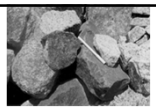
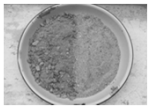
KUALITI DALAM KERJA
PENURAPAN JALAN

Oleh:
Ir. Mohd Hizam bin Harun
Makmal Penyelidikan Jalan, CREaTE

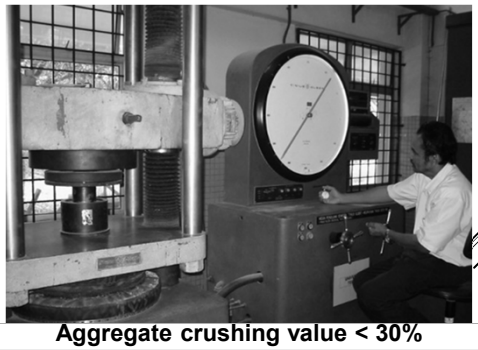
APA ada dalam
ASPHALT?

Agregat Kasar
Agregat Halus
Mineral Filler
Bitumen
Asphalt

Batu-batan keras, dipecahkan, ditapis, bentuk bersegi, bebas dari habuk, tanah liat, bahan organik, dsb.

COARSE AGGREGATES
Ujian



Aggregate crushing value < 30%

COARSE AGGREGATES
Ujian

Sodium Sulfate Soundness < 12%

COARSE AGGREGATES
Ujian

Flakiness index < 30%

COARSE AGGREGATES

Ujian

Polished stone value < 40

COARSE AGGREGATES

Ujian

Water absorption < 2%

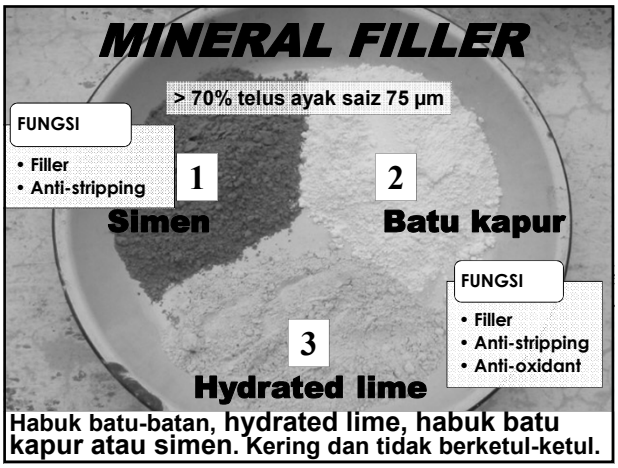
FINE AGGREGATES

BATU HALUS

1

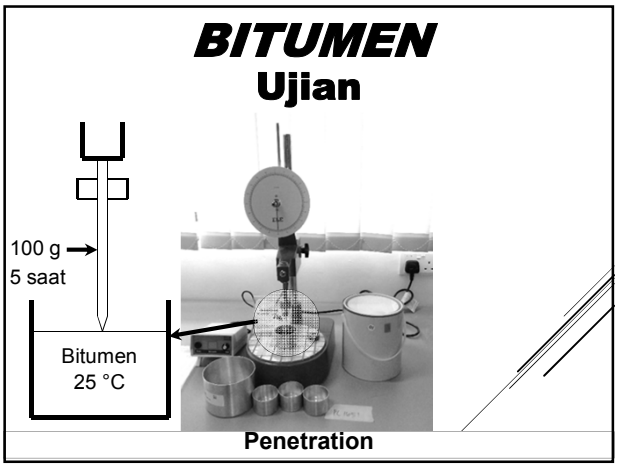
Quarry dust

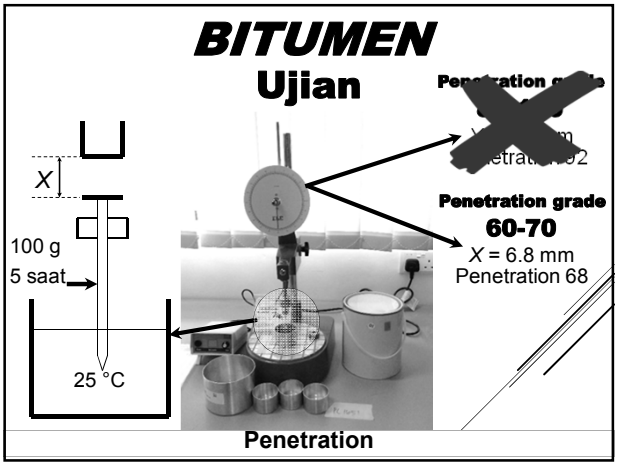
Pasir asli, serbuk kuari atau pasir lombong yang bersih, bebas dari tanah liat, bahan organik dsb.

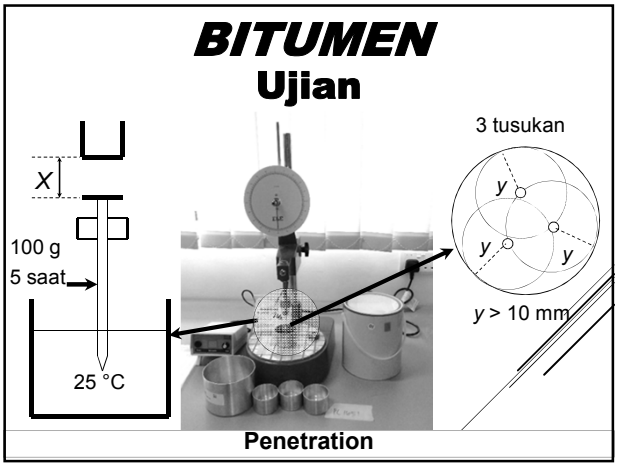

MINERAL FILLER
> 70% telus ayak saiz 75 µm
FUNGSI
• Filler
• Anti-stripping
1
Simen
2
Batu kapur
FUNGSI
• Filler
• Anti-stripping
• Anti-oxidant
3
Hydrated lime
Habuk batu-batan, hydrated lime, habuk batu kapur atau simen. Kering dan tidak berketul-ketul.


BITUMEN
SURAT ARAHAN KPKR BIL. 1/2017
ARAHAN PENGGUNAAN BITUMEN PENETRATION GRADE 60 – 70
DALAM KERJA PENURAPAN JALAN
Berkuatkuasa 1 Mei 2017
1.0 TUJUAN
Surat Arahan ini bertujuan untuk menetapkan satu (1) gred bitumen sahaja digunakan iaitu bitumen penetration grade 60 – 70 dalam kerja penurapan jalan. Sehubungan itu, penggunaan bitumen penetration grade 80 – 100 tidak lagi dibenarkan.
JKR/SPJ
Penetration grade 80-100
Penetration grade 60-70
Polymer modified bitumen

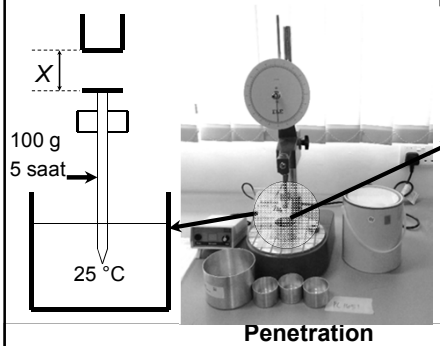

BITUMEN 60-70
Penggunaan di Asia Tenggara
Thailand
1988
Vietnam
1990an
Filipina
1980an
Malaysia
2008
1 Mei 2017: Tidak guna gred 80-100
Singapura
1970an
Indonesia
1987
2008: Tidak guna gred 80-100


BITUMEN
Ujian
100 g
5 saat
Bitumen
25 °C
Penetration

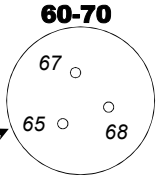

BITUMEN
Ujian
X
100 g
5 saat
25 °C
Penetration grade
60-70
X = 6.8 mm
Penetration 68
Penetration


