KURSUS REKABENTUK JAJARAN JALAN DAN PERSIMPANGAN

Oleh :

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CAWANGAN JALAN

20 FEBRUARI 2019

INTRODUCTION TO ROAD DESIGN

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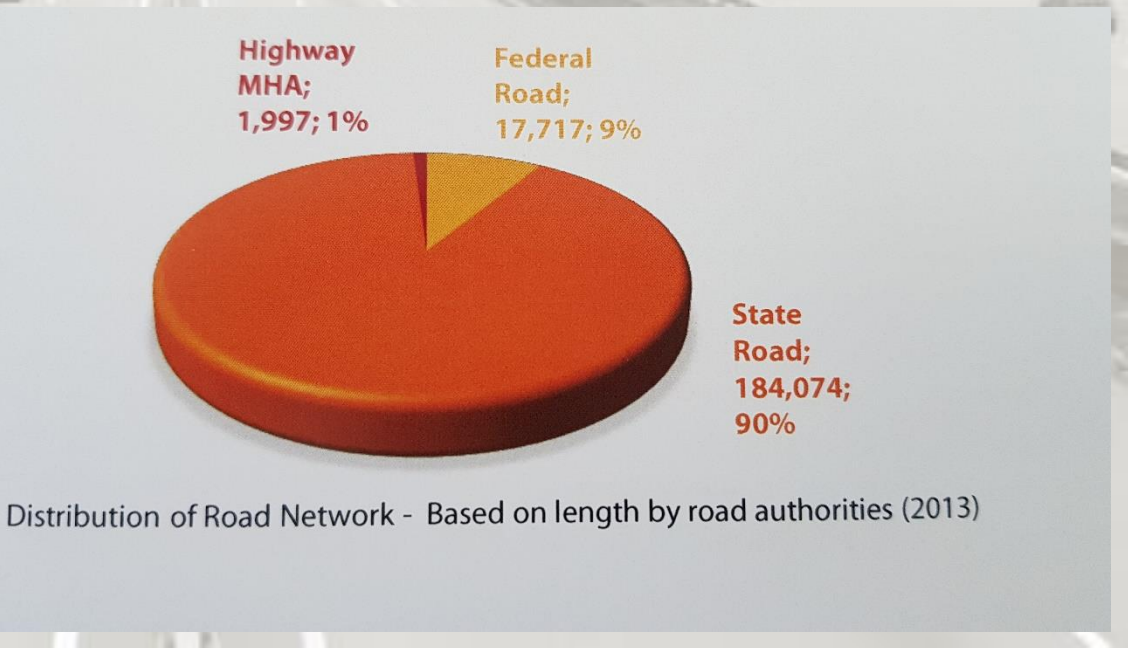
KANDUNGAN

A. MALAYSIAN ROAD NETWORK

B. GEOMETRIC ROAD DESIGN

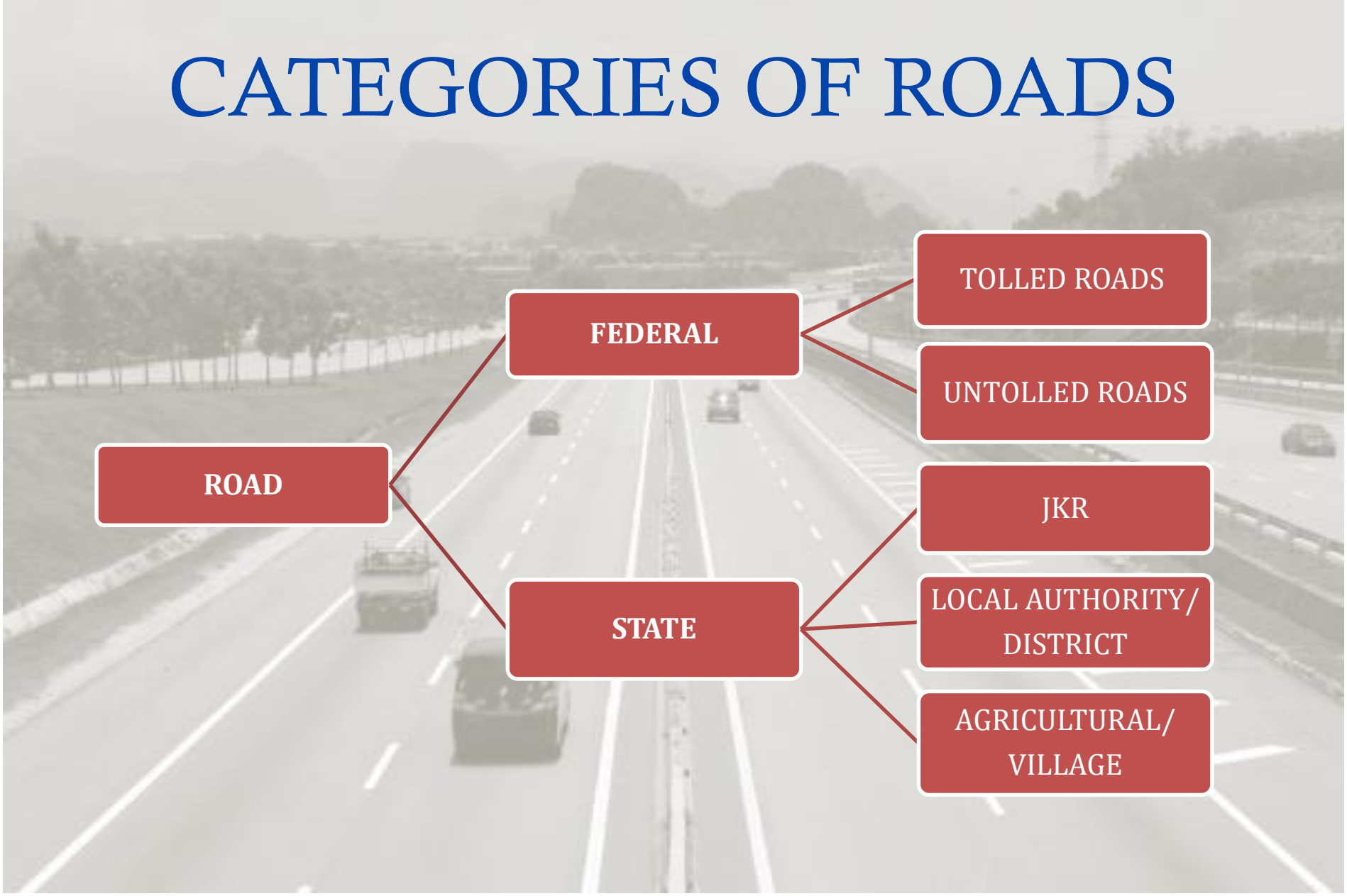
MALAYSIAN ROAD NETWORK

- 204,000 km of roads in Malaysia (2014). 76% are paved.
- 2 categories of road:- Federal and State.
  - Federal PWD manages 17,700km (8.68%) of Federal Roads.
  - MHA manages 1996 km (0.98%) of Federal Roads
  - State manages 184,000km (90.2%) of State Roads.
    - 73.4% paved roads
    - 26.6% unpaved roads

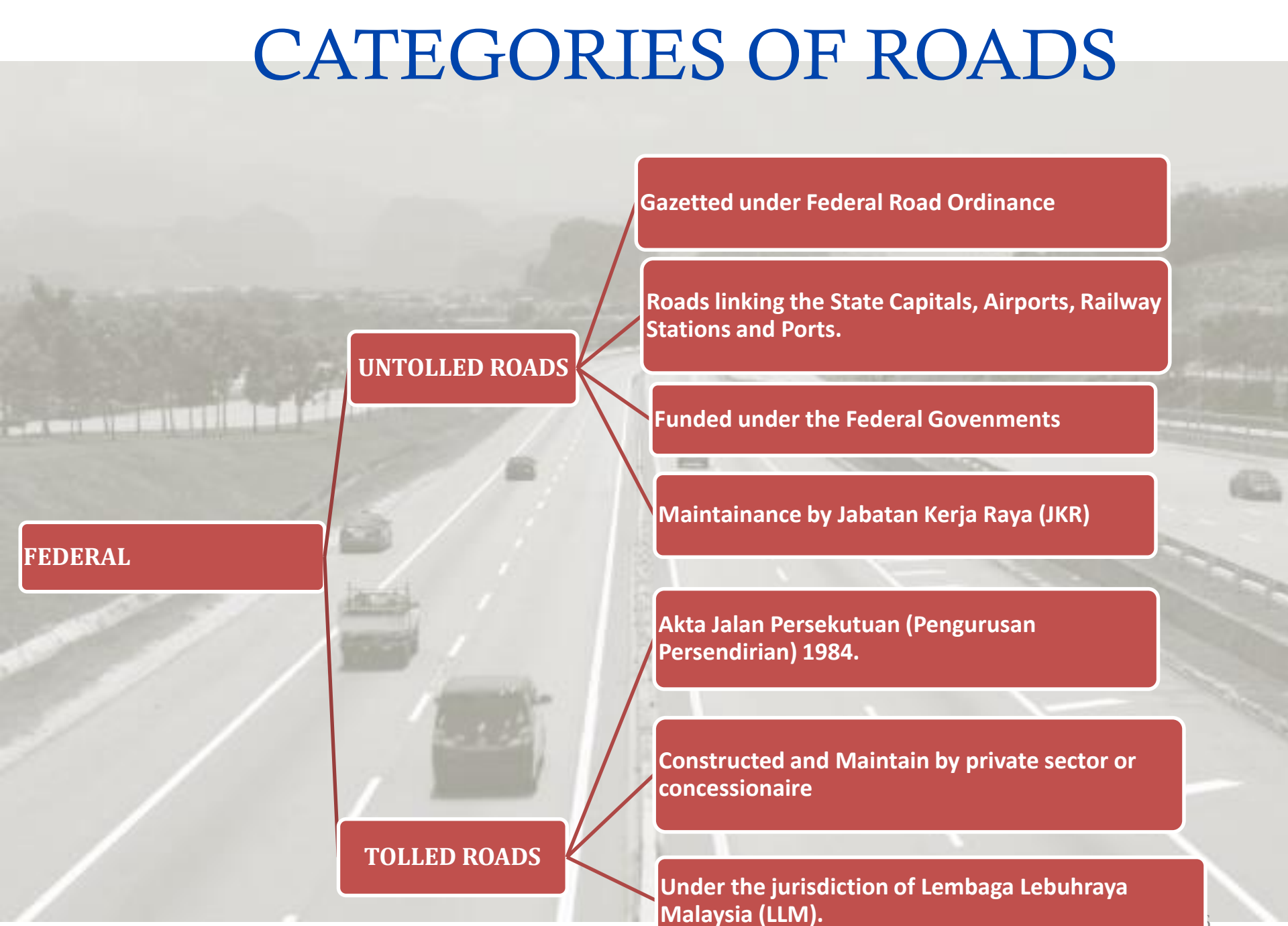


Distribution of Road Network - Based on length by road authorities (2013)

CATEGORIES OF ROADS



CATEGORIES OF ROADS



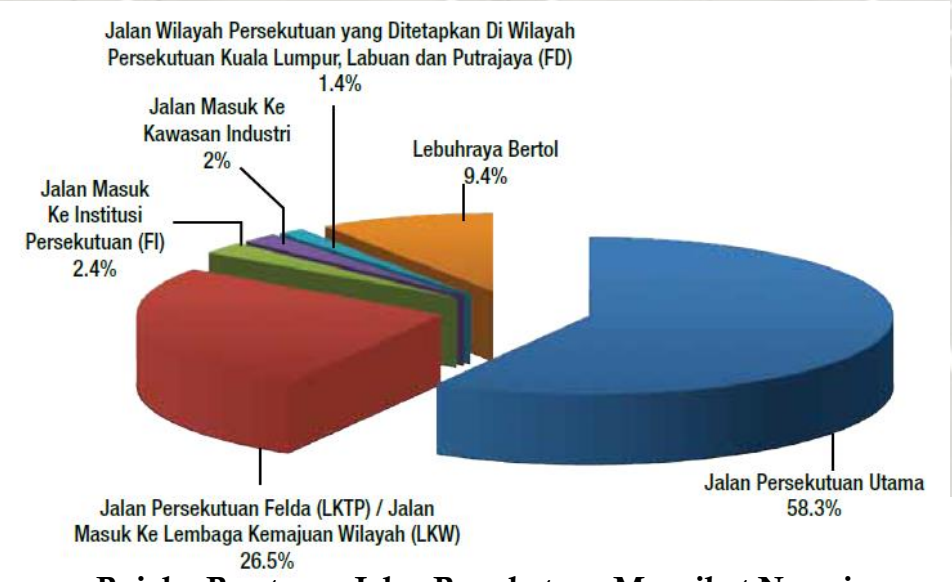
CATEGORIES OF ROADS

- Jalan negeri secara amnya merupakan jalan premier yang menyediakan perjalanan dalam negeri dan menghubungkan pusat-pusat pentadbiran daerah.
- Jalan-jalan lain yang termasuk dalam kategori ini adalah jalan penghubung dan lain-lain jalan raya kecil dikawasan kampung serta luar bandar.
- Secara umumnya semua jalan adalah jalan negeri melainkan diwartakan sebagai jalan persekutuan.
- Penyenggaraan jalan negeri adalah tanggungjawab Kerajaan Negeri masing-masing tetapi dibiayai oleh Kerajaan Persekutuan melalui Geran Tahunan Jalan negeri.

MALAYSIAN ROAD NETWORK

JALAN PERSEKUTUAN	JALAN NEGERI
▪ Jalan Persekutuan Utama ▪ Jalan Persekutuan FELDA/FELCRA (LKTP) ▪ Jalan Masuk Ke Institusi Persekutuan (FI) ▪ Jalan Masuk Ke Kawasan Perindustrian ▪ Jalan Masuk Ke Lembaga Kemajuan Wilayah (LKW) ▪ Jalan Wilayah Persekutuan yang ditetapkan di Wilayah Persekutuan Kuala Lumpur, Labuan dan Putrajaya (FD) ▪ Lebuhraya bertol	▪ Jalan Standard ▪ Jalan Substandard ▪ Jalan Kawasan Perumahan ▪ Jalan Kampung ▪ Jalan Pertanian ▪ Jalan Sehala Pulau Pelancongan

(sumber : Laporan Statistik Jalan Malaysia Edisi 2013, BSFJ, JKR)

