STRENGTHENING Industrial & Warehouse& WAREHOUSE INFRASTRUCTURE- "Aligning With Global Best Practices: Precision Industrial & Warehouse Flooring With Laser Screed."

"SUPPORTING INDIA'S Industrial & WAREHOUSEING GROWTH: LASER SCREED FOR SUPERIOR FLOORING"

M/S EXPERIVA FLOORING INDIA LLP
NEW DELHI BRANCH

arvind@experivaflooring.com, +91 9582222940
&
ritesh@experivaflooring.com, +91 9599625570om


adani
Power


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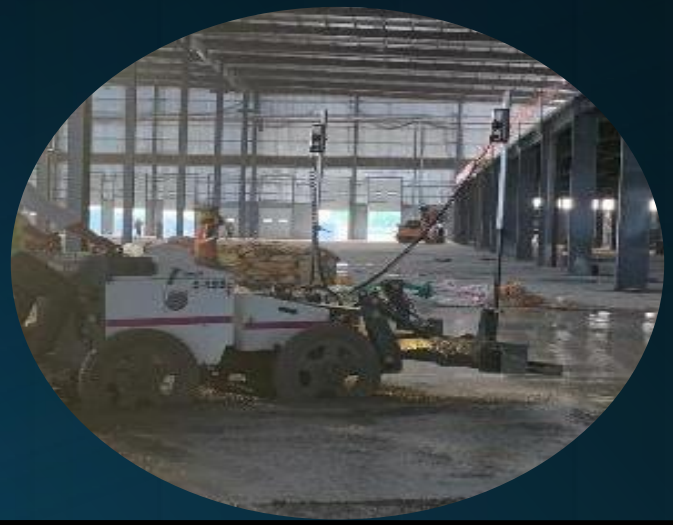
vivo V25 · Abhi patil.
Jan 22, 2024, 09:44

FM-II FLOORING- A JOURNEY OF LEARNING AND GRATITUDE: "*OUR EXPERIENCE WITH THE ADANI COPPER MELT PROJECT*", MUNDRA, GUJARAT

- Adani's Copper Melt project at Mundra, Gujarat, is a state-of-the-art facility that plays a key role in India's copper processing industry. Spread across **3,40,000 SQF** and valued at **3.3 crores**, this project is part of Adani's vision to support industrial growth with robust infrastructure.
- **KEY FEATURES OF OUR WORK:**
- **FLOOR THICKNESS**: The project required a durable 350mm thick floor, capable of supporting the heavy equipment and operations within the facility.
- **ADVANCED EQUIPMENT**: We employed the Somero S10A machine, known for its accuracy and efficiency, ensuring precise leveling and smooth finishing.
- **TEAM STRUCTURE**: A dedicated workforce of 35 laborers and 3 engineers oversaw the project, ensuring high-quality execution.
- **120MM GROOVE CUTTING**: Essential groove cutting at 120mm depth was executed to provide expansion joints and prevent floor cracking.
- **WET-ON-WET FLOORING**: The floor was completed using the wet-on-wet technique, creating stronger bonding between layers, increasing durability, and speeding up the process.

INTRODUCTION



We as a company take much pride in introducing ourselves as one of the pioneers, Grade "A" flooring contractors in the construction industry as Industrial & Warehouseand warehouse contractors for flooring **C/o. M/s. Experiva Engineering Pvt. Ltd.**

IMPRESSIVE PORTFOLIO:

Renowned Clients: Impressive portfolio includes renowned organizations like Flipkart, Morgan Stanley, Amazon, Reliance, Adani and many more.
Project Scale: Successfully delivered some of India's largest single-box projects.
Noteworthy Projects: Staggering projects for HAIER – (1100000 sqf)Flipkart (700,000 sqf) and Morgan Stanley (650,000 sqf).
Global Expansion:
Dubai Operations: Recently expanded operations to Dubai.
Project Execution: Successfully executed two projects in Dubai.
(Recent Milestone: *ATC YOKOHAMA Project:* *Completed a monumental 160,00,000 sqf area at ATC YOKOHAMA in Visakhapatnam, showcasing commitment to excellence)*

Our services include turnkey contracting services of commercial flooring like *Laser Screeding, Floor densification, Repair and Rehabilitation of floor - from designing to installation followed by certification* . For the last 7 years with help of our latest infrastructure and advanced technology, we have been engaged in providing superior quality services to our clients across the nations to deliver the perfect customer experience and attribute our growth to executing our project with 100% customer satisfaction

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- **High Load-Bearing Capacity**: **Industrial & Warehouse** floors endure greater loads than any other part of the building due to the weight of Machinery, equipment, and vehicles.
- **Significant Wear and Tear**: Constant vehicular movement, heavy machinery, and exposure to fuels and chemicals contribute to faster wear and tear.
- **Difficult to Repair During Operations**: Once the floor is operational, scheduling repairs is challenging, as maintenance managers rarely have the luxury of shutting down operations for floor repairs and curing.
- **Time Constraints for Execution**: Floors are typically one of the last construction activities, often delayed by earlier project phases, putting pressure on timely completion.
- **Premature Load Application**: To meet tight commissioning deadlines, Industrial & Warehouse floors are frequently subjected to loads earlier than recommended, which can affect the long-term durability of the flooring.
- **Operational Efficiency Depends on Floor Quality**: A well-executed floor directly impacts the efficiency of vehicular or MHE movement, maintenance activities, and the overall functioning of the Industrial & Warehousefloors.

INDUSTRIAL & WAREHOUSE FLOORING – "Built To Last: Industrial & Warehouse & Warehouse Flooring That Can't Be Repaired Must Be Done Right"

INDUSTRIAL & WAREHOUSE FLOORING – "Built To Last: Industrial & Warehouse Flooring That Can't Be Repaired Must Be Done Right"

- **Minimized Downtime Through Superior Floor Design**: Investing in durable flooring systems reduces future maintenance needs, minimizing interruptions in hangar operations.
- **Essential Role in Safety**: High-quality, level, and non-slip floors are vital for ensuring the safety of personnel and equipment, especially in high-traffic areas where aircraft are moved and serviced.
- **Critical to Long-Term Facility Performance**: Poorly designed or constructed floors can lead to costly maintenance, operational inefficiencies, and even safety hazards, affecting the long-term productivity of the hangar.
- **Built to Withstand Harsh Conditions**: Hangar floors must resist oil, fuel, and chemical spills, making material selection (e.g., epoxy coatings, densified concrete) crucial for long-term performance.
- **Laser Screed Flooring for Precision and Durability**: This advanced method ensures precise leveling and flatness, critical for smooth aircraft handling and load distribution, reducing the risk of early damage.

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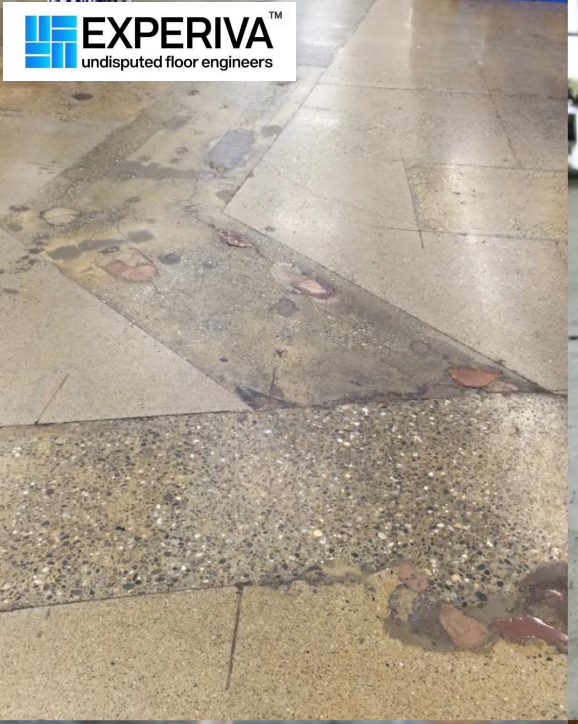

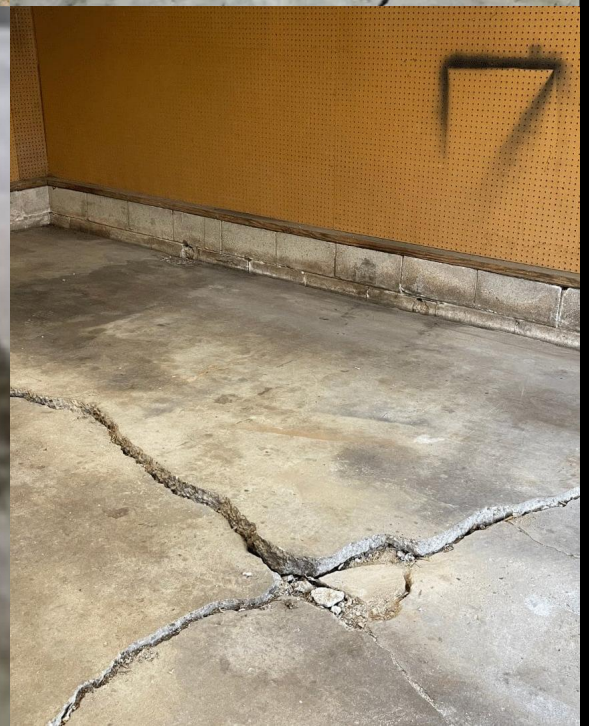

WHY FLOORING MATTERS IN INDUSTRIAL & WAREHOUSE PROJECTS ?

- Industrial & Warehouse floor require specialized flooring that can support **heavy loads, withstand high foot and vehicle traffic**, and endure exposure to chemicals and fuels. The floor must be **flat, level, and durable**, with minimal joints to ensure smooth operations and easy movement of aircraft and maintenance equipment.
- Common issues in poorly designed Industrial and warehouse floors include:
- **Cracking or uneven surfaces**, which can compromise safety and hinder operations.
- **Frequent repairs and high maintenance costs** due to joint failure and surface wear.
- **Moisture accumulation**, causing corrosion and damaging aircraft.
- At **EXPEIRVA** we address these challenges through **advanced flooring technologies and precise design solutions**, ensuring that hangar floors are built to last and perform optimally in the long run.

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ENSURING PRECISION AND DURABILITY IN INDUSTRIAL & WAREHOUSE FLOORING: MEETING GLOBAL STANDARDS WITH EXPERT TEAMS

- **Extensive Industry Experience**:
  With over **20 years of experience** in flooring, I have led and executed numerous complex flooring projects, including **airplane hangars**. My partner, **Mr. Ritesh Jain**, brings **26 years of experience** in the construction industry, making us a highly skilled and knowledgeable team capable of handling the unique demands of such projects.
- **Proven Track Record in Complex Projects**:
  Our team has successfully completed multiple challenging hangar flooring projects in the past. These projects require a high degree of precision, durability, and specialized techniques to support the heavy loads and harsh conditions that come with aircraft operations.
- **Expertise in Advanced Flooring Technologies**:
  As one of the **top flooring contractors in India**, we are at the forefront of utilizing **advanced flooring technologies**, including laser screed flooring, steel fiber-reinforced concrete, and high-performance coatings, repair and rehabilitation. Our technical expertise ensures that every floor we deliver meets the highest standards of durability, flatness, and load-bearing capacity.

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ENSURING PRECISION AND DURABILITY IN INDUSTRIAL & WAREHOUSE FLOORING:

MEETING GLOBAL STANDARDS WITH EXPERT TEAMS

- **Global Reach and Recognition**:
  While we have established a strong presence in India, we have also ***expanded our operations to Dubai***, solidifying our reputation as industry leaders. Our experience in diverse geographical markets enables us to tackle complex flooring challenges across various environments.
- **Ability to Deliver on Tight Deadlines with Precision**:
  In high-stakes projects like airplane hangars, time is of the essence. We are known for our ability to **meet tight deadlines** while ensuring **precision and quality**. Our project management approach ensures on-time delivery, even in cases where early loading or operational constraints put extra pressure on

LASER SCREED FLOORING TECHNOLOGY:

MANUAL LIMITATIONS:
"Challenges in Manual Levelling for Small Concrete Areas"

LASER SCREED ADVANTAGES:
"Precision with Laser Technology: Transforming Concrete Flooring"

ACCURATE LASER REFERENCE:
"Consistent Levelling: The Laser as a Reliable and Extended Reference Line"

TWO-COMPONENT SYSTEM:
"Efficient Collaboration: The Laser Transmitter and Levelling Machine in Action"

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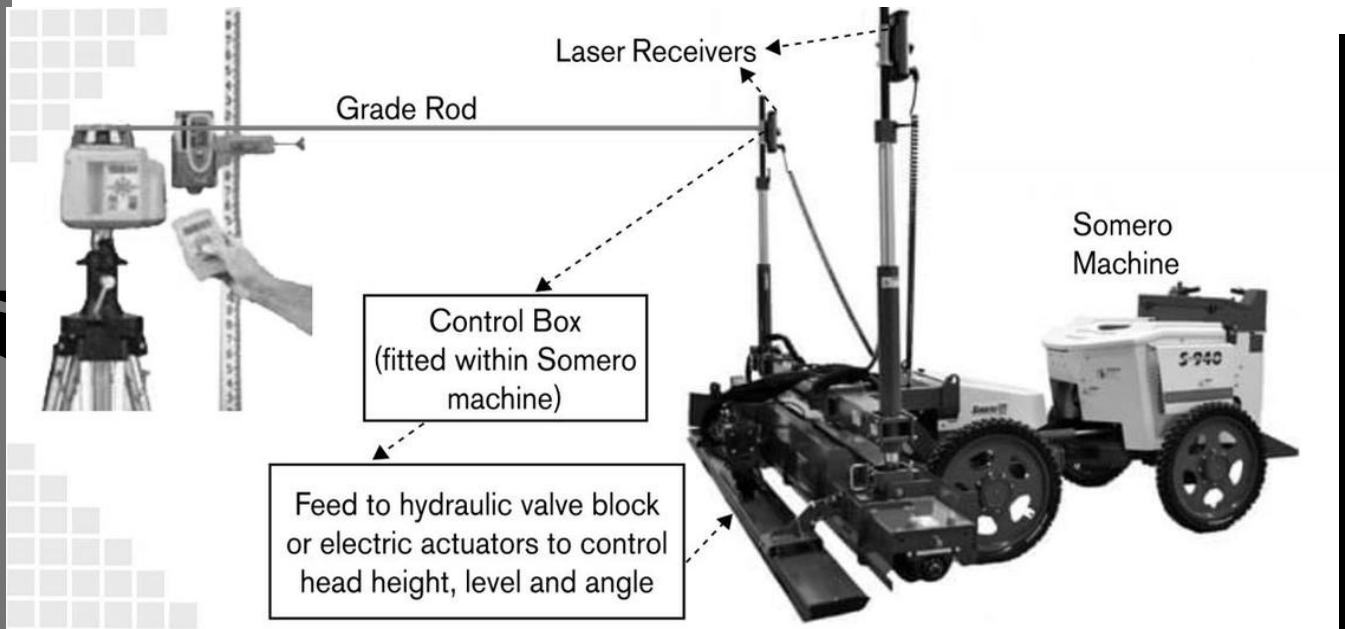

Flat finished floors with precise levels

Major reduction in construction joints

10 to 25 meter wide panels mechanized leveling

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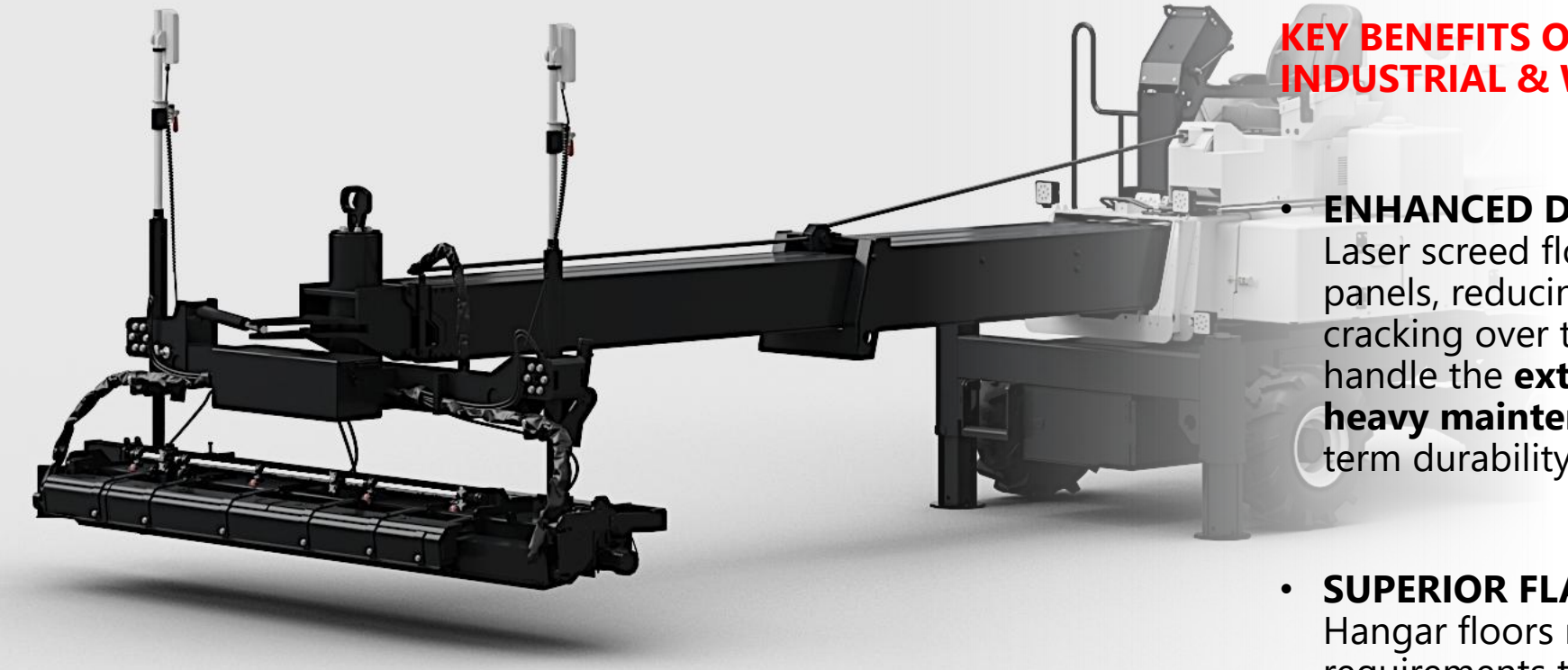
PRECISION AND DURABILITY



KEY BENEFITS OF LASER SCREED FLOORING IN INDUSTRIAL & WAREHOUSE FLOORING:

- **ENHANCED DURABILITY**:
  Laser screed floors are made from large, jointless panels, reducing weak points and preventing cracking over time. These floors are designed to handle the **extreme weight of machine and heavy maintenance equipment**, ensuring long-term durability.

- **SUPERIOR FLATNESS AND LEVELNESS**:
  Hangar floors must meet strict flatness requirements to ensure **smooth MHE movement** and prevent damage to landing gear or tires. Laser screed machines guarantee high-precision results, providing **uniform surfaces** that meet industry standards like *ASTM E1155* for flatness.

PRECISION AND DURABILITY

COST EFFICIENCY:
By reducing the number of joints and improving surface durability, laser screed technology minimizes the need for **ongoing repairs and maintenance**. This reduces overall life cycle costs and ensures that hangar operations remain efficient with minimal downtime.

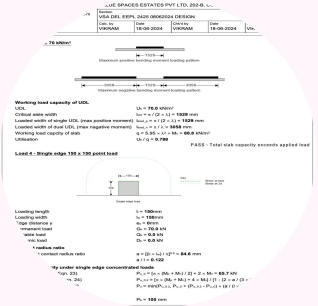
FAST AND EFFICIENT INSTALLATION:
Laser screed machines allow for faster construction with **larger panels**, reducing the time required to install the floor while maintaining precision. This efficiency is crucial for meeting project timelines in large-scale facilities like hangars.

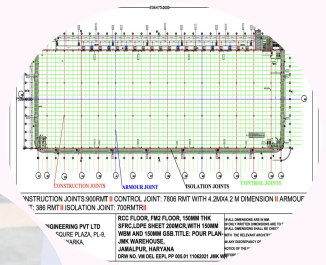
LASER SCREED FLOORING (FM- FLOORINGS)

EXPLANATION OF FM-STANDARDS

- **FM-II (Free Movement Area)** "standards ensure that floors meet the specific flatness and levelness requirements for areas where vehicles or equipment can move freely in any direction."
- These standards are essential, like those in Industrial and warehouse, where smooth and level surfaces are critical for safety and efficiency.
- **FM-II** compliance guarantees precise tolerances, reducing wear and tear on both the flooring and equipment over time.

BTS VALUE PROPOSITION





WARRANTY 07

REPAIR & REHABILITATION 08

FLOOR SURVEY (FM/DM) 06

SOIL TESTING- K /Evd VALUE 01

BUILT TO SUIT VALUE PROPOSITION

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LASER SCREEDING & POLISHING 05

DESIGN & DETAILING DRAWINGS 02

WORK PROCESS CONTROL 04

RMC DESIGN 03

THE FUTURE OF FLOORING: BIGGER PANELS AND THEIR IMPORTANCE IN LASER SCREED APPLICATIONS

1. INCREASED EFFICIENCY

- Larger panels reduce the number of pours required, resulting in faster installation.
- Fewer joints and seams mean less downtime between pours, improving project timelines.

2. IMPROVED FLOOR FLATNESS AND LEVELNESS (FF/FL)

- Bigger panels enhance the floor flatness due to fewer disruptions and seams.
- Laser screed technology ensures that larger panels are laid with consistent precision, leading to better overall floor quality.

3. COST SAVINGS

- Fewer pours and joints translate to reduced labour costs.
- Minimizes the need for additional materials, such as dowel bars and joint fillers, which lowers material costs.

4. REDUCED JOINTS AND MAINTENANCE

- Fewer joints mean less need for maintenance and repair over time, as joints are common points of wear and failure in flooring.
- This results in long-term durability and cost-effectiveness.

5. ENHANCED STRUCTURAL INTEGRITY

- Larger, continuous panels provide more stability and structural integrity to the flooring, reducing the risk of cracking and movement.
- Improves load distribution, which is crucial for heavy-duty Industrial & warehouse environments.

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BIGGER PANELS, BETTER FLOORS: REVOLUTIONIZING LASER SCREED FLOORING

6. ENVIRONMENTAL IMPACT

- Larger panels reduce waste from joint materials and extra pouring steps, making the process more sustainable.
- The reduction in construction time also contributes to lowering the overall carbon footprint of the project.

7. TECHNOLOGY COMPATIBILITY

- Modern laser screed machines are designed to handle larger panels with ease, making the installation smoother.
- Precision technology in laser screeding ensures that bigger panels are laid with high accuracy, enhancing the overall quality of the flooring.

8. AESTHETIC AND FUNCTIONAL BENEFITS

- Bigger panels result in smoother, seamless floors, providing better aesthetics, which is particularly important for commercial and retail spaces.
- It also improves the usability of the space, reducing tripping hazards and making the surface more uniform for machinery and equipment.

9. FLEXIBILITY FOR LARGE-SCALE PROJECTS

- Ideal for large spaces like warehouses, airports, and Industrial & Warehouse buildings where larger, uninterrupted floors are needed.
- Reduces logistical complexity in projects involving large surface areas.

10. FUTURE-PROOFING FLOORS

- Investing in larger panels with laser screed technology ensures the flooring system will meet future industry standards for strength, durability, and performance.

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FLOOR DESIGNING & AUTOCAD DRAWINGS

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ROLE OF AUTOCAD DRAWINGS IN FLOOR DESIGN

- AutoCAD drawings play a vital role in ensuring the precise execution of the hangar floor design. With professional 2D and 3D drawings, designers can visualize every aspect of the floor, including dimensions, joint placements, and load-bearing capacities.

ACCURATE IMPLEMENTATION:

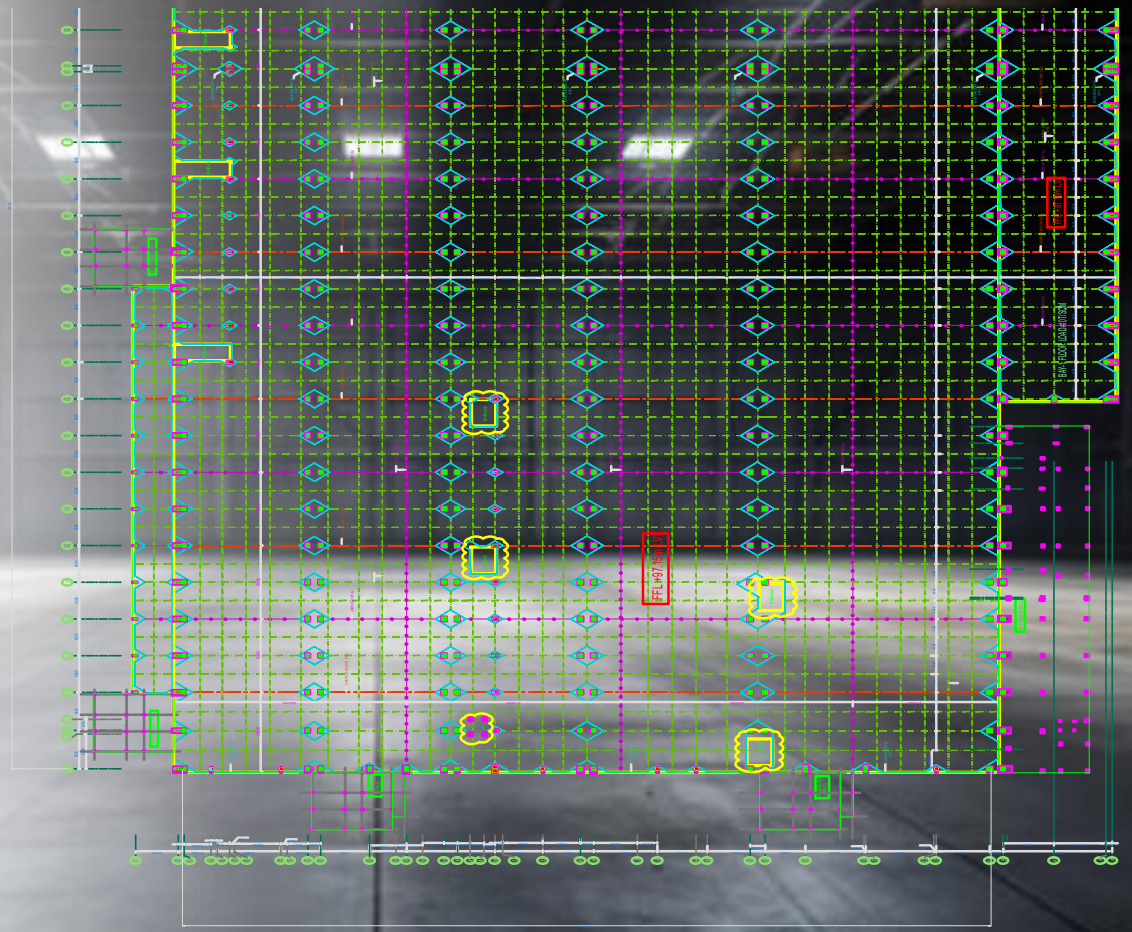
- AutoCAD drawings provide a comprehensive visual guide for contractors, ensuring that the design is executed accurately.
- These drawings detail floor thicknesses, reinforcements, and joint locations, ensuring that the floor meets both aesthetic and functional requirements.

COLLABORATION AND CUSTOMIZATION:

- AutoCAD drawings allow for easy collaboration between engineers, architects, and contractors. Any design changes can be quickly incorporated and shared, allowing for customization based on site conditions or client requirements.

PREVENTING ERRORS:

- By visualizing the entire project in a digital format, AutoCAD minimizes errors during the construction phase. Accurate placement of joints and panels can reduce weak points and ensure a durable, smooth surface.