BITUMEN
Ujian
X
100 g
5 saat
25 °C
3 tusukan
y
y
y
y > 10 mm
Penetration

BITUMEN
Ujian



Contoh 1:
Penetration grade
60-70

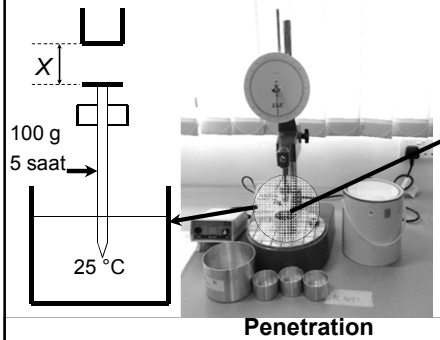


Perbezaan tiga keputusan ujian

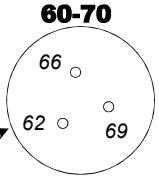
= 68 – 65 ≤ 4

Penetration

BITUMEN
Ujian



Contoh 2:
Penetration grade
60-70



Perbezaan tiga keputusan ujian

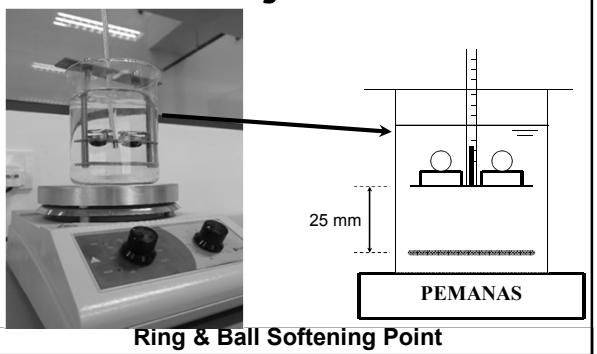
= 69 – 62 > 4

Penetration

BITUMEN
Ujian

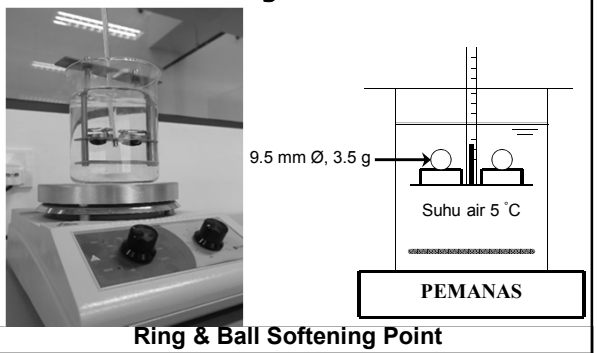
Ring & Ball Softening Point

BITUMEN
Ujian



Ring & Ball Softening Point

BITUMEN
Ujian



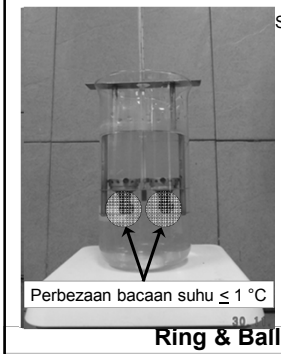
Ring & Ball Softening Point

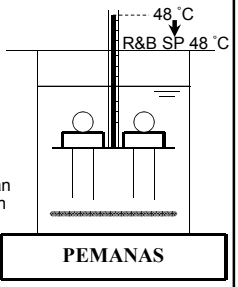
BITUMEN
Ujian

Penetration grade

~~80-100~~ 60-70

Softening Point ~~45 - 53 ˚C~~ 48 - 56 ˚C



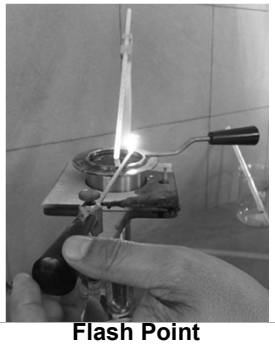


Ring & Ball Softening Point

BITUMEN
Ujian

Flash Point

BITUMEN
Ujian

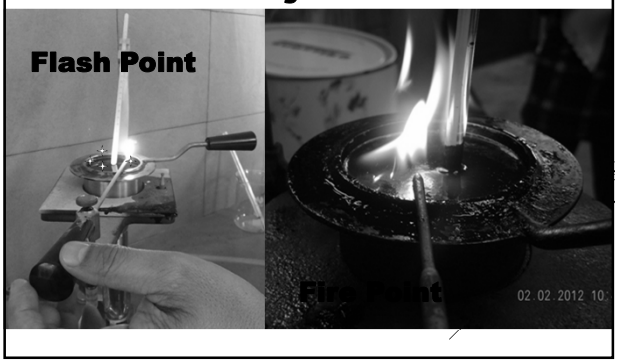


Flash Point

BITUMEN
Ujian

Flash Point

BITUMEN
Ujian



BITUMEN
Perbandingan

Penetration Grade **60-70**

Penetration	: 60-70	80-100
Softening Point:	45-52°C	48-56°C
Flash Point	> 225°C	> 250°C

Penetration Grade **80-100**

PETRONAS PENAPISAN (MELAKA) SDN BHD (164522-V)
ANALYTICAL TECHNOLOGY & SERVICES DEPARTMENT (ATSD)
BANGUNAN PENTADBIRAN, PERSIARAN PENAPISAN
76300 SG. UDANG, MELAKA, MALAYSIA
TEL : 06 - 3522020 FAX : 06 - 3522557

MS ISO/IEC 17025 TESTING SAMM NO. 124

CERTIFICATE OF QUALITY

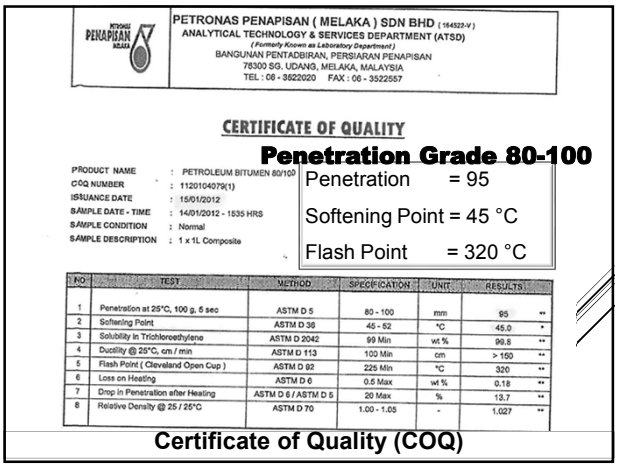
Penetration Grade 80-100

PRODUCT NAME	: ASPHALT IN BULK
COQ NUMBER	: 1120101805(1)
ISSUANCE DATE	: 07/01/2012
SAMPLE DATE - TIME	: 06/01/2012 - 2057 HRS
SAMPLE CONDITION	: Normal
SAMPLE DESCRIPTION	: 1 x 1L Composite

Penetration = 114
Softening Point = 43.4 °C
Flash Point = 330 °C
?

NO.	TEST	METHOD	SPECIFICATION	UNIT	RESULTS	
1	Relative Density @ 25/25°C	ASTM D 70	Report	-	1.017	**
2	Loss on Heating	ASTM D 6	Report	wt %	0.12	**
3	Solubility in 1,1,1 - Trichloroethylene	ASTM D 2042	Report	wt %	99.8	**
4	Penetration at 25°C, 100 g, 5 sec	ASTM D 5	Report	mm	114	**
5	Softening Point	ASTM D 36	Report	°C	43.4	**
6	Drop in Penetration after Heating	ASTM D 6 / ASTM D 5	Report	%	12.28	**
7	Flash Point (Cleveland Open Cup)	ASTM D 92	Report	°C	330	**
8	Ductility @ 25°C	ASTM D 113	Report	cm	> 150	**

Certificate of Quality (COQ)



PETRONAS PENAPISAN (MELAKA) SDN BHD (164522-V)
ANALYTICAL TECHNOLOGY & SERVICES DEPARTMENT (ATSD)
(Formerly Known as Laboratory Department)
BANGUNAN PENTADBIRAN, PERSIARAN PENAPISAN
78300 SG. UDANG, MELAKA, MALAYSIA
TEL : 06 - 3522020 FAX : 06 - 3522557

CERTIFICATE OF QUALITY

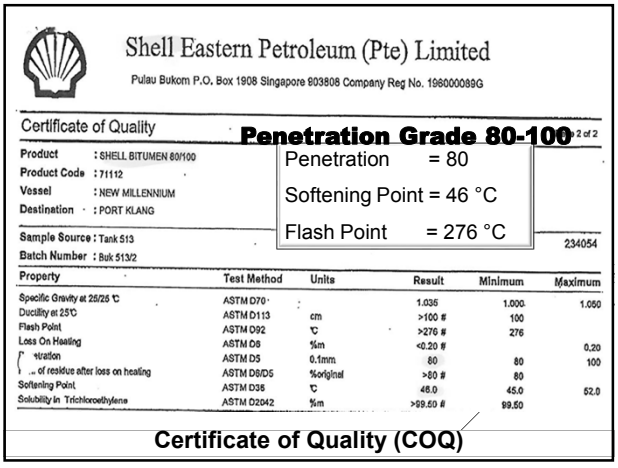
Penetration Grade 80-100

PRODUCT NAME : PETROLEUM BITUMEN 80/100
COQ NUMBER : 1120104079(1)
ISSUANCE DATE : 15/01/2012
SAMPLE DATE - TIME : 14/01/2012 - 1535 HRS
SAMPLE CONDITION : Normal
SAMPLE DESCRIPTION : 1 x 1L Composite

Penetration = 95
Softening Point = 45 °C
Flash Point = 320 °C

NO	TEST	METHOD	SPECIFICATION	UNIT	RESULTS
1	Penetration at 25°C, 100 g, 5 sec	ASTM D 5	80 - 100	mm	95 **
2	Softening Point	ASTM D 36	45 - 52	°C	45.0 *
3	Solubility in Trichloroethylene	ASTM D 2042	99 Min	wt %	99.8 **
4	Ductility @ 25°C, cm / min	ASTM D 113	100 Min	cm	> 150 **
5	Flash Point (Cleveland Open Cup)	ASTM D 92	225 Min	°C	320 **
6	Loss on Heating	ASTM D 6	0.5 Max	wt %	0.18 **
7	Drop in Penetration after Heating	ASTM D 6 / ASTM D 5	20 Max	%	13.7 **
8	Relative Density @ 25 / 25°C	ASTM D 70	1.00 - 1.05	-	1.027 **

Certificate of Quality (COQ)



Shell Eastern Petroleum (Pte) Limited
Pulau Bukom P.O. Box 1908 Singapore 903808 Company Reg No. 198000089G

Certificate of Quality

Penetration Grade 80-100

Page 2 of 2

Product : SHELL BITUMEN 80/100
Product Code : 71112
Vessel : NEW MILLENNIUM
Destination : PORT KLANG

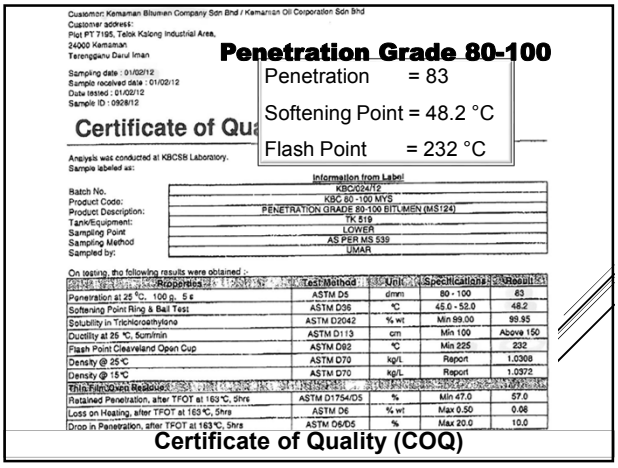
Penetration = 80
Softening Point = 46 °C
Flash Point = 276 °C

Sample Source : Tank 513
Batch Number : Buk 513/2

234054

Property	Test Method	Units	Result	Minimum	Maximum
Specific Gravity at 25/25 °C	ASTM D70		1.035	1.000	1.050
Ductility at 25°C	ASTM D113	cm	>100 #	100	
Flash Point	ASTM D92	°C	>276 #	276	
Loss On Heating	ASTM D6	%m	<0.20 #		0.20
Penetration	ASTM D5	0.1mm	80	80	100
% of residue after loss on heating	ASTM D6/D5	%original	>80 #	80	
Softening Point	ASTM D36	°C	46.0	45.0	52.0
Solubility in Trichloroethylene	ASTM D2042	%m	>99.50 #	99.50	

Certificate of Quality (COQ)



