Chapter 10. TRAFFIC DEMAND FORECAST

10.1 Forecast Procedure

The four-step forecast method is used to project future traffic demand. The volume of road traffic including the number of bus passengers is obtained by undertaking the tasks entailed in each of the following steps:

Step 1 Trip Production
Step 2 Trip Generation/Attraction
Step 3 Trip Distribution/ Modal Split
Step 4 Traffic Assignment

10.2 Trip Production

(1) Trip Production Rate (Gross)

The results of the Home Interview survey indicate that trip production rate (gross, hereafter use gross rate without note) is 1.58 for over 6 years old population.

(2) Forecast by Car Driving License Holders

The results of the Home Interview survey show that there is a significant difference between car driving license holders and non-car driving license holders with respect to trip production rate; at 2.28 and 1.04 respectively. Therefore, separate forecasts are made for driving license holders and non-holders.

(3) Trip Production Model

Future total trip production in the study area was estimated by using trip production rates (number of trips per person) on the assumption that the rates will be an unchangeable factor in the future. The total trip production was estimated by car driving license holders and non-holders due to the fact that the production rates of driving license holders and non-holders are considerably different as mentioned above.

Total trips produced = 2.28 x number of driving license holders + 1.04 x number of non-holders

(4) External Trips

For trips made into the Study Area by non-residents, which account for 7% of the total trips inside the study area, a simple forecast method using the growth rate was adopted. In this case, the population growth rate of Syria was used as the growth rate.

10.3 Trip Generation and Attraction

(1) Trip Generation/Attraction Models

Linear models which have as their explanatory variables the population indices determined for the future socioeconomic framework are used to forecast trip generation and attraction in each zone. The linear models developed on the basis of the Home Interview survey results are shown below in general form and the parameters applied are shown in Table 10.3.1.

$Gi = \kappa + \alpha Xi + \beta D$

where, Gi = Generated Trips at zone i

Xi = Independent Variable

D = Adjustment coefficient corresponding to zone characteristics

κ, α, β = Parameters

Table 10.3.1 Parameter of Trip Generation/Attraction Models

Purpose	κ	α	β	x	D	r2
Generation						
To Work	896.140	0.2599		Population (Resident Place Base)		0.9996
To School	0.000	0.6454		Students (Resident Place Base)		0.8362
Others	2032.226	0.1805	20365.63	Population (Resident Place Base)	Dummy	0.7354
To Home	1568.180	0.9026		All of Workers (Work Place Base)		0.9020
Attraction						
To Work	161.421	0.4062	6863.18	All of Workers (Work Place Base)	Dummy	0.7670
To School	480.614	0.4745	29302.19	Students (School Place Base)	Dummy	0.9188
Others	2397.480	0.2368	14572.93	Workers of Secondary and Tertially Industries (Work Place Base)	Dummy	0.7518
To Home	1162.040	0.6182		Population (Resident Base)		0.9600

D is a dummy variable that expresses special characteristics related to land use or urban functions not fully explained by population, number of students, number of workers or other demographic factors. Zones to which the dummy variable is applied are those that attract a larger number of trips than their population indices warrant - such as zones containing a business center, university, government offices, markets or hospitals.

(2) Zones generating large number of trips

Since overall trip generation in a zone is more or less proportionate to the zone's population, those zones, where a sharp increase in population is forecast, also expect to have a sharp increase in the number of trips generated. Zones where trip generation will increase rapidly are in the rural Damascus area. Zones in Damascus City where trip generation (excluding Home Trip) in 2020 is more than twice the trip generation (excluding Home Trip) in 1998 are: Dumar (2.37 times), Kafer Sussah (2.90 times), Lowan (2.47 times), Bab Sharqi (5.92 times) and Jourr (2.76 times). In addition, zones outside Damascus City excluding Jaramana, Kafar Batna and Arbeen show steep increase in trip generation (Table 10.3.2).

Table 10.3.2 Ratios of Generation/Attraction of 2020 to 1998(Excluding "to Home" trips)

Zone		1998		2020		Ratios of Trips (2020/1998)	
No.	Name	Generation	Attraction	Generation	Attraction	Generation	Attraction
1	Assad Addin	30,229	22,514	33,959	31,173	1.12	1.38
2	Naqsh Bandi	20,618	10,423	23,678	14,585	1.15	1.40
3	Ayubia	13,356	8,060	15,437	10,966	1.16	1.36
4	Abu Jaash	17,337	11,159	20,506	14,959	1.18	1.34
5	Saliheah	15,765	30,905	17,758	40,254	1.13	1.30
6	Shoura	16,273	11,884	18,478	17,359	1.14	1.46
7	Masstaba	9,024	7,286	10,633	10,357	1.18	1.42
8	Mrabutt	8,247	7,411	9,840	10,351	1.19	1.40
9	West Malki	5,082	11,892	5,512	16,023	1.08	1.35
10	Kiwan	6,309	11,656	7,329	16,285	1.16	1.40
11	Rabwa	6,355	5,747	8,368	7,811	1.32	1.36
12	Mazeh	77,085	122,756	104,763	172,398	1.36	1.40
13	Old Mazeh	14,935	13,064	26,788	21,669	1.79	1.66
14	Dumar	39,724	35,741	94,205	74,036	2.37	2.07
15	Mazraa	13,048	55,589	13,354	68,946	1.02	1.24
16	Rawda	17,005	66,566	19,343	87,234	1.14	1.31
17	Sarouja	10,968	34,647	11,056	47,519	1.01	1.37
18	Hijaz	8,468	67,077	8,855	101,668	1.05	1.52
19	Kanawat	37,136	23,434	43,047	45,166	1.16	1.93
20	Bab Sryja	6,977	9,833	6,903	16,637	0.99	1.69
21	Anssari	7,058	6,726	8,047	9,199	1.14	1.37
22	Baramrka	7,512	72,718	7,258	90,977	0.97	1.25
23	Kafer Sussah	19,440	22,664	56,283	53,224	2.90	2.35
24	Lowan	48,412	19,557	119,572	40,624	2.47	2.08
25	Qadam	41,972	39,026	54,715	55,863	1.30	1.43
26	Zahira	16,010	14,757	18,928	21,473	1.18	1.46
27	Ka'ah	10,153	6,143	11,700	8,000	1.15	1.30
28	Daqaq Mosq	8,463	5,094	9,663	6,490	1.14	1.27
29	Haqra	8,555	5,623	10,143	7,091	1.19	1.26
30	Bab Massr	8,661	5,656	10,015	7,240	1.16	1.28
31	Midan Wastani	21,819	35,044	25,839	44,095	1.18	1.26
32	Bab Mussalla	10,663	31,508	10,916	42,045	1.02	1.33
33	Bilal	31,267	18,133	61,377	31,368	1.96	1.73
34	Dawanina Qarawana	6,450	6,562	7,743	8,886	1.20	1.35
35	Amin	4,246	9,729	4,742	18,255	1.12	1.88
36	Souroji	7,096	5,243	7,033	7,109	0.99	1.36
37	Shaghour	5,938	8,792	5,894	13,831	0.99	1.57
38	Bab Aljabi	6,279	8,954	6,157	14,484	0.98	1.62
39	Soweqa	4,876	5,669	5,113	7,937	1.05	1.40
40	Tejari	3,617	61,575	4,184	75,183	1.16	1.22
41	Ashahem Mosq	4,399	4,996	4,730	6,712	1.08	1.34
42	Qaynarya	4,349	7,037	4,418	11,211	1.02	1.59
43	Aaqayba	6,749	6,173	7,853	7,789	1.16	1.26
44	Aqssar Mosq	9,068	6,385	10,446	8,142	1.15	1.28
45	Aamara	8,778	9,818	9,452	17,064	1.08	1.74
46	Bab Touma	9,250	32,597	10,653	50,588	1.15	1.55
47	Bab Sarqi	4,706	12,514	27,861	28,172	5.92	2.25
48	Jourr	31,307	23,562	86,424	52,672	2.76	2.24
49	Dewania	13,835	14,415	16,024	22,311	1.16	1.55
50	Qussor	14,468	17,526	17,106	21,763	1.18	1.24
51	Ma'monaya	18,081	21,612	21,342	31,186	1.18	1.44
52	Fars Khuri	10,184	9,006	11,885	13,285	1.17	1.48
53	Qasser Al Ibad	15,506	11,909	17,404	16,849	1.12	1.41
54	Zeinabia	9,344	10,251	9,322	16,219	1.00	1.58
55	Aboun	41,483	52,727	60,551	74,659	1.46	1.42
56	Barzeh Town	64,243	41,335	84,432	63,692	1.31	1.54
57	Falouja	18,192	14,287	21,074	18,065	1.16	1.26
58	Karmil	37,782	19,278	47,725	25,265	1.26	1.31
59	Hatteen	25,216	16,940	32,524	23,729	1.29	1.40
60	Tadamann	47,371	28,147	57,973	39,315	1.22	1.40
61	Wahda	16,539	10,768	20,733	15,249	1.25	1.42
62	Dowelaa	32,647	18,201	47,029	27,948	1.44	1.54
63	Tall	50,980	32,133	226,942	152,796	4.45	4.76

(continued)

Zone		1998		2020		Ratios of Trips (2020/1998)	
No.	Name	Generation	Attraction	Generation	Attraction	Generation	Attraction
61	Sednaya	15,152	13,007	44,606	28,440	2.94	2.19
65	Rankous	9,195	7,383	30,575	20,923	3.33	2.83
66	Ein Al-Feejeh	13,137	10,476	34,504	25,443	2.63	2.43
67	Dimas	9,345	16,097	23,649	42,222	2.53	2.62
68	Qudsaya	37,743	22,913	120,966	97,171	3.20	4.24
69	Qatana	84,269	62,268	677,384	466,752	8.04	7.50
70	Daraya	108,748	61,280	213,705	177,853	1.97	2.90
71	Suhnaya	25,267	28,138	104,885	84,821	4.15	3.01
72	Kusweh	65,374	49,852	283,562	278,069	4.34	5.58
73	Ghuzlanieh	19,781	21,950	59,857	53,974	3.03	2.46
74	Babbyla	147,601	115,625	384,521	277,673	2.61	2.40
75	Jaramana	45,185	29,654	76,309	81,841	1.69	2.76
76	Muleiha	30,966	30,190	90,336	103,352	2.92	3.42
77	Nashabyyah	29,671	18,459	96,343	148,798	3.25	8.06
78	Harran Al-Auameed	20,741	14,637	193,828	93,447	9.35	6.38
79	Kafar Batna	61,284	36,729	103,664	65,542	1.69	1.78
80	Arbeen	48,992	34,091	72,326	87,012	1.48	2.55
81	Harasta	47,111	48,078	92,568	103,582	1.96	2.15
82	Douma	103,447	82,660	291,975	388,307	2.82	4.70
83	Dumair	19,330	14,774	79,430	123,362	4.11	8.35

10.4 Generation (Attraction) of Intra-zonal Trips

The following log-linear model is applied to estimate intra-zonal trips:

$$\ln Tii = \ln \kappa + \alpha \ln Gi + \beta \ln Ai + \gamma \ln Zi + \delta \ln D1 + \varepsilon \ln D2$$

where, Tii = Intra-zonal trips in zone i
Gi = Trip generation in zone i
Ai = Trip attraction in zone i
Zi = Area of zone i (km^2)
D1, D2 = Adjustment coefficients corresponding to zone characteristics
$\kappa, \alpha, \beta, \gamma, \delta, \varepsilon$ = Parameters

Parameters used in the models are shown in Table 10.4.1.

Table 10.4.1 Parameters of Intra-Zonal Models

Y	κ	α	β	γ	δ	ε	r2
Purposes							
To Work	-1.75580	0.65473	0.37494	0.24802	-0.27090	0.48502	0.9096
To School	-0.56030	0.56991	0.37303	0.12512	-0.83110	0.31446	0.9763
Others	-0.60900	0.52782	0.31749	0.20046	-0.68480	0.35821	0.9445
To Home	-0.71960	0.26731	0.60121	0.21841	-0.90080	0.39219	0.9493

10.5 Trip Distribution and Modal Choice

(1) Forecast Method and Model

Since an OD pair model was applied for modal selection, the step of modal choice and step of trip distribution are applied to the traffic of each OD pair at the same time. Principal independent variables of the standard distribution model (from i zone to j zone) consist of trips generated in i zone, trips attracted in j zone and distance by road between zone i to zone j. Also the standard modal choice models include distance between zone i to zone j (to separate walk trips), number of car owners (to separate trips by private mode and public mode) and

present ratios of trips using trucks and other transportation means (to estimate trips using other transportation means). These variables are used in the OD pair model with some modification.

Variables to show level of linkage between zone i and zone j are adopted in the OD model, such as riding (transfer) times of microbuses when going from zone i to zone j, travel time between zone i and zone j by each transport mode which substitute distance from i to j stated in the previous paragraph. Average household income by zone and numbers of car driving license holders by zone are also reflected in the model.

In terms of dummy variables, which express characteristics related to land use not fully explained by variables mentioned above, two to four are introduced in a model. Application of two dummy variables means three types of land use characteristics (including standard land use) exist and application of three dummy variables means four types of land use characteristics, and so on.

(2) Walking/Two-Wheeler Trips Split Model

Walking/Two-wheeler trips have significantly different nature from other trips. It is advisable to exclude walking/two-wheeler trips from the total trips before applying the OD models. The share of trips made by walking or two-wheeler is estimated in accordance with the equation given below. Parameters are shown in Table 10.5.1.

$W = \kappa + \alpha Dij + \beta Dij^2 + \gamma Dij^3$

Where W = Modal share of walking/ wheelers (%)

Dij = Distance between zone i and zone j (km)

$\kappa, \alpha, \beta, \gamma$ = Parameters

Table 10.5.1 Parameters of Walking/Two-Wheeler Trips Split Model

κ	α	β	γ	r2
0.86660	-0.88587	0.40160	-0.06245	0.90

For the calculation of walking or two-wheeler trips a tentative OD table (trip base for all purposes) was prepared using Frater method.

(3) Models

Models are applied to trips excluding intra-zonal trips and walk/two-wheeler trips. Models excluding "To Home" trips of each mode are as follows, and the parameters are shown in Table 10.5.2. "To Home" trips of each mode are estimated as turning over of each purpose of each mode under the control of total "To Home" trips.

$Tijk = \kappa + \alpha GENi + \beta ATTj + \gamma RTij + \delta TTijk + \varepsilon OWNi + \zeta INCi + \eta DLHi + \theta Dum1i + \iota Dum2i + \lambda Dum3i + \mu Dum4i$

where, GENi = Generated Trips from Zone i
ATTj = Attracted Trips to Zone j
RTij = Riding (Transfer) Times of Microbuses to go to Zone i to Zone j
TTijk = Travel Time to Zone i to Zone j by the Mode k
OWNi = Number of Car Owning Households of Zone i
INCi = Average Personal Income of Zone i

DLHi = Number of Car Driving License Holders of Zone i
Dum1i = Dummy to represent Land Characteristics 1 of Zone i
Dum2i = Dummy to represent Land Characteristics 2 of Zone i
Dum3i = Dummy to represent Land Characteristics 3 of Zone i
Dum4i = Dummy to represent Land Characteristics 4 of Zone i
$\kappa, \alpha, \beta, \gamma, \delta, \varepsilon, \zeta, \eta, \theta, \iota, \lambda, \mu$ = Parameters

Table 10.5.2 Parameters of Modal Choice Models

	Parameters												
Purpose and Mode	Constant	Gen	Att	RT	TT	Own	Inc	DLH	Dum1	Dum2	Dum3	Dum4	r2
To Work													
By Passenger Cars	3.5	0.00219	0.00112	-	-	0.00866	-	-	849.8	219.5	-137.5	-	0.81
By Taxi	28.5	0.00288	0.00076	-	-	0.00616	-	-	420.1	173.9	-72.5	-129.8	0.81
By Microbus	49.9	0.00624	0.00404	-	-1.29442		-0.00310	-0.00012	3917.3	2159.2	800.8	-336.1	0.75
To School													
By Passenger Cars	17.8	0.00314	0.00005	5.92744	-	-0.00030	-	-	207.0	82.9	-	-	0.82
By Taxi	-17.5	0.00995	0.00089	2.85035	-	-	0.00280	-0.00585	472.9	187.5	-	-	0.88
By Microbus	37.4	0.01369	0.00767	-	-1.23811	-	-0.00165	-0.00343	3361.5	1081.3	-281.9	-	0.80
Others													
By Passenger Cars	22.9	0.00166	0.00137	0.51198	-0.19626	-	-	0.01006	1588.8	720.9	234.2	-	0.82
By Taxi	55.4	0.00104	0.00200	0.82333	-	0.00698	-	0.00534	2810.6	1541.2	748.6	369.0	0.83
By Microbus	63.4	0.00316	0.00215	-1.70722	-0.33268	-	-0.00282	-	2830.6	1331.3	716.1	372.8	0.84
All Purposes													
By Other Modes	78.1	-0.00001	0.00161	-	-	-	-	0.00561	974.3	504.0	223.4	-	0.84

Note:
Gen: Generated Trips from Zone i
Att: Attracted Trips to Zone j
RT: Riding (Transfer) Times of Microbus to go Zone j from Zone i
TT: Travel Time by the mode selected to Zone j from Zone i
Own: Number of Car owning Households
Inc: Average Personal Income
DLH: Number of Car Driving License Holders
Dum1: Dummy t represent Land Characteristics 1
Dum2: Dummy t represent Land Characteristics 2
Dum3: Dummy t represent Land Characteristics 3
Dum4: Dummy t represent Land Characteristics 4

10.6 Traffic Assignment

OD trips subject to assignment to the transportation networks are inter-zonal OD trips by passenger car, taxi, microbus or others composed mainly of trucks and regular size bus. The assignment of inter-zonal trips by passenger car or taxi to the road network is undertaken in accordance with the equilibrium minimum-time route method, which takes into consideration the capacity of each link of roadway. The assignment of microbuses is done on bus routes.

All OD trips to be assigned are converted into passenger-car units. Since the conversion involves different types of vehicles, the average number of passengers per vehicle and the passenger-car equivalent depends on the weighted average of each vehicle type. Table 10.6.1 gives the average number of passengers per vehicle and the passenger-car equivalent used in the calculations for trip assignment.

Table 10.6.1 Average Number of Passengers per Vehicle and Passenger Car Equivalent

	Passenger Car	Taxi	Microbus	Others
Passengers/Vehicle	1.47	1.00	9.83	1.79
Passenger Car Equivalent	1.00	1.00	1.50	2.00

Note: Passengers/Vehicle: Passenger Car; Based on Home Interview Results.
Taxi and Microbus; Trips passing Screen Line/ Number of Vehicles counted at Screen Line.
Others: Based on Cordon Line Survey Results.
Passenger Car Equivalent: Based on Highway Capacity Manual.

10.7 Forecast Results

Traffic demand for the year 2020 is assigned on the Master-plan network. Table 10.7.1 shows the results in comparison to the performance of 1998. Trip composition of person trip base by transport mode shows an increase of passenger car use trips (21% to 28%) and a decrease of taxi use trips (20% to 17%). By trip purpose there is also some increase of "To Work" trips (24% to 26%) but changes by purpose are considerably small.

Trip composition of passenger car and taxi in terms of vehicle-kilometer inverts during 22 years, from 37% to 51% and 50% to 37% respectively. Average speed decreases from 33.3 km/hr to 27.8 km/hr.

Table 10.7.1 Estimate Results

Year 1998							
Trip composition By Purpose	psn trips	Ratio(%) of Component	veh. km	Ratio(%) of Component	veh.hr	Ratio(%) of Component	Ave. Speed (km/hr)
To Work	584,995	23.9	-		-		-
To School	195,276	8.0	-		-		-
Others	446,667	18.3	-		-		-
To Home	1,218,821	49.8	-		-		-
By Mode							
Passenger Car	516,412	21.1	5,238,262	36.8	156,876	36.7	-
Taxi	484,535	19.8	7,148,254	50.3	215,720	50.5	-
Microbus	1,360,951	55.6	1,533,002	10.8	45,545	10.7	-
Others	83,861	3.5	305,056	2.1	9,113	2.1	-
Total Trips	2,445,759	100.0	14,224,574	100.0	427,254	100.0	33.3
Year 2020							
Trip composition By Purpose	psn trips	Ratio(%) of Component	veh. km	Ratio(%) of Component	veh.hr	Ratio(%) of Component	Ave. Speed (km/hr)
To Work	1,425,617	26.0	-	-	-	-	-
To School	330,171	6.0	-	-	-	-	-
Others	989,814	18.0	-	-	-	-	-
To Home	2,742,300	50.0	-	-	-	-	-
By Mode							
Passenger Car	1,540,843	28.1	27,242,123	50.6	980,398	50.6	106,625
Taxi	946,401	17.2	20,034,677	37.2	720,716	37.2	31,335
Microbus	2,835,063	51.7	5,741,420	10.7	206,916	10.7	39,541
Others	165,595	3.0	836,344	1.5	29,896	1.5	-
Total Trips	5,487,902	100.0	53,854,564	100.0	1,937,926	100.0	27.8

Note: Traffic demands of Work/Two Wheels are excluded from traffic demands.

