PEDESTRIANS' CROSSING PROBLEMS AT THE MANZESE FOOTBRIDGE AND PROPOSED MEASURES

[1] Ali A. Shariff, [2] Saidi A. Tamba and [3] Azizi A. Mdimi
National Institute of Transport
P.O. Box 705, Dar es Salaam.
Email: [1]alishariff50@yahoo.com , [2]tamba1tz@yahoo.com and [3]azmdimi@yahoo.co.uk

ABSTRACT

In its efforts to restore safety to pedestrians the Government of Tanzania constructed the Manzese Footbridge along the Morogoro road. The project cost was TShs. 46,300 Million at the price in year 1990. The bridge design was carried out in accordance with Road Bridge Design Manual published by Japan Road Association.

Unfortunately, only one pedestrian bridge has been built in Dar es Salaam since 1991. Footbridges and underpasses have hundred percent potential of protecting the pedestrian's safety when the traffic stream being crossed is heavy. It is not known why this advantage is not fully utilized by pedestrians in Dar es Salaam city. The paper tries to find out the reasons behind this trend.

A case study of the footbridge at Manzese and two neighbouring zebra crossings one on either side of the bridge were used. Experimental data of the number of pedestrians crossing at the bridge, Tip Top and Bakhresa zebra crossings at fifteen minute intervals were collected for five working days starting from 1200 to 1515hours. The average deviations of pedestrians crossing at Tip Top and Bakhresa from the bridge were analysed by means of a paired t-statistic to uncover the usage inadequacy of the crossing facilities. Manzese foot bridge quality was also analysed by the Five Point Likert Scale using five quality attribute sentences. A random sample of 165 people was used in the analysis.

The t-statistic showed that the bridge crossing is not significant at 5% level but significant at Tip Top and Bakhresa zebra crossings. This reveals that the pedestrians are not using the bridge compared with the other two zebra crossings. The Likert method showed that inadequate security, loss of muscle energy, no plaza, dizziness and no facilities to attract crossing of all types of pedestrians are reasons hindering its use. It is recommended that the above findings can be rectified by providing security lighting, police patrol and modification of bridge structure.

***Keywords**: Dar es salaam, Morogoro Road, Manzese footbridge,. Under passes, zebra crossing Fire Point Likert Scale, Paired t-test*

1.0. INTRODUCTION

Dar es Salaam City has a population of over 3.3millions, with Manzese being one among the densely populated areas (2002 Population Census). Social and economic activities have also been increasing at a fast rate. These activities require safe and efficient roads for transport. This situation calls for frequent revisit of road facilities so as to cope with the rapid development.

The first pedestrian bridge in Dar es Salaam, was constructed across Morogoro road at Manzese market area in 1991. The bridge is located where many people are focusing to the market every day. The feasibility study of constructing the bridge was submitted to the Government of Tanzania by JICA and therefore revealed that the bridge designed taking into consideration not only the economic and structural aspects but also aesthetic point of view United Republic Of Tanzania(URT, 1991).

Features of the bridge are as shown below:

- Location: Manzese Msufini
- Purpose: Pedestrian bridge
- Type of Bridge: Prestressed Hallow Slab Concrete (PC)
  Bridge Length: 48 m

- Span Arrangement :10.1 x 2@12.25 x 10.1
- Bridge Width: 5m
- Step Width : 3m

Bridge design was conducted in accordance with Road Bridge Design Manual published by Japan Road Association with design conditions as shown in Appendix I and II with:

- Live load (Pedestrian load) : 350 kg/sq. m
- Earthquake load : Not applicable

Vertical clearance applied for the bridge was 5.0m in minimum, taking into account the large country buses carrying goods on their tops.