Customer: Kemaman Bitumen Company Sdn Bhd / Kemaman Oil Corporation Sdn Bhd
Customer address:
Plot PT 7195, Telok Kalong Industrial Area,
24000 Kemaman
Terengganu Darul Iman

Sampling date : 01/02/12
Sample received date : 01/02/12
Date tested : 01/02/12
Sample ID : 0928/12

Penetration Grade 80-100

Penetration = 83
Softening Point = 48.2 °C
Flash Point = 232 °C

Certificate of Qu

Analysis was conducted at KBCSB Laboratory.
Sample labeled as:

Information from Label	
Batch No.	KBC/024/12
Product Code:	KBC 80 -100 MYS
Product Description:	PENETRATION GRADE 80-100 BITUMEN (MS124)
Tank/Equipment:	TK 519
Sampling Point	LOWER
Sampling Method	AS PER MS 539
Sampled by:	UMAR

On testing, the following results were obtained :-

Properties	Test Method	Unit	Specifications	Result
Penetration at 25 °C, 100 g, 5 s	ASTM D5	dmm	80 - 100	83
Softening Point Ring & Ball Test	ASTM D36	°C	45.0 - 52.0	48.2
Solubility in Trichloroethylene	ASTM D2042	% wt	Min 99.00	99.95
Ductility at 25 °C, 5cm/min	ASTM D113	cm	Min 100	Above 150
Flash Point Cleveland Open Cup	ASTM D92	°C	Min 225	232
Density @ 25°C	ASTM D70	kg/L	Report	1.0308
Density @ 15°C	ASTM D70	kg/L	Report	1.0372
Thin Film Oven Residue				
Retained Penetration, after TFOT at 163°C, 5hrs	ASTM D1754/D5	%	Min 47.0	57.0
Loss on Heating, after TFOT at 163°C, 5hrs	ASTM D6	% wt	Max 0.50	0.08
Drop in Penetration, after TFOT at 163°C, 5hrs	ASTM D6/D5	%	Max 20.0	10.0

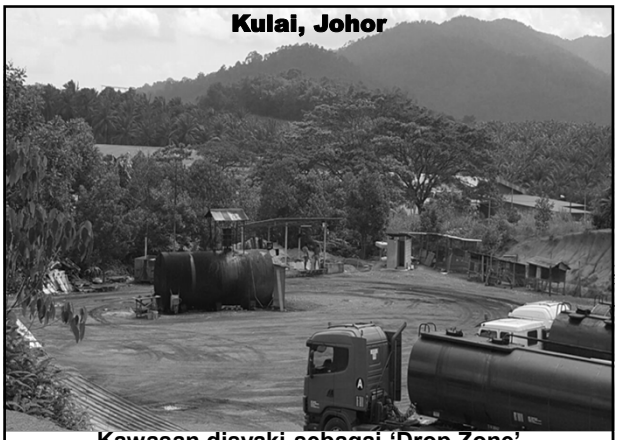
Certificate of Quality (COQ)

Ujian bitumen jarang / tidak pernah dibuat di kuari.

Kaedah penghantaran bitumen: Semua pembekal tidak menggunakan pengangkutan sendiri.

***Tanker's Manhole Security Seal*: mudah dibuka.**

Kulai, Johor



Kawasan disyaki sebagai 'Drop Zone'

Cherating, Kuantan

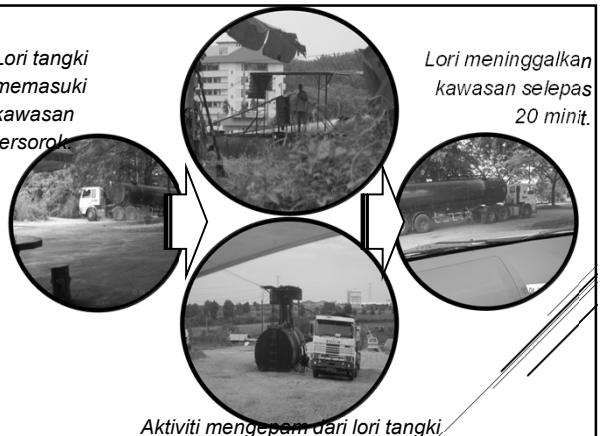
Lokasi 1

Lokasi 2

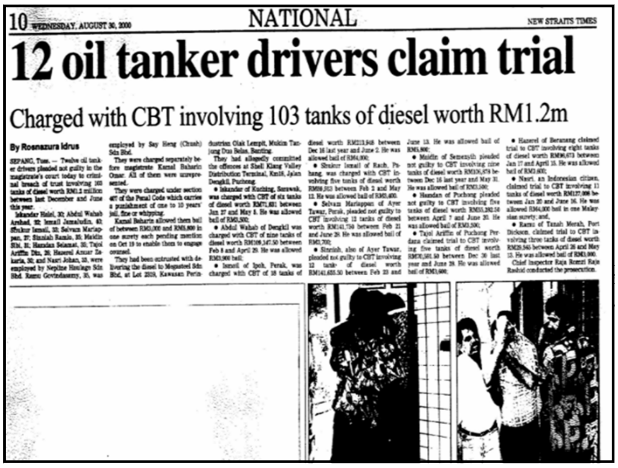
Kawasan disyaki sebagai 'Drop Zone'

Lori tangki memasuki kawasan tersorok.

Lori meninggalkan kawasan selepas 20 minit.



Aktiviti mengepam dari lori tangki ke tangki simpanan.



10 WEDNESDAY, AUGUST 30, 2000 NATIONAL NEW STRAITS TIMES

12 oil tanker drivers claim trial

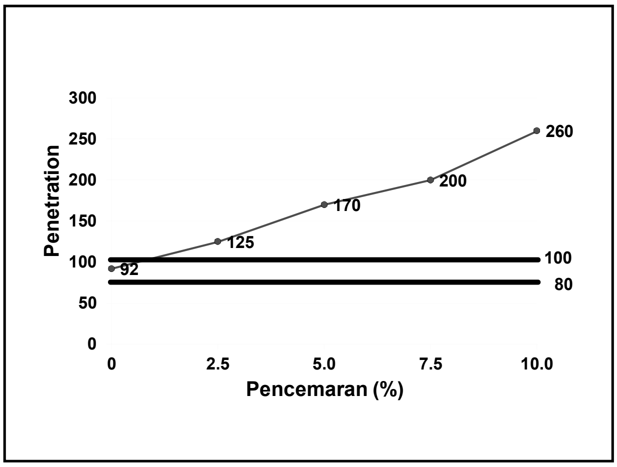
Charged with CBT involving 103 tanks of diesel worth RM1.2m

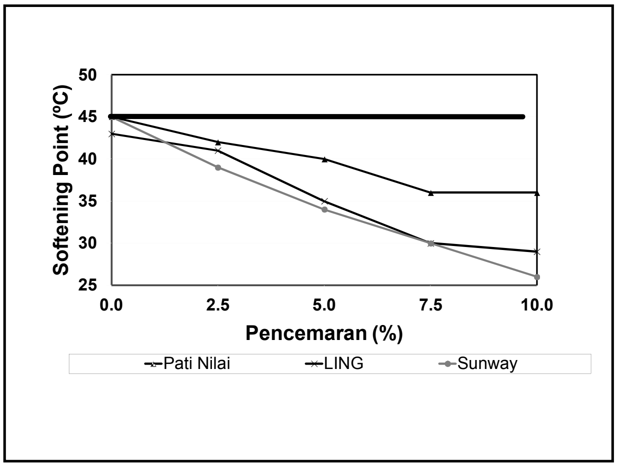
By Rosnazura Idrus

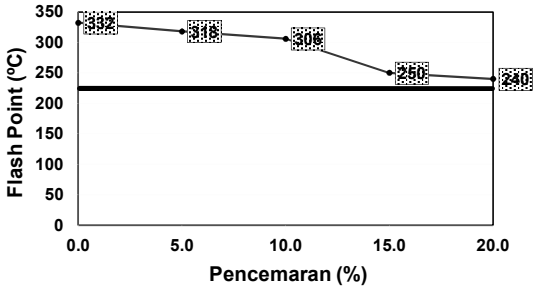
SEPANG, Tues. — Twelve oil tanker drivers pleaded not guilty in the magistrate's court today to criminal breach of trust involving 103 tanks of diesel worth RM1.2 million between last December and June this year.

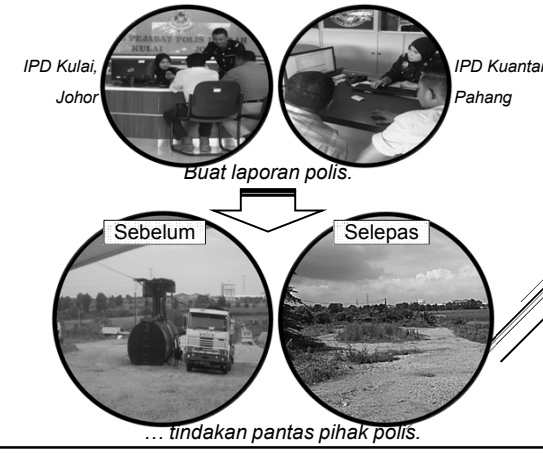
They were charged separately before magistrate Kamal Baharin Omar. All of them were unrepresented.

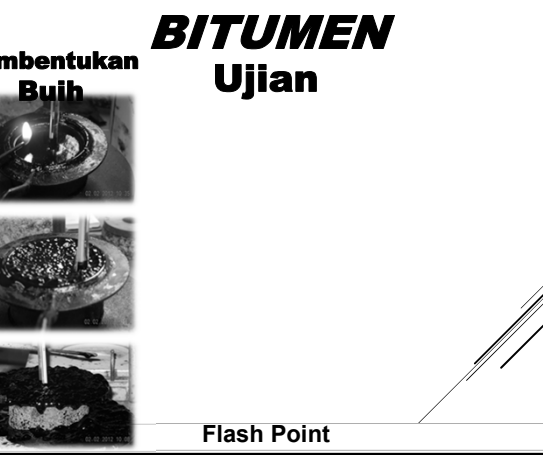
They were charged under section 407 of the Penal Code which carries a punishment of one to 10 years' jail, fine or whipping.