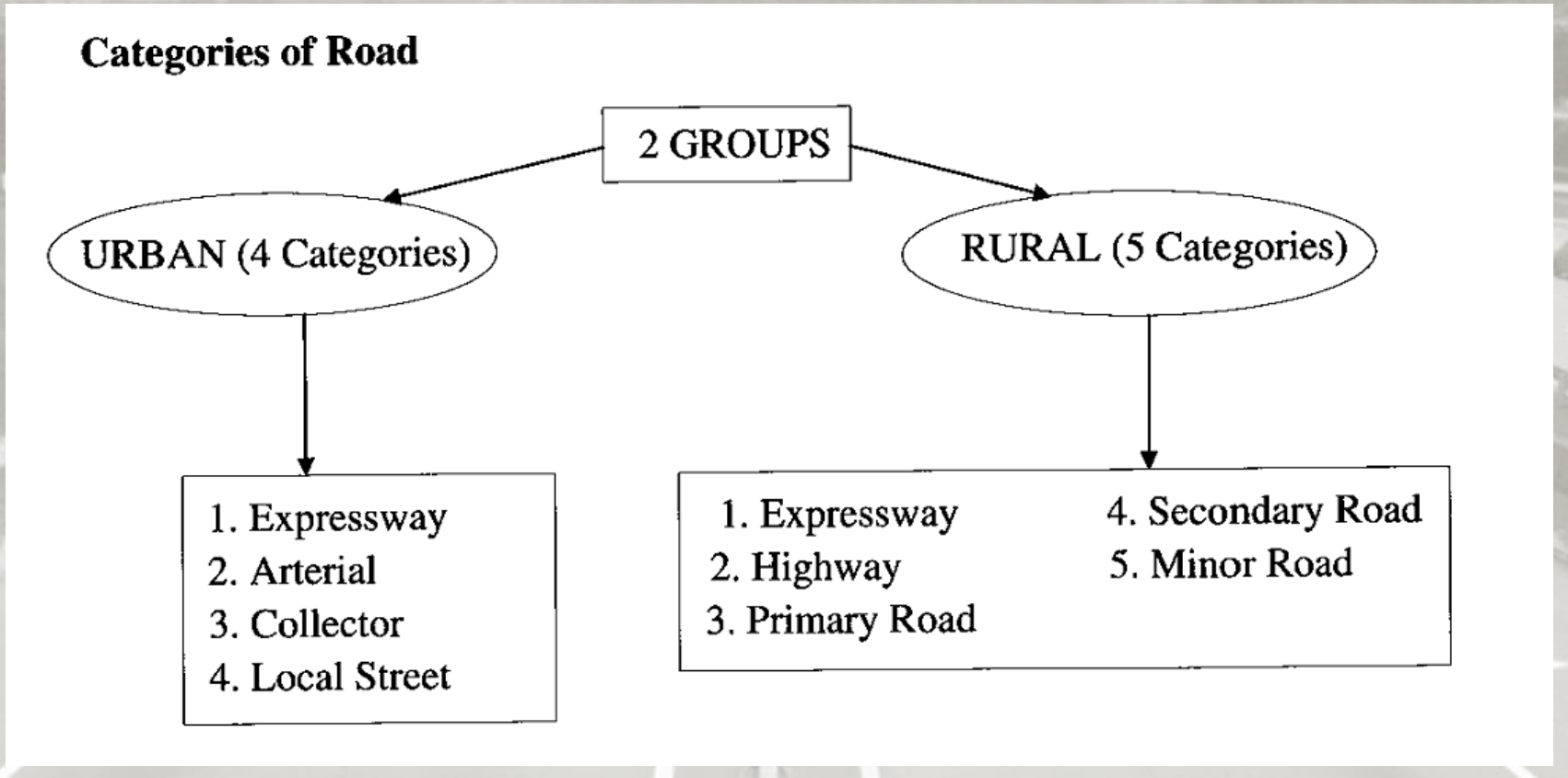


Rajah : Peratusan Jalan Persekutuan Mengikut Negeri

MALAYSIA ROAD CLASSIFICATION

- Roads are grouped by area, i.e. rural and urban.
- Aside from transportation, roads provide 2 sub-function: **mobility** and **accessibility.**
- Different category of roads affect mobility and accessibility differently as shown.

CATEGORY OF ROADS



CATEGORY OF ROAD

Why different road categories / classification exist?

- To help **clarify policies** concerning the highway planning decisions
- Ability to develop and apply specific **planning criteria** according to road designation in the hierarchy
- To clarify **planning objectives** for each road hierarchy level

CATEGORY OF ROAD

Urban VS Rural

Urban Areas	Rural Areas
Roads within a gazetted municipal limit	Any road outside municipality limits including road connecting municipalities that are more than 5km apart
Townships having a population of at least 10,000 where buildings and house are gathered and business is prevalent.	Low population density
Characterised by busy pedestrian activities and frequent stopping of vehicles owing to short intersection spacing and congested built up areas.	Low pedestrian activities
Lower design speeds	Higher design speeds
Different cross sectional elements to take into account of traffic and adjoining land use.	

CATEGORY OF ROADS (URBAN)

- **Expressways *(Lebuh raya Ekspres)***
  - a divided highway for through traffic with **full control** of access and **grade-separated intersections**

- **Arterials *(Jalan Utama)***
  - A continuous road with **partial access control** for through traffic within urban areas
  - Basically conveys traffic from **residential areas to central business districts** or from one city part to another without penetrating the city center

CATEGORY OF ROADS (URBAN)

- **Collectors *(Jalan Pengumpul)***
  - A road with **partial access** control serving as a collector/distributor of traffic between arterials and local road system
  - Penetrate and serve **neighborhoods, commercial areas and industrial areas**

- **Local streets *(Jalan tempatan)***
  - The **basic** road network within a neighborhood
  - Serves primarily to **offer access** to abutting lands
  - Links to the collector road, serve short trip length

CATEGORY OF ROADS (URBAN)

Typical Road Links in Urban Area

CATEGORY OF ROADS (RURAL)

- **Expressways *(Lebuh raya Ekspres)***
  - a divided highway for through traffic with **full control of access** and **grade-separated** intersections
  - Forms the **basic framework** of National road transportation for fast travelling
  - Provides the highest level of **comfort** and **travelling speed**
  - Designed to the highest road standards
  - Serves long trips with **smooth** traffic flow

CATEGORY OF ROADS (RURAL)

- **Highway *(Jalan Raya Utama)***
  - Constitutes the **interstate national road network** for intermediate traffic, complements expressway network
  - Links directly/indirectly the Federal Capital, State capitals, large urban centers, points of entry/exit to the country
  - Serves long to intermediate trip length
  - **Smooth** traffic provided with **partial access control**

CATEGORY OF ROADS (RURAL)

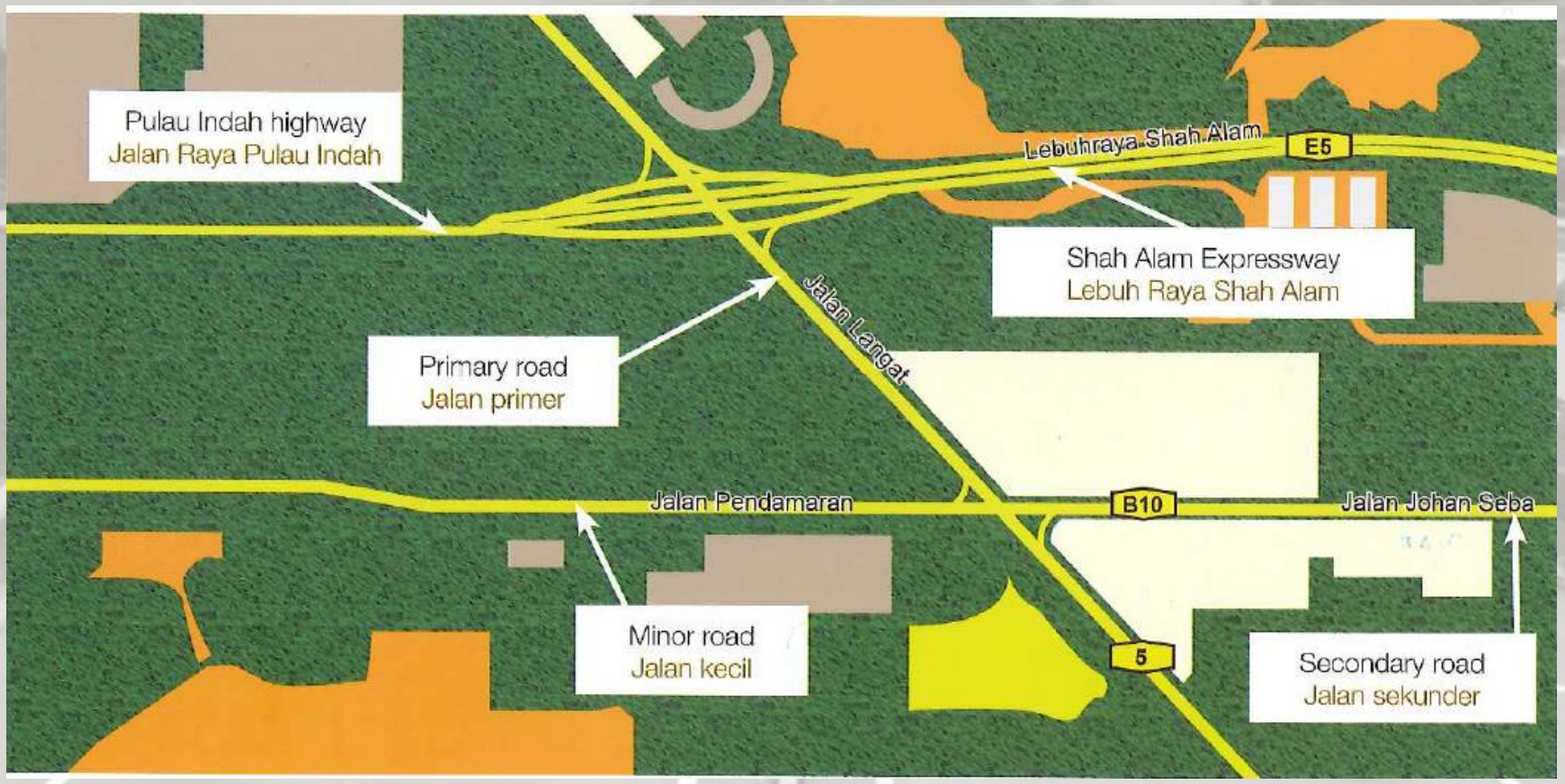
- **Primary roads *(Jalan Primer)***
  - Constitutes the **major roads** forming the basic road network system within a **State**
  - Links State capital to district capital or major towns
  - Serves **intermediate** trip lengths with **medium** travel speed
  - Smooth traffic provided with **partial access control**

CATEGORY OF ROADS (RURAL)

- **Secondary roads *(Jalan Sekunder)***
  - Constitutes the **major** roads forming the basic road network system within a District or Regional Development Areas
  - Serves **intermediate/short** trip lengths with medium/low travel speed
  - Smooth traffic provided with **partial access control**

- **Minor roads *(Jalan Kecil)***
  - Applies to all **other** roads other than described above
  - Serves local traffic with **short trip** length with **no access control**

CATEGORY OF ROADS (RURAL)



Typical Road Links in Rural Area

TABLE 2-1 : CHARACTERISTICS OF ROAD CATEGORIES

AREA	ROAD CATEGORIES	Trip Length			Design Volume			Speed			NETWORK
		Long	Med	Short	High	Med	Low	High	Med	Low	
RURAL	Expressway										National network
	Highway										National network
	Primary Road										State network
	Secondary Road										District network
	Minor Road										Supporting network
URBAN	Expressway										National network
	Arterial										Major links to Urban centres
	Collector										Major streets within urban centres
	Local Street										Minor streets/town network.

ROAD DESIGN STANDARD

The Importance of Standardisation

To provide **uniformity** in the design of roads according to their performance requirement

To provide **consistent, safe and reliable** road facilities for movement of traffic

To provide **guidance** for less subjective decision on road design

ROAD DESIGN STANDARD

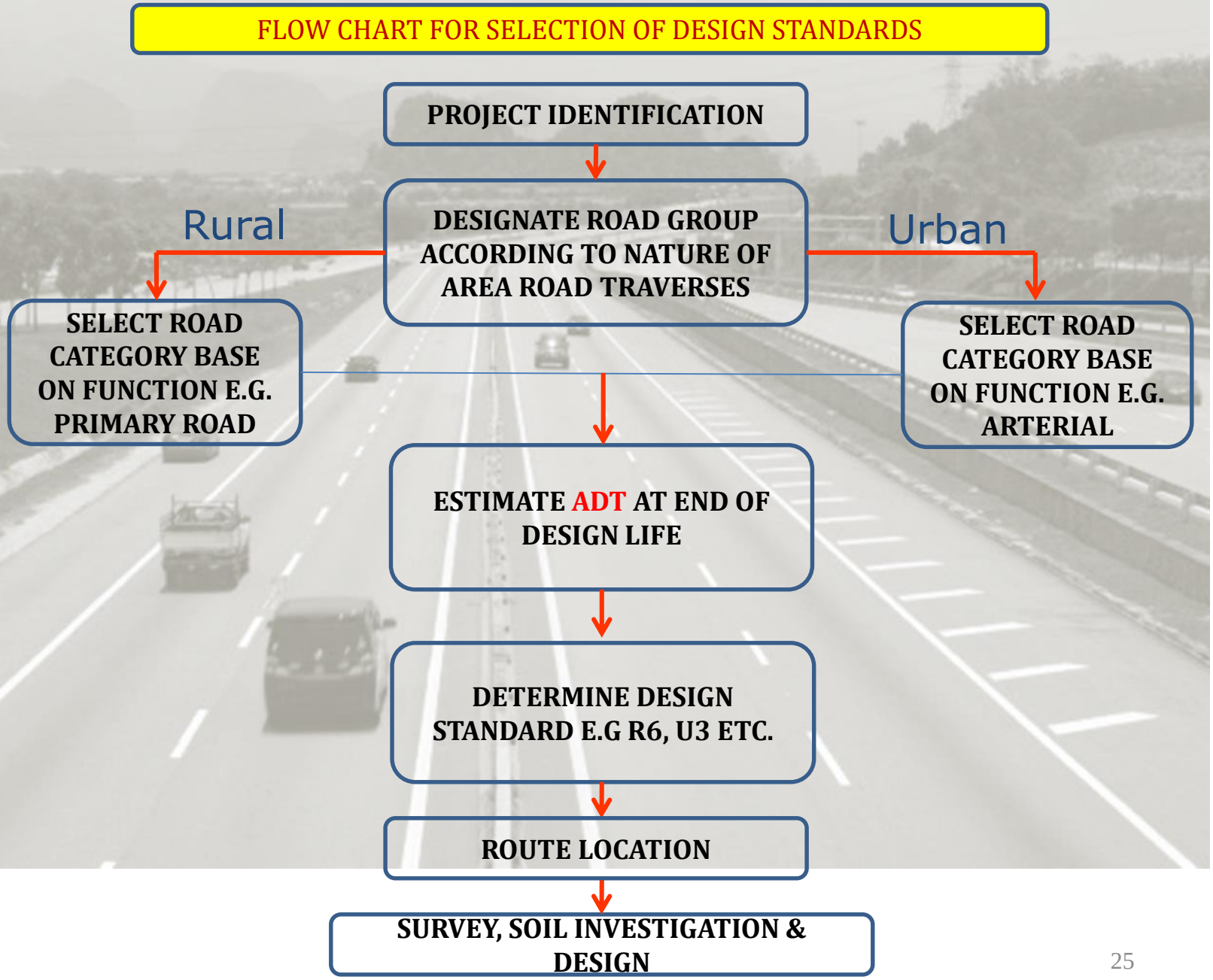
Selection of Design Standard

1. •Assessment of the **function** of the proposed road & area it traverses. Should be done in conjunction with **HPU data** and **analysis reports**
2. •If overlapping of function – use **ultimate function** as selection criteria
3. •Calculate Projected **Average Daily Traffic** (ADT) at the end of the Design Life & obtain the Design Standard (Refer to Guideline, Table 2-3)
4. •**Capacity analysis** - to determine the required number of lanes.

ROAD DESIGN STANDARD

Area	Projected ADT / Road Category	All Traffic Volume	> 10,000	10,000 To 3,000	3,000 To 1,000	1,000 To 150	< 150
RURAL	Expressway	R6	-	-	-	-	-
	Highway	R5	-	-	-	-	-
	Primary Road	-	R5	R4	-	-	-
	Secondary Road	-	-	R4	R3	-	-
	Minor Road	-	-	-	-	R2	R1
URBAN	Expressway	U6	-	-	-	-	-
	Arterials	-	U5	U4	-	-	-
	Collector	-	-	U4	U3	-	-
	Local Street	-	-	-	U3	U2	U1

Selection of Design Standard



ROAD DESIGN STANDARD (URBAN)

Table 5.0: Selection of Design Standard (Urban)
Jadual 5.0: Pemilihan Piawai Reka Bentuk (Bandar)

Area Kawasan	Road Category Kategori Jalan	Road Standard Piawaian Jalan	Design Speed Halaju Reka bentuk	Min Lane Width (m) Lebar Laluan Minimum (m)	Min Radius (m) Jejari Minimum (m)	Max Grade (%) Kecerunan maksimum (%)	Description Penerangan
Urban Bandar	Expressway Lebuh Raya Ekspres	U6	80-100	3.67	230-500	3-6	Design speed, maximum grade and Radius depend on Topography; Halaju reka bentuk, kecerunan maksimum dan jejari minimum bergantung kepada topografi
	Arterial Jalan Utama	U5	60-90	3.5	125-305	5-11	
		U4	50-80	3.25	85-230	7-13	
	Collector Jalan Pengumpul	U5	60-80	3.5	125-230	5-11	
		U4	50-70	3.25	85-175	7-13	
		U3	40-60	3.0	50-125	7-13	
	Local Street Jalan Tempatan	U4	50-70	3.25	85-175	7-13	
		U3	40-60	3.0	50-125	7-13	
		U2	30-50	2.7	30-85	6-16	
		U1	30-40	5*	30-50	6-16	

Note Nota:

Topography : Flat terrain, rolling terrain or mountainous terrain.
Topografi : Rupa bumi rata, rupa bumi beralun atau rupa bumi berbukit.
Maximum grades : The vertical profile of roads affects vehicle performance.
Gred maksimum : Permukaan jalan yang curam akan menjejaskan prestasi kenderaan.

