

Using Expert System Fixing Priority To The Identified Short Term Transport Facility Projects In Salem

T. SUBRAMANI¹

¹
*Professor & Dean, Department of Civil Engineering,
VMKV Engg College, Vinayaka Missions University,
Salem, Tamilnadu, India*

Abstract

Salem is the fifth largest city with a population of 7.54 lakhs (2011) in Tamil Nadu. Local Authorities faced with great difficulties to identify required various road improvement projects. Local authorities have inadequate funds to improve these road networks from all angles at any point of time. Repair or improvement works may have to be under taken on a basis which has to be decided based on socio-economic, administrative, technical, political factors etc., The identified road network selected for the study comprises 162 road links in Salem Corporation. Existing traffic condition, surface condition of carriageway, street lighting, footpath condition and drainage condition in the Salem Corporation area has been studied in detail. Traffic volume count survey was conducted on the identified 162 road links in Salem Corporation. Identify the type of transport facilities required for the road links. In programming process, priorities are set for project implementation. Even in cases where a formal process of priority setting does not exist, the allocation of organizational and financial resources for the development of some projects over others is an implicit setting of priorities. In programming process, priorities are set for project implementation. The important technique devised in this study is working out priority indices based on measures of current conditions of the facilities. There are two approaches for fixing the priorities to select road links to improve existing conditions. In the first approach priorities are fixed mainly based on hierarchy of road net work and considering location of road links with weightages assigned to the road links In the second approach priorities are fixed mainly based on location of road links and considering hierarchy of road net work with weightages assigned to the road links.

Keywords – Expert System, Priority, Transport, Projects

I. Introduction - Importance Of Transportation In Urban Development

Transportation contributes to the economic, industrial, social and cultural development of any country. It is well recognized that transport performs a key role in achieving fast economic growth of developing countries. Export and import, industry agriculture defence, social services (health, education), general administration, maintenance of law and order, exploitation of untapped resources, mobility of persons etc., are some of the many areas of activity which are very closely linked to the availability of adequate transportation.

Growth of urban areas and nature extent of availability of various classes of labour force are influenced by the extent of development of transport facilities. This growth in term has a cause and effect impact on transport services. Since increase in urban population demands better transportation facilities and a services. It may be necessary in the case of a country of India's vastness to provide transportation facilities in anticipation of demand, so that the transportation acts as a catalytic agent in development of different sectors.

II. Definition For Programming

Programming is a technical and political process that established priorities for projects by assessing current and future resource availability in order to stage projects over time. Technical analysis and political considerations are elements of programming that are closely interrelated, with the relative impact of each on any one project decision varying greatly as decision makers seek to satisfy both the relevant transportation policies and the many interest groups

involved. There are two tasks which play in important role in the programming process and which are critical to its success – setting priorities for project selection and determining the availability of funds (Meyer M.D., Miller E.J. 1984).

III. Need For Programming

With limited resources available for improvements to the transportation network, much of the interest of decision makers is focused on the programming and budgeting process. The specifics of this process vary from on city or governmental structure to another. In some cases, political decision makers may be interested in the progress of specific projects because these projects are important politically. In other cases decision makers may not be interested in specific projects, but rather in the overall policy that represent. If there were unlimited resources for transportation projects in a urban centre , there would not be much problem in prioritising the activities. However, the financial and organized resources available for transportation investment are always limited and may in some instances ever be shrinking. In addition to the constraint of declining funding levels, the small number of construction firms in an urban area and the limited ability of government agencies to supervise project construction also limit the number of projects that can be implemented in any one year. Further the limited capacity of government agencies to design facilities or to monitor the design process constrains the number of projects that can reach the programming stage. Given these circumstances, it becomes necessary to establish priorities for project implementation that is to determine which projects require immediate attention and would receive funding.

IV. Objectives Of The Present Study

1. To examine the existing transport infrastructure facility like roads in the selected Salem urban centre.
2. To conduct Traffic volume survey on the selected 162 road links in Salem Corporation
3. To identify the required road improvement projects in the selected urban centre.
4. To identify the traffic congested road links in Salem Corporation.
5. To find the extra widening required for the different road links to carry existing traffic volume.
6. To find the roads which require Traffic management measures with widening of carriageway.

