2nd International Symposium on Asphalt Pavements & Environment
2012 FORTALEZA, BRAZIL

ISAP Technical Committee on Asphalt Pavements and Environment
ISAP TC APE

October 1st - 3rd, 2012 - Fortaleza, Brazil

Construction Practices and Techniques

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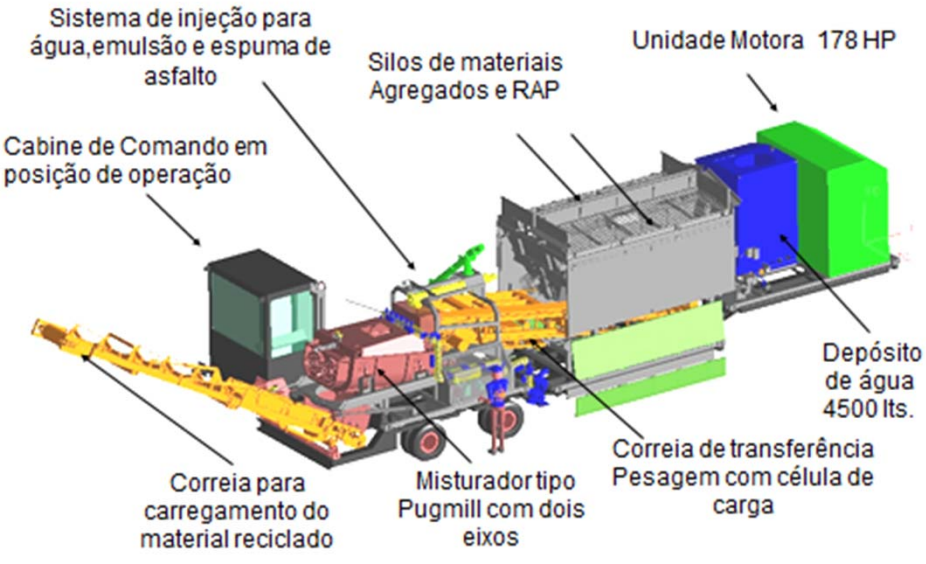
Grupo ANE

FREMIX®

Presentation Topics:

- ***KMA plant characteristics;***
- ***Foamed bitumen;***
- ***Technology fail criteria;***
- ***Jobsite presentation:***
  - ✓ ***Rod. dos Bandeirantes - SP;***
  - ✓ ***Rod. BR-101 – RJ;***
  - ✓ ***Rod. Ayrton Senna – SP;***
  - ✓ ***Av. Sapopemba - SP.***

Desenho esquemático da Usina Móvel do tipo KMA



Foamed Bitumen Technology

Foamed Bitumen Technology

Foam Bitumen *is the result of the asphalt binder at approximately* 170°C, which expands when in contact with air and water at room temperature inside expansion chambers.

Finally,
What is foamed RAP?

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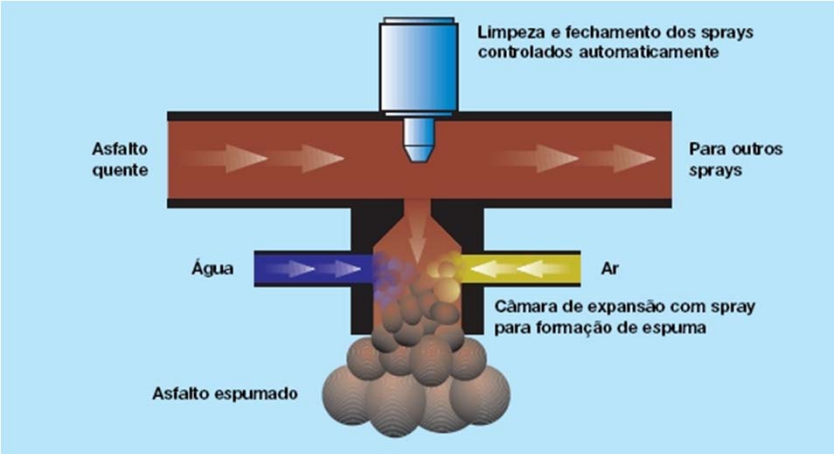
RAP = Reclaimed Asphalt Pavement

Finally,
What is foamed RAP?