Flash Point (ºC)
350
300
250
200
150
100
50
0
0.0
5.0
10.0
15.0
20.0
Pencemaran (%)
332
318
306
250
240


IPD Kulai, Johor
IPD Kuantan, Pahang
Buat laporan polis.
Sebelum
Selepas
… tindakan pantas pihak polis.


BITUMEN
Ujian
Pembentukan Buih
Flash Point

REKABENTUK

Asphalt / Premix

Batu Kasar + Batu Halus + Mineral Filler + Bitumen ?

TUJUAN:

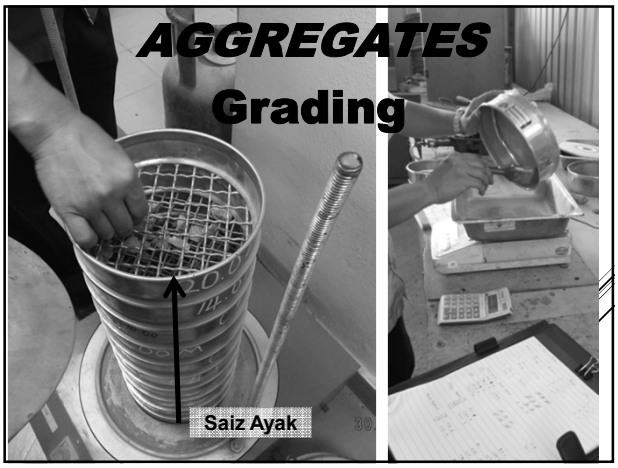
Untuk menentukan kombinasi bitumen dan batu-baur bagi menghasilkan bahan turapan yang berdaya tahan.

Rekabentuk asphalt

Kenapa tidak ada satu rekabentuk sahaja bagi seluruh negara?

Walaupun **grading sama**, **kandungan bitumen berbeza** sebab:
* Rupa bentuk batu berbeza.
* Tekstur batu berbeza.

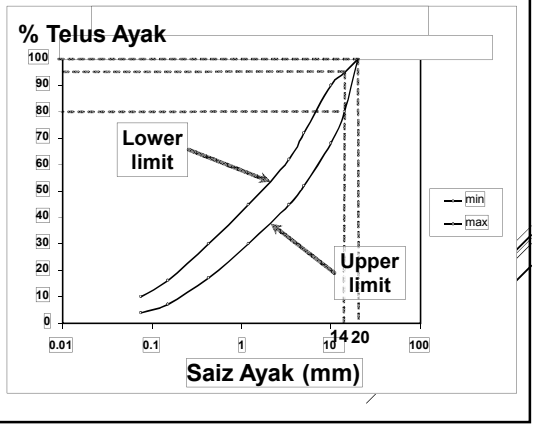
Specific gravity (ketumpatan) batu berbeza, melibatkan pengiraan:
* Density.
* Air voids.

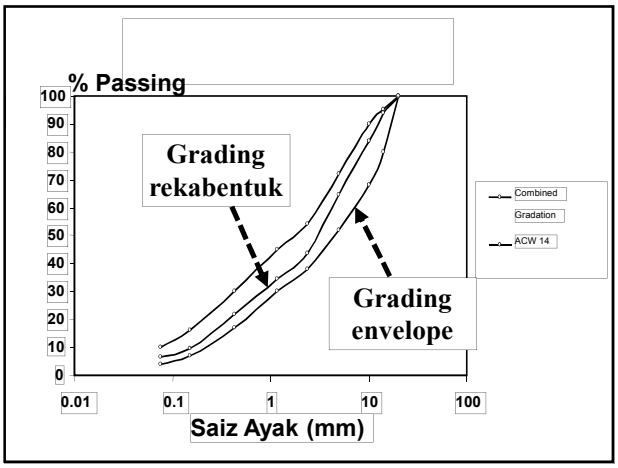


Jadual 4.8 JKR/SPJ

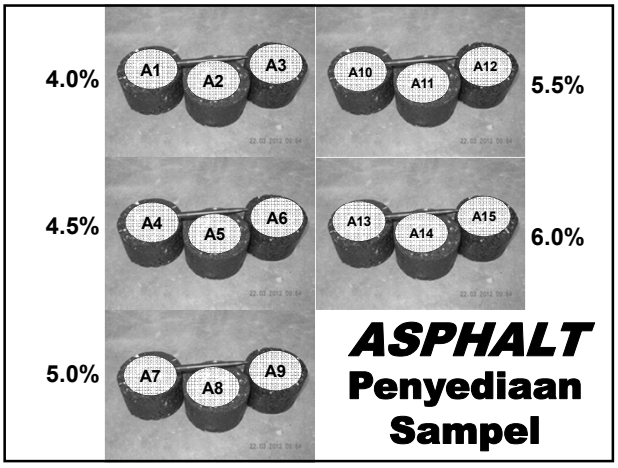
Had grading bagi asphaltic concrete

Jenis Mix	Wearing Course	Binder Course
	ACW 14	ACB 28
Saiz Ayak	% Telus Ayak	
37.5 mm	-	100
28.0 mm	-	80 – 100
20.0 mm	100	72 – 93
14.0 mm	80 – 95	58 – 82
10.0 mm	68 – 90	50 – 75
5.0 mm	52 – 72	36 – 58
3.35 mm	45 – 62	30 – 52
1.18 mm	30 – 45	18 – 38
425 µm	17 – 30	11 – 25
150 µm	7 – 16	5 – 14
75 µm	4 – 10	3 – 8





Perlu sediakan spesimen Marshall



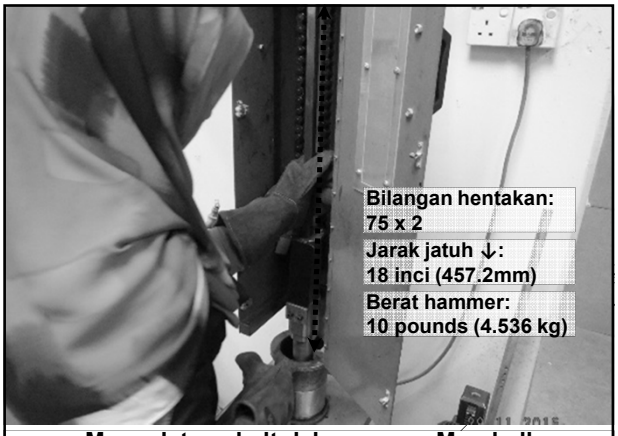
Kombinasi batu baur

Sukatan kandungan bitumen

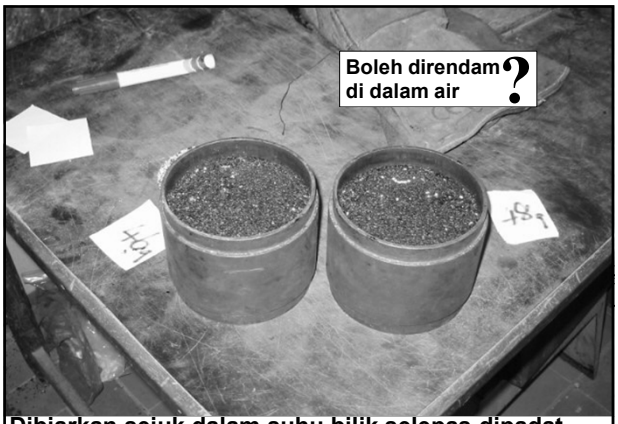
Bancuhan batu-baur & bitumen (asphalt)

Mengisi asphalt ke dalam acuan Marshall

Asphalt dalam acuan Marshall

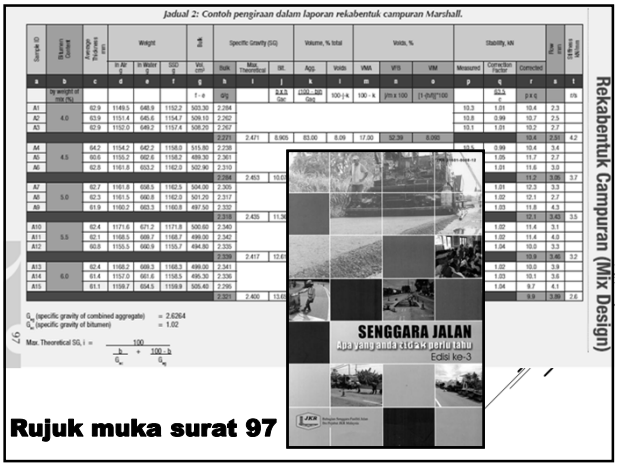


Memadat asphalt dalam acuan Marshall

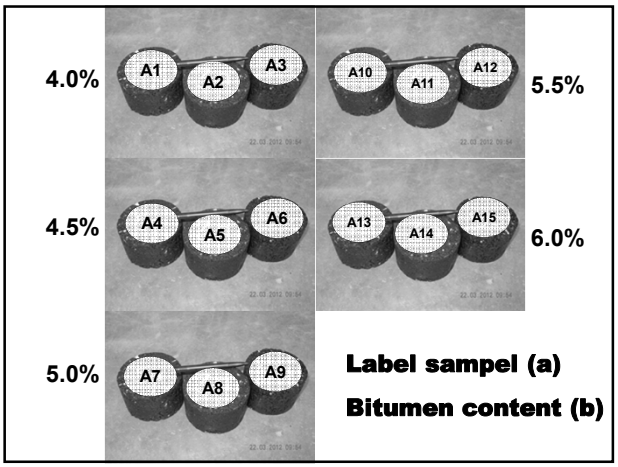


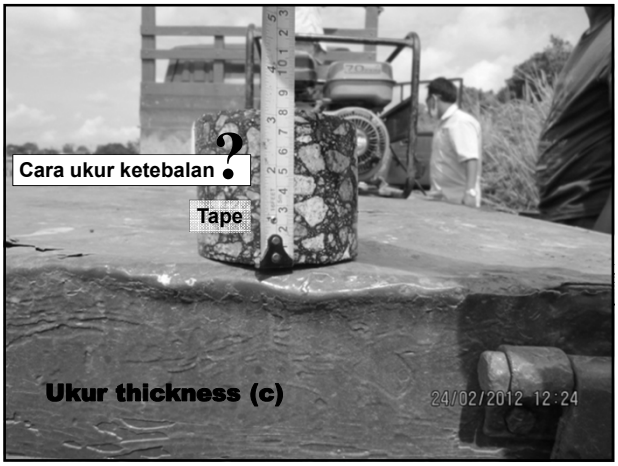
Dibiarkan sejuk dalam suhu bilik selepas dipadat sebelum dikeluarkan dari acuan.

