Markolines®

India’s Largest Highway Maintenance Company

Introduction to our Specialized Offerings for Maintenance, Rehabilitation and Reconstruction of Roads/Highways


Markolines
WR 240
WIRTGEN
WIRTGEN
PAVING THE PATH
TOWARDS AN INNOVATIVE
FUTURE USING STATE OF
THE ART TECHNOLOGY.
www.markolines.com

ABOUT US

Founded in 2002
with single product
Road Marking

India's Largest company
providing **end to end**
solutions in Highway
Maintenance

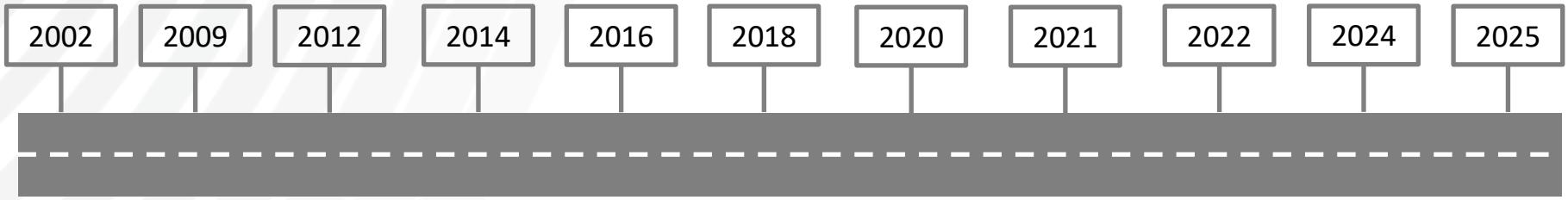
India's 1st Highway
Maintenance Company
listed on BSE Platform".

Vision:
"To be Leading MNC
providing Latest and
Innovative
Technologies in Highway
Maintenance."

PAN India
presence

Exclusive
Technology Centre
for Pavement Préservation

MARKOLINES JOURNEY



2002
- Incorporated Mark-O-line Traffic Controls Pvt. Ltd.
- Started Thermoplastic Road Marking
- Introduced the extrusion technology for road marking in India

2009
- Ventured into Highway Operation & Maintenance

2012
- 10 Toll Plazas under management within a short span of three years

2014
- Ventured in Microsurfacing
- Partnered With Bergkamp Inc. USA For Microsurfacing
- Established the Technology Centre for Pavement Preservation

2016
- Started Major Maintenance & Repairs (MMR) for highways
- Received a single order of 125 kms for MMR which was worth 1.5 times of the earlier year's turnover

2018
- Ventured into Cold-in-place Recycling (CIPR).
- Executed First Airport Maintenance Project in India.

2020
- Executed India's Largest BSM/CIPR of 152 Lane Kms/6.35 Lakh Sqm
- Single Largest Work Order For Microsurfacing (13.21 Lakh Sqm)

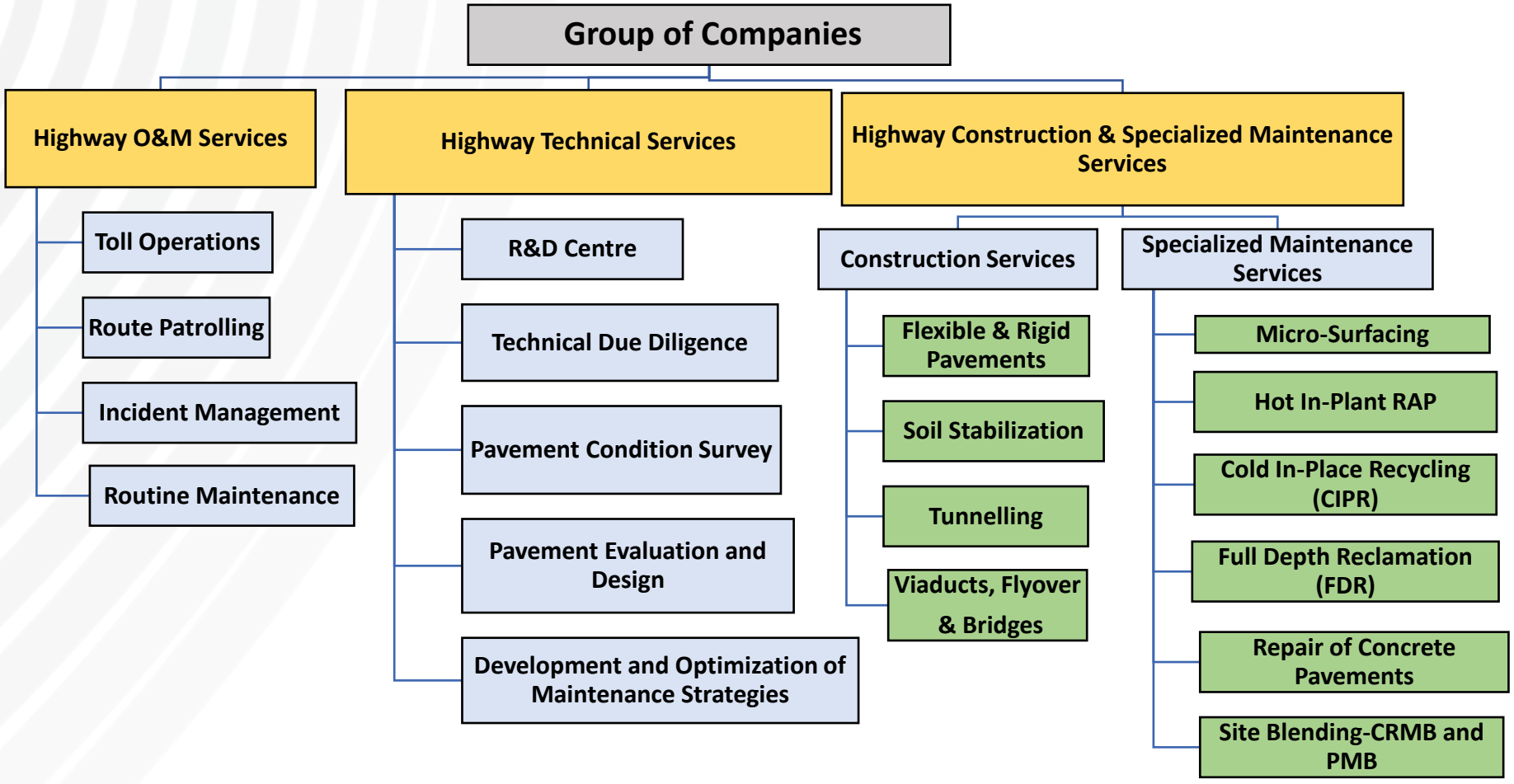
2021
- Company Got Listed Successfully On Bombay Stock Exchange (B.S.E.)
- Company Name Changed To Markolines Pavement Technologies Limited

2022
- Widening of existing carriageway from 3.0 mtr to 5.5 mtr with FDR Technology.
- Ventured in Tunnelling business

2024
- Ventured in Rigid Pavement Maintenance
- Ventured into Mastic Production in MMR Region

2025
- Migration to BSE Main Board (Applied For).
- Merger of Markolines Infra Ltd. Into Markolines Pavement Technologies Ltd. (Proposed)

