Markolines

Our Specialized Offerings for Recycling and Rehabilitation of Pavements:-

- Soil Stabilization/ CTB.
- Cold In Place Recycling/ Full Depth Reclamation with Cement and Foam Bitumen (CIPR/BSM/FDR) as per IRC 120:2015.
- Rehabilitation with Glass Grid.
- Reclaimed asphalt pavement (RAP) upto 40%/60%.

About Us

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Markolines was founded in 2002. We started out as a road marking company. Over the years, we have transformed this single product company into a leading Highway O&M service provider.

Today, we have a complete gamut of products under four verticals. We have established a well-equipped Technology Centre that steers the Company's goal of enhancing the on-ground performance of the technology.

We place our customer at the heart of everything we do and in all our projects, we adopt a customer-focused approach, committed to delivering a service that directly addresses the needs of our clients and the society we work in.

Our Offerings

Highway Operations	Highway Maintenance	Specialised Maintenance Services
•Toll Operations •Route Patrolling •Incident Mgmt	•Routine Maintenance •Preventive Maintenance •Major Maintenance & Repairs	•Microsurfacing, MS with Fibers for Runways/ NH. • Bitumen Stabilised Material/ Cold In Place Recycling - FDR • Soil Stabilization / CTB. • Hot In Plant Recycling (RAP)

Soil Stabilization

Stabilization can increase the strength of a soil and/or control the shrink-swell properties of a soil, thus improving the load bearing capacity of a sub-grade to support pavements and foundations.

Soil Stabilization can be utilized on roadways, parking areas, site development projects, airports and many other situations where sub-soils are not suitable for construction. Stabilization can be used to treat a wide range of sub-grade materials, varying from expansive clays to granular materials. This process is accomplished using a wide variety of additives, including lime, fly-ash, and cement.

Benefits of Soil Stabilization process can include:

- Higher resistance (R) values
- Reduction in plasticity
- Lower permeability
- Reduction of pavement thickness
- Elimination of excavation, exporting unsuitable material and importing new materials
- Aids compaction
- Provides "all-weather" access onto and within project sites

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SOIL STABILIZATION

BEFORE

AFTER

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Soil Modification/Stablization with Binding Agent

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

+

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

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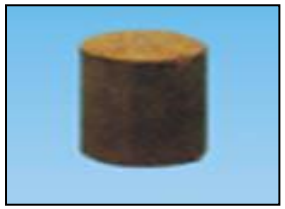
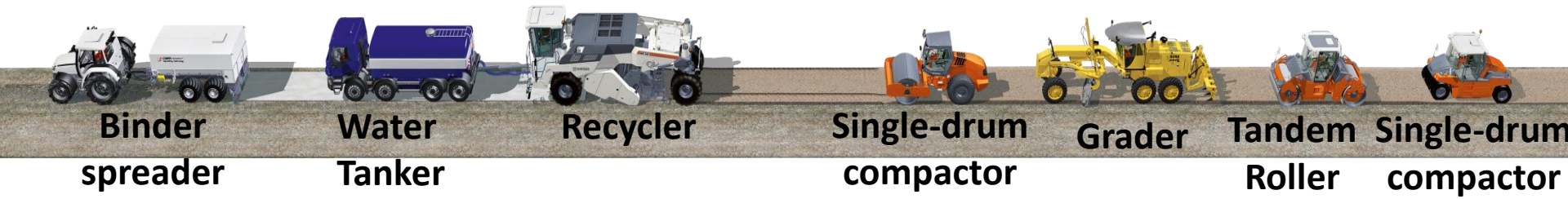


Modified Soil.
Increased CBR.
Fit For Construction

Stabilization/ Full Depth Reclamation Process – Equipment Used

Soil stabilization with added lime

Soil stabilization with added cement+ Chemical Additives



FULL DEPTH RECLAMATION OF MDR IN NASHIK

1. Cement Spreading

2 and 3 Pulverization of soil with Recycler

4. Grading and Rolling

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What is CIPR/FDR

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.