Alternative study was conducted to find the most reasonable pedestrian bridge. The following alternative bridges were considered:

Alternative 1: Prestressed Concrete Hollow Slab Bridge
Alternative 2: Metal Plate Floor Bridge

The result of comparative study is presented in Appendix I and II which allow the construction of PC type of bridge. Figure 1 shows the picture of Manzese Foot Bridge:

Figure 1. Manzese Foot Bridge

The bridge is concretized which means a lot of money has been used in its construction. Simple beautiful bridge structures using timber (Mninga) with a gentle slope and pedestrians plaza could have been used to lower construction costs in Tanzania as a third alternative. Timber Bridge could be shifted easily to other places by using a small amount of money in case the need arises.

Five similar foot bridges could have been constructed in the city of Dar es Salaam during that time using timber (1:5.8, Timber Construction Concrete Timber Ratio).

At roads with high vehicle densities, underpasses and footbridges are very safe pedestrians crossing facilities. The chance for pedestrians crushed at these facilities is zero.

Consequently, zebra crossing is not a very safe pedestrian crossing facility when the traffic stream being crossed is heavy. Amazingly, at Manzese bridge pedestrians prefer zebra crossing which is riskier than the footbridge. Tip Top zebra crossing is 285m away from the bridge while Bakhresa is 395m away. In between there are rail guides to prohibit pedestrian from crossing haphazardly, leading them to use the bridge, still pedestrians seem to prefer to much use of the neighboring zebra crossings. What are the reasons behind this trend?

2.0 EXPERIENCES FROM OTHER COUNTRIES

Pedestrian facilities in Ghana according to Kontoh (2004) include footways, footbridges and pedestrian crossings. It was observed that pedestrian facilities in Ghana were designed for the normal pedestrians resulting in the young, the elderly, the disabled and the cart puller being disadvantaged when walking.

Considering the two foot bridges at Kaneshie, a lot more questions may be asked but the bottom line is that; Ghana needs to appreciate the complexity of traffic mix and adopt user-friendly designs for the benefit of all persons in the community. The two bridges in Ghana seem to have similar characteristics to the bridge under study. However it is not known yet why people are reluctant to use it effectively.

In Dhaka city, according to Khaled (2005), non-use of the footbridges, ignorance and lack of awareness of the pedestrians about traffic rules are the major reasons for mishaps on the city streets in Dhaka city. Experts suggested relocation of the existing non-use footbridges, construction of adequate zebra crossing or underpass instead of foot bridges, fencing the road dividers and awareness campaigns for the pedestrians and vehicles operators as means of safe road crossing.

More over, the footbridges in the capital remain useless for their inaccurate location, insecure and unclean environment, hawkers and beggars problems and the negative attitude of the pedestrians on the whole, according to a survey. The Centre for Urban Studies counted 231,091 pedestrians at 16 footbridge locations and found that less than half of them had used the footbridges.

At the same time, most of the pedestrians identified dirty environment, lack of security and keeping occupied the major portion of the bridges by the hawkers and beggars as the reasons for the non-use of the footbridges. Some others mentioned their discomfort in using the footbridges pointing to their technical aspects like the structure, height, width, length and the staircases. It is more time consuming, said a few others.

The study conducted in late 2004 also found that fencing the footpath and road median are the effective method to direct the pedestrians towards the footbridges. The Dhaka City Corporation under the Dhaka urban Transport Project had constructed 25 footbridges at different locations for safe road crossing. Further, the survey found that the Shahbagh footbridge is hardly used by the pedestrians as it is far way from the intersection. Moreover, substantial open spaces on the footbridges in new market, Farmgate, Jatrabrai, Baitul Mokarram and Shahbagh remain mostly occupied by the hawkers and beggars. It is not known whether the situation at the Manzese footbridge would be the same as that outlined in this paragraph.