Our Portfolio



Various treatments based on pavement condition as per IRC 82-2015, FWD analysis

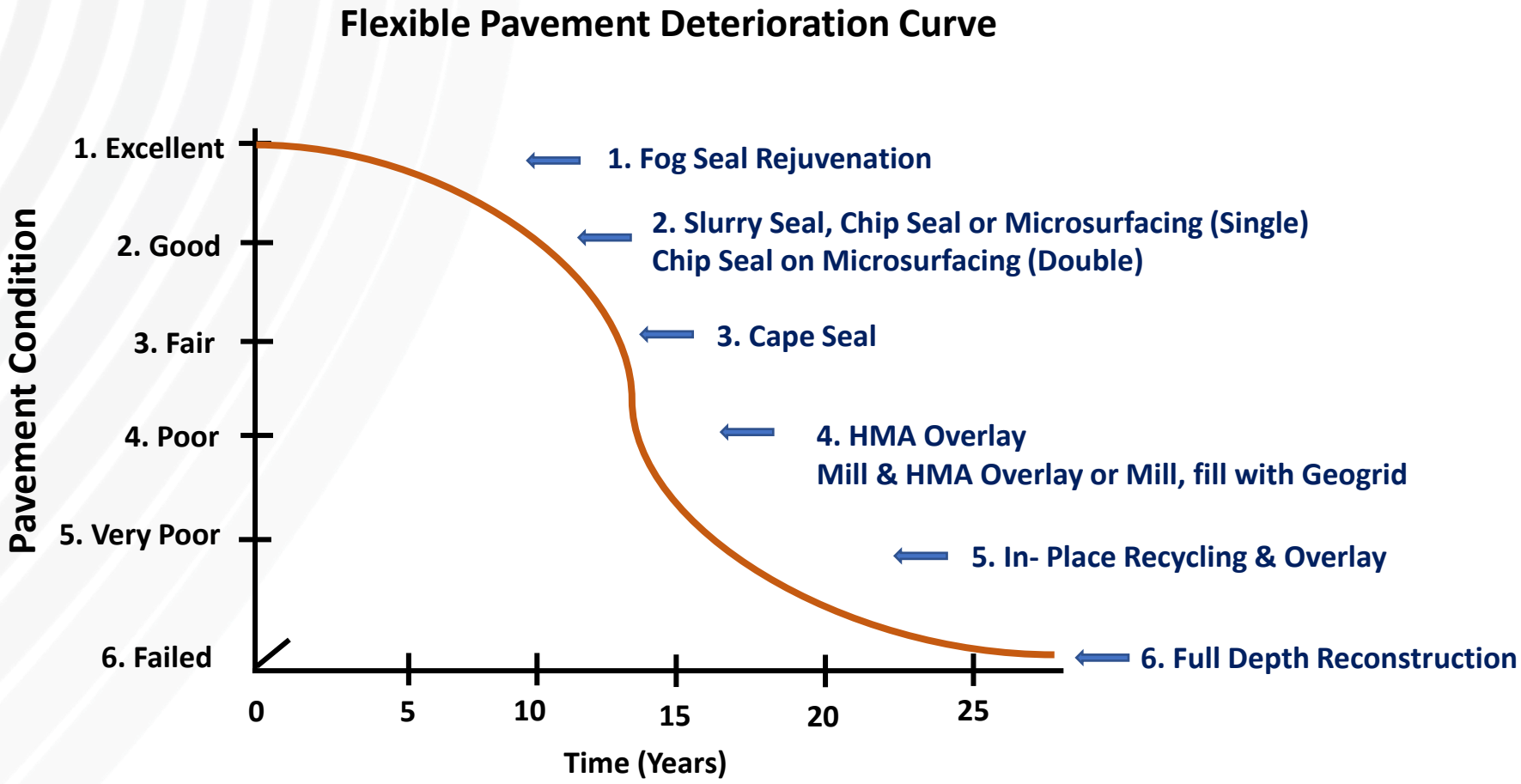


Fig:- Methods of Rehabilitation Based on Pavement Condition

Various potential treatment solutions at varying level of distress

Preventive Treatments

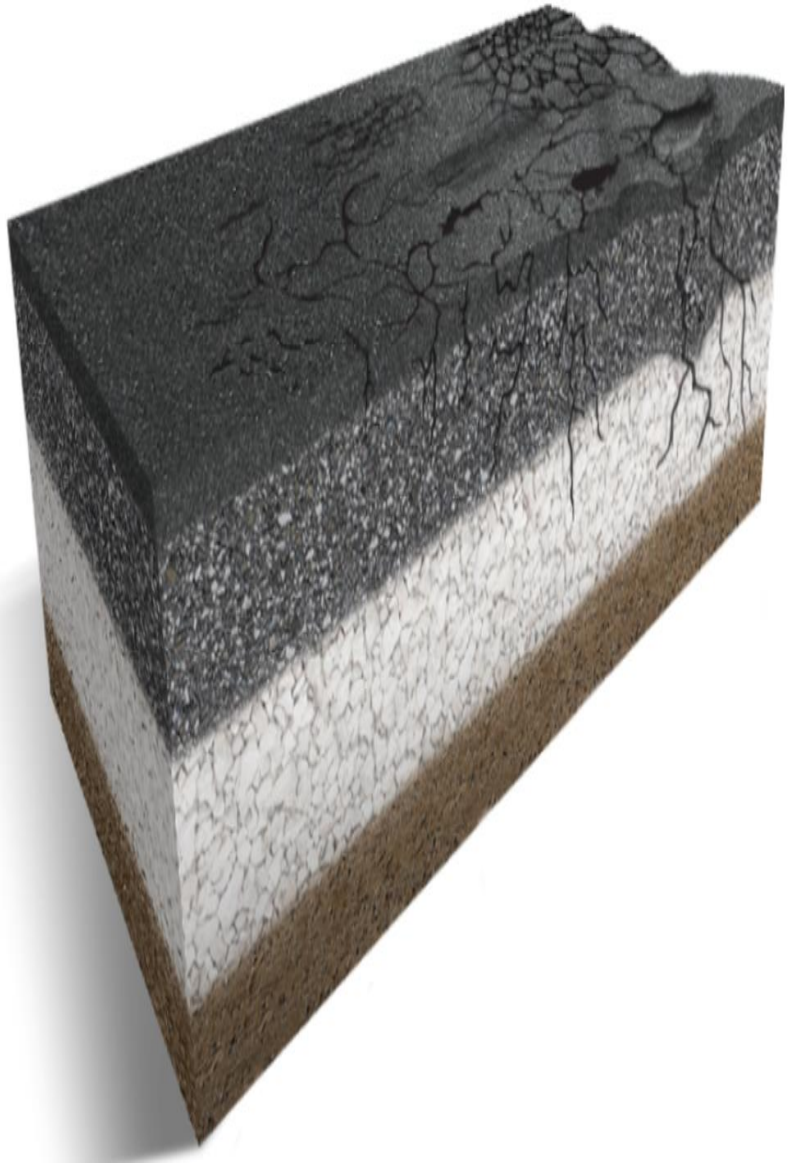
Fog Seal
Rejuvenating Fog Seal
Slurry Seal
Micro Surfacing
Cape Seal
Ultra Thin Lift HMA
Chip Seal/Surface Dressing
Crack Seal
Scrub Seal

Tack Coat
Prime Coat

Reactive/Major Rehab Treatments

Cold Planing & Micro Milling
Hot In-place Recycling
Cold In-place Recycling
Cold Central Plant Recycling
Full Depth Reclamation

Base Stabilization
Soil Stabilization & Soil Modification



INTRODUCTION TO MICROSURFACING- ROADS PRESERVATION TREATMENT

PROCESS

It is an eco-friendly laboratory designed mixture of Polymer modified emulsion, aggregates, mineral filler, water and other additives accurately proportioned, mixed and uniformly spread over a properly prepared surface

TYPES

Available as Type II (4 to 6 mm thick) and Type III (6 to 8 mm thick).

USES

Can be used both for Preventive Maintenance (to prevent surface distresses on good pavement) and Corrective Maintenance (to correct surface distresses like rutting on older pavement)

APPROVALS

- IRC: SP: 81-2008 : Tentative Specifications for Slurry Seal & Microsurfacing.
- Ministry of Road Transport & Highways (MoRTH – Fifth Edition (2013), Clause – 514)
- IRC:SP:100-2014 : Use of Cold Mix Technology in Construction of Road & Maintenance by Emulsions.
- MoRTH letter dated 28th Sep. 2016 mandating use of Micro Surfacing for renewal course , maintenance and repair on National Highways

MICRO SURFACING COMPONENTS

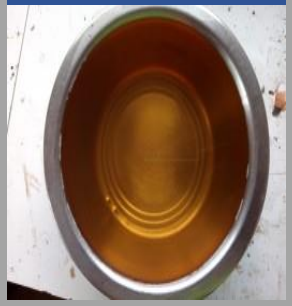
PREMIUM AGGREGATE

STONE DUST

CEMENT

MODIFIED EMULSION

ADDITIVE



WATER

MICROSURFACING MIX DESIGN

Particulars	Type II 4 – 6 mm	Type III 6 – 8 mm
Premium Quality Aggregate	8.4 to 10.8 kg per sqm.	11.1 to 16.3 kg per sqm.
Binder (Polymer Modified Emulsion)	13 – 15% by weight of aggregate	10 – 15% by weight of aggregate
Additive	Up to 2% by wt of aggregate	Up to 2% by wt of aggregate
Cement/Filler	0.5 – 2.0% by weight of aggregate	0.5 – 2.0% by weight of aggregate
Water	13 – 15% by weight of aggregate	10-15 % by weight of aggregate

APPLICATION METHODOLOGY

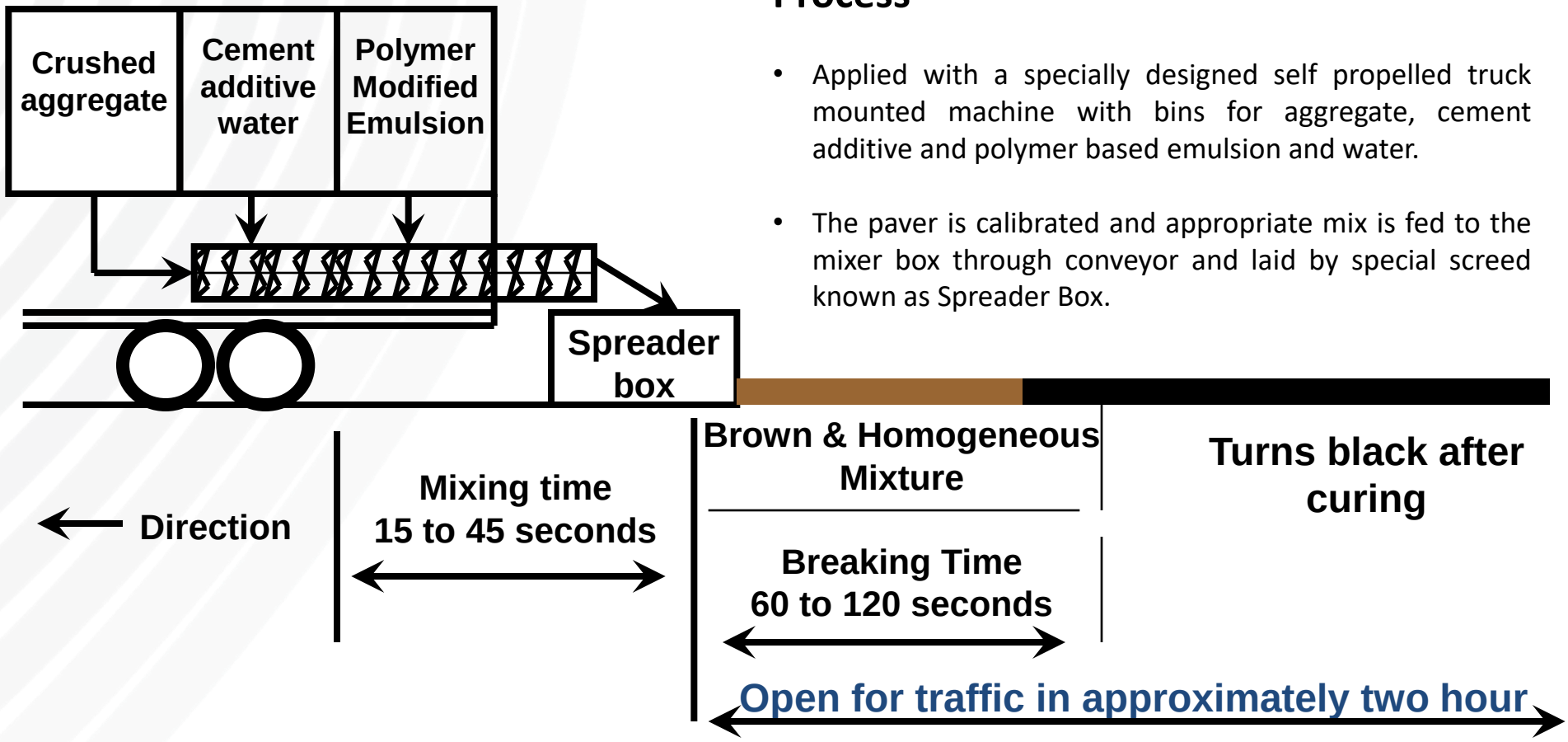
Markolines

Prerequisite:

- Clean surface to ensure its free of dust and soil etc.
- Fill pot holes, cracks and Ruts.

