



Technical Assistance Consultant's Report

Project Number: 48356
March 2016

India: Supporting Sustainable Urban Transport I Aizawl City (Financed by the Technical Assistance Special Fund) Vol. 3 – Appendices

Prepared by CDM Smith Inc. United States

For Public Work Department, Government of Mizoram
Urban Development Poverty Alleviation Department, Government of Mizoram
Aizawl Municipal Council, Government of Mizoram

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Asian Development Bank

Asian Development Bank,
Public works Department, Government of Mizoram

TA 8765 IND: Supporting Sustainable Urban Transport in Aizawl City

Final Report
Vol. 3: Appendices

March 2016

CDM Smith



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APPENDIX 1: DATA COLLECTED

- 1.1: Summary of Data Collected
- 1.2: List of persons and organisations contacted

Appendix 1.1: Summary of Data Collected

Primary Surveys:

- The Consultants conducted traffic volume counts at Ritz Hotel and bus volume counts at Temple Square.
- Site visits were made to the western side near Vaivakawn and to the eastern side through Ramhlun, Vengthar, Republic and around Thuampui to find out possible alignment of aerial ropeway.
- The Consultants also did measurements of available road width and footpath width on the north-south corridor between Millennium Centre and Zodin Square.
- Measurements were taken at all the junctions shown in Volume 2 to prepare base drawings, including: Bangkawn, Millennium Centre, Israel Point, Bazar Bunkawn (including junction with Armed Veng road), Zodin, Temple Square, Raj Bhaban, Tennis Club, Sikulpuikawn, Vaivakawn and Khatla.

List of other Topographic & Traffic Survey Locations

Junction turning movement volume Count (7.30 am to 11.30 am)	MID BLOCK volume count ((16 hour count – from 5 am till 9 pm)
Temple Square Jn. Zodin Jn. Millennium Jn. Vaivakawn Jn. Chanmari Jn. Bangkawn (s) Jn.	Hotel Ritz Bungkawn Mid-point Zarkawt
Topo surveys of the following Junctions	
Chanmari Jn. to Raj Bhavan Vaivakawn Jn. (twins) Khatla Jn. (twins) Bawngkawn Jn. (twins)	

Secondary Data Collected:

Maps and drawings

- Topo-survey sheets for Aizawl area from PWD (B)
- Available maps of Aizawl from Tourist department
- Drawing of proposed parking at Chanmari from AMC
- Drawings for proposed foot over bridges from North Eastern Consultants

Video

- Video of road junction from Traffic Police

Data

- Road width data in the central area from PWD
- List of one way roads and traffic restrictions from Traffic Police
- List of petrol pumps
- Data on registered vehicles from Transport Department
- Bus routes and fare structure from Bus Association
- List of parking area and fees collected, from AMC
- Traffic and pedestrian flow data at various junctions from Traffic Police
- Ambient air quality data from Mizoram Pollution Control Board

Documents

- Schedule of rates from PWD
- Building Regulation from AMC
- Parking rate revision and notification from AMC
- Organisation structure diagrams from UDPA, Transport Department, Police Department, AMC, PWD
- Allocation of funds and revenue collection from Transport Department Financial statement of state from Finance Department (2012,2013, 2014, 2015)
- Note on ropeway proposal for Kohima from UD&PA

Past reports

- Aizawl City Master Plan-2011, 2002
- City Development Plan for Aizawl City, 2006 from UDPA
- Survey Report on Transit and Transportation, from PWD
- Comprehensive Traffic and Transportation Plan for the city of Aizawl – Mobility Plan, 2011, from UD&PA
- Master Plan for Aizawl Vision 2030, 2012, from AMC

Appendix 1.2: List of persons and organisations contacted

Elected Representatives

1. Shri Lal Thanhawla, Chief Minister, Government of Mizoram
2. Mr. Ronald S Tlau, Member of Parliament (Rajya Sabha)

Secretary to Chief Minister

3. Mr. Lalmalsawma, IAS. Chief Secretary

Finance Department, Govt. of Mizoram

4. Mr .Ruata, IAS, Secretary, Finance, Govt. of Mizoram

PWD

5. Mr. Lalram Thanga, Principal Secretary to Chief Minister, and Secretary, PWD
6. Mr Henry Lalmuankima, Chief Engineer, PWD (Building)
7. Mr Lalthan Zwala, Executive Engineer, PWD (B),
8. Mr Thanglura, Executive Engineer PWD, North
9. Mr Vanlalmuana, Executive Engineer, PWD, South
10. Mr David Sapzova, Executive Engineer PWD South
11. Mr Lalnun Nema, PWD HRD Manager

Urban Development and Poverty Alleviation Department

12. Mr. Vanlalramsanga, Secretary, UD&PA,
13. Mr Vanlalmawia, Joint Secretary, UD&PA
14. Mr Lalmuansanga Ralte, Under Secretary, UD & PA
15. Mr Zoduailova Zote, Joint Director, Town Planning, UDPA
16. Mr L Andrew, Deputy Director, UD&PA
17. Mr James Lalnunmawia, Joint Director, UD&PA

Aizawl Municipal Corporation

18. Ms. Margaret Zohmingthangi, Chief Executive, AMC
19. Mr Rosiamngheta, Executive Councillor, AMC
20. Mr Zohmingthanga, Executive Engineer, AMC

Mizoram Police Department

21. Mr C. Lalthanmawia, Superintendant of Police (Traffic)
22. Mr Puia, Officer in Charge, Traffic Police

Transport Department

23. Mr L. Biakthanga, Director, Transport Department
24. Mr Marama, Joint Director, STA, Transport Dept

State Planning Board

25. Mr. PL Thanga IAS (Rtd), Member Secretary, State Planning Board

Mizoram Pollution Control Board

26. Ms Lalramnghaki Pachauau, Scientist B, Mizoram Pollution Control Board,
27. Ms P C Lalmoanpuil, Assistant Environmental Engineer, MPCB

Power and Electricity

28. Mr R K Gupta, Commissioner, Power & Electricity

Energy, Oil, Fuel Distribution, Aviation

29. Mr Dominic, IOCL Petrol pump, MizoFed, Manager
30. Mr P P Boragohen, IOCL Area Manager, Silchar
31. Mrs Singson, Aizawl HPCL dealer
32. Mr Manas Boro, HPCL Sales Manager, Guwahati
33. Mr Tanmay Singh, Tata Motors, Mumbai
34. Mr Sameer Chakraborty, Mr Sudhir Shankar Das, Ashok Leyland
35. Mr Tluanga, Project Director, ZEDA, City Solar Cell
36. Mr Saidenga, Assistant Director, Aviation Department

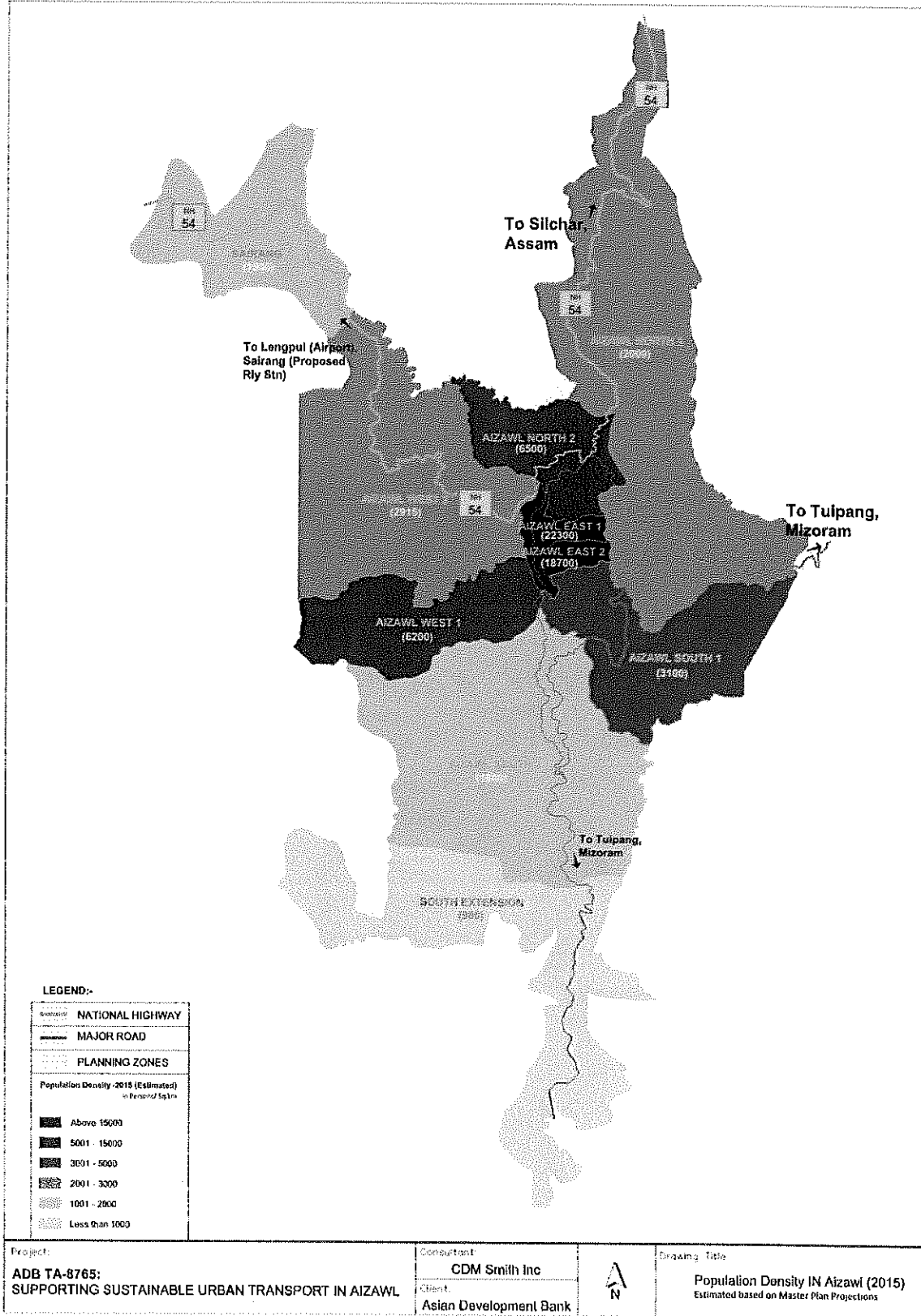
Transport Operators' Organisations

37. Mr Jeffrey Fanai, Vice President, Aizawl City Bus Owners' Association
38. Mr P Sanghmingthanga, General Secretary, Aizawl City Bus Owners' Association
39. Mr Vanremsanga, Chairman, Line Bus Owner's Association
40. Mr PC Lalzuiliana, Chairman, Line Bus Association
41 – 44 Zorum Taxi Driver's Association: Pu Laldawngliana, President, Pu Zawma, Secretary, Pu Tluanga, Vice President, Pu Sangzuala, Gen. Secretary

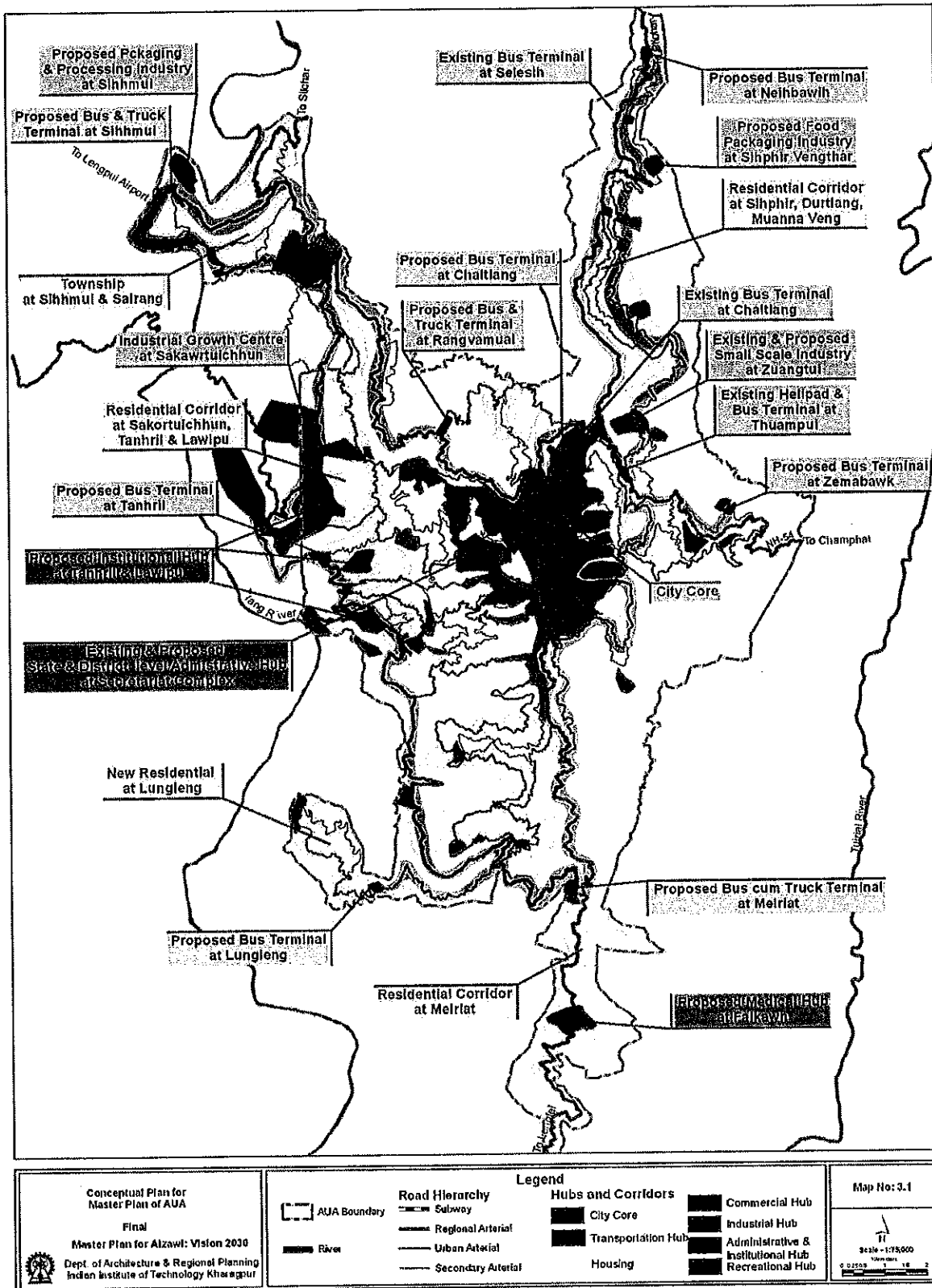
APPENDIX 2: TRAFFIC AND TRANSPORT IN AIZAWL

- 2.1: Population densities in Aizawl, 2015 (from Master Plan, 2010)
- 2.2: Proposed future development in Aizawl, 2031 (from Master Plan, 2010)
- 2.3: Key Facts and Figures from the Comprehensive Mobility Plan for Aizawl, 2011
- 2.4: Bus route map of Aizawl
- 2.5: Schematic bus route map of Aizawl
- 2.6. Traffic Survey Count Results (Junction Counts)

Appendix 2.1: Population Density in Aizawl in 2015 (from Master Plan, 2010)



Appendix 2.2: Proposed Future Development in Aizawl City, 2031 (from Master Plan-2010)



Appendix 2.3: Key Facts and Figures from the Comprehensive Mobility Plan for Aizawl, 2011

(Note: Traffic surveys and base year for CMP were not clearly stated in report, but believed to be 2007)

Road characteristics

Fairly low journey speed. Average is about 16.8 kmph, falling to about 4 kmph during peak hours in some stretches. The most congested stretches are: Raj Bhavan to Zodin and Katla to Temple with average journey speed of about 3.5 to 4 kmph.

Low journey speed exists in the peripheral area too because of poor road condition and geometrics.

Household travel demand

Average travel rate is 1.3 trips per person including walking and 0.7 trips excluding walking. Walk trips account for about half of the total trips. The average trip length is about 3 km, average travel time is 21.5 mins and average travel cost is Rs 7.8 per trip (2011).

Around 50% of trips are by walk with trip length of nearly 1 km. excluding walk, mini buses account for over 50% trips, taxis about 20%, two-wheelers and cars about 21%.

Two most important trip purposes are: work and education. Two-wheelers are most popular for work trips and buses for education trips.

The O-D pattern reveals compact work – home relationship. Almost 29% of total trips are in the zone of residence. Major attraction zones are significant producers of home based trips. This indicates mixed use scenario where major work centres and residential areas are closely situated.

Taxi user characteristics

Average trip length is 7.75 km, different from what was obtained from household survey. This may be because non home based trips account for the difference.

Over half the trips are less than 3.5 km in length, 20% of trips are more than 9 km in length. Average travel cost is about Rs 33 but 80% of trips have less travel cost.

Average travel time is about 27 mins, 80% of trips take less time.

Overall travel demand

Major attraction zones are: Dawrpui, Chanmari, Zarkawt, Venglui and Mission Veng. These six zones account for more than 50% of total trip attraction.

Major production zones are: Chatlang, Chanmari, Armed Veng (South), Chhinga Veng, Chanmari West and Ramthar. These six zones account for 20% of total trip production.

The residential areas are more spread out than work zones. The other important trip production zones are: Tuikual South, Bethlehem Vengthlang, Bawngkawn, Tuikual North, Venglui, Ramhlun South, Ramhlun North, Republic Veng and Bungkawn together accounting for 21% of total trips produced.

External zones do not contribute significant passenger traffic, major interaction zone are within Aizawl district. Among zones outside study area, Assam contributes to passenger interaction.

Vehicle ownership

Aizawl has about 120 cars and 240 two-wheelers per 1000 households. Cycle and other NMT are very rarely used. Motorised vehicle ownership is about 0.4 per household.

There were about 51,400 private vehicles and 5,200 government vehicles registered in Aizawl district in 2007. Between 2000 and 2003 passenger cars grew about 60%

Public transport

Four routes operated by private buses are:

- Chanmari to Sihphir (via Ramhlun)
- Temple to Ramrikawn
- Ngaizel to Zemabawk
- Bazaar to ITI

Total fleet size on primary route is 500 of which 300 – 400 are operational at any given time. Frequency is 5-10 mins in peak time and 15-20 mins in off peak time. About 1200-1500 bus trips are made each day, all routes combined. Average travel length by bus is 4.6 km. Average occupancy is 26 and average operating speed is 11 kmph.

There is no fixed fare structure and tickets are not issued. The fare works out to be between Rs 1.6 and 2.7 per km. Re 1 is the minimum fare.

Taxi characteristics

Taxis travel about 53 km in a day earning Rs 681. Average breakdown rate is quite high, 18.8 per 1000 km. One third of taxis are operated by owners and two thirds are rented.

Traffic characteristics

Outer cordon classified traffic volume are available for five locations: Zemabawk, Selesih, Rangvamual, Saikhamakawn and Mission Vengthlang. 80% of vehicles at these locations carry passengers, 20% goods. Rangvamual caters to one third of total traffic, followed by Zemabawk, Selesih, Saikhamakawn. Mission Vengthlang has very little traffic.

Mid block classified traffic volume are available for 18 locations. The top five locations with their traffic volume (in numbers) are:

- Hotel Ritz **34418**
- Vanapa hall **25729**
- Zarkawat Main Street **20443**
- Mission Veng **14761**
- Bawngkawn Main Road **14427**

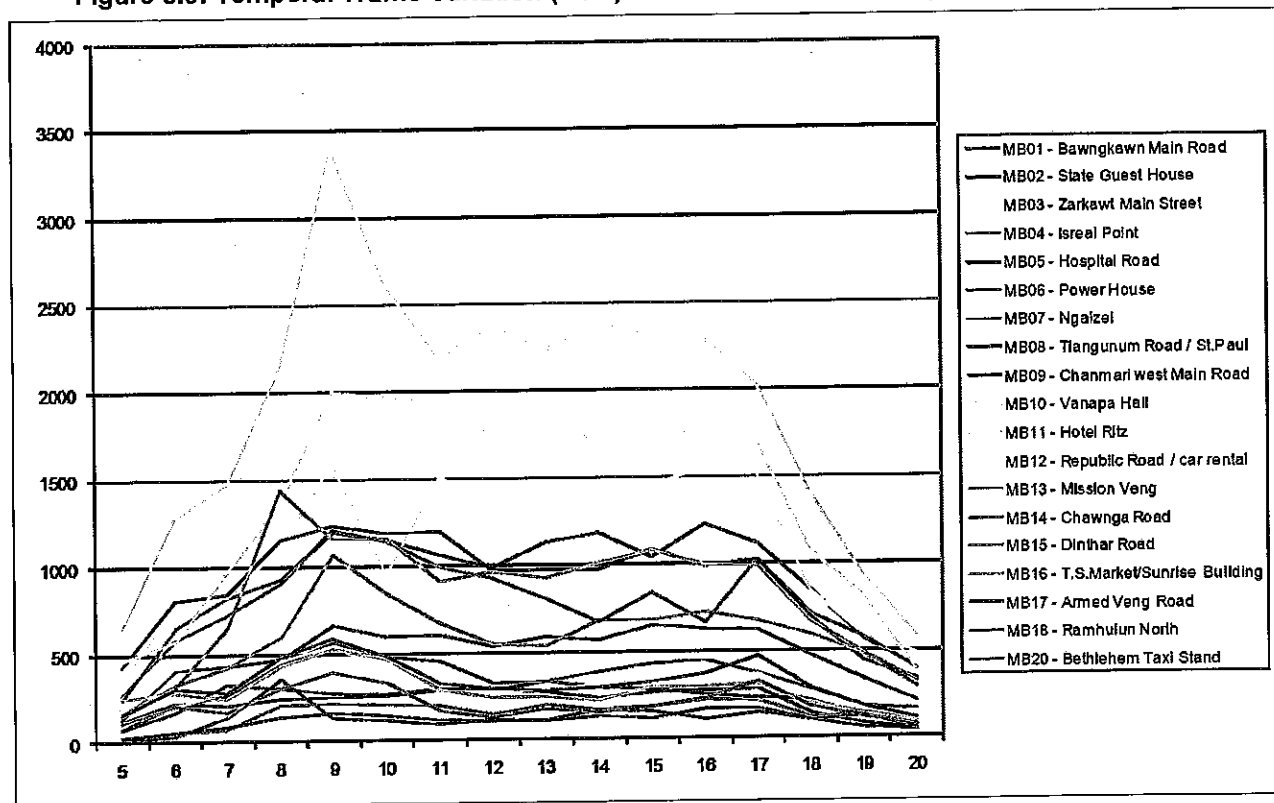
At all these locations, taxis comprised about 40%, two-wheelers about 30%, private cars about 20%, and buses about 5% of traffic. At most of the locations, morning peak hour is between 9 and 10 AM, evening peak hour is between 4 and 5 PM.

Table 3.19: Summary of Total Traffic at Mid-Block Locations (from CMP, 2011).

Note: Data believed to refer to 2007

Location	Location Code	Two Wheelers	Mini Bus	Taxis	Std. Bus	Passenger Cars	LCV	Trucks & Others	Total
Bawngkawn Main Road	MB01	3978	1077	4712	249	3096	1020	295	14427
State Guest House	MB02	2740	457	2851	34	2111	346	87	8626
Zarkawt Main Street	MB03	7137	589	7158	36	4845	570	108	20443
Isreal Point	MB04	3643	339	5245	145	3698	406	65	13541
Hospital Road	MB05	4850	592	6081	38	3873	399	135	15968
Power House	MB06	564	571	1193	13	634	287	81	3343
Ngaizel	MB07	474	887	988	5	420	242	96	3112
Tiangunum Road / St.Paul	MB08	1071	4	764	0	514	24	5	2382
Chanmari west Main Road	MB09	2097	21	2816	5	1253	151	7	6350
Vanapa Hall	MB10	9082	707	9306	22	6028	457	127	25729
Hotel Ritz	MB11	10874	1254	13370	39	8384	279	218	34418
Republic Road / car rental	MB12	2053	91	2443	17	809	118	27	5558
Mission Veng	MB13	4814	939	4949	24	3501	470	64	14761
Chawnga Road	MB14	943	10	1157	0	615	42	20	2787
Dinthar Road	MB15	3159	202	4919	32	1812	281	57	10462
T.S.Market/Sunrise Building	MB16	1899	132	2606	1	709	20	4	5371
Armed Veng Road	MB17	1664	141	2911	0	961	138	37	5852
Ramhulun North	MB18	755	14	765	0	453	103	17	2107
Bethlehem Taxi Stand	MB20	956	119	2080	1	338	84	22	3600
All	All	62753	8146	76314	661	44054	5437	1472	198837
Percentage Composition									
Bawngkawn Main Road	MB01	27.57	7.47	32.66	1.73	21.46	7.07	2.04	100
State Guest House	MB02	31.76	5.30	33.05	0.39	24.47	4.01	1.01	100
Zarkawt Main Street	MB03	34.91	2.88	35.01	0.18	23.70	2.79	0.53	100
Isreal Point	MB04	26.90	2.50	38.73	1.07	27.31	3.00	0.48	100
Hospital Road	MB05	30.37	3.71	38.08	0.24	24.25	2.50	0.85	100
Power House	MB06	16.87	17.08	35.69	0.39	18.97	8.59	2.42	100
Ngaizel	MB07	15.23	28.50	31.75	0.16	13.50	7.78	3.08	100
Tiangunum Road / St.Paul	MB08	44.96	0.17	32.07	0.00	21.58	1.01	0.21	100
Chanmari west Main Road	MB09	33.02	0.33	44.35	0.08	19.73	2.38	0.11	100
Vanapa Hall	MB10	35.30	2.75	36.17	0.09	23.43	1.78	0.49	100
Hotel Ritz	MB11	31.59	3.64	38.85	0.11	24.36	0.81	0.63	100
Republic Road / car rental	MB12	36.94	1.64	43.95	0.31	14.56	2.12	0.49	100
Mission Veng	MB13	32.61	6.36	33.53	0.16	23.72	3.18	0.43	100
Chawnga Road	MB14	33.84	0.36	41.51	0.00	22.07	1.51	0.72	100
Dinthar Road	MB15	30.19	1.93	47.02	0.31	17.32	2.69	0.54	100
T.S.Market/Sunrise Building	MB16	35.36	2.46	48.52	0.02	13.20	0.37	0.07	100
Armed Veng Road	MB17	28.43	2.41	49.74	0.00	16.42	2.36	0.63	100
Ramhulun North	MB18	35.83	0.66	36.31	0.00	21.50	4.89	0.81	100
Bethlehem Taxi Stand	MB20	26.56	3.31	57.78	0.03	9.39	2.33	0.61	100
All	All	31.56	4.10	38.38	0.33	22.16	2.73	0.74	100

Figure 3.9: Temporal Traffic Variation (PCU) at mid-block Locations (from CMP, 2011)

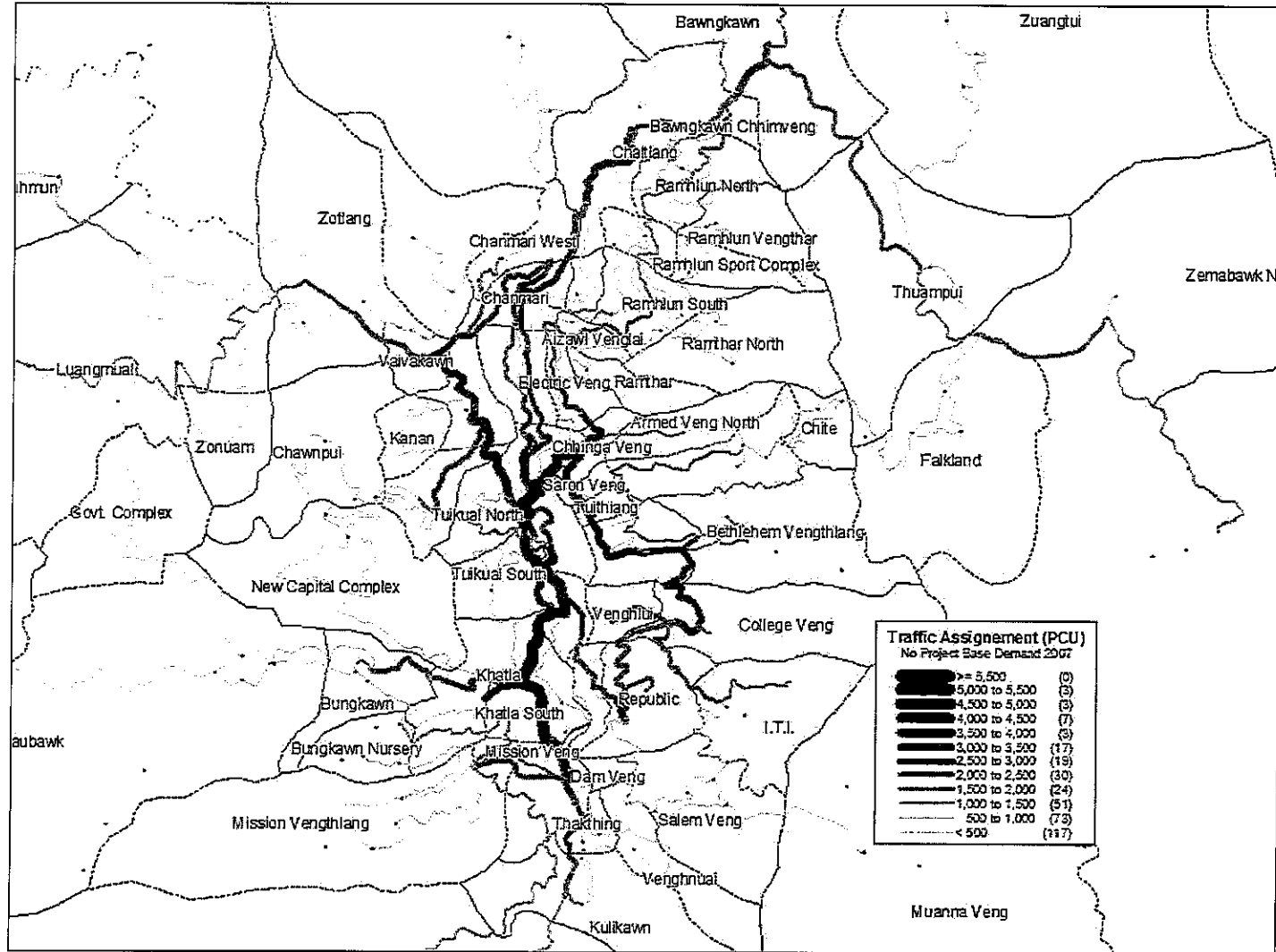


Junction characteristics

Traffic volume counts are available for 11 junctions. Nine major junctions and their ADT in numbers are:

- Bazar Bungkawn 40523
- Zodin Square 37966
- Zarkawt 24001
- Sikulpuikawn 22503
- Rajbhavan 23378
- Khatla 17468
- Temple 15465
- Chanmari 17703
- Vaivakawn 13958

From CMP, 2011: Figure 6.23, Traffic Assignment Year 2012 Demand and Network Scenario 1 (Do Nothing)



Pedestrian movement

2007 data for pedestrian movement at eight major locations and volume (across + along) are:

Power house / lower bazaar **32979**
Civil hospital **15925**
Zonet **6795**
Bara bazar **19989**
Zion Street **27571**
Vanapa hall **11504**
Tennis court (Civil Secretariat) **4829**
Tennis court (Thakthing) **9279**

Parking

There is no organised parking supply except at Millennium Centre. Most parking is on-street for passenger and goods vehicles. The stretches where on-street parking occurs regularly are:

Bara bazaar – Dawrpui
Ngalzel bus terminal
Chanmari – Zonet
Civil Hospital Road – Bungkawn
Ramrikawn – FCI
Vanapa hall
Zonet point – Zarkawt
New Street
Vaivakawn
Greenwood Hospital Road – Bawngkawn

High parking accumulations are at Zonet – Chanmari section, Dawrpui Church – Israel point for private vehicles and at Ramrikawn for goods vehicles.

Road Safety

Road accident data are available for 2005, 2006 and 2007. 48 accidents and 3.7 fatalities occur per lakh population.

Short term Proposed Improvements

Intersection improvement – Khatla junction
Road widening and removal of bottlenecks
Provision of bus bays and stops
Shifting of work hours
Reversible lanes
One way street
Proper signing and marking
ITS application

Proposed one way routes

1. Zodin – Raj Bhavan

2. Raj Bhavan – Sikulpuikawn
3. Khatla – Zodin

Improvement in pedestrian facilities – improve stairs

Off street parking – multi level parking

Development of intra city bus terminals

Provision of bus bays and stops

ITS applications

Medium term Improvements

Development planning & policy initiatives

Public transport service expansion

Terminals and depots

Road network expansion including grade separation

Taxi stands

Pedestrian facilities and network

Junction improvement

Long term Improvements

Development planning and policy initiatives – development policy, parking policy and Road network improvement – ring roads.

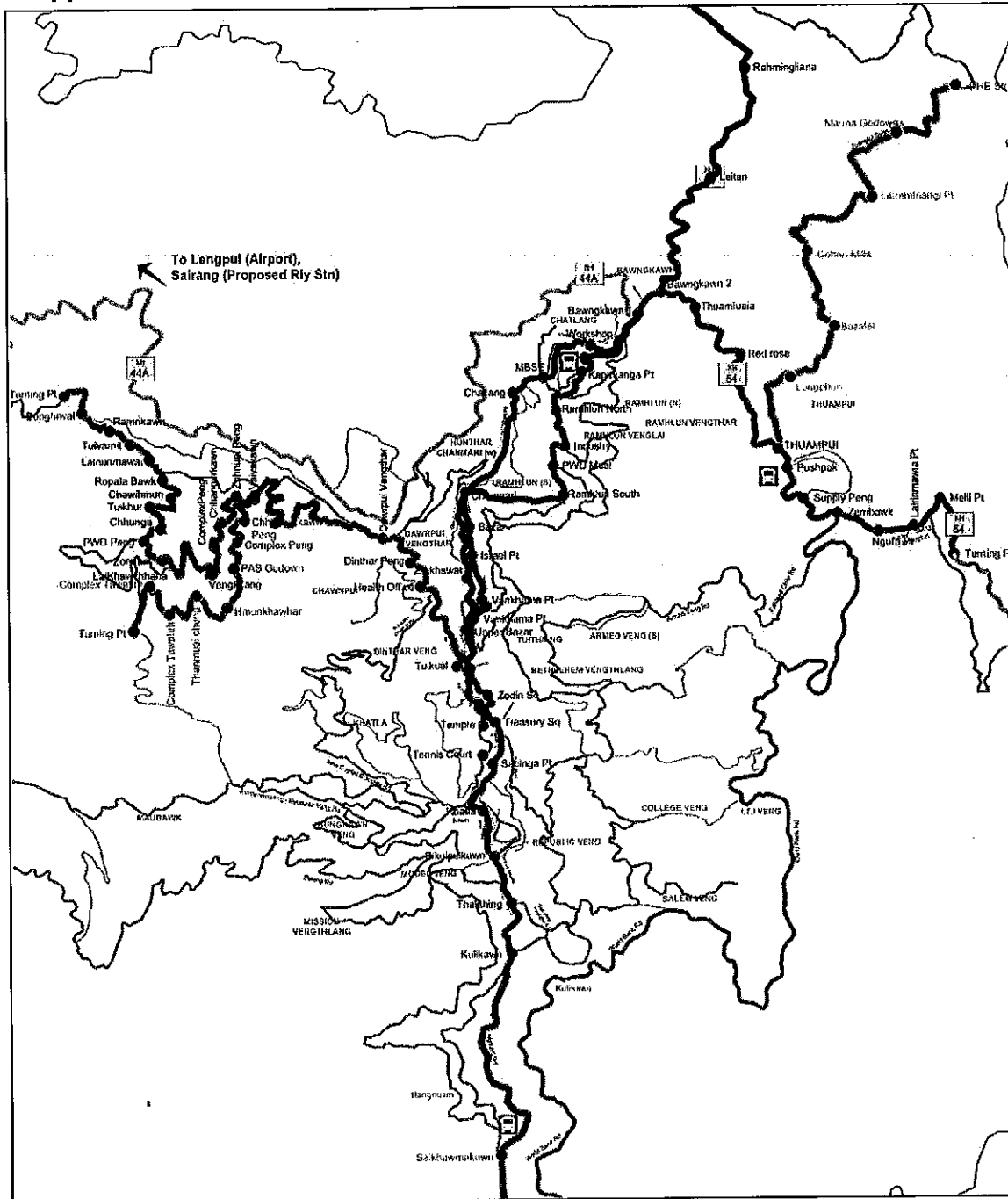
The following existing road proposed to be upgraded:

- Bazar Bungkawn – Armed veng – Chite Falkland road,
- Mizoram University – Ramrikawn – NH44A via PTC,
- New Capital Complex Khatla – Luangmual Complex – Mizoram University road,
- Khatla – Lawipuroad,

The proposed ring roads alignments are:

- Zemabawk – Melriat (Eastern part),
- Melriat – Samtlang – S. Hlimen – Tlangnuam – Tlawng road – Lawipu – Mizoram University – Sihhmui (NH 44A),
- NH44A – NH 54 up to Rangvamual,
- Rangvamual – Maumual ISBT,
- Maumual – Chite valley through tunnel connectivity up to Zemabawk.

Appendix 2.4: Bus Route Map of Aizawl



APPENDIX 3: SHORT TERM TRAFFIC AND TRANSPORT IMPROVEMENTS

- 3.1 Traffic Survey Count Results
- 3.2 Existing Restrictions on Motor Vehicles in Aizawl
- 3.3 Major Road Junctions in Aizawl
- 3.4 Possible One-Way System between Raj Bhavan and Assam Rifles Gate
- 3.5 Some of Existing One-Way Roads in Aizawl
- 3.6 Cost estimates for short term improvements

Appendix 3.1: Traffic Survey Count Results (Junction Counts)

Name of Intersection: Zodin Square Jn

Date/Day: 8/10/2015 Thursday

Direction From: Zarkawt - U turn

Time	Passenger Vehicles									Goods Vehicles			Slow	Total
	City Bus		Inter-City Bus		Other Bus	Mini Bus	Cars/Jeep/Van	Taxi	2-Wheelers	Trucks	MAV/Containers	Goods Vans (LCV)	Cycles	
	Private	Govt.	Private	Govt.										
7.30 - 8.30	1	0	0	0	0	0	86	108	211	0	0	12	0	428
8.31 - 9.30	1	0	0	0	0	0	82	88	202	0	0	10	0	373
9.31 - 10.30	0	0	0	0	0	0	61	92	215	1	0	3	0	372
10.31 - 11.30	0	0	0	0	0	0	75	89	193	0	0	5	1	363
Total	2	0	0	0	0	0	204	287	651	1	0	30	1	1363

Direction From: Zarkawt - RajBhavan

Time	Passenger Vehicles									Goods Vehicles			Slow	Total
	City Bus		Inter-City Bus		Other Bus	Mini Bus	Cars/Jeep/Van	Taxi	2-Wheelers	Trucks	MAV/Containers	Goods Vans (LCV)	Cycles	
	Private	Govt.	Private	Govt.										
7.30 - 8.30	49	0	0	0	1	0	324	436	1155	0	0	32	0	2007
8.31 - 9.30	37	0	0	0	0	7	330	463	1015	0	0	21	0	1882
9.31 - 10.30	16	0	0	0	0	9	405	462	1204	0	0	25	0	2121
10.31 - 11.30	18	0	0	0	1	9	235	334	854	0	0	23	0	1474
Total	120	0	0	0	2	25	1303	1695	4238	0	0	101	0	7384

Direction From: RajBhavan - Zarkawt

Time	Passenger Vehicles									Goods Vehicles			Slow	Total
	City Bus		Inter-City Bus		Other Bus	Mini Bus	Cars/Jeep/Van	Taxi	2-Wheelers	Trucks	MAV/Containers	Goods Vans (LCV)	Cycles	
	Private	Govt.	Private	Govt.										
7.30 - 8.30	29	0	0	0	14	2	126	152	431	0	0	20	0	774
8.31 - 9.30	39	0	0	0	24	1	116	171	453	0	0	14	0	818
9.31 - 10.30	25	0	0	0	5	0	90	143	491	0	0	7	0	761
10.31 - 11.30	27	0	0	0	3	0	73	123	414	0	0	13	0	653
Total	120	0	0	0	46	3	405	588	1789	0	0	54	0	3626

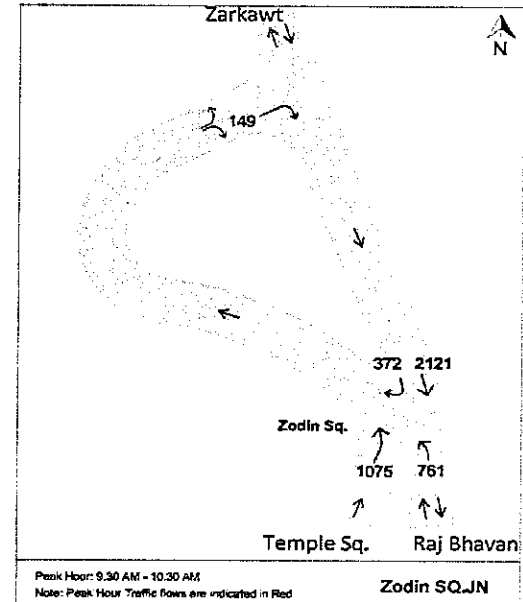
Direction From: Temple Sq. Jn. - Zarkawt

Time	Passenger Vehicles									Goods Vehicles			Slow	Total
	City Bus		Inter-City Bus		Other Bus	Mini Bus	Cars/Jeep/Van	Taxi	2-Wheelers	Trucks	MAV/Containers	Goods Vans (LCV)	Cycles	
	Private	Govt.	Private	Govt.										
7.30 - 8.30	0	0	0	0	0	0	164	142	441	0	0	6	0	753
8.31 - 9.30	0	0	0	0	0	0	166	162	508	0	0	6	0	862
9.31 - 10.30	0	0	0	0	0	0	173	180	714	0	0	8	0	1075
10.31 - 11.30	0	0	0	0	0	0	154	142	859	0	0	9	0	1164
Total	0	0	0	0	0	0	677	626	2522	0	0	29	0	4814

Direction From: RajBhavan - U turn

Name of Intersection: Zodin Jn. (at Canteen Quai)

Time	Passenger Vehicles									Goods Vehicles			Slow	Total
	City Bus		Inter-City Bus		Other Bus	Mini Bus	Cars/Jeep/Van	Taxi	2-Wheelers	Trucks	MAV/Containers	Goods Vans (LCV)	Cycles	
	Private	Govt.	Private	Govt.										
7.30 - 8.30	2	0	0	0	2	1	15	24	44	0	0	7	0	85
8.31 - 9.30	0	0	0	0	4	2	20	14	73	0	0	3	0	116
9.31 - 10.30	0	0	0	0	2	0	16	14	112	0	0	5	0	149
10.31 - 11.30	0	0	0	0	0	0	21	5	78	0	0	8	0	110
Total	2	0	0	0	6	3	72	57	307	0	0	21	0	460



Name of Intersection: Temple Square Jn

Date/Day: 12/10/2015 Monday

Direction From: Alzawl Club to Vaivakawn

Time	Passenger Vehicles								Goods Vehicles			Slow	Total		
	City Bus		Inter-City Bus		Other Bus	Mini Bus	Car./Jeep/Van	Taxi	2-Wheelers	Trucks	MAV/Containers			Goods Vans (LCV)	Cycles
	Private	Govt.	Private	Govt.											
7:30 - 8:30	0	0	0	0	0	0	0	54	84	181	0	0	10	0	309
8:31 - 9:30	0	0	0	0	0	0	0	38	32	177	0	0	11	0	258
9:31 - 10:30	0	0	0	0	0	0	0	79	24	190	0	0	7	0	262
10:31 - 11:30	0	0	0	0	0	0	0	41	44	246	0	0	14	0	345
Total	0	0	0	0	0	0	0	212	164	756	0	0	42	0	1122

Direction From: Alzawl Club to Zodin Sq.

