MINISTRY OF WORKS
THE UNITED REPUBLIC OF TANZANIA

PREPARATORY SURVEY
ON
THE PROJECT
FOR
IMPROVEMENT OF TAZARA INTERSECTION
IN
THE UNITED REPUBLIC OF TANZANIA

FINAL REPORT

February 2012

JAPAN INTERNATIONAL COOPERATION AGENCY

ORIENTAL CONSULTANTS CO., LTD.
EIGHT-JAPAN ENGINEERING CONSULTANTS CO., LTD.
INTERNATIONAL DEVELOPMENT CENTER OF JAPAN INC.

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PREFACE

Japan International Cooperation Agency (JICA) decided to conduct the preparatory survey and entrust the survey to the consultant (consist of Oriental Consultants Co., Ltd. and International Development Center of Japan Inc.).

The survey team held a series of discussions with the officials concerned of the Government of the United Republic of Tanzania, and conducted a field investigation. As a result of further studies in Japan, the present report was finalized.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of the United Republic of Tanzania for their close cooperation extended to the survey team.

February, 2012

Kiyofumi KONISHI

Director General,

Economic Infrastructure Department

Japan International Cooperation Agency

SUMMARY

① Outline of the Country

The United Republic of Tanzania (hereinafter referred to as "Tanzania") is located in the middle of the east coast of Africa, facing onto the Indian Ocean. As of the year 2010, the population of Tanzania is estimated to be about 45 million and is increasing at an annual average growth rate of 3%. The national land area is about 945,000km^2, bordering Kenya and Uganda to the north, Rwanda and Burundi to the west, and Zambia, Malawi, and Mozambique to the south. Tanzania is located at a critical point to establish the transport route for cargoes to the inland countries (Uganda, Rwanda, Burundi, Zambia, and Malawi) that have no harbor opening to the sea.

Tanzania has the hot and moist climate characteristics of the coastal area. The climate of Dar es Salaam where the Tazara Intersection is situated is tropical, with high temperature throughout the year. The annual rainfall is about 1,100 - 1,400mm. It is said that there are two wet seasons; March to May and October to December. But the rainfall varies to a relatively considerable degree from year to year. The June to October period corresponds to the dry season. The annual average temperature is about 25.8°C and is slightly higher at about 26.9°C during a period from October to March. During the May to August period, the temperature is about 24.2°C. Temperature difference varies little throughout the year.

The economy of Tanzania has achieved solid growth since the year 2000, with the GDP growth rate being around 6 to 8% a year and GDP per capita reaching US$400 (in terms of the prices of 2000) in 2010. GNI per capita of Tanzania is US$530 (2010) but its growth rate has been slowing down since around 2005 when compared with the surrounding countries. The difference in GNI relative to Zambia and Kenya was growing in 2010 and it is almost on the same level with Rwanda, Uganda, and Mozambique at present. The industrial structure of Tanzania also shows an increase in the ratio of the secondary industries since 2000, but about 40% of GDP is accounted for by primary industry, mainly, agriculture, followed by the tertiary industries accounting for about 40%. The agricultural sector remains the core industry of Tanzania.

② Background, History, and Outline of the requested Project

Dar es Salaam, the largest economic city of Tanzania, has a natural good harbor opening to the Indian Ocean. In this context, this City functions as a starting point to make up a network of all transport systems, such as trunk roads, railways, and harbors. Therefore, this City is not only a strategic point for the traffic throughout Tanzania, but also a critical access point to the international corridor communicating to inland countries. On the other hand, the economic growth in the past decade has pushed up the number of registered vehicles within the City at a rate exceeding the population growth rate, which has caused worsening of traffic congestion year by year along the trunk roads. This in turn inhibits economic activities of the City. In addition, the

City has a rapidly growing population. If no adequate measures are taken in the future, traffic congestion in and around the Dar es Salaam metropolitan area will worsen further. These adverse factors are expected to hinder the growth of the economy of Dar es Salaam and thus the East African countries.

Under such situations, the Government of Tanzania requested the Japanese Government to implement "Dar es Salaam Transport Policy and System Development Master Plan (JICA: June, 2008)" (hereinafter referred to as the "JICA Master Plan 2008) for the purpose of improving the traffic situation in Dar es Salaam. In response, the Japan International Cooperation Agency (hereinafter referred to as "JICA") implemented the study for a period from April, 2007 to June, 2008. In the course of study, JICA developed the traffic master plan with the target year set at 2030 and selected multiple priority plans to be implemented by the period from the year 2008 to 2015. Among them, raising the intersection was proposed for the Tazara Intersection as one of those whose improvement is required urgently. On the basis of the proposal, the Government of Tanzania requested the Japanese Government to implement the "Tazara Intersection Improvement Project."

In response to the above request, JICA implemented the study for preparation of cooperation (1) (hereinafter referred to as the "preliminary study") in July, 2010, verifying the necessity, urgency, and validity of this project, confirming beneficial effects of this project, identifying the object, contents, and scale of the study, and confirming responses related to the environmental and social considerations. The following conclusions were drawn from the study results:

- To mitigate congestion of Tazara Intersection by raising, construction of the overpass is essential.
- The Overpass, if constructed, will prove beneficial to users of public transport passing through the Tazara Intersection. Specifically, this will help improve the life of the low-income group.
- The Overpass, if constructed, is expected to enhance the reliability and safety of physical transport using the International Corridor or the Nelson Mandela Road.
- The Overpass, if constructed, will provide high economic effect for both the Nelson Mandela Road and Nyerere Roads. Considering the urgency of solving the problem of traffic congestion, however, implementation of the Nyerere Road is recommended because of the possibility of early commencement of the project and fewer restrictions in terms of related projects and the environmental and social considerations.

On the basis of the above conclusions, implementation of this study (2) was determined. Note that the following points were presented as prerequisites for implementation of the study.

① Construction of the overpass (length: 300m, width: 8.5m×2) in the Tazara Intersection toward the Nyerere Road

② Construction of the access road (about 150m×2)

③ Outline of the study result and the contents of the project

JICA dispatched the study group for preparation of cooperation to report the field study during the period from May 30 to July 2, 2011 and the intermediate study on the overpass plan from November 6 to November 12, 2011. The study group held discussions with the government agencies while implementing the field survey on the intersection concerned and related areas. The team confirmed the necessity and urgency of improvements of the section concerned in terms of the present state of the points concerned, development state of the regions and areas, and the planning and progress of rapid bus services (BRT).

With the objective of constructing the required overpass and access way to the Tazara Intersection following the work in Japan after return, the draft outline of the survey for preparation for cooperation was presented in the field from December 10 to December 19, 2011, with basic agreement obtained from the Government of Tanzania.

For two overpasses proposed by the team for implementation of this project, the Government of Tanzania demanded strongly to add the BRT lane. However, the team obtained the Government agreement for not including the BRT lane by explaining to the Government that the time for BRT construction and its operation method are not yet determined and that the land sufficient for construction of an overpass for the BRT lane (12 m) has been secured.

Further more, the team explained and obtained the Government's basic agreement on the transfer and removal of public facilities, such as the water supply pipes buried under or the electric wires provided overhead the road section concerned, which may hinder the overpass construction work. Principal contents of the Tazara Intersection to be improved in this project are summarized in the table below.

Principal Contents		
Direction of overpass		Nyerere Road
Overpass (m)	PC box girder bridge	(45m+65m+45m)x2 lanes
	PC hollow bridge	(5 spansx30m)x2 lanes+(4 spansx30m)x2lanes
Access road		99.6mx2+70mx2
Street、frontage road, sidewalk, drainage		1 set
Lighting poles, guardrails, others		1 set

④ Project period and approximate project costs

The project period is scheduled to be a total of 47.5 months including the detail design (four months), time related to bidding (three months), and construction work (40.5 months). The Tanzanian portion of the cost is estimated as approximate 14.590 billion Tanzania Shillings.

⑤ Project evaluation

Relevance

This project will be implemented for the Tazara Intersection where the Nyerere Road, along which the relatively low-income group lives, crosses the Nelson Mandela Road that makes up a part of the physical corridor connecting the Dar es Salaam port with the inland area of Tanzania. Chronic traffic congestion is observed at present in the Tazara Intersection. Improvement of this intersection is expected to improve accessibility of wayside residents to the daily traffic while contributing to smooth international cargo transport. It may be determined that the relevance of implementing this project is high as described below:

(1) Beneficial effects of the project

The ratio of the traffic volume passing through the Tazara Intersection relative to the traffic volume per day within the whole of Dar es Salaam was estimated. Improvement of this Intersection is expected to provide direct benefit to about 18% of the bus users, 10% of passenger cars, and 30 to 40% of motor truck traffic of the whole of Dar es Salaam. Moreover, the population of the food poverty population that can enjoy direct benefit of improvement of this Intersection is estimated to be 56,000 (26.5% of the food poverty population of the whole of Dar es Salaam). In terms of the minimum-required bear necessity consumption expenditure (hereinafter referred to as "CBN"), this is estimated to be 76,000 (16.1% of CBN of the whole of Dar es Salaam).

(2) Urgency of the project

Traffic congestion and the consequential economic loss to Dar es Salaam are growing more severe year by year. Future prediction using micro-simulation shows that, if the overpass at the Tazara Intersection is not put into service, the economic loss per day will be 46 million Tanzania Shillings in 2015. Considering the financial state of the Government of Tanzania, implementation of this project is urgently required.

(3) Consistency with medium to long-term projects and higher-level projects of Tanzania

The Government of Tanzania developed, as the national development strategy, the NPS (National Poverty Eradication Strategy) in 1997 to present the framework for eradication of poverty. In 1999, the Government publicized the "Tanzania Development Vision 2025", presenting the directions of the development (improving the living standard, securing good governance and the rule of law, and a strong and competitive economy). On the basis of national development strategies, the PRS (Poverty Reduction Strategy） was developed in 2000, followed by the second PRS, that is, the NSGRP (National Strategy for Growth and Reduction of Poverty) (called MKUKUTA) in July, 2005, and the third PRS (MKUKUTA II) in July, 2010.

Similarly to the second PRS, the third PRS presents the comprehensive policy framework for five years for which eradication of poverty and economic growth are presented as targets. The stress is placed on the ownership of the nation, with the result-oriented inter-disciplinary approach employed. In this strategy, three elements were identified as contributing to the growth and eradication of poverty; "Growth and eradication of low-income poverty", "improvement of the life quality and social welfare", and "governance and accountability."

The 10 year Transport Sector Investment Programme (TSIP) was developed, which was to be the document of comprehensive strategy for the transport and traffic sector, in 2007. In this context, the road sector is highlighted as the largest investment area. The objective of this project is to mitigate traffic congestion at the Tazara Intersection, one of congestion points in Dar es Salaam. Consequential anticipation on reduction of economic loss caused by traffic congestion and improvement of road traffic service for wayside residents agrees with the targets of higher-level projects of this country.

(4) Consistency with the position and policy of aid of Japan

Our aid plan (June, 2008) and business development plan (August, 2010) for Tanzania are both intended principally for development of infrastructures while including the policy development and implementation aid, development and maintenance of trunk roads into the "Domestic Transport Network Establishment Aid Program." As aids for the transport and traffic sector, the loan assistances for the "Road Improvement project of the Arusa – Namanga – Athi River Section" and the "Road Sector Assistance Project" and grants-in-aid for the "Kilwa road widening project", and technical cooperation for the "LBT（Labour Based Technology） training capacity strengthening project", etc. were implemented. Apart from the above, the development survey of the "JICA Master Plan 2008" was implemented from 2007 to 2008. This project was proposed to be one of projects to be dealt with at top priority.

The TICAD IV Yokohama Action Plan proposed the "Wide area Transport Infrastructure" as an important subject while clearly noting the support for "Development and Improvement of Domestic and Wide-area Economic Corridor." This plan is to improve the accessibility to the Dar es Salaam Harbor and the International Trunk Roads and corresponds to the TICAD IV Yokohama Action Plan.

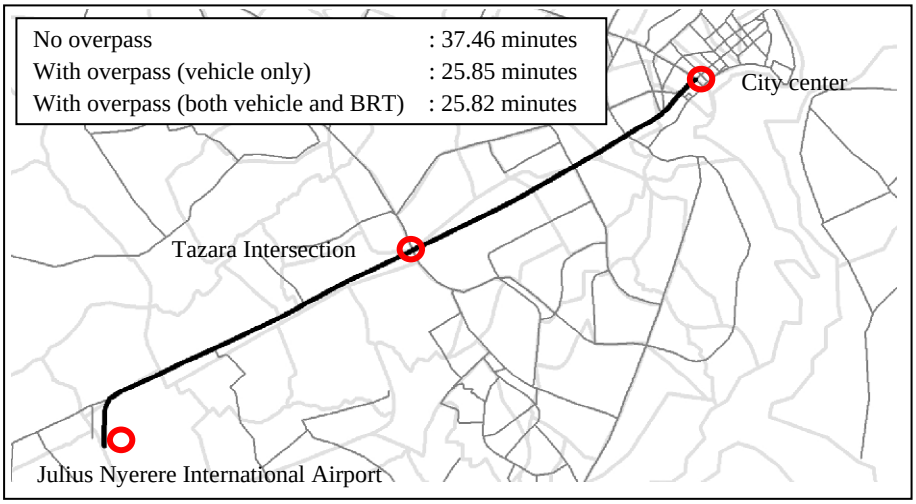
Effectiveness

(1) Quantitative effects

1) Reduction of the travel time

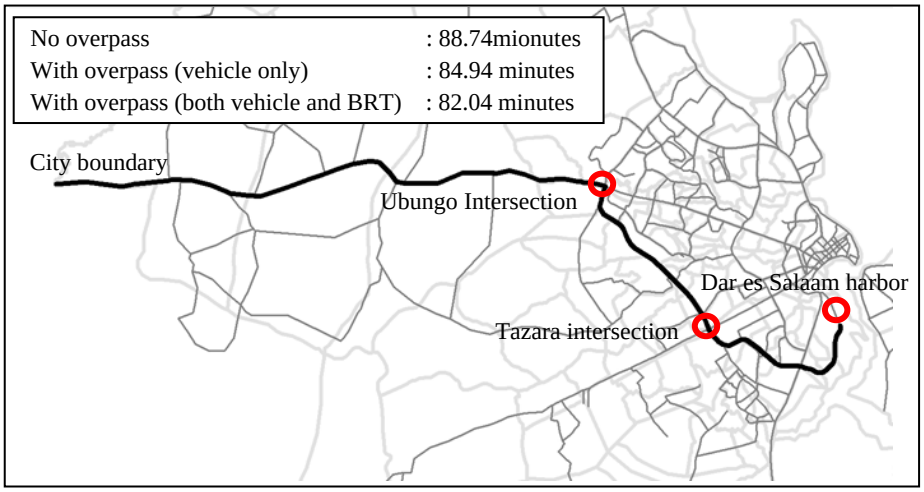
Implementation of this project will help reduce the time of travel within the city and also the wider area.

a) Airport to the city center (11km)



Source: JICA Study Team

b) Dar es Salaam Harbor to the city border (36km)



Source: JICA Study Team

2) Mitigation of congestion in the intersection

Implementation of this project will help mitigating congestion of the Tazara Intersection.

Effect index	Without Project	With Project (both vehicle and BRT)	With Project (vehicle only)	Present state (2011)
Degree of Saturation in Morning Peak Hour	2.35	1.65	1.64	1.040
Degree of Saturation in Evening Peak Hour	1.95	1.14	1.12	1.452
Average Travel Speed (km/hour)	32.6	48.5	44.3	34.2
Average Stop Time (sec/km/vehicle)	96.3	6.8	23.4	87.0
Average Number of Stops (No./km/vehicle)	1.7	0.2	0.4	1.3
Average Travel Time (Sec/km/vehicle)	176.5	76.9	95.4	165.9

Source: Study team. One-hour simulation result (average of all car models including BRT) using the observed traffic volume of peak hours (7:00 to 8:00 am) in the morning. BRT operation frequency assumed to be five-minute interval. Prediction for the year of 2015.

3) Effects of improving the wayside environment

Air pollution caused by road traffic congestion is also one of the urban traffic problems of Dar es Salaam. If this project is implemented, the travel speed will be improved and the wait time in the intersection will be reduced. From the trial calculation, it may be expected that this project, if implemented, will reduce Nox and CO_2 emissions during waiting in the intersection by 12.4 ton/year and 1,972 ton/year for 2015, respectively.

(2) Qualitative effects

The qualitative effects expected from this project are described below:

a) Poverty eradication effect

The access time can be reduced from the wayside area of Nyerere Road west of the Tazara Intersection, where many relatively low-income groups live, to the city centerand Kaliako area where the Dar es Salaam's largest market is located, along with clinics and other facilities. This is expected to contribute to activation and stabilization of the economic activities of the low-income group, and consequentially to the eradication of poverty.

b) Smoothing of domestic and international physical flow

This project will mitigate congestion of Nelson Mandela Road, which in turn reduces the time for road traffic of cargoes to the Dar es Salaam Harbor and inland countries. In consequence, physical flow to and from inland countries will become more active.

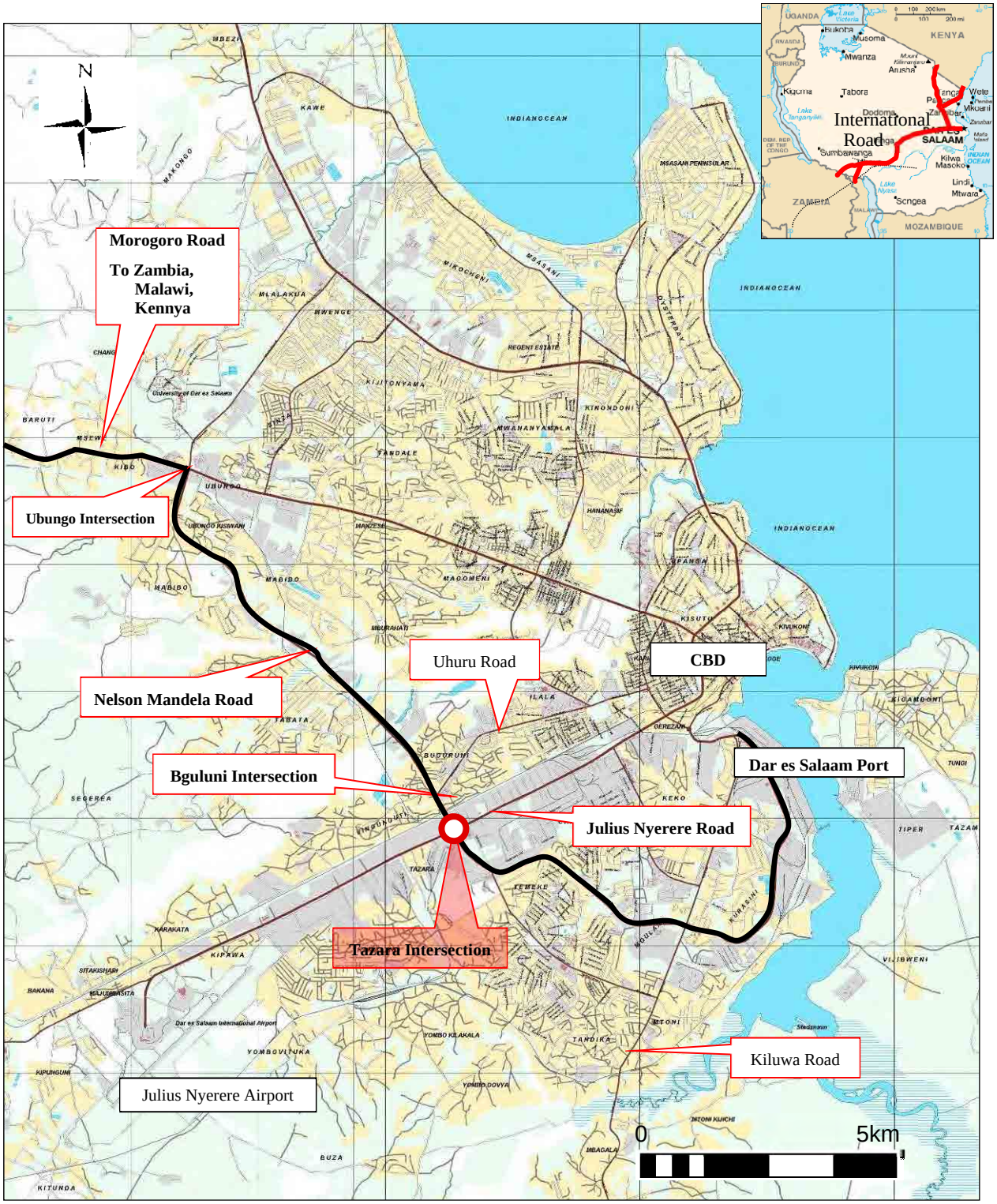
c) Reduction of accidents in the intersection

Minor collisions occurring due to congestion in and around the Tazara Intersection can be reduced, enhancing the transport safety.

d) Activation of the enterprise activities in Dar es Salaam

The Tazara Intersection of this project is located in the industrial (mainly light industry) area and along the Nyerere Road where the overpass will be constructed, there are large commercial and public facilities, including Japanese enterprises. Implementation of this project will reduce the transport cost of materials and products to the Dar es Salaam Harbor, which in turn contributes to activation of the wayside commercial activities.

Contents



Survey Location Map

Perspective of the Project (View point from Nelson Mandela Road)

Perspective of the Project (View point from Nyerere Road (1/3))

Perspective of the Project (View point from Nyerere Road (2/3))

Perspective of the Project (View point from Nyerere Road (3/3))

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Abbreviations

AfDB	African Development Bank
BD	Basic Design
BS	British Standard
BRT	Bus Rapid Transit
CBN	Cost of Basic Needs
CBR	California Bearing Ratio
CRB	Contractor Registration Board
DART	Dar Rapid Transit Agency
DAWASA	Dar Water and Sewer Suply Authority
DD	Detailed Design
EAC	East African Community
EIA	Environmental Impact Assessment
E/N	Exchange of Notes
ESAL	Equivalent Single Axle Loads
EU	European Union
F/O	Flyover
FS	Feasibility Study
G/A	Grant Agreement
GNI	Gross National Income
GDP	Gross Domestic Product
GNP	Gross National Product
GOT	Government of Tanzania
JICA	Japan International Cooperation Agency
M/D	Minutes of Discussion
MoID	Ministry of Infrastructure Development
MoW	Ministry of Works
MP	Master Plan
NEMC	National Environmental Management Council
NSGRP	National Strategy for Growth and Reduction of Poverty
PC	Prestressed Concrete
PCU	Passenger Car Unit
PMMR	Performance based Management and Maintenance of Road
PMORALG	Prime Minister's Office Regional Administration & Local
RAP	Resettlement Action Plan
RC	Reinforced Concrete
ROW	Right of Way
SADC	Southern African Development Community
SATCC	Southern African Transport and Communications Commission
TANESCO	Tanzania Electric Supply Company
TANROADS	Tanzania National Roads Agency
TOR	Terms of Reference
TRL	Tanzania Railway Limited
Tshs	Tanzania Shillings
WB	World Bank

Chapter 1 Background of the Project

1.1 Background, Circumstances and Outline of the Request for the Grant Aid

1.1.1 Substance Requested

Dar es Salaam, which faces toward the Indian Sea is the largest economic city (hereinafter referred to as "the City") in the United Republic of Tanzania (hereinafter referred to as "Tanzania"). As the City has a natural and functional port, it is an entrance to the international corridors and a strategic point for transport to the landlocked countries such as Uganda, Burundi, Rwanda and Zambia for all transport systems, including the road, rail, air and maritime transport in Tanzania. On the other hand, the number of registered vehicles has increased even more rapidly than the population growth rate in the last ten (10) years. This fact has caused traffic congestion on each trunk road and delayed economic activities of the City. And furthermore, as the population increase has quickly progressed in the City, if adequate measures are not taken smoothly, traffic congestion will be increased, and the economic growth of the City and the East African countries will be checked.

In this context, the Government of Tanzania (hereinafter referred to as "GOT") sent a request for implementation of the Urban Transport Policy and System Development Master Plan Study (hereinafter referred to as "M/P") for improving the transport network in the City to the Government of Japan (hereinafter referred to as "GOJ). In response, the GOJ entrusted Japan International Cooperation Agency (hereinafter referred to as "JICA") to implement the M/P formulated for the target year 2030 from April 2007 to June 2008. Priority projects have been selected for implementation between 2008 and 2015 in the M/P. Tazara Intersection was recommended to be improved by a crossing with flyover as one of the urgent projects. Based on the M/P, the GOT requested to the GOJ to conduct the project for Improvement of Tazara Intersection on June 2008 (hereinafter referred to as "the Project").

Tazara Intersection is located eight (8) kilometers toward the southwest from the Central Business District of Dar es Salaam city (hereinafter referred to as "CBD"). This place is the intersection that connects Nyerere Road and the Nelson Mandela Road. The Nyerere Road is the only trunk road to connect between CBD and Julius Nyerere International Airport. Industrial areas, including some Japanese descent factories, exist along the Nyerere Road. The Nelson Mandela Road has formed one of the logistic distribution networks to connect inland areas to Dar es Salaam Port (hereinafter referred to as "the Port") for transporting not only domestic goods but also goods to the landlocked countries. Both Roads usually have heavy traffic. Therefore vehicle travelling speeds are down to about six (6) kilometers per hour (km/h) due to confirmed traffic congestion at the Tazara Intersection during peak hours in the morning and evening.

Based on the request above, JICA conducted the preparatory survey of the Project (hereinafter

referred to as “the Preparatory Survey (1)” in July 2010. The JICA Preparatory Survey (1) team confirmed the necessity, urgency and relevance of the Project and benefits of the Project, definiteness of target/scope/contents of the Project, and accordance with social environmental considerations. Conclusions based on the result of the Preparatory Survey (1) are as below;

- In order to reduce traffic congestion at Tazara Intersection, a crossing with a flyover bridge needs to be constructed,
- Construction of the crossing with a flyover bridge should be beneficial to the users for transporting public busses (including DalaDala) through Tazara Intersection, especially for the lower income groups,
- Vehicles using Nelson Mandela Road which is the international corridor, are able to expect reliability of the logistic distribution and improvement of traffic safety, and
- Construction of the crossing with a flyover bridge certainly increases the economic effect of Nyerere Road and Nelson Mandela Road.

1.1.2 Agreement of the Substance Requested

The Preparatory Survey of the Project was carried out from May 31st to 1st July, 2011. During the Project, the Japanese side and the Tanzanian side agreed the following requested items through discussions;

① Construction of the flyover bridge at the Tazara intersection along the Nyerere Road, and
② Construction of approach roads to the flyover bridge.

Through the discussions, the Tanzanian side requested that some countermeasures against the traffic congestion along Nelson Mandela Road near Tazara Intersection should be taken within the scope of the Project. JICA assessed the appropriateness of the request through the Survey and reported the findings to the GOJ. Implementation and components of the Project were decided by the GOJ on 9th June, 2011 and reported in the Minutes of Discussion. (Refer to Appendix 4)

Nelson Mandela Road was improved by EU funding, excluding 600m between the railways of Tanzanian Railway Limited (hereinafter referred to as “TRL”) and Tazara Intersection as shown in Photo 1.1.1. and 1.1.2. The EU and Tanzania National Roads Agency (hereinafter referred to as “TANROADS”) have not yet decided whether this section should be improved or not.

