9.2.2 Person trips

1) Trip rate

The person trip volume in Sana'a was estimated first by determination of the average trip rate per person and second by multiplying it by the population. The average trip rate per person was determined by conducting a survey in which a questionnaire was distributed to selected employees in MMH, CPO and HA. The size of the survey is summarized below:

Households surveyed	100
Households answered	53
Recovery percentage	53%
Effective answers: male	157 persons
: female	35 persons

The above survey and the population data shown in Statistical Year Book issued in 1987 have resulted in the total trips and number of individuals as in the following figures:

Trips	male	female	(In trips) total
6-11 years	102	14	116
12-	659	103	762
Total	761	117	878

Persons	male	female	(In persons) total
6-11 years	68	63	131
12-	190	230	420
Total	258	293	551

Therefore, the trip rate per person in 1987 is calculated as:-

male	761/258	=	2.94
female	117/293	=	0.40
Total	878/551	=	1.59

Of the above rate for the total, walk trip rate is calculated at 27.9%. Accordingly, the trips rate using vehicles per person is (762 x 0.726) = 550 trips

550 trips/551 persons = 1.0 trip/person

2) Total person trips

When the above trip rate in 1987 is compared with the rates in cities of other countries, being shown in Table 9.2.1, it is found the rate in Sana'a seems relatively low. When the rate is multiplied by the total population, the total person trips in 1987 are calculated as in Table 9.2.2.

Average vehicle occupancy rates were surveyed on the streets in Sana'a. The occupancy rates and traffic volume are used to find a percent share between private vehicle users and public service vehicle users. The percent is used to divide the total person trips of 1987 in Table 9.2.2 into those two categories.

3) Changes in the future

It can be supposed that the trip rate in Sana'a will increase gradually because of economic development and changes in social lives. It is assumed the rate will be 3% and 10% larger in 1991 and 2000, respectively. Total persons trips in 1987, 1991 and 2000 are approximated as in Table 9.2.2.

Walk trips and public service vehicle users will increase because the immigration from rural areas are generally in low income classes, while motorization will grow in medium-high income classes. A gradual percent change is assumed from 1987 to 1991 and 2000.

9.2.3 Vehicles on roads

Newly registered vehicles are shown in the Statistical Year Book, from which Table 9.2.3 is produced. The figures in the Table are for the Governorates of Sana'a, Taiz and Hodeidah, and demolished vehicles are not netted out. In order to grasp the actual net

vehicles registered, the following works are conducted in Table 9.2.4.

- The number of vehicles in 1978 is used because it was estimated in the Master Plan Study (1978).
- Vehicle life is at 10 years and 1/10 of the new vehicles registered in one year is assumed to be demolished every year afterward.
- Vehicles in the city is determined by using the percent ratio of population in the city over the Governorate.

Table 9.2.1 Person Trip Rate in Selected Cities

City	year	Trip rates per person
1. Manila	(1980)	1.80 (Excluding walk)
2. Bangkok	(1978)	1.60 (" ")
3. Cairo	(1983)	1.00 (" ")
4. Singapore	(1987)	2.00 (" ")
5. Jakarta	(1985)	1.68 (Including walk)
6. Klan Valley	(1985)	2.54 (" ")
7. Casa Blanca	(1985)	2.64 (" ")
8. Dabao	(1980)	2.34 (" ")
9. Panama	(1980)	2.42 (" ")
10. Tokyo	(1987)	2.53 (" ")
11. Sapporo	(1972)	2.68 (" ")

From each study report.

Table 9.2.2 Traffic Demand Forecast

		1987	1991	2000
Sana'a	• Population	465,000 (100)	650,000 (140)	1,080,000 (232)
	• Average trips per person	1.59 (100)	1.64 (103)	1.75 (110)
	• Total person trips	587,000 (100)	846,000 (144)	1,530,000 (260)
	• Walk	218,000 (100)	330,000 (151)	645,900 296)
	• Vehicle using trips	369,000 (100)	516,000 (140)	856,100 (232)
	(Public transport)	207,000 (100)	303,000 (146)	557,000 (269)
	(Private transport)	162,000 (100)	213,000 (131)	300,000 (185)
	• Vehicle registered (net)	37,100 (100)	56,000 (151)	144,000 (388)
Taiz	• Population	189,000 (100)	238,000 (126)	403,000 (213)
	• Average trips per person	1.59 (100)	1.64 (103)	1.75 (110
	• Total person trips	239,000 (100)	310,000 (130)	560,000 (234)
	• Walk	84,500 (100)	115,300 (129)	230,500 (229)
	• Vehicle using tips	154,500 (100)	194,700 (126)	329,500 (213)
	(Public transport)	83,100 (100)	107,100 (129)	189,000 (229)
	(Private transport)	71,400 (100)	87,600 (123)	139,600 (196)
	• Vehicles registered (net)	16,200 (100)	22,000 (136)	44,000 (272)

		1987	1991	2000
Hodeidah	• Population	164,000 (100)	208,000 (127)	351,000 (214)
	• Average trips per person	1.59 (100)	1.64 (103)	1.75 (110)
	• Total person trips	206,700 (100)	270,600 (130)	488,000 (236)
	• Walk	62,000 (100)	87,200 (141)	178,000 (287)
	• Vehicle using trips	144,700 (100)	183,400 (127)	310,000 (214)
	(Public transport)	86,700 (100)	111,900 (129)	196,100 (226)
	(Private transport)	58,000 (100)	71,500 (123)	113.900 (196)
	• Vehicles registered (net)	10,200 (100)	13,900 (136)	27,700 (272)

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Table 9.2.3 Vehicles Plate Numbers Issued in Governorates

Unit : Number of Vehicles.

Sana'a	1981	1982	1983	1984	1985	1986	Total
Pub. Trans.	2682	1715	2301	828	16272	12894	36692
Priv Trans.	1106	1341	3003	-	7516	-	12966
Taxi	1379	1459	1690	-	-	761	5289
Private	1652	3099	3661	1664	-	9233	19309
Others	789	622	374	90	-	1231	3106
Total	7608	8236	11029	2582	23788	24119	77362

Taiz	1981	1982	1983	1984	1985	1986	Total
Pub. Trans	887	914	884	-	9194	3515	15394
Priv.Trans.	163	235	448	-	3367	-	4213
Taxi	538	626	737	-	-	472	2373
Private	581	900	1205	-	-	2674	5360
Others	-	1	2	-	-	4	7
Total	2169	2675	3276	-	12561	6665	27347

Hodeidah	1981	1982	1983	1984	1985	1986	Total
Pub. Trans.	2034	2271	2366	587	4704	5463	17425
Priv.Trans.	240	576	720	-	1792	-	3328
Taxi.	623	1211	1194	-	-	380	3408
Private	748	925	1122	96	-	1645	4536
Others	5	-	14	-	-	-	19
Total	3650	4983	5416	683	6496	7488	28716

All Govts.	1981	1982	1983	1984	1985	1986	Total
Pub.Trans.	12092	9630	12104	2137	50883	44479	131325
Priv.Trans.	2505	3421	9337	-	18077	-	33340
Taxi	4092	4515	5104	-	-	2262	15973
Private	4735	7676	9672	1875	-	20296	44254
Others	807	626	395	90	-	11	1929
Total	24231	25868	36612	4102	68960	67048	226821

Source: Statistical Year Book,
1983 and 1987 and Traffic Police.

The resulted figures of the three cities for the 8 years preceding 1986 are shown in Table 9.2.4. It is found that increases were high at 22% p.a. in Sana'a, 17% p.a. in Taiz and 10% p.a. in Hodeidah.

The increase in on-road vehicles will not be as high as in the past, because import has been strictly controlled since January 1986. Although vehicles to be used by governmental organizations are given import license, it is hard to predict any overall change in the import policy. It is assumed the increase in vehicles on roads in those three cities will be a half of the percentage achieved in the past years, i.e. 11% p.a. or Sana'a, 8% p.a. in Taiz and Hodeidah. The resulted figures in 1991 and 2000 are in Table 9.2.2.

The above assumption will result in an estimate of vehicles at 3.9 times larger in Sana'a, 2.7 times in Taiz and Hodeidah, all from 1987 to 2000. Even though they are subject to change as a result of many factors, they can be used to indicate a trend of motorization demand and compared with other countries.

9.3 Growth Prospect for 1991 and 2000

Traffic growth prospects for 1991 in the three cities is discussed in the previous section 9.2 and the figures are shown in Table 9.2.2. The year 1991 is just three years from 1988, and it is not likely to change radically due to the development of the country during the three years. It is considered the increase of vehicle traffic on roads will be as follows:-

Table 9.2.4 Vehicles in Governorate and City, 1978-87

Year	Sana'a		Taiz		Hodeidah	
	Governorate Registered 2)	City Veh. on Roads 3)	Governorate Registered 2)	City Veh. on Roads 3)	Governorate Registered 2)	City Veh. on Roads 3)
1978 1)	-	7420	-	5440	-	2508
1979	-	8192	-	5465	-	2669
1980	13654	9246	2894	5431	5911	5067
1981	7608	9755	2103	5341	2612	5263
1982	8239	12097	2676	6244	4857	6017
1983	11029	15099	3275	7321	5416	6858
1984	2582	15662	0	8258	683	7175
1985	28788	23200	12561	10487	6496	8128
1986	24119	30455	19226	13829	7498	9197
1987 4)	-	37149	-	16160	-	10157

Notes:
1) From Master Plan Study (1978)
2) From Statistical Year Books (1981 - 87)
3) Calculated in this study. Vehicles on roads mean "the net registered and active vehicles".
4) Using the average annual growth rate

Remarks:
1) The number of vehicles in 1978 is quoted from the Master Plan Study (1978)
2) Vehicles newly registered in one year is assumed to be demolished at its 1/10 every year afterward. All registered in that year will disappear in 10 years.
3) Vehicles in the city is determined by using the percent ratio of population of that city over the Governorate.

	1987-91	-1992
Sana'a	+40%	+48% (8.8% p.a.)
Taiz	+26%	+34% (6.0% p.a.)
Hodeidah	+27%	+35% (6.1% p.a.)

The estimate for 2000 is an indicative figures since they are subject of change by unknown factors in the longer period beyond 1991. The estimate will move upward or downward depending on socio-economic development and government policies. The indicated increase for 2000 is:-

	1991-2000	
Sana'a	+166%	(5.8% p.a.)
Taiz	+169%	(6.0% p.a.)
Hodeidah	+169%	(6.0% p.a.)

The growth prospect thus discussed will indicate the following points:-

(1) Traffic volume of Sana'a will be larger by 40% in 1991 and by 48% in 1992. The short term action plans to be completed by 1991 should consider in this increase. There will be some road sections which may need a larger scale improvement than the action plans. The situation is same in Taiz and Hodeidah.
The necessity of study on larger improvement plans are emphasized in 10.1.2 of chapter 10.

(2) Increases in road traffic will continue in the future, and it is likely the traffic will far exceed the road capacity of the city even improved by action plans. This prospect would necessitate the preparation of a long range development plan of roads and public transport service as well.

(3) Micro buses will enlarge congestion and accident problems because of their frequent and sudden stoppings if traffic volume increases as the forecast above. A plan to mitigate the problems concerned with micro-buses is the regular service by larger buses. It is proposed in Chapter 14.

CHAPTER 10 MITIGATION OF PROBLEMS

CHAPTER 10 MITIGATION OF PROBLEMS

10.1 Approach

10.1.1 Phasing of Development Plans

The transport development plan should be classified into phases such as programs in a short term and those in a long term. The target year of completion of short term programs is considered until 1991 and the long term concept is upto 2000 in this study. The short term plan can be understood as the first phase of long term development objectives, and can be classified into two programs: one to plan long term capital improvements, and the other covers improvement of management and minor investment. The latter approach supports the increase of efficiency in using the existing facilities, with which this study is associated.

-1 Short Term Strategy for the Increase of Efficiency

In this study the objectives to solve traffic problems are:

a to accomplish a smooth traffic flow

b to mitigate traffic congestion

c to decrease traffic accidents

An appropriate systematic traffic management plan is essential for the safe and smooth flow of the increasing amount of traffic on roads. Traffic management is particularly important to make the maximum use of the existing road facilities. Under the circumstances improvement plans related to management require relatively low cost. A short term traffic management plan is possible to carry out in a trial and error method while observing the effect of the plan. The emphasis may differ every several years. Based on this understanding, the study has been conducted and candidate plans are listed first and they are reviewed and priority ones are consolidated. It is discussed in 10.2.1 Action Plans afterwards.

There is a case when a large cost project is included in the short term phasing. The project may increase the capacity substantially, for instance, by constructing a bypass road or a subway, etc. They should be approached as a part of the phased investment plan which generally comes out by a long range urban master plan and transport development plan.

10.1.2 Long Term Development Strategy

A long range increase tendency of traffic can be studied in association with urban development and traffic forecast. An overall urban development strategy should be prepared from a long term view point, which is called a master plan, and the development strategy for the transport sector should be consolidated simultaneously.

1) Plans

A master plan of the transport sector should be prepared with phasing -- short, medium, long -- from the view points below:-

-1 Spatial expansion of urban area should be guided to locate various activities in the suburban areas, which will mitigate excessive concentration of traffic in the central area.

-2 Roads should be classified by function, and distribution of roads by functional hierarchy should be planned in each area and among the areas. Road development works should be done to accomplish this hierarchy.

-3 Plans for widening some sections, grade separation of intersections, bypasses, subways, etc. are expected to change the traffic flows on roads. Feasibility of those plans can be studied by a traffic flow simulation which is supported by surveys of origin - destination trips, zoning, transport network, and model formulas with parameters determined.
(This report does not depend on these kinds of extensive surveys since the study terms were rather limited in the diagnostic approach as defined in the scope of Work.)

-4 Drainage, sewerage, power lines, etc. should be constructed related with the road network development. Construction plan of these facilities should be coordinated by agencies concerned. Possibility of utilizing wadi Zaira in the old Sana'a zone both as a road and as a drainage channel should be studied.

-5 Ownership of private vehicles will increase at a rate larger than the supply of road capacity. A plan to utilize mostly the public passenger service system should be studied. Limiting the use of private vehicles should be studied also.

-6 Parking facilities are in short supply and people use the road shoulder for parking even if it is earmarked as no-parking zone. Preparation and implementation of rules requiring parking space provision within the building or compound should be promoted. At the same time, provision of parking space and buildings for public, either free or toll-paying, should be promoted.

-7 A system of road maintenance and rehabilitation should be developed in MMH and municipalities. But, it cannot be done at once under the current situation in Y.A.R. Engineering theory, technology, practice, administration, management of work should be organized by phase in a long range program.

