APPENDIX2:
ROAD SECTOR

1. Road Development Plan of Ha Nam Province

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Introductory

1. The neccessary to adjust the development planning for transportation in Ha Nam province

- Located in Red river Delta, about 50km from Hanoi to the south, Ha Nam province has the diversified transportation network including road, inland waterway and railway. In 2003, Ha Nam had adjusted the development plan of transportation in the period 2003-2010 and development plan orientation to 2020 in line with the National Transport Strategy and the general development plan for Vietnam transport sectors. After nearly 4 years of construction and development, Ha Nam province has made many achievements in transportation construction and development, contributing for the socio-economic development and economic restructuring of the province.

- After the adjusment to the Transport Development plan, Ha Nam province has focused on building, improving and upgrading the important routes, river-crossing projects, funded by the Central and local capitals, for examples: National road No. 21A, 38, provincial road 491, 493 (Km0 to Km 10+00), 494..; constructing and completing projects of Kha Phong bridge, Cau Tu bridge, Bong Lang bridge, Phu Ly; the National road 21A and Nhat Tuu bridge have been approved for construction by the Ministry of Transport; the ring road in Phu Ly city is on progress and expected to be finished in 2008; preparing for the construction of Dong Van junction (including the intersection of National road 38 with National Road 1A and the North-South railway); expanding National road 1A (section of Dong Van – Phu Ly) and Nhat Tuu bridge; launching the construction of the provincial road No. 492, 497 (planned to be constructed in late 2007). Especially, the province is implementing the construction of the highway Cau Gie- Ninh Binh and studying the plan of North- south express railway.

- After almost 4 year of planning, along with the general development of Transportation sector in the whole country, Ha Nam transportation has developed strongly, initially meet the demand of socio-economic development of the province and the demand on transport of the people.

- However, some targets set in the adjustment plan for transportation development of Ha Nam province in the period 2003-2010 and orientation to 2020 are not accordant with the actual development of the province, while some others are not followed the plan. Some major projects set up in the plan have changes during the implementation and need to be updated accordingly, such as: “Cau Gie-Ninh Binh Highway has been adjusted about the direction, intersections with National and provincial routes in the area... Moreover, Ha Nam province has faced the drastic change in the process of urbanization, the formation of industrial zone, new urban area and administrative and cultural centres. It requires the neccessary to make the adjustment and orientation to the principal axis of transportation routes of the province as well as the transport system, which are in line with the development of space and urban architecture and the entire province.

- Recently, the socio-economic development of the country and Ha Nam province has changed, the sectors of transportation also have moved to correspond to the modification strategy and development plan for transportation of the country, as well strive for

socio-economic targets of the province, therefore, the adjustment for transport development planning of Ha Nam province is essential.

2. Objectives and study scope of the adjustment for Ha Nam transport development plan.

* Studied objectives: entire the transportation infrastructure in field of road, inland waterway and railway.

* Studied scope: including the cadastral boundary of Ha Nam province and parts of neighboring provinces (Ha Tay, Hung Yen, Thai Binh, Nam Dinh, Ninh Binh, Hoa Binh).

* Scope of adjustment: the whole infrastructure of transportation of Ha Nam province. Details for each sectors as follows:

- Road:

+ Detailed plan for the road network to the provincial level, updating the plan of urban routes; the rural networks from district level and lower will be made the general development plan for every phase.

+ General plan for the development of bus station system at the centre of city and districts, and stop station system serving for the interprovincial coaches, system of parking lots in urban areas.

+ Making the development orientation for means and mode of road transport.

+ General plan for road transport infrastructure and services development.

- Inland waterway:

+ Detailed plan on the system of river routes and habors in the area.

+ General plan for the development of means of waterway transport.

+ General plan for river transport infrastructure and services development

- Railway:

+ Researching and proposing the planning of national railway, electrified express railway and specialized railway. Recommending the position of stations in the province.

3. Purposes and objectives of the study on planning adjustment

- Purpose of the adjustment of transportation development plan in Ha Nam is aimed to build up a uniform and modern transport system, with the ability to meet demand for transportation of passengers and goods within the province and to neighboring areas quickly, ensure traffic safety and in accordance with the spatial development of the province. This will help accelerate the process of socio-economic development and economic restructuring of Ha Nam, towards industrialization and modernization from now until 2015 and orientation to 2025.

Completing the adjusted development plan of provincial transport aims to make the legal basis for the construction of traffic works, taking advantage and mobilize investment capital for the provincial transport in the future.

- Objects of the research for adjusted plan:

+ Review and update the change of the plan during the process of construction and development for transport sector of the province since 2003 till now.

+ Adjust the development strategy for sections of transport to correspond to the general strategy for transport development of the country, the region and the province.

+ Recommend the solutions to the adjustment in line with the spatial development orientation and other socio-economic sectors of the province, based on the survey and data analysis on the transportation need in areas.

+ Make priority investment schemes, effective investment stage, in line with capacity and actual resources that can be mobilized by the province.

4. Method of making adjustment for transport development plan

- Collecting, studying the available materials including: standards, instruction documents, plans, strategies of relevant authorities, related documents and statistic data of Ha Nam province.

- Surveying, investigating for data in order to evaluate the actual condition of transport system in Ha Nam and the progress of implementation the adjusted plan since 2003 till now.

- Handling and analyzing data to identify the shortcomings, challenges and advantages of the construction of transport system.

- Report the results of survey for the adjusted development plan for transport sector: contents of the report will be presented in 7 chapters:

+ Chapter I: Natural and social – economic conditions of Ha Nam province
+ Chapter II: current condition of transport system in Ha Nam
+ Chapter III: Socio-economic development orientation of Ha Nam to 2025.
+ Chapter IV: Forecast of transport demand.
+ Chapter V: Adjustment for transport development plan.
+ Chapter VI: Capital estimation investing for Tranport development.
+ Chapter VII: Evaluation on the strategic effects to environment.

5. Legal fundamentals for the plan adjustments.

1. Decree No. 08/2005/NĐ-CP by the Government , dated on 24, January 2005 on construction planning.
2. Decision No. 567/QĐ-UBND issued on 18 May 2007 by Ha Nam People Committee, about the approved duties and cost estimation for making adjustment for transport development plan in Ha Nam province in 2007-2015 period and orientation to 2025.
3. Economic contract no. 29/HĐ among Ha Nam Transport Department , Transport management and Planning JSC, University of transport and communications signed on 31/5/2007 about the consultancy for the adjusment of transport development plan in Ha Nam province.

5.2. Transport development planning

5.2.1. Road transport

5.2.1.1. Specific targets for road transport development for each stage.

Based on the Decision No. 162/2002/QĐ – TTg issued on 15/11/2002 by the Prime Minister on the approval for Vietnam road transport development plan to 2010 and orientation to 2020, updated the Decision of Prime Minister no. 206/2004/QĐ-TTg on 10/12/2004 on the approved Strategy of Vietnam transportation plan to 2020, primary targets of road transport sector as followings :

a. Transportation

**** Period 2007 – 2010:***

- To meet social demand on transportation for goods and passengers to ensure the smooth travel in the whole province.

- To distribute the appropriate transportation, promote the advantages of road transport due to the diverse and mobility, which are highly effective in short operating range or collecting goods for other transport types.

**** Period 2010 – 2015:***

- Organize, manage and create healthy competitive environment of transportation, in order to improve the quality of transport activities, build transportation systems with high competitiveness, saving cost, time, and ensure traffic safety.
- Apply policies and mechanisms to encourage the development of urban public transport, primarily the transport by bus, in order to meet transportation needs in disadvantaged areas.

**** Period 2015-2025:*** Continue improving and step by step modernizing the road transport system.

b. Transport infrastructure

**** Period 2007 – 2015:***

- External transport system:

Continue to construct and complete the section of National road Cau Gie – Ninh Binh in the province. Upgrade and expand other National roads No. QL1A, QL21A, QL21B, QL38. To connect particular road systems with the national road system to boost road transport development of the province, satisfy the demands of socio-economic development of the local.

- Provincial road system:

+ Continue to strengthen, restore and upgrade the existing transport infrastructure according to particular specifications, invest fully in major transport works and the construction of principal projects to gradually complete the transport network. Design and construct the new transports works according to Vietnamese standards, with the consideration to the regional and international integration.
+ Till 2015, the provincial road system is upgraded to meet standard of plain road level IV, having 100% cement concrete or asphalt pavement. The bridge system in these routes is also renovated to be relevant to the road level.
+ The new-built road system of the province must meet criteria of the plain road level III.
+ Upgrade the whole Southeast and Northwest ring roads to meet the standards of plain road level III. Renovate the brigde system on these routes to be in accordance with the road level.
+ Construct new routes to industrial parks and tourism places.

- Urban traffic infrastructure:

+ Develop properly urban transport infrastructure and public transport, assure that the land area for traffic accounts for 23.14%, according to the general planning of Phu Ly city
+ Continue to upgrade and strengthen the routes in old urban zone, complete the inner route network for new urban areas and give name to the new routes.
+ Construct the main urban arteries : N1, ĐT.499, Lê Chân, Lê Công Thanh, centre line of National road No. QL.38 – Phu Ly city, routes to industrial parks, schools…

- Rural traffic infrastructure:

Ensure that all vehicles may access to centres of communes or group of communes through the rural road system at all the time of the year. The percentage of concrete and asphalt pavement of these roads is more than 50%.

- Build up the stations, parking lots and stop station for coaches. :

+ Construct the interprovincial bus station in Phu Ly city, replaces for the existing station.

+ Construct the stop station for interprovincial coaches.
+ Construct the parking lots in urban area to assure that the land for transport takes about 2% of total area for urban construction.
- Enhance capacity for maintenance activities, invest more for researching and apply advanced technical achievements in management and maintenance the road transport infrastructure.

**** Period 2016 – 2025:***

Continue to improve and complete construction for the road system, modernize the traffic infrastructure to prevent traffic congestion and ensure the traffic safety.

c. Transport means

**** Period 2007 – 2015:***

- Increase the number of heavy and medium loading capacity vehicles for transportation to meet the development of industries in the area, gradually limit the operation of non-motorized vehicles and mechanical vehicles, aims to improve the transportation competitiveness and ensure traffic safety.
- Step by step prevent the increase number of motorbikes at the rate of less than 10%/year by economic and technical solutions, control the number of this vehicles in the province, then reduce the useage of motorbikes in urban area. Motorbikes are mainly used in rural areas and the regions with low population density.
- Along with the restriction to motorbikes, promote the development of public transport, initially for urban bus and bus to economic and politic centres of the province.

**** Period 2015 – 2025:***

- Enhance capacity of road transport vehicles, ensure the competitiveness in provincial and interprovincial transport, restrict the transportation by mechanical and non-motorized vehicles in province.
- Improve capacity and number of buses and coaches to meet the travelling demand of people.

5.2.1.2. Development plan for road transport infrastructure

a. Highway route Cau Gie-Ninh Binh.

**** Project scope:***

- Location: Cau Gie-Ninh Binh highway project is planned to go through the boundaries of Ha Tay, Ha Nam, Nam Dinh and Ninh Binh provinces.
- Route direction: the east of National road QL1A.
- Beginning point: at Km210+00 on National road QL1A toward the Phap Van – Cau Gie freeway (prior to Cau Gie)
- Finishing point: at Km265+600 on National road QL10, the section connect Ninh Binh – Phat Diem.

**** Project scale:***

- Total length of the route is 56 Km, including 36km in Ha Nam province.
- Road grade: Highway type A
- Expected speed: 100 - 120km/h.

**** Planning of implementation phases:***

- Phase 1 : the route is constructed with the foundation for 6 lanes 35,5m wide and 4-lane pavement.
- Phase 2: constructing 2 lanes remain to achieve the scale of 6 lane road, the road base is 35.5m wide.

- Implement land clearance with the road background = 35.5m.

**** Planning for the traffic junctions on the route:***

- Phase 1: Following the agreement with Ministry of Transport, the section through Ha Nam province has two connected grade separation interchanges : the interchange with National road QL38 at the roundabout, and Liem Tuyen interchange. The other junctions with other routes and with railway Phu Ly – Nam Dinh use overpasses.
- Phase 2: Construction of the interchanges Phú Thứ, Chằm Thị, Liên Sơn.
- Functions of connected grade separation junctions as follows:

+ The connected grade separation junction with National road No. QL38 at the ring is a complete rosette junction, which connects National road QL38 (the main road connecting Ha Nam with Ha Tay and Hung Yen province) with the highway.

+ Liem Tuyen interchange is complete grade separation junction with approach road sections connecting to the highway. This junction links the provincial road ĐT.499 and National road QL21A (connected by the collector) with highways. The interchange serves for the interprovincial vehicles traveling from Nam Dinh on national road QL21A, vehicles access to industrial zones on the ring DT494 as well vehicles moving from ĐT.499 into highway. The interprovincial station and rest stops are planned to be located around this junction.

**** Planning for the collector road along highway:***

Construct the collector road system (along the route), civil tunnel, traffic safety system, ancillary works and toll sytem.

The collector road along the highway has the roadbed width of 5.5m, 3.5m width of pavement.

b. Planning for national road axis

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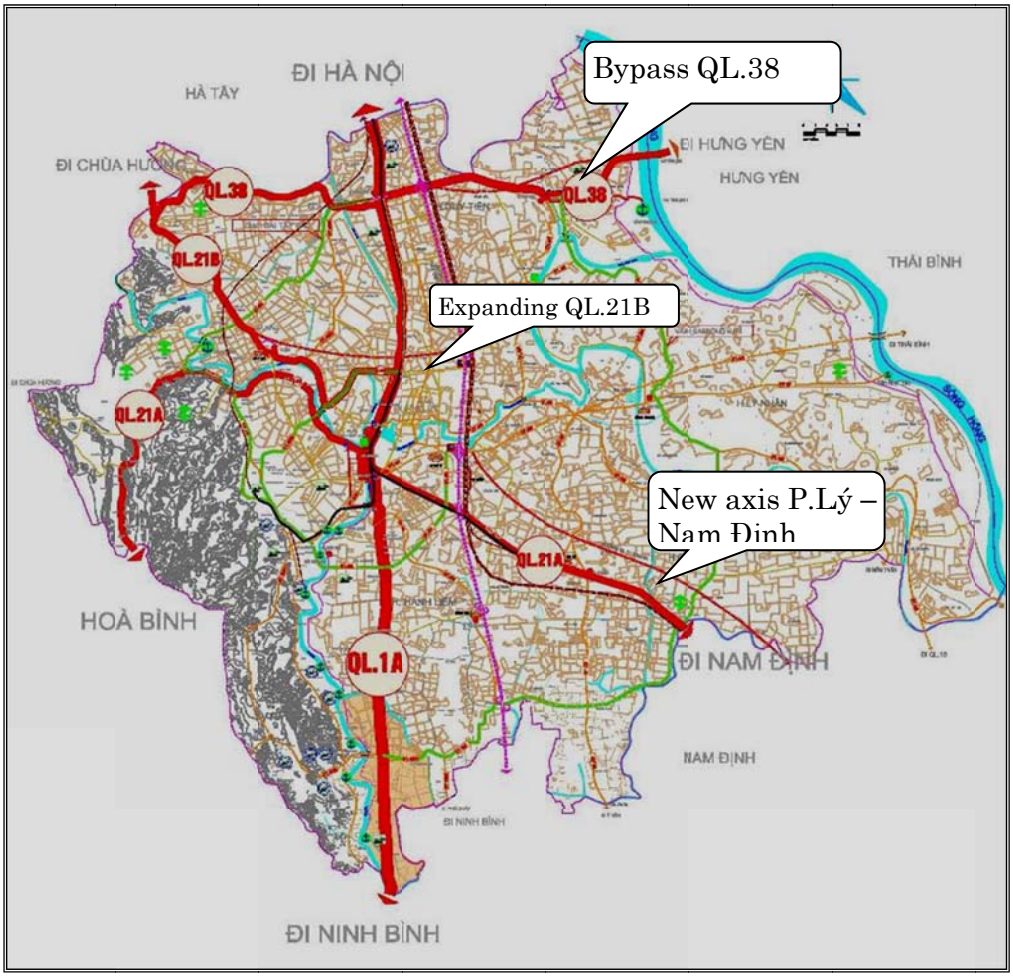


Figure 5.1: National road network planning in Ha Nam province

Table 5.1. National road network plan of Hanam province

No.	Name	Length (km)	Technical actual state	Plan 2007 - 2010	Plan 2011 - 2015	Plan 2016 - 2025
1	**QL.1A**	36	*+ Road level III plain, road-bed width Bn= 12m, road surface width Bm=11m* *+ Only part across Phu Ly city and Dong Van town is urban four-lane road*	*+ Expanding part from Dong Van town to Phu Ly city about 15km into main urban four-lane road* *+ Maintain and repair small damaged parts on the road*	*+ Maintain and repair road-bed, road surface, rainforce equipment to ensure traffic safety*	*+modernize infrastructure against traffic jam, ensure traffic safety* *+ improve Phu Ly bridge to ensure traffic through in Chau Giang river*
2	**QL.21A**	39,67	*+ Road level III plain, some parts are upgraded to be main urban road.* *+ 1.3 km of the road level VI has not upgraded*	*+ Upgraded route from Do Xa to National way 1.A 1,3 km long, meet the level III road plain standard, road surface width: 7m, road-bed width: 12m* *+ Improve road surface power, construct drainage system, install equipment, road-sign on the route*	*+maintain, repair road-bed, road surface, improve equipment to ensure traffic safety.*	*+maintain, repair road-bed, road surface, improve equipment to ensure traffic safety.*
3	**QL.21B**	17	*+ 2km of road level IV, road-bed width: 9m, road surface width: 7m, average quality* *+15km of road level VI, road-bed width: 5m, road surface width: 3.5m, bad quality*		*+ Upgrade the whole route (from Km41+00 to km58+00) to meet the level III road plain standard, road surface width: 7m, road-bed width: 12m* *+ fix route from Que town to QL.1A and lengthen to connect with the highway* *+ Construct intersection point with different level*	

					from QL.1A and North-South railway.	
4	**QL.38**	26	*- the route from Yen Lenh bridge to Dong Van town is 13km long, level III plain, road surface width Bm= 7-9m, road-bed Bn= 12m* *- The route from Dong Van town to Dau market (km84-km97) is 13km long, level IV plain, road surface covered with tar, road surface width Bm=7-9m, road-bed width: Bn=9m.*	*+ Construct intersection point with different level from QL.1A and North-South railway.*	*+Upgrade QL.38 (Km84-Km97) to meet level III road plain standard, road surface width: 7m, road-bed width12m* *+fix and improve local parts evading residential areas on the route.*	*+Construct a new bypass for the part that across Hoa Mac town of Ql. 38. The route is 8.5 km long from Yen Lenh bridge pier to intersection point with the highway at Vuc Vong*

Ghi chú: Phân cấp đường theo TCVN 4054-2005 và TCXDVN 104 - 2007

c. Provincial road development plan.

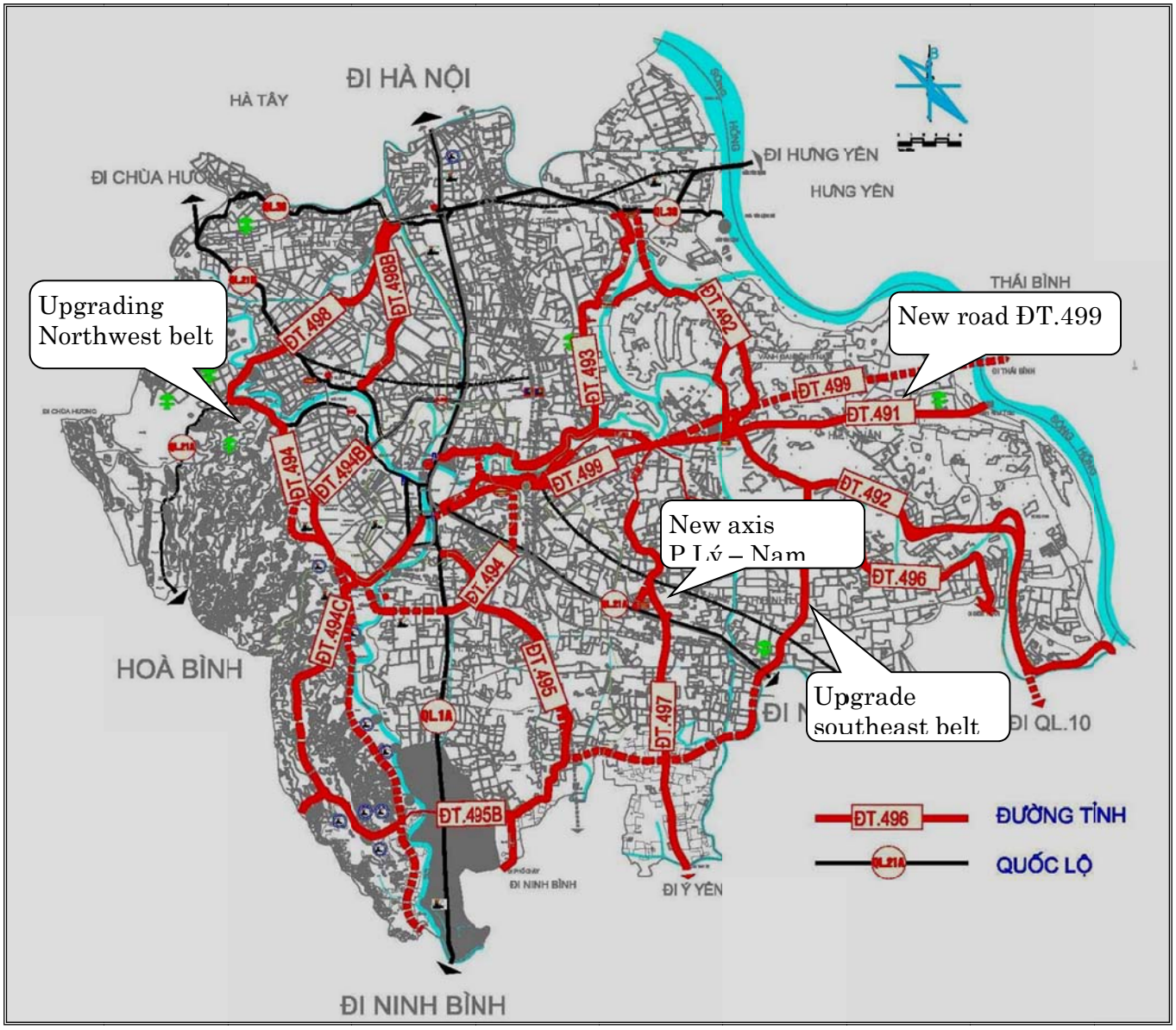


Figure 5.2: Provincial road network plan of Ha Nam

Plan for provincial road development for each phase is expressed in Table 5.2 below :

Table 5.2. Provincial road network plan

(No.)	*Route/item*	*Length* (km)	*Technical actual state*	*Period 2007-2010*	*Period 2011-2015*	*Period 2016-2025*
1	**ĐT491**	24,2	*Road level IV plain, tar concrete surface with good quality, width Bm= 8m; road-bed width Bn= 9m*		*Frequently maintain and repair*	*Modernize traffic infrastructure to ensure traffic safety*
2	**ĐT492**	36,70	*+ Road level VI covered with tar Bm= 3.5m, road-bed Bn=6m* *+ Upgrade a part (from Km11+900 – Km13+00) to meet level V standard, tar concrete surface Bm= 6m, road-bed Bn=7.5m*	*+ Upgrade the route to meet the level IV standard, Bm=7m, Bn=9m* *+ Parts in Southeast belt (13.5km) are upgraded to be level III plain; Bm=7m, Bn=12m*		*Frequently maintain and repair*
3	**ĐT493**	20,00	*Road level VI, macadam surface + mix with tar Bm=3.5m, road-bed Bn= 6.5m*		*Upgrade road surface quality*	*Upgrade to meet level IV standard, Bm=7m, Bn=9m*
4	**ĐT494**					
4.1	Part of Northwest belt	8,30	*+ Road IV with cement concrete surface Bm= 8m; road-bed Bn=9m* *+ 4.3km of road level IV with macadam surface covered with tar Bm=1m, road-bed Bn=9m*	*Upgrade to be level III plain, Bm= 7-8m, Bn=12m*		*Frequently maintain and repair*
4.2	Part of Phu Ly city belt (N2)	10,00	*Under construction*	*Construct to becom the main urban road, road surface*		*Mordernize traffic infrastructure*

				covered with tar concrete, Bm=15m; Bn=27m		
5	**ĐT494B**	3,6	*Cement concrete road width Bm= 8m, road-bed Bn=9m, meet the level IV standard.*			*Frequently maintain and repair*
6	**ĐT494C**	6,00	*+ 3km of the first part meets the level IV standard, tar concrete surface width Bm=7m, road-bed Bn=9m* *+ The next 1km meets the level V standard, cement concrete surface width Bm= 6m; road-bed Bn=7m* *+ The left 2km meets level VI standard, Bm= 3.5m, Bn= 6.5m*	*Upgrade the whole route to meet level IV standard, Bm= 7m; Bn=9m*	*Frequently maintain and repair*	
7	**ĐT495**	15,2	*Road level VI, macadam surface covered with tar Bm=3.5m, road-bed Bn= 6.5m*		*Upgrade the whole route to meet level IV standard, Bm= 7m; Bn=9m*	
8	**ĐT495B**	12	*+ The first 5.5km is road level VI, surface covered with tar, Bm= 3.5m, Bn=6m* *+ The next 4km is road level IV, Bm=8m, Bn=9m* *+ The last 2.5km is mixing road, Bn= 2-4m*		*Upgrade to level IV plain, Bm= 7m; Bn= 9m, only part in Southeast belt 2km long, upgrade to be level III, Bm= 7m; Bn=9m*	
9	**ĐT496**	20,7	*Road level VI plain, macadam surface covered with tar with average*		*Upgrade the whole route to meet level IV standard, Bm= 7m; Bn=9m*	

			quality, Bm= 3.5m, Bn= 6.5m			
10	**ĐT497**	19,50	*Road level VI plain, Bm = 3,5m, road-bed Bn = 6,5m.*	*Upgrade the whole route to meet level IV standard, Bm= 7m; Bn=9m*		*Frequently maintain and repair*
11	**ĐT498**	10,50	*+ the first 1.5km (Km2 to Km3+500) is road level IV, Bm= 8m, Bn= 9m* *+ The left 9km is road level VI, surface covered with tar width 3.5m, road-bed 6.5m*	*Upgrade the whole route to meet level III standard, Bm= 7m; Bn=12m (in the Northwest belt)*		*Frequently maintain and repair*
12	**ĐT498B**	8,3	*+ 6.4km meets the level V standard, Bm=6m, Bn=7m* *+ 1.9km is road level VI, Bm= 3.5m, Bn= 6m*	*Upgrade the whole route to meet level IV standard, Bm= 7m; Bn=9m*		
13	**ĐT499**	20,30	*On the point of start new construction*	*Construct route DT.499, scale : Parts across urban areas: 48m including four-lane road for motor vehicles 15m wide, central reservation + safe line 4m; boundary reservation + safe line 6m, local road 2x5.5=11m, pavement 2x6=12m; other parts 33m (plan) including central reservation + safe line 2m, four-lane road for motor vehicles 15m wide; non-motorized vehicles 6m, boundary 2x0.5=1m; storage part: 2x4.5=9m*		
New route : Phu Ly-Nam Dinh		16,58		*Construct route DT.499, scale : Parts across urban areas: 48m including four-lane road for motor vehicles 15m wide, central reservation + safe line 4m; boundary reservation + safe line 6m, local road 2x5.5=11m, pavement 2x6=12m; other part 52.5m (plan) including central reservation + safe line 2m, lanes for motor vehicles and non-motorized vehicles : (3x3.75m+3m)= 28.5m; collector road: 2x6m=12m; talus road-bed= 2x5m=10m*		

14	***Traffic routes of diverge freshets of Day river***					
14.1	*Traffic routes of diverge freshets of Day river (belt route + Le Chan road)*		*Including: DT.498, a part of DT.494 and Le Chan road*	*Routes plan: DT.498, DT.494 and Le Chan road*		
14.2	*5 additional routes of diverge freshets*	15,6		*Upgrade the routes to meet level IV standard, Bm= 7m; Bn=9m*		
14.3	Phu Van bridge	248,9 (m)		*Loading capacity for design H30, XB80*		
15	***Southeast belt***					
15.1	*QL38- Vinh Tru town*	12,00		*Upgrade to level III, Bm=7m, Bn=12m*		
15.2	*DT.492 to QL21A*				*Upgrade to level III, Bm=7m, Bn=12m*	
15.3	QL21A to QL1A				*Upgrade to level III, Bm=7m, Bn=12m*	
16	***Mai Xa bridge***	19,10 (m)		*Loading capacity for design H30, XB80*		
17	***Specialized road along cement industrial park***	18,00		*Road level III, cement concrete surface width Bm=11m, Bn=12m*		

Remarks:Road level is classified according to Vietnamese standards 4054-2005 and Vietnam construction specifications 104 - 2007

d. Planning of Urban road system development

- Upgrade and improve the existing urban road network, construct some new routes and bridges to meet the demand of planning of Phu Ly city. According to the general plan of Phu Ly city, the proportion of land for transportation accounts for 23,14% total area of urban construction (including street and other traffic works such as parking lots, garage…)
- Construct the road network for new urban areas, consisting of: routes for Dong Van – Yen Lenh urban chain, Dong Van – Phu Ly …

1. Traffic road of the east:

* Period 2007 – 2015: Renovate the existing routes and construct the new route in line with the plan of Phu Ly city
* Period 2015 – 2025: Modernize traffic infrastructure.

2. Traffic road in new urban zones of West Day River :

* Period 2007 – 2015: Complete the road network as defined in 1997 plan. The network is planned in chessboard form, the main arteries are North-south and East-west directions.
* Period 2015 – 2025: Modernize the traffic infrastructure.

3. Traffic road in new urban zone of Phu Ly city:

Including the area of North and south of Chau River, along the main axis of East –west and the connecting road to expected terminals. The network is planned in chessboard form, direction of the main axises is Northeast-southwest and Nortwest-Southeast.

* Period 2007 – 2015:

- Complete the main route of Eastwest – Le Chan in accordance with the standards of main route for urban area.
- Expanding the route of Le Thanh Cong street across the Chau Giang River.
- Construct the urban artery road N1, beginning from National highway QL1A (Phu Ly bridge intersection) to National road QL21A , expanding to the highway at Liem Tuyen intersection with the total length of 4km, construction scope of the main urban route, the total width of cross profile is 42m, including : the area for mechanized vehicles 4x3,75m=15m; for non-motorized vehicles 2x2,5m=5m; median trip width 8m; safety lane 2x0,5m=1m; street side 2x6,5m=13m.
- Construct the belt route N2 of Phu Ly city (provincial road ĐT.494), scale of urban artery, MCN width, Bm=15m; Bn=27m.

* Period 2015 – 2025: Modernize the traffic infrastructure.

In conclusion, the urban traffic network of Phu Ly city is the radial belt, including the main routes :

+ The city belt starts from Thanh Tuyền (crossing with National road 1A) – to Kien Khe – But Son cement factory – follow provincial route ĐT.494B to Thanh Son, over Thanh Son bridge connecting with NR 21B to the Ba Đa extending street, Cau Gie – Ninh Binh highway, follow the collection lines of Cau Gie-Ninh Binh Highway to QL21A – follow the extension of QL21A and closing the city belt at Thanh Tuyen (cross National road 1A). The collector line of

Cau gie-Ninh Binh highway is extended to 13m width for each side, in which 7m of roadbed, 5m of pavement and 1m of curb (bordering to the highway)…

+ Radial route connect Phu Ly city with center of districts in the province including : QL1A, QL21A, QL21B, ĐT.491, N2 axis route, ĐT.499, East-west axis (Le Chan street), Le Cong Thanh street. .

+ The urban road network is in chessboard form (including the routes in the new and old urban zone).

4. Traffic road for the urban chain Dong Van- Yen Lenh and Dong Van – Phu Ly :

* Period 2007 – 2015: Construct the route Dong Van – Yen Lenh and the road network for Dong Van – Yen Lenh urban chain in Duy Tien district.

* Period 2015 – 2025: Construct the route Dong Van – Phu Ly in parallel with the highway, connecting the national route 38 to provincial road 499, as well the road system to develop Dong Van – Phu Ly urban chain.

5. Bridge construction in urban area :

- Across Chau Giang River : including the bridge on Le cong Thanh street, bridge connect Lam Ha urban zone with Nam Chau Giang urban area.
- Across Day river : including Phu Van bridge, Phu Van 2 bridge, Thanh Son bridge.

e. Rural traffic system planning

* Period 2007 to 2010:

+ Target of 100% of district road surfaces are paved with concrete or asphalt ; upgrade, renovate the road system to meet road level V, VI standards. To improve the brigde and culvet system to be in line with the road level.

+ 80% of communal roads are covered with tar or concrete ; renovate these systems to satisfy the criteria of rural road type A or type B.

+ The roads connecting villages or to the rice fields will be hardened by concrete, stone or other available materials.

* Period 2010 to 2015 :

+ Upgrade the district road system to meet road level 5 standards, improve the bridges and culvet system to be consistent with road level.

+ Concreting or asphalting for entire communal road pavement, improve this road system to meet the standard of rural road type A or type B.

+ Upgrade the village road system to meet the rural road standard of type 1 (Bm=3m ; Bn=4,5m) or type 2 (Bm=2m ; Bn=3m).

- Planning orientation for period 2015 to 2025:

+ Upgrade the district road to satisfy the standard level IV, V, renovate the bridge and culvet system to be relevant to road level.

+ Regularly maintain the communal road system, village road system.

Table 5.3 Rural road network plan

No.	Item	Period 2007-2010		Period 2011-2015		Period 2016-2025	
		Scale	(km)	Scale	(km)	Scale	(km)
1	*District road*	*Total length*	*285,4*	*Total length*	*285,4*	*Total length*	*285,4*
1.1	*Upgrade road level*	*Upgrade district route from level A, B of rural road to level VI plain*	*158*	*Upgrade from road level VI to road level V*	*210*		
1.2	*Improve road surface quality*	*Cover with tar, cement concrete*	*81*			*Improve road surface quality*	*285,4*
2	*Commune and between communes road*	*Total length*	*731,11*	*Total length*	*731,11*	*Total length*	*731,11*
2.1	*Upgrade road level*	*Upgrade to road level B of rural road*	*195*	*Upgrade to road level A of rural road*	*461,11*		
2.2	*Upgrade road level*	*Upgrade to road level A of rural road*	*270*				
2.3	*Improve road surface quality*	*Cover with tar, cement concrete*	*331*	*Cover with tar, cement concrete*	*83*	*Improve road surface quality*	*731,11*
3	*Village road, road to the field*	*Total length*	*3661*	*Total length*	*3661*	*Total length*	*3661*
3.1	*Upgrade road level*			*Rural road level 1*	*2295*	*Improve road surface quality*	*2295*
3.2	*Upgrade road level*			*Rural road level 2*	*1366*	*Improve road surface quality*	*1366*
3.3	*Improve road surface quality*	*Cover with tar, cement concrete*	*2499*				

f. Stations and parking lots planning.

1. Planning of Station, stop station for coach:

- In order to improve the quality and facilitate road transport development, while ensure traffic safety as well protect environmental landscape, it's neccessary to make the investment plan for the construction of station for interprovincial and local coaches, which will support for the operation and management of coaches. These stations should be arranged in accordance with the flow of passengers in and out, be appropriate with existing land planning, satisfy transport demand of the people. Structure of station include 3 main sections :

+ External service area: waiting courts, workplaces, guest shelters, place for transportation of goods including cargo yards, warehouses ...

+ Vehicle inspection area.

+ Residental area for service staff for eating, living, ancillary works

- At Phu Ly city:

+ To construct the central station in the East as approved plan of Phu Ly city. In addition, to arrange the parking lots, stop stations for buses. According to the detailed plan of transport service works of Ha Nam province, the level 1 station will be built from now till 2015, with the capacity of 240 vehicles/day and total surface area is 21.844m^2.

+ Construct the stop station for interprovincial coaches on the axis N1 at the east of Phu Ly city, on the planning of N1 route, near by the Liem Tuyen interchange. Following the detailed plan for transport service work, the local will build up 2 stop stations in the scale of station level 1, capa with city of 240 vehicles/ day, area of 16.400 m.

+ Construct the service station on highway: This is a work under the highway Cau Gie – Ninh Binh project, at the position of Km227 in Tien Hiep commune – Duy Tien – Ha Nam. The main items in this service area includes parking lots, maintenance shop, service shop, rest house, petrol station... The construction scale: surface area of 159.644m2, located 2 sides of the highway.

- Renovate, upgrade the stations at town and district centres.

Table 5.4. Couch station, service station in Hanam province plan

Type of Couch station, stop station	Scale	Area (m2)	Capacity (vehicle/day)
Central Couch station	Level 1	21.844	300
Vinh Tru coach station	Level 3	5.000	100
Hoa Mac coach station	Level 3	5.000	100
Que coach station	Level 4	3.000	50
Non coach station	Level 5	2.000	30
Coach stop station	Level 1	16.400	240
Highway service station	Level 1	159.644	

(*) Standards for station are based on the Decision No. 08/2005/QĐ-BGTVT by the Ministry of Transport

2. Planning for station and parking areas

Stations and parking lots are located in Phu Ly city and towns of districts. At present, the number of automobiles has grown, therefore, the construction of parking lots in urban area should be identified in such positions as following :

Public places : Theatres, cinemas, stadiums, stations, ports, hosiptals.

Commercial works : supermarkets, shops

Cargo storages such as warehouse, factories, administrative centres, education institutes.

Parking lots may have 1 floor, multi-floor or underground.

Public parking lots : need satisfy following requirements:

At place having a large number of passengers.

Shortest distance for passenger to walk to station.

It's convenient for passengers to travel fast.

Ensure the safety for passenger to load and unload vehicles easily.

The distance between parking lots in urban areas is 300 - 400m, the suburban areas is 1000m - 1500m.

For the streets with wide sidewalk, it's possible to arrange the parking lots by reduce sidewalk area

Total areas of land for static traffic is 100ha, in which:

Land area for static traffic of Phu Ly city: 32ha (accounting for 2% of land area for urban construction. *(Sources : Adjustment for general planning of Phu Ly city)*

Land area for static traffic of other districts of Ha Nam is: 68 ha.

5.2.1.3. Development orientation for road transport and vehicles

a. To develop the transport mode.

* Period 2007 – 2015:

- Meet social demands on transportation to ensure the smooth circulation of the province.

- Reasonable distribution of transportation, promote the advantages of the diversity and flexibility of road traffic, which take effect in short distance of operation, and for collecting cargos for other modes of transport.

* Period 2010 – 2015:

- Organize, manage and create healthy competitive environment of transportation, in order to improve the quality of transport activities, build transportation systems with high competitiveness, saving cost, time and ensuring traffice safety.
- Apply policies and mechanisms to encourage the development of urban public transport, primarily the transport by bus, in order to meet transportation needs in disadvantaged areas. Establish the bus, routes to connect centre of districts in province with Phu Ly city, firstly 4 routes :

+ Phu Ly – Dong Van town – Hoa Mac town
+ Phu Ly – Que town
+ Phu Ly – Vinh Tru town
+ Phu Ly – Binh My town

Time and frequency of operation will be calculated to suitable to the demand for travelling of the route.

* Period 2015-2025:

- Continue to complete and gradually modernize the road transport network.
- Continue to develop the internal bus system in the city.

Table 5.5. Forecast result of passengers and goods transportation by land in Hanam province

No.	Target	Unit	2010	2015	2025
1	Goods transportation				
	Transport volume	T	5.026.035	6.490.510	10.958.513
	Freight – traffic volume	T.KM	179.469.004	231.762.290	391.305.163
2	Passengers transportation				
	Transport volume	HK	2.997.829	3.373.593	3.905.127
	Transport volume	HK.KM	201.170.081	226.385.829	262.054.572

b. Development of transport vehicles.

* Period 2007 – 2015:

- Increase the number of heavy and medium loading vehicles for transportation to meet the development of industries in the area, gradually limit the operation of non-motorized vehicles and mechanized vehicles, aims to improve the transportation competitiveness and to ensure traffic safety.

- Step by step prevent the growth in number of motorbikes at the rate of less than 10%/year by economic and technical solutions, control the number of this vehicles in the province, then reduce the useage of motorbikes in urban area. Motorbikes are mainly used in rural areas and the regions with low population density.

* Period 2015 – 2025:

- Enhance capacity of road transport vehicles, ensure the competitiveness in provincial and interprovincial transport, restrict the frieght transportation by mechanized and non-motorized vehicles in province.
- Improve capacity and nummber of buses and coaches to meet the travelling demand of people.

According to the calculation results, estimated forecast about the transport mode in land as follows :

Table 5.6 Forecast transporting modes by land

No.	Types	To 2015	To 2025	Loading capacity
1	Truck	1500	3900	10 ton /vehicle
2	Couch	450	1170	40 seat /vehicle
3	Bus	70	150	60 - 90 seat /vehicle
4	Taxi, car	1400	3800	4 seat /vehicle
5	Motorbike	110000	140000	

5.2.1.4. Development plan for land transport mechanics and services

- Period 2007 – 2010, it is expected to construct the maintenance factory for motorized vehicles in Phu Ly city. The later phase will invest for a car assembly line.
- Invest for the construction of land transport works in Ha Nam province, including :

+ Construct the examination centre for driving land motorized vehicles in Phu Ly city, with the scale in 2010 is centre level 2, in 2020 is centre level 1, total area is 35.890 m2.
+ Construct the registration centre for motorized vehicles in Phu Ly city, scale in 2010 is the centre level II with the design capacity is 6.000-12.000 vehicles/year ; to be centre level III with capacity of 12.000-24.000 vehicles/year. The planned area is 11.900m2.

- Solutions : Promote to develop the private economics in transport mechanics and services.

2. TCVN 4054: 2005

TCVN **VIETNAMESE STANDARD**

TCVN 4054: 2005

Third Edition

Highway - Specifications for Design

HANOI - 2005

Foreword

TCVN 4054: 2005 replaces TCVN 4054 - 1998

TCVN 4054: 2005 is edited by the Technical Subcommittee TCVN/TC98/SC2 "Highway Transportation Works" based on a draft that is proposed by Ministry of Transport, approved by General Department of Standard - Metrology - Quality Control and issued by Ministry of Science, Technology and Environment.

Table of Contents

VIETNAMESE STANDARD **TCVN 4054 : 2005**

Third Edition

Highway - Specifications for Design

1. Scope of Application

1.1 This standard sets out requirements for the design of the public highway network, including new construction, rehabilitation and improvement projects. The design of specialized roads such as Freeway/Expressway, Urban roads, Industrial district roads, Forestry roads and other roads etc. should comply with the respective sectional standards. When designing rural roads, provisions for appropriate road class in this standard could be applied.

In the case of highway design involving other works such as railway, irrigation work, or the highway passing over residential area, urban area, cultural and historic relics etc. the highway design should follow not only this standard but the existing regulations of the State for the related works also.

1.2 In special case, it's possible to apply technical specifications in other standards but only after has technical and economic analysis been done.

Highway sections which are followed other technical specifications should be designed concentratively along the alignment and the total length of the sections should not exceed 20% total length of the designed alignment.

2. Reference Materials

The following reference materials are very important in applying the standard. It's possible to apply the cited reference materials with issuance date. The materials without issuance date might be applied with the latest edition including revised editions.

TCVN 5729: 1997 Freeway/Expressway - Specifications for Design

22TCN 16: Specification for measuring smoothness of pavement surface by 3m length straight edge

22TCN 171 Specification for surveying geological conditions and designing stabilized method for embankment in the landslide and settlement area

22TCN 211 Flexible pavement specifications

22TCN 211 Standard for transportation work design in seismic zone

22TCN 223 Rigid pavement specifications

22TCN 237 Roadway traffic signal regulations

22TCN 242 Specification for environmental impact assessment when preparing project feasible report and design

22TCN 251 Testing specifications for determining general elastic modulus of the flexible pavement by Benkelman level beam

22TCN 262 Highway embankment on soft soil design survey standard

22TCN 272 Bridge design standard

22TCN 277 Standard for testing and evaluating pavement surface by international roughness IRI

22TCN 278 Testing specification for determining pavement roughness by blinding

22TCN 332-05 Testing specification for determining CBR of soil, crushed stone in laboratory

22TCN 333-05 Specification for soil, crushed stone compaction in laboratory

22TCN 334-05 Technical specification for construction and acceptance of macadam foundation in highway pavement structure

3. General Specifications

3.1 Specifications for design

3.1.1 When carrying out highway design, not only provisions stipulated in this standard must be followed sufficiently but comprehensive study should be done also to have safe, effective and sustainable highway.

3.1.2 The elements of alignment such as horizontal alignment, vertical alignment, and cross-section should be coordinated closely together with taking the most use of topographic conditions in order to make a spatially well-proportioned route assuring both favorable sight distance and intrinsic mechanical stability for obtaining following objectives:

- satisfying traffic volume properly in order to ensure appropriate traffic flow;
- ensuring maximum safety and comfortableness for vehicles and road users;
- having highly economical effectiveness by evaluation norms regarding work construction cost, maintenance cost, expense for transport price, transport duration and traffic accident forecast;
- mitigating negative impacts to environment, creating properly ecological equilibrium in order for the road to become a positively integral part of the landscape in the locality.

3.1.3 In principles, high- class highways (of category I, II and III) shall not be planned running through urban centers. When designing, following considerations should be made:

- connection between the road with the urban area especially large urban area
- method for separation of the local traffic, particular from high- class highway in order to ensure mobility of the traffic.

The highway shall ensure two functions, these are:

- mobility presenting by high speed, cut-down of travel time and safety during traveling
- accessibility i.e. vehicle can reach the destination favorably.

These two functions are incompatible. Therefore, it's necessary to limit accessibility of the high-level highway with high traffic volume and long distance in order to ensure mobility; in contrast for the low-level highway (of category IV, V, VI) the accessibility shall be ensured.

For the high- level highway, it's necessary to ensure:

- separation of the local traffic from the through traffic on the high-level highway.
- detour residential area, but taking into consideration of the connection with the urban area especially large urban area requiring radial traffic

3.1.4 For highway design, staged construction shall be considered based on long-term master plan. The option of staged construction should be suitable with the recently estimated traffic volume and a part of the master plan. That means the master plan shall take full or most use of the works built in previously staged construction. When executing the staged construction plan, provision of land reservation for future construction shall also be considered.

3.2. Design Vehicles

The design vehicle shall be the prevailed vehicle type in the traffic flow used for calculating highway factor.

The dimensions for design vehicles are given in Table 1.

Table 1 - Dimensions for design vehicles

Dimensions are in meters

Vehicle Type	Overall Length	Overall Width	Height	Front Overhang	Rear Overhang	Wheel base
Car	6.00	1.80	2.00	0.80	1.40	3.80
Truck	12.00	2.50	4.00	1.50	4.00	6.50
Semi-trailer	16.50	2.50	4.00	1.20	2.00	4.00 ÷ 8.80

3.3. Design Traffic Volume

3.3.1 Design traffic volume is defined as the total number of passenger car equivalent vehicles that pass over a given cross section during a given time interval, estimated for the future year. The future year is defined as the 20th year after putting into operation of the Class I and II highways and the 15th year for the Class III and IV highways; the 10th year for the Class IV and VI and rehabilitation ones.

3.3.2. The equivalent factors for converting various sized vehicles to passenger car units can be obtained from Table 2.

Table 2 - Passenger Car Equivalent factors

Terrain	Type of vehicles					
	Bicycle	Motorbike	Car	Trucks of 2 axles and mini bus with less than 25 seats	Truck of more than 3 axles and large bus	Trailer and bus with trailer
Flat and rolling	0.2	0.3	1.0	2.0	2.5	4.0
Mountainous	0.2	0.3	1.0	2.5	3.0	5.0

NOTE:

- Classification of the terrain is based on common natural slope of the hill side and mountain side as follows: flat and rolling ≤ 30%; Mountains > 30%.
- For the highway having separated bicycle lanes, the number of bicycles is not converted.

3.3.3 Design volume characteristics:

3.3.3.1 The Annual Average Daily Traffic Volume in the future year (abbreviated N_{AADT}) has its unit as PCU/daily (passenger car unit/ daily).

This traffic volume could be used to determine technical classification for highway and to calculate other elements.

3.3.3.2 The peak-hour traffic volume in the future year (abbreviated $\mathbf{N}_{Peak\text{-}hour}$) has its unit as PCU/hour (passenger car unit/hour).This traffic volume is used for determining and arranging the number of lanes, forecasting the quality of traffic flow, traffic organization, etc.

$\mathbf{N}_{Peak\text{-}hour}$ could be determined as follows:

- For statistical data available, it can be computed from $N_{average\ daily}$ using the time variation factors.
- For annual hourly volumes available, using the 30th highest hour volume of the statistic year;
- If there is no special study, it's possible to apply $\mathbf{N}_{Peak\text{-}hour} = (0.10 \div 0.12)\ N_{average\ daily}$

3.4 Design categories for highway

3.4.1 Design classification is the highway technical specifications criteria in order to satisfy:

- traffic requirement proper to the function of the highway in the transport network;

- requirement on design traffic volume (this criteria is extendable because there are cases of important road with low traffic volume or temporally low traffic).

- based on terrain, each design category has particular standard requirements for appropriate investment and economic effectiveness.

- **3.4.2** Technical classification is based on function and design traffic volume of the highway in the network and stipulated in the Table 3

Table 3 – Highway Technical Classification according to function and design traffic volume

Design categories	Design traffic volume (PCU/daily)	Major functions of highway
Expressway	> 25.000	Arterial road, in compliance with TCVN 5729:1997
I	> 15.000	Arterial road, connecting large national economic, political, cultural centers National Highway
II	> 6.000	Arterial road, connecting large national economic, political, cultural centers National Highway
III	> 3.000	Arterial road, connecting large national and regional economic, political, cultural centers National Highway or Provincial Road
IV	> 500	Highway connecting regional centers , depots, residential areas National highways, Provincial road, District roads
V	> 200	Road serving for local traffic. Provincial road, district road, communal road
VI	< 200	District road, communal road
* These values are for reference. Selection of road classification should base on road function and terrain type.		

3.4.3 Each highway section must cover a minimum length as stipulated in its category. This minimum length is 5km for the Class IV downward, and 10km for the other categories.

3.5 Design speed, (V_{tk})

3.5.1 Design speed is defined as the speed used for the calculation of major technical elements of each highway in difficult situations. This speed differs from the permitted operating speed on the roadway stipulated by road management agency. The permitted operating speed is dependent on the actual condition of the road (climate, weather, road condition, traffic condition etc.)

3.5.2 Design speed of each road category is based on its topographic condition and stipulated in the Table 4

Design categories	**I**	**II**	**III**		**IV**		**V**		**VI**	
Topography	flat	flat	flat	mountain	flat	mountain	flat	mountain	flat	mountain
Design speed, V_{tk} (km/h)	120	100	80	60	60	40	40	30	30	20
NOTE: Classification of the terrain is based on common natural slope of the hill side and mountain side as follows: flat and rolling ≤ 30%; Mountain > 30%.										

4. Cross sections

4.1 General requirements for design of highway cross- sectional layout

4.1.1 Layout of highway components including traveled way, shoulder, separator, frontage road and auxiliary lanes (climbing lane, speed-change lane) on the highway cross- section shall in compliance with traffic organization requirements in order for all vehicles (all type of automobiles, motorbikes, non-motorized vehicles) to operate safely, comfortably and to take the most use of the road serviceability.

Based on design category and design speed of the highway, the layout of the cited components must comply with traffic organization alternatives stipulated in the Table 5.

Table 5- Traffic Organization Alternatives on the roadway cross-section

Design categories		**I**	**II**	**III**	**IV**	**V**	**VI**
Design speed, V_{tk} (km/h)	Mounta - inous area	-	-	60	40	30	20
	Flat and rolling	120	100	80	60	40	30
Frontage road*		exist	exist	None	None	None	None
Separated lanes for bicycles and		Bicycles and non-motorized vehicles are arranged on		- arrange on stabilized	No separated lane; bicycles and non-motorized vehicles		Bicycles and non-

Design categories	I	II	III	IV	V	VI
non-motorized vehicles	frontage road (refer to 4.6.2 and 4.6.6)		part of shoulder - side separator ** by line marking	travel on stabilized part of shoulder		motorized vehicles travel on traveled way
Separation between 2 traffic direction	With separation band between 2 traffic direction		Two lanes without median separator. Four lanes with double lines marking for separation			
Turnaround loop	To cut the median separator for turnaround loop according to 4.4.4		No limitation			
Limited access	Frontage road is parallel to the main road. Distance between entrance and exit is at least 5km and traffic organization is reasonable.		No limitation			
* For frontage road, refer to Article 4.6. ** For side separator, refer to Article 4.5.						

4.1.2 The minimum width of cross- sectional elements of highway categories is given in Table 6 applied for flat and rolling terrain, and in Table 7 applied for mountainous terrain.

Table 6- Minimum width of cross-sectional elements applied for flat rolling terrain

Design categories	I	II	III	IV	V	VI
Design speed, (Km/h)	120	100	80	60	40	30
Minimum number of lanes for motorized vehicle, (nos)	6	4	2	2	2	1
Width of a lane, (m)	3.75	3.75	3.5	3.5	2.75	3.5
Width of traveled way for motorized vehicle, (m)	2 ×11.25	2 ×7.50	7.00	7.00	5.50	3.50
Width of median separator[1)], (m)	3.00	1.50	0	0	0	0
Width of shoulder and stabilized part of shoulder[2)], (m)	3.50 (3.00)	3.00 (2.50)	2.50 (2.00)	1.00 (0.50)	1.00 (0.50)	1.50
Width of roadbed, (m)	32.5	22.5	12.00	9.00	7.50	6.50

1) Width of median separator for each structure is defined in Article 4.4 and Figure 1. The minimum value is applied for separator made of pre-cast concrete or curb stone with cover and without constructing piers (poles) on separated bands. In other cases, separator width must comply with provisions in Article 4.4.

2) Number in the bracket is the minimum width of stabilized part of shoulder. If possible, it suggests to stabilize the whole shoulder width, especially when the highway without side lane for non-motorized vehicles.

Table 7- Minimum width of cross-sectional elements applied for mountainous terrain

Design categories	**III**	**IV**	**V**	**VI**
Design speed, (Km/h)	60	40	30	20
Number of lanes for motorized vehicle, (nos)	2	2	1	1
Width of a lane, (m)	3.00	2.75	3.50	3.50
Width of traveled way for motorized vehicle, (m)	6.00	5.50	3.50	3.50
Width of shoulder*, (m)	1.50 (stabilized 1.0m)	1.00 (stabilized 0.5m)	1.50 (stabilized 1.0m)	1.25
Width of roadbed, (m)	9.00	7.50	6.50	6.00

* Number in the bracket is the minimum width of stabilized part of shoulder. If possible, it suggests to stabilize the whole shoulder width, especially when the highway without side lane for non-motorized vehicles.

4.1.3 When designing highway cross-section, it's necessary to study carefully land use plan of the area where the highway passes through, to consider staged construction alternatives of the cross-section (as for road of class I and II) and to take into consideration the land reservation for future road improvement; and to determine right-of - way according to the existing State regulations as well.

4.2 Traveled Ways

4.2.1 Traveled way consists of an integral number of lanes. This number should be an even number, except for cases that traffic volume in each direction has a significant difference or there is a special traffic control on the highway.

4.2.2 The number of lanes on the cross section is determined by the road category given in Tables 6 and 7, and must be checked by the formula:

$$n_{lane} = \frac{N_{rush\text{-}hour}}{Z.N_{lth}}$$

Where:

n_{lane} = required number of lanes, rounded up as per Article 4.2.1;

$N_{rush\text{-}hour}$ = rush-hour design traffic capacity, which is determined as per Article 3.3.3;

$N_{actual\ capacity}$ = actual capacity of through traffic flow, which is determined, if there is no study and calculation, as follows:

– When there is median separator between the vehicles in opposite directions and side separator between motor vehicles and non-motorized ones, it is 1800 PCU/h/lane;

– When there is median separator between the vehicles in the opposite directions but no side separator for motor vehicles and non-motorized ones, it is 1500 PCU /h/lane;

– When there is no separator between the vehicles in the opposite directions and motor vehicles use the same lane with non-motorized ones, it is 1000 PCU /h/lane;

Z = volume-to-capacity ratio:

when $V_{tt} \geq$ 80km/h, Z = 0.55;

when V_{tt} = 60km/h, Z = 0.55 for the flat area and Z = 0.77 for the rolling-mountainous areas;

when $V_{tt} \leq$ 40km/h, Z = 0.85

The above-mentioned calculation method shall be applied for the expected traveled way with number of lane more than that given in the Tables 6 and 7.

4.2.3 Lane width.

In common case, the lane width for each highway categories is stipulated in the Tables 6 and 7.

4.3 Shoulders

4.3.1 Dependent on highway category, the shoulders have a stabilized part whose width is prescribed in Tables 6 and 7 (value in the bracket). Structure of the stabilized part is regulated by Article 8.8.

4.3.2 For highway with design speed of 60km/h or more, there must be a direction guiding stripe (edge line). It is a continuous yellow or white color stripe, 20cm wide, placed on the stabilized shoulder and close to the edge of pavement. At places for passing such as intersections, merging and diverging maneuvers etc., this stripe is broken line in accordance with the regulations on road signs. In case that there is a side separator on the road class III to separate bicycle lane on the stabilized part of the shoulder, the direction guiding stripe can

be replaced with double continuous white line, width of each line is 10cm and distance between each line is 10cm (total width of the double line is 30cm).

4.3.3 At places where there are auxiliary lanes such as climbing lane, speed-change lane etc., these lanes will replace the stabilized part of shoulder. If the width of remaining soil shoulder is not wide enough, it is necessary to widen the roadbed in order to ensure that the remaining shoulder is not less than 0.5m in width.

4.3.4 Road for non-motorized vehicles

For the highway class I and II, non-motorized vehicles must be separated from the motorized lanes (as stipulated in the Table 5) in order to travel on the same frontage road with the local traffic. As for road class III, the non-motorized vehicles travel on the stabilized part of the shoulder, which is separated from the motorized lane by a side separator; refer to Article 4.5).

The width of bicycle pavement in one direction is calculated by the formula:

$b = 1 \times n + 0.5$ m (in which **n** is number of bicycle lanes in one direction)

The through capacity of a bicycle lane is 800 bicycles/hour/one direction. In case that the bicycle lane is arranged on the stabilized part of the shoulder, when the stabilized part is required widening for sufficient width b (width of the stabilized part of the shoulder shall be equal to b plus width of side separator). The width of bicycle pavement must be sufficient to account for passing capacity of other non-motorized vehicles.

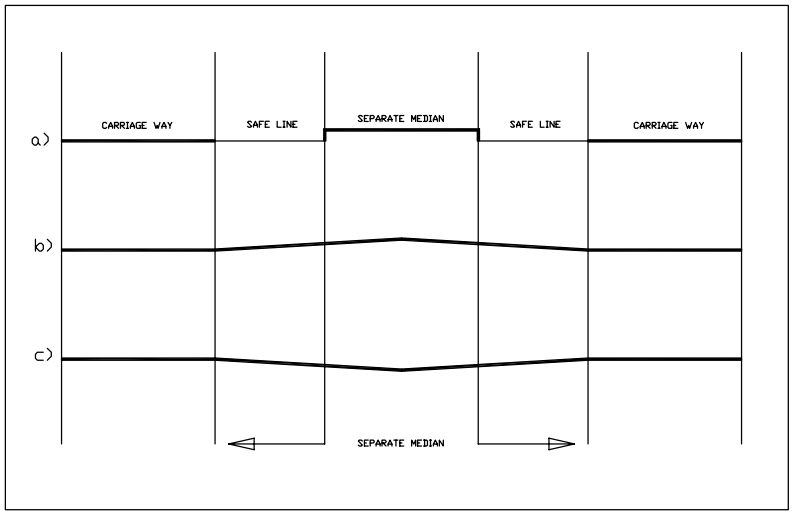
4.3.5 Surface of the non-motorized way must be as smooth as the adjacent motorized lane.

4.4 Median Separator.

4.4.1 Median separator shall only be arranged for the 4-lane highway upward (refer to Table 5), including separator and two safety parts (stabilized) on both sides. The minimum dimensions of the separator are given in Table 8, and Figure 1.

Table 8 - Minimum dimensions of a median

The structure of separator	**Separated part** (m)	**Safety part (stabilized)** (m)	**Minimum width of a median** (m)
Pre-cast concrete, curb stones with covers; no constructing piers (poles) on separator	0.50	2 × 0.50	1.50
Curb stones, with covers, piers (poles) on separator	1.50	2 × 0.50	2.50
Without covers	3.00	2 × 0.50	4.00



Legend: a. Raised medians;

b. Flush medians, with the pavement surface;

c. Depressed medians, collected storm water to the middle.

Figure 1. Structure of median

4.4.2 When the roadbed is divided into two separated parts, the one-way roadbed consists of traveled lane and shoulders. The formation of right shoulder is shown in Table 6 or Table 7 depending on the terrain; the left one has the same width as the right shoulder but the width of stabilized part can be reduced to 0.50m. The edge striping of 0.20m wide is still placed on the stabilized part of shoulder close to the pavement.

4.4.3 When the width of separating bands is less than 3.00m, the separating parts must be surfaced and rounded by curbstone.

When the separating bands is from 3.00 to 4.50m in width:

- if it is protected by curbstone, it is necessary to ensure that soil in the separated area does not cause dirt to the pavement (soil surface is lower than curbstone); the curb stone is at least 18cm in height and must have compacted clay layer to prevent water from seeping to the underneath pavement.
- it is necessary to grow grass or shrubs for soil protection, height of the shrubs should not be more than 0.80m.

When the width of separated band is over 4.50m (to reserve land for widened lanes or separate one-way roadways), it should be depressed and has drainage facilities to protect the roadbed from water infiltration. The formation of shoulder is prescribed as in Article 4.4.2.

4.4.4 The median should be cut to provide the path for turnaround loop. The turnaround loop is arranged as follows:

- The interval between turnaround loops is not under 1.0km (when the width of median is less than 4.5 m) and not over 4km (when the width of median is more than 4.5 m).

- near (approaching) tunnels and long bridges.

The length and the edge of cutting place on the separator must be large enough for three-axle truck to turn around. The cutting edge shall be trimmed by the truck's orbit to prevent the truck from hitting the edge of curbstone.

4.5 Side separator

4.5.1 Side separator shall only be arranged in cases mentioned in Table 5, in order to separate bicycle and non- motorized vehicle lane on the stabilized part of the shoulders (or widening stabilized part) from the traveled way for motorized vehicle.

4.5.2 Arrangement and structure of the side separator can be one of the following alternatives:

- By two continuous line in compliance with 22TCN 237 (only for road class III);

- By guardrail (made of corrugated iron). Height from the shoulder's surface to crest of the guardrail is 0.80m.

The above-mentioned cases are placed on the stabilized part, but the side safety part must be at least 0.25m far from the edge of the nearside motor lane.

Width of the side separator consists of width of the guardrail (or marking line) and width of the side safety part.

4.5.3 The side separator shall be cut for water drainage with the interval of less than 150m. The turnaround loop for non-motorized vehicles shall be arranged so as to coincide with that for the motorized vehicles, according to the Article 4.4.4.

4.6 Frontage road

4.6.1 Frontage road is the auxiliary road arranged along both sides of the road class I and II, has following functions:

- To prevent traffic (motorized, non-motorized vehicles and pedestrians) from accessing freely the road class I and II;

- To meet the traveling demand of the cited vehicles in local scope (local traffic) in one-way or two- way (in the scope between the permitted accesses to the road class I and II)

4.6.2 On the road class I and II, frontage road shall be arranged on the sections having significant local traffic such as sections through residential areas, industrial zones, tourism landscape, forestry and agricultural

farm etc. When it's impossible to arrange frontage road (in staged construction, or having difficulties etc.) provisions in Article 4.6.6 shall be applied.

Determination of above-mentioned local traffic demand is required surveying, forecasting by socio-cultural-economic development plan for each section to be arranged frontage road.

4.6.3 Frontage road shall be arranged separately from the main roadway of the road class I and II. Length of each frontage road (i.e. interval between permitted accesses to the road class I and II) is equal or larger than 5 km. Frontage roads can be arranged at both sides of the main line and it can be one-way or two-way road each side (in order to facilitate the local traffic). If there are frontage roads at both sides of the main line, it's possible to organize traffic from frontage roads by grade- separated underpass or overpass structures (do not cross the main line) at the locations of the permitted accesses to the main line only when it's really necessary.

4.6.4 Frontage road can be arranged right at the right-of-way of the main road class I and II. In this case the ROW shall be in compliance with the existing regulations taking account of the boundary of the edge side structure of the frontage road.

4.6.5 Frontage road is designed by category V and VI (for flat or rolling terrain) but its roadbed width can be reduced minimally to 6.0m (if two-way frontage road) and 4.5m (if one-way frontage road). Cross-sectional arrangement of the frontage road shall be selected by Design consultant depending on the actual requirements.

4.6.6 As for sections without frontage road, on the road class I and II it's necessary to arrange bicycle and non-motorized vehicles lane on the stabilized part which is separated by guardrail with height of at least 0.80m from the road surface.

4.7 Climbing auxiliary lanes

4.7.1 Climbing auxiliary lane is considered to be placed only when having enough the three following conditions:

- Climbing traffic flow exceeds 200 vehicle/h, in which volume of truck exceeds 20 vehicle/h;
- when grade is over 4% and;
- length of grade is more than 800m;

As for road sections expected to be arranged climbing lane, it's necessary to make comparison on economic and technical norms of the two alternatives, i.e. arrangement of climbing lane or road grade deduction.

The climbing lane is usually taken into consideration for two-lane roadway without median separator and with constraint passing condition.

4.7.2 Formation and arrangement of climbing lanes:

- The width of a climbing lane is 3.50m and can be reduced to 3.00m in difficult cases.

- Climbing lanes should be located separately, if impossible, the climbing lane shall be placed on stabilized part of the shoulder; if the stabilized part width is not adequate, it needs widening to sufficient width of 3.5m and soil shoulder width must be 0.5m (at this climbing segment bicycles and non-motorized vehicles shall travel on the same climbing lane with trucks).

- A transition part for vehicle to enter the climbing lane must be placed 35m prior to the entrance of the climbing lane and widened in tapered shape with enlarged width of 1:10; a transition part for vehicle to exit the climbing lane must also be widen in tapered shape from the top point of the grade with narrow width of 1:20 (length of the taper is 70m)

4.8 Speed- change lanes

Speed- change lane is arranged at entrance and exit of frontage road to road class I and II. Formation of the speed- change lane is provided in Article 11.3.5.

4.9 Cross- slope

Cross slope of cross- sectional elements of the straight line is prescribed in Table 9. The cross slope in curved sections must follow regulation on super-elevation (refer to Article 5.6).

Table 9 - Cross slope rate of cross-sectional elements

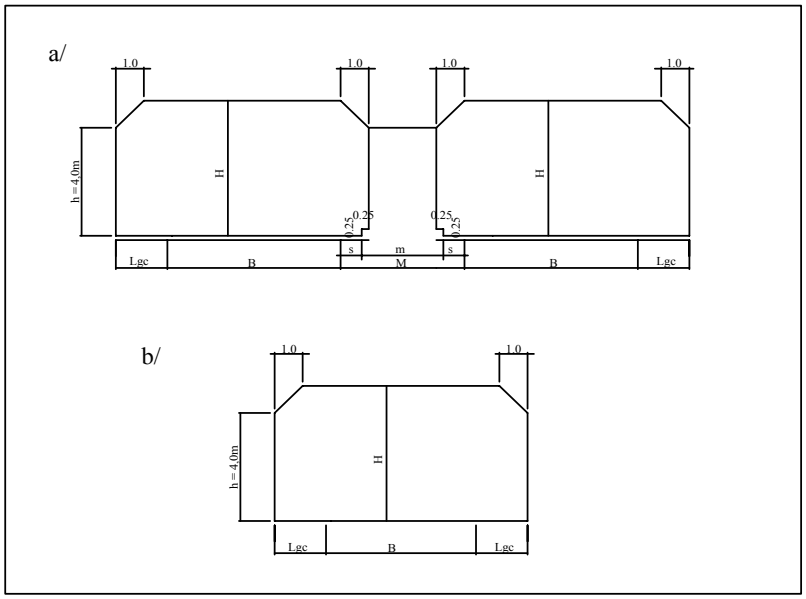
Cross- sectional elements	Cross Slope Rate, %
1. Pavement and shoulder stabilized part	
Cement concrete and asphalt concrete	1.5 - 2.0
Other types of road surface, good and flat rock paved surface	2.0 - 3.0
Medium- quality rock paved surface	3.0 - 3.5
Gravel macadamized, aggregate, low-type surface	3.0 - 3.5
2. Non-stabilized shoulder part	4.0 - 6.0
3. Separator	Depending on covering material, applied correspondingly to 1.

