



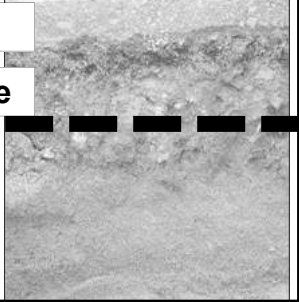
Cold in-place recycling (CIPR)
Ringkas



oleh
Ir. Mohd Hizam bin Harun
CREaTE, Alor Gajah, Melaka

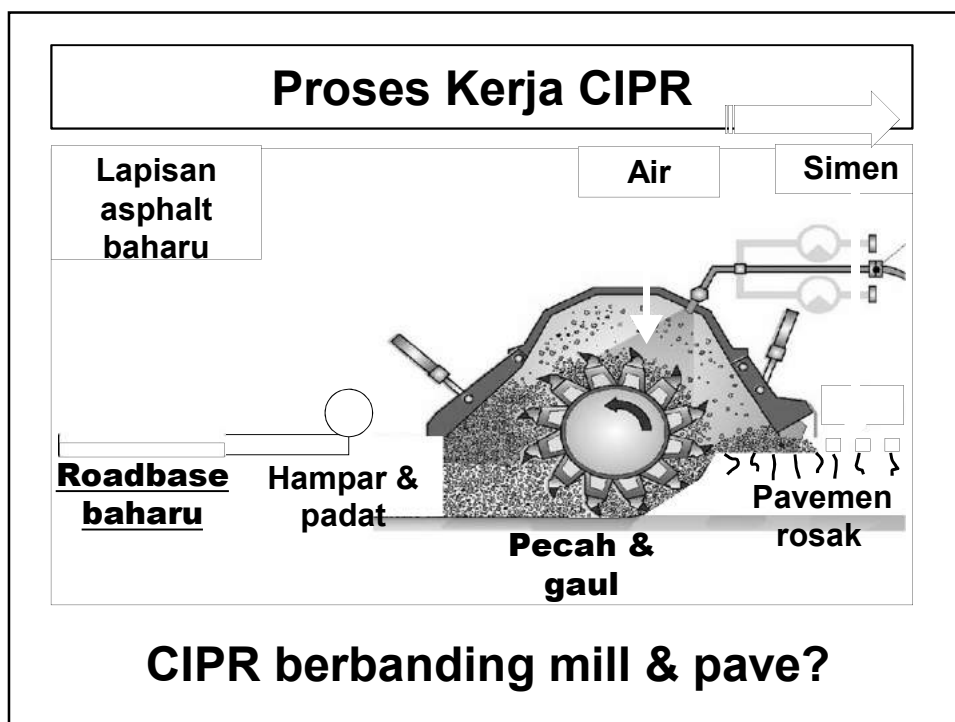
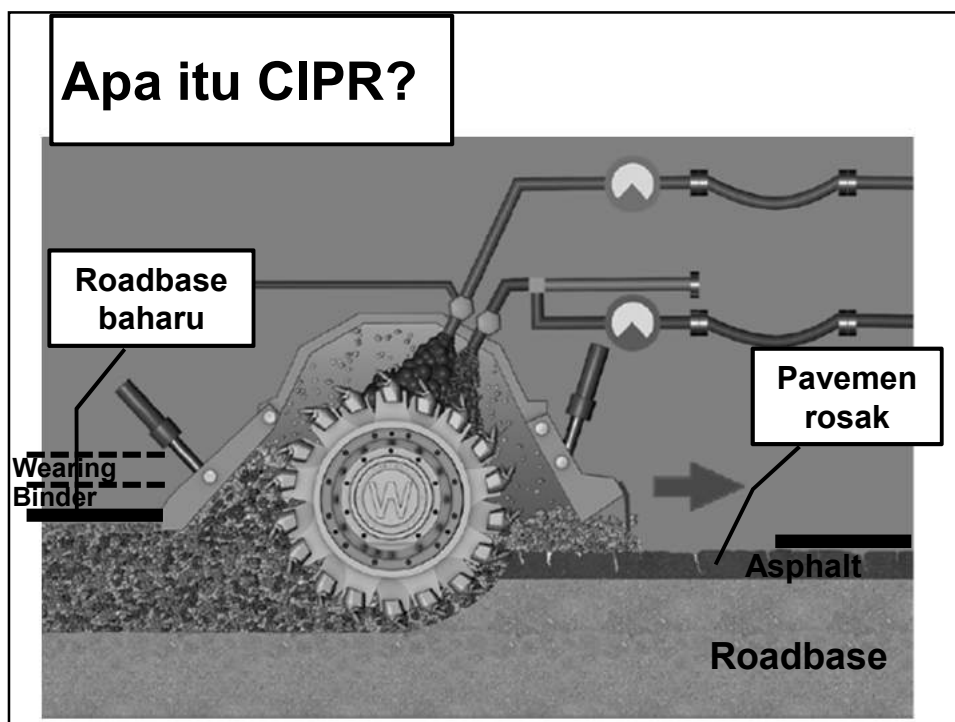
Apa itu CIPR?