RAP = Reclaimed Asphalt Pavement

Foamed RAP = is the product of mixing milled pavement with foamed asphalt

Expansion Chamber



Foamed asphalt process

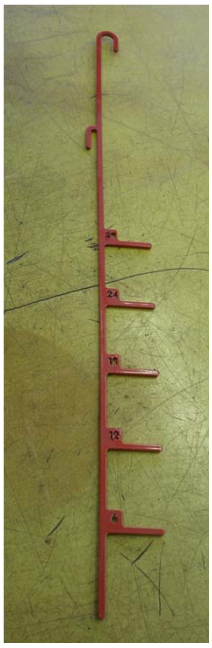
Quality control of foamed asphalt

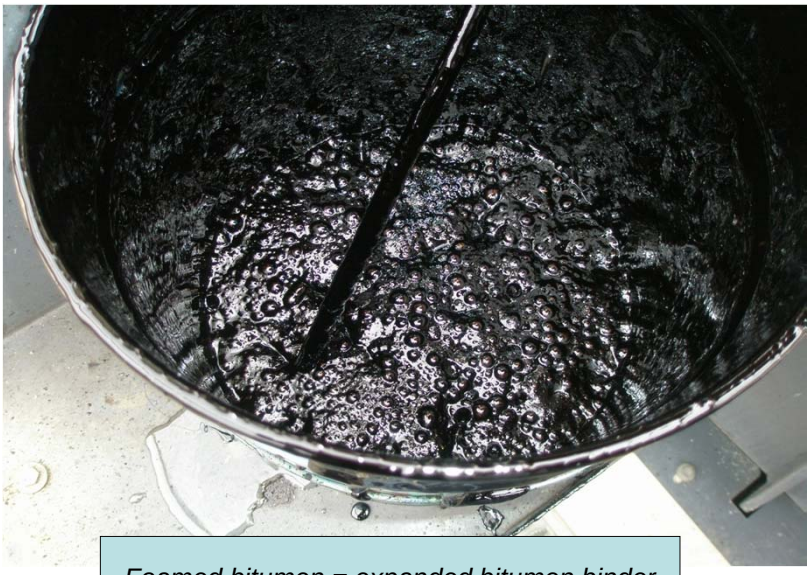
- ***Expansion rate***
- ***Half-life***

Quality control of foamed bitumen

- ***Expansion rate***
- ***Half-life***

Half-life *is the time measured between the maximum expansion and a half of that expansion.*



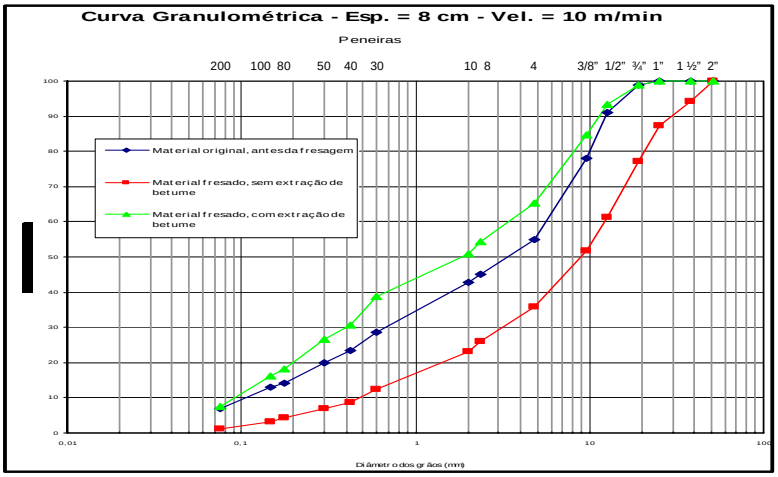


Foamed bitumen = expanded bitumen binder

WLB10S machine and mini Pug-mill mixer

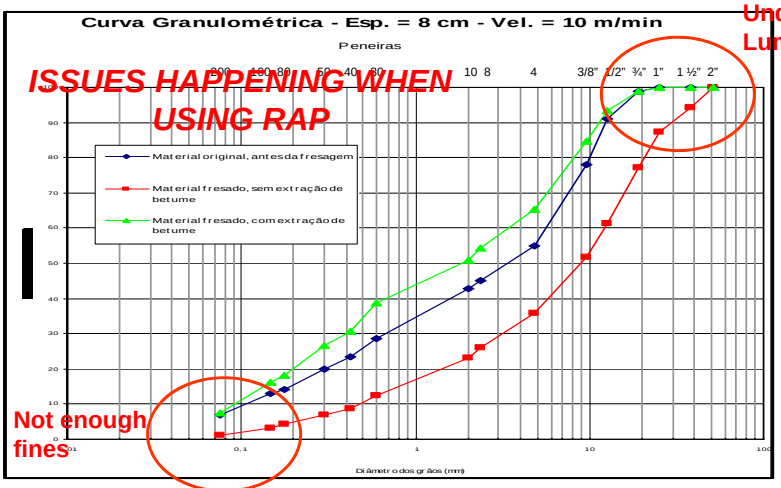
Design of bitumen binder % in lab

RAP aggregate gradation



Fonte: Livro **Fresagem de Pavimentos Asfálticos**

RAP aggregate gradation



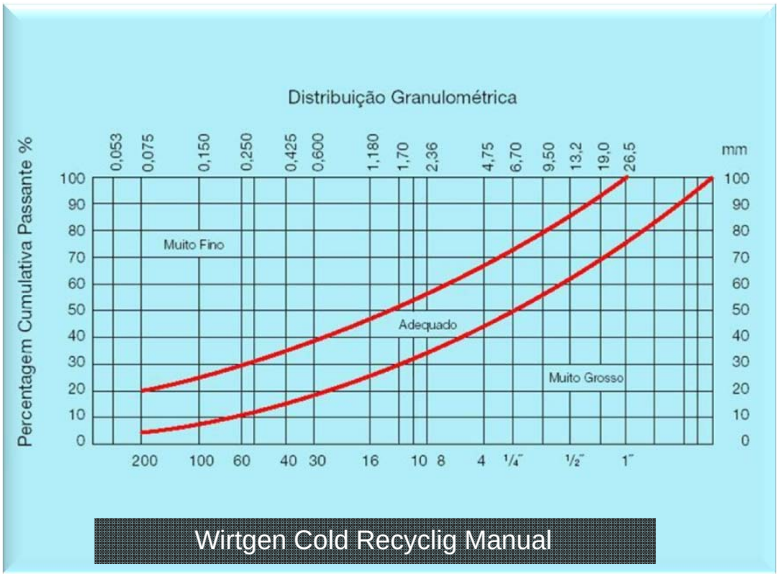
ISSUES HAPPENING WHEN USING RAP

Undesired Lumps

Not enough fines

Fonte: Livro **Fresagem de Pavimentos Asfálticos**

Adequate gradation of foamed RAP



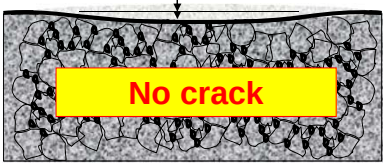
Wirtgen Cold Recyclig Manual

Pavement failure criteria

- **HMA**
- **Cemented layers**

BSM´s

20mm



Fatigue cracking

Rutting

Pavement failure criteria

Rutting:

Lower maintenance cost compared with greater depth interventions.