7. To Rank the problems for prioritization in the order of their magnitude and complexity by using rating values.
8. Prepare the order of priority for taking up road improvement projects with respect to the hierarchy of road net work & location of road links.

V. Methodology

1. Summarize the findings and recommendations of various previous studies.
2. Identify and collect an relevant information required from local agencies such as demographic trends, map showing the existing land-use and growth trends, income and expenditure, road network details – physical condition, traffic information.
3. Critically evaluate the data to understand the overall conditions of existing infrastructural facilities in the Salem urban centre.
4. Conduct traffic volume survey on identified 162 road links.
5. Analysis the data to identify the magnitude and complexity of the problems, using computer programs
6. Identify the type of road improvement projects require to meet the existing traffic.
7. Prepare a questionnaire and conduct survey to assign ratings to various road attributes.
8. Ranking the problems for prioritization in the order of their magnitude and complexity by using rating values.
9. Find the order of priority for taking up road improvement projects with respect to the hierarchy of road net work & location of road links

VI. Study Of Past And Present Conditions In Salem City

A. Salem – General

Salem is the fifth largest city in Tamil Nadu over an area of 91.34 Sq.kms. Salem city is located at distance of 350 kms from a Chennai on the west, and 160 kms from Coimbatore and it got the fifth largest population of 7.54 lakhs as per 2011 census in Tamil Nadu.. It is situated at the trijunction of Bangalore, Trichirappalli and Chennai roads. The City is located at 11 40' North and 78 10' on the East. The general topography is plain The city is surrounded by the hills viz. the shervarous and Nagarmalai on the North, The Kanjamalai on the west, the Goodamalai on the East.

B. Population Growth

The population in Salem has grown at a rate of 23 percent per decade between 1951 and 1971, the rate has been lower for the decade 1971 – 1981 at 17 percent and 14 percent per decade between 1991 and 2011. Table.1 gives the growth of population within the Salem town. Population growth of Salem City Corporation given in Table 1.

Table 1.
Population Growth Of Salem City Corporation

Year	Salem town / corporation* population	Decade variation	% of decade variation
1901	70621	-	-
1911	59153	(-) 11468	(-) 16.24
1921	52244	(-) 6909	(-) 11.68
1931	102149	(-) 49935	95.58
1941	129702	27523	26.94
1951	202335	72633	56
1961	249145	46810	23.13
1971	308716	59571	23.9
1981	361394	52678	17.06
1991*	579951	218557	60.47
2001*	672330	92379	15.92
2011*	754000	81670	12.15

C. Existing Land-Use Structures

The extent of Salem town is 91.34 Sq.km of this the developed area is 4648 Hectares i.e. 48.71 percent of the total area and undeveloped area is 4894 hectares i.e. 51.29 percent of the total area. The Table 2. gives the existing land use details of Salem City Corporation area & Figure. 1. is showing the existing land use details of Salem City Corporation area.

D. Existing Traffic Situation

The traffic in Salem town is heterogeneous in nature comprising of slow moving vehicles such as hand carts, animal drawn vehicles, bicycle and fast moving vehicles such as mini cargo vans, Passenger vans Lorries, buses etc. In the absence of separate lanes for slow moving vehicles and cyclists all the vehicles are found to use the available narrow carriageway. The pedestrian side walks have been provided only near Collectorate. In almost all the main roads vendors occupy the road margins and side walks. Hence the

Table 2.
Existing Land Use Details Of Salem City Area

Sl. No	Use	Area in hectares	% to developed area	% to total area
	Developed area			
1	Residential	3091	66.50	32.39
2	Commercial	461	9.92	4.83
3	Industrial	465	10.00	4.88
4	Education	316	6.80	3.31
5	Public and semi-public	315	6.78	3.30
	Total developed area	4648	100	48.71
	Undeveloped area			
6	Agricultural area			
	A. Wet	1240	25.33	13.00
	B. Dry	2465	50.36	25.83
	C. Hillocks	728	14.89	7.63
7	Reserved forest	461	9.42	4.83
	Total undeveloped area	4894	100	51.29
	Net total	9542		100.00