When CIPR/FDR can be used

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

Alligator Cracks

Rutting (ideal candidate for CIPR)

Patched

Dry Ravelled

Advantages of CIPR/FDR

 **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

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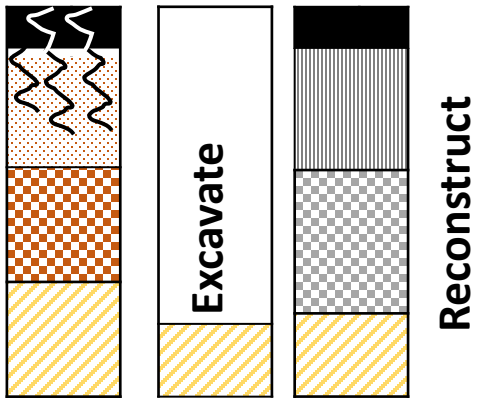
Option -1 (Convectional)

Total Reconstruction

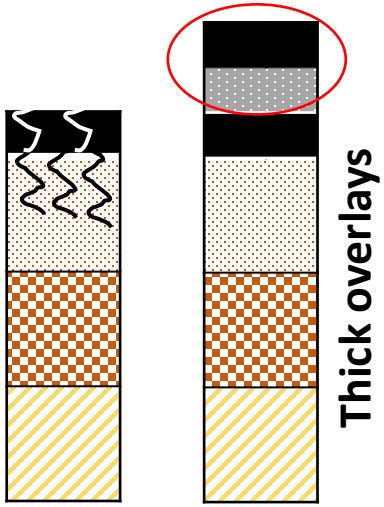
Expensive, Long Construction time, Traffic management challenges



Option -2

Thick Asphalt Overlays

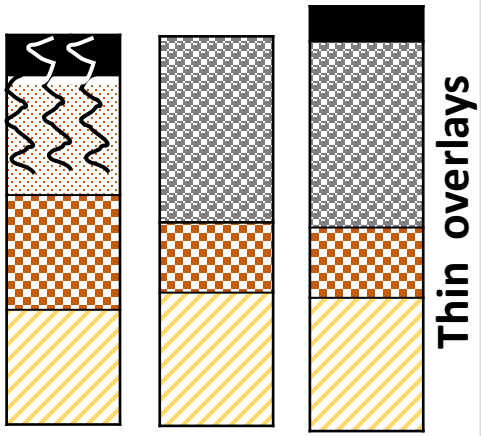
Relatively quick method, elevation problems, reflection cracking



Option -3

CIPR/FDR

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



CIPR/ FDR using Foamed Bitumen and Cement - Process

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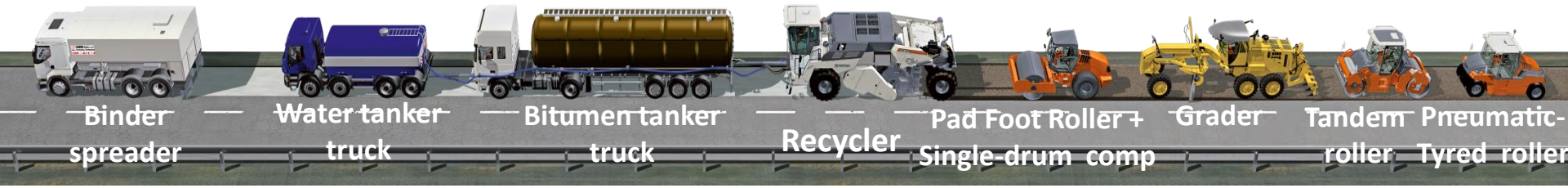
Recycling with pre-spread cement and bitumen



1. Cold in place recycling is carried out using specialised recycling machines, the heart of which is a milling drum equipped with a large number of hardened steel picks and the foaming attachment. The drum rotates upwards, milling the material in the existing road.
2. Based on the mix design Fresh/ virgin aggregates and Cement as a Binder is spread by Grader/ Paver on the surface. The Recycler then mills the damaged pavement wherein water from Water tanker is drawn in the Recycler by a flexible hose and is then sprayed in the mixing chamber., is mixed thoroughly with the milled material to bring it up to its optimum compaction moisture content and facilitates foaming of Bitumen, when it comes in contact with hot bitumen and compressed air. The addition of water is microprocessor based wherein exact quantity is added.
3. Recycling with foamed bitumen – it is produced onboard the recycling machine using a specialised process that adds a small percentage of water and compressed air, comes in contact with hot bitumen. Due to this the bitumen gets foamed up – expanding 20 times its original volume, which coats the aggregate.
4. The foaming process enables normal grades of bitumen to be mixed with cold, moist recycled material. In the case of granular materials, between 3% and 5% of foamed bitumen (by mass) is normally added and for recycling of old pavement it is approx. 2.5% depending on the job mix formula.
5. Behind the machine the recycled layer of material is compacted using a heavy-duty vibratory roller and profiled with a motor grader. Finally, a rubber - tyred roller is normally used to obtain a well-knitted surface finish.
6. Once compaction of the recycled layer has been completed it is cured for 2-3 days and primed before allowing traffic to ply over it to avoid damage to CIPR. An overlay is then laid as per Pavement design.

