NOTA KURSUS PENGAWASAN PROJEK JALAN BERDASARKAN SPESIFIKASI JKR

SECTION 4 : FLEXIBLE PAVEMENT

OLEH:
ROZAIDI EZDWAN BIN ABDUL LATIB
UNIT PROJEK KHAS (ZON SELATAN)
CAWANGAN JALAN
IBU PEJABAT JKR MALAYSIA

SECTION 4: FLEXIBLE PAVEMENT

FLEXIBLE PAVEMENT

- Typical Diagram Pavement Layers

Source : JKR/SPJ/2013-S4

FLEXIBLE PAVEMENT

- **Sub Base**

  Shall be a natural or artificial mixture of locally available material such as **sand, gravel, crushed aggregate** etc, **free from organic matter, clay lumps** & other deleterious materials.

  - Material Testing (Clause 4.2.2.2)
    - Shall passed grading limit
    - CBR value **not less** than 30%
    - Plasticity index **not more** than 12
    - 10% fines value **not less** than 30kN
    - Sand equivalent of aggregate fraction passing No 4 (4.75mm) **not less** than 45%
    - Sub base compacted by layer and passed 95% FDT during construction

Source : JKR/SPJ/2013-S4

FLEXIBLE PAVEMENT

Construction

Sub-base material shall be transported, laid and compacted at a moisture content within the range +1% to -2% of the optimum moisture content without drying out or segregation.

Sub-base material shall be placed over the full width of the formation to the required thickness in one layer or more, each layer not exceeding 200 mm compacted thickness. Where two or more layers are required, they shall be of approximately equal thickness and none shall be less than 100 mm compacted thickness.

Compaction shall be carried out in a longitudinal direction along the roadbed, and shall generally begin at the outer edge and progress uniformly towards the crown on each side in such a manner that each section receives equal compactive effort.

The sub-base shall be finished in a neat and workmanlike manner, and shall have an average thickness over any 100 metre length not less than the required thickness. The top surface of the sub-base shall have the required shape, superelevation, levels and grades.

FLEXIBLE PAVEMENT

❑ Roadbase (Crushed Aggregate)

Shall be crushed rock, crushed gravel or a mixture of crushed rock & gravel, which shall be hard, durable, clean & essential free from clay & other deleterious materials

- ➢ Material Testing (Clause 4.2.3.2)
  - Shall passed grading limit
  - CBR value **not less** than 80%
  - Plasticity index **not more** than 6
  - Aggregate crushing value **not more** than 25%
  - Flakiness index **not more** than 25%
  - Soundness test **not more** than 18%
  - Sand equivalent of aggregate fraction passing No 4 (4.75mm) **not less** than 45%
  - Roadbase compacted by layer and passed 95% FDT during construction