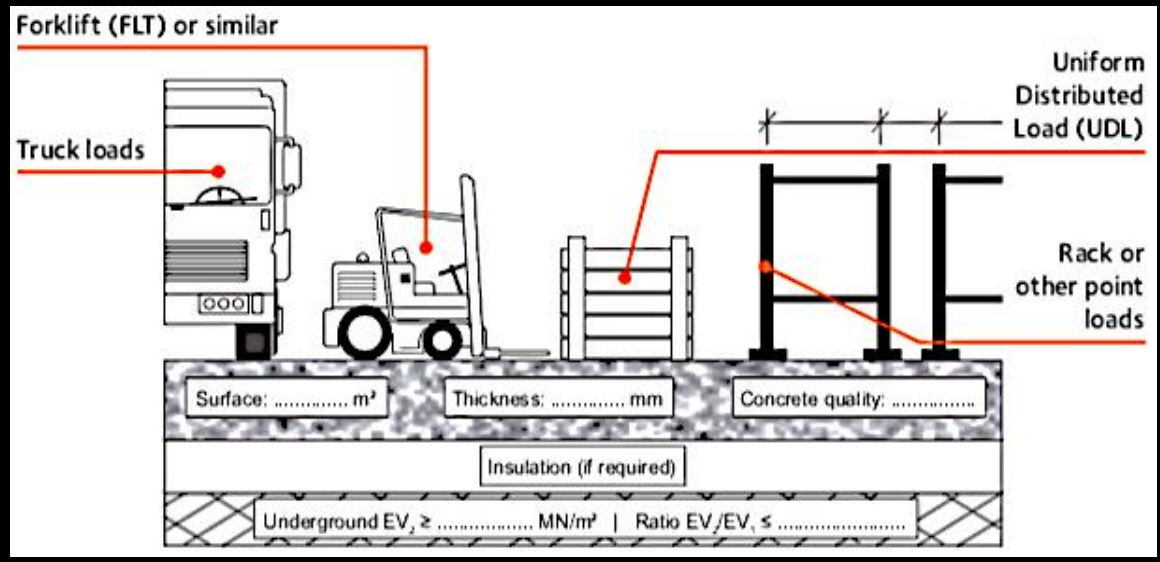


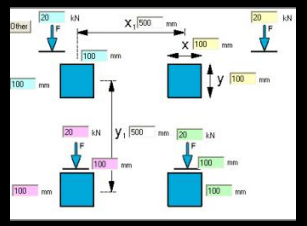
FLOOR DESIGNING- MOMENT CALCULATION: INFINITE ELEMENT ANALYSIS

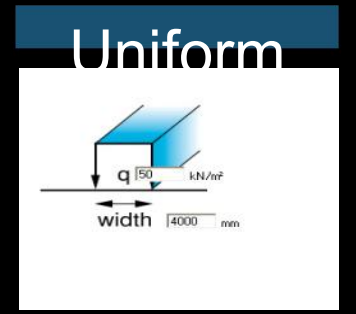
Performance of a floor depends on design specification and techniques used in its construction:

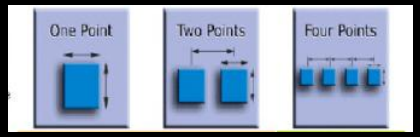
REQUIREMENT OF INDUSTRIAL & WAREHOUSE FLOOR:-

- **THICKNESS OF SLAB**
- **CONCRETE MIX DESIGN**
- **REINFORCEMENT: REBAR, STEEL FABRIC/MESH, MACROSYNTHETIC FIBER- PP/STEEL:** Floor should remain serviceable assuming plant maintenance and no gross misuse or overloading
- **LOAD:** Static point loads, uniformly distributed loads and dynamic loads without unacceptable deflection cracking settlement or damaged to joints.
- **JOINTS: JOINT SHOULD BE A ROBUST IN BOTH DESIGN AND CONSTRUCTION**
- Joint layouts (should take into account the location of racking legs or mezzanine floor columns).
- Joints detailing for minimise the risk of cracking.
- **SURFACE REGULARITY: FLOOR TOLERANCE**
- **FLOOR SURFACE REQUIREMENT**: suitable abrasion, chemical, slip resistance.
- **APPEARANCE-**The floor should have required type of finish









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DESIGN REQUEST FORM

Total area: _____ m^2 Remarks: _____

Please fill out the form as much as possible and send it back so that can make the best structural design for you.

1. System information

Slab type: _____ Construction: _____ Design type: _____

Topping material
Type: _____
Thickness: _____ mm

Insulation under slab
Type: _____
Thickness: _____ mm

Separation sheet (PE): _____
Operational temperature: _____

Original concrete class: _____
Original slab thickness: _____ mm

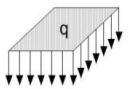
Original designed reinforcement
Type: _____ MPa

Upper reinforcement area: _____ m
Lower reinforcement area: _____ m

2. Ground condition

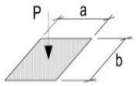
Westergaard modulus *K*: _____ MPa/m California Bearing Ratio CBR: _____ %

3. Loadings



3.1. Uniform loading

Load q: _____ kN/m^2
*Safety factor: _____

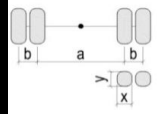


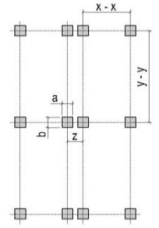
3.2. Concentrated single load

Load P: _____ kN
Dimensions a x b: _____ mm
Distance to neighboring loads: _____
*Safety factor: _____

3.4. Fork lift load

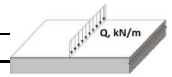
Total weight: _____ kN
Axle load: _____ kN
Wheels per axle: _____
Wheel spacing: _____ mm
Contact pressure: _____ MPa
Daily passed: _____
Vehicle speed: _____ km/h
Ground contact x _____ y _____
*Safety factor: _____





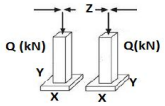
3.3. Racking system load

Back to back: _____ k
Base plate a x b: _____ m
Distance x-x: _____ m
Distance y-y: _____ m
Distance z: _____ m
Aisle width: _____ m
*Safety factor: _____



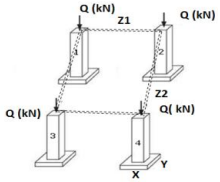
3.5. Line load

Load q: _____ kN
*Safety factor: _____



3.6. Dual Point load

Load from shelf leg: _____ k
Base plate x x y: _____ m
Distance z: _____ m
*Safety factor: _____



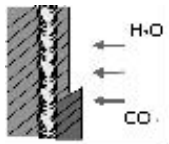
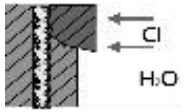
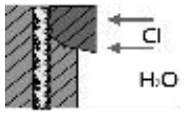
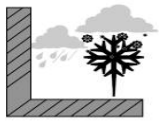
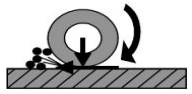
3.7. Quadruple(four) Point load

Load on each leg: _____ kN
Base plate x x y: _____ mm
Distance Z_1: _____ mm
Distance Z_2: _____ mm
*Safety factor: _____

4. Concrete design details

Please fill out the form as much as possible and send it back so that can make the best estimation for you.

4.1. Exposure

Type	Description of environment		Exposure class	
1. No risk of corrosion or attack		Very dry, no concrete attack	XO	☐
2. Corrosion induced by carbonation		Dry or permanently wet	XC1	☐
		Wet, rarely dry	XC2	☐
		Moderate humidity	XC3	☐
		Cyclic wet and dry	XC4	☐
3. Corrosion induced by chlorides other than from sea water		Moderate humidity	XD1	☐
		Wet, rarely dry	XD2	☐
		Cyclic wet and dry	XD3	☐
4. Corrosion induced by chlorides from sea water		Moderate humidity	XS1	☐
		Wet, rarely dry	XS2	☐
		Cyclic wet and dry	XS3	☐
5. Freeze/thaw attack with or without de-icing		Moderate water sautration, without de-icing agents	XF1	☐
		Moderate water saturation, with de-icing agents	XF2	☐
		High water saturation, without de-icing agents	XF3	☐
		High water saturation, with de-icing agents	XF4	☐
6. Chemical attack		Slightly aggressive chemical environment	XA1	☐
		Moderately aggressive chemical environment	XA2	☐
		Highly aggressive chemical environment	XA3	☐
7. Mechanical attack		Moderate wear	XM1	☐
		Severe wear	XM2	☐
		Very severe wear	XM3	☐

Additional description (For example: concrete under cover but exposed to temperature variations)

4.2. Strength class desired by client: _____

4.3. Placement details

Anticipated method
☐ Truck ☐ Pump ☐ Dumper ☐ Other _____

Exposure during placement
☐ Indoor ☐ Outdoor, Night ☐ Outdoor, Day ☐ Cold weather (< 5 ˚C) ☐ Hot weather (>25 ˚C)

4.4. Specified flatness tolerances: _____

DESIGN OUTPUT

EXPERIVA ENGINEERING PVT LTD T1 T2, MANISH PLAZA, PLOT N0-VII, SECTOR-10, DWARKA, NEW DELHI-10075 INDIA	Project: VALUE SPACES ESTATES PVT LTD, 202-B, CORPORATE				Job Ref.: POLIVAKKAM	
	Section: VSA DEL EEPL 2425 08062024 DESIGN				Sheet no./rev.: 4	
	Calc. by: VIKRAM	Date: 18-06-2024	Chk'd by: VIKRAM	Date: 18-06-2024	App'd by: VIKRAM	Date: 18-06-2024

Loading width	l_w = **150**mm
Distance x	x = **300**mm
Permanent load	G_k = **70.0** kN
Variable load	Q_k = **0.0** kN
Dynamic load	D_k = **0.0** kN

Contact radius ratio

Equivalent contact radius ratio	$a = [((2 \times [(l_l \times l_w) / \pi]^{0.5} \times x) + (l_l \times l_w)) / \pi]^{0.5}$ = **152.7** mm
Radius ratio	a / l = **0.220**

Ultimate capacity under dual internal concentrated loads

For a/l equal to 0 (Eqn. 21)	$P_{u\_0} = 2 \times \pi \times (M_p + M_n)$ = **149.5** kN
For a/l equal to 0.2 (Eqn. 22)	$P_{u\_0.2} = 4 \times \pi \times (M_p + M_n) / [1 - (a / (3 \times l))]$ = **322.6** kN
Thus for a / l equal to 0.220	$P_u = \min(P_{u\_0.2}, P_{u\_0} + (P_{u\_0.2} - P_{u\_0}) \times (a / (l \times 0.2)))$ = **322.6** kN

Check ultimate load capacity of slab

Number of loads	N = **2**
Loading applied to slab	$F_{uls} = N \times ((G_k \times \gamma_G) + (Q_k \times \gamma_Q) + (D_k \times \gamma_D))$ = **168.0** kN
Utilisation	F_{uls} / P_u = **0.521**

PASS - Total slab capacity exceeds applied load

Punching shear at the face of the loaded area

Shear factor	$k_2 = 0.6 \times (1 - f_{ck} / 250N/mm^2)$ = **0.53**
Length of perimeter at face of loaded area	$u_0 = 4 \times (l_l + l_w)$ = **1200** mm
Shear stress at face of contact area	$v_{max} = 0.5 \times k_2 \times f_{cd}$ = **4.973** N/mm²
Maximum load capacity in punching	$P_{p,max} = v_{max} \times u_0 \times d$ = **740.0** kN
Utilisation	$F_{uls} / P_{p,max}$ = **0.227**

PASS - Total slab capacity in punching at face of loaded area exceeds applied load

Punching shear at the critical perimeter

Shear factor	$k_s = \min(1 + (200mm / d)^{0.5}, 2)$ = **2.00**
Minimum shear stress at 2d from face of load	$v_{Rd,c,min} = 0.035 \times k_s^{3/2} \times (f_{ck} / 1N/mm^2)^{0.5} \times 1N/mm^2$ = **0.524** N/mm²
Ratio of reinforcement by area in x-direction	$\rho_x = A_{s,prov} / d$ = **0.00152**
Ratio of reinforcement by area in y-direction	$\rho_y = A_{s,prov} / d$ = **0.00152**
Reinforcement ratio	$\rho_1 = (\rho_x \times \rho_y)^{0.5}$ = **0.00152**
Maximum shear stress at 2d from face of load	$v_{Rd,c} = \max(0.18 \times k_s / \gamma_c \times (100 \times \rho_1 \times f_{ck} / 1N/mm^2)^{1/3} \times 1N/mm^2, v_{Rd,c,min})$ = **0.524** N/mm²
Length of perimeter at 2d from face of load	$u_1 = 2 \times (x + l_l + l_w + 2 \times \pi \times d)$ = **2758** mm
Max. load capacity in punching at 2d from face	$P_p = v_{Rd,c} \times u_1 \times d$ = **179.2** kN
Utilisation	F_{uls} / P_p = **0.938**

PASS - Total slab capacity in punching at 2d from face of loaded area exceeds applied load

EXPERIVA ENGINEERING PVT LTD T1 T2, MANISH PLAZA, PLOT N0-VII, SECTOR-10, DWARKA, NEW DELHI-10075 INDIA	Project: VALUE SPACES ESTATES PVT LTD, 202-B, CORPORATE				Job Ref.: POLIVAKKAM	
	Section: VSA DEL EEPL 2425 08062024 DESIGN				Sheet no./rev.: 1	
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CONCRETE INDUSTRIAL GROUND FLOOR SLAB DESIGN

In accordance with TR34, 4th Edition 2013

Tedds calculation version 2.0.01

SLAB THICKNESS- 180MM, REINFORCEMENT- FABRIC 6MM WELDED WIRE MESH 150MMX150MMC/C, POINT LOAD-7KN AND UDL-7KN/M2

Design summary

Load 1 -Single internal 150 x 150 point load

Description	Unit	Provided	Required	Utilisation	Result
Slab capacity in flexure	kN	248.2	84.0	0.338	PASS
Shear at face	kN	370.0	84.0	0.227	PASS
Shear at 2d	kN	140.2	77.2	0.551	PASS

Load 2 -Dual internal 150 x 150 point load

Description	Unit	Provided	Required	Utilisation	Result
Slab capacity in flexure	kN	322.6	168.0	0.521	PASS
Shear at face	kN	740.0	168.0	0.227	PASS
Shear at 2d	kN	179.2	168.0	0.938	PASS

Load 3 -UDL 70 kN/m²

Description	Unit	Provided	Required	Utilisation	Result
Slab capacity in flexure	kN/m²	88.8	70.0	0.788	PASS

Load 4 -Single edge 150 x 150 point load

Description	Unit	Provided	Required	Utilisation	Result
Slab capacity in flexure	kN	149.0	84.0	0.564	PASS
Shear at face	kN	277.5	84.0	0.303	PASS
Shear at 2d	kN	79.8	69.8	0.875	PASS

Load 5 -Single corner 150 x 150 point load

Description	Unit	Provided	Required	Utilisation	Result
Slab capacity in flexure	kN	100.5	84.0	0.836	PASS
Shear at face	kN	370.0	84.0	0.227	PASS
Shear at 2d	kN	77.3	75.7	0.980	PASS

Load 6 -Dual edge 150 x 150 point load

Description	Unit	Provided	Required	Utilisation	Result
Slab capacity in flexure	kN	241.2	163.2	0.677	PASS
Shear at face	kN	740.0	163.2	0.221	PASS
Shear at 2d	kN	164.3	163.2	0.993	PASS

Slab details

Reinforcement type	Fabric
Concrete class	C28/35
Slab thickness	h = **180** mm
Characteristic strength of reinforcement	f_{yk} = **500** N/mm²
Diameter of reinforcement	ϕ_b = **6** mm
Spacing of reinforcement	s_s = **150** mm
Area of bottom steel provided	$A_{s,prov}$ = **188** mm²/m
Nominal cover	c_{nom_b} = **50** mm
Effective depth of reinforcement	d = h - c_{nom_b} - ϕ_b = **124** mm

Partial safety factors

Concrete (with or without fibre)	γ_c = **1.50**

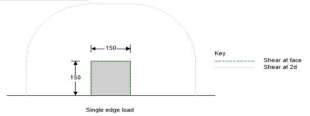
Maximum negative bending moment loading pattern

Working load capacity of UDL

UDL	U_k = **70.0** kN/m²
Critical aisle width	$l_{crit} = \pi / (2 \times \lambda_1)$ = **1529** mm
Loaded width of single UDL (max positive moment)	$l_{load\_p} = \pi / (2 \times \lambda_1)$ = **1529** mm
Loaded width of dual UDL (max negative moment)	$l_{load\_n} = \pi / \lambda$ = **3058** mm
Working load capcity of slab	$q = 5.95 \times \lambda^2 \times M_n$ = **88.8** kN/m²
Utilisation	U_k / q = **0.788**

PASS - Total slab capacity exceeds applied load

Load 4 - Single edge 150 x 150 point load



Single edge load

Loading length	l_l = **150**mm
Loading width	l_w = **150**mm
Edge distance y	e_y = **0**mm
Permanent load	G_k = **70.0** kN
Variable load	Q_k = **0.0** kN
Dynamic load	D_k = **0.0** kN

Contact radius ratio

Equivalent contact radius ratio	$a = [(l_l \times l_w) / \pi]^{0.5}$ = **84.6** mm
Radius ratio	a / l = **0.122**

Ultimate capacity under single edge concentrated loads

For a/l equal to 0 (Eqn. 23)	$P_{u\_0} = [\pi \times (M_p + M_n) / 2] + 2 \times M_n$ = **65.7** kN
For a/l equal to 0.2 (Eqn. 24)	$P_{u\_0.2} = [\pi \times (M_p + M_n) + 4 \times M_n] / [1 - (2 \times a / (3 \times l))]$ = **142.9** kN
Thus for a / l equal to 0.122	$P_u = \min(P_{u\_0.2}, P_{u\_0} + (P_{u\_0.2} - P_{u\_0}) \times (a / (l \times 0.2)))$ = **112.7** kN

Plate dowel shear capacity

Plate width	P_b = **100** mm

IGINEERING PVT LTD H PLAZA, PLOT N0-VII, /ARKA, NEW DELHI-10075 INDIA	Project: VALUE SPACES ESTATES PVT LTD, 202-B, CORPORATE				Job Ref.: POLIVAKKAM	
	Section: VSA DEL EEPL 2425 08062024 DESIGN				Sheet no./rev.: 10	
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of plate dowel	$A_v = 0.9 \times P_b \times t_p$ = **540** mm²
city of plate (Eqn 19)	$P_{sh,plate} = A_v \times 0.6 \times f_{yd,plate}$ = **70.4** kN
ng	x_l = **6** mm
f application of load from face of conc.	e = x_l / 2 = **3.0** mm
ompression factor	k_3 = **3**
b_1 (Appendix D)	$b_1 = 2 \times e \times k_3 \times f_{cd} \times P_b$ = **34** kN
c_1 (Appendix D)	$c_1 = 2 \times k_3 \times f_{cd} \times P_b^2 \times t_p^2 \times f_{yd,plate}$ = **8765** kN²
ing/bearing capacity (Eqn 19)	$P_{max,plate} = 0.5 \times [(b_1^2 + c_1)^{0.5} - b_1]$ = **32.9** kN

apacity

epth (6.5.3)	$d_{eff,d} = 0.75 \times d_{dowel}$ = **68** mm
or	$k_{s,d} = \min(1 + (200mm / d_{eff,d})^{0.5}, 2)$ = **2.00**
hear stress	$v_{Rd,c,d,min} = 0.035 \times k_{s,d}^{3/2} \times (f_{ck} / 1N/mm^2)^{0.5} \times 1N/mm^2$ = **0.524** N/mm²
ear stress taken by concrete	$v_{Rd,c,d} = \max(0.18 \times k_{s,d} / \gamma_c \times (100 \times \rho_1 \times f_{ck} / 1N/mm^2)^{1/3} \times 1N/mm^2,$ $v_{Rd,c,d,min})$ = **0.524** N/mm²
gth	$l_{l,d} = \min(8 \times t_p, P_l / 2 - x_l)$ = **44** mm
t 2 times the effective depth	$u_{1,d} = 2 \times (l_{l,d} + \pi \times d_{eff,d}) + P_b$ = **612** mm
oad per dowel to avoid bursting	$P_{burst,t} = v_{Rd,c,d} \times u_{1,d} \times d_{eff,d}$ = **21.6** kN
city	$P_{plate\_cap} = \min(P_{max,plate}, P_{sh,plate}, P_{burst,t}) / s_d$ = **48.1** kN/m
of aggregate transfer	P_{agg} = **15** %
ive edge capacity (cl.7.9.1)	$P_{u,total} = \min(P_u / (1 - P_{agg}) + P_{plate\_cap} \times 1.8 \times l, P_u / (1 - 0.5), 4 \times \pi \times (M_p +$ $M_n) / [1 - (a / (3 \times l))]) = 241.2$ kN

mate load capacity of slab

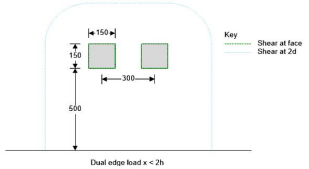
loads	N = **2**
plied to slab	$F_{uls} = N \times ((G_k \times \gamma_G) + (Q_k \times \gamma_Q) + (D_k \times \gamma_D))$ = **163.2** kN
	F_{uls} / P_{u_total} = **0.677**

EXPERIVA ENGINEERING PVT LTD T1 T2, MANISH PLAZA, PLOT N0-VII, SECTOR-10, DWARKA, NEW DELHI-10075 INDIA	Project: VALUE SPACES ESTATES PVT LTD, 202-B, CORPORATE				Job Ref.: POLIVAKKAM	
	Section: VSA DEL EEPL 2425 08062024 DESIGN				Sheet no./rev.: 9	
	Calc. by: VIKRAM	Date: 18-06-2024	Chk'd by: VIKRAM	Date: 18-06-2024	App'd by: VIKRAM	Date: 18-06-2024

Reinforcement ratio	$\rho_1 = (\rho_x \times \rho_y)^{0.5}$ = **0.00152**
Maximum shear stress at 2d from face of load	$v_{Rd,c} = \max(0.18 \times k_s / \gamma_c \times (100 \times \rho_1 \times f_{ck} / 1N/mm^2)^{1/3} \times 1N/mm^2, v_{Rd,c,min})$ = **0.524** N/mm²
Length of perimeter at 2d from face of load	$u_1 = l_l + l_w + e_x + e_y + \pi \times d$ = **1190** mm
Max. load capacity in punching at 2d from face	$P_p = v_{Rd,c} \times u_1 \times d$ = **77.3** kN
Ground reaction (cl.7.10.2)	$R_p = 1.4 \times (d / l)^2 \times F_{uls} + 0.47 \times (2 \times l_l + l_w) \times d \times F_{uls} / l^2$ = **8.3** kN
Total imposed shear load	$F_{uls\_total} = F_{uls} - R_p$ = **75.7** kN
Utilisation	F_{uls_total} / P_p = **0.980**

PASS - Total slab capacity in punching at 2d from face of loaded area exceeds applied load

Load 6 - Dual edge 150 x 150 point load



Dual edge load x < 2h

Loading length	l_l = **150**mm
Loading width	l_w = **150**mm
Distance x	x = **300**mm
Edge distance y	e_y = **500**mm
Permanent load	G_k = **68.0** kN
Variable load	Q_k = **0.0** kN
Dynamic load	D_k = **0.0** kN

Contact radius ratio

Equivalent contact radius ratio	$a = [((2 \times [(l_l \times l_w) / \pi]^{0.5} \times x) + (l_l \times l_w)) / \pi]^{0.5}$ = **152.7** mm
Radius ratio	a / l = **0.220**

Ultimate capacity under dual edge concentrated loads

For a/l equal to 0 (Eqn. 23)	$P_{u\_0} = [\pi \times (M_p + M_n) / 2] + 2 \times M_n$ = **65.7** kN
For a/l equal to 0.2 (Eqn. 24)	$P_{u\_0.2} = [\pi \times (M_p + M_n) + 4 \times M_n] / [1 - (2 \times a / (3 \times l))]$ = **153.9** kN
Thus for a / l equal to 0.220	$P_u = \min(P_{u\_0.2}, P_{u\_0} + (P_{u\_0.2} - P_{u\_0}) \times (a / (l \times 0.2)))$ = **153.9** kN

Plate dowel shear capacity

Plate width	P_b = **100** mm
Plate length	P_l = **100** mm
Plate thickness	t_p = **6** mm
Plate spacing	s_s = **450** mm
Characteristic strength of plate dowel	$f_{yk,plate}$ = **250** N/mm²
Design strength of plate dowel	$f_{yd,plate} = f_{yk,plate} / \gamma_s$ = **217** N/mm²

EXPERIVA ENGINEERING PVT LTD T1 T2, MANISH PLAZA, PLOT N0-VII, SECTOR-10, DWARKA, NEW DELHI-10075 INDIA	Project: VALUE SPACES ESTATES PVT L				Job Ref.	
	Section: VSA DEL EEPL 2425 08062024 D					
	Calc. by: VIKRAM	Date: 18-06-2024	Chi			
	VIKRAM	18-06-2024	VIKRAM	18-06-2024	VIKRAM	18-06-2024

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Reinforcement (bar or fabric)	γ_s = **1.15**
Permanent	γ_G = **1.20**
Variable	γ_Q = **1.50**
Dynamic loads	γ_D = **1.60**

Subgrade reaction

Modulus of subgrade reaction	k = **0.070** N/mm³

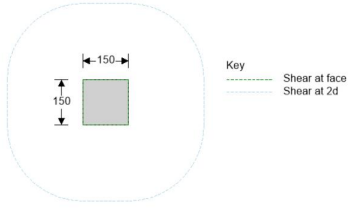
Concrete details - Table 6.1. Strength properties for concrete

Characteristic compressive cylinder strength	f_{ck} = **28** N/mm²
Characteristic compressive cube strength	f_{cu} = **35** N/mm²
Mean value of compressive cylinder strength	$f_{cm} = f_{ck} + 8$ N/mm² = **36** N/mm²
Mean value of axial tensile strength	$f_{ctm} = 0.3$ N/mm² $\times (f_{ck} / 1$ N/mm²$)^{2/3}$ = **2.8** N/mm²
Flexural tensile strength	$f_{cfd,fl} = f_{ctm} \times (1.6 - h / 1m) / \gamma_c$ = **2.6** N/mm²
Design concrete compressive strength (cylinder)	$f_{cd} = f_{ck} / \gamma_c$ = **18.7** N/mm²
Secant modulus of elasticity of concrete	$E_{cm} = 22$ kN/mm²$\times [f_{cm} / 10$ N/mm²$]^{0.3}$ = **32** kN/mm²
Poisons ratio	ν = **0.2**
Radius of relative stiffness (Eqn. 20)	$l = [E_{cm} \times h^3 / (12 \times (1 - \nu^2) \times k)]^{0.25}$ = **695** mm
Characteristic of system (Eqn. 33)	$\lambda = (3 \times k / (E_{cm} \times h^3))^{0.25}$ = **1.027** m⁻¹

Moment capacity

Negative moment capacity (Eqn. 2)	$M_n = M_{un} = f_{cfd,fl} \times (h^2 / 6)$ = **14.1** kNm/m
Positive moment capacity (Eqn. 3)	$M_p = M_{pfab} = 0.95 \times A_{s,prov} \times f_{yk} \times d / \gamma_s$ =**9.7** kNm/m

Load 1 - Single internal 150 x 150 point load



Single internal load

Loading length	l_l = **150**mm
Loading width	l_w = **150**mm
Permanent load	G_k = **70.0** kN
Variable load	Q_k = **0.0** kN
Dynamic load	D_k = **0.0** kN

Contact radius ratio

Equivalent contact radius ratio	$a = [(l_l \times l_w) / \pi]^{0.5}$ = **84.6** mm
Radius ratio	a / l = **0.122**

Perimeter at 2 times the effective depth	$u_{1,d} = 2 \times (l_{l,d} + \pi \times d_{eff,d}) + P_b$ = **612** mm
Maximum load per dowel to avoid bursting	$P_{burst,t} = v_{Rd,c,d} \times u_{1,d} \times d_{eff,d}$ = **21.6** kN
Plate capacity	$P_{plate\_cap} = \min(P_{max,plate}, P_{sh,plate}, P_{burst,t}) / s_d$ = **48.1** kN/m
Percentage of aggregate transfer	P_{agg} = **15** %
Total effective edge capacity (cl.7.9.1)	$P_{u,total} = \min(P_u / (1 - P_{agg}) + P_{plate\_cap} \times 1.8 \times l, P_u / (1 - 0.5), 4 \times \pi \times (M_p +$ $M_n) / [1 - (a / (3 \times l))]) = 100.5$ kN

Check ultimate load capacity of slab

Number of loads	N = **1**
Loading applied to slab	$F_{uls} = N \times ((G_k \times \gamma_G) + (Q_k \times \gamma_Q) + (D_k \times \gamma_D))$ = **84.0** kN
Utilisation	F_{uls} / P_{u_total} = **0.836**