Time	Passenger Vehicles								Goods Vehicles			Slow	Total		
	City Bus		Inter-City Bus		Other Bus	Mini Bus	Car./Jeep/Van	Taxi	2-Wheelers	Trucks	MAV/Containers			Goods Vans (LCV)	Cycles
	Private	Govt.	Private	Govt.											
7:30 - 8:30	12	0	0	0	0	0	0	86	84	196	0	0	7	0	394
8:31 - 9:30	25	0	0	0	0	0	0	177	80	170	0	0	9	0	461
9:31 - 10:30	24	0	0	0	0	0	0	155	150	158	0	0	11	0	471
10:31 - 11:30	15	0	0	0	0	0	0	180	120	178	0	0	9	0	509
Total	76	0	0	0	0	0	0	616	420	702	0	0	36	0	1922

Direction From: Treasury to Alzawl Club

Time	Passenger Vehicles								Goods Vehicles			Slow	Total		
	City Bus		Inter-City Bus		Other Bus	Mini Bus	Car./Jeep/Van	Taxi	2-Wheelers	Trucks	MAV/Containers			Goods Vans (LCV)	Cycles
	Private	Govt.	Private	Govt.											
7:30 - 8:30	0	0	0	0	0	0	0	0	0	22	0	0	0	0	22
8:31 - 9:30	0	0	0	0	0	0	0	0	0	17	0	0	0	0	17
9:31 - 10:30	0	0	0	0	0	0	0	0	0	17	0	0	0	0	17
10:31 - 11:30	0	0	0	0	0	0	0	0	0	22	0	0	0	0	22
Total	0	0	0	0	0	0	0	0	0	78	0	0	0	0	78

Direction From: Treasury to Vaivakawn

Time	Passenger Vehicles								Goods Vehicles			Slow	Total		
	City Bus		Inter-City Bus		Other Bus	Mini Bus	Car./Jeep/Van	Taxi	2-Wheelers	Trucks	MAV/Containers			Goods Vans (LCV)	Cycles
	Private	Govt.	Private	Govt.											
7:30 - 8:30	0	0	0	0	0	0	0	56	79	148	0	0	8	0	286
8:31 - 9:30	0	0	0	0	0	0	0	96	103	153	0	0	4	0	346
9:31 - 10:30	0	0	0	0	0	0	0	88	160	174	0	0	3	0	425
10:31 - 11:30	0	0	0	0	0	0	0	100	155	184	0	0	6	0	443
Total	0	0	0	0	0	0	0	330	497	659	0	0	16	0	1987

Direction From: Treasury to Zodin Sq.

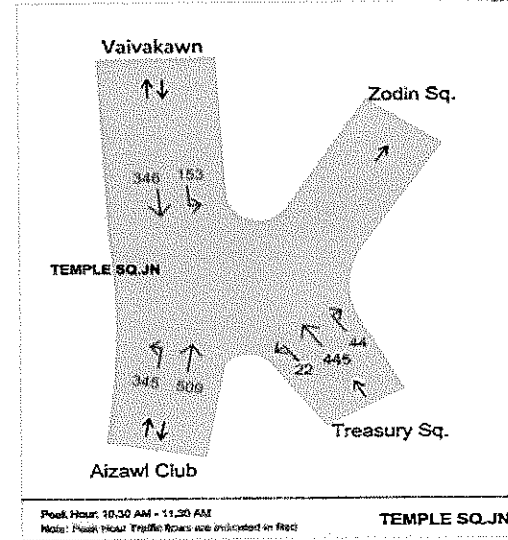
Time	Passenger Vehicles								Goods Vehicles			Slow	Total		
	City Bus		Inter-City Bus		Other Bus	Mini Bus	Car./Jeep/Van	Taxi	2-Wheelers	Trucks	MAV/Containers			Goods Vans (LCV)	Cycles
	Private	Govt.	Private	Govt.											
7:30 - 8:30	0	0	0	0	0	0	0	12	0	29	0	0	0	0	41
8:31 - 9:30	0	0	0	0	0	0	0	14	4	31	0	0	0	0	49
9:31 - 10:30	0	0	0	0	0	0	0	17	4	35	0	0	0	0	56
10:31 - 11:30	0	0	0	0	0	0	0	16	4	24	0	0	0	0	44
Total	0	0	0	0	0	0	0	59	12	119	0	0	0	0	174

Direction From: Vaivakawn to Alzawl Club

Time	Passenger Vehicles								Goods Vehicles			Slow	Total		
	City Bus		Inter-City Bus		Other Bus	Mini Bus	Car./Jeep/Van	Taxi	2-Wheelers	Trucks	MAV/Containers			Goods Vans (LCV)	Cycles
	Private	Govt.	Private	Govt.											
7:30 - 8:30	8	0	0	0	0	1	0	50	59	154	0	0	4	0	271
8:31 - 9:30	1	0	0	0	0	2	0	67	67	112	1	0	3	0	341
9:31 - 10:30	3	0	0	0	0	2	0	73	85	155	1	0	3	0	323
10:31 - 11:30	2	0	0	0	0	3	0	82	98	157	1	0	3	0	346
Total	14	0	0	0	0	6	0	272	309	621	3	0	13	0	1341

Direction From: Vaivakawn to Zodin Sq.

Time	Passenger Vehicles								Goods Vehicles			Slow	Total		
	City Bus		Inter-City Bus		Other Bus	Mini Bus	Car./Jeep/Van	Taxi	2-Wheelers	Trucks	MAV/Containers			Goods Vans (LCV)	Cycles
	Private	Govt.	Private	Govt.											
7:30 - 8:30	0	0	0	0	0	0	0	16	34	111	0	0	6	0	167
8:31 - 9:30	0	0	0	0	0	0	0	23	53	192	0	0	7	0	235
9:31 - 10:30	0	0	0	0	0	0	0	28	55	115	0	0	4	0	202
10:31 - 11:30	0	0	0	0	0	0	0	18	41	90	0	0	4	0	153
Total	0	0	0	0	0	0	0	85	183	498	0	0	21	0	753



Peak Hour: 10:30 AM - 11:30 AM
Note: Peak Hour Traffic flow are indicated in Red

TEMPLE SQ.JN

Name of Intersection: Bawngkawn Jn.

Date/Day: 8/10/2015 Thursday

1 Direction From: Chatlang/Ramhlun to Thuampui

Time	Passenger Vehicles										Goods Vehicles			Slow	Total
	City Bus		Inter-City Bus		Other Bus	Mini Bus	Cars/Jeep/Van	Taxi	2-Wheelers	Trucks	MAV/Containers	Goods Vans (LCV)	Cycles		
	Private	Govt.	Private	Govt.											
7.30 - 8.30	1	0	0	0	2	0	41	67	92	0	0	2	0	207	
8.31 - 9.30	2	0	0	0	0	0	72	82	152	0	0	10	0	308	
9.31 - 10.30	2	0	0	0	0	0	65	96	173	0	0	12	0	348	
10.31 - 11.30	1	0	0	0	0	0	59	104	192	0	0	13	0	369	
Total	6	0	0	0	2	0	238	359	589	0	0	39	0	1193	

2 Direction From: Chatlang/Ramhlun to Sairang

Time	Passenger Vehicles										Goods Vehicles			Slow	Total
	City Bus		Inter-City Bus		Other Bus	Mini Bus	Cars/Jeep/Van	Taxi	2-Wheelers	Trucks	MAV/Containers	Goods Vans (LCV)	Cycles		
	Private	Govt.	Private	Govt.											
7.30 - 8.30	20	0	0	0	3	1	48	84	183	1	0	9	0	329	
8.31 - 9.30	21	0	0	0	3	1	70	132	256	0	0	19	0	498	
9.31 - 10.30	18	0	0	0	3	0	89	109	240	1	0	27	0	487	
10.31 - 11.30	21	0	0	0	1	0	90	117	245	1	0	38	0	511	
Total	80	0	0	0	10	2	297	442	903	3	0	69	0	1352	

3 Direction From: Sairang To Thuampui

Time	Passenger Vehicles										Goods Vehicles			Slow	Total
	City Bus		Inter-City Bus		Other Bus	Mini Bus	Cars/Jeep/Van	Taxi	2-Wheelers	Trucks	MAV/Containers	Goods Vans (LCV)	Cycles		
	Private	Govt.	Private	Govt.											
7.30 - 8.30	0	0	0	0	0	0	9	9	23	0	0	1	0	42	
8.31 - 9.30	0	0	0	0	0	0	9	10	15	0	0	4	0	38	
9.31 - 10.30	0	0	0	0	0	0	13	12	15	0	0	1	0	41	
10.31 - 11.30	0	0	0	0	0	1	12	33	37	0	0	1	0	84	
Total	0	0	0	0	0	1	43	64	80	0	0	7	0	165	

4 Direction From: Bungkawn To Chatlang/Ramhlun

Time	Passenger Vehicles										Goods Vehicles			Slow	Total
	City Bus		Inter-City Bus		Other Bus	Mini Bus	Cars/Jeep/Van	Taxi	2-Wheelers	Trucks	MAV/Containers	Goods Vans (LCV)	Cycles		
	Private	Govt.	Private	Govt.											
7.30 - 8.30	4	0	0	0	1	1	190	172	155	0	5	6	0	534	
8.31 - 9.30	6	0	0	0	5	3	227	223	185	2	1	7	0	671	
9.31 - 10.30	18	0	0	0	4	3	188	171	176	2	8	13	0	589	
10.31 - 11.30	5	0	0	0	2	3	150	142	172	1	3	6	0	524	
Total	33	0	0	0	12	7	865	708	688	5	17	38	0	1705	

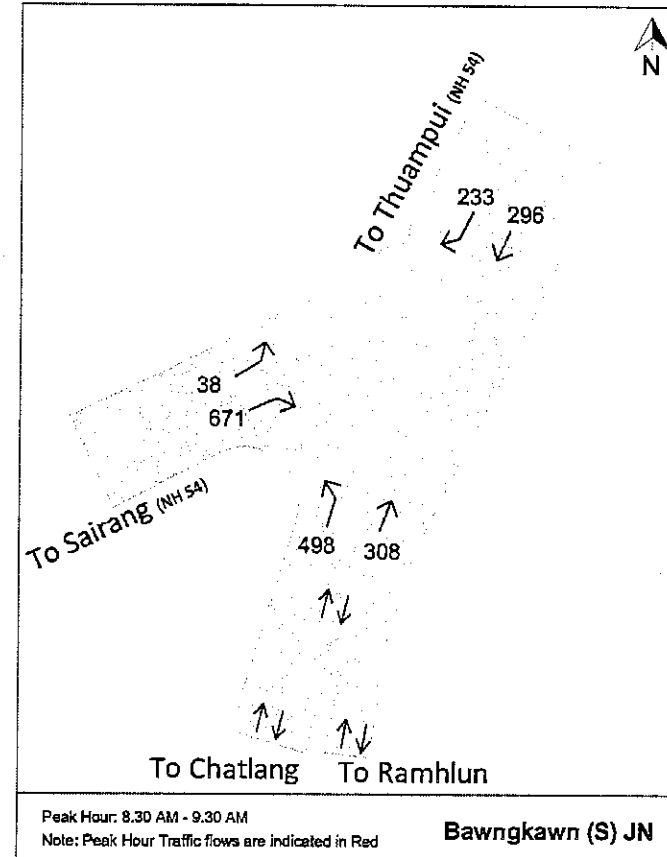
5 Direction From: Thuampui To Chatlang/Ramhlun

Name of Intersection: Zodin Jn. (at Canteen Quai)

Time	Passenger Vehicles										Goods Vehicles			Slow	Total
	City Bus		Inter-City Bus		Other Bus	Mini Bus	Cars/Jeep/Van	Taxi	2-Wheelers	Trucks	MAV/Containers	Goods Vans (LCV)	Cycles		
	Private	Govt.	Private	Govt.											
7.30 - 8.30	0	0	0	1	0	0	48	65	149	0	0	4	0	270	
8.31 - 9.30	0	0	0	0	2	2	47	81	158	0	0	6	0	296	
9.31 - 10.30	2	0	0	0	1	2	46	67	130	0	0	4	0	252	
10.31 - 11.30	1	0	0	0	1	0	68	120	149	0	1	5	0	345	
Total	3	0	0	1	4	4	209	336	586	0	1	19	0	1162	

6 Direction From: Thuampui To Bungkawn

Time	Passenger Vehicles										Goods Vehicles			Slow	Total
	City Bus		Inter-City Bus		Other Bus	Mini Bus	Cars/Jeep/Van	Taxi	2-Wheelers	Trucks	MAV/Containers	Goods Vans (LCV)	Cycles		
	Private	Govt.	Private	Govt.											
7.30 - 8.30	0	0	0	0	1	0	24	32	65	0	0	3	0	125	
8.31 - 9.30	0	0	0	0	2	0	44	71	113	0	0	3	0	233	
9.31 - 10.30	0	0	0	0	2	0	35	88	118	0	0	4	0	247	
10.31 - 11.30	0	0	0	0	1	0	11	33	48	0	0	4	0	97	
Total	0	0	0	0	6	0	114	224	344	0	0	14	0	606	



Name of Intersection: Chanmari Jn.

Date/Day: 12/10/2015 Monday

1 Direction From: Chatlang - Chamari

Time	Passenger Vehicles											Trucks	Goods Vehicles			Slow	Total
	City Bus		Inter-City Bus		Other Bus	Mini Bus	Car/Jeep/Van	Taxi	2-Wheelers	MAV/Containers	Goods Vans (LCV)		Cycles				
	Private	Govt.	Private	Govt.													
7:30 - 8:30	0	0	0	0	0	0	0	22	12	114	0	0	0	0	0	156	
8:31 - 9:30	0	0	0	0	0	0	116	141	256	0	0	1	1	1	1	516	
9:31 - 10:30	0	0	0	0	0	0	56	210	156	0	0	3	0	0	0	465	
10:31 - 11:30	0	0	0	0	0	0	14	171	109	0	0	0	0	0	0	414	
Total	0	0	0	0	0	0	390	679	727	0	0	4	1	1	1	1792	

2 Direction From: Chatlang - Lower Zarkawt/Electric Veng

Time	Passenger Vehicles											Trucks	Goods Vehicles			Slow	Total
	City Bus		Inter-City Bus		Other Bus	Mini Bus	Car/Jeep/Van	Taxi	2-Wheelers	MAV/Containers	Goods Vans (LCV)		Cycles				
	Private	Govt.	Private	Govt.													
7:30 - 8:30	0	0	0	0	0	0	21	64	113	0	0	2	0	0	0	199	
8:31 - 9:30	0	0	0	0	0	0	11	64	113	0	0	2	0	0	0	199	
9:31 - 10:30	0	0	0	0	0	0	20	42	125	0	0	4	0	0	0	201	
10:31 - 11:30	0	0	0	0	0	0	31	39	111	0	0	7	0	0	0	188	
Total	0	0	0	0	0	0	63	109	445	0	0	15	0	0	0	687	

3 Direction From: Chatlang to Ramhnu

Time	Passenger Vehicles											Trucks	Goods Vehicles			Slow	Total
	City Bus		Inter-City Bus		Other Bus	Mini Bus	Car/Jeep/Van	Taxi	2-Wheelers	MAV/Containers	Goods Vans (LCV)		Cycles				
	Private	Govt.	Private	Govt.													
7:30 - 8:30	0	0	0	0	0	0	22	29	130	0	0	3	0	0	0	200	
8:31 - 9:30	10	0	0	0	1	0	91	67	230	0	0	7	0	0	0	341	
9:31 - 10:30	11	0	0	0	0	0	45	54	209	0	0	3	0	0	0	319	
10:31 - 11:30	13	0	0	0	0	0	25	39	140	0	0	3	0	0	0	241	
Total	34	0	0	0	1	0	183	249	687	0	0	16	0	0	0	1161	

4 Direction From: Ramhnu to Chamari

Time	Passenger Vehicles											Trucks	Goods Vehicles			Slow	Total
	City Bus		Inter-City Bus		Other Bus	Mini Bus	Car/Jeep/Van	Taxi	2-Wheelers	MAV/Containers	Goods Vans (LCV)		Cycles				
	Private	Govt.	Private	Govt.													
7:30 - 8:30	0	0	0	0	0	0	10	83	97	0	0	4	0	0	0	204	
8:31 - 9:30	0	0	0	0	1	0	135	107	154	0	0	5	0	0	0	420	
9:31 - 10:30	0	0	0	0	3	0	106	100	200	0	0	20	0	0	0	527	
10:31 - 11:30	0	0	0	0	3	0	29	110	215	0	0	21	0	0	0	445	
Total	0	0	0	0	7	0	173	402	765	0	0	50	0	0	0	1676	

5 Direction From: Ramhnu Rd to Lower Zarkawt / Electric Veng

Time	Passenger Vehicles											Trucks	Goods Vehicles			Slow	Total
	City Bus		Inter-City Bus		Other Bus	Mini Bus	Car/Jeep/Van	Taxi	2-Wheelers	MAV/Containers	Goods Vans (LCV)		Cycles				
	Private	Govt.	Private	Govt.													
7:30 - 8:30	15	0	0	0	0	0	15	14	18	0	0	12	0	0	0	59	
8:31 - 9:30	19	0	0	0	0	0	20	21	22	0	0	10	0	0	0	132	
9:31 - 10:30	24	0	0	0	0	0	18	21	27	0	0	9	0	0	0	120	
10:31 - 11:30	14	0	0	0	0	0	20	15	20	0	0	9	0	0	0	110	
Total	72	0	0	0	0	0	73	70	77	0	0	40	0	0	0	421	

6 Direction From: Chamari to Zarkawt

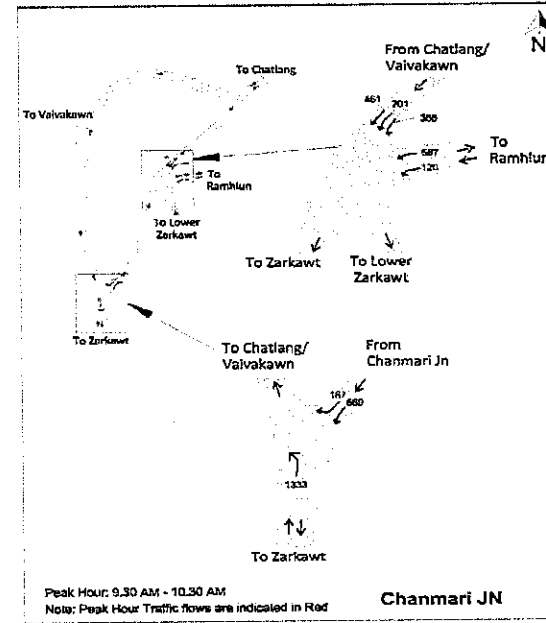
Time	Passenger Vehicles											Trucks	Goods Vehicles			Slow	Total
	City Bus		Inter-City Bus		Other Bus	Mini Bus	Car/Jeep/Van	Taxi	2-Wheelers	MAV/Containers	Goods Vans (LCV)		Cycles				
	Private	Govt.	Private	Govt.													
7:30 - 8:30	0	0	0	0	0	0	123	149	313	0	0	11	0	0	0	576	
8:31 - 9:30	0	0	0	0	0	0	161	184	291	0	0	11	0	0	0	647	
9:31 - 10:30	0	0	0	0	0	0	169	138	230	0	0	9	0	0	0	547	
10:31 - 11:30	0	0	0	0	0	0	251	163	162	0	0	9	0	0	0	585	
Total	0	0	0	0	0	0	724	621	1219	0	0	40	0	0	0	2355	

7 Direction From: Chamari to Vaivakawt/Chatlang

Time	Passenger Vehicles											Trucks	Goods Vehicles			Slow	Total
	City Bus		Inter-City Bus		Other Bus	Mini Bus	Car/Jeep/Van	Taxi	2-Wheelers	MAV/Containers	Goods Vans (LCV)		Cycles				
	Private	Govt.	Private	Govt.													
7:30 - 8:30	0	0	0	0	0	0	17	67	92	0	0	0	0	0	0	186	
8:31 - 9:30	0	0	0	0	0	0	25	64	36	0	0	1	0	0	0	126	
9:31 - 10:30	0	0	0	0	0	0	25	72	50	0	0	0	0	0	0	147	
10:31 - 11:30	0	0	0	0	0	0	23	64	72	0	0	0	0	0	0	160	
Total	0	0	0	0	0	0	105	267	250	0	0	1	0	0	0	599	

8 Direction From: Zarkawt to Vaivakawt/Chatlang

Time	Passenger Vehicles											Trucks	Goods Vehicles			Slow	Total
	City Bus		Inter-City Bus		Other Bus	Mini Bus	Car/Jeep/Van	Taxi	2-Wheelers	MAV/Containers	Goods Vans (LCV)		Cycles				
	Private	Govt.	Private	Govt.													
7:30 - 8:30	0	0	0	0	0	0	221	213	170	0	0	9	0	0	0	613	
8:31 - 9:30	0	0	0	0	0	0	146	168	196	0	0	17	0	0	0	517	
9:31 - 10:30	0	0	0	0	0	0	212	209	147	0	0	27	0	0	0	695	
10:31 - 11:30	0	0	0	0	0	0	218	218	443	0	0	14	0	0	0	923	
Total	0	0	0	0	0	0	797	808	964	0	0	67	0	0	0	2738	



Name of Intersection: Vaivakawn Jn.

Date/Day: 09/10/2015 Friday

1 Direction From: Temple Sq. to Luangmual

Time	Passenger Vehicles								Goods Vehicles				Cycles	Total
	City Bus		Inter-City Bus		Other Bus	Mini Bus	Cars/Jeep/Van	Taxi	2-Wheelers	Trucks	MAV/Containers	Goods Vans (LCV)		
	Private	Govt.	Private	Govt.										
7.30 - 8.30	5	0	0	0	1	0	44	112	180	1	0	7	0	350
8.31 - 9.30	12	0	0	0	3	0	63	146	203	0	0	7	0	434
9.31 - 10.30	9	0	0	0	3	1	50	109	201	0	0	4	0	377
10.31 - 11.30	3	0	0	0	0	1	41	116	144	0	0	10	0	315
Total	29	0	0	0	7	2	198	485	728	1	0	28	0	1362

2 Direction From: Temple Sq. to Bungkawn

Time	Passenger Vehicles								Goods Vehicles				Cycles	Total
	City Bus		Inter-City Bus		Other Bus	Mini Bus	Cars/Jeep/Van	Taxi	2-Wheelers	Trucks	MAV/Containers	Goods Vans (LCV)		
	Private	Govt.	Private	Govt.										
7.30 - 8.30	0	0	0	0	0	0	39	104	127	0	0	12	0	282
8.31 - 9.30	3	0	0	0	0	0	35	86	101	0	0	9	0	234
9.31 - 10.30	3	0	0	0	0	0	52	104	160	0	0	16	0	355
10.31 - 11.30	0	0	0	0	0	0	50	114	150	0	0	31	0	345
Total	6	0	0	0	0	0	176	408	558	0	0	68	0	1395

3 Direction From: Luangmual to Bungkawn

Time	Passenger Vehicles								Goods Vehicles				Cycles	Total
	City Bus		Inter-City Bus		Other Bus	Mini Bus	Cars/Jeep/Van	Taxi	2-Wheelers	Trucks	MAV/Containers	Goods Vans (LCV)		
	Private	Govt.	Private	Govt.										
7.30 - 8.30	0	0	0	0	0	0	22	105	82	3	0	9	0	221
8.31 - 9.30	0	0	0	0	0	0	48	112	63	0	0	11	0	234
9.31 - 10.30	0	0	0	0	0	0	59	131	174	1	0	19	0	384
10.31 - 11.30	0	0	0	0	0	0	74	134	83	1	0	14	0	366
Total	0	0	0	0	0	0	203	482	402	5	0	53	0	1273

4 Direction From: Luangmual to Temple Sq.

Time	Passenger Vehicles								Goods Vehicles				Cycles	Total
	City Bus		Inter-City Bus		Other Bus	Mini Bus	Cars/Jeep/Van	Taxi	2-Wheelers	Trucks	MAV/Containers	Goods Vans (LCV)		
	Private	Govt.	Private	Govt.										
7.30 - 8.30	4	0	0	0	0	1	61	135	157	0	0	7	0	365
8.31 - 9.30	7	0	0	0	4	0	52	125	197	0	0	3	0	388
9.31 - 10.30	2	0	0	0	1	0	103	156	329	0	0	4	0	595
10.31 - 11.30	4	0	0	0	0	0	78	144	263	0	0	9	0	498
Total	17	0	0	0	5	1	294	560	946	0	0	25	0	1846

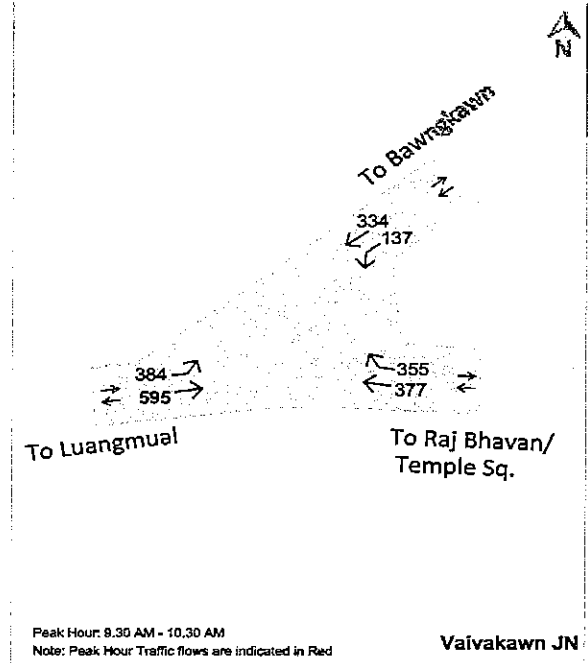
5 Direction From: Bungkawn to Temple Sq.

Name of Intersection: Zodin Jn. (at Canteen Quad)

Time	Passenger Vehicles								Goods Vehicles				Cycles	Total
	City Bus		Inter-City Bus		Other Bus	Mini Bus	Cars/Jeep/Van	Taxi	2-Wheelers	Trucks	MAV/Containers	Goods Vans (LCV)		
	Private	Govt.	Private	Govt.										
7.30 - 8.30	0	0	0	0	0	0	24	81	52	0	0	9	0	166
8.31 - 9.30	1	0	0	0	4	0	33	89	55	0	0	3	0	165
9.31 - 10.30	0	0	0	0	0	0	11	51	62	0	0	3	0	137
10.31 - 11.30	0	0	0	0	0	0	35	170	80	0	0	16	0	301
Total	1	0	0	0	4	0	103	381	249	0	0	31	0	870

6 Direction From: Bungkawn to Luangmual

Time	Passenger Vehicles								Goods Vehicles				Cycles	Total
	City Bus		Inter-City Bus		Other Bus	Mini Bus	Cars/Jeep/Van	Taxi	2-Wheelers	Trucks	MAV/Containers	Goods Vans (LCV)		
	Private	Govt.	Private	Govt.										
7.30 - 8.30	0	0	0	0	0	0	72	121	133	0	0	15	0	341
8.31 - 9.30	8	0	0	0	0	0	75	136	148	0	0	8	0	375
9.31 - 10.30	0	0	0	0	0	0	61	92	165	0	0	15	0	334
10.31 - 11.30	3	0	0	0	0	0	70	91	138	0	0	13	0	315
Total	11	0	0	0	0	0	278	440	583	0	0	51	0	1359



Peak Hour: 8.30 AM - 10.30 AM
 Note: Peak Hour Traffic flows are indicated in Red

Vaivakawn JN

Name of Intersection: Millenium Centre

Date/Day: 09/10/2015 Friday

1 Direction From: Zarkawt - Bara Bazar

Time	Passenger Vehicles										Goods Vehicles			Slow	Total
	City Bus		Inter-City Bus		Other Bus	Mini Bus	Cars/Jeep/Van	Taxi	2-Wheelers	Trucks	MAV/Containers	Goods Vans (LCV)	Cycles		
	Private	Govt.	Private	Govt.											
7.30 - 8.30	0	0	0	0	0	0	137	165	351	0	0	8	0	661	
8.31 - 9.30	0	0	0	0	0	0	159	130	283	0	0	4	0	576	
9.31 - 10.30	0	0	0	0	0	0	178	188	285	0	0	7	0	659	
10.31 - 11.30	0	0	0	0	0	0	107	124	349	0	0	6	0	577	
Total	0	0	0	0	0	0	591	607	1250	0	0	25	0	2553	

2 Direction From: Zarkawt to Police Sta rd.

Time	Passenger Vehicles										Goods Vehicles			Slow	Total
	City Bus		Inter-City Bus		Other Bus	Mini Bus	Cars/Jeep/Van	Taxi	2-Wheelers	Trucks	MAV/Containers	Goods Vans (LCV)	Cycles		
	Private	Govt.	Private	Govt.											
7.30 - 8.30	0	0	0	0	0	0	34	49	53	0	0	4	0	140	
8.31 - 9.30	0	0	0	0	0	0	34	69	122	0	0	0	0	225	
9.31 - 10.30	0	0	0	0	0	0	32	85	159	0	0	1	0	277	
10.31 - 11.30	0	0	0	0	0	0	20	67	92	0	0	0	0	179	
Total	0	0	0	0	0	0	120	270	426	0	0	5	0	821	

3 Direction From: Upper Bazar to Zarkawt

Time	Passenger Vehicles										Goods Vehicles			Slow	Total
	City Bus		Inter-City Bus		Other Bus	Mini Bus	Cars/Jeep/Van	Taxi	2-Wheelers	Trucks	MAV/Containers	Goods Vans (LCV)	Cycles		
	Private	Govt.	Private	Govt.											
7.30 - 8.30	30	0	0	0	13	1	188	311	478	0	0	33	0	1054	
8.31 - 9.30	33	0	0	0	14	2	169	305	509	0	0	25	0	1057	
9.31 - 10.30	19	0	0	0	3	2	155	298	836	0	0	14	1	1128	
10.31 - 11.30	25	0	1	0	1	0	127	237	493	0	0	27	0	912	
Total	108	0	1	0	31	3	639	1151	2116	0	0	99	1	4153	

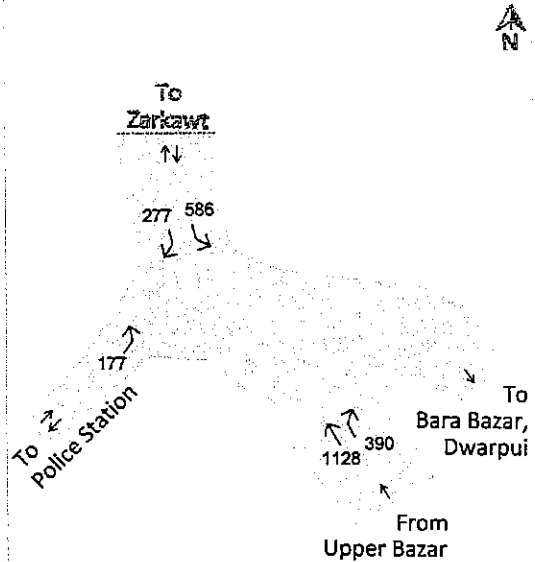
4 Direction From: Upper Bazar to Barabazar

Time	Passenger Vehicles										Goods Vehicles			Slow	Total
	City Bus		Inter-City Bus		Other Bus	Mini Bus	Cars/Jeep/Van	Taxi	2-Wheelers	Trucks	MAV/Containers	Goods Vans (LCV)	Cycles		
	Private	Govt.	Private	Govt.											
7.30 - 8.30	1	0	0	0	0	0	116	176	247	0	0	0	0	543	
8.31 - 9.30	0	0	0	0	1	1	50	99	163	0	0	2	0	316	
9.31 - 10.30	0	0	0	0	0	0	75	118	194	0	0	3	0	390	
10.31 - 11.30	1	0	0	0	0	0	89	188	256	0	0	5	0	541	
Total	2	0	0	0	1	1	330	581	862	0	0	13	0	1790	

5 Direction From: Police Stan to Zarkawt

Time	Passenger Vehicles										Goods Vehicles			Slow	Total
	City Bus		Inter-City Bus		Other Bus	Mini Bus	Cars/Jeep/Van	Taxi	2-Wheelers	Trucks	MAV/Containers	Goods Vans (LCV)	Cycles		
	Private	Govt.	Private	Govt.											
7.30 - 8.30	0	0	0	0	0	0	64	78	125	0	0	4	0	269	
8.31 - 9.30	0	0	0	0	0	0	28	25	64	0	0	4	0	121	
9.31 - 10.30	0	0	0	0	0	0	33	34	107	0	0	3	0	177	
10.31 - 11.30	0	0	0	0	0	0	32	34	105	0	0	3	0	175	
Total	0	0	0	0	0	0	157	169	402	0	0	14	0	821	

Name of Intersection: Zodin Jn. (at Carsten Qial)



Peak Hour: 9.30 AM - 10.30 AM

Note: Peak Hour Traffic flows are indicated in Red

Millennium JN

Traffic Survey Count Results, Mid-block'

Bawngkawn Mid Point

Direction: Chandmari to Bungkawn Date: 7/Oct/15 Day: Wednesday

Time	Passenger Vehicles									Goods Vehicles			Slow Cycles	Total
	City Bus		Inter-City Bus		Other Bus	Mini Bus	Cars/Jee p/Van	Taxi	2-Wheelers	Trucks	MAV/Container	Goods Vans		
	Private	Govt.	Private	Govt.										
6.00 - 7.00	2	0	0	0	0	10	39	67	76	8	0	21	0	223
7.00 - 8.00	5	0	0	0	0	15	135	184	225	7	4	38	0	613
8.00 - 9.00	11	0	0	0	0	37	119	142	253	5	2	41	0	610
9.00 - 10.00	10	0	0	0	0	33	154	168	381	6	1	29	0	782
10.00 - 11.00	0	0	0	0	0	24	167	171	452	4	2	41	0	861
11.00 - 12.00	0	0	0	0	0	28	202	174	475	6	3	35	0	923
12.00 - 13.00	3	0	0	0	0	35	143	197	415	4	0	51	0	848
13.00 - 14.00	0	0	0	0	0	26	112	222	460	4	0	37	0	861
14.00 - 15.00	0	0	0	0	0	31	150	201	235	4	0	24	0	845
15.00 - 16.00	5	0	0	0	0	30	136	211	161	4	1	26	0	574
16.00 - 17.00	2	0	0	0	0	18	162	215	407	3	0	27	0	834
17.00 - 18.00	8	0	0	0	0	22	171	174	396	7	0	28	0	806
18.00 - 19.00	0	0	0	0	0	12	128	111	151	5	4	12	0	423
19.00 - 20.00	0	0	0	0	0	3	64	55	60	9	2	7	0	200
20.00 - 21.00	0	0	0	0	0	0	70	39	51	1	1	1	0	163
21.00 - 22.00	0	0	0	0	0	0	27	13	18	1	1	4	0	62
Total Vehicles	46	0	0	0	0	324	1979	2344	4214	78	21	422	0	9428

Bawngkawn Mid Point

Direction: Bungkawn to Chandmari Date: 7/Oct/15 Day: Wednesday

Time	Passenger Vehicles									Goods Vehicles			Slow Cycles	Total
	City Bus		Inter-City Bus		Other Bus	Mini Bus	Cars/Jee p/Van	Taxi	2-Wheelers	Trucks	MAV/Container	Goods Vans		
	Private	Govt.	Private	Govt.										
6.00 - 7.00	2	0	0	0	0	16	39	78	74	8	2	17	0	236
7.00 - 8.00	6	0	0	0	0	26	120	171	256	13	1	29	0	624
8.00 - 9.00	12	0	0	0	0	41	85	120	224	4	0	27	0	513
9.00 - 10.00	5	0	0	0	0	31	69	129	174	4	0	13	0	445
10.00 - 11.00	1	0	0	0	0	21	100	121	240	6	0	19	0	508
11.00 - 12.00	7	0	0	0	0	17	120	170	371	4	1	33	0	723
12.00 - 13.00	1	0	0	0	0	25	107	140	330	10	0	43	0	656
13.00 - 14.00	3	0	0	0	0	22	110	181	351	6	1	34	0	708
14.00 - 15.00	4	0	0	0	0	16	102	172	245	6	1	28	0	574
15.00 - 16.00	8	0	0	0	0	33	101	159	118	2	0	38	0	459
16.00 - 17.00	17	0	0	0	0	27	153	103	338	5	0	29	0	672
17.00 - 18.00	3	0	0	0	0	18	96	132	1139	4	0	22	0	1414
18.00 - 19.00	0	0	0	0	0	27	138	147	121	8	5	24	0	470
19.00 - 20.00	0	0	0	0	0	2	72	61	80	8	5	10	0	238
20.00 - 21.00	0	0	0	0	0	0	57	26	64	8	11	12	0	178
21.00 - 22.00	0	0	0	0	0	0	41	17	41	3	4	5	0	111
Total Vehicles	71	0	0	0	0	322	1530	1927	4166	99	31	383	0	8529

Zarkawt

Direction: **Raj Bhavan to Chandmari** Date: **7/Oct/15** Day: **Wednesday**

Time	Passenger Vehicles									Goods Vehicles			Slow	Total
	City Bus		Inter-City Bus		Other Bus	Mini Bus	Cars/Jee p/Van	Taxi	2-Wheelers	Trucks	MAV/Container	Goods Vans	Cycles	
	Private	Govt.	Private	Govt.										
6.00 - 7.00	0	0	0	0	0	16	91	245	224	5	1	27	1	610
7.00 - 8.00	7	0	0	0	0	22	251	327	749	0	0	48	1	1405
8.00 - 9.00	21	0	0	0	0	33	277	373	873	0	0	22	0	1599
9.00 - 10.00	5	0	0	0	0	29	251	256	1109	0	0	25	0	1675
10.00 - 11.00	0	0	0	0	0	20	201	251	800	0	0	27	0	1299
11.00 - 12.00	1	0	0	0	0	23	186	304	689	0	0	36	0	1239
12.00 - 13.00	4	0	0	0	0	25	282	176	437	0	0	24	0	948
13.00 - 14.00	0	0	0	0	0	21	190	361	697	0	0	27	0	1298
14.00 - 15.00	1	0	0	0	0	13	158	296	267	0	0	17	0	752
15.00 - 16.00	3	0	0	0	0	23	214	477	533	0	0	16	0	1266
16.00 - 17.00	4	0	0	0	0	25	276	338	620	0	0	12	0	1275
17.00 - 18.00	7	0	0	0	0	18	218	125	392	0	0	11	0	771
18.00 - 19.00	9	0	0	0	0	16	250	247	324	0	0	31	0	877
19.00 - 20.00	1	0	0	0	0	1	150	170	248	2	0	19	0	591
20.00 - 21.00	0	0	0	0	0	1	121	105	145	8	0	10	0	390
21.00 - 22.00	0	0	0	0	0	0	89	60	103	3	3	7	0	265
Total Vehicles	63	0	0	0	0	286	3205	4111	8210	18	4	359	2	16258

Zarkawt

Direction: **Chandmari to Raj Bhavan** Date: **7/Oct/15** Day: **Wednesday**

Time	Passenger Vehicles									Goods Vehicles			Slow	Total
	City Bus		Inter-City Bus		Other Bus	Mini Bus	Cars/Jee p/Van	Taxi	2-Wheelers	Trucks	MAV/Container	Goods Vans	Cycles	
	Private	Govt.	Private	Govt.										
6.00 - 7.00	0	0	0	0	0	20	82	334	220	2	2	26	1	687
7.00 - 8.00	3	0	0	0	0	23	309	467	628	0	0	36	0	1466
8.00 - 9.00	8	0	0	0	0	49	301	507	892	0	0	51	0	1808
9.00 - 10.00	0	0	0	0	0	30	436	470	958	7	0	21	0	1922
10.00 - 11.00	0	0	0	0	0	27	381	343	679	2	0	26	0	1458
11.00 - 12.00	0	0	0	0	0	26	246	406	672	1	0	28	0	1379
12.00 - 13.00	0	0	0	0	0	18	185	394	666	1	0	10	0	1274
13.00 - 14.00	0	0	0	0	0	27	221	366	721	1	0	14	1	1351
14.00 - 15.00	1	0	0	0	0	21	302	411	448	2	0	21	0	1206
15.00 - 16.00	2	0	0	0	0	26	247	485	789	2	0	18	0	1569
16.00 - 17.00	7	0	0	0	0	25	300	551	843	2	0	23	0	1751
17.00 - 18.00	2	0	0	0	0	23	330	356	710	2	0	11	0	1434
18.00 - 19.00	1	0	0	0	0	14	292	311	629	2	0	25	0	1274
19.00 - 20.00	0	0	0	0	0	4	199	207	352	0	0	18	0	780
20.00 - 21.00	0	0	0	0	0	0	148	159	284	6	0	14	0	613
21.00 - 22.00	0	0	0	0	0	1	90	89	198	6	2	12	0	398
Total Vehicles	24	0	0	0	0	334	4069	5856	9689	38	4	354	2	20370

Supporting Sustainable Urban Transport in Aizawl City, ADB TA 8765 IND
Classified Traffic Volume Count Survey

Road: Way to Bazaar		Location: Near Hotel Ritz		Direction: 2 hrs		Date: 15/9/2015					
Weather: FINE		MOTORISED VEHICLES									
Time Period	Two Wheeler	CAR			BUS		TRUCK		Others	Non Motorised Cycle	Sub Total
		Car/Jeep	Taxi	Sumo	City Bus	Others	LCV	HCV			
9:15 - 9:30	390	69	120	20	8	3	6	0	0	0	616
9:30 - 9:45	345	65	100	30	5	6	6				557
9:45 - 10:00	364	80	150	29	7	0	7	0	0	0	637
10:00 - 10:15	392	45	90	19	6	0	3	0	0	0	555
10:30 - 10:45	290	40	140	29	7	3	8	0	0	0	517
10:45 - 11:00	310	50	133	21	5	0	9	0	0	0	528
11:00 - 11:15	337	47	132	28	9	0	7	0	0	0	560
11:15 - 11:30	330	47	135	28	5	1	9	0	0	0	555
Sub-Total	2758	443	1000	204	52	13	55	0	0	0	4525

Road: Way to Raj Bhavan		Location: Near Hotel Ritz		Direction: 2 hrs		Date: 15/9/2015					
Weather: FINE		MOTORISED VEHICLES									
Time Period	Two Wheeler	CAR			BUS		TRUCK		Others	Non Motorised Cycle	Sub Total
		Car/Jeep	Taxi	Sumo	City Bus	Others	LCV	HCV			
9:15 - 9:30	342	108	130	11	4	3	6	0	0	0	604
9:30 - 9:45	475	150	149	8	6	2	12	2	0	0	804
9:45 - 10:00	349	90	100	10	5	3	4	0	0	0	561
10:00 - 10:15	355	82	95	9	3	3	5	0	0	0	552
10:30 - 10:45	484	76	139	15	6	0	8	2	0	0	730
10:45 - 11:00	380	65	164	16	7	0	9	0	0	0	641
11:00 - 11:15	386	74	141	19	7	2	11	0	0	0	640
11:15 - 11:30	320	72	138	15	8	1	10	0	0	0	564
Sub-Total	3091	717	1056	103	46	12	65	4	0	0	5096

2nd Sept 2015 (Wednesday)