ROAD DESIGN STANDARD (RURAL)

Table 5.1: Selection of Design Standard (Rural)
Jadual 5.1: Pemilihan Piawaian Reka Bentuk (Luar Bandar)

Area Kawasan	Road Category Kategori Jalan	Road Standard Piawaian Jalan	Design Speed Halaju Reka Bentuk	Min Lane Width (m) Lebar Laluan Minimum (m)	Min Radius (m) Jejari Minimum (m)	Max Grade (%) Kecerunan maksimum (%)	Description Penerangan
Rural Luar Bandar	Expressway Lebuh Raya Ekspres	R6	80-120	3.67	280-560	4-6	Design speed, maximum grade and radius depend on topography Halaju reka bentuk, kecerunan maksimum dan jejari minimum bergantung pada topografi
	Highway Jalan Raya Utama	R5	70-100	3.5	195-465	5-8	
	Primary Road Jalan Primer	R5	70-100	3.5	195-465	5-8	
		R4	60-90	3.25	150-335	5-10	
	Secondary Road Jalan Sekunder	R4	60-90	3.25	150-335	5-10	
		R3	50-80	3.0	100-280	5-10	
	Minor Road Jalan Kecil	R2	40-60	2.7	60-150	6-16	
		R1	30-50	5*	35-100	6-16	

Road Location Lokasi Jalan

Type I : Relatively free in road location with very little problems relating to land acquisition, affected buildings or other socially sensitive areas.
Jenis I : Lokasi jalan bebas daripada masalah pengambilan tanah, bangunan yang terjejas atau kawasan sensitif lain.
Type II : Intermediate between I and III.
Jenis II : Perantaraan antara I dan II.
Type III : Very restrictive in road location with problems relating to land acquisition, affected buildings and other sensitive areas.
Jenis III : Sangat terhad di lokasi jalan yang mempunyai masalah pengambilan tanah, bangunan yang terjejas dan kawasan sensitif lain.

ACCESS CONTROL

The condition where the right of owners or occupants of abutting lands to access (in connection with a road) is fully or partially controlled by the public authority.

Access Control

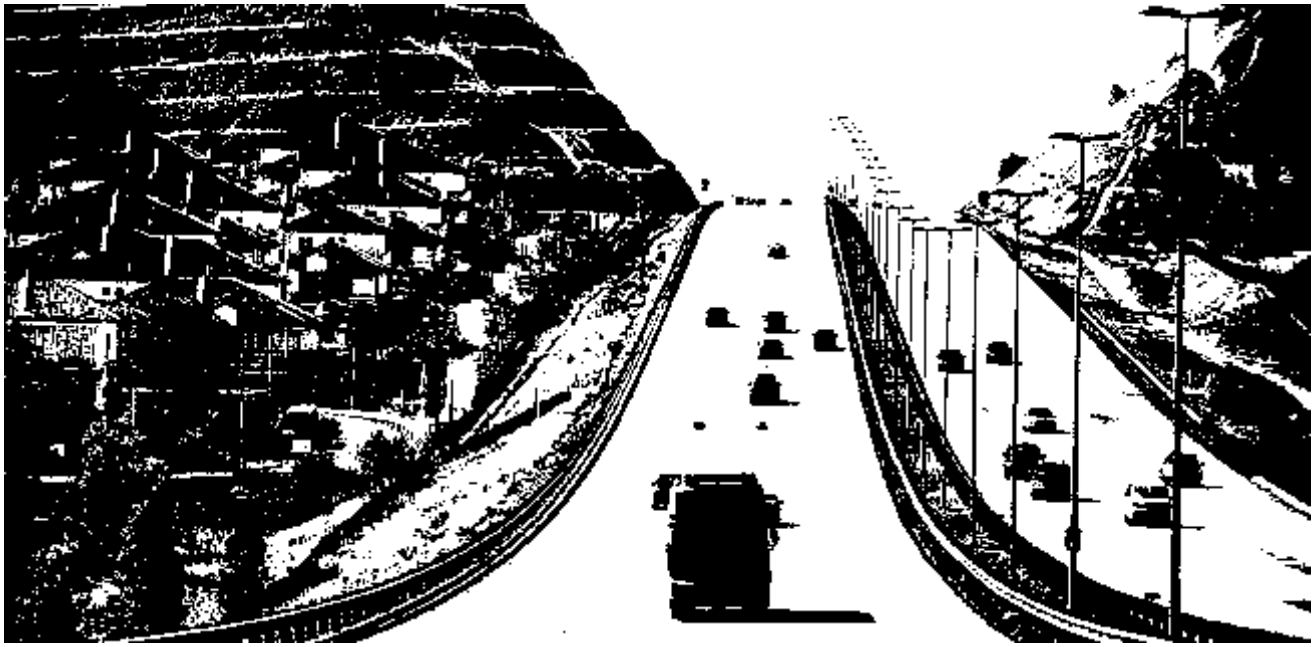
Types	Descriptions
Full control of access	• Preference given to through traffic • Access provided only to selected public roads • Prohibits at-grade crossings or direct private driveway connections
Partial control of access	• Preference given to through traffic • Access provided to selected public roads with some crossings • At-grade intersections (signalised preferred) are allowed but only at selected locations
Non-Control Access	• No limitation of access

SELECTION OF ACCESS CONTROL

Design Standard/ Road Category	R6	R5	R4	R3	R2	R1/R1a
Expressway	F	-	-	-	-	-
Highway	-	P	-	-	-	-
Primary Road	-	P	P	-	-	-
Secondary Road	-	-	P	P	-	-
Minor Road	-	-	-	-	N	N

Design Standard/ Road Category	U6	U5	U4	U3	U2	U1
Expressway	F	-	-	-	-	-
Arterial	-	P	P	-	-	-
Collector	-	-	P	P	-	-
Local Street	-	-	-	N	N	N

DESIGN CONTROL AND CRITERIA



CONTENT

- Topography and Land Use
- Traffic
- Design Vehicles Characteristics
- Speed
- Capacity

Topography and Land Use

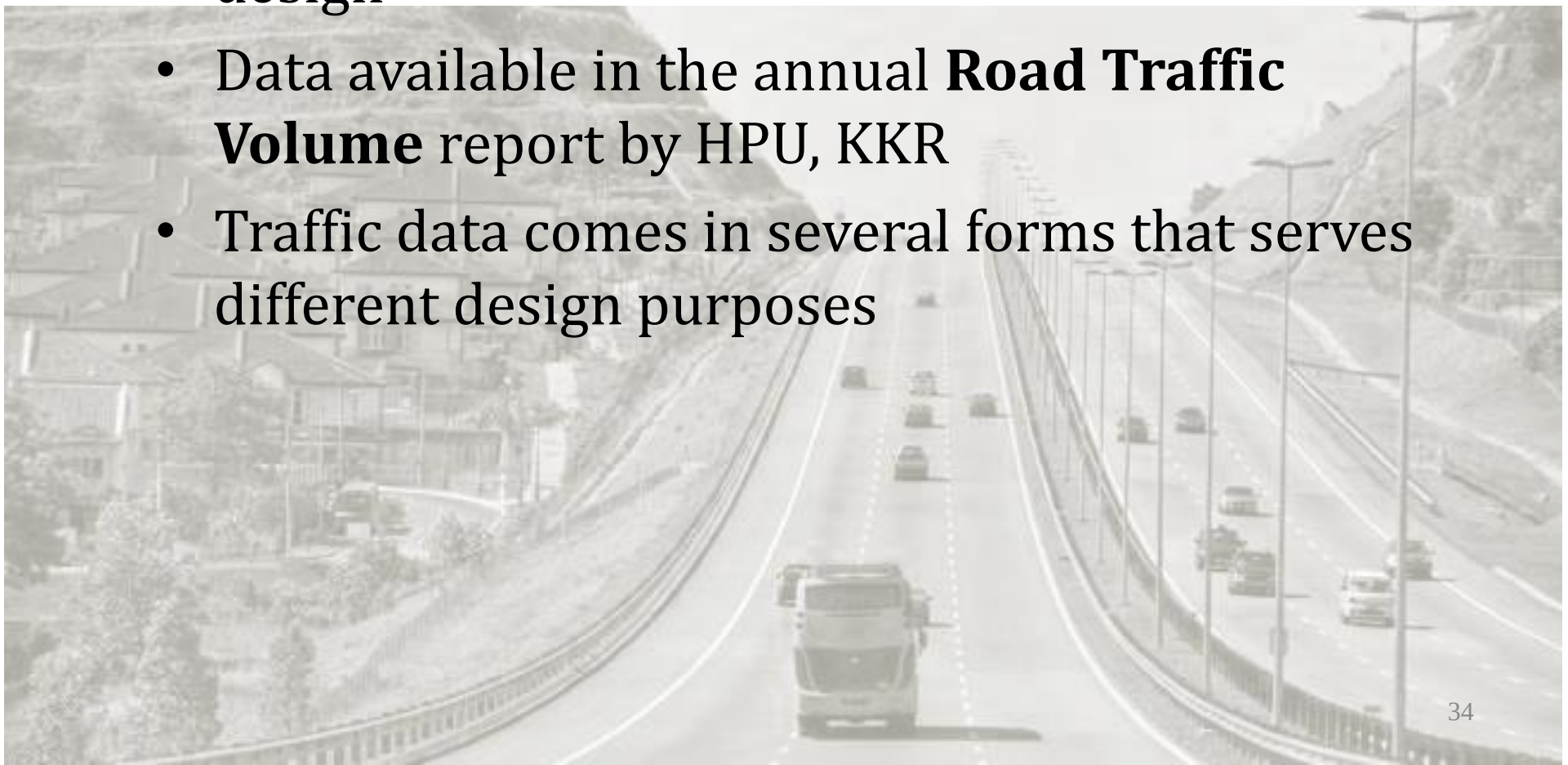
- Cross slopes less than 3%
- Long sight distances
- Straightforward construction

- Cross slopes between 3%-25%
- Natural slopes consistently rise or fall below road grade

- Cross slopes more than 25%
- Ground elevation changes abruptly requiring benching and excavation

TRAFFIC

- Traffic data serves as **loads** in road geometric design
- Data available in the annual **Road Traffic Volume** report by HPU, KKR
- Traffic data comes in several forms that serves different design purposes



TRAFFIC

Volume

- Average Daily Traffic (ADT)
- Design Hourly Volume (DHV)
- Design Hourly Volume Ratio (K)

Composition

- Passenger Car Unit (PCU)
- Level of Service (LOS)

TRAFFIC

Average Daily Traffic (ADT)

- **total traffic** for a year divided by 365
- used to determine **annual usage** (eg. justification for proposed expenditure, design structural road elements and designate the road standard)
- does not indicate traffic volume fluctuations during various months, days or hours

Design Hourly Volume (DHV)

- 30th highest hourly volume of the year or 30HV
- In unusual/highly seasonal traffic fluctuation (holiday resorts) lower HV maybe more appropriate

Design Hourly Volume Ratio (K)

- **Ratio of DHV to the designed ADT**
- Value ranges from 7% - 20%
- As a guide K=12% for urban, K=15% for rural

Traffic Composition

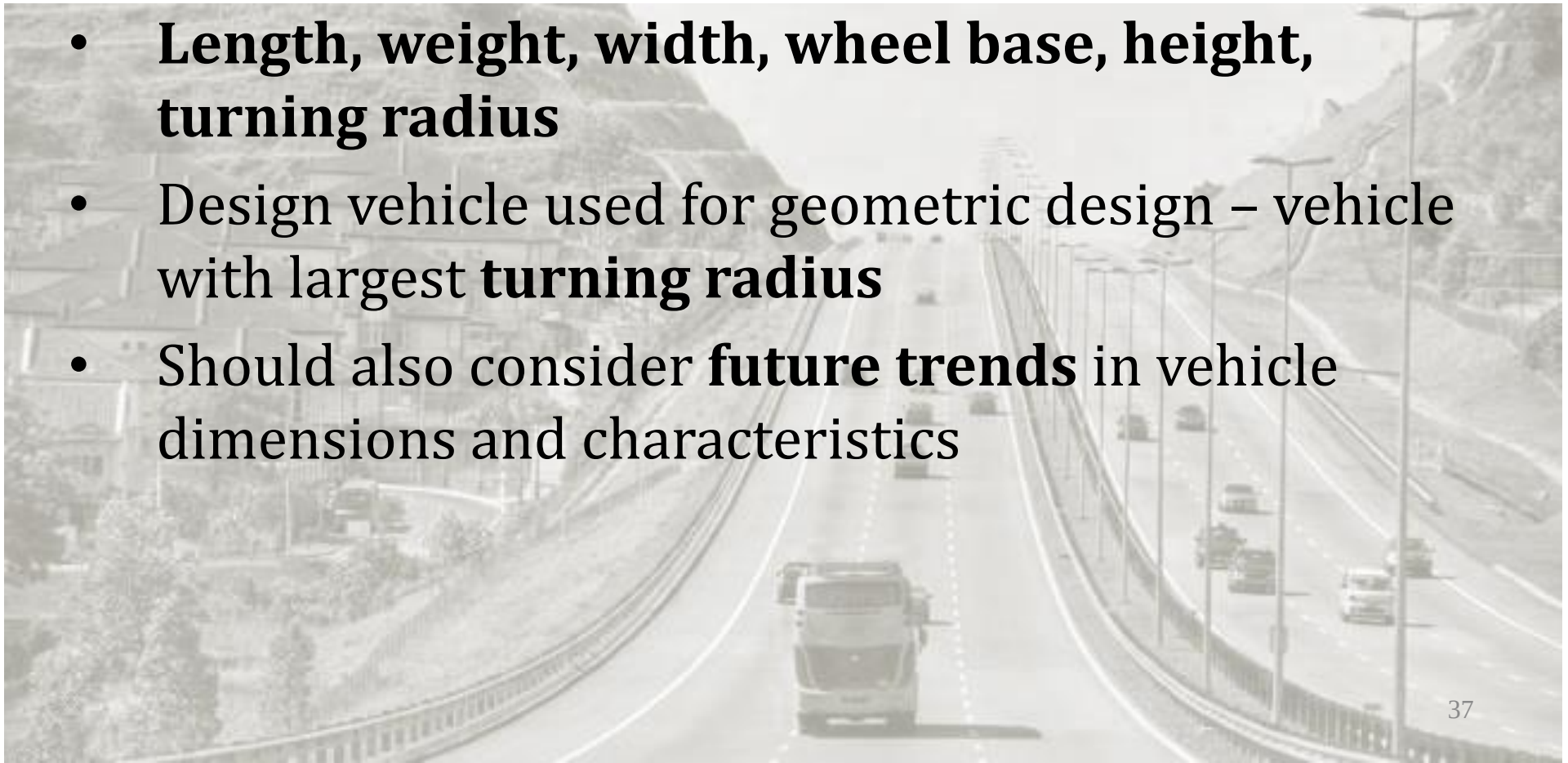
- **Percentage** of various vehicle classes in DHV
- Different vehicle class have different operating characteristics
- Commercial vehicles impose **greater** traffic effect compared to passenger vehicle (heavier, slower, larger)
- 6 vehicle class in the National Traffic Census: Motorcycles, Cars/taxis, Light vans/Utility vehicles, Medium lorries (2-axle), Heavy lorries (3 or more axle), buses