4.10 Clearances.

4.10.1 Clearance is defined as a space limit to ensure traveling of all types of vehicles. In the clearance area no obstacle, including highway facilities such as road signs, lighting poles, etc. is allowed to be placed.

4.10.2 The minimum clearance of highway categories is prescribed in Figure 2. On the improved highway, in case of difficulty rising, it's possible to keep the old clearance but not less than 4.30m. In this case, it's required to design gantry for clearance limitation, which is placed before the limited clearance of at least 20m.

For highway passing over railway, clearance height shall follow the standard 22 TCN272 (depending on railway gauge and type of locomotive)



a- Highways of $V_{tk} \geq$ 80 km/h with median;

b- All types of highway without median;

B - Width of traveled way;

L_{gc} - width of stabilized shoulder part (see Table 7);

m - Separated part;

s - Safety part (stabilized); M - width of separator;

M, m, s- minimum values (see Tables 6 and 7)

H - Clearance height from the highest point of traveled lane (the height does not take into account of the reserved height for pavement raising when repairing or improvement);

h - Clearance height at the edge of stabilized shoulder

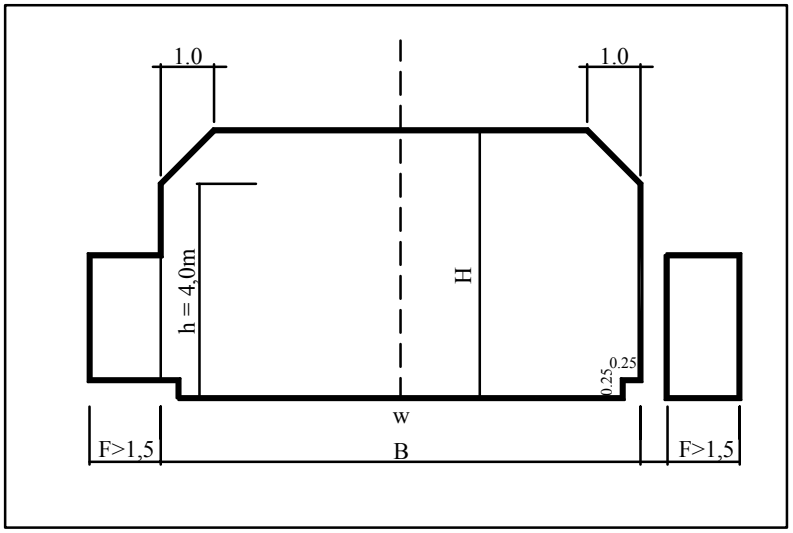
H = 4.75 m h = 4.00 m for highway class I, II, III

H = 4.50 m h = 4.00 m for remaining highway classes

Figure 2. Highway Clearances

4.10.3 In case of bicycle (or pedestrian) traffic is separated from traveled way, minimum clearance of for non-motorized vehicle way and walkway is a rectangle of 2.50m high and minimum 1.50m wide. This clearance may be placed close to the clearance of traveled way or separated by a side separator, same as clearance in tunnel (Figure 3).

4.10.4 The clearance in tunnel is in compliance with the existing specifications for tunnel design and showed in Figure 3. The soil shoulder part is transformed into space for placing guardrails.



F - width of bikeway or walkway; G - width for placing highway facilities.

NOTE: The left part is the case of walkway and bikeway close with traveled way, the right part is the case of separation

Figure3. Clearances in the tunnel

4.10.5 The width of roadway on the bridge:

- For bridge length L ≥ 100 m, the width of roadway follows clearance standard of the bridge design.

- For bridge length L < 100 m, the width of roadway is determined by the width of traveled way and the width required for pedestrians and non-motorized vehicles movement combined. However, it must not be larger than the roadbed width.

- For bridge length L < 25 m, roadway width is equaled to the bridge width.

5. Horizontal alignment and Vertical alignment

5.1 Sight Distance

5.1.2 Sight distance on the roadway must be necessarily ensured to improve operating safety and psychological reliability for driver to travel at design speed.

Minimum value on stopping sight distance, opposing sight distance and overtaking sight distance are given in the Table 10.

Table 10 - Minimum sight distance on roadway

Design categories	I	II	III		IV		V		VI	
Design speed, $V_{tk,}$ km/h	120	100	80	60	60	40	40	30	30	20
Stopping sight distance (S1), m	210	150	100	75	75	40	40	30	30	20
Ahead opposing sight distance (S2), m	-	-	200	150	150	80	80	60	60	40
Overtaking sight distance S_{xv}, m	-	-	550	350	350	200	200	150	150	100

Sight distances are calculated from the driver's eye sight with height of 1.00m above road surface; to opposing vehicle with height of 1.20m, to object on the roadway with height of 0.10m.

5.1.2 When designing, it's necessary to check sight distance. At locations with insufficient sight distance, it's necessary to remove all obstacles (clearing trees, excavating side slope etc.). After removing, obstacles must be 0.30m lower than sight line. In difficult cases, it's possible to use convex mirror, signs, speed limit sign or prohibited passing sign

5.2 Highway elements on horizontal alignment

5.2.1 On the horizontal alignment, the alignment consists of tangents continued with circular curvature sections. When the design speed $V_{tk} \geq 60$ km/h, it is necessary to provide a clothoid transition curve between tangent and curvature.

5.2.2 The length of straight line between two reverse curvatures must be sufficient for placing of the transition curve or super-elevation runoff.

5.3 Curvature on horizontal alignment (Horizontal curve)

5.3.1 Only in difficult situations, the minimum radius of horizontal curvature may be applied. The use of normal minimum radius upward should be encouraged; topographic condition should be taken advantages in order to ensure the best quality of vehicle operation.

Provisions on radius of horizontal alignment are given in Table 11.

Table 11 - Minimum radius of horizontal alignment

Highway categories	I	II	III		IV		V		VI	
Design speed, km/h	120	100	80	60	60	40	40	30	30	20
Radius of horizontal alignment, m										
- limited minimum	650	400	250	125	125	60	60	30	30	15
- normal minimum	1000	700	400	250	250	125	125	60	60	50
- non-superelevation minimum	5500	4000	2500	1500	1500	600	600	350	350	250

5.4 Traveled way widening on curvatures

5.4.1 It's required to widen the traveled way if vehicle traveling on curvature. When curvature radius is ≤ 250m the traveled way shall be widened as shown in Table 12.

5.4.2 When the traveled way has more than two lanes, each lane is widened by a half of the value recognized in Table 12 and its multiple is 0.1m.

As for traffic flow with special vehicle, it's necessary to check the values given in the Table 12.

Table 12- Extra width allowance on curve of two-lane traveled way on plan

Units are given in millimeter

Traffic flow	Radius of horizontal curvature							
	250 ÷ 200	<200 ÷ 150	< 150 ÷ 100	<100 ÷ 70	<70 ÷ 50	<50 ÷ 30	<30 ÷ 25	<25 ÷ 15
Car	0.4	0.6	0.8	1.0	1.2	1.4	1.8	2.2
Truck	0.6	0.7	0.9	1.2	1.5	2.0	-	-
Trailer	0.8	1.0	1.5	2.0	2.5	-	-	-

5.4.3 The widening part is on both sides, crest and sag side of the curve. In difficult conditions, it's possible to place the widening part on one side, sag or crest side of the curve.

5.4.4 The widening part is placed in the area of stabilized shoulder. The direction guiding stripe (and the others such as the auxiliary lanes for non-motorized vehicle etc.) must be placed on the right side of the widening part. When it is necessary, the roadbed must be widened to ensure the remaining part of soil shoulder is not less than 0.50m.

5.4.5 The widening section totally coincides with the super-elevation section and transition curvature. When these two elements are absent, it is formed as follows:

- a half of widening section is placed on the straight line, other half on the curvature.
- on the widening section, the enlargement is even (linear). Widening 1m on the minimum length of 10m;

5.5 Super-elevation rate and tangent runout

5.5.1 Super-elevation is the one-side cross slope of traveled way grading toward the sag side of the curve.

The super-elevation rate is based on the horizontal curve radius and design speed given in Table 13. The maximum super-elevation rate does not exceed 8% and the minimum super-elevation rate is not smaller than 2%.

5.5.2 The stabilized part of the shoulder has the same grade and direction with super-elevation, the non-stabilized part of shoulder on back of the curve grades toward back of curve.

5.5.3 When there are separated traveled ways, the super-elevation can be made for each way separately.

5.5.4 The length of super-elevation runoff (in curve section with super-elevation) shall not be smaller than value given in Table 14.

Table 13 – Super-elevation rate corresponding with horizontal curve radius and design speed

Design	**Super-elevation Rate, %**							**Normal cross-fall**
Speed, V_{tk}, km/h	**8**	**7**	**6**	**5**	**4**	**3**	**2**	
	Horizontal curve radius, m							
120	650÷ 800	800÷ 1000	1000÷ 1500	1500÷ 2000	2000÷ 2500	2500÷ 3500	3500÷ 5500	≥ 5500

100	400÷ 450	450÷ 500	500÷ 550	550÷ 650	650÷ 800	800÷ 1000	1000÷ 4000	≥ 4000
80	250÷ 275	275÷ 300	300÷ 350	350÷ 425	425÷ 500	500÷ 650	650÷ 2500	≥ 2500
60	-	125÷ 150	150÷ 175	175÷ 200	200÷ 250	250÷ 300	300÷ 1500	≥ 1500
40	-	-	60÷ 75		75÷ 100		100÷ 600	≥ 600
30	-		30÷ 50		50÷ 75		75÷ 350	≥ 350
20	-		25÷ 50		50÷ 75	75÷ 150	150÷ 250	≥ 250

Table 14 – Super-elevation rate (i_{sc}) and tangent runout length

Design Speed, $V_{tk,}$ km/h										
120			**100**			**80**			**60**		
R, m	**i_{sc}**	**L,m**	**R,** m	**i_{sc}**	**L,m**	**R,** m	**i_{sc}**	**L,m**	**R,** m	**i_{sc}**	**L,m**
650÷ 800	0.08	125	400÷ 450	0.08	120	250÷ 275	0.08	110	125÷ 150	0.07	70
800÷ 1000	0.07	110	450÷ 500	0.07	105	275÷ 300	0.07	100	150÷ 175	0.06	60
1000÷ 1500	0.06	95	500÷ 550	0.06	90	300÷ 350	0.06	85	175÷ 200	0.05	55
1500÷ 2000	0.05	85	550÷ 650	0.05	85	350÷ 425	0.05	70	200÷ 250	0.04	50
2000÷ 2500	0.04	85	650÷ 800	0.04	85	425÷ 500	0.04	70	250÷ 300	0.03	50
2500÷ 3500	0.03	85	800÷ 1000	0.03	85	500÷ 650	0.03	70	300÷ 1500	0.02	50
3500÷ 5500	0.02	85	1000÷ 4000	0.02	85	650÷ 2500	0.02	70	-	-	-

Design speed, $V_{design,}$ km/h								
40			**30**			**20**		
R, m	i_{SC}	L,m	**R,** m	i_{SC}	L,m	**R,** m	i_{SC}	L,m
65÷ 75	0.06 0.05	35 30	30÷**50**	0.06 0.05	33 27	15÷**50**	0.06 0.05	20 15
75÷ 100	0.04	25	50÷**75**	0.04	22	50÷**75**	0.04	10

	0.03	20		0.03	17			
100÷600	0.02	12	75÷350	0.02	11	75÷150	0.03	7

NOTE:

1) L- Length of the superelevation section or transition curve is determined according to the Article 5.5.5 and 5.6.1.

2) Value L given in the table is applied for dual carriageway road. As for road class I and II, if the road is double lanes the above values shall be applied; as for three lanes the above value is multiplied by 1.2; multiplied by 1.5 for four- lane road; and by 2 for six- lane road.

5.5.5 Super-elevation runoff

Super-elevation shall be done by revolving the traveled way on the crest side of the curve about centerline profile to the cross slope of traveled way, and then continue revolving about the centerline profile to the full rate of super-elevation. In case of divided highway, super-elevation is attained by revolving about the inside and outside edges of the pavement.

5.5.6 Super-elevation runoff, widening runoff shall be placed coincidently with the transition curve. When there is no transition curve, the runoff will be half on the circular curve and half on the tangent.

5.6 Transition curves.

5.6.1 When design speed $V_{tk} \geq 60$ km/h, transition curves are placed so as to connect the tangent to the circular curve and vice versa.

5.6.2 Super-elevation rate (i_{sc}) and length of super-elevation runoff (L) depend on radius of horizontal curve (R) and design speed (V_{tk}), and shall not be smaller than values given in the Table 14.

5.6.3 Transition curve can be a clothoid curvature, third-degree parabolic curvature or compound circular curves.

5.7 Longitudinal Grade.

5.7.1 Depending on highway category, the maximum grade is indicated in Table 15. In difficult cases, the maximum gradient may be about 1% steeper but shall not exceed 11%.

For the highway in areas with elevation of 2000m above mean sea level, the maximum gradient is not to exceed 8%.

5.7.2 When the highway runs through residential areas, a grade shall not exceed 4%.

5.7.3 Longitudinal gradient in tunnel is not steeper than 4% and not flatter than 0.3 %.

5.7.4 On excavation sections, minimum longitudinal grade is 0.5% (in difficult situation, it may be allowed to use the grade of 0.3% but the gradient length is not over 50m).

Table 15 - Maximum longitudinal grade of highway categories

Design categories	**I**	**II**	**III**		**IV**		**V**		**VI**	
Topography	flat	flat	Flat, rolling	Mountain	Flat, rolling	Mountain	Flat, rolling	Mountain	Flat, rolling	Mountain
Maximum longitudinal grade	3	4	5	7	6	8	7	10	9	11

5.7.5 When the section length with grade exceeds the values given in Table 16, it's necessary to have a straight line with grade of 2.5% and sufficient length for vertical curve.

Table 16 - Maximum length of longitudinal grade (Unit is given in meter)

Grade	**Calculated speed, V_{tk}, (km/h)**						
%	**20**	**30**	**40**	**60**	**80**	**100**	**120**
4	1200	1100	1100	1000	900	800	-
5	1000	900	900	800	700	-	-
6	800	700	700	600	-	-	-
7	700	600	600	500	-	-	-
8	600	500	500	-	-	-	-
9	400	400	-	-	-	-	-
10 and 11	300	-	-	-	-	-	-

5.7.6. The minimum length of the grade change section must be sufficient for arrangement of vertical curve and not less than the values given in Table 17.

Table 17 - Minimum length of grade change section

Design speed, V_{tk}, (km/h)	**120**	**100**	**80**	**60**	**40**	**30**	**20**
Minimum length of grade change section, m	300	250	200 (150)	150 (100)	120 (70)	100 (60)	60 (50)
NOTE: values in bracket are applied for improved, upgraded roads when quantity of compensated pavement is large.							

5.7.7 On horizontal curvatures with small radius, the gradient given in the Table 16 must be decreased by a reduction value given in Table 18.

Table 18 - Reduction value of grade on the horizontal curves of small radius

Radius of horizontal curve, m	**15 - 25**	**25 - 30**	**30 - 35**	**35 - 50**
Reduction value of maximum grade, %	2.5	2	1.5	1

5.8 Vertical curve

5.8.1 Grade change section on vertical alignment (larger than 1% when design speed ≥ 60km/h, larger than 2% when design speed < 60km/h) must be continued by vertical curves (crest and sag) – These curves can be circular curves or second-degree parabolic curvature.

5.8.2 Vertical curve radius must be in compliance with topography in order to provide favorable conditions for traveling and highway landscape, but not less than the values given in Table 19.

Table 19 - Minimum radius of the crest and sag vertical curves

Design speed, km/h	**120**	**100**	**80**	**60**	**40**	**30**	**20**
Radius of crest vertical curvature, m							
- Limited minimum	11000	6000	4000	2500	700	400	200
- Normal minimum	17000	10000	5000	4000	1000	600	200
Radius of sag vertical curvature, m							
- Limited minimum	4000	3000	2000	1000	450	250	100
- Normal minimum	6000	5000	3000	1000	700	400	200
Minimum length of the vertical curvature, m	100	85	70	50	35	25	20

5.9 Curves in zigzag.

5.9.1 The use of curves in zigzag should be limited except in case of alignment development on the complicated mountainous terrain.

5.9.2 Technical specifications at turning path on the zigzag curve are shown in Table 20

Table 20 - Technical specification at turning path on curves of zigzag

Design speed, V_{tk}	60	40	30	20
Calculated speed for turning, km/h	25	20	20	20
Minimum radius of horizontal curve, m	20	15		
Maximum super-elevation rate, %	6	6		
Widening value of two-lane traveled way part	2.5	3.0		
Maximum gradient at turning part	5.0	5.5		

6. Combination of highway elements

6.1 Combination of highway elements is to:

- Create good sight distance, provide adequate information for driver to have prompt actions in any situation;

- Create confidence, comfortableness for driver to have good, effective and tireless environment ;

- Avoid hidden place, place causing illusion for driver resulting in disruption and wrong actions.

- Create aesthetic structure contributing in the landscape of the highway area.

6.2 All requirements given in the Article 6.1 are compulsory for highways with design speed over 80km/h, are encouraged with for those with design speed over 60km/h and oriented for other categories.

6.3 When designing, it's necessary to consider the combination of elements on horizontal alignment for ensuring cost-effectiveness.

6.4 Elements on horizontal alignment

6.4.1 On the horizontal alignment, the alignment on various curves with maximum radius is better than on the long, straight lines placed between short curves; the alignment taking the most advantage of the terrain (running along the forest boundary, along hill and river) is better than that crossing or requiring construction of special structures (retaining wall, viaduct etc.)

6.4.2 Small deflection angle shall require large radius of horizontal curve. See Table 21.

Table 21 - Minimum radius of horizontal curves depending on deflection angle

Deflection angle (degree)		**1**	**2**	**3**	**4**	**5**	**6**	**8**
Minimum radius of horizontal curve, m	Grade I and II, $V_{tk} \geq$ 100km/h	20000	1000	8000	6000	4000	2000	1500
	Other categories	10000	6000	4000	3000	2000	1000	800

6.4.3 When designing, sudden changes should be avoided:

- Adjacent horizontal curves radius should not be twice bigger than each other;
- At the end of a straight line, minimum radius of horizontal curve should not be placed;
- Length of curve should be approximately equal or bigger than length of straight line placed before.

6.4.4 When the highway is dual carriageway with divided two directions, it's necessary to design as two routes with independent roadbed, and the median is widened for harmony of landscape; it's possible to design as two separated roadbeds for saving quantity and having more beautiful and stable structure.

6.4.5 On high category roads, it's encouraged to place continuous clothoids between horizontal curves.

6.5 Coordination of horizontal and vertical alignment

6.5.1 Various vertical curves should not be placed on one long tangent (or horizontal curve with large radius) in order to prevent the alignment from having many hidden places.

To avoid bending alignment, various horizontal curves should not be placed on a flat alignment section.

6.5.2 Number of horizontal curve should be equal to that of vertical curve and their vertices should be coincided to each others. When it's required to shift, the shift of the two vertices of the curves (horizontal and vertical) should not be one forth bigger than length of the horizontal curve.

6.5.3 It should be designed long horizontal curves covering outside of the vertical curve.

6.5.4 It should not be designed vertical curve with small radius to be inside the horizontal curve in order to avoid crests or sags. Radius of sag vertical curve (R_{sag}) should be ensured to be bigger than that of the horizontal curve ($R_{horizontal}$).

6.6 Coordination with landscape

6.6.1 It's necessary to study carefully all topographical and natural factors of the region for reasonable combination which shall not break natural law, and avoid any structures of deep excavation and high embankment, and special structures.

6.6.2 Regulation on slope (Table 24 and 25) shall be obtained by mechanical principles of soil. The slope could be:

- Changed for consistency with common cross fall on the terrain;

- Rounded at the top of slope and widened at both ends of slope;

- As for slope under 1m, due to requiring less quantity, the slope should be 1:4÷ 1:6 and rounded at top and toe of slope;

- As for high slope, it's necessary to build berm that shall stabilize the slope and a part that prevent slope scour, and to plant shrubs.

7. Roadbed

7.1 Basic requirements and design principles

7.1.1 Roadbed shall be ensured stability maintaining geometric dimensions, strong enough for bearing impacts of traffic loading and natural factors during its serviceability.

In order to have appropriate design method, it's necessary to conduct topographic, geological and hydrological surveys (especially with presence of water sources, factors causing scouring and pavement destruction) and study carefully related data.

Roadbed construction shall be ensured not to damage the natural equilibrium, cause negative impacts on environment and destroy regional landscape. It's necessary to take notice that once the environment is damaged, the roadbed itself shall be destroyed too resulting in instability of the roadbed.

7.1.2 Design principles

7.1.2.1 Effective area of the roadbed shall be ensured (when there is no special calculation, this area can be 80cm downward from subgrade) to obtain the following requirements:

- Not to be too wet and not to be affected by the external damp source (rain-water, underground water, water beside roadbed);

- 30 cm uppermost shall ensured minimum bearing capacity CBR* of 8 for highway category I, II and of 6 for other categories;

- Subsequent 50 cm shall ensured minimum bearing capacity CBR* of 5 for highway category I, II and of 4 for other categories;

In which: CBR - California Bearing Ratio is determined in laboratory with soil specimen to be compacted by standard compaction according to 22TCN 332-05 and saturated in 4 days and nights.

7.1.2.2 Embankment on soft soil shall be applied according to 22TCN 262.

7.1.2.3 Roadbed on the complicated geological condition shall be applied according to 22TCN 171.

7.1.2.4 Roadbed on seismic area shall be applied according to 22TCN 221.

7.1.2.5 In order to mitigate negative impacts on environment and landscape, it's necessary to take into consideration the following principles:

- Limit damage to vegetation. If possible, organic soil in the excavation should be collected for backfilling the borrow pits and slope sides;

- Limit damage to natural equilibrium, avoid deep cutting and high filling and cut and fill quantity should be equilibrated. In complicated terrain, it's necessary to make comparison on alternatives of viaduct, tunnel, and roadbed of balcony. Roadbed slope height should not higher than 20m;

- On the slope above 50%, it's necessary to consider alternative of two separated roadbeds;

- The low cutting and filling should have alternative of sloping (1:3 ~ 1:6) and rounding for consistency of topography and traffic safety;

- Limit negative impacts on socio- economy of residence such as flooding to fields and houses. Locations and openings of drainage facilities should be adequate not to obstruct flood flow causing embankment destruction at other location, avoid obstruction to the local circulation and respect the local drainage plan.

7.2 Roadbed width

Roadbed width and width of roadbed's elements given in Table 6 and 7 is minimum values. In such cases as designing more lanes, placing median with cover but constructing piers (poles) on separated bands or without cover, placing side separator and increasing bicycle lane width (b) by calculation, designer has to determine width of the designed roadbed.

7.3 Design elevation of roadbed

7.3.1 Design elevation of roadbed is the elevation of centerline. When there are two separated roadbed, there will be two design elevations on the two profiles separately.

7.3.2 The design elevation of pavement edge of the sections running along the rivers bank, approaches of small bridges, culverts and flooded fields must be at least 0.50m higher than the flooded water level of design frequency given in Table 30. Flooded water level includes the height of backwater and waves hitting to the surface of foreslope).

In difficult circumstances, especially case of road running through sections with crowded population and inundated water maintaining less than 20 days, determination of calculated flooding frequency shall be

considered in terms of technical, economical points and environmental point also. In such case, when designing, the long-term stability of the structure should be checked and decision making are responsibility of investment decision- makers.

7.3.3 Elevation of the subgrade must be higher than calculated underground water level (or permanent standing water level) according to provisions in Table 22.

Table 22 - Minimum height from calculated under ground water table (or permanent stagnant water) to the subgrade

Units are given in centimeter

Types of filling soil	Number of consecutive days maintaining water level per year	
	Over 20 days	Under 20 days
Silty sand, fine sand, lean clayey sand	50	30
Pumice sand, ponderous clayey sand	70	40
Silty clay sand	120 - 80	50
Pumice sandy clay, ponderous sandy clay, fat clay, ponderous clay	100 - 120	40

7.3.4 The elevation of pavement at the pipe culvert location must be higher than the top of pipe by a minimum height of 0.50m. When the thickness of pavement is more than 0.50m, this difference in height must be enough for construction of the thickness of pavement.

7.4 Filling soil

7.4.1 Filling soil is taken from excavation borrow-pits, digging pits. Soil taken shall comply with principle of mitigating negative impact on environment as mentioned in the Article 7.1.2.5. Digging pits must be designed with a form that will not be detrimental to the surrounding landscape and can be used after completing the construction when necessary.

Soil obtained from all sources must undergo testing and must be placed layer by layer, without mixing up.

All layers are filled interposingly. However, when the drainage layer is put above the layer of difficult drainage, the surface of the below layer must have a cross slope from 2% to 4% for removal of water from the road itself.

7.4.2 Do not use salty and plastered soil (over 5%), mud, peat, alluvium and humus (over 10% of organic composition) for filling soil.

Inside effective area (see 7.1.2.1), do not use ponderous sand with free expansion over 4%.

Do not use silty soil and weathered rock for filling roadbed located in flooded area.

At the location behind abutment and retaining wall, filling material should be granular soil with large internal friction angle.

When using filling material of disposal rock or gravel soil, allowable maximum particle size is 10cm for filling scope inside effective area which is 80cm from subgrade and 15cm from the underneath area; however the largest size shall not be exceed 2/3 depth of compaction layer (depending on type of equipment used for compaction).

7.4.3 Do not use weathered rock and rock likely to be weathered for embankment.

7.4.4 When the embankment is filled by sand, roadbed must be covered at both sides of the slope and the top of embankment to prevent erosion of the surface and facilitate traveling of machines, equipment for embankment construction. Soil covered at slope sides must have plasticity index of equal or over 7; the soil for filling top of the embankment should be hilly aggregate. Do not use loose material for top of the embankment to prevent rain-water, surface water from penetrating into the sand filling.

The minimum coverage thickness at the slope sides and embankment top (subgrade) is 1.0m and 0.3m correspondingly.

When the requirements are not met, the followings should be done:

- To reduce thickness of filling to 0.5m (perpendicular to the slope surface), and to design stability method for preventing slope scouring and anti-penetration method for inside of the roadbed.

- To design method for replacing covering soil on the top of embankment.

7.5 Treatment method for natural ground before filling

7.5.1 Where the natural ground has a cross slope less than 20%, it is a must to remove the organic soil layer, and then filled up the natural ground directly.

Where the natural ground has cross slope from 20% to 50%, it is necessary to bench before filling.

Where the natural ground has a cross slope steeper than 50%, the support works (such as: toe wall, retaining wall, viaduct, balcony bridge etc.) must be considered to be included.

7.5.2 In the area of the embankment bottom, it's necessary to design drainage method for preventing flow on upper side of slope from concentrating on toe of the embankment slope.

In case of the embankment located on field or permanently inundated area, it has to dredge for mud and change the soil. When possible, it's necessary to use loose filling material with filter layer (such as geotextile) for filling in the area of permanent inundation or use lime mixed soil which has cohesiveness for changing soil.

7.5.3 Treatment for weak soil before filling shall comply with 22TCN 262.

7.5.4 Geological investigations and testing must be undertaken in special areas such as soft soil/sand-moving/karst areas, complicated geological area for calculating and finding the structural solutions to ensure roadbed stability. These solutions must be fit with the highway category, structural works and geological condition of the highway location.

7.6 Density of roadbed compaction

7.6.1 Roadbed must be compacted to the standard compaction state as given in Table 23. Besides, the body of embankment which is affected by inundated water or underground water shall obtain the minimum compaction state of 0.95 regardless of highway category. At the location behind the abutment and retaining wall, the required compaction state should be increased from 1% to 2% in comparison with the values given in Table 23.

Table 23 - Standard compaction of roadbed (standard compaction according to 22TCN 333-05)

<table>
<tr><td colspan="3" rowspan="2"></td><td rowspan="2">Depth below</td><td colspan="2">Compaction state</td></tr>
<tr><td colspan="3">Types of roadbed</td><td>Pavement bottom
(cm)</td><td>Highways category I to IV</td><td>Highways category V, VI</td></tr>
<tr><td></td><td colspan="2">When the thickness of pavement is more than 60cm</td><td>30</td><td>≥ 0.98</td><td>≥ 0.95</td></tr>
<tr><td>Embank-ment</td><td colspan="2">When the thickness of pavement is less than 60cm</td><td>50</td><td>≥ 0.98</td><td>≥ 0.95</td></tr>
<tr><td rowspan="2"></td><td rowspan="2">Below the above depths</td><td>Newly filled</td><td></td><td>≥ 0.95</td><td>≥ 0.93</td></tr>
<tr><td>Natural ground*</td><td>Up to 80</td><td>≥ 0.93</td><td>≥ 0.90</td></tr>
<tr><td colspan="3" rowspan="2">Cutting and no-cut/no-fill sections (natural ground)**</td><td>30</td><td>≥ 0.98</td><td>≥ 0.95</td></tr>
<tr><td>30- 80</td><td>≥ 0.93</td><td>≥ 0.90</td></tr>
<tr><td colspan="6">* This is a case of low embankment, the effective area of 80cm as mentioned in the Article 7.1.2 with a part inside natural ground area. In such case, the natural soil part of the effective area shall have the minimum compaction state of 0.90;

** If the natural ground does not meet the required compaction state in Table 23, it’s necessary to remove the unsatisfied soil and compact again to the required state.</td></tr>
</table>

7.6.2 In the effective area, the soil after being compacted must have bearing capacity according to the required CBR mentioned in the Article 7.1.2.1. If the compacted soil does not meet the requirements given in Table 23, or does not obtain the required CBR even after compaction, it's necessary to design soil improvement, strengthening or changing in order to meet both mentioned requirements (testing for determining ratio of lime, ratio of appropriate improvement must be conducted).

7.7 Design of cut slope

7.7.1 Gradient of cut slope

Side slope rate can be selected from Table 24 on the basis of geological structure condition and the height of slope. It's necessary to make investigations on cut slope and natural slope which is stable for a long time with similar geological condition and located in the area adjacent to the designed highway area, in order to have firm basis for determination of the designed cut slope.

Table 24 – Slope of cut sections

Types and condition of soil/rock	**Rate of cut slope when height of slope (m)**	
	≤ 12m	**≥ 12m**
- Cohesive soil or incohesive soil having medium dense to dense state	1 : 1.00	1 : 1.25
- Granular soil	1 : 1.50	1 : 1.75
-Lightly weathered rock	1 : 0.30	1 : 0.50
- Highly weathered rock	1 : 1.00	1 : 1.25
- Lightly weathered soft rock	1 : 0.75	1 : 1.00
- Highly weathered soft rock	1 : 1.00	1 : 1.25
NOTE: As for soil excavation, height of the slope should not be over 20m. As for soft rock excavation, if the surface of the rock layer slopes outward with the slope angle above 25^0, the design slope should be as steep as the rock layer surface and the height of the slope should be limited less than 30m.		

7.7.2 When the slope height is over 12m, it's necessary to conduct the analysis to check stability by appropriate method corresponding to the most unfavorable state (weathered soil, rock saturated with water). As for slope of loose, cohesionless material, a flat sliding surface method should be applied; as for cohesive soil a circular sliding surface method should be applied, the minimum stability coefficient should be equal or bigger than 1.25

As for rock slope, it's necessary to have comparison analysis with gradient of other stable slopes (embankment/ structural slope or natural slope) that exist in the adjacent area.

7.7.3 When the slope has several layers of different types of soil and rock, it is necessary to design various gradients correspondingly making a terraced slope; or at the gradient changing location a berm with width in a range of 1.0m to 3.0m and gradient of 5% to 10% should be placed sloping inward to the gutter; on the berm it's required to build rectangular or triangular drainage gutter ensuring capable to drain water from the upper talus. When the cut slope has not several layers of different types of soil and rock but it is high, it is necessary to design the similar berm as mentioned above, with height between the berms ranging from 6m to 12m.

7.7.4 When the slope structure involves easily falling soils, a berm with a minimum width of 1.0m should be placed between the outer edge of the side ditch and the toe of cut slope. However, there is no need to place this berm when there is a protected wall, or the height of cut slope is lower than 12m.

7.7.5 It's necessary to have improvement methods for preventing slope surface scouring, weathered soil and rock from causing local scour (such as planting grass, shrubs or concrete grid etc.) and when required, it's necessary to construct retaining wall, foot curbs for enhancing stability of the slope.

7.7.6 It's required to have plan for disposing waste soil from the excavation, not to dispose the waste soil randomly to the under slope side resulting in unstable to natural slope, not to dispose to the under fields, garden or watercourses. The disposed area shall be leveled as a plain for planting protective vegetation and considered to have suitable drainage method.

7.8 Design of embankment slope

7.8.1 Depending on the height of the embankment and type of filling material, slope of the embankment is given in Table 25.

Table 25 - Slope of the fill sections

Type of soil/rock	**Slope of the embankment when height of fill slope**	
	under 6m	**from 6m to 12m**
Lightly weathered rocks	1 : 1 ÷ 1 : 1.3	1 : 1.3 ÷ 1.5
Slightly weathered rock with size more than 25cm, dry rip rap	1 : 0.75	1 : 1.0
Crushed stone, graveled stone, sand mixed with gravel, clinker.	1:1.3	1:1.3 ÷1.5
Large and medium size sand, clay, clayey sand, easily weathered rock	1:1.5	1:1.75
Silty soil, fine sand	1:1.75 ÷ 2	1:1.75 ÷2
* See more in the Article 7.8.2		

7.8.2 If the embankment has stone slope, stone size shall be more than 25cm and stacked as dry rip- rap (with small size stone for wedge) in thickness ranging from 1.0m – 2.0m with gradient as given in the Table 25; depending on the gradient of the slope, stone can be stacked in terraced slope (no need uniform slope). Inside the dry rip-rap, stone can be stack as follows: rip-rap a lift of large- size stones, then place a lift of small- size stones above and compact by vibrated heavy roller to make the top stone stable. Trial should be made to determine thickness of the stone lifts, quantity of the inserted stone and number of necessary rolling. Trial result shall be a basis for checking and acceptance (including compaction state) of the stone embankment.

7.8.3 In case of the embankment (if sand) is located on inundated area. Gradient of the embankment slope must be 1:2 – 1:3 for the roadbed under normally inundated water level and 1:1.75 – 1:2.0 for the roadbed under the design water level.

7.8.4 When the embankment slope is relatively high, a berm with width from 1.0 to 3.0m shall be placed for each 8m- 10 m high; there must have cross- fall and masonry gutter on the berm as given in the Article 7.7.3. Besides, the surface of high slope should be strengthened with stone or pre-cast concrete slab.

7.8.5 In case of the slope height is more than 12.0m, checking must be done as stipulated in the Article 7.7.2. When checking the stability of the inundated embankment it's necessary to consider the hydrodynamic pressure caused by hydraulic gradient. Height of soil slope should not be higher than 16.0m and 20.0m for stone slope.

7.8.6 In case that the embankment is high and located on slope side, if the stability checking results are not ensured, treatment methods shall be designed to increase stability (foot curbs or shoulder curbs) by dry rip-rap, masonry or cement concrete.

7.8.7 Embankment slope shall be strengthened with appropriate methods taking into account of the regional hydrological condition and climate to prevent scouring caused by rainfall, water run off, wave and changes of the inundated water level.

7.8.8 Earth borrow pit for embankment shall be planned beforehand and accepted by local authority according to the following principles:

- Taking the most use of the fallow, earth with suitable quality and exploitation condition;
- Not impact on the environment and saving land;
- Combining the earth exploitation with aqua-agricultural works (creating reservoir, fish breeding pond etc.)

8. Pavement and structure of the stabilized shoulder (to be translated)

8.5 Roughness

8.5.1 The top layer, in case of need, should have one more surface roughness layer with a suitable structure to ensure the average sand filling depth H_{tb} (mm) as prescribed in the Standard 22TCN278 depending on the designed speed and/or dangerous level of the designed section as shown in Table 28.

Table 28 Requirement of road surface roughness

Designed speed, V_{tk}, km/h or dangerous level	Sand filling average depth, H_{tb}, mm	Characteristic of surface roughness
<60	0.25≤Htb<0.35	Smooth
60≤V<80	0.35≤Htb<0.45	Smooth
80<V<120	0.45≤Htb<0.80	Average
Road passing the dangerous difficult topographical area (bendy road, curve radius is less than 150m and without speed limit, vertical slope	0.80≤Htb<1.20	Rough

8.5.2 Its able to apply the methods assessing roughness as the …factor by using immediately-breaking specific vehicle when design the top layer of the pavement.

8.5.3 The sections with disqualified roughness should be designed by installing signs of slippery road and speed limit.

8.6 Flatness

8.6.1 The flatness of road surface should be ensured as the international roughness index IRI (m/km) prescribed in the Standard 22TCN 277 and shown in Table 29.

Table 29- Requirement of road surface flatness as IRI

Designed speed, Vtk, km/h	Required IRI, m/km	
	Newly-constructed road	Improved, upgraded road
120 and 100	≤2.0	≤2.5
80	≤2.2	≤2.8
60	≤2.5	≤3.0
From 40 to 20 (asphalted road surface)	≤4.0	≤5.0
From 40 to 20 (low-grade road surface)	≤6.0	≤8.0

8.6.2 Flatness shall be also assessed as 3m long ruler as regulated in 22 TCN16

As for high-grade road surface A1 (asphalt concrete, cement concrete), 70% of air gap should be less than 3mm and 30% of the remaining ones should be less than 5mm. All air gaps should be less than 5mm and 10mm as for high-grade road surface A2 (refer to Table 26) and for low-grade road surface B1 and B2, respectfully.

8.7 Bridge surface

8.7.1 It's required to make a specified design for surface layer of bridge and viaduct and have a similar type of surface layer for the adjoining sections.

8.7.2 It's required to have design method to ensure a safety, smooth traffic circulation on bridge, especially on bridge approach road.

8.8 Pavement Structure

8.8.1 In case there is no central reservation or there is a side median by two markings between the motorized lane and consolidation shoulder (refer to the item 4.5.2), namely the motorized vehicle may encroach or park/stop on the permanent consolidation shoulder, if using soft pavement structure for shoulder, it should be calculated to design as the current pavement standard to satisfy the following requirements:

- Bearing the calculated traveling traffic volume (standardized vehicle/lane/day, night) from 35% to 50% against that of the adjoining motorized lane;

- The top layer of consolidation shoulder should be as the same as the one of the adjoining motorized lane;

- The consolidation structure should be studied in order to be utilized as maximum when proceeding improvement, expanding and upgrading of road surface;

- Satisfying the required minimum numeric value of elastic module as regulated as 22 TCN251;

- Auditing the tension-bending strength and skidding condition of the heaviest wheel possibly parking on the consolidation shoulder (not considering the impulse factor and repeat factor during auditing);

- The consolidation structure of shoulder should be designed as that of pavement in a possible economic condition.

8.8.2 In case there is a side median between the motorized lane and consolidation shoulder of 1st and 2nd grade road to stop the motorized vehicle encroaching or parking on the shoulder (the side median should be 30cm to 80cm higher than road surface, refer to Item 4.5.2), the pavement type and numerous value elastic module shall be applied in accordance with 22TCN211, but reduce one grade, (for example, as for 1st grade road, the shoulder is able to apply the pavement type of both A1 and A2 grade road of which the required minimum elastic module value is corresponding to that of 2nd grade road.

8.8.3 In case the motorized lane is designed as a rigid pavement (cement concrete) and there is no side median to stop the motorized vehicle encroaching or parking on the shoulder, the pavement structure for shoulder should be as cement concrete, but the cement concrete slab of shoulder is 18cm thick as minimum. The cement concrete for shoulder shall be closely jointed at longitudinal joints (connecting the cement concrete slab of the adjacent motorized lane) and at horizontal joints.

9. Design of drainage facilities system

9.1 Planning of drainage facilities system

First of all, a master plan of completed drainage system should be done, including drainage facilities such as intercepting ditch, side ditch, and water receiving ditch, bridge, culvert, underground drain, pit, and evaporation pond etc., these facilities must cooperate closely to each other. Locations, dimensions of the drainage facilities must be reasonable and suitable with the regional drainage plan in order to ensure high effectiveness and low cost.

Arrangement of ditches and canals for subgrade drainage must ensure ability to receive and collect water in order to prevent water from running freely into the subgrade; must incorporate with arrangement of drainage culvert and bridge on the highway, and determine direction of runoff from ditch and canal draining to bridge, culvert or watercourses; methods for connecting drainage ditches with bridge, culvert or watercourses are necessary needed. In contrary, when arranging bridge, culvert, it's necessary to consider requirement of fast draining from ditches and canals.

Arrangement of the drainage facilities on the highway shall take irrigation and drainage requirements into consideration. At the same time flood drainage after highway construction must be considered as well.

9.2 Highway surface and shoulder drainage

9.2.1 On the tangents and curves having radius requires no superelevation (Table 11), highway cross section is designated as a type of two slope with cross- fall values as given in the Article 4.9.

On the curves with radius as given in the Table 13 needs superelevation, the elevation gradient shall comply with the values given in the Table 11 and longitudinal gradient of the section must be 1% to ensure highway drainage and subgrade drainage.

9.2.2 For highway class I and II with median, it's necessary to design gutter near median side to collect rain- water on the superelevation curves. If the median is uncovered, flush type, drainage ditch shall be provided (open or with cover) at the lowest location of the median (dimension of the ditch is 20cm- 30cm wide

and 20cm- 30cm deep). If the median is covered and curbed type higher than road surface, inlet hole and pipe with radius from 20 to 40 cm for carry water from roadbed area to the drainage facilities shall be provided near the median curb, minimum gradient of the drainage pipe is 0.3%. At the location of longitudinal pipe connecting with cross culvert, connecting hole (manhole) shall be provided.

9.2.3 In case of uncovered, curbed and raised separator, inlet shall be provided either on tangent or curve to collect seepage water on the separator and drain out of the roadbed area. It's possible to provide permeable material under the subgrade and placed in the middle of the median, and to place drainage pipe with diameter from 6cm to 8 cm covered with filter material.

9.2.4 On the multi- lane highway class I and II, rain- water on the carriage way is very large, it's necessary to stabilized high embankment sections and slope for protection from scouring or to design 8cm- 12cm high retaining wall of concrete or masonry along out edge of the stabilized parts in order to prevent water from running directly onto highway slope; rain-water from highway pavement shall run along the retaining wall and concentrate on the chute placed on highway slope, and drain out of the roadbed area.

9.3 Side ditch (longitudinal ditch)

9.3.1 Side ditch is constructed to drain rain- water highway surface, shoulder, cut slope and area of two sides of highway on cut subgrade, part- cut and part- fill subgrade, fill subgrade lower than 0.60m.

9.3.2 Dimension of side ditch under normal conditions is designed by fixed form, not need hydraulic calculation. Only if the side ditch is used to drain not only surface water on the pavement, shoulders and right-of- way but also water on the catchments on highway sides, shall side ditch dimension be calculated by hydraulic formula, but depth of ditch shall not be over 0.80m.

Ditch cross- section can be trapezium, triangular, rectangular or semi- circular. The common use is trapezium ditch with bottom width of 0.04m, minimum depth from natural ground is 0.30m, and ditch slope of cut roadbed is equal to that of the cut roadbed slope based on geological structure, ditch slope of cut roadbed is 1: 1.5 ÷ 3. It can be used triangular ditch with depth of 0.30m, slope toward carriage way is 1:3 and the opposing side is 1:1.5 as for fill roadbed, and 1: m based on slope m of the cut roadbed; at the location with geological condition of rock, it can be used rectangular or triangular cross-section.

9.3.3 In order to avoid mud and debris deposition on ditch bed, ditch bed gradient shall not be less than 0.5%; in special case, it's possible to be 0.3 %.

9.3.4 When planning the surface water drainage system, it's noted that drainage water is prevented from draining from ditch of fill roadbed to cut roadbed, except case of the roadbed length is shorter than 100m, water from intercepting ditch, directing ditch etc must be prevented from running into longitudinal ditch and water in the longitudinal ditch must be drained to hollow place, watercourses near the highway or through across drainage facilities. Culverts with minimum diameter of 0.75m shall be placed at maximum 500m away from the trapezium ditch and at 250m away from the triangular ditch to drain water from side ditch to adjacent mountain sides. As for fix form culvert, no hydraulic calculation is required.

9.3.5 A place where water drains from side ditch shall be far away from the road embankment. If there is a pit hole near fill roadbed, longitudinal ditch of the cut roadbed is designed toward the pit hole. If there is no pit hole, longitudinal ditch of the cut roadbed is placed parallel to highway centerline, until reaching the location where fill roadbed is higher than 0.50m, the ditch shall be designed so as to separate from the roadbed until its depth is zero.

9.3.6 As for agricultural land, if the ditch is used as an irrigation/ drainage canal, its dimension shall be increased and at the same time roadbed needs treatment methods to avoid sliding and scouring.

9.3.7 Through residential area, side ditch should be designed as masonry or concrete type and paved with closed grate, and provided with inlet system.

9.3.8 Side ditch in tunnel should be bigger in dimension compared with normal one in order to increase drainage capacity and should be of masonry or concrete type.

9.3.9 At the sections with gradient of ditch steeper than gradient value causing ditch bed scouring , it's necessary to base on runoff velocity to design suitable stability method (stone patching, masonry, concrete). In possible condition, ditch be should be stabilized by dry rip-rap or masonry, independent to ditch gradient in order to ensure drainage capacity of the ditch and to minimize maintenance works.

9.4 Intercepting ditch

9.4.1 When catchment area of the mountain side running toward the highway or cut slope height is ≥ 12m, intercepting ditch shall be provided to receive water running down to highway and to carry water to drainage facility, and watercourses or hollow area near the highway; do not let the water running directly onto the side ditch.

9.4.2 Intercepting ditch shall be planned suitably with alignment, longitudinal gradient and drainage cross-section. Intercepting ditch must be designed as triangular cross- section, minimum bottom width of 0.50m and slope of ditch bank is 1: 1.5, depth of ditch is determined by hydraulic calculation and calculation water level in the ditch must be ensured to be at least 20cm lower than ditch edge, it should not be deeper than 1.50m.

9.4.3 When intercepting ditch is remarkable long, it should be divided into short segments. Calculated discharge of each section is equal to the discharge volume through its last section, it means that discharge volume of the catchment running directly to the calculated ditch segment plus all discharge volume of the catchment of the upper segments.

9.4.4 Gradient of the intercepting ditch is normally selected by area condition so that runoff velocity shall not cause ditch bottom scouring. Under compulsory circumstance required by area topography, intercepting ditch must be designed with big steep, it's necessary to have suitable stabilized method for ditch bottom. It's best to stabilize by block stone or concrete slab, or to design the ditch having chute or drop water. To avoid mud and debris depositing in the ditch, gradient of the ditch shall not be less than 3‰ ÷ 5‰.

9.4.5 At the area with steep mountain side, large catchment area, sliding- prone geology, it's possible to build two or more intercepting ditches. In contrary, if the cross slope of hill side is small and catchment area of

water running to the longitudinal ditch is not large, it need not to build intercepting ditch but drainage capacity of the side ditch should be checked.

9.4.6 Location of intercepting ditch is at least 5m away from edge of cut roadbed slope. And soil taken from intercepting ditch excavating shall be used to embank a small dyke in the direction toward the terrain slope (lower side); dyke surface has cross slope of 2% toward the ditch and dyke foot is at least 1m away from edge of the cut roadbed slope.

In case of intercepting ditch is provided to prevent water from running to fill roadbed, the ditch shall be at least 5m away from the edge of side ditch if having side ditch, otherwise shall be at least 2m away from toe of fill roadbed slope; soil taken from intercepting ditch excavating shall be used to embank a small dyke in the direction toward the roadbed; dyke surface has cross slope of 2% toward the ditch.

Intercepting ditch should not be placed too far away from the roadbed because effectiveness of the ditch shall be limited.

9.4.7 At deep cut section, terraced slope shall be applied to prevent water from causing scour on slope, it's necessary to arrange drainage ditches along slope berms and at the end of the ditch, water is concentrated in the chute or drop water to drain to watercourses or bridge, culvert of chute or drop water type.

9.4.8 Frequency for calculating discharge of intercepting and side ditch is 4%.

9.5 Drainage ditch

9.5.1 Drainage ditch is designed to carry water from local hollow area to the nearest drainage facility or from longitudinal ditch intercepting ditch to hollow area or bridge, culvert, or to connect watercourses with culvert downstream.

9.5.2 Drainage ditch should not be longer than 500m. Soil taken from intercepting ditch excavating shall be used to embank a small dyke along the ditch. If the drainage ditch is arranged along roadbed, edge of ditch shall be at least 3m and 4m away from toe of slope, there shall be a 0.50m – 0.60m high protecting dyke between ditch and roadbed.

9.5.3 Ditch direction should be selected as straight as possible. At direction change locations, curve radius shall be 10 to 20 times as much as the surface width of the ditch, but not less than 10m.

9.5.4 Cross- section of the ditch is determined by hydraulic calculation, but ditch depth should not be less than 0.50m and ditch bottom should not be less than 0.40m; edge of the ditch shall be at least 0.40m higher than flowing water level in the ditch.

9.5.5 Frequency for calculating discharge of the drainage ditch is equal to that of relevant drainage structure.

9.6 Chute and drop water

9.6.1 At the location drainage ditch having big slope, it's necessary to make chute or drop water in order to prevent structure from scouring caused by runoff. Selection of drainage facility is based on comparison of alternatives depending on specific conditions. Chute and drop water are normally used at ditch having big slope, connecting between culvert upstream, downstream and natural watercourse bed; at section with drainage

ditch from drainage facility running along cut or fill roadbed slope, section connecting intercepting ditch with watercourse or bridge, culvert.

9.6.2 Cross- section the chute is commonly rectangular type, its width and depth is calculated by hydraulic condition, depending on design discharge, slope of chute and velocity permitted for non- scouring of the material for chute and depending on dimensions of structure connecting with the chute.

9.6.3 Chute structure can be concrete, reinforcement concrete, masonry. In order to reduce runoff velocity of the chute, chute bottom shall be made rough and at the end of the chute there is commonly energy dissipation pond (well) or energy dissipation wall.

9.6.4 Drop water with energy dissipation pond is normally used when drainage canal and ditch gradient is very steep. Drop water cross- section is rectangular, made of concrete or reinforcement concrete, stone. Drop water width and height; pond depth and length; and energy dissipation wall height and thickness are calculated by hydraulic formula and depending on dimension of the adjacent structure to the drop water.

9.6.5 Structure of chute and drop water is designed by typical designing. In case of suitable typical designs are unavailable, it's possible to refer to the following regulations.

- Height of chute and drop water is higher than the minimum calculated water level of at least 0.20m.
- In order to be skid- resistant, the chute bottom shall be designed so as to be embedded about 0.30- 05.0m into the ground per each interval of 2.5- 4.0m;
- Gradient of the chute should not steeper than 1:1.5. If the gradient is more than that, drop water shall be designed;
- Drop water is normally designed with the height of each berm is 0.30m- 0.60m and gradient of berm surface is 2%- 3%.

9.6.6 Frequency for calculation of design discharge of chute and drop water is adopted the calculated discharge frequency of the structures relating to the chute and drop water.

9.7 Under- ground drainage facilities

9.7.1 On the highway sections with high underwater level or underground water running down from slope and the highway has possible risk of unstable roadbed must have appropriate treatment methods.

9.7.2 Depending on particular case, following type of under- ground drainage facilities can be used:

- Under- ground ditch is placed deeply under longitudinal ditch, shoulder, subgrade in order to reduce under- ground water level under the carriage way.
- Under- ground ditch is placed inside the cut roadbed slope in order for the highway slope to be ensured unwetted and to prevent the under- ground water from seeping through foreslope to outside;
- Under- ground ditch is placed behind retaining wall, and wing of tunnel and abutment.

9.7.3 Under- ground drainage ditch can be in form of open or close ditch. The open type is only be used when the under- ground water level is high; and the close type is normally used when the under-ground water

level is deep. Bottom width of the under-ground ditch is from 0.30m to 1m depending on depth of the ditch and construction conditions.

9.7.4 Structure of the close under- ground drainage ditch is designed according to general diagram as follows: The uppermost top of the ditch is cover by impermeable material (soil) compacted closely to prevent rain water from seeping into the ditch; after that is the 2 layers of reversed turfs to prevent soil from dropping to underneath filter material; under the turf is sand layer and then a layer of crushed stone or cobble stone; the undermost bottom is provided with pipe or drainage tunnel to increase drainage capacity.

9.7.5 In case of using under-ground drainage ditch at positive slope of cut roadbed to prevent under-ground water from running outside, it's necessary to use under-ground drainage ditch with impermeable retaining wall one side running along the ditch, and reverse filter layer at the other side.

9.7.6 Stone used for covering the ditch is un-weathered and undissolved (in water) type, pipe commonly used for the under- ground ditch is concrete pipe with minimum diameter from 15cm to 20cm or can be terracotta, brick or stone with diameter of 30cm – 50cm, length of each segment of the drainage pipe is 0.3m – 0.6m; drainage pipe is placed next to each other with clearance of 1cm- 0.5cm to allow water to run into the drainage pipe.

10 Bridges, Culverts, Tunnels and other water crossing structures

10.1 The various types of bridges (river bridge, railway bridge, flyover, viaduct, etc.,), culverts and tunnels on highway is designed as the sectional standards.

10.2 Cross-section of the various bridges and tunnels on highway should satisfy the requirements of traveling vehicle, as specified in the Article 4.10.5

Dimension, shape and characteristic of cross-section of bridge and tunnel should be suitable with their approach roads; dimension of the traveled way on the bridge is unchanged; in a difficult condition, its allowed to narrow the different elements of bridge cross-section, but do not change the cross-section of approach road toward bridge and tunnel. As for small-sized bridges, its cross-section is not allowed to be narrowed in comparison with the highway design standards.

10.3 The central reservation on bridge is composed as follows:

- In case the width of central reservation is less than 3m, the composition of its surface should be similar to that of traveled way on bridge deck, and provided with separated fence and safety equipments;

- In case the width of central reservation is more than 3m, it's able to keep space, arrange a lane of 0.75 wide and 0.25 high covered by a separated fence and safety equipments.

10.4. The horizontal and vertical alignment of bridge and tunnel such as minimum curve radius, super-elevation curve, transition curve, super-elevation, expansion, maximum gradient, minimum vertical curve radius, etc., should comply with the design standards prescribed to each type of road class. However, as for large-sized, medium-sized bridge and tunnel, it should not be designed with the gradient more than 4% to

increase the traffic capacity and convenience as well as the traffic safety; and with small curve radius, it's necessary to arrange an extension section for roadway.

In case there are vertical crest curve at both approach roads, in order to make transition of the section from elevation of bridge surface to elevation of embankment passing river plain, it's required to arrange one section near the bridge approaches with the same elevation of bridge profile to create a vertical curve, and ensure the connection point of the vertical curve is 10m far from bridge as minimum.

10.5 The selection of river bridge location should satisfy the economic, technical, geological, hydrological requirements, convenience and traffic safety as well as make a comparison with the following criteria:

10.5.1 The economic, technical criteria and environment protection

- Total construction cost
- Minimum construction time;
- Utilizing local material;
- Navigation clearance under bridge is convenient and safe;
- Minimum affect of bridge construction on surrounding environment;
- Convenience and traffic safety.

10.5.2 Hydrological, topographical and geomorphologic condition

- Riverbed should be stable, straight;
- River width should be the narrowest, with small floodplain, deep water, no branch, without old tributary and marsh;
- Flow regime is less changeable;
- Direction of flow in the flood season and dry season is nearly parallel to each other;
- As for large and medium bridges, bridge centerline must be perpendicular to the main channel. In difficult circumstances, it's possible to be skewed with the main channel but must ensured safety for navigation river; or to be perpendicular to the valley and skewed with the main channel if no navigation clearance is required. The bridge opening shall not be designed so as to contract the main channel width.

10.5.3 About geology, location which is be selected, shall has rock layer condition basically similar to the riverbed condition, good and stable river bank soil, and avoid scouring, karst and plaster area.

10.6 Calculated hydrological frequency for structures on the highway is given in Table 30

Table 30- Calculated hydrological frequency for structures on the highway (Unit is given in %)

Structure Name	Highway category		
	Expressway	I, II	III to VI
Embankment, protection work	According to calculated frequency for bridge and culvert		
Large and medium bridge	1	1	1
Small bridge and culvert	1	2	4
Intercepting and side ditches	4	4	4

NOTE:

1) Generally, the improved and upgraded highway shall comply with regulations on design flood frequency as same as to the newly- constructed one. In case of technical difficulties and large quantity requirements rising, specification for calculated frequency given in the Table 30 is allowed to be reduced, but need approval from relevant authorities.
2) If during surveying, it has investigated the historic flood water level that is higher than flood water level calculated by frequency given in the above table, it's necessary to use historic flood water level as a value for calculation for large bridge.
3) On the highway running through urban and residential areas, design elevation of roadbed shall comply with design elevation of the master plan for the area and calculated flood frequency of drainage facilities and roadbed shall be in accordance with design standard for urban road.
4) With large bridge, $L_c \geq 100$m; medium bridge, 25m $\leq L_c < 100$m; small bridge, $L_c < 25$m. Where: L_c is drainage opening clearance.

10.7 Culverts constructed under embankment must be as long as the roadbed width, there is head wall and wing wall at the top of culvert to prevent embankment slope stability from sliding, resulting in roadbed scour by water penetration. Minimum thickness of the embankment above pipe culverts and box culverts without reinforcement but under truck loading is given in the Article 7.3.4.

Compaction of embankment over culvert shall ensure the same compaction of roadbed; soil filling for embankment on the culvert shall be the same type of the roadbed.

Culverts constructed on upstream excavation section must have receiving hole to collect runoff from side ditches and watercourses. In case that the culvert is placed deeply and high runoff, receiving hole shall be replaced with energy-dissipation structures, and chute for directing runoff from watercourse to the culvert shall be provided. In case the deep excavation crossing with runoff, it's necessary to consider aqueduct installation alternative to carry water across the highway.

Minimum opening regulated is 0.75m with length not more than 15m. To facilitate repair and maintenance works, culvert with opening of 1m and length less than 30m is necessarily used. Culvert with opening of 1.25m and 1.5m its permitted length must be more than 30m.

In general, culvert opening is selected under unpressured regime. Pressure and semi-pressure regime is only applied for high embankment section, and section with soil filling is not a permeable type to which water from culvert upstream is difficult to penetrate into the roadbed. Longitudinal gradient of the culvert should not be

steeper than that of runoff at culvert downstream. Culvert gradient shall be from 2% to 3% to prevent mud and debris from collecting on the culvert bed.

10.8 At river crossing sites, if it is not yet possible to build a bridge, a ferry or a pontoon bridge can be installed. Roads approaching to ferry or pontoon bridge must have normal slope of 8% to 12% depending on area condition, and must be at least 9m wide, paved by cement concrete or block stone.

10.9 On the low category highway, if it is allowed to be closed traffic, it's possible to construct submersible road or tunnel for the following cases:

- Over wide, flat river plain, with water depth is mostly not high.
- Over slow watercourse;
- Over hollow area at the mountain foot;
- Submersible road can be combined with culvert or submersible bridge in order to limit standing water at the upstream of the submersible road and increase drainage capacity of the submersible road when high flood occurs;
- Maximum inundated water depth that allow vehicle to travel on the submersible road is given in Table 31.

Table 31 - Permitted value of inundated water depth above submersible road

(with design flood frequency of 4%)

Water velocity, (m/sec)	**Permitted maximum inundated water depth (m)**		
	Car	**Chained vehicle**	**Non-motorized vehicle**
< 1.5	0.5	0.7	0.4
1.5 - 2.0	0.4	0.6	0.3
> 2.0	0.3	0.5	0.2
* In special case, determination of design flood frequency might be considered for selection as mentioned in the Article 7.3.2			

Minimum traveled way of the submersible and underpass roads is 7m; its pavement is of cement concrete or block stone. Gradient of the submersible road slope at upstream side is 1: 2 and 1: 3 to 1:5 at downstream. Slope surface must be protected from scouring by concrete or masonry. Toe of slope at downstream side must have anti- scouring method which is retaining wall made of block stone with minimum depth of 0.70m. Along

toe of highway slope, riverbed must be protected from scouring. Width of protected area is 2m toward upstream side and (2.5- 3) times of water flowing velocity toward downstream. Projecting materials commonly used are dry riprap or cement mortar.

Two approach roads of the submersible and underpass roads must have guide signs for indicating water level permitted for vehicle travel through. System of marker post shall be placed along submersible road to guide traveled way area and inundated water depth gauge on the submersible road, which can be viewed by drivers.

11. Intersections.

11.1 General requirement

11.1.1 Intersection is a place where are many traffic conflicts, accidents causing in congestion. Task of intersection design is to solve the traffic conflicts (absolute or limited) in order to obtain the following objectives:

- to ensure capacity through the intersection appropriately and ensure quality of the traffic flow;
- to ensure traffic safety;
- cost-effectiveness;
- to ensure landscape and environment hygiene;

In which the two first objectives are very important, need being complied.

11.1.2 When designing intersection, following factors are necessarily taken into consideration:

a) Traffic factors:

- Function of the existing cross roads in the road network;
- Traffic volume of: vehicles entering the intersection, vehicles of turning movement at present (existing intersection), and anticipated (20 years for basic construction, 5 years for short- term traffic organization); daily average traffic volume, peak hours volume;
- Composition of traffic flow, typical characteristics of special vehicles;
- Pedestrians volume;
- Parking stations in the intersection area (if any).

b) Physical factors:

- Topography of the intersection location and natural conditions;
- Regional planning and drainage conditions;
- Angle of intersection and improvement possibility;

- Environmental and aesthetic requirements.

c) Economic factors:

- Construction, maintenance costs;

- Land acquisition costs and compensation costs:

- Norms of technical- economic analysis.

d) Landscape factors;

e) Human factors:

- Habits, disciplines, skills of the drivers;

- Disciplines, social knowledge of road users and roadside residents.

11.1.3 Intersection classification

Intersection classification is based on conflict solving methods:

a) Grade-separated intersection, using structures (tunnel or bridge) to separate traffic flow for conflict solving. Two main types are:

- Interchanges: there are ramps in the interchange for vehicles to change direction;

- Flyover: without ramps. The main traffic movement passes through the intersection via structures to separate from other traffic movement.

b) At-grade intersection:

- Simple intersection: conflicts might be acceptable (when traffic volume less than 30 PCU/h and speed of turning vehicle under 25km/h). This type can be widened or not;

- Channelized intersection when some traffic movements having requirements (about turning volume and turning speed), these turning lane shall be separated, have protection (by island, marking and called channelized intersection). The channelized intersection shall define intersection angle which is advantage for conflict, create area for waiting vehicles before crossing other traffic flow.

- Roundabouts: to transfer dangerous conflicts of crossing type to conflicts of weaving type.

c) Signal controlled intersection: conflicted traffic movements are separated by time- divided. This type is not recommended for highway, especially when the design speed is more than 60km/h.

11.1.4 Selection of intersection. Selection is mainly based on factors (in the Article 11.1.2), technical-economic norms, taking the most use of designer's creativeness, when necessary it's possible to refer to data of traffic volume in intersection given in Table 32.

Table 32- Scope of application of intersections

Traffic volume on main highway, PCU/day and night	**Traffic volume on side road,** PCU/day and night			
	Simple intersection	**Intersection with island on side road**	**Intersection with island, waiting lane and lane for left-turning movement on main highway**	**Other types**
≤ 1000	≤ 500	500 ÷1000	-	-
≤ 2000	≤ 500	500 ÷ 2000	-	-
≤ 3000	≤ 450	450 ÷ 1000	1000 ÷1700	≥ 1700
≤ 4000	≤ 250	≤ 250	250 ÷ 1200	> 1200
≤ 5000	-	-	≤ 700	> 700
> 5000	-	-	≤ 400	> 400

11.2 Grade- separated intersection

11.2.1 Structures and clearances

Determination of using structure (over or under) is based on following principles:

- Giving priority for priority direction;
- Taking the most advantages of topography and favorable conditions when construction;
- Harmony with other intersection on the alignment;
- Through technical- economic analysis.

The structures should follow the clearances stipulated in the Article 4.7.

11.2.2 Carriage way on the main line of the grade- separated intersection.

In the grade- separated intersection, the carriage way of the main line should not be narrowed down in comparison with that at near (approach) and far (exit) side of intersection. Besides, considering:

- The median of underneath road must be widened adequately for providing structural supports and safety devices if over-passing having pier;

- Each direction should be added with one 3.75m wide collector lane at the right side of the traveling direction- The collector lane should be length enough to be a speed change lane for vehicles from ramps entering into the main line and vice versa (according to Article 4.8);

- One more 1.5h wide part should be added (where h is curb height of the sidewalk)

11.2.3 Left- turning ramp is classified into 3 types:

- Indirect left- turning type (turning head through 270^0)

- Semi- direct left- turning type (turning head through 90^0 on three quadrants);

- Direct left- turning type (turning head through 90^0 on one quadrant).

The indirect left- turning type is taken into consideration when left- turning volume is less than 500 PCU/h.

The semi- direct left- turning type is taken into consideration when left- turning volume is more than 500 PCU/h.

The direct left- turning type is taken into consideration when left- turning volume is more than 1500 PCU/h.

11.2.4 Cross- section of the left and right turning ramps

Cross- section of the ramps (left and right turning) is determined according to the Article 4.2. However it's necessary to follow the minimum provisions as follows:

- When ramp length is more than 80m, dual lane shall be placed.

- When ramp length is less than 80m, single lane might be designed but it's necessary to arrange stabilized shoulder under circumstance that a truck overtakes another truck parking on the road.

11.2.5 Design speed in the grade- separated intersection is given in Table 33.

11.2.6 Distance between interchanges with ramps must be not less than 4km.

Table 33 - Design speed of turning ramps (Units are given in kilometer per hour)

Maximum design	**With the speed-change lane at the entrance and exit of turning ramp**		**Without the speed-change lane at the entrance and exit of turning ramp**		**Design speed of ramp**
speed *	**Recommended minimum speed**	**Absolute minimum speed**	**Recommended minimum speed**	**Absolute minimum speed**	

120	90	80	80	60	50
100	80	70	70	50	45
80	65	55	55	40	40
60	50	40	40	30	30
* Selecting the higher speed in the design speeds of intersecting roadways					

11.3 At- grade intersection

11.3.1 Alignment and intersection angle

- Alignment on the intersection should avoid curvature, when curvature is necessarily used its radius should not be smaller than common minimum radius of the highway category;

- The best angle of intersection is square angle. When the intersection angle is smaller than 60^0 alignment improvement should be considered to improve the intersection angle;

- Intersection point should be located on flat place. When gradient is over 4%, sight distance should be corrected;

- Profile of the side road should not interfere or change the cross- section of the main line. When the two highways are at the same category, priority should not be given unequally; vertical alignment shall be designed so as to ensure good traffic continuity and water drainage.

11.3.2 Design vehicle and design speed

11.3.2.1 Design vehicle: when volume of passenger car is more than 60% and less than 60%, design vehicle can be passenger car and truck correspondingly. Trailer can be used as design vehicle when the volume of trailers is more than 20%.

11.3.2.2 Design speed at turning path:

a) With straight movement, using design speed of the main highway;

b) With right turning movement, design speed is 60% less than that of the main highway.

c) With left turning movement, design speed has two cases:

- Minimum design speed is not more than15 km/h;

- Higher design speed is not more than 40% of the design speed on the open-road.

11.3.3 Super-elevation and side friction factor

Maximum super-elevation at intersections is 6% and not over 4% when crossing residential area.

Side friction factor permitted to be used at intersections is 0.25.