2) Users behavior

Behavior of road users, vehicle drivers and pedestrians are crude and often they ignore general rules of traffic safety causing conflict and accidents. Although this situation cannot be alleviated immediately, it should be improved gradually so that people can move in ordered manner. For that purpose, campaign and education through T.V., newspaper, schools, driving school, etc. should be conducted.

3) Administrative Systems

Administrative Systems are not well developed yet in managing roads, traffic, transport, and accidents. They should be organized and staff should be trained and strengthened in the following categories:

-1 Road maintenance and rehabilitation: organization, facilities, staffing and practice.

-2 Traffic police: organization & staff training on vehicle registration and periodic mechanical checks, license issue, statistical filing of accidents, and the traffic flow management.

-3 Traffic planning: organization & staff training on field surveys and analysis such as vehicle counting, travel speed survey, origin-destination survey, trend of increase/
decrease of vehicles registered, traffic forecast and assignment on road network, ----- together with road inventory study and updated filing of road conditions. Studies and planning of roads and traffic management should be initiated by this group.

4) Public Passenger Transport Service

-1 Administrative system responsible for licensing taxis, bus routes & frequencies, fares, etc.

-2 Determine the share in operation and routes of private operators and publicly owned operators (GLTC) in the whole city area.

-3 Control the operation of micro-buses in such way as number of licensed vehicles, enforce the stopping in the selected zones/spots, and fix in routes for operation, etc.

Examples of projects to be developed by stage are shown in Table 10.1.1.

Table 10.1.1 Conceptual Long Range Projects

	Project	City	Short	Medium	Long
a	Road network and other infrastructure development	Sana'a	0	0	0
		Taiz		0	0
		Holdeidah			0
b	Improvement of street and other structure in urbanized area (Pavement, roadwidth uniformity, bridge, drainage, etc.)	Sana'a	0	0	0
		Taiz	0	0	0
		Holdeidah	0	0	0
c	Construction of bypass and arterial roads	Sana'a		0	0
		Taiz		0	0
		Holdeidah			0
d	Public bus passenger service improvement including medium or large bus operation	Sana'a	0	0	0
		Taiz		0	0
		Hodeidah			0
e	Parking space/building construction with other regulations	Sana'a	0	0	0
		Taiz	0	0	0
		Hodeidah		0	0
f	Maintenance and rehabilitation of roads (organization, staff, theory, practice ...)	Sana'a	0	0	0
		Taiz	0	0	0
		Hodeidah	0	0	0
g	Financing, i.e. cost of investment and maintenance, revenues in tax & fee, and user charges if any.	Government	0	0	0

10.2 Short Term Countermeasures

10.2.1 Action plans

In order to accomplish a smooth traffic flow in current problem areas, the objective of short term action plans is postulated to mitigate the traffic congestion at bottlenecks. And the mitigation requires measures to increase the traffic capacity by the improvement of traffic management and by minor investment on facilities. They can be named urgent plans or action plans.

Action plans can be summarized into the groups A through D in Fig. 10.2.1. Group A shows plans for physical improvement which may require minor cost of investment. Group B is composed of improvement of management of traffic flows by enforcing rules and regulations. A and B can be developed into action plans. Appendix Table 10.2.1 shows the analysis of intersection capacity, with which the extent of the result of signal improvement is measured.

Group C is a set of public relations campaigns to initiate drivers and pedestrians to practice safe and orderly behavior in traffic flows, while D is shown to emphasize the necessity of an efficient administrative system to cope with the road traffic which is expected to increase every year.

Based on the problems classified in Figs. 8.4.1 through 8.4.3 countermeasures are studied and action plans are formulated. Action plans on the problematic points are determined from the following viewpoints.

1. Cost should be less
2. Behavior of people, drivers, in the traffic movement can not be changed at once. Behavior can be changed toward safer and ordered one by various means. Action plans proposed should be realistic and modest, not asking a drastic change.
3. Field observation is used to formulate action plans, because the past traffic data are not available.
4. Improvement of public bus service system is studied separately in Chapter 14.

Table 10.2.1 shows the candidate list for action plans. Figs. 10.2.2 through 10.2.4 shows the locations of those plans.

Fig. 10.2.1 Summary of Short Term Countermeasures

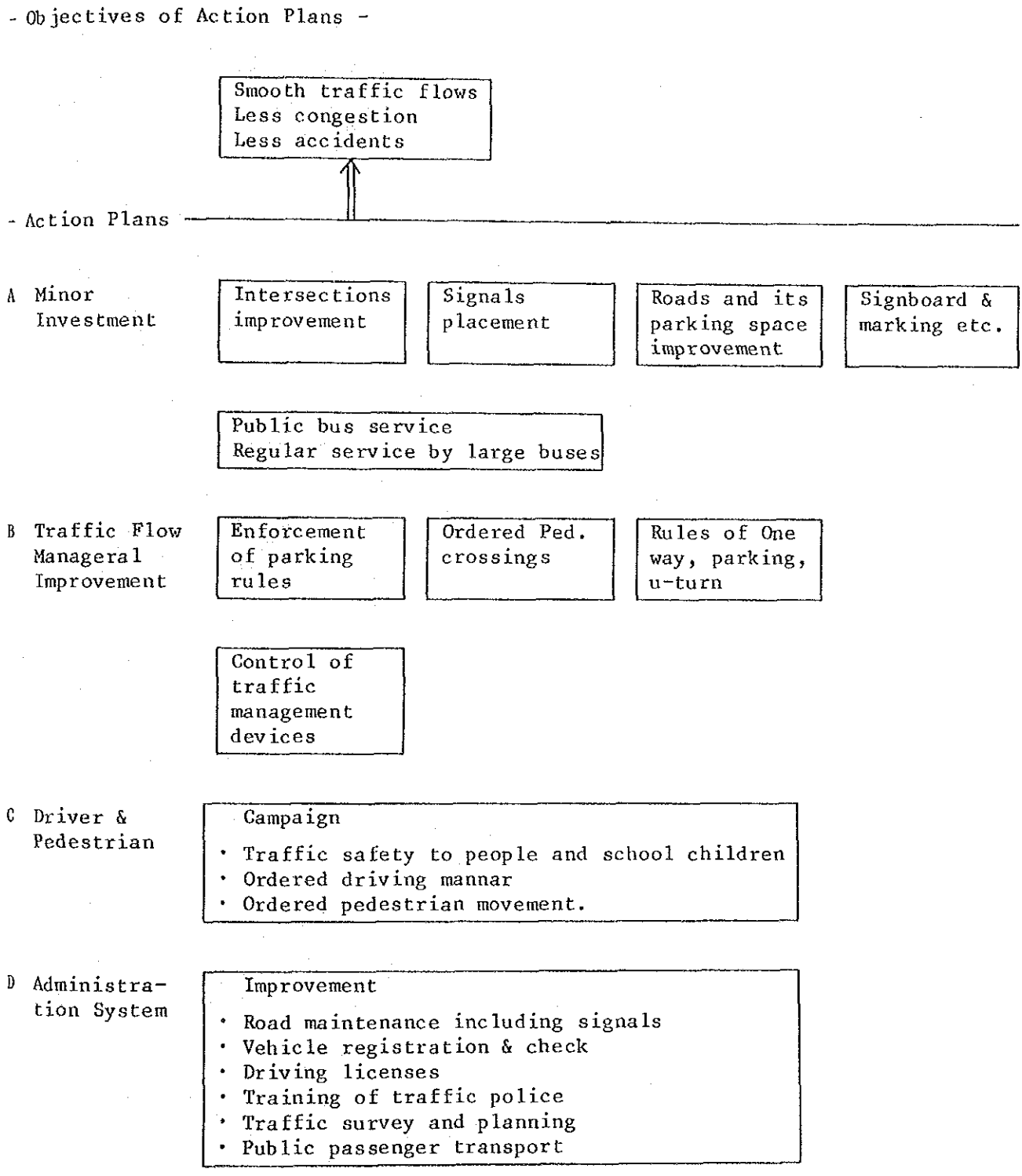


Table 10.2.1 Candidate List for Short Term Action Plans

Current Traffic Problems	Main Causes	Method of Countermeasures	Need & Policy for Plan	Priority for Actual Plan	Actual Plans	Gavernorate Sana'a	Taiz	Hodeida
1.Traffic congestion at signalized intersection		1.Improvement of signal control			1.Improvement of signal control			
		a.Control system		A	a.Control system	*	*	*
		b.Phase & Split		A	b.Phase & Split	*	*	*
		2.Improvement of intersecton	Accomplishment of a smooth traffic flow		c.Newly signalized intersection	*	*	*
		a.Widening of approachs		A				
		b.Channelization & Marking		A				
2.Congestion of micro buses at stops		1.Improvement of bus stops			2.Improvement of intersections			
		a.Bus bay		A	a.Widening of approachs	*	*	*
		b.Bus priority lane		B	b.Channelization & Marking	*	*	*
		c.Bus terminal		B	c.Turning lane	*	*	*
		d.Large buses			d.Guard fence	*	*	-
3.Obstruction of traffic flow caused by left-turn vehicles	1.The problems of existing traffic congestion is caused by lack of well-developed traffic management facilities.	1.Improvement of intersectoin			3.Improvement of curb parking control			
		a.Turning lane	Mitigating of traffic congestion	A	a.No parking restriction	*	*	-
		2.Traffic regulation			b.Parking bay & Parking meter	*	*	-
		a.No left turn		A	c.Parking building	-	-	-
4.Traffic congestion at unsignalized intersection caused by merging and diverging		1.Improvement of signal control						
		a.Signalized intersection		A				
		2.Traffic regulation			4.Improvement of micro bus stop			
		a.Traffic sign		A	a.Bus bay	*	-	-
		b.Mount up at exit		A	b.Large buses	*	-	-
5.Obstruction of traffic flow caused by indiscriminate crossing of pedestrians		1.Improvement of pedestrian cotrol devices & safty devices	Decrease of traffic accidents		5.Improvement of safty facilities	*		
		a.Pedestrian crossing		A	a.Pedestrian crossing	*	*	*
		b.Guard fence		A	b.Guard fence	*	*	*
		c.Pedestrian bridge		A	c.Pedestrian bridge	*	-	-
		d.Pedestrian priority street		B				
		e.Widening sidewalk		B				
6.Obstruction of traffic flow caused by curb parking	2.Traffic capacity on main roads are enough in short term.	1.Improvement of curb parking cotrol			6.Improvement of traffic regulation			
		a.No parking restriction		A	a.Traffic sign	*	*	-
		b.Time limited parking cotrol		A	b.Mount up at exit	*	*	-
		c.Parking bay & Parking meter		A	c.No parking restriction	*	*	-
		d.Parking building		B	d.Enforcement of traffic regulation	*	*	-
7.High frequency of traffic accidents		1.Improvement of intersection			7.Others			
		a.Channelization		A	a.Lane mark	*	-	*
		b.Safety devices(same as 5.1)		A	b.Canpaign of importance of traffic safety	*	*	*
		2.Improvement of signal control						
		a.Control system		A	c.Training of traffic police	*	*	*
		b.Signalized intersection		A	d.License system	*	*	*
8.Traffic congestion caused by inadequate road capacity		1.Improvement of intersection	Increase of traffic capacity on road.					
		a.Widening of approachs		A				
		2.Improvement of signal control						
		a.Phase & Split		A				
		3.Improvement of curb parking cotrol						
		a.No parking restriction		A				
9.Poor road condition		1.Improvement of road condition						
		a.Widning of sidewalk		B				
		b.Lane mark						
		c.Maintenance & Rehabilitation						
10.Others		1.P.R & education for traffic safety		A				
		2.Improvement of license system		A				
		3.Enforcement of traffic regulation		A				
		4.Training for traffic police		A				