PASS - Total slab capacity exceeds applied load

Punching shear at the face of the loaded area

Shear factor	$k_2 = 0.6 \times (1 - f_{ck} / 250N/mm^2)$ = **0.53**
Length of perimeter at face of loaded area	$u_0 = 2 \times (l_l + l_w)$ = **600** mm
Shear stress at face of contact area	$v_{max} = 0.5 \times k_2 \times f_{cd}$ = **4.973** N/mm²
Maximum load capacity in punching	$P_{p,max} = v_{max} \times u_0 \times d$ = **370.0** kN
Utilisation	$F_{uls} / P_{p,max}$ = **0.227**

PASS - Total slab capacity in punching at face of loaded area exceeds applied load

Punching shear at the critical perimeter

Shear factor	$k_s = \min(1 + (200mm / d)^{0.5}, 2)$ = **2.00**
Minimum shear stress at 2d from face of load	$v_{Rd,c,min} = 0.035 \times k_s^{3/2} \times (f_{ck} / 1N/mm^2)^{0.5} \times 1N/mm^2$ = **0.524** N/mm²
Ratio of reinforcement by area in x-direction	$\rho_x = A_{s,prov} / d$ = **0.00152**
Ratio of reinforcement by area in y-direction	$\rho_y = A_{s,prov} / d$ = **0.00152**

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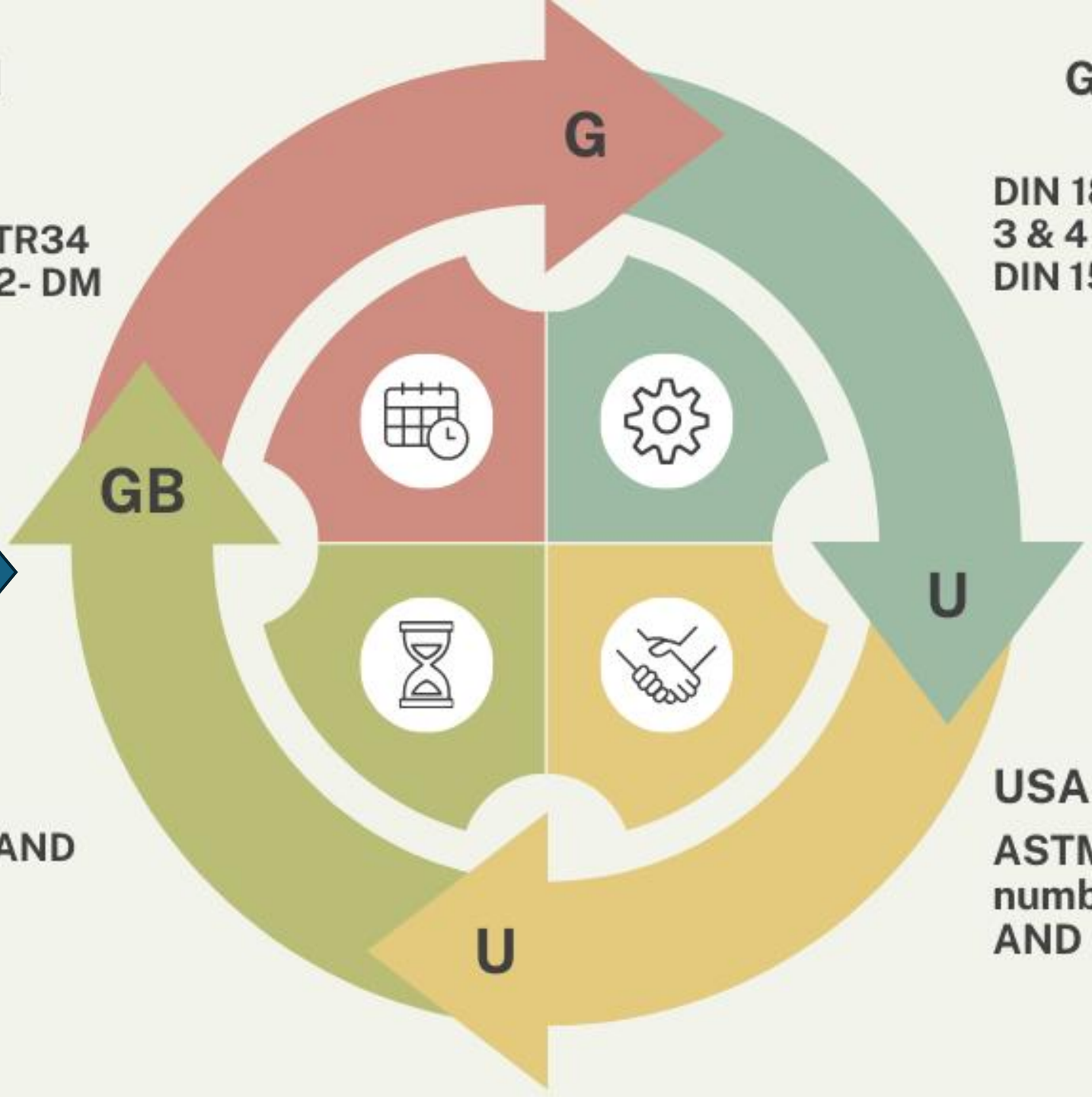
GREAT BRITAIN

Concrete Society's TR34
Table 3.1-FM and 3.2- DM

WORLDWIDE SURFACE REGULARITY BENCHMARKS: "Key Specifications"

USA

ACI 360, 360R-34 AND 302, 310.



GERMAN

DIN 18202 Table 3 Groups 3 & 4
DIN 15185 Tables 1 & 2

USA

ASTM E 1155 M – F numbers
AND F min numbers

DELIVERING EXCELLENCE: TR34 – 4TH EDITION "CONTRACTOR EXPERTISE"

FREE-MOVEMENT (FM) AREA:

- In free-movement areas, materials handling equipment (MHE) can move freely or randomly in any direction. These areas are commonly found in outlets, Industrial, warehouse, low-level storage zones(up to 13Mtrs) , marshalling areas, and food distribution centres.
- The FM criteria apply where trucks operate at lower levels, such as marshalling areas, block stacking zones, and aisles wider than 2.8 meters.
- FM2 Classification:
  This flooring classification is ideal for Industrial & Warehouse s/warehouses where reach trucks operate between 8 to 13 meters and + in height without a side shift.

Meeting Modern Surface Regularity Standards for Free Movement Floors

DELIVERING EXCELLENCE: TR34 – 4TH EDITION "CONTRACTOR EXPERTISE"

FREE-MOVEMENT (FM) AREA:

- In free-movement areas, materials handling equipment (MHE) can move freely or randomly in any direction. These areas are commonly found in outlets, Industrial, warehouse, low-level storage zones(up to 13Mtrs) , marshalling areas, and food distribution centres.
- The FM criteria apply where trucks operate at lower levels, such as marshalling areas, block stacking zones, and aisles wider than 2.8 meters.

FM2 CLASSIFICATION:

- This flooring classification is ideal for Industrial & Warehouse where reach trucks operate between 8 to 13 meters and + in height without a side shift.

TR34 4th Edition Table 3.1

Note *– Side shift is the ability of a truck to adjust the pallet transversely to the fork direction*

FM 1

WHERE VERY HIGH STANDARDS OF FLATNESS AND LEVELNESS ARE REQUIRED.
REACH TRUCKS OPERATING AT ABOVE 13M WITHOUT SIDE SHIFTS

PROPERTY "E"-4.5MM AND "F"-1.8MM

PROPERTY "E"-6.5MM AND "F"-2.0MM

FM 2

REACH TRUCKS OPERATING AT 8 – 13M WITHOUT SIDE SHIFTS.

FM 3

FLOORS TO TAKE DIRECTLY APPLIED FLOORING.
REACH TRUCKS OPERATING AT UP TO 8M WITHOUT SIDE SHIFT.
REACH TRUCKS OPERATING UP TO 13M WITH SIDE SHIFT.

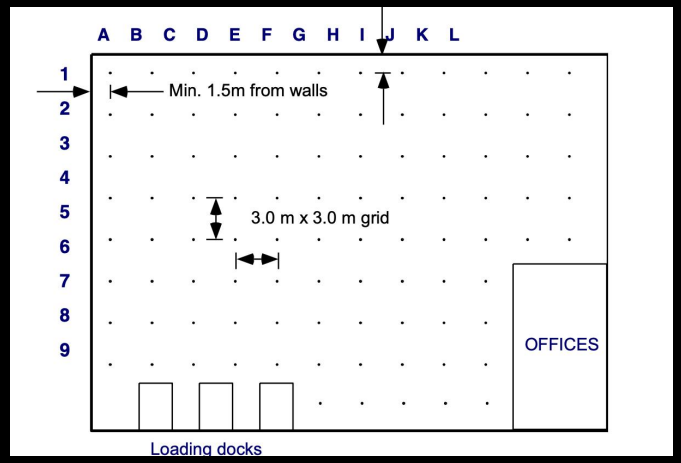
PROPERTY "E"-8.00MM AND "F"-2.2MM

PROPERTY "E"-10.00 MM AND "F"-2.8 MM

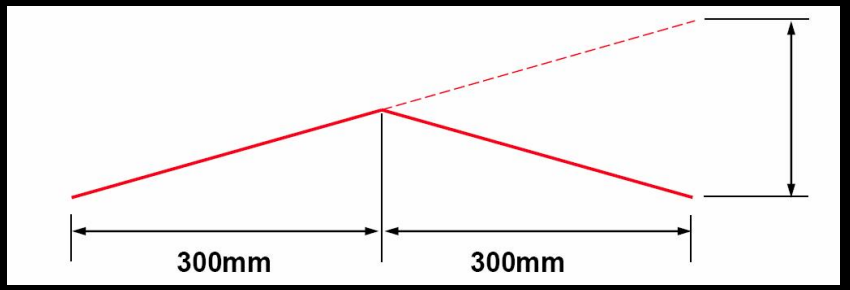
FM 4

FLOORS TO TAKE APPLIED SCREEDS.
WORKSHOPS AND MANUFACTURING FACILITIES WHERE MHE LIFT HEIGHTS ARE RESTRICTED TO 4M.

PROPERTIES E AND F



PROPERTY E: To control levelness, the elevational difference between two fixed points 3m apart, along with and across the floor.



PROPERTY F: The change in the elevational difference between two consecutive points of elevational difference (Property I) each measured over 300mm.

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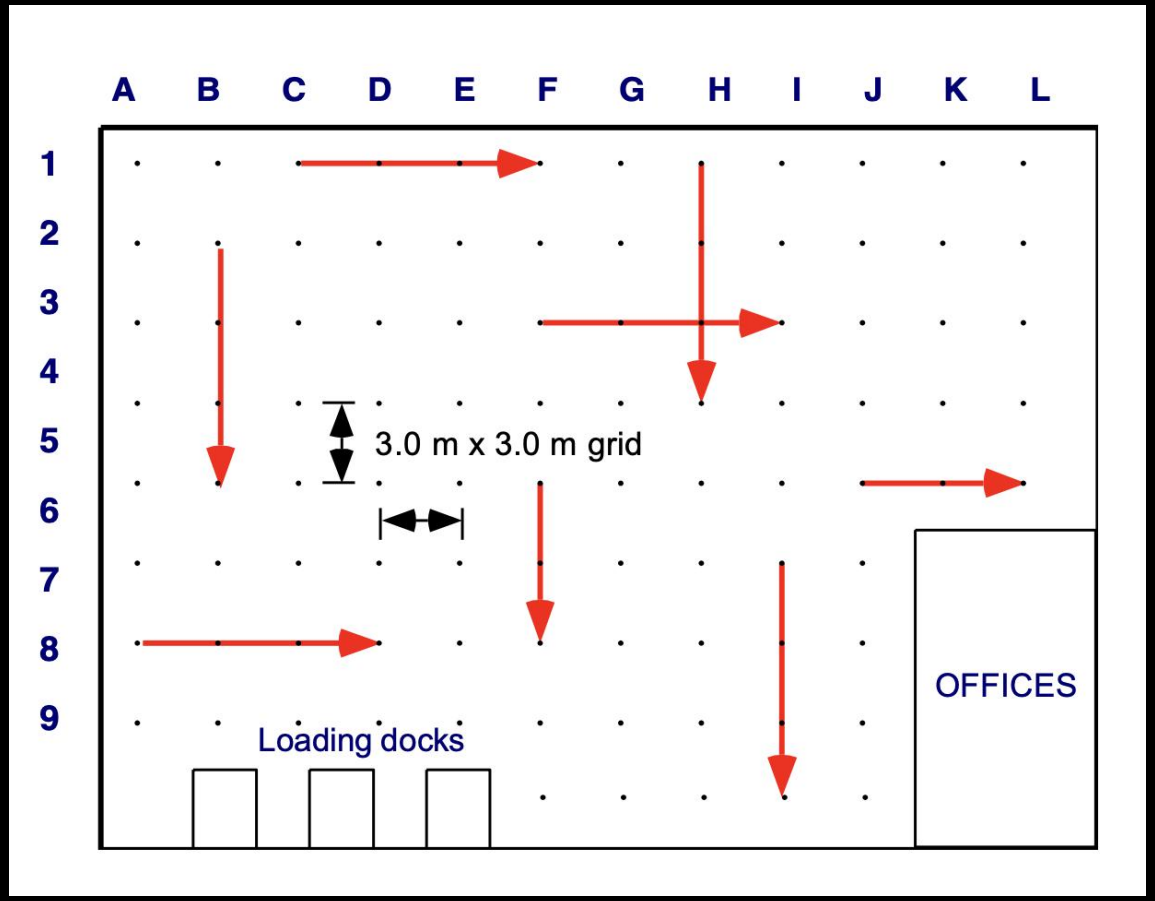
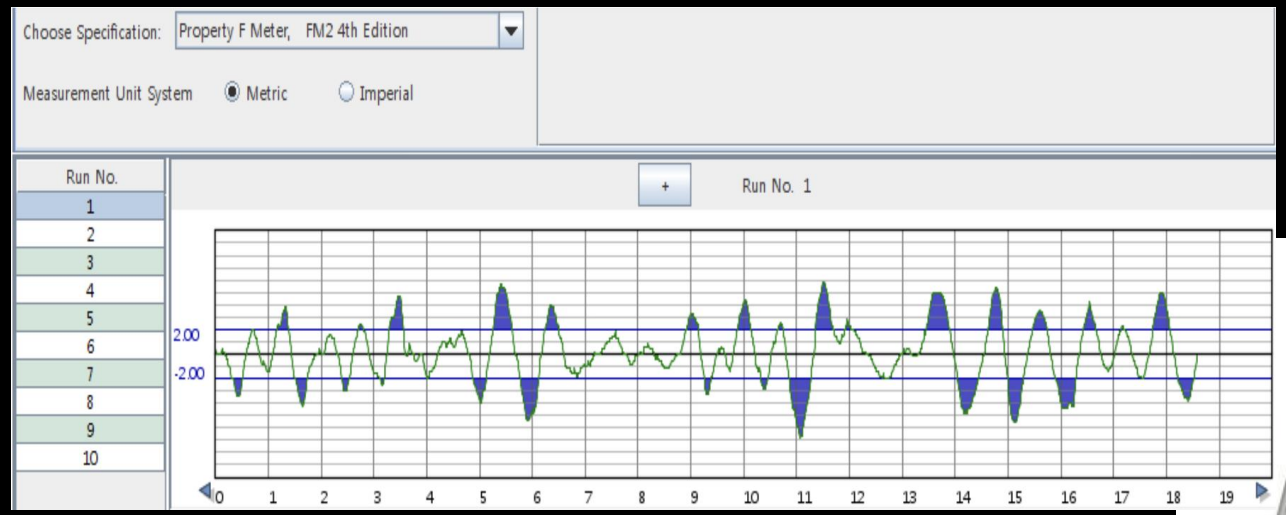
SURFACE REGULARITY FM - AS PER TR34 – 4TH EDITION

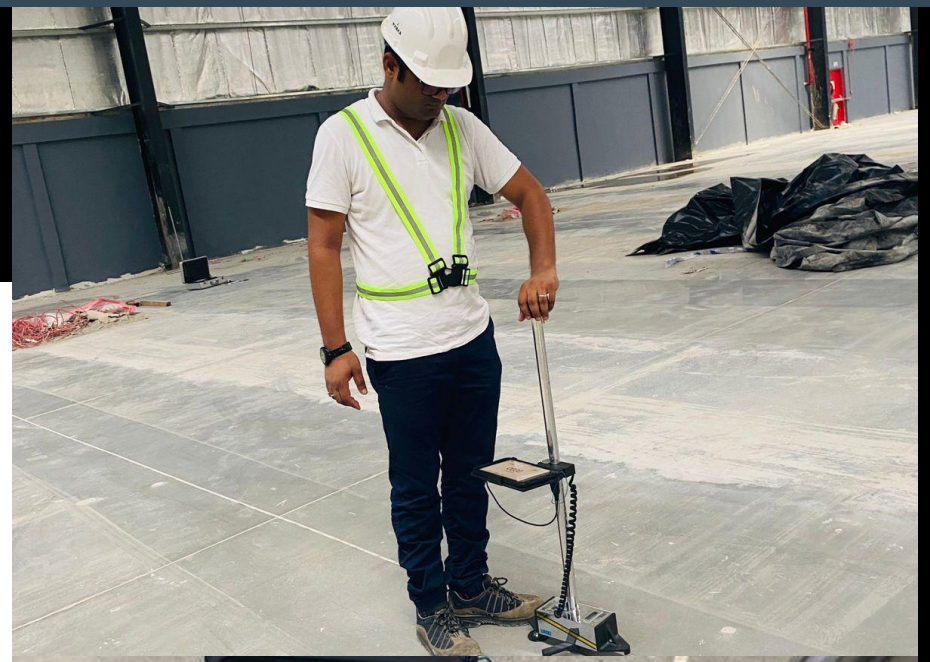
Using a Floor "Profile-o-meter" (Dip Stick)
Property II/F is measured as the rate of change in slope over a 600mm distance.

- **Prop II/F Meter Survey Method**
  The Prop II/F meter is simply run along sections of the floor at walking speed, automatically generating profiles for each of the straight-edge tests. As a guideline, the total length of the survey runs (L in meters) should be calculated by dividing the total floor area (A) by 10.
- **Example:**
  For a floor area of 30m x 30m = 900m^2,
  Total length of survey lines (L) = 900 ÷ 10 = 90 meters.
- Half of the total survey length should be run in one direction, with the other half performed at right angles to the first.

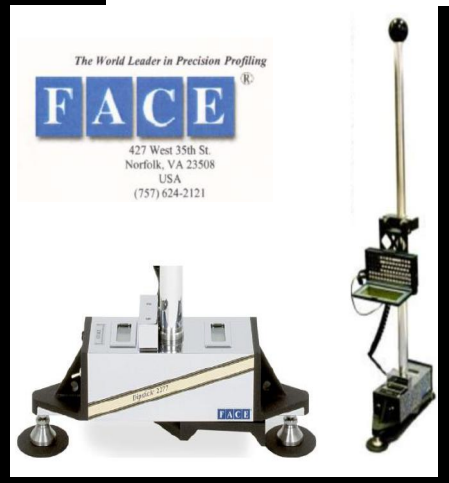


SURFACE REGULARITY FM - AS PER TR34 – 4TH EDITION





- **3rd Party Floor Survey (Optional):**
  A 3rd party floor survey should be conducted using a Floor Surveying Instrument – Digital Profileograph (Make: FACE Inc. USA Dipstick) and a Precise Parallel Plate Micrometer for free movement areas (FM-2), as per TR34 – 4th Edition Guidelines.
- **Note:**
  In case of an in-house survey, an EEPL surveyor will perform the survey and provide an analysis based on the TR34 – 4th Edition standards.
  The floor should be surveyed within one month of pouring, as specified by the guidelines.



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FREE MOVEMENT SURVEY SUMMARY: ANALYZING PROPERTIES E

In a free movement survey, the goal is to evaluate the surface regularity of a floor by analysing its compliance with the specified values for Properties E and F. The process involves calculating the 95th percentile, which represents the figure below which 95% of all the readings fall.

- **Compliance Check:** If the calculated 95th percentile figure is less than the permissible values outlined in the TR34 table for Properties E and F, the floor is considered compliant.
- **Datum Check:** Remember to include a datum check to ensure the consistency and reliability of the measurements.
- **Post-Survey Actions:**
  If the floor does not meet the Free Movement specifications, this must be monitored after the floor goes into service. Inaccessible rack storage positions and other areas requiring remediation will need localized correction as determined by the building's occupant.
- **Benefits of Flat and Level Floors:**
  A properly flat and level floor significantly contributes to reducing maintenance costs for material handling equipment, particularly trucks, by minimizing wear and tear.

POST POUR - LEVEL REPORT

Experiva Engineering Pvt Ltd
Corporate Office –
T1 & T2, Manish Plaza,
Plot No. 7, Sector-10,
Dwarka, New Delhi- 110078

PROJECT NAME:- INDOSPACE **DATE :-**

SITE DETAIL :- DHATIR VILLAGE, PALWAL
GRID LINE/PANEL NO. AS PER DRAWINGS:- PANEL No. AT GRID (3M X 3M):- 01

PROPERTY E

S. No.	A	B	C	D	E	F	G	H	I	J
1	-5	-3	-4	0	0	2	1			
2	-1	3	4	-2	-2	-2	-1			
3	1	5	2	3	-1	-1	0			
4	0	3	0	0	0	5	-2			
5	2	2	5	0	2	2	2			
6	2	0	2	0	2	2	2			
7	4	2	0	0	4	5	7			
8	2	5	3	4	5	2	3			
9	-3	2	-2	5	5	3	0			
10	1	4	3	4	3	1	2			
11	2	2	5	3	5	-2	-2			
12	0	2	5	2	0	-1	-2			
13	5	-1	-2	-3	-3	-3	-2			
14										
15										
16										
17										
18										

Down Check

S. No.	A	B	C	D	E	F	G	H	I	J
1	4	6	8	-2	-2	-4	-2			
2	2	2	-2	1	1	1	1			
3	-1	-2	-2	1	1	6	-2			
4	2	-1	5	2	2	-3	4			
5	0	-2	-3	0	0	0	0			
6	2	2	-2	2	2	3	5			
7	-2	3	3	1	1	-3	-4			
8	-5	-3	-5	0	0	1	-3			
9	4	2	5	-2	-2	-2	2			
10	1	-2	2	2	2	-3	-4			
11	-2	0	0	-5	-5	1	0			
12	5	-3	-7	-3	-3	-2	0			
13										
14										
15										
16										
17										
18										

Total Count	84
Values > 6.5	1
Values < -6.5	1

Cross Check

S. No.	A	B	C	D	E	F	G	H	I	J
1	2	-1	4	0	2	-1				
2	4	1	-6	0	0	1				
3	4	-3	1	-4	0	1				
4	3	-3	0	0	5	-7				
5	0	3	-5	2	0	0				
6	-2	2	-2	2	0	0				
7	-2	-2	0	4	1	2				
8	3	-2	1	1	-3	1				
9	5	-4	7	0	-2	-3				
10	3	-1	1	-1	-2	1				
11	0	3	-2	2	-7	0				
12	2	3	-3	-2	-1	-1				
13	-6	-1	-1	0	0	1				
14										
15										
16										
17										
18										

Total Count	78
Values > 6.5	1
Values < -6.5	2

SUMMARY

Cross Check		Down Check		Total	%age	Allowed for FM2
Total Points	78	Total Points	84	162		
Value > 6.5	1	Value > 6.5	1			
Value < - 6.5	2	Value < - 6.5	1			
Total	3		2	5	3.09%	5%

Method:
A 3m grid was set out. The optical level Sokia B 20 was set up using the datum used for setting the finished floor levels during the pour. Reading was then taken on the intersection point of the 3 m grid and recorded.

Survey Analysis:
The readings were transferred into an Excel spreadsheet and the elevation differences between adjacent points were calculated. This was first done by comparing all the readings vertically down the page to produce the down check sheet and then the readings horizontally across the page to produce cross-check sheet. The number of readings outside the specified tolerances was calculated.

Data Analysis and Permissible Limits:
The Property E data are analyzed and the 95 percentile value is calculated.

Note:
The 95 percentile value is the Property value below which 95% of the values will fall. Five percent of the values will be greater (≤ ±15mm of datum). The floor is non-compliant if the maximum permitted 95 percentile values are exceeded.

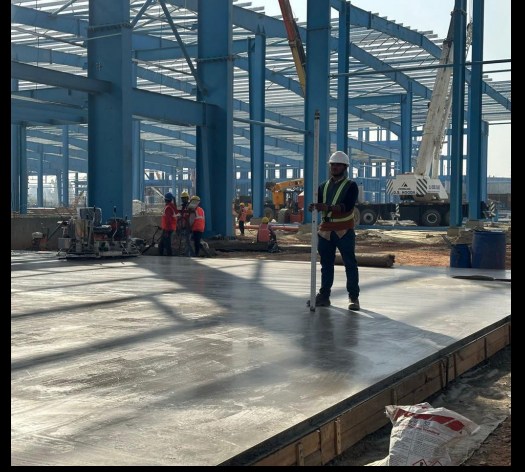
Result:
On average in the area surveyed, more than 95% of the readings complied with the 95% limit specified by TR34 4th Edition. We consider this a GOOD result when compared to the limits for Property E imposed by TR34 4th Edition.

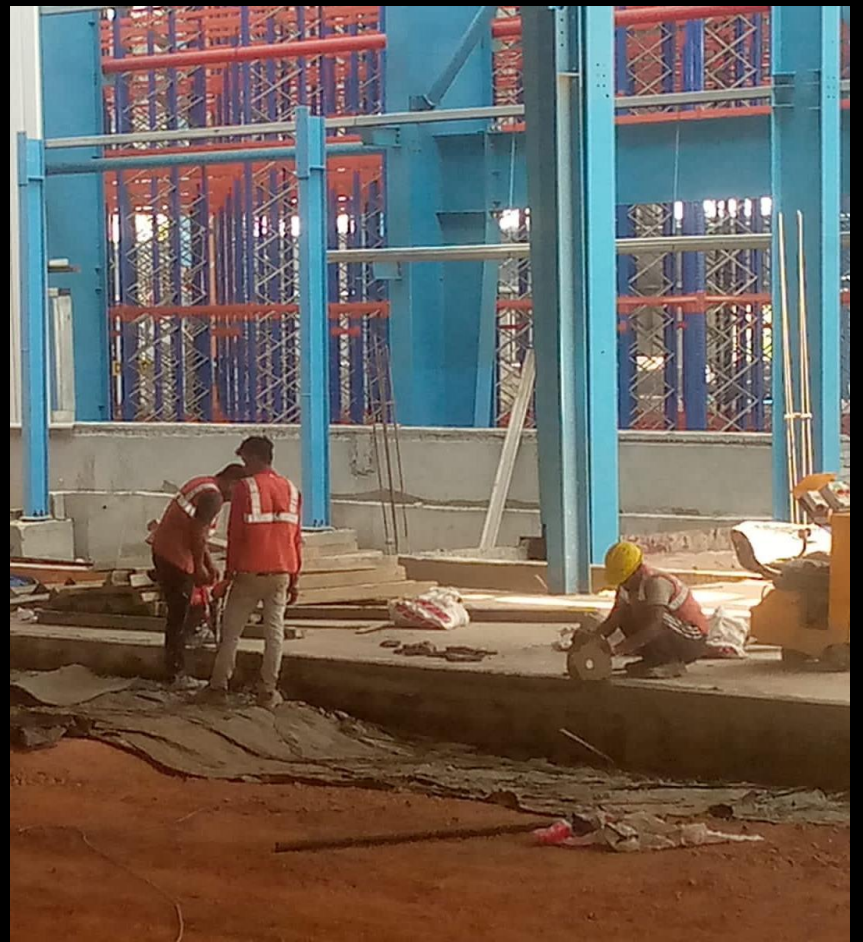
Conclusion:
THIS FLOOR PANEL COMPLIES WITH THE SPECIFICATION FM2 (PROPERTY E) AS PER TR-34 4TH EDITION.


LARSEN & TOUBRO CONSTRUCTION
BUILDING & FACTORIES,INDEPENDENT COMPANY
Grasim Paint Factory
HSIID (Industrial Area Division) Industrial Estate,Panipat Dist. Panipat (H.R.)