Source : JKR/SPJ/2013-S4

FLEXIBLE PAVEMENT

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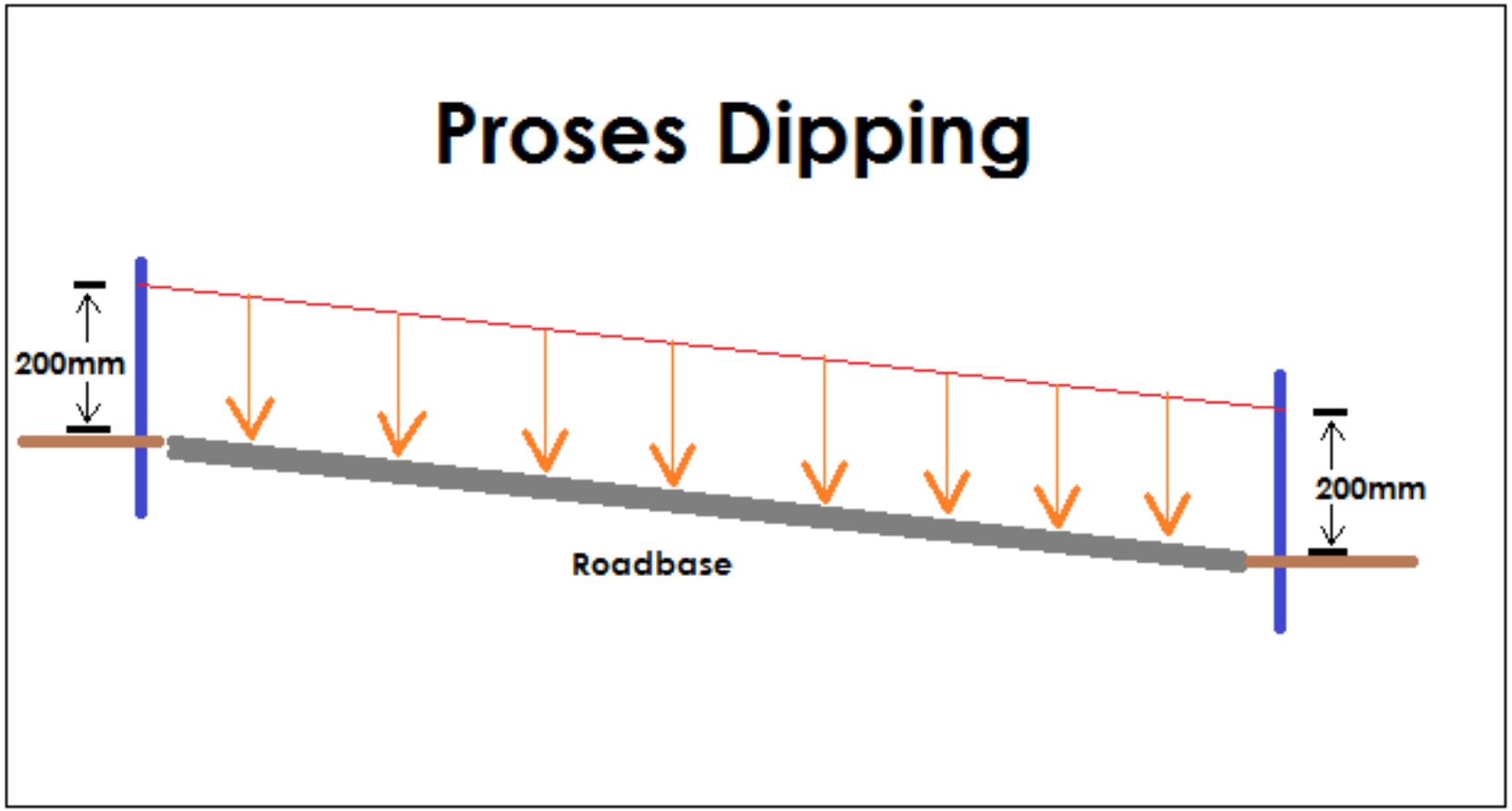

FLEXIBLE PAVEMENT

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Prime Coat

The main function of a prime coat is to penetrate the layer to which it is applied, while leaving a small residual amount of binder on the surface to:

Assist in promoting adhesion between the base and newly applied bituminous surfacing or layer.

Inhibit the ingress of water from rain into the base, while not hampering the migration of water in the vapour phase out of the base.

Limit the absorption of binder from the next spray application into the base.

Bind the finer particles in the upper zone of the base to accommodate light construction traffic for a short period, until the new surfacing is placed.

FLEXIBLE PAVEMENT

- **Prime Coat**

Shall be slow-setting cationic bitumen emulsion of grade SS-1K

- During Construction (Clause 4.3.1.4)
  - Prime coat shall only carried out in dry & warm weather when the surface to be treated is essentially dry
  - Spray temperature range 25°C - 45°C
  - Spray rate range 0.5 – 1 litre/m^2 (tray spray rate test to be conduct with frequency 1 test per 16,000m^2 daily operation covered)
  - Curing left undisturbed for at least 24 hour

