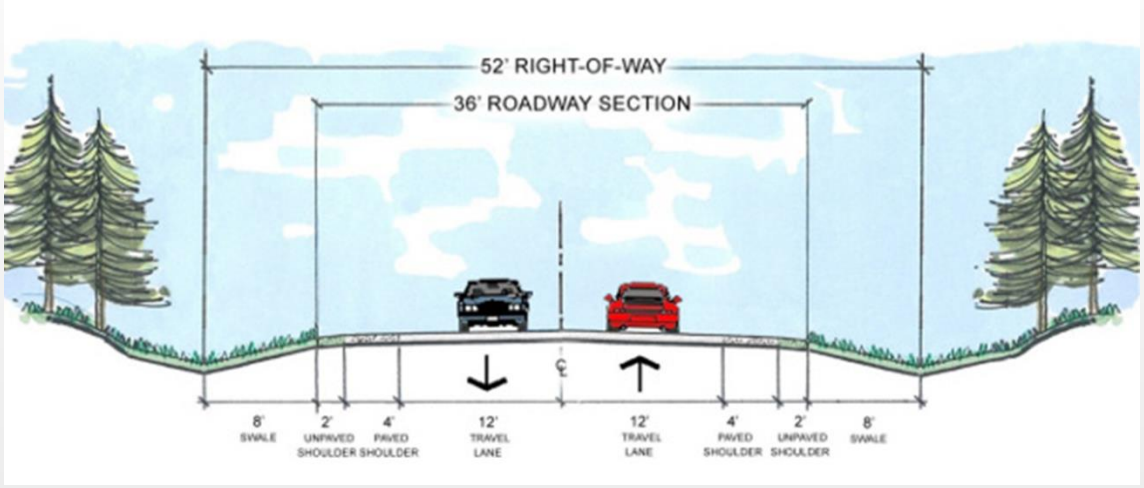


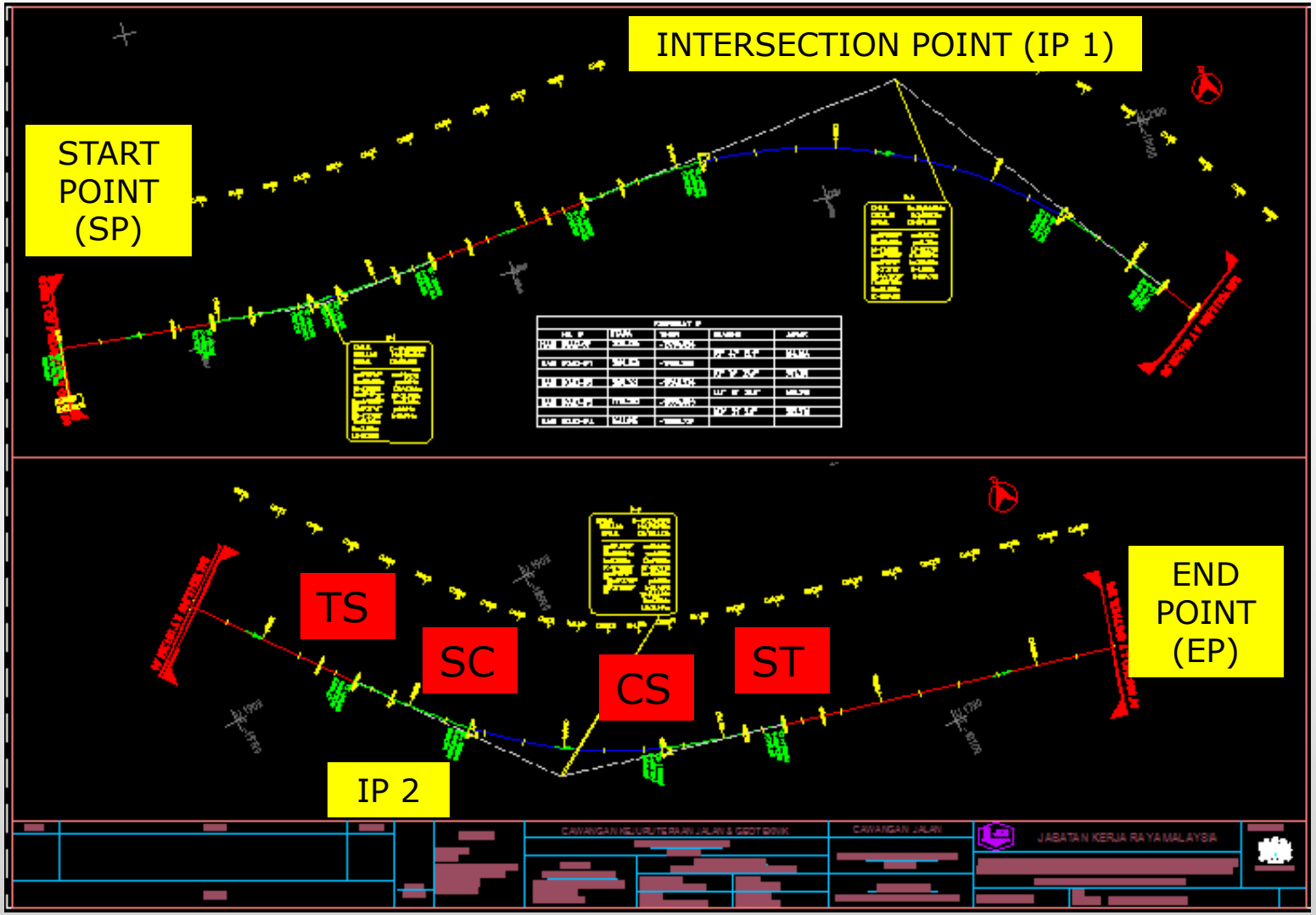
CROSS SECTION ELEMENTS

Ir. MUNIRAH BINTI HASAN, JAK, BRJ ZON TENGAH, PKJJ CJ

CONTENT

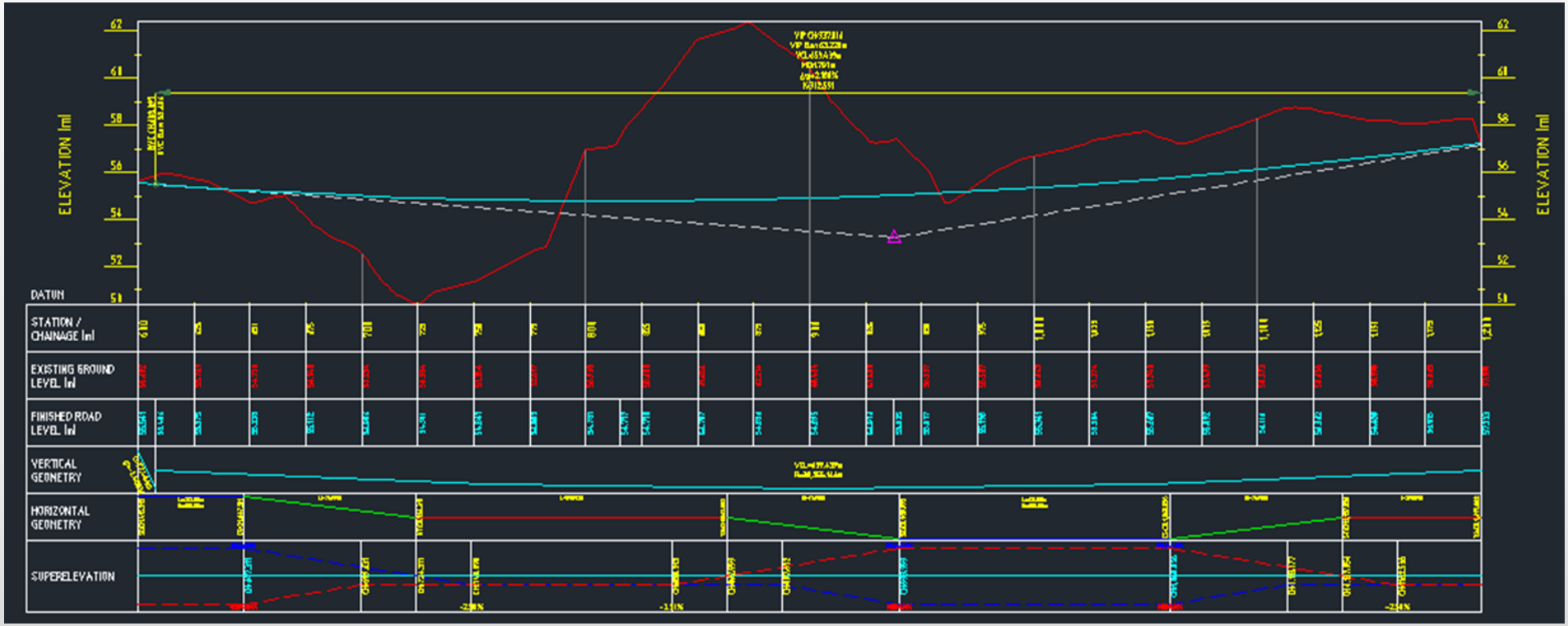
- PAVEMENT
- LANE WIDTHS & MARGINAL STRIP
- SHOULDERS
- KERBS
- SIDEWALK
- MEDIAN
- U-TURNS
- BRIDGE & STRUCTURE CROSS SECTION
- BUS LAY-BYS