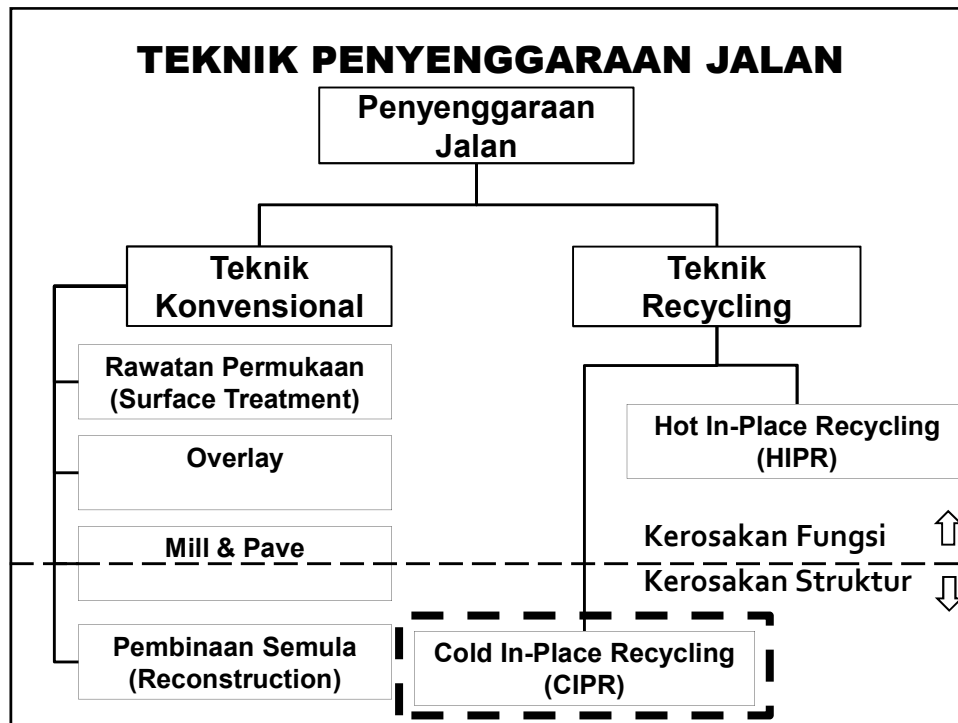
**Kitar semula lapisan pavemen sedia ada
(biasanya lapisan asphalt dan sebahagian
roadbase),
+ agen penstabil,
dapat lapisan roadbase yang lebih kuat.**