Source : JKR/SPJ/2013-S4

FLEXIBLE PAVEMENT

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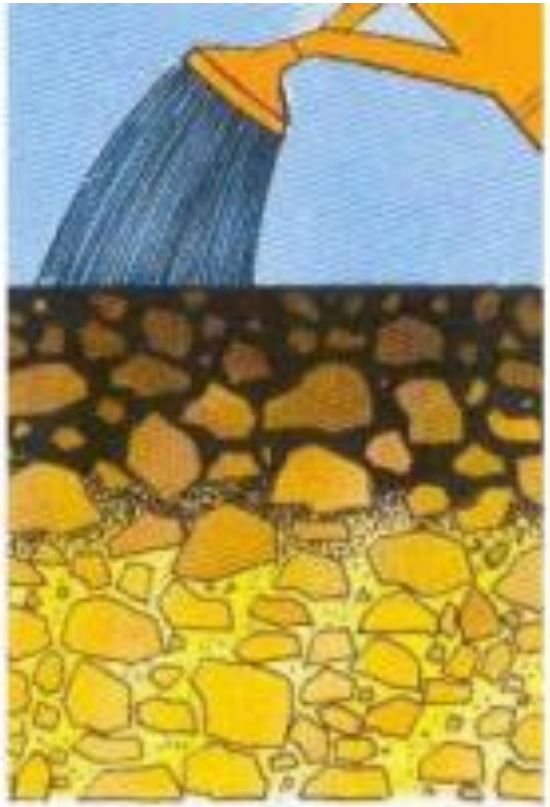
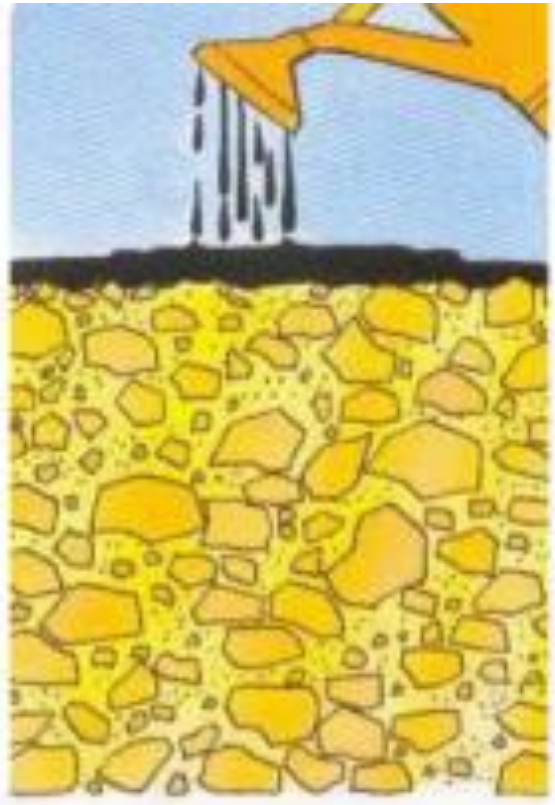


The emulsion must penetrate the first few milimeters of the layer very quickly



Prime coat will not succeed if the emulsion is of a viscosity that does not correspond to the gravel or has too high a breaking speed.

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- Prime Coat
  - Material Testing
  - (Clause 4.3.1.2)

TABLE 4.3.2 MS 161 REQUIREMENTS FOR BITUMEN EMULSION SS-1K

Properties	Unit	Grade SS-1K	Test Methods (or technically identical with)
Tests on emulsion:			
Saybolt Furol viscosity at 25 °C, minimum maximum	sec.	20 100	ASTM D244
Storage stability test, 24 h, maximum	% difference	1	ASTM D244
Sieve test, maximum	%	0.10	ASTM D244
Cement mixing test, maximum.	%	2	ASTM D244
Residue from distillation, minimum	% mass	57	ASTM D244
Tests on residue from distillation:			
Penetration at 25 °C,100g, 5 sec. minimum maximum	0.1 mm	60 200	ASTM D5
Solubility in trichlorethylene, Minimum	% mass	97.5	ASTM D2042

The S.O. shall receive a copy of the test results for each delivery of cut-back bitumen, bitumen emulsion or other materials employed in the Works.

