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Methodology to Develop Pedestrian Walkability Index for Ambo Road

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ABSTRACT:

Walking is an essential mode of transport. Most journeys, even if mainly by car, bus or bike, include walking as a component. New and improved pedestrian facilities enable greater access and mobility within our communities. A pedestrian-friendly environment plays an important role in encouraging walking as a mode of travel, and this has proven health and environmental benefits.

Improper and inadequate planning for pedestrians will lead to many negative consequences like unnecessary fatalities and injuries. Most of the developing countries do not make pedestrian planning as a pre-requisite and there are a few incentives for them to do so. Helping city planners to understand the scope and extent of local pedestrian conditions, relative to other cities, would be a positive step in the right direction, as it would help them to identify specific counter measures and costs associated with improving pedestrian conditions.

This article concentrates on finding of pedestrian walkability index for AMBO roads in Ethiopia

I.I NTRODUCTION

The goal of a transportation system is to provide safe and efficient mobility and access to different modes of travel to a wide variety of travellers with diverse needs. Land transportation is one of the most important ways of transportation as it covers most area and mode. Virtually every trip begins and ends with walking. Walking is the most basic form of transportation, and it is important for transportation officials to provide facilities that enhance safe movement for pedestrians along roads and streets.

An individual's transportation needs, and his or her ability to meet them, are likely to vary not only according to the physical roadway environment, but also according to their socioeconomic situations and the proximity of potential attractors. Everybody travels, whether it is for work, school, or simply pleasure. Lately the government agencies have pushed enthusiastically for sustainable and low-carbon emission transportation development, and people are advised to walk when possible. Inarguably, walking is most desirable method of transportation for sustainable development, and engineers can inspire people to walk more by designing pedestrian-friendly urban streets. However, to promote walking in a city and increase its patronage to a desirable level, engineers and policy makers must make pedestrians feel more comfortable walking than driving in urban streets. In order to lead pedestrians into thinking that their sidewalk pavements are really walker-friendly, engineers should focus on providing pedestrians with very attractive sidewalk pavements that are significantly wider than the minimum value specified in the highway design standard. A recent study on pedestrian behavior indicates that, of the various reasons that people give up walking in favor of car use for their travel, a sidewalk pavement with a too-narrow width is the main reason for their car use (Kockelman, 1997).

Walking is an essential mode of transport. Most journeys, even if mainly by car, bus or bike, include walking as a component. New and improved pedestrian facilities enable greater access and mobility within our communities. A pedestrian-friendly environment plays an important role in encouraging walking as a mode of travel, and this has proven health and environmental benefits.

Walking is a significant mode of transport. A pedestrian can be defined as "Any person who is afoot or who is on a wheel chair, or by a means of conveyance propelled by human power other than a bicycle". Therefore the needs of the pedestrians, like the needs of motor vehicles, should be considered in the design of the urban environment and transportation facilities. Efforts should be directed toward the safe, accessible, and convenient mobility for pedestrians. Whether in a developed or developing city, nearly all trips will require some walking to reach the last mile connectivity, either directly to a destination or to another mode of transport. How well the pedestrian environment can service these trips will impact the overall quality and efficiency of the urban transportation network and in turn, overall mobility and accessibility for residents and visitors.

PEDESTRIAN WALKABILITY INDEX

Walkability is a measure of how safe an area is for walking. The walkability survey provides a qualitative analysis of walking conditions including safety, security and convenience of walking environment. This walkability survey was undertaken to assess the pedestrian friendliness of the Ambo city. This analysis provides a better understanding of the current situation of walkability in the city and is able to identify the factors for improving pedestrian facilities. There are several methodologies to assess walkability and they vary with regard to the emphasis in qualitative or quantitative assessment, components, sampling and scoring. The most comprehensive is the Global Walkability Index (GWI) developed by the World Bank. Hence, the methodology used to calculate the walkability index in this work is adopted from the Global Walkability Index toolkit developed for the World Bank with many modifications. The parameters considered in the field walkability survey were changed and a pedestrian interview survey was included. The walkability survey which was carried out consists of two components, namely

i. Field Walkability Survey for facility rating
ii. Pedestrian Interview Survey.

