Detailed Project Report

Development of Four/Six-lane Access Control Expressway from Design Chainage Km 515.000 to Km 528.300 (Kunjwani to Sidhra Section of NH-44) and from Design Chainage Km 550.900 to Km 566.520 (Domel to Katra Section) on Hybrid Annuity Mode under Bharatmala Pariyojna in the UT of J&K.

(Package-17)

PROJECT REPORT

January - 2022

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1. PROJECT REPORT

1.1 PROJECT BACKGROUND

The National Highways Authority of India (NHAI) has been constituted through an Act of Parliament for faster, economical and quality Road Construction work throughout India. NHAI aims at provisioning and maintaining the national highways network to meet user expectations in the most time-bound and cost-effective manner within the strategic policy framework. The National Highways Authority of India (NHAI) is the nodal agency of Ministry of Road Transport and Highways (MORT&H), Government of India and has been entrusted with the Development of Delhi - Ludhiana - Amritsar – Katra Expressway having an approximate length of 600 Km including spurs through BOT & EPC basis.

As part of the development, MoRT&H entrusted NHAI with engagement of a Consultant to carry out the “Consultancy services for Preparation of DPR for Development of Delhi - Amritsar – Katra Expressway having an approximate length of 600 Km including spurs” for project transaction preparation. NHAI through competitive bidding has appointed M/s. Feedback Infra Private Limited for providing the required consultancy services and issued letter of Commencement of Services vide their letter No.: NHAI/Punjab/ CC/ N-1/109706 dated 11.12.2017.

The Delhi - Amritsar – Katra expressway has been referred to as the Project Highway in this Report. The Project Highway starts from Kundli Manesar Palwal Expressway (KMP) in National Capital Region (NCR) and ends at Katra in Jammu & Kashmir. As phase I development, Delhi to Gurdaspur (397.7 km) has been considered the entire Greenfield Alignment passes through following Districts namely Jhajjar, Jind, Kaithal, Karnal, Rohtak, Sonipat of Haryana and Sangrur, Patiala, Ludhiana, Kapurthala, Jalandhar and Gurdaspur of Punjab. As Phase 2 development, Gurdaspur to Katra has been considered. The Project Highway starts at Ch. 397.700 and ends at Ch. 566.520, the total length of the Project Highway is 168.82 Kms.

Presently Delhi – Amritsar – Katra is connected by two different routes:

- Delhi to Katra via Panipat-Jhalandar-Pathankot-Jammu (NH44)
- Delhi to Katra via Jind - sangrur - Amritsar - Pathankot – Jammu (NH-352 & 52)

The present project report pertains to Package 17 of Phase 2 in most of the stretch is brownfield section and partial length of greenfield section. The six/four lane access-controlled expressway from Kunjwani to Sidhra section (Km 515+000 to km 528+300) and Domel to Katra section (km 550+900 to km 566+520) in the state of UT of J&K.

1.2 PROJECT CORRIDOR

The project corridor is divided into two sections.
Section-1: The start from Kunjwani near Maharaja Gulab Singh Chowk at km 515+000 and ends near Sidhra Junction at Km 528+300.
Section-2: The start from Domel at km 550+900 and ends in Katra at Km 566+520 along the approved alignments by the NHAI/ MoRT&H.
Key plan of the project highway is shown in figure below:

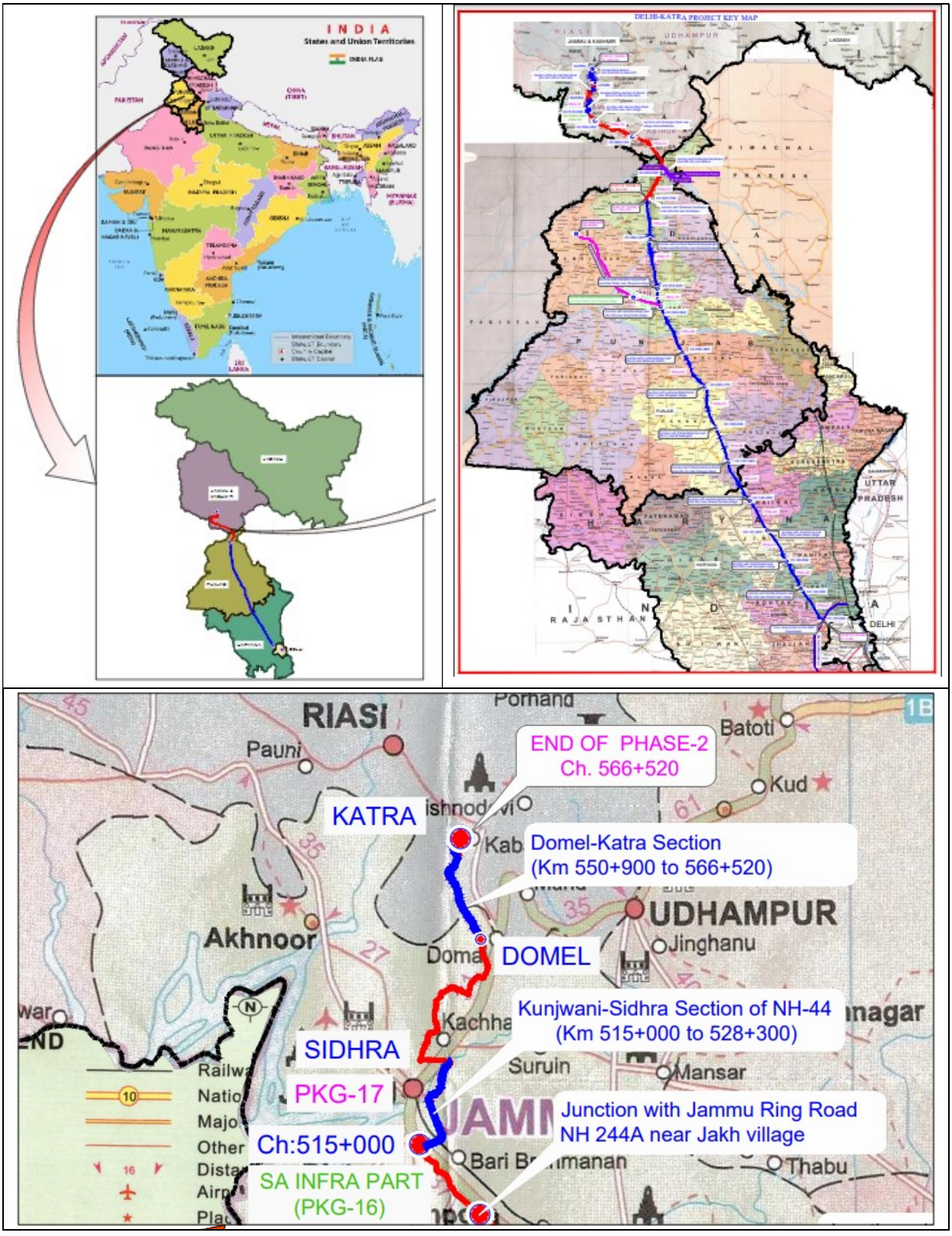


Figure 1.1: Key Plan of the Project Highway

1.3 ENVIRONMENT FEATURES OF PROPOSED PROJECT HIGHWAY

Land Use and Administrative Set-up

The land use pattern of 10 Km either side of the project alignment is mainly agricultural and human habitation, besides some Reserved Forest areas, Conservation Reserve and Wild Life Sanctuary.

Project section is passing through Jammu and Riasi district in the UT of Jammu & Kashmir. Extent of the alignment length under Package XVII across the districts is presented in Table below.

Table 1.1: List of Districts and Talukas along the Project Highway Package XVII

Sl. No.	State / UT	Name of District	Name of Taluka	Approx. Length in Km
1	UT of Jammu & Kashmir	Jammu	Bahu, Jammu, Nagrota, Dansal	14.950
2		Riasi	Katra	13.970
			Total length (Km)	28.920

Details of various environmental clearances applicable for the project package are presented below.

- Environment Clearance: Project Package is the part of Delhi-Amritsar-Katra Expressway in the state UT of Jammu and Kashmir. Project is widening and improvement of existing National Highway, with additional right of way or land acquisition less than 40m on existing alignment and 60 m on re-alignments or by-passes. Hence, as per conditions of EIA Notification 2006 and its subsequent amendments, Environmental Clearance is not applicable for the project package XVII.

- Wildlife Clearance: The package fall within notified Wildlife Sanctuary i.e Ramnagar WLS and Bahu Conservation Reserve within 10km. Therefore, wildlife clearance is applicable for the project Package XVII application is already submitted to MoEF&CC portal.

- Forest Clearance: Under UT of Jammu & Kashmir, block plantations are declared as Reserved Forest. Thus, Forest Clearance shall be applicable due to widening of existing roads in Jammu & Kashmir UT. NHAI shall obtain the clearance before the start of the construction works. Details of protected forest getting affected in Jammu & Kashmir UT under Package XVII are tabulated below.

Table 1.2: Affected Protected Forest Land in UT of J&K

Design Chainage (Km)		Length in km	Forest Division	Proposed diversion of RF (m2)	Proposed diversion of PF (ha)
From	To				
521+800	523+239	1.439	Jammu	27979.8	2.8
523+239	523+793	0.554	Jammu	5718.5	0.6
523+793	524+828	1.035	Jammu	13447.7	1.3
524+828	526+418	1.59	Jammu	6904.4	0.7
526+418	527+712	1.294	Jammu	3762.5	0.4
527+712	528+300	0.588	Jammu	4461.1	0.4
552+116	553+055	0.939	Riasi	3506.1	0.4
552+500	552+537	0.037	Riasi	0.0	0.0

Design Chainage (Km)		Length in km	Forest Division	Proposed diversion of RF (m2)	Proposed diversion of PF (ha)
From	To				
552+908	555+590	2.682	Riasi	78666.4	7.9
555+590	556+836	1.246	Riasi	35326.9	3.5
556+836	557+950	1.114	Riasi	14096.4	1.4
557+870	561+894	4.024	Riasi	68571.7	6.9
560+979	561+463	0.484	Riasi	13057.3	1.3
Total Forest Area in Ha.					27.5

Other than the above clearances obtained by NHAI, the contractor too shall have to procure and obtain a number of other clearances, permissions and NOCs for the project, before the start of construction works. These are:

- Prior Environmental Clearance from MoEF&CC / SEIAA for mining of sand and aggregate quarries, if new mines opened by the Contractor
- Conversion of land use, from the State revenue department for setting camps and plants
- Approval of Monitoring Consultant / Supervision Consultant / Authority Engineer for location and layout of Camps & plants before start of Construction
- NOC and Consents under Air & Water Acts for establishing and operating the construction plants including but not limited to hot mix plants, WMM, crushers etc. from State Pollution Control Board
- Prior permission for felling of trees from Forest dept. / District Authorities
- NOC under the Hazardous and Other Wastes (Management and Trans-boundary Movement) Rules, 2016 from SPCB
- PUC certificate for use of vehicles for construction from Transport department
- NOC for water extraction for construction and allied works from Irrigation department
- Approval of Monitoring Consultant / Supervision Consultant / Authority Engineer for Traffic Management Plan before start of Construction
- Approval of Monitoring Consultant / Supervision Consultant / Authority Engineer for the Emergency Action Plan for accidents responding to involving fuel & lubricants before the construction starts.

1.4 INDICATIVE DESIGN STANDARDS and SPECIFICATIONS

1.4.1 General

The postulates and considerations for designing the Greenfield eight lane Highway are as follows:

- The Highway will be designed as a fully access-controlled high-speed ed facility.
- The Highway will be designed for six/four-lane divided configuration.
- The Highway will be provided with modern road furniture and traffic information systems for the safe, convenient, and fast movement of vehicles.
- The roadsides will be made aesthetically pleasing through suitable planting of trees, shrubs, etc. Wayside amenities to provide rest, food, fuel, repair facilities etc. at periodic intervals for the convenience of the traveling public and truck drivers will also be a part of the project.
- Traffic safety will be in-built in the design process itself, and all the accident prevention measures will be taken.

The formulation of the design standards is required in order to avoid any inconsistency in design from one section to the other and provide desired level of service and safety. For this project it is proposed to follow Design Standards given in IRC codes, guidelines and special publications, and MORTH circulars as applicable to National Highways. The project corridor is eight lane Greenfield Highway and is to be designed as per standards and specifications of IRC SP 99-2013. Where the said standards are silent the following standards shall be referenced and the one considered the best and most relevant adopted:

- American Association of State Highway and Transport Officials (AASHTO) standards
- British Standards
- Any other National or International Standard as considered suitable.

1.4.2 Classification of Design Standards for Geometrics of Highway

The project highway shall follow the design standards mentioned below.

Design Speed

The design speeds given in table below are adopted for various terrain classifications.

Table 1.3: Design Speed

Nature of Terrain	Cross Slope of Ground	Design Speed (KMPH)
		Ruling
Plain and Rolling Terrain	Up to 25%	100 Kmph
Mountainous Terrain	More than 25%	80 Kmph

The project corridor passes through rolling and mountainous terrain. The adopted design speed is 100 Kmph for rolling terrain and 80 kmph for mountainous terrain for the Greenfield/Brownfield Section.

Right of Way

The recommended minimum Right of Way is given in table below.

Table 1.4: Recommended Minimum Right of Way

Section	Right of Way (ROW)
Rural Section	60 m
Urban Section	60-30 m
Forest Area	60-30 m

At interchanges, toll booth, highway amenities, connecting roads additional land shall be required as mentioned in drawings volume. The co-ordinates for the LA shall be provided separately as **Annexure 1**.

Lane Width of Carriageway

The standard lane width of the Project Corridor is 3.750 m. Project Corridor shall have three lanes in each direction of traffic in Jammu town section and two lanes in each direction of traffic in the remaining section.

Median

The median shall be depressed and recommended width of median including shyness is 12m in Greenfield section and at Bridge and ROB sections in Greenfield sections a median width of 4.5m is proposed. In Brownfield sections 4.5m wide median is proposed and at elevated expressway location a median width of 2.5m is proposed. Other specifications for the median are mentioned below:

- The depressed median has suitably designed and provision of rainwater harvesting system at suitable intervals for effective drainage of surface runoff from the median.
- An edge strip of 0.75m width of depressed median adjacent to carriageway in either direction shall be paved with same specifications as of the adjacent carriageway.
- As far as possible, the median shall be of uniform width for the Project road. However, where changes are unavoidable, a transition of 1 in 50 is to be provided.
- Median is to be well planted to cutoff the glare coming from the vehicle traveling in opposite directions.
- In Median longitudinal gradient is designed in such a way that the water flow away from SVUP, LVUP VUP median. Median drains shall be terminated well before these structures with effective drainage arrangement.
- At VUP, SVUP, LVUP and Bridge location, median wall is eliminated and slope of 1:6 is provided; in place of median wall pitching and toe wall is to be provided.

Shoulders

The shoulders on the outer side (left side of carriageway) shall be 3 m wide paved plus 2 m wide earthen as per Section 2, Clause 2.6 of SP 99. The shoulder composition shall be as below;

- The composition and specification of the paved shoulder shall be same as that of the main carriageway.
- The earthen shoulder shall be provided with 200 mm thick layer of non-erodible/granular material for protection against erosion.

Barriers

Thrie -beam crash barrier has been provided throughout the project corridor except at structure locations. At culverts parapet wall has been provided and at SVUP/LVUP /VUP/FO/ RoB concrete crash barrier has been provided.

Design of Horizontal/Vertical Alignment

The general principles and design criteria laid down in relevant IRC & MORTH guidelines have been followed in conjunction with the relevant circulars. The following latest code of standards & technical specifications has been used for the alignment design;

Table 1.5: Summary of Code of Standards & Technical Specifications

Publication	Issued by
IRC:38- – Guidelines for Design of Horizontal Curves	Indian Road Congress (IRC)
IRC:SP:23- Vertical Curves for Highway	Indian Road Congress (IRC)
IRC: 92- Guidelines for Design of Interchanges in Urban Areas	Indian Road Congress (IRC)
IRC:SP:99 - Manual of specifications and standards for expressways	Indian Road Congress (IRC)

The Project corridor is designed as per IRC SP 99 Guidelines. Few parameters have been considered based on MOM such as width of ROW, median width, rain water harvesting in medians and boundary wall on RoW edge at a spacing of 500m.

Horizontal Alignment

Alignment is fluent and is blended with the topography. The horizontal curves have been designed as per IRC 38 requirement.

Radii of horizontal Curves

The desirable minimum radii of horizontal curves are given below;

Table 1.6: Minimum Radii of horizontal Curves

Design Parameters	Radii (m)		
Design Speed (Km/h)	120	100	80
Absolute Minimum Radius (m)	670	440	260
Desirable Minimum Radius (m)	1000	700	400

Transition Curves

Properly designed transition curves are provided at both ends of the circular curve. The minimum length of transition curves is designed for 120 / 100 Kmph as per IRC: 38 (latest).

Sight Distance

The desirable minimum sight distance for 6 lane divided carriageway for 120 /100/80 Kmph design speed is given in below table. An Intermediate sight distance has been provided throughout as per Section 2 clause 2.9.3 of IRC SP 99.

Table 1.7: Safe sight Distance

Design Speed (Kmph)	Safe Stopping Sight Distance (m)	Desirable Minimum Sight Distance (m) (Intermediate Sight distance)
120	250	500
100	180	360
80	120	240

Vertical Alignment

The vertical alignment should provide for a smooth longitudinal profile. Grade changes are not too frequent to cause kinks and visual discontinuities in the profile.

The vertical design, especially at grade change location, such as VUP/LVUP, ROB, bridge locations Intermediate sight distance (ISD) is adopted as per IRC SP 23. Length of approaches is also designed with ISD only.

Gradients

The ruling gradients for plain terrain has been adopted everywhere in the project highway as per section 2, clause 2.9.4.2 of IRC SP 99 latest revision.

Table 1.8: Gradients

Terrain	Ruling Gradient
Plain	2.50%
Rolling	3%

In cut sections, minimum gradient for drainage considerations is 0.5 percent (1 in 200) if the side drains are lined; and 1.0 percent (1 in 100) if this are unlined. Ruling gradient is adopted to design vertical alignment.

Vertical Curves

The vertical alignment should provide for a smooth longitudinal profile; kinks and visual discontinuities in the profile should be avoided as far as possible.
The vertical design at grade change location, such as VUP/LVUP, ROB, bridge locations Intermediate sight distance (ISD) is adopted. The minimum grade change requiring vertical curve and minimum length of vertical curve as per IRC SP 23 is as follows:

Table 1.9: Minimum Length of Vertical curve

Design speed (Km/h)	Minimum Grade change Requiring Vertical curve	Minimum Length of Vertical Curve (m)	K value for Hog Curve (ISD)	K value for Sag Curve
120	0.5%	100	261	61
100	0.5%	85	135	41.5
80	0.6%	70	60	25.3

1.4.3 Coordination of Horizontal and Vertical alignment

The overall appearance of project road is enhanced considerably by judicious combination of the horizontal and vertical alignments. Plan and profile of the road shall not be designed independently but in unison, so as to produce an appropriate three-dimensional effect. Proper co-ordination in this respect will ensure safety, avoid visual discontinuities and contribute to overall aesthetics.

Vertical curvature superimposed upon horizontal curvature gives a pleasing effect. As such the vertical and horizontal curves shall coincide as far as possible and their length shall be somewhat longer than the vertical curve. Short vertical curve superimposed on long horizontal curves have been avoided at or near the apex.

Cross fall and Super Elevation

The cross fall on straight sections of project road carriageway shall be as given in table below. Each carriageway shall have unidirectional cross fall.

Table 1.10: Cross fall on different Surfaces

Cross-sectional Element	Annual Rainfall	
	1000 mm or more	Less than 1000 mm
Carriageway, Paved Shoulders, Edge Strip	2.5 Percent	2.0 Percent

The cross fall for earthen/granular shoulders on straight portions is at least 1.0 percent steeper than the values given in above table. On super elevated sections, the earthen portion of the shoulder on the outer side of the curve is provided with reverse cross fall so that the earth does not drain on the carriageway and the storm water drains out with minimum travel path.

Super Elevation

The super elevation is limited to 5%. Super elevation shall not be less than the minimum specified cross fall.

1.4.4 Lateral and Vertical Clearance for Interchange/ Flyovers/Rob/Vup/Svup/Lvup

The lateral and vertical clearance is as per table 1.11

Interchanges
The details are given in Para 1.4.5 of this chapter.

Flyover

Flyovers are provided at crossing between the project road and the NH/SH depending upon the importance of road. All existing four lane road are considered for FO.

Vehicular Under Pass (VUP)

VUP's are provided at crossing between the project road and MDR's. The lane width of the crossroad varies from 7.0m to 10.0m. The provision of future widening from 2 lane to 4 lanes is taken into consideration for these roads. These are provided perpendicular to the Project road.

Light Vehicular under pass (LVUP)

The location of LVUP has been provided for metal Roads/ODR's. These are low configuration road compared to VUP's. These are provided perpendicular to the Project road.

Small Vehicular Underpass (SVUP)

To ensure complete access control and make cost effective grade separation, a smaller dimension VUP (SVUP) has been provided for Village Road/Mud roads with width lesser than 5.50m. All crossroads are not provided with SVUP's. At s few crossroad Box of size 4mx3m Box is provided.

Few, mud roads/ tracks which are at close interval and for which direct underpasses are not provided shall be connected by connecting roads with crossroads were Underpass is provided.

Lateral and Vertical Clearance at Underpasses

Lateral and Vertical clearance at underpasses shall not be less than the values given below;

Table 1.11: Lateral Clearance and Vertical Clearance

Type of Underpass	Minimum Lateral Clearance (m)	Minimum Vertical Clearance (m)
Flyover	30 m for SH and 2x30 for NH	5.5
VUP	20	5.5
LVUP	12	4.5
SVUP	7	4.5
RoB	Depending upon Railway ROW	6.550

1.4.5 Interchange Design

Being fully access controlled, there will be no at grade junctions with Expressway. Entry/Exit will be only from interchanges. At grade intersections adversely influence the quality of highways in terms of speed, capacity and safety because of interruptions to the flow of traffic. Thus the basic requirement for the design of intersections is not only to cater for safe movements for the drivers, but also to provide them full traffic information by way of signs, pavement markings and traffic signals. Further, simplicity and uniformity should be the guiding principles for interchange design to ensure the safe passage of maneuvers and reduce conflict points, either by elimination of certain maneuvers or separated in space, horizontally or vertically. The interchanges are proposed on National highway/ State Highways.

The interchanges are designed with proper ramps and loops as per IRC: 92 latest versions. Interchanges are designed considering following components;

- Acceleration lane
- Deceleration lane
- Loops
- Ramps

Acceleration/Deceleration Lane

Acceleration/Deceleration lane shall be provided as per IRC 92. Each entry and exit ramp shall have acceleration/deceleration lane for the Project Highway. The length of the acceleration/deceleration lanes shall be decided on the basis of speed differentials of the Project road traffic and the speed permitted on the ramps.

Table 1.12: Minimum Acceleration Lengths for Entry (Grades of 2% or Less)

Design Sped V (Km/h)	Acceleration Length L (m)
	V' Speed on Entry Curve at A (Km/h)
	60
120	410

Table 1.13: Minimum Deceleration Lengths for Exit (Grades of 2% or Less)

Design Sped V (Km/h)	Deceleration Length L (m)
	V' Speed on Exit Curve at A (Km/h)
	60
100	155

Table 1.14: Recommended Design Speeds for Ramps

Configuration	Type of Ramp	Range of Design Speed (Km/h)
		100-120
		Range of Ramp Design Speeds
Service Interchange	Semi-Direct	40-60
	Loop	60-80
	Direct	60-90

Access Control

Access has been provided through interchanges and entry ramps only.

Connecting Roads

Connecting roads of service road standard are provided to maintain proper circulation of local traffic, continuity of travel and to facilitate crossing over to the other side of the Project Road through an underpass wherever required. These have been provided outside the RoW. These roads have been provided at locations where the distance between 2 crossroads is less than 200m. Width of connecting road is kept as 7 m.

1.4.6 Median Openings

Median openings with detachable barrier have been provided at about 12 to 15km (between two interchanges) for traffic management for maintenance works and vehicles involved in accidents.

1.4.7 Boundary Wall at ROW

Road boundary wall to be constructed as specified in Ministry Circular no. RW-NH 24036/27/2010-PPP/dated 04.02.2019.

1.4.8 Typical Cross Sections

The proposed TCS developed for the project corridor are for 3x3 and 2x2 lane divided carriageway. The details are provided in Chapter-6 of this report.

1.4.9 Drainage

The IRC: SP 42 will generally be followed for design of highway drainage. The planning of highway and drainage is intricately linked with the terrain, alignment of the highway and the proposed cross drainage works. The planning and designing of adequate drainage system is a primary requirement for maintaining a structural soundness and functional efficiency of a road. Pavement structure including sub-grade must be protected from any ingress of water; otherwise over a period of time it may weaken the sub-grade by saturating it and cause distress in the pavement structure. Hence disposal of water from the pavement and sub-grade is a basic consideration in road design. Over and above quick drainage takes away the water from pavement surface and reduces chances of skidding of vehicles. In order to guard the pavement from the poorly drained conditions, planning, designing, construction and maintenance of longitudinal drains on either side of the roads is very much essential. The surface water from the pavement and shoulders will be made to flow in to the drains by providing suitable cross Slopes / Camber.

Earthen drains are provided through-out the project corridor to ensure the efficient drainage from carriageway to drain. All drains are connected to cross drainage structure. Median drains are provided with rain water harvesting structure. Proper drainage arrangements are provided for grade separated structures. If requires, CD work is also provided for loops and ramps.

1.4.10 Capacity of Project Highway

For the purpose of design and future augmentation of the Project Expressway, the design service volume for level of service- B for plain/rolling terrain shall be 1300 PCU/hr/lane. The design service volume can be determined as per MORTH Guidelines for Expressways. The design service volume per day will depend on the peak hour flow and will be as specified in the below given table.

Table 1.15: Design service volume for Expressways in Plain and Rolling Terrain (in PCUs/Day) for LOS-B

Design Service Volume in PCUs per day for LOS B		
4- Lane	**6-Lane**	**8-Lane**
86,000 for Peak hour flow (6%) 65,000 for Peak hour flow (8%)	1,30,000 for Peak hour flow (6%) 98,000 for Peak hour flow (8%)	1,73,000 for Peak hour flow (6%) 1 30,000 for Peak hour flow (8%)

1.4.11 Service Road

Throughout Service Road to be provided in brownfield section of this project.

1.4.12 Embankment and Cut Sections

The design and construction of the road in embankment and in cutting shall be carried out in accordance with Section 300 of MORTH Specifications IRC: SP-99 latest version.

1.4.13 Highway Amenities:

Wayside amenities provided in the project highway are of size 4ha and 10 Ha. Wayside amenities generally provided at approximately 20 to 25Km interval

In the bigger wayside amenity having size of 10 Ha, all facilities such as drinking water kiosk, toilet facilities, truck parking, bus parking, car parking, separate restaurants for truck driver, restaurants for other road users, children park, petrol station, garage, generator set/ solar system area, ATM's, Ambulance area, medical room etc. to be provided. Other than this some portion of land is left for land monetization purpose. These facilities are generally in LOOPs of Interchanges.

In the smaller wayside amenity having size of 160m x 250m, facilities such as drinking water kiosk, toilet facilities, truck parking, bus parking, car parking, restaurants, petrol station, garage, generator set/ solar system area, ATM's etc. to be provided. At present small way side amenity of size 4 hec to be developed.

1.4.14 Traffic Control Devices, Road Safety Devices and Road Side Furniture

Traffic Control Devices, Road Safety Devices and Road Side Furniture shall comprise of road signs, road markings, object markers, hazard markers, studs, delineators, attenuators, safety barriers, boundary fences, boundary stones, kilometer stones, etc. Relevant IRC Guidelines (IRC 2, IRC:8, IRC:35, IRC:67, IRC SP 99,etc), MORTH Guidelines, IRC:SP - 99 and Section 800 of MORTH Specifications shall be followed.

1.4.15 Traffic Management Systems

Advance Traffic Management Systems (ATMS) shall be provided as per Clause-816 of MORTH Specifications for road and bridge works.

1.4.16 Toll booth

Toll booths shall be provided as per IRC: SP-99.

Toll booth are designed for peak hour traffic projected for minimum 25 years. The total number of toll booths and lanes are designed to ensure the service time of not more than 10 seconds per vehicle at peak flow. The width of each toll lane will be 3.5m for ETC/Manual/Smart card lanes proposed as per NHAI guidelines and one lane at the extreme outer side for over dimensional vehicles of 4.50m. Between each toll lane, traffic islands will be provided so as to accommodate toll booth. These islands will be of minimum 25 m length and 1.8m width. Protective barriers of reinforced concrete will be placed at the front of each island to prevent out of control approaching vehicles crashing into the toll booth. They would be painted with reflective chevron markings.

The area of toll booth covering the flared portion shall be same as that of main carriageway. The fee collection system shall be electronic toll collection (ETC) system. The design of the Toll Booth(s) shall be aesthetically pleasing. The fee collection staff should be efficient, courteous and adequately trained before deployment.

1.5 DESIGN CRITERIA FOR STRUCTURES

Definition of Structures

Interchanges: Interchange is a system of interconnecting roads (ramps and loops) in conjunction with one or more grade separations that provide for the uninterrupted movement of traffic between two or more roads.

Culverts: Cross drainage structures having length ≤ 6 m shall be classified as culverts.

Major and minor bridges: Bridges having length upto 60m shall be classified as minor bridges and bridges having length greater than 60m shall be classified as major bridges

Rail over Bridge (ROB): Structure provided over the railway lines to carry the Project Highway

Rail under Bridge (RUB): Structure provided below the railway lines to carry the Project Highway

Vehicular Underpass (VUP): Grade separated structure which is provided for crossing of vehicles under the Project Highway

Vehicular Overpass (VOP): Grade separated structure which is provided for crossing of vehicles over the Project Highway

Viaducts: Structures carrying the project road over land and spanning across the valleys are termed as viaducts

1.5.1 Design Standards Structures

The design shall cover all aspects of preliminary design pertaining to various parts of Bridges / Grade separators / ROBs etc. The design shall generally be based on relevant IRC codes of practice, MoRTH circulars. However, where the IRC codes are not applicable or silent, appropriate BIS or other international Codes of Practice, such as, British / American / Australian Codes based on sound engineering practice shall be used.

The section below outlines the standards to be adopted for the design of the structures which include Flyovers and Interchanges, Major Bridges, Minor Bridges, VUP, LVUP SVUPs and Culverts.

The IRC codes/Standards/Act, MoRTH Publications, IS & BIS codes shall be followed in the project. Design of all proposed structures shall be done in accordance with the provisions of the following Latest IRC Codes:

LIST OF IRC CODES

IRC: 5	-	Section I- General Features of Design (Eighth Revision)
IRC: 6	-	Section II- Loads and Stresses
IRC: 22	-	Section IV-Composite construction for Road Bridges (Second Revision)
IRC: 24	-	Section V-Steel Road Bridges (Second Revision)
IRC: 78	-	Section VII- Foundations and Substructure (Second Revision)
IRC:83(Part-II)	-	Section IX- Bearings, Part II: Elastomeric Bearings
IRC: 83(Part-III)	-	Section IX-Bearings, Part III: POT, POT-CUM-PTFE, Pin and Metallic Guide Bearings
IRC: 87	-	Guidelines for the Design and Erection of False work for Road Bridges
IRC: 89	-	Guidelines for Design and Construction of River Training and Control Works for Road Bridges (First Revision)
IRC:112	-	Code of Practice for Concrete Road Bridges
IRC: SP13	-	Guidelines for Design of Small Bridges and Culverts
IRC: SP:40	-	Techniques for strengthening & rehabilitation of bridges.
IRC: SP:64	-	Guidelines for the Analysis and Design of Cast-in-Place Voided Slab Superstructure
IRC: SP:66	-	Guidelines for Design of Continuous Bridges
IRC: SP:69	-	Guidelines & Specifications for Expansion Joints
IRC: SP:70	-	Guidelines for the Use of High Performance Concrete in Bridges.
IS:14593	-	Design and Construction of Bored cast in situ Piles founded on Rocks.
IS: 2062	-	Hot rolled medium and high tensile structural steel specifications.
IS:14268	-	Uncoated stress relieved low relaxation seven Ply strand for pre stressed concrete specifications
IS-2911	-	For Pile foundations
IRC:SP:114	-	Seismic design for Road Bridges

1.5.2 Special Design Requirements

The complete structure shall be designed to be safe against collapse and to maintain at all times an acceptable serviceability level. These shall be also designed to be durable to withstand the deteriorating effects of climate and environment.

All new bridges shall have independent superstructures for each direction of travel. Choice of single or independent structure for culverts shall be decided based site condition. Width of median in structural portion will be maintained same as that in the approaches.
In cases where median is kept open to sky, suitable provision will be made for retaining the earth likely to spill from median portion of immediate embankment.

All new bridges will be provided for carriageway width as per Manual IRC: SP:-99.

Bridge superstructure may be reinforced concrete, pre-stressed concrete or steel-concrete composite construction. Similarly, the substructure and foundations may also be concrete, steel or steel-concrete composite construction.

Bearing of new bridges shall be easily accessible for inspection and maintenance.

Reinforced Earth/R.C.C Retaining wall type can be provided for high fill/embankment with aesthetically pleasing appearance. Design life of reinforcing elements for earth retaining structures shall be 100 years minimum. Structure with viaduct shall be provided for ensuring unhindered local cross movement of pedestrians and local vehicular traffic

1.5.3 Design Basis

The design would be carried out using the limit state design philosophy satisfying the requirements of IRC-112. The structure would be designed to meet both the ultimate and serviceability requirements of the code.

Ultimate limit state: This cover static equilibrium and failure of structural element or structure as a whole when acted upon by ultimate design load.

Serviceability limit state: This deals with the condition of structure subjected to serviceability design loads. These conditions include level of internal stress, fatigue failure, deflection, cracking and discomfort by vibrations.

Load Combination shall be adopted as per table B.1 to B.4 of Annex-B of IRC: 6 as given below:

- Table B.1 for Verification of Equilibrium.
- Table B.2 for Verification of Structural Strength
- Table B.3 for Verification of Serviceability
- Table B.4 for Base Pressure and Design of Foundation

At present the combination of loads shown in Table B.4 shall be used for structural design of foundation only. For checking the base pressure under foundation, load combination given in IRC: 78-2014 shall be used. Table B.4 shall be used for checking of base pressure under foundation only when relevant material safety factor and resistance factor are introduced in IRC: 78-2014.

Table 1.16: Design Parameters for Structures

S. No.	Design Figure		Standard
1	**Service life (Years)**		
	Foundations		100
	Piers		100
	Deck		100
	Bearings i. for MJBR, VUPs and Railroad structures		50
	ii. for other structures		25
	Expansion Joints		10
	Parapets(Concrete)		100
	Parapets(Metals)		20
	Exposure Condition:		
	As the general environment condition is Moderate		
2	Minimum clear cover to reinforcement is given below. According to Exposure condition clear cover is provided for structural components as per IRC: 112.		
	i	Superstructures	40mm
	ii	Crash Barrier	50mm
	iii	Substructures	50mm
	iv	Pre-stressing cable duct	75/90mm
	v	Pre-cast elements	45mm
	vi	Foundations	75mm
	vii	Earth Face of Abutment, return wall, retaining wall, box side wall	75mm
	viii	Non Earth Face	50mm
3	**Grade of Steel**		
	i	HYSD bars	Fe500D (Section 1600 of Specifications: High yield strength deformed bars Fe500 conforming to IS: 1786)
	ii	Structural Steel	Fe490(IS 2062)
4	**Grade of Concrete**		
	i	Pre stressed Concrete Girder and RCC Deck and Box Girder	M45/M50
	ii	Precast RCC Girder with RCC Deck	M35
	iii	RCC Box type structure-MNB	M35
	iv	Pier and Pier Cap	M35
	v	Bearing Pedestal	M40

S. No.	Design Figure			Standard
	vi	RCC Abutment, Abutment cap, Return Wall, Dirt wall.		M35
	vii	Open foundation, Pile and Pile cap		M35
	viii	Crash Barrier		M40
	ix	Approach slab		M30
	x	Box Culverts		M30
	xi	Leveling course		M15
	xii	Head Wall		M20
	xiii	Parapet wall		M30
5	**Dead load-(unit wt.)**			
	i	Pre-stressed Concrete		2.5 T/m³
	ii	Reinforced Concrete (RCC)		2.5 T/m³
	iii	Plain Cement Concrete (PCC)		2.5 T/m³
	iv	Steel		7.854 T/m³
	v	Wearing Coat		2.2 T/m³
6	**Live Load**			
	i	Footpath	400 Kg/m² (Rural area) 500 Kg/m²(Urban area)	
	ii	c/w 5.3m to 9.6m	One lane of class 70R or Two lane of Class A	
	iii	c/w 9.6m to 13.1 m	One lane of class 70R for every two lanes with one lane of class A on the remaining lane or 3 lanes of class A	
	** Live Load shall be considered at inner edge of the carriageway for stage 2 constructions and Girder shall be capable to take care the same.			
7	**Impact factor**			
	Concrete Bridges			
	i	for Class A	4.5/(6+L)	
	ii	for Class 70 RT and 70RW	**Upto-9m**	
			For Tracked-25% for span up to 5m and linear reducing to 10% for span up to 9m.	
			For Wheeled-25% for span up to 9m	
			More than 9 m-	
			For Tracked-10% for span between 9m to 40m.As per curve for span more than 40m.	
			For wheeled-25% for span up to 12m and as per curve for span more than 12m	
	Steel Bridges			
	i	for Class A	9/(13.5+L)	
	ii	for Class 70 RT & Class 70 R W	**Up to -9m**	
			For Tracked-25% for span up to 5m and linear reducing to 10% for span up to 9m.	
			For wheeled-25% for span up to 9m	
			More than 9m-	

S. No.	Design Figure			Standard
			For Tracked-10% for all spans. For wheeled-25% for span up to 23m and as per curve for span more than 23m.	
8	**Wind Load**			
	i	As per basic wind speed 47m/s as per IRC: 6, clause 209.		
9	**Horizontal Forces due to water current**			
	i	Case-I	Parallel to pier	
	ii	Case-II	At inclination of (20±θ) to the pier	
10	**Longitudinal forces**			
	i	Case-I	In case of single lane and two lane 20% of first train load plus 10% of load of succeeding train or part thereof	
	ii	Case-II	In case of bridges with more than two lane braking force for two lane plus 5 % of the loads on the lanes in excess of two	
11	**Buoyancy**			
	i	100 % buoyancy for stability check		
	ii	15 % buoyancy for design		
12	**Temperature (as per IRC:6-2017 clause 215)**			
	For bridge having difference between max and min air shade temperature-			
	>20^0 C	Mean of Maximum and Minimum air shade temperature +,- 10˚C whichever is critical		
	<20^0 C	Mean of Maximum and Minimum air shade temperature +,- 5˚C whichever is critical		
	The nonlinear temperature gradient for design of superstructure shall be considered as per clause 215.3 of IRC: 6.			
13	**Seismic force (as per IRC:6-2017, clause 219)**			
	i	Zone IV	Bridges in Seismic Zone- IV need to be designed for seismic forces and forces shall be considered as per Clause 219 of IRC 6	
14	**Expansion Joints**			
	i	Filler type	For span up to 10m(Section 2600 of the specification)	
	ii	Strip Seal Type	For Span >10m and movement up to ±80 (Section 2600 of specification)	
	iii	Modular Type	movement more than ±80 (Section 2600 of specification)	
15	**Bearing**			
	i	Elastomeric	As per design requirements	
	ii	Pot cum PTFE	As per design requirements	
	iii	Pin and Guided Bearing	As per design requirements	
	iv	Spherical Bearing	As per design requirements	
16	**Wearing Coat**		50 mm thick	

S. No.	Design Figure	Standard
17	**Pre stressing (**IS: 14268, section 1800 of Specifications): • Uncoated stress relieved low relaxation steel • Type of Strand-Stress relieved multiply strands of low relaxation Ultimate Stress in Cable -1861 Mpa • Maximum pre stress jacking force-0.783(90% of 0.1% of proof load) 1) The maximum force applied to a tendon at active end during tensioning, shall not exceed 90% of 0.1% proof stress 2) The analysis of pre stressed section would be as per the stress strain properties given in clause 6.3.5 of IRC-112. 3) Maximum pre stressing force applied to structure immediately after transfer shall not be greater than 75% of characteristic tensile strength of pre stressing steel or 0.85 of 0.1% of proof load whichever less is. 4)For serviceability limit state the section would be checked for 10% lower (Inferior) and 10% higher (Superior) values of pre stressing force as per IRC -112	
18	**Sheathing**	HDPE
	Time Dependent material properties	
19	**Shrinkage:** Total shrinkage is auto-generous shrinkage and drying shrinkage	
20	**Creep:** Creep to be calculated with time and stress as per IRC112	
21	**Coefficient of thermal Expansion-**$12x10^{-6}$/degree C	
22	**Modulus of Elasticity-**Modulus of Elasticity to be calculated as per short term and long term creep and shrinkage	
23	**Minimum Bar Diameter**	10 mm (refer Table 5.1, IRC112)
	Diameter if any reinforcing bar including transverse ties, stirrups etc. shall not be less than 10 mm. Diameter of any longitudinal reinforcement bars in columns/ vertical member shall not be less than 12 mm. However, diameter of the reinforcing bars shall not exceed 25 mm in slabs and 32 mm in other member.	
24	**Margin in Material (FOS)**	
	All critical sections shall be checked for stresses under various load combinations. A suitable margin (preferably 5%) shall be there between maximum stress and allowable stress in concrete as well as reinforcement in the final design.	

1.5.4 Design Load and Stresses

Design loads shall be as per IRC: 6, appropriate for the proposed carriageway width, type and properties of stream, location, altitude, etc.

Dead Load (DL)

The dead load i.e. the self-weight of the superstructure, substructure and foundations, backfill will be considered as per the Cl. 203 of IRC: 6 and are summarized as below;

Wet concrete including reinforcement - 2.6 t/m^3 (IRC: 87 – 2011)
Concrete (Cement Reinforced) - 2.5 t/m^3
Concrete (Cement Prestressed) - 2.5 t/m^3
Concrete (Asphalt) - 2.2 t/m^3
Earth (Compacted) - 2.0 t/m^3
Concrete (Cement - plain with plum) - 2.5 t/m^3

Superimposed Dead Load (SIDL)

SIDL comprises of the following items

Crash barrier without Hand Rail – 0.8 t/m
Crash barrier with Hand Rail – 1.0 t/m
Wearing Course – 0.246 t/m^2
Railing – 0.6 t/m
Footpath Load

Crash barrier is adopted as per IRC: 5.

Live Load Combinations

Live load combinations mentioned in IRC: 6 Table-6 shall be followed as per relevant carriageway width.
In general for Bridges and Flyovers following combinations shall be used for typical 4 lanes.

i. Class A 3-Lane Loading
ii. 1 Lane of 70R + 1 Lane of Class A Loading
iii. 1 Lane of 70R + 1 Lane of 70R T Loading
iv. IRC Class SV Loading special Multi Axle Hydraulic Trailer Vehicle
(Prime Mover with 20 Axle Trailer – GVW =385Ton shall be considered to ply for single carriageway or Dual Carriageway Bridge with a maximum eccentricity of 300mm)

Live load combinations mentioned in IRC: 6-2017 Table-6 shall be followed as per relevant carriageway width. In general for Bridges and Flyovers following combinations shall be used for typical 6 lanes.

i. Class A 4-Lane Loading
ii. 1 Lane of 70R + 2 Lane of Class A Loading
iii. 1 Lane of 70R + 2 Lane of 70R T Loading
iv. IRC Class SV Loading special Multi Axle Hydraulic Trailer Vehicle
(Prime Mover with 20 Axle Trailer – GVW =385Ton shall be considered to ply for single carriageway or Dual Carriageway Bridge with a maximum eccentricity of 300mm)

Minimum clear distance between the two vehicles shall be 1.2m.

The loads which are not mentioned in this clause shall be as per IRC: 6.

Where ever footpath is provided in the bridge Footpath live load is taken and bridge is also designed for without footpath case.

Live Load shall be considered at inner edge of the carriageway for stage 2 construction and Girder shall be capable to take care the same.

Reduction in the longitudinal effect on bridges having more than two traffic lanes due to the low probability that all lanes will be subjected to the characteristic loads simultaneously shall be in accordance with the Table shown below:

Table 1.17: Lane Reduction Factor for Live Load

Number of lanes	**Reduction in longitudinal effect**
For two lanes	No reduction
For three lanes	10% reduction
For SV Loading, during passage on bridge, no other vehicle shall be considered to ply on the bridge. No wind, seismic, braking forces and impact on the live load need to be considered as SV shall moves at a speed not exceeding 5kmph over the bridge.	

Notes:

a) However, it should be ensured that the reduced longitudinal effects are not less severe than the longitudinal effect, resulting from simultaneous loads on two adjacent lanes. Longitudinal effects mentioned above are bending moment, shear force and torsion in longitudinal direction.

b) The above Table is applicable for individually supported superstructure of multi-laned carriageway. In the case of separate sub-structure and foundations, the number of lanes supported by each of them is to be considered while working out the reduction percentage. In the case of combined sub-structure and foundations, the total number of lanes for both

Special vehicle loading

Structure need to be checked for special vehicle also. The total load 385T of special vehicle is the load considered to act at 300mm from center of carriageway. No other load is considered to moving on structure when special vehicle is moving.

Congestion Factor

For bridges, flyovers/grade separators close to areas such as ports, heavy industries and mines and any other areas where frequent congestion of heavy vehicles may occur, additional check for congestion of vehicular live load on the carriageway shall be considered. In the absence of any stipulated value, the congestion factor, as mentioned in Table 7 of IRC 6 shall be considered. This factor shall be used as a multiplying factor on the global effect of vehicular live load only.

Under this condition, horizontal force due to braking/acceleration, centrifugal action and temperature gradient effect need not be included, but the effect of live load impact shall be included.

Longitudinal forces

In all road bridges, provision shall be made for longitudinal forces arising from anyone or more of the following causes:

a) Tractive effort caused through acceleration of the driving wheels;
b) Braking effect resulting from the application of the brakes to braked wheels.
c) Frictional resistance offered to the movement of free bearings due to change of temperature or any other cause. The braking effect on a simply supported span or a continuous unit of spans or on any other type of bridge unit shall be assumed to have the following value:

i. In the case of a single lane or a two lane bridge: twenty percent of the first train load plus ten percent of the load of the succeeding trains or part thereof, the train loads in one lane only being considered. Where the entire first train is not on the full span, the braking force shall be taken as equal to twenty percent of the loads actually on the span or continuous unit of spans.
ii. In the case of bridges having more than two-lanes: as in (a) above for the first two lanes plus five per cent of the loads on the lanes in excess of two.

Construction Live Load

Construction load wherever applicable may be considered as 0.36 t/m^2 of the form area to be considered as per IRC 87.This load include load due to mobile construction plant or equipment and temporary loads.

A minimum dynamic amplification of 50% of the loads during normal lifting operations is to be assumed. When Pre cast segmental construction is done consequence to stability to the structure to be determine due to sudden loss of segment. Dynamic amplification of 100% is to be considered.

Differential Settlement

If the riding quality permits, clause 706.3.2.1 of IRC: 78-2014 specify that the calculated differential settlement between the foundations of simply supported span shall not exceed L / 400 of the distance between the foundations, where L is distance between two foundations. In case of structure sensitive to differential settlement such as continuous structures the value of differential settlement shall be taken as 10mm.

Temperature Gradient

Effective bridge temperature shall be estimated from the isotherms of shade air temperature given in fig 15 and fig 16 of IRC: 6. Difference in temperature between the top surface and other levels through the depth of the structure, where ever applicable shall be taken in accordance with clause :215.3 of IRC:6.

Centrifugal Forces

Centrifugal forces are considered for spans in curved portion as per IRC 6 Centrifugal forces shall be determined from following formula:

$C = WV^2/127R$

Where,

C =Centrifugal force acting normal to the traffic. W = Live load (tons/m)
V= Design speed of vehicles (Km/ hour)
R = Radius of curvature (m)

It is considered to be acting at 1.2m above deck level**.**

Earth Pressure

1. All earth retaining structures like Abutment and Other Earth Retaining Structures designed to retain earth fills shall be proportioned to withstand pressure calculated in accordance with any rational theory. Coulomb's theory, subject to the modification that the center of pressure exerted by the backfill, when considered dry, is located at an elevation of 0.42 of the height of the wall above the base instead of 0.33 of that height.

2. For RCC Box Structure-Active Earth pressure / Earth pressure at rest will be considered to be acting on the vertical walls of the RCC Box. The Co-efficient of such Earth pressure will be taken as 0.5.

3. Surcharge Pressure-All Earth retaining wall is designed for a live load surcharge pressure equivalent to 1.2 m earth fill as per IRC 6.

Wind forces

1. The superstructure shall be designed for wind induced horizontal forces (acting in the transverse and longitudinal direction) and vertical loads acting simultaneously. The assumed wind direction shall be perpendicular to longitudinal axis for a straight structure or to an axis chosen to maximize the wind induced effects for a structure curved/skewed in plan.

2. The substructure shall be designed for wind induced loads transmitted to it from the Super structure and wind loads acting directly on the substructure. Loads for

wind with Live Load and without Live load shall be envisaged.

3. The longitudinal force on bridge superstructure (in N) shall be taken as 25% and 50% of the transverse wind load as calculated as per Clause 209 for beam/box/ plate girder bridges and truss girder bridges respectively.

Water Current Forces

Any part of a road bridge which may be submerged in running water shall be designed to sustain safely the horizontal pressure due to the force of the current.

On piers parallel to the direction of the water current, the intensity of pressure shall be calculated from the following equation:

P = 52KV^2

Where,

P = intensity of pressure due to water current, in kg/m^2

V = the velocity of the current at the point where the pressure intensity is being calculated, in meter per second, and

K = a constant having the following values for different shapes of piers illustrated in Fig.11

i. Square ended piers (and for the superstructure)1.50
ii. Circular piers or piers with semi-circular ends 0.66
iii. Piers with triangular cut and ease waters, the angle included between the faces being 30° or less 0.50
iv. Piers with triangular cut and ease waters, the angle included between the faces being more than 30° but less than 60° 0.50 to 0.70
v. do- 60 to 90° 0.70 to 0.90
vi. Piers with cut and ease waters of equilateral 0.45 arcs of circles
vii. Piers with arcs of the cut and ease waters 0.50 intersecting at 90°

Buoyancy

1. In the design of abutments, especially those of submersible bridges, the effects of buoyancy shall also be considered assuming that the fill behind the abutments has been removed by scour.

2. To allow for full buoyancy, a reduction shall be made in the gross weight of the member affected by reducing its density by the density of the displaced water. The density of water may be taken as 1 .0 t/m^2.
For artesian condition, HFL or actual water head, whichever is higher, shall be considered for calculating the uplift.

3. In the design of submerged masonry or concrete structures, the buoyancy effect through pore pressure may be limited to 15% of full buoyancy. 213.4 In case of submersible bridges, the full buoyancy effect on the superstructure shall be taken into consideration.

Seismic Forces

The project corridor falls under seismic IV (High seismic zone). Seismic design is carried out as per zone and as per codal provisions along with provision of ductile detailing and seismic arrestor Block.

All bridges supported on piers, pier bents and arches, directly or through bearings, and not exempted below in the category (a) and (b), are to be designed for horizontal and Vertical forces as given in the following clauses.

The following types of bridges need not be checked for seismic effects:

a) Culverts and minor bridges up to 10 m span in all seismic zones.

The effect of Vertical component may be omitted for all elements in zone-III for following cases as applicable for said project.

a) Bearing and Linkage
b) Horizontal cantilever structural element
c) For stability

Combination of component motion

The seismic force assumed to be coming from any horizontal direction. For this purpose two separate analyses shall be performed for design seismic forces along two orthogonal directions. The design seismic forces resultants at any cross-section of a bridge component resulting from the analysis in three orthogonal horizontal directions shall be combined as below:

a) ±r1 ± 0.3r2± 0.3r3
b) ±0.3r1 ± r2±0.3r3
c) ±0.3r1 ± 0.3r2± r3
Where,

r1 = Force resultant due to full design seismic force along x-direction

r2 = Force resultant due to full design seismic force along z-direction

r3 = Force resultant due to full design seismic force along y-direction

To improve the performance of the Bridge during earth quake, the bridges in seismic zone IV may be specifically detailed for ductility for which IRC: 112 shall be referred.

Seismic Analysis

The Seismic Analysis of the bridges shall be carried out using following method as per applicability defined in Table 5.3, of IRC :SP:114 – 2018,depending upon the complexity of the structure and the input ground motion.

a) Elastic seismic acceleration method (Static load)
b) Elastic Response Spectrum Method
c) Time history Method

Accidental Load

Bridge piers of wall type, columns or the Frames built in median or in the vicinity of the carriageway supporting the superstructure shall be design to withstand Vehicle collision loads as per clause 222.1 of IRC: 6.

The effect of collision load shall not be considered on abutments or on the structures separated from the edge of the carriageway by a minimum distance of 4.5m and also not be combined with principal live loads on the carriageway supported by the structural members subjected to such collision loads as well as wind or seismic load as per cl 222.1.2 of IRC: 6.

Where pedestrian/cycle track bridge ramps and stairs are structurally independent of the main highway spanning structure, their support need not be design for vehicle collision loads.

Material factor of safety under collision load, reference shall be made to the provision in IRC: 112 for concrete and IRC: 24 for steel. For permissible overstressing in foundation, refer provision of IRC: 78.

Collision Load

The normal loads given in Table 22 of IRC: 6 shall be considered to act horizontally as Vehicle Collision loads. Supports shall be capable of resisting the main and residual components acting simultaneously. Load normal to the carriage way below and loads parallel to the carriageway below shall be considered to act separately and shall not be combined.

The loads in Table 22 indicated in clause 222.3.1 are assumed for vehicles plying at velocity of about 60km/hours. In case of vehicles travelling in lesser velocity, the load may be reduced in proportion to the square of the velocity but not less than 50 percent.

The bridge supports shall be designed for residual load component only, if protected with suitably designed fencing system taking in to account its flexibility, having a minimum height of 1.5m above the carriageway level.

Culverts

As per Manual the culverts with vertical clearance 3 m can be used by cattle and pedestrians during dry season.

1.6 Hydrology, Training works and Road Drainage

1.6.1 Hydrological study

For performing the hydrological and hydraulic analysis which essentially need the design flood of a specific return period for fixing the waterway vis-à-vis the design HFL of bridges depending upon their size and importance to ensure safety as well as economy. As per IRC 5-Section I General Features of Design specify that the waterway of a bridge is to be designed for a maximum flood of 100 years return period and SP 13. The catchment area shall be marked on the topo-sheets of Survey of India or Bhuwan website for their assessment.

The following methods can be used to estimate the peak discharge for bridge sites on major and minor streams up to the catchment area of 2500 Km^2;

- Empirical Formulae
- Rational Method
- Slope Area Method
- Synthetic Unit Hydrograph Method

In case of catchment area is more than 2500 sq km, the discharge calculations shall be based on the Slope Area method at local enquiry highest flood level/ water marks on nearest bridge or the basis of dam outflow data with reference to the catchment area at proposed bridge location.

Highest of above shall be considered at design discharge or 1.5 times the second highest discharge adopted in case difference in discharge is doubled than the second highest . With the design discharge, calculations for the 100-year flood level shall be obtained using manning's equation based on the 100-year flood discharge. Afflux calculation, span arrangement and scour levels for piers and abutment shall be estimated.

Floor protection has been provided wherever is broken or already in existence in U/S & D/S of the bridge.

1.6.2 Road drainage

Road drainage shall be designed to cater the rainwater into the side drain quickly in order to avoid stagnation of rainwater over road surface. The section of the drain shall be designed on the basis of IRC 42 and IRC 50.

The relevant latest publications and Indian Standards are given below;

Table 1.18: Relevant Codes & References

Designation	Issued by	Date of issue
IRC:5 Standard specifications and code of practice for road bridges section-I	IRC	2015
SP13 : Guidelines for the design of small bridges and culverts	IRC	2004
IRC: SP-84-Manual of specifications and standards for four laning of highways through public private partnership	IRC	2014
IRC-78 -Standard specifications and code of practice for road bridges Section – VII	IRC	2014
IRC:89 - Guidelines for design and construction of River Training and control works for road bridges	IRC	1997
SP42 : Guidelines on road drainage	IRC	2004
Central Water Commission : flood estimation report Western Himalayan subzone 7	CWC	1994

1.6.3 Side Slopes

IRC: 36-2010 recommends the following side slopes for highway embankments, purely from the safety point of view.

- 1V: 1.5 H up to 12m heights with slope protection
- 1V: 1.5 H with partial retaining wall above 12m embankment height.

1.6.4 Slope Protection Measure

Side Slope of embankments affected by flood shall be protected with pitching or geo-fibre on over granular filter. The Pitching shall be extended up to 0.5m above the HFL. All other locations side slopes shall be protecting by seeding & mulching as per specification clause 308 of specification of road & bridge works (MoRT&H) in consultation with the NHAI/ Independent Engineer.

1.6.5 River Training & Flood Protection Works

The proposed protective measures are to be designed in accordance with the requirement of IRC: 89-1998.
It is proposed to provide stone pitching of suitable thickness all around the abutments and in the front portion of abutment with suitable thickness, which will be extended up to 1.5m above HFL.

In order to prevent embankment erosion during high flood, bank protection works shall be provided as required.

For River Training works, if required, for protection of Embankment, detailed hydrological investigation will be carried out and necessary protection works if required will be provided, based on study report.

Floor protection has been provided wherever is broken or already in existence in U/S & D/S of the bridge as per IRC 89: 1998, IRC SP-82: 2008, CBIP Technical Report No. 17 & IS 6966: 1989.

1.7 TRAFFIC SURVEYS

In order to capture traffic and travel characteristics, speed characteristics, users' preference regarding toll imposition of traffic passing through the existing alternative routes from Delhi to Gurdaspur, following primary traffic surveys were conducted.

- Classified traffic volume count (CTVC) using ATCC method
- Origin – destination survey (OD)
- Speed and Delay studies

The classified volume count surveys were carried out at five locations, considering the possibility of diversion of traffic from existing alternative routes to proposed expressway. These locations are characterized by centres of heavy economic activities, population and are away from the influence of city areas in order to avoid the influence of local traffic. The surveys were conducted continuously for seven consecutive days for 24 hours through Automatic Traffic Counter and Classifier (ATCC) method.

Table 1.19: Schedule of Traffic Volume Count Survey

Location	Start Date	End Date	Duration (days)
Mukarba Chowk-Panipat Section of NH-44(Near Bhagan Toll Plaza)	21/05/2018	01/05/2018	7
Kurukshetra- Ambala Section of NH-44(Near Sharifgarh)	21/05/2018	01/05/2018	7
Ludhiana-Jalandhar Section of NH-44*			-
Jalandhar-Pathankot Section of NH-44*			-
Pathankot-Jammu Section of NH-44*			-
Amritsar - Gurdaspur Section of NH-54*			-
Gurdaspur - Pathankot Section of NH-54*			-
Hissar-Sirsa Section of NH-9*			-
Churu -Hissar Section of NH-52	10/01/2019	16/01/2019	7
Jalandhar-Amritsar Section of NH-3	11/01/2019	17/01/2019	7
Patiala-Rajpura Section of NH-44(Near Daun Kalan)	21/05/2018	01/05/2018	7
Jammu – Domel Section of NH-44*			-
Domel – Katra	06/02/2020	12/02/2020	7

CVC surveys at rest of locations along NH-44, NH-09 and NH-54 were not carried out as IHMCL data was available. For the purpose of OD analysis, the CVC data from the surveys carried out earlier has been used to determine the volume count according to the vehicular classification used for the present study.

The AADT value of base year (FY-2019) is used for the traffic volume projection up to horizon year and projected traffic volume is used in design of pavement and for projecting the tollable traffic.