Source : JKR/SPJ/2013-S4

FLEXIBLE PAVEMENT

- **AC 28 (binder course)**

  Consist of mix designation of AC 28 for binder course

  - Material Testing (Clause 4.3.3)
    - Grading limit
    - Design bitumen content
    - Stability
    - Flow
    - Stiffness
    - Air voids in mix (VIM)
    - Void in aggregate filled with bitumen (VFB)
    - Marshall density
    - Job Mix Formulae
    - Trial lay

Source : JKR/SPJ/2013-S4

FLEXIBLE PAVEMENT

- Table 4.3.3 Gradition Limits for Asphaltic Concrete

MIX TYPE	BINDER COURSE
MIX DESIGNATION	AC 28
BS SIEVE SIZE (mm)	PERCENTAGE PASSING BY WEIGHT
28.0	100
20.0	72 – 90
14.0	58 – 76
10.0	48 – 64
5.0	30 – 46
3.35	24 – 40
1.18	14 – 28
0.425	8 – 20
0.150	4 – 10
0.0075	3 – 7

Source : JKR/SPJ/2013-S4

FLEXIBLE PAVEMENT

- **AC 28**

Table 4.3.4 Design Bitumen Contents	
AC 28 Binder Course	3.5 – 5.5%

Table 4.3.7 Requirement of Compacted Density for Asphaltic Concrete	
Binder Course	95 – 100% Marshall Density

Source : JKR/SPJ/2013-S4

FLEXIBLE PAVEMENT

- **AC 28**

Table 4.3.5 Test and Analysis Parameters	
Parameter	Binder Course
Stability, S	> 8000 N
Flow, F	2.0 – 4.0 mm
Stiffness, S/F	> 2000 N/mm
Air void in mix (VIM)	3.0 – 7.0%
Voids in aggregate filled with bitumen (VFB)	65 – 75%

Source : JKR/SPJ/2013-S4

FLEXIBLE PAVEMENT

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Tack Coat

The function of a tack coat is to ensure **bonding** between the **new asphalt** layer and the **primed surface** or **old asphalt layer**. The tack coat is applied in a thin coat and uniformly covers the entire surface, including all vertical joint surfaces. Too little tack coat causes debonding, and too much tack coat can cause slippage between the layers.

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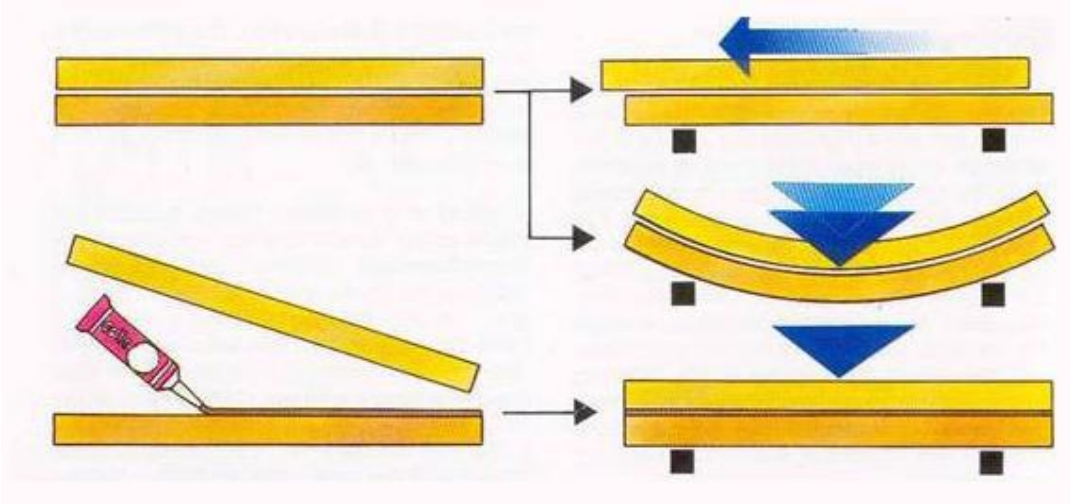
- **Tack Coat**

  Shall be rapid-setting cationic bitumen emulsion of grade RS-1K

  - During Construction (Clause 4.3.1.4)
    - Tack coat shall only be applied on to a clean and dry surface binder pavement course
    - Spray temperature range 25°C - 45°C
    - Spray rate range 0.25 – 0.55 litre/m^2 (tray spray rate test to be conduct with frequency 1 test per 16,000m^2 daily operation covered)