Spesimen Marshall 4” Ø x 2½” tinggi

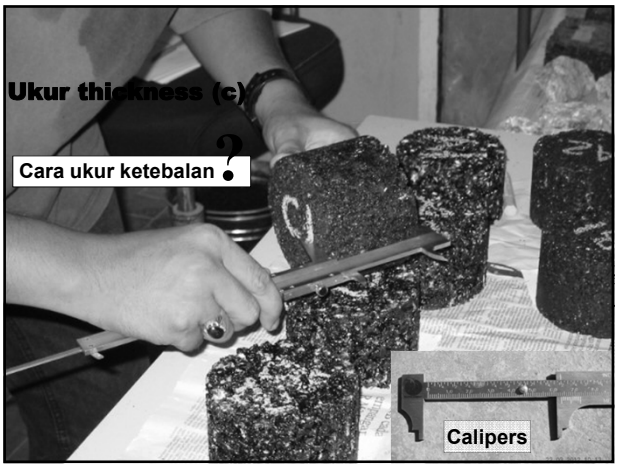


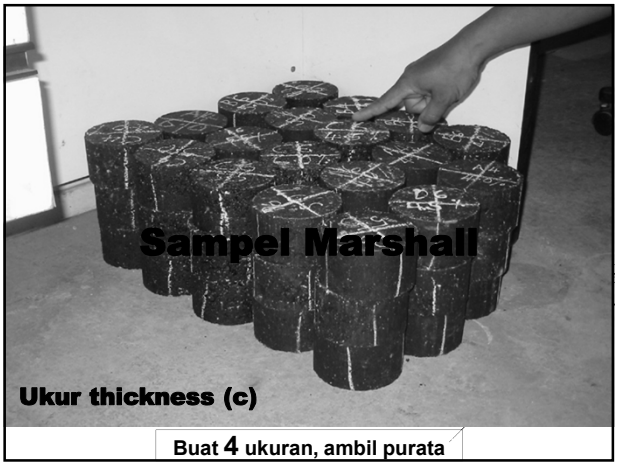
Rujuk muka surat 97


4.0%
A1
A2
A3
A10
A11
A12
5.5%
4.5%
A4
A5
A6
A13
A14
A15
6.0%
5.0%
A7
A8
A9
Label sampel (a)
Bitumen content (b)


Cara ukur ketebalan ?
Tape
Ukur thickness (c)
24/02/2012 12:24

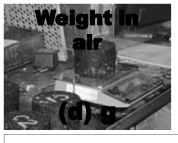

Pembaris
Cara ukur ketebalan ?
Ukur thickness (c)
22.03.2012 09:34


Ukur thickness (c)
Cara ukur ketebalan ?
Calipers


Sampel Marshall
Ukur thickness (c)
Buat 4 ukuran, ambil purata


Weight in air (d)
24/02/2012 13:07

ASPHALT
Ujian



Bulk volume, (g) = $f - e$	*Unit: gram*
SG_{bulk}, (h) = $\frac{d}{g} = \frac{d}{f - e}$	*tiada unit*
$Density_{bulk} = h \times \rho_{water}$	*Unit: kg/m3*

Ujian Density

ASPHALT
Ujian

Density$_{water}$, ρ_{water} = 997 g/m³ *suhu air* = **25 °C**

Sekiranya suhu air > 25 ± 1 °C ? **Rujuk ASTM D 2726**

Suhu air	ρ_{water}
10 °C	1,000 g/m³
20 °C	998 g/m³
23 °C	
25 °C	**997 g/m³**
27 °C	
28 °C	996 g/m³
30 °C	996 g/m³

Ujian Density

ASPHALT
Ujian

Specific Gravity (SG)	
Bulk	Max. Theoretical
(**h**)	(**i**)
$\frac{\mathbf{d}}{\mathbf{f} - \mathbf{e}}$	$\frac{\mathbf{100}}{\frac{\mathbf{b}}{\mathbf{G_{ac}}} + \frac{\mathbf{100} - \mathbf{b}}{\mathbf{G_{ag}}}}$

G_{ac} = specific gravity of bitumen

G_{ag} = specific gravity of combined aggregates

Ujian Density

ASPHALT
Ujian

Volume, % total		
Bitumen	Aggregate	Voids
(**j**)	(**k**)	(**l**)
$\frac{\mathbf{b} \times \mathbf{h}}{G_{ac}}$	$\frac{(\mathbf{100} - \mathbf{b}) \times \mathbf{h}}{G_{ag}}$	**100 – j – k**

Pembetulan !

Ujian Density

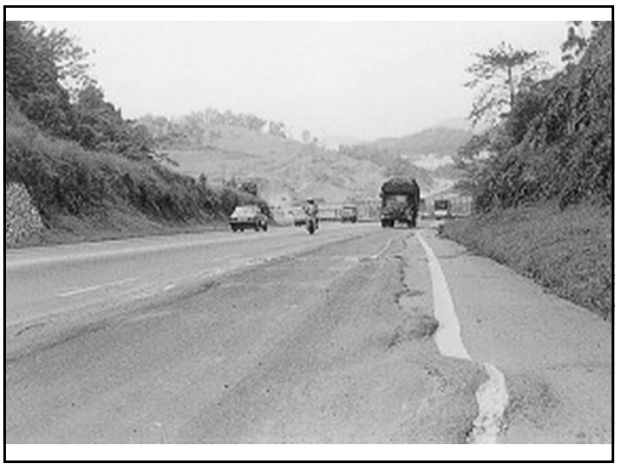
ASPHALT
Ujian

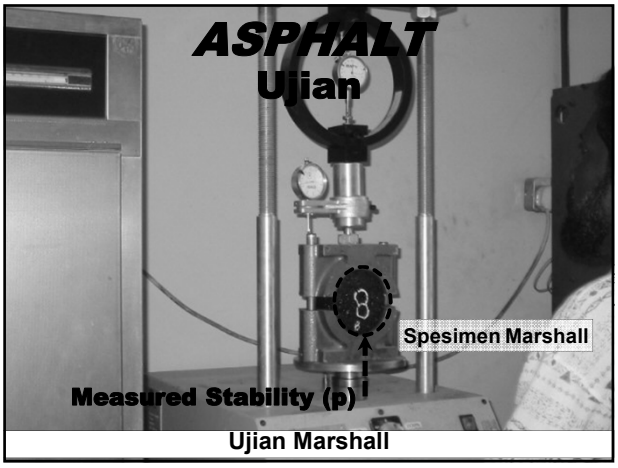
Voids (%)		
VMA	VFB	VIM
(m)	(n)	(o)
100 – k	$\frac{j}{m}$ x 100	$(1 - \frac{h}{i})$ x 100

Jika h = i, o = 0

maximum theoretical density (i)

Ujian Density





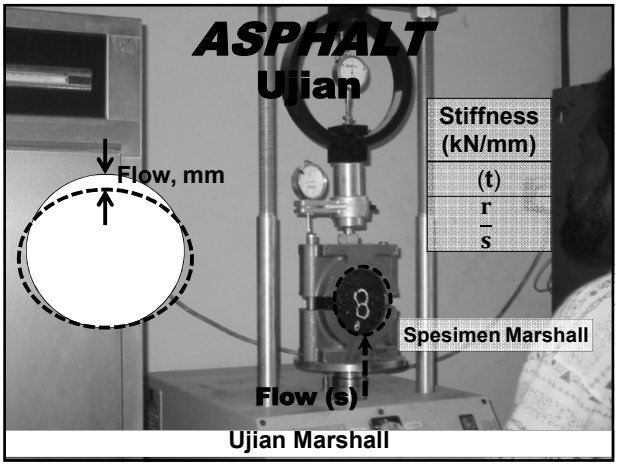
Ujian Marshall

ASPHALT
Ujian

Stability (kN)		
Measured	Correction Factor	Corrected
(**p**)	(**q**)	(**r**)
-	$\frac{63.5}{c}$	p x q

Ujian Marshall

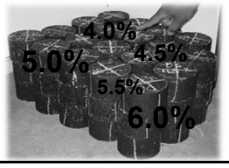
ASPHALT
Ujian



Ujian Marshall

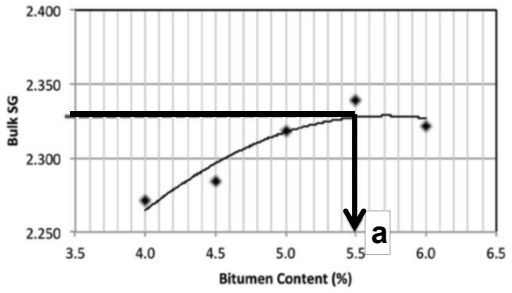
ASPHALT
Rekabentuk Campuran

Bitumen Content (%)	Bulk SG	Stability (kN)	Flow (mm)	VIM (%)	VFB (%)
4.0	2.271	10.4	2.51	8.093	52.39
4.5	2.284	11.2	3.05	6.870	59.45
5.0	2.318	12.1	3.43	4.783	70.38
5.5	2.339	10.9	3.46	3.224	79.64
6.0	2.321	9.9	3.89	3.260	80.72