Procedure: ***Cold milling and overlay.***

Basic steps:

1st step:
- Pavement evaluation;
Functional and structural conditions, drainage etc.

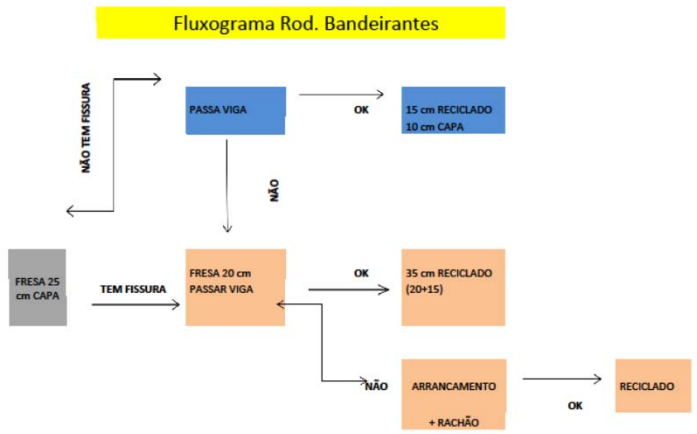
2ª step: Design
- Choice of the adequate solution (in place, plant);
- Economical analysis;
- Layers thickness design;
- Selection of new materials (crusher dust, bitumen binder etc);
- Recycled mix design;
- Lab tests.

3ª step: Jobsite execution
- Choice of adequate equipment;
- Quality control;
Foam quality, mix condition, compaction etc.

Rodovia dos Bandeirantes

Grupo CCR - AutoBan / Engelog

Cement base recycled in KMA plant




Plant placed near the road


1st step: Cold milling of HMA


2nd step:
Cold milling of cemented layer

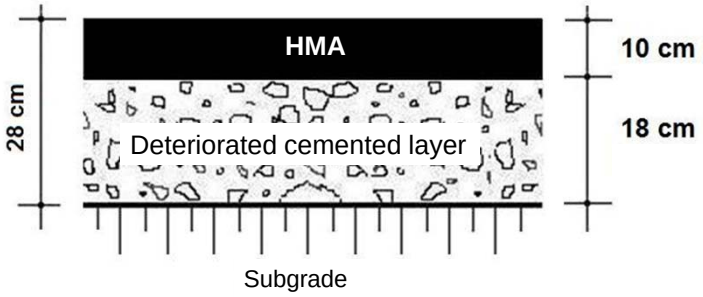

DYNAPAC
Execution of the 1st cemented base layer
Next steps: 2nd cemented base layer and 10cm HMA

Rodovia BR-101

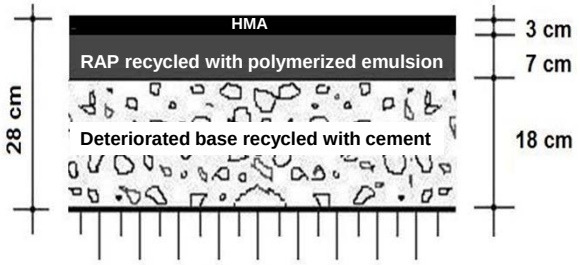
Section: Rio de Janeiro

Cement base recycling in KMA plant
Milled HMA recycled using polymerized emulsion in KMA plant