Traffic Projection

- Desirably, a road should be designed to accommodate traffic within its design life with reasonable maintenance
- Normal traffic projection = **15 years** after completion of road

DESIGN VEHICLE CHARACTERISTICS

- **Physical characteristics** of vehicles affects the geometric design of roads
- **Length, weight, width, wheel base, height, turning radius**
- Design vehicle used for geometric design – vehicle with largest **turning radius**
- Should also consider **future trends** in vehicle dimensions and characteristics



DESIGN VEHICLE CHARACTERISTICS

TABLE 3-1-DIMENSION OF DESIGN VEHICLES

Design Vehicles		Dimension in Metres						Turning Radius (Metres)	
Type	Equivalent Type in AASHTO	Wheel base	Overhang		Overall Length	Overall Width	Height	Inner	Outer
			Front	Rear					
Passenger Car	P	3.4	0.90	1.5	5.8	2.1	1.3	4.2	7.3
Rigid Truck	SU	6.10	1.2	1.8	9.1	2.60	4.10	8.5	12.8
Semi-Trailer	WB-15	9.10	0.9	0.60	16.7	2.60	4.10	5.8	13.7

Note : A. Maximum allowable overall lengths under current Malaysian Legislation are as follows:
(i) Rigid vehicle - 12.2 m (40 ft)
(ii) Articulated vehicle - 16.0 m (52.5 ft)
(iii) Semi-Trailer - 12.5 m (41ft)
(iv) Trailer - 9.0 m (29.5 ft)
(v) Truck Trailer - 18.0 m (59 ft)

B. Maximum allowable overall width under current Malaysian Legislation is 2.5 m.

SPEED

- **Primary factor** in transportation and geometric design
- Depends on **driver capabilities, vehicle, physical road characteristic, weather, presence of other vehicle and legal limits**
- Selected to meet the **function** of the road (longer road – higher design speed)
- Should also consider **future trends** in vehicle dimensions and characteristics

SPEED

Design Speed

- "A speed selected to establish minimum geometric design elements for a particular section of highway"
- Directly affects sight distance and vertical and horizontal alignment design

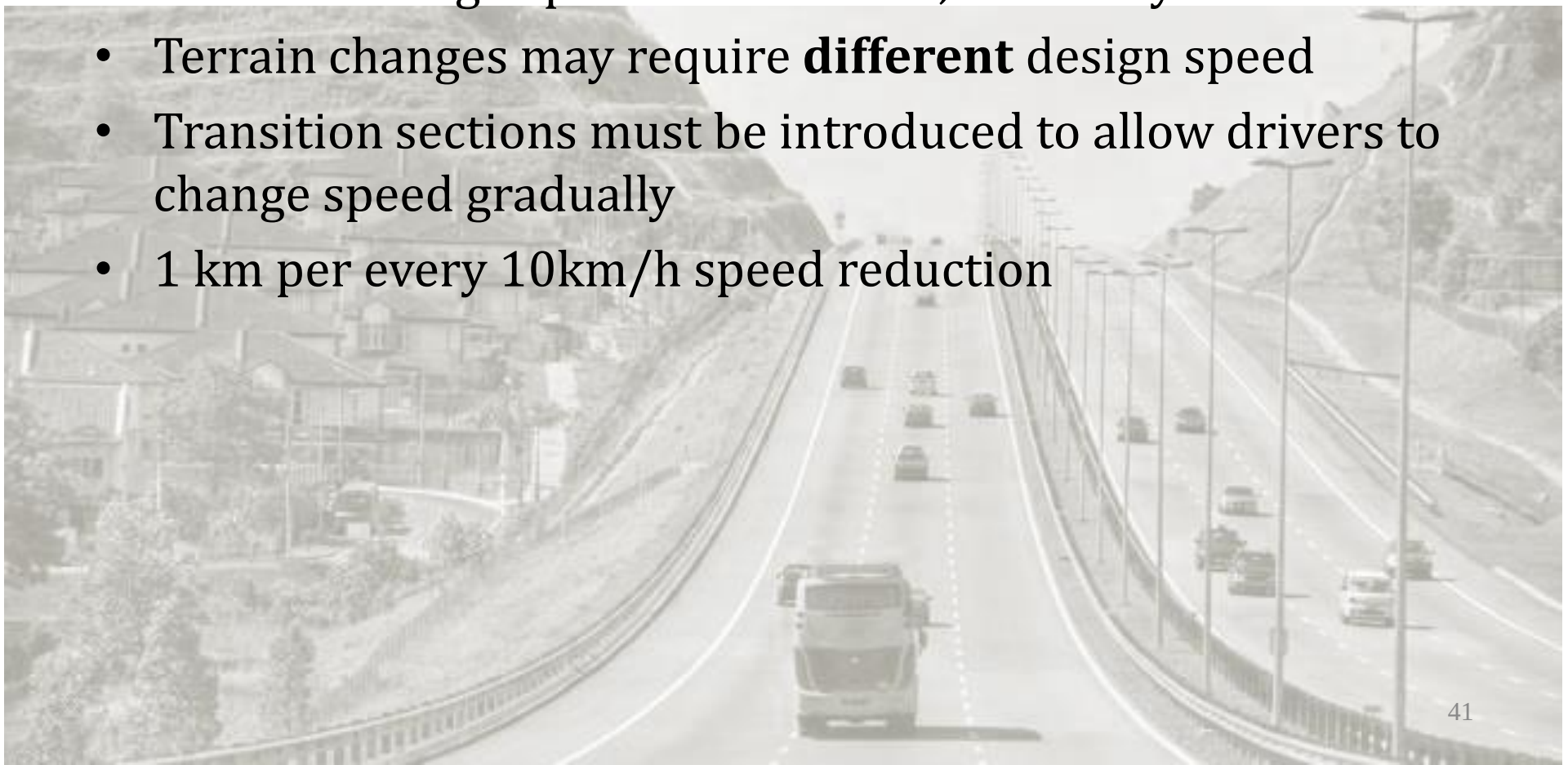
Operating Speed

- "Highest overall speed a driver can travel under favourable weather and prevailing traffic conditions without exceeding the design speed" – AASHTO Green Book 1994
- "the speed at which drivers are observed operating their vehicles during free-flow conditions" - AASHTO Green Book 2001

SPEED

Design Sections

- Constant design speed is **desirable**, not always achievable
- Terrain changes may require **different** design speed
- Transition sections must be introduced to allow drivers to change speed gradually
- 1 km per every 10km/h speed reduction



SPEED

TABLE 3-2A: DESIGN SPEED FOR RURAL ROADS

Design Standard	Category of Road	Design Speed (kph)		
		Terrain		
		Flat	Rolling	Mountainous
R6	Expressway	110	100	80
R5	Highway Primary Roads	100 100	90 90	70 70
R4	Primary Roads Secondary Roads	90 90	80 80	60 60
R3	Secondary Roads	80	60	50
R2	Minor Roads	60	50	40
R1		50	50	30

SPEED

TABLE 3-2B : DESIGN SPEED FOR URBAN ROADS

Design Standard	Category of Road	Design Speed (kph)		
		Area Type		
		I	II	III
U6	Expressway	100	90	80
U5	Arterials Collectors	90 80	70 70	60 60
U4	Arterials Collectors Local Streets	80 70 70	60 60 60	50 50 50
U3	Collectors Local Streets	60 60	50 50	40 40
U2 U1	Local Streets	50 40	40 30	30 30

Note : Type I - relatively free in road location with very little problems as regards land acquisition, affected buildings or other socially sensitive areas.

Type II - Intermediate between I and III.

Type III - Very restrictive in road location with problems as regards land acquisition, affected buildings and other sensitive areas.

CAPACITY

- Refers the **ability** of a roadway to accommodate traffic
- Definition: the **maximum** number of vehicles that can pass over a given section of a lane or roadway during a given time period under prevailing conditions
- Applicable only to uninterrupted flow or open roadway conditions
- Stated in terms of **passenger car units (p.c.u)**

TABLE 3-3 : CONVERSION FACTORS TO P.C.U'S.

Type of Vehicle	Equivalent Value in p.c.u's			
	Rural Standards	Urban Standards	Round About Design	Traffic Signal Design
Passenger Cars	1.00	1.00	1.00	1.00
Motorcycle	1.00	0.75	0.75	0.33
Light Vans	2.00	2.00	2.00	2.00
Medium Lorries	2.50	2.50	2.80	1.75
Heavy Lorries	3.00	3.00	2.80	2.25
Buses	3.00	3.00	2.80	2.25

CAPACITY

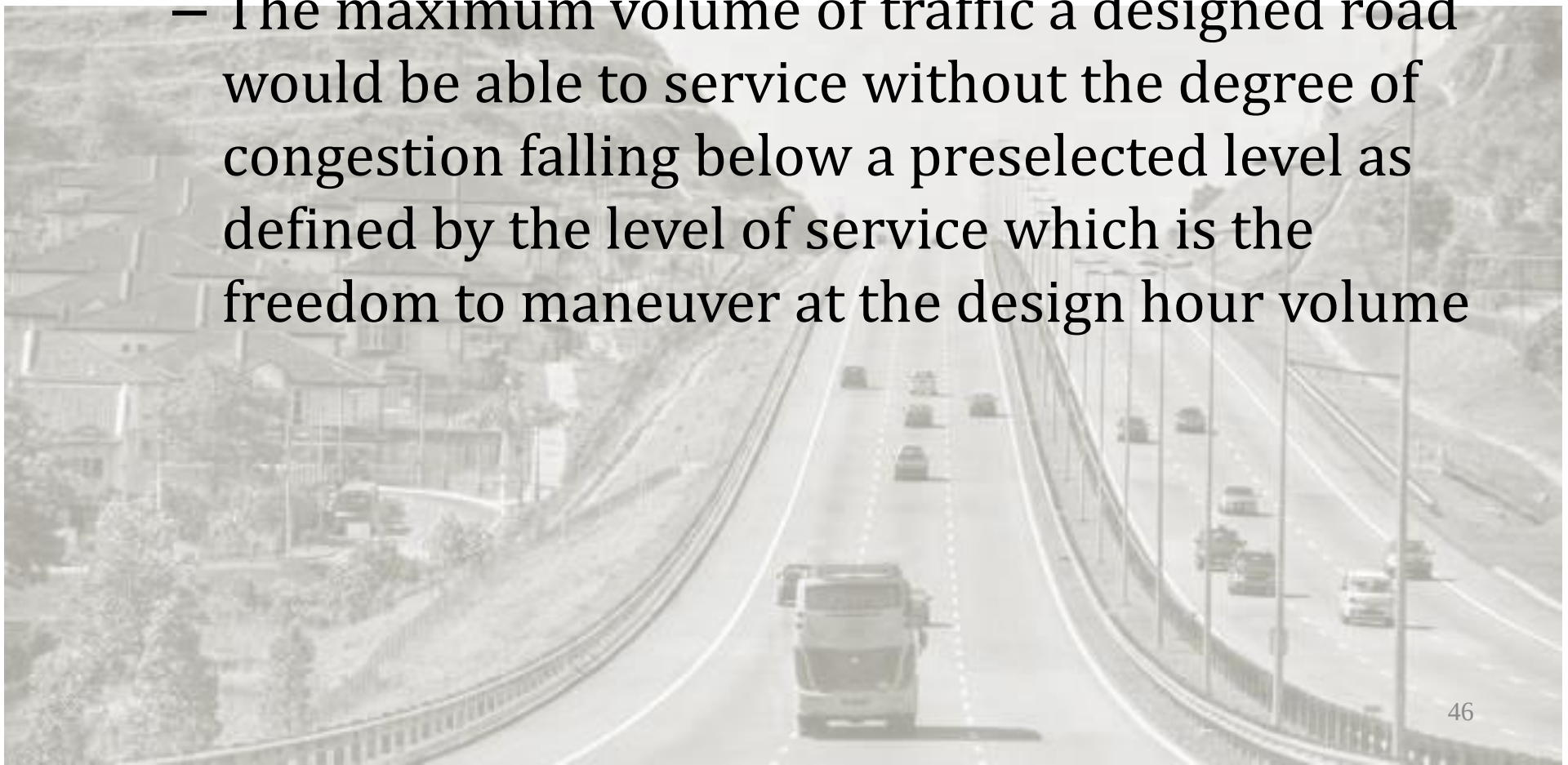
Capacity under ideal condition

- For **2-lane two way** (total) = 2,800 pcu/hr
- For **multi-lane** (per lane) = 2,000 pcu/hr
- Consists of the following:-
  - Design speed > 100km/h
  - Lane width > 3.65m
  - Clear shoulder > 1.8m
  - 50/50 directional split for traffic
  - No impediment to traffic (traffic control devices)
- If condition not met, use adjustment factor from the Highway Capacity Manual (HCM)

CAPACITY

Service Volume

- The maximum volume of traffic a designed road would be able to service without the degree of congestion falling below a preselected level as defined by the level of service which is the freedom to maneuver at the design hour volume



LEVEL OF SERVICE (LOS)

- Level Of Services (LOS) are **qualitative measures** that describe traffic conditions in terms of speed, travel time, freedom to manoeuvre, comfort, convenience, traffic interruption and safety.
- LOS A represents the best condition while LOS F represents heavily congested flow with traffic demands exceeding highway capacity.

LEVEL OF SERVICE (LOS)

TABLE 3-4 : LEVELS OF SERVICE.

Level of Service	Remarks
A	Free Flow with low volumes, densities and high speeds. Drivers can maintain their disered speeds with little or no delay.
B	Stable Flow. Operating speeds beginning to be restricted somewhat by traffic conditions. Some slight delay.
C	Stable Flow. Speeds and maneuverability are more closely controlled by higher volumes. Acceptable delay.
D	Approaching Unstable Flow. Tolerable operating speeds which are considerably affected by operating conditions. Tolerable delay.
E	Unstable Flow. Yet lower operating speeds and perhaps stoppages of momentary duration. Volumes are at or near capacity congestion and intolerable delay.
F	Forced Flow. Speeds and volume can drop to zero. Stop pages can occur for long periods. Queues of vehicles backing up from,a restriction downstream.