Level checklist

	0 m	3 m	6 m	9 m	12 m	15 m	18 m	21 m	24 m	27 m
0m	+0.5	-2	-0.5	-1.5	0	-2	0			
3m	0	+2	+1	0	-0.5	+2	-1			
6m	-1	0	0	0	-1	-2	0			
9m	0	-1	-2	0	-3	0	0			
12m	0	+1.5	-1	0	+1	-3	0			
15m	-2	0	-1	0	-0.5	-1	0			
18m	-1	-2	0	0	-1	+1	0			
21m	-0.5	-2	-0.5	-1.5	0	-1	+2			
24m										
27m										
30m										
33m										





PRECISION IN EVERY SQM: FM-1 FLOORING AT GRASIM PAINTS, PANIPAT, HARYANA

We had the opportunity to execute **FM-1 flooring** using our state-of-the-art **laser screed machine** for the **Grasim Paints project in Panipat**, covering a massive **40,000 sqm with slab depth of 350mm & 250mm**. As part of a collaborative effort with the main contractor, **L&T**, we ensured top-tier floor flatness and levelness, delivering a flooring solution that meets the highest industry standards for durability and precision.

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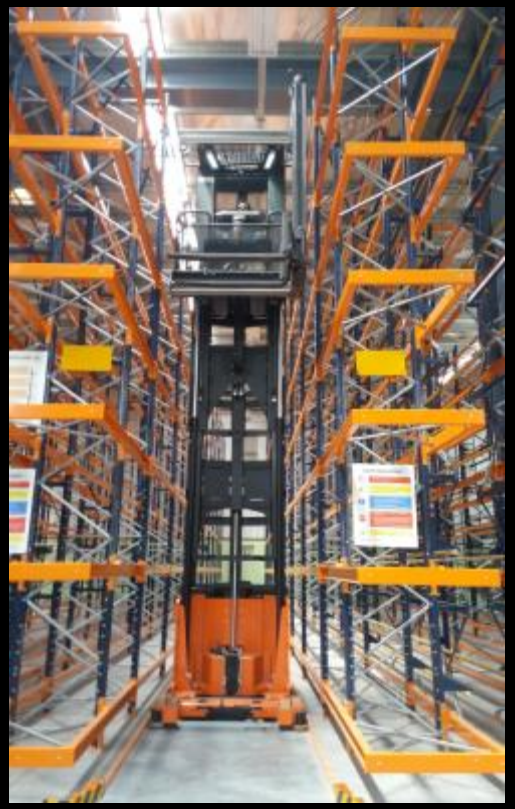
DM FLOOR-Surface Regularity DM - AS PER TR34 – 4th Edition



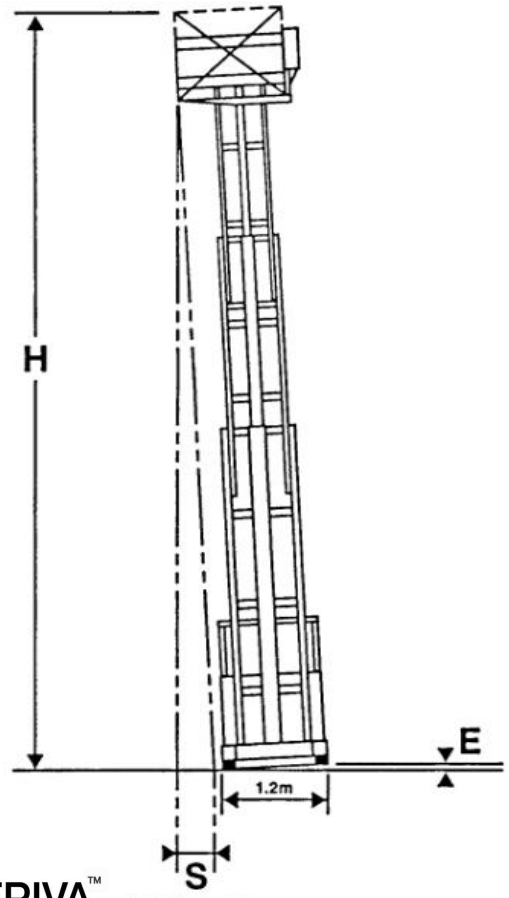
Defined Movement Areas (DM):

Defined Movement Areas are areas where Material Handling Equipment (MHE) follows specific, constrained paths. These systems typically involve wire-guided or rail-guided setups.
These areas are characterized by trucks being restricted to fixed, pre-defined routes, such as in Very Narrow Aisle (VNA) systems.

DEFINED MOVEMENT

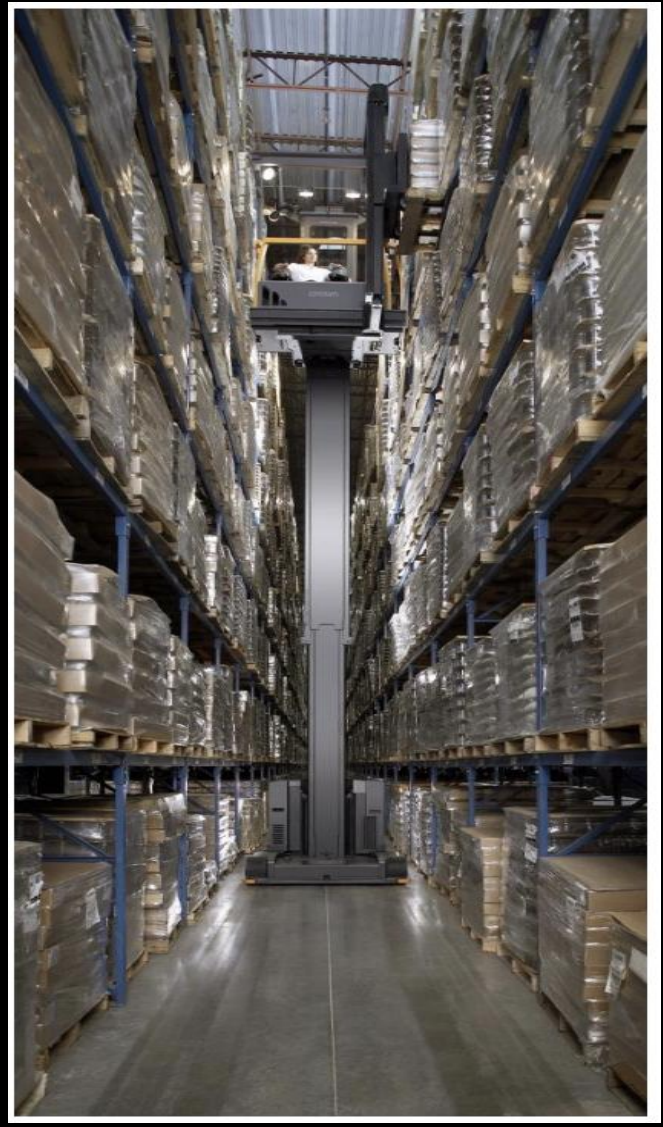
Understanding the need for a flat and level floor in a VNA application

STATIC LEAN TABLE



The table below shows the static lean 'S' of a fork lift truck assuming the mast is rigid. Due to the engineering tolerances in the mast and the dynamic force when the truck is moving this could increase the static lean by up to three times the figure shown.
The centre to centre distance between the load wheels of the fork lift truck is 1.2 metres.

Height of racking H (metres)	Difference in elevation between left and right hand fork truck load wheels E (mm)									
	3	4	5	6	7	8	9	10	11	12
6	15	20	25	30	35	40	45	50	55	60
6.5	16	22	27	33	38	43	49	54	60	65
7	18	23	29	35	41	47	53	58	64	70
7.5	19	25	31	38	44	50	56	63	69	75
8	20	27	33	40	47	53	60	67	73	80
8.5	21	28	35	43	50	57	64	71	78	85
9	23	30	38	45	53	60	68	75	83	90
9.5	24	32	40	48	55	63	71	79	87	95
10	25	33	42	50	58	67	75	83	92	100
10.5	26	35	44	53	61	70	79	88	96	105
11	28	37	46	55	64	73	83	92	101	110
11.5	29	38	48	58	67	77	86	96	105	115
12	30	40	50	60	70	80	90	100	110	120
12.5	31	42	52	63	73	83	94	104	115	125
13	33	43	54	65	76	87	98	108	119	130



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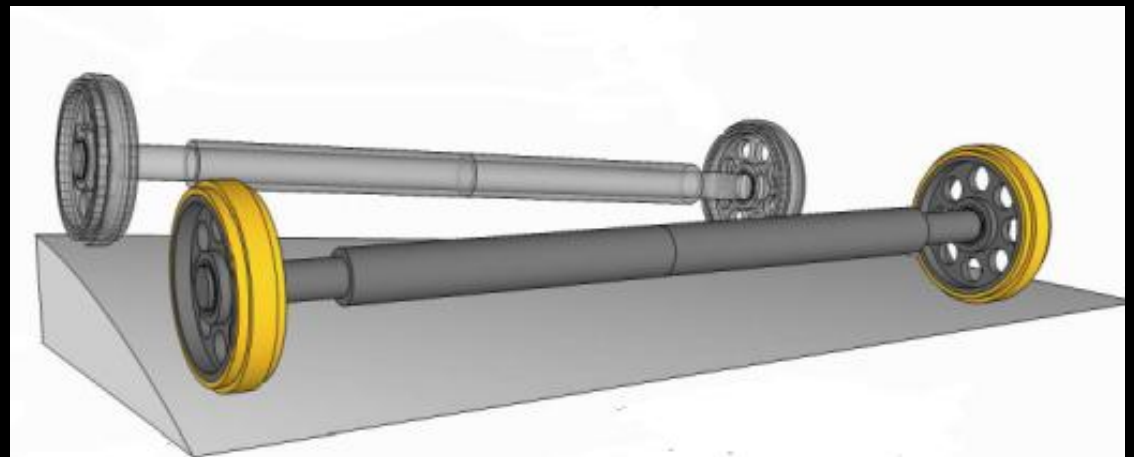
TR34 (FOURTH EDITION) DM AREAS



		Z slope	dZ	d^2Z	dX	d^2X
Floor classification	MHE Lift Height (metres)	mm per m	Transverse elevational difference unit value – mm per m of front axle length Z.	Transverse rate of change for each 300mm of forward travel Fixed % of Property A value	Longitudinal elevational difference unit value – 2m x Z slope x 1.1	Longitudinal change in elevational difference for each 300mm of forward travel (mm) = A
DM 1	Over 13	1.3	Z x 1.3	75% dZ	2 x 1.3 x 1.1	1.3
DM 2	8 to 13	2.0	Z x 2.0	75% dZ	2 x 2.0 x 1.1	2.0
DM 3	Up to 8	2.5	Z x 2.5	75% dZ	2 x 2,5 x 1.1	2.5

TR34 4th Edition Table 3.2 EN 15620

Two properties are considered to evaluate the surface regularity of DM areas.

- **Property dZ: The elevational difference in mm between the centers of the truck front wheels.**
- **Property dX: The elevational difference in mm between the center of the front axle and the centre of the rear axle**

The data collected is used to produce two differential graphs

Transverse graph checks:
Property dZ
Property d^2Z

Longitudinal graph checks:
Property dX
Property d^2X

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FOR **DM (DEFINED MOVEMENT)** WE MUST CONSIDER THE PROPERTIES **dZ AND dX.**

Floor Classification	Racking top beam height	Property Z_{SLOPE}	Property dZ	Property d^2Z	Property dX	Property d^2X
Calculation	-	mm per m	$Z \times Z_{SLOPE}$	dZ x 0.75	Fixed Values $2 \times Z_{SLOPE} \times 1.1$	Fixed Values
DM 1	Over 13m	1.3	Z x 1.3	Z x 1.0	2.9	1.5
DM2	8 – 13m	2.0	Z x 2.0	Z x 1.5	4.4	2.0
DM3	Up to 8m	2.5	Z x 2.5	Z x 1.9	5.5	2.5

Property Z: The transverse dimension between the centres of the truck front wheels, in mm.

Property X: The longitudinal dimension between the centre of the front and rear truck axles. This is taken to be a fixed 2m.

Property Z_{SLOPE}: The cross-aisle slope between the centres of the truck front wheels in mm/m.

Property dZ: The elevational difference in mm between the centres of the truck front wheels.

Property dX: The elevational difference in mm between the centre of the front axle and the centre of the rear axle.

Property d^2Z: The change in dZ in mm over a forward movement of 300mm along the wheel tracks.

Property d^2X: The change in dX in mm over a forward movement of 300mm along the wheel tracks.

CONTRACTOR: ART LINES CONTRACTING CO. LLC

SOG DETAILS: DM -1 FLOOR

- Client: M/s Indus Kishore Logistics DWC LLC
- Slab Depth- 175 mm
- SFRC Concrete
- Location: JAFZA DUBAI

SURFACE REGULARITY DM - AS PER TR34 – 4TH EDITION

- **Long Strip Construction: The Proven Method for TR34 Superflat Concrete Floors**
- The long strip method is the traditional and most effective approach for constructing TR34 superflat concrete floors, particularly for Very Narrow Aisle (VNA) warehouse applications. No other construction method can achieve the precise tolerances required for these floors without significant remedial work.
- When quality and precision are essential for defined traffic areas, choose long strip construction—a reliable, proven solution with no risk!

Surface Regularity DM - AS PER TR34 – 4th Edition

- **Oblique Saw Cutting in Concrete Flooring:**
- **Purpose:**
  - In Defined Movement (DM) areas, oblique saw cuts are made to prevent both the front and rear wheels of Material Handling Equipment (MHE) from crossing the joint simultaneously.
- **Angle of the Cut:**
  - The saw cuts are made at an angle, typically between 15° to 90°, to ensure smooth transitions for MHE.
- **Joint Positioning:**
  - The 15° oblique angle is designed so that only one set of wheels (either front or rear) crosses the joint at a time, preventing rocking or movement of the MHE.
- **Wheel Diameter Consideration:**
  - The angle and distance between joints are determined based on the diameter of the MHE wheels, ensuring that one side moves ahead by at least one full revolution before the next side encounters the joint.
- **Application:**
  - This technique is particularly effective in DM areas, where precise wheel paths are required (e.g., VNA applications). For Free Movement (FM) areas, such precise cutting is not required as MHEs approach joints at varying angles.

INDUSTRIAL & WAREHOUSE-FLOOR WORK METHODOLOGY

- "TR34-compliant Industrial & Warehouseflooring prioritizes durability and safety, meeting rigorous standards for load-bearing capacity and abrasion resistance. These robust designs ensure enhanced productivity and safety in Industrial & Warehousesettings.” We fully adhere to the guidelines.

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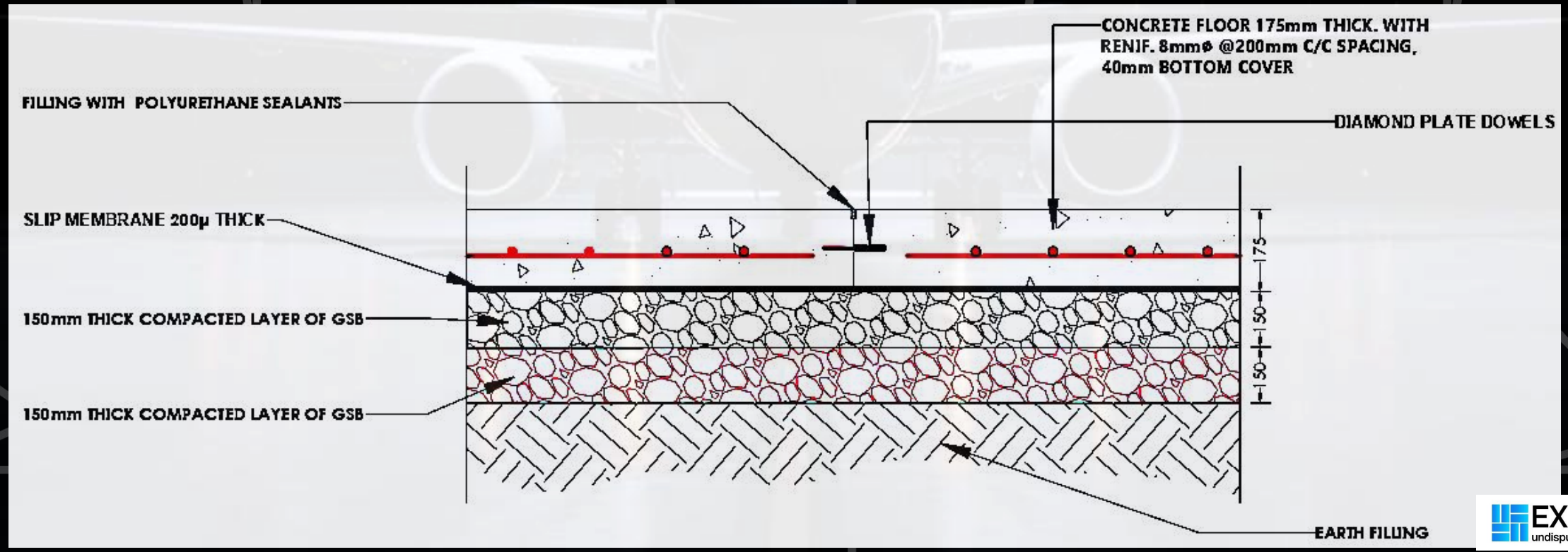
Site Evaluation and Soil Analysis

- **Subsurface Investigation:**
- Conduct a thorough subsurface investigation to understand soil composition and characteristics.
- Identify any potential challenges such as expansive soils or poor load-bearing capacity.
- **Soil Bearing Capacity:**
- Determine the bearing capacity of the soil to ensure it can support the intended loads.
- •Consider factors like soil type, compaction, and moisture content in the evaluation.
- **Site Slope and Drainage:**
- Assess the site slope and implement proper drainage measures to prevent water accumulation.
- Addressing drainage issues is crucial for maintaining the stability of the slab over time.

Sub-base Option-I (with 2-Layers of GSB)



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SUB BASE

Grading of GSB Material Grade II as per MoRTH

IS Sieve Designation	Percent by Weight Passing the IS Sieve (Grade II)
75 mm	-
53 mm	100
26.5 mm	70-100
9.50 mm	50-80
4.75 mm	40-65
2.36 mm	30-50
0.85 mm	-
0.425 mm	10-15
0.075 mm	<5

Sub-base Compaction:

- The sub-base material should be spread in uniform layers across the entire width.
- Granular material must be free from organic or harmful substances.
- GSB (Granular Sub-Base) is laid in layers of 150 mm thickness, compacted while maintaining moisture control.
- Compaction is typically done using a Vibro compactor or a smooth-wheeled roller, weighing between 80 to 100 kN.
- Rolling starts from the lower edge and moves towards the upper edge, continuing until 98% of the maximum dry density is achieved.
- The effective "k" value (ground reaction modulus) over the GSB layer must be determined by conducting a plate load test on-site.

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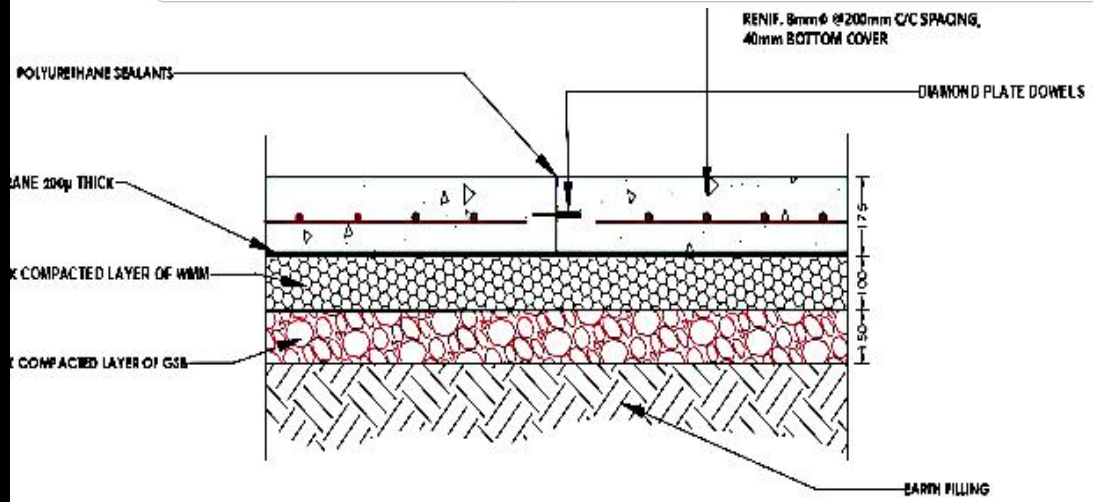
SUB-BASE – OPTION-II
(with Single Layer of GSB & Single Layer of WMM)

Wet Mix Macadam (WMM):

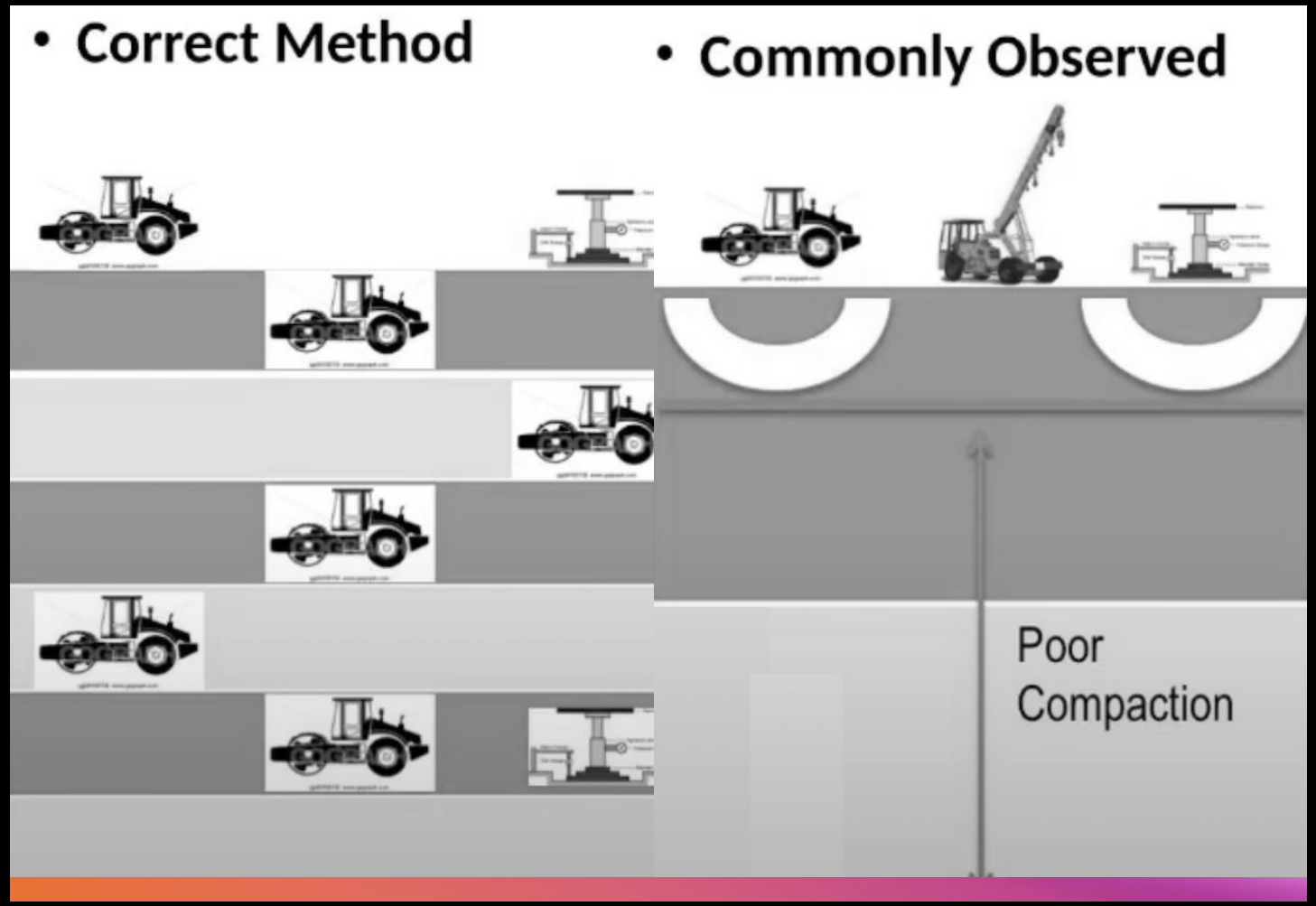
- Constructed as a subbase in accordance with Clause 406 of MoRTH Specification for Road and Bridgeworks.
- Thickness of a single compacted Wet Mix Macadam layer should be no less than 75mm when vibrating.
- Aggregate should satisfy the grading requirement as per MoRTH table 400-13.
- Wet Mix Macadam should be prepared in an approved mixing plant of suitable capacity with controlled water addition and forced mixing arrangement (e.g., pugmill).
- The mix should be spread using a paver finisher.
- In exceptional cases where mechanical means like a motor grader are not available, alternative methods may be used.