MID BLOCK COUNT

Location: Ritz Hotel

Towards Bazaar along the North-South Main Road

TIME	CARS	JEEP/SUV	SCOOTY/BIKE	BICYCLE	TRUCKS/UMV/HMV	Sub-Total
10:00 - 10:15	150	29	225	0	0	404
10:20 - 10:35	103	29	315	0	1	448
10:40 - 10:55	145	41	255	0	0	441
11:00 - 11:15	138	39	225	0	2	404
Sub-Total	536	138	1020	0	3	1697

Towards Raj Bhavan along the North-Soth Main road

TIME	CARS	JEEP/SUV	SCOOTY/BIKE	BICYCLE	TRUCKS/UMV/HMV	Sub-Total
10:00 - 10:15	191	58	287	0	0	536
10:20 - 10:35	210	70	325	0	0	605
10:40 - 10:55	207	46	248	0	0	501
11:00 - 11:15	204	69	220	0	3	496
Sub-Total	812	243	1080	0	3	2138

Speed and Delay Survey (Survey done in Private Car/Taxi)

10:15									12:30						16:30					
Sl. No	Segment Start	Segment End	Segment Distance (Km)	Running Time (secs)	Delay Time (secs)	Journey time (secs) (ta)	Running Speed (km/hr)	Journey Speed (Km/hr)	Segment Distance (Km)	Running Time (secs)	Delay Time (secs)	Journey time (secs) (ta)	Running Speed (km/hr)	Journey Speed (Km/hr)	Segment Distance (Km)	Running Time (secs)	Delay Time (secs)	Journey time (secs) (ta)	Running Speed (km/hr)	Journey Speed (Km/hr)
1	Thuanpui	Bangwan Jn	1.8	263	27	290	24.6	22.3	1.8	294	18	312	22.0	20.8	1.8	331	31	362	19.6	17.9
2	Bangwan Jn	Chalthang Jn	1.6	181	15	196	31.8	29.4	1.6	107	27	134	33.8	43.0	1.6	291	85	376	19.8	15.3
3	Chalthang Jn	Bara Bazar	1.1	296	16	312	13.4	12.7	1.1	344	56	400	11.5	9.9	1.1	486	30	566	8.1	7.0
4	Bara Bazar	Milliniam Jn	0.9	91	110	201	35.6	16.1	0.9	285	86	371	11.4	8.7	0.9	77	170	247	42.1	13.1
5	Milliniam Jn	Zodin Jn	0.8	730	70	800	3.9	3.6	0.8	261	52	313	11.0	9.2	0.8	222	68	290	13.0	9.9
6	Zodin Jn	Temple Sq Jn (Raj Bhavan)	0.7	85	260	345	29.6	7.3	0.7	67	44	111	37.6	22.7	0.7	109	56	165	23.1	13.3
7	Temple Sq Jn (Raj Bhavan)	Tressury	1.1	189	120	309	21.0	12.8	1.1	156	12	168	25.4	23.6	1.1	174	73	247	22.8	16.0
8	Tressury	KaliKuan	0.7	397	200	597	6.3	4.2	0.7	127	130	257	19.8	9.8	0.7	202	100	302	12.5	8.3
			8.7	2232	818	3050	14.0	10.3	8.7	1641	425	2066	19.1	15.2	8.7	1892	663	2555	16.6	12.3
11:10									13:15						17:15					
Sl. No	Segment Start	Segment End	Segment Distance (Km)	Running Time (secs)	Delay Time (secs)	Journey time (secs) (ta)	Running Speed (km/hr)	Journey Speed (Km/hr)	Segment Distance (Km)	Running Time (secs)	Delay Time (secs)	Journey time (secs) (ta)	Running Speed (km/hr)	Journey Speed (Km/hr)	Segment Distance (Km)	Running Time (secs)	Delay Time (secs)	Journey time (secs) (ta)	Running Speed (km/hr)	Journey Speed (Km/hr)
1	KaliKuan	Tressury	0.7	932	15	947	2.7	2.7	0.7	710	18	728	3.5	3.5	0.7	661	28	689	3.8	3.7
2	Tressury	Temple Sq Jn (Raj Bhavan)	1.1	63	525	588	62.9	6.7	1.1	83	380	463	47.7	8.6	1.1	292	260	552	13.6	7.2
3	Temple Sq Jn (Raj Bhavan)	Zodin Jn	0.7	606	430	1036	4.2	2.4	0.7	18	312	330	140.0	7.6	0.7	480	400	880	5.3	2.9
4	Zodin Jn	Milliniam Jn	0.8	127	136	263	22.7	11.0	0.8	321	67	388	9.0	7.4	0.8	206	82	288	14.0	10.0
5	Milliniam Jn	Bara Bazar	0.9	119	74	193	27.2	16.8	0.9	165	13	178	19.6	18.2	0.9	283	52	335	11.4	9.7
6	Bara Bazar	Chalthan Jn	1.1	168	134	302	23.6	13.1	1.1	79	216	295	50.1	13.4	1.1	162	35	197	24.4	20.1
7	Chalthan Jn	Bangwan Jn	1.6	292	22	314	19.7	18.3	1.6	526	42	568	11.0	10.1	1.6	267	43	310	21.6	18.6
8	Bangwan Jn	Thuanpui	1.8	261	36	297	24.8	21.8	1.8	293	37	330	22.1	19.6	1.8	164	30	194	39.5	33.4
			8.7	2568	1372	3940	12.2	7.9	8.7	2195	1085	3280	14.3	9.5	8.7	2515	930	3445	12.5	9.1

Speed and Delay Survey (Survey done in City Bus)

Sl. No.	Segment Start	Segment End	10:15						12:30						16:30					
			Segment Distance (Km)	Running Time (secs)	Delay Time (secs)	Journey time (secs)	Running Speed (km/hr)	Journey Speed (km/hr)	Segment Distance (Km)	Running Time (secs)	Delay Time (secs)	Journey time (secs)	Running Speed (km/hr)	Journey Speed (km/hr)	Segment Distance (Km)	Running Time (secs)	Delay Time (secs)	Journey time (secs)	Running Speed (km/hr)	Journey Speed (km/hr)
1	ZEMABAWK	THUAMPUI	378	8	386	394	170100	3454	320	12	332	344	96000	3349	444	8	452	460	199800	3475
2	THUAMPUI	BAWNGKAWN	82	17	99	116	17366	2545	27	8	35	43	12150	2281	104	17	121	138	22024	2713
3	BAWNGKAWN	BETHESDA HOSPITAL	284	12	296	308	85200	3320	302	31	333	364	35071	2987	266	21	287	308	45800	3109
4	BETHESDA HOSPITAL	RAMHLUN NORTH	87	6	93	89	52200	3164	99	21	120	141	16971	2528	95	19	114	133	18000	2571
5	RAMHLUN NORTH	RAMHLUN SOUTH	104	36	140	176	10400	2127	307	16	323	336	69075	3260	121	34	155	189	12812	2305
6	RAMHLUN SOUTH	RAMHLUN (Industry Jn)	129	11	140	151	42218	3076	160	17	177	194	33882	2969	155	21	177	198	26743	2838
7	RAMHLUN (Industry Jn)	CHANDMARI	137	9	146	155	54800	3182	313	19	332	351	58305	3210	332	24	356	380	49800	3145
8	CHANDMARI	BAZAR	1254	258	1510	1788	17634	2556	471	36	507	543	47100	3123	549	121	670	791	16334	2499
9	BAZAR	ISRAEL	69	132	201	333	1882	748	140	68	208	276	7412	1620	93	108	201	309	3100	1084
10	ISRAEL	A.R.GROUND	94	60	154	214	5640	1681	78	45	124	169	6320	1683	38	64	102	166	2138	824
11	A.R.GROUND	ZODIN	85	62	147	209	4936	1464	95	52	147	199	6577	1719	72	72	144	216	3600	1200
12	ZODIN	TREASURY SQUARE	37	84	101	165	2081	807	85	99	194	293	3455	1167	55	84	139	223	2367	888
13	TREASURY SQUARE	KHATLA	71	16	87	103	15975	2482	222	19	241	260	42063	3074	85	26	121	147	13154	2927
14	KHATLA	THAKHING	79	41	120	161	6937	1767	18	58	76	134	1117	484	61	35	96	131	6274	1676
15	THAKHING	SIKULPUKAWN	40	23	63	88	8261	1074	37	16	53	69	8325	1930	44	21	65	86	7543	1842
16	SIKULPUKAWN	KULIKAWN	97	27	124	151	12933	2313	82	17	99	116	17395	2545	153	12	165	177	45900	3112
			3027	780	3807	4587	13971	2376	2767	534	3301	3835	18664	2597	2678	687	3365	4052	14033	2379
			11:10						13:15						17:15					
Sl. No.	Segment Start	Segment End	Segment Distance (Km)	Running Time (secs)	Delay Time (secs)	Journey time (secs)	Running Speed (km/hr)	Journey Speed (km/hr)	Segment Distance (Km)	Running Time (secs)	Delay Time (secs)	Journey time (secs)	Running Speed (km/hr)	Journey Speed (km/hr)	Segment Distance (Km)	Running Time (secs)	Delay Time (secs)	Journey time (secs)	Running Speed (km/hr)	Journey Speed (km/hr)
1	KULIKAWN	Mission veng	126	82	218	310	4930	1483	162	26	168	214	22431	2725	301	17	318	335	83741	3235
2	Mission veng	SIKULPUKAWN	31	65	96	161	1717	693	59	60	119	179	3540	1187	94	33	127	160	10255	2115
3	SIKULPUKAWN	KHATLA	164	71	235	306	8316	1929	293	56	349	405	18836	2604	306	52	358	410	21186	2687
4	KHATLA	Tennis Court	28	114	142	256	884	394	313	37	350	387	30454	2912	63	64	127	191	3544	1187
5	Tennis Court	Zodin	252	197	449	646	4805	1404	154	112	266	378	4950	1467	434	104	538	642	15023	2434
6	Zodin	Upper Bazar	265	153	418	571	6235	1671	444	150	594	744	10658	2148	289	112	400	512	9257	2025
7	Upper Bazar	Chandmari	802	98	700	798	22114	2716	319	232	551	783	4950	1467	325	211	536	747	5546	1566
8	Chandmari	RAMHLUN SOUTH	900	72	972	1044	45000	3103	351	153	504	657	8258	1923	525	152	677	820	12434	2280
9	RAMHLUN SOUTH	RAMHLUN NORTH	142	16	158	174	31950	2938	73	15	88	103	17520	2552	14	12	26	38	4200	1326
10	RAMHLUN NORTH	RAMHLUN (Industry Jn)	25	29	54	83	3103	1084	18	14	32	46	4829	1409	16	32	48	80	1800	720
11	RAMHLUN (Industry Jn)	BAWNGKAWN	43	42	85	127	3686	1219	13	26	42	71	1614	659	8	28	36	64	1029	450
12	BAWNGKAWN	THUAMPUI	74	72	146	218	3700	1222	40	36	76	112	4000	1285	25	16	41	57	5625	1679
13	THUAMPUI	ZEMABAWK	54	12	66	78	16200	2492	118	12	130	142	35400	2992	34	28	62	90	4371	1360
			2706	1033	3738	4772	9430	2041	2357	832	3289	4221	8104	2010	2433	861	3294	4155	10173	2108

Speed and Delay Survey (2 Wheeler)

9:15								
Sl. No	Segment Start	Segment End	Segment Distance (Km)	Running Time (secs)	Delay Time (secs)	Journey time (secs) (ta)	Running Speed (km/hr)	Journey Speed (Km/hr)
1	Thuampui	Bangwan Jn	1.8	342	8	350	18.9	18.5
2	Bangwan Jn	Chalthan jn	1.6	286	12	298	20.1	19.3
3	Chalthan jn	Bara Bazar	1.1	120	80	200	33.0	19.8
4	Bara Bazar	Milliniam Jn	0.9	166	60	226	19.5	14.3
5	Milliniam Jn	Zodin Jn	0.8	158	12	170	18.2	16.9
6	Zodin Jn	Temple Sq Jn (Raj Bhavan)	0.7	107	36	143	23.6	17.6
7	Temple Sq Jn (Raj Bhavan)	Tressury	1.1	151	90	241	26.2	16.4
8	Tressury	Kolicon	0.7	121	22	143	20.8	17.6
			8.7	1451	320	1771	21.6	17.7

10:30								
Sl. No	Segment Start	Segment End	Segment Distance (Km)	Running Time (secs)	Delay Time (secs)	Journey time (secs) (ta)	Running Speed (km/hr)	Journey Speed (Km/hr)
1	Kolicon	Tressury	0.7	337	83	420	7.5	6.0
2	Tressury	Temple Sq Jn (Raj Bhavan)	1.1	229	30	259	17.3	15.3
3	Temple Sq Jn (Raj Bhavan)	Zodin Jn	0.7	133	16	149	18.9	16.9
4	Zodin Jn	Milliniam Jn	0.8	210	10	220	13.7	13.1
5	Milliniam Jn	Bara Bazar	0.9	80	15	95	40.5	34.1
6	Bara Bazar	Chalthan jn	1.1	74	22	96	53.5	41.3
7	Chalthan jn	Bangwan Jn	1.6	159	80	239	36.2	24.1
8	Bangwan Jn	Thuampui	1.8	110	70	180	58.9	36.0
			8.7	1332	326	1658	23.5	18.9

Pedestrian Volume Count (3 locations)

PEDESTRIAN VOLUME COUNT SURVEY AT INTERSECTION

Location: Hessig's College		Day & Date: 12/10/2015 Monday			
Time	Northbound		Southbound		
	Along the road	Across the road	Along the road	Across the road	
7:30 - 8:30	127	151	91	59	
8:30 - 9:30	115	123	90	54	
9:30 - 10:30	16	75	78	44	
10:30 - 11:30	68	81	60	31	
Total Vehicles	326	400	319	218	

Location: Hotel Residency		Day & Date: 12/15/2015 Monday			
Time	Northbound		Southbound		
	Along the road	Across the road	Along the road	Across the road	
7:30 - 8:30	62	77	50	71	
8:30 - 9:30	35	52	78	74	
9:30 - 10:30	51	66	71	75	
10:30 - 11:30	70	60	62	62	
Total Vehicles	218	255	261	282	

Location: Microam Rural Bank		Day & Date: 12/15/2015 Monday			
Time	Northbound		Southbound		
	Along the road	Across the road	Along the road	Across the road	
7:30 - 8:30	115	123	128	102	
8:30 - 9:30	110	100	140	100	
9:30 - 10:30	104	75	117	103	
10:30 - 11:30	78	66	120	148	
Total Vehicles	407	364	505	453	

Parking Survey Results

Parking Survey Results: Chanmari to Millennium Centre, 16th November 2015, 11-11.30 am

SECTION	EAST SIDE				WEST SIDE				TOTAL			
	Cars	M/C's	Others	Sub-Total	Cars	M/C's	Others	Sub-Total	Cars	M/C's	Others	TOTAL
Chanmari to Reebok Show Room	10	23		33	1	24		24	11	46	0	57
Reebok Showroom to New Life	3	17	1	21	6	8		14	9	25	1	35
New Life Hospital to KFC	0	30	1	31	4	7		11	4	37	1	42
KFC to Hotel Regency	1	13		14	7	27	1	35	8	40	1	49
Hotel Regency to Addidas	5	67		72	0	11		11	5	78	0	83
Addidas to ICIC Bank	0	15		15	0	5		5	0	20	0	20
ICIC Bank to Hotel Millennium	3	5		8	5	5		10	8	10	0	18
Hotel Millennium to Sumkhuma Pt	7	69		76	0	7		7	7	76	0	83
Sumkhuma Point to First Steps	13	47		60	2	4		6	15	51	0	66
First Steps to Millennium Centre	5	28		33	0	3		3	5	31	0	36
TOTALS	47	314	2	363	25	100	1	126	72	414	3	489

Parking Survey Results: Millennium Centre to Raj Bhaban, Monday 30th November 2015, 11am to 1pm

Note: taxis at official taxi ranks NOT included

SECTION	EAST SIDE				WEST SIDE				TOTAL			
	Cars	M/C's	Others	Sub-Total	Cars	M/C's	Others	Sub-Total	Cars	M/C's	Others	TOTAL
Going south:												
East Corridor Millennium Centre to Hotel Floria	13	67		80	0	0		0	13	67	0	80
East Corridor Hotel Floria to Nokia	23	65	2	90	0	0		0	23	65	2	90
Nokia to SBI	0	65		65	0	0		0	0	65	0	65
SBI to Aizawl Watch House	0	0		0	8	9		17	8	9	0	17
Aizawl Watch House to Hotel Ritz	0	0		0	13	10		23	13	10	0	23
Hotel Ritz to AR Canteen (upper road)	15	0		15	0	36		36	15	36	0	51
AR Canteen (upper road) to AR Ground	25	2		27	0	140		140	25	142	0	167
AR Ground to Gandhi Statue	0	0		0	0	44		44	0	44	0	44
Gandhi Statue to Vanapa Hall	0	29		29	133	7		140	133	36	0	169
Vanappa Hall to DC Office	41	23		64	0	45		45	41	68	0	109
DC Office to Assembly and Tennis Court	8	1		9	8	3		11	16	4	0	20
Returning north:												
West corridor Tennis Court to Agriculture office	16	43		59	27	54	1	82	43	97	1	141
West corridor Agriculture office to Temple Square	0	7		7	14	27		41	14	34	0	48
West corridor Temple Square to Solomon's Cave	12	0		12	0	26		26	12	26	0	38
West corridor Solomon's Cave to Landmark	0	0		0	0	0		0	0	0	0	0
West corridor Landmark to Zodin Square	0	0		0	3	21		24	3	21	0	24
West corridor Hospital Road	0	0		0	8	91		99	8	91	0	99
TOTALS	153	302	2	457	214	513	1	728	367	815	3	1185
GRAND TOTAL	200	616	4	820	239	613	2	854	439	1229	6	1674

Appendix 3.2: Existing Restrictions on Motor Vehicles in Aizawl City

I. HEAVY MOTOR VEHICLES / MEDIUM MOTOR VEHICLES:

Periodic No Entry:

- a) Medium size vehicles (MMV) are restricted between 10:00am – 5:00pm from Sakawrtuichhun to Lungverh road.
- b) Electric Veng to Modern School Junction (upwards), vehicle restricted timing:
 - i) Summer (15th Feb – 14th Nov) – 8:00pm – 6:00am
 - ii) Winter (15th Nov – 14th Feb) – 7:00pm – 6:00am

New Market area is restricted for all HMV/MMV which carry load.

Permanent restricted roads for HMV/MMV:

- a) Bawngkawn to Chanmari via Chatlang.
- b) Chanmari to Bawngkawn via Ramhlun road.
- c) Vaivakawn to Chanmari via Chanmari West road.
- d) Vaivakawn to Aizawl Temple.
- e) Treasury Square to Khatla Vis Tennis Court.
- f) Khatla to Sikulpuikawn.
- g) Sikulpuikawn to Treasury Square via Upper Republic.
- h) Ztu Kamlova Point near tennis court to Maenga Point Raj Bhavan 'N' gate (Upwards).
- i) Raj Bhavan 'S' gate to Republic road (Restricted for both ways).
- j) Khatla Bazaar to Khatla kawn going through Bungkawn Nursery.
- k) Sikulpuikawn and Venghlui junction going through Upper Republic towards Venghlui.
- l) Mini road near Kulikawn Presbyterian Church to Mission veng Bazaar passing through Venghnuai and Damveng towards Mission Veng Bazaar.
- m) From Bazar Bungkawn to Electric Veng.

II. 407 TRUCK AND EQUIVALENT VEHICLES:

Restricted Timings for Particular Areas:

- a) Vaivakawn to Temple Square
Summer (1st March – 31st Oct): 8:00am – 10:00am, and 4:00 pm – 6:00pm
Winter (1st Nov – 28th Feb): 9:00am – 11:00am, and 3:00pm – 5:00pm
- b) Chanmari to Dawrpui via Zarkawt upper road: 7:00am – 7:00pm (all year)
- c) Treasury Square to Sikulpuikawn via Raj Bhavan: 7:00am – 7:00pm (except Sat & Sun)
- d) Temple Square to Tennis Court. (7:00am – 7:00pm)
- e) Bawngkawn to Chatlang (24hours): City Bus will be running as the timing of HMV.
- f) Towards Bungkawn Damveng (7:00 pm – 7:00am), only permitted to run on Chawnga road. The only entry is from Maubawk kawn to Bungkawn Vengthar.
- g) Ramhlun Industry Peng – Ramhlun North – Ramhlun Vengthar
Rush Hour – 8:00am – 10:00am
407 and HMV are restricted in both ways in these roads:
Summer – 4:00pm – 6:00pm

Winter – 3:00pm – 5:00pm

- h) 407, HMV/MMV are restricted from Vaivakawn to Chanmari West junction:
- i) Timing of restriction: 8:00am – 6:00pm, (including holidays and Sunday)

Permanent Restricted Area for 407 and equivalent vehicles:

- a) Republic Veng to Treasury Square.
- b) Maenga Point to Zodin via Vanapa Hall.
- c) Sikulpuikawn to Raj Bhavan.
- d) Khatla kawn to Sikulpuikawn via Peter Street.
- e) Ramhlun 'N' to Chaltlang Basic mual (Both ways).
- f) Tennis Court to Khatla via Industry Office.
- g) Industry office to Tuikual 'S'.
- h) Vaivakawn to Bazar Bungkawn via Dawrpui Vengthar.
- i) Bawngkawn to Chaltlang.
- j) Venghnuai to Salem Veng.

III. ALL VEHICLES NO ENTRY:

- a) BOC junction to Hrangbana College junction via western side.
- b) Dawrpui Bungkawn to Dawrpui Church via Bara Bazar.
- c) Israel point to Chanmari via Lower Zarkawt.
- d) Maj. Laldailova point to Bazar Bungkawn via Upper Bazar.
- e) Israel point to Maj. Laldailova point via Dawrpui church.
- f) Zodin to Temple via Solomon's cave.
- g) Zodin to A.R Canteen kual.
- h) A.R Canteen kual to Zodin.
- i) Temple to AOC (under Vanapa Hall).
- j) AR Bungalow to AOC via Congress Bhavan.
- k) Aizawl Hospital to Sikulpuikawn.
- l) Bazar Bungkawn to Vaivakawn. (Two wheeler not included)
- m) Electric veng to Chhinga veng. (Two wheeler not included)

IV. PERIODIC NO ENTRY

- a) Mission Veng junction. Damveng/Venghnuai, Thakthing: 7:00am – 10:00am
- b) From Khatla kawn, taking right turn towards Sikulpuikawn, going upwards, no vehicles are permitted during 8:00am -10:00am and 4:00pm – 6:00pm.
- c) Both ways form Zarkawt, CM Bungalow road to Zarkawt traffic point via Babutlang road. 7:30am – 8:30am.
- d) Kulikawn to Tlangnuam road, 7:00am – 8:00am.
- e) Modern school to New market, for LMV 6:00am – 8:00pm (emergency matters not included).
- f) Mission Veng to Venghnuai. (Restricted on Saturday from 6:00am - 6:00pm).
- g) Venghlui to Treasury Square. Restricted during 7:00am – 7:00pm. Not restricted on Sunday.
- h) Mission Veng Bazar to Venghnuai and Thakthing, 8:30am – 10:00am.

V. RESTRICTED TIMINGS AND AREA FOR TWO WHEELERS

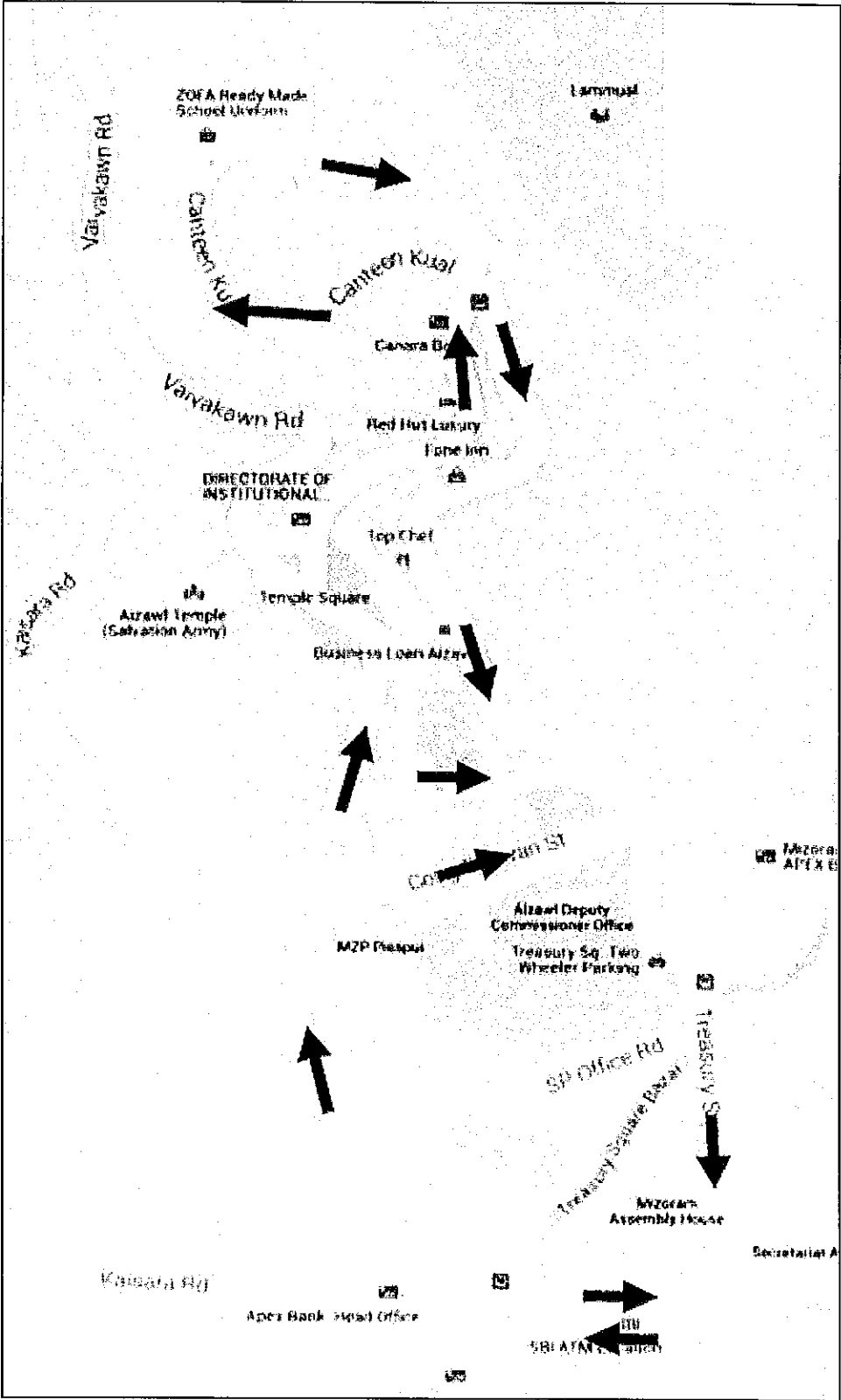
- a) Modern School junction to New Market, 7am – 10:00am and 3:00pm – 7:00pm. (Govt. holiday and Sundays not included)
- b) Between post Office and Mr. Siamkima's house; Morning: 8:30am -10:30am, Evening: 4:00pm – 5:30pm
- c) Venghloi to Treasury; 7:00am – 7:00pm (Not restricted on Sundays)

Appendix 3.3: Major Road Junctions in Aizawl

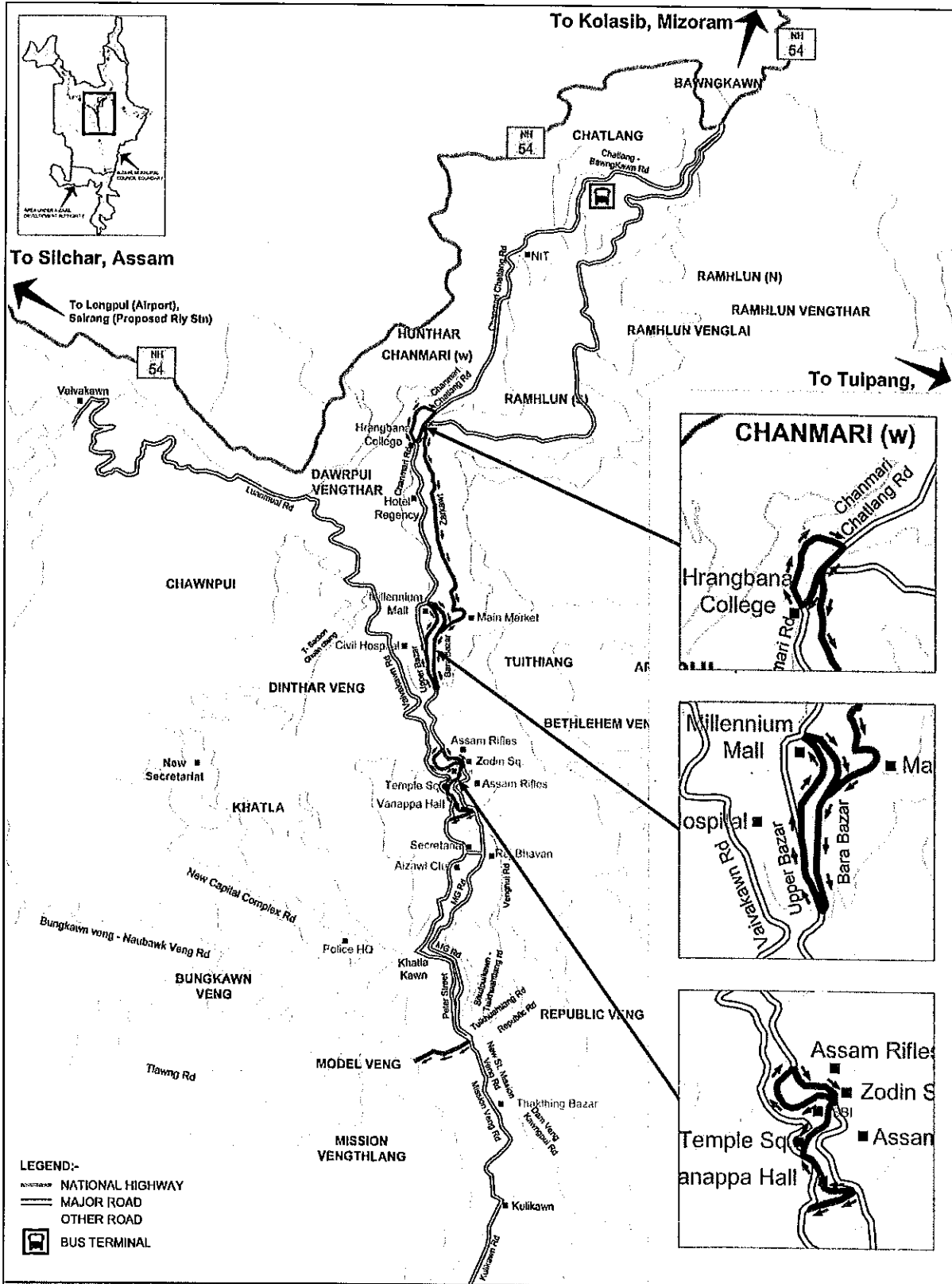
Sl. No.	Common Name	Official Police Point Name	Locality	Traffic Signal	
				Thru Signal	Without Signal
1	Thuampui, Mulco Junction	Liancheuo	Thuampui, Mulco Junction		
2	Thuampui, Helipad Junction	Dr. H Lalrintluanga	Thuampui, Thuampai Jn		
3	Bangkawn-Silchar Road	Zasanga	Baongkaon - Lempui Road / Dutlang Rd Jn		
4	Bangkawn-Lempui Road	Zosangliana	Baongkaon Sairang road Jn near Baonkaon Police str		
5		Hniartzi	Ramkuan Industry Jn, City bus Stand		
6		Chatlang Dawrkaon	Chatlang	•	•
7	Chanmari (Hrangbana College)	HrangBana	Chandmari Jn		
8		Chandmary west peng	Chandmari & Chandmary (W) Jn		•
9		BOC Peng Chandmari	chandmari		•
10		Sumkhuma	Zarkawt Jn near city Bus Stand		
11	Millennium Centre, near Church	R. Thangsana	Dawrpui nr millinium Centre		
12	Millennium Centre, Dawrpui	Maj. Laldaillova	Dawrpui nr Church/ Millinium Centre		
13		Bazar Bungkaon (Cross Duty)	Dawrpui, Bazar Bungkwon		•
14		Israel Point	Dawrpui, Israel city bus stand		
15		Vanglaini point	Dawrpui, Bazar BungKwon		
16		Dinthar Peng	Dinthar Jn	•	•
17		Modern School Peng	Saron Veng near Modern School		•
18		Vaivakawn/ Dawrpui Vengthar Peng	Vaivakawn nr city bus stand		•
19		Zobela	Vaivakawn		
20	Zodin Junction	Dr. C Thaitianga	Zodin nr Assam Rifles Ground		
21		Electric / Chhinga Veng	Electric Veng	•	•
22	Temple Square	F. Kapsanga	Tuikual, Aizawl Temple Square		
23		Brig C Vankunga	Treasury AOC		
24		F Hrangvela point	Treasury nr Assembly House		
25	Raj Bhaban North Gate	Meanga point	Treasury nr Raj Bhavan North Gate		
26		Ztu. Kamlova	Tuikuan near tennis court		
27	Khatla Kawn	PHQ Peng	Khatla PHQ Jn	•	•
28		Governor South Gate	Rajbhavan	•	•
29		Pi. Pang peng	Republic Veng Jn		•
30		Zokaithanga Point	Khatla Kaon nr City bus stand		
31	Sikulpuikawn	R. Lalzaua Point	Mission Veng, Sikulpuikaon		
32		JL Point	Mission Veng near Synod		
33	Kulikawn	Kulikawn	Kulikawn	•	•
34		C. Malsawna Point	college Veng		
35		Marova Point	Khatla new Secretariat Jn near Assam Rifles Canteen		

Source: Information supplied by SP, Traffic, July 2015

Appendix 3.4: Possible One Way System between Raj Bhavan and Assam Rifles Gate



Appendix 3.5: Some of Existing One Way Roads in Aizawl



Project: ADB TA-8765: SUPPORTING SUSTAINABLE URBAN TRANSPORT IN AIZAWL	Consultant: CDM Smith Inc	 N	Drawing Title: One Way Route Map of Aizawl
	Client: Asian Development Bank		

Appendix 3.6: Quantity Estimates for Short Term Traffic Management Measures

N o.	Improvement Description	Unit	Bangka wr Jr-1	Bangka wr Jr-2	Millenn um Centre	Isra ei Poi nt	Baza Barka wn	Zooh n Sq.	Temp le Sq Jn.	Raj Brav an	Tenn is Club	Sikulpu k Jn.	Vaivake wr Jr.1	Vaivaka wr Jr.2	Khat le Jr.1	Khat le Jr.2
			J1	J2	J3	J4	J5	J6	J7	J8	J9	J10	J11	J12	J13	J14
1	Footpath - new (average 1m)	metre	45	32	80	47	20		28	75	44	110	15			
2	Ex. Footpath widening (up to 0.5m)	metre		95		24	60		35			20				
3	Ex. Footpath widening (0.5m - 1.5m)	metre			38			50	100	50	35		120	150	82	130
4	Retro reflective signs	each	5	5	5	2	3	6	4	3	3	9				
5	Retro Reflective Pavement markings-lane	metre	80	32	70	65	55	100	65	170	80	160	35	50	40	80
6	Retro Reflective Pavement markings-Ghost Traffic Island	Sq. mt		23		1.5	10		10	9	11	19	65	16	38	24
7	Retro Reflective Pavement markings 0.5m thick and 2m wide -zebra Xing	metre	26		25	8	9	15	43	33	36	23	7		17	11
8	Bus STOP	each		1		12			37			22				
9	2m wide coloured Carriageway Tiles (Mid-Block - pedestrian xing)	Each											22	32		
10	Pedestrian refuge island	sqm			26	54	43		9	70	28	18		4	7	3
11	Pedestrian tubular Railing	metre					65									
12	Stop line markings	metre	15	27	10		7	21	20	43	13	80	37	32	28	40
13	Arrow markings	each	9	10	7	4	7	3	9	9	7	16	4	9	9	13
14	Mountable Mini Roundabout	Each	1								1	1		1	2	

Quantity and Cost Estimates for Corridor Improvements

Improvement Description		Unit	Chanman-to-Mil. Ctr	Mil Ctr-to-Bangkawn	Bangkawn-to-Mil Ctr	Bangkawn-to-Mandir	Mandir-to-Petrol bunk	Petrol bunk-to-Sikulpukaw	Sikulpukaw-to-Kulikaw	Khatia-to-Vivakaw	Bangkawn W-to-Bangkawn E	Unit Cost (INR)
Sl.No	Distance	metre	850	450	450	400	1100	2600	1000	2700	240	
1	Stairway-FP meeting point improvement	each	17			5		5	60	50	10	20,000
	Cost Estimate (1) @ Rs. 20000 per unit		340000	0	0	100000	0	100000	1200000	1000000	200000	2,940,000
2	Ex. Access reconstruction/Steps remodification	metre	500		450	50		50	120	100	480	2,000
	Cost Estimate (2) @ Rs. 2000 per M.T		1000000	0	900000	100000	0	100000	240000	200000	960000	3,500,000
3	Retro reflective signs	each	17	9	9	8	22	52	20	54	4.8	5,000
	Cost Estimate (3) @ Rs. 5000 per unit		85000	45000	45000	40000	110000	260000	100000	270000	24000	979,000
4	Retro Reflective Pavement markings-lane	metre	1700	900	900	800	2200	5200	2000	5400	480	100
	Cost Estimate (4) @ Rs. 100 per M.T		170000	90000	90000	80000	220000	520000	200000	540000	48000	1,958,000
5	Retro Reflective Pavement markings 0.5m thick and 2m wide -zebra Xing	metre	3.4	1.8	1.8	1.6	4.4	10.4	4	10.8	0.96	500
	Cost Estimate (5) @ Rs. 500 per M.T		1700	900	900	800	2200	5200	2000	5400	480	19,580
6	Ex .Junction regradation	LS						1	1	2	1	750,000
	Cost Estimate (6) @ Rs. 750000 Lumpsome Cost		0	0	0	0	0	750000	750000	1500000	750000	3,750,000
Total											13,146,580	

APPENDIX 4: MEDIUM TO LONG-TERM PUBLIC TRANSPORT OPTIONS FOR AIZAWL

Appendix 4.1: Background Details of Five Public Transport Modes Considered for Aizawl

Appendix 4.2: Broad Assessment of Public Transit Options for Aizawl

Appendix 4.3: Strategic Pedestrian Routes

Appendix 4.4: Calculations for proposed bus package

Appendix 4.5: Calculations for 3 ropeway options

Appendix 4.6: Service Level GAP/Benchmark Analysis for Urban Transport in Aizawl City

Appendix 4.7: Power requirement for proposed Ropeway in Aizawl

Appendix 4.8: Wind effect on ropeways

Appendix 4.1: Background Details of Five Public Transport Modes Considered for Aizawl

1. The following Appendix contains a brief overview of five different public transport modes considered for Aizawl, together with their main advantages and disadvantages. The modes are:
 1. Aerial ropeways (top-supported cable cars)
 2. Cable liners (bottom-supported cable cars)
 3. Ultra-light rail
 4. Light mono-rail
 5. Modern bus system with bus priorities

Aerial Ropeways

2. Cable car ropeways exist all over the world and are an in-coming technology. South America leads the way: in Medellin city three routes totaling 9.1km were built in the 2000's carrying 6,000 passengers per hour (two-way) and over 5 million passengers per year. Other substantial schemes have been developed or are being considered in dozens of cities. There are various types of ropeway technology with different levels of sophistication, cost and performance. The basic technology common to all is that cable cars are suspended from a steel ropeway (or two or three ropeways), and pulled along by a cable powered by an external motor which can be electric or diesel.

Table 4-1: Advantages & Disadvantages of Aerial Cable Systems

Main Advantages	Main Disadvantages
a) Ability to carry substantial passenger numbers (2,000-10,000 pass/hr, two-way)	a) Capacity is lower than track-based mass transit
b) Comparatively lower capital cost compared with other mass transit	b) Route distances are usually less than 5km
c) Can be constructed within 2-3 years	c) Passenger stations can be large, requiring land and new buildings
d) Good operating speeds (maximum speed over 30kph, and average 16kph)	d) Occasional risk of service interruption due to strong winds (though some systems can operate safely in wind speeds up to 100kph)
e) Able to cross valleys and climb steep hills	
f) Does not take existing road space, and limited land space requirements	
g) Environmentally friendly (low noise, low emissions, etc.)	
h) Technology is tried and tested, and already used in India to some extent	
i) The network can be readily extended over time	

Cable Liners (bottom supported cable cars)

3. Cable liners are also cable cars, but 'bottom supported' systems – i.e. running on rails and pulled by a cable. There are various types of bottom supported cable-pulled vehicles, and they have existed for over 100 years (such as the San Francisco cable cars and other

funiculars). However, cable liners have recently emerged in ultra-modern settings, particularly as airport shuttles. In Caracas, Venezuela a mass transport cable liner opened in 2013. Described as South America's first cable liner, it is 2.1km long with five stations and a capacity of 6,000 passengers per hour (two-way). In Naples, Italy, four funicular lines of 0.8 to 1.3km are in use as part of the city's metro. The busiest line has a capacity of 12,400 passengers per hour (2-way). Funicular lines do not have to be long to be useful: the funicular in Lugano, Switzerland which links the city centre to its railway station is just 220m in length and uses small cabin-sized trains.

Table 4-2: Advantages & Disadvantages of Cables Cars/ Liners

Main Advantages	Main Disadvantages
<ul style="list-style-type: none"> a) Shares some of the advantages of top-supported cable cars (e.g. cleaner, quieter technology; ability to climb steep gradients), and also has other advantages such as: b) Higher passenger capacity (10-20,000 passengers/hour) c) Higher speeds (max. 47kph) 	<ul style="list-style-type: none"> a) Higher capital cost compared with top-supported cable cars b) Need for a suitable track alignment, which takes up space and requires a fairly straight run c) Track length usually not more than a few kilometers d) Cable liner technology is not yet widely adopted around the world, and only seen in a few places e) Funiculars are more widely used for smaller scale applications, in urban transport as well as tourist applications.

Ultra-Light Rail (Trams)

4. Ultra-Light Rail operates like a tram, on rails in the road or on separate tracks. It is lighter than LRT (Light Rail) systems because the vehicles are self-powered using energy-efficient hybrid drive technology at a far lower cost than conventional LRT. As the ULR trams generate their own power they do not need overhead wires or insulation, so are easier, quicker and cheaper to install. ULR trams have lower axle weights than conventional trams, so a shallow track can be constructed in the top layer of the roadway, thus avoiding buried services. Investment costs for ULR are characteristically 70% less than for conventional LRT, while their passenger capacity can be similar, depending on carriage size and number. They also successfully negotiate mixed traffic and pedestrian areas.

Table 4-3: Advantages & Disadvantages of Ultra-Light Rail

Main Advantages	Main Disadvantages
<ul style="list-style-type: none"> a) Can run on existing bus routes (including steep roads of up to 14% gradient) and utilize all existing bus stops b) Has the high capacity, safety, comfort and ride quality of LRT, but much lower investment and operational cost c) Fuel savings of about 50% compared with standard buses, due to steel wheels on rail, and hybrid drive allowing brake energy to be recovered and engine to operate at maximum efficiency d) Very environmentally friendly (minimal toxic emissions, no particulates, zero net carbon emissions, low noise and vibration) e) Safe operation in pedestrian areas f) Proven technology (modern trams are operating all over Europe) g) Significantly longer working life than buses, and lower operational costs h) Can be implemented within 2-3 years with limited impact on existing road traffic. 	<ul style="list-style-type: none"> a) In Aizawl, would need to run on existing north-south roads. Traffic management measures would be needed to ensure trams are not delayed by congestion b) Small ULR trams may not be feasible on some of Aizawl's east-west feeder roads, due to limited width and steep, sharp bends. c) Therefore ULR would be more suitable for the main north-south corridor.