Fig. 10.2.2 Location of Short Term Action Plan in Sana'a

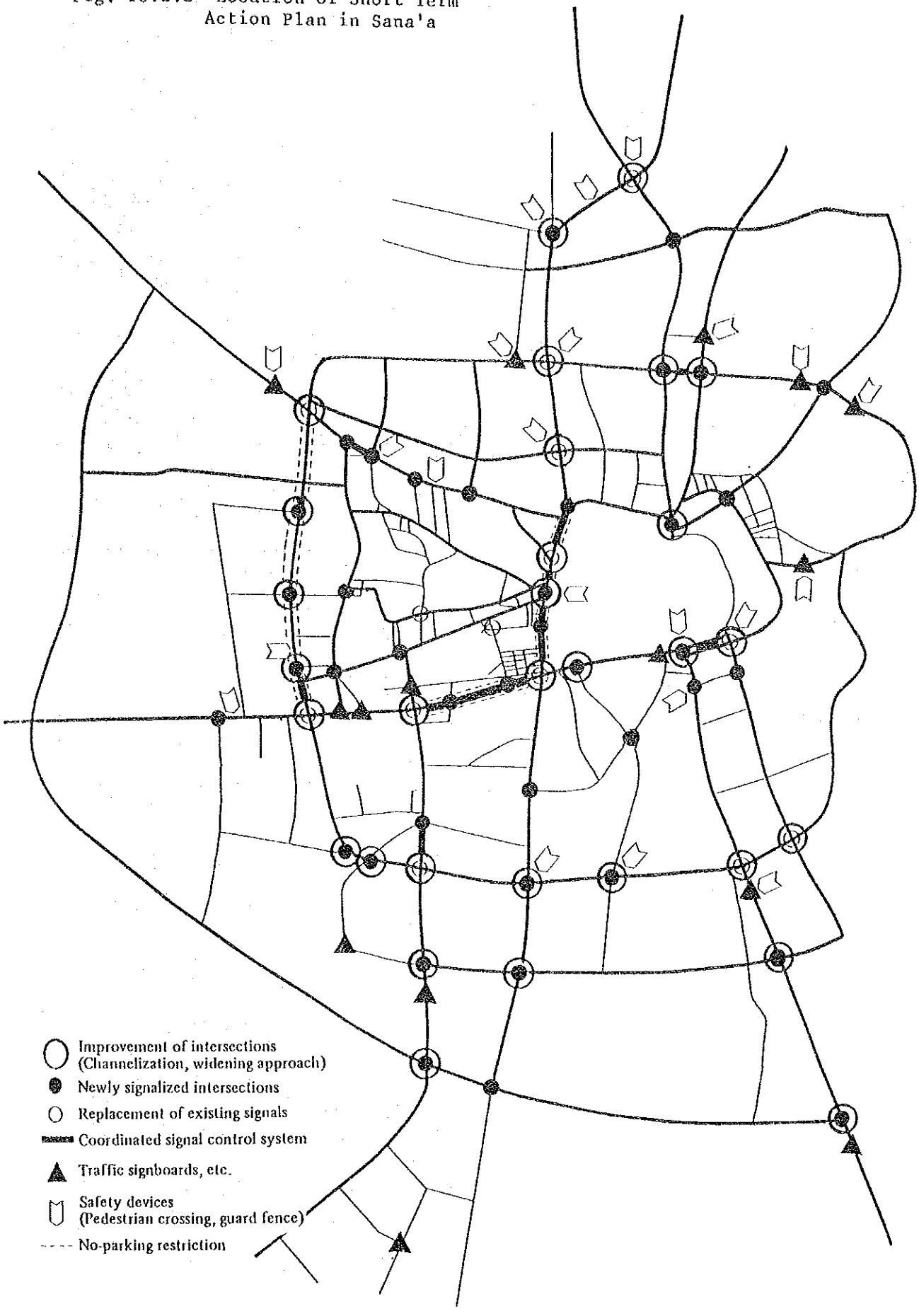


Fig. 10.2.3 Location of Short Term Action Plan in Taiz

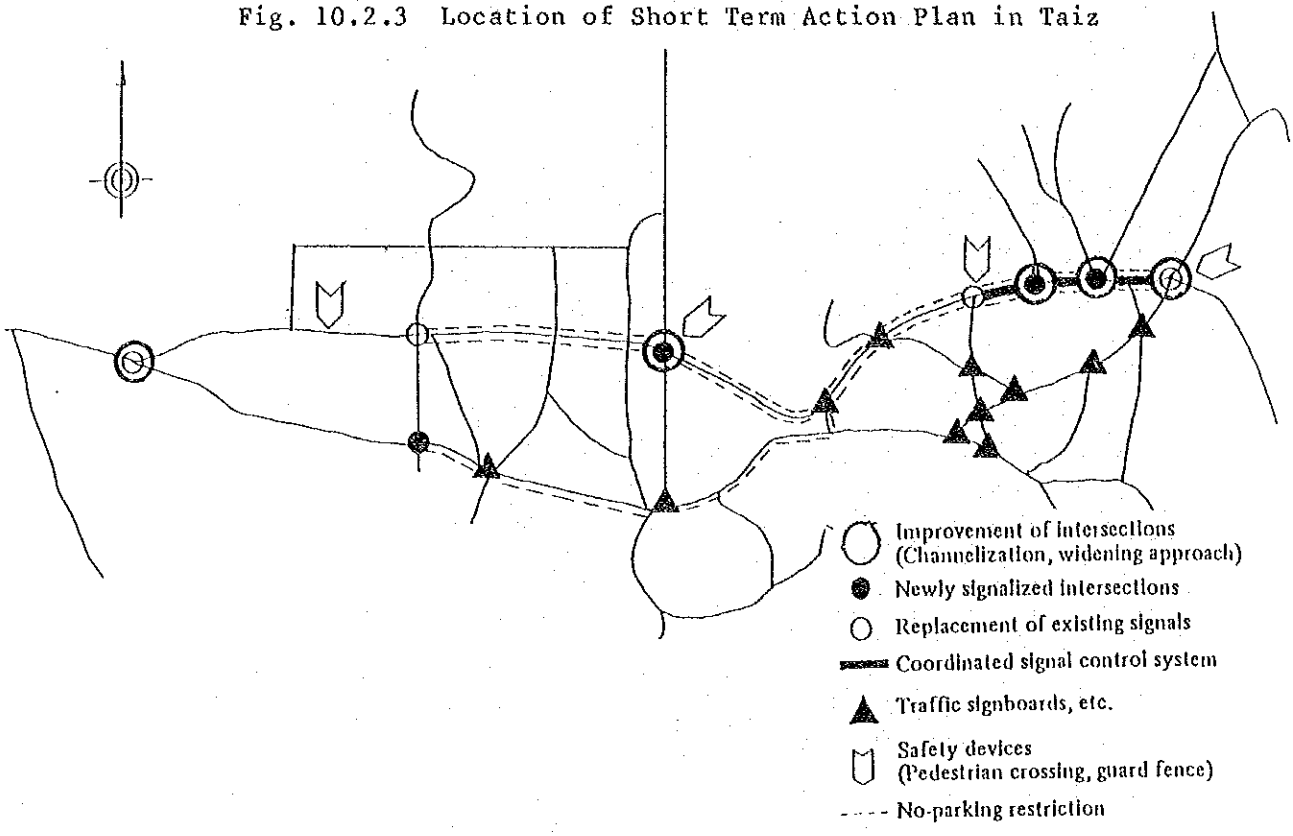
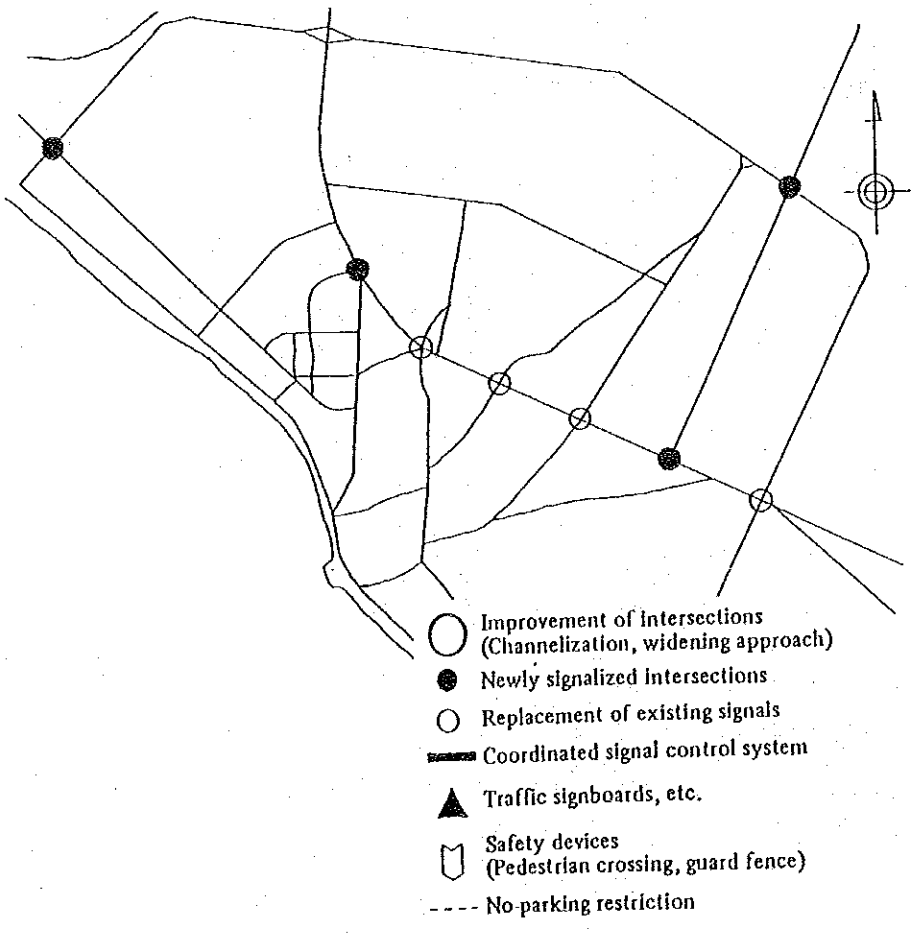


Fig. 10.2.4 Location of Short Term Action Plan in Hodeidah



10.2.2 Projects formation

Action plans proposed are composed of a number of minor improvements spreading over the city of Sana'a as shown in Fig. 10.2.2. Action plans in Taiz and Hodeidah are shown in Fig. 10.2.3 and Fig. 10.2.4, respectively. They are classified as plans of signal control, intersection improvement, guard fences, traffic signboards, marking and reflectors and so on. Scale of improvement is studied as discussed in Chapter 11.

Improvement plans are classified into groups of projects, No.1 - No.16 with which cost and benefit are summarized. Grouping is based on the road network formation and economic activities along the road. Action plans in each project are shown in Appendix Fig. 10.2.1. Their locations on the network are shown in Fig. 10.2.5 through 10.2.7.

Sana'a : Project No.1 - No.14
Taiz : Project No.15
Hodeidah: Project No.16

Fig. 10.2.5 Projects in Sana'a

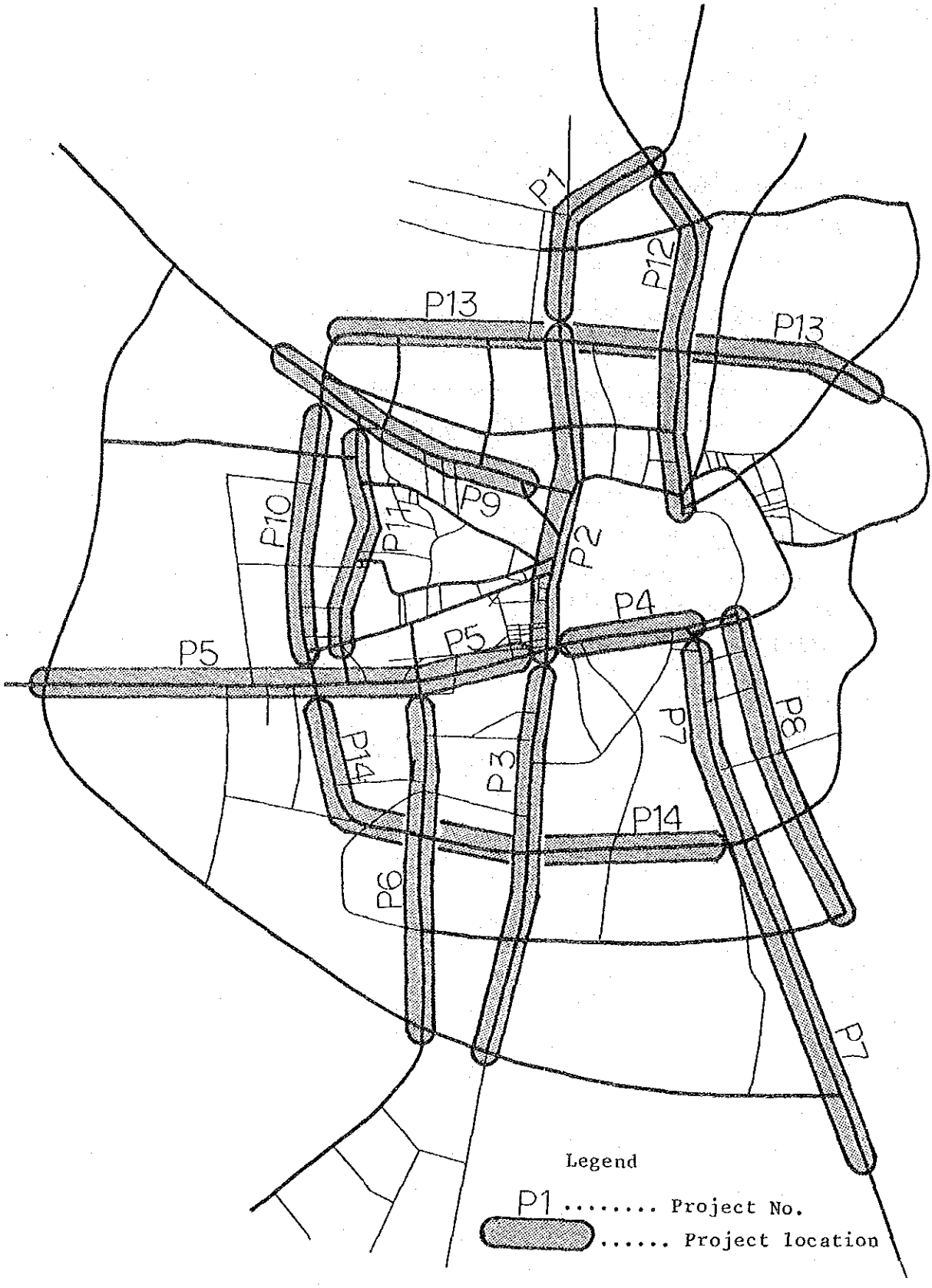
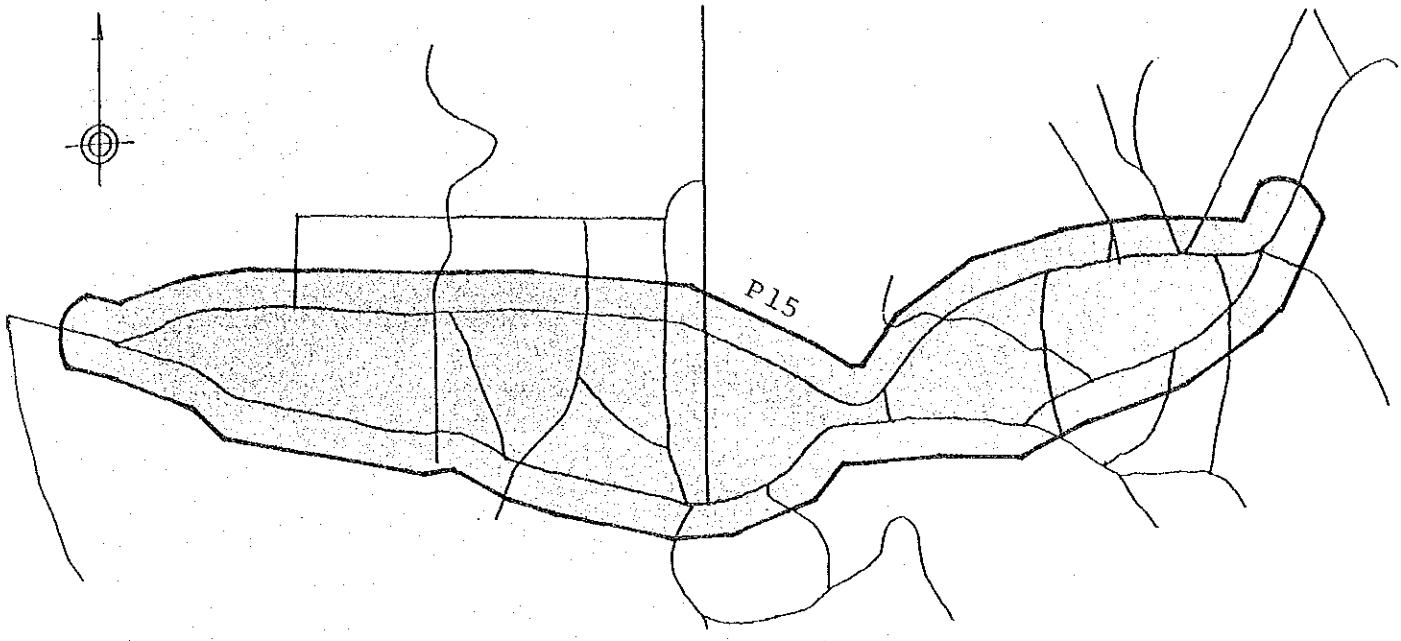
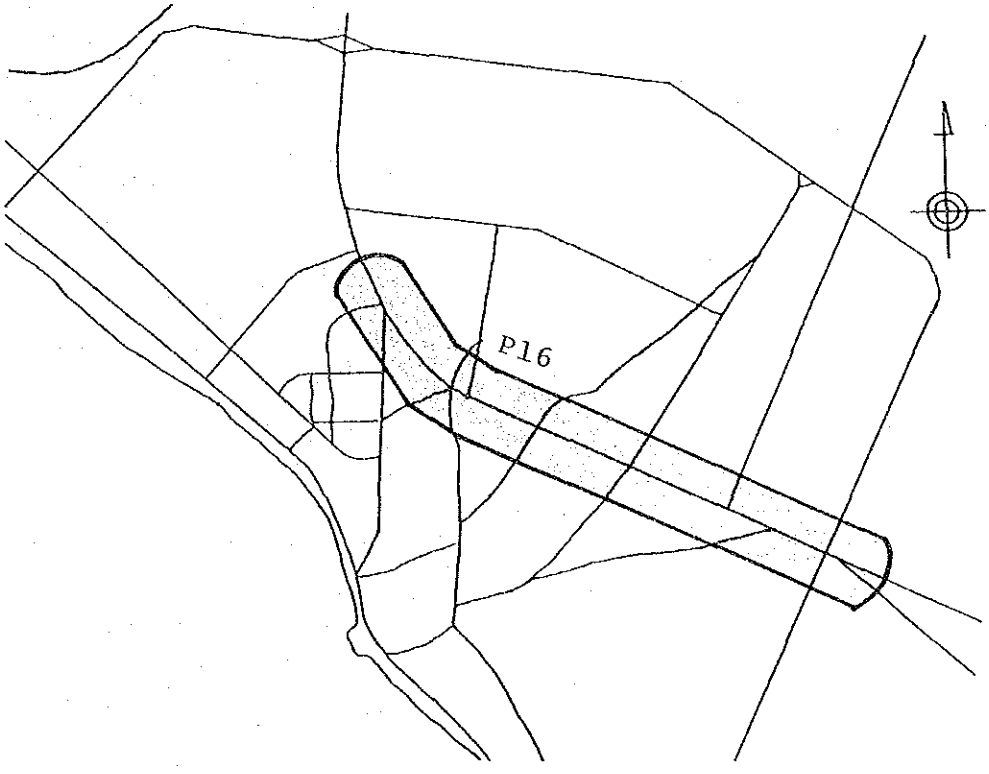