Source : JKR/SPJ/2013-S4

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- **AC 14 (wearing course)**

  Consist of mix designation of AC 14 for wearing course

  - Material Testing (Clause 4.3.3)
    - Grading limit
    - Design bitumen content
    - Stability
    - Flow
    - Stiffness
    - Air voids in mix (VIM)
    - Void in aggregate filled with bitumen (VFB)
    - Marshall density
    - Job Mix Formulae
    - Trial lay

Source : JKR/SPJ/2013-S4

FLEXIBLE PAVEMENT

- Table 4.3.3 Gradition Limits for Asphaltic Concrete

MIX TYPE	WEARING COURSE
MIX DESIGNATION	AC 14
BS SIEVE SIZE (mm)	PERCENTAGE PASSING BY WEIGHT
28.0	
20.0	100
14.0	90 – 100
10.0	76 – 86
5.0	50 – 62
3.35	40 – 54
1.18	18 – 34
0.425	12 -24
0.150	6 – 14
0.0075	4- 8

Source : JKR/SPJ/2013-S4

FLEXIBLE PAVEMENT

- AC 14

Table 4.3.4 Design Bitumen Contents	
AC 14 Wearing Course	4.0 – 6.0%

Table 4.3.7 Requirement of Compacted Density for Asphaltic Concrete	
Wearing Course	98 – 100% Marshall Density

Source : JKR/SPJ/2013-S4

FLEXIBLE PAVEMENT

- **AC 14**

Table 4.3.5 Test and Analysis Parameters	
Parameter	Wearing Course
Stability, S	> 8000 N
Flow, F	2.0 – 4.0 mm
Stiffness, S/F	> 2000 N/mm
Air void in mix (VIM)	3.0 – 5.0%
Voids in aggregate filled with bitumen (VFB)	70 – 80%

Source : JKR/SPJ/2013-S4

FLEXIBLE PAVEMENT

- **AC 28 & AC 14**
  - During Construction (Clause 4.3.3.5)
    - Surface preparation & cleaning (Dry weather)
    - Temperature of mix on the lorry **not exceed** 163 °C
    - Temperature unload to paver hopper **not less** 130 °C
    - Temperature initial rolling **not less** 120°C
    - Take loose sample for testing with frequency of 1 test per 200 ton
    - Opening to traffic **not less** than 4 hour
    - Within 24 hours of laying and compacting the bituminous mix, contractor shall cut core sample of not less 100mm diameter with frequency of 1 test per 500m^2 (tolerance in surface level of pavement course shall comply the specification in clause 4.5.2)

Source : JKR/SPJ/2013-S4

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Paver shall be controlled by an automatic levelling device.

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Back Casting or Hand Casting

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Thickness control

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Suhu yang sesuai?

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Top 3 factors in pavement construction… ?

1. Compaction
2. Compaction
3. Compaction

Compaction is the process by which the **volume of air** in the mixture is **reduced** by using **external forces** to reorient the constituent aggregate particles into a **more closely** spaced arrangement.

This reduction of air volume in a mixture produces a corresponding increase in **unit weight**, or **density**.

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Compaction

The compaction operation is the most important aspect of the paving process. Compaction develops the strength and stability of the mix, and closes the interconnected voids through which water and air could penetrate the mix in the layer.

To ensure full, uniform coverage of the paved mat, it is essential that a regular rolling pattern is adopted. Rollers vary in width, and a particular pattern does not apply to all rollers. For this reason, the best rolling pattern for each roller used must be established and followed to obtain the most uniform compaction of the paved width.

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i. **Breakdown rolling (150 °C – 120 °C range)**

2 passes of Steel Tandem Roller without vibration
2 passes of Steel Tandem Roller with vibration

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ii. Intermediate rolling (120 °C – 90 °C range)

8 or 10 or 12 passes

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YES

NO

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iii. Finishing rolling (90 °C – 70 °C range)

2 passes steel tandem without vibration

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Coring:

Sampel yg diambil dari struktur jalan yang telah siap diturap dan dipadatkan (binder dan wearing) selepas 24jam.

Berbentuk silinder berdiameter 100mm.

