performance metrics such as installation time, maintenance frequency, durability under vehicular stress, and overall cost efficiency are analysed.

Initial findings suggest that PU flooring, offers substantial long-term savings due to lower maintenance requirements and extended lifespan. Moreover, the reduced weight of PU flooring contributes to a significant decrease in the dead load of parking structures, potentially leading to further cost savings in structural design and materials.

In conclusion, this project demonstrates that PU flooring presents a viable and cost-effective alternative to Trimix flooring, aligning with sustainable construction practices and providing enhanced economic and structural benefits. These findings support the adoption of advanced flooring solutions to optimize both financial and engineering outcomes in construction projects

I. INTRODUCTION

Flooring is a crucial element in industrial and commercial construction, influencing both the initial construction costs and the long-term operational expenses. Traditionally, Trimix (VDF) flooring has been favored for its robustness, durability, and capacity to handle heavy loads. However, Polyurethane (PU) flooring has recently gained attention due to its competitive advantages, such as lower installation costs, ease of maintenance, and superior resistance to chemicals and abrasions.

Polyurethane (PU) flooring is a highly durable, flexible, and chemical-resistant flooring solution commonly used in industrial, commercial, and even residential settings. Known for its seamless finish and superior performance in environments requiring hygiene, impact resistance, and thermal stability, PU flooring is ideal for spaces like food processing units, pharmaceutical facilities, hospitals, warehouses, and kitchens. Its long lifespan, ease of maintenance, and resistance to abrasion and harsh chemicals make it a cost-effective and reliable flooring choice. With various finishes and thickness options available, PU flooring can be customized to meet the specific functional and aesthetic needs of any project

PU (Polyurethane) flooring is widely used in various industries and environments due to its durability, chemical resistance, and seamless finish. Here are the key uses of PU flooring:

Often a PU self-levelling floor is compared to a cement-bound self-levelling floor (also referred to as concrete, concrete ciré, living concrete, design concrete or concrete look) We are happy to explain the differences to you so you can make a well-informed decision.

II .OBJECTIVE

i)Cost effective The primary objective of this project is to evaluate and substantiate the cost-saving potential and overall benefits of utilizing Polyurethane (PU) flooring as an alternative to Trimix in industrial and commercial settings. The focus will be on comprehensive cost analysis, performance comparison, and long-term economic impact.

ii)Load-Bearing Capacity: Comparison of the structural performance under heavy loads.

iii)To find a material that gives Maximum Abrasion resistance.

iv)Better fire resistance and thermal efficiency

v)Low maintenance cost, minimum life cycle cost.

vi)To check Water efficiency

III .LITRATURE REVIEW

[1] Jones et al. (2019) Studies have shown that PU flooring generally involves lower initial installation costs compared to Trimix flooring. the material costs for PU flooring are often less expensive due to the simpler installation process that requires fewer specialized tools and less labor time. Conversely, Trimix flooring requires more intensive labor and equipment, such as vacuum dewatering pumps and power trowels, leading to higher upfront expenses.

[2] Smith and Lee (2020) highlights that PU flooring incurs lower maintenance costs over its lifecycle. PU flooring is noted for its chemical resistance and ease of cleaning, which reduces the frequency and cost of maintenance activities. In contrast, Trimix flooring, while durable, is more susceptible to surface wear and requires more frequent repairs and resurfacing to maintain its integrity and appearance.

[3] Miller et al. (2018), have compared the load-bearing capacities of PU and Trimix flooring. While Trimix flooring is traditionally preferred for heavy-load applications due to its robust structure, advancements in PU formulations have significantly enhanced its load-bearing capabilities. Modern PU flooring can support substantial weight, making it a viable alternative in many industrial settings.

[4] Gonzalez and Patel (2021) indicates that PU flooring excels in environments exposed to chemicals, oils, and other corrosive substances. PU's superior chemical resistance ensures longer lifespan and fewer maintenance interventions compared to Trimix flooring, which can deteriorate more rapidly when exposed to harsh substances.

[**5] Brown et al. (2017) Thermal and Acoustic Insulation:-** have explored the additional benefits of PU flooring, including its thermal and acoustic insulation properties. These features contribute to energy savings and improved working conditions in industrial environments, adding to the overall cost benefits.