Photo 1.1.1 Section Improved

Photo 1.1.2 Section Un-improved

1.2 Natural Condition

(1) Geographical Features

Topography of the City is composed of plateaus with altitudes is from 40m high to 200m high and flatlands in the seashore area. Surface soil is composed of sand, gravel, mud and clay of the Alluvial epoch. The bearing stratum at Tazara Intersection is composed of limestone deposited on coral reef during the Pleistocene epoch. According to the past boring survey data for the area surrounding Tazara Intersection, surface soil is composed of fine sand (0 to 14m deep) and lower stratum is also composed of fine sand including gravel (14 to 20m deep). N value of the bearing stratum (16 to 19m deep), which is composed of very hard rock, is more than 50. Characteristics of the geological investigation data are shown in Table 1.2.1.

Table 1.2.1 Geological Investigation Data at Tazara Intersection

Point of Bore hole	Depth(m)	Soil	N Value	Hardness	Bearing Stratum
Nyerere Road	0 -14	Sand	5 -15	Middle	15m deep
	14 – 20	Gravel/Sand	Over 50	Very hard	

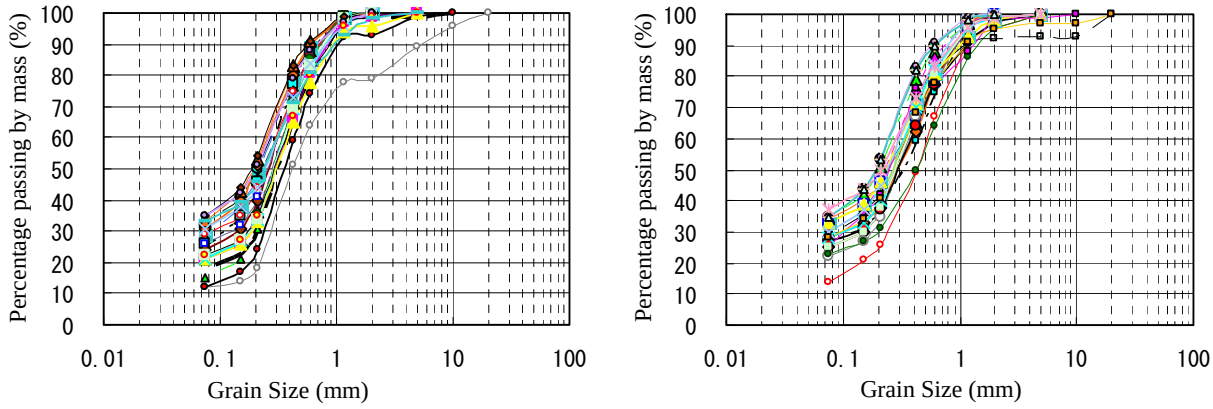
Source: JICA (1995) Dar es Salaam Development Plan

Four (4) boring surveys have been carried out in the area surrounding Tazara Intersection. The additional boring surveys and Standard Penetration Tests requested were carried out toward Nyerere Road in the Project. The survey results are shown below. In other words, the area surrounding Tazara Intersection is composed of a sand layer including lots of fine fraction (grain size is less than 0.075mm as shown in Figure 1.2.1).

① Five (5) meters deep from surface is composed of loose sand with an N value less than ten (10). From five (5) to ten (10) meters deep is composed of relatively firm sand with an N value less than thirty (30). More than ten (10) meters deep is composed of firm sand with an N value more than thirty (30).

② Based on the boring survey, foundation work for the flyover bridge should be set on soil with more than thirty (30) N value as the bearing stratum.

③ There is no ground water level in the boreholes showing in an underground survey of less than two (2) meters deep from the ground surface. However in the rainy seasons from March to May and October to December, this should be monitored during construction of subterranean work.

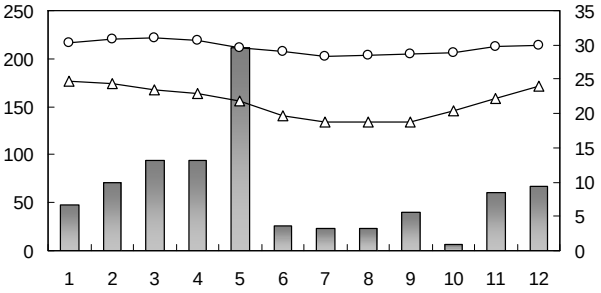


Source：Report on Geotechnical investigations for the Proposed Flyover at TAZARA Junction Dar es Salaam TANROAD 2008

Figure 1.2.1 Grain Size Distribution of Sand Foundation

(2) Climate

The City has a typically tropical climate and high temperature throughout the year. Annual rainfall is about 1,100mm to 1,400mm. There are two (2) rainy seasons from March to May and from October to December. A dry season is from June to October. Annual average temperature is estimated at 25.8 °C, temperature in June and October is estimated at about 26.9°C. Temperature in May to August is estimated at about 24.2 °C. Change of temperature is very slight.



Source: Preparatory Survey for Dar es Salaam Transport Policy and System Development Master Plan

Figure 1.2.2 Climate Data in Dar es Salaam

1.3 Environmental and Social Considerations

1.3.1 Environmental Certificate

Projects for construction and expansion or upgrading of roads are obligated to conduct an Environmental Impact Assessment (EIA） study and obtain an EIA Certificate from the National Environment Management Council according to the Environmental Management Act in Tanzania. Thus, Tazara Intersection Improvement Project requires an EIA study and certificate.

The tentative schedule of the EIA procedure is shown in Table 1.3.1. The period for issue of the environmental certificate will be about five months not including the EIA study period.

Table 1.3.1 Tentative Schedule of EIA Procedure

Year	2011							2012					
Month	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.
JICA Preparatory Survey	Site Survey			Draft F/O Design ▲			Draft Final Report ▲		Final Report ▲				
EIA Procedure													
Preparation & submission of project brief, Selection of EIA consultant and Screening													
Preparation & submission of scoping and TOR, and Approval by NEMC													
EIA study and Holding of public meetings										▲			
Submission to NEMC & review of EIS										Submission ▲			
Issue of environmental certificate													▲

1.3.2 Environmental and Social Impacts

The environmental and social impacts of the "Tazara Intersection Improvement Project (the F/O bridge)" are summarized in Table 1.3.2. No involuntary resettlement or serious impacts on the natural environment will occur in the project. The considerable impacts are as follows:

1. Generation of exhaust gas, dust, turbid water, noise, vibration and waste caused by construction works.
2. Felling of roadside trees in the right of way
3. Additional land acquisition of about 1,300m2 (4.5m x 295m)
4. Relocation or protection of utility facilities such as water and sewer pipes, electric cable, telephone lines and gas pipes.
5. Impact on street vendors during construction phase.
6. Temporary traffic congestion and relocation of bus stations during construction phase.
7. Traffic accidents and control caused by change of driving patterns in and around Tazara intersection.

These impacts are unavoidable to some degree by their nature, but can be mitigated by proper respective countermeasures.

Table 1.3.2 Summary of Environmental and Social Impacts

Category	No.	Impact Item	Assessment		Reason / Remarks
			Pre-Construction Phase Construction Phase	Operation Phase	
Pollution	1	Air pollution	B-	B±	**Construction Phase:** Generation of dust and exhaust gas caused by excavating works or operation of construction equipment **Operation Phase:** In the future, total amount of air pollutant caused by vehicle exhaust gas will increase. However, because of improved traffic efficiency, the amount may be reduced compared to without project.
	2	Water pollution	C-	D	**Construction Phase:** Impact on water resources of turbid water caused by construction works will not occur normally, because drainage ditches have been installed in the project site. However, in case of accidental massive leaking of fuel or oil, impact of polluted ground water on the food factory located near the construction site may occur. **Operation Phase:** No considerable impact on water quality
	3	Waste	B-	D	**Construction Phase:** Generation of construction waste caused by construction works and general waste from construction office **Operation Phase:** No considerable generation of waste
	4	Soil pollution	C-	D	**Construction Phase:** Soil pollution caused by construction works will not occur normally. In case of accidental massive leaking of fuel or oil, soil pollution may occur. However, there are no agricultural lands around the project site. **Operation Phase:** No considerable impact on soil quality
	5	Noise and vibration	B-	B±	**Construction Phase:** Increase in noise and vibration level caused by construction works. Impact on the hospital located near the construction site may occur. **Operation Phase:** In the future, noise level caused by vehicles will increase. However, because the F/O bridge will be installed in the central part of the right of way, the level on the road side may be reduced compared to without project.
	6	Ground subsidence	D	D	No considerable impact on ground subsidence
	7	Offensive odors	C-	D	**Construction Phase:** In case of operation of ill-serviced construction equipment, generation of exhaust gas with offensive odors **Operation Phase:** No considerable generation of offensive odors
	8	Bottom sediment	D	D	No considerable impact on bottom sediment
Natural Environment	9	Protected areas	D	D	No protected area in or around the project site
	10	Ecosystem	B-	B-	**Pre-Construction Phase:** Felling of about 50 roadside trees including Neem and Mast trees **Operation Phase:** No considerable impact on ecosystem, but necessity of recovery of roadside vegetation
	11	Hydrology	C-	D	**Construction Phase:** Impact on ground water by pilling works will not occur normally. However, a food factory located near the construction site has been used ground water, therefore, monitoring of ground water should be conducted. **Operation Phase:** No considerable impact on hydrology
	12	Geographical features	D	D	No considerable impact on geographical features. Existing quarry site and borrow pit will be used for aggregate.

Category	No.	Impact Item	Assessment		Reason / Remarks
			Pre-Construction Phase Construction Phase	Operation Phase	
Social Environment	13	Resettlement/ Land Acquisition	B-	D	**Pre-Construction Phase:** Additional land acquisition of about 1,300m^2 without involuntary resettlement **Operation Phase:** Because of no important facilities in the acquired area, no impact on the present land user
	14	Poor people	B±	B+	**Construction Phase:** Impact on daily street vendors who include poor people Job creation as unskilled labor for poor people **Operation Phase:** Travel time of mini-bus which is used by poor people will be reduced by improved traffic flow.
	15	Ethnic minorities and indigenous peoples	D	D	No residential area of ethnic minorities or indigenous peoples in or around the project site
	16	Local economies, such as employment, livelihood, etc.	B±	B+	**Construction Phase:** Impact on street vendors who have conducted selling activity around Tazara intersection Job creation as unskilled labor for local people **Operation Phase:** Reduction of travel time by improved traffic flow will contribute to local economies.
	17	Land use and utilization of local resources	B-	D	**Construction Phase:** Temporary change of land use in some open space occupied by Tazara station as the construction yard **Operation Phase:** No considerable impact on land use or utilization of local resources
	18	Water usage	C-	D	**Construction Phase:** Impact on ground water by pilling works will not occur normally. However, a food factory located near the construction site has been used ground water, therefore, monitoring of ground water should be conducted. **Operation Phase:** No considerable impact on water usage
	19	Existing social infrastructures and services	B-	B-	**Pre-Construction Phase:** Relocation or protection of utility facilities such as water and sewer pipes, electric cable, telephone lines and gas pipes **Construction Phase:** Temporary traffic congestion and relocation of bus stations **Operation Phase:** Right turn prohibition to access road side facilities including hospital through opposite line along F/O bridge
	20	Social institutions such as social infrastructure and local decision-making institutions	D	D	No considerable impact on social institutions
	21	Misdistribution of benefits and damages	D	D	No considerable impact on misdistribution of benefits
	22	Local conflicts of interest	D	D	No considerable impact on local conflicts
	23	Cultural heritage	C-	D	**Construction Phase:** Tazara station house and a monument in station square have historical value. Direct impact on these structures will not occur normally. However, some part of the station square will be used as the construction yard. Prevention measures against accidental damage should be considered in advance.

Category	No.	Impact Item	Assessment		Reason / Remarks
			Pre-Construction Phase Construction Phase	Operation Phase	
	24	Landscape	D	D	**Construction Phase:** Construction work will damage the landscape. However, because the construction site is located in an industrial area, particular landscape conservation measures will not be required. **Operation Phase:** Appearance of the F/O bridge and loss of roadside trees will change the landscape. However, because the project site is located in an industrial area, particular landscape conservation measures will not be required.
	25	Gender	D	D	No considerable impact on gender
	26	Children's rights	D	D	No considerable impact on children's rights
	27	Infectious diseases such as HIV/AIDS	D	D	Because the project site is located in a well developed urban area, considerable new influx of infected persons as construction workers will not occur.
	28	Working conditions (including occupational safety)	B-	D	**Construction Phase:** Impact on sanitary conditions around the construction site due to waste from construction workers Labor accidents including falls
	29	Accidents	B-	C-	**Construction Phase:** Labor accident including falls involving pedestrians and street vendors **Operation Phase:** Decrease of minor accidents in the junction will be expected. On the other hand, because Tazara F/O bridge will be the first F/O bridge in Tanzania, traffic accidents may increase in Tazara intersection in the initial stage.
Other	30	Trans-boundary impacts or climate change	D	D	No trans-boundary impacts such as climate change

A+/-: Significant positive/negative impact is expected.
B+/-: Positive/negative impact is expected to some extent.
C+/-: Extent of positive/negative impact is unknown. (A further examination is needed, and the impact could be clarified as the study progresses)
D: No impact is expected

1.3.3 Policy Framework for Project Affected Persons and Entitlements

The Project Affected Persons (PAPs) are categorized in the following three types.

1. Owners of partially affected property in additional acquired land
2. Authorized non-transient street vendors around Tazara intersection
3. Other street vendors (daily transient vendors) around Tazara intersection

According to the "RESETTLEMENT POLICY FRAMEWORK" formulated in the Second Central Transport Corridor Project (World Bank's BRT Project Phase I), the entitlements per category of the PAPs are summarized in Table 1.3.3. The entitlement and compensation in the "Tazara Intersection Improvement Project" should conform to this framework.

Table 1.3.3 Entitlements per Category of PAPs

PAPs Category	Entitlements through Valuers	Entitlements through Complementary Compensation	PAPs and Affected Property in the Project
Owner of partially affected property	Land indemnification Structure indemnification Disturbance allowance	Complementary transition allowance	Land, fence (200m long), street lights (2) and trees (5~6) owned by Tazara station and TANESCO
Authorized non-transient street vendors	Disturbance allowance	Relocation assistance Moving assistance	Booths to register for mobile phones (3) and open-air café (1)
Other street vendors (daily transient vendors)	-	Relocation assistance	Street vendors selling newspaper, fruits, clothing, etc. (5~20 persons).

Source : THE CONCEPTUAL DESIGN OF A LONG TERM INTEGRATED DAR ES SALAAM BRT SYSTEM AND DETAILED DESIGN FOR THE INITIAL CORRIDOR, RESETTLEMENT POLICY FRAMEWORK February, 2007

Compensation to Tazara station and TANESCO:

Tazara station and TANESCO, which occupy the additional acquired land have an entitlement to monetary compensation for the lost property. TANROADS, which is the project proponent, and Tazara station or TANESCO will have official meetings to decide the compensation cost and abandonment conditions. The actual compensation cost is estimated by official valuers.

Compensation to street vendors :

The authorized non-transient street vendors have an entitlement to a disturbance allowance according to Tanzanian regulations. The disturbance allowance is estimated by official valuers. If the vendors would like to continue their business in another place, the entitlements on succession of the business license, preparation of another business site and moving assistance should be provided as complementary compensation. Because the daily transient vendors have no entitlement to any monetary compensation according to Tanzanian regulations, the entitlements on assurance of the business activity and preparation of another business site should be provided as complementary compensation.

1.3.4 Environmental Management Plan and Monitoring Plan

The supervision consultant and construction contractor must observe the environmental management plan mentioned in the approved EIA report. The supervision consultant should establish a system for the environmental monitoring and assume the responsibility during the construction period.

The draft monitoring form of important environmental items is shown in Table 1.3.4. These environmental items should be monitored, even if the items are not referred to in the approved EIA report.

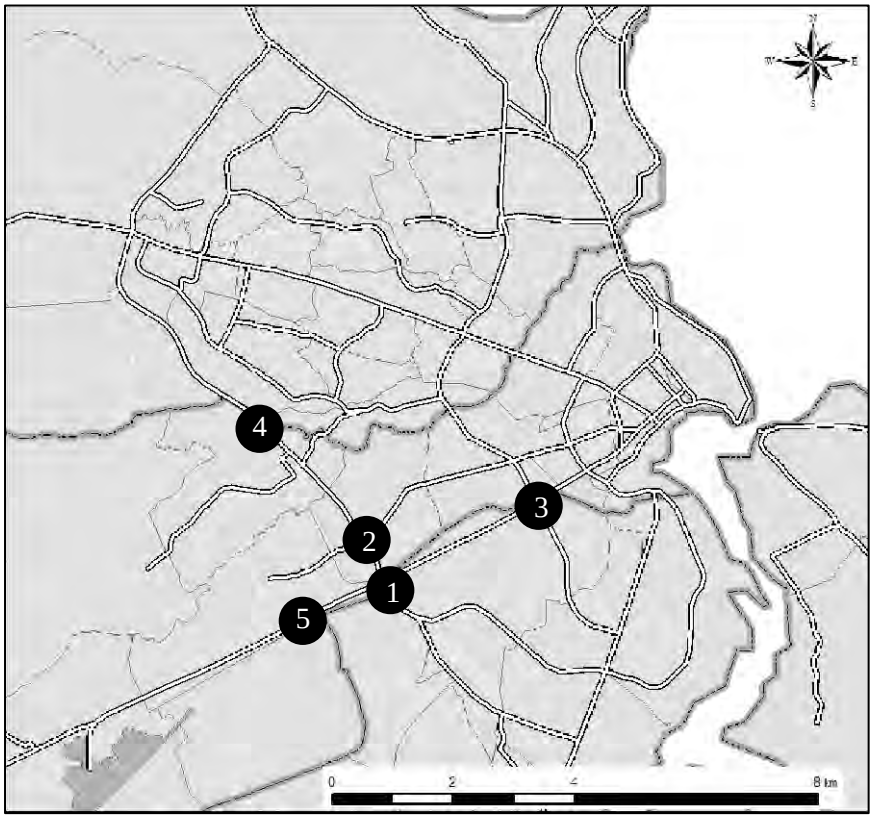
Table 1.3.4 MONITORING FORM (Draft)

Environmental Item	Responsible Person and Organization	Item	Location	Method	Frequency	Monitoring Results
Construction phase						
Air quality	- Supervision consultant - Construction contractor	Dust	Around construction site	Visual observation and interviews with pedestrians	Visual observation: Daily Interviews: Monthly or as needed	
Noise and vibration	- Supervision consultant - Construction contractor	Noise and vibration caused by construction works	Around construction site, especially Dar Group Hospital	Interviews with persons concerned, hospital and pedestrians	Weekly or as needed	
Ground water quality and quantity	- Supervision consultant - Construction contractor	Oil, quantity etc.	Wells in Azam factory	Interview with persons concerned and the factory	Weekly or as needed	
Waste	- Supervision consultant - Construction contractor	Disposal methods of construction waste	Construction site and disposal site	Visual observation and meetings with contractor	Visual observation: Daily Meetings: Monthly or as needed	
Roadside tree felling	- Supervision consultant - Construction contractor	Status of needless tree felling	Construction site	Visual observation and meetings with contractor	Visual observation: Daily Meetings: Monthly or as needed	
Accidents	- Supervision consultant - Construction contractor	Effect of accident prevention measures	Construction site	Visual observation, and interviews with pedestrians and construction workers	Visual observation: Daily Interviews: Monthly or as needed	
Commercial activity near junction	- Supervision consultant - Construction contractor - Ward office - TANROADS	Status of street vendors	Construction site	Visual observation and interviews with street vendors	Visual observation: Daily Interviews: Monthly or as needed	
Operation phase						
Noise and vibration	- TANROADS	Noise and vibration caused by vehicular traffic	Dar Group Hospital	Measurement by noise level meter and interviews with persons concerned and the hospital	Yearly	
Traffic management	- TANROADS	Status of vehicular traffic	Around Tazara junction	Interviews with road users and record of traffic accidents	2~6 times during the first year after completion	
Commercial activity near junction	- Ward office - TANROADS	Status of street vendors	Around Tazara junction	Interviews with street vendors	2~6 times during the first year after completion	

1.4 Traffic Volume Survey

1.4.1 Outline of Traffic Survey Result

A traffic survey was carried out in June 2011 for the verification of the traffic demand forecast at Tazara Intersection carried out by the former traffic surveys which were located on Tazara Intersection and other neighboring intersections on Julius Nyerere Road and Nelson Mandela Road. Traffic survey points are shown in Figure 1.4.1. The survey was carried out two times during 6 a.m. to 9 a.m. and 4 p.m. to 7 p.m. which means the peak times respectively. Four types of vehicles were surveyed at each survey point. The survey outline and vehicle types are shown in Table 1.4.1 and 1.4.2.



Source: JICA Survey team

Figure 1.4.1 Traffic Survey Points

Table 1.4.1 Survey Outline

Code	Intersection Name	Main Road	Connection Road	Survey Time (hour)		Survey date
				Peak time (a.m.)	Peak time (p.m.)	
IC-1	Tazara	Julius Nyerere	Nelson Mandela	3	3	8th
IC-2	Buguluni	Nelson Mandela	Uhulu	3	3	8th
IC-3	Chang Omebe	Julius Nyerere	Chang Ombe	3	3	9th

Source: JICA Survey team

Table 1.4.2 Vehicle Type for Survey

Type	Vehicle
1	Passenger car
2	Mini-bus, bus
3	Truck, trailer
4	Motorcycle, tricycle

Source: JICA Survey team

Other traffic surveys on Julius Nyerere Road and Nelson Mandela Road were carried out on weekdays during four hours at 6 a.m. to 8 p.m as shown in Table 1.4.3, 1.4.4.

Table 1.4.3 Survey Outline

Code	Road Name	Survey Time (hour)	Survey date
TC-4	Nelson Mandela	14(6 a.m. to 8 p.m.)	9th
TC-5	Julius Nyerere	14 (6 a.m. to 8 p.m.)	9th

Source: JICA Survey team

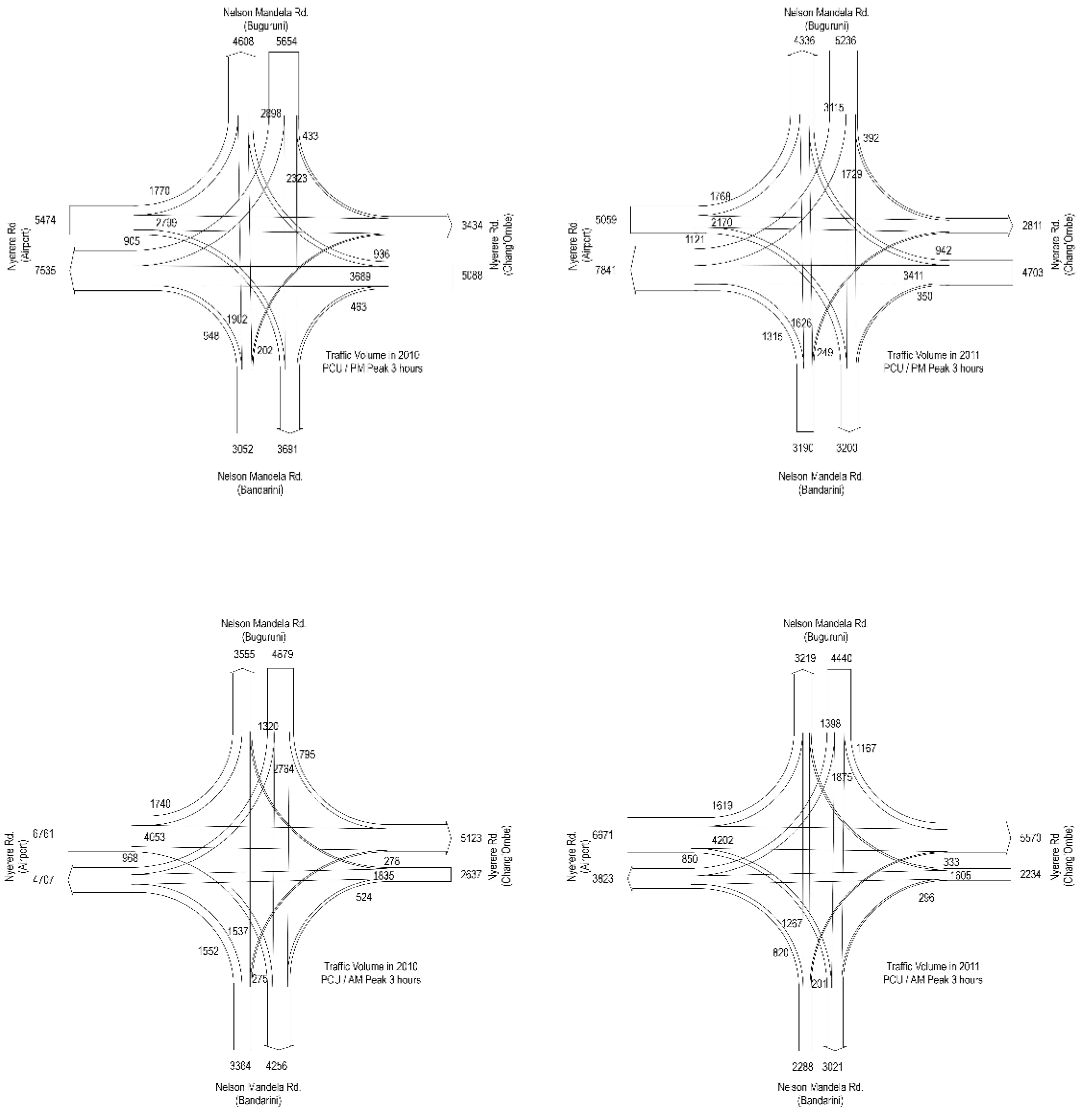
Table 1.4.4 Vehicle Type for Survey

Type	Vehicle
1	Passenger car
2	Mini-bus
3	Circular route bus, other buses
4	Truck (2 axles)
5	Truck (3 axles)
6	Trailer (more than 3 axles)
7	Motor cycle, tricycle

Source: JICA Survey team

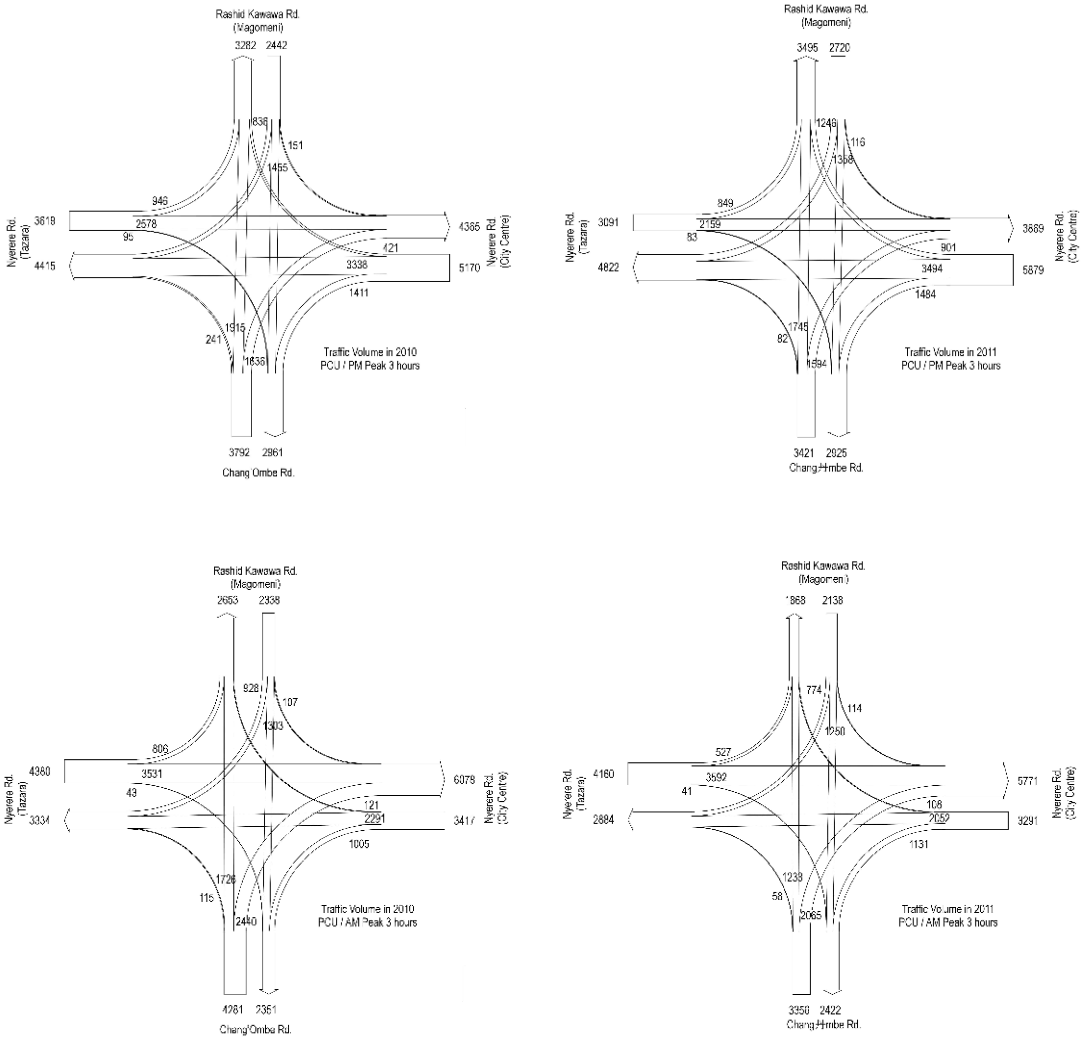
1.4.2 Outline of Traffic Survey Result

The traffic survey results are shown in Figures 1.4.2, 1.4.3, 1.4.4 compared with 2010's results.