Frequency of test:

500m2 ATAU minimum 2 core per day.

Tujuan:

1. untuk mendapatkan ketebalan (thickness)
2. Untuk mendapatkan Marshall Density.

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TABLE 4.5.1: TOLERANCES IN SURFACE LEVELS OF PAVEMENT COURSES

Pavement Course	Tolerance
Wearing Course	± 5 mm
Binder Course	± 5 mm
Roadbase	+ 0 mm to - 20 mm
Sub-base	+ 10 mm to - 20 mm

The combination of permitted tolerances in the levels of different pavement courses shall not result in a pavement thickness less than that shown on the Drawings. Each pavement course shall have an average thickness not less than that shown on the Drawings.

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Jalan dah siap… dah boleh buka pada trafik…?

Belum boleh lagi bang…..

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Surface Regularity

The regularity of the completed pavement surface shall be measured **before traffic is allowed on it** and is measured in terms of its lane IRI.

Lane IRI shall be measured using the **ARRB Walking Profiler** (WP) following the procedures as outlined in AUSTROADS PAT 01:2001

Other types of equipment may be used to measure lane IRI provided that the output from the equipment correlate strongly with the output from WP **(R2 > 0.95)**.

Source :

FLEXIBLE PAVEMENT

ARRB WP G1

ARRB WP G2

ARRB Walking Profiler

ARRB WP G3

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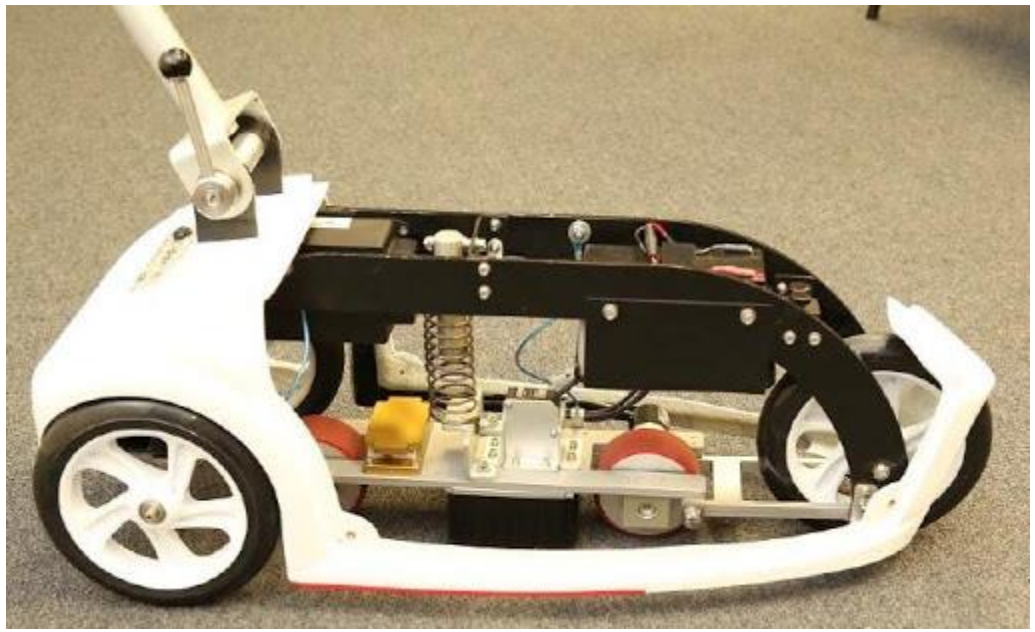
ARRB WP G2 vs ARRB WP G3