11.3.4 Sight distance at intersections

There must be a field of vision at intersection (as illustrated in Figure 4), which is limited to:

- vehicles on the no-priority roadway is away from the conflict point at a distance of stopping sight of

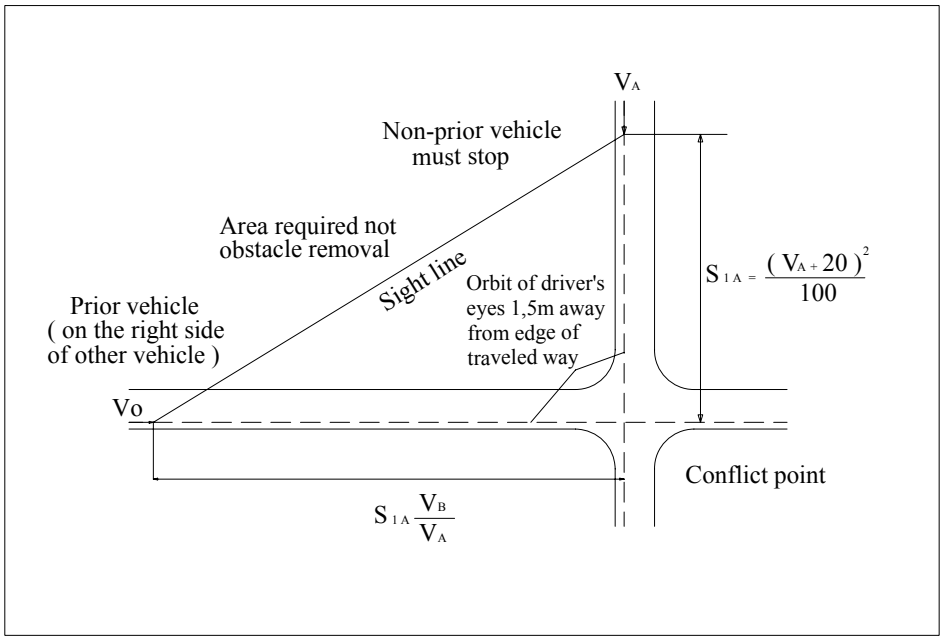
$$S_{1A} = \frac{(V_A + 20)^2}{100} \text{ m;}$$

vehicle operator on the no-priority roadway observes a priority vehicle approaching (on the right hand) when it is far from the conflict point at a distance of $S_{1A} \frac{V_B}{V_A}$

in which:

VA is design speed of no-priority vehicles, in kilometer per hour;

VB is design speed of priority vehicles, in kilometer per hour;



NOTE - the hatched section means area required not to remove obstacles

Figure 4 - Sight distance at four-leg intersection, the predominant is on the right

11.3.5 Speed change lane

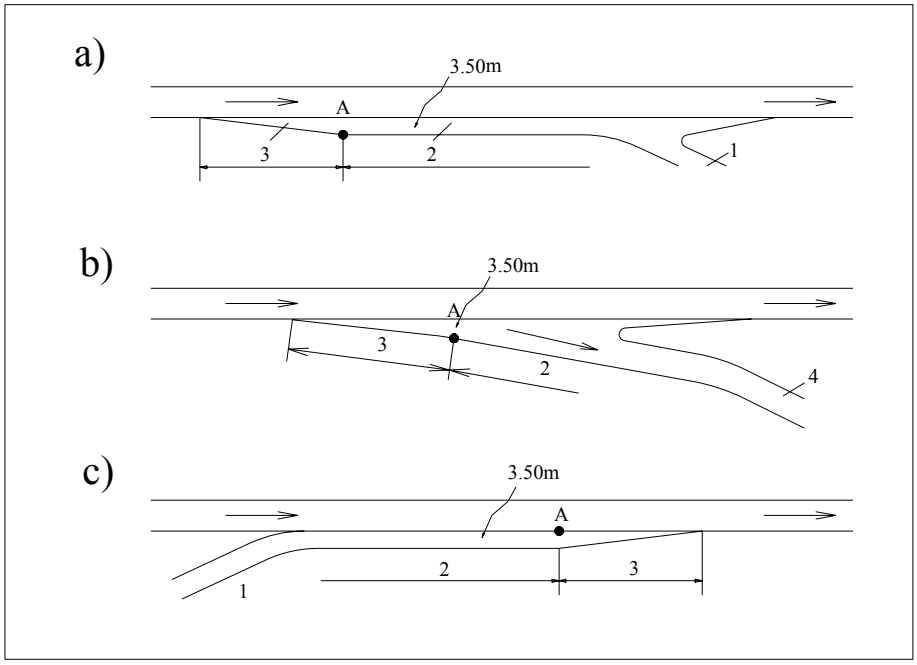
Speed change lane is provided at location where vehicle turns into the other highway category. Acceleration lane shall be provided at the location where vehicle on the low design speed highway entering into the higher one. On contrary, deceleration lane shall be provided.

11.3.5.1 Deceleration lane is parallel or direct connected (see Figure 5a and 5b) and acceleration lane is parallel (see Figure 5c).

11.3.5.2 Speed change lane is 3.50m wide. Minimum length of the taper is 35m (1m of widening on 10m length). Length of the speed change lane is 1m/s^2 and 2 m/s^2 according to positive acceleration and negative acceleration correspondingly. Length of the deceleration lane and the acceleration lane is not less than 30m, and 120m correspondingly.

11.3.5.3 Speed change lane should be located on the longitudinal grade of less than 2%. When grade is compulsory more than 2%, correction by grade or multiplying with 1.2 should be considered.

11.3.5.4 Sight distance should be ensured at the exit and entrance of the speed change lane to the main lane to which vehicles shall enter.



NOTE:

a) Parallel exit

b) Direct connected exit;

c) Entrance to the expressway;

Parallel type

1- Ramp;

2- Speed- change section (Figure a) and b): deceleration; Figure c): acceleration)

3- Tapered lane change section;

4- Ramp acting as speed change lane and lane change

Figure 5- Diagram of speed change lane arrangement

11.3.6 Island in at-grade intersection

a) An island is a defined area for the following purposes:

- Reduction of excessive pavement areas between turning lanes;
- Clear channelization of turning movement;
- Fixing conflict points and providing advantageous intersection angle for conflicted movements;
- Providing a protection area for stopping vehicles to wait for turning or entering the main movement;
- Providing a refuge area for pedestrian;
- Location of traffic control devices.

b) Principles of arrangement and forms of islands:

- Fewer islands are preferred;
- Large islands are preferred to small one;
- Islands should be placed so as to: provide an advantage for the predominant traffic directions, obstruct traffic directions where the slow movement is needed, prevent prohibited traffic directions, and provide clear arrangement on intersection, help unhesitant continuity of traffic.

c) Offset of the island:

In order to prevent vehicles from colliding to island, the island needs offsetting to the edge of the nearside lane providing the island offset. The offset at the entrance direction of the island is regulated from 1.0m to 1.5m. The offset at the exit is 0.5m. The island periphery is obtained by connecting even curves; island nose is rounded with radius of 0.5m.

Pavement at the island offset is similar to that of the carriageway, and marked with zebra-marking.

11.4 Railroad grade crossing

11.4.1 A railroad-highway grade crossing must be placed outside the range of railroad stations, wagon gathering track, entry of railroad tunnel and signal lighting poles at the station entrance. The best intersecting angle should be a right one, it must not be smaller than 45^0.

11.4.2 Railroad-highway grade crossing should not be applied in the following cases:

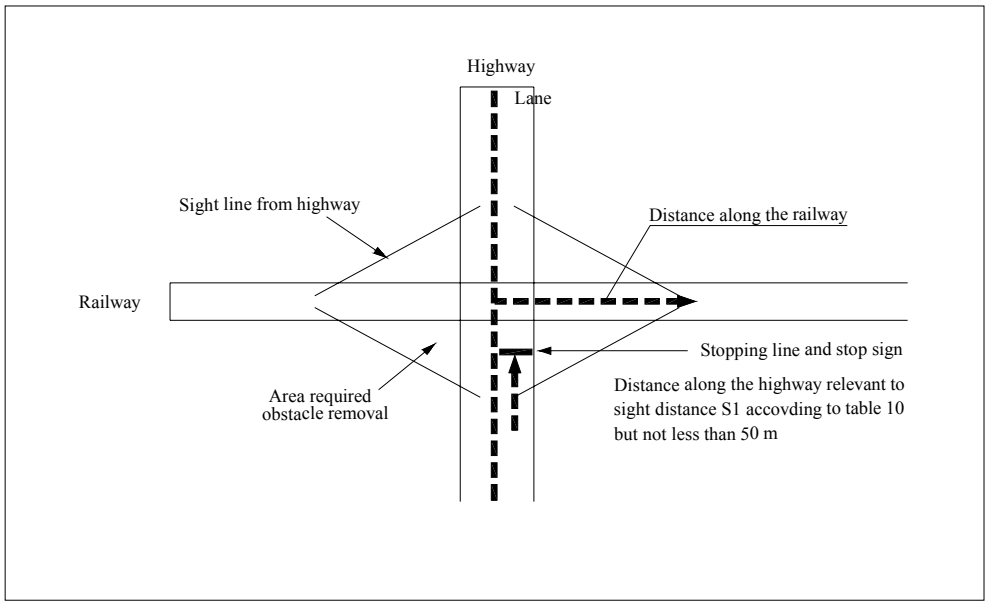
- Highway with design speed $V_{design} \geq$ 80km/h crossing a railroad;

- Highway with design speed $V_{design} <$ 80km/h crossing a high-speed railroad (120km/h), especially where adequate sight distance is not available.

11.4.3 An adequate sight distance must be ensured at railroad-highway at-grade crossing (where there is no barrier or flagman) so that the highway driver can observe the approaching train. Particularly, unobstructed area for sight distance availability should be ensured, as shown in Figure 6 and Table 34.

Table 34- Distance required obstacle removal along the railroad from the crossing

Maximum speed of the train on the crossing section, km/h	120	100	80	60	40
Distance along the railroad, m	400	340	270	200	140



***** When the actual area is limited, it's possible to provide "Stopping line" and "Stop sign" on the highway, placing 5m away from the edge of the outside rail according to the 22TCN 237. Sight distance of 5m must be ensured along the highway and along the railroad with the values given in the Table 34.

Figure 6 - A sketch of unobstructed area for sight distance availability at railroad-highway at-grade crossing

11.4.4 Width of highway carriageway at a railroad at-grade crossing to both sides should not smaller than 6m with length of a stopping sight distance S1 in Table 10 calculated from the outside rail edge plus 5m.

11.4.5 At a railroad crossing, the highway must be made level (0% gradient) or provided the same longitudinal gradient as the superelevated rate of railroad in the minimum area of 16m (in which successive vertical curve is excluded), or it is allowable to reduce to10m in difficult case.

11.4.6 Highway structure at the intersection should be reinforcement concrete slabs with minimum length of 2.0m each side from the outside rail edge; it's allowable to reduce to 1.0m in difficult case.

11.5 Other intersections

11.5.1 In the range of electricity lines, telephone lines, the highway design must follow the requirements of the respective management departments and following instructions:

- Minimum vertical distance from the road surface to telegraph/telephone lines crossing highway is 5.5 m;

- Horizontal distance from the edge of roadbed to the posts of above-mentioned lines must be not less than four-third of post height and not lower than 5m.

11.5.2 Horizontal and vertical distances from the highway to the electricity lines are in accordance with the existing regulations.

11.5.3 When the highway crosses with pipes such as water pipe, gas pipe, oil pipe, energy pipe, underground power lines, it's necessary to comply with the existing regulations of the relevant section.

12. Traffic Safety Devices on highways

12.1 Signs

The 22TCN 237 shall be applied.

12.2 Traffic Pavement Markings

The 22TCN 237 shall be applied.

12.3 Guide posts, guardrails.

12.3.1 Guide post functions as direction guiding, Guide posts are necessarily placed on the ea soil part of shoulder when the down slope is high from 2m upward on the curve with small radius and approach roads of bridge; guide posts spacing are given in Table 35. When there are guardrails, guide posts need not to be placed.

Table 35 - Spacing of guide posts on horizontal curvature radius

Units are given in meter

Horizontal curve radius	Distance between guide posts
on the tangent	10
> 100	8-10
from > 30 to 100	4-6
from > 15 to 100	2-3

The cross section of guide posts may be circular, square, and triangular but its dimension must not be less than 15cm. The height of guide posts is 0.60m above shoulder elevation and that of the underground section is not less than 35cm.

Painting colors used for guide posts follow the instructions of the regulation on road signs. It is recommended to use reflectorizing paint, or to paint at least a reflectorizing stripe of 4cm wide, 18cm long at about 30 to 35cm beneath the top of posts and towards traveling direction.

12.3.2 Guardrails must be placed on the highway where the embankment height is over 4m, on bridges, viaducts, overflies, location of piers and abutments of underpass/overpass, pedestrian paths in tunnels etc.

Railings may be made of concrete or corrugated steel may be used. The cross section of steels is at least 4mm in thickness, 300 to 350mm in height and it should be formed in corrugated shape for increasing rigidity.

Railing bars and posts are designed and checked based on strength requirements given in Table 36.

Railings must extend over the protection areas by at least 10m on both sides.

12.3.3 When railing bars and posts are made of equivalent materials, mechanical conditions must be checked following the requirement in Table 36

Table 36 - Minimum requirements for guardrail

Force elements	Calculated force, kN
Corrugated iron for railing under flexural force between two posts:	
- in the direction from the centerline to the edge	9
- in the direction from the edge to the centerline	4.5
Steel for post, expulsive force at the top of it	
- in the direction of traffic movement	25
- in the perpendicular direction to traffic movement	35
Bolt: All directions	25

Push force at each railing section	400

12.4 Lighting

Highways are not artificially lighted on their alignment, except some particular circumstances that artificial lighting may be considered at the following places: large intersections, long bridges, tunnels and residential areas. The difference in illumination between lighted place and unlighted one is not more than 1 candela/m^2 over the 100m long for preventing glare.

13. Auxiliary works

13.1 Planting

13.1.1 Planting is the must of the highway project. Planting has the following purposes: protecting works, providing shade zone, creating landscape, guiding direction etc. At the same time, it can reduce traffic noise and dust, and prevent the glare for opposing vehicles.

13.1.2 Turf: turf must be grown on separators and islands without covers, dikes which are left over near the highways.

Fill slopes and cut slopes must be grown with turf by ways of seeding or assembling grass pieces etc. for preventing erosion and improving highway landscape.

The selection of seed species must follow consultation with agronomists, and combination various grass varieties should be considered so as to ensure year-round greenery. The height of turf is not over 5cm. Turf height over 5cm must be trimmed away.

13.1.3 Shrubs

Shrubs have the following effects: create landscape, prevent the glare from head-light of opposing vehicles, and reduce traffic noise and dust.

Shrubs can be grown at medians, berms of cut and fill slopes. It must not be grown at small islands.

It is necessary to prune down shrubs, prune off branches, replace the dead ones and trim the top of shrubs so that their height will not be over 0.80m

13.1.4 Big trees

Big trees must be planted outside the soil shoulder. They can be planted on both sides along the roadway or made into a clump of trees beside the road.

The selection of tree species must follow consultation with agronomists. Tree species should be suitable to the habitat, their roots do not spoil highway structures, trees should not fall down easily, their branches should not be fragile, and they should serve good decorative effect.

13.2 Bus stops

13.2.1 Bus stops can be classified into three types:

- Simple stops: Buses stop located on the part of traveled way, close to the right edge. Buses decelerate or accelerate right on the outer lane;

- Avoiding stops: Buses use a part of traveled way and a part of shoulder for stopping. Buses decelerate or accelerate right on the outer lane;

- Separating stops: Buses stop at the area which is outside the traveled way and separated by level, curbs, railings, separators. Buses decelerate or accelerate on a part of outer lane and a part of lane which is separated from main traveled way.

13.2.2 The scope of bus-stop application is as follows:

a) When the frequency of buses is smaller than the value given in Table 37, a simple stop can be used; when it is bigger, an avoiding stop must be used.

Table 37 - The scope for applying bus- stop

Average Daily Traffic Volume in future year $N_{average\ annual}$ *(PCU/daily)*	**1000**	**2000**	**3000**	**4000**	**5000**
Anticipated frequency of bus, *buses/hour*	5	2,8	1.6	1.2	1.0

Besides the instructions in Table 37, avoiding stops must be placed in the following cases:

- When the shoulder is more than 3.0m wide;

- When the width of shoulders is from 2.0m to 3.0m and the volume of two-wheel vehicles is more than 50 vehicles/ hour in one direction;

- When the above-mentioned conditions are not available but the bus stop is 15m away from the pedestrian crossing.

b) Separating stops must be provided on the highway with the calculated speed Vdesign $\geq$ 80 km/h.

13.2.3 Bus stop arrangements:

- Simple stop: Buses stops on the carriage way, and the stabilized shoulder is used for loading;

- Avoiding stops: Minimum width from the edge of carriage way is 3.0m. The dimension of loading platform is 1.5m wide and 15m long. Its arrangement is illustrated in Figure 7

- Separation stops must have entrance and exit roads and speed-change lanes must be taken into consideration.

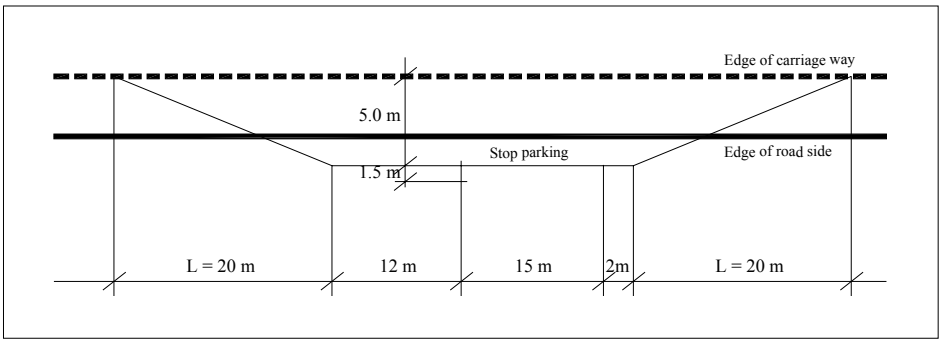


Figure 7 - Minimum arrangement of an avoiding bus stop

132.4 Location of bus stops

- Bus stops are placed on the right hand side of traveled way and in the same direction of the traffic movement.

- The spacing of bus stops is 300 to 500m at least. The bus stops must be not located on curvatures with radius value smaller than the normal minimum horizontal curve radius.

- Bus stops are located on both sides of roadway, the distance between the starting point and the ending point of bus stops must be at least 10m;

- Bus stops may be located on the near (approach) side or the far (exit) side of intersections. The distance from bus stop to intersection must be in consideration of accelerated section, observation time (when bus stop is located on near side), deceleration section (when it is located on the far side), and the impact of bus stop to through traffic capacity of intersection. When bus stop is located on far side, it must be at least 50m far from the center of intersection.

When bus stop is placed on the near side, it must be at least 40m away from the center of intersection for the highway with the calculated speed $V_{design} \leq$ 60 km/h, and 60m away for the highway with $V_{design} \geq$ 80 km/h.

At intersections with the pavement markings for pedestrian crossings, bus stop must be placed at least 10m away from that crossing.

13.3 Rest and other service areas

13.3.1 It is necessary to provide rest and other service areas on highways with the calculated speed $V_{design} \geq$ 60 km/h. The rest areas serve the following purposes: to reduce the fatigue of highway users, increase traffic safety and make better use of the country's tourism potentials.

13.3.2 Rest and other service areas must be separated from the roadway. The acceleration and declaration factors must be included in the design of entrance and exit roads. Guide signs must be installed on the main roadways in accordance with the instructions in 22 TCN 237.

13.3.3 Rest areas.

Small rest areas: having the area of 3000 m^2 more or less, with parking areas; fixed facilities for the rest area may be provided (less than 10 places together with tables and chairs, roofs, taps for drinking water, information boards about locality's history and geography).

Large rest areas: having the area of more than 5.000 m^2. Parking areas for cars, trucks and buses are provided. It may include following services, which are managed by local authorities: medical stations, petrol stations, car services, soft drink bars and shopping counters, public telephone points (or post offices).

13.3.4 The spacing of large rest areas is 60km to 100km.

The spacing of small rest areas is 15km to 30km

On highways of more than 100km in length, it might be necessary to consider providing motels.

The selection of rest area location, service capacity must be consulted with local authorities.

13.3.5 Parking areas must be paved with adequate strength. Minimum dimensions of parking areas are as follows:

- For cars: 2.5m x 5.00m;
- For trucks: 4.0m x 20.00m;
- For buses: 5.0m x 15.00m.

13.3.6 It is important to plant trees at rest areas, in order to:

- Separate rest areas and roadways; provide the relaxing surroundings for highway users to take a rest;
- Separate parking areas and among sections in the rest areas. High trees should be grown at parking areas to provide the shadow zones.

13.4 Toll plaza

13.4.1 Toll plaza is placed at the following locations:

- Near the approach to large bridges or tunnels;

- At interchanges;

- Appropriate locations;

- Spacing of toll-plazas should not be less than 70 km.

13.4.2 Toll station lanes

13.4.2.1.1 The number of the toll lanes of a station depends on the followings:

- Peak hour volume of the design year;

- Length of the waiting line should not be over 500m;

- Time needed for toll collection. This is dependent on toll types: manual, semi- automatic or automatic collection'

- Separated lane shall be provided if having simultaneously various payment methods (cash, ticket, e-card etc. or with various vehicles such as motorbikes, trucks, containers etc.)

- Near urban area, it's possible to provide some lanes which are reversible to accommodate heavy peak traffic volume (high volume in the morning and low volume in the afternoon).

- A lane shall be designed to accommodate over-size vehicles to detour the toll gate.

13.4.2.1.2 Toll lane width:

- Non- motorized lane is 3.8m in width and provided with vehicle counting device;

- Lanes are separated by islands of 30m long and 2m wide. On the island, there are booth for toll collection staff, lifting barriers between lanes, and devices and equipment installation such as toll collector, vehicle counting device, guide signs etc.;

- Separated lanes, at least 2 lanes should be provided for motorbikes with dimension of (2 x 1m) + 0.5m) = 2.5m;

- Pavement of the toll lanes (on the lane for queuing also) is paved with cement concrete.

13.4.3 Other regulations

13.4.3.1 Clearance of the toll gate is at least 5.0m. The width is adequate for exit and entrance vehicles (including separation island and reserved lane for future widening). The length is adequate for vehicles to queue with the possible queuing length is as long as 800m.

13.4.3.1.1 Toll plaza shall not be placed at the end of the slope with gradient more than 3%.

13.4.3.1.2 The toll plaza shall be lit, provided with telecommunication system (radio, telephone etc.) and ventilation system and sound proof.

13.4.4 As a minimum the station building shall include the following rooms and systems:

- Managers office;
- Security officers office;
- Strong room for storing currency and goods;
- Locker room and lockers for staff;
- Canteen;
- Male and Female toilets;
- Generator station for stand by power.

14. Environmental protection

14.1 During design stage, it's necessary to analyze and evaluate environmental impacts resulting from highway construction and operation, with aims to find out mitigating measures and to comply with the existing legal documents;

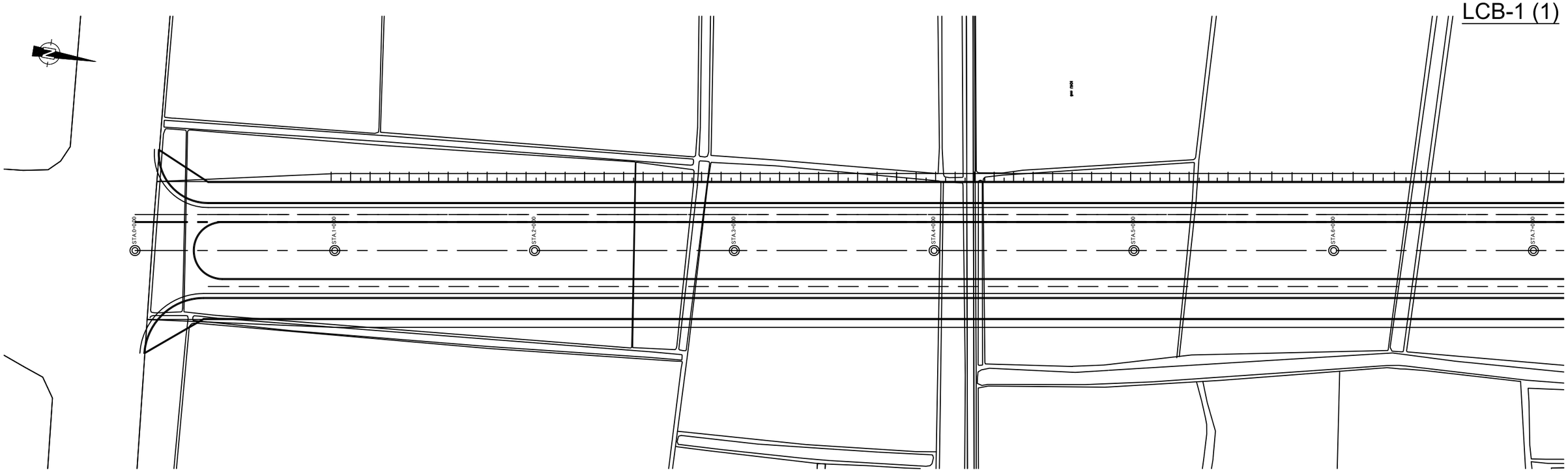
14.2 Environmental impacts analysis is conducted by 2 steps:

- During basic design: preliminary evaluation on environmental impacts is to study and select alignment alternative, refer to the 22TCN 242;

- During technical design and final drawing design: detailed study on environmental impacts is to analyze economic benefits and loss with the aims of recommending and deciding the suitable treatment methods for highway construction and operation

3. Drawings

LCB-1 (1)



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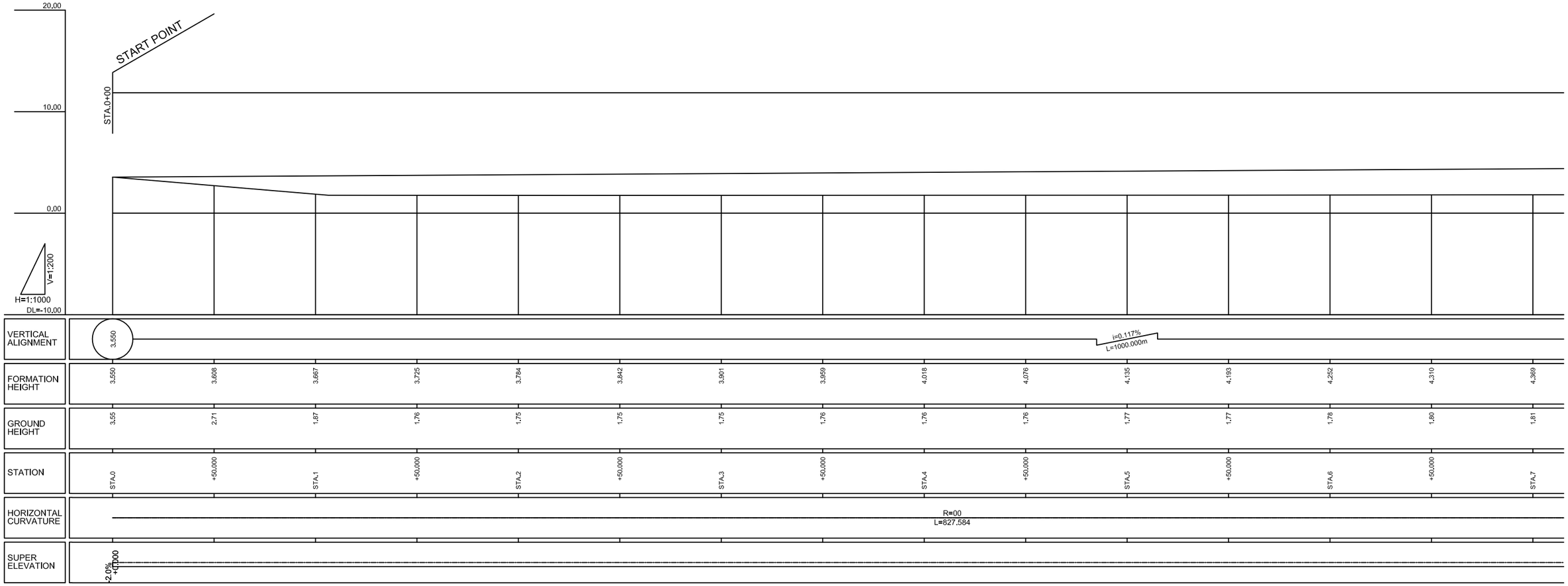

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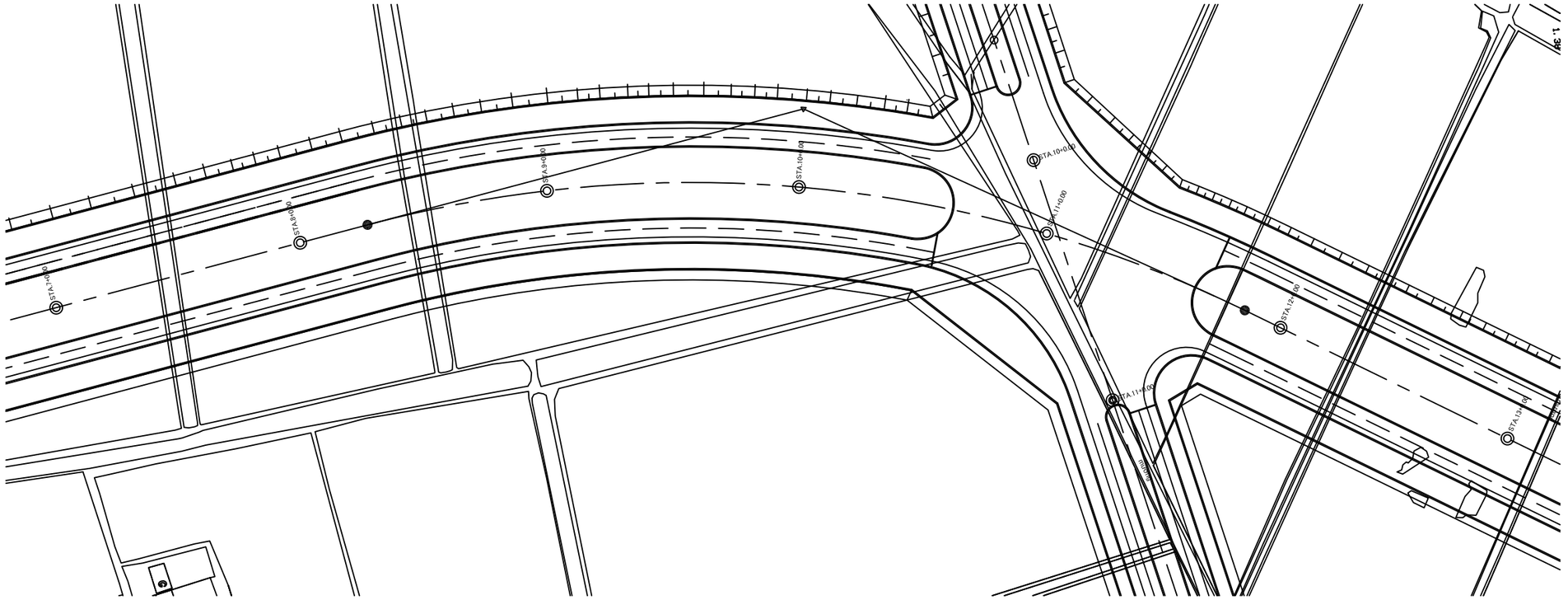

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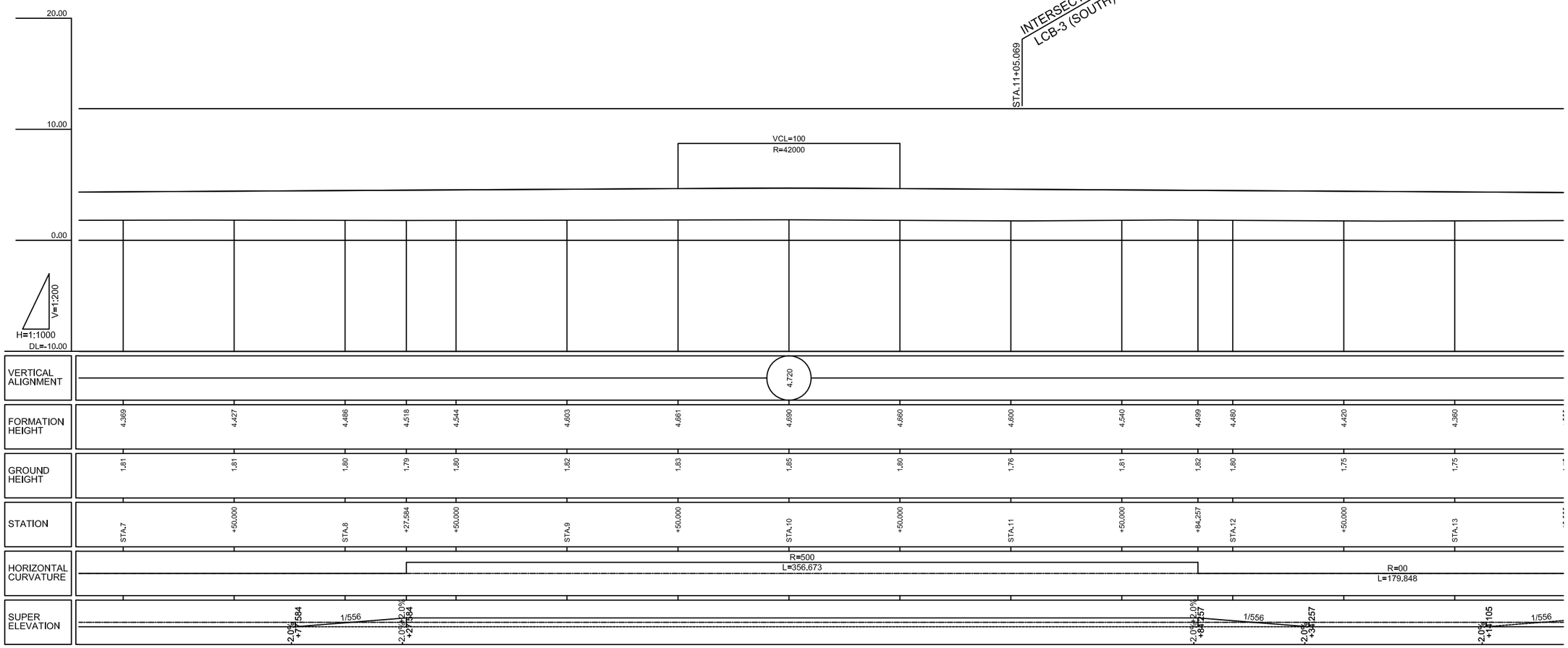

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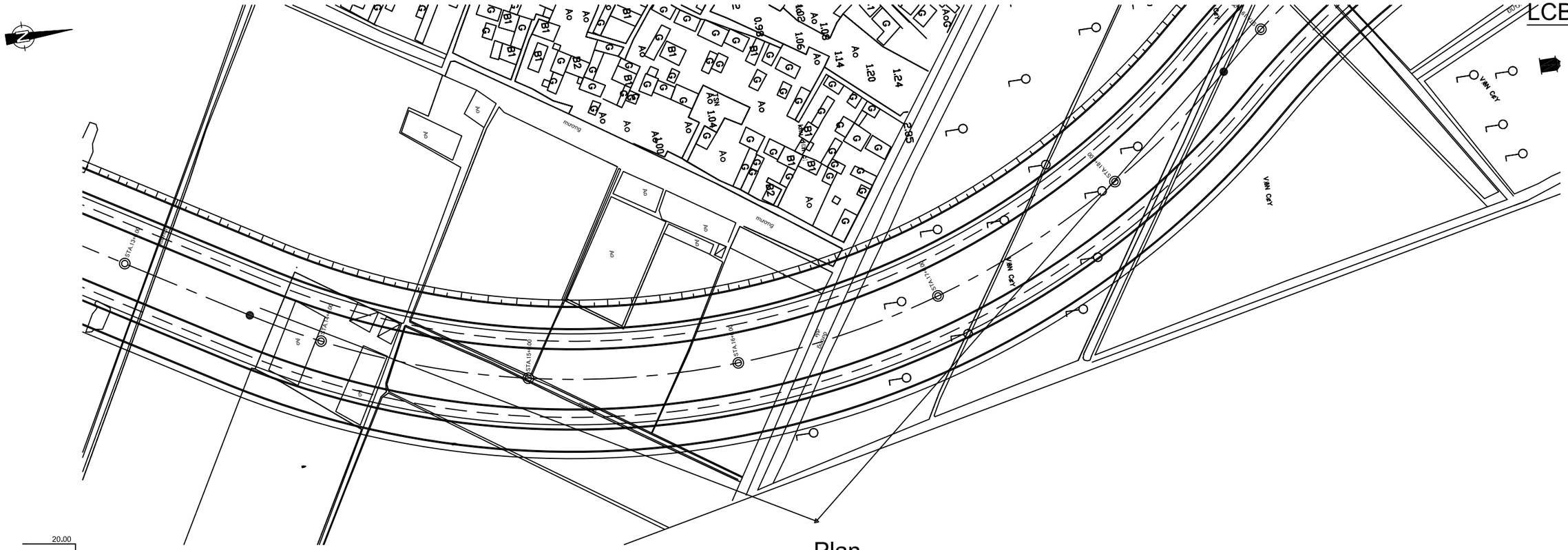

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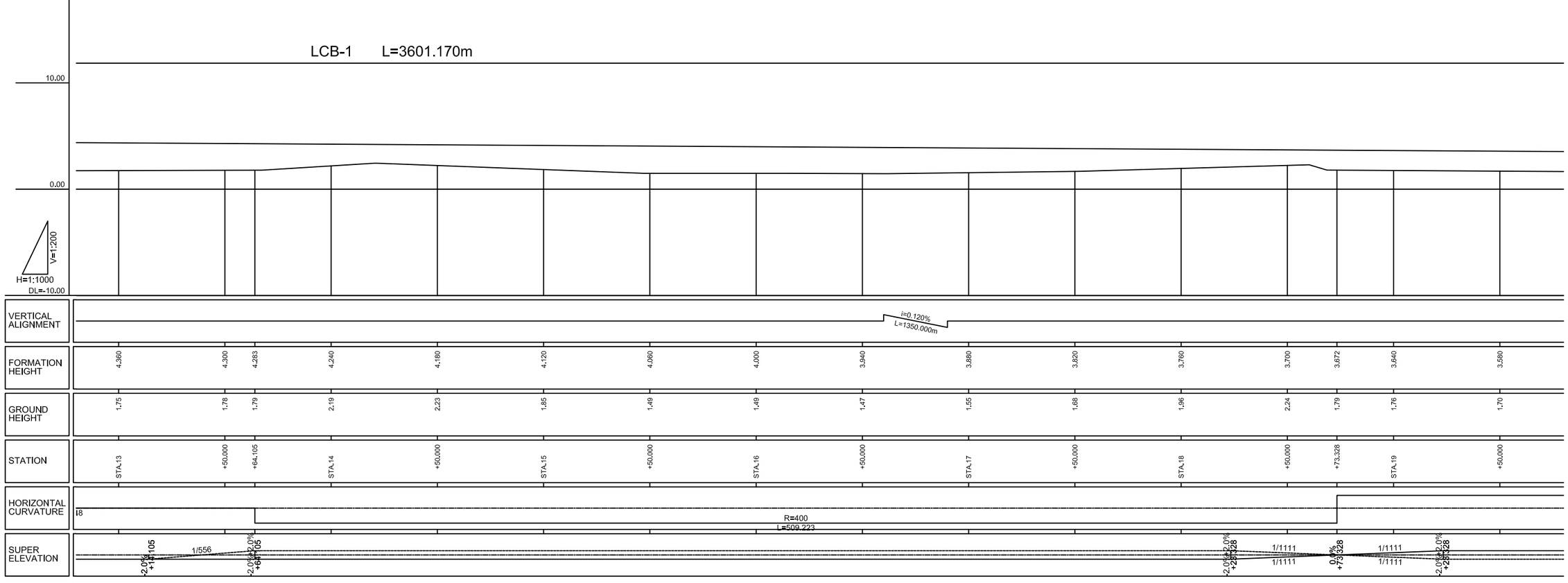

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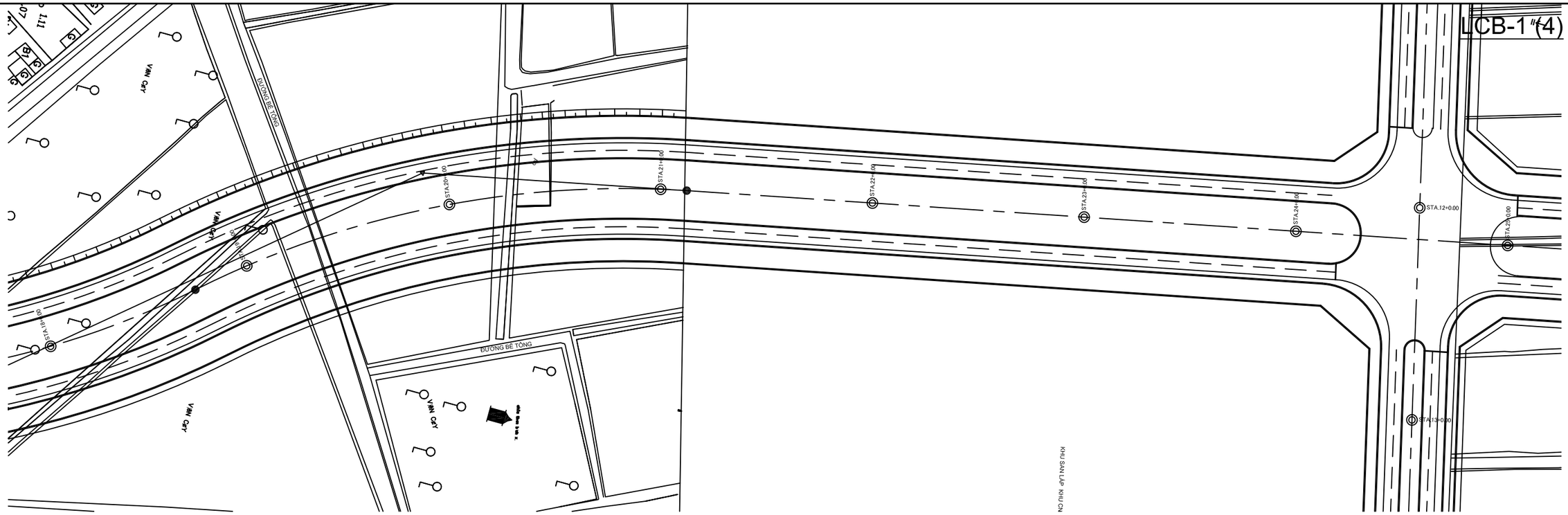

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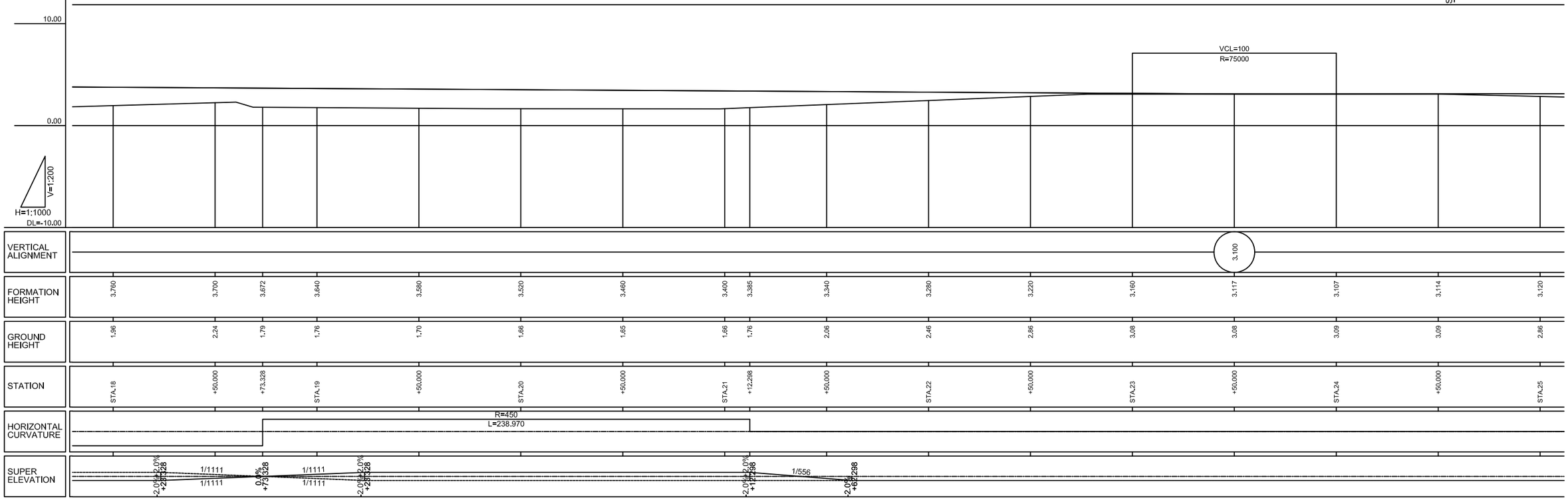
INTERSECTION
LCB-3 (NORTH)
STA.24+57.915



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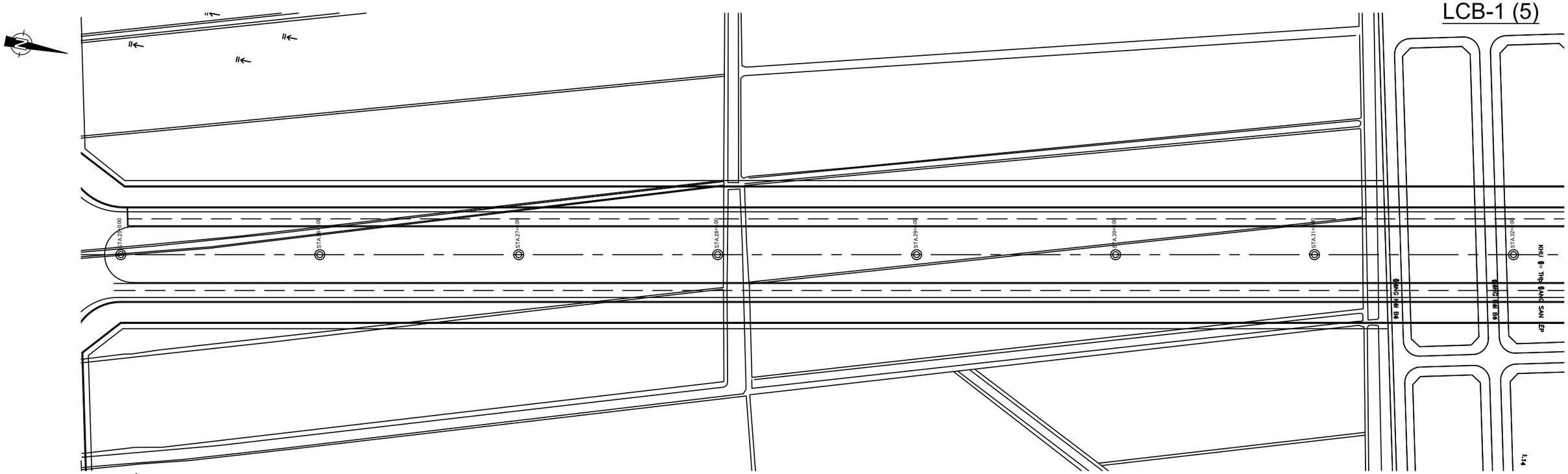
A-2-100

LCB-1 (5)



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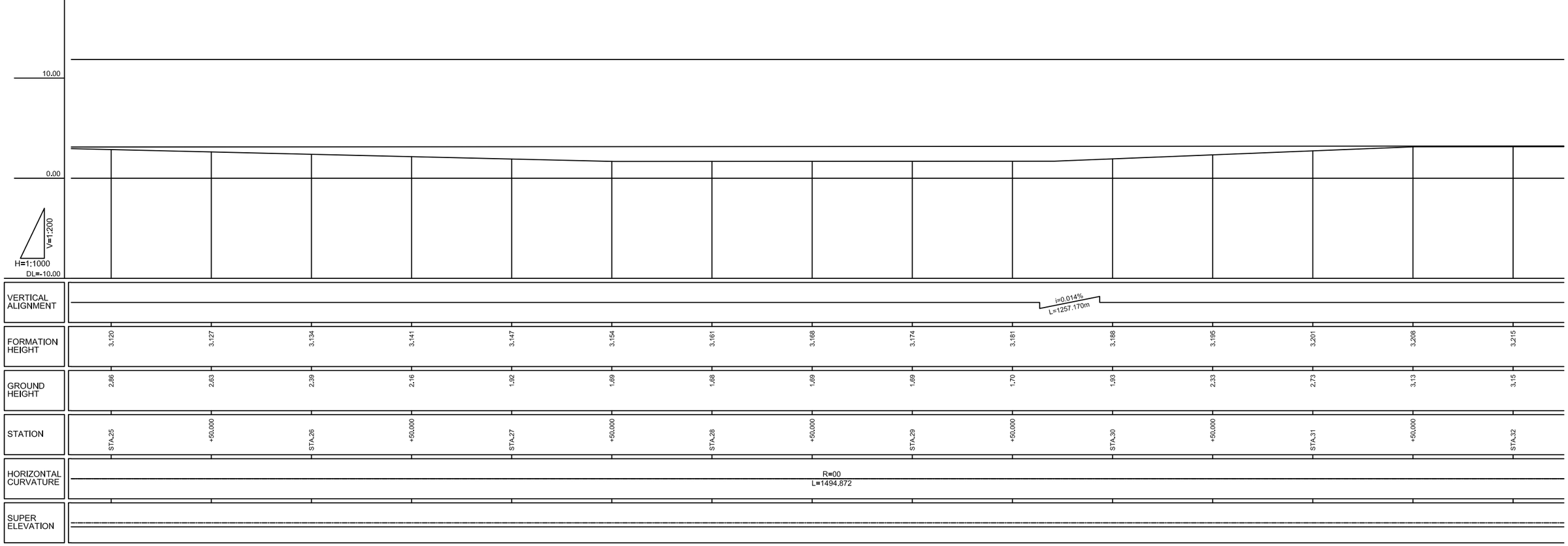

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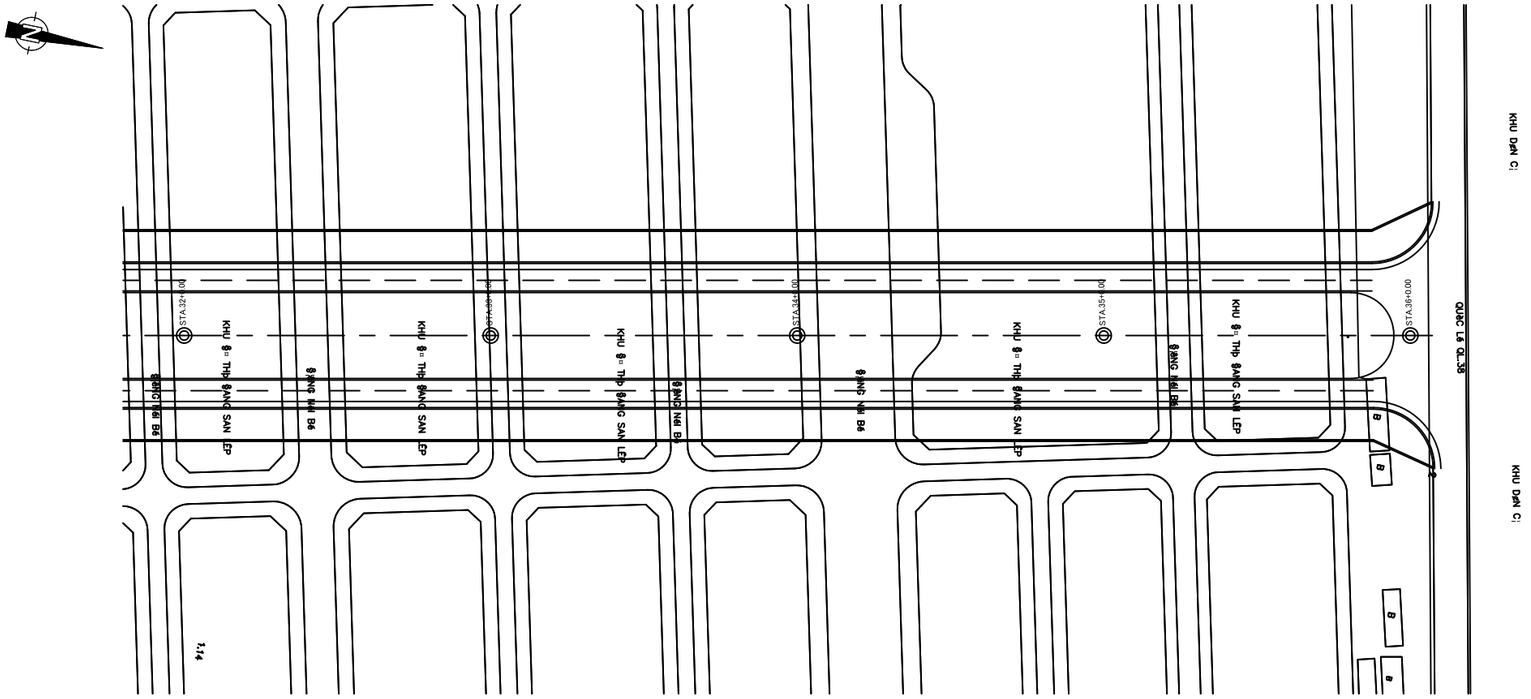

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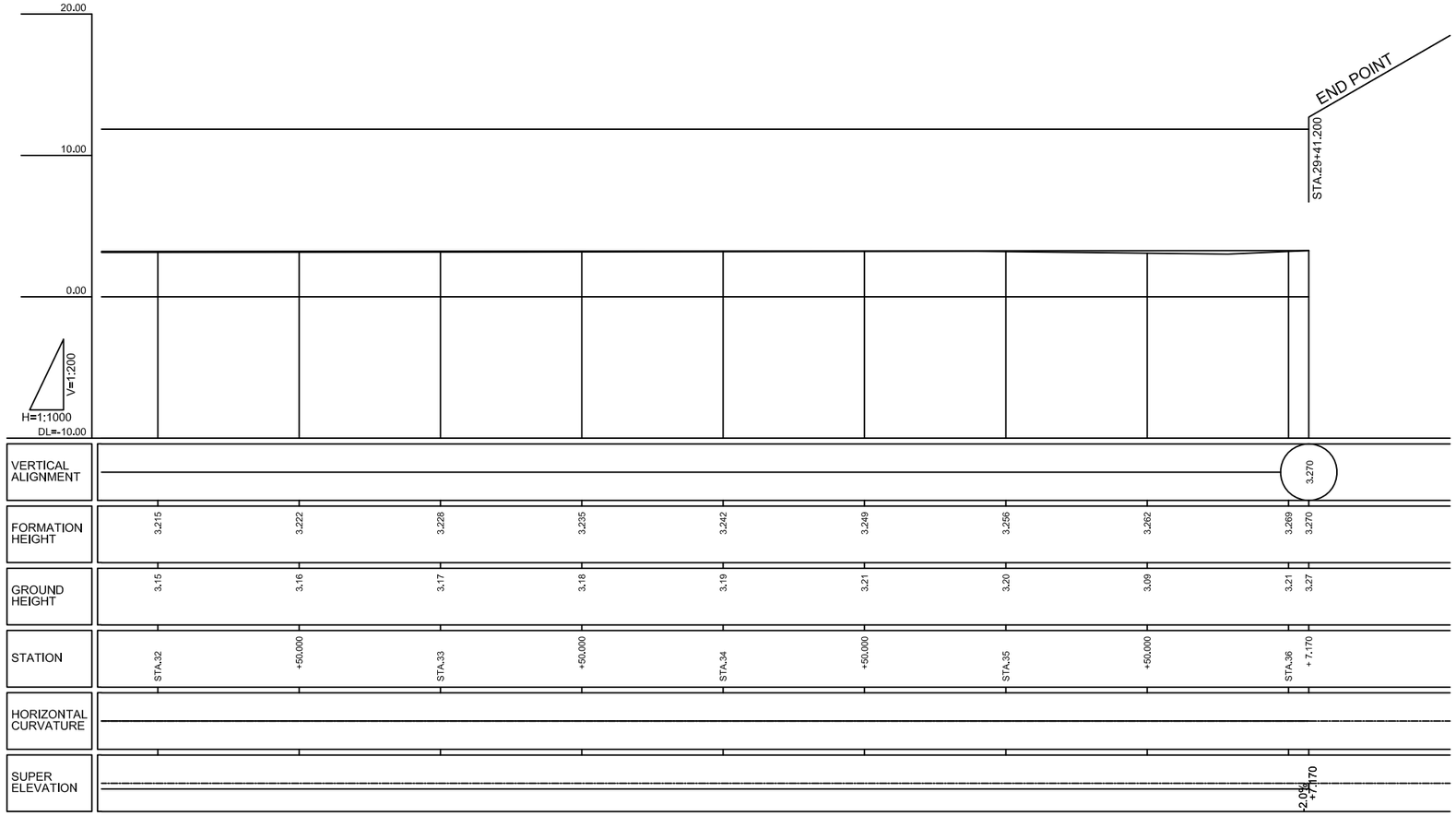

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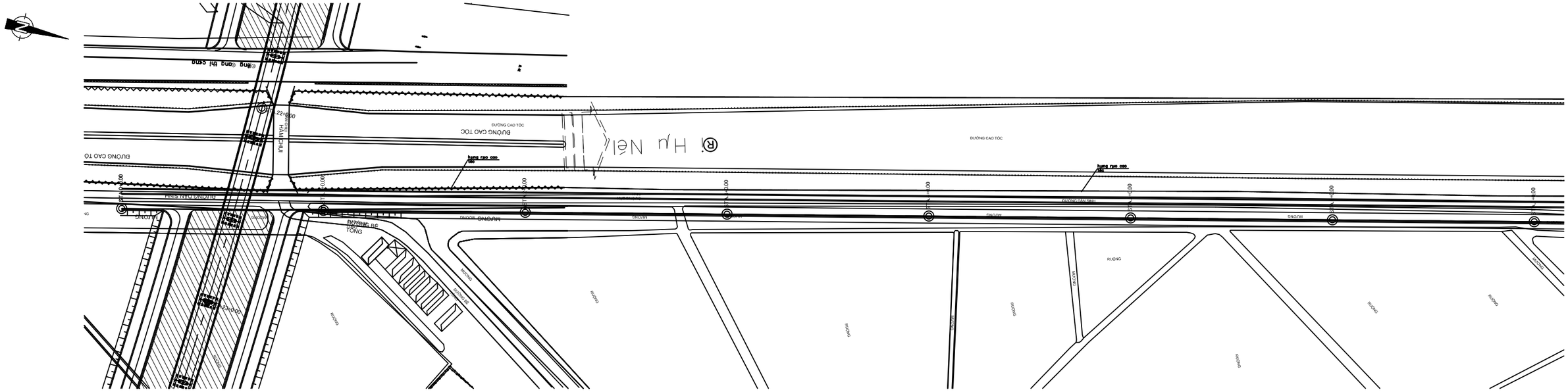

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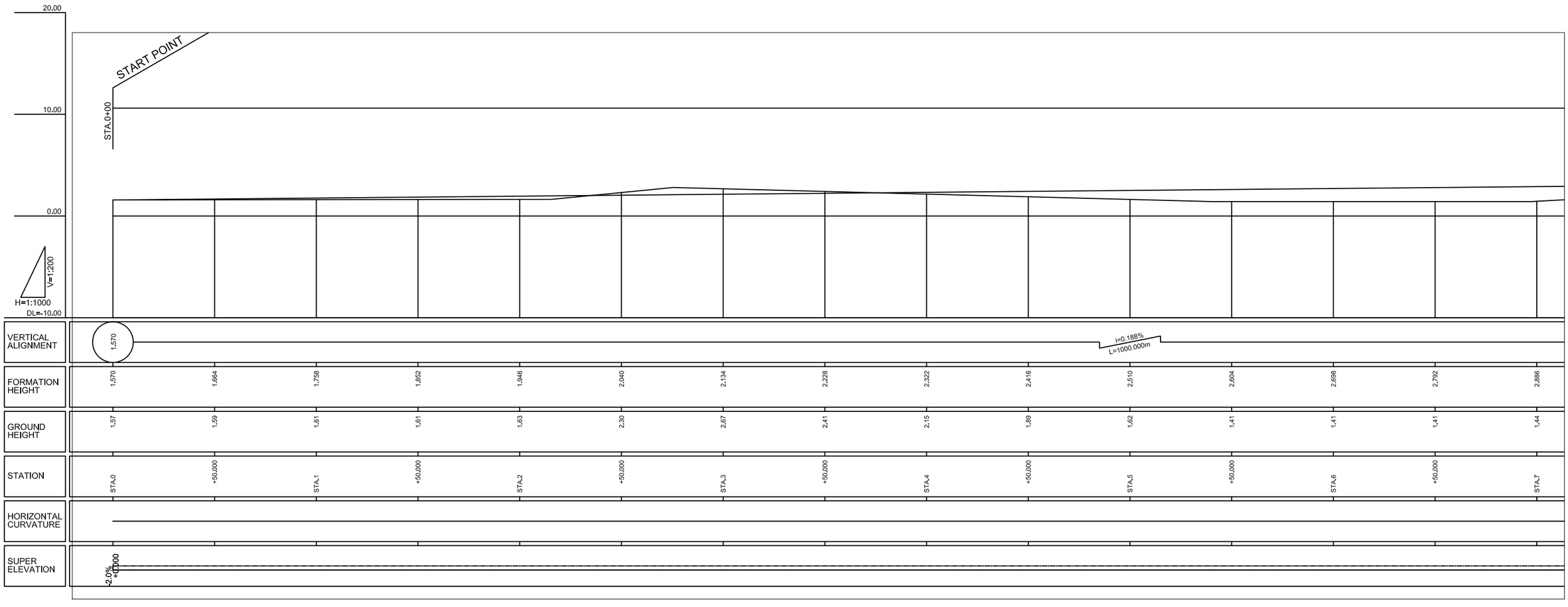

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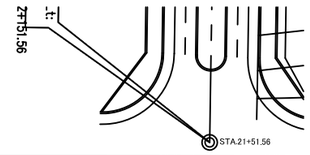

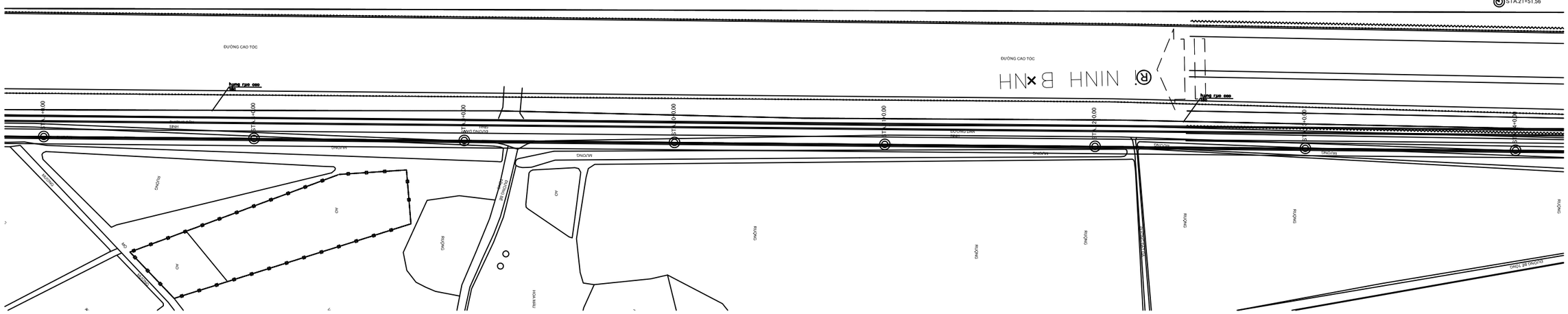

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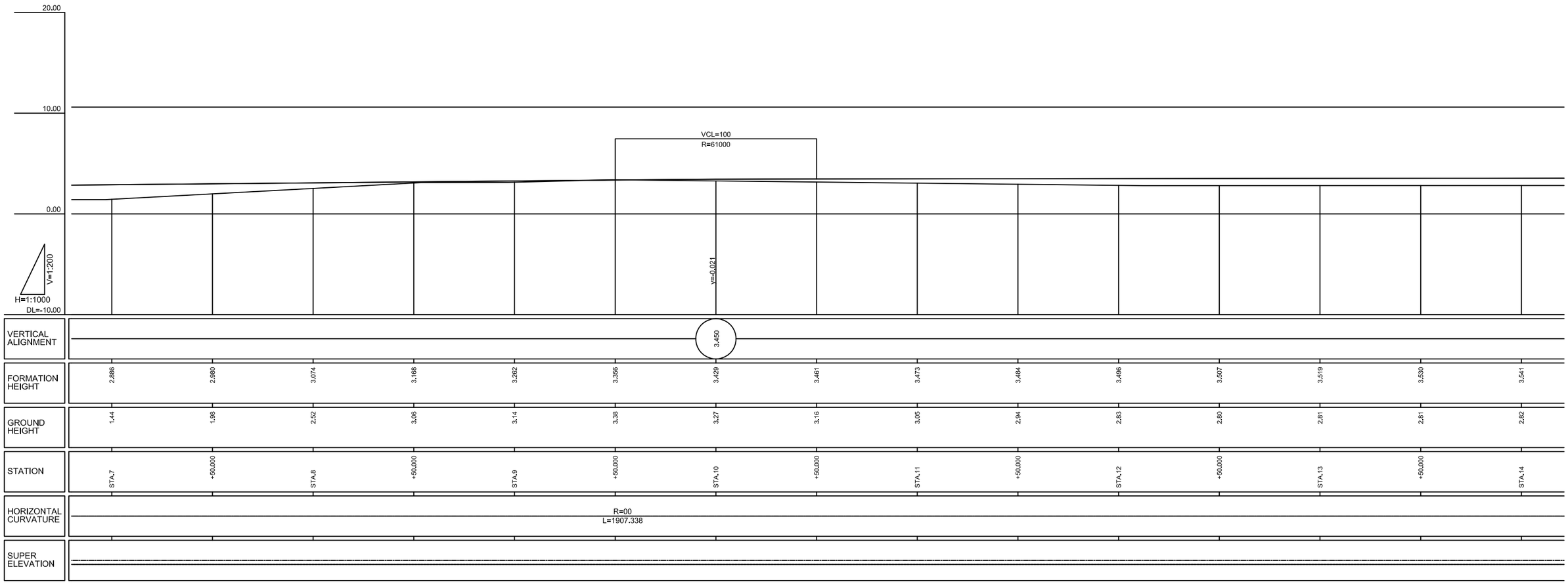

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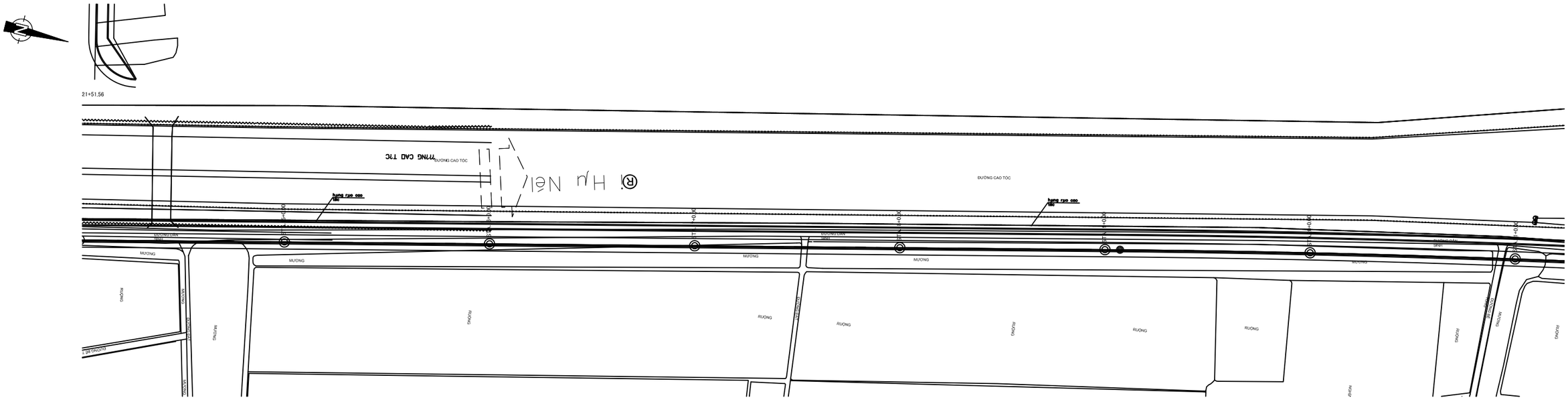