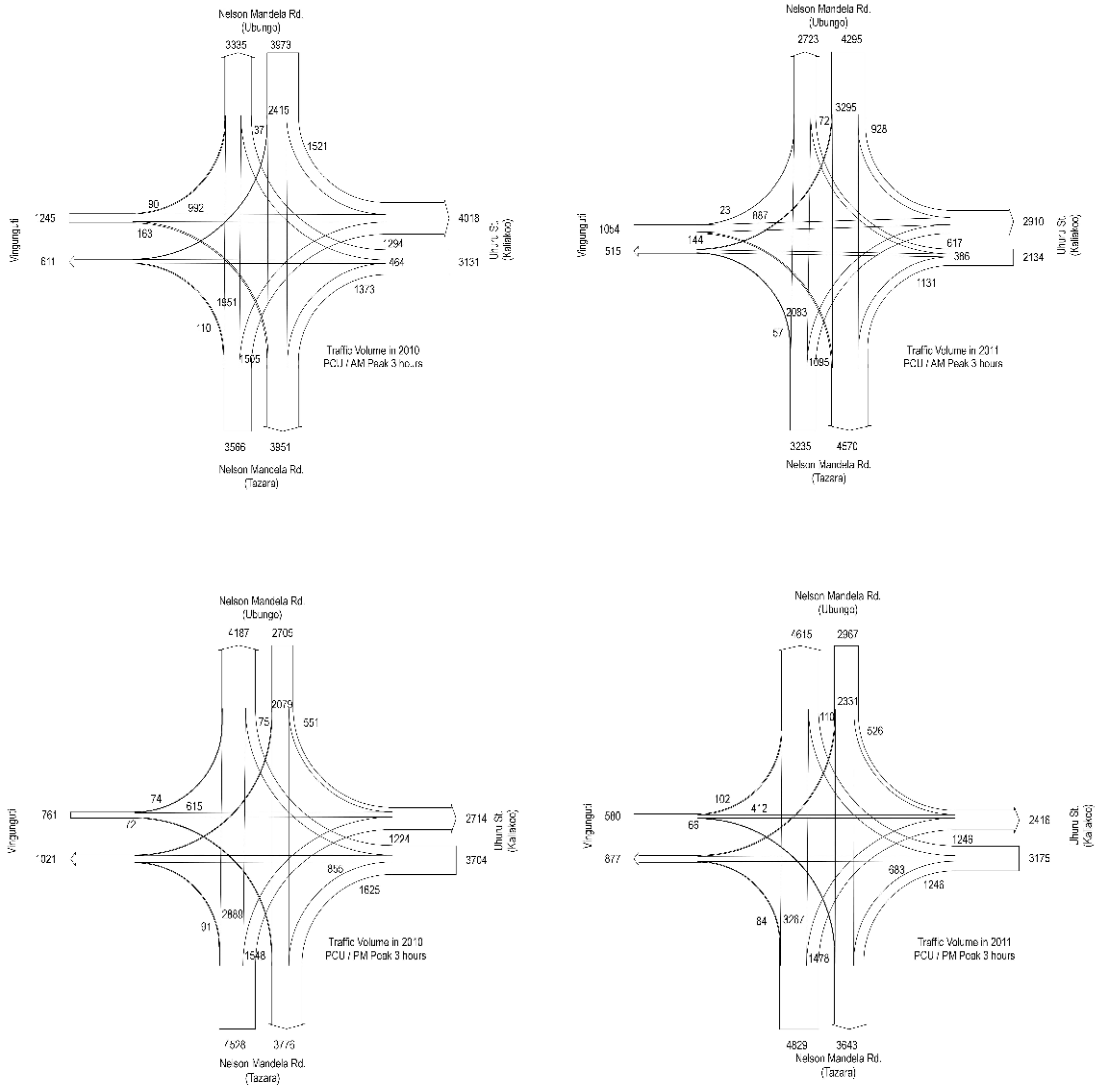
Sourse: JICA Survey team

Figure 1.4.2 Traffic Volume (at Tazara Intersection)



Source: JICA Survey team

Figure 1.4.3 Traffic Volume (at Chang Ombe Intersection)



Source: JICA Survey team

Figure 1.4.4 Traffic Volume (at Buguluni Intersection)

The result of the traffic volume, which is the peak of morning time, and saturation rate at Tazara Intersection has reduced compared with the survey in 2010. The reason seems to be the staggering working hours and avoiding traffic congestion. Furthermore, the reduction in the number of mini-buses had a tendency to reduce the total volume because of the conversion to bigger buses. However the traffic volume of the return route between Julius Nyerere Airport, Tazara Intersection, Buguluni Intersection Uhuru Road and Kariako has increased. Therefore traffic congestion at Tazara Intersection has become worse in the afternoon. Table 1.4.5 shows the result of the traffic surveys on Julius Nyerere Road and Nelson Mandela Road.

Table 1.4.5 Traffic Volume

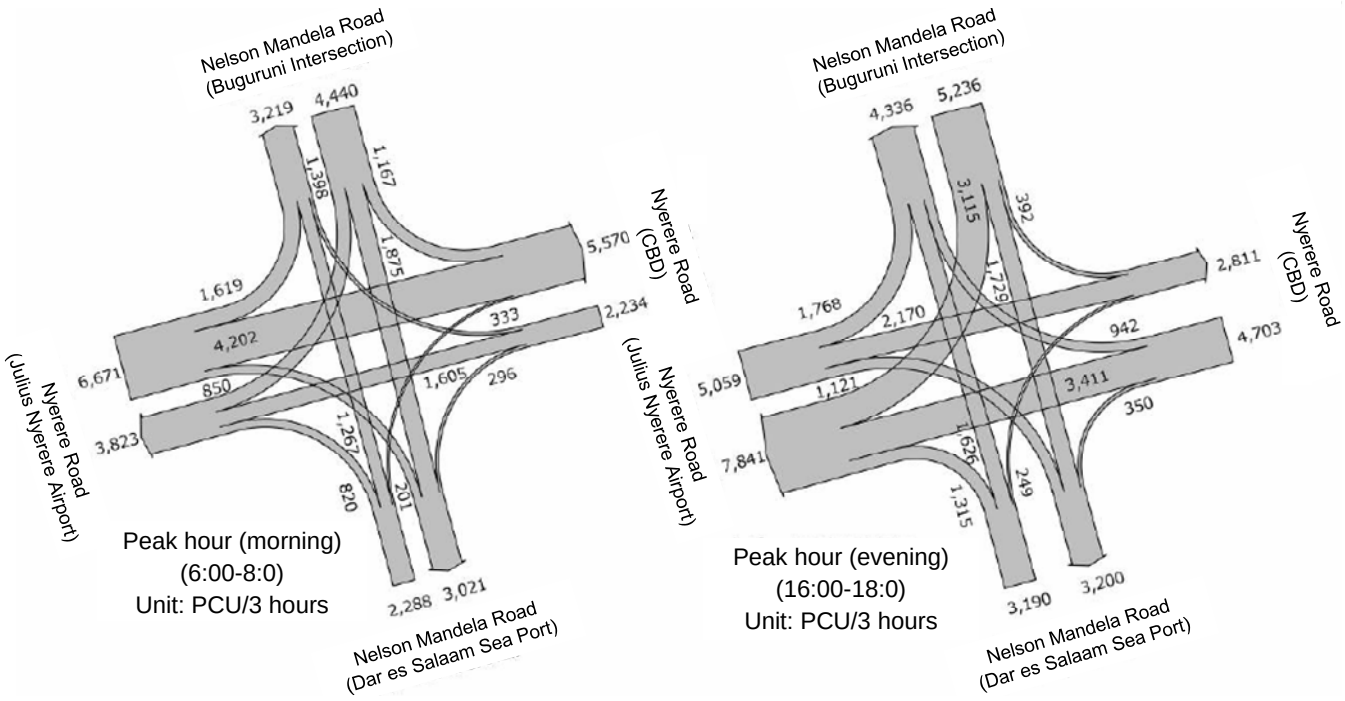
(Unit: vehicle)

	Nyerere Road	Nelson Mandela Road
Passenger car	22,556	11,819
Mini-buses	6,309	3,693
Circular route bus, other buses	211	313
Truck (2 axles)	2,637	1,576
Truck (3 axles)	518	504
Trailer (more than 3 axles)	772	1,286
Motorcycle, tricycle	6,587	4,381
Total Volume	39,590	23,572

Source: JICA Survey team

1.4.3 Saturation Degree of Tazara Intersection

Tazara Intersection is located on Nyerere Road, which is connected with the Julius Nyerere Airport and CBD at the crossing with Nelson Mandela Road, which is connected with the Dar es Salaam Port and inland Tanzania. Therefore, public busses for people along each Road and trucks always complicate on the Tazara Intersection. Traffic volume flowing into Tazara Intersection is about 14 thousand vehicles in the morning peak hours (3 hours) and about 15 thousand vehicles in the evening peak hours (3 hours). As described in Table 1.4.6, the existing Tazara Intersection is already expected to saturate.



Source: JICA Survey Team (June 2011)

Figure 1.4.5 Traffic Volume at Tazara Intersection

Table 1.4.6 Existing Saturation

Time Zone		Saturation Degree (Saturated = more than 1.0)
Morning Peak hour	6:00 - 7:00	0.996
	7:00 - 8:00	1.040
	8:00 - 9:00	0.988
Evening Peak hour	16:00 - 17:00	1.066
	17:00 - 18:00	1.452
	18:00 - 19:00	1.414

1.4.4 Forecast for BRT

(1) Relaxation of Degree of Congestion at Tazara Intersection

Table 1.4.7 shows the result of a simulation analysis for an elevated or at grade crossing of BRT. If BRT crosses at grade on Tazara Intersection, traffic signals for BRT shall be installed for smooth traffic flow. As a result of the simulation analysis, the flyover bridge for BRT shall be constructed in 2015.

Table 1.4.7 Forecast for BRT (2015)

Index of effectiveness	Without Project	With Project (Vehicle/BRT)	With Project (Vehicle)	Present Situation (2011)
Average delay time (sec/km/vehicle)	108.8	10.4	29.0	98.0
Average Travel Speed (km/hour)	32.6	48.5	44.3	34.2
Average Stop Time (sec/km/vehicle)	96.3	6.8	23.4	87.0
Average Number of Stops (No./km/vehicle)	1.7	0.2	0.4	1.3
Average Travel Time (Sec/km/vehicle)	176.5	76.9	95.4	165.9
Degree of Saturation in Morning Peak Hours	2.35	1.65	1.64	1.040
Degree of Saturation in Evening Peak Hours	1.95	1.14	1.12	1.452

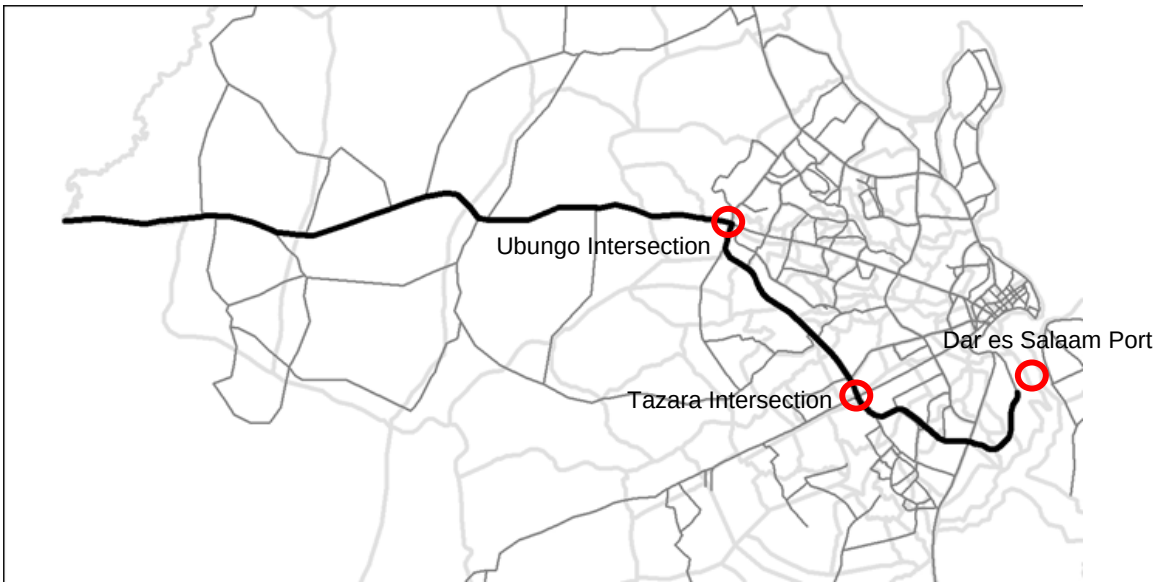
Source: JICA Survey Team, BRT operates every 5 minutes.

(2) Reduction of Travel Time

Necessary time from the Dar es Salaam Port to the boundary of the City for international logistic distribution, and necessary time from the Julius Nyerere Air Port to the CBD are confirmed for the target year 2015. As a result of the simulation, travel time from the Dar es Salaam Port to the boundary was reduced by four (4) minutes. Travel time from the Julius Nyerere Air Port to the CBD was reduced by about twelve (12) minutes as shown in Figure 1.4.6.

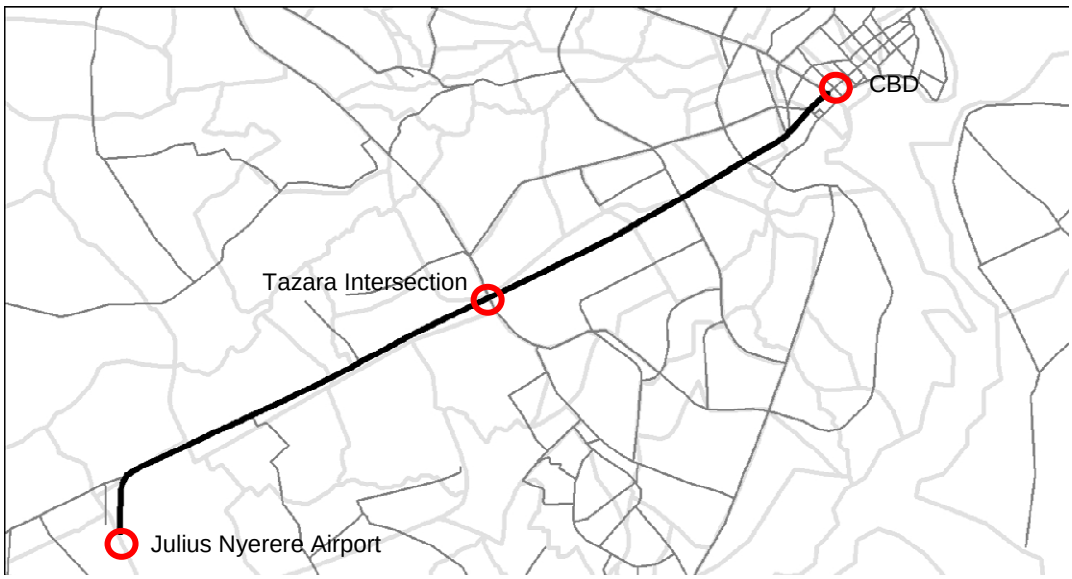
1) From the Dar es Salaam Port to the Boundary (36km)

Without Project : 88.74 minutes
With Project (Vehicle only) : 84.94 minutes
With Project (Vehicle/BRT) : 82.04 minutes



2) From the Julius Nyerere Airport to the CBD (11km)

Without Project : 37.46 minutes
With Project (Vehicle) : 25.85 minutes
With Project (Vehicle/BRT) : 25.82 minutes



Source: JICA Survey Team

Figure 1.4.6 Reduction of Travel time

1.5 Public Utilities

The public utilities located in Julius Nyerere Road that affect the Project are shown in Table1.5.1. In addition, high-voltage power lines (132 kv) of TANESCO are planed to be installed 18 m above the ground level at the point of sag. This height is enough for the vehicles that will pass on the Project's bridge. Location and total length of each utility are shown in Figure 1.5.1 and Table 1.5.2.

Table 1.5.1 Public Utilities under Julius Nyerere Road

Utilities	Owner	Existing Location
• Power lines • Electrical poles	TANESCO	• Above Julius Nyerere Road at the Intersection with Nelson Mandela Road • Underground on both sides of Julius Nyerere Road
• Telephone wires • Optical fiber cables	TTCL	• Above Julius Nyerere Road • Underground on both sides of Julius Nyerere Road
• Water pipes • Sewerage pipes	DAWASA	• Underground on both sides of Julius Nyerere Road • South side of Julius Nyerere Road (Airport side)
Gas pipes	PANAFRICAN	ASL TZ LIMITED, in front of Exhibition hall, (city center side)

Each utility that affects the Project should be relocated by the owner.

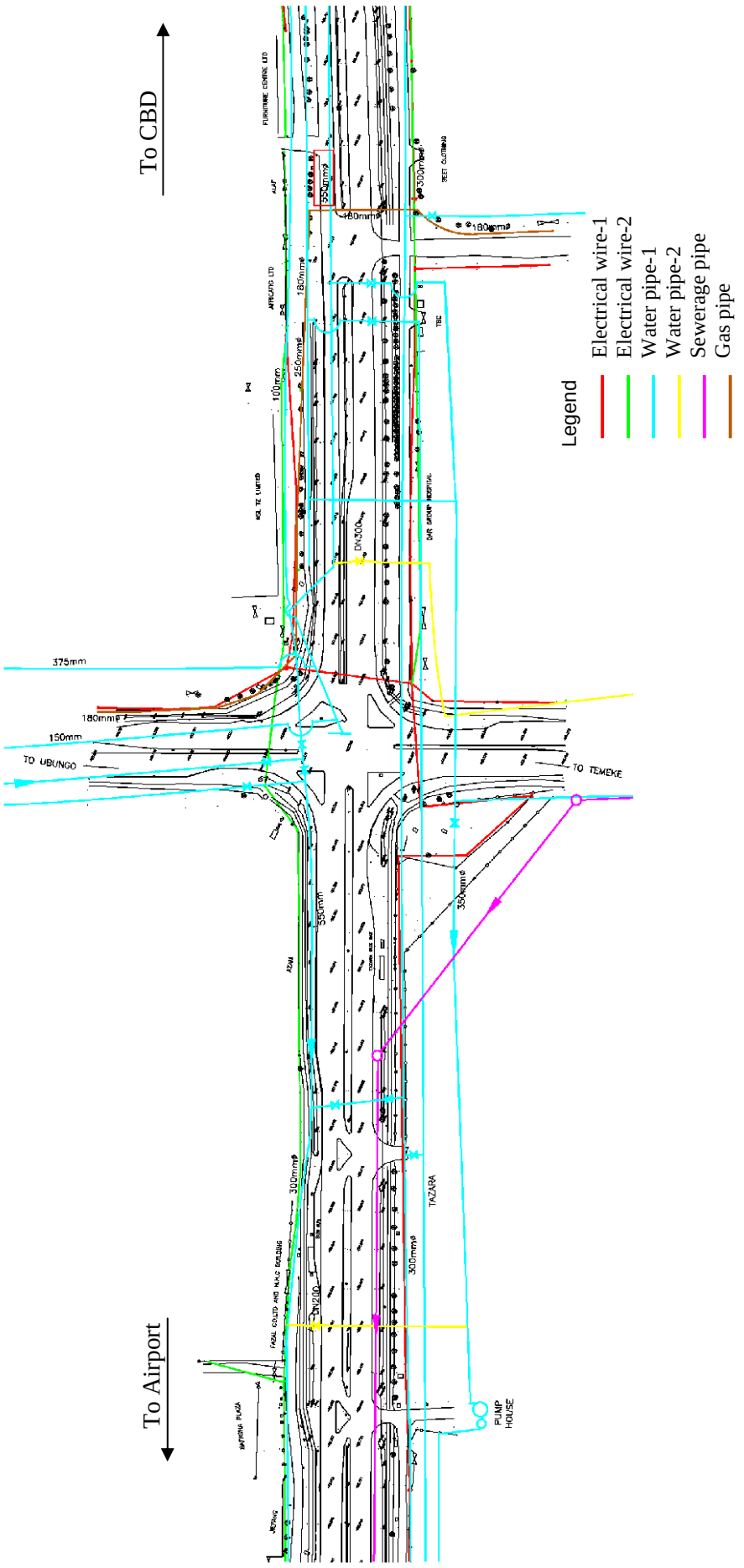


Figure 1.5.1 Location of Each Utility

Table 1.5.2 Public Utilities to be Relocated

ID	Item	Specification	Unit	Qty	Remarks
G1	Gas Pipe	D180	m	55	Road Crossing
		Total	m	55	
W1	Water Pipe	D300	m	270	LHS Walkway
W2	Water Pipe	D300	m	124	LHS Walkway
W3	Water Pipe	D550	m	168	LHS Walkway
W4	Water Pipe	D550	m	9	Road Crossing
W5	Water Pipe	D550	m	65	LHS Walkway
W6	Water Pipe	D550	m	33	LHS C/W
W7	Water Pipe	D550	m	433	LHS C/W
W8	Water Pipe	D180	m	432	LHS C/W
W9	Water Pipe	D100	m	64	LHS C/W
W10	Water Pipe	D350	m	43	Road Crossing
W11	Water Pipe	D300	m	57	Road Crossing
W12	Water Pipe	D180	m	57	Road Crossing
W13	Water Pipe	D300	m	862	RHS Walkway
W14	Water Pipe	D300	m	236	RHS Walkway
W15	Water Pipe	D350	m	50	Road Crossing
W16	Water Pipe	D600	m	80	Mandela Rd.
W17	Water Pipe	D600	m	28	Mandela Rd.
W18	Water Pipe	D300	m	89	Mandela Rd.
W19	Water Pipe	D300	m	17	Mandela Rd.
W20	Water Pipe	D150	m	100	Mandela Rd.
W21	Water Pipe	D150	m	25	Mandela Rd.
W22	Water Pipe	D300	m	42	Road Crossing
W23	Water Pipe	D300	m	48	Road Crossing
W24	Water Pipe	D200	m	50	Road Crossing
		Total	m	3,382	
P1	Power Line	33kv	m	80	
P2	Power Line	33kv	m	62	
P3	Power Line	33kv	m	243	
P4	Power Line	33kv	m	247	
P5	Power Line	33kv	m	277	
P6	Power Line	11kv	m	29	
P7	Power Line	11kv	m	403	
		Total	m	1,341	

Chapter 2 Contents of the Project

2.1 Basic Concept of the Project

2.1.1 Overall Goal and Target of the Project

(1) Overall Goal

The government of the United Republic of Tanzania (hereinafter referred to as "Tanzania") worked out the program called the "National Poverty Eradication Strategy (NPES)" as Tanzania's national development strategy in 1997 and presented the framework of the poverty reduction to the Tanzanian nation. In 1999, the government of Tanzania expressed "The Tanzanian Development Vision (Vision 2025)" and presented the course of development such as "High quality Livelihood", "Peace, Stability and Unity", "Good Governance", "A well Educated and Learned Society", and "A strong and Competitive Economy". Based on such programs the government of Tanzania has worked out the program of the "Poverty Reduction Strategy (PRS)" in 2000 and has implemented "The National Strategy for Growth and Reduction of Poverty II (NSGRP II)" for five years (2010/11-2014/15) in 2005 which is known as MKUKUTA II.

MKUKUTA II is organized under three clusters such as Cluster 1: Growth for Reduction of Income Poverty; Cluster II: Improvement of Quality of Life and Social Well-being; Cluster III: Governance and Accountability. Above all, the government of Tanzania has valued the growth element to achieve the continuous poverty reduction above everything else, and set themselves the task of accelerating the continuous and far-sighted growth. The "Transport Sector Investment Program 2006" is a ten year investment program for the Transport Sector that was worked out based on MKUKUTA II as the investment program for the road sector.

Based on the above mentioned, the road network development is targeted to contribute to the improvement of accessibility, to the improvement and extension of the trunk road, and to the transport facilities along the port, airport and development corridor.

(2) Target of the Project

The Project is targeted to reduce traffic congestion on Nelson Mandela Road and Julius Nyerere Road, and to strengthen the poverty reduction and the transport on the international corridors, by constructing a flyover (F/O) bridge on the Tazara Intersection along Nyerere Road (Referred to as the "Project").