OBJECTIVES OF THE PROJECT

1. To calculate the pedestrian walkability index for the proposed study areas.
2. To study and evaluate the existing conditions of pedestrian facilities based on HCM and ERA.
3. To calculate the Level of service for the footpaths in the study areas based on HCM
4. To check the adequacy of footpath in the study locations based on ERA.
5. To integrate the available pedestrian width of footpath and propose the required one based on the studies identified above.
6. To establish a relationship for pedestrian speed, density and flow.

II METHODOLOGY

The methodology to obtain walkability index and level of service for the pedestrians. The areas in which the survey was carried out, the Performa sheets used for the field survey are explained in this chapter. This work is mainly carried out in three categories,

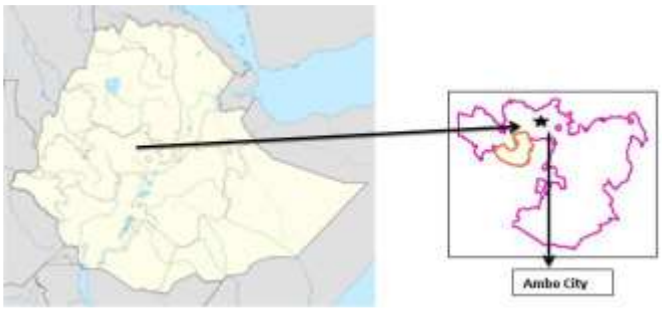
1) Pedestrian walkability index
2) Pedestrian level of service
3) Adequacy of footpath

III. EXECUTION OF THE WORK

BACKGROUND OF AMBO TOWN

Ambo is one of the reforming cities of Oromia and it is found in West Shewa Zone of Oromia National Regional State, 114 Kilometers to the west of Addis Ababa along the Addis Ababa-Nekemte highway. According to data from Ambo Structure Plan Studies, Ambo City was founded in 1888 E.C. and it has got Municipal Administration Status in 1931. Geographically, the city is situated at 8º56'- 59'N,(Latitude) and 37º47'- 55'E(Longitudinal). The total area of city covered by structural/ master Plan is 85.86 km^2, while the total Built-up area/'Municipal area'/ of the city is 22.14km^2. The average altitude of the city is about 2120MSL. The city administration composed of six kebeles namely Keble 01, Kebele 02, Kebele 03, Kisose Oddo Liban(04),Awaro Qora(05) and Sanqale Faris(06) with considerable decision making power in local affairs. The Kebeles are the lowest administrative structure of the city.

Important and Unique Feature of the city includes the availability of the hot springs, the Water Falls within the boundary of the city, the Ambo Stone (colorful wall and floor finishing material at Sankale), the natural bridge over the Huluqa River (just under the highway bridge) in the city commonly termed as the "God's Bridge" and the famous Ambo mineral water which engraved the name of the City even beyond the national border.



Location of Ambo city

SUMMARY REPORT ON ROAD ASSET

According to the infrastructure asset inventory result; there is a total length of about 282.58 kilometers of road in Ambo urban boundary of which 252.74 km (89.44%) belongs to the city administration and 29.84km (10.56%) belongs to the Ethiopian Road Authority

The Extent of the City`s Road Network

Service component	Unit of measurement	Quantity (to be provided)
Land areas within the city boundary	km^2	85.56
Total length of road (all surface types)	km	282.58
Total area within the road reserve	km^2	5.2
Percentage of the city area occupied by the road reserve	%	6.0

The inventory result further revealed that from the total of 252.74kilometer road,that belongs to Ambo City Administration, about 117.12 kilo metre(46%) is covered with Gravel followed by Earth surfaced road which accounted 92.12 kilo metre (36%) while Cobble Road and Red Ash Road covered a total length of 12.51kilo meter(5%) and 24.44 kilo meter(10%)kilometers respectively. The inventory result also showed there are about 5 bridges and 114culvertsin Ambo City Administration.