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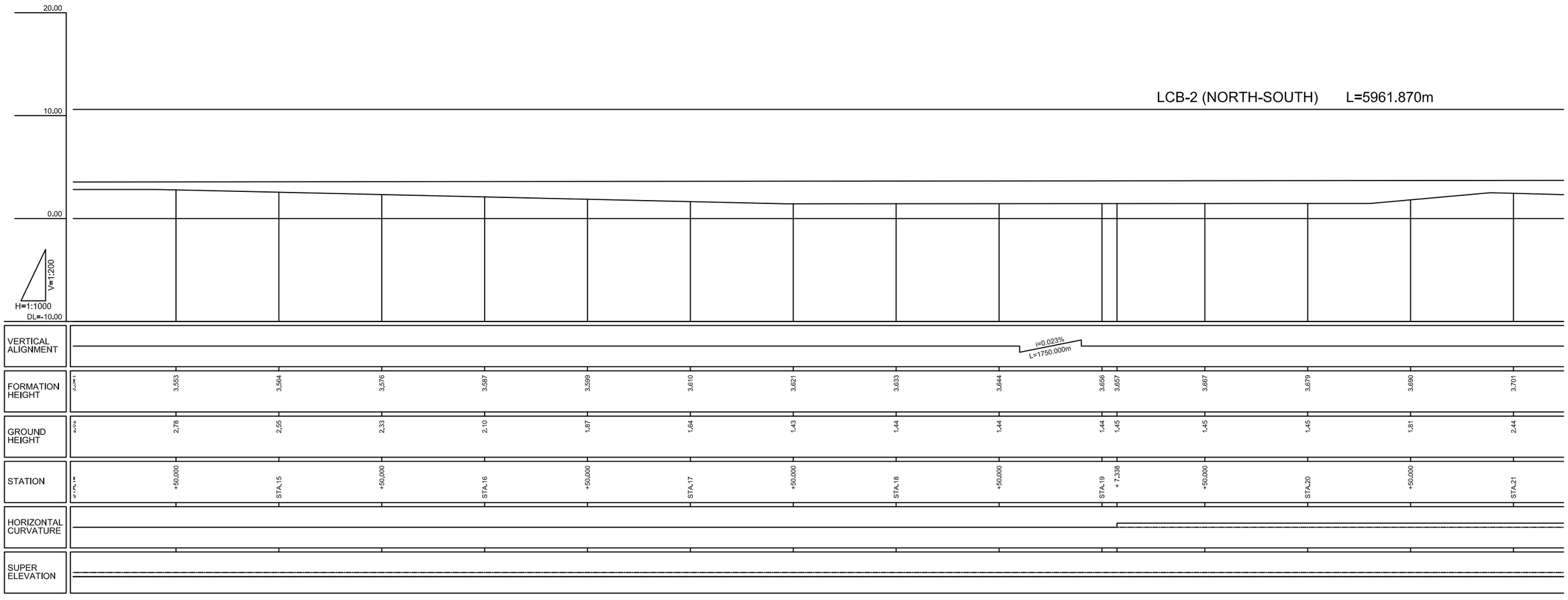

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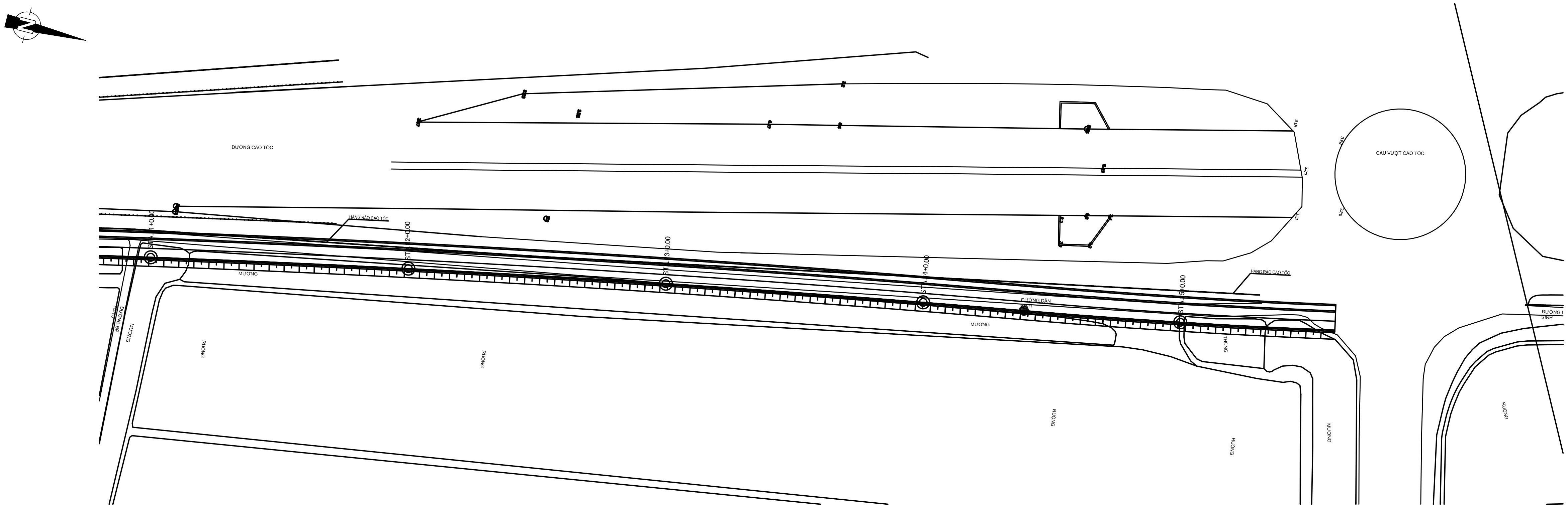

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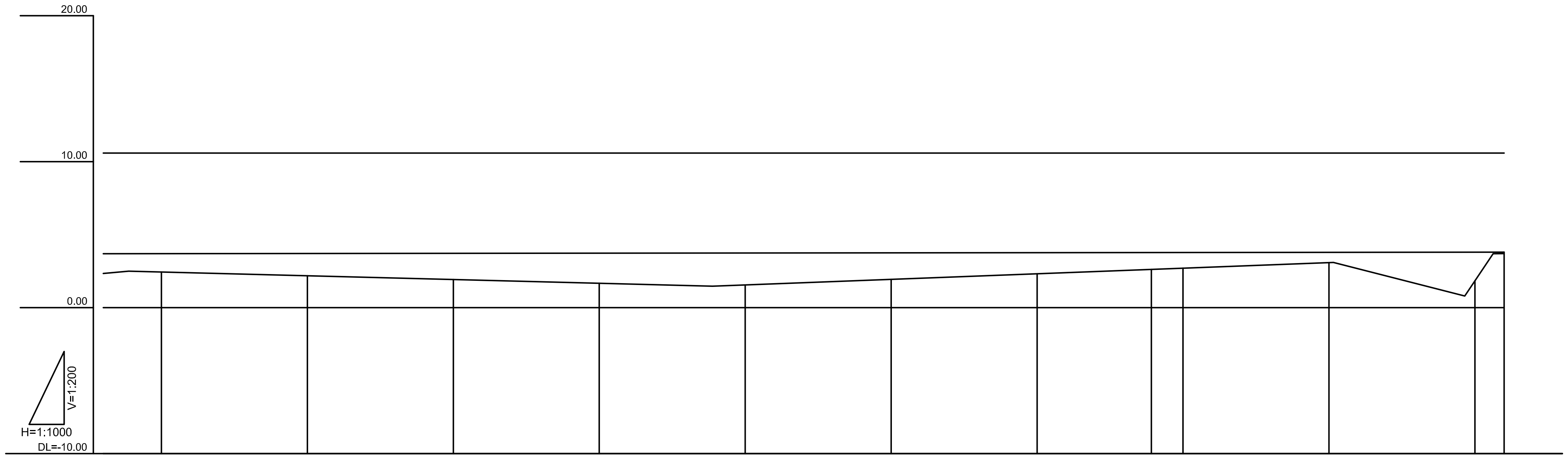

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GROUND HEIGHT	2.44	2.19	1.93	1.67	1.56	1.94	2.32	2.62	2.71	3.09	1.84	1.84
STATION	STA.21	+50.000	STA.22	+50.000	STA.23	+50.000	STA.24	+39.142	+50.000	STA.25	+50.000	+60.000
HORIZONTAL CURVATURE	R=7000 L=531.804											
SUPER ELEVATION												

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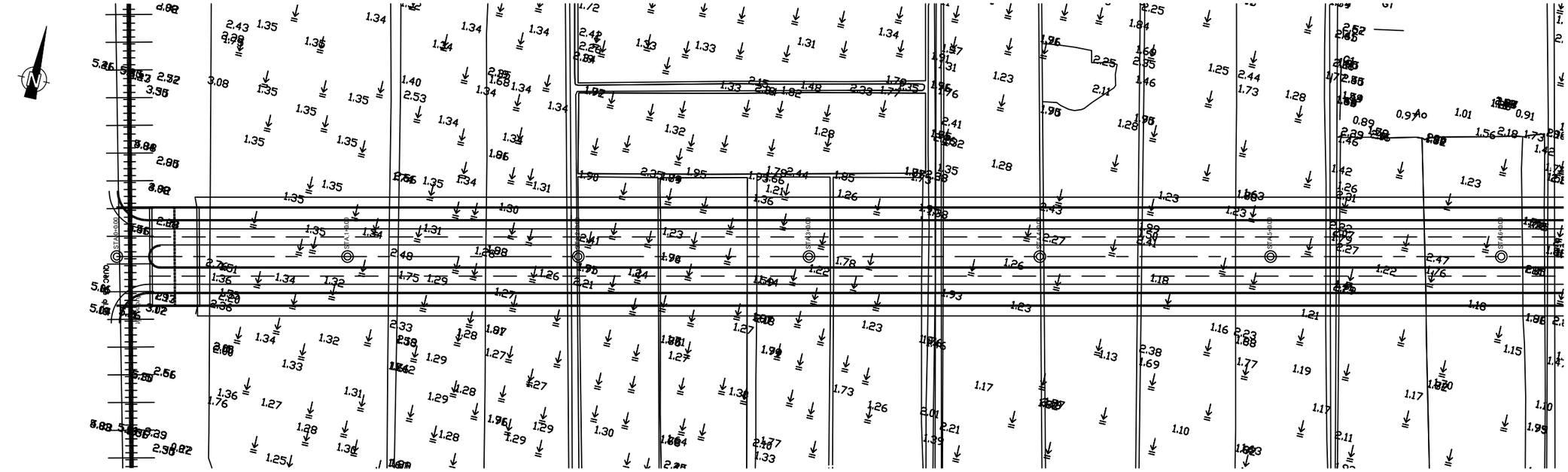

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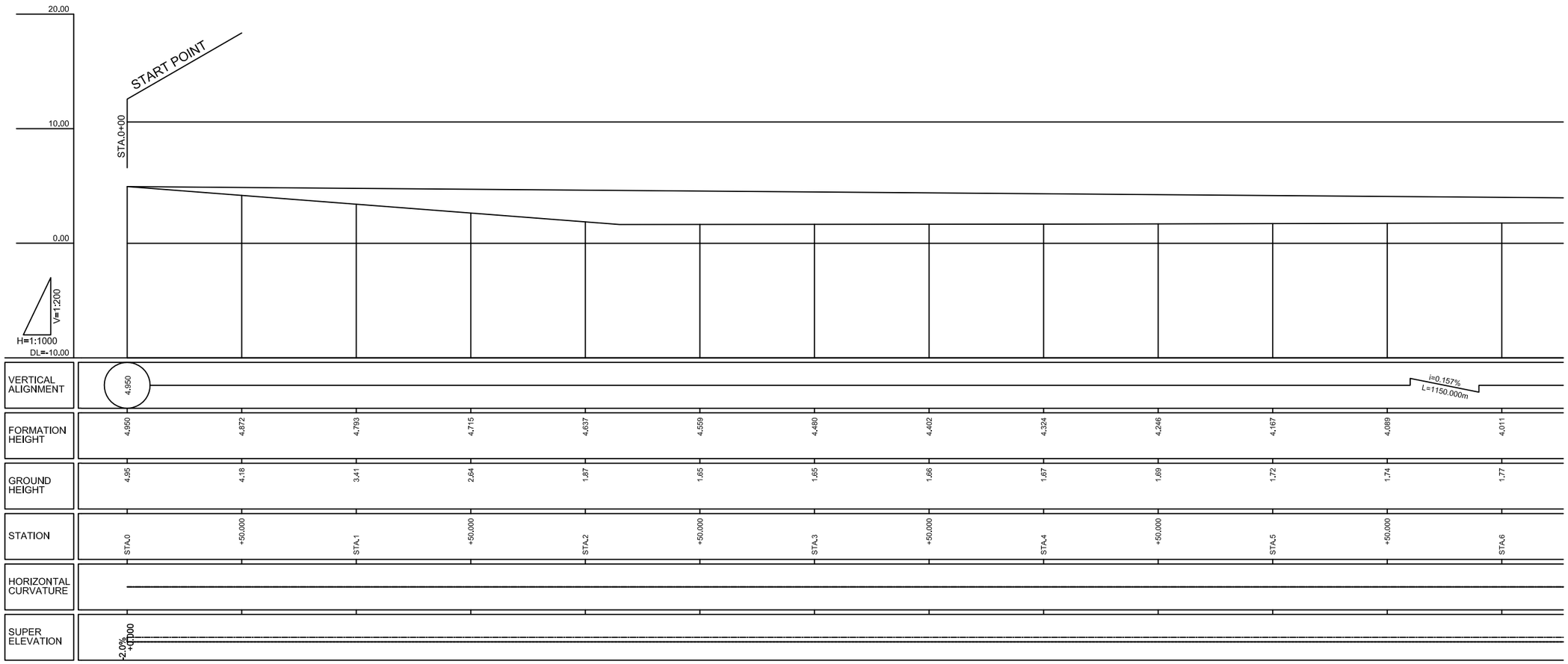

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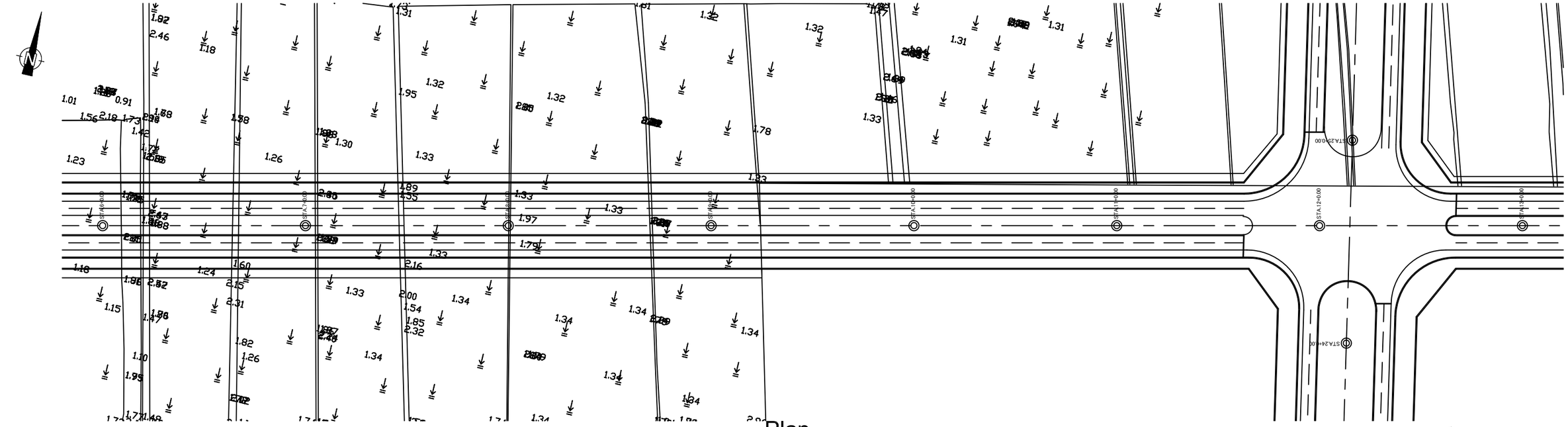

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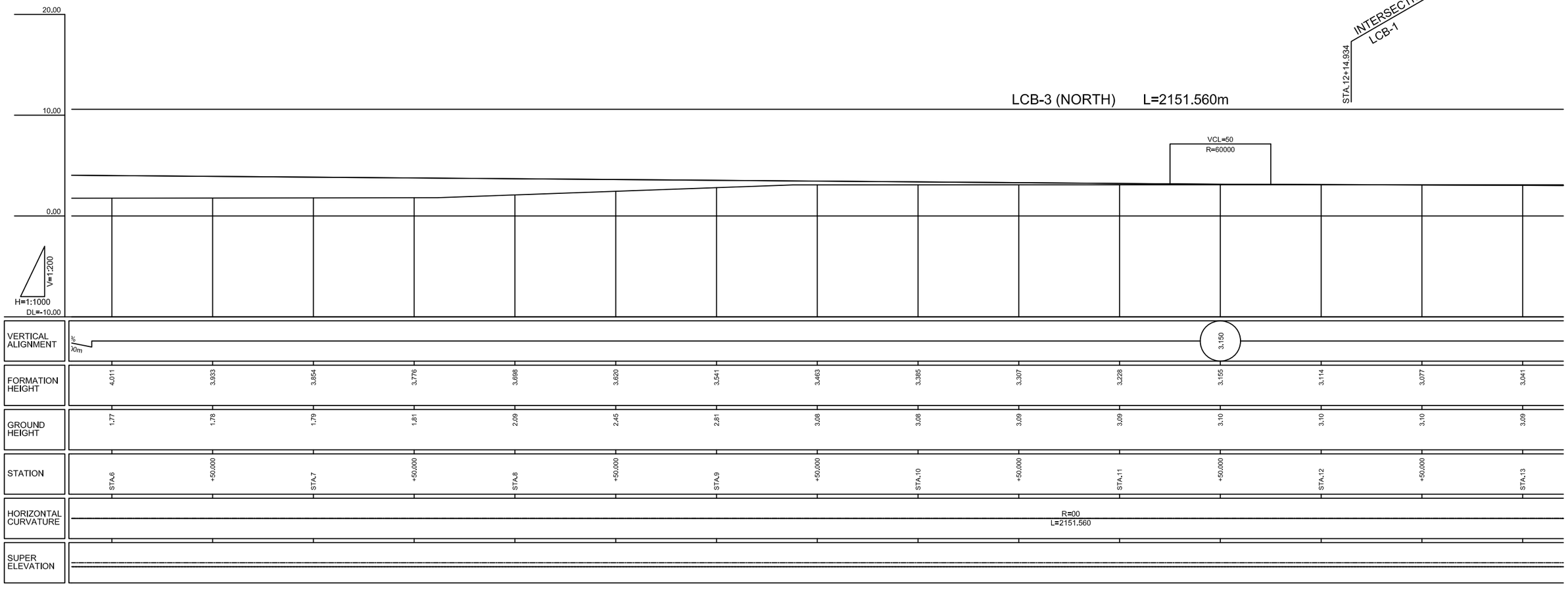

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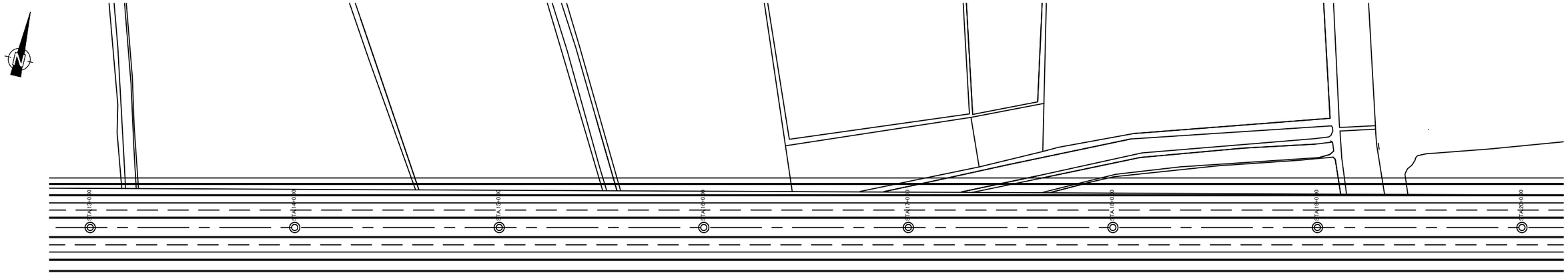

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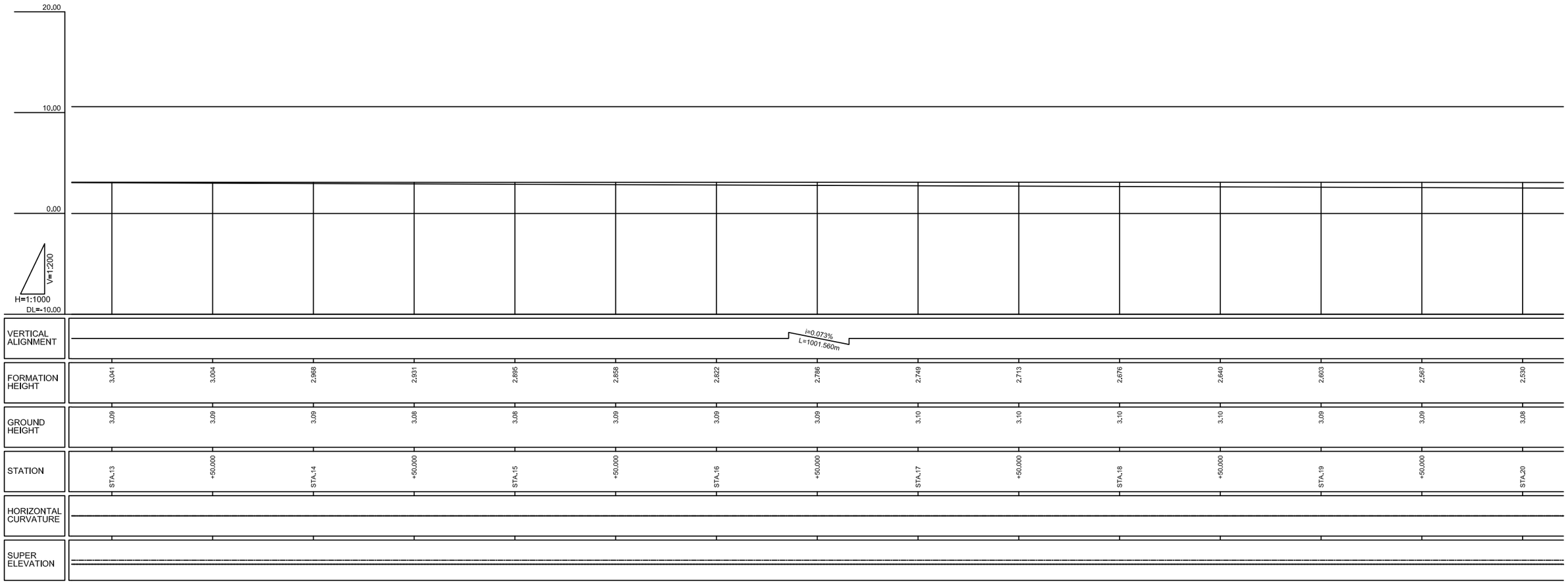

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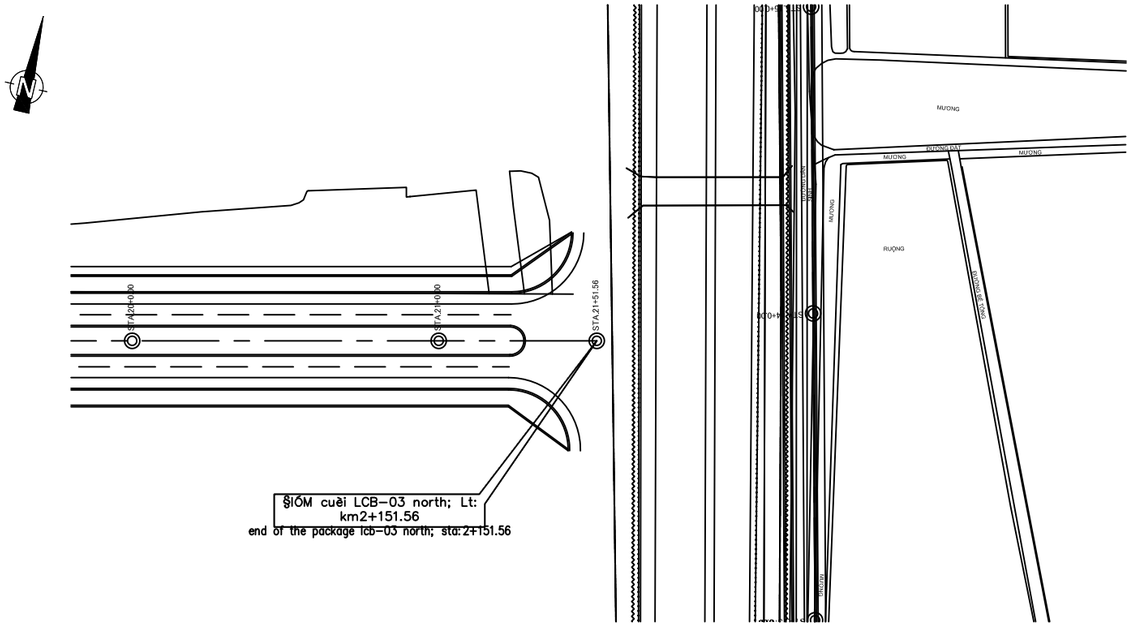

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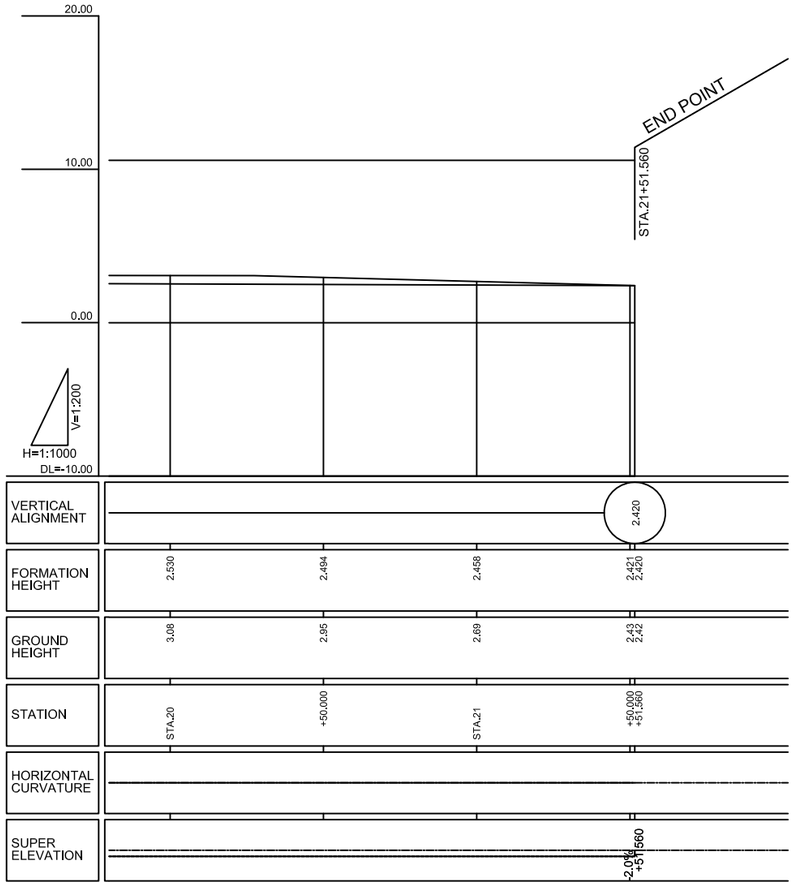

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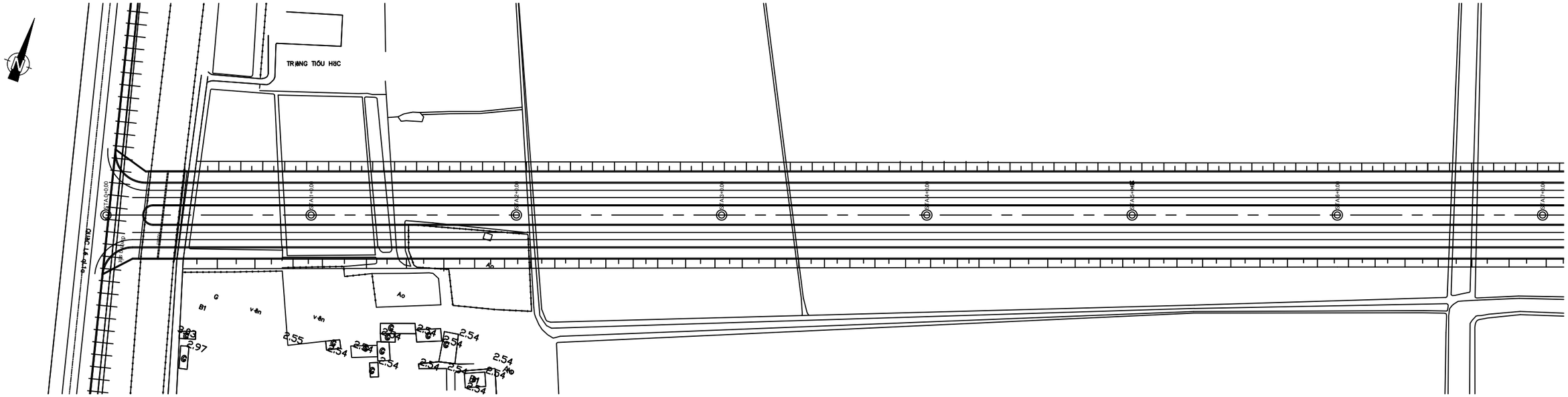

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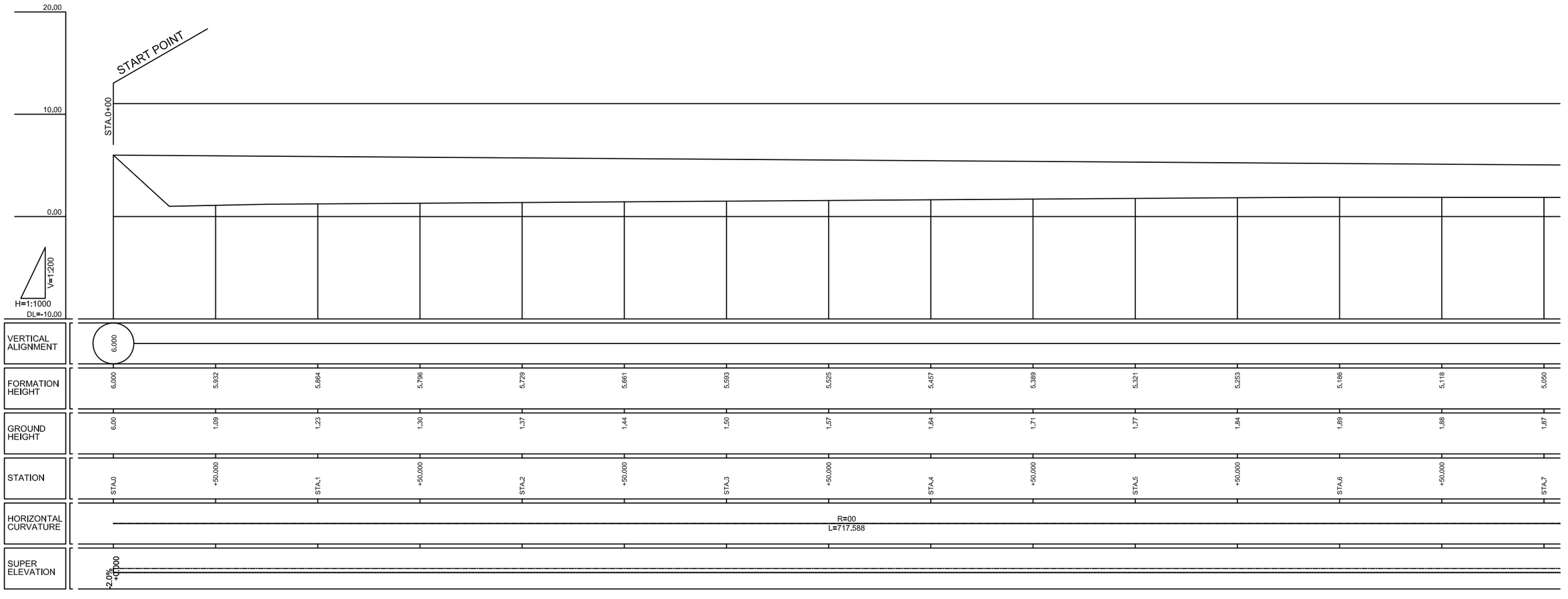

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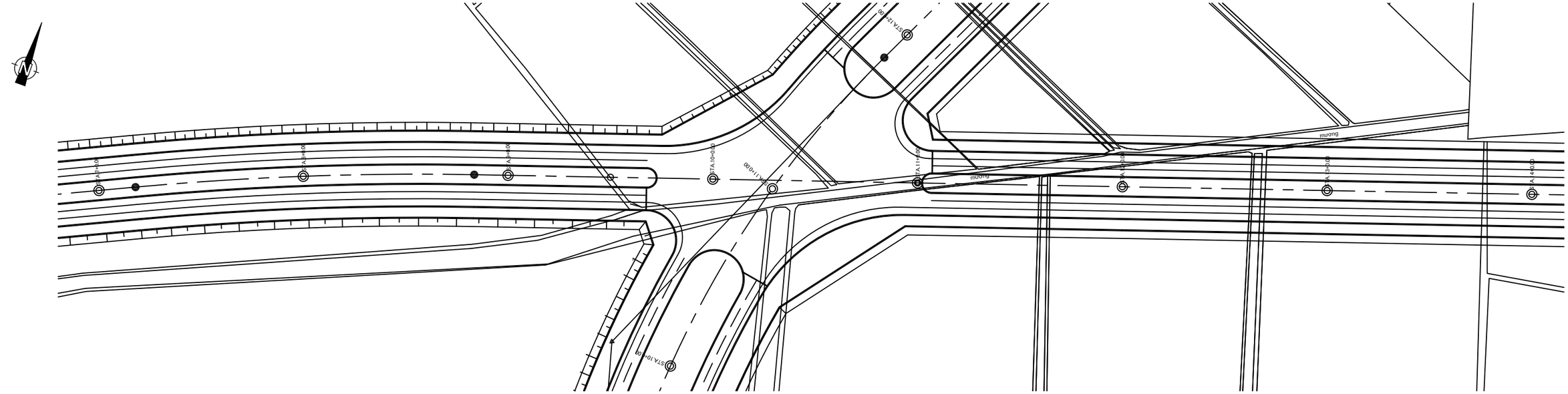

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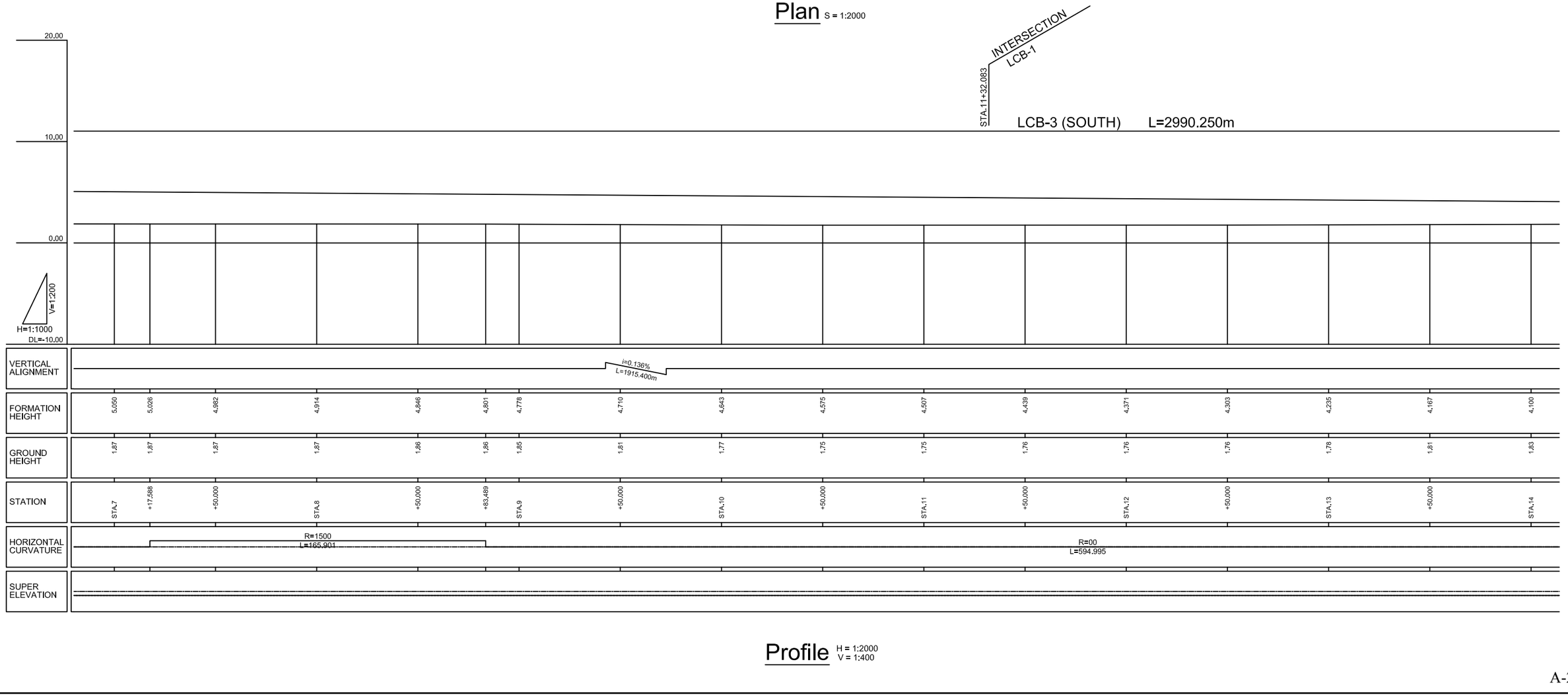

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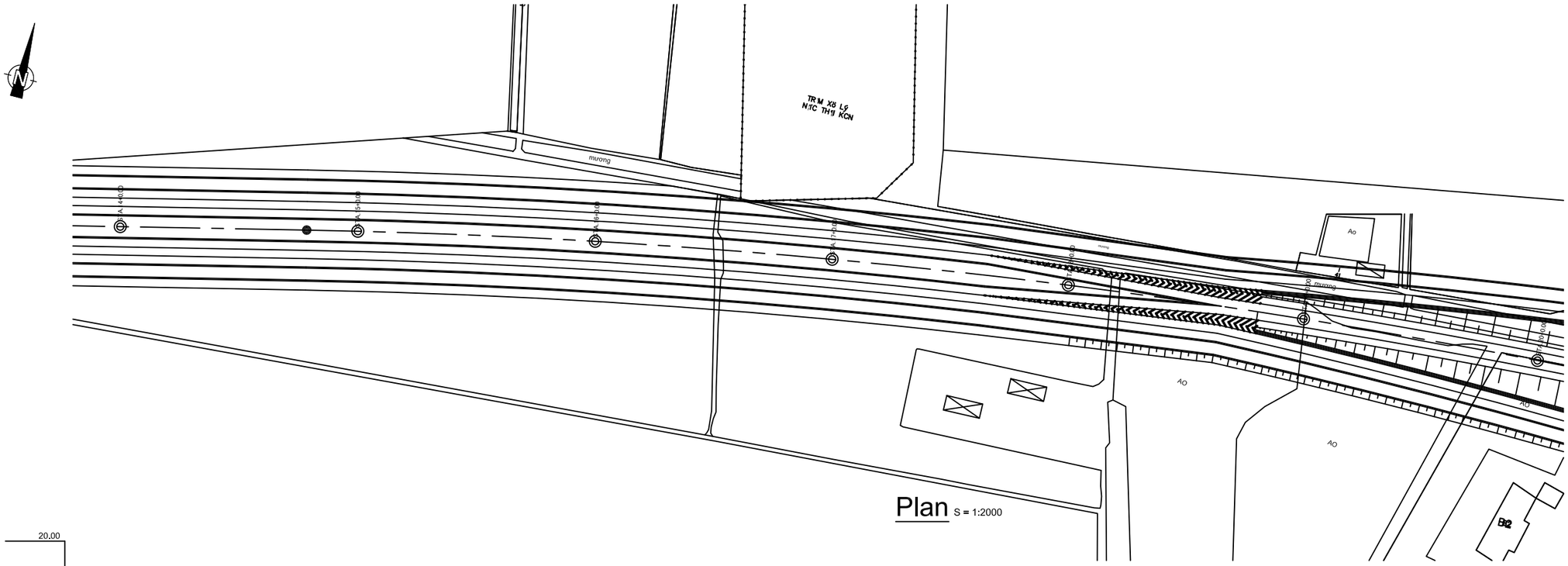

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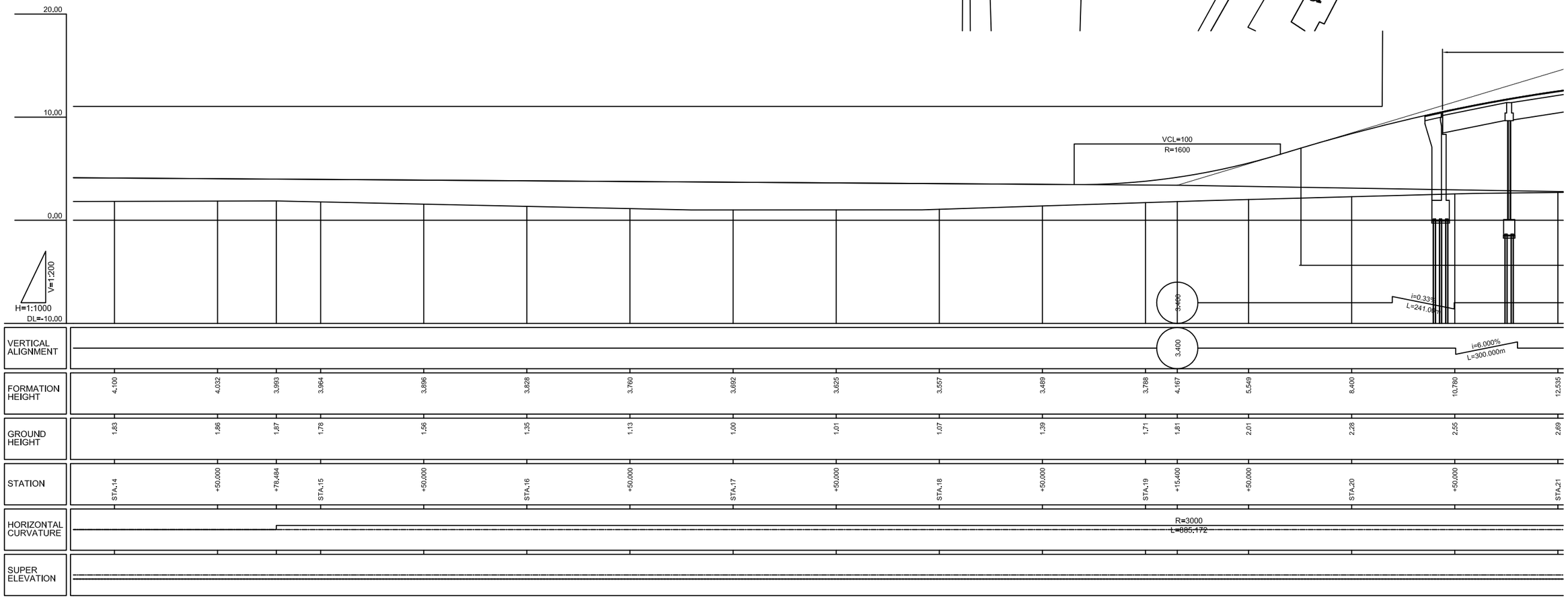

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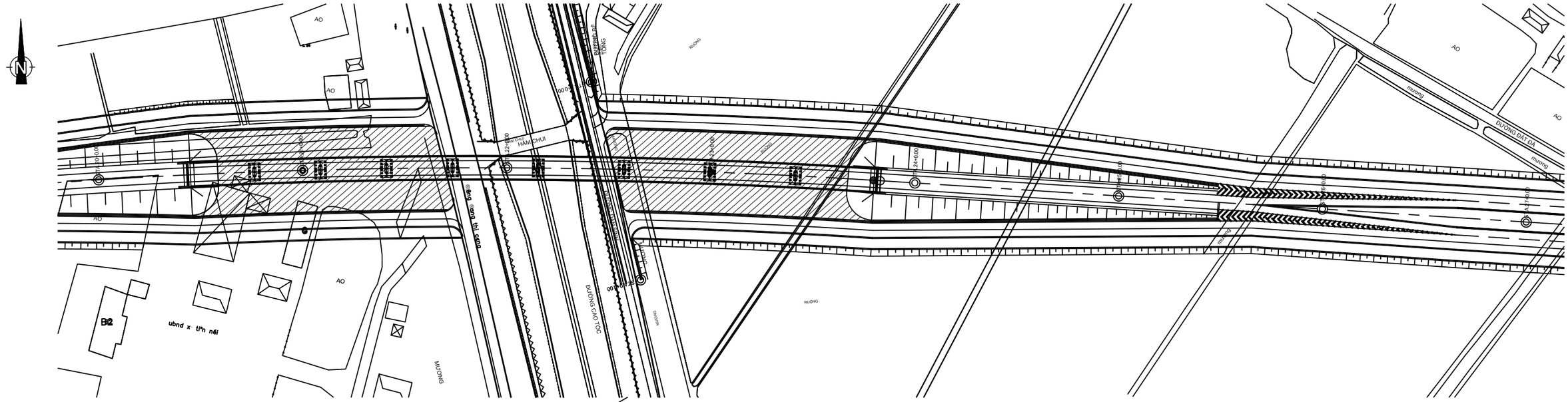

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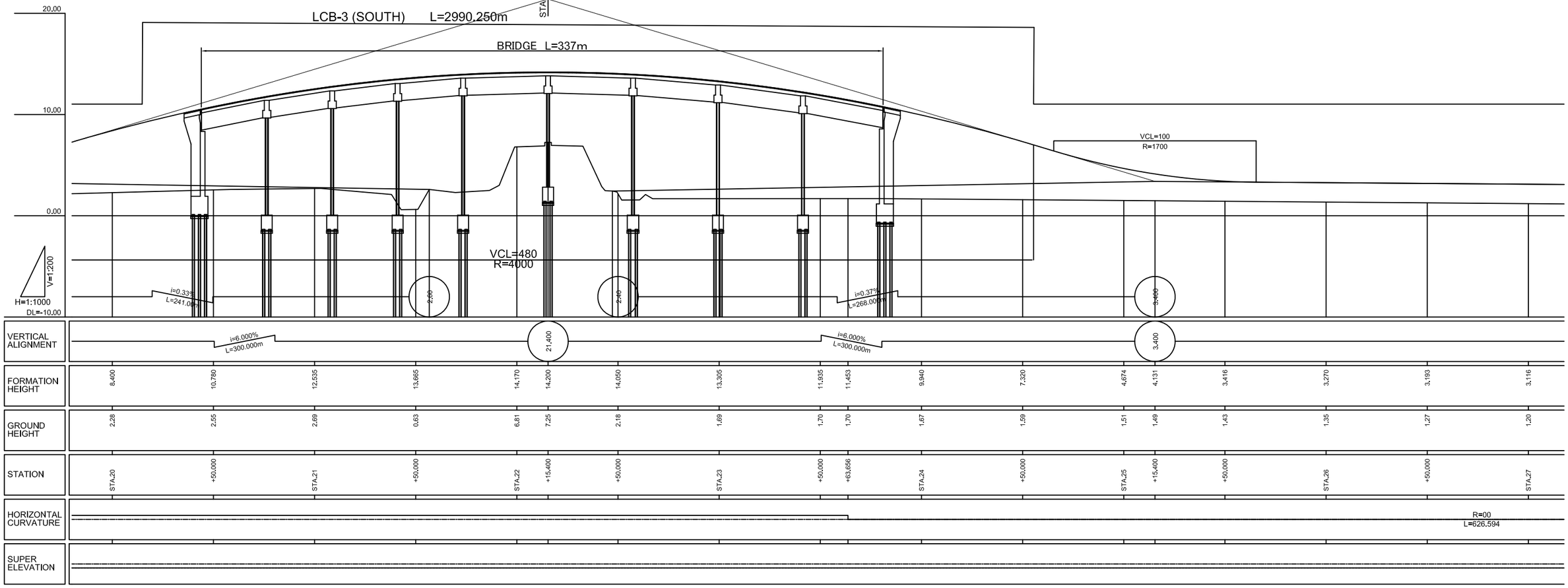

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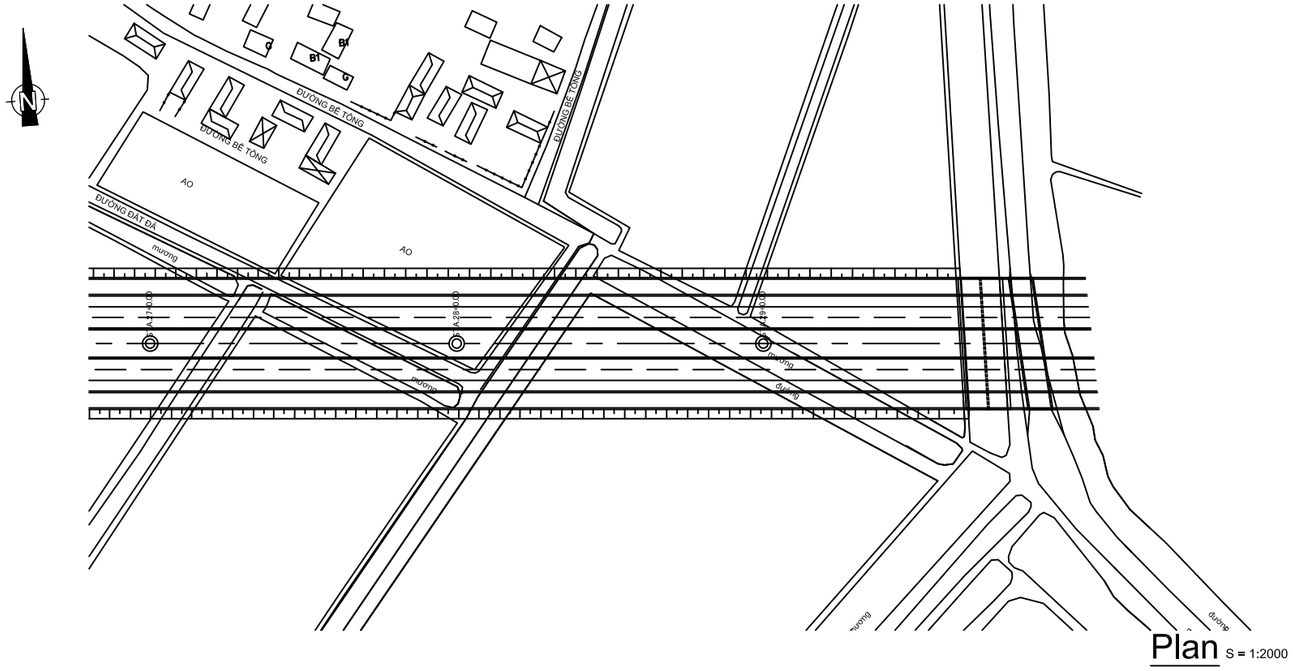

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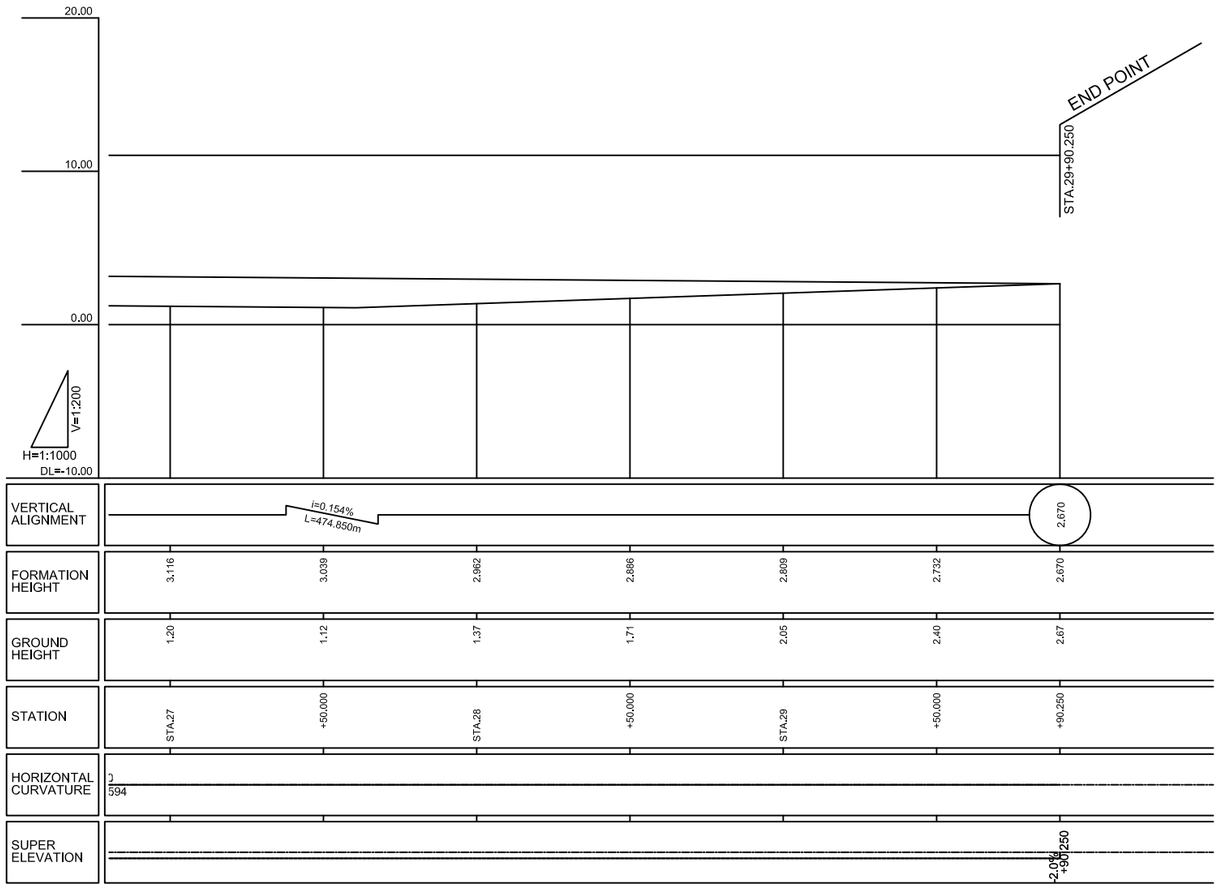

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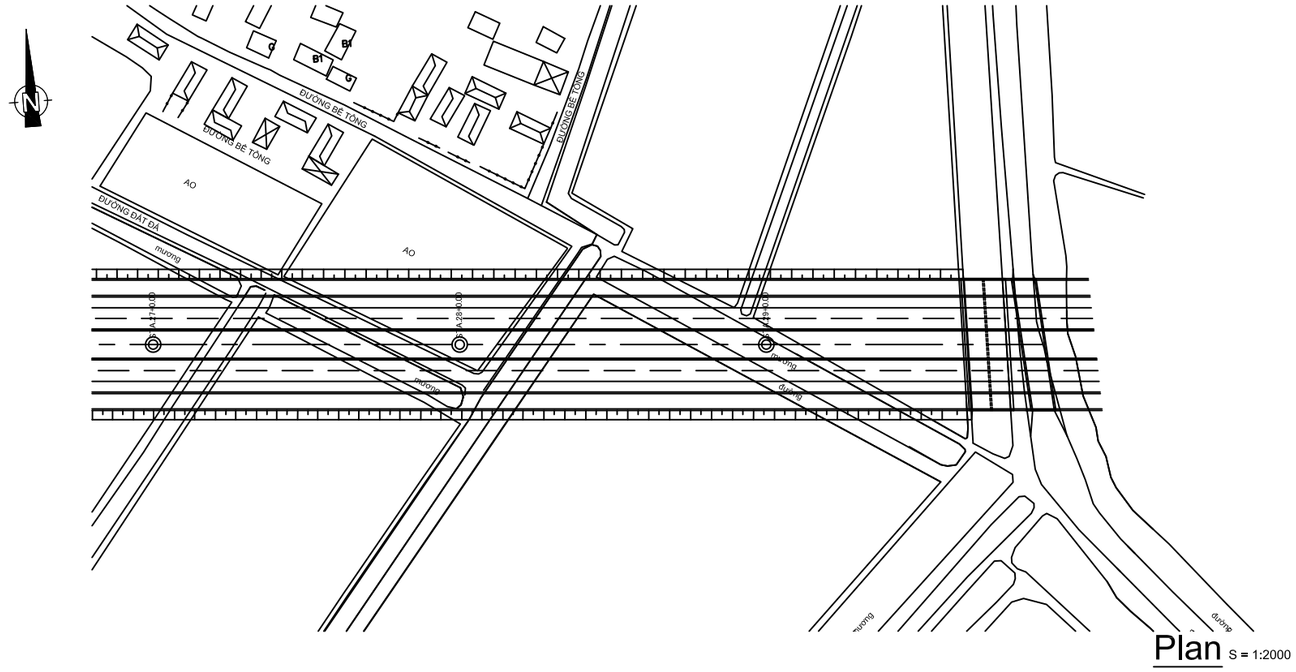

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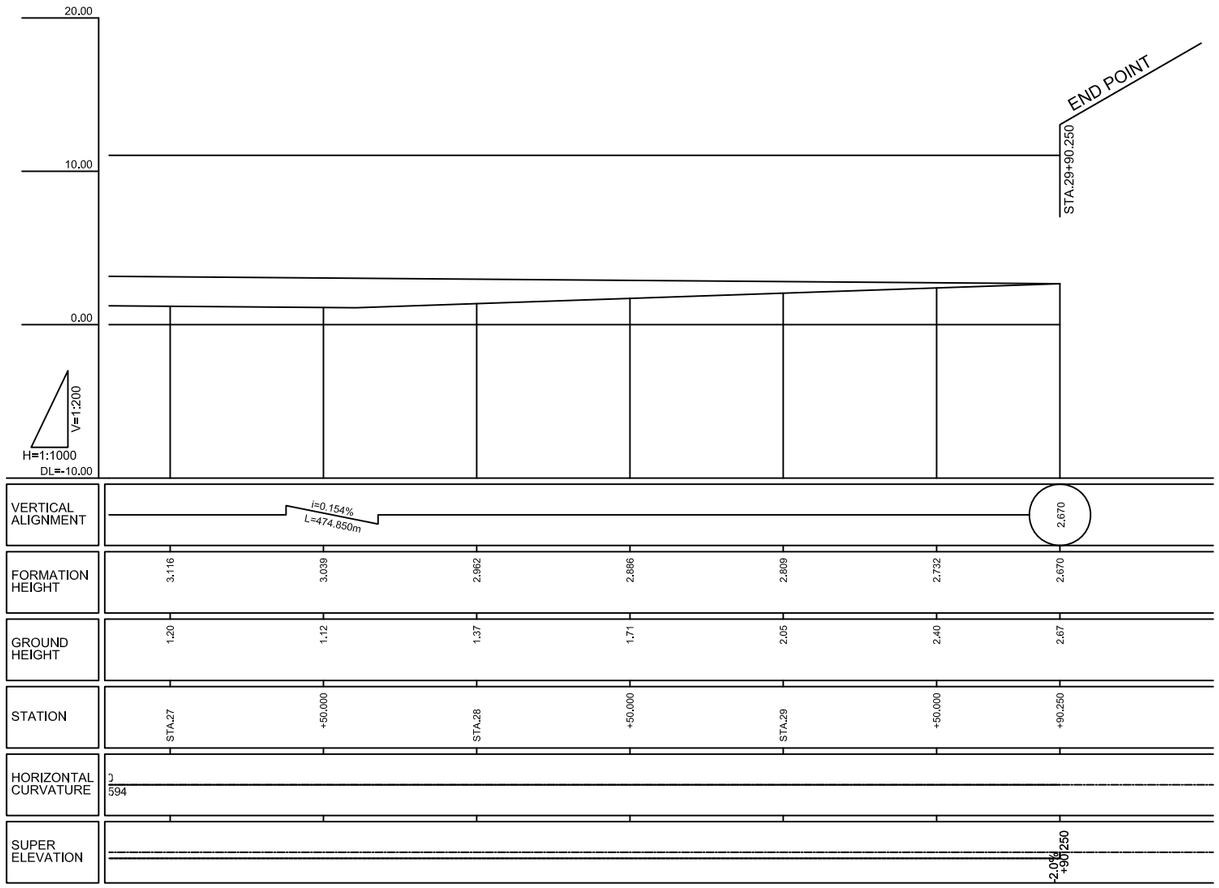

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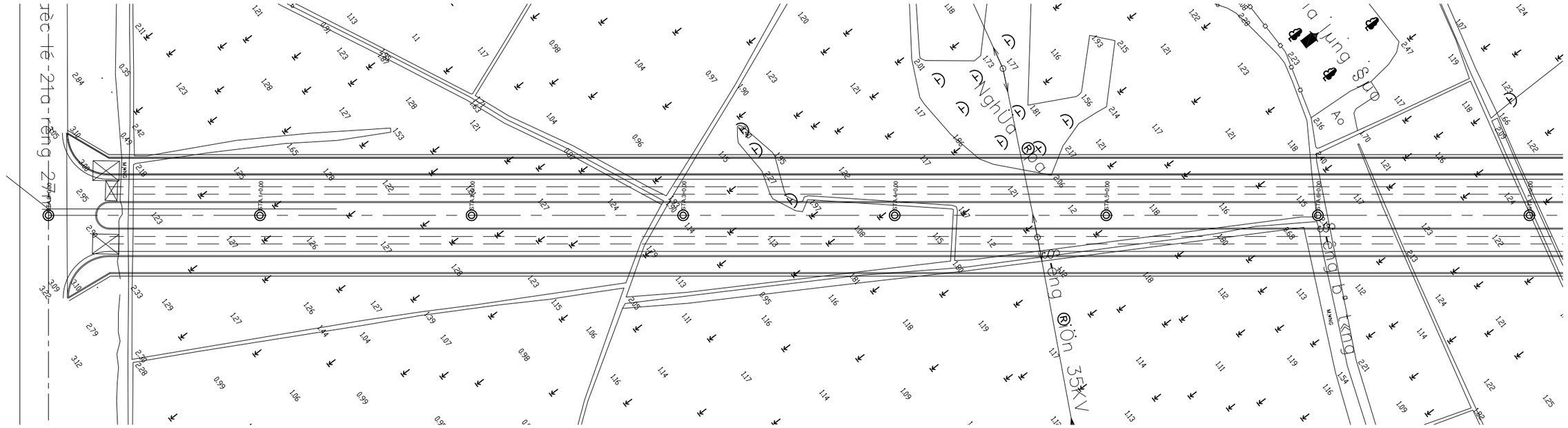

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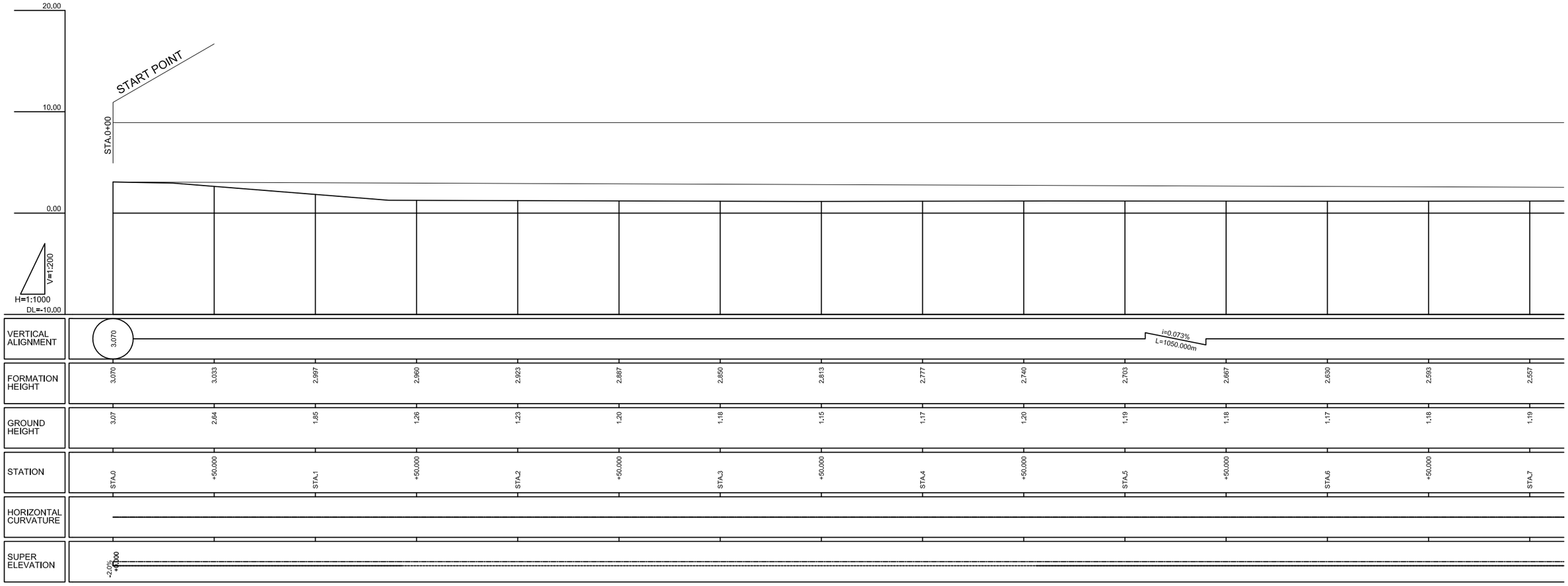

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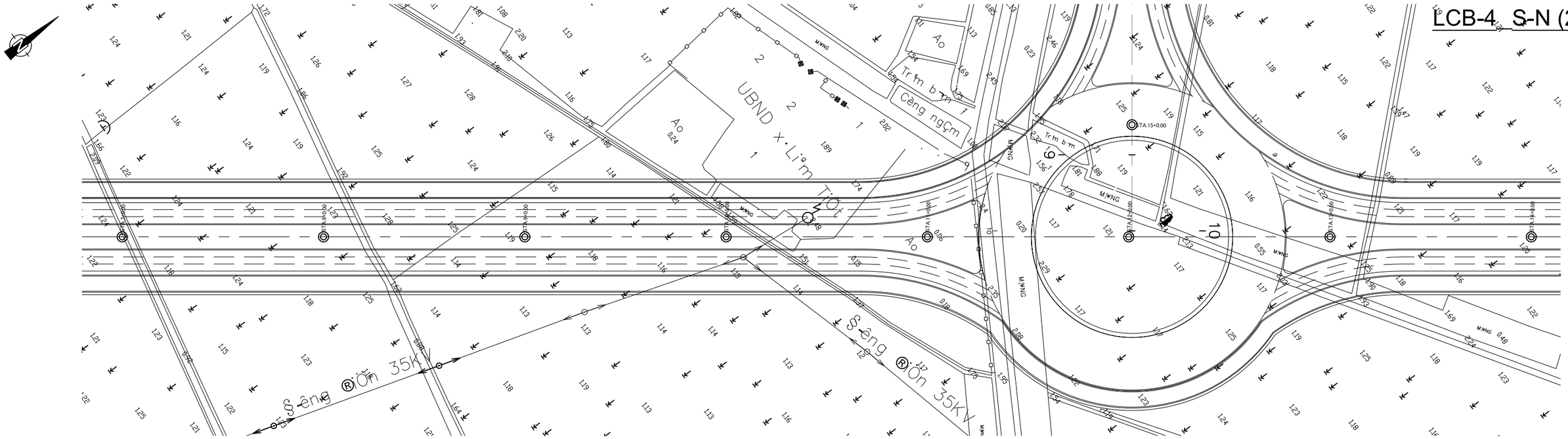