Light Monorail

5. Monorails are typically high cost investments and are not extensively used around the world. The Bombay monorail, India's first, cost over \$22million per kilometer, and the government has recently decided that it will stop operating as it is making a loss. A lighter type of monorail is available, though the technology is not yet widespread. It involves smaller, lighter vehicles and smaller guideways. It is cheaper because the guideway beam on which the carriages run is not part of the system. With ordinary monorails, the carriages straddle a concrete beam, which also makes it more complex to switch guideways. With a light monorail, the carriage runs on wheels on top of a concrete beam, while the guidance and electrical power are drawn from a light steel guideway between the wheels (see diagram). This allows smaller, cheaper structures and carriages, (and about 65% of the total system cost is in the guideway). The column support has a width of around 1.0-1.2m, though 0.5m clearance is also needed on either side of the column if located on a road (i.e. 2.0-2.2m in total). The carriages are 2.35m wide, so a two-directional system needs at least 5m.

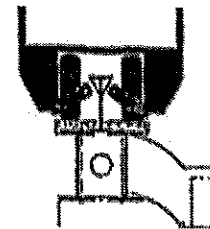
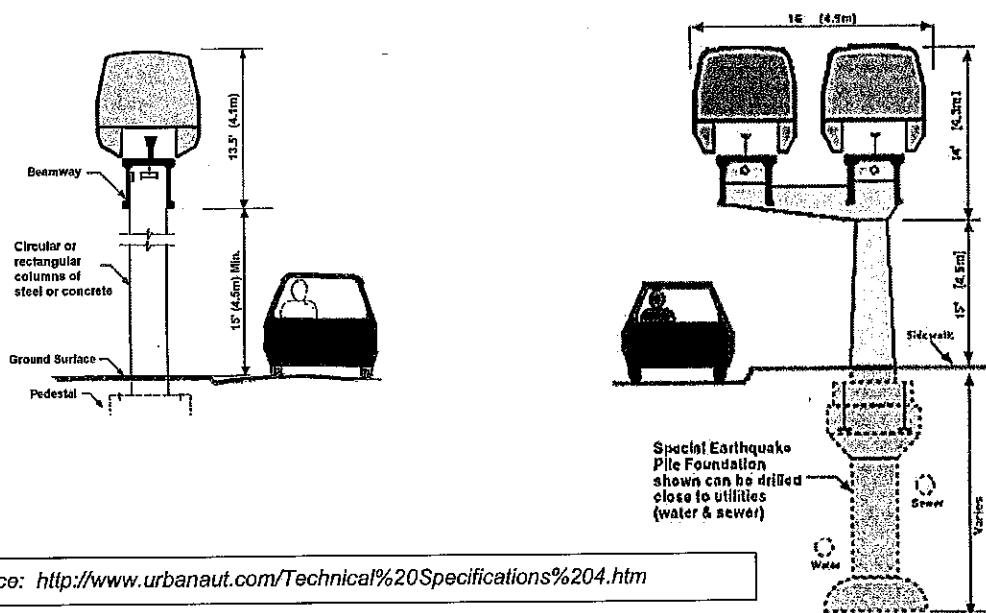


Figure 4-1: Conceptual drawings of Light Monorail



Source: <http://www.urbanaut.com/Technical%20Specifications%204.htm>

Table 4-4: Advantages & Disadvantages of Light Monorail

Main Advantages	Main Disadvantages
<ul style="list-style-type: none"> a) High capacity b) Columns take up only a limited amount of road-space if a road alignment was adopted c) Light structure allows significant gaps between columns (30—45m) d) Low noise and emissions 	<ul style="list-style-type: none"> a) High cost b) Difficulty of finding a suitable off-road alignment c) Alignment along main roads would have a big visual impact on buildings fronting the road. (A two-way elevated track would be 5m wide at carriage level, and some road sections on the north-south corridor are only 7m wide between buildings) d) Likelihood of some land acquisition and building demolition to achieve the alignment e) Construction along a main road would cause major traffic delays for a long period f) Could also have a major impact on existing utilities, e.g. relocation of existing electric lines g) Substantial electric power demand, and sub-power stations needed every 2km h) Frequent corners and bends on a road alignment would reduce system speed and efficiency i) Would serve only a north-south corridor (east-west gradients are too steep) j) Imported technology and equipment, and not widely proven k) Passenger demand may not support such a large capital investment.

Modern Bus System with Bus Priorities

6. There are currently about 260 city buses in Aizawl, of which only half are regularly in service. This is low for a city of this size. Much of the existing demand is catered for by taxis, which provide a useful door-to-door service but take up a lot of road space relative to passengers carried. Some of the city's buses are also old and poor quality. A modern bus system would include:
- High-quality vehicles – powerful engines, low emissions, low noise, comfortable and attractive
 - High-quality bus shelters, with seating, electronic information signs, bus maps, timetables and other facilities
 - Integrated ticketing (Smart Cards), which can be used for other modes and also offering volume discounts
 - Well-designed terminals and interchanges with other modes (e.g. taxi stands, pedestrian footways, park-and-ride facilities)
7. A modern bus system would also need traffic management measures to be successful, so that buses are not stuck in traffic jams. Hence the package of bus improvements would include traffic and engineering measures such as bus lanes, bus priorities, traffic signals, junction improvements and improved footways and drains – for example:
- Bus lanes at major junctions (where road width allows)
 - (Where road width doesn't allow), smart traffic signals allowing buses to 'jump' the traffic queue by using the on-coming lane
 - Pre-signal bus gates – see diagram below
 - Re-grading existing junctions to reduce the effect of steep, sharp corners
 - Providing roadside footways and covered drains
 - Introducing micro-buses (10-12-seaters) on some narrow feeder roads
 - Institutional measures to ensure an integrated, comprehensive city bus system.

Example of a Pre-Signal Bus Gate
(Allowing buses to jump traffic queues)

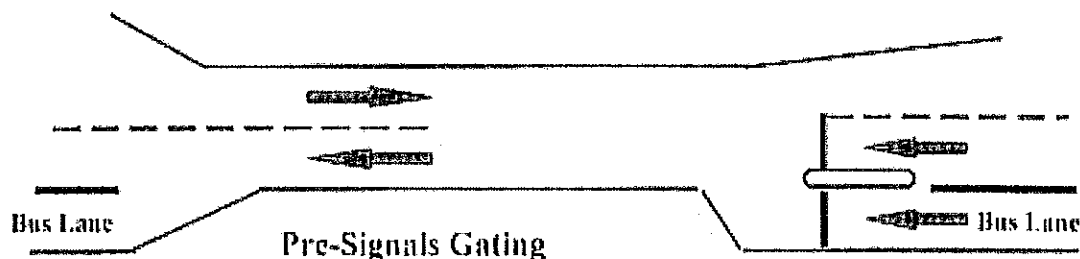


Table 4-5: Advantages & Disadvantages of Modern Bus system

Main Advantages	Main Disadvantages
<ul style="list-style-type: none"> a) Significantly lower capital cost than the other mass transport options (approximately one-tenth the cost of a monorail and one-fifth that of a cable car ropeway, per kilometer) b) Serves longer corridors (e.g. up to 30km) c) Enables a network to be provided as opposed to a single corridor d) Bus stops available at frequent intervals, enabling passengers to hop-on, hop-off e) Can operate on steep gradients (outperforms the rail-based options) f) Passenger fares may be lower (compared with the other options) g) System flexibility – buses can easily be re-routed and new routes started h) Good scope for local private sector participation (e.g. in bus purchase), compared with a single high-cost system i) System is already in place; improvements can start immediately. 	<ul style="list-style-type: none"> a) Success of the bus system needs effective traffic management, including modern traffic signals. (Note: this also applies to the ULR option and also to some extent to a mono-rail or cable liner using a road alignment) b) Buses do not (yet) have the 'wow' factor that a monorail or cable car ropeway would have c) Bus lanes, bus priorities and high quality bus stops will reduce space available for on-street parking d) Total bus capacity on the main north-south corridor may not be as high as for a monorail or cable car ropeway (depending on the extent to which bus priorities are introduced).

Appendix 4.2 Broad Assessment of Public Transit Options for Aizawl

Sl. No.	Criteria	Ropeway (top supported cable car)	Cable Biner (bottom supported cable car)	Light Monorail	Ultra-Light Rail Transit (ULTRANS)	Bus Package
A. Transport Performance						
1	Average speed	M	H	H	H	M
2	Max speed	M	M	H	H	M
3	Distance served	M	L	M	H	H
4	Passenger capacity	M	H	H	H	M
5	Demands on existing road	L	H	H	H	M
6	Integration with other public	L	L	L	H	H
7	Ease of future extension /	L	M	M	H	H
8	Station interval	H	M	M	H	H
9	Comfort of use and access	L	L	L	H	H
10	Fare collection system	H	H	H	M	M
B. Technical Feasibility						
1	Right of Way required on the road	L	H	H	H	H
2	Land required off the road	M	H	H	H	L
3	RoW available during	P	N	N	N	P
4	Max gradient	H	M	M	H	H
5	Min Turning Radius	L	L	L	M	H
6	Construction time	L	H	H	M	L
7	space requirement for stations or	M	M	M	L	L
8	Span length	L	L	L	NA	NA
9	Ground stability (for supports)	U	U	U	NA	NA
10	Vulnerability to landslides	H	M	M	L	L
11	Vulnerability to high winds	H	L	L	L	L
12	Vulnerability to heavy rains	L	L	L	L	L
13	Size of terminal required	L	M	M	M	L
14	Size of depot required	L	M	M	H	L
15	Land acquisition for route	L	M	M	L	L
16	Land acquisition for terminal &	L	M	M	M	L
C. Operational and Maintenance						
1	Ease of procurement	D	D	D	D	F
2	Annual operating cost	M	H	H	H	L
3	Maintenance cost	L	M	M	M	H
4	Ease of maintenance / capacity	D	D	D	D	E
5	Power source	Grid	Grid	Grid	Hybrid	Hybrid
6	Energy requirement	L	L	L	L	M
7	Safety features	M	M	M	H	H
8	Inter-modal transfer facility	L	L	L	H	H
9	Inter-route transfer facility	L	L	L	H	H
D. Economic & Financial						
1	Capital cost	M	H	H	H	L
2	Total cost	M	H	H	H	L
3	Land acquisition cost	L	L	L	NA	NA
4	Scope of generating additional	H	M	M	L	L
5	Possibility on PPP	M	L	L	L	H
6	Viability Gap funding / loan	M	H	H	H	L
E. Environmental & Social						
1	Appearance	G	P	P	G	G
2	Impact on surrounding buildings	L	H	H	L	L
3	Acceptability to local people	H	M	M	H	L
4	Energy efficiency	M	M	M	H	M
5	Alternate energy use	L	L	L	H	H
F. Other Relevant Costs / Benefits						
1	Impact on future Indian technical	H	H	H	H	L
2	Whether technology is available	Dev	New	Av	New	New
3	Whether technology is tested	T	T	New	New	T

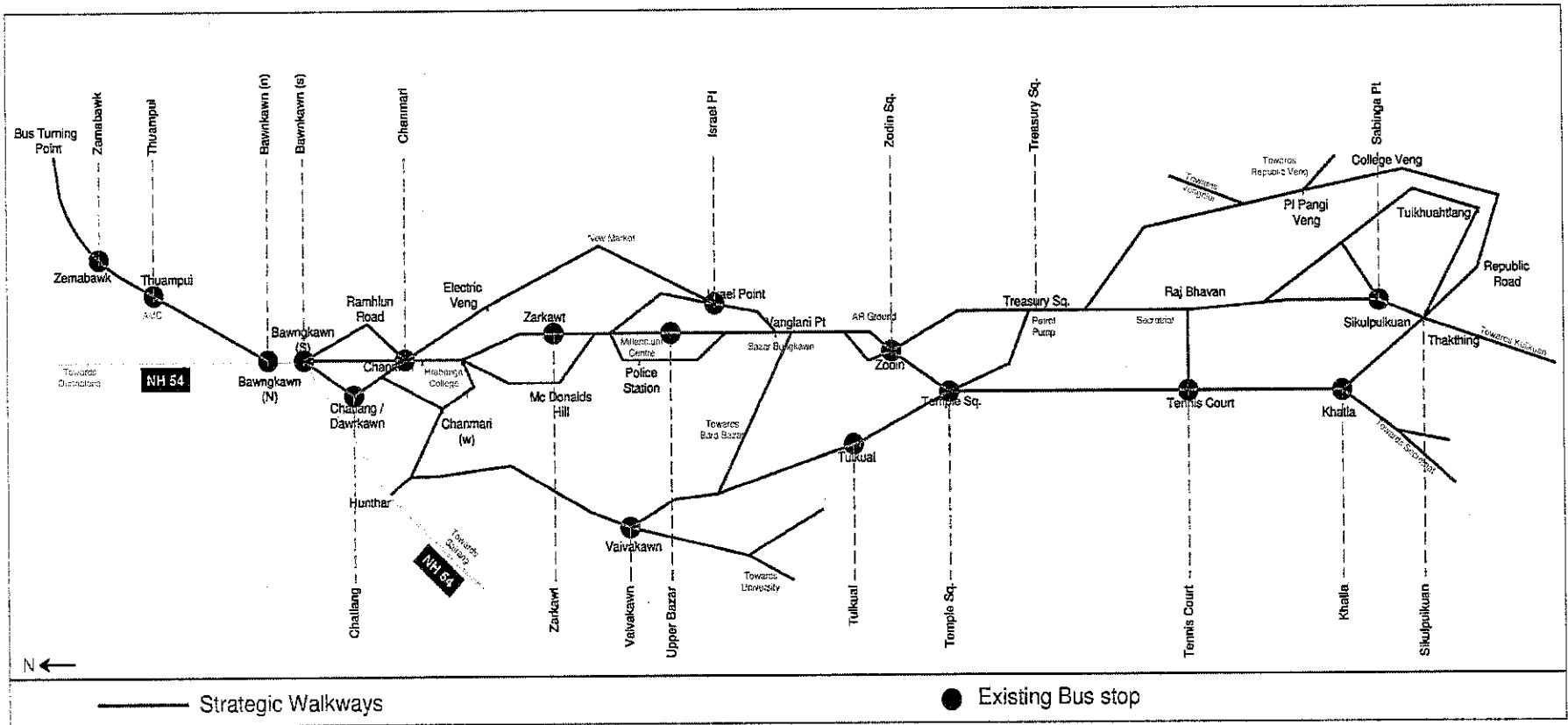
ASSESSMENT LEVELS

L Low
M Medium
H High
P Partial
N None

NA Not applicable
U Unsure
E Easy
D Difficult
G Good
P Poor

Av Available
Dev Developable
T Tested

Appendix 4.3: Strategic Pedestrian Routes



Appendix 4.4: Calculations for proposed bus package

Table A: Cost calculation for Core bus package

Component	Sub-component	Length	Cost per lane	Number	Cost per number	Lump Sum	Total Sub component	Total Sub component	Total Component	2016	2017	2018	2019	2020
										Cost in Year 1	Cost in Year 2	Cost in Year 2	Cost in Year 4	Cost in Year 5
		km	Rs/km	Nr.	Rs/nr.	Rs	Rs	Rs crore	Rs crore	Rs crore	Rs crore	Rs crore	Rs crore	Rs crore
Road/infra														
	Cost for North South							51.7						
	Cost for other routes							9.7						
								61.4		20.43	20.43	20.43		
	Project development and consultancy (10%)							6.1		2.04	2.04	2.04		
	Insurance (3%)							1.8		0.61	0.61	0.61		
	Pre operative expenses (2%)							1.2		0.41	0.41	0.41		
	Contingency (5%)							3.1		1.07	1.07	1.07		
								12.3	73.6					
Vehicles	New buses			370	1,300,000		481,000,000	48.1		15.36	15.36	15.36	15.36	15.36
	Depot			2	50,000,000		100,000,000	10.0		3.30	3.30	3.30	3.30	3.30
	Workshop			2	60,000,000		120,000,000	12.0		3.96	3.96	3.96	3.96	3.96
									70.1					
Operation	Information System					2,000,000	2,000,000	0.2					0.02	0.02
	Fleet management					48,100,000	48,100,000	4.8					0.16	0.16
	Maintenance & repair					48,100,000	48,100,000	4.8					0.16	0.16
									9.8				0.32	0.32
									153.6	9.7	41.5	43.5	43.5	15.2
	Land acquisition (depot & workshop)							1.0		0.5	0.5			
	Rehabilitation & resettlement							0.6		0.24	0.18	0.18		
								155.16	10.46	42.14	43.64	43.46	15.22	

Table B: Year wise cost breakdown for bus package (in Rs/Crore)

Years			2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2025	2027	2028	2029	2030
			Design	Construction			Operation					Operation					Operation
Cost head			Year 1	Year 2	Year 3	Year 4	Yr 5 / Yr 1 O	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7	Yr 8	Yr 9	Yr 10	Yr 11
Capital cost			9.72	41.46	43.46	43.46	5.58	4.81	5.05	5.30	5.57	5.85	6.14	6.45	6.77	7.11	7.46
Operating cost						0.18	9.64	9.74	9.83	9.93	10.03	10.13	10.23	10.34	10.44	10.54	10.65
Maintenance & repair								4.81	5.05	5.30	5.57	5.85	6.14	6.45	6.77	7.11	7.46
LA & R&R			0.74	0.68	0.18	0.00	0.00										
			10.46	42.14	43.64	43.64	15.22	19.36	19.93	20.54	21.17	21.82	22.51	23.23	23.98	24.76	25.57

Table C: Year wise ridership estimate for North-South bus route

Year	Base pax	Modal Shift from			Total Shifted pax	Induced pax	2 way	2 way	
		2W	Car	Taxi			Total daily pax	Peak hr pax	
2015	15080				0	0	15080	1508	
2016	15080				0	0	15080	1508	
2017	15080				0	0	15080	1508	
2018	15080				0	0	15080	1508	
2019	15080	Introduce bus package from 2020						15080	1508
2020	15080	205	50	336	592	690	16362	1636	
2021	15080	411	101	672	1183	1489	17753	1775	
2022	15080	616	151	1008	1775	2406	19262	1926	
2023	15080	822	201	1344	2367	3452	20899	2090	
2024	15080	1027	251	1680	2959	4637	22675	2268	
2025	15080	1232	302	2016	3550	5972	24603	2460	
2026	15080	1438	352	2352	4142	7472	26694	2669	
2027	15080	1643	402	2688	4734	9149	28963	2896	
2028	15080	1848	453	3024	5326	11019	31425	3142	
2029	15080	2054	503	3361	5917	13098	34096	3410	
2030	15080	2054	503	3361	5917	15997	36994	3600	

Notes for ridership estimation:

- 1) Modal shift considered for 2 Wheelers 5%, cars 5%, taxi 25%
- 2) Bus passengers kept constant at current level till 2020 when new bus package is to be introduced
- 3) Modal shift of passengers to buses considered to increase by 10% each year from 2020 to 2029
- 4) Theoretical demand for bus travel considered to increase at 2% each year from 2015.
- 5) Induced passengers considered as difference between theoretical demand and modal shift
- 6) The maximum capacity of bus service taken as 3600 pax in peak hour, both directions. Ridership has been kept constant at this value from 2030.

Table D: Bus fare structure, Existing and Proposed (2016 Values)

Bus Trip Distance	0-1 km	1-2 km	2-4 km	4-6 km	6-8 km	8-10 km	> 10 km
Official fare (in INR)	5	10	12	15	17	20	24
	0-1 km	2-5 km	5-10 km	>10 km			
Actual fare (in INR)	10	15	25	35			

Note: Above fares are in 2016 values. For the economic and financial analysis, fares are increased to allow for inflation up to the start of operation in 2020.

Table E: Cost calculation for Supplementary Bus Package

Component	Sub-component	Quantity	Cost per unit (INR)	Amount (INR)	Total Cost Component (INR crore)	Total Component (INR crore)
Bus route Infrastructure	Bus shelter	140	3,40,000		11.2	
	Footways & curbing at stops			1,10,00,000	1.1	
	Bus stop signing & marking			25,00,000	0.3	
	Infrastructure Cost				12.3	
	Project development & implementation (2%)				2.5	
	Total Infrastructure Cost				14.8	14.76
Vehicles	Buses for 5 routes	70	25,00,000		17.5	
	Additional cost for City AC buses (10% of city buses)	14	11,00,000		4.1	
	Depot (3rd depot)	1	5,00,00,000		5.0	
	Workshop (3rd workshop)	1	6,00,00,000		6.0	
	Vehicle related cost				32.6	32.67
Operation	Information System & ticketing			7,00,00,000	7.0	

	Fleet management	70		1,75,00,000	1.8	
	Maintenance & repair	70		77,00,000	0.8	
	Operation cost					9.52
						56.9
LA & RR	Land acquisition (depot & workshop)					0.6
	Rehabilitation & resettlement					0.4
				USD mill	8.90	57.9

Appendix 4.5: Calculations for 3 ropeway options

Table A: Cost calculation for 3 ropeway options

Sl. No.	Component	% of total cost	Cost per route (Rs Crore/100 Cr/km)		
			EW Long	EW Short	North South
	Length of system (km)		5.50	2.40	7.50
CAPITAL COST					
1	System components	0.45	245.79	139.43	335.16
2	Rotatable spares (1 year)	0.05	26.30	14.92	35.86
3	Demolition / Compensation	0.01	6.05	3.43	8.25
4	Civil Work	0.08	45.75	25.95	62.38
5	Stations	0.26	145.08	82.30	197.84
6	Project development / Supervision	0.06	34.09	19.34	46.49
7	Project Consultancy-5%	0.05	25.15	14.27	34.30
8	Preoperative Expenses	0.00	2.42	1.37	3.30
9	Insurance	0.01	3.36	1.91	4.58
10	Contingency -3%	0.03	16.02	9.09	21.84
	Total		550.00	312.00	750.00
	Land acquisition for stations		0.30	0.60	1.00
	R&R		0.18	0.36	0.60

Table B: Operation & Maintenance cost for 3 ropeway options

Sl. No.	Description	O & M (First Year) Rs Cr			O & M (15th Year) Rs Cr		
		EW long	EW-Short	NS	EW-Long	EW-Short	NS
1	Power Expenses	8.38	4.75	11.43	9.63	7.96	19.13
2	Operating Expenses	30.57	17.34	41.69	35.14	23.40	56.25
3	Maintenance	6.11	3.47	8.33	7.02	1.87	4.50
4	Major Maintenance	0.00	0.00	0.00	21.78	9.36	22.50
5	Insurance	2.99	1.70	4.07	3.43	2.81	6.75
6	Contingencies	1.43	0.81	1.96	1.65	1.40	3.38
	Total (Rs Cr)	49.5	28.08	67.50	78.66	46.8	112.50

Table C: Year-wise cost breakdown for 3 ropeway options

		2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
East West Long		Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11
1	Power Expenses	8.38	8.47	8.55	8.64	8.72	8.81	8.90	8.99	9.08	9.17	9.26
2	Operating Expenses	30.57	30.88	31.18	31.50	31.81	32.13	32.45	32.77	33.10	33.43	33.77
3	Maintenance	6.11	6.17	6.23	6.30	6.36	6.42	6.49	6.55	6.62	6.68	6.75
4	Major Maintenance					18.00					19.80	
5	Insurance	2.99	3.02	3.05	3.08	3.11	3.14	3.17	3.20	3.24	3.27	3.30
6	Contingencies	1.43	1.45	1.46	1.48	1.49	1.51	1.52	1.54	1.55	1.57	1.58
		49.49	49.98	50.48	50.98	69.49	52.01	52.53	53.05	53.59	73.92	54.66

		2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
East West Short		Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11
1	Power Expenses	5.15	5.20	5.25	5.31	5.36	5.41	5.47	5.52	5.58	5.63	5.69
2	Operating Expenses	18.79	18.97	19.16	19.36	19.55	19.74	19.94	20.14	20.34	20.55	20.75
3	Maintenance	3.76	3.79	3.83	3.87	3.91	3.95	3.99	4.03	4.07	4.11	4.15
4	Major Maintenance	0.00				15.00					16.50	
5	Insurance	1.84	1.85	1.87	1.89	1.91	1.93	1.95	1.97	1.99	2.01	2.03
6	Contingencies	0.88	0.89	0.90	0.91	0.92	0.93	0.94	0.95	0.95	0.96	0.97
		30.41	30.71	31.02	31.33	46.65	31.96	32.28	32.60	32.93	49.76	33.59

		2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
North South		Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11
1	Power Expenses	11.43	11.54	11.66	11.78	11.89	12.01	12.13	12.25	12.38	12.50	12.63
2	Operating Expenses	41.69	42.10	42.52	42.95	43.38	43.81	44.25	44.69	45.14	45.59	46.05
3	Maintenance	8.33	8.42	8.50	8.59	8.67	8.76	8.85	8.93	9.02	9.11	9.20
4	Major Maintenance	0.00				20.00					22.00	
5	Insurance	4.07	4.12	4.16	4.20	4.24	4.28	4.33	4.37	4.41	4.46	4.50
6	Contingencies	1.96	1.98	2.00	2.02	2.04	2.06	2.08	2.10	2.12	2.14	2.16
		67.48	68.15	68.84	69.52	90.22	70.92	71.63	72.35	73.07	95.80	74.54

Table D: Proposed fare structure (2016 values)

Stages	0-1 km	1-3 km	>3km
INR	20	40	60

Note: The above proposed fares are in 2016 values. For the economic and financial analysis, the fares have been adjusted upwards to allow for inflation up to start of operation (assumed five years' time).

Table E: Lengths of 3 ropeway options

Length of EW short	2.4 km	Average length of travel EW short	2 km
Length of EW long	5.5 km	Average length of travel EW long	3 km
Length on NS ropeway	7.5 km	Average length of travel NS	4 km

Notes for ridership estimate:

- 1) Modal shift considered: 2 Wheelers 15%, Mini bus 20%, Taxi 20%, Std bus 5%, Cars 20%
- 2) Modal shift of passengers to ropeway considered to increase from 2021 to 2025. Considered 50% in year 1, 15% in years 2 and 3, and 10% in years 4 and 5
- 3) Theoretical demand for travel considered to increase at 2% each year from 2015.
- 4) Induced passengers considered as half the difference between theoretical demand and modal shift
- 5) Additional 250 pax daily considered as ridership due to novelty factor and tourists
- 6) The maximum capacity of ropeway taken as 3000 pphpd or 60,000 per day. For E-W long option, ridership has been kept constant at this value from 2039.
- 7) For NS ropeway, ridership estimated for central section. Ridership for northern section considered as 60% of central section. Ridership for southern section considered as 50% of central section.
- 8) Ridership of long EW section taken as sum of ridership of the east and west section plus 10% of the sum

Table F: Predicted Ridership on North South ropeway, Central section (2.2 km)

Year	Modal shift from						Total Shift pax	Induced pax	Daily pax	Pax for novelty use	Total Daily pax	PPHPD
	2W	Car	Taxi	Sumo	City Bus	Other Bus						
2021	4929	1207	2420	0	2340	125	11021	9988	21008	250	21258	1063
2022	5751	1408	2823	0	2730	146	12857	11060	23917	250	24167	1208
2023	6572	1609	3226	0	3120	166	14694	12153	26847	250	27097	1355
2024	7394	1811	3629	0	3510	187	16531	13268	29799	250	30049	1502
2025	8215	2012	4033	0	3900	208	18368	14406	32774	250	33024	1651
2026	8215	2012	4033	0	3900	208	18368	15566	33934	250	34184	1709
2027	8215	2012	4033	0	3900	208	18368	16750	35118	250	35368	1768
2028	8215	2012	4033	0	3900	208	18368	17957	36325	250	36575	1829
2029	8215	2012	4033	0	3900	208	18368	19189	37556	250	37806	1890
2030	8215	2012	4033	0	3900	208	18368	20445	38812	250	39062	1953
2031	8215	2012	4033	0	3900	208	18368	21726	40093	250	40343	2017
2032	8215	2012	4033	0	3900	208	18368	23032	41400	250	41650	2082
2033	8215	2012	4033	0	3900	208	18368	24365	42733	250	42983	2149
2034	8215	2012	4033	0	3900	208	18368	25725	44092	250	44342	2217
2035	8215	2012	4033	0	3900	208	18368	27112	45479	250	45729	2286
2036	8215	2012	4033	0	3900	208	18368	28526	46894	250	47144	2357
2037	8215	2012	4033	0	3900	208	18368	29969	48336	250	48586	2429
2038	8215	2012	4033	0	3900	208	18368	31440	49808	250	50058	2503
2039	8215	2012	4033	0	3900	208	18368	32941	51309	250	51559	2578

2040	8215	2012	4033	0	3900	208	18368	34472	52840	250	53090	2655
2041	8215	2012	4033	0	3900	208	18368	36034	54402	250	54652	2733
2042	8215	2012	4033	0	3900	208	18368	37627	55995	250	56245	2812
2043	8215	2012	4033	0	3900	208	18368	39252	57619	250	57869	2893
2044	8215	2012	4033	0	3900	208	18368	40909	59277	250	59527	2976
2045	8215	2012	4033	0	3900	208	18368	42599	60967	250	61217	3061
2046	8215	2012	4033	0	3900	208	18368	42599	60967	250	61217	3061
2047	8215	2012	4033	0	3900	208	18368	42599	60967	250	61217	3061
2048	8215	2012	4033	0	3900	208	18368	42599	60967	250	61217	3061
2049	8215	2012	4033	0	3900	208	18368	42599	60967	250	61217	3061
2050	8215	2012	4033	0	3900	208	18368	42599	60967	250	61217	3061
2051	8215	2012	4033	0	3900	208	18368	42599	60967	250	61217	3061

Table G: Predicted Ridership on East West long ropeway (5.5 km)

Year	Modal shift from					Total shift pax	Pax for Novelty use	Induced pax	Daily total pax	PPHPD
	2-wh	bus	taxi	Std. bus	car					
2021	2177	1510	1959	1724	1007	8377	250	8113	16739	837
2022	2830	1963	2547	2241	1309	10890	250	9610	20750	1037
2023	3483	2416	3134	2758	1612	13403	250	11153	24805	1240
2024	3918	2718	3526	3103	1813	15078	250	12741	28069	1403
2025	4353	3020	3918	3448	2015	16754	250	14378	31381	1569
2026	4353	3020	3918	3448	2015	16754	250	16063	33067	1653
2027	4353	3020	3918	3448	2015	16754	250	17799	34803	1740
2028	4353	3020	3918	3448	2015	16754	250	19587	36591	1830

2029	4353	3020	3918	3448	2015	16754	250	21429	38433	1922
2030	4353	3020	3918	3448	2015	16754	250	23326	40330	2016
2031	4353	3020	3918	3448	2015	16754	250	25280	42284	2114
2032	4353	3020	3918	3448	2015	16754	250	27293	44296	2215
2033	4353	3020	3918	3448	2015	16754	250	29366	46369	2318
2034	4353	3020	3918	3448	2015	16754	250	31501	48504	2425
2035	4353	3020	3918	3448	2015	16754	250	33700	50704	2535
2036	4353	3020	3918	3448	2015	16754	250	35965	52969	2648
2037	4353	3020	3918	3448	2015	16754	250	38298	55302	2765
2038	4353	3020	3918	3448	2015	16754	250	40702	57705	2885
2039	4353	3020	3918	3448	2015	16754	250	43177	60000	3000
2040	4353	3020	3918	3448	2015	16754	250	45726	60000	3000
2041	4353	3020	3918	3448	2015	16754	250	48352	60000	3000
2042	4353	3020	3918	3448	2015	16754	250	51057	60000	3000
2043	4353	3020	3918	3448	2015	16754	250	53843	60000	3000
2044	4353	3020	3918	3448	2015	16754	250	56712	60000	3000
2045	4353	3020	3918	3448	2015	16754	250	59668	60000	3000
2046	4353	3020	3918	3448	2015	16754	250	62712	60000	3000
2047	4353	3020	3918	3448	2015	16754	250	65848	60000	3000
2048	4353	3020	3918	3448	2015	16754	250	69077	60000	3000
2049	4353	3020	3918	3448	2015	16754	250	72404	60000	3000
2050	4353	3020	3918	3448	2015	16754	250	75830	60000	3000
2051	4353	3020	3918	3448	2015	16754	250	79359	60000	3000

Table H: Predicted Ridership on East West short ropeway

Year	Modal shift from							total shift pax	Novelty pax	daily total pax	PPHPD
	2-wh	bus	taxi	std bus	car	lcw	truck				
2021	974	855	1086	1419	889	0	0	5221	250	10148	507
2022	1266	1111	1411	1844	1155	0	0	6788	250	12578	629
2023	1558	1367	1737	2270	1422	0	0	8354	250	15033	752
2024	1753	1538	1954	2554	1600	0	0	9398	250	16994	850

2025	1947	1709	2171	2837	1777	0	0	10442	250	18981	949
2026	1947	1709	2171	2837	1777	0	0	10442	250	19953	998
2027	1947	1709	2171	2837	1777	0	0	10442	250	20954	1048
2028	1947	1709	2171	2837	1777	0	0	10442	250	21985	1099
2029	1947	1709	2171	2837	1777	0	0	10442	250	23047	1152
2030	1947	1709	2171	2837	1777	0	0	10442	250	24140	1207
2031	1947	1709	2171	2837	1777	0	0	10442	250	25267	1263
2032	1947	1709	2171	2837	1777	0	0	10442	250	26427	1321
2033	1947	1709	2171	2837	1777	0	0	10442	250	27622	1381
2034	1947	1709	2171	2837	1777	0	0	10442	250	28853	1443
2035	1947	1709	2171	2837	1777	0	0	10442	250	30121	1506
2036	1947	1709	2171	2837	1777	0	0	10442	250	31427	1571
2037	1947	1709	2171	2837	1777	0	0	10442	250	32772	1639
2038	1947	1709	2171	2837	1777	0	0	10442	250	34157	1708
2039	1947	1709	2171	2837	1777	0	0	10442	250	35584	1779
2040	1947	1709	2171	2837	1777	0	0	10442	250	37054	1800
2041	1947	1709	2171	2837	1777	0	0	10442	250	38568	1928
2042	1947	1709	2171	2837	1777	0	0	10442	250	40127	2006
2043	1947	1709	2171	2837	1777	0	0	10442	250	41734	2087
2044	1947	1709	2171	2837	1777	0	0	10442	250	43388	2169
2045	1947	1709	2171	2837	1777	0	0	10442	250	45092	2255
2046	1947	1709	2171	2837	1777	0	0	10442	250	46847	2342
2047	1947	1709	2171	2837	1777	0	0	10442	250	48655	2433
2048	1947	1709	2171	2837	1777	0	0	10442	250	50516	2526
2049	1947	1709	2171	2837	1777	0	0	10442	250	52434	2622
2050	1947	1709	2171	2837	1777	0	0	10442	250	54410	2720
2051	1947	1709	2171	2837	1777	0	0	10442	250	56444	2822

Table J: Predicted Ridership on N-S ropeway – north section

Year	Daily pax	PPHPD
2021	12755	638
2022	14500	725
2023	16258	813
2024	18030	901
2025	19814	991
2026	20510	1026
2027	21221	1061
2028	21945	1097
2029	22684	1134
2030	23437	1172
2031	24206	1210
2032	24990	1249
2033	25790	1289
2034	26605	1330
2035	27437	1372
2036	28286	1414
2037	29152	1458
2038	30035	1502
2039	30935	1547
2040	31854	1593
2041	32791	1640

Table K: Predicted Ridership on N-S ropeway – south section

Year	Daily pax	PPHPD
2021	10629	531
2022	12084	604
2023	13549	677
2024	15025	751
2025	16512	826
2026	17092	855
2027	17684	884
2028	18287	914
2029	18903	945
2030	19531	977
2031	20172	1009
2032	20825	1041
2033	21491	1075
2034	22171	1109
2035	22865	1143
2036	23572	1179
2037	24293	1215
2038	25029	1251
2039	25779	1289
2040	26545	1327
2041	27326	1366

Table L: Revenue from East West ropeway short

Year	Daily pax	Avg length	Fare (Rs)	Amount (Rs)	Daily Amount Rs Cr	Annual Amount Rs Cr
2021	10148	2	40	405926.12	0.04	14.21
2022	12578	2	40	503114.48	0.05	17.61
2023	15033	2	40	601338.87	0.06	21.05
2024	16994	2	40	679745.74	0.07	23.79
2025	18981	2	40	759251.75	0.08	26.57
2026	19953	2	40	798120.59	0.08	27.93
2027	20954	2	40	838155.51	0.08	29.34
2028	21985	2	40	879391.47	0.09	30.78
2029	23047	2	40	921864.5	0.09	32.27
2030	24140	2	40	965611.73	0.10	33.80
2031	25267	2	40	1010671.4	0.10	35.37
2032	26427	2	40	1057082.8	0.11	37.00
2033	27622	2	40	1104886.6	0.11	38.67
2034	28853	2	40	1154124.5	0.12	40.39
2035	30121	2	40	1204839.5	0.12	42.17
2036	31427	2	40	1257076	0.13	44.00
2037	32772	2	40	1310879.6	0.13	45.88
2038	34157	2	40	1366297.2	0.14	47.82
2039	35584	2	40	1423377.5	0.14	49.82
2040	37054	2	40	1482170.1	0.15	51.88
2041	38568	2	40	1542726.5	0.15	54.00
2042	40127	2	40	1605099.6	0.16	56.18
2043	41734	2	40	1669343.8	0.17	58.43
2044	43388	2	40	1735515.4	0.17	60.74
2045	45092	2	40	1803672.2	0.18	63.13
2046	46847	2	40	1873873.7	0.19	65.59
2047	48655	2	40	1946181.2	0.19	68.12
2048	50516	2	40	2020657.9	0.20	70.72
2049	52434	2	40	2097368.9	0.21	73.41
2050	54410	2	40	2176381.3	0.22	76.17
2051	56444	2	40	2257764	0.23	79.02

Note: Additional revenue of 0.5 Cr possible from commercial development at stations. Considered 345 days operation in a year

Table M: Revenue from East West ropeway long

year	daily total	Avg length	Fare (Rs)	Amount (Rs)	Daily Amount Rs Cr	Annual Amount Rs Cr
2021	16739	3	60	1004357.7	0.10	35.15
2022	20750	3	60	1244992.8	0.12	43.57
2023	24805	3	60	1488323.5	0.15	52.09
2024	28069	3	60	1684169.9	0.17	58.95
2025	31381	3	60	1882876.1	0.19	65.90
2026	33067	3	60	1984006.2	0.20	69.44

2027	34803	3	60	2088170.3	0.21	73.09
2028	36591	3	60	2195459.3	0.22	76.84
2029	38433	3	60	2305967	0.23	80.71
2030	40330	3	60	2419789.9	0.24	84.69
2031	42284	3	60	2537027.5	0.25	88.80
2032	44296	3	60	2657782.2	0.27	93.02
2033	46369	3	60	2782159.6	0.28	97.38
2034	48504	3	60	2910268.3	0.29	101.86
2035	50704	3	60	3042220.2	0.30	106.48
2036	52969	3	60	3178130.7	0.32	111.23
2037	55302	3	60	3318118.5	0.33	116.13
2038	57705	3	60	3462306	0.35	121.18
2039	60180	3	60	3610819	0.36	126.38
2040	62730	3	60	3763787.5	0.38	131.73
2041	65356	3	60	3921345	0.39	137.25
2042	68060	3	60	4083629.3	0.41	142.93
2043	70846	3	60	4250782	0.43	148.78
2044	73716	3	60	4422949.4	0.44	154.80
2045	76671	3	60	4600281.8	0.46	161.01
2046	79716	3	60	4782934.1	0.48	167.40
2047	82851	3	60	4971066	0.50	173.99
2048	86081	3	60	5164841.9	0.52	180.77
2049	89407	3	60	5364431.1	0.54	187.76
2050	92833	3	60	5570007.9	0.56	194.95
2051	96363	3	60	5781752	0.58	202.36

Note: Additional revenue of 1 Cr possible from commercial development at stations

Table N: Revenue from North South ropeway long

yr	daily total	Avg length	Fare (Rs)	Amount (Rs)	Daily Amount Rs Cr	Annual Amount Rs Cr
2021	21258	3	60	1275496	0.13	44.00
2022	24167	3	60	1450020.6	0.15	50.03
2023	27097	3	60	1625831.7	0.16	56.09
2024	30049	3	60	1802954.8	0.18	62.20
2025	33024	3	60	1981416.3	0.20	68.36
2026	34184	3	60	2051037.3	0.21	70.76
2027	35368	3	60	2122050.7	0.21	73.21
2028	36575	3	60	2194484.4	0.22	75.71
2029	37806	3	60	2268366.8	0.23	78.26
2030	39062	3	60	2343726.8	0.23	80.86
2031	40343	3	60	2420594	0.24	83.51
2032	41650	3	60	2498998.6	0.25	86.22
2033	42983	3	60	2578971.2	0.26	88.97
2034	44342	3	60	2660543.3	0.27	91.79
2035	45729	3	60	2743746.9	0.27	94.66
2036	47144	3	60	2828614.5	0.28	97.59
2037	48586	3	60	2915179.5	0.29	100.57

2038	50058	3	60	3003475.7	0.30	103.62
2039	51559	3	60	3093537.9	0.31	106.73
2040	53090	3	60	3185401.4	0.32	109.90
2041	54652	3	60	3279102.1	0.33	113.13
2042	56245	3	60	3374676.8	0.34	116.43
2043	57869	3	60	3472163	0.35	119.79
2044	59527	3	60	3571599	0.36	123.22
2045	61217	3	60	3673023.6	0.37	126.72
2046	61217	3	60	3673023.6	0.37	126.72
2047	61217	3	60	3673023.6	0.37	126.72
2048	61217	3	60	3673023.6	0.37	126.72
2049	61217	3	60	3673023.6	0.37	126.72
2050	61217	3	60	3673023.6	0.37	126.72
2051	61217	3	60	3673023.6	0.37	126.72

Note: Additional revenue of 2 Cr possible from commercial development at stations

Appendix 4.6: Service Level GAP/Benchmark Analysis for Urban Transport in Aizawl City

Indicator*	Sub-Indicator*	Parameter	Formula	Unit	Value**	LOS***
1. City Wide Public Transport System	1. Presence of Organized Public Transport System in Urban Area (%)	No of Buses in the city	a	Nos	590	2
		Buses under the ownership of STU/SPV or under concession agreement	b	Nos	290	
		Presence of Public Transport System (%)	b/a	%	49%	
	2. Extent of Supply Availability of Public	No of Buses available in a city on any day	a	Nos	160	2
		Total Population of the city	b	Nos	356800	
		Availability of PT per lakh population	a/b	Ratio	0.45	
	3. Service Coverage of Public Transport in the city	Total length in road kms of the corridors on which public transport systems ply in the city.	a	km	76	3
		Area of the urban limits of the city	b	sq. km	152	
		Service Coverage	a/b	km/sq.km	0.50	
	6. % of Fleet as per Urban Bus Specification	Total number of buses in the city	a	Nos	290	4
Total number of buses in the city as per urban bus specifications in the city		b	Nos	15		
% of Fleet as per Urban Bus Specification		b/a	%	5%		
5. City wide speed	1. Speed of vehicles	Average across various corridors		kph	18	3
	2. Speed of Buses	Average across various corridors		kph	11	3
		City-wide Traffic Speed along Major corridors		kph	15	3
6. Parking Spaces	1. Paid Parking Availability	Total on-street paid parking spaces	a	ECS	35	3
		Total available on street parking spaces	b	ECS	100	
		Availability of Paid Parking Spaces	a/b	%	0.35	
	2. Difference in Parking Fee	Max parking fee (for 2hrs)	a	INR	30	2
		Min parking fee (for 2hrs)	b	INR	10	
Ratio of Maximum to Minimum parking fee		a/b	ratio	3		
	Overall City Wide Parking Availability		LOS		3	
7. Road Safety	1. Total Fatality Rate	Total number of fatalities	a	Nos	12	2
		Population	b	Nos	356800	
		Fatality rate per lakh population	$10^5 * a/b$	Ratio	3.36	
	2. NMT Fatality Rate	Total number of NMT fatalities	a		0	1
		Total number of fatalities	b		12	
		Fatality rate for pedestrian and NMT	a/b	%	0%	
	Overall City wide road safety		LOS		2	
* Source: jnnurm.nic.in/wp-content/uploads/2010/12/SLB-Urban-Transport.pdf						
** Baseline data from secondary sources for Aizawl City						
*** Consultant estimate as per MoUD guidelines						

Appendix 4.7: Power requirement for proposed Ropeway in Aizawl

Section	km	KW
EW east section	2.6	380
EW west section	2.8	410
NS north section	3.5	520
NS central section	2.2	320
NS south section	1.8	270

Installed power generating capacity in Mizoram	29	MW
Peak demand	80	MW
Regular demand	40	MW

Source: ZEDA, GoM

Appendix 4.8: Wind effect on ropeways

Three existing ropeways were studied for effect of wind: Medellin, Columbia, La Paz, Bolivia and London, UK.