Chapter 11. MASTER PLAN BUDGETING POLICY

11.1 Basic Planning Policy

GDP/Capita of Syria exceeds 1,000 US Dollars. This income scale means that self-sustained development is available. The study team sets basic stance for policy making as follows:

- Effective use of existing facilities
- Selective investments to fundamental development projects
- Planning in the limit of budgeting capability of Damascus City
- Planning to find out new funds collectable
- Planning to induce private investments to the urban transport sector
- Gradual changes of systems to ease conflict due to introduction of new system

11.2 Governorate Road/Transport Budget Scale

Records of revenues and expenses are summarized in Table 11.2.2 (in currency) and Table 11.2.3 (in percent) by item of revenues and expenses. Growth rates of revenues and expenses are tabulated in Table 11.2.1.

From these tables, the following facts are clarified:

1) Both average growth rates of revenues and expenses are mostly same, 11.5%, 10.7% per annum respectively and balanced, (expenses/revenues=0.993). It is rather higher than growth rate of GDP during the same period, 6.4%.
2) Revenues are composed of Taxes/Fees, Exceptional Revenues/Loans and Properties/ Investments, 50%, 40% and 10% respectively. Recently a share of Taxes/Fees increases and that of Exceptional Revenues/Loans decreases.
3) Expenses are composed of Investments, Administration Expenses, and Wages/Others, at 40%, 34% and 17% respectively. Shares are fluctuated to some extent.
4) The share of Road Maintenance in Administrative Expenses is 40% in average and share of Road Construction in Investment is 35% in average. Conclusively, the share of Road Expenses to the Total Expenses becomes roughly 28% (Construction: 0.4 x 0.35 = 0.14 and Maintenance: 0.35 x 0.4 = 0.14).

Table 11.2.1 Ratio of Revenues and Expenses to the Last Year Records

	1992/1991	1993/1992	1994/1993	1995/1994	1996/1995	1997/1996	Average
Revenue	1.309	1.199	0.995	1.062	1.030	1.123	1.115
Expense	1.311	1.207	1.138	1.122	0.898	1.016	1.107
Exp./Rev.	1.001	1.007	1.144	1.057	0.871	0.905	0.993

Ratio of each item of budgets to GDP is calculated as shown in Table 11.2.4 in permil. Because of the difference of growth rates of Governorate Budget and GDP mentioned above the said ratios tend to increase.

Table 11.2.2 Budget of Damascus Governorate in Currency

Year	1991	1992	1993	1994	1995	1996	1997	Average
Revenues (in current million SP)								
Taxes and Fees	694	1,011	1,385	1,241	1,542	1,799	1,954	1,375
Properties and Investments	174	222	259	416	322	258	278	276
Other Revenues	18	39	25	59	67	56	93	51
Exceptional Revenues and Loans	924	1,097	1,170	1,109	1,070	977	1,146	1,070
Revenue Total	1,809	2,369	2,839	2,825	3,001	3,091	3,470	2,772
Expenses								
Compensations, Wages and Salaries	265	401	410	532	541	630	642	489
Public administrative Expenses	331	729	902	1,248	1,573	1,251	1,023	1,008
Investment Expenses	921	1,093	1,211	1,196	1,278	1,137	1,401	1,177
Subsidy and Activity Expenses	50	58	56	92	84	83	77	71
Debts and Liabilities	242	89	284	189	180	181	189	193
Expenses Total	1,809	2,371	2,863	3,258	3,656	3,281	3,332	2,938
Public Administrative Expenses								
Road Infrastructure Maintenance	132	281	418	578	588	550	322	410
Road Maintenance	53	110	220	301	321	257	122	198
Lighting Maintenance	41	80	99	120	120	119	115	99
Green Areas Maintenance	37	45	64	88	93	100	68	71
Drainage Maintenance	0	37	19	39	36	58	8	28
Signals Maintenance	2	10	16	30	18	16	10	14
Other Maintenance Works	199	448	485	671	985	701	701	598
Public Expenses Total	331	729	902	1,248	1,573	1,251	1,023	1,008
Investment Expenses								
Road Infrastructure Construction	298	357	311	332	467	322	779	409
Road Construction	85	127	102	169	292	117	218	159
Buildings	33	56	71	65	60	36	87	58
Lighting	23	41	10	7	29	31	31	25
Green Areas	40	38	29	16	29	40	30	32
Drainage	56	48	43	19	6	0	0	25
Equipment	60	45	55	52	36	42	278	81
Topographical Planning	1	2	1	4	6	8	5	4
Bridges & Tunnels	0	0	0	0	9	24	10	6
North Bypass	0	0	0	0	0	24	120	21
Fire	3	6	6	2	0	286	1	43
Sewage	621	733	894	839	826	584	755	750
MOI	0	0	0	27	0	0	0	4
Investment Expenses Total	922	1096	1,211	1,200	1,293	1,192	1,535	1,207
Road Expenses Share in Total Expenses								
Road Infrastructure Investment	297	355	310	327	453	267	644	379
Road Construction	85	127	102	169	292	117	218	159
Road Facilities	152	183	153	106	125	108	148	139
Road Equipment	60	45	55	52	36	42	278	81
Road Infrastructure Maintenance	132	281	418	578	588	550	322	410
Road Maintenance	53	110	220	301	321	257	122	198
Lighting Maintenance	41	80	99	120	120	119	115	99
Green Areas Maintenance	37	45	64	88	93	100	68	71
Drainage Maintenance	0	37	19	39	36	58	8	28
Signals Maintenance	2	10	16	30	18	16	10	14
Road Expenses Total	429	636	728	905	1,041	817	966	789
Share (%)	23.7	26.8	25.4	27.8	28.5	24.9	29.0	27.0

Source: Damascus Governorate

Table 11.2.3 Budget of Damascus Governorate in Percentile

Year	1991	1992	1993	1994	1995	1996	1997	Average
Revenues (in percentile)								
Taxes and Fees	38.3	42.7	48.8	43.9	51.4	58.2	56.3	49.6
Properties and Investments	9.6	9.4	9.1	14.7	10.7	8.4	8.0	10.0
Other Revenues	1.0	1.6	0.9	2.1	2.2	1.8	2.7	1.8
Exceptional Revenues and Loans	51.1	46.3	41.2	39.3	35.7	31.6	33.0	38.6
Revenue Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Expenses								
Compensations, Wages and Salaries	14.6	16.9	14.3	16.3	14.8	19.2	19.3	16.6
Public administrative Expenses	18.3	30.8	31.5	38.3	43.0	38.1	30.7	34.3
Investment Expenses	50.9	46.1	42.3	36.7	35.0	34.6	42.1	40.1
Subsidy and Activity Expenses	2.7	2.5	2.0	2.8	2.3	2.5	2.3	2.4
Debts and Liabilities	13.4	3.8	9.9	5.8	4.9	5.5	5.7	6.6
Expenses Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Public Administrative Expenses								
Road Infrastructure Maintenance	39.9	38.6	46.3	46.3	37.4	44.0	31.5	40.7
Road Maintenance	15.9	15.1	24.4	24.1	20.4	20.5	11.9	19.6
Lighting Maintenance	12.2	10.9	11.0	9.6	7.6	9.5	11.2	9.8
Green Areas Maintenance	11.1	6.2	7.1	7.1	5.9	8.0	6.6	7.0
Drainage Maintenance	0.0	5.0	2.1	3.1	2.3	4.7	0.8	2.8
Signals Maintenance	0.6	1.3	1.7	2.4	1.1	1.3	1.0	1.4
Other Maintenance Works	60.1	61.4	53.7	53.7	62.6	56.0	68.5	59.3
Public Expenses Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Investment Expenses								
Road Infrastructure Construction	32.3	32.6	25.7	27.7	36.1	27.0	50.7	33.9
Road Construction	9.2	11.6	8.4	14.1	22.6	9.8	14.2	13.2
Buildings	3.6	5.1	5.9	5.4	4.6	3.0	5.7	4.8
Lighting	2.5	3.7	0.8	0.6	2.2	2.6	2.0	2.1
Green Areas	4.3	3.5	2.4	1.3	2.2	3.4	2.0	2.7
Drainage	6.1	4.4	3.6	1.6	0.5	0.0	0.0	2.1
Equipment	6.5	4.1	4.5	4.3	2.8	3.5	18.1	6.7
Topographical Planning	0.1	0.2	0.1	0.3	0.5	0.7	0.3	0.3
Bridges & Tunnels	0.0	0.0	0.0	0.0	0.7	2.0	0.7	0.5
North Bypass	0.0	0.0	0.0	0.0	0.0	2.0	7.8	1.7
Fire	0.3	0.5	0.5	0.2	0.0	24.0	0.1	3.6
Sewage	67.4	66.9	73.8	69.9	63.9	49.0	49.2	62.1
MOI	0.0	0.0	0.0	2.3	0.0	0.0	0.0	0.3
Investment Expenses Total	100	100	100	100	100	100	100	100
Road Expenses Share in Total Expenses								
Road Infrastructure Investment	69.2	55.8	42.6	36.1	43.5	32.7	66.7	48.0
Road Construction	19.8	20.0	14.0	18.7	28.1	14.3	22.6	20.2
Road Facilities	35.4	28.8	21.0	11.7	12.0	13.2	15.3	17.6
Road Equipment	14.0	7.1	7.6	5.7	3.5	5.1	28.8	10.3
Road Infrastructure Maintenance	30.8	44.2	57.4	63.9	56.5	67.3	33.3	52.0
Road Maintenance	12.3	17.3	30.2	33.3	30.9	31.5	12.6	25.1
Lighting Maintenance	9.4	12.5	13.6	13.2	11.5	14.5	11.9	12.5
Green Areas Maintenance	8.6	7.1	8.8	9.7	8.9	12.2	7.0	9.0
Drainage Maintenance	0	5.8	2.6	4.3	3.4	7.1	0.8	3.5
Signals Maintenance	0.5	1.5	2.1	3.3	1.7	1.9	1	1.8
Total of Road Expenses	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Damascus Governorate

Table 11.2.4 Budget of Damascus Governorate in Permill.

Year	1991	1992	1993	1994	1995	1996	1997	Average
GDP in current mil SP	311,564	371,630	413,755	506,101	569,262	655,124	669,380	499,545
Revenues								
Taxes and Fees	2.2	2.7	3.3	2.5	2.7	2.7	2.9	2.8
Properties and Investments	0.6	0.6	0.6	0.8	0.6	0.4	0.4	0.6
Other Revenues	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Exceptional Revenues and Loans	3.0	3.0	2.8	2.2	1.9	1.5	1.7	2.1
Revenue Total	5.8	6.4	6.9	5.6	5.3	4.7	5.2	5.5
Expenses								
Compensations, Wages and Salaries	0.8	1.1	1.0	1.1	1.0	1.0	1.0	1.0
Public administrative Expenses	1.1	2.0	2.2	2.5	2.8	1.9	1.5	2.0
Investment Expenses	3.0	2.9	2.9	2.4	2.2	1.7	2.1	2.4
Subsidy and Activity Expenses	0.2	0.2	0.1	0.2	0.1	0.1	0.1	0.1
Debts and Liabilities	0.8	0.2	0.7	0.4	0.3	0.3	0.3	0.4
Expenses Total	5.8	6.4	6.9	6.4	6.4	5.0	5.0	5.9
Public Administrative Expenses								
Road Infrastructure Maintenance	0.4	0.8	1.0	1.1	1.0	0.8	0.5	0.8
Road Maintenance	0.2	0.3	0.5	0.6	0.6	0.4	0.2	0.4
Lighting Maintenance	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Green Areas Maintenance	0.1	0.1	0.2	0.2	0.2	0.2	0.1	0.1
Drainage Maintenance	0.0	0.1	0.0	0.1	0.1	0.1	0.0	0.1
Signals Maintenance	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
Other Maintenance Works	0.6	1.2	1.2	1.3	1.7	1.1	1.0	1.2
Public Expenses Total	1.1	2.0	2.2	2.5	2.8	1.9	1.5	2.0
Investment Expenses								
Road Infrastructure Construction	1.0	1.0	0.8	0.7	0.8	0.5	1.2	0.8
Road Construction	0.3	0.3	0.2	0.3	0.5	0.2	0.3	0.3
Buildings	0.1	0.2	0.2	0.1	0.1	0.1	0.1	0.1
Lighting	0.1	0.1	0.0	0.0	0.1	0.0	0.0	0.1
Green Areas	0.1	0.1	0.1	0.0	0.1	0.1	0.0	0.1
Drainage	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.1
Equipment	0.2	0.1	0.1	0.1	0.1	0.1	0.4	0.2
Topographical Planning	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bridges & Tunnels	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
North Bypass	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0
Fire	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.1
Sewage	2.0	2.0	2.2	1.7	1.5	0.9	1.1	1.5
MOI	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
Investment Expenses Total	3.0	2.9	2.9	2.4	2.3	1.8	2.3	2.4
Road Expenses Share in Total Expenses								
Road Infrastructure Investment	1.0	1.0	0.7	0.6	0.8	0.4	1.0	0.8
Road Construction	0.3	0.3	0.2	0.3	0.5	0.2	0.3	0.3
Road Facilities	0.5	0.5	0.4	0.2	0.2	0.2	0.2	0.3
Road Equipment	0.2	0.1	0.1	0.1	0.1	0.1	0.4	0.2
Road Infrastructure Maintenance	0.4	0.8	1.0	1.1	1.0	0.8	0.5	0.8
Road Maintenance	0.2	0.3	0.5	0.6	0.6	0.4	0.2	0.4
Lighting Maintenance	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Green Areas Maintenance	0.1	0.1	0.2	0.2	0.2	0.2	0.1	0.1
Drainage Maintenance	0.0	0.1	0.0	0.1	0.1	0.1	0.0	0.1
Signals Maintenance	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0

Logically, in a long run we can assume that growth rates of GDP and the Governorate budget

are to be equal. The projections of future budgets are obtained by products of these shares and GDP based on that assumption. By applying GDP projected in section 9.7 to the shares shown in Table 11.2.4, estimates of road budgets during 1998 and 2020 are obtained as shown in Table 11.2.5. As presented in the Table, total budget from 1998 till 2010 becomes 21.7 billion SP and from 2011 till 2020, 31.2 billion SP in fixed prices of 1998.

Table 11.2.5 Estimates of Road Budget of Damascus Governorate

Year	GDP	Governorate Budget	Road Budget	Road Construction	Road Maintenance
1998	712,657	3,920	1,137	569	568
1999	758,265	4,170	1,209	605	604
2000	806,295	4,435	1,286	643	643
2001	856,842	4,713	1,367	684	683
2002	910,008	5,005	1,451	726	725
2003	965,898	5,312	1,540	770	770
2004	1,024,613	5,635	1,634	817	817
2005	1,086,260	5,974	1,732	866	866
2006	1,150,948	6,330	1,836	918	918
2007	1,218,783	6,703	1,944	972	972
2008	1,289,885	7,094	2,057	1,029	1,028
2009	1,364,365	7,504	2,176	1,088	1,088
2010	1,442,339	7,933	2,301	1,151	1,150
2011	1,523,925	8,382	2,431	1,216	1,215
2012	1,609,245	8,851	2,567	1,284	1,283
2013	1,698,419	9,341	2,709	1,355	1,354
2014	1,791,570	9,854	2,858	1,429	1,429
2015	1,888,826	10,389	3,013	1,507	1,506
2016	1,990,309	10,947	3,175	1,588	1,587
2017	2,096,151	11,529	3,343	1,672	1,671
2018	2,206,485	12,136	3,519	1,760	1,759
2019	2,321,436	12,768	3,703	1,852	1,851
2020	2,441,140	13,426	3,894	1,947	1,947

Source: in million SP of 1997

11.3 Other Fund Resources

As for private investments on the urban transport sector, investment to bus fleet and taxi fleet, construction of bus terminals and construction of off-road parking facilities are considered. Private investments excluding investments to taxi fleet are shown in Table 11.3.1.

Table 11.3.1 Investment to Urban Transport Sector by Private Investors

Year	Investment to Bus Fleet	Investment to Bus Terminal	Investment to Off-Road parking facility	Total Investment (Unit: million SP)
2000	1,417	191	346	1,954
2001	1,511	191	0	1,702
2002	1,615	0	0	1,615
2003	1,734	0	175	1,909
2004	1,867	0	0	1,687
2005	2,007	0	105	2,112
2006	1,447	0	0	1,447
2007	1,503	0	87	1,590
2008	1,560	0	0	1,560
2009	1,620	128	140	1,888
2010	1,683	128	0	1,811
2011	1,624	0	0	1,624
2012	1,738	0	0	1,738
2013	1,886	64	0	1,950
2014	2,035	64	0	2,099
2015	2,200	392	0	2,592
2016	2,386	0	0	2,386
2017	2,579	0	0	2,579
2018	2,073	0	0	2,073
2019	2,189	0	0	2,189
2020	2,309	0	0	2,309

PART III

URBAN TRANSPORTATION PLAN

Chapter 12. URBAN TRANSPORTATION MASTER PLAN

12.1 Planning Formulation Policy

(1) Composition of Master Plan

The Master Plan is composed of plans of Road Network Development, Public Transport Network Development, and Traffic Management and Traffic Facility Management.

Also from the point of view of implementation scheduling, the Master Plan is divided into three plans; Short Term Plan (until 2005), Middle Term Plan (until 2010) and Long Term Plan (until 2020).

(2) Design Goal

The objective of the Master Plan is to maintain the present service level of Damascus City during the planning period (2000-2020).

(3) Finances of the Plans

Road Network Development, and Traffic Management and Traffic Facility Management are financed from Road Budget of Damascus Governorate. Public Transport Network Development relies on Investments from the Private Sector.

(4) Basic Planning Policy

The basic planning policy of the Master Plan is as follows;

- Self-sustained development
- Effective use of existing facilities
- Inducement of private investment to urban transport sector and introduction of BOT concept for promising projects
- Conservation of historical nature of the city
- Inheritance of previous urban development plans

Major causes of traffic congestion in future are the increase of passenger cars and microbuses. Means to cope with congestion caused by them are;

- New development of roads
- Widening of roads
- Improvement of intersections
- Control of traffic flow by coordinated traffic signal system
- Control of passenger car use
- Parking control
- Introduction of larger size buses
- Introduction of railway system

These plans are discussed in detail in the relevant following chapters by sector.

(5) Estimated Budget Scale

The budget scale is estimated as summarized in Table 12.1.1.

Table 12.1.1 Governorate Budget Scale for Urban Transportation Improvement

Planning Period	Transport Budget Total (unit: million SP)	Of which, Development Portion	Of which, Maintenance Portion
2000-2005	9,010	4,506	4,504
2006-2010	10,314	5,158	5,156
2011-2020	31,212	15,610	15,602

Table 12.1.1 shows that one fifth (1/5) of the total transport budget is allocated to each of the first planning period (6 years until 2005) and the second planning period (5 years from 2006 until 2010), and the remaining three fifths (3/5) is allocated to the last planning period (10 years from 2011 until 2020).

12.2 Sectoral Planning (Components of the Master Plan)

12.2.1 Road Network Development

(1) Road Network

The present road network in Damascus City consists of several radial arterial roads passing through the inner city and only one ring road. In addition, the outer north and south bypasses partly serve as ring roads.

(2) Planning Scheme

Large traffic volumes commute from outside of Damascus City to inside the City in the morning and vice versa in the evening. This flow will increase in the future. The planning area does not cover the said movement.

In this plan, it is assumed that development of the road network outside of the planning area (Damascus City) is to be completed following the road network improvement plan adopted by the Government of Syria.

The basic planning concept of the road network development is as follows (refer to Figure 13.2.3 in the following chapter):

- A Radial-Ring road pattern is applied to the road network development concept of Damascus City.
- A network of three (3) Ring Roads is considered, of which (1) Inner Ring Road is the existing ring road where road capacities at major intersections shall be increased by grade-separation, (2) Medium Ring Road is composed of the existing South Bypass and its extension to the east up to Aleppo Highway, and (3) Outer Ring Road is composed of North Bypass, its extension and connection of existing road sections in the eastern and southern sections.
- Radial Arterial roads are composed of the existing eleven (11) roads such as New Aleppo Highway, Duma Highway, Zablatani Road, International Airport Highway, New Derra Highway, Dariya Road, Swaida Road, New Beirut Highway, Old Beirut Road, Kassioun / Zabadani Road and Seidnaya Road.

(3) Traffic Demand

Traffic demand at present and for the year 2020 are shown in Figure 12.2.1. Movement inside the City area changes a little between 1998 and 2020 but that from outside to the City and vice versa grows significantly.