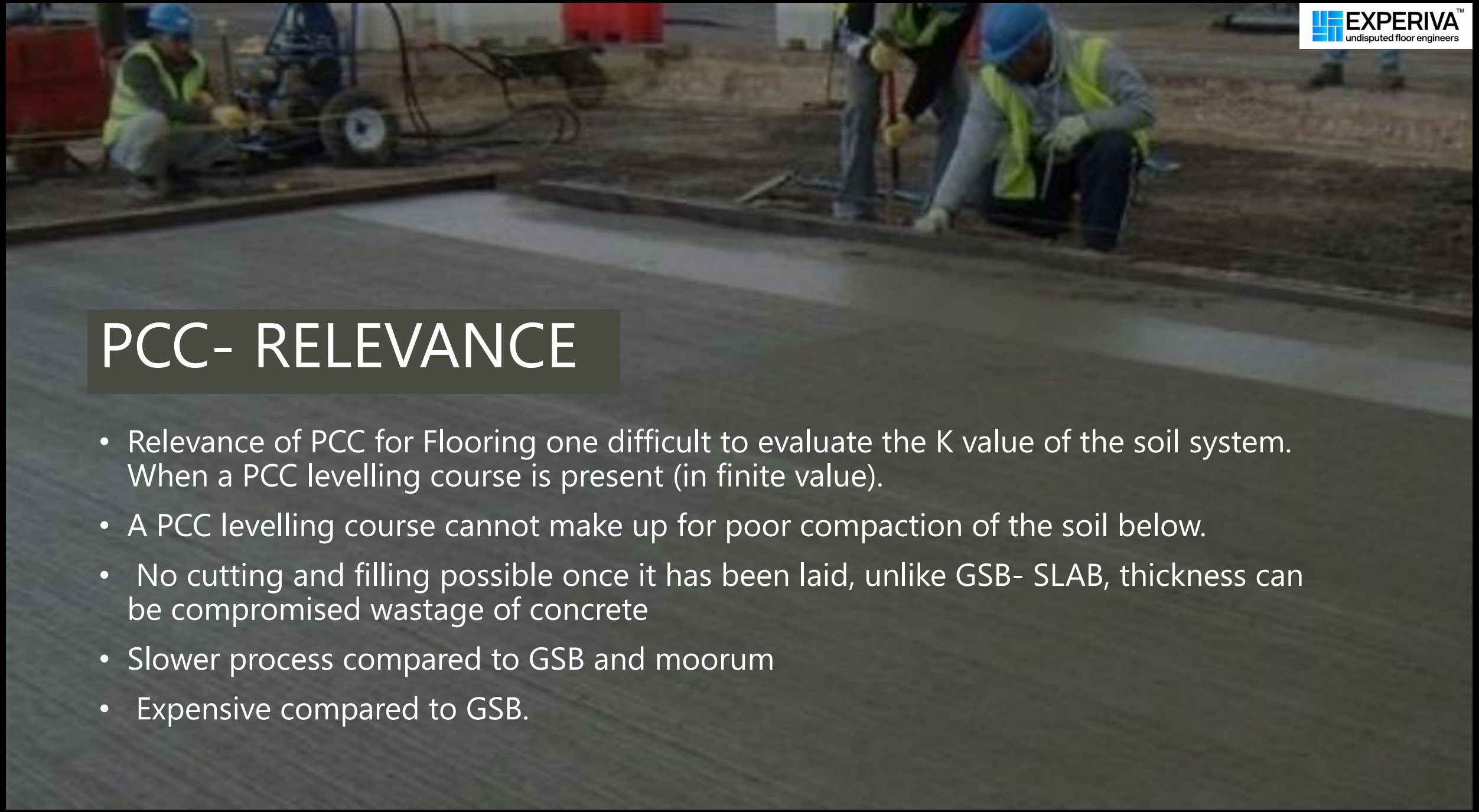
IS Sieve Designation	Percent by Weight Passing the IS Sieve
53 mm	100
45 mm	95-100
26.5 mm	-
22.4 mm	60-80
11.2 mm	40-60
4.75 mm	25-40
2.36 mm	15-30
0.6 mm	8-22
0.075 mm	0-5



COMPACTION

- **Point to be Consider**
- Lift Hight
- Type of Roller
- Watering
- Testing type
- Test Frequency
- Walls and columns





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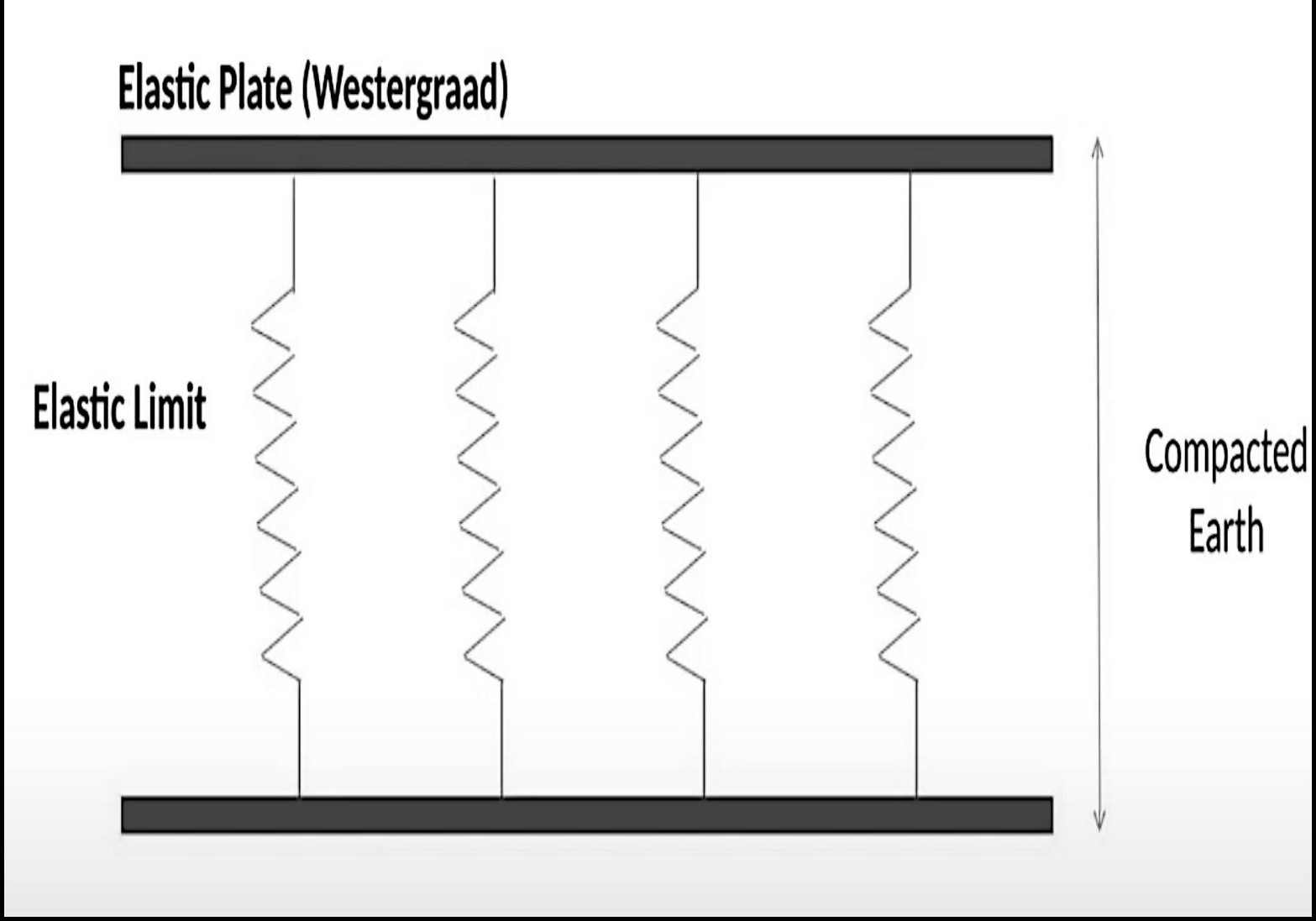
PCC- RELEVANCE

- Relevance of PCC for Flooring one difficult to evaluate the K value of the soil system. When a PCC levelling course is present (in finite value).
- A PCC levelling course cannot make up for poor compaction of the soil below.
- No cutting and filling possible once it has been laid, unlike GSB- SLAB, thickness can be compromised wastage of concrete
- Slower process compared to GSB and moorum
- Expensive compared to GSB.

SOIL IS SIMPLIFIED AS A SPRING



K Value of this soil simplified as a spring

The K value is also known as Modulus of Sub Grade Reaction

3RD PARTY SUB-BASE TEST

PLATE LODE TEST: (FOR K VALUE)

•The strength of each GSB layer shall be evaluated by conducting a plate load test using 750mm dia. Plate as per IS 9214. Plate load test for (K) Value on sub-base to be conducted for frequency of one test for every 2500 sqm For Sub Base layer Under Slab.

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PLATE LOAD TEST TO DETERMINE K VALUE

- THE PLATE LOAD TEST IS A FIELD TEST, WHICH IS PERFORMED TO DETERMINE THE ULTIMATE BEARING CAPACITY OF THE SOIL AND THE PROBABLE SETTLEMENT UNDER A GIVEN LOAD.

EQUATION TO DETERMINE SOIL BEARING CAPACITY FOR CLAY FROM THE PLATE LOAD TEST.

- ***ULTIMATE BEARING CAPACITY = ULTIMATE LOAD FOR THE PLATE.***

  K= q/d

  K=spring constant

  q= allowable pressure

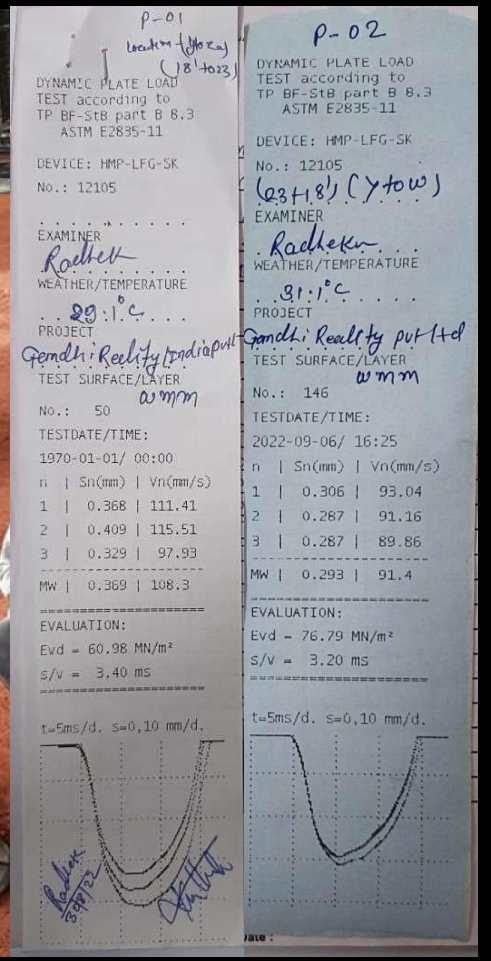
  d= Deflection

- WHEN A K-VALUE IS MENTIONED IN THE TEXT THIS IS ALWAYS THE K-VALUE OF **WESTERGAARD.**

- THE QUALITY OF THE SUB-BASE IS MEASURED USING A PLATE-BEARING TEST (PLATE DIAMETER = 760 MM) AND EXPRESSED AS A K-VALUE (N/MM^3).

COMPACTION TEST BY- LIGH WEIGHT DEFLECTOMETER: DYNAMIC PLATE LOAD TESTING- ASTM E2835

The **Light Weight Deflectometer (LWD)** plate is an essential tool for assessing soil compaction. It allows for examination of subsurface layers of soil, reaching depths of approximately **0.5 meters** using dynamic plate testing methods. This test is especially valuable for determining compaction values of sublayers in areas such as floors, foundations, and other embedded structures.



Key Notes:

- **Minimum Evd Value**: 50 MN/mm² to 55 MN/mm².
- **Testing Method**: ASTM E2835-11 (2015).

Significance:

This test method provides accurate measurement of plate deflection by applying an impulse load. It involves the use of a portable impulse plate load testing device, making it ideal for on-site evaluations.

Deliverables:

A **printed copy of the test results** is provided on-site immediately after the test is conducted.

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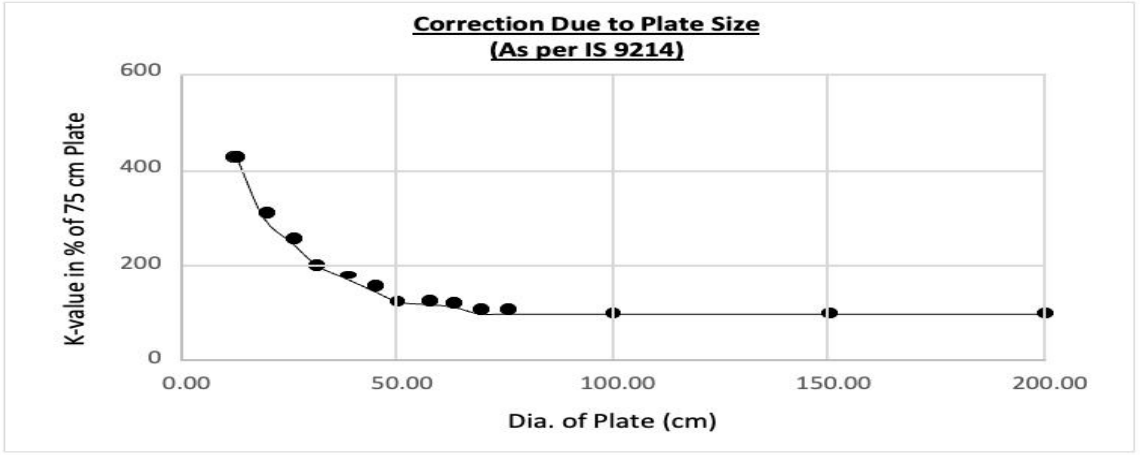
OBTAINING K VALUE FROM DYNAMIC DEFORMATION MODULUS PER SQM

Evaluation of the Modulus of Sub-grade Reaction (K-value) from Dynamic Deformation Modulus (Ev_d) obtained from Light Weight Deflectometer Test

Report No.
Site:
Ev_d Data Obtained from:

Test Point	Ev_d (MN/m²)	Co-relation Applicable	E_{V1}	Poisson's ratio (v)	$K_{300} = EV_1/300(1-v^2)$ MPa/mm	K_{750} (MPa/mm)
EVD-01	60.98	Evd/1.2	50.82	0.28	0.184	0.081
EVD-02	76.79	Evd/1.2	63.99	0.28	0.231	0.102
EVD-03	59.37	Evd/1.2	49.48	0.28	0.179	0.079
EVD-04	79.79	Evd/1.2	66.49	0.28	0.240	0.106
EVD-14	76.27	Evd/1.2	63.56	0.28	0.230	0.101

[Note: Ev_d = Dynamic Deformation Modulus (obtained from light weight deflectometer test)
Ev_1 = 1st Static Deformation Modulus (simulated)
K_{300} = Modulus of sub-grade reaction for 300 mm dia. plate
K_{750} = Modulus of sub-grade reaction for 750 mm dia. plate]



[Ref: "Characterisation of in situ soils based on the resilient soil modulus obtained using Light Weight Deflectometer (LWD)" - Barounis, N. & Smith, T. (2017)

IS 9214 : Method of Determination of Modulus of Subgrade Reaction (K-value) of Soil in Field

DIN 18134 : Soil Testing procedures and testing equipment - Plate load test.]

SUPERVISING SUB-BASE PREPARATION

Supervising Sub-base Preparation

- Ensure proper supervision during sub-base preparation, maintaining level tolerances of **+10 mm to -10 mm**.
- The civil contractor will provide the necessary **material, labour, and machinery** for the task.
- Confirm that the **top layer of the sub-base** is uniformly leveled, and create a level sheet in a **grid size of 3m x 3m**, noting the **average level difference from the datum**.
- **Datum Point – Finished Floor Level**
- The **Main Contractor/GC Project Team** is responsible for the precise transfer of the **reference level (datum point)** to the floor construction area to ensure accurate final floor elevation.
- **EEPL** will establish local datum points for each pour based on the central datum provided by the **GC Project Team**, ensuring consistency across the project.

SLIP MEMBRANE: (SCOPE - PROVIDED & APPLIED BY EFIL)

Material: The slab is constructed on a **200µ - 300µ polyethylene slip membrane**, with overlaps of at least **150mm**and taped with **100mm wide jointing tape** to ensure a secure installation.

- **Installation**:
  - The membrane must be laid **smoothly**, without any ripples or folds.
  - Any creases should be positioned with the **point facing downward** to prevent any unevenness.
- **Under Formed Joints**: Membrane laps under formed joints in the slab should extend **at least 300mm** beyond the joint.

Purpose and Benefits of Slip Membranes:

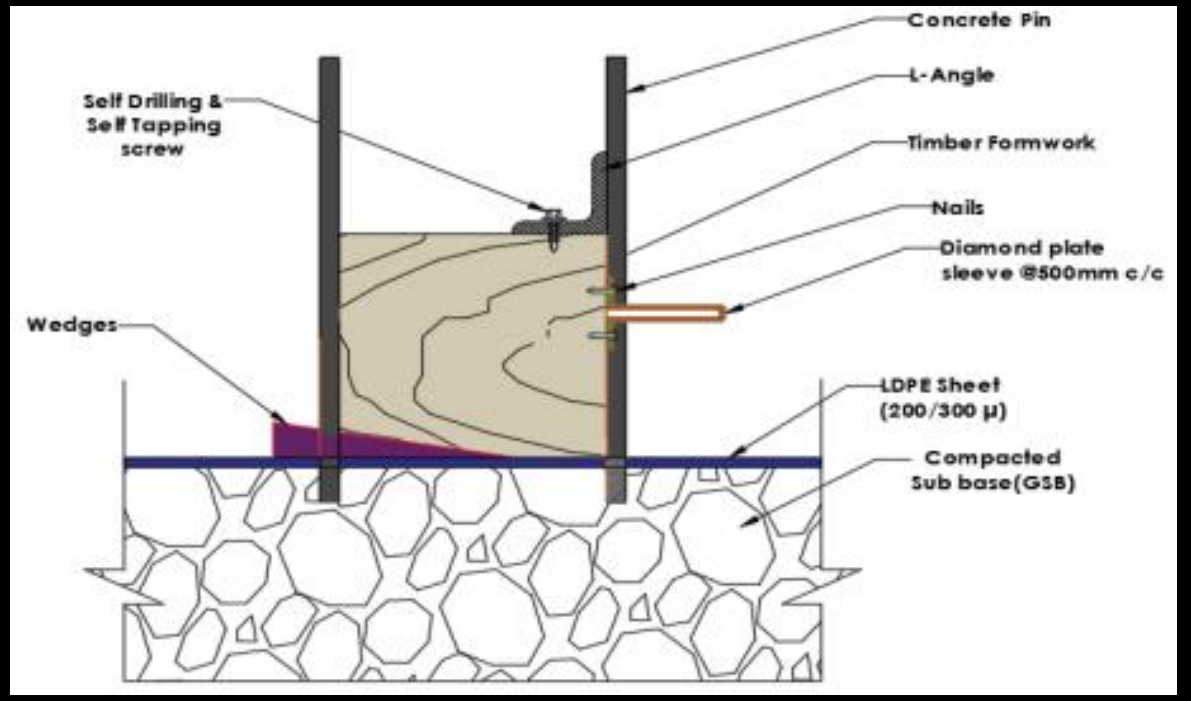
•**Reducing Friction**: A slip membrane, typically a smooth **plastic sheet**, is introduced between the concrete grade slab and the underlying sub-base to **reduce friction** during concrete curing.

•**Managing Shrinkage**:

- **Concrete shrinkage** occurs naturally over time after casting.
- Without the slip membrane, this shrinkage causes **axial tensile stresses** within the slab due to the resistance between the slab and sub-base, leading to cracking.
- The slip membrane **reduces the coefficient of friction**, allowing the slab to move freely as it shrinks, **reducing stress** and minimizing cracking.

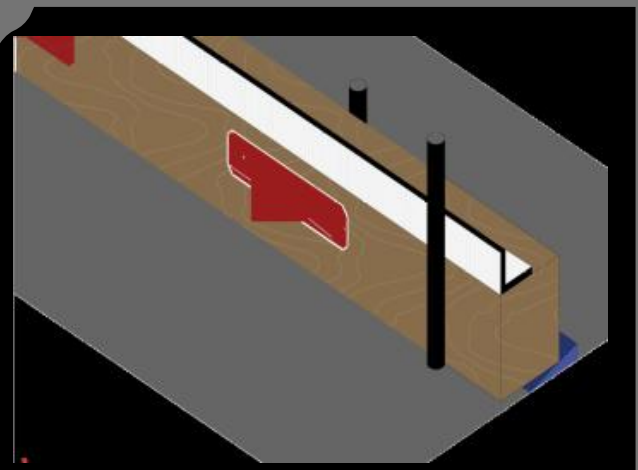
Formwork: Adjustable Timber Formwork

- **Material**: Adjustable formwork using **seasoned imported timber** combined with a **40 x 40 mm angle** of **6 mm thickness**.
- **Angle Support**: The **40 x 40 mm angle** is fixed securely on top of the timber using **TDT/TST Screws**, providing strong and stable formwork support.
- **Wedges and Shims**: **Wedges/shims** are required to ensure the formwork is properly leveled and aligned at **construction joints**, minimizing gaps and deviations.
- **Precision at Construction Joints**: The formwork ensures a **clean and precise finish** at construction joints, maintaining high-quality alignment for the concrete pours.



Best Practices for Formwork Handling:

•**Careful Removal**: Formwork should be removed **carefully** to avoid any damage, particularly to the **arris** (sharp edge where two surfaces meet), preserving the quality of the concrete finish.
•**Cleaning Between Pours**: All formwork, whether **permanent or removable**, must be **fully cleaned prior to each pour** to avoid contamination, ensuring the best surface quality for each successive concrete layer.



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AUXILIARY / ADDITIONAL REINFORCEMENT

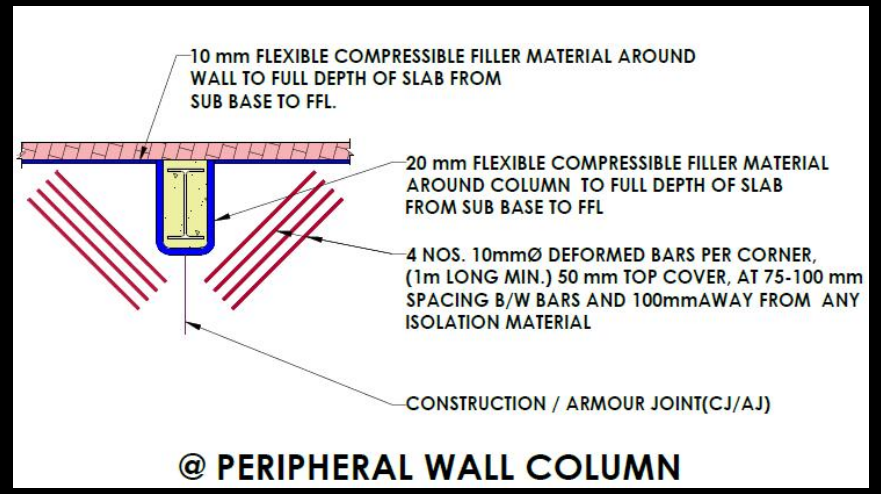
Purpose: Additional reinforcement is provided to mitigate the **notching effect** caused by **re-entrant corners** near columns, walls, loading docks, floor penetrations, and other critical locations.

Reinforcement Details:

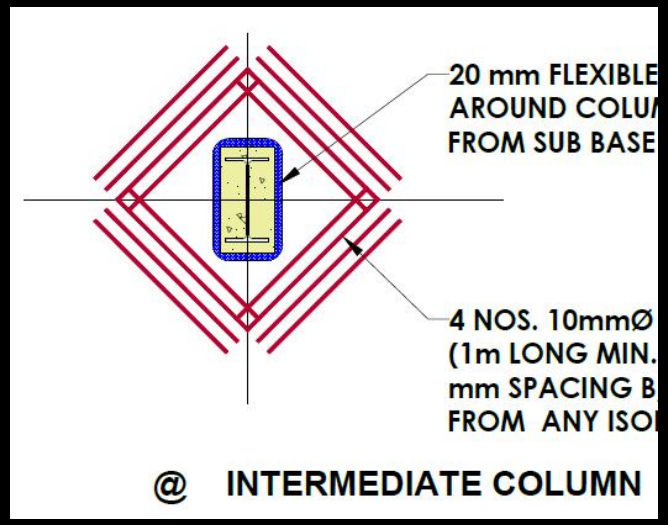
- **Reinforcing Bars**: Use **4 bars** of **10 mm diameter** for added strength.
- **Bar Length**: The bars should be of the **required length**, with a minimum of **1 meter**.
- **Angle of Installation**: Reinforcement bars are placed at a **45-degree angle** to evenly distribute the stresses at critical points.

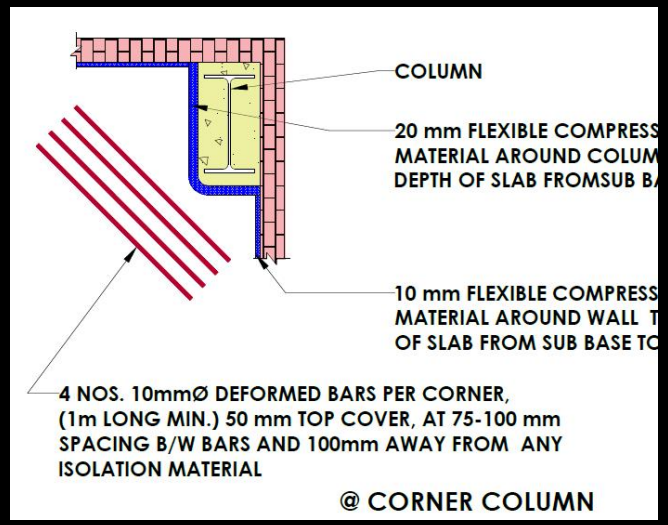
Spacing:

- **Bar Spacing**: Maintain a **75-100 mm spacing** between the bars to ensure sufficient reinforcement.



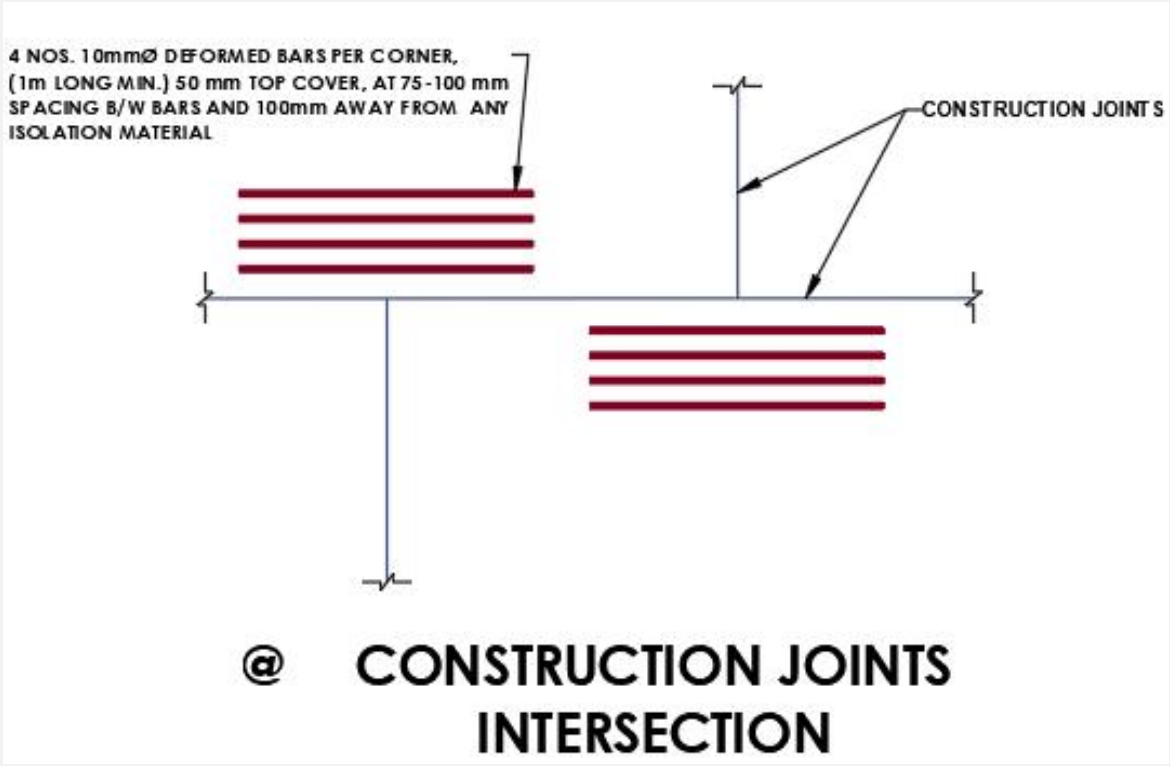
AUXILIARY/ADDITIONAL REINFORCEMENT

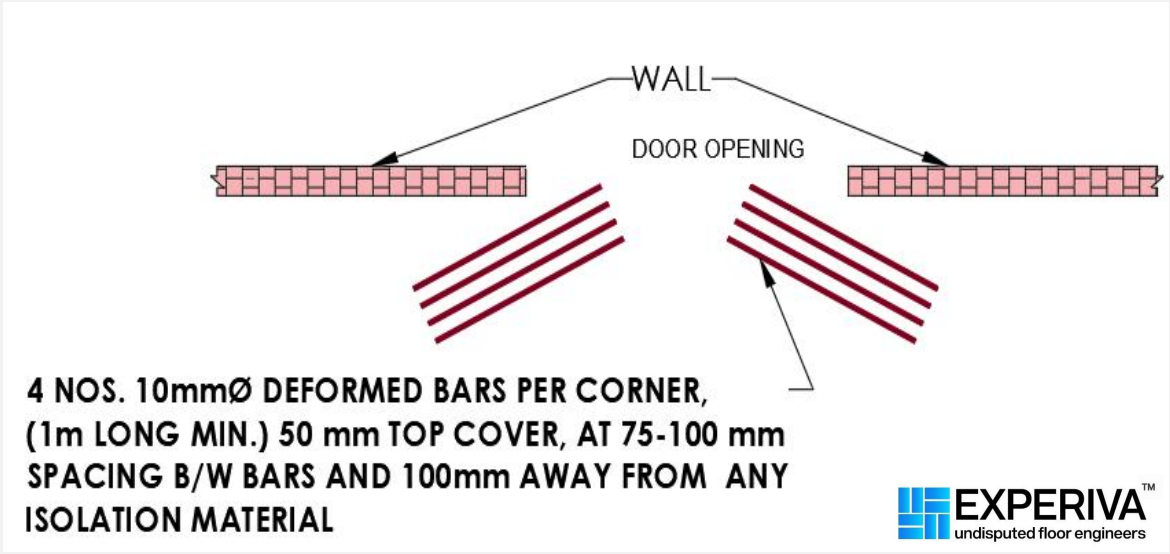


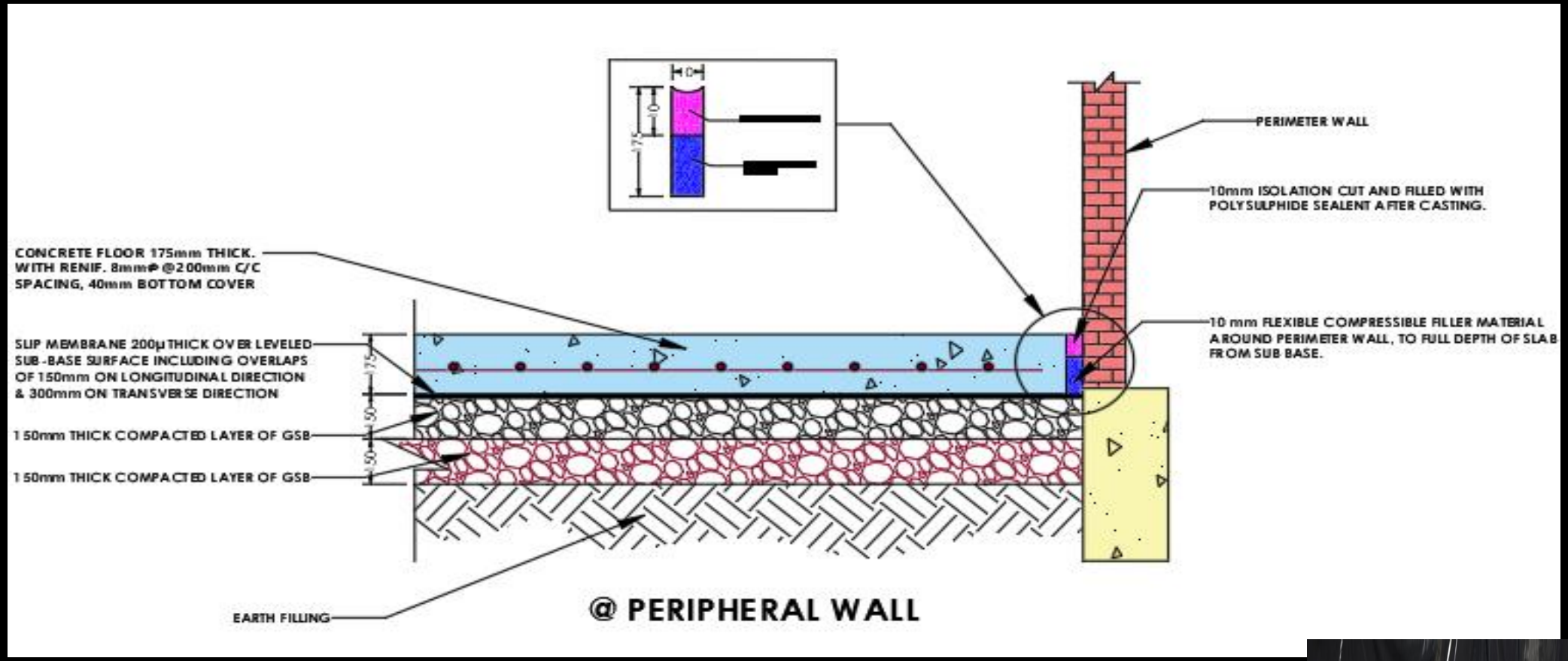


- **Positioning**:
- **Isolation Material**: The reinforcement bars should be placed **from the isolation material** into the **upper part of the floor**.
- **Distance from Isolation**: Bars must be positioned a maximum of **75-100 mm away** from any isolation material, ensuring the reinforcement is placed in the optimal location.

