

Chapter 3

The Feasibility of the Project

3.1 The Feasibility of the Project Locations

3.1.1 The Availability of the Location Preparation

The train route of this Project will use the existing carriageway of 80 m. width and will expropriate additional land along the new route for radius curving adjustment to obtain the designed speed.

In the preparation of the construction of the Project site already SRT's property, SRT can proceed by informing the renters or land users to leave the premise as agreed in the lease and with compensations on building dismantling as specified in the SRT land expropriation regulations. While most of the additional site for expropriation is farm land, a Decree of Land Expropriation must be stipulated with reference to Act of Land Expropriation 1987 and Guidelines on Land Expropriation Compensations 2013.

The additional land for expropriation starts from km.966+100 to km. 967+500 located at Thoong Mor Sub-district and Padang Besar Sub-District, Sadao District, Songkhla Province covering 9 plots of 35,166.41 square meter or 21.98 rais.

3.1.2 The Availability of the Facilities at the Project Location

As most of the Project location is found on the existing train line cutting across Highway 4 and several large communities, the facilities such as entrance to the station, etc. are already available including public utilities needed for the station and other buildings, electrical system, pipe water system and sanitary system. These can be easily accessed and linked to the Project location along the highway. As for the design of the Station compound, the Consultants have considered future needs of public utilities and included necessary details such as the electrical system for the train operation, the road network, etc.

The basic public utilities needed for the Double Tracks Electric Train system and the stations include the following:

- 1) The road and lighting system on Highway 4 is found near the station and can be extended into the station compound with additional modifications of street lights, direction signage to facilitate passengers' entrance and exit to the station daytime and nighttime. The station network are:

1. Sala Thung Lung Station

- Location
 - km. 944+900
 - Located at the present Thung Lung Station no longer used
 - Existing station located in the center of Thung Lung marketplace, Ban Thung Lung, Patong Sub-district, Hat Yai District, Songkhla Province. The location is between the SRT property and Hat Yai Highway-Sadao-Dan Nok or Kanjanawanit Road.
 - Around the station area, there are residential communities, schools, temples, houses and markets. Currently, the station building no longer exists. Only the station signage and the platform can be found with the area turned into public park and garden.
- Physical Features Overview
 - North: ground level through path, school ground, Thung Lung community connected with Ban Phru Sub-District; the train route heading to Hat Yai
 - South: Thung Lung community and some unoccupied area, connected with Kha Mee Kiat Sub-District; the route heading to Padang Besar.
 - East: mostly rubber plantation and some residential community
 - West: the entrance roadway and Thung Lung rotary entering from the main road to Hat Yai-Sadao-Dan Nok Highway or Kanjanawanit Road; existing station and platform turned into public park and garden.

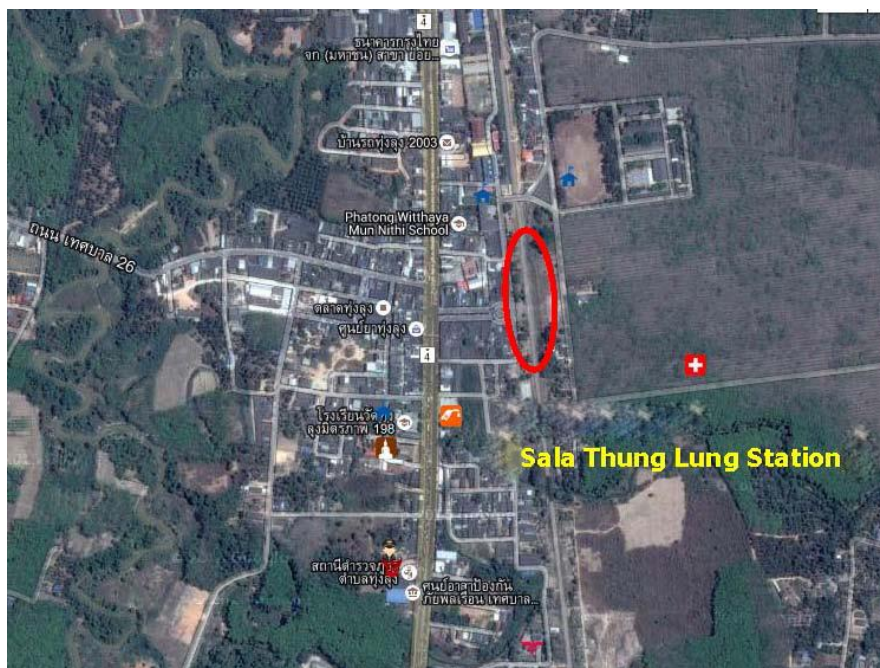


Figure 3.1-1 The Present Location of Thung Lung Station

2. Khlong Ngae Station

- Location
 - Km.952+600
 - Located at the current station, the only station along the Hat Yai-Padang Besar route still in operation.
 - The station located in the center of Khlong Nage community between the train route and Hat Yai-Sadao-Dan Nok Highway or Kanjanawarit Road.
 - Around the station area, there are residential communities, schools, houses. The location is found between the main road and the commuting road within the community along the train tracks and Khlong Ngae market.
- Overview Physical Features
 - North: ground level through path, school ground, Khlong Ngae community connected with Thung Lung sub-district; the train route heading to Hat Yai
 - South: Khlong Ngae community with unoccupied area along the train route with a ground level through path crossing with Tha Pho road; the train route heading padang besar
 - East: residential community, business buildings, Khlong Ngae market and Hat Yai-Sadao-Dan Nok Highway or Kanjanawarit road; entrance and exit to the station
 - West: residential community along the train tracks flanked with commuting roads in the community

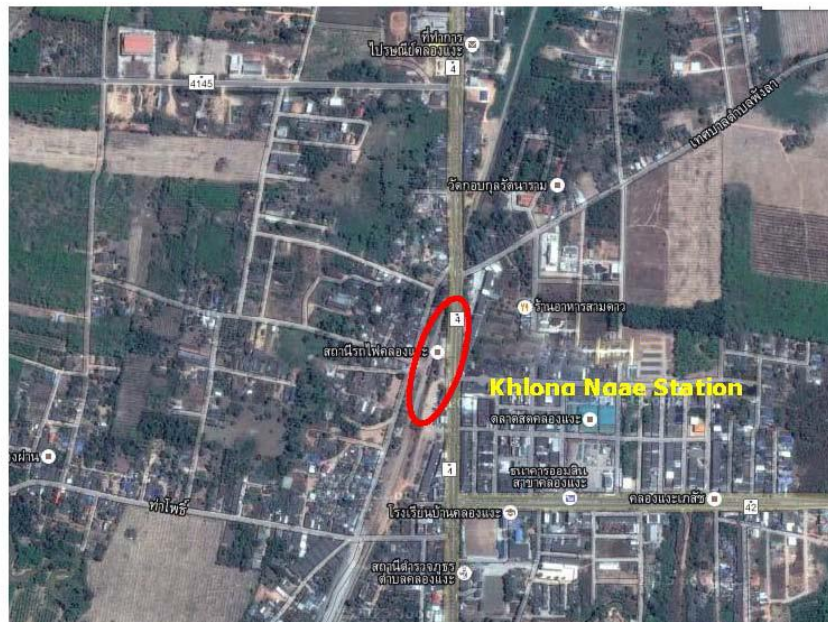


Figure 3.1-2 The Location of the Present Khlong Ngae Station

3. Padang Besar Station

- Location
 - km.972+900
 - Located on the SRT property; some area turned into Padang Besar public park.
 - The train route stops before Padang Besar Station 500 m. before Malaysia (the borderline).
 - The site of Padang Besar Station 2 has been under construction (within Thai border) to replace the previous station as there had not been any station but only a train stopping point here at Highway 973+000.
 - The station is found within the public park area, community and Padang Besar market, Thai-Malaysian border near Padang Besar Customs, Sadao Immigration Check Point.
- Physical Features Overview
 - North: ground level through path, Khlong Ngae community, connected to Thung Lung Sub-District; the route heading to Hat Yai.
 - South: Connected with SRT's Unloading Yard/Container Yard, Thai-Malaysian border, residential community and marketplace; the train route heading to Padang Besar.
 - East: Public park area surrounded with drainage canal, some encroaching from houses and residential community, business buildings along Highway 4054 (Sadao-Padang Besar), the main road heading to Sadao border crossing point.
 - West: Public park area flanked with Pong Phol Road, the entrance-exit to the station, residential community along the train line.



Figure 3.1-3 The Location of Padang Besar 2 Station (On the Thai border)

- 2) The Drainage and Flood Prevention System There is no rainwater draining or flood prevention system around the station and the surrounding buildings and none around Thung Lung Station, Khlong Ngae Station and Padang Besar 2 Station, Such a system is needed to reduce the impact from heavy rain. The design must include rainwater absorption and draining from the site to prevent flooding.
- 3) The Sewage and Water Treatment System Along Highway 4, there is found the existing sewage pipe to drain sewage and excess water from the buildings at the station but a new effective design according to the specified standard to reduce environmental impact to the surrounding community.
- 4) The Electrical System Along Highway 4, there are electrical power stations but more sub-stations will be needed to supply the high voltage electrical lines for the operation of the electric train and other related activities at the station and surrounding buildings.
- 5) The Telephone and Telecommunication System At the site, there is optic fiber cable along Highway 4 but for the train operation, both telephone and mobile cellular network must be installed to meet the demand of the passengers.

3.2 The Service Facilities

3.2.1 The Service Facilities related to the Project

The Hat Yai- Padang Besar Double Tracks Electric Train System provides the following basic service facilities:

- 1) The train route
- 2) The train tracks
- 3) The track system
- 4) The station and the platform
- 5) Split level track crossing points

These basic service facilities will be provided to the passengers of the train particularly around the station. The design will consider the convenience and time of the passengers' connections to other travel modes or destinations in the following areas:

- The parking area for the train passengers who will use the high speed train to travel to other cities.
- The parking area for mass transit buses that will bring the passengers to the station such as local buses, medium-sized truckspicking up cargo from the train.
- The business area providing business activities to the passengers at the station and making a full use of the station such as banks, food court, shopping arcade and post office.

3.3 The Steps and Operation Periods

The Hat Yai-Padang Besar Double Tracks Electric Train Project covering a distance of 44.5 km. consists of the following operations:

- The construction of the ground level single track of 45 km.
- The construction of the ground level double tracks of 7 km.
- The construction of the elevated double tracks of 5 km.
- The construction of 2 ground level stations and 3 stops
- The construction of one elevated station (Khleng Ngae Station)
- The construction and improvement of the track crossing points, signaling system and telecommunication system

The construction plan will consider the safety and impact of the construction steps that may occur to the train operation and other train systems. The construction steps can be divided into 6 steps as shown in **Table 3.3-1**.

- 1) The preparation steps which will take approximately 3 months include the following
 1. The preparation for the construction of the Project office, on-site office, and construction workers' lodging
 2. The detailed survey of the Project route to be used in the construction and the calculation of the actual workload
 3. Obtaining permit for the construction materials, procurement and import of materials such as the tracks, etc
- 2) The civil and structure work which will take approximately 21 months include the following:
 1. The construction of the carriageway and sub-ballast.
 2. The drainage system: RC Pipe Culvert and Box Culvert.
 3. The construction of the bridge crossing the water channel.
 4. The Construction of the Station ,Entrance and architectural design of the station.
 5. The Construction of the underpass level crossing points .
- 3) The track system work which will take approximately 24 months include 2 areas of work:
 1. Track Materials Supply. As the track materials such as tracks, switchers, locks, have to be imported from overseas and take time in the manufacturing process while the reinforced sleepers can be manufactured in Thailand. However, the ordering and testing steps would take about 14 months.

2. Lay Plain Track work includes setting the route, adjusting the sleepers, installing the tracks and switchers. Importing process will generally take about 3 months and after that, assembling of the tracks will take place as the tracks will be shipped in shorter pieces of 25 meters long. The assembling will take place at the shop before the tracks are transported to the location. This process will take about 6 months and the installing of the tracks has to wait for the completion of the earth work. The track installing process will then take about 18 months.
3. The Electrical and Transmission System Work will take about 15 months.
4. The Signaling and Telecommunication Work will take approximately 15 months including the following:
 - The moving of the existing signaling system, the telegram poles and the fiber optic cable, and the installment of the signaling system at the temporary crossing point during the construction period which will take about 15 months.
5. The Testing of the Train Operation will take about 2 months.

Table 3.3-1
The Construction Plan

Order	Work	Period (month)																																				
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	
1	Preparation work																																					
2	Civil Works																																					
2.1	Carriageway and drainage work																																					
2.2	Bridge construction																																					
2.3	Construction of the station and entrance/exit																																					
2.4	Construction of the overpass and underpass																																					
3	Track system work																																					
3.1	Preparation of track materials																																					
3.2	Track installment																																					
4	Electrical system and electrical transmission for the train operation																																					
5	Signaling system																																					
6	Testine of the train operation																																					

3.4 The Technical Feasibility

3.4.1 The Feasibility of the Capacity to Service and Accommodate the Volume of Passengers and Cargo

3.4.1.1 The Specification of the Location of the Stations

Along the Hat Yai-Padang Besar Train route, there will be 4 stations and 3 stopping points. The Project design of the stations

has been adjusted to be suitable with the train operation concept and future travel modes. The old stations such as Sala Thung Lung Station, which is no longer used will be rebuilt and modernized while the current one such as Khlong Ngae Station, will be renovated to harmonize with the new image of the Project. More stops will be added to provide a full service cycle such as Ban Phru Stop, Khlong Rum Stop, Tha Khoy Stop.

On the feasibility of the location of the station compound, the design has paid attention to the full use of land and facilities to support related activities and accessibility to the station. The preparation of the location considers future development with reference to the City Planning and problems that may arise from land expropriation.

However, the modifications of the roles of the stations and the development guidelines of the station compound can be described as follow:

The location of the stations: 4 stations and 3 stops:

- **Hat Yai Junction** Located at the current Hat Yai Depot and working as the departure point; the design already included in the renovation of Hat Yai Depot under the Suratthani-Hat Yai-Songkhla Double Tracks Train
- **Ban Pru Stopping Point** Located within the train area at Ban Phru Sub-district, Hat Yi District, Songkhla Province
- **Sala Thung Lung Junction** Located at Sala Thung Lung Station, Patong Sub-district, Hat Yai District, Songkhla Province
- **Khlong Ngae Junction** Located at the current Khlong Ngae Station
- **Khlong Ram Stopping Point** Located within the train line at Ban Khlong Ram, Thung Mor Sub-district, Sadao District, Songkhla Province
- **Ban Tha Khoy Stopping point** Located within the train line at Ban Tha Khoy, Padang Besar Sub-district, Sadao District, Songkhla Province
- **Padang Besar 2 Junction** Located within the train area near Padang Besar Station 2 on the Thai border, Padang Besar Sub-district, Sadao District, Songkhla Province. At present, this area has been turned into public park and some occupied as residence and business shops.

The modifications of the roles of the stations and development guidelines of the Project can be summed up as follow:

Table 3.4-1

Summary of the Modifications of the Roles of the Stations and Development Guidelines of the Station Compound

Station/Stopping Point	Modifications of Roles		Development	
	Present	Future	Present building	New building
Hat Yai	Station	Station	Still in operation	Suratthani-Hat Yai Depot Project
Ban Phru	Non-existing	Stop	None	New waiting building
Sala Thung Lung	Station area still remaining	Station	None	New building (Type:S)
Khlong Ngae	Station	Station	Still in operation	New building (Type:S)
Khlong Ram	Non-existing	Stop	None	New waiting building
Ban Tha Khoy	Non-existing	Stop	None	New waiting building
Padang Besar 2	Under construction to be a sub-station	Station	New station (not in operation)	New building (Type:M)

3.4.1.2 Projection of the Passenger and Freight Volume

1) Steps and Procedures

• The Study Framework

In conducting the Analysis and the Projection of the Volume of Passengers and Freight, the Consultants will refer to the National Area Model (NAM) which has been designed for the development and maintenance of database and information and has been used as a model to develop multi-modal transportation and logistics (TDL) under Office of Transportation. This model can be applied in the analysis of the volume of the multi-modal transportation such as by car, train, air and waterway.

The operation procedures of the model takes 4 steps: Travel Initiation Model, Travel Distribution Model, Selection of Travel Mode Model and Types of Travel Model. The National Area Model (NAM) consists of 2 models:

- Passenger Model
- Freight Model

• The Division of the Area of the Study

In the Study, the Consultants have divided the study area in Songkhla into sub-districts to reflect precise travel behavior as shown in **Figure 3.4-1**. Besides the sub-district divisions of the area, the study also looks into the location along Thai border: 12 border crossing points and 38 Logistic Nodes.

2) Transport Network Model

Transport Network Model will be developed from the Database and related maps along with the collected data from related offices. The data on the road network will be used in the study of traffic and stored in the computer as “Node” and “Link”. “Node” will be coded with number references while “Link” will be considered as the route connecting from one Node to the other. The details on the road and public transportation network will only apply these “Links” in the selection of the travel mode. Besides, there will be “Centroid” of each sub-division of the location used as the starting and ending point of each travel between those sub-division locations. The details of the Transportation Network are:

- The Road Network: The data in drawing the Road Network Model include distance, the capacity of the road, the types of the road, etc.
- The Public Transportation Model looks into 3 main travel modes: train, water and coastal, and air. The data used in the Model include route/line, travel mode, service company, fare tables, location of the station, capacity, speed.

The details of the present Transportation Network will be brought into consideration which include the transportation network by road, train, air, water and coastal channel and also the linkage with other transportation locations such as cargo transport stations, seaports, airports, train stations, etc. as shown in **Figure 3.4-2**

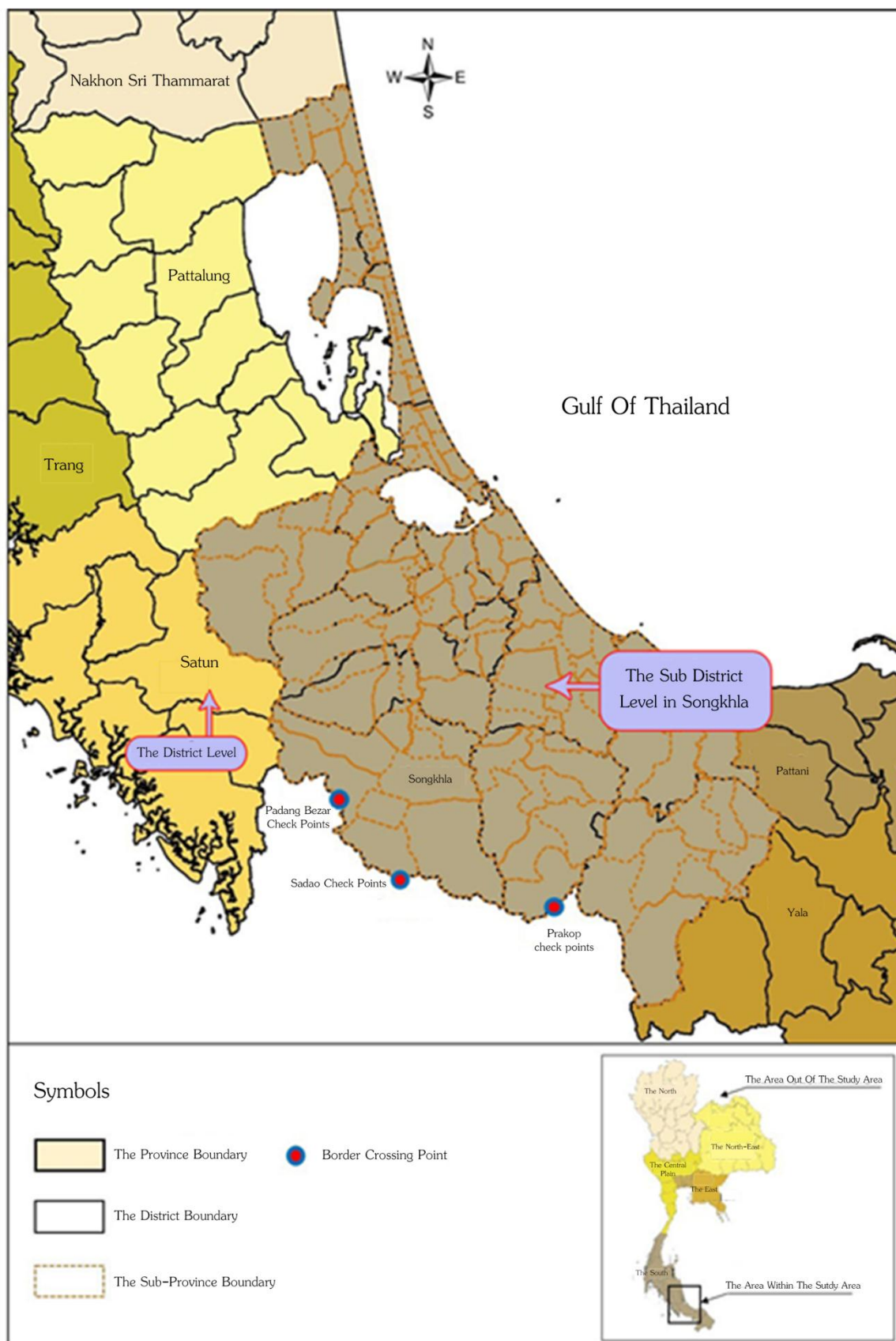


Figure 3.4-1 The Sub-Divisions of the Study Area

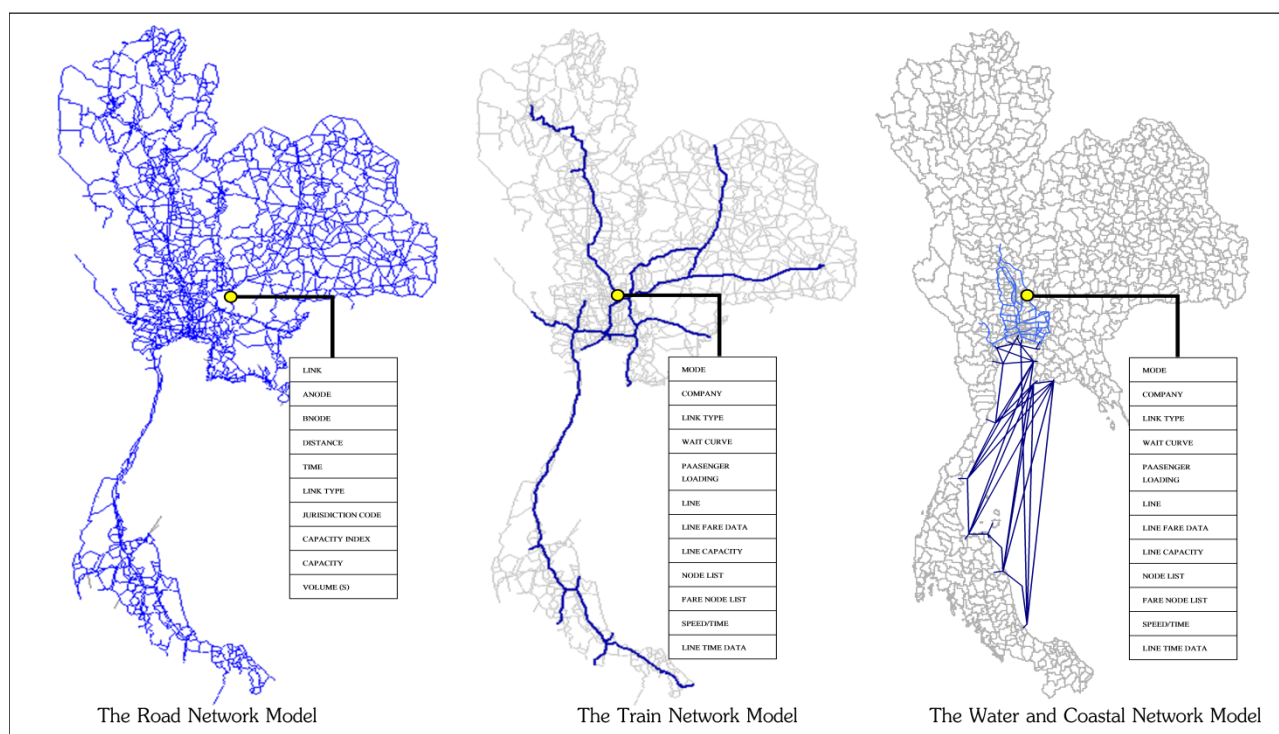


Figure 3.4-2 The Multi-Modal Transportation Model

3) The Location of the Stations

In the Projection of the Passenger and Freight Volume, the specification of the location of the boarding and de-boarding stations must be clearly made. On the Hat Yai-Padang Besar Train route of a total 44.5 km., the stations and the stops are specified as follow:

- Hat Yai Depot
- Ban Phru Stopping Point
- Sala Thung Lung Station (Patong)
- Khlong Ngae Station
- Khlong Ram Stoppint Point
- Tha Khoy Stopping Point
- Padang Besar Station

4) The Modification of the Models

The Consultants have compared the Passenger Travel Model with the collected data and additional survey data by adjusting several variables in the Model to draw out realistic collaborations before its application to the Projection as shown in **Figure 3.4-3** It was found that R^2 was quite high. In sum, the validity of this Model is acceptable and the Model can be used in the Projection of Travel and Transport Volume.

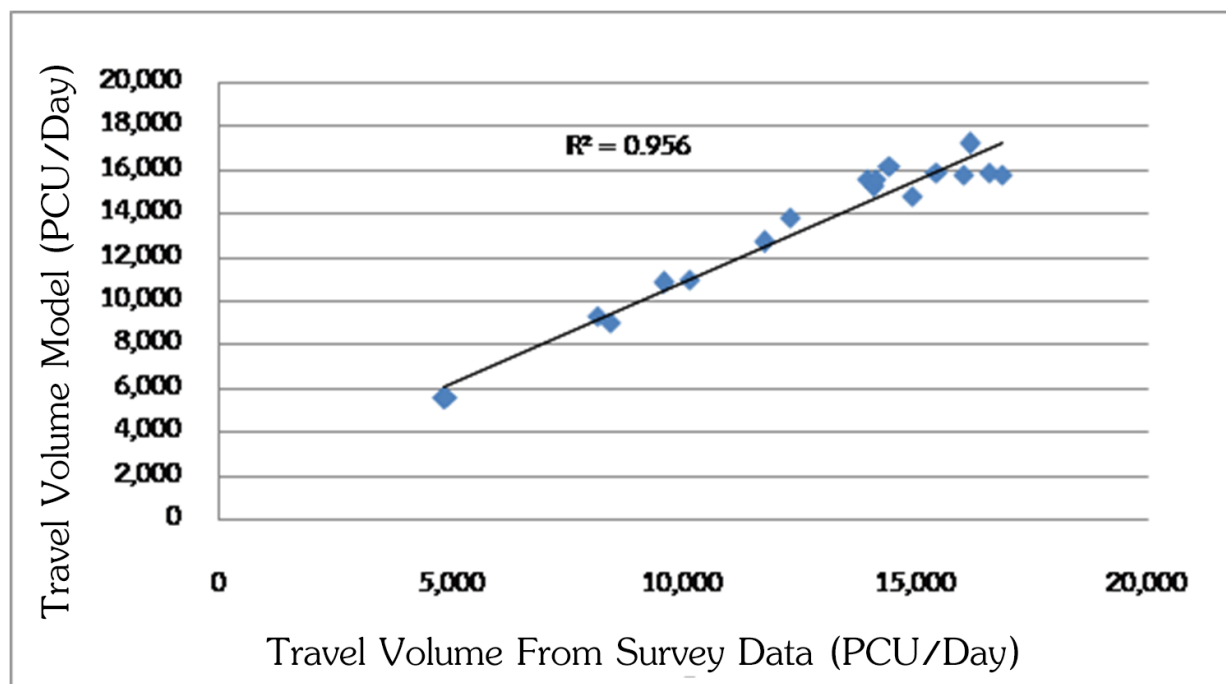


Figure 3.4-3 The Results of the Model Comparison

5) The Projection of the Passenger Volume

▪ The Analysis of the Present Transportation Volume

At present, transportation on the Study location can be grouped into 4 types: personal cars, public buses, trains and airplanes. The volume of each type is shown in Table 3.4-2. It was found that there were approximately 220,795 people travelling on the Study location, of which 156,062 people or 70.68% travel in the personal cars, 51,694 people or 23.41% by public buses and 8,157 people or 3.86% by plane and 2.05% by train.