HORIZONTAL ALIGNMENT



VERTICAL ALIGNMENT

Vertical profile

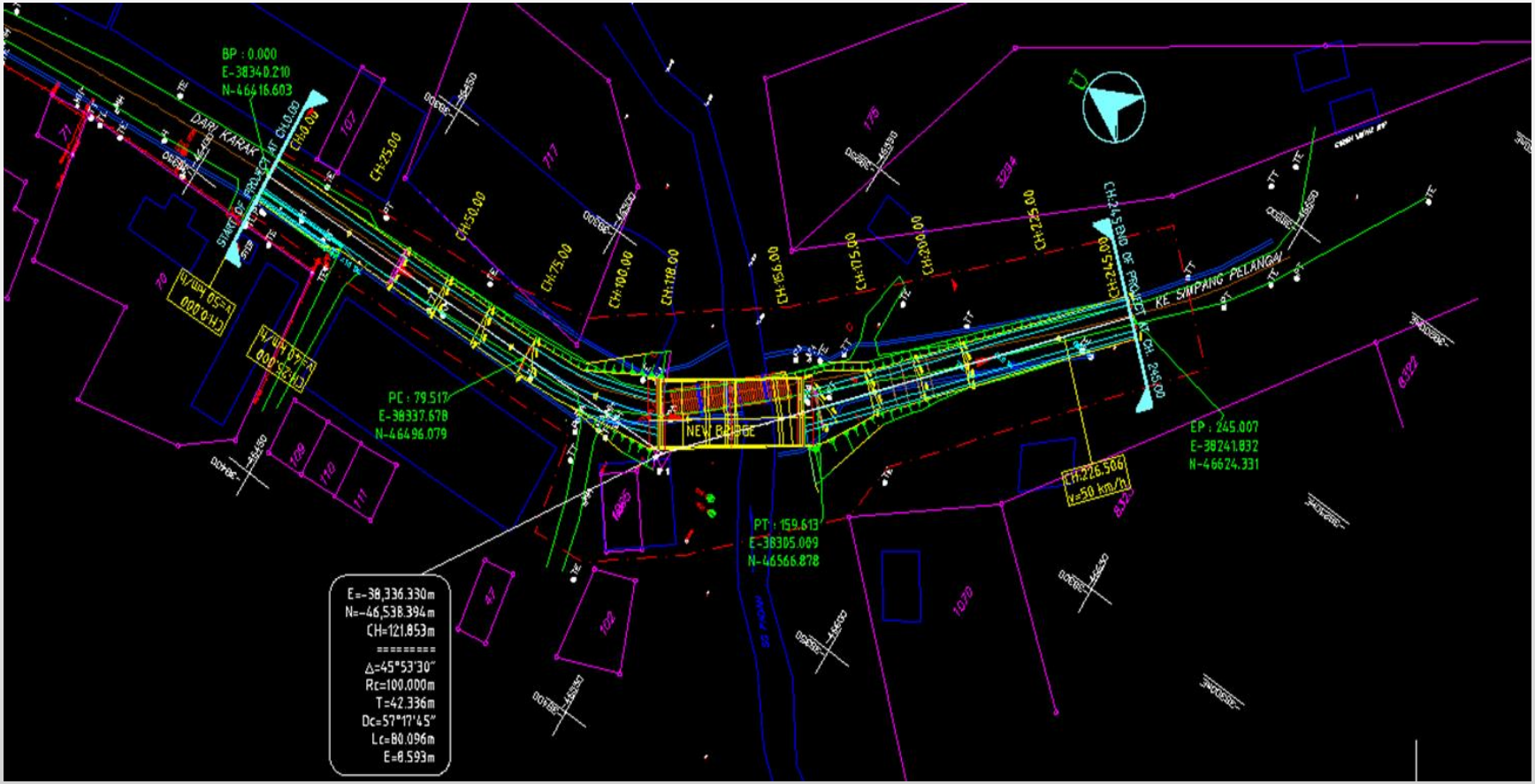


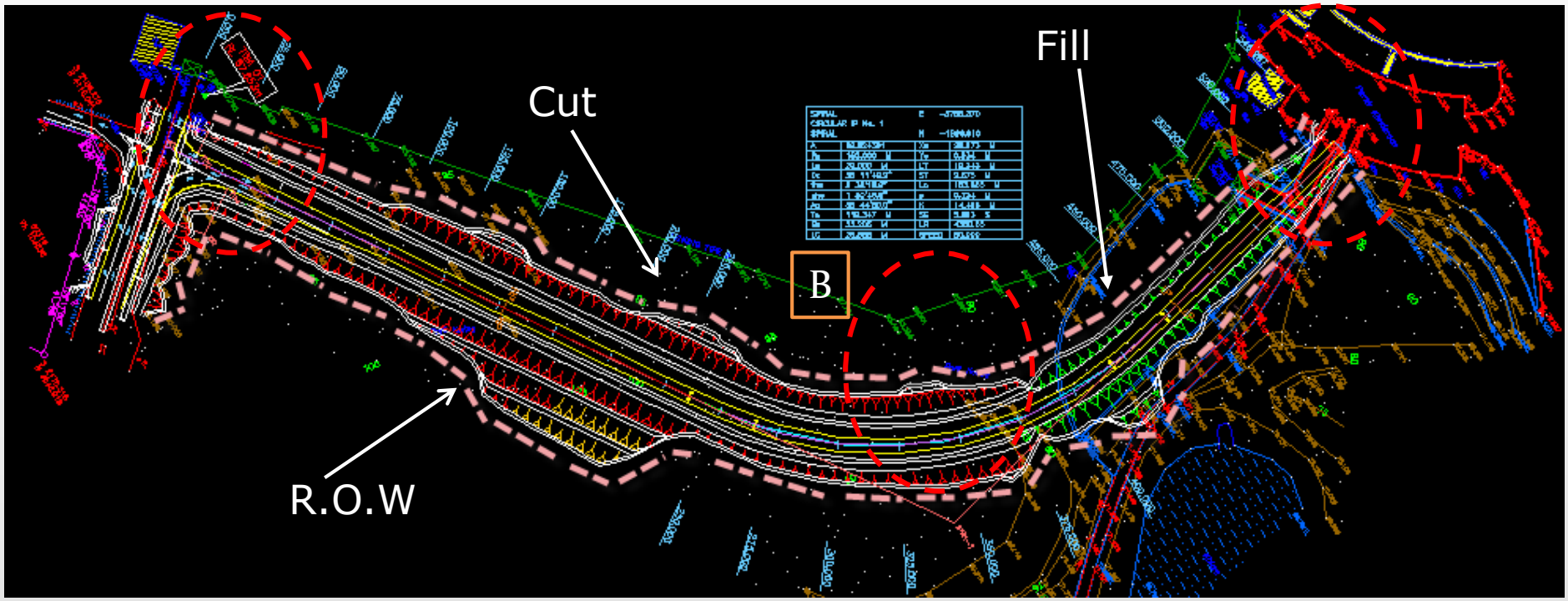
Superelevation diagram

START OF PROJECT (CH.0.00)

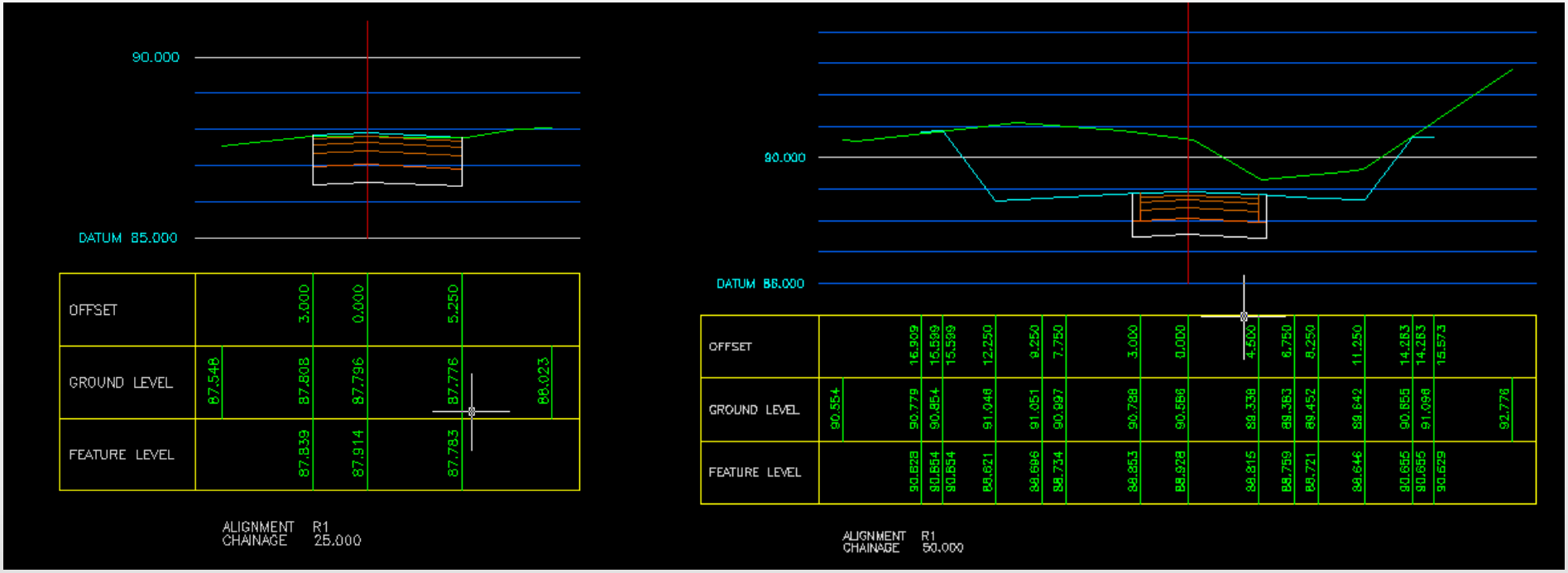
EVERY 25m CHAINAGE

END OF PROJECT (CH.....00)