CIPR/ FDR As per IRC 120 :2015 - Foamed Bitumen – Construction Process

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Spreading of Aggregate with Grader as per design proportion

Spreading of Cement with Streu Master

Milling & pulverisation by WR240 Writgen Recycler

The sheep foot roller for compacting top layer

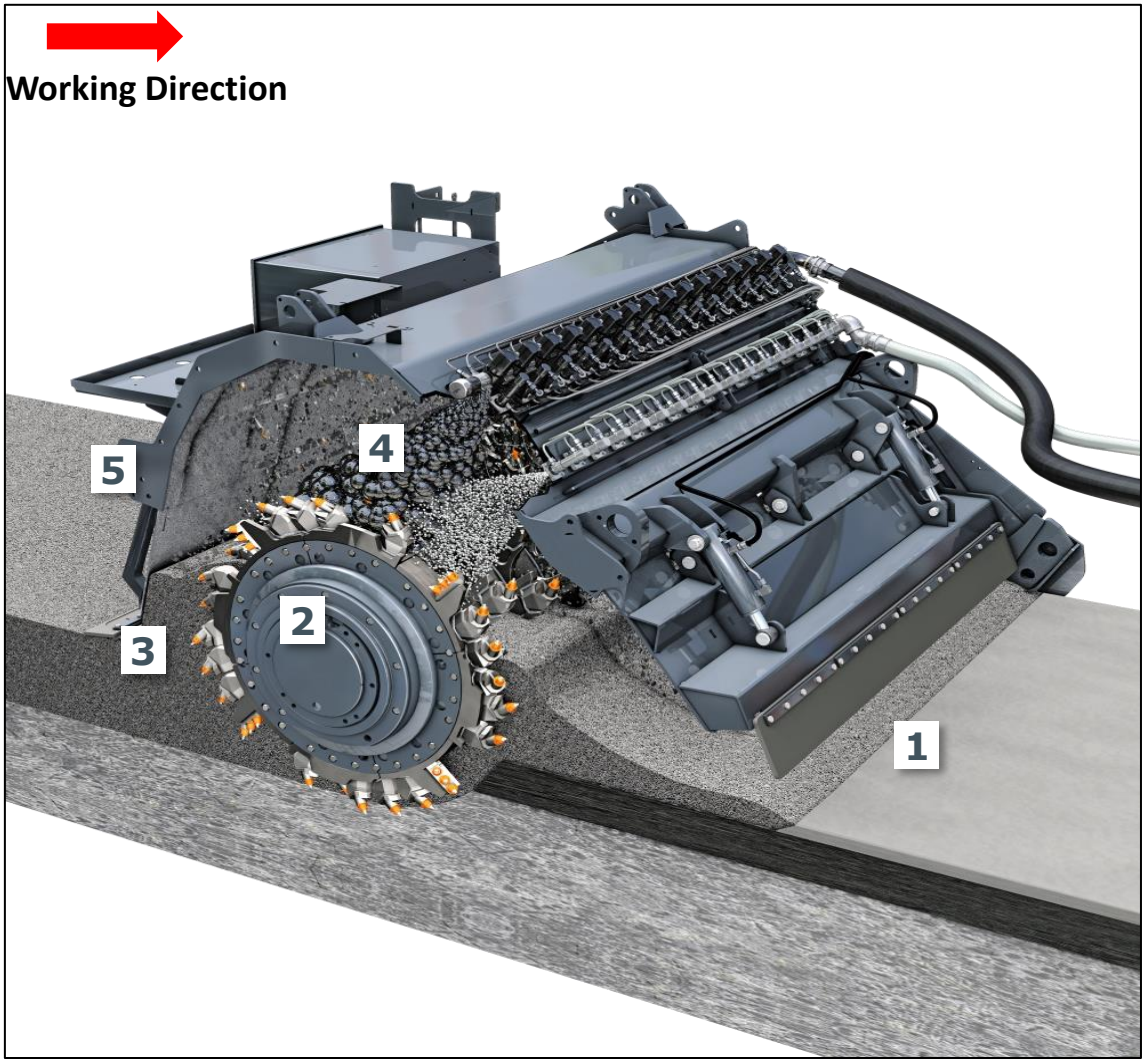
Maintaining the grade & profile of recycled surface with Grader