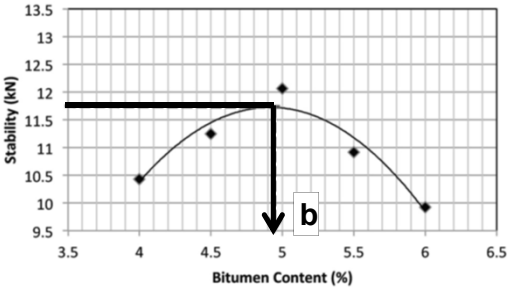
ASPHALT
Kandungan Bitumen Optimum

Bulk SG vs Bitumen content



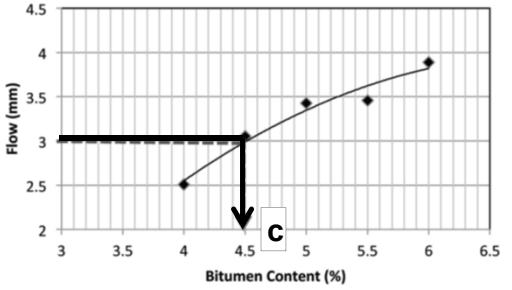
ASPHALT
Kandungan Bitumen Optimum

Stability vs Bitumen content

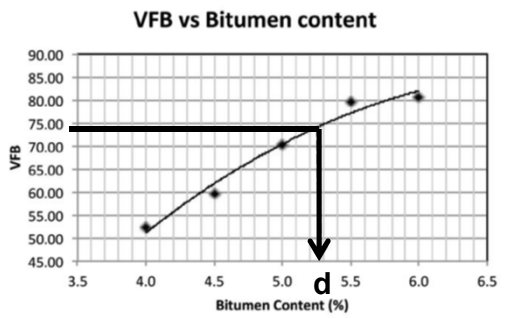


ASPHALT
Kandungan Bitumen Optimum

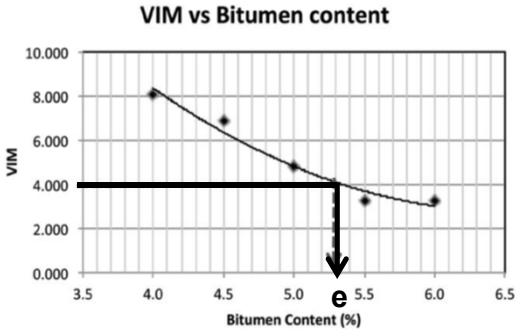
Flow vs Bitumen content



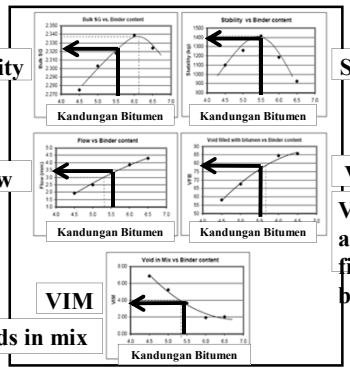
ASPHALT
Kandungan Bitumen Optimum



ASPHALT
Kandungan Bitumen Optimum



Kandungan Bitumen Optimum = $\frac{a+b+c+d+e}{5}$



Density

Stability

Flow

VF

Voids in aggregate filled with bitumen

VIM

Voids in mix

ASPHALT
Parameter Ujian bagi Spesimen Marshall

Parameter	Wearing Course	Binder Course
Stability	> 8000 N	
Flow	2.0 – 4.0 mm	
Stiffness	> 2000 N/mm	
Voids in mix (VIM)	3.0 – 5.0 %	3.0 – 7.0 %
Voids in aggregate filled with bitumen (VFB)	70 – 80 %	65 – 75 %

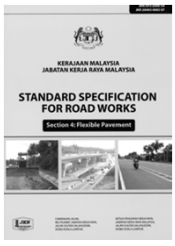
ASPHALT

Rekabentuk campuran asphalt diluluskan oleh S.O.

Trial Lay atau PLANT TRIAL ?

ASPHALT
PLANT TRIAL / Trial Lay?

Klausa 4.3.3.3 (b): Plant Trials



Setelah mendapat kelulusan awal ke atas cadangan *job mix formula* (JMF), kontraktor hendaklah **membancuh**, **menghampar** dan **memadat** asphaltic concrete mengikut JMF seperti yang dicadangkan.

Jalankan ujian ke atas sampel bagi mengesahkan **pematuhan ke atas JMF**, dan **pemadatan yang memuaskan**.

Kawasan trial lay disediakan dan ditanggung oleh kontraktor dan TIDAK menjadi sebahagian daripada Kontrak.

ASPHALT
Trial Lay
ROLLING PATTERN

statik getar statik
2 – 2 – 10 – 2

Steel Wheel Roller **Pneumatic Tyre Roller**


ASPHALT
Trial Lay
ROLLING PATTERN

2 passes
2 passes
2 passes


PEMADATAN ASPHALT

JKR/SPJ/1988 Clause 4.2.4.4 (e) Rollers

- A pneumatic tyre roller and two steel wheel tandem rollers shall be provided.

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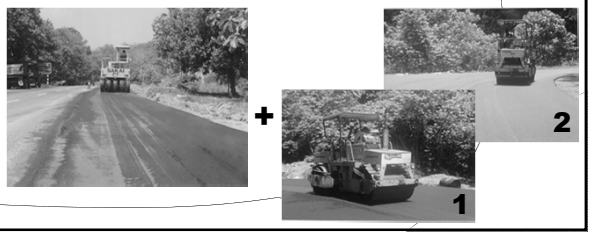

JKR/SPJ/1988 Clause 4.2.4.4 (e) Rollers

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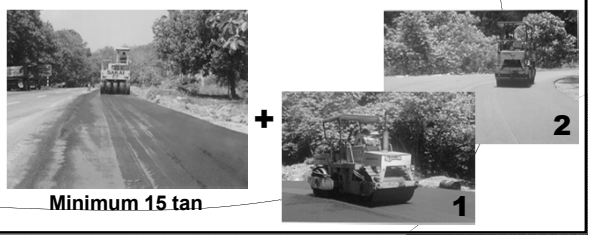
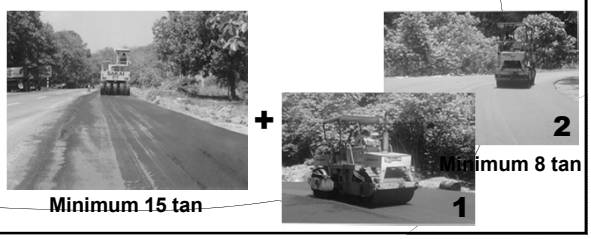


JKR/SPJ/1988 Clause 4.2.4.4 (e) Rollers

- A pneumatic tyre roller and two steel wheel tandem rollers shall be provided.



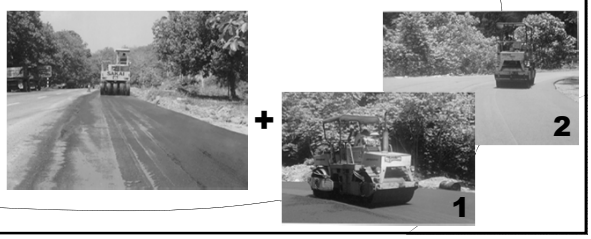
JKR/SPJ/1988 Clause 4.2.4.4 (e) Rollers

- A pneumatic tyre roller and two steel wheel tandem rollers shall be provided.

  However, a three wheel steel roller may be substituted for one of the tandem rollers if the S.O. shall so approve.

JKR/SPJ/1988 Clause 4.2.4.4 (e) Rollers

- However, a three wheel steel roller may be substituted for one of the tandem rollers if the S.O. shall so approve.



JKR/SPJ/1988 Clause 4.2.4.4 (e) Rollers

- However, a three wheel steel roller may be substituted for one of the tandem rollers if the S.O. shall so approve.

+

JKR/SPJ/1988 Clause 4.2.4.5 (i) Compaction of Asphaltic Concrete

- Initial (or breakdown) rolling shall be carried out with an approved steel wheel tandem roller or three wheel steel roller.

  The final rolling shall be carried out with an approved steel wheel tandem roller.


Construction


Pneumatic tyre
roller


Steel wheel
tandem roller
Pneumatic tyre
roller


Steel wheel
tandem roller
Pneumatic tyre
roller
?


• Di mana supervisor?


• Di mana supervisor?
• Ada orang check temperature?


• Di mana supervisor?
• Ada orang check temperature?
• Siapa yang tentukan bila nak gelek, di mana nak gelek?


• Di mana supervisor?
• Ada orang check temperature?
• Siapa yang tentukan bila nak gelek, di mana nak gelek?
• Ada orang check rolling pattern?

ASPHALT
Trial Lay

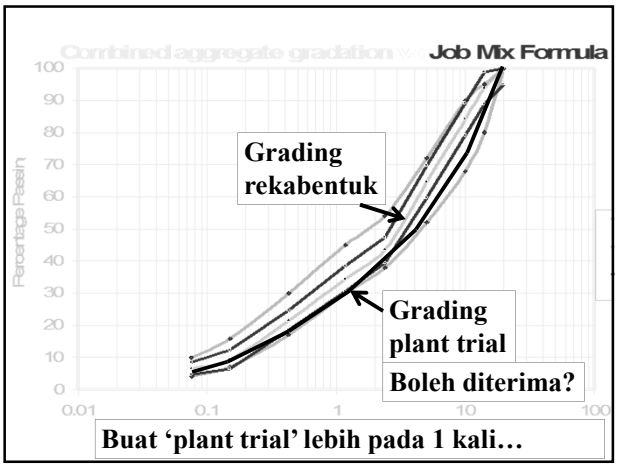
Sekiranya
TARGET DENSITY
tidak tercapai ?

TUKAR salah satu/semua faktor berikut:
- **Saiz roller**
- **Rolling temperature**
- **Rolling pattern**

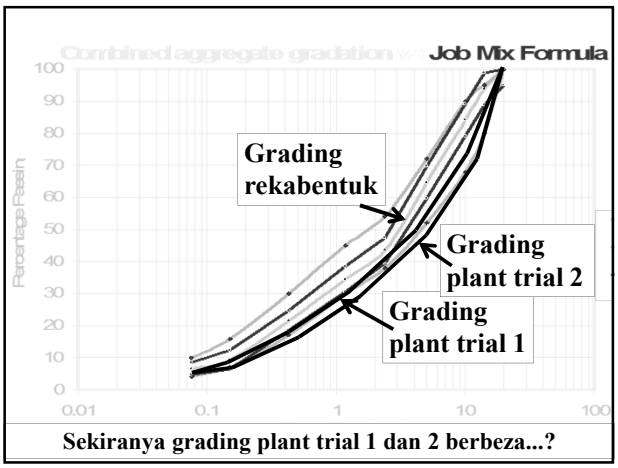
Pastikan asphalt yang dihasilkan sama seperti yang direkabentuk + toleransi (job mix formula).