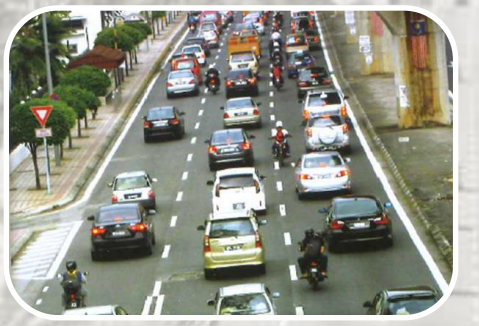
LEVEL OF SERVICE (LOS)

LOS A

LOS B

LOS C

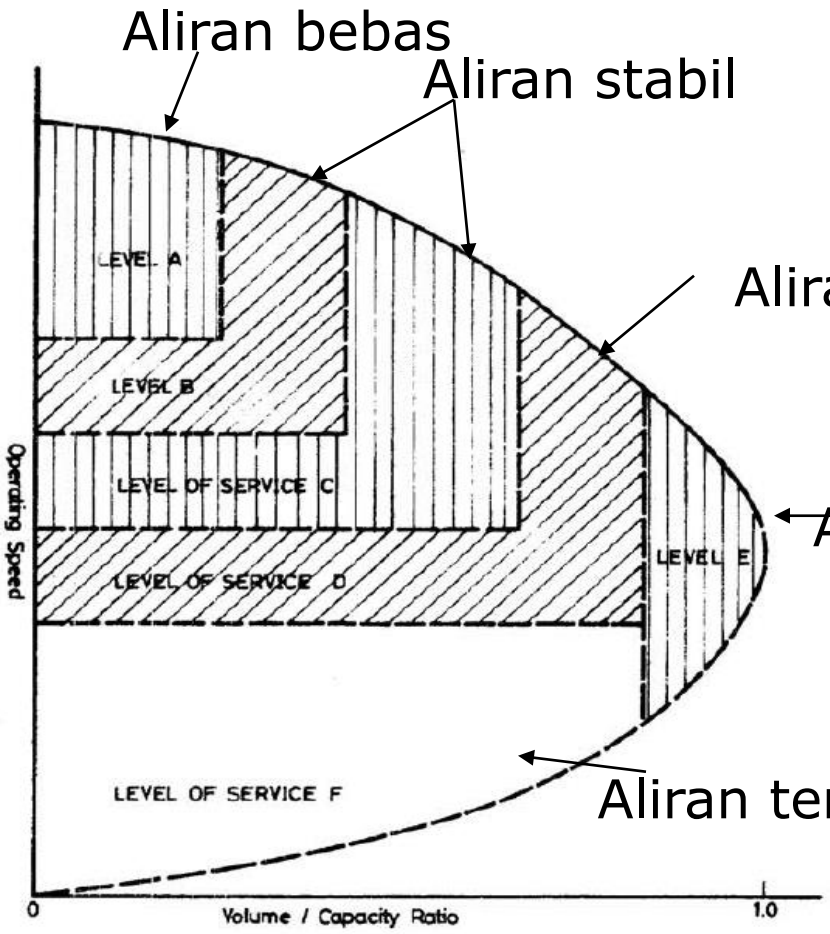
LOS D



LOS E

LOS F

LEVEL OF SERVICE (LOS)



RELATIONSHIP OF LOS TO OPERATING SPEED AND VOLUME/CAPACITY RATIO

CAPACITY

- Design Level of Service and Volume/Capacity Ratio
  - Selection of design level of service in Table 3-5A and Table 3-5B

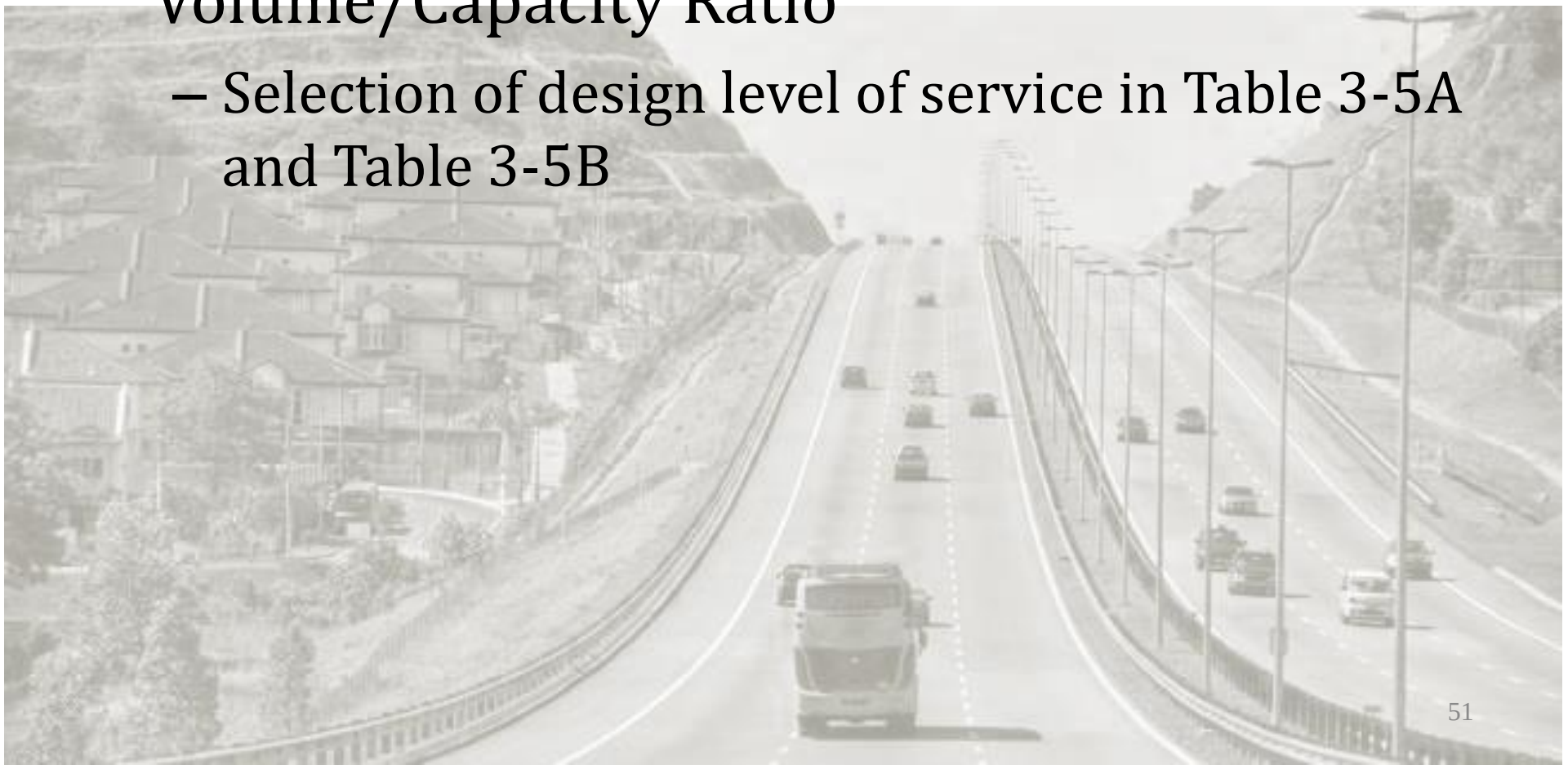


TABLE 3-5A : DESIGN LEVEL OF SERVICE AND VOLUME/ CAPACITY RATIO (RURAL)

Road Category	Design Level of Service	Volume / Capacity Ratio
Expressway	C	0.70-0.80
Highway	C	0.70-0.80
Primary Road	D	0.80-0.90
Secondary Road	D	0.80-0.90
Minor Road	E	0.90-1.00

TABLE 3-5B : DESIGN LEVEL OF SERVICE AND VOLUME/ CAPACITY RATIO (URBAN)

Road Category	Design Level of Service	Volume / Capacity Ratio
Expressway	D	0.80-0.90
Arterial	D	0.80-0.90
Collector	D	0.80-0.90
Local Street	E	0.90-1.00

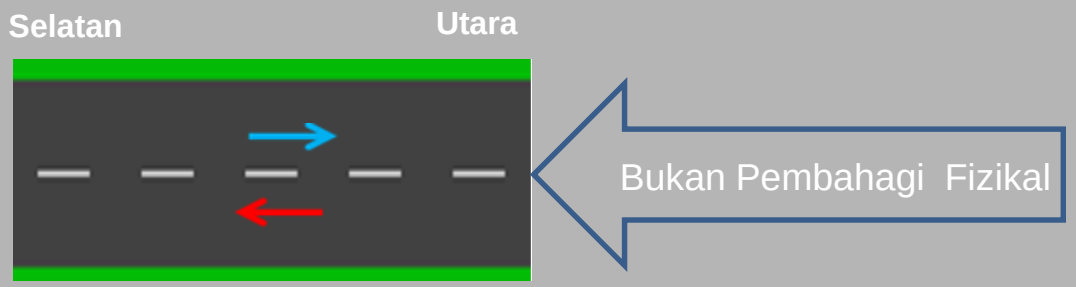
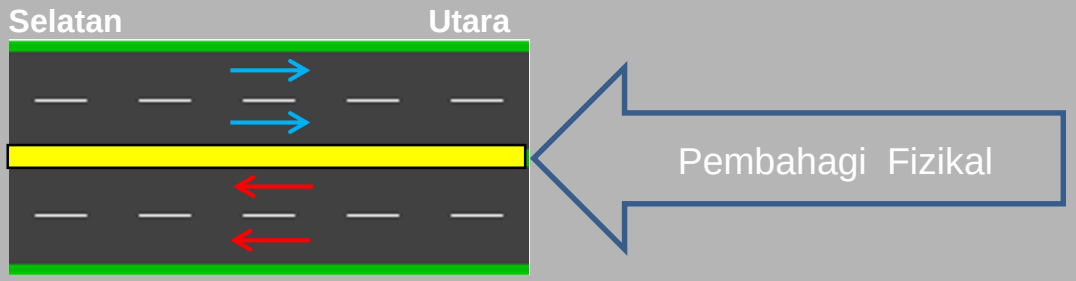
TERMINOLOGI JALAN

1. **Jalan Tunggal *(Single Carriageway)***
Bermaksud jalan yang mana lorong atau lorong-lorongnya sehala atau dua hala **tidak dipisahkan** oleh **pembahagi fizikal**.

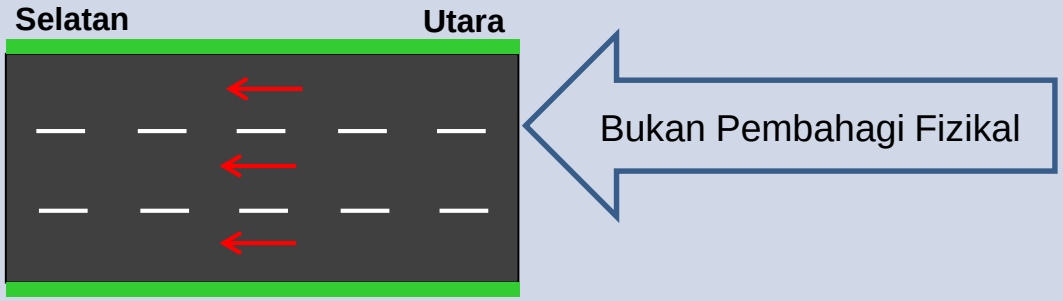
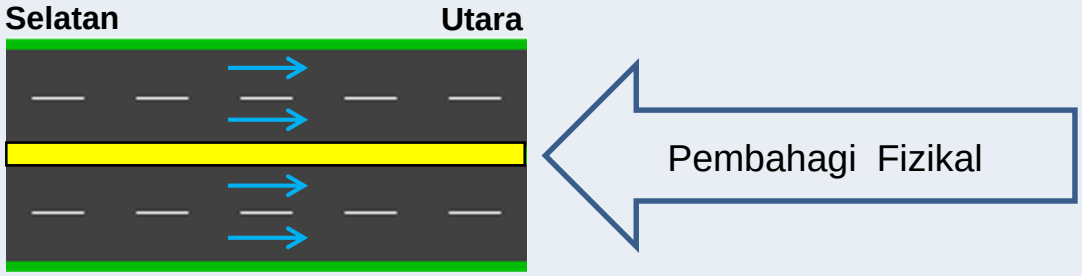
2. **Jalan Berkembar (*Dual Carriageway)***
Bermaksud jalan yang mana lorong atau lorong-lorongnya sehala atau dua hala **dipisahkan** oleh **pembahagi fizikal**.

3. **Lorong *(Lane)***
Merujuk **jumlah keseluruhan lorong** samada jalan berkenaan adalah jalan sehala, dua hala, jalan tunggal atau pun jalan berkembar.

TERMINOLOGI JALAN

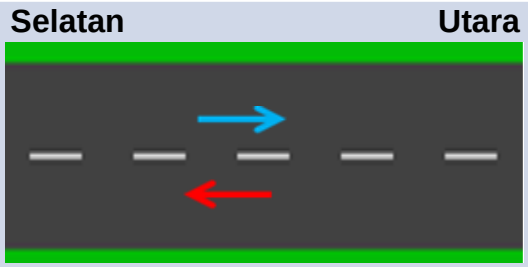
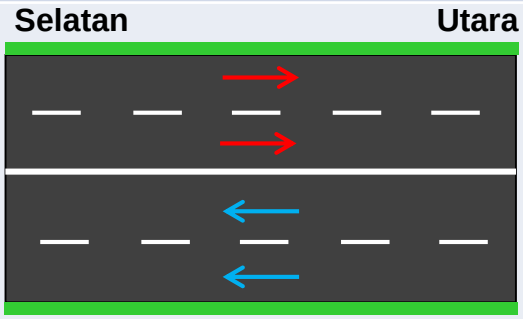
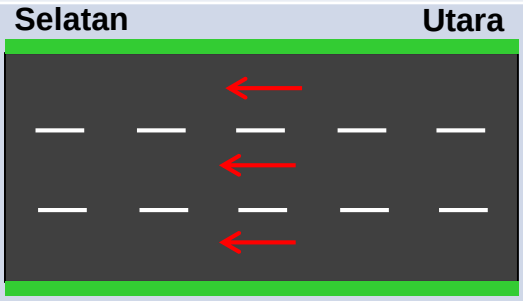
RAJAH SKEMATIK	TERMINOLOGI
	Jalan Tunggal 2 Lorong *(2- Lane, Single Carriageway)*
	Jalan Berkembar 4 Lorong *(4- Lane, Dual Carriageway)*

TERMINOLOGI JALAN

RAJAH SKEMATIK	TERMINOLOGI
	Jalan Tunggal 3 Lorong Sehala *(3- Lane 1 Way, Single Carriageway)*
	Jalan Berkembar 4 Lorong Sehala *(4- Lane 1-Way, Dual Carriageway)*