Fig. 10.2.6 Projects in Taiz



All improvement plans in Taiz are in Project 15.

Fig. 10.2.7 Projects in Hodeidah



All improvement plans in Taiz are in Project 16.

CHAPTER 11 ENGINEERING STUDIES

CHAPTER 11 ENGINEERING STUDIES

11.1 Approach

A number of action plans to make full use of the existing facilities are proposed in Chapter 10. The scale of each plan is studied at its site on the basis of the following objectives and approaching strategies.

Objectives: to accomplish a smooth traffic flow
to mitigate traffic congestion
to decrease traffic accidents

Approaches: investment cost should be less
: Scheduled to be completed within the 3rd 5 year plan
period (by the end of 1991).

11.2 Projects Proposal

11.2.1 Signal Control Plan

A. Sana'a

1) Basic Policy

The signal control plan mainly aims at the installation of new traffic signals at intersections in order to control both motor vehicle and pedestrian traffic. New signals will also reduce traffic accidents at those high accident incidence points.

2) Plan Conditions

(A) Plan Location

Both the signal intersections pointed as traffic bottlenecks through the analysis of the current situation and non-signalized intersections where the volume at merging and/or diverging traffic is large or where is a high incidence of traffic accidents will be subject to the signal control plan.

(B) Control System

The control system is a proposed pre-timed signal, based on the understanding of current traffic situation. The type of pre-timed traffic signal, mono-dial or multi-dial, will be decided for each of the subject intersection dependent on the volume of traffic on major street, minor streets and the traffic fluctuation pattern. The type of signal coordination will be based on the intervals of signalized intersections, street width, traffic regulations and other road facility on major streets. Tables 11.2.1 and 11.2.2 shows the criteria for the type of signal control system to be set up.

a. Point Control

Major and minor streets at bottleneck intersections are classified by the hourly traffic fluctuation pattern and the control system must be selected depending on the particular traffic pattern at a given intersection: mono-dial type signal control or multi-dial type signal control.

Mono-dial type signal control will be installed at the intersections that are currently without signal lights, where the merging/diverging traffic is many or where traffic accidents tend to occur. It is considered they do not require the precision level of multi-dial type signal control. Fig. 11.2.1 shows classified hourly fluctuation patterns of traffic at bottleneck intersections and Table 11.2.3 show typical hourly fluctuation patterns.

b. Coordinated Control

The coordinated control system to be installed is a multi-dial type coordinated control system.

(C) Description of Control

The pre-timed signal uses 2 phase signal cycles in principle which are adjustable for green time in the major direction

Table 11.2.1 Criteria for the Type of Signal Control System

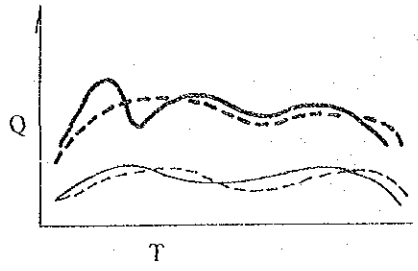
System		Description	Traffic Flow Condition
Fixed time signal	Mono Dial Type	The cycle/phase does not vary	The hourly traffic variation in both roads is not notable. It is not necessary to vary the cycle/phase in order to maintain smooth traffic flow.
	Multi Dial Type	The cycle/phase does vary	The hourly traffic variation pattern is distinguished as follows: 1. Morning peak hour 2. Midday peak hour 3. Evening peak hour It is necessary to change the cycle/phase pattern with each traffic variation in order to maintain a smooth traffic flow. The total traffic volume passed at intersection does not vary, although the hourly percentage of turning by direction is variable. The daily variation pattern of turning will be constant.

Table 11.2.2 Criteria for Coordinated Control System

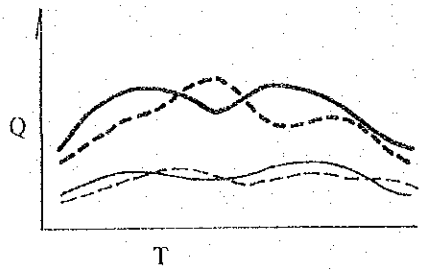
System		Description	Traffic Flow Condition
Simple Coordinated Control	Mono Dial Type	The coordinated pattern does not vary.	The traffic variation on the major street is not notable. It is not necessary to change the coordinated pattern in order to keep a smooth traffic flow on the major street.
	Multi Dial Type	The coordinated pattern does vary.	The hourly traffic variation pattern is distinguished as follows: 1. Morning peak hour 2. Midday peak hour 3. Evening peak hour It is necessary to vary the coordinated pattern in order to maintain a smooth traffic flow on major street.

Fig. 11.2.1 Hourly Fluctuation Pattern of Traffic at Bottleneck Intersections

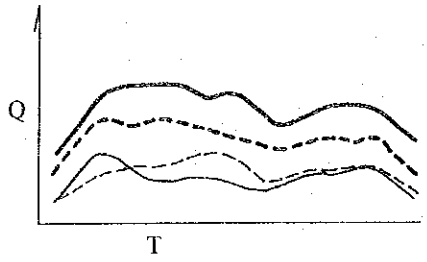
a. Airport Rd. – Ring Rd.



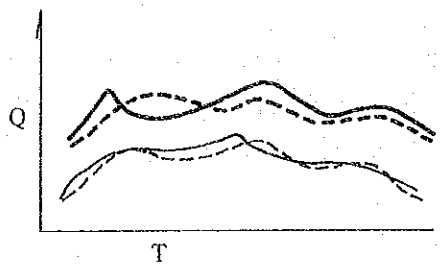
b. Ali Abdul Munghni – St. No. 30



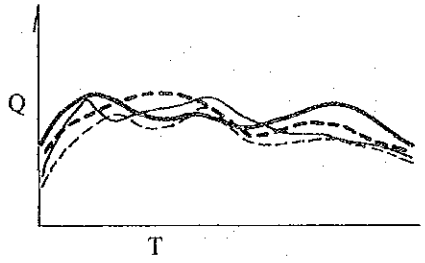
c. Old Airport Rd. – Az Zubayri St.



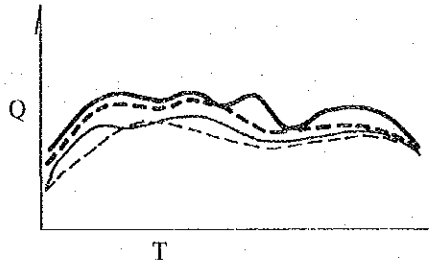
d. Ring Rd. – Wadi Dahr Rd.



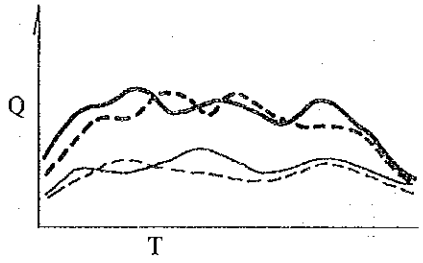
e. Az Zubayri St. – Ring Rd.

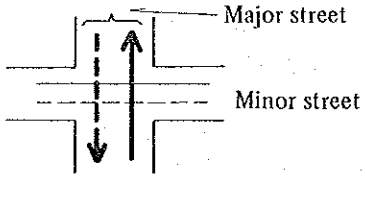


f. Ring Rd. – Haddah Rd.



g. Taiz Rd. – Ring Rd.





h. Az Zubayri St. – Taiz Rd.

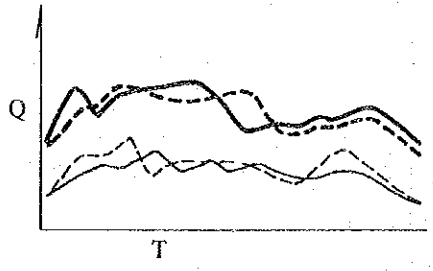
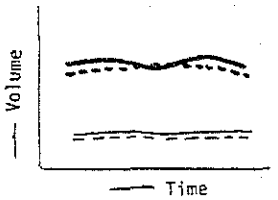
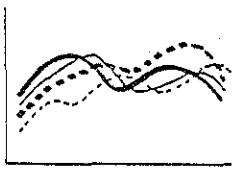


Table 11.2.3 Typical Hourly Variation Patterns of Intersection Traffic

Pattern	Traffic Flow Condition: Traffic Volume	Traffic Flow Condition: Traffic Variation	Selection of the Signal Control Syst
Pattern 1 	There is a great difference between the major to minor street, and little traffic in the minor street.	Not notably on both streets at peak hour.	Checking both directions, the traffic both streets during all day will be controlled constantly. The signal control type will be the mono-dial type signal.
Pattern 2 	There is a gret difference between the major to minor streets, and little traffic in the minor street.	Notably in major streets at peak hours. (There are three patterns: Morning peak hours, Midday peak hours, Evening peak hours). It is not notable in the minor streets.	Checking the traffic in the major stre the traffic on the minor street will b controlled. The signal control type w be the multi-dial type signal.
Pattern 3 	The volume in the major street is the same as the volume in one direction of the minor street.	Notable in the flow of one direction on minor street at peak hours. It is different between major street and minor street. The number oa peak patterns will be more than 4 in both streets.	Checking the traffic in the major street the traffic on the minor street will be controlled. The signal control type will be the multi-dial type signal.
Pattern 4 	There is heavy traffic on both streets. (Both streets will be arterial streets).	Notable on both streets at peak hours. It is different between major street and minor street. The number of patterns will be at least 5 on both streets.	Checking the flow of one direction in minor street, the traffic on the major street will be controlled. The signal control type will be the multi-dial type signal.

in accordance with fluctuations in the traffic (see Fig. 11.2.2, Typical Signal Phase). A left turn arrow signal with left turn lane area should be installed at those intersections where a high proportion of vehicles turns left. Based on a detailed review of the traffic fluctuation pattern, phasing will be predetermined for time periods for multi-dial control.

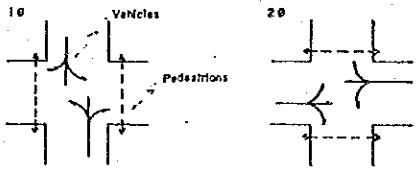
(D) Other Facilities

With the upgrading of the existing traffic signals and the installation of new traffic signals, plans for the installation of left-turn lane, safety facilities, road markings, etc. should be made. (refer to 11.2.3 of this chapter). They are necessary to prevent the deterioration of intersection capacity and to protect pedestrians.