Table 3.4-2
The Present Types of Transportation

Type of Transportation	Transportation Volume (People/day)	%
Personal cars	156,062	70.68%
Public buses	51,694	23.41%
Trains	4,522	2.05%
Airplanes	8,517	3.86%
Total	220,795	100.00%

Source: The Consultants

However, when considering the distribution of transportation between different locations, it was found that most transportation between Hat Yai and the upper north of the South was 35,289 people or 15.98% of the total volume, between Hat Yai and Songkhla province was 28,838 people or 13.06%, and 22,038 people or 9.98% was between Sadao and Hat Yai.

Moreover, when looking at the distribution of transportation between the major border check points in Songkhla and other areas, it was found that:

- Travel in and out at Sadao Border check point was 17,238 people /day with most of the number, 7,160 people or 41.54%, travel between Sadao District and Sadao border check point while 4,449 people or 25.81% travel between Hat Yai and Sadao, and 2,337 people or 13.56% between Songkhla and Sadao border check point.
- Travel in and out of Padang Besar border check point was 2,427 people /day, 1,504 people or 61.98% of which travel between Hat Yai and Padang Besar border check point, and 360 people or 14.85% between Songkhla and Padang Besar border check point, and 326 people or 13.42% between Bangkok and its vicinity and Padang Besar border check point.

■ The Projection of Future Travel Volume at the Study Location

From the Projection shown in **Table 3.4-3**, it was found that in 2021, the total travel volume would be 264,673 people/day, with an increase to 334,219 people/day, 423,597 people/day and 490,612 people/day in 2030, 2040 and 2050 respectively, or at an increase of 2.3%/year.

Table 3.4-3
Travel Volume According to Types of Transportation

Types of Transportation	2021		2030		2040		2050	
	Travel volume (people-trip/day)	%	Travel volume (people-trip/day)	%	Travel volume (people-trip/day)	%	Travel volume (people-trip/day)	%
Personal cars	185,026	69.91	232,236	69.49	291,803	68.89	337,782	68.85
Public buses	58,460	22.09	71,803	21.48	85,978	20.3	95,412	19.45
Trains	10,645	4.02	15,946	4.77	24,458	5.77	32,134	6.55
Airplanes	10,543	3.98	14,234	4.26	21,358	5.04	25,284	5.15
Total	264,673	100	334,219	100	423,597	100	490,612	100

Source: The Traffic and Transportation Model

When comparing the proportion of transportation types between 2015 and 2050, it was found that in 2050, travel by personal cars and public buses would decrease while travel by train and plane would increase. This could be explained by the fact that the State organizations have been promoting public transportation system within their important planning and policy; for example, The Development Project of the Double Tracks Train System which will provide travel speed and punctuality by train; The Development of Travel and Transport by Plane which has been supporting low cost airlines to attract more passengers. However, The Road Network

Development Plan also aims to develop motorway system between Hat Yai and Malaysian border to meet the increasing volume of travel in and out at Sadao border check point.

■ The Projection of Passenger Volume at the Study Location

The Projection of Passenger Volume of the Hat Yai-Padang Bezar Train as shown in **Table 3.4-4** has indicated that in 2021, the starting year of the train operation, the volume of boarding passengers would be 4,732 people/day and increase to 7,405, 10,857 and 15,470 people/day in 2030, 2040 and 2050 respectively. When considering the number of boarding and de-boarding passengers at each station, it was found that the highest number was found at Hat Yai Station, and secondly Padang Bezar Station which is the departure and destination station. It showed that 35% of the total number of passengers was at Hat Yai Station. When considering the MaxLine Load as shown in **Table 3.4-5** and **Table 3.4-6**, it was found that in 2021, the maximum volume would be 2,319 people/day/direction with an increase to 3,629, 5,320 and 7,581 people/day/direction in 2030, 2040 and 2050 respectively.

Table 3.4-4
The Projection of Passenger Number (people-trip/day)

Year	Passenger Number(people/day)	Passenger Number(people/year)
2021	4,732	1,727,180
2030	7,405	2,702,825
2040	10,857	3,962,805
2050	15,470	5,646,550

Source: The Traffic and Transportation Model

Table 3.4-5
The Projection of Southward Passenger Number (people/day)

Stations	2021			2030			2040			2050		
	On	Off	Line Load	On	Off	Line Load	On	Off	Line Load	On	Off	Line Load
External	-	-	643	-	-	1,006	-	-	1,475	-	-	2,102
Hat Yai Depot	1,670	0	2,313	2,614	0	3,620	3,833	0	5,308	5,462	0	7,564
Ban Phru Stop	10	4	2,319	15	6	3,629	21	9	5,320	30	13	7,581
Sala Thung Lung Station (Patong)	33	139	2,213	50	216	3,463	74	317	5,077	105	490	7,196
Khlong Ngae Station	3	307	1,909	7	480	2,990	11	703	4,385	15	964	6,247
KhLong Ram Stop	5	7	1,907	8	11	2,987	12	16	4,381	17	23	6,241
Tha Khoy Stop	7	10	1,904	11	15	2,983	16	21	4,376	23	30	6,234
Padang Besar Station	0	748	1,156	0	1,172	1,811	0	1,718	2,658	0	2,336	3,898
Onward to Malaysia	-	-	1,156	-	-	1,811	-	-	2,658	-	-	3,898

Source: The Traffic and Transportation Model

Table 3.4-6
The Projection of Northward Passenger Number (people/day)

Stations	2021			2030			2040			2050		
	On	Off	Line Load	On	Off	Line Load	On	Off	Line Load	On	Off	Line Load
From Malaysia	-	-	1,167	-	-	1,825	-	-	2,675	-	-	3,925
Padang Besar Station	709	0	1,876	1,111	0	2,936	1,628	0	4,303	2,207	0	6,132
Tha Khoy Stop	7	3	1,880	11	5	2,942	16	7	4,312	23	10	6,145
Khlong Ram Stop	10	6	1,884	15	9	2,948	21	13	4,320	30	19	6,156
Khlong Ngae Station	313	4	2,193	490	7	3,431	719	11	5,028	987	15	7,128
Sala Thung Lung Station (Patong)	150	30	2,313	234	47	3,618	344	69	5,303	527	98	7,557
Ban Phru Stop	5	11	2,307	8	17	3,609	12	24	5,291	17	34	7,540
Hat Yai Depot	0	1,482	825	0	2,319	1,290	0	3,399	1,892	0	4,844	2,696
External	-	-	825	-	-	1,290	-	-	1,892	-	-	2,696

Source: The Traffic and Transportation Model

6) The Projection of Freight Volume

• The Projection of Freight Transport on the Hat Yai-Padang Bezar Train

From the records of SRT of the freight transport during 2008-2014 as shown in **Table 3.4-7**, it was found that most of the freight transport on this train route was international transport of containers while only a small number would be other products such as noodles, flour, sugar, gypsum, etc. When considering the transport volume by train during 2008-2014, it was found that the volume had decreased significantly. From interviews with the concerned offices and business operators, it revealed that train transport was still in high demand but there was not enough containers or locomotive engines for service.

• The Projection of Future Freight Volume

In the Projection of future freight volume which includes possible changes in transport mode to train transport, the hypotheses were:

- For processed agricultural products, train transport from the manufacturing factories would be within 50-100 km from the train route;
- SRT is equipped with locomotive engines, transport carriage, service staff, loading area and container yard at the departure and destination stations;
- SRT can provide service to multiple customers on one train (without requiring customers to rent the whole train)
- SRT has promotion measures for rail transport to small and medium sized business operators

From the collection of data on freight transport, the factors determining the decision to choose rail transport were the potentials and suitability of the cargo for freight transport. On the Hat Yai- Padang Bezar route onward to Malaysia, the cargo would be export items either through Padang Bezar border customs or currently through Sadao check point such as rubber products, rubber wood products, tapioca, rice, sugar and other goods such as electronics equipment, electrical appliances, appliances and engines, etc. The types of freight for rail transport on each study location were found to vary in terms of transport activities and depending on varying factors of the economic growth of the South. In the Projection, the Consultants have applied Time Series/Forecasting method in the analysis to project the growth of each product and have included the interview with the business operators on trends and changes of transport type to rail transport. This can be summed up on the Projection of Freight Volume by the Hat Yai-Padang Bezar route as shown in **Table 3.4-8** and **Table 3.4-9**.

Table 3.4-7 The Records of Freight Transport on the Hat Yai-Padang Besar Train Route

Types of Cargo	2008		2009		2010		2011		2012		2013		2014	
	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import
International Containers	326,309	130,149	174,844	59,819	126,039	32,808	108,591	23,443	101,733	13,640	83,620	10,208	80,481	2,642
Sugar	1,540	-	1,883	-	705	-	1,499	-	974	-	1,050	-	870	-
Noodles, Flour	-	-	-	-	-	-	23,843	-	20,874	-	18,520	-	11,571	-
Gypsum	12,255	-	5,658	-	4,010	-	-	-	-	-	-	-	-	-
Rice products	-	-	45	-	-	-	-	0.2159	-	0.1341	-	0.1221	-	0.0328
Total	340,104	130,149	182,430	59,819	130,754	32,808	133,933	23,443	123,581	13,640	103,190	10,208	92,922	2,642

Source: SRT

Table 3.4-8 The Summary of Rail Transport on the Hat Yai-Padang Besar Train Route

Year	Rubber	Rubber wood products and Rubber wood furniture	Palm oil	Cassava	Rice	Sugar	Other products	Total
2020	554,755	218,204	81,871	32,229	27,980	24,116	255,256	1,194,411
2021	569,416	222,937	85,871	35,023	29,244	24,845	257,305	1,224,641
2022	584,464	227,670	90,066	37,935	30,569	25,573	259,369	1,255,646
2023	599,911	232,403	94,466	40,965	31,953	26,301	261,451	1,287,450
2024	615,765	237,136	99,081	44,114	33,397	27,029	263,549	1,320,071
2025	632,039	241,869	103,921	47,381	34,901	27,758	265,664	1,353,533
2026	648,743	246,602	108,998	50,766	36,464	28,486	267,796	1,387,855
2027	665,888	251,335	114,322	54,269	38,088	29,214	269,945	1,423,061
2028	683,486	256,068	119,907	57,891	39,771	29,942	272,112	1,459,177
2029	701,549	260,801	125,765	61,631	41,514	30,671	274,296	1,496,227
2030	720,090	265,534	131,909	65,490	43,317	31,399	276,497	1,534,236
2031	736,450	270,267	137,792	69,466	45,179	32,127	278,174	1,569,455
2032	753,182	275,000	143,938	73,561	47,102	32,855	279,860	1,605,498
2033	770,293	279,733	150,358	77,775	49,084	33,583	281,557	1,642,383
2034	787,794	284,466	157,065	82,106	51,126	34,312	283,265	1,680,134
2035	805,692	289,199	164,070	86,556	53,228	35,040	284,982	1,718,767
2036	823,997	293,932	171,388	91,124	55,389	35,768	286,710	1,758,308
2037	842,717	298,665	179,033	95,811	57,611	36,496	288,449	1,798,782
2038	861,863	303,398	187,018	100,616	59,892	37,225	290,198	1,840,210
2039	881,444	308,131	195,359	105,539	62,233	37,953	291,958	1,882,617
2040	901,470	312,864	204,073	110,580	64,634	38,681	293,728	1,926,030
2041	916,913	317,597	213,872	115,740	67,095	39,409	296,647	1,967,273
2042	932,621	322,330	224,141	121,018	69,615	40,138	299,594	2,009,457
2043	948,598	327,063	234,904	126,414	72,195	40,866	302,571	2,052,611
2044	964,849	331,796	246,183	131,929	74,835	41,594	305,578	2,096,764
2045	981,378	336,529	258,004	137,561	77,535	42,322	308,614	2,141,943
2046	998,190	341,262	270,392	143,313	80,295	43,051	311,681	2,188,184
2047	1,015,290	345,995	283,376	149,182	83,114	43,779	314,778	2,235,514
2048	1,032,683	350,728	296,982	155,170	85,994	44,507	317,906	2,283,970
2049	1,050,374	355,461	311,242	161,276	88,933	45,235	321,065	2,333,586
2050	1,068,369	360,194	326,187	167,500	91,932	45,964	324,255	2,384,401

Source: The Consultants

Table 3.4-9 The Summary of Rail Transport on the Northbound and Southbound Hat Yai-Padang Besar Train Route

	2021				2030				2040				2050			
	Southbound		Northbound		Southbound		Northbound		Southbound		Northbound		Southbound		Northbound	
	On	Off	On	Off	On	Off	On	Off	On	Off	On	Off	On	Off	On	Off
External	762,289	-	-	216,256	992,234	-	-	245,478	1,263,754	-	-	308,165	1,588,536	-	-	381,504
Hat Yai	193,240	-	-	52,856	235,155	-	-	61,369	277,070	-	-	77,041	318,985	-	-	95,376
Through Padang Besar border check point Malaysia	-	955,529	269,112	-	-	1,227,389	306,847	-	-	1,540,824	385,206	-	-	1,907,521	476,880	-
Total	955,529	955,529	269,112	269,112	1,227,389	1,227,389	306,847	306,847	1,540,824	1,540,824	385,206	385,206	1,907,521	1,907,521	476,880	476,880
Total two Directions	1,224,641				1,534,236				1,926,030				2,384,401			

Source: The Consultants

3.4.1.3 The Operation, Maintenance and Number of the Trains

In the planning of the train operation and the analysis of the capacity, the main objective is to conduct a review study of the data on passengers and freight to develop and recommend suitable train operation plan for the Hat Yai-Padang Besar Double Tracks Train route which will covers 44.50 kilometers.

1) The Train Operation Development

The main objective is to study and review data on passengers and freight transport to develop and recommend a suitable type of train operation along the Hat Yai-Padang Besar Double Tracks Train route. The basic steps and procedures are:

- The specification of the location and number of the stations, storing and distribution yard for freight, distance and the route
- The Consultants will bring into the development analysis the projection of passengers and freight, the locations and number of the stations, the storing and distribution yard for freight, distance and the train route and the stopping area for the train.
- The calculation of the required service operation time.
- The calculation of the train fleet size and required train numbers to meet the set service and schedule
- The preliminary findings of the efficient operation planning on route capacity, passenger or freight service capacity, train schedule, and train diagram

2) Types and Services

The concept of the train operation and service in this Project will be based on the present types and services offered by SRT with only additional electric trains operated by Malaysia. However, if additional electric train is needed, the system should be in line with that in Malaysia as already specified in the Kuala Lumpur Electric Train Project which requires all train fleet to be Electrified Multiple Unit.

However, as the specified train route is located near Thai-Malaysian border and far from Bangkok, the train operation from Hua Lampong Station still uses non-air-conditioned fleet and has a small number of passengers. This has affected the management of the route capacity. The Consultants therefore suggested the use of local trains in linking the route and did not propose acquiring any ordinary train to the Project. The overall concept of the train fleet in this Project includes the following:

- **The Electrified Multiple Unit (EMU):** These are passenger electric trains operated on a long distance route without stopping at every station.

- **Diesel-Powered Long Distance Trains** : These are Express Trains, Rapid Trains and Ordinary Trains with diesel-powered locomotive engine with passenger carriage, freight carriage and supply carriage
- **Diesel-Powered Commuter Trains** : These are short distance train operated as Diesel Multiple Unit: DMU with the engine at the head and tail of the fleet for shuttle service convenience.
- **Diesel-Powered Freight Train** : The freight trains operated by the diesel-powered engine at the head of the fleet which transport many types of cargo such as heavy freight, containers, oil containers, dry cement container and others.

3) The Electrical System for the Train Operation

As mentioned above, the locomotive to be used in the planning and model drawing consist of 4 types:

- Diesel Electric Locomotives with AC-AC power made by CSR Qishuyan, procured in 2014; maximum 20 tons of weight on the axle; to be used in the passenger train
- Diesel Electric Locomotive of General Electric (GEA) No. 4523-4560 operated since 1995 with 14.42 tons of maximum weight/axle will be brought back for long-distance service
- Diesel Train of APD60 (APD) of Daewoo No.2525-2544 operated since 1996 with 14 tons of maximum weight /axle will be brought back for long-distance service
- Electrified Train with the same Bombardier basic data as used in the Preliminary Design of the Kuala Lumpur-Padang Besar Train Route by Keretapi Tanah Melayu Berhad (KTMB), Malaysia.

4) The Planning of the Train Operation Schedule

■ Train Operation Schedule and Line Load

In the Project Study, the Consultants have analysed and applied the basic data in the planning of the train operation at various speed levels: 140, 120, 100 and 80 km./hour to be incorporated with the train scheduling and fleet management. The Train Running Simulation has been used in the calculation of the train schedule and line load.

In the Train Operation Model, the Consultants have set the stopping time at each station at 1 minute for every type of train fleet as all stations on the route are stops and small stations. The preliminary results of the time for the train operation at various speeds are shown in **Table 3.4-10**

In the beginning, the Consultants have designed the Model without any Train Rolling Resistance value as the data was still incomplete. However, since the obtained data on the line load was satisfactorily precise and valid and the distance of the route was quite short, without any irregular case, the track shuffling should not be included in the Operation Plan as it could cause unnecessary delay. The Train Running Model can then

be set on basic data and procedures without any track shuffling at the line load of 152 trains per day per two running directions.

Table 3.4-10
Train Operation Schedule at a Various Speed

Stations/Stops	Location	Distance (km.)	Operation Time (min. excluding stop)				Station size
			80 km/hr	100 km/hr	120 km/hr	140 km/hr	
Hat Yai Depot	928+580	0.000	–	–	–	–	Large station
Ban Phru Stop	935+925	7.345	6:19	5:32	5:2	3:39	Stop
Sala Thung Lung Station (Patong)	944+887.5	8.963	7:41	7:41	5:33	5:7	Small station
Khlong Ngae Station	952+625	7.738	5:50	6:11	4:25	4:31	Small station
Khlong Ram Stop	961+100	8.475	6:22	6:35	4:45	4:24	Stop
Tha khoy Stop	967+450	7.350	5:1	5:27	3:48	3:8	Stop
Padang Besar Station	972+900	4.450	4:20	4:16	3:39	2:45	Medium size station
Total		44.320	37:26	37:10	28:56	24:44	

Source: The Consultants

■ The Volume of Passengers and Freight

In drawing the Preliminary Train Operation Plan, there must be a projection of the distribution of passenger volume in terms of Line Load which has been summed up in **Table 3.4-11** and **Table 3.4-12**. The types of train operation can be classified into 4 types for the northbound trains from Hat Yai via Padang Besar and the southbound trains from Padang Besar via Hat Yai. it was found that on both directions, the projection of the passengers indicated a maximum of 37.69% and 33.685 for the northbound and southbound trains respectively. While travel to and from Malaysia connecting with the Project route would be 35.20% and 31.38% respectively. On the freight volume, the projection is displayed in **Table 3.4-13**

Table 3.4-11
The Projection of Line Load of the Northbound Passengers

(Northbound)	2021	2030	2040	2050
Station	Line Load			
From Bangkok	612	1,006	1,475	2,102
Hat Yai Depot	2,201	3,620	5,308	7,564
Ban Phru Stop	2,207	3,629	5,320	7,581
Sala Thung Lung Station (Patong)	2,106	3,463	5,077	7,196
Khlong Ngae Station	1,817	2,990	4,385	6,247
Khlong Ram Stop	1,815	2,987	4,381	6,241
Tha Khoy Stop	1,812	2,983	4,376	6,234
Padang Besar Station	1,100	1,811	2,658	3,898
To Malaysia	1,100	1,811	2,658	3,898

Source: The Consultants

Table 3.4-12
The Projection of Line Load of the Southbound Passengers

(Southbound)	2021	2030	2040	2050
Stations	Line Load			
From Malaysia	1,110	1,825	2,675	3,925
Padang Besar Station	1,785	2,936	4,303	6,132
Tha Khoy Stop	1,789	2,942	4,312	6,145
Khlong Ram Stop	1,793	2,948	4,320	6,156
Khlong Ngae Station	2,087	3,431	5,028	7,128
Sala Thung Lung Station (Patong)	2,201	3,618	5,303	7,557
Ban Phru Stop	2,195	3,609	5,291	7,540
Hat Yai Depot	785	1,290	1,892	2,696
To Bangkok	785	1,290	1,892	2,696

Table 3.4-13
The Projection of the Freight Volume

Freight Volume (ton/day)	2021		2030		2040		2050	
	North bound	South bound	North bound	South bound	North bound	South bound	North bound	South bound
Bangkok	2,088	523	2,718	673	3,462	844	4,352	1,046
Hat Yai	529	131	644	168	759	211	874	261
Padang Besar	654	2,617	841	3,362	1,055	4,221	1,307	5,226
Total	2,617		3,362		4,221		5,226	

Source: The Consultants

■ The Train Route and Fleet Operation

From the preliminary study of the data of the present train route, there are 3 main routes and/or types of service : 1) The Bangkok-Butterworth Long-Distance Air-Conditioned Sleeper

Train 2) The Kula Lumpur-Hat Yai Long-Distance Air-Conditioned Sleeper Train 3) Transit Freight Train to Padang Bezar Cargo Station

In this Project, the Consultants will increase the number of local trains to provide pick-up and send-off transportation to local passengers at every station from Nakhon Sri Thammarat (Khao Choomthong Depot) vai Hat Yai Depot to Padang Bezar Station. The Consultants have proposed 5 main types of train management and service as follow:

- **Rapid Trainds (Kuala Lumpur-Hat Yai)** The initial plan would be the long distance train service from Kuala Lumpur via Butterworth, Padang Bezar to Hat Yai Depot, the destination station in this Project, with stops to send off and pick up passengres along the route at Khlong Ngae Station and Sala Thung lung Station (with a possible adjustment). This will be Electrified Multiple Unit.
- **Special Diesel Express Trains (Bangkok-Butterworth)** This provides long distance train service from Hua Lampong Station via Choomporn, Suratthani, hat Yai, Pdang Bezar to Butterworth Station, the final destination in the Project with stops to send off and pick up passengers along the route only at Khlong Ngae Station. The train will be operated with Diesel-powered locomotive and with passenger cars and a dining car
- **Special Diesel Express Trains (Kuala Lumpur-Hat Yai)** This provides long distance train service from Kuala Lumpur Station via Tan Jong Malim, Kuala Lumpur, Butterworth, Padang Bezar to Hat Yai Depot, the final destination in this Project without any stop along the route. The traint will be operated with Diesel-powered locomotive and with First, Second and Third Class passenger cars and a dining car
- **Local Diesel Train (Suratthani-Padang Bezar)** This provides train service from Suratthani via Thoong Song Depot, Pattalung, Hat yai depot to Padang Bezar Station, the final destination in the Project, with stops to send off and pick up passengers at every station along the route. The train will be operated with Diesel-powered locomotive and with First, Second and Third Class sleeper cars and a dining car.
- **Diesel Freight Train (Bangkok-Padang Bezar)** This provides train service from Bangkok to Pa, the final destination in the Project. Thedang Bezar Station. The train will be operated with Diesel-powered locomotive and with freight carriers of various specifications. In the beginning, the Consultants have suggested only large-sized containers carriers and highest transport weight on the axle for border crossing.

The Consultants have prepared the summary report on the number of the stations and stops of each type of the trains starting from Special Express Trains, Express Trains, Rapid Trains and Local Commuter Trains and Freight Trains as shown in **Figure 3.4-4**

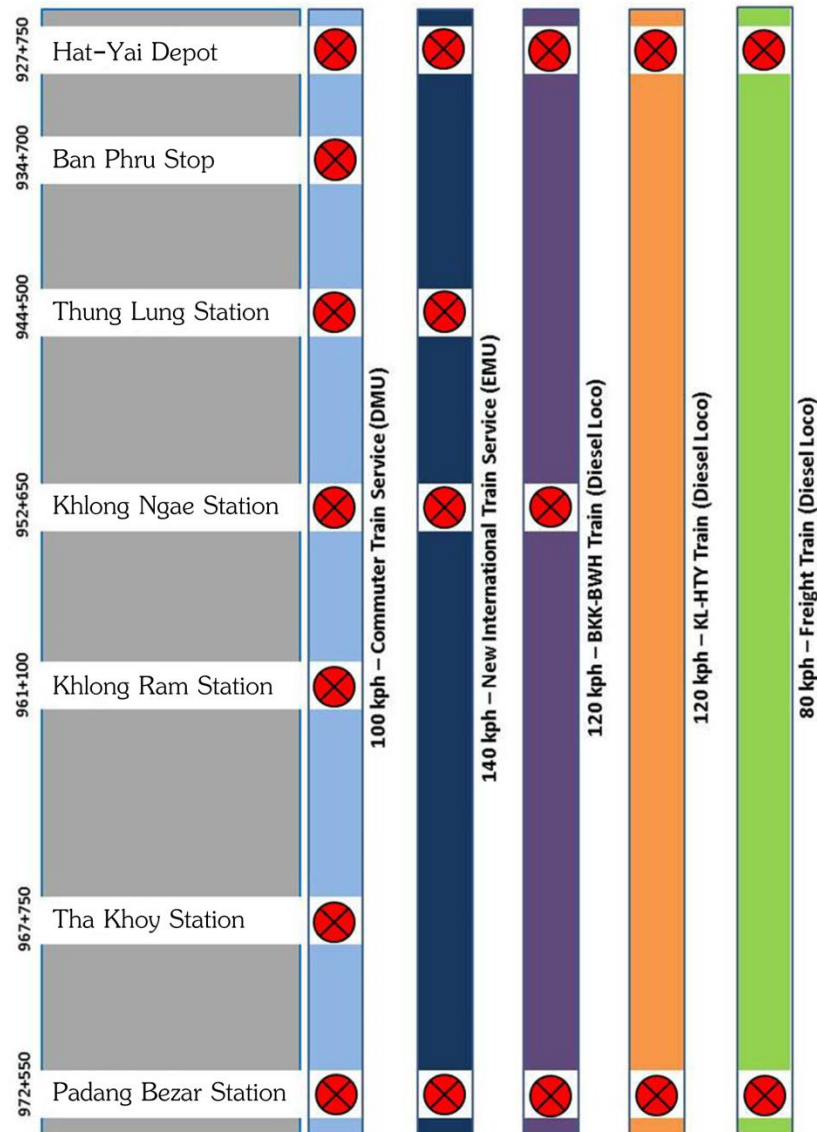


Figure 3.4-4 The Stop Plan for each Train Type

■ The Number of Trains and Train Operation Plan

The Consultants have calculated the number of train operations and Rolling Stock of each type of the trains in order to estimate the cost of train procurement and the expenses of maintenance and train operation.