A
C
Cut
Fill
B
R.O.W

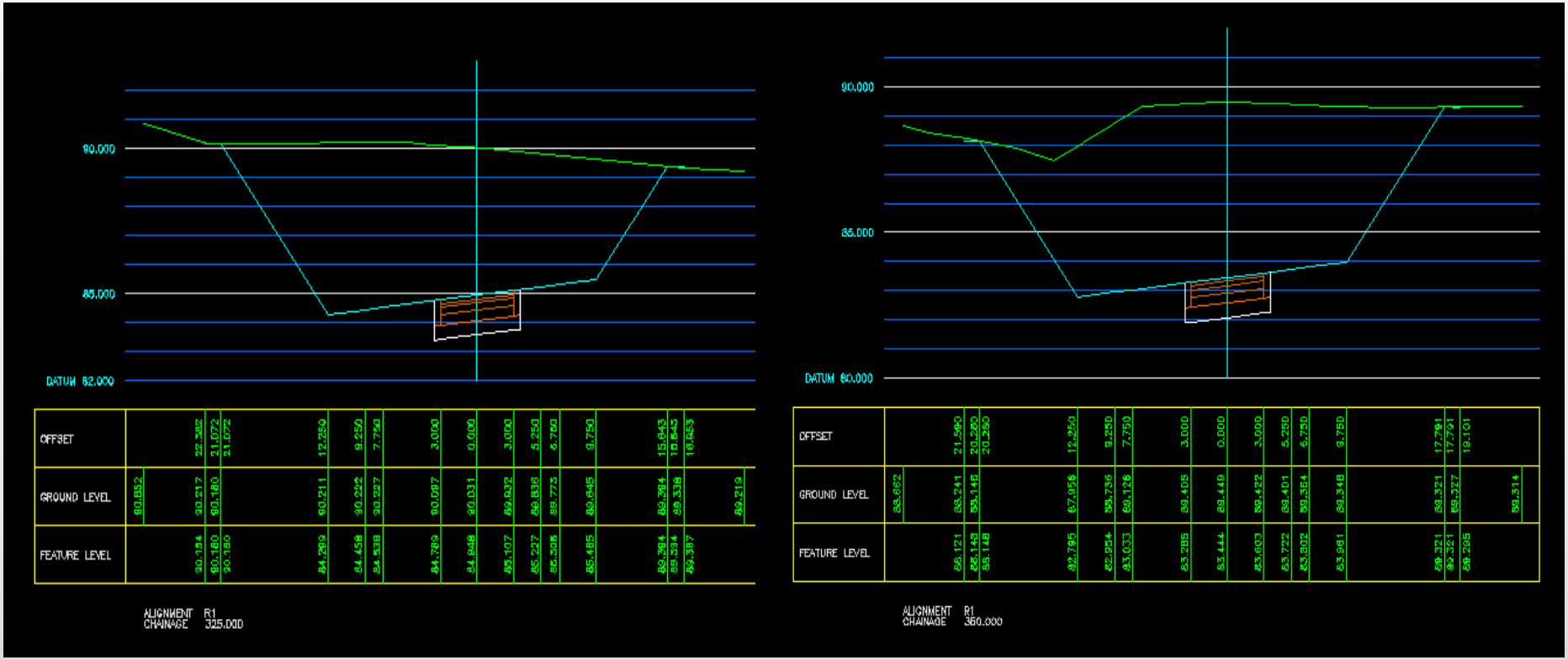
A



CH 25.00

CH 50.00

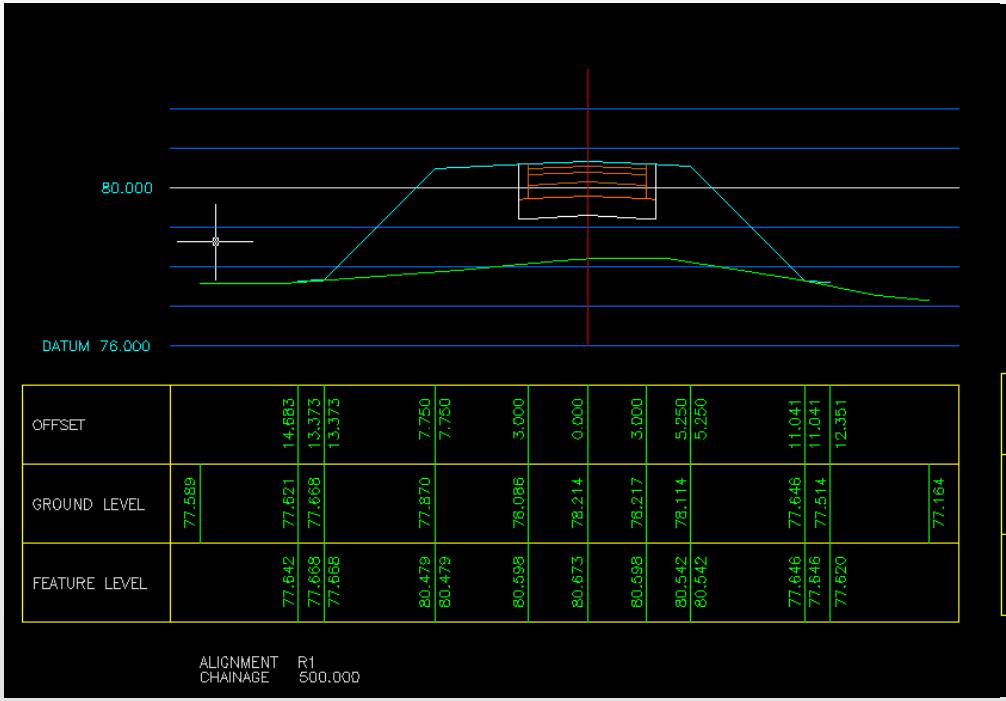
B



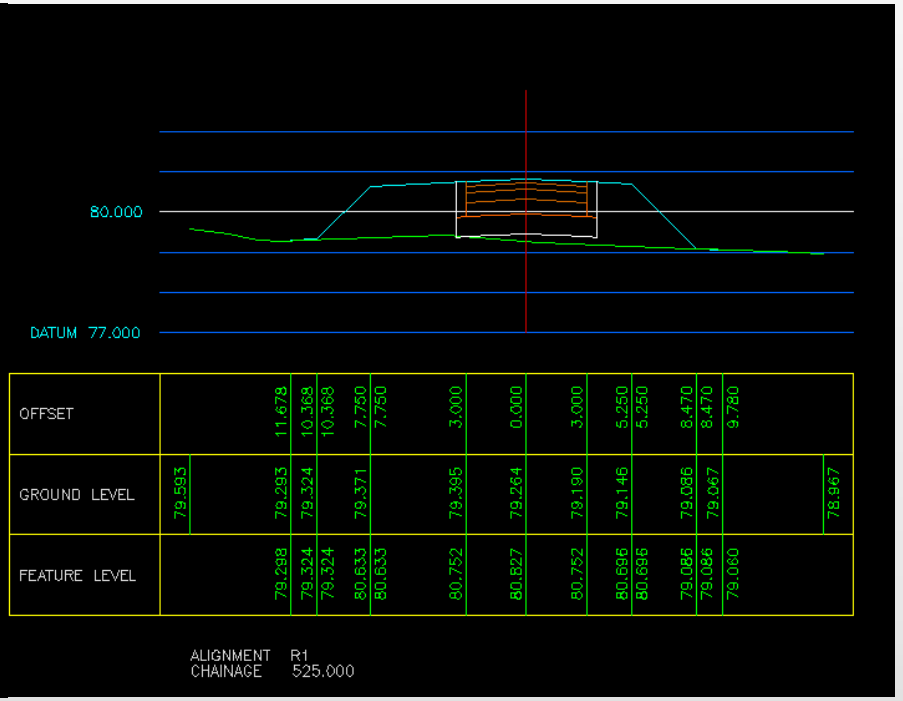
CH 325.00

CH 350.00

C

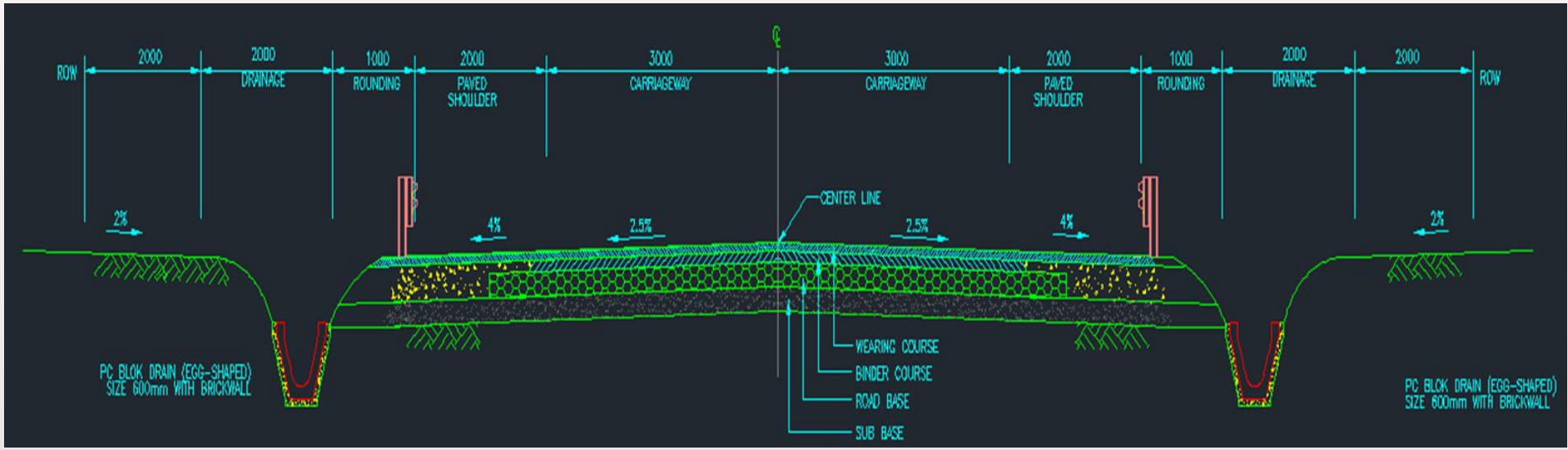


CH 500.00

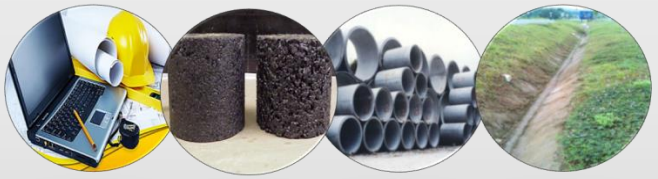


CH 525.00

TYPICAL ROAD CROSS SECTION



PAVEMENT



PAVEMENT

Surface type

- Selection of pavement type is determined by
  1) Volume & Composition of Traffic
  2) Soil characteristics
  3) Weather
  4) Availability of materials
  5) Maintenance
  6) Service life cost

- Structural design of pavement
  – ATJ 5/85 (Pindaan 2013)- Manual for the Structural Design of Flexible Pavement
  - Design Guide for Alternative Pavement Structures, Low-Volume Roads

PAVEMENT

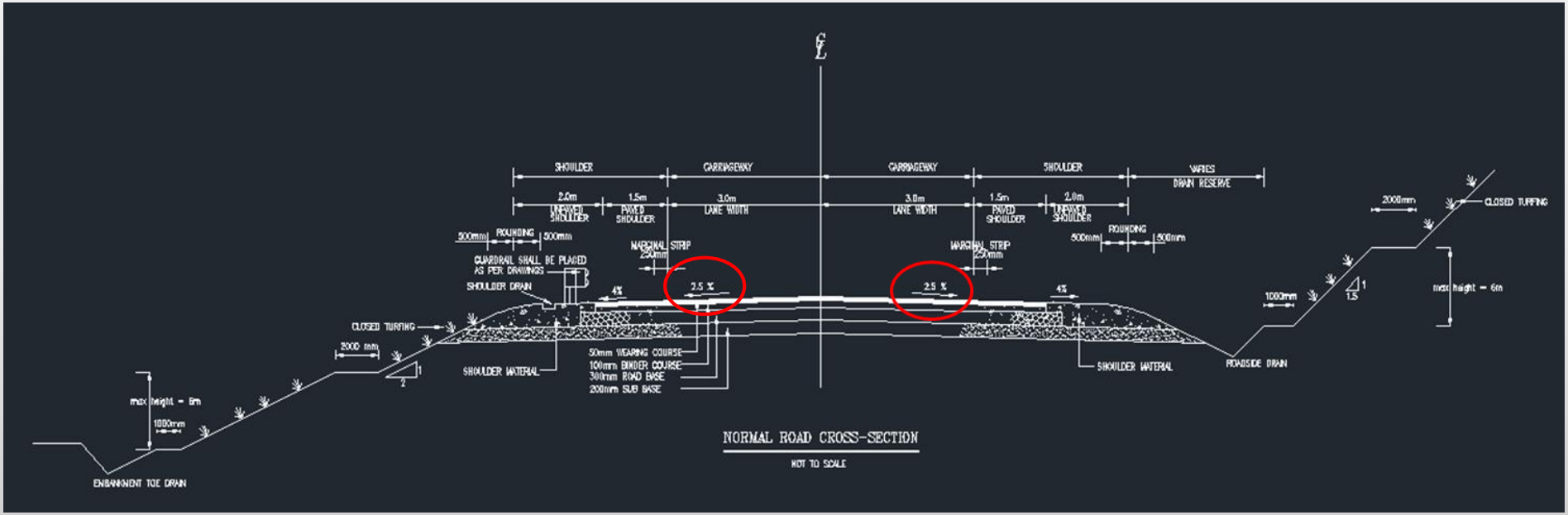
Design Standard	Description
R6 / U6	Asphaltic Concrete / Concrete / Specialty Mix
R5 / U5	Asphaltic Concrete / Concrete / Specialty Mix
R4 / U4	Asphaltic Concrete / Specialty Mix
R3 / U3	Concrete / Specialty Mix / Asphaltic Concrete
R2 / U2	Surface Treatment / Semigrout / Asphaltic Concrete
R1 / U1	Gravel / Surface Treatment