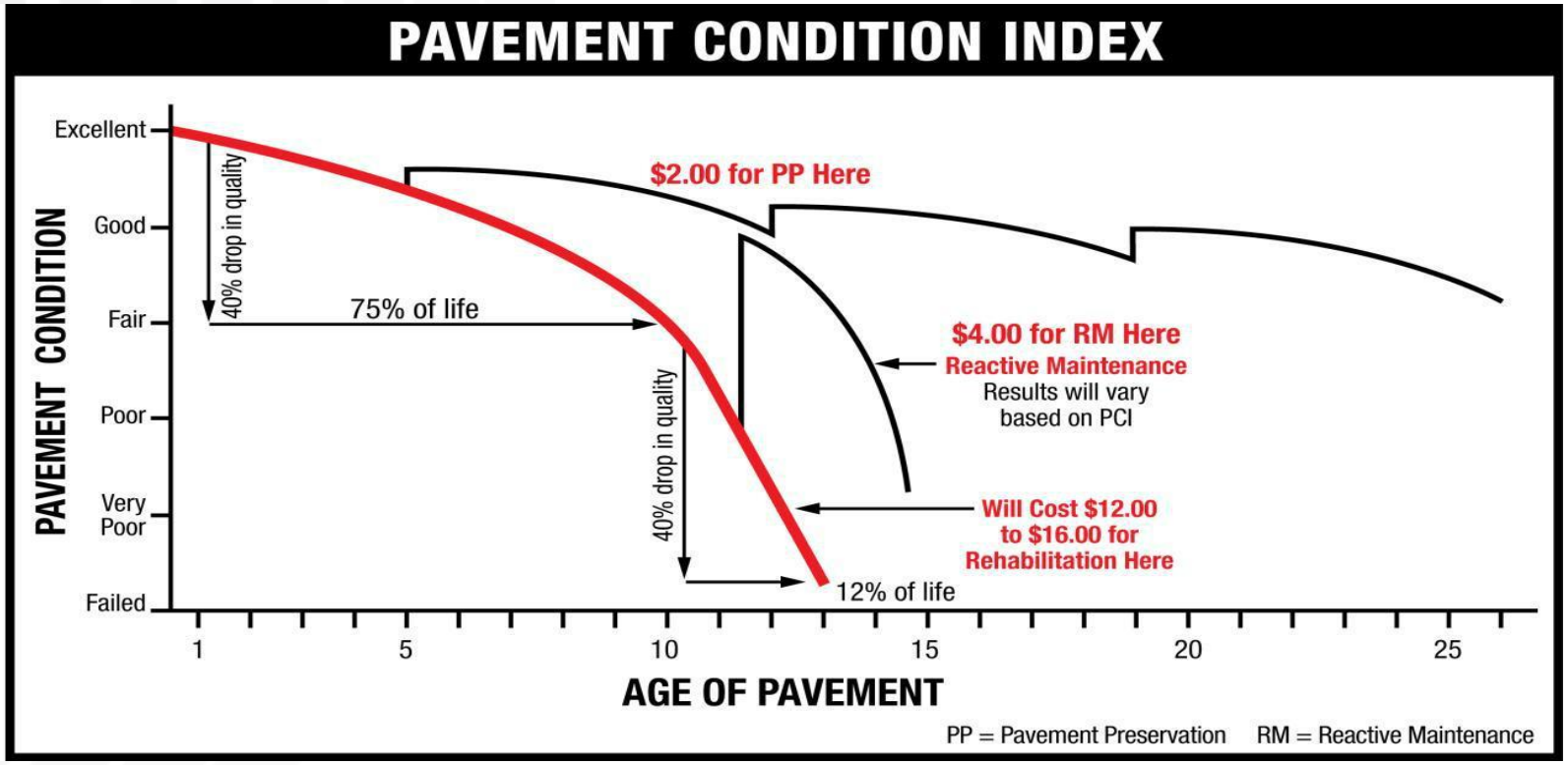
Process

- Applied with a specially designed self propelled truck mounted machine with bins for aggregate, cement additive and polymer based emulsion and water.
- The paver is calibrated and appropriate mix is fed to the mixer box through conveyor and laid by special screed known as Spreader Box.



ADVANTAGES

- Quick Application with minimum traffic hold up and traffic opening in max 2 hrs, causes minimum traffic disruption. Night placement is possible.
- Cost effective as compared to Hot-Mix (BC) and extends life span of the road.
- Rectifies surface defects and Ruts including minor cracks, hungry surface due to ageing & surface Oxidation.
- Environment friendly - Nonpolluting for environment since no heating or hot paving required
- Restores surface structure, slows the age hardening in the original road surface.
- Microsurfacing can also be done on concrete pavement to improve the riding quality. It reduces Tyre burst of Cars and ensure smother ride with less noise.
- Seals the surface and prevents ingress of water as it is a dense bitumen rich mix having polymer bitumen from 6.8% to 7.5%.
- Does not increase pavement height significantly (Road furniture, drainage is not disturbed). Saving of Natural resources.



Proper Timing Reduces Costs

- **Preventive:** Three preservation treatments over 25 years cost $2/yd^2 per treatment for a total cost of **$6/yd^2 over the life of the road**.
- **Reactive:** Using pavement preservation after not treating for 11 years costs $4/yd^2 and **only lasts about four years between treatments** due to a deteriorated road base structure.
- **Rehabilitation:** Not treating for 12 or more years will result in a required mill and fill or full rehabilitation with a cost **upwards of $12 to $16/yd^2**.

Source: International Slurry Surfacing Assn, U.S.A

INNOVATIONS IN MICRO SURFACING

- **Highly Modified Micro surfacing** - Protects road in Demanding situations and gives High pavement life - Very Heavy Traffic, extreme temperatures
  - 4.5 %+ Polymer Loadings
  - Often with Polymer Modified Bitumen
- **Fiberized Micro surfacing**
  - 2% Pre-cut special grade Fiberglass is added with special equipment to the mix. The fibers form a mesh to provide longer life, resistance to raveling , increase flexibility and delay reflective cracking.

Photo of Attachment - for Adding Slurry Fil Glass Fiber

Slurry Fil fibers being added on Aggregate belt prior to discharge in Mixer box.

MICRO SURFACING WITH FIBRES

BEFORE

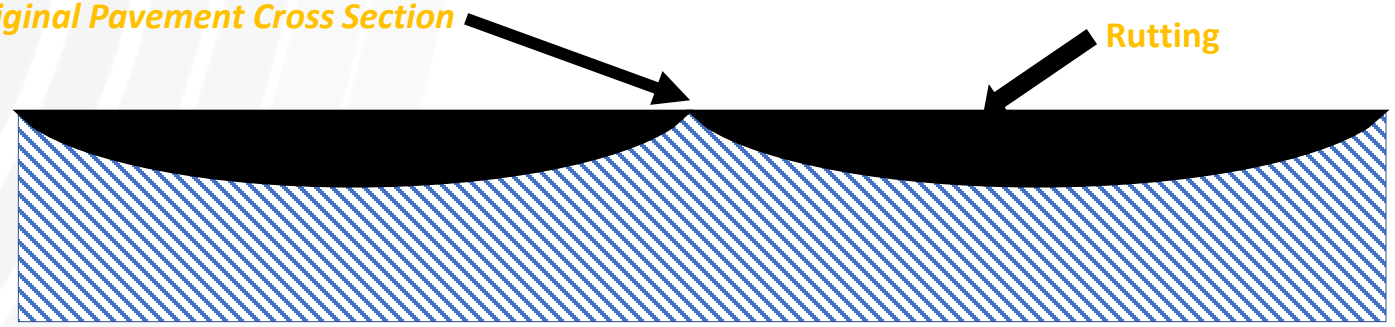
AFTER

MULTI-LAYER SYSTEMS

- Can be laid in Double or multiple lifts.
- Combination Treatments
  - ✓ Cape Seals
    - Micro surfacing provided over Chip Seal/ Surface dressing
  - ✓ Triple Seals
    - Micro surfacing used as Rut Course followed by
    - Chip Seal followed by
    - Micro surface course
  - ✓ Micro surfacing Leveling/ PCC Course w/HMA Overlay
  - ✓ Fog Seal over Micro Surfacing
  - ✓ Micro surfacing can be done on pre mix carpet without seal coat and on DBM thereby eliminating costly BC treatment
  - ✓ On Cement concrete road Micro-surfacing is done in two layers as recommended in IRC SP: 100

REPROFILING RUTTED WHEELPATHS WITH MICROSURFACING

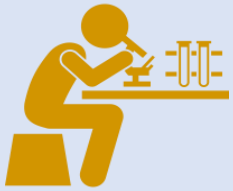
For each inch of applied micro surface mix add 1/8” to 1/4” crown to each rut fill to compensate for return traffic compaction



RUTS 1/2 “ & OVER MUST USE THE RUT BOX

OUR EXPERTISE IN MICROSURFACING

Executed more than 113.70 LAC SQM (equivalent to 2900 lane Kms) of Microsurfacing



Technology Centre for pavement preservation solutions

Ownership of Microsurfacing pavers

Tie-up with international organizations such as Bergkamp, Ingevity and Owens Corning for technical back-up

Experienced & Well-Trained Execution Team

Quality of finished Microsurfacing project greatly depends on the quality of Emulsion and Aggregates..

POST - APPLICATION

Photo Gallery (Before Work)

BMC– Eastern Expressway Project

Photo Gallery (After Work)

BMC – Eastern Expressway Project

Photo Gallery (Construction Activity)