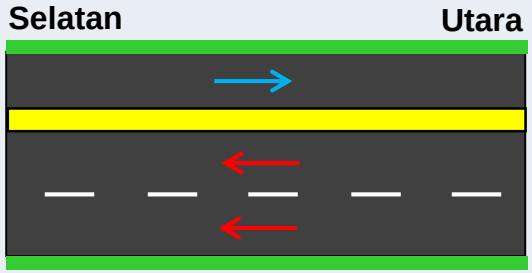
TERMINOLOGI JALAN

Contoh Penggunaan Kod : Jalan Tunggal

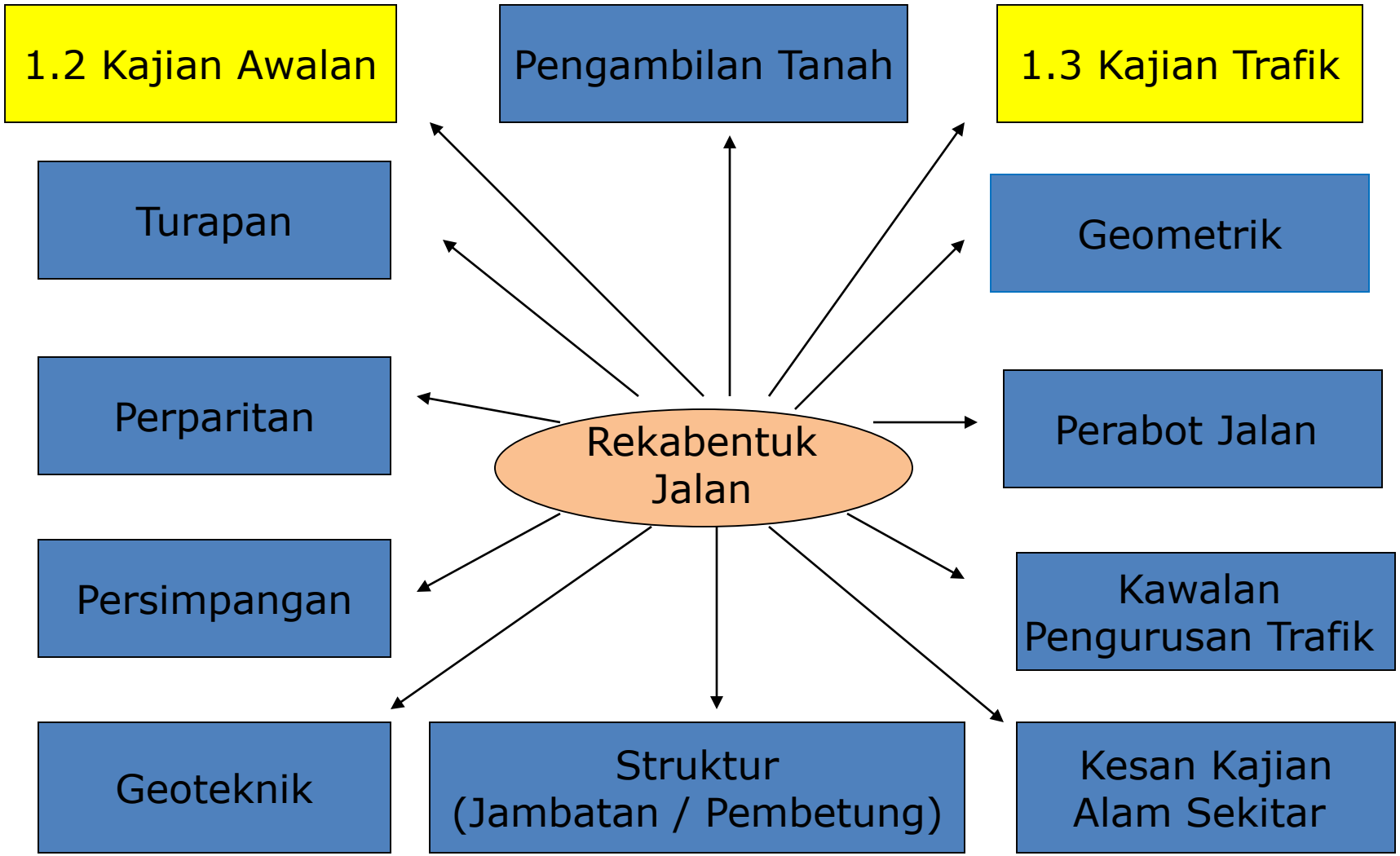
RAJAH SKEMATIK	TERMINOLOGI	KOD
	Jalan Tunggal 2 Lorong *(2- Lane, Single Carriageway)*	T1-1
	Jalan Tunggal 4 Lorong *(4- Lane, Single Carriageway)*	T2-2
	Jalan Tunggal 3 Lorong Sehala *(3-Lane 1-Way Single Carriageway)*	T3

TERMINOLOGI JALAN

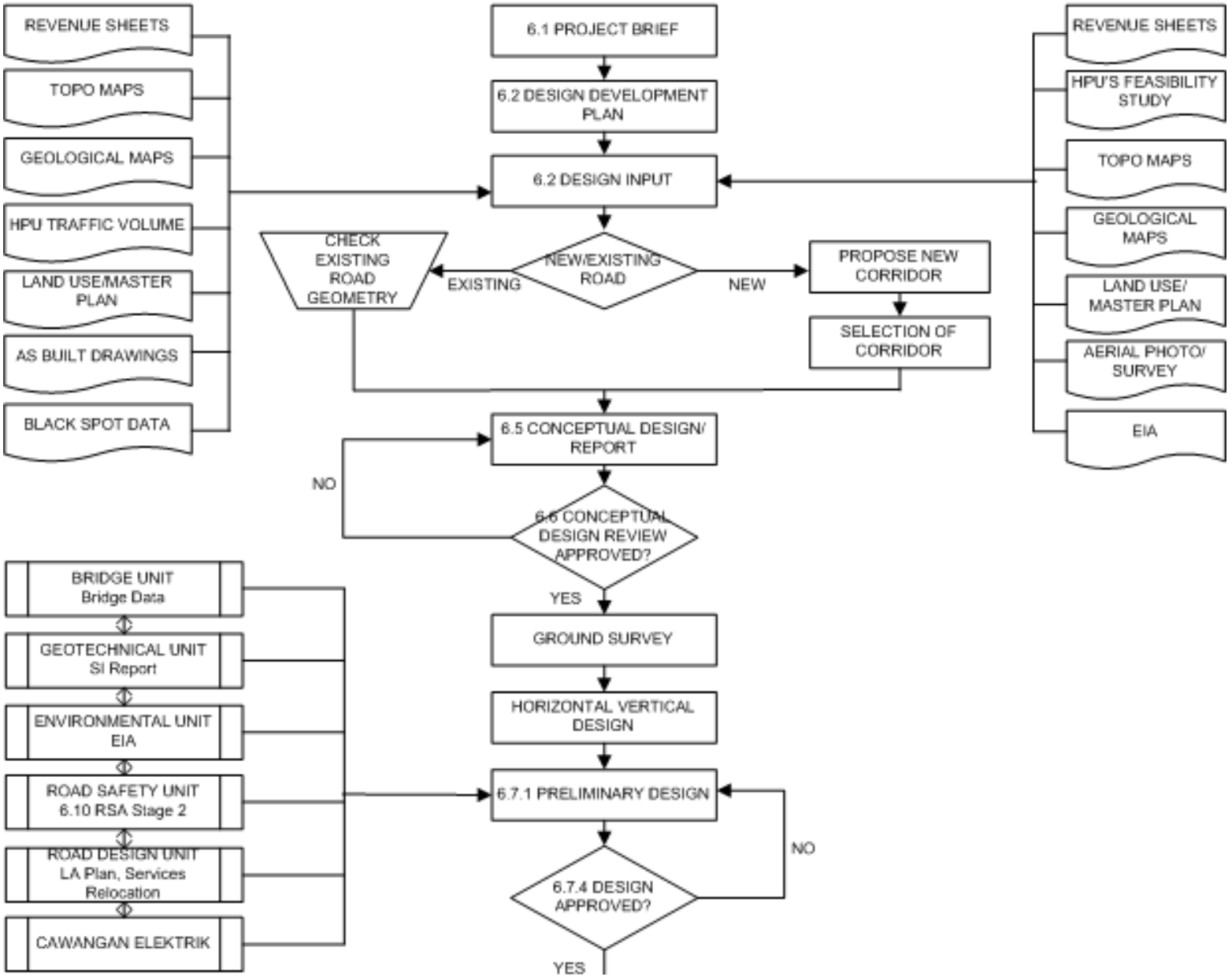
Contoh Penggunaan Kod : Jalan Berkembar

RAJAH SKEMATIK	TERMINOLOGI	KOD
	Jalan Berkembar 4 Lorong *(4- Lane, Dual Carriageway)*	K2 - 2
	Jalan Berkembar 3 Lorong *(3- Lane, Dual Carriageway)*	K1-2
	Jalan Berkembar 4 Lorong Sehala *(4-Lane 1-Way Dual Carriageway)*	K2 + 2

KOMPONEN DI DALAM REKABENTUK JALAN

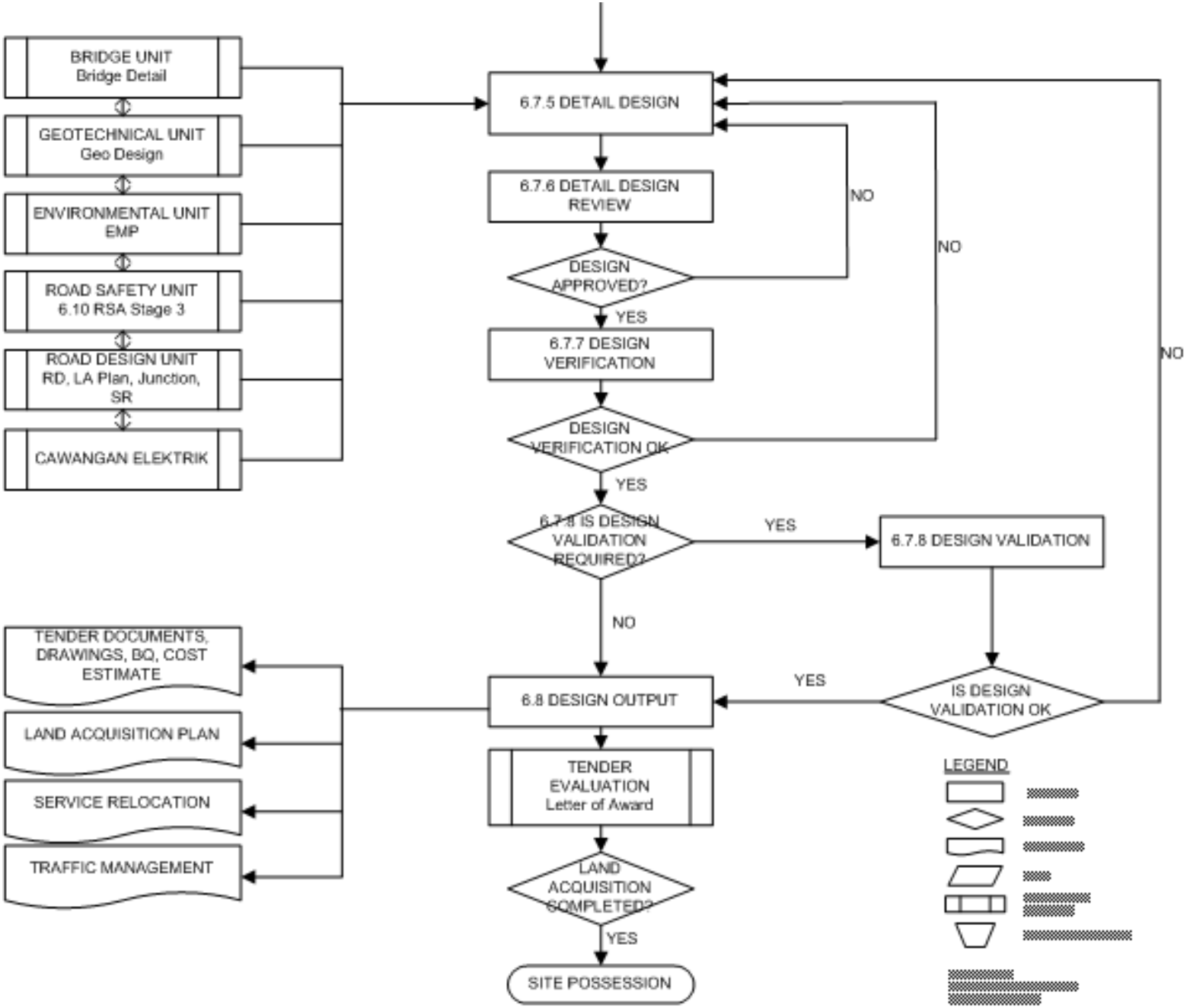


ROAD DESIGN PROCESS



SAMBUNG

SAMBUNG


BRIDGE UNIT
Bridge Detail
GEOTECHNICAL UNIT
Geo Design
ENVIRONMENTAL UNIT
EMP
ROAD SAFETY UNIT
6.10 RSA Stage 3
ROAD DESIGN UNIT
RD, LA Plan, Junction, SR
CAWANGAN ELEKTRIK
6.7.5 DETAIL DESIGN
6.7.6 DETAIL DESIGN REVIEW
NO
DESIGN APPROVED?
YES
6.7.7 DESIGN VERIFICATION
NO
DESIGN VERIFICATION OK
YES
6.7.8 IS DESIGN VALIDATION REQUIRED?
YES
6.7.8 DESIGN VALIDATION
NO
TENDER DOCUMENTS, DRAWINGS, BQ, COST ESTIMATE
LAND ACQUISITION PLAN
SERVICE RELOCATION
TRAFFIC MANAGEMENT
6.8 DESIGN OUTPUT
YES
IS DESIGN VALIDATION OK
NO
TENDER EVALUATION
Letter of Award
LAND ACQUISITION COMPLETED?
YES
SITE POSSESSION
LEGEND

DATA NEEDED

- Traffic Data
- Survey Data
- S.I – Geotechnical Design
- Pavement Evaluation
- Utility Mapping

AKTIVITI TERPERINCI DI DALAM REKABENTUK JALAN

a) Lawatan tapak
b) Penentuan koridor jajaran dan kerja ukur tanah
c) Rekabentuk Geometri – penjajaran datar, tegak/pugak dan keratan rentas tipikal jalan.
d) Rekabentuk Persimpangan – susunatur, *setting out*, kesendengan dan penanda jalan & papan tanda jalan.
e) Rekabentuk Turapan
f) Rekabentuk Peparitan
g) Perabut dan Papan Tanda Jalan
h) Lampu Jalan dan Lampu Isyarat
i) Environmental Protection Work / EIA
j) Rekabentuk Geoteknik
k) Rekabentuk Jambatan & Struktur
l) Pengurusan Trafik di Peringkat Pembinaan
m) Penyelenggaraan Jalan semasa Pembinaan / DLP
n) Taking-off dan penyediaan BQ
o) Penyediaan Tender Dokumen (Seksyen I, II dan III)

LAWATAN TAPAK

Keperluan

- Mengetahui secara kasar kehendak sesuatu tapak projek dan kawasan persekitaran & berdekatan, serta memahami kerja-kerja yang akan terlibat semasa proses merekabentuk jalan.

Perkara yang perlu disiasat & diambil perhatian semasa lawatan tapak

a. Siasat secara keseluruhan jajaran jalan
b. Siasat keadaan kemudahan awam sediada.
c. Siasat kedudukan dan keadaan jambatan, struktur, laluan keretapi sediada.
d. Tandakan kawasan berbatu, berpaya.
e. Akses jalan utama dan minor

Perkara yang perlu disiasat & diambil perhatian semasa lawatan tapak (sambungan)

f. Jumlah isipadu trafik, jika tiada jalankan bancian.
g. Lokasi selekoh merbahaya
h. Keadaan geometrik jalan sediada.
i. Keadaan topografi jalan / muka bumi sediada.
j. Keadaan guna tanah yang berdekatan dan melalui sepanjang jajaran.
k. Keadaan turapan – laksanakan penilaian turapan.
l. Bahan binaan yang terdapat di persekitaran/ berdekatan.
m. Sistem perparitan dan pembetung sediada.
n. Sungai, terusan, tasik – dapatkan flood level, rainfall intensity.
o. Kemudahan awam sediada.
p. Kawasan pembangunan, penempatan, kemudahan awam spt sekolah, masjid, klinik / hospital
q. Semak dengan majlis daerah / JKR Negeri & Daerah mengenai perancangan pembangunan di kawasan jajaran.
r. Semak lokasi tanah perkuburan.