2.1.2 Outline of the Project

The Project has been expected to bring livelihood improvement for low income people who use public transport, and to the advancement of safety and reliability of distribution transports which use Nelson Madela Road which is the international corridor. The investment outline of

the Project is shown in Table 2.1.1.

Table 2.1.1 Investment Outline of the Project

Contents		
Construction period		40.5 months
Flyover Bridge (m)	continuous PC box type	(45m+65m+45m)x2 ways
	Continuous PC hollow slab type	50mx2 ways+40mx2 ways
Access road		99.6mx2 ways+70mx2 ways
Street, service road, side walk, drainage		1 set
Accessory facilities, others		1 set

2.2 Outline Design of the Japanese Assistance

2.2.1 Design Policy

(1) Basic Concept

The Project aims to improve infrastructure that is currently incapable of supporting sustainable economic development, and to relieve traffic congestion arising in line with population growth and increased car ownership.

TAZARA intersection is the crossing point of Nelson Mandela Road and Nyerere Road, which are key trunk roads in Dar es Salaam. This intersection is the source of chronic traffic congestion. Accordingly, concerning the improvement of TAZARA intersection, based on the request from the Government of Tanzania, and taking the findings of the field survey and discussions into account, the following policies were decided in order to secure the smooth and safe flow of traffic.

Basic policy of F/O Bridge design

- The F/O bridge and approach road shall meet Tanzanian design criteria.
- Width and load bearing capacity in conformance with Tanzanian design standards shall be secured.
- Traffic volume and characteristics (large vehicles, small vehicles and bus traffic, etc.) and related plans (BRT program) shall be examined and reflected in the plan.
- Safety facilities shall be installed and consideration shall be given to traffic safety.
- The F/O bridge and approach road construction shall be planned with a view to minimizing impacts on the social environment.

(2) Natural Condition Policy

1) Topographical Conditions

The topographical conditions in Dar es Salaam are classified into the following five types.

Lowlands (elevations of lower than 5 m above sea level)

Lowlands spread at the bay area, river mouth and the hinterland along the coast. In these lowlands, marsh areas and swampy areas are widely spread where soft soil is deep and drainage conditions are rather poor.

Plains / Terrace (5 to 20 m above sea level)

Flat plains and terrace areas are observed between 5 to 20 m above sea level. These areas with some minor local hollows extend several kilometers wide along the coast. Geologically, its origin was a coastal plain associated with the local terrace which was formed due to past drop in sea level.

Terrace / Hill (20 to 60 m above sea level)

Gentle hilly areas are observed in the area between 20 to 60 m above seal level, which is the dominant part of the residential area of Dar es Salaam. Ground surface consists of residual weathered limestone. Many terrace areas of 500 to 1,000 m in width are observed around the banks of the rivers in Dar es Salaam.

Hills (60 to 150 m above sea level)

The origin of these hills is raised coral reefs. Undulation in these areas changes from gentle to steep in accordance with the weathering degree.

Mountains (150 m or more above sea level)

Mountainous areas are observed in the western area of Dar es Salaam at around approximately 30 km inland from the coast. This rather undulated mountainous area is composed of limestone associated with sandstone of an older geological era.

Topographical condition of the TAZARA F/O bridge belongs to (3) Terrace / Hill (20 to 60 m above sea level) type.

2) Geological Conditions

The geological basement of Tanzania consists of an igneous, sedimentary and volcanic complex of an old geological era. It forms a backbone mountain range of inland Tanzania which connects to the tectonic line extending from Lake Victoria.

A geological investigation was carried out in 4 locations along Nyerere road. Summary results

are shown in Figure 2.2.1.

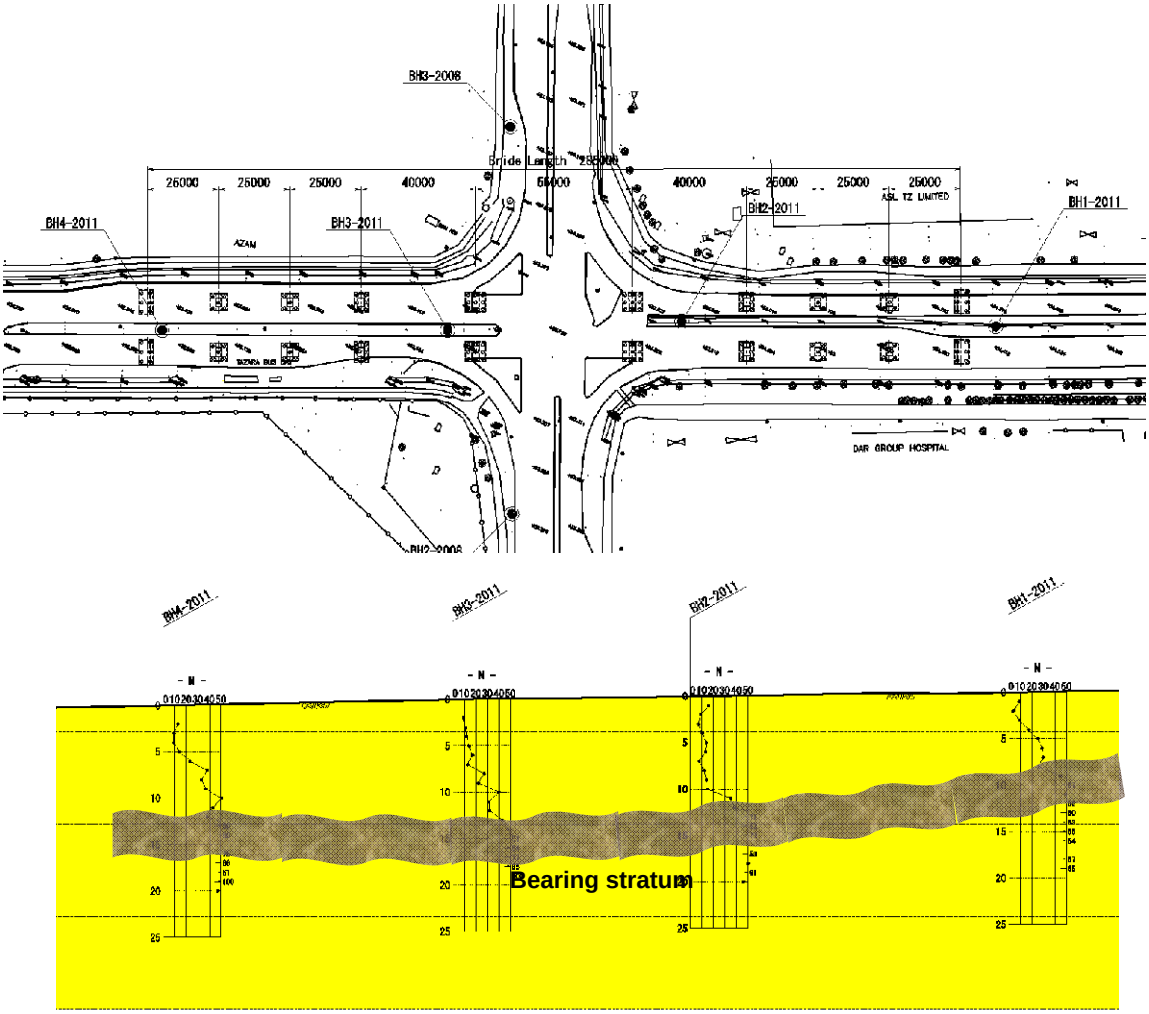


Figure 2.2.1 Boring Log

The geological basement of TAZARA intersection consists of a sand layer which includes a comparatively high percentage of fine-grained fraction (less than grain-size 0.075mm).

- Surface layer (0 - 5m depth) : loose sand (N ≦10)
- Middle layer (5 - 10m depth) : Medium to dense sand (N ≦30)
- Bottom layer (10m or more depth) : Very dense sand (N ≧30)

According to the above results, bottom layer (dense sand layer) can be the bearing layer of the pile foundation for TAZARA F/O bridge.

Underground water was not observed during the trial excavation (GL-2m) for underground utilities. Therefore, although it is necessary to pay attention to temporary underground water level rises in the rainy season, a large-scale water stop countermeasure will not be required during the construction of the pile-caps.

3) Climate

The study area is close to the equator (7 degrees south in latitude) with the climate of a tropical forest zone. Since Dar es Salaam faces the Indian Ocean, it has the characteristics of a marine climate in which a relatively comfortable wind (not extremely hot) blows from the sea.

Temperature

Temperature is relatively stable throughout the year. Average maximum and minimum temperature are 31°C and 19°C, respectively.

Rainfall

The annual rainfall totals 1,100 ~ 1,400mm. There are two climatological seasons, namely the rainy season and the dry season, and there are two rainy seasons: a major rainy season starts in March and lasts till May and a minor rainy season starts in November and lasts till December. The rainfall in the rainy season accounts for approximately 55% of the annual rainfall.

On the other hand, the dry season is from January to February and from June to October. Days with rainfall during the dry season are 5 days in a month on average. Especially from June to September, it becomes very dry and rainfall in this season is less than 40 mm per month.

Table 2.2.1 Average Temperature and Rainfall in Dar es Slaam

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Ave. Temp. (°C)	27.3	27.6	27.6	26.7	25.5	24.3	23.3	23.8	24.2	25.3	26.4	27.4	
Min Temp. (°C)	23.5	23.3	22.8	22.4	21.3	19.2	18.2	18.1	18.4	19.7	21.3	22.8	
Max. Temp. (°C)	31.8	32.4	32.1	30.7	29.8	29.3	28.9	29.4	30.3	30.9	31.4	31.6	
Ave. Rainfall (mm)	76.3	54.9	138.1	254.2	197.8	42.9	25.6	24.1	22.8	69.3	125.9	117.8	1149.7
Ave. rainfall days	7	4	11	18	13	5	4	4	3	5	8	9	91
Season	Dry		Major Rainy			Dry					Minor Rainy		

Source: National Bureau of Statistics (average data from 1971 to 2000)

(3) Social Policy

No issues of resettlement were found, and land acquisitions for the proposed F/O bridge were found to be very minor and not to affect to the F/O bridge construction. The Survey team has confirmed that the Tanzanian Government will complete land acquisition for TAZARA station prior to starting of construction work.

The site investigations of the Study found that daradara station should be provided at about the same location during construction. Furthermore, temporary drainage facilities should be provided during construction.

(4) Road Alignment and Road Design Policy

Existing road width is varied and the narrowest width is about 50m which is in front of TAZARA Station. Since the F/O bridge requires a width of 59m, road widening with some horizontal alignment changes will be necessary.

Land acquisition to accommodate the approach road design shall be minimized so as not to generate negative social impacts. AZAM is one of the major industrial companies in the country which creates a large amount of food products and distributes to the entire country. Dar es Salaam Hospital has many inpatients and receives ambulances which contributes to the city medical care arrangements. Those two properties can be identified as critical and the alignment design and land acquisition plan shall be made so as not to affect those properties.

The crosses sectional design shall accommodate the future BRT plan. The BRT track is designed with 9m of width for normal sections and 12m of width for its station at a minimum. According to the design consultant for the BRT, the BRT is designed to pass at grade at the TAZARA intersection even if the F/O is provided. On the other hand, there is an opinion that the BRT track shall be elevated at the intersection so as to maximize the F/O's benefit and another F/O, which requires 12m width including the construction work space, shall be provided for the BRT, later.

In order to incorporate any future BRT options, an empty space of 12m is left at the median of the road way in the cross sectional design.

(5) Bridge Design Policy

Bridge design should consider the following items.

1) Gradient should consider the large-sized vehicles,
2) Clearance for passing under the F/O bridge at the Intersection is based on Tanzanian Standards,
3) Span length at the Intersection should consider the pedestrian crossing and stopping line,
4) Lane width should consider the shoulder,
5) Abutment height should consider existing sceneries, and
6) Main material of F/O bridge should be concrete.

(6) Construction Policy in Tanzania

It is necessary to obtain approval from the Tanzanian Government for Project implementation.

The capacity of local contractors has improved regarding bridge and road construction due to their experience with donor-funded projects or projects funded by the Tanzanian Government. However, on-site Survey Team visits of several completed bridges found that there is still a problem with quality control, such as the smoothness of the bridge's road surface. Accordingly,

Japanese engineers dispatched on site for this Project will train the engineers of the local sub-contractor in quality control throughout the construction.

Construction equipment and materials for the Project should be procured from the domestic market as much as possible.

Careful attention should be given to the use of oil products and reinforcement materials, which have experienced drastic price hikes in recent years, as this will have a significant impact on Project cost.

(7) Local Contractor Policy

The Japanese contractor who is going to work on this Project will actively utilize local contractors, and the Japanese contractor is expected to transfer skills and knowledge in construction site quality control and safety management.

(8) Operation & Maintenance Policy

TANROADS will be the implementing agency of the Project for detailed design, tendering and construction stages of TAZARA F/O bridges. After the completion of construction, the facilities will be turned over to TANROADS Dar es Salaam regional office for operation and maintenance.

The basic procedure for road and bridge maintenance consists of the TANROADS regional office periodically inspecting the relevant roads and bridges, providing annual maintenance plans based on the inspection results, and submitting a maintenance budget plan to the TANROADS head office. After funds are allocated, the regional office will contract the maintenance works.

The Study Team has deemed the regional office capable of maintaining the system of roads and structures for the proposed F/O bridge, given that the maintenance level has been standardized with support from foreign donors and that maintenance work itself does not required a high level of skill.

However, it is necessary for the Japanese side to monitor the performance of the maintenance activities of TANROADS and to explain the importance of maintenance works considering that the Tanzanian Government has been struggling for many years for the need of proper road and bridge maintenance.

(9) Facility Grade Setting Policy

The Project will involve the construction of the F/O bridge and approach roads with the necessary associated facilities.

The grade of these facilities are shown hereunder, other requests from the Tanzanian

Government through this Survey will be incorporated into the Project scope if the request is determined to be appropriate from both technical and Japan Grant Aid Scheme viewpoints.

- Design Standard for Bridge
  - Draft Code of Practice for the Design of Road Bridges and Culverts Reprinted July 2001, SATCC
  - Specifications for Highway Bridges (Part I-V), Japan Road Association
- Design Standard for Highway
  - Draft Road manual 1989 Edition with its Revisions, Ministry of Communications and Works, the United Republic of Tanzania
  - Draft Code of Practice for the Geometric Design of Trunk Road, Reprinted July 2001, SATCC
  - A policy on Geometric Design of Highways and Streets 2001, AASHTO
  - Road Structure Ordinance, Japan Road Association
- Live Load: NA and NB (45 units)
- Vertical Clearance under F/O bridge: 5.5m, 5.0m (under construction)
- Lane Width: 3.25m
- Accessories: Signal and Street lights along Nyerere Road

(10) Construction Methodology & Scheduling Policy

The bridge erection method and construction yard was studied. Careful attention will be given to the social conditions, work items and movement of equipment on site for the preparation of an appropriate construction schedule. Firstly, the duration of the rainy season and rainfall intensity should be considered. Secondly, some items of work for the substructure and retaining wall can only be undertaken during the dry season. Finally, minimum impact to the current traffic flow should be carefully considered, as the Project bridges are located along busy international tank roads.

2.2.2 Basic Plan

2.2.2.1 Planning of Approach Road

(1) Design Condition for Approach Road

The following design standards and specifications shall be applied for the Approach road.

Geometrical Design

- Draft Road Manual 1989 Edition, Ministry of Communications and Works, the United Republic of Tanzania
- Draft Code of Practice for the Geometric Design of Trunk Roads, Reprinted July 2001, SATCC

- A Policy on Geometric Design of Highways and Streets 2001, AASHTO
- Road Structure Ordinance, Japan Road Association

Pavement Design

- Pavement and Material Design Manual 1999, Ministry of Works, the United Republic of Tanzania
- Draft Code of Practice for Design of Road Pavements, Reprinted July 2001, SATCC
- AASHTO Guide for Design Pavement Structures 1993

Intersection Design

- At Grade Intersection Plan and Design Manual, Japan Society Traffic Engineers

Traffic Safety

- Draft Manual for Traffic Signs and Road Markings 1989 Edition, Ministry of Communications and Works, the United Republic of Tanzania

Construction Method/Material Specification

- Standard Specification for Road Works 2000, Ministry of Works, the United Republic of Tanzania

(2) Principal Design Conditions for Approach Road

Table 2.2.2 shows principal design conditions for approach road

Table 2.2.2 Principal Design Conditions for Approach Road

Parameters	Unit	Design	Remarks
Design Speed	km/hr	60	Draft Road Manual
Design Vehicle		Semi Trailer combination large W=2.6, L=16.7 H=4.1	
Lane Width	M	3.25	Draft Road Manual
Shoulder Width	M	1.5	Draft Road Manual
Reserve for BRT	M	9.0-12.0	
Min. Stopping Sight Distance	M	75	Draft Road Manual
Min. Horizontal Curve Radius	M	135	Draft Road Manual
Min. R of Curve omitting Transition	M	500	Draft Road Manual
Max. Gradient	%	5	Draft Road Manual
Max. Super-elevation	%	8	Draft Road Manual
Crest Vertical Curve Stopping	Kmin	16	Draft Road Manual
Sag Vertical Curve Stopping	Kmin	16	Draft Road Manual
Normal Cross-fall	%	2.5	Draft Road Manual
Shoulder Cross-fall	%	2.5	Draft Road Manual
Side walk Width	M	2.0	For Pedestrians
Service Road Width	M	3.0	Similar to Nelson Mandela Road

Source: JICA Survey Team

(3) Horizontal Alignment Design

The horizontal alignment design shall satisfy the geometrical elements and maintain performance of the existing road. Introduction of larger size curves attains smoothness of alignment and brings comfort for the drivers.

Dar es Salaam Station, TAZARA Railway has a large space and the space is not being effectively used. The service of TAZARA Railway is limited to two operations per week. Since the property is government owned, the land acquisition at the Station is considered as possible.

Considering the above, the alignment design change is made and illustrated in the following Figures 2.2.2, 2.2.3,

Source: JICA Survey Team

Figure 2.2.2 Summary of Alignment Change

Source: JICA Survey Team

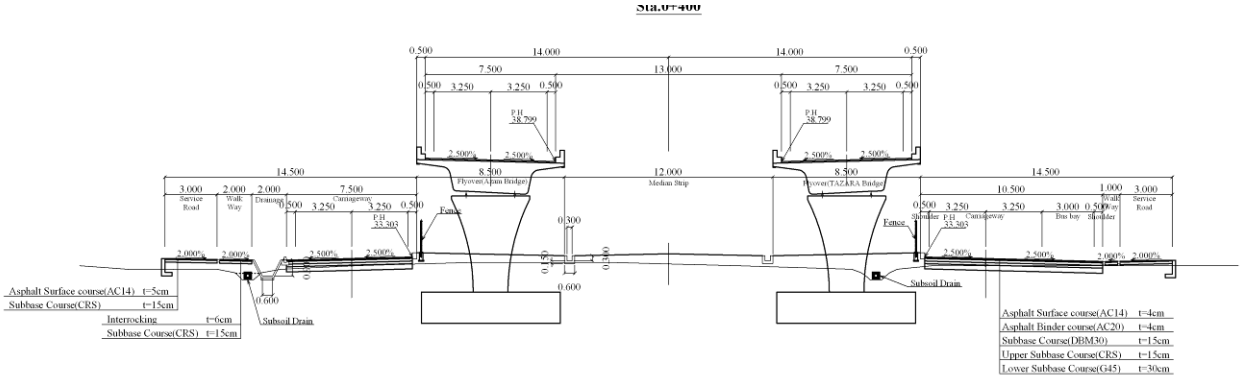
Figure 2.2.3 Land Acquisition Area

(4) Cross Sectional Design

Julius Nyerere Road

The road cross section shall be designed within available land and the cross sectional elements shall satisfy the geometrical requirements. The number of lanes is designed in consideration of traffic volume and composition. Daladala is not expected to use the F/O and the existing bus bay shall be renewed along the Julius Nyerere Road. As the volume of “Daladala” traffic is

forecast to be the same after the F/O construction, the number of lanes in the at grade road section next to the F/O shall be two (2) in order to maintain the traffic other than Daladala smoothly (Refer to Figure 2.2.4).

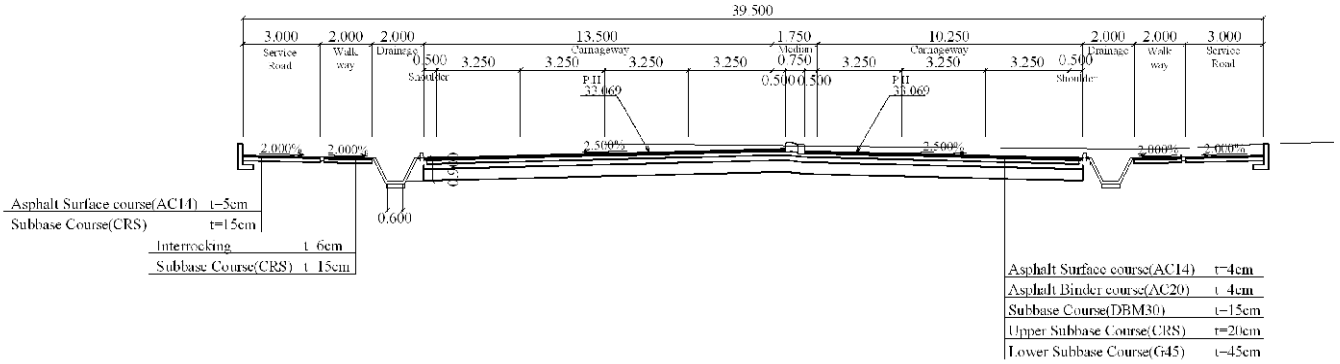


Source: JICA Survey Team

Figure 2.2.4 Typical Cross Section at F/O Section for Julius Nyerere Road

Nelson Mandela Road

Improvement work for the Mandela Road is limited to the intersection area with Julius Nyerere Road. The cross sectional design shall be the same as for a normal section which has been introduced in the previous section implemented with EU fund. Right and left turn lanes are provided in the design and their widths shall be designed as 3.25m which is the same width as the through traffic lane (Refer to 2.2.5).



Source: JICA Survey Team

Figure 2.2.5 Cross Section at Intersection for Nelson Mandela Road

(5) Intersection Design

Since there is no intersection design manual or guidelines in Tanzania, the At Grade Intersection Plan and Design Manual, Japan Society of Traffic Engineers (herein after referred to as “the Intersection Design Manual”) shall be applied. The Intersection Design Manual prepares design calculations for several traffic conditions.

Traffic Lane Shifting

If there is traffic lane shifting at the roadway in the design, the lane shifting length shall be according to the design calculations in Table 2.2.3.

Table 2.2.3 Lane Shifting Design Calculations

(Unit: m)

Land Use / Design Speed (km/h)	Rural		Urban	
	Design Calculation	Absolute Length	Design Calculation	Absolute Length
80	V x ⊿W/2	85	-	-
60		60	V x ⊿W/3	40
50	V x ⊿W/3	40		35
40		35		30
30		30		25
20		25		20

Note: △W: Shift Distance in Cross Section

Source: Intersection Design Manual

For a design speed of 60km/h and shifting distance of 2.0m (Urban),

Lane Shift Length=60 x 2 /3= 40m (Absolute=40m)

Right Turn Lane Length

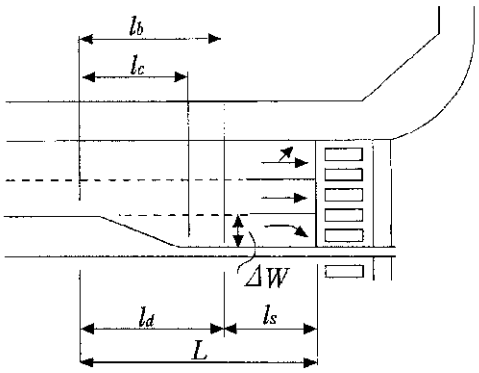
The Right Tune Lane Length is composed of the tapered and storage lengths

L=ld+ls

L: Right Turn Lane Length

ld: Tapered Length

ls: Storage Length



Note: △W: Shift Distance in cross section Source: Intersection Design Manual

Figure 2.2.6 Composition of Right Turn Lane Length

Tapered length (ld) is necessary length for deceleration of vehicle and transition for right turn vehicles shifting away from the through traffic lane. Therefore it should not be shorter than lb, which is the length for the deceleration, and lc, which is the length for the shifting.

The required length for the lb, deceleration by the design speed is shown in Table 2.2.4.