Medellín in Columbia is located in the Aburra valley and is surrounded by hills. Many of the communities are located in very steep grounds to the extent that not even a regular bus system could be either useful or commercially profitable. The Metrocable system uses Monocable Detachable Gondola (MDG) technology. The system has been in operation from 2004. The line length is 2 km and operates at average speed of 16 km/hr. The elevation is 399 m.

Mi Teleférico is an aerial cable car urban transit system opened in 2014 in the Bolivian city of La Paz. Currently three lines are in operation and six more lines are in the planning stage. The system length is 6 km. It is a MDG system. Operation started in 2014.

The Emirates Air Line is a cable car link across the river Thames in London, UK.. The service opened in June 2012. It is of MDG technology and the length is 1 km.

High wind speeds have an effect on ropeways. Mono and bi cable gondola systems are more affected than tri-cable gondola system. In conditions of sustained wind speed, ropeway service may need to be suspended for some time. Tri cable gondola system are more stable in high wind and can operate till 100 km/hr wind speed.

Wind speed data for Aizawl, Medellin, La Paz and London was studied. Historical wind speed data was searched for Aizawl area. The website: myweather2.com/city-town/India/Aizawl publishes weather news and historical weather data for nearly all countries in the world. This website belongs to Myweather2 which is a company registered in the UK and is a leading provider of personalised, location based, global weather information with clients around the world. Weather2 services are delivered via mobile telephone and the Internet.

Wind speed data for Aizawl is published on the website. Month wise data for average wind speed and historically maximum ever wind speed in every month is shown in Table 1. It can be seen that historically, the maximum wind speed occurred in October and the speed was 83 km/hr. The next high value was 78 km/hr in April.

Table 1: Month wise wind speed in Aizawl

Month	Average wind speed (km/hr)	Maximum recorded wind speed in month (km/hr)
January	1	70
February	2	67
March	4	74
April	5	78
May	4	63
June	5	74
July	5	76
August	4	52
September	3	63
October	2	83
November	1	76
December	1	67

Wind speed data for Medellin, Columbia and La Paz, Bolivia were studied. No available record was found saying that ropeways in these cities were shut down due to high wind speed.

Table 2: Month wise wind speed in Medellin, Columbia and La Paz, Bolivia

Month	Medellin, Columbia		La Paz, Bolivia	
	Average wind speed (km/hr)	Maximum recorded wind speed in month (km/hr)	Average wind speed (km/hr)	Maximum recorded wind speed in month (km/hr)
January	4	72	10	65
February	5	72	10	93
March	4	69	10	83
April	4	72	9	41
May	5	69	9	85
June	6	85	10	63
July	7	94	11	83
August	7	107	11	61
September	5	76	11	78
October	4	80	11	83
November	3	69	11	93
December	4	69	11	81

It is seen that the maximum wind speed in Medellin was 107 km/hr and that in La Paz was 93 km/hr. The ropeways could operate at that speed and had built in safety features to withstand high winds.

The Emirates cable car in London across river Thames had been shut down for several hours in the last few years. Wind speed data from two locations in London was studied. The wind speed data is shown in Table 3. It is seen that the highest wind speed was 93 in February and November, followed by 85 km/hr in February.

Table 3: Month wise wind speed in London, UK

Month	At Street Circuit		Near Canary Wharf	
	Average wind speed (km/hr)	Maximum recorded wind speed in month (km/hr)	Average wind speed (km/hr)	Maximum recorded wind speed in month (km/hr)
January	17	65	15	70
February	16	93	14	85
March	15	83	15	56
April	15	41	14	69
May	15	85	13	50
June	14	63	11	56
July	13	83	11	48
August	13	61	11	74
September	13	78	11	56
October	14	83	12	69
November	14	93	12	57
December	15	81	13	65

The closure time was studied from newspaper report, published in The Evening Standard on 19 March 2015. Average closure was for about 7 hours in a day and for 4 days in the windy months. The highest observed wind speed in Aizawl is less than that in Medellin, La Paz and London. The ropeway system in these cities is mono cable type. The system proposed for Aizawl is bi cable detachable gondola type. This is more stable than no cable.

It can be said that the proposed ropeway can operate safely in Aizawl. The modern ropeways have built in features for stability against high winds. The most stable system - tri cable gondola is 50% more expensive than bi cable. It would not be feasible to construct tri cable system for a few windy days in a year. In the worst situation the ropeway can be closed for 5 hours on 2 to 3 days in the windiest months of October and April.

APPENDIX 5: ECO-FRIENDLY FUELS -BACKGROUND DETAILS AND ASSESSMENT

The following pages provide background details of various types of eco-friendly fuels and vehicles, and a qualitative assessment of their various advantages, disadvantages and suitability for Aizawl.

Appendix 5.1: Long-list of eco-friendly fuels for road transport

Appendix 5.2: Rapid assessment of eco-friendly fuel options for Aizawl

Appendix 5.3: Background details of the various eco-friendly fuels:

1. Low-emission diesel / clean diesel
2. Hybrid electric vehicles
3. All-electric vehicles
4. Fuels derived from Natural Gas (LPG, CNG, CNG from coal bed methane, LNG)
5. Bio-fuels
6. Ethanol
7. Methanol
8. Hydrogen fuel cells

Appendix 5.1: Long-List of Eco-Friendly Fuels for Road Transport

	Fuel Source / Vehicle Type	Further Details	Vehicle and Infrastructure Requirements	Current Application Elsewhere (India & Overseas)
1	Low-Emission Diesel	Cleaner diesel fuels that produce lower emissions – mechanical treatments reduce emissions of ozone-forming compounds (NOx and HC) and trap particulate matter (PM).	Infrastructure for supply and distribution needed. Vehicles can fill up fuel from pumps like regular fuel. No special conversion kits required.	Available in USA and some European countries. Not available at pumps in India yet.
2	Hybrid Electric Battery/Diesel	HEVs combine two or more energy conversion technologies (e.g. heat engines, fuel cells, generators, or motors) with one or more energy storage technologies (e.g. fuel, batteries, ultra-capacitors, or flywheels). This gives significant reduction in emissions.	Either new buses (more expensive) or retro-fit existing buses. Charging points needed. Maintenance workshops needed.	Tata have come out with electric buses, and Bengaluru has started using hybrid electric buses. Widely used in Europe and North America, supported by government subsidies, but take-up has been relatively slow nonetheless. London recently introduced a fleet of hybrid buses (electric-diesel), but extensive teething problems.
3	All-Electric (Battery-Powered)	Motive power is drawn directly from electricity and there is no combustion, hence no tail pipe emission. Electricity used to power vehicles is commonly provided by batteries, but recently fuel cells are also being explored.	Charging stations required all over the city. There will be a rise in power needs.	Usage in USA, Europe and China is still fairly limited, despite subsidies and infrastructure support (2 lakh sold world-wide in 2013). Very limited usage in personal cars in India (just 3,000 in 2012). Usage of electric bus at experimental stage in India.
4	LPG (Liquefied Petroleum Gas or 'Auto-Gas')	LPG is a by-product of natural gas processing or a product that comes from crude oil refining. LPG has less emission than conventional fuel.	LPG supply and distribution for vehicle use needs to be improved. Presently LPG is used for domestic purpose in relatively small containers.	Vehicles with LPG conversion kits are used all over India. Kits are easily available and cheap. All auto rickshaws plying in Kolkata have been converted to LPG. Several buses have also been converted.

5	CNG (Compressed Natural Gas)	Natural gas is produced either from gas wells or during crude oil production. Due to its low energy density for use as a vehicular fuel, it is compressed under high pressure to facilitate storage in cylinders mounted in vehicle. It is better than conventional fuels both in exhaust emissions.	CNG buses and cars are commercially available, and conversion kits are also available. Supply of CNG is essential. Currently CNG supply is available in Delhi, Maharashtra and Andhra Pradesh only.	All buses in Delhi have been converted to CNG, and some in Mumbai. CNG is not available in Kolkata.
6	LNG (Liquefied Natural Gas)	It is produced from natural gas and is primarily methane. It is converted to liquid for the purpose of storage and transport. LNG offers advantage over CNG as a fuel for demanding, heavy duty vehicle applications. It has significantly lower NOx and particulate emission than diesel.	LNG is not available in India. Vehicles that can run on LNG are also not available. LNG storage is complex because of high pressure and toxic fumes.	It is used as a fuel for goods vehicles in California, USA. It is not in use in India.
7	Bio-Fuels: Bio-Ethanol Bio-Diesel Other Bio-Fuels	Bio-fuels can be 100% bio, or blends of bio-fuel with diesel and petrol (e.g. B5 = 5% bio/95% diesel; B20 = 20%/80%; etc). 'Bio-diesel' is diesel produced wholly from agricultural crops. Pure bio-diesel is one of the greenest fuels.	Development of a supply of fuel and vehicle is an issue.	Bio fuels are used in North America and Europe. Govt policy encourages its use in India.
8	Ethanol, Methanol, and other Alcohols	Alcohols are blended with petrol / diesel and emission quality is improved. Usually 5% ethanol or up to 15% methanol is blended with petrol.	Supply and distribution of blended fuel is an issue. Vehicles that can use such fuel are also not easily available.	Blended fuels have been used in USA for some time. It is used in western Europe. It has limited use in India. Govt encourages its use.

9	Hydrogen Fuel Cell	Compressed hydrogen is used as a fuel. It reacts chemically with oxygen to produce electricity and water as by product. Electricity is used to drive vehicles. There is no tail pipe emission. Water is the only emission.	Very expensive to use. Availability of fuel, buses / cars, maintenance and repair are issues.	Technology not very developed yet in the western world. Vehicles and fuel not easily available in India. Tata and Ashok Leyland have plans for introducing buses.
10	Others eco-fuels: e.g. DME, P-series fuel, Purinox, Hythane	DME (Dimethyl Ether) is an ether compound, synthesized from natural gas. P-series fuel includes blends of methyltetrahydrofuran, ethanol and hydrocarbons. Purinox is water-diesel emulsified fuel. Hythane is a mix of hydrogen and natural gas. It is suitable for CNG / LNG / dual fuel vehicles.	Availability of fuel and vehicles to run on the fuel are issues.	DME and P-series used on a small scale in USA, but still in research stage in India. Purinox: Worldwide about 6000 vehicles run on this. In India its use has not been encouraged. Hythane: Has been in use in USA for some time. Hythane Company is trying to market it in India.

Appendix 5-2: Rapid Assessment of Eco-friendly Fuel Options for Aizawl

S. No.	Criteria	CNG	LPG	Electric Vehicle	Hydrogen fuel	Biofuel / Hygro
A	Technical Feasibility					
1	Availability of vehicle	G	F	P	U	F
2	Availability of fuel	P	P	P	P	P
3	Compatibility with / ease of adaptation to present vehicles	G	G	U	U	G
B	Vehicle Performance					
1	Performance in hilly terrain	F	F	F	F	F
2	Fuel efficiency in hilly terrain	P	P	P	U	P
3	Safety features	G	P	G	U	G
C	Operational and Maintenance Requirements					
1	Need for maintenance	Min	Min	Ex	Ex	Min
2	Availability of spares	F	F	P	P	F
3	Requirement of training	Min	Min	Ex	Ex	Min
D	Economic & Financial Feasibility					
1	Capital cost of vehicles	M	M	H	H	L
2	Maintenance cost	M	M	H	H	L
3	Operation cost	M	M	L	H	M
4	Replacement incentive	L	L	M	M	L
5	Subsidy incentive	L	L	H	M	M
6	PPP possibility	L	L	M	M	L
C	Environmental & Social Impacts					
1	Emission	F	F	G	G	F
2	Acceptability	F	F	G	G	F
D	Other Relevant Advantages / Disadvantages					
1	Best practice	L	L	H	H	M
2	Previous experience	Av	Av	Par	N	Par
3	Cost of fuel distribution network	H	M	H	H	M

Assessment

G	Good
F	Fair
P	Poor
U	Not known
Ex	Extensive
Min	Minimal
H	High
Med	Medium
L	Low
Av	Available
Par	Partial
N	New

Appendix 5-3: Background Details on Alternative Eco-Fuel Options

Eco-Fuels Considered:

1. Low-emission diesel / clean diesel
2. Hybrid electric vehicles
3. All-electric vehicles
4. Fuels derived from Natural Gas (LPG, CNG, CNG from coal bed methane, LNG)
5. Bio-fuels
6. Ethanol
7. Methanol
8. Hydrogen fuel cells

1. Low Emission Diesel / Clean Diesel

Reducing sulfur content in fuels not only reduces air pollution related to sulfur, but also allows for the use of exhaust after-treatment technologies. Sulfur in fuel contributes to formation of particulates that clog filters and therefore reduce the effectiveness of emission reduction technologies like diesel particulate filters. Developing countries commonly have sulfur content levels above 500 parts per million (ppm); sulfur levels below this value allow for the use oxidation catalysts. Below 50 ppm, additional emissions reduction technologies are available (UNEP 2007).

These are cleaner diesel fuels that produce lower emissions and enable advanced emission treatment systems (e.g. catalysts and filters) to be used, which in turn lower carbon monoxide (CO), nitrogen oxide (NOx) and hydrocarbon (HC) emissions. Advanced low-Sulphur fuels are also available. Emissions treatment such as particulate filters and oxidation catalysts reduce emissions of ozone-forming compounds (NOx and HC) and trap and eliminate particulate matter (PM). These can result in 97% less Sulphur and reduce soot emission by 10%.

2. Hybrid Electric Vehicles

Hybrid Electric Vehicles (HEVs) combine two or more energy conversion technologies (e.g. heat engines, fuel cells, generators, or motors) with one or more energy storage technologies (e.g. fuel, batteries, ultra-capacitors, or flywheels). The combination of conventional and electric propulsion systems reduces emission and fuel consumption, while giving extended range and convenient refueling.

HEVs can either have a parallel or a series design. In a parallel design, the energy conversion unit and electric propulsion system are connected directly to the vehicle's wheels. The primary engine is used for highway driving; the electric motor provides added power during hill climbs, acceleration, and other periods of high demand. In a series design, the primary engine is connected to a generator that produces electricity. The electricity charges the batteries and drives an electric motor that powers the wheels.

Tata Star bus 32-Seater CNG Electric Hybrid Bus works in the Parallel configuration. The bus uses

power generation from both electric motor and CNG engine to run the vehicle. Energy from braking is not lost - it is utilised to recharge the battery. The Parallel configuration is ideal for operating hybrid electric buses in the 'Stop-and-Go' traffic conditions of cities. Tata first introduced a hybrid CNG-electric bus in 2010, and now produces both series and parallel hybrid buses, for both diesel and CNG fuels together with electric battery and motor. Tata now manufactures a hybrid electric bus of its 32-seater Star bus. There are challenges such as absence of standards for hybrid vehicles under Central Motor Vehicles Rules. The lithium ion batteries are expensive and cannot be easily recharged due to lack of recharge stations. Tata claims an overall 30% reduction in emissions for its series hybrid bus, which combines electric with either CNG or diesel.

Ashok Leyland will start manufacturing and marketing electric and hybrid buses in India from 2015. It will be launching the Solo bus from Optare, UK in New Delhi in early 2015, and then look at manufacturing electric and hybrid buses in India. Optare has been selling 100 electric buses a year in the U.K. The buses are expensive (Rs.2-3 crore), and can run up to 200 km.

Emissions and Fuel Savings: Based on a London test, a reduction in CO2 emissions of 31% and fuel savings in the range of 40% have been demonstrated compared with a modern "Euro-4" compliant bus.

Teething problem in London: Transport for London had introduced a fleet of 200 new hybrid Routemaster buses which were supposed to be cleanest and greenest. It is reported that 80 run on only diesel and all have battery problem. Drivers have reported that because of failing batteries, they are not used. Using only diesel engine slows the bus and has poor acceleration.

Government Support

To promote eco-friendly vehicles, the GoI launched Faster Adoption and Manufacturing of Hybrid and Electric vehicles (FAME) scheme, offering incentives on electric and hybrid vehicles of up to Rs 29,000 for motorbikes and Rs 1.38 lakh for cars. It is a part of the National Electric Mobility Mission Plan. The scheme envisages Rs 795 crore support in the first two fiscal years, starting with the current year. The scheme has been started initially in metropolitan cities, eventually it will be launched in smart cities and other cities. As per the scheme, depending on technology, battery operated scooters and motorcycles will be eligible for incentives ranging from Rs 1,800 to Rs 29,000. For three-wheelers it will be from Rs 3,300 to Rs 61,000. For four-wheelers, the incentives will range from Rs 13,000 to Rs 1.38 lakh, while for light commercial vehicles it will be from Rs 17,000 to Rs 1.87 lakh. For buses it will range from Rs 34 lakh to Rs 66 lakh.

Assessment Summary (Hybrid buses):

Costs	Environmental Benefits	Tried and Tested	Ease of Introduction	Supported by Indian Govt. policy
Higher capital cost, but fuel savings expected over time	Significant reductions in CO2 and other emissions	Used on only a limited scale so far in developed countries, and not yet seen in India	Feasible: manufacture of hybrid buses was recently started in India. Need for charging infrastructure to be set up	Yes: the FAME programme will give Rs 795 crore grant support in 2015-17, with grants of up to Rs 1.38 lakh for 4-wheelers and Rs.34-66 lakh for

				buses. Priority to cities under the 'Smart Cities' programme (e.g. Aizawl)
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3. All-Electric Vehicles

Electricity is unique among the alternative fuels in that mechanical power is derived directly from it, whereas the other alternative fuels release stored chemical energy through combustion to provide mechanical power. Electricity used to power vehicles is commonly provided by batteries, but recently fuel cells are also being explored.

Batteries are energy storage devices. A large number of various types of batteries are being tested for use in electric vehicles. Some of the technologies include lead-acid, nickel cadmium, nickel iron, nickel zinc, nickel metal hydride, sodium nickel chloride, zinc bromine, sodium sulphur, lithium, zinc air and aluminum air. On the other hand fuel cells convert chemical energy to electricity, which then power the motor.

Fuel cells are becoming the most promising so far as electricity generation is concerned. A fuel cell is an electrochemical energy conversion device. It is two to three times more efficient than an internal combustion engine in converting fuel to power. A fuel cell produces electricity, water and heat using fuel and oxygen in the air. Water is the only emission when hydrogen is the fuel.

While drivers must periodically recharge battery powered vehicles with electricity generated elsewhere, fuel-cell vehicles make their own power from on board supply of hydrogen, or a hydrogen-rich fuel such as natural gas, methanol, ethanol or gasoline. This enables drivers to fill up at a service station, rather than recharge the car, making it a more practical solution for today's automobiles. There are six basic types of fuel cells, solid oxide, phosphoric acid, alkaline, molten carbonate, direct methanol and Proton-Exchange Membrane (PEM). The PEM fuel cell has several advantages for transportation use:

- High power density
- Relatively quick start up
- Compact size
- Low operating temperature
- Low noise levels.

Emissions

There are no tailpipe emissions. Water is the only emission when hydrogen is used as the fuel in fuel cells. But the process of commercial hydrogen production to feed the fuel cell is associated with some CO₂ emissions.

Advantages of electric fuel:

- No tailpipe emissions.
- Vehicles using electric fuel demand less maintenance.
- Electric fuel vehicle have less moving parts to service and replace.
- Acceleration, speed and handling for well-designed vehicles are equivalent to, or better than, those of comparable internal combustion powered vehicles.
- Fuel cells vehicles are highly efficient.
- Fuel cells have high power density.

Disadvantages of electric fuel:

- Batteries may take time in charging.
- Weather extremes and use of accessories such as air conditioning can affect the range of electric vehicles.

- Noble metal required for some fuel cells thereby increasing the cost.
- Impurities in the hydrogen can hamper cell performance.
- Commercial production of hydrogen to cater to the fuel cells results in substantial copious CO2 emissions.
- Costly technology.
- Limited life of the battery is also a limitation of electric vehicles.

More than 4000 electric vehicles are operating throughout the United States with the largest numbers in California.

Operation & Performance:

- Efficient operation when properly designed.
- Less moving parts demand less maintenance.
- Less noisy while in operation.
- Range spans from 50 to 130 miles depending on the vehicle weight, design and type of battery.
- Decrease in available specific energy in transient driving cycles and decrease in vehicle range with increased speed is reported.
- Sometimes cold weather may drop the specific energy, which the battery can store and hence vehicle range.

Safety Issues:

When designed properly the electric vehicles are quite safe. The battery or fuel cell stack on-board the vehicles contain enough charge to be fatal, so proper design and grounding should be done.

Storage & Distribution:

Electric vehicles require charging facilities, which automatically exists with the infrastructure of electricity utility distribution system. Installation of equipment at charging locations are expensive and sometimes charging may take much time depending on the remaining state of charge of the batteries and available voltage.

Indian Initiative on Electric Vehicles:

In India Bharat Heavy Electricals Ltd., Eddy Current Controls India Ltd., Cheetlec Vehicles India Ltd. and recently Bajaj are established to produce electric vehicles. The technologies developed so far have reached a level to meet the basic operational requirements of urban road transport and industrial sector in a limited way. They are on their way to commercialize various models developed.

India's first electric bus was inaugurated in Bangalore in September 2014. It has been manufactured by BYD Auto. It ran for 170 km in a day with speed of 60-65 km/hr during peak hours. It is being tested to see how it performs in Indian urban conditions. India's first commercial electric car, was produced by the erstwhile REVA Electric Car Company (RECC) in 2001. The number of such cars in use is dismally low at just about 4,000 units. Now Reva is a full-fledged electric arm under the flagship of Mahindra & Mahindra (MREV) one of the large vehicle manufacturers in India and also the largest producer of tractors in the world. MREV's latest offering, the e2O, was launched in March of 2013. The vehicle is powered by more advanced lithium-ion batteries, which enable it to drive up to 100km in one charge. The Exide battery from China, much lighter than lead-acid one, contributes to a more nimble handling and claims a significantly longer life span. Sales are low, primarily because of high price. For a tiny hatchback which can seat 4 adults, and takes 4 hours to charge, is priced at Rs 6.75 lakh in Delhi, after 29% state government subsidy. M & M expects that if the National Electric Mobility Mission Plan 2020 (NEMMP) is implemented it might play a role in changing the scenario. Under NEMMP, the government is considering to give incentives of Rs 14,000 crore for promotion of electric vehicle.

4. Fuels Derived from Natural Gas

4a. Liquefied Petroleum Gas (LPG)

LPG is a by-product of natural gas processing or a product that comes from crude oil refining and is composed primarily of propane and butane with smaller amounts of propylene and butylene. LPG is a by-product of two sources: natural gas processing and crude oil refining. The components of LPG are: ethane 0.2%, propane 57.3%, butane 41.1% and pentane 1.4%. It is the third most widely-used auto fuel in the world (after petrol and diesel), popular largely because of lower taxes.

Advantages of LPG:

- Reduction in emissions.
- Very less carbon build-up increases life of engine parts like spark plugs.
- Fueling is akin to that of conventional diesel or gasoline and time needed is also similar.
- Service life of a vehicle increases with LPG.
- Little or no damage to soil and water if it is spilled, due to its rapid evaporation.
- Higher octane number.

Disadvantages of LPG:

No major disadvantages.

Safety Issues:

Safety is an issue with LPG, however, standards for application, storage and distribution already exists. The hazard associated with on-board storage similar to that of gasoline. LPG fuel systems have many built-in safety features and they generally maintain their integrity in severe collisions and do not permit massive leaks. LPG is about twice as heavier than air and unlike CNG does not disperse easily in air. Its flammability limits and auto ignition temperature are lower than natural gas and as such should not be handled carelessly. Accident statistics, though limited, indicate that LPG or propane is as safe as gasoline.

Emissions

LPG outperforms conventional fuels in both regulated and non-regulated emissions. For all parameters: HC, CO, NOx, particulates and CO2, LPG buses performed better than diesel Euro II buses.

Indian experience

Some motor manufacturers specifically build LPG vehicles. Bi-fuel models (petrol and LPG, or bio-fuel and LPG) are also available. It can be used in scooters and mopeds too. Existing petrol vehicles can be converted to LPG, though converting diesel-engined vehicles is more costly and complex, and not so common.

India is world's fourth largest user of LPG. It is mostly used as a domestic fuel, and heavily subsidized. It is also used in transport sector, with 0.5 million vehicles, about 0.5% of total motor transport fuel consumption. Assam has three refineries which produce about half of the regional LPG demand of 32,800 metric tonnes (2014). The rest is imported from outside the region. A project was launched in Guwahati in 2007 to convert auto-rickshaws to LPG, but the conversion cost was Rs 20-25,000 and there was a poor response from owners.

Government supports LPG mainly through exemption from excise tax and generally lower state sales tax compared with diesel and gasoline (these vary by state and fuel). In 2013 LPG prices (at Rs 48 per litre) were only 65% that of petrol prices, but 89% of the diesel price.

Several cities – Bangalore, Ahmedabad, Chennai, Hyderabad and Kolkata – have been encouraging the use of LPG through 'stick and carrot' measures: e.g. mandatory conversion of auto-rickshaws, a green tax on older vehicles, subsidies on conversion costs. The main mode of conversion has been auto-rickshaws. Savings on fuel costs for switching from diesel to LPG are small, and give owners less incentive. The cost of converting diesel buses to LPG in Kolkata in

2009 was estimated at Rs. 1.5 lakh (\$ 2143) or 3.5% of the vehicle's capital cost. The High Court in Kolkata had ruled that 15 year old buses and taxis should be phased out by June 2009, which would affect 70% of the fleet. The bus service provider in Goa is studying the feasibility of using LPG for fleet of 543 buses. LPG is already the mandated fuel for public transport buses in New Delhi and Mumbai.

4b. Compressed Natural Gas (CNG)

Natural gas is a mixture of hydrocarbons-mainly methane (CH₄) and is produced either from gas wells or in conjunction with crude oil production. Due to its low energy density for use as a vehicular fuel, it is compressed to a pressure of 200-250 bars to facilitate storage in cylinders mounted in vehicle and so it is called compressed natural gas (CNG).

Compressed natural gas (CNG) is widely used as a fuel for motor vehicles. Worldwide there were more than 15 million vehicles using it in 2011, and in Pakistan more than half of all motor vehicles are powered by CNG. Similarly in Dhaka, more than half of all cars and vans and nearly all auto-rickshaws are powered by CNG. It is less widespread in India. In 2011 there were over 1 million CNG-powered vehicles, especially auto-rickshaws, but these were concentrated in cities and states with access to natural gas supplies – e.g. Mumbai, Delhi, Gujarat, Uttar Pradesh and Andhra Pradesh. There are also natural gas reserves in Assam and Tripura, but CNG use in North East India is negligible.

Emissions:

It stands substantially better than conventional fuels both in life cycle emissions and vehicle exhaust emissions.

Advantages of CNG:

- CNG is a cleaner fuel than petrol or diesel. Although a fossil fuel (derived from methane gas), it produces less CO₂ and nitrous oxides (NO_x), and considerably less particulate matter than conventional petrol or diesel fuels.
- No visible tail pipe emissions.
- Eliminates sulphur and lead from the exhaust emissions.
- Reduction in CO, NO_x and Particulate emissions.
- Significant reduction in benzene and other toxic emissions.
- Higher octane value of CNG reduces knocking problems of a vehicle.
- Reduces noise from running vehicles.
- CNG cannot be adulterated.
- Reduce noise in operation.

Disadvantages of CNG:

- Infrastructure needed for supply
- On board storage
- Safety issue

Safety Issues:

CNG has a distinct odor which helps in identifying leakage. Its ignition temperature is high, so it does not catch fire easily. It is relatively safe to use. Recent research at the Council of Scientific and Industrial Research (CSIR) says, even though CNG vehicles are safer than diesel, gases produced while burning CNG contain carbon nanoparticles that are suspected to cause cancer.

Indian experience:

CNG buses are used in Delhi, Mumbai. Several other cities are in various stages of implementing use of CNG buses in their fleet. Indian Oil Corporation (IOC), the largest fuel retailer in India supplies CNG at 160 outlets for urban transport vehicles. It has plans to expand service. The Hiranandani Group has on-going projects which will result in making West Bengal the Gateway to

Green Energy for Eastern India. They are in the process of setting up an offshore LNG terminal near Digha coast, which will bring gas to Bengal and Eastern States. The total investment will be over Rs 4,000 crore.

4c. Compressed Natural Gas (CNG) – from Coal Bed Methane (CBM)

Coal bed Methane is a natural gas extracted from coal beds and is considered as a better alternative to petrol or diesel fuel.

The West Bengal government in partnership with Essar Oil is exploring the option of using CBM. They are in talks with Indian Oil Corporation to convert CBM to CNG for running the fleet of about 5000 buses in Kolkata. West Bengal has a rich deposit of CBM in the coalfields of the Durgapur-Asansol-Raniganj belt in Bardhaman district. The proposed fuel for Kolkata buses may be costlier than CNG, though the price can come down with large-scale production. Essar Oil's envisages transportation of gas to Kolkata through truck-mounted cascades.

India is estimated to have CBM resource base of 1.5 to 2 trillion cubic meters. Apart from Essar, other companies in the sector are GEECL, Oil and Natural Gas Corp and Reliance Industries Ltd.

4d. Liquefied Natural Gas (LNG)

LNG is a natural gas in liquid form that is clear, odourless, colourless, non-corrosive and nontoxic. It is produced from natural gas and is primarily methane. It is converted to liquid for the purpose of storage and transport. LNG offers advantage over CNG as a fuel for demanding, heavy duty vehicle applications. It has significantly lower NOx and particulate emission than diesel. It is used as a fuel for goods vehicles in California, USA. It is not in use in India.

5. Bio-Fuels

There are several pilot level tests that are being undertaken in India to examine the potential of biofuel but no project in public transport buses. Only 10 buses belonging to Bangalore Metropolitan Transport Corporation and 25 buses belonging to the Karnataka State Road Transport Corporation (KSRTC) are being run on a trial basis in the city. In Haryana, about 20 buses running out of Gurgaon into the state will run on 5% biofuel blended diesel; and in Gujarat, 4 buses are running on 5% biofuel blend. The biofuel to Gujarat State Road Transport Corporation is being supplied by Gujarat Oleo Chem Ltd, which has set up a biofuel blending and extraction plant in South Gujarat. These are small projects in comparison to this proposed project of running 1490 buses on 20% biofuel blend, making it "uncommon practice". Therefore this project passes the common practice test.

Metropolitan Transport Corporation (Chennai) Limited (MTCL), plan to partially switch their operating bus fleet from the current use of diesel to biofuel in a phased manner. The purpose of this project is to use the oil extracted from vegetable oil plants for use as a fuel blend with diesel i.e., biofuel, in public transport buses operated by the MTCL, in Chennai City, Tamilnadu, INDIA. The biofuel will be obtained from the open market available from the rural areas of Tamilnadu. The proposed project promotes greenhouse gas mitigation by partially substituting petro-diesel with biofuel in 200 public transport (buses) vehicles owned by MTCL.

The project will include the partial fuel switch from diesel to 10% biodiesel blend in 200 buses owned by MTCL. These buses operate in the Chennai Metropolitan Area. Currently, these buses run on an average 265.5 km per day per bus and operate at an efficiency of about 3.61 km per litre of diesel. Under this project, the 200 buses will receive 10% biodiesel from the open market, which will be supplemented when the plants are mature by the plantation raised by the project proponent on their own lands. Biodiesel will be obtained from Pongamia pinnata trees which are common to this area. This tree is hardy and requires minimum maintenance and water.

No engine modification is required on these buses to operate on biofuel. *Source: Project Design Document, Biofuel Switch in Public Transport (Tamilnadu Energy Development Agencies, TEDA), CDM, UNFCCC, 2007*

6. Ethanol

Ethanol (ethyl alcohol) is a clear, colourless liquid with a characteristic, agreeable odor. In USA there is a demand for ethanol as an oxygenated blended with gasoline. In USA each year, more than 1.5 billion gallons are added to gasoline to increase octane and improve the emission quality of gasoline.

Emission:

- Decreased emissions of CO by 32%.
- Decreased emissions of HC by 12%.
- Compares favorably for NOx compared to regular petrol but PM10 is about the same

Advantages of ethanol:

- It reduces dependence on imported fuels.
- It reduces air pollution.
- Ethanol is renewable.
- Refueling is akin to that of gasoline or diesel.
- Is applicable for both light and heavy-duty vehicles.
- More energy density compared to gasoline with optimized compression ratio.
- Maintenance assistance required is more or less identical to that of conventionally fueled vehicles.

Disadvantages of Ethanol:

- Demands frequent refueling keeping the volume of the tank unaltered.
- Use of special compatible lubricants required.
- Ethanol, especially E85 requires special replacement parts.
-

Indian experience:

Ministry of Petroleum & Natural Gas, Gol launched three pilot projects in the country in 2001. Other technical and R&D activities are also been carried out in various parts of India. Based on the experience of the pilot projects, Gol in 2001 took a decision to introduce petrol blended with 5% ethanol for use in motor vehicles all over the country in a phased manner. In the first phase, the 5% ethanol blended petrol will be introduced in the States of Andhra Pradesh, Gujarat, Haryana, Karnataka, Maharashtra, Punjab, Tamil Nadu and Uttar Pradesh. Rest of the States/Union Territories will be taken up in the second phase.

On the other hand, India is also working to blend 10% ethanol in petrol. The pilot projects and R&D initiatives are also lined up to study the feasibility of 10% ethanol-gasoline blend. Amendment in BIS specification to accommodate this 10% blend is being pursued

7. Methanol

Methanol (CH₃OH) is an alcohol fuel. Methanol is methane with one hydrogen molecule replaced by a hydroxyl radical, (OH). Methanol can be produced from a variety of feedstock, including natural gas, coal, biomass and cellulose. Methanol perhaps is not the cleanest gasoline alternatives but it has a distinct advantage in controlling ozone formation. USA is focused on methanol and methanol blends as it promises significant ozone improvements and control smog formation at a reasonable cost. Methanol is mostly used in light-duty vehicles. More than 20,000 M85 flexible-fuel vehicles are in operation in USA.

Advantages of Methanol:

- Methanol has very lower ozone forming potential.
- Emissions of sulphur and sulphur compounds are virtually negligible.

- Very low evaporative emissions due to its low vapor pressure.
- Easy refueling.
- Methanol is the most practical carrier of hydrogen to run fuel cells.
- Methanol has high-octane quality.

Disadvantages of Methanol:

- High formaldehyde emissions.
- Acute toxicity – special care and training needed for people operating and repairing vehicles.
- Availability is much dependent on the availability of natural gas.
- Low energy content compared to gasoline.
- Demands special lubricants and spare parts.
- May be costly.

Up to 15% blends (methanol and gasoline) can be used without need for engine modifications. Pilot studies in India (1995-6) found if all the petrol driven vehicles in Delhi used a methanol-gasoline blend of 3% methanol and 97% gasoline, it may be possible to have 11% reduction in hydrocarbons emissions, 7% CO reduction and 30% NOx reduction compared to pure gasoline driven vehicles.

8. Hydrogen Fuel Cells

Hydrogen-powered vehicles have been around since the 19th Century and were used to a limited extent during the World Wars as an alternative to petrol-powered engines at the time of fuel shortages. Today they are used as a fuel to drive a 'fuel cell' that powers an electric motor which drives the vehicle. Compressed hydrogen is fed into a fuel cell "stack", where a chemical reaction takes place with oxygen which produces electricity and water as a by-product. Hence hydrogen fuel cell vehicles do not produce emissions at the point of energy generation, though energy is required for producing the hydrogen fuel.

The technology is yet not widely used. In 2011 there were only 100 fuel cell buses world-wide, and only a handful of cars on the road. California has about 300 FCEV's (fuel cell electric vehicles). In India, the Tata bus company introduced a hydrogen fuel cell bus in 2012, and Mahindra has developed a few dual hydrogen fuel cell / diesel SUV's. But generally in India the technology is still at the research and development stage. The limiting factors are:

- very high cost of vehicles;
- higher costs of storing and distributing hydrogen;
- Lack of a distribution network.

The environmental benefits of hydrogen fuel are also reduced if the gas is obtained by 'cracking' natural gas, which is currently the main source of industrial hydrogen, as this process consumes a lot energy and also releases methane, a serious greenhouse gas.

Assessment Summary, Hydrogen Fuel Cells:

Cost	Environmental Benefits	Tried and Tested	Ease of Introduction	Supported by Indian Govt. policy
High, both for vehicles and infrastructure	High for the vehicle, but greatly reduced if hydrogen is obtained from methane	Not widely used, even in developed countries	Complex, both in producing the hydrogen and distributing it	Mainly support for R&D at this stage

Table 1. Comparison of Different Alternative Fuel Technologies

Criteria	Clean Diesel	CNG	Hythane	Hybrid	Hydrogen/ Fuel Cell
Purchase Price (AUD)	@600,000	@700,000	@700,000	@1,300,000	@2,000,000
Fuel	Fuel is easily available	Can use existing fuel infrastructure.	Can use existing CNG infrastructure.	Can use existing fuel infrastructure.	Lack of fuel and fueling infrastructure.
Emissions	Higher emissions	Reduced emissions compared to diesel.	Reduced emissions compared to CNG.	Lower emissions.	No tailpipe emissions.
Technology	Mature technology	Old technology with new application.	Minor modifications to CNG technology.	New technology - unproven service record.	Technological barriers still to be overcome.
Safety	Most stable fuel	Natural gas stored in high pressure cylinders – high potential for leaks, explosion.	Natural gas and hydrogen stored at high pressure – potential for leaks and explosion.	Diesel is a stable fuel, but electric motor drive system presents potential for electrocution.	Hydrogen is stored in high pressure cylinders – high potential for leaks and explosion.
Performance	Proven service record	Limited range of operation.	Limited range of operation.	Flexibility due to dual power system.	Unproven technology and unknown durability.
Summary	Stable fuel, proven technology but higher emissions	Low emissions and proven technology. More expensive than diesel.	Very low emissions – combines strengths of natural gas and hydrogen.	Low emissions, but new technology and expensive.	Lowest on road emissions but unproven tech and very expensive.

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APPENDIX 6: ECONOMIC AND FINANCIAL ASSESSMENT

- 6.1 Economic Analysis
- 6.2 Tables relating to Financial Analysis
- 6.3 Details of Mizoram Budget, FY2013-FY2016

Appendix 6.1: Economic Analysis

1 Scope and Objectives

The objective of the economic analysis is to identify and quantify the benefits and costs associated with the investment proposal in order to select the optimum solution along with the economic viability in terms of its likely investment return potential. This is carried out in order to assess the economic feasibility and prioritize the identified public transport investment proposal and assist the governments in Mizoram State and Govt, of India and Asian Development Bank (ADB) in making the right decision.

2 Options Considered

- I. Expansion and improvement of bus transport system on the north-south corridor;
- II. Introduction of aerial ropeway system in the demand corridors. The following three route options were considered:
 - a. East West Corridor from Thuampui to Luangmual (length 5.5 Km)
 - b. East West Corridor with shortened route from Thuampui to Power House (Aizawl centre) (length 2.4 Km)
 - c. North South Corridor from Durtlang to Kulikawn (length 7.5 Km)

3 Approach to the Analysis

The economic analysis contained in this chapter has been undertaken in accordance with the available guidelines including Guidelines for the Economic Analysis of Projects, and Framework for the Economic and Financial Appraisal of Urban Development Sector Projects. Economic analysis involves comparing 'with project' and 'without project' alternatives. By comparing the above alternatives, the net agency costs and net user costs and finally net project benefits associated with the project during its analysis period were calculated for the proposed improvement proposals in order to arrive at their internal rate of return (IRR) and net present value (NPV) for economic analysis.

In accordance with previous economic feasibility analysis carried out for other similar studies for high investment transport infrastructure projects with long gestation period, 30 year operation period is considered for Life-Cycle Cost Analysis (LCCA) and that will include:

- Base Year (2015)
- Construction period:
 - Bus package constructed between 2017-2019
 - Rope Way package constructed between 2017-2020
- Project operating period:
 - Bus package to be operated from 2020 to 2050
 - Ropeway package to be operated from 2021 to 2050
- End of the analysis period: 2050

Thus a period of 30 years of operation is considered for the evaluation. All the costs were at 2015 (Base Year) level and also in the analysis, the results including NPV, IRR

were estimated for the base year level. Accordingly, all the costs and input variables for calculating the project benefits are updated to 2015 (Base year).

Considering the component-wise opportunity cost, the financial cost was converted into economic cost in accordance with the available guidelines from international funding agencies like Asian Development Bank (ADB).

Appropriate Excel-based models were developed to quantify the relevant project benefits; life cycle costing; project net benefits and finally economic feasibility criteria like EIRR and ENPV.

Unit rates for vehicle operating costs and travel time costs were available from "Updated Road User Cost Study, 2009", and travel data for Aizawl City was estimated based on traffic surveys and assumptions about future operating conditions and modal shift.

The cost-benefit analysis was carried out by using the discounted cash flow (DCF) technique to obtain the economic internal rate of return (EIRR) and economic net present value (ENPV) for the proposed investments and the likely quantified project benefits during the project analysis period

Economic Opportunity Cost of Capital (EOCC): Given the complexity of estimating country-specific economic opportunity cost of capital (EOCC), a discount rate of 12% in constant economic prices is generally used in ADB-financed projects as a proxy for EOCC. The EIRR must be compared with the economic opportunity cost of capital; to establish the project's feasibility.

4 Cost Estimates

For economic analysis, only the cost estimates of the proposed packages estimated on macro level base was adopted. Adding the pre-operative expenses, physical contingency, applicable taxes, etc, the total financial cost for all the proposed corridors was estimated for the base year (2015). To accommodate the implications of land acquisition, resettlement and rehabilitation, taxes, physical contingency, pre-operative expenses etc, a lump sum to the engineering cost was considered to estimate the final financial project cost.

Estimated financial cost was converted into economic cost. The economic cost included base costs and physical contingency but excluded price contingency, financing charges, taxes & duties. The shadow wage factor of 0.8¹ and the shadow exchange factor of 1.03² were applied to convert financial values to economic values

The construction cost (at 2015 price levels) used in the analysis is presented in **Table 1**. Based on similar other studies and macro-level estimates provided by the planning team, appropriate annual O&M and periodical capital replacement / augmentation costs were considered during the analysis period.