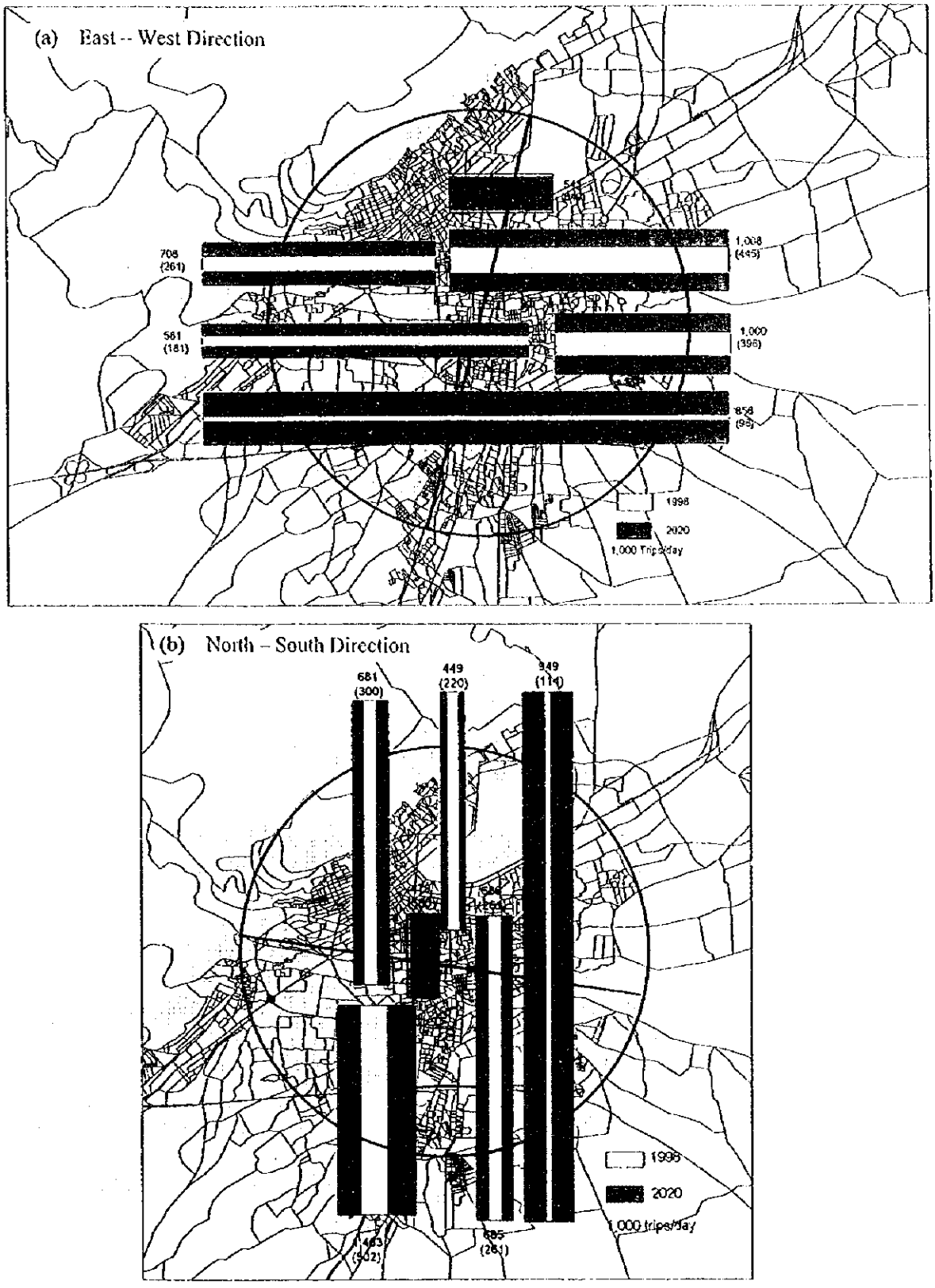


Figure 12.2.1 Traffic Demand at Present and in the Year 2020

12.2.2 Public Transport Network Development

(1) Present Services

Public transport in Damascus principally consists of microbuses and taxis. Microbuses transport 47% of person trips excluding walk/two-wheeler trips and taxis transport 18% based on the Home Interview survey of 1998. Regular size buses transport 11% but mostly for passengers to go to factories or schools on an exclusive contract base.

Hijaz Railway Co. operates trains from Qatana (zone 69), Feija (zone 66) and Serghaya (out of the study area) on a day service basis. Railway companies (Hijaz Co. and Syrian Railways General Organization) have no plan to provide urban transport services at present.

(2) Microbus

1) Existing Issues

Criteria of public services may be considered as follows;

- Transfer times up to destination
- Frequency of services
- Scheduled operation
- Speed in operation
- Fare
- Safety

Transfer times up to destination was 0.53 in average and two times transfer is the maximum in the city. Cases of two times transfer are concentrated in Zones 11 (Rabweh), 14 (Dummar), 6 (Shora) and 15 (Mazra Ah). Also, transfer points are concentrated in Zones 18 (Hijaz), 51 (Ma Amounyeh), 22 (Baramkeh), 10 (Kiwati) and 1 (Assd Al Dinseveral) (see Table 12.2.1).

The fact that concentration of transfers to several points shows that routes are well prepared, however the fact that residents of the said four zones are forced to change a bus in two times indicates that some adjustment of routes may be necessary.

Frequency of services is good excluding the hilly area of Kassioun Mountain and Old Damascus area, where 167,000 passengers a day (16% of the total microbus passengers) use microbuses. Speed in operation is mostly the same as driving speed of passenger cars due to the size of microbus and nature of operation. Fares range from 3 SP to 5 SP, which is relatively cheap. Safety is also not a major issue.

Scheduled operation is not a big problem during high demand time because of very high frequency especially on high demand routes. In case of low demand time or route, however, it is important. There is no operation schedule and no control.

Table 12.2.1 Zones for Transferring

Zone No.	Zone Name	No. of Zone Pairs forced to be transferred
18	Hijaz	775
51	Ma Amounyeh	390
22	Baramkeh	345
10	Kiwati	218
1	Assd Al Din	174
31	Midan	126
17	Saroujeh	124
9	Malki	45
6	Saliyeh	43
55	Kaboun	25
49	Diwanyeh	17
46	Bab Touma	14
34	Dawamneh	11

2) Demand

The future demand is estimated as shown in Table 12.2.2. Demand in the city will decrease but demand from the city outside including return trips from outside will increase in correspondence to conurbation of outside of city. Total demand of 1998 is 0.7 million trips a day and that of 2020 is estimated to be 1.0 million, which is 1.4 times of the 1998 demand.

Table 12.2.2 Number of Microbus Passengers estimated

Year		1998	2005	2010	2020
Number of Passengers	In City	561,243	616,283	605,961	461,214
	City-Out	160,265	235,638	309,073	503,500
	Total	721,508	851,921	915,034	964,714

3) Planning Policy

The microbus plan consists of rerouting, strengthening of bus fleet, means to assure standard operation speed (ex. bus lanes, exclusive roads for bus or prioritized traffic signal system for bus), construction of terminals and establishment of a bus operation control center.

The present bus system is convenient for passengers as mentioned above though carriers are not so comfortable. The most serious problem of the public transport at present is traffic congestion caused by the microbus service itself. There are 4,125 buses operating in the city and 6,430 buses operating on the routes from outside of the city to inside.

In addition to rerouting, improvement of bus terminals, and introduction of exclusive bus lane or bus road, necessity of changing to large buses from microbuses are examined by route.

(3) Railway

In correspondence to developments of towns/cities outside of Damascus City the necessities of upgrading of existing railways will increase. Preliminary studies show that this will be necessary by the year 2020. The Land Use Development Master Plan, however, is still in the stage of study and feasibility of Qatana Region to accommodate one million population

should also to be examined in detail. In addition to these, structural changes of National Economy are also foreseen due to the start of open door policy, exploring efforts of crude oil, possible development of peace treaty in the Middle East and so on. These factors may have large effect on the activities of Damascus City in the future.

Due to these factors which should be thoroughly examined, the Railway Improvement Projects are not included in this Master Plan, however, it is recommended that detailed studies start around 2010 in coordination with the development of Damascus Metropolitan Area.

(4) Taxi

1) Existing Issues

Taxi serves 18% of person trips excluding walk/two-wheeler trips based on the Home Interview survey. This figure is very high compared with other cities. Based on an interview survey on small samples of taxi passengers there were no strong complaints about the service in general, but there were a few, such as refusing passengers or dirty cabs.

Taxi is used not only for inside city trips but also for inside to outside trips. One of the reasons why taxi is used for rather long distance trips is the cheap fare system; 3 SP for the first 500 meters with additional 1 SP for every 235 meters or 56 seconds.

2) Demand

The future demand estimated is shown in Table 12.2.3. Demand in the city fluctuate but demand from the City to the outside including return trips from outside increase. In-city trips of 1998 are 0.2 million trips a day and that of 2020 will be also 0.2 million. The demand from the inside to the outside of the city will increase from less than 0.1 million to 0.2 million due to conurbation of the adjacent zones to the City.

Table 12.2.3 Number of Taxi Passengers estimated

Year		1998	2005	2010	2020
Number of Passengers	In City	244,003	272,032	275,763	230,850
	City-Out	61,463	83,514	109,093	166,500
	Total	305,466	357,546	384,856	397,350

3) Planning Policy

One of the major transport issues in the City center is congestion of streets caused by parking. Introduction of parking control policy is inevitable. To ease the inconvenience in introducing a parking control policy and encourage transfer to taxi from passenger car, the improvement of quality of present taxi service is quite important. Improvement measures include:

- Same or better convenience as that of passenger car
- Same or cheaper cost than that of passenger car
- Same or similar comfort as that of passenger car

The first requirement is broken down into; a) door to door nature and, b) availablity at any time. Radio taxi system whereby requests are received by call can be one solution. The second item is broken down into; a) cheaper fare and, b) higher car operation cost. An answer to the cheaper fare may be difficult, but inevitable higher car operation cost when charging on road

parking makes taxi cost relatively cheap compared to use of passenger car. The same comfort as a passenger car is quite difficult but similar comfort may be possible by renewal of taxi fleets. This may suggest the necessity of two types of services, expensive with new vehicles and cheap with old ones as the present.

12.2.3 Traffic Management and Traffic Facility Management

(1) Planning Scheme

Based on the Master Plan policy concerning the effective use of existing facilities and difficulties of road widening/new construction due to the historical nature of Damascus, projects of traffic management are given much higher priority than priorities given in Urban Transport Master Plans of other capital cities.

Major items of Traffic Management Plan and Traffic Facility Management Plan are classified as follows;

- Intersections improvement and Traffic Signals
- On-Street Parking Control and Off-Street Parking Facilities
- Traffic Safety Measures

(2) Intersection Improvement and Traffic Signal

1) Existing Issues

The present saturation degrees at 26 major intersections were calculated. Intersections with more than 0.9 saturation degree are concentrated along the inner ring road and Ath Thawra St. Based on the road network plan, it is a fundamental issue to strengthen the inner ring road transport capacity.

2) Planning Policy

The introduction of Area Traffic Control (ATC) system along the inner ring road and in the center of the City is urgently required.

Major intersections are classified into two groups for consideration of introduction of ATC. These two groups are;

Category A: Intersections where grade separation improvements are required
Category B: Intersections where at grade improvement and traffic signal improvements are required

(3) On-Street Parking Control and Off-Street Parking Facilities

1) Existing Issues

Most houses/apartments have no parking facilities. There are several off-street parking facilities in the center of the City, but they can accommodate only 950 cars in total. As for demand, peak hour parking demand at present in the center of the City is estimated as 25,924, of which 13,827 (53%) is for "to work" purpose trips.

As a result streets in the central area are full of parked cars and traffic flows are badly disturbed.

2) Planning Policy

The center of the City is considered as the planning area for parking control. Major planning measures are the construction of off-street parking facilities and maintenance of on-street parking system.

Gradual but steady introduction of parking control measures is advised considering lack of custom to pay money for parking of a car in Damascus.

(4) Traffic Safety Measures

Intersection channelization, pavement marking and traffic signs are important facilities from the traffic safety point of view. Concrete plans to upgrade traffic safety facilities are studied. As for intersections, especially rotary type intersections, it is urgently required to establish the required design standard.

12.3 Budget Assignment

The road improvement budget of Damascus Governorate until 2020 is sufficient for road sector improvement of the Master Plan. Requirements of public transport sector however are beyond the budget. Maintenance of fleet and construction/betterment if terminals are considered as part of investment by the private sector in principle.

Chapter 13. ROAD NETWORK PLAN

13.1 Demand Structure

Damascus is an old and historical city rich of cultural assets with a road network developed over the centuries under the influence of different civilizations. During the last decades, informal influx caused different imbalances in the physical distribution of population and infrastructure system which affected the land-use pattern of the city. Other economical and social difficulties resulted in the non-completion of several road and transportation plans.

Based on the traffic assignment results, and to present the size of the traffic problem in the future, the present traffic volumes on the road network are shown in Figure 13.2.1 while Figure 13.2.2 shows volumes estimated for the target year 2020 in the case of applying the present road network without improvement. It can be concluded that without carrying out urgent improvements on the road network, the traffic situation will be hard to handle and the city will be blocked by traffic congestion.

By the year 2020, the future traffic demand is expected to exceed the capacity of all the arterial roads and main streets especially on the inner ring road and in the surrounding areas of the city as a result of the expected rapid growth in socioeconomic activities and development.

13.2 Network Planning Concept

The planning concept of the road network of the city aims mainly to solving the traffic and transport problems through an optimum use of existing transport facilities with minimum construction works and to formulate a road network in the city which can cope with the expected future traffic demand.

13.2.1 Objectives and Targets of Road Development Plan

The main objectives and planning concept of the road development plan in Damascus city can be set out as follows:

1) To help in realizing the targets of national and urban socioeconomic development plans by providing a reliable transport infrastructure system in the country.

2) To enlarge and enforce the physical foundation of the transport infrastructure in the city to cope with the requirements of the future urban economic growth by providing reliable and high quality transport services.

3) To guide the urban growth in the planned direction and to realize an orderly land-use plan and urban development.

4) To alleviate traffic congestion in the central areas and to ensure safe and punctual transport system.

5) To promote the effective use of land with poor accessibility and physical constraints, and to provide easy access to new development areas.

6) To consider the harmony and balance between different transport modes, and the environment and cultural heritage of Damascus.

Figure 13.2.1 Assigned Traffic Volumes – 1998

Figure 13.2.2 Assigned Traffic Volumes – 2020

In view of the above mentioned objectives, the general targets of the road development plan are set out as follows:

1) To complete a major road network which meets the following requirements.
   - The network should provide connections to all of the areas in the city
   - The network should support the socioeconomic development of the city
   - The network should consist of continuous roads without stub connections except for short stretches in special cases.
   - All components and elements of the road network should be maintained at an acceptable level-of-service.
   - The component roads should be well distributed over the city according to the transport demand.

2) To minimize construction works in urban areas and apply effective management schemes on the roads of the central and ancient areas.
   - In addition to minimizing the financial burden required for resettlement and compensation in the transport system investments, Damascus has a special environmental and cultural nature which should be preserved by limiting the network requirements in the urban area to improvement works and applying road management schemes to improve the network efficiency.

3) To increase the serviceability and efficient usability of the existing facilities.
   - Although the road network in many areas is adequate, it does not function efficiently. Applying some improvements and management measures can improve the level-of-service and the traffic flow without major construction activities.

4) To support an efficient public transport system.
   - The road network should support efficient public mass transport systems which cover the city by means of bus routes integrated with a commuting railway transport system to reduce the high dependency on private transport.

5) To develop a transport infrastructure system in the suburban corridor as a belt area for the future land-use expansion plans.
   - The outer ring roads and other assisted roads will serve the transport system of the city in many directions. It will help in alleviating the traffic volumes in the central area by handling the international and transit traffic, and will serve the urbanization plans in new satellite cities in Damascus Capital Region.

13.2.2 Road Network Development

The present road network in Damascus City consists mainly of several radials connecting the city with other cities and go through the inner city while the outer ring roads are not well developed and functioning only as partial bypasses. The inner ring road suffers severe congestion at at-grade intersections and narrow sections while the north and south bypasses are not yet completed and connected to form a ring road surrounding the city. Movement on main corridors inside the city is interrupted at low-capacity intersections and road sections occupied by on-street parking.

The historical planning of Damascus has been developed under the influence of different civilizations and variant colonial and cultural atmospheres which left clear fingerprints in

every spot of the City. This is reflected on the characteristics of road network which can not be geometrically classified according to each road width and function. In addition, the informal expansion in land-use and construction area and the non-existence of a complete view for the growing transport demand reflected on the traffic situation which became unbearable in several points including the transport infrastructure and facilities.

The last road plan for Damascus, which was developed by Eckoshar and Banshoya in 1968, is not completely implemented due to different aspects as explained in Chapter 2. In the procedure applied here to establish the new road development plan, a main step was to carry out a comprehensive evaluation on the viability of the non-implemented projects of 1968 plan from the technical, environmental and economic points of view. Viable projects which meet the concept of this plan were included in addition to other developed conceptual projects which can form the main components of the future road network.

The road development plan is designed to be as realistic as possible with minimum activities in the central and congested areas of the city and to develop the main transport infrastructure in suburban areas based on the following:

- Previously planned, committed and on-going projects
- Future land-use planning and socioeconomic activities
- Population growth and distribution
- Trip pattern and characteristics
- Future traffic demand and assigned volumes
- Road network requirements
- Requirements of different modes of transport
- Social and physical environmental considerations
- Technical and economic viability
- Budget allocation and investment resources
- Interaction with transport system of Damascus Countryside Governorate

13.2.3 Arterial Network Plan

Based on the criteria and procedure presented in above sections, and by optimizing the functional operations of main components of the existing network, a conceptual plan was established for the development of the arterial road network as presented in Figure 13.2.1. This conceptual arterial network plan consists basically of ring roads for central area, suburban area and outer areas as well as radial roads which are connecting the city with other cities and regions.

The basic planning concept for this component of arterial roads is to develop a network on which an uninterrupted movement of traffic can be provided for the main traffic directions in the city by constructing grade-separation structures at main intersections and applying other improvement and management measures. Such uninterrupted movement will smoothly handle the heavy inbound and outbound traffic in addition to through traffic outside the center of the city. The general improvement criteria for these arterials includes the following measures:

- To close or minimize median openings along the roads
- To limit the access from side streets to ramps of grade-separation structures
- To provide facilities for pedestrian movement through underpasses

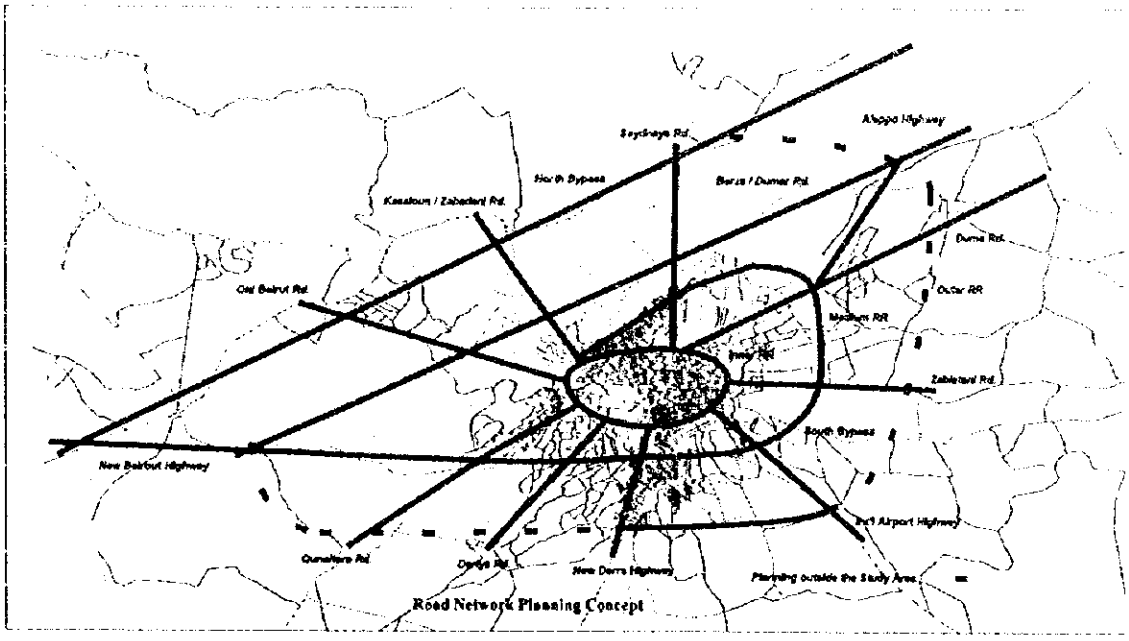


Figure 13.2.3 Arterial Network Planning Concept

- To separate railway lines from road traffic through the construction on tunnel to accommodate railways inside the inner ring road
- To provide standardized cross-section for the roads wherever possible
- To prevent on-street parking along both sides and providing off-street parking areas at appropriate locations and to provide extra side-space at bus stops
- To provide traffic control and safety devices such as signs, markings, guardrails, etc. when necessary at appropriate locations

(1) Ring Roads

1) Inner Ring Road: Upgrading and improving the existing inner ring road will provide an arterial road with a very important function to handle local circular traffic between different centers of the city without the need to use the central area street network. Major intersections along the road require grade-separation schemes to replace the existing signalization system with interchanges and underpasses. This Inner Ring Road is surrounding most of the important activity centers as well as the historical Old City.