AUXILIARY/ADDITIONAL REINFORCEMENT

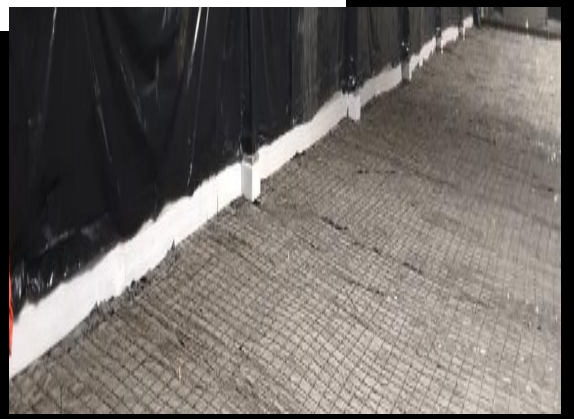




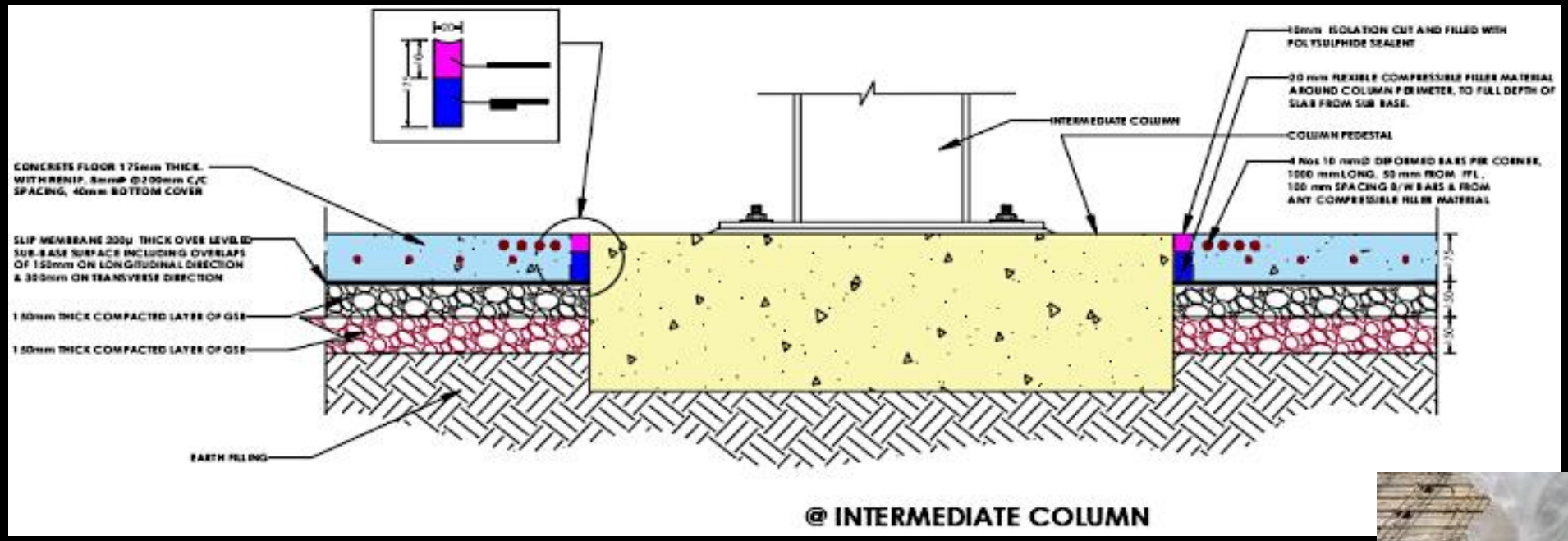


ISOLATION JOINTS – WALLS: (SCOPE-PROVIDING & APPLYING BY EEPL)

Providing & proper fixing of 10 mm thick compressible board for isolation joints between slab and walls etc. and cutting , filling of top 10 mm groves with Polysulphide sealant of approved make as per manufacturers specification and recommendation.(Make: STP SHALISEAL PS PG, or Equivalent)



OUR SERVICES – ISOLATION JOINTS-COLUMN: (SCOPE-PROVIDING & APPLYING BY EEPL)



Providing & proper fixing of 20 mm thick compressible board for isolation joints between column, beam etc. and cutting, filling of top 10 mm groves with Polysulphide sealant of approved make as per manufacturers specification and recommendation.

Note: The slab is to be isolated from the column bases with compressible isolation material, such. It is essential that the isolation material is a close fit to sub base to ensure complete isolation of the slab. All joints in the isolation material to be fully taped.

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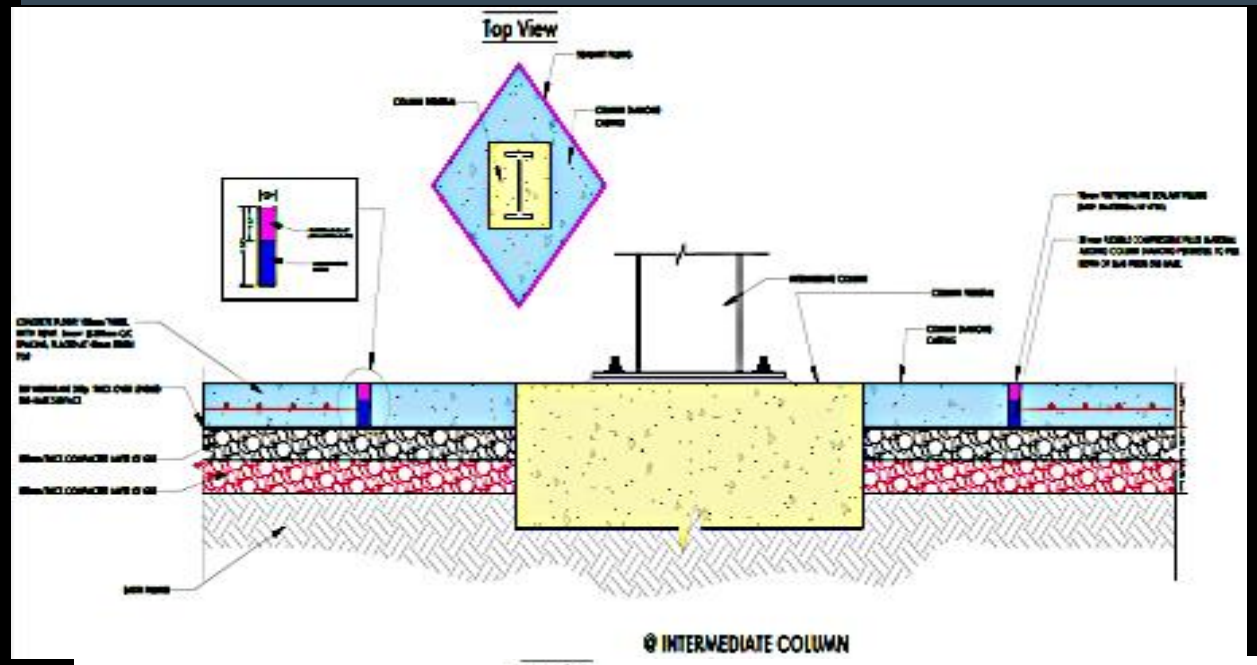
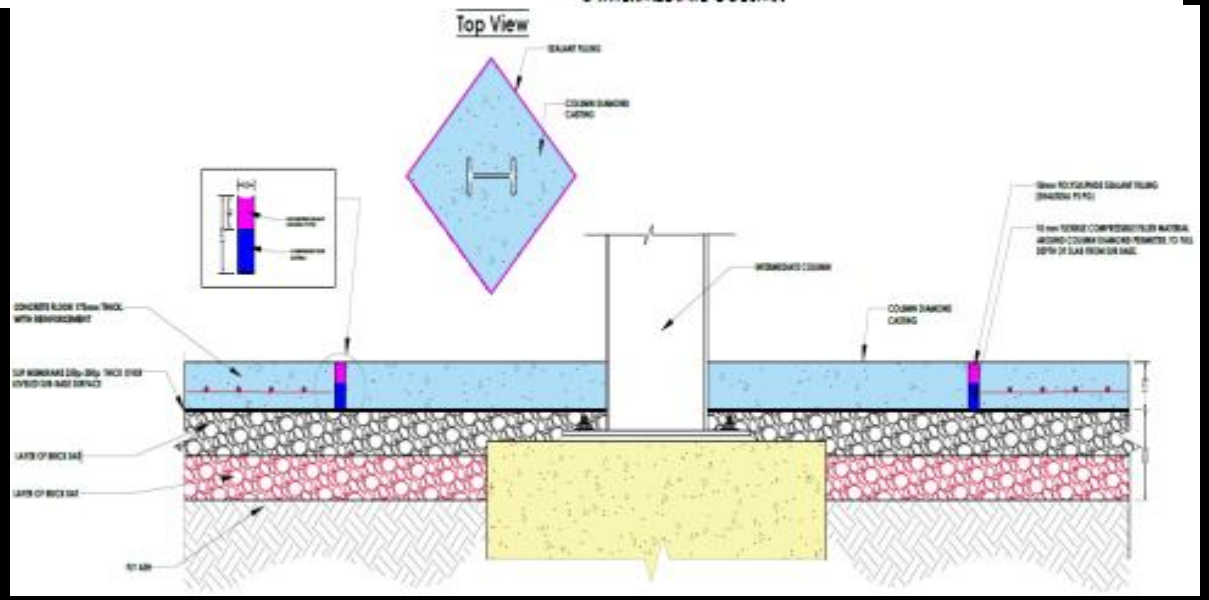
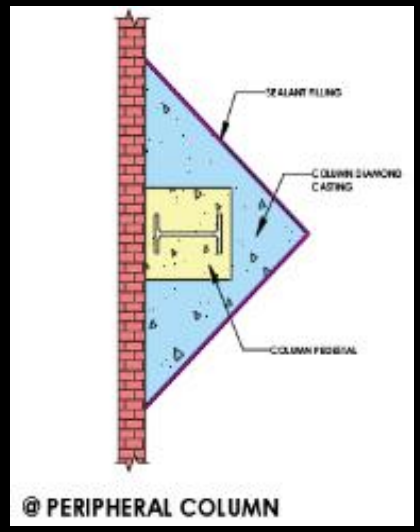
ALTERNATIVE DETAILING OF ISOLATION AROUND COLUMNS AND PEDESTALS

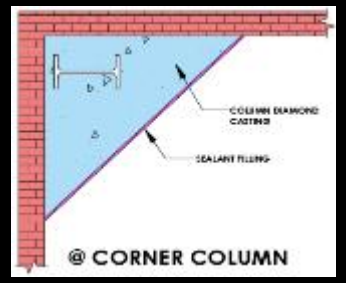


@ INTERMEDIATE COLUMN





@ PERIPHERAL COLUMN



@ CORNER COLUMN

Alternately, isolation may be provided around columns by way of avoiding formation of any re-entrant corner.

A square isolation joints at columns may be rotated (forming a diamond shape), thereby eliminating any need of diagonal auxiliary reinforcements.

ALTERNATIVE DETAILING OF ISOLATION AROUND COLUMNS AND PEDESTALS

Alternately, isolation may be provided around columns by way of avoiding formation of any re-entrant corner. Providing & fixing 2mm thk MS brackets to panels and height adjustable so that fix to the top of column foundations or floor FFL. Material should be robust steel leave-in-place profile manufactured by EEPL. The form is left in place. Formwork with curved edges over which the compressible board of 10 mm shall be there, where it allows optional capping rebate formers to the top for placement of joint filler, with Superior floor finish, it allows for expansion and contraction, also there no stripping or patching required as well as enhance flexibility.

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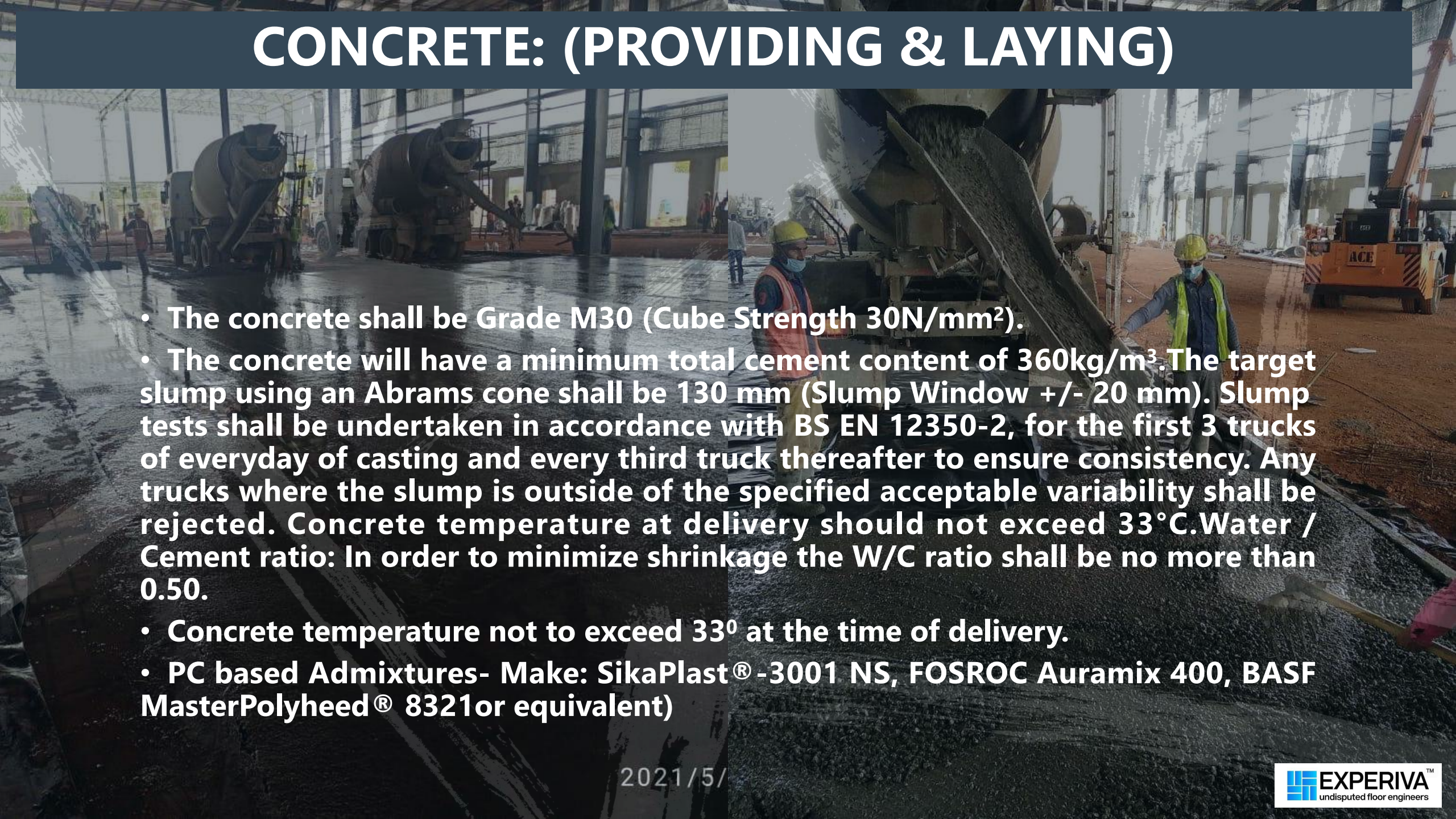
CONCRETE: (PROVIDING & LAYING)



- The concrete shall be Grade M30 (Cube Strength 30N/mm^2).
- The concrete will have a minimum total cement content of 360kg/m^3.The target slump using an Abrams cone shall be 130 mm (Slump Window +/- 20 mm). Slump tests shall be undertaken in accordance with BS EN 12350-2, for the first 3 trucks of everyday of casting and every third truck thereafter to ensure consistency. Any trucks where the slump is outside of the specified acceptable variability shall be rejected. Concrete temperature at delivery should not exceed 33°C.Water / Cement ratio: In order to minimize shrinkage the W/C ratio shall be no more than 0.50.
- Concrete temperature not to exceed 33^0 at the time of delivery.
- PC based Admixtures- Make: SikaPlast®-3001 NS, FOSROC Auramix 400, BASF MasterPolyheed® 8321or equivalent)

2021/5/

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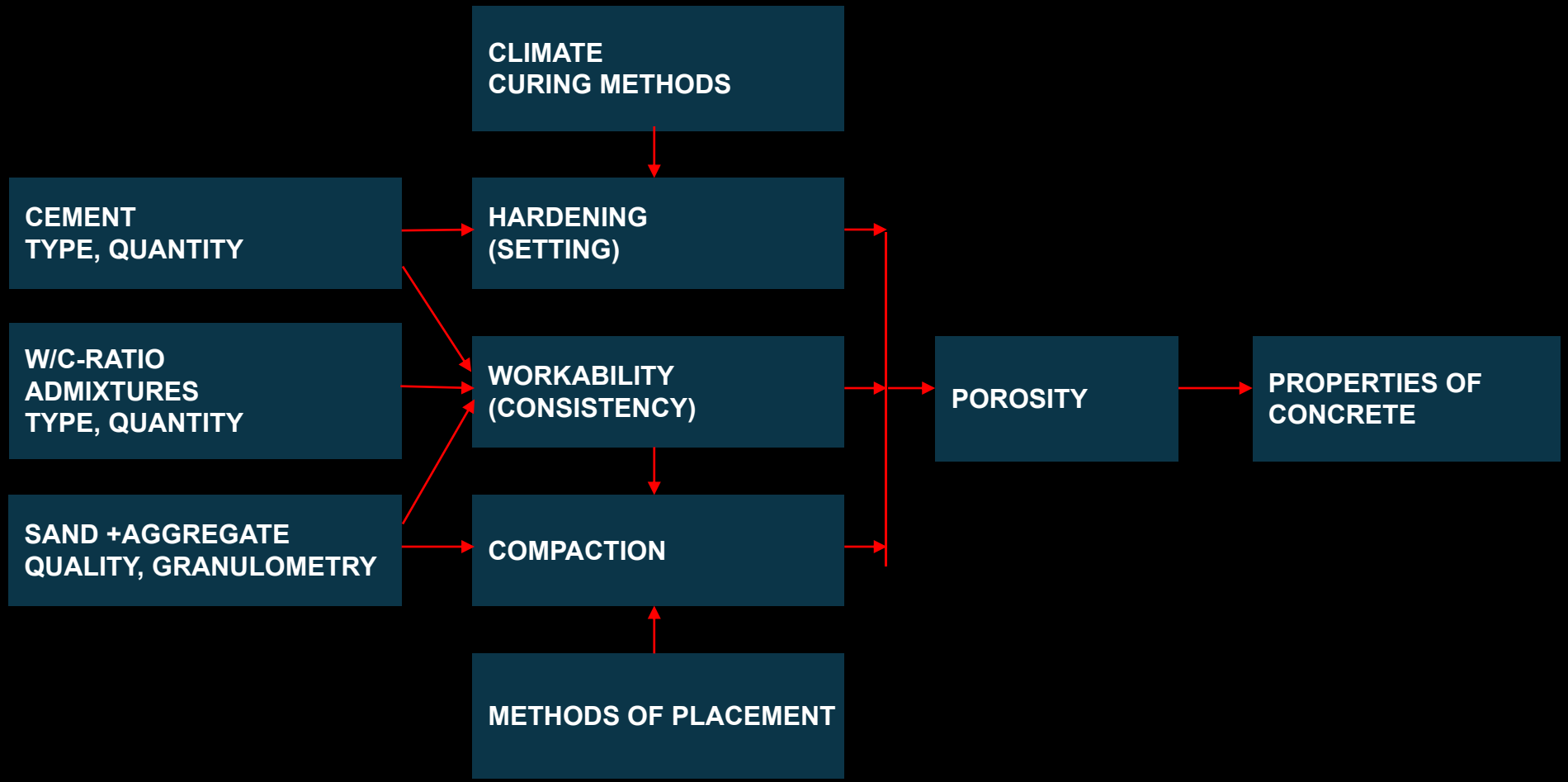
WATER, ADMIXTURE & AIR

- Fresh Water
  - Usually Tap Water
- Sea Water
  - Contains Chlorides

- Chemical Admixtures
- Mineral Admixtures

- Entrapped
  - Accidental and Unwanted
- Entrained
  - Deliberate and desirable

FACTORS INFLUENCING THE QUALITY OF CONCRETE



LAYING & FINISHING FLOOR (LASER SCREED FLOORING)

- **Levelling & Compacting:** Use laser screed machine for accurate levelling and compacting in large panel sizes.
- **Concrete Finishing:** Achieve smooth surfaces using ride-on trowels, ensuring FM2 floor tolerances as per TR34 (3rd edition).
- **Flatness Operations:** Utilize bump-cutter, ride-on trowels, and check rods for achieving floor flatness.
- **Tools & Equipment:** Use beam screed, specialized formwork with steel 'L' angles, imported flooring tools.
- **Concrete Details:** Work with workable RMC (Ready-Mix Concrete) of 120-140 mm slump, following approved sizes and drawings as directed by the engineer in charge.

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CONCRETE PLACEMENT STOPPER

BROADCASTING OF FLOOR HARDNER

- **High-Quality Work Surface:** Essential for commercial, manufacturing, and warehouse/Industrial & Warehousefloors ensuring long-term durability, abrasion resistance, dustproofing, and safety.
- **Cost-Effective Solution:** Dry shake floors provide the best price/performance ratio in most Industrial & Warehouseapplications compared to alternative concrete treatments or finishes.
- **Dry Shake Hardeners Benefits:**
  - Installation time-saving.
  - Enhanced durability for high-wear areas.
  - Improved traction for better safety.
  - Aesthetic options for customization.
  - Overall economy in floor lifecycle costs.
- **Application Process:**
  - Hardener applied by mechanical spreader on semi-hardened concrete.
  - Total of 3-4 kg/sqm in two application stages for optimal strength and finish.

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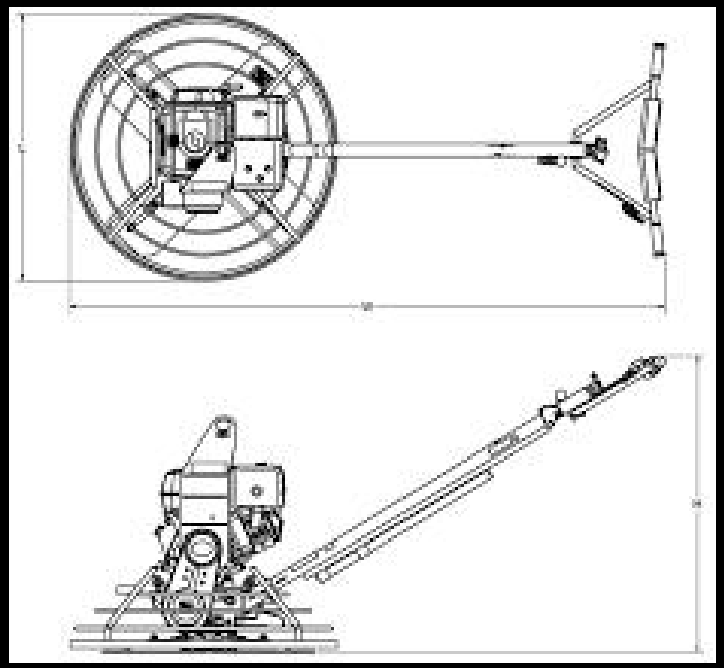
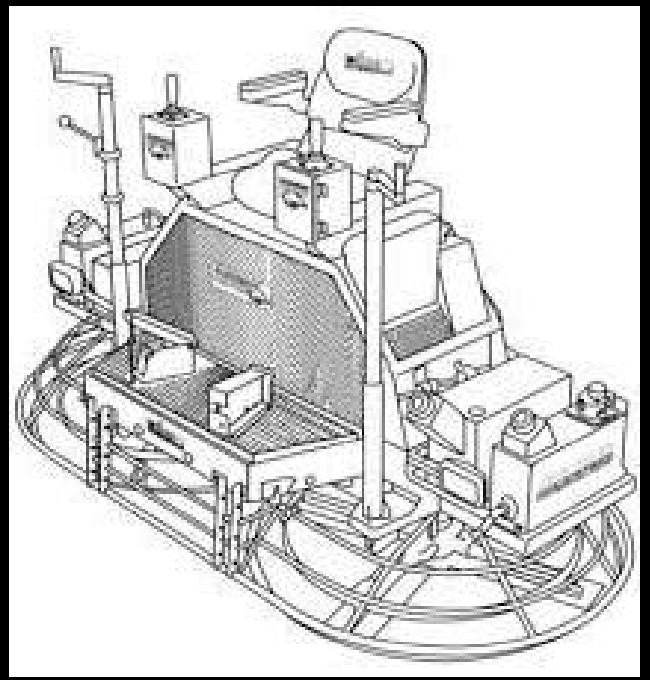
BUMPCUTTER & BULL FLOATER

- **FL (Floor Levelness):** Controlled by accurate form setting and initial concrete strike-off.
- **FF (Floor Flatness):** Determined by finishing operations after concrete placement.
- **Bump Cutter Usage:** Used for cutting high spots and filling low areas by redistributing concrete.
- **Higher FF Values:** Proper bump cutter usage improves floor quality, increasing FF (flatness) numbers.
- **Benefit:** Ensures smoother and more even slabs, optimizing floor performance.

WORKING MECHANISM OF RIDE ON TROWEL AND WALK BEHIND FLOATERS

- **Precision Control:** Operators can use pitch control to bring the cream of the cement to the surface, ensuring a smooth finish.
- **High Efficiency:** Ride-on trowels offer faster and more efficient surface finishing compared to manual methods.
- **Ease of Use:** They are designed to be easy to handle, even for large surface areas.
- **Durability:** Built with high tolerance capacity and long functional life, ensuring reliable performance over time.
- **Smooth Finish:** Achieve desired levels of smoothness and hardness, often with just 3 passes of the pan and blade.
- **Float Pans:** Used during early stages, float pans help distribute the weight evenly, allowing the machine to 'float' on fresh concrete for optimal surface leveling.