BMC – Eastern Expressway Project

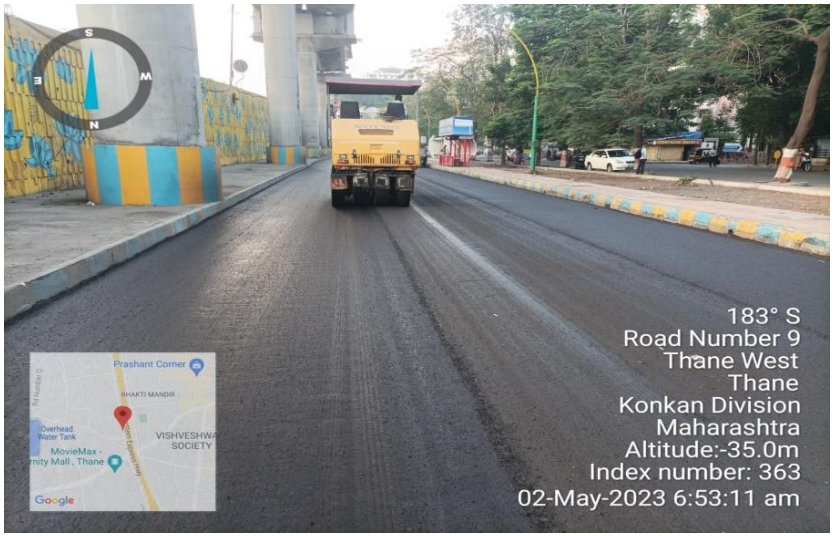
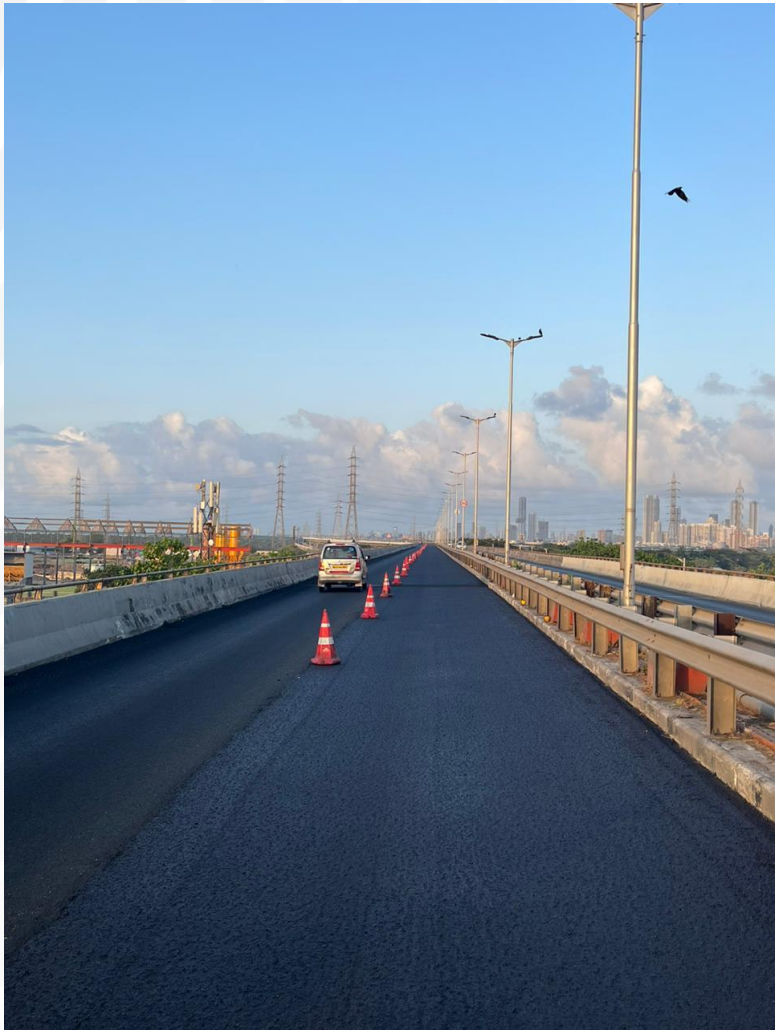
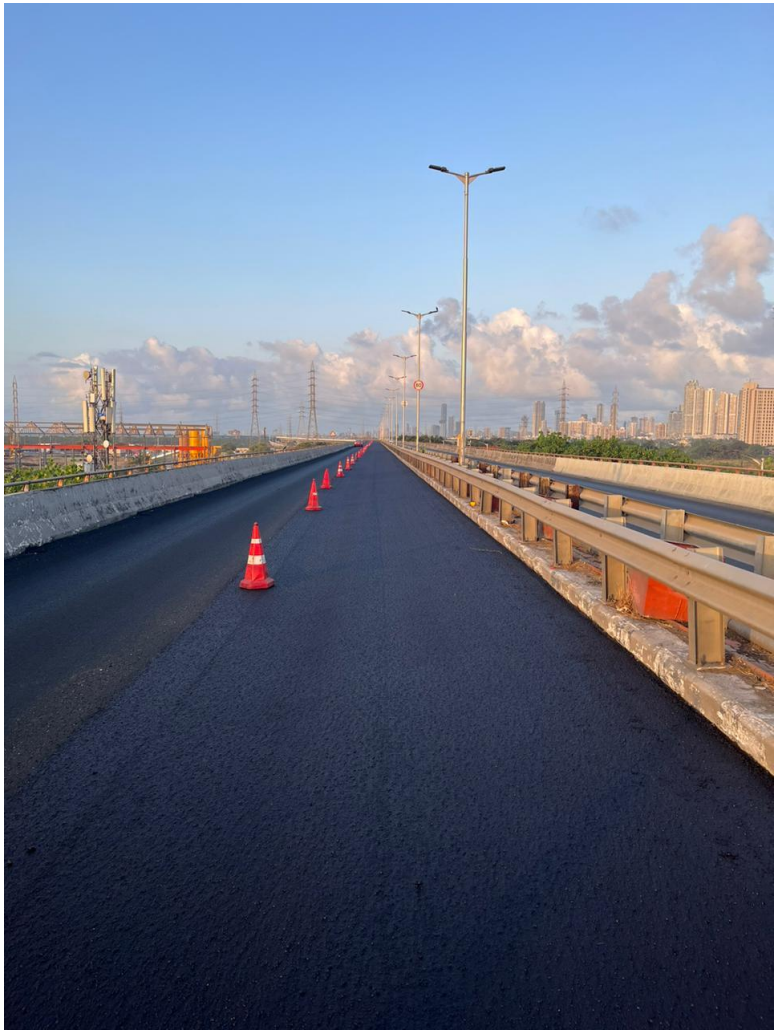


Photo Gallery (Work in Progress)

MCGM – Eastern Freeway Project





Markolines

Micro surfacing is a versatile product that has many uses beyond surface sealing of roadways.

First project in India, where highly modified Micro surfacing with fibres was executed on an active runway at Ahmedabad Airport Sep 2018 of AAI.

Photo Gallery- Microsurfacing

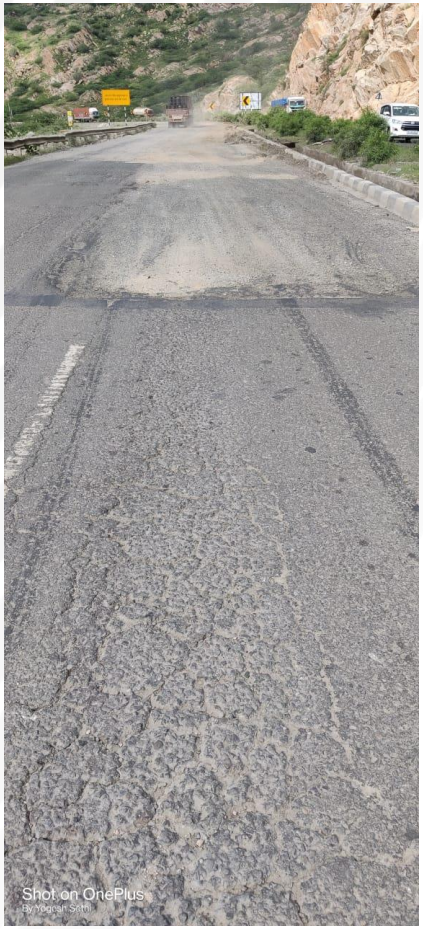


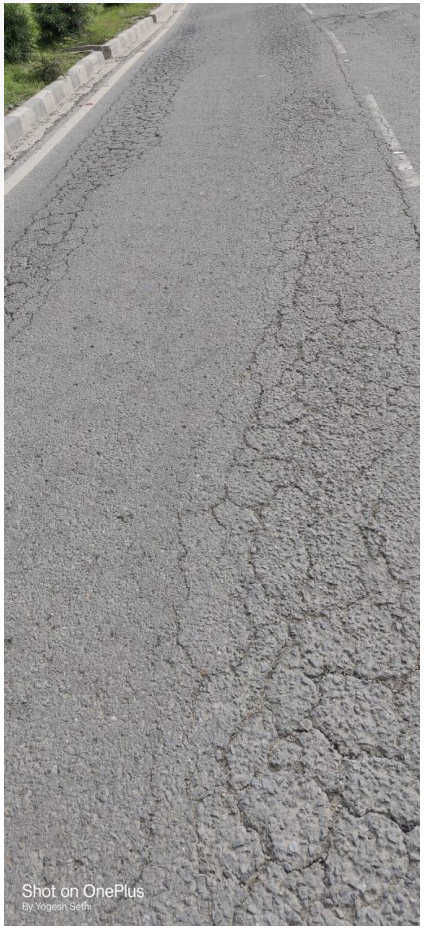



Right Materials , Machinery and Manpower are crucial factor in determining the success of Microsurfacing

MILL & FILL- REHABILITATION WITH GLASS GRID

Road Condition prior Glass Grid work





MILL & FILL- REHABILITATION WITH GLASS GRID

Distressed Existing Surface

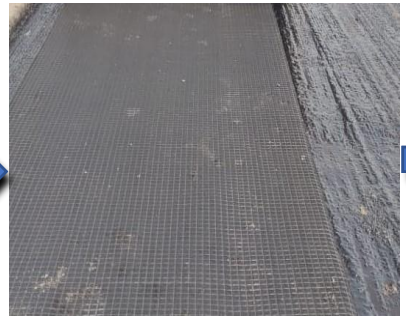
Milling Machine to mill the distressed layer

Broomer & Compressor used for cleaning

Cracked Surface after Milling up to required thickness

Applying tack coat at rate of 1 Kg/sqm for Glass grid installation

Fixing Glass Grid by rolling with PTR on cracked surface

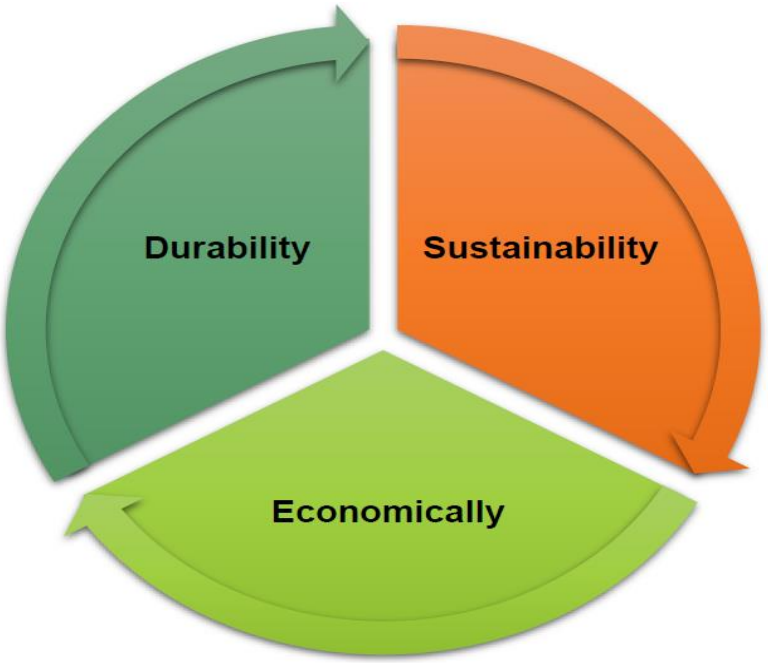


Glass grid after fixing

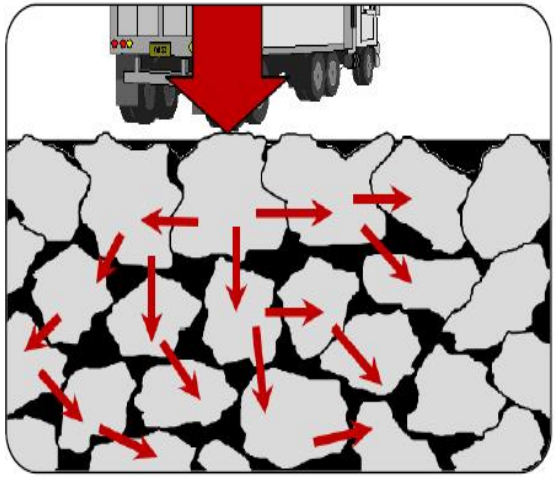
BT laying

Stone Matrix Asphalt (SMA)

- Stone Matrix Asphalt (SMA) is a durable and long-lasting pavement technology that enhances road performance and its longevity.
- With its high resistance to rutting and cracking, SMA is an ideal choice for high traffic roads, highways and port roads.
- Stone Matrix Asphalt is a gap-graded mix that consists of a high proportion of coarse aggregates, providing superior stone-to-stone contact.
- This dense structure enhances resistance to deformation and cracking, making it an excellent choice for heavy traffic loads.