   The concept of planning this ring road as a main arterial road is to utilize the developed western section with grade-separation intersections on the streets of Al Hourieh, Mouassat, 23rd July and 17th and to be connected to Abou Baker As Seddik, Al Mojtahed, Ibn Assaker, An Nasera, Fares Al Khouri and 6th Tishreen. The northern part of the road require the development of the section connecting the streets of Omar Ibn Alkhattab with Ibrahim Hanano through Nasib Bakri and Abou Jaafar al Mansour.

2) Medium Ring Road: This ring road is mainly composed of the existing South Bypass after completing the eastern section to meet Aleppo highway. Next, it will turn to the west through new sections including Mt. Kassioun East-West Road which is also required to

provide an access between the northeastern and western parts for the city.

The Mt. Kassioun Road was included in the 1968 Plan of the city but it was not implemented due to the rapid expansion of informal and illegal housing areas on the mountain slopes on which the road is planned to pass.

3) Outer Ring Road: The planning concept of this road is to be mainly composed of the North Bypass with extensions to New Beirut Highway in the west and to be connected with existing road sections in the eastern and southern areas of the city in order to formulate a strategic outer ring road.

This road is mostly located outside the Damascus Governorate except for some segments at the south but it is an essential road for the city development to handle the transit and international traffic outside the city center as well as to cope with the future growth in population and land-use activities.

(2) Radial Arterials

Most of the existing roads connecting Damascus with other cities and regions are planned to form the radial arterials in the road network. Some of these roads are functioning well with good operational and physical characteristics but others require upgrading and improvement works especially to provide interchanges at intersections with other arterials. The radial arterials are composed of:

- **New Aleppo Highway**: is the main inter-city highway to Homs, Aleppo and cities in the northern regions of the country and to neighboring countries.
- **Duma Highway**: is the old Aleppo road and serves mainly industrial areas in the suburbs of the city and northwestern areas.
- **Zablatani Road**: provides access to eastern development areas
- **International Airport Highway**: is serving also developed eastern areas
- **New Derra Highway**: is the main south entrance of the city and serves as an international highway connecting Damascus with Amman in Jordan.
- **Dariya Road**: is required to handle expected population growth in the south
- **Swaida Road**: is required to handle expected population growth in the south
- **New Beirut Highway**: is the main international highway to Lebanon
- **Old Beirut Road**: is used at present as one of the connecting roads between the new city of Dummar and Damascus.
- **Kassioun/Zabadani Road:** is crossing Mt. Kassioun to most of the tourism cities on the mountains.
- **Seydnaya Road**: is connecting Damascus with cities in the mountainous areas in the north.

13.2.4 Inner City Network Development

With the concentration of social and economic activities in the central areas of the city inside and around the inner ring road and in the old city, large-scale development projects such as the construction of many new roads will be unrealistic in most cases. The concept of improving the road network in the inner city depends mainly on the following:

- Minimum construction activities of new roads in heavy populated areas.
- Traffic management including advanced traffic control systems and parking areas.
- Grade-separation schemes where traffic management measures prove to be insufficient.

As the central areas have good access in the north, south and west directions, only one new road is planned to explore the northern walls of the old city and to provide access to the eastern areas of the city up to eastern section of the South Bypass. This new road will function as an extension to Fayez Mansour motorway on the west of the city, with 10 lanes at most sections, which is considered as the main west entrance and is the international highway to Beirut in Lebanon.

Other major interchange schemes found to be necessary include an the connection between north and south entrances at the most congested area of the city center through an underpass from Othman Ibn Afaan to Ath Thawra streets. The existing components of the network do not provide straight link between north and south, i.e. between Ath Thawra street, which is connected with the northern entrances of the city, and Othman Ibn Afaan street, which is the main south entrance with a width of about 60 meters and accommodating space for railway lines. The two streets are connected together through An Naser street on two right-angles. It is planned to construct underpasses at the two right-angle at-grade intersections on An Naser street to continue an uninterrupted movement of traffic in the city center.

Another major project is planned as one of the alternatives of development the inner-city road network which is providing a second level through an underpass along the western half of the inner ring road preferably as a toll road. This double-deck road will improve the function of handling heavy traffic on the ring roads and will introduce the concept of applying the toll system on roads in Syria.

13.2.5 Functional Road Hierarchy of Future Network

The future road network established based on the conceptual plan of this chapter is subject here to the same classification criteria of the functional road hierarchy presented and applied in Chapter 5 on the present road network.

Figure 13.2.4 shows the functional road hierarchy of the future road network. The function and requirements of main components of the network can be stated as follows:

Arterial Distributors: Basically ring roads and main radials are planned to serve under this category as arterial distributors with high capacities, however, their ultimate function will depend on the scope of reducing roadside dynamic activities and access requirements as well as upgrading the road facilities.

The completion and improvement of missing links on the inner and medium ring roads and the construction of the strategic outer ring road will provide high level-of-service facilities for

Road Network in 2020

Arterial Distributor
Main Distributor
Secondary Distributor

Road Network in 2020

Arterial Distributor
Main Distributor
Secondary Distributor

Figure 13.2.4 Future Road Network Classification - 2020

traffic outside central areas of the city and required arterials for future expansion in urban areas. With the fact that the more junctions on an arterial road, the more local it function, schemes for grade separation structures at main intersections and access control at others are required.

Main Distributors: Roads under this category are planned to handle high traffic volumes and to provide direct access to and connection between the arterial distributors. They are forming a network covering inter-zonal and medium distance trips in the city and planned public transport systems. In addition, all the large centers of the city are connected through this main distributors network.

Secondary Distributors: The road network under this category is planned to function as feeders for the main distributors and to serve medium distance traffic. Such roads provide access to large socioeconomic activity centers and may serve medium-sized public transport vehicles.

Local Distributors: This category of roads provides access to the secondary distributors of the network and serves intra-zonal and local traffic. Most of these roads are located in residential and commercial areas with uncontrolled intersections which require traffic management and safety measures.

13.3 Road Network Projects

To realize the targeted function of each road category in the road network, the following types of main projects, shown graphically on Figure 13.2.1 and presented in Table 13.3.1 for the area of Damascus Governorate, were investigated to determine the optimum required projects which will formulate the base of the road development plan. Projects for Damascus Governorate are classified into three groups as follows:

- Road Widening Projects
- Road Construction Projects
- Structure Projects

As the planning procedure and transport analysis process of the transport pattern in Damascus Governorate is interacted to a large extent with that of Damascus Countryside Governorate, another additional required projects were introduced as an assumption to develop the rural road network up to the year 2020.

- Widening Projects - Countryside
- New Road Construction Projects - Countryside

As such projects are only used as assumptions without any details in the network, the new road construction projects were considered to including all required structures in their packages.

To summarize the objectives, components and characteristics of each project, project profiles presented in Appendix 13-1 were prepared for projects selected to be included in the master plan (excluding FS projects, which are described in more details in Part IV). Such profiles include mainly the following information:

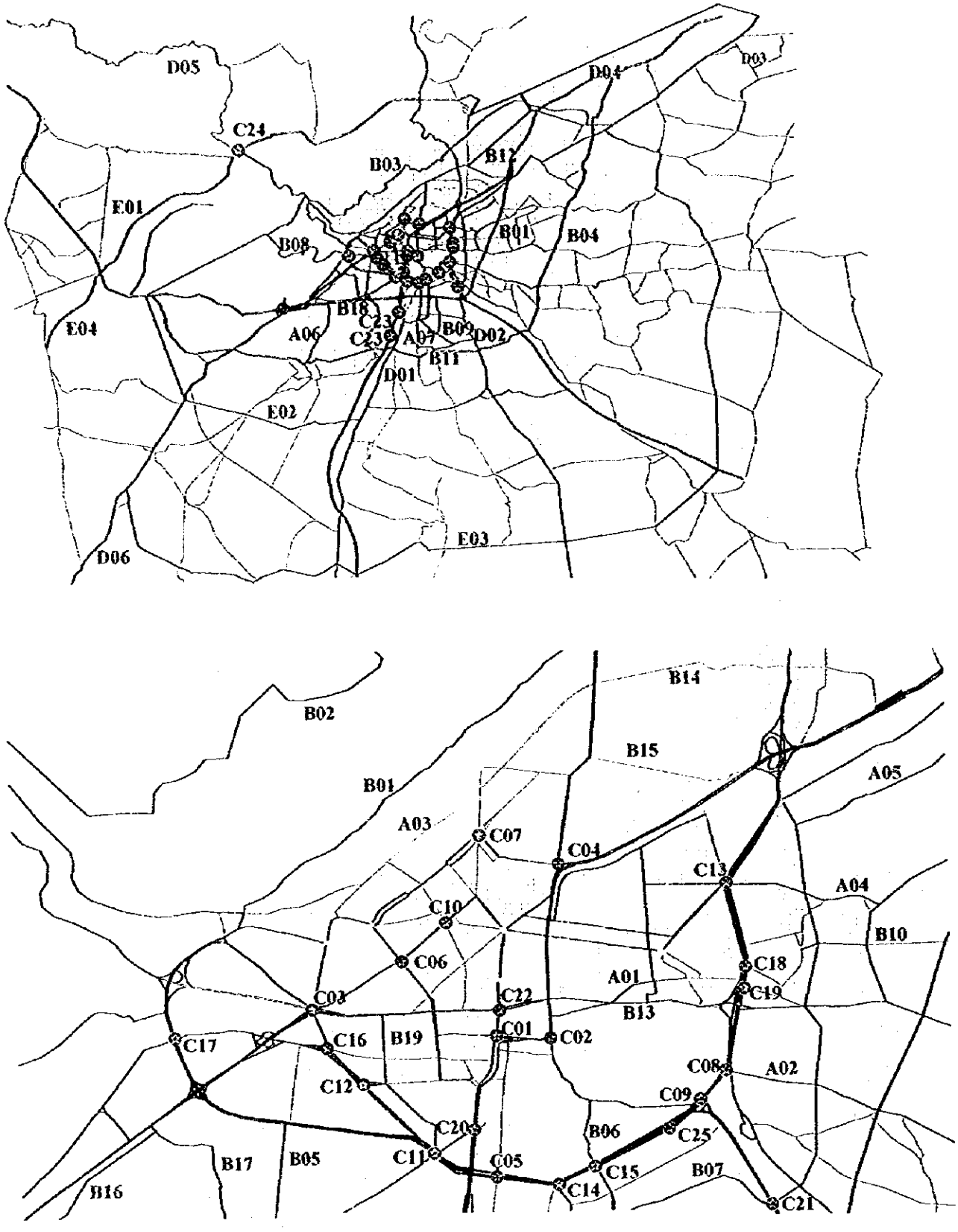


Figure 13.3.1 Future Road and Structure Projects

Table 13.3.1 Future Road and Structure Projects in Damascus Governorate

Project	Sub-Project	Lane	Project Name	Length (m)
A: Widening Projects				
A01		W04	Malek Faisal Street	1,700
A02		W06	Al Zablatani St. from Ibn Assaker to South Bypass Ext.	1,700
A03		W03	Abdel Ghani an Nabolsi	350
A04		W06	Anwar Kamel to South Bypass I/C #2	1,900
A05		W04	Tora River Street from Garajat Sq.	1,800
A06		W06	Daria Road	3,000
A07		W06	Al Quds Road	4,000
A08		W06	Dummar Road	2,000
A09		W06	Swaida Road	2,000
A10		W04	Saad Zaghloul Street	350
A11		W06	Tora Riverside Street	1,000
Sub-Total				19,800
B: New Road Construction Projects				
B01			Medium Ring Road	
	a	N06	Mt. Kassioun East-West Road	3,800
	b	N06	Mt. Kassioun to Aleppo Highway	4,200
	c	N06	Aleppo Highway to Zablatani Road	4,000
	d	N06	Zablatani Road to Airport Highway	3,000
B02			Berza / Dummar Road	
	a	N06	New Beirout Highway to Old Beirout Road	5,000
	b	N06	Old Beirout Road to Kassioun / Zabadani Road	2,000
	c	N06	Kassioun / Zabadani Road to Seydnaya Road	3,000
	d	N06	Seydnaya Road to Aleppo Highway	4,000
B03			North Bypass	
	a	N06	Seydnaya Road to Outer Ring Road	4,000
	b	N06	Outer Ring Road to Aleppo Highway	5,000
B04			Outer Ring Road	
	e	N06	International Airport Highway to New Derra Highway	6,000
B05		N06	Kafar Sousseh from 17th April to Outer Ring Road	4,000
B06		N04	Aal al Bait St. and Quds St. Connection	700
B07		N06	Al Kahira Parallel St. from Al Quds to Fares Al Khouri St.	6,400
B08		N04	Mezze – Dummar Road	4,000
B09		N04	Connecting Rd. for Thalatheen, Yarmuk, Palestine	2,500
B10		N06	Al Zablatani Streets east South Bypass	1,200
B11		N06	Extension of Al Thalatheen Road	3,400
B12		N06	South Berzeh Road	5,000
B13		N06	Old City North Wall Street	1,500
B14		N04	Abou Jarash Garden – North	2,000
B15		N04	Abou Jarash Garden – South	1,100
B16		N04	Mezze South – 1	2,000
B17		N04	Mezze South – 2	1,100
B18		N04	Mezze South – 3	1,500
B19		N04	University Street and Bridge	1,400
Sub-Total				81,800

(continued)

Project	Sub-Project	Lanes	Project Name	Length (m)
C: Structure Projects				
C01		S04	Hejaz Station / South Entrance Tunnel	1,100
C02		S06	An Naser and Ath Thawra Intersection	300
C03		S04	Al Umawiyeen Square	350
C04		S04	Al Faihaa Square	250
C05		S04	Al Mojtahed and Khaled Ibn Alwalid Intersection	210
C06		S02	Al Mahdi Ibn Barakeh and Al Jalaa Intersection	210
C07		S02	Hittin Square	200
C08		S02	Bab Sharki Square	300
C09		S02	Hassan Kharat Square	225
C10		S02	8th Azar (Arnus) Square	300
C11		S04	17th April and Kafar Sousseh Square	450
C12		S02	Ali Bin Abi Taleb and Abu Bakr As Siddiq Intersection	200
C13		S04	Abbasyyeen Square	270
C14		S04	Bab Mossala Square	230
C15		S04	Ibn Assaker and Al Quds Intersection	230
C16		S02	Basel Al Assad Square	250
C17		S04	Al Mouassat Square	300
C18		S04	Shiekh Raslan – Bilal Square	450
C19		S02	Shiekh Raslan – Zablatani Overpass	400
C20		S04	Bab Sereeja Bridge over South Entrance	50
C21		S04	At Tabbaaleh Bridge over Airport Highway	150
C22		S04	Victoria Bridge Extension	100
C23		S02	Underpass Ramps south of New Deraa Highway	300
C24		S01	I/C of North Bypass with Beirut Road	1,000
C25		S04	Inner Ring Road Double-Deck	6,000
C26		S04	6th Tishreen -- Hamadani Overpass	200
C27		S04	6th Ayyar – 17th April Underpass	200
C28		S04	Mt. Kassioun Tunnel	4,800
Sub-Total				19,025

- Existing Condition
- Objective
- Traffic Volume
- Work Items
- Economic and Financial Cost
- Implementation Program
- Layout and Location Map

The following sections provide a brief description for each type of projects and for the main and large-scale projects presented in the study.

13.3.1 Road Widening Projects

Taking into consideration the planning policy of minimizing the acquisition of new land for road improvement projects, some of the existing roads in the network are not fulfilling their assumed function at present or their upgraded function in the future as they have limited capacity in principal which require to be increased.

Basically, all the radial arterial and main distributors are planned to have a minimum of 6 lanes outside the medium ring road and extended to the outer borders of Damascus Countryside Governorate. These areas are expected to accommodate future increase in

population and resulted high demand of traffic volumes.

To improve the function of such roads and streets, widening schemes are planned to increase the number of lanes of the following eleven main streets. Widening schemes of minor streets are not included in this plan.

A01-Malek Faisal Street: The project of widening Malek Faisal Street was included here as an alternative to the project of providing an eastern arterial as a north wall street for the Old City (B13) which can open also its this northern part for cultural and tourism activities.

Such arterial will provide direct access to the eastern direction of the city which will alleviate congestion at several intersections in the central areas of the city. This project was later excluded as the alternative (B13) proved higher viability in the overall evaluation process.

A02-Al Zablatani Street: With providing easy access to the east, Al Zablatani street will require more lanes and upgrading in order to handle the expected future demand in this direction and to the outer ring roads.

A03-Abdel Ghani an Nabolsi Street: This street requires widening only for a short segment of about 350m in order to provide constant width for the whole street especially it is located in a weak area of the road network. A width for 3 lanes is required as the street is planned to handle one-way traffic in the future.

A04-Anwar Kamel Street: Widening this street will provide more links on the network in the eastern area of the city which lacks enough roads especially with the existence of different social and economic activities in the area.

A05-Tora River Street: The street passes along an industrial areas the southern riverside of Tora River. Widening and upgrading it will decrease the traffic congestion on the parallel Factories street to the north and will serve residential areas by providing a higher social and recreational level in the area.

A06-Daria Road: The road passes through countryside areas with few houses and other activities. Improving the existing road will provide a strong link going south of the city which will handle the expected future demand of newly developed areas to the west and south directions.

A07-Al Quds Road: The road passes through a populated area with high density which lacks wide streets to serve as collector roads. The widening scheme will provide a strong link connecting the center area of the city with two ring roads which will result in alleviating traffic congestion and improving the quality of environment.

A08-Dummar Road: The objective of this project was to improve the traffic conditions in newly developed areas subject to high demand in the future. This project was later excluded at it is included partially under the project B02 which provides an arterial road connecting the two areas of Berza and Dumar.

A09-Swaida Road: This road is functioning as one of the main radial arterials passing through high-density populated suburban areas outside the south bypass. It requires widening to 6 lanes to provide enough capacity for the expected future traffic demand on the road.

A10-Saad Zaghloul Street: As on of the main commercial streets just south to the Old City, this street is one of the most congested streets in the area. Increasing its width to a minimum of 4 lanes for vehicular traffic will provide direct access for the traffic to the south from the city center. The street should have also wide sidewalks to accommodate the heavy volume of pedestrian flow.

A11-Tora Riverside Street: Widening of the street will provide a missing link to the inner ring road in the northern part to improve its function. Works on this residential street will not require any removal of buildings, as the river sides will be replaced by retaining walls instead of the its existing side slopes.

13.3.2 Road Construction Projects

The planned new construction road projects are located mainly outside the central area and have the objective of improving the traffic movement on outer ring roads of the city. In addition, new roads are planned to connect newly developed areas to accommodate future increase in population.

One of the main new roads to be urgently completed is the medium ring road as it is planned to be as an extension to the South Bypass. Other new road projects are planned to provide main links to the road network in order to increase its efficiency and to cover areas without enough rate of arterial, main or secondary distributors.

B01-Medium Ring Road: This ring road is planned to improve the function of the south bypass by providing northern links just near Mt. Kassioun. The northern section, which is Mt. Kassioun East-West Road planned long-time ago, requires a massive scheme for resettlement as it passes through an informal housing area with high density of population. The connection to Aleppo highway is located in rough topography land.

B02-Berza/Dummar Road: This northern arterial will directly connect Aleppo highway with new Beirut highway. Some sections of this arterial are existed which may require some improvement works while others will require new construction. The road will provide high transport level-of-service for suburban areas to the north and west of the city where the existing road rate is low.

B03-North Bypass: Most of this road is completed and under operation. Work is going on for the uncompleted sections. It is located outside the jurisdiction of Damascus Governorate which is financing the project as it will basically improve the traffic situation inside the city by handling the flow of heavy vehicles.

B04-Outer Ring Road: This is a newly planned road mostly located in Damascus Country Governorate which is not included in the planning area under this study. It was used as an assumption to complete the road network for analysis procedures. Most of the alignment is going on existing narrow countryside roads and upgrading such roads may affect the green areas south of the city.