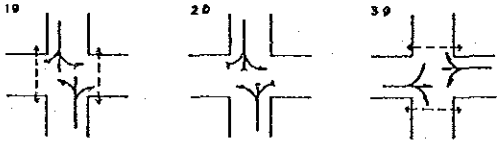
Fig. 11.2.2 Type of Signal Phase

A. Signal Phases

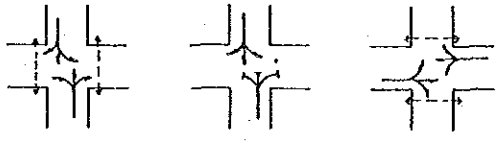
EX. 1 : TWO - PHASES

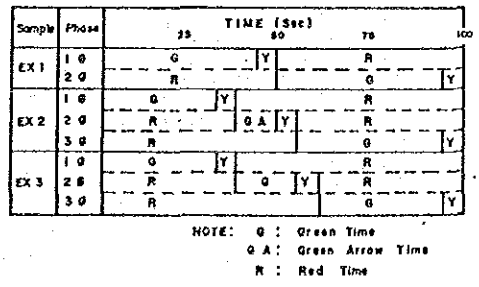


EX 2 : THREE - PHASES (1)

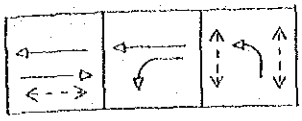


EX 3 : THREE - PHASES (2)



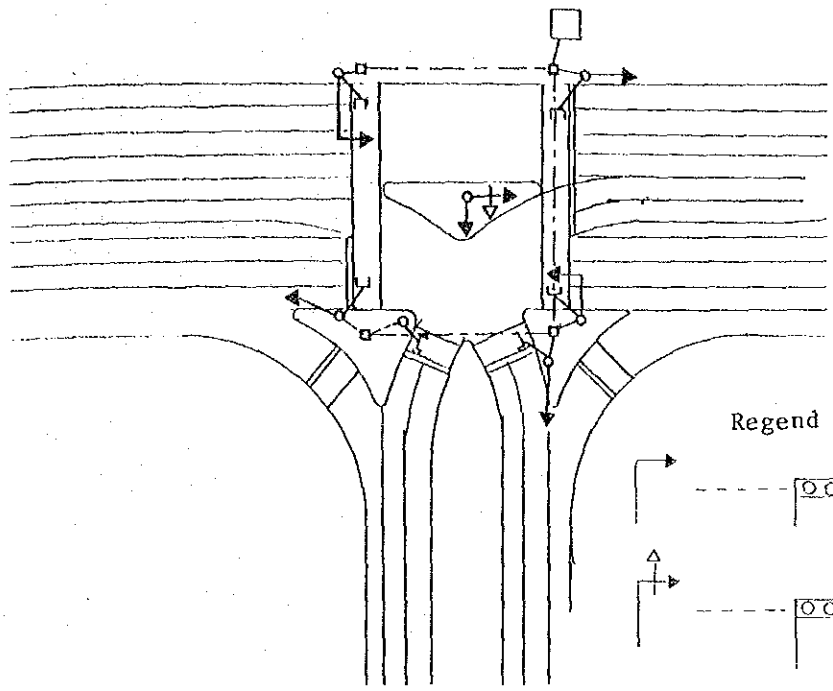


B. Examples of Signal Installation



vehicle

Pedestrian



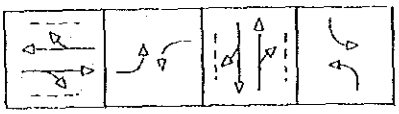
Regend

Signal

Signal with Arrow

Arrow Signal (Stand Type)

Signal for Pedestrian



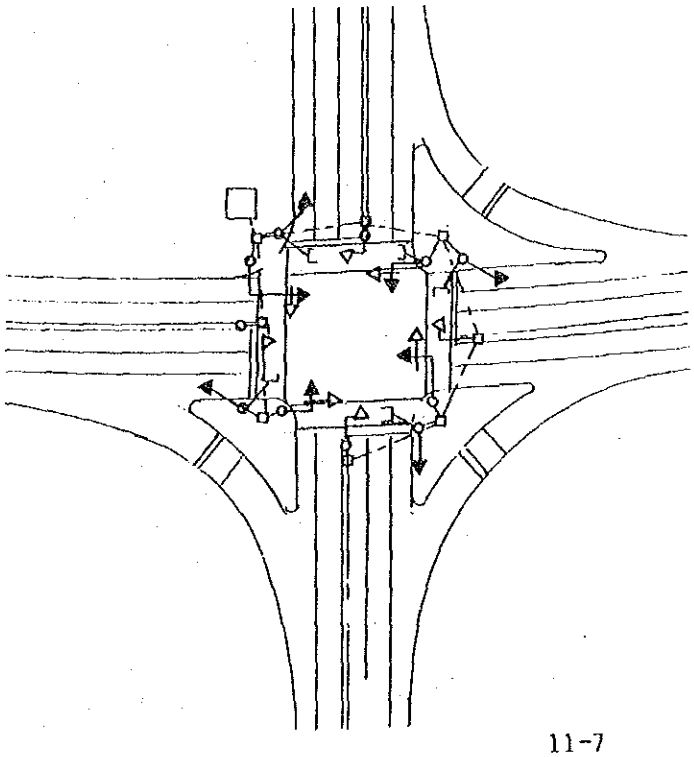
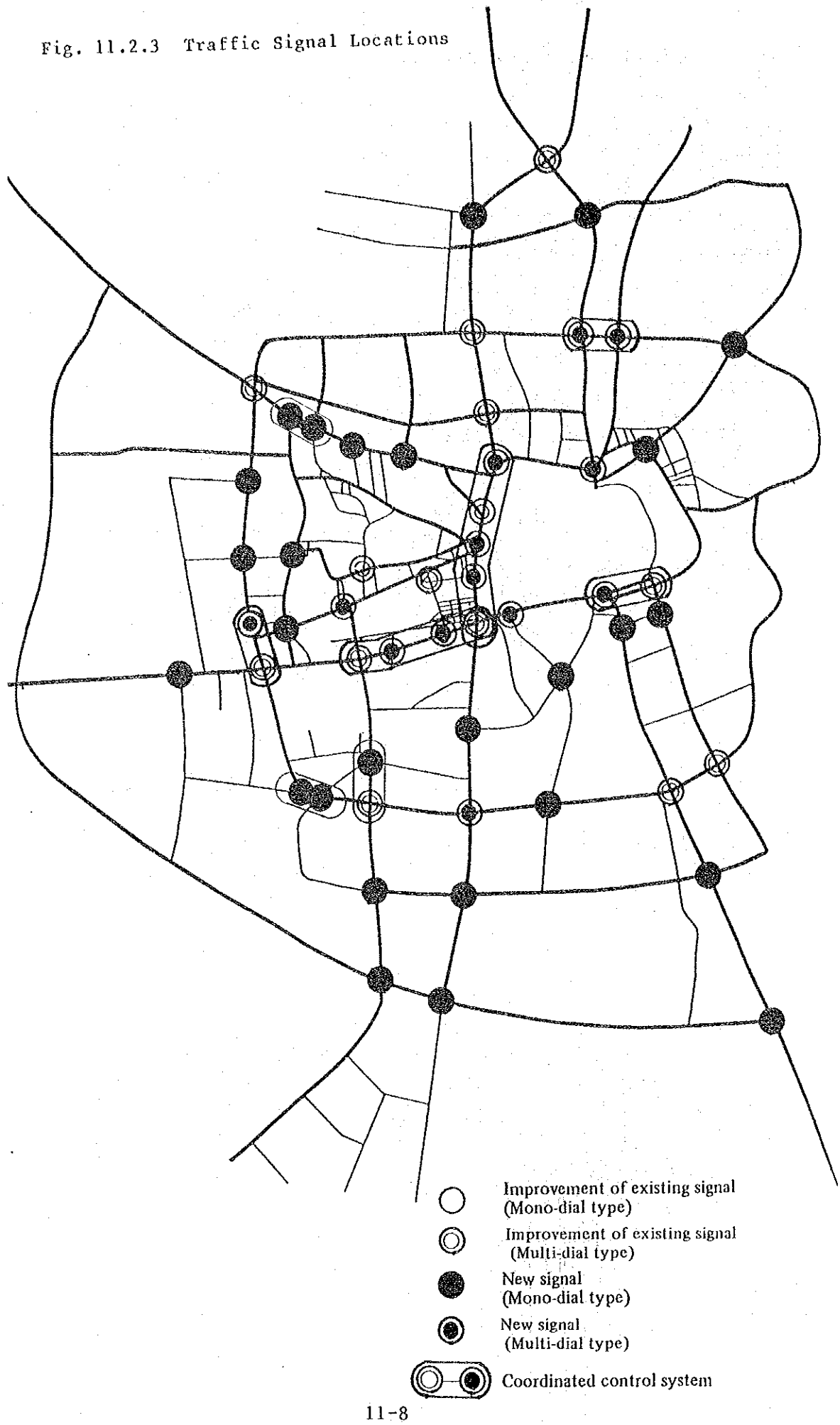


Fig. 11.2.3 Traffic Signal Locations



Past experience has shown that the multi system can be used in place of the mono system without any increase in cost difference. Consequently, the cost estimate for the multi and the mono are assumed to be equal, while a coordinated system at this modest scale is estimated to be higher by 20% than the multi type signal. Proposed signal locations are in Fig. 11.2.3.

B. Taiz

It is proposed the existing 5 signals should be replaced and 3 new signals be placed on those trunk roads (Fig. 11.2.4)

C. Hodeidah

It is proposed the existing 4 signals to be replaced and 4 new signals are to be installed. (Fig. 11.2.5)

Fig. 11.2.4 Traffic Signal Locations, Taiz

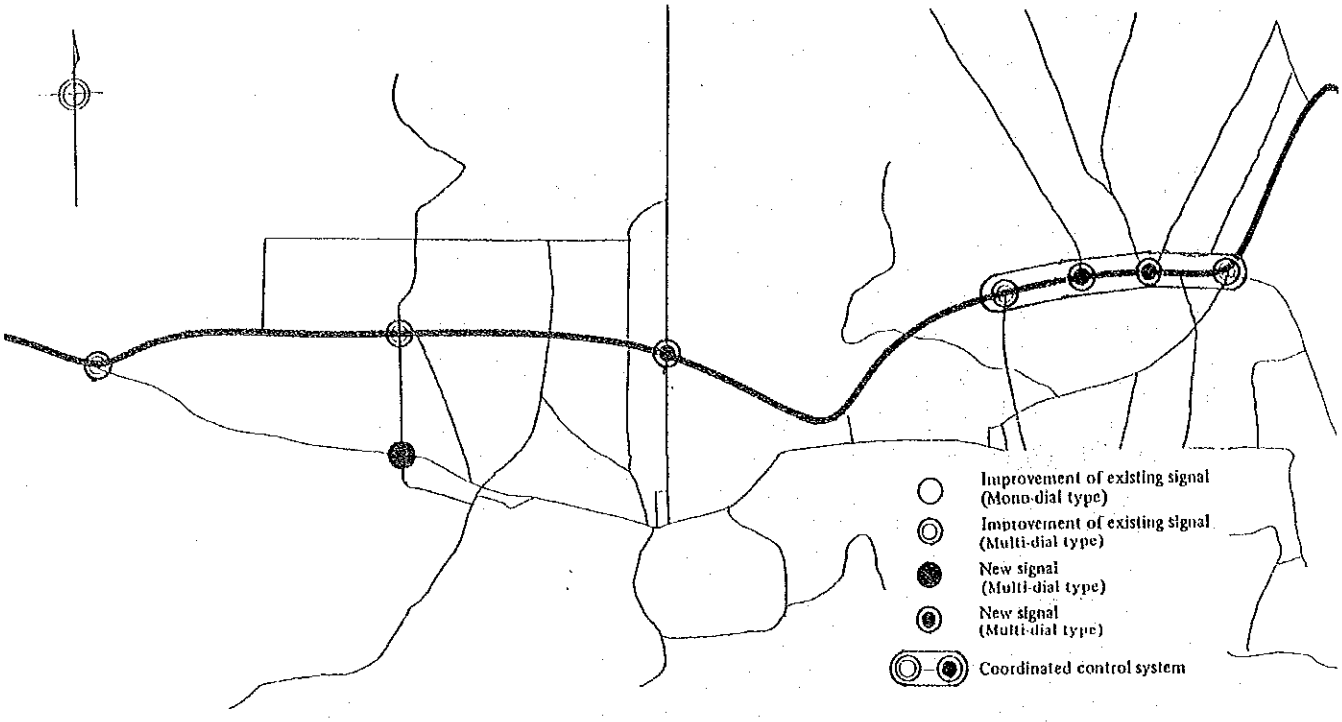
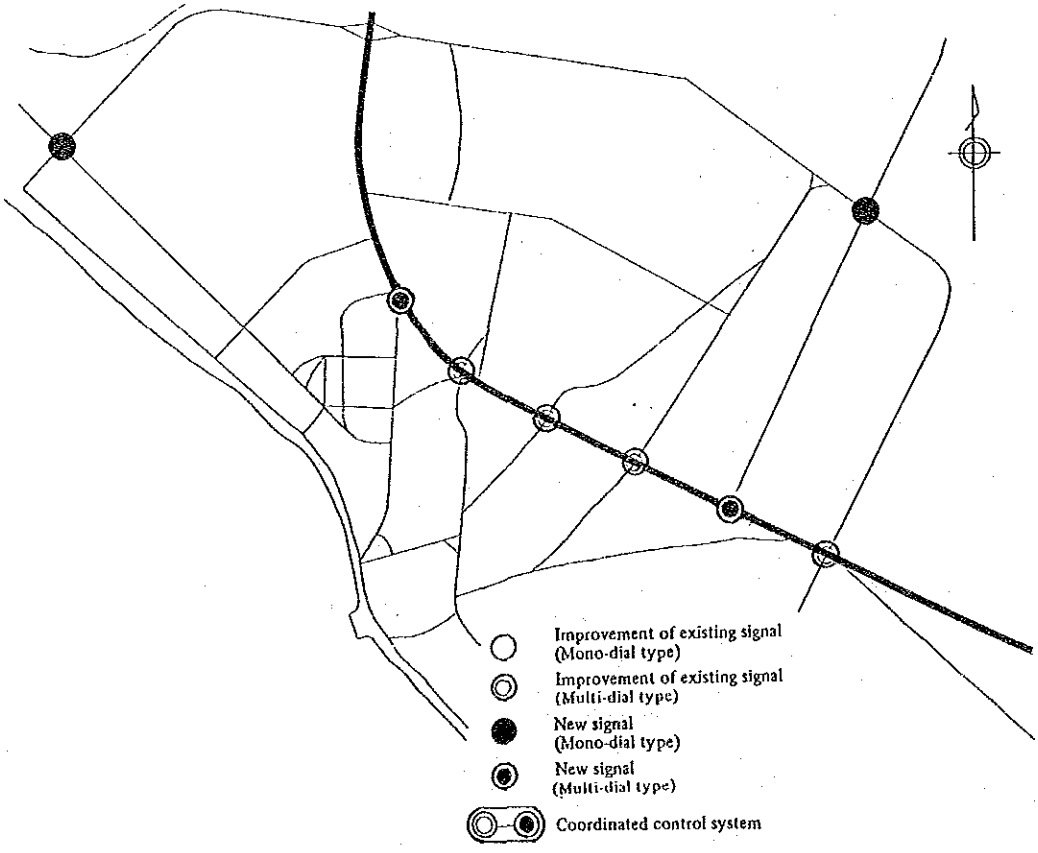


Fig. 11.2.5 Traffic Signal Locations, Hodeidah



11.2.2 Intersection Improvement Plan

A. Sana'a

1) Basic Policy

The purpose of the intersection improvement plan is the mitigation of traffic congestion at intersections in order to secure a smooth traffic flow and to prevent or reduce traffic accidents. This plan will include the widening of approaches (the provision of additional lanes) and the channelization of traffic.

2) Plan Conditions

The subject locations of this plan will be the signal intersections which are considered by the analysis of the current situation to be traffic bottlenecks and the intersections where there is a high incidence of traffic accidents. The traffic volume and capacity of each bottleneck will be calculated and at bottlenecks where the traffic volume is in excess of the calculated capacity, the signal phases will be improved and/or the approach will be widened. Traffic channelization will be introduced where it is deemed necessary by the analysis of traffic accidents and/or where the shape of the intersections is considered better to change.

The estimated growth rate of the traffic volume for 1992 is calculated using a coefficient of 1.48, given by the analysis of future demand. Based on the calculation results, either the improvement of signal phases or the widening of approach road or both should be selected. In those cases where these improvements are considered to be impracticable, or not mitigate the congestion substantially, the introduction of a flyover intersection, bypath, etc. should be studied. These plans should be studied in the context of a long term development strategy.