Table 5.1 ATJ 8/86 (Pindaan 2015) : Pavement Surface Type

PAVEMENT

Normal Cross Slope

- To minimize water ponding on flat sections
- To control the flow of water
- The range of cross slopes for various pavement types varies from 2.5% - 6.0%



PAVEMENT

Typical Flexible Pavement Structure

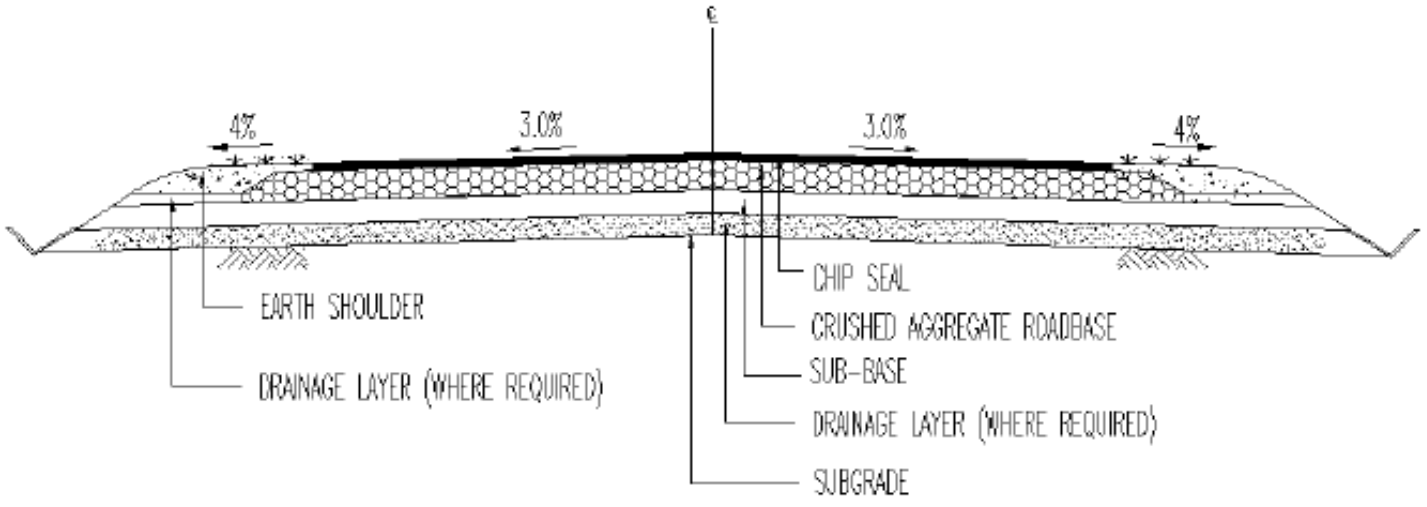


FIGURE 1.1: Single Carriageway – Minor (Low-Volume) Road

PAVEMENT

Typical Flexible Pavement Structure

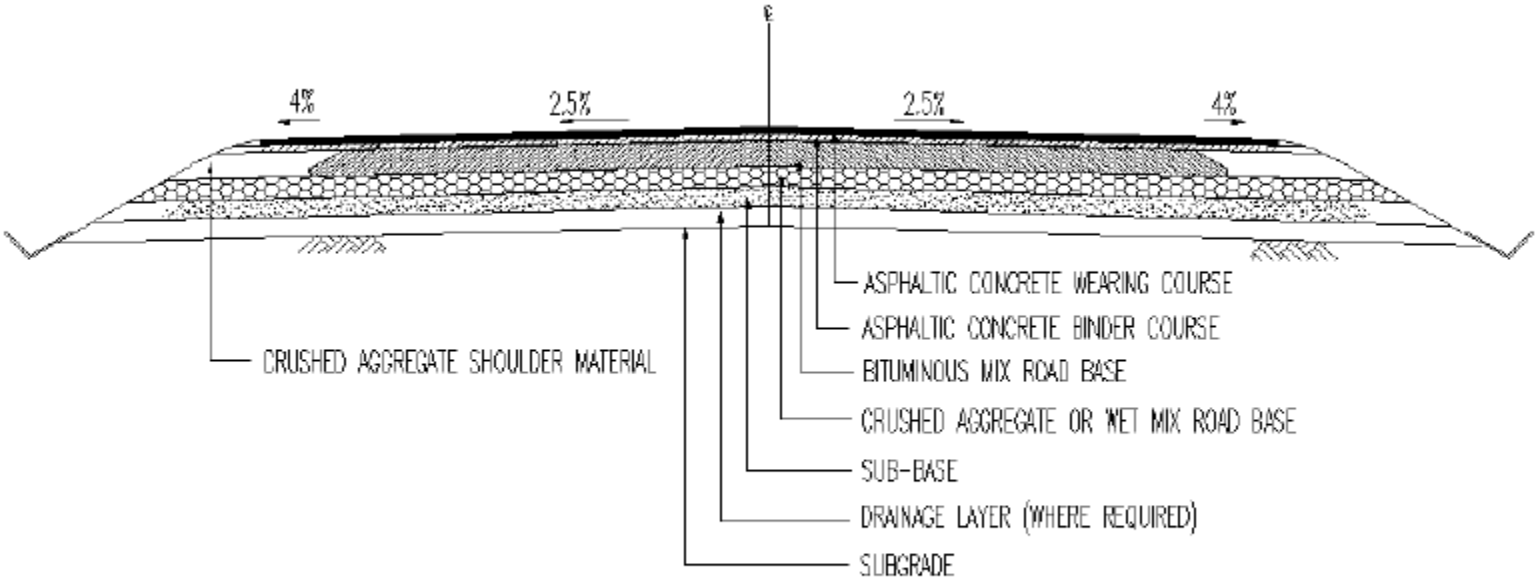
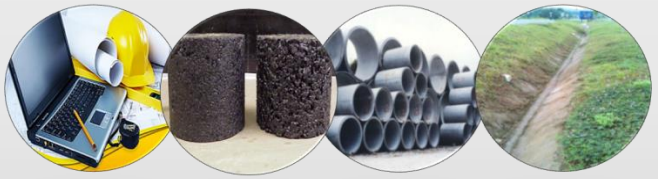


FIGURE 1.3: Dual Carriageway – Major Road

LANE WIDTHS & MARGINAL STRIP



LANE WIDTHS

- Important for safety & comfort of driving
- The capacity of road primarily depends on the number of traffic lanes and their width
- The lane width is determined by

  1. Size of vehicle
  2. Average Daily Traffic Volume of commercial vehicles
  3. Requirement for overtaking and passing

MARGINAL STRIP

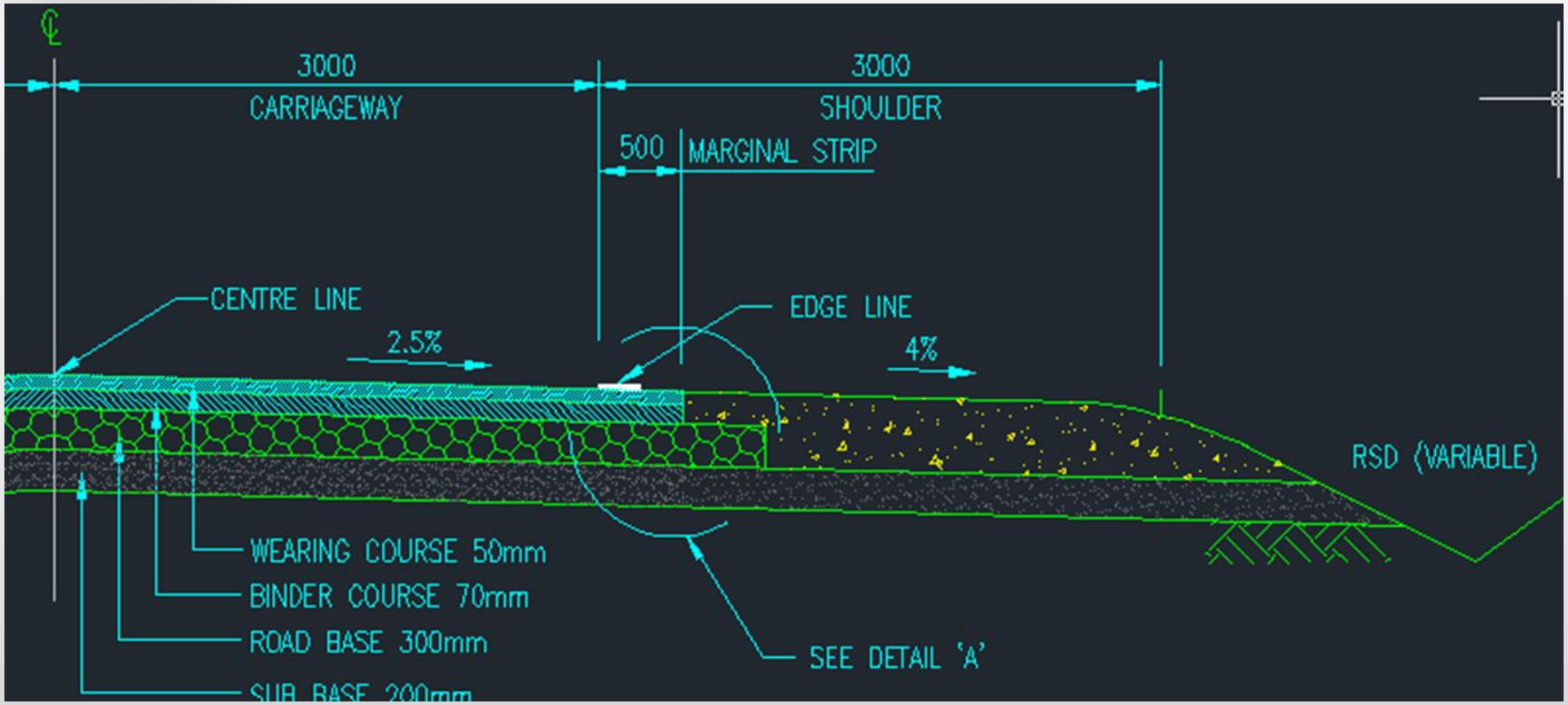
- Narrow pavement strip attached to both edges of a carriageway
- For divided roads, the marginal strips are provided on both sides of the carriageway in both directions