B05-Kafr Sousseh Road: The northern section of this road from 17th April street up to the south bypass is under construction as a part of the Kafr Sousseh plan. Extending this road to the south will provide a new arterial west of the city to the outer ring road, which will improve the function of the network in an area lacks high level-of-service arterials.

B06-Aal Al Bait and Quds Streets connection: Connecting these two streets will provide a north-south main arterial to discharge traffic from the city center to the south direction through Al Quds street. It will function as an extension to the main north arterial of Ath Thawra street and will directly connect it to the inner ring road and south bypass which is provided by an interchange at this location.

B07-Al Kahira barallel Road: This road will connect the two streets of Al Quds and Fares Al Khouri through a partial ring road to the east of the city. Alignment of the road passes between the inner ring road and south bypass extension in an area with low density of roads. It will improve the traffic condition on the inner ring road and will handle big portion of traffic especially for the public transport system. Many segments of the road are either existed or included in previous plans.

B08-Mezze / Dummar Road: This road project was later excluded from the plan as it did not show high viability. There are other existing and planned alternative roads in the area to handle the high transport demand of the future. In addition, the alignment of this road passes through special-nature lands which make it not suitable for implementation.

B09-Connecting Rd. for Thalatheen, Yarmuk, Palestine: The objective of this road is to provide main street in the highly populated congested area south of the city. It was later excluded from the plan as the difficulties in implementation due to the required large-scale scheme of land acquisition and resettlement showed that the project will not be viable.

B10-Al Zablatani Streets east South Bypass: The road network in the area east of the south bypass extension does not have enough roads to serve the local traffic. Three streets are planned in this area to provide essential transport facilities and to promote future socioeconomic activities and development.

B11-Extension of Al Thalatheen Road: This road passes through a heavily populated area with many commercial activities and suffers from congestion at intersections. Expanding the road to connect with other arterial roads in the area, such as Suwaida road, will solve the existing traffic congestion problems and provide easy access to other parts of the city.

B12-South Berzeh Road: The road alignment passes through hilly areas and some farms. The objective of this road is to directly connect the areas of Berzeh, Rukn Ad Deen and Kassioun in the west to Duma and Adrah in the east with access to old and new Aleppo highways.

B13-Old City North Wall Street: The main road network in the city center includes arterials to the west, north and south, without an arterial to the east. This road will enhance the function of the network and will clear the northern section of the Old City walls for cultural and tourism activities. This is a main section in the planned east-west corridor improvement project which includes other structure road projects aiming to provide smooth traffic movement in the city center.

B14-Abou Jarash Garden-North: The objective of this project is to provide an east-west link to serve with other roads as a ring road for the center area. There is a narrow road at present on the same proposed alignment. Providing a 4-lane road here will alleviate traffic at several intersections in the center of the city. Protecting the green area of the roadsides is an important task to be considered after implementing the project.

B15-Abou Jarash Garde-South: This project will provide a missing link for the present inner ring road which will improve its function by extending it to the north of the city. A 4-lane road is required to be implemented on the alignment of an existing narrow road and the protection of the green area on the roadsides should be carefully considered.

B16-Mezze South-1: This road connects Mezze road directly to the south bypass in an area which requires a main street for future development. The road will improve the function of the network in the area by connecting other arterials.

B17-Mezze South-2: The alignment of this road passes through arable lands which require development in the future. The planned road will serve the local road network by providing connection between main arterial roads south of the city.

B18-Mezze South-3: This road is parallel to the south bypass which will serve mainly the local traffic in the area instead of interrupting the main flow on the bypass. It will help also in developing this countryside area to function as a suburban area for the city.

B19-University Street and Bridge: There is only one bridge over the main western arterial of Shoukri Al Quwatli street which is the Al Assad Bridge. This bridge handles heavy traffic volumes at present as it passes nearby the city center and serves areas with developed socioeconomic activities. Providing another north-south bridge and road will significantly improve the traffic conditions in the area which accommodate a university, public transport terminals and many tourism attraction spots and hotels.

13.3.3 Structure Projects

As most of the traffic problems in the city are caused due to congestion at the limited capacity of at-grade intersections, most of the planned structure projects have the objective of providing high-capacity grade-separated structures either at the presently congested intersections or on the newly planned arterial and main distributors. In Chapter 15, traffic volumes at intersections were analyzed and required improvement plan is established which is also considering the future requirements of the road network as well as the functional hierarchy of its arterials.

In general, the planned grade-separation structures have basically the main objective of improving traffic conditions, first on ring roads and then on other arterials. That can be achieved through the concept of providing non-interrupted movement for the traffic on such roads and keeping other directions of traffic, especially inbound traffic to the city center, under the control of signals.

A total number of 28 structure projects are planned to cover the needs of the network up to the target year of 2020, and later years, with a total length of about 19.0 kilometers. Following is a brief description for the main structure projects in the plan.

C01-C02 [T01/2]-Hejaz Station/South Entrance and An Naser/Ath Thawra Intersection: The road network of the city of Damascus is planned on the basis of north-south and east-west corridors of traffic movement. This project deals with the development of a well-functioned link (tunnel) to connect the existing two arterials of Ath Thawra street, from the city center to the north, and the southern entrance of the city. The existing streets connecting the two arterials are the most congested streets in the central areas of Damascus. Such connecting

underground link will function as an inner-city bypass to discourage the traffic accessibility to the city center and provide easy access to outside areas. The project will insure the pedestrian movement on the ground level and separate the through traffic from the local movement. For the high importance of this project, it is included as one of the feasibility study projects, with two selected alternatives of T01 and T02, as presented in Chapter 23.

C03-Al Umawiyeen Square: This square is characterized as a seven-leg rotary with about 8 lanes in road-width equipped with a signalization system composed of several signals installed either at some of the legs or on the rotary itself. With the high traffic volumes passing the square, this traffic control system results in a considerable delay and congestion due to the required several stops for vehicles in order to pass the square. Analysis of the traffic movements in the area showed that grade-separation between traffic movements is required as an urgent solution in order to alleviate congestion on the square.

C04-Al Faihaa Square: Traffic congestion at this square is severe as it is located at the crossing point of Aleppo highway with the northern arterial of Ath Thawra street. The existing traffic signal is the only advanced one equipped with detectors in the city, however, high volumes of traffic in the area are causing many problems. Providing an underpass in this area will eliminate the crossing movements of traffic and separate local traffic from through traffic. The underpass will ease traffic on the inner ring road and also the pedestrian movement will be improved.

C05-Al Mojtahed and Khaled Ibn Alwalid Intersection: An underpass is planned for this intersection with two directions on the extension of Abu Baker Al Siddiq and Mujtaheed. That will provide continuity of movement on the inner ring road, separate local traffic from through traffic, provide regular movement for pedestrian and decrease the pollution especially for Mujtaheed Hospital.

C06 - Al Mahdi Ibn Barakeh and Al Jalaa Intersection: The structure project here is planned to be a one-way underpass with two lanes from Al Mahdi Bin Barakah to Omar Bin Abdul Aziz through Al Jalaa' Street. This will provide continuity of non-interrupted outbound traffic movement from the city to Umawyeen square and areas to the west. Other benefits include the separation of through traffic from local movements and decreasing the pollution and delay.

C07 - Hittin Square: It is planned as a one-way, two-lane underpass from Omar Bin Al Khatab street to Oqbah Bin Naffaa' street through Hittin square. It will provide northern section to the inner ring road and improve the traffic movement in northern areas of the city. It will also provide the continuity of outbound movement from the city center through Omar Ibn Al Khatab street to Umawiyeen square.

C08 - Bab Sharki Square: A two-lane one-way underpass is planned to handle the heavy traffic movement on the inner ring road in the direction from the airport ring road to Al Sheikh Raslan. Other objectives of the project are to separate the through traffic from the local movement, organize the pedestrian movement and decrease the pollution.

C09 - Hassan Kharat Square: This square is located on the inner ring road at the beginning of the highway to the international airport. An underpass is planned here with for one-way traffic in two lanes in the direction form Ibn Assaker to Bab Sharqi to basically improve the movement on the ring road.

C10 - 8th Azar (Arnus) Square: An underground parking area under this square is included in the feasibility study projects, and required space is reserved to implement an underpass to solve the traffic congestion problem in the area. A one-way 2-lane underpass is required here to handle the heavy traffic in the direction from Mahdi Bin Barakah to Shahbander streets. As this underpass will serve the inbound traffic to the city center, it should be implemented during the second half of the plan after improving the traffic conditions in the city.

C11-17th April and Kafar Sousseh Square: An underpass is required here to connect 17th April and Abou Baker As Seddik streets with two lanes for each direction of traffic in order to improve the movement on the inner ring road. It will separate local and through traffic and solve the traffic congestion in the area.

C12-Ali Bin Abi Taleb and Abou Baker As Siddiq Intersection: The objective of this project is to provide a one-way two-lane underpass for the left-turn movement from Abou Baker As Siddiq street to Ali Bin Abi Taleb. This will provide continuity of traffic movement on the main streets in the area and will cancel the heavy traffic movement in Palestine street beside the university colleges.

C13-Abbasyyeen Square: This square is considered as the eastern gate to the city with heavy congestion due to high volumes of public transport and heavy vehicles. To improve the movement on the inner ring road and access to the east, a two-way two-lane underpass is planned to connect An Nasera and Fares Al Khouri streets as the two high-volume streets. This plan will provide continuity for the through movement on the inner ring road and will keep more capacity for local traffic in the highly populated area.

C14-Bab Mossala (Al Yarmouk) Square: An underpass is required here to provide continuity of smooth movement on the inner ring road and separate through traffic from local movements. The underpass can be extended to include the nearby project of C15 in one package. Providing one structure for two intersections will facilitate the north-south movement on the proposed road project B06 connecting Aal Al Bait with Al Quds streets.

C15-Ibn Assaker and Al Quds Intersection: The road project B06 will result in an intersection on the inner ring road which should be solved as grade-separated underpass for the continuity of traffic movement. It is preferred to be implemented in one package with C14 due to the short distance between the two locations.

C16-Basel Al Assad Square: A one-way two-lane underpass is planned for this square in order to handle the heavy traffic volumes coming on the inner ring road from south of the city to the west through Abou Baker As Seddik to Felastine street. Local movements of pedestrian and car traffic will have higher capacity and traffic congestion will be alleviated in the area.

C17-Al Mouassat Square: With the main concept of improving the movement on the ring roads of the network, this intersection will require an underpass to separate traffic movements in this congested area. It should handle the two directions of the inner ring road traffic in a total of four lanes.

C18-Shiekh Raslan-Bilal Square: This square is also located on the inner ring road which should provide non-interrupted movement for the traffic. The underpass will solve congestion problems in the heavily populated area, will support public transport system and will separate local and through traffic.

C19-Shiekh Raslan-Zablatani Overpass: With providing an arterial to the east of the city center through the Old City North Wall street B13, this overpass is planned as a two-lane one-way to only handle the outbound traffic coming to Al Zablatani street east of the city. It has mainly the objective of providing direct access outside of the city center in the eastern direction.

C20-Bab Sereeja Bridge over South Entrance: This project is directly connected to the C01 project of extending the low-level cross-section of the south entrance road to Al Fahama square south of Al Hejaz railway station. After implementing C01, it will be an easy task to connect Bab Sreeja street to Abou Mousa Al Ashaari through a bridge on the at-grade level.

C21-At Tabbaaleh Bridge: This bridge is located over Airport Highway to connect both sides of the planned road project B07 to handle two directions of traffic in two lanes for each.

C22-Victoria Bridge Extension: The existing Victoria overpass is ending at a location which closes Yousef al Azmeh street and divides it into two separate sections. This is causing traffic congestion in the area especially for U-turn movement close to Ath Thawra street. Extending this overpass will allow the continuity of movement on Yousef al Azmeh street providing and alleviate congestion in the area

C23-Underpass Ramps south of New Deraa Highway: Ramps at interchanges of the newly constructed highway are not yet implemented which cause disturbance in the traffic movements in many areas south of the city. Budget was allocated by the Governorate to implement such ramps in order to fully utilize the highway and improve traffic movement on other connected streets.

C24-I/C of North Bypass with Beirut Road: This project is only to complete the interchanges of the north bypass in order to fulfil its assumed function. The bypass is located outside the boundary of the Governorate but it is comprehensively financed by the Governorate budget.

C25-Inner Ring Road Double-Deck: The project is planned to provide two levels, underpass and at-grade, for the traffic movement on about 6.0 kilometers segment of the inner ring road at its congested section between the junctions of 17th April and 6th Tishreen streets. Such project will replace the construction of several grade-separation structures along the inner ring road to improve and upgrade its function and can be operated as a toll road. In the preliminary evaluation of the project, it was excluded from the plan for technical considerations when implementing it after other grade-separation projects on the road, in addition to its high initial capital cost.

C26-6th Tishreen – Hamadani Overpass: With the implementation of B16 road project, the intersection with the highway of 6th Tishreen will require a grade-separation scheme to improve the traffic conditions. An overpass is planned, as it will not disturb the landscape of the area, with 2-lane for each of the two directions of traffic.

C27-6th Ayyar -17th April Underpass: With the implementation of the Kafr Soousseh road project B05, its intersection with the inner ring road at 17th April street will require an underpass in order to improve the traffic conditions in the area. The underpass will provide the required continuity of movement on the Inner Ring Road and will smoothly connect the

northern and southern sides of the interchange.

C28-Mt. Kassioun Tunnel: This project was planned as an alternative to Mt. Kassioun East-West Road (B01a) which requires a massive land acquisition and resettlement plan. In case of implementing the road project, this tunnel will not be necessary as the road will provide an east-west link north of the city in addition to its role in readjusting the surrounding informal housing area. The project is not included in the plan due to its high costs, however, it should be implemented in case of the impossibility of the road project (B01a).

An alignment for the tunnel was topographically and geologically investigated. It is planned to connect the two points of Rokn Ad Deen hospital in the east and Beiroun street to the west, beside the water supply station, with a total length of 4,800 meters. The geology of the area is limestone dominated from Cretaceous period (100 million years ago) to Eocene period (38 million years ago). The strike and dip of portal plan points are N34E in east portal and N28E, SW62 in west portal. Near the west portal of the tunnel there is a water supply tunnel with a length of about 14 kilometers, height of 3.5 meters and width of 4.0 meters which transfers the water supplied to Damascus from springs near the upper-stream of Barada river. That proves that the geological characteristics of the area allows the construction of a road tunnel. Figure 13.3.2 shows alignment and geological details of the proposed tunnel. At present, this tunnel is not considered in the plan as it is only a (B01a) alternative for future considerations.

13.3.4 Road Projects in Damascus Countryside Governorate

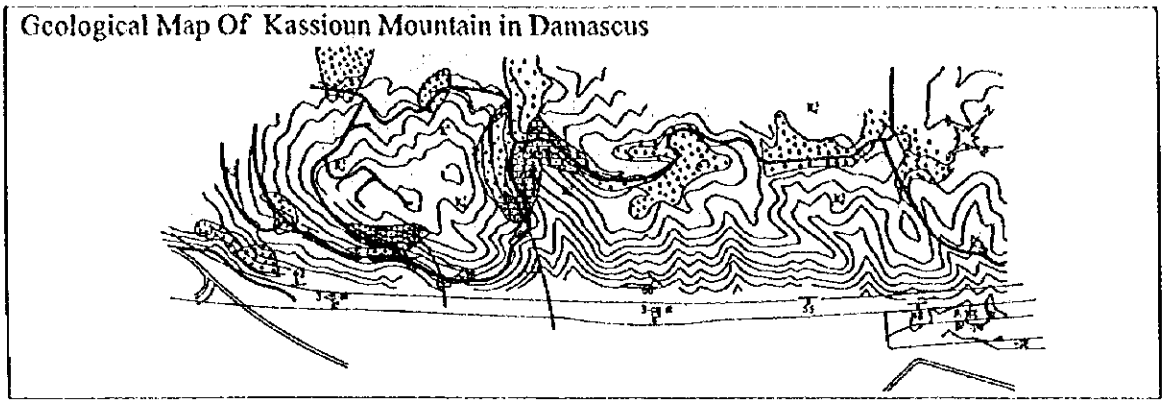
The planning procedure and transport analysis process of the future trip pattern and road network in Damascus Governorate is interacted to a large extent with the future development of the road network in Damascus Countryside Governorate. In addition to projects planned inside the boundary of Damascus Governorate, and only for the purpose of investigating the future traffic pattern in the study area which includes most of Damascus Countryside Governorate as well, another additional required projects were introduced as an assumption to develop the countryside road network up to the year 2020. Table 13.3.2 presents assumptions of the required main road projects in Damascus Countryside Governorate which were done for as follows:

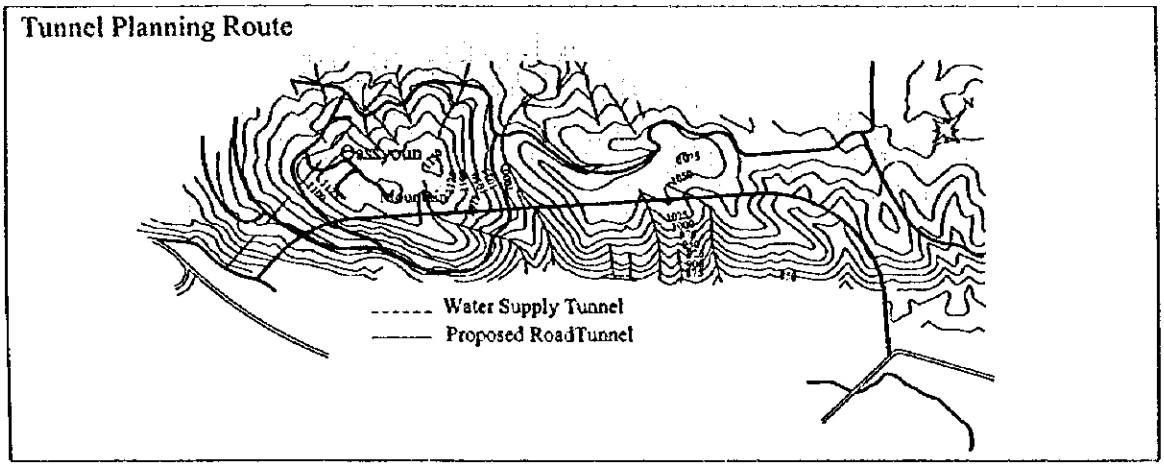
(1) Widening Projects - Countryside

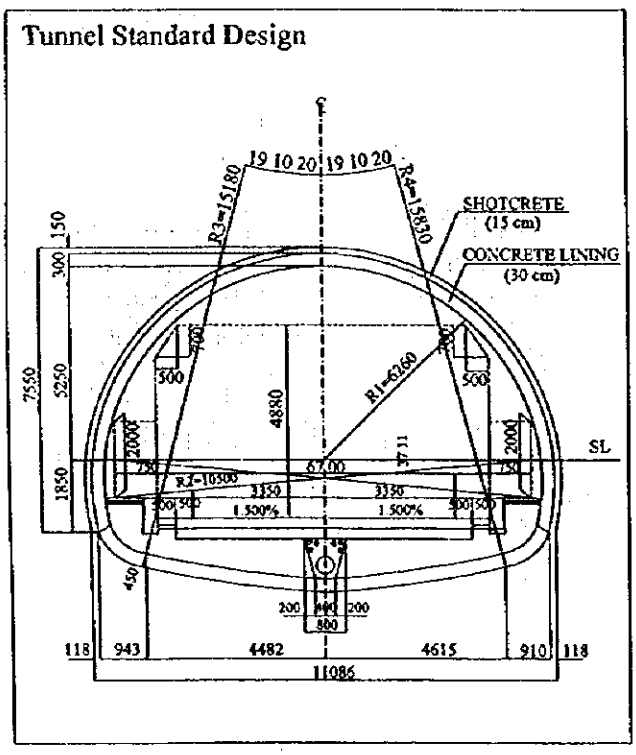
Basically, all the radial inter-city arterials which are serving the network in Damascus as arterial or main distributors are planned to be widening to the standard cross section of six lanes in order to handle not only the future inter-city traffic but also to balance the distribution of, and accommodate the trips generated due to the population increase in development expansion areas. Out of eleven radials connecting Damascus with other cities at present, six of them were found to be with less than the six lane cross-section required to accommodate future traffic demand. In total, the required length to be widened is about 100 kilometers

(2) New Road Construction Projects - Countryside

In Damascus Countryside Governorate, there are no strong links connections between inter-city radials which may accommodate part of the outer traffic without approaching the built-up area of Damascus. Two ring roads are added to the network in the countryside areas which are the newly proposed Damascus Countryside Ring Road and the MOC Ring Road which is planned by the Ministry of Communications. Other two main roads are the Quodsayya Road and South countryside Bypass in the northern and southern countryside. The total length of the four road projects is approximately 209 kilometers.