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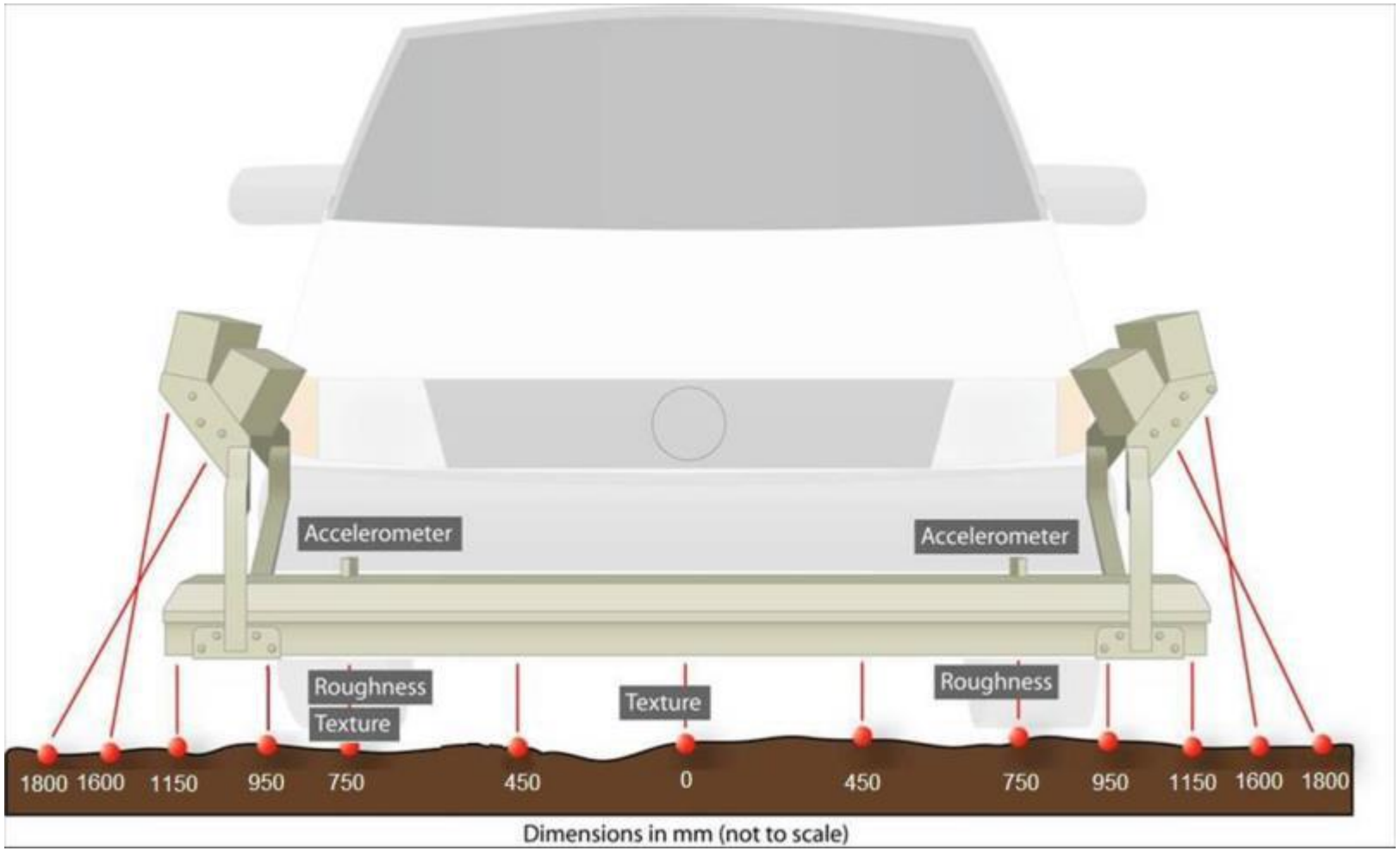
Gambar: Kenderaan Road Scanner

FLEXIBLE PAVEMENT

Typical Laser Layout (13 lasers)