Narrow path along with dumping of garbage and filth on the approach roads to the footbridges also make difficulties in using the footbridges, the survey found. Experts in Dhaka suggested relocation of the existing non-use footbridges, construction of adequate zebra crossing or underpass instead of foot bridges, fencing the road dividers and awareness campaign for the pedestrians and vehicle operators as means of safe road crossing (Khaleda, 2005). There are proposals for 10 more footbridges at Bangla Motor intersection, Sonargaon intersection, in front of the fish market and Dania University College on the Dhaka-Chittagong Highway, Pragati Swarani intersection, Abdullahpur intersection, Rajuk

College intersection, Phoenix intersection at Tongi Diversion Road, Old Airport, Paribagh and in front of Shanir Akhra College. Abdul Khaleq, General Manager of Traffic Survey of the Dhaka Transport Coordination Board, told New Age that the proposed footbridges would be constructed under phase two of the project.

In Manchester City, Pero's bridge limited its gradient to 5 per cent to ensure that the bridge was accessible for wheelchair users. This quick little footbridge shows how a simple structure crossing a short gap can create life and interest in an area popular with both visitors and locals (Collis, 2003;. However the gradient of Manzese footbridge is far more than 5 per cent. Moreover, it has not created life and interest in the area popular with both visitors and locals.

The final configuration of the Spence street footbridge on the Yarra River took into consideration community interests as well as those of client. For example the open ends allow for unimpeded pedestrian and cycle access along the promenades on both sides of the river (ibid;178). It is not known whether the final confirmation of the Manzese footbridge took into consideration community interest.

Corporation street footbridge linking Mark Spencer and the Arndale Centre, (two of the Manchester city's main shopping locations) has set new standards of structural and façade engineering in urban footbridge design. Innovative techniques were used in its realization range from the use of prestressed steel to form the hyperbolic paraboloid of the primary structure, to the incorporation of state of the art glazing materials to ensure public safety in the event of glass panel failure. One of the biggest design challenges set by the brief was to conceive a form that could both accommodate a slopping pedestrian route and address the street sympathetically (Ibid, 188 – 191). Most of the government and public buildings are not user friendly for disabled people. Certainly the Manzese foot bridge lacks standards that make it not attractive to pedestrians crossing. Nevertheless, Hunger Ford Bridge and Spencer Street Foot Bridge in UK have to a large extent quenched thirst of pedestrians, the aged, cyclists and the disabled. (Collis, Ibid).

Experiences obtained from these few countries and author's opinions basing on the above outlined information revealed by induction that the Manzese foot bridge is not used effectively. The reasons behind this may be:

- Inadequate security for pedestrians
- More energy is required to ascend the bridge
- The disabled, aged people and the sick are discouraged to use it.
- No Plaza around the bridge to attract pedestrians
- Many pedestrians feel dizzy when ascending the bridge.

3.0 STUDY APPROACH

A study was carried at Manzese footbridge and its neighbouring zebra crossings that is Tip Top and Manzese Bakhresa. Pedestrians walking toward the side of the road where vehicles move to town, was noted as inbound 1 while those walking in the opposite direction was noted as outbound 2. The number of pedestrians crossing the Bridge in every fifteen minutes was recorded both for inbound 1 as well as outbound 2. This was achieved by using clickers and stop watches. The observations were recorded. Simple structured questionnaire was used to get opinions of community interest by the help of the Five Point Likert Scale (see Table 4.3). Coefficient of variation (CV) was used to test consistency of the data in respective study locations. The t-test was used to test the validity of the claims of usage of Manzese footbridge.

Inbound deviation of pedestrian crossing:

The deviation of Bakhresa from footbridge was given by

BB1 = Footbridge - Bakhresa

The deviation for Tip Top from Footbridge was given by

BT1 = Footbridge -Tip Top

Outbound deviation of pedestrian crossing:

The deviation for Tip Top from Footbridge was given by

BT2 = Footbridge -Tip Top

The deviation for Bakhresa form foot bridge was given by:

BB2 = Footbridge – Bakhresa

The coefficient of variation was found by the formula:

C.V = (SD/X) 100%

The calculated t-statistic (i.e. test statistic) was given by

t -= D $\sqrt{}$ (n – 1)/SD

The tabulated t-value at 5% level is 2.179 for 13 observations

4.0 RESULTS AND DISCUSSION

Table 4.1 below gives a summary of average number of pedestrian crossing at Manzese footbridge, Tip Top, and Manzese Bakhresa from 1200 to 1515 hours for five working days.