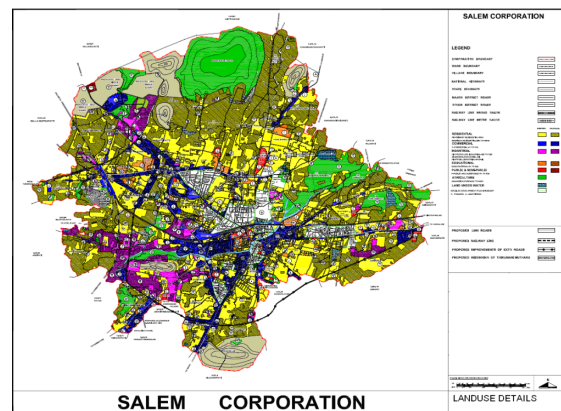


Figure.1. Existing land-use details of salem city corporation

pedestrians are deprived of the use of road margins and side walks and use the carriage way, causing hindrance to the free vehicle movement. This may be noticed more in the central area of the old town comprising of Collectorate and Bus stand complex the main private companies.

VII. Identified Road Network For The Present Study

Salem district as a whole has only 10,133.7 km. of road, out of which 214.6 km are cement concrete roads, 5098.1 kms. are bituminous surfaced road and the remaining 4821 kms. are water Bound Macadam roads. The unsurfaced road of 2352.7 kms. also exist in the district.

Salem Corporation has about 748.13kms. of surfaced roads under its control and maintenance as detailed below. The width of road ranges from 3.5 m to 14.0m in the major road network excluding the lanes and small roads. The details of the various categories of roads with their lengths in the town is show in Table. 3

Table.3 Types Of Roads With Their Length In Salem Corporation

Sl. No	Category	Road length (km)
1	Cement Concrete Super Roads	54.47
2	Black Topped Roads	628.17
3	Wbm Roads	17.04
4	Earthern Road	23.46
5	Others	24.66
	Total Length of Municipal Roads	748.13

The arterial road network of Salem Chosen for the study consists of four major radial corridors originating from the city bus stand. These roads are Attur road in the east, Trichy road and Coimbatore road in the South and Omalur road in the North west. In addition to these, there are a few secondary radial roads. One orbital corridor is identified and it consists of Shandipet road pallapatti main road and court road. Fig.2. shows the identified road network selected for the present study.

VIII. Field Studies Traffic Volume Survey

One of the fundamental measures of traffic on a road system is the volume of traffic using the road in a given

interval of time. It is also termed as flow and is expressed in vehicles per hour.

When the traffic is composed of number of types of vehicles, it is the normal practice to convert the flow into equivalent passenger car units (PCU), by using certain equivalence factors. The flow is then expressed as PCU per hour.

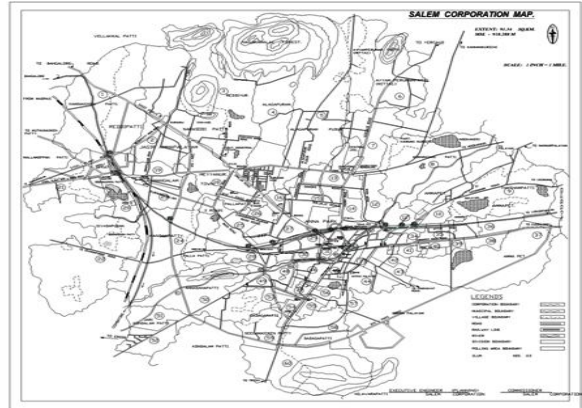


Figure.2. Identified road network of Salem city Corporation

A knowledge of the vehicular volume using a road network is important for understanding the efficiency at which the system works at present and the general quality of service offered to the road users knowing the flow characteristics, one can easily determine whether a particular section of a road is handling traffic much above or below its capacity. If the traffic is heavy, the road suffers from congestion with consequent loss in journey speeds. Lower speeds cause economic loss to the community due to time lost by the occupants of the vehicles and the higher operational cost of vehicles. Congestion also leads to traffic hazards. Volume counts are, therefore, indicators of the need to improve the transport facilities and are in an invaluable tool in the hands of transport planner.