Asphalt

Roadbase



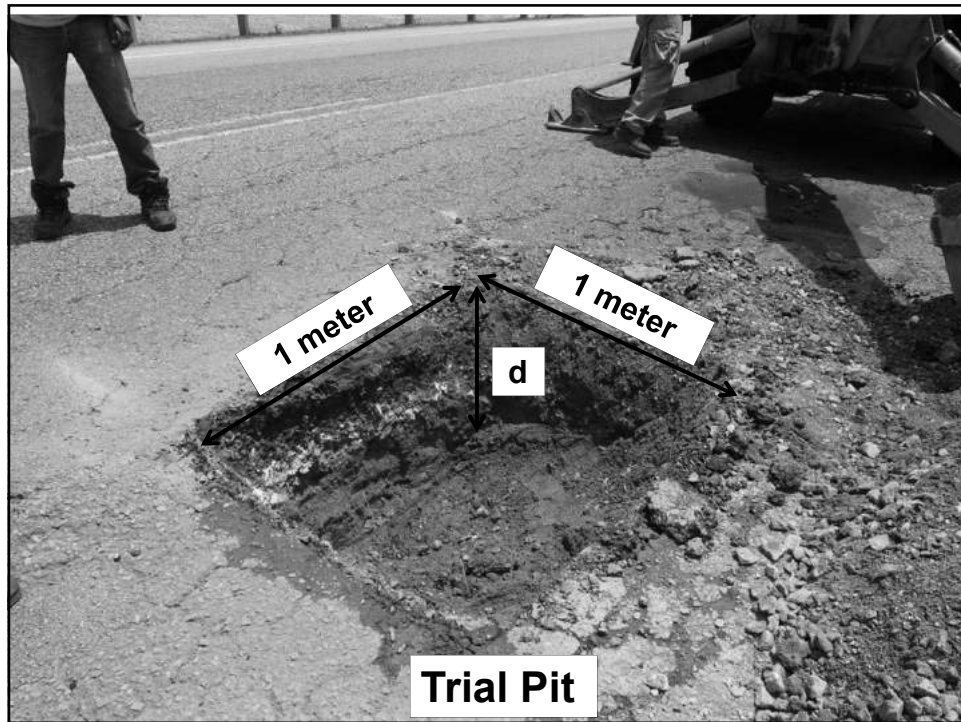


COLD IN-PLACE RECYCLING

Perbandingan Kos

(Mill and Pave)		(CIPR)	
40 mm WC 80 mm BC 80 mm BC Existing roadbase Sub-base	Cost/m² (RM) Milling 160 mm Deep = 21.80 Prime Coat = 1.60 BC 160 mm (Inlay) = 92.60 Tack Coat (2 layers) = 3.00 WC 40 mm (Overlay) = 23.90 Cost per m² = 142.90	50 mm WC 60 mm BC 200 mm recycle Existing roadbase Sub-base	Cost/m² (RM) Recycle 200 mm with 4% Cement = 20.90 Prime Coat = 1.60 BC 60 mm (Overlay) = 34.70 Tack Coat (1 layer) = 1.50 WC 50 mm (Overlay) = 29.90 Cost per m² = 88.60

➔ **38% lebih murah**



	Berapa banyak ambil? Minimum <u>100 kg</u> setiap lapisan.
Reclaimed Asphalt Pavement (RAP)	Roadbase / Crusher Run
	

Trial Pit					
Objektif					
1. Mengambil sampel asphalt dan roadbase. <table border="1"><tr><td data-bbox="421 1570 1267 1626"> a. In-situ moisture content. </td></tr><tr><td data-bbox="421 1632 1267 1688"> b. Jenis dan kuantiti agen penstabil. </td></tr><tr><td data-bbox="421 1695 1267 1751"> c. Kekuatan CIPR (UCS & ITS). </td></tr><tr><td data-bbox="421 1758 1267 1814"> d. OMC dan MDD. </td></tr><tr><td data-bbox="421 1821 1267 1921"> e. Plasticity index, aggregate crushing value, flakiness index, grading. </td></tr></table>	a. In-situ moisture content.	b. Jenis dan kuantiti agen penstabil.	c. Kekuatan CIPR (UCS & ITS).	d. OMC dan MDD.	e. Plasticity index, aggregate crushing value, flakiness index, grading.
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c. Kekuatan CIPR (UCS & ITS).					
d. OMC dan MDD.					
e. Plasticity index, aggregate crushing value, flakiness index, grading.					

Trial Pit

Objektif

1. Mengambil sampel asphalt dan roadbase.
2. Menentukan ketebalan lapisan asphalt dan roadbase sedia ada.
3. Menentukan kedalaman lapisan pavemen yang akan dikitar semula.