Table 4.1 Average number of Pedestrians crossing at Manzese Footbridge, Tip Top and Manzese Bakhresa

Time	AT FOOT BRIDGE		AT ZEBRA CROSSING (TIP TOP)		AT ZEBRA CROSSINGS (MANZES BAKHRESA)	
Hours	inbound 1	outbound 2	inbound 1	outbound 2	inbound 1	outbound 2
1215	59	74	310	212	174	39
1230	91	118	172	250	282	65
1245	87	107	212	216	345	52
1300	99	104	545	217	342	115
1315	49	84	415	250	516	194
1330	99	78	370	170	294	285
1345	84	94	200	150	358	193
1400	89	97	105	75	386	179
1415	60	61	112	98	307	213
1430	53	68	197	160	371	335
1445	75	68	114	142	365	177
1500	59	53	120	109	458	231
1515	62	83	100	116	382	186
mean	74.31	83.77	228.62	166.54	352.31	174.15
SD	18.00	19.35	140.57	58.35	83.10	87.76
CV	0.2423	0.2310	0.6149	0.3504	0.2359	0.5039

Sketch

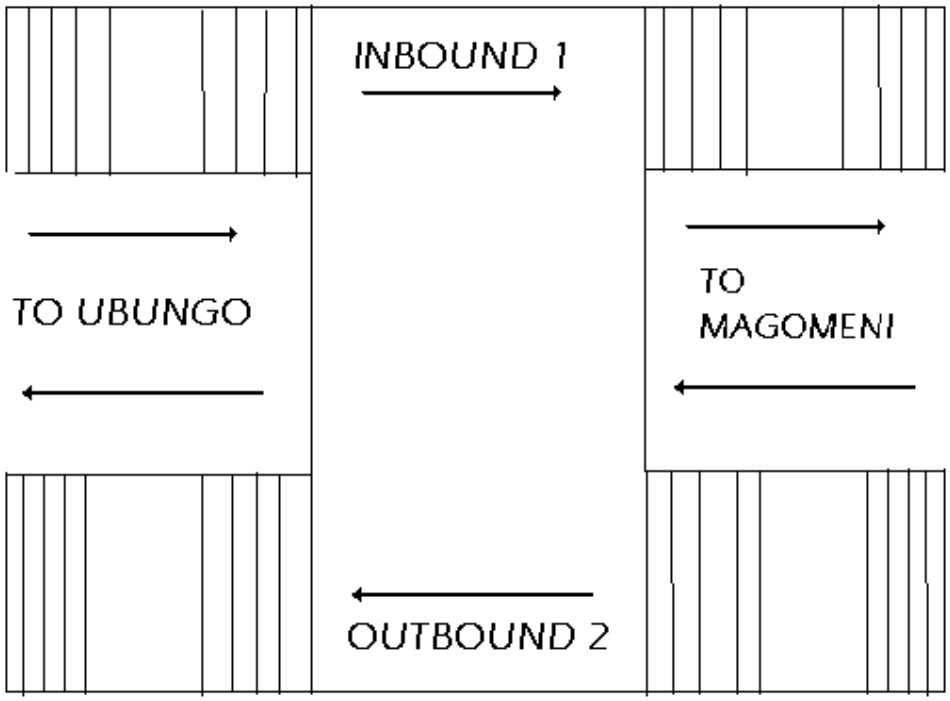


Table 4.1. contains status and usage data situated in the first seven columns. The data of Manzese Footbridge are found in the first three columns having the coefficient of variation (CV) of 24.2% and 23.1% respectively. The variation is not high revealing that the data of inbound 1 and outbound 2 do not vary much with respect to time. This may be attributed by the resistance generated by the pedestrians to use the bridge by reasons which are required to be identified. Columns four and five give status of Tip Top. The coefficient of variation is 61.5% and 35% respectively indicating a high variation of pedestrians crossing especially at Tip Top (inbound 1).