In order to update the data base of the present existing traffic conditions, Traffic volume counts on selected road links in the urban centre were conducted. The detailed field survey programme was organized for 14 hours between 6 AM -8 PM. The block period is 15 minutes. Traffic volume count survey was conducted on the 162 road links and shown in Figure 3. With the help of these data the peak hour of traffic flow on each road link has been identified.

IX. Physical Characteristics

Physical Characteristics of road links in the network studied by field visits during the study and updated to the present existing condition. The study of physical characteristics comprises of surface condition, lighting condition footpath condition and drainage condition.

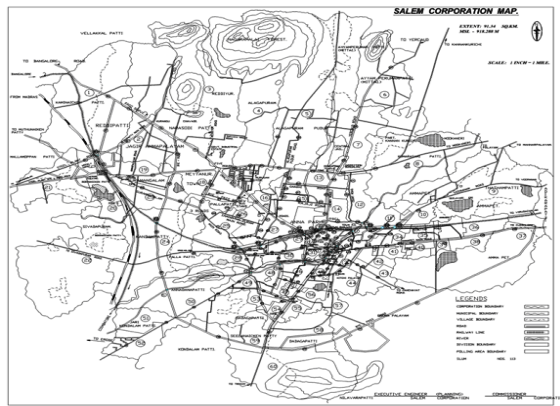


Figure 3. Traffic volume count survey points on the 162 road links

X. Road Network Details

Road network details collected from directorate of Town and Country Planning, Salem Corporation & Salem Local Planning Authority.

A. List Of Data Collected

The following data have been collected for Salem city

- i. Linkwise – road name details
The arterial road network which has been studied is broken into number of links. A link is defined as one-way part of the route between two intersections. The number of road links analyzed in the study is 162. The road links studied in the urban centres are given in Fig.3.
- ii. Linkwise – Physical informations. Following Physical information are collected for 162 road links. The following details of overall road links were collected for the study
Length of road links
Carriageway width
Footpath width
Right of way
Onstreet parking and width covered
Encroached area.
- iii. Linkwise Traffic Informations

Linkwise peak hour traffic flow in road links are calculated from the Traffic volume count survey

- iv. Linkwise – Existing physical conditions
Linkwise existing physical conditions, surface condition, lighting condition, footpath condition and drainage condition in 162 road links are collected. Surface condition, lighting condition, drainage condition and footpath conditions are graded as very poor, poor and fair. Details of existing landuse along the roadside, type of encroachment and onstreet parking on all road links are observed.

XI. Procedure Adopted To Identify The Conjested Road Links

The extent of the traffic volume on the road links determined from the traffic volume survey conducted at different locations. The equivalent PCU value of the peak hour traffic volume on the road links has been calculated. The equivalent PCU factors adopted for various vehicles are shown in Table.4

XII.Road Link Capacity

The step by step procedure adopted for calculating road link capacity is as follows.

Table.4 The Equivalent PCU Factors Adopted For Various Vehicles

Vehicle	PCU
Bus, Lorry/Truck	3
Car / Van	1
Two wheeler	0.5
Auto rickshaw	0.6
Cycle	0.4
Cycle rickshaw	1.5
HD cart	4.5
BD cart	8

1. The absolute capacity of a road link is assumed to be between 1300 and 1500 PCU Per hour per lane. Adopting the average of 1400 PCU per land width of 3.5 m, the absolute capacity is taken as 400 PCU per hour per metre width of carriageway.
2. The absolute capacity (400 PCU per metre) multiplied by the “effective” carriageway width gives the actual capacity of the road link. The effective carriageway width has been calculated by reducing the actual width

of the carriageway due to different factors affecting the capacity.

- The factors affecting the capacity are parking, encroachment and landuse. The reduction due to parking and encroachment is shown in Table .5. Predominant land use along the road link affects the capacity and the reduction in capacity due to this factor is shown in Table.6.

Calculated the effective width of carriageway considering the above three factors (Parking, encroachment, landuse). The capacity of each road link has been calculated by using the physical information's (width of carriageway, parking space, encroachment) is follows.