¹ Estimated based on the state level / Aizawl city level data

² Estimated based on the national level export, import data and customs duty using the ADB suggested methodology

Table 1: Details of Project Costs (2015-16 Prices)

Details	Length (Km)	Financial Cost (Rs. Million)	Economic Cost (Rs. Million)
1. Bus Corridor Package	10	1541.59	1280.6
2. Ropeway Corridor Package:			
• East West Long Corridor	5.5	5501.8	4586
• East West Short Corridor	2.4	3123.6	2603.7
• North South Corridor	7.5	7506	6256.66

Note: * - Land acquisition costs and applicable taxes are excluded for Economic Analysis. Also shadow price for unskilled labour wages and import cost were considered for economic cost conversion.

5 Project Benefits

Proposed improvement corridors will be expected to divert passengers from the existing modes like car, bus, IPT with better comfort and improved speed. These improvements will benefit the users in terms of better speed with service quality and reduced travel time. Accordingly, the economic benefits considered in the present analysis for the sub-projects in transport component in this investment proposal include:

- Bus Corridor Package
 - a. Value of Travel Time Savings
 - b. Value of vehicle operating cost (VOC) savings
- Ropeway Corridor Package
 - a. Value of Travel Time Savings
 - i. For passengers who shifted to Ropeway
 - ii. For the remaining passengers due to reduction in congestion
 - b. Value of vehicle operating cost (VOC) savings
 - i. For passengers who shifted to Ropeway
 - ii. For the remaining passengers due to reduction in congestion

The above project economic benefits were estimated on an annual basis for all routes proposed in the technical section for the analysis scenario discussed above. The diverted traffic estimated for both scenarios / proposed routes from the diversion model was used to estimate the (i) year wise daily vehicle kms for different road vehicle categories (for the vehicles from which the estimated traffic was diverted); and (ii) year wise daily passenger hours for different vehicle categories (for the vehicles from which

the estimated traffic was diverted). Converting passenger traffic, appropriate vehicle occupancy rates were used to convert into vehicle kms. Ridership estimated for different corridors / options during the analysis period by the traffic team were adopted for this analysis.

Using the VOC unit rates and time value unit rates for different urban passenger modes estimated in (2009) with suitable updates to 2015 using the Wholesale Price Index (WPI), project benefits (savings in VOC and travel time) were estimated on annual basis (Tables 2, 3 and 4).

Table 2: Estimation of VOC - Economic Cost - Aizawl City

Vehicle Category	Vehicle Operation Cost (Rs./ Km) - Economic Cost (2015)*
Car - New Technology	6.70
Bus	26.93
TW	2.30
Auto rickshaw	6.55
Share-Auto	7.39
Taxi	7.73
2-Axle Truck	24.30
LCV	18.03
Goods Tempo	7.58
Goods Auto	5.91

*Note: * - 2008 values estimated for various urban studies and Indian Roads Congress (IRC) SP 30 are escalated to 2015 using the Wholesale Price Index (WPI).*

Table 3: Estimate of Passenger Travel Time for Mizoram State (2015)

Details		Unit	Value	Datum year	Annual Growth (%)	2015
Input...						
Gross State Domestic Product (NSDP)****	A	Rs million	50,667	2013-14	8.10%	59,175
Population*	B	Million	1.19	2015	2.10%	1.19
Working population: Main *	C	%	37.83%	2015	2.10%	0.45
Working population: Marginal*	D	%	6.53%	2015	2.10%	0.08
Working population: FTE**	E=C+D/2	%	41.09%	2015	2.10%	0.49
Computed...						
Assumed NSDP (70%) to households	F=A*0.70	Rs Million				41,422
Average income per FTE worker	G=(F/B)/E	Rs/year				84,440
Average income per FTE worker***	H=G/2400	Rs/hour				35.18
Work time value, with 33% overheads	I=H1.33	Rs/hour				46.79
Non-work time value at 30%	J=H0.30	Rs/hour				14.04

Note: Travel time is worked out for Aizawl City using the guidelines from 'The Value of Time in Economic Evaluation of Transport Projects', Transport NO. OT-5, World Bank, Kenneth M. Gwilliam, January 1997.

* Census of India, 2011

** Full-time equivalent workers, assuming marginal workers are employed half-time.

*** Assuming 2,400 worked hours per year.

**** Statistical Abstract of Mizoram 2013; and Reserve Bank of India Documents

Table 4: Vehicle Category wise Passenger Travel Time for Aizawl in Mizoram State (2015)

Vehicle Type	Time value (Rs / Hour), 2015		
	Work	Non work	Combined
Bus	70.19	21.06	50.54
Mini Bus	70.19	21.06	50.54
TW	88.3	26.49	63.58
Car - Old Tech	88.3	26.49	63.58

6 Economic Analysis

As part of the economic feasibility analysis, the feasibility parameters developed including the analysis results under various sensitivity scenarios are shown in Table 5.

Table 5: Summary of Economic Analysis Results

Details	EIRR %	ENPV/INR Million @ 12%	Economic Benefit-to- cost Ratio	Switching Value %
A. Bus Package				
Base Case	19.1%	509.39	1.340	
20% Construction Cost increase	16.3%	357.12	1.217	67%
20% O&M Cost increase	17.1%	362.40	1.221	69%
20% Benefit decrease	13.6%	108.25	1.072	25%
Delay in operation by one year	15.4%	286.05	1.191	
B. Ropeway Package				
OPTION 1: East West Long Corridor				
Base Case	24.9%	5,632.50	2.230	
20% Construction Cost increase	22.5%	5,134.34	2.011	226%
20% O&M Cost increase	23.7%	5,214.83	2.044	270%
20% Benefit decrease	20.7%	3,590.18	1.784	55%
Delay in operation by one year	21.2%	4,442.41	1.970	
OPTION 2: East West Short Corridor				
Base Case	17.6%	1,272.37	1.468	
20% Construction Cost increase	15.9%	989.55	1.329	90%
20% O&M Cost increase	16.3%	1,010.94	1.339	97%
20% Benefit decrease	14.2%	473.64	1.174	32%
Delay in operation by one year	15.3%	807.71	1.297	
OPTION 3: North South Short Corridor				
Base Case	15.7%	1,674.07	1.266	
20% Construction Cost increase	13.9%	994.44	1.143	49%
20% O&M Cost increase	14.3%	1,093.97	1.159	58%
20% Benefit decrease	12.2%	79.53	1.013	21%
Delay in operation by one year	13.5%	769.08	1.122	

7 Conclusion

The evaluation has indicated that the proposed medium / long term improvement packages were found to be economically viable, with the calculated EIRR values exceeding the economic opportunity cost of capital (EOCC) of 12%. The sensitivity analysis had demonstrated the robustness of these results, along with the identification of risk areas which need to be focused during implementation. For ropeway corridor package, the East West Long Corridor (OPTION 1) was found to be the preferred one with higher EIRR among the three options considered, though the remaining two options were also found feasible with EIRR more than the minimum required 12%.

Furthermore, for this investment proposed, the calculated EIRR value is considered minimum estimates of economic return, as there are a number of economic benefits like travel comfort, tourism benefits, decongestion along with reduction in accidents on the impacted road corridors, growth of central city areas and environment improvement that have not been quantified.

APPENDIX – 6.1 (1) – Tables for Economic Analysis

TA 8765 IND: Supporting Sustainable Urban Transport in Aizawl City

Economic Feasibility Analysis

Bus Package

INR Million

Year	Benefit		Total	Delayed Benefit	Economic Cost			Net Benefits							
	Time Cost Savings	VOC Cost Savings			Capital	O&M	Total	Base case	Capital + 20%	O&M + 20%	Benefit (-) Delay Deap & O&M				
											10%	20%	0%	10%	
2015	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
2016	-	-	-	-	3.7	-	3.7	(3.7)	(4.5)	(3.7)	(4.1)	(3.7)	(3.7)	(4.1)	
2017	-	-	-	-	3.7	-	3.7	(3.7)	(4.5)	(3.7)	(4.1)	(3.7)	(3.7)	(4.1)	
2018	-	-	-	-	489.1	-	489.1	(489.1)	(586.9)	(489.1)	(538.0)	(489.1)	(489.1)	(538.0)	
2019	-	-	-	-	784.1	-	784.1	(784.1)	(940.9)	(784.1)	(862.5)	(784.1)	(784.1)	(862.5)	
2020	299.19	99.51	398.7	-	-	160.8	160.8	237.9	237.9	205.7	237.9	158.2	(180.8)	221.8	
2021	301.43	100.25	401.7	398.7	-	160.8	160.8	240.9	240.9	208.7	240.9	160.6	237.9	224.8	
2022	303.69	101.00	404.7	401.7	-	160.8	160.8	243.9	243.9	211.7	243.9	163.0	240.9	227.8	
2023	305.97	101.76	407.7	404.7	-	160.8	160.8	246.9	246.9	214.8	246.9	165.4	243.9	230.9	
2024	308.26	102.53	410.8	407.7	-	160.8	160.8	250.0	250.0	217.8	250.0	167.8	246.9	233.9	
2025	310.58	103.29	413.9	410.8	-	160.8	160.8	253.1	253.1	220.9	253.1	170.3	250.0	237.0	
2026	330.49	109.92	440.4	413.9	-	160.8	160.8	279.6	279.6	247.5	279.6	191.5	253.1	263.5	
2027	332.14	110.47	442.6	440.4	-	160.8	160.8	281.8	281.8	249.7	281.8	193.3	279.6	265.7	
2028	333.80	111.02	444.8	442.6	-	160.8	160.8	284.0	284.0	251.9	284.0	195.1	281.8	267.9	
2029	335.47	111.57	447.0	444.8	-	160.8	160.8	286.3	286.3	254.1	286.3	196.8	284.0	270.2	
2030	337.15	112.13	449.3	447.0	-	160.8	160.8	288.5	288.5	256.3	288.5	198.6	286.3	272.4	
2031	374.61	124.59	499.2	449.3	-	160.8	160.8	338.4	338.4	306.2	338.4	238.6	288.5	322.3	
2032	374.61	124.59	499.2	499.2	-	160.8	160.8	338.4	338.4	306.2	338.4	238.6	338.4	322.3	
2033	374.61	124.59	499.2	499.2	-	160.8	160.8	338.4	338.4	306.2	338.4	238.6	338.4	322.3	
2034	374.61	124.59	499.2	499.2	-	160.8	160.8	338.4	338.4	306.2	338.4	238.6	338.4	322.3	
2035	374.61	124.59	499.2	499.2	-	160.8	160.8	338.4	338.4	306.2	338.4	238.6	338.4	322.3	
2036	374.61	124.59	499.2	499.2	-	160.8	160.8	338.4	338.4	306.2	338.4	238.6	338.4	322.3	
2037	374.61	124.59	499.2	499.2	-	160.8	160.8	338.4	338.4	306.2	338.4	238.6	338.4	322.3	
2038	374.61	124.59	499.2	499.2	-	160.8	160.8	338.4	338.4	306.2	338.4	238.6	338.4	322.3	
2039	374.61	124.59	499.2	499.2	-	160.8	160.8	338.4	338.4	306.2	338.4	238.6	338.4	322.3	
2040	374.61	124.59	499.2	499.2	-	160.8	160.8	338.4	338.4	306.2	338.4	238.6	338.4	322.3	
2041	374.61	124.59	499.2	499.2	-	160.8	160.8	338.4	338.4	306.2	338.4	238.6	338.4	322.3	
2042	374.61	124.59	499.2	499.2	-	160.8	160.8	338.4	338.4	306.2	338.4	238.6	338.4	322.3	
2043	374.61	124.59	499.2	499.2	-	160.8	160.8	338.4	338.4	306.2	338.4	238.6	338.4	322.3	
2044	374.61	124.59	499.2	499.2	-	160.8	160.8	338.4	338.4	306.2	338.4	238.6	338.4	322.3	
2045	374.61	124.59	499.2	499.2	-	160.8	160.8	338.4	338.4	306.2	338.4	238.6	338.4	322.3	
2046	374.61	124.59	499.2	499.2	-	160.8	160.8	338.4	338.4	306.2	338.4	238.6	338.4	322.3	
2047	374.61	124.59	499.2	499.2	-	160.8	160.8	338.4	338.4	306.2	338.4	238.6	338.4	322.3	
2048	374.61	124.59	499.2	499.2	-	160.8	160.8	338.4	338.4	306.2	338.4	238.6	338.4	322.3	
2049	374.61	124.59	499.2	499.2	-	160.8	160.8	338.4	338.4	306.2	338.4	238.6	338.4	322.3	
NPV	1,505.1	500.6	-	2,005.7	1,782.3	761.3	734.9	1,496.3	509.4	357.1	362.4	433.3	108.3	286.1	359.8
Discount Rate @ 12% EIRR								19.1%	16.3%	17.1%	17.6%	13.6%	15.4%	16.7%	
ENPV INR								509.4	357.1	362.4	433.3	108.3	286.1	359.8	
Sensitivity Indicator EIRR								0.7	0.5	0.8	1.5	1.3	1.9		
ENPV INR Mill								1.5	1.4	1.5	3.9	2.9	2.3		
Switching Value EIRR								66.9%	69.3%	66.9%	25.4%	34.0%			
ENPV INR Mill															

APPENDIX – 6.1 (2) – Tables for Economic Analysis

TA 8765 IND: Supporting Sustainable Urban Transport in Alzawl City

Economic Feasibility Analysis

Ropeway Package - East West Long Corridor

INR Million

Year	Benefit		Total	Delayed Benefit	Economic Cost			Net Benefits						
	Time Cost Savings	VOC Cost Savings			Capital	O&M	Total	Base	Capital +	O&M +	Capital +	Benefit (-)	Delay	Deap & O&M
								case	20%	20%	10%	20%		
2015	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2016	-	-	-	-	104.9	-	104.9	(104.9)	(125.8)	(104.9)	(115.3)	(104.9)	(104.9)	(115.3)
2017	-	-	-	-	104.9	-	104.9	(104.9)	(125.8)	(104.9)	(115.3)	(104.9)	(104.9)	(115.3)
2018	-	-	-	-	155.3	-	155.3	(155.3)	(186.4)	(155.3)	(170.9)	(155.3)	(155.3)	(170.9)
2019	-	-	-	-	1,568.5	405.1	1,973.6	(1,973.6)	(2,287.3)	(2,054.6)	(2,130.5)	(1,973.6)	(1,973.6)	(2,171.0)
2020	-	-	-	-	2,652.4	405.1	3,057.5	(3,057.5)	(3,588.0)	(3,138.6)	(3,322.8)	(3,057.5)	(3,057.5)	(3,363.3)
2021	891.89	254.46	1,146.3	-	-	405.1	405.1	741.2	741.2	660.2	741.2	512.0	(405.1)	700.7
2022	1,105.58	315.42	1,421.0	1,146.3	-	405.1	405.1	1,015.9	1,015.9	934.9	1,015.9	731.7	741.2	975.4
2023	1,321.66	377.07	1,698.7	1,421.0	-	405.1	405.1	1,293.6	1,293.6	1,212.6	1,293.6	953.9	1,015.9	1,253.1
2024	1,495.58	428.69	1,922.3	1,698.7	-	405.1	405.1	1,517.2	1,517.2	1,436.1	1,517.2	1,132.7	1,293.6	1,476.7
2025	1,672.03	477.04	2,149.1	1,922.3	-	405.1	405.1	1,744.0	1,744.0	1,662.9	1,744.0	1,314.2	1,517.2	1,703.5
2026	1,781.84	502.66	2,284.5	2,149.1	-	405.1	405.1	1,859.4	1,859.4	1,778.4	1,859.4	1,406.5	1,744.0	1,818.9
2027	1,854.34	529.05	2,383.4	2,284.5	-	405.1	405.1	1,978.3	1,978.3	1,897.3	1,978.3	1,501.6	1,859.4	1,937.8
2028	1,949.61	556.23	2,505.8	2,383.4	-	405.1	405.1	2,100.7	2,100.7	2,019.7	2,100.7	1,599.6	1,978.3	2,060.2
2029	2,047.75	584.23	2,632.0	2,505.8	-	405.1	405.1	2,226.9	2,226.9	2,145.8	2,226.9	1,700.5	2,100.7	2,186.4
2030	2,148.82	613.06	2,761.9	2,632.0	-	405.1	405.1	2,356.8	2,356.8	2,275.8	2,356.8	1,804.4	2,226.9	2,316.3
2031	2,252.93	642.77	2,895.7	2,761.9	-	405.1	405.1	2,490.6	2,490.6	2,409.6	2,490.6	1,911.5	2,356.8	2,450.1
2032	2,360.16	673.36	3,033.5	2,895.7	-	405.1	405.1	2,628.4	2,628.4	2,547.4	2,628.4	2,021.7	2,490.6	2,587.9
2033	2,470.61	704.87	3,175.5	3,033.5	-	405.1	405.1	2,770.4	2,770.4	2,689.4	2,770.4	2,135.3	2,628.4	2,729.9
2034	2,584.38	737.33	3,321.7	3,175.5	-	405.1	405.1	2,916.6	2,916.6	2,835.6	2,916.6	2,252.3	2,770.4	2,876.1
2035	2,701.55	770.76	3,472.3	3,321.7	-	405.1	405.1	3,067.2	3,067.2	2,986.2	3,067.2	2,372.7	2,916.6	3,026.7
2036	2,822.24	805.19	3,627.4	3,472.3	-	405.1	405.1	3,222.3	3,222.3	3,141.3	3,222.3	2,496.8	3,067.2	3,181.8
2037	2,946.56	840.66	3,787.2	3,627.4	-	405.1	405.1	3,382.1	3,382.1	3,301.1	3,382.1	2,624.7	3,222.3	3,341.6
2038	3,074.60	877.19	3,951.8	3,787.2	-	405.1	405.1	3,546.7	3,546.7	3,465.7	3,546.7	2,756.3	3,382.1	3,506.2
2039	3,206.48	914.82	4,121.3	3,951.8	-	405.1	405.1	3,716.2	3,716.2	3,635.2	3,716.2	2,891.9	3,546.7	3,675.7
2040	3,342.32	953.57	4,295.9	4,121.3	-	405.1	405.1	3,890.8	3,890.8	3,809.8	3,890.8	3,031.6	3,716.2	3,850.3
2041	3,482.23	993.49	4,475.7	4,295.9	-	405.1	405.1	4,070.6	4,070.6	3,989.6	4,070.6	3,175.5	3,890.8	4,030.1
2042	3,626.35	1,034.61	4,661.0	4,475.7	-	405.1	405.1	4,255.8	4,255.8	4,174.8	4,255.8	3,323.7	4,070.6	4,215.3
2043	3,774.78	1,076.95	4,851.7	4,661.0	-	405.1	405.1	4,446.6	4,446.6	4,365.6	4,446.6	3,476.3	4,255.8	4,406.1
2044	3,927.67	1,120.57	5,048.2	4,851.7	-	405.1	405.1	4,643.1	4,643.1	4,562.1	4,643.1	3,633.5	4,446.6	4,602.6
2045	4,085.14	1,165.50	5,250.6	5,048.2	-	405.1	405.1	4,845.5	4,845.5	4,764.5	4,845.5	3,795.4	4,643.1	4,805.0
2046	4,247.34	1,211.78	5,459.1	5,250.6	-	405.1	405.1	5,054.0	5,054.0	4,973.0	5,054.0	3,962.2	4,845.5	5,013.5
2047	4,414.41	1,259.44	5,673.8	5,459.1	-	405.1	405.1	5,268.7	5,268.7	5,187.7	5,268.7	4,134.0	5,054.0	5,228.2
2048	4,586.48	1,308.54	5,895.0	5,673.8	-	405.1	405.1	5,489.9	5,489.9	5,408.9	5,489.9	4,310.9	5,268.7	5,449.4
2049	4,763.72	1,359.10	6,122.8	5,895.0	-	405.1	405.1	5,717.7	5,717.7	5,636.7	5,717.7	4,493.2	5,489.9	5,677.2
2050	4,946.28	1,411.19	6,357.5	6,122.8	-	405.1	405.1	5,952.4	5,952.4	5,871.3	5,952.4	4,680.9	5,717.7	5,911.9
NPV	7,944.9	2,266.7	10,211.6	9,021.5	2,490.8	2,088.3	4,579.1	5,632.5	5,134.3	5,214.8	5,383.4	3,590.2	4,442.4	5,174.6
Discount Rate @ 12%														
EIRR 24.9%														
ENPV INR 5,632.5														
Sensitivity Indicator														
EIRR 0.5														
ENPV INR Mill 0.4														
Switching Value EIRR 226.1%														
23.7%														
5,383.4														
20.7%														
3,590.2														
21.2%														
4,442.4														
23.1%														
5,174.6														
0.8														
0.8														
123.0%														

APPENDIX – 6.1 (3) – Tables for Economic Analysis

TA 8765 IND: Supporting Sustainable Urban Transport in Aizawl City

Economic Feasibility Analysis

Ropeway Package - East West Short Corridor

INR Million

Year	Benefit		Total	Delayed Benefit	Economic Cost			Net Benefits							
	Time Cost Savings	VOC Cost Savings			Capital	O&M	Total	Base	Capital +	O&M +	Capital +	Benefit (-)	Delay	Deap & O&M	
								case	20%	20%	10%	20%	0%	10%	
2015	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
2016	-	-	-	-	59.5	-	59.5	(59.5)	(71.4)	(59.5)	(65.5)	(59.5)	(59.5)	(65.5)	
2017	-	-	-	-	59.5	-	59.5	(59.5)	(71.4)	(59.5)	(65.5)	(59.5)	(59.5)	(65.5)	
2018	-	-	-	-	88.2	-	88.2	(88.2)	(105.8)	(88.2)	(97.0)	(88.2)	(88.2)	(97.0)	
2019	-	-	-	-	890.5	253.6	1,144.1	(1,144.1)	(1,322.2)	(1,194.8)	(1,233.1)	(1,144.1)	(1,144.1)	(1,258.5)	
2020	-	-	-	-	1,505.9	253.6	1,759.5	(1,759.5)	(2,060.7)	(1,810.2)	(1,910.1)	(1,759.5)	(1,759.5)	(1,935.4)	
2021	351.90	102.32	454.2	-	-	253.6	253.6	200.7	200.7	149.9	200.7	109.8	(253.6)	175.3	
2022	436.15	126.82	563.0	454.2	-	253.6	253.6	309.4	309.4	258.7	309.4	196.8	200.7	284.0	
2023	521.30	151.58	672.9	563.0	-	253.6	253.6	419.3	419.3	368.6	419.3	284.7	309.4	394.0	
2024	589.27	171.35	760.6	672.9	-	253.6	253.6	507.1	507.1	456.3	507.1	354.9	419.3	481.7	
2025	658.20	191.39	849.6	760.6	-	253.6	253.6	596.0	596.0	545.3	596.0	426.1	507.1	570.7	
2026	691.89	201.19	893.1	849.6	-	253.6	253.6	639.5	639.5	588.8	639.5	460.9	596.0	614.2	
2027	726.60	211.28	937.9	893.1	-	253.6	253.6	684.3	684.3	633.6	684.3	496.7	639.5	659.0	
2028	762.35	221.67	984.0	937.9	-	253.6	253.6	730.5	730.5	679.7	730.5	533.6	684.3	705.1	
2029	799.17	232.38	1,031.5	984.0	-	253.6	253.6	778.0	778.0	727.3	778.0	571.7	730.5	752.6	
2030	837.09	243.41	1,080.5	1,031.5	-	253.6	253.6	826.9	826.9	776.2	826.9	610.8	778.0	801.6	
2031	876.16	254.76	1,130.9	1,080.5	-	253.6	253.6	877.3	877.3	826.6	877.3	651.2	826.9	852.0	
2032	916.39	266.46	1,182.9	1,130.9	-	253.6	253.6	929.3	929.3	878.6	929.3	692.7	877.3	903.9	
2033	957.83	278.51	1,236.3	1,182.9	-	253.6	253.6	982.8	982.8	932.1	982.8	735.5	929.3	957.4	
2034	1,000.52	290.92	1,291.4	1,236.3	-	253.6	253.6	1,037.9	1,037.9	987.2	1,037.9	779.6	982.8	1,012.5	
2035	1,044.48	303.71	1,348.2	1,291.4	-	253.6	253.6	1,094.6	1,094.6	1,043.9	1,094.6	825.0	1,037.9	1,069.3	
2036	1,089.76	316.88	1,406.6	1,348.2	-	253.6	253.6	1,153.1	1,153.1	1,102.4	1,153.1	871.7	1,094.6	1,127.7	
2037	1,136.41	330.44	1,466.8	1,406.6	-	253.6	253.6	1,213.3	1,213.3	1,162.6	1,213.3	919.9	1,153.1	1,187.9	
2038	1,184.45	344.41	1,528.9	1,466.8	-	253.6	253.6	1,275.3	1,275.3	1,224.6	1,275.3	969.5	1,213.3	1,249.9	
2039	1,233.93	358.80	1,592.7	1,528.9	-	253.6	253.6	1,339.2	1,339.2	1,288.4	1,339.2	1,020.6	1,275.3	1,313.8	
2040	1,284.90	373.62	1,658.5	1,592.7	-	253.6	253.6	1,404.9	1,404.9	1,354.2	1,404.9	1,073.2	1,339.2	1,379.6	
2041	1,337.40	388.88	1,726.3	1,658.5	-	253.6	253.6	1,472.7	1,472.7	1,422.0	1,472.7	1,127.5	1,404.9	1,447.4	
2042	1,391.47	404.60	1,796.1	1,726.3	-	253.6	253.6	1,542.5	1,542.5	1,491.8	1,542.5	1,183.3	1,472.7	1,517.1	
2043	1,447.16	420.80	1,868.0	1,796.1	-	253.6	253.6	1,614.4	1,614.4	1,563.7	1,614.4	1,240.8	1,542.5	1,589.0	
2044	1,504.53	437.48	1,942.0	1,868.0	-	253.6	253.6	1,688.4	1,688.4	1,637.7	1,688.4	1,300.0	1,614.4	1,663.1	
2045	1,563.61	454.66	2,018.3	1,942.0	-	253.6	253.6	1,764.7	1,764.7	1,714.0	1,764.7	1,361.0	1,688.4	1,739.3	
2046	1,624.47	472.36	2,096.8	2,018.3	-	253.6	253.6	1,843.3	1,843.3	1,792.5	1,843.3	1,423.9	1,764.7	1,817.9	
2047	1,687.15	490.58	2,177.7	2,096.8	-	253.6	253.6	1,924.2	1,924.2	1,873.5	1,924.2	1,488.6	1,843.3	1,898.8	
2048	1,751.72	509.36	2,261.1	2,177.7	-	253.6	253.6	2,007.5	2,007.5	1,956.8	2,007.5	1,555.3	1,924.2	1,982.1	
2049	1,818.22	528.69	2,346.9	2,261.1	-	253.6	253.6	2,093.3	2,093.3	2,042.6	2,093.3	1,624.0	2,007.5	2,068.0	
2050	1,886.71	548.61	2,435.3	2,346.9	-	253.6	253.6	2,181.8	2,181.8	2,131.0	2,181.8	1,694.7	2,093.3	2,156.4	
NPV	3,094.0	899.7	-	3,993.7	3,529.0	1,414.1	1,307.2	2,721.3	1,272.4	989.5	1,010.9	1,131.0	473.6	807.7	1,000.2
								Discount Rate @ 12% EIRR	17.6%	15.9%	16.3%	16.7%	14.2%	15.3%	16.1%
								ENPV INR	1,272.4	989.5	1,010.9	1,131.0	473.6	807.7	1,000.2
								Sensitivity Indicator EIRR	0.5	0.4	0.5	1.0	0.9		
								ENPV INR Mill	1.1	1.0	1.1	3.1	2.1		
								Switching Value EIRR	90.0%	97.3%	90.0%	31.9%	46.8%		

APPENDIX – 6.1(4) – Tables for Economic Analysis

TA 8765 IND: Supporting Sustainable Urban Transport in Aizawl City

Economic Feasibility Analysis

Ropeway Package - North South Corridor

INR Million

Year	Benefit			Delayed Benefit	Economic Cost			Net Benefits							
	Time Cost Savings	VOC Cost Savings	Total		Capital	O&M	Total	Base case	Capital + 20%	O&M + 20%	Capital + 10%	Benefit (-) Delay 0%	Deap & O&M 10%		
2015	-	-	-	-	-	-	-	-	-	-	-	-	-		
2016	-	-	-	-	143.1	-	143.1	(143.1)	(171.7)	(143.1)	(157.4)	(143.1)	(143.1)	(157.4)	
2017	-	-	-	-	143.1	-	143.1	(143.1)	(171.7)	(143.1)	(157.4)	(143.1)	(143.1)	(157.4)	
2018	-	-	-	-	211.9	-	211.9	(211.9)	(254.3)	(211.9)	(233.1)	(211.9)	(211.9)	(233.1)	
2019	-	-	-	-	2,139.9	562.6	2,702.6	(2,702.6)	(3,130.5)	(2,815.1)	(2,916.5)	(2,702.6)	(2,702.6)	(2,972.8)	
2020	-	-	-	-	3,618.7	562.6	4,181.3	(4,181.3)	(4,905.1)	(4,293.9)	(4,543.2)	(4,181.3)	(4,181.3)	(4,599.5)	
2021	944.43	223.31	1,167.7	-	-	562.6	562.6	605.1	605.1	492.6	605.1	371.5	(562.6)	548.8	
2022	1,073.65	253.87	1,327.5	1,167.7	-	562.6	562.6	764.9	764.9	652.3	764.9	499.4	605.1	708.6	
2023	1,203.83	284.65	1,488.5	1,327.5	-	562.6	562.6	925.8	925.8	813.3	925.8	628.1	764.9	869.6	
2024	1,334.98	315.66	1,650.6	1,488.5	-	562.6	562.6	1,088.0	1,088.0	975.5	1,088.0	757.9	925.8	1,031.7	
2025	1,467.12	346.90	1,814.0	1,650.6	-	562.6	562.6	1,251.4	1,251.4	1,138.8	1,251.4	888.6	1,088.0	1,195.1	
2026	1,518.67	359.09	1,877.8	1,814.0	-	562.6	562.6	1,315.1	1,315.1	1,202.6	1,315.1	939.6	1,251.4	1,258.8	
2027	1,571.25	371.52	1,942.8	1,877.8	-	562.6	562.6	1,380.1	1,380.1	1,267.6	1,380.1	991.6	1,315.1	1,323.9	
2028	1,624.89	384.20	2,009.1	1,942.8	-	562.6	562.6	1,446.4	1,446.4	1,333.9	1,446.4	1,044.6	1,380.1	1,390.2	
2029	1,679.59	397.14	2,076.7	2,009.1	-	562.6	562.6	1,514.1	1,514.1	1,401.6	1,514.1	1,098.7	1,446.4	1,457.8	
2030	1,735.39	410.33	2,145.7	2,076.7	-	562.6	562.6	1,583.1	1,583.1	1,470.5	1,583.1	1,153.9	1,514.1	1,526.8	
2031	1,792.31	423.79	2,216.1	2,145.7	-	562.6	562.6	1,653.4	1,653.4	1,540.9	1,653.4	1,210.2	1,583.1	1,597.2	
2032	1,850.36	437.52	2,287.9	2,216.1	-	562.6	562.6	1,725.2	1,725.2	1,612.7	1,725.2	1,267.7	1,653.4	1,669.0	
2033	1,909.58	451.52	2,361.1	2,287.9	-	562.6	562.6	1,798.4	1,798.4	1,685.9	1,798.4	1,326.2	1,725.2	1,742.2	
2034	1,969.98	465.80	2,435.8	2,361.1	-	562.6	562.6	1,873.1	1,873.1	1,760.6	1,873.1	1,386.0	1,798.4	1,816.9	
2035	2,031.58	480.37	2,512.0	2,435.8	-	562.6	562.6	1,949.3	1,949.3	1,836.8	1,949.3	1,446.9	1,873.1	1,893.0	
2036	2,094.42	495.23	2,589.6	2,512.0	-	562.6	562.6	2,027.0	2,027.0	1,914.5	2,027.0	1,509.1	1,949.3	1,970.7	
2037	2,158.52	510.38	2,668.9	2,589.6	-	562.6	562.6	2,106.3	2,106.3	1,993.7	2,106.3	1,572.5	2,027.0	2,050.0	
2038	2,223.90	525.84	2,749.7	2,668.9	-	562.6	562.6	2,187.1	2,187.1	2,074.6	2,187.1	1,637.1	2,106.3	2,130.8	
2039	2,290.58	541.81	2,832.2	2,749.7	-	562.6	562.6	2,269.5	2,269.5	2,157.0	2,269.5	1,703.1	2,187.1	2,213.3	
2040	2,358.60	557.69	2,916.3	2,832.2	-	562.6	562.6	2,353.6	2,353.6	2,241.1	2,353.6	1,770.4	2,269.5	2,297.4	
2041	2,427.98	574.10	3,002.1	2,916.3	-	562.6	562.6	2,439.4	2,439.4	2,326.9	2,439.4	1,839.0	2,353.6	2,383.2	
2042	2,498.75	590.83	3,089.6	3,002.1	-	562.6	562.6	2,526.9	2,526.9	2,414.4	2,526.9	1,909.0	2,439.4	2,470.7	
2043	2,570.93	607.90	3,178.8	3,089.6	-	562.6	562.6	2,616.2	2,616.2	2,503.6	2,616.2	1,980.4	2,526.9	2,559.9	
2044	2,644.56	625.31	3,269.9	3,178.8	-	562.6	562.6	2,707.2	2,707.2	2,594.7	2,707.2	2,053.2	2,616.2	2,650.9	
2045	2,719.66	643.06	3,362.7	3,269.9	-	562.6	562.6	2,800.1	2,800.1	2,687.5	2,800.1	2,127.5	2,707.2	2,743.8	
2046	2,719.66	643.06	3,362.7	3,362.7	-	562.6	562.6	2,800.1	2,800.1	2,687.5	2,800.1	2,127.5	2,800.1	2,743.8	
2047	2,719.66	643.06	3,362.7	3,362.7	-	562.6	562.6	2,800.1	2,800.1	2,687.5	2,800.1	2,127.5	2,800.1	2,743.8	
2048	2,719.66	643.06	3,362.7	3,362.7	-	562.6	562.6	2,800.1	2,800.1	2,687.5	2,800.1	2,127.5	2,800.1	2,743.8	
2049	2,719.66	643.06	3,362.7	3,362.7	-	562.6	562.6	2,800.1	2,800.1	2,687.5	2,800.1	2,127.5	2,800.1	2,743.8	
2050	2,719.66	643.06	3,362.7	3,362.7	-	562.6	562.6	2,800.1	2,800.1	2,687.5	2,800.1	2,127.5	2,800.1	2,743.8	
NPV	6,448.1	1,524.6	-	7,972.7	7,067.7	3,398.2	2,900.5	6,298.6	1,674.1	994.4	1,094.0	1,334.3	79.5	769.1	1,044.2
								Discount Rate @ 12% EIRR	15.7%	13.9%	14.3%	14.7%	12.2%	13.5%	14.1%
								ENPV INR	1,674.1	994.4	1,094.0	1,334.3	79.5	769.1	1,044.2
								Sensitivity Indicator EIRR	0.6	0.4	0.6	1.1			1.0
								ENPV INR Mill	2.0	1.7	2.0	4.8			3.8
								Switching Value EIRR	49.3%	57.7%	49.3%	21.0%			26.6%

Appendix 6.2: Background Tables Supporting Financial Analysis

APPENDIX – 6.2(1) – Tables Supporting the Financial Analysis AIZWAL BUS OPERATION PACKAGE

Rs. Million

Cash Flow Statement

Year	Sources of Funds								Uses of Funds					
	Equity	Debt	Addl. Grant to Operator	Grant 1	PAT	Salvage Value	Add: Depreciation	TOTAL Inflow	Capex	Principal Repayment	Total Outflow	Opening Balance	Surplus/ Deficit	Closing Balance
Y1	36	-	-	-	-	-	-	36	36	-	36	-	-	-
Y2	36	-	-	-	-	-	-	36	36	-	36	-	-	-
Y3	79	352	158	-	-	-	-	589	589	-	589	-	-	-
Y4	-	-	1,133	-	-	-	-	1,133	1,133	-	1,133	-	-	-
Y5	-	-	-	-	-139	-	98	-41	-	39	39	-	-80	-80
Y6	-	-	-	-	-127	-	98	-29	-	39	39	-80	-68	-149
Y7	-	-	-	-	-110	-	98	-12	-	39	39	-149	-51	-199
Y8	-	-	-	-	-91	-	98	6	-	39	39	-199	-33	-232
Y9	186	-	-	-	-71	-	98	213	186	39	225	-232	-12	-244
Y10	-	-	-	-	-54	-	106	52	-	39	39	-244	13	-231
Y11	-	-	-	-	-28	-	106	79	-	39	39	-231	40	-191
Y12	-	-	-	-	3	-	106	109	-	39	39	-191	70	-121
Y13	-	-	-	-	39	-	106	146	-	39	39	-121	106	-15
Y14	249	-	-	-	81	-	106	436	249	-	249	-15	187	173
Y15	-	-	-	-	109	-	119	228	-	-	-	173	228	401
Y16	-	-	-	-	120	-	119	239	-	-	-	401	239	640
Y17	-	-	-	-	130	-	119	248	-	-	-	640	248	888
Y18	-	-	-	-	139	-	119	258	-	-	-	888	258	1,146
Y19	2,252	-	-	-	120	-	119	2,491	2,252	-	2,252	1,146	239	1,385
Y20	-	-	-	-	58	-	208	266	-	-	-	1,385	266	1,651
Y21	-	-	-	-	69	-	208	277	-	-	-	1,651	277	1,928
Y22	-	-	-	-	82	-	208	290	-	-	-	1,928	290	2,219
Y23	-	-	-	-	94	-	208	303	-	-	-	2,219	303	2,521
Y24	443	-	-	-	107	-	208	758	443	-	443	2,521	315	2,836
Y25	-	-	-	-	105	-	230	335	-	-	-	2,836	335	3,172
Y26	-	-	-	-	119	-	230	350	-	-	-	3,172	350	3,521
Y27	-	-	-	-	134	-	230	364	-	-	-	3,521	364	3,886
Y28	-	-	-	-	152	-	230	382	-	-	-	3,886	382	4,268
Y29	591	-	-	-	168	-	230	989	591	-	591	4,268	399	4,667
Y30	-	-	-	-	124	1,449	260	1,833	-	-	-	4,667	1,833	6,500

APPENDIX – 6.2(2) – Tables Supporting the Financial Analysis
AIZWAL BUS OPERATION PACKAGE

Profit & Loss Account

Rs. Million

	Fare Box Income	Commercial Space	Advertiseme nt Space	Revenue Income	O&M	EBIDTA	Less: Interest	Less: Depre- ciation	PBT	Tax	PAT
Y1	-	-	-	-	-	-	-	-	-	-	-
Y2	-	-	-	-	-	-	-	-	-	-	-
Y3	-	-	-	-	-	-	-	-	-	-	-
Y4	-	-	-	-	-	-	-	-	-	-	-
Y5	108.59	-	8.03	116.62	115.61	1.01	42.19	97.73	-138.92	-	-138.92
Y6	123.71	-	8.03	131.74	121.12	10.61	39.85	97.73	-126.96	-	-126.96
Y7	140.93	-	9.24	150.17	126.89	23.28	35.16	97.73	-109.61	-	-109.61
Y8	160.56	-	9.24	169.80	132.94	36.86	30.47	97.73	-91.35	-	-91.35
Y9	182.92	-	9.24	192.16	139.28	52.88	25.78	97.73	-70.63	-	-70.63
Y10	208.39	-	10.64	219.03	145.92	73.11	21.09	106.31	-54.29	-	-54.29
Y11	237.40	-	10.64	248.05	152.87	95.17	16.41	106.31	-27.54	-	-27.54
Y12	270.46	-	10.64	281.10	160.16	120.94	11.72	106.31	2.91	-	2.91
Y13	308.12	-	12.23	320.36	167.79	152.56	7.03	106.31	39.22	-	39.22
Y14	351.03	-	12.23	363.26	175.79	187.47	-	106.31	81.16	-	81.16
Y15	399.91	-	12.23	412.15	184.17	227.97	-	118.77	109.20	-	109.20
Y16	417.81	-	14.10	431.91	192.95	238.96	-	118.77	120.19	-	120.19
Y17	436.51	-	14.10	450.61	202.15	248.46	-	118.77	129.69	-	129.69
Y18	456.04	-	14.10	470.14	211.78	258.36	-	118.77	139.59	0.53	139.06
Y19	476.45	-	16.25	492.70	221.88	270.82	-	118.77	152.05	31.87	120.18
Y20	497.78	-	16.25	514.03	232.45	281.57	-	208.07	73.51	15.41	58.10
Y21	522.67	-	16.25	538.92	243.53	295.38	-	208.07	87.32	18.30	69.02
Y22	548.80	-	18.68	567.48	255.14	312.34	-	208.07	104.27	21.86	82.42
Y23	576.24	-	18.68	594.92	267.30	327.62	-	208.07	119.55	25.06	94.49
Y24	605.05	-	18.68	623.73	280.04	343.69	-	208.07	135.62	28.43	107.19
Y25	635.31	-	21.48	656.78	293.39	363.39	-	230.25	133.14	27.91	105.24
Y26	667.07	-	21.48	688.55	307.38	381.17	-	230.25	150.92	31.63	119.29
Y27	700.43	-	21.48	721.90	322.03	399.88	-	230.25	169.63	35.55	134.07
Y28	735.45	-	24.74	760.19	337.38	422.82	-	230.25	192.57	40.36	152.20
Y29	772.22	-	24.74	796.96	353.46	443.51	-	230.25	213.26	44.97	168.29
Y30	810.83	-	24.74	835.58	370.30	465.27	-	259.85	205.42	81.68	123.74

APPENDIX – 6.2(3) – Tables Supporting the Financial Analysis
AIZWAL ROPE CAR - East West Corridor (Long 5.5 Km)

Rs. Million

Cash Flow Statement

Year	Sources of Funds								Uses of Funds					
	Equity	Debt	Addl. Grant to Operator	Grant 1	PAT	Salvage Value	Add: Depreciation	TOTAL Inflow	Capex	Principal Repayment	Total Outflow	Opening Balance	Surplus/ Deficit	Closing Balance
Y1	153	-	-	-	-	-	-	153	153	-	153	-	-	-
Y2	153	-	-	-	-	-	-	153	153	-	153	-	-	-
Y3	226	-	-	-	-	-	-	226	226	-	226	-	-	-
Y4	29	1,310	946	-	-	-	-	2,286	2,286	-	2,286	-	-	-
Y5	-	-	3,865	-	-	-	-	3,865	3,865	-	3,865	-	-	-
Y6	-	-	-	-	(1,026)	-	546	(480)	-	164	164	-	(644)	(644)
Y7	-	-	-	-	(1,000)	-	546	(454)	-	164	164	(644)	(617)	(1,261)
Y8	-	-	-	-	(962)	-	546	(416)	-	164	164	(1,261)	(580)	(1,841)
Y9	-	-	-	-	(918)	-	546	(372)	-	164	164	(1,841)	(536)	(2,377)
Y10	1,308	-	-	-	(1,136)	-	546	718	1,308	164	1,472	(2,377)	(754)	(3,131)
Y11	-	-	-	-	(867)	-	610	(257)	-	164	164	(3,131)	(420)	(3,551)
Y12	-	-	-	-	(796)	-	610	(186)	-	164	164	(3,551)	(350)	(3,901)
Y13	-	-	-	-	(709)	-	610	(99)	-	164	164	(3,901)	(263)	(4,164)
Y14	-	-	-	-	(603)	-	610	7	-	-	-	(4,164)	7	(4,158)
Y15	1,746	-	-	-	(855)	-	610	1,500	1,746	-	1,746	(4,158)	(245)	(4,403)
Y16	-	-	-	-	(539)	-	697	158	-	-	-	(4,403)	158	(4,245)
Y17	-	-	-	-	(479)	-	697	218	-	-	-	(4,245)	218	(4,027)
Y18	-	-	-	-	(411)	-	697	286	-	-	-	(4,027)	286	(3,741)
Y19	-	-	-	-	(328)	-	697	370	-	-	-	(3,741)	370	(3,371)
Y20	14,259	-	-	-	(677)	-	697	14,280	14,259	-	14,259	(3,371)	21	(3,351)
Y21	-	-	-	-	(717)	-	1,272	555	-	-	-	(3,351)	555	(2,795)
Y22	-	-	-	-	(599)	-	1,272	673	-	-	-	(2,795)	673	(2,122)
Y23	-	-	-	-	(474)	-	1,272	797	-	-	-	(2,122)	797	(1,325)
Y24	-	-	-	-	(335)	-	1,272	937	-	-	-	(1,325)	937	(388)
Y25	3,108	-	-	-	(720)	-	1,272	3,660	3,108	-	3,108	(388)	552	164
Y26	-	-	-	-	(150)	-	1,427	1,277	-	-	-	164	1,277	1,441
Y27	-	-	-	-	45	-	1,427	1,473	-	-	-	1,441	1,473	2,913
Y28	-	-	-	-	273	-	1,427	1,701	-	-	-	2,913	1,701	4,614
Y29	-	-	-	-	517	-	1,427	1,944	-	-	-	4,614	1,944	6,558
Y30	4,147	-	-	-	93	8,490	1,427	14,158	4,147	-	4,147	6,558	10,011	16,568