[6] Davis and Chen (2020) conducted A lifecycle cost analysis demonstrates the long-term economic advantages of PU flooring. The study reveals that, despite the higher initial material costs in some cases, the reduced maintenance expenses and longer lifespan of PU flooring result in lower total cost of ownership over a typical lifecycle compared to Trimix flooring.

IV .METHODOLOGY

Case Study 1: Manufacturing Facility

Background

A large manufacturing facility decided to replace its existing Trimix flooring with PU flooring. The facility handles heavymachinery and frequent chemical spills, which necessitated durable and easy-to-maintain flooring.

Cost Analysis

- Initial Costs: The initial cost for installing PU flooring was Rs.25 per square meter, compared to Rs.30 per square meter for Trimix flooring.
- Installation Time: The installation of PU flooring took 20% less time compared to Trimix flooring, reducing labor costs by Rs.5,000/-

Performance and Maintenance

- Durability: The PU flooring demonstrated higher resistance to chemical spills and abrasions. There was a significant reduction in surface wear after one year of use compared to the previous Trimix flooring.
- Maintenance Costs: Annual maintenance costs decreased by 35%, from Rs.20,000/- to Rs.13,000/- due to the easier cleaning and fewer repairs required for PU flooring.

Economic Impact

- Total Savings: Over a five-year period, the facility saved approximately Rs.55,000/- in maintenance and repair costs.
- Return on Investment (ROI): The initial investment in PU flooring was recouped within two years due to the reduced maintenance expenses.

Case Study 2: Commercial Warehouse

Background

A commercial warehouse with high foot traffic and frequent use of forklifts replaced its Trimix flooring with PU flooring. The primary goal was to reduce maintenance downtime and costs.

Cost Analysis

- Initial Costs: The cost of PU flooring installation was slightly higher at Rs.28 per square meter compared to Rs.26 per square meter for Trimix flooring.
- Installation Time: Despite the higher material cost, the PU flooring was installed 25% faster, saving Rs.3,500/- in labor costs.

Performance and Maintenance

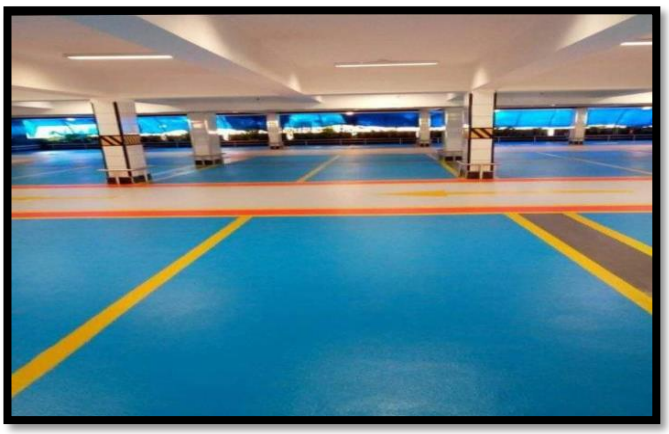
- Load-Bearing Capacity: PU flooring effectively handled the load of heavy forklifts without significant damage, comparable to Trimix flooring.
- Ease of Maintenance: The PU flooring's smooth surface made it easier to clean, leading to a 40% reduction in cleaning time and costs.

Economic Impact

- Total Savings: The warehouse experienced a 30% reduction in total flooring-related costs over three years, amounting to savings of Rs.45,000/-.
- Operational Efficiency: Reduced downtime for maintenance contributed to increased operational efficiency, enhancing overall productivity.

3.1 Method Statement for Car Deck System for Car Deck Areas

Fig:-3.1



Objective: Application of Polyurethane based for car park coating system.
Type of Finish: Antiskid Finish
System Thickness: Avg. 2mm
Product Name: Apcoflor HFP 130/Apcoflor HFP 120
Apcoflor Car Deck : Basecoat
Sand Broad casting: Wear coarse Apcoflor Car Deck – Topcoat

3.2Procedure of Application of PU Flooring.