The Consultants have analysed the Train Operation Plan into 2 cases: with the electrified system and without the electrified system. The results of the necessary number of passenger trains and freight trains for each case as shown in **Table 3.4-14** to **Table 3.4-15** will be illustrated in the 2050 Train Operation Diagram in **Figure 3.4-5**.

Table 3.4-14
The Suitable Number of Trips with the Electrified Train System

Number of Trips (per day per direction)		2021	2030	2040	2050
Special Diesel Express Trains (Bangkok-Butterworth)	Number of trips(2 directions)	2 (4)	2 (4)	3 (6)	4 (8)
	Passenger Line Load (people/day)	736	968	1,452	1,936
Rapid Electric Train (Kuala Lumpur-Hat Yai)	Number of trips(2 directions)	1 (2)	2 (4)	2 (4)	4 (8)
	Passenger Line Load (people/day)	450	900	900	1,800
Special Diesel Express Trains (Kuala Lumpur-Hat Yai)	Number of trips(2 directions)	1 (2)	1 (2)	2 (4)	2 (4)
	Passenger Line Load (people/day)	344	496	992	992
Diesel Local Commuter Trains (Suratthani-Padang Besar)	Number of trips(2 directions)	2 (4)	3 (6)	4 (8)	6 (12)
	Passenger Line Load (people/day)	760	1,596	2,128	3,192
Total Passenger Line Load (people/day)		2,320	4,020	5,532	8,040
Max. Passenger Line Load (people/day)		2,207	3,629	5,320	7,581
Freight Trains (Bangkok-Padang Besar)	Number of trips(2 directions)	4 (8)	5 (10)	6 (12)	7 (14)
Freight Line Load (ton/day)		2,700	3,375	4,320	5,355
Max. Freight Line Load (ton./day)		2,617	3,362	4,221	5,226
Total number of trains (train/day/2 directions)		20	26	34	46

Source: The Consultants

Table 3.4-15
The Suitable Number of Trips without the Electrified System

Number of Trips (per day per direction)		2021	2030	2040	2050
Special Diesel Rapid Trains (Bangkok-Butterworth)	Number of trips(2 directions)	3 (6)	4 (8)	5 (10)	7 (14)
	Passenger Line Load (people/day)	1,104	1,936	2,420	3,398
Rapid Electric Trains (Kuala Lumpur-Hat Yai)	Number of trips(2 directions)	-	-	-	-
	Passenger Line Load (people/day)	-	-	-	-
Special Diesel Express Trains (Kuala Lumpur-Hat Yai)	Number of trips(2 directions)	1 (2)	1 (2)	2 (4)	2 (4)
	Passenger Line Load (people/day)	344	496	992	992
Local Diesel Commuter Trains (Suratthani-Padang Besar)	Number of trips(2 directions)	2 (4)	3 (6)	4 (8)	6 (12)
	Passenger Line Load (people/day)	760	1,596	2,128	3,192
Total Passenger Line Load (people/day)		2,208	4,028	5,540	7,582
Max. Passenger Line Load (ton./day)		2,201	3,629	5,320	7,581
Diesel Freight Trains (Bangkok-Padang Besar)	Number of trips(2 directions))	4 (8)	5 (10)	6 (12)	7 (14)
Freight Line Load (ton/day)		2,700	3,375	4,320	5,355
Max. Freight Line Load (ton./day)		2,617	3,362	4,221	5,226
Total number of Trains (trains/day/2 directions)		20	26	34	46

Source: The Consultants

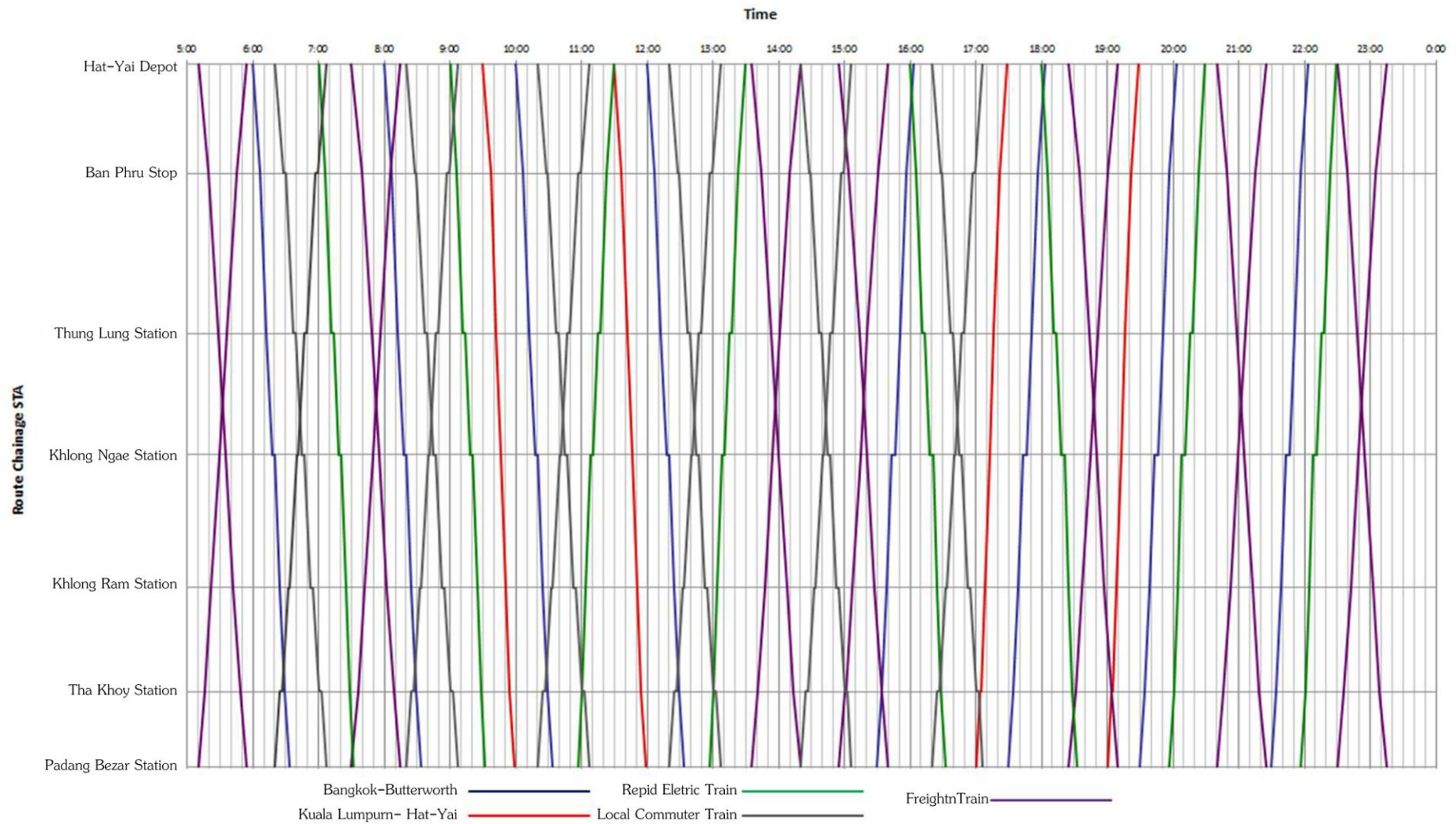


Figure 3.4-5 The Train Operation Diagram in 2050

■ The Cost Estimate of the Train Operation and Maintenance

The Cost Estimates of the Train Operation in this Project have been based on the extension of the connecting routes between major cities and will calculate only the cost of fuel including the expenses of the train operation by the track system in this Project. This will not cover the train operation outside of the Project as the returns from the passenger fares will not be part of the Project.

From the suitable number of trips for the Project Train Operation as discussed above and from the Train Operation of each route, the number of trains needed for the operation is shown in **Table 3.4-16**

From the collected data, the Cost Estimates of Maintenance and Train Operation with and without the Electrified System are shown in **Table 3.4-17** and **Table 3.4-19**

Table 3.4-16
The Suitable Number of Trains for Each Route

The Suitable Number of Trains	With the Electrified System				Without the Electrified System			
	2021	2030	2040	2050	2021	2030	2040	2050
Special Diesel Express Trains (Bangkok-Butterworth)	4	4	6	8	6	8	8	14
Rapid Electric Trains (Kuala Lumpur-Hat Yai)	1	2	2	4	-	-	-	-
Special Diesel Express Trains (Kuala Lumpur-Hat Yai)	1	1	2	2	1	1	2	2
Diesel Freezer Train (Nakhon Sri Thammarat-Padang Besar)	2	3	4	6	2	3	4	6
Diesel Freight Train (Bangkok-Padang Besar)	6	8	10	12	6	8	10	12
Diesel Freight Train (Hat Yai-Padang Besar))	1	1	1	1	1	1	1	1

Table 3.4-17
The Suitable Number of Rolling Stock of each Type for the Train Operation

(Car)	Number of Rolling Stock /Electrified System				Number of Rolling Stock /Non-Electrified System			
	2021	2030	2040	2050	2021	2030	2040	2050
Diseel Track	14	29	29	38	14	29	29	38
Locomotive	16	19	25	30	22	30	35	47
Container Carrier	149	181	221	276	149	181	221	276
Brake Van	9	11	13	15	9	11	13	15
First Class Passenger Car	3	3	5	6	5	6	8	11
Second Class Passenger Car	3	6	9	12	5	12	15	21
Third Class Passenger Car	13	16	24	31	19	31	39	54
Dining Car	3	3	5	6	5	6	8	11
Total	210	268	331	414	228	306	368	473

Table 3.4-18
The Cost of the Train Operation with the Electrified System

		The Cost of Train Operation and Maintenance			
(baht/year)		2021	2030	2040	2050
Maintenance	Diesel Track Train	4,952,682	10,259,128	10,259,128	13,442,995
	Locomotive	9,177,787	10,898,622	14,340,293	17,208,351
	Container Carrier	449,191	545,662	666,250	832,059
	Brake Van	73,109	89,355	105,602	121,848
	First Class Passenger Car	7,117,573	7,117,573	11,862,621	14,235,145
	Second Class Passenger Car	979,095	1,958,190	2,937,284	3,916,379
	Third Class Passenger Car	4,243,089	5,222,263	7,833,394	10,118,134
	Dining Car	251,469	251,469	419,115	502,938
	Total cost of maintenance	27,243,995	36,342,261	48,423,687	60,377,849
Train operation	Personnel Management	26,376,000	28,492,800	30,609,600	32,726,400
	Fuel	42,769,935	58,144,820	78,946,772	100,657,632
	Electrical Power for Train operation	12,143,412	17,966,465	17,966,465	31,566,429
	Total cost of train operation	81,289,347	104,604,085	127,522,837	164,950,460
Total cost of train operation and maintenance		108,533,342	140,946,346	175,946,524	225,328,310

Source: The Consultants

Table 3.4-19
The Cost of the Train Operation without the Electrified System

		The Cost of Train Operation and Maintenance			
(baht/year)		2021	2030	2040	2050
Maintenance	Diesel Track Train	4,952,682	10,259,128	13,442,995	20,164,493
	Locomotive	12,619,458	17,208,351	20,076,410	26,959,750
	Container Carrier	449,191	545,662	666,250	832,059
	Brake Van	73,109	89,355	105,602	121,848
	First Class Passenger Car	11,862,621	14,235,145	18,980,193	26,097,766
	Second Class Passenger Car	1,631,825	3,916,379	4,895,474	6,853,664
	Third Class Passenger Car	6,201,437	10,118,134	12,729,266	17,625,137
	Dining Car	419,115	502,938	670,584	922,053
	Total cost of maintenance	38,209,437	56,875,092	71,566,773	99,576,769
Train operation	Personnel Management	23,352,000	25,242,000	27,132,000	29,022,000
	Fuel	53,988,373	78,711,956	97,659,533	132,466,252
	Electrical Power for Train operation	-	-	-	-
	Total cost of train operation	77,340,373	103,953,956	124,791,533	161,488,252
Total cost of train operation and maintenance		115,549,810	160,829,048	196,358,306	261,065,021

Source: The Consultants

3.4.2 The Engineering Feasibility

In the Design of the Hat Yai-Padang Besar Double Tracks Electric Train, the Project route will combine the high speed trains (120-160 km/hour) and the international freight trains (120 km/hour) from the ASEAN countries such as Singapore, Malaysia into Thai borders. Therefore the Design has been drawn to accommodate transportation of both passenger trains and freight trains.

1) The Geometric Requirement of the Track System

Table 3.4-20
The Geometric Requirement of the Track System

Item	Passenger Train	Freight Train	Remarks
Maximum Design Speed	160 km/hr	120 km/hr	
Maximum operational Speed	120 km/hr	100 km/hr	
Number of tracks between station on the main line	2		
Track gauge	1,000 mm.		
Rail Profile			
Main Track	EN54 E1(UIC54)		
Side track & Maintenance Shop	EN54 E1(UIC54)		
Track Spacing			
Between main tracks	4.50 m.		for Maximum Design Speed 160 km/hr
Between main track & side track	6.00 m.		

3.4.2.1 Track Structure

1) Track Types

The track structure is Ballasted Track or Classical Track or Conventional Track with the weight shifting components of rail, fastening system, sleeper, ballast bed, sub-ballast and subgrade, the general component of a ballasted track.

The rail/wheel interaction will be shifted to the rail fastener, sleeper, sub-ballast and sub-grade via protective ballast layer as shown in **Figure 3.4.6** The impact of the rail/wheel interaction will depend on the thickness of the designed protective ballast layer.

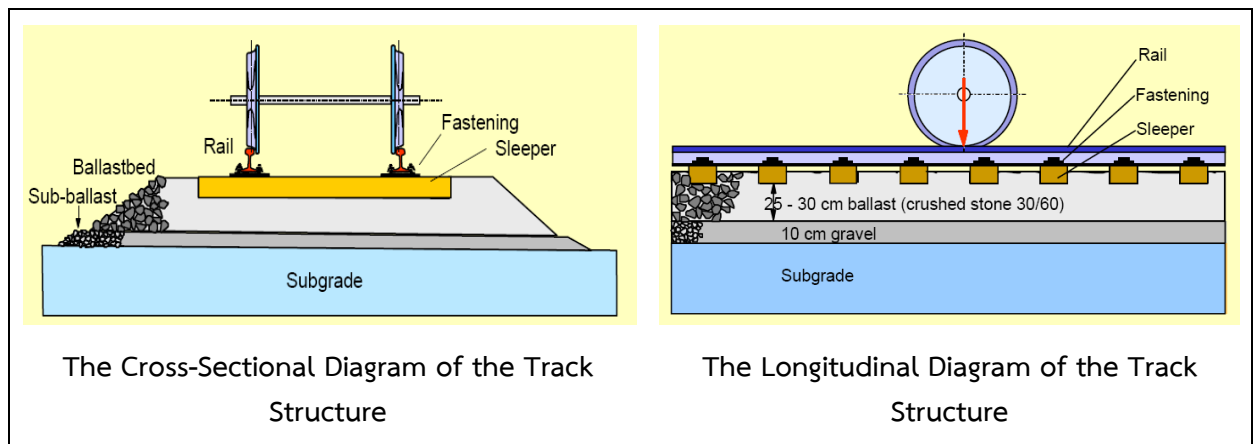


Figure 3.4-6 The Structure of Ballasted Tracks

Table 3.4-21
Summary of the Project Track System

Item	Details
1. Design Axle Loads	- 16 tons for passenger Trains - 20 tons for freight trains
2. Track Gauge	- 1,000 mm.
3. Rail profile	- UIC 54
4. Rail Inclination	- 1:70
5. Long connecting rail (CWR)	- For the principal track
6. The lowest thickness of ballast under the sleepers	- 300 mm. for the principal track - 250 mm. for the alternating track
7. Sleeper	- Prestressed Monoblock Concrete Sleeper
8. Turnout Angle	- 1:16 For the principal track - 1:10 and 1:8 for the alternating track

3.4.2.2 Permanent Way Structure

In the Design of the Way Structure, the Consultants have analysed the stability and strength of the subgrade along the train line of the Project as it passes through diverse geological structures and foundation soil qualities on the assumption that the quality of the soil structure would be significant to the stability of the way structure.

As for the location for the design of the subgrade which starts from km. 932+000 to km. 945+500, the soil structure is softer than in the other location along the train line as it is found on the low basin often flooded. However, from the analysis, it was found that no fortification of the soil will be needed and there is no need for the modification of the way structure or prevention of land collapse as the land collapse tendency is still stable and will not cause any damage to the tracks as shown in **Figure 3.4-7**

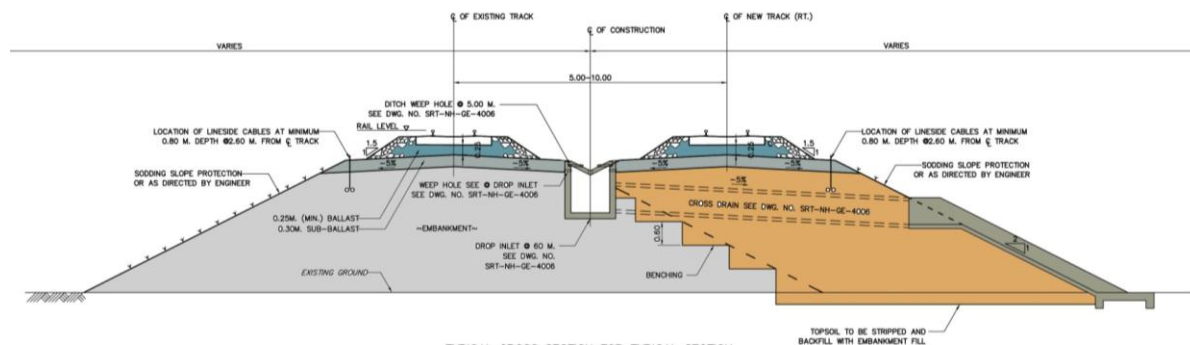


Figure 3.4-7 The Ground Level Track Structure

3.4.2.3 The Elevated Train Tracks

The Design of the Elevated Train Tracks

The Project will use the elevated tracks in two sections: from Sta.933+077 to Sta.93+572 of 2,495 meters and from Sta.951+558 to Sta.953+687 of 2,120 meters.

In the design of the elevated tracks or bridge, the Consultants have foreseen the following objectives:

- Strong and durable structure
- Aesthetic presentation
- Modern construction technology suitable with the location
- Reasonable cost of construction
- Maximal use of construction materials from within the country
- Minimal maintenance cost

The suitability of the design will be considered from the following factors: construction cost, safety, stability of the structure, construction methods, construction time, topographical condition, environment and geological conditions.

In general, the elevated track structure will be constructed at the crossing point with the main street in the city. The Consultants have followed the procedures according to the criteria and international standard with some modifications of the existing track structure that may come into the elevated train line. The design of the track type will depend on several factors such as distance of the bridge, topographical condition, etc. If the distance of the elevated track is not too long, the structure will be reinforced concrete cast on location but if the distance is longer, compressed concrete beams or metal bridge will be used.

For this Project, the elevated tracks will use double tracks combined with the elevated bridge of 25 meters with compressed concrete beams as this structure can be conveniently built and is not costly. Many builders in the South can cast these beams. The Design of the elevated track structure is shown in **Figure 3.4-8**

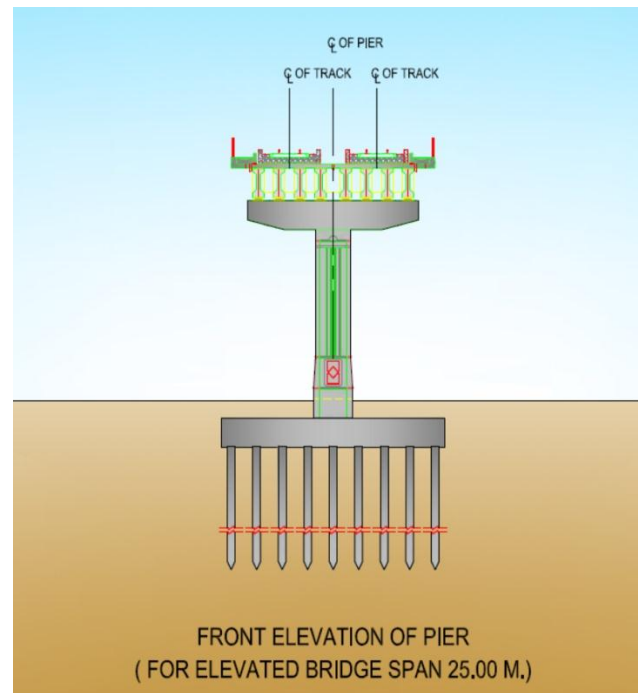


Figure 3.4-8 The Structure of the Elevated Tracks

3.4.2.4 The Design of the Elevated Bridge

1) Summary of the Bridge Structure

Along the Project Train Line, there will be construction of 31 bridges, a total distance of 5,770 meters, which are: the ground level bridge for the single track train (using the existing bridge structure) of 635 m., the ground level bridge for the double tracks train of 520m., and the elevated bridge for the double tracks train of 4,615 m. as shown in **Table 3.4-22**

Table 3.4-22 Summary of the Train Bridge

No.	Sta.	Number of Track	Type of Structure	No. Span x Span Length	Total Length (m.)
1	STA. 929+279.334(RT.)	Single Track	Concrete Bridge	4x10.00=40.00 M.	40
2	STA. 930+370.013(RT.)	Single Track	Steel Bridge	25.00+50.00=75.00 M.	75
3	STA. 931+052.058(RT.)	Single Track	Steel Bridge	2x20.00=40.00 M.	40
4	STA. 932+117.659(RT.)	Single Track	Steel Bridge	3x10.00=30.00 M.	30
5	STA. 933+077.068(RT) to STA. 935+572.068 (RT)	Double Track Elevated	Concrete and Steel Bridge	(33x25.00)+(2x60.00)+(62x25.00) = 2495 M.	2,495
6	STA. 936+673.485(RT.)	Single Track	Steel Bridge	1x10.00=10.00 M.	10
7	STA. 936+868.416(RT.)	Single Track	Concrete Bridge	1x20.00 = 20.00 M.	20

No.	Sta.	Number of Track	Type of Structure	No. Span x Span Length	Total Length (m.)
8	STA. 938+391.891(RT.)	Single Track	Steel Bridge	1x25.00 = 25.00 M.	25
9	STA. 940+181.409(RT.)	Single Track	Steel Bridge	1x25.00 = 25.00 M.	25
10	STA. 941+235.961(RT.)	Single Track	Steel Bridge	3x20.00 = 60.00 M.	60
11	STA. 941+777.927(RT.)	Single Track	Concrete Bridge	3x10.00=30.00 M.(x2)	30
12	STA. 942+746.129(RT.)	Single Track	Steel Bridge	1x25.00 = 25.00 M.	25
13	STA. 944+391.129(RT.)	Double Track	Steel Bridge	1x30.00 = 30.00 M.	30
14	STA. 945+474.129(RT.)	Double Track	Steel Bridge	1x50.00 = 50.00	50
15	STA. 946+058.802(RT.)	Double Track	Steel Bridge	1x20.00 = 20.00 M.	20
16	STA. 946+480.312 (RT)	Single Track	Concrete Bridge	1x20.00=20.00 M. (x2)	20
17	STA. 947+057.930(RT.)	Single Track	Steel Bridge	1x10.00=10.00 M.	10
18	STA. 947+825.930(RT.)	Single Track	Steel Bridge	1x25.00 = 25.00 M.	25
19	STA. 948+332.777(RT.)	Single Track	Steel Bridge	3x10.00=30.00 M.	30
20	STA. 948+887.085(RT.)	Single Track	Steel Bridge	1x40.00 = 40.00 M.	40
21	STA. 950+845.746(RT.)	Single Track	Steel Bridge	1x30.00 = 30.00 M.	30
22	STA. 951+558.881(RT) to STA. 953+687.881 (RT)	Double Track Elevated	Concrete and Steel Bridge	(30x25.00)+(2x60.00)+(22x25.00)+50.00+(17x25.00)+50.00+(7x25.00) = 2120 M.	2,120
23	STA. 954+314.500(RT.)	Double Track	Steel Bridge	30.00+50.00+30.00=110 M.	110
24	STA. 954+656.235(RT) to STA. 954+906.235 (RT)	Double Track	Concrete and Steel Bridge	10x25.00=250.00 M.	250
25	STA. 956+332.772(RT.)	Double Track	Steel Bridge	1x15.00 = 15.00	15
26	STA. 956+887.970(RT)	Single Track	Concrete Bridge	1x10.00=10.00 M. (x2)	20
27	STA. 957+230.715(RT.)	Single Track	Concrete Bridge	1x10.00 = 10.00 M.	10
28	STA. 960+178.028(RT.)	Single Track	Steel Bridge	1x15.00=15.00 M.	15
29	STA. 962+926.830(RT.)	Single Track	Concrete Bridge	2x10.00 = 20.00 M.	20
30	STA. 963+664.830(RT.)	Single Track	Concrete Bridge	2x10.00 = 20.00 M.	20
31	STA. 965+695.852(RT.)	Double Track	Steel Bridge	1x15.00 = 15.00 M.	15
33	STA. 967+080.697(RT.)	Double Track	Steel Bridge	1x30.00=30.00 M.	30

No.	Sta.	Number of Track	Type of Structure	No. Span x Span Length	Total Length (m.)
35	STA. 972+314.524(RT.)	Single Track	Steel Bridge	1x15.00=15.00 M.	15
				Total	5,770

3.4.2.5 Types of the Bridge Structure

In the Design of the Train Bridge, the Consultants have considered the volume of the stream running under the bridge and suitable topographical condition according to the international engineering standard such as strength, durability and safety. Moreover, the Consultants also considered suitability to the environment by laying a minimal number of piles in the water.

The factors for the selection of the bridge type are:

1) The construction cost

As there are a number of bridges to be constructed, the cost of construction in the bridge structure work will be high. Besides designing the bridges for suitable cost, the Consultants have also looked into suitable types of bridge to the water channel and reasonable construction cost.

2) The method of construction

As at some location, the access to the bridge construction is difficult, the construction method has to be appropriate and practical.

3) The type of nearby bridge

In finding the suitable location of each bridge, the Consultants will bring into consideration the positioning of the piles and the span of the underpass of the nearby bridges.

4) Aesthetic value

The design of each bridge will consider the structure and the suitable proportion to yield aesthetic value to the bridge.

5) Difficulty of the construction

The Consultants have designed the construction method of each bridge not to be complicated and without complex technology so most building contractors can operate and only necessary heavy equipment will be required.

6) Time for the Construction

To reduce field work, the bridges have been designed to use pre-fab materials that will be assembled on site. The construction of each bridge should take between 12-18 months except for the long bridges.

7) Construction Materials

As for most construction materials, the Consultants have chosen those that are made in Thailand with international standard and certified with ISO.