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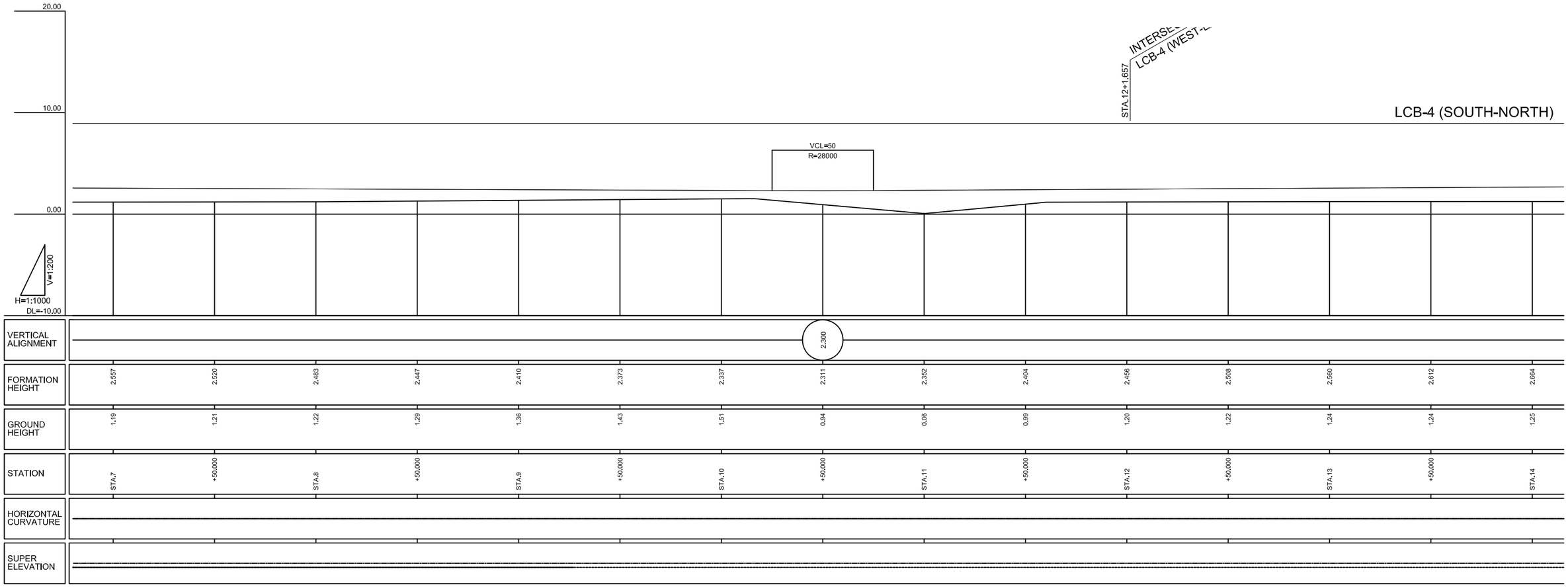
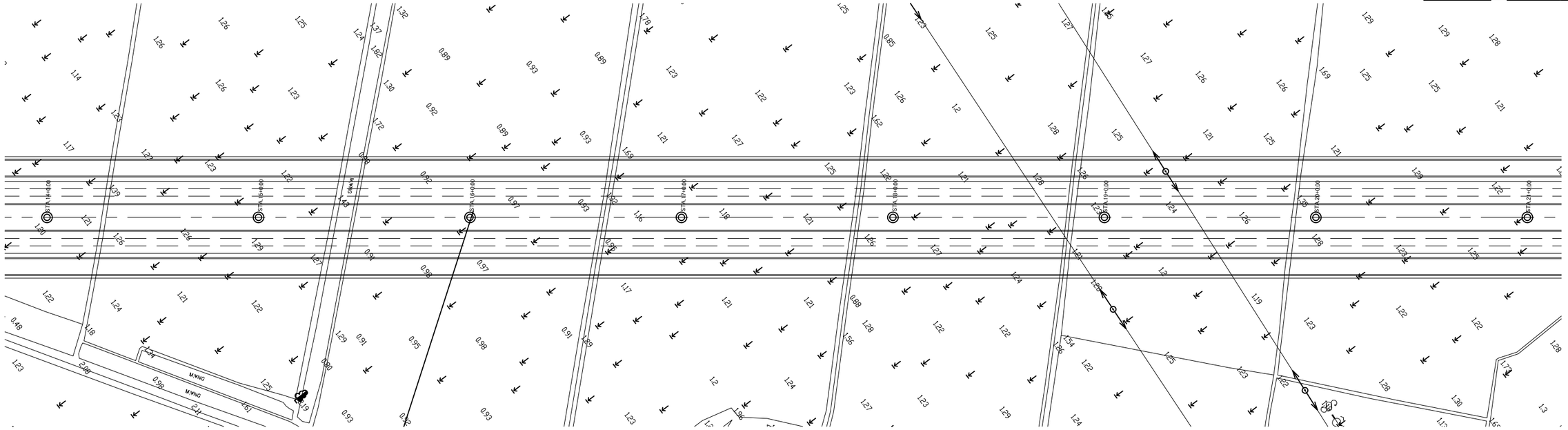


Profile H = 1:2000 V = 1:400



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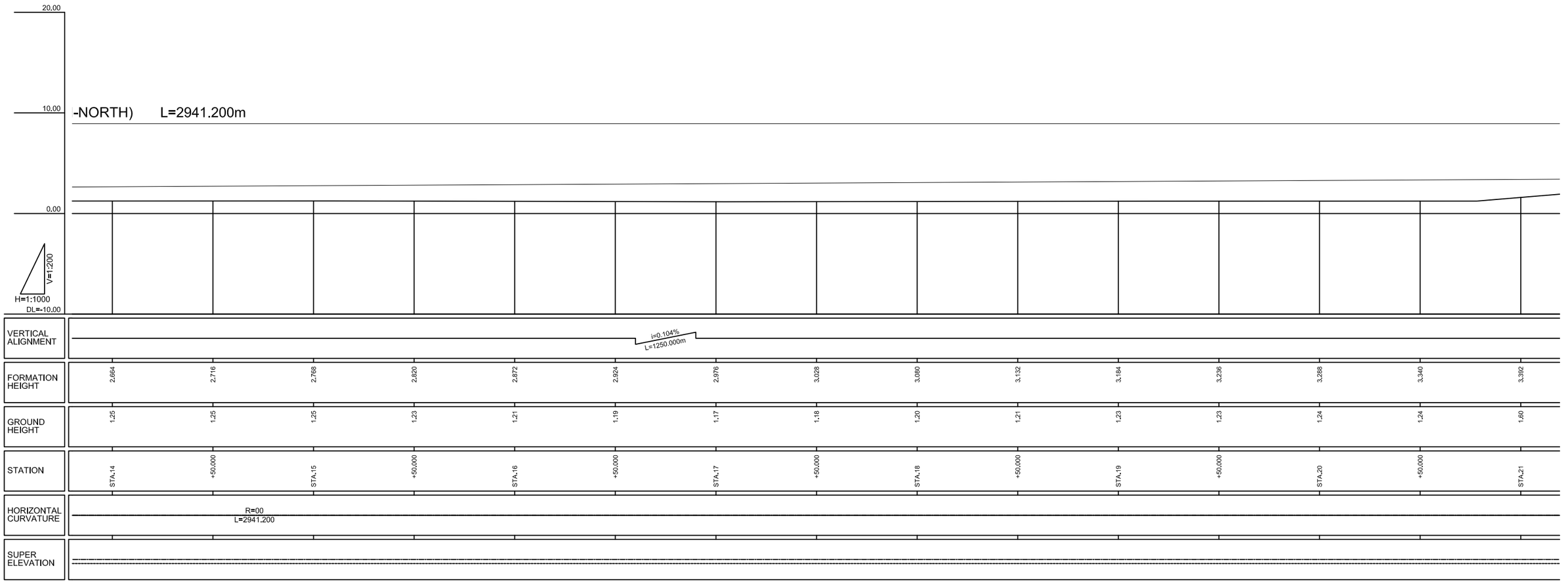

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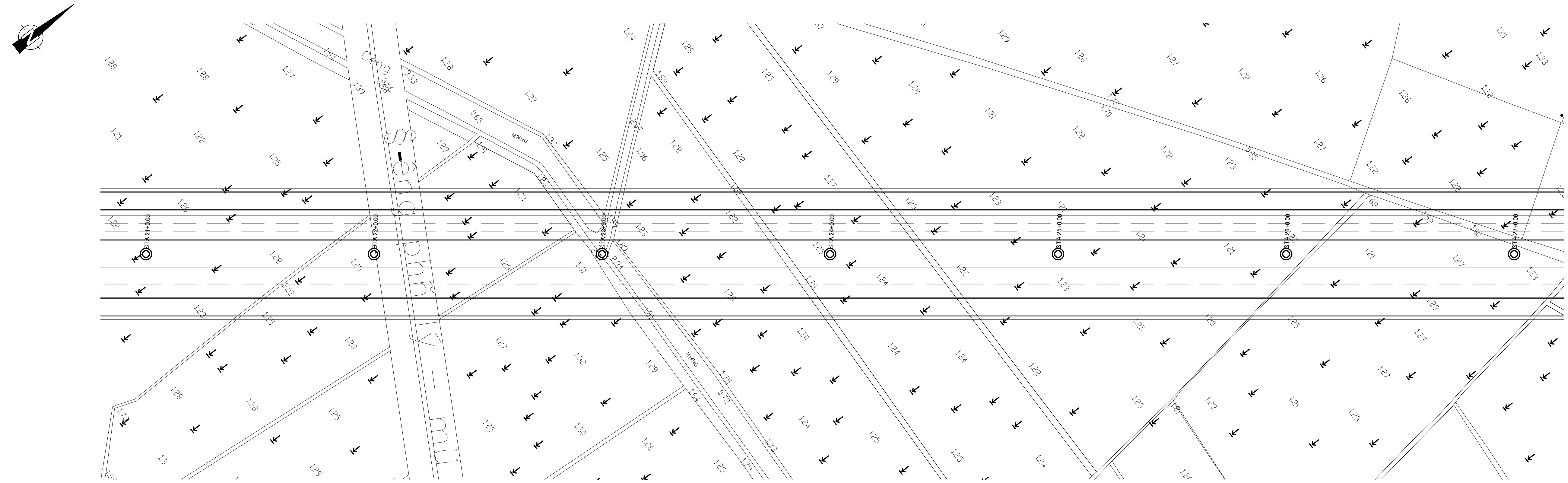
LCB-4 _S-N (4)



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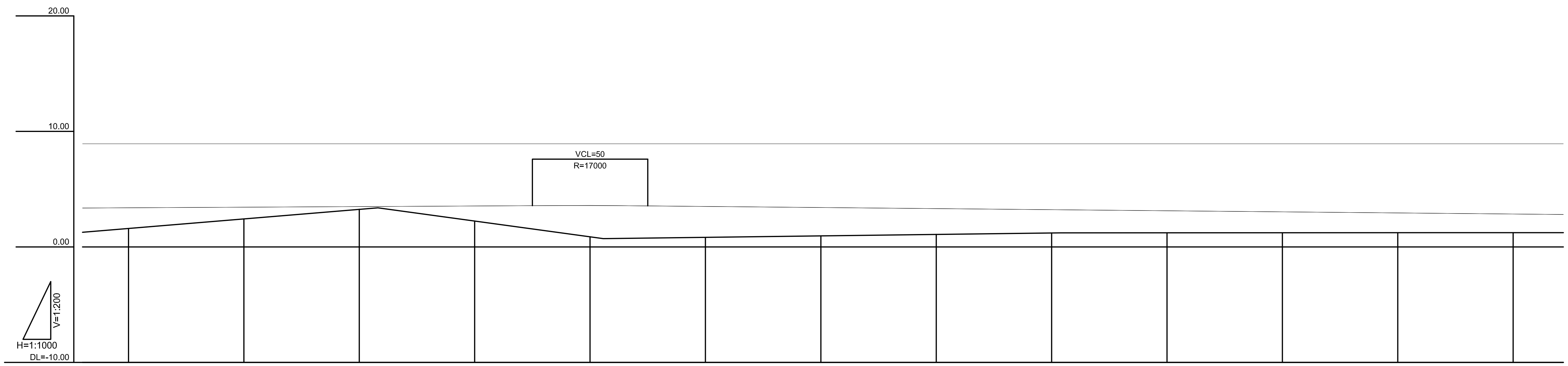
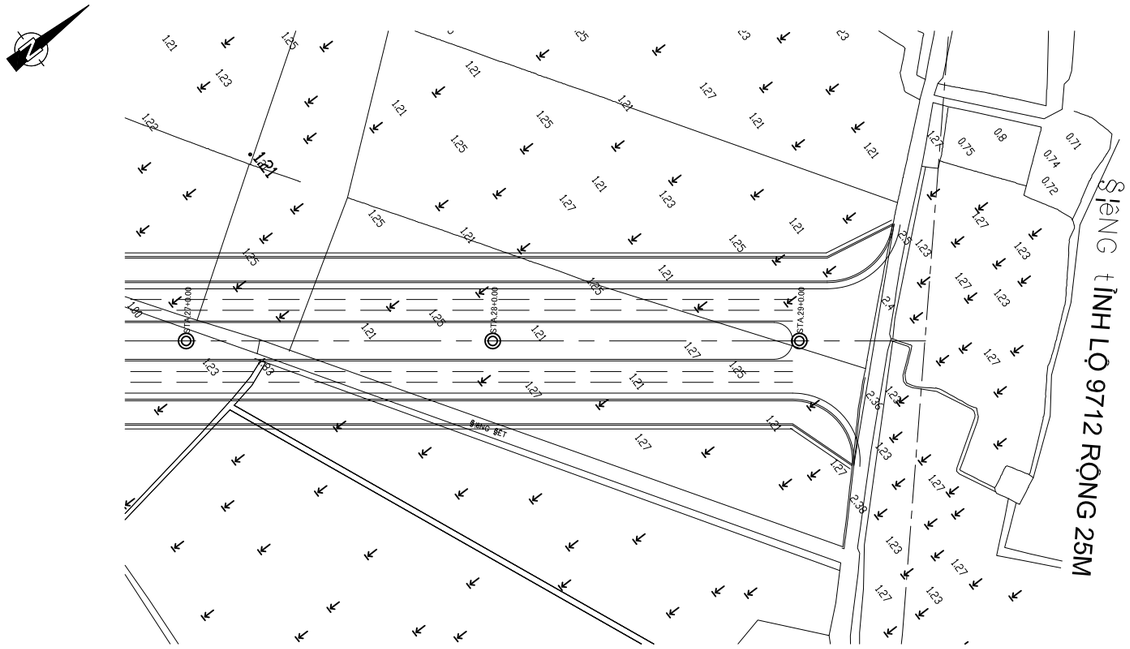


VERTICAL ALIGNMENT					3.600						i=0.187% L=641.200m		
FORMATION HEIGHT	3.392	3.444	3.496	3.548	3.582	3.506	3.413	3.319	3.226	3.132	3.039	2.945	2.851
GROUND HEIGHT	1.60	2.43	3.26	2.24	0.88	0.83	0.96	1.08	1.21	1.23	1.23	1.24	1.24
STATION	STA.21	+50.000	STA.22	+50.000	STA.23	+50.000	STA.24	+50.000	STA.25	+50.000	STA.26	+50.000	STA.27
HORIZONTAL CURVATURE													
SUPER ELEVATION													

Profile H = 1:2000 V = 1:400



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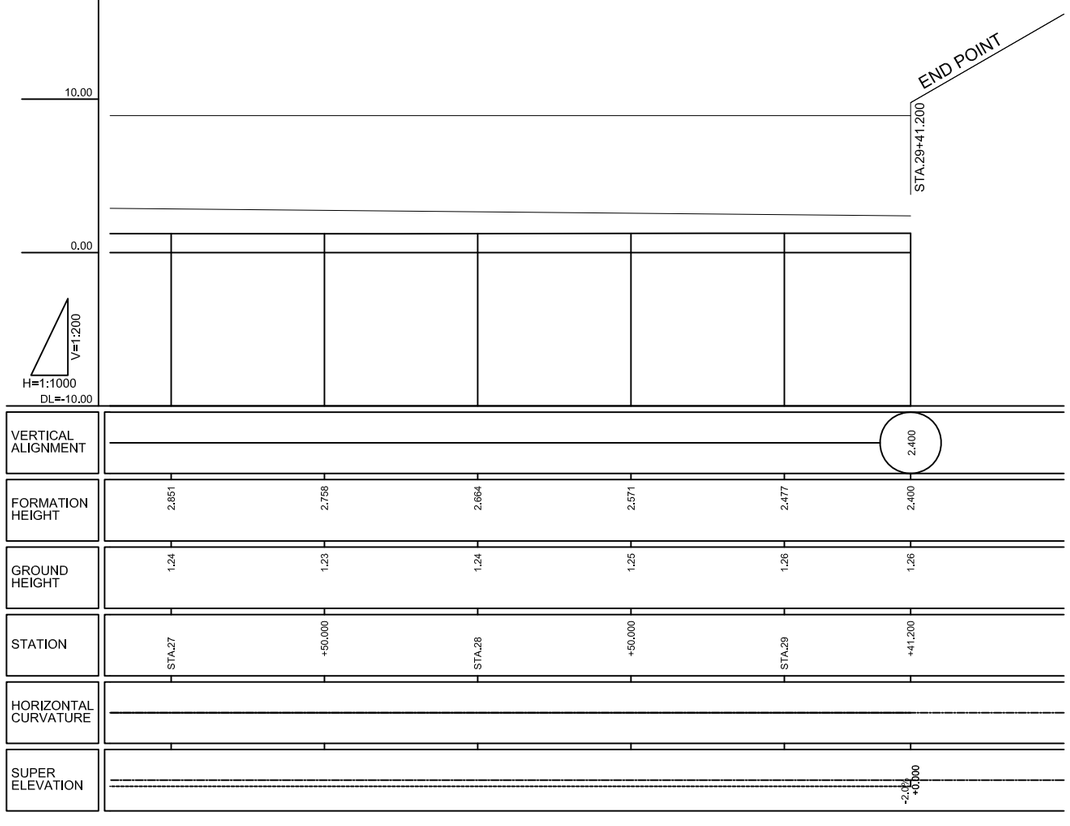

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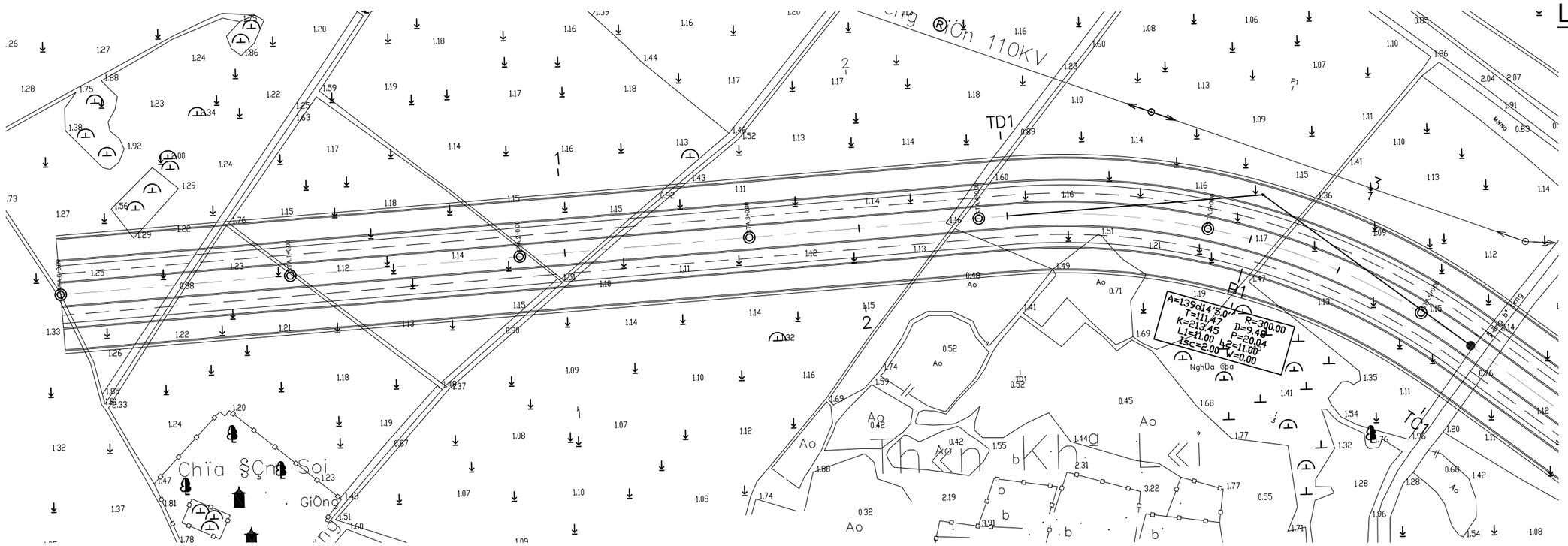

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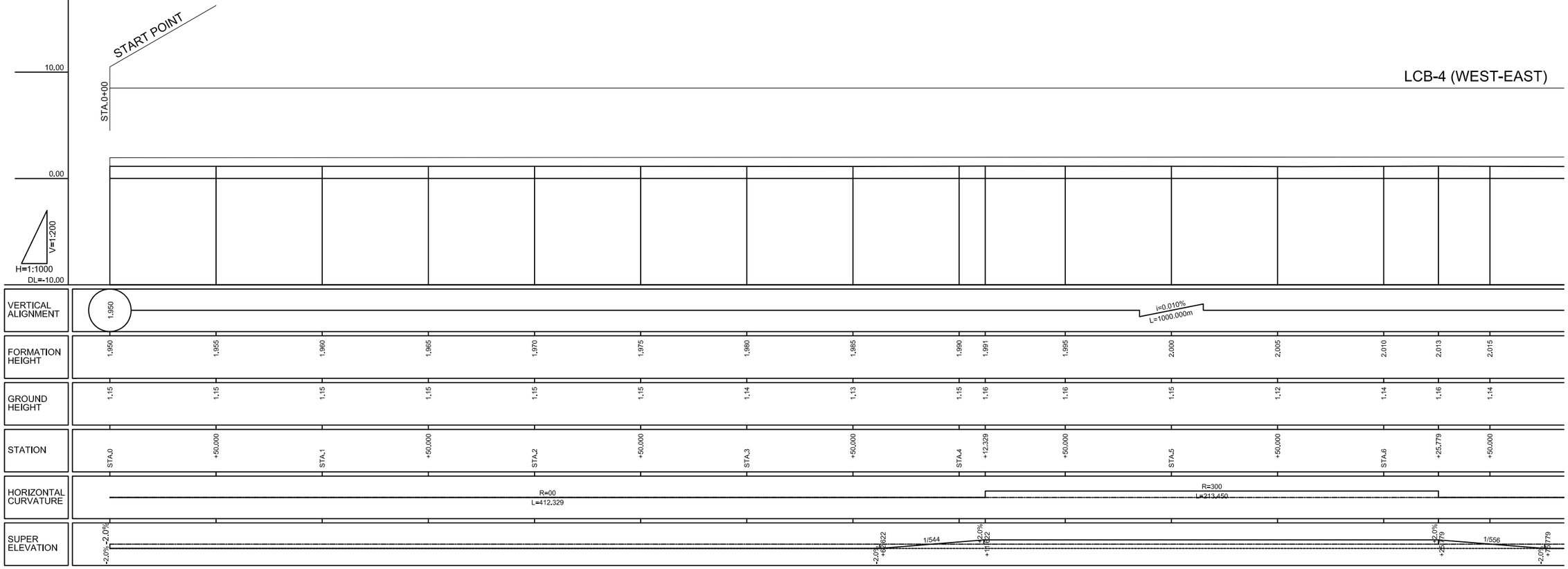

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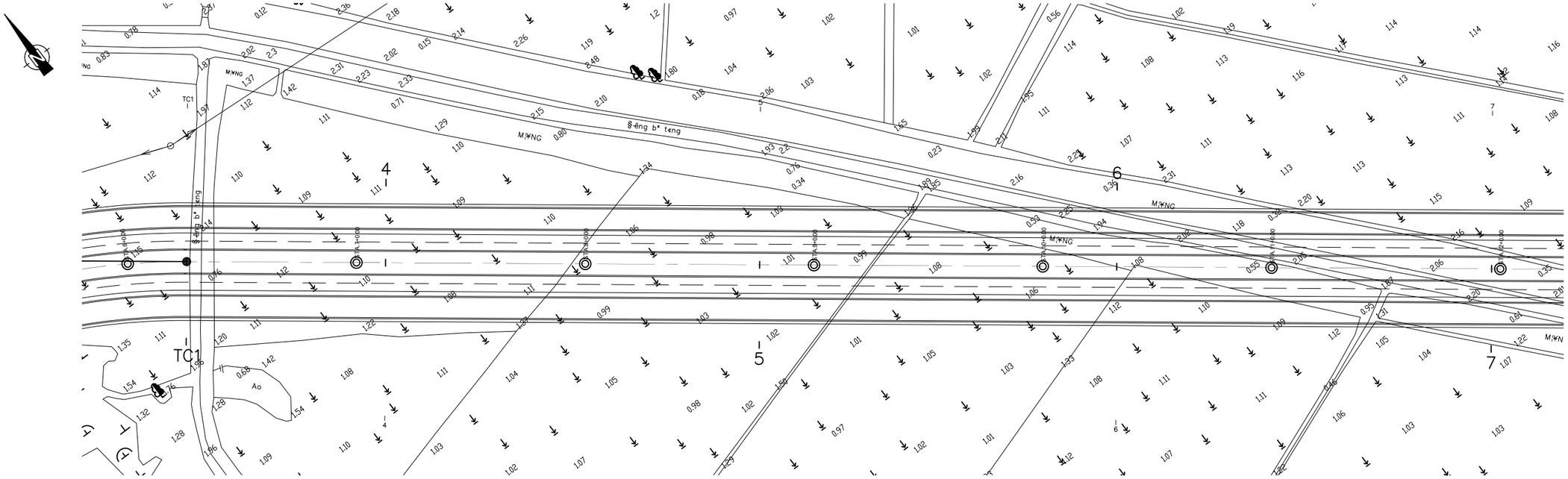
V = 1:400



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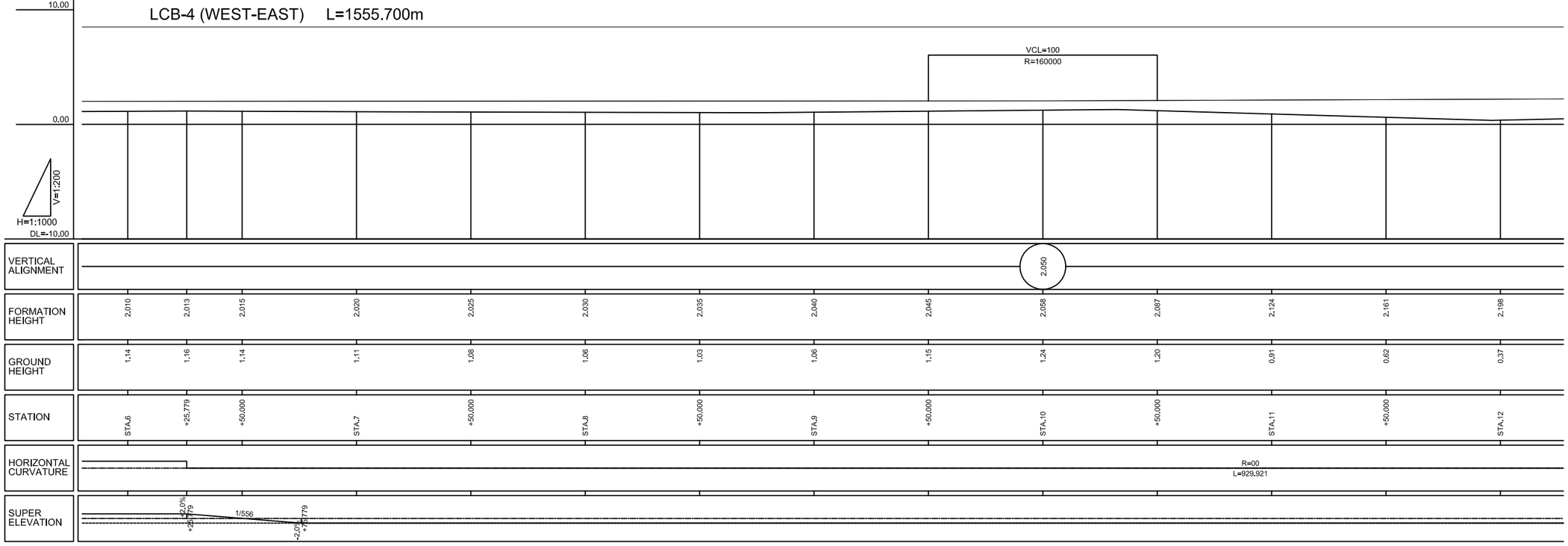

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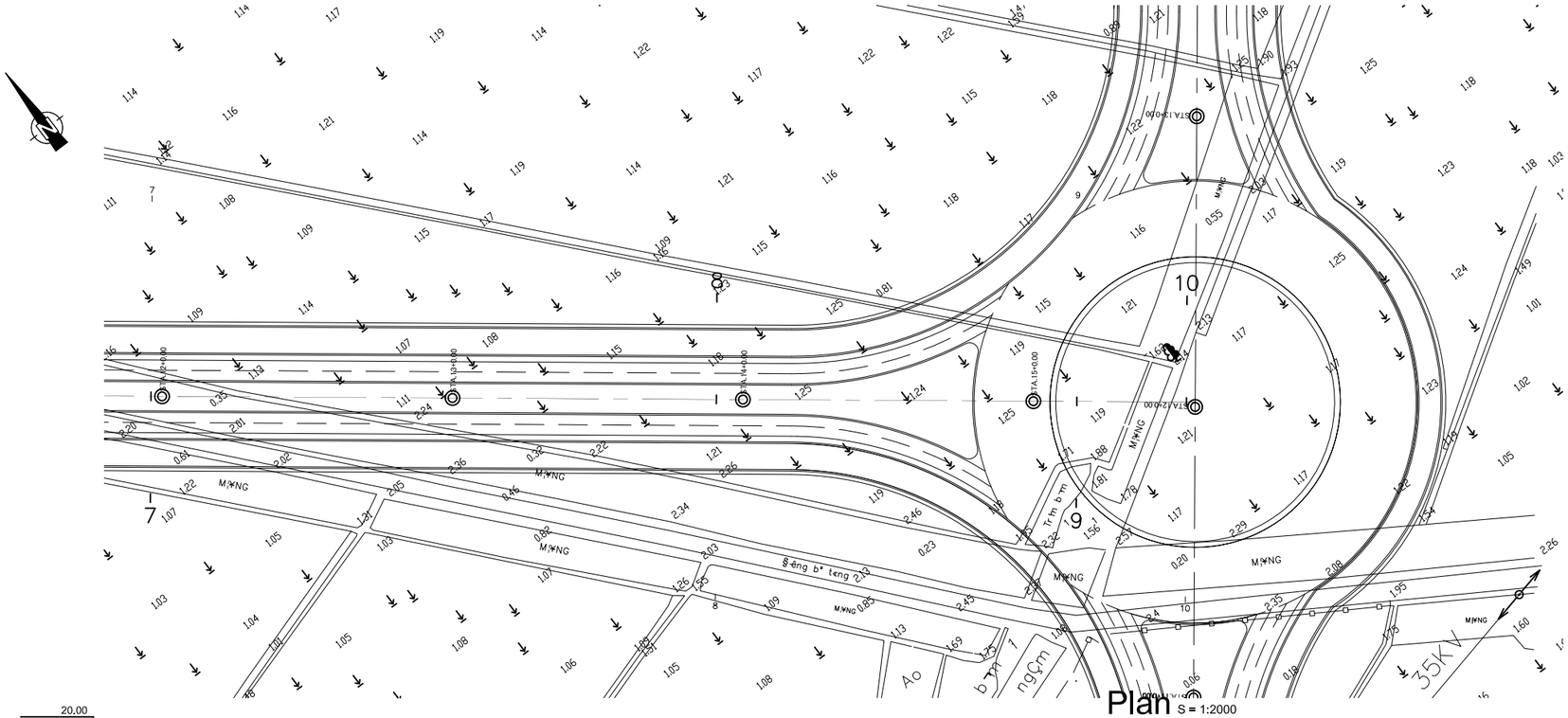
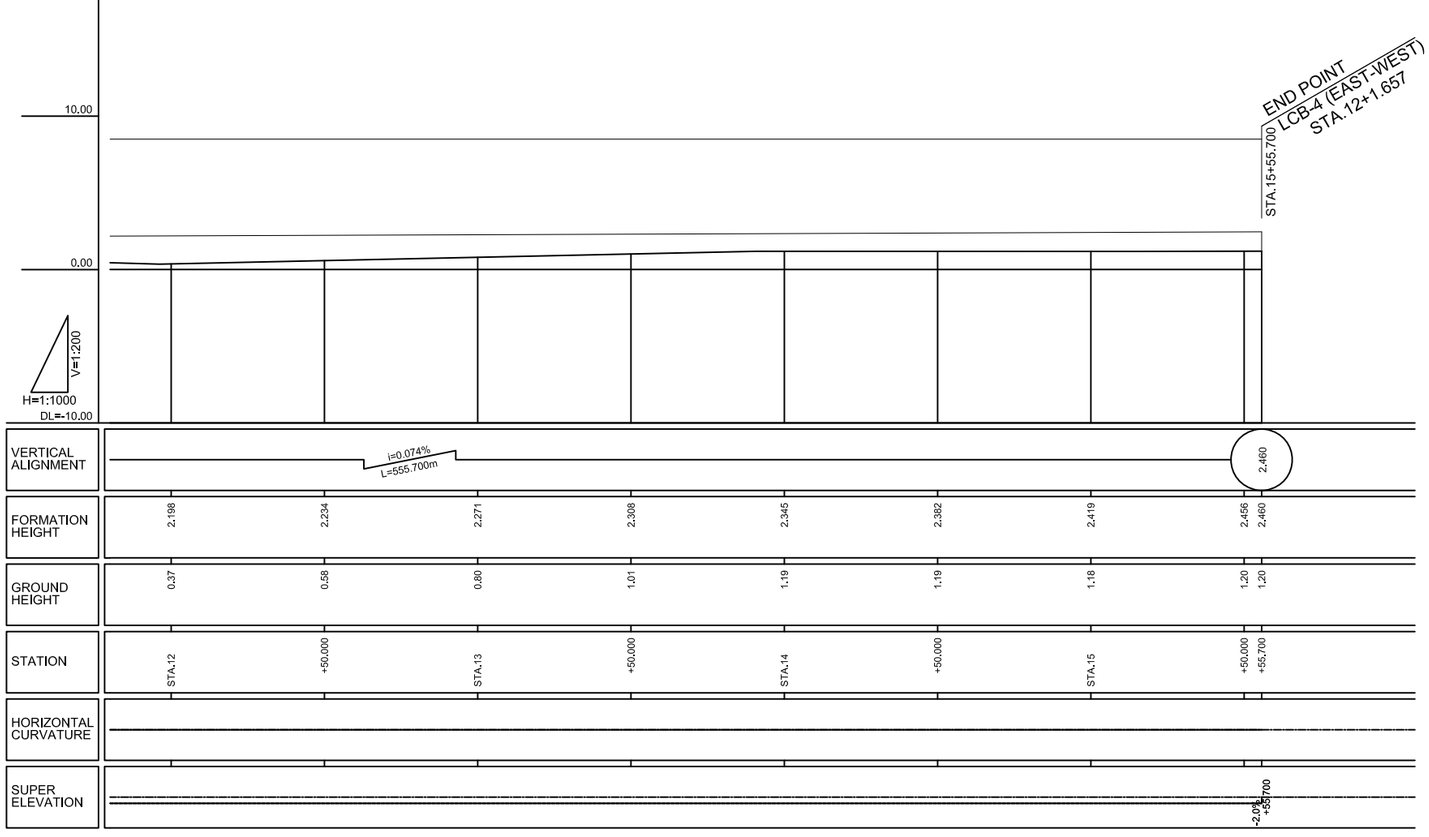
V = 1:400



Plan S = 1:2000



Profile H = 1:2000 V = 1:400

4. Cost Breakdown

(Unit:VND)

NO.	WORK ITEM	WORK TYPE	Unit	Quantity	Unit Cost (VND)			SUB TOTAL COST (VND)			TOTAL COST (VND)
					LABOR	MATERIAL	MACHINE	LABOR	MATERIAL	MACHINE	
I	**ROAD BASE**										
1	**Earth Work**										
1.1		**Excavation (by machine)**	m3	237,491	8,731		9,129	2,073,534,794	0	2,168,056,252	4,241,591,046
1.2		**Excavation (by hand)**	m3	0	86,002			0	0	0	0
1.3		**Backfill (by machine)**	m3	237,491	3,132		5,263	743,822,125	0	1,249,915,659	1,993,737,784
1.4		**Backfill (by hand)**	m3	0	120,611			0	0	0	0
1.5		**Embankment (by machine)**	m3	399,387	3,132	163,000	7,319	1,250,879,708	65,100,061,440	2,923,112,575	69,274,053,723
1.6		**Embankment (by hand)**	m3	0	126,011	163,000		0	0	0	0
		Transportation of soil	m3	71,247			12,457	0	0	887,527,990	887,527,990
1.7		**Slope Protection**	m2	7,500	44,104	10,253	15,222	330,780,000	76,897,500	114,165,000	521,842,500
2	**Side Ditch Treatment**										
		L gutter	m	7,200	308,236	293,172	60,097	2,219,298,045	2,110,836,806	432,697,260	4,762,832,111
2.7		**U Ditch with Cover (1,000*1,000)**	m	7,200	1,343,697	2,305,073	109,649	9,674,618,400	16,596,525,600	789,472,800	27,060,616,800
2.8		**Catch Basin (1,200*1,200)**	nos.	240	741,805	10,357,546		178,033,200	2,485,811,040	0	2,663,844,240
3	**Transport**										
3.1		**Removal of Excavated Unsuitable Soil**	m3	71,247		20,000	12,457	0	1,424,946,600	887,527,990	2,312,474,590
4	**Others**										
4.1		**Settlement Observation**	m	200	168,110	370,275	30,373	33,621,923	74,055,010	6,074,526	113,751,459
	Sub Total							16,504,588,195	87,869,133,996	9,458,550,052	113,832,272,243

(Unit:VND)

NO.	WORK ITEM	WORK TYPE	Unit	Quantity	Unit Cost (VND)			SUB TOTAL COST (VND)			TOTAL COST (VND)
					LABOR	MATERIAL	MACHINE	LABOR	MATERIAL	MACHINE	
II	**PAVEMENT**										
1	**Main Routes Road Way**										
1.1		**Sub Base Course (Crushed Stone 30cm)**	m2	68,400	2,460	90,312	6,350	168,264,000	6,177,340,800	434,340,000	6,779,944,800
1.2		**Base Course (Crushed Stone 15cm)**	m2	68,400	1,388	45,156	3,175	94,939,200	3,088,670,400	217,170,000	3,400,779,600
1.3		**Binder Course (Asphart 7cm)**	m2	68,400	29,370	333,562	161,537	2,008,908,000	22,815,640,800	11,049,130,800	35,873,679,600
1.4		**Wearing Course (Asphart 5cm)**	m2	68,400	20,979	238,259	115,383	1,434,963,600	16,296,915,600	7,892,197,200	25,624,076,400
2	**Side Walk**										
2.2		**Base Course (Crushed Stone 10cm)**	m2	64,800	925	30,104	2,117	59,940,000	1,950,739,200	137,181,600	2,147,860,800
2.3		**Sand and Mortar Buffer**	m2	64,800	15,920	27,530	594	1,031,616,000	1,783,944,000	38,491,200	2,854,051,200
2.4		**Interlocking Block**	m2	64,800	27,338	92,920		1,771,502,400	6,021,216,000	0	7,792,718,400
2.5		**Concrete Curb**	m	7,200	63,659	88,734	2,669	458,344,800	638,884,800	19,216,800	1,116,446,400
	Sub Total							7,028,478,000	58,773,351,600	19,787,727,600	85,589,557,200
III	**MEDIAN STRIP**										
1	**Median Strip Work**										
1.1		**Concrete Curb**	m	7,200	55,054	54,139	1,816	396,388,800	389,800,800	13,075,200	799,264,800
1.2		**Organic Soil**	m3	50,000	3,132	185,000	7,319	156,600,000	9,250,000,000	365,950,000	9,772,550,000
	Sub Total							552,988,800	9,639,800,800	379,025,200	10,571,814,800
IV	**CROSS DRAINAGE SYSTEM**										
1	**Structure**										
1.1		**Box Calvert (B x H = 1.5 x 1.7m)**	m	100	244,096	4,569,853	55,011	24,409,600	456,985,300	5,501,100	486,896,000
1.2		**Box Calvert (B x H = 2.0 x 2.0m)**	m	100	395,921	5,965,412	62,080	39,592,100	596,541,200	6,208,000	642,341,300
1.3		**Box Calvert (B x H = 3.0 x 3.0m)**	m	100	552,757	12,921,896	62,080	55,275,700	1,292,189,600	6,208,000	1,353,673,300
1.4		**Box Calvert (B x H = 4.0 x 3.0m)**	m	100	552,757	19,371,896	74,967	55,275,700	1,937,189,600	7,496,700	1,999,962,000
1.5		**Pipe Calvert (phi1000)**	m	2,000	57,184	1,426,963	48,604	114,368,000	2,853,926,000	97,208,000	3,065,502,000
1.6											
	Sub Total							288,921,100	7,136,831,700	122,621,800	7,548,374,600

(Unit:VND)

NO.	WORK ITEM	WORK TYPE	Unit	Quantity	Unit Cost (VND)			SUB TOTAL COST (VND)			TOTAL COST (VND)
					LABOR	MATERIAL	MACHINE	LABOR	MATERIAL	MACHINE	
V	**TRANSPORT SAFETY SYSTEM**										
1	**Facilities**										
1.1		**km Milestone**	pc	4	239,063	227,810	8,542	956,252	911,240	34,168	1,901,660
1.2		**Guide Post**	pc	10	187,126	96,171	16,044	1,871,260	961,710	160,440	2,993,410
1.3		**Protection Fence**	m	5,000	13,669	397,880	0	68,345,000	1,989,400,000	0	2,057,745,000
1.4		**Lighting (LED)**	pc	150	5,868,932	31,144,057	8,802,399	880,339,821	4,671,608,550	1,320,359,901	6,872,308,272
1.5		**Traffic Lights**	pc	4	78,000,000	448,400,000	380,000,000	312,000,000	1,793,600,000	1,520,000,000	3,625,600,000
2	**Surface Marking**										
2.1		**Round Road Signs**	pc	100	289,743	302,714	16,044	28,974,300	30,271,400	1,604,400	60,850,100
2.2		**Triangle Road Signs**	pc	100	251,513	163,588	16,044	25,151,300	16,358,800	1,604,400	43,114,500
2.3		**Square Road Signs**	pc	100	187,126	96,171	16,044	18,712,600	9,617,100	1,604,400	29,934,100
2.4		**2mm in thickness paint line**	m2	1,620	43,348	114,768	51,526	70,223,760	185,924,160	83,472,120	339,620,040
2.5		**6mm in thickness slow down paint line**	m2	285	104,949	328,735	124,887	29,910,465	93,689,475	35,592,795	159,192,735
	Sub Total							1,436,484,758	8,792,342,435	2,964,432,624	13,193,259,817
							Total	25,811,460,853	172,211,460,531	32,712,357,276	230,735,278,660

(Unit:VND)

NO.	WORK ITEM	WORK TYPE	Unit	Quantity	Unit Cost (VND)			SUB TOTAL COST (VND)			TOTAL COST (VND)
					LABOR	MATERIAL	MACHINE	LABOR	MATERIAL	MACHINE	
I	**ROAD BASE**										
1	**Earth Work**										
1.1		**Excavation (by machine)**	m3	64,122	8,731		9,129	559,849,182	0	585,369,738	1,145,218,920
1.2		**Excavation (by hand)**	m3	0	86,002			0	0	0	0
1.3		**Backfill (by machine)**	m3	28,947	3,132		5,263	90,662,004	0	152,348,061	243,010,065
1.4		**Backfill (by hand)**	m3	0	120,611			0	0	0	0
1.5		**Embankment (by machine)**	m3	29,754	3,132	163,000	7,319	93,189,528	4,849,902,000	217,769,526	5,160,861,054
1.6		**Embankment (by hand)**	m3	0	126,011	163,000		0	0	0	0
		Transportation of soil	m3	19,237			12,457	0	0	239,630,326	239,630,326
1.7		**Slope Protection**	m2	19,820	44,104	10,253	15,222	874,154,511	203,217,536	301,704,607	1,379,076,654
2	**Side Ditch Treatment**										
		L gutter	m	7,539	308,236	293,172	60,097	2,323,789,995	2,210,222,039	453,070,089	4,987,082,123
2.7		**U Ditch with Cover (1,000*1,000)**	m	7,539	1,343,697	2,305,073	109,649	10,130,131,683	17,377,945,347	826,643,811	28,334,720,841
2.8		**Catch Basin (1,200*1,200)**	nos.	251	741,805	10,357,546		186,415,597	2,602,851,310	0	2,789,266,907
3	**Transport**										
3.1		**Removal of Excavated Unsuitable Soil**	m3	19,237		20,000	12,457	0	384,732,000	239,630,326	624,362,326
4	**Others**										
4.1		**Settlement Observation**	m	200	168,110	370,275	30,373	33,621,923	74,055,010	6,074,526	113,751,459
	Sub Total							14,291,814,423	27,702,925,242	3,022,241,010	45,016,980,675

(Unit:VND)

NO.	WORK ITEM	WORK TYPE	Unit	Quantity	Unit Cost (VND)			SUB TOTAL COST (VND)			TOTAL COST (VND)
					LABOR	MATERIAL	MACHINE	LABOR	MATERIAL	MACHINE	
II	**PAVEMENT**										
1	**Main Routes Road Way**										
1.1		**Sub Base Course (Crushed Stone 30cm)**	m2	75,143	2,460	90,312	6,350	184,850,665	6,786,273,665	477,155,171	7,448,279,501
1.2		**Base Course (Crushed Stone 15cm)**	m2	75,143	1,388	45,156	3,175	104,297,855	3,393,136,832	238,577,585	3,736,012,272
1.3		**Binder Course (Asphart 7cm)**	m2	75,143	29,370	333,562	161,537	2,206,936,592	25,064,698,115	12,138,301,544	39,409,936,251
1.4		**Wearing Course (Asphart 5cm)**	m2	75,143	20,979	238,259	115,383	1,576,415,484	17,903,388,001	8,670,172,450	28,149,975,935
2	**Side Walk**										
2.2		**Base Course (Crushed Stone 10cm)**	m2	31,294	925	30,104	2,117	28,946,950	942,074,576	66,249,398	1,037,270,924
2.3		**Sand and Mortar Buffer**	m2	31,294	15,920	27,530	594	498,200,480	861,523,820	18,588,636	1,378,312,936
2.4		**Interlocking Block**	m2	31,294	27,338	92,920		855,515,372	2,907,838,480	0	3,763,353,852
2.5		**Concrete Curb**	m	0	63,659	88,734	2,669	0	0	0	0
	Sub Total							5,455,163,398	57,858,933,489	21,609,044,784	84,923,141,671
III	**MEDIAN STRIP**										
1	**Median Strip Work**										
1.1		**Concrete Curb**	m	0	55,054	54,139	1,816	0	0	0	0
1.2		**Organic Soil**	m3	0	3,132	185,000	7,319	0	0	0	0
	Sub Total							0	0	0	0

(Unit:VND)

NO.	WORK ITEM	WORK TYPE	Unit	Quantity	Unit Cost (VND)			SUB TOTAL COST (VND)			TOTAL COST (VND)
					LABOR	MATERIAL	MACHINE	LABOR	MATERIAL	MACHINE	
IV	**CROSS DRAINAGE SYSTEM**										
1	**Structure**										
1.1		**Box Calvert (B x H = 1.5 x 1.7m)**	m	100	244,096	4,569,853	55,011	24,409,600	456,985,300	5,501,100	486,896,000
1.2		**Box Calvert (B x H = 2.0 x 2.0m)**	m	100	395,921	5,965,412	62,080	39,592,100	596,541,200	6,208,000	642,341,300
1.3		**Box Calvert (B x H = 3.0 x 3.0m)**	m	100	552,757	12,921,896	62,080	55,275,700	1,292,189,600	6,208,000	1,353,673,300
1.4		**Box Calvert (B x H = 4.0 x 3.0m)**	m	100	552,757	19,371,896	74,967	55,275,700	1,937,189,600	7,496,700	1,999,962,000
1.5		**Pipe Calvert (phi1000)**	m	2,000	57,184	1,426,963	48,604	114,368,000	2,853,926,000	97,208,000	3,065,502,000
1.6											
	Sub Total							288,921,100	7,136,831,700	122,621,800	7,548,374,600
V	**TRANSPORT SAFETY SYSTEM**										
1	**Facilities**										
1.1		**km Milestone**	pc	4	239,063	227,810	8,542	956,252	911,240	34,168	1,901,660
1.2		**Guide Post**	pc	6	187,126	96,171	16,044	1,122,756	577,026	96,264	1,796,046
1.3		**Protection Fence**	m	0	13,669	397,880	0	0	0	0	0
1.4		**Lighting (LED)**	pc	86	5,868,932	31,144,057	8,802,399	504,728,164	2,678,388,902	757,006,343	3,940,123,409
1.5		**Traffic Lights**	pc	0	78,000,000	448,400,000	380,000,000	0	0	0	0
2	**Surface Marking**										
2.1		**Round Road Signs**	pc	4	289,743	302,714	16,044	1,158,972	1,210,856	64,176	2,434,004
2.2		**Triangle Road Signs**	pc	4	251,513	163,588	16,044	1,006,052	654,352	64,176	1,724,580
2.3		**Square Road Signs**	pc	4	187,126	96,171	16,044	748,504	384,684	64,176	1,197,364
2.4		**2mm in thickness paint line**	m2	8,820	43,348	114,768	51,526	382,329,360	1,012,253,760	454,459,320	1,849,042,440
2.5		**6mm in thickness slow down paint line**	m2	100	104,949	328,735	124,887	10,494,900	32,873,500	12,488,700	55,857,100
	Sub Total							902,544,960	3,727,254,320	1,224,277,323	5,854,076,603
							Total	20,938,443,881	96,425,944,751	25,978,184,917	143,342,573,549

(Unit:VND)

NO.	WORK ITEM	WORK TYPE	Unit	Quantity	Unit Cost (VND)			SUB TOTAL COST (VND)			TOTAL COST (VND)
					LABOR	MATERIAL	MACHINE	LABOR	MATERIAL	MACHINE	
I	**ROAD BASE**										
1	**Earth Work**										
1.1		**Excavation (by machine)**	m3	78,796	8,731		9,129	687,967,876	0	719,328,684	1,407,296,560
1.2		**Excavation (by hand)**	m3	0	86,002			0	0	0	0
1.3		**Backfill (by machine)**	m3	78,796	3,132		5,263	246,789,072	0	414,703,348	661,492,420
1.4		**Backfill (by hand)**	m3	0	120,611			0	0	0	0
1.5		**Embankment (by machine)**	m3	120,726	3,132	163,000	7,319	378,114,772	19,678,386,900	883,595,790	20,940,097,462
1.6		**Embankment (by hand)**	m3	0	126,011	163,000		0	0	0	0
		Transportation of soil	m3	23,639			12,457	0	0	294,468,532	294,468,532
1.7		**Slope Protection**	m2	5,335	44,104	10,253	15,222	235,294,840	54,699,755	81,209,370	371,203,965
2	**Side Ditch Treatment**										
		L gutter	m	5,930	308,236	293,172	60,097	1,827,838,529	1,738,508,647	356,374,271	3,922,721,447
2.7		**U Ditch with Cover (1,000*1,000)**	m	5,930	1,343,697	2,305,073	109,649	7,968,123,210	13,669,082,890	650,218,570	22,287,424,670
2.8		**Catch Basin (1,200*1,200)**	nos.	198	741,805	10,357,546		146,630,122	2,047,341,593	0	2,193,971,715
3	**Transport**										
3.1		**Removal of Excavated Unsuitable Soil**	m3	23,639		20,000	12,457	0	472,776,000	294,468,532	767,244,532
4	**Others**										
4.1		**Settlement Observation**	m	200	168,110	370,275	30,373	33,621,923	74,055,010	6,074,526	113,751,459
	Sub Total							11,524,380,344	37,734,850,795	3,700,441,623	52,959,672,762

(Unit:VND)

NO.	WORK ITEM	WORK TYPE	Unit	Quantity	Unit Cost (VND)			SUB TOTAL COST (VND)			TOTAL COST (VND)
					LABOR	MATERIAL	MACHINE	LABOR	MATERIAL	MACHINE	
II	**PAVEMENT**										
1	**Main Routes Road Way**										
1.1		**Sub Base Course (Crushed Stone 30cm)**	m2	58,839	2,460	90,312	6,350	144,743,940	5,313,867,768	373,627,650	5,832,239,358
1.2		**Base Course (Crushed Stone 15cm)**	m2	58,839	1,388	45,156	3,175	81,668,532	2,656,933,884	186,813,825	2,925,416,241
1.3		**Binder Course (Asphart 7cm)**	m2	58,839	29,370	333,562	161,537	1,728,101,430	19,626,454,518	9,504,675,543	30,859,231,491
1.4		**Wearing Course (Asphart 5cm)**	m2	58,839	20,979	238,259	115,383	1,234,383,381	14,018,921,301	6,789,020,337	22,042,325,019
2	**Side Walk**										
2.2		**Base Course (Crushed Stone 10cm)**	m2	28,066	925	30,104	2,117	25,961,050	844,898,864	59,415,722	930,275,636
2.3		**Sand and Mortar Buffer**	m2	28,066	15,920	27,530	594	446,810,720	772,656,980	16,671,204	1,236,138,904
2.4		**Interlocking Block**	m2	28,066	27,338	92,920		767,268,308	2,607,892,720	0	3,375,161,028
2.5		**Concrete Curb**	m	4,300	63,659	88,734	2,669	273,733,700	381,556,200	11,476,700	666,766,600
	Sub Total							4,702,671,061	46,223,182,235	16,941,700,981	67,867,554,277
III	**MEDIAN STRIP**										
1	**Median Strip Work**										
1.1		**Concrete Curb**	m	4,300	55,054	54,139	1,816	236,732,200	232,797,700	7,808,800	477,338,700
1.2		**Organic Soil**	m3	19,360	3,132	185,000	7,319	60,635,520	3,581,600,000	141,695,840	3,783,931,360
	Sub Total							297,367,720	3,814,397,700	149,504,640	4,261,270,060

(Unit:VND)

NO.	WORK ITEM	WORK TYPE	Unit	Quantity	Unit Cost (VND)			SUB TOTAL COST (VND)			TOTAL COST (VND)
					LABOR	MATERIAL	MACHINE	LABOR	MATERIAL	MACHINE	
IV	**CROSS DRAINAGE SYSTEM**										
1	**Structure**										
1.1		**Box Calvert (B x H = 1.5 x 1.7m)**	m	100	244,096	4,569,853	55,011	24,409,600	456,985,300	5,501,100	486,896,000
1.2		**Box Calvert (B x H = 2.0 x 2.0m)**	m	100	395,921	5,965,412	62,080	39,592,100	596,541,200	6,208,000	642,341,300
1.3		**Box Calvert (B x H = 3.0 x 3.0m)**	m	100	552,757	12,921,896	62,080	55,275,700	1,292,189,600	6,208,000	1,353,673,300
1.4		**Box Calvert (B x H = 4.0 x 3.0m)**	m	100	552,757	19,371,896	74,967	55,275,700	1,937,189,600	7,496,700	1,999,962,000
1.5		**Pipe Calvert (phi1000)**	m	2,000	57,184	1,426,963	48,604	114,368,000	2,853,926,000	97,208,000	3,065,502,000
1.6		**Box Calvert (B x H = 10.0 x 3.0m)**	m	200	5,527,570	129,218,960	620,800	1,105,514,000	25,843,792,000	124,160,000	27,073,466,000
	Sub Total							1,394,435,100	32,980,623,700	246,781,800	34,621,840,600
V	**TRANSPORT SAFETY SYSTEM**										
1	**Facilities**										
1.1		**km Milestone**	pc	4	239,063	227,810	8,542	956,252	911,240	34,168	1,901,660
1.2		**Guide Post**	pc	10	187,126	96,171	16,044	1,871,260	961,710	160,440	2,993,410
1.3		**Protection Fence**	m	4,100	13,669	397,880	0	56,042,900	1,631,308,000	0	1,687,350,900
1.4		**Lighting (LED)**	pc	86	5,868,932	31,144,057	8,802,399	504,728,164	2,678,388,902	757,006,343	3,940,123,409
1.5		**Traffic Lights**	pc	8	78,000,000	448,400,000	380,000,000	624,000,000	3,587,200,000	3,040,000,000	7,251,200,000
2	**Surface Marking**										
2.1		**Round Road Signs**	pc	6	289,743	302,714	16,044	1,738,458	1,816,284	96,264	3,651,006
2.2		**Triangle Road Signs**	pc	6	251,513	163,588	16,044	1,509,078	981,528	96,264	2,586,870
2.3		**Square Road Signs**	pc	6	187,126	96,171	16,044	1,122,756	577,026	96,264	1,796,046
2.4		**2mm in thickness paint line**	m2	1,935	43,348	114,768	51,526	83,878,380	222,076,080	99,702,810	405,657,270
2.5		**6mm in thickness slow down paint line**	m2	100	104,949	328,735	124,887	10,494,900	32,873,500	12,488,700	55,857,100
	Sub Total							1,286,342,148	8,157,094,270	3,909,681,253	13,353,117,671
							Total	19,205,196,373	128,910,148,700	24,948,110,297	173,063,455,370

(Unit:VND)

NO.	WORK ITEM	WORK TYPE	Unit	Quantity	Unit Cost (VND)			SUB TOTAL COST (VND)			TOTAL COST (VND)
					LABOR	MATERIAL	MACHINE	LABOR	MATERIAL	MACHINE	
I	**ROAD BASE**										
1	**Earth Work**										
1.1		**Excavation (by machine)**	m3	81,987	8,731		9,129	715,828,497	0	748,459,323	1,464,287,820
1.2		**Excavation (by hand)**	m3	0	86,002			0	0	0	0
1.3		**Backfill (by machine)**	m3	81,987	3,132		5,263	256,783,284	0	431,497,581	688,280,865
1.4		**Backfill (by hand)**	m3	0	120,611			0	0	0	0
1.5		**Embankment (by machine)**	m3	157,036	3,132	163,000	7,319	491,837,692	25,596,916,900	1,149,348,680	27,238,103,272
1.6		**Embankment (by hand)**	m3	0	126,011	163,000		0	0	0	0
		Transportation of soil	m3	24,596			12,457	0	0	306,393,618	306,393,618
1.7		**Slope Protection**	m2	7,750	44,104	10,253	15,222	341,806,000	79,460,750	117,970,500	539,237,250
2	**Side Ditch Treatment**										
		L gutter	m	4,300	308,236	293,172	60,097	1,325,414,110	1,260,638,648	258,416,419	2,844,469,177
2.7		**U Ditch with Cover (1,000*1,000)**	m	4,300	1,343,697	2,305,073	109,649	5,777,897,100	9,911,813,900	471,490,700	16,161,201,700
2.8		**Catch Basin (1,200*1,200)**	nos.	143	741,805	10,357,546		106,325,383	1,484,581,593	0	1,590,906,976
3	**Transport**										
3.1		**Removal of Excavated Unsuitable Soil**	m3	24,596		20,000	12,457	0	491,922,000	306,393,618	798,315,618
4	**Others**										
4.1		**Settlement Observation**	m	200	168,110	370,275	30,373	33,621,923	74,055,010	6,074,526	113,751,459
	Sub Total							9,049,513,989	38,899,388,801	3,796,044,965	51,744,947,755
II	**PAVEMENT**										
1	**Main Routes Road Way**										
1.1		**Sub Base Course (Crushed Stone 30cm)**	m2	58,839	2,460	90,312	6,350	144,743,940	5,313,867,768	373,627,650	5,832,239,358
1.2		**Base Course (Crushed Stone 15cm)**	m2	58,839	1,388	45,156	3,175	81,668,532	2,656,933,884	186,813,825	2,925,416,241
1.3		**Binder Course (Asphart 7cm)**	m2	58,839	29,370	333,562	161,537	1,728,101,430	19,626,454,518	9,504,675,543	30,859,231,491
1.4		**Wearing Course (Asphart 5cm)**	m2	58,839	20,979	238,259	115,383	1,234,383,381	14,018,921,301	6,789,020,337	22,042,325,019
2	**Side Walk**										
2.2		**Base Course (Crushed Stone 10cm)**	m2	28,057	925	30,104	2,117	25,952,725	844,627,928	59,396,669	929,977,322
2.3		**Sand and Mortar Buffer**	m2	28,057	15,920	27,530	594	446,667,440	772,409,210	16,665,858	1,235,742,508
2.4		**Interlocking Block**	m2	28,057	27,338	92,920		767,022,266	2,607,056,440	0	3,374,078,706
2.5		**Concrete Curb**	m	4,300	63,659	88,734	2,669	273,733,700	381,556,200	11,476,700	666,766,600
	Sub Total							4,702,273,414	46,221,827,249	16,941,676,582	67,865,777,245

III	**MEDIAN STRIP**										
1	**Median Strip Work**										
1.1		**Concrete Curb**	m	4,300	55,054	54,139	1,816	236,732,200	232,797,700	7,808,800	477,338,700
1.2		**Organic Soil**	m3	0	3,132	185,000	7,319	0	0	0	0
	Sub Total							236,732,200	232,797,700	7,808,800	477,338,700
IV	**CROSS DRAINAGE SYSTEM**										
1	**Structure**										
1.1		**Box Calvert (B x H = 1.5 x 1.7m)**	m	100	244,096	4,569,853	55,011	24,409,600	456,985,300	5,501,100	486,896,000
1.2		**Box Calvert (B x H = 2.0 x 2.0m)**	m	100	395,921	5,965,412	62,080	39,592,100	596,541,200	6,208,000	642,341,300
1.3		**Box Calvert (B x H = 3.0 x 3.0m)**	m	100	552,757	12,921,896	62,080	55,275,700	1,292,189,600	6,208,000	1,353,673,300
1.4		**Box Calvert (B x H = 4.0 x 3.0m)**	m	100	552,757	19,371,896	74,967	55,275,700	1,937,189,600	7,496,700	1,999,962,000
1.5		**Pipe Calvert (phi1000)**	m	2,000	57,184	1,426,963	48,604	114,368,000	2,853,926,000	97,208,000	3,065,502,000
1.6											
	Sub Total							288,921,100	7,136,831,700	122,621,800	7,548,374,600
V	**TRANSPORT SAFETY SYSTEM**										
1	**Facilities**										
1.1		**km Milestone**	pc	4	239,063	227,810	8,542	956,252	911,240	34,168	1,901,660
1.2		**Guide Post**	pc	4	187,126	96,171	16,044	748,504	384,684	64,176	1,197,364
1.3		**Protection Fence**	m	2,150	13,669	397,880	0	29,388,350	855,442,000	0	884,830,350
1.4		**Lighting (LED)**	pc	86	5,868,932	31,144,057	8,802,399	504,728,164	2,678,388,902	757,006,343	3,940,123,409
1.5		**Traffic Lights**	pc	4	78,000,000	448,400,000	380,000,000	312,000,000	1,793,600,000	1,520,000,000	3,625,600,000
2	**Surface Marking**										
2.1		**Round Road Signs**	pc	0	289,743	302,714	16,044	0	0	0	0
2.2		**Triangle Road Signs**	pc	4	251,513	163,588	16,044	1,006,052	654,352	64,176	1,724,580
2.3		**Square Road Signs**	pc	4	187,126	96,171	16,044	748,504	384,684	64,176	1,197,364
2.4		**2mm in thickness paint line**	m2	12,900	43,348	114,768	51,526	559,189,200	1,480,507,200	664,685,400	2,704,381,800
2.5		**6mm in thickness slow down paint line**	m2	100	104,949	328,735	124,887	10,494,900	32,873,500	12,488,700	55,857,100
	Sub Total							1,419,259,926	6,843,146,562	2,954,407,139	11,216,813,627

VI	**APPRACH ROAD**										
1	**Earth Work**										
1.1		**Excavation (by machine)**	m3	4,620	8,731		9,129	40,337,220	0	42,175,980	82,513,200
1.2		**Backfill (by machine)**	m3	4,620	3,132		5,263	14,469,840	0	24,315,060	38,784,900
1.3		**Embankment (by machine)**	m3	106,766	3,132	163,000	7,319	334,391,112	17,402,858,000	781,420,354	18,518,669,466
1.4		**Slope Protection**	m2	9,100	44,104	10,253	15,222	401,346,400	93,302,300	138,520,200	633,168,900
2	**Transport**										
2.1		**Removal of Excavated Unsuitable Soil**	m3	1,386			12,457	0	0	17,265,402	17,265,402
3	**Pavement**										
3.1		**Sub Base Course**	m2	2,310	2,460	90,312	6,350	5,682,600	208,620,720	14,668,500	228,971,820
3.2		**Base Course**	m2	2,310	1,388	45,156	3,175	3,206,280	104,310,360	7,334,250	114,850,890
3.3		**Binder Course (Asphart 7cm)**	m2	2,310	29,370	333,562	161,537	67,844,700	770,528,220	373,150,470	1,211,523,390
3.4		**Wearing Course (Asphart 5cm)**	m2	2,310	20,979	238,259	115,383	48,461,490	550,378,290	266,534,730	865,374,510
4	**Side Ditch Treatment**										
4.1		**Excavation (by machine)**	m3	0	8,731		9,129	0	0	0	0
4.2		**Backfill (by machine)**	m3	0	3,132		5,263	0	0	0	0
4.3		**Embankment (by machine)**	m3	0	3,132	163,000	7,319	0	0	0	0
4.4		**U Ditch with Cover (1,000*1,000)**	m	840	1,343,697	2,305,073	109,649	1,128,705,480	1,936,261,320	92,105,160	3,157,071,960
4.5		**Catch Basin (1,200*1,200)**	pc		741,805	10,357,546		0	0	0	0
	Sub Total							2,044,445,122	21,066,259,210	1,757,490,106	24,868,194,438
							Total	17,741,145,751	120,400,251,222	25,580,049,392	163,721,446,365

(Unit:VND)

NO.	WORK ITEM	WORK TYPE	Unit	Quantity	Unit Cost (VND)			SUB TOTAL COST (VND)			TOTAL COST (VND)
					LABOR	MATERIAL	MACHINE	LABOR	MATERIAL	MACHINE	
I	**BRIDGE**	**(6 PCI Girder Connection Type)**									
1	**Superstructure**	**(Concrete Simple I-Girder)**	pc	1	37,482,157,229			37,482,157,229	0	0	37,482,157,229
2	**Substructure**		pc	1	53,333,017,694			53,333,017,694	0	0	53,333,017,694
2.1		**Abatment Structure (Concrete)**	pc					0	0	0	0
2.2		**Pier Structure (Concrete)**	pc					0	0	0	0
3	**Foundation**	**Concrete Pile (phi=1,200)**	m	1	12,700,749,715			12,700,749,715	0	0	12,700,749,715
4	**Pavement**										
4.1		**Binder Course (Asphart 7cm)**	m2					0	0	0	0
		Waterproof Layer (Coating Film)	m2					0	0	0	0
4.2		**Wearing Course (Asphart 5cm)**	m2					0	0	0	0
5	**Site Preparation**		LS	1	3,656,338,341			3,656,338,341	0	0	3,656,338,341
	Sub Total							107,172,262,979	0	0	107,172,262,979
							Total	107,172,262,979	0	0	107,172,262,979

(Unit:VND)

NO.	WORK ITEM	WORK TYPE	Unit	Quantity	Unit Cost (VND)			SUB TOTAL COST (VND)			TOTAL COST (VND)
					LABOR	MATERIAL	MACHINE	LABOR	MATERIAL	MACHINE	
I	**ROAD BASE**										
1	**Earth Work**										
1.1		**Excavation (by machine)**	m3	38,200	8,731		9,129	333,524,200	0	348,727,800	682,252,000
1.2		**Excavation (by hand)**	m3	0	86,002			0	0	0	0
1.3		**Backfill (by machine)**	m3	38,200	3,132		5,263	119,642,400	0	201,046,600	320,689,000
1.4		**Backfill (by hand)**	m3	0	120,611			0	0	0	0
1.5		**Embankment (by machine)**	m3	70,758	3,132	163,000	7,319	221,615,437	11,533,625,883	517,881,030	12,273,122,350
1.6		**Embankment (by hand)**	m3	0	126,011	163,000		0	0	0	0
		Transportation of soil	m3	11,460			12,457	0	0	142,757,220	142,757,220
1.7		**Slope Protection**	m2	4,680	44,104	10,253	15,222	206,406,720	47,984,040	71,238,960	325,629,720
2	**Side Ditch Treatment**										
		L gutter	m	3,120	308,236	293,172	60,097	961,695,820	914,695,949	187,502,146	2,063,893,915
2.7		**U Ditch with Cover (1,000*1,000)**	m	3,120	1,343,697	2,305,073	109,649	4,192,334,640	7,191,827,760	342,104,880	11,726,267,280
2.8		**Catch Basin (1,200*1,200)**	nos.	104	741,805	10,357,546		77,147,720	1,077,184,784	0	1,154,332,504
3	**Transport**										
3.1		**Removal of Excavated Unsuitable Soil**	m3	11,460		20,000	12,457	0	229,200,000	142,757,220	371,957,220
4	**Others**										
4.1		**Settlement Observation**	m	200	168,110	370,275	30,373	33,621,923	74,055,010	6,074,526	113,751,459
	Sub Total							6,145,988,860	21,068,573,426	1,960,090,382	29,174,652,668