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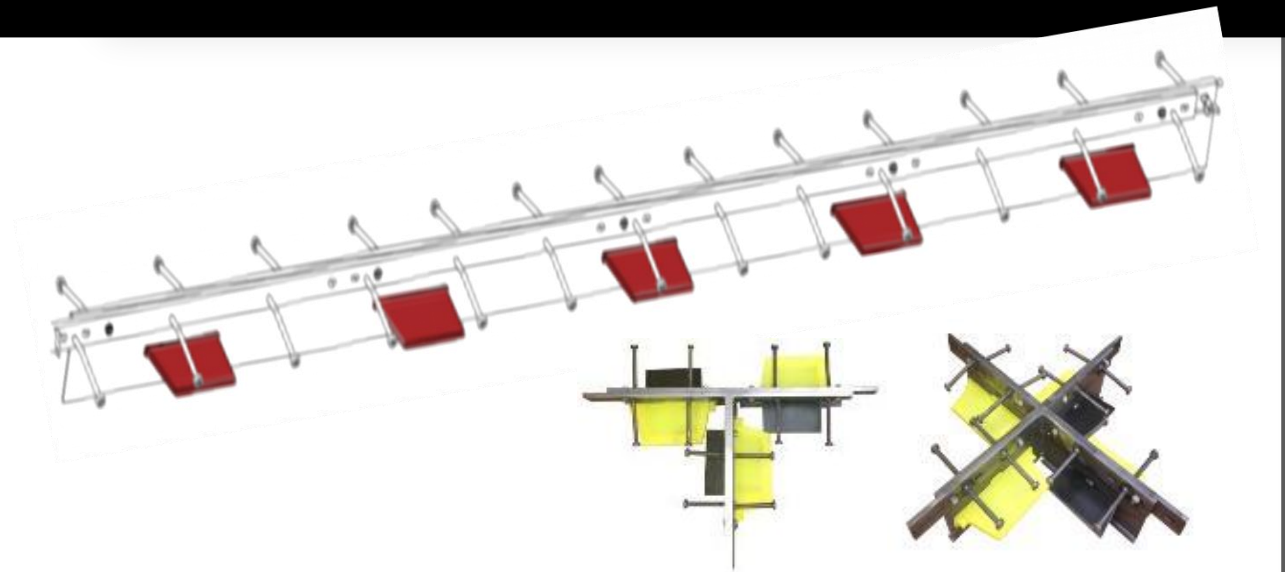
FINISH AFTER RIDE ON TROWEL

- **Increased Productivity:** Covers large areas quickly, reducing labor time and enhancing project efficiency.
- **Consistent Surface Finish:** Ensures a uniform, high-quality finish with minimal variation across the concrete floor.
- **Improved Flatness and Smoothness:** Ride-on trowels are ideal for achieving superior flatness and smoothness, critical for warehouse and Industrial & Warehousefloors.
- **Enhanced Durability:** Provides a dense, hard surface, improving the concrete's wear resistance and longevity.

ADVANCE DOWELING SYSTEM - ARMOURED JOINTS TO WITHSTAND ABRASION & IMPACT

Optimal Load Transfer: Ensures effective load transfer across construction joints, maintaining floor stability.



- **Prevents Joint Resistance:** Eliminates resistance to joint opening and movement in both horizontal directions, improving structural integrity.
- **Durable Edge Protection:** Provides strong edge protection, especially under heavy traffic, preventing damage and wear.
- **Prevents Random Cracks:** Controls slab contraction, preventing the formation of random cracks during curing.
- **Efficient Joint Protection:** Protects construction joints from impact damage, reducing future repair costs and enhancing floor longevity.
- **Standards Compliance:** Designed to meet the requirements of BS EN 1991-1-1:2002, BS EN 1992-1-1:2004, and TR34 4th Edition for high-quality floor slabs.

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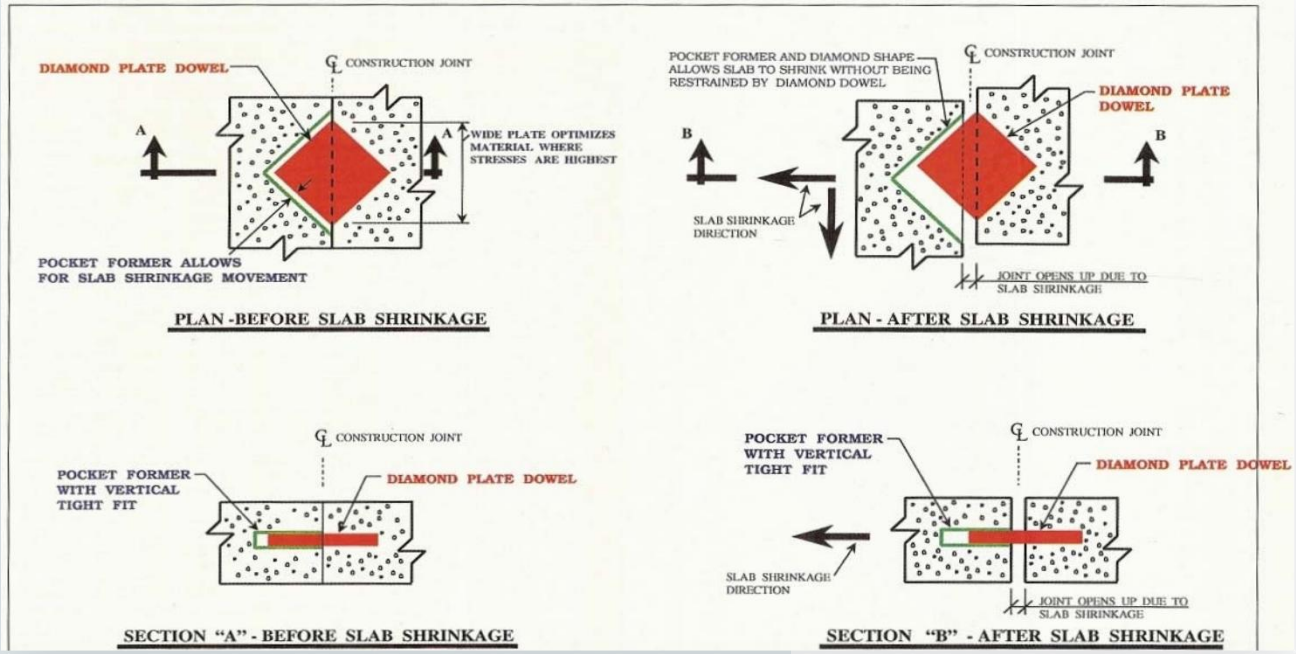
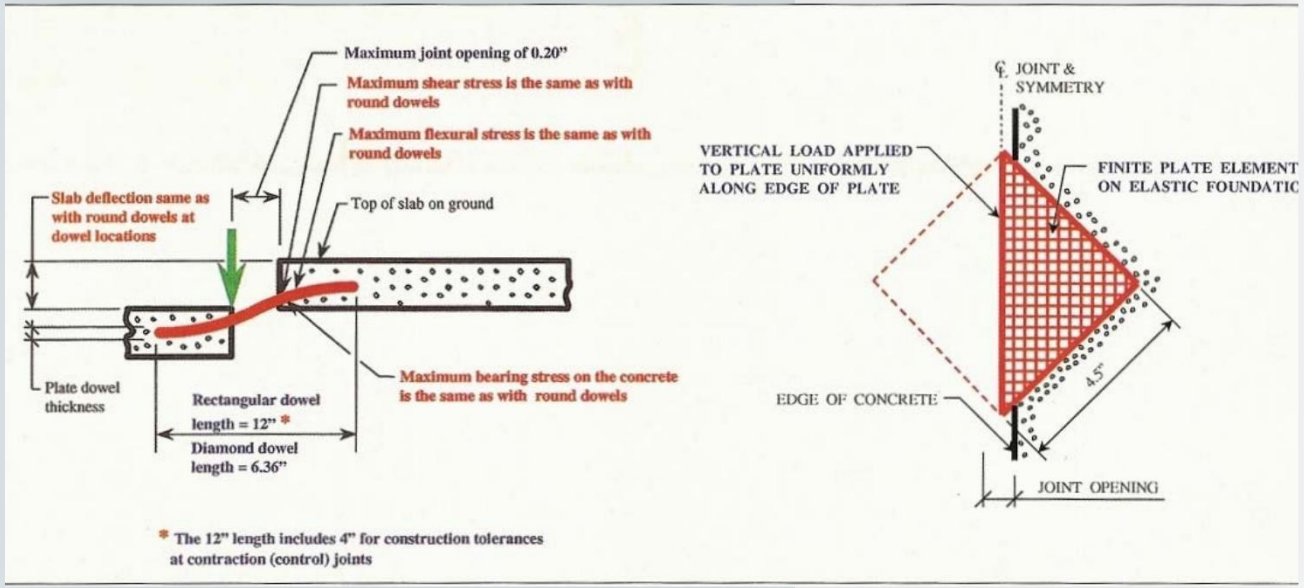
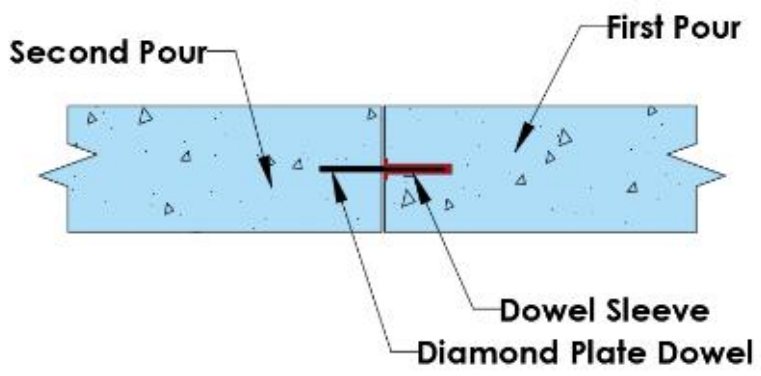




ADVANCE DOWELING SYSTEM- PLATE DOWEL

- **Efficient Load Transfer:**
- Plate dowels transfer shear loads effectively across joints, outperforming traditional round dowels.
- **Accommodates Horizontal Movement:**
- Allows slabs to move horizontally without restraint, reducing the risk of cracks.
- **Reduces Cracking:**
- Minimizes restraint cracks by accommodating slab movement, especially for long joint spacings.
- **Two Types of Dowels:**
- **Rectangular** and **Diamond Plate Dowels**: Diamond dowels allow unrestricted movement, especially useful for shrinkage-prone slabs.
- **Durability and Stress Reduction:**
- Diamond dowels reduce stress by flexibly allowing movement at the joint.
- **Industry Compliance:**
- Complies with **BS EN 1991-1-1:2002**, **BS EN 1992-1-1:2004**, and **TR34 4th edition** standards.



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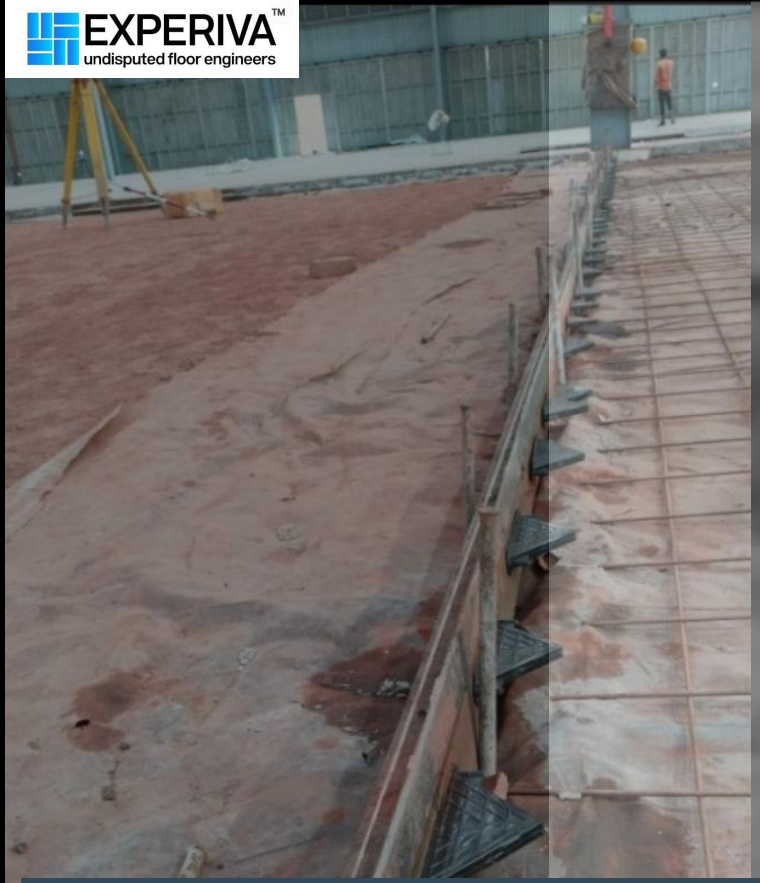
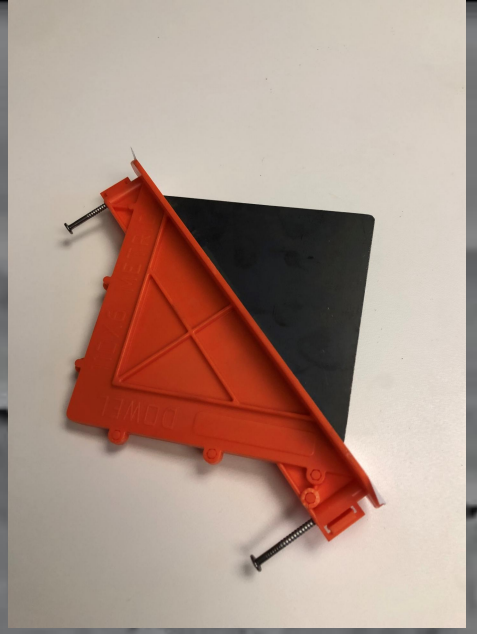
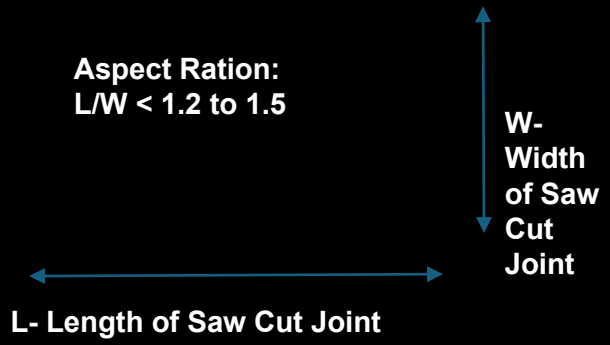


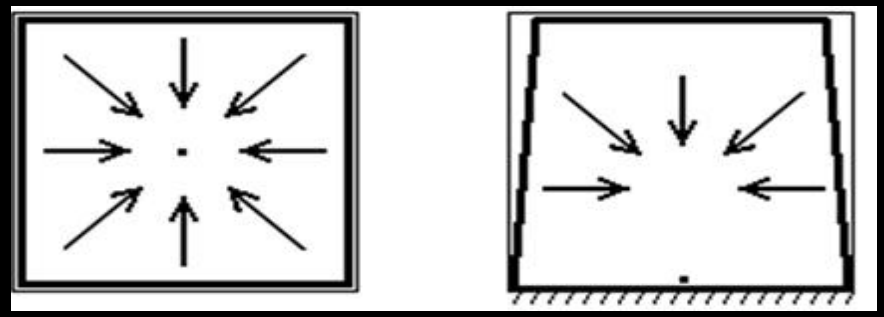


Free Movement Dowel Joints: Free movement dowel joints are construction joints created by formwork and are provided at the perimeter of each bay which allows unrestrained lateral horizontal movement of the ground supported slab at the joint, but the vertical movement is restricted by appropriately designed Diamond Plate Dowels. These dowels are smooth (undeformed) with a debonded /sleeve end to allow free movement in lateral as well as the longitudinal direction. Sleeves are provided with a good fit and sufficient stiffness to prevent vertical movement.
Note: Diamond Plate Dowels are load transferring devices designed and placed along construction joints to transfer shear loads across a joint between a slab or panel to minimize differential deflection between adjacent slab/ panels under load.

SAWN CUT JOINTS

1. **Purpose:**
    1. Control cracking in concrete slabs by managing restrained movement.
2. **Depth & Width:**
    1. Saw cuts: **1/3 to 1/4 depth** of the slab, max width **4mm**.
3. **Spacing & Aspect Ratio:**
    1. Max **6 meters** spacing.
    2. Aspect ratio: **1:1.2 to 1:1.5**.
4. **Timing:**
    1. Cut joints **24-36 hours** after concrete placement.
5. **TR34 Compliance:**
    1. Follow **TR34** standards for joint placement and spacing to avoid random cracking.





Stress distribution on a free panel Stress distribution on a panel with one recessed side

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CURING

Predictable Strength Gain:

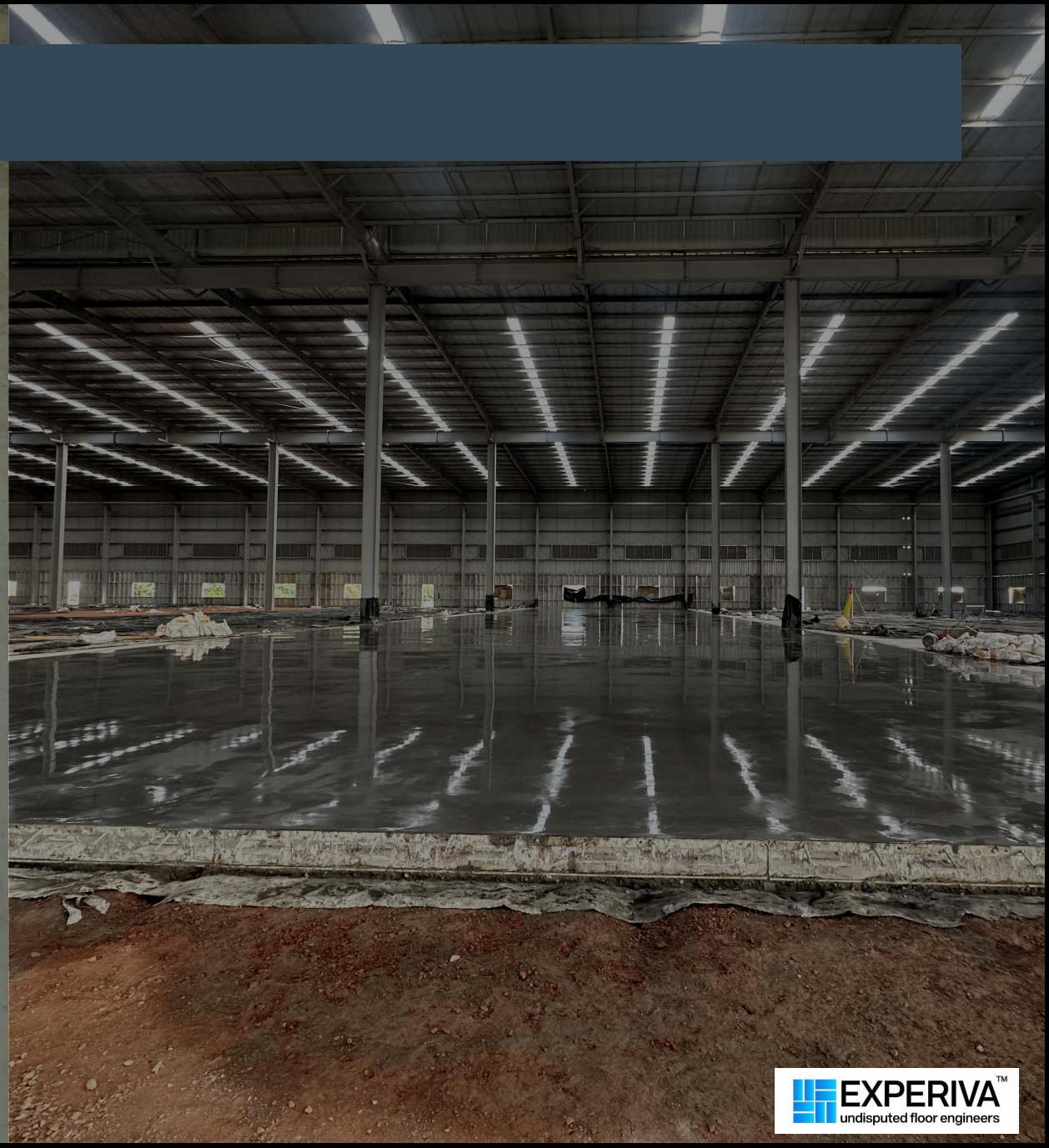
- Proper curing ensures concrete reaches its designed strength.
- Laboratory tests show that concrete in dry environments can lose up to 50% of its strength potential without curing.

Improved Durability:

- Well-cured concrete has better surface hardness, making it more resistant to wear and tear.
- Curing helps seal the surface, making it watertight and less prone to moisture damage, extending the concrete's lifespan.

Enhanced Serviceability and Appearance:

- Curing prevents the surface from becoming soft and prone to damage.
- Proper curing ensures a better finish and overall appearance, improving the floor's performance over time.



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CURING

Role of Curing Compounds:

- Curing compounds are applied to concrete to retain moisture during the early stages of hydration.
- They help minimize evaporation, particularly in environments where traditional curing methods like water application may be impractical.
- Curing compounds ensure uniform moisture retention, leading to stronger, more durable concrete.

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SEALANT

Purpose of Sealant in Joints:

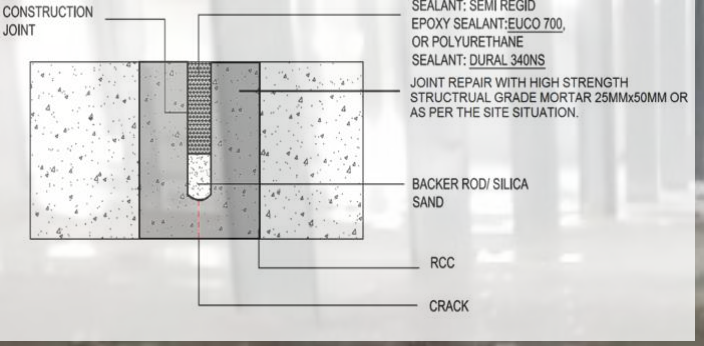
- Saw cut and construction joints are necessary to accommodate expansion and contraction of the concrete.
- Sealants are used to fill the joints, ensuring a watertight and flexible bond while allowing movement in the joint.

Materials Used:

- PU-based sealants with Shore A Hardness 28-34 are commonly used for filling joints, ensuring flexibility and durability.
- Backer rods are inserted into the joint before the sealant to control depth and reduce the amount of sealant used.

Process:

- For construction joints, a saw cut of 10–15 mm deep is made after the joint opens up visibly (typically 14–28 days).
- The joint is cleaned, and the sealant is applied, filling the top 10 mm section of the joint.
- Control joints are filled similarly, with a size of 4 x 50/60 mm for control joints and 4 mm x 15 mm for construction joints.



SEALANT

- **Prevents Water Ingress**:
- Sealants create a watertight barrier, preventing water from entering the joint and causing damage to the slab.
- **Absorbs Movement**:
- Sealants are flexible and allow the joints to expand and contract without cracking, ensuring the integrity of the floor over time.
- **Enhances Durability**:
- Properly filled joints reduce wear and tear, as the sealant prevents debris from entering and protects the edges of the concrete.
- **Smooth Floor Levels**:
- Grinding the joint surface ensures the joints do not protrude, maintaining a smooth floor surface, improving operational efficiency, and preventing damage to machinery or goods.
- **Prolongs Service Life**:
- Well-sealed joints minimize the risk of cracks and slab damage, extending the life of the concrete floor.

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FLOOR USAGE POST-COMPLETION:

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- **Light Traffic Usage:** Floor can be used 7 days after completion by light traffic, but loads should not exceed 30% of the design capacity.
- **Full Load Capacity:** The floor should not be loaded to its design capacity until after 28 days.
- **Joint Sealing and Inspection:**
- **Sealing Before Completion:** All joints must be sealed with compounds having a Shore A hardness of 28-40 before practical completion.
- **Regular Inspections:** Joints are to be inspected every 3 months during the defects liability period to check for damage.
- **Arris Damage Repair:** Significant arris damage must be repaired using resin mortar according to manufacturer recommendations.
- **Re-sealing:** After the defects liability period, joints in aisles or free-movement areas must be resealed with a high-hardness sealant (Shore A hardness of 80).

FLOOR USAGE POST-COMPLETION:

- **Traffic Restrictions:**
- **General Foot Traffic:** Permitted 7 days after casting.
- **Light Equipment (e.g., Scissor Lifts):** Allowed after 14 days.
- **Full Structural Strength Usage:** Achieved after 28 days.

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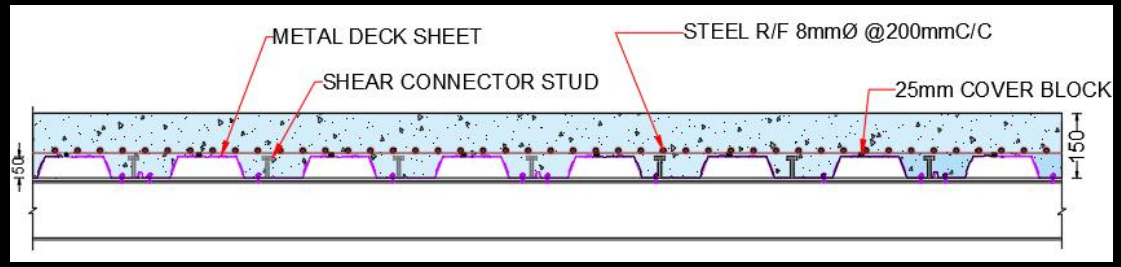
MEZZANINE / DECK SLAB WITH STUDS -150 MM THK.



- **Steel Bar Reinforcement (As per TR34)**:
- 8 mm diameter bars, spaced 200 mm c/c in both directions, ensuring compliance with TR34 guidelines for load distribution and reinforcement.
- **Mesh Installation**:
- Bars placed using 25 mm plastic cover blocks, maintaining alignment and corrosion protection as per TR34 recommendations.
- **Proper Overlap**:
- Ensures continuous reinforcement in line with TR34 specifications for structural strength and load transfer.
- **Deck Slab Depth (150 mm)**:
- Slab designed to meet TR34 guidelines, providing the necessary thickness for mezzanine floor durability.
- **Engineering Expertise (TR34 Compliance)**:
- Our team ensures that all work adheres to TR34 standards, guaranteeing safety, structural integrity, and long-term performance.