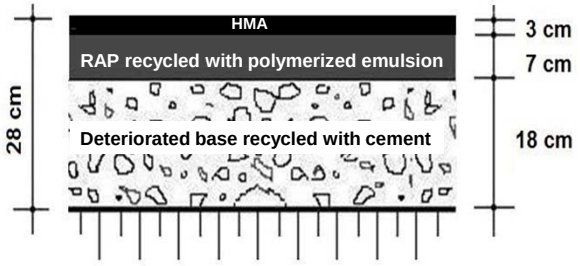
Existent cross-section



Constructed cross-section

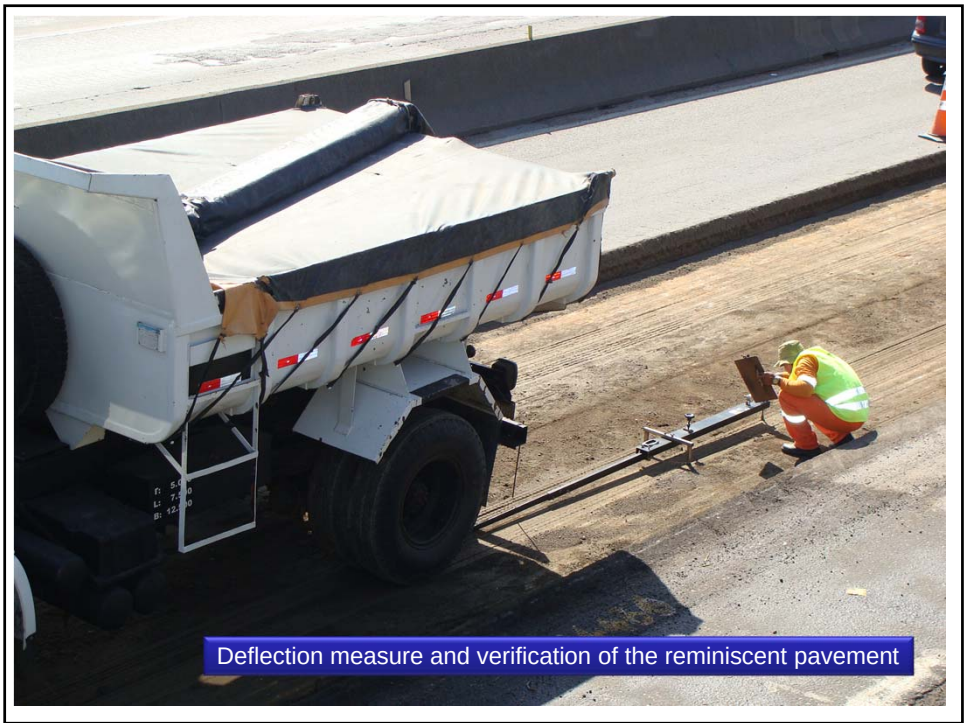


Constructed cross-section



25/28 cm of the thickness were recycled


2nd step:
Cold milling of the cemented layer
1st step:
Cold milling of the HMA layer
Wirtgen
LATINA
W 1900


Deflection measure and verification of the reminiscent pavement

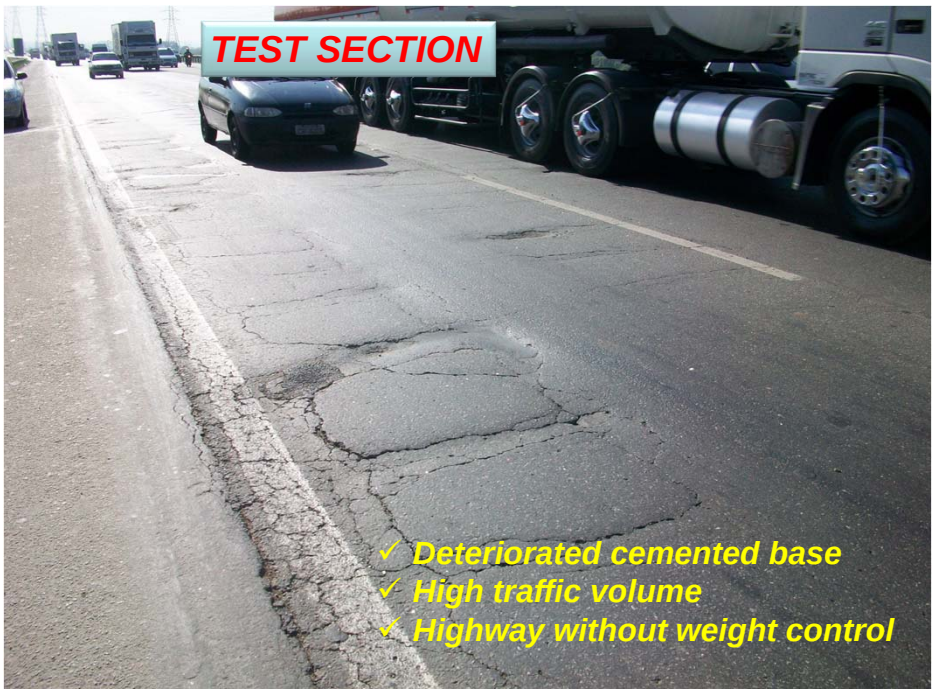
Plant installed near the jobsite

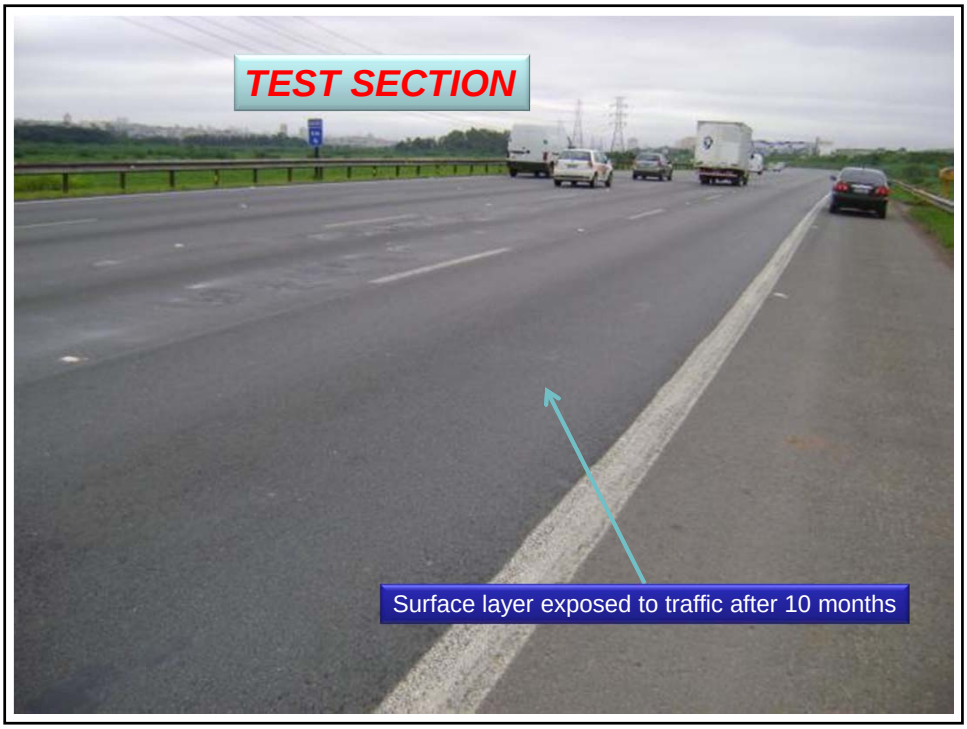
RAP mixing with polymerized emulsion in KMA plant