Type of Road	Unit	Principal Arterial Road	Sub Arterial Road	Collectors & Local Road	Total
Asphalt	Km	0.00	1.19	0.09	1.28
Cobble Stone	Km	0.00	0.00	12.46	12.51
Gravel	Km	0.00	7.02	110.13	117.12
Red Ash	Km	0.00	0.00	24.44	24.44
Large Block Stone	Km	0.00	0.00	0.30	0.30
Earthen	Km	0.28	1.65	90.19	92.12
Earthen Pressed	Km	0.00	0.00	4.98	4.98
Total	Km	0.28	9.86	242.29	252.74

Sample of road inventory map of Ambo city

THE STUDY AREA

CALCULATION OF PEDESTRIAN WALKABILITY INDEX

The methodology used to calculate the walkability index is adopted from the Global Walkability Index toolkit developed for the World Bank with many modifications. The length of the stretch and the pedestrian count taken for about 5 minutes in all the selected stretches are used to calculate the walkability index. The Pedestrian walkability index is calculated by

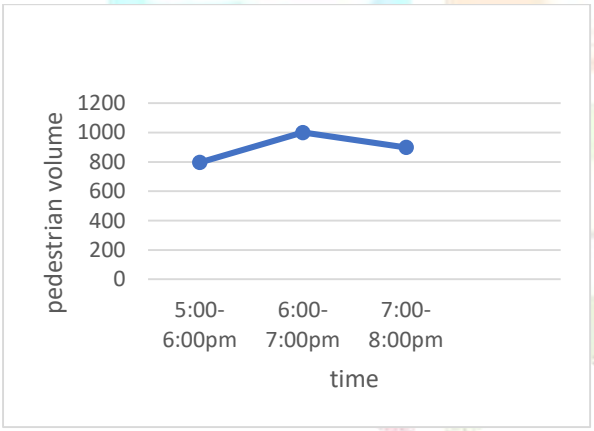
PWI = ((∑ (Facility rating × length of the stretch × pedestrians count×10))/ Number of stretches)/1000
Where,
PWI = Pedestrian walkability index
Facility rating = is the ratings provided by the pedestrians in the field walkability survey
Length of stretch = field data obtained
Number of stretches = the stretches selected for the study.

PEDESTRIAN LEVEL OF SERVICE

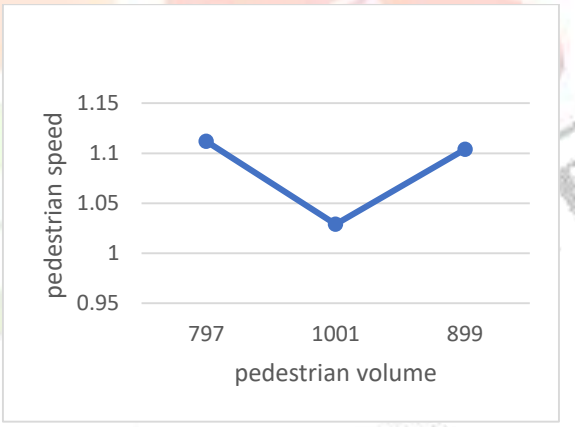
The pedestrian level of service was calculated for all the stretches in selected locations. The pedestrian volume was taken for an interval of 15 minutes for 3 hours in all the locations. The walking speed of 10 persons was taken and an average pedestrian walking speed was calculated manually. Then the pedestrian flow, pedestrian density was calculated.

Relation between Pedestrian speed Vs pedestrian Flow and Pedestrian speed Vs Density.The fundamental relationship between speed, density, and volume for pedestrian flow is analogous to vehicular flow. As volume and density increase, pedestrian speed declines. As density increases and pedestrian space decreases, the degree of mobility afforded to the individual pedestrian declines, as does the average speed of the pedestrian stream, it is shown in Figures below.