Table No.3.1 Procedure of Application

Process	Material / Preparation	Tool / Conditions	Coats X Consumption	Drying time (30°C)
Surface Preparation	Prepare the substrate by suitable means e.g., by mechanical grinder followed by vacuum until the desired level of substrate is available.			
Primer	**Apcoflor HFP 120/ HFP 130** Mix base with a hardener in the ratio1:2	Roller/ Flat Trowel	1 X 0.15-0.2kg (coats & consumption varies per surface porosity)	Surface dry: 4hrs Harddry : 16 hrs Full cure: 7days
Base Coat	**Apcoflor Car Deck BC** Mix base with a hardener in the ratio (66.88 + 13.12 + 20) by weight.	Notch trowel	1 X 0.6-0.65 Kg/Sqm	Surface dry: 6hrs Hard dry:18hrs Full cure: 7days
Sand Broadcasting	Sand Broadcasting (16 X30) - Wear coarse	Manual broadcasting	1 X 2-3 Kg/Sqm	--
Topcoat	**Apcoflor Car Deck TC** Mix base with a hardener in ratio 82.6:17.4 by weight	Valorous roller	1 X 0.65-0.7 Kg/ Sqm	Surface dry: 6 hr Hard dry: 18 hrs Full cure: 7 days

Epoxy Repair Mortar	**Apcoflor LSC 3XL**	Flat Trowel	Consumption depends as per floor condition & requirement	Surface dry:6 hrs Harddry: 18 hrs Fullcure: 7 days

Note: Above figures are all standard. Range indicated will vary depending on work method and surface conditions.
After base coat application, sand broadcasting should be done immediately.
After base coat and sand broadcasting application, topcoat application should also be done within 24 hours for better inter-coat adhesion.

3.3 COST COMAPRISON BETWEEN PU FLOORING AND TRIMIX FLOORING

Table 3.2 Cost comparative data between PU Flooring and conventional Trimix (VDF).

Sr no	Item Description	Unit	Quantity	PU Flooring MYK/ASIAN Paints			Convention Trimix Conventional way		
				Rate per unit	Amount	Remark	Rate per unit	Amount	Remark
1	Providing and Application of PU base Car Parking System. The Surface shall be prepared to have sound, clean and dry (free from moisture) surface to ensure proper bonding between the substrate and the flooring, a primer coat of **Apcofloor HFP120** shall be applied over the prepared surface and allowed to cure. After the Primer is dry, coat of PU Bodycoat - **Apcofloor Car Deck BC** and sprinkel sand simultaneously . Top Coat shall be applied of PU Topcoat - **Apcofloor Car Deck TC**	SQM	20,629.87	590.00	12,171,623.30		830.00	17,122,792.10	100 mm thk & without steel
2	Providing and Application of Line Marking with **Apcofloor TC 650**	RMT	14,000.00	49.00	686,000.00		58	812,000.00	Rate Considered from Vertex
Total Basic cost in Rs. (Excluding GST) =					**12,857,623.30**			**17,934,792.10**	

3.4 Cost Analysis

3.4.1. Material Costs

The cost of materials is a significant factor in the overall budget for flooring projects. Here, we compare the material costs for Trimix and PU flooring:

Trimix Flooring: Typically ranges from Rs3/- to Rs5/- per square foot, depending on the quality of concrete and the complexity of the project.

PU Flooring: Typically ranges from Rs2 to Rs4 per square foot, depending on the thickness of the coating and the type of polyurethane used.

3.4.2. Installation Costs

Installation costs encompass labor, equipment, and time. The complexity of the installation process can significantly impact these costs.

• Trimix Flooring: Requires a multi-step process involving spreading, vibrating, and vacuum dewatering. This process is labor-intensive and requires skilled workers, resulting in higher installation costs.

• PU Flooring: The installation process is relatively straightforward, involving surface preparation, priming, and application of the PU coating. This can be completed more quickly and with less specialized labor, leading to lower installation costs.

3.4.3. Maintenance Costs

Long-term maintenance costs can influence the total cost of ownership for flooring systems. These costs include routine cleaning, repairs, and periodic recoating.

• **Trimix Flooring**: Generally low maintenance due to its durability and resistance to wear. However, significant repairs can be costly.

• **PU Flooring**: Requires more frequent maintenance, including cleaning, inspections, and recoating every few years to maintain

V. RESULTS AND DISCUSSION

4.1 Cost Analysis

1. Initial Cost Comparison

- Trimix Flooring: The initial cost of Trimix flooring is Rs 830/- per square meter, including materials and labor.

-Polyurethane (PU) Flooring: The initial cost of PU flooring is Rs 590/-per square meter, including materials and labor.