Table 1.20: Summary of ADT and AADT at Survey Locations

Sl. No.	Location	ADT		AADT	
		Nos.	PCUs	Nos.	PCUs
1	Mukarba Chowk-Panipat Section of NH-44	73241	88652	71556	86154
2	Kurukshetra- Ambala Section of NH-44	53228	75367	51825	72851
3	Ludhiana-Jalandhar Section of NH-44	51141	59177	52081	60010
4	Jalandhar-Pathankot Section of NH-44	15243	21498	16336	23041
5	Pathankot-Jammu Section Of NH-44	21333	26544	23420	29545
6	Amritsar - Gurdaspur Section of NH-54	21572	23923	23132	25656
7	Gurdaspur - Pathankot Section of NH-54	22188	28458	22204	28377
8	Patiala-Rajpura Section Of NH-7	28702	31910	28150	31150
9	Hissar-Sirsa Section of NH-9	12995	17289	14475	19314
10	Churu -Hisar Section of NH-52	5715	13189	6073	14024
11	Jalandhar-Amritsar Section Of NH-44	37998	38386	39838	40430
12	Jammu - Domel Section of NH-44	16995	23501	16374	22485
13	Domel – Katra Section	5542	6486	5428	6339

Table 1.21: Annual Average Daily Traffic at Survey Locations

Vehicle Type	Mukarba Chowk-Panipat Section of NH-44	Kurukshetra- Ambala Section of NH-44	Ludhiana-Jalandhar Section of NH-44	Jalandhar-Pathankot Section of NH-44	Pathankot-Jammu Section Of NH-44	Amritsar - Gurdaspur Section of NH-54	Gurdaspur– Pathankot section of NH-54	Patiala-Rajpura Section of NH-7	Hissar-Sirsa Section of NH-9	Churu -Hissar Section of NH-52	Jalandhar-Amritsar Section of NH-3	Jammu - Domel Section of NH-44	Domel - Katra
Car / Jeep / Van	45343	32784	27731	6335	8916	11567	7004	17469	8193	1791	21319	8934	3066
Taxi										0	478		470
Shared Jeep										24	70		0
Minibus	681	608	0	0	0	0	0	94	0	8	181	0	158
School. Bus	2437	2406	0	0	0	0	0	891	0	8	89	0	11
Govt. Bus										49	475	0	59
Pvt. Bus										58	532	0	259
Maxx/Pick-Up	2251	1424	3175	604	317	1019	671	1171	789	593	1369	866	0
LCV (4 tyre)	5595	3874	2946	811	953	427	586	605	675	167	146	888	0
LCV (6 tyre)	0	0	0	0	0	0		0	0	282	781		110
2 Axle	1044	1956	3016	2064	2187	1078	1302	417	912	203	392	2324	171
3 Axle	1773	2049	1277	1252	1298	761	1581	434	536	618	268	384	23
MAV (4 to 6 Axles)	1221	2114	643	314	743	531	1050	328	534	1565	366	235	8
MAV (> 6 Axles)	0	5	0	0	0	0	0	7	0	0	0	0	0
Others	35	0	11	4	4	2	5	0	2	0	3	8	0
Total vehicles	**60380**	**47220**	**38799**	**11384**	**14418**	**15385**	**12199**	**21416**	**11641**	**5366**	**26469**	**14539**	**4335**
Total PCUs	**78423**	**69700**	**51147**	**19535**	**24479**	**21142**	**21951**	**26422**	**16751**	**12944**	**31827**	**21250**	**5543**
Non Tollable Traffic													

Vehicle Type	Mukarba Chowk-Panipat Section of NH-44	Kurukshetra- Ambala Section of NH-44	Ludhiana-Jalandhar Section of NH-44	Jalandhar-Pathankot Section of NH-44	Pathankot-Jammu Section Of NH-44	Amritsar - Gurdaspur Section of NH-54	Gurdaspur– Pathankot section of NH-54	Patiala-Rajpura Section of NH-7	Hissar-Sirsa Section of NH-9	Churu -Hissar Section of NH-52	Jalandhar-Amritsar Section of NH-3	Jammu - Domel Section of NH-44	Domel - Katra
3-Wheeler	1535	293	1687	97	193	203	557	726	313	17	2277	130	280
2-Wheeler	9030	4001	11121	4436	8466	7043	8978	5621	2225	503	10435	1634	764
Agriculture Tractor	60	37	49	34	14	15	23	32	25	5	18	9	2
Agriculture Tractor/ Trailer	293	131	329	232	102	104	275	206	239	176	142	61	14
Cycle	182	11	87	140	195	310	157	29	26	2	351	1	3
Cycle Rickshaw	18	1	9	13	32	72	15	8	6	0	38	0	0
Animal Drawn Cart	10	0	0	0	0	0	0	0	0	1	5	0	0
Toll Exempted Car	23	73	0	0	0	0	0	49	0	2	53	0	11
Toll Exempted Bus	0	0	0	0	0	0	0	0	0	0	20	0	1
Toll Exempted LCV	8	28	0	0	0	0	0	35	0	0	28	0	1
Toll Exempted Truck	17	30	0	0	0	0	0	28	0	1	2	0	17
Total Non-Tollable (Nos.)	**11176**	**4605**	**13282**	**4952**	**9002**	**7747**	**10005**	**6734**	**2834**	**707**	**13369**	**1835**	**1093**
Total Non-Tollable (PCUs)	**7732**	**3151**	**8863**	**3506**	**5066**	**4514**	**6427**	**4728**	**2564**	**1080**	**8603**	**1236**	**796**
Grand Total (Nos.)	**71556**	**51825**	**52081**	**16336**	**23420**	**23132**	**22204**	**28150**	**14475**	**6073**	**39838**	**16374**	**5428**
Grand Total (PCUs)	**86154**	**72851**	**60010**	**23041**	**29545**	**25656**	**28377**	**31150**	**19314**	**14024**	**40430**	**22485**	**6339**

1.8 MATERIAL INVESTIGATIONS

Borrow Area Soil

Borrow area soil locations have been identified for the sub-grade and embankment and representative samples have been collected from potential locations for laboratory testing. Summary of observed CBR test results of borrow area soil samples are given in table below;

Table 1.22: Summary of CBR Test Results of Borrow Area Soil Samples

S. No.	Location (Km)	Direction	OMC %	Maximum Dry Density (MDD) gm/cc	Soaked CBR %	Un-Soaked CBR %	FSI, %	Suitability
1	404.000	LHS	10.6	1.87	9.9	12.4	-	Sub-grade/Embankment
2	410.000	RHS	11.2	1.91	9.4	12.9	-	Sub-grade/Embankment
3	415.000	RHS	10.4	1.84	10.4	13.9	-	Sub-grade/Embankment
4	423.000	RHS	11.6	1.89	7.9	10.9	10	Embankment
5	425.700	RHS	14.9	1.86	7.9	10.6	10	Embankment
6	429.500	LHS	15.4	1.82	8.4	11.4	-	Sub-grade/Embankment
7	443.000	RHS	13.2	1.73	9.6	12.9	-	Sub-grade/Embankment
8	447.000	LHS	16.2	1.75	7.6	10.4	10	Embankment
9	454.000	RHS	1.88	12.1	6.9	9.3	10	Embankment
10	458.000	RHS	1.86	12.4	7.4	9.9	10	Embankment
11	463.500	RHS	1.97	10.7	10.4	11.9	-	Sub-grade/Embankment
12	466.000	LHS	15.3	1.84	7.6	10.9	10	Embankment
13	468.550	LHS	1.91	9.8	9.4	10.6	-	Sub-grade/Embankment
14	474.000	LHS	1.94	10.2	10.4	12.9	-	Sub-grade/Embankment
15	481.000	LHS	1.89	10.8	9.9	10.9	-	Sub-grade/Embankment
16	484.000	RHS	14.6	1.85	8.4	11.9	-	Embankment
17	489.000	RHS	11.9	1.77	10.4	12.9	-	Sub-grade/Embankment
18	490.000	RHS	1.97	11	8.9	10.2	-	Sub-grade/Embankment
19	499.000	RHS	2.01	12.4	7.9	9.9	10	Embankment
20	526.300	RHS	10.3	1.75	10.4	13.6	-	Sub-grade/Embankment
21	529.800	LHS	11.6	1.79	10.9	13.9	-	Sub-grade/Embankment
22	535.500	LHS	12	1.82	9.9	13.6	-	Sub-grade/Embankment
23	541.500	RHS	9.2	2.01	9.9	10.6	-	Sub-grade/Embankment
24	546.800	RHS	9.9	1.97	9.4	10.9	-	Sub-grade/Embankment
25	551.000	LHS	14.3	1.8	9.2	12.9	-	Embankment
26	551.000	LHS	10.5	1.85	9.4	10.2	-	Sub-grade/Embankment
27	557.000	LHS	11.3	1.93	10.4	12.2	-	Sub-grade/Embankment
28	560.300	LHS	10.8	1.89	8.9	10.2	-	Sub-grade/Embankment
29	562.100	RHS	11.2	1.91	8.9	9.9	-	Sub-grade/Embankment

1.9 GEOMETRIC IMPROVEMENT

Project highway is a brown-field alignment for most of the stretch proposed to be developed with a design speed of 100/80 kmph. All design parameters are as per IRC SP 99: 2013 are to be followed.

The geometric design of the Project Highway shall conform to the standards set out in the Manual for Expressway (IRC: SP: 99-2013). The project highway is to be developed as Six/Four lane divided carriageway. The various typical cross sections used for the project road sections are given in table below:

Table 1.23: TCS Schedule

A. Kunjwani to Sidhra Section of NH-44 (Km 515+000 to km 528+300)

Sl. No.	Design Chainage (Km)		Design Length (m)	TCS Type	Remarks
	From	To			
1	515+000	515+200	200	20	-
2	515+200	515+298	98	21H	-
3	515+298	515+318	20	MNB	-
4	515+318	515+628	310	21H	-
5	515+628	515+760	132	21A	-
6	515+760	515+970	210	21	-
7	515+970	516+088	118	21A	-
8	516+088	516+118	30	RUB	-
9	516+118	516+250	132	21A	-
10	516+250	517+280	1030	21H	-
11	517+280	517+300	20	LVUP	-
12	517+300	517+792	492	21H	-
13	517+792	517+822	30	MNB	-
14	517+822	518+061	239	21H	-
15	518+061	518+069	8	MNB	-
16	518+069	518+440	371	21H	-
17	518+440	518+510	70	21B	-
18	518+510	518+579	69	21H	-
19	518+579	518+587	8	MNB	-
20	518+587	518+655	68	21H	-
21	518+655	518+663	8	MNB	-
22	518+663	518+731	68	21H	-
23	518+731	518+739	8	MNB	-
24	518+739	518+950	211	21H	-
25	518+950	519+021	71	20	-
26	519+021	519+051	30	MNB	-
27	519+051	519+250	199	20	-
28	519+250	519+645	395	21H	-
29	519+645	519+715	70	21B	-
30	519+715	519+832	117	21H	-
31	519+832	519+862	30	MNB	-
32	519+862	520+120	258	21H	-
33	520+120	520+150	30	20	-

Sl. No.	Design Chainage (Km)		Design Length (m)	TCS Type	Remarks
	From	To			
34	520+150	520+200	50	20B	-
35	520+200	520+250	50	20E	-
36	520+250	520+805	555	21W	-
37	520+805	520+895	90	Flyover	-
38	520+895	520+907	12	21W	-
39	520+907	520+939	32	MNB	-
40	520+939	521+220	281	21W	-
41	521+220	521+250	30	20E	-
42	521+250	521+300	50	20F	-
43	521+300	521+520	220	20A	-
44	521+520	521+765	245	21V	-
45	521+765	521+795	30	VUP	-
46	521+795	521+900	105	21J	-
47	521+900	521+940	40	MNB	-
48	521+940	522+200	260	21J	-
49	522+200	522+350	150	20C	
50	522+350	522+500	150	21J	
51	522+500	522+665	165	21K	-
52	522+665	522+695	30	Flyover	-
53	522+695	522+800	105	21K	-
54	522+800	522+950	150	21D	-
55	522+950	522+970	20	21E	-
56	522+970	523+090	120	Viaduct	-
57	523+090	523+160	70	21F	-
58	523+160	523+300	140	21D	-
59	523+300	523+480	180	21G	-
60	523+480	523+690	210	21D	-
61	523+690	523+960	270	21C	Greenfield
62	523+960	523+990	30	21I	
63	523+990	524+280	290	21L	-
64	524+280	524+645	365	21M	-
65	524+645	524+750	105	21L	-
66	524+750	524+930	180	21C	Greenfield
67	524+930	525+000	70	21L	-
68	525+000	525+400	400	21M	-
69	525+400	525+440	40	21N	-
70	525+440	525+680	240	21C	Greenfield
71	525+680	525+720	40	21N	-
72	525+720	525+900	180	21L	-
73	525+900	526+275	375	21P	-
74	526+275	526+545	270	21C	Greenfield
75	526+545	526+990	445	21P	-
76	526+990	527+080	90	20D	-
77	527+080	527+150	70	21S	-

Sl. No.	Design Chainage (Km)		Design Length (m)	TCS Type	Remarks
	From	To			
78	527+150	527+240	90	21U	-
79	527+240	527+380	140	21O	-
80	527+380	527+520	140	21T	-
81	527+520	527+715	195	21S	-
82	527+715	527+735	20	MNB	-
83	527+735	527+870	135	21S	-
84	527+870	527+905	35	Flyover	Greenfield
85	527+905	528+005	100	MJB	
86	528+005	528+120	115	21Q	
87	528+120	528+170	50	21R	-
88	528+170	528+300	130	20D	-

B. Section of Service Road on RHS which is split from Main Alignment towards existing road between Km 522+000 to km 528+300.

Sl. No.	Design Chainage of RHS Service Road (Km)		Design Length (m)	TCS Type	Remarks
	From	To			
1	522+470	522+650	180	22C	LHS TLY +RHS SR
2	522+650	522+770	120	22I	LHS TLY +RHS SR
3	522+910	523+150	240	22C	LHS TLY +RHS SR
4	523+690	523+910	220	22H	
5	523+910	523+965	55	22J	LHS SR +RHS TLY
6	523+965	523+975	10	MNB	Minor Bridge
7	523+975	524+030	55	22J	LHS SR +RHS TLY
8	524+030	524+230	200	22H	
9	524+950	525+070	120	22J	LHS SR +RHS TLY
10	525+070	525+150	80	22H	
11	525+150	525+160	10	MNB	Minor Bridge
12	525+160	525+380	220	22H	
13	525+660	526+015	355	22H	
14	526+015	526+025	10	MNB	Minor Bridge
15	526+025	526+350	325	22H	
16	526+860	526+994	134	22H	
17	526+994	527+022	28	MNB	Minor Bridge
18	527+022	527+250	228	22H	
19	528+540	528+652	112	22D	
20	528+652	528+688	36	MNB	Minor Bridge
21	528+688	528+920	232	22D	

Note: TLY-Truck Lay Bye, SR-Service Road,

C. Section of Ramps to connect LHS Service Road which is terminated due to following up existing road alignment between Km 523+000 to km 528+300.

Sl. No.	Design Chainage of Ramps (Km)		Design Length (m)	TCS Type	Remarks
	From	To			
R-2	Ramp-2 between Expressway Chainage Km 523+690 to 523+960				
1	0+000	0+050	50	22E	Ramp-2
2	0+050	0+200	150	22F	Ramp-2
3	0+200	0+315	115	22	Ramp-2
4	0+315	0+325	10	MNB	Ramp-2
5	0+325	0+480	155	22	Ramp-2
6	0+480	0+520	40	22A	Ramp-2
7	0+520	0+560	40	22G	Ramp-2
8	0+560	0+600	40	22E	Ramp-2
R-3	Ramp-3 between Expressway Chainage Km 524+750 to 524+930				
1	0+000	0+050	50	22E	Ramp-3
2	0+050	0+130	80	22F	Ramp-3
3	0+130	0+195	65	22	Ramp-3
4	0+195	0+205	10	MNB	Ramp-3
5	0+205	0+300	95	22	Ramp-3
6	0+300	0+390	90	22F	Ramp-3
7	0+390	0+420	30	22	Ramp-3
8	0+420	0+466	46	22E	Ramp-3
R-4	Ramp-4 between Expressway Chainage Km 525+440 to 525+680				
1	0+000	0+050	50	22E	Ramp-4
2	0+050	0+200	150	22F	Ramp-4
3	0+200	0+295	95	22	Ramp-4
4	0+295	0+305	10	MNB	Ramp-4
5	0+305	0+450	145	22	Ramp-4
6	0+450	0+570	120	22F	Ramp-4
7	0+570	0+610	40	22G	Ramp-4
8	0+610	0+645	35	22E	Ramp-4
R-5	Ramp-5 between Expressway Chainage Km 526+280 to 526+550				
1	0+000	0+070	70	22E	Ramp-5
2	0+070	0+180	110	22	Ramp-5
3	0+180	0+208	28	MNB	Ramp-5
4	0+208	0+400	192	22	Ramp-5
5	0+400	0+461	61	22E	Ramp-5

D. Domel – Katra Section (Km 550+900 to km 566+520)

Sl. No.	Design Chainage (Km)		Design Length (m)	TCS	Remarks
	From	To			
1	550+900	551+000	100	29B	-
2	551+000	551+169	169	29C	-
3	551+169	551+181	12	LVUP	-
4	551+181	551+340	159	29C	-
5	551+340	551+400	60	29B	-
6	551+400	551+610	210	29D	-
7	551+610	551+630	20	VUP	-
8	551+630	552+210	580	29D	-
9	552+210	552+310	100	Interchange	-
10	552+310	552+330	20	29E	-
11	552+330	552+420	90	29F	-
12	552+420	552+660	240	29G	-
13	552+660	552+730	70	29H	-
14	552+730	552+750	20	MNB	-
15	552+750	552+860	110	29H	-
16	552+860	552+880	20	VUP	-
17	552+880	552+905	25	29H	-
18	552+905	552+921	16	MNB	-
19	552+921	553+050	129	29I	-
20	553+050	553+200	150	29J	-
21	553+200	553+330	130	29K	-
22	553+330	553+600	270	29L	-
23	553+600	553+800	200	29M	-
24	553+800	553+810	10	MNB	-
25	553+810	553+880	70	29M	-
26	553+880	554+000	120	29L	-
27	554+000	554+100	100	29I	-
28	554+100	554+271	171	29H	-
29	554+271	554+287	16	MNB	-
30	554+287	554+341	54	29H	-
31	554+341	554+353	12	LVUP	-
32	554+353	554+650	297	29H	-
33	554+650	555+020	370	29N	-
34	555+020	555+060	40	29L	-
35	555+060	555+210	150	29O	-

Sl. No.	Design Chainage (Km)		Design Length (m)	TCS	Remarks
	From	To			
36	555+210	555+470	260	29M	-
37	555+470	555+530	60	29P	-
38	555+530	555+620	90	Viaduct	-
39	555+620	555+650	30	29P	-
40	555+650	555+700	50	29L	-
41	555+700	555+800	100	29Q	-
42	555+800	555+980	180	29L	-
43	555+980	556+060	80	29P	-
44	556+060	556+240	180	Viaduct	-
45	556+240	556+390	150	29P	-
46	556+390	556+525	135	29I	-
47	556+525	556+650	125	30A	-
48	556+650	556+745	95	30B	-
49	556+745	556+805	60	30H	-
50	556+805	557+070	265	30C	-
51	557+070	557+280	210	30D	-
52	557+280	557+370	90	30E	-
53	557+370	557+500	130	30F	-
54	557+500	557+605	105	30G	-
55	557+605	557+800	195	29R	-
56	557+800	558+000	200	29S	-
57	558+000	558+130	130	29L	-
58	558+130	558+300	170	29S	-
59	558+300	559+080	780	29L	-
60	559+080	559+170	90	29S	-
61	559+170	559+230	60	29L	-
62	559+230	559+640	410	29M	-
63	559+640	559+744	104	29T	-
64	559+744	559+756	12	LVUP	-
65	559+756	559+850	94	29P	-
66	559+850	560+000	150	29L	-
67	560+000	560+045	45	29P	-
68	560+045	560+195	150	Viaduct	-
69	560+195	560+250	55	29P	-
70	560+250	560+350	100	29S	-
71	560+350	560+470	120	29U	-

Sl. No.	Design Chainage (Km)		Design Length (m)	TCS	Remarks
	From	To			
72	560+470	560+650	180	29V	-
73	560+650	560+870	220	29W	-
74	560+870	560+910	40	31A	-
75	560+910	561+675	765	31	-
76	561+675	561+700	25	32A	-
77	561+700	562+000	300	32B	-
78	562+000	562+080	80	32C	-
79	562+080	562+180	100	32D	-
80	562+180	562+230	50	32E	-
81	562+230	562+650	420	31B	-
82	562+650	562+830	180	32C	-
83	562+830	562+870	40	32A	-
84	562+870	563+070	200	32C	-
85	563+070	563+250	180	31	-
86	563+250	563+320	70	32C	-
87	563+320	563+540	220	32B	-
88	563+540	563+610	70	33A	-
89	563+610	563+645	35	33B	-
90	563+645	563+765	120	Viaduct	-
91	563+765	563+835	70	33J	-
92	563+835	563+845	10	VUP	-
93	563+845	563+865	20	33C	-
94	563+865	563+885	20	VUP	-
95	563+885	563+910	25	33C	-
96	563+910	564+020	110	33D	-
97	564+020	564+220	200	33E	-
98	564+220	564+306	86	33F	-
99	564+306	564+314	8	SVUP	-
100	564+314	564+420	106	33F	-
101	564+420	564+450	30	Flyover	-
102	564+450	564+611	161	33F	-
103	564+611	564+618	7	SVUP	-
104	564+618	564+740	122	33F	-
105	564+740	564+950	210	33G	-
106	564+950	565+180	230	33F	-
107	565+180	565+280	100	33G	-

Sl. No.	Design Chainage (Km)		Design Length (m)	TCS	Remarks
	From	To			
108	565+280	565+355	75	33E	-
109	565+355	565+369	14	VOP	-
110	565+369	565+500	131	33E	-
111	565+500	565+610	110	33H	-
112	565+610	565+975	365	33G	-
113	565+975	566+124	149	33I	-
114	566+124	566+200	76	33K	-
115	566+200	566+320	120	33L	-
116	566+320	566+420	100	Bridge	-
117	566+420	566+450	30	33N	-
118	566+450	566+520	70	33M	-

E. Section of Ramps to connect LHS Service Road which is terminated due to following up existing road alignment between Km 555+000 to km 561+000.

Sl. No.	Ramps Chainage (Km)		Design Length (m)	TCS Type	Remarks
	From	To			
1	0+000	0+286	286	34I	Ramp-1 between Expressway Chainage Km 555+470 to 555+650
2	0+000	0+582	582	34I	Ramp-2 between Expressway Chainage Km 555+980 to 556+390
3	0+000	0+243	243	34I	Ramp-3 between Expressway Chainage Km 559+640 to 559+850
4	0+000	0+300	300	34I	Ramp-4 between Expressway Chainage Km 560+000 to 560+250

F. Section of Katra Bus Stand Link including Loop and Ramps of IC at Km 563+545.

Sl. No.	Design Chainage of Katra Bus Stand Link and Ramps (Km)		Design Length (m)	TCS	Remarks
	From	To			
1	0+000	0+230	230	34A	4 Lane
2	0+230	0+980	750	ROB cum Viaduct	
3	0+980	1+020	40	Viaduct	Loop-1 (2 lane)
4	1+020	1+250	230	Viaduct	
5	1+250	1+360	110	34J	
6	0+980	1+115	135	Viaduct	Ramp-1 (2 lane)
7	1+115	1+225	110	34F	
8	1+225	1+240	15	Underpass	
9	1+240	1+252	12	34D	
10	1+252	1+275	23	VUP	

Sl. No.	Design Chainage of Katra Bus Stand Link and Ramps (Km)		Design Length (m)	TCS	Remarks
	From	To			
11	1+275	1+295	20	34F	
12	0+000	0+150	150	Viaduct	Ramp-2 (2 lane)
13	0+150	0+200	50	34D	
14	0+200	0+230	30	34E	
15	0+230	0+290	60	Viaduct	
16	0+290	0+340	50	34G	
17	0+340	0+415	75	MJB	
18	0+415	0+530	115	34G	
19	0+530	0+593	63	34H	
20	0+000	0+090	90	34E	Ramp-3 (2 lane)
21	0+090	0+120	30	34D	
22	0+120	0+140	20	VUP	
23	0+140	0+235	95	34F	
24	0+235	0+485	250	Viaduct	

Table 1.24: Typical Cross Sections

TCS No.	TCS Description
20	Typical Cross Section for 6-Lane (2X3) Expressway with 4-Lane (2x2) Service Road including Both Side Drain for Builtup Area (Plain/Rolling Terrain - Brown Field Alignment)
20A	Typical Cross Section for 4-Lane (2X2) Expressway with 6-Lane (3+3) Service Road including Both Side Drain for Builtup Area (Mountainous Terrain - Brown Field Alignment)
20B	Typical Cross Section for 5-Lane (2+3) Expressway with 4-Lane (2x2) Service Road and Both Side Ramp including Both Side Drain for Builtup Area (Mountainous Terrain - Brown Field Alignment)
20C	Typical Cross Section for 4-Lane (2X2) Expressway with 4-Lane (2X2) Service Road including Both Side Drain for Builtup Area (Mountainous Terrain - Brown Field Alignment)
20D	Typical Cross Section for 4-Lane (2X2) Expressway with 4-Lane (2X2) Service Road including RHS Drain for Builtup Area (Mountainous Terrain - Brown Field Alignment)
20E	Typical Cross Section for 5-Lane (2+3) Expressway with 5-Lane (3+2) Service Road including Both Side Drain for Builtup Area (Mountainous Terrain - Brown Field Alignment)
20F	Typical Cross Section for 4-Lane (2X2) Expressway with 5-Lane (3+2) Service Road and RHS Ramp including Both Side Drain for Builtup Area (Mountainous Terrain - Brown Field Alignment)
21	Typical Cross Section for 6-Lane (2X3) Elevated Expressway with 6-Lane (2x3) Service Road and 4-Lane (2x2) Slip Road including Both Side Drain (Plain/Rolling Terrain - Brown Field Alignment)
21A	Typical Cross Section for 6-Lane (2X3) Elevated Expressway with 6-Lane (2x3) Service Road including Both Side Drain (Plain/Rolling Terrain - Brown Field Alignment)

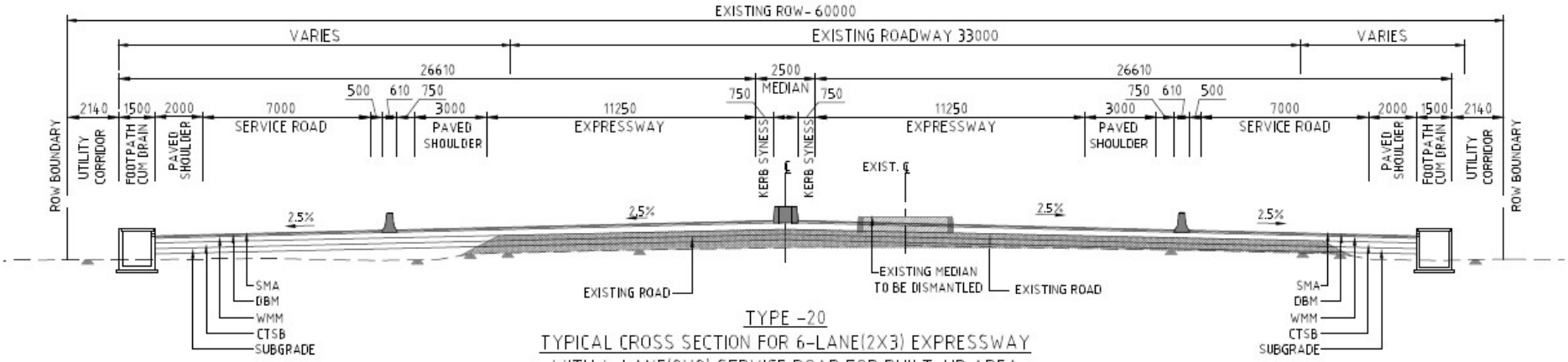
TCS No.	TCS Description
21B	Typical Cross Section for 6-Lane (2X3) Expressway (Flyover Section) with 4-Lane (2x2) Service Road including Both Side Drain (Plain/Rolling Terrain - Brown Field Alignment)
21C	Typical Cross Section for 4-Lane (2X2) Elevated Expressway without Service Road (Mountainous Terrain - Green Field Alignment)
21D	Typical Cross Section for 4-Lane (2X2) Expressway with 4-Lane (2X2) Service Road including RHS Breast Wall (Mountainous Terrain - Brown Field Alignment)
21E	Typical Cross Section for 4-Lane (2X2) Expressway with Service Road including LHS Retaining Wall (Mountainous Terrain - Brown Field Alignment)
21F	Typical Cross Section for 4-Lane (2X2) Expressway with Service Road (Mountainous Terrain - Brown Field Alignment)
21G	Typical Cross Section for 4-Lane (2X2) Expressway with 4-Lane (2X2) Service Road including LHS Retaining Wall and RHS Breast Wall (Mountainous Terrain - Brown Field Alignment)
21H	Typical Cross Section for 6-Lane (2X3) Expressway with 4-Lane (2x2) Service Road for Elevated/Flyover approach including Both Side Drain (Plain/Rolling Terrain - Brown Field Alignment)
21I	Typical Cross Section for 4-Lane (2X2) Expressway (Flyover Section) with 4-Lane (2x2) Service Road (Mountainous Terrain - Brown Field Alignment)
21J	Typical Cross Section for 4-Lane (2X2) Expressway with 4-Lane (2X2) Service Road for Elevated/Flyover Approach including Both Side Drain (Mountainous Terrain - Brown Field Alignment)
21K	Typical Cross Section for 4-Lane (2X2) Expressway with 4-Lane (2X2) Service Road for Elevated/Flyover Approach including LHS Toe Wall and RHS Breast Wall (Mountainous Terrain - Brown Field Alignment)
21L	Typical Cross Section for 4-Lane (2X2) Expressway with 4-Lane (2X2) Service Road including Both Side Breast Wall (Mountainous Terrain - Brown Field Alignment)
21M	Typical Cross Section for 4-Lane (2X2) Expressway with 4-Lane (2X2) Service Road including Both Side Breast Wall (Mountainous Terrain - Brown Field Alignment)
21N	Typical Cross Section for 4-Lane (2X2) Expressway with Service Road including LHS Breast Wall (Mountainous Terrain - Brown Field Alignment)
21O	Typical Cross Section for 4-Lane (2X2) Expressway for ROB Section with Both Side Service Road (Mountainous Terrain - Brown Field Alignment)
21P	Typical Cross Section for 4-Lane (2X2) Expressway with 4-Lane (2X2) Service Road including RHS Breast Wall (Mountainous Terrain - Brown Field Alignment)
21Q	Typical Cross Section for 4-Lane (2X2) Expressway with 2-Lane Service Road on LHS (Mountainous Terrain - Greeen Field Alignment)
21R	Typical Cross Section for 4-Lane (2X2) Expressway with 4-Lane (2X2) Service Road including RHS Drain (Mountainous Terrain - Brown Field Alignment)
21S	Typical Cross Section for 4-Lane (2X2) Expressway with 4-Lane (2X2) Service Road (Mountainous Terrain - Brown Field Alignment)
21T	Typical Cross Section for 4-Lane (2X2) Expressway with 4-Lane (2X2) Service Road including LHS Toe Wall (Mountainous Terrain - Brown Field Alignment)
21U	Typical Cross Section for 4-Lane (2X2) Expressway with 4-Lane (2X2) Service Road including LHS Toe Wall (Mountainous Terrain - Brown Field Alignment)

TCS No.	TCS Description
21V	Typical Cross Section for 4-Lane (2X2) Expressway with 6-Lane (2X3) Service Road for Elevated/Flyover Approach including Both Side Drain (Mountainous Terrain - Brown Field Alignment)
21W	Typical Cross Section for 5-Lane (2+3) Expressway with 5-Lane (3+2) Service Road for Elevated/Flyover Approach including Both Side Drain (Mountainous Terrain - Brown Field Alignment)
22	Typical Cross Section for 2-Lane Ramp (Mountainous Terrain - Brown Field Alignment)
22A	Typical Cross Section for 2-Lane Ramp including LHS Retaining Wall (Mountainous Terrain - Brown Field Alignment)
22B	Typical Cross Section for 2-Lane LHS Ramp and 2-Lane RHS Service Road including RHS Breast Wall (Mountainous Terrain - Brown Field Alignment)
22C	Typical Cross Section for Truck Lay Bye on LHS and 2-Lane Service Road on RHS including RHS Breast Wall (Mountainous Terrain - Brown Field Alignment)
22D	Typical Cross Section for 4-Lane (2x2) Service Road (Mountainous Terrain - Brown Field Alignment)
22E	Typical Cross Section for 2-Lane Ramp including LHS Retaining Wall (Mountainous Terrain - Brown Field Alignment)
22F	Typical Cross Section for 2-Lane Ramp including RHS Retaining Wall (Mountainous Terrain - Brown Field Alignment)
22G	Typical Cross Section for 2-Lane Ramp including Both Side Retaining Wall (Mountainous Terrain - Brown Field Alignment)
22H	Typical Cross Section for 2-Lane RHS Service Road including RHS Breast Wall (Mountainous Terrain - Brown Field Alignment)
22I	Typical Cross Section for Truck Lay Bye on LHS and 2-Lane Service Road on RHS including RHS Breast Wall (Mountainous Terrain - Brown Field Alignment)
22J	Typical Cross Section for 2-Lane Service Road on LHS and Truck Lay Bye on RHS including RHS Breast Wall (Mountainous Terrain - Brown Field Alignment)
29B	Typical Cross Section for 4-Lane (2X2) Expressway with 4-Lane (2x2) Service Road including Both Side Drain (Mountainous Terrain - Brown Field Alignment)
29C	Typical Cross Section for 4-Lane (2X2) Expressway with 4-Lane (2x2) Service Road including Both Side Drain and Breast Wall (Mountainous Terrain - Brown Field Alignment)
29D	Typical Cross Section for 4-Lane (2X2) Expressway with 4-Lane (2x2) Service Road including Both Side Drain (Mountainous Terrain - Brown Field Alignment)
29E	Typical Cross Section for 4-Lane (2X2) Expressway with 4-Lane (2x2) Ramps including LHS Walkway and Breast Wall (Mountainous Terrain)
29F	Typical Cross Section for 4-Lane (2X2) Expressway with 4-Lane (2x2) Ramps and LHS Service Road including LHS Walkway and Breast Wall (Mountainous Terrain)
29G	Typical Cross Section for 4-Lane (2X2) Expressway with 4-Lane (2x2) Ramps and Both Side Service Road including LHS Walkway and Both Side Toe Wall (Mountainous Terrain)
29H	Typical Cross Section for 4-Lane (2X2) Expressway with Both Side Service Road including LHS Walkway and Both Side Toe Wall for Elevated/Flyover Approach (Mountainous Terrain)
29I	Typical Cross Section for 4-Lane (2X2) Expressway with Both Side Service Road including LHS Walkway and RHS Toe Wall & LHS Breast Wall for Elevated/Flyover Approach (Mountainous Terrain)

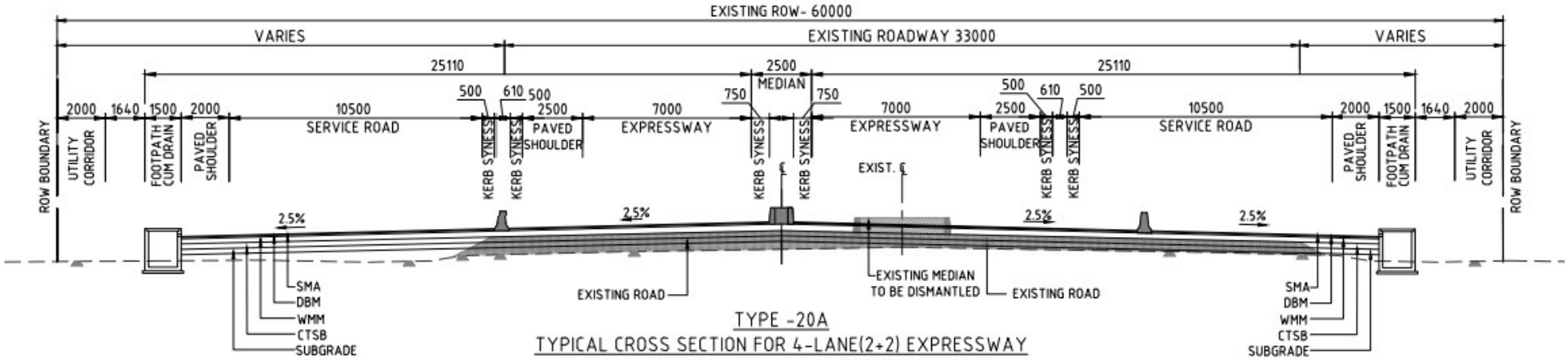
TCS No.	TCS Description
29J	Typical Cross Section for 4-Lane (2X2) Expressway with Both Side Service Road including LHS Walkway and Toe Wall (Mountainous Terrain)
29K	Typical Cross Section for 4-Lane (2X2) Expressway with Both Side Service Road including LHS Walkway and Breast Wall (Mountainous Terrain)
29L	Typical Cross Section for 4-Lane (2X2) Expressway with Both Side Service Road including LHS Walkway and Breast Wall & RHS Toe Wall (Mountainous Terrain)
29M	Typical Cross Section for 4-Lane (2X2) Expressway with Both Side Service Road including LHS Walkway and Both Side Toe Wall (Mountainous Terrain)
29N	Typical Cross Section for 4-Lane (2X2) Expressway with Both Side Service Road including LHS Walkway and Toe Wall & RHS Retaining Wall for Elevated/Flyover Approach (Mountainous Terrain)
29O	Typical Cross Section for 4-Lane (2X2) Expressway with Both Side Service Road including LHS Walkway and Breast Wall (Mountainous Terrain)
29P	Typical Cross Section for 4-Lane (2X2) Expressway with RHS Service Road and Retaining Wall for Elevated/Flyover Approach (Mountainous Terrain)
29Q	Typical Cross Section for 4-Lane (2X2) Expressway with Both Side Service Road including LHS Walkway and Both Side Breast Wall (Mountainous Terrain)
29R	Typical Cross Section for 4-Lane (2X2) Expressway with Both Side Service Road including LHS Walkway and Breast Wall for Elevated/Flyover Approach (Mountainous Terrain)
29S	Typical Cross Section for 4-Lane (2X2) Expressway with Both Side Service Road including LHS Walkway and RHS Retaining Wall (Mountainous Terrain)
29T	Typical Cross Section for 4-Lane (2X2) Expressway with Both Side Service Road including LHS Walkway and RHS Retaining Wall for Elevated/Flyover Approach (Mountainous Terrain)
29U	Typical Cross Section for 4-Lane (2X2) Expressway with Both Side Service Road including LHS Walkway and Breast Wall & RHS Toe Wall (Mountainous Terrain)
29V	Typical Cross Section for 4-Lane (2X2) Expressway with Both Side Service Road including LHS Walkway and RHS Retaining Wall (Mountainous Terrain)
29W	Typical Cross Section for 4-Lane (2X2) Expressway with Both Side Service Road including LHS Walkway and Breast Wall & RHS Retaining Wall for Elevated/Flyover Approach (Mountainous Terrain)
30A	Typical Cross Section for 4-Lane (2X2) Expressway Elevated Section with Both Side Service Road including LHS Walkway (Mountainous Terrain)
30B	Typical Cross Section for 4-Lane (2X2) Expressway Elevated Section with Both Side Service Road including LHS Walkway and Toe Wall (Mountainous Terrain)
30C	Typical Cross Section for 4-Lane (2X2) Expressway Elevated Section with Both Side Service Road including LHS Walkway and Retaining Wall & RHS Breast Wall (Mountainous Terrain)
30D	Typical Cross Section for 4-Lane (2X2) Expressway Elevated Section with Both Side Service Road including LHS Walkway and Retaining Wall (Mountainous Terrain)
30E	Typical Cross Section for 4-Lane (2X2) Expressway Elevated Section with Both Side Service Road including LHS Walkway and Both Side Breast Wall (Mountainous Terrain)
30F	Typical Cross Section for 4-Lane (2X2) Expressway Elevated Section with Both Side Service Road including LHS Walkway and Toe Wall (Mountainous

TCS No.	TCS Description
	Terrain)
30G	Typical Cross Section for 4-Lane (2X2) Expressway Elevated Section with Both Side Service Road including LHS Walkway (Mountainous Terrain)
30H	Typical Cross Section for 4-Lane (2X2) Expressway Elevated Section with Both Side Service Road including LHS Walkway (Mountainous Terrain)
31	Typical Cross Section for 4-Lane (2X2) Expressway Elevated Section including LHS Walkway (Mountainous Terrain)
31A	Typical Cross Section for 4-Lane (2X2) Expressway Elevated Section including LHS Walkway and Both Side Service Road (Mountainous Terrain)
31B	Typical Cross Section for 4-Lane (2X2) Expressway Elevated Section including LHS Walkway and Connecting Road (Mountainous Terrain)
32A	Typical Cross Section for 4-Lane (2X2) Expressway including LHS Walkway and Both Side Toe Wall (Mountainous Terrain)
32B	Typical Cross Section for 4-Lane (2X2) Expressway including LHS Walkway and Both Side Breast Wall (Mountainous Terrain)
32C	Typical Cross Section for 4-Lane (2X2) Expressway including LHS Walkway and Breast Wall & RHS Toe Wall (Mountainous Terrain)
32D	Typical Cross Section for 4-Lane (2X2) Expressway including LHS Walkway, Connecting Road and Breast Wall (Mountainous Terrain)
32E	Typical Cross Section for 4-Lane (2X2) Expressway including LHS Walkway, Connecting Road and Breast Wall & RHS Toe Wall (Mountainous Terrain)
33A	Typical Cross Section for 4-Lane (2X2) Highway including RHS Breast Wall (Mountainous Terrain)
33B	Typical Cross Section for 4-Lane (2X2) Highway including LHS Toe wall and RHS Breast Wall (Mountainous Terrain)
33C	Typical Cross Section for 4-Lane (2X2) Highway including RHS Drain (Mountainous Terrain)
33D	Typical Cross Section for 4-Lane (2X2) Highway including LHS Breast wall and RHS Drain (Mountainous Terrain)
33E	Typical Cross Section for 4-Lane (2X2) Highway including Both Side Retaining wall and RHS Walkway (Mountainous Terrain)
33F	Typical Cross Section for 4-Lane (2X2) Highway including RHS Walkway for Elevated/Flyover Approach (Mountainous Terrain)
33G	Typical Cross Section for 4-Lane (2X2) Highway including RHS Walkway and Retaining Wall (Mountainous Terrain)
33H	Typical Cross Section for 4-Lane (2X2) Highway including Retaining Wall and RHS Walkway & Service Road (Mountainous Terrain)
33I	Typical Cross Section for 4-Lane (2X2) Highway including RHS Walkway and Retaining Wall and (Mountainous Terrain)
33J	Typical Cross Section for 4-Lane (2X2) Highway including LHS Breast Wall and RHS Drain (Mountainous Terrain)
33K	Typical Cross Section for 4-Lane (2X2) Highway including LHS Walkway and RHS Breast Wall (Mountainous Terrain)
33L	Typical Cross Section for 4-Lane (2X2) Highway including Ramp & LHS Walkway and RHS Retaining Wall (Mountainous Terrain)

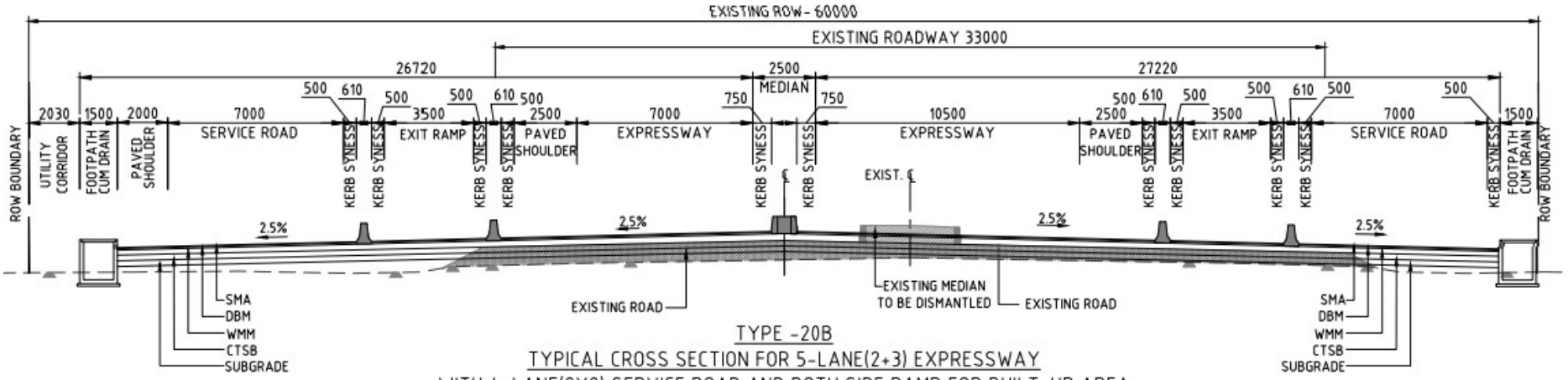
TCS No.	TCS Description
33M	Typical Cross Section for 4-Lane (2X2) Highway including LHS Walkway and Both Side Retaining Wall (Mountainous Terrain)
33N	Typical Cross Section for 2-Lane Highway including LHS Walkway and Both Side Retaining Wall (Mountainous Terrain)
34	Typical Cross Section for 4-Lane (2X2) Expressway Elevated Section (Mountainous Terrain)
34A	Typical Cross Section for 4-Lane (2X2) Expressway for Elevated/Flyover Approach and RHS Connecting Road (Mountainous Terrain)
34B	Typical Cross Section for 2-Lane Elevated Loop (Mountainous Terrain)
34C	Typical Cross Section for 2-Lane Elevated Loop/Ramp including Walkway (Mountainous Terrain)
34D	Typical Cross Section for 2-Lane Loop/Ramp including Walkway and Both Side Retaining Wall (Mountainous Terrain)
34E	Typical Cross Section for 2-Lane Loop/Ramp including LHS Walkway & Breast Wall and Both Side Retaining Wall (Mountainous Terrain)
34F	Typical Cross Section for 2-Lane Loop/Ramp including Both Side Retaining Wall (Mountainous Terrain)
34G	Typical Cross Section for 2-Lane Loop/Ramp including Both Side Breast Wall (Mountainous Terrain)
34H	Typical Cross Section for 2-Lane Loop/Ramp including LHS Breast Wall (Mountainous Terrain)
34I	Typical Cross Section for Service Road including LHSWalkway and Breast Wall (Mountainous Terrain)
34J	Typical Cross Section for 2-Lane Loop/Ramp including Walkway and Breast Wall (Mountainous Terrain)
34K	Typical Cross Section for 2-Lane with Paved Shoulder (Mountainous Terrain)



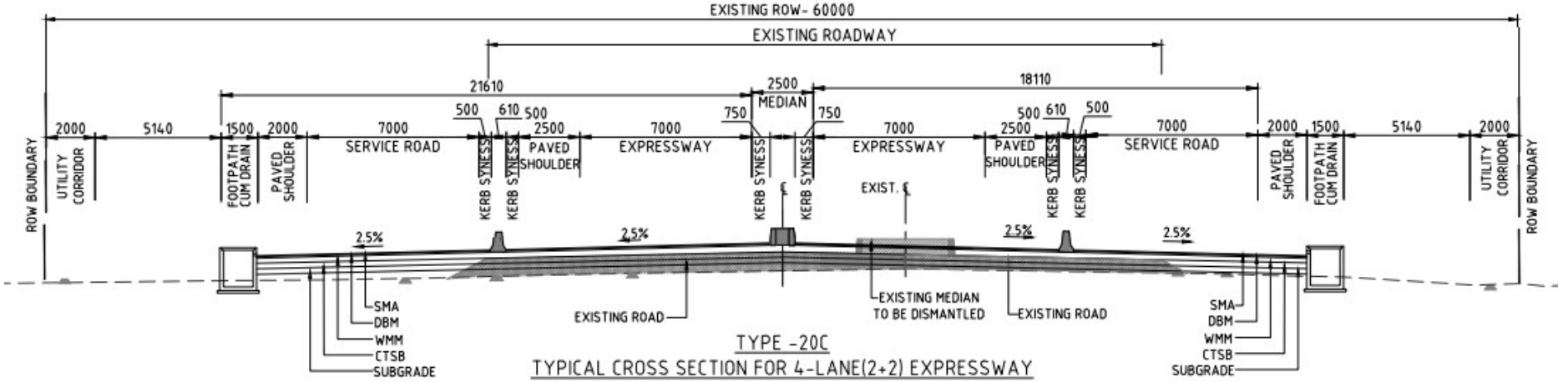
TYPE -20
TYPICAL CROSS SECTION FOR 6-LANE(2X3) EXPRESSWAY
WITH 4-LANE(2X2) SERVICE ROAD FOR BUILT-UP AREA
(PLAIN/ROLLING TERRAIN-BROWN FIELD ALIGNMENT)



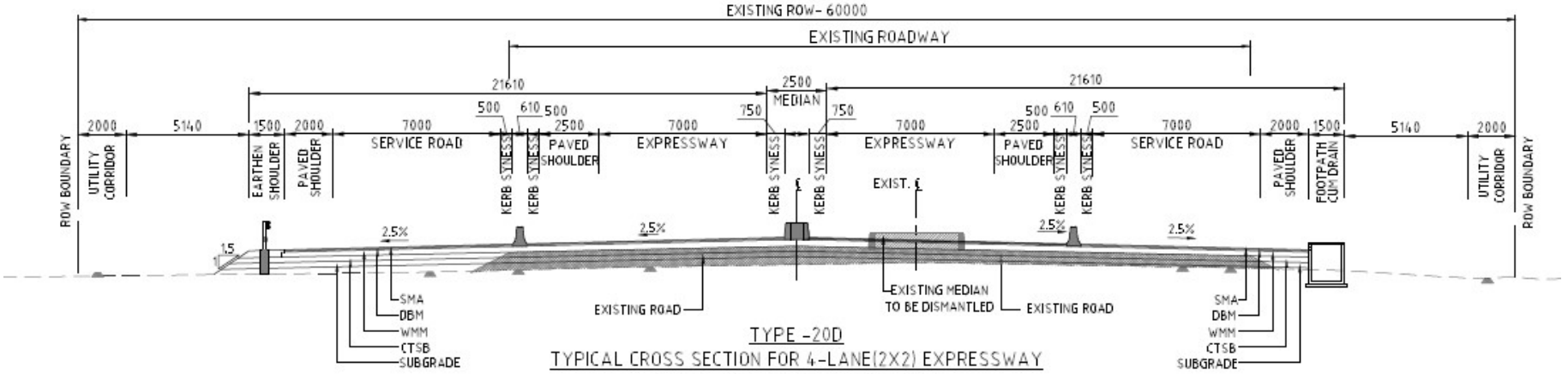
TYPE -20A
TYPICAL CROSS SECTION FOR 4-LANE(2+2) EXPRESSWAY
WITH 6-LANE(3+3) SERVICE ROAD FOR BUILT-UP AREA
(MOUNTAINOUS TERRAIN-BROWN FIELD ALIGNMENT)



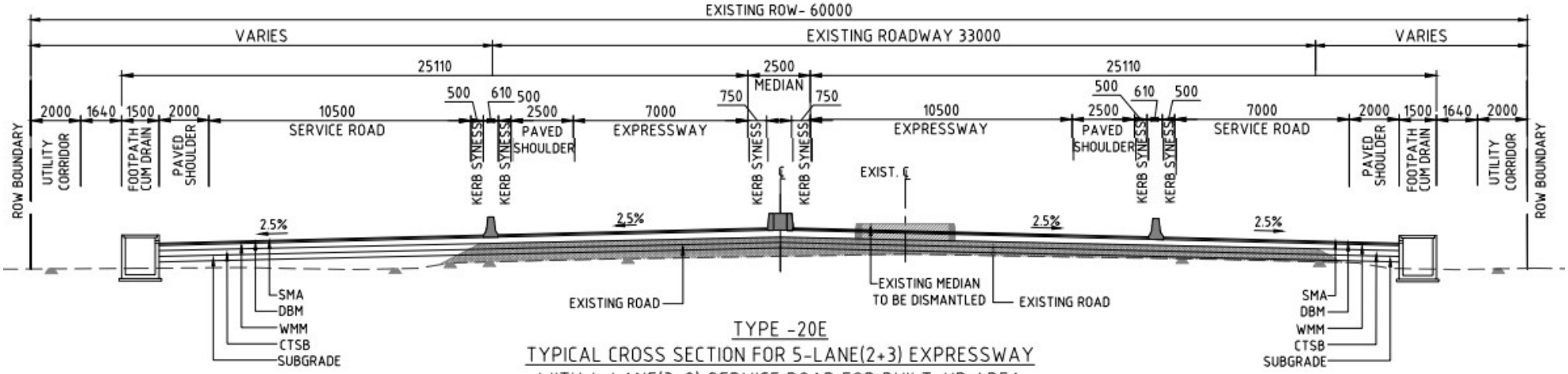
TYPE -20B
TYPICAL CROSS SECTION FOR 5-LANE(2+3) EXPRESSWAY
WITH 4-LANE(2X2) SERVICE ROAD AND BOTH SIDE RAMP FOR BUILT-UP AREA
(MOUNTAINOUS TERRAIN-BROWN FIELD ALIGNMENT)



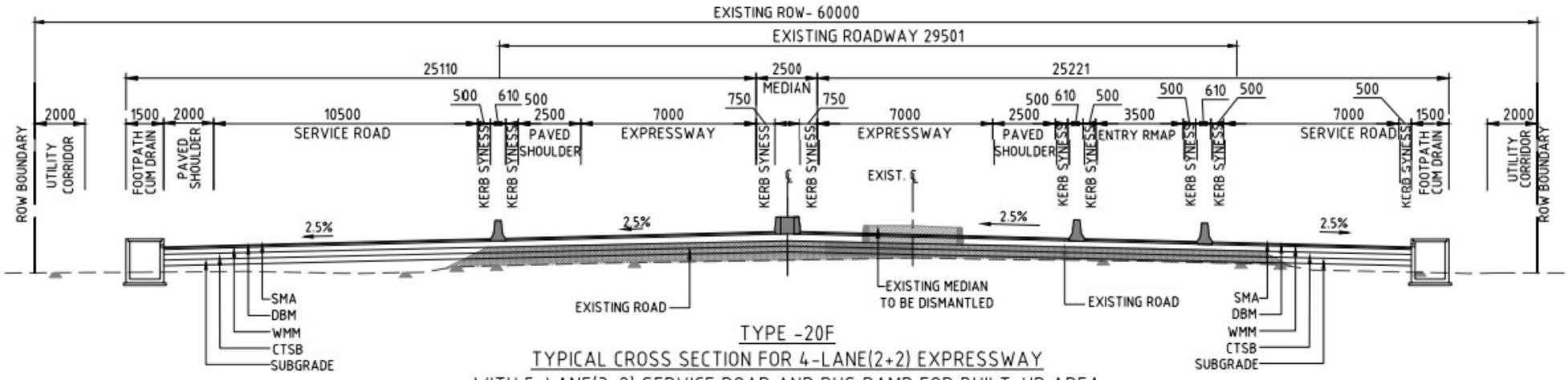
TYPE -20C
TYPICAL CROSS SECTION FOR 4-LANE(2+2) EXPRESSWAY
WITH 4-LANE(2X2) SERVICE ROAD FOR BUILT-UP AREA
(MOUNTAINOUS TERRAIN-BROWN FIELD ALIGNMENT)



TYPE -20D
TYPICAL CROSS SECTION FOR 4-LANE(2X2) EXPRESSWAY
WITH 4-LANE(2X2) SERVICE ROAD
(MOUNTAINOUS TERRAIN-BROWN FIELD ALIGNMENT)

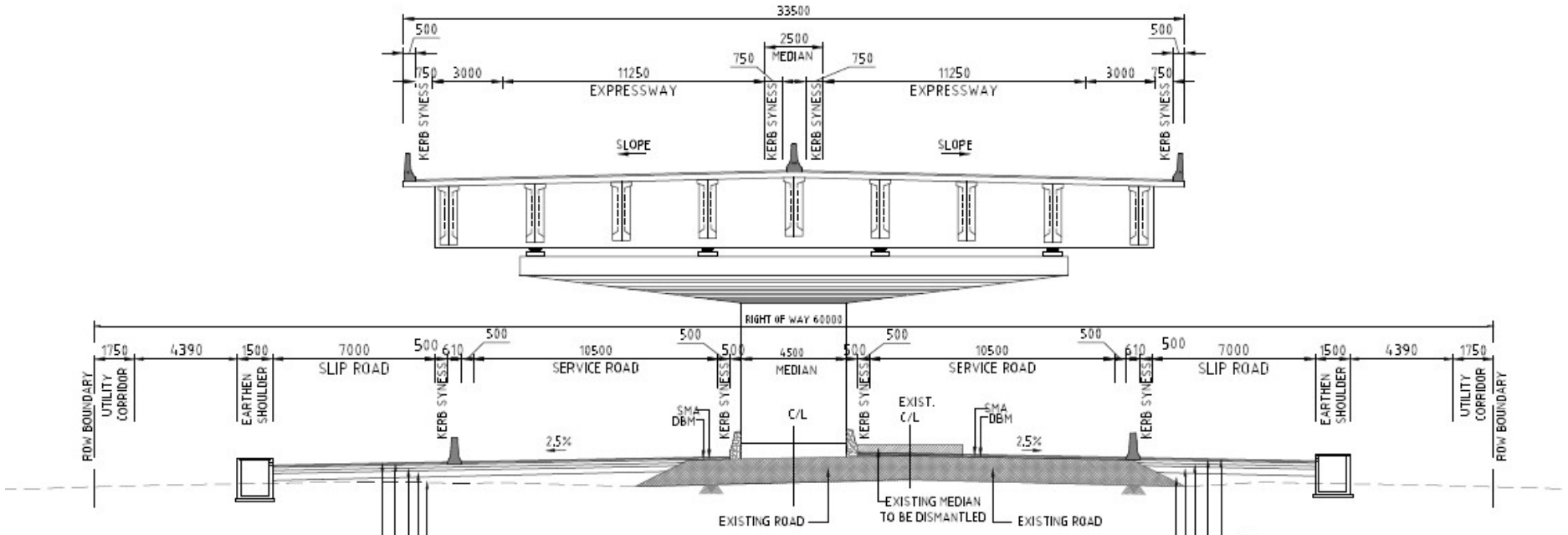


TYPE -20E
TYPICAL CROSS SECTION FOR 5-LANE(2+3) EXPRESSWAY
WITH 4-LANE(3+2) SERVICE ROAD FOR BUILT-UP AREA
(MOUNTAINOUS TERRAIN-BROWN FIELD ALIGNMENT)



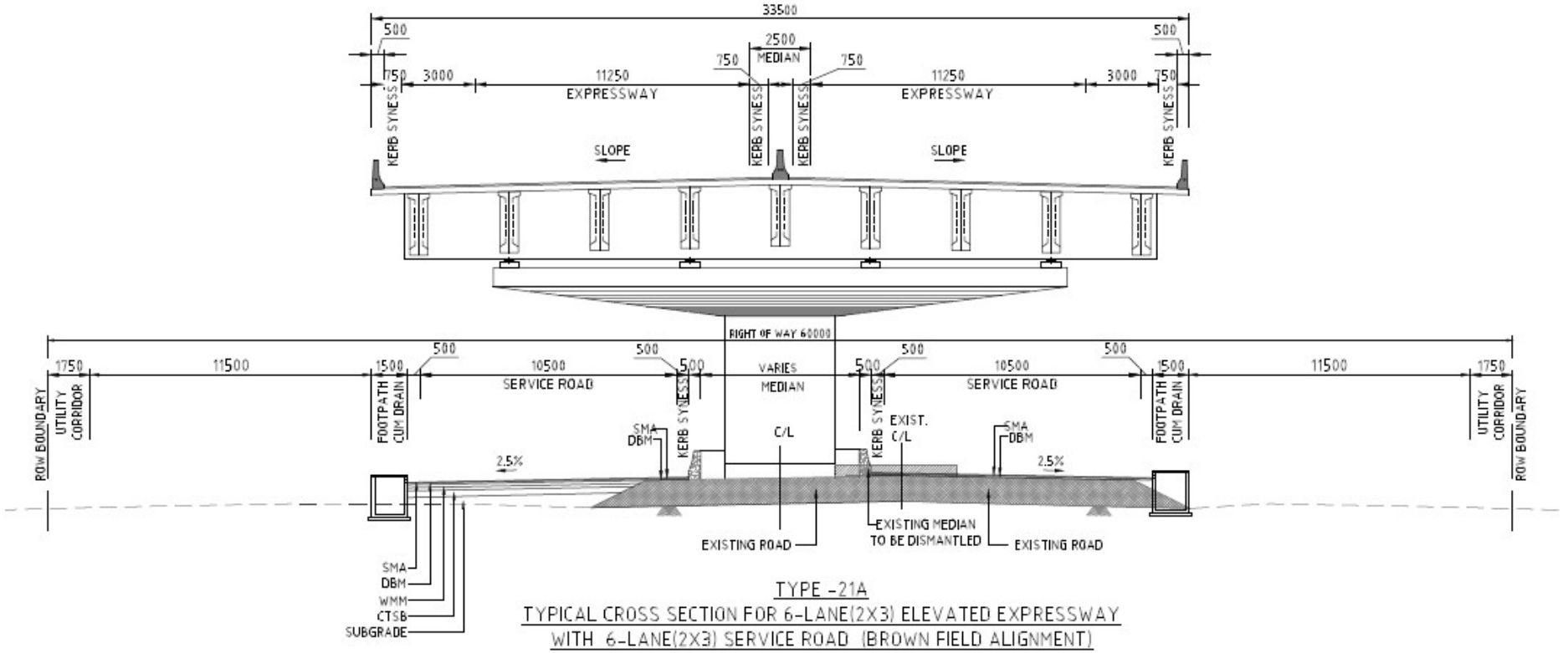
TYPE -20F

TYPICAL CROSS SECTION FOR 4-LANE(2+2) EXPRESSWAY WITH 5-LANE(3+2) SERVICE ROAD AND RHS RAMP FOR BUILT-UP AREA (MOUNTAINOUS TERRAIN-BROWN FIELD ALIGNMENT)