The result may be influenced by the high number of pedestrians crossing to Tip Top marketing centre at certain peak times. Manzese Bakhresa data are found in column six and seven with coefficient of variation of 23.6% and 50.4% respectively. The variation is somehow high. At certain peak times, the pedestrians are crossing for purchase at Manzese Bakhresa Marketing centre. Rsearch assumed that the trend would be the same from 0600 hour to 1200 hour noon.

In order to make the study much more interesting, deviations of pedestrians crossing at Tip Top and Manzese Bakhresa from the Foorbridge are given in Table 4.2 ready for further analysis.

Table 4.2 Deviations of pedestrians crossing at TipTop and Bakhresa from the Footbridge

Time	BT1	BB1	BT2	BB2
1215	-251	-115	-138	35
1230	-81	-191	-132	53
1245	-125	-258	-109	55
1300	-446	-243	-113	-11
1315	-366	-467	-166	-110
1330	-271	-195	-92	-207
1345	-116	-274	-56	-99
1400	-16	-297	22	-82

1415	-52	-247	-37	-152
1430	-144	-318	-92	-267
1445	-39	-290	-74	-109
1500	-61	-399	-56	-178
1515	-38	-320	-33	-103
mean	-154.3076	-278	-82.7692	-90.3846
SD	137.1728	90.3050	51.0165	100.423
t-stat.	-3.896814	-10.6640	-5.62015	-3.11780

Table 4.2 contains comparison data of Manzese footbridge with respect to Tip Top and Manzese Bakhresa zebra crossing. The comparison analysis with the help of the paired t- statistic shows that all values are negative and are significant at 5% level since tabulated t-statistic is – 2.179. This reveals a severe under usage of the facility. Rehabilitation of the Manzese footbridge is vital in the sense that it would help to harvest the laid down benefit to the pedestrians. It could be seen from the results that the Manzese footbridge is under used when compared to its neighbouring zebra crossings of Tip Top and Manzese Bakhresa. The response from the Manzese user community identified security, tiredness, dizziness, inadequate facilities to support disabled, aged people and the sick are the main factors hindering the effective usage of the facility.

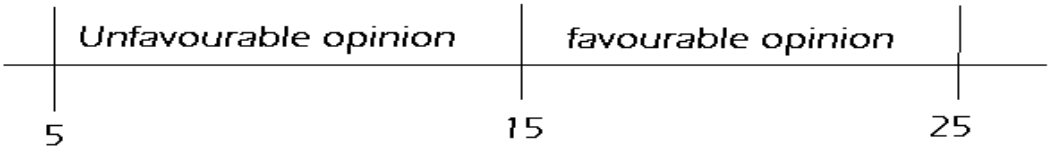
The t-statistics for the difference in usage of Tip Top and Manzese Bakhresa from the bridge are negative and significant at 5% level so supports the claim. This result shows that, around the Manzese area, the pedestrians prefer to cross on zebra crossing than across the bridge.

Opinions concerning the quality attributes of Manzese footbridge is analyzed by means of the Five Point Likert Scale as shown in Table 4.3 below:

Table 4.3 Analysis of Quality Attributes of Manzese Bridge using Five Point Likert Scale

Opinions / Sentences	**Strongly Disagree (1)**	**Disagree (2)**	**Neutral (3)**	**Agree (4)**	**Strongly Agree (5)**	**Total**
Security is adequate at the bridge	09 (0.25)	08 (0.22	06 (0.17)	06 (0.17)	06 (0.17)	**35**
Much muscle energy is used in ascending the bridge	03 (0.09)	02 (0.06)	01 (0.03)	13 (0.40)	13 (0.40)	**32**
There are facilities for disabled, aged and sick people on the bridge.	26 (0.81)	04 (0.12)	00 (0.00)	01 (0.03)	01 (0.03)	**32**
There are attractive shops/Plaza beside the bridge	12 (0.36)	10 (0.30)	03 (0.09)	06 (0.18)	02 (0.06)	**33**
People fill dizzy when ascending the bridge	07 (0.21)	07 (0.21)	07 (0.21)	06 (0.18)	06 (0.18)	**33**
Total	**54**	**31**	**17**	**35**	**28**	**165**

( ) = Row ratio
5 x 5 = 25 Most favourable response possible
5 x 3 = 15 A neutral attitude
5 x 1 = 5 Most unfavourable attitude.