The structure of the Train Bridge suitable for each length is:

<u>The length of the Bridge (m.)</u>	<u>The structure of the Upper Part of the Bridge</u>
10	Cast In-situ Reinforced Concrete Slab
15, 20, 25, 30	Pre-stressed Concrete Girder when there is no restriction on height under the bridge
15, 20, 25, 30	Steel bridge when there is not enough height under the bridge
40 up	Steel bridge

In the design of the bridge across the running stream or over the existing train tracks, the drainage bridge has been included. The Consultants have chosen the bridges with the length wider than the stream so it will not block the running course. In case of an existing bridge, the piles of the new bridge will be set parallel with the old bridge not blocking the water course. If the length of the bridge is not too long, cast in-situ reinforced concrete slab will be used but if the length is longer, pre-stressed concrete slab or steel bridge will be used instead. Examples of the bridge structure are shown in Figure 3.4-9 to Figure 3.4-11

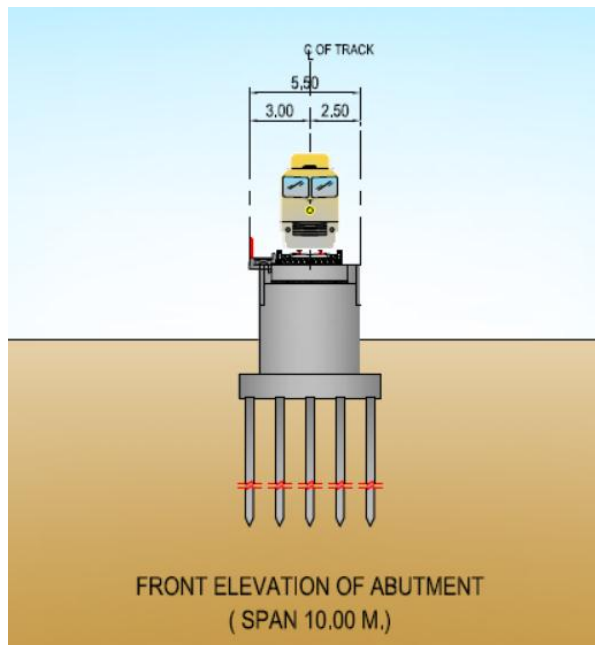


Figure 3.4-9 The Bridge Structure with Cast In-Situ Reinforced Concrete Slabs

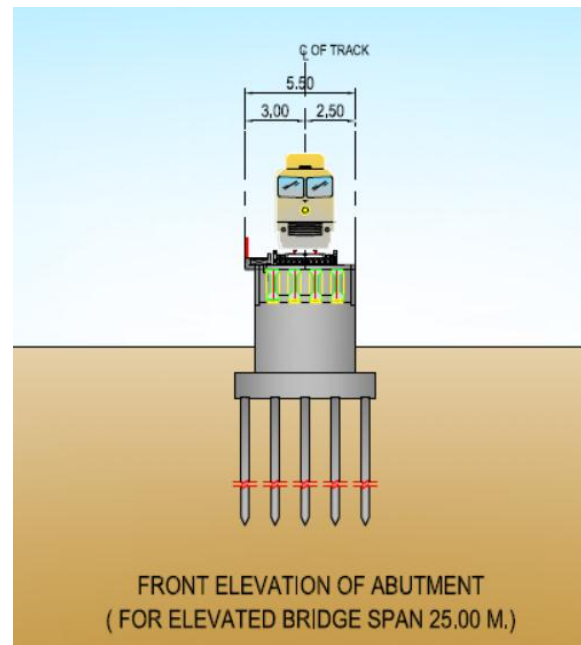


Figure 3.4-10 The Bridge Structure of Pre-Stressed Concrete Slabs

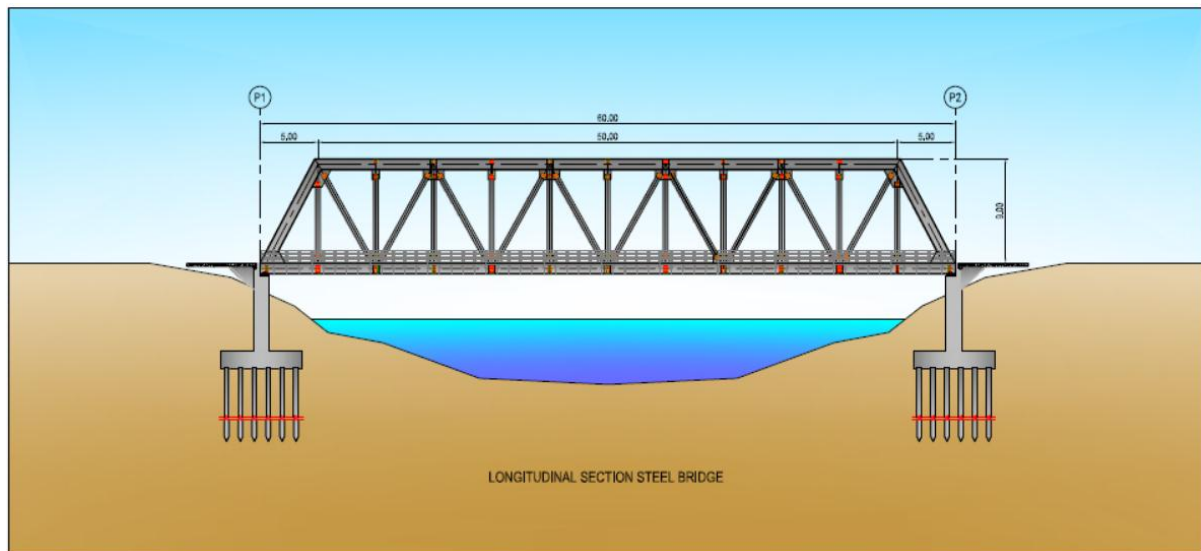


Figure 3.4-11 The Steel Bridge Structure

3.4.2.6 The Stations and the Compound

1) The Location of the Station and the Compound

Along the Hat Yai-Padang Besar Train route, there will be 4 stations and 3 stops. The design of the Project has adjusted the station compound to suit the new concept of the Train Operation and the Train Line which will connect with other transportation modes in the future. The old stations will be renovate and modernized into future stations such as Sala Thung Lung Station. The station compound will be developed to suit future development plan such as Khlong Ngae Station. Additional train stops will be included to serve a complete service cycle such as Ban Phru Stop, Khlong Ram Stop, Tha Khoy Stop.

In order to comply with City Planning Measures and Land Management, considerations should be made on the suitable locations of the buildings at the train station and the design should focus on the maximal use of land, facilities supporting service and access to the station, land preparation for future development to avoid impact to the people from and land expropriation.

In the modification of the roles of the station and the development guidelines of the station compound, the types of the locations of the 4 stations and 3 stops are:

- **Hat Yai Junction** Located at the current Hat Yai Depot and working as the departure point; the design already included in the renovation of Hat Yai Depot under the Suratthani-Hat Yai-Songkhla Double Tracks Train.
- **Ban Phru Stopping Point** Located within the train area at Ban Phru Sub-district, Hat Yi District, Songkhla Province.

- **Sala Thung Lung Junction** Located at Sala Thung Lung Station, Patong Sub-district, Hat Yai District, Songkhla Province
- **Khlong Ngae Junction** Located at the current Khlong Ngae Station
- **Khlong Ram Stopping Point** Located within the train line at Ban Khlong Ram, Thung Mor Sub-district, Sadao District, Songkhla Province
- **Ban Tha Khoy Stopping point** Located within the train line at Ban Tha Khoy, Padang Bezar Sub-district, Sadao District, Songkhla Province
- **Padang Bezar 2 Junction** Located within the train area near Padang Bezar Station 2 on the Thai border, Padang Bezar Sub-district, Sadao District, Songkhla Province. At present, this area has been turned into public park and some occupied as residence and business shops.

The modifications of the roles of the stations and development guidelines of the station compound can be summed up as follow:

Table 3.4-23 Modifications of Roles and Functions of the Stations and Development Guidelines of the Station Compound

Stations/Stops	Modifications of Roles		Development	
	Present	Future	Present station building	Future station building
Hat Yai	Station	Station	Still in operation	Under the Suratthani-Hat Yai Double Track train Project
Ban Phru	Non-existing station condition	Stop	None	New stop building for new train
Sala Thung Lung	Remaining station compound	Station	None	New building (Type-S)
Khlong Ngae	Station	Station	Still in operation	New building (Type-S)
Khlong Ram	Non-existing station condition	Stop	None	New stop building for new rain
Tha Khoy	Non-existing station condition	Stop	None	New stop building for new train
Padang Bezar 2	Sub-station under construction	Station	New station (not in operation)	New building (Type-M)

2) The Architectural Design of the Station

To adhere with Thailand's vision of Transportation Infrastructure Development and the Rail Transport Development Plan, in the Study and the Design of the hat Yai-Padang Bezar Double Tracks Train project, the Consultants have conducted a Feasibility Study and Review of the Locations of the Stations and the Compound, all necessary components, related facilities by referring to the projection of transportation needs of freight and passengers, and the number of trains. The Master Plan includes the architectural design to be used in the calculation of the

construction cost, and also the effective road network entering and leaving the station and the compound.

1. The Principle Concept of the location of the Station and Compound

- Located in the community area for travel convenience
- Available parking area or transportation linkage
- No problem of landscape with historical or religious sites
- Avoiding as much land expropriation as possible
- Avoiding removing public utilities
- Allowing business development to service providers and the community around the station

2. The Station Planning

The station planning should harmonize with the location and represent the unique image of the community and consider facilities for the disabled.

The main considerations in the design of the station are efficiency, economics, clear understanding, safety and architectural creativity. The architectural design should be easy to apply and durable and representing the unique image of the Train system. The success of the station design would depend on the followings:

- convenient connection with other transport mode
- providing pleasant atmosphere to the surrounding area by allowing shops, restaurants and other facilities which aim to promote the community along the train line
- designing attractive entrance and exits

Without complicated approaches, the station would reach its goal in being compact in size, efficient and worthy of investment. The project will efficiently provide convenience to city travellers not only to meet the State's objectives but also the needed of the people in the society.

The ideal planning of the station and its compound must include convenience in transportation connection, necessary facilities for passengers, support system for freight transport and logistics. As for the Hat Yai-Padang Besar Train Project, considerations must include international standard customs procedures, convenience and practicality of use, economics and suitability to the train operation, lower cost of investment and management and finally safety measures for the passengers.

The architectural design of the station structure can choose contemporary Thai identity image of modern design depending on each station with consideration to the nearby location. As the station area is not large, the added architectural value may not require large budget but it will be worthwhile for the local people.

The station planning will also include emergency evacuation from the station in many cases such as fire so passengers and the disabled can be safely evacuated in time.

3) The Design of the Passenger Building

- **The Design Concept of the Station Building**

The design concept of the station building focuses on the use of the overall area and the technical access of the staff and station users and for the general public. Considerations should be made of transportation standard around the station for convenience and safe access. The architectural design should be aware of the weather condition and the uniqueness of the location, the projected number of passengers, types of service, the length of the fleet and future expansion. Good planning of the station will successfully meet future needs.

The design of the station compound includes the use of equipment and facilities according to the international standard of architecture and engineering such as safety system, emergency evacuation system according to National Fire Protection Association (NFPA), Universal design (UD), Standards and Regulations of National Safety Council of Thailand, Standards and Regulations of the Fire department, department of Civil Work and City Planning, etc.

- **The Design Concept of Architectural Form**

With consideration of the unique identity of the location and modern architecture, the design of the station and the compound for passengers should be:

“Retaining the traditional and unique architectural form on the use area with modernity and Universal Design”

This means integration between “modernity” and “locality” to create new unique image of the community around the station. The modern architectural design could be represented by simplicity of form and structure including the use of modern construction materials. The uniqueness of the location can be displayed in integrating the present station which is historically significant with the physical configurations of the surrounding community and location especially along the Hat Yai-Padang Besar Train line. (Figure 3.4-12) Moreover, the architectural design must correspond with the weather condition with heavy rain for convenience of passengers.



Figure 3.4-12 The Architectural Concept of the Project Train Station

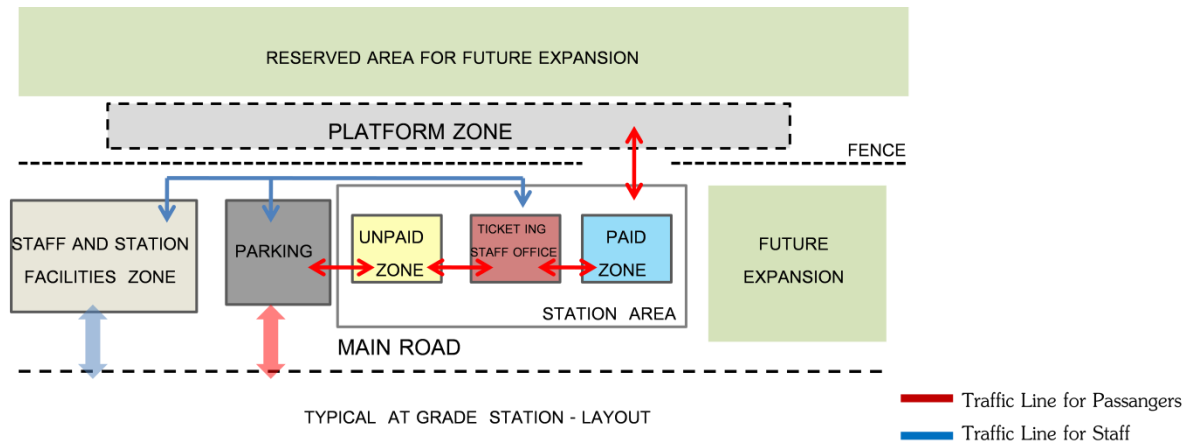
In the design of the stations for the Hat Yai-Padang Besar Train Project, the following points are considered:

- History and significance of the station building and compound along the Hat Yai-Padang Besar Train Line
- The architectural form of the station building along the Hat Yai-Padang Besar Train Line
 - The building will be a mixture of European and Thai architecture with the arch form decorated with sculpted stucco along the gable and roofline or Clipped Gable with 30 degree slope, terra cotta roof tiles and wooden doors and windows.
 - The building has an applied Thai architecture design with a unique form of the Thai gable with minimal decorations
- The architectural form that influences the design of the Hat Yai-Padang Besar Train Station is that of the Khlong Ngae Station which had been built during King Chulalongkorn in 1909 for the train connection with Malaysia. The Khlong Ngae Station is one of the historical train stations with unique building design that is still in operation on the train route from Hat Yai to Padang Besar. The building was a mixture of concrete and wood influenced by the Victorian architecture with carvings and delicate arch roof support. The building was painted with cream color outlined with brown and dark brown color.

4) The Concept of the Function Area

- The Detailed Design of the Function Area of the Station Building and Outlying Buildings

- The layout of the station building and other outlying buildings is in line with the planning of the compound, the train operation system and number of passengers projected at each station. The composition of the station building and outlying buildings are:



- The Station Plaza consists of parking area for passengers, multi-purpose parking, area connecting with other transport modes and facilities for the community such as green area for recreation, , activity area, monument sculpture of important local people or symbol, police box, etc.
- The Station building is divided into public area for passengers and special area for staff
- The Platform is designed to serve the train operation, entrance and exit to the station
- The detailed design of the station building and outlying buildings focuses on convenience for passengers and staff. The layout of the function area is as follow:
 - The area for passenger traffic and service such as the entrance hall, ticketing area, waiting area, PR section including First Aid Room, telecommunication service area, banking service, Prayer Room, rest rooms. These areas should be set as Paid Area for passengers with the train tickets and Unpaid Area for those without the tickets. Facilities should be provided for the elderly and the disabled according to the Universal.
 - Design Concept. The function area for the staff includes ticket booth, train operation control room, offices for the Station Manager and clerical staff, meeting room, inventory room, rest room.

- Business area such as restaurants, shops, souvenir shops, bookstores. This area should be separate from the main station building with connecting walkway for convenience and future expansion.

The layout of the station building includes:

- Station Plaza: parking for passengers, multi-purpose parking connected with the outlying community
- Station buildings: public area for passengers and restricted area for staff
- Platform: servicing area for traffic and train operation work

The design of the layout of the station will suit the location and the outlying buildings for easy access to the station and emergency evacuation. The entrance-exit must connect with other transportation modes. The station plaza will provide activities area and keep close to the identity of the local community near the station.

The design of the station and plaza will consider the specific location, number of running trains, projected number of passengers and freight volume at each station, number of staff and local community attractions such as tourist attractions, government offices, etc.

The number of passengers is the main factor in deciding the size of the station to meet future expansion. From the study of maximal number of passengers, there will be 3 types of station classified according to the number of passengers per hour:

- (1) Small stations servicing 1-80 passengers per hour or not more than 900 passengers per day such as Sala Thung Lung Station.
- (2) Medium stations servicing 81-160 passengers per hour or between 900-1,600 passengers per day such as Khlong Ngae Station.
- (3) Large stations servicing more than 161-400 passengers per hour or between 1,600-4,000 passengers per day such as Padang Besar Station.

Most station buildings in the Project will be built new at nearby locations so not to affect the local way of living or the existing train operation. However, there should be conservation of the original station and promotion of activities for the benefit of the local Community in conjunction with travel and tourism such as turning the building into library, local museum, etc.

As for the development plan for Khlong Ngae Station, there will be preservation of the original building and construction of new buildings only around them by not adding any new structure to the original building so not to cause any damage to this distinctive historical station building. The new building will be built next to the original one along with the train bridge or underpass for convenience of transportation connection at present and future expansion.

1. Sala Thung Lung Station

The station compound of Sala Thung Lung Station is located in the suburban area south of Hat Yai near Hat Yai Airport. The old residential community which has a unique structure is quite dense along Kanjanawarit Road and Sala Thung Lung Station. The development plan of Sala Thung Lung Station compound to serve the electric train must consider the followings:

- 1) The location of the station will turn to be future urban space but the original public park should be kept and future development should serve the new station
- 2) Preparation for parking area for personal cars, passengers and staff and activities required for transportation connection such as parking for public buses, hired vehicles, bicycles, motorcycles and common area of the station such as passenger pick-up area, freight pick up area.
- 3) Preparation for future expansion of travel activities and linkage to Transit-Oriented Development from growth in travel and transport and Hat Yai itself
- 4) Effective traffic system that will not pose any problem to travel or the community activities but in fact support travel and transportation with facilities for passenger and freight transportation by trains at Sala Thung Lung Station

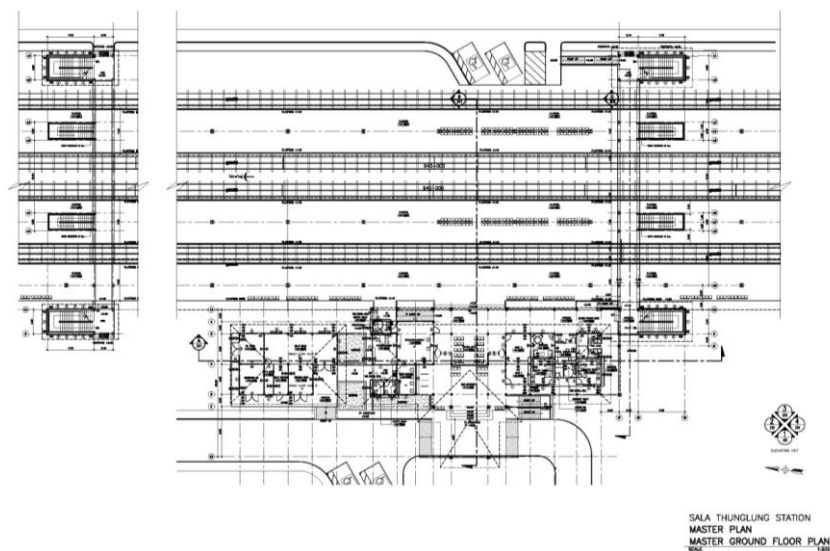


Figure 3.4-13 The Sala Thung Lung Station Plan

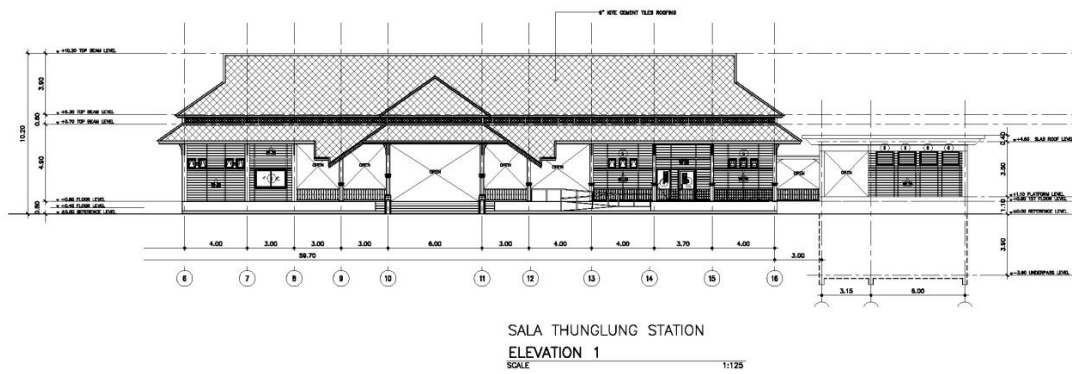


Figure 3.4-14 The Front View of Sala Thung Lung Station

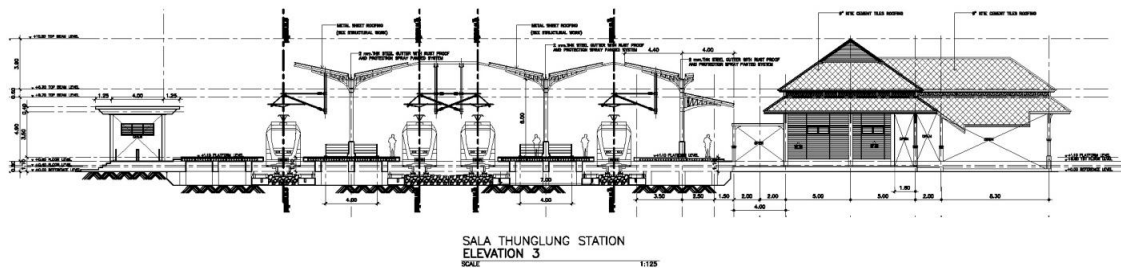
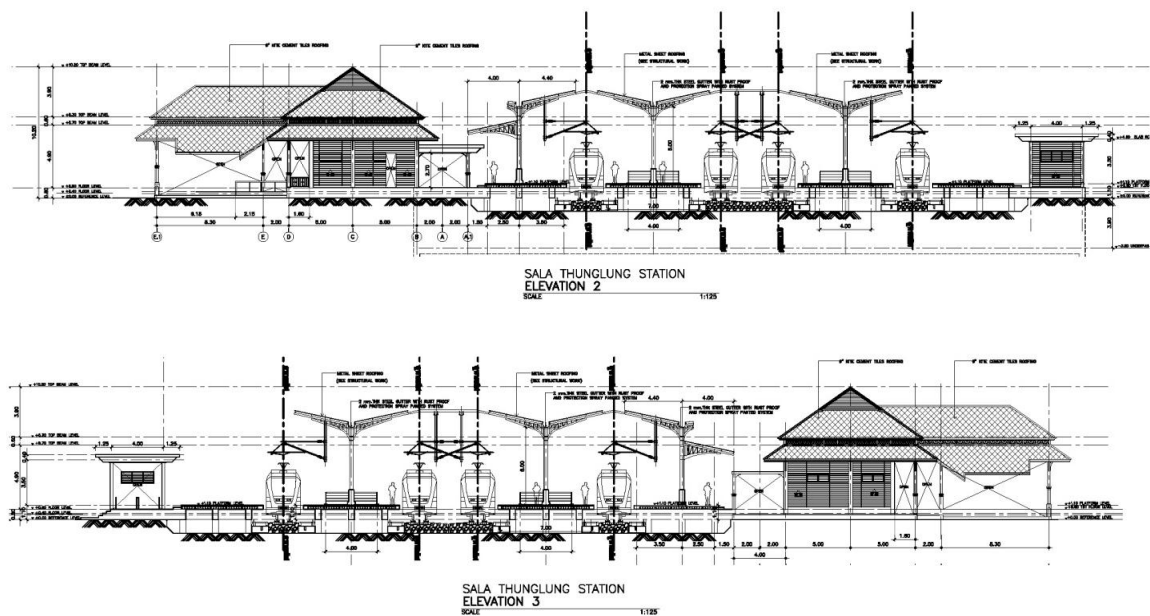


Figure 3.4-15 The Side View of Sala Thung Lung Station



Figure 3.4-16 The View of the Platform at Sala Thung Lung Station

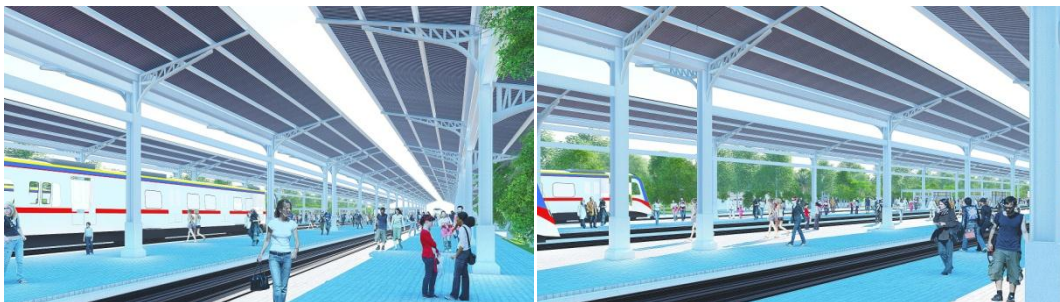


Figure 3.4-17 The View of the Platform at Sala Thung Lung Station

2. Khlong Ngae Station

The Station is located at Phang La Sub-district with highly populated Khlong Ngae residential community situated east of Kanjanawanit Road across from the old train station. This is an old business section and has been a center of the road network to the border such as Sadao. In the future, if there is a construction of Route 4145 to Satun Province, the connection will then be extended to Prajandai Border Check Point. Khlong Ngae Community has high growth potential in serving border trading and future development. The development of the Padang Besar-Hat Yai Station and the Station Compound should consider the followings:

- 1) Khlong Ngae Station is an elevated train track and platform above ground. The area in the south of the Station can be used as parking area and travel supporting activities area, and helps reduce the crossing point between the train tracks and the road.
- 2) The area at the Station classified as ROW can be used as parking area, and Inter-Transport Facility with the area under the platform above the crossing point between the track and the road.
- 3) For inter-transport activities into the Station, the Station compound has been connected for smooth convenience by the use of bridge and underpass of the elevated structure. The preparation of the area and use of the land around the Station has been made to serve future change of the city from the Trend of Development in commerce (TOD).
- 4) The change of the original road network into a loop cycle has provided smooth circulation system in passenger pick-up and entry/exit to the local roads
- 5) Preparation of the structure and the area to meet future expansion of train operation and freight transport and preparation of the area for equipment for train operation and container yard.