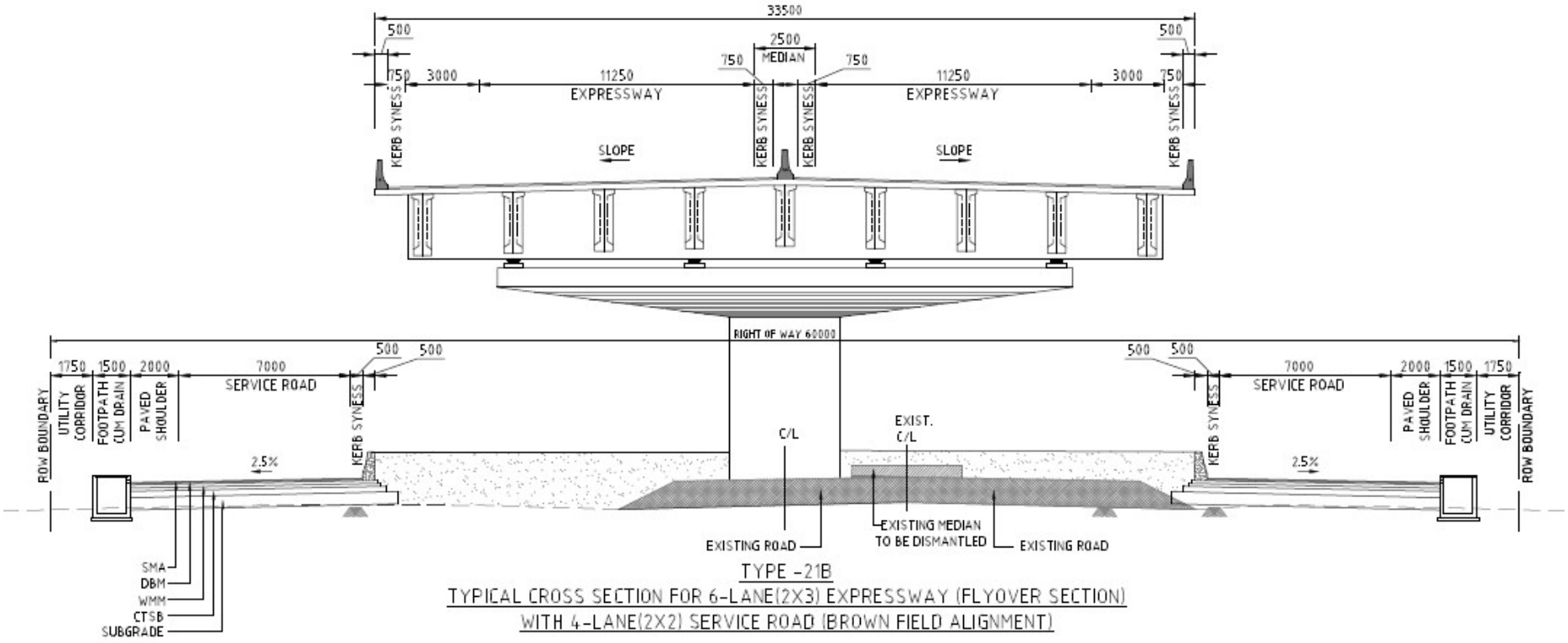
TYPE -21

TYPICAL CROSS SECTION FOR 6-LANE(2X3) ELEVATED EXPRESSWAY WITH 6-LANE(2X3) SERVICE ROAD AND 4-LANE(2X2) SLIP ROAD (BROWN FIELD ALIGNMENT)



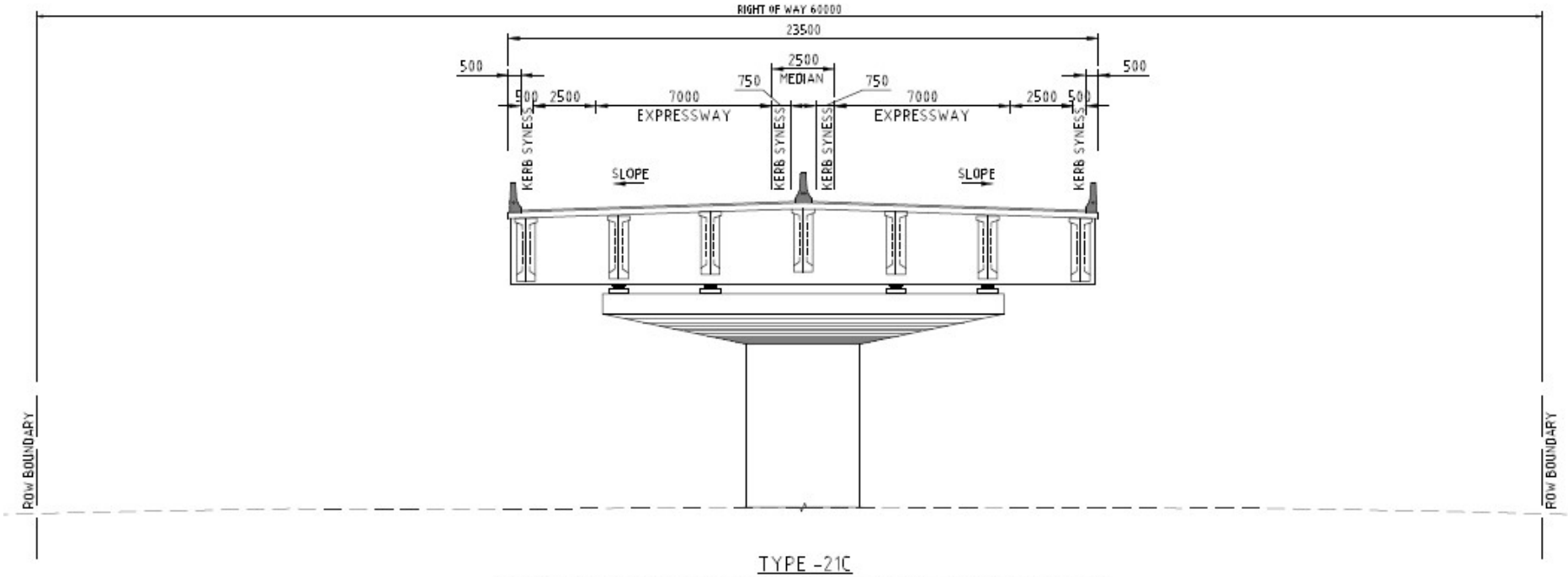
TYPE -21A

TYPICAL CROSS SECTION FOR 6-LANE(2X3) ELEVATED EXPRESSWAY WITH 6-LANE(2X3) SERVICE ROAD (BROWN FIELD ALIGNMENT)

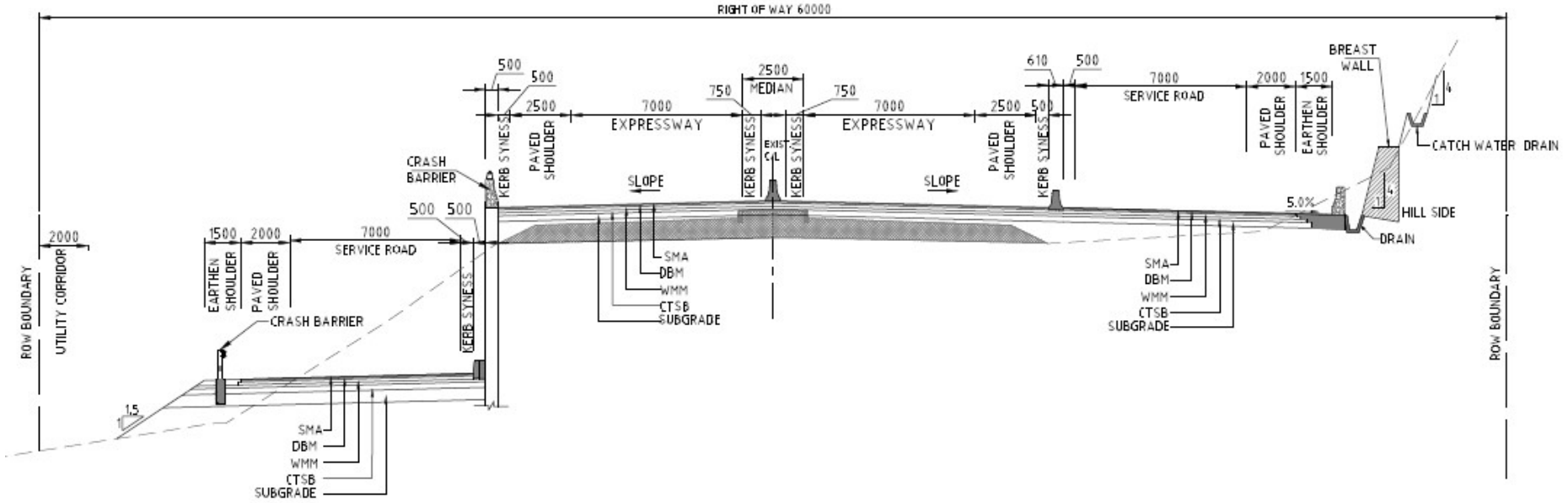


TYPE -21B

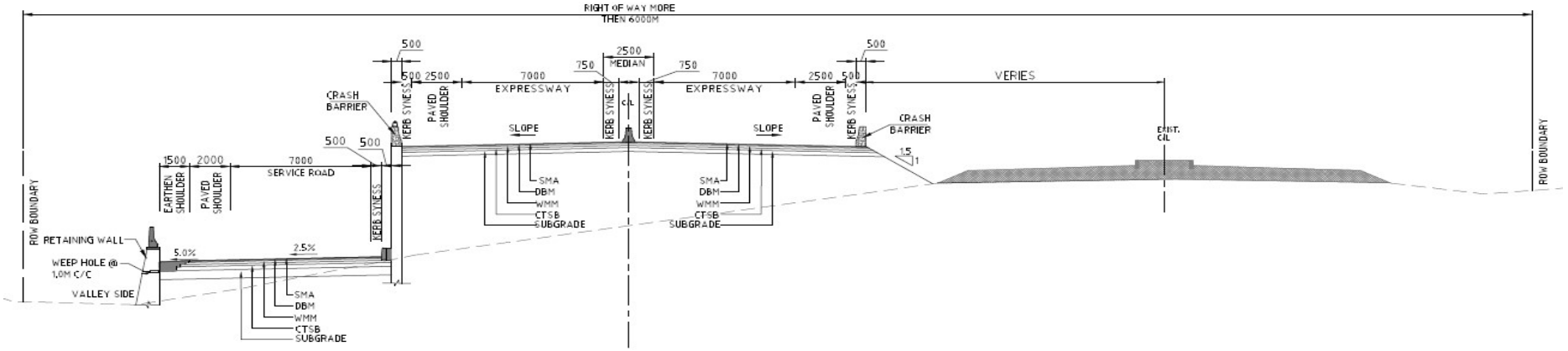
TYPICAL CROSS SECTION FOR 6-LANE(2X3) EXPRESSWAY (FLYOVER SECTION) WITH 4-LANE(2X2) SERVICE ROAD (BROWN FIELD ALIGNMENT)



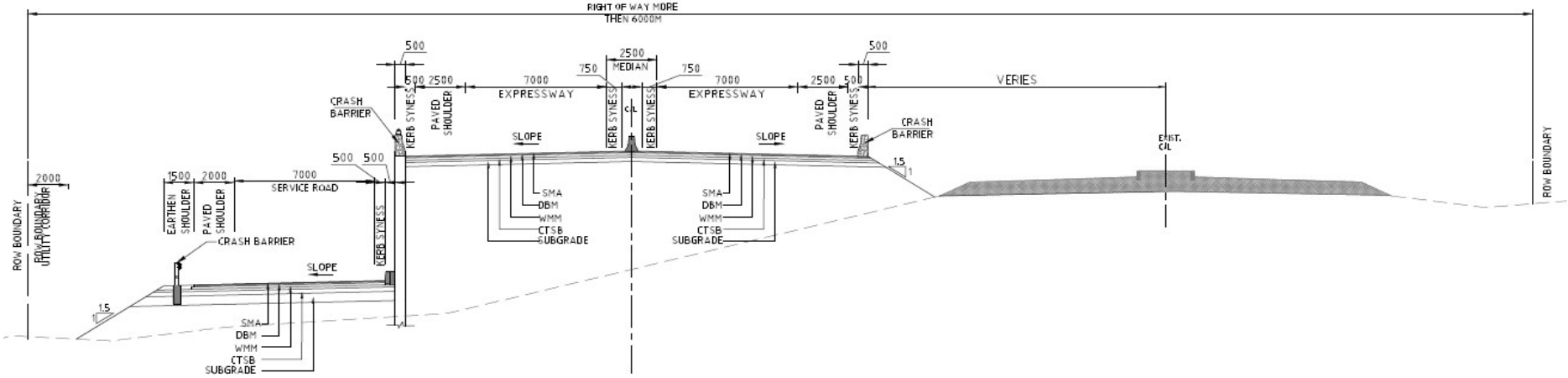
TYPE -21C
TYPICAL CROSS SECTION FOR 4-LANE(2X2) ELEVATED EXPRESSWAY
WITHOUT SERVICE ROAD (MOUNTAINOUS TERRAIN - GREEN FIELD ALIGNMENT)



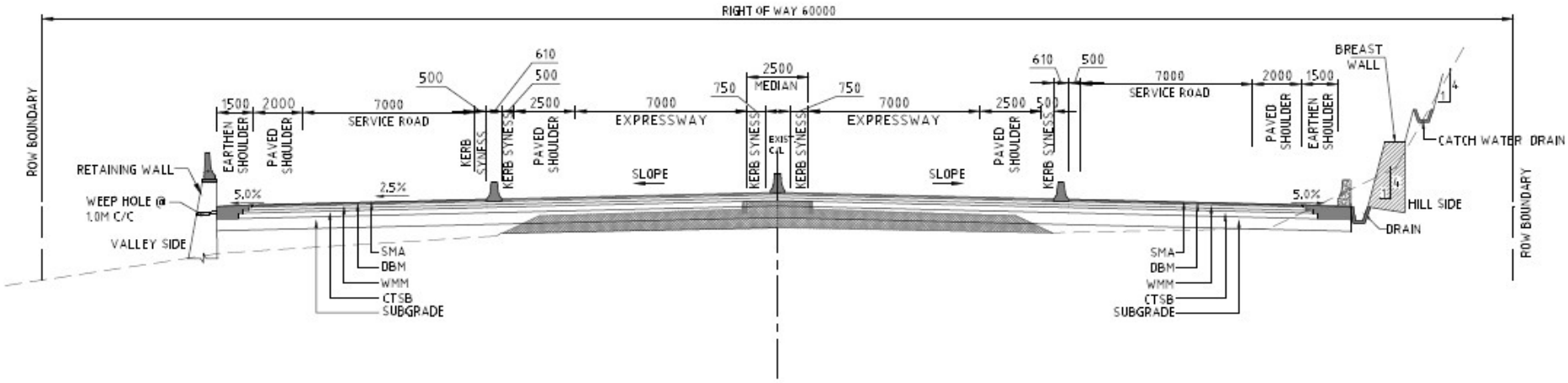
TYPE -21D
TYPICAL CROSS SECTION FOR 4-LANE(2X2)EXPRESSWAY
WITH 4-LANE(2X2) SERVICE ROAD (BROWN FIELD ALIGNMENT)



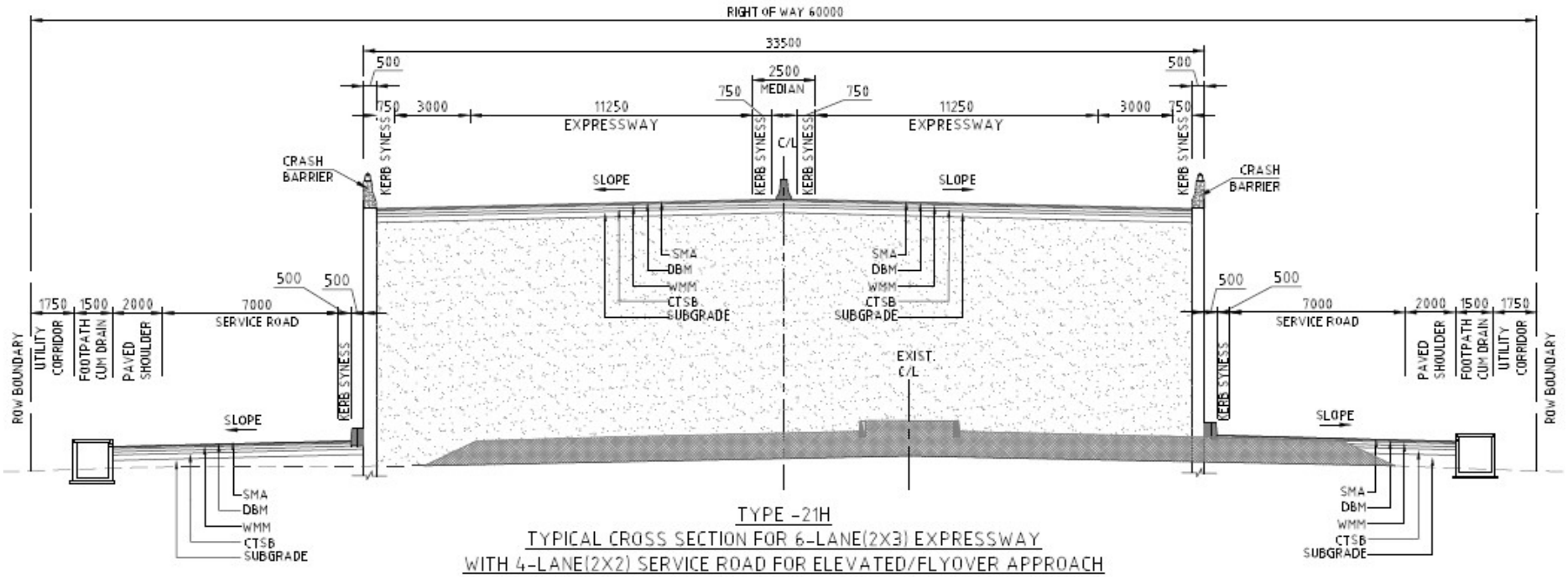
TYPE –21E
TYPICAL CROSS SECTION FOR 4-LANE(2X2)EXPRESSWAY WITH SERVICE ROAD
(MOUNTAINOUS TERRAIN – BROWN FIELD ALIGNMENT)



TYPE –21F
TYPICAL CROSS SECTION FOR 4-LANE(2X2)EXPRESSWAY WITH SERVICE ROAD
(MOUNTAINOUS TERRAIN – BROWN FIELD ALIGNMENT)

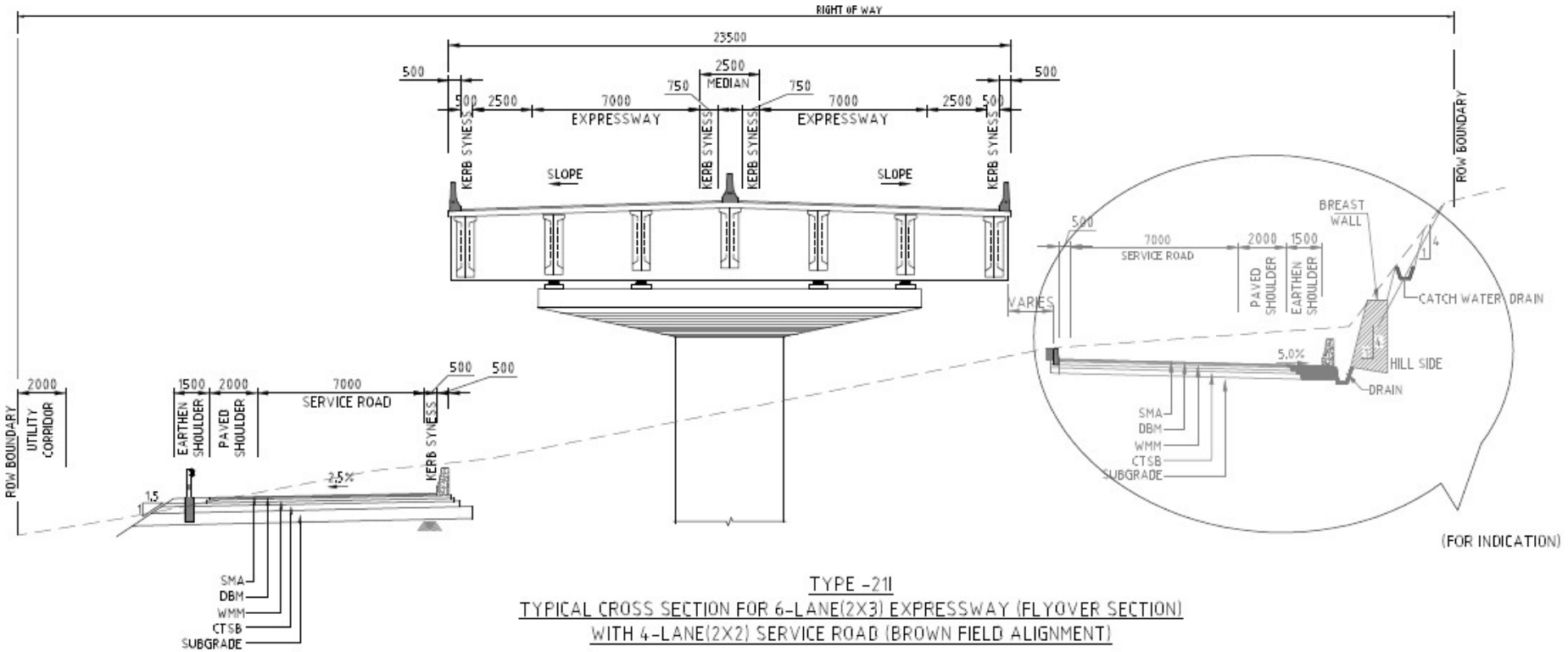


TYPE -21G
TYPICAL CROSS SECTION FOR 4-LANE(2X2)EXPRESSWAY
WITH 4-LANE(2X2) SERVICE ROAD (BROWN FIELD ALIGNMENT)



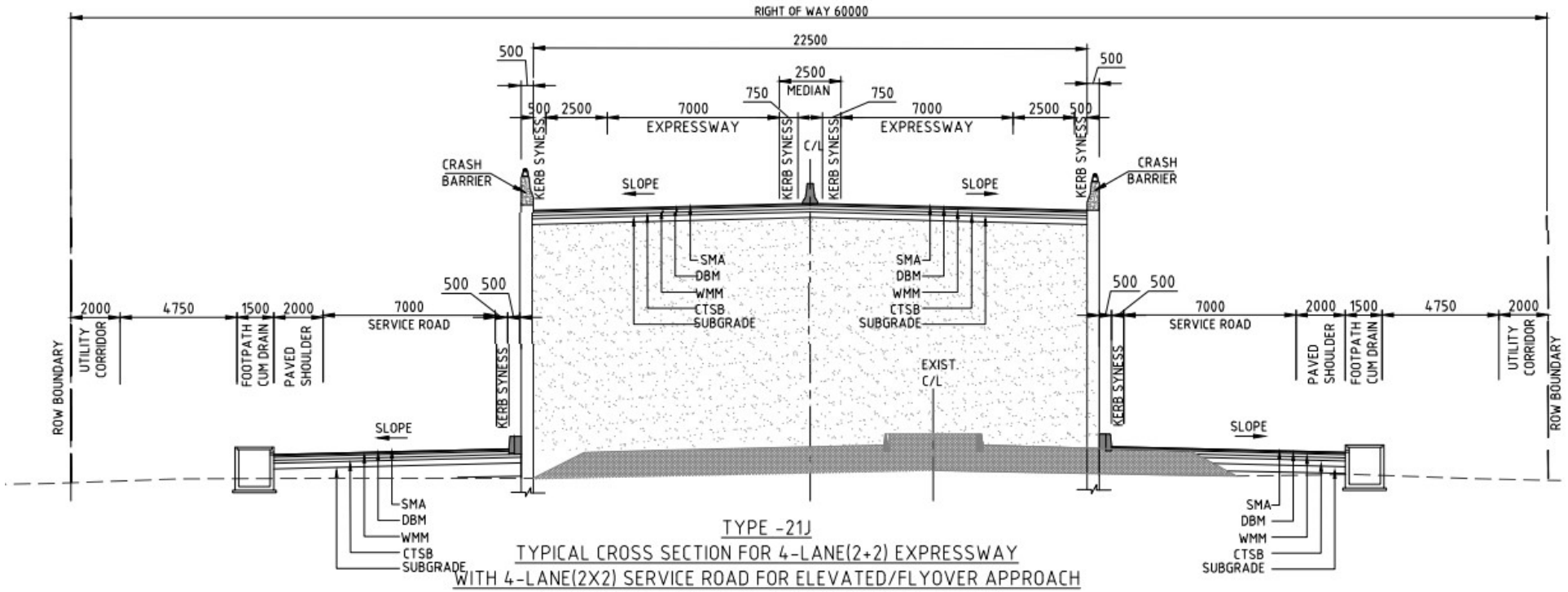
TYPE -21H

TYPICAL CROSS SECTION FOR 6-LANE(2X3) EXPRESSWAY WITH 4-LANE(2X2) SERVICE ROAD FOR ELEVATED/FLYOVER APPROACH (BROWN FIELD ALIGNMENT)



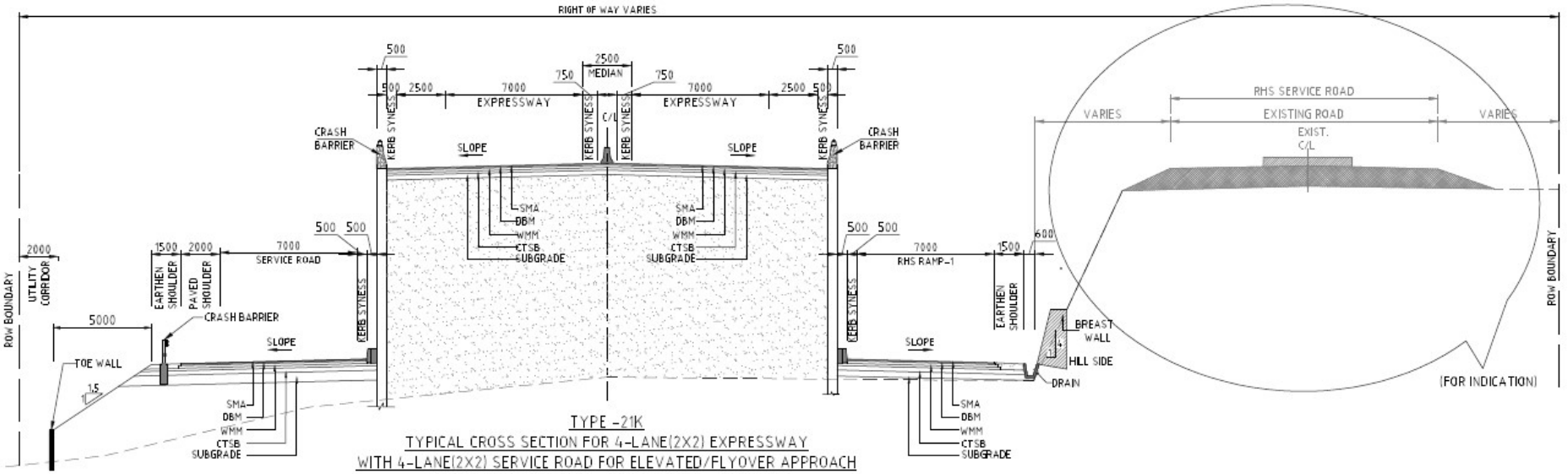
TYPE -2II

TYPICAL CROSS SECTION FOR 6-LANE(2X3) EXPRESSWAY (FLYOVER SECTION) WITH 4-LANE(2X2) SERVICE ROAD (BROWN FIELD ALIGNMENT)

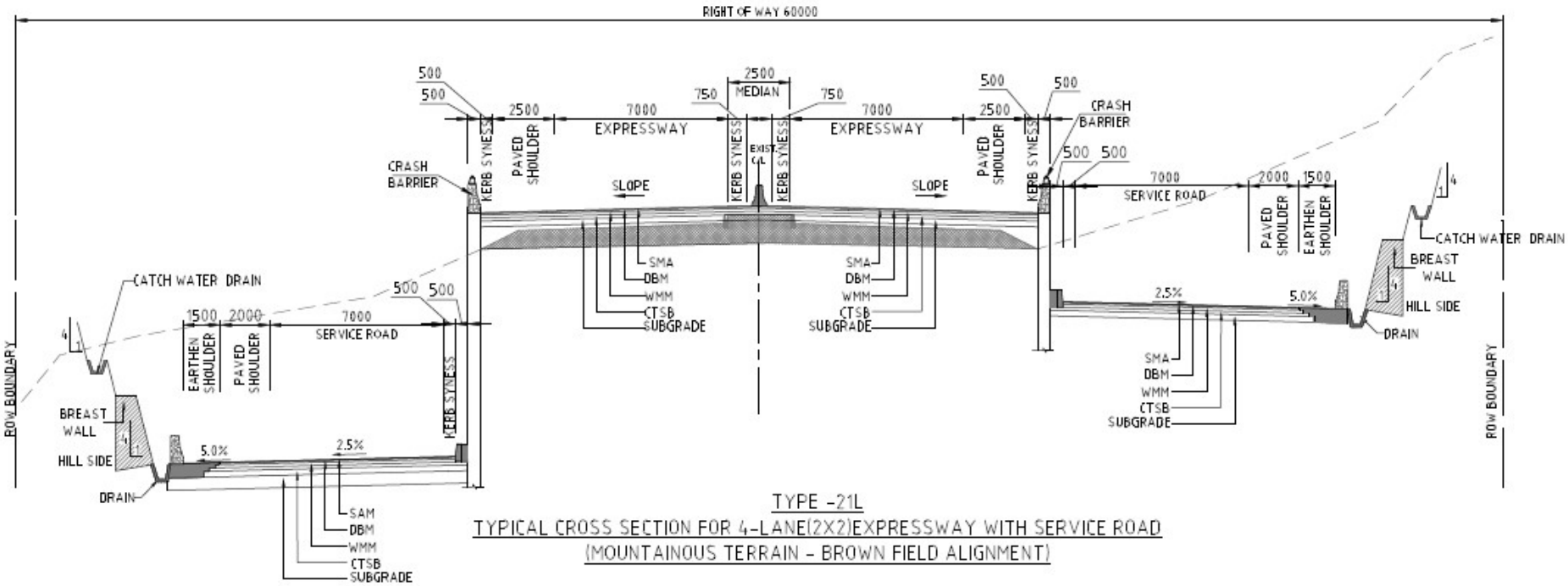


TYPE -21J

TYPICAL CROSS SECTION FOR 4-LANE(2+2) EXPRESSWAY WITH 4-LANE(2X2) SERVICE ROAD FOR ELEVATED/FLYOVER APPROACH (MOUNTAINOUS TERRAIN - BROWN FIELD ALIGNMENT)



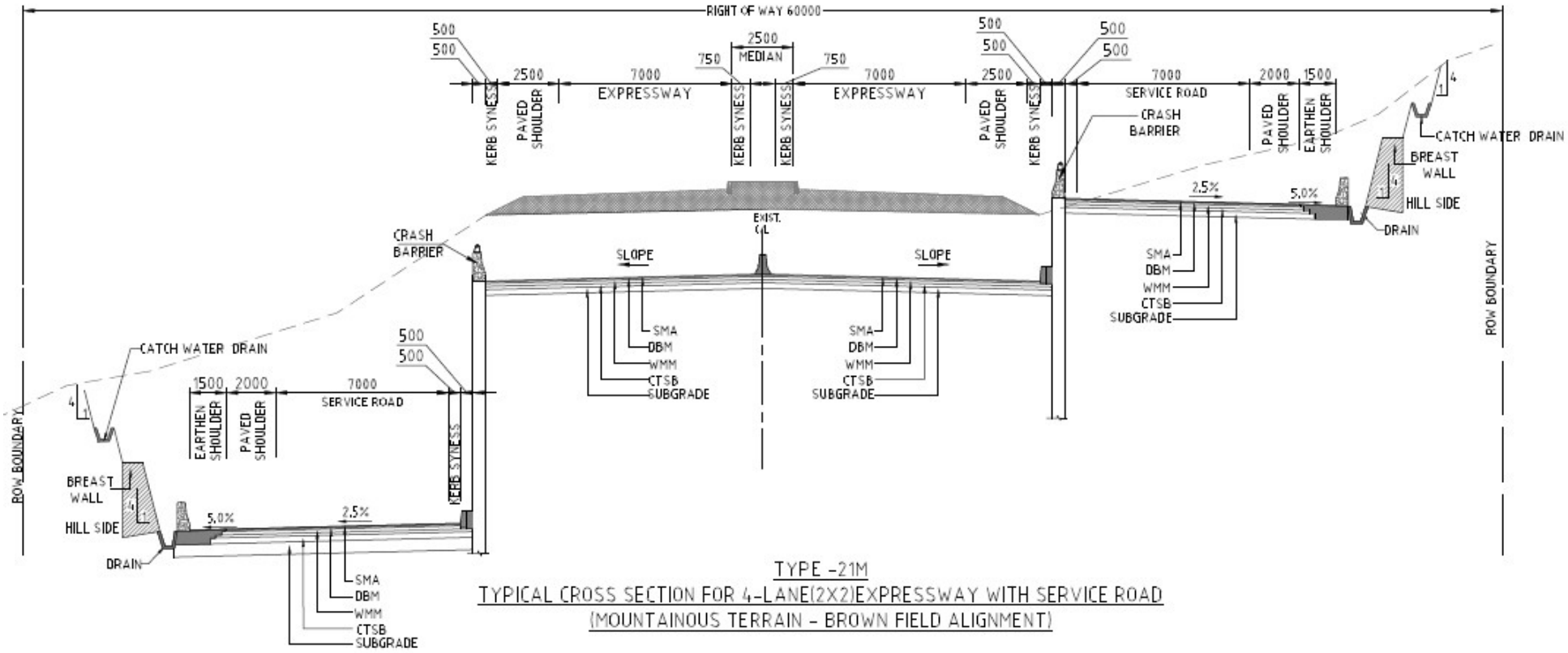
TYPE -21K
TYPICAL CROSS SECTION FOR 4-LANE(2X2) EXPRESSWAY
WITH 4-LANE(2X2) SERVICE ROAD FOR ELEVATED/FLYOVER APPROACH
(MOUNTAINOUS TERRAIN - BROWN FIELD ALIGNMENT)



TYPE -21L

TYPICAL CROSS SECTION FOR 4-LANE(2X2)EXPRESSWAY WITH SERVICE ROAD

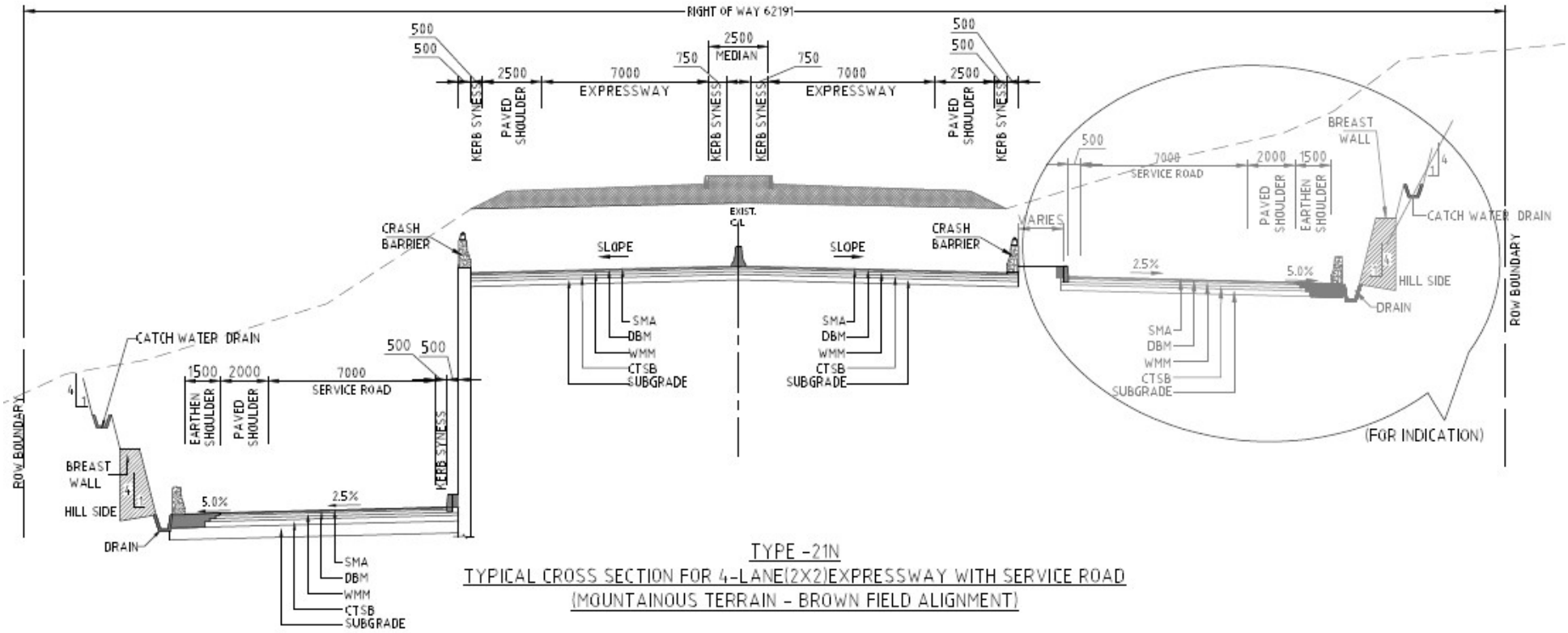
(MOUNTAINOUS TERRAIN - BROWN FIELD ALIGNMENT)



TYPE -21M

TYPICAL CROSS SECTION FOR 4-LANE(2X2)EXPRESSWAY WITH SERVICE ROAD

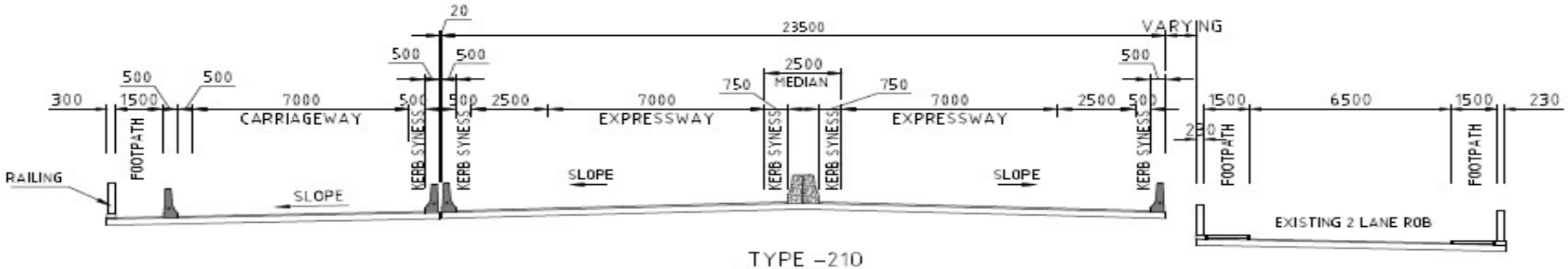
(MOUNTAINOUS TERRAIN - BROWN FIELD ALIGNMENT)



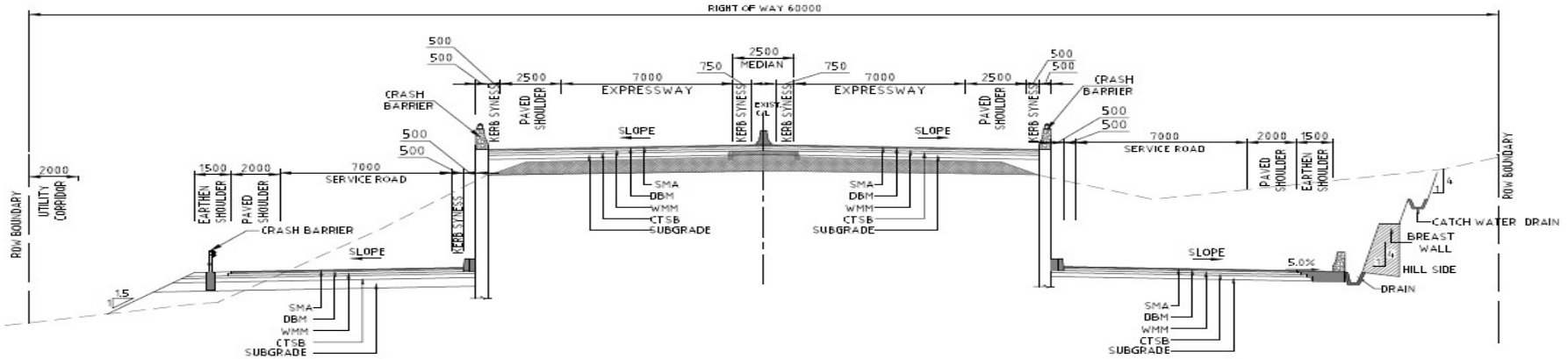
TYPE -21N

TYPICAL CROSS SECTION FOR 4-LANE(2X2)EXPRESSWAY WITH SERVICE ROAD

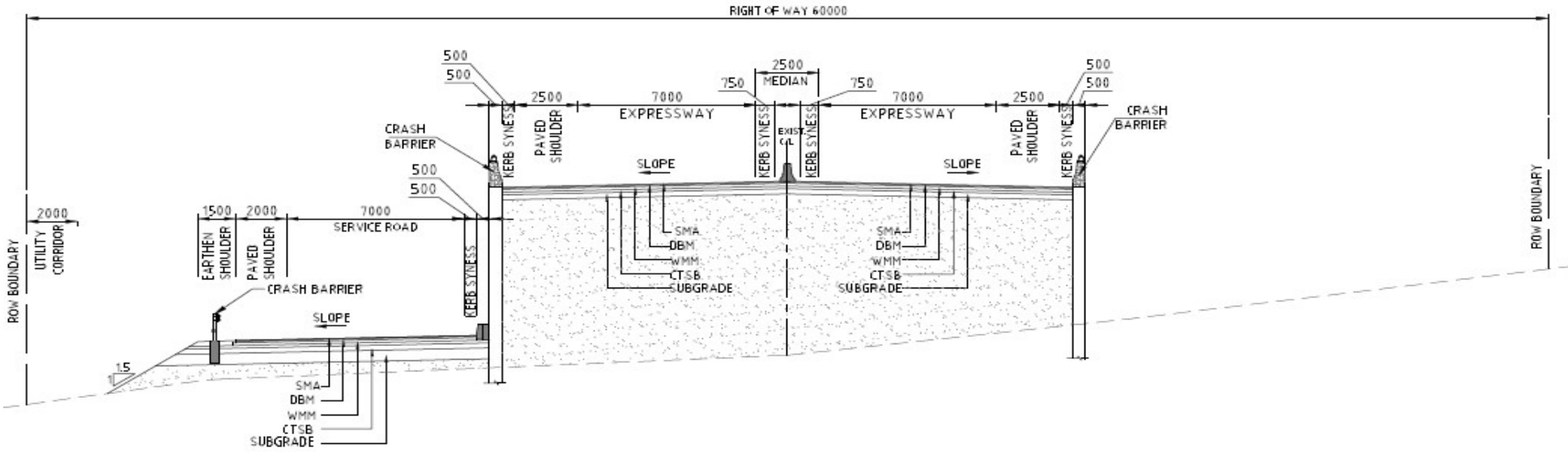
(MOUNTAINOUS TERRAIN - BROWN FIELD ALIGNMENT)



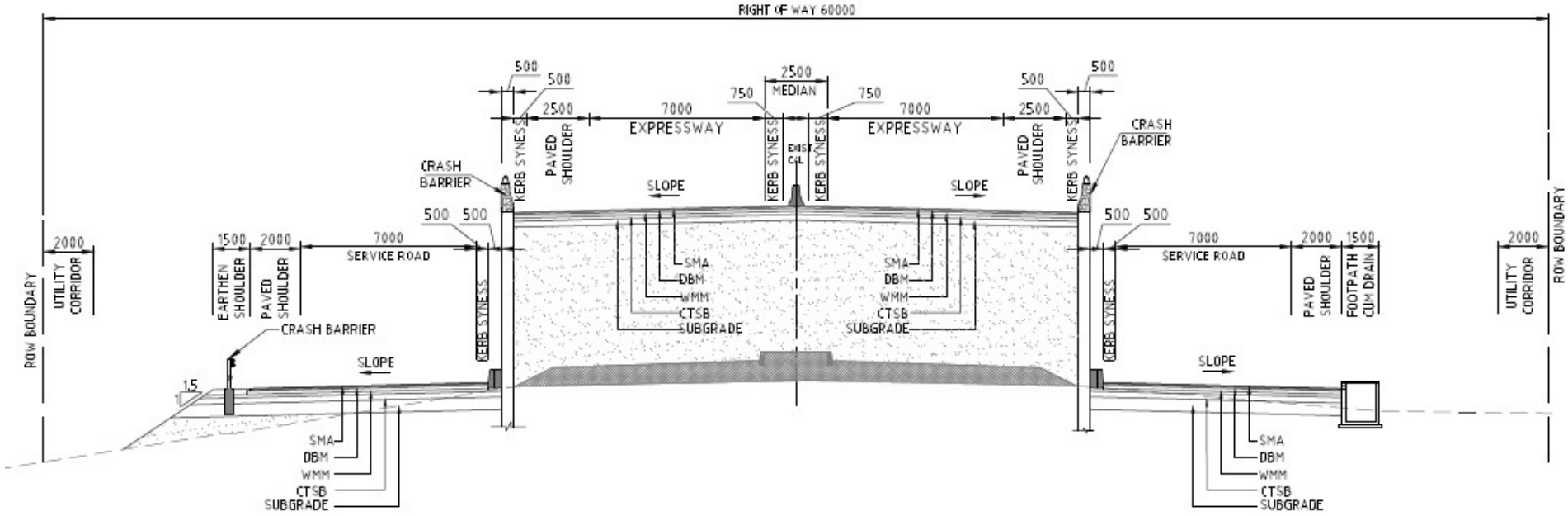
TYPE –210
TYPICAL CROSS SECTION FOR 4-LANE(2X2)EXPRESSWAY
FOR ROB SECTION WITH BOTH SIDE SERVICE ROAD
(MOUNTAINOUS TERRAIN - BROWN FIELD ALIGNMENT)



TYPE –21P
TYPICAL CROSS SECTION FOR 4-LANE(2X2)EXPRESSWAY
WITH 4-LANE(2X2) SERVICE ROAD (BROWN FIELD ALIGNMENT)



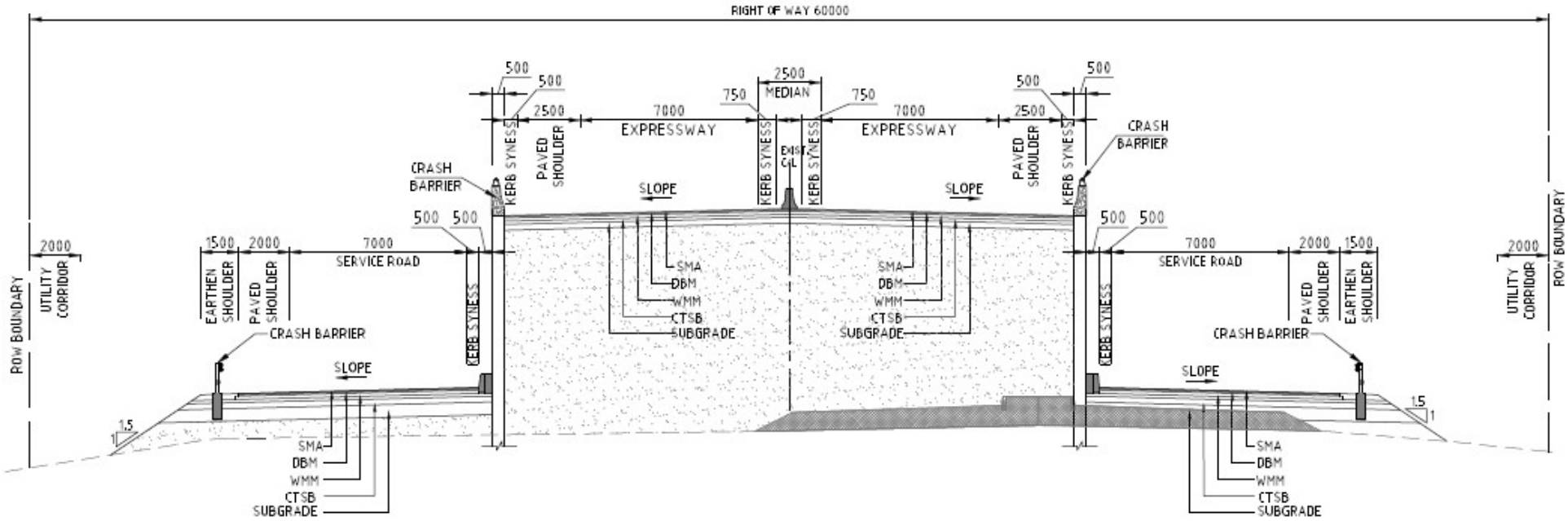
TYPE -210
TYPICAL CROSS SECTION FOR 4-LANE(2X2)EXPRESSWAY
WITH 2-LANE SERVICE ROAD ON LHS (RE-ALIGNMENT)



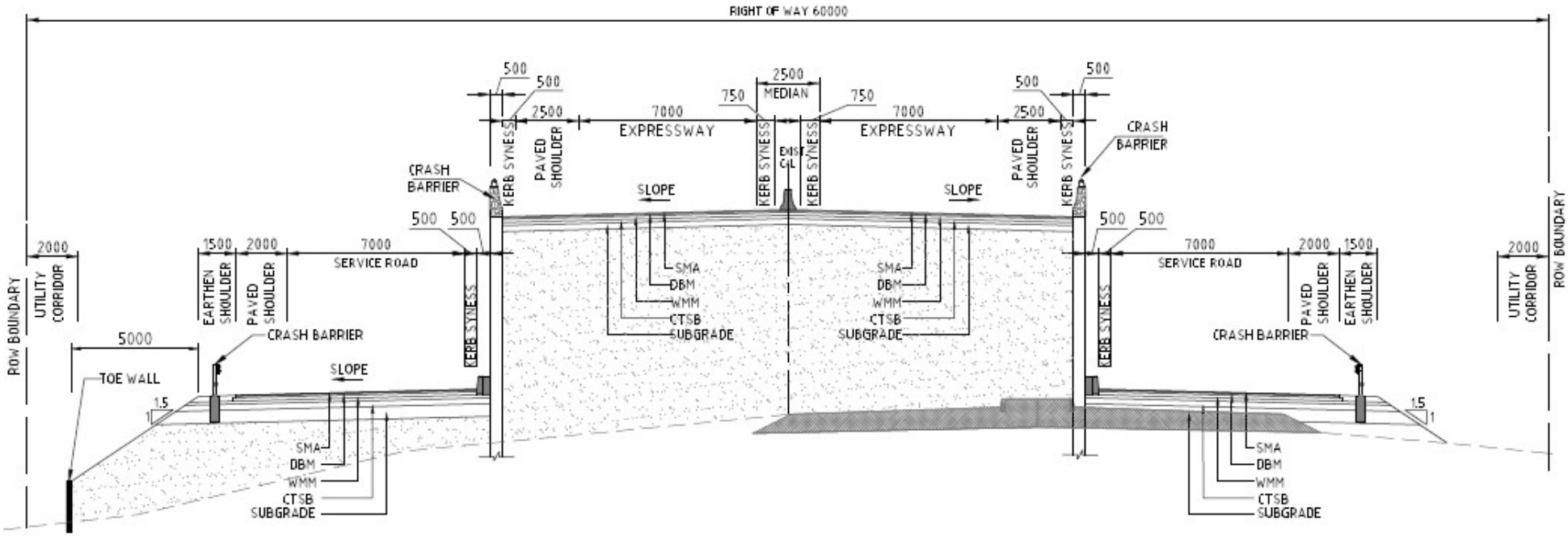
TYPE -21R

TYPICAL CROSS SECTION FOR 4-LANE(2X2)EXPRESSWAY

WITH 4-LANE(2X2) SERVICE ROAD (BROWN FIELD ALIGNMENT)

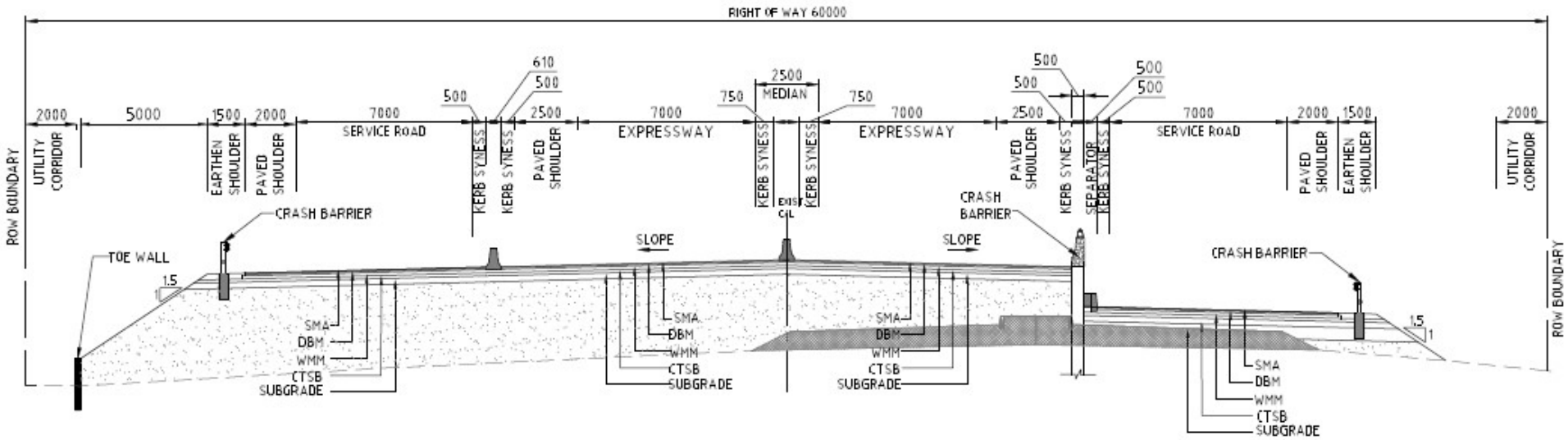


TYPE -21S
TYPICAL CROSS SECTION FOR 4-LANE(2X2)EXPRESSWAY
WITH 4-LANE(2X2) SERVICE ROAD (BROWN FIELD ALIGNMENT)

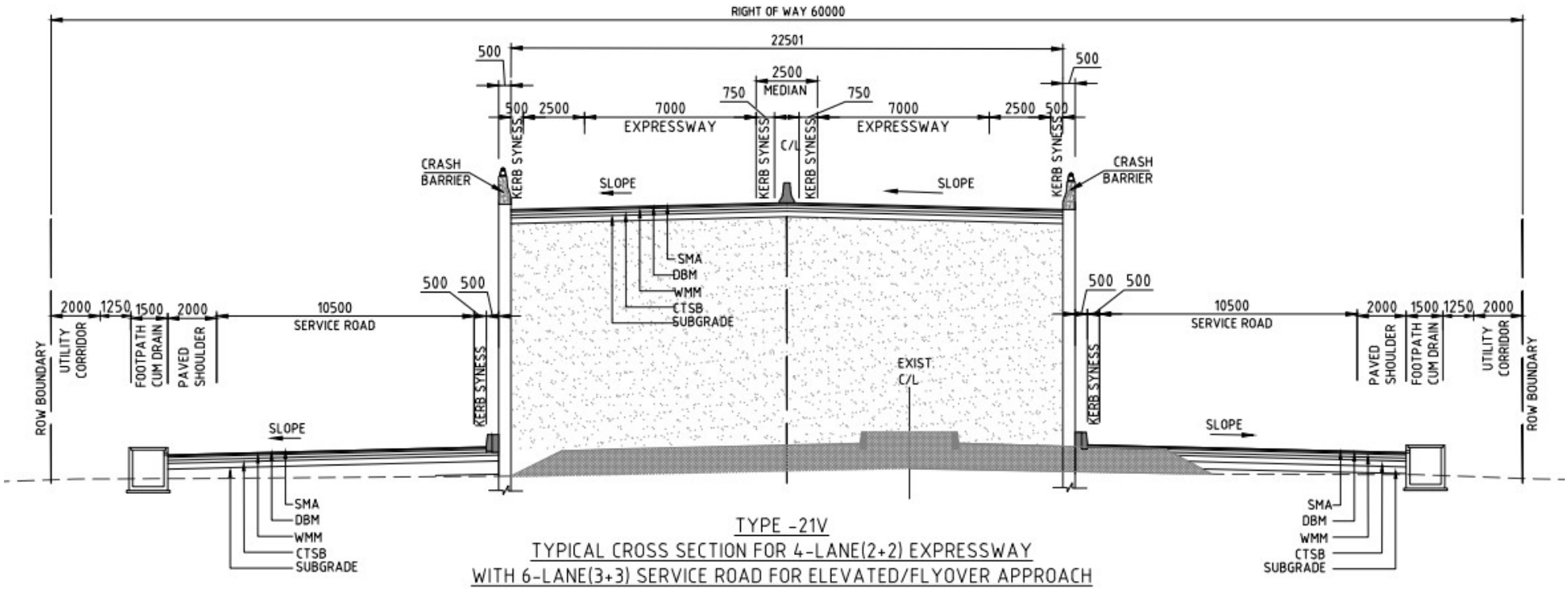


TYPE -21T

TYPICAL CROSS SECTION FOR 4-LANE(2X2)EXPRESSWAY WITH 4-LANE(2X2) SERVICE ROAD (BROWN FIELD ALIGNMENT)

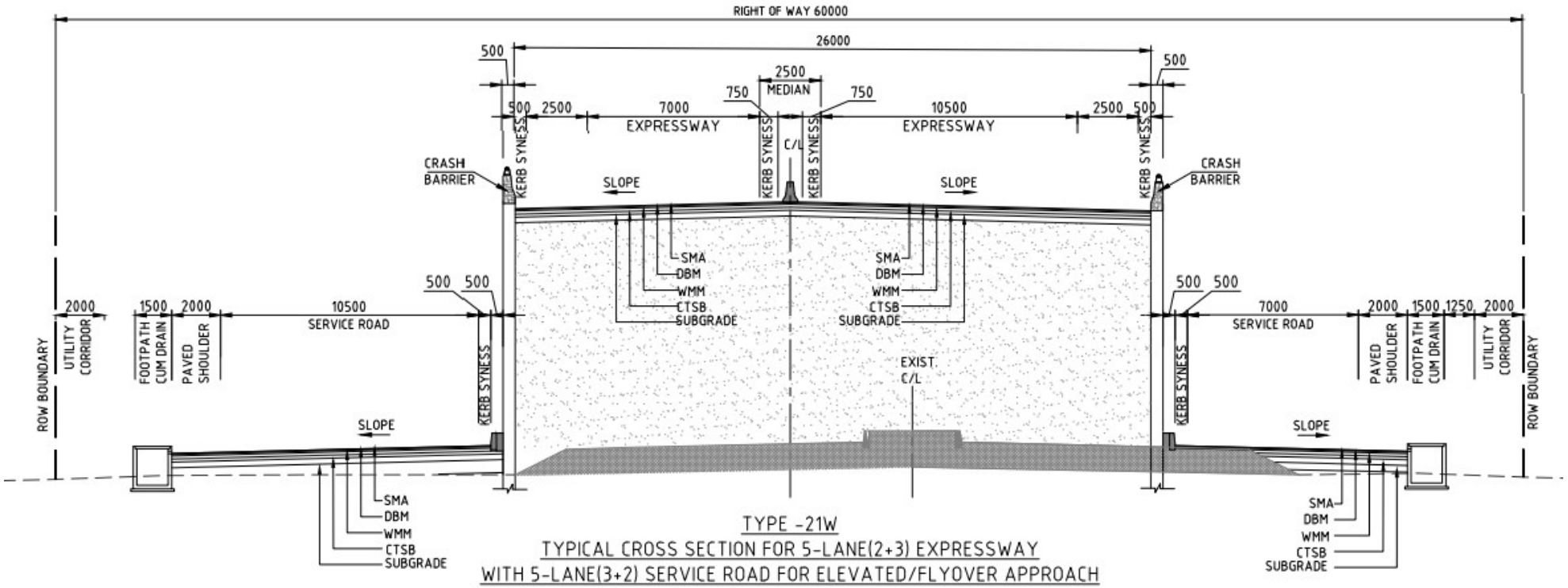


TYPE -21U
TYPICAL CROSS SECTION FOR 4-LANE(2X2)EXPRESSWAY
WITH 4-LANE(2X2) SERVICE ROAD (BROWN FIELD ALIGNMENT)



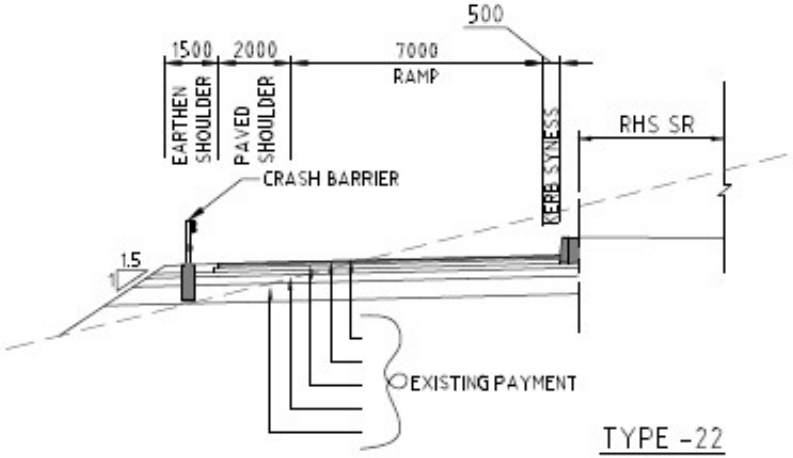
TYPE -21V

TYPICAL CROSS SECTION FOR 4-LANE(2+2) EXPRESSWAY WITH 6-LANE(3+3) SERVICE ROAD FOR ELEVATED/FLYOVER APPROACH (MOUNTAINOUS TERRAIN - BROWN FIELD ALIGNMENT)