Compaction with Single Drum smooth wheeled soil compactor

Tandem roller for sealing top layer

Pneumatic Tyre Roller for finishing surface

CIPR/FDR using Foamed Bitumen



Cold recycling

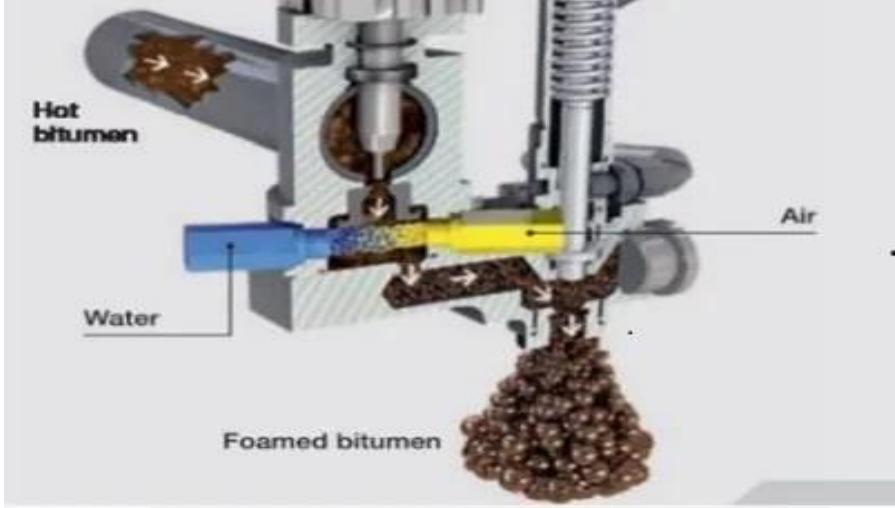
The milling and mixing rotor mills and granulates the asphalt layers. Binders and water are added via injection bars and mixed in to produce a homogeneous recycled material

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

Mix-Design for CIPR / FDR

Materials

- RAP
- Virgin Aggregate (20 mm down and Stone dust)
- Cement
- Water
- Foamed Bitumen (VG30)



Foaming process

Characterization of Foamed Bitumen

Study of foamed bitumen and the variation of foam characterization (Half Life and Expansion Ratio) was carried out using Wirtgen Foam Bitumen laboratory plant, WLB-10, according to following test conditions for mix design:

Parameters	Test Conditions
Air pressure	550 kPa
Water pressure	600 kPa
Bitumen temperature	180 °C
water content	4%-8%, each 2% increment
Amount of bitumen foamed during each test	500 g @ 50g/s
Bitumen	VG-30

- ***Note - Best foam having an Expansion Ratio of 16 times (minimum required 8 to 10 times) and Half life of 12 seconds (Minimum required 6 Seconds) was observed at temperature of 180 °C (Temp. range 160 to 200 depending upon grade of bitumen) and Foaming water content of 6%.***

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CIPR/FDR using Foamed Bitumen

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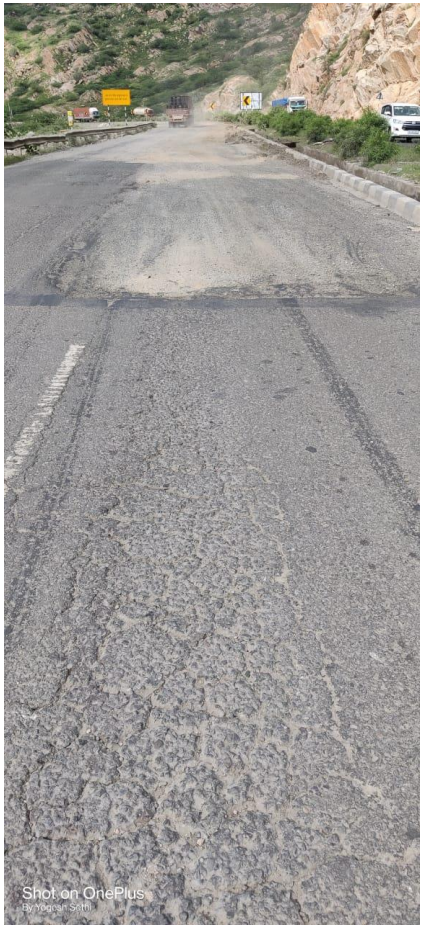
Foamed Bitumen treatment is a stabilising process

- 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.

REHABILITATION OF ROAD BY GEO GRID

Road Condition prior Geo Glass Grid work



REHABILITATION OF ROAD BY GEO GRID

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After Milling And Before Laying Of Geo Grid

Fixing Of Geo GLASS GRID

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

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