LANE WIDTHS & MARGINAL STRIP

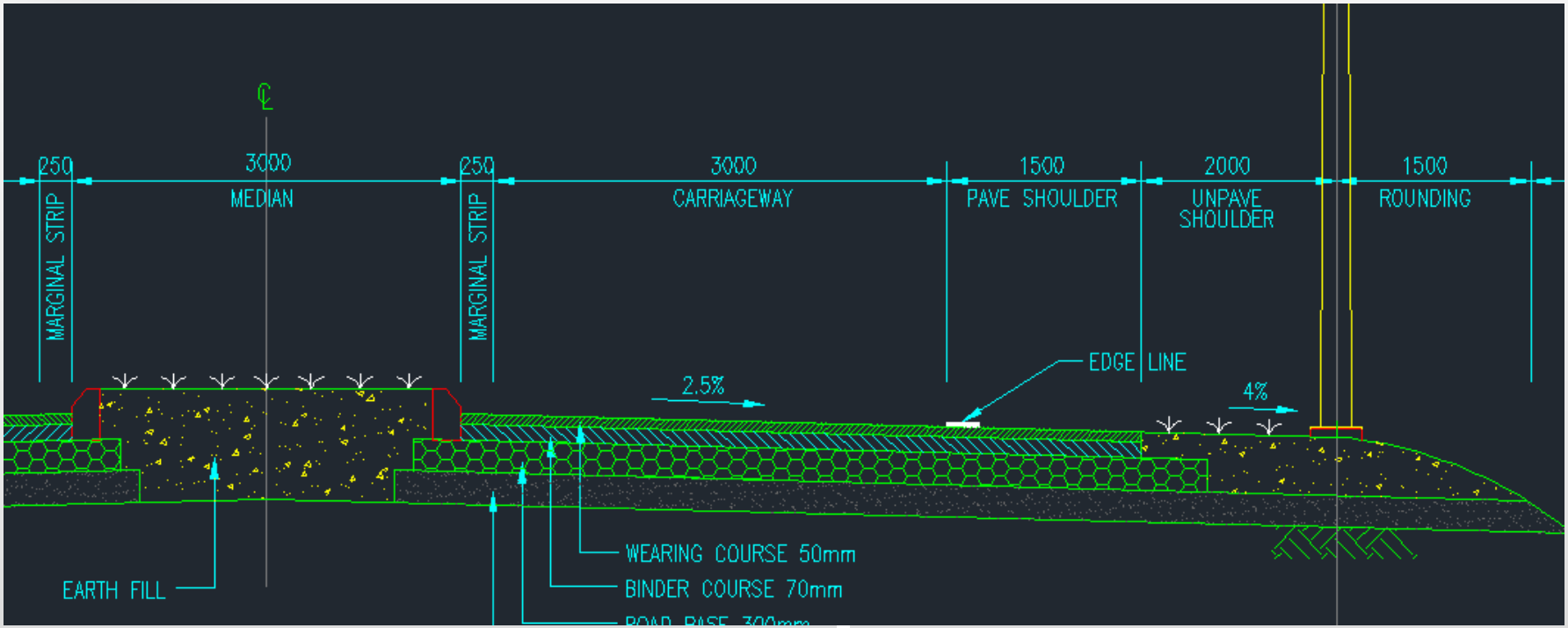
Design Standard	Lane Width (m)	Marginal Strip Width (m)
R6 / U6	3.65	0.50
R5 / U5	3.50	0.50
R4 / U4	3.50	0.25
R3 / U3	3.25	0.25
R2 / U2	3.00	0.25
R1 / U1	5.00 (total two-way)	0.00
Interchange Ramps Single lane Multilane Single lane loop	 4.50 3.50 4.50	 Lt 1.50 Rt 0.50 Lt 0.50 Rt 0.50 Lt 1.50 Rt 0.50

Table 5.2 ATJ 8/86 (Pindaan 2015) : Lane & Marginal Strip Widths

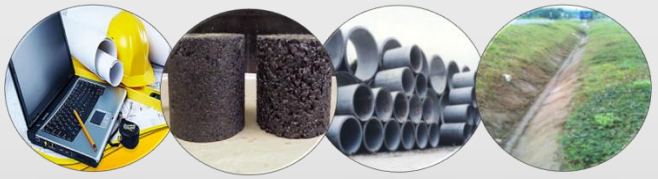
LANE WIDTHS & MARGINAL STRIP



LANE WIDTHS & MARGINAL STRIP



SHOULDERS



SHOULDERS

- The portion of the roadway continuous with the travelled way
- Functions:
  - for emergency stopping free of the traffic lane
  - for occasional motorist who desires to stop for various reason
  - to escape potential accident or reduce their severity
  - contribute to driving ease and comfort
  - improving safety (sight distance) in cut sections
  - improving highway capacity and encourage uniform speed
  - space for signs and guardrails
  - enhance structural support to the pavement

SHOULDERS

- Types of shoulders:
  - Paved : bituminous or concrete surface
  - Unpaved : crushed rock, earth or turf
- Width of shoulders (usable)

TABLE 5.3A: USABLE SHOULDER WIDTH (RURAL)

Design Standard	Usable Shoulder Width (m)		
	Terrain		
	Flat	Rolling	Mountainous
R6	3.00	3.00	2.50
R5	3.00	3.00	2.50
R4	3.00	3.00	2.00
R3	2.50	2.50	2.00
R2	2.00	2.00	1.50
R1	1.50	1.50	1.50

Source: REAM GL 2/2002: A Guide on Geometric Design of Roads, Table 5-3A

SHOULDERS

TABLE 5.3B: PAVED SHOULDER WIDTH (URBAN)

Design Standard	Paved Shoulder Width (m)		
	Area Type *		
	I	II **	III **
U6	3.00	3.00	2.50
U5	3.00	3.00	2.50
U4	3.00	2.50	2.00
U3	2.50	2.00	1.50
U2	2.00	1.50	1.50
U1	1.50	1.50	1.50

Source: REAM GL 2/2002: A Guide on Geometric Design of Roads, Table 5-3B

Notes:

* For Area Type definition, see Table 3-2B

** For Areas Type II & III, U1 to U4, shoulder may be replaced by sidewalk

SHOULDERS

TABLE 5.4: PAVED SHOULDER WIDTH (RURAL)

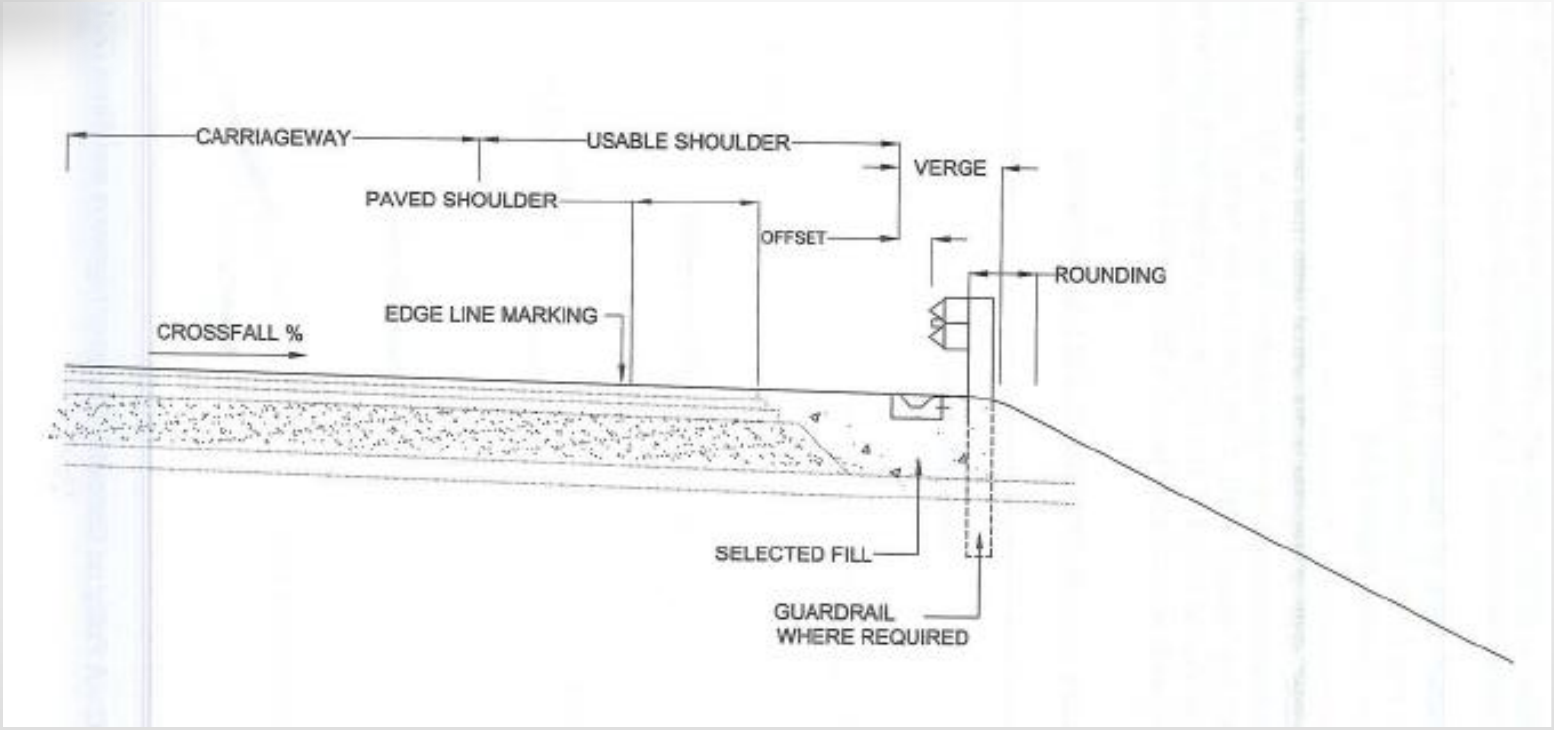
Design Standard	Paved Shoulder Width (m)
R6	2.5
R5	2.5
R4	1.5
R3	1.5

Note:

(i) For R5 & R6 in mountainous terrain, road shoulder should be paved even though minimum usable shoulder width might not be attainable.