3) Description of Plan

(A) Improvement of Bottleneck Intersections

Table 11.2.4 shows the method of intersection improvement for each location. Bottlenecks with a traffic volume in

Table 11.2.4 Methods of Intersection Improvement

Intersection		Type of Improvement a	b	c	d
Airport road	Sadah road	O		O	O
	St.No.10		O	O	O
Al Qiyada st.	Ring road			O	O
	St.No.9	O		O	O
Ali Abdul Munghni st.	Shuub st.		O		
	St.No.30			O	O
	Tahrir square		O	O	O
	Bab al Bisgh st.		O		
	Az Zubayri st.			O	O
Old Airport road	St.No.33		O		
	Ring road			O	O
Az Zubayri st.	Bab al Yemen	O		O	O
	St.No.4			O	O
	Sifa Bin Thi Yazan		O		
	St.No.30		O		
	Haddah road	O		O	O
	Ring road	O		O	O
	Ad Dirasat st.		O		
Haddah road	St.No.15		O		
	Ring road			O	O
	45m road			O	O
	Sana'a Bypass			O	O
Taiz road	St.No.5		O		
	Ring road			O	O
	45m road		O	O	O
	Sana'a Bypass		O	O	O
Mostasfa al Thourah st.	St.No.23	O		O	O
	St.No.5		O		
	Ring road			O	O
Wadi Dhar road	St.No.11		O		
	St.No.10		O		
	St.No.8		O		
	Zirah st.		O		
	Ring road			O	O
Ring road	St.No.5		O		
	St.No.25		O	O	O
	St.No.1		O	O	O
Zirah st.	St.No.9			O	
	Jamal Abdul Nasi st.			O	
Sadah road	Northeastern Blvd.		O		
	Ring road			O	O
	Bab Shuub		O	O	O
Ring road	St.No.24		O		
	St.No.20		O	O	O
	St.No.15		O	O	O
	Ath Thalathin st.		O	O	O

Legend: a:Improvment of signal phase
b:Newly established signal
c:Fleared intersection with additional lane
d:Channelization

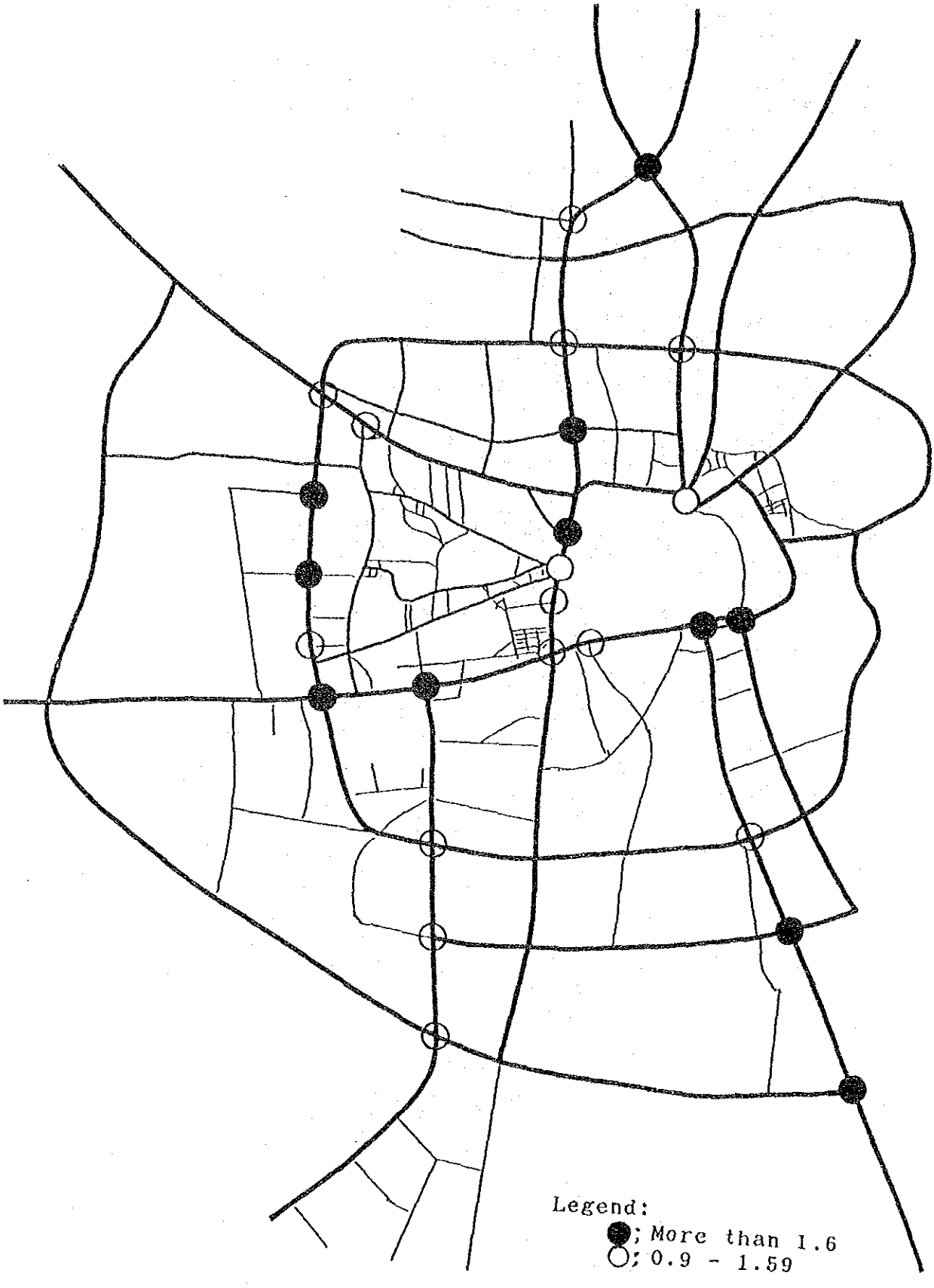
Table 11.2.5 Heavily Congested Intersections

Main Intersection		Node No. **	(Traffic Vol. 1992/ Traffic Design Capacity)*)
Airport road	Sadah road	5	1.81
	St. No. 10	6	1.55
Al Qiyada st.	Ring road	14	1.66
	St. No. 9	20	1.74
Ali Abdul Munghni st.	St. No. 30	43	1.71
	Az Zubayri st.	64	2.16
Az Zubayri st.	Bab al Yemen	61	1.62
	St. No. 4	62	1.78
	Haddah road	66	1.80
	Ring road	69	2.50
Haddah road	Ring road	80	1.36
	45m road	92	1.25
	Sana'a Bypass	94	1.51
Taiz road	Ring road	88	1.53
	45m road	90	1.74
	Sana'a Bypass	97	1.80
Mostasfa al Thourah st.	St. No. 23	60	1.75
Wadi Dhar road	Zirah st.	31	1.05
	Ring road	32	1.16
Ring road	St. No. 15	52	1.74
	St. No. 25	48	1.64
	St. No. 1	39	1.73
Sadah road	Ring road	13	1.46
	Bab Shuub	24	1.27

* Estimated for the case without improvement. Details in Appendix Table 10.2.1

** See Appendix Fig. 4.5.1.

Fig. 11.2.6 Location of Heavy Congested Intersections



excess of the calculated capacity and their expected degrees of congestion in 1992 are shown in Fig. 11.2.6 and Table 11.2.5. Details are in Appendix Table 10.2.1.

(B) Improvement in High Accident Locations

According to the analysis of traffic accidents described earlier, it is clear that one of the causes of these accidents lies with the geometric conditions of the intersections. The traffic channelization plan will, therefore, be effective in reducing the number of traffic accidents. In those locations that do not have traffic signals and where there is a high incidence of accidents, the provision of new signals will be effective for the same purpose.

The traffic channelization plan will be carried out at locations which satisfy the following criteria.

a. Locations where channelization is deemed to be necessary based on the traffic accident analysis.

b. Locations where improved channelization is deemed to be necessary as a result of the introduction of the signal control plan.

c. The improvement of intersections which can be flared with additional lanes.

The traffic channelization plan will be executed in accordance with Table 11.2.6 Basic Items of Traffic Channelization. The plans for channelization should be carried out on the basis of the following standards.

d. When the areas of traffic conflict are large, tending to distract drivers and pedestrians and, therefore, causing traffic accidents, reduce the size of the areas.

e. Move the traffic flow line as close as possible to right angle in order to reduce the areas of possible conflict and to give drivers cautious understanding of their relative positions in view of their vehicle and speed. (See the picture B in chapter 6)

Table 11.2.6 Basic Items of Traffic Channelization

Intersection		a	b	c	d	e	f	g	h	i
Airport road	Sadah road		O		O	O	O	O	O	O
	St.No.10					O	O	O	O	
Al Qiyada st.	Ring road		O		O	O	O	O	O	O
	St.No.9					O	O	O	O	
Ali Abdul Munghni st.	St.No.30	O			O	O	O	O	O	O
	Tahrir square	O				O	O	O	O	
	Az Zubayri st.		O		O	O	O	O	O	O
Old Airport road	Ring road		O		O	O	O	O	O	O
	45m road	O			O	O	O	O	O	O
	Sana'a Bypass	O			O	O	O	O	O	O
Az Zubayri st.	Bab al Yemon		O		O	O	O	O	O	O
	St.No.4		O		O	O	O	O	O	
	Haddah road					O	O	O	O	
	Ring road					O	O	O	O	
Haddah road	Ring road						O	O	O	
	45m road	O			O	O	O	O	O	O
	Sana'a Bypass	O			O	O	O	O	O	O
Taiz road	Ring road					O	O	O	O	
	45m road					O	O	O	O	
	Sana'a Bypass	O			O	O	O	O	O	O
Mostasfa al	St.No23		O			O	O	O	O	O
Thourah st.	Ring road		O		O	O	O	O	O	O
Wadi Dhar road	Ring road		O		O	O	O	O	O	
Ring road	St.No.5				O	O	O	O	O	
	St.No.25				O	O	O	O	O	
	St.No.1				O	O	O	O	O	
Sadah road	Ring road					O	O	O	O	
	Bab Shuub		O		O	O	O	O	O	O
Ring road	Marib road					O	O	O	O	O
	St.No.20					O	O	O	O	
	St.No.15					O	O	O	O	
	Ath Thalathin st.	O			O	O	O	O	O	O

a The introduction of channelizing islands.
b The improvement of the size of channelizing islands.
c The landscaping of channelizing islands.
d The available width of channels (the provision of plants).
e Channelization by pavement markings.
f Directional pavement markings.
g The protection of pedestrians.
h The improvement of corner cut-offs.
i The minimization of the area of the intersection.
j Moving the flow of traffic as close as possible to right angles.

f. Reduce the angle of access into through traffic to less than 15° in order that traffic will be able effectively to merge with a minimum difference in speed.

g. Left turn lane should have enough queueing length and width. It should be painted clearly and/or shown by signboard. (See the picture E in chapter 6)

h. Reduce the speed of traffic flow at the approach to an intersection by narrowing or bending the approach way. It is, however, necessary to ensure that the curve does not present an impediment to the main flow of traffic.

i. A conflict point within an intersection may be divided by channelization.

j. Channelization may be used to prevent turning in a forbidden direction.

k. It is easy to provide the necessary space for traffic control devices (such as road marking and signals) which support channelization by the use of the channels themselves.

(C) Based on understanding of those items, the standard structure of typical intersection are illustrated in Fig. 11.2.7. Fig. 11.2.9 shows the locations of intersections to be improved. Examples of problem - improvement plan are shown in Fig. 11.2.8 and comments are as under:

a. Lane numbers

Lane number and width in the approach section and those in exit section are not same. It can be causes of accident and congestion. (Fig. 12.2.8 (a))

b. Lane width

Lane width is marked at 3.5 m (12 ft) in most intersections. Since large sized trucks are not allowed to enter in-city roads of Sana'a, majority is small-medium size vehicles with a vehicle width about 2.0 m. They stop neglecting the lane mark, resulting in conflict andaccidents. Lane width should be narrowed and marked clearly. (Fig. 11.2.8 (b))

c. Roadways

Roadways and center lines skew at the approach and exit section. It has no uniformity in flow and causes congestion and accidents. (Fig. 11.2.8 (c), (g))

d. Sight distance

Sight distance is not properly reserved in some intersections. (Fig. 11.2.8 (d))

e. Right turn lane

The radius of right turn lane is not necessary to be large enough with which vehicles pass at rather normal speed. It should be considered that vehicles run at a slow speed on the right turn lane, subsequently the radius can be small at about 10m. (Fig. 11.2.8 (d))

f. Merging lane

At the end of right turn lane a distance for merging is not necessary. Vehicles can merge when the signal phase changes. The existing merging lane can be designated for stopping area of buses and taxis. (Fig. 11.2.8 (e))

g. Left turn lane and arrow signal

Most intersections have no left turn lane properly designed in width and length. Turning lane should be clearly marked and also a left turn arrow signal should be attached at selected heavy volume intersections. (Fig. 11.2.8 (f))

h. Capacity

Major factor of intersection capacity is the roadwidth and lane number at the approach sections. In order to increase the capacity, the existing median should be deleted and a left turn lane should be placed, and lane width should be reduced to 2.75-3.00 m. (Fig. 11.2.8 (f))

i. No-stopping and no-parking

In order to maintain the capacity at its maximum use, no-stopping and no-parking rules should be marked clearly and strictly enforced by traffic police. (Fig. 11.2.8 (h))