II	**PAVEMENT**										
1	**Main Routes Road Way**										
1.1		**Sub Base Course (Crushed Stone 30cm)**	m2	28,327	2,460	90,312	6,350	69,685,404	2,558,304,149	179,878,990	2,807,868,543
1.2		**Base Course (Crushed Stone 15cm)**	m2	28,327	1,388	45,156	3,175	39,318,431	1,279,152,074	89,939,495	1,408,410,000
1.3		**Binder Course (Asphart 7cm)**	m2	28,327	29,370	333,562	161,537	831,975,738	9,448,944,199	4,575,923,214	14,856,843,151
1.4		**Wearing Course (Asphart 5cm)**	m2	28,327	20,979	238,259	115,383	594,280,525	6,749,257,997	3,268,500,394	10,612,038,916
2	**Side Walk**										
2.2		**Base Course (Crushed Stone 10cm)**	m2	25,501	925	30,104	2,117	23,587,972	767,667,353	53,984,580	845,239,905
2.3		**Sand and Mortar Buffer**	m2	25,501	15,920	27,530	594	405,968,119	702,029,040	15,147,303	1,123,144,462
2.4		**Interlocking Block**	m2	25,501	27,338	92,920		697,132,942	2,369,507,389	0	3,066,640,331
2.5		**Concrete Curb**	m	3,120	63,659	88,734	2,669	198,616,080	276,850,080	8,327,280	483,793,440
	Sub Total							2,860,565,211	24,151,712,281	8,191,701,256	35,203,978,748
III	**MEDIAN STRIP**										
1	**Median Strip Work**										
1.1		**Concrete Curb**	m	3,120	55,054	54,139	1,816	171,768,480	168,913,680	5,665,920	346,348,080
1.2		**Organic Soil**	m3	0	3,132	185,000	7,319	0	0	0	0
	Sub Total							171,768,480	168,913,680	5,665,920	346,348,080
IV	**CROSS DRAINAGE SYSTEM**										
1	**Structure**										
1.1		**Box Calvert (B x H = 1.5 x 1.7m)**	m	0	244,096	4,569,853	55,011	0	0	0	0
1.2		**Box Calvert (B x H = 2.0 x 2.0m)**	m	490	395,921	5,965,412	62,080	194,001,290	2,923,051,880	30,419,200	3,147,472,370
1.3		**Box Calvert (B x H = 3.0 x 3.0m)**	m	0	552,757	12,921,896	62,080	0	0	0	0
1.4		**Box Calvert (B x H = 4.0 x 3.0m)**	m	0	552,757	19,371,896	74,967	0	0	0	0
1.5		**Pipe Calvert (phi1000)**	m	0	57,184	1,426,963	48,604	0	0	0	0
1.6											
	Sub Total							194,001,290	2,923,051,880	30,419,200	3,147,472,370

V	**TRANSPORT SAFETY SYSTEM**										
1	**Facilities**										
1.1		**km Milestone**	pc	3	239,063	227,810	8,542	745,877	710,767	26,651	1,483,295
1.2		**Guide Post**	pc	4	187,126	96,171	16,044	748,504	384,684	64,176	1,197,364
1.3		**Protection Fence**	m	3,120	13,669	397,880	0	42,647,280	1,241,385,600	0	1,284,032,880
1.4		**Lighting (LED)**	pc	62	5,868,932	31,144,057	8,802,399	366,221,365	1,943,389,157	549,269,719	2,858,880,241
1.5		**Traffic Lights**	pc	0	78,000,000	448,400,000	380,000,000	0	0	0	0
2	**Surface Marking**										
2.1		**Round Road Signs**	pc	6	289,743	302,714	16,044	1,738,458	1,816,284	96,264	3,651,006
2.2		**Triangle Road Signs**	pc	0	251,513	163,588	16,044	0	0	0	0
2.3		**Square Road Signs**	pc	0	187,126	96,171	16,044	0	0	0	0
2.4		**2mm in thickness paint line**	m2	1,404	43,348	114,768	51,526	60,860,592	161,134,272	72,342,504	294,337,368
2.5		**6mm in thickness slow down paint line**	m2	100	104,949	328,735	124,887	10,494,900	32,873,500	12,488,700	55,857,100
	Sub Total							483,456,976	3,381,694,264	634,288,014	4,499,439,254
							Total	9,855,780,817	51,693,945,531	10,822,164,772	72,371,891,120

(Unit:VND)

NO.	WORK ITEM	WORK TYPE	Unit	Quantity	Unit Cost (VND)			SUB TOTAL COST (VND)			TOTAL COST (VND)
					LABOR	MATERIAL	MACHINE	LABOR	MATERIAL	MACHINE	
I	**ROAD BASE**										
1	**Earth Work**										
1.1		**Excavation (by machine)**	m3	89,260	8,731		9,129	779,329,060	0	814,854,540	1,594,183,600
1.2		**Excavation (by hand)**	m3		86,002			0	0	0	0
1.3		**Backfill (by machine)**	m3	89,260	3,132		5,263	279,562,320	0	469,775,380	749,337,700
1.4		**Backfill (by hand)**	m3		120,611			0	0	0	0
1.5		**Embankment (by machine)**	m3	341,198	3,132	163,000	7,319	1,068,632,136	55,615,274,000	2,497,228,162	59,181,134,298
1.6		**Embankment (by hand)**	m3		126,011	163,000		0	0	0	0
		Transportation of soil	m3	26,778			12,457	0	0	333,573,546	333,573,546
1.7		**Slope Protection**	m2	8,820	44,104	10,253	15,222	388,997,280	90,431,460	134,258,040	613,686,780
2	**Side Ditch Treatment**										
		L gutter	m	5,880	308,236	293,172	60,097	1,812,426,737	1,723,850,059	353,369,429	3,889,646,225
2.7		**U Ditch with Cover (1,000*1,000)**	m	5,880	1,343,697	2,305,073	109,649	7,900,938,360	13,553,829,240	644,736,120	22,099,503,720
2.8		**Catch Basin (1,200*1,200)**	nos.	196	741,805	10,357,546		145,393,780	2,030,079,016	0	2,175,472,796
3	**Transport**										
3.1		**Removal of Excavated Unsuitable Soil**	m3	26,778		20,000	12,457	0	535,560,000	333,573,546	869,133,546
4	**Others**										
4.1		**Settlement Observation**	m	200	168,110	370,275	30,373	33,621,923	74,055,010	6,074,526	113,751,459
	Sub Total							12,408,901,596	73,623,078,785	5,587,443,289	91,619,423,670

II	**PAVEMENT**										
1	**Main Routes Road Way**										
1.1		**Sub Base Course (Crushed Stone 30cm)**	m2	83,686	2,460	90,312	6,350	205,868,618	7,557,888,866	531,408,831	8,295,166,315
1.2		**Base Course (Crushed Stone 15cm)**	m2	83,686	1,388	45,156	3,175	116,156,765	3,778,944,433	265,704,415	4,160,805,613
1.3		**Binder Course (Asphart 7cm)**	m2	83,686	29,370	333,562	161,537	2,457,870,449	27,914,612,964	13,518,454,843	43,890,938,256
1.4		**Wearing Course (Asphart 5cm)**	m2	83,686	20,979	238,259	115,383	1,755,657,615	19,939,045,125	9,655,991,353	31,350,694,093
2	**Side Walk**										
2.2		**Base Course (Crushed Stone 10cm)**	m2	45,142	925	30,104	2,117	41,756,563	1,358,961,692	95,566,101	1,496,284,356
2.3		**Sand and Mortar Buffer**	m2	45,142	15,920	27,530	594	718,664,302	1,242,765,592	26,814,485	1,988,244,379
2.4		**Interlocking Block**	m2	45,142	27,338	92,920		1,234,098,284	4,194,616,012	0	5,428,714,296
2.5		**Concrete Curb**	m	5,880	63,659	88,734	2,669	374,314,920	521,755,920	15,693,720	911,764,560
	Sub Total							6,904,387,516	66,508,590,604	24,109,633,748	97,522,611,868
III	**MEDIAN STRIP**										
1	**Median Strip Work**										
1.1		**Concrete Curb**	m	5,880	55,054	54,139	1,816	323,717,520	318,337,320	10,678,080	652,732,920
1.2		**Organic Soil**	m3	0	3,132	185,000	7,319	0	0	0	0
	Sub Total							323,717,520	318,337,320	10,678,080	652,732,920
IV	**CROSS DRAINAGE SYSTEM**										
1	**Structure**										
1.1		**Box Calvert (B x H = 1.5 x 1.7m)**	m	0	244,096	4,569,853	55,011	0	0	0	0
1.2		**Box Calvert (B x H = 2.0 x 2.0m)**	m	0	395,921	5,965,412	62,080	0	0	0	0
1.3		**Box Calvert (B x H = 3.0 x 3.0m)**	m	300	552,757	12,921,896	62,080	165,827,100	3,876,568,800	18,624,000	4,061,019,900
1.4		**Box Calvert (B x H = 4.0 x 3.0m)**	m	0	552,757	19,371,896	74,967	0	0	0	0
1.5		**Pipe Calvert (phi1000)**	m	300	57,184	1,426,963	48,604	17,155,200	428,088,900	14,581,200	459,825,300
1.6											
	Sub Total							182,982,300	4,304,657,700	33,205,200	4,520,845,200

V	**TRANSPORT SAFETY SYSTEM**										
1	**Facilities**										
1.1		**km Milestone**	pc	6	239,063	227,810	8,542	1,405,690	1,339,523	50,227	2,795,440
1.2		**Guide Post**	pc	4	187,126	96,171	16,044	748,504	384,684	64,176	1,197,364
1.3		**Protection Fence**	m	5,880	13,669	397,880	0	80,373,720	2,339,534,400	0	2,419,908,120
1.4		**Lighting (LED)**	pc	118	5,868,932	31,144,057	8,802,399	690,186,419	3,662,541,103	1,035,162,163	5,387,889,685
1.5		**Traffic Lights**	pc	0	78,000,000	448,400,000	380,000,000	0	0	0	0
2	**Surface Marking**										
2.1		**Round Road Signs**	pc	6	289,743	302,714	16,044	1,738,458	1,816,284	96,264	3,651,006
2.2		**Triangle Road Signs**	pc	0	251,513	163,588	16,044	0	0	0	0
2.3		**Square Road Signs**	pc	0	187,126	96,171	16,044	0	0	0	0
2.4		**2mm in thickness paint line**	m2	3,528	43,348	114,768	51,526	152,931,744	404,901,504	181,783,728	739,616,976
2.5		**6mm in thickness slow down paint line**	m2	100	104,949	328,735	124,887	10,494,900	32,873,500	12,488,700	55,857,100
	Sub Total							937,879,435	6,443,390,998	1,229,645,258	8,610,915,691
							Total	20,757,868,367	151,198,055,407	30,970,605,575	202,926,529,349

(Unit:VND)

NO.	WORK ITEM	WORK TYPE	Unit	Quantity	Unit Cost (VND)			SUB TOTAL COST (VND)			TOTAL COST (VND)
					LABOR	MATERIAL	MACHINE	LABOR	MATERIAL	MACHINE	
I	**ROAD BASE**										
1	**Earth Work**										
1.1		**Excavation (by machine)**	m3	32,740	8,731		9,129	285,852,940	0	298,883,460	584,736,400
1.2		**Excavation (by hand)**	m3	0	86,002			0	0	0	0
1.3		**Backfill (by machine)**	m3	32,740	3,132		5,263	102,541,680	0	172,310,620	274,852,300
1.4		**Backfill (by hand)**	m3	0	120,611			0	0	0	0
1.5		**Embankment (by machine)**	m3	48,918	3,132	163,000	7,319	153,212,557	7,973,705,883	358,034,070	8,484,952,510
1.6		**Embankment (by hand)**	m3	0	126,011	163,000		0	0	0	0
		Transportation of soil	m3	9,822			12,457	0	0	122,352,654	122,352,654
1.7		**Slope Protection**	m2	2,340	44,104	10,253	15,222	103,203,360	23,992,020	35,619,480	162,814,860
2	**Side Ditch Treatment**										
		L gutter	m	3,120	308,236	293,172	60,097	961,695,820	914,695,949	187,502,146	2,063,893,915
2.7		**U Ditch with Cover (1,000*1,000)**	m	3,120	1,343,697	2,305,073	109,649	4,192,334,640	7,191,827,760	342,104,880	11,726,267,280
2.8		**Catch Basin (1,200*1,200)**	nos.	104	741,805	10,357,546		77,147,720	1,077,184,784	0	1,154,332,504
3	**Transport**										
3.1		**Removal of Excavated Unsuitable Soil**	m3	9,822		20,000	12,457	0	196,440,000	122,352,654	318,792,654
4	**Others**										
4.1		**Settlement Observation**	m	200	168,110	370,275	30,373	33,621,923	74,055,010	6,074,526	113,751,459
	Sub Total							5,909,610,640	17,451,901,406	1,645,234,490	25,006,746,536

II	**PAVEMENT**										
1	**Main Routes Road Way**										
1.1		**Sub Base Course (Crushed Stone 30cm)**	m2	28,327	2,460	90,312	6,350	69,685,404	2,558,304,149	179,878,990	2,807,868,543
1.2		**Base Course (Crushed Stone 15cm)**	m2	28,327	1,388	45,156	3,175	39,318,431	1,279,152,074	89,939,495	1,408,410,000
1.3		**Binder Course (Asphart 7cm)**	m2	28,327	29,370	333,562	161,537	831,975,738	9,448,944,199	4,575,923,214	14,856,843,151
1.4		**Wearing Course (Asphart 5cm)**	m2	28,327	20,979	238,259	115,383	594,280,525	6,749,257,997	3,268,500,394	10,612,038,916
2	**Side Walk**										
2.2		**Base Course (Crushed Stone 10cm)**	m2	15,584	925	30,104	2,117	14,414,747	469,125,985	32,990,291	516,531,023
2.3		**Sand and Mortar Buffer**	m2	15,584	15,920	27,530	594	248,089,479	429,014,030	9,256,605	686,360,114
2.4		**Interlocking Block**	m2	15,584	27,338	92,920		426,021,996	1,448,019,749	0	1,874,041,745
2.5		**Concrete Curb**	m	1,560	63,659	88,734	2,669	99,308,040	138,425,040	4,163,640	241,896,720
	Sub Total							2,323,094,360	22,520,243,223	8,160,652,629	33,003,990,212
III	**MEDIAN STRIP**										
1	**Median Strip Work**										
1.1		**Concrete Curb**	m	3,120	55,054	54,139	1,816	171,768,480	168,913,680	5,665,920	346,348,080
1.2		**Organic Soil**	m3	0	3,132	185,000	7,319	0	0	0	0
	Sub Total							171,768,480	168,913,680	5,665,920	346,348,080
IV	**CROSS DRAINAGE SYSTEM**										
1	**Structure**										
1.1		**Box Calvert (B x H = 1.5 x 1.7m)**	m	0	244,096	4,569,853	55,011	0	0	0	0
1.2		**Box Calvert (B x H = 2.0 x 2.0m)**	m	490	395,921	5,965,412	62,080	194,001,290	2,923,051,880	30,419,200	3,147,472,370
1.3		**Box Calvert (B x H = 3.0 x 3.0m)**	m	0	552,757	12,921,896	62,080	0	0	0	0
1.4		**Box Calvert (B x H = 4.0 x 3.0m)**	m	0	552,757	19,371,896	74,967	0	0	0	0
1.5		**Pipe Calvert (phi1000)**	m	0	57,184	1,426,963	48,604	0	0	0	0
1.6											
	Sub Total							194,001,290	2,923,051,880	30,419,200	3,147,472,370

V	**TRANSPORT SAFETY SYSTEM**										
1	**Facilities**										
1.1		**km Milestone**	pc	3	239,063	227,810	8,542	745,877	710,767	26,651	1,483,295
1.2		**Guide Post**	pc	4	187,126	96,171	16,044	748,504	384,684	64,176	1,197,364
1.3		**Protection Fence**	m	3,120	13,669	397,880	0	42,647,280	1,241,385,600	0	1,284,032,880
1.4		**Lighting (LED)**	pc	62	5,868,932	31,144,057	8,802,399	366,221,365	1,943,389,157	549,269,719	2,858,880,241
1.5		**Traffic Lights**	pc	0	78,000,000	448,400,000	380,000,000	0	0	0	0
2	**Surface Marking**										
2.1		**Round Road Signs**	pc	6	289,743	302,714	16,044	1,738,458	1,816,284	96,264	3,651,006
2.2		**Triangle Road Signs**	pc	0	251,513	163,588	16,044	0	0	0	0
2.3		**Square Road Signs**	pc	0	187,126	96,171	16,044	0	0	0	0
2.4		**2mm in thickness paint line**	m2	1,404	43,348	114,768	51,526	60,860,592	161,134,272	72,342,504	294,337,368
2.5		**6mm in thickness slow down paint line**	m2	100	104,949	328,735	124,887	10,494,900	32,873,500	12,488,700	55,857,100
	Sub Total							483,456,976	3,381,694,264	634,288,014	4,499,439,254
							Total	9,081,931,746	46,445,804,453	10,476,260,253	66,003,996,452

(Unit:VND)

NO.	WORK ITEM	WORK TYPE	Unit	Quantity	Unit Cost (VND)			SUB TOTAL COST (VND)			TOTAL COST (VND)
					LABOR	MATERIAL	MACHINE	LABOR	MATERIAL	MACHINE	
I	**ROAD BASE**										
1	**Earth Work**										
1.1		**Excavation (by machine)**	m3	83,210	8,731		9,129	726,506,510	0	759,624,090	1,486,130,600
1.2		**Excavation (by hand)**	m3		86,002			0	0	0	0
1.3		**Backfill (by machine)**	m3	83,210	3,132		5,263	260,613,720	0	437,934,230	698,547,950
1.4		**Backfill (by hand)**	m3		120,611			0	0	0	0
1.5		**Embankment (by machine)**	m3	316,998	3,132	163,000	7,319	992,837,736	51,670,674,000	2,320,108,362	54,983,620,098
1.6		**Embankment (by hand)**	m3		126,011	163,000		0	0	0	0
		Transportation of soil	m3	24,963			12,457	0	0	310,964,091	310,964,091
1.7		**Slope Protection**	m2	5,370	44,104	10,253	15,222	236,838,480	55,058,610	81,742,140	373,639,230
2	**Side Ditch Treatment**										
		L gutter	m	5,880	308,236	293,172	60,097	1,812,426,737	1,723,850,059	353,369,429	3,889,646,225
2.7		**U Ditch with Cover (1,000*1,000)**	m	5,880	1,343,697	2,305,073	109,649	7,900,938,360	13,553,829,240	644,736,120	22,099,503,720
2.8		**Catch Basin (1,200*1,200)**	nos.	196	741,805	10,357,546		145,393,780	2,030,079,016	0	2,175,472,796
3	**Transport**										
3.1		**Removal of Excavated Unsuitable Soil**	m3	24,963		20,000	12,457	0	499,260,000	310,964,091	810,224,091
4	**Others**										
4.1		**Settlement Observation**	m	200	168,110	370,275	30,373	33,621,923	74,055,010	6,074,526	113,751,459
	Sub Total							12,109,177,246	69,606,805,935	5,225,517,079	86,941,500,260

II	**PAVEMENT**										
1	**Main Routes Road Way**										
1.1		**Sub Base Course (Crushed Stone 30cm)**	m2	83,686	2,460	90,312	6,350	205,868,618	7,557,888,866	531,408,831	8,295,166,315
1.2		**Base Course (Crushed Stone 15cm)**	m2	83,686	1,388	45,156	3,175	116,156,765	3,778,944,433	265,704,415	4,160,805,613
1.3		**Binder Course (Asphart 7cm)**	m2	83,686	29,370	333,562	161,537	2,457,870,449	27,914,612,964	13,518,454,843	43,890,938,256
1.4		**Wearing Course (Asphart 5cm)**	m2	83,686	20,979	238,259	115,383	1,755,657,615	19,939,045,125	9,655,991,353	31,350,694,093
2	**Side Walk**										
2.2		**Base Course (Crushed Stone 10cm)**	m2	32,756	925	30,104	2,117	30,299,513	986,093,548	69,344,939	1,085,738,000
2.3		**Sand and Mortar Buffer**	m2	32,756	15,920	27,530	594	521,479,182	901,779,012	19,457,201	1,442,715,395
2.4		**Interlocking Block**	m2	32,756	27,338	92,920		895,489,816	3,043,708,892	0	3,939,198,708
2.5		**Concrete Curb**	m	3,680	63,659	88,734	2,669	234,265,120	326,541,120	9,821,920	570,628,160
	Sub Total							6,217,087,078	64,448,613,960	24,070,183,502	94,735,884,540
III	**MEDIAN STRIP**										
1	**Median Strip Work**										
1.1		**Concrete Curb**	m	5,880	55,054	54,139	1,816	323,717,520	318,337,320	10,678,080	652,732,920
1.2		**Organic Soil**	m3	0	3,132	185,000	7,319	0	0	0	0
	Sub Total							323,717,520	318,337,320	10,678,080	652,732,920
IV	**CROSS DRAINAGE SYSTEM**										
1	**Structure**										
1.1		**Box Calvert (B x H = 1.5 x 1.7m)**	m	0	244,096	4,569,853	55,011	0	0	0	0
1.2		**Box Calvert (B x H = 2.0 x 2.0m)**	m	0	395,921	5,965,412	62,080	0	0	0	0
1.3		**Box Calvert (B x H = 3.0 x 3.0m)**	m	300	552,757	12,921,896	62,080	165,827,100	3,876,568,800	18,624,000	4,061,019,900
1.4		**Box Calvert (B x H = 4.0 x 3.0m)**	m	0	552,757	19,371,896	74,967	0	0	0	0
1.5		**Pipe Calvert (phi1000)**	m	300	57,184	1,426,963	48,604	17,155,200	428,088,900	14,581,200	459,825,300
1.6											
	Sub Total							182,982,300	4,304,657,700	33,205,200	4,520,845,200

V	**TRANSPORT SAFETY SYSTEM**										
1	**Facilities**										
1.1		**km Milestone**	pc	6	239,063	227,810	8,542	1,405,690	1,339,523	50,227	2,795,440
1.2		**Guide Post**	pc	4	187,126	96,171	16,044	748,504	384,684	64,176	1,197,364
1.3		**Protection Fence**	m	5,880	13,669	397,880	0	80,373,720	2,339,534,400	0	2,419,908,120
1.4		**Lighting (LED)**	pc	118	5,868,932	31,144,057	8,802,399	690,186,419	3,662,541,103	1,035,162,163	5,387,889,685
1.5		**Traffic Lights**	pc	0	78,000,000	448,400,000	380,000,000	0	0	0	0
2	**Surface Marking**										
2.1		**Round Road Signs**	pc	6	289,743	302,714	16,044	1,738,458	1,816,284	96,264	3,651,006
2.2		**Triangle Road Signs**	pc	0	251,513	163,588	16,044	0	0	0	0
2.3		**Square Road Signs**	pc	0	187,126	96,171	16,044	0	0	0	0
2.4		**2mm in thickness paint line**	m2	3,528	43,348	114,768	51,526	152,931,744	404,901,504	181,783,728	739,616,976
2.5		**6mm in thickness slow down paint line**	m2	100	104,949	328,735	124,887	10,494,900	32,873,500	12,488,700	55,857,100
	Sub Total							937,879,435	6,443,390,998	1,229,645,258	8,610,915,691
							Total	19,770,843,579	145,121,805,913	30,569,229,119	195,461,878,611

(Unit:VND)

NO.	WORK ITEM	WORK TYPE	Unit	Quantity	Unit Cost (VND)			SUB TOTAL COST (VND)			TOTAL COST (VND)
					LABOR	MATERIAL	MACHINE	LABOR	MATERIAL	MACHINE	
Ⅰ	**PAVEMENT**										
1	**Side Walk**										
1.1		**Base Course (Crushed Stone 10cm)**	m2	0	925	30,104	2,117	0	0	0	0
1.2		**Sand and Mortar Buffer**	m2	30,550	15,920	27,530	594	486,356,000	841,041,500	18,146,700	1,345,544,200
1.3		**Interlocking Block**	m2	30,550	27,338	92,920		835,175,900	2,838,706,000	0	3,673,881,900
1.4		**Concrete Curb**	m	0	63,659	88,734	2,669	0	0	0	0
	Sub Total							1,321,531,900	3,679,747,500	18,146,700	5,019,426,100
Ⅱ	**TRANSPORT SAFETY SYSTEM**										
1	**Facilities**										
1.1		**Lighting (LED)**	pc	50	5,868,932	31,144,057	8,802,399	293,446,607	1,557,202,850	440,119,967	2,290,769,424
1.2		**Traffic Lights**	pc	0	78,000,000	448,400,000	380,000,000	0	0	0	0
	Sub Total							293,446,607	1,557,202,850	440,119,967	2,290,769,424
Ⅲ	**ROAD RIHABILITATION**										
1	**Rehabilitation**		m2	55,020	39,679	93,633	68,063	2,183,135,526	5,151,680,815	3,744,852,328	11,079,668,669
	Sub Total							2,183,135,526	5,151,680,815	3,744,852,328	11,079,668,669
							Total	3,798,114,033	10,388,631,165	4,203,118,995	18,389,864,193

APPENDIX 3:

ENVIRONMENTAL AND SOCIAL CONSIDERATIONS

1. Environmental Check List

Environmental Checklist: 15. Waste Water Treatment（1）

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
1 Permits and Explanation	(1) EIA and Environmental Permits	(a) Have EIA reports been already prepared in official process? (b) Have EIA reports been approved by authorities of the host country's government? (c) Have EIA reports been unconditionally approved? If conditions are imposed on the approval of EIA reports, are the conditions satisfied? (d) In addition to the above approvals, have other required environmental permits been obtained from the appropriate regulatory authorities of the host country's government?	(a) Y (b) N (c) - (d) -	(a) EIA report was prepared by Investor (Ha Nam province). (b) EIA report will be approved by Ministry of Environment and Natural Resources (MONRE) by February, 2019. (c) EIA report has not been approved yet. (d) In addition to the approved EIA report, the project must be issued with a number of other permits, such as the register of the hazardous waste generator. (According to Circular No. 36/2015 / TT-BTNMT on management of hazardous waste), discharge permit (comply with Decree 201/2013 / ND-CP guiding the implementation of a number of articles of the Law on Water Resources) for concentrated waste water treatment plants.
	(2) Explanation to the Local Stakeholders	(a) Have contents of the project and the potential impacts been adequately explained to the Local stakeholders based on appropriate procedures, including information disclosure? Is understanding obtained from the Local stakeholders? (b) Have the comment from the stakeholders (such as local residents) been reflected to the project design?	(a) Y (b) Y	(a) Explanations to the local stakeholders were done based on related laws and regulations of Vietnam and Ha Nam province such as 2013 Land Law (45/2013/QH13). (b) Comments from the stakeholders (such as local residents) are reflected to the project components or the locations.
	(3) Examination of Alternatives	(a) Have alternative plans of the project been examined with social and environmental considerations?	(a) Y	(a) Zero option and the plan that minimized land acquisition and resettlement have been examined.
2 Pollution Control	(1) Water Quality	(a) Do pollutants, such as SS, BOD, COD, pH contained in treated effluent from a sewage treatment plant comply with the country's effluent standards? (b) Does untreated water contain heavy metals?	(a) Y (b) N	(a) Pollutants comply with the Colum A of the national standard on industrial waste water ((QCVN40:2011/BTNMT). (b) The waste water treatment plant accept the domestic waste water and treated industrial wastewater that comply with the Colum B of the national standard on industrial waste water ((QCVN40:2011/BTNMT).
	(2) Wastes	(a) Are wastes, such as sludge generated by the facility operations properly treated and disposed of in accordance with the country's standards?	(a) Y	(a) Wastes, such as sludge will be properly treated and disposed of in accordance with Circular No.36/2015/TT-BTNMT on management of hazardous waste.
	(3) Soil Contamination	(a) If wastes, such as sludge are suspected to contain heavy metals, are adequate measures taken to prevent contamination of soil and groundwater by leachates from the wastes?	(a) N	(a) Wastes, such as sludge doesn't contain heavy metals, since only processed industrial waste water, agricultural drainage and domestic wastewater will be accepted by the project.
	(4) Noise and Vibration	(a) Do noise and vibrations generated from the facilities, such as sludge treatment facilities and pumping stations comply with the country's standards?	(a) Y	(a) Noise and vibration comply with the Vietnam standards of noise (QCVN26：2010BTNMT) and vibrations (QCVN27：2010BTNMT).
	(5) Odor	(a) Are adequate control measures taken for odor sources, such as sludge treatment facilities?	(a) Y	(a) Covering facilities for sludge treatment facilities will be implemented.

Environmental Checklist: 15. Waste Water Treatment（2）

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
3 Natural Environment	(1) Protected Areas	(a) Is the project site located in protected areas designated by the country's laws or international treaties and conventions? Is there a possibility that the project will affect the protected areas?	(a) N	(a) There are no protected areas in the project site including the surrounding.
	(2) Ecosystem	(a) Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)? (b) Does the project site encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions? (c) If significant ecological impacts are anticipated, are adequate protection measures taken to reduce the impacts on the ecosystem? (d) Is there a possibility that the project will adversely affect aquatic environments, such as rivers? Are adequate measures taken to reduce the impacts on aquatic environments, such as aquatic organisms?	(a) N (b) N (c) N (d) N	(a) There are no natural forests in the project site including the surrounding. (b) The project site doesn't encompass the protected habitats of endangered species. (c) The Project is considered not to have any significant impact on ecosystem, because the project site was already developed as an agricultural land, (d) The project is considered not to have any impact on aquatic environments, because pollutants from waste water treatment plant comply with the Colum A of the National technical regulation on domestic wastewater (QCVN 14 : 2008/BTNMT).
4 Social Environment	(1) Resettlement and Land Acquisitions	(a) Is involuntary resettlement caused by project implementation? If involuntary resettlement is caused, are efforts made to minimize the impacts caused by the resettlement? (b) Is adequate explanation on compensation and resettlement given to affected people prior to resettlement? (c) Is the resettlement plan, including compensation with full replacement costs, restoration of livelihoods and living standards developed based on socioeconomic studies on resettlement? (d) Is the compensations going to be paid prior to the resettlement? (e) Is the compensation policies prepared in document? (f) Does the resettlement plan pay particular attention to vulnerable groups or people, including women, children, the elderly, people below the poverty line, ethnic minorities, and indigenous peoples? (g) Are agreements with the affected people obtained prior to resettlement? (h) Is the organizational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan? (i) Are any plans developed to monitor the impacts of resettlement? (j) Is the grievance redress mechanism established?	(a) N (b) Y (c) Y (d) Y (e) Y (f) Y (g) Y (h) Y (i) Y (j) Y	(a) This Project does not occur resettlement, but generate some land acquisitions by the Project. (b) Stakeholder meetings were conducted to the Affected Persons. (c) Abbreviated Resettlement Action Plan (A-RAP) was prepared and included compensation with full replacement costs, restoration of livelihoods and living standards developed based on socioeconomic studies on land acquisitions. (d) Compensations will be paid prior to the land acquisitions (e) Compensation policies for land acquisitions were prepared in document (A-RAP Report). (f) The A-RAP paid particular attention to vulnerable groups and people, including women, children, the elderly, people below the poverty line, ethnic minorities, and indigenous peoples. (g) This project will not cause any resettlement. Any official agreements with the affected people obtained prior to the land acquisitions. It means that any specific objections to the Project were not mentioned through all of the stakeholder meetings. (h) The organizational framework established to properly implement the land acquisitions. The capacity and budget will be secured to implement the plan. (i) Internal and independent monitoring activities for the land acquisitions are prepared on the A-RAP Report. (j) The grievance redress mechanism for this project was proposed in the A-RAP Report.

Environmental Checklist: 15. Waste Water Treatment（3）

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
	(2) Living and Livelihood	(a) Is there a possibility that changes in land uses and water uses due to the project will adversely affect the living conditions of inhabitants? (b) Is there a possibility that the project will adversely affect the living conditions of inhabitants? Are adequate measures considered to reduce the impacts, if necessary?	(a) N (b) Y	(a) There are few possibility that changes in land uses due to the project will adversely affect the living conditions of inhabitants. On the other hand, compensations and livelihood rehabilitation programs are considered in the A-RAP Report. There is no possibility that changes in water uses due to the project will adversely affect the living conditions because of the characteristics of the project components. (b) Some adequate mitigation measures such as compensations for land acquisitions are considered as well.

Environmental Checklist: 15. Waste Water Treatment（4）

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
4 Social Environment	(3) Heritage	(a) Is there a possibility that the project will damage the local archeological, historical, cultural, and religious heritage? Are adequate measures considered to protect these sites in accordance with the country's laws?	(a) N	(a) There is no possibility that the project will damage the local archeological, historical, cultural, and religious heritage due to locations of the heritage sites and the project construction sites.
	(4) Landscape	(a) Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	(a) N	(a) There is no possibility that the project will adversely affect the local landscape due to locations of the local landscape sites and the project construction sites
	(5) Ethnic Minorities and Indigenous Peoples	(a) Are considerations given to reduce impacts on the culture and lifestyle of ethnic minorities and indigenous peoples? (b) Are all of the rights of ethnic minorities and indigenous peoples in relation to lands and resources respected?	(a) N (b) N	(a) No ethnic minorities and indigenous peoples live in the Project Site. (b) No ethnic minorities and indigenous peoples live in the Project Site.
	(6) Working Conditions and Accidents	(a) Is the project proponent not violating any laws and ordinances associated with the working conditions of the country which the project proponent should observe in the project? (b) Are tangible safety considerations in place for individuals involved in the project, such as the installation of safety equipment which prevents industrial accidents, and management of hazardous materials? (c) Are intangible measures being planned and implemented for individuals involved in the project, such as the establishment of a safety and health program, and safety training (including traffic safety and public health) for workers etc.? (d) Are appropriate measures taken to ensure that security guards involved in the project not to violate safety of other individuals involved, or local residents?	(a) N (b) Y (c) Y (d) Y	(a) The project proponent is not violating any laws and ordinances associated with the working conditions of Vietnam. (b) Tangible safety considerations in place for individuals involved in the project, such as the installation of safety fences which prevents industrial accidents. (c) Intangible measures being planned and implemented for individuals involved in the project, such as the establishment of disaster prevention organizations. (d) Appropriate measures being taken to ensure that the local government involved in the project not to violate safety of other individuals involved, or local residents.

Environmental Checklist: 15. Waste Water Treatment（5）

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
5 Others	(1) Impacts during Construction	(a) Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)? (b) If construction activities adversely affect the natural environment (ecosystem), are adequate measures considered to reduce impacts? (c) If construction activities adversely affect the social environment, are adequate measures considered to reduce impacts? (d) If the construction activities might cause traffic congestion, are adequate measures considered to reduce such impacts?	(a) Y (b) N (c) Y	(a) EIA report was prepared and adequate mitigation measures were considered in the report. (b) The Project is considered not to have any significant impact on ecosystem. (c) Any significant adverse social impacts are not expected during the construction. But, some mitigation measures such as livelihood rehabilitation plan, for the possible adverse social impacts (land acquisitions, poverty) are considered.
	(2) Monitoring	(a) Does the proponent develop and implement monitoring program for the environmental items that are considered to have potential impacts? (b) What are the items, methods and frequencies of the monitoring program? (c) Does the proponent establish an adequate monitoring framework (organization, personnel, equipment, and adequate budget to sustain the monitoring framework)? (d) Are any regulatory requirements pertaining to the monitoring report system identified, such as the format and frequency of reports from the proponent to the regulatory authorities?	(a) Y (b) Y (c) Y (d) Y	(a) EIA and A-RAP reports were prepared, and the monitoring program and the monitoring system were considered in the reports. (b) The monitoring program in the EIA and A-RAP reports show items, methods and frequencies of the monitoring program. (c) The monitoring system, implementation schedule and adequate budget to sustain the monitoring are considered in the EIA and A-RAP Report. (d) The monitoring system in the EIA and A-RAP reports show the monitoring format and the frequency of reports.
6 Note	Note on Using Environmental Checklist	(a) If necessary, the impacts to transboundary or global issues should be confirmed (e.g., the project includes factors that may cause problems, such as transboundary waste treatment, acid rain, destruction of the ozone layer, or global warming).	(a) N	(a) The project is considered not to have any impacts on the trans-boundary impacts or climate change due to scale of the project.

1) Regarding the term “Country’s Standards” mentioned in the above table, in the event that environmental standards in the country where the project is located diverge significantly from international standards, appropria environmental considerations are required to be made.
In cases where local environmental regulations are yet to be established in some areas, considerations should be made based on comparisons with appropriate standards of other countries (including Japan's experience
2) Environmental checklist provides general environmental items to be checked. It may be necessary to add or delete an item taking into account the characteristics of the project and the particular circumstances of the country and locality in which the project is located.

Environmental Checklist: 7. Roads （1）

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
1 Permits and Explanation	(1) EIA and Environmental Permits	(a) Have EIA reports been already prepared in official process? (b) Have EIA reports been approved by authorities of the host country's government? (c) Have EIA reports been unconditionally approved? If conditions are imposed on the approval of EIA reports, are the conditions satisfied? (d) In addition to the above approvals, have other required environmental permits been obtained from the appropriate regulatory authorities of the host country's government?	(a) Y (b) N (c) - (d) -	(a) EIA report was prepared by Investor (Ha Nam province). (b) EIA report will be approved by Ministry of Environment and Natural Resources (MONRE) by February, 2019. (c) EIA report has not been approved yet. (d) In addition to the approved EIA report, no other environmental permit for the Road sub-projects is necessary to be obtained.
	(2) Explanation to the Local Stakeholders	(a) Have contents of the project and the potential impacts been adequately explained to the Local stakeholders based on appropriate procedures, including information disclosure? Is understanding obtained from the Local stakeholders? (b) Have the comment from the stakeholders (such as local residents) been reflected to the project design?	(a) Y (b) Y	(a) Explanations to the local stakeholders were done based on related laws and regulations of Vietnam and Ha Nam province such as 2013 Land Law (45/2013/QH13). (b) Comments from the stakeholders (such as local residents) are reflected to the project components or the locations.
	(3) Examination of Alternatives	(a) Have alternative plans of the project been examined with social and environmental considerations?	(a) Y	(a) Zero option and the plan that minimized land acquisition and resettlement have been examined.
2 Pollution Control	(1) Air Quality	(a) Is there a possibility that air pollutants emitted from the project related sources, such as vehicles traffic will affect ambient air quality? Does ambient air quality comply with the country's air quality standards? Are any mitigating measures taken? (b) Where industrial areas already exist near the route, is there a possibility that the project will make air pollution worse?	(a) N (b) N	(a) The air pollutants from the passing vehicles meet the standards of air quality(QCVN05：2013/BTNMT). (b) The air pollutants during operation is expected to meet the standards of air quality(QCVN05：2013/BTNMT).
	(2) Water Quality	(a) Is there a possibility that soil runoff from the bare lands resulting from earthmoving activities, such as cutting and filling will cause water quality degradation in downstream water areas? (b) Is there a possibility that surface runoff from roads will contaminate water sources, such as groundwater? (c) Do effluents from various facilities, such as parking areas/service areas comply with the country's effluent standards and ambient water quality standards? Is there a possibility that the effluents will cause areas not to comply with the country's ambient water quality standards?	(a) N (b) N (c) -	(a) Soil runoff will be properly treated, so that it won't cause water quality degradation in downstream water areas. (b) Road surface drainage will be properly treated, so that it won't pollute the groundwater. (c) There is no parking/service area in the project.
	(3) Wastes	(a) Are wastes generated from the project facilities, such as parking areas/service areas, properly treated and disposed of in accordance with the country's regulations?	(a) -	(a) There is no parking/service area in the project.
	(4) Noise and Vibration	(a) Do noise and vibrations from the vehicle and train traffic comply with the country's standards?	(a) N	(a) Some location of noise level are higher than the permitted level of noise (QCVN 26:2010/BTNMT). The mitigation measure of reduction of noise and vibration will be achieved by alleviation of congestion through improving the road transport network.

Environmental Checklist: 7. Roads （2）

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
3 Natural Environment	(1) Protected Areas	(a) Is the project site located in protected areas designated by the country's laws or international treaties and conventions? Is there a possibility that the project will affect the protected areas?	(a) N	(a) There are no protected areas in the project site including the surrounding.
	(2) Ecosystem	(a) Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)? (b) Does the project site encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions? (c) If significant ecological impacts are anticipated, are adequate protection measures taken to reduce the impacts on the ecosystem? (d) Are adequate protection measures taken to prevent impacts, such as disruption of migration routes, habitat fragmentation, and traffic accident of wildlife and livestock? (e) Is there a possibility that installation of roads will cause impacts, such as destruction of forest, poaching, desertification, reduction in wetland areas, and disturbance of ecosystems due to introduction of exotic (non-native invasive) species and pests? Are adequate measures for preventing such impacts considered? (f) In cases the project site is located at undeveloped areas, is there a possibility that the new development will result in extensive loss of natural environments?	(a) N (b) N (c) N (d) N (e) N (f) -	(a) There are no natural forests in the project site including the surrounding. (b) The project site doesn't encompass the protected habitats of endangered species. (c) The Project is considered not to have any significant impact on ecosystems, because the project sites have been already developed as an agricultural land. (d) The Project is considered not to have any significant impact on movement and habitat of wild animals and farm animals, because the project sites have been already developed as an agricultural land. (e) The Project is considered not to have any significant impact on ecosystem, because the project sites have been already developed as an agricultural land. (f) The project sites are not undeveloped areas and have been cultivated as the rice fields.
	(3) Hydrology	(a) Is there a possibility that alteration of topographic features and installation of structures, such as tunnels will adversely affect surface water and groundwater flows?	(a) N	(a) The adverse effect on the flow of surface water and groundwater doesn’t occur due to the modification of the terrain, because most of the project site is rice field.
	(4) Topography and Geology	(a) Is there any soft ground on the route that may cause slope failures or landslides? Are adequate measures considered to prevent slope failures or landslides, where needed? (b) Is there a possibility that civil works, such as cutting and filling will cause slope failures or landslides? Are adequate measures considered to prevent slope failures or landslides? (c) Is there a possibility that soil runoff will result from cut and fill areas, waste soil disposal sites, and borrow sites? Are adequate measures taken to prevent soil runoff?	(a) N (b) N (c) Y	(a) Most of route is located in the rice field, so that there is no bad geological location. (b) Most of the project site is located in the rice field, so that landslides doesn’t occur. (c) Mitigation measures against soil runoff during construction will be implemented.

Environmental Checklist: 7. Roads （3）

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
4 Social Environment	(1) Resettlement and Land Acquisitions	(a) Is involuntary resettlement caused by project implementation? If involuntary resettlement is caused, are efforts made to minimize the impacts caused by the resettlement? (b) Is adequate explanation on compensation and resettlement assistance given to affected people prior to resettlement? (c) Is the resettlement plan, including compensation with full replacement costs, restoration of livelihoods and living standards developed based on socioeconomic studies on resettlement? (d) Are the compensations going to be paid prior to the resettlement? (e) Are the compensation policies prepared in document? (f) Does the resettlement plan pay particular attention to vulnerable groups or people, including women, children, the elderly, people below the poverty line, ethnic minorities, and indigenous peoples? (g) Are agreements with the affected people obtained prior to resettlement? (h) Is the organizational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan? (i) Are any plans developed to monitor the impacts of resettlement? (j) Is the grievance redress mechanism established?	(a) N (b) Y (c) Y (d) Y (e) Y (f) Y (g) Y (h) Y (i) Y (j) Y	(a) This Project does not occur resettlement, but generate some land acquisitions by the Project. (b) Stakeholder meetings were conducted to the Affected Persons. (c) Abbreviated Resettlement Action Plan (A-RAP) was prepared and included compensation with full replacement costs, restoration of livelihoods and living standards developed based on socioeconomic studies on land acquisitions. (d) Compensations will be paid prior to the land acquisitions (e) Compensation policies for land acquisitions were prepared in document (A-RAP Report). (f) The A-RAP paid particular attention to vulnerable groups and people, including women, children, the elderly, people below the poverty line, ethnic minorities, and indigenous peoples. (g) This project will not cause any resettlement. Any official agreements with the affected people obtained prior to the land acquisitions. It means that any specific objections to the Project were not mentioned through all of the stakeholder meetings. (h) The organizational framework established to properly implement the land acquisitions. The capacity and budget will be secured to implement the plan. (i) Internal and independent monitoring activities for the land acquisitions are prepared on the A-RAP Report. (j) The grievance redress mechanism for this project was prepared on the A-RAP Report.

Environmental Checklist: 7. Roads （4）

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
	(2) Living and Livelihood	(a) Where roads are newly installed, is there a possibility that the project will affect the existing means of transportation and the associated workers? Is there a possibility that the project will cause significant impacts, such as extensive alteration of existing land uses, changes in sources of livelihood, or unemployment? Are adequate measures considered for preventing these impacts? (b) Is there any possibility that the project will adversely affect the living conditions of the inhabitants other than the target population? Are adequate measures considered to reduce the impacts, if necessary? (c) Is there any possibility that diseases, including infectious diseases, such as HIV will be brought due to immigration of workers associated with the project? Are adequate considerations given to public health, if necessary? (d) Is there any possibility that the project will adversely affect road traffic in the surrounding areas (e.g., increase of traffic congestion and traffic accidents)? (e) Is there any possibility that roads will impede the movement of inhabitants? (f) Is there any possibility that structures associated with roads (such as bridges) will cause a sun shading and radio interference?	(a) N (b) N (c) N (d) Y (e) N (f) N	(a) Newly installed access roads will pass through the residential land. But, Not significant adverse impacts are expected. Some adequate mitigation measures such as compensations for land acquisitions are considered based on the related laws and regulations of Vietnam and Ha Nam province. (b) Some adequate mitigation measures such as compensations for land acquisitions are considered as well. (c) There are no possibility that diseases, including infectious diseases, such as HIV will be brought due to immigration of workers associated with the project. Because the scale of the influx of the construction workers are limited. (d) During the construction, the project may adversely affect road traffic in the surrounding areas (e.g., increase of traffic congestion and traffic accidents). The countermeasures are i) collecting materials dropped during transportation, ii) preparing and disseminating cleat operation rules for preventing traffic accidents. (e) The roads will not impede the movement of inhabitants. Because the project construction are very limited scale and not long-term. (f) There are no possibility that structures associated with roads (such as bridges) will cause a sun shading and radio interference. Because the road sector components does not includes large-scale facilities, which may cause sun shading and radio interference.

Environmental Checklist: 7. Roads （5）

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
4 Social Environment	(3) Heritage	(a) Is there a possibility that the project will damage the local archeological, historical, cultural, and religious heritage? Are adequate measures considered to protect these sites in accordance with the country's laws?	(a) N	(a) There is no possibility that the project will damage the local archeological, historical, cultural, and religious heritage due to locations of the heritage sites and the project construction sites.
	(4) Landscape	(a) Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	(a) N	(a) There is no possibility that the project will adversely affect the local landscape due to locations of the local landscape sites and the project construction sites
	(5) Ethnic Minorities and Indigenous Peoples	(a) Are considerations given to reduce impacts on the culture and lifestyle of ethnic minorities and indigenous peoples? (b) Are all of the rights of ethnic minorities and indigenous peoples in relation to land and resources to be respected?	(a) N (b) N	(a) No ethnic minorities and indigenous peoples live in the Project Site. (b) No ethnic minorities and indigenous peoples live in the Project Site.
	(6) Working Conditions and Accidents	(a) Is the project proponent not violating any laws and ordinances associated with the working conditions of the country which the project proponent should observe in the project? (b) Are tangible safety considerations in place for individuals involved in the project, such as the installation of safety equipment which prevents industrial accidents, and management of hazardous materials? (c) Are intangible measures being planned and implemented for individuals involved in the project, such as the establishment of a safety and health program, and safety training (including traffic safety and public health) for workers etc.? (d) Are appropriate measures being taken to ensure that security guards involved in the project not to violate safety of other individuals involved, or local residents?	(a) N (b) Y (c) Y (d) Y	(a) The project proponent not violating any laws and ordinances associated with the working conditions of Vietnam. (b) Tangible safety considerations in place for individuals involved in the project, such as the installation of safety fences which prevents industrial accidents. (c) Intangible measures being planned and implemented for individuals involved in the project, such as the establishment of disaster prevention organizations. (d) Appropriate measures being taken to ensure that the local government involved in the project not to violate safety of other individuals involved, or local residents.
	(1) Impacts during Construction	(a) Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)? (b) If construction activities adversely affect the natural environment (ecosystem), are adequate measures considered to reduce impacts? (c) If construction activities adversely affect the social environment, are adequate measures considered to reduce impacts?	(a) Y (b) N (c) Y	(a) EIA report was prepared and adequate mitigation measures were considered in the report. (b) The Project is considered not to have any significant impact on ecosystem. (c) Any significant adverse social impacts are not expected during the construction. But, some mitigation measures such as livelihood rehabilitation plan, for the possible adverse social impacts (land acquisitions, poverty) are considered.

Environmental Checklist: 7. Roads （6）

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
5 Others	(2) Monitoring	(a) Does the proponent develop and implement monitoring program for the environmental items that are considered to have potential impacts? (b) What are the items, methods and frequencies of the monitoring program? (c) Does the proponent establish an adequate monitoring framework (organization, personnel, equipment, and adequate budget to sustain the monitoring framework)? (d) Are any regulatory requirements pertaining to the monitoring report system identified, such as the format and frequency of reports from the proponent to the regulatory authorities?	(a) Y (b) Y (c) Y (d) Y	(a) EIA and A-RAP reports were prepared, and the monitoring program and the monitoring system were considered in the reports. (b) The monitoring program in the EIA and A-RAP reports show items, methods and frequencies of the monitoring program. (c) The monitoring system, implementation schedule and adequate budget to sustain the monitoring are considered in the EIA and A-RAP Report. (d) The monitoring system in the EIA and A-RAP reports show the monitoring format and the frequency of reports.
6 Note	Reference to Checklist of Other Sectors	(a) Where necessary, pertinent items described in the Forestry Projects checklist should also be checked (e.g., projects including large areas of deforestation). (b) Where necessary, pertinent items described in the Power Transmission and Distribution Lines checklist should also be checked (e.g., projects including installation of power transmission lines and/or electric distribution facilities).	(a) N (b) N	(a) There is no items relating to forestry in this project. (b) There is no items relating to power transmission and distribution in this project.
	Note on Using Environmental Checklist	(a) If necessary, the impacts to transboundary or global issues should be confirmed, if necessary (e.g., the project includes factors that may cause problems, such as transboundary waste treatment, acid rain, destruction of the ozone layer, or global warming).	(a) N	(a) The project is considered not to have any impacts on the trans-boundary impacts or climate change due to scale of the project.

1) Regarding the term “Country's Standards” mentioned in the above table, in the event that environmental standards in the country where the project is located diverge significantly from international standards, appropriate environmental considerations are required to be made.
In cases where local environmental regulations are yet to be established in some areas, considerations should be made based on comparisons with appropriate standards of other countries (including Japan's experience).
2) Environmental checklist provides general environmental items to be checked. It may be necessary to add or delete an item taking into account the characteristics of the project and the particular circumstances of the country and locality in which it is located.

2. Monitoring Forms

MONITORING FORM for Sewerage Sector

-If environmental reviews indicate the need of monitoring by JICA, JICA undertakes monitoring for necessary items that are decided by environmental reviews. JICA undertakes monitoring based on regular reports including measured data submitted by the project proponent. When necessary, the project proponent should refer to the following monitoring form for submitting reports.

-When monitoring plans including monitoring items, frequencies and methods are decided, project phase or project life cycle (such as construction phase and operation phase) should be considered.

１． Responses/Actions to Comments and Guidance from Government Authorities and the Public

Monitoring Item	Monitoring Results during Report Period
EIA Status/ EIA Approval	
Information disclosure of EIA report	
Stakeholder's meeting	

２． Mitigation Measures

Construction Phase

Item	Unit	Measured Value (Mean)	Measured Value (Max.)	Country's Standards	Remarks (Measurement Point, Frequency, Method, etc.)
- Air Quality (Ambient Air Quality)					
CO	$\mu g/m^3$			**30000**	**Measurement Point: K1 (Same location in EIA) Frequency: Every six months Method: Based on QCVN 05, 06:2013/BTNMT**
SO_2	$\mu g/m^3$			**125**	
NO_2	$\mu g/m^3$			**100**	
TSP	$\mu g/m^3$			**200**	
$PM_{2.5}$	$\mu g/m^3$			**50**	
CxHy	$\mu g/m^3$			**1500**	
Pb	$\mu g/m^3$			**1.5**	
- Water Quality (Wastewater)					
pH	-			**6 - 9**	**Measurement Point: Construction site Frequency: Every six months Method: Based on QCVN 40: 2011/BTNMT(Value C, Category A)**
Temperature	^0C			**40**	
Odor	-			**-**	
BOD_5	mg/l			**30**	
COD	mg/l			**75**	
TSS	mg/l			**50**	
Total Fe	mg/l			**1**	
Total Cu	mg/l			**2**	
As	mg/l			**0.05**	
Hg	mg/l			**0.005**	
Cd	mg/l			**0.05**	
Zn	mg/l			**3**	
Mn	mg/l			**0.5**	
Ammonia	mg/l			**5**	
Total N	mg/l			**20**	
Total P	mg/l			**4**	
Coliform	MPN			**3000**	

	/100 ml				
- Water Quality （Ambient Water Quality）					
pH	-			**5.5-9**	**Measurement Point:** **NM1 (Same location in EIA)** **Frequency:** **Every six months** **Method:** **Based on QCVN 08-MT: 2015/BTNMT (Column B1)**
BOD_5 (20°C)	mg/l			**15**	
Temperature	^0C			**-**	
DO	mg/l			**≥4**	
EC	mS/cm			**-**	
Color	Pt-Co			**-**	
TSS	mg/l			**50**	
COD	mg/l			**30**	
Cl^-	mg/l			**350**	
NO_2^-	mg/l			**0.05**	
NO_3^-	mg/l			**10**	
Fe	mg/l			**1.5**	
Pb	mg/l			**0.05**	
Zn	mg/l			**1.5**	
As	mg/l			**0.05**	
Total N	mg/l			**-**	
Total P	mg/l			**-**	
Detergent /surfactant	mg/l			**0.4**	
oil and grease	mg/l			**1**	
Coliform	MPN /100 ml			**7500**	
- Noise / Vibration					
Noise level	dBA			**Time:6～21 70 Time:21～6 55**	**Measurement Point:** **K1 (Same location in EIA)** **Frequency:** **Every six months** **Method:** **Based on QCVN 26: 2010/BTNMT, QCVN 27: 2010/BTNMT**
Vibration level	dB			**Time:6～21 75 Time:21～6 Background Level**	
- Waste					

Monitoring Item	**Monitoring Results during Report Period**
Waste management and treatment situation (Amount of Waste and record of treatment)	The waste management Report for once a month.

Operation Phase

Item	**Unit**	**Measured Value （Mean）**	**Measured Value （Max.）**	**Country's Standards**	**Remarks (Measurement Point, Frequency, Method, etc.)**
- Water Quality （Effluent Wastewater）					
pH	-			**5 - 9**	**Measurement Point:** **Sewage Treatment Facility** **Frequency:** **Every six months** **Method:** **Based on QCVN 14:**
BOD_5	mg/l			**30**	
TSS	mg/l			**50**	
TDS	mg/l			**500**	
Sulfide (H_2S)	mg/l			**1.0**	
Ammonia	mg/l			**5**	

Nitrate (NO_3)	mg/l			**30**	**2008/BTNMT (Value C, Category A)**
Animal fat and vegetable grease	mg/l			**10**	
Total surface-active substances	mg/l			**5**	
PO_4	mg/l			**6**	
Total Coliform	MPN /100 ml			**3000**	
- Water Quality（Ambient Water Quality）					
pH	-			**5.5-9**	**Measurement Point: NM1 (Same location in EIA) Frequency: Every six months Method: Based on QCVN 08-MT: 2015/BTNMT (Column B1)**
BOD_5 (20°C)	mg/l			**15**	
Temperature	^0C			**-**	
DO	mg/l			**≥4**	
EC	mS/cm			**-**	
Color	Pt-Co			**-**	
TSS	mg/l			**50**	
COD	mg/l			**30**	
Cl^-	mg/l			**350**	
NO_2^-	mg/l			**0.05**	
NO_3^-	mg/l			**10**	
Fe	mg/l			**1.5**	
Pb	mg/l			**0.05**	
Zn	mg/l			**1.5**	
As	mg/l			**0.05**	
Total N	mg/l			**-**	
Total P	mg/l			**-**	
Detergent /surfactant	mg/l			**0.4**	
oil and grease	mg/l			**1**	
Coliform	MPN /100 ml			**7500**	
- Waste (Sludge)					
Volume	kg			-	**Measurement Point: Sewage Treatment Facility Frequency: Every six months Method: Based on QCVN 50 -MT: 2015/BTNMT**
Cu	mg/kg			**300**	
As	mg/kg			**25**	
Zn	mg/kg			**300**	
Pb	mg/kg			**300**	
Cd	mg/kg			**10**	
Cr	mg/kg			**250**	

- Waste

Monitoring Item	Monitoring Results during Report Period
Waste management and treatment situation (Amount of Waste and record of treatment)	The waste management Report for once a month.

- Offensive Odors

Monitoring Item	Monitoring Results during Report Period
Status of implementation of tests and monitoring based on laws and regulations	Confirm implementation status of test and monitor air concentrations for every three months

３． Natural Environment

Since significant impact on natural environment does not occur by the project, the monitoring is not performed.

- Ecosystem

Monitoring Item	Monitoring Results during Report Period
Nothing	

４． Social Environment

Name of person in charge and filling this monitoring form:_____
Date of filling this monitoring form:_____

A. Public Consultations

No.	Date	Place	Contents of the consultation / main comments and answers
1			
2			
3			
4			
5			
6			

B. Resettlement/Land Acquisitions

Activities	Planned Total	Unit	Progress in Quantity			Progress in %		Expected Date of Completion	Responsible Organizations
			During the Quarter	Till the Last Quarter	Up to the Quarter	Till the Last Quarter	Up to the Quarter		
Approval of A-RAP									
Approval of policy framework of compensation, assistance and resettlement									
Approval of Investment Policy									
Budget securing for resettlement activities									
Approval of Project Investment Decision									
Land acquisition declaration by Ha Nam PPC									
Approval of plan of compensation, assistance and resettlement									
Contract with External Monitoring Agency		MM							
Establishment of necessary organizations									
Income Restoration Program (IRP) preparation									
Income Restoration Program (IRP) implementation									
Detailed Measurement Survey (DMS)									
Finalization of PAPs List based on DMS		Number of PAPs							
Calculation of compensation amount									
Negotiation and compensation		**Number of PAPs**							
Lot 1		Number of PAPs							
Lot 2		Number of PAPs							
Lot 3		Number of PAPs							

Grievance Redress	**-**	**Number of cases**							
Lot 1	-	Number of cases							
Lot 2	-	Number of cases							
Lot 3	-	Number of cases							
Site clearance		**Number of cases**							
Lot 1		Number of cases							
Lot 2		Number of cases							
Lot 3		Number of cases							

C. Poverty

Monitoring Item	Monitoring Results during Report Period
- Poverty Line under MOLISA (Decision No. 59/2015/QĐ-TTg, dated 19/11/2015, promulgating multidimensional poverty levels applicable during 2016-2020 for every 6 months.	Socio-Economic Survey to the Project Affected Households、in particular for the vulnerable households in the Sewerage Sector Project Sites for every 6 months.

D. Working Environment

Monitoring Item	Monitoring Results during Report Period
- Labors Working Environment Situations (Number of industrial environment related disease such as water-borne diseases in the Project Sites) for every 6 months.	Labors Working Situations/Accidents Report in the Sewerage Sector Project Sites for every 6 months.

E. Accidents

Monitoring Item	Monitoring Results during Report Period
- Project related Accident Situations (Number of Traffic Accidents or Industrial Accidents in the Project Area) for every 6 months.	The Traffic Accidents Report in the Road Sector Project Sites for every 6 months.

MONITORING FORM for Road Sector

-If environmental reviews indicate the need of monitoring by JICA, JICA undertakes monitoring for necessary items that are decided by environmental reviews. JICA undertakes monitoring based on regular reports including measured data submitted by the project proponent. When necessary, the project proponent should refer to the following monitoring form for submitting reports.

-When monitoring plans including monitoring items, frequencies and methods are decided, project phase or project life cycle (such as construction phase and operation phase) should be considered.

１． Responses/Actions to Comments and Guidance from Government Authorities and the Public

Monitoring Item	Monitoring Results during Report Period
EIA Status/ EIA Approval	
Information disclosure of EIA report	
Stakeholder's meeting	

２． Mitigation Measures

Construction Phase

Item	Unit	Measured Value (Mean)	Measured Value (Max.)	Country's Standards	Remarks (Measurement Point, Frequency, Method, etc.)
- Air Quality (Ambient Air Quality)					
CO	μg/m^3			**30000**	**Measurement Point: K2, K3, K4 (Same location in EIA) Frequency: Every six months Method: Based on QCVN 05, 06:2013/BTNMT**
SO_2	μg/m^3			**125**	
NO_2	μg/m^3			**100**	
TSP	μg/m^3			**200**	
$PM_{2.5}$	μg/m^3			**50**	
CxHy	μg/m^3			**1500**	
Pb	μg/m^3			**1.5**	
- Noise / Vibration					
Noise level	dBA			**Time:6～21 70 Time:21～6 55**	**Measurement Point: K2, K3, K4 (Same location in EIA) Frequency: Every six months Method: Based on QCVN 26: 2010/BTNMT, QCVN 27: 2010/BTNMT**
Vibration level	dB			**Time:6～21 75 Time:21～6 Background Level**	
- Waste					

Monitoring Item	Monitoring Results during Report Period
Waste management and treatment situation (Amount of Waste and record of treatment)	The waste management Report for once a month during construction.

Operation Phase

Item	Unit	Measured Value (Mean)	Measured Value (Max.)	Country's Standards	Remarks (Measurement Point, Frequency, Method, etc.)
- Air Quality (Ambient Air Quality)					
CO	μg/m^3			**30000**	**Measurement Point:** **K2, K3, K4 (Same location in EIA)** **Frequency:** **Every six months** **Method:** **Based on QCVN 05, 06:2013/BTNMT**
SO_2	μg/m^3			**125**	
NO_2	μg/m^3			**100**	
TSP	μg/m^3			**200**	
$PM_{2.5}$	μg/m^3			**50**	
CxHy	μg/m^3			**1500**	
Pb	μg/m^3			**1.5**	
- Noise / Vibration					
Noise level	dBA			**Time:6～21 70 Time:21～6 55**	**Measurement Point:** **K2, K3, K4 (Same location in EIA)** **Frequency:** **Every six months** **Method:** **Based on QCVN 26: 2010/BTNMT, QCVN 27: 2010/BTNMT**
Vibration level	dB			**Time:6～21 75 Time:21～6 Background Level**	

３．Natural Environment

Since significant impact on natural environment does not occur by the project, the monitoring is not performed.

- Ecosystem

Monitoring Item	Monitoring Results during Report Period
Nothing	

４． Social Environment

Name of person in charge and filling this monitoring form:_____
Date of filling this monitoring form:_____

A. Public Consultations

No.	Date	Place	Contents of the consultation / main comments and answers
1			
2			
3			
4			
5			
6			

B. Land Acquisitions Activities

Activities	Planned Total	Unit	Progress in Quantity			Progress in %		Expected Date of Completion	Responsible Organizations
			During the Quarter	Till the Last Quarter	Up to the Quarter	Till the Last Quarter	Up to the Quarter		
Approval of A-RAP									
Approval of policy framework of compensation, assistance and resettlement									
Approval of Investment Policy									
Budget securing for resettlement activities									
Approval of Project Investment Decision									
Land acquisition declaration by Ha Nam PPC									
Approval of plan of compensation, assistance and resettlement									
Contract with External Monitoring Agency		MM							
Establishment of necessary organizations									
Income Restoration Program (IRP) preparation									
Income Restoration Program (IRP) implementation									
Detailed Measurement Survey (DMS)									
Finalization of PAPs List based on DMS		Number of PAPs							
Calculation of compensation amount									
Negotiation and compensation		**Number of PAPs**							
Lot 1		Number of PAPs							
Lot 2		Number of PAPs							
Lot 3		Number of PAPs							

Grievance Redress	**-**	**Number of cases**							
Lot 1	-	Number of cases							
Lot 2	-	Number of cases							
Lot 3	-	Number of cases							
Site clearance		**Number of cases**							
Lot 1		Number of cases							
Lot 2		Number of cases							
Lot 3		Number of cases							

C. Poverty

Monitoring Item	Monitoring Results during Report Period
- Poverty Line under MOLISA (Decision No. 59/2015/QĐ-TTg, dated 19/11/2015, promulgating multidimensional poverty levels applicable during 2016-2020.	- Socio-Economic Survey to the Project Affected Households, in particular for the vulnerable households in the Road Sector Project Sites for every 6 months.

D. Working Environment

Monitoring Item	Monitoring Results during Report Period
Labors Working Environment Situations (Number of environment related disease such as respiratory disease in the Project Sites).	- Labors Working Situations/Accidents Report in the Road Sector Project Sites for every 6 months.

E. Accidents

Monitoring Item	Monitoring Results during Report Period
- Project related Accident Situations (Number of Traffic Accidents or Industrial Accidents in the Project Area)	- The Traffic Accidents Report in the Road Sector Project Sites for every 6 months.

3. Annexes of Social Considerations

Annexes of Social Considerations

Annex 1 Replacement Cost Survey

A. Valuation and compensation for affected assets

1. As required by the JICA Involuntary Resettlement Policy, the replacement cost survey should be used as a basis for calculating replacement costs for all impacts on land and non-land assets affected by the project.

B. Objective of the replacement cost survey

2. The key objective of the replacement cost survey is to ensure that the compensation rate for calculating the compensation for all affected assets is the replacement cost. This objective will be achieved through a detailed market survey process and/or factors such as productive capacity, equivalence factors, value of alternative assets, disadvantage of the affected entity influence, ... and compare and evaluate the compensation rates issued by the provincial People's Committee.

- Determine the land price at market rate at the time of resettlement implementation.
- Determine the price of trees and crops at market rate at the time of resettlement implementation.
- Determine the price of materials and labor for construction of houses and structures at market rate at the time of resettlement implementation.

C. Methods for determining replacement costs

3. Replacement cost surveys were conducted simultaneously through different channels such as affected households and neighbors, local officials, local housing offices from 15 to 20 in November 2018, including:

- Directly interview by questionnaire with households in the affected area and neighboring areas to collect information on market prices of lands and non-land assets in the project area;
- Consultation with Representatives of DOF, DOC, DONRE, Units of Ha Nam People's Committee and related ward/commune on prices of land, assets, harvest, crops.
- Communications with local authorities, determination of lands, crops, and other assets in affected areas, collection of legal documents issued, including sets of unit prices of land and other assets (inclusive of assistances):

  + Decision No. 38/2014/QD-UBND dated September 12, 2014 on "Compensation, Support and Resettlement when Land is Recovered in Ha Nam Province"

  + Decision No. 49/2014/QD-UBND dated November 20, 2014 on "Compensation rate for crops and livestock when the State recovers land"

  + Decision No. 50/2014/QD-UBND dated December 19, 2014 on the regulation on land price in 2015 in Ha Nam province, applied for 05 years (2015 - 2019).

  + Decision No. 48/2017/ QĐ-UBND dated December 18, 2017 on issuing the unit prices to compensate for houses, structures, other constructions and moving tombs or graves when the State acquires land in Ha Nam in 2018
- Consultations with several construction companies in the local area on the unit price of building and construction materials.
- Access to real estate offices, local real estate websites to find out information.

4. During the implementation of the project, an independent valuation agency will conduct surveys of replacement costs for land and non-land assets affected by the project. This agency will set up a replacement cost based on results of the survey to submit to the Ha Nam Provincial People's Committee for approval, then apply for compensation.

D. Replacement cost survey results are the following:

Compensation rate for land:

- For agricultural land: There have been almost no transfers and trading of agricultural land and other types of land over the past few years. Agricultural land transfers only take place within families, namely relatives without (or not yet) certified by People's Committees of communes/wards, thus it is impossible to determine prices of such transfers. However, according to consultations with local people and local authorities in the project area. The price of agricultural land varies from 50,000 to 58,000 VND/m^2 depending on the location of the land plot.
- For residential land: Some households living in communes had residential land and garden transactions, but mostly facade land and center land of communes/wards. According to local people assessment, the compensation rates for residential land issued by the PPC **(Decision No.50/2014/QD-UBND)** are very low. Survey results and proposed substitute prices for residential land are presented in the table below.