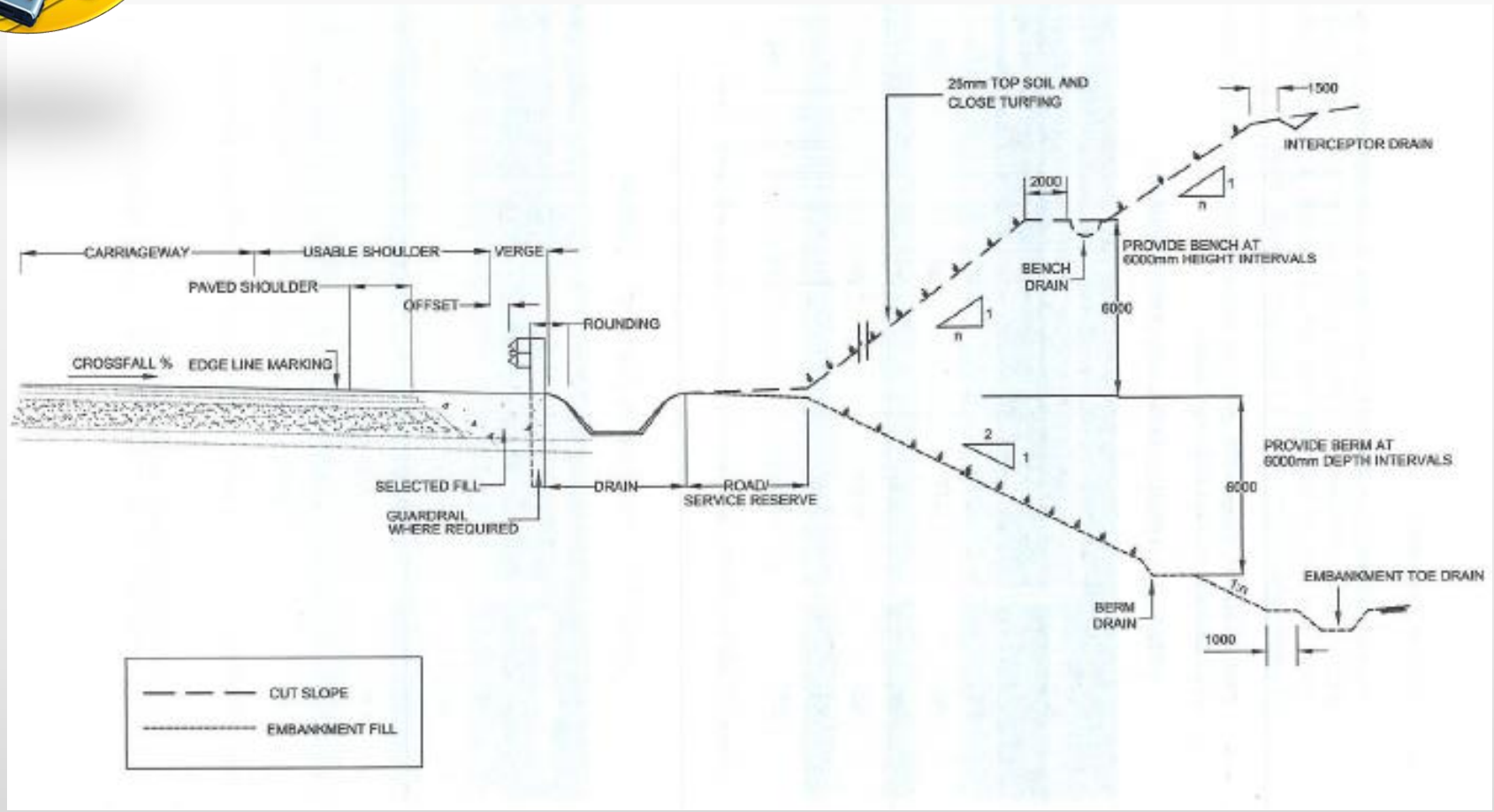
(ii)For R1 & R2, there is no requirement of minimum shoulder width to be paved.

SHOULDERS



Typical cross section of shoulder and verge

SHOULDERS



Typical road cross section of cut slope and embankment fill

SHOULDERS

Shoulder cross slopes

a) Should be sufficiently to rapidly drain surface water but not to the extent that vehicular use would be hazardous.

b) Bituminous / concrete surface shoulder : 2.5% - 6%

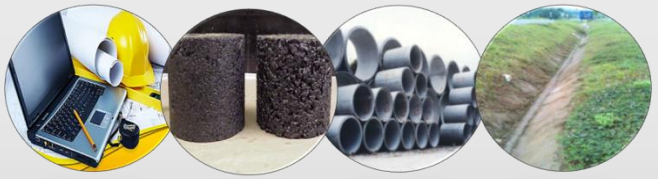
c) Gravel/crushed rock shoulder : 4% - 6%

d) Where kerbs are used on the outside of the shoulder – minimum cross slope should not be less then 4% to prevent water ponding on the roadway

Shoulder structure

The structure for paved shoulder should be similar as structure for the carriageway

KERBS



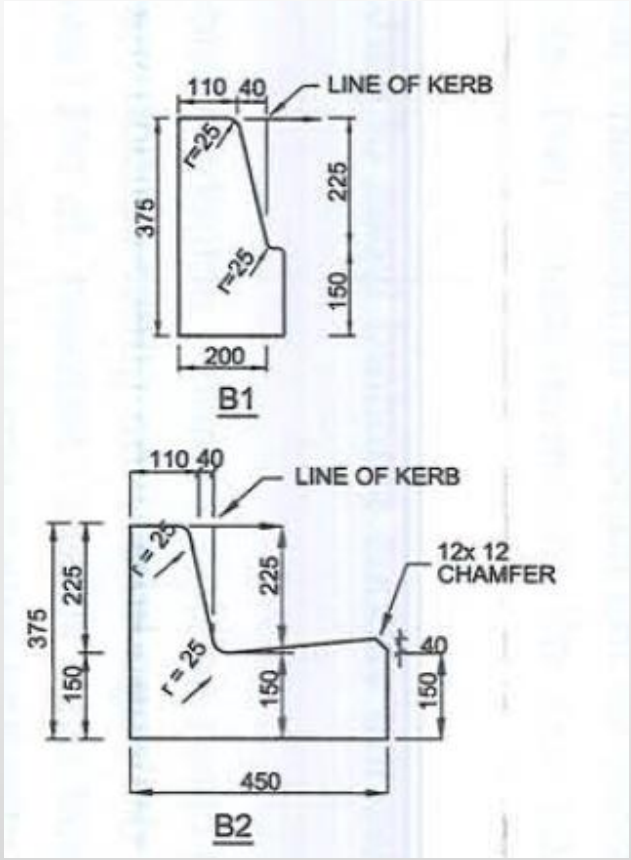
KERBS

- Functions:
  - Used for drainage control
  - Pavement delineation
  - Aesthetics
  - Delineation of pedestrian walkways
  - To assist in the orderly development of the roadside

- Mostly needed on roads in urban areas
- In rural areas, the use of kerbs should be avoided as far as possible except in localized areas which has predominant aspects of urban condition

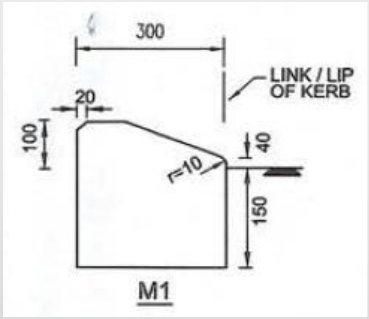
KERBS

- Barrier kerbs
  - High & steep faced
  - Designed to inhibit or discourage vehicles from leaving the roadway
  - Not to be used on expressways
  - Not to be used where the speed > 70km/hr
  - Recommended for use in built-up areas adjacent to footpaths

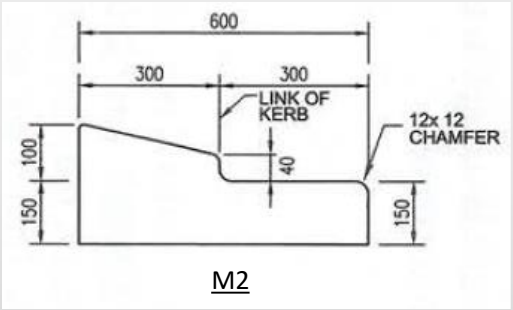


KERBS

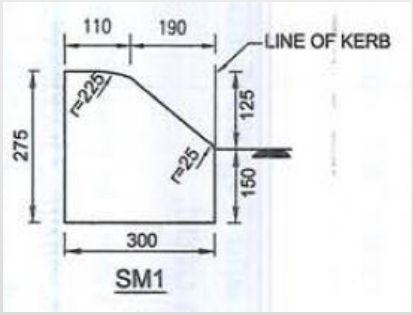
- Mountable / Semi-mountable kerbs
  - allow vehicles to cross over and park clear of carriageway
  - for delineation and drainage on all intersections
  - suitable for all roads including expressways (SM)



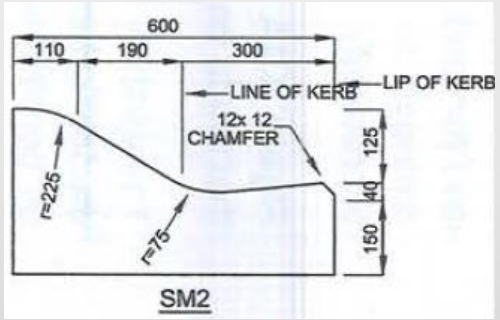
M1



M2



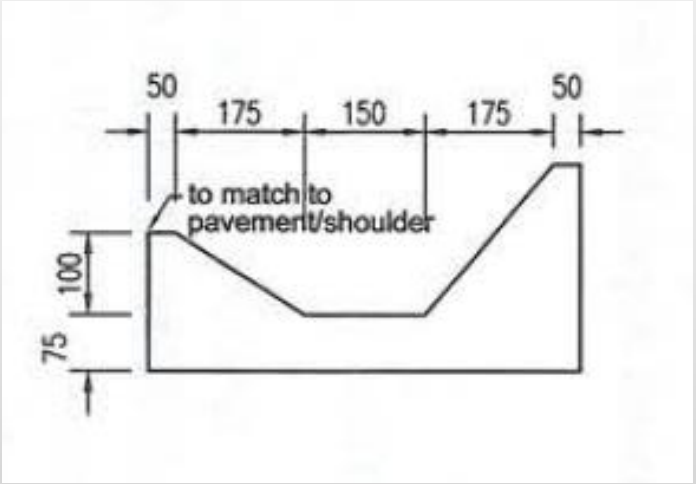
SM1



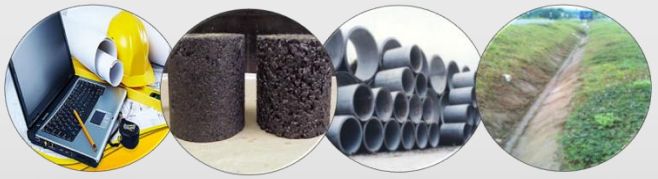
SM2

KERBS

- Channel kerbs
  - used where surface runoff is considerably large
  - used on embankment along the paved shoulder immediately in front of barrier (guardrail/NJB)