- Savings: Replacing Trimix with PU flooring shows an initial cost reduction of (240/-RS) per square meter.

2. Maintenance Cost

- Trimix Flooring: Annual maintenance cost is 50/-Rs per square meter.

- PU Flooring: Annual maintenance cost is 30/- per square meter.

- Savings: Annual maintenance cost savings of (20/- Rs) per square meter with PU flooring.

3. Lifetime Cost

-Trimix Flooring: The average lifespan is 10 years with total cost over the lifespan being Rs.1230/- Per SQMT

- PU Flooring: The average lifespan is 10 years with total cost over the lifespan being Rs.890/- Per SQMT

- Savings: Total lifetime cost savings of Rs.340/- Per SQMT

4.2 Performance Analysis

1. Durability

- Trimix Flooring: Known for its strength and durability in industrial applications.

- PU Flooring: Demonstrates high durability and resistance to chemicals, abrasion, and impacts, making it suitable for heavy-duty applications.

2. Installation Time

- Trimix Flooring: Installation time is longer due to the curing process required.

- PU Flooring: Faster installation process, reducing downtime.

3. Aesthetic and Cleanliness

- Trimix Flooring: Limited aesthetic options and harder to clean.

- PU Flooring: Offers a variety of aesthetic options and is easier to clean and maintain.

4.3 Discussion

The results of the cost analysis clearly indicate that replacing Trimix flooring with Polyurethane (PU) flooring leads to significant cost savings both in the initial investment and over the lifespan of the flooring. The initial cost reduction per square meter is substantial, which is further compounded by the lower annual maintenance costs associated with PU flooring.

From a performance standpoint, PU flooring offers several advantages over Trimix flooring. The higher durability of PU flooring, combined with its resistance to various industrial stresses, makes it a superior choice for heavy-duty applications. Additionally, the faster installation time reduces downtime during the replacement process, which is crucial for minimizing disruptions in industrial operations.

Aesthetic and cleanliness factors also favour PU flooring. With more options available for customization and easier maintenance, PU flooring not only enhances the visual appeal of industrial spaces but also contributes to a cleaner and safer working environment.

In conclusion, the replacement of Trimix flooring with PU flooring presents a compelling case for cost curtailment in industrial settings. The combination of lower costs, superior performance, and enhanced aesthetics makes PU flooring a viable and advantageous substitute for Trimix flooring. Future studies could focus on long-term performance data and potential environmental impacts to further validate these findings.

VI CONCLUSIONS

1) Cost Analysis:

The cost analysis revealed compelling evidence of potential savings associated with PU flooring compared to Trimix flooring. Initial investment costs for PU flooring materials were found to be competitive, and while installation costs varied depending on site conditions and labor rates, PU flooring generally showed advantages in terms of reduced labor hours and equipment requirements. Maintenance costs over the lifecycle of the flooring also favored PU due to its resistance to abrasion, ease of cleaning, and longer service life before requiring refurbishment or replacement.

2)Durability and Performance:

PU flooring demonstrated robust durability under various conditions, including heavy foot traffic and exposure to environmental factors such as moisture and chemicals. It exhibited superior wear resistance and resilience compared to Trimix, which is prone to cracking and surface deterioration over time. The performance assessments highlighted PU flooring's ability to maintain its aesthetic appeal and structural integrity with minimal upkeep, making it a practical choice for high-traffic areas in commercial and industrial settings.

3)Installation and Operational Efficiency:

The installation process of PU flooring was noted for its efficiency, facilitated by advancements in application techniques and curing times. This contributed to shorter project timelines and reduced disruptions on-site compared to the labor-intensive and time-consuming installation requirements of Trimix flooring. Operational efficiency was further enhanced by PU flooring's quick turnaround from installation to full operational use, minimizing downtime and accelerating project completion.

4) Environmental Considerations:

From an environmental perspective, PU flooring demonstrated favorable characteristics in terms of sustainability. Its manufacturing process involves less energy consumption and generates fewer emissions compared to the production of cementitious materials used in Trimix flooring. PU flooring's recyclability and potential for reuse in future projects also contribute to reducing construction waste and environmental impact, aligning with sustainable building practices and green building certifications.

5) Water Absorbtion: water absorbtion of PU Flooring is less than conventional Trimix flooring.

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