APPENDIX – 6.2(4) – Tables Supporting the Financial Analysis
AIZWAL ROPE CAR - East West Corridor (Long 5.5 Km)

Profit & Loss Account

Rs. Million

Year	Fare Box Income	Commercial Space	Advertisement Space	Revenue Income	O&M	EBIDTA	Less: Interest	Less: Depreciation	PBT	Tax	PAT
Y1	-	-	-	-	-	-	-	-	-	-	-
Y2	-	-	-	-	-	-	-	-	-	-	-
Y3	-	-	-	-	-	-	-	-	-	-	-
Y4	-	-	-	-	-	-	-	-	-	-	-
Y5	-	-	-	-	-	-	-	-	-	-	-
Y6	266	16	8	291	613	(323)	157	546	(1,026)	-	(1,026)
Y7	308	19	9	336	643	(306)	147	546	(1,000)	-	(1,000)
Y8	357	19	9	385	673	(288)	128	546	(962)	-	(962)
Y9	414	19	9	441	705	(264)	108	546	(918)	-	(918)
Y10	479	21	11	511	1,013	(502)	88	546	(1,136)	-	(1,136)
Y11	554	21	11	586	774	(188)	69	610	(867)	-	(867)
Y12	642	21	11	674	811	(137)	49	610	(796)	-	(796)
Y13	743	25	12	780	850	(70)	29	610	(709)	-	(709)
Y14	860	25	12	897	890	7	-	610	(603)	-	(603)
Y15	996	25	12	1,033	1,278	(245)	-	610	(855)	-	(855)
Y16	1,093	28	14	1,135	977	158	-	697	(539)	-	(539)
Y17	1,199	28	14	1,242	1,024	218	-	697	(479)	-	(479)
Y18	1,316	28	14	1,359	1,073	286	-	697	(411)	-	(411)
Y19	1,445	32	16	1,493	1,124	370	-	697	(328)	-	(328)
Y20	1,585	32	16	1,634	1,613	21	-	697	(677)	-	(677)
Y21	1,740	32	16	1,788	1,233	555	-	1,272	(717)	-	(717)
Y22	1,909	37	19	1,965	1,292	673	-	1,272	(599)	-	(599)
Y23	2,095	37	19	2,151	1,354	797	-	1,272	(474)	-	(474)
Y24	2,299	37	19	2,355	1,418	937	-	1,272	(335)	-	(335)
Y25	2,523	43	21	2,588	2,036	552	-	1,272	(720)	-	(720)
Y26	2,769	43	21	2,834	1,557	1,277	-	1,427	(150)	-	(150)
Y27	3,039	43	21	3,103	1,631	1,473	-	1,427	45	-	45
Y28	3,335	49	25	3,409	1,709	1,701	-	1,427	273	-	273
Y29	3,660	49	25	3,734	1,790	1,944	-	1,427	517	-	517
Y30	4,017	49	25	4,091	2,570	1,521	-	1,427	93	-	93

APPENDIX – 6.2(5) – Tables Supporting the Financial Analysis
 AIZWAL ROPE CAR - East West Corridor (Short 2.4 Km)

Rs. Million

Cash Flow Statement

	Sources of Funds								Uses of Funds			Opening Balance	Surplus/ Deficit	Closing Balance
	Equity	Debt	Addl. Grant to Operator	Grant 1	PAT	Salvage Value	Add: Depreciation	TOTAL Inflow	Capex	Principal Repayment	Total Outflow			
Y1	87	-	-	-	-	-	-	87	87	-	87	-	-	-
Y2	87	-	-	-	-	-	-	87	87	-	87	-	-	-
Y3	128	-	-	-	-	-	-	128	128	-	128	-	-	-
Y4	17	743	537	-	-	-	-	1,297	1,297	-	1,297	-	-	-
Y5	-	-	2,193	-	-	-	-	2,193	2,193	-	2,193	-	-	-
Y6	-	-	-	-	(622)	-	310	(312)	-	93	93	-	(405)	(405)
Y7	-	-	-	-	(609)	-	310	(299)	-	93	93	(405)	(392)	(797)
Y8	-	-	-	-	(592)	-	310	(283)	-	93	93	(797)	(376)	(1,173)
Y9	-	-	-	-	(573)	-	310	(263)	-	93	93	(1,173)	(356)	(1,529)
Y10	742	-	-	-	(621)	-	310	431	742	93	835	(1,529)	(405)	(1,933)
Y11	-	-	-	-	(554)	-	346	(208)	-	93	93	(1,933)	(301)	(2,234)
Y12	-	-	-	-	(522)	-	346	(176)	-	93	93	(2,234)	(269)	(2,503)
Y13	-	-	-	-	(479)	-	346	(133)	-	93	93	(2,503)	(226)	(2,729)
Y14	-	-	-	-	(429)	-	346	(83)	-	-	-	(2,729)	(83)	(2,812)
Y15	990	-	-	-	(483)	-	346	853	990	-	990	(2,812)	(137)	(2,949)
Y16	-	-	-	-	(410)	-	396	(15)	-	-	-	(2,949)	(15)	(2,964)
Y17	-	-	-	-	(386)	-	396	9	-	-	-	(2,964)	9	(2,955)
Y18	-	-	-	-	(358)	-	396	37	-	-	-	(2,955)	37	(2,917)
Y19	-	-	-	-	(320)	-	396	75	-	-	-	(2,917)	75	(2,842)
Y20	8,089	-	-	-	(405)	-	396	8,080	8,089	-	8,089	(2,842)	(9)	(2,851)
Y21	-	-	-	-	(568)	-	721	154	-	-	-	(2,851)	154	(2,698)
Y22	-	-	-	-	(513)	-	721	208	-	-	-	(2,698)	208	(2,489)
Y23	-	-	-	-	(459)	-	721	262	-	-	-	(2,489)	262	(2,227)
Y24	-	-	-	-	(399)	-	721	323	-	-	-	(2,227)	323	(1,905)
Y25	1,763	-	-	-	(475)	-	721	2,010	1,763	-	1,763	(1,905)	247	(1,658)
Y26	-	-	-	-	(333)	-	810	477	-	-	-	(1,658)	477	(1,181)
Y27	-	-	-	-	(246)	-	810	563	-	-	-	(1,181)	563	(618)
Y28	-	-	-	-	(139)	-	810	670	-	-	-	(618)	670	52
Y29	-	-	-	-	(31)	-	810	779	-	-	-	52	779	831
Y30	2352	0	0	0	(102)	4816	810	7876	2352	0	2352	831	5524	6355

APPENDIX – 6.2(6) – Tables Supporting the Financial Analysis
AIZWAL ROPE CAR - East West Corridor (Short 2.4 Km)

Profit & Loss Account

Rs. Million

	Fare Box Income	Commercial Space	Advertisem ent Space	Revenue Income	O&M	EBIDTA	Less: Interest	Less: Depre- ciation	PBT	Tax	PAT
Y1	-	-	-	-	-	-	-	-	-	-	-
Y2	-	-	-	-	-	-	-	-	-	-	-
Y3	-	-	-	-	-	-	-	-	-	-	-
Y4	-	-	-	-	-	-	-	-	-	-	-
Y5	-	-	-	-	-	-	-	-	-	-	-
Y6	137	16	8	161	384	(223)	89	310	(622)	-	(622)
Y7	159	19	9	186	402	(216)	84	310	(609)	-	(609)
Y8	183	19	9	211	421	(210)	72	310	(592)	-	(592)
Y9	212	19	9	240	442	(202)	61	310	(573)	-	(573)
Y10	245	21	11	277	539	(262)	50	310	(621)	-	(621)
Y11	283	21	11	315	485	(169)	39	346	(554)	-	(554)
Y12	327	21	11	359	508	(148)	28	346	(522)	-	(522)
Y13	379	25	12	415	532	(117)	17	346	(479)	-	(479)
Y14	438	25	12	474	557	(83)	-	346	(429)	-	(429)
Y15	506	25	12	543	680	(137)	-	346	(483)	-	(483)
Y16	555	28	14	597	612	(15)	-	396	(410)	-	(410)
Y17	608	28	14	650	641	9	-	396	(386)	-	(386)
Y18	666	28	14	708	671	37	-	396	(358)	-	(358)
Y19	730	32	16	779	703	75	-	396	(320)	-	(320)
Y20	800	32	16	849	858	(9)	-	396	(405)	-	(405)
Y21	877	32	16	926	772	154	-	721	(568)	-	(568)
Y22	961	37	19	1,017	809	208	-	721	(513)	-	(513)
Y23	1,053	37	19	1,109	847	262	-	721	(459)	-	(459)
Y24	1,154	37	19	1,210	888	323	-	721	(399)	-	(399)
Y25	1,265	43	21	1,330	1,083	247	-	721	(475)	-	(475)
Y26	1,387	43	21	1,451	974	477	-	810	(333)	-	(333)
Y27	1,520	43	21	1,584	1,021	563	-	810	(246)	-	(246)
Y28	1,666	49	25	1,740	1,069	670	-	810	(139)	-	(139)
Y29	1,826	49	25	1,900	1,120	779	-	810	(31)	-	(31)
Y30	2,001	49	25	2,075	1,367	708	-	810	(102)	-	(102)

APPENDIX – 6.2(7) – Tables Supporting the Financial Analysis
 AIZWAL ROPE CAR - North South Corridor (7.5 Km)

Rs. Million

Cash Flow Statement

	Sources of Funds								Uses of Funds			Opening Balance	Surplus/ Deficit	Closing Balance
	Equity	Debt	Addl. Grant to Operator	Grant 1	PAT	Salvage Value	Add: Depreciation	TOTAL Inflow	Capex	Principal Repayment	Total Outflow			
Y1	208	0	0	0	0	0	0	208	208	0	208	0	0	0
Y2	208	0	0	0	0	0	0	208	208	0	208	0	0	0
Y3	309	0	0	0	0	0	0	309	309	0	309	0	0	0
Y4	40	1,786	1,291	0	0	0	0	3,117	3,117	0	3,117	0	0	0
Y5	0	0	5,271	0	0	0	0	5,271	5,271	0	5,271	0	0	0
Y6	0	0	0	0	-1,458	0	745	-714	0	223	223	0	-937	-937
Y7	0	0	0	0	-1,441	0	745	-697	0	223	223	-937	-920	-1,857
Y8	0	0	0	0	-1,412	0	745	-667	0	223	223	-1,857	-890	-2,747
Y9	0	0	0	0	-1,378	0	745	-634	0	223	223	-2,747	-857	-3,604
Y10	1,784	0	0	0	-1,488	0	745	1,040	1,784	223	2,008	-3,604	-967	-4,572
Y11	0	0	0	0	-1,381	0	832	-549	0	223	223	-4,572	-773	-5,344
Y12	0	0	0	0	-1,333	0	832	-501	0	223	223	-5,344	-725	-6,069
Y13	0	0	0	0	-1,274	0	832	-442	0	223	223	-6,069	-665	-6,734
Y14	0	0	0	0	-1,198	0	832	-367	0	0	0	-6,734	-367	-7,101
Y15	2,381	0	0	0	-1,346	0	832	1,866	2,381	0	2,381	-7,101	-515	-7,616
Y16	0	0	0	0	-1,252	0	951	-302	0	0	0	-7,616	-302	-7,917
Y17	0	0	0	0	-1,233	0	951	-282	0	0	0	-7,917	-282	-8,199
Y18	0	0	0	0	-1,210	0	951	-259	0	0	0	-8,199	-259	-8,459
Y19	0	0	0	0	-1,177	0	951	-226	0	0	0	-8,459	-226	-8,685
Y20	19,445	0	0	0	-1,387	0	951	19,009	19,445	0	19,445	-8,685	-436	-9,121
Y21	0	0	0	0	-1,891	0	1,734	-157	0	0	0	-9,121	-157	-9,277
Y22	0	0	0	0	-1,840	0	1,734	-106	0	0	0	-9,277	-106	-9,383
Y23	0	0	0	0	-1,791	0	1,734	-57	0	0	0	-9,383	-57	-9,440
Y24	0	0	0	0	-1,734	0	1,734	0	0	0	0	-9,440	0	-9,440
Y25	4,238	0	0	0	-1,967	0	1,734	4,005	4,238	0	4,238	-9,440	-233	-9,673
Y26	0	0	0	0	-1,801	0	1,946	146	0	0	0	-9,673	146	-9,527
Y27	0	0	0	0	-1,718	0	1,946	228	0	0	0	-9,527	228	-9,299
Y28	0	0	0	0	-1,615	0	1,946	331	0	0	0	-9,299	331	-8,968
Y29	0	0	0	0	-1,511	0	1,946	435	0	0	0	-8,968	435	-8,533
Y30	5,655	0	0	0	-1,780	11,577	1,946	17,399	5,655	0	5,655	-8,533	11,744	3,211

APPENDIX – 6.2(8) – Tables Supporting the Financial Analysis
AIZWAL ROPE CAR - North South Corridor (7.5 Km)

Profit & Loss Account											Rs. Million	
0	Fare Box Income	Commercial Space	Advertisement Space	Revenue Income	O&M	EBIDTA	Less: Interest	Less: Depreciation	PBT	Tax	PAT	
Y1	0	0	0	0	0	0	0	0	0	0	0	
Y2	0	0	0	0	0	0	0	0	0	0	0	
Y3	0	0	0	0	0	0	0	0	0	0	0	
Y4	0	0	0	0	0	0	0	0	0	0	0	
Y5	0	0	0	0	0	0	0	0	0	0	0	
Y6	328	16	8	353	852	-499	214	745	-1,458	0	-1,458	
Y7	369	19	9	397	893	-496	201	745	-1,441	0	-1,441	
Y8	414	19	9	442	935	-493	174	745	-1,412	0	-1,412	
Y9	466	19	9	493	980	-486	147	745	-1,378	0	-1,378	
Y10	523	21	11	555	1,178	-623	121	745	-1,488	0	-1,488	
Y11	588	21	11	620	1,075	-456	94	832	-1,381	0	-1,381	
Y12	660	21	11	692	1,127	-434	67	832	-1,333	0	-1,333	
Y13	742	25	12	778	1,180	-402	40	832	-1,274	0	-1,274	
Y14	833	25	12	870	1,237	-367	0	832	-1,198	0	-1,198	
Y15	936	25	12	973	1,487	-515	0	832	-1,346	0	-1,346	
Y16	1,013	28	14	1,056	1,357	-302	0	951	-1,252	0	-1,252	
Y17	1,097	28	14	1,139	1,422	-282	0	951	-1,233	0	-1,233	
Y18	1,188	28	14	1,230	1,490	-259	0	951	-1,210	0	-1,210	
Y19	1,286	32	16	1,335	1,561	-226	0	951	-1,177	0	-1,177	
Y20	1,393	32	16	1,441	1,877	-436	0	951	-1,387	0	-1,387	
Y21	1,508	32	16	1,556	1,713	-157	0	1,734	-1,891	0	-1,891	
Y22	1,633	37	19	1,688	1,795	-106	0	1,734	-1,840	0	-1,840	
Y23	1,768	37	19	1,824	1,880	-57	0	1,734	-1,791	0	-1,791	
Y24	1,914	37	19	1,970	1,970	0	0	1,734	-1,734	0	-1,734	
Y25	2,072	43	21	2,136	2,369	-233	0	1,734	-1,967	0	-1,967	
Y26	2,243	43	21	2,308	2,162	146	0	1,946	-1,801	0	-1,801	
Y27	2,429	43	21	2,493	2,265	228	0	1,946	-1,718	0	-1,718	
Y28	2,630	49	25	2,704	2,373	331	0	1,946	-1,615	0	-1,615	
Y29	2,848	49	25	2,922	2,486	435	0	1,946	-1,511	0	-1,511	
Y30	3,083	49	25	3,157	2,991	167	0	1,946	-1,780	0	-1,780	

Appendix 6.3: Details of Mizoram Budget (FY 2013 – FY2016)

	INR Million				
Details	2012-13 Actuals	2013-14 Actuals	2014-15 RE	2015-16 BE	AAGR %
REVENUE ACCOUNT					
A Tax Revenue					
1 State Own Tax Revenue	2,232	2,298	2,704	2,984	10%
2 Devolution of Central Taxes & Duties	7,860	8,581	9,382	24,137	45%
<i>Sub Total</i>	10,091	10,879	12,086	27,121	39%
B Non-Tax Revenue	2,128	1,943	2,785	2,925	11%
C Grants -in - Aids & Contributions					
Non-Plan Grants	10,572	11,416	11,145	22,114	28%
Plan Grants	22,577	23,411	31,570	24,278	2%
<i>Sub Total</i>	33,148	34,827	42,715	46,392	12%
D Total Revenue Receipts	45,368	47,648	57,586	76,437	19%
E Total Revenue Expenditure	45,089	45,314	62,783	51,308	4%
Out of which					
General/ Social Services	30,828	32,116	42,097	36,161	5%
Interest Payments	3,076	3,074	3,224	3,216	1%
Urban Development	469	663	1,012	601	9%
Transport	1,182	1,366	2,080	2,008	19%
F Revenue Account (Surplus/Deficit)	278	2,335	-5,197	25,128	349%
CAPITAL ACCOUNT					
G Capital Receipts					
Public Debt	4,203	11,232	13,505	2,346	-18%
Loans & Advances (Recoveries)	295	331	400	400	11%
<i>Sub Total</i>	4,498	11,563	13,905	2,746	-15%
H Capital Expenditure					
Capital Outlay	6,076	3,193	10,874	14,663	34%
Public Debt	2,861	9,567	12,797	2,511	-4%
Loans & Advances	303	65	27	281	-2%
<i>Sub Total</i>	9,239	12,824	23,697	17,454	24%
I Capital Account (Surplus/Deficit)	-4,741	-1,261	-9,793	-14,709	46%
J Overall Transactions	-4,463	1,074	-14,990	10,420	-233%
FISCAL INDICATORS					
Revenue Deficit	-278	-2,335	5,197	-25,128	349%
Fiscal Deficit	6,362	5,261	5,303	39,671	84%
Primary Deficit	-3,286	-2,187	-2,079	-36,456	123%
FISCAL PERFORMANCE					
NSDP (INR Million)	46,883	50,667	54,756	59,175	8%
Revenue Balance/NSDP	0.6%	4.6%	-9.5%	42.5%	
Fiscal Deficit/NSDP	13.6%	10.4%	9.7%	67.0%	
Capital outlay/NSDP	13.0%	6.3%	19.9%	24.8%	
Debt Liabilities/NSDP	63.5%	38.2%	30.7%	NA	
State own revenue/NSDP	21.5%	21.5%	22.1%	45.8%	

Source:

1. Annual Financial Statement (Budget) 2014-2015, 11 November, 2014, Govt. of Mizoram
2. Annual Financial Statement (Budget) 2015-2016, 19 March, 2015, Govt. of Mizoram
3. Hand Book of Statistics on the Indian Economy, 2013-14, Reserve Bank of India

APPENDIX 7: INSTITUTIONAL ARRANGEMENTS FOR URBAN TRANSPORT IN AIZAWL

Introduction

There are several government and private organisations / institutions in charge of operation and maintenance of traffic and transport in Aizawl and for construction of facilities and regulation. The various institutions and their functions are summarized in Table 1.

Table 1: Organisations and their functions

Sl. No.	Organisation	Function related to traffic & transport
A. GOVERNMENT ORGANISATIONS		
1	Aizawl Municipal Corporation	<ul style="list-style-type: none"> • Improvement of footpath, railings, public amenities • Construction of pedestrian over-bridge and off-street parking • Parking designation & management • Zonal planning functions of erstwhile Aizawl Development Authority
2	Urban Development & Poverty Alleviation Department	<ul style="list-style-type: none"> • Planning and development of urban area in Mizoram. • Headed by Secretary Planning • Implementing body for Central government schemes like SMART city, AMRUT, JNNURM and National urban livelihood. • Recently got mandate from state government to be in charge of urban transport matters
3	Town & Country Planning Organisation (under Urban Development & Poverty Alleviation Department)	<ul style="list-style-type: none"> • Land use planning • Planning for future development of transport infrastructure
4	Police Department (Traffic)	<ul style="list-style-type: none"> • Enforcement and management of traffic flow • Parking enforcement
5	Public Works Department (Buildings)	<ul style="list-style-type: none"> • Road maintenance • minor construction • repair of road structures
6	Transport Department	<ul style="list-style-type: none"> • Registration and record of all vehicles • Issuing of bus, taxi, maxi-cab & truck permits
7	State Transport Authority	<ul style="list-style-type: none"> • Issue of permits for routes

8	Mizoram Pollution Control Department	<ul style="list-style-type: none"> • Checking vehicle emissions and issuing fitness certificate • Monitoring ambient air quality and publishing data
B. CO-ORDINATING BODIES		
9	Traffic Coordination & Management Committee	<ul style="list-style-type: none"> • High level committee to coordinate activities of various departments for better traffic management
10	Aizawl Road Authority	<ul style="list-style-type: none"> • Approval of road projects
11	AMC – Traffic Management Committee	<ul style="list-style-type: none"> • Coordination of parking management
C. PRIVATE SECTOR ORGANISATIONS (SOME)		
12	Aizawl City Bus Owner's Association (ACBOA)	<ul style="list-style-type: none"> • Operation of city bus service along major routes
13	Zoram Taxi Owner's Association (ZTOA)	<ul style="list-style-type: none"> • Operation of taxi service
14	Mizoram Maxi-cab Owner's Association (MMCOA)	<ul style="list-style-type: none"> • Operation of Sumo service
15	Zoram Driver's Union (ZDU)	<ul style="list-style-type: none"> • Looks after demand of taxi divers
16	Mizoram Taxi Owner's Association (MTOA)	<ul style="list-style-type: none"> • Looks after demand of taxi owners
17	Line Bus Association	<ul style="list-style-type: none"> • Operation of line buses in the minor east west routes

Organisation details

1. Aizawl Municipal Corporation

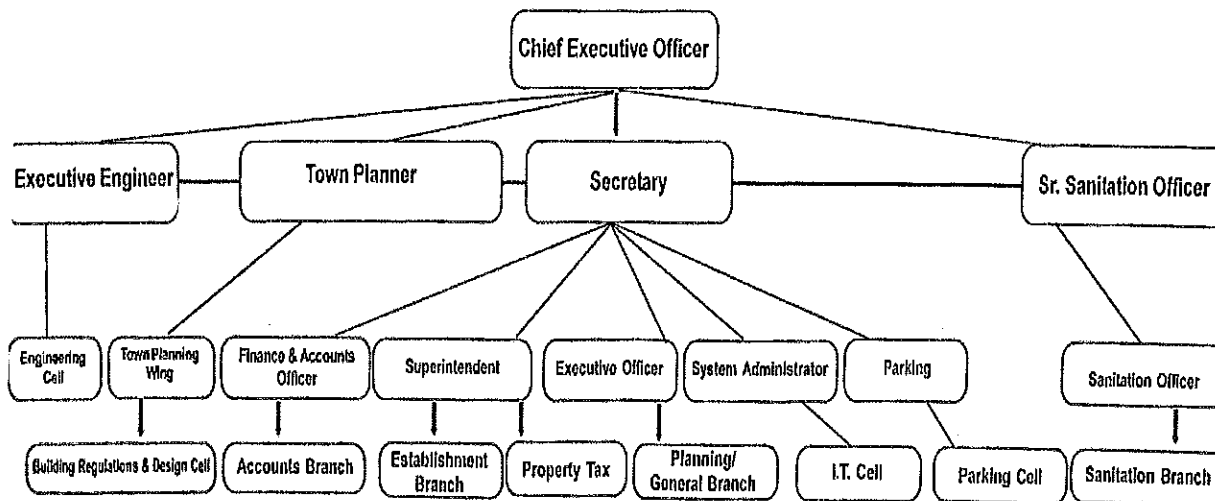
AMC was formed in 2008. It has 19 wards and 96 staff. Of the total 96 staff, 3 are on deputation, 57 are contractual or transferred from other institutions and 39 are regular. Of the total staff of 96 persons, 25 are technical and 71 non-technical plus the 300+ sanitation workers.

The organisation chart of AMC is shown in **Figure 1**.

Figure 1: Organisation Chart of AMC

PRESENT ORGANISATION CHART OF AIZAWL MUNICIPAL COUNCIL

ADMINISTRATIVE SET UP / EXECUTIVE WING



The main functions of AMC are: public health, sanitation, conservancy and solid waste management, burial and burial grounds, cremation grounds, public amenities including street lighting, parking lots, bus stops and public conveniences; regulation of slaughter houses and tanneries. Roads and highways function is handled by PWD.

AMC has a Traffic Management Committee that decides all matters relating to parking. It is chaired by the Executive Councilor, parking, and includes the SP Traffic and all councilors, and also representatives of the transport operators. AMC has 3 persons (staff) working in its Parking Cell.

The Engineering Department is headed by the Executive Engineer. The organisation structure is:

AMC Engineering Department Staffing Structure

Post	Number of Staff	Comments
Executive Engineer	1	
Assistant Engineer	1	In practice there is only 0.5 person working in this role, as he is also shared with the Building Regulations Enforcement Team
Junior Engineer	5	Three are graduates and two are diploma holders
Zonal Assistants	4 (5 posts sanctioned)	The role of the zonal assistants is to support the JE's. One is a graduate, and three are diplomas.
Clerk	1	

The Engineering Department is divided into five zones covering the 19 wards. Each zone is looked after by a Junior Engineer. These zones do not correspond with the PWD north and south zones in Aizawl.

The Engineering Cell's functions are:

(1) Implementing the 'Action Plan' - a work list of projects for Aizawl, which is influenced by the local councilors' requests – i.e. small schemes spread across Aizawl. About 80-90% of the Cell's work is focused on the action plan, mostly drains, footpaths, public amenities.

(2) Another 10-20% is checking building designs and checking on unsafe/dangerous buildings. This work was inherited from PWD. There is a 'Technical Committee on Safety of Buildings', and the Engineering Cell does this work, taking help from PWD for testing (e.g. hammer testing) and reports.

AMC's Town Planning Team has a Town Planner; under him are four Enforcement Officers (EO) who came from ADA (Aizawl Development Agency), whose role is now transferred to AMC. The four EO's are as follows:

- 1 Assistant Town Planner (Enforcement Officer who also deals with parking)
- 1 Assistant Engineer (Enforcement Officer, the person mentioned above who is part-time Engineering Dept. and part-time Town Planning team)
- 2 Assistant Architects – they are the Enforcement Officers for the Building Regulations (and one of them also looks after advertisements and hoardings).

ADA's functions have been transferred to AMC; its dissolution has just been passed by Cabinet, and staff have moved into the AMC building. ADA staff were shifted to AMC, and it's not yet clear what their future or future role is. Some of the senior ADA posts were on deputation from Government departments; others were appointed directly by ADA.

ADA was intending to prepare Zonal Plans for Aizawl (there are 10 zones identified in the Master Plan). None have been prepared yet, and it is not clear what will be done in future about zonal plans.

Relationship of UDPA with AMC's planning functions is not clear, there seems to be a lack of coordination.

Traffic management activities: The same lack of co-ordination applies to traffic management activities. The Traffic Police do not consult much with AMC on traffic management proposals. However, AMC is now getting involved in all of the relevant committees.

Traffic management / engineering schemes:

AMC does not have enough support to do traffic management & engineering schemes. For example, there is no workforce as such for parking schemes.

Two recent projects that AMC is implementing are: (1) constructing pedestrian footbridges; (2) constructing off-street car parking.

Footbridges: Proposed at 3 locations:

1. Israel Point
2. Bazar Bawngkawn
3. Zodin Square (50m north of Zodin junction)

Design proposals and tender applications were obtained from 6 local architecture/ construction firms for 'design and build'.

The project has to be approved by the Aizawl Road Authority.

Off-Street Parking:

AMC has also considered off-street parking schemes at three locations, located underneath side roads that are hollowed-out to create space ('cavern parking'). The three locations are:

1. Chanmari (south of the main church);
2. North of Junction 23 (Brig. C Vankunga), next to the petrol pump (under the main road);
3. under the main road near the State Bank of India, south of Junction 20.

Use of Auto-CAD, and Equipment Requirements:

PWD uses AutoCAD in many of its drawings, particularly for building projects and some important road projects. CAD drawings are prepared by the Architecture Cell at PWD, and AMC's junior engineers upwards are using AutoCAD.

Equipment needed - facilities for producing large prints of drawings. They already have printers and plotters.

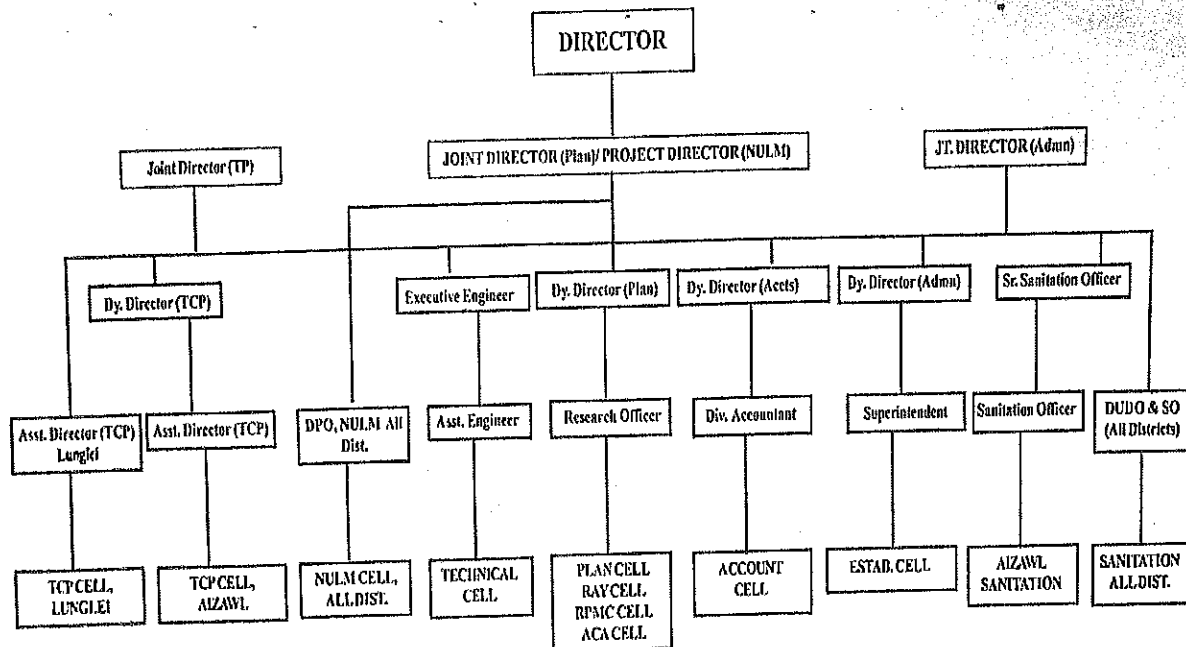
2. Urban Development and Poverty Alleviation Department (UD&PA)

The department is responsible for planning and development of urban area in Mizoram. It is headed by Director and supported by 3 Joint Directors, Joint Director Town Planning looks after all town planning efforts. Joint Director Plan looks after AMRUT, JNNURM and National urban livelihood. Joint Director Admin is responsible for administrative matters.

The organisation chart of UD & PA is shown in **Figure 2**.

Figure 2: Organisation Chart of UD & PA

**ORGANISATION CHART
URBAN DEVELOPMENT & POVERTY ALLEVIATION DEPARTMENT**



Town & Country Planning (TCPO)

TCPO is under Urban Development and Poverty Alleviation (UD&PA) department. They have 57 persons for the entire state. It is headed by Director, an administrative person. The hierarchy of ranks are:

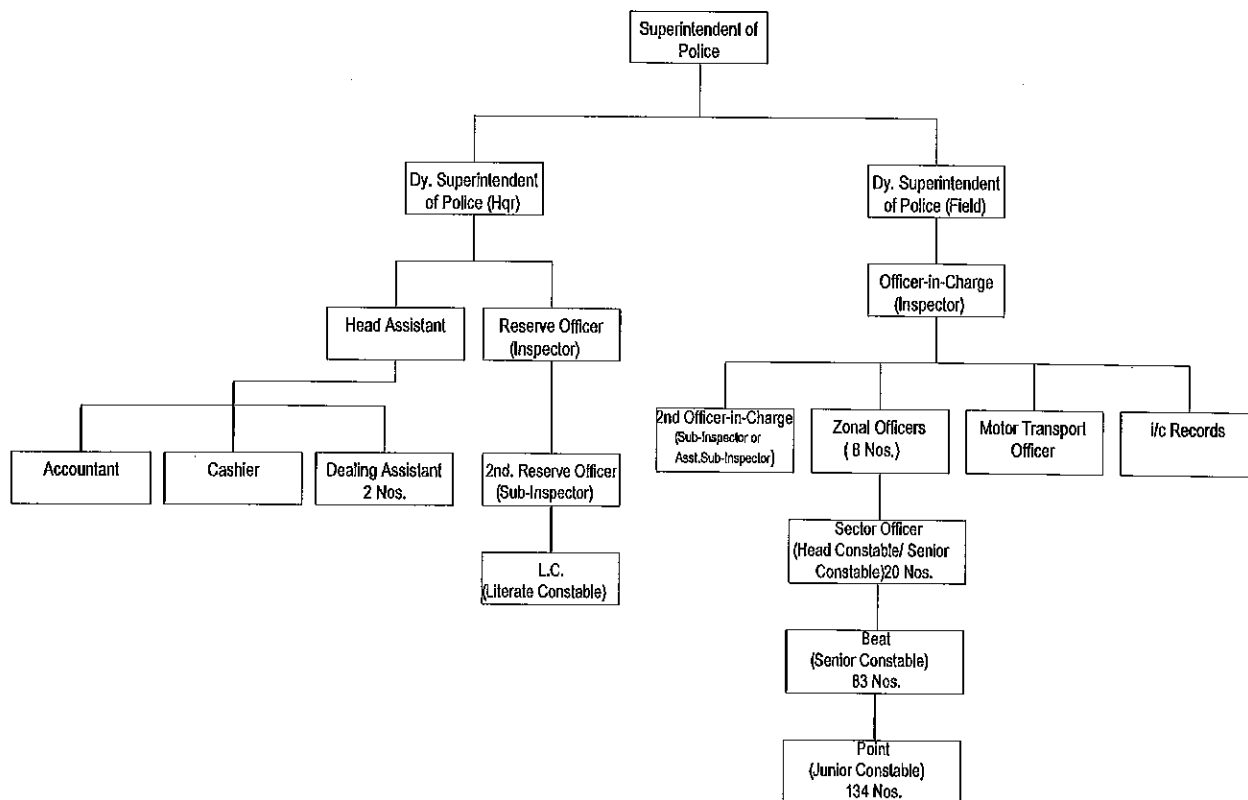
- Senior Town Planner, designated as Joint Director of Town Planning.
- Chief Town Planner, the position is not there at present.
- Deputy Director / Town Planner / District Urban Development officer – 2 posts
- Assistant Director / Assistant Town Planner – 5 posts, no one at present
- Planning Assistant / Junior Engineer / Urban Surveyor – 6 posts
- Draftsman – 3 posts
- Tracer – 3 posts / Section Assistant – 1 post

3. Traffic Police

Traffic management in Aizawl is done by the Traffic Police. AMC specifies the parking areas and stands for public transport vehicles. Management of traffic is done by deploying police personnel who manually control vehicle and pedestrian movement. Towing of vehicles and fines are enforced by police. A traffic control room has been set up.

The organisation chart of Traffic Police is shown in **Figure 3**

Figure 3: Organisation Chart of Traffic Police



Area wise management is done by Zonal Officers, Sector Officers and police on Beat and Point duty.

Aizawl has been divided into 6 zones. Each zone covers a local council area. Zones are administered by Zonal Officers who is of Sub Inspector or Assistant Sub Inspector rank. He supervises the zone working as a mobile patrolling officer. He is also responsible for inquiry and investigation of cases in the zone.

Zones are divided into sectors. There are 22 sectors in the city. Each sector is administered by a Sector Officer, who is a noncommissioned officer, an elite constable. He patrols on foot and gives necessary instructions to the police on Beat and Point duty. He has a wireless set and communicates with other Sector officers and Beat Officers. He is responsible for attending to the accident cases in his area and to preserve the scene till arrival of the Zonal Officer.

Each sector is divided into 2 to 3 beat areas, totaling to 64 beats in the city. Beat areas are looked after by Senior Constables. His responsibilities are similar to Sector Officer. He works closely with police on traffic point station duty. He is equipped with wireless set.

Static duty points have been set up at all important road junctions. Police are deployed at these points to regulate traffic flow. He has a wireless set and is under supervision of Beat Officer.

There is a mobile squad responsible for clearing traffic obstruction and to apprehend rule violators. An enforcement squad has been formed for conducting special drive for road clearance, clearing the route for VIP movement and to cover unscheduled functions or gathering, as a reserve force.

City wide traffic movement is regulated from traffic control room. It is administered by Officer in charge the second in command and is operated 24 hours. All activities of field officers are monitored and necessary instructions are given over wireless sets.

Closed circuit television monitoring has been set up at 10 important road junctions. These are monitored from control room at the SP office.

There are two mini tow trucks available for towing vehicles. All traffic accidents in the city are handled by the Traffic Police. There are round the clock Duty Officers of the rank of Sub Inspectors or Assistant Sub Inspectors

Improvement proposals

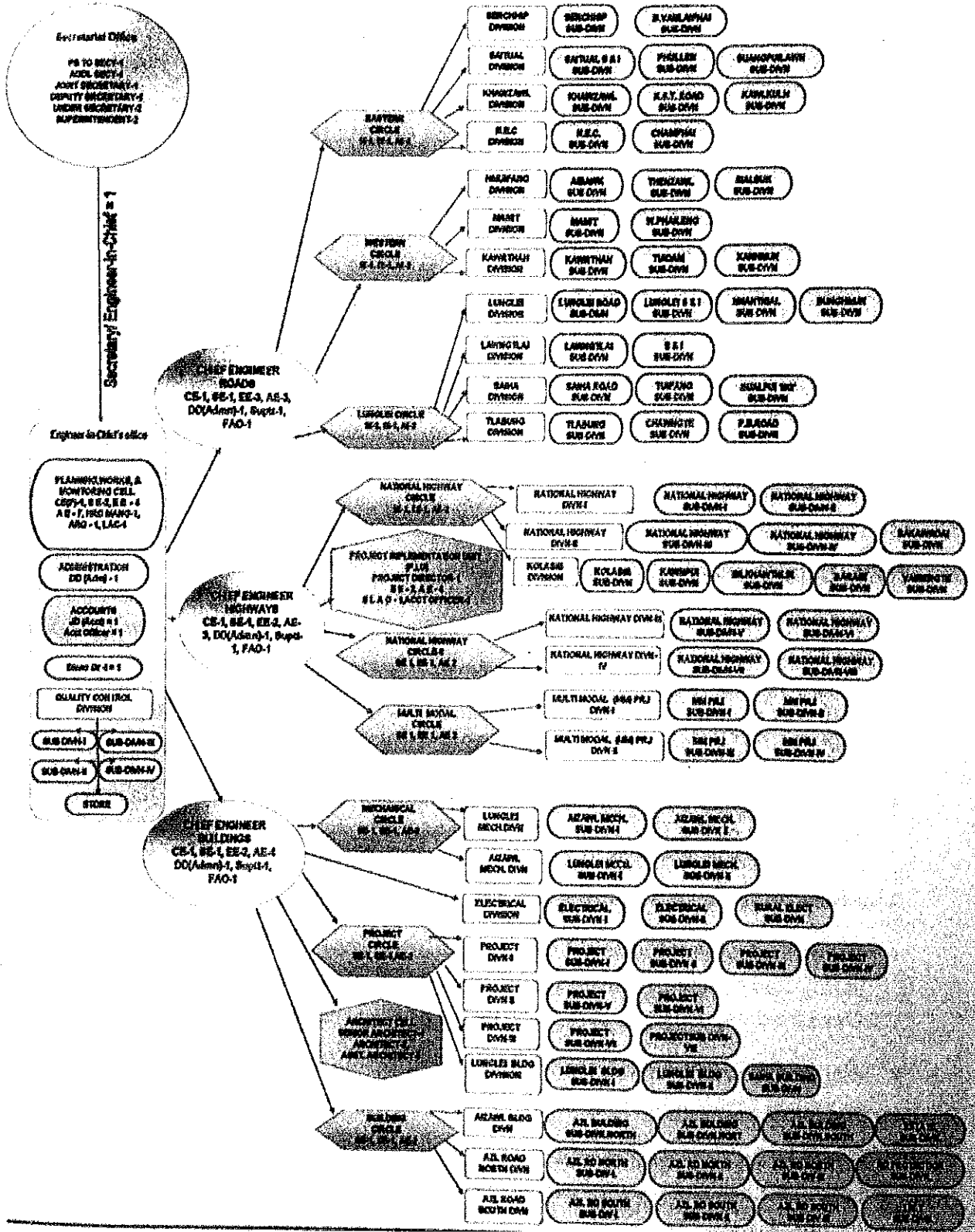
The Traffic Police have suggested several proposals for improvement of traffic flow in the city. The proposals are for short term, medium term and long term.

Short term proposals	Medium term proposals	Long term proposals
<ol style="list-style-type: none"> 1. Shifting of electric and telephone poles that obstruct traffic flow 2. Removal of road side automobile work shops 3. Removal of road side hawkers 4. Setting up proper driving training schools and mandating that all driving license applicants go through proper training 5. Issuance of vehicles with fitness certificates 	<ol style="list-style-type: none"> 1. Widening of narrow roads and levelling of roads 2. Vehicle owners to have garages to keep their vehicles 3. Creating sites for storing impounded vehicles 4. Increasing the number of people in Traffic Police 5. Include a subject on traffic rules and road signs in high school and college curricula. 	<ol style="list-style-type: none"> 1. Implementation of a ropeway system of transport 2. Provision of pedestrian over-bridges 3. Clearance of road between Treasury Square and Chanmari 4. Clearance of road in New market area 5. Setting up a Traffic Institute 6. Shifting of important institutions and centres 7. Increase the number of CCTVs for better traffic control

4. Public Works Department (PWD)

The organisation chart of PWD is shown in Figure 4.