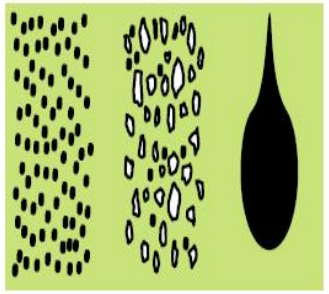


Stone Matrix Asphalt (SMA)



Stones to Stone /Stone Matrix

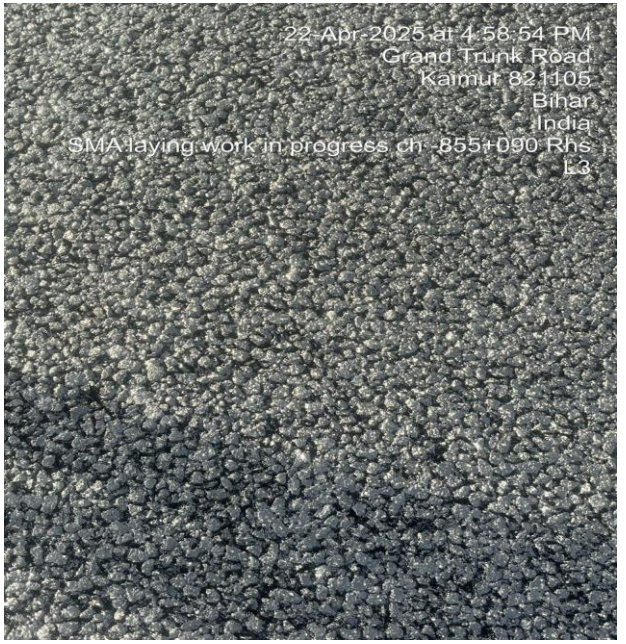
Stone Matrix Asphalt (SMA)

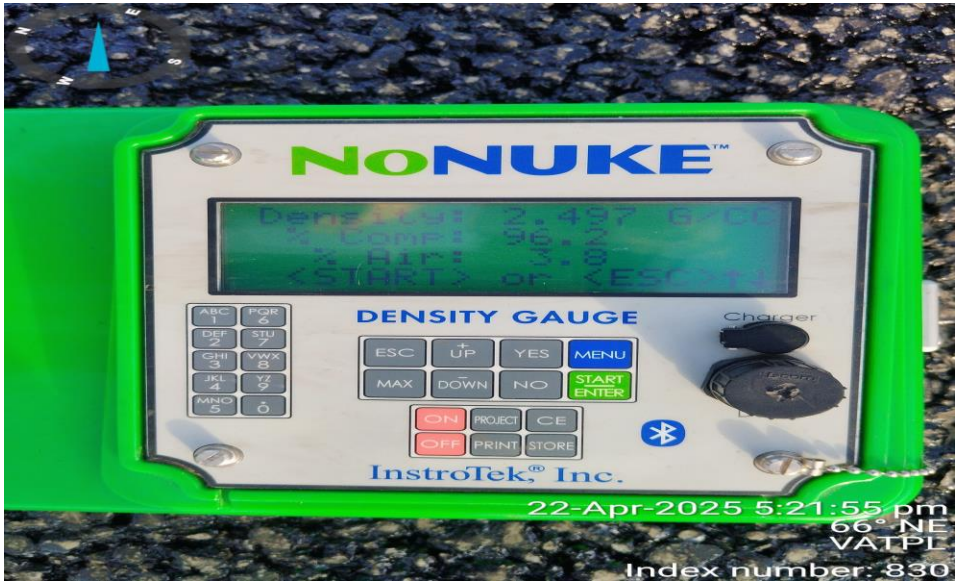


Fine Aggregate/Filler/ Bitumen

Fiber

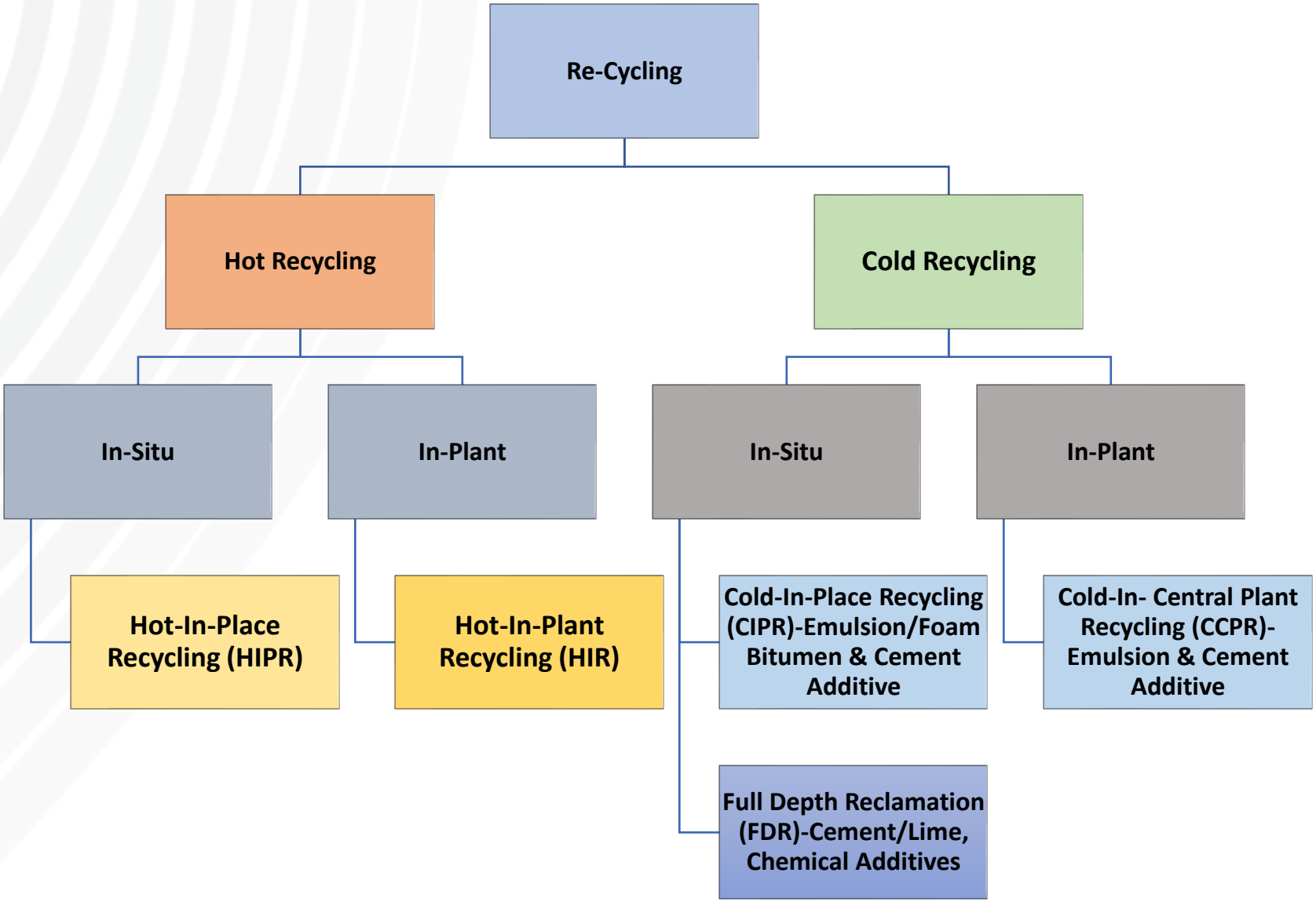
Stone Matrix Asphalt





Reclamation & Re-Cycling

The process in which the existing pavement materials are reclaimed and re-used after reprocessing.



Hot-In Plant Recycling

- Process of using ***Reclaimed Asphalt Pavement (RAP)***, heating it in a central plant

''Reclaimed Asphalt Pavement (RAP)- is old asphalt pavement that is milled up or ripped off the highway/Roadway. This material can be reused in new asphalt mixtures because the components of the mix—the asphalt binder & Aggregate **still have value.''**

- This process involves producing and laying hot mix asphalt using a blend of Reclaimed Asphalt Pavement (RAP) from stockpiles along with fresh aggregates and Virgin binder to meet design specifications.

10-50% RAP or more can be utilized

Type of Plant is Critical

Virgin Aggregate require to match the gradation and mechanical properties

Hot-In Plant Recycling

Few Considerations:

- Type of Plant (Conventional Batch Plant, Double Barrel, Parallel Drum)
- Amount of RAP-(20%, 30%, 40%, 60%, 100%)
- Quality of RAP
- Selection of Rejuvenators for High RAP
- Fractionalization of RAP In Screening Plant
- Mix Design & Selection of Binder

**Use of Rejuvenator

- If RAP is limited to 20%, no rejuvenators are required, and the RAP can be added as cold RAP into a pug mill
- If 20 to 50% RAP has to be used in the design of bituminous mix, a suitable rejuvenator has to be added

Hot-In Plant Recycling

Selection of Plant

- **If RAP is limited to 20%-**A conventional Batch Mix Plant with RAP feeding mechanism into the pug mill can be used.
- **If 20 to 50% -** RAP has to be heated using a double barrel hot mix plant or a parallel dryer drum for heating the RAP. It is recommended to use the process of fractionation when 20-50% RAP material is used.