SP 70 Ayrton Senna

STRUCTURAL REHABILITATION

Cold recycling in KMA plant with foamed bitumen


TEST SECTION
✓ Deteriorated cemented base
✓ High traffic volume
✓ Highway without weight control


TEST SECTION
Surface layer exposed to traffic after 10 months

Mix design
Mixture in KMA 220 Plant

Crushed RAP. 84%
Crusher dust 15%
Hydrated Lime. 1%

Total 100%

CAP 50-70 (bitumen binder): 2,2%

Mix design
Mixture in KMA 220 Plant

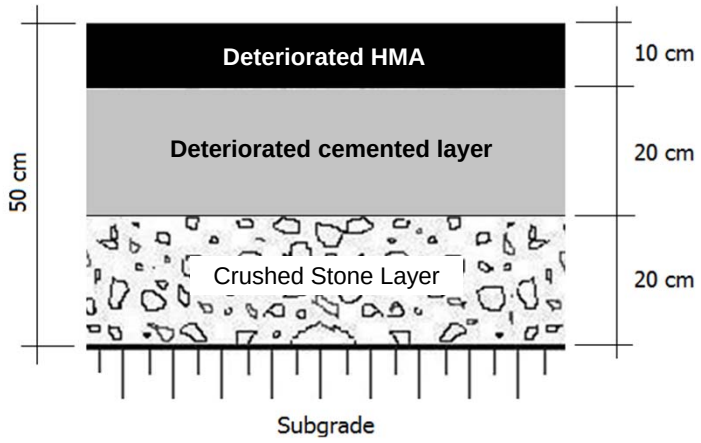
Crushed RAP. 84%
Crusher dust 15%
Hydrated Lime. 1%

Total 100%

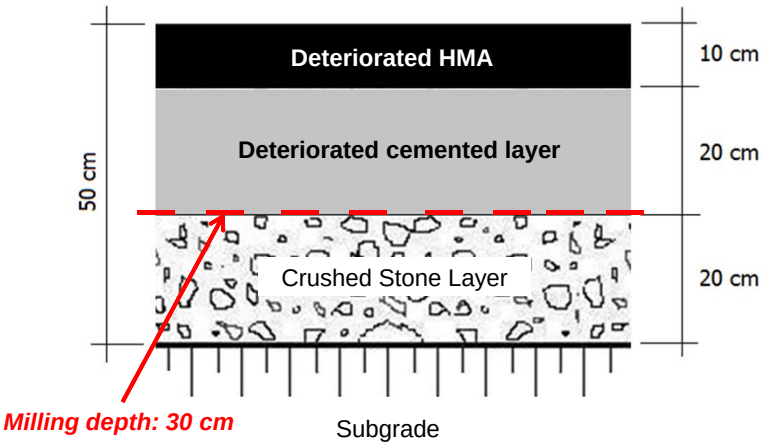
When lime is used as active filler: stockpiling is possible