Figure 4: Organisation Chart of PWD



The PWD in Mizoram is under three Chief Engineers (CE), CE Highways, CE Roads and CE Buildings.

CE Highways has authority over all National Highways in Mizoram and looks after all projects funded by Ministry of Road Transport & Highways (MORTH) Government of India. In Aizawl area only NH-54 is under his jurisdiction. This highway goes through Lengpui – Bungkawn - Zemabawk – Lunglei.

CE Roads has authority over all rural roads in the state, including state highways (SH), major district roads (MDR), other district roads (ODR). The development work is from North Eastern Council funds and state government funds. CE Roads does not have authority on any roads in Aizawl.

CE Buildings has authority over all government buildings in the state and all roads within Aizawl, except NH-54. He is responsible for construction, maintenance and repair of roads and structures on roads.

CE Buildings has 3 Superintending Engineers (SE) under him: SE Building, SE Project Circle and SE Mechanical Circle.

SE Mechanical Circle has 3 Executive Engineers (EE) under him. EE Mechanical Aizawl – looks after all mechanical equipment in Aizawl. EE Electrical Aizawl – looks after internal wiring and building electrification in Aizawl. EE Electrical Lunglei looks after electrification in other parts of the state.

SE Project Circle is responsible for construction of government buildings in Mizoram. He has 4 EE under him. EE Project Division 1 looks after buildings in Aizawl, Kolkata, Delhi and other states. EE Project Division 2 looks after government buildings in Aizawl and western Mizoram. EE Project Division 3 looks after buildings in Aizawl and eastern Mizoram. EE Lunglei Building Division looks after all government buildings in Lunglei and southern and western Mizoram.

SE Buildings is responsible for maintenance of all government buildings in Aizawl and maintenance of all roads in Aizawl except NH. He has 3 EE under him. EE Building Division Aizawl looks after maintenance of buildings in Aizawl. EE Aizawl Roads North Division looks after roads in northern Aizawl. EE Aizawl Roads South Division looks after roads in south Aizawl. Bazaar Bungkawn is the dividing line between north and south Aizawl.

There is a requirement of equipment and training of engineers. They have a few license for building design software – STAAD Pro. Additional licenses are required. AutoCAD is available, more license and training required. They do not have any road design software. Usually they engage consultants for road projects for design, improvement works and new alignment.

The main problem at PWD is that funds for road maintenance work is insufficient. They handle landslides, road blocks, formation damage, culvert and retaining wall damage with very little funds. Flood damage repair funds from government of Mizoram are utilised for the works. Government of India Finance Commission gives grants to state government for road maintenance. State government allocates funds to all departments. Allocation for PWD is not sufficient. Bypass road was constructed with the World Bank funds then it was handed over to the PWD.

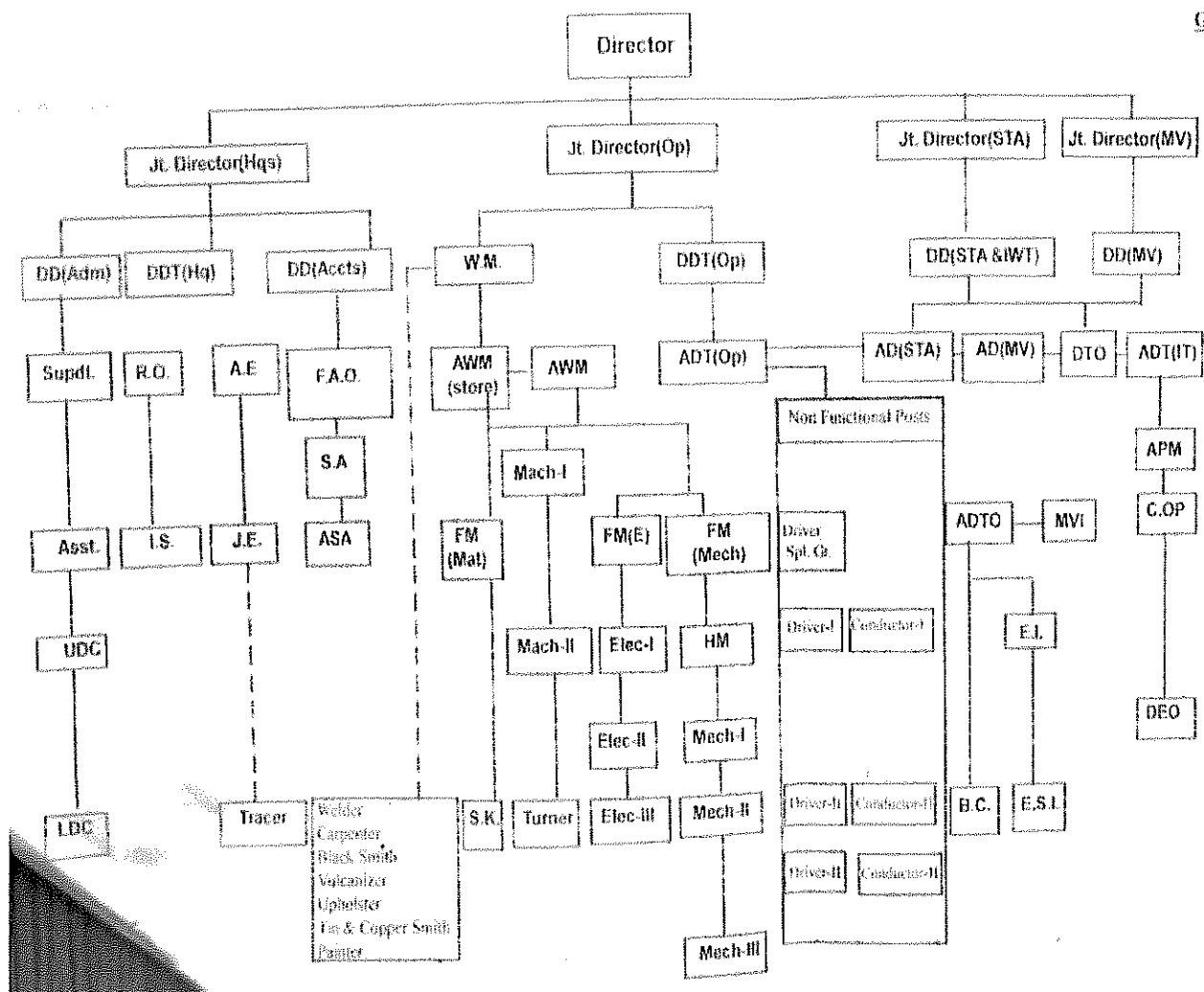
Road Fund Act was passed some time back in the Assembly, for collection of cess on fuel sales. Road Fund Board was formed with Minister of Roads as the Chairman. The Board and cess collection are not functional yet. If such funds are available, road maintenance can be done better.

5. Transport Department

The function of this department is to register motor vehicles, give permits to commercial vehicles, buses and taxis, collect fees, maintain and publish records related to vehicles. The department has 847 employees all over the state. It is headed by Director and supported by 4 Joint Directors (JD): JD - Headquarters, JD - Operations, JD – State Transport Authority and JD – Motor Vehicles. Organisation structure and number of people are shown in **Figure 5**.

Figure 5: Organisation Chart of Transport Department

ORGANISATION CHART : TRANSPORT DEPARTMENT



6. State Transport Authority

The Authority is responsible for approval bus routes that are run by private bodies. It also approves fare structure for buses and taxis. It is headed by Chairman, who is the Commissioner of Transport. It has 4 non official members who are nominated by the government and 2 official members – Secretary and Associate Secretary. Director Transport acts as Secretary and Joint Director – STA acts as Associate Secretary.

7. Mizoram Pollution Control Board

The board is responsible for monitoring air and water quality in Mizoram as per guidelines of the Central Pollution Control Board. It has created an Environmental Information System (ENVIS) System where data can be accessed from their web site.

Air Quality Monitoring Station	Vehicle Emission Testing Stations
1. Bazaar Bunkawn	1. Khatla
2. Khatla	2. Ngaizel
3. Leipuitlang	3. Bawngkawn
4. Bawngkawn	4. Zemabawk

Each testing centre has 2 persons with testing equipment. They have shortage of staff and funds.

B. Coordinating Bodies

Aizawl Road Authority

Aizawl Road Authority is a committee with five members:

1. Chairman – Health Minister
2. Vice-Chair – AMC Chairman
3. Member-Secretary – PWD Engineer-in-Chief
4. MLA (member of the legislative assembly)
5. One other

The function of the Aizawl Road Authority is to approve major road projects for the city and district.

Local Administration Department

This department puts up request for local roads in the local councils to the government for implementation.

AMC Traffic Management

AMC have a Traffic Management Committee (different from the high-level Aizawl Coordination Committee on Traffic Management). The committee decides all matters relating to parking. It is chaired by the Executive Councilor i/c parking, and includes the SP Traffic and all councilors, and also representatives of the transport operators

Coordination Committee on Traffic Management

A Coordination Committee was constituted by the Government of Mizoram in 1995 to ensure coordination and advanced planning of activities like construction of roads, laying of electrical, telephone, sewerage and water supply line, etc., by various departments to avoid and minimise accidents and to issue clearance certificates through Transport Department. Initially the Committee comprised of eight members. The name of the Committee was later changed to Coordination Committee on Traffic Management with wider scope of functions. The members are:

Sl. No	Designation	Members
1	Chairman	Home Minister
2	Vice Chairman	Parliamentary Secretary, Home Department
3	Chief Secretary	Member
4	Addn Secretary, Home	Member Secretary
5	D. C Aizawl	Member
6	Director, Transport Dept.	Member
7	Director, LAD	Member
8	Director, Land Revenue & Settlement	Member
9	Director, Information & Public Relation	Member
	Member	
10	CE, PWD, Building	Member
11	Director, Trade & Commerce	Member
12	Director, UD&PA	Member
13	SP, Aizawl	Member
14	SP, Traffic	Member
15	President, MJA	Member
16	Chairman, AMC	Member

Some of the major issues on which action has been taken are:

1. The Committee resolved to increase the funds for road safety and traffic management from fines collected by Police.
2. Construction of pavement railing has been taken up by UD&PA.
3. All taxis in Aizawl have been divided into three groups and period of entry for each group have been restricted.
4. Road marking machine and speed radar gun have been procured by the Traffic Police.
5. The Pollution Control Board has been instructed to be stringent about issuing fitness and pollution certificate.
6. Two wheeler parking has been allowed on the southern side of Millennium Centre.
7. All traffic points have been painted in similar colour.
8. Larger office space was allotted to Traffic Police and SP at the New Secretariat Complex.
9. Suppliers at wholesale market have been instructed to deliver their goods during lean traffic period.
10. AMC has been assigned to mark pedestrian zebra crossings.
11. Sumo and Maxi- cab stands have been shifted out from the road stretch between Bawngkawn and Sikulpuikawn.
12. Vehicles including two wheelers are not allowed to enter New Market between 5 AM and 10 PM. Only garbage collecting trucks are allowed to enter.
13. Aizawl Traffic Facebook Group has been created to answer traffic related queries.
14. Awareness campaign about good behaviour was conducted among taxi drivers.
15. Budget has been setup for conducting annual road safety week.
16. Heavy vehicle movement was banned from Vaivakawn to Chawlhmun via Zohnuai Road.
17. Parking charges and regulation has been revised.
18. It was resolved that "No vehicle zone" would be observed in the central part of the city during Christmas.

Some on- going programme are:

1. Construction of pedestrian over-bridges at upper Bazaar and Dwarpoi taxi stand.
2. Survey of vehicles parked on the road side.
3. Introduction of rope way system, tunnel and steel structure foot over-bridges

Some pending programme are:

- Introduction of two-wheeler taxi
- Replacement of big buses by small buses.
- Replacement of line buses by 10-seater Sumos.
- Increasing the number of vehicle registration counters.
- Providing license to hawkers after clearance from Committee.
- Conducting training for two-wheeler drivers
- All government offices to have parking on the ground floor of the building.
- Training for bus drivers and conductors.
- Shifting of electric posts, telephone posts, television cable from roads for free movement of vehicles and pedestrians.
- Instructing vehicle owners to have garage to keep their vehicles.

C. Private Sector Organisations

There are several private organisations providing transport service in the city.

- Aizawl City Bus Owner's Association (ACBOA)
- Zoram Taxi Owner's Association (ZTOA)
- Mizoram Maxi-cab Owner's Association (MMCOA)

- Zoram Driver's Union (ZDU)
- Mizoram taxi Owner's Association (MTOA)

Aizawl Bus Owner's Association

This is an association of private bus owners whose buses run every day. It has an Executive Council of 17 people, headed by the President, supported by Vice President, General Secretary, Secretary, Treasurer and Finance Secretary. They have an Action Committee to discipline bus drivers and conductors. The association has 14 employees. Each bus owner contributes money for their salary.

Interaction with the government:

Interaction between private service providers and government organisations take place at different levels.

- At the Transport Department / STA bus owners apply for vehicle registration, testing, fitness certificate, route permit and vehicle permit. Taxi and Maxi-cab owners have similar interaction.
- At the AMC, taxi associations interacts about allocation and payment for parking space at taxi stands. Parking fee collection is let out to private bodies by the AMC.
- At the PWD, private contractors interact with government engineers regarding road maintenance and repair. Consultants interact regarding project development and design.

D. Institutional setup required for project implementation and delivery: Urban Metropolitan Transport Authority (UMTA)

Currently different government departments / organisations deal with different aspects of urban transport. There is a need to establish a unified authority to deal with all urban transport aspects under one umbrella. Legislation for UMTA can be taken up in the lines of Model Act of Government of India.

According to the recommendations of the Working Group on Urban Transport in the 12th five year plan:

- UMTA should be an executive body governed by a Board made up of heads of various departments in the city, local elected leaders and eminent citizens. It should be supported by a team of professionals with a Chief Executive.
- UMTA should be based in the city and should report to the Metropolitan Planning Committee (MPC)/ District Planning Committee (DPC) as envisaged under the 74th Constitution Amendment Act (CAA). Until the MPC/DPC is constituted, UMTA should report to the relevant department at the State Headquarters.
- UMTA should be empowered to set up SPVs for various components of Urban Transport.
- UMTA should undertake the following functions:
 - Policy Functions: such as formulation of policies, strategies and financing for the city urban transport systems.
 - Regulatory Functions: to ensure co-ordination of various available modes of public transport to ensure seamless travel.
 - Integrated and holistic planning: such as comprehensive, integrated transport planning of all components of Urban Transport on a city wide/ urban Agglomeration (UA) basis for implementation including integrated land use. Transport planning with inputs from urban Development Authority. This will include planning for an integrated, multimodal public

transport system, MRTS, planning of bus routes, terminals, interchange points, intermediate public transport, Non-Motorised Transport (NMT) and transport demand management. It will also plan goods movement in the city.

- o Planning of road network and associated infrastructure in conjunction with planning of city wide public transport system. Infrastructure includes roads and associated facilities such as road furniture, traffic signals, road intersections, flyovers, grade separators, bridges, by-passes, and facilities for inter modal transfer and parking.
- o Organising and co-ordinating services that is franchising/ route allocation, contract monitoring, co-ordination of services, ensuring supply of services to meet demand, provisioning of new supplies, monitoring the work assigned to the implementing agencies. All service providers including Rail Transit and BRTS will be monitored by UMTA (however, construction, operation and maintenance of various MRTS, bus services and other infrastructure will continue through existing city agencies.)
- o Common services such as resolution of day-to-day matters, dispute resolution, Public Relations (PR), security services, management of revenue sharing arrangements. Provision and management of common facilities i.e. depots, terminals, and Passenger Information System (PIS), integrated ticketing, data management, management of multimodal interchanges, last mile connectivity, planning movements around MRT stations, co-ordination with other agencies and planning for future extension.
- o Traffic Engineering and Management.
- o Capacity building to upgrade the skills of the city officials.

Examples of UMTA are:

- Hyderabad Urban Metropolitan Transport Authority (HUMTA)
- Chennai Urban Metropolitan Transport Authority (CUMTA)

E. URBAN TRANSPORT FUNDS

National Urban Transport Fund

In order to facilitate highly capital intensive projects like Metro Rail et cetera, it is essential to provide cheaper, long tenure finance. For this a dedicated non-lapsable, non-fungible and statutory National level UTF (NUTF) needs to be set up (according to the recommendations of the Working Group on Urban Transport in the 12th Five Year Plan) in the first year of the 12th plan. Since the entire funding cannot be through traditional sources, innovative financing mechanisms will therefore be required to be tapped. Some possible sources proposed were:

- Green Surcharge of Rs. 2 on petrol sold across the country
- Green Cess on existing personalised vehicles at the rate of three per cent of the annual insured value for both cars and two wheelers
- Urban Transport tax on purchase of cars and two wheelers at 7.5 per cent of the total cost of petrol vehicles and 20 per cent in case of personalised diesel cars.

The above levies would serve the twin purpose of generating a dedicated and sustained stream of resources at the national level and provide de-incentive for middle class, lower middle class to give up the use of private vehicles.

State Urban Transport Fund

At the State level, additional sales tax on petrol, additional registration fee on four-wheelers and two-wheelers, high registration fee for personal vehicles running on diesel, annual renewal fee on driving license and vehicle registration, congestion tax, green tax etc. may be used to draw sources for the Dedicated Urban Transport Fund at the State level. The inelastic demand of petrol with respect to price in a short run would ensure sufficient accruals to the funding and which would, in the long run, incentivize such people to shift to the public transport system. The funds so generated by the States can be used for new projects in urban transport, compensate towards exemption of tax on urban buses and replacement of assets of public transport companies and, towards meeting the cost of various other concessions extended to encourage public transport by the State Government.

City Urban Transport Fund

The cities can generate fund out of betterment levy on land in areas which benefit by investment in urban transport projects; rationalization of parking-fee, property development tax, property development on the land banks with parastatals, advertisement revenue on transit corridors, employment tax (as done in France) etc. This fund at the city level can be used for establishing a fare contingency fund to meet the difference between the 'public fare' (paid by the commuters) and the 'technical fare' (payable to the private operators) to sustain the operations and; to provide ULBs' share for funding the urban transport projects.

Special Purpose Vehicles

A Special Purpose Vehicle is a legal entity created to fulfil narrow, specific or temporary objectives. Normally a company transfers assets to the SPV for management or for financing large projects and thereby achieves a narrow set of goals without putting the firm at risk. This SPV also known as Special Purpose Entity (SPE) can be owned by one or more entities. The SPV is usually a subsidiary company with an asset/ liability structure and legal status such that makes its obligations secure even if the parent company goes bankrupt.

Examples of SPV are:

- Atal Indore City Transport Service Limited (AICTSL) was set up as an SPV between Indore Municipal Corporation (IMC) and Indore Development Authority (IDA) with an initial capital of 25 lakhs with equal contributions from both authorities
- Pune Mahanagar Parivahan Mahamandal Limited (PMPML): this SPV was formed between Pune Municipal Corporation (PMC) and Pimpri Chinchwad Municipal Corporation (PCMC).
- Ahmedabad Janmarg Limited (AJL) was constituted as an SPV by the Ahmedabad Municipal Corporation (AMC), Ahmedabad Urban Development Authority and Government of Gujarat (GoG) in order to run and operate BRTS buses.
- Jaipur City Transport Service Limited (JCTSL), an SPV formed with equal partnership of Jaipur Nagar Nigam (JNN) and Jaipur Development Authority (JDA)

APPENDIX 8: STAKEHOLDER CONSULTATIONS

- 8.1 Participants and Discussions at the First Stakeholder Workshop
- 8.2 Participants and Discussions at the Second Stakeholder Workshop

Appendix 8.1: Participants and Discussions at the First Stakeholder Workshop

List of Participants invited for the first stakeholder consultation workshop, 21st Sept 2015

GOVERNMENT OFFICIALS	NON-GOVERNMENT STAKEHOLDERS
<p>PWD Chief Engineer, Mr. Lalmuankima Henry Superintending Engineer, Mr. C. Lalthmingthanga</p>	<p>Itzawl City Bus Owner's Association (ACBOA) President Mr. Malsawmtluanga</p>
<p>Traffic Police SP, Traffic, Mr. C. Lalthanmawia</p>	<p>Zoram Taxi Owner's Association (ZTOA) President Mr. R Pahlira</p>
<p>AMC CEO, Ms. Margret Zohmingthangi Executive Councilior, Mr. Rosinmugheta Executive Engineer, Mr. Zohmingthanga</p>	<p>Mizoram Maxicab Owner's Association (MMCOA) President Mr. Lalthanmawia</p>
<p>UD&PA Joint Director (Town Planning), Mr. Zoduailova Zotc Joint Director, Mr. Vanlalmawia</p>	<p>Zoram Driver's Union (ZDU) President – Mr. C. Vanlalsanga,</p>
<p>Transport Dept. Director, Mr. L. Biakthanga</p>	<p>Mizoram Taxi Owner's Association (MTOA) President Mr. P C Zoliansanga,</p>
<p>Min of Finance Secretary, Mr. F. Vanlalruata</p>	<p>Taxi Owner's Association, President Mr. Pahlira</p>
<p>Planning Dept Secretary, Mr. C. Vanlalramsanga</p>	<p>Truck Owner's Association, President Mr. Zoliansanga</p>
<p>Land Revenue & Settlement, Director, Mr. R. Lalramnghaka</p>	<p>Taxi Driver's Association President Mr. Laldawngliana</p>
	<p>Truck Driver's Association, President Mr. Marama</p>
	<p>Young Mizo Association, President Mr. Lalbiakzuala</p>
	<p>Mizoram Church Leaders Committee, Chairman Rev. Rinmawia</p>
	<p>Mizoram Journalist Association, President Mr. Vanlalrema</p>

Key Points from the Consultation Workshop 1

Date: 21 Sept 2015
Venue: Chatlang Tourist Lodge

Notes prepared by CDM Smith

Introduction

A consultation workshop was held on Monday 21st September to present and discuss the findings of the Initial Assessment Report with representatives of government and non-government organisations involved with transport in Aizawl, and also representatives from the wider civil society. The workshop included a presentation and open discussion, followed by a break-out session with round-table group discussions. 25 participants were invited and 15 attended representing government (PWD, AMC, Traffic Police, Dept. of Transport, UD&PA) and non-government transport sector organisations.

Main Points from the Discussions

1. The meeting was chaired by Mr. Henry, Chief Engineer, Buildings (PWD, Aizawl). He introduced the project and highlighted the need to tackle the city's growing traffic problems.
2. Mr. Gallagher, Team Leader, CDM Smith gave a presentation on the project, particularly objectives. Initial findings and proposals for short term traffic improvements and long term public transport development.
3. The main discussion points are summarized below and grouped under topics. Please note that they give a general synopsis of the points raised, (rather than minutes of the meeting).
4. **Footways:** There was overall consensus that since 50% of the trips were made by walking, pedestrian crossings and footways need improvement and has to be high on the priority list. One participant also pointed out that the footways should be properly designed and at a higher level than the road so that two/four wheelers are restricted to park on the footpaths.
5. **Buses:** There was a general consensus was that bus would remain as the backbone of the public transportation system in Aizawl and it can be supplemented by other forms of public transport. Since Aizawl is facing acute shortage of funds, the general perception was that the proposed public transportation system should not be very expensive. It was also pointed out that if a good system is in place in Aizawl, users will not be reluctant to pay for good services as they are already paying high fares for taxi.
6. **Medium to Long Term Options:** Most participants preferred the option of a N-S improved bus corridor and an E-W ropeway connection, after the consultants had explained the technical and financial feasibility and issues related to alignment and construction for all the systems.
7. **Electric Power Constraint:** However, some participants felt that since ropeways and cable liners are energy intensive and would require dedicated source of electricity, they might not be a good option for Aizawl considering the power shortage they are already facing. The same opinion was made regarding the possibility of pedestrian escalators on some important stairs.
8. **Problems with Present Bus Services:** Consultants were informed that previously buses used to complete four round trips in a day (in the North-South axis) which has now reduced to acute traffic congestion. It was also pointed out that the dwell time of buses at stops was high which also leads to congestion.
9. The general perception in Aizawl about a riding a bus is also poor and it is not an attractive option for slightly well to do families. Some of the reasons being the buses being poorly maintained, with limited seats and overcrowding. Taxis are seen a better medium of transport even if it's considered expensive for shorter trips. It was suggested that if the quality of buses

are improved and they are seen as a preferred mode of transport then demand for taxis will automatically go down. AMC had planned to start 'Green-line buses; as a skip-stop express service but failed to get clearances from Transport department.

10. **Parking Issues:** Removal of parking between Chanmari and Raj Bhavan for putting bus lanes was accepted by a few of the participants, but they felt it should be done in a phased manner. But alternative parking spaces (e.g. Off street parking complex between Chanmari and treasury square) have to be earmarked for private cars since modal shift will only happen gradually. High parking fees in the central areas as a deterrent for parking was already tried, but due to protests had to be backtracked. Some off-street parking were constructed by households by taking bank loans which is now rented to either their neighbors or others (Rent is Rs. 1500-2000 per space per month). Dedicated multistoried car parks are a must and can be built on PPP mode.
11. **Off-Street Cavern Parking:** Officials from AMC also said that they are looking at possibilities of constructing facilities for cavern parking near Chanmari YMA Hall. AMC's proposal for construction of pedestrian foot over-bridges at 3 locations were also highlighted
12. **Need for Truck-Terminals:** Parking of truck terminals is currently restricted outside city limit and more parking facilities have to be provided.
13. **Traffic management issues:** Regarding bus Q-jumps the perception was that it can only work in few sections of the road where road width is sufficient and not along the entire corridor, but can be experimented as a pilot project to test its practicality. If buses alone are given priority, it could slow down the private cars which also have a considerable share of government officials and VIP's, and therefore may not be acceptable. For efficient traffic junction management to enable Q-jumps, more manned police personal may be required, but they already have shortage of staff. There was also an opinion that Aizawl should be managed by traffic police man instead of automated traffic signals as human intervention is required for decision making along the narrow corridors and junctions.
14. **Need for bypasses:** The need for having the western bypass road was highlighted for heavy vehicles not bound for Aizawl City. It was also suggested to construct a bypass road from Silchar to FCI (Food Corporation of India).
15. **Support for Flyovers:** Some participants proposed an elevated road or flyovers on the north-south axis and felt it should be taken up as a priority. Suggested locations were Bangkawn, Chanmari to Treasury Square and Chatlang to Bangkawn. Consultants explained the pros and cons of elevated flyover along the existing main spline to the participants. Some participants were also apprehensive about the idea to having an elevated road since the soil condition was poor which could lead to poor foundation. Foundations would also reduce the road lane width and lead to further congestion. Since road space is already constrained below, there might not be sufficient space to design feeder connections to the elevated road, which would limit its usefulness.
16. **Air quality and vehicle testing:** Another important point flagged by a participant was that the concerned department should keep track of the old vehicles and should penalize them by cancelling their licenses and not permit them to ply on the road as they cause a lot of pollution. He also felt that need for regular quality inspection of petrol/ diesel at fuel pumps to check for adulteration which could also lead to more pollution and reduced vehicular life.

Detailed List of GROUP A's Discussion Points

Short-Term Measures

- Q Jump:
 - Will work where there is space but it will not work for crowded and narrow roads

- Will not work if a small section is done it should be implemented along an entire length.
- Pilot corridor is ok
- Need a balance because it causes excessive delays to cars as all junctions are crowded. Also most govt. and VIPs travel in general traffic.
- Will increase man power. Where will we get man power.
- Signals:
 - Aizawl is not ready for signals
 - Automatic signals with automatic signal timing is not feasible
 - If it is fixed signals then what is the additional advantage for putting signals then police
- Parking:
 - Parking must be restricted to only some areas.
 - Removal of parking between Chanmari to Rajbhavan is ok
 - Removal of parking to implement bus lanes is ok
 - Must build off-site parking complex between Chanmari to Treasury Sq
 - Must study really how much parking is affecting traffic flow. Cannot remove parking unless it is affecting traffic flow
 - Excessive parking fee is already tried in Aizawl once but was not successful.
- Foot paths
 - Safety first, traffic flow is secondary
 - Escalators will require lot of space to handle both directions. How downward direction thru escalator?
 - Put and widen footpaths so it can restrict parking
 - Foot bridges work if there is enforcement and people are forced to take it. But in off peak times people will not use it.
- Bus Lane
 - Bus lane is possible
 - Gyrotory bus lane will help buses but is not feasible because of narrow roads. It also will impact the dropping zone. Chanmari is an important place where people come in and go. Dropping zone cannot be removed.
 - Most traffic jam at Chanmari is caused due to the road going to Vivakawn.

Medium to Long-Term Measures

- Mindset is the problem. People are thinking it is below dignity to travel in bus. Also there is no space in buses. Need to make celebrities travel in bus.
- Renovation of bus system is needed
- Previously buses made 4 round trips per day on main N-S spine. Now only 2 per day are due to traffic jam.
- New routes possible but profit concerns prohibit. One such bus route is to Sairang but not taken due to low revenue.
- Need a city bypass road. Lot of unnecessary traffic passing and causing congestion. Bypass road for Silchar to FCI is useful.
- Elevated road may be required. Some places possible. eg. Bangkawn area; Chanmari to Treasury Square. Challtang to Bangkawn if we put elevated road it will help.
- New public transport system?: Along ridge you can try monorail; across ridge you can try ropeway
- Cost of the system is a factor. Mizoram does not have money.
- People will be willing pay for good system if it is possible. They are already paying for taxis.
- For elevated system, access to the system can be a problem especially for senior people.
- For main spine, bus system is ok.
- Too many taxis in Aizawl. If bus system is improved it will automatically bring taxis down
- Need to implement Greenline Express bus service. It is tried but Transport Department discontinued. It is a skip-stop/express service.

- Too much time is spent at bus stops. Buses are stopping for longer time for boarding/alighting.

Detailed List of GROUP B's Discussion Points

- Option for bus on N-S with ropeway on E-W direction is favoured
- Proposal for bus lane is very good, needs to be checked on the ground if enough space is available.
- Bus priority and queue jumping concept is acceptable.
- If buses are given preference, taxi use will automatically decrease
- Buses can be used by all if service is improved. Rich can also use buses
- 2-wheelers can share bus lane
- Now 2-wheelers do not stop at junctions, driver education is needed
- Rules should be enforced for 2-wheelers also
- Trucks are restricted from entering Aizawl between 8 am and 8 pm. They want to enter at all times
- Parking of trucks along NH inside city limits but outside central Aizawl
- Capacity of truck terminal is limited, maximum 30 vehicles can park. More terminals needed outside city limit
- Need bypass on the western side between Lengpui and Kulikawn for heavy vehicles not bound for Aizawl to bypass city
- Steel frame footbridges are preferred. All seem to like footbridges.
- Roads belong to PWD, buildings have encroached.
- House owners have violated rules, land settlement certificates show drawings
- A new 'Aizawl Road Protection Squad' could prevent encroachments
- In 2007/8 government gave loan to several new buildings to build garages. They used the money to set up shops.
- It is government policy matter to break down unauthorised structures.
- Parking structures are built privately by taking bank loans, then rent the spaces out to neighbours to pay back loan. In central area rent is Rs 1500-2000 per space per month.
- Road is legally under PWD, not AMC. So, AMC local councils cannot enforce encroach removal.
- Under Municipal Act 2007, government handed over power and functions to AMC. Till now AMC has limited power.
- Road protection is in PWD's power
- Road Fund Act passed in 2007 but not functional. It calls for fund creation from toll and cess. Not in practice.
- Vehicle testing and examination – checking of buses, trucks, cars by PCB
- Four checking station. No shortage of equipment, shortage of men.
- Stern action is required in enforcement. Special drives to be conducted for stringent checking.
- Trucks get clearance from PCB. Trucks from Mizoram and outside all have clearance certificates.
- Some buses emit black smoke. Owners are not very well to do and do not maintain buses very well.
- Many drivers do not know how to use gears properly on uphill slopes. When vehicles are driven on wrong gear, black smoke comes out. Driver training is needed.
- Traffic signal – manual traffic control is preferred.

Other Points Raised

- The first priority is the moral development of the people. e.g: Going early if you want to reach early and not rushing to it to avoid accident and to get used to walk if it is a walking distance instead of parking vehicles anywhere available.

- For the traffic management, the major priority should be the development of over-bridge for vehicles before developing fly-over for pedestrian.
- Making more one-way streets. Eg: Zodin
- For pedestrian, we can make proper foot-path in the govt. Or private property area, but to do this, the govt. Authorities need to take real actions (for rich and for poor people).
- If we are going to make the footpath safer and to restrict parking in the footpath, we can make the footpath at higher level from the blacktop (unable to go up by a two-wheeler).
- Remove all the roadside parking for two-wheeler and 4-wheeler.
- Before removing all the parking space, we have to construct a parking spot which will be able to contain all the vehicles which used to be parked roadside.
- Govt. should take strict actions regarding old vehicles, like cancelling their licence or renewing their license if they are going to purchase another new vehicles instead of letting them getting a new license which is difficult.
- Checking the quality of diesel/petrol in all the petrol pumps is a must.
- The construction planning of fly-over for pedestrian has also been done at 3 locations in Aizawl.
- Replacement of vehicle licence for old vehicles.

Appendix 8.2: Participants and Discussions at the Second Stakeholder Workshop Key Points from Consultation Workshop 2

Date: 18th Jan 2016

Venue: Chatlang Tourist Lodge.

Notes Prepared by CDM Smith

Introduction

The second Consultation workshop was held on 18th January 2016 to present and discuss the proposals of the draft Final Report with representatives of Government and non-Government organisations involved with transport in Aizawl, and also representatives from the wider civil society. The Workshop included a presentation and open discussion, followed by a break-out session with round table group discussions. 30 Participants were invited and 18 attended representing government (PWD, AMC, Traffic Police, Dept. of Transport, U.D&P.A) and non-government transport sector organisations.

Main Points of Discussion:

1. The workshop started with opening speech by Mr. Henry, CE PWD (B), followed by a presentation by the Team Leader Mr. Rob Gallagher on the Draft Final Report.

SHORT TERM IMPROVEMENTS:

2. Local Council member welcomed consultant's suggestions for improvement of side steps and mentioned that it can be done if all authorities worked and cooperated together
3. UDPA Joint Secretary mentioned that availability of funds is always a problem, efforts to improve the side stairs is always welcome. Retrofitting the stairs have a social implication. The department requested ADB for some funds for taking up these improvements. Mr. Gallagher explained that the improvements can be taken up as a part of the medium term proposals.
4. **Clarification about the Right of way:** RoW is till the building line. Usually building is constructed first then access to building is provided. The space between building line and road edge is used by the house owner. It is an encroachment.
5. The space between road edge and building line can be used as a footway. For doing this UDPA and all departments must work together. Construction of footway is acceptable to people but awareness campaign needs to be taken up.
6. If footways are constructed, some parking will have to go. People will agree but there must be a government will to take it up.
7. **On street parking:** YMA is the main NGO in Aizawl. If YMA is involved in the process of removal of on street parking and construction of footways, they can interact with shop owners and house owners and people generally tend to listen to YMA's views.
8. Good public transport and fewer parking spaces would be acceptable to people but need to provide good public transport first.
9. **Junction improvement:** The suggested improvements can be tried out on a temporary basis by Traffic Police to see if it works. It can then be discussed in the Traffic Management Committee. A demonstration project by the Police is necessary. The funds for the improvement can be from AMRUT scheme.

MEDIUM TERM IMPROVEMENTS:

10. UDPA JS mentioned that he had been to the Shimla conference on ropeways and understands that ropeway can be a solution for urban transport. MoUD in Delhi is now open to financing such projects. Earlier the Metro rail and BRT were only accepted as urban transport projects. But these are not possible in hilly cities.
11. The JS enquired if it is possible to set aside a cost for doing detailed study. He was concerned about the operation and maintenance cost, whether revenues would cover the cost, safety of the system. He mentioned that maintenance cost is very high and doubted whether it is sustainable over long time. His concern was that the wires and other parts are to be procured from abroad and whether it proper maintenance can be done.
12. Consultants from Project Team explained that O&M costs are more than the revenue from fares for the first few years. After eight year the revenue exceeds the O&M costs and thereafter revenue is always more than O&M cost. The specifications for construction and maintenance can be written in such a way that Indian companies can participate. If ropeways are built in several hilly cities in India, capacity building for Indian companies can be done, especially under the 'Make in India' scheme of Government of India. Mr. Gallagher explained that since this project is only a pre-feasibility study, other factors can be detailed out in the feasibility stage. J. S wanted the cost of feasibility study to be included in the package.
13. Rob explained that ropeway for urban transport is a relatively new technology. It has been used in South American cities over the last 10 -15 years.
14. The Local Councillor from Dawrpui asked, if bus lanes are provided and parking is taken away, will parking facilities be constructed as a part of the project? Team members replied that experience from other cities show that stand alone parking structures are not financially successful. A mall or cinema complex needs to be developed to make the parking structure viable. It attracts more traffic and increases congestion on the road. For the present project, the consultants have considered removal of some parking from the road side. These vehicles can park on the nearby streets or private properties can be used for parking.
15. The Local Councillor mentioned that a parking structure is under construction near Civil Hospital. The shopping area in Dawrpui needs parking.
16. Team members explained that parking can be taken up in the medium term not in the short term. For ropeway stations, the consultants have suggested transit oriented development. Some stations will have provision for parking.
17. **Traffic signal:** The general perception was that traffic signals are good but not recommended right now, may be taken up in the long term.
18. **Bus package:** The perception was – if people think bus is good and takes less time, it would work. The short term measures will dictate, if improvement measures can be done, bus package will work. If bus facilities are improved, people will not hesitate to pay more.
19. **Bus Authority:** Several corporations in the state are almost defunct. State transport department operates buses by incurring losses. If government body is made responsible for operating the new buses proposed under the bus package it will poorly managed and eventually start making losses. This model has not been very successful in other north-eastern cities like Guwahati, Shillong and Silchar. If government buys buses and lets the private bodies to run the service, the chances of success is much work. Some sort of

arrangement needs to be worked out between authority and private body. Government should not push out then private body from bus operation.

20. **Ropeway:** Suitability – east west option looks alright. Since the city is growing, in the long term it will be good. Alignment is acceptable.

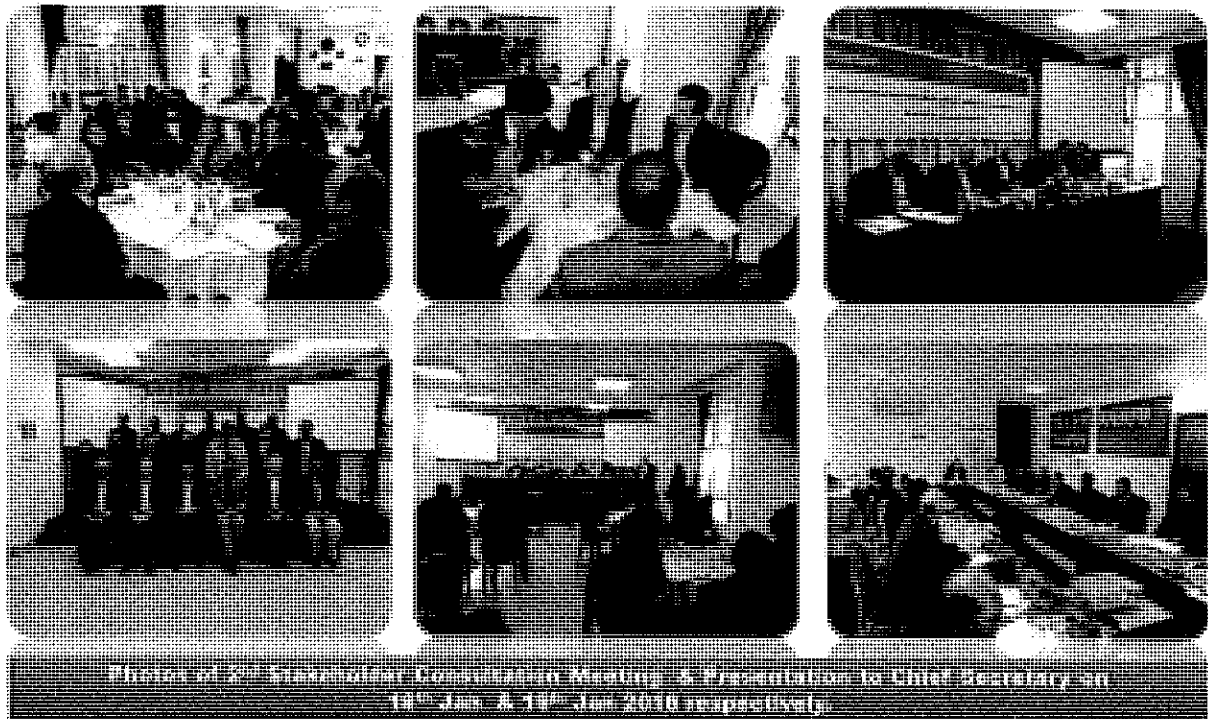
21. **Should be recommended to the government?** Yes, can recommend. Ropeway can play a key role in decentralisation of activities outside the city towards the East and West. It will take less time to travel from east and west to central area where most of the offices and commercial areas are located

22. **How to strengthen testing?**

Pollution Control Board conducts tests. Even after repairs, vehicles do not qualify. There is adulteration of fuel which needs to be stopped. Department of Weights and Measures can check adulteration of petrol and diesel.

23. **Low emissions:** Now trucks are not allowed on roads in the day time. More control on vehicles is difficult. The idea of "Low emission zone" is supported but is difficult to implement.

24. **Growth in traffic:** The measures suggested to curb growth of cars and two wheelers – increase in vehicle tax, increase in parking fees. Initially people will oppose but finally they will accept. Need to take an integrated approach – improvement of public transport and control on private transport with awareness programmes.



List of Participants for the 2nd Stakeholder consultation workshop

	Sl. No	Name	Designation	Organisation
Government Stakeholder	1	Mr. Vanlalmawia	Joint Secretary	UD & PA
	2	Mr. Lalmuankima henry	Chief Engineer	PWD
	3	Mr. Joseph Remmawia	SDO	PWD
	4	Mr. C Lalthanmawia	S.P	Traffic (Police)
	5	Mr. C. Vanlalvena	D.S.P	Traffic (Police)
	6	Mr. L Baikthanga	Director	Transport
	7	Mr. R. Remmawia	Joint Director	Transport
	8	Mr. Lalrambeiseia	Senior RO	Planning
	9	Mr. Laltanpuia	Under Secretary	Finance Department
Non - Government Stakeholder	10	Mr. Zosangzuala	Secretary	Dawrpui Local Council
	11	Mr. Lalmuanawma	Member	Zarkawt Local Council
	12	Mr. P.C Lazuiliana	President	Line Bus Association
	13	Mr. Malsawmtluanga	President	ACBOA
	14	R. Zahlira	Treasurer	ACBOA
	15	Mr. CVL Siama	Central Executive Committee member	CYMA
	16	Mr. R Laltanpuia	Finance Secretary	MTDA
	17	Mr. K. Lalsangzuala	Executive Member	MTDA
	18	Mr. C. Voulalsounga	President	Zoram Driver's Union
ADB	1	Mr. Guenter Hoelscher	Transport Specialist	ADB
Consultant: CDM Smith	1	Mr. Rob Gallagher	Team Leader / Urban Transport Specialist	CDM Smith
	2	Mr. Suvendu Seth	Transport Specialist	CDM Smith
	3	Mr. Vittal Puvvada	Traffic Engineer	CDM Smith
	4	Mr. Vishnu Venugopalan	Urban Planner	CDM Smith
	5	Ms. Lalhrui Tluangi	Facilitator / Translator	CDM Smith

UD & PA: Urban Development and Poverty Alleviation

PWD: Public works Department

ACBOA: Aizawl City Bus Owner Association

MTDA: Mizoram Truck Owners Association