Total score (TS) = 1.72 + 1.82 + 1.5 + 3.84 + 4.2 = 13.08

Since 13.08 < 15 the opinions of the people to quality of Manzese bridge is unfavourable. This suggests that all of the five factors of qualities are critical.

5.0 CONCLUSIONS AND RECOMMENDATIONS

From what has been analysed in the study it may be concluded that much remains to be done at the Manzese footbridge in its construction technology so as to attract more pedestrians and cyclists to use the facility effectively. The following reasons are verified from the survey to be the significant factors hindering the usage at the Manzese footbridge:

- Inadequate security for pedestrians crossing especially during nights
- Use much muscle energy to ascend the bridge owing to its height.
- No facilities to attract disabled, aged people and the sick to use it .
- Some people feel dizzy during ascending and walking on the bridge.
- No Plaza to attract pedestrians.

The following recommendations are worth being applied in order to rectify the pedestrian situation at Manzese footbridge:

- To provide security lighting for pedestrians
- To provide police patrol during night
- To modify the footbridge to accommodate disabled, aged people, the sick and cycle traffic.
- To prohibit the use of the bridge by petty traders and hawkers
- To build pedestrian plaza in order to attract more pedestrians to cross

6.0 REFERENCES

Chakroborty, P. (2003), Principles of Transportation engineering, Prentice – Hall of India New Delhi.

Collis, H. (2003), Transport Engineering and Architecture, Laurence King Publishing in Association with Arup, London

DfT, Puffin Pedestrian Crossings dft.gov.uk/stellent/groups/dft_roads/documents/page/dft_roads_504816.hcspfT, The Installation of Puffin Pedestrian Crossings dft.gov.uk/stellent/groups/dft_roads/documents/page/dft_roads_404745.hcsp

Khaled, P. (2005); "No use of footbridge, ignorance about rules cause mishaps; New Age Metro, Dynamic Daring Daily".

Khaleda, P. (2005), "Non-use of the footbridges and ignorance and lack of awareness of the pedestrians".

Kontoh, A. (2004), in http//www.ghanaweb.com

Malekela, R. (2005), "Planning and design of safer roads strategies for rural and urban roads improvement" In: Proceedings of the Tanzania Road Association – Annual Road convention, November, 23 - 24

Mtaki, K. (2005), "Enforcement of road safety law in Tanzania, the Case of non-motorised transport", In: Proceedings of the Tanzania Road Association – Annual Road convention, November, 23 - 24.

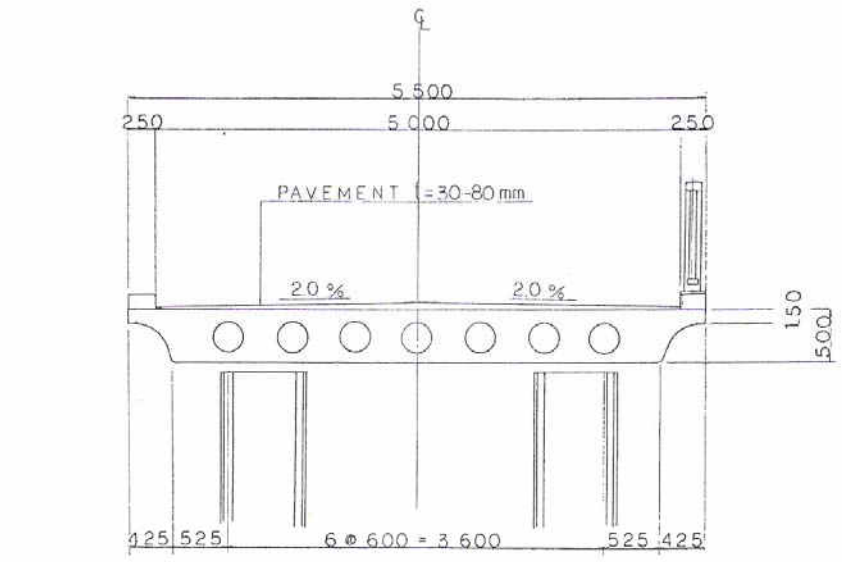
Myer Kutz, (2004), Handbook of Transport Engineering, Mc Graw-Hill, New York.