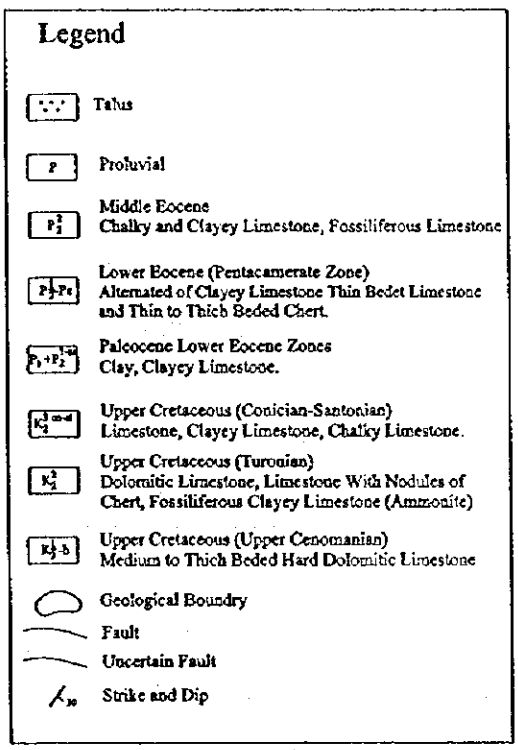


Figure 13.3.2 Mt. Kassioun Tunnel Layout

Table 13.3.2 Assumption of Future Road Projects in Damascus Countryside Governorate

Project	Sub-Project	Lanes	Name	Length (m)
P: Widening Projects				
P01		W06	Old Derra Road	21,000
P02		W06	Al Swaida Road	20,000
P03		W06	Palmayra Road	17,000
P04		W06	Sednaya Road	10,000
P05		W06	Zabadani Road	10,000
P06		W06	Al Qunaitera Road	22,000
			Sub-Total	100,000
Q: New Road Construction Projects				
B04			Outer Ring Road	
	A	N06	North Bypass to Aleppo Highway	2,000
	B	N06	Aleppo Highway to Duma Road	2,600
	C	N06	Duma Road to Zablatani Road	6,000
	D	N06	Zablatani Road to International Airport Highway	5,000
	F	N06	New Derra Highway to Dariya Road	4,000
	G	N06	Dariya Road to Qunaitera Road	4,500
	H	N06	Qunaitera Road to New Beirut Highway	4,000
Q01		N06	Quodsayya Road	10,000
Q02		N04	South Countryside Bypass	24,000
Q03		N04	Damascus Countryside Ring Road	75,000
Q04		N06	MOC Ring Road	100,000
Sub-Total				209,000

13.4 Preliminary Cost Estimate

Economic and financial costs of the road and structure projects in the plan were estimated based on data collected and applied in the country in similar projects in order to economically evaluate the projects viability, select high priority projects and to establish an implementation program for the different projects included in the plan. Considering the type of each sub-project, the cost estimation procedure incorporates the costs of material, equipment, labor and unit work item to establish the construction direct cost, which is added to taxes, profit, land acquisition and compensation as well as engineering design and supervision cost.

As this stage is to preliminary estimate the construction cost, a simplifying procedure was applied in which the unit work item per kilometer, or per each construction unit of roads and structures as well as other different construction projects based on the design standards to be applied in Syria and according to the applied typical cross sections of roads and structures, as presented in Figure 13.4.1.

13.4.1 Project Type

Three major types of improvement work projects are applied in this road plan in order to develop the road network in Damascus Governorate, which are as follows:

1) Widening Projects

Projects under this type have a total length of about 20 kilometers of urban streets to be implemented according to the standard cross sections. These projects are composed of segments on seven roads in the built-up area which require increasing the right-of-way of the road with required resettlement and compensation schemes. Four of the roads are planned to be widen to 6 lanes, two roads to 4 lanes, and one road to 3 lanes to serve as a one-way street.

2) New Road Construction Projects

Roads under this type category have a total length of more than 82 kilometers divided on 19 projects mainly to be constructed as 6-lane roads. Few sections do not require the acquisition of land to provide the required right-of-way but resettlement schemes will be necessary especially some of the roads are passing through populated areas. For such roads, construction is planned in the second half of the planning period to allow enough time for completion of the lengthy resettlement process.

3) Structure Projects

About 19 kilometer length of new structure projects are planned to develop the road network in the urban areas of Damascus Governorate. New road construction projects include also some packages of structures mainly to provide non-interrupted movement of traffic on arterial distributors. As overpasses are not environmentally preferred in some urban areas with special landscape characteristics, most of the structures are underpasses with two or four lanes. Underpasses are planned to be open as long as possible in order to decrease the construction and ventilation cost, however, some of them will be closed in order to utilize the surface area in handling more traffic volumes.

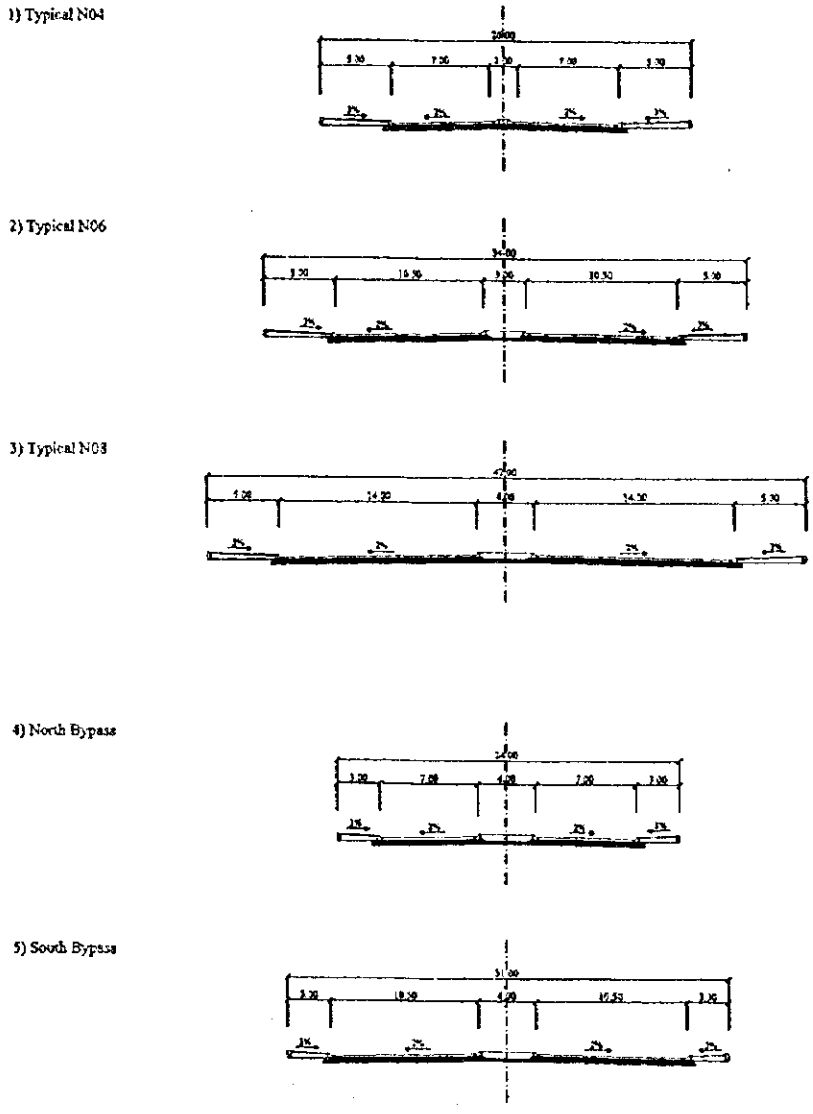


Figure 13.4.1 Typical Road Cross-Sections

13.4.2 Basic Cost Elements

To estimate the construction cost for the different projects included in the plan, the work items of each project type were defined for each project component and a survey was carried out to collect the unit cost and basic cost elements for each work item. Data for unit and total costs of labor, material, equipment and different work items, mainly for similar road and structure projects and other related works, were collected from the following governmental agencies:

- Ministry Housing and Utilities
- Ministry of Reconstruction
- Ministry of Supplies and Internal Trade
- General Organization for Housing
- Damascus Governorate

All of the costs collected from the above agencies are presenting projects implemented locally. Large-scale projects which may be implemented through international financing institutions, however, require additional international standard requirements which will affect the cost estimation procedures and may result in higher costs. In this regard, projects implemented in other developing countries with similar conditions as in Syria were considered in a calibration procedure to adjust the collected unit costs.

1) Labor Cost

Estimation of the labor cost is based on the Cost Analysis Guidelines for Construction Works published by the Ministry of Reconstruction in 1993. The basic salary is that salary presented in the Basic Labor Law No. 1/1985 and its other amendments. The net annual working days are estimated in the Guidelines as 252 days with a monthly average of 21 working days with 8 hours daily, as presented in Table 13.4.1.

Table 13.4.2 gives the local labor salary and different allowances based on the basic monthly salary and other allowances approved by the governmental authorities for such road and structure projects. The labor rates which represent the economic labor cost are presented in Table 13.4.3 after deducting applied taxes.

2) Equipment Cost

The hourly cost of machinery and equipment to be used in the construction woks of the projects is estimated based on the expenses of initial price, depreciation, parts consumption, maintenance and operation of other similar projects being carried out in Syria. The equipment cost is stated in Table 13.4.4 based on the different cost elements and divided into foreign and local portions.

Table 13.4.1 Net Working Days

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Calendar	31	28	31	30	31	30	31	31	30	31	30	31	365
Fridays	5	4	4	4	5	4	5	4	4	5	4	4	52
N. Holidays	4	0	2	7	2	0	1	0	0	1	1	1	19
Rain/Snow Days	3	3	4	0	0	0	0	0	0	0	1	3	14
Annual Leave													28
Work Days													252

Table 13.4.2 Labor Salary and Allowances

Qualification	Basic Salary	Social Benefits	Allowances							Monthly Salary
			Specialty	Heating	Family	Medical	Bonus	Transport	Others	
Engineer	4,189	716	1877	375	75	150	726	750	10	8,869
Assistant Engineer	3,369	576	652	375	75	150	701	750	10	6,658
Foreman	3,632	621	259	375	75	150	709	750	10	6,581
Topographer	3,369	576	653	375	75	150	701	750	10	6,659
Observer	3,238	554	210	375	75	150	698	750	10	6,060
Heavy mach. Driver	3,231	553	225	375	75	150	697	750	10	6,066
Truck driver	3,231	553	225	375	75	150	697	750	10	6,066
Light mach. Driver	2,894	495	159	375	75	150	572	750	10	5,480
Bus driver	3,231	553	225	375	75	150	679	750	10	6,048
Skilled labor	3,238	554	210	375	75	150	689	750	10	6,051
Paving labor	2,186	374	115	375	75	150	597	750	10	4,632
Unskilled labor	2,105	360	108	375	75	150	514	750	10	4,447
Lubricant labor	2,331	399	225	375	75	150	520	750	10	4,835

Table 13.4.3 Labor Rate

Qualification	Monthly Salary	Total Taxes	% of Taxes	Net Salary
Engineer	8,868	1,352.36	15.25	7,516
Assistant Engineer	6,658	937.94	14.09	5,720
Foreman	6,581	923.50	14.03	5,658
Topographer	6,659	938.13	14.09	5,721
Observer	6,060	825.74	13.63	5,234
Heavy mach. Driver	6,066	826.83	13.63	5,239
Truck driver	6,066	826.83	13.63	5,239
Light mach. Driver	5,480	717.03	13.08	4,763
Bus driver	6,048	823.46	13.62	5,224
Skilled labor	6,051	824.06	13.62	5,227
Paving labor	4,632	558.01	12.05	4,074
Unskilled labor	4,447	523.35	11.77	3,924
Lubricant labor	4,835	596.04	12.33	4,239

3) Material Cost

The market prices of purchase materials used in the project construction are being collected from different agencies responsible for material distribution. To calculate the economic cost of materials, 5% of sales tax was deducted from local materials. The imported materials are estimated by CIF without import tax, as for international tenders.

4) Direct Cost by Work Item

The costs for major work items were calculated from the standard productivity for each item as well as the labor, equipment and material costs. Costs of major work items are estimated for both the foreign and local currency portions and by economic and financial costs.

Table 13.4.4 Equipment Cost

No.	Description	Type	Specification	Base Cost USD	Tire Cost USD	No. of Tires	Depreciation USD	Spare Parts USD	Tire Cons. USD	Maintenance SP	Fuel SP	Lubricants SP	Filter USD	Operator SP	Equipment Cost USD/hr	Equipment Cost SP/hr
1	Bulldozer	Cat. D7	200 HP	76,000	-	-	6.33	11.78	-	11.40	112.50	13.30	0.10	43.25	18.21	180.5
2	Bulldozer	Cat. D8	335 HP	98,462	-	-	8.21	15.26	-	14.75	188.45	22.60	0.17	43.25	23.64	269.1
3	Bulldozer	Cat. D9	460 HP	124,640	-	-	10.39	19.32	-	18.70	258.75	31.05	0.23	43.25	29.94	351.8
4	Bulldozer	Komatsu 355	410 HP	110,183	-	-	9.18	17.08	-	16.55	230.65	27.65	0.20	43.25	26.47	318.1
5	Chain Loader / shovel	Cat. D973	210 HP	87,822	-	-	7.32	13.61	-	13.20	118.15	14.20	0.11	43.25	21.04	188.8
6	Tire Loader	Cat. 966 D	200 HP	59,867	6,433	4	5.49	10.21	2.57	9.90	112.50	13.50	0.10	43.25	18.37	179.2
7	Tire Loader	Cat. 988 B	375 HP	145,244	14,808	4	10.37	19.30	5.92	18.65	210.95	25.30	0.19	43.25	35.78	298.2
8	Grader	Cat. G 14	180 HP	73,636	5,291	6	6.14	11.41	2.12	11.05	101.25	12.15	0.09	43.25	19.76	167.7
9	Scraper	Cat. 613 C	175 HP, 8.4m3	57,422	5,750	4	4.79	8.90	2.30	8.60	98.45	11.80	0.09	43.35	16.07	162.2
10	Scraper	Cat. 631 C	450 HP, 24 m3	152,000	14,808	4	12.67	23.56	5.92	22.80	253.10	30.40	0.23	43.25	42.38	349.6
11	Tire Excavator	Bocklin 90	110 HP	51,004	889	4	4.25	7.90	0.36	7.65	61.90	7.45	0.06	43.25	12.57	120.3
12	Tire Excavator	Cat. 214	101 HP	47,289	1,333	6	3.94	7.33	0.53	7.10	56.80	6.80	0.05	43.25	11.86	114.0
13	Hammer Excavator	Hammer 0.5 ton	195 HP	59,111	-	-	5.91	10.99	-	10.65	109.70	13.15	0.10	43.25	17.00	176.8
14	Chain Excavator	Bocklin 942	160 HP	51,004	-	-	4.25	7.91	-	7.65	90.00	10.80	0.08	43.25	12.24	151.7
15	Chain Excavator	Cat. 225	150 HP	51,004	-	-	4.25	7.91	-	7.65	84.40	10.80	0.08	43.25	12.24	146.1
16	Tipping Truck	Shibel 6 m3	160 HP	12,044	1,687	6	1.18	1.47	1.12	2.15	45.00	5.40	0.04	35.45	3.81	88.0
17	Tipping Truck	Fiat 12 m3	260 HP	19,794	1,687	6	1.98	2.46	1.12	3.55	73.15	8.80	0.07	35.40	5.63	120.9
18	Tipping Truck	Scania 16 m3	296 HP	23,644	3,178	10	2.36	2.93	2.12	4.25	83.25	10.00	0.07	35.40	7.49	132.9
19	Dumber	Faun 32 T	378 HP	77,371	8,624	6	6.43	10.35	5.75	11.55	106.30	12.75	0.09	43.25	22.62	173.9
20	Dumber	Pocklid R35 35 T	450 HP	79,716	10,501	6	6.64	10.70	7.00	11.95	126.55	15.20	0.12	43.25	24.46	197.0
21	Crane Truck	Scania 3 T	260 HP	27,022	1,687	6	2.70	3.35	1.12	4.85	73.85	8.75	0.07	44.90	7.24	132.4
22	Water Tank Truck	Fiat 20 m3	260 HP	23,644	2,811	10	2.36	2.93	1.87	4.25	73.15	8.80	0.07	35.40	7.24	121.6
23	Water Tank Truck	Scania 20 m3	296 HP	23,644	3,178	10	2.36	2.93	2.12	4.25	83.32	10.00	0.07	35.40	7.49	133.0
24	Driller with Compressor	Buhler	333 HP	28,373	-	-	2.84	5.28	-	5.10	187.30	22.50	0.17	43.25	8.28	258.2
25	Compressor	11.2 m3/ d	105 HP	13,511	267	4	1.35	2.51	0.11	2.40	75.00	9.00	0.07	35.10	4.04	121.5
26	Compressor	5 m3/ d	46 HP	6,756	133	2	0.84	1.57	0.06	1.55	37.50	4.50	0.03	35.10	2.50	78.7
27	Rubber Roller	Clark 280	180 HP	27,360	2,613	7	2.28	4.24	1.05	4.10	101.25	12.15	0.09	44.90	7.66	162.4
28	Steel Roller for earth	Bumak	133 HP	25,333	1,289	2	2.53	4.71	0.52	4.55	74.80	9.00	0.07	38.75	7.83	127.1
29	Sheep-leg Roller	-	133 HP	30,400	1,289	2	3.04	5.65	0.52	4.45	74.80	9.00	0.07	43.25	9.28	131.5
30	Steel Roller for pavement	Clark	80 HP	21,956	-	-	1.83	3.40	-	3.30	45.00	5.40	0.04	44.90	5.27	98.6
31	Asphalt Finisher	Blonux 95	140 HP	47,289	1,778	4	4.73	8.80	0.71	8.50	78.75	9.45	0.07	88.00	14.31	184.7
32	Tractor with Tank	Otrella	70 HP	22,222	1,044	4	2.22	2.76	0.70	4.00	39.40	4.75	0.04	31.75	5.71	79.9
33	Asphalt Sprayer	10 T	200 HP	25,333	1,477	6	2.53	3.14	0.98	4.55	56.25	6.75	0.05	82.85	6.71	150.4
34	Asphalt Plant	Fibau 120 T/hr	-	304,000	-	-	25.33	47.12	-	45.60	3200.00	40.00	-	387.70	72.45	3773.3
35	Truck Mixer	Mercedes 6 m3	400 HP	42,222	3,178	10	4.22	5.24	2.12	7.60	112.50	13.50	0.10	35.40	11.68	169.0
36	Concrete Pump Truck	-	260 HP	84,444	3,556	10	8.44	15.71	2.37	15.20	146.25	17.55	0.13	121.69	26.65	300.7
37	Concrete Pump	36 m3/d	300 HP	110,451	4,267	10	11.05	20.54	2.84	19.90	168.75	20.25	0.15	121.60	34.58	330.5
38	Cement Tank (Silo)	Scania	350 HP	54,044	4,920	18	5.40	6.70	3.28	9.75	98.45	11.80	0.09	43.25	15.47	163.3
39	Grout Pump	-	13 HP	6,756	-	-	0.68	1.26	-	1.20	7.30	0.90	0.01	0.00	1.94	9.4
40	Electric generator	60 KVA	450HP	15,556	-	-	1.94	3.62	-	3.50	253.15	30.40	0.23	44.90	5.79	332.0
41	Electric generator	60 KVA	280 HP	12,160	-	-	1.52	2.83	-	2.75	157.50	18.90	0.14	44.90	4.49	224.1
42	Electric generator	60 KVA	-	4,289	-	-	0.54	1.00	-	0.95	37.90	4.05	0.03	44.90	1.56	87.8
43	Crusher	200 T/hr	450 HP	337,778	-	-	21.11	39.27	-	38.00	253.15	30.40	-	245.90	60.38	567.5
44	Concrete Mixer	Fibau 20 m3/hr.	-	33,778	-	-	2.81	3.49	0.11	0.00	0.00	0.00	-	122.40	6.41	122.4
45	Diesel Welder	-	-	3,378	-	-	0.34	0.63	-	0.60	22.50	2.70	0.02	0.00	0.99	25.8
46	Lubricant Vehicle	Pick-up 3 ton	-	10,133	460	6	1.01	1.26	0.31	53.85	105.00	12.60	0.09	31.75	2.67	203.2
47	Crane	PPM 60T	350 HP	152,000	2,249	-	10.13	18.85	1.12	18.25	196.90	23.65	0.18	69.05	30.28	307.9

5) Indirect Cost

To estimate the economic cost of each project for the purpose of economic evaluation, it is required to deduct the indirect cost from the financial cost. The indirect cost is the cost which can not be accounted for, as having been incurred in the performance of a specific item of work. It consists of such items as the office overhead, profits and other taxes and fees incurred by the contractor during the construction. The indirect cost also includes the expenditures for temporary facilities, transportation, preparing and removing heavy machinery, construction of plants and power facilities, provision of preventive measures, field supervision and general administration.