Table 2.2.4 Required Deceleration Length (lb)

(Unit: m)

Road Category / Design Speed (km/h)	Main Road in Rural Area	Sub Road in Rural Area and Urban Road
80	60	45
60	40	30
50	30	20
40	20	15
30	10	10
20	10	10

Source: Intersection Design Manual

On the other hand, the required length for shifting away from through traffic is calculated as follows,

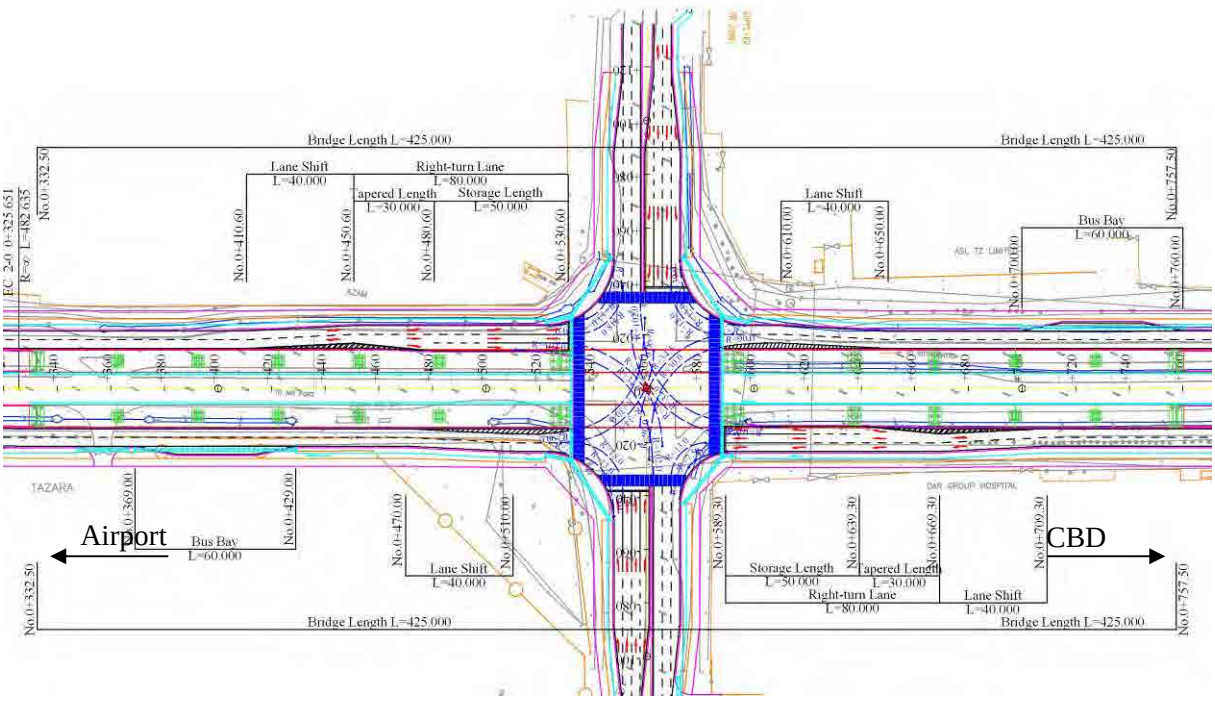
$$lc = V \times \triangle W/6$$

where

V: Design Speed (km/h)

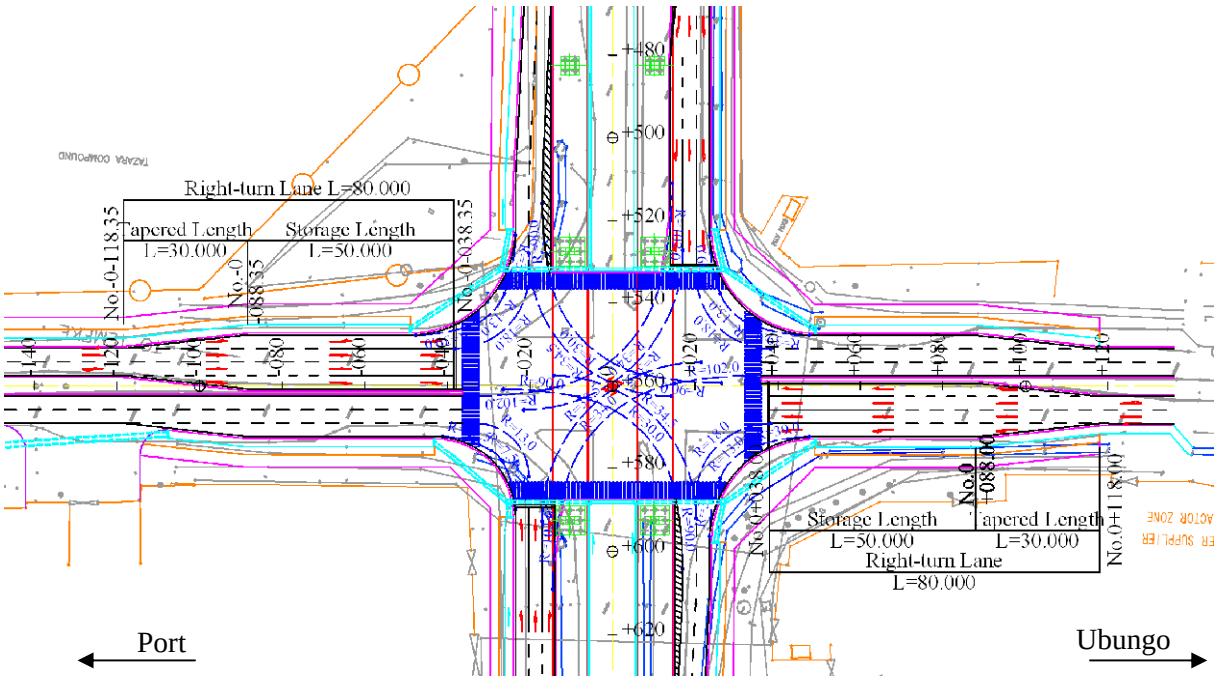
△W: Shift Distance in Cross Section (Width of Right Tune Lane)

In the case of a design speed of 60km/h and width of right turn lane of 3m, the calculated lc is obtained as 30m. The intersection designs are made as a result of the above design calculations as shown in Figures 2.2.7, 2.2.8.



Source: JICA Survey Team

Figure 2.2.7 Intersection Design along Julius Nyerere Road



Source: JICA Survey Team

Figure 2.2.8 Intersection Design along Nelson Mandela Road

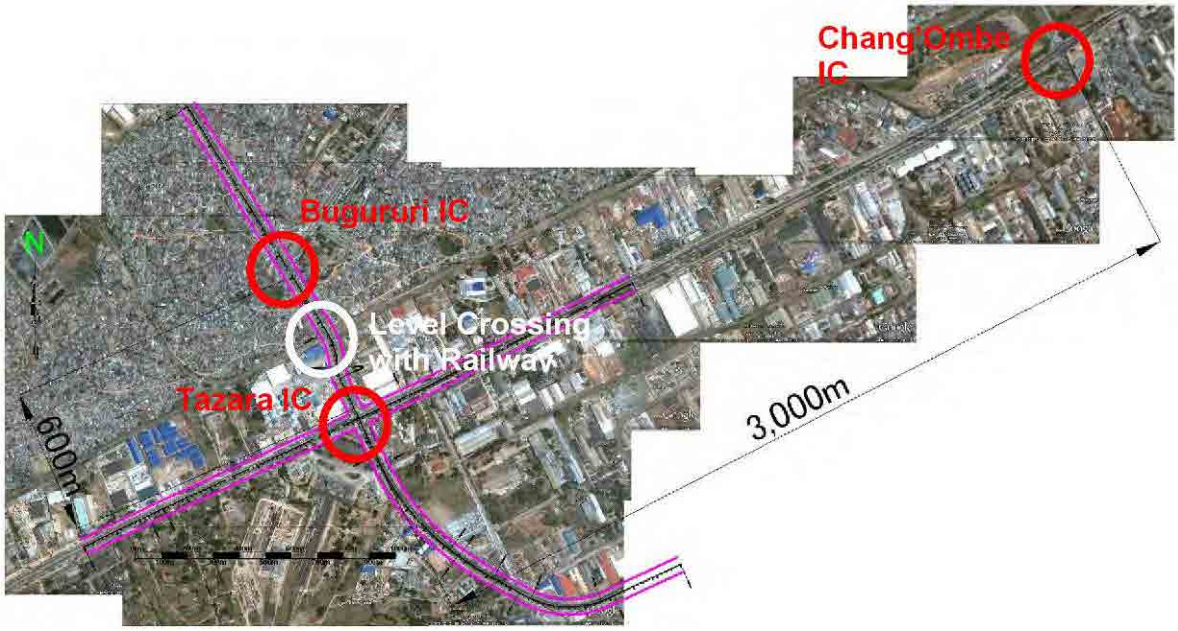
Countermeasures for Neighboring Intersection

It is generally considered that two intersections located within 1km interfere with each other in terms of traffic flow. In order to attain smooth traffic flow in major movements, the synchronization of traffic signals is considered as a countermeasure (See Figure 2.2.9).

There are two type of synchronization of traffic signals, which are “1. Central Control System” and “2. Local Control System”.

1. The Central Control system is an area-wise traffic control system controlled by computer programs which is effective to regulate various complicated traffic movements. All signals in that network are center controlled and this requires a control computer and monitoring system that requires a huge initial cost.
2. The Local Control System is synchronization with plural stand alone signals by time offset with consideration of traveling time between neighboring signals. The system does not require a control center and therefore no huge initial investment is required.

The 2. Local Control System has been applied to the CBD in Kampala, Uganda and the system is working.

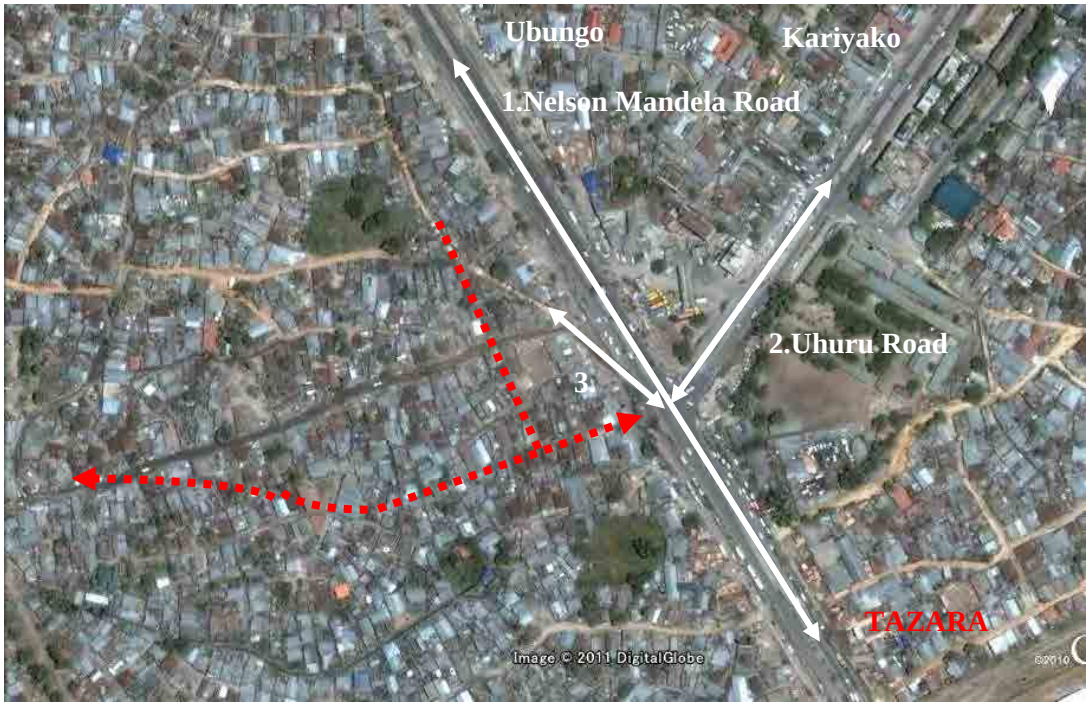


Source: JICA Survey Team

Figure 2.2.9 Neighboring Intersections to Tazara

The above figure shows the relationship with the nearest intersections to the Tazara Intersection. There is the Chang'Ombe intersection 3km along the Julius Nyerere Road and there is the Buguruni Intersections 0.6m along the Nelson Mandela Road. There is also a railway level crossing 0.3km from the Tazara Intersection.

As explained above, two intersections, Tazara and Buguruni, interfere with each other. One of the benefits of the Tazara F/O is considered to be that it will give a priority to the traffic along the Mandela Road since the road caters to many national and international logistics. The synchronization of the two intersections is expected to produce smooth traffic flow along the Nelson Mandela Road that contributes to the development of the country at minimum cost. The methodology of the synchronization is simple and requires only to set the cycle time to be the same as the travel time offset for through traffic along Mandela Road. Necessary arrangements are adjustment of signal programs and clock times.



Source: JICA Survey Team

Figure 2.2.10 Buguruni Intersections

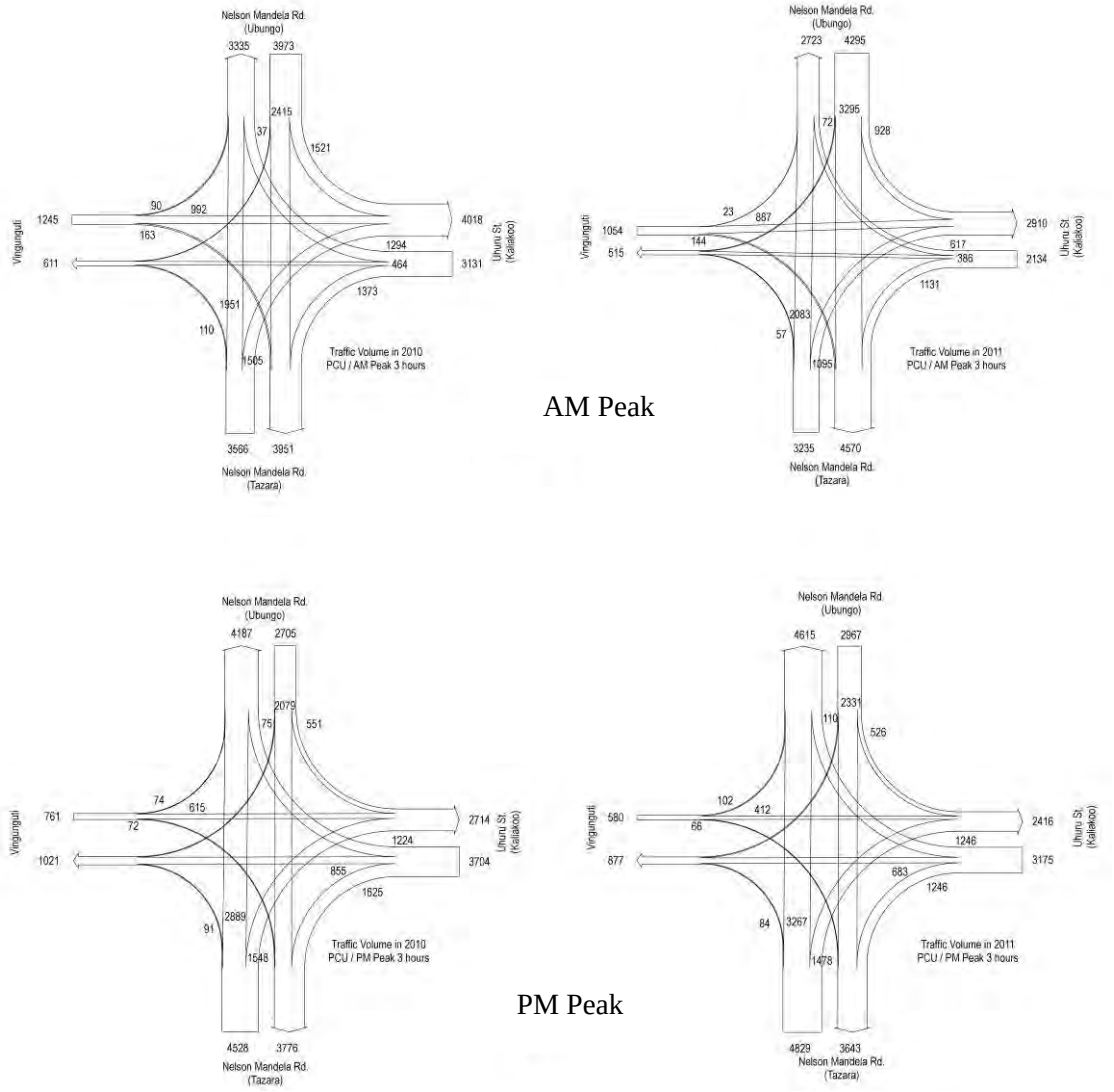
Buguruni intersection has been identified as a T-junction; however it is actually an X-junction as shown in Figure 2.2.10. Branch 3 shown in the above figure caters to mixed traffic composed of mainly Dalada and private vehicles and its volume is too large to ignore. As the figures below show, the major traffic movement from/to the branch is through traffic to/from Uhuru Road which disturbs the through traffic along Nelson Mandela Road (See Figure 2.2.11).

TANROADS has carried out rehabilitation work on the entire stretch of Mandela Road with financial assistance from EU.

As for the Buguruni intersection, pavement and drainage improvement has been introduced and carried out and provision of right turn lanes along Mandela Road and the signalization at the intersection have also been carried out. However, the improvement plan and design has not considered “the branch 3” and the signals have not been provided for the traffic on branch 3. It, therefore, needs further improvement.

As noticed from the above figure, the angle from branch 3 is too sharp to accommodate traffic flow and it, therefore, needs drastic road alignment improvement with a proper land-use plan since it may require resettlement.

Hence, it is proposed that a land use plan shall be established under local imitative and consensus with the residents.



Source: JICA Survey Team

Figure 2.2.11 Traffic Movements at Buguruni Intersections

(6) Pavement Design

Traffic Class

Pavement and Material Design Manual 1999, Ministry of Works gives the traffic class judged from cumulative ESALs expected as shown in Table 2.2.5.

Table 2.2.5 Pavement Design Life Selection Guidance

Traffic Class Designation							
Traffic Ranges (million ESALs)	TLC02	TLC05	TLC1	TLC3	TLC10	TLC20	TLC50
	<0.2	0.2-0.5	0.5-1.0	1.0-3	3-10	10-20	20-50

Source: Pavement and Material Design Manual 1999, Ministry of Works

Vehicle Equivalent Factor

The following equivalent factors shall be applied for the estimation of design traffic.

Inter City Bus and other Buses: 0.56
2 Axle truck: 0.56
3 Axle truck: 0.80
Trailer and Truck with more than 3 Axles: 15.80

Average Daily Traffic & Growth Rate

As confirmed in the traffic survey result and "Dar es Salaam Transport Policy and System Development Master Plan 2008, JICA", the average daily traffic and growth rate are obtained as shown in Table 2.2.6. Table 2.2.7 shows the traffic demand in 2015.

Table 2.2.6 Growth Rate

Vehicle Category	Inter City Bus and Other Buses	2 Axle Truck	3-Axle Truck	Trailer Truck, more than 3 Axle Truck
Ratio (%)	0.0%	2.9%	2.9%	6.4%

Source: JICA Master Plan 2008

Table 2.2.7 Daily Heavy Traffic in 2015 for Mandela Road

Vehicle Category	Inter City Bus and Other Buses	2 Axle Truck	3-Axle Truck	Trailer Truck, more than 3 Axle Truck	Total
Nos.	385	2,175	696	2,026	5,282

Source: JICA Survey team

Cumulative Design Traffic

The Cumulative Design Traffic is estimated by the following formula,

$$DT = T * 365 * \frac{[1 + r/100]^p - 1}{r/100} \quad \text{..... Equation 1}$$

where:

DT is the cumulative design traffic in a vehicle category, for one direction, and
T = average daily traffic in a vehicle category in the first year (one direction)
r = average assumed growth rate, per cent per annum
p = design period in years (20 years)

Lane Distribution Factor

The Tanzania pavement design manual specifies lane distribution factors as shown in Table 2.2.8.

Table 2.2.8 Lane Distribution Factor

Road Type	Design Traffic Loading	Comments
Single Carriageway		
Paved road width 4.5m or less	Up to twice the sum of the ESALs in each direction* (2.0)	As a minimum, total traffic must be designed for since there will be significant overlap in each direction For width of 3.5m or less, double the total should be used due to channelization
Paved road width 4.5m to 6.0m	80% of the sum of the ESALs in each direction *(1.8)	To allow for considerable overlap in the central section of the road
Paved road with more than 6.0m	Total ESALs in the most heavily trafficked direction	No overlap effectively, vehicles remaining in lanes
Dual Carriageway		
Less than 2,000 commercial vehicles per day in one direction	90% of the ESALs in the direction(0.9)	The majority of heavy vehicles will travel in one lane effectively
More than 2,000 commercial vehicles per day in one direction	80% of the ESALs in the direction (0.8)	The majority of heavy vehicles will still travel in one lane effectively, but greater congestion leads to more switching
*It is judicious to use double the total ESALs expected, as normally these are low trafficked roads and this may lead to difference in pavement structure		

Source: Tanzania Pavement Design Manual

Design Traffic Loading

Applying the above traffic factors, data and formulae, the design traffic loading was obtained as shown in Table 2.2.9.

Table 2.2.9 Design Traffic Loading

A	B	C	D	E	F	G	H	I	J
Type of Vehicle	Daily Traffic Volume in First Year	Directional Distribution Factor	Daily Traffic Volume for One Direction	Growth Rate	Design Year	Cumulative Design Traffic	VEF	Lane Distribution Factor	ESAL
	(Nos.)	(%)	(Nos.)	(%)	(Year)	(Nos.)			
Inter City Bus and Other Buses	385	50	193	0.0	20	1,408,913	0.56	0.8	631,193
2 Axle Truck	2,175	50	1,088	2.9	20	10,562,881	0.56	0.8	5,915,213
3-Axle Truck	696	50	348	2.9	20	3,378,569	8.00	0.8	27,028,549
Trailer Truck, more than 3 Axle Truck	2,026	50	1,013	6.4	20	14,200,867	15.80	0.8	224,373,701
Total	5,282		2,642			29,551,230		Total	257.9E+6

Source: JICA Survey team

As discussed above, the Tanzanian pavement design manual only covers up to 50 million ESAL. The pavement design catalog in the Tanzanian manual, thus, shall not be applied to the design. The SATCC pavement design manual has similar pavement design approach (pavement design

catalog) and the design manual suggested that AASHTO design method is applied if the ESAL is greater than coverage of the design manual.

It is decided that the AASHTO design method is to be applied for the pavement design accepting the suggestion of the SATCC manual.

Design Result by AASHTO

The following sheet shows the design result by the AASHTO method.

PAVEMENT THICKNESS DESIGN - FLEXIBLE PAVEMENT
(Design CBR 10%)
(AASHTO)

DATA TRAFFIC :

Design Life (Year)	20
Distribution Factor	0.5
Lane Coefficeint	0.8

Total ESAL for 20 years	**257,948,656**

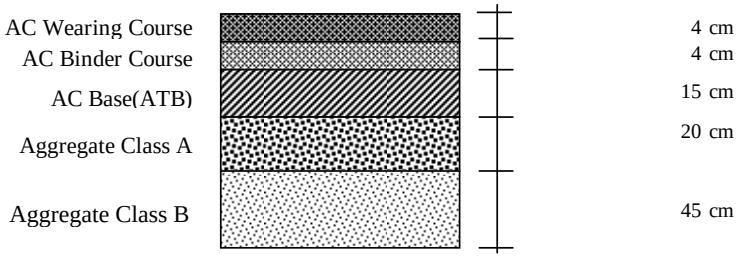
CBR (%)	10.0	kg/cm^3
Resilient Modulus (MR)	15,000	psi
SERVICEABILITY :		
- Terminal Serviceability (Pt)	2.50	
- Initial Serviceability (Po)	4.20	
- Serviceability Loss (ΔPSI)	1.70	
RELIABILITY, R (%)	80.00	
STANDARD NORMAL DEVIATION (Zr)	(0.841)	
STANDARD DEVIATION (So)	0.45	
DRAINAGE COEFFICIENT (m)	1.00	
STRUCTURAL NUMBER (SN)	5.843	

CHECK EQUATION : 8.412 = 8.412

Pavement Thickness:

Pavement Type	Layer coeff.	Layer thickness (inch)	Structural Number	
AC Wearing Course	0.39	1.57	0.61	
AC Binder Course	0.39	1.57	0.61	
AC Base(ATB)	0.33	5.91	1.95	
Aggregate class A	0.135	7.87	1.06	
Aggregate class B	0.094	17.72	1.67	
			5.906	0.063

Sketch :



Source: JICA Survey Team

2.2.2.2 Planning of F/O Bridge

(1) Design Conditions for F/O Bridge

1) Design Standard & Specifications

The following bridge design standard and specifications will be applied for the F/O bridge design:

- Draft Code of Practice for the Design of Road Bridges and Culverts Reprinted July 2001, SATCC
- Specifications for Highway Bridges (Part I-V), Japan Road Association

2) Major Design Conditions for F/O Bridge

Table 2.2.10 shows the major design conditions for Tazara F/O bridge.

Table 2.2.10 Major Design Conditions for F/O Bridge

Items	Specifications
1.F/O Bridge Length	425m (=5@30+45+65+45+4@30)
2.F/O Width	See Figure 2.2.11
3.Super elevation	2.5%
4.Maximum Grade	4.0%
5.Pavement thickness	Asphalt Pavement t = 80mm
6.Vertical Clearance under F/O Bridge	5.5m
7.Temporary Vertical Clearance during erection	5.0m
8.Minimum reserve for BRT lane	7.0m
9.Public Utility Ducts for future use	Four (4) ducts to be considered
10.Ancillary Facilities	Railing, Expansion Joint, Lighting

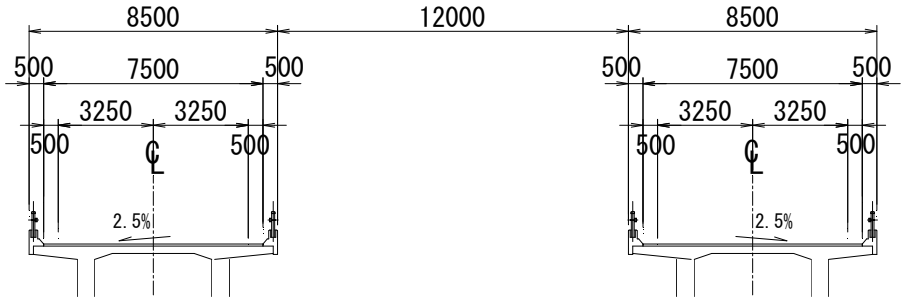


Figure 2.2.12 Typical Cross-section for F/O Bridge

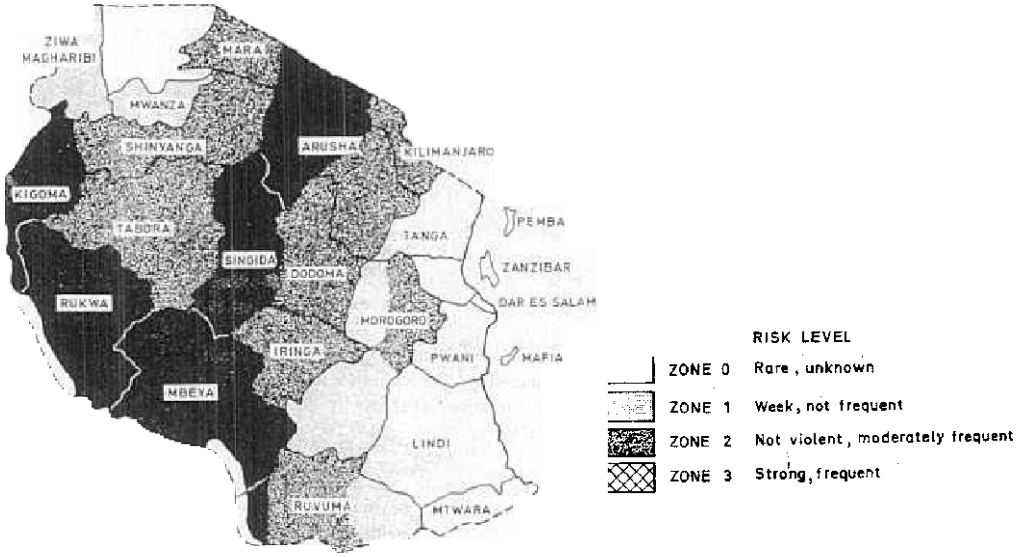
3) Design Loads

Live Load

NA and NB 45 units will be applied for the F/O bridge.

Seismic Load

According to Figure 2.2.13 seismic risk map of buildings in Tanzania, Dar es Salaam is in the area of lowest risk for earthquake. Accordingly, the minimum level for seismic force (Kh=0.05) shall be considered in the F/O bridge design.



Source: BRU Technical Guideline no.2, Loads for Structural Design Building Research Unit, Ministry of Lands, Housing and Urban Development

Figure 2.2.13 Seismic Risk Map of Tanzania

Other Loads

The following types of loads shall be considered as required:

- Dead Load
- Impact Load
- Wind Load
- Influence of creep for concrete
- Influence of dry shrinkage for concrete
- Earth pressure
- Static water pressure

4) Material Strength

Unit Weight for Materials

Table 2.2.11 Unit Weight for Materials

Designation	Self-weight (kN/m^3)	Designation	Self-weight (kN/m^3)
Steel	77.0	Cement, Mortar	21.0
Reinforced Concrete	24.5	Asphalt Concrete	22.5
Pre-stressed Concrete	24.5	Concrete Pavement	23.0
Non-reinforced Concrete	23.0	Timber	8.0

Strength of Materials

Specifications in terms of strength for concrete, reinforcement and other materials will be in accordance with Japanese Standards and Specifications or equivalent.