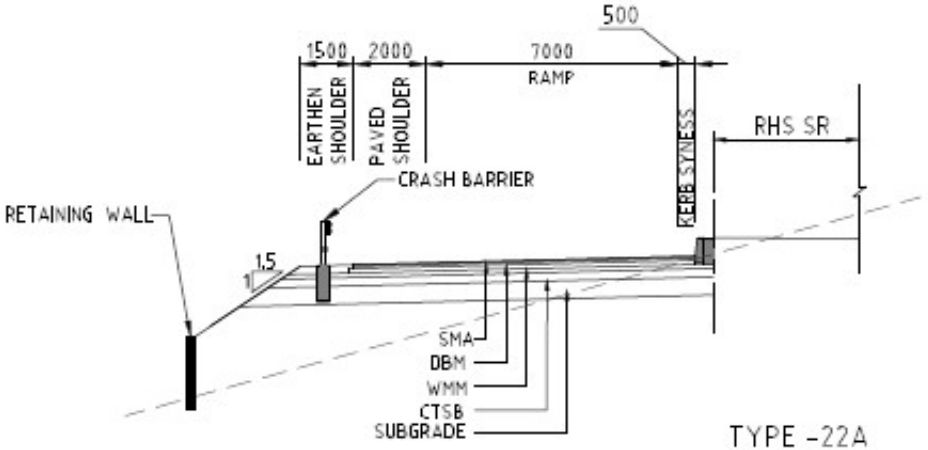


TYPE -21W

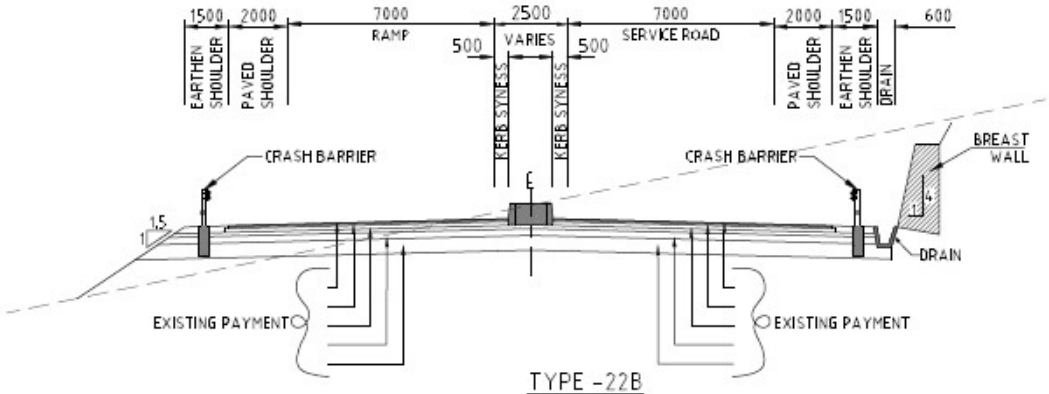
TYPICAL CROSS SECTION FOR 5-LANE(2+3) EXPRESSWAY WITH 5-LANE(3+2) SERVICE ROAD FOR ELEVATED/FLYOVER APPROACH (MOUNTAINOUS TERRAIN - BROWN FIELD ALIGNMENT)



TYPE -22
TYPICAL CROSS SECTION FOR RAMP PORTION

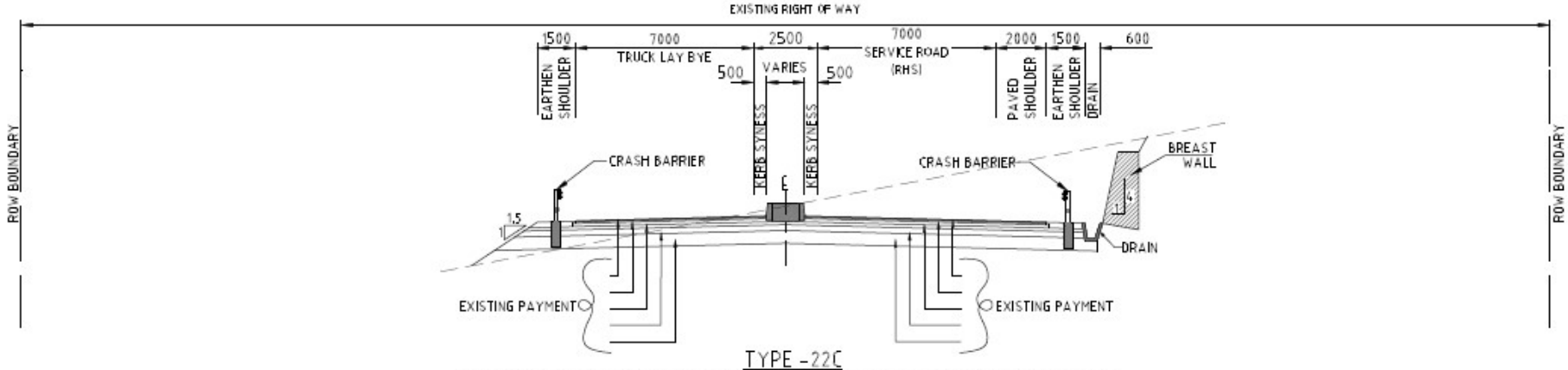


TYPE -22A
TYPICAL CROSS SECTION FOR RAMP PORTION



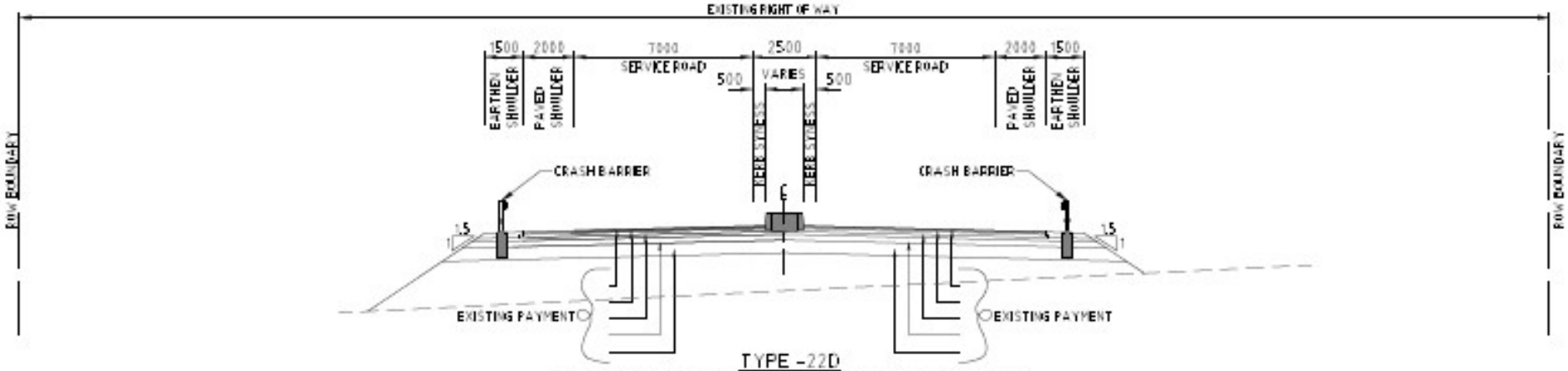
TYPE -22B

TYPICAL CROSS SECTION FOR LHS RAMP & RHS SERVICE ROAD

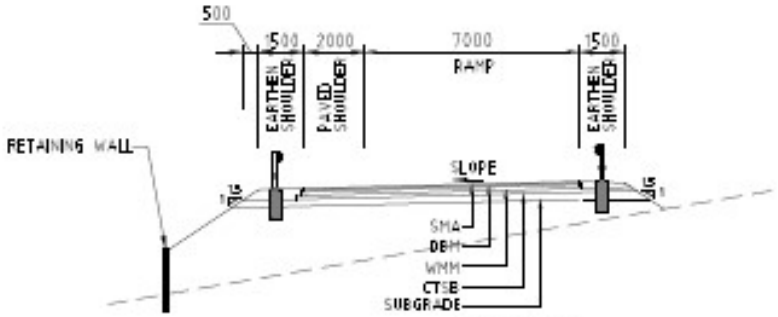


TYPE -22C

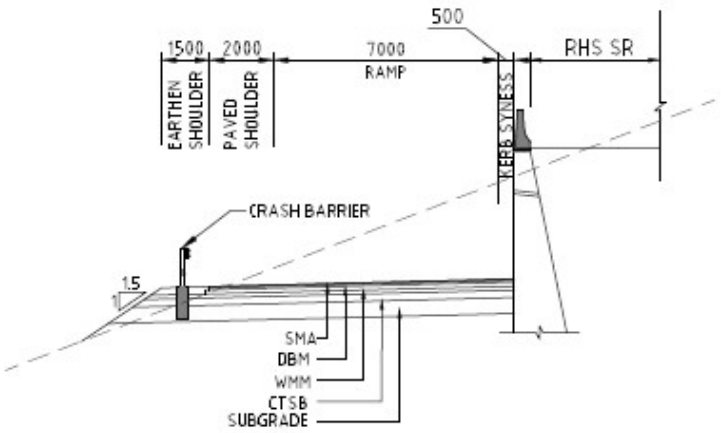
TYPICAL CROSS SECTION FOR LHS TRUCK LAY BYE & RHS SERVICE ROAD



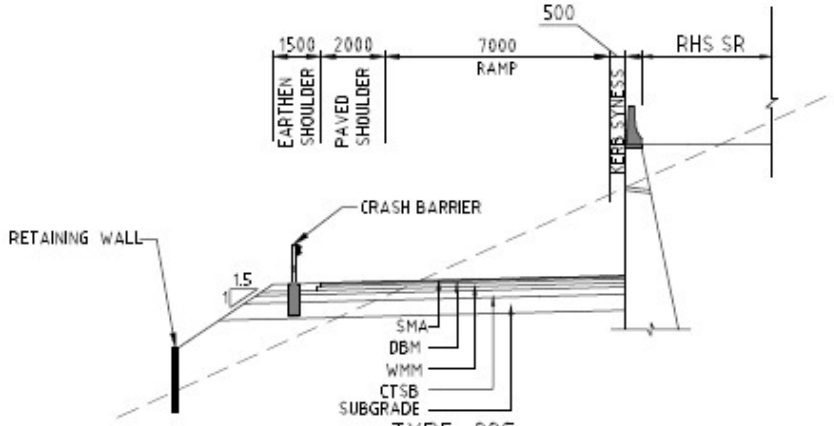
TYPE -22D
TYPICAL CROSS SECTION BOTH SIDE SERVICE ROAD



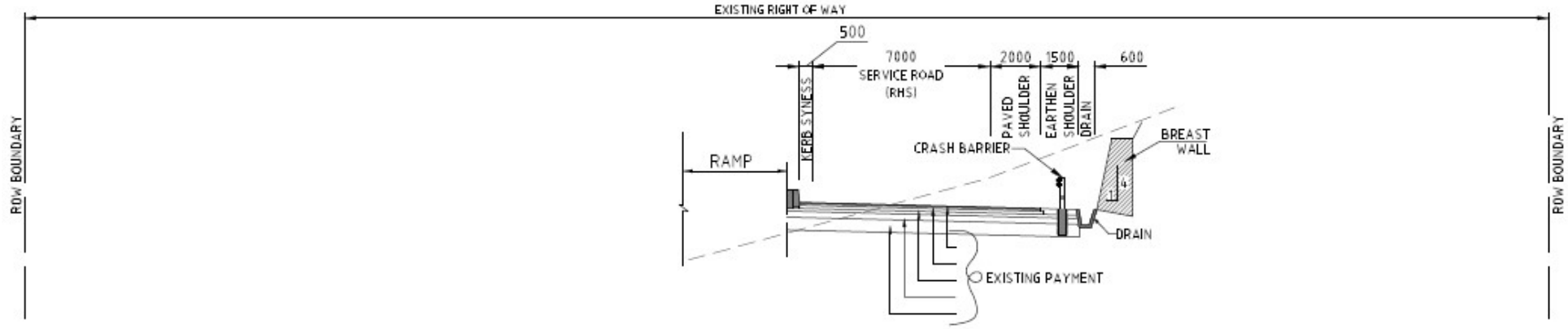
TYPE -22E
TYPICAL CROSS SECTION FOR 2-LANE RAMP
(MOUNTAINOUS TERRAIN)



TYPE -22F
TYPICAL CROSS SECTION FOR 2-LANE RAMP
(MOUNTAINOUS TERRAIN)

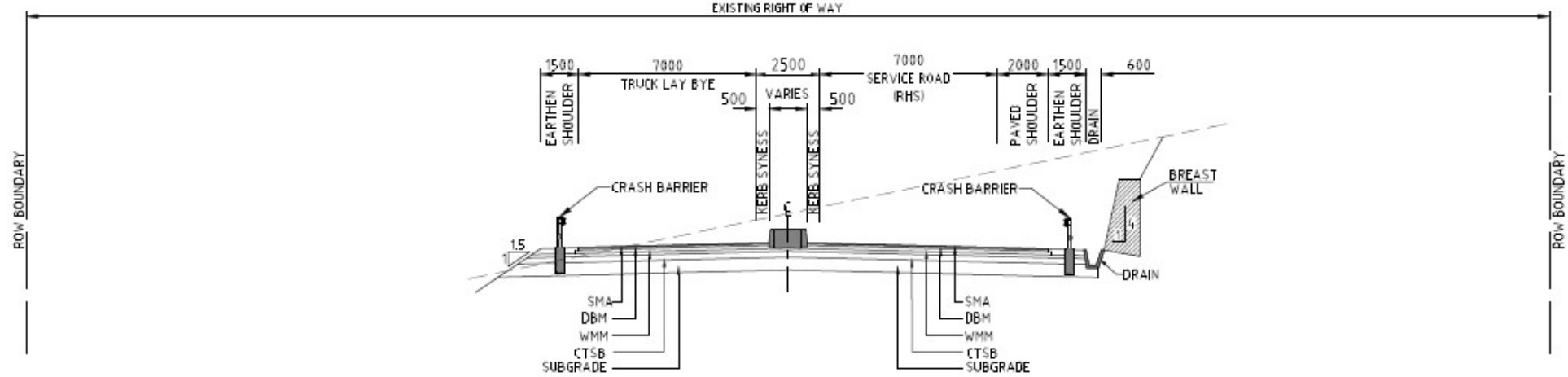


TYPE -22G
TYPICAL CROSS SECTION FOR 2-LANE RAMP
(MOUNTAINOUS TERRAIN)



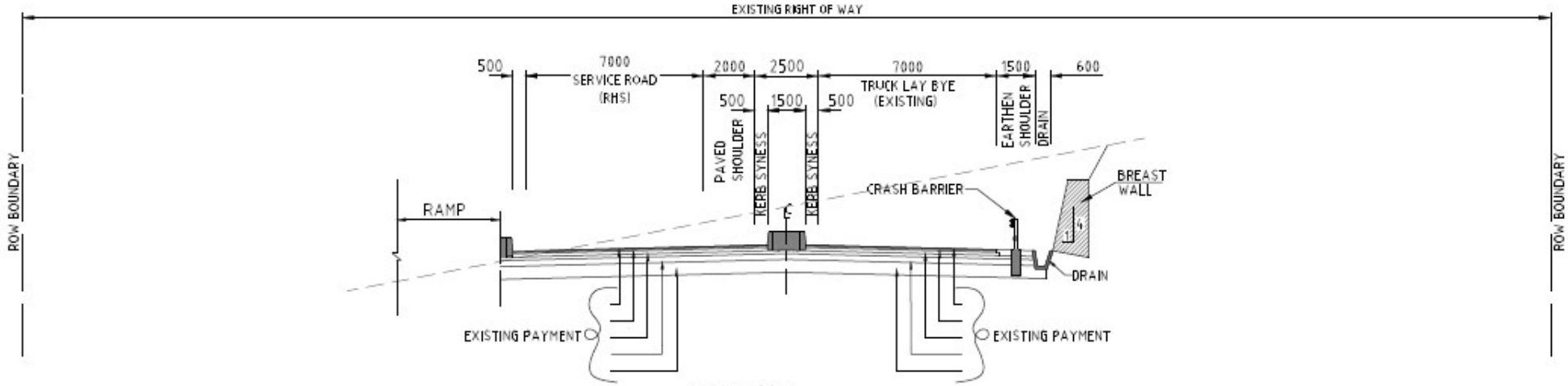
TYPE -22H

TYPICAL CROSS SECTION FOR RHS SERVICE ROAD



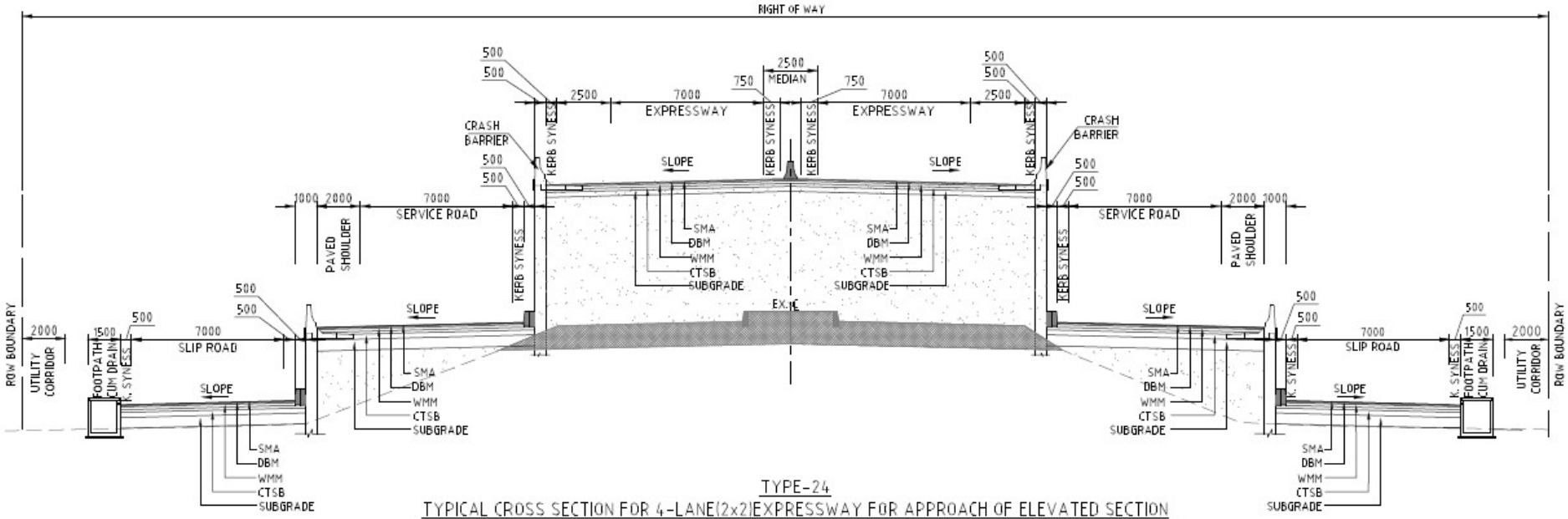
TYPE -22I

TYPICAL CROSS SECTION FOR LHS TRUCK LAY BYE & RHS SERVICE ROAD



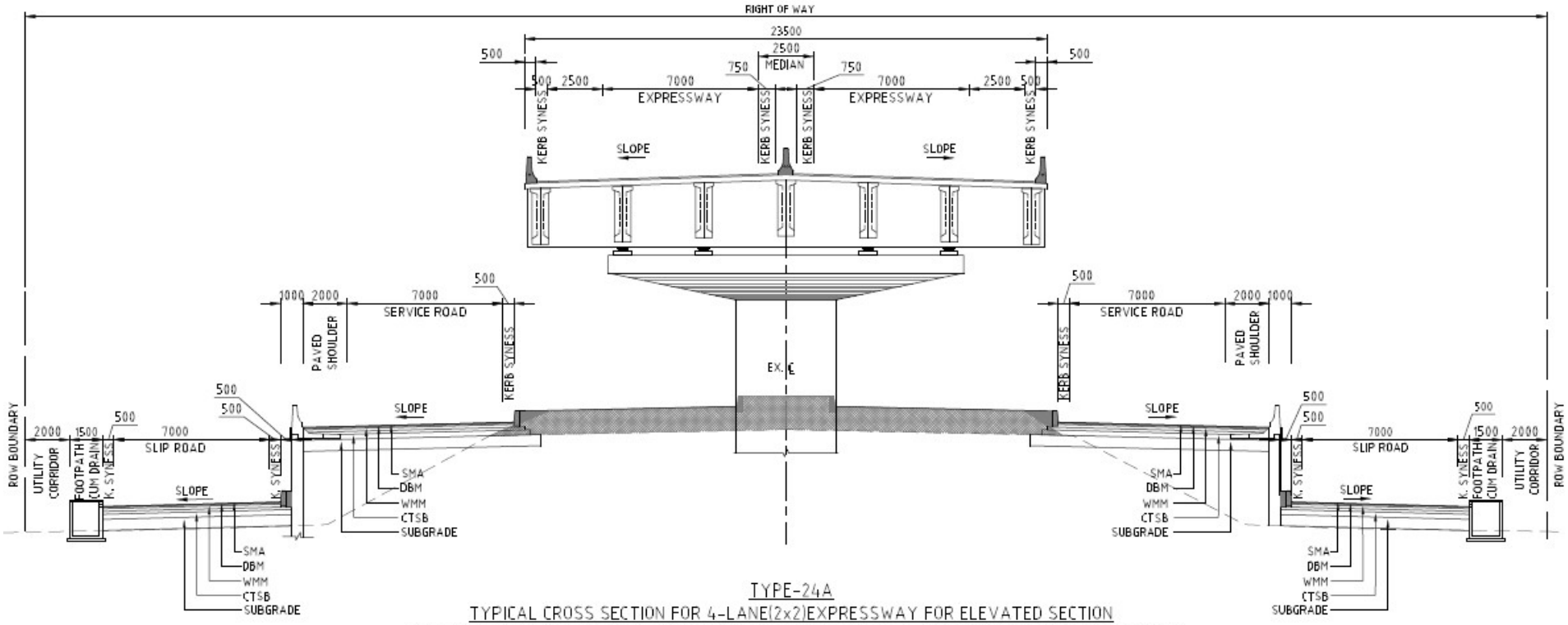
TYPE -22J

TYPICAL CROSS SECTION FOR LHS SERVICE ROAD & RHS TRUCK LAY BYE



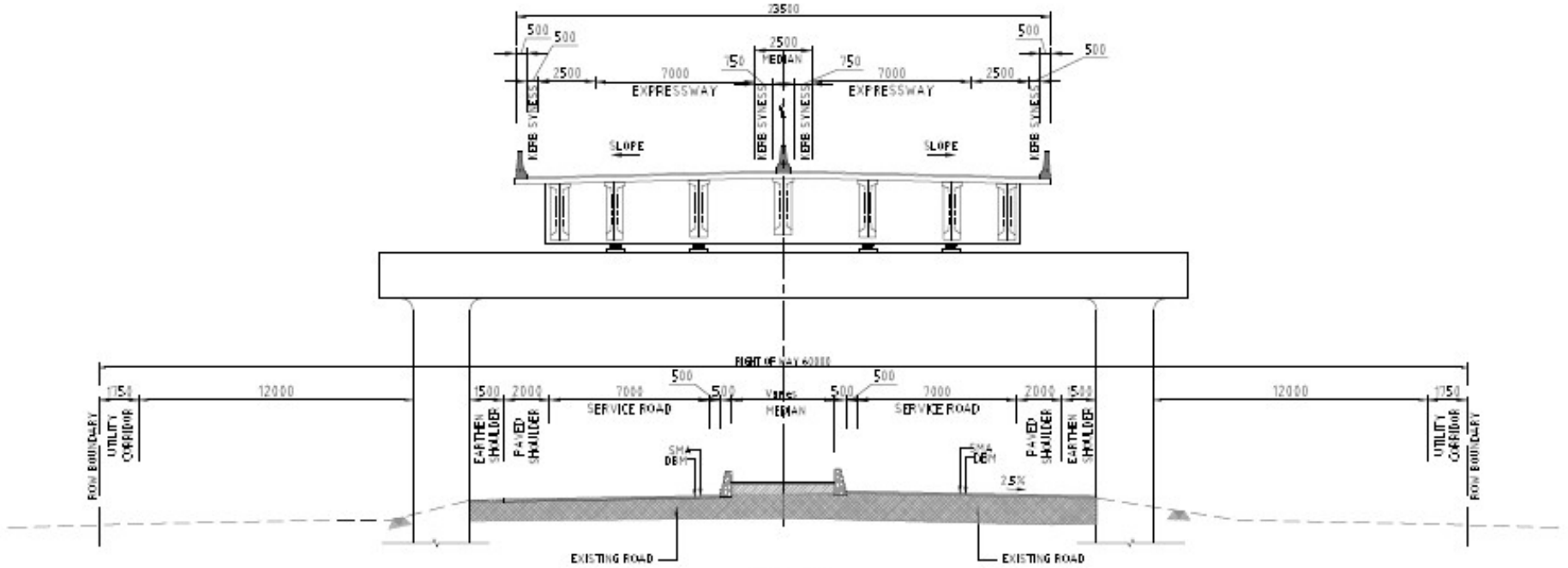
TYPE-24

TYPICAL CROSS SECTION FOR 4-LANE(2x2)EXPRESSWAY FOR APPROACH OF ELEVATED SECTION WITH SERVICE ROAD AND SLIP ROAD (MOUNTAINOUS TERRAIN-S-CURVE BROWN FIELD ALIGNMENT)



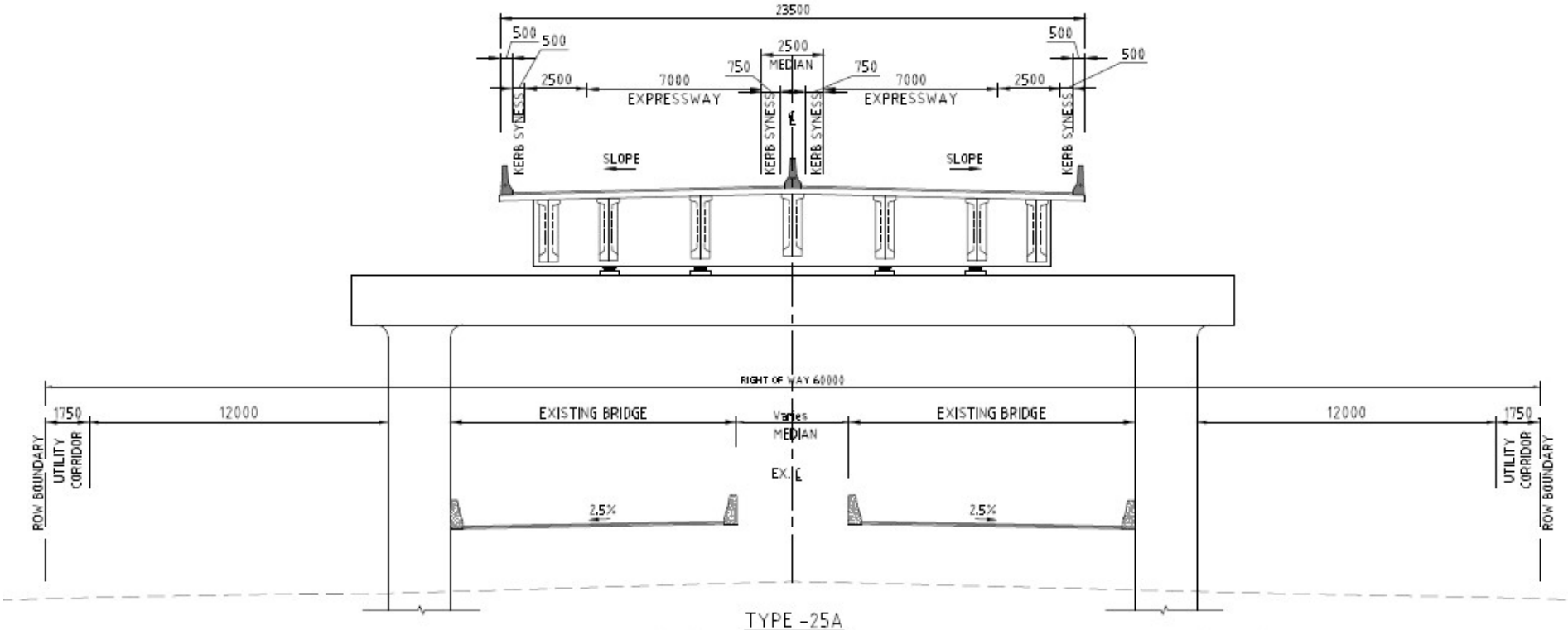
TYPE-24A

TYPICAL CROSS SECTION FOR 4-LANE(2x2)EXPRESSWAY FOR ELEVATED SECTION WITH SERVICE ROAD AND SLIP ROAD (MOUNTAINOUS TERRAIN-S-CURVE BROWN FIELD ALIGNMENT)



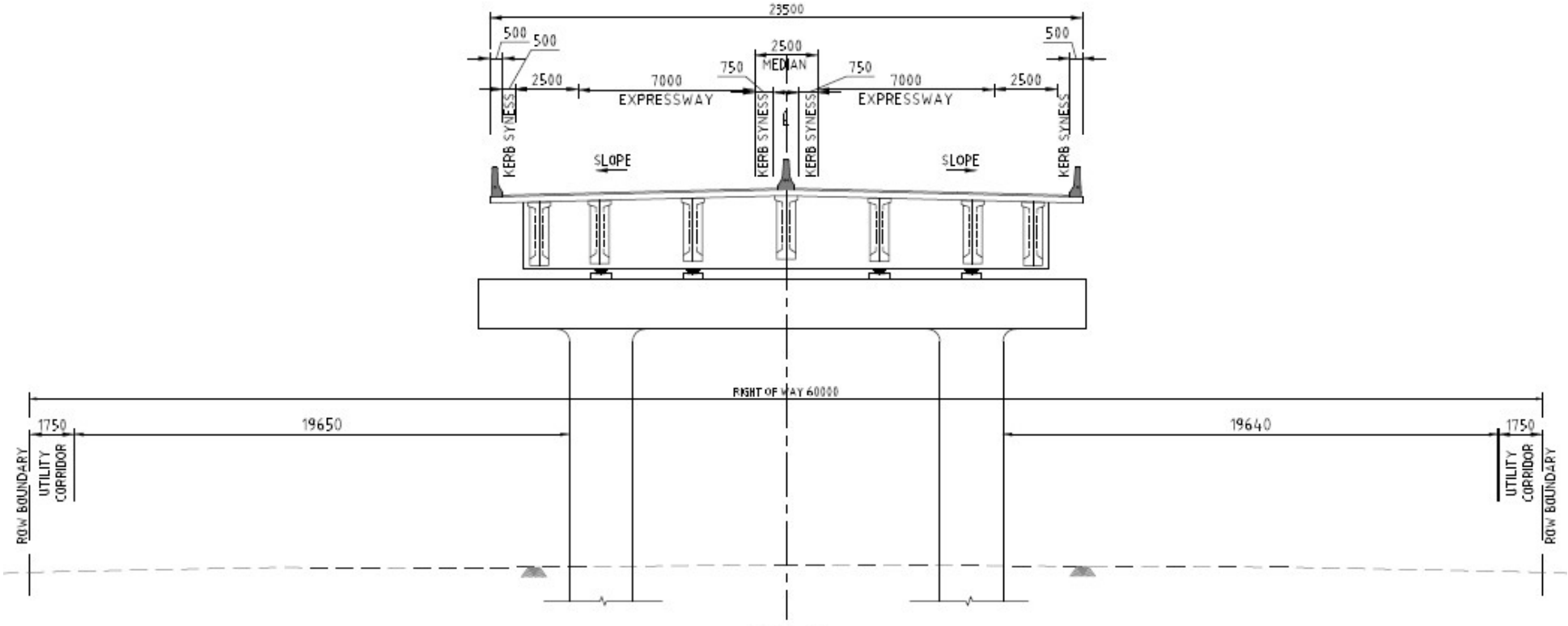
TYPE -25

TYPICAL CROSS SECTION FOR 4-LANE(2X2) EXPRESSWAY ELEVATED SECTION WITH SERVICE ROAD (MOUNTAINOUS TERRAIN-S-CURVE BROWN FIELD ALIGNMENT)



TYPE -25A

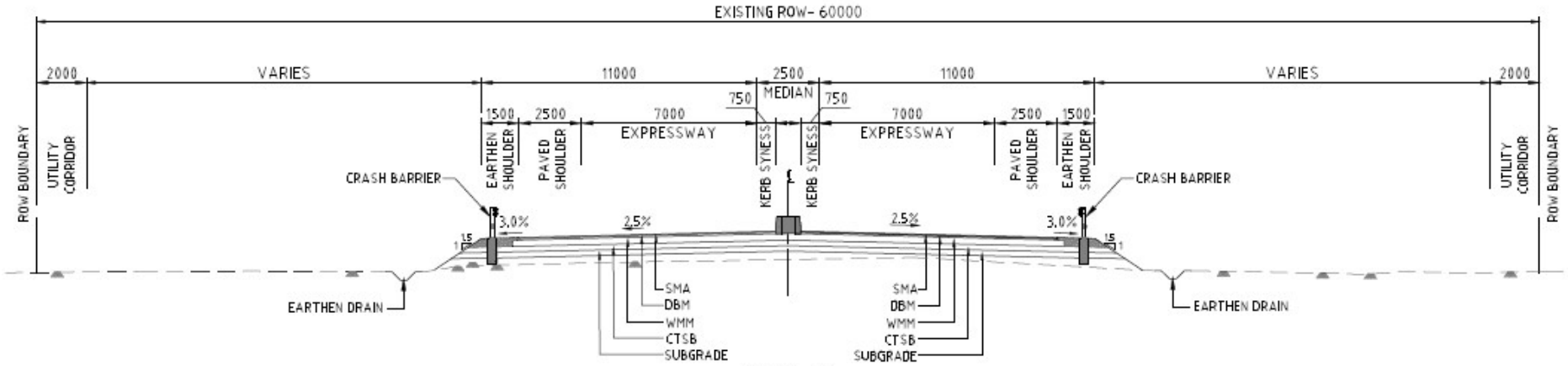
TYPICAL CROSS SECTION FOR 4-LANE(2X2) EXPRESSWAY ELEVATED SECTION WITH SERVICE ROAD (BRIDGE)
(MOUNTAINOUS TERRAIN-S-CURVE BROWN FIELD ALIGNMENT)



TYPE -26

TYPICAL CROSS SECTION FOR 4-LANE(2X2) EXPRESSWAY ELEVATED SECTION

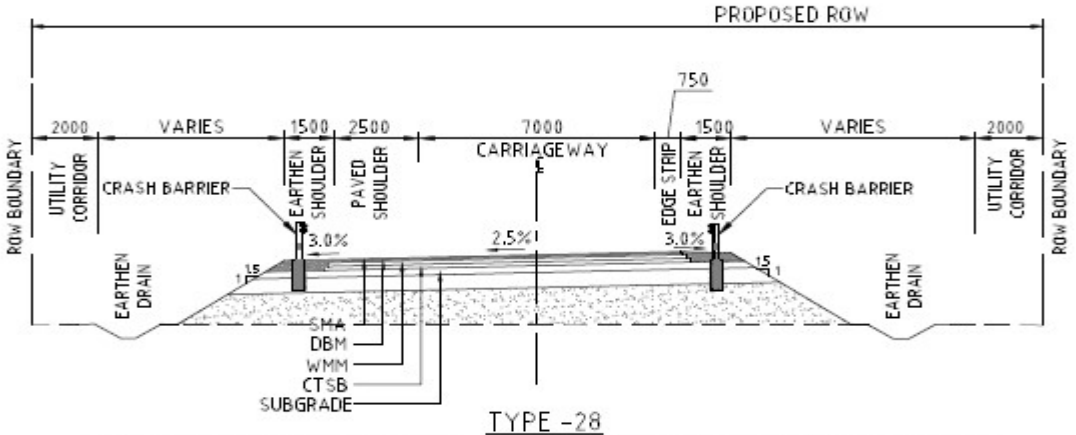
(MOUNTAINOUS TERRAIN-S-CURVE GREEN FIELD ALIGNMENT)



TYPE -27

TYPICAL CROSS SECTION FOR 4-LANE(2X2) EXPRESSWAY

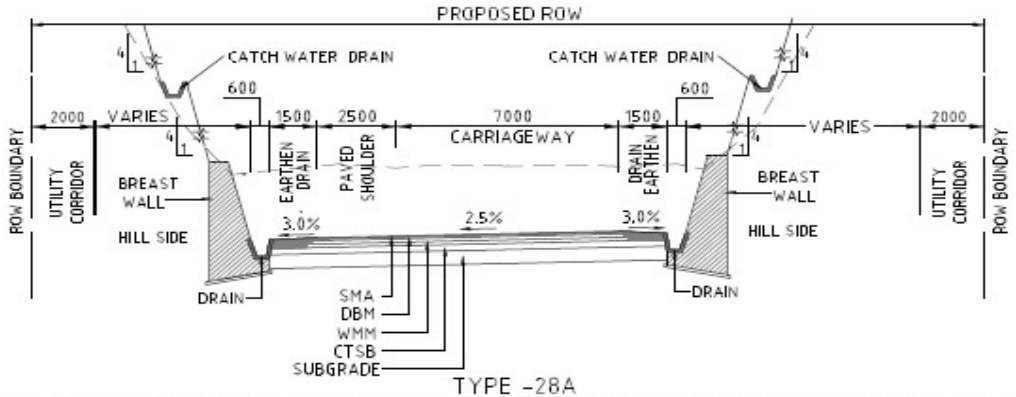
(MOUNTAINOUS TERRAIN-GREEN FIELD ALIGNMENT)



TYPE -28

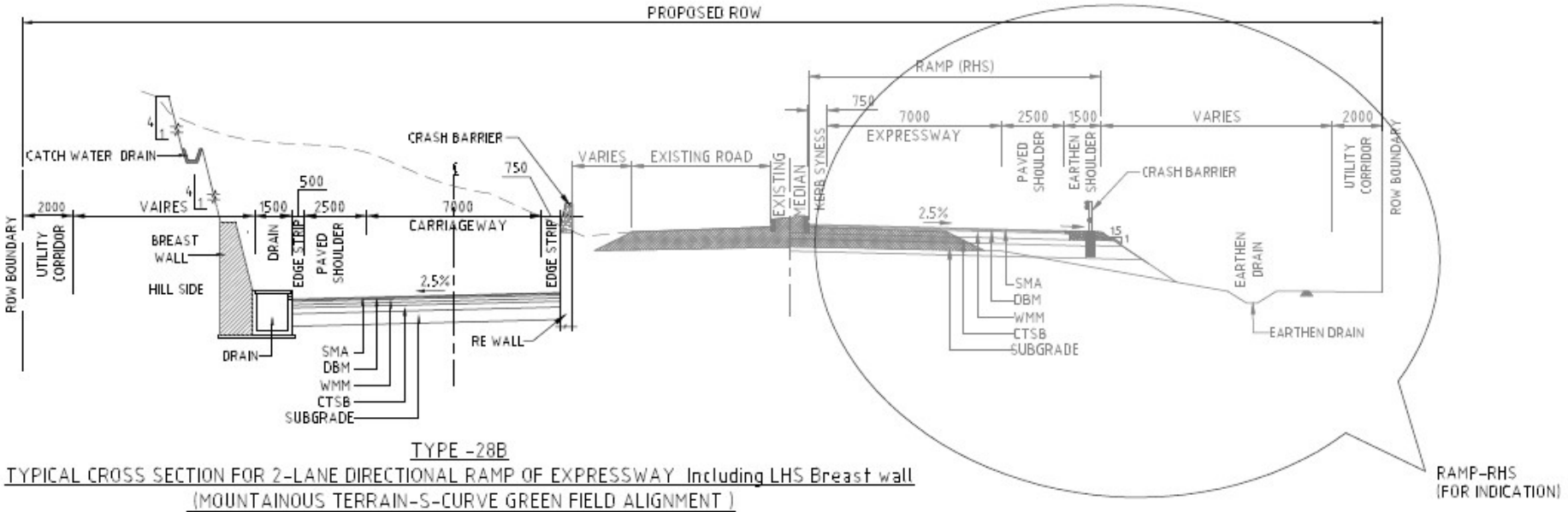
TYPICAL CROSS SECTION FOR 2-LANE DIRECTIONAL RAMP OF EXPRESSWAY

(MOUNTAINOUS TERRAIN-S-CURVE GREEN FIELD ALIGNMENT)



TYPE -28A

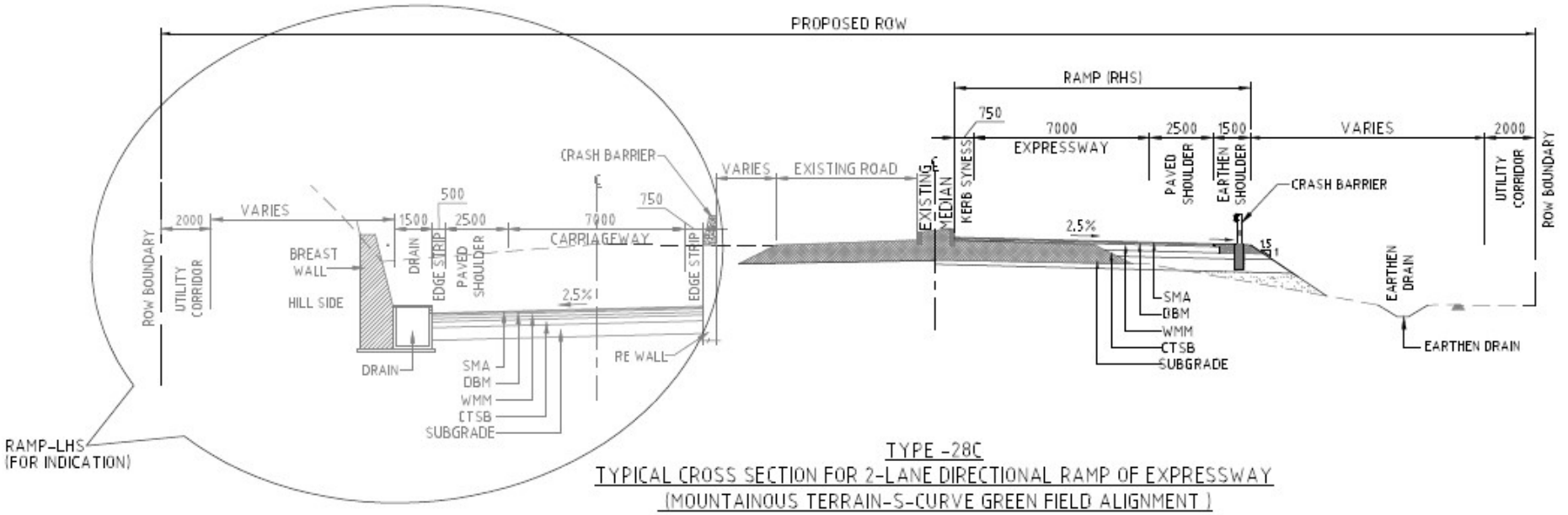
TYPICAL CROSS SECTION FOR 2-LANE DIRECTIONAL RAMP OF EXPRESSWAY INCLUDING BREAST WALL
(MOUNTAINOUS TERRAIN-S-CURVE GREEN FIELD ALIGNMENT)



TYPE -28B

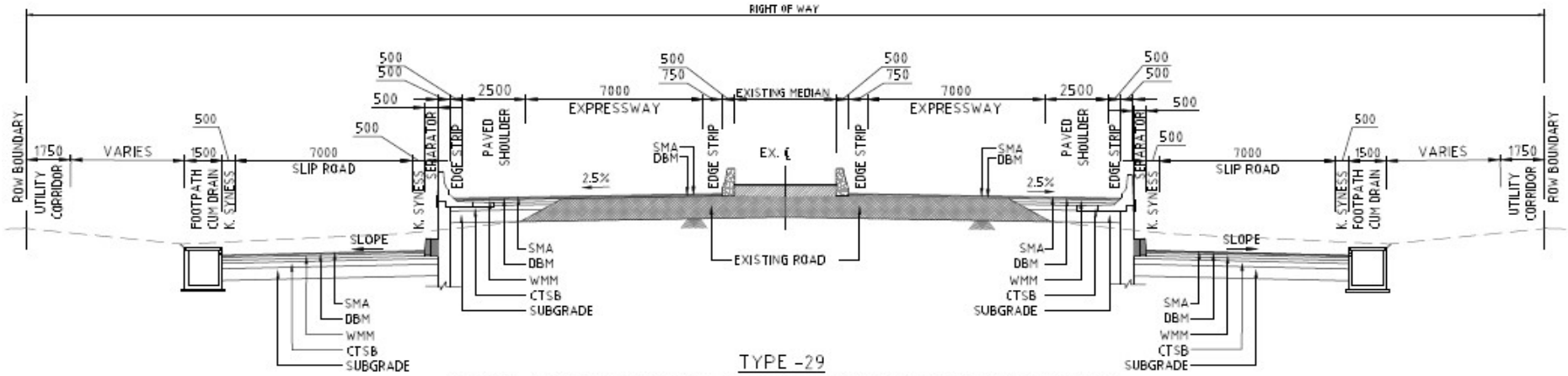
TYPICAL CROSS SECTION FOR 2-LANE DIRECTIONAL RAMP OF EXPRESSWAY Including LHS Breast wall
(MOUNTAINOUS TERRAIN-S-CURVE GREEN FIELD ALIGNMENT)

RAMP-RHS
(FOR INDICATION)



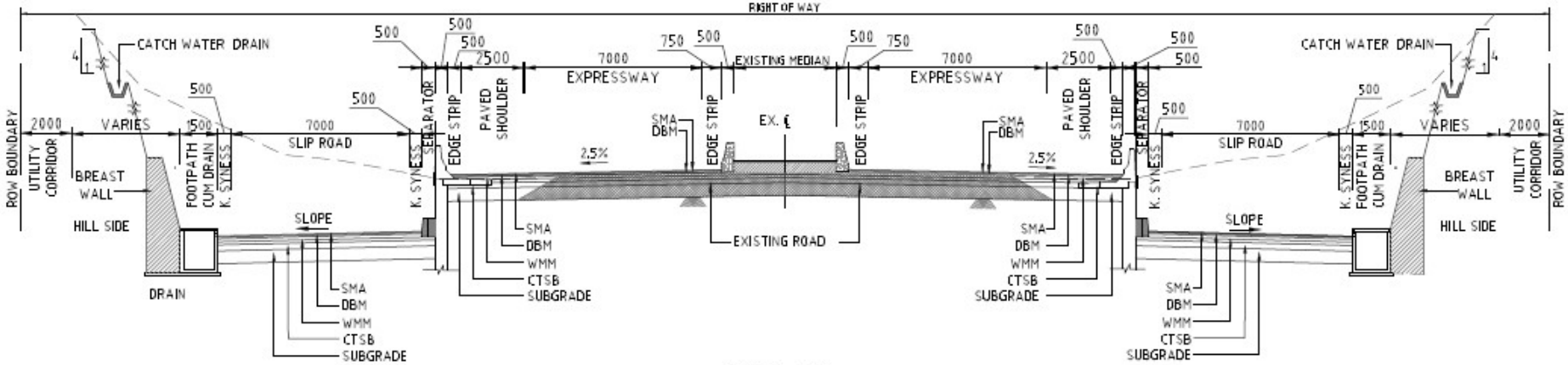
TYPE -28C

TYPICAL CROSS SECTION FOR 2-LANE DIRECTIONAL RAMP OF EXPRESSWAY
(MOUNTAINOUS TERRAIN-S-CURVE GREEN FIELD ALIGNMENT)



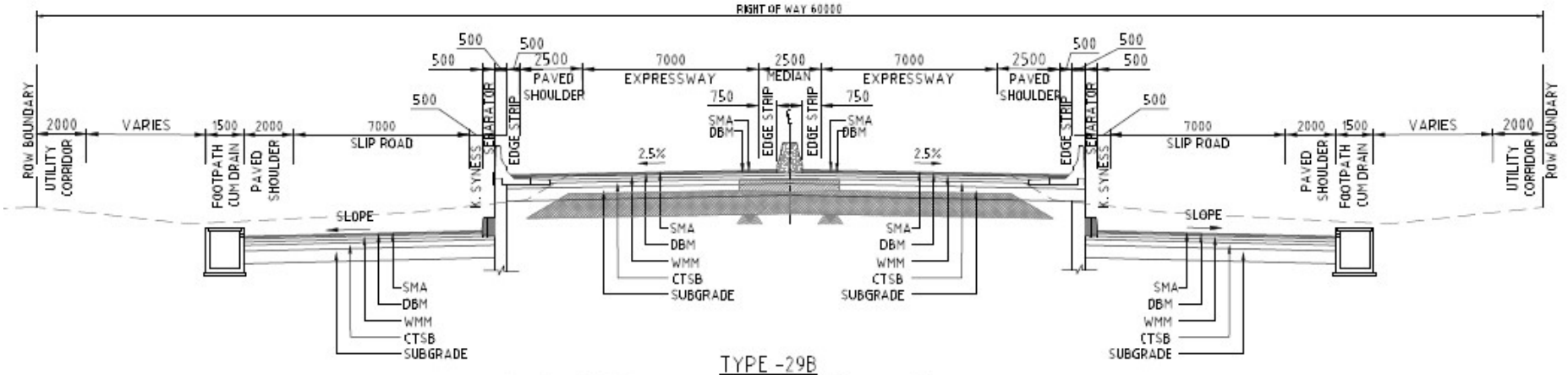
TYPE -29

TYPICAL CROSS SECTION FOR 4-LANE(2X2)EXPRESSWAY WITH BOTH SIDE SLIP ROAD (MOUNTAINOUS TERRAIN-S-CURVE BROWN FIELD ALIGNMENT)



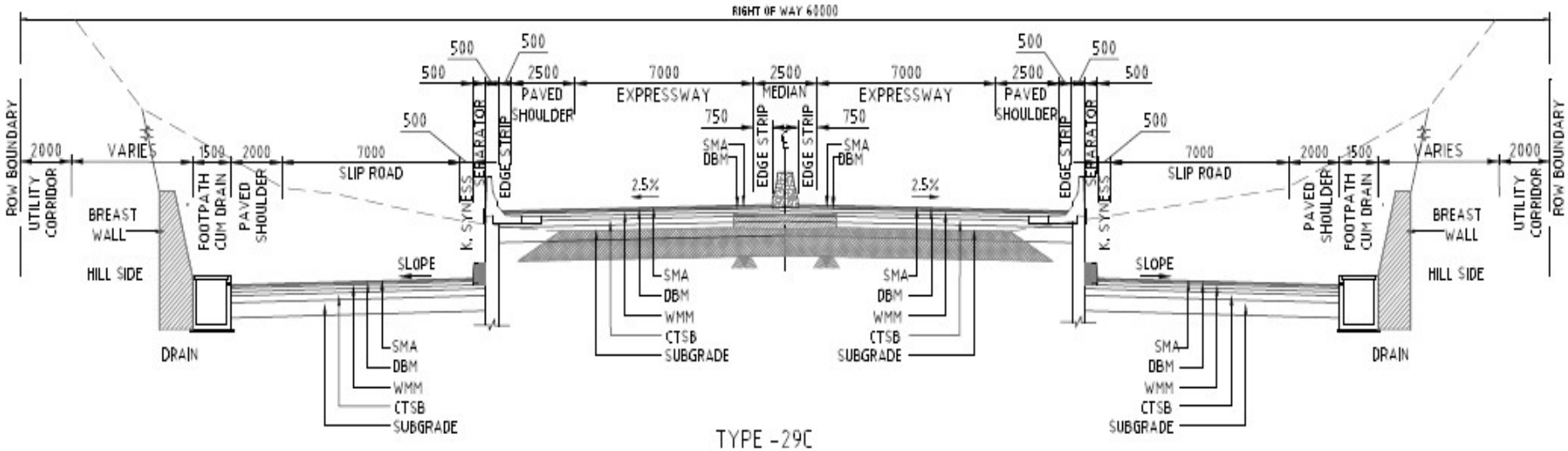
TYPE -29A

TYPICAL CROSS SECTION FOR 4-LANE(2X2)EXPRESSWAY WITH BOTH SIDE SLIP ROAD INCLUDING BREAST WALL (MOUNTAINOUS TERRAIN-S-CURVE BROWN FIELD ALIGNMENT)



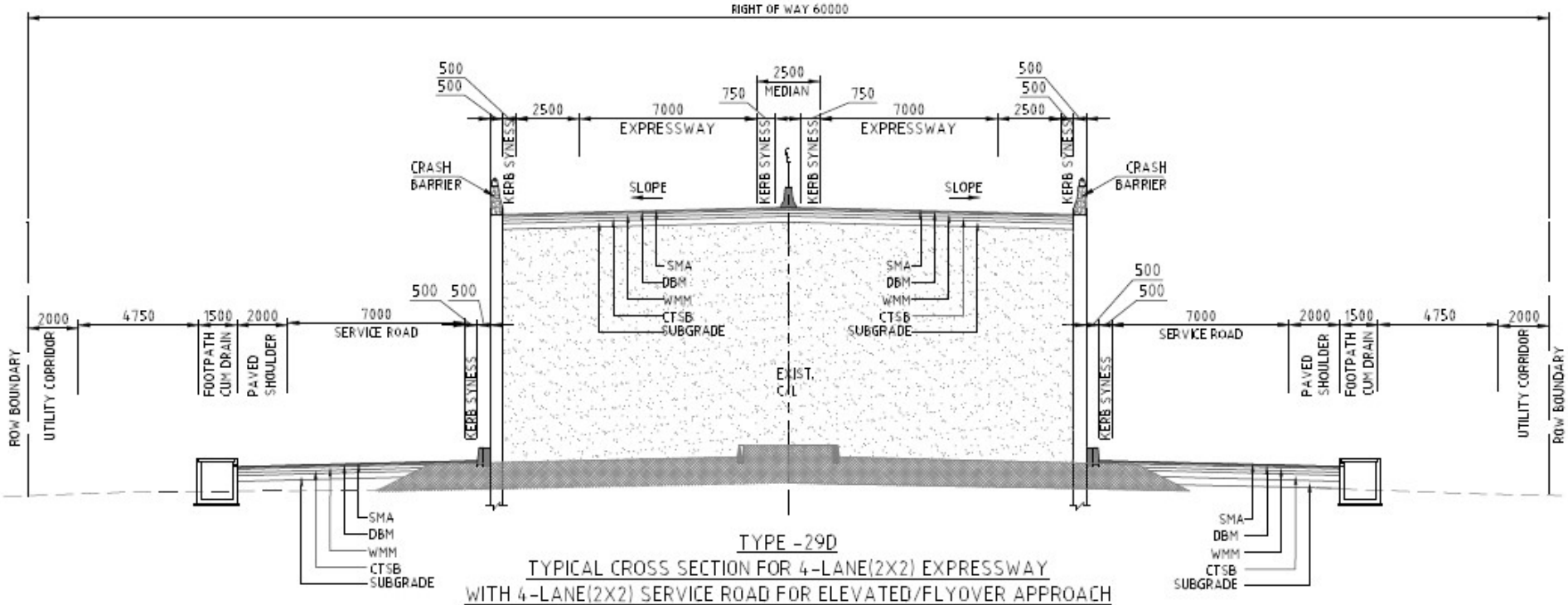
TYPE -29B

TYPICAL CROSS SECTION FOR 4-LANE(2X2) EXPRESSWAY WITH WITH 4-LANE(2X2) SERVICE ROAD (MOUNTAINOUS TERRAIN BROWN FIELD ALIGNMENT)



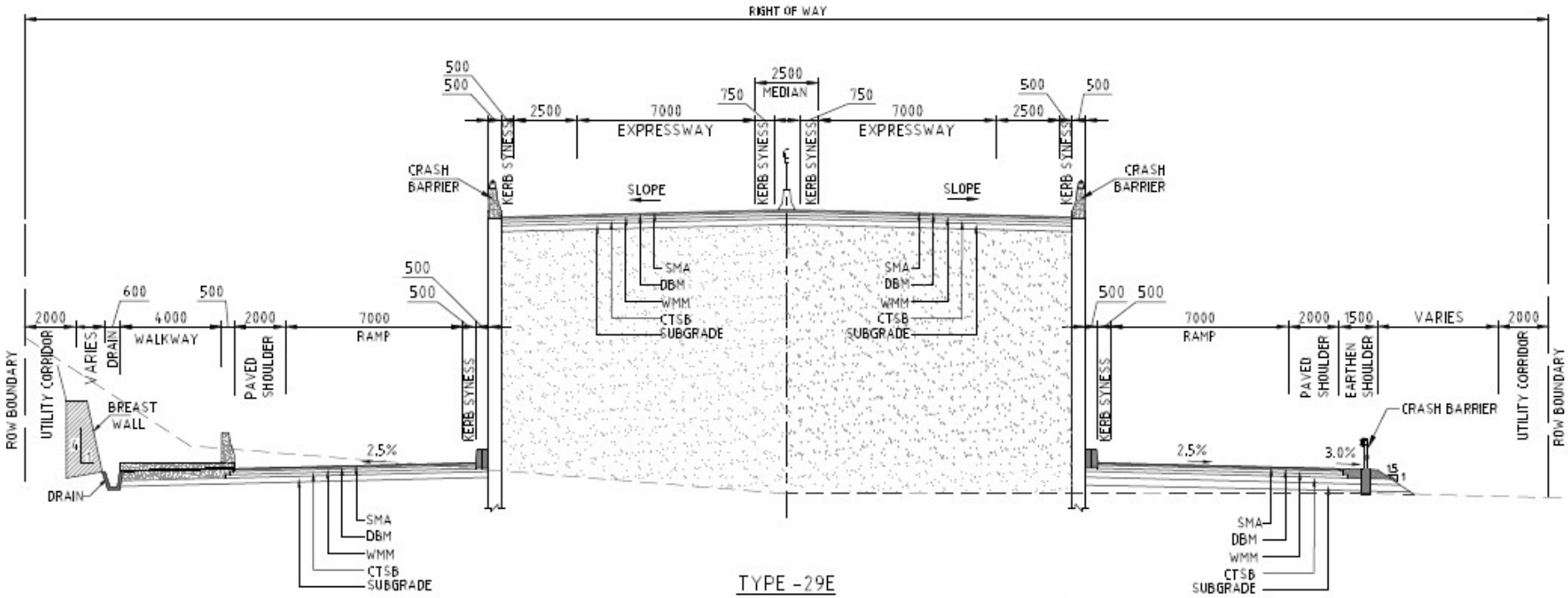
TYPE -29C

TYPICAL CROSS SECTION FOR 4-LANE(2X2) EXPRESSWAY WITH 4-LANE(2X2) SERVICE ROAD INCLUDING BREAST WALL (MOUNTAINOUS TERRAIN BROWN FIELD ALIGNMENT)



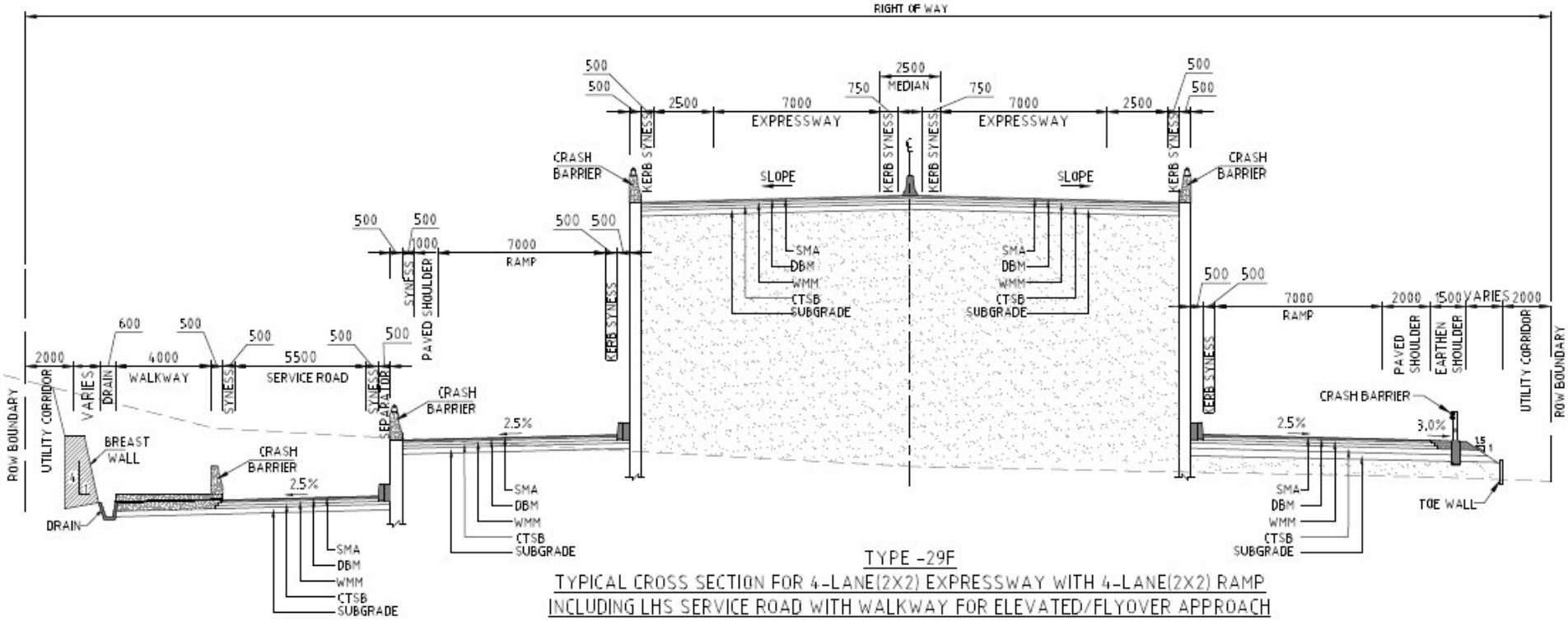
TYPE -29D

TYPICAL CROSS SECTION FOR 4-LANE(2X2) EXPRESSWAY WITH 4-LANE(2X2) SERVICE ROAD FOR ELEVATED/FLYOVER APPROACH (MOUNTAINOUS TERRAIN - BROWN FIELD ALIGNMENT)