Effective width of of carriageway = Actual width of carriageway x (1-landuse/ 100)) - Parking space - Encroachment.

Capacity of road link = Effective width of carriageway x 400
PCU

Table.5 The Reduction Due To Parking And Encroachment

Type of parking \ Severity of Encroachment	Reduction (m)
Parking prohibited on either side	0
Parking permitted on one side	2.5
Parking permitted on either side	5
No Encroachment	0
Marginal Encroachment	1
Substantial Encroachment	2

Table.6. Reduction In Capacity Due To Land Use

Predominant land use	Reduction (per cent)
Open space	0
Residential	5
Institutional	10
Industrial	15
Commercial	30

XIII. Level Of Service Of Road Links

Comparison of updated traffic volume and capacity of road link give a volume capacity ratio. According to the volume capacity ratio the level of service of the road links are identified. It led to the identification of the degree of congestion in each road link.

Table.8. Shows the Level of Service adopted corresponding to the volume capacity ratio. For design purpose Level of Service "C" is suitable for urban streets (Kadiyali L.R 2007).

The road link with Volume Capacity ratio more than 0.8 are classified as congested links. The effective width of carriageway, capacity, volume capacity ratio and Level of Service of all road links in Salem City corporation area calculated

Table 7. Level Of Service Adopted In This Study

Volume capacity ratio	Level of service
< 0.6	A
0.6 - 0.7	B
0.7 - 0.8	C
0.8 - 0.9	D
0.9 - 1.0	E
1.0 <	F

XIV. Identify The Type Of Improvements Required For Road Links To Carry Existing Traffic Flow

Road links which are having volume capacity ratio more than 0.8 are considered as a congested links and these road links required improvements to carry existing traffic volume. The following procedure is adopted to identify the required improvement.

Road links which are having volume capacity ratio more than 0.8 reflect that road link will have insufficient width of carriageway to carry existing traffic. Instead of providing extra widening of carriageway it has been assumed that to prohibit the existing on street parking and remove the encroachment. After removing on street parking and encroachment the effective width of carriageway, capacity and volume capacity ratio have been calculated. If the volume capacity ratio is less than 0.8 then that road link required only removal of on street parking and encroachment to carry existing traffic flow.

If the volume capacity ratio after removing the on street parking and encroachment is more than 0.8 then that road links required a widening of carriageway. For providing extra widening the available extra width has been calculated from right-of- way. If the right of way is not available to widen the carriageway then that road link required traffic management measure.

If right of way have space then widen the carriageway up to its full width leaving one metre on each side for pedestrian movements. Again the effective width of carriageway and volume capacity ratio has been calculated. If the volume capacity ratio more than 0.8 then that road link required traffic management measure with extra widening. If the volume capacity ratio less than 0.7 than it reflect that extra widening width has been calculated by assuming average volume capacity ratio of 0.75.

XV. Technologies Used For Fixing Priority To Implement Road Improvement Projects.

Several efforts have been made to develop comparative analysis techniques to rank project along various dimension. The most popular approach is the use of priority indices based on current condition of the facility. In this study the points assumed to the various grades of attributes are shown in Table.8. The points assumed to the various grades of the attributes are varied from 0.75 to 3. The rating for each attribute like improving surface condition of carriageway, street lighting, footpath condition drainage condition and widening of carriageway are assigned from the experts view.

XVI. Expert System

Questionnaire has been prepared for the purpose of collecting experts view on various road improvements to fix the rating to each. Survey has been conducted with experts and their views on various road attributes has been collected. Average value of each road attribute from the survey has been assumed as a rating to each road attribute. The rating assigned to each road attribute is shown in Table.9.

The weightage of the each road link has been calculated by using points allotted to various grades of road attributes and rating assigned to the each road attributes from the survey.