Compensation rate for structures

- The finding out unit prices for architectures of affected areas faces many difficulties. Recently, prices of construction materials fluctuate erratically. Due to the diverse types of housing structures in the province, applied compensation rates will be calculated for each item accordingly.
- Recently, prices of construction materials changed erratically. Due to the diversity of building structures in the area, the applicable rates will be calculated for each item. For architectural objects of the people, excluding deduction for depreciation, the People's Committee of Ha Nam province issued **Decision No. 48/2017/QD-UBND dated December 18, 2017** on the promulgation of compensation rate for house, architectural objects and graves when the state recovers land in Ha Nam province, the compensation rate is equivalent to the new construction price and close to the replacement cost of architectural objects. Housing prices and construction material prices are equivalent and have no significant difference with the replacement unit costs. Therefore, the PPC rates will be used

Compensation rates for crops and livestock

- In respect of crops and livestock, the Provincial People's Committee issued Decision **No.49/2014/QD-UBND dated November 20, 2014** regarding issuance of compensation rates for crops and livestock in case of land acquisition by the State, including detailed unit prices for each crop. Compensation rates are based on market price survey of Ha Nam Department of Construction.
- The survey results of the Consulting unit showed that market prices of crops and livestock in Ha Nam province are stable for recent 2 years, especially prices of crops and vegetables. For fruit trees and timber trees, there is no great fluctuations. Therefore, the Consultant applied these compensation rates for trees and crops according to the current rate issued by Ha Nam PPC as a basis for cost estimate of compensation for households impacted with crops and trees affected by the project. During the application of compensation rate for each type of affected trees and crops, the Consultant proposed application of compensation rates higher than those stipulated in Decision **No. 49/QD-UBND dated 20 November 2014** to ensure compensation rates for affected households close to replacement cost. However during the actual compensation process, an independent valuation agency should be hired to conduct survey to determine replacement cost at time of compensation.

❖ **Conclusion and recommendations**

5. Establishment of compensation rates as a result of land acquisition and site clearance in Ha Nam Province has been carried out every year with adjustments according to market fluctuations.

6. In areas affected by the Project, the alignments basically affect land managed by the Commune People's Committees, agricultural land and a part of residential land. In such areas, there is almost no real estate market and few trading transactions relating to land and non-land assets;

7. Therefore, in the process of preparing A-RAP, the Local Consultant conducted replacement cost survey, which has an objective to get information assumed market costs by several interviewed with the local officials, the households in the project area and the neighboring area.

8. However, during the process of implementing the project, there shall be an independent evaluation agency, which the project implementation body will hire to conduct replacement cost survey for land, properties and crops affected by the Project. The agency shall establish the replacement cost as basis for Ha Nam Province People's Committee to make decisions on compensation rates close to market prices.

❖ **Recommended compensation rates to be applied:**

9. **Proposed compensation rate for land**:

No,	Location/Component	Project location	Compensation rates accord to Decisions of Ha Nam province	Replacement costs applicable to the project
I	**Residential land**			
	Center road (LCB-01)	Hoang Dong commune	750,000 VND/m^2	1,500,000 VND /m^2
II	**Agricultural land**			
	Agricultural land and Aquaculture land	Duy Tien Distric; Thanh Liem Distric	50,000 VND /m^2	50,000 VND /m^2
	Agricultural land and Aquaculture land	Phu Ly City	58,000 VND /m^2	58,000 VND /m^2
III	**Structures**			
1	*Semi-permanent house*	Ha Nam province	2,391,000/m^2	2,391,000/m^2
2	*Sheds*	Ha Nam province		650,000/ m2
3	*Yards*	Ha Nam province	166,000 m^2	166,000 m^2
4	Graves	Ha Nam province	From 3,095,000 to 6,185,000 VND/Pcs	6,000,000 VND/Pcs
IV	**Trees - Crops**			
1	Rice	Ha Nam province	9,000 VND/m^2	12,000 VND/m^2
2	Fruit trees	Ha Nam province	From 36,000 to 360,000 VND/tree	From 36,000 to 360,000 VND/tree
3	Timber trees	Ha Nam province	From 18,000 to 96,000 VND/tree	From 18,000 to 96,000 VND/tree

10. When calculating of compensation, compensation rates will be updated to reflect replacement costs and replacement costs attributable to the compensation made to affected households. The compensation rates will be determined by an independent appraiser before the application for payment of compensation for affected organizations/individuals when preparing the detailed compensation, assistance and resettlement plans.

Annex 2 Detailed Cost Estimates of the A-RAP Implementation

No.	Item	Unit	Quantity	Unit price	Amount	
					Exchange rate: VND 23.200 = USD.$ 1	
I	**Center road (LCB-01)**				**19,127,844,000**	**824,476**
1	***Compensation for land***				***5,041,900,000***	***217,323***
	- Residential land	*m2*	***41***	***1,500,000***	***61,500,000***	***2,651***
	- Agricultural land	*m2*	***99,608***	***50,000***	*4,980,400,000*	214,672
2	**Compensation for house**		-	-	***90,858,000***	***3,916***
	- Semi-permanent house	*m2*	***38***	***2,391,000***	*90,858,000*	3,916
3	**Compensation for structures**		-	-	***23,070,000***	***994***
	- Sheds	*m2*	***24***	***650,000***	*15,600,000*	672
	- Yards	*m2*	***45***	***166,000***	*7,470,000*	322
4	***Compensation for Grave relocation***	Pcs	***146***	***6,000,000***	876,000,000	37,758
5	***Compensation for crops and trees***		-	-	***1,206,096,000***	**51,986**
	- Rice	m2	***99,608***	***12,000***	1,195,296,000	51,521
	- Fruit trees	m2	***90***	***120,000***	10,800,000	465.52
6	***Subsistence allowance***	***m2***	***99,608***	***15,000***	***1,494,120,000***	**64,401**
7	***Vocational training allowance***	***m2***	***99,608***	***100,000***	***9,960,800,000***	**429,344**
8	***Support for vulnerable HH***	***HH***	***13***	-	***54,000,000***	**2,327**
	- Poor HH	HH	***5***	***6,000,000***	30,000,000	1,293
	- Policy preferential HHs, elderly HHs	HH	***8***	***3,000,000***	24,000,000	1,034
9	***Bonus for timely hand over***	***HH***	***127***	***3,000,000***	**381,000,000**	**16,422**
II	**Expressway East Bypass Road (LCB-02)**				-	-
III.1	***Feeder Road North and South (LCB-03) - North Main Road***				***6,024,660,000***	***259,684***
1	***Compensation for land***				***1,629,000,000***	***70,216***
	- Agricultural land	*m2*	*32,580*	*50,000*	*1,629,000,000*	70,216
2	***Compensation for crops***		-		***390,960,000***	***16,852***
	- Rice	*m2*	*32,580*	12,000	390,960,000	16,852
3	***Subsistence allowance***	***m2***	*32,580*	***15,000***	***488,700,000***	***21,065***
4	***Vocational training allowance***	***m2***	*32,580*	***100,000***	***3,258,000,000***	***140,431***
5	***Support for vulnerable HH***	***HH***	*5*		***18,000,000***	***776***
	- Poor HH	HH	*1*	6,000,000	6,000,000	259
	- Policy preferential HHs, elderly HHs	HH	*4*	3,000,000	12,000,000	517
6	***Bonus for timely hand over***	***HH***	***80***	**3,000,000**	**240,000,000**	**10,345**
III.2	***Feeder Road North and South (LCB-03) - South Main Road***				***13,505,658,000***	***582,140***

No.	Item	Unit	Quantity	Unit price	Amount	
					Exchange rate: VND 23.200 = USD.$ 1	
1	***Compensation for land***				***3,797,500,000***	***163,685***
	- Agricultural land	*m2*	*72,370*	*50,000*	*3,618,500,000*	155,970
	- Aquaculture land	*m2*	*3,580*	*50,000*	*179,000,000*	7,716
2	***Compensation for crops, trees and pet***		-		***959,608,000***	***41,362***
	- Rice	m2	*72,370*	12,000	868,440,000	37,432
	- Fruit trees	tree	*68*	360,000	24,480,000	1,055
	- Fruit trees: banana	Bush	*49*	120,000	5,880,000	253
	- Timber trees	tree	*42*	84,000	3,528,000	152
	- Fishes	m2	*3,580*	16,000	57,280,000	2,469
3	***Subsistence allowance***	***m2***	*72,370*	***15,000***	***1,085,550,000***	***46,791***
4	***Vocational training allowance***	***m2***	*72,370*	***100,000***	***7,237,000,000***	***311,940***
5	***Support for vulnerable HH***	***HH***	*14*		***57,000,000***	***2,457***
	- Poor HH	HH	*5*	6,000,000	30,000,000	1,293
	- Policy preferential HHs, elderly HHs	HH	*9*	3,000,000	27,000,000	1,164
6	***Bonus for timely hand over***	***HH***	***123***	**3,000,000**	**369,000,000**	**15,905**
IV.1	***North-South and East (LCB-04)***				***28,635,855,000***	***1,234,304***
1	***Compensation for land***				***7,928,310,000***	***341,738***
	- Agricultural land	*m2*	*136,695*	*58,000*	*7,928,310,000*	341,738
2	***Compensation for crops and trees***		-		***1,660,500,000***	***71,573***
	- Rice	m2	*136,695*	12,000	1,640,340,000	70,704
	- Timber trees	tree	*240*	84,000	20,160,000	869
3	***Subsistence allowance***	***m2***	*136,695*	***15,000***	***2,050,425,000***	***88,380***
4	***Vocational training allowance***	***m2***	*136,695*	***116,000***	***15,856,620,000***	***683,475***
5	***Support for vulnerable HH***	***HH***	*25*		***99,000,000***	***4,267***
	- Poor HH	HH	*8*	6,000,000	48,000,000	2,069
	- Policy preferential HHs, elderly HHs	HH	*17*	3,000,000	51,000,000	2,198
6	***Bonus for timely hand over***	***HH***	*347*	**3,000,000**	**1,041,000,000**	**44,871**
IV.2	***West Cross Road (LCB-04)***				***13,166,620,000***	***567,527***
1	***Compensation for land***				***3,746,800,000***	***161,500***
	- Agricultural land	*m2*	*63,140*	*58,000*	*3,662,120,000*	157,850
	- Aquaculture land	*m2*	*1,460*	*58,000*	*84,680,000*	3,650
2	***Compensation for crops, trees and pet***		-		***812,480,000***	***35,021***
	- Rice	m2	*63,140*	12,000	757,680,000	32,658
	- Fruit trees	tree	*51*	360,000	18,360,000	791

No.	Item	Unit	Quantity	Unit price	Amount	
					Exchange rate: VND 23.200 = USD.$ 1	
	- Fruit trees: banana	bush	*67*	120,000	8,040,000	347
	- Timber trees	tree	*60*	84,000	5,040,000	217
	- Fishes	m2	*1,460*	16,000	23,360,000	1,007
3	***Subsistence allowance***	***m2***	*63,140*	***15,000***	***947,100,000***	***40,823***
4	***Vocational training allowance***	***m2***	*63,140*	***116,000***	***7,324,240,000***	***315,700***
5	***Support for vulnerable HH***	***HH***	*10*		***39,000,000***	***1,681***
	- Poor HH	HH	*3*	6,000,000	18,000,000	776
	- Policy preferential HHs, elderly HHs	HH	*7*	3,000,000	21,000,000	905
6	***Bonus for timely hand over***	***HH***	*99*	**3,000,000**	**297,000,000**	**12,802**
V	***Treatment facilities***				***2,915,450,000***	***125,666***
1	***Compensation for land***				***738,340,000***	***31,825***
	- Agricultural land	*m2*	*12,730*	*58,000*	*738,340,000*	31,825
2	**Compensation for structures**				***26,000,000***	***1,121***
	- Sheds	*m2*	*40*	*650,000*	*26,000,000*	1,121
3	***Compensation for crops***				***282,480,000***	***12,176***
	- Rice	m2	12,730	12,000	152,760,000	6,584
	- Fruit trees: banana	tree	130	84,000	10,920,000	470
	- Timber trees	tree	300	96,000	28,800,000	1,241
	- Timber trees: bamboo	tree	5,000	18,000	90,000,000	3,879
4	***Subsistence allowance***	***m2***	*12,730*	***15,000***	***190,950,000***	***8,231***
5	***Vocational training allowance***	***m2***	*12,730*	***116,000***	***1,476,680,000***	***63,650***
6	***Support for vulnerable HH***	***HH***	*6*		***21,000,000***	***905***
	- Poor HH	HH	*1*	6,000,000	6,000,000	259
	- Policy preferential HHs, elderly HHs	HH	*5*	3,000,000	15,000,000	647
7	***Bonus for timely hand over***	***HH***	*60*	**3,000,000**	**180,000,000**	**7,759**
VII	**Total items**				**83,376,087,000**	**3,593,797**
VIII	Management expense = 2% IX				1,667,521,740	71,876
IX	Contingency (10% of total)				8,337,608,700	359,380
X	Other expense				1,667,521,740	71,876
a	Independent monitoring = 1 % IX				833,760,870	35,938
b	Replacement cost survey expense (temporary)				833,760,870	**35,938**
	Total				**95,048,739,180**	**4,096,928**
	Rounding				**95,048,739,000**	**4,096,000**

APPENDIX4:

(DRAFT)TERMS OF REFERENCE FOR DESIGN AND SUPERVISION CONSULTANT

(DRAFT)
Terms of Reference
for
Design and Supervision Consultant for the Works under
Ha Nam Investment Climate Improvement Project
in
The Socialist Republic of Vietnam

Chapter 1. Background

- The Government of the Socialist Republic of Vietnam has received a loan from the Japan International Cooperation Agency (hereinafter referred to as "JICA") to finance the Ha Nam Investment Environment Improvement Project which is to enhance the foundations for promoting investment to the Province, by improving socio-economic infrastructure such as road and sewerage systems around Ha Nam industrial and urban areas, thereby stimulate economic activities and improve the socioeconomic development of greater Hanoi Metropolitan area.
- The Project comprises of the following components, which are shown with package names (LCB-1 to LCB-5 for Road Sector, ICB-1 and ICB-2 for Sewerage Sector):

Road Sector

- Construction of "Center Road (LCB-1)", which crosses from NH38 to the university area passing through Dong Van III Industrial Park; 3.5 km.
- Construction of "Expressway East Bypass Road (LCB-2)", which lies along Expressway, Dong Van I & II areas and Dong Van III Industrial Park expansion area; 3.0 km.
- Construction of "Feeder Road North and South (LCB-3) (Road Section)", which crosses Dong Van III Industrial Park from west and east at north and south sides; 2.0 km and 2.8 km.
- Construction of "Feeder Road North and South (LCB-3) (Bridge Section)", which crosses expressway; 337 m of flyover and 440 m of approach road.
- Construction of "North-South and East-West Cross Road (LCB-4)", which passes through the hospital area, not crossing expressway; 2.9 km and 1.4 km.
- Rehabilitation of "Phu Ly City Road (LCB-5)", which rehabilitates existing paved road and existing bridges in Phu Ly City; 3.0 km and 0.9 km.

Sewerage Sector

- Construction of "Wastewater Treatment Plant (WWTP) (ICB-1)", which lies near DT. 974 Road, Dinh Xa Commune in Phu Ly City.
  Capacity: 3,000 m^3/d (Maximum daily wastewater flow)
  Treatment method: advanced pre-treated trickling filter system (PTF)
- Construction of "Main Sewer (ICB-2)", which lies in Hospital Area.
  Dia. 300 mm: L = 14.6 km by Open cut method, Gravity system
  Dia. 300 mm: L = 0.9 km by pipe jacking method, Gravity system
  Dia. 400 mm: L = 2.6 km by pipe jacking method, Gravity system
  Dia. 500 mm: L = 1.2 km by pipe jacking method, Gravity system
  Manhole Pump: Q = 1.0 m^3/min

- The Government of the Socialist Republic of Vietnam intends to use part of the proceeds of the loan for eligible payments for consulting services for which this ToR is issued.
- The Project is expected to be completed in February 2025.
- Location of the Project
  - Locations of the road project are shown in **Annex 1**.
  - Locations of the sewerage project are shown in **Annex 2**.
- Executing Agency: The Project Management Unit (the PMU) established by Ha Nam Province People's Committee (HNPPC)

■ Technical information: available relevant basic data and studies, technical standard or specifications to be used, etc.
- Preparatory Survey on Ha Nam Provence Investment Climate Improvement Project (2019), JICA
- Data Collection Survey on Improvement of Investment Environment Utilizing PPP in Ha Nam Province (2016), JICA
- Prime Minister Decision on Approving the Master Plan on Socio-Economic Development of Ha Nam Province to 2020, No.1226/QD-TTg
- TCVN 4054: 2005, Highway Specification for Design issued in 2005
- 22TCN 272-05, Bridge Design Standard issued in 2005
- QCVN01:2008/BXD - Regional and urban planning and urban residential planning
- Guideline for introducing a Technology for Advanced Pre-treated Trickling Filter System issued in February 2017, National Institute for Land and Infrastructure Management, Japan
- QCVN 14:2008/BTNMT - National technical regulation on domestic wastewater
- QCVN 40:2011/BTNMT - National technical regulation on industrial wastewater
- TCVN 7957: 2008, Drainage and sewerage - External Networks and Facilities - Design Standard

■ Related projects
- Road Development Mater Plan – Bypass Road of NR38 and PR499 Road under construction (BOT)
- Road improvement and rehabilitation project under the title of No.3 Rural Transportation project (World Bank) covering 12 km rural roads
- Construction of the center road with 6.7 km in total including one bridge with 150m long

■ The Project is expected to comprise the following contract packages:

Sector	Package No.	Package name	Procurement method (ICB/LCB, with/without PQ)	Applicable Standard Bidding Documents
Road	LCB-1	Center Road	LCB without PQ	-
	LCB-2	Expressway East By Pass Road	LCB without PQ	-
	LCB-3	Feeder Road North and Feeder Road South	LCB without PQ	-
	LCB-4	North-South and East-West Cross Road	LCB without PQ	-
	LCB-5	Phu Ly City Road Rehabilitation	LCB without PQ	-
Sewerage	ICB-1	WWTP	ICB without PQ	SBD Works
	ICB-2	Main Sewer	ICB without PQ	SBD Works

Chapter 2. Objectives of Consulting Services

The consulting services shall be provided by a consulting firm (hereinafter referred to as "the Consultant") in compliance with Guidelines for the Employment of Consultants under Japanese ODA Loans, April 2012. The objective of the consulting services is to achieve the efficient and proper preparation and implementation of the Project through the following works:

(1) Detailed Design
(2) Tender Assistance
(3) Construction Supervision
(4) Facilitation of Implementation of Environmental Management Plan (EMP), Environmental Monitoring Plan (EMoP) and Resettlement Action Plan (RAP)
(5) Technology Transfer

Chapter 3. Scope of Consulting Services

(1) Detailed Design

The Consultant shall:

(a) Review and verify all available primary and secondary data collected during the JICA's preparatory survey for the Project;

(b) Carry out all the required engineering surveys and investigations such as topographical survey, hydrological survey, geotechnical survey, material availability survey, etc, as applicable to the concerned project components (**Annex-3**);

(c) Prepare detailed work plan, progress reports and implementation schedule for the Project to ensure effective monitoring and timely project outputs, and regularly update the same;

(d) Prepare Project Definition Report which lists all the anticipated design standards that will be used and submitted to the PMU for approval prior to the detail design.

(e) Prepare the detailed design of the Project in sufficient detail to ensure clarity and understanding by the PMU, contractors and other relevant stakeholders. All the design should be in conformity with the Socialist Republic of Vietnam Standards or with the appropriate international standards. The detailed design will, as a minimum, include construction drawings, detailed cost estimates, necessary calculations to determine and justify the engineering details for the Project, associated contract documentation to include detailed specifications, bill of quantities (BOQ), and implementation schedule for the Project. Such detailed specifications will contain those in relation to i) quality control of plant materials and workmanship, ii) safety, and iii) protection of the environment. The detailed design shall be prepared in close consultation with, and to meet the requirements of the PMU and will be incorporated into the detailed design report to be submitted for approval of the PMU;

(f) Perform the followings based on the survey of the existing drainage systems: i) identify, design and quantify any necessary additional, replacement, or amendments to existing structures; ii) check streambeds and cross-drainage channels above and below the roads for possible erosion effects; iii) design and quantify any necessary protective works; iv) examine the existing side drainage; and v) specify, design, and quantify new side drainage and line drains where necessary to eliminate scour and erosion or to provide support for narrow road cross sections.

(g) Investigate, test, and define sources and estimated quantities of construction materials and prepare the material sources map with indicative properties, its applicability (i.e. for sub-grade, for sub-base, etc) and estimated quantities.

(h) Assess the air pollution and noise impact to be caused by the Project based on the measured baseline data (background noise) and define appropriate mitigation measures.

(i) Identify existing public utilities within the project sites; and

(j) Prepare necessary HIV prevention program to be implemented by the contractors.

(2) Tender Assistance

The Consultant shall:

(a) Define technical and financial requirements, capacity and/or experience for qualification criteria taking into consideration of technical feature of the Project;

(b) Prepare bidding documents including qualification documents, with one-stage and two-envelop procedures in accordance with the latest version of Standard Bidding Documents under Japanese ODA Loans for Procurement of Works together with all relevant specifications, drawings and other documents;

(c) Prepare bidding documents which includes i) clauses stating that the Contractor is to comply with the requirement of the Environmental Management Plan (EMP) and JICA Guidelines for environmental and social considerations (April 2010) (JICA Environmental Guidelines), ii) the specification clearly stipulating the safety requirements in accordance with the laws and regulations in the country of the

Borrower, relevant international standards (including guidelines of international organization), if any, and also in consideration of "the Guidance for the Management of Safety for Construction Works in Japanese ODA Projects of JICA," iii) the requirement to furnish a safety plan to meet the safety requirements, iv) the requirement for the personnel for key positions to include an accident prevention officer, and v) the requirement to submit method statements of safety to the PMU and the consultant at the construction stage;

(d) Assist the PMU in issuing bid invitation, conducting pre-bid conferences, issuing addendum/corrigendum, and clarifications to bidders' queries;

(e) Evaluate bids in accordance with the criteria set forth in the bidding documents. In such evaluation, the Consultant shall carefully confirm that bidders' submissions in their technical proposal including, but not limited to, site organization, mobilization schedule, method statement, construction schedule, safety plan, and EMP have been prepared in consistent with each other and will meet such requirements set forth in applicable laws and regulations, specifications and other parts of the bidding documents;

(f) Prepare a bid evaluation report for approval of the bid evaluation committee;

(g) Assist the PMU in contract negotiation by preparing agenda and facilitating negotiations including preparation of minutes of negotiation meeting; and

(h) Prepare a draft and final contract agreement.

(3) Construction Supervision

The Consultant shall perform his duties during the contract implementation period of the contracts to be executed by the Employer and the Contractor. FIDIC MDB Harmonized Edition (2010) complemented with the Specific Provisions as included in the Standard Bidding Documents under Japanese ODA Loans for Procurement of Works will be applied to the civil works of the Project. In this context, the Consultant shall:

(a) Act as the Engineer to execute construction supervision and contract administration services in accordance with the power and authority to be delegated by the PMU;

(b) Provide assistance to the Employer concerning variations and claims which are to be ordered/issued at the initiative of the PMU. Advise the Employer on resolution of any dispute with the Contractor;

(c) Issue instructions, approvals and notices as appropriate;

(d) Provide recommendation to the PMU for acceptance of the Contractor's performance security, advance payment security and required insurances;

(e) Provide commencement order to the Contractor;

(f) Assess adequacy of all inputs such as materials, labor and equipment provided by the Contractor;

(g) Check and approve the Contractor's method of work, including site organization, program of performance, quality assurance system, safety plan, method statements of safety, and environmental monitoring plan so that the requirements set forth in the applicable laws and regulations, the specifications or other parts of the contract are to be duly respected;

(h) Regularly monitor physical and financial progress, and take appropriate action to expedite progress if necessary, so that the time for completion set forth in the contract will be duly respected by the Contractor;

(i) Explain and/or adjust ambiguities and/or discrepancies in the Contract Documents and issue any necessary clarifications or instructions. Issue further drawings and give instructions to the Contractor for any works which may not be sufficiently detailed in the contract documents, if any;

(j) Review and approve the Contractor's working drawings, shop drawings and drawings for temporary works. Also, review and approve, if any, design prepared by the Contractor for any part of the permanent works;

(k) Liaise with the appropriate authorities to ensure that all the affected utility services are promptly relocated;

(l) Carry out field inspections on the Contractor's setting out of the works in relation to original points, lines and levels of reference specified in the contract;

(m) Organize, as necessary, management meetings with the Contractor to review the arrangements for future work. Prepare and deliver minutes of such meetings to the Employer and the Contractor;

(n) Supervise the works so that all the contractual requirements are met by the Contractor, including those in relation to i) quality of the works, ii) safety and iii) protection of the environment. Confirm that an accident prevention officer proposed by the Contractor is duly assigned at the project site; Require the contractors to take appropriate remedied if any questions are recognized regarding the safety measures;

(o) Supervise field tests, sampling and laboratory test to be carried out by the Contractor;

(p) Inspect the construction method, equipment to be used, workmanship at the site, and attend shop inspection and manufacturing tests in accordance with the specifications;

(q) Survey and measure the work output performed by the Contractor verify statements submitted by the Contractor and issue payment certificates such as interim payment certificates and final payment certificate as specified in the contract;

(r) Coordinate the works among different contractors employed for the Project;

(s) Modify the designs, technical specifications and drawings, relevant calculations and cost estimates as may be necessary in accordance with the actual site conditions, and issue variation orders (including necessary actions in relation to the works performed by other contractors working for other projects, if any);

(t) Carry out timely reporting to the PMU for any inconsistency in executing the works and suggesting appropriate corrective measures to be applied;

(u) Inspect, verify and fairly determine claims issued by the parties to the contract (i.e. the PMU and Contractor) in accordance with the civil works contract;

(v) Perform the inspection of the works, including Test on Completion, and to issue certificates such as the Taking-Over Certificate, Performance Certificate as specified in the contract;

(w) Supervise commissioning and carry out tests during the commissioning, if applicable;

(x) Provide periodic and/or continuous inspection services during defects notification period and if any defects are noted, instruct the Contractor to rectify;

(y) Prepare as-build drawings for the parts of the works constructed in accordance with the design provided by the Employer. Check and certify as-built drawings for the parts of the works designed by the Contractor, if any;

(z) Prepare an operation and maintenance manual for the works constructed in the Project. Check and certify an operation and maintenance manual for the parts of the works designed by the Contractor, if any;

(aa) Prepare guideline for HIV/AIDS protection activities;

(bb) Prepare Safety guideline for traffic safety education to local people;

(cc) In case of accidents during the construction, assist the Employer to report to JICA the details of such accidents in a manner reasonably requested by JICA; and

(dd) Prepare and submit reports to the PMU, which are detailed in **Chapter 6** in relation to the implementation of the Project.

(4) Facilitation of implementation of Environmental Management Plan (EMP), Environmental Monitoring Plan (EMoP) and Resettlement Action Plan (RAP)

The Consultant shall:

(a) Update EMP as appropriate; incorporate necessary technical specifications with design and contract documentation;

(b) Assist the PMU in dissemination and explanation of additionally confirmed and identified environmental issues to public including holding public consultations;

(c) During the preparation of bidding documents, clearly identify environmental responsibilities as explained in the EIA/IEE and EMP;

(d) Assist the PMU to review the Construction Contractor's Environmental Program to be prepared by the contractor in accordance with EMP, relevant plans and JICA Environmental Guidelines and to make recommendations to the PMU regarding any necessary amendments for its approval;

(e) Assist the PMU to implement the measures identified in the EMP;

(f) Monitor the effectiveness of EMP and negative impacts on environment caused by the construction works and provide technical advice, including a feasible solution, so that PMU can improve situation when necessary;

(g) Assist PMU in monitoring the compliance with conditions stated in the EPC and the requirements under EMP and JICA Environmental Guidelines;

(h) Assist the PMU in preparation of the answer to the request from JICA's advisory committee for environmental and social considerations, if necessary;

(i) Assist PMU in the capacity building of PMU staff on environmental management through on-the-job training on environmental assessment techniques, mitigation measure planning, supervision and monitoring, and reporting;

(j) Update and/or prepare RAP as necessary based on detailed design in accordance with the agreed resettlement framework, including entitlement matrix and compensation plan; coordinate with various agencies in preparing the procedures for timely land acquisition and disbursement of compensation to project affected persons (PAPs);

(k) Assist the PMU in identifying the eligible PAPs, and in preparation/updating of the list of eligible PAPs and 'Payment Statement' for individual eligible PAPs. The places where each eligible PAPs will relocate to are necessary to be recorded so that the PMU could implement monitoring on income and living conditions of resettled persons;

(l) Assist the PMU in conducting social assessment during early stage of the detailed design stage and review the existing income restoration plan and special assistance plan for vulnerable PAPs and revise/update the contents of the plans if necessary based on priorities identified with support of relevant government agencies and Non-Governmental Organizations (NGOs). The following contents should be included in the plans;
   i. Skills Training
   ii. Project related Job Opportunities
   iii. Provision of social welfare grant
   iv. Provision of Agricultural Extension Services
   v. Provision of the special allowance to vulnerable PAPs

(m) Assist the PMU to implement the measures identified in the revised RAP;

(n) Monitor land acquisition and compensation activities being undertaken by the PMU and/or competent authorities, and report the results in monthly progress reports;

(o) Assist in procurement of Implementation NGO (INGO) and external monitoring agency (EMA).

(p) Assist the PMU in facilitating stakeholder's participation (including focus group discussions for vulnerable PAPs) and providing feedback their comments on RAP;

(q) Assist the PMU in establishment of grievance redress mechanism including formation of Grievance Redress Committee;

(r) Assist the PMU to ensure that the PAPs are fully aware of the grievance redress procedure and the process of bringing their complaints, investigate the veracity of the complaints, and recommends actions/measures to settle them amicably, fairly and transparently before they go to the redress committee or the courts of law; and

(s) Provide technical services with grievance redress committee for keeping and updating records when necessary.

(5) Technology Transfer

The Consultant shall carry out the technology transfer as an important aspect in design and supervision works. The Consultant shall provide the opportunity to the PMU officers and staffs to be involved in the working team of the Consultant during the design, contract administration and supervision works for their capacity building wherever possible. If requested by the PMU, the Consultant shall brief and demonstrate the survey and design procedure, the construction supervision and contract management process and procedures. The consultant shall assist the PMU and its staff to build their capacity as a part of on the job training under the Project.

Chapter 4. Expected Time Schedule

The total duration of consulting services will be 59 months. The implementation schedule expected is as shown in **Table 4-1** by sectors.

Table 4-1 Implementation Schedule Expected

Key Activities			Date	Duration in Months
Commencement of Consulting Services			April 2020	59
Completion of Consulting Services			February 2025	
Road Sector	Detailed Design	Commencement of Detailed Design, Preparation of Drawings and Tender Documents	April 2020	6
		Completion of Detailed Design	September 2020	
	Tender Assistance	Commencement of Tender Assistance	September 2020	5
		Completion of Tender Assistance	January 2021	
	Construction Supervision	Commencement of Civil Works	February 2021	18
		End of Civil Works	July 2022	
		Defect Notification Period	August 2022 to July 2023	12
Sewerage Sector	Detailed Design	Commencement of Detailed Design, Preparation of Drawings and Tender Documents	April 2020	10
		Completion of Detailed Design	January 2021	
	Tender Assistance	Commencement of Tender Assistance	February 2022	13
		Completion of Tender Assistance	February 2022	
	Construction Supervision	Commencement of Civil Works	March 2022	24
		End of Civil Works	February 2024	
		Defect Notification Period	March 2024 to February 2025	12

Chapter 5. Staffing (Expertise required)

Twenty one (21) of International Experts and twenty one (21) of Local Experts will be engaged, for a total of 214.5 man-months for International Experts and 355 man-months for Local Experts and required man-month for supporting staffs.

(1) Qualification of Key Experts

The qualification of Key Experts is shown in **Table 5-1** to **Table 5-3**.

Table 5-1 Qualification of Key Experts (Project Managing)

Designation	Qualification
A-1 Project Manager	Education: • Bachelor Science, Master degree or doctorate degree in Civil Engineering Experience: • Duly licensed/registered civil engineer • Experience in design and construction supervision for at least two (2) sewerage projects with capacity of not less than 3,000m3/day • Working Experience: 15 years or more • More than five (5) experiences of leading a consultants' team as the Team Leader or the Deputy Team Leader • Experience of detailed design and tender assistance at least one (1) road project in ICB (International Competitive Bidding) contract

Table 5-2 Qualification of Key Experts (Road Sector)

Designation	Qualification
RA-1 Team Leader/Civil Engineer	Education: • Bachelor Science, Master degree or doctorate degree in related field and added advantage Experience: • Duly licensed/registered civil engineer • Experience in road design field: 15 years or more • Experience in road plan, design and supervision at soft ground in past of 10 years or more • More than three (3) experience of leading a consultants' team as the Team Leader or the Deputy Team Leader
RA-2 Sr. Engineer (Road/Structure)	Education: • Bachelor Science, Master degree or doctorate degree in related field and added advantage Experience: • Duly licensed/registered civil engineer • Experience in road design field: 15 years or more • Experience in road plan and design at soft ground in past of 10 years or more • At least three (3) experiences in embankment design on the soft ground as the road engineer
RA-4 Sr. Engineer (Bridge/Structure)	Education: • Bachelor Science, Master degree or doctorate degree in related field and added advantage Experience: • Experience in bridge design field: 10 years or more • Experience in bridge for friction pile foundation in past of 10 years or more • At least three (3) experiences as the bridge engineer.
RA-7 Document Specialist	Education: • Bachelor Science Experience: • Experience in bridge and road design field: 10 years or more. • At least three (3) experiences as the Document Specialist. • Experience in LCB contract is desirable

Table 5-3 Qualification of Key Experts (Sewerage Sector)

Designation	Qualification
SA-1 Team Leader/Sewerage	Education: • Bachelor Science, Master degree or doctorate degree in related field and added advantage Experience: • Duly licensed/registered sewerage engineer • Experience in sewerage design and construction supervision for at least two (2) sewerage projects with capacity of not less than 3,000m3/day • 15 years or more of experience in sewerage sector • At least one (1) project in sewerage system in Vietnam or similar countries in Asia in past 10 years • More than three (3) experiences of leading a consultants' team as the Team Leader or the Deputy Team Leader • Experience of detailed design, tender assistance and construction supervision at least one (1) project in ICB contract
SA-2 Sr. Engineer (Sewer)	Education: • Bachelor Science, Master degree or doctorate degree in related field and added advantage Experience: • Duly licensed/registered civil engineer • 10 years or more of experience in sewerage sector • At least ten (10) experiences in detailed designs and construction supervision of pipes (including the jacking method) in past 10 years • Experience in construction supervision for at least 1 project applying pipe jacking • Experience in ICB contract is desirable
SA-4 Sr. Engineer (Treatment Process)	Education: • Bachelor Science, Master degree or doctorate degree in related field and added advantage Experience: • Experience in sewerage planning and design field: 10 years or more • At least ten (10) experiences in detailed design and construction supervision of wastewater treatment projects
SB-1 Deputy Team Leader/Sewerage	Education: • Bachelor Science, Master degree or doctorate degree in related field and added advantage Experience: • Experience in design and construction supervision in urban environment or urban development sector: 15 years or more • More than three (3) experiences of leading a consultants' team as the Team Leader or the Deputy Team Leader • Experience in ICB contract is desirable

(2) Qualification of International Non-Key Experts

The qualification of International Non-Key Experts is shown in **Table 5-4**. The qualification of International Non-Key Experts is not evaluated in the evaluation of technical proposals.

Table 5-4 Qualification of International Non-Key Experts (Road Sector)

Designation	Qualification
RA-3 Jr. Engineer (Road Structure)	Education: • Bachelor Science in related field and added advantage Experience: • Duly licensed/registered civil engineer • Experience in road design field: 10 years or more • Experience in road plan and design at soft ground in past of 10 years or more • At least two (2) experiences in embankment design on the soft ground as the road engineer

RA-5 Sr. Engineer (Construction Planning and Cost Estimate)	Education: • Bachelor Science in related field and added advantage Experience: • Duly licensed/registered civil engineer • Experience in construction planning and cost estimate field: 10 years or more • At least two (2) experiences in construction planning and cost estimate engineer
RA-6 Sr. Engineer (Survey)	Education: • Bachelor Science Experience: • Experience in on-site engineering survey field; 10 years or more • At least two (2) experience as the on-site survey engineer
RA-8 Social Specialist	Education: • Bachelor Science Experience: • Experience in social environment field; 10 years or more • At least two (2) experiences as the social specialist
RA-9 Environmental Specialist	Education: • Bachelor Science Experience: • Experience in natural environment field; 10 years or more • At least two (2) experience as the environmental specialist

Table 5-5 Qualification of International Non-Key Experts (Sewerage Sector)

Designation	Qualification
SA-3 Architectural Engineer	Education: • Bachelor Science in related field and added advantage Experience: • Duly licensed/registered architectural engineer • Experience in architectural design works in past of 5 years or more • At least two (2) experiences in architectural design works of WWTP or similar infrastructures
SA-5 Sr. Engineer (Structure)	Education: • Bachelor Science in related field and added advantage Experience: • Duly licensed/registered civil engineer • Experience in structural design field: 10 years or more • At least two (2) experiences in structural design works of WWTP or similar infrastructures
SA-6 Sr. Engineer (Mechanical)	Education: • Bachelor Science in related field and added advantage Experience: • Duly licensed/registered mechanical engineer • Experience in mechanical design field: 10 years or more • At least two (2) experiences in mechanical design works of WWTP or similar infrastructures
SA-7 Sr. Engineer (Electrical)	Education: • Bachelor Science in related field and added advantage Experience: • Duly licensed/registered electrical engineer • Experience in electrical design field: 10 years or more • At least two (2) experiences in electrical design works of WWTP or similar infrastructures
SA-8 Sr. Engineer (Construction and Cost Estimate)	Education: • Bachelor Science in related field and added advantage Experience: • Duly licensed/registered civil engineer • Experience in construction planning and cost estimate field: 10 years or more • At least three (2) experiences in construction planning and cost estimate engineer

SA-9 Sr. Engineer (Survey)	Education: • Bachelor Science Experience: • Experience in on-site engineering survey field; 10 years or more • At least two (2) experience as the on-site survey engineer
SA-10 Environmental Specialist	Education: • Bachelor Science Experience: • Experience in natural environment field; 10 years or more • At least two (2) experience as the environmental specialist
SA-11 Social Specialist	Education: • Bachelor Science Experience: • Experience in social environment field; 10 years or more • At least two (2) experiences as the social specialist

The Consultant may propose other experts and supporting staffs required to accomplish the tasks outlined in the terms of reference in addition to experts indicated in **Table-5-1** to **Table 5-5**.

(3) Scope of works for the respective personnel
Detailed information on the major tasks and duties Key Experts and International Non-Key Experts of the project manager, the detailed engineering design team and the construction supervision team shall perform is provided as follows:

Project Managing

No	Position	I or L	Major Tasks and Duties
A-1	Project Manager	I	1) Lead the detailed design team. Ensure all deliverables are prepared in accordance with quality and time constraints. 2) Administer and supervise site investigation and design and documentation activities for civil works contracts. 3) Prepare improvement/design standards. 4) Data collection and review of available information about the Project. 5) Ensure the tender documents for construction works. 6) Assist the PMU to appraise tender as part of the tender evaluation process. 7) Assist the PMU evaluate the capacity of contractors. 8) Prepare reports and documents. 9) Assist PMU in commissioning and reception of the completed work

Road Sector

No	Position	I or L	Major Tasks and Duties
RA-1	Team Leader / Civil Engineer (Key-Expert)	I	1) Lead the road detailed design team. Ensure all deliverables are prepared in accordance with quality and time constraints. 2) Administer and supervise site investigation and design and documentation activities for civil works contracts. 3) Prepare improvement/design standards. 4) Data collection and review of available information about the Project. 5) Ensure the tender documents for construction works. 6) Assist the PMU to appraise tender as part of the tender evaluation process. 7) Assist the PMU evaluate the capacity of contractors. 8) Prepare reports and documents. 9) Lead the consultant team in tendering assistance. 10) With assistance from the Procurement/Contract Administration Expert and other relevant experts, prepare tender documentation suitable for procurement under LCB in accordance with the relevant

			regulations and rules in Vietnam. 11) With assistance from the Procurement/Contract Administration Expert and other relevant experts, prepare bid documents and relevant documents, including bid evaluation criteria. 12) Assist HNPPC in issuing bid invitation, conducting pre-bid conferences, issuing addendum/corrigendum, and clarifications to bidders' queries. 13) Assist HNPPC in evaluating bids in accordance with the criteria set forth in the bidding documents. 14) Assist HNPPC in preparing a bid evaluation report for approval of the bid evaluation committee. 15) Assist HNPPC in contract negotiations. 16) Assist HNPPC in preparing and finalizing the contract agreement. 17) Shall act as "the Engineer" of the project. 18) Responsible for the overall implementation and management of construction supervision. 19) Shall access the progress of, quality of, safety of, environment condition of construction work. 20) Shall attend important meeting with HNPPC, PMU, contractor and other concerned agencies. 21) Shall certify the monthly progress billings of the contractor. 22) Shall check the change orders submitted by the contractor and take necessary procedure. 23) Shall listen to claims from the contractor and take necessary procedure. 24) Responsible for reporting to and consulting with JICA
RA-2	Sr. Engineer (Road Structure) (Key Expert)	I	1) Data collection and review of available information about the Project. 2) Conduct field reconnaissance survey. 3) Conduct detailed design (Highway/Road). 4) Conduct pavement design. 5) Conduct ancillary works design. 6) Assist HNPPC in issuing bid invitation, conducting pre-bid conferences, issuing addendum/corrigendum, and clarifications to bidders' queries. 7) Assist HNPPC in preparing a bid evaluation report for approval of the bid evaluation committee. 8) Shall access the topographical condition, geological condition and other conditions which may affect safe construction of the road and if safety of constructing is judged to be a problem, come up with possible remedial measure. 9) Shall access contractor's proposal with regards to modification of construction method, materials, and other modifications, necessary recommendations shall be reported to the Team Leader.
RA-3	Jr. Engineer (Road Structure) (Non-Key Expert)	I	1) Data collection and review of available information about the Project. 2) Conduct field reconnaissance survey. 3) Conduct detailed design (Highway/Road). 4) Conduct pavement design. 5) Conduct ancillary works design. 6) Assist HNPPC in issuing bid invitation, conducting pre-bid conferences, issuing addendum/corrigendum, and clarifications to bidders' queries. 7) Assist HNPPC in preparing a bid evaluation report for approval of the bid evaluation committee. 8) Shall access the topographical condition, geological condition and other conditions which may affect safe construction of the road and if safety of constructing is judged to be a problem, come up with possible remedial measure. 9) Shall access contractor's proposal with regards to modification of construction method, materials, and other modifications, necessary recommendations shall be reported to the Team Leader.
RA-4	Sr. Engineer	I	1) Data collection and review of available information about the Project.

	(Bridge Structure) (Key Expert)		2) Conduct field reconnaissance survey. 3) Conduct geological/geotechnical investigation. 4) Conduct bridge design. 5) Conduct ancillary works design. 6) Assist HNPPC in preparing a bid evaluation report for approval of the bid evaluation committee.ssist HNPPC in issuing bid invitation, conducting pre-bid conferences, issuing addendum/corrigendum, and clarifications to bidders' queries. 7) Shall access the topographical condition, geological condition and other conditions (especially expressway) which may affect safe construction of the flyover and if safety of constructing is judged to be a problem, come up with possible remedial measure. 8) Shall access contractor's proposal with regards to modification of construction method, materials, and other modifications, necessary recommendations shall be reported to the Team Leader.
RA-5	Sr. Engineer (Construction Planning and Cost Estimate) (Non-Key Expert)	I	1) Data collection and review of available information about the Project. 2) Conduct field reconnaissance survey. 3) Collect and provide utility Maps. 4) Provide traffic management plan / scheme during construction. 5) Conduct quantity calculation. 6) Conduct unit price analysis. 7) Conduct construction planning. 8) Conduct cost estimation.
RA-6	Sr. Engineer (Survey) (Non-Key Expert)	I	1) Data collection and review of available information about the Project. 2) Conduct field reconnaissance survey. 3) Conduct topographic survey. 4) Conduct geological survey.
RA-7	Document Specialist (Key Expert)	I	1) Data collection and review of available information about the Project. 2) Conduct field reconnaissance survey. 3) Provide technical specifications. 4) Provide tender and contract documents. 5) Assist the PMU to appraise tender as part of the tender evaluation process. 6) Assist the HNPPC to design, administer and monitor all procurement activities to ensure compliance with agreed procurement frameworks. 7) Prepare bid documents in compliance with JICA and HNPPC procurement guidelines. Bid documents will be prepared for LCB 8) Assist the HNPPC in the preparation of invitation for bids, evaluation of bids received, and award of civil works contracts.
RA-8	Social Specialist (Non-Key Expert)	I	1) Checking for collected data and review of available information about project 2) Conduct field reconnaissance survey 3) Provide resettlement action plan 4) Monitored resettlement and land acquisition
RA-9	Environment Specialist (Non-Key Expert)	I	1) Checking for collected data and review of available information about project 2) Conduct field reconnaissance survey 3) Provide environment impact assessment 4) Planned effectiveness for natural environment 5) Shall monitor the contractor's performance in accordance with EMP 6) Assistance PMU in public relations for the environmental consideration 7) Shall report to the Team Leader with regard to progress, problem and other necessary things

Sewerage Sector

No	Position	I or L	Major Tasks and Duties
SA-1	Team Leader / Sewerage (Key Expert)	I	1) Lead the detailed design team. Ensure all deliverables are prepared in accordance with quality and time constraints. 2) Administer and supervise site investigation and design and documentation activities for civil works contracts. 3) Prepare improvement/design standards. 4) Data collection and review of available information about the Project. 5) Ensure the tender documents for sewerage works. 6) Assist the PMU in appraising tender as part of the tender evaluation process. 7) Assist the PMU in evaluating the capacity of contractors. 8) Lead the consultant team in tendering assistance. 9) Prepare design reports and documents. 10) With assistance from the Procurement/Contract Administration Expert and other relevant experts, prepare tender documentation suitable for procurement under ICB in accordance with the procurement guidelines of JICA. 11) With assistance from the Procurement/Contract Administration Expert and other relevant experts, prepare bid documents and relevant documents, including bid evaluation criteria. 12) Assist HNPPC in issuing bid invitation, conducting pre-bid conferences, issuing addendum/corrigendum, and clarifications to bidders' queries. 13) Assist HNPPC in evaluating bids in accordance with the criteria set forth in the bidding documents. 14) Assist HNPPC in preparing a bid evaluation report for approval of the bid evaluation committee. 15) Assist HNPPC in contract negotiations. 16) Assist HNPPC in preparing and finalizing the contract agreement. 17) Responsible for the overall implementation and management of construction supervision. 18) Access the progress of, quality of, safety of, environment condition of construction work. 19) Attend important meeting with HNPPC, PMU, contractor and other concerned agencies. 20) Certify the monthly progress billings of the contractor. 21) Check the change orders submitted by the contractor and take necessary procedure. 22) Listen to claims from the contractor and take necessary procedure. 23) Responsible for reporting to and consulting with JICA
SA-2	Sr. Engineer (Sewer) (Key Expert)	I	1) Data collection and review of available information about the Project. 2) Conduct field reconnaissance survey. 3) Conduct design calculation 4) Prepare detailed design drawings for Main Sewer components. 5) Prepare detailed design reports for Main Sewer components 6) Assistance in preparing bid documents for construction and procurement work for Main Sewer components 7) Access the topographical condition, geological condition and other conditions which may affect safe construction of the sewer pipe and if safety of constructing is judged to be a problem, come up with possible remedial measure. 8) Access contractor's proposal with regards to modification of construction method, materials, and other modifications, necessary recommendations shall be reported to the Team Leader.
SA-3	Architect Engineer (Non-Key Expert)	I	1) Data collection and review of available information about the Project. 2) Conduct field reconnaissance survey. 3) Conduct architectural design for WWTP component

SA-4	Sr. Engineer (Treatment Process) (Key Expert)	I	1) Data collection and review of available information about the Project. 2) Conduct field reconnaissance survey. 3) Conduct design calculation and detailed design for WWTP treatment process. 4) Preparation of detailed design reports for WWTP component 5) Assistance in preparing bid documents for construction and procurement work for WWTP component 6) Attend commissioning test and preparation/compilation of O&M manual for WWTP and Pumping Stations(PSs)
SA-5	Sr. Engineer (Structure) (Non-Key Expert)	I	1) Data collection and review of available information about the Project. 2) Conduct topographical/geographical survey. 3) Conduct detailed design for WWTP component. 4) Prepare detailed design reports for WWTP component 5) Assistance in preparing bid documents for construction and procurement work for WWTP component 6) Access the topographical condition, geological condition and other conditions which may affect safe construction of WWTP and PSs and if safety of constructing is judged to be a problem, come up with possible remedial measure. 7) Access contractor's proposal with regards to modification of construction method, materials, and other modifications, necessary recommendations shall be reported to the Team Leader.
SA-6	Sr. Engineer (Mechanical) (Non-Key Expert)	I	1) Data collection and review of available information about the Project. 2) Conduct field reconnaissance survey. 3) Conduct mechanical design for WWTP component 4) Prepare detailed design reports for WWTP component 5) Assistance in preparing bid documents for construction and procurement work for WWTP component 6) Access the topographical condition, geological condition and other conditions which may affect safe construction of WWTP and PSs and if safety of constructing is judged to be a problem, come up with possible remedial measure. 7) Access contractor's proposal with regards to modification of construction method, materials, and other modifications, necessary recommendations shall be reported to the Team Leader.
SA-7	Sr. Engineer (Electrical) (Non-Key Expert)	I	1) Data collection and review of available information about the Project. 2) Conduct field reconnaissance survey. 3) Conduct electrical design for WWTP component. 4) Conduct ancillary works design. 5) Prepare control and instrumental flow diagrams including SCADA system for WWTP 6) Prepare detailed design reports for WWTP component. 7) Assistance in preparing bid documents for construction and procurement work for WWTP component. 8) Access the topographical condition, geological condition and other conditions which may affect safe construction of WWTP and PSs and if safety of constructing is judged to be a problem, come up with possible remedial measure. 9) Access contractor's proposal with regards to modification of construction method, materials, and other modifications, necessary recommendations shall be reported to the Team Leader.
SA-8	Sr. Engineer (Construction Planning and Cost Estimate) (Non-Key Expert)	I	1) Data collection and review of available information about the Project. 2) Conduct field reconnaissance survey. 3) Collect and provide utility maps. 4) Conduct construction planning 5) Conduct quantity calculation. 6) Conduct unit price analysis. 7) Assistance in preparing bid documents for construction and procurement work for sewerage works.

SA-9	Sr. Engineer (Survey) (Non-Key Expert)	I	1) Data collection and review of available information about the Project. 2) Conduct geological survey. 3) Preparation of geotechnical investigation reports. 4) Assistance in preparing bid documents for construction and procurement work for sewerage works.
SA-10	Environmental Specialist (Non-Key Expert)	I	1) Data collection and review of available information about the Project. 2) Review and monitor activities. 3) Conduct field reconnaissance survey. 4) Monitor and evaluate land acquisition and parcellary survey. 5) Assistance in preparing bid documents for construction and procurement work for sewerage works. 6) Update EMP and EMoP. 7) Supervise implementation of EMP and EMoP.
SA-11	Social Specialist (Non-Key Expert)	I	1) Data collection and review of available information about the Project. 2) Review and monitor activities. 3) Conduct field reconnaissance survey. 4) Monitor and evaluate land acquisition and parcellary survey. 5) Assistance in preparing bid documents for construction and procurement work for sewerage works.
SB-1	Deputy Team Leader/Sewerage (Key Expert)	L	1) Lead the sewerage sector team. Ensure all deliverables are prepared in accordance with quality and time constraints. 2) Administer and supervise site investigation and design and documentation activities for civil works contracts. 3) Data collection and review of available information about the Project. 4) Ensure the tender documents for sewerage construction works. 5) Assist the PMU to appraise tender as part of the tender evaluation process. 6) Assist the PMU evaluate the capacity of contractors. 7) Prepare reports and documents. 8) Access contractor's proposal with regards to modification of construction method, materials, and other modifications, necessary recommendations shall be reported to the Team Leader. 9) Access contractor's proposal with regards to modification of construction method, materials, and other modifications, necessary recommendations shall be reported to the Team Leader.

Chapter 6. Reporting

Within the scope of consulting services, the Consultant shall prepare and submit reports and documents to the PMU as shown in **Table 6-1**. The Consultant shall provide electronic copy of each of these reports.

Table 6-1 Reporting

Category	Type of Report	Timing	No. of Copies
Consultancy Services	Inception Report	Within 1 month after commencement of the services	10
	Monthly Progress Report	Every month	10
	Quarterly Progress Report	Every quarter	10
	Project Completion Report (for submission to JICA)	At the end of Services	10
Detailed Design	Project Definition Report (whether this report is needed or not is to be confirmed later)	2nd month (Road Sector) 3rd month (Sewerage Sector) after the commencement of service	20
	Draft Detailed Design Report	4th month (Road Sector) 9th month (Sewerage Sector) after the commencement of service	20
	Cost Estimate Report	5th month (Road Sector) 10th month (Sewerage Sector) after the commencement of service	20
	Final Detailed Design Report	5th month (Road Sector) 11th month (Sewerage Sector) after the commencement of service	20
	Final Design Report	6th month (Road Sector) 12th month (Sewerage Sector) after the commencement of service	20
Tender Assistance	Bidding Document Report	3rd month (Road Sector) 3rd month (Sewerage Sector) after the commencement of service	20
	Technical Evaluation Report	4th month (Road Sector) 4th month (Sewerage Sector) after the commencement of service	15
	Tender Evaluation Report	After the evaluation and selection of most responsible contractors	15
Technology Transfer	Technology Transfer Plan	At appropriate timing in accordance with the Inception Report	10
	Technology Transfer Execution and Evaluation Report	Within 1 month after technology transfer	10
Environment and Social Safeguard	Environmental Monitoring Report	Every quarter	10
	Land Acquisition and Resettlement Monitoring Report	Every month	10
	Environmental and Social Safeguard Evaluation Report	At the end of the Project	20
Review of Detailed Design and Construction Supervision	Project Review Report	3rd month after the commencement of services	10
	Quality Control Report	Every month	10
	Quarterly Progress Report	Every three (3) months during construction	10
	Operation and Maintenance Manual	Within three (3) month after completion of construction	10
	Construction Completion Report	Within three (3) month after completion of construction	10
Other Report	Technical Report	As required or upon request	As required

Contents to be included in each report are as follows:

(1) Consultant Service

a) Inception Report (10 copies): To be submitted within 1 month after the commencement of the services, presenting the methodologies, schedule, organization, etc.

b) Monthly Progress Report (10 copies): Describes briefly and concisely all activities and progress for the previous month by the 10th day of each month. Problems encountered or anticipated will be clearly stated, together with actions to be taken or recommendations on remedial measures for correction. Also indicates the work to be performed during the coming month.

c) Quarterly Progress Report (10 copies): Describes the progress status of the services

d) Project Completion Report (10 copies): To be submitted to JICA at the end of Service.

(2) Detailed Design (Road Sector)

a) Project Definition Report (20 copies), to be submitted in the 2nd month after the commencement of services, presenting the design criteria and standards.

b) Draft Detailed Design Report (20 copies), to be submitted in the 4th month after the commencement of services, presenting detailed engineering design.

c) Cost Estimate Report (20 copies), to be submitted in the 5th month after the commencement of services, presenting detailed cost estimate.

d) Final Detailed Design Report (20 copies), to be submitted in the 5th month after the commencement of services, compiling all the items carried out during services.

e) Final Design Report (20 copies), to be submitted in the 6th month after the commencement of services, finalizing detailed design, cost estimate, bid plan, bid evaluation criteria, technical evaluation criteria and bidding documents through the incorporation of comments on the Draft Design Report, provided by and the Consultant.

(3) Detailed Design (Sewerage Sector)

a) Project Definition Report (20 copies), to be submitted in the 3rd month after the commencement of services, presenting the design criteria and standards.

b) Draft Detailed Design Report (20 copies), to be submitted in the 9th month after the commencement of services, presenting detailed engineering design.

c) Cost Estimate Report (20 copies), to be submitted in the 10th month after the commencement of services, presenting detailed cost estimate.

d) Final Detailed Design Report (20 copies), to be submitted in the 11th month after the commencement of services, compiling all the items carried out during services.

e) Final Design Report (20 copies), to be submitted in the 12th month after the commencement of services, finalizing detailed design, cost estimate, bid plan, bid evaluation criteria, technical evaluation criteria and bidding documents through the incorporation of comments on the Draft Design Report, provided by and the Consultant

(4) Tender Assistance (Road Sector)

a) Bidding Document Report (20 copies), to be submitted in the 3rd month after the commencement of the services, presenting the bidding documents and bid evaluation criteria.

b) Technical Evaluation Report (15 copies), to be submitted in the 4th month after commencement of the services, presenting the results of technical evaluation and to recommend the qualified applicants.

c) Tender Evaluation Report (15 copies), to be submitted after the evaluation and selection of most responsible contractors, presenting the results of the tenders to select the most responsible contractors.

(5) Tender Assistance (Sewerage Sector)

a) Bidding Document Report (20 copies), to be submitted in the 3rd month after the commencement of the services, presenting the bidding documents and bid evaluation criteria.

b) Technical Evaluation Report (15 copies), to be submitted in the 4th month after commencement of the services, presenting the results of technical evaluation and to recommend the qualified applicants.

c) Tender Evaluation Report (15 copies), to be submitted after the evaluation and selection of most responsible contractors, presenting the results of the tenders to select the most responsible contractors.

(6) Technology Transfer

a) Technology Transfer Plan (10 copies) to be submitted at appropriate timing in accordance with the Inception Report.
b) Technology Transfer Execution and Evaluation Report (10 copies) to be submitted within 1 month after technology transfer.

(7) Assistance in Environment and Resettlement Monitoring

a) Environmental Monitoring Report (10 copies), to be submitted at every three (3) months after the commencement of the services, presenting the environmental impacts and implementation of environmental mitigation measures during and [at the completion of / after] the construction stage. Environmental monitoring forms attached as **Annex 4** will be filled and attached to the Report.

b) Land Acquisition and Resettlement Monitoring Report (10 copies), to be submitted at every month during land acquisition and resettlement implementation period. RAP monitoring form attached as **Annex 4** will be filled and attached to the Report.

c) Environmental and Social Safeguard Evaluation Report (20 copies), to be submitted by the end of the consulting services, presenting the EMP, EMoP and RAP prepared.

(8) Review of Detailed Design and Construction Supervision

a) Project Review Report (10 copies), to be submitted in the 3rd months after the commencement of services.

b) Quality Control Report (10 copies), to be submitted at every month during construction, presenting the quality control of the Project.

c) Quarterly Progress Report (10 copies), to be submitted at every three (3) months during construction, presenting the progress status of the Project.

d) Operation and Maintenance Manual (10 copies), to be submitted within three (3) month after completion of construction, containing technical procedures for the appropriate operation and maintenance of all project facilities.

e) Construction Completion Report (10 copies), to be submitted within three (3) month after completion of construction, which comprises a full size of as-built drawings for all the structures and facilities completed, and the final details of the construction completed together with all data, records, material tests results, field books.

Chapter 7. Obligations of the Executing Agency

A certain range of arrangements and services will be provided by the Executing Agency to the Consultant for smooth implementation of the Consulting Services. In this context, the Executing Agency will:

(1) Report and Data

Make available to the Consultant existing reports and data related to the Project;

- Data Collection Survey on Improvement of Investment Environment Utilizing PPP in Ha Nam Province (2016); and
- Prime Minister Decision on Approving the Master Plan on Socio-Economic Development of Ha Nam Province to 2020, No.1226/QD-TTg.

(2) Office space

Provide an office space in the Headquarters of the Executing Agency with necessary equipment, furniture and utility. However, the Consultant's requirement for office space, including necessary equipment, furniture and utilities, should be clearly stated in the proposal with its rental cost for the case where the HNPPC would be unable to provide such facilities;

(3) Cooperation and Counterpart Staff

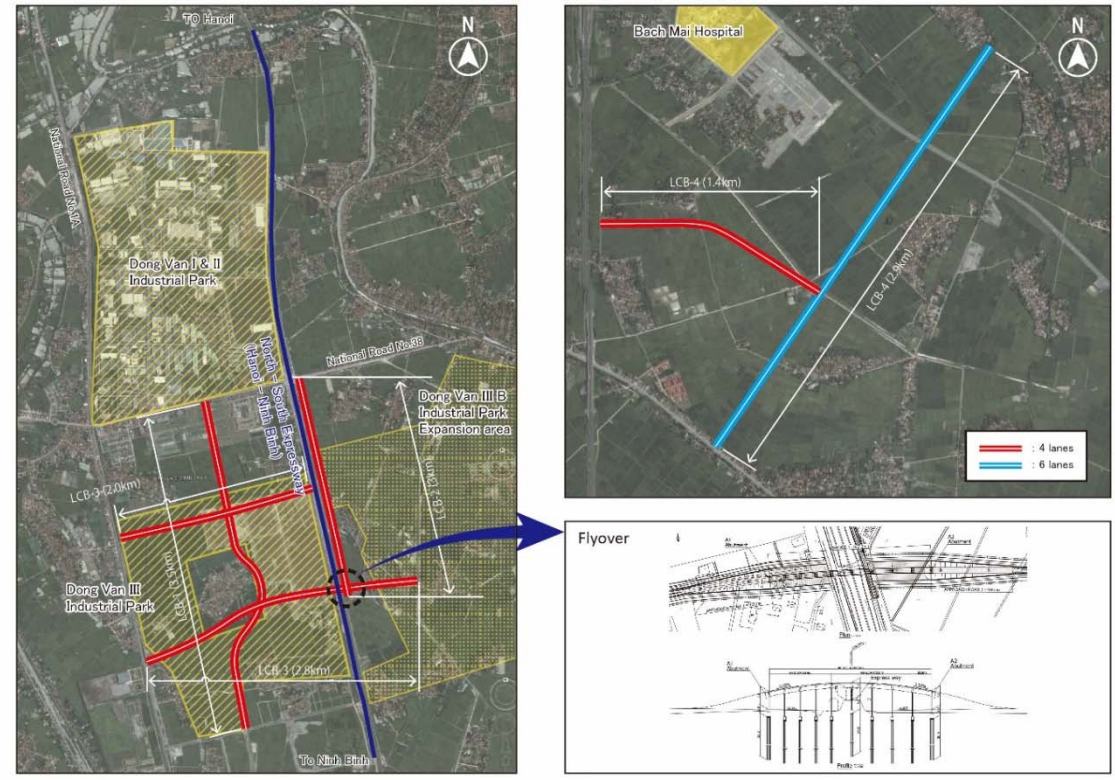
Appoint counterpart officials, agent and representative as may be necessary for effective implementation of the Consulting Services;

(4) Assistance and exemption

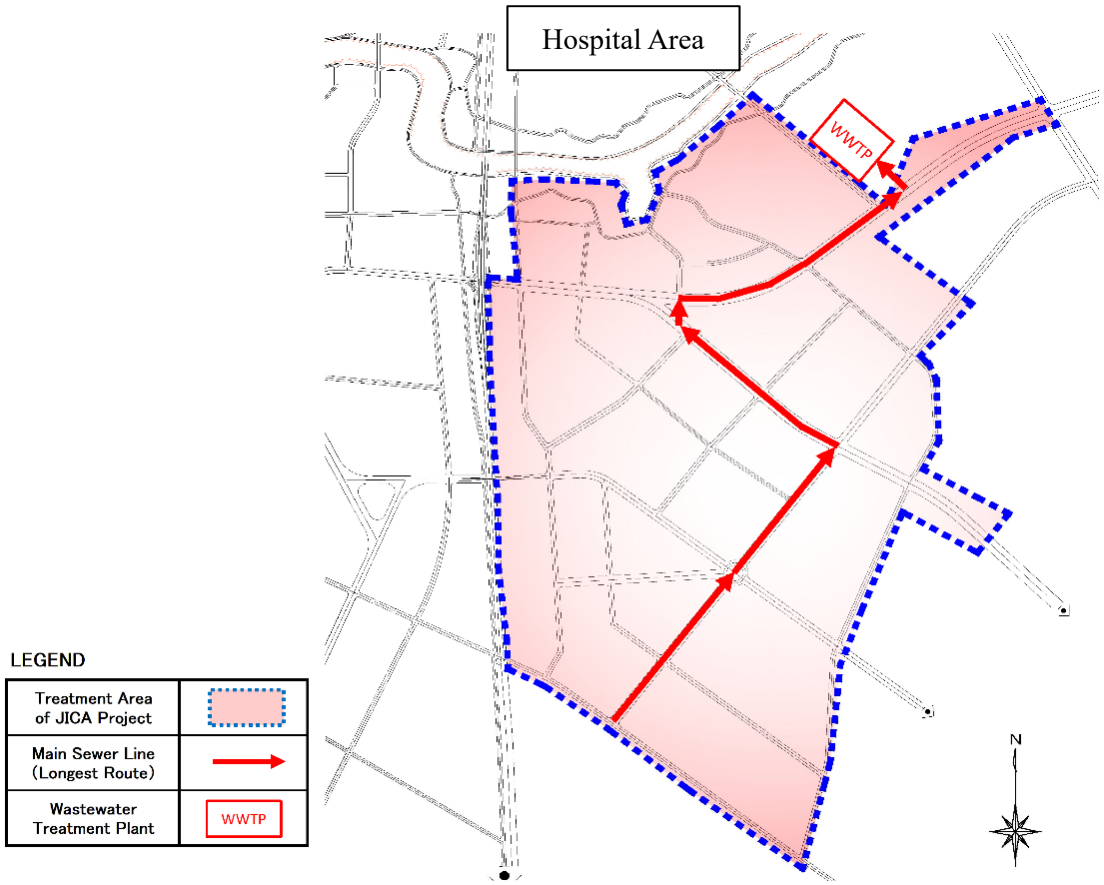
Use its best efforts to ensure that the assistance and exemption, as described in the Standard Request for Proposal issued by JICA, will be provided to the Consultant, in relation to

- Work permit and such other documents;
- Entry and exit visas, residence permits, exchange permits and such other documents;
- Clearance through customs;
- Instructions and information to officials, agent and representatives of the Borrower's Government;
- Exemption from any requirement for registration to practice their profession; and
- Privilege pursuant to the applicable law in the Borrower's Country.

Annex 1: Locations of the Road Project



Annex 2: Locations of the Sewerage Project



Annex 3: Required Engineering Surveys and Investigation (Sub-Contract)

(1) Sewerage Sector:

Sewerage Sector	Items	Unit	Quantities	Remarks
Topographic Survey	Wastewater Treatment Plant			
	1) Plan survey	m^2	250,000	500m x 500m, 1/1000
	2) Profile survey	m	12,500	500m x 25 pitch, 1/100
	3) Bench Mark	Nos	2	100m (20m intervals),1/500
	Pump station			
	1) Plan survey	m^2	30,000	100m x 100m x 3 points, 1/1000
	2) Profile survey	m	3,000	100m x 10 pitch x 3 points, 1/100
	3) Bench Mark	Nos	3	(One Point in each stations)
	Pipe line (main)			
	1) Plan Survey	m^2	2,000,000	Pipe Length 40km x 50m
	2) Profile survey	m	40,000	20m interval
	3) Cross Section	m	100,000	20m interval
	4) Benchmark	Nos	16	
Geological Survey	1) Drilling and sampling including Standard Penetration Test (SPT)_WWTP	m	150	5 points SPT: 150 nos Sampling : 5m interval
	2) Drilling and sampling including Standard Penetration Test (SPT)_Pump Station	m	600	12 points SPT: 600 nos Sampling : 5m interval
	2) Drilling and sampling including Standard Penetration Test (SPT)_Sewer	m	500	50 points (25km/500m) SPT: 500 nos Sampling : 5m interval
	1) Shear Strength Test	nos	250	-
	2) Atterbergs Limit	nos	250	-
	3) Unit Weight	nos	250	-
	4) Natural Moisture Content	nos	250	-
	5) Grain Size Distribution	nos	250	-
	6) Consolidation test	nos	250	-
	7) Uniaxial Compression test	nos	250	-
Report	Data Compilation/Encoding, Drawings and Report Preparation	L.S.	1	English and Vietnamese

(2) Road Sector:

Road Sector	Items	Unit	Quantities	Remarks
Topographic Survey	1) Plan survey	m^2	1,950,000	19,500m x 100m, 1/1000
	2) Profile survey	m	19,500	19,500m (20m intervals),1/500
	3) Cross Section survey	m	195,000	100m (20m intervals),1/500
	1) Plan survey	m^2	32,000	3,200m x 100m, 1/100
	2) Profile survey	m	3,200	3,200m (20m intervals),1/500
	3) Cross Section survey	m	16,000	100m (20m intervals),1/500
Geological Survey	1) Drilling and sampling including Standard Penetration Test (SPT)_Soil Layer: 45m	m	315	7 points (Flyover) SPT: 315 nos Sampling : 7 m interval
	2) Drilling and sampling including Standard Penetration Test (SPT)_Rock Layer: 5m	m	35	7 points (Flyover) SPT: 35 nos Sampling : 4m interval
	3) Drilling and sampling including Standard Penetration Test (SPT)_Soil Layer: 5m	m	750	150 points (Road Section) SPT: 750 nos Sampling : 5m interval
	1) Shear Strength Test	nos	304	-
	2) Atterbergs Limit	nos	304	-
	3) Unit Weight	nos	304	-
	4) Natural Moisture Content	nos	304	-
	5) Grain Size Distribution	nos	304	-
	6) Consolidation test	nos	304	-
	7) Uniaxial Compression test	nos	304	-
Report	Data Compilation/Encoding, Drawings and Report Preparation	L.S.	1	English and Vietnamese

Annex 4: EIA monitoring form and RAP monitoring form

MONITORING FORM for Sewerage Sector

-If environmental reviews indicate the need of monitoring by JICA, JICA undertakes monitoring for necessary items that are decided by environmental reviews. JICA undertakes monitoring based on regular reports including measured data submitted by the project proponent. When necessary, the project proponent should refer to the following monitoring form for submitting reports.