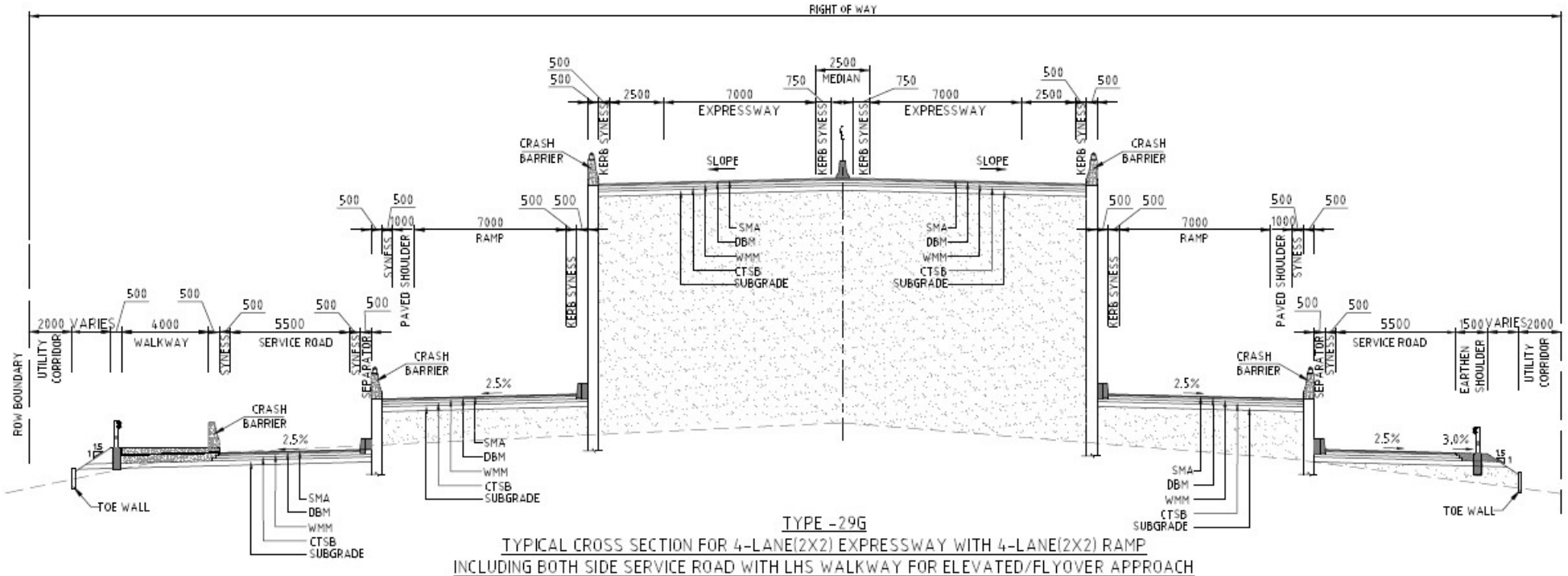
TYPE -29E

TYPICAL CROSS SECTION FOR 4-LANE(2X2) EXPRESSWAY WITH 4-LANE(2X2) RAMP INCLUDING LHS WALKWAY FOR ELEVATED/FLYOVER APPROACH (MOUNTAINOUS TERRAIN)



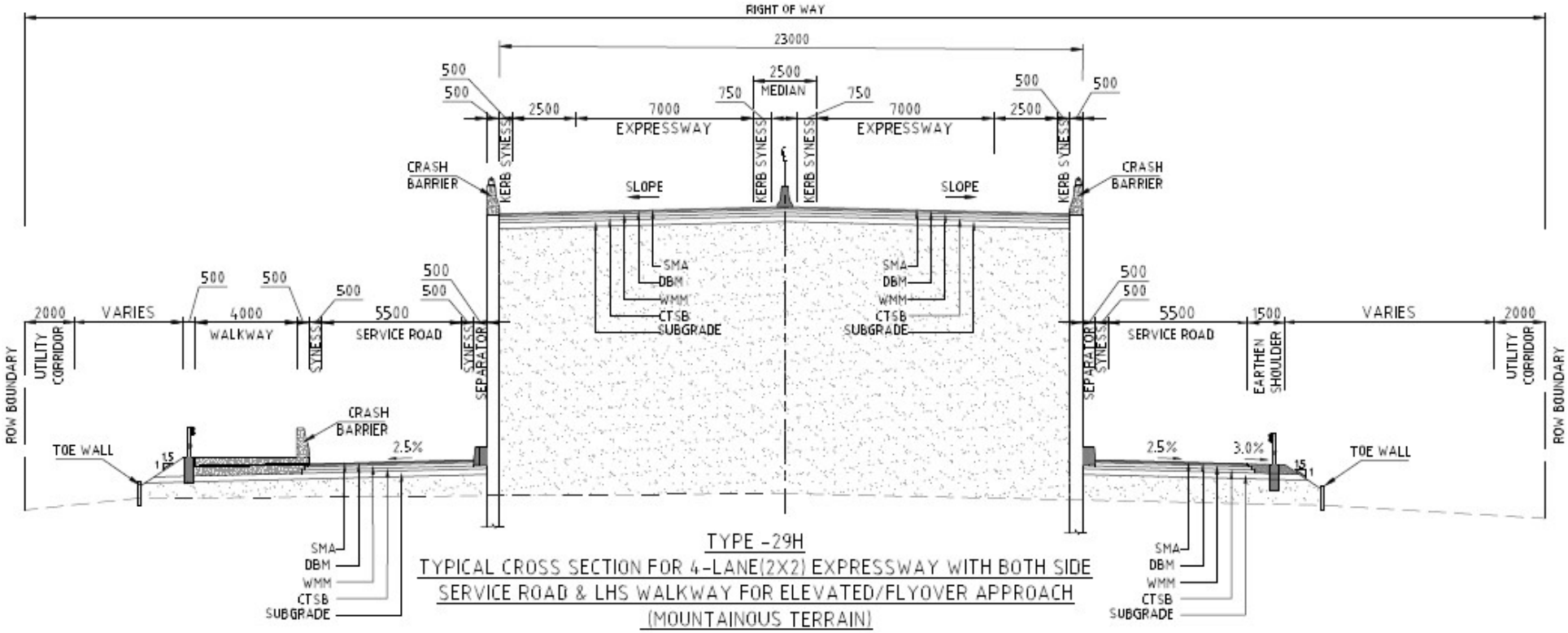
TYPE -29F

TYPICAL CROSS SECTION FOR 4-LANE(2X2) EXPRESSWAY WITH 4-LANE(2X2) RAMP INCLUDING LHS SERVICE ROAD WITH WALKWAY FOR ELEVATED/FLYOVER APPROACH (MOUNTAINOUS TERRAIN)



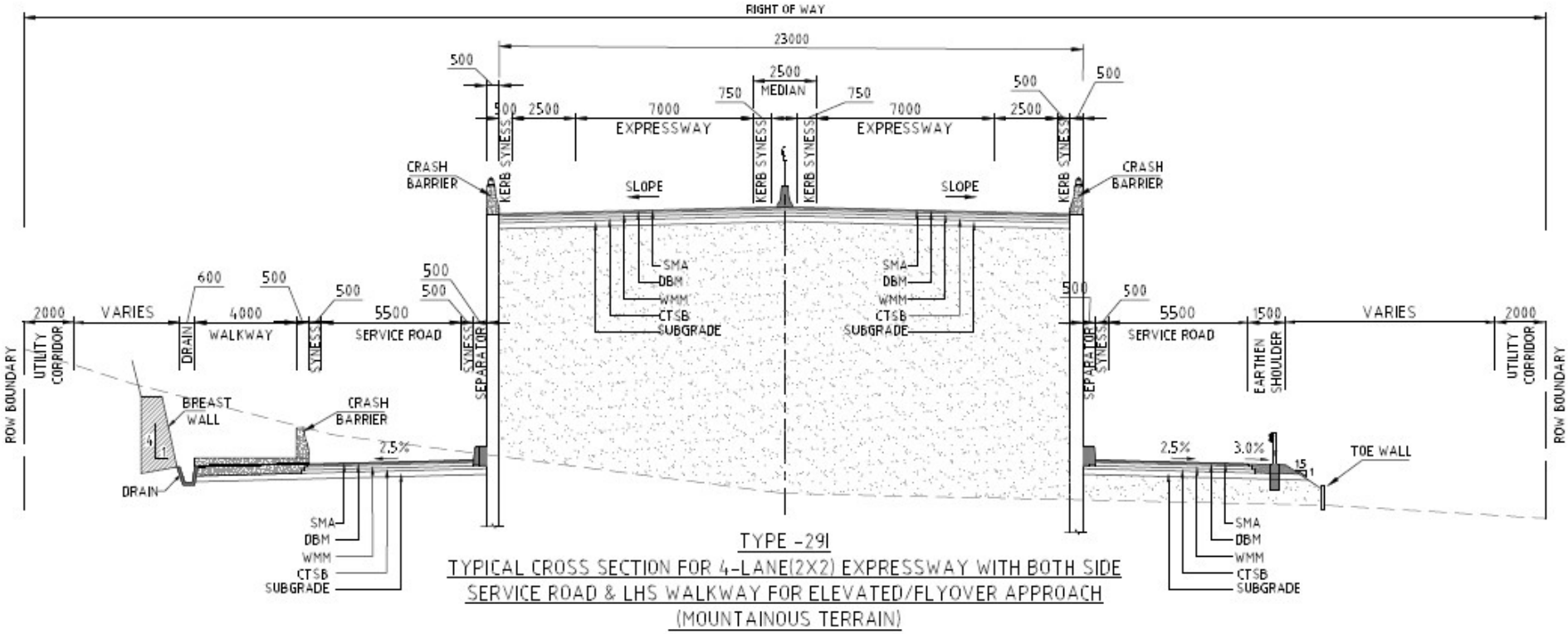
TYPE -29G

TYPICAL CROSS SECTION FOR 4-LANE(2X2) EXPRESSWAY WITH 4-LANE(2X2) RAMP INCLUDING BOTH SIDE SERVICE ROAD WITH LHS WALKWAY FOR ELEVATED/FLYOVER APPROACH (MOUNTAINOUS TERRAIN)



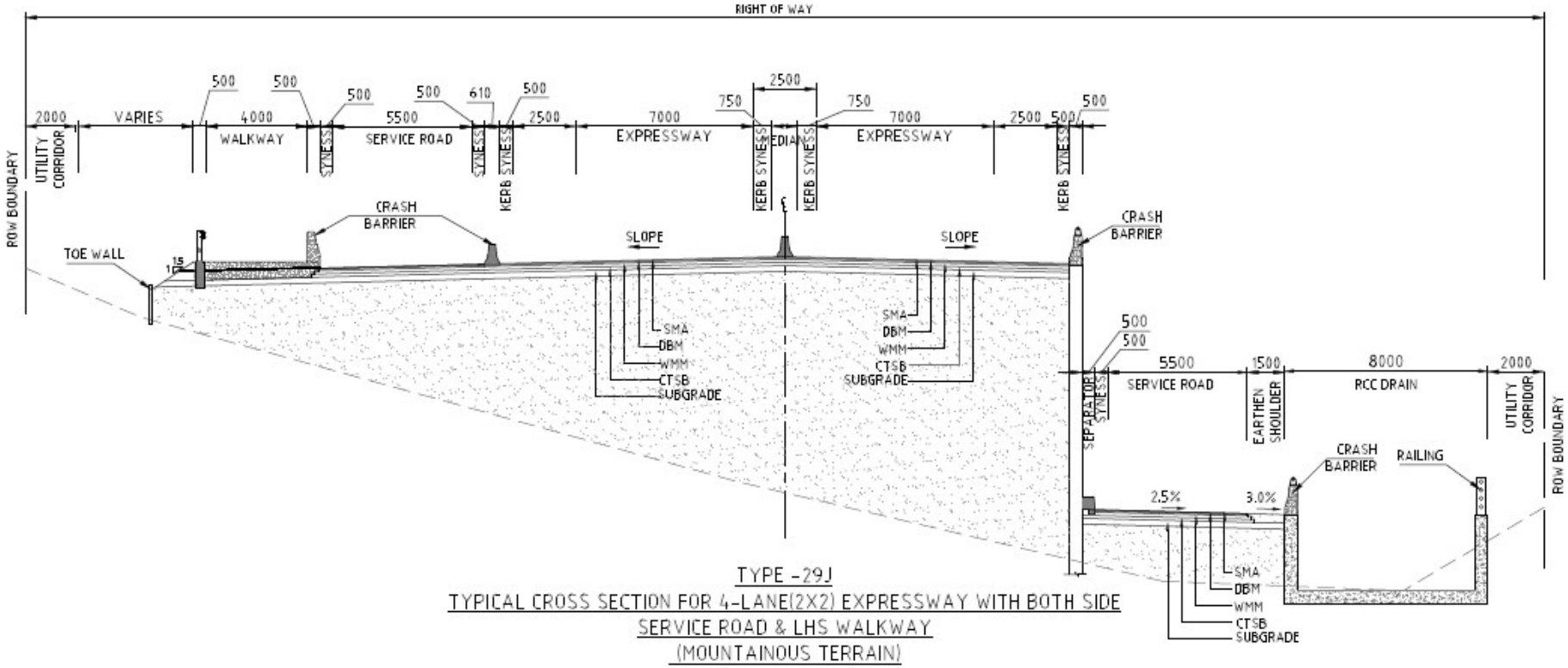
TYPE -29H

TYPICAL CROSS SECTION FOR 4-LANE(2X2) EXPRESSWAY WITH BOTH SIDE SERVICE ROAD & LHS WALKWAY FOR ELEVATED/FLYOVER APPROACH (MOUNTAINOUS TERRAIN)



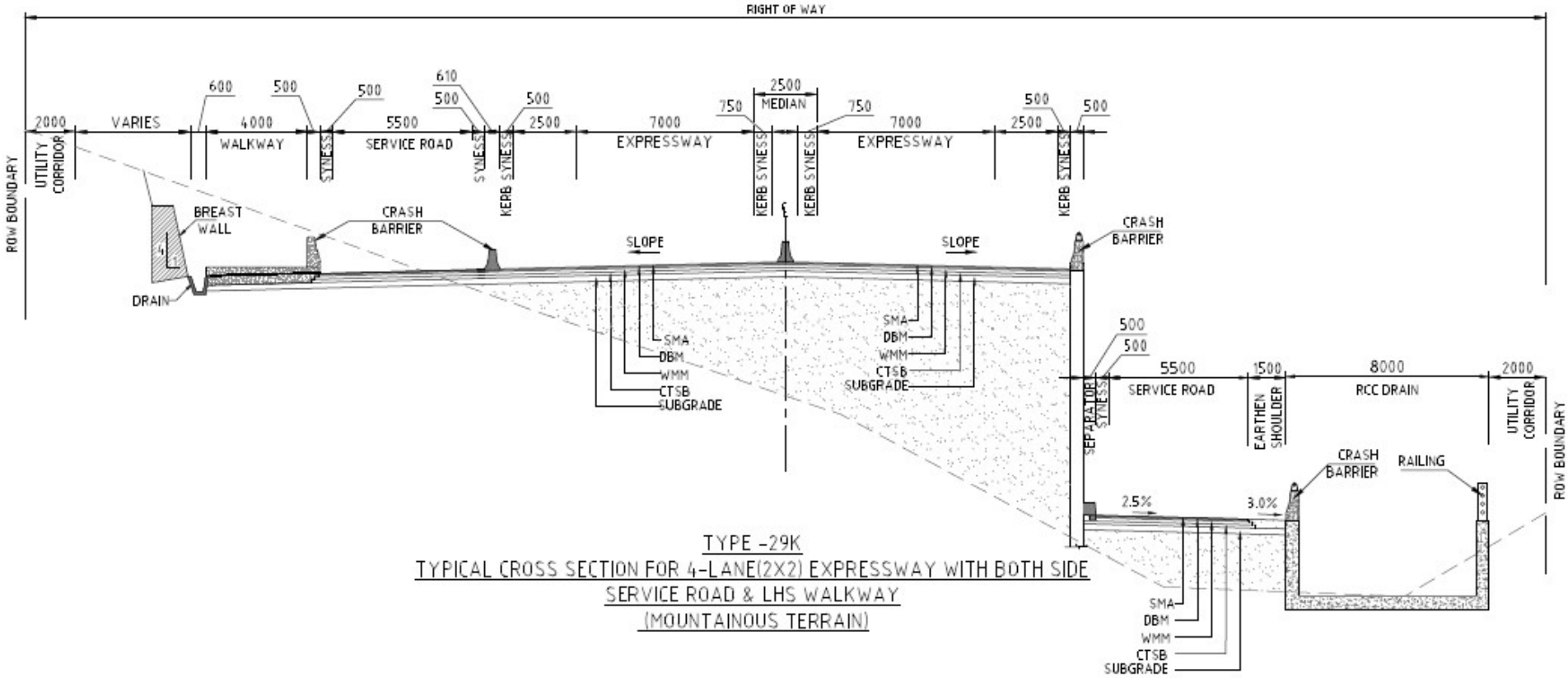
TYPE -29I

TYPICAL CROSS SECTION FOR 4-LANE(2X2) EXPRESSWAY WITH BOTH SIDE SERVICE ROAD & LHS WALKWAY FOR ELEVATED/FLYOVER APPROACH (MOUNTAINOUS TERRAIN)

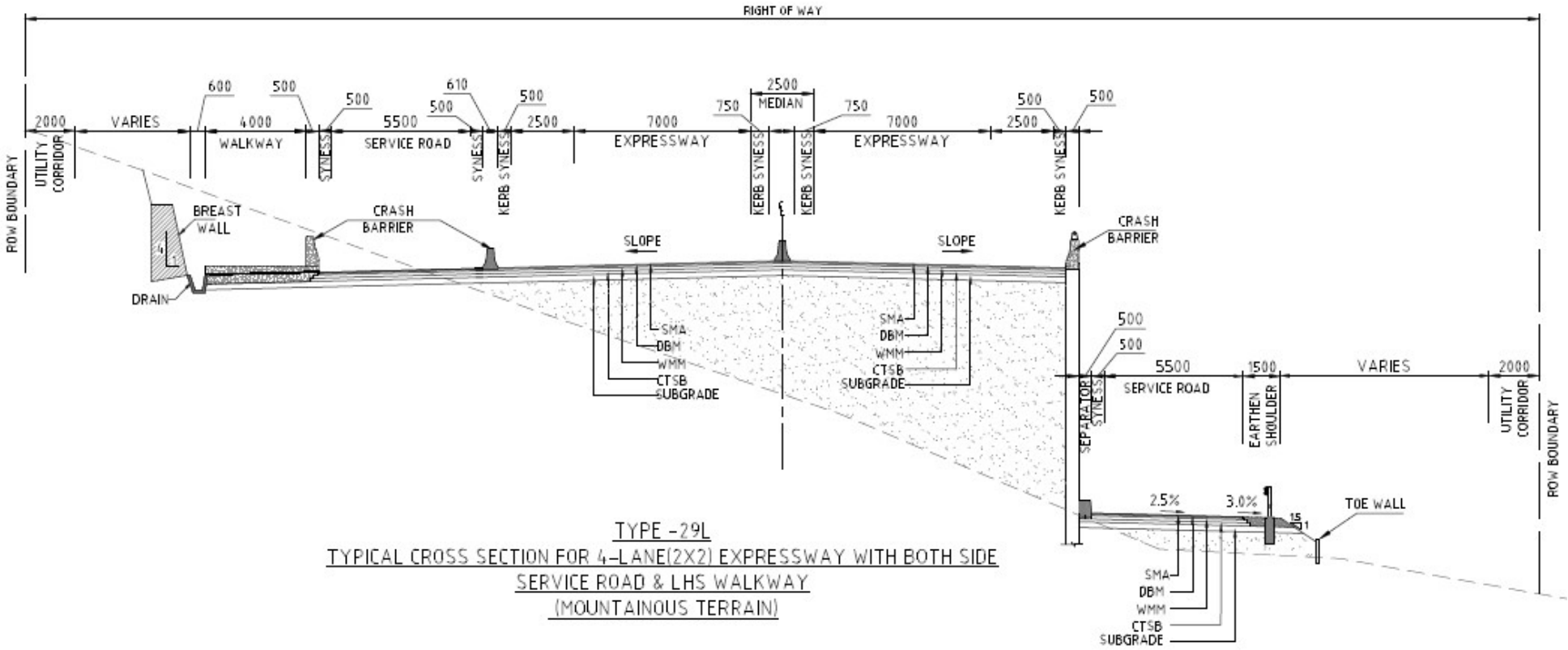


TYPE -29J

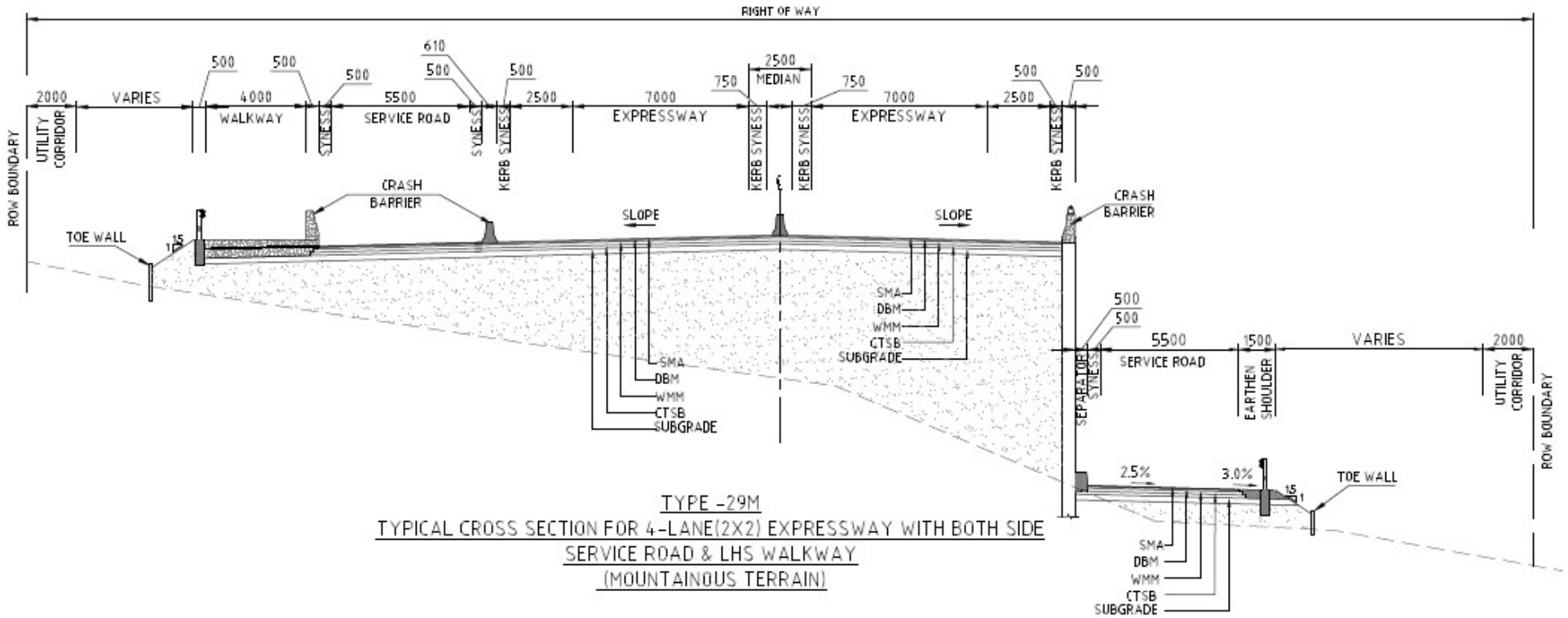
TYPICAL CROSS SECTION FOR 4-LANE(2X2) EXPRESSWAY WITH BOTH SIDE SERVICE ROAD & LHS WALKWAY (MOUNTAINOUS TERRAIN)



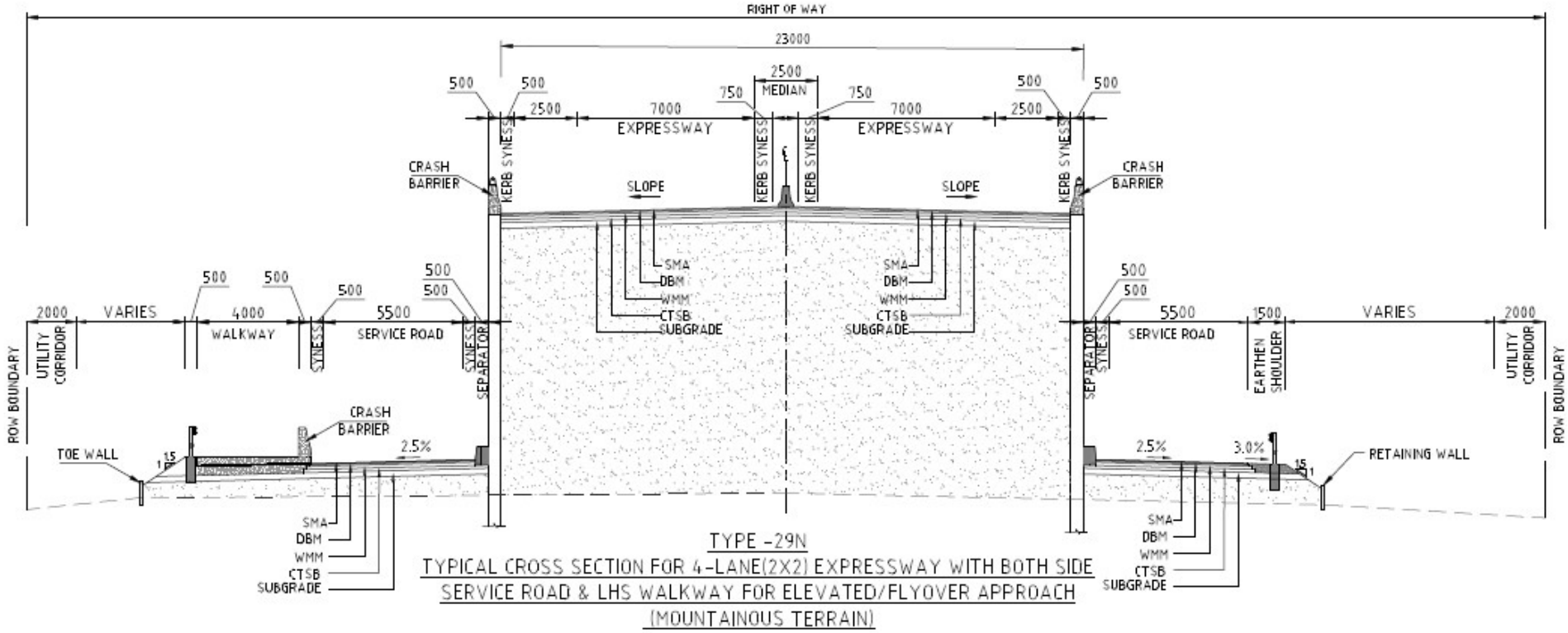
TYPE -29K
TYPICAL CROSS SECTION FOR 4-LANE(2X2) EXPRESSWAY WITH BOTH SIDE SERVICE ROAD & LHS WALKWAY
(MOUNTAINOUS TERRAIN)



TYPE -29L
TYPICAL CROSS SECTION FOR 4-LANE(2X2) EXPRESSWAY WITH BOTH SIDE SERVICE ROAD & LHS WALKWAY
(MOUNTAINOUS TERRAIN)

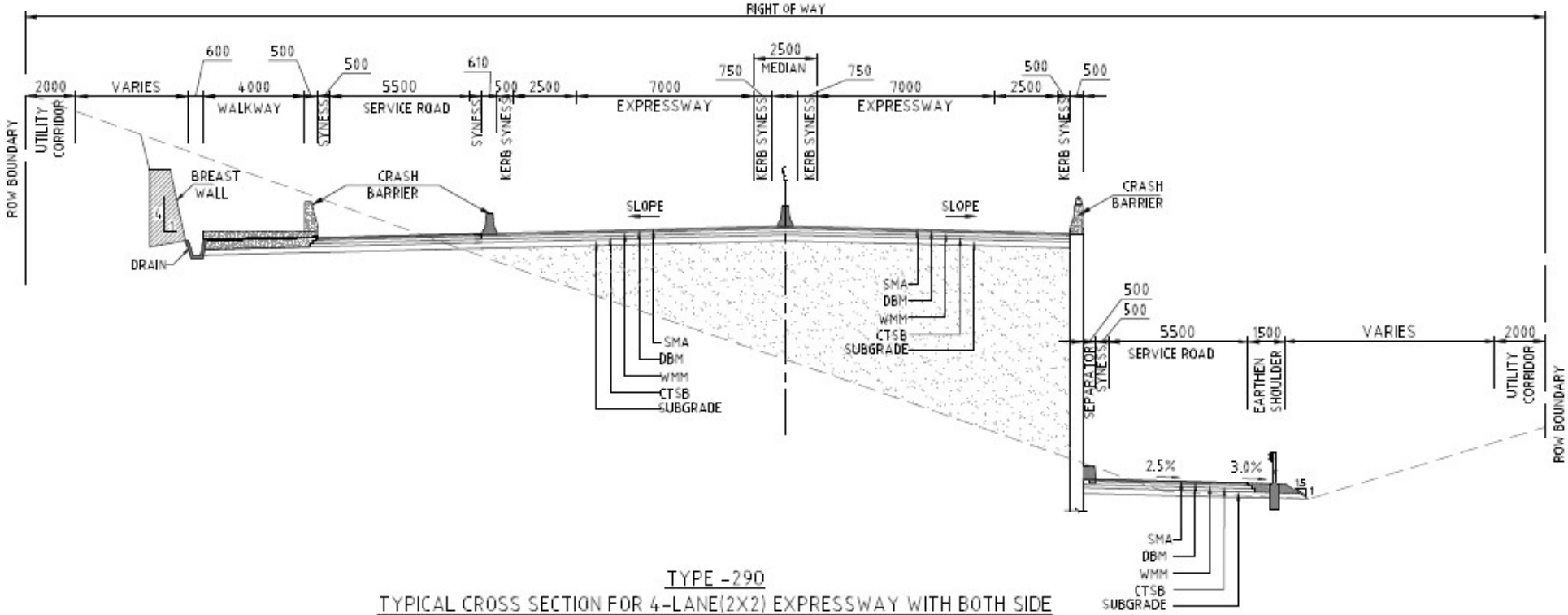


TYPE -29M
TYPICAL CROSS SECTION FOR 4-LANE(2X2) EXPRESSWAY WITH BOTH SIDE SERVICE ROAD & LHS WALKWAY
(MOUNTAINOUS TERRAIN)

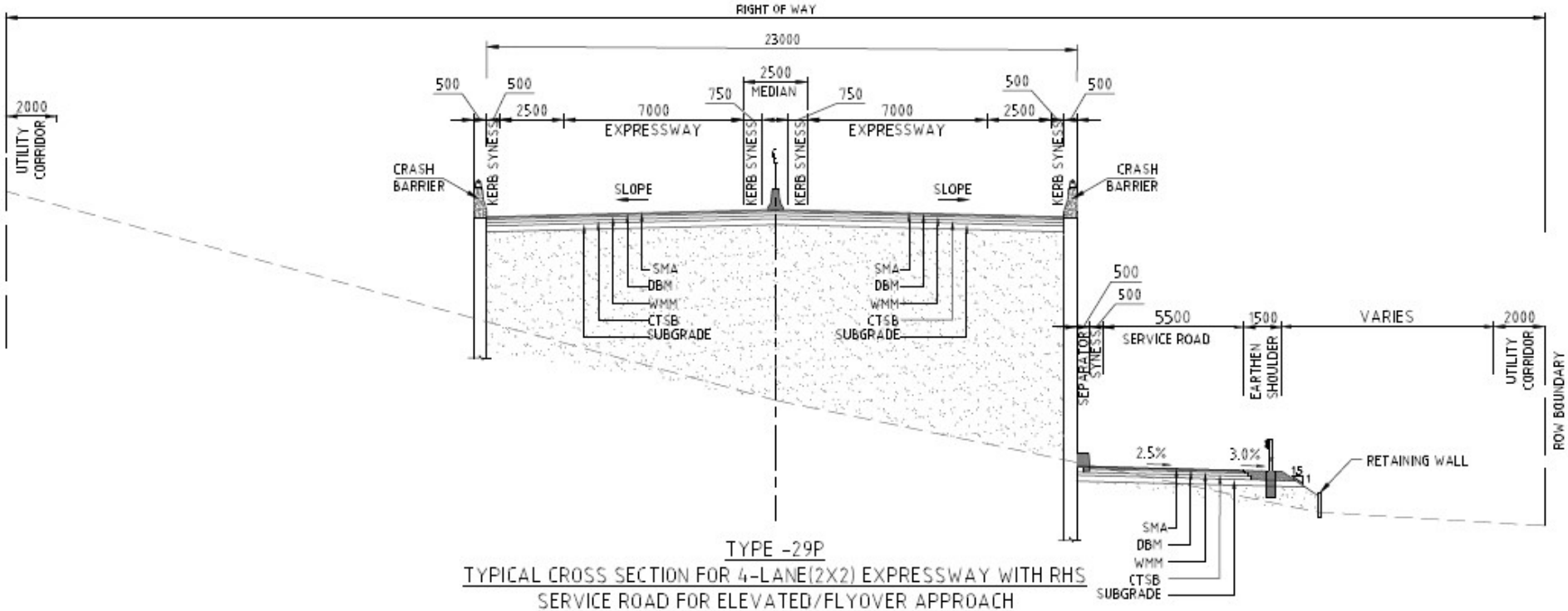


TYPE -29N

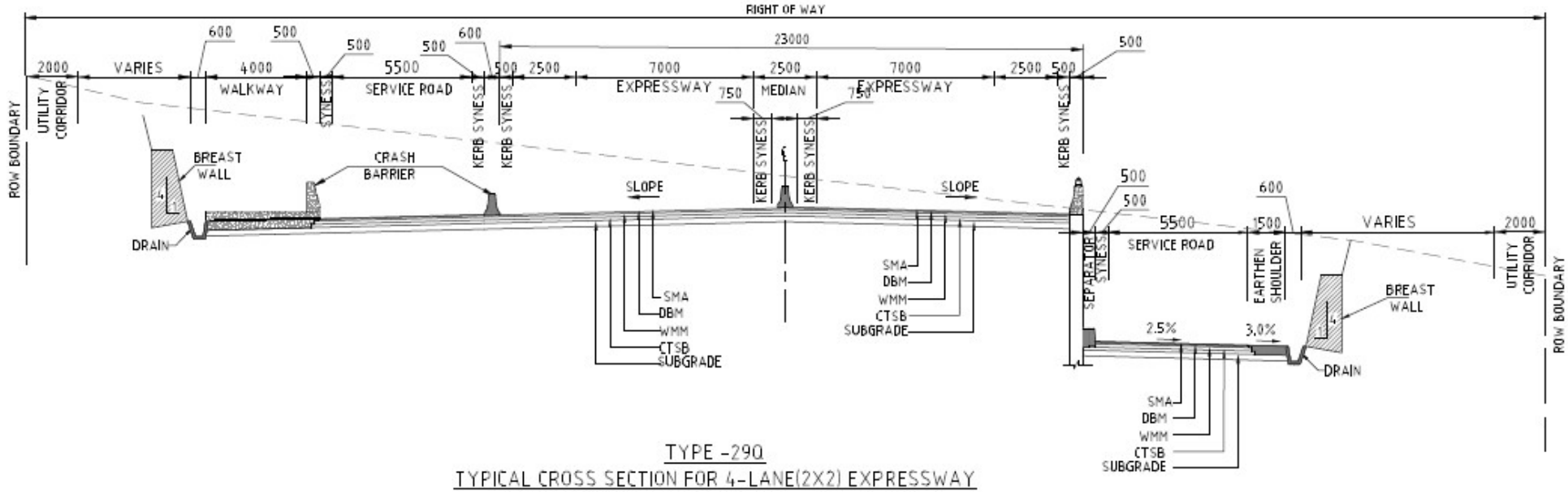
TYPICAL CROSS SECTION FOR 4-LANE(2X2) EXPRESSWAY WITH BOTH SIDE SERVICE ROAD & LHS WALKWAY FOR ELEVATED/FLYOVER APPROACH (MOUNTAINOUS TERRAIN)



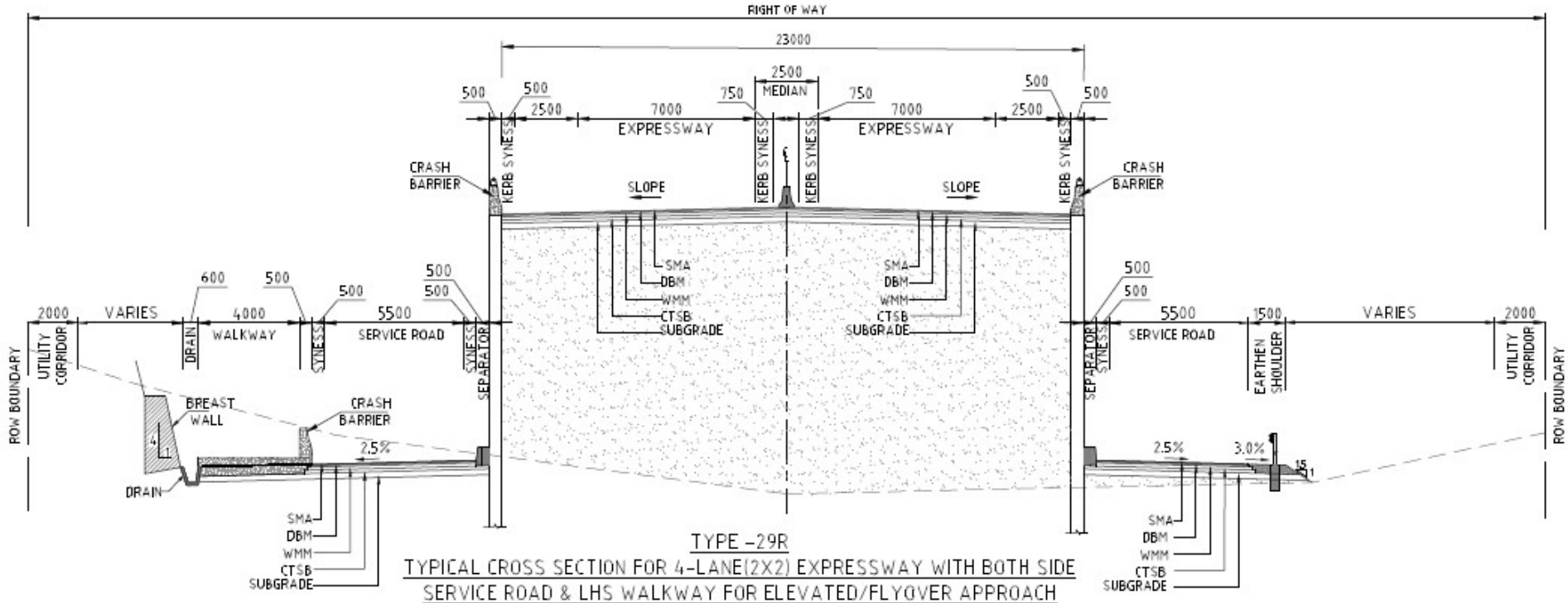
TYPE -290
TYPICAL CROSS SECTION FOR 4-LANE(2X2) EXPRESSWAY WITH BOTH SIDE SERVICE ROAD & LHS WALKWAY
(MOUNTAINOUS TERRAIN)



TYPE -29P
TYPICAL CROSS SECTION FOR 4-LANE(2X2) EXPRESSWAY WITH RHS SERVICE ROAD FOR ELEVATED/FLYOVER APPROACH (MOUNTAINOUS TERRAIN)

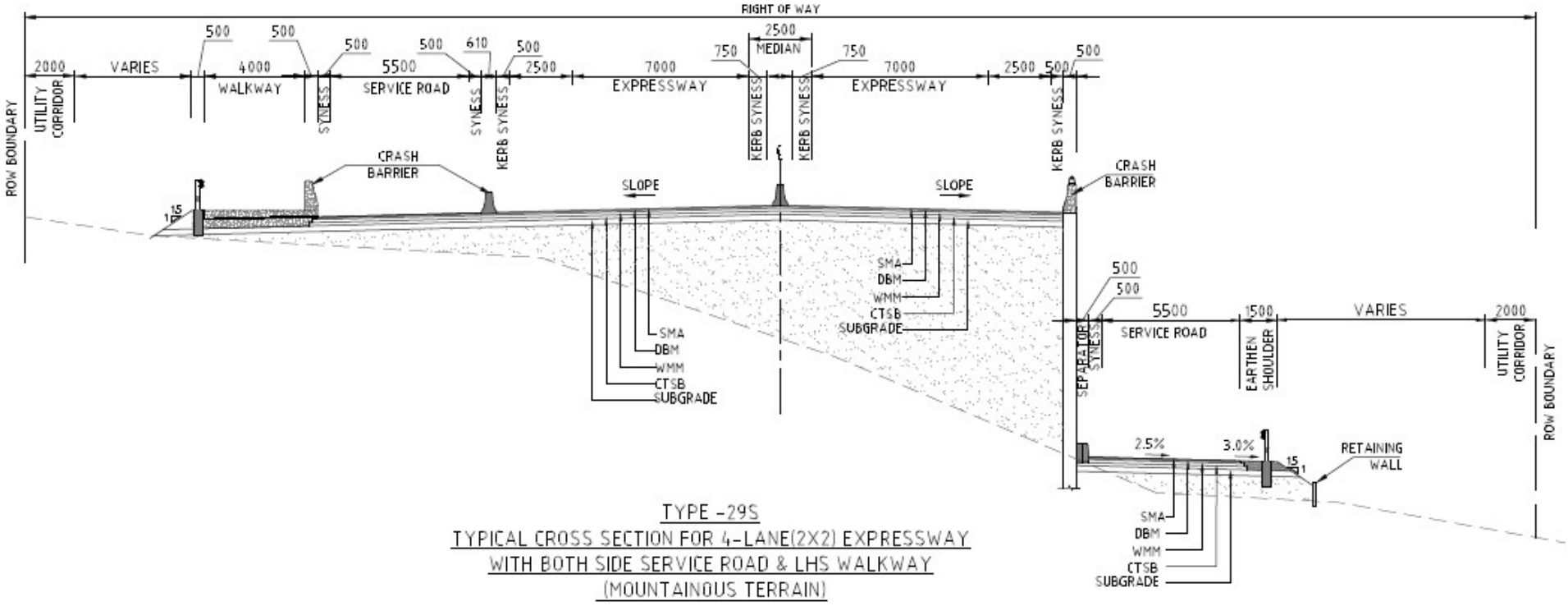


TYPE -290
TYPICAL CROSS SECTION FOR 4-LANE(2X2) EXPRESSWAY
WITH BOTH SIDE SERVICE ROAD & LHS WALKWAY
(MOUNTAINOUS TERRAIN)

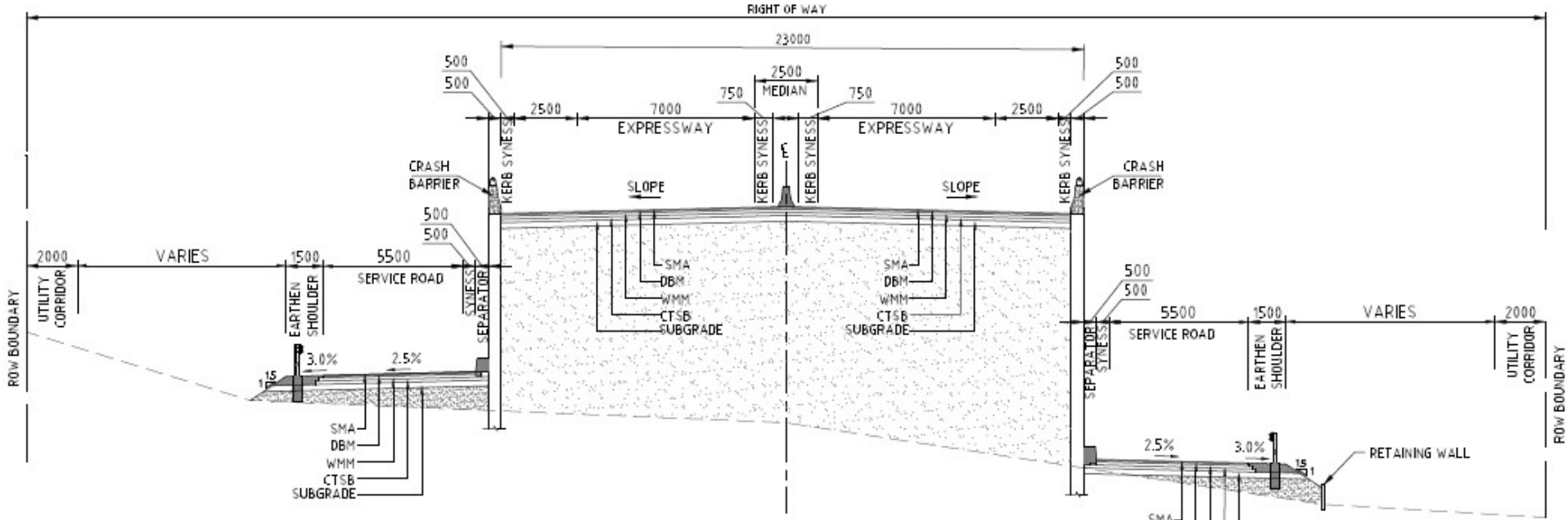


TYPE -29R

TYPICAL CROSS SECTION FOR 4-LANE(2X2) EXPRESSWAY WITH BOTH SIDE SERVICE ROAD & LHS WALKWAY FOR ELEVATED/FLYOVER APPROACH (MOUNTAINOUS TERRAIN)



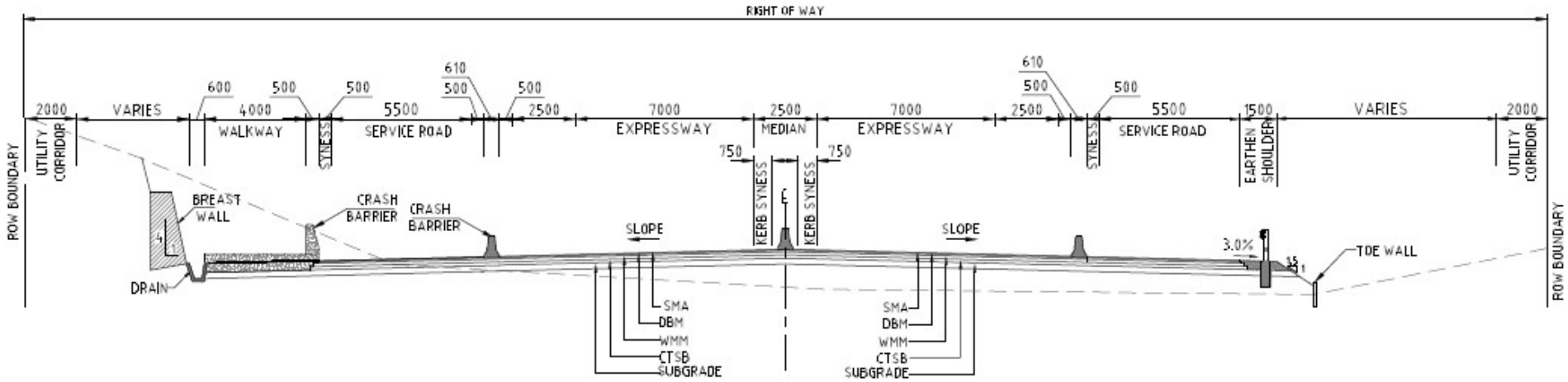
TYPE -29S
TYPICAL CROSS SECTION FOR 4-LANE(2X2) EXPRESSWAY
WITH BOTH SIDE SERVICE ROAD & LHS WALKWAY
(MOUNTAINOUS TERRAIN)



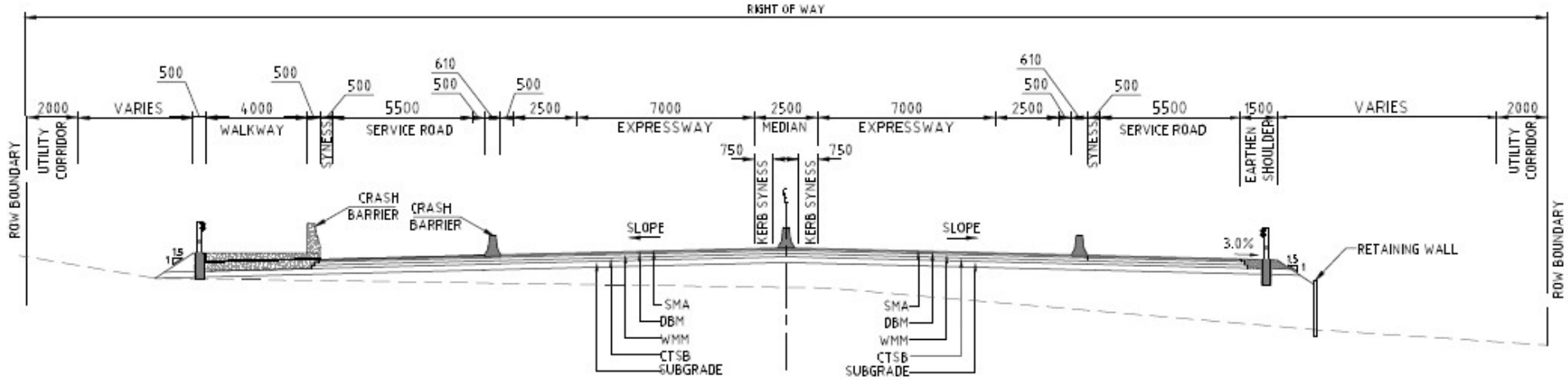
TYPE -29T

TYPICAL CROSS SECTION FOR 4-LANE(2X2) EXPRESSWAY WITH BOTH SIDE SERVICE ROAD FOR ELEVATED/FLYOVER APPROACH (MOUNTAINOUS TERRAIN)

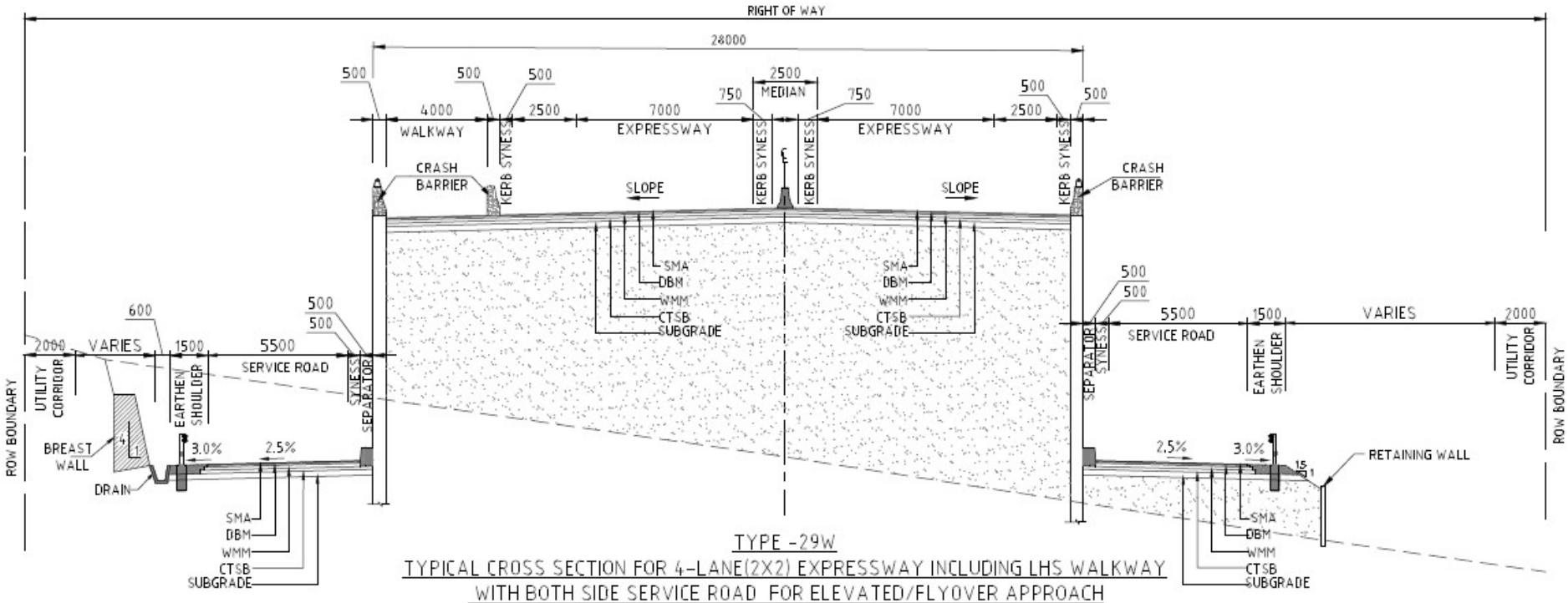
531



TYPE -29U
TYPICAL CROSS SECTION FOR 4-LANE(2X2) EXPRESSWAY
WITH BOTH SIDE SERVICE ROAD & LHS WALKWAY
(MOUNTAINOUS TERRAIN)

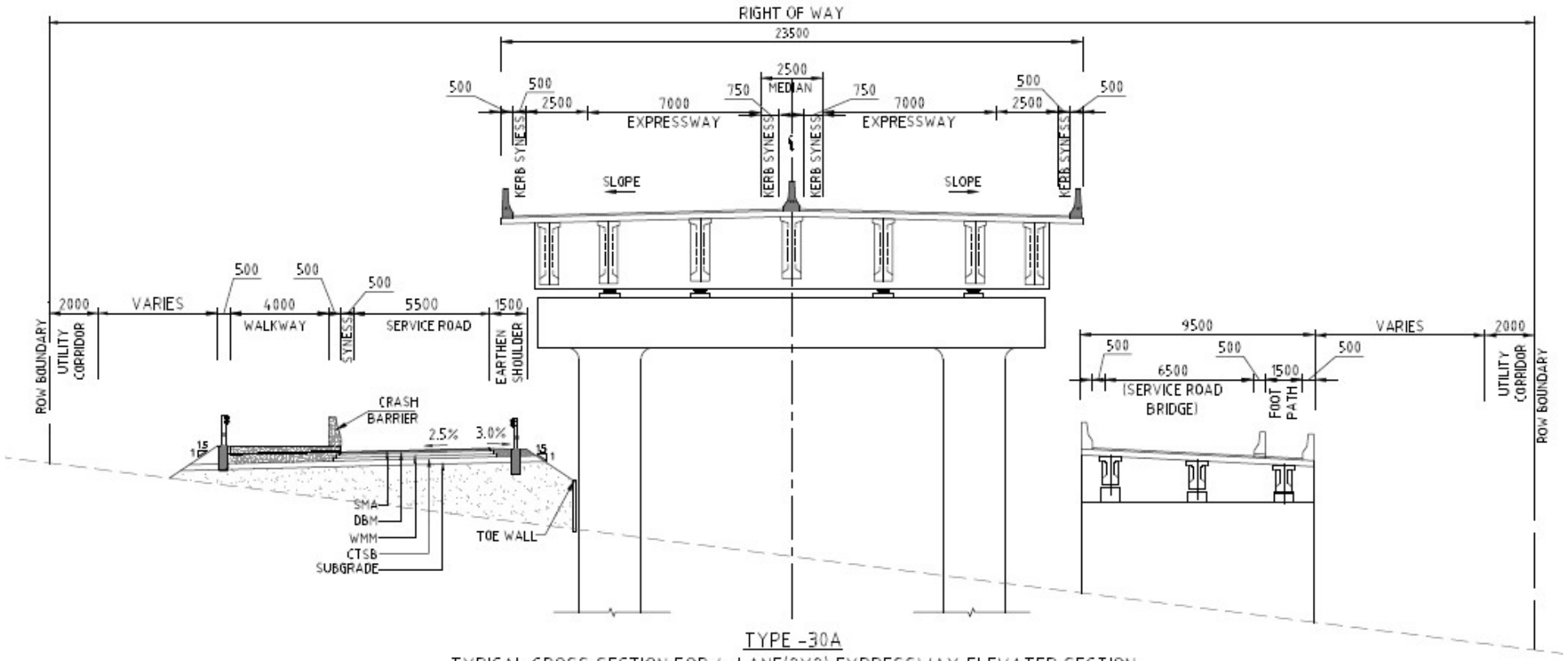


TYPE -29V
TYPICAL CROSS SECTION FOR 4-LANE(2X2) EXPRESSWAY
WITH BOTH SIDE SERVICE ROAD & LHS WALKWAY
(MOUNTAINOUS TERRAIN)



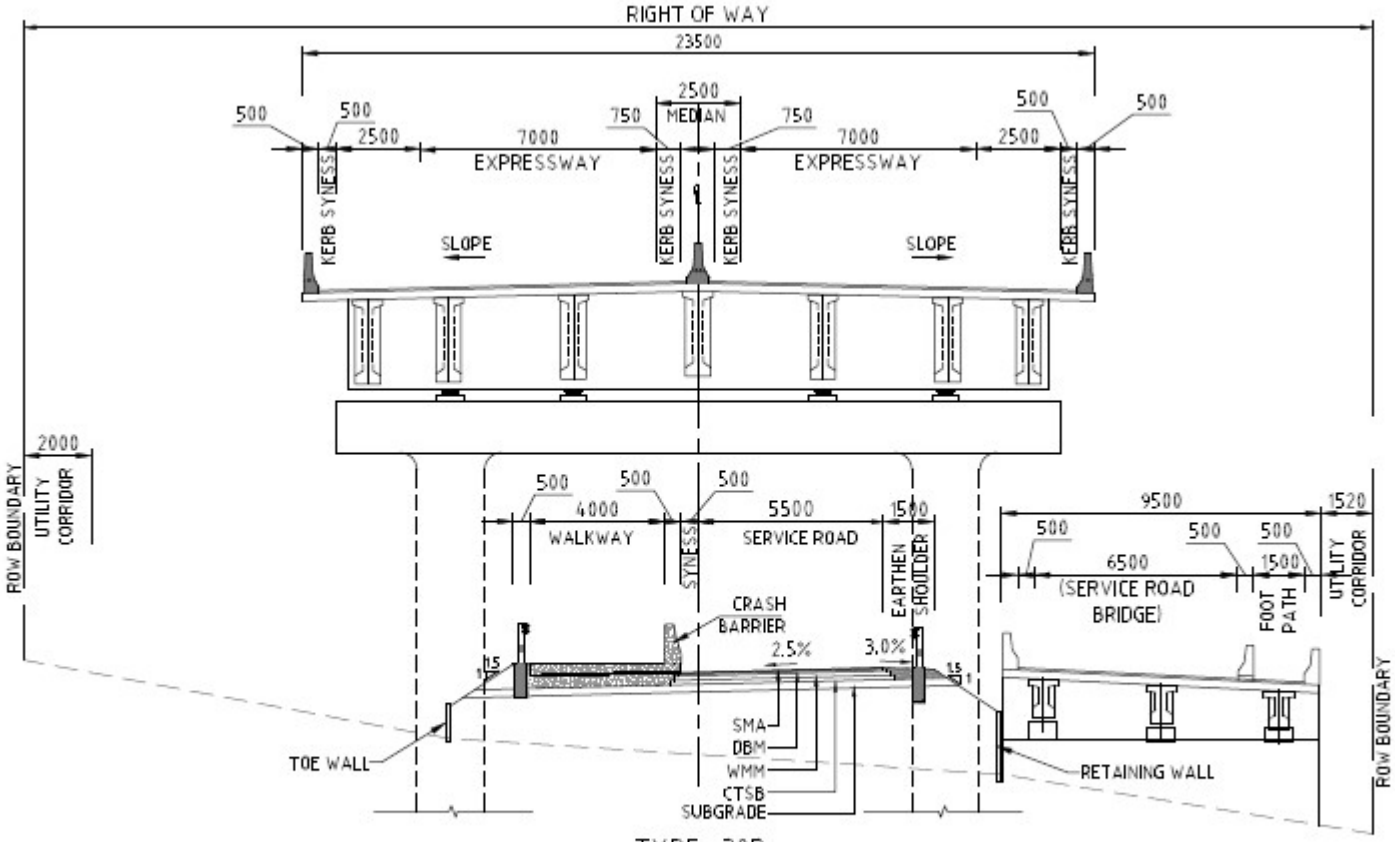
TYPE -29W

TYPICAL CROSS SECTION FOR 4-LANE(2X2) EXPRESSWAY INCLUDING LHS WALKWAY WITH BOTH SIDE SERVICE ROAD FOR ELEVATED/FLYOVER APPROACH (MOUNTAINOUS TERRAIN)