Agen Penstabil

Chemical



Simen ✓



Lime

Bituminous

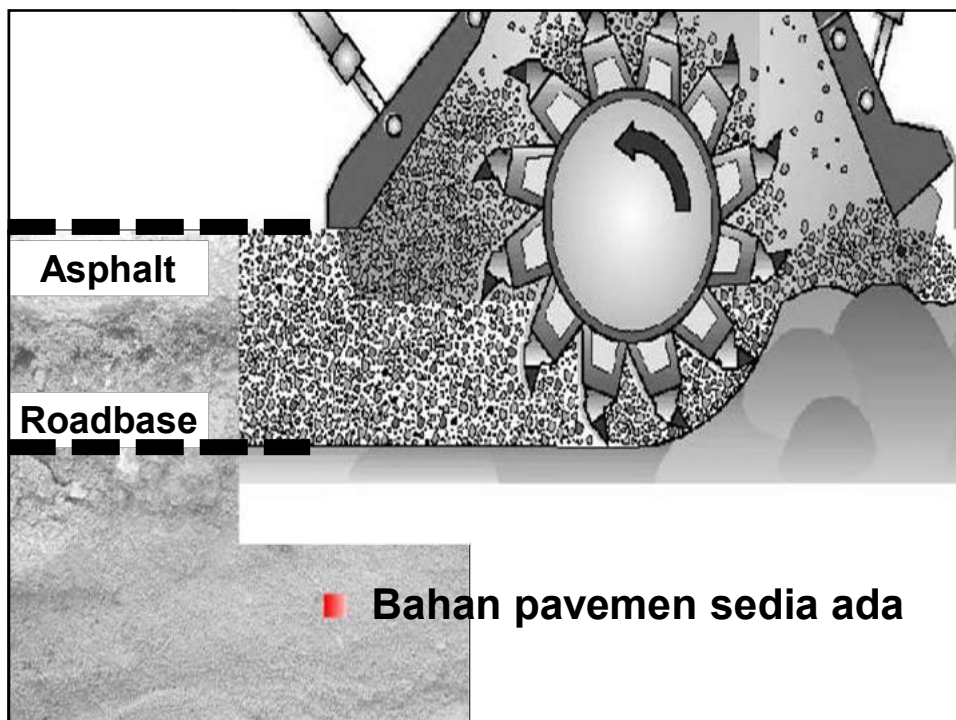


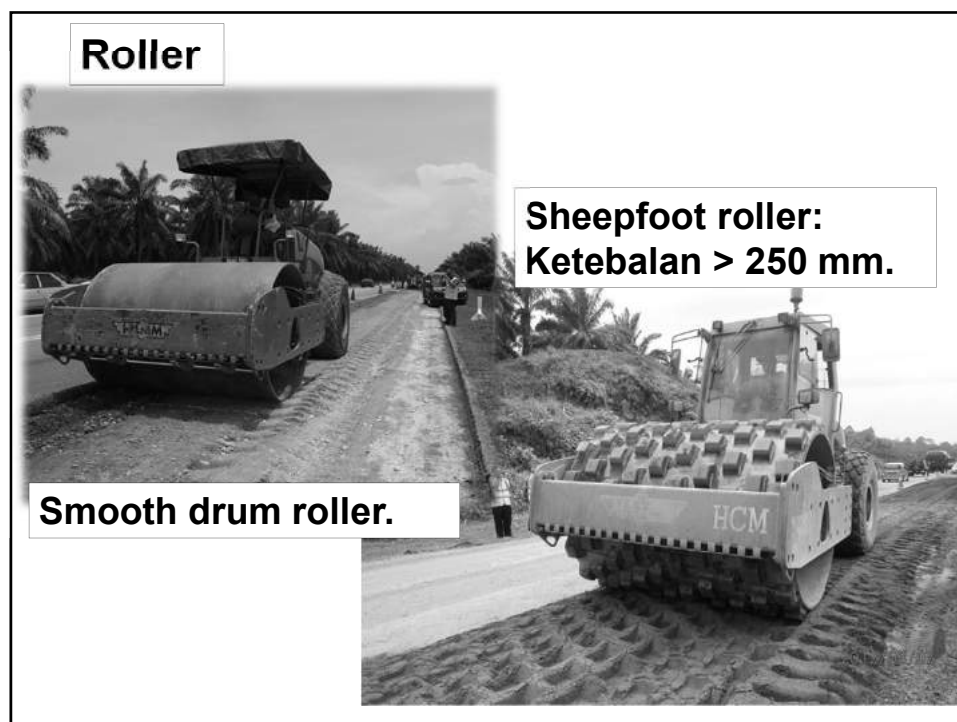
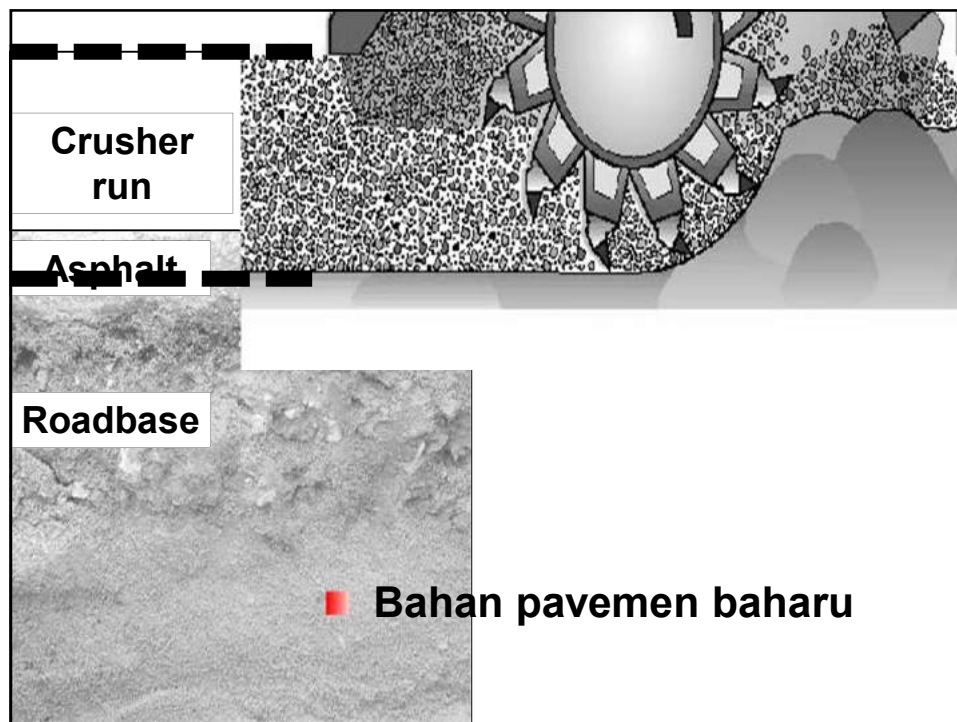
Foamed Bitumen