-When monitoring plans including monitoring items, frequencies and methods are decided, project phase or project life cycle (such as construction phase and operation phase) should be considered.

1. Responses/Actions to Comments and Guidance from Government Authorities and the Public

Monitoring Item	Monitoring Results during Report Period
EIA Status/ EIA Approval	
Information disclosure of EIA report	
Stakeholder's meeting	

2. Mitigation Measures

- Air Quality（Ambient Air Quality）

Item	Unit	Measured Value (Mean)	Measured Value (Max.)	Country's Standards	Remarks (Measurement Point, Frequency, Method, etc.)
Construction Phase					
CO	$\mu g/m^3$			-	**Measurement Point:** **K5 (Same location in EIA)** **Frequency:** **Every six months** **Method:** **Based on QCVN 05: 2013/BTNMT**
SO_2	$\mu g/m^3$			**125**	
NO_2	$\mu g/m^3$			**100**	
TSP	$\mu g/m^3$			**200**	
$PM_{2.5}$	$\mu g/m^3$			**50**	
CxHy	$\mu g/m^3$			**1500**	
Pb	$\mu g/m^3$			**1.5**	

- Water Quality（Wastewater）

Item	Unit	Measured Value (Mean)	Measured Value (Max.)	Country's Standards	Remarks (Measurement Point, Frequency, Method, etc.)
Construction Phase					
pH	-			**6 - 9**	**Measurement Point:** **Construction site** **Frequency:** **Every six months** **Method:** **Based on QCVN 40: 2011/BTNMT** **(Value C, Category A)**
Temperature	^0C			**40**	
Odor	-			**-**	
BOD_5	mg/l			**30**	
COD	mg/l			**75**	
TSS	mg/l			**50**	
Total Fe	mg/l			**1**	
Total Cu	mg/l			**2**	
As	mg/l			**0.05**	

Hg	mg/l			**0.005**	
Cd	mg/l			**0.05**	
Zn	mg/l			**3**	
Mn	mg/l			**0.5**	
Ammonia	mg/l			**5**	
Total N	mg/l			**20**	
Total P	mg/l			**4**	
Coliform	MPN /100 ml			**3000**	
Operation Phase					
pH	-			**5 - 9**	**Measurement Point:** **Sewage Treatment Facility** **Frequency:** **Every six months** **Method:** **Based on QCVN 14: 2008/BTNMT (Value C, Category A)**
BOD_5	mg/l			**30**	
TSS	mg/l			**50**	
TDS	mg/l			**500**	
Sulfide (H_2S)	mg/l			**1.0**	
Ammonia	mg/l			**5**	
Nitrate (NO_3)	mg/l			**30**	
Animal fat and vegetable grease	mg/l			**10**	
Total surface-active substances	mg/l			**5**	
PO_4	mg/l			**6**	
Total Coliform	MPN /100 ml			**3000**	

- Water Quality（Ambient Water Quality）

Item	Unit	Measured Value (Mean)	Measured Value (Max.)	Country's Standards	Remarks (Measurement Point, Frequency, Method, etc.)
Construction Phase					
pH	-			**5.5-9**	**Measurement Point:** **NM5 (Same location in EIA)** **Frequency:** **Every six months** **Method:** **Based on QCVN 08-MT: 2015/BTNMT (Column B1)**
BOD_5 (20°C) (*)	mg/l			**15**	
Temperature	^0C			**-**	
DO	mg/l			**≥4**	
EC	mS/cm			**-**	
Color	Pt-Co			**-**	
TSS	mg/l			**50**	
COD	mg/l			**30**	
Cl^-	mg/l			**350**	
NO_2^-	mg/l			**0.05**	
NO_3^-	mg/l			**10**	
Fe	mg/l			**1.5**	
Pb	mg/l			**0.05**	
Zn	mg/l			**1.5**	
As	mg/l			**0.05**	
Toal N	mg/l			**-**	
Total P	mg/l			**-**	
Detergent	mg/l			**0.4**	

/surfactant					
oil and grease	mg/l			**1**	
Coliform	MPN /100 ml			**7500**	
Operation Phase					
pH	-			**5.5-9**	**Measurement Point:** **NM5 (Same location in EIA)** **Frequency:** **Every six months** **Method:** **Based on QCVN 08-MT: 2015/BTNMT (Column B1)**
BOD_5 (20°C) (*)	mg/l			**15**	
Temperature	^0C			**-**	
DO	mg/l			**≥4**	
EC	mS/cm			**-**	
Color	Pt-Co			**-**	
TSS	mg/l			**50**	
COD	mg/l			**30**	
Cl^-	mg/l			**350**	
NO_2^-	mg/l			**0.05**	
NO_3^-	mg/l			**10**	
Fe	mg/l			**1.5**	
Pb	mg/l			**0.05**	
Zn	mg/l			**1.5**	
As	mg/l			**0.05**	
Toal N	mg/l			**-**	
Total P	mg/l			**-**	
Detergent /surfactant	mg/l			**0.4**	
oil and grease	mg/l			**1**	
Coliform	MPN /100 ml			**7500**	

- Waste

Monitoring Item	Monitoring Results during Report Period
Waste management and treatment situation (Amount of Waste and record of treatment)	The waste management Report for once a month.

- Waste (Sludge)

Item	Unit	Measured Value (Mean)	Measured Value (Max.)	Country's Standards	Remarks (Measurement Point, Frequency, Method, etc.)
Operation Phase					
Volume	kg			-	**Measurement Point: Sewage Treatment Facility Frequency: Every six months Method: Based on QCVN 50 -MT: 2015/BTNMT**
Cu	mg/kg			**300**	
As	mg/kg			**25**	
Zn	mg/kg			**300**	
Pb	mg/kg			**300**	
Cd	mg/kg			**10**	
Cr	mg/kg			**250**	

- Noise / Vibration

Item	Unit	Measured Value (Mean)	Measured Value (Max.)	Country's Standards	Remarks (Measurement Point, Frequency, Method, etc.)
Construction Phase					
Noise level	dBA			**Time:6～21 75 Time:21～6 55**	**Measurement Point: K5 (Same location in EIA) Frequency: Every six months Method: Based on QCVN 26: 2010/BTNMT, QCVN 27: 2010/BTNMT**
Vibration level	dB			**Time:6～21 75 Time:21～6 Background Level**	

3. Natural Environment

Since significant impact on natural environment does not occur by the project, the monitoring is not performed.

- Ecosystem

Monitoring Item	Monitoring Results during Report Period
Nothing	

4. Social Environment

Name of person in charge and filling this monitoring form:_____
Date of filling this monitoring form:_____

A. Public Consultations

No.	Date	Place	Contents of the consultation / main comments and answers
1			
2			
3			
4			
5			
6			

B. Resettlement/Land Acquisitions

Activities	Planned Total	Unit	Progress in Quantity			Progress in %		Expected Date of Completion	Responsible Organizations
			During the Quarter	Till the Last Quarter	Up to the Quarter	Till the Last Quarter	Up to the Quarter		
Approval of A-RAP									
Approval of policy framework of compensation, assistance and resettlement									
Approval of Investment Policy									
Budget securing for resettlement activities									
Approval of Project Investment Decision									
Land acquisition declaration by Ha Nam PPC									
Approval of plan of compensation, assistance and resettlement									
Contract with External Monitoring Agency		MM							
Establishment of necessary organizations									
Income Restoration Program (IRP) preparation									
Income Restoration Program (IRP) implementation									
Detailed Measurement Survey (DMS)									
Finalization of PAPs List based on DMS		Number of PAPs							
Calculation of compensation amount									
Negotiation and compensation		**Number of PAPs**							
Lot 1		Number of PAPs							

Lot 2		Number of PAPs							
Lot 3		Number of PAPs							
Grievance Redress	**-**	**Number of cases**							
Lot 1	-	Number of cases							
Lot 2	-	Number of cases							
Lot 3	-	Number of cases							
Site clearance		**Number of cases**							
Lot 1		Number of cases							
Lot 2		Number of cases							
Lot 3		Number of cases							

C. Poverty

Monitoring Item	Monitoring Results during Report Period
- Poverty Line under MOLISA (Decision No. 59/2015/QĐ-TTg, dated 19/11/2015, promulgating multidimensional poverty levels applicable during 2016-2020 for every 6 months.	

D. Working Environment

Monitoring Item	Monitoring Results during Report Period
- Labors Working Environment Situations (Number of industrial diseases such as water-borne diseases of the Operators in the Project Sites) for every 6 months.	

E. Accidents

Monitoring Item	Monitoring Results during Report Period
- Project related Accident Situations (Number of Traffic Accidents or Industrial Accidents in the Project Area) for every 6 months.	

MONITORING FORM for Road Sector

-If environmental reviews indicate the need of monitoring by JICA, JICA undertakes monitoring for necessary items that are decided by environmental reviews. JICA undertakes monitoring based on regular reports including measured data submitted by the project proponent. When necessary, the project proponent should refer to the following monitoring form for submitting reports.

-When monitoring plans including monitoring items, frequencies and methods are decided, project phase or project life cycle (such as construction phase and operation phase) should be considered.

1. Responses/Actions to Comments and Guidance from Government Authorities and the Public

Monitoring Item	Monitoring Results during Report Period
EIA Status/ EIA Approval	
Information disclosure of EIA report	
Stakeholder's meeting	

2. Mitigation Measures

- Air Quality（Ambient Air Quality）

Item	Unit	Measured Value (Mean)	Measured Value (Max.)	Country's Standards	Remarks (Measurement Point, Frequency, Method, etc.)
Construction Phase					
CO	$\mu g/m^3$			-	**Measurement Point: K6, K7, K14 (Same location in EIA) Frequency: Every six months Method: Based on QCVN 05: 2013/BTNMT**
SO_2	$\mu g/m^3$			**125**	
NO_2	$\mu g/m^3$			**100**	
TSP	$\mu g/m^3$			**200**	
$PM_{2.5}$	$\mu g/m^3$			**50**	
CxHy	$\mu g/m^3$			**1500**	
Pb	$\mu g/m^3$			**1.5**	
Operation Phase					
CO	$\mu g/m^3$			-	**Measurement Point: K6, K7, K14 (Same location in EIA) Frequency: Every six months Method: Based on QCVN 05: 2013/BTNMT**
SO_2	$\mu g/m^3$			**125**	
NO_2	$\mu g/m^3$			**100**	
TSP	$\mu g/m^3$			**200**	
$PM_{2.5}$	$\mu g/m^3$			**50**	
CxHy	$\mu g/m^3$			**1500**	
Pb	$\mu g/m^3$			**1.5**	

- Waste

Monitoring Item	Monitoring Results during Report Period
Waste management and treatment situation (Amount of Waste and record of treatment)	The waste management Report for once a month during construction.

- Noise / Vibration

Item	Unit	Measured Value (Mean)	Measured Value (Max.)	Country's Standards	Remarks (Measurement Point, Frequency, Method, etc.)
Construction Phase					
Noise level	dBA			**Time:6～21 75 Time:21～6 55**	**Measurement Point: K6, K7, K14 (Same location in EIA) Frequency: Every six months Method: Based on QCVN 26: 2010/BTNMT, QCVN 27: 2010/BTNMT**
Vibration level	dB			**Time:6～21 75 Time:21～6 Background Level**	
Operation Phase					
Noise level	dBA			**Time:6～21 75 Time:21～6 55**	**Measurement Point: K6, K7, K14 (Same location in EIA) Frequency: Every six months Method: Based on QCVN 26: 2010/BTNMT, QCVN 27: 2010/BTNMT**
Vibration level	dB			**Time:6～21 75 Time:21～6 Background Level**	

3. Natural Environment

Since significant impact on natural environment does not occur by the project, the monitoring is not performed.

- Ecosystem

Monitoring Item	Monitoring Results during Report Period
Nothing	

4. Social Environment

Name of person in charge and filling this monitoring form:_____
Date of filling this monitoring form:_____

A. Public Consultations

No.	Date	Place	Contents of the consultation / main comments and answers
1			
2			
3			
4			
5			
6			

B. Land Acquisitions Activities

Activities	Planned Total	Unit	Progress in Quantity			Progress in %		Expected Date of Completion	Responsible Organizations
			During the Quarter	Till the Last Quarter	Up to the Quarter	Till the Last Quarter	Up to the Quarter		
Approval of A-RAP									
Approval of policy framework of compensation, assistance and resettlement									
Approval of Investment Policy									
Budget securing for resettlement activities									
Approval of Project Investment Decision									
Land acquisition declaration by Ha Nam PPC									
Approval of plan of compensation, assistance and resettlement									
Contract with External Monitoring Agency		MM							
Establishment of necessary organizations									
Income Restoration Program (IRP) preparation									
Income Restoration Program (IRP) implementation									
Detailed Measurement Survey (DMS)									
Finalization of PAPs List based on DMS		Number of PAPs							
Calculation of compensation amount									
Negotiation and compensation		**Number of PAPs**							
Lot 1		Number of PAPs							

Lot 2		Number of PAPs							
Lot 3		Number of PAPs							
Grievance Redress	**-**	**Number of cases**							
Lot 1	-	Number of cases							
Lot 2	-	Number of cases							
Lot 3	-	Number of cases							
Site clearance		**Number of cases**							
Lot 1		Number of cases							
Lot 2		Number of cases							
Lot 3		Number of cases							

C. Poverty

Monitoring Item	Monitoring Results during Report Period
- Poverty Line under MOLISA (Decision No. 59/2015/QĐ-TTg, dated 19/11/2015, promulgating multidimensional poverty levels applicable during 2016-2020.for every 6 months	

D. Working Environment

Monitoring Item	Monitoring Results during Report Period
Labors Working Environment Situations (Number of Industrial Diseases such as Respiratory Disease of the Operators in the Project Sites). for every 6 months	

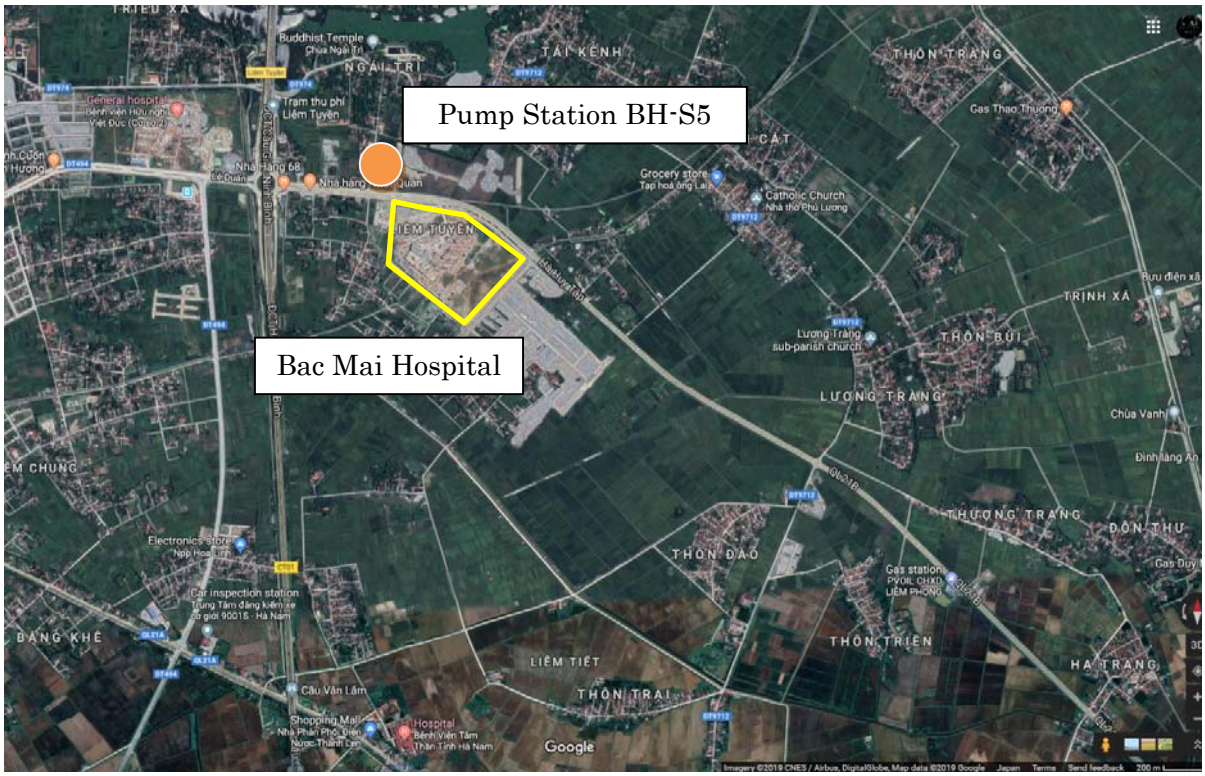
E. Accidents

Monitoring Item	Monitoring Results during Report Period
- Project related Accident Situations (Number of Traffic Accidents or Industrial Accidents in the Project Area) for every 6 months	

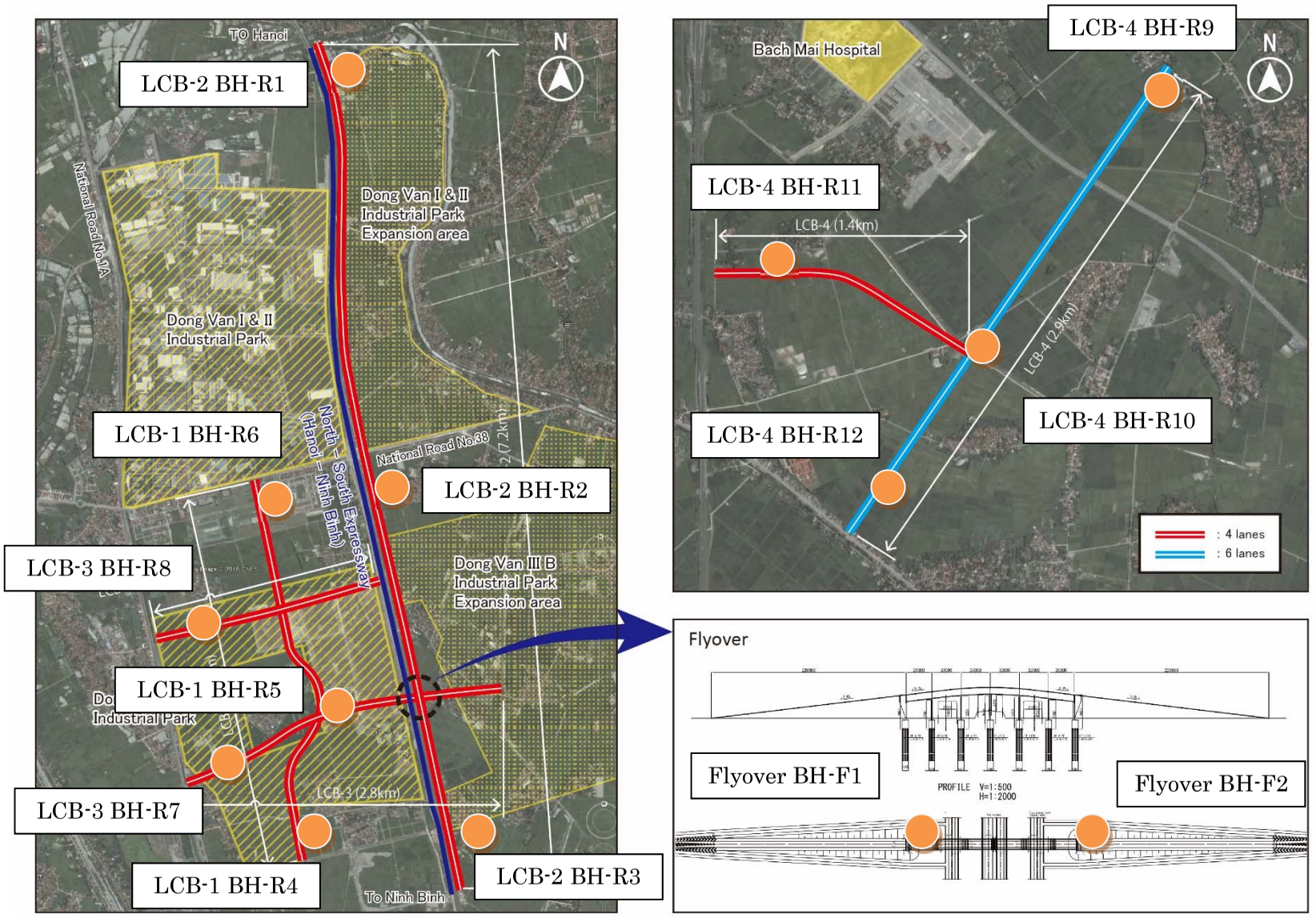
APPENDIX5:
GEOLOGICAL INVESTIGATION SURVEY RESULT

1. Location of Geological Investigation Survey

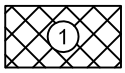
1) Pump Station



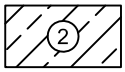
2) Flyover and LCB-1 to LCB-4



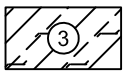
CONVENTIONAL SIGNS



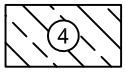
Đất san lấp



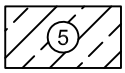
Sét pha màu xám vàng, xám ghi, xám nâu, trạng thái dẻo mềm.



Bùn sét pha màu xám ghi, xám đen. Đôi chỗ xen kẹp cát pha, chứa tàn tích mùn thực vật.



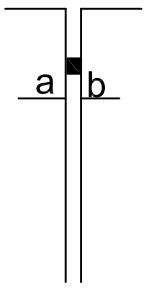
Sét pha kẹp cát pha, màu xám ghi, xám nâu, trạng thái dẻo chảy.



Sét pha màu xám nâu, xám ghi, trạng thái dẻo mềm.

Ranh giới địa chất xác định/ Supposed Boundary

Ranh giới địa chất giả định/ Definite Boundary



■ Vị trí lấy mẫu đất thí nghiệm (M: mẫu thí nghiệm; L: mẫu lưu).
Location of sample test

a: Cao độ ranh giới lớp đất/ *Elevation of layer*

b: Độ sâu ranh giới lớp đất/ Depth of layer

BOREHOLE LOG

Sheet: 1/1

PROJECT: TĂNG CƯỜNG MÔI TRƯỜNG ĐẦU TƯ HÀ NAM
LOCATION: STATION 5 - LIÊM TUYỀN - PHỦ LÝ - HÀ NAM
BOREHOLE ID: BH-S5 COORDINATE BH X: GROUND WATER LEVEL (M): 1.00M
ELEVATION OF BOREHOLE (M): 0.00 Y: STARTED DATE: 07/11/2016
DESCRIBER: NGUYỄN VĂN QUẢNG DEPTH: 30.00M COMPLETED DATE: 08/11/2016

Symbol of layer	Level of layer bottom	Depth of layer bottom	Thickness of layer	STRATUM COLUMN SCALE 1/150	Number of sample / Depth of sample (m)	SPT TEST: Depth (m)	Number of blows /15 cm: N1	N2	N3	N_{SPT} (N_2+N_3)	N_{SPT} Diagram (0 10 20 30 40 50)	STRATUM DESCRIPTION
1	-0.60	0.60	0.60									Đất san lấp
2	-1.50	1.50	0.90		UD1 1.0-1.2	1.20 / 1.65	2	2	3	5		Sét pha màu xám vàng, xám ghi, xám nâu, trạng thái dẻo mềm.
3	-23.00	23.00	21.50		UD2 5.0-5.2 UD3 10.0-10.2 UD4 16.0-16.2 UD5 23.0-23.2	2.20 / 2.65	0	0	1	1		Bùn sét pha màu xám ghi, xám đen. Đôi chỗ xen kẹp cát pha, chứa tàn tích mùn thực vật.
						3.20 / 3.65	1	1	1	2		
						4.20 / 4.65	1	1	1	2		
						5.20 / 5.65	1	1	2	3		
						6.20 / 6.65	2	2	2	4		
						7.20 / 7.65	1	1	2	3		
						8.20 / 8.65	2	2	3	5		
						9.20 / 9.65	1	1	2	3		
						10.20 / 10.65	2	2	3	5		
						11.20 / 11.65	2	3	3	6		
						12.20 / 12.65	1	1	2	3		
						13.20 / 13.65	2	2	2	4		
						14.20 / 14.65	2	2	3	5		
						15.20 / 15.65	1	2	2	4		
						16.20 / 16.65	2	3	3	6		
						17.20 / 17.65	1	1	2	3		
						18.20 / 18.65	2	3	3	6		
						19.20 / 19.65	2	3	4	7		
						20.20 / 20.65	2	2	2	4		
						21.20 / 21.65	2	2	3	5		
						22.20 / 22.65	2	3	3	6		
4	-27.20	27.20	4.20			23.20 / 23.65	3	3	4	7		Sét pha kẹp cát pha, màu xám ghi, xám nâu, trạng thái dẻo chảy.
						24.20 / 24.65	3	3	5	8		
						25.20 / 25.65	2	2	3	5		
						26.20 / 26.65	2	3	3	6		
5	-30.00	30.00	2.80		UD6 29.0-29.2	27.20 / 27.65	3	3	4	7		Sét pha màu xám nâu, xám ghi, trạng thái dẻo mềm.
						28.20 / 28.65	3	3	5	8		
						29.20 / 29.65	3	5	5	10		

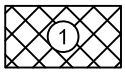
REMARKS : UD: Undisturbed sample
D: Disturbed sample
R: Rock sample

▮ Test Sample
● Save Sample

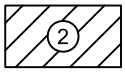
ICC

DRAWING

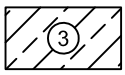
CONVENTIONAL SIGNS



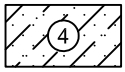
Đất đắp nền đường/ Embankment



Sét màu xám vàng, xám ghi, trạng thái dẻo mềm/ Yellowish grey, light grey, medium stiff, Clay



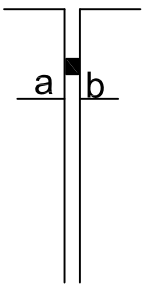
Sét pha màu xám ghi, xám nâu, trạng thái dẻo chảy.



Cát pha kẹp cát, sét pha màu xám nâu, xám ghi, trạng thái dẻo.

Ranh giới địa chất xác định Supposed Boundary

Ranh giới địa chất giả định Definite Boundary



■ Vị trí lấy mẫu đất thí nghiệm (M: mẫu thí nghiệm; L: mẫu lưu).
Location of sample test

a: Cao độ ranh giới lớp đất/ *Elevation of layer*

b: Độ sâu ranh giới lớp đất/ Depth of layer

BOREHOLE LOG

Sheet: 1/1

PROJECT: TĂNG CƯỜNG MÔI TRƯỜNG ĐẦU TƯ HÀ NAM
LOCATION: ROAD - LCB1
BOREHOLE ID: BH-R4
ELEVATION OF BOREHOLE (M): 0.00
DESCRIBER: NGUYỄN VĂN THAO

COORDINATE BH X: ____ Y: ____
DEPTH: 5.00M

GROUND WATER LEVEL (M): 1.00M
STARTED DATE: 04/11/2016
COMPLETED DATE: 04/11/2016

Symbol of layer	Level of layer bottom	Depth of layer bottom	Thickness of layer	STRATUM COLUMN SCALE 1/100	Number of sample / Depth of sample (m)	SPT TEST: Depth (m)	Number of blows /15 cm: N1	N2	N3	N_{SPT} (N_2+N_3)	N_{SPT} Diagram (0 4 8 12 16 20)	STRATUM DESCRIPTION
1	-1.00	1.00	1.00									Đất đắp nền đường
2	-2.40	2.40	1.40		UD1 1.5-1.7	1.70 / 2.15	2	3	4	7		Sét màu xám vàng, xám ghi, xám nâu, trạng thái dẻo mềm.
3	-5.00	5.00	2.60		UD2 2.5-2.7	2.70 / 3.15	1	1	1	2		Sét pha màu xám ghi, xám nâu, trạng thái dẻo chảy.
					UD3 3.5-3.7	3.70 / 4.15	1	1	2	3		
					UD4 4.5-4.7	4.70 / 5.15	1	1	1	2		

PROJECT: TĂNG CƯỜNG MÔI TRƯỜNG ĐẦU TƯ HÀ NAM
LOCATION: ROAD - LCB1
BOREHOLE ID: BH-R5
ELEVATION OF BOREHOLE (M): 0.00
DESCRIBER: NGUYỄN VĂN THAO

COORDINATE BH X: ____ Y: ____
DEPTH: 5.00M

GROUND WATER LEVEL (M): 0.90M
STARTED DATE: 04/11/2016
COMPLETED DATE: 04/11/2016

Symbol of layer	Level of layer bottom	Depth of layer bottom	Thickness of layer	STRATUM COLUMN SCALE 1/100	Number of sample / Depth of sample (m)	SPT TEST: Depth (m)	Number of blows /15 cm: N1	N2	N3	N_{SPT} (N_2+N_3)	N_{SPT} Diagram (0 4 8 12 16 20)	STRATUM DESCRIPTION
1	-0.80	0.80	0.80									Đất đắp nền đường
2	-2.20	2.20	1.40		UD1 1.0-1.2	1.20 / 1.65	2	2	3	5		Sét màu xám vàng, xám ghi, trạng thái dẻo mềm.
3	-5.00	5.00	2.80		UD2 2.0-2.2	2.20 / 2.65	1	2	2	4		Sét pha màu xám ghi, xám nâu, trạng thái dẻo chảy.
					UD3 3.0-3.2	3.20 / 3.65	1	1	1	2		
					UD4 4.0-4.2	4.20 / 4.65	0	1	1	2		
					UD5 4.8-5.0	5.00 / 5.45	1	1	2	3		

REMARKS : UD: Undisturbed sample
D: Disturbed sample
R: Rock sample

▮ Test Sample
● Save Sample

ICC

DRAWING

BOREHOLE LOG

Sheet: 1/1

PROJECT: TĂNG CƯỜNG MÔI TRƯỜNG ĐẦU TƯ HÀ NAM
LOCATION: ROAD - LCB1
BOREHOLE ID: BH-R6 COORDINATE BH X: GROUND WATER LEVEL (M): 0.80M
ELEVATION OF BOREHOLE (M): 0.00 Y: STARTED DATE: 04/11/2016
DESCRIBER: NGUYỄN VĂN THAO DEPTH: 5.00M COMPLETED DATE: 04/11/2016

Symbol of layer	Level of layer bottom	Depth of layer bottom	Thickness of layer	STRATUM COLUMN SCALE 1/100	Number of sample / Depth of sample (m)	SPT TEST: Depth (m)	Number of blows /15 cm: N1	N2	N3	N_{SPT} (N_2+N_3)	N_{SPT} Diagram (0 4 8 12 16 20)	STRATUM DESCRIPTION
1	-1.30	1.30	1.30									Đất san lấp: Cát hạt mịn, xám ghi, xám nâu.
2	-2.00	2.00	0.70		UD1 1.4-1.6	1.60 / 2.05	2	3	3	6		Sét màu xám vàng, xám ghi, xám nâu, trạng thái dẻo mềm.
3	-3.10	3.10	1.10		UD2 2.4-2.6	2.60 / 3.05	1	1	2	3		Sét pha màu xám ghi, xám nâu, trạng thái dẻo chảy.
4	-5.00	5.00	1.90		UD3 3.4-3.6	3.60 / 4.05	2	3	4	7		Cát pha kẹp cát, sét pha màu xám nâu, xám ghi, trạng thái dẻo.
					UD4 4.4-4.6	4.60 / 5.05	3	4	4	8		

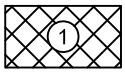
REMARKS : UD: Undisturbed sample
D: Disturbed sample
R: Rock sample

Test Sample
Save Sample

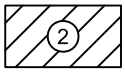
ICC

DRAWING

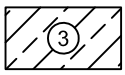
CONVENTIONAL SIGNS



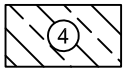
Đất đắp nền đường/ Embankment



Sét màu xám vàng, xám ghi, trạng thái dẻo mềm/ Yellowish grey, light grey, medium stiff, Clay



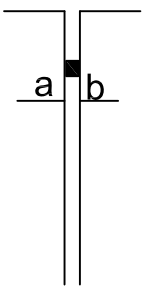
Sét pha màu xám ghi, xám đen, trạng thái dẻo chảy.



Sét pha màu xám ghi, xám gụ, lẫn rễ thực vật, trạng thái chảy/ Light grey, grey, very soft, Silty clay with plant roots

Ranh giới địa chất xác định Supposed Boundary

Ranh giới địa chất giả định Definite Boundary



■ Vị trí lấy mẫu đất thí nghiệm (M: mẫu thí nghiệm; L: mẫu lưu).
Location of sample test

a: Cao độ ranh giới lớp đất/ *Elevation of layer*

b: Độ sâu ranh giới lớp đất/ Depth of layer

BOREHOLE LOG

Sheet: 1/1

PROJECT: TĂNG CƯỜNG MÔI TRƯỜNG ĐẦU TƯ HÀ NAM
LOCATION: ROAD - LCB2
BOREHOLE ID: BH-R1 COORDINATE BH X: Y:
ELEVATION OF BOREHOLE (M): 0.00
DESCRIBER: NGUYỄN VĂN THAO DEPTH: 5.00M
GROUND WATER LEVEL (M): 1.00M
STARTED DATE: 03/11/2016
COMPLETED DATE: 03/11/2016

Symbol of layer	Level of layer bottom	Depth of layer bottom	Thickness of layer	STRATUM COLUMN SCALE 1/100	Number of sample / Depth of sample (m)	SPT TEST: Depth (m)	Number of blows /15 cm: N1	N2	N3	N_{SPT} (N_2+N_3)	N_{SPT} Diagram	STRATUM DESCRIPTION
1	-1.00	1.00	1.00									Đất đắp nền đường
2	-2.60	2.60	1.60		UD1 1.1-1.3	1.30 / 1.75	2	3	4	7		Sét màu xám vàng, xám ghi, xám nâu, trạng thái dẻo mềm.
					UD2 2.0-2.2	2.20 / 2.65	2	2	3	5		
4	-5.00	5.00	2.40		UD3 3.0-3.2	3.20 / 3.65	0	1	1	2		Sét pha màu xám ghi, xám gụ, lẫn rễ thực vật, trạng thái chảy.
					UD4 4.0-4.2	4.20 / 4.65	1	1	2	3		
					UD5 4.8-5.0	5.00 / 5.45	1	1	2	3		

PROJECT: TĂNG CƯỜNG MÔI TRƯỜNG ĐẦU TƯ HÀ NAM
LOCATION: ROAD - LCB2
BOREHOLE ID: BH-R2 COORDINATE BH X: Y:
ELEVATION OF BOREHOLE (M): 0.00
DESCRIBER: NGUYỄN VĂN THAO DEPTH: 5.00M
GROUND WATER LEVEL (M): 1.00M
STARTED DATE: 03/11/2016
COMPLETED DATE: 03/11/2016

Symbol of layer	Level of layer bottom	Depth of layer bottom	Thickness of layer	STRATUM COLUMN SCALE 1/100	Number of sample / Depth of sample (m)	SPT TEST: Depth (m)	Number of blows /15 cm: N1	N2	N3	N_{SPT} (N_2+N_3)	N_{SPT} Diagram	STRATUM DESCRIPTION
1	-0.90	0.90	0.90									Đất đắp nền đường
2	-1.80	1.80	0.90		UD1 1.0-1.2	1.20 / 1.65	2	2	3	5		Sét màu xám vàng, xám ghi, trạng thái dẻo mềm.
3	-3.00	3.00	1.20		UD2 2.0-2.2	2.20 / 2.65	1	1	2	3		Sét pha màu xám ghi, xám đen, trạng thái dẻo chảy.
					UD3 3.0-3.2	3.20 / 3.65	0	1	1	2		
4	-5.00	5.00	2.00		UD4 4.0-4.2	4.20 / 4.65	1	1	2	3		Sét pha màu xám ghi, xám gụ, lẫn rễ thực vật, trạng thái chảy.
					UD5 4.7-4.9	4.90 / 5.35	1	2	2	4		

REMARKS : UD: Undisturbed sample
D: Disturbed sample
R: Rock sample

Test Sample
Save Sample

ICC

DRAWING

BOREHOLE LOG

Sheet: 1/1

PROJECT: TĂNG CƯỜNG MÔI TRƯỜNG ĐẦU TƯ HÀ NAM
LOCATION: ROAD - LCB2
BOREHOLE ID: BH-R3 COORDINATE BH X: Y:
ELEVATION OF BOREHOLE (M): 0.00
DESCRIBER: NGUYỄN VĂN THAO DEPTH: 5.00M
GROUND WATER LEVEL (M): 0.80M
STARTED DATE: 03/11/2016
COMPLETED DATE: 03/11/2016

Symbol of layer	Level of layer bottom	Depth of layer bottom	Thickness of layer	STRATUM COLUMN SCALE 1/100	Number of sample / Depth of sample (m)	SPT TEST: Depth (m)	Number of blows /15 cm: N1	N2	N3	N_{SPT} (N_2+N_3)	N_{SPT} Diagram (0 4 8 12 16 20)	STRATUM DESCRIPTION
1	-0.90	0.90	0.90									Đất đắp nền đường
2	-2.00	2.00	1.10		UD1 1.0-1.2	1.20 / 1.65	2	3	3	6		Sét màu xám vàng, xám ghi, xám nâu, trạng thái dẻo mềm.
3	-3.30	3.30	1.30		UD2 2.0-2.2	2.20 / 2.65	1	1	2	3		Sét pha màu xám ghi, xám gụ, trạng thái dẻo chảy.
4	-5.00	5.00	1.70		UD3 3.0-3.2	3.20 / 3.65	0	0	1	1		Sét pha xen kẹp cát pha, màu xám ghi, xám đen, trạng thái chảy.
					UD4 4.0-4.2	4.20 / 4.65	1	1	2	3		
					UD5 4.8-5.0	5.00 / 5.45	2	2	3	5		

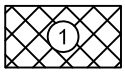
REMARKS : UD: Undisturbed sample
D: Disturbed sample
R: Rock sample

Test Sample
Save Sample

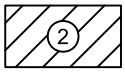
ICC

DRAWING

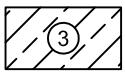
CONVENTIONAL SIGNS



Đất đắp nền đường/ Embankment



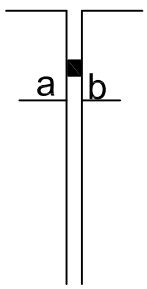
Sét màu xám vàng, xám ghi, trạng thái dẻo mềm/ Yellowish grey, light grey, medium stiff, Clay



Sét pha màu xám ghi, xám nâu, trạng thái dẻo chảy - chảy.

Ranh giới địa chất xác định/ Supposed Boundary

Ranh giới địa chất giả định/ Definite Boundary



■ Vị trí lấy mẫu đất thí nghiệm (M: mẫu thí nghiệm; L: mẫu lưu).
Location of sample test

a: Cao độ ranh giới lớp đất/ *Elevation of layer*

b: Độ sâu ranh giới lớp đất/ Depth of layer

BOREHOLE LOG

Sheet: 1/1

PROJECT: TĂNG CƯỜNG MÔI TRƯỜNG ĐẦU TƯ HÀ NAM
LOCATION: ROAD - LCB7
BOREHOLE ID: BH-R1 COORDINATE BH X: Y:
ELEVATION OF BOREHOLE (M): 0.00
DESCRIBER: NGUYỄN VĂN THAO DEPTH: 5.00M

GROUND WATER LEVEL (M): 0.80M
STARTED DATE: 05/11/2016
COMPLETED DATE: 05/11/2016

Symbol of layer	Level of layer bottom	Depth of layer bottom	Thickness of layer	STRATUM COLUMN SCALE 1/100	Number of sample / Depth of sample (m)	SPT TEST: Depth (m)	Number of blows /15 cm: N1	N2	N3	N_{SPT} (N_2+N_3)	N_{SPT} Diagram (0 4 8 12 16 20)	STRATUM DESCRIPTION
1	-0.60	0.60	0.60									Đất đắp bờ ruộng
2	-2.50	2.50	1.90		UD1 0.8-1.0 UD2 1.8-2.0	1.00 / 1.45 2.00 / 2.45	2 2	3 2	4 3	7 5		Sét màu xám vàng, xám ghi, xám nâu, trạng thái dẻo mềm.
3	-5.00	5.00	2.50		UD3 2.8-3.0 UD4 3.8-4.0 UD5 4.8-5.0	3.00 / 3.45 4.00 / 4.45 5.00 / 5.45	1 1 1	1 2 1	1 2 2	2 4 3		Sét pha màu xám ghi, xám nâu, trạng thái dẻo chảy - chảy.

PROJECT: TĂNG CƯỜNG MÔI TRƯỜNG ĐẦU TƯ HÀ NAM
LOCATION: ROAD - LCB3
BOREHOLE ID: BH-R8 COORDINATE BH X: Y:
ELEVATION OF BOREHOLE (M): 0.00
DESCRIBER: NGUYỄN VĂN THAO DEPTH: 5.00M

GROUND WATER LEVEL (M): 1.00M
STARTED DATE: 05/11/2016
COMPLETED DATE: 05/11/2016

Symbol of layer	Level of layer bottom	Depth of layer bottom	Thickness of layer	STRATUM COLUMN SCALE 1/100	Number of sample / Depth of sample (m)	SPT TEST: Depth (m)	Number of blows /15 cm: N1	N2	N3	N_{SPT} (N_2+N_3)	N_{SPT} Diagram (0 4 8 12 16 20)	STRATUM DESCRIPTION
1	-0.80	0.80	0.80									Đất đắp bờ ruộng
2	-2.40	2.40	1.60		UD1 1.0-1.2 UD2 2.0-2.2	1.20 / 1.65 2.20 / 2.65	1 2	2 2	3 2	5 4		Sét màu xám vàng, xám ghi, trạng thái dẻo mềm.
3	-5.00	5.00	2.60		UD3 3.0-3.2 UD4 4.0-4.2 UD5 4.8-5.0	3.20 / 3.65 4.20 / 4.65 5.00 / 5.45	1 0 1	1 1 1	1 1 2	2 2 3		Sét pha màu xám ghi, xám nâu, trạng thái dẻo chảy - chảy.

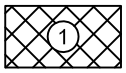
REMARKS : UD: Undisturbed sample
D: Disturbed sample
R: Rock sample

Test Sample
Save Sample

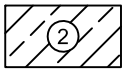
ICC

DRAWING

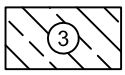
CONVENTIONAL SIGNS



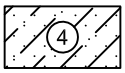
Đất đắp nền đường/ Embankment



Sét màu xám vàng, xám ghi, trạng thái dẻo mềm/ Yellowish grey, light grey, medium stiff, Clay



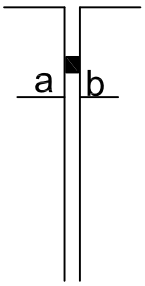
Sét pha màu xám ghi, xám nâu, trạng thái dẻo chảy - chảy.



Sét pha kẹp các ổ cát pha màu xám ghi, xám đen, trạng thái dẻo chảy.

Ranh giới địa chất xác định/ Supposed Boundary

Ranh giới địa chất giả định/ Definite Boundary



■ Vị trí lấy mẫu đất thí nghiệm (M: mẫu thí nghiệm; L: mẫu lưu).
Location of sample test

a: Cao độ ranh giới lớp đất/ *Elevation of layer*

b: Độ sâu ranh giới lớp đất/ Depth of layer

BOREHOLE LOG

Sheet: 1/1

PROJECT: TĂNG CƯỜNG MÔI TRƯỜNG ĐẦU TƯ HÀ NAM
LOCATION: ROAD - LCB4
BOREHOLE ID: BH-R9 COORDINATE BH X: Y: GROUND WATER LEVEL (M): 0.50M
ELEVATION OF BOREHOLE (M): 0.00 STARTED DATE: 06/11/2016
DESCRIBER: NGUYỄN VĂN THAO DEPTH: 5.00M COMPLETED DATE: 06/11/2016

Symbol of layer	Level of layer bottom	Depth of layer bottom	Thickness of layer	STRATUM COLUMN SCALE 1/100	Number of sample / Depth of sample (m)	SPT TEST: Depth (m)	Number of blows /15 cm: N1	N2	N3	N_{SPT} (N_2+N_3)	N_{SPT} Diagram (0 4 8 12 16 20)	STRATUM DESCRIPTION
1	-0.30	0.30	0.30									Đất ruộng canh tác.
2	-2.10	2.10	1.80		UD1 0.7-0.9 UD2 1.7-1.9	0.90 / 1.35 1.90 / 2.35	2 2	2 2	3 2	5 4		Sét pha màu xám nâu, xám ghi, trạng thái dẻo mềm.
3	-5.00	5.00	2.90		UD3 2.7-2.9 UD4 3.7-3.9 UD5 4.7-4.9	2.90 / 3.35 3.90 / 4.35 4.90 / 5.35	1 0 1	1 1 1	2 1 1	3 2 2		Sét pha màu xám ghi, xám nâu, trạng thái dẻo chảy - chảy.

PROJECT: TĂNG CƯỜNG MÔI TRƯỜNG ĐẦU TƯ HÀ NAM
LOCATION: ROAD - LCB4
BOREHOLE ID: BH-R10 COORDINATE BH X: Y: GROUND WATER LEVEL (M): 0.80M
ELEVATION OF BOREHOLE (M): 0.00 STARTED DATE: 06/11/2016
DESCRIBER: NGUYỄN VĂN THAO DEPTH: 5.00M COMPLETED DATE: 06/11/2016

Symbol of layer	Level of layer bottom	Depth of layer bottom	Thickness of layer	STRATUM COLUMN SCALE 1/100	Number of sample / Depth of sample (m)	SPT TEST: Depth (m)	Number of blows /15 cm: N1	N2	N3	N_{SPT} (N_2+N_3)	N_{SPT} Diagram (0 4 8 12 16 20)	STRATUM DESCRIPTION
1	-0.60	0.60	0.60									Đất đắp bờ ruộng
2	-1.70	1.70	1.10		UD1 1.0-1.2	1.20 / 1.65	2	2	3	5		Sét pha màu xám nâu, xám ghi, trạng thái dẻo mềm.
3	-4.30	4.30	2.60		UD2 2.0-2.2 UD3 3.0-3.2 UD4 4.0-4.2	2.20 / 2.65 3.20 / 3.65 4.20 / 4.65	1 1 1	1 1 1	2 2 1	3 3 2		Sét pha màu xám ghi, xám nâu, trạng thái dẻo chảy - chảy.
4	-5.00	5.00	0.70		UD5 4.8-5.0	5.00 / 5.45	1	2	2	4		Sét pha kẹp các ổ cát pha màu xám ghi, xám đen, trạng thái dẻo chảy.

REMARKS : UD: Undisturbed sample
D: Disturbed sample
R: Rock sample

Test Sample
Save Sample

ICC

DRAWING

BOREHOLE LOG

Sheet: 1/1

PROJECT: TĂNG CƯỜNG MÔI TRƯỜNG ĐẦU TƯ HÀ NAM
LOCATION: ROAD - LCB4
BOREHOLE ID: BH-R11
COORDINATE BH X: ____ Y: ____
GROUND WATER LEVEL (M): 0.50M
ELEVATION OF BOREHOLE (M): 0.00
STARTED DATE: 07/11/2016
DESCRIBER: NGUYỄN VĂN THAO
DEPTH: 5.00M
COMPLETED DATE: 07/11/2016

Symbol of layer	Level of layer bottom	Depth of layer bottom	Thickness of layer	STRATUM COLUMN SCALE 1/100	Number of sample / Depth of sample (m)	SPT TEST: Depth (m)	Number of blows /15 cm: N1	N2	N3	N_{SPT} (N_2+N_3)	N_{SPT} Diagram (0 4 8 12 16 20)	STRATUM DESCRIPTION
1	-0.30	0.30	0.30									Đất ruộng canh tác.
2	-1.60	1.60	1.80		UD1 0.8-1.0	1.00 / 1.45	2	2	2	4		Sét pha màu xám nâu, xám ghi, trạng thái dẻo mềm.
3	-4.00	4.00	2.40		UD2 1.8-2.0 UD3 2.8-3.0 UD4 3.8-4.0	2.00 / 2.45 3.00 / 3.45 4.00 / 4.45	0 1 1	1 1 1	1 2 2	2 3 3		Sét pha màu xám ghi, xám nâu, trạng thái dẻo chảy - chảy.
4	-5.00	5.00	1.00		UD5 4.8-5.0	5.00 / 5.45	2	2	3	5		Sét pha màu xám ghi, xám nâu, trạng thái dẻo chảy - chảy.

PROJECT: TĂNG CƯỜNG MÔI TRƯỜNG ĐẦU TƯ HÀ NAM
LOCATION: ROAD - LCB4
BOREHOLE ID: BH-R12
COORDINATE BH X: ____ Y: ____
GROUND WATER LEVEL (M): 0.50M
ELEVATION OF BOREHOLE (M): 0.00
STARTED DATE: 07/11/2016
DESCRIBER: NGUYỄN VĂN THAO
DEPTH: 5.00M
COMPLETED DATE: 07/11/2016

Symbol of layer	Level of layer bottom	Depth of layer bottom	Thickness of layer	STRATUM COLUMN SCALE 1/100	Number of sample / Depth of sample (m)	SPT TEST: Depth (m)	Number of blows /15 cm: N1	N2	N3	N_{SPT} (N_2+N_3)	N_{SPT} Diagram (0 4 8 12 16 20)	STRATUM DESCRIPTION
1	-0.30	0.30	0.30									Đất ruộng canh tác
2	-2.00	2.00	1.10		UD1 0.9-1.1 UD2 1.8-2.0	1.10 / 1.55 2.00 / 2.45	2 2	2 1	3 2	5 3		Sét pha màu xám nâu, xám ghi, trạng thái dẻo mềm.
3	-5.00	5.00	3.00		UD3 2.8-3.0 UD4 3.8-4.0 UD5 4.8-5.0	3.20 / 3.65 4.20 / 4.65 5.00 / 5.45	1 1 1	1 1 1	2 1 2	3 2 3		Sét pha màu xám ghi, xám nâu, trạng thái dẻo chảy - chảy.

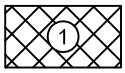
REMARKS : UD: Undisturbed sample
D: Disturbed sample
R: Rock sample

Test Sample
Save Sample

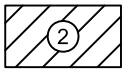
ICC

DRAWING

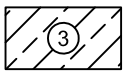
CONVENTIONAL SIGNS



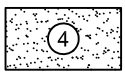
Đất đắp nền đường/ Embankment



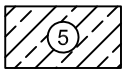
Sét màu xám vàng, xám ghi, trạng thái dẻo mềm/ Yellowish grey, light grey, medium stiff, Clay



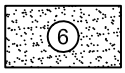
Sét pha màu xám ghi, xám gụ, lẫn rễ thực vật, trạng thái chảy/ Light grey, grey, very soft, Silty clay with plant roots



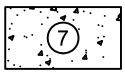
Cát mịn xen kẹp cát pha, sét màu xám ghi, xám tro, trạng thái chặt vừa/ Light grey, grey, medium dense small Sand with clayey sand, clay



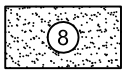
Sét pha màu xám ghi, xen kẹp cát pha, cát, trạng thái dẻo chảy/ Light grey, very soft silty clay with clayey sand, sand



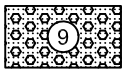
Cát hạt mịn màu xám ghi, xám đen, trạng thái chặt vừa. Đôi chỗ lẫn vỏ sò vỏ hến, mùn thực vật/ Light grey, blackish grey, medium dense small Sand with sea shell, organic



Cát hạt mịn lẫn sỏi sạn, màu xám ghi, xám trắng, trạng thái chặt/ Light grey white, dense small sand with gravel



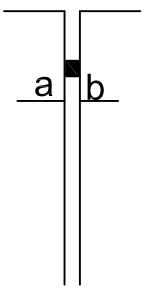
Cát mịn màu xám ghi, xám tro, trạng thái chặt vừa./ Light grey grey, medium dense small sand



Sạn sỏi cát chứa cuội màu xám trắng, xám đen, trạng thái rất chặt/ Whitish grey, backish grey, very dense, Gravel with coble

Ranh giới địa chất xác định Supposed Boundary

Ranh giới địa chất giả định Definite Boundary



■ Vị trí lấy mẫu đất thí nghiệm (M: mẫu thí nghiệm; L: mẫu lưu).
Location of sample test

a: Cao độ ranh giới lớp đất/ *Elevation of layer*

b: Độ sâu ranh giới lớp đất/ Depth of layer

BOREHOLE LOG

Sheet: 1/3

PROJECT: TĂNG CƯỜNG MÔI TRƯỜNG ĐẦU TƯ HÀ NAM
LOCATION: FLYOVER
BOREHOLE ID: BH-F1 COORDINATE BH X: Y: GROUND WATER LEVEL (M): 1.50M
ELEVATION OF BOREHOLE (M): 0.00 STARTED DATE: 03/11/2016
DESCRIBER: ĐỖ XUÂN NGUYÊN DEPTH: 80.00M COMPLETED DATE: 10/11/2016

Symbol of layer	Level of layer bottom	Depth of layer bottom	Thickness of layer	STRATUM COLUMN SCALE 1/150	Number of sample / Depth of sample (m)	SPT TEST: Depth (m)	Number of blows /15 cm: N1	N2	N3	N_{SPT} (N_2+N_3)	N_{SPT} Diagram	STRATUM DESCRIPTION
1	-1.40	1.40	1.40			1.50 / 1.95	2	3	3	6		Đất đắp nền đường
2	-2.90	2.90	1.50		UD1 2.3-2.5	2.50 / 2.95	2	2	2	4		Sét màu xám vàng, xám ghi, trạng thái dẻo mềm.
3	-7.00	7.00	4.10		UD2 6.3-6.5	3.50 / 3.95	1	1	1	2		Sét pha màu xám ghi, xám gụ, lẫn rễ thực vật, trạng thái chảy.
						4.50 / 4.95	1	2	2	4		
						5.50 / 5.95	0	1	1	2		
						6.50 / 6.95	1	1	2	3		
4	-17.50	17.50	10.50		D3 11.5-11.7	7.50 / 7.95	2	3	3	6		Cát mịn xen kẹp cát pha, sét màu xám ghi, xám tro, trạng thái chặt vừa.
						8.50 / 8.95	3	3	5	8		
						9.50 / 9.95	3	4	5	9		
						10.50 / 10.95	3	3	6	9		
						11.50 / 11.95	2	3	5	8		
						12.50 / 12.95	3	4	5	9		
						13.50 / 13.95	4	4	6	10		
						14.50 / 14.95	5	6	6	12		
						15.50 / 15.95	3	4	5	9		
					D4 16.5-16.7	16.50 / 16.95	2	3	4	7		
						17.50 / 17.95	3	3	3	6		
5	-22.00	22.00	4.50		UD5 20.3-20.5	18.50 / 18.95	2	2	3	5		Sét pha màu xám ghi, xen kẹp cát pha, cát, trạng thái dẻo chảy.
						19.50 / 19.95	2	2	2	4		
						20.50 / 20.95	2	2	3	5		
						21.50 / 21.95	2	3	3	6		
6	-30.00	30.00	10.00		D6 25.5-25.7	22.50 / 22.95	6	7	8	15		Cát hạt mịn màu xám ghi, xám đen, trạng thái chặt vừa. Đôi chỗ lẫn vỏ sò vỏ hến, mùn thực vật.
						23.50 / 23.95	10	11	13	24		
						24.50 / 24.95	8	8	9	17		
						25.50 / 25.95	8	9	10	19		
						26.50 / 26.95	8	10	13	23		
						27.50 / 27.95	7	9	9	18		
						28.50 / 28.95	10	11	12	23		
						29.50 / 29.95	9	12	14	26		

N_{SPT} Diagram: 0 20 40 60 80 100

REMARKS : UD: Undisturbed sample
D: Disturbed sample
R: Rock sample

Test Sample
Save Sample

ICC

DRAWING

BOREHOLE LOG

Sheet: 2/3

PROJECT: TĂNG CƯỜNG MÔI TRƯỜNG ĐẦU TƯ HÀ NAM
LOCATION: FLYOVER
BOREHOLE ID: BH-F1 COORDINATE BH X: Y:
ELEVATION OF BOREHOLE (M): 0.00
DESCRIBER: ĐỖ XUÂN NGUYÊN DEPTH: 80.00M

GROUND WATER LEVEL (M): 1.50M
STARTED DATE: 03/11/2016
COMPLETED DATE: 10/11/2016

Symbol of layer	Level of layer bottom	Depth of layer bottom	Thickness of layer	STRATUM COLUMN SCALE 1/150	Number of sample / Depth of sample (m)	SPT TEST: Depth (m)	Number of blows /15 cm: N1	N2	N3	N_{SPT} (N_2+N_3)	N_{SPT} Diagram	STRATUM DESCRIPTION
6	-32.00	32.00	10.00		D7 30.5-30.7	30.50/30.95	11	14	15	29		Cát hạt mịn màu xám ghi, xám đen, trạng thái chặt vừa. Đôi chỗ lẫn vỏ sò vỏ hến, mùn thực vật.
						31.50/31.95	9	10	12	22		
7	-35.80	35.80	3.80		D8 34.5-34.7	32.50/32.95	13	15	16	31		Cát hạt mịn lẫn sỏi sạn, màu xám ghi, xám trắng, trạng thái chặt
						33.50/33.95	11	17	18	35		
						34.50/34.95	10	13	17	30		
						35.50/35.95	12	16	18	34		
8	-54.00	54.00	18.20		D9 39.5-39.7	36.50/36.95	9	13	15	28		Cát mịn màu xám ghi, xám tro, trạng thái chặt vừa.
						37.50/37.95	10	12	14	26		
						38.50/38.95	12	14	15	29		
						39.50/39.95	10	13	14	27		
						40.50/40.95	9	13	15	28		
						41.50/41.95	9	11	13	24		
						42.50/42.95	12	13	16	29		
						43.50/43.95	10	12	13	25		
					D10 44.5-44.7	44.50/44.95	11	14	16	30		
						45.50/45.95	8	11	13	24		
						46.50/46.95	10	12	15	27		
						47.50/47.95	9	13	14	27		
						48.50/48.95	10	12	16	28		
					D11 49.5-49.7	49.50/49.95	9	11	13	24		
						50.50/50.95	11	13	15	28		
						51.50/51.95	12	14	17	31		
						52.50/52.95	11	13	15	28		
						53.50/53.95	10	14	15	29		
9	-60.00	60.00	26.00		D12 54.5-54.7	54.50/54.95	18	25	30	55		Sạn sỏi cát chứa cuội màu xám trắng, xám đen, trạng thái rất chặt.
						55.50/55.95	21	26	35	61		
						56.50/56.95	25	34	37	71		
						57.50/57.95	29	30	38	68		
						58.50/58.95	27	41	50	91		
					D13 59.5-59.7	59.50/59.95	24	35	37	72		

N_{SPT} Diagram: 0 20 40 60 80 100

REMARKS : UD: Undisturbed sample
D: Disturbed sample
R: Rock sample

Test Sample
Save Sample

ICC

DRAWING

BOREHOLE LOG

Sheet: 3/3

PROJECT: TĂNG CƯỜNG MÔI TRƯỜNG ĐẦU TƯ HÀ NAM
LOCATION: FLYOVER
BOREHOLE ID: BH-F1 COORDINATE BH X: Y:
GROUND WATER LEVEL (M): 1.50M
ELEVATION OF BOREHOLE (M): 0.00 STARTED DATE: 03/11/2016
DESCRIBER: ĐỖ XUÂN NGUYÊN DEPTH: 80.00M COMPLETED DATE: 10/11/2016

Symbol of layer	Level of layer bottom	Depth of layer bottom	Thickness of layer	STRATUM COLUMN SCALE 1/150	Number of sample / Depth of sample (m)	SPT TEST: Depth (m)	Number of blows /15 cm: N1	N2	N3	N_{SPT} (N_2+N_3)	N_{SPT} Diagram (0 20 40 60 80 100)	STRATUM DESCRIPTION
9	-80.00	80.00	26.00		D14 63.5-63.7 D15 69.0-69.2 D16 75.0-75.2 D17 79.0-79.2	60.50/60.95 62.00/62.45 63.50/63.95 65.00/65.45 66.00/66.45 67.50/67.95 69.00/69.45 70.00/70.45 71.50/71.95 73.00/73.45 75.00/75.45 77.00/77.45 79.00/79.45	31 36 28 42 32 31 41 32 38 29 32 27 38	35 46 35 50 40 35 46 40 52 36 36 31 42	45 50 37 52 45 40 50 43 60 40 43 36 50	80 96 72 102 85 75 96 83 112 76 79 67 92		Sạn sỏi cát chứa cuội màu xám trắng, xám đen, trạng thái rất chặt.

REMARKS : UD: Undisturbed sample
D: Disturbed sample
R: Rock sample

■ Test Sample
● Save Sample

ICC

DRAWING

BOREHOLE LOG

Sheet: 1/2

PROJECT: TĂNG CƯỜNG MÔI TRƯỜNG ĐẦU TƯ HÀ NAM
LOCATION: FLYOVER
BOREHOLE ID: BH-F1 COORDINATE BH X: GROUND WATER LEVEL (M): 1.00M
ELEVATION OF BOREHOLE (M): 0.00 Y: STARTED DATE: 10/11/2016
DESCRIBER: ĐỖ XUÂN NGUYÊN DEPTH: 60.00M COMPLETED DATE: 14/11/2016

Symbol of layer	Level of layer bottom	Depth of layer bottom	Thickness of layer	STRATUM COLUMN SCALE 1/150	Number of sample / Depth of sample (m)	SPT TEST: Depth (m)	Number of blows /15 cm: N1	N2	N3	N_{SPT} (N_2+N_3)	N_{SPT} Diagram (0 20 40 60 80 100)	STRATUM DESCRIPTION
1	-1.00	1.00	1.00			1.20 / 1.65	2	2	3	5		Đất đắp nền đường
2	-2.50	2.50	1.50		UD1 2.0-2.2	2.20 / 2.65	2	2	2	4		Sét màu xám vàng, xám ghi, trạng thái dẻo mềm.
3	-6.10	6.10	3.60		UD2 5.0-5.2	3.20 / 3.65	0	1	1	2		Sét pha màu xám ghi, xám gụ, lẫn rễ thực vật, trạng thái chảy.
						4.20 / 4.65	1	1	1	2		
						5.20 / 5.65	1	1	2	3		
4	-17.20	17.20	11.10		D3 9.2-9.4	6.20 / 6.65	1	2	2	4		Cát mịn xen kẹp cát pha, sét màu xám ghi, xám tro, trạng thái chặt vừa.
						7.20 / 7.65	3	4	4	8		
						8.20 / 8.65	3	5	5	10		
						9.20 / 9.65	3	4	5	9		
						10.20 / 10.65	3	5	6	11		
						11.20 / 11.65	4	4	5	9		
					D4 14.2-14.4	12.20 / 12.65	3	5	6	11		
						13.20 / 13.65	5	6	6	12		
						14.20 / 14.65	4	5	5	10		
						15.20 / 15.65	3	5	6	11		
						16.20 / 16.65	4	4	6	10		
5	-21.50	21.50	4.30		UD5 19.0-19.2	17.20 / 17.65	2	2	3	5		Sét pha màu xám ghi, xen kẹp cát pha, cát, trạng thái dẻo chảy.
						18.20 / 18.65	2	2	2	4		
						19.20 / 19.65	2	3	3	6		
						20.20 / 20.65	2	2	3	5		
						21.20 / 21.65	2	3	5	8		
6	-30.00	30.00	9.90		D6 24.2-24.4	22.20 / 22.65	7	8	9	17		Cát hạt mịn màu xám ghi, xám đen, trạng thái chặt vừa. Đôi chỗ lẫn vỏ sò vỏ hến, mùn thực vật.
						23.20 / 23.65	8	9	9	18		
						24.20 / 24.65	7	9	12	21		
						25.20 / 25.65	8	10	13	23		
						26.20 / 26.65	7	9	12	21		
						27.20 / 27.65	7	8	9	17		
						28.20 / 28.65	8	8	10	18		
					D7 29.2-29.4	29.20 / 29.65	9	10	12	22		

REMARKS : UD: Undisturbed sample
D: Disturbed sample
R: Rock sample

▮ Test Sample
● Save Sample

ICC

DRAWING

BOREHOLE LOG

Sheet: 2/2

PROJECT: TĂNG CƯỜNG MÔI TRƯỜNG ĐẦU TƯ HÀ NAM
LOCATION: FLYOVER
BOREHOLE ID: BH-F1 COORDINATE BH X: GROUND WATER LEVEL (M): 1.00M
ELEVATION OF BOREHOLE (M): 0.00 Y: STARTED DATE: 10/11/2016
DESCRIBER: ĐỖ XUÂN NGUYÊN DEPTH: 60.00M COMPLETED DATE: 14/11/2016

Symbol of layer	Level of layer bottom	Depth of layer bottom	Thickness of layer	STRATUM COLUMN SCALE 1/150	Number of sample / Depth of sample (m)	SPT TEST: Depth (m)	Number of blows /15 cm N1	N2	N3	N_{SPT} (N_2+N_3)	N_{SPT} Diagram	STRATUM DESCRIPTION
6	-31.40	31.40	9.90			30.20/30.65	9	11	13	24		Cát hạt mịn màu xám ghi, xám đen, trạng thái chặt vừa. Đôi chỗ lẫn vỏ sò vỏ hến, mùn thực vật.
						31.20/31.65	13	17	19	36		
7	-36.20	36.20	4.80		D8 33.2-33.4	32.20/32.65	14	15	17	32		Cát hạt mịn lẫn sỏi sạn, màu xám ghi, xám trắng, trạng thái chặt
						33.20/33.65	11	17	18	35		
						34.20/34.65	10	12	16	28		
						35.20/35.65	12	14	17	31		
8	-53.30	53.30	17.10		D9 38.2-38.4	36.20/36.65	10	12	15	27		Cát mịn màu xám ghi, xám tro, trạng thái chặt vừa.
						37.20/37.65	9	11	13	24		
						38.20/38.65	10	13	14	27		
						39.20/39.65	11	13	16	29		
						40.20/40.65	10	12	14	26		
					D10 42.2-42.4	41.20/41.65	10	12	14	26		
						42.20/42.65	9	11	13	24		
						43.20/43.65	12	13	17	30		
						44.20/44.65	9	12	15	27		
						45.20/45.65	10	13	17	30		
						46.20/46.65	9	11	13	24		
					D11 47.2-47.4	47.20/47.65	9	13	14	27		
						48.20/48.65	11	11	12	23		
						49.20/49.65	10	12	15	27		
						50.20/50.65	9	10	12	22		
						51.20/51.65	13	14	15	29		
					D12 52.2-52.4	52.20/52.65	9	12	14	26		
						53.20/53.65	11	18	27	45		
9	-60.00	60.00	6.70		D13 54.2-54.4	54.20/54.65	24	28	35	63		Sạn sỏi cát chứa cuội màu xám trắng, xám đen, trạng thái rất chặt.
						55.20/55.65	33	40	46	86		
						56.20/56.65	27	31	40	71		
						57.20/57.65	26	33	40	73		
						58.20/58.65	33	46	60	106		
					D14 59.2-59.4	59.20/59.65	35	42	45	87		

N_{SPT} Diagram: 0 20 40 60 80 100

REMARKS : UD: Undisturbed sample
D: Disturbed sample
R: Rock sample

Test Sample
Save Sample

ICC

DRAWING