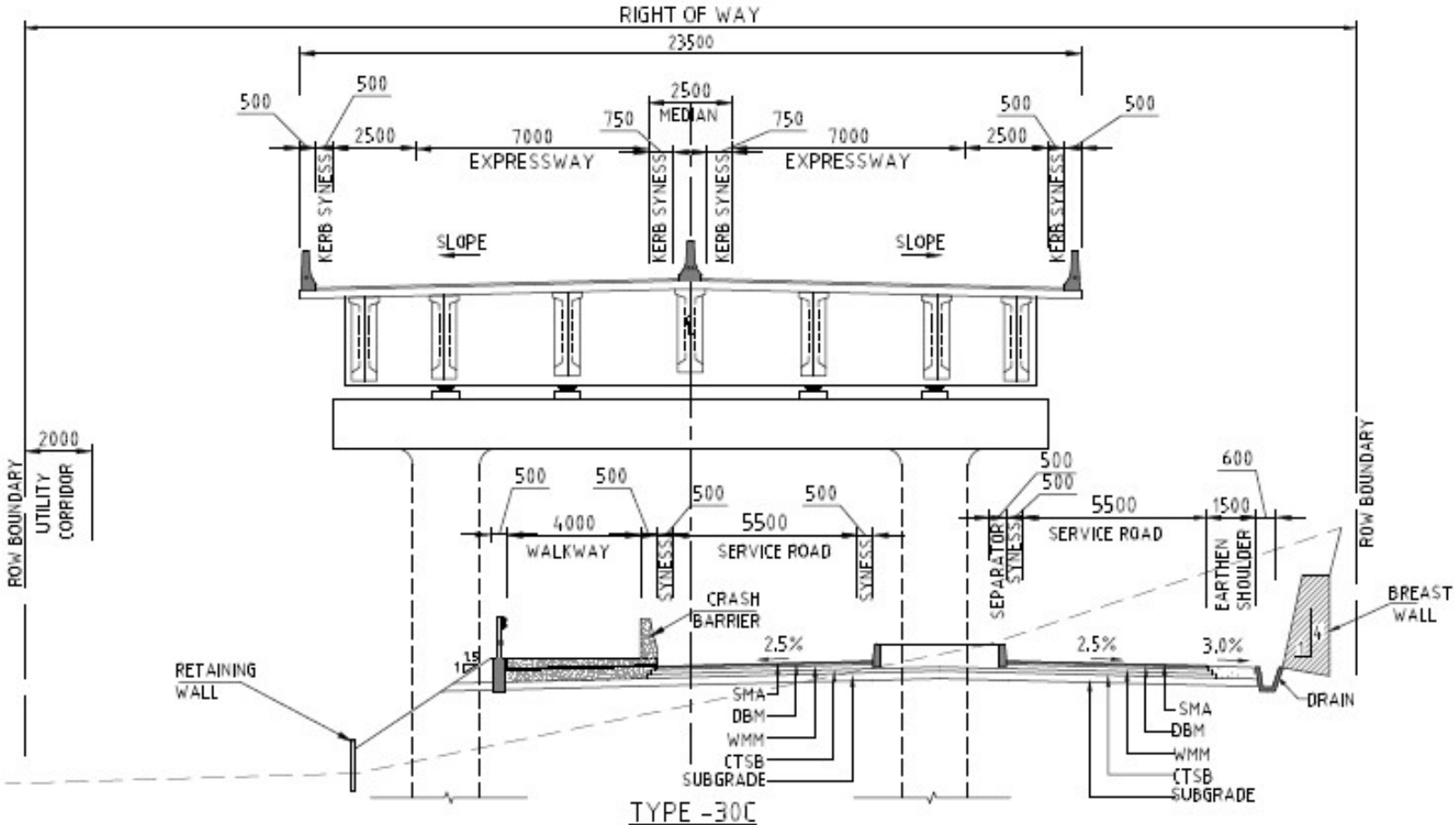
TYPE -30A

TYPICAL CROSS SECTION FOR 4-LANE(2X2) EXPRESSWAY ELEVATED SECTION INCLUDING BOTH SIDE SERVICE ROAD & LHS WALKWAY (MOUNTAINOUS TERRAIN)



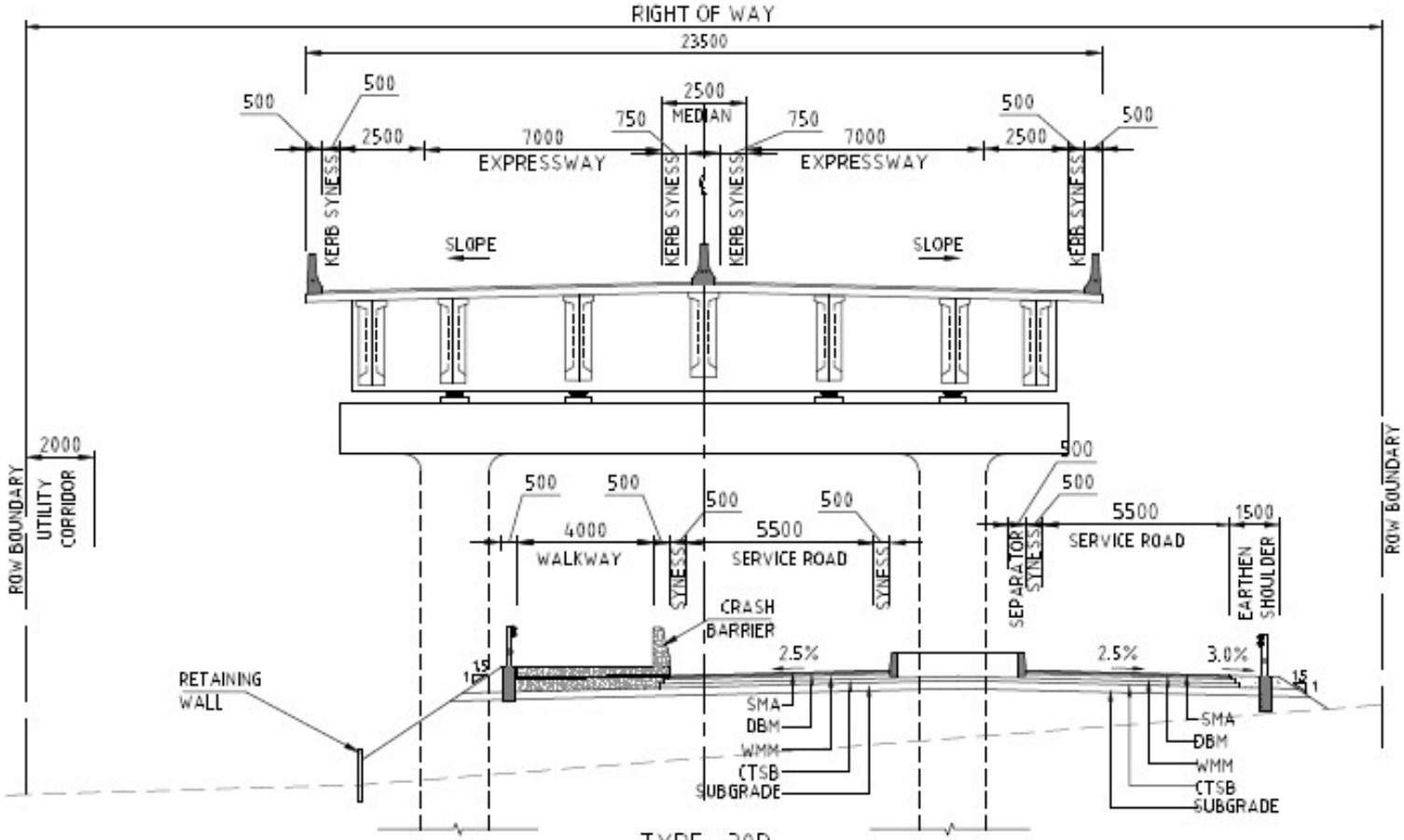
TYPE -30B

TYPICAL CROSS SECTION FOR 4-LANE(2X2) EXPRESSWAY ELEVATED SECTION INCLUDING BOTH SIDE SERVICE ROAD & LHS WALKWAY (MOUNTAINOUS TERRAIN)



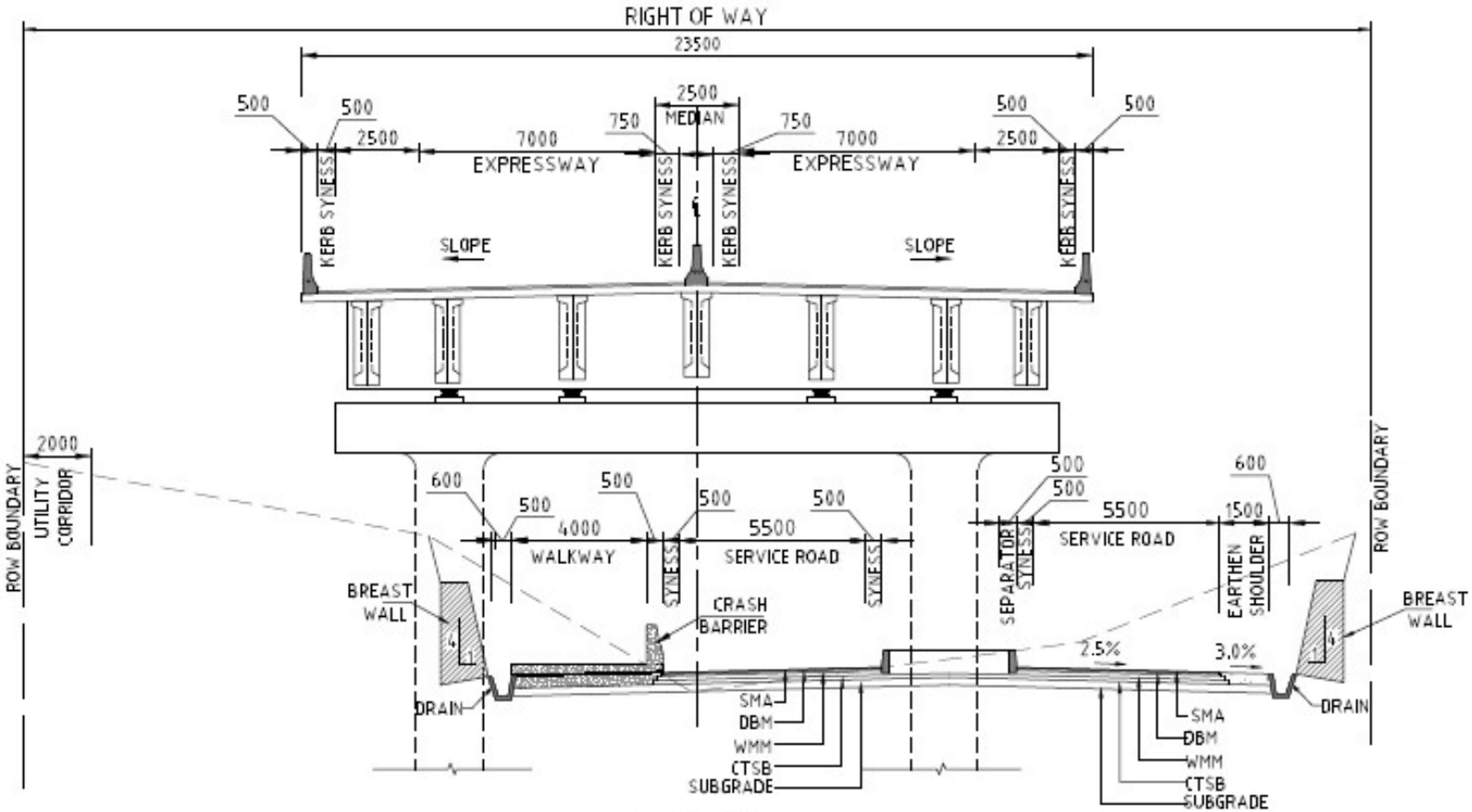
TYPE -30C

TYPICAL CROSS SECTION FOR 4-LANE(2X2) EXPRESSWAY ELEVATED SECTION INCLUDING BOTH SIDE SERVICE ROAD & LHS WALKWAY (MOUNTAINOUS TERRAIN)



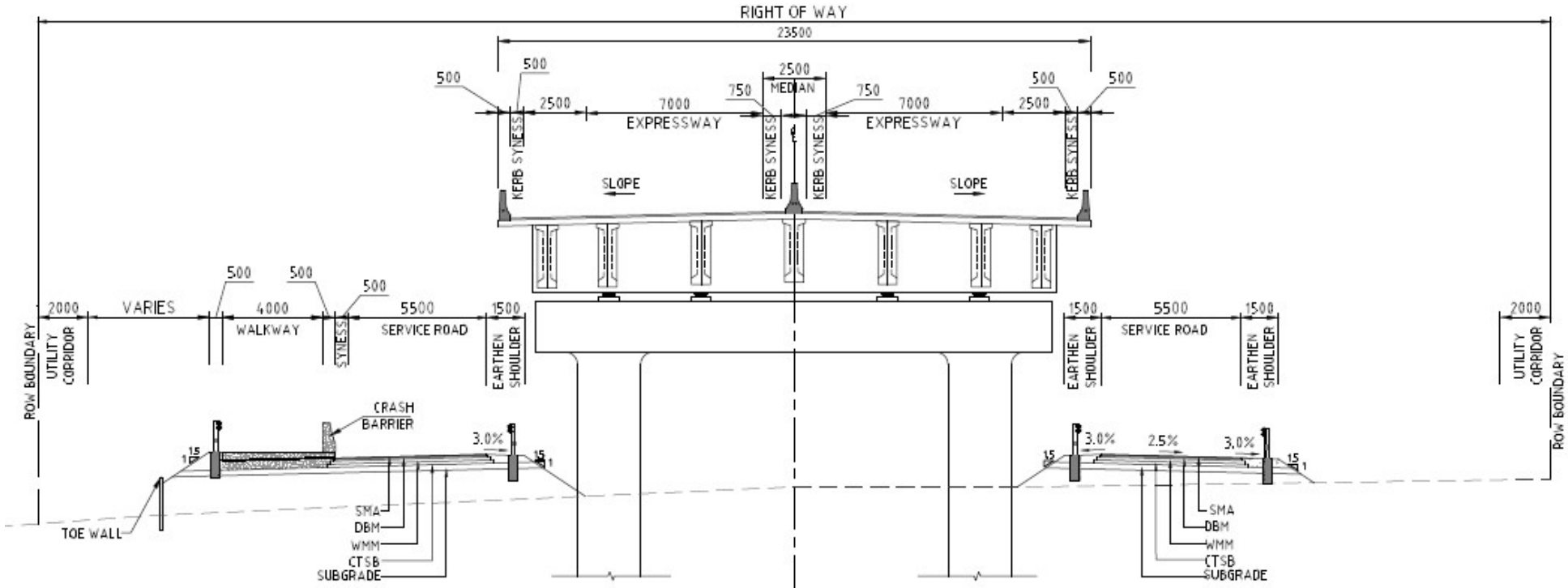
TYPE -30D

TYPICAL CROSS SECTION FOR 4-LANE(2X2) EXPRESSWAY ELEVATED SECTION INCLUDING BOTH SIDE SERVICE ROAD & LHS WALKWAY (MOUNTAINOUS TERRAIN)



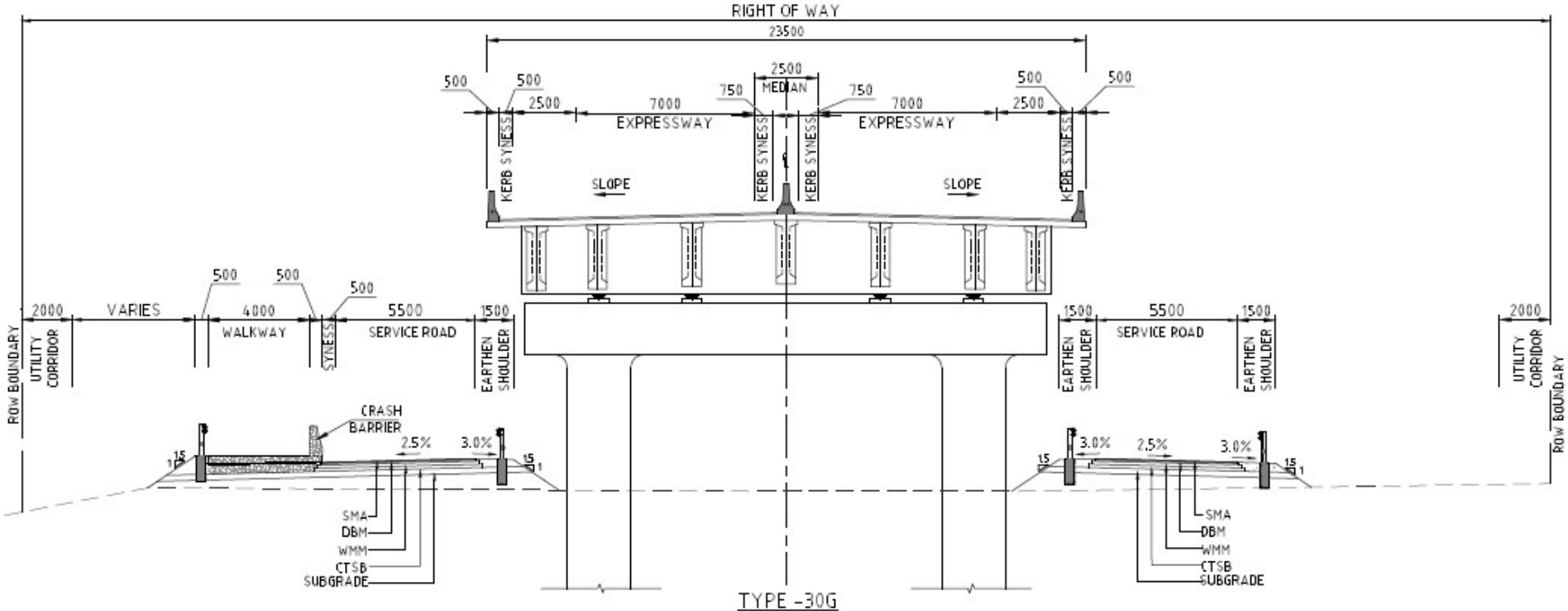
TYPE -30E

TYPICAL CROSS SECTION FOR 4-LANE(2X2) EXPRESSWAY ELEVATED SECTION INCLUDING BOTH SIDE SERVICE ROAD & LHS WALKWAY (MOUNTAINOUS TERRAIN)



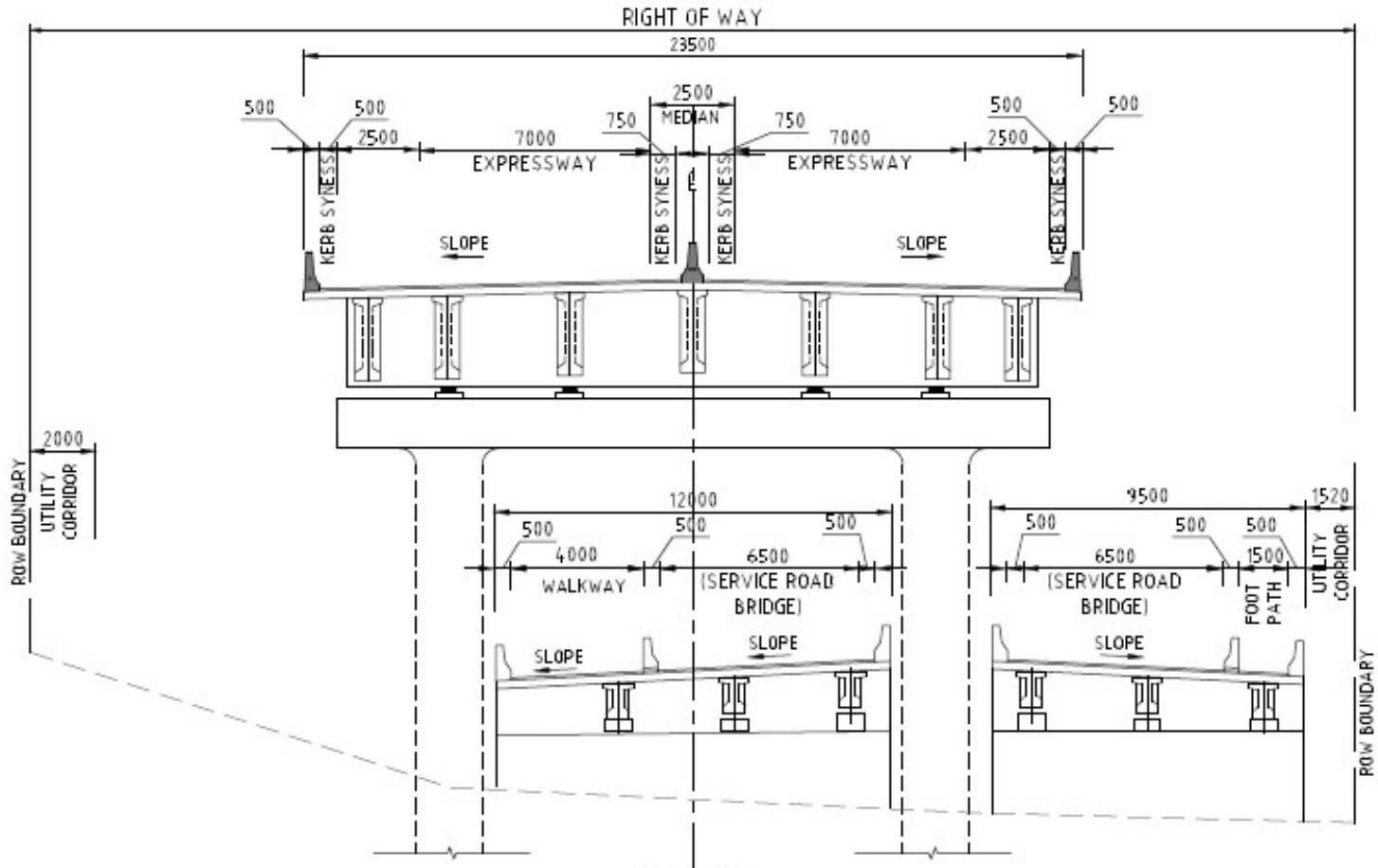
TYPE -30F

TYPICAL CROSS SECTION FOR 4-LANE(2X2) EXPRESSWAY ELEVATED SECTION INCLUDING BOTH SIDE SERVICE ROAD & LHS WALKWAY (MOUNTAINOUS TERRAIN)



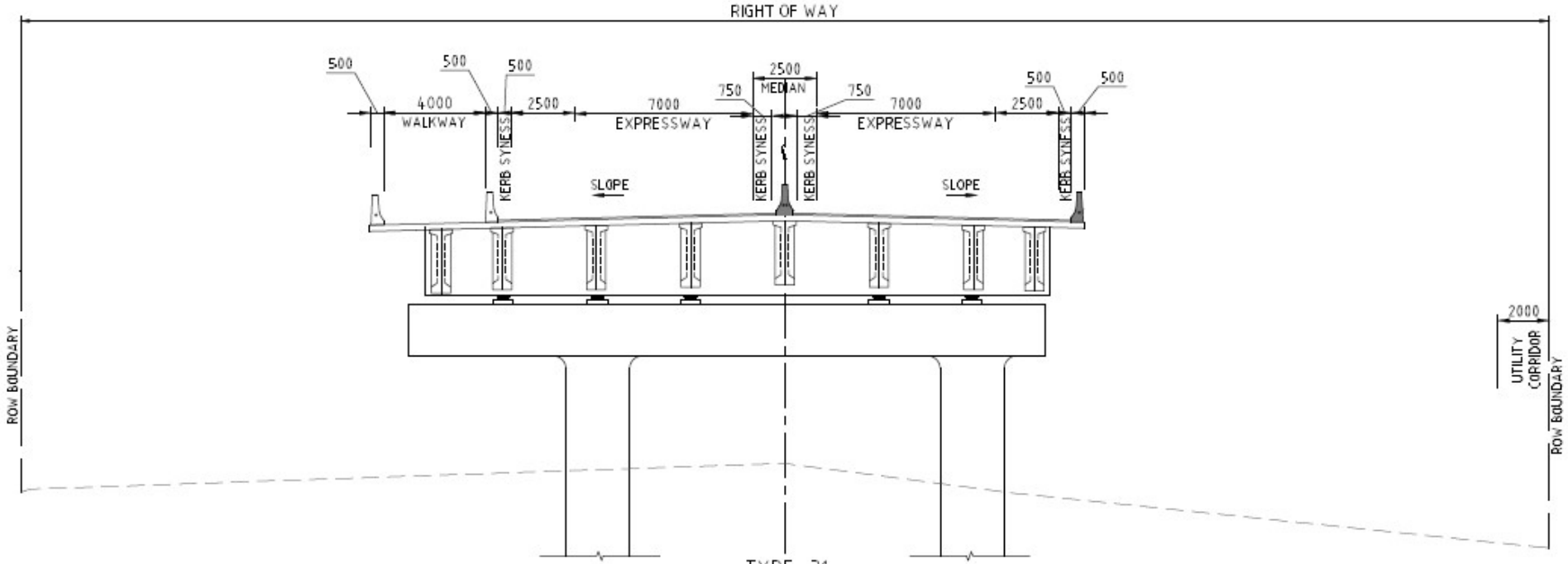
TYPE -30G

TYPICAL CROSS SECTION FOR 4-LANE(2X2) EXPRESSWAY ELEVATED SECTION INCLUDING BOTH SIDE SERVICE ROAD & LHS WALKWAY (MOUNTAINOUS TERRAIN)



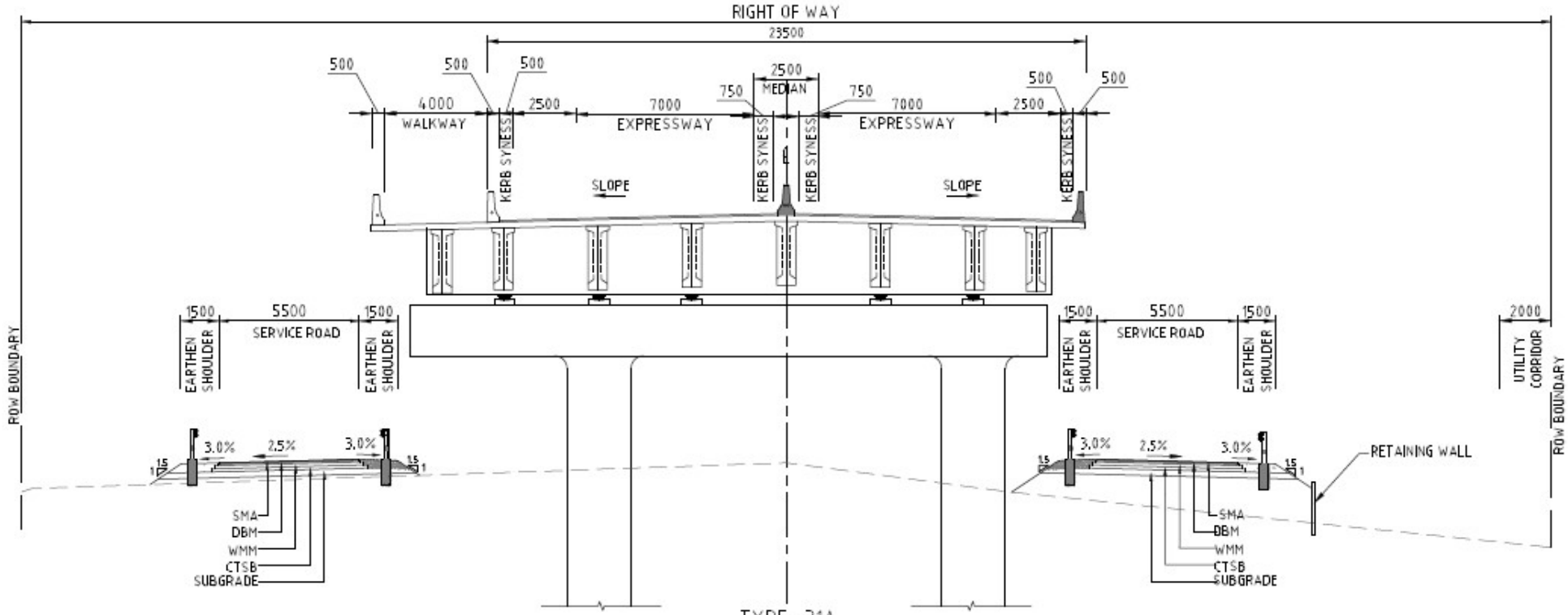
TYPE -30H

TYPICAL CROSS SECTION FOR 4-LANE(2X2) EXPRESSWAY ELEVATED SECTION INCLUDING BOTH SIDE SERVICE ROAD & LHS WALKWAY (MOUNTAINOUS TERRAIN)



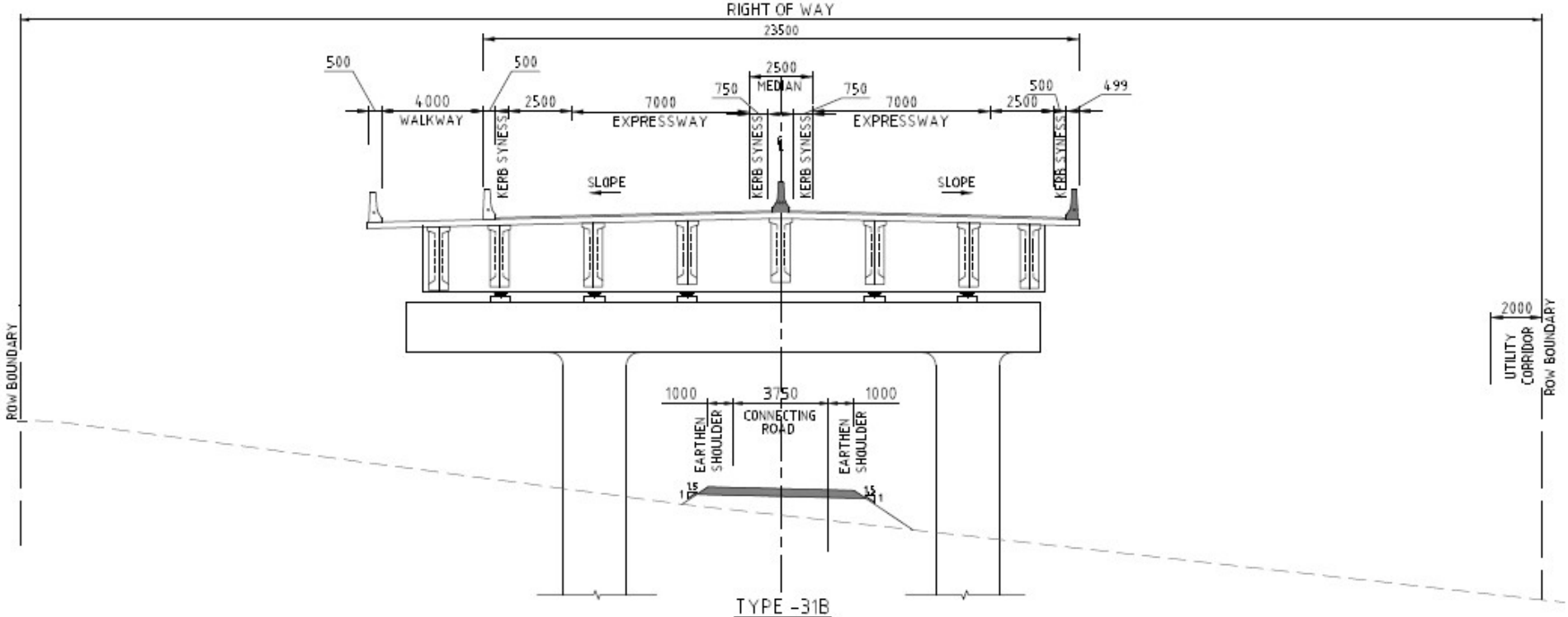
TYPE -31

TYPICAL CROSS SECTION FOR 4-LANE(2X2) EXPRESSWAY ELEVATED SECTION INCLUDING LHS WALKWAY (MOUNTAINOUS TERRAIN)



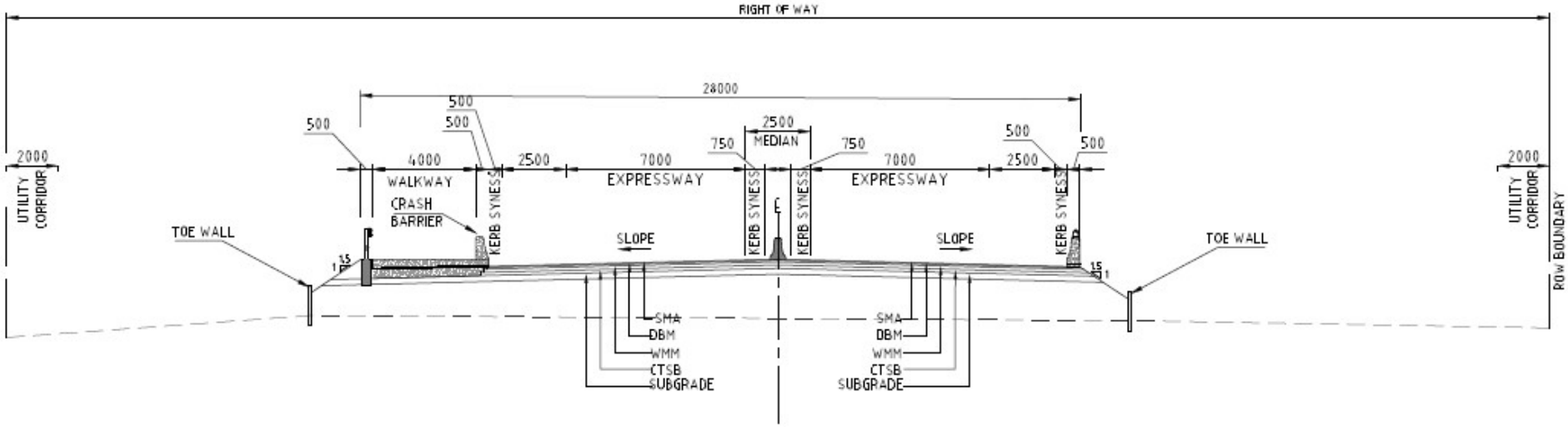
TYPE -31A

TYPICAL CROSS SECTION FOR 4-LANE(2X2) EXPRESSWAY ELEVATED SECTION INCLUDING LHS WALKWAY & BOTH SIDE SERVICE ROAD (MOUNTAINOUS TERRAIN)

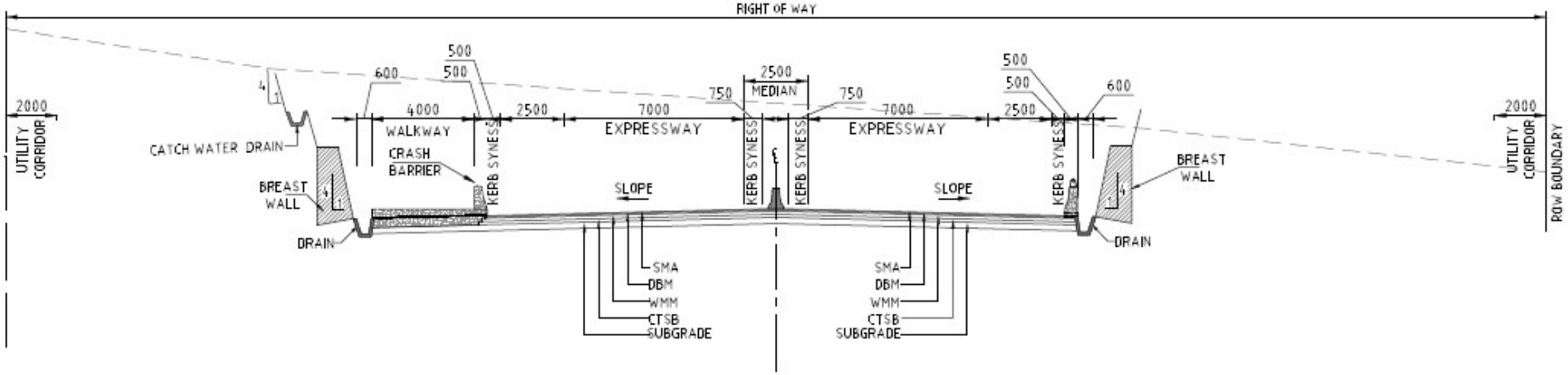


TYPE -31B

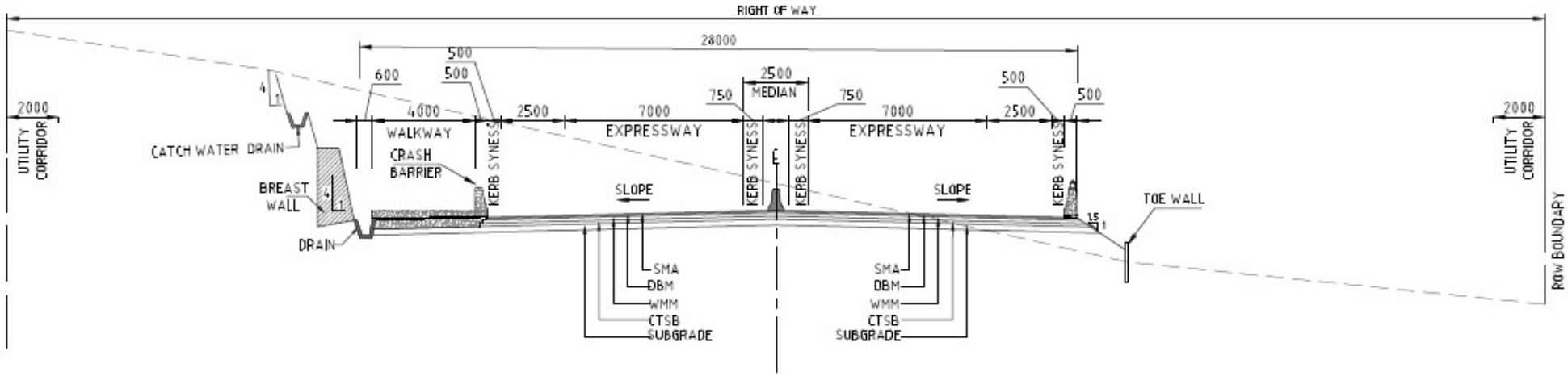
TYPICAL CROSS SECTION FOR 4-LANE(2X2) EXPRESSWAY ELEVATED SECTION INCLUDING LHS WALKWAY (MOUNTAINOUS TERRAIN)



TYPE -32A
TYPICAL CROSS SECTION FOR 4-LANE(2X2) EXPRESSWAY
INCLUDING LHS WALKWAY
(MOUNTAINOUS TERRAIN)

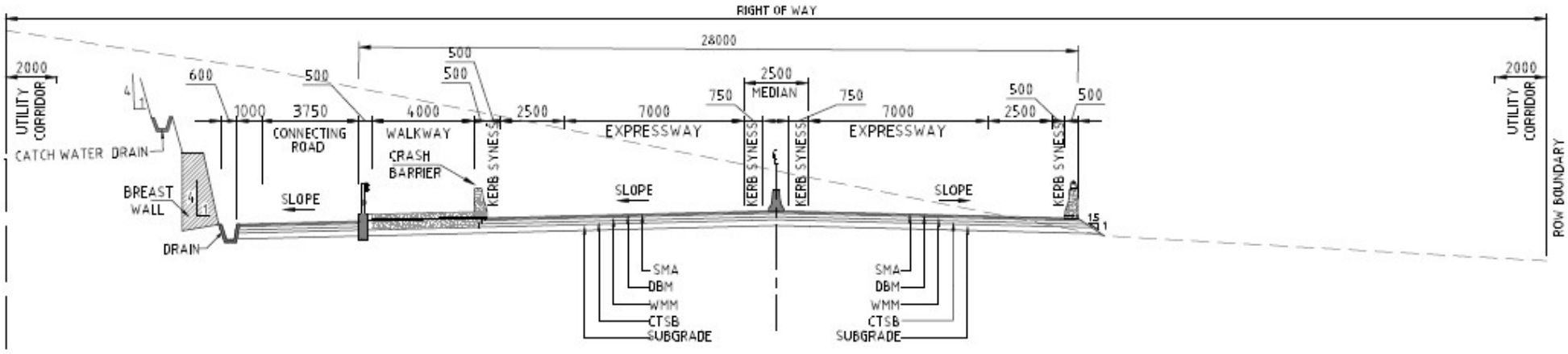


TYPE -32B
TYPICAL CROSS SECTION FOR 4-LANE(2X2) EXPRESSWAY
INCLUDING LHS WALKWAY
(MOUNTAINOUS TERRAIN)

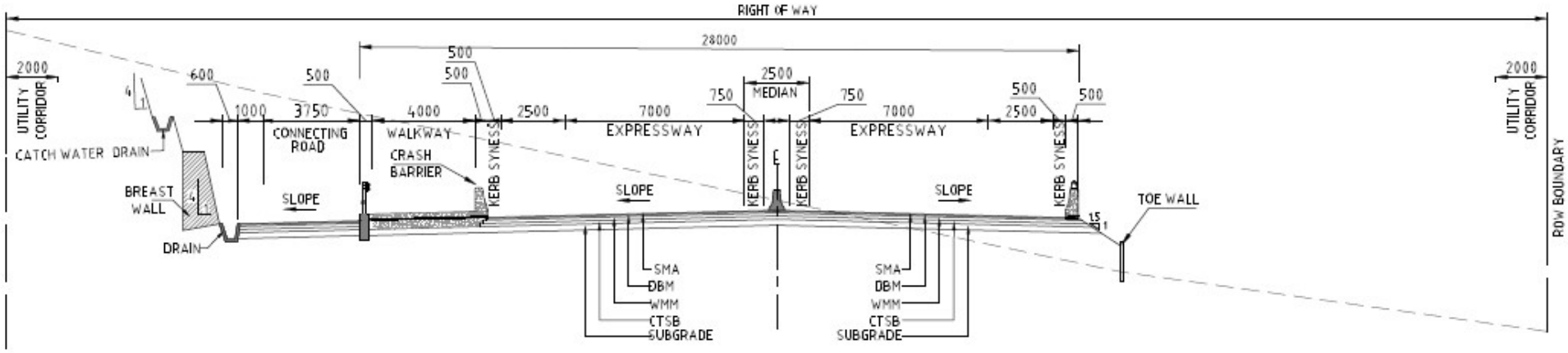


TYPE -32C

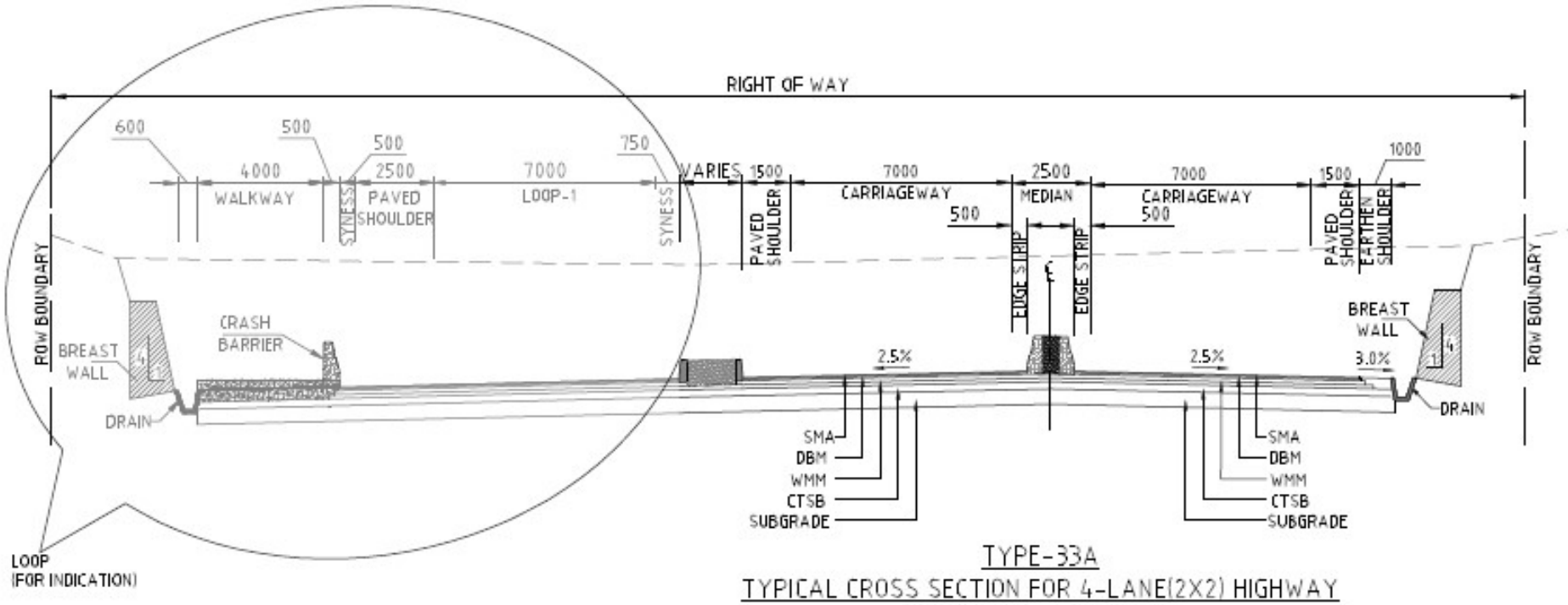
TYPICAL CROSS SECTION FOR 4-LANE(2X2) EXPRESSWAY INCLUDING LHS WALKWAY (MOUNTAINOUS TERRAIN)



TYPE -32D
TYPICAL CROSS SECTION FOR 4-LANE(2X2) EXPRESSWAY
INCLUDING LHS WALKWAY & CONNECTING ROAD
(MOUNTAINOUS TERRAIN)



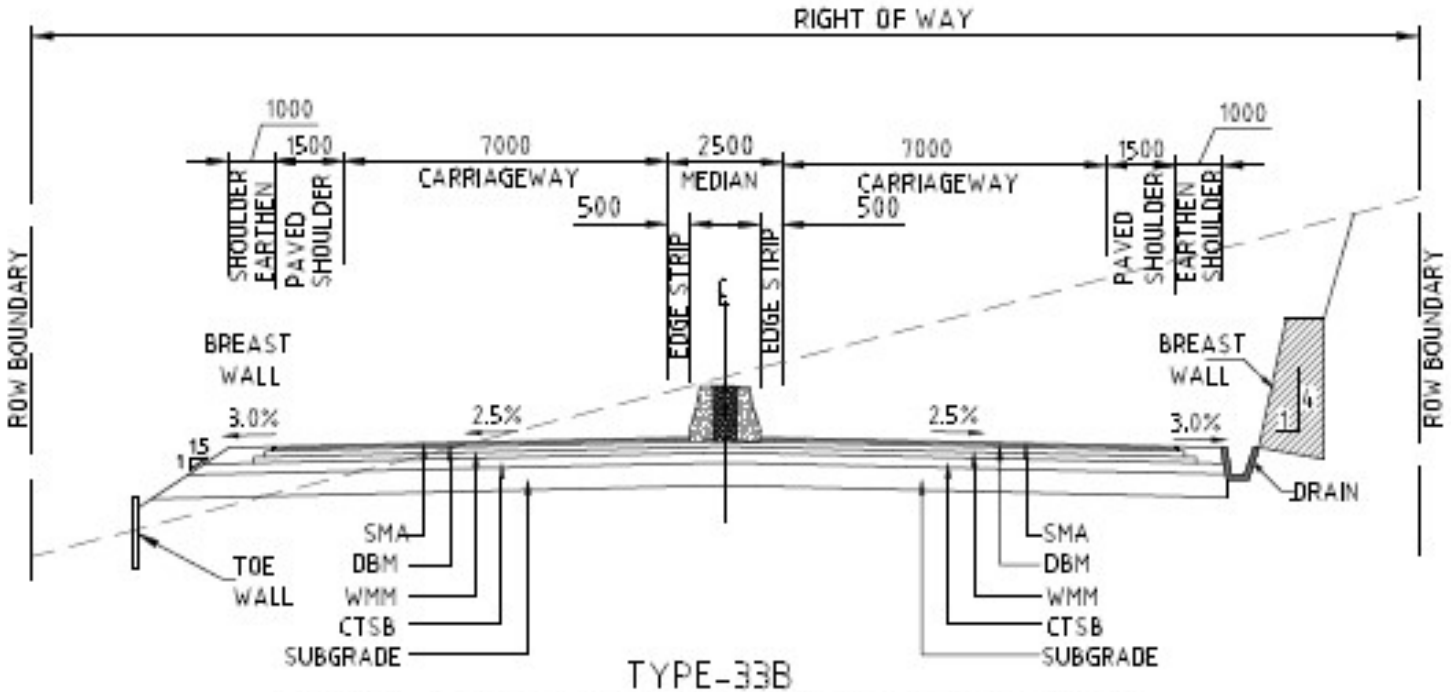
TYPE -32E
TYPICAL CROSS SECTION FOR 4-LANE(2X2) EXPRESSWAY
INCLUDING LHS WALKWAY & CONNECTING ROAD
(MOUNTAINOUS TERRAIN)



TYPE-33A

TYPICAL CROSS SECTION FOR 4-LANE(2X2) HIGHWAY

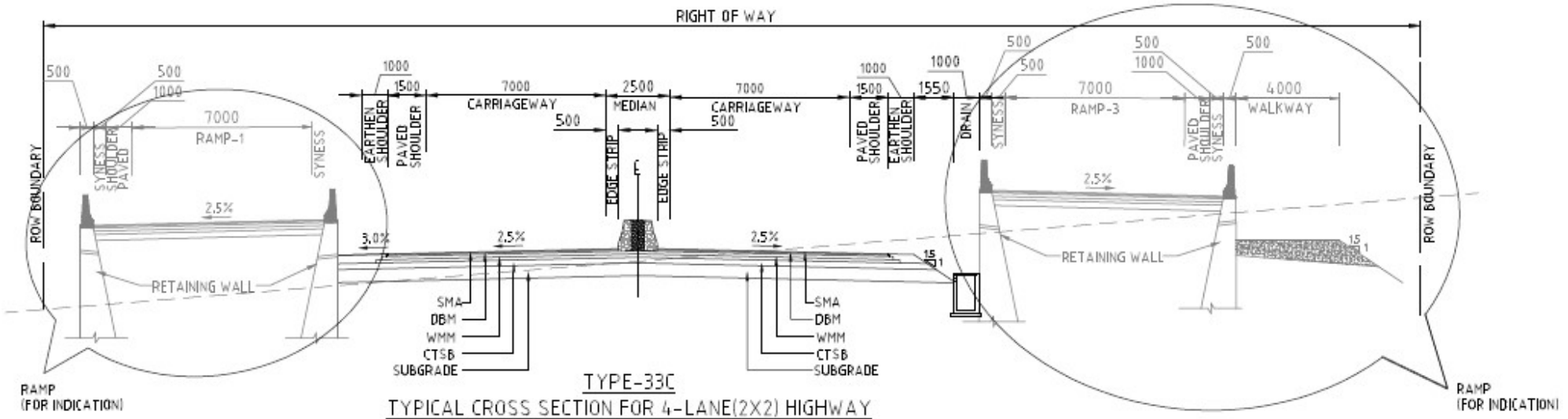
(MOUNTAINOUS TERRAIN)



TYPE-33B

TYPICAL CROSS SECTION FOR 4-LANE(2X2) HIGHWAY

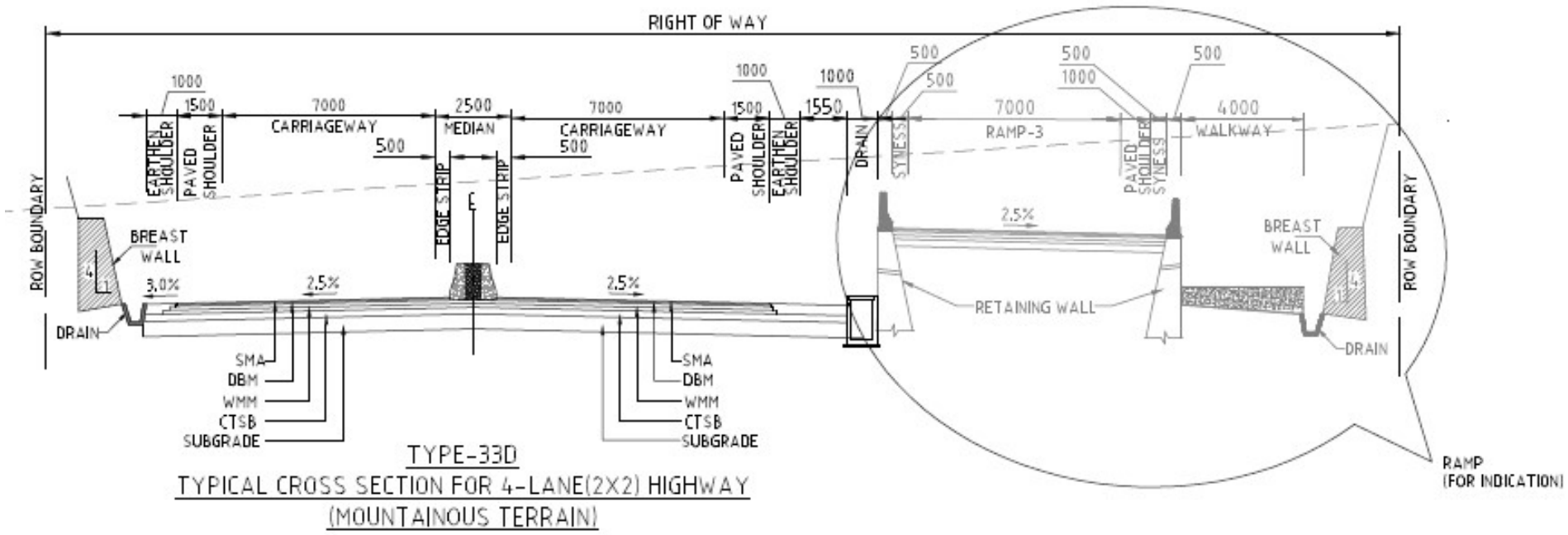
(MOUNTAINOUS TERRAIN)



TYPE-33C

TYPICAL CROSS SECTION FOR 4-LANE(2X2) HIGHWAY

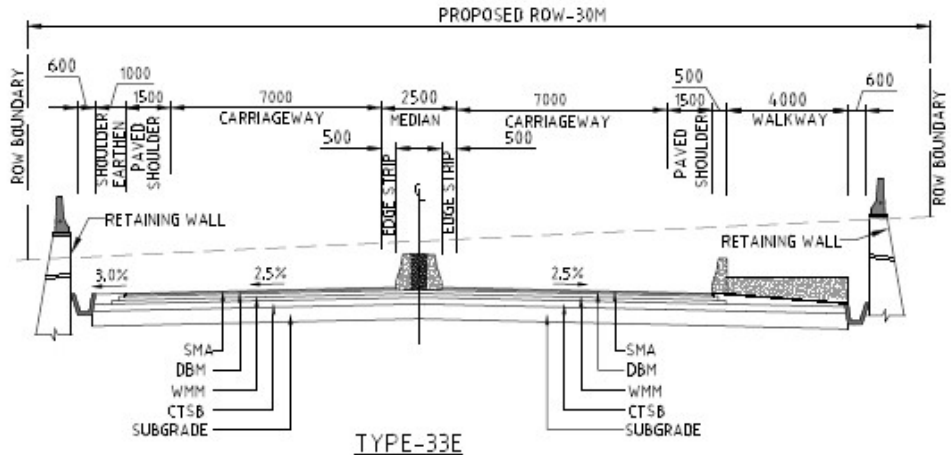
(MOUNTAINOUS TERRAIN)



TYPE-33D

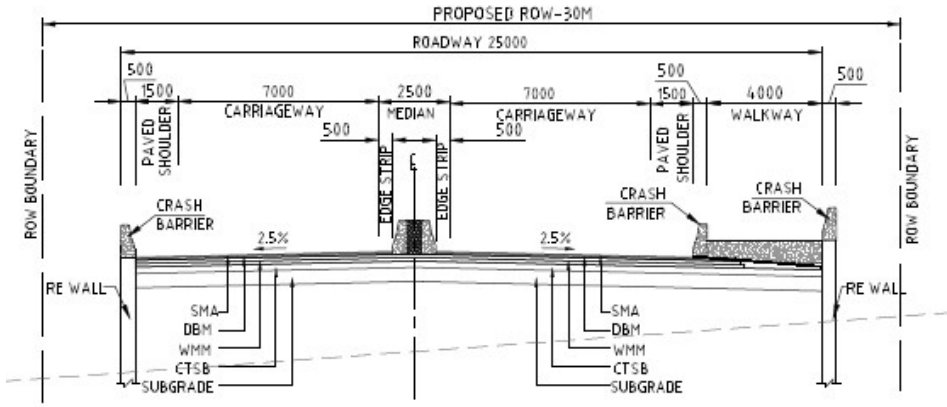
TYPICAL CROSS SECTION FOR 4-LANE(2X2) HIGHWAY

(MOUNTAINOUS TERRAIN)



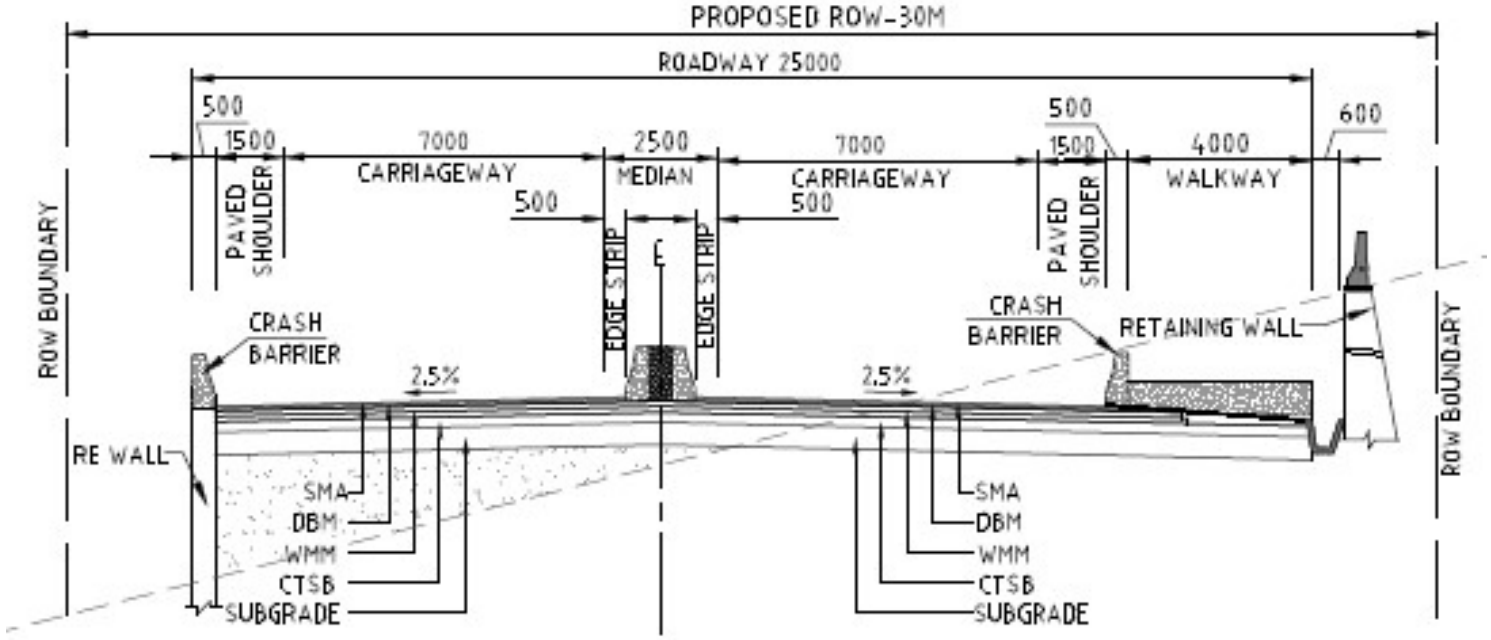
TYPE-33E

TYPICAL CROSS SECTION FOR 4-LANE(2X2) HIGHWAY INCLUDING RHS WALKWAY (MOUNTAINOUS TERRAIN)



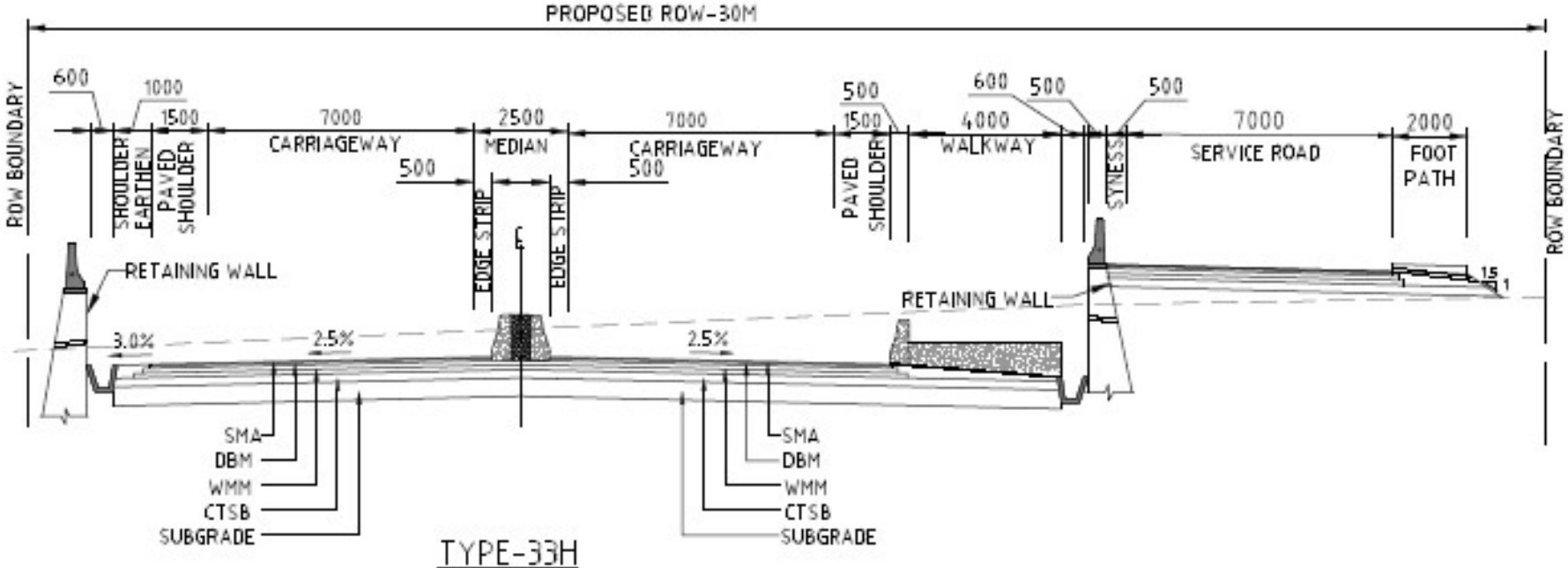
TYPE-33F

TYPICAL CROSS SECTION FOR 4-LANE(2X2) HIGHWAY INCLUDING RHS WALKWAY FOR ELEVATED/FLYOVER APPROACH (MOUNTAINOUS TERRAIN)