Table 2.2.12 Concrete Strength

Designation	Minimum Strength (N/mm^2)
PC Box Girder	36.0
PC Hollow Slab	30.0
Abutment & Pier	21.0
Concrete Pile	30.0
Lean Concrete	18.0

Table 2.2.13 Strength of Reinforcement

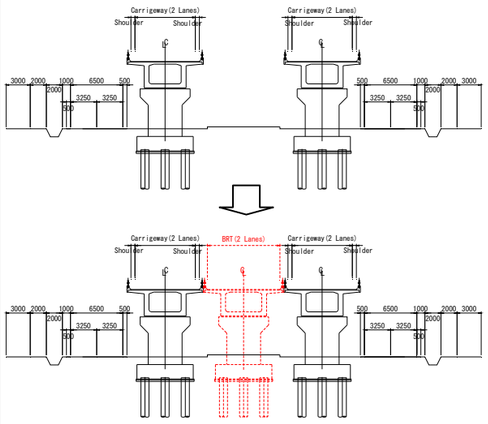
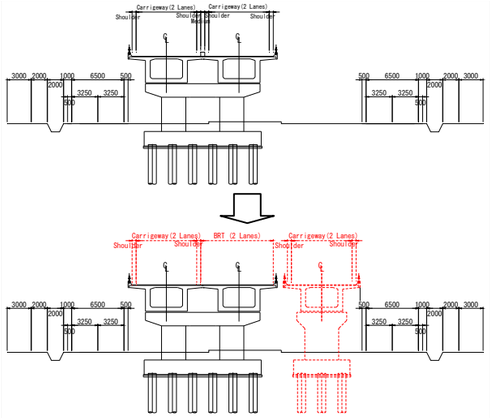
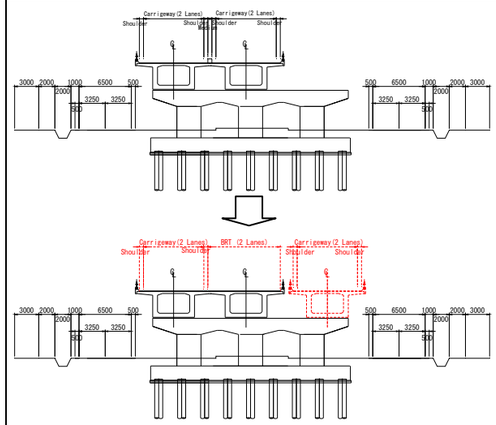
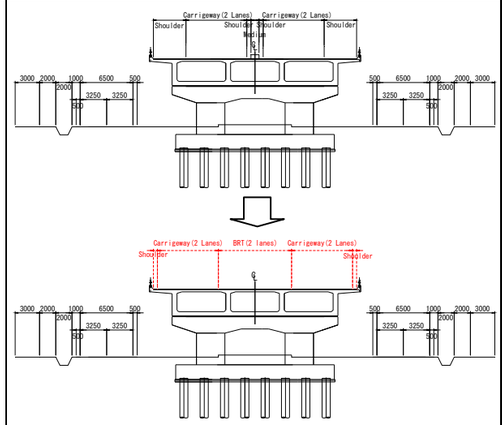
Designation	Yield Strength (N/mm^2)
Round Bar	$\sigma py > 235$
Deformed Bar (SD295)	$295 < \sigma py < 390$
Deformed Bar (SD345)	$345 < \sigma py < 440$

(2) Improvement Options for F/O Bridge

Four (4) improvement options were proposed by the Survey Team and these options were evaluated from engineering view points by the team as well.

As a result of the evaluation, Option 1, two separated bridges, was evaluated and selected as a suitable F/O type for Japan's Grant Aid. Other options were not selected because of the inflexibility for the future BRT construction and operation plan. Therefore option 1 was studied and designed for the outline design. The result of the evaluations is shown in Table 2.2.14.

Table 2.2.14 Improvement Options for F/O Bridge

Option	Option 1	Option 2	Option 3	Option 4
Description of Alternatives	1st Stage: Two Separated bridges (total 4 lanes) shall be constructed for normal through traffic by Japan's Grant Aid. 2nd Stage: A bridge is expected to be constructed for BRT (2 lanes) by another donor or Tanzania.	1st Stage: A 4 lane bridge shall be constructed by Japan's Grant Aid and the bridge will be opened for normal through traffic until BRT starts to operate. 2nd Stage: A bridge (Track C) is expected to be constructed by another donor or Tanzania, and Track B on the 1st bridge will be converted to BRT track and Track C will be used for normal through traffic after 2nd Bridge opened.	1st Stage: A 4 lane bridge and entire substructure shall be constructed by Japan's Grant Aid and the bridge will be opened for normal through traffic until BRT starts to operate. 2nd Stage: Only superstructure (Track C) is expected to be constructed by another donor or Tanzania, and Track B will be converted to BRT track and Track C will be used for normal through traffic after completion of the entire bridge.	1st Stage: The entire bridge with adequate width shall be constructed by Japan's Grant Aid. It will cover normal through traffic and future BRT. 2nd Stage: Providing centre 2 lanes for BRT.
Cross Section				
1 Construction Cost Ratio — 1st Stage	**1.00**	**0.95**	**1.10**	**1.25**
1 Construction Cost Ratio — 2nd Stage	**0.50***	**0.55***	**0.35**	**0.00**
2 Flexibility for BRT Plan	**There is the flexibility for the BRT plan (elevated or at grade)**. **A**	Although BRT can be constructed at grade, **BRT and normal traffic will be interlaced.** **B**	BRT tracks must be elevated (not at grade) since there are piers in the centre median. **There is no flexibility for the BRT Plan.** **C**	BRT tracks must be elevated (not at grade) since there are piers in the centre median. **There is no flexibility for the BRT Plan.** **C**
3 Constructability	For 1st Stage There is enough space and no difficulty for bridge construction since diversions of current traffic will be provided at outer-sides before bridge construction. For 2nd Stage It will be possible to construct BRT bridge (9m width) with no difficulty since the distance between separated bridges in 1st stage was kept 12m width. **B**	For 1st Stage Same as Option 1. For 2nd Stage There is no difficulty for construction **A**	For 1st Stage Same as Option 1. For 2nd Stage Difficult arrangements will be required at the time of superstructure erection. **C**	For 1st Stage Same as Option 1. For 2nd Stage No construction work without lane conversion **A**
4 Road Alignment	A straight alignment can be designed for entire section. **A**	S (two) curves need to be inserted in approach section for a direction during tentative open to traffic (before BRT comes). **C**	S (two) curves need to be inserted in approach section for a direction during tentative open to traffic (before BRT comes). **C**	A straight alignment can be designed for entire section **A**
5 Traffic Management	No difficulty for traffic management. **A**	No difficulty for traffic management. **A**	Diversion of existing traffic will be required to keep temporary construction road. **C**	Diversion of existing traffic will be required to keep temporary construction road. **C**
6 Environmental Aspect	Land acquisition in TAZARA station side may be required. **B**	Same as Option 1. **B**	Same as Option 1. **B**	Land acquisition will not be required. **A**
Evaluation	Any BRT design can be accommodated with this alternative. Recommended	Although any BRT design can be accommodated with this alternative, Road alignment is inferior to Option 1.	There is no flexibility for future BRT Construction Some items are inferior to other alternatives.	Although there is no flexibility for future BRT Construction, the cost of 2nd stage will be very small. However, since BRT construction is not determined, and construction time, fund and operation are not in sight, precedent construction of BRT F/O portion will be very costly.

(3) Bridge Planning and Superstructure Type

Superstructure types of the TAZARA F/O bridge shall be divided into 2 types as follows:

- Main Bridge: Portion crossing Nelson Mandela Road
- Approach Bridge: Approach portion of main bridge

1) Span arrangement for main bridge

As a result of setting the piers of the main span 5m back from the stop line of the intersection, the main span will be 65m in length.

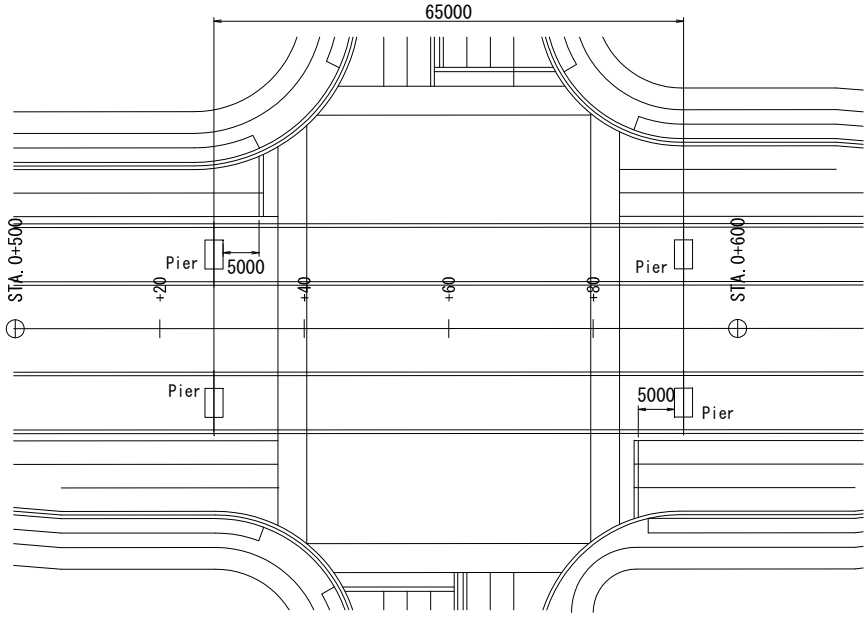


Figure 2.2.14 Pier locations of Main Bridge at TAZARA Intersection

Regarding the side span length, recommended length (span arrangement) is 45m since this span ratio (side span / main span = 0.7) is superior in terms of bending moment.

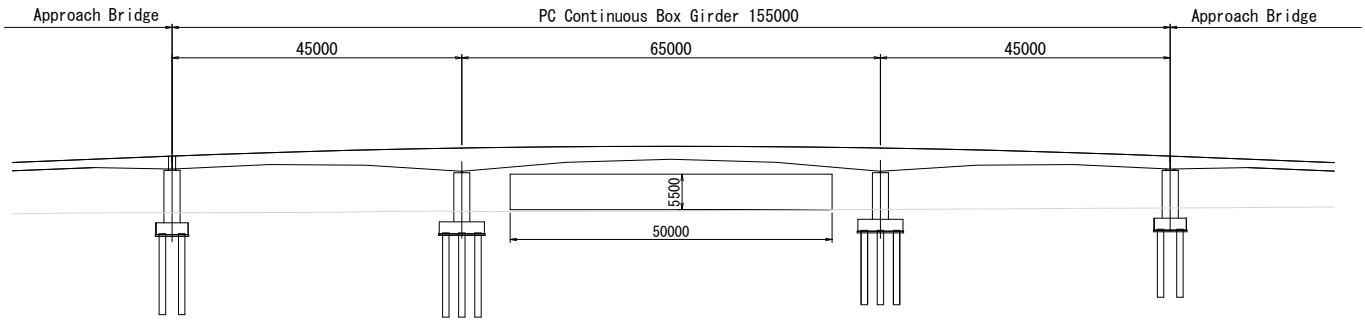


Figure 2.2.15 Profile of Main Bridge

2) Superstructure of Main Bridge

There are various structural forms that are available for bridge spans of 65m. First screening of the bridge is shown in Table 2.2.15.

Table 2.2.15 First Screening of Main Bridge Type

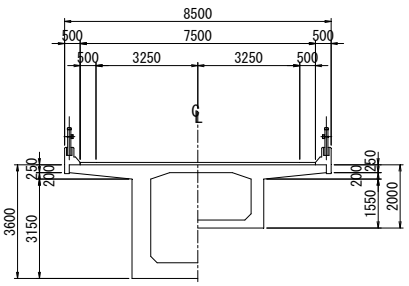
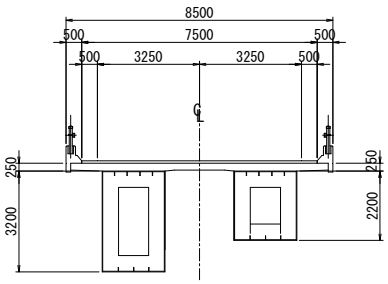
	Bridge Type	Description	Evaluation
Concrete Bridge	Continuous PC Box	This type is commonly applied to F/O bridges in many countries. No major technical problems are encountered in adopting this type of superstructure.	**Nominated to 2nd Screening**
	PC Cable-stayed	This type is not commonly applied to F/O bridges. Although no major technical problems are encountered in adopting this type, periodic inspection will be required for stay cables and anchorages and maintenance cost will be high.	Not applicable
	PC Extra-dosed		Not applicable
Steel Bridge	Continuous Steel Box	This type is commonly applied to F/O bridges in Japan. No major technical problems are encountered in adopting this type of superstructure. All steel girders must be imported from other countries. Construction and maintenance cost will be high. But construction period will be shorter than concrete bridges.	**Nominated to 2nd Screening**

As a result of the first screening, Continuous the PC Box Girder Bridge and Continuous Steel Box Bridge are nominated to the second screening.

Evaluation items in the second screening are as follows:

- Property of Structure
- Constructability
- Construction Period
- Construction Cost
- Maintenance
- Bridge Aesthetics

Table 2.2.16 Second Screening of Main Bridge Type

	3-span Continuous PC Box	3-span Continuous Steel Box
Cross-section		
Property of Structure	• Girder depth is L/18～L/36 (L: main span) • All bridge structures are made of concrete and major materials are available in Tanzania.	• Girder depth is L/20～L/30 (L: main span) • All bridge structures except slab are made of steel and major materials are imported from other countries.
Constructability	• There is enough space and no difficulty for bridge construction since diversions of current traffic will be provided at outer-sides before bridge construction. • Bridge deck is constructed by cast-in-place balanced cantilever method from pier with deck block length of 2.5-4.0m and all staging method. • No difficulty for traffic management.	• There is enough space and no difficulty for bridge construction since diversions of current traffic will be provided at outer-sides before bridge construction. • Girder is constructed by cantilever method from pier. • No difficulty for traffic management.
	A	A
Construction Period	Approximately 2 years	Approximately 1.8 years
	B	A
Construction Cost Ratio	1.00	1.14
	A	C
Maintenance	Not much maintenance is required, except for bridge bearings, expansion joints and drainage system	Maintenance cost will be higher than concrete bridge since re-painting will be required every 10-15 years
	A	C
Bridge Aesthetics	It can be a symbol and landmark of Dar es Salaam	It can be a symbol and landmark of Dar es Salaam
	B	B
Evaluation	**A**	**C**

As a result of the second screening, a 3-span Continuous PC Box Girder (45m+65m+45m=155m) is applied to the Main Bridge.

3) Span Arrangement and Superstructure of Approach Bridge

A concrete bridge shall be applied to the approach bridge in consideration of the economic and maintenance aspects. The maximum height of the abutment shall be around 3m in consideration of the esthetic aspect and minimum area division. Consequently, the Approach Bridge length will be around 150m on the airport side and around 120m on the city center side, and span length will be 30m in consideration of the economic aspect.

The following bridge types with 30m span length are considered.

- Continuous PC Hollow Slab
- Semi-continuous PC-T Girder
- Semi-continuous PC-I Girder

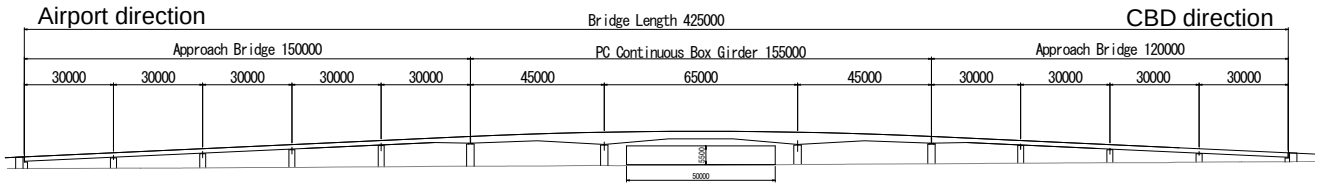
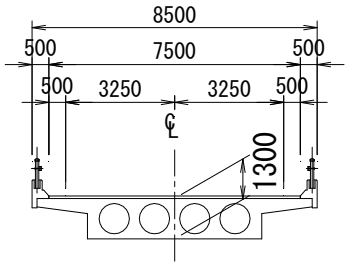
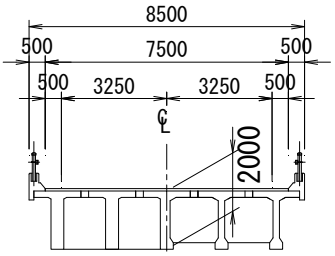
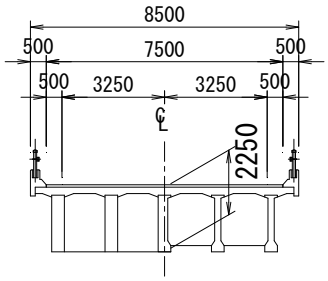


Figure 2.2.16 Profile of Approach Bridge

Table 2.2.17 Types of Approach Bridge

Cross-section	Comment	Evaluation
Option1: PC Hollow Slab 	Properties of Structure - Slab depth will be **1.3m** (L/22, L: span length) - All structures will be cast-in-place Constructability - No difficulty for bridge construction (all staging method) Construction Cost Ratio - 1.00 Bridge Aesthetics: Superior to other options (**structure depth is smallest and bottom of slab is flat**)	**A**
Option2: PC-T Girder 	Properties of Structure - Girder depth will be **2.0m** (L/15, L: span length) - Girders will be erected by crane Constructability - No difficulty for bridge construction Construction Cost Ratio - 1.05 Bridge Aesthetics - **Inferior to option 1** (bottom of girder is not flat and girder depth is thick)	**C**
Option 3: PC-I Girder 	Properties of Structure - Girder depth will be **2.0m** (L/15, L: span length) - Girders will be erected by crane Constructability - No difficulty for bridge construction Construction Cost Ratio - 1.10 Bridge Aesthetics - **Inferior to option 1** (bottom of girder is not flat and girder depth is thick)	**C**

As a result of the above comparison, a PC Hollow Slab Bridge is applied to the Approach Bridge in consideration of the esthetic aspect and minimum area division.

(4) Foundation Type

Four bore holes were drilled along Nyerere Road at Tazara Intersection. Figure 2.1.17 shows the boring logs.

A pile foundation will be appropriate for the Tazara F/O bridge based on the results of the geological investigation.

RC driving pile, PC driving pile and Cast-in-place concrete pile will be considered. In the case of the driving pile, construction will be easy. However, a great deal of noise will be generated during construction, and the size of the pile-caps is much larger than cast-in-place concrete piles since the number of piles is increased. Accordingly, cast-in-place concrete piles was selected for the Tazara F/O bridge in consideration of the bridge scale, social environment and constructability.

As for the diameter of the piles, 1.0m is common in Tanzania. A large machine will be required and cost will increase when the diameters become more than 1.5m. Therefore, cast-in-place concrete piles (D=1.0m) were selected for the foundation type (Figure 2.2.17).

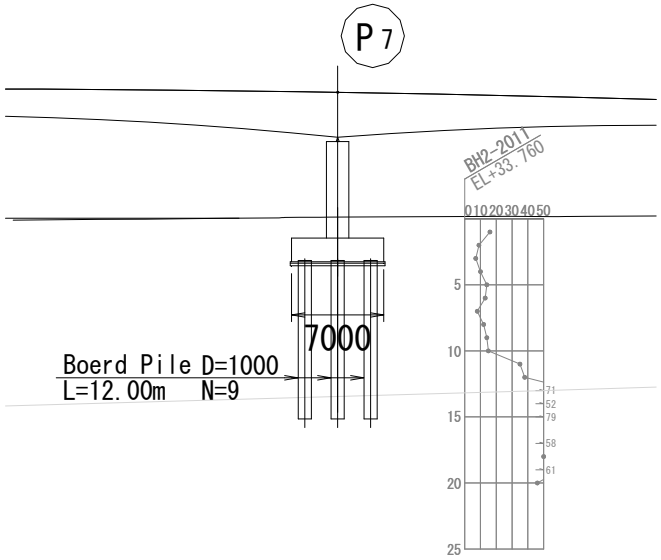


Figure 2.2.17 Cast-in-place Concrete Pile (P7)

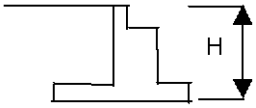
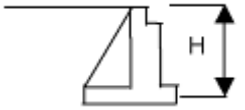
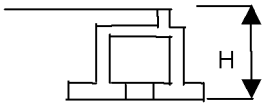
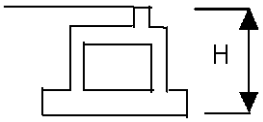
Regarding the covering depth on the pile-cap, 1.5m (minimum depth) will be secured in consideration of the many underground utilities (depth around 1.0m) and future BRT plan.

(5) Substructure Type

1) Abutment Type

The abutment type shall be selected based on its height range as shown in Table 2.2.18.

Table 2.2.18 Applicable Abutment Type

Abutment Type		Applicable H (m)	Characteristics
Gravity Type		H≦5	- Simple Structure - No difficulty in construction - Relatively heavy
Inverted-T Type		5＜H≦12	- Cost effective within applicable height range - No difficulty in construction
Buttressed Type		10≦H	- Complicated to build - Careful compaction of backfill required
Rigid-Frame Type		10≦H≦15	- Complicated Structure - High cost - Good for expanding discharge capacity
Box Type		15≦H	- Complicated structure and construction - High cost - Only applicable when height exceeds 15m

Abutment height was determined based on the road profile and the position of the bearing strata according to the results of the geological investigation. Table 2.2.19 shows the selection results for abutment type.

Table 2.2.19 Selection results for Abutment Type

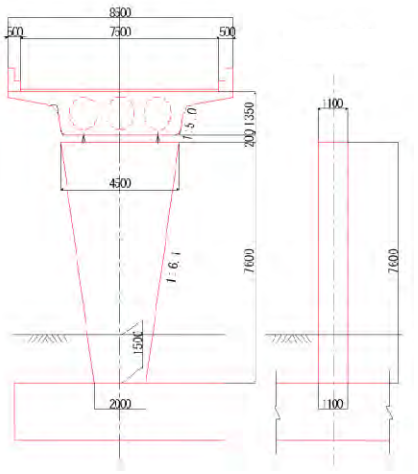
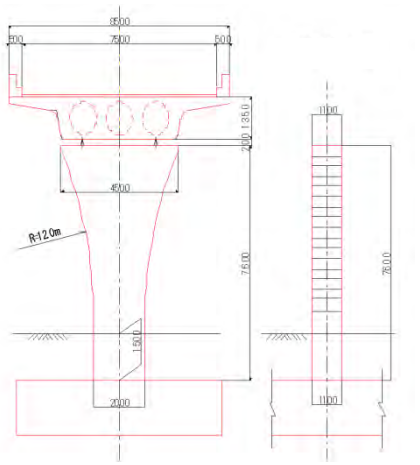
Abutment	Height (m)	Type
A1	6.8	Inverted-T Type
A2	5.8	Inverted-T Type

2) Pier Type

Pier type shall consider the city landscape just as was done for the main bridge and approached bridge. On this account a simple shape was adopted and compared in rectangular shape and T shape.

As a result of the comparison in Table 2.2.20, the T shape was selected for the economic and landscape aspects.

Table 2.2.20 Comparison of Pier Type

Type	Rectangle Shape		T Shape	
Pier shape				
Characteristics	- Inverted rectangle shape.		- Curved T shape.	
Constructability	- Good constructability since there is no beam member.	A	- Inferior in constructability due to assembling re-bar and form work for curve shape.	B
Landscape	- Continuity with superstructure shape is kept. - It is preferable as a structure in the city.	B	- Curve shape gives a soft impression. - Continuity with superstructure shape is kept. - It is preferable as a structure in the city.	A
Cost ratio	1.08	B	1.00	A
Evaluation	- Inferior in economic and landscape aspects.	**B**	- Superior in economic and landscape aspects although constructability is somewhat inferior.	**A**

2.2.3 Outline Design Drawings

Outline design drawings of the proposed F/O bridge are attached with 56 drawings as follows:

1.	Cover	;1
2.	General View	;1
3.	F/O bridge cross section	;1
4.	F/O bridge (East bound) superstructure	;4
5.	F/O bridge (Main span) superstructure	;4
6.	F/O bridge (West bound) superstructure	;4
7.	Plan of Road section	;6
8.	Cross section of Road section	;30
9.	Drainage	;1
10.	Fence	;1
11.	Electrical pole, relevant drawings	;3
		56

2.2.4 Implementation Plan

2.2.4.1 Implementation Policy

(1) Construction Policy

Construction policy for the F/O bridge and approach road are as follows;

a) To plan in consideration of existing road condition, traffic situation, resident characteristics such as the disturbance to outpatients, shoppers and users of public facilities, etc.), natural condition (prior confirmation of weather condition, topographic condition and geological condition) and public utilities under the ground (relocations regarding gas pipes, water and sewer pipes, electrical wires and telephone wires), and
b) To plan for securing traffic safety and in consideration of the environment (prevention of noise, air and soil pollution, and sewage outflow and so on).

(2) Procurement Policy

a) To use local materials and equipment,
b) To plan for easy maintenance after opening the facilities and easy procurement of materials and equipment.

(3) Construction Plan

1) Construction Yard

A construction yard will be established at the existing open space (approximately 16,000 m2) of Tazara Station located at the corner of Julius Nyerere Road and Nelson Mandela Road as shown in Figure 2.2.18. But the open space which is requested is about 6,500 square meters and must be borrowed from Tazara Railway Company. After completion of the Project, the construction yard will be restored to its original form.