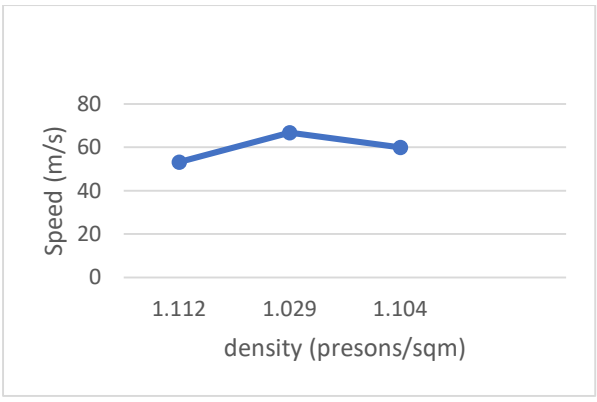
Pedestrian Volume Vs Time



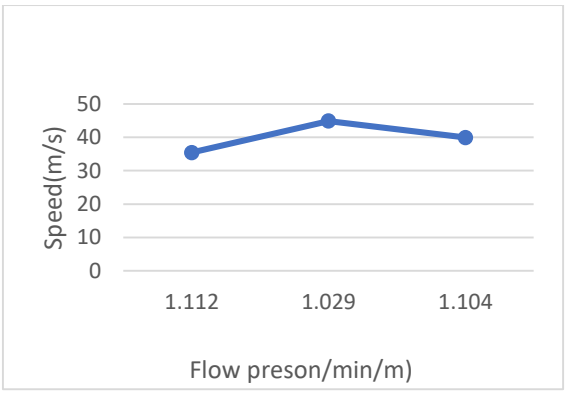
Pedestrian Speed Vs volume



Pedestrian Speed Vs Density



Pedestrian Speed Vs Flow



ADEQUACY OF FOOTPATHS

Based on the ERA norms the adequacy of the footpaths were checked and required widths are proposed.

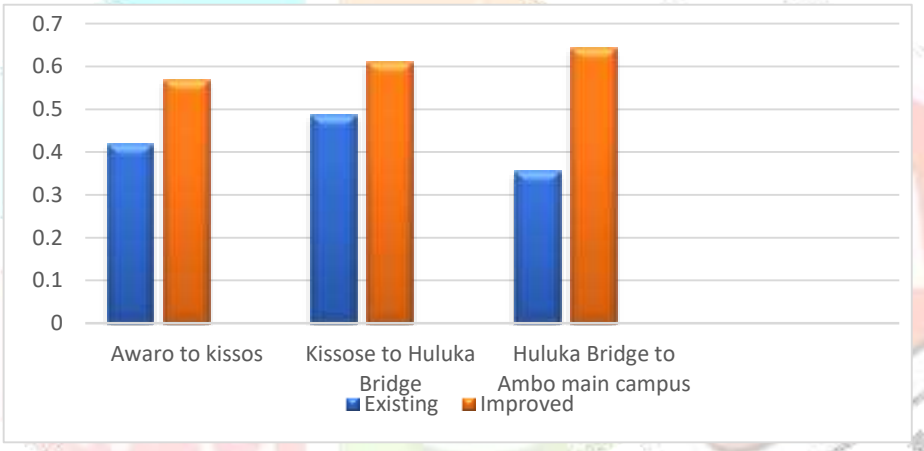
Adequacy of Road Width in Ambo.

Zone	Stretch	Volume (per hour)	Width of footpath	Adequacy	Min Recommended width as per ERA (m)
IOT to AU	1	584	1.25	Inadequate	2.5
	2	1072	1.5	Inadequate	2.5
	3	899	1.5	Inadequate	2.5

Improved LOS of IOT

Stretch number	Existing LOS		Improved LOS	
	Speed	Flow	Speed	Flow
1) Awaro campus to Kissose	E	C	C	A
2) Kissose to Huluka Bridge	E	D	C	A
3) Huluka Bridge to Ambo main campus	E	D	C	B