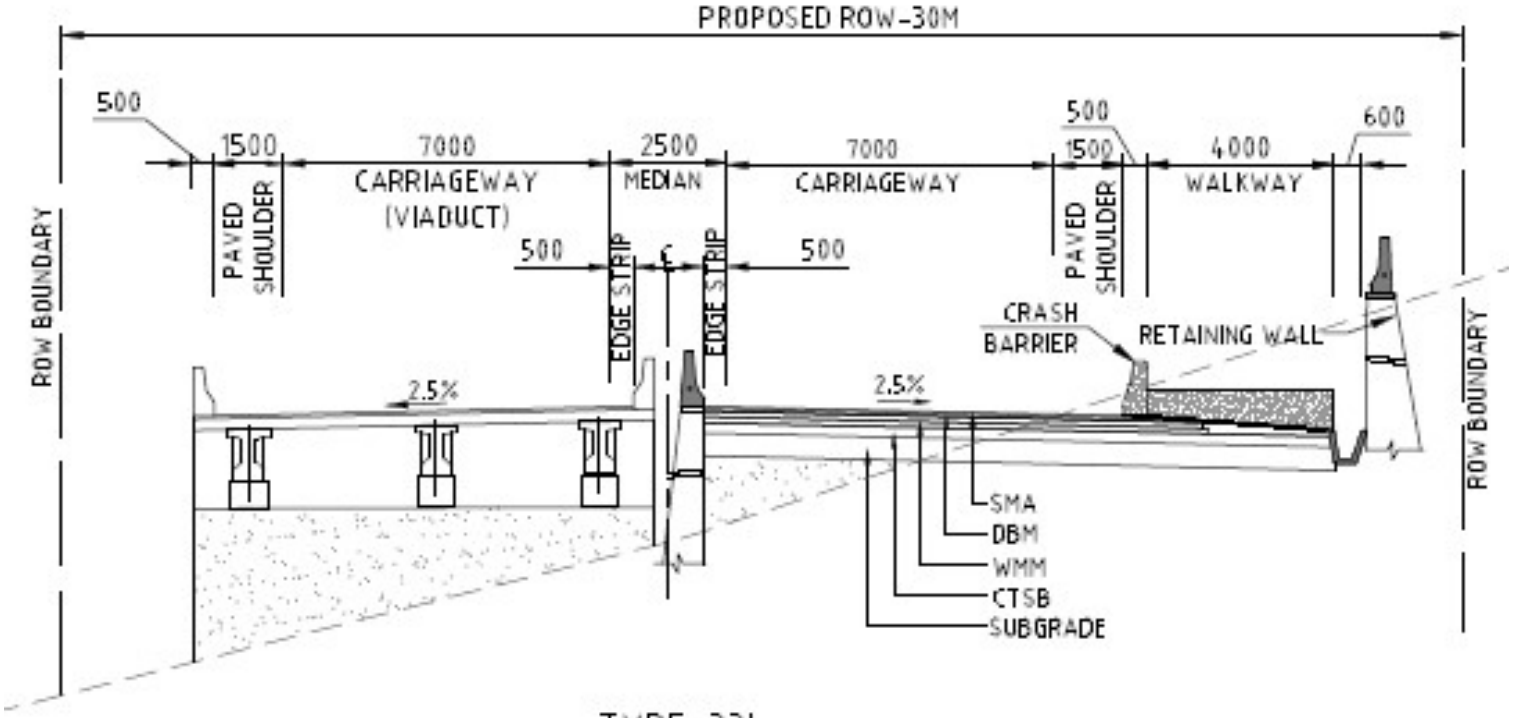
TYPE-33G

TYPICAL CROSS SECTION FOR 4-LANE(2X2) HIGHWAY INCLUDING RHS WALKWAY (MOUNTAINOUS TERRAIN)



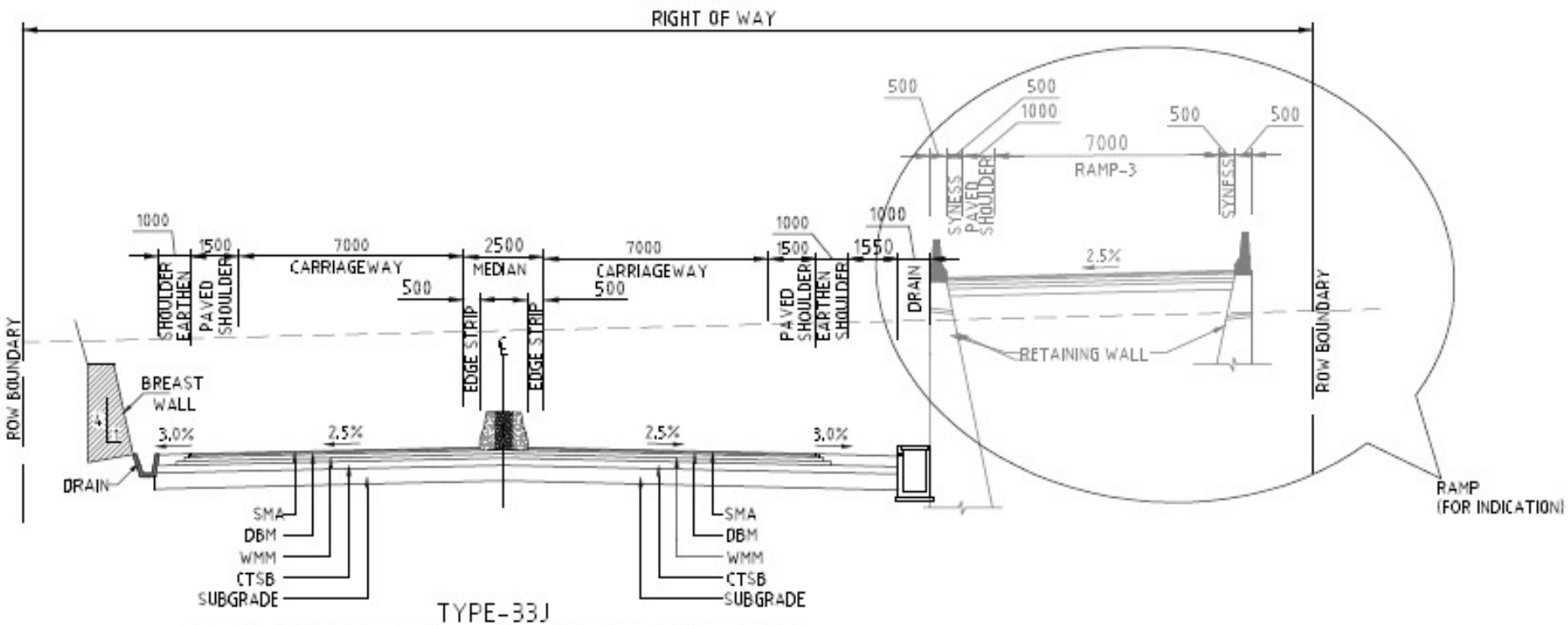
TYPE-33H

TYPICAL CROSS SECTION FOR 4-LANE(2X2) HIGHWAY INCLUDING RHS WALKWAY & SERVICE ROAD (MOUNTAINOUS TERRAIN)



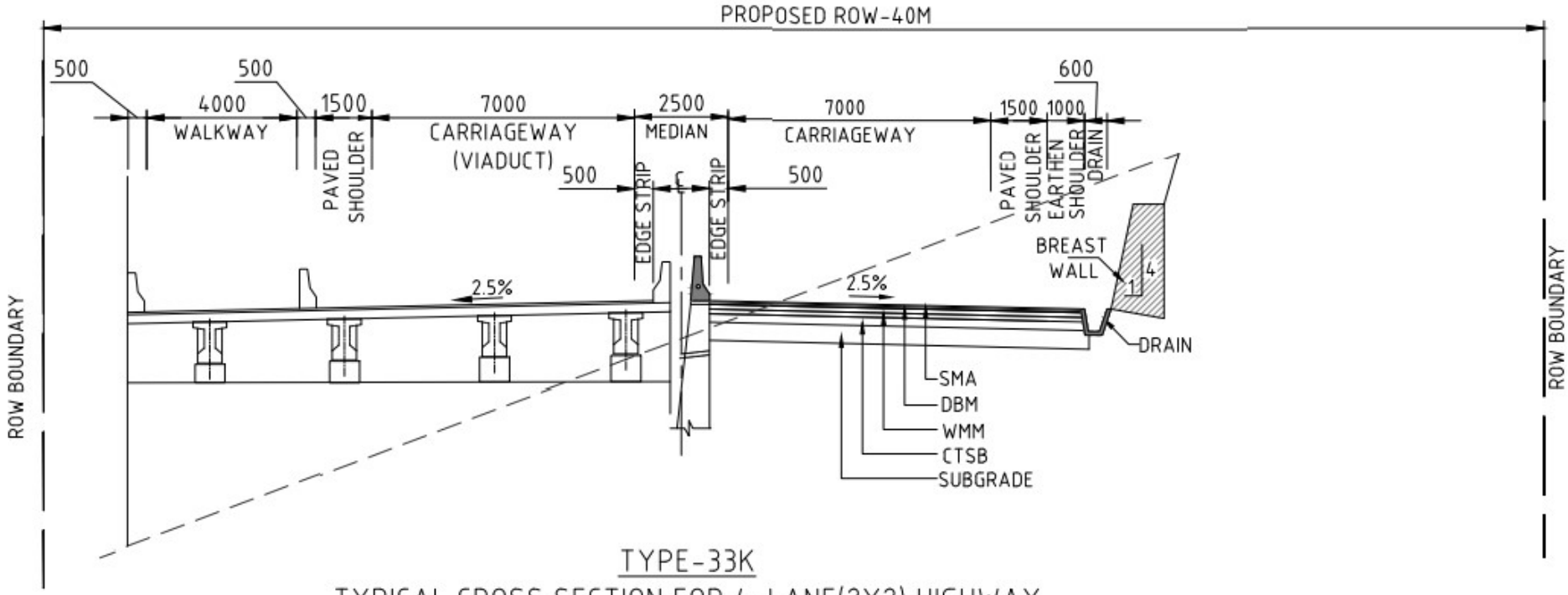
TYPE-331

TYPICAL CROSS SECTION FOR 4-LANE(2X2) HIGHWAY INCLUDING RHS WALKWAY & SERVICE ROAD (MOUNTAINOUS TERRAIN)



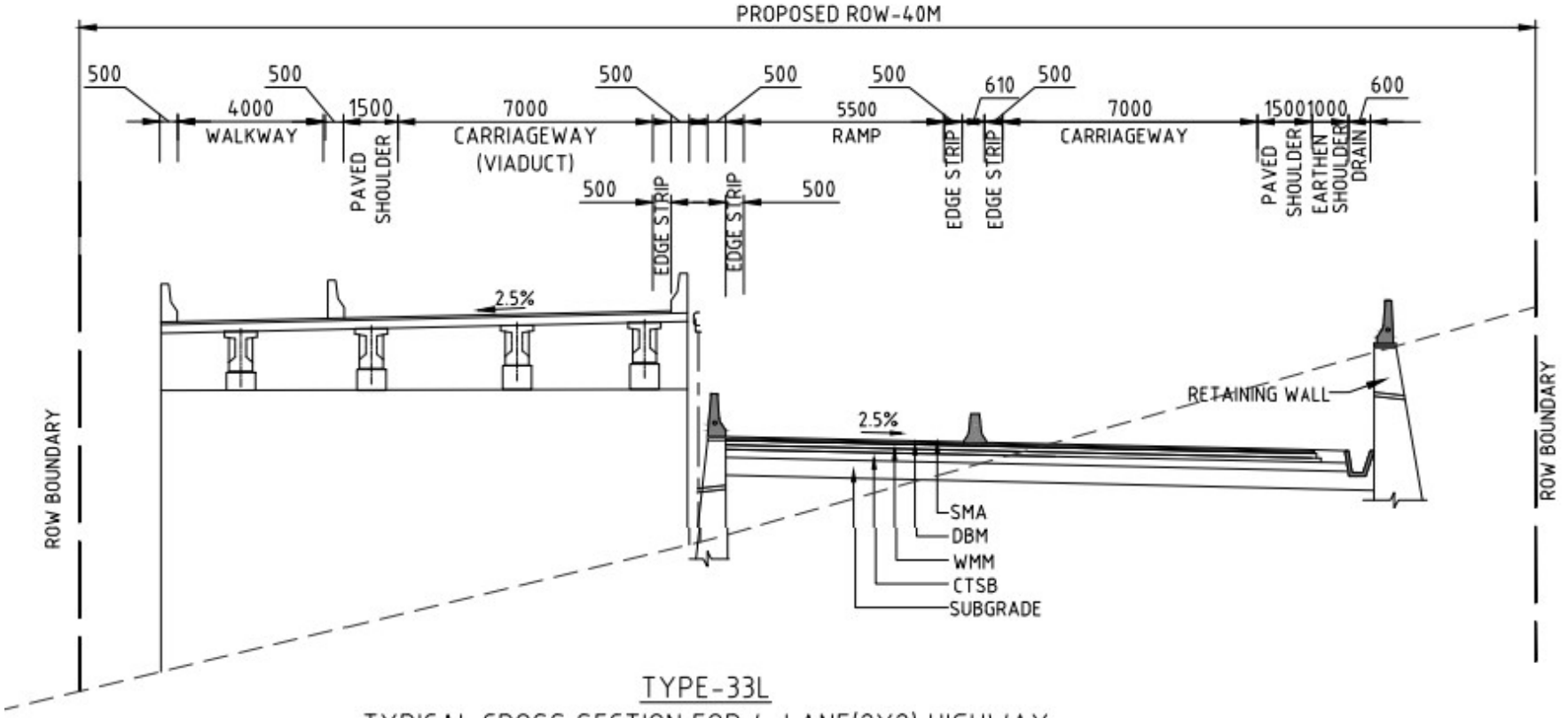
TYPE-33J

TYPICAL CROSS SECTION FOR 4-LANE(2X2) HIGHWAY (MOUNTAINOUS TERRAIN)

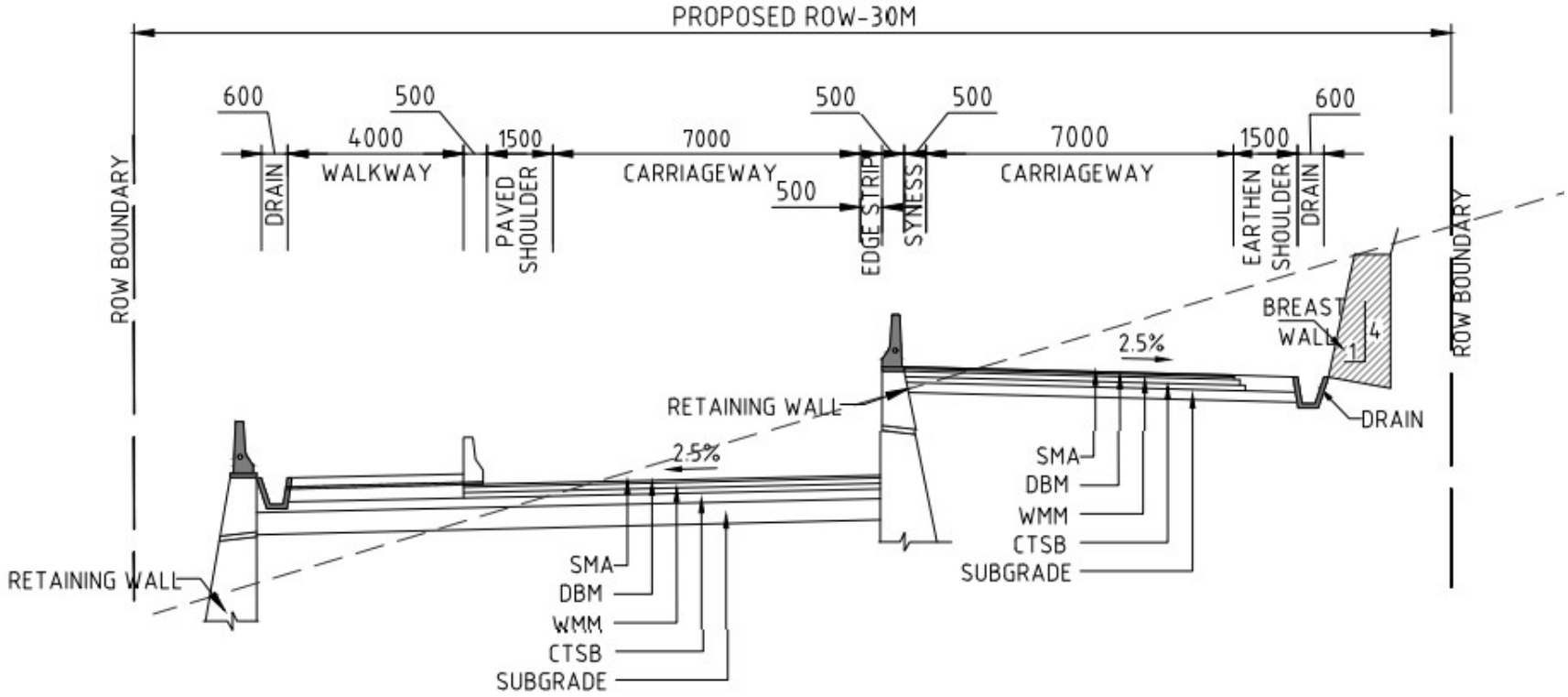


TYPE-33K

TYPICAL CROSS SECTION FOR 4-LANE(2X2) HIGHWAY INCLUDING LHS WALKWAY & SERVICE ROAD (MOUNTAINOUS TERRAIN)

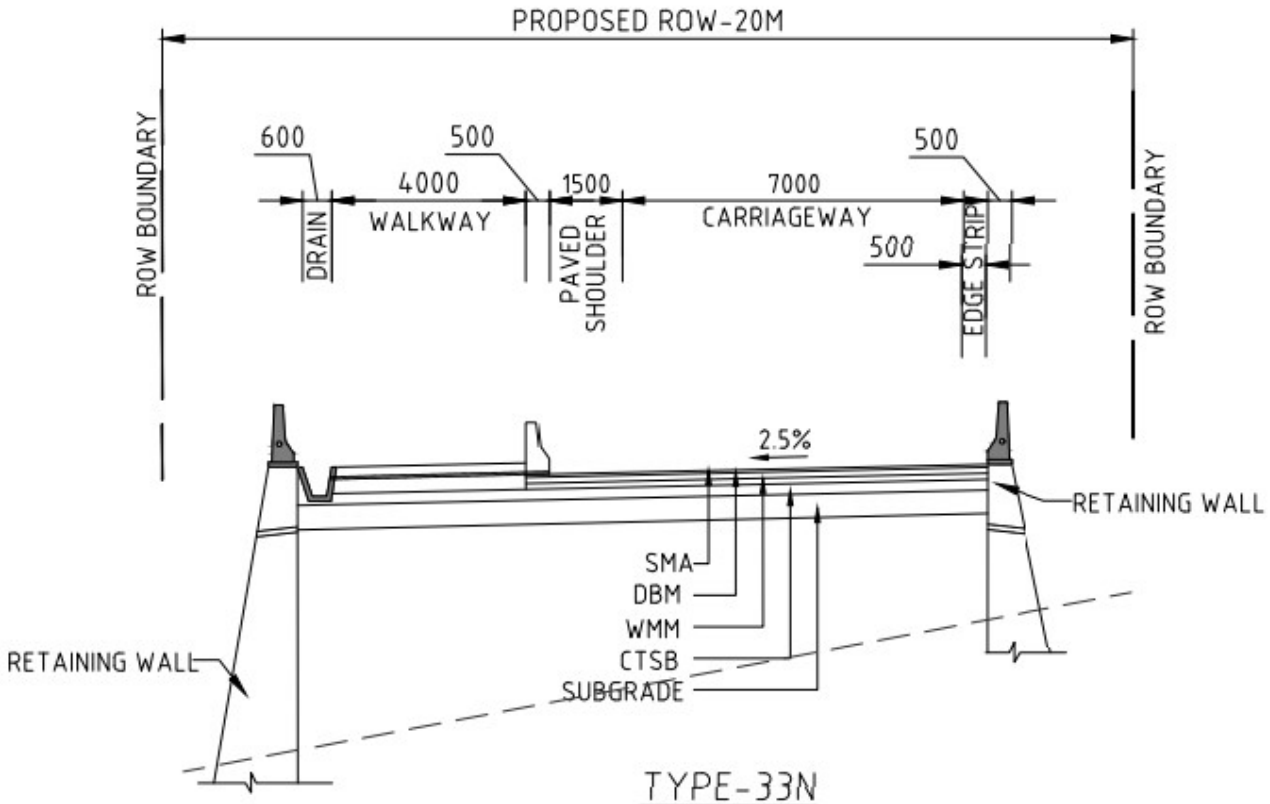


TYPE-33L
TYPICAL CROSS SECTION FOR 4-LANE(2X2) HIGHWAY
INCLUDING RAMP & LHS WALKWAY
(MOUNTAINOUS TERRAIN)



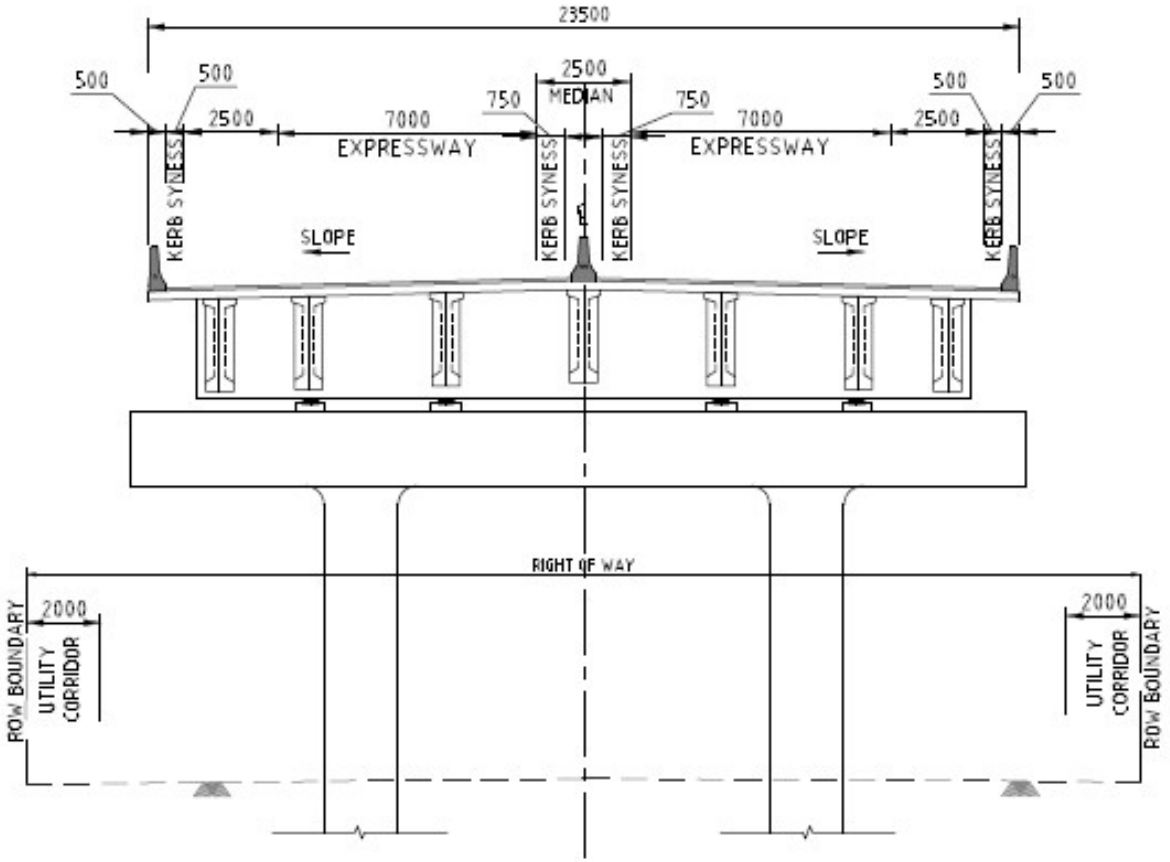
TYPE-33M

TYPICAL CROSS SECTION FOR 4-LANE(2X2) HIGHWAY INCLUDING LHS WALKWAY (MOUNTAINOUS TERRAIN)



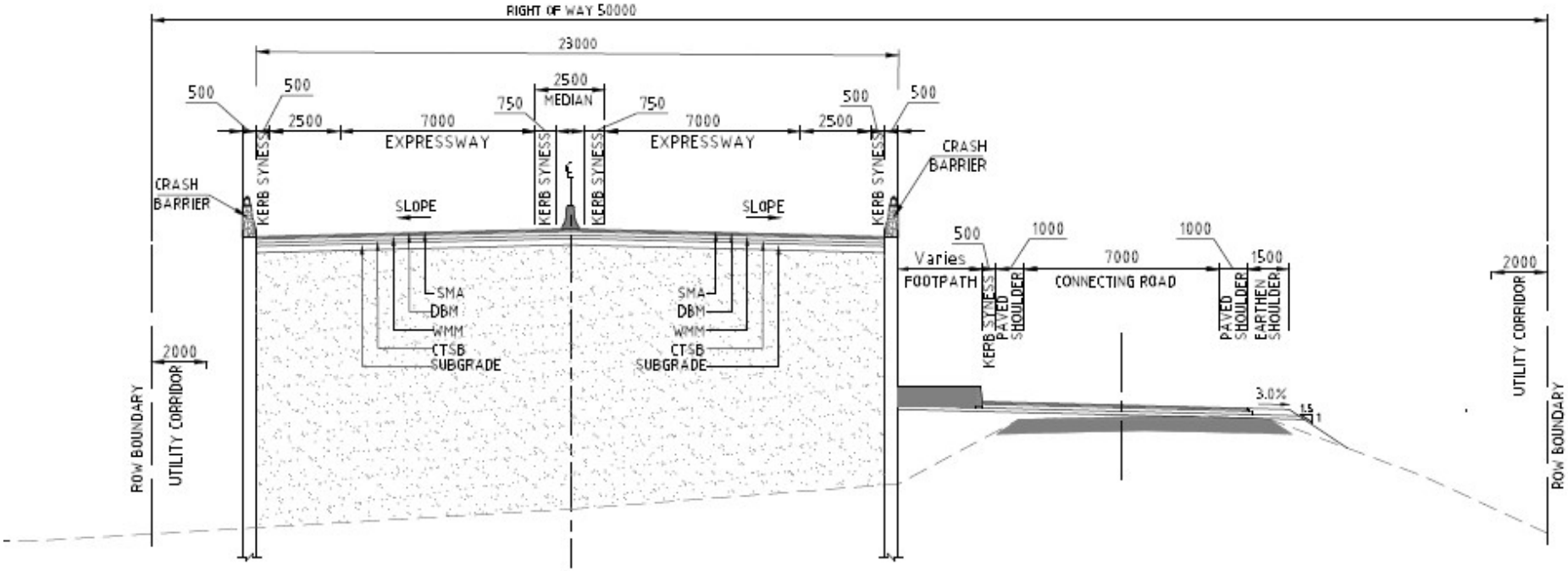
TYPE-33N

TYPICAL CROSS SECTION FOR 2-LANE HIGHWAY INCLUDING LHS WALKWAY (MOUNTAINOUS TERRAIN)



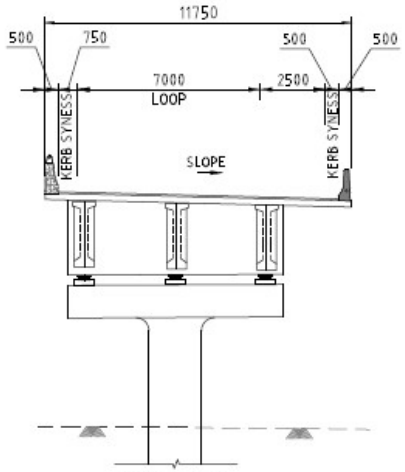
TYPE -34

TYPICAL CROSS SECTION FOR 4-LANE(2X2) EXPRESSWAY ELEVATED SECTION (MOUNTAINOUS TERRAIN)

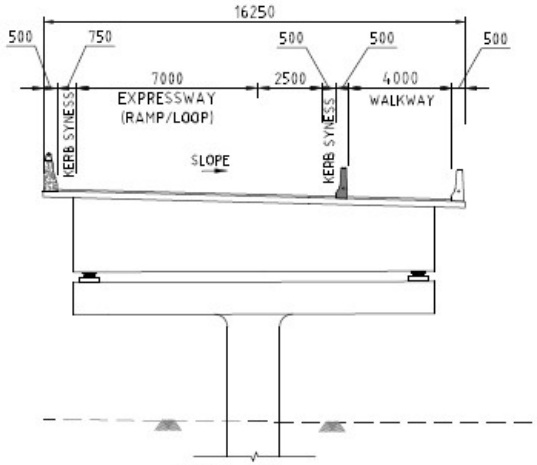


TYPE -34A

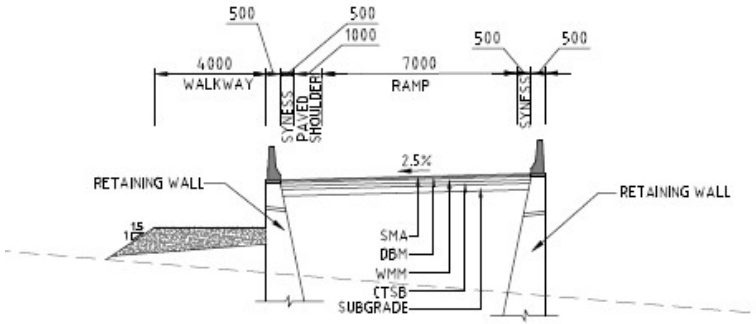
TYPICAL CROSS SECTION FOR 4-LANE(2X2) EXPRESSWAY FOR ELEVATED /FLYOVER APPROACH SECTION (MOUNTAINOUS TERRAIN)



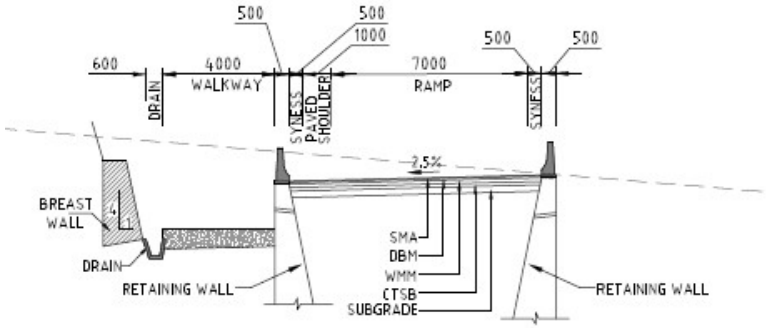
TYPE -34B
TYPICAL CROSS SECTION FOR 2-LANE ELEVATED LOOP
(MOUNTAINOUS TERRAIN)



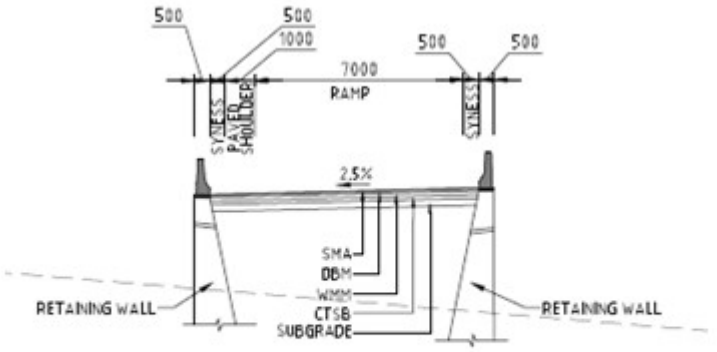
TYPE -34C
TYPICAL CROSS SECTION FOR 2-LANE ELEVATED LOOP/RAMP WITH WALKWAY
(MOUNTAINOUS TERRAIN)



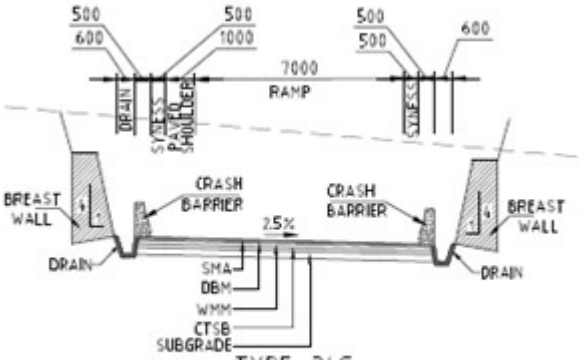
TYPE -34D
TYPICAL CROSS SECTION FOR 2-LANE LOOP/RAMP INCLUDING LHS WALKWAY
(MOUNTAINOUS TERRAIN)



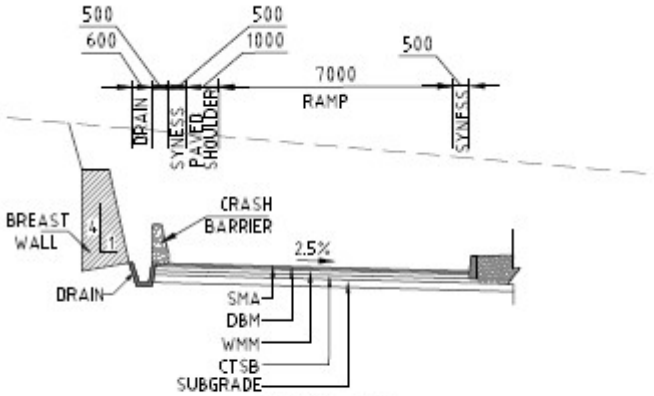
TYPE -34E
TYPICAL CROSS SECTION FOR 2-LANE LOOP/RAMP INCLUDING LHS WALKWAY
(MOUNTAINOUS TERRAIN)



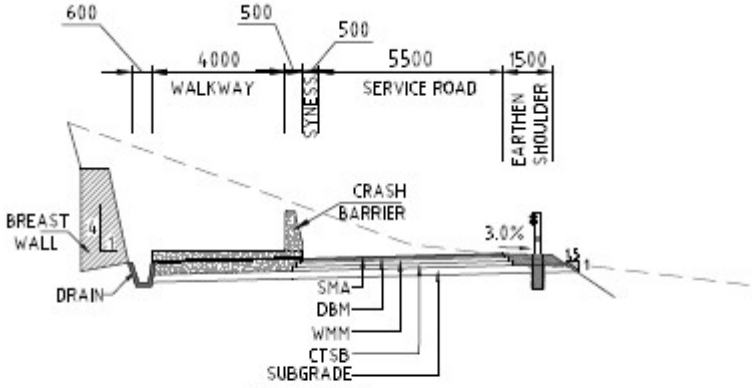
TYPE -34F
TYPICAL CROSS SECTION FOR 2-LANE LOOP/RAMP
(MOUNTAINOUS TERRAIN)



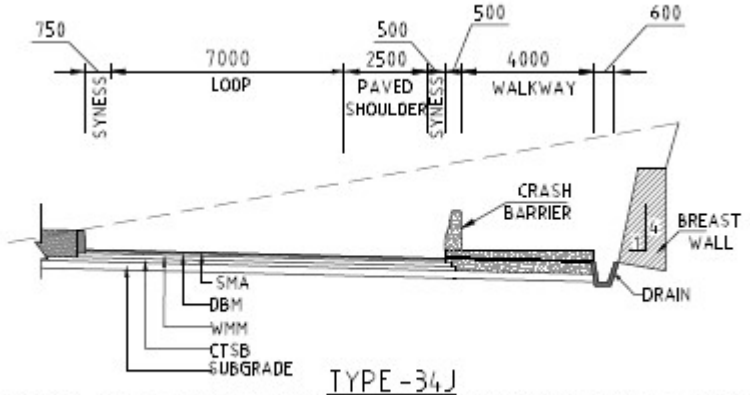
TYPE -34G
TYPICAL CROSS SECTION FOR 2-LANE LOOP/RAMP
(MOUNTAINOUS TERRAIN)



TYPE -34H
TYPICAL CROSS SECTION FOR 2-LANE LOOP/RAMP
(MOUNTAINOUS TERRAIN)

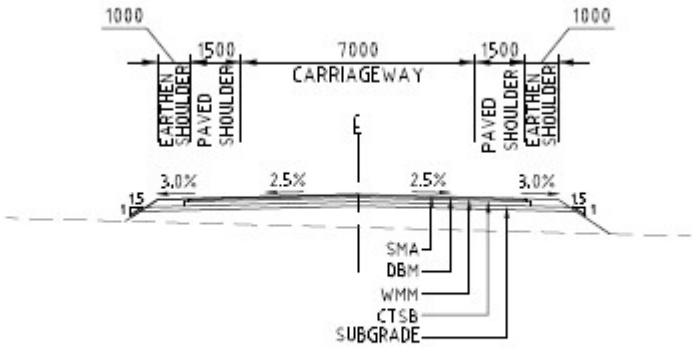


TYPE -34I
TYPICAL CROSS SECTION FOR SERVICE ROAD INCLUDING LHS WALKWAY
(MOUNTAINOUS TERRAIN)



TYPE -34J

TYPICAL CROSS SECTION FOR LOOP/RAMP INCLUDING LHS WALKWAY (MOUNTAINOUS TERRAIN)



TYPE -34K

TYPICAL CROSS SECTION OF 2-LANE CARRIAGEWAY WITH PAVED SHOULDER (MOUNTAINOUS TERRAIN)

1.10 WAY SIDE AMENITIES / SERVICE AREA

The locations of the wayside amenities are given below.

Table 1.25: Wayside Amenities locations

S. No.	Design Chainage (Km)	Side	Type of facility	Area
1	552+735	RHS	Road user facility	2.15 ha

1.11 TOLL BOOTHS

Toll booths has been provided as per IRC: SP-99. Toll booth are designed for peak hour traffic projected for minimum 25 years. The total number of toll booths and lanes are designed to ensure the service time of not more than 10 seconds per vehicle at peak flow. The width of each toll lane will be 3.5m for ETC/Manual/Smart card lanes proposed as per NHAI guidelines and one lane at the extreme outer side for over dimensional vehicles of 4.50m. Between each toll lane, traffic islands will be provided so as to accommodate toll booth. These islands will be of minimum 25 m length and 1.8m width. Protective barriers of reinforced concrete will be placed at the front of each island to prevent out of control approaching vehicles crashing into the toll booth. They would be painted with reflective chevron markings.

The area of toll booth covering the flared portion will be same as that of main carriageway. The fee collection system will be electronic toll collection (ETC) system. The Toll Booth(s) are aesthetically pleasing as per the design. The fee collection staff would be efficient, courteous and adequately trained before deployment.

1.12 INTERSECTION PROPOSALS

Being fully access controlled, there will be no at grade junctions with the project Highway. Entry/Exit will be only from interchanges. At grade intersections adversely influence the quality of highways in terms of speed, capacity and safety because of interruptions to the flow of traffic. Thus the basic requirement for the design of intersections is not only to cater for safe movements for the drivers, but also to provide them full traffic information by way of signs, pavement markings and traffic signals. Further, simplicity and uniformity should be the guiding principles for interchange design to ensure the safe passage of manoeuvres and reduce conflict points, either by elimination of certain manoeuvres or separated in space, horizontally or vertically.
Moreover, for a project highway carrying a high volume of traffic on the proposed four lane carriageway and where the design speed is 120 Kmph proposing an at grade intersection would be fatal and would also not pass the safety audit requirements. Keeping in view the safety hazard at high speed & volume of traffic on the project highway no at-grade intersection has been provided.

Grade separation shall be provided at all intersection with National Highway and State Highway. In addition to this Grade Separators will be provided across other categories of roads. It has been decided to give safe crossing to all roads. In case two crossings are at close interval then access will be given to one and other will be joined by service road. Grade separated interchange is proposed at the following location:

Table 1.26: List of Interchanges

S. No	Design Chainage	Type of Interchange	Road crossing
1	552+260	Rotary and Ramps	NH-44
2	563+545	Trumpet with Ramps	Expressway Link Road

1.13 PROPOSAL FOR STRUCTURES

The summary of structures along the project highway is given in table below:

Table 1.27: Summary of Proposed Structures

Sl. No.	Type of structures	Numbers
1	ROB	2
2	RUB	1
3	Interchange	2
4	Flyover	4
5	Major Bridge	1
6	Major Bridge cum LVUP	0
5	Major Bridge cum SVUP	0
7	Major Bridge cum VUP	1
8	Minor Bridge	15
9	Minor Bridge cum LVUP	1
10	Minor Bridge cum SVUP	0
11	Minor Bridge cum VUP	0
12	VUP	4
13	VOP	1
14	LVUP	4
15	SVUP	2
16	ROB cum Elevated	1
17	Viaduct	13
18	Viaduct cum Major Bridge	1
19	Culvert	93
20	Structures on Loops of Interchange (VUP)	1
21	Culverts on Loops of Interchange	1
22	Additional culverts	35
Total		**183**

Structure proposals:

Major Bridges:

S. No.	Design Chainage (In Km)	Span Arrangement (m)	Total width (m)	Proposal	Remarks
1	563+750	4x30	1x20.5	New Construction	Natural Stream

Major Bridge cum LVUP

S. No.	Design Chainage (In Km)	Span Arrangement (m)	Total width (m)	Proposal	Remarks
Nil					

Major Bridge cum SVUP

S. No.	Design Chainage (In Km)	Span Arrangement (m)	Total width (m)	Proposal	Remarks
Nil					

Major Bridges cum VUP:

S. No.	Design Chainage (In Km)	Span Arrangement (m)	Total width (m)	Proposal	Remarks
1	527+937	Expressway: 1x35+4x25, SR (LHS): 3x22	Expressway: 1x23.5, SR LHS: 1x12.5	New Construction	Natural Stream

Minor Bridges

S. No.	Design Chainage (In Km)	Span Arrangement (m)	Total width (m)	Proposal	Remarks
1	515+308	1x20	12.5+2x16.75+12.5	Reconstruction	Nalla
2	517+807	3x10	12.5+2x16.75+12.5	Reconstruction	Nalla
3	518+065	1x8	12.5+2x16.75+12.5	Reconstruction	Nalla
4	518+583	1x8	12.5+2x16.75+12.5	Reconstruction	Nalla
5	518+659	1x8	12.5+2x16.75+12.5	Reconstruction	Nalla
6	518+735	1x8	12.5+2x16.75+12.5	Reconstruction	Nalla
7	519+036	3x10	12.5+2x16.75+12.5	Reconstruction	Nalla
8	519+847	3x10	12.5+2x16.75+12.5	Reconstruction	Nalla
9	520+923	4x8	12.5+2x16.75+12.5	Reconstruction	Nalla
10	527+725	1x20	12.5+2x16.75+12.5	Reconstruction	Nalla
11	552+740	MCW: 1x20, SR: 2x10, WSA: 2x10	Varies as per GAD	New Construction	Nalla
12	552+913	1x15	12+23.5+9.5	Reconstruction	Nalla
13	553+805	1x10	12+23.5+9.5	Reconstruction	Nalla
14	554+279	1x15	12+23.5+9.5	Reconstruction	Nalla
15	556+775	2x25.981	1x12	Reconstruction	Nalla

Minor Bridge cum LVUP:

S. No.	Design Chainage (In Km)	Span Arrangement (m)	Total width (m)	Proposal	Remarks
1	521+920	MCW: 1x40, SR: 3x10	MCW: 1x23.5, SR: 1x48.5	Reconstruction	Nalla

Minor Bridges cum SVUP

S. No.	Design Chainage (In Km)	Span Arrangement (m)	Total width (m)	Proposal	Remarks
Nil					

Minor Bridge cum VUP:

S. No.	Design Chainage (In Km)	Span Arrangement (m)	Total width (m)	Proposal	Remarks
Nil					

Road over-bridges

S. No.	Design Chainage (in Km)	Proposed Span Arrangement (m)	Skew	Proposal	Total Width (m)
1	527+319	Expressway: 3x45 LHS SR: 3x45,	0 deg	New Construction	1x12.3+2x11.75
2	0+262 of Bus stand Link	1x15+1x37.28+1x30	0 deg	New Construction	2x11.75

ROB cum Elevated:

S. No.	Design Chainage (In Km)	Span Arrangement (m)	Proposal	Total width (m)
1	515+943	14x30+1x25+1x63.5+4x30	New Construction	1x33.5

RUB:

S. No.	Design Chainage (In Km)	Span Arrangement (m)	Proposal	Total width (m)	Remarks
1	516+103	1x13x5.5	New Construction	1x34.650	RHS SR

Viaduct:

S. No.	Design Chainage (In Km)	Span Arrangement (m)	Proposal	Total width (m)
1	522+680	1x30	New Construction	1x23.5
2	523+030	LHS SR: 4x30, MCW: 4x30,	New Construction	12.5+23.5
3	523+825	10x30	New Construction	1x23.5
4	524+840	6x30	New Construction	1x23.5
5	526+390	9x30	New Construction	1x23.5
6	555+575	3x30	New Construction	12+23.5+9.5
7	556+150	6x30	New Construction	12+23.5+9.5
8	557+065	MCW: 36x30, RHS SR: 9x30	New Construction	23.5+9.5

S. No.	Design Chainage (In Km)	Span Arrangement (m)	Proposal	Total width (m)
9	560+120	MCW: 5x30, RHS SR: 5x30	New Construction	23.5+9.5
10	561+275	27x30	New Construction	1x28
11	562+440	14x30	New Construction	1x28
12	563+160	6x30	New Construction	1x28

Viaduct cum VUP:

S. No.	Design Chainage (In Km)	Span Arrangement (m)	Proposal	Total width (m)
1	525+565	8x30	New Construction	1x23.5

Viaduct cum MJB:

S. No.	Design Chainage (In Km)	Span Arrangement (m)	Proposal	Total width (m)
1	566+212	4x30+11x20+1x50+1x20	New Construction	Varies as per GAD

Culverts

S. No.	Design Chainage (Km)	Type of structure	Proposal	Proposed Span (m)	TCS type
1	515+545	PIPE	Reconstruction	1x2x2	21H
2	516+543	RCC BOX	Reconstruction	1x2x2	21H
3	517+467	RCC BOX	Reconstruction	1x2x2	21H
4	519+294	RCC BOX	Reconstruction	1x4x3	21H
5	520+205	RCC BOX	Reconstruction	1x6x4	20E
6	520+492	RCC BOX	Reconstruction	1x6x4	21W
7	520+646	RCC BOX	Reconstruction	1x2x2	21W
8	521+113	RCC BOX	Reconstruction	1x2x2	21W
9	521+549	RCC BOX	Reconstruction	1x2x2	21V
10	522+113	RCC BOX	Reconstruction	1x2x2	21J
11	522+500	RCC BOX	Reconstruction	1x2x2	As per GAD
12	522+650	RCC BOX	New Construction	1x2x2	21K
13	522+765	RCC BOX	Reconstruction	1x2x2	As per GAD
14	523+333	RCC BOX	Reconstruction	1x2x2	21G
15	523+700 (On RHS SR)	RCC BOX	New Construction	1x4x2	As per GAD
16	0+060 (On Ramp-2)	RCC BOX	New Construction	1x4x2	As per GAD
17	524+200 (On RHS SR & Ramp-3)	RCC BOX	New Construction	1x4x2	As per GAD
18	525+020	RCC BOX	New Construction	1x4x2	As per

S. No.	Design Chainage (Km)	Type of structure	Proposal	Proposed Span (m)	TCS type
	(On RHS SR)				GAD
19	525+780 (On RHS SR & Ramp-4)	RCC BOX	New Construction	1x4x2	As per GAD
20	525+833	RCC BOX	Reconstruction	1x2x2	21L
21	526+060	RCC BOX	Widening	1x4.8x3.1	21P
22	526+611	RCC BOX	Reconstruction	1x2x2	21P
23	526+652	RCC BOX	Reconstruction	1x2x2	21P
24	526+926	RCC BOX	Widening	1x2x2	21P
25	527+223	RCC BOX	Reconstruction	1x6x4	21U
26	527+755	RCC BOX	Reconstruction	1x2x2	21S
27	550+738	RCC BOX	Reconstruction	1x2x2	As per GAD
28	550+834	RCC BOX	Reconstruction	1x2x2	As per GAD
29	550+915	RCC BOX	Reconstruction	1x2x2	29B
30	551+090	RCC BOX	Reconstruction	1x6x2	29C
31	551+485	RCC BOX	Reconstruction	1x6x2	29D
32	551+563	RCC BOX	Reconstruction	1x6x4	29D
33	551+703	RCC BOX	Reconstruction	1x4x3	29D
34	551+909	RCC BOX	Reconstruction	1x2x2	29D
35	552+225	RCC BOX	Reconstruction	1x2x2	As per GAD
36	552+450	RCC BOX	New Construction	1x2x2	29G
37	WSA at 552+750	RCC BOX	Reconstruction	1x2x2	As per GAD
38	553+100	RCC BOX	New Construction	1x2x2	29J
39	553+185	RCC BOX	New Construction	1x6x4	29J
40	553+255	RCC BOX	Reconstruction	1x2x2	29K
41	553+338	RCC BOX	Reconstruction	1x4x3	29L
42	553+452	RCC BOX	Reconstruction	1x2x2	29L
43	553+663	RCC BOX	Reconstruction	1x6x4	29M
44	554+215	RCC BOX	Reconstruction	1x2x2	29H
45	554+500	RCC BOX	New Construction	1x2x2	29H
46	554+775	RCC BOX	Reconstruction	1x2x2	29N
47	555+005	RCC BOX	Reconstruction	1x2x2	29N
48	555+285	RCC BOX	New Construction	1x2x2	29M
49	555+353	RCC BOX	Reconstruction	1x2x2	29M
50	0+118 (Ramp-1)	RCC BOX	Reconstruction	1x2x2	34I
51	0+165 (Ramp-1)	RCC BOX	Reconstruction	1x2x2	34I
52	0+182 (Ramp-1)	RCC BOX	Reconstruction	1x2x2	34I
53	555+835	RCC BOX	Reconstruction	1x4x3	29L
54	555+918	RCC BOX	Reconstruction	1x2x2	29L
55	0+070 (Ramp-2)	RCC BOX	New Construction	1x2x2	34I

S. No.	Design Chainage (Km)	Type of structure	Proposal	Proposed Span (m)	TCS type
56	0+216 (Ramp-2)	RCC BOX	Reconstruction	1x4x3	34I
57	0+437 (Ramp-2)	RCC BOX	Reconstruction	1x4x3	34I
58	556+472	RCC BOX	Reconstruction	1x2x2	29I
59	557+700	RCC BOX	New Construction	1x2x2	29R
60	557+920	RCC BOX	New Construction	1x2x2	29S
61	558+200	RCC BOX	New Construction	1x2x2	29S
62	558+425	RCC BOX	Reconstruction	1x2x2	29L
63	558+491	RCC BOX	Reconstruction	1x2x2	29L
64	558+620	RCC BOX	Reconstruction	1x2x2	29L
65	558+840	RCC BOX	Reconstruction	1x2x2	29L
66	558+956	RCC BOX	Reconstruction	1x2x2	29L
67	559+158	RCC BOX	Reconstruction	1x2x2	29S
68	559+260	RCC BOX	Reconstruction	1x2x2	29M
69	559+331	RCC BOX	Reconstruction	1x2x2	29M
70	559+388	RCC BOX	Reconstruction	1x2x2	29M
71	559+521	RCC BOX	Reconstruction	1x2x2	29M
72	559+720	RCC BOX	New Construction	1x6x4	29T
73	0+139 (Ramp-3)	RCC BOX	Reconstruction	1x2x2	34I
74	0+139 (Ramp-4)	RCC BOX	Reconstruction	1x4x3	34I
75	0+167 (Ramp-4)	RCC BOX	Reconstruction	1x4x3	34I
76	560+290	RCC BOX	New Construction	1x4x3	29S
77	560+361	RCC BOX	New Construction	1x2x2	29U
78	560+403	RCC BOX	Reconstruction	1x2x2	29U
79	560+506	RCC BOX	Reconstruction	1x4x3	29V
80	560+587	RCC BOX	Reconstruction	1x2x2	29V
81	560+692	RCC BOX	Reconstruction	1x2x2	29W
82	560+845	RCC BOX	Reconstruction	1x2x2	29W
83	562+060	RCC BOX	New Construction	1x2x2	32C
84	562+760	RCC BOX	New Construction	1x2x2	32C
85	562+850	RCC BOX	New Construction	1x2x2	32A
86	564+280	RCC BOX	New Construction	1x2x2	33F
87	564+600	RCC BOX	New Construction	1x2x2	33F
88	564+980	RCC BOX	New Construction	1x6x4	33F
89	565+520	RCC BOX	New Construction	1x4x3	33H
90	565+735	RCC BOX	Reconstruction	1x2x2	33G
91	566+050	RCC BOX	New Construction	1x2x2	33I
92	566+244	RCC BOX	Reconstruction	1x2x2	33L
93	At Round about (Katra Bus stand Link)	RCC BOX	Reconstruction	1x2x2	As per GAD

Note: 01 (one) no. of Pipe culverts of 1200mm (min) diameter shall be provided per km across the expressway for local canal/ field canal/ utility crossings as per the site requirement

in each package. Location for such culverts shall be finalized in consultation with Authority Engineer and NHAI.

Culverts on Ramps:

S. No.	Design Chainage (Km)	Type of structure	Proposed Span (m)	Type of TCS	Proposal	Remarks
1	1+170	RCC BOX	1x2x2	Rotary	New Construction	Ramp-1 of IC at Km 563+545

Small Vehicular Underpasses (SVUPs):

S. No.	Design Chainage (In Km)	Type of structure	Span Arrangement (m)	Skew angle (deg)	Total width (m)	Remarks
1	564+615	RCC Box	1x7x4.5	0	25	Cart Track
2	564+310	RCC Box	1x7x4.5	0	25	Cart Track

Light Vehicular Underpasses (LVUPs):

Sl. No.	Chainage (in Km)	Type of Crossing	Type of Structure	Span Arrangement (Clear opening) (m)	Skew angle (deg)	Deck Configuration (m)	Remarks
1	517+290	BT Road	RCC Box	2x10x4.5	0	2x16.75	New Construction
2	551+175	BT Road	RCC Box	1x12x4.5	0	2x11.75	New Construction
3	554+347	BT Road	RCC Box	1x12x4.5	0	2x11.75	New Construction
4	559+430	BT Road	RCC Box	1x12x4.5	0	2x11.75	New Construction

Vehicular Underpass (VUP):

Sl. No.	Chainage (km)	Type of Crossing	Clear Span (m)	Skew angle (deg)	Deck Configuration (m)	Remarks
1	521+780	BT Road	1x30	0	2x11.75	New Construction
2	551+620	BT Road	1x20	0	2x11.75	New Construction
3	552+870	BT Road	1x20	0	11.75+14.660	New Construction
4	563+877	BT Road	1x20	0	10.5+20.5+10.5	New Construction

Flyover:

S. No.	Design Chainage (In Km)	Clear Span (m)	Skew angle (deg)	Total width (m)	Remarks
1	518+475	1x20+1x30+1x20	0	2x16.75	New Construction
2	519+680	1x20+1x30+1x20	0	2x16.75	New Construction
3	520+850	3x30.0	0	1x11.75+1x15.250	New Construction
4	564+435	1x30	0	1x25	New Construction

Vehicular Overpass (VOP):

S. No.	Design Chainage (In Km)	Span Arrangement	Total width (m)	Remarks
1	565+362	1x12x5.5+1x15x5.5	1x12	New Construction

Animal Underpass (AUP)

S. No.	Design Chainage (In Km)	Type of structure	Span Arrangement (m)	Total width (m)	Remarks
Nil					

Subway:

S. No.	Design Chainage (In Km)	Opening Size	Remarks
Nil			

Interchange:

S. No.	Design Chainage (In Km)	Clear Span (m)	Skew angle (deg)	Total width (m)	Remarks
1	552+260	4x25	0	1x23.5	Jammu to Udhampur NH-44
1	563+545	Ramp-4: 6x30+1x29.843+ 8x30+1x21.5+1x30+6x25+ 1x20, Ramp-2: 5x20+2x30 & 3x25, Ramp-1:7x20, Ramp-3:1x23.465+6x20+ 1x25+3x30, Loop-1: 1x15+1x24+4x30+ 16x20	0	varies as per GAD	SMVDK Railway station & Temple

Structures of Interchange Loops:

S. No.	Str. Legend	Design Chainage	Type of structure	Proposed Span (CLEAR) (m)	Skew angle (deg)	Total width (m)
1	Ramp-2 of IC at 563+545	563+839	VOP	1x12x5.5	0	1x63.0

TOE WALL AND RETAINING WALLS

Retaining wall / Toe Wall shall be provided as per TCS and site requirement.

HAZARDOUS LOCATIONS

Safety barriers shall be provided at the hazardous location.

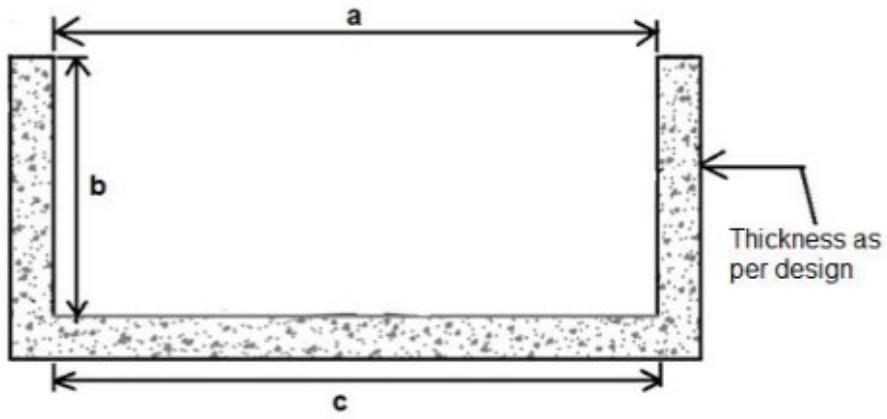
Realigned Nalla/drain and Canal:

The details of realigned nalla/drain and canal are given below.

Table 1.28:: Details of Realigned of nalla/drain and canal

Sl. No.	Stretches (Km)		Total Length (m)	Minimum Size (m)			Remarks
	From	To		a	b	c	
1	553+050	553+320	270	7.0	2.6	7.0	Open Channel
2	564+980	565+600	620	3.0	2.0	3.0	Covered Drain for Walkway

TYPICAL CROSS SECTION OF AT REALINGED LOCATION



Service/Slip Roads

The details of service/slip roads are given below.

A. Service road along Main Alignment of Expressway for Kunjwani to Sidhra Section

Sl. No.	Design Chainage (Km)		Side (LHS/RHS]	Length (m)	Width of Service Road (m) (Lane Width + Shoulder Width)
	From	To			
1	515+000	522+500	Both	7500	As per TCS
2	522+500	522+800	LHS	300	As per TCS

Sl. No.	Design Chainage (Km)		Side (LHS/RHS]	Length (m)	Width of Service Road (m) (Lane Width + Shoulder Width)
	From	To			
3	522+800	522+950	Both	150	As per TCS
4	522+950	523+160	LHS	210	As per TCS
5	523+160	523+690	Both	530	As per TCS
6	523+960	524+750	Both	790	As per TCS
7	524+930	525+440	Both	510	As per TCS
8	525+680	526+280	Both	600	As per TCS
9	526+550	527+870	Both	1320	As per TCS
10	527+870	528+120	LHS	250	As per TCS
11	528+120	528+300	Both	180	As per TCS

B. Service Road on RHS which is split from Main Alignment towards existing road for Kunjwani to Sidhra Section.

Sl. No.	Design Chainage of RHS Service Road (Km)		Side	Length (m)	Width of Service Road (m) (Lane Width + Shoulder Width)
	From	To			
1	522+470	522+710	RHS	240	As per TCS
2	522+910	523+150	RHS	240	As per TCS
3	523+690	524+230	RHS	540	As per TCS
4	524+950	525+380	RHS	430	As per TCS
5	525+660	526+350	RHS	690	As per TCS
6	526+860	527+250	RHS	390	As per TCS
7	528+540	528+920	RHS	380	As per TCS

C. Ramps (Function as LHS Service Road) to connect LHS Service Road which is terminated due to follow existing road alignment for Kunjwani to Sidhra Section.