ASPHALT
Toleransi

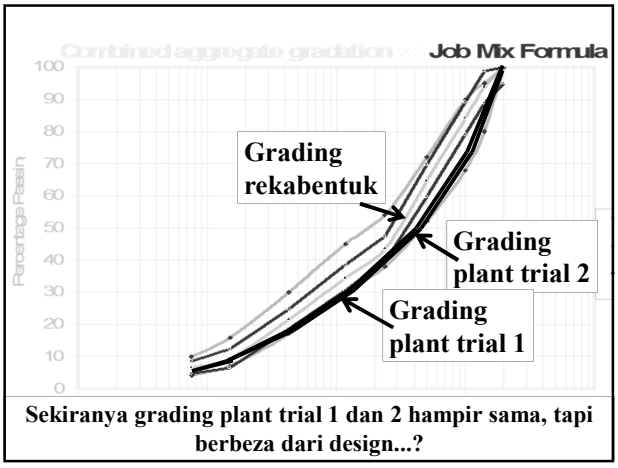
Parameter	Variasi yang dibenarkan (% berat asphalt)
Kandungan bitumen	± 0.2 %
Batu baur yang telus ayak 5.0 mm dan ayak yang lebih besar	± 5.0 %
Batu baur yang telus ayak 3.35 mm dan 1.18 mm	± 4.0 %
Batu baur yang telus ayak 0.425 mm dan 0.150 mm	± 3.0 %
Batu baur yang telus ayak 0.075 mm	± 2.0 %



Buat 'plant trial' lebih pada 1 kali…



Sekiranya grading plant trial 1 dan 2 berbeza...?



Sekiranya grading plant trial 1 dan 2 hampir sama, tapi berbeza dari design...?

ASPHALT
Trial lay

Sekiranya hanya ***compacted thickness*** sahaja yang **GAGAL**, boleh teka ***laying thickness*** tanpa ulang trial lay?

Sekiranya hanya ***compacted density*** sahaja yang **GAGAL**, boleh teka ***rolling pattern*** atau ***rolling temperature*** tanpa ulang trial lay?

Sekiranya **prosedur hamparan dan mampatan** seperti yang ditentukan semasa trial lay **tidak diikuti**, **BUANG MASA** buat trial lay.

Trial lay boleh dibuat di tapak kerja senggara.
Sekiranya LULUS, bayar.
Sekiranya GAGAL, tidak dibayar dan seksyen trial lay tidak akan dibuang. Ulang trial lay.

ASPHALT
Job Mix Formula

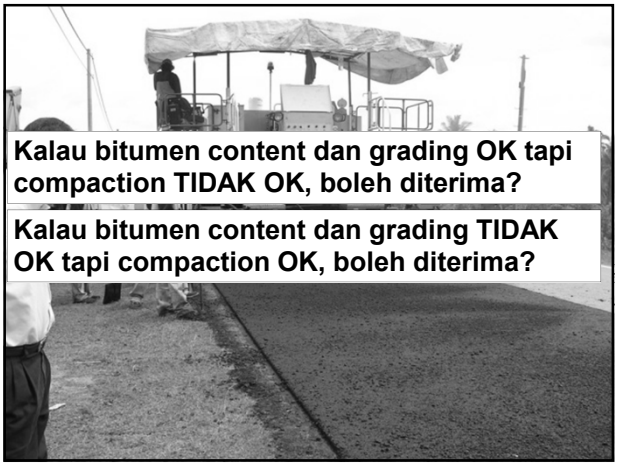
Setelah S.O. meluluskan Job Mix Formula (JMF), kontraktor bertanggungjawab untuk menghasilkan 'asphalt dengan grading dan kandungan bitumen yang TEPAT seperti yang ditetapkan dalam JMF'.

ASPHALT
Job Mix Formula

Ujian ke atas Asphalt:
- Kandungan bitumen
- Grading
- Marshall:
  - Density
  - Air Voids
  - Stability
  - Flow

Setiap 200 tan asphalt dihasilkan.

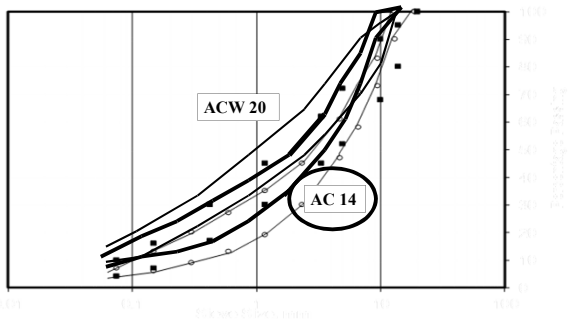
Asphalt yang tidak patuh Job Mix Formula sewajarnya TIDAK DITERIMA.



Kalau bitumen content dan grading OK tapi compaction TIDAK OK, boleh diterima?

Kalau bitumen content dan grading TIDAK OK tapi compaction OK, boleh diterima?

Mana lebih kasar?



TACK COAT

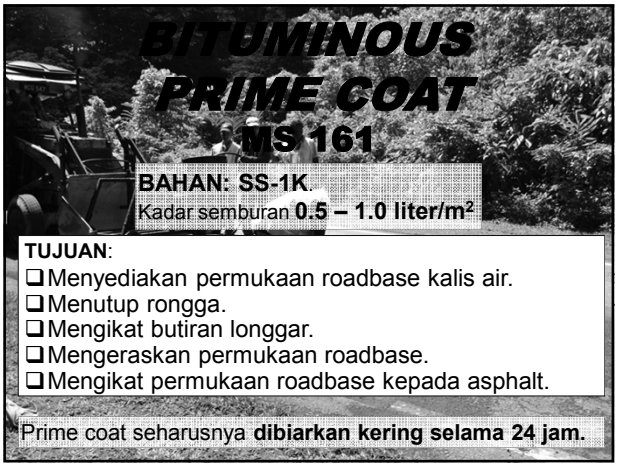
TUJUAN: Untuk memastikan lapisan turapan baru melekat pada permukaan jalan sedia ada.

BAHAN: Rapid setting bitumen emulsion grade RS-1K, mematuhi MS 161.

BITUMINOUS TACK COAT

MS 161

Jenis / Kandungan	RS-0K K1-40	RS-1K	RS-2K	RS-3K
Min. bitumen, %	38	**50**	60	65
Air, %	62	**50**	40	35



TUJUAN:
- ❑ Menyediakan permukaan roadbase kalis air.
- ❑ Menutup rongga.
- ❑ Mengikat butiran longgar.
- ❑ Mengeraskan permukaan roadbase.
- ❑ Mengikat permukaan roadbase kepada asphalt.

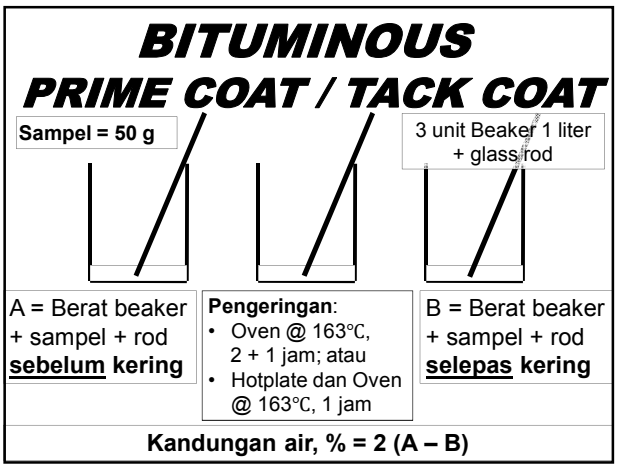
Prime coat seharusnya **dibiarkan kering selama 24 jam.**


STIR
BEFORE USE
Batch No. 28A03 Drum No. 019
09.04.2013 11:11


09.04.2013 11:26


Tin sampel bersih
09.04.2013 11:12

BITUMINOUS PRIME COAT / TACK COAT



Kandungan air, % = 2 (A – B)

Aplikasi: **0.25 – 0.55 liter/m²**, semburan **rata**, **tidak berbelang-belang**

Aplikasi: **0.25 – 0.55 liter/m²**, semburan **rata**, **tidak berbelang-belang**

Semburan **tidak rata**

Semburan **terlalu sedikit**

Semburan **terlalu banyak**

Kerosakan yang biasa dikaitkan dengan tack coat.

Kerosakan yang biasa dikaitkan dengan tack coat.

Kerosakan yang biasa dikaitkan dengan tack coat.

Suhu bitumen **< 177**℃ (350℉).

TURAPAN ASPHALT
Kawalan suhu

Suhu asphalt **< 163**℃ (325℉).

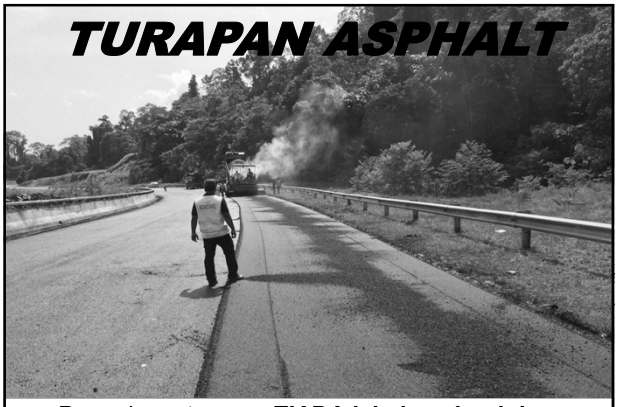
TURAPAN ASPHALT
Kawalan suhu

Suhu asphalt **sebelum dimasukkan ke dalam paver > 130**℃.

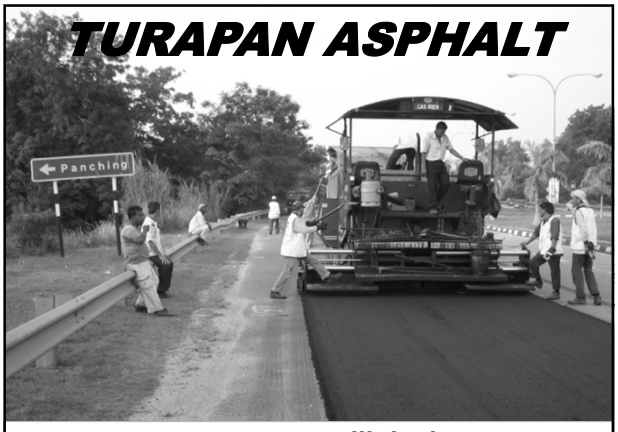
TURAPAN ASPHALT
Kawalan suhu

Suhu mula gelek **> 120**℃ (seharusnya ikut **seperti *trial lay***, **berhenti gelek** apabila **suhu < 80**℃).