6) Engineering and Supervision Cost

The engineering design and supervision cost is estimated based on the assumption that the projects are subject to international bidding. The ratio of 12% of the sum of the direct and indirect construction costs, which is applied in other similar international-standard projects in Syria, was adopted in the cost estimation procedure, and was assumed to be equal in both the local and foreign portions. This ratio is divided as 5% for the detailed engineering design and 7% for the construction supervision.

7) Right-of-Way Acquisition and Compensation Cost

The right-of-way acquisition and compensation costs were estimated based on the values of land and compensation prices paid for different projects in Damascus for some similar nature, taking into account the price escalation and inflation rates. Project areas in the city were classified into categories based on the present market prices of land and reference values paid previously by the Governorate were applied to determine cost to be used in each of the road projects of the plan.

Costs of lands owned by the Governorate or previously acquired, partially or completely, for projects in the plan are not included in this estimation as these costs will not affect the financial burden of implementing the projects during future years.

8) Contingency Cost

In general, the contingency costs are divided into physical contingency and price contingency. The physical contingency is reserved to cover any physical factors such as the discovery of unexpected obstacles under unusual conditions that interrupt the continuation of the work.

As in similar projects in Syria, the physical contingency was considered as 10% of the direct cost of each project. Price contingency, on the other hand, which is reserved for the escalation in prices as a result of inflation during the construction period, was not considered in the cost estimation procedure as it is usually included in the financial analysis of the projects.

13.4.3 Project Cost

Table 13.4.5 presents the preliminary results of the estimated economic cost of each project road based on the unit cost of different work items. Table 13.4.6 and Table 13.4.7 give the total cost for road and structure projects respectively including as contingency and 20% for profit as applied in similar projects in Syria. The major work items used in this preliminary cost estimation can be generally broken-down as follows:

Table 13.4.5 Construction Cost of Road Projects ('000 SP)

Project	Sub-Project	Lane	Const. Length m	Earthwork		Sub-base		Pavement		Sidewalk		Drainage		Structure		Construction Cost	
				Foreign	Local	Foreign	Local	Foreign	Local	Foreign	Local	Foreign	Local	Foreign	Local	Foreign	Local
Widening Projects																	
A01		4	1,700	1,870	935	2,890	1,870	1,870	935	765	765	2,040	1,870	0	0	9,435	6,375
A02		6	1,700	2,805	1,403	4,335	2,805	2,805	1,403	1,148	1,148	3,060	2,805	0	0	14,153	9,563
A03		3	350	289	144	446	289	289	144	118	118	315	289	0	0	1,457	984
A04		6	1,900	3,135	1,568	4,845	3,135	3,135	1,568	1,283	1,283	3,420	3,135	0	0	15,818	10,688
A05		4	1,800	1,980	990	3,060	1,980	1,980	990	810	810	2,160	1,980	0	0	9,990	6,750
A06		6	3,000	4,950	2,475	7,650	4,950	4,950	2,475	2,025	2,025	5,400	4,950	0	0	24,975	16,875
A07		6	4,000	6,600	3,300	10,200	6,600	6,600	3,300	2,700	2,700	7,200	6,600	0	0	33,300	22,500
A08		6	2,000	3,300	1,650	5,100	3,300	3,300	1,650	1,350	1,350	3,600	3,300	0	0	16,650	11,250
A09		6	2,000	3,300	1,650	5,100	3,300	3,300	1,650	1,350	1,350	3,600	3,300	0	0	16,650	11,250
A10		4	350	385	193	595	385	385	193	158	158	420	385	0	0	1,943	1,313
A11		6	1,000	1,650	825	2,550	1,650	1,650	825	675	675	1,800	1,650	0	0	8,325	5,625
Subtotal			19,800	30,264	15,132	46,771	30,264	30,264	15,132	12,381	12,381	33,015	30,264	0	0	152,694	103,172
New Road Construction Projects																	
B01	a	6	3,800	12,540	6,270	19,380	12,540	12,540	6,270	5,130	5,130	13,680	12,540	60,000	30,000	123,270	72,750
	b	6	4,200	13,860	6,930	21,420	13,860	13,860	6,930	5,670	5,670	15,120	13,860	30,000	15,000	99,930	62,250
	c	6	4,000	13,200	6,600	20,400	13,200	13,200	6,600	5,400	5,400	14,400	13,200	120,000	60,000	186,600	105,000
	d	6	3,000	9,900	4,950	15,300	9,900	9,900	4,950	4,050	4,050	10,800	9,900	60,000	30,000	109,950	63,750
B02	a	6	5,000	16,500	8,250	25,500	16,500	16,500	8,250	6,750	6,750	18,000	16,500	60,000	30,000	143,250	86,250
	b	6	2,000	6,600	3,300	10,200	6,600	6,600	3,300	2,700	2,700	7,200	6,600	60,000	30,000	93,300	52,500
	c	6	3,000	9,900	4,950	15,300	9,900	9,900	4,950	4,050	4,050	10,800	9,900	60,000	30,000	109,950	63,750
	d	6	4,000	13,200	6,600	20,400	13,200	13,200	6,600	5,400	5,400	14,400	13,200	60,000	30,000	126,600	75,000
B03	a	6	4,000	13,200	6,600	20,400	13,200	13,200	6,600	5,400	5,400	14,400	13,200	60,000	30,000	126,600	75,000
	b	6	5,000	16,500	8,250	25,500	16,500	16,500	8,250	6,750	6,750	18,000	16,500	0	0	83,250	56,250
B04	c	6	6,000	19,800	9,900	30,600	19,800	19,800	9,900	8,100	8,100	21,600	19,800	180,000	90,000	279,900	157,500
B05		6	4,000	13,200	6,600	20,400	13,200	13,200	6,600	5,400	5,400	14,400	13,200	120,000	60,000	186,600	105,000
B06		4	700	1,540	770	2,380	1,540	1,540	770	630	630	1,680	1,540	0	0	7,770	5,250
B07		8	6,400	21,120	10,560	32,640	21,120	21,120	10,560	8,640	8,640	23,040	21,120	120,000	60,000	226,560	132,000
B08		4	4,000	8,800	4,400	13,600	8,800	8,800	4,400	3,600	3,600	9,600	8,800	60,000	30,000	104,400	60,000
B09		4	2,500	5,500	2,750	8,500	5,500	5,500	2,750	2,250	2,250	6,000	5,500	0	0	27,750	18,750
B10		6	1,200	3,960	1,980	6,120	3,960	3,960	1,980	1,620	1,620	4,320	3,960	0	0	19,980	13,500
B11		6	3,400	11,220	5,610	17,340	11,220	11,220	5,610	4,590	4,590	12,240	11,220	0	0	56,610	38,250
B12		6	5,000	16,500	8,250	25,500	16,500	16,500	8,250	6,750	6,750	18,000	16,500	0	0	83,250	56,250
B13		6	1,500	4,950	2,475	7,650	4,950	4,950	2,475	2,025	2,025	5,400	4,950	30,000	15,000	54,975	31,875
B14		4	2,000	4,400	2,200	6,800	4,400	4,400	2,200	1,800	1,800	4,800	4,400	0	0	22,200	15,000
B15		4	1,100	2,420	1,210	3,740	2,420	2,420	1,210	990	990	2,640	2,420	0	0	12,210	8,250
B16		4	2,000	4,400	2,200	6,800	4,400	4,400	2,200	1,800	1,800	4,800	4,400	0	0	22,200	15,000
B17		4	1,100	2,420	1,210	3,740	2,420	2,420	1,210	990	990	2,640	2,420	0	0	12,210	8,250
B18		4	1,500	3,300	1,650	5,100	3,300	3,300	1,650	1,350	1,350	3,600	3,300	0	0	16,650	11,250
B19		4	1,400	3,080	1,540	4,760	3,080	3,080	1,540	1,260	1,260	3,360	3,080	60,000	30,000	75,540	40,500
Subtotal			81,800	252,010	126,005	389,470	252,010	252,010	126,005	103,095	103,095	274,920	252,010	1,140,000	570,000	2,411,505	1,429,125

Table 13.4.6 Financial and Economic Cost of Road Projects ('000 SP)

Project	Sub-Project	Lane	Construction Cost			Contingency		Tax	Profit	Eng-ineering	ROW	Financial Cost			Economic Cost		
			Foreign	Local	Total	Foreign	Local	Local	Local			Foreign	Local	Total	Foreign	Local	Total
A: Widening Projects																	
A01		4	9,435	6,375	15,810	944	638	5,217	3,478	3,130	479,414	11,944	496,687	508,630	11,944	491,469	503,413
A02		6	14,153	9,563	23,715	1,415	956	7,826	5,217	4,696	0	17,916	25,910	43,825	17,916	18,084	35,999
A03		3	1,457	984	2,441	146	98	806	537	483	83,280	1,844	85,948	87,792	1,844	85,142	86,986
A04		6	15,818	10,688	26,505	1,582	1,069	8,747	5,831	5,248	41,069	20,023	70,027	90,050	20,023	61,280	81,304
A05		4	9,990	6,750	16,740	999	675	5,524	3,683	3,315	317,259	12,646	335,548	348,195	12,646	330,024	342,670
A06		6	24,975	16,875	41,850	2,498	1,688	13,811	9,207	8,286	264,960	31,616	310,683	342,299	31,616	296,873	328,488
A07		6	33,300	22,500	55,800	3,330	2,250	18,414	12,276	11,048	353,280	42,154	414,244	456,398	42,154	395,830	437,984
A08		6	16,650	11,250	27,900	1,665	1,125	9,207	6,138	5,524	0	21,077	30,482	51,559	21,077	21,275	42,352
A09		6	16,650	11,250	27,900	1,665	1,125	9,207	6,138	5,524	212,952	21,077	243,434	264,511	21,077	234,227	255,304
A10		4	1,943	1,313	3,255	194	131	1,074	716	644	119,868	2,459	123,424	125,883	2,459	122,350	124,809
A11		6	8,325	5,625	13,950	833	563	4,604	3,069	2,762	0	10,539	15,241	25,780	10,539	10,638	21,176
Subtotal			152,694	103,172	255,866	15,269	10,317	84,436	56,291	50,662	1,872,082	193,295	2,151,628	2,344,923	193,295	2,067,192	2,260,487
B: New Road Construction Projects																	
B01	a	6	123,270	72,750	196,020	12,327	7,275	64,687	43,124	38,812	726,317	155,003	933,559	1,088,562	155,003	868,872	1,023,875
	b	6	99,930	62,250	162,180	9,993	6,225	53,519	35,680	32,112	741,182	125,979	914,912	1,040,891	125,979	861,393	987,372
	c	6	186,600	105,000	291,600	18,660	10,500	96,228	64,152	57,737	127,620	234,128	432,368	666,497	234,128	336,140	570,269
	d	6	109,950	63,750	173,700	10,995	6,375	57,321	38,214	34,393	574,290	138,141	757,146	895,288	138,141	699,825	837,967
B02	a	6	143,250	86,250	229,500	14,325	8,625	75,735	50,490	45,441	0	180,296	243,821	424,116	180,296	168,086	348,381
	b	6	93,300	52,500	145,800	9,330	5,250	48,114	32,076	28,868	0	117,064	152,374	269,438	117,064	104,260	221,324
	c	6	109,950	63,750	173,700	10,995	6,375	57,321	38,214	34,393	0	138,141	182,856	320,998	138,141	125,535	263,677
	d	6	126,600	75,000	201,600	12,660	7,500	66,528	44,352	39,917	0	159,218	213,338	372,557	159,218	146,810	306,029
B03	a	6	126,600	75,000	201,600	12,660	7,500	66,528	44,352	39,917	0	159,218	213,338	372,557	159,218	146,810	306,029
	b	6	83,250	56,250	139,500	8,325	5,625	46,035	30,690	27,621	0	105,386	152,411	257,796	105,386	106,376	211,761
B04	e	6	279,900	157,500	437,400	27,990	15,750	144,342	96,228	86,605	1,556,784	351,193	2,013,907	2,365,099	351,193	1,869,565	2,220,757
B05		6	186,600	105,000	291,600	18,660	10,500	96,228	64,152	57,737	1,778,220	234,128	2,082,968	2,317,097	234,128	1,986,740	2,220,869
B06		4	7,770	5,250	13,020	777	525	4,297	2,864	2,578	316,148	9,836	330,373	340,209	9,836	326,076	335,912
B07		6	226,560	132,000	358,560	22,656	13,200	118,325	78,883	70,995	1,402,944	284,713	1,780,849	2,065,563	284,713	1,662,525	1,947,238
B08		4	104,400	60,000	164,400	10,440	6,000	54,252	36,168	32,551	0	131,116	172,696	303,811	131,116	118,444	249,559
B09		4	27,750	18,750	46,500	2,775	1,875	15,345	10,230	9,207	531,750	35,129	582,554	617,682	35,129	567,209	602,337
B10		6	19,980	13,500	33,480	1,998	1,350	11,048	7,366	6,629	317,995	25,293	354,574	379,866	25,293	343,525	368,818
B11		6	56,610	38,250	94,860	5,661	3,825	31,304	20,869	18,782	474,178	71,662	577,817	649,479	71,662	546,513	618,175
B12		6	83,250	56,250	139,500	8,325	5,625	46,035	30,690	27,621	525,375	105,386	677,786	783,171	105,386	631,751	737,136
B13		6	54,975	31,875	86,850	5,498	3,188	28,661	19,107	17,196	793,148	69,071	884,576	953,646	69,071	855,915	924,986
B14		4	22,200	15,000	37,200	2,220	1,500	12,276	8,184	7,366	480,800	28,103	521,443	549,546	28,103	509,167	537,270
B15		4	12,210	8,250	20,460	1,221	825	6,752	4,501	4,051	264,440	15,457	286,794	302,250	15,457	280,042	295,498
B16		4	22,200	15,000	37,200	2,220	1,500	12,276	8,184	7,366	470,592	28,103	511,235	539,338	28,103	498,959	527,062
B17		4	12,210	8,250	20,460	1,221	825	6,752	4,501	4,051	258,826	15,457	281,179	296,636	15,457	274,427	289,884
B18		4	16,650	11,250	27,900	1,665	1,125	9,207	6,138	5,524	352,944	21,077	383,426	404,503	21,077	374,219	395,296
B19		4	75,540	40,500	116,040	7,554	4,050	38,293	25,529	22,976	84,140	94,582	204,000	298,582	94,582	165,707	260,289
Subtotal			2,411,505	1,429,125	3,840,630	241,151	142,913	1,267,408	844,939	760,445	11,777,692	3,032,878	15,842,298	18,875,176	3,032,878	14,574,891	17,607,768

Table 13.4.7 Financial and Economic Cost of Structure Projects ('000 SP)

Project	Lane	Construction Length m	Construction Cost			Contingency		Tax	Profit	Eng-ineering	Financial Cost			Economic Cost		
			Foreign	Local	Total	Foreign	Local	Local	Local		Foreign	Local	Total	Foreign	Local	Total
T01	4	2,110														
C01	4	1,100	222,000	74,000	296,000	22,200	7,400	97,680	65,120	58,608	273,504	273,504	547,008	273,504	175,824	449,328
C02	6	300	150,000	50,000	200,000	15,000	5,000	66,000	44,000	39,600	184,800	184,800	369,600	184,800	118,800	303,600
C03	4	350	112,500	37,500	150,000	11,250	3,750	49,500	33,000	29,700	138,600	138,600	277,200	138,600	89,100	227,700
C04	4	250	70,000	30,000	100,000	7,000	3,000	33,000	22,000	19,800	86,900	97,900	184,800	86,900	64,900	151,800
C05	4	210	58,800	25,200	84,000	5,880	2,520	27,720	18,480	16,632	72,996	82,236	155,232	72,996	54,516	127,512
C06	2	210	29,400	12,600	42,000	2,940	1,260	13,860	9,240	8,316	36,498	41,118	77,616	36,498	27,258	63,756
C07	2	200	28,000	12,000	40,000	2,800	1,200	13,200	8,800	7,920	34,760	39,160	73,920	34,760	25,960	60,720
C08	2	300	42,000	18,000	60,000	4,200	1,800	19,800	13,200	11,880	52,140	58,740	110,880	52,140	38,940	91,080
C09	2	225	31,500	13,500	45,000	3,150	1,350	14,850	9,900	8,910	39,105	44,055	83,160	39,105	29,205	68,310
C10	2	300	42,000	18,000	60,000	4,200	1,800	19,800	13,200	11,880	52,140	58,740	110,880	52,140	38,940	91,080
C11	4	450	126,000	54,000	180,000	12,600	5,400	59,400	39,600	35,640	156,420	176,220	332,640	156,420	116,820	273,240
C12	2	200	28,000	12,000	40,000	2,800	1,200	13,200	8,800	7,920	34,760	39,160	73,920	34,760	25,960	60,720
C13	4	270	75,600	32,400	108,000	7,560	3,240	35,640	23,760	21,384	93,852	105,732	199,584	93,852	70,092	163,944
C14	4	230	68,760	22,920	91,680	6,876	2,292	30,254	20,170	18,153	84,712	84,712	169,425	84,712	54,458	139,170
C15	4	230	64,400	27,600	92,000	6,440	2,760	30,360	20,240	18,216	79,948	90,068	170,016	79,948	59,708	139,656
C16	2	250	35,000	15,000	50,000	3,500	1,500	16,500	11,000	9,900	43,450	48,950	92,400	43,450	32,450	75,900
C17	4	300	84,000	36,000	120,000	8,400	3,600	39,600	26,400	23,760	104,280	117,480	221,760	104,280	77,880	182,160
C18	4	450	126,000	54,000	180,000	12,600	5,400	59,400	39,600	35,640	156,420	176,220	332,640	156,420	116,820	273,240
C19	2	400	56,000	24,000	80,000	5,600	2,400	26,400	17,600	15,840	69,520	78,320	147,840	69,520	51,920	121,440
C20	4	50	14,000	6,000	20,000	1,400	600	6,600	4,400	3,960	17,380	19,580	36,960	17,380	12,980	30,360
C21	4	150	42,000	18,000	60,000	4,200	1,800	19,800	13,200	11,880	52,140	58,740	110,880	52,140	38,940	91,080
C22	4	100	28,000	12,000	40,000	2,800	1,200	13,200	8,800	7,920	34,760	39,160	73,920	34,760	25,960	60,720
C23	2	300	42,000	18,000	60,000	4,200	1,800	19,800	13,200	11,880	52,140	58,740	110,880	52,140	38,940	91,080
C24	1	1,000	70,000	30,000	100,000	7,000	3,000	33,000	22,000	19,800	86,900	97,900	184,800	86,900	64,900	151,800
C25	4	6,000	1,680,000	720,000	2,400,000	168,000	72,000	792,000	528,000	475,200	2,085,600	2,349,600	4,435,200	2,085,600	1,557,600	3,643,200
C26	4	200	56,000	24,000	80,000	5,600	2,400	26,400	17,600	15,840	69,520	78,320	147,840	69,520	51,920	121,440
C27	4	200	56,000	24,000	80,000	5,600	2,400	26,400	17,600	15,840	69,520	78,320	147,840	69,520	51,920	121,440
C28	4	4,800	1,344,000	576,000	1,920,000	134,400	57,600	633,600	422,400	380,160	1,668,480	1,879,680	3,548,160	1,668,480	1,246,080	2,914,560
Subtotal		19,025	4,781,960	1,996,720	6,778,680	478,196	199,672	2,236,964	1,491,310	1,342,179	5,931,245	6,595,755	12,527,001	5,931,245	4,358,791	10,290,03

1. Earthwork:
   - Clearing and grubbing
   - Removal existing curb
   - Embankment
   - Excavation
   - Sub-grade preparation
2. Sub-base:
   - Sub-base course
   - Base course
3. Pavement:
   - Prime coat
   - Tack coat
   - Asphalt concrete
4. Sidewalk:
   - Center-median
   - Curb and gutter
   - Sidewalk
   - Shoulder
5. Drainage:
   - Drainage pipes
   - Side ditches
   - Manholes
6. Structure:
   - Underpass
   - Overpass
   - Interchange
   - Ramps
7. Miscellaneous:
   - Markings
   - Safety devices
   - Guardrails
   - Sodding
   - Plantation

13.5 Implementation Plan

To establish the implementation program of the road network projects, the scheduling concept and procedure was set up to include a future budgetary framework based on the actual road investment in the past and the planned investments for authorities in-charge of the different elements of the road network in Damascus. In addition, priority of projects was determined based on a multi-criteria method in which all the important related aspects were investigated.