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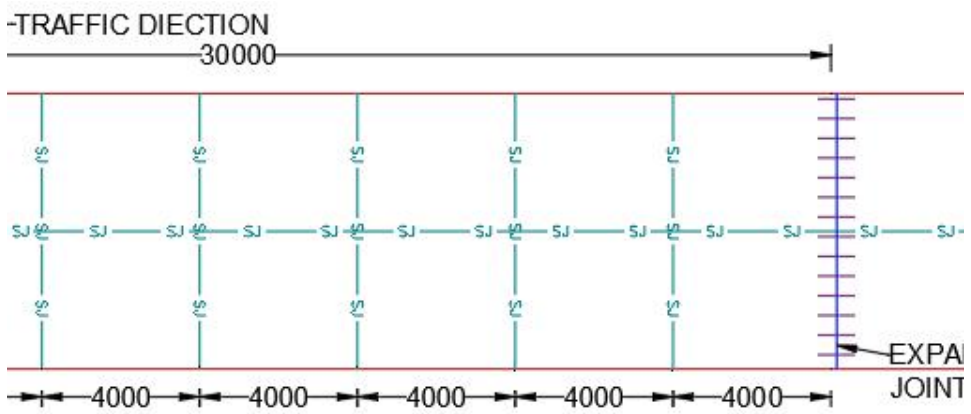
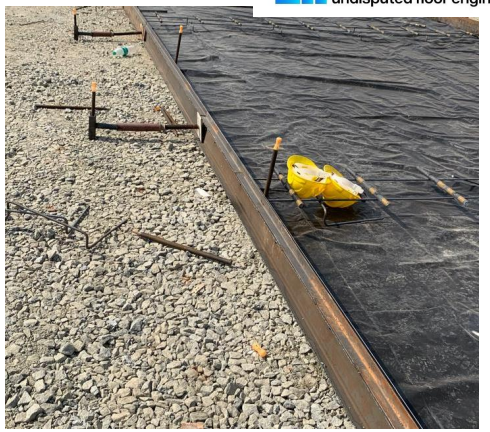
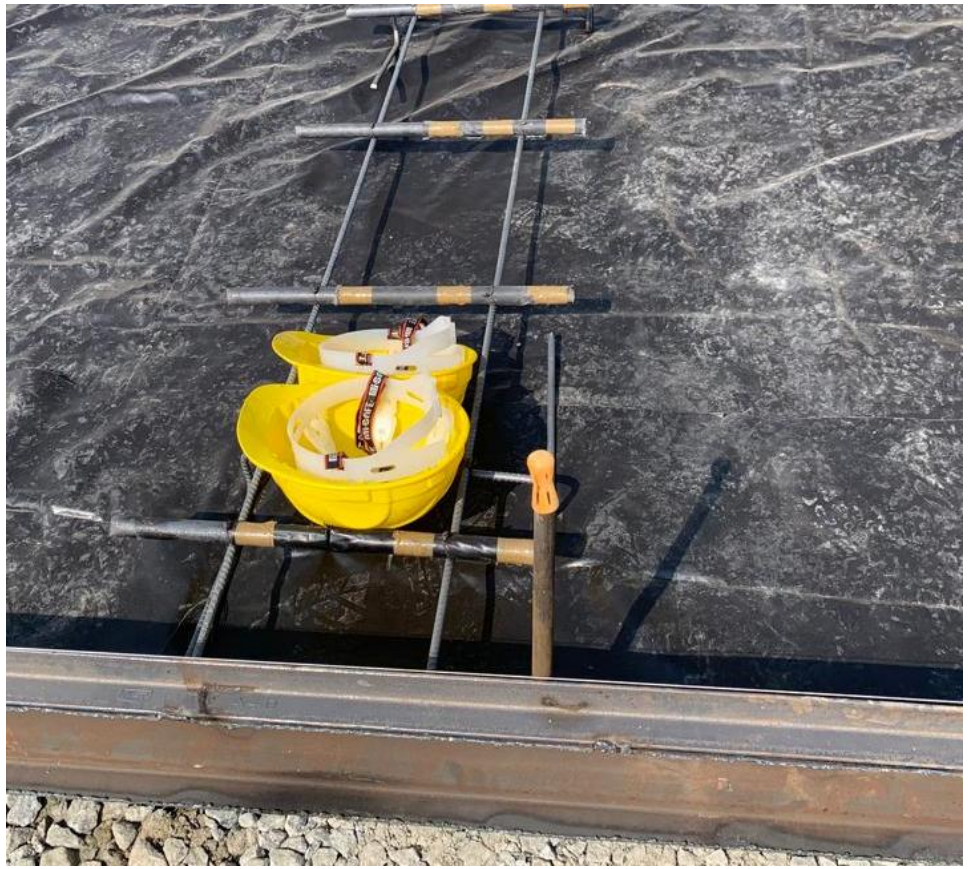
CONCRETE ROAD CASTING AS PER TR34 GUIDELINES

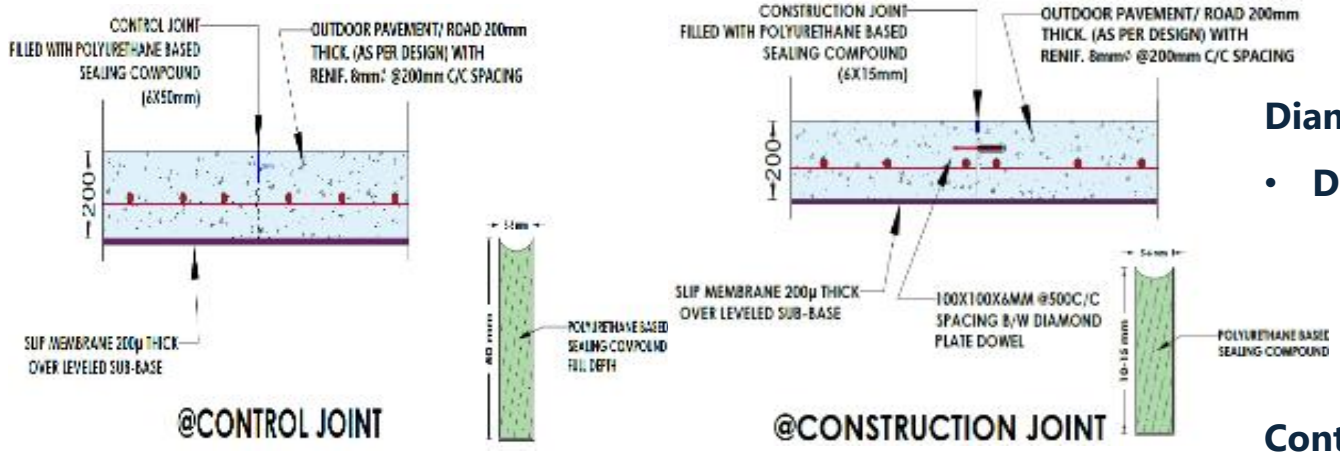


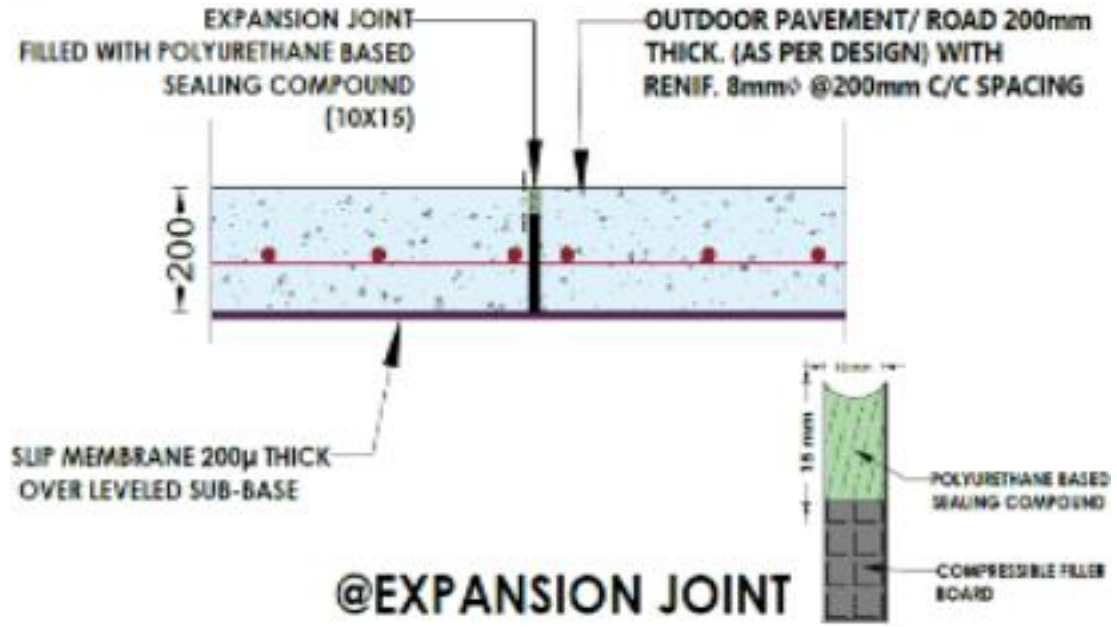




- **Concrete Grade (M30)**:
- High-quality design mix using OPC/PPC 43/53 grade cement, with a minimum cement content of 360 kg/cum, ensuring strength and durability.
- **Slump Control**:
- Slump at site: 130 mm (+/- 20 mm) as per BS EN 12350-2, ensuring the right workability.
- **Temperature Monitoring**:
- Concrete temperature at delivery not to exceed 33°C for optimal performance.
- **Admixture Use**:
- PC/PCE-based super plasticizers included in the mix design for improved flow and performance.
- **Thickness & Delivery**:
- Average thickness of 200 mm, with concrete supplied and pumped to the pour location free of cost.
- **Engineering Compliance (TR34)**:
- All work is conducted as per TR34 standards, ensuring structural integrity and longevity.

ROAD & APRON WORK BY TRUSS SCREED





Diamond Plate Dowels at Construction/Expansion Joints:

- **Dowel Specifications**:
  - 6 mm thick diamond plate dowels (100 x 100 mm) at 500 mm c/c spacing for effective load transfer.
  - Includes PVC sleeve at one end for ease of movement and joint flexibility.

Control & Construction Joints:

- **Sealing Compound**:
  - Polyurethane-based sealant (Shore A Hardness 10-15) for durability.
  - Control Joint size: 6 x 50 mm; Construction Joint size: 6 x 15 mm.
  - Sealant applied full depth to ensure long-lasting joint protection.

Expansion Joints:

- **Joint Design**:
  - Polyurethane-based sealant (Shore A Hardness 10-15) with compressible board for expansion and contraction.
  - Expansion joint size: 10 x 15 mm, provided at intervals of 30 meters for proper structural movement.

PROCEDURE

- **Concrete Placement & Poker Vibration**:
  - Concrete is poured in place and vibrated using a poker vibrator, focusing on panel edges for thicknesses exceeding 100 mm to ensure full compaction, particularly at the sides.
- **Surface Vibration Using Truss Screed/Magic Screed**:
  - Truss Screed or Magic Screed vibrators run across the surface, supported on channel shuttering or timber formwork with steel 'L' angles spaced 4-6 meters apart, ensuring uniform leveling and compaction.
- **Diamond Plate Dowels Installation**:
  - 6 mm thick diamond plate dowels (100 x 100 mm) placed at 500 mm c/c spacing, incorporating PVC sleeves at one end to allow for joint movement and expansion.
- **Initial Stiffening Stage**:
  - Wait until the concrete reaches a point where light foot traffic leaves a 3-6 mm imprint, with the concrete still showing a wet sheen but without bleed water.
- **Further Compaction with Power Floater**:
  - Once concrete has stiffened, use a Power Floater to further compact and level the surface, preparing for final finishing.
- **Finishing with Power Trowel & Riding Trowelling Machine**:
  - Use a Power Trowel for surface finishing, followed by a riding trowelling machine to densify the concrete and achieve a smooth, hard-wearing finish.
  - Delay initial panning as much as possible, using non-overlapping passes. Alternate passes in longitudinal and transverse directions for uniform compaction.

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ESSENTIAL EQUIPMENT FOR HIGH-PERFORMANCE LASER SCREED FLOORING

S.No		Machine Name	Purpose of Machine
1		Laser Screed Machine	For Concrete screeding and levelling
2		Ride on Trowel	For final Finishing of concrete surface
3		Edger Power Trowel	To finish near Corners and Wall

ESSENTIAL EQUIPMENT FOR HIGH-PERFORMANCE LASER SCREED FLOORING

4		Power Trowel	For finishing Green Concrete
5		Bump Cutter	For remove high spots when levelling the surface of a floor
11		Jack Hammer	Breaking Concrete/ Chipping Work

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7		Needle Vibrator	For vibrating Concrete (mainly at Edges)
8		Auto Level (Sokkia B20)	To fix the channel/Shuttering at desired level
9		Groove Cutting Machine	For cutting Control & Construction Joint

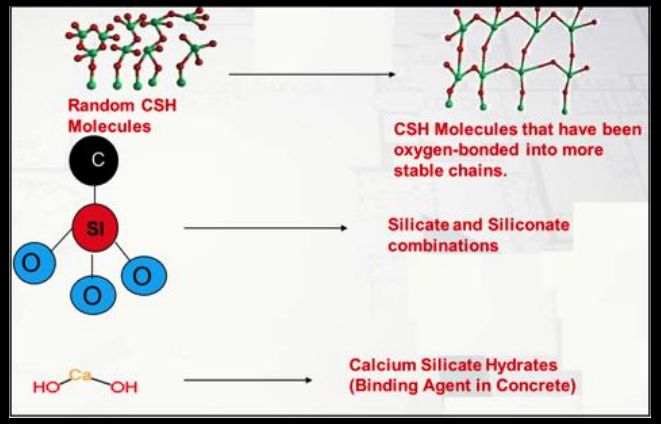
ESSENTIAL EQUIPMENT FOR HIGH-PERFORMANCE LASER SCREED FLOORING

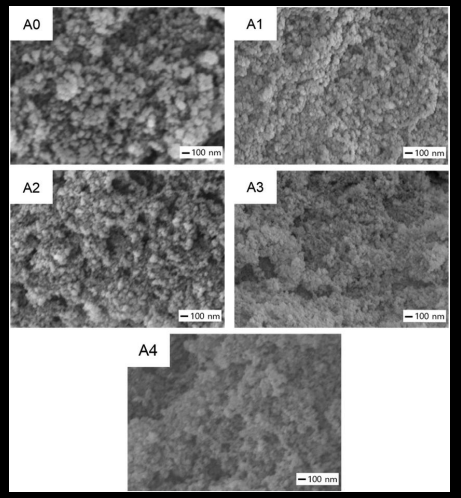
ESSENTIAL EQUIPMENT FOR HIGH-PERFORMANCE LASER SCREED FLOORING

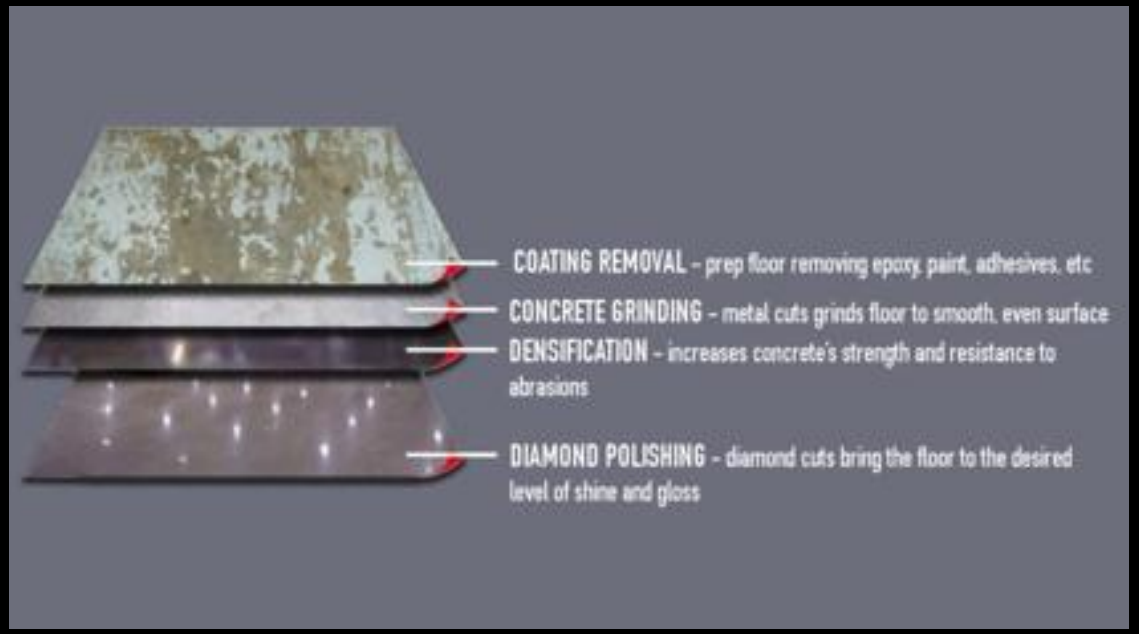
10		Hand Grinder	Required for repair work
11		Electric Panel Board	For Distribution of Electricity
12		Drill Machine	For Driling & Fixing Screw

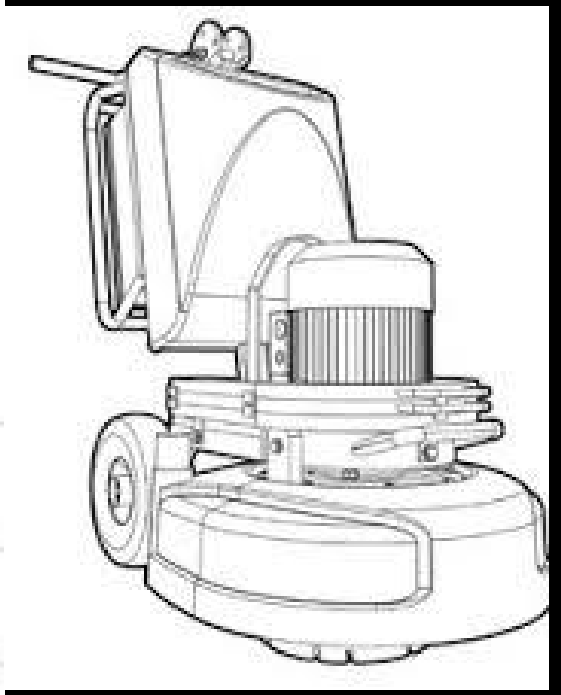
DENSIFICATION

- Concrete normally contains some free lime—calcium carbonate—which contributes nothing to strength and durability. It's there because the chemical reactions that make concrete hard don't reach every last bit of cement.
- Every concrete surface contains pores, which weaken it.
- Certain chemicals, when dissolved in water, react with free lime to form c-s-h gel. These chemicals consist of silicate ions combined with one of the metals from the left side of the periodic table: lithium, sodium, potassium, or magnesium. The silicate ions are the key to the reaction. The metallic ions are relatively unimportant, though they may play a role in how the solution penetrates the concrete.
- The c-s-h gel fills pores in the floor surface, making the concrete stronger and more resistant to wear.









OUR PLANETARY AND GEARED GRINDING MACHINES

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DENSIFICATION IS ALL ABOUT 3 ASPECTS

- **THE RIGHT GRINDING MACHINE, RIGHT TOOLS, DIAMONDS, PVC FOR GRINDING AND POLISHING PADS-30%.**
- **THE RIGHT DENSIFIER(30%).**
- **UNDERSTANDING OF FLOORING AND DESIGN ENGINEERING (40%).**

GRINDING

1. **Cutting Action**: Surface grinding utilizes bonded abrasives on rotating wheels to cut tiny chips from the concrete surface, making it an efficient cutting action rather than mere rubbing.
2. **Large Contact Area**: Unlike cylindrical grinding, surface grinding features a larger contact area, allowing for greater material removal and enhancing surface flatness.
3. **Wheel Characteristics**: The grinding wheel for surface grinding is typically softer in grade and wider, optimizing it for the demands of flat surface work and ensuring effective grinding performance.
4. **Precision and Accuracy**: The sequential process of adjusting machine components, truing the wheel, and mounting workpieces ensures high precision, allowing for accurate levelling and squaring of surfaces.
5. **Versatility**: Surface grinding is essential in various applications, including levelling, finishing, and preparing concrete surfaces for further treatments, enhancing the overall quality and durability of the final product.

GRINDING

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TYPES OF DENSIFIERS FOR CONCRETE DENSIFICATION

Sodium Silicate Densifiers:

1. **Chemical Reaction**:
    1. Sodium silicate reacts with calcium hydroxide (free lime) present in the concrete to form calcium silicate hydrate (CSH).
    2. This process fills the pores in the concrete, reducing porosity and increasing surface hardness.
2. **Advantages**:
    1. Cost-effective.
    2. Deep penetration into concrete.
3. **Limitations**:
    1. Can leave a white residue if not properly applied.
    2. Longer curing time compared to other densifiers.

Potassium Silicate Densifiers:

1. **Chemical Reaction**:
    1. Similar to sodium silicate, potassium silicate reacts with the free lime to form CSH, but it tends to penetrate deeper and react faster.
2. **Advantages**:
    1. Faster reaction time.
    2. Can provide a glossier finish.
3. **Limitations**:
    1. More expensive than sodium silicate.
    2. Can lead to efflorescence if over-applied.

TYPES OF DENSIFIERS FOR CONCRETE DENSIFICATION

LITHIUM SILICATE DENSIFIERS:

1. **Chemical Reaction**:
    1. Lithium silicate reacts with calcium hydroxide in the concrete to form CSH, similar to sodium and potassium silicates.
    2. Lithium silicates have smaller molecular structures, allowing deeper penetration into the concrete matrix.
2. **Advantages**:
    1. Reduces the risk of efflorescence (white surface deposits).
    2. Quick reaction and curing time.
    3. Provides excellent abrasion resistance and sheen.
3. **Limitations**:
    1. Higher cost compared to sodium or potassium silicate.

COLLOIDAL SILICA DENSIFIERS:

1. **Chemical Reaction**:
    1. Colloidal silica particles react with free lime and other calcium compounds in the concrete to form CSH.
    2. It fills the capillaries and voids within the concrete, increasing density and hardness.
2. **Advantages**:
    1. Fast-acting.
    2. High-quality finish with a polished sheen.
    3. Excellent abrasion and stain resistance.
3. **Limitations**:
    1. More expensive compared to silicate-based densifiers.
    2. May not penetrate as deeply as silicate densifiers.

TYPES OF DENSIFIERS FOR CONCRETE DENSIFICATION

Hybrid Densifiers (Combination of Lithium and Colloidal Silica):

1. **Chemical Reaction**:
    1. A combination of lithium silicate and colloidal silica densifies concrete by enhancing both surface hardness and deeper penetration.
2. **Advantages**:
    1. Combines the benefits of fast reactivity and deep penetration.
    2. Offers high strength and shine, along with a low risk of efflorescence.
3. **Limitations**:
    1. Higher price point.
    2. Requires skilled application for optimal performance.

POLISHING

- Polishing removes small amounts of material to create a smooth or glossy surface.
- It uses cushion wheels impregnated or coated with abrasives.
- Used to reduce or smooth surfaces for high-finish applications or to remove material from irregular contours.
- Rough polishing uses abrasives of No. 60 grain or coarser.


DVF Process

BUFFING

- Buffing smooths the surface using plastic flow of material more than abrasion.
- Finer abrasives are used compared to polishing, held by grease cakes or similar substances.
- Produces a high-luster finish without much regard to accuracy in dimension or plane.
- Colour buffing imparts high lustre with soft abrasives and buffing wheels.

PROCESS OVERVIEW:

1. **Surface Preparation:**
    1. Begin by cleaning and drying the base surface to remove any dirt or debris.
    2. Open the concrete pores using a grinder to eliminate minor blemishes, scratches, or stains.
2. **Application of Liquid Densifier:**
    1. Apply liquid densifier to harden and strengthen the surface, improving durability.
    2. Common densifier products: *SIKA Sikafloor® CureHard-24*, *SURIE POLEX Densi-Hard*, *BASF MASTERTOP™ 33*, or equivalent.
3. **Grinding & Polishing:**
    1. **Step 1-3: Coarse Grinding**: Grind the surface using a 60/100 grit resin-bond to remove imperfections and refine the surface.
    2. **Step 4-5: Medium Grinding**: Use a 200-grit resin-bond to smooth out the surface.
    3. **Step 6-7: Fine Polishing**: Polish using progressively finer abrasives (400 grit to 800 grit), achieving a smooth and semi-gloss finish.
    4. **Step 8-12: High Gloss Finish**: Polish with 1500 to 3000 grit for a high-gloss, reflective surface, ideal for higher aesthetic requirements.

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KEY POLISHING SYSTEMS:

1-5-Step Polishing:

1. Basic process for functional and cost-effective flooring.
2. Suitable for medium-traffic areas.
3. Delivers a smooth, semi-reflective finish.

5-7-Step Polishing:

1. Provides enhanced durability and appearance.
2. Used for Industrial & Warehousefloors where aesthetics and resilience are equally important.
3. Achieves a glossy, polished surface with improved light reflectivity.

7-12-Step Polishing:

1. The highest level of refinement, resulting in a mirror-like, ultra-glossy finish.
2. Suitable for high-end commercial applications with superior stain resistance and aesthetics.
3. Offers the best reflective properties, slip resistance, and surface durability.

BENEFITS OF Ddensified CONCRETE FLOORS:

- **Sustainable Design**: Utilizes the existing concrete material, reducing the need for new resources.
- **Non-Slippery Surface**: Despite the glossy finish, the high coefficient of friction ensures slip resistance.
- **Enhanced Lighting**: Reflective surfaces can reduce the need for artificial lighting and improve natural light distribution.
- **Dust and Allergen Control**: Seals capillary pores, reducing dust mite and allergen buildup.
- **Surface Hardness**: Increases the hardness of the top concrete surface, improving durability.
- **Abrasion Resistance**: Significantly improves resistance to wear and tear over standard concrete.
- **Dustproofing**: Seals pores, preventing dust generation and keeping the surface clean.
- **Tire Marks Reduction**: The hard surface finish minimizes tire marks, making it ideal for industrial use.
- **Low Maintenance**: Easy to clean with water or neutral pH cleaners, eliminating the need for waxing or coatings.
- **Durability**: Resistant to chipping and denting, unlike softer surfaces like wood or tile.
- **Stain Resistance**: Highly resistant to spills and stains, maintaining a clean appearance.
- **Cost-Effective**: Long-lasting performance with minimal maintenance costs, leading to significant savings.
- **Aesthetic Appeal**: Reflective surfaces enhance ambient lighting, creating a bright, professional look.
- **Eco-Friendly**: No harsh chemicals used in the process; contributes to sustainable building practices.
- **Operational Efficiency**: Quick installation with minimal disruption, allowing businesses to continue operations smoothly.

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Haier
Inspired Living
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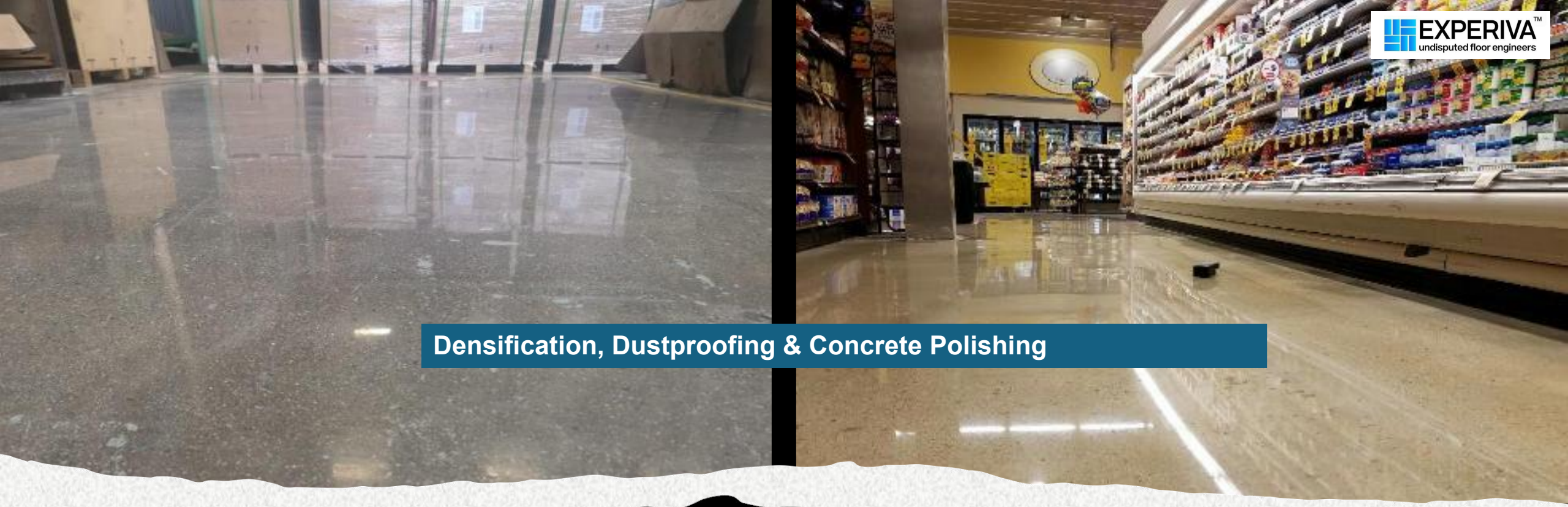
Genie S-65 MACO
Genie


amazon
710



Densification, Dustproofing & Concrete Polishing

DUPONT, SHONA

- LOTS RETAIL SHOP

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Densification, Dustproofing & Concrete Polishing

HALDIRAM SEC-68, NOIDA

EICHER, BHOPAL

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Densification, Dustproofing & Concrete Polishing

MUNDRA MASTER BATCH, SONIPAT

FASHION FOR EVER, GURGOAN

GMR-HOSUR, BANGLORE

- Name of the site: **GMR (Contractor-Pragati Infra Solutions Pvt Ltd)**
- Key highlights: Area-9,00,000.00, order worth-3.64 cr

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FLIPKART- MORGAN STAINLY- PRAGATI INFRA

- Name of the site: FLIPKART, FARUKHNAGAR
- Key highlights: Area 700000SQF,
- 2.2 Cr

DHL/MONDELEZ WAREHOUSE LUCKNOW

- Name of the site: DHL/MONDELEZ (BG LINK LLP)
- Key highlights: Area 4,50,000SQF, 7.06 Cr
- Pictures with captions

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Clientel

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THANK YOU

TAJ MAHAL HAVE NOT BEEN SO BEAUTIFUL

“IF SHAHJAHAN ASKED FOR THREE QUOTATION AND DECIDE FOR THE LOWEST”