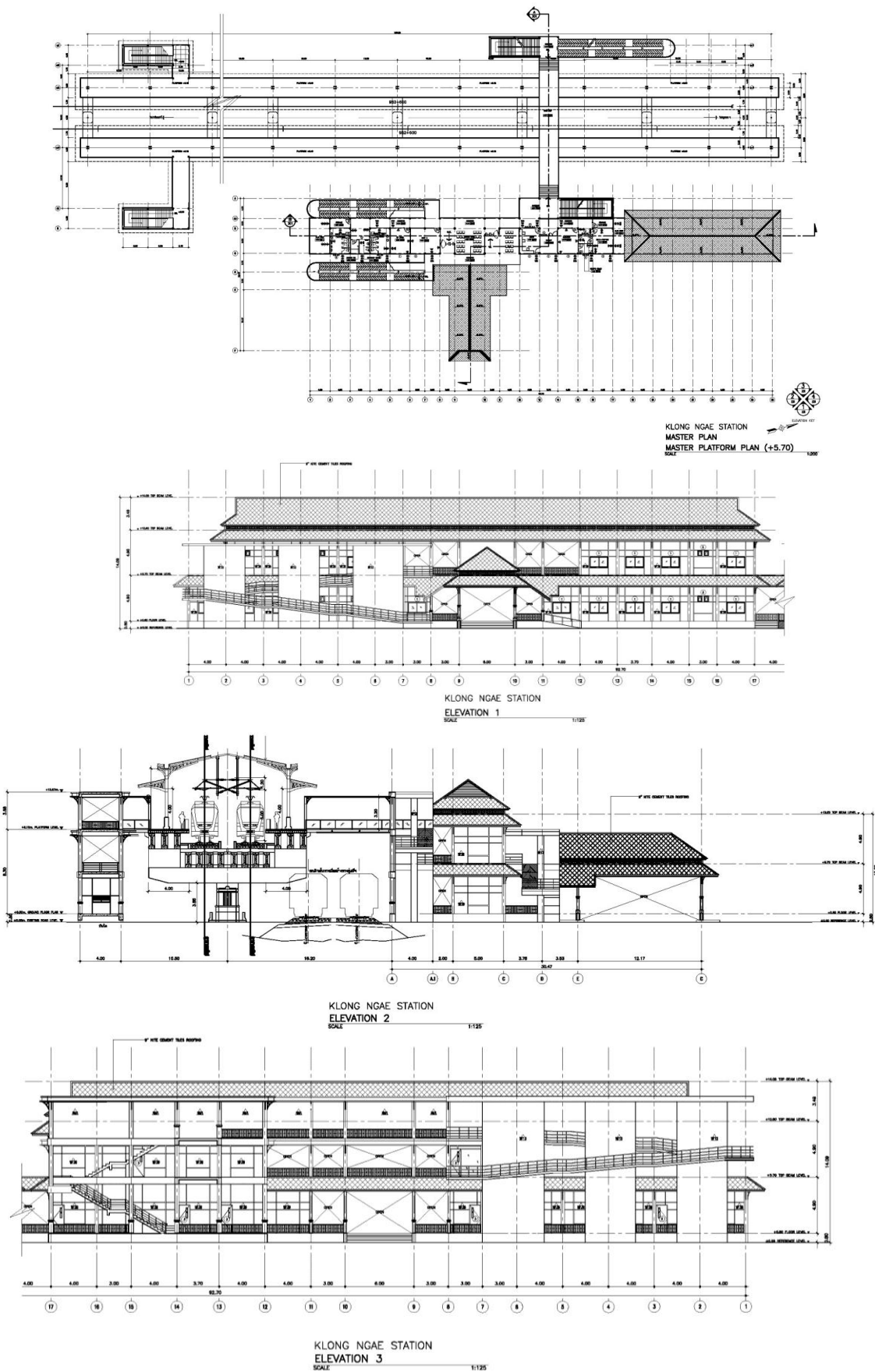


Figure 3.4-18 Khlong Ngae Station Plan



Figure 3.4-19 The Front View of Khlong Ngae Station



Figure 3.4-20 The Front View of Khlong Ngae Station



Figure 3.4-21 The Panorama View of Khlong Ngae Station



Figure 3.4-22 The Outlook of the Slope Area at Khlong Ngae Station



Figure 3.4-23 The Outlook of the Ground Floor Walkway at Khlong Ngae Station

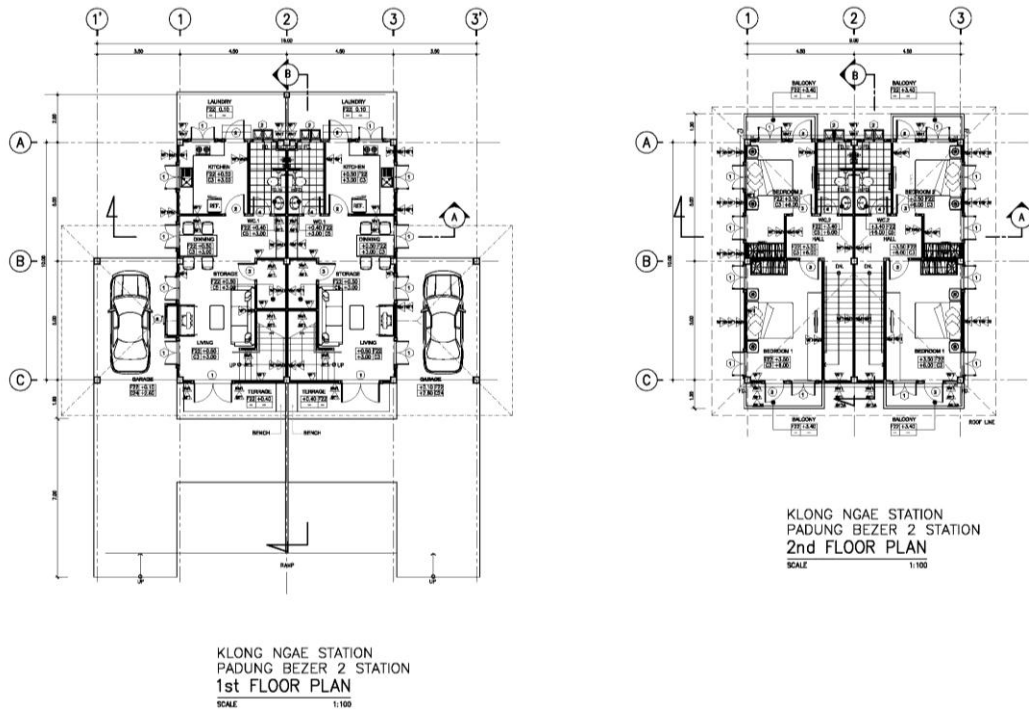


Figure 3.4-24 The Staff Lodge Type-A Plan at Khlong Ngae Station

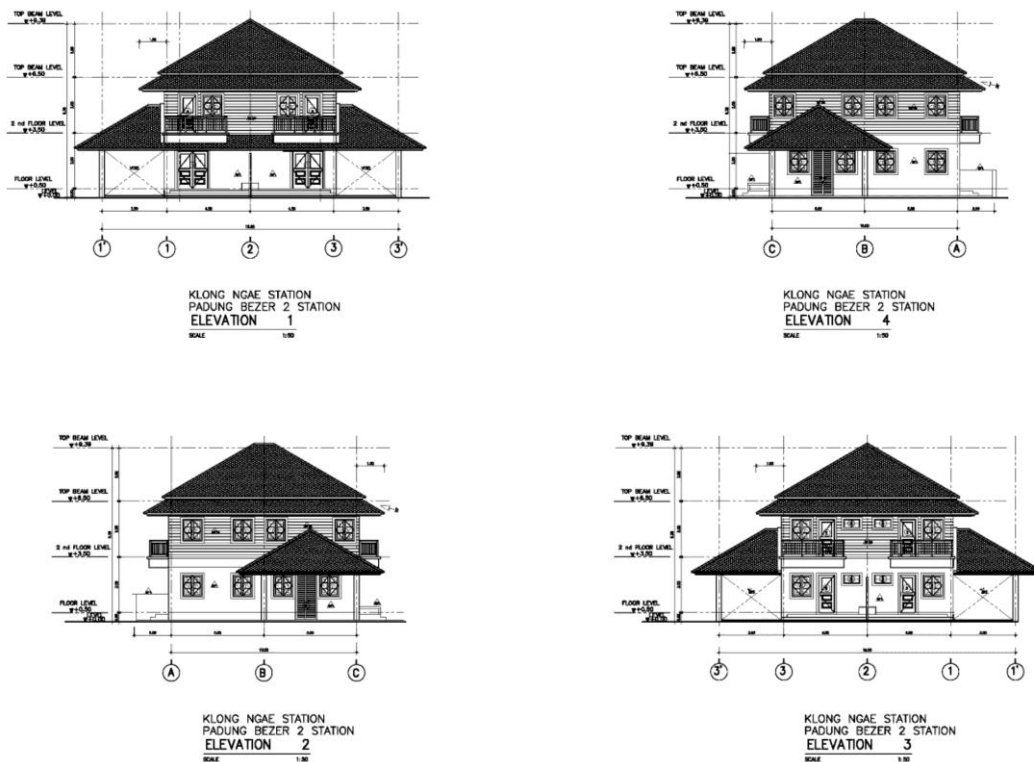


Figure 3.4-25 The Side View of the Staff Lodge Type A at Khlong Ngae Station

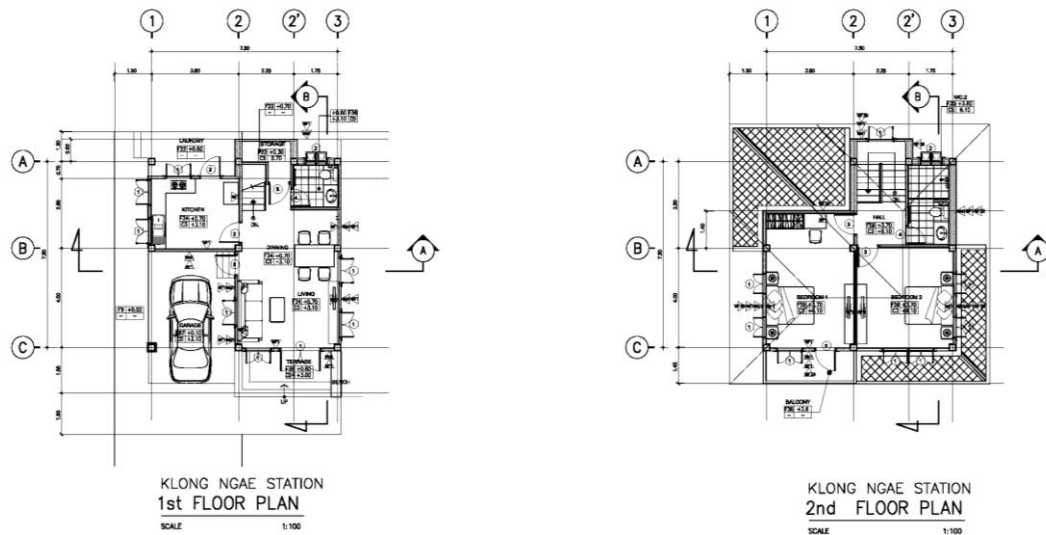


Figure 3.4-26 The Staff Lodge Type-B Plan at Khlong Ngae Station

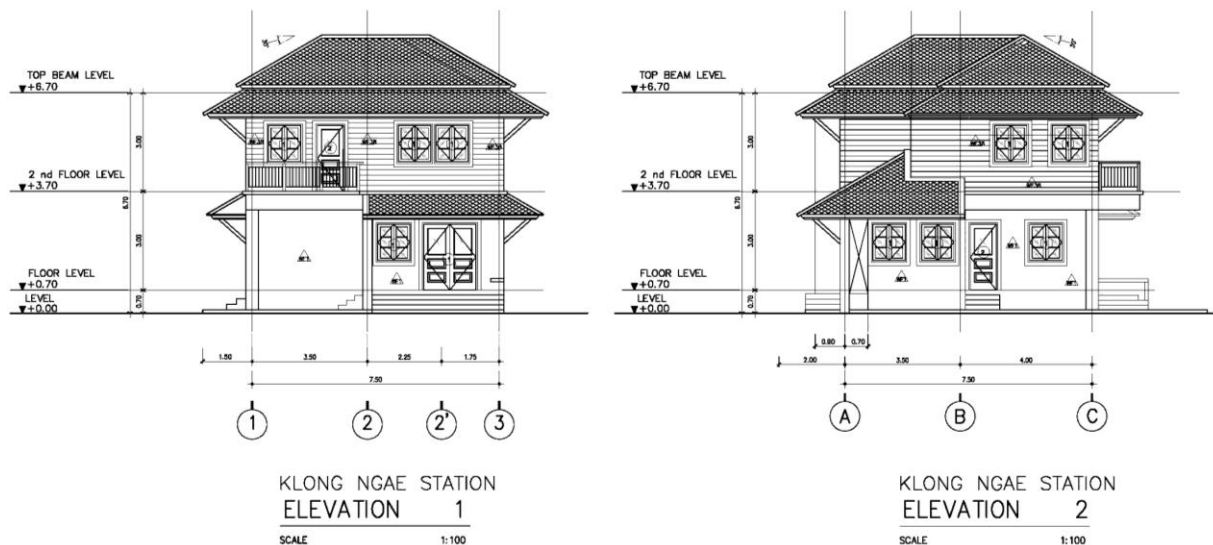


Figure 3.4-27 The Side View of the Staff Lodge Type B at Khlong Ngae Station

3. Padang Besar Station

From the study of the urban area and the not too busy road network in the community and the location of the train station which is near the border, the development plan of the outlying area of Padang Besar Station should consider the followings:

- 1) The location of the station for the Double Track Electric Train should be on the unoccupied lot of the public park which will be the center of future business development. This will provide convenience and suitability to travel activities across the border.
- 2) The use of the unoccupied land on the west as parking area, container yard, and related activities such as customs process, inter-transit activities and equipment storing area.

- 3) The landscape design of the central area of the Station takes an Urban Park design to be suitable with the property development into commercial use to generate income to SRT with ROW regulations. The station compound will be orderly and efficiently managed to serve travel activities and border trading.
- 4) The development of the road network to solve traffic problem should look into separating cargo transport from travelling activity or reducing traffic congestion such as reducing the crossing points between the road and the train track, elevating the train track and lowering the road at the crossing point in front of the border check point.
- 5) There should be planning for a special area to accommodate future urban expansion, changes in the use of land as a result of the State projects in the area, the joint commercial development with private sector related with border trading and tourism.

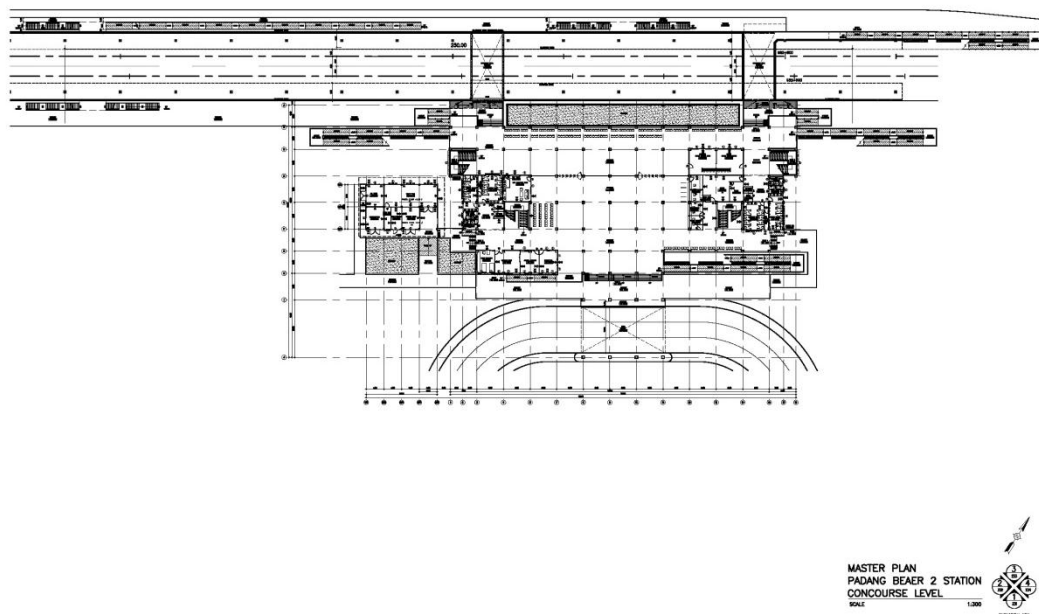


Figure 3.4-28 Concourse Plan of Pradang Bezar 2 Station

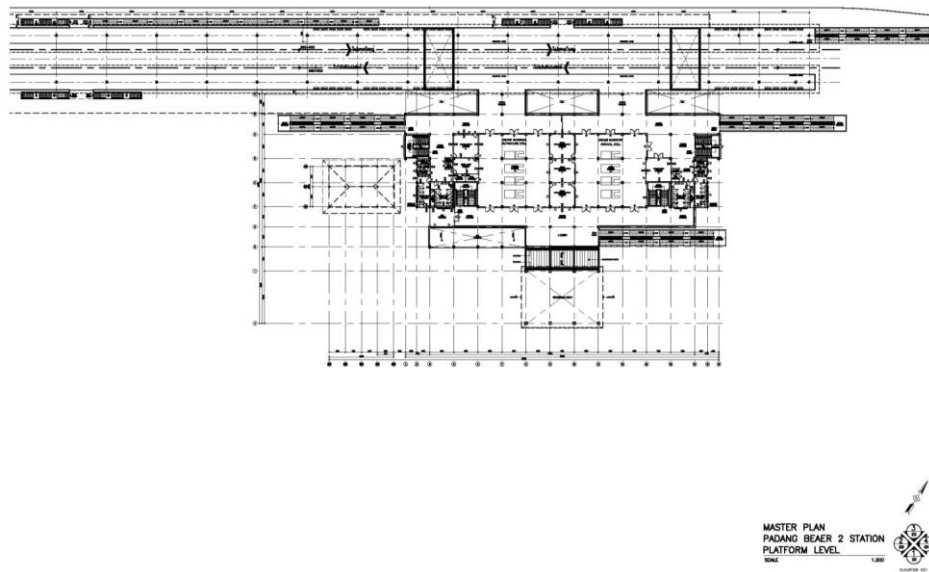


Figure 3.4-29 Platform Plan of Padang Besar 2 Station

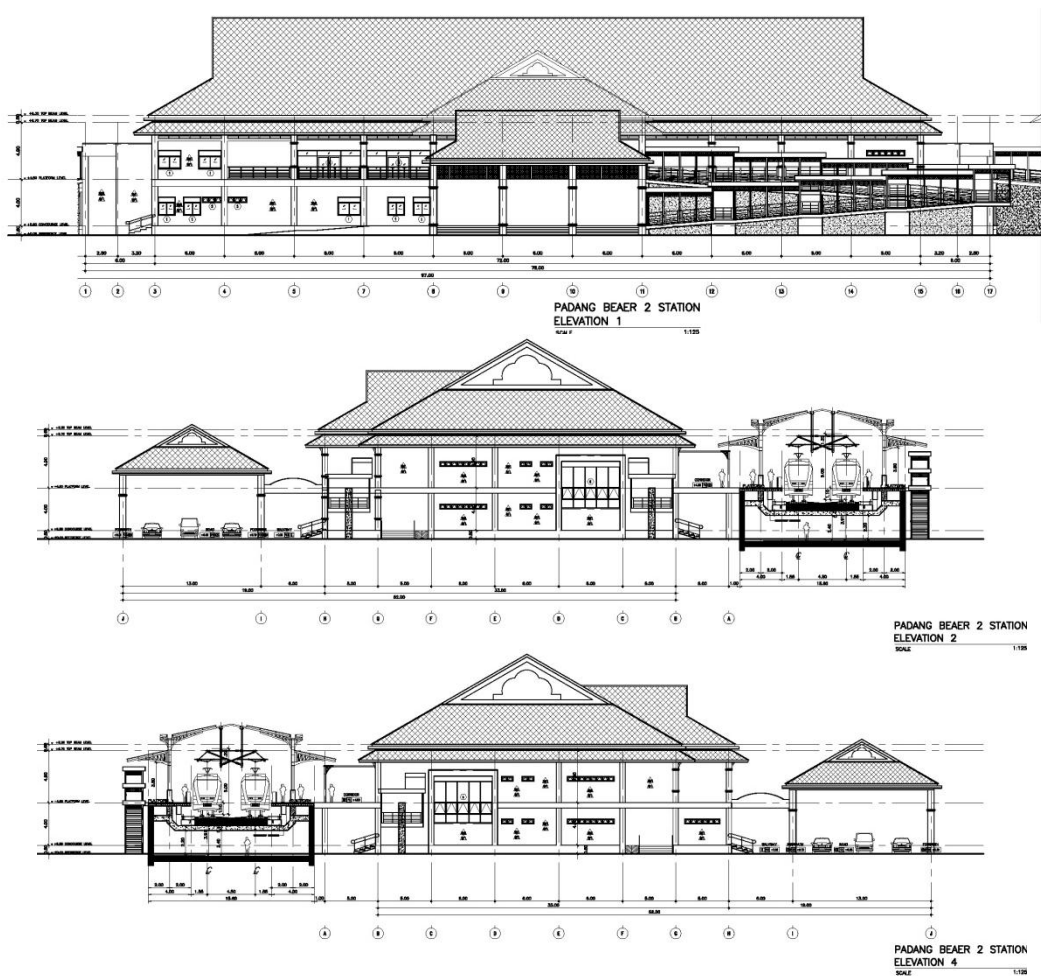


Figure 3.4-30 The Side View of Padang Besar 2 Station

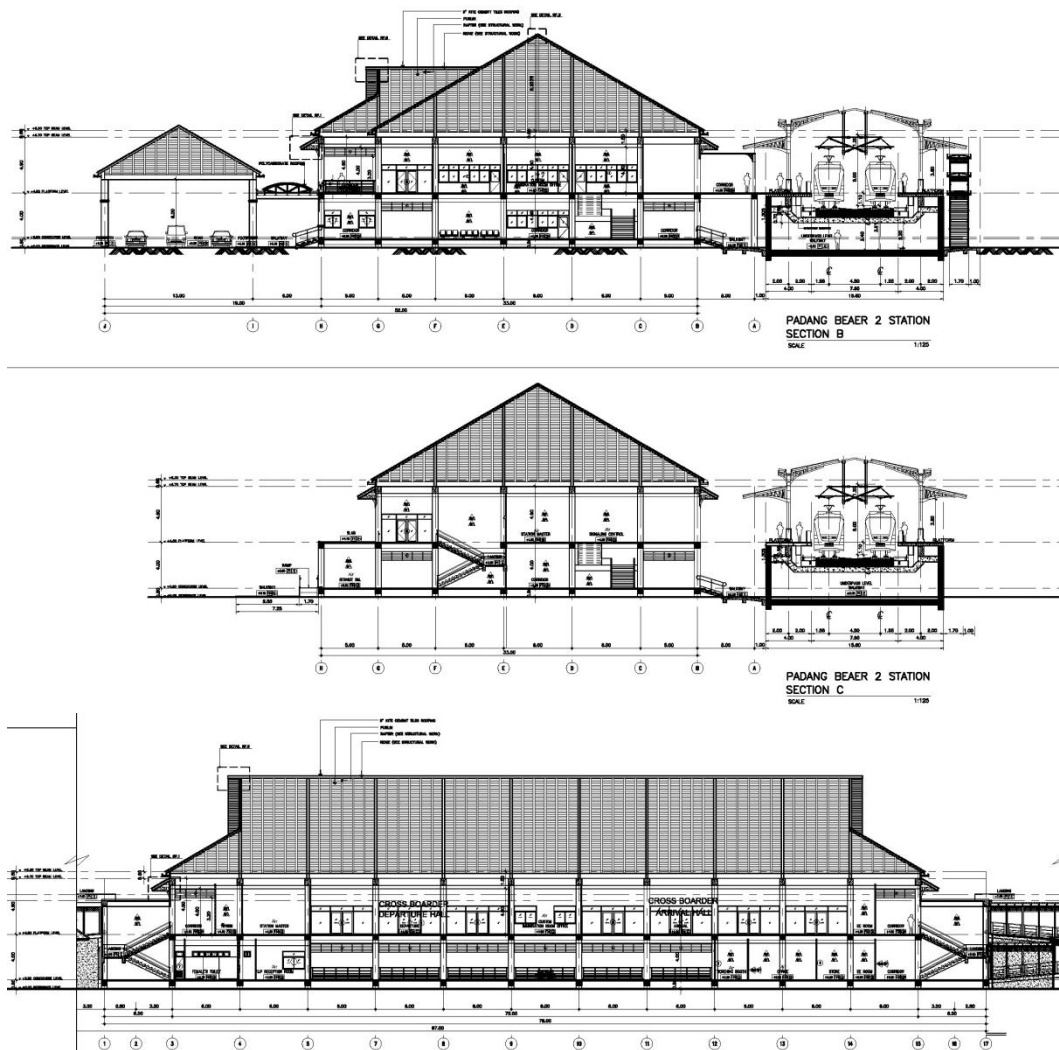


Figure 3.4-31 The Cross Sectional View of Padang Bezar 2 Station



Figure 3.4-32 The Panoramic View of the Exterior of Padang Besar 2 Station

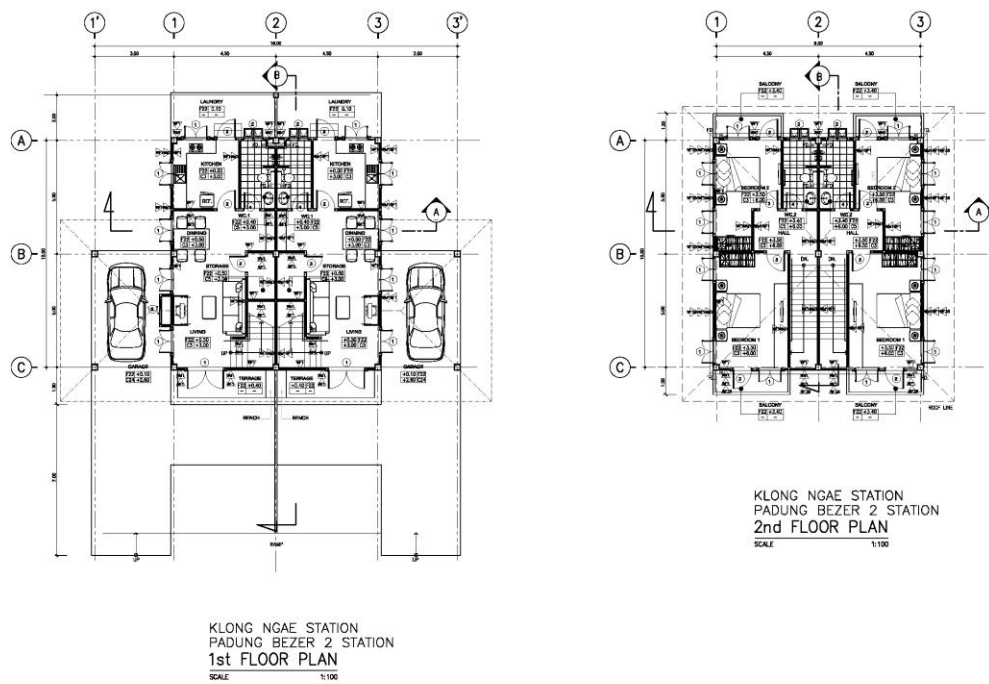


Figure 3.4-33 The Staff Lodge Type A Plan, Padang Bezar 2 Station

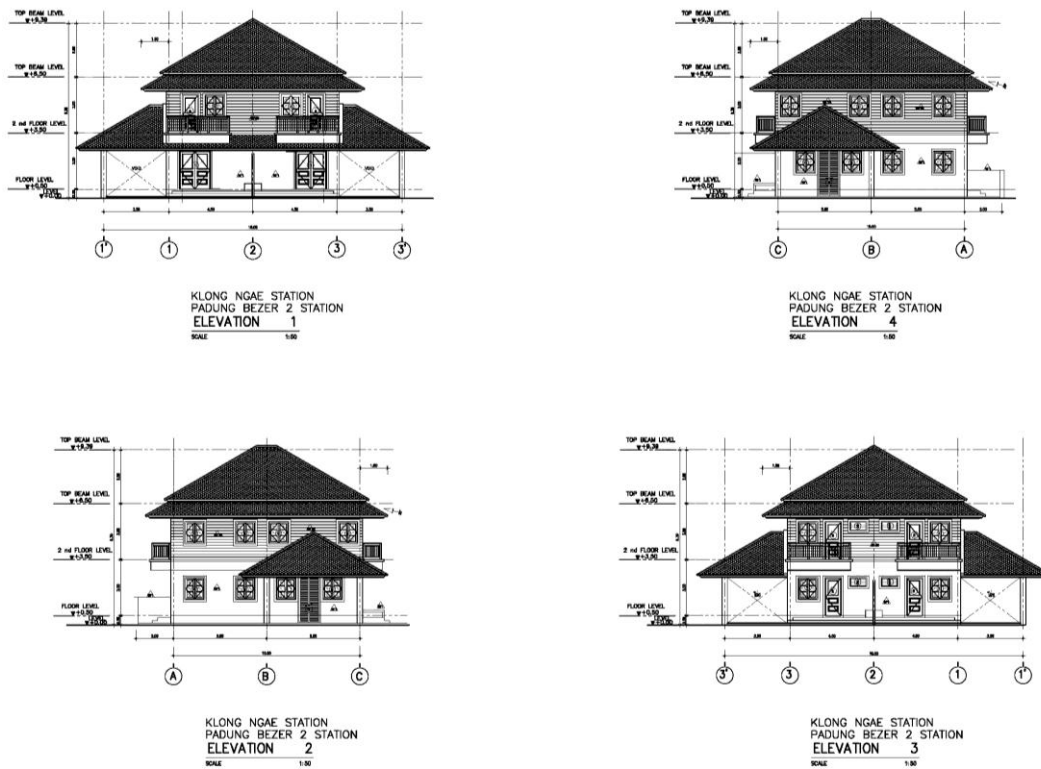


Figure 3.4-34 The Side View of the Staff Lodge Type A Plan, Padang Bezar 2 Station