Paquette, R.J. (1982), Transportation Engineering: Planning and design, John Wiley & Sons, INC, New York.

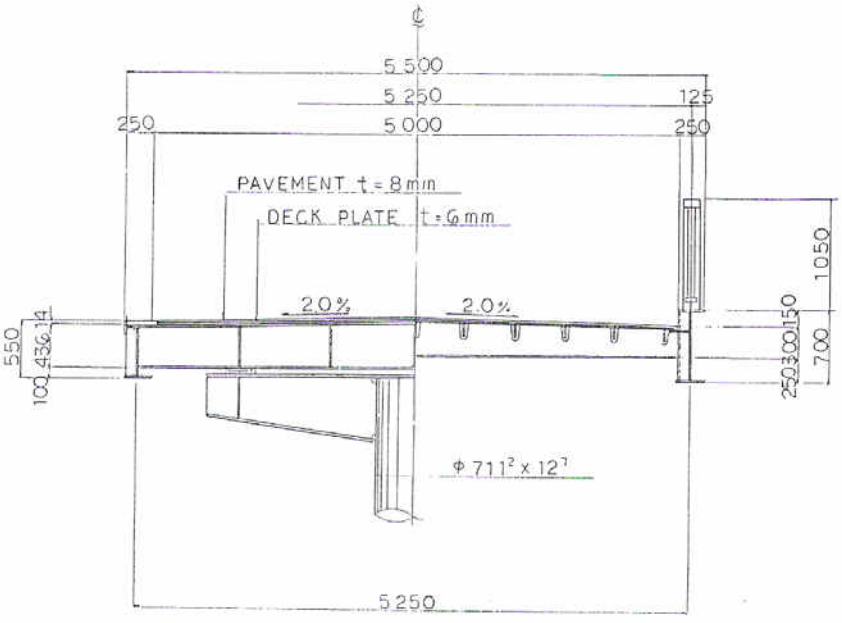
URT, (1991) Basic Design Study Report on the project for Road Improvement And Maintenance In Dar es Salaam In The United Republic Of Tanzania, Japan International Cooperation Agency. GRS - CR (4) 91 - 002

Vazirani, V.N. (1988), Transportation engineering VOL. II, Khanna Publishers, New Delhi.

Appendix I: Typical Cross Section of Alternative Bridge



Alternative 1: Prestressed Concrete Hollow Slab Bridge



Alternative 2: Metal Plate Floor Bridge

Appendix II: Alternative Study on Pedestrian Bridge at Manzese

Items of Evaluation	Alternative 1 PC Hollow Slab	Alternative 2 Metal Plate Floor
1. Project Cost - Super Structure - Sub Structure	46,300 Million (34,500) (11,800)	41,300 Million (40,800) (6,500)
2. Workability	Stagings required for construction of the super-structure will interefere with public traffic.	No staging works are required.
3. Maintenance	Maintenance cost is very small.	Painting is required at every 7 years.
4. Aethetic View	Excelent	Good
5. Technology Transfer	New technology	Ordinary technology
6. Conclusion	The Study Team recommendes PC Hollow Slab Bridge from the view point of construcion and maintenance costs as well as aethetic aspect and technology transfer.	