13.5.1 Procedure

After estimating the costs and benefits for each project on an individual basis, the economic return was determined based on the benefit / cost ratio which was taken account as a ranking factor. On the other hand, a future budgetary framework was set up based on the past and planed road investments by Damascus Governorate.

Other aspects rather than the B/C ratio, either social, economic or environmental, were included in the established priority ranking criteria, in order to get more comprehensive prioritization and scheduling procedure. The work flow of the established procedure is as presented in Figure 13.5.1.

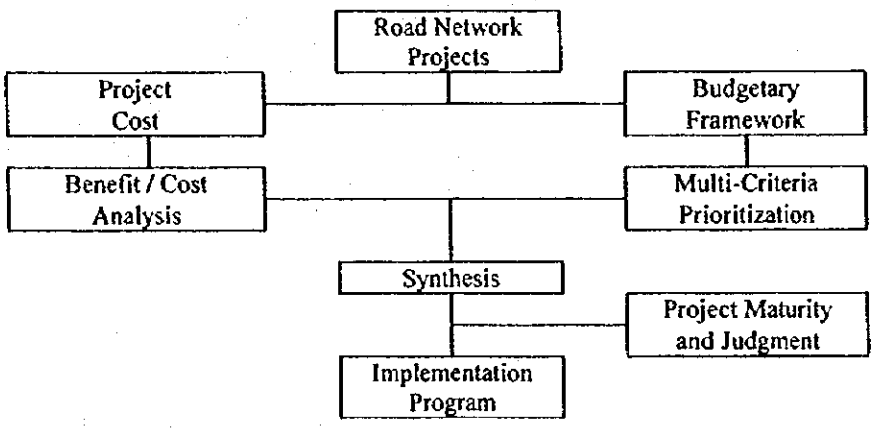


Figure 13.5.1 Road Network Scheduling Work Flow

13.5.2 Priority of Road Projects

A multi-criteria process was established in order to identify the priority of each project in the plan in such a manner to exclude non-viable projects from the plan and to establish an implementation schedule based mainly on the priority ranking of each project and annual financial capabilities of the Governorate.

Five ranking levels were established for each of the multi-criteria items used in the process applied for project prioritization, in which criteria weighting was identified based on the nature and importance of each individual criteria. Table 13.5.1 presents the ranking levels for each of the aspects which can be generally described as follows:

1) Project Status: Under this aspect, the status of each project was investigated and ranks established to give more priority for projects in advanced stages. On-going projects or projects which have budget allocation or are already approved and committed by the government for implementation have higher ranking priority. Lower ranks were given to high potential projects for which feasibility studies are finished or are being carried out. Roads which are still only in the planning stage were given a low priority ranking.

2) Future Development: As the socioeconomic development depends to a large extent on the development of the transport infrastructure of the city which depends mainly on the road network, projects which promote more development in any of the socioeconomic sectors were given higher priority than others with lower impacts.

3) Network Requirement: Projects which have high impact on improving the function of the road network in the city and act as major links have higher priority than other projects with local impact only.

4) Resettlement: The size of required resettlement scheme was determined for each project and top priority was given to projects do not require any resettlement. Projects with intensive schemes for resettlement occupied the lower ranks of prioritization.

5) Land Acquisition: The low price of private land which may be acquired in order to implement each project gives higher priority. Acquiring expensive land in the center of the city results in lower priority ranks.

6) Social Acceptance: Some of the projects will not acquire high social acceptance as they may cause some disturbance at some locations. Such projects will take lower priority than other projects with high acceptance.

7) Cost Scale: Projects with very high cost which will acquire huge investments and can not be implemented through the available budgetary frame were given lower priority than those with limited investments.

8) Antiquities: Due to the special nature of Damascus city from the historical point of view, the possibility of discovering antiquities during excavation works is very high in some areas especially near the Old City.

9) Benefit Scale: The economic viability of each of the projects is a main item in the multi-criteria process and it was considered in terms of the following two parameters:

- Macro-scale: based on the benefit/cost ratio when implementing each project taking into account the whole benefits on the network

- Micro-scale: based on the traffic volume passing through the project per unit cost.

The benefit scale will increase when a project scale becomes larger, so that another index to show the cost performance of a project is selected for the project prioritizing. In the standard evaluation process, the B/C, which shows the cost performance of a project, is defined as the sum of the discounted benefits divided by the sum of the discounted cost over the project life. However it is affected by the investment schedule and no schedule is fixed at this stage. Therefore, a single year B/C ratio in 2015 calculated from the annual benefit of a project compared with its amortized cost was applied for this purpose. Figure 13.5.2 shows the annual benefits in regard to the project cost. In this figure, and from the benefit scale point of view, low cost projects with high B/C ratio have higher scheduling priority than other expensive projects with lower B/C ratios.

Table 13.5.1 Multi-Criteria Ranking

Criteria	1	2	3	4	5
Project Status	Newly planned	Existed and approved in previous plan	Committed for implementation	Budget has been allocated	On-going, either in design stage or construction
Future Development	No impact on socioeconomic development in future	Low impact on future development	Medium impact on future development	High impact on future development	Very high impact on future development
Network Requirement	No impact on network	Low impact on network	Medium impact on network	Important link in network	Very important link in network
Resettlement	Extensive housing area with very large-scheme for resettlement	Large-scheme resettlement	Medium-scheme resettlement	Little resettlement required	No resettlement required
Land Acquisition	Very high-price land	High-price land	Moderate-price land	Low-price or public land	Very low-price or public land
Social Acceptance	Very low social acceptance is expected	Low social acceptance	Medium acceptance	High acceptance	Very high acceptance
Cost Scale	Large-scale and expensive	Large-scale and not so expensive	Medium-scale and expensive	Medium-scale and not so expensive	Small-scale
Antiques	Direct impact on roadside antiques / High expectations to discover Antiques	Indirect impact on roadside antiques/ Some expectations to discover antiques	Low impact on roadside antiques / Little expectations to discover antiques	Very little expectations to discover antiques	No-antiques in the project area
Benefit-scale	Very low ratio of B/C	Low ratio of B/C	Moderate ratio of B/C	High B/C ratio and volume per unit cost	Very high B/C ratio and volume / unit cost

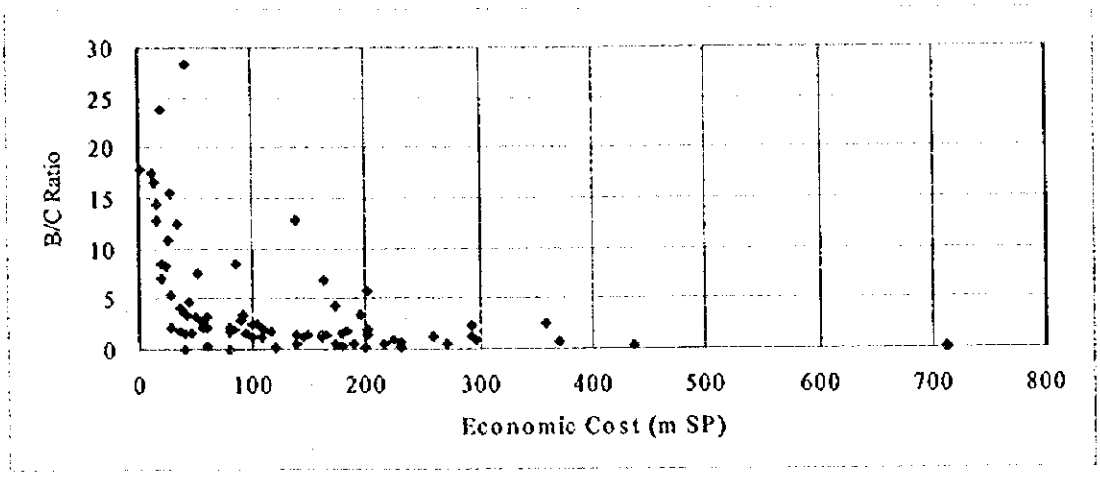


Figure 13.5.2 Annual Benefit and Project Cost

13.5.3 Budgetary Framework

In order to formulate an effective and useful master plan, the scale of investment must be determined in a moderate range. If the total amount is far beyond the financial capacity of Damascus Governorate, the plan will only result in a mere dream. On the other hand, the master plan has the nature of the long-term goal to be targeted. In this sense, a master plan should aim at the maximum possible investment taking the future economic growth and resulting annual budget increase into consideration.

13.5.4 Annual Program

Based on the results of the multi-criteria prioritization process and projects' cost-scale in comparison with the available estimated financial investments of Damascus Governorate, the annual implementation program was established as presented in Table 13.5.2 for only projects included in the plan as few projects were excluded during the process of preliminary evaluation and prioritization.

The recommended road network in the plan is composed of different projects covering a total of over 100 kilometers out of the previously investigated 120 kilometers, under the jurisdiction of Damascus Governorate. The schemes include about 16.1 kilometers for widening of urban roads, 75.3 kilometers for new construction schemes and 8.1 kilometers for new structures to be constructed. The total number of road and structure projects in the plan is 50 projects which can be set up as in the following three groups:

A:	Road Widening Projects	9 Projects
B:	Road New Construction Projects	17 Projects
C:	Structure New Construction Projects	24 Projects

During the 20 years of the plan, the required annual investment and the estimated budgetary resources of the Governorate, based on the normal growth of GDP, are presented graphically in Figure 13.5.3. At the first five years, the available budget will not cover the required investments for urgent projects. After that, there will be excess in the budget which can cover the deficit of the first years. Several projects are grouped to be implemented into one program of related projects to maximize their benefits. On the other hand, the implementation schedule of 20 years was divided into three programs as follows:

Table 13.5.2 Annual Implementation Program

Project		Project Name	Length (m)	Cost ('000)	Year 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A: Widening Projects																									
A02		Al Zablatani	1,700	43,825																					
A03		Abdel Ghani an Nabolsi	350	87,792																					
A04		Anwar Kamel	1,900	90,050																					
A05		Tora River Street	1,800	348,195																					
A06		Daria Road	3,000	342,299																					
A07		Al Quds Road	4,000	456,398																					
A09		Swaida Road	2,000	264,511																					
A10		Saad Zaghloul Street	350	125,883																					
A11		Tora Riverside Street	1,000	25,780																					
B: New Road Construction Project																									
B01	a	Mt. Kassioun Road	3,800	1,088,562																					
	b	Mt. Kassioun / Aleppo Rd	4,200	1,040,891																					
	c	Aleppo H'way / Zablatani	4,000	666,497																					
	d	Zablatani / Airport H'way	3,000	895,288																					
B02	a	New Beirout / Old Beirout	5,000	424,116																					
	b	Old Beirout / Zabadani	2,000	269,438																					
	c	Kassioun / Seydnaya Rd	3,000	320,998																					
	d	Seydnaya Rd / Aleppo Rd	4,000	372,557																					
B03	a	Seydnaya Rd / ORR	4,000	372,557																					
	b	ORR to Aleppo H'way	5,000	257,796																					
B04	c	Airport Rd to New Deraa Rd	6,000	2,365,099																					
B05		Kafar Sousseh Rd	4,000	2,317,097																					
B06		Aal al Bait Street	700	340,209																					
B07		Al Kahira Parallel St	6,400	2,065,563																					
B10		Al Zablatani Streets	1,200	379,866																					
B11		Al Thalatheen Road Ext	3,400	649,479																					
B12		South Berzeh Road	5,000	783,171																					
B13		Old City North Wall Street	1,500	953,646																					
B14		Abou Jarash Garden – North	2,000	549,546																					
B15		Abou Jarash Gardeo – South	1,100	302,250																					
B16		Mezze South – 1	2,000	539,338																					
B17		Mezze South – 2	1,100	296,636																					
B18		Mezze South – 3	1,500	404,503																					
B19		University Str. and Bridge	1,400	298,582																					
C: Structure Projects																									
T01/2		Hejaz Tunnel	2,120	1,247,400																					
C03		Al Umawiyeen Sq	940	646,800																					
C04		Al Faihaa Sq	250	184,800																					
C05		Al Mojtahed / Ibn Alwalid	210	155,232																					
C06		Al Mahdi / Al Jalaa	210	77,616																					
C07		Hittin Sq	200	73,920																					
C08		Bab Sharki	300	110,880																					
C09		Hassan Kharat	225	83,160																					
C10		8th Azar (Arnus) Square	300	110,680																					
C11		17th April / Kafar Sousseh	450	332,640																					
C12		Ali Bin Abi Taleb / Abu Bakr	200	73,920																					
C13		Abbasyyeen Sq	270	199,584																					
C14		Bab Mossala Sq	600	337,501																					
C15		Ibn Assaker / Al Quds	230	170,016																					
C16		Basel Al Assad Sq	250	92,400																					
C17		Al Mouassat Sq.	300	221,760																					
C18		Shiekh Raslan – Bilal Sq	450	332,640																					
C19		Zablatani Overpass	400	147,840																					
C20		Bab Sereeja Bridge	50	36,960																					
C21		At Tabbaaleh Bridge	150	110,880																					
C22		Victoria Bridge Extension	100	73,920																					
C23		Ramps of New Deraa Rd	300	110,880																					
C24		I/C of N-Bypass with Beirut	1,000	184,800																					
C26		Hamadani Overpass	200	147,840																					
C27		17th April Underpass	200	147,840																					

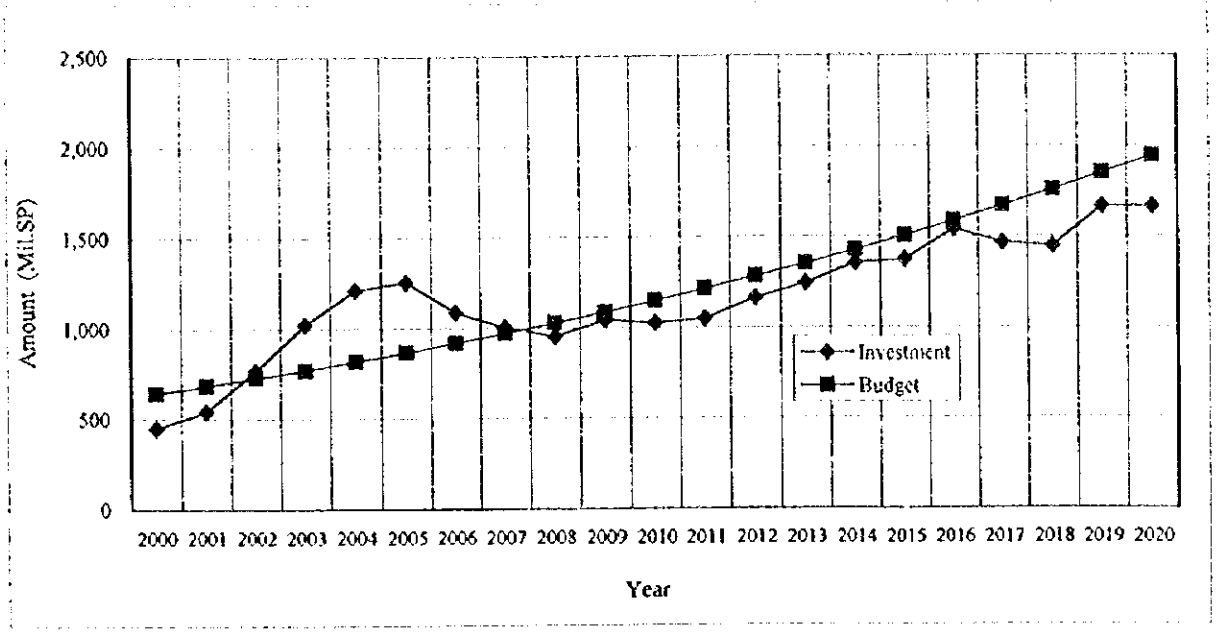


Figure 13.5.3 Annual Investment Plan

Short Term	from	2000	to	2005
Medium Term		2006		2010
Long Term		2011		2020

The following items are taken into consideration when planning the starting year and the completion year of each project package:

- To set the starting year so to complete the package in the designated program period depending on its implementation period.
- To establish an increasing trend of annual investment without remarkable fluctuation taking into consideration the budgetary limitations and constraints.
- To implement a set of related projects and packages on optimum way that economizes the cost.
- To include the detailed engineering designs just before the beginning of the implementation period of each project.

The proposed annual schedule for implementation, as presented in Table 13.5.2, mostly satisfies the criteria established above. As shown in the table, the main projects to be implemented in each program are as follows:

Short Term (2000 – 2005):
Projects to be implemented during this short term program include the most urgent projects which are included in the feasibility study in following sections. Such projects do not require acquisition of land or resettlement schemes, except for the south bypass extension project which can be considered as on-going project, and will show high impact in improving the traffic conditions on the network.

- New Road Construction Projects:
  - *B01*: Medium Ring Road (South Bypass Extension: *B01c:* from Aleppo Highway to Zablatani Road and *B01d:* from Zablatani Road to Airport Highway)
  - *B03:* North Bypass Completion (*B03a:* from Seydnaya Road to Outer Ring Road, and *B03b:* from Outer Ring Road to Aleppo Highway)

- *B04:* Outer Ring Road - Damascus Governorate Segment (*B04e:* from International Airport Highway to New Derra Highway)
- *B13:* Old City North Wall Street

- New Structure Construction Projects:
  - *T01:* Ath Thwra – Al Hejaz – South Entrance Tunnel
  - *C03:* Al Umawyeen Square Underpass
  - *C08:* Bab Sharki Square Underpass
  - *C14:* Bab Mossala (Al Yarmouk) Square Underpass

Medium Term (2006 - 2010):

Other projects which will provide high impact and benefits to the functionality of the road network but they are not included in the first program due to budgetary limitations are composing most of the projects in this program.

In addition, projects which are required to complete the function or enhance the benefits of previously implemented projects in the first program are also included in the second program.

- Road Widening Projects:
  - *A02:* Al Zablatani St. from Ibn Assaker to South Bypass Extension
  - *A05:* Tora River Street from Garajat Square
  - *A11:* Tora Riverside Street

- New Road Construction Projects:
  - *B01:* Medium Ring Road (*B01b:* Mt. Kassioun to Aleppo Highway)
  - *B06:* Aal al Bait St. and Quds St. Connection
  - *B11:* Extension of Al Thalatheen Road
  - *B15:* Abou Jarash Garden – South

- New Structure Construction Projects:
  - *C07:* Hittin Square Underpass
  - *C12:* Ali Bin Abi Taleb and Abu Bakr As Siddiq Intersection
  - *C19:* Shiekh Raslan – Zablatani Overpass
  - *C22:* Victoria Bridge Extension
  - *C23:* Underpass Ramps south of New Deraa Highway

Long Term (2011 – 2020):

Most of the widening projects are included in the long term program as they require time for the acquisition of land and resettlement schemes. Other projects which will complete the master plan of the road network in the city with higher financial investments and lower priority are included in this long term program.

- Road Widening Projects:
  - *A03:* Abdel Ghani an Nabolsi
  - *A04:* Anwar Kamel to South Bypass I/C #2
  - *A06:* Daria Road
  - *A07:* Al Quds Road
  - *A09:* Swaida Road

- *A10:* Saad Zaghloul Street

- New Road Construction Projects:
  - *B01:* Medium Ring Road (*B01a:* Mt. Kassioun East-West Road)
  - *B02:* Berza / Dummar Road (*B02a:* from New Beirout Highway to Old Beirout Road, *B02b:*from Old Beirout Road to Kassioun / Zabadani Road, *B02c:*from Kassioun / Zabadani Road to Seydnaya Road and *B02d:* from Seydnaya Road to Aleppo Highway)
  - *B05:* Kafar Sousseh from 17th April to Outer Ring Road
  - *B07:* Al Kahira Parallel St. from Al Quds to Fares Al Khouri
  - *B10:* Al Zablatani Streets east South Bypass
  - *B12:* South Berzeh Road
  - *B14:* Abou Jarash Garden – North
  - *B16:* Mezze South – 1
  - *B17:* Mezze South – 2
  - *B18:* Mezze South – 3
  - *B19:* University Street and Bridge

- New Structure Construction Projects:
  - *C04:* Al Faihaa Square Underpass
  - *C05:* Al Mojtahed and Khaled Ibn Alwalid Intersection Underpass
  - *C06:* Al Mahdi Ibn Barakeh and Al Jalaa Intersection Underpass
  - *C09:* Hassan Kharat Square Underpass
  - *C10:* 8th Azar (Arnus) Square Underpass
  - *C11:* 17th April and Kafar Sousseh Square Underpass
  - *C13:* Abbasyyeen Square Underpass
  - *C16:* Basel Al Assad Square Underpass
  - *C17:* Al Mouassat Square Underpass
  - *C18:* Shiekh Raslan – Bilal Square Underpass
  - *C20:* Bab Sereeja Bridge over South Entrance
  - *C21:* At Tabbaaleh Bridge over Airport Highway
  - *C26:* 6th Tishreen – Hamadani Overpass
  - *C27:* 6th Ayyar – 17th April Underpass