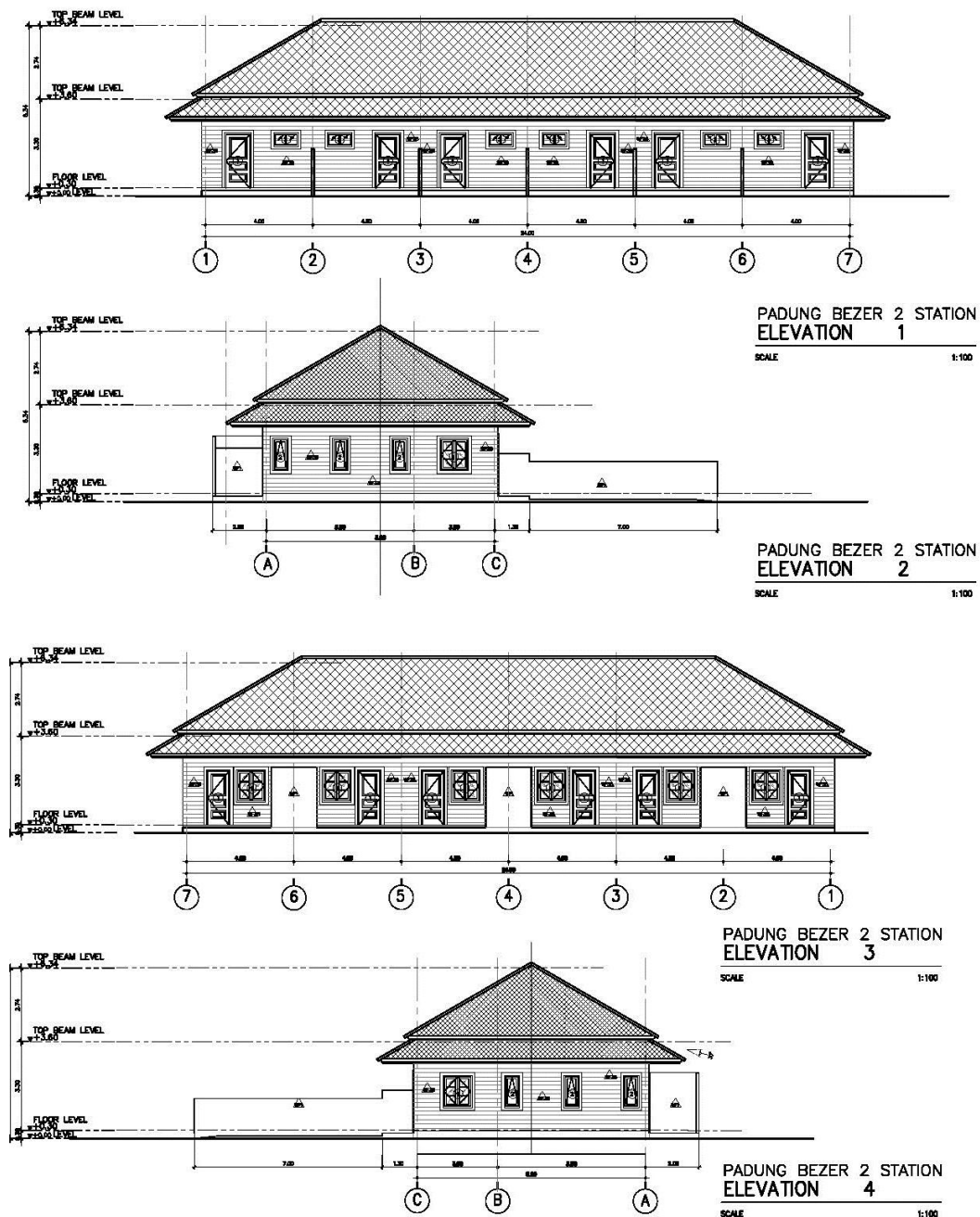


Figure 3.4-36 The Side View of the Staff Lodge RUNNING ROOM Plan, Padang Bezar 2 Station

3.4.2.7 Signaling and Telecommunication System

1) The Design of Signaling Control System

- The Design Principle

The Signaling System has been designed initially with the 3-Color Code Electric System as basically used on the SRT Double Track Trains before changing into the Automatic train Protection System-ATP which provides higher automatic safety level.

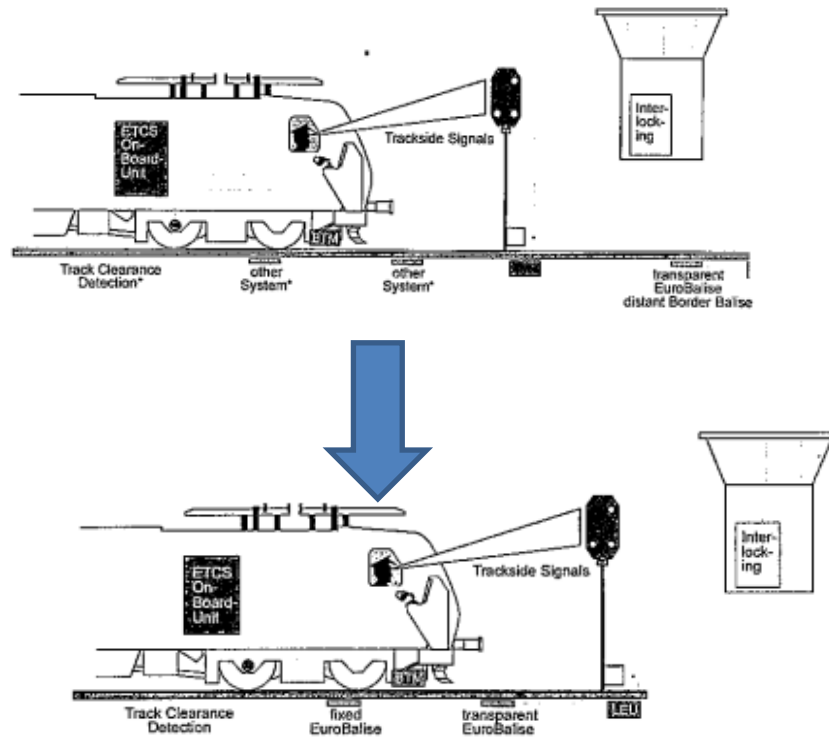


Figure 3.4-37 The Development of the Signaling System

- The Present Signaling System

The Signaling System on the Hat Yai-Padang Besar Train Route (on the Thai border), the system and control operation has been found with faults and damage from long years of operation. Besides, it will not support with the new technology for the Electric Train.

From the data analysis form the field survey, it was found that the signaling control system ha to be changed in line with the Electric Trains in Malaysia to facilitate the continued running of the Malaysian Electric Trains crossing into Thai border.



Figure 3.4-38 The Present Signaling System at Padang Besar Station

From **Figure 3.4-38**, The stationary signaling system at Hat Yai Station heading toward Padang Besar Station (on Thai border), the Consultants have designed the new system to serve the speed of different types of trains. The signaling poles and equipment will be replaced with the Automatic Signaling System for more safety on the train operation. In designing the system, the Consultants have collected data from Track Work, Track Alignment, Overhead Catenary System and System Operation Plan for precision and efficiency in the train operation.

2) The Signaling System on Ipoh-Padang Besar Train Project

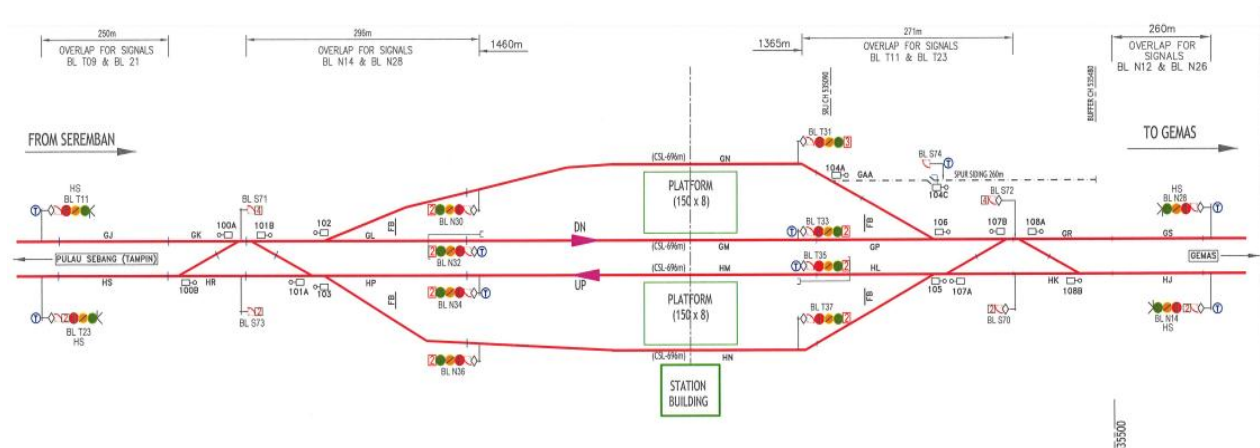
At present, Malaysia has already installed the Automatic Train Protection System on all their double track trains to prevent train collision and also installed the Signaling System and OCS to boost train operation. This has offered many transportation options to passengers.

The Malaysian Signaling System Development which has met the European Standard consists of the following systems:

- Computer-based Interlocking System: CBI Certified with European Train Control level 1 Standard, the system has been designed to be connected efficiently with other systems under the same standard. As the system is computer-based, the data processing is precise. Besides, improvement or repair of the system takes very little time.
- Automatic Train Protection System: ATP Malaysia also faces the same problem with the train operation as in Thailand at present. In the previous system before the change to the European Standard, there is a risk when the train runs at a higher speed than specified or the train conductor runs through the signaling light. The

Malaysian engineer have noticed the Incidents and have therefore installed the new system for better standard and prevention of accident.

- The positioning of the signaling poles: Malaysia has set The positioning of the signaling poles according to different speeds of each train and adjusted the signaling lighting system to 4 lights to accommodate higher number of trains.
- The Signaling Control System: Malaysia has installed computer-based Signaling Control system for safety and efficiency.



4) Supervisory Control And Data Acquisition, SCADA

The SCADA System to be used in the Project consists of basic equipment as follow:

- Workstations Control and Terminal Maintenance Control : display of control status of the equipment network
- Servers: This is the operation system of SCADA with sufficient data memory unit and 50% on reserve
- Remote Terminal Units (RTU): Automatic system connecting with equipment control and monitoring system
- Data Storage: Storage of data and the system software
- Printers: printing records such as warning signals, sent commands
- Signaling cable connected with the equipment under control and monitoring using copper wire for short distance and fiber optic for long distance. Backbone Transmission System is also used for connection between stations and the Traction and Feeder Sub-station.

The control and monitoring system through SCADA is operated from the main Workstation located in the Central Control Room at Hat Yai Depot and in case that the Main Workstation is at fault, the control would be switched to Local Workstation located at Traction and Feeder Sub-Station at Khlong Ngae Station.

The storing and operation process under SCADA will be managed with the Remote Terminal Unit (RTU) which will be installed in the Telecommunication Equipment Room at Hat Yai Depot, Sala Thung Lung Station, Padang Besar Station and in the Control Room at Traction Power Substation (Feeder Station), Khlong Ngae Station.

This Project will use SCADA System in data storage and Traction Power System such as the system and equipment at Traction Substation, OCS Wayside Equipment and Back-up Power System.

The standard of telecommunication between the SCADA equipment and electrical equipment under the control and monitoring system of Serial Port type will apply Protocol Standard IEC 60870-5.

5) The Design of the Telecommunication System

The Telecommunication System on the Train

The Telecommunication System on the Train consists of the following sub systems:

- The Radio System for Train Operation

At present, the Radio System has been used for connection between stations across Thai and Malaysian border at Padang Besar Station to facilitate border crossing of the trains. Therefore, no additional system is needed except when there will be more staff.

The Telecommunication System along the Route and at the Station

- The Basic Telecommunication Network (BTN): Certified technology such as Synchronous Digital Hierarchy Technologies (SDH), etc.
- Linkage with the existing network needs to be set up at Ban Phai Station through data and voice communication between SRT projects with the existing network and the Project Network
- The Basic Telecommunication Network (BTN) should use STM-4 and can be improved in the future as foreseen in SRT Development Plan for optimal benefit or at least linked with other sub-systems.
- STM-4 (622Mb/s, ITU-T G.957/8)

PABX Telephone System

- The main system should be linked with the Automatic Network System presently used by SRT similar to the TOT system
- All PABX sub units installed should be part of the extension of the main PABX system and should be precise and correct without any blocking between the Control Center and stations.
- All telephones must be DTMF dialing

Radio Communication System

- Traffic Controller: TC at Center of Train Operation Control: CTC and Train Operators: TO
- Station Master: SM and Train Operators
- Engineering Officers and Maintenance and Repair Officers
- Maintenance and Repair Officers and Train Operators at the Maintenance Center
- Maintenance and Repair Officers with mobile radio at the station along the route and at the Maintenance Center

6) Malaysia Telecommunication System

The Telecommunication System in Malaysia has been developed for the efficiency of the Train Operation at 160 km/hour. The System consists of 2 systems:

The Telecommunication System at the Station

The Telecommunication System at the Station uses fiber optic cable in data transfer managed by Backbone Transmission System linked by PA System voice command, CCTV System, PID System, Radio System, Signaling System and **Master Clock**.



Figure 3.4-40 The Telecommunication System at Padang Besar Station



Figure 3.4-41 Master Clock



Figure 3.4-42 CCTV System

The Telecommunication System on the Train

The Telecommunication System on the Train is used in the Train Operation for efficiency and safety consisting of the radio System, PA System, etc. This provides more convenience to passengers during their travel.

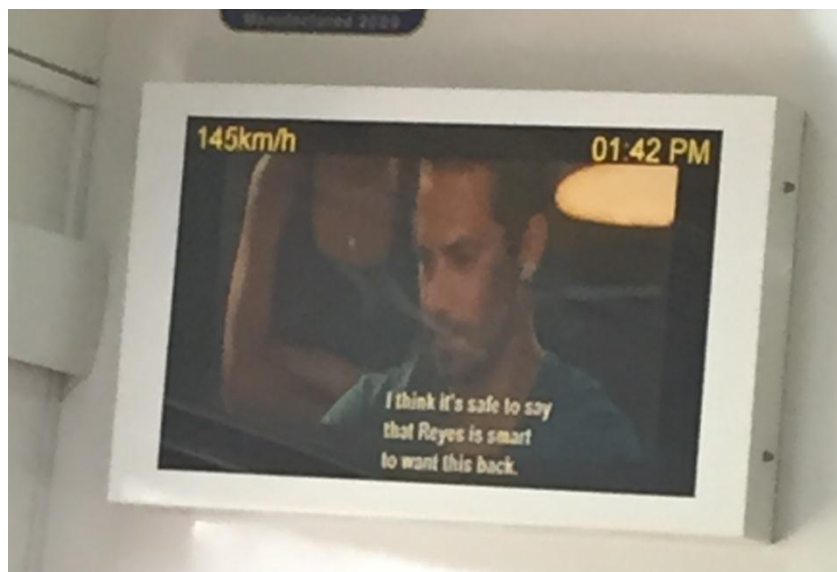


Figure 3.4-43 The Infotainment System on the Train

Summary of the Telecommunication System

The Design of the Telecommunication System should consider data transfer between trains, stations and Control Center for efficient communication with international standard. The system should be stable and low in maintenance cost. The new system must work effectively with the system SRT presently uses and future system according to the Investment Plan.

3.4.2.8 Power Supply

From the Needs Analysis and the Engineering Feasibility Study of the Project, the Consultants have concluded that the Power Supply System suitable for the Hat Yai-Padang Besar Double Tracks Train Project is The AC Voltage System at 25 kv AC, 50 Hz. With Overhead Contact Line System: OCLS.

Note: This is the Power Supply System used by the Airport rail Link between Bangkok Airport and Suvarnaphumi Airport and the Suburban Train System joint co-operation with Long distance Trains in linking with mass transit system in Bangkok and suburb (The Red Line)

The supporting data from the Engineering Feasibility Study are:

- Compatibility with the Electric Train System from Malaysia with no need for change of the electrical system
- The physical features of the Project including the train speed needed for the train operation is in line with this Power Supply System
- The Voltage System of 25kv AC, 50 Hz is more efficient and economical in maintenance cost than the Direct Current Electrified railway System currently used in the BTS and MRT System.
- The Voltage System of 25kv AC, 50 Hz can save the system installment cost. At present, the motor-driven Alternating Current is highly efficient and suitable to the operation of the high speed trains in yielding stability on speed acceleration on high slope and sharp curve. This system produces high power supply than other systems when compared with the same size and weight. Therefore, this system is being used in the train operation worldwide for both passenger trains, freight trains and high speed trains.
- The Voltage System of 25kv AC, 50 Hz will require preparation for Traction Power System installment at every 30-50 km.

From the Detailed Study and Train Operation Plan of the Project, the Consultants have made conclusion on the suitable Traction Power Supply System as shown in the Feeding Diagram below with all basic details of the Power Supply System:

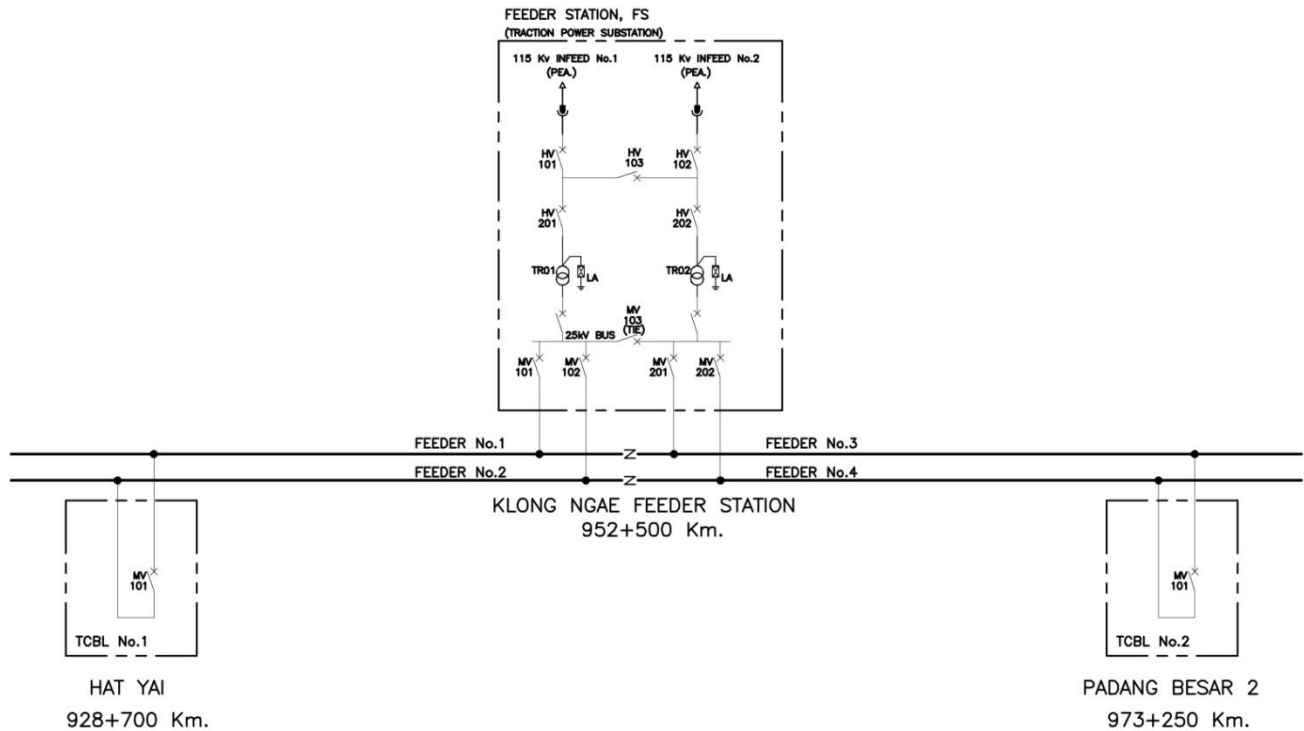


Figure 3.4-44 Feeding Diagram of the Project

From the details on the Feeder Diagram of the Power Supply System, there must be constructions of 3 Feeder Stations as follow:

The Construction of Feeder Station (FS) at Khlong Ngae Station

The Feeder Stations are most important to the Electric Train System as they provide the Traction Power Supply System vital for the train operation along the Project route.

The construction of the FS consists of the following main work and equipment

- Underground Duct Bank of 115kv to connect with the PEA Network
- The construction of the Station building and compound
- The procurement and installment of the main electrical equipment:
 - 115kV Switchgears (115kV circuit breakers or 115kV isolators)
 - 115 / 25kV Single phase power transformers
 - 25kV Switchgears (25kV Circuit breakers)
 - Protection / Control system equipments
- The construction of Underground Duct Bank of 25kv to connect with the Overhead Contact Line System: OCLS

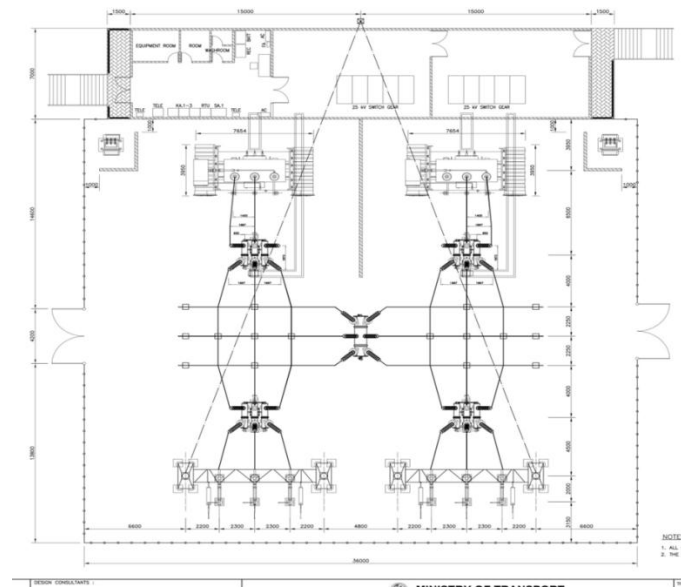


Figure 3.4-45 The Details of the Feeder Station (FS)



Figure 3.4-46 The Example of the Feeder Station(FS) from The Electric Train Project Overseas

The Construction of the Circuit Breaker Location (TCBL) at Hat Yai Station and Padang Bezar Station

TCBL Stations are generally located where the OCLS needs connection of 25kv feeder circuit (for example, from feeder circuit No.1 to feeder circuit No.2) when the problem with any feeder circuit occurs or when there is a need for power supply to maintain the train operation. Normally, the Feeder Stations will be located at both ends of the Project.

The construction of the TCBL consists of the following work and equipment:

- The construction of the Underground Duct bank of 25kv to connect with the Overhead Contact Line System
- The construction of the station and compound
- Procurement and installment of basic electrical equipment:
 - 25kV Switchgears (25kV Circuit breakers)
 - Protection / Control system equipments

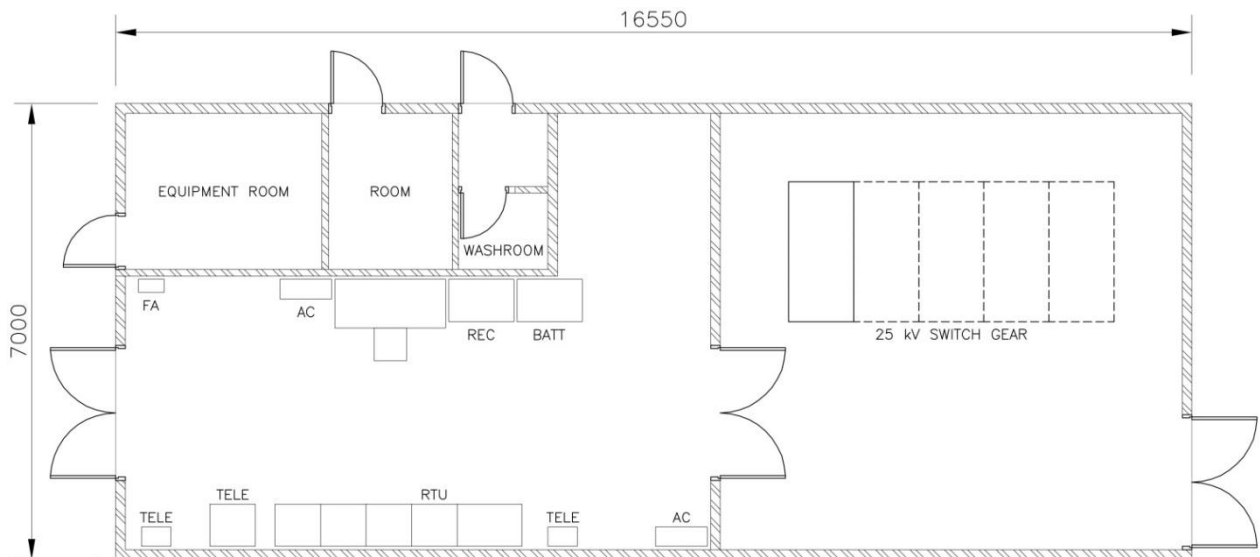


Figure 3.4-47 The Details of TCBL at Hat Yai Station and Padang Besar Station



Figure 3.4-48 The Example of TCBL from the Electric Train Project Overseas

Overhead Contact Line System; OCLS

The most used standard system for electric trains worldwide can be classified into 2 types:

- 1 Third Rail: used by BTS and MRT
- 2 Overhead Contact Line System; OCLS

From the Needs Analysis and the Engineering Feasibility Study of the “Power Supply System” of the Project, the Consultants have concluded that the Power Supply System suitable for the Hat Yai-Padang Besar Double Tracks Train Project is the Overhead Catenary System: OCS.