Bitumen Emulsion

Bila perlu tambah crusher run baru?





Rolling Pattern



**Rolling Pattern lazim: 2 static,
6 – 10 vibrate.**

Roller

Berat minimum static roller

Ketebalan lapisan yang dipadatkan	Berat minimum static roller (tonne)
< 150 mm	12
150 mm – 200 mm	15
200 mm – 250 mm	19
> 250 mm	24

Bila perlu dipadatkan?

**Tempoh maksimum selepas digaul dengan
simen = 3 jam**



JKR/SPJ/2008
Clause 4.10.5.5 Protection and Maintenance

The Contractor shall protect and maintain the completed layer until the next pavement layer or surfacing is applied.

KERJA CIPR DI TAPAK BINA			
No.	AKTIVITI	YA	TIDAK
	1. Sembur tack coat minimum 0.25 liter/m ² sejurus selepas pemadatan.		



Curing

Objektif:

Mendapatkan kekuatan lapisan CIPR sebelum binder course diturap.

Lapisan CIPR

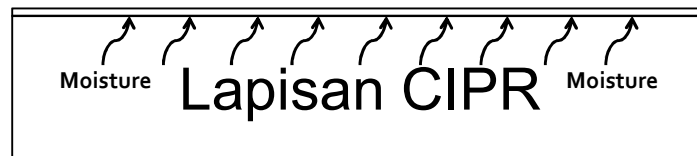
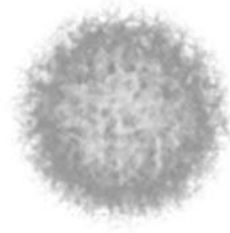
Protection

Sembur tack coat/sediakan temporary surfacing.

Lapisan CIPR

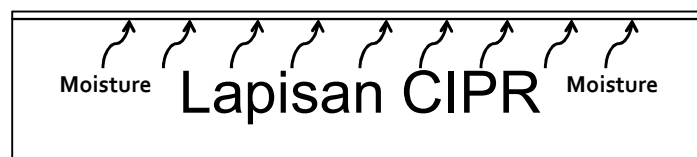
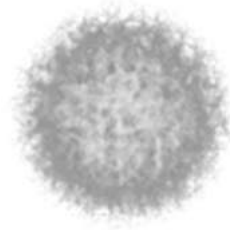
Protection

Elak berlakunya pengeringan/kehilangan air dengan cepat.