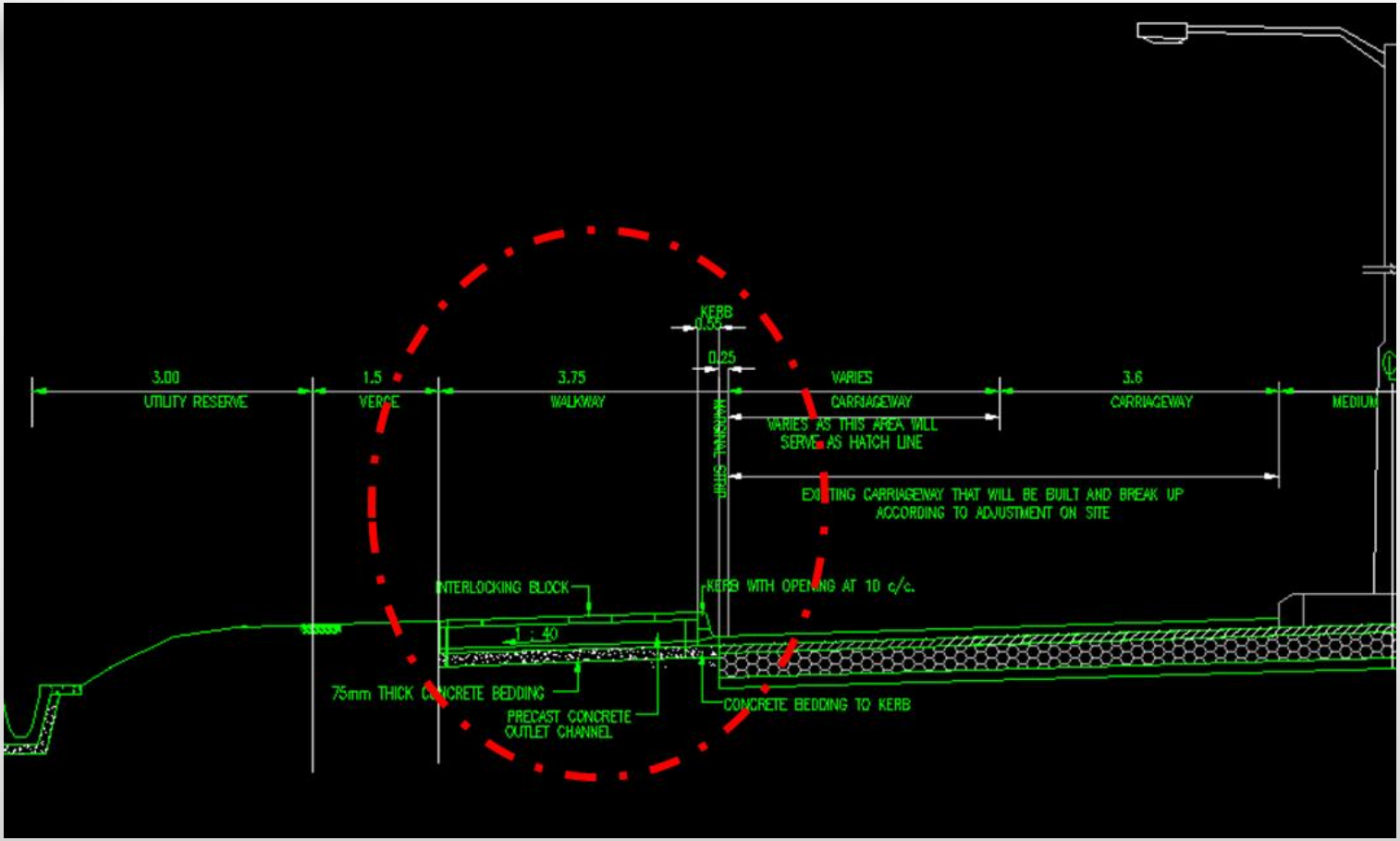
SIDEWALK



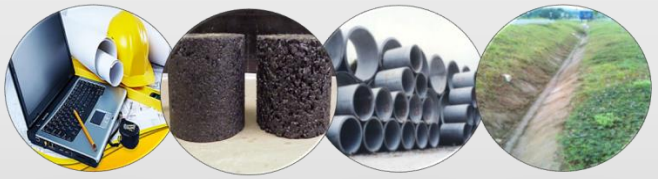
SIDEWALK

- No numerical warrants, justification depends on vehicle-pedestrian hazard (volume of pedestrian, vehicular traffic, timing and speed)
- Urban areas; adjacent to the kerb, raised above pavement or in absence of kerb, a strip (safety barriers or hedges/trees) with a minimum width of 1.0 m separating sidewalk and travelled way
- Rural areas; well away from travelled way and separated from shoulder by at least 1.0 m
- Desirable width 2.0 m; Minimum 1.50 m (restrictions on right of way)
- Must have all-weather surface

SIDEWALK


KERB
0.50
0.25
3.00
UTILITY RESERVE
1.5
VERGE
3.75
WALKWAY
VARIES
CARRIAGEWAY
3.6
CARRIAGEWAY
MEDIUM
MASONAL STRIP
VARIES AS THIS AREA WILL SERVE AS HATCH LINE
EXISTING CARRIAGEWAY THAT WILL BE BUILT AND BREAK UP ACCORDING TO ADJUSTMENT ON SITE
INTERLOCKING BLOCK
KERB WITH OPENING AT 10 c/c.
1:40
75mm THICK CONCRETE BEDDING
PRECAST CONCRETE OUTLET CHANNEL
CONCRETE BEDDING TO KERB

MEDIAN



MEDIAN

- Desirable on roads with four or more lanes
- Function:
  - to provide the desired freedom from the interference of opposing traffic
  - to provide a recovery area for out-of-control vehicles
  - to provide for speed changes and storage of right turning & u-turning vehicles
  - to provide for future lanes
- Should be highly visible both night & day

MEDIAN

TABLE 5.5A: MEDIAN WIDTH AND TYPES (RURAL)

Design Standard	Median Width (m)						Median Type
	Terrain						
	Flat		Rolling		Mountainous		
	Min.	Des.	Min.	Des.	Min.	Des.	
R6	4.0	10.0	4.0	10.0	4.0	10.0	B,C,E,F
R5	4.0	6.0	3.0	5.0	2.0	4.0	E,F
R4	3.0	5.0	2.0	4.0	1.5	3.0	E,F

Source: Adapted from REAM GL 2/2002: A Guide on Geometric Design of Roads, Table 5-5A

Note:
Min. - Minimum
Des. - Desirable (for consideration of landscaping or other aesthetic features)

MEDIAN

TABLE 5.5B: MEDIAN WIDTH AND TYPES (URBAN)

Design Standard	Median Width (m) Area Type I		Area Type II		Area Type III		Median Type
	Min.	Des.	Min.	Des.	Min.	Des.	
U6	4.0	9.0	3.5	6.0	2.0	4.0	B,C,E,F
U5	3.0	6.5	2.5	4.0	2.0	3.0	B,C,E
U4	2.5	5.0	2.0	3.0	1.5	2.0	A,B,C,D
U3	2.0	4.0	1.5	2.0	1.5	2.0	A,B,D

Source: Adapted from REAM GL 2/2002: A Guide on Geometric Design of Roads, Table 5-5B

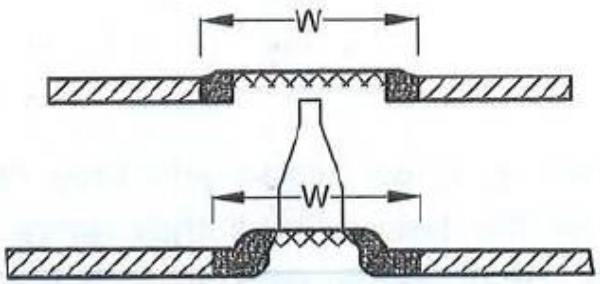
Note:

Min. - Minimum

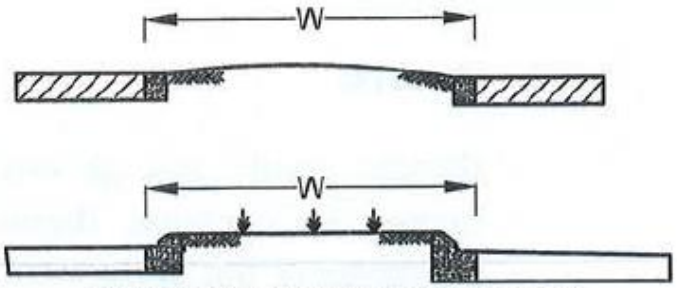
Des. - Desirable (for consideration of landscaping or other aesthetic features)

MEDIAN

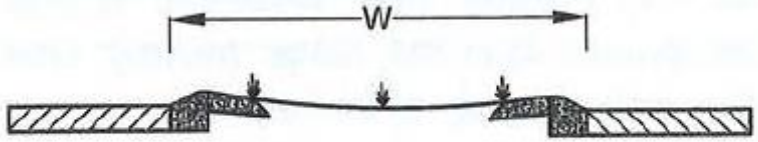
A) KERBED (TYPE A,B & C)



KERBED AND CROWNED PAVED
TYPE A



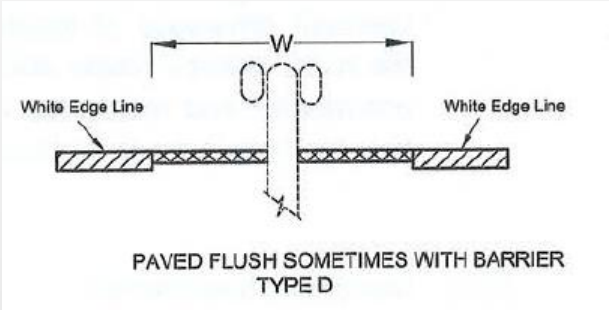
KERBED AND CROWNED TURF COVER
TYPE B



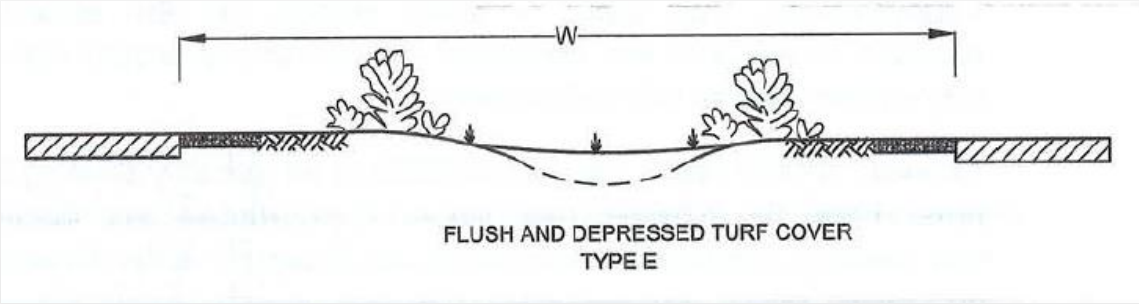
KERBED AND DEPRESSED TURF COVER
TYPE C

MEDIAN

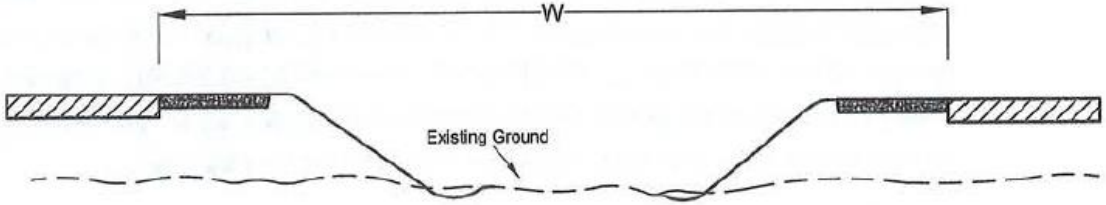
B) NON KERBED (TYPE D,E & F)