Permukaan turapan **TIADA lekukan, bonjolan, koyakan, segregation**.



Permukaan turapan **TIADA lekukan, bonjolan, koyakan, segregation**.



Turap dengan **paver yang diluluskan** oleh S.O.

Turap dengan **paver yang diluluskan** oleh S.O.

Paver dipasang **automatic levelling device**.

Hand-casting bagi membetulkan kecacatan di permukaan turapan **dikawal ke tahap minimum**.

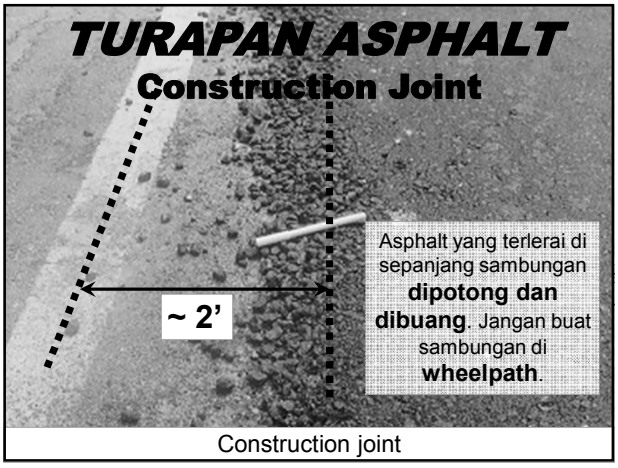
Hand-casting bagi membetulkan kecacatan di permukaan turapan **dikawal ke tahap minimum**.

TURAPAN ASPHALT
Ketebalan lapisan turapan

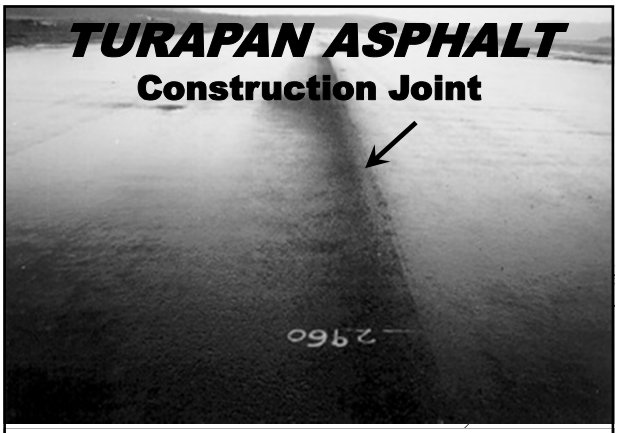
Ketebalan (selepas dimampat) setiap lapisan turapan
> 2 x saiz batu paling besar, dan < 100 mm.

TURAPAN ASPHALT
Ketebalan lapisan turapan

TURAPAN ASPHALT
Ketebalan lapisan turapan



Construction joint



Construction joint yang **TIDAK BAIK**

Potong joint di Labuan

Mesin penggelek mesti ada **tangki air & sistem perenjis** untuk memastikan **semua tayar basah & bersih** semasa menggelek.


TURAPAN ASPHALT
Pemadatan
?


TURAPAN ASPHALT
Pemadatan
?


TURAPAN ASPHALT
Pemadatan
?
Kalau gelek panas, nanti tak dapat thickness…?

TURAPAN ASPHALT
Pemadatan

Kerja penurapan dijalankan **hanya semasa cuaca baik (dry weather)**.

TURAPAN ASPHALT
Pemadatan

Asphalt **cepat sejuk** sebelum sempat dipadatkan.

Air meresap masuk ke dalam asphalt yang belum padat, **membentuk ruang apabila air kering**.

Kerja penurapan dijalankan **hanya semasa cuaca baik (dry weather)**.

TURAPAN ASPHALT

Dibuka kepada trafik

Jangan dibuka kepada trafik sehingga **bahan turapan telah sejuk selepas siap digelek** (pada kebiasaannya tidak kurang dari 4 jam selepas mula digelek).

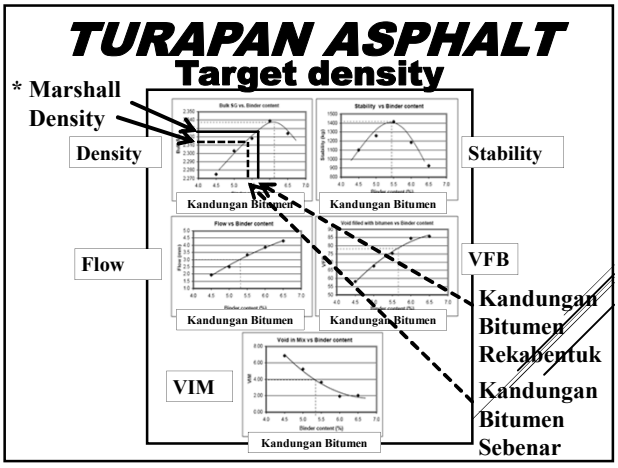
TURAPAN ASPHALT
Pengambilan sampel core

Satu sampel setiap 500 m², **> 2 sampel** bagi **setiap sesi penurapan**, dalam tempoh 24 jam.

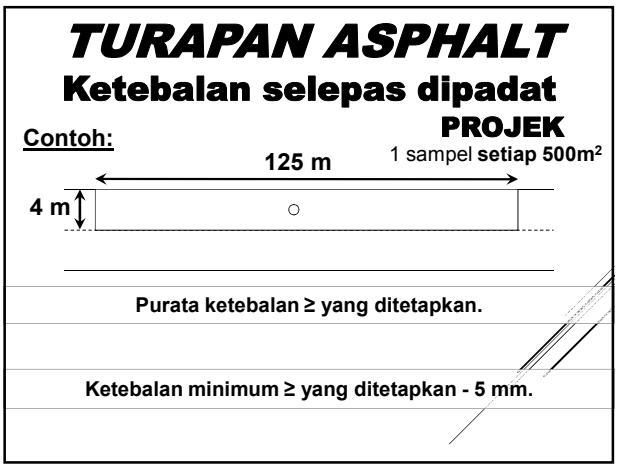
TURAPAN ASPHALT
Compacted density

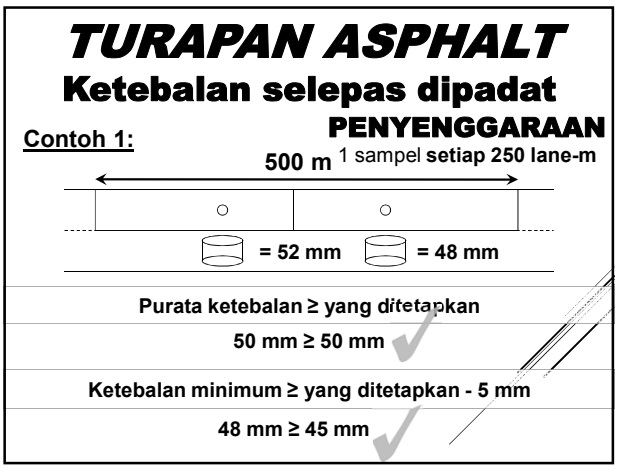
Wearing course: 98 - 100% Marshall density
Binder course : 95 - 100% Marshall density

TURAPAN ASPHALT
Target density




TURAPAN ASPHALT
Compacted thickness
Toleransi ±5 mm?
Purata ketebalan ≥ yang ditetapkan.
Ketebalan minimum ≥ yang ditetapkan - 5 mm.
Syahida binti Aripin | Makmal Penyelidikan Jalan, CREaTE


TURAPAN ASPHALT
Ketebalan selepas dipadat
Contoh:
PROJEK
1 sampel setiap 500m²
125 m
4 m
Purata ketebalan ≥ yang ditetapkan.
Ketebalan minimum ≥ yang ditetapkan - 5 mm.


TURAPAN ASPHALT
Ketebalan selepas dipadat
Contoh 1:
PENYENGGARAAN
500 m
1 sampel setiap 250 lane-m
= 52 mm
= 48 mm
Purata ketebalan ≥ yang ditetapkan
50 mm ≥ 50 mm
Ketebalan minimum ≥ yang ditetapkan - 5 mm
48 mm ≥ 45 mm

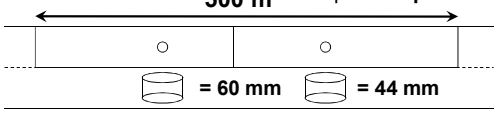
TURAPAN ASPHALT

Ketebalan selepas dipadat

PENYENGGARAAN

Contoh 2:

500 m 1 sampel **setiap 250 lane-m**



Purata ketebalan ≥ yang ditetapkan

52 mm ≥ 50 mm ✓

Ketebalan minimum ≥ yang ditetapkan - 5 mm

44 mm < 45 mm ✗

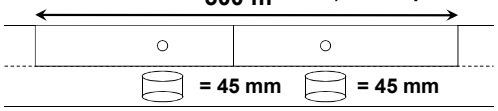
TURAPAN ASPHALT

Ketebalan selepas dipadat

PENYENGGARAAN

Contoh 3:

500 m 1 sampel **setiap 250 lane-m**



Purata ketebalan ≥ yang ditetapkan

45 mm < 50 mm ✗

Ketebalan minimum ≥ yang ditetapkan - 5 mm

45 mm ≥ 45 mm ✓

TURAPAN ASPHALT

Compacted thickness

Purata ketebalan ≥ yang ditetapkan.

Ketebalan minimum ≥ yang ditetapkan - 5 mm.

Sekiranya density TIDAK CUKUP, apakah PUNCAnya?

- Rolling pattern
- Hand-casting
- Tidak buat trial lay
- Saiz roller
- Suhu gelek (rolling temperature)
- Satu (1) steel wheel tandem roller
- Grading, bitumen content tidak ikut rekabentuk
- Kerja turapan semasa hujan

Sekiranya thickness TIDAK CUKUP, apakah PUNCAnya?

- Kontraktor curi thickness?
- Paver pakai sensor
- Laying thickness tidak cukup
- Salah faham ada toleransi ± 5 mm dalam spesifikasi
- Gelek terlalu panas
- Tidak buat trial lay

Sekian