GEOMETRIC ROAD DESIGN

ELEMENTS OF DESIGN

1.0 SIGHT DISTANCE

- Stopping Sight Distance
- Passing Sight Distance
- Decision Sight Distance

2.0 HORIZONTAL ALIGNMENT

- Superelevation
- Minimum radius
- Type of Curves – Transitional Curves and Circular Curves
- Pavement widening on curves
- Sight distance on horizontal curves
- Overtaking lane

3.0 VERTICAL ALIGNMENT

- Gradient
- Critical Grade Length
- Maximum grades
- Minimum grades
- Climbing lane

4.0 CROSS SECTION ELEMENTS

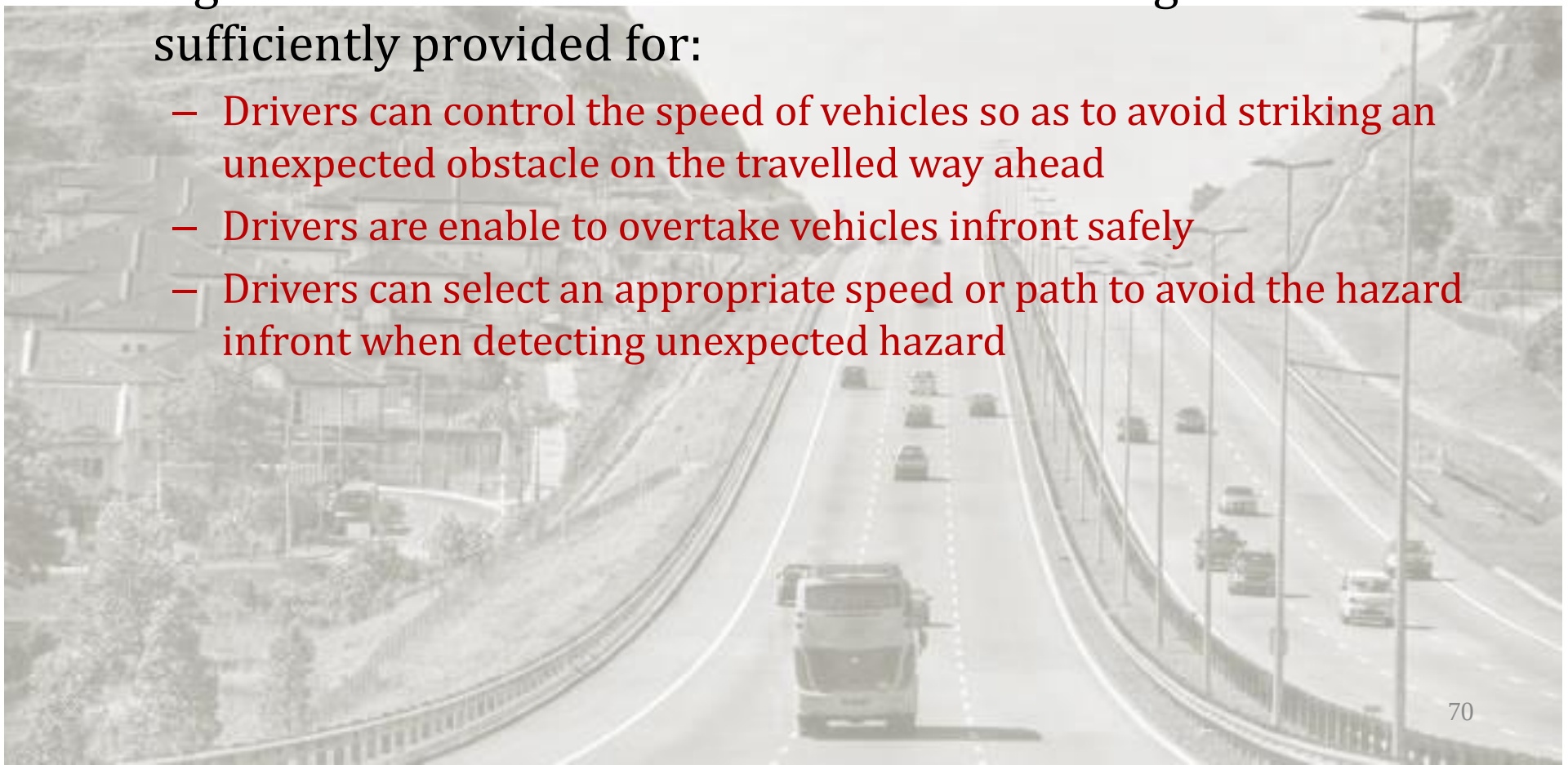
- Surface type
- Normal cross slope
- Lane widths and marginal strips
- Width of shoulders
- Shoulder cross slope
- Kerbs
- Traffic barriers - Medians
- Pedestrian crossings
- U-Turns
- Bus laybyes
- Minimum reserve width

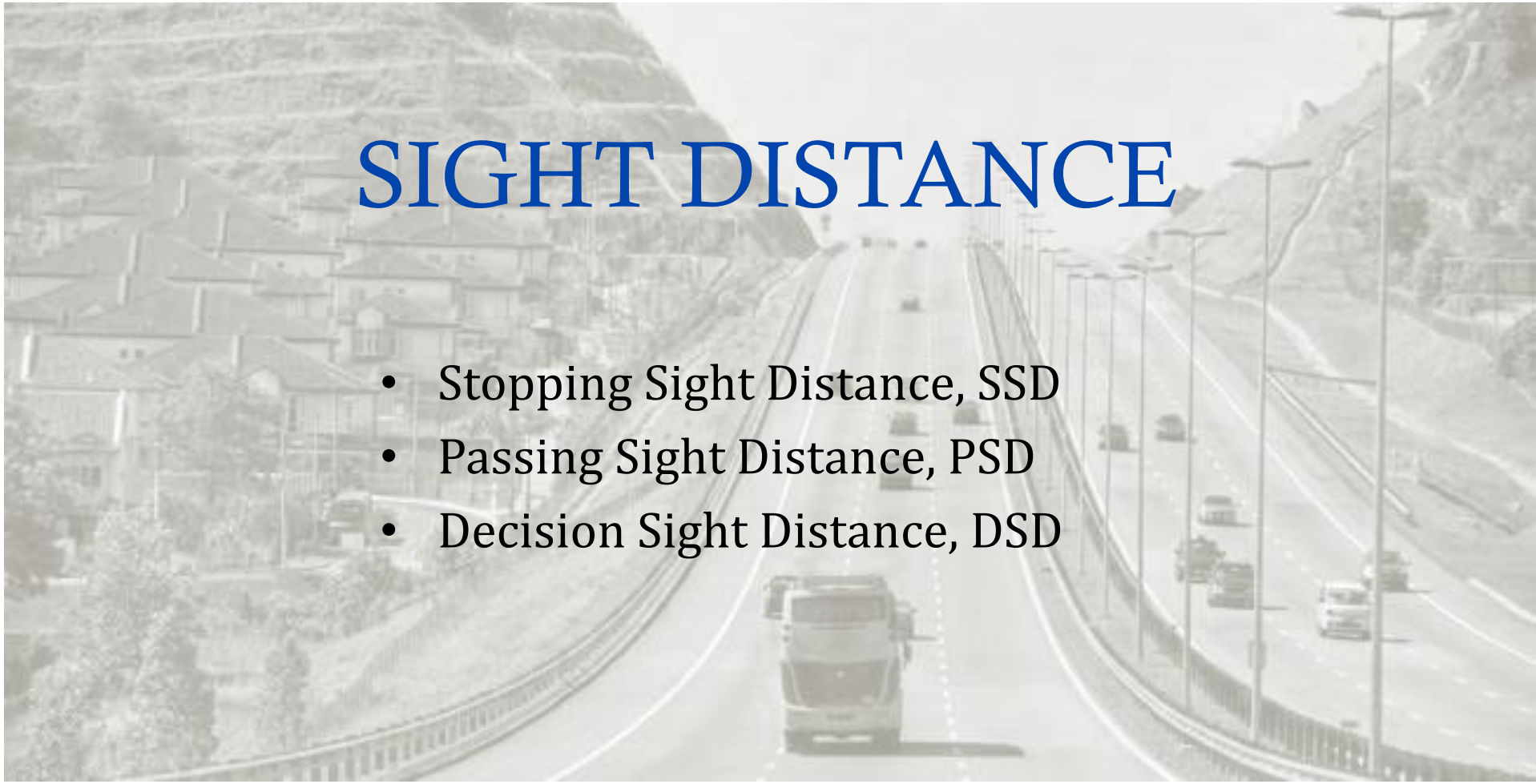
OTHER ELEMENTS AFFECTING GEOMETRIC DESIGN

1. **DRAINAGE**
2. **LIGHTING**
3. **UTILITIES**
4. **SIGNAGE AND MARKINGS**
5. **TRAFFIC SIGNAL**
6. **EROSION CONTROL, LANDSCAPE DEVELOPMENT AND ENVIRONMENTAL IMPACTS**
7. **EMERGENCY ESCAPE RAMPS**

SIGHT DISTANCE

- Sight Distance – Length of road ahead visible to drivers
- Sight distance in Horizontal and Vertical Design need to be sufficiently provided for:
  - Drivers can control the speed of vehicles so as to avoid striking an unexpected obstacle on the travelled way ahead
  - Drivers are enable to overtake vehicles infront safely
  - Drivers can select an appropriate speed or path to avoid the hazard infront when detecting unexpected hazard





SIGHT DISTANCE

- Stopping Sight Distance, SSD
- Passing Sight Distance, PSD
- Decision Sight Distance, DSD

STOPPING SIGHT DISTANCE SSD

- Length required to enable a vehicle travelling at or near the design speed to stop before reaching an object in its path

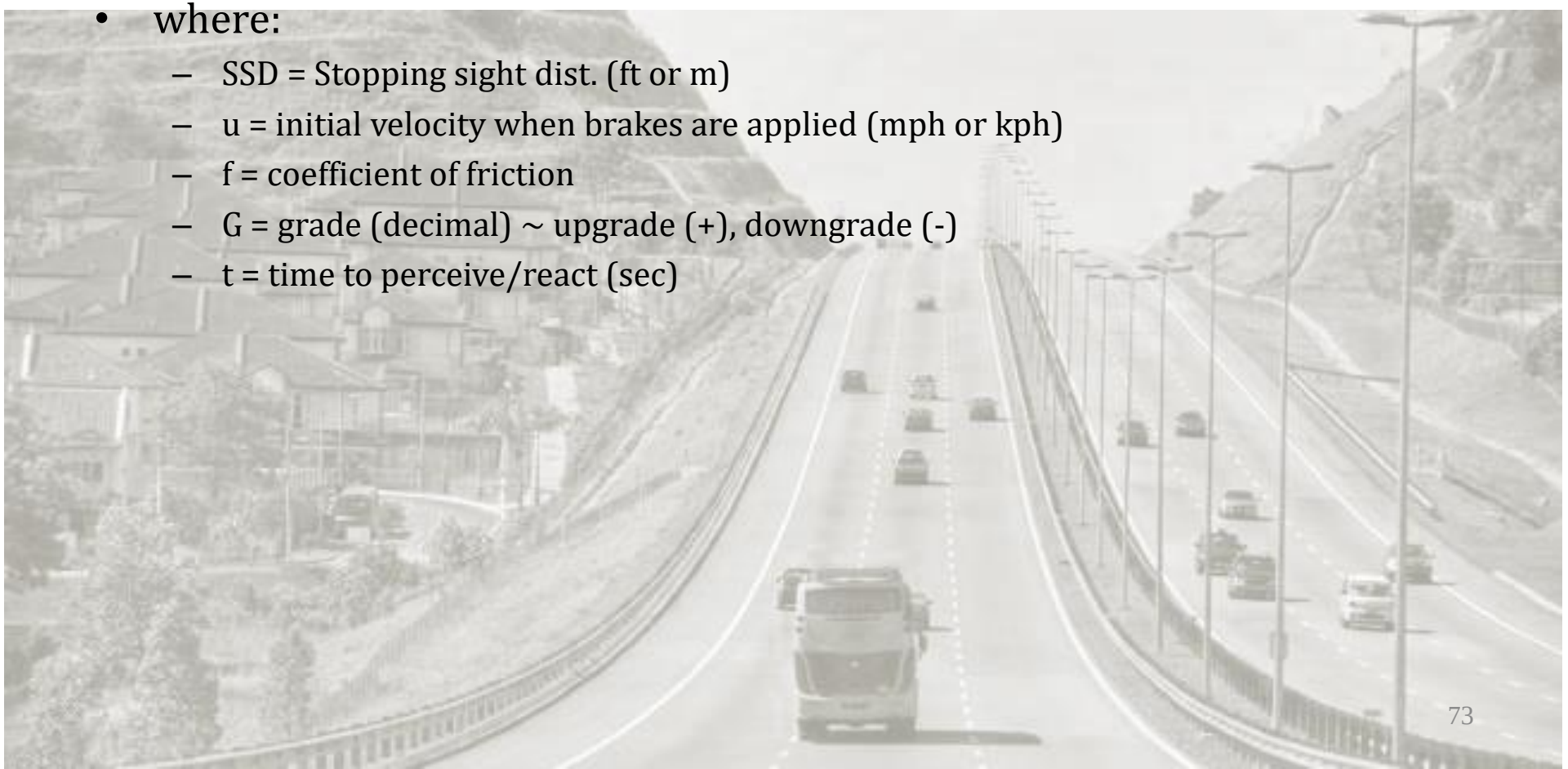
- Minimum SSD consists or two distances:
  - Distance travelled when the driver sights the object that needs the driver to stop to the instant the brakes are applied: distance of reaction time, 3s
  - Distance required to stop the vehicle after brake is applied

Design speed (km/hr)	Minimum stopping sight distance (m)
110	250
100	205
90	170
80	140
70	110
60	85
50	65
40	45

Table 4.1 Minimum stopping distance

STOPPING SIGHT DISTANCE
SSD

- $$SSD = 0.28u_i t + \frac{u_i^2 - u_f^2}{254(f \pm G)}$$ **(metric units)**
- where:
  - SSD = Stopping sight dist. (ft or m)
  - u = initial velocity when brakes are applied (mph or kph)
  - f = coefficient of friction
  - G = grade (decimal) ~ upgrade (+), downgrade (-)
  - t = time to perceive/react (sec)



STOPPING SIGHT DISTANCE SSD

TABLE 4.2: EFFECTS OF GRADES IN STOPPING SIGHT DISTANCE - (WET CONDITIONS)

Design Speed (kph)	Stopping Sight Distance (m) for Downgrades			Stopping Sight Distance (m) for Upgrades		
	3%	6%	9%	3%	6%	9%
30	32	35	35	31	30	29
40	50	50	53	45	44	43
50	66	70	74	61	59	58
60	87	92	97	80	77	75
70	110	116	124	100	97	93
80	136	144	154	123	118	114
90	164	174	187	148	141	136
100	194	207	223	174	167	160
110	227	243	262	203	194	186
120	263	281	304	234	223	214

Source: AASHTO – A Policy on Geometric Design of Highways and Street (2001), Exhibit 3-2

PASSING SIGHT DISTANCE
PSD

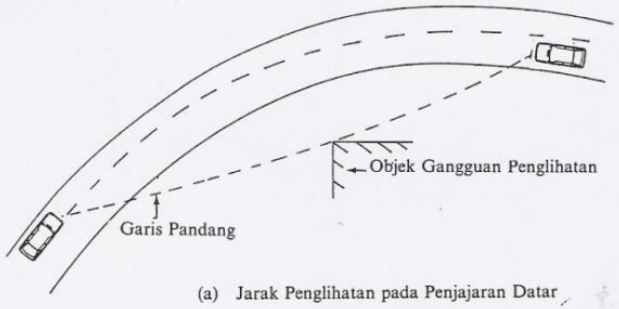
- Minimum length needed to safely complete a normal passing maneuver
- Consists of:
  - Distance traversed during perception and reaction time and during initial acceleration to the point of encroachment on the passing lane
  - Distance travelled while the passing vehicles occupies the passing lane
  - Distance between the passing vehicle at the end or its maneuver and the opposite vehicles
  - Distance traversed by an opposing vehicle for two thirds of the time the passing vehicle occupies the passing lane

TABLE 4.4: MINIMUM PASSING SIGHT DISTANCES (2-LANE, 2-WAY)

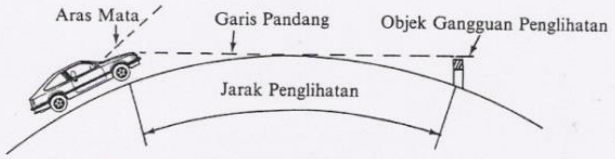
Design Speed (kph)	Min. Passing Sight Distance (m)
120	775
110	730
100	670
90	615
80	540
70	485
60	410
50	345
40	270
30	200

Source: AASHTO – A Policy on Geometric Design of Highways and Street (2001), Exhibit 3-7