Fig. 11.2.7 Standard Structure of Typical Intersection

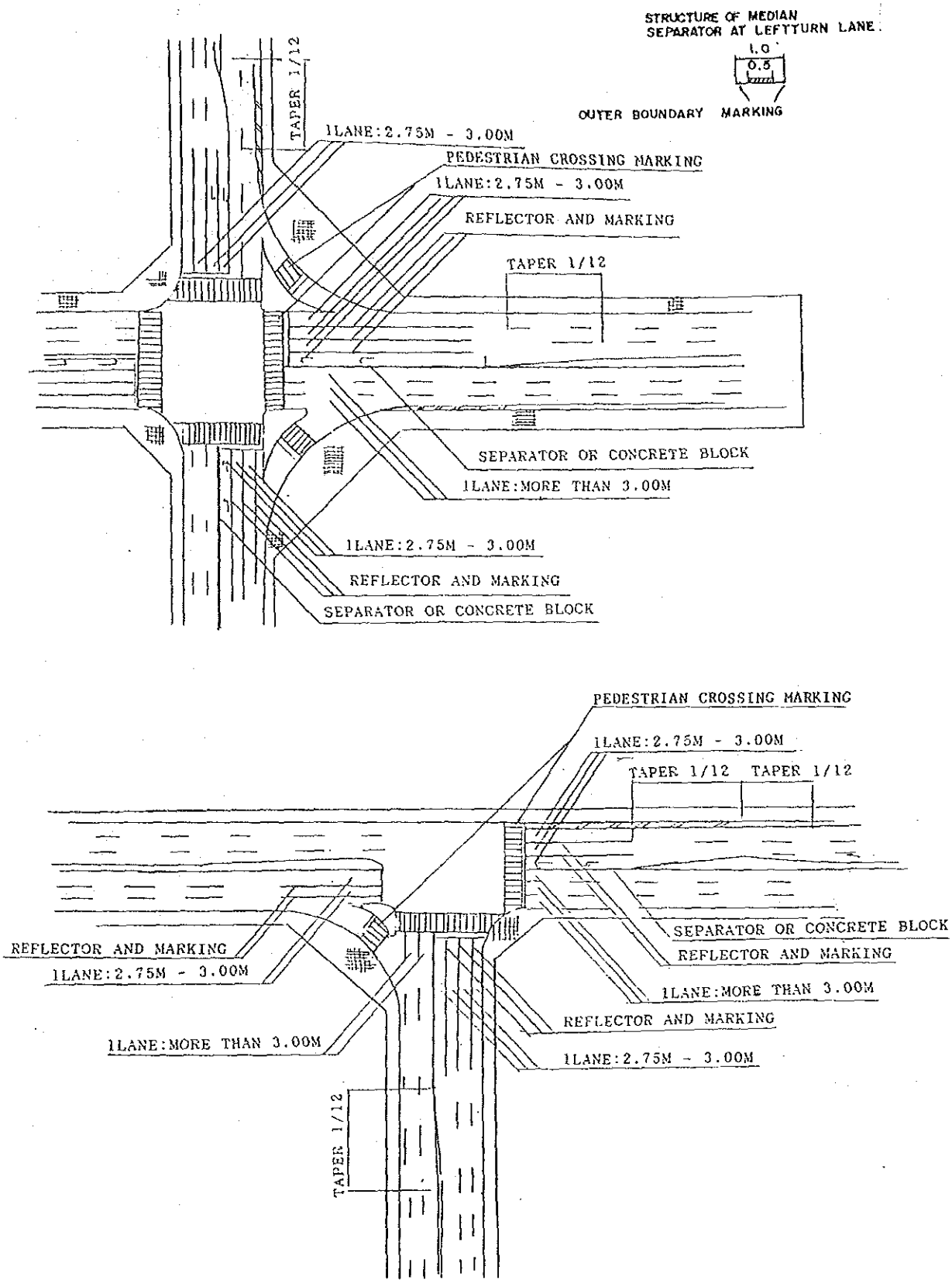
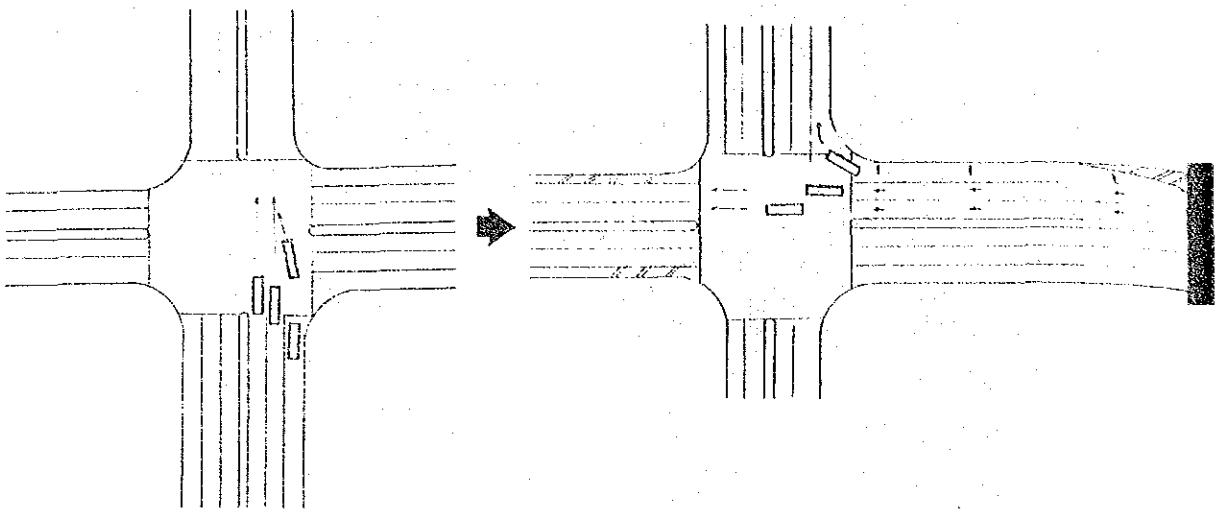
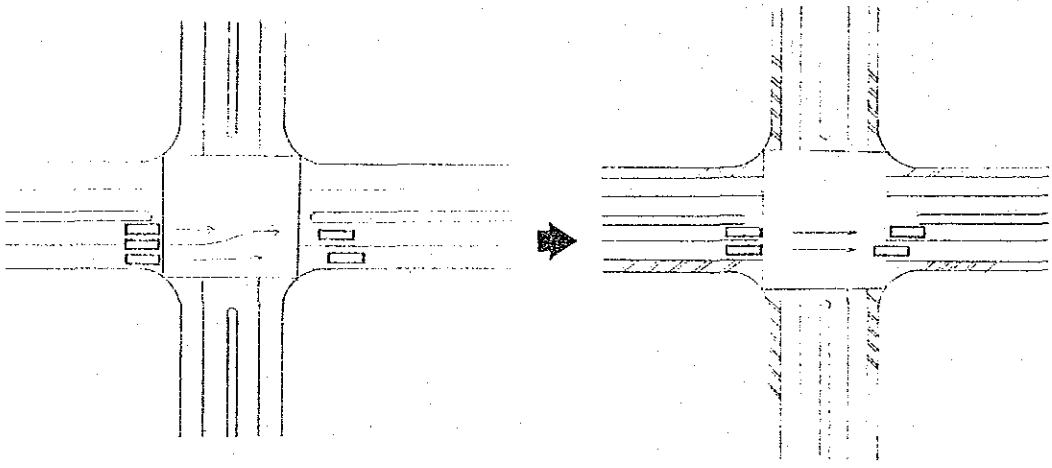


Fig. 11.2.8 Improvement Concept of Intersections (1)

(a) Different lane numbers



(b) Lane width



(c) Improvement of roadway

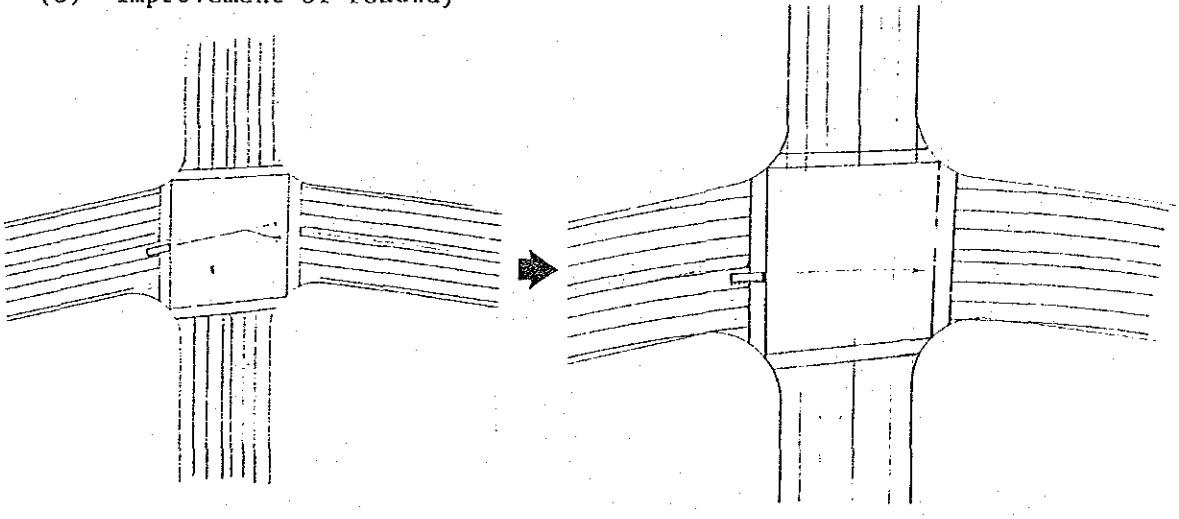
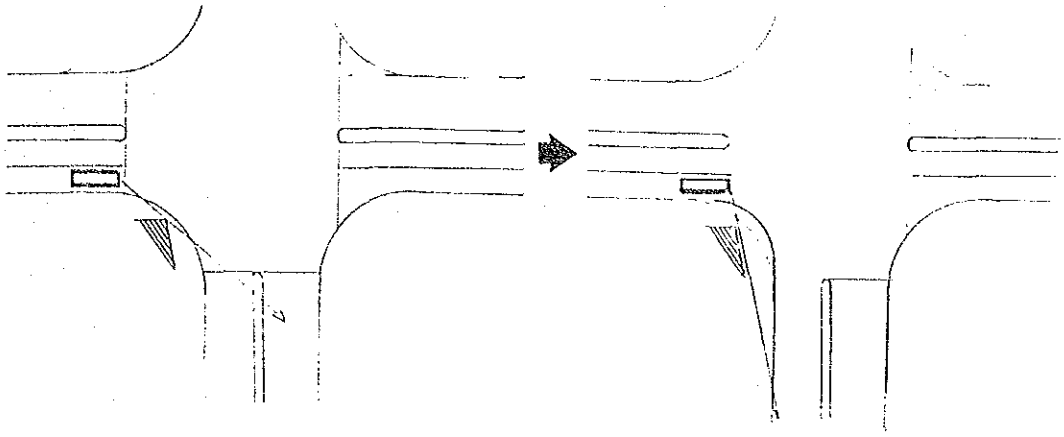
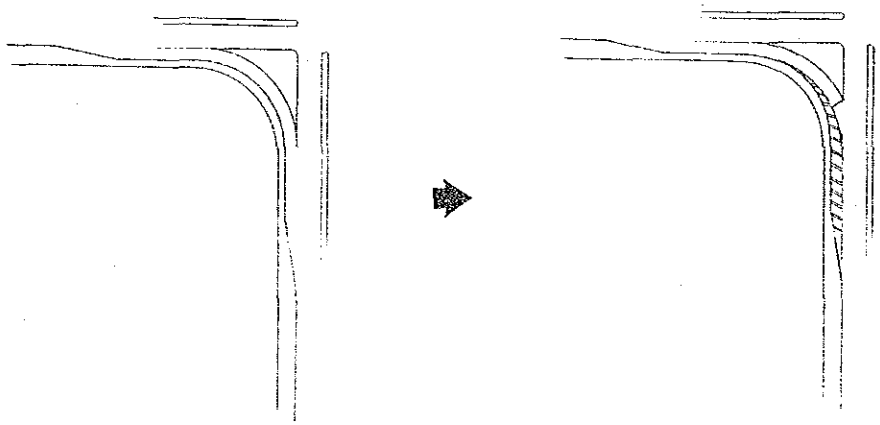


Fig. 11.2.8 Improvement Concept of Intersections (2)

(d) Sight distance at intersection



(e) Converted to Bus stop or sidewalk of acceleration lane on street



(f) Setting of left turn lane

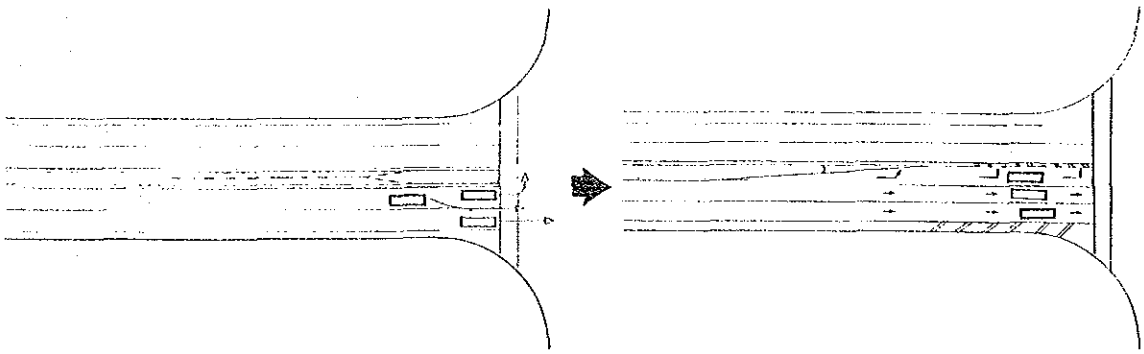
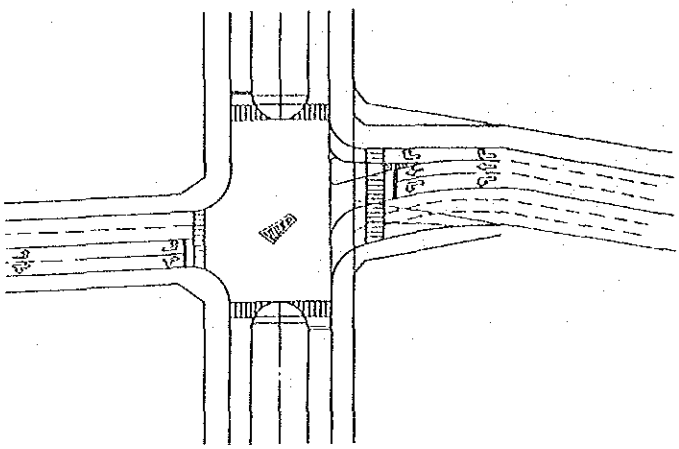
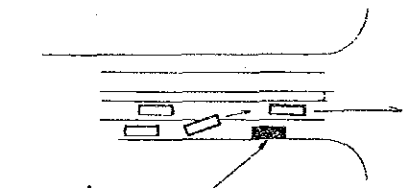


Fig. 11.2.8 Improvement Concept of Intersections (3)

(g) Improvement of road way



(h) Prohibit car stopping near the corner



B. Taiz and Hodeidah

Locations of improvement of intersection are studied in Taiz in the same way as in Sana'a. The locations are in Fig. 11.2.10. There is no plan of improvement of intersections in Hodeidah.