Improved values of Pedestrian walkability index



IV. RESULTS DISCUSSION AND CONCLUSION

RESULTS

Awaro to kissos

Stretch nor	Adequacy as per ERA	Recommended width as per ERA	Existing LOS as per HCM		Improved LOS as per HCM		Existing PWI	Improved PWI
			Speed	Flow	Speed	Flow		
1	Inadequate	2.5m	E	C	C	A	0.417	0.567
2	Inadequate							
3	Inadequate							
4	Inadequate							
5	Inadequate							

KISSOSE TO HULUKA BRIDGE

Stretch nor	Adequacy as per ERA	Recommended width as per ERA	Existing LOS as per HCM		Improved LOS as per HCM		Existing PWI	Improved PWI
			Speed	Flow	Speed	Flow		
1	Inadequate	2.5m	E	D	C	A	0.486	0.609
2	Inadequate							
3	Inadequate							
4	Inadequate							

HULUKA BRIDGE TO AMBO MAIN CAMPUS

Stretch nor	Adequacy as per ERA	Recommended width as per ERA	Existing LOS as per HCM		Improved LOS as per HCM		Existing PWI	Improved PWI
			Speed	Flow	Speed	Flow		
1	Inadequate	2.5m	E	D	C	B	0.354	0.642
2	Indequate							
3	Indequate							

DISCUSSIONS

i. **Awaro campus to Kissose:** Even though the walkability index of this area was mostly found to be satisfactory, the field observation shows that it has serious shortage of pedestrian facilities. All stretch had inadequate width, and the footpath surface has to be improved and barricading has to be done. The stretches had inadequate width of footpath, poor footpath surface and lot of obstructions which needs to be improved. These stretches has acute shortage of footpath widths and more than 50% of the pedestrians were found walking on the main road way. They also had poor footpath surface, no crossing facilities, and no Lighting facilities. Hence all the stretches should be provided with adequate width of footpaths, proper crossing facilities and Lighting along footpath. Proper improvement has to be provided to avoid pedestrian vehicle conflict. By providing these suggestive measures, the pedestrian walkability index can be improved.

ii. **Kissose to Huluka Bridge:** This stretch had inadequate width of footpath, poor footpath surface and bad crossing facilities. There we no crossing facilities at regular intervals and Pedestrians were found crossing the road haphazardly risking their lives. Hence stretches should be provided with good footpath surface, more crossing facilities and proper barricading. The footpath width was inadequate, footpath surface was in poor condition, obstructions and encroachment were high in these stretches. Hence adequate width of footpaths should be provided, and the obstructions and encroachment should be cleared.

iii. **Huluka to Ambo main campus:** In this area had very high pedestrian volume and less pedestrian facilities. Even though the width of the footpaths was good, it was inadequate accommodate the high pedestrian volume. Stretches had many obstructions, lacked good surface condition and crossing facilities for the pedestrians. Hence adequate footpath widths should be provided with good crossing facilities and proper barricading has to be done.

CONCLUSIONS

i. The walkability index values indicate that, there is a definite shortage of pedestrian facilities in the urban area and the pedestrians are subjected to high risk which is evident from the pedestrian accidents.
ii. The studies on walkability will help the city planners to understand the importance of walkability which can be used to improve the PWI to ensure safety.
iii. The study develops the scientific measurement supported by technical analysis which can be taken for improvements.
iv. It is estimated that about 30% of the pedestrian fatalities have occurred when they are forced to use the carriage way due to inadequate footpath facilities. Hence by providing safe walking environment to the pedestrians as suggested, more than 30% of the fatalities can be reduced.

5.5 Scope for further work

i. The walkability study has to be carried out for all the zones in the city.
ii. Time estimate and cost analysis will have to be carried out for the various improvement measures for proposed width of the footpath.
iii. Suitable measures provided in this study can be adopted to improve the pedestrian facilities for other zones of the city based on the approach developed.
iv. A software program may be developed for quick measurement of PWI, which helps the planners to know the status of the existing walkways and also to validate the same.

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