CAP 50-70 (bitumen binder): 2,2%

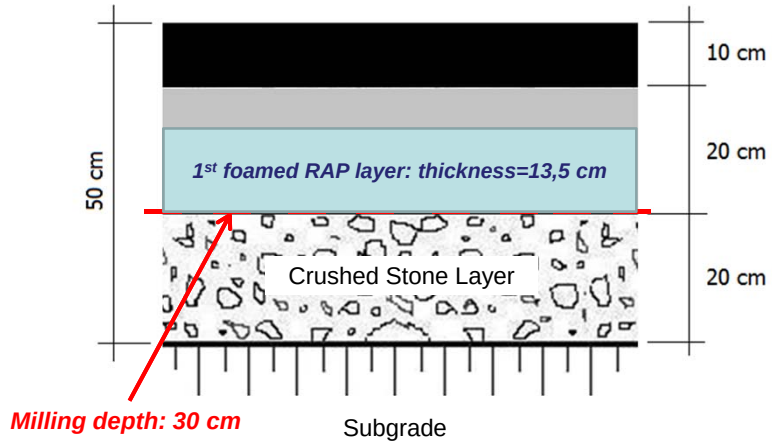
Existent cross-section



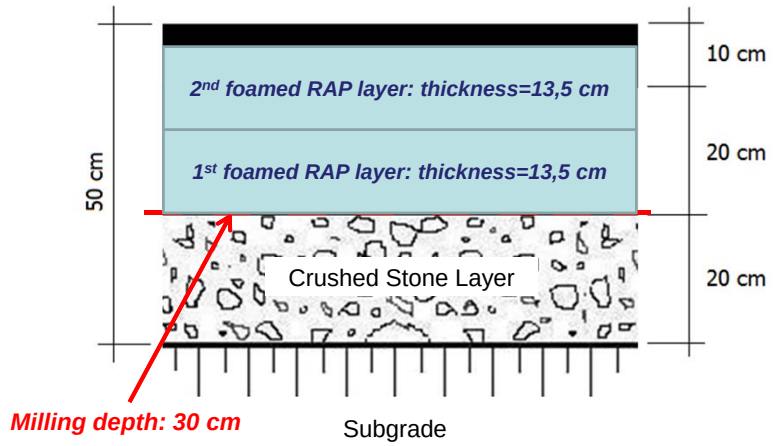
Existent cross-section



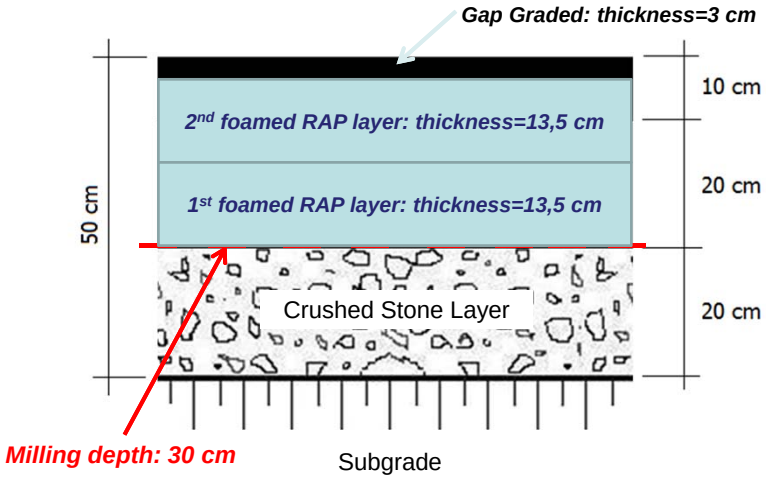
Execution steps

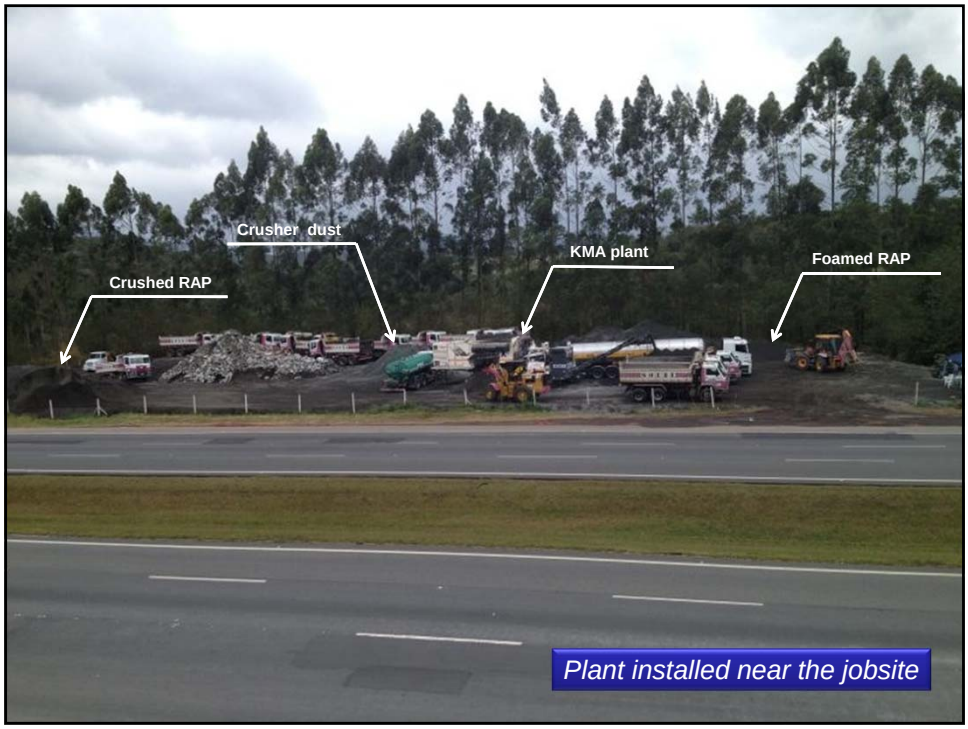


Execution steps



Execution steps






W 1900
Cold milling step


W 1900
Cold milling step
30 cm thickness in one pass


thickness = 30 cm
Verification of the reminiscent pavement


HMA = 20 cm
Cemented Layer = 10 cm
In this section, not all the cracked layer was milled


Deflection measures – Benkelmann beam
New milling process to take away reminiscent cracked cemented layer