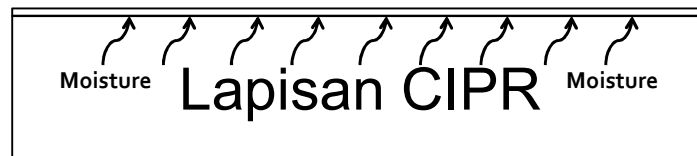
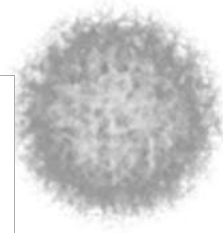
Protection

**Simen memerlukan air untuk mengeras & membentuk kekuatan
➔ Proses hidrasi.**



Protection

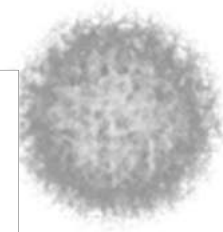
Shrinkage cracks di permukaan berlaku apabila kadar pengeringan melebihi kadar kekuatan diperolehi.

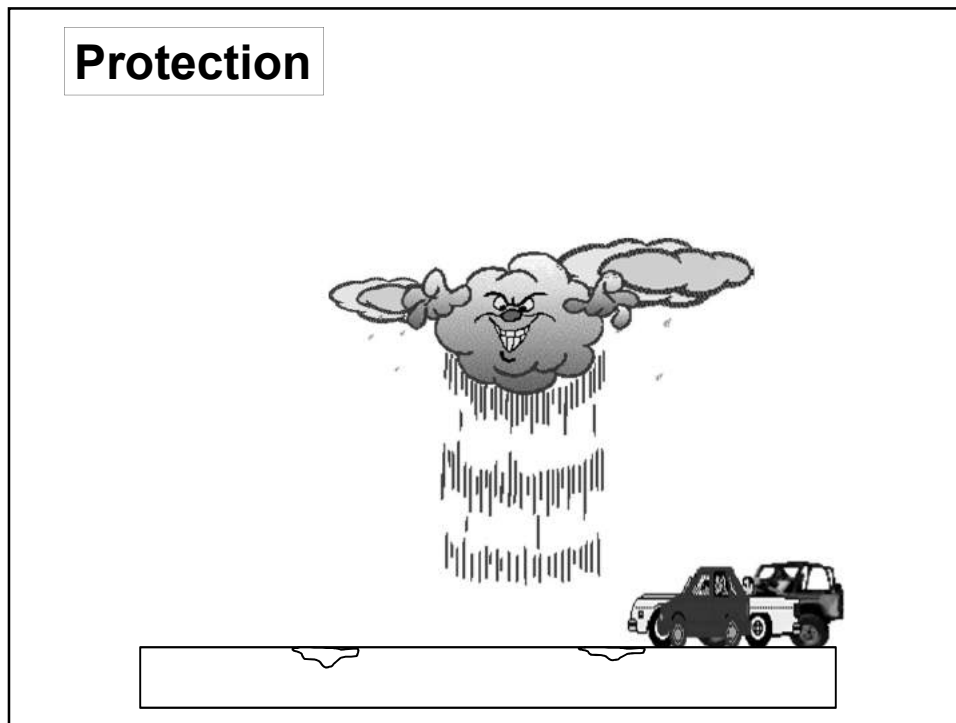


Protection

Permukaan yang kering apabila dibuka pada trafik boleh mengakibatkan;

- 1. Ravelling.**
- 2. Kehilangan kekuatan di bahagian atas permukaan.**
- 3. Pothole terbentuk.**





KERJA CIPR DI TAPAK BINA			
No.	AKTIVITI	YA	TIDAK
	1. Sembur tack coat minimum 0.25 liter/m ² sejurus selepas pemadatan.		
	2. Curing (dibiarkan terdedah kepada persekitaran) minimum 72 jam sebelum binder course diturap serta-merta.		



Kenapa tack coat, bukan prime coat?



Roadbase konvensional



Lapisan CIPR