Screening of RAP and Stockpiling

It is the process of screening the RAP into 2 or 3 fractions. Generally, they are:

- 20-10 mm
- 10-4.75 mm
- 4.75mm Down

The advantage of Screening of RAP and having stockpiles of different sizes provides more flexibility and control in meeting the mix design requirements.

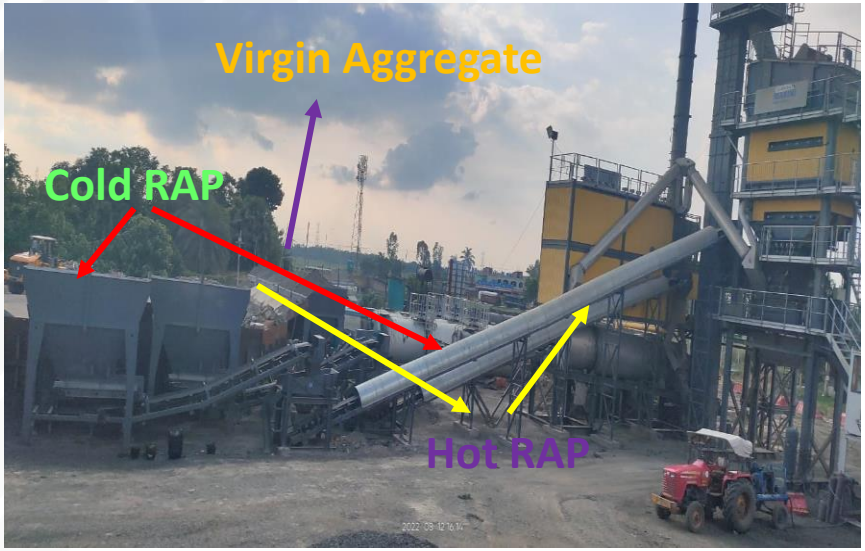
Advantages of Using RAP

- Reduced Materials Costs
- Conservation of natural resources
- Reduced landfill wastes
- Energy savings
- Sustainable construction practice

HOT IN PLANT RECLAIMED ASPHALT PAVEMENT (RAP)

HMP with RAP attachment...37% RAP used in DBM at FRHL Project.

HOT IN PLANT RAP



HMP with RAP attachment...37% RAP used in DBM at FRHL Project.

HMP with RAP attachment...25% RAP used in DBM at MBEL Project.

Production of Mastic by HMP at Ulwe and delivery by Cookers in MMR

WHAT IS CIPR

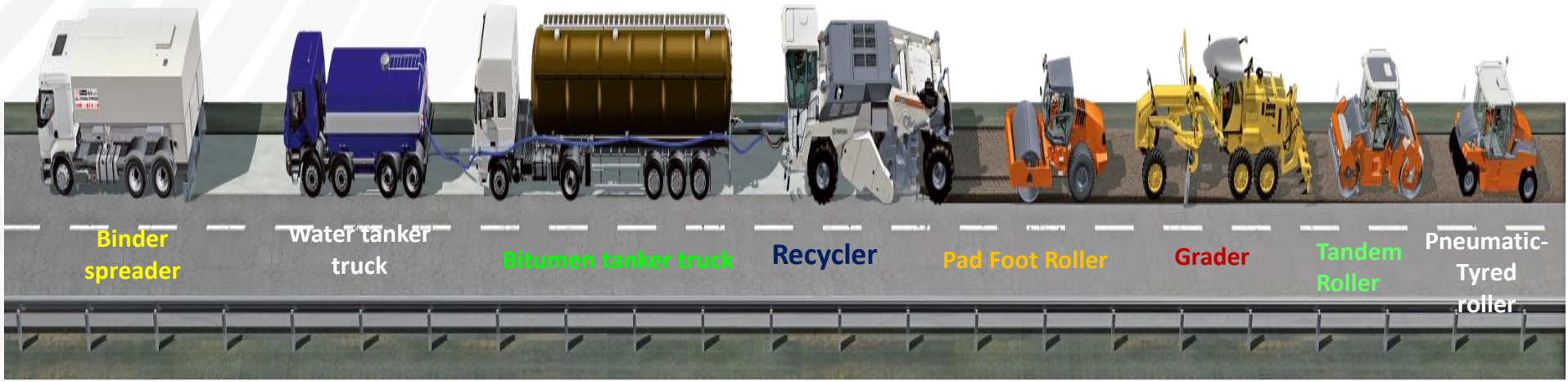
Asphalt Recycling and Reclaiming Association (ARRA) defines CIR as "**recycling of asphalt pavement without the application of heat during the recycling process to produce a rehabilitated pavement**".

In simple words, Cold-in-Place (CIR) recycling is a method of removing and reusing the existing asphalt surface. It involves grinding off the top layer (up to 200mm) of the existing asphalt surface and mixing the crushed asphalt with foamed bitumen and placing it back down with a recycler and allied machinery.

The cold-in-place process is typically performed using a "train" of equipment which includes a water tanker, bitumen tanker, recycler, rollers and graders.

CIPR MACHINERY TRAIN

Recycling with pre-spread cement and bitumen



WHERE CIPR CAN BE USED

CIPR can be used for rehabilitation of NH /MDR/Runways/ Port roads etc.

Alligator Cracks

Rutting (ideal candidate for CIPR)

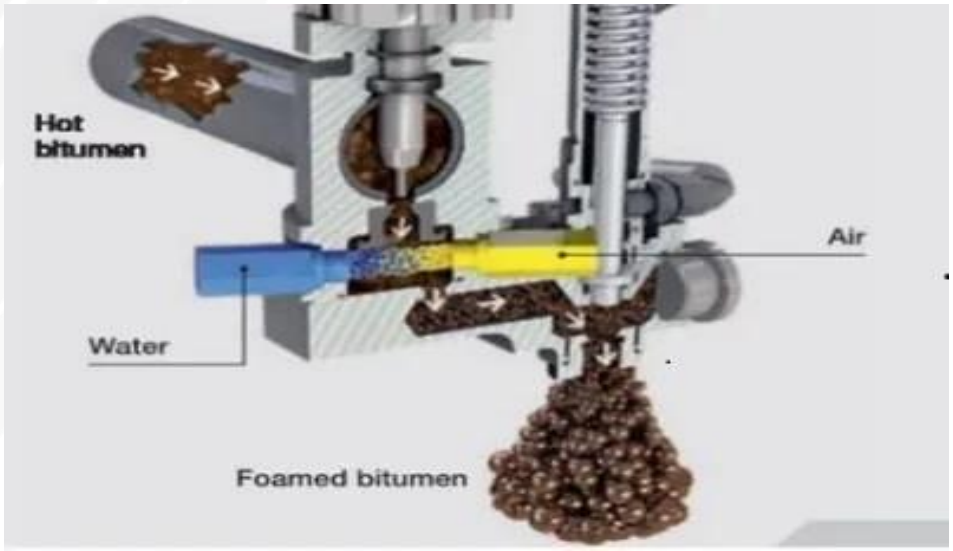
Patched

Dry Ravelled

MIX-DESIGN FOR CIPR

Materials

- RAP (Existing road) upto 70% subject to Mix design
- Fresh aggregate
- Cement 1% maximum
- Water as per Mix design
- Foamed Bitumen (VG30) maximum 2.5%



Foaming process

CIPR with Foamed Bitumen – Construction Process

Spreading of Aggregate with Grader as per design proportion

Spreading of Cement with microprocessor controlled spreader truck

Milling & pulverisation by WR240 Wirtgen Recycler

The sheep foot roller for compacting top layer

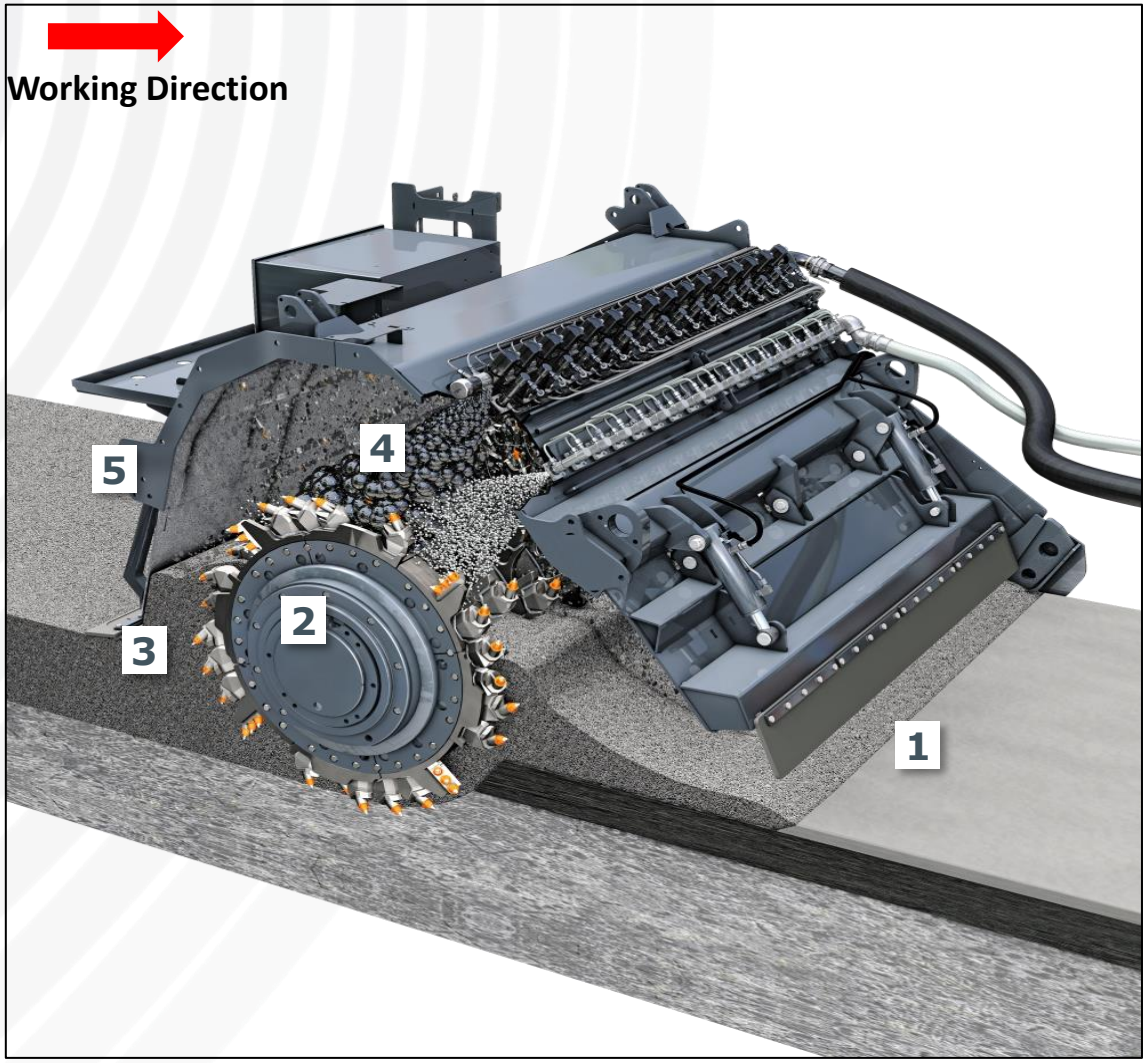
Maintaining the grade & profile of recycled surface with Grader