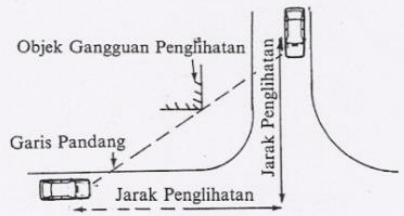
SIGHT DISTANCE



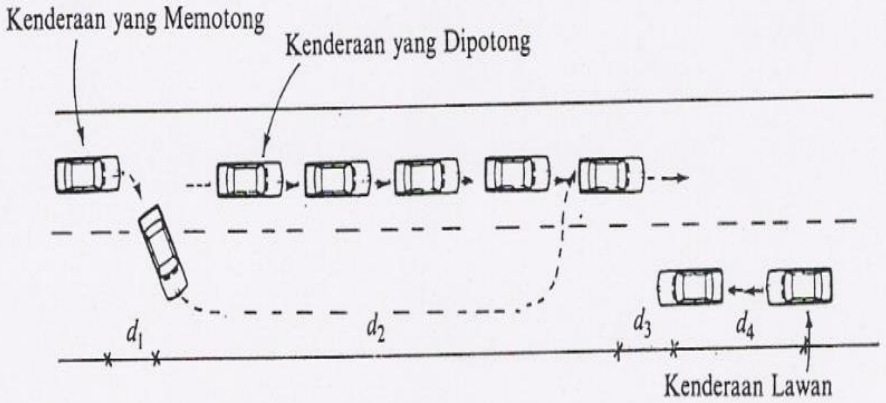
(a) Jarak Penglihatan pada Penjajaran Datar



(b) Jarak Penglihatan pada Penjajaran Tegak



(c) Jarak Penglihatan pada Persilangan Searas



Rajah 5.6 OPERASI MEMOTONG KENDERAAN

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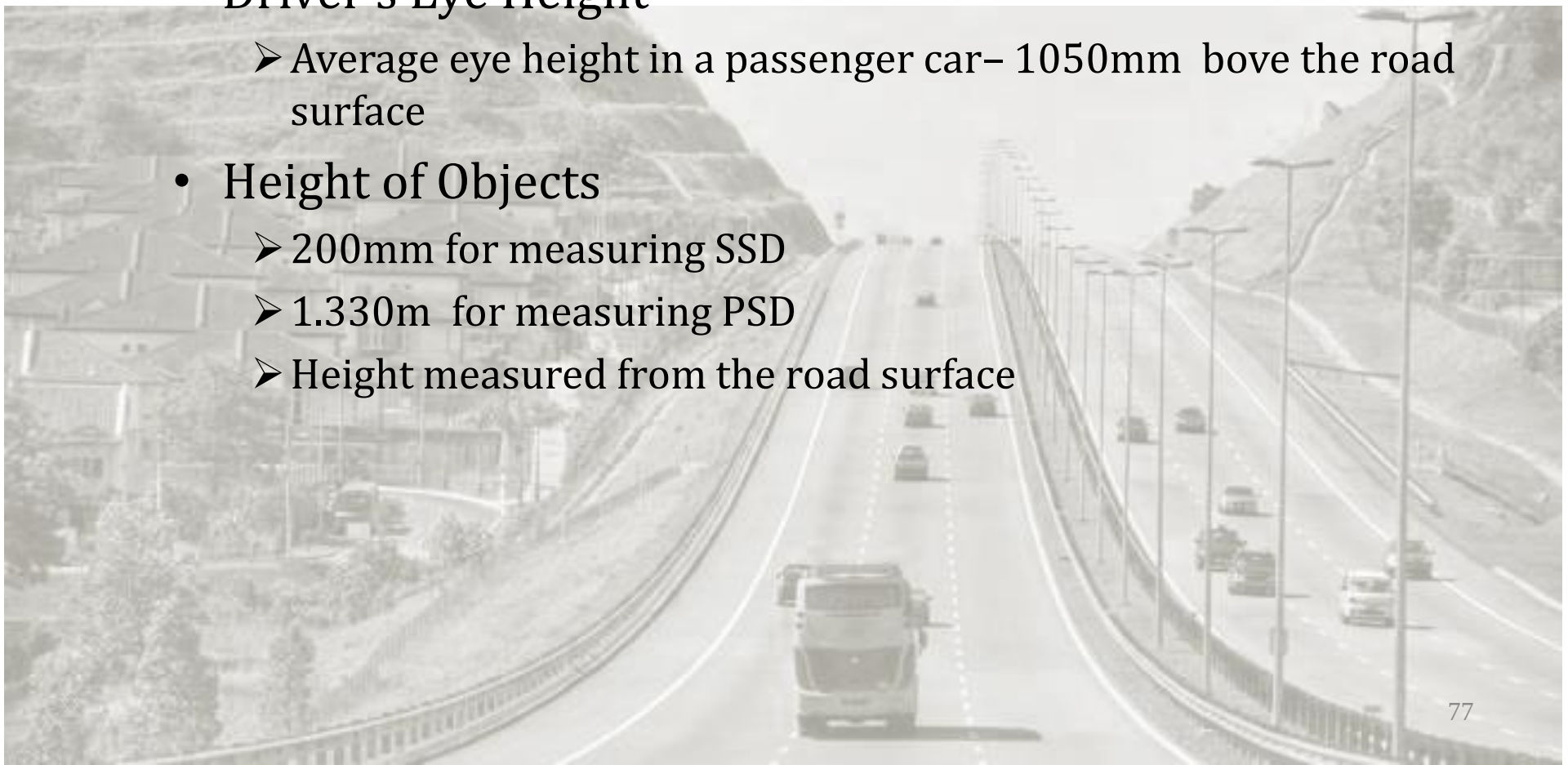
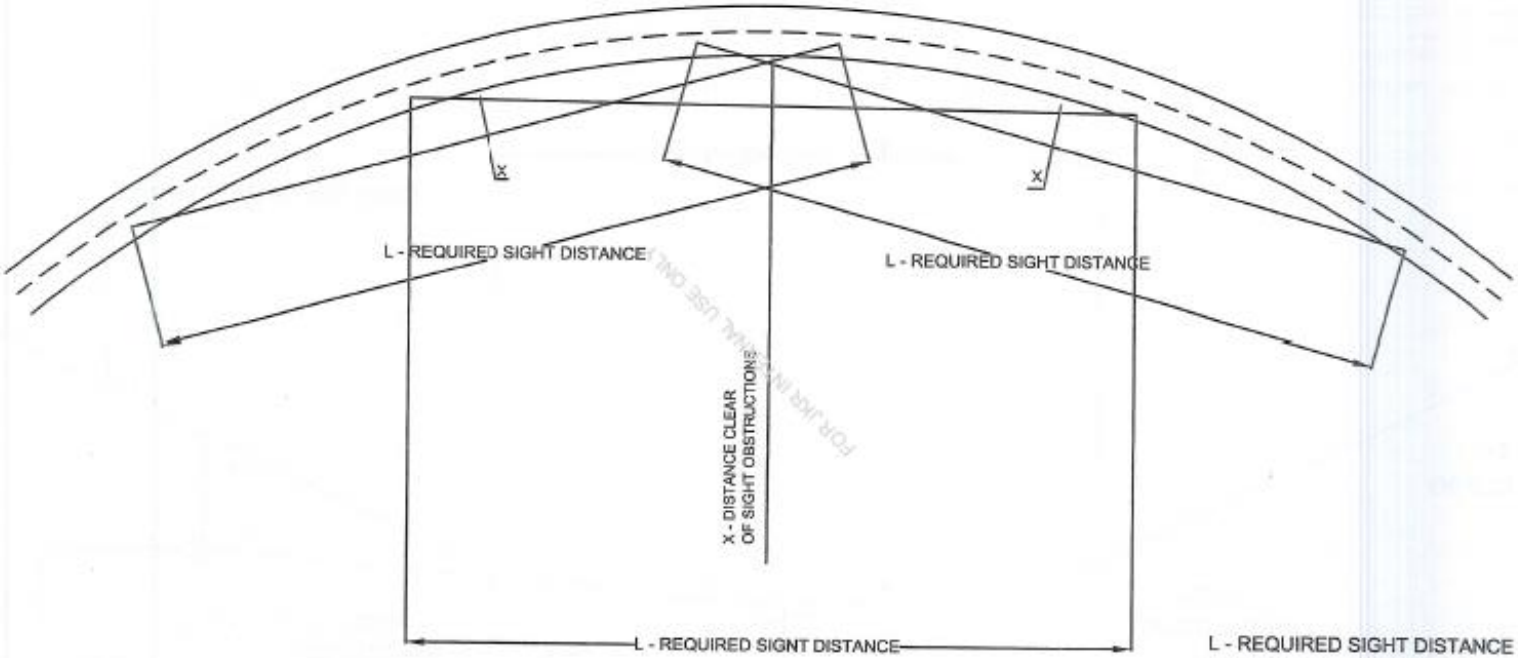
SIGHT DISTANCE

Criteria for measuring sight distance:

- Driver's Eye Height
  - Average eye height in a passenger car– 1050mm bove the road surface
- Height of Objects
  - 200mm for measuring SSD
  - 1.330m for measuring PSD
  - Height measured from the road surface



HORIZONTAL CURVE

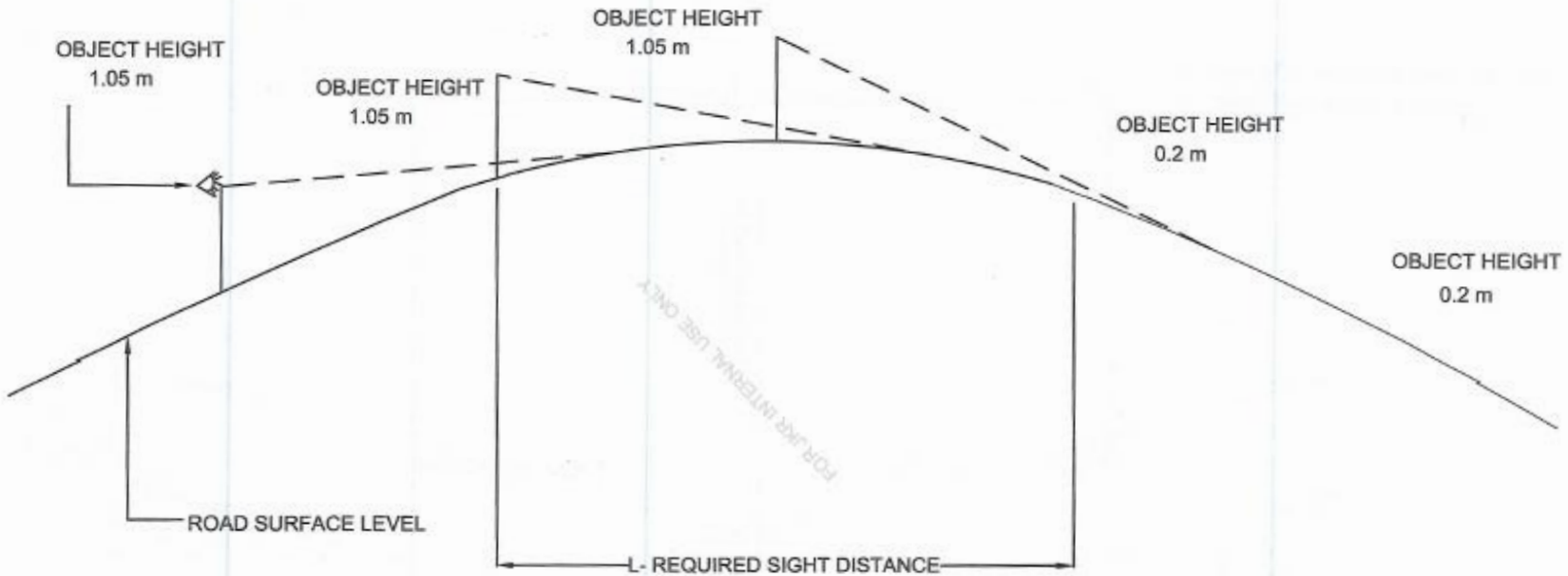


L - REQUIRED SIGHT DISTANCE
X - DISTANCE CLEAR OF SIGN OBSTRUCTIONS

Source : REAM GL 2/2002 A Guide on Geometric Design of Roads, Figure 4-1

FIGURE 4.1 : MEASURING SIGHT DISTANCE ON PLAN

Scale : Not to scale

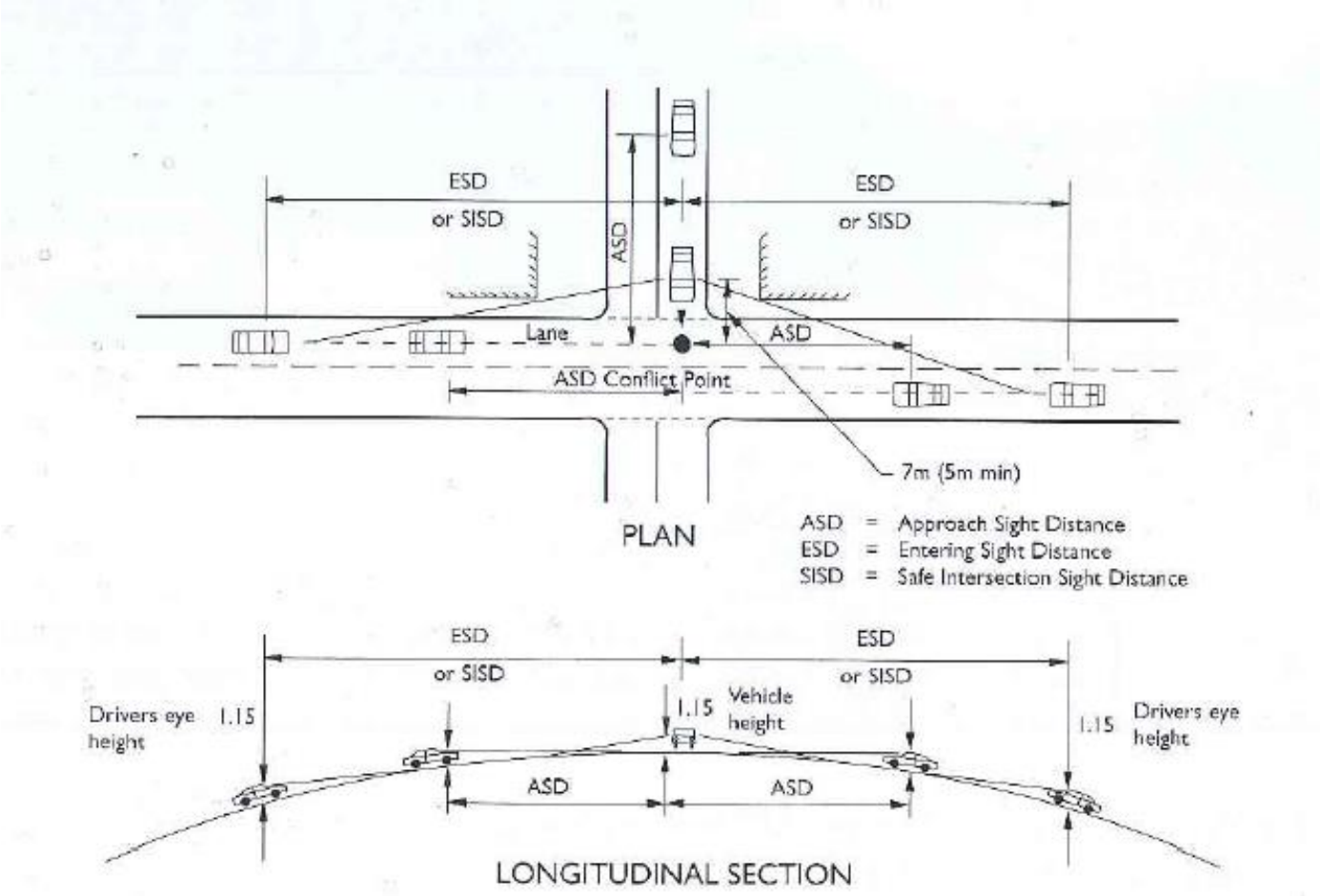


Source : REAM GL 2/2002 A Guide on Geometric Design of Roads, Figure 4-2

FIGURE 4.2 : MEASURING SIGHT DISTANCE ON PROFILE

Scale : Not to scale

INTERSECTION SIGHT DISTANCE CRITERIA



THANK YOU