Weightage of each road link has been calculated as follows.
 $Weightage = (X_{11} \setminus X_{12} \setminus X_{13})W_1 + (X_{21} \setminus X_{22} \setminus X_{23})W_2 + (X_{31} \setminus X_{32} \setminus X_{33})W_3 + (X_{41} \setminus X_{42} \setminus X_{43})W_4 + (X_{51} \setminus X_{52} \setminus X_{53})W_5$

Where

$X_{11}, X_{12}, X_{13}, \dots, X_{55} =$ Points allotted to various grades of each road attributes

$W_1, W_2, W_3, W_4, W_5 =$ Ratings assigned to the various attributes from the survey

If the the road link have all road attributes with very poor or poor grade, the the weightage of the road link should be very low of 96.125. If the road link have all road attributes with fair grade, the weightage should be very high of 300.

Table.8. Points assumed to the various grades of each road attributes

S. No	Item	Grade	Points	Variable
1	Surface condition	Very poor	1	X11
		Poor	2	X12
		Fair	3	X13
2	Lighting Condition	Very poor	1	X21
		Poor	2	X22
		Fair	3	X23
3	Drainage Condition	Very poor	1	X31
		Poor	2	X32
		Fair	3	X33
4	Foot path Condition	Very poor	1	X41
		Poor	2	X42
		Fair	3	X43
5	Level of service	F	3	X51
		E	3	X52
		D	3	X53
		C	2.25	X54
		B	1.5	X55
		A	0.75	X56

Table.9. Ratings assigned to each road attribute

S. No	Item	Rating	Variables
1	Improving the road surface condition	37.4	w1
2	Improving the street lighting	10.9	w2
3	Widening of carriage way for the given traffic volume	15.5	w5

4	Improving the footpath for pedestrian	14.3	w4
5	Improving the drainage condition	21.9	w3

XVII. Methods Adopted For Fixing Priority To Implement Road Improvement Projects

In this study two approaches are considered to fix the priority for implementing road improvement projects.

A. Priority Based On Hierarchy Of Road Net Work

In this approach the priority for selecting road links to implement road improvement projects are fixed on the basis of hierarchy of road network. According to the hierarchy of road network following priority is assumed.

- Priority 1. Radial roads in CBD area with low weightage.
- Priority 2. Radial roads in Fringe area with low weightage.
- Priority 3. Orbital roads in CBD area with low weightage.
- Priority 4. Orbital roads in Fringe area with low weightage.
- Priority 5. Other roads in CBD area with low weightage.
- Priority 6. Other roads in Fringe area with low weightage.

As per above priority basis the priority has been fixed to the road improvement projects of road links in Salem corporation area.

B. Priority Based On Location Of Road Links

In this approach the priority for selecting road links to implement road improvement projects are fixed on the basis of location of road link. According to the location of road link following priority is assumed.

- Priority 1. Radial roads in CBD area with low weightage.
- Priority 2. Orbital roads in CBD area with low weightage
- Priority 3. Other roads in CBD area with low weightage.
- Priority 4. Radial roads in Fringe area with low weightage.

- Priority 5. Orbital roads in Fringe area with low weightage.
- Priority 6. Other roads in Fringe area with low weightage.

As per above priority basis the priority has been fixed to the road improvement projects of road links in Salem corporation area.

XIX. Conclusion

An important product of the analysis is the development of a program which outlines the improvements to be carried out. From the study made, the type of improvement required to the road links to carry the existing traffic flow has been identified. Total number of road links requiring various types of improvements in Salem city corporation area to carry existing traffic flow is shown in Table.10.

Table.10. Types Of Improvements Required To Carry Existing Traffic Flow

Sl. No	Type of Improvement Required	Total Number of Road links
1.	Removal of onstreet parking and encroachment	44
2.	Widening of carriageway	52
3.	Traffic Management Measure required with extrawidening of carriageway	23

In programming process, priorities are set for project implementation. Even in cases where a formal process of priority setting do s not exist, the allocation of organizational and financial resources for the development of some projects over others is an implicit setting of priorities. The important technique devised in this study is working out priority indices based on measures of current conditions of the facilities. There are two approaches for fixing the priorities to select road links to improve existing conditions.

In the first approach priorities are fixed mainly based on hierarchy of road net work and considering location of road links with weightages assigned to the road links. In the second approach priorities are fixed mainly based on location of road links and considering hierarchy of road net work with weightages assigned to the road links.

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