Compaction with Single Drum smooth wheeled soil compactor

Tandem roller for sealing top layer

Pneumatic Tyre Roller for finishing surface

CIPR USING FOAMED BITUMEN



Cold recycling

The milling and mixing rotor mills and granulates the asphalt layers. Binders and water are added via injection bars and mixed in to produce a homogeneous recycled material

1. Pre-spread Aggregate and Cement
2. Inject Water
3. Inject air resulting in Foaming of Bitumen
4. Milling and Mixing Rotor
5. Recycled, Homogeneous construction Material

CIPR USING FOAMED BITUMEN

Foamed Bitumen treatment is a stabilising process

- Bubbles of foam are thin films of bitumen (low viscosity) surrounding expanded water vapour (steam)
- These bubbles burst into small bitumen particles when mixed with aggregate
- Small bitumen particles can only adhere to the fine material
- The resulting mix is comprised of uncoated coarse granular particle with millions of sticky elastic “spots” in the mortar that hold aggregate together (spot welding). It is not coating of aggregates as in bitumen mixes.

ADVANTAGES OF CIPR

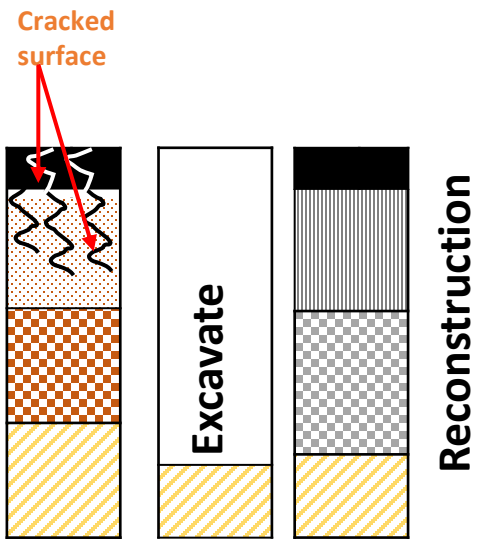
 **SAVINGS**	• Aggregates from the existing pavement is re-used • Since the plant is at site, there is reduction in transportation and fuel costs • Time-saving technique, as transportation of MIX from plant to site is eliminated
 **GREEN TECHNOLOGY**	• Conservation of natural resources – as existing pavement is used, and less energy is consumed in the overall process • Environment friendly as emission of gases is reduced
 **OTHER BENEFITS**	• CIR overlay lasts *10-15 years as compared to 5-8 years of traditional overlay • Shorter construction period, due to high production capacity of recycling machines • Minimum traffic disruption- process is carried on one half of the road, leaving the other half open to traffic **Subject to traffic and overloading*

STRUCTURAL REHABILITATION METHODS

Option -1 (Convectional)

Total Reconstruction

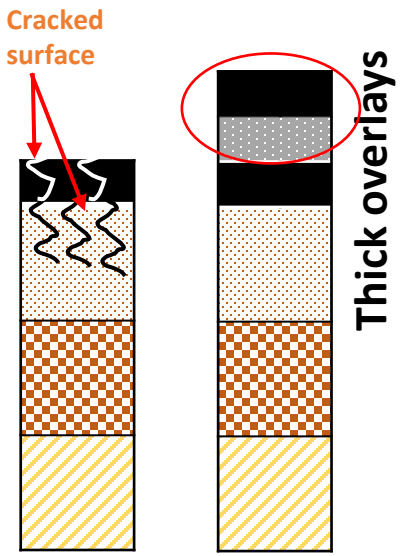
Expensive, Long Construction time, Traffic management challenges



Option -2

Thick Asphalt Overlays

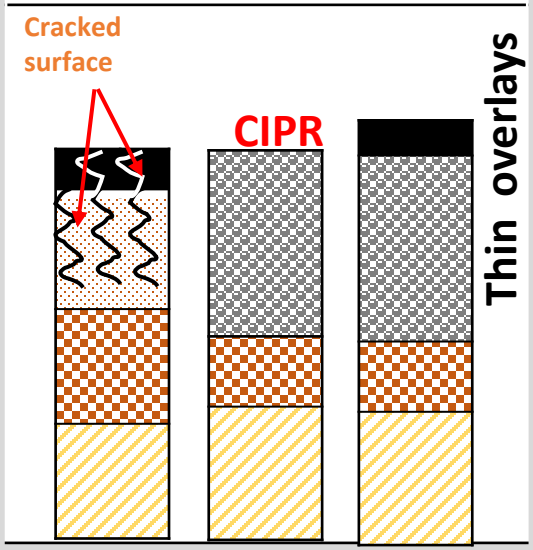
Relatively quick method, elevation problems, reflection cracking



Option -3

CIPR

Price effective as thin asphalt overlay required on FDR Environment friendly, all distress are eliminated



FULL DEPTH RECLAMATION (FDR)

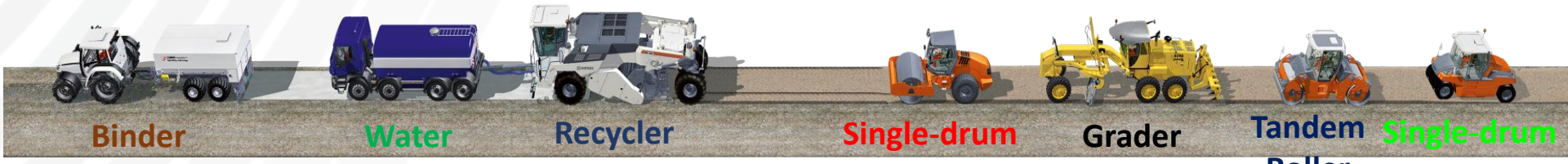
Full depth reclamation is a process in which all of the asphalt pavement section and a predetermined amount of underlying materials are treated with recycling agents to produce a stabilized base course. Asphalt emulsions and/or chemical agents or fly ash and Portland cement, Lime or combination thereof are added as recycling agents.

The main steps include pulverization, introduction of additive, shaping of the mixed material, compaction, and application of wearing or surface course. This method of recycling is normally performed to a depth of 100 to 300 mm (4 to 12 in)

Full depth reclamation has been recommended for pavements with deep rutting, load-associated cracks, non-load associated thermal cracks, reflection cracks, and pavements with maintenance patches such as spray, skin, pothole, and deep hot mix. It is particularly recommended for pavements having a base or subgrade problem.

STABILIZATION/ CIPR/FULL DEPTH RECLAMATION TRAIN

Soil stabilization with added cement+ Chemical Additives



WHERE FDR CAN BE USED?

FDR can be used for rehabilitation of NH /MDR/Runways/ Port roads, Village Roads etc.

Highly Distressed/Base or Subbase Failure

Widening of Existing Road

Rutting

Patched

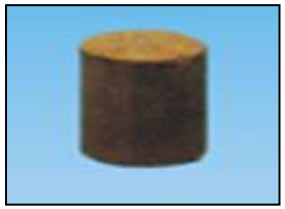
MATERIALS USED IN FDR

Untreated Soil.
Low CBR.
Poor support.
Unfit for construction.

+

Lime / Cement/Pond ash/or
combination thereof with
Commercial Chemical additives

=



Modified Soil.
Increased CBR.
Fit For Construction

MIX-DESIGN FOR FDR

Materials

- Existing Pavement layer Materials
- Virgin Aggregate/Soil if required
- Cement
- Water
- Chemical Additive

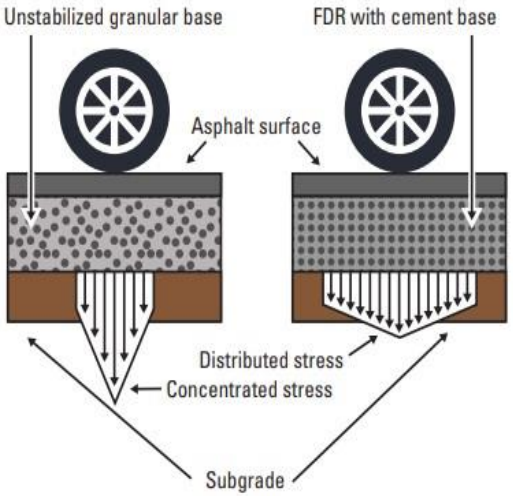


Fig:-Unstabilized base results in more concentrated stress on subgrade than FDR with Cement