PAVED FLUSH SOMETIMES WITH BARRIER
TYPE D



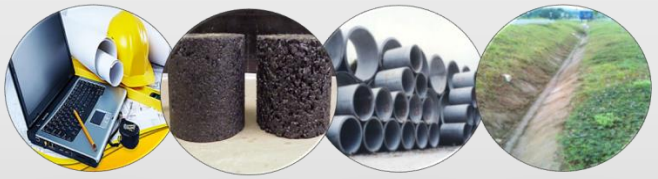
FLUSH AND DEPRESSED TURF COVER
TYPE E



SEPARATE ROADWAYS NATURAL GROUND MEDIAN
TYPE F

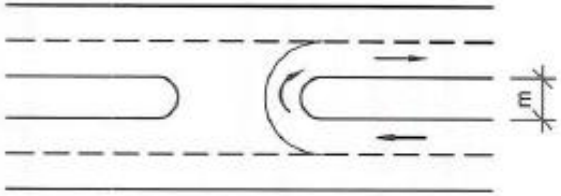
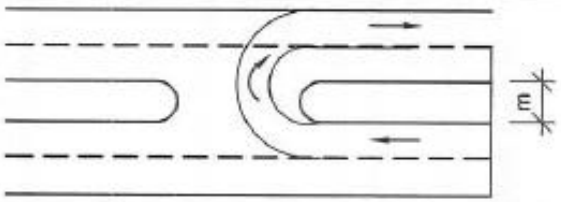
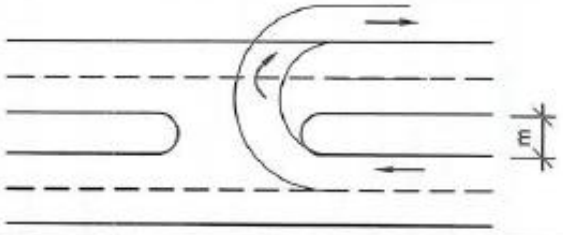
W = Width of median

U-TURNS

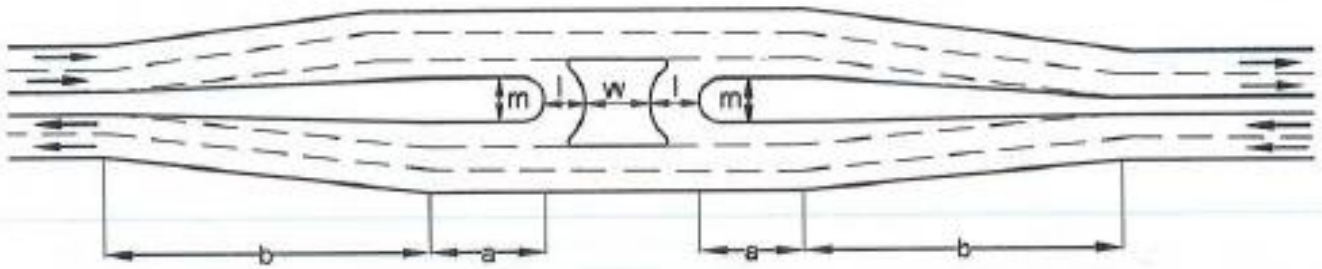


U-TURNS

- Direct u-turns

TYPE OF MANEUVER		MINIMUM WIDTH OF MEDIAN - (m) METRE FOR DESIGN VEHICLE		
		P	SU	WB-15
INNER LANE TO INNER LANE		9.75	19.50	21.25
INNER LANE TO OUTER LANE		6.00	15.75	17.75
INNER LANE TO SHOULDER		3.00	12.75	14.50

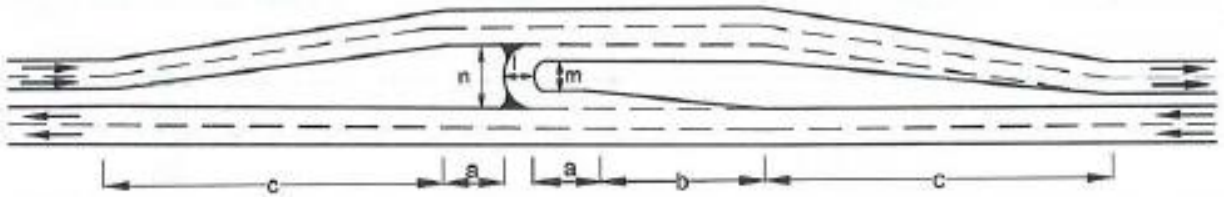
U-TURNS



DIMENSION	MINIMUM DISTANCE (m)
m	10.0
l	7.5
w	10.0
a	20.0
b	60.0

FIGURE 5-7A: RECOMMENDED LAYOUT FOR DIRECT U-TURN (LOW SPEEDS)

U-TURNS

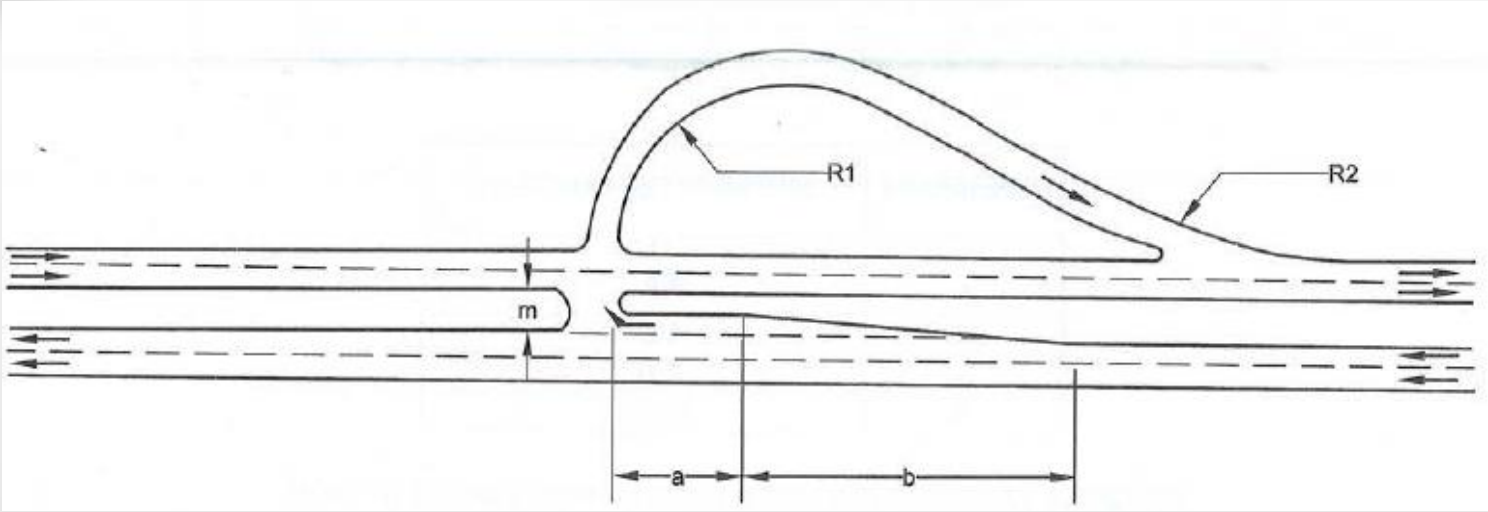


DIMENSION	MINIMUM WIDTH / DISTANCE (m)
a	20
b	60
c	120
l	7.5
m	10.0
n	17.0

FIGURE 5-7B: RECOMMENDED LAYOUT FOR DIRECT U-TURN (HIGH SPEEDS)

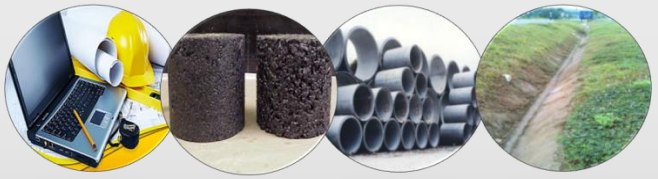
U-TURNS

- Indirect u-turns



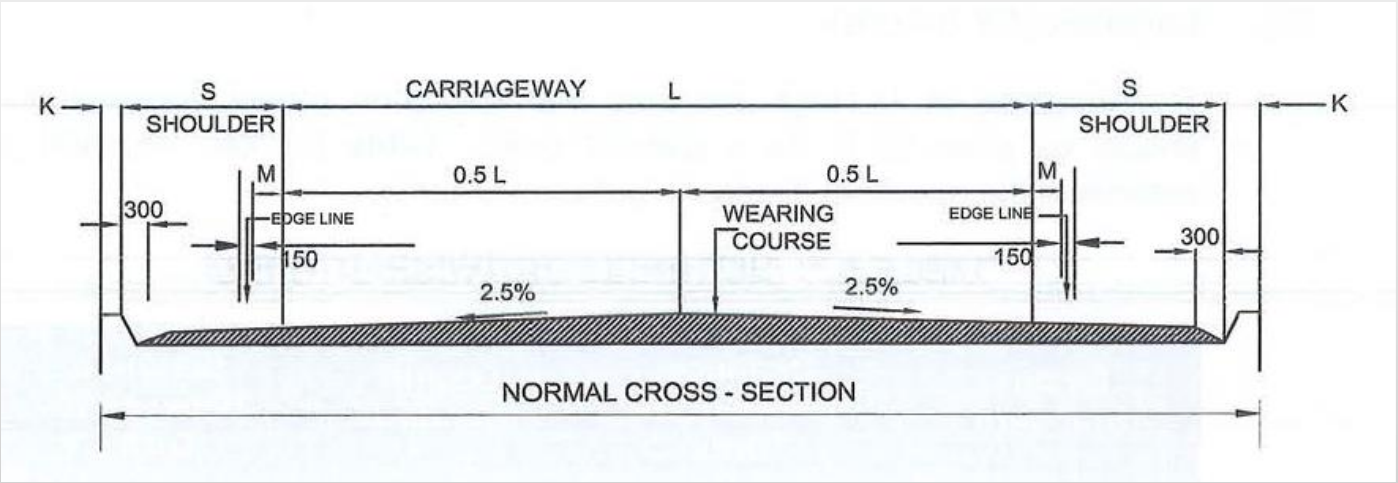
DIMENSION	MINIMUM DISTANCE (m)	DIMENSION	MINIMUM DISTANCE (m)
m	4	R1	50
l	8	R2	100
a	20	b	60

BRIDGE & STRUCTURE CROSS SECTION

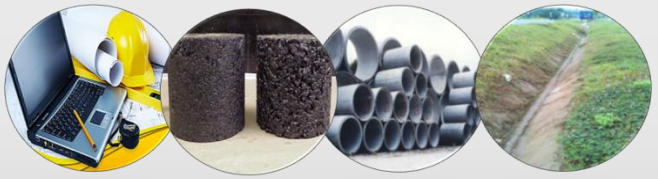


BRIDGE & STRUCTURE CROSS SECTION

- The width of the shoulder should be the same as that of the carriageway
- Required clearance:
  - vertical height clearance minimum 5.4 m.
  - recommended additional 0.1 m to be allowed for future resurfacing.
  - whenever resurfacing will reduce the clearance to less than 5.4 m, milling will be required to maintain the minimum clearance.



BUS LAY-BYS



BUS LAY-BYS

- Serve to remove bus from through traffic lanes
- Locations:
  - Not to be located on any interchange ramps or structures, slip roads or within 60m of any junction or intersection
  - Distance between lay-bys > 150m
- Layout

THANK YOU