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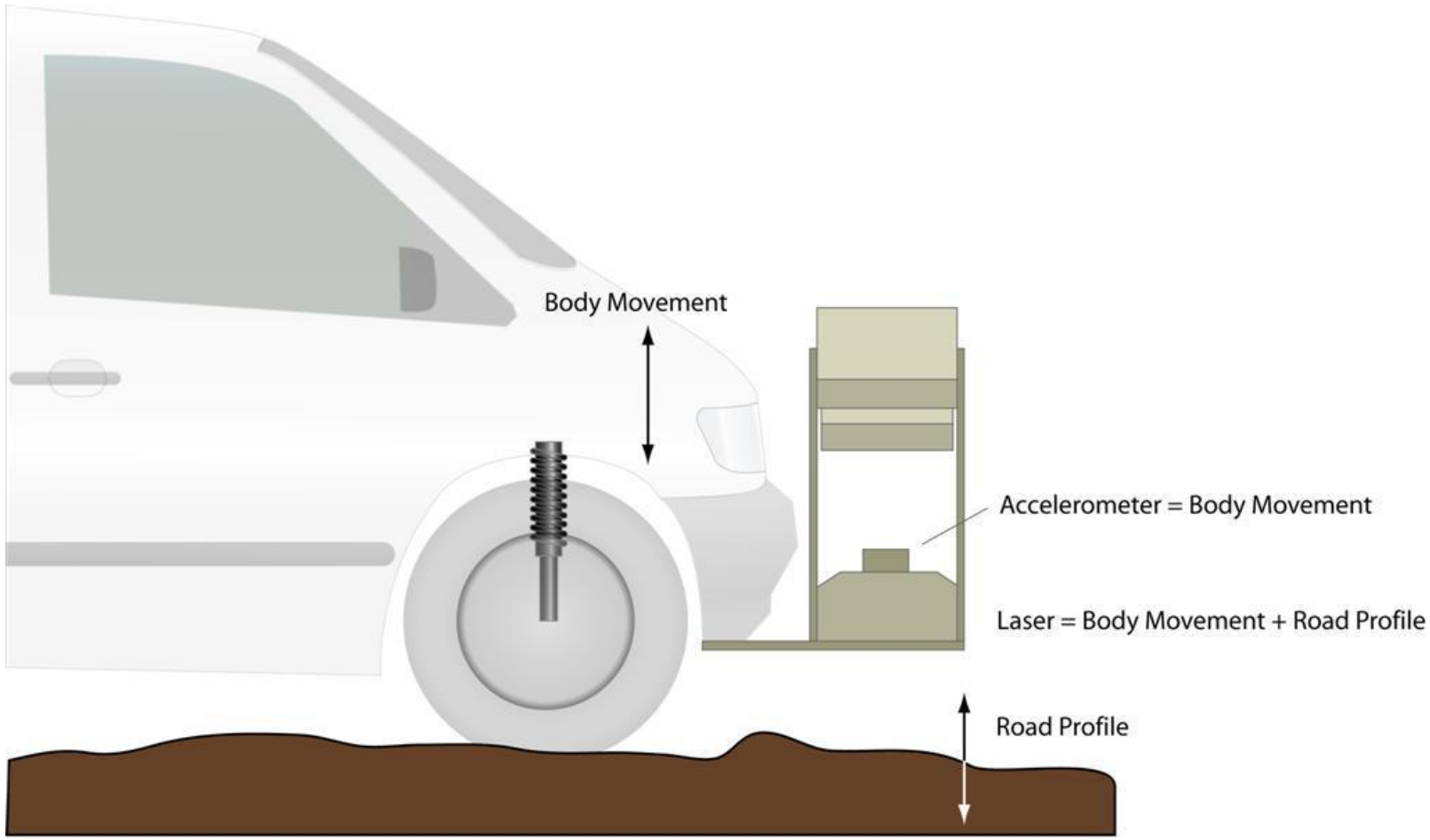
Profiler Components



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- **Acceptance Criteria (Clause 4.5.3.3)**
  - Completed **pavement surface** shall be measured by International Roughness Index (IRI) before allowed for traffic.
  - The lane IRI measured for the whole road length and each 100 meter section shall be **less than** 2.0 m/km

Rectification work for non-compliance

In case of non-compliance, the Contractor shall carry out rectification works on any part of the completed pavement surface so that the lane IRI values for the whole road length and for each 100 meter section are less than 2.0 m/km.

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Pavement Condition Criteria

Condition Criteria	Roughness (m/km)	Rutting (mm)	All Crack (%)
Good	< 2.0	< 10	<5
Fair	2.0 - 3.0	10 – 15	5 – 10
Poor	3.0 – 3.4	15 – 25	10 – 15
Bad	≥ 3.4	≥ 25	≥15

Terima Kasih