Execution of the 1st Foamed RAP and compaction

Compaction verification test: SAND CONE

Execution of the 2nd Foamed RAP and compaction

Execution of the gap graded surface layer
Thickness of 3 cm and compaction

Execution of the gap graded surface layer
Thickness of 3 cm and compaction

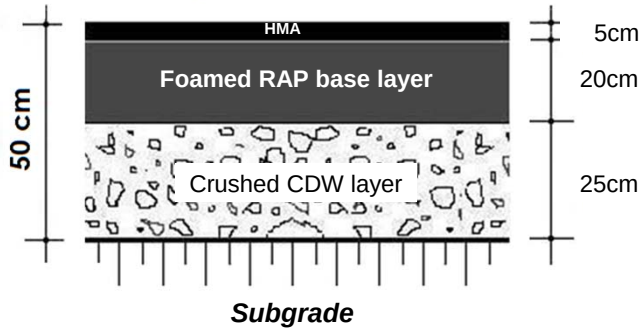
SUSTAINABLE PAVEMENT

AVENIDA SAPOPEMBA

Section: Av. dos Sertanistas até Av. Bento Guelfi – São Paulo

Avenida Sapopemba

Cross-section



Mix design
Mixture in KMA 220 Plant

RAP 80%
Crusher dust 19%
Hydrated lime. 1%

Total 100%

CAP 50-70 (bitumen binder): 2,5%

CONSTRUCTION STEPS


Kerb and gutter

CONSTRUCTION STEPS

Mill and replace structural layers

CONSTRUCTION STEPS

CDW Sub-base

CONSTRUCTION STEPS

Sub-base compaction

CONSTRUCTION STEPS

Foamed RAP base

CONSTRUCTION STEPS

Base compaction

CONSTRUCTION STEPS

HMA surface layer

CONSTRUCTION STEPS

Compaction

CONSTRUCTION STEPS

Compaction

CONSTRUCTION STEPS

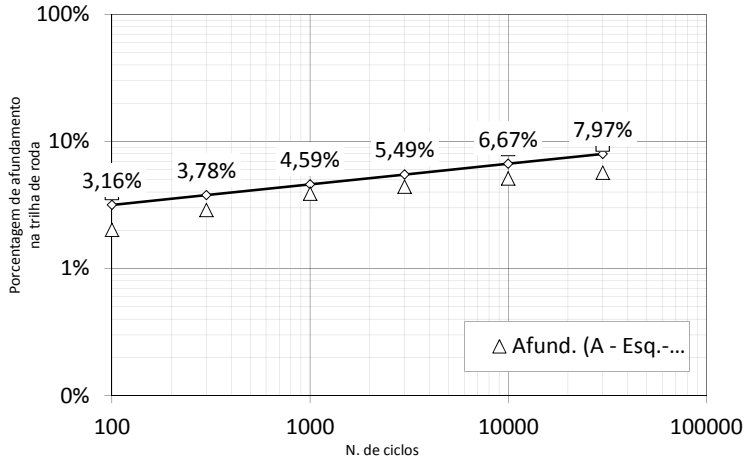
Lab tests:

All lab tests the presented projects were conducted at the Laboratório de Tecnologia de Pavimentação da Escola Politécnica da Universidade de São Paulo LTP-EPUSP

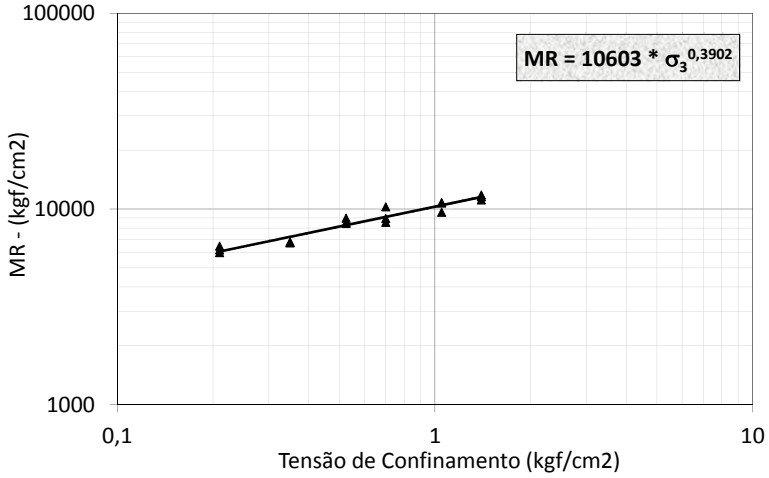
- Rutting (ornierage);

- Resilient Modulus.

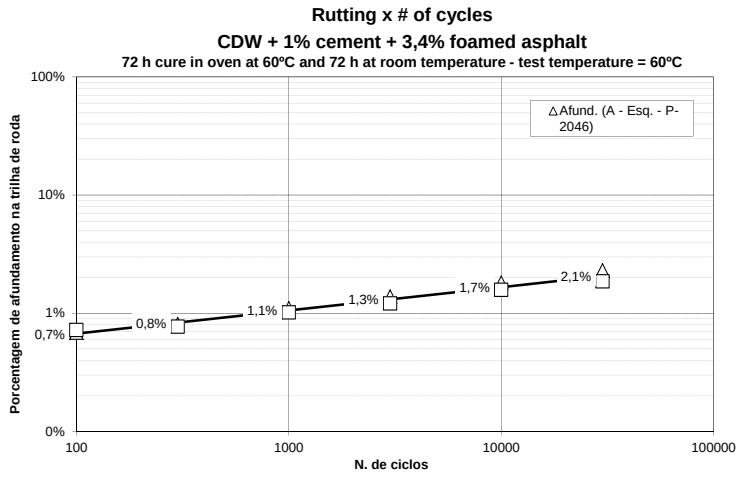
Foamed RAP – Rutting
80% RAP + 19% crushed dust + 1% cement + 2,5% bitumen binder