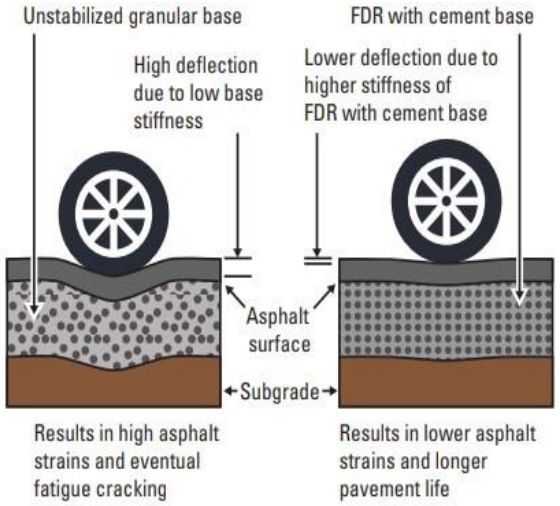
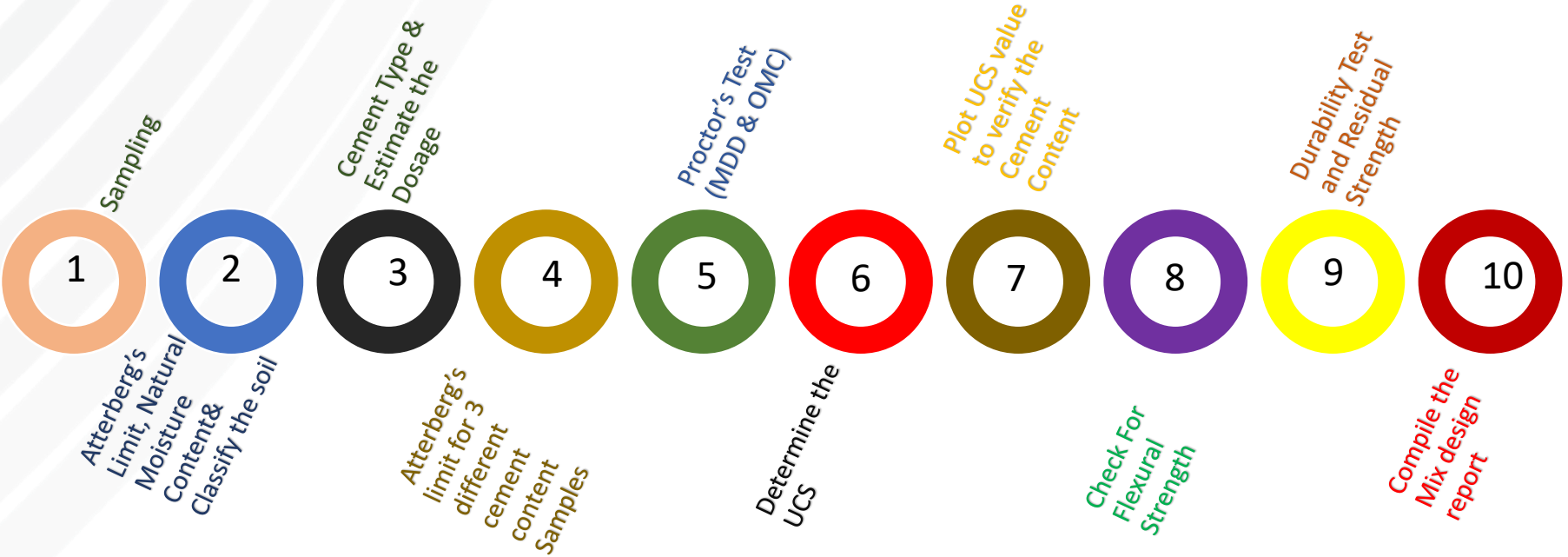


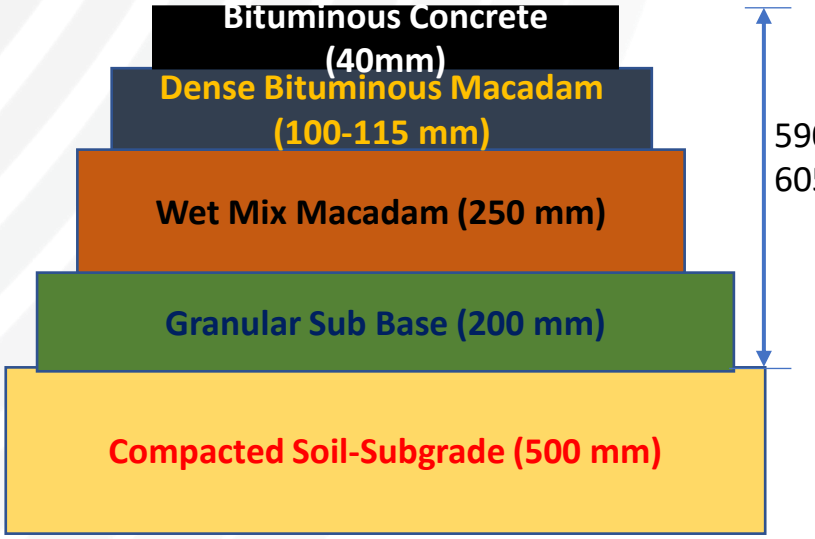
Fig:-FDR with Cement base reduces fatigue Cracking compared to Unstabilized Base

Mix Design Process



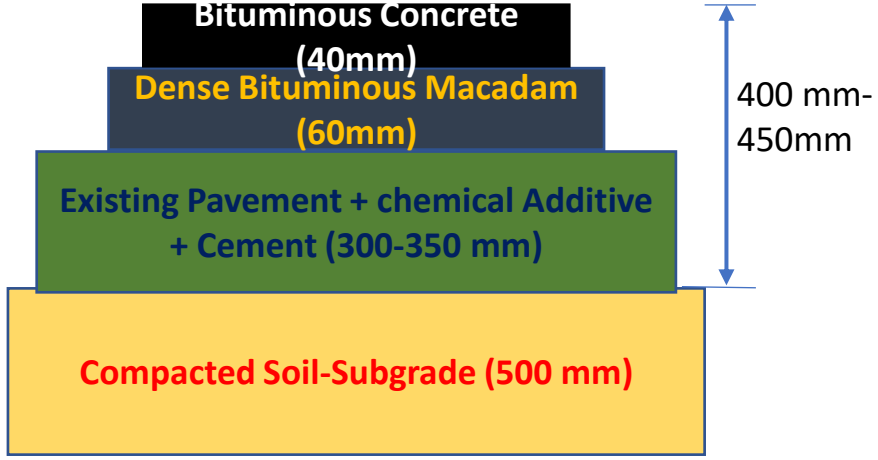
TYPICAL CROSS-SECTION for Flexible Pavement

Conventional Flexible Design



Stabilized Pavement With Full Depth Recycling Technology

25%-32% Crust Reduction



For Traffic>20MSA
CBR=8%

Stabilization of Soil or Sub-Base/Base Course or Existing Pavement Crust - Construction Process

Cement Spreading by Microprocessor Controlled Spreader Truck

Addition of Liquid Chemical Additive

Pulverization of soil with Recycler

Compaction by Pad Foot Roller

Grading & Profiling with motor Grader

Compaction by Soil Compactor

Final surface after Compaction

Laying of Paving fabric and Providing BC / PQC over the stabilized Layer

ADVANTAGES OF FDR

"Make Your Resource Go the Extra Mile (Kilometer) with Engineered Solutions"

 **Lower Cost**	✓ Between 10-25% less expensive than traditional mill & fill or remove and replace ✓ Reuse of materials in-place saves on purchase, excavation, trucking and reduces burden on surrounding roads ✓ Requires thinner surface course than the traditional construction methods
 **GREEN TECHNOLOGY**	✓ Conserves resources by recycling the existing material ✓ Reduce carbon foot prints ✓ Air quality problems resulting from dust, smoke and fumes are eliminated ✓ Environmental friendly, since disposal problem is avoided
 **ENGINEERING BENEFITS**	✓ Enhance road performance with better strength, impermeability, and flexibility ✓ Improve the structural capacity and durability ✓ Eliminates the need for a levelling course and address re-profiling & road widening ✓ Reduces swelling to impart dimensional stability ✓ Provides moisture and frost resistant base
 **TIME SAVING**	✓ In-Place work eliminates time for trucking and hauling ✓ Only moderate traffic disruptions ✓ Decrease construction times minimize impact to the travelling public ✓ Fast construction cycle

Rigid Pavement Maintenance Services

Our team of experts with extensive experience in technical due diligence and investigation is dedicated to delivering cost-effective and sustainable rehabilitation services, tailored to meet the specific needs of Customers. We pride ourselves on our commitment to excellence, timely execution, and customer satisfaction, making us a trusted partner in the industry.

Rigid Pavement failures are broadly categorized into two categories where we as MARKOLINES offer our services:

- **Structural Distresses:** These affect the pavement's load-bearing capacity and are typically caused by excessive loading, improper joint spacing, and material issues.
  - ✓ **Structural Cracks:** These can compromise the pavement's integrity. Partial or complete panel replacement is the solution offered.
  - ✓ **Damage to DLP/GSB/Subgrade:** Depending on the extent of the damage, full or partial depth replacement is adopted to mitigate the issue.
- **Functional Distresses:** These affect the riding quality and safety but do not significantly impact loadbearing capacity.
  - ✓ Plastic Shrinkage Cracks, Edge Cracks, Corner Cracks, Punchouts, Pop-Outs, Transverse, Longitudinal, and Diagonal Cracks are developed affecting the riding quality. To cater to this we use stitching or stapling, depending on severity.
  - ✓ **Ravelling and Roughness:** Treated with partial depth repairs using speciality chemicals.
  - ✓ **Separation at Joints and Sealant Failure:** Micro concrete or speciality chemicals are used for partial depth rehabilitation, depending on damage severity.

Rigid Pavement Maintenance Services

REPAIR OF CONCRETE ROADS

Chiselling of cracks

Application of hot sealant

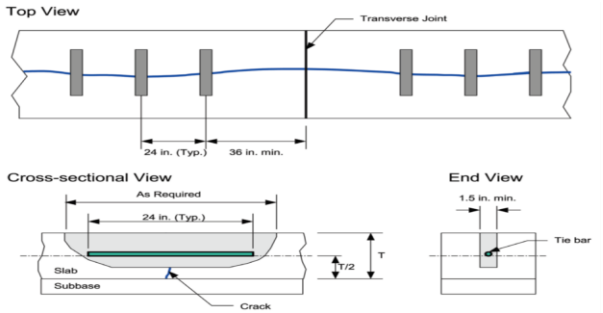
Crack Sealing

Inserting Bars along longitudinal joint

Cross Stitching Along Longitudinal Joint

Concrete Stitching

Slot Stitching



Slot Stitching Cross-sectional view

Slot Stitching

FILLING OF POT-HOLES BY MARKO-COLD MIX

Series of Potholes

Pothole filled with ready to use Marko-Cold Mix

Series of Potholes filled with ready to use Marko-Cold Mix

New Twin Tunnel Alignment of Khambatki ghat in Satara dist. of NHAI

New Twin Tunnel Alignment of Khambatki ghat Viaduct in Satara dist. of NHAI

Photo Gallery Tunnel Projects

Photo Gallery Tunnel Projects

Markolines

Markolines Pavement Technologies Limited
A Wing, 6th Floor, Shree Nand Dham,
Sector 11, CBD Belapur, Navi Mumbai - 400 614.
Maharashtra, INDIA
EMAIL: info@markolines.com
Phone: +91 22 6266 1111

Contact Person Details

Dr. Niyaz Momin
VP- Highway Maintenance
niyaz@markolines.com
+91-9833932406

Mr. S.P. Nagarkar
Director -Technical
sp.nagarkar@markolines.com
+91-7710002487