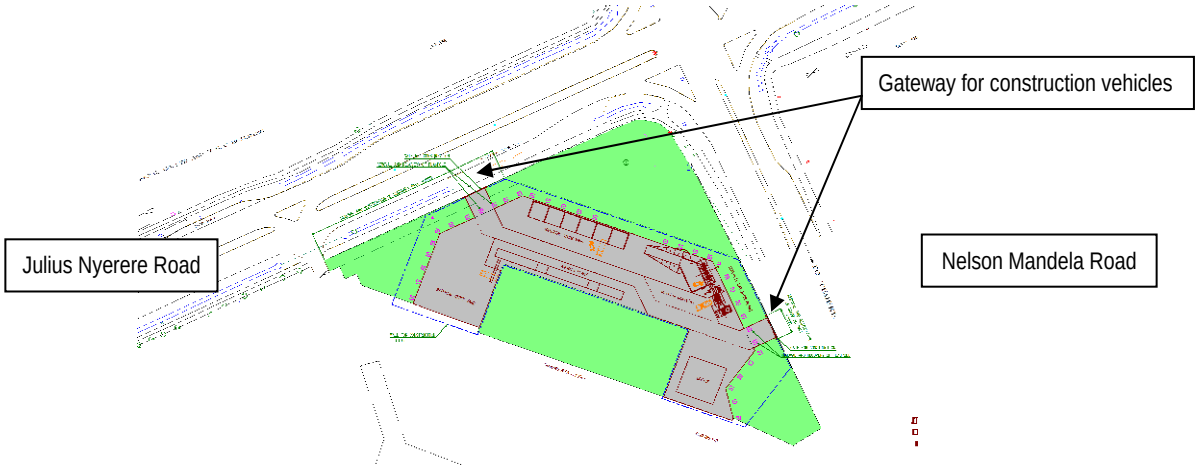


Figure 2.2.18 Construction Yard

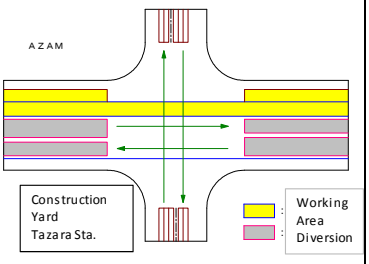
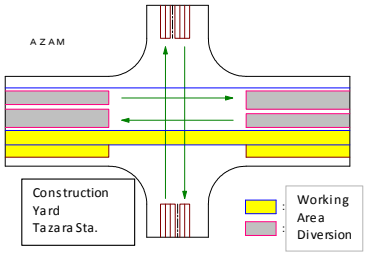
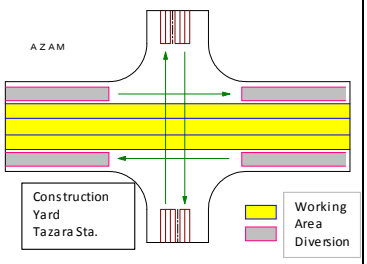
Function of the construction yard should consider the items below;

a) Contractor's office and parking,
b) Concrete plant yard,
c) Stockyard for aggregates (for about one week),
d) Temporary stock area for materials and equipment, and
e) Space for construction vehicles to turn around.

2) Construction Procedure

In order to keep the existing traffic flowing smoothly, a temporary diversion should be planed. Comparison of construction procedures is shown in Table 2.2.21. As a result of the comparison of construction procedures, Case 1 is the most suitable procedure for the vehicles during construction work.

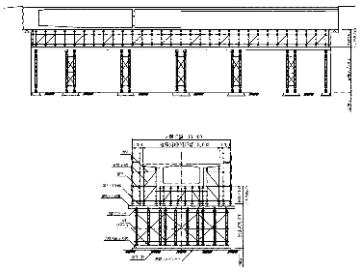
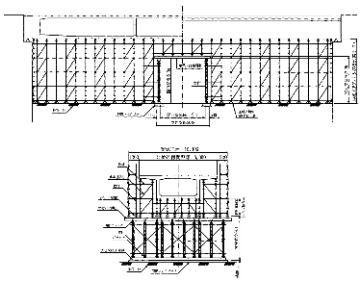
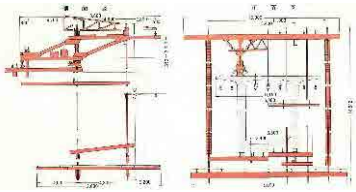
Table 2.2.21 Comparison of Construction Procedures

Construction way	CASE 1： Construction from AZAM side		CASE 2： Construction from TAZARA Station		CASE 3： Construction from both sides	
Outline						
Description	F/O bridge and Niyerere Road are constructed from Azam side. Tazara Station side is used for diversion.		F/O bridge and Niyerere Road are constructed from Tazara station side. Azam side is used for diversion.		BRT part is used for working area and both F/O bridges are constructed.	
Construc-tability	- Construction period is much longer than CASE 3 because of one lane (two parties). - Construction zone is possible as the completed bridge and road. - It is easy to access from construction yard to working area.	A	- Construction period is much longer than CASE 3 because of one lane (two parties). - Construction zone is possible as the completed bridge and road. - Construction works of Azam side are difficult to access from construction yard because Tazara station side is completed. Azam side needs to make a detour for construction.	B	- Construction period is much shorter than CASE 1 because of both lanes (four parties). - Diversion is not enough for road construction work. - Construction work of Azam side should be constructed before constructing Tazara station side because of the avoidance of diversion.	C
Site for BRT	Use for diversion	A	Use for diversion	A	use for construction area	A
Economic Aspect	Construction machines are small scale.	A	Construction machines are small scale.	A	Construction machines are large scale and costly.	C
Evaluation	A (Recommendable)		B		C	

3) Erection Method for Main F/O Bridge

In order to erect the F/O bridge over the Intersection, the erection method should have the minimum influence possible on the existing traffic and surrounding residents. Table 2.2.22 shows the best erection method for the main F/O bridge. As a result of the comparison of erection methods, Case 2 is the most suitable method for the existing traffic and surrounding residents.

Table 2.2.22 Comparison of Erection Methods

Method	CASE 1: Frame square sets		CASE 2: Frame square sets + all staging		CASE 3: Cantilever	
Outline						
Description	Installation of each support to keep the form. This method is used for restriction of clearance.		Clearance can be used for passing vehicles.		All clearances are able to use for passing vehicles without restriction.	
Construc-tability	- This method is used for low type of piers. - Each clearance can be used for diversion. - There are problems for safety because of traffic congestion for diversion.	B	- This method is used for low type of piers. - Each clearance can be used for diversion. - There is no traffic congestion because the side span can be used for diversion.	A	- This method is used for high type of piers. - Construction period is much longer than other cases because of block erection. - There is no restriction of clearance.	C
Clearance	Among each support can be used for diversion.	B	Among clearance and side span can be used for diversion.	B	There is no restriction.	A
Economic Aspect	More expensive method than CASE 2	A	Most economical method	A	Most expensive method and long construction period	C
Evaluation	B		A (Recommendable)		C	

4) Construction Step

In order to meet the planned construction schedule, and ensure traffic safety and smooth traffic flow, proper construction steps are very important. Based on Figure 2.2.18, the constructions step should be as shown in Figures 2.2.19 and 2.2.20. Furthermore, traffic flagman should be placed at each control point for smooth traffic flow.

2.2.4.2 Implementation Condition

(1) Considerations in Terms of Construction

a) Guard against theft and missing equipment /construction materials,
b) Place security guards at the construction yard and the working areas during night in order to ensure the aforesaid,
c) Set up a barricade around the working place and working areas in order to secure traffic safety,
d) Properly place traffic flagman in order to ensure the aforesaid,
e) Fully consider the social environment such as prevention of noise, regulation of air and soil pollution and sewage outflow, legal disposal of waste materials during construction work, and preventive measures against HIV.

(2) Considerations in Terms of Procurement

a) Prepare in advance customs arrangements in terms of importing equipment/materials,
b) Confirm whether land acquisition and relocation of public utilities were suitably executed by the Tanzanian side.

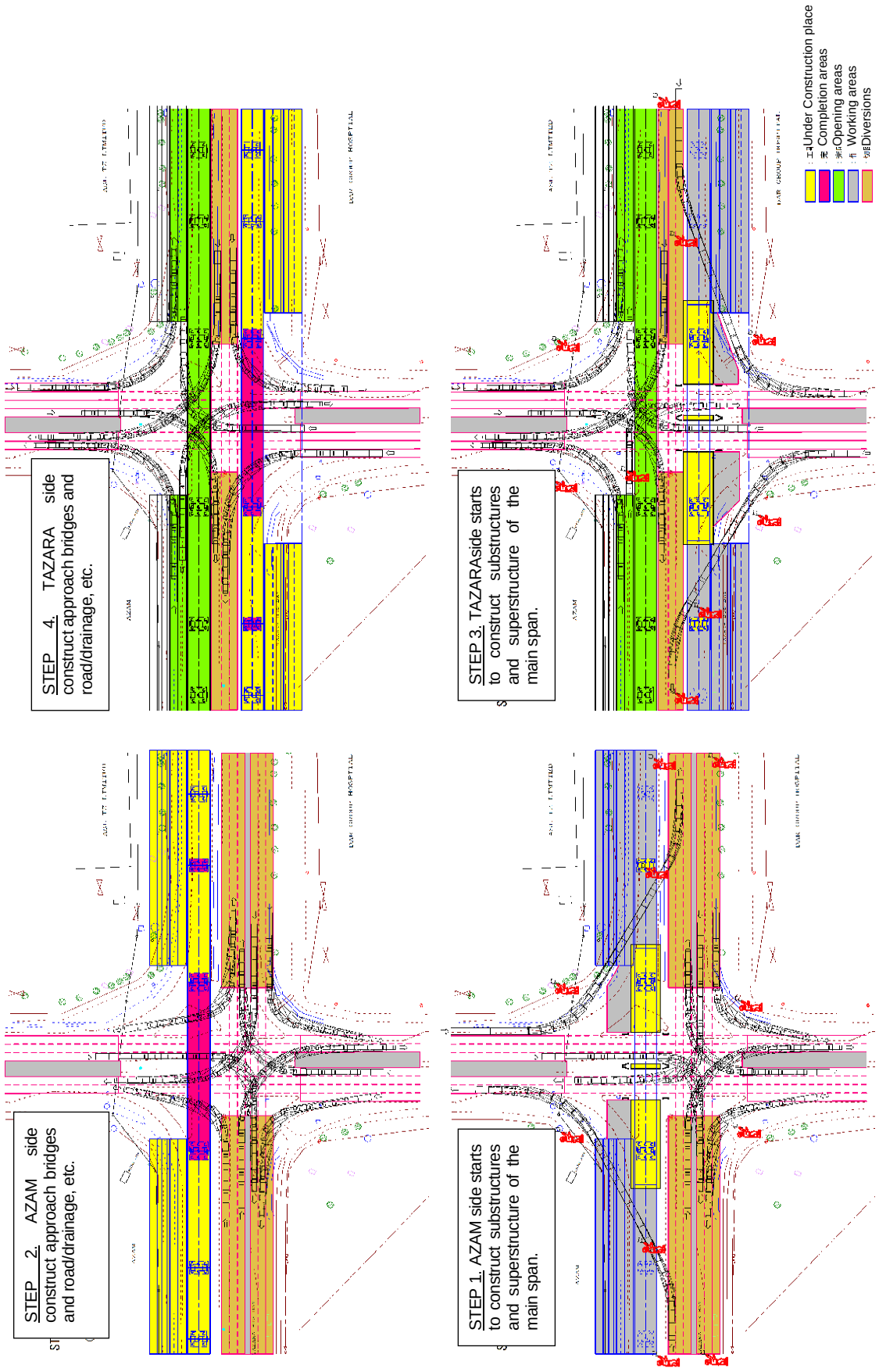


Figure 2.2.19 Construction Steps of Main Bridge/Approach Bridge and Road

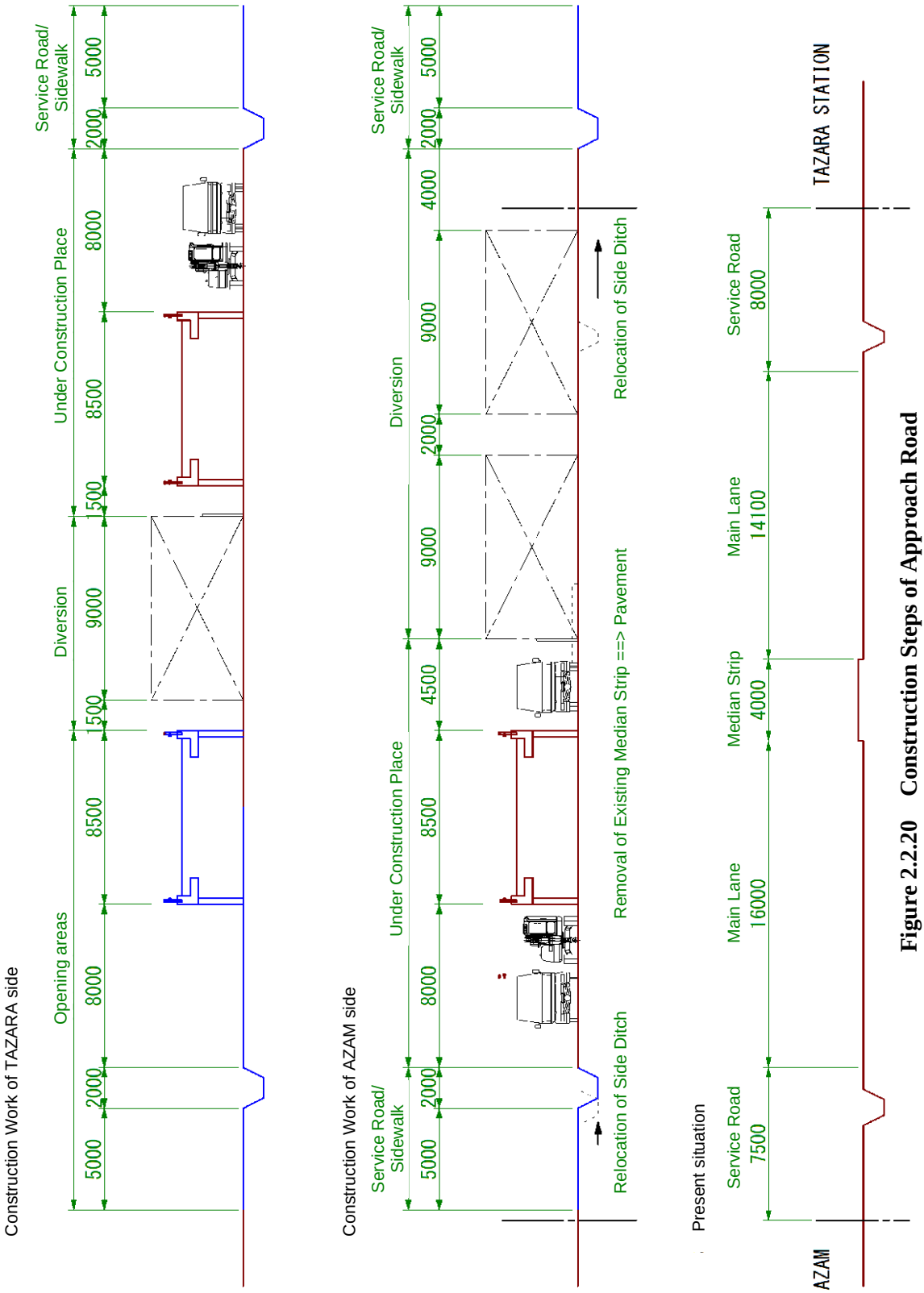


Figure 2.2.20 Construction Steps of Approach Road

2.2.4.3 Scope of the Work

For the grant aid of Japan for this Project, the burden of the Project will be shared between Japan and Tanzania as follows;

(1) Burden share of Japan

a) Transport of equipment and materials from Japan or a third country to the port of discharge (Dar es Salaam port)
b) Transport by land from the port of discharge of Tanzania or the source of equipment and materials procurement
c) Construction of bridge/road facilities (concrete structures, pavement, drainage facilities, and accessory facilities) as shown in the design
d) Construction and removal of the temporary yard, working areas, diversion and camp site necessary to the works
e) Procurement of the equipment, materials, and labor necessary for the works
f) Management services necessary for the construction work
g) Consulting services necessary for implementation of the project

(2) Burden share of Tanzania

a) Acquisition and compensation for the ROW, relocation of public facilities within the ROW and the arrangement of the temporary yard
b) Authorization to Pay (A/P) notification to the Japanese bank according to the Banking Arrangement (B/A), bearing the miscellaneous charge for payment
c) Exemption of customs and duties on imported materials and equipment unloaded at the port in Tanzania
d) Provision of privilege to the Japanese involved in the project concerning the imported goods and services provided within the scope of the authentication agreement
e) Necessary arrangement for the Japanese to be exempted from payment of duties, internal tax, or value-added tax imposed on the provision of goods and services within the scope of the authentication agreement
f) Necessary arrangements and coordination for the relocation of public facilities such as electricity, water supply, and other auxiliary facilities within the area related to the Works, and supply electricity to the lighting facilities/traffic signals installed in the Project
g) Implementation of road maintenance for the sections specified as compulsory by Tanzania
h) Continue sustainable bridge/road maintenance after completion of the Works by the Japanese side
i) Appropriate use and maintenance of facilities constructed by the Japan grant aid scheme
j) Bearing of the expenses necessary for the construction of facilities, other than the expenses accommodated by the grant aid scheme

2.2.4.4 Construction Supervision

(1) Consultant Services

After the Project is approved by the Cabinet of Japan, the Exchange of Notes (E/N) will be signed between the Government of Japan (GOJ) and the Government of Tanzania (GOT) to make a pledge for assistance, which is followed by the conclusion of the Grant Agreement (G/A) between Japan International Cooperation Agency (JICA) and the GOT to define the necessary articles to implement the Project, such as payment conditions, responsibilities of the GOT, and procurement conditions. In order to maintain technical consistency, the consulting firm (s) which conducted the Preparatory Survey will be recommended by JICA to continue to work on the Project's implementation after the E/N and G/A.

Then the consultant will sign the agreement document with the responsible organization (Ministry of Works) for implementing the detailed design, procurement assistance for tendering of contractors and construction supervision.

1) Preparation of tender documents

Based on the result of this report, the consultant will prepare the tender documents which will be approved by MOW and TANRODS. The tender documents include the following contents;

a) Drawings and Quantity volumes,
b) Indication of tender and Contract documents for contractor

2) Implementation of Construction Tendering

The consultant should assist TANROADS for tendering of contractors. The contents of the tender assistance are as follows;

a) Announcement of tender,
b) Pre-qualification,
c) Explanation of tender and site
d) Evaluation of tender
e) Negotiation

3) Supervision Services

After verification of the contractor (s) by the GOJ, the consultant should issue the notice to proceed to the contractor and supervise construction work. Progress reports should be submitted to TANROADS, the Embassy of Japan, JICA Tanzania office and JICA headquarters. The contents for the supervision by the consultant are as follows;

a) Approve construction plans and shop drawings

b) Manage the construction schedule
c) Inspect the quality of materials and facilities
d) Monitor and confirm the construction progress
e) Issue certificates for payment, completion, and other necessary certificates
f) Submit monthly reports, final drawings, final photos, and final report

(2) Consultant Service System

1) System for Preparation of Tender Documents and Assistance for Tendering

a) Apply JICA Guideline for preparing tender documents and contract documents for contractor (s)
b) Post the same engineers such as a chief consultant, expert for preparation of tender documents, bridge engineers and road engineers for tendering

2) Work Supervision System

a) Select an engineer with extensive experience for the main supervisor
b) Post the same engineers such as a chief consultant, bridge and road engineers

2.2.4.5 Quality Control Plan

The quality control of the works will follow the Tanzanian Standard. However, for the items not contained in this Standard, AASHTO or the Japanese standards or other international test methods will apply. The quality control methods in draft form are shown in Table 2.4.3. The plan for the finished work quality control in draft form is shown in Table 2.4.4.

Table 2.2.23 Quality Control Methods (Draft)

Type of work concerned	Control items	Quality control test, inspection, etc.	Test frequency and timing
1) Earth works, asphalt pavement, subgrade, base course, backfilling of structures	Material control	CBR test, soil test (specific gravity, grain size, liquid limit・plastic limit, density), aggregate test (specific gravity, grain size distribution, strength, water absorption), bituminous material (quality certificate, component analysis table)	Before execution of work
	Daily control	Compaction density test, bituminous material (stability, flow value, porosity, Marshall test, temperature)	During execution of the work, at the time of mixing
2) Concrete	Batcher plant performance inspection	Weighing instrument, mixing performance test	Before execution of work and once a month
	Material control	Cement・admixture (quality certificate, component analysis table), aggregate test (specific gravity, grain size, strength, water absorption, alkali-aggregate reaction)	Before execution of the work, at change of material
	Concrete mixing test (test mixing)	Slump, air content, temperature, test piece strength	Before execution of the work
	Daily control	Fresh concrete (air content, slump, temperature)	During execution of the work
		Witness test (compaction, curing, removal of laitance)	During execution of the work
		Concrete specimen (strength test, preparation of control chart)	At seven and 28 days after placement
3) Reinforcing bars, PC cables	Material control	To confirm mill sheet, Quality, tensile/bending test result	Before execution of the work
	Daily control	inspection items; size of materials, measurements, arrangement, wrap length, cover, fixed condition, construction joints	During execution of the work
4) PC cable tendon	Concrete strength	Compressive strength of concrete	Before tensioning of tendon
	Tendon	Calibration of jack and pump	Before tensioning of tendon, During tensioning of tendon of 50 cables
	Tendon test	Tendon control chart	Before tensioning of final tendon
	Tendon control	Single Cable Group of cables	During tensioning of tendon, control chart of tendon
5) PC grout	Design of mix proportion	Consistency, bleeding ratio, expansion ratio, strength, salinity	Before using
	Daily control	Consistency, temperature Bleeding ratio, expansion ratio, compressive strength	1 time/day 1 time/day

Table 2.2.24 Plan of Finished Work Quality (Draft)

Type of work concerned	Work item	Work quality item	Control value	Remark
Earth work	Roadbed	Proposed height	More than 0 cm	Interval 20cm
		Width	More than - 10cm	Ditto
	Base work	Proposed height	More than - 2.5cm	Ditto
		Thickness	More than – 5cm	Ditto
		Width	More than – 10cm	Ditto
Pavement work	Asphalt concrete	Width	More than – 3cm	Ditto
		Thickness	More than – 1.5cm	Ditto
Concrete structure	Footing	Proposed height	±5cm	
		Thickness	±75mm or ±3%	
	Pier, abutment, wall	Plane location	±30mm	
		Proposed height	-30mm to +10mm	
		Top of the structure length/width	±30mm	
		Cross section measurement	-10mm to +20mm or ±2%	
	Slab	Bridge length	-25mm to +30mm	
		Width	0 to +30mm	
		Slab/curb height	-20m to +20mm	
		Thickness	-10mm to +20mm	
PC structure	Girder	Bridge length	-25mm to +30mm	

2.2.4.6 Procurement Plan

(1) Procurement of Materials

1) Labour

Construction Engineers/Labour

Workers are in high demand in Tanzania. It is possible to keep skilled laborers such as carpenters, plasterers, electricians and operators of heavy equipment. However there are no skilled foremen or laborers for PC bridge work. Therefore all skilled foremen and laborers should be Japanese.

Labour-related Laws

When employing the local workers, the enterprises are governed by the employment act, the "LABOUR RELATIONS ACT, 2004-THE UNITED REPUBLIC OF TANZANIA". This was adopted by the President of Tanzania on June 4, 2004. Working time is limited as follows;

a) Working days in a week : 6 days
b) Working hours in a week : 45 hours
c) Working hours in a day : 9 hours
d) Overtime work in a month: 50 hours/4 weeks

2) Construction Materials

This Project will use construction materials produced or procurable within Tanzania as much as possible. Main construction materials are as follows.

Asphalt (bituminous material)

Asphalt bituminous material will be imported from Saudi Arabia.

Bituminous Mixture (plant)

Bituminous mixture from Tanzanian plants is extremely expensive. Consequently, material will be imported from South Africa will procure and mixture with plant of construction yard.

Concrete

There are two concrete factories in Dar es Salaam. However a concrete plant in the construction yard shall be used for the following three reasons;

a) Distance from the factories to the site is around 14 km. However, the main route over Nelson Mandela Road is always congested with traffic from morning to night. Vehicles will travel about 6km per hour. Therefore, it will sometimes take 2 to 4 hours. This makes it impossible to deliver high quality concrete.
b) Neither of those two companies have any experience in producing high strength concrete such as more than 35 N/mm2.
c) Agitator-body trucks can not supplied enough concrete to the Project because the average concrete volume for casting in the girders will be 350 cubic meters which conversion value to an agitator-body truck will be between 80 and 90 vehicles per day. However produced volume of a factory will be 200 to 250 cubic meters per day. Therefore capacity produced from a factory and transported by an agitator-body truck are not enough and limit for keeping qualities of concrete material.

Cement

Adequate quantities of acceptable cement are produced in Tanzania. Consequently this Project will procure domestic material.

Raw Materials (aggregates, borrow materials, river sand and gravel)

Raw materials will be procured in Tanzania as shown Figure 2.22.21.

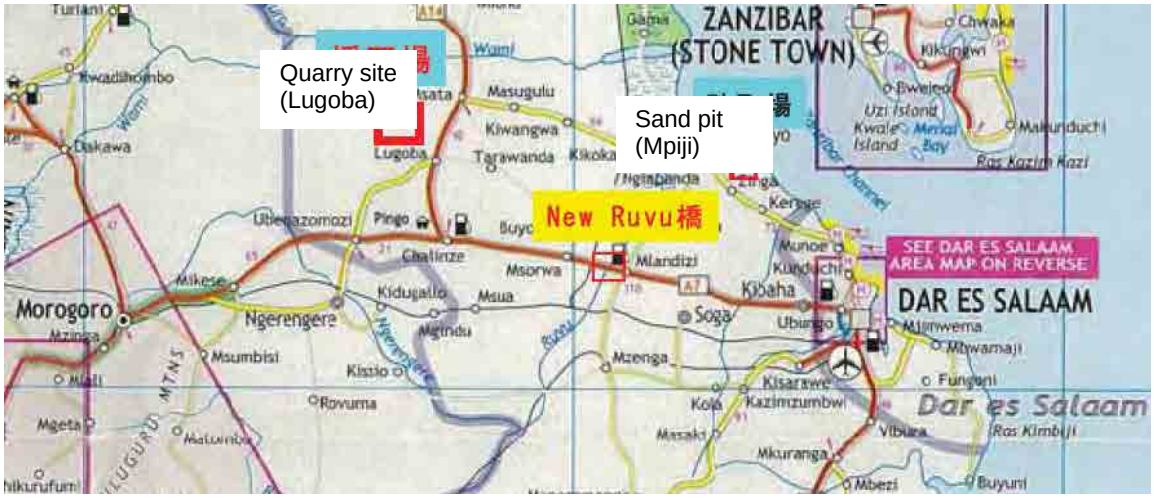


Figure 2.2.21 Quarry Site/Sand Pit

Steel (Reinforcing bars, steel materials, PC cables)

Local prices of these materials are too expensive. Consequently steel will be procured from Japan.

Oil

Oil will be procured from Saudi Arabia.

Accessories (bearings, expansion joints, railing)

There are no materials available locally. All materials will be procured from Japan.

(2) Construction Machines

Main construction machines required are shown in Table 2.22.22.