Sl. No.	Ramps Chainage (Km)		Design Length (m)	Width of Service Road (m) (Lane Width + Shoulder Width)	Remarks
	From	To			
1	0+000	0+360	360	As per TCS	Ramp-1 between Expressway Km 522+500 to 522+860 on RHS
2	0+000	0+600	600	As per TCS	Ramp-2 between Expressway Km 523+690 to 523+960
3	0+000	0+466	466	As per TCS	Ramp-3 between Expressway Km 524+750 to 524+930
4	0+000	0+645	645	As per TCS	Ramp-4 between Expressway Km 525+440 to 525+680
5	0+000	0+461	461	As per TCS	Ramp-5 between Expressway Km 526+280 to 526+550

D. Service Road along Main Alignment of Expressway for Domel to Katra Section

Sl. No.	Design Chainage (Km)		Side (LHS/RHS]	Length (m)	Width of Service Road (m) (Lane Width + Shoulder Width)
	From	To			
1	550+900	552+220	Both	1320	As per TCS
2	552+330	552+420	LHS	90	As per TCS
3	552+420	555+470	Both	3050	As per TCS
4	555+470	555+650	RHS	180	As per TCS
5	555+650	555+980	Both	330	As per TCS
6	555+980	556+390	RHS	410	As per TCS
7	556+390	559+640	Both	3250	As per TCS
8	559+640	559+850	RHS	210	As per TCS
9	559+850	560+000	Both	150	As per TCS
10	560+000	560+250	RHS	250	As per TCS
11	560+250	560+910	Both	660	As per TCS

E. Ramps (Function as LHS Service Road) to connect LHS Service Road which is terminated due to follow existing road alignment for Domel to Katra Section.

Sl. No.	Ramps Chainage (Km)		Design Length (m)	Width of Service Road (m) (Lane Width + Shoulder Width)	Remarks
	From	To			
1	0+000	0+286	286	As per TCS	Ramp-1 between Expressway Km 555+470 to 555+650
2	0+000	0+582	582	As per TCS	Ramp-2 between Expressway Km 555+980 to 556+390
3	0+000	0+243	243	As per TCS	Ramp-3 between Expressway Km 559+640 to 559+850
4	0+000	0+300	300	As per TCS	Ramp-4 between Expressway Km 560+000 to 560+250

F. Slip Roads and Ramps for Kunjwani to Sidhra Section

Sl. No.	Design Chainage (Km)		Side (LHS/RHS]	Length (m)	Width of Slip Road (m)	Remarks
	From	To				
1	515+760	515+970	Both	210	As per TCS	-
2	421+250	421+300	Both	50	As per TCS	Exit Ramp

G. Ramps for Entry from Service Road to Expressway and Exit from Expressway to Service Road/Connecting Road at the given below locations

Sl. No.	Design Chainage (Km)	LHS	RHS
1	515+050	Exit from Delhi Side	Entry towards Delhi Side
2	519+150	Entry towards Katra Side	Exit from Katra Side
3	520+175	Exit from Delhi Side	Exit from Katra Side
4	521+275	-	Entry towards Delhi Side

5	522+500	-	Entry towards Delhi Side
6	523+180	-	Exit from Katra Side
7	523+375	Entry towards Katra Side	-
8	560+400	Entry towards Katra Side	Entry towards Delhi Side
9	566+200	-	Exit from Delhi Side to RHS Connecting Road

H. Details of Ramps/Loops of Interchange as given below:

Interchange at Chainage (Km)	Ramp /Loop No	Description	Lane Configuration	Length (m)
552+260 Roundabout with ramps	-	Rotary (Radius-30m)	3	188
	R1	Rotary to Katra Side	2	397
	R2	Katra Side to Rotary	2	416
	R3	Rotary to Delhi Side (RHS Service Road for Expressway)	2	1321
	R4	Delhi Side to Rotary (LHS Service Road for Expressway)	2	1319
	R5	Udhampur Side (NH-44) to Rotary	2	201
	R6	Rotary to Udhampur Side (NH-44)	2	196
563+545 Trumpet	L1 & R1	Katra Bus Stand Link (980m)	2+2	1295
	R1	From Katra Bus Stand Side to Katra Temple Side	2	
	L1 & R1	Katra Bus Stand Link (980m)	2+2	1360
	L1	Expressway to Katra Bus Stand Side	2	
	R2	From Katra Bus Stand Side to Expressway Side	2	593
	R3	From Katra Temple Side to Katra Bus Stand Side	2	485

Connecting Roads

The details of connecting roads are given below.

Table 1.29: Details of Connecting Roads

Sl. No.	Design Chainage (Km)		Side (LHS/RHS]	Length (m)
	From	To		
1	524+000	424+200	LHS	220
2	562+070	562+280	LHS	210
3	562+280	562+550	Below Viaduct	270
4	564+320	564+450	LHS	130
5	RHS of Expressway between km 566+200 to km 566+520			766

Sl. No.	Design Chainage (Km)		Side (LHS/RHS]	Length (m)
	From	To		
	followed existing road alignment.			
6	Connect to Katra Market to Round about near Katra Bus Stand/ Katra Railway Station.			315

The connecting roads is indicated above are minimum specified. The realignment of existing track to the SVUP outside the PROW and connecting roads between consecutive underpasses wherever required as per plan & profile. Length of connecting roads given in above table excludes length across the project Expressway. For proper connectivity of cross roads on either side of project expressway which shall be deemed to be included in the scope of work.

1.14 PAVEMENT DESIGN

The pavement design has been carried out as per IRC: 37-2018, IRC: SP-99 and MoRTH specifications, Vth Revision.

1.14.1 Type of Pavement

a) The pavement shall be flexible pavement with Cement Treated Subbase (CTSB) for the main carriageway including loops/ramps at interchange locations for the entire length of project highway.

b) For connecting roads/Service roads/Slip Roads and access roads to wayside amenities, flexible pavement with Cement Treated Subbase (CTSB) shall be proposed.

c) Rigid Pavement shall be provided at Toll Plaza/Toll Booth locations.

1.14.2 Design Methodology

a) flexible pavement with Cement Treated Subbase (CTSB) shall be constructed New/Widening/Reconstruction Section for the main carriageway including paved shoulders and loops/ramps at interchange locations for the entire length of project highway. flexible pavement is typically designed for a minimum design period of 30 years.

b) flexible pavement with Cement Treated Subbase (CTSB) shall be constructed for the Service Road carriageway. The Service Road flexible pavement is typically designed for a minimum design period of 20 years.

c) For slip roads including access to wayside amenities and interconnecting roads to VUPs/LVUPs/SVUPs, flexible pavement shall be provided for minimum 10 MSA design traffic.

d) Rigid pavement shall be provided at proposed toll plazas/toll booths. Rigid pavement shall be designed for a design period of 30 years.

e) Stage construction shall not be permitted.

1.14.3 Design Parameters

Notwithstanding anything to the contrary contained in this Agreement or the IRC: SP:99-2013, the Contractor shall design the pavement of main carriageway including paved shoulders, loop/ramp at interchange locations as 150 MSA, Flexible Pavement with Cement Treated Subbase (CTSB) for minimum subgrade CBR of 12 % and Service road Pavement design with 50 MSA and Minimum effective designed 12 CBR (%) while the pavement for slip road shall be designed for design traffic of 10 MSA. The pavement at Toll Plaza locations shall be designed by the Contractor as Rigid Pavement.

1.14.4 Recommended Pavement Design

Notwithstanding anything to the contrary contained in this Agreement or the IRC:SP:99-2013, the Contractor shall design the pavement for main carriageway and overlay for existing Road including connecting roads/service roads/slip roads. However, in no case the pavement thickness shall not be less than as given below:

Table 1.30: Main Carriageway/Widening/New/Reconstruction Section

Pavement layer	Grade of Bitumen	Pavement Type	Design MSA	Minimum Subgrade CBR	Minimum Crust layer thickness (mm)
Bituminous (SMA)	VG-40	Flexible With CTSB	150	12	50
Dense Bituminous Concrete (DBM)					100
Wet Mix Macadam, WMM					150
Cemented Treated Subbase (CTSB)					250

Table 1.31: Service Road Pavement composition

Pavement layer	Grade of Bitumen	Pavement Type	Design MSA	Minimum Subgrade CBR	Minimum Crust layer thickness (mm)
Bituminous (SMA)	VG-40	Flexible With CTSB	50	12	40
Dense Bituminous Concrete (DBM)					70
Wet Mix Macadam (WMM)					150
Cemented Treated Subbase (CTSB)					200

Table 0.6: Pavement Composition for Slip roads

Pavement layer	Grade of Bitumen	Pavement Type	Minimum Crust layer thickness (mm)
Bituminous Concrete (BC)	VG-40	Flexible With CTSB	40
Dense Bituminous Concrete (DBM)			50
Wet Mix Macadam (WMM)			150
Cemented Treated Subbase (CTSB)			200

Table 0.7: Pavement Composition for Toll Plaza's

Pavement Composition	Pavement Type	Minimum Crust Thickness (mm)
Pavement Quality Concrete (PQC)	Rigid	300
Dry Lean Concrete (DLC)		150
Granular Sub-base (GSB)		200

Note: De-bonding interlayer of polythene sheet having a minimum thickness of 125 micron is recommended separation layer between DLC and PQC.

The minimum thickness is to be provided at strengthening of Existing Main Carriageway Road sections is given below.

The Proposed overlay thickness of existing main carriageway road given table below and detailed of overlay sections are given in widening schedules.

Table 0.8: Overlay for Existing Pavement Road

Recommended overlay thickness (mm)		Remarks
BC	DBM	
50	-	

1.15 MATERIALS

All materials to be used in works shall be in conformity with the requirements laid down for relevant item in MORTH Specifications, Vth Revision. If any material, which is not covered in MORTH Specifications, is used, shall conform to IRC or relevant Indian or International Standards, provisions.

Annexure 1

Details of Proposed ROW:

Sl No	Stretches		Length (m)	PROW Width (in m)	Remarks
	From (Km)	To (Km)			
Main Expressway (Kunjwani to Sidhra Section)					
1	515+000	523+720	8720	60	
2	523+720	523+920	200	30	Forest Area
3	523+920	524+780	860	60	
4	524+780	524+900	120	30	Forest Area
5	524+900	525+470	570	60	
6	525+470	525+650	180	30	Forest Area
7	525+650	526+310	660	60	
8	526+310	526+510	200	30	Forest Area
9	526+510	528+300	1790	60	
Main Expressway (Domel to Katra Section)					
10	550+900	556+600	5700	60	
11	556+600	556+700	100	60-40	Viaduct
12	556+700	557+280	580	40	Viaduct
13	557+280	557+380	100	40-60	Viaduct
14	557+380	560+920	3540	60	
15	560+920	561+660	740	40	Viaduct
16	561+660	563+900	2240	60	
17	563+900	564+310	410	30	Katra Temple Link
18	564+310	564+450	140	45	Katra Temple Link
19	564+450	566+100	1650	30	Katra Temple Link
20	566+100	566+330	230	40	Katra Temple Link
21	566+330	566+440	110	20	Katra Temple Link
22	566+440	566+520	80	30	Katra Temple Link

Service Road on RHS which is split from Expressway Alignment towards existing road for Kunjwani to Sidhra Section.

Sl. No.	Design Chainage of RHS Service Road (Km)		Length (m)	PROW Width (m)	Remarks
	From	To			
1	522+470	522+710	240	60	Existing ROW
2	522+910	523+150	240	60	Existing ROW
3	523+690	524+230	540	60	Existing ROW
4	524+950	525+380	430	60	Existing ROW
5	525+660	526+350	690	60	Existing ROW
6	526+860	527+250	390	60	Existing ROW

Sl. No.	Design Chainage of RHS Service Road (Km)		Length (m)	PROW Width (m)	Remarks
	From	To			
7	528+540	528+920	380	60	Existing ROW

Katra Bus stand Link connect via IC at Km 563+545 of Domel to Katra Section.

Sl No	Ramp/Loop Chainage of IC		Length (m)	PROW Width (in m)	Remarks
	From (Km)	To (Km)			
1	0+000	0+290	290	50	
2	0+290	0+400	110	30	
3	0+400	1+360	960	Varies as per IC	

Ramps (Function as LHS Service Road) to connect LHS Service Road which is terminated due to follow existing road alignment for Domel to Katra Section.

Sl No	Ramp Chainage		Length (m)	PROW Width (in m)	Remarks
	From (Km)	To (Km)			
1	0+000	0+286	286	25	Ramp-1 between Expressway Chainage Km 555+470 to 555+650
2	0+000	0+582	582	25	Ramp-2 between Expressway Chainage Km 555+980 to 556+390
3	0+000	0+243	243	25	Ramp-3 between Expressway Chainage Km 559+640 to 559+850
4	0+000	0+300	300	25	Ramp-4 between Expressway Chainage Km 560+000 to 560+250

Details of Proposed ROW Coordinates: -

Coordinates of Expressway from Design Chainage Km 515+000 to 528+300 (Kunjwani to Sidhra Section).

Design Chainage (Km)	LHS-PROW		RHS-PROW	
	Easting	Northing	Easting	Northing
515+000	489073.159	3614922.72	489102.235	3614870.235
515+050	489117.489	3614946.937	489145.661	3614893.962
515+100	489161.911	3614970.267	489189.772	3614917.128
515+150	489206.194	3614993.484	489234.055	3614940.345
515+200	489250.477	3615016.701	489278.337	3614963.562
515+250	489294.444	3615039.867	489322.84	3614987.012
515+300	489337.8	3615063.778	489367.05	3615011.39
515+350	489381.457	3615088.152	489410.706	3615035.765
515+400	489425.113	3615112.527	489454.363	3615060.14
515+450	489468.769	3615136.902	489498.019	3615084.514
515+500	489512.425	3615161.277	489541.675	3615108.889
515+550	489556.082	3615185.652	489585.331	3615133.264
515+600	489600.344	3615210.063	489628.631	3615157.15
515+650	489646.813	3615233.174	489671.68	3615178.57
515+700	489694.199	3615253.168	489716.423	3615197.436
515+750	489740.858	3615271.547	489762.807	3615215.706
515+800	489787.445	3615289.855	489809.29	3615233.973
515+850	489834.938	3615307.74	489855.38	3615251.329
515+900	489882.863	3615324.431	489901.888	3615267.527
515+950	489930.548	3615339.932	489949.305	3615282.939
516+000	489977.132	3615355.912	489997.308	3615299.406
516+050	490023.302	3615373.051	490044.884	3615317.067
516+100	490069.598	3615391.268	490091.644	3615335.465
516+150	490115.98	3615409.61	490138.254	3615353.898
516+200	490161.478	3615428.463	490185.137	3615373.324
516+250	490206.49	3615448.446	490231.52	3615393.917
516+300	490251.962	3615469.538	490276.764	3615414.904
516+350	490298.43	3615489.936	490321.859	3615434.699
516+400	490345.394	3615509.166	490367.435	3615453.361
516+450	490391.973	3615527.478	490413.922	3615471.637
516+500	490438.508	3615545.769	490460.457	3615489.928
516+550	490485.042	3615564.06	490506.991	3615508.219
516+600	490531.576	3615582.351	490553.525	3615526.51
516+650	490578.11	3615600.642	490600.06	3615544.801
516+700	490624.645	3615618.933	490646.594	3615563.092
516+750	490671.179	3615637.224	490693.128	3615581.383
516+800	490717.672	3615655.504	490739.7	3615599.694
516+850	490763.841	3615673.991	490786.365	3615618.379
516+900	490810.184	3615692.761	490832.708	3615637.149

Design Chainage (Km)	LHS-PROW		RHS-PROW	
	Easting	Northing	Easting	Northing
516+950	490856.332	3615711.508	490879.207	3615656.04
517+000	490900.811	3615730.916	490926.368	3615676.631
517+050	490942.494	3615752.844	490973.142	3615701.261
517+100	490981.209	3615778.858	491017.387	3615730.992
517+150	491016.8	3615809.005	491058.062	3615765.445
517+200	491048.828	3615842.912	491094.666	3615804.196
517+250	491076.9	3615880.161	491126.748	3615846.767
517+300	491100.668	3615920.294	491153.912	3615892.633
517+350	491119.84	3615962.814	491175.822	3615941.228
517+400	491134.178	3616007.198	491192.209	3615991.952
517+450	491143.507	3616052.898	491202.87	3616044.181
517+500	491147.711	3616099.351	491207.675	3616097.27
517+550	491146.738	3616145.984	491206.563	3616150.564
517+600	491140.6	3616192.221	491199.548	3616203.407
517+650	491129.365	3616237.623	491186.784	3616255.032
517+700	491113.726	3616282.993	491169.857	3616304.19
517+750	491095.648	3616329.007	491151.373	3616351.251
517+800	491077.111	3616375.443	491132.835	3616397.688
517+850	491058.574	3616421.88	491114.298	3616444.125
517+900	491040.037	3616468.317	491095.761	3616490.562
517+950	491021.499	3616514.753	491077.223	3616536.998
518+000	491002.962	3616561.19	491058.686	3616583.435
518+050	490984.425	3616607.627	491040.149	3616629.872
518+100	490965.887	3616654.064	491021.611	3616676.308
518+150	490947.35	3616700.5	491003.074	3616722.745
518+200	490928.813	3616746.937	490984.537	3616769.182
518+250	490910.275	3616793.374	490965.999	3616815.619
518+300	490891.738	3616839.81	490947.462	3616862.055
518+350	490873.201	3616886.247	490928.925	3616908.492
518+400	490854.663	3616932.684	490910.387	3616954.929
518+450	490836.105	3616979.028	490891.771	3617001.418
518+500	490817.447	3617025.417	490873.113	3617047.806
518+550	490798.789	3617071.805	490854.455	3617094.195
518+600	490780.131	3617118.193	490835.797	3617140.583
518+650	490761.473	3617164.581	490817.139	3617186.971
518+700	490742.815	3617210.97	490798.481	3617233.359
518+750	490724.157	3617257.358	490779.823	3617279.748
518+800	490705.499	3617303.746	490761.164	3617326.136
518+850	490686.84	3617350.135	490742.506	3617372.524
518+900	490668.182	3617396.523	490723.848	3617418.913
518+950	490649.524	3617442.911	490705.19	3617465.301
519+000	490630.866	3617489.299	490686.532	3617511.689

Design Chainage (Km)	LHS-PROW		RHS-PROW	
	Easting	Northing	Easting	Northing
519+050	490612.208	3617535.688	490667.874	3617558.078
519+100	490593.536	3617582.12	490649.236	3617604.424
519+150	490575.155	3617629.155	490631.219	3617650.528
519+200	490557.429	3617675.993	490613.55	3617697.218
519+250	490539.742	3617722.76	490595.862	3617743.985
519+300	490522.054	3617769.527	490578.175	3617790.752
519+350	490504.367	3617816.294	490560.487	3617837.519
519+400	490486.679	3617863.061	490542.8	3617884.286
519+450	490468.992	3617909.828	490525.112	3617931.053
519+500	490451.305	3617956.595	490507.425	3617977.82
519+550	490433.617	3618003.362	490489.738	3618024.587
519+600	490415.93	3618050.129	490472.05	3618071.354
519+650	490398.242	3618096.896	490454.363	3618118.121
519+700	490380.555	3618143.663	490436.675	3618164.888
519+750	490362.867	3618190.43	490418.988	3618211.655
519+800	490345.18	3618237.197	490401.3	3618258.422
519+850	490327.493	3618283.964	490383.613	3618305.189
519+900	490309.805	3618330.731	490365.926	3618351.956
519+950	490292.118	3618377.498	490348.238	3618398.723
520+000	490274.43	3618424.265	490330.551	3618445.49
520+050	490256.743	3618471.032	490312.863	3618492.257
520+100	490239.055	3618517.799	490295.176	3618539.024
520+150	490221.368	3618564.566	490277.488	3618585.791
520+200	490203.681	3618611.333	490259.801	3618632.558
520+250	490185.993	3618658.1	490242.114	3618679.325
520+300	490168.306	3618704.867	490224.426	3618726.092
520+350	490150.618	3618751.634	490206.739	3618772.859
520+400	490132.928	3618798.457	490189.086	3618819.582
520+450	490115.324	3618845.256	490171.482	3618866.381
520+500	490097.72	3618892.054	490153.878	3618913.179
520+550	490080.116	3618938.853	490136.274	3618959.978
520+600	490062.512	3618985.652	490118.67	3619006.776
520+650	490044.908	3619032.45	490101.066	3619053.575
520+700	490027.304	3619079.249	490083.462	3619100.373
520+750	490009.7	3619126.047	490065.859	3619147.172
520+800	489992.096	3619172.846	490048.255	3619193.97
520+850	489974.492	3619219.644	490030.651	3619240.769
520+900	489956.888	3619266.443	490013.047	3619287.567
520+950	489939.285	3619313.241	489995.443	3619334.366
521+000	489921.681	3619360.04	489977.839	3619381.164
521+050	489904.077	3619406.838	489960.235	3619427.963
521+100	489886.473	3619453.637	489942.631	3619474.761

Design Chainage (Km)	LHS-PROW		RHS-PROW	
	Easting	Northing	Easting	Northing
521+150	489868.869	3619500.435	489925.027	3619521.56
521+200	489851.265	3619547.234	489907.423	3619568.358
521+250	489833.661	3619594.032	489889.819	3619615.157
521+300	489816.057	3619640.831	489872.215	3619661.955
521+350	489798.453	3619687.629	489854.611	3619708.754
521+400	489780.849	3619734.428	489837.007	3619755.553
521+450	489763.327	3619781.78	489819.824	3619801.983
521+500	489746.838	3619829.775	489803.822	3619848.56
521+550	489731.554	3619878.168	489788.989	3619895.522
521+600	489717.484	3619926.927	489775.336	3619942.84
521+650	489704.638	3619976.023	489762.869	3619990.484
521+700	489693.022	3620025.424	489751.597	3620038.426
521+750	489682.651	3620075.063	489741.518	3620086.671
521+800	489672.978	3620124.119	489731.845	3620135.727
521+850	489663.305	3620173.174	489722.171	3620184.782
521+900	489653.631	3620222.229	489712.498	3620233.837
521+950	489643.958	3620271.285	489702.825	3620282.893
522+000	489633.675	3620319.043	489692.056	3620332.886
522+050	489621.411	3620366.221	489679.163	3620382.483
522+100	489607.23	3620412.858	489664.256	3620431.512
522+150	489591.472	3620460.691	489648.719	3620478.652
522+200	489577.145	3620509.892	489635.091	3620525.453
522+250	489564.878	3620559.648	489623.422	3620572.782
522+300	489554.528	3620609.623	489613.492	3620620.724
522+350	489547.878	3620663.636	489607.824	3620665.845
522+400	489551.894	3620719.897	489610.92	3620709.122
522+450	489568.018	3620773.947	489623.318	3620750.7
522+500	489595.351	3620823.286	489644.345	3620788.653
522+550	489632.744	3620865.515	489673.107	3620821.138
522+600	489678.327	3620898.733	489708.173	3620846.686
522+650	489729.779	3620921.299	489748.132	3620864.174
522+700	489780.816	3620934.505	489793.887	3620875.946
522+750	489829.638	3620945.375	489842.674	3620886.808
522+800	489878.444	3620956.238	489891.48	3620897.671
522+850	489927.249	3620967.101	489940.285	3620908.535
522+900	489976.055	3620977.965	489989.091	3620919.398
522+950	490024.861	3620988.828	490037.897	3620930.261
523+000	490073.666	3620999.692	490086.702	3620941.125
523+050	490122.472	3621010.555	490135.508	3620951.988
523+100	490171.277	3621021.418	490184.313	3620962.852
523+150	490218.311	3621032.674	490234.511	3620974.902
523+200	490261.648	3621048.23	490285.233	3620993.06

Design Chainage (Km)	LHS-PROW		RHS-PROW	
	Easting	Northing	Easting	Northing
523+250	490306.699	3621068.413	490331.445	3621013.753
523+300	490354.964	3621088.692	490375.323	3621032.251
523+350	490408.738	3621102.48	490418.26	3621043.24
523+400	490460.309	3621108.459	490466.01	3621048.731
523+450	490510.083	3621113.21	490515.783	3621053.481
523+500	490557.701	3621118.841	490567.446	3621059.636
523+550	490600.436	3621129.855	490621.348	3621073.631
523+600	490639.232	3621149.271	490671.786	3621098.871
523+650	490672.907	3621176.628	490715.557	3621134.443
523+700	490699.865	3621210.62	490750.604	3621178.63
523+750	490733.003	3621244.532	490761.225	3621234.385
523+800	490743.953	3621289.866	490773.709	3621286.044
523+850	490745.405	3621337.172	490775.374	3621338.555
523+900	490741.557	3621386.366	490771.436	3621389.048
523+950	490722.146	3621434.825	490781.906	3621440.189
524+000	490718.409	3621486.324	490778.373	3621488.41
524+050	490721.12	3621541.691	490780.458	3621532.777
524+100	490735.53	3621596.225	490791.537	3621574.727
524+150	490761.318	3621646.39	490811.37	3621613.318
524+200	490795.863	3621689.24	490839.589	3621648.154
524+250	490832.003	3621725.506	490874.048	3621682.701
524+300	490867.674	3621760.543	490909.718	3621717.738
524+350	490903.345	3621795.58	490945.389	3621752.775
524+400	490939.016	3621830.617	490981.06	3621787.812
524+450	490974.686	3621865.654	491016.731	3621822.849
524+500	491010.357	3621900.691	491052.402	3621857.886
524+550	491046.028	3621935.728	491088.072	3621892.923
524+600	491081.699	3621970.765	491123.743	3621927.96
524+650	491117.37	3622005.802	491159.414	3621962.997
524+700	491152.724	3622040.634	491195.292	3621998.349
524+750	491182.59	3622074.706	491231.166	3622039.488
524+800	491217.85	3622106.413	491245.361	3622094.458
524+850	491231.686	3622150.955	491261.128	3622145.216
524+900	491220.622	3622197.061	491280.603	3622198.552
524+950	491214.844	3622240.067	491273.09	3622254.46
525+000	491199.926	3622280.814	491253.695	3622307.43
525+050	491176.421	3622317.644	491223.557	3622354.77
525+100	491144.949	3622353.805	491189.438	3622394.064
525+150	491110.972	3622393.673	491158.531	3622430.248
525+200	491080.935	3622438.202	491132.687	3622468.566
525+250	491056.719	3622486.148	491111.849	3622509.82
525+300	491038.661	3622536.733	491096.311	3622553.347

Design Chainage (Km)	LHS-PROW		RHS-PROW	
	Easting	Northing	Easting	Northing
525+350	491027.043	3622589.172	491086.314	3622598.469
525+400	491022.045	3622642.65	491082.012	3622644.484
525+450	491023.744	3622696.335	491083.473	3622690.679
525+500	491046.813	3622746.116	491076.09	3622739.587
525+550	491061.231	3622795.905	491089.466	3622785.777
525+600	491081.289	3622843.28	491108.399	3622830.433
525+650	491089.339	3622894.913	491143.468	3622869.027
525+700	491110.91	3622940.02	491165.039	3622914.134
525+750	491132.482	3622985.127	491186.61	3622959.242
525+800	491154.053	3623030.235	491208.182	3623004.349
525+850	491174.902	3623074.605	491229.843	3623050.488
525+900	491190.863	3623118.04	491248.342	3623100.854
525+950	491201.316	3623163.057	491260.491	3623153.171
526+000	491206.891	3623210.499	491266.64	3623205.011
526+050	491211.454	3623260.27	491271.206	3623254.822
526+100	491214.648	3623308.659	491274.597	3623306.205
526+150	491215.404	3623357.147	491275.4	3623357.692
526+200	491213.738	3623405.612	491273.631	3623409.155
526+250	491209.654	3623453.932	491269.294	3623460.464
526+300	491204.047	3623503.471	491263.658	3623510.291
526+350	491213.267	3623554.852	491243.072	3623558.262
526+400	491207.634	3623604.697	491237.475	3623607.784
526+450	491205.268	3623656.588	491235.252	3623655.703
526+500	491211.183	3623708.686	491240.604	3623702.839
526+550	491211.624	3623764.408	491267.709	3623743.114
526+600	491235.324	3623813.962	491287.1	3623783.658
526+650	491266.915	3623858.9	491312.946	3623820.426
526+700	491304.74	3623897.646	491344.959	3623853.122
526+750	491342.639	3623930.977	491382.155	3623885.827
526+800	491380.263	3623963.907	491419.779	3623918.757
526+850	491417.888	3623996.837	491457.404	3623951.687
526+900	491455.513	3624029.767	491495.029	3623984.617
526+950	491491.548	3624062.254	491533.228	3624019.106
527+000	491523.662	3624096.535	491569.441	3624057.764
527+050	491552.205	3624133.844	491601.627	3624099.835
527+100	491576.892	3624173.81	491629.466	3624144.904
527+150	491597.446	3624216.054	491652.644	3624192.54
527+200	491613.644	3624260.15	491670.91	3624242.266
527+250	491625.868	3624306.367	491684.287	3624292.685
527+300	491637.266	3624355.048	491695.686	3624341.37
527+350	491649.455	3624405.311	491706.994	3624388.297
527+400	491681.101	3624460.593	491724.361	3624419.001

Design Chainage (Km)	LHS-PROW		RHS-PROW	
	Easting	Northing	Easting	Northing
527+450	491735.408	3624494.436	491754.084	3624437.416
527+500	491786.114	3624507.423	491800.261	3624449.115
527+550	491834.704	3624519.212	491848.851	3624460.904
527+600	491883.308	3624531	491897.43	3624472.686
527+650	491932.612	3624542.325	491945.586	3624483.744
527+700	491981.43	3624553.136	491994.403	3624494.556
527+750	492030.195	3624563.94	492043.27	3624505.382
527+800	492070.188	3624577.174	492097.767	3624523.885
527+850	492101.986	3624601.118	492145.495	3624559.775
527+900	492124.204	3624634.13	492178.878	3624609.284
527+950	492134.418	3624672.582	492194.246	3624666.989
528+000	492131.512	3624712.262	492189.836	3624726.542
528+050	492115.802	3624748.824	492166.215	3624781.384
528+100	492088.975	3624778.231	492125.958	3624825.49
528+150	492053.973	3624797.177	492073.465	3624853.958
528+200	492009.905	3624806.582	492019.943	3624865.736
528+250	491960.982	3624814.454	491970.138	3624873.751
528+300	491911.567	3624822.084	491921.1654	3624881.313

Coordinates of Expressway from Design Chainage Km 550+900 to 566+500 (Domel to Katra Section).

Design Chainage (Km)	LHS-PROW		RHS-PROW	
	Easting (E)	Northing (N)	Easting (E)	Northing (N)
550+900	495778.570	3637685.583	495838.561	3637686.641
550+950	495778.634	3637736.198	495838.634	3637736.025
551+000	495778.778	3637786.198	495838.778	3637786.025
551+050	495779.772	3637837.737	495839.682	3637834.456
551+100	495785.860	3637890.921	495844.960	3637880.564
551+150	495798.223	3637943.014	495855.674	3637925.711
551+200	495816.685	3637993.270	495871.674	3637969.267
551+250	495840.586	3638040.601	495892.858	3638011.144
551+300	495865.780	3638084.223	495917.679	3638054.115
551+350	495890.871	3638127.472	495942.769	3638097.363
551+400	495915.961	3638170.721	495967.860	3638140.612
551+450	495941.052	3638213.970	495992.950	3638183.861
551+500	495963.968	3638255.657	496018.120	3638229.820
551+550	495979.879	3638297.694	496037.567	3638281.199
551+600	495988.596	3638341.789	496048.221	3638335.093
551+650	495989.877	3638386.719	496049.787	3638390.007
551+700	495983.688	3638431.734	496042.427	3638443.967
551+750	495972.877	3638480.023	496031.398	3638493.262
551+800	495961.844	3638528.790	496020.365	3638542.030

Design Chainage (Km)	LHS-PROW		RHS-PROW	
	Easting (E)	Northing (N)	Easting (E)	Northing (N)
551+850	495950.811	3638577.558	496009.332	3638590.798
551+900	495939.778	3638626.325	495998.299	3638639.565
551+950	495928.745	3638675.093	495987.266	3638688.333
552+000	495917.289	3638722.737	495975.339	3638737.908
552+050	495906.357	3638775.553	495965.904	3638782.907
552+100	495904.677	3638831.004	495964.560	3638827.268
552+150	495913.233	3638885.804	495971.411	3638871.130
552+200	495926.710	3638933.305	495985.178	3638919.831
552+250	495926.531	3638968.435	495984.562	3638983.683
552+300	495908.860	3639000.187	495954.712	3639038.885
552+350	495876.264	3639037.197	495921.225	3639076.927
552+400	495843.156	3639074.665	495888.117	3639114.395
552+450	495810.320	3639111.464	495854.370	3639152.203
552+500	495777.177	3639143.765	495815.895	3639189.601
552+550	495740.860	3639168.956	495770.166	3639221.313
552+600	495699.618	3639187.500	495720.334	3639243.810
552+650	495653.623	3639202.581	495671.328	3639259.909
552+700	495605.849	3639217.335	495623.554	3639274.663
552+750	495557.311	3639232.752	495576.785	3639289.504
552+800	495507.357	3639253.270	495534.283	3639306.889
552+850	495460.224	3639282.916	495496.898	3639330.403
552+900	495419.625	3639321.025	495464.698	3639360.628
552+950	495387.057	3639366.191	495438.869	3639396.449
553+000	495363.564	3639415.233	495419.262	3639437.541
553+050	495345.911	3639463.349	495402.495	3639483.306
553+100	495329.280	3639510.503	495385.864	3639530.459
553+150	495312.650	3639557.656	495369.234	3639577.612
553+200	495296.020	3639604.809	495352.604	3639624.766
553+250	495279.390	3639651.963	495335.974	3639671.919
553+300	495262.760	3639699.116	495319.344	3639719.072
553+350	495246.130	3639746.269	495302.714	3639766.226
553+400	495229.511	3639792.856	495285.729	3639813.822
553+450	495211.168	3639835.600	495264.603	3639862.894
553+500	495187.365	3639873.154	495234.967	3639909.685
553+550	495156.597	3639908.691	495200.347	3639949.751
553+600	495122.284	3639944.653	495165.630	3639986.140
553+650	495087.712	3639980.775	495131.058	3640022.262
553+700	495052.986	3640017.279	495096.858	3640058.208
553+750	495018.753	3640055.984	495064.845	3640094.391
553+800	494986.845	3640096.870	495035.244	3640132.322
553+850	494957.525	3640139.648	495008.043	3640172.008
553+900	494930.903	3640184.157	494983.345	3640213.299

Design Chainage (Km)	LHS-PROW		RHS-PROW	
	Easting (E)	Northing (N)	Easting (E)	Northing (N)
553+950	494907.087	3640229.491	494960.669	3640256.489
554+000	494884.642	3640274.239	494938.280	3640301.128
554+050	494862.235	3640318.937	494915.872	3640345.826
554+100	494839.827	3640363.635	494893.465	3640390.524
554+150	494817.372	3640408.521	494871.178	3640435.069
554+200	494795.811	3640456.536	494851.752	3640478.230
554+250	494780.187	3640509.095	494838.900	3640521.399
554+300	494772.894	3640562.441	494832.718	3640567.063
554+350	494770.294	3640613.505	494830.247	3640615.864
554+400	494768.327	3640663.466	494828.281	3640665.826
554+450	494765.510	3640711.707	494825.240	3640717.398
554+500	494758.002	3640756.227	494816.093	3640771.360
554+550	494742.831	3640797.715	494796.950	3640823.622
554+600	494719.936	3640837.795	494770.341	3640870.344
554+650	494692.427	3640878.635	494741.993	3640912.446
554+700	494664.251	3640919.941	494713.817	3640953.751
554+750	494636.075	3640961.246	494685.642	3640995.057
554+800	494607.900	3641002.552	494657.466	3641036.362
554+850	494579.724	3641043.857	494629.291	3641077.668
554+900	494551.549	3641085.162	494601.115	3641118.973
554+950	494523.373	3641126.468	494572.940	3641160.278
555+000	494495.202	3641167.766	494544.759	3641201.590
555+050	494467.153	3641206.891	494514.527	3641243.700
555+100	494436.529	3641242.512	494479.992	3641283.868
555+150	494401.941	3641276.460	494443.245	3641319.980
555+200	494365.674	3641310.880	494406.978	3641354.400
555+250	494329.408	3641345.300	494370.712	3641388.820
555+300	494293.141	3641379.720	494334.445	3641423.240
555+350	494256.875	3641414.140	494298.179	3641457.660
555+400	494220.608	3641448.561	494261.913	3641492.080
555+450	494183.850	3641484.798	494227.449	3641526.019
555+500	494149.318	3641526.856	494198.553	3641561.138
555+550	494121.790	3641574.377	494176.024	3641600.042
555+600	494102.003	3641623.683	494158.632	3641643.514
555+650	494085.872	3641671.437	494142.763	3641690.501
555+700	494069.986	3641718.846	494126.877	3641737.910
555+750	494053.890	3641764.882	494109.949	3641786.253
555+800	494035.169	3641808.519	494089.258	3641834.484
555+850	494012.849	3641850.431	494064.588	3641880.807
555+900	493987.095	3641890.445	494036.243	3641924.860
555+950	493958.169	3641930.654	494006.776	3641965.830
556+000	493928.856	3641971.161	493977.463	3642006.336

Design Chainage (Km)	LHS-PROW		RHS-PROW	
	Easting (E)	Northing (N)	Easting (E)	Northing (N)
556+050	493899.543	3642011.667	493948.150	3642046.842
556+100	493870.230	3642052.173	493918.838	3642087.349
556+150	493840.917	3642092.679	493889.525	3642127.855
556+200	493811.604	3642133.186	493860.212	3642168.361
556+250	493782.292	3642173.692	493830.899	3642208.867
556+300	493752.979	3642214.198	493801.586	3642249.374
556+350	493723.666	3642254.705	493772.274	3642289.880
556+400	493694.353	3642295.211	493742.961	3642330.386
556+450	493665.040	3642335.717	493713.648	3642370.893
556+500	493635.728	3642376.223	493684.335	3642411.399
556+550	493606.256	3642417.193	493655.408	3642451.604
556+600	493577.909	3642461.682	493630.027	3642491.410
556+650	493560.899	3642512.025	493605.445	3642531.831
556+700	493544.140	3642560.541	493581.588	3642574.597
556+750	493526.573	3642607.356	493564.024	3642621.408
556+800	493509.008	3642654.169	493546.458	3642668.221
556+850	493491.442	3642700.982	493528.893	3642715.034
556+900	493473.877	3642747.795	493511.327	3642761.847
556+950	493456.312	3642794.608	493493.762	3642808.660
557+000	493438.746	3642841.421	493476.197	3642855.473
557+050	493421.181	3642888.234	493458.631	3642902.286
557+100	493403.298	3642933.931	493440.058	3642949.696
557+150	493382.197	3642977.020	493417.199	3642996.376
557+200	493356.872	3643018.289	493390.255	3643040.325
557+250	493329.216	3643059.843	493362.506	3643082.019
557+300	493299.940	3643100.419	493336.554	3643124.809
557+350	493268.282	3643139.499	493313.288	3643169.295
557+400	493237.887	3643182.045	493290.300	3643211.251
557+450	493215.013	3643231.763	493271.398	3643252.264
557+500	493200.383	3643283.734	493259.012	3643296.493
557+550	493190.776	3643333.853	493249.808	3643344.584
557+600	493181.834	3643383.047	493240.866	3643393.778
557+650	493172.891	3643432.241	493231.924	3643442.971
557+700	493163.949	3643481.435	493222.982	3643492.165
557+750	493155.007	3643530.629	493214.040	3643541.359
557+800	493146.376	3643580.462	493205.602	3643590.055
557+850	493138.884	3643630.654	493198.332	3643638.763
557+900	493132.644	3643681.016	493192.276	3643687.638
557+950	493127.660	3643731.519	493187.440	3643736.648
558+000	493123.755	3643781.644	493183.579	3643786.220
558+050	493119.349	3643830.694	493179.039	3643836.763
558+100	493113.815	3643879.629	493173.336	3643887.189

Design Chainage (Km)	LHS-PROW		RHS-PROW	
	Easting (E)	Northing (N)	Easting (E)	Northing (N)
558+150	493106.948	3643928.396	493166.260	3643937.441
558+200	493098.921	3643976.984	493157.989	3643987.510
558+250	493089.710	3644025.363	493148.497	3644037.362
558+300	493079.308	3644073.776	493137.896	3644086.716
558+350	493068.524	3644122.599	493127.112	3644135.539
558+400	493057.741	3644171.422	493116.329	3644184.363
558+450	493046.957	3644220.246	493105.545	3644233.186
558+500	493036.174	3644269.069	493094.761	3644282.009
558+550	493025.390	3644317.892	493083.978	3644330.832
558+600	493014.606	3644366.716	493073.194	3644379.656
558+650	493003.451	3644414.750	493061.728	3644429.026
558+700	492991.132	3644462.432	493049.033	3644478.161
558+750	492977.642	3644509.797	493035.132	3644526.968
558+800	492962.944	3644556.801	493019.986	3644575.403
558+850	492947.112	3644603.435	493003.673	3644623.458
558+900	492930.078	3644649.644	492986.119	3644671.074
558+950	492911.909	3644695.699	492967.594	3644718.041
559+000	492893.290	3644742.103	492948.975	3644764.445
559+050	492874.671	3644788.507	492930.356	3644810.849
559+100	492856.052	3644834.911	492911.737	3644857.253
559+150	492837.433	3644881.315	492893.118	3644903.658
559+200	492818.814	3644927.719	492874.499	3644950.062
559+250	492800.195	3644974.123	492855.880	3644996.466
559+300	492781.576	3645020.527	492837.261	3645042.870
559+350	492762.957	3645066.931	492818.642	3645089.274
559+400	492744.338	3645113.335	492800.023	3645135.678
559+450	492725.719	3645159.739	492781.404	3645182.082
559+500	492707.100	3645206.143	492762.785	3645228.486
559+550	492688.517	3645252.053	492743.844	3645275.267
559+600	492668.432	3645295.237	492721.761	3645322.724
559+650	492644.933	3645336.497	492695.788	3645368.328
559+700	492618.065	3645375.787	492666.234	3645411.562
559+750	492588.016	3645415.090	492635.550	3645451.703
559+800	492557.505	3645454.701	492605.039	3645491.314
559+850	492526.994	3645494.313	492574.528	3645530.926
559+900	492496.483	3645533.925	492544.017	3645570.538
559+950	492465.972	3645573.536	492513.506	3645610.150
560+000	492435.461	3645613.148	492482.995	3645649.761
560+050	492404.950	3645652.760	492452.485	3645689.373
560+100	492374.440	3645692.372	492421.974	3645728.985
560+150	492343.867	3645732.103	492391.563	3645768.506
560+200	492313.433	3645774.830	492363.967	3645807.183

Design Chainage (Km)	LHS-PROW		RHS-PROW	
	Easting (E)	Northing (N)	Easting (E)	Northing (N)
560+250	492287.648	3645823.170	492342.752	3645846.974
560+300	492270.136	3645874.960	492328.271	3645889.804
560+350	492259.460	3645925.989	492318.508	3645936.640
560+400	492250.657	3645975.180	492309.694	3645985.885
560+450	492240.764	3646021.800	492298.795	3646037.051
560+500	492225.920	3646063.958	492280.408	3646089.061
560+550	492203.661	3646102.118	492252.378	3646137.143
560+600	492174.070	3646137.558	492217.975	3646178.452
560+650	492139.817	3646172.942	492182.685	3646214.922
560+700	492104.833	3646208.665	492147.701	3646250.646
560+750	492069.850	3646244.388	492112.718	3646286.369
560+800	492034.866	3646280.112	492077.734	3646322.092
560+850	491999.668	3646316.243	492043.150	3646357.586
560+900	491965.039	3646356.011	492012.124	3646393.191
560+950	491941.063	3646403.476	491974.771	3646425.006
561+000	491915.188	3646448.784	491950.878	3646466.842
561+050	491894.008	3646496.469	491931.323	3646510.873
561+100	491877.681	3646546.023	491916.246	3646556.630
561+150	491866.354	3646596.955	491905.785	3646603.658
561+200	491860.206	3646648.768	491900.112	3646651.502
561+250	491859.255	3646700.935	491899.231	3646699.671
561+300	491863.488	3646752.938	491903.137	3646747.690
561+350	491872.920	3646804.255	491911.853	3646795.073
561+400	491887.431	3646854.372	491925.248	3646841.351
561+450	491906.845	3646902.801	491943.172	3646886.070
561+500	491931.016	3646949.041	491965.498	3646928.763
561+550	491959.692	3646992.630	491991.973	3646969.014
561+600	491992.553	3647033.157	492022.312	3647006.439
561+650	492029.305	3647070.193	492056.256	3647040.629
561+700	492064.810	3647109.780	492100.600	3647061.630
561+750	492108.836	3647139.246	492139.646	3647087.752
561+800	492155.614	3647164.111	492181.125	3647109.808
561+850	492204.549	3647184.224	492224.643	3647127.689
561+900	492252.639	3647200.234	492271.435	3647143.255
561+950	492297.242	3647216.694	492320.606	3647161.431
562+000	492339.545	3647237.125	492368.309	3647184.471
562+050	492379.597	3647261.678	492413.474	3647212.158
562+100	492416.998	3647290.106	492455.650	3647244.216
562+150	492451.375	3647322.126	492494.415	3647280.325
562+200	492482.383	3647357.419	492529.382	3647320.123
562+250	492509.714	3647395.631	492560.201	3647363.213
562+300	492533.093	3647436.381	492586.565	3647409.165

Design Chainage (Km)	LHS-PROW		RHS-PROW	
	Easting (E)	Northing (N)	Easting (E)	Northing (N)
562+350	492552.581	3647479.652	492608.153	3647457.031
562+400	492571.139	3647525.902	492626.836	3647503.588
562+450	492589.734	3647572.316	492645.431	3647550.002
562+500	492608.328	3647618.729	492664.025	3647596.416
562+550	492626.923	3647665.143	492682.619	3647642.830
562+600	492645.517	3647711.557	492701.214	3647689.244
562+650	492664.111	3647757.971	492719.808	3647735.658
562+700	492682.706	3647804.385	492738.402	3647782.072
562+750	492701.300	3647850.799	492756.997	3647828.486
562+800	492719.894	3647897.213	492775.591	3647874.900
562+850	492738.489	3647943.627	492794.185	3647921.314
562+900	492757.083	3647990.041	492812.780	3647967.727
562+950	492775.677	3648036.455	492831.374	3648014.141
563+000	492794.272	3648082.868	492849.968	3648060.555
563+050	492812.866	3648129.282	492868.563	3648106.969
563+100	492831.460	3648175.696	492887.157	3648153.383
563+150	492850.055	3648222.110	492905.751	3648199.797
563+200	492868.649	3648268.524	492924.346	3648246.211
563+250	492887.244	3648314.938	492942.940	3648292.625
563+300	492905.838	3648361.352	492961.535	3648339.039
563+350	492924.432	3648407.766	492980.129	3648385.452
563+400	492941.560	3648454.767	492998.723	3648431.866
563+450	492956.362	3648501.520	493017.307	3648479.293
563+500	492966.823	3648544.738	493032.525	3648531.675
563+550	492970.484	3648586.453	493038.746	3648587.895
563+600	492965.064	3648627.975	493041.711	3648646.612
563+650	492950.815	3648667.352	493033.656	3648707.973
563+700	492928.410	3648702.728	493001.343	3648760.902
563+750	492897.851	3648734.687	492958.005	3648800.247
563+800	492861.092	3648766.777	492918.890	3648834.031
563+850	492823.171	3648799.366	492867.322	3648850.740
563+900	492790.865	3648838.488	492829.398	3648883.325
563+950	492754.855	3648881.669	492799.423	3648913.192
564+000	492737.220	3648936.408	492783.976	3648948.631
564+050	492726.318	3648982.274	492763.752	3648999.975
564+100	492700.789	3649017.250	492721.770	3649043.486
564+150	492660.588	3649043.669	492675.748	3649069.557
564+200	492617.552	3649070.949	492634.935	3649095.762
564+250	492577.134	3649102.331	492596.826	3649125.190
564+300	492540.112	3649137.656	492561.924	3649158.375
564+350	492495.623	3649167.354	492530.202	3649194.965
564+400	492464.196	3649206.996	492499.396	3649233.834

Design Chainage (Km)	LHS-PROW		RHS-PROW	
	Easting (E)	Northing (N)	Easting (E)	Northing (N)
564+450	492447.926	3649259.987	492474.903	3649273.189
564+500	492430.160	3649309.338	492459.423	3649316.428
564+550	492423.307	3649361.345	492453.436	3649361.958
564+600	492426.516	3649412.783	492456.326	3649409.414
564+650	492432.130	3649462.467	492461.941	3649459.098
564+700	492437.746	3649512.150	492467.556	3649508.781
564+750	492443.361	3649561.834	492473.171	3649558.465
564+800	492448.977	3649611.518	492478.787	3649608.149
564+850	492456.679	3649662.248	492486.028	3649655.524
564+900	492473.956	3649711.789	492501.136	3649698.906
564+950	492501.396	3649756.503	492525.183	3649738.042
565+000	492537.175	3649794.293	492557.246	3649771.996
565+050	492574.691	3649827.514	492594.555	3649805.032
565+100	492610.842	3649861.018	492631.935	3649839.789
565+150	492644.390	3649896.911	492666.930	3649877.256
565+200	492675.384	3649935.032	492699.061	3649917.193
565+250	492704.325	3649975.373	492728.801	3649958.026
565+300	492733.238	3650016.166	492757.714	3649998.819
565+350	492762.132	3650056.941	492786.645	3650039.646
565+400	492788.167	3650097.866	492823.606	3650078.843
565+450	492807.269	3650141.864	492845.345	3650128.926
565+500	492821.405	3650189.221	492860.090	3650178.107
565+550	492835.211	3650237.277	492873.896	3650226.164
565+600	492849.017	3650285.334	492887.709	3650274.218
565+650	492862.823	3650333.390	492891.657	3650325.106
565+700	492876.629	3650381.446	492905.463	3650373.162
565+750	492893.941	3650430.747	492920.580	3650416.968
565+800	492930.211	3650472.080	492947.844	3650447.804
565+850	492972.912	3650499.606	492988.851	3650474.191
565+900	493014.994	3650526.170	493031.427	3650501.071
565+950	493054.459	3650554.864	493073.082	3650531.768
566+000	493090.887	3650587.311	493111.666	3650566.246
566+050	493123.985	3650623.334	493146.865	3650603.930
566+100	493152.273	3650664.799	493182.899	3650639.068
566+150	493184.714	3650703.275	493214.838	3650676.959
566+200	493226.799	3650738.997	493247.056	3650704.514
566+250	493279.139	3650758.215	493286.061	3650718.834
566+300	493333.752	3650758.797	493329.333	3650719.042
566+350	493374.302	3650759.493	493382.36	3650741.136
566+400	493393.639	3650784.482	493413.389	3650781.352
566+450	493383.001	3650814.269	493402.973	3650836.655
566+500	493343.28	3650835.848	493356.42	3650862.817

Interchange Coordinates

IC at Design Chainage Km 552+260

LHS-PROW		RHS-PROW	
Easting (E)	Northing (N)	Easting (E)	Northing (N)
495913.233	3638885.804	495996.2569	3638956.546
495917.812	3638935.355	496008.7277	3639004.916
495903.284	3638962.327	496015.765	3639053.129
495898.401	3638991.360	496007.1803	3639102.386
495871.018	3639032.562	495995.5851	3639150.937
495837.910	3639070.030	495975.0604	3639196.381
495805.171	3639106.702	495955.4888	3639229.062
495772.645	3639138.400	495907.4886	3639192.512
495737.415	3639162.801	495932.8424	3639147.661
495697.194	3639180.910	495946.6512	3639099.743
495651.557	3639195.892	495949.7907	3639049.129
495604.479	3639212.897	495923.4733	3639078.913
495556.705	3639230.987	495890.365	3639116.381
495507.368	3639253.291	495856.563	3639154.231
-	-	495817.818	3639191.878
-	-	495771.597	3639223.870
-	-	495721.362	3639246.606
-	-	495672.213	3639262.775
-	-	495623.956	3639275.965
-	-	495576.789	3639289.516
-	-	495534.295	3639306.913

IC at Design Chainage Km 563+545

PROW	
Easting (E)	Northing (N)
492933.9226	3648431.455
492949.4626	3648478.979
492963.0644	3648529.063
492916.3165	3648518.337
492866.8733	3648522.325
492823.7684	3648546.846
492796.2983	3648588.049
492788.9502	3648637.12
492801.9615	3648685.103
492818.2641	3648732.147
492818.2315	3648782.091
492823.4814	3648809.303
492875.1352	3648844.027

PROW	
Easting (E)	**Northing (N)**
492885.0988	3648843.917
492929.9118	3648825.178
492967.3094	3648791.991
493004.0141	3648758.069
493012.7724	3648747.614
493047.9949	3648754.699
493081.1145	3648790.688
493099.292	3648837.247
493118.4296	3648883.439
493136.9827	3648929.87
493142.4014	3648978.599
493131.906	3649027.408
493117.9964	3649075.434
493104.3788	3649123.541
493098.464	3649173.055
493100.8395	3649222.994
493099.3622	3649272.851
493086.4113	3649318.817
493059.3718	3649353.42
493075.8657	3649401.587
493122.027	3649395.509
493167.1708	3649379.662
493216.3659	3649380.744
493264.4936	3649381.419
493314.7737	3649395.735
493322.0819	3649370.272
493301.6971	3649364.435
493256.7641	3649344.811
493213.0958	3649337.614
493164.7068	3649328.067
493139.9981	3649296.193
493145.8777	3649246.633
493143.9149	3649196.68
493149.247	3649147.078
493162.721	3649098.933
493173.1173	3649062.649
493154.4947	3649057.255
493166.1298	3649015.999
493173.3657	3648966.612
493170.4476	3648916.785
493157.811	3648868.474
493141.7843	3648821.112

PROW	
Easting (E)	**Northing (N)**
493144.993	3648773.268
493109.722	3648726.391
493093.6902	3648679.031
493074.1885	3648633.086
493044.2006	3648593.248
493037.4881	3648586.697

Wayside Amenities Coordinates

WSA-1: At Design Chainage Km 552+735 on LHS

PROW	
Easting (E)	**Northing (N)**
495760.4704	3639229.845
495714.3772	3639249.129
495666.7867	3639264.451
495618.5003	3639277.426
495570.5962	3639291.67
495524.9198	3639311.863
495484.3086	3639340.862
495500.1085	3639369.113
495540.7199	3639398.28
495588.0077	3639412.688
495631.6628	3639392.151
495664.2982	3639355.255
495692.2657	3639313.827
495722.4658	3639274.034
495754.989	3639236.059

2 COST ESTIMATE

2.1 Introduction and Assumption

Cost estimation is important for the DPR as it provides vital input to the economic and financial evaluation of the project. The cost estimates have been prepared for the Project Corridor for the recommended Greenfield alignment. The estimate has been prepared for constructing a 6/4 lane carriageway with paved shoulder configurations including construction of:

- Structures (minor/ major bridge, elevated structure, VUP, LVUP, SVUP, ROB)
- Cross drainage structures,
- Unlined longitudinal drains,
- Interchanges
- Road signs and markings,
- Toll plaza and administrative buildings,
- Wayside amenities

2.1.1 Typical Cross section (specify TCS Adopted)

The typical cross sections which have been proposed to be used for the Project Corridor have been provided in previous section.

2.1.2 Quantification (general outline of items and unit for quantities)

2.1.3 The main items that have been covered in cost estimation are as following:

S. No	Description of work	Items of work
1.	Site clearance	▪ Clearing & grubbing
2.	Earth work	▪ Earth work excavation for ordinary soil ▪ Constructions of embankment with borrow material from approved source. ▪ Construction of embankment with useful material obtained from roadway excavation. ▪ Construction of subgrade and shoulder with selected soil. ▪ Excavation and disposal of unsuitable materials
3.	Non-Bituminous base & subbase courses	▪ Granular sub base ▪ Wet mix macadam
4.	Bituminous course	▪ Prime coat ▪ Tack coat ▪ Dense Bituminous macadam ▪ Bituminous concrete
5	CD – Structures	▪ New construction of Culverts
6.	Bridges, Grade Separators, Underpasses and ROB's	▪ New construction of Bridges, Grade Separators, Underpasses and ROB's
7.	Drainage & protection	▪ PCC Toe wall ▪ Unlined drain

S. No	Description of work	Items of work
	works	▪ Boundary wall ▪ Geo Green for High Embankment
8.	Traffic signs marking and other appurtenance	▪ Pavement markings ▪ Road signage ▪ 5th km, Ordinary km and Hectometer Stones ▪ Metal beam crash barrier and Guard post ▪ Solar blinkers ▪ Gantry/Overhead Cantilever sign Board
9.	Miscellaneous	▪ Landscaping and Tree plantation ▪ Electrical Works ▪ Rain Water Harvesting
10.	Project Facilities	▪ Advanced traffic management system (ATMS) ▪ Rest Area (Wayside Amenities)
11.	Toll plaza & Wayside Amenities	▪ Administrative building in toll plaza ▪ Toll plaza road works ▪ ETC Lane ▪ Toll Plaza Equipment ▪ Crane, Highway Patrol, Ambulance ▪ Medical Aid Post, Traffic Aid Post, Vehicle Rescue Post

The quantities for various items of work have been computed as detailed below:

- The quantities for sub grade, subbase, base and bituminous/rigid courses have been computed as per TCS.
- The quantities for earthwork (earthwork excavation and embankment construction) have been computed as per corresponding TCS with certain assumptions
- The quantities for structures like bridges, ROB, culverts, VUP, LVUP, SVUP etc., have been calculated based on the preliminary GAD's and design calculations.
- The quantities for drainage & protection works and other items have been computed based on the proposed details and drawings.

2.2 Adoption of unit rates

2.2.1 Construction Items

The unit rates for each construction items have been arrived by using the latest available "**Schedule of Rates (SOR): (Highways Department & PWD Department) for J&K 2020**". The detailed analysis has been carried out as per **Standard Data Book of Ministry of Road Transport & Highways (MORTH**) for deriving unit rates of items of Road and Bridge works.

Rate Analysis Assumption

1.) Basic rate of metal and sand considered from J&K SOR 2020.
2.) Cartage cost considered from J&K SOR 2020.
3.) Machinery rates taken from Punjab CSR 2020 due to non-availability of rate in J&K SOR 2020.
4.) Basic Rate of Bitumen considered from IOCL Panipat Refinery dated 15/11/2021.
5.) Basic Rate of Cement considered from inampro Website of November 2021.
6.) Basic rate of Steel considered from SAIL of November 2021.
7.) Labour Rates taken from J&K SOR 2020.

Overhead Charges and Contractor's profit

1. Overhead Charges considered as 5%.
2. Contractor's profit considered as 10%.
3. Considering above stated factors construction cost has been derived and 12% GST applied on construction cost to achieve the Total Civil Cost.

2.2.2 Materials Source and Lead

The location of material quarry like gravel, sand, crushed aggregate has been obtained from the material investigations. The leads of different materials have been derived by drawing the lead chart and the basic material rates has been adopted as per J&K Schedule of Rates for the year 2020 (Highways Department & PWD Department).

The lead distance for some of the major material sources are shown in the following table:

Table 2.1: Material Source

Material	Source Average Lead Distance	Source
Aggregate	13 & 15 Km	Average Lead of various Quarries
Sand	13 & 15 Km	Average Lead of various Quarries
Bitumen	505 & 542 Km	Average From Panipat Refinery
Cement	129 & 166 Km	Average From INAM-PRO
Steel	0 Km	Jammu SAIL

2.3 Costing of Safety Devices

Adequate numbers of road signs and pavement markings (as per IRC Guidelines: IRC 35/ IRC 67/ IRC SP 99) have been considered as safety measures while estimating cost for road safety to give information to the road users to avoid accident and aid in convenience on the project road. Details of major road safety devices adopted for the project are as under

- Pavement markings
- Road signage
- 5th km, Ordinary km and Hectometer Stones
- Metal beam crash barrier and Guard post
- Solar blinkers
- Gantry/Overhead Cantilever sign Board

2.4 Project Cost Abstract

The detailed cost estimates for all packages are given in a separate volume.

Sr. No.	Particulars	Amount (INR)
1	Site clearance and Dismantling	3,06,73,026
2	Earth Work	56,18,08,156
3	Granular Sub Base Courses and Base Courses (Non- Bituminous)	63,32,21,780
4	Bituminous and Rigid Pavement Courses	1,32,19,67,808
5	Culverts	63,20,48,140

Sr. No.	Particulars	Amount (INR)
6	Bridges	
	a) Minor Bridges	88,69,47,060
	b) Major Bridges	52,56,48,335
	c) FO, ROB	5,96,88,10,906
	d) VUP/PUP	28,79,36,394
	e) RE Wall	1,06,32,55,041
	f) FOB	
7	Drainage & Protective Works	1,06,31,86,228
8	Junctions	8,49,46,425
9	Traffic signs, Road markings and other road appurtenances	51,26,87,766
10	Miscellaneous Works	47,97,69,811
11	Maintenance of roads	2,11,84,071
12	Toll Plaza	0
13	Environmental Plan	56,89,966
	Civil Cost excluding GST	**14,07,97,80,914**
	Utility Shifting Cost	76,20,84,598
	Total Civil Cost including Utility Shifting Cost	**14,84,18,65,512**
	12% GST on Total Civil Cost	1,78,10,23,861
	Total Civil Cost including Utility Shifting Cost & GST	**16,62,28,89,373**
	Total Project Length in Km	**28.92**
	Cost Per Km including Utility Shifting in Crores (On Civil Cost)	**51.320**
	Cost Per Km including GST in Crores (On Total Civil Cost)	**57.479**