The supporting data from the Electrical Engineering Feasibility Study are:

- Complete compatibility with the Electric Train System from Malaysia with no need for change of the electrical system
- No obstacle to the operation of the Diesel –powered trains or Diesel freight trains with the only restriction on clearing height of the Diesel locomotive
- Ability to accommodate the train speed at 160km/h as set for various types of the Project work
- The safety from the electrical system structure (as the electrified section is installed much higher)

OCLS Components

The Power Supply System has been designed for approximately 30 years of Design life. The system equipment must have all specific descriptions which have been approved for their use. The main equipment of the OCLS are:

1. **Cantilever** : used in locking Catenary and Contact wire
2. **Tensioning Device** : used in maintaining the tensile forces of the Contact wire at a specified level
3. **Isolators** : used in splitting-connecting the electrical circuit for the Catenary and Contact wire in case of a need for sectional circuit control in the power supply system
4. **Sections Insulators** : used as electric insulation for the circuit of the Catenary and Contact wire with different phases such as at the Feeder Station
5. **Neutral Sections** : used in the separation of the Catenary and Contact wire of different phases such as at the Feeder Station
6. **Steel Poles (Mast) and Foundation** : used as support in the equipment installment such as cantilever, tensioning device, Isolators, etc.

3.4.2.9 The Drainage System

1) The Study of the Water Retaining Area along the Train Route

In the design of the Drainage System, the Consultants have studied the data on the volume of rainwater during the Return Period of 100 years and divided the lowland by Songkhla Lake into small sections as shown in **Figure 3.4-49** The small lowland areas that Concerned with The Hat Yai-Padang Besar Train route are the 6th to 15th small Lowland area. However, from the records of Department of Irrigation, it was found that the volume of water in the 6th Lowland area will not affect the Project route as there are two canals: Lam Nui and Ram Yai canal, that have detoured the water course to the North before joining with U Ta Pao canal and flowing into Sonkhla Lake. **Figure 3.4-50** shows various streams in U Ta Pao Canal Lowland while **Figure 3.4-51** shows the Ground Level Value at different locations in that area. The Design Study of the Drainage System along the Project Route will include from the 7 th to 15th small Lowland area and the analysis will focus on 2 aspects: the Drainage system along the Project Route and the Drainage System crossing the train tracks.

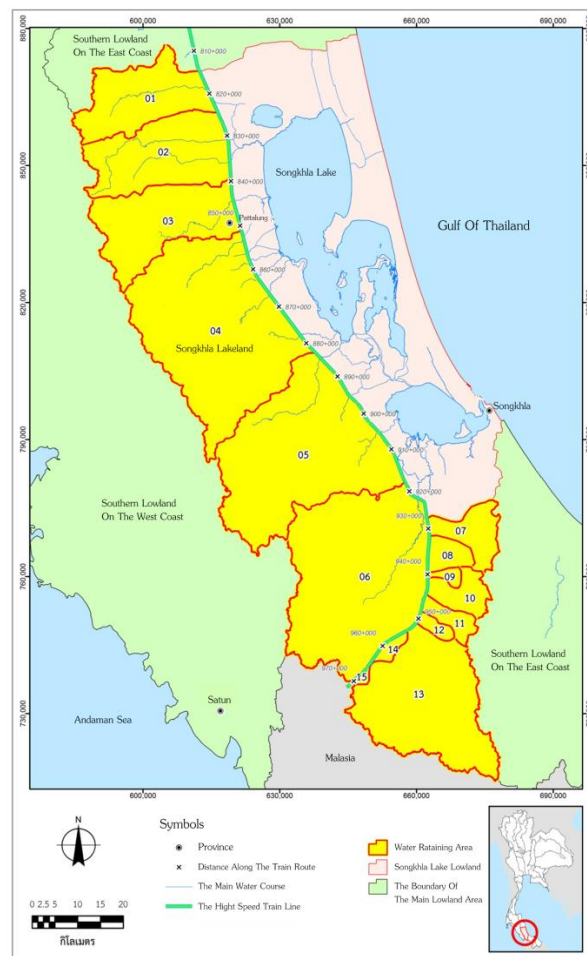
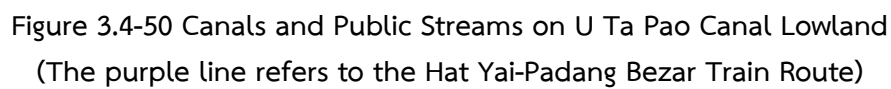


Figure 3.4-49 The Water Retaining Area in Songkhla Lake Lowland



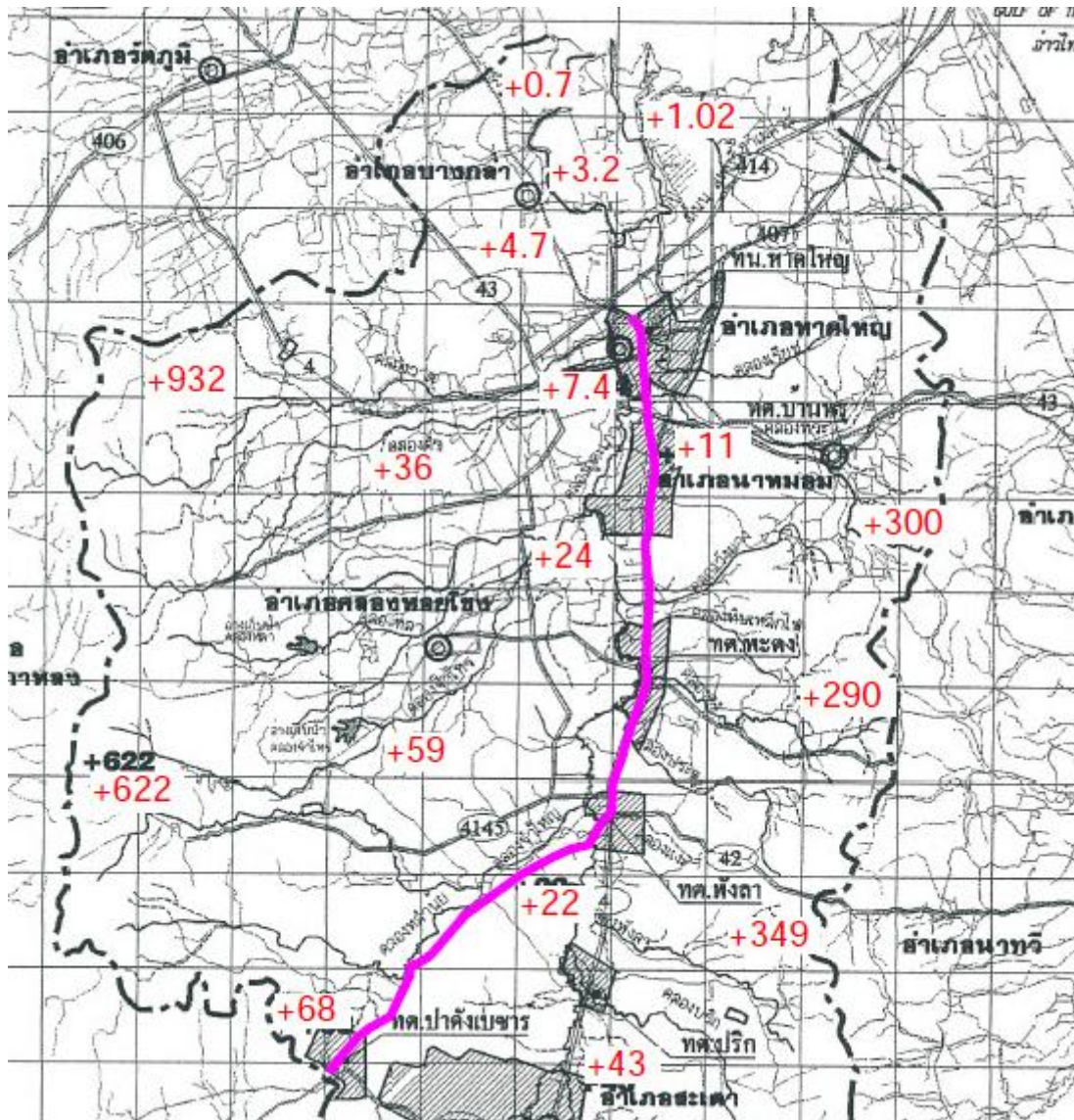


Figure 3.4-51 The Topographical Condition of the Lowland Area
(The red number refers to the Ground Level Value of the previous level in that area)

2) The Analysis of the Volume of Rainfall

The Consultants have analysed the volume of rainfall in the area from various records of yearly highest volume to draw a Correlation Graph of Intensity, Frequency and IDF Curve and the distribution of collected rainfall in a day record of IDF Curve. This will be used in the assessment of immerse flood which will affect draining along the train route according to the Flood Volume Assessment Theory. The Consultants have collected the data form the Correlation Graph of Intensity, Frequency and IDF Curve collected by Department of Irrigation and the data of the rainfall volume collected at every 15 minutes at the Monitoring Station along the train route over the past 5-10 years. This will be used in adjusting the current IDF to be more relevant with the rainstorm activity affected by the global weather change. The Correlation Graph of Intensity, Frequency and IDF at the Rainfall Monitoring Station along the Train rote is shown in **Figure 3.4-52**

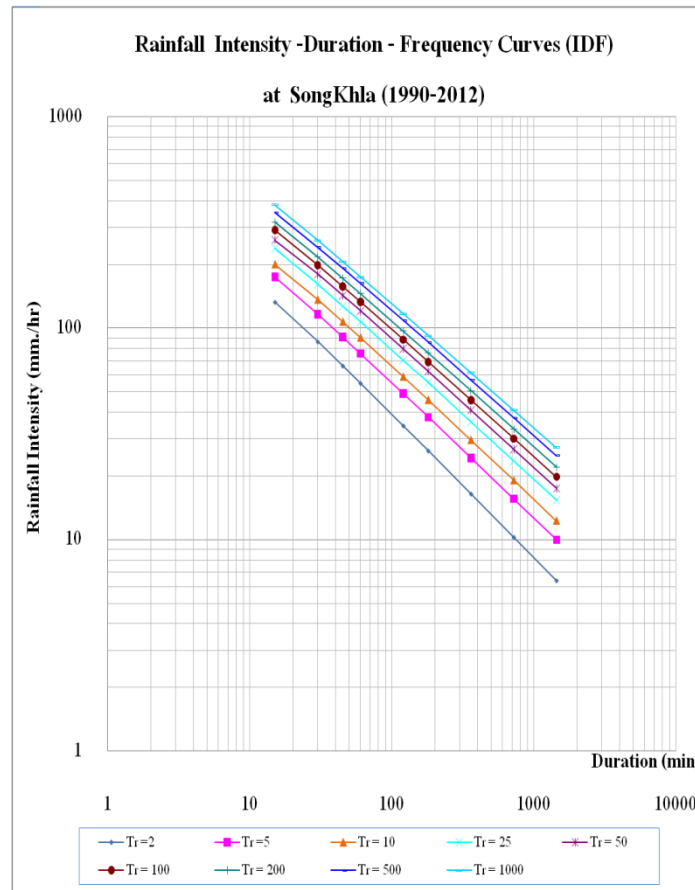


Figure 3.4-52 The Correlation Graph of the Rainfall Intensity (unit: mm./cm.) and Duration and IDF at Songkhla Rainfall Monitoring Station

3) The Size of the Draining Channel

The calculation of the size of the draining channel suitable for the rainfall volume of 100 years IDF will yield both speed and efficiency in draining the rainfall so it will not affect the nearby community. The design of the Draining Station, the size and number of the flood gates will be sufficient for the water volume as shown in **Table 3.4-24**

Table 3.4-24 The Recommended Size of the Draining Pipe along the Train Route

Water Retaining Area	Km	Flowing Rate	Draining Station Type			Slope Gradient	Accommodating Flowing rate	Safety Value	Recommended Size
		(cub.m./sec)	P	A.	R	m/m	(cub.m./sec)		
7	929+034.80	0.73	3.60	1.44	0.40	0.001	1.902	2.619	Box culvert 1.5x 1.5 m.
	929+420.88	0.94	3.60	1.44	0.40	0.001	1.902	2.019	Box culvert 1.5x 1.5 m.
	930+391.00	250.40	36.00	90.00	2.50	0.001	403.267	1.610	1 60m. bridge(calculated from the current stream of 30m.wide 3m. deep)
	931+066.00	16.20	21.00	45.00	2.14	0.001	181.941	11.229	1 25m. bridge (calculated from the current stream of 15.wide 3m. deep)
8	932+135.00	26.61	13.00	21.00	1.62	0.001	70.328	2.643	3 8m. bridges (calculated from the current stream of 7m.wide 3m. deep)
	933+470.00	41.99	16.00	30.00	1.88	0.001	110.963	2.643	4 4m. bridges (calculated from the current stream of 10m.wide 3m. deep)
	934+487.00	20.58	13.00	18.00	1.38	0.001	54.394	2.643	1 9m. bridge (calculated from the current stream of 9m.wide 2m. deep)
	935+310.00	41.99	16.00	30.00	1.88	0.001	110.963	2.643	4 8m. bridges(calculated from the current stream of 10m.wide 2m. deep)
	935+478.10	0.29	3.60	1.44	0.40	0.001	1.902	6.625	Box culvert 1.5 x 1.5m.

Water Retaining Area	Km	Flowing Rate	Draining Station Type			Slope Gradient	Accommodating Flowing rate	Safety Value	Recommended Size
		(cub.m./sec)	P	A.	R	m/m	(cub.m./sec)		
8	936+624.70								Pedestrian bridge (Steel beam of 5.3m)
	936+878.50	16.98	11.00	15.00	1.36	0.001	44.869	2.643	1 12m. bridge (calculated from the current stream of 5m.wide 3m. deep)
	938+403.30	9.87	16.00	30.00	1.88	0.001	110.963	11.237	1 25m. bridge (calculated from the current stream of 10m.wide 3m. deep)
9	940+191.20	50.55	13.00	21.00	1.62	0.001	70.328	1.391	1 25m. bridge (calculated from the current stream of 7m.wide 3m. deep)
10	941+247.20	21.39	11.00	15.00	1.36	0.001	44.869	2.098	3 20m. bridges (calculated from the current stream of 5m.wide 3m. deep)
	941+810.00	86.72	21.00	45.00	2.14	0.001	181.941	2.098	2 10m. bridge (calculated from the current stream of 15m.wide 3m. deep)
	942+759.30	33.52	13.00	21.00	1.62	0.001	70.328	2.098	1 25m. bridge (calculated from the current stream of 7m.wide 3m. deep)
	944+409.00	33.52	13.00	21.00	1.62	0.001	70.328	2.098	1 30m. bridge (calculated from the current stream of 7m.wide 2m. deep)
11	945+481.40	62.57	16.00	30.00	1.88	0.001	110.963	1.774	1 50m. bridge (calculated from the current stream of 10m.wide 3m. deep)

Water Retaining Area	Km	Flowing Rate	Draining Station Type			Slope Gradient	Accommodating Flowing rate	Safety Value	Recommended Size
		(cub.m./sec)	P	A.	R	m/m	(cub.m./sec)		
11	946+072.50	34.79	14.00	20.00	1.43	0.001	61.710	1.774	1 20m. bridge (calculated from the current stream of 10m.wide 3m. deep)
	946+500.00	14.71	9.00	10.00	1.11	0.001	26.095	1.774	1 10m. bridge (calculated from the current stream of 5m.wide 3m. deep)
	947+061.00	7.43	7.00	6.00	0.86	0.001	13.170	1.774	1 4.9m. bridge (calculated from the current stream of 3m.wide 3m. deep)
12	948+351.70	15.59	16.00	30.00	1.88	0.001	110.963	7.116	3 8m. bridges (calculated from the current stream of 10m.wide 3m. deep)
	948+905.80	15.59	16.00	30.00	1.88	0.001	110.963	7.116	1 40m. bridge (calculated from the current stream of 10m.wide 3m. deep)
	950+863.50	35.81	26.00	60.00	2.31	0.001	254.875	7.116	1 25m. bridge (calculated from the current stream of 20m.wide 3m. deep)
13	952+475.00	0.47	3.60	1.44	0.40	0.001	1.902	4.013	Box Culvert 1.5 x 1.5 m.
	953+491.60	7.63	8.00	7.50	0.94	0.001	17.476	2.291	1 30m. bridge (calculated from the current stream of 3m.wide 2.5m. deep)
	954+320.30	384.39	40.00	150.00	3.75	0.001	880.715	2.291	1 60m. bridge (calculated from the current stream of 30m.wide 5m. deep)
	954+820.21	326.51	43.00	140.00	3.26	0.001	748.097	2.291	1 50m. bridge (calculated from the current stream of 35m.wide 4m. deep)

Water Retaining Area	Km	Flowing Rate	Draining Station Type			Slope Gradient	Accommodating Flowing rate	Safety Value	Recommended Size
		(cub.m./sec)	P	A.	R	m/m	(cub.m./sec)		
14	956+324.13	1.96	7.00	6.00	0.86	0.001	13.170	6.736	1 20m. bridge (calculated from the current stream of 3m.wide 2m. deep)
	956+793.40	0.51	4.50	2.25	0.50	0.001	3.448	6.736	1 2.80m. bridge (calculated from the current stream of 1.5m.wide 1.5m. deep)
	957+258.30	3.87	9.00	10.00	1.11	0.001	26.095	6.736	1 8m. bridge (calculated from the current stream of 4m.wide 2.5m. deep)
	958+495.22	0.46	3.60	1.44	0.40	0.001	3.803	8.359	Box Culvert 1.5 x 1.5 m. (2 pipes)
	959+185.50	0.46	3.60	1.44	0.40	0.001	3.803	8.359	Box Culvert 1.5 x 1.5 m. (2 pipes)
	959+610.88	0.17	3.60	1.44	0.40	0.001	1.902	10.953	Box Culvert 1.5 x 1.5 m.
	960+207.00	4.89	10.00	12.00	1.20	0.001	32.963	6.736	1 8m. bridge (calculated from the current stream of 4m.wide 3m. deep)
	960+649.00	0.11	3.60	1.44	0.40	0.001	1.902	16.887	Box Culvert 1.5 x 1.5 m.
	961+684.65	0.46	3.60	1.44	0.40	0.001	3.803	8.359	Box Culvert 1.5 x 1.5 m. (2 pipes)
	962+004.30	21.00	12.00	16.00	1.33	0.001	47.149	2.245	1 12m. bridge (calculated from the current stream of 12m.wide 4m. deep)
	962+491.70	0.17	3.60	1.44	0.40	0.001	1.902	10.953	1Box Culvert 1.5 x 1.5 m.

Water Retaining Area	Km	Flowing Rate	Draining Station Type			Slope Gradient	Accommodating Flowing rate	Safety Value	Recommended Size
		(cub.m./sec)	P	A.	R	m/m	(cub.m./sec)		
14	962+955.92	16.47	16.00	30.00	1.88	0.001	110.963	6.736	2 8m. bridges (calculated from the current stream of 10m.wide 3m. deep)
	963+693.50	16.47	16.00	30.00	1.88	0.001	110.963	6.736	2 8m. bridges (calculated from the current stream of 10m.wide 3m. deep)
	964+803.00	0.11	3.60	1.44	0.40	0.001	1.902	16.887	Box Culvert 1.5 x 1.5 m.
15	965+300.52	1.37	3.60	1.44	0.40	0.001	3.803	2.771	Box Culvert 1.5 x 1.5 m. (2 pipes)
	965+717.92	3.16	5.50	3.75	0.68	0.001	7.066	2.233	1 2.7m. bridge (calculated from the current stream of 2.5m.wide 1.5m. deep)
	965+931.40	1.37	3.60	1.44	0.40	0.001	3.803	2.771	Box Culvert 1.5 x 1.5 m. (2 pipes)
	966+301.30	2.33	6.30	4.41	0.70	0.001	8.457	3.637	1 10m. bridge
	966+861.00	1.54	4.50	2.25	0.50	0.001	3.448	2.233	1 1.60m. bridge (calculated from the current stream of 1.5m.wide 1.5m. deep)
	967+160.13	8.09	7.20	5.76	0.80	0.001	36.224	4.475	1 10m. bridge
	967+513.39	8.09	7.20	5.76	0.80	0.001	36.224	4.475	1 10m. bridge
	967+879.10	0.52	3.60	1.44	0.40	0.001	1.902	3.631	Box Culvert 1.5 x 1.5 m.
	968+338.40	0.52	3.60	1.44	0.40	0.001	1.902	3.631	Box Culvert 1.5 x 1.5 m.

Water Retaining Area	Km	Flowing Rate	Draining Station Type			Slope Gradient	Accommodating Flowing rate	Safety Value	Recommended Size
		(cub.m./sec)	P	A.	R	m/m	(cub.m./sec)		
15	968+582.65	2.33	6.30	4.41	0.70	0.001	8.457	3.637	Box Culvert 2.4 x 2.4 m.
	969+119.55	4.05	6.00	4.50	0.75	0.001	9.036	2.233	1 4.9m. bridge (calculated from the current stream of 3m.wide 1.5m. deep)
	970+000.13	1.37	3.60	1.44	0.40	0.001	3.803	2.771	Box Culvert 1.5 x 1.5 m.(2 pipes)
	970+304.81	2.33	6.30	4.41	0.70	0.001	8.457	3.637	Box Culvert 2.4 x 2.4 m.
	970+606.00	0.34	3.60	1.44	0.40	0.001	1.902	5.598	Box Culvert 1.5 x 1.5 m.
	970+757.77	1.37	3.60	1.44	0.40	0.001	3.803	2.771	Box Culvert 1.5 x 1.5 m. (2 pipes)
	972+389.09	1.37	3.60	1.44	0.40	0.001	3.803	2.771	Box Culvert 1.5 x 1.5 m. (2 pipes)

3.4.2.10 The Design of the Carriageway to Solve Crossing Point between the Tracks and the Road

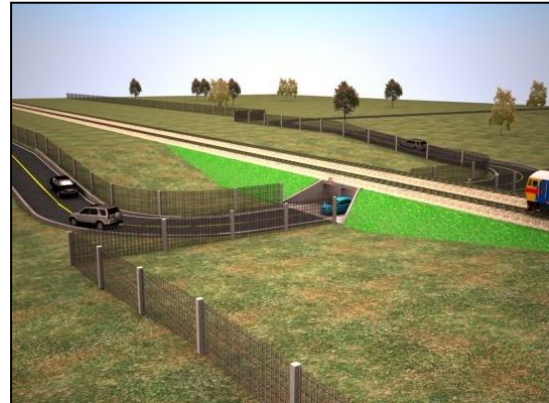
From the survey and collection of data, it was found that the Hat Yai-Padang Bezar Train Route will have 33 crossing points along the current train line. However, some of these points have already solved by constructing 2 split level crossing points, so still 31 points need to be managed: 9 stop barricades, 14 stop signs and bridges and 8 locally used roadways.

The summary of the solutions to the problems of the crossing points between the train track and the roadway is:

- Type 1: 6 Overpass U-Turns
- Type 2: 15 Under pass Boxes
- Type 3: 10 Elevated Railways



Overpass U-Turn



Underpass Box



Elevated Railway

3.4.2.11 The Estimate of the Construction Cost

The Estimate of the Construction Cost of the Project has been based on the set estimation of Department of Comptroller General, Ministry of Finance and SRT Regulations. The estimates of the construction cost is 13,341.00 million baht which covers the following works:

- 1) Civil Works and Building Engineering Service including the cost in the dismantling of public utilities blocking the designed infrastructure such as train tracks, draining station, crossing points, transit points and fencing along the train line.
- 2) Track Works System such as track installment along the route
- 3) Mechanical and Electrical Works such as Telecommunication System, Electrical System, Signaling System
- 4) Land expropriation and relocation of tenants along the train route
- 5) The Consultants' fees: 4%

Table 3.4-25
The Construction Cost Estimate of the Project

No.	Items	Total Investment Capital	Factor F	Construction Cost 2015	Notes
1	GENERAL REQUIREMENTS	98,809,189.08	1.0000	98,809,189.08	Factor F requirements
2	EARTHWORKS	416,413,133.11	1.1606	483,289,082.28	- 10% advanced capital
3	ROAD AND STATION YARDS	685,059,191.28	1.1606	801,244,454.10	- 10% collateral
4	STRUCTURES	2,141,783,197.22	1.1479	2,458,552,932.08	- 7% loan interest
5	BUILDING	522,699,547.14	1.1781	615,792,336.48	- 7% VAT
6	PIPE AND DRAINAGE	117,359,980.00	1.1479	134,717,521.04	
7	UTILITIES	4,157,961.12	1.0000	4,157,961.12	
8	TRACK WORKS	991,124,653.83	1.1606	1,150,299,273.23	
9	SIGNALLING AND TELECOMMUNICATIONS	554,902,444.55	1.1606	644,019,777.14	
10	POWER SUPPLY	1,143,796,770.00	1.1606	1,327,490,531.26	
	Total construction costs	6,676,106,067.32		7,718,373,057.83	
11	The Consultants' fees 4%			308,734,922.31	
12	Rolling Stock			5,263,000,000.00	
13	Land expropriation fees and relocation of resident			50,645,052.94	
Total	The construction costs estimates (Thirteen billion three hundred and fourty one million baths)			13,341,000,000.00	

3.5 The Economic Study

The Economic Study explores the impact from the Hat Yai-Padang Besar Double Tracks Train Project, both positive and negative impact, on Thailand including the impact from transport value and benefit on the road users such as cost of transportation, travel Saving Time , and decreasing accident, which will benefit travellers of other roads. The Project will solve traffic congestion, save fuel cost and benefit transport operators such as lower freight transport cost.