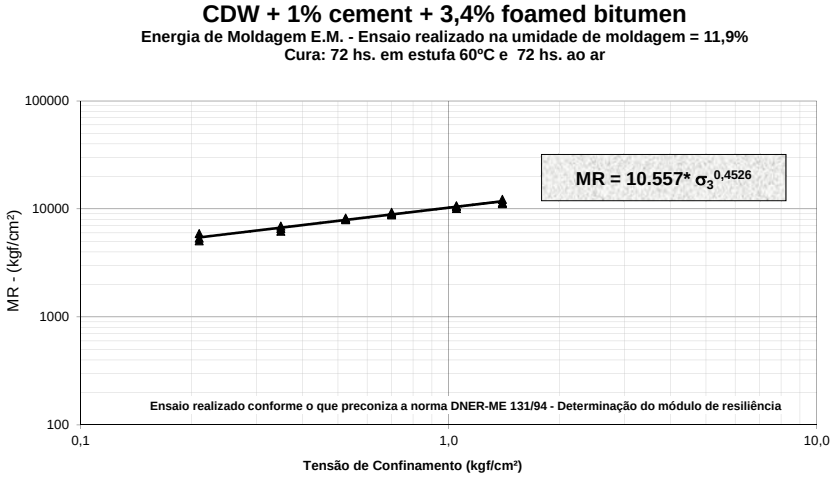
Foamed RAP – Resilient Modulus
80% RAP + 19% crushed dust + 1% cement + 2,5% bitumen binder



Foamed CDW – Rutting

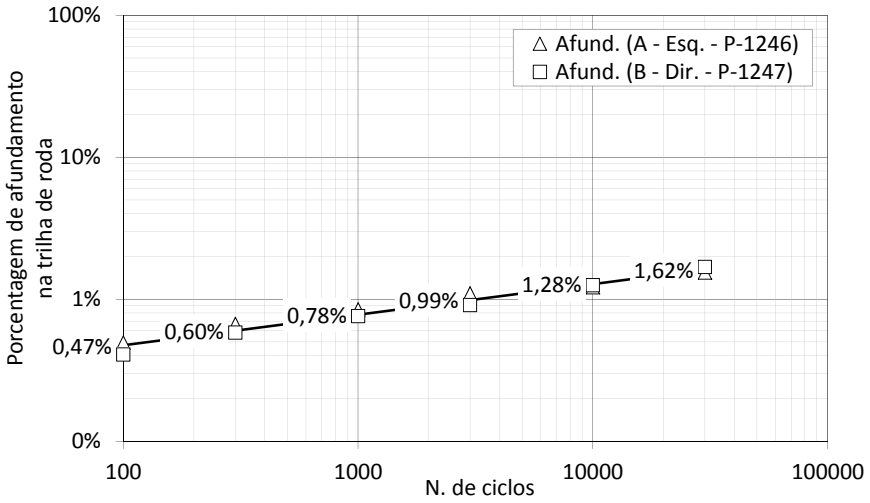


Foamed CDW – Resilient Modulus



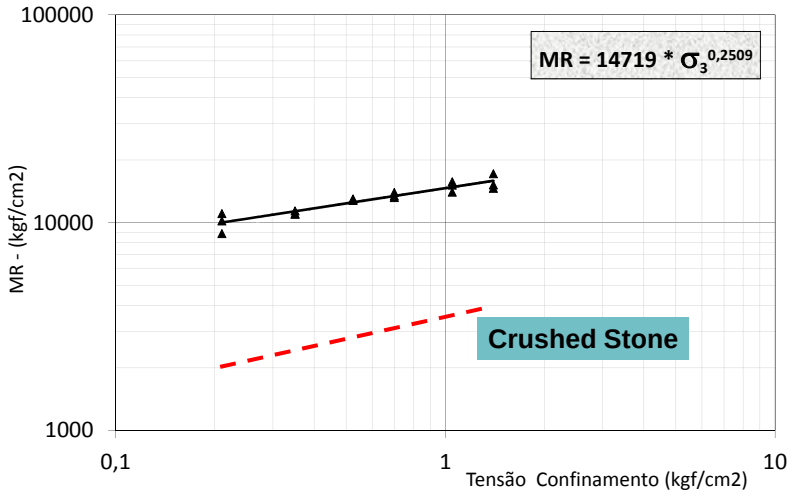
Foamed crushed stone – Rutting

99% crushed stone + 1% cement + 3% foamed bitumen

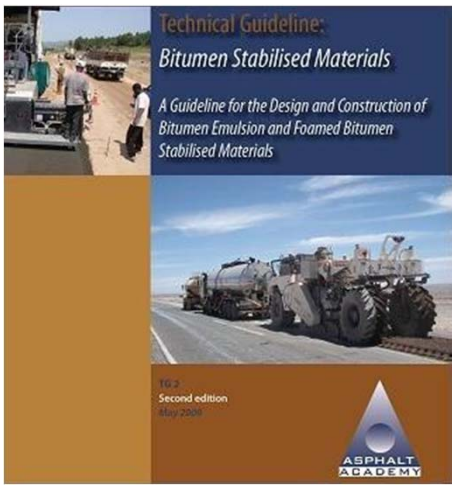


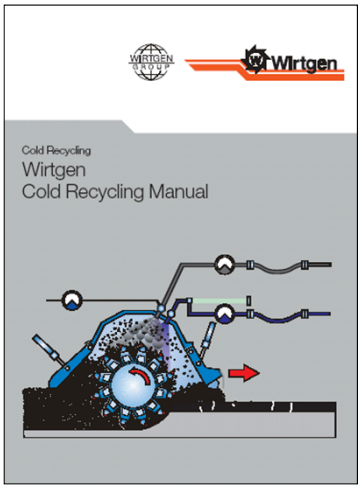
Foamed crushed stone – Resilient Modulus

99% crushed stone + 1% cement + 3% foamed bitumen



Bibliography





Grato pela atenção!

Desde 1967

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