Table 2.2.25 Suppliers of Principal Equipment

NO.	Item	Specification	Remark	NO.	Item	Specification	Remark
1	Bulldozer	15t	Local	16	Tyer roller	8～20t	Local
2	Backhoe	0.28m3	Local	17	Vibration roller	0.8～1.1t	Local
3	Backhoe	0.45m3	Local	18	Tampa	60～80kg	Local
4	Backhoe	0.60m3	Local	19	Motor grader	3.1m	Local
5	Backhoe	0.80m3	Local	20	Asphalt finisher	1.7～3.1m	Local
6	Wheel loader	1.9～2.1m3	Local	21	Breaker	600～800kg	Local
23	Truck	3～3.5t	Local	22	Agitator truck	4.4m3	Local
7	Dump truck	2t	Local	23	Water pump	φ150mm	Local
8	Dump truck	4t	Local	24	Line marker	Hand guide	Local
9	Dump truck	10t	Local	25	Concrete pump	90～110m3/hr	Japan
10	Trailer	50t	Local	26	Vibro hammer	60kw	Japan
11	Truck crane	4.9t	Local	27	Excavator	1500mm	Japan
12	Truck crane	16t	Local	28	Crawler crane	50～55t	Japan
13	Truck crane	20t	Local	29	Asphalt plant	50t/hr	S. Africa
14	Truck crane	25t	Local	30	Concrete plant	90m3/hr	Italy
15	Road roller	10～12t	Local				

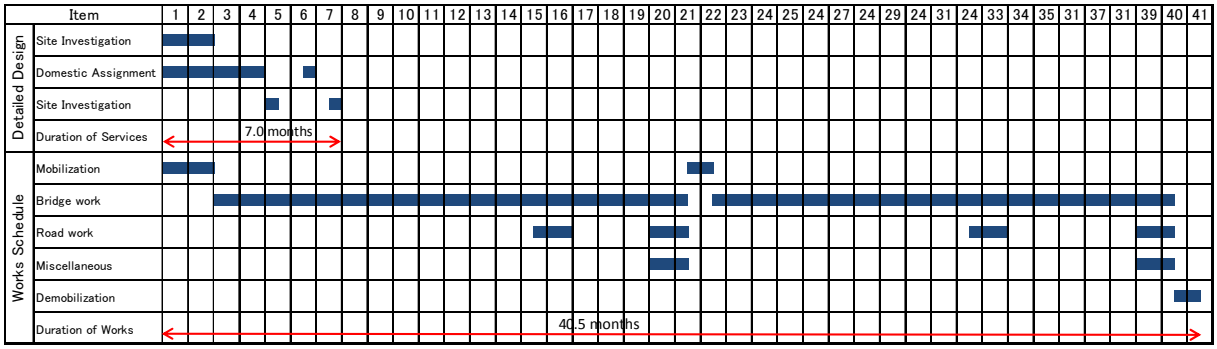
2.2.4.7 Implementation Schedule

Table 2.4.6 shows the implementation schedule prepared based on the result of the Survey. After the Survey, the Project will be implemented upon conclusion of the Exchange of Notes and Grant Agreement. The preparation of tender documents, tender opening and the commencement of work will follow after the completion of the detailed design study.

The finalization of design, the preparation of tender documents, and assistance with the tender procedures will be executed within the scope of works in Japan. The explanation of the detailed design to Tanzania counterparts will be given subsequent to the completion of the detailed design. Assistance with bidding and activities related to the contract conclusion will be given, which will require a length of about seven months.

On the other hand, the work schedule will require a total of 40.5 months, including seven wet seasons (three months/one wet season). The principal works will be bridge works, road earth works, drainage, and bridge/road auxiliary works.

Table 2.2.26 Implementation Schedule



2.3 Obligations of Recipient Country

The matters and items to be undertaken by Tanzania under the Project are as described below.

(1) General

1) Complete Bank arrangements (B/A);
2) Advise commission of an Authorization to Pay (A/P) and make payment commissions paid to the Bank in Japan.

(2) Implementation Matters

1) Secure land for the project sites, lease temporary yards, compensate for resettlement, and remove/relocate obstructive utilities;
2) Secure all the expenses and prompt execution of customs clearance at the port of disembarkation for unloading products purchased under the Grant Aid;
3) Afford Japanese nationals whose services may be required in connection with supply of the products and the services under the verified contracts;
4) Exempt Japanese nationals and the third country nationals entering Tanzania to work on the project from customs duties, internal taxes and other fiscal levies which may normally be imposed in the recipient country with respect to the supply of the products and services under the verified contracts;
5) Provide electricity, water supply, drainage and other incidental facilities to the vicinities of the sites;
6) Properly maintain and use the facilities constructed under the Grant Aid;
7) Conduct the necessary maintenance works for the sections borne by Tanzania;
8) Bear all the expenses, other than those to be borne by the Grant, necessary for construction of the facilities.

(3) Others

1) Secure the budget for land acquisition, temporary yard leasing, compensation for resettlement, and tax exemption covered by the recipient country;
2) Contract with a Japanese consulting firm for detailed design (D/D) and construction supervision;
3) Contract with Japanese construction firm (s) for construction work.

2.4 Project Operation & Maintenance Plan

2.4.1 Operation & Maintenance System

Large-scale repair work will not be required for 20 to 30 years after the completion of the F/O Bridge, provided that routine inspection and maintenance as shown in Table 4.2.1 are properly executed. Accordingly, it is possible for TANROAS regional office to carry out the inspection and maintenance work based on the current maintenance system of TANROADS.

2.4.2 Inspection & Maintenance Method

(1) Periodic Inspection & Maintenance

Bridge structures, approach roads and retaining walls will have to be maintained by TANROADS regional office. Table 2.4.1 shows the recommended intervals for the inspection and maintenance activities of the proposed F/O Bridge. Note that it is recommended to execute inspections before and after the rainy season.

Table 2.4.1 Maintenance & Inspection Schedule

	Item	Maintenance & Repair Works	Inspection Interval
Bridge	① Drainage pipe	Clearing of sediment	3 months
	② Expansion joint	Repairing of metal & seal rubber	3 months
	③ Railing	Repairing damage from collisions	3 months
	④ Bearing	Removal of soil deposits	6 months
	⑤ AC pavement	Repairing of cracks	6 months
	⑥ Substructure	Repairing damage from collisions	6 months
Road and Retaining wall	① Pavement	Patching, smoothing	3 months
	② Shoulder/slope	Planting turf, reinforcement of soils, repairing riprap	3 months
	③Retaining Wall	Repairing damage from collisions	6 months

It is important to keep records of periodic inspections conducted by TANROADS regional office for the assessment of the conditions of the facilities for establishment of a repair schedule. Accordingly, proper inspection procedures including checking methods, intervals and reporting should be established from the outset.

(2) Maintenance of Approach Roads

Although minor maintenance activities will be encountered, patching and leveling should be executed periodically. Overlay should be undertaken approximately at every 7-10 years taking into consideration the life span of asphalt pavement.

In the construction stage, close supervision should be made of materials to be pursued in accordance with the specifications. However, based on the embankment materials used, advice on future maintenance will be given to the Tanzanian side after the construction of the approach roads.

2.5 Project Cost Estimation

2.5.1 Initial Cost Estimation

(1) Cost Estimate

The total cost of the Project by the Japanese Grant Aid is confidential until the contractor for construction will be verified by the Ministry of Foreign Affairs in Japan as shown in Table 2.5.1.

Table 2.5.1 Approximate Project Costs

Items			Cost (Hundred Million JPY)
Construction Facilities	Bridge	Bridge work	Confidential
	Road	Earth work, Pavement work and other related works	Confidential
	Subtotal		Confidential
Detailed Design and Construction Supervision			Confidential
Total			Confidential

(2) Condition of Estimation

1) Time of estimate: July 2011
2) Exchange rate: 1US$ =JPY83.00 (at the above mentioned time)
   1US$= Tshs1,520.51 (at the above mentioned time)
3) Implementation period: Detailed design and construction period are shown in Table 2.4.6, Implementation schedule
4) Others: On the Condition that the Project is implemented under Japan's Grant Aid Scheme, The above mentioned exchange rate is to be reviewed by the Japanese Government.

(3) Cost Borne by Tanzanian Government Side

Approximate costs required for the undertakings of the Tanzanian Government side are shown in Table 2.5.2. This cost estimate is provisional.

Table 2.5.2 Approximate Costs to be Borne by Tanzanian Government Side

Items	Description	Cost (Mili. Tshs)	Remarks
Environmental Considerations	Survey for Environmental Impact Assessment	40.0	
	Land Acquisition	10,000.0	
Relocation of public utilities	Relocation of electrical pole/wire, telephone wire, water supply pipe and gas pipe	700.0	
Construction yard	Compensation for temporary construction yard	200.0	
Exemption from VAT(Reimbursable)/ Import duty and customs		3,100.0	
Payment commission		550.0	
Total		14,590.0	

Note ; The cost tabulated in the table are preliminary.

2.6 Operation and Maintenance Cost

The periodic inspection and minor repair/maintenance will be carried out under TANRADS. The normal cost for operation and maintenance per year after 5 years is estimated as shown below and the total cost for operation and maintenance accounts for 0.02% of the investment for maintenance in 2011/2012 (1,298 million Tshs) and so the implementation of adequate maintenance can be carried out.

Table 2.6.1 Approximate Cost for Operation and Maintenance

Term	Work Item		Specification	Unit cost	unit	Quantity	Year	Total
Daily Maintenance (Every year)	Bridge/ Approach road	Pavement repair	1%/year	0.141	m^2	64.7	4	36.5
		Drain repair	0.1%/year	o.186	m	0.7	4	0.5
		Rail repair	0.1%/year	0.823	m	1.7	4	5.6
		Lighting repair	0.1%/year	9.90	No.	0.03	4	1.2
		Bearing repair	0.1%/year	11.1	No.	0.06	4	2.7
		Ex. joint repair	0.1%/year	15.2	m	0.03	4	1.8
	Four years daily maintenance cost							48.3
	Road	Pavement repair	1%/year	0.146	m2	357	4	208
		Drain repair	0.1%/year	0.889	m	3.6	4	12.8
		Signboard repair	0.1%/year	0.407	No.	0.05	4	0.1
		Fence repair	0.1%/year	0.213	m	0.8	4	0.7
		Line repair	0.1%/year	0.002	m	16.4	4	0.1
	Four years daily maintenance cost							221.7
	Total Four years daily maintenance cost							270
Periodic Maintenance (Five years)	Bridge/ Approach road	Bridge/Appr.	1/year	24.7	m	11.9	1	294
		Pavement repair	5%/year	0.141	m^2	318	1	44.8
		Drain repair	1%/year	o.186	m	6.8	1	1.3
		Rail repair	1%/year	0.823	m	17.0	1	14.0
		Lighting repair	1%/year	9.90	No.	0.3	1	3.0
		Bearing repair	1%/year	11.1	No.	0.6	1	6.7
		Ex. joint repair	1%/year	15.2	m	0.3	1	4.6
	Five years periodic maintenance cost							368.4
	Road	Pavement repair	5%/year	0.146	m^2	1,786	1	261
		Drain repair	1%/year	0.889	m	356	1	316
		Signboard repair	1%/year	0.407	No.	0.5	1	0.2
		Fence repair	1%/year	0.213	m	7.9	1	1.7
		Line repair	1%/year	0.002	m	164	1	0.3
	Five years periodic maintenance cost							581
	Periodic maintenance cost (one time)							949.4
Operation /management cost		Maintenance cost	10%	1	No.		1	94.9
Five years total maintenance cost (average yearly maintenance cost)								1,314.3 (262.9)

Remark; Above costs will be changed because they are now only rough estimates.

Chapter 3 Project Evaluation

3.1 Preconditions

The preconditions necessary for the Project implementation will be as follows. And furthermore, the resettlement and the removal of obstacles and more compensation or the documents approved from the relevant organizations need in principle to be complete by time of the announcement of prequalification for contractors after the E/N.

- TANROADS shall secure their own property such as ROW (60m). Especially, there are obstacles which are public utilities under the ground in ROW. TANESCO and DAWASA are operating and managing their facilities. The drawings and quantities of each utility are presented in Chapter 1.5,
- In order to secure the ROW, land acquisition of TRL and TANESCO needs approximately 1,300m2 (4.5m x 295m). The detailed contents are described in Chapter 1.3,
- There are fences (approximately 200m long), lighting poles (2 pieces), and several trees along Nyerere Road on the Tazara station side. Removal or relocation of these obstacles should be arranged by TANROADS with each owner. The detailed contents are described in Chapter 1.3,
- TANROADS should conduct an EIA and get approval documents from NEMC as presented in Chapter 1.3,
- In order to use a storage site for materials and site office of contractor, and to get materials from a quarry site and borrow pit, the contractor needs an official permit,
- In order to maintain traffic safety during construction work, TANROADS should educate the road users and the people that occupy the areas along the road, and
- Roles to be conducted by TANROADS are presented in Chapter 3.3, 3.4 and 3.5.

It is supposed that TANROADS is able to suitably use and maintain the flyover bridge. TANROADS is able to maintain an adequate budget for operation and maintenance of this flyover bridge after completion of the Project. Therefore it is supposed that the Tanzanian side will secure this precondition for the implementation of the Project.

3.2 Necessary Inputs by Recipient Country

Necessary inputs for the realization and sustainability of the Project effects are as follows;

- In order to smoothly conduct the accomplishment of the Project, the Tanzanian side should prepare the budget in advance as described in this report “2.4 Project Operation Plan”,
- In order to secure the permanent function of the Project, the Tanzanian side should arrange necessary staff to permanently carry out all necessary work after completion of the Project for which an adequate budget has been maintained as described in this report “2.4 Project Operation Plan”,
- TANROADS needs to form a team to undertake an EIA, obtain official approval for the EIA, and to subsequently implement the requirements of the EIA,

- This Project is the first time to construct a flyover bridge which considers the urban aesthetic scenery in Tanzania. In order to maintain traffic safety during the construction work, traffic control staff should be arranged at the construction site. Therefore, TANROADS needs to arrange bridge engineers from Japan to obtain technical transfer regarding the construction methods for the flyover bridges.

3.3 Important Assumptions

Important assumptions for the realization and sustainability of the Project effects are as follows;

- After completion of the Project, existing traffic volume will be expected to increase. Therefore, daily and routine maintenance will be necessary in order to maintain the safety of the facilities.
- This Project will construct the flyover bridge for the exclusive use of vehicles. However, detailed design of BRT is now on going. If BRT constructs a new flyover bridge in the median between inbound and outbound lanes of the Project, TANROADS will need to continue to monitor the structure of the Project in perpetuity for confirmation and checking of the safety of the Project.
- Traffic congestion in the City has increased every year. In order to avoid traffic congestion, illegal parking and stopping on the road should be prohibited, and other new flyover bridges should be constructed at congested intersections.

If the above important assumptions are conducted properly, the intended Project effects shall be realized.

3.4 Project Evaluation

3.4.1 Relevance

This project will be implemented for the Tazara Intersection where Nyerere Road, along which a relatively low-income group lives, crosses with Nelson Mandela Road, which makes up a part of the physical corridor connecting the Dar es Salaam port with the inland area of Tanzania. Chronic traffic congestion is observed at present in the Tazara Intersection. Improvement of this intersection is expected to improve accessibility of wayside residents to the daily traffic while contributing to smooth international cargo transport. It may be determined that the relevance of implementing this project is high as described below:

(1) Beneficiaries of the Project

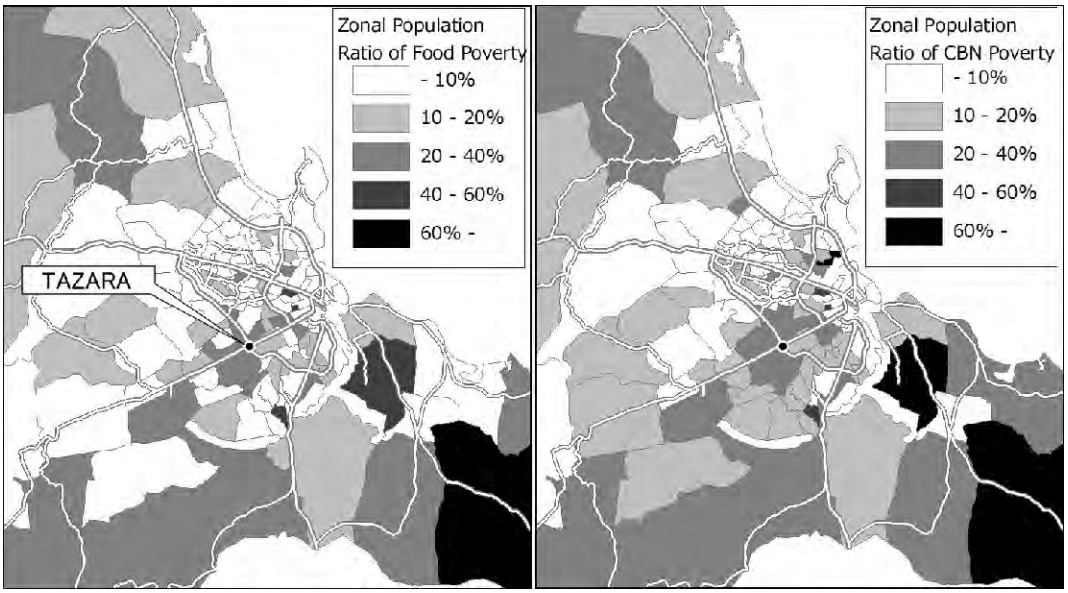
The ratio of the traffic volume passing through the Tazara Intersection relative to the traffic volume per day within the whole of Dar es Salaam was estimated. Improvement of this Intersection is expected to provide direct benefit to about 18% of the bus users, 10% of the passenger cars, and 30 to 40% of the motor truck traffic of the whole of Dar es Salaam.

Table 3.4.1 Traffic Volume in Dar es Salaam and Tazara intersection

	Daily Traffic Volume in Dar es Salaam in 2007	Traffic Volume through Tazara Intersection in 2007	Proportion of through traffic at Tazara Intersection
Bus Passengers	1,942,310 person trips	348,320 person trips	17.9%
Motorcycles	20,349 vehicle trips	4,024 vehicle trips	19.8%
Passenger Cars	141,766 vehicle trips	14,924vehicle trips	10.5%
Trucks	31,470 vehicle trips	10,143vehicle trips	32.2%
Trailers	5,626 vehicle trips	2,223vehicle trips	39.5%

Source：Dar es Salaam Transport Policy and System Development Master Plan (JICA: 2008.6)

Moreover, the population of the food poverty population that can enjoy direct benefits from improvement of this Intersection is estimated to be 56,000 (26.5% of the food poverty population of the whole of Dar es Salaam). In terms of the minimum-required bare necessity consumption expenditure (hereinafter referred to as "CBN"), this is estimated to be 76,000 (16.1% of CBN of the whole of Dar es Salaam).



Notes: Population ratio of food poverty households and CBN poverty households to population aged 5 years old and more.

Source: Estimated by JICA Study Team based on the Household Budget Survey in 2007 and Household Interview Survey in Master Plan.

Figure 3.4.1 Distribution Map of Food Poverty and CBN Poverty

(2) Urgency of the Project

Traffic congestion and the consequential economic loss to Dar es Salaam are growing more severe year by year. Future predictions using micro-simulation shows that, if the overpass at the Tazara Intersection is not put into service, the economic loss per day will be 46 million Tanzania Shillings in 2015. Considering the financial state of the Government of Tanzania, implementation of this project is urgently required.

(3) Consistency with medium to long-term projects and higher-level projects of Tanzania

The Government of Tanzania developed, as the national development strategy, NPS (National Poverty Eradication Strategy) in 1997 to present the framework for eradication of poverty. In 1999, the Government publicized the "Tanzania Development Vision 2025", presenting the directions of the development (improving the living standard, securing good governance and the rule of law, and a strong and competitive economy). On the basis of national development strategies, the PRS (Poverty Reduction Strategy） was developed in 2000, followed by the second PRS, that is, the NSGRP (National Strategy for Growth and Reduction of Poverty) (called MKUKUTA) in July, 2005, and the third PRS (MKUKUTA II) in July, 2010.

Similarly to the second PRS, the third PRS presents the comprehensive policy framework for five years for which eradication of poverty and economic growth are presented as targets. The stress is placed on the ownership of the nation, with the result-oriented inter-disciplinary approach employed. In this strategy, three elements were identified as contributing to the growth and eradication of poverty; "Growth and eradication of low-income poverty", "improvement of the life quality and social welfare", and "governance and accountability."

The 10 year Transport Sector Investment Program (TSIP) was developed in 2007, which was to be the document of comprehensive strategy for the transport and traffic sector. In this context, the road sector is highlighted as the largest investment area. The objective of this project is to mitigate traffic congestion at the Tazara Intersection, one of congestion points in Dar es Salaam. Consequential anticipation on reduction of economic loss caused by traffic congestion and improvement of road traffic service for wayside residents agrees with the targets of the higher-level projects of this country.

(4) Consistency with the position and policy of aid of Japan

Our aid plan (June, 2008) and business development plan (August, 2010) for Tanzania are both focused principally on development of infrastructures while including the policy development and implementation aid, development and maintenance of trunk roads into the "Domestic Transport Network Establishment Aid Program." As aids for the sector of transport and traffic, the loan assistances of the "Road Improvement project of the Arusa – Namanga – Athi River Section" and the "Road Sector Assistance Project" and grants-in-aid for the "Kilwa road widening project", and technical cooperation for "LBT（Labour Based Technology） training capacity strengthening project", etc. were implemented. Apart from the above, the development survey of the "JICA Master Plan 2008" was implemented from 2007 to 2008. This project was proposed to be one of the projects to be dealt with at top priority.

The TICAD IV Yokohama Action Plan proposed the "Wide area Transport Infrastructure" as an

important subject while clearly noting the support for the “Development and Improvement of the Domestic and Wide-area Economic Corridor.” This plan is to improve the accessibility to the Dar es Salaam harbor and the International Trunk Roads and corresponds to the TICAD IV Yokohama Action Plan.

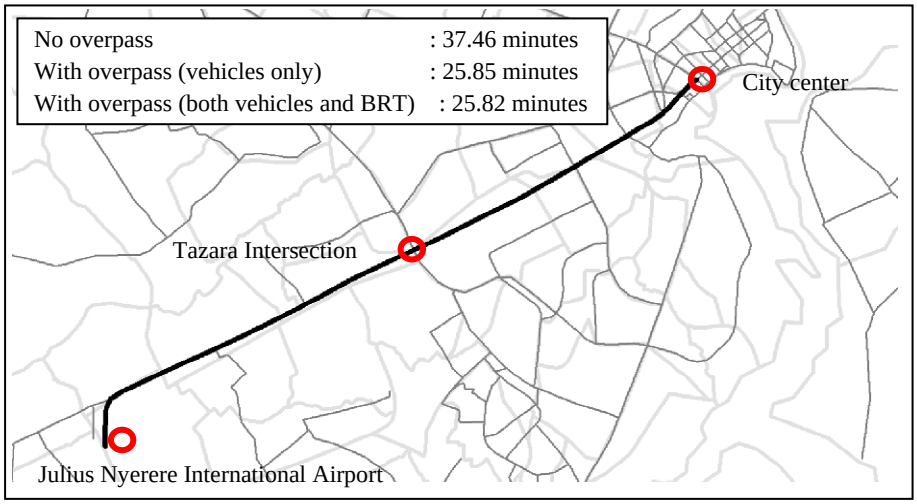
3.4.2 Effectiveness

(1) Quantitative Effect

1) Reduction of the travel time

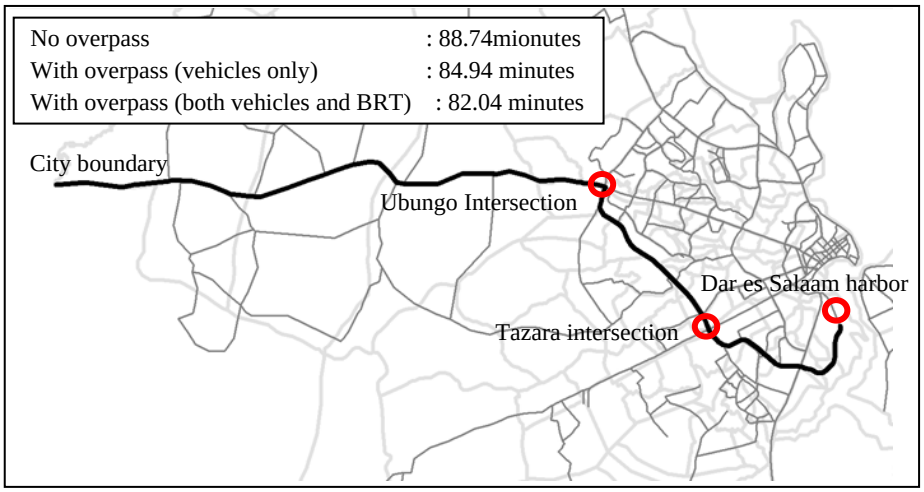
Implementation of this project will help reducing the time for trips within the city and wide area as shown in Figure 3.4.2.

a) Airport to the city center (11km)



Source: JICA Study Team

b) Dar es Salaam harbor to the city border (36km)



Source: JICA Study Team

Figure 3.4.2 Reduction of the travel time

2) Mitigation of congestion in the intersection

Implementation of this project will help mitigating congestion in the Tazara Intersection as shown in Table 3.4.1.

Table 3.4.2 Congestion of Tazara Intersection

Effect index	Without Project	With Project (both vehicles and BRT)	With Project (vehicles only)	Present state (2011)
Degree of Saturation in Morning Peak Hours	2.35	1.65	1.64	1.040
Degree of Saturation in Evening Peak Hours	1.95	1.14	1.12	1.452
Average Travel Speed (km/hour)	32.6	48.5	44.3	34.2
Average Stop Time (sec/km/vehicle)	96.3	6.8	23.4	87.0
Average Number of Stops (No./km/vehicle)	1.7	0.2	0.4	1.3
Average Travel Time (Sec/km/vehicle)	176.5	76.9	95.4	165.9

Source: Study team. One-hour simulation result (average of all car models including BRT) using the observed traffic volume of peak hours (7:00 to 8:00 am) in the morning. BRT operation frequency assumed to be five-minute intervals. Prediction for the year of 2015.

3) Effects for improving the wayside environment

Air pollution caused by road traffic congestion is also one of the urban traffic problems of Dar es Salaam. If this project is implemented, the travel speed will be improved and the wait time in the intersection will be reduced. From the trial calculation, it may be expected that this project, if implemented, will reduce Nox and CO2 emissions during waiting in the intersection by 12.4 ton/year and 1,972 ton/year, respectively, for 2015.

(2) Qualitative effects

The qualitative effects expected from this project are described below:

1) Poverty eradication effect

The access time can be reduced from the wayside area of Nyerere Road west of the Tazara Intersection, where many relatively low-income groups live, to the city center and Kariyako area where the Dar es Salaam's largest market is located along with clinics and other facilities. This is expected to contribute to activation and stabilization of the economic activities of the low-income group, and consequentially to the eradication of poverty.

2) Smoothing of domestic and international physical flow

This project will mitigate congestion on Nelson Mandel Road, which in turn reduces the time for

road traffic cargoes to the Dar es Salaam harbor and inland countries. In consequence, physical flow to and from inland countries will become more active.

3) Reduction of accidents in the intersection

Minor collisions occurring due to congestion in and around the Tazara Intersection can be reduced, enhancing transport safety.

4) Activation of the enterprise activities in Dar es Salaam

Tazara Intersection is located in an industrial (mainly light industry) area and, along Nyerere Road where the overpass will be constructed, there are large commercial and public facilities, including Japanese enterprises. Implementation of this project will reduce the transport cost of materials and products to the Dar es Salaam harbor, which in turn will contribute to activation of the wayside commercial activities.