3.5.1 The Financial Assessment of the Capital Investment

The Costs of Investment of the Project consist of the construction cost and expenditures of the Project operation as follow:

(1) The Investment Costs:

- Construction costs
- Land rights and property compensation costs
- Construction supervision costs
- Environmental management costs

(2) The Operation Costs:

- Regular operation and maintenance costs
- Periodic maintenance costs
- Environmental management costs

In the Financial Analysis of the Project, the monetary value has been converted to Economic Value for the Electrified Train Project (**Table 3.5-1**) and the Diesel Train Project (**Table 3.5-2**) In the analysis, the conversion Factor: CF has been applied as follow:

■ Building compensations	CF = 0.92
■ The Detailed Design and construction supervision	CF = 0.92
■ Construction	CF = 0.88
■ Operation and maintenance	CF = 0.92
■ Land	CF = 1.00

The Conversion Factor: CF has been drawn from World Bank's Report on: Shadow Prices for Economic Appraisal of Project: An Application to Thailand published as the Working Paper (Number 609) 1983 by Sadig Ahmed

Table 3.5-1
The Economic Value of the Electrified Train Project

Unit: million baht

Year.	Land Rights and Building Compensations	Civil Work	Signaling & Telecom	Power Supply	O&M	Environment	Total Investment Cost
2018	50.65	1,011.54	113.35	233.64		3.97	1,413.14
2019		2,023.08	226.70	467.28		2.70	2,719.76
2020		2,023.08	226.70	467.28		2.70	2,719.76
2021					99.85	0.82	100.67
2022					102.79	0.54	103.34
2023					105.82	0.54	106.36
2024					108.94	0.00	108.94
2025					112.15	0.00	112.15
2026					115.45	0.37	115.82
2027					118.85	0.00	118.85
2028					122.35	0.00	122.35
2029					125.96	0.00	125.96
2030					129.67	0.00	129.67
2031					132.58	0.37	132.95
2032					135.55	0.00	135.55
2033					138.59	0.00	138.59
2034					141.70	0.00	141.70
2035					144.88	0.00	144.88
2036					148.13	0.37	148.50
2037					151.45	0.00	151.45
2038					154.85	0.00	154.85
2039					158.32	0.00	158.32
2040					161.87	0.00	161.87
2041					165.93	0.37	166.29
2042					170.08	0.00	170.08
2043					174.34	0.00	174.34
2044					178.71	0.00	178.71
2045					183.18	0.00	183.18
2046					187.77	0.37	188.14
2047					192.47	0.00	192.47
2048					197.30	0.00	197.30
2049					202.24	0.00	202.24
2050					207.30	0.00	207.30
Total	50.65	5,057.70	566.74	1,168.19	4,469.08	13.12	11,325.47

Source: The Consultants

Table 3.5-2
The Economic Value of the Diesel Train Project

Unit: million baht

Year.	Land Rights and Building Compensations	Civil Work	Signalling & Telecom.	Power Supply	O&M	Environment	Total Investment Cost
2018	50.65	1,011.54	113.35	0.00		3.97	1,179.50
2019		2,023.08	226.70	0.00		2.70	2,252.48
2020		2,023.08	226.70	0.00		2.70	2,252.48
2021					106.31	0.82	107.12
2022					110.28	0.54	110.83
2023					114.41	0.54	114.95
2024					118.69	0.00	118.69
2025					123.13	0.00	123.13
2026					127.74	0.37	128.11
2027					132.52	0.00	132.52
2028					137.48	0.00	137.48
2029					142.63	0.00	142.63
2030					147.96	0.00	147.96
2031					150.95	0.37	151.31
2032					153.99	0.00	153.99
2033					157.09	0.00	157.09
2034					160.26	0.00	160.26
2035					163.49	0.00	163.49
2036					166.79	0.37	167.16
2037					170.15	0.00	170.15
2038					173.58	0.00	173.58
2039					177.08	0.00	177.08
2040					180.65	0.00	180.65
2041					185.87	0.37	186.24
2042					191.24	0.00	191.24
2043					196.76	0.00	196.76
2044					202.45	0.00	202.45
2045					208.30	0.00	208.30
2046					214.32	0.37	214.69
2047					220.51	0.00	220.51
2048					226.88	0.00	226.88
2049					233.44	0.00	233.44
2050					240.18	0.00	240.18
Total	50.65	5,057.70	566.74	0.00	5,035.13	13.12	10,723.33

Source: The Consultants

3.5.2 The Financial Assessment of the Benefit

The Benefit from the Project can be classified into Direct Benefit and Indirect Benefit.

- **Direct Benefit**

Direct Benefit is obtained from the Project Operation to be studied in this Study which includes:

- (1) Vehicle Operating Cost Saving: VOC
- (2) Value of Time Saving : VOT
- (3) Accident Cost Saving : ACC
- (4) Environmental Cost
- (5) Transport Cost

The Financial Analysis of the Benefit of the Project can be summed up for the Electrified Train Project in **Table 3.5-3** and the Diesel Train project in **Table 3.5-4**

Table 3.5-3
The Economic Value of the Electrified Train Project

Unit: million baht /year

Year	Benefit				
	VOC	VOT	Saving of Poution	ACC	Saving of Transport
2021	513.8	252.1	374.3	6.1	50.3
2030	879.2	458.8	542.9	8.9	61.9
2040	1,344.4	677.9	767.5	12.6	72.3
2050	1,876.3	871.3	1,057.8	17.4	96.1

Source: The Consultants

Table 3.5-4
The Economic Value of the Diesel Train Project

Unit: million baht /year

Year	Benefit				
	VOC	VOT	Saving of Poution	ACC	Saving of Transport
2021	418.2	202.7	305.5	5.0	40.7
2030	712.3	368.5	475.3	7.3	52.6
2040	1,081.8	529.7	654.7	10.0	62.2
2050	1,476.0	679.1	837.0	13.7	84.0

Source: The Consultants

- **Indirect Benefit**

- (1) The Development Boost of the Project Area

- The Development of the Double Tracks Train will boost the development of the local community and major area of the Project and will be beneficial in the followings:
- Creating incentive for investment growth and employment for personal income growth and in turns, increasing GDP
- Boosting transport business and investment incentive and in turn creating jobs in the local community and economic benefit to the country as a whole

- (2) Tourism Promotion

Transportation is very vital to tourist industry development which is the main national income. The Double Tracks Electric Train Project will benefit freight transport and services in freight volume and punctuality of transport time as it evades traffic congestion on the roadways.

- (3) The Economic Boost

Freight Rail Transport is crucial to freight transport industry and services in terms of volume. The development of the Double Tracks Electric train will efficiently facilitate freight transport and service and provide punctuality of transport time.

3.5.3 The Assessment of the Economic Indicator

The Consultants have analysed the Financial Returns of the Investment and Risks of the Project. To obtain the overview, the followings data have been included: The Investment Cost Estimate (excluding the State subsidy), Direct Benefit which includes Vehicle Operating Costs, Time Costs and Accident Costs. The collected data have been used in the finding of the Economic Indicator for Net Present Value: NPV, Benefit Cost Ratio: B/C Ratio and Economic Internal Rate of Returns: EIRR.

3.5.4 The Results of The Financial Feasibility Study of the Project

From the Results of the Financial Feasibility Study of the Electrified Train Project (**Table 3.5-5**) it was found that the Project is financially feasible with EIRR of 18.89% NPV of 4,365.30 million baht (Discount Rate of 12%) and B/C Ratio of 1.72 and for the Diesel Train project, EIRR is 18.50% NPV of 3,392.87 million baht (Discount Rate of 12%) and B/B Ratio of 1.65 (**Table 3.5-6**)

Table 3.5-5
The Results of the Financial Feasibility Study of the Electrified Train Project

EIRR 18.78 %
NPV 3,446.10 million baht
B/C Ratio 1.71

Unit: million baht

Year	Year of Operation	Capital Investment				Capital Investment	Benefit						Total Benefit	Net Value
		Construction Cost	Operation& Maintenance Cost	Fleet cost	Environment Cost		Salvage Value	VOC	VOT	Pollution Cost	ACC	Time Saving Value		
2016	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2017	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2018	Constr 1.	1,409.17	0.00	0.00	3.97	1,413.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-1,413.14
2019	Constr 2.	2,717.05	0.00	0.00	2.70	2,719.76	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-2,719.76
2020	Constr 3.	2,717.05	0.00	0.00	2.70	2,719.76	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-2,719.76
2021	1	0.00	99.85	0.00	0.82	100.67	0.00	513.76	252.13	374.31	6.15	50.34	1,196.69	1,096.02
2022	2	0.00	102.79	0.00	0.54	103.34	0.00	545.36	269.47	390.25	6.41	51.51	1,263.00	1,159.66
2023	3	0.00	105.82	0.00	0.54	106.36	0.00	578.91	288.00	406.82	6.68	52.70	1,333.11	1,226.75
2024	4	0.00	108.94	0.00	0.00	108.94	0.00	614.52	307.81	424.05	6.96	53.93	1,407.27	1,298.33
2025	5	0.00	112.15	0.00	0.00	112.15	0.00	652.32	328.98	441.98	7.25	55.18	1,485.71	1,373.56
2026	6	0.00	115.45	0.00	0.37	115.82	0.00	692.45	351.60	460.61	7.56	56.46	1,568.68	1,452.86
2027	7	0.00	118.85	0.00	0.00	118.85	0.00	735.04	375.79	479.99	7.87	57.77	1,656.46	1,537.61
2028	8	0.00	122.35	0.00	0.00	122.35	0.00	780.26	401.63	500.14	8.21	59.11	1,749.35	1,626.99
2029	9	0.00	125.96	0.00	0.00	125.96	0.00	828.25	429.25	521.10	8.55	60.48	1,847.63	1,721.67
2030	10	0.00	129.67	0.00	0.00	129.67	0.00	879.20	458.78	542.88	8.91	61.88	1,951.65	1,821.98
2031	11	0.00	132.58	0.00	0.37	132.95	0.00	933.28	490.33	565.52	9.29	63.31	2,061.74	1,928.79
2032	12	0.00	135.55	0.00	0.00	135.55	0.00	971.91	508.30	585.60	9.61	64.25	2,139.67	2,004.12
2033	13	0.00	138.59	0.00	0.00	138.59	0.00	1,012.14	526.93	606.24	9.94	65.21	2,220.45	2,081.86
2034	14	0.00	141.70	0.00	0.00	141.70	0.00	1,054.03	546.23	627.45	10.28	66.18	2,304.18	2,162.48
2035	15	0.00	144.88	0.00	0.00	144.88	0.00	1,097.65	566.25	649.25	10.63	67.16	2,390.95	2,246.07
2036	16	0.00	148.13	0.00	0.37	148.50	0.00	1,143.08	587.00	671.65	11.00	68.16	2,480.89	2,332.40
2037	17	0.00	151.45	0.00	0.00	151.45	0.00	1,190.39	608.51	694.66	11.38	69.18	2,574.12	2,422.67
2038	18	0.00	154.85	0.00	0.00	154.85	0.00	1,239.66	630.81	718.30	11.77	70.20	2,670.75	2,515.90
2039	19	0.00	158.32	0.00	0.00	158.32	0.00	1,290.97	653.93	742.58	12.17	71.25	2,770.91	2,612.59
2040	20	0.00	161.87	0.00	0.00	161.87	0.00	1,344.40	677.89	767.53	12.59	72.31	2,874.73	2,712.86
2041	21	0.00	165.93	0.00	0.37	166.29	0.00	1,400.05	702.74	793.16	13.03	73.38	2,982.35	2,816.06
2042	22	0.00	170.08	0.00	0.00	170.08	0.00	1,446.34	719.73	819.45	13.45	75.61	3,074.58	2,904.49
2043	23	0.00	174.34	0.00	0.00	174.34	0.00	1,494.17	737.13	846.47	13.89	77.91	3,169.55	2,995.21
2044	24	0.00	178.71	0.00	0.00	178.71	0.00	1,543.57	754.95	874.24	14.34	80.27	3,267.37	3,088.66
2045	25	0.00	183.18	0.00	0.00	183.18	0.00	1,594.61	773.21	902.78	14.80	82.71	3,368.11	3,184.93
2046	26	0.00	187.77	0.00	0.37	188.14	0.00	1,647.34	791.90	932.11	15.28	85.22	3,471.86	3,283.72
2047	27	0.00	192.47	0.00	0.00	192.47	0.00	1,701.81	811.05	962.25	15.78	87.81	3,578.70	3,386.23
2048	28	0.00	197.30	0.00	0.00	197.30	0.00	1,758.09	830.66	993.23	16.29	90.48	3,688.74	3,491.45
2049	29	0.00	202.24	0.00	0.00	202.24	0.00	1,816.22	850.74	1,025.06	16.82	93.23	3,802.06	3,599.82
2050	30	0.00	207.30	0.00	0.00	207.30	1,272.53	1,876.27	871.31	1,057.76	17.36	96.06	5,191.30	4,983.99

Source: The Consultants

Table 3.5-6
The Results of the Financial Feasibility Study of the Diesel Train Project

EIRR 18.24%
NPV 2,575.33 million baht
B/C Ratio 1.62

Unit: million baht

Year	Year of Operation	Capital Investment				Capital Investment	Benefit						Total Benefit	Net Value
		Construction Cost	Operation& Maintenance Cost	Fleet cost	Environment Cost		Salvage Value	VOC	VOT	Pollution Cost	ACC	Time Saving Value		
2016	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2017	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2018	Constr 1.	1,146.56	0.00	0.00	3.97	1,150.53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-1,150.53
2019	Constr 2.	2,249.78	0.00	0.00	2.70	2,252.48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-2,252.48
2020	Constr 3.	2,249.78	0.00	0.00	2.70	2,252.48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-2,252.48
2021	1	0.00	106.31	0.00	0.82	107.12	0.00	418.15	202.72	305.55	5.02	40.67	972.11	864.99
2022	2	0.00	110.28	0.00	0.54	110.83	0.00	443.64	216.64	338.31	5.23	41.85	1,045.67	934.84
2023	3	0.00	114.41	0.00	0.54	114.95	0.00	470.69	231.51	348.61	5.45	43.06	1,099.32	984.36
2024	4	0.00	118.69	0.00	0.00	118.69	0.00	499.39	247.41	358.91	5.68	44.31	1,155.68	1,036.99
2025	5	0.00	123.13	0.00	0.00	123.13	0.00	529.83	264.39	369.21	5.92	45.59	1,214.94	1,091.80
2026	6	0.00	127.74	0.00	0.37	128.11	0.00	562.13	282.55	379.51	6.16	46.91	1,277.26	1,149.15
2027	7	0.00	132.52	0.00	0.00	132.52	0.00	596.41	301.95	389.81	6.42	48.26	1,342.84	1,210.32
2028	8	0.00	137.48	0.00	0.00	137.48	0.00	632.77	322.68	400.11	6.69	49.66	1,411.90	1,274.42
2029	9	0.00	142.63	0.00	0.00	142.63	0.00	671.34	344.83	410.41	6.97	51.09	1,484.65	1,342.02
2030	10	0.00	147.96	0.00	0.00	147.96	0.00	712.27	368.51	475.27	7.27	52.57	1,615.89	1,467.92
2031	11	0.00	150.95	0.00	0.37	151.31	0.00	755.69	393.81	461.12	7.57	54.09	1,672.29	1,520.97
2032	12	0.00	153.99	0.00	0.00	153.99	0.00	786.42	406.99	496.47	7.81	54.94	1,752.63	1,598.65
2033	13	0.00	157.09	0.00	0.00	157.09	0.00	818.40	420.62	507.07	8.05	55.80	1,809.94	1,652.85
2034	14	0.00	160.26	0.00	0.00	160.26	0.00	851.68	434.70	517.67	8.31	56.67	1,869.03	1,708.77
2035	15	0.00	163.49	0.00	0.00	163.49	0.00	886.31	449.26	528.27	8.57	57.56	1,929.96	1,766.47
2036	16	0.00	166.79	0.00	0.37	167.16	0.00	922.34	464.30	538.87	8.83	58.46	1,992.81	1,825.65
2037	17	0.00	170.15	0.00	0.00	170.15	0.00	959.85	479.85	544.47	9.11	59.37	2,052.65	1,882.50
2038	18	0.00	173.58	0.00	0.00	173.58	0.00	998.88	495.91	550.07	9.39	60.30	2,114.55	1,940.97
2039	19	0.00	177.08	0.00	0.00	177.08	0.00	1,039.49	512.51	555.67	9.69	61.25	2,178.61	2,001.53
2040	20	0.00	180.65	0.00	0.00	180.65	0.00	1,081.76	529.67	654.68	9.99	62.21	2,338.31	2,157.66
2041	21	0.00	185.87	0.00	0.37	186.24	0.00	1,125.74	547.41	627.25	10.30	63.18	2,373.89	2,187.65
2042	22	0.00	191.24	0.00	0.00	191.24	0.00	1,160.14	560.68	686.08	10.64	65.21	2,482.75	2,291.51
2043	23	0.00	196.76	0.00	0.00	196.76	0.00	1,195.59	574.27	701.78	10.98	67.31	2,549.93	2,353.17
2044	24	0.00	202.45	0.00	0.00	202.45	0.00	1,232.12	588.19	717.48	11.34	69.48	2,618.61	2,416.16
2045	25	0.00	208.30	0.00	0.00	208.30	0.00	1,269.76	602.45	738.18	11.71	71.71	2,693.81	2,485.52
2046	26	0.00	214.32	0.00	0.37	214.69	0.00	1,308.56	617.05	758.88	12.09	74.02	2,770.60	2,555.92
2047	27	0.00	220.51	0.00	0.00	220.51	0.00	1,348.54	632.01	779.58	12.48	76.40	2,849.02	2,628.51
2048	28	0.00	226.88	0.00	0.00	226.88	0.00	1,389.74	647.33	800.28	12.89	78.86	2,929.11	2,702.23
2049	29	0.00	233.44	0.00	0.00	233.44	0.00	1,432.21	663.03	820.98	13.30	81.40	3,010.92	2,777.48
2050	30	0.00	240.18	0.00	0.00	240.18	1,189.56	1,475.97	679.10	836.97	13.74	84.02	4,279.35	4,039.17

Source: The Consultants

3.5.5 Summary of the Economic Feasibility Study of the Project

From the Economic Feasibility Study of the Project, it was found that:

- From the Study of the Electrified Train Project and the Diesel Train Project, the Economic Feasibility of the Project can be summed up as follow **Table 3.5-7**

Table 3.5-7
Summary of the Economic Feasibility Study of the Project

Feasibility Indicator	The Results of the Feasibility Indicators		The Results of the Feasibility Study
	Case 1	Case 2	
EIRR	18.78%	18.24%	Feasible because EIRR is higher than Discount Rate 12%
NPV	3,446.10 m. baht	2,575.33 m. baht	Feasible because NPV has a Positive Value
B/C	1.71	1.62	Feasible because B/C is higher than 1

Source: The Consultants

1. The Electrified Train System
2. The Diesel train System

- From the Analysis, it was found that the Double Tracks Electric Train Project and the Diesel Train Project, both are highly feasible
- In terms of Financial Investment. The Projects will yield economic benefit to the society and Thailand as they will give Positive NPV and Higher B/C than 1 including EIRR higher than Discount Rate 12%. When analyzing both Projects, it was found that the Electrified Train Project will yield higher EIRR than the Diesel Train Project. Therefore, the Electrified Train project will be highly feasible in terms of investment.
- When considering the Sensitivity of the Project, it was found that in case the Project has the most negative impact with 20% increase of the capital investment and decrease of 20% profit, EIRR of the Electrified Train Project will be 13.48 % while EIRR of the Diesel Train Project will be 12.89% This will make the Electrified Train project have EIRR higher than 12%. This shows that the project with low risk of investment will be more attractive in terms of investment.

3.6 The Financial Analysis

The Financial Analysis has been conducted according to the Regulations of Office of Public Debt Management, Ministry of Finance, for the Special Project with the State Investment. The timeframe of the analysis has been set at 30 years after the Project operation begins. The Consultants have conducted the Financial Analysis of the Project in 6 steps:

- Various sources of investment fund for the Project by considering the most suitable form of investment in determining the investment source and the feasibility of the Project
- Revenue and Expenditures of the Project. This will be studied in terms of Cash Flow Stream throughout the Project
- Determination of reasonable Economic Factor to be used in the Financial Analysis for suitable forms of investment
- Determination of the Financial Hypothesis necessary for the Financial Analysis
- Applying suitable Financial Model in the Financial Analysis to look for suitable form of investment
- Conducting the Financial Sensitivity of the Project to analyse the sensitivity factor of the most suitable form of investment from the uncertainty of financial factors

3.6.1 The Preparation of the Projection of Expenses of the Project Investment and operation

In the Financial Analysis, the Investment Cost of the Project is divided into 2 groups:

(1) The Project Capital Investment

- Land costs –Major expense on the Capital Investment besides the construction cost; study and estimate of the cost details will be conducted
- Building compensations – Part of the expenses on land procurement; quite expensive as the property is already developed and there are a large number of buildings on the property
- Construction of the Project – Expenses include construction materials, labor hire, miscellaneous and other engineering works such as drainage work, electrical system, etc.
- Monitoring and assessment of environmental impact during construction

(2) The Project Operation Costs

- The Project Operation costs – These will begin when the Project starts its operation so the estimates will be calculated subject to future value with inflation rate as conversion factor

- Maintenance Costs – Yearly and periodic maintenance after the Project Operation begins. The estimates will be calculated subjected to future value with inflation rate as conversion factor.
- Monitoring of Environmental Impact during the Project Operation.
- Depreciation Costs – expenses to be calculated with Corporate Income Tax to be submitted to Treasury Department for State-funded projects, private investment and management, and including joint-stock companies.

The details of the Financial Costs of the Project Investment for the Electrified Train Project as in **Table 3.6-1** and Diesel-Powered Train Project as and **Table 3.6-2** and the Financial Estimates as in **Table 3.6-3**

Table 3.6-1
The Economic value of the Investment Cost on the Electrified Train Project

Unit: million baht

Year	Land Rights and Building Compensations	Civil Works	Signalling & Telecom.	Power Supply	O&M	Environmental Cost	Total Investment Costs
2018	54.54	1,237.86	138.71	285.91		4.64	1,721.66
2019		2,537.62	284.35	586.12		3.25	3,411.33
2020		2,601.06	291.46	600.77		3.33	3,496.62
2021					125.87	1.03	126.90
2022					132.81	0.70	133.51
2023					140.14	0.72	140.86
2024					147.88	0.00	147.88
2025					156.04	0.00	156.04
2026					164.66	0.52	165.18
2027					173.74	0.00	173.74
2028					183.33	0.00	183.33
2029					193.45	0.00	193.45
2030					204.13	0.00	204.13
2031					213.93	0.59	214.52
2032					224.19	0.00	224.19
2033					234.95	0.00	234.95
2034					246.23	0.00	246.23
2035					258.04	0.00	258.04
2036					270.43	0.67	271.10
2037					283.41	0.00	283.41
2038					297.01	0.00	297.01
2039					311.26	0.00	311.26
2040					326.20	0.00	326.20
2041					342.72	0.76	343.48
2042					360.09	0.00	360.09
2043					378.34	0.00	378.34
2044					397.51	0.00	397.51
2045					417.65	0.00	417.65
2046					438.82	0.86	439.68
2047					461.05	0.00	461.05
2048					484.41	0.00	484.41
2049					508.96	0.00	508.96
2050					534.75	0.00	534.75
Total	54.54	6,376.54	714.52	1,472.81	8,612.01	17.08	17,247.48

Table 3.6-2
The Economic value of the Investment Cost on the Diesel Train Project

Unit: million baht

Year	Land Rights and Building Compensations	Civil Works	Signalling & Telecom.	Power Supply	O&M	Environmental Cost	Total Investment Costs
2018	54.54	1,237.86	138.71	0.00		4.64	1,435.75
2019		2,537.62	284.35	0.00		3.25	2,825.21
2020		2,601.06	291.46	0.00		3.33	2,895.84
2021					134.00	1.03	135.03
2022					142.49	0.70	143.19
2023					151.52	0.72	152.24
2024					161.12	0.00	161.12
2025					171.33	0.00	171.33
2026					182.18	0.52	182.71
2027					193.73	0.00	193.73
2028					206.00	0.00	206.00
2029					219.05	0.00	219.05
2030					232.93	0.00	232.93
2031					243.56	0.59	244.16
2032					254.69	0.00	254.69
2033					266.32	0.00	266.32
2034					278.48	0.00	278.48
2035					291.20	0.00	291.20
2036					304.49	0.67	305.16
2037					318.40	0.00	318.40
2038					332.94	0.00	332.94
2039					348.14	0.00	348.14
2040					358.11	0.00	358.11
2041					377.66	0.76	378.42
2042					398.29	0.00	398.29
2043					420.04	0.00	420.04
2044					442.98	0.00	442.98
2045					467.18	0.00	467.18
2046					492.69	0.86	493.55
2047					519.60	0.00	519.60
2048					547.98	0.00	547.98
2049					577.90	0.00	577.90
2050					603.55	0.00	603.55
Total	54.54	6,376.54	714.52	0.00	9,638.54	17.08	16,801.21

Table 3.6-3
The Hypothesis in the Financial Feasibility of the Project

Details s	Hypothesis	Notes
1. Inflation rate 1.1 Construction Cost 1.2 Operation Cost 1.3 Revenue 1.4 Year in the Project Cost Assessment	2.5 %/year 2.5 %/year 2.5 %/year 2015	Office of Public Debt Management
2. Revenue 2.1 Passenger Fare - First Class Car - Second Class Car - Third Class Car 2.2 Fee from Fares 2.3 Freight Transport Fee	0.86 baht/person/km 0.42 baht/person/km 0.18 baht/person/km 53.48 % of Revenues from Passenger fares & Fees 1.83 baht/ton-km	SRT
3. Asset Life 3.1 Civil Works 3.2 Signaling & Telecom	40 years 32 years	
4. Timeframe in the Analysis 4.1 Project Analysis 4.2 Land Rights 4.3 Construction 4.4 Operation Period	30 years + construction period 1 year 3 years 30 years	Office of Public debt Management
5. First Year of Construction	2018	
6. First Year of Operation	2021	
7. Reduction rate	5%	
8. Tax 8.1 Tax Revenue to the Ministry of Finance	35 % from Net Profit	

3.6.2 The Projection of the Project Revenue

In the Study, the Consultants have prepared the Projection of the Project Revenue. The annual revenue will be calculated from the projected volume of passengers and freight multiplied by Passenger Fares and Freight Transport Fees in the target years. In the Study, the Consultants have set an assumption of the fixed increasing rate of the volume of passengers and freight during the target years using Linear Interpolation Method. This will yield the same volume of passengers and freight matched with the Line Load. The summary of the Projection of the Revenue on the Electrified Train Project (**Table 3.6-4**) and the Diesel Train Project (**Table 3.6-5**)

Table 3.6-4
The Project Revenue of the Electrified Train Project

Unit: million baht

Year	Passenger Fare	Transportation Fee	Freight Transport Fee	Total
2021	70	80	54	204
2030	146	167	89	401
2040	274	313	142	729
2050	479	548	215	1,243

Source: The Consultants

Table 3.6-5
The Project Revenue of the Diesel Train Project

Unit: million baht

Year	Passenger Fare	Transportation Fee	Freight Transport Fee	Total
2021	50	57	45	151
2030	106	121	77	304
2040	204	234	125	563
2050	363	415	191	968

Source: The Consultants

3.6.3 The Results of the Financial Feasibility Study of the Project

From the Financial Feasibility Study of the Project, it was found that the Electrified Train Project has NPV of -4,188.00 million baht (5% Discount Rate) and B/C Ratio of 0.58 while the Diesel Train Project has NPV of -4,683.19 million baht (5% Discount Rate) and B/C Ratio of 0.48 as shown in **Table 3.6-6**

Table 3.6-6
The Results of the Financial Feasibility Study of the Project

Case	NPV	B/C Ratio	FIRR
The Electrified Train System	-4,188.00 m.baht	0.58	0.30%
The Diesel Train System	-4,683.19 m.baht	0.48	-2.43%*

Note: *The Return Rate has a negative From thvalue consecutively because the Investment Capital of the Project includes investment on Infrastructure, Signaling & Telecommunication System and Power Supply which has high investment cost while the Returns are low.

From the Results of the Financial Feasibility Study of the Project, it was found that:

- From the Financial Analysis, both Projects have been found to have low Financial Feasibility with Negative NPV. Moreover, FIRR of both Projects is lower than the Investment Capital Gains and the B/C ration is lower than 1. This shows that both Projects will not be feasible in terms of investment.
- When considering the Sensitivity of the Project which has the most Positive impact : the Investment Capital decreases to 20% and the Financial Returns increases to 20%, the Electrified Train Project will have NPV of -1,105.58 million baht and -2,141.57 million baht for the Diesel Train Project with both Projects still have Negative NPV. Although the investment of this Project may be very beneficial to the society and the country, the Financial returns will not be worth the investment. Therefore, the Project may require additional government financial support.