Fig. 11.2.9 Locations of Intersection Improvement Plan

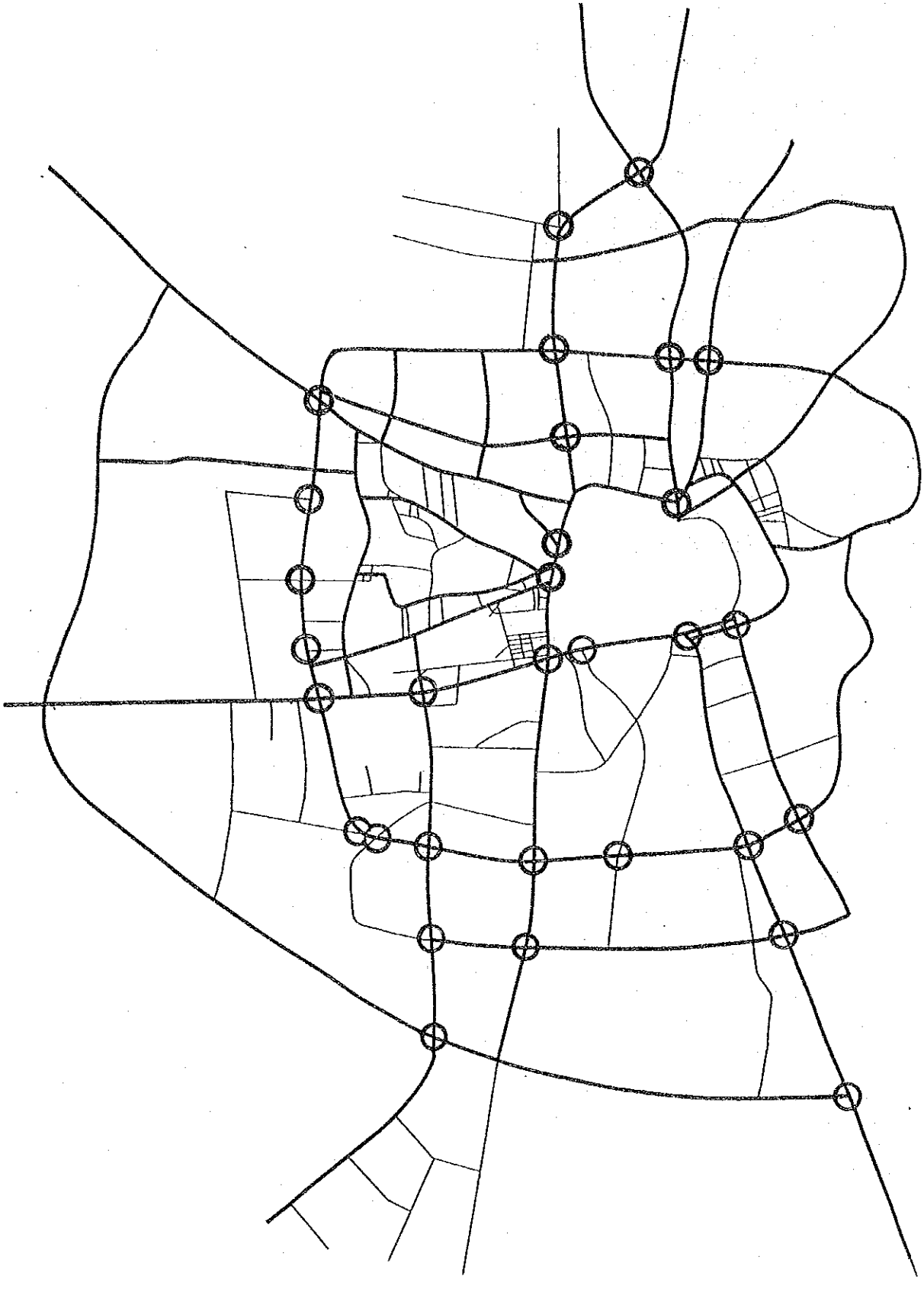
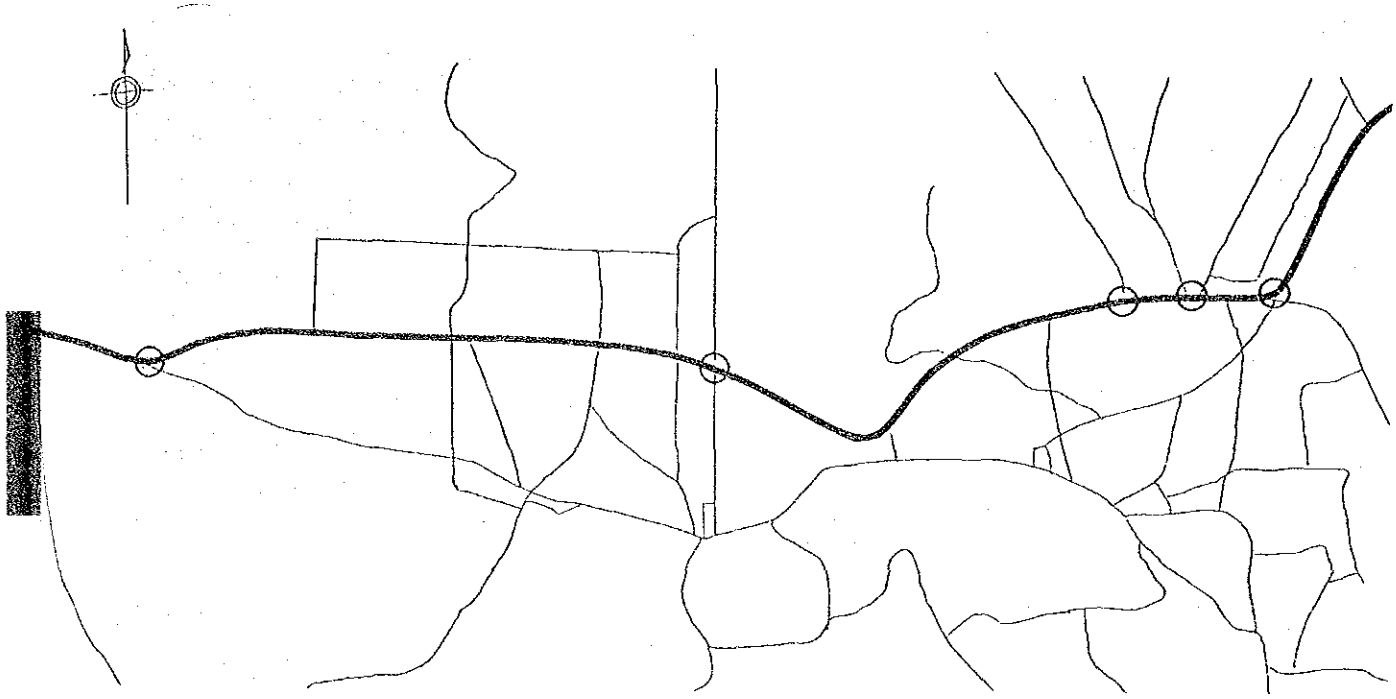


Fig. 11.2.10 Locations of Intersection Improvement Plan, Taiz



11.2.3 Traffic Safety Facilities Plan

1) Basic Policy

The traffic safety facilities plan is the preparation of facilities for the safety of drivers and pedestrians. They will materialize road functions into full use including a smooth flow of traffic. Traffic safety facilities will include pedestrian crossings, guard fences, traffic sign boards, road markings, reflectors and so on.

2) Plan Conditions

The points, where both motor and pedestrian traffic intermingle to a high degree, thus resulting in the need to achieve a smooth and safe flow of traffic, will be subject to this plan.

3) Description of Plan

(A) Pedestrian Bridge

The locations for the installation of pedestrian bridges will be determined by the following criteria.

a. School and hospital locations with high pedestrian crossing and vehicle traffic volumes.

b. Bus stop areas where passengers transfer buses and large pedestrian and vehicle traffic volumes.

c. Commercial areas with large buildings with high pedestrian and vehicle traffic volumes.

d. Areas that have a high incidence of vehicle-pedestrian accidents.

e. Roads that have more than 2 lanes a side without a median nor safety zone for pedestrians.

According to the above-mentioned criteria and the field surveys the following 11 locations are considered primarily to be possible sites for the installation of pedestrian bridges. With regard to some other points, however, pedestrian safety measures are already included in the intersection improvement plan and as a result they can be excluded from the possible installation points for pedestrian bridges.

a. Airport Rd.; Section Sadah Rd. - St. No. 19 (Pro. No. 1)

b. Ali Abdul Mughni St.; Front of Tahrir square (Pro. No. 2)

c. Az Zubayri St.; Front of Bab Al Yemen (Pro. No. 4)

d. Az Zubayri St.; Section Ring Rd. - St. No. 2 (Pro. No. 5)

e. Haddah Rd.; Front of Haddah Centre (Pro. No. 6)

f. Taiz Rd.; Section Ring Rd. - 45 m Rd. (Pro. No. 7)

g. Wadi Dahr Rd.; Front of Ministry of Justice (Pro. No. 9)

h. Ring Rd. (West side); Section St. No. 1 - St. No. 25 (Pro. No. 10)

i. Ring Rd. (West side); Front of Old Sana'a University (Pro. No. 10)

j. Ring Rd. (North side); Section Eastern Boulevard - Marib Rd. (Pro No. 13)

k. Ring Rd. (North side); Section Airport Rd. - St. No. 14 (Pro. No. 13)

An width of 10 m is supposed for b and c, while the 3 m width is for the others.

Fig. 11.2.11 shows the installation locations of the pedestrian bridges.

One important point to note is that pedestrians do not like to walk up and down those bridges. They prefer rather to cross the road. This is a general characteristic of the people not only in Yemen but in other countries. In Tokyo some pedestrian bridges are rarely used, people prefer to cross the road at signalized sections with a longer walk distance. In Taiz, there are two pedestrian bridges but people use them occationaly.

Conceptually it is safer and better for smooth traffic flows than the at-grade crossing. In this study it is proposed to accompany a guard fence installation (150 m length on the median) which may enforce people to use the bridge, not cross the road. (see the following (B) (C))

It is said MMH and Sana'a Capital Office have prepared plans of pedestrian bridges which can be constructed when materials are supplied from Saudi Arabia. Locations are mostly same as

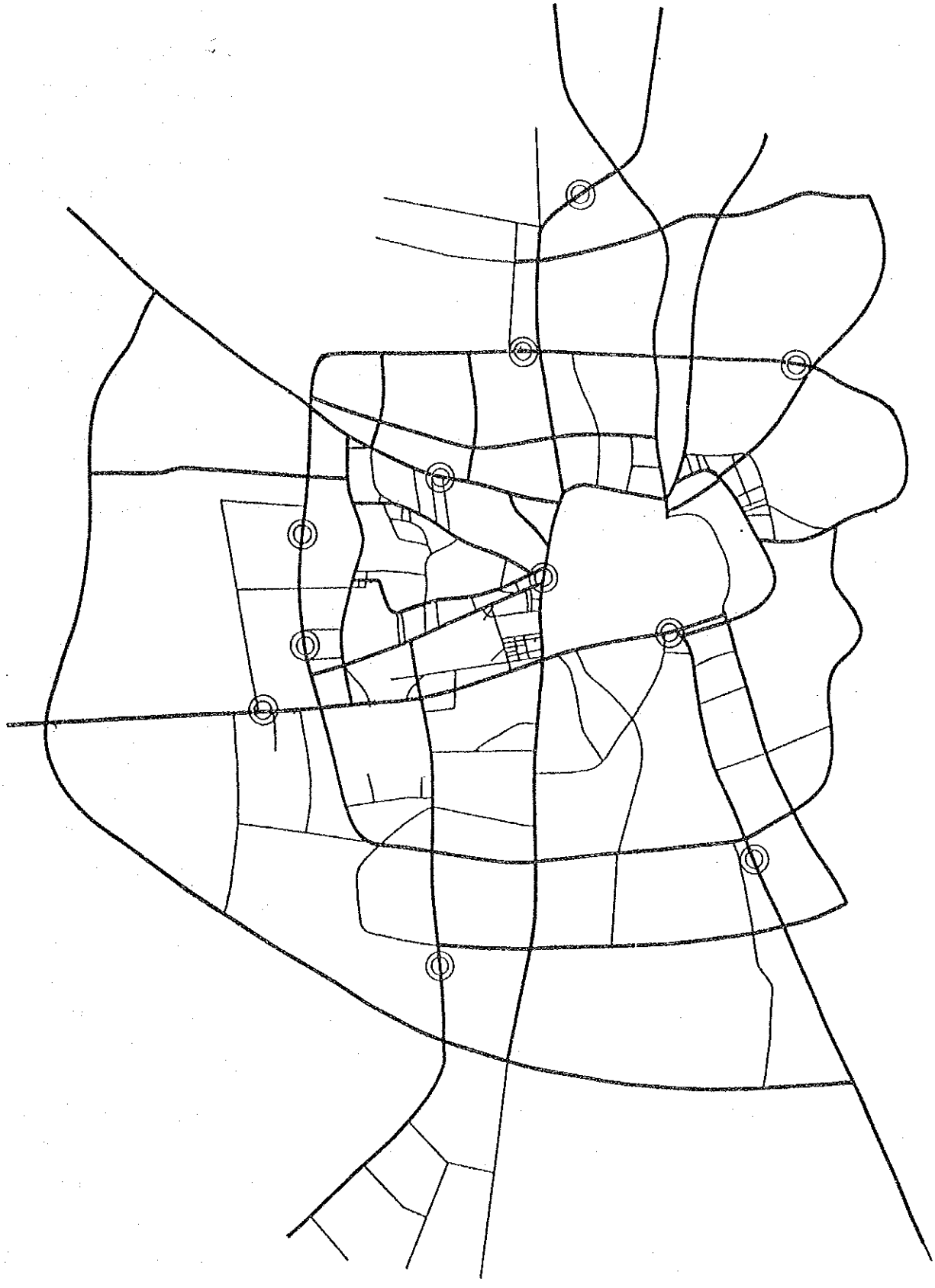
in Fig. 11.2.11 but the program of construction is not finalized yet.

MMH had prepared plans of three underground paths crossing the Ali Abdul Mughni street. They have not been implemented yet. Also there are ideas to construct shopping corridors along the underground paths. Construction cost is rather high in either case when compared with overhead bridges.

Plan of underground paths together with shopping corridors is an idea worthy to be studied. Cost, funding sources, repayment program, maintenance, rent of the shops, etc. should be studied. Privatization possibility is also a subject of the study.

There are two pedestrian bridges in Taiz. It is considered no additional ones are necesary. In Hodeidah no pedestrian bridges are proposed.

Fig. 11.2.11 Pedestrian Bridge Location



(B) Guard Fences

As the indiscriminate crossing of streets by pedestrians obstructs the flow of traffic, thus causing traffic accidents, the object of this plan is to prevent the disorderly crossing of streets by pedestrians. The protection of the pedestrians themselves and the maintainance of a smooth traffic flow are expected by means of installing guard fences.

The following criteria are used to select sites for the installation of guard fences.

a. All sections near major signal intersections of arterial streets.

b. Sections located on either side of pedestrian crossings.

c. Sections located on either side of pedestrian bridges.

The length of guard fences to be installed each at these points will be approximately 150 m. It is proposed to be placed on medians rather than both sides. Fig. 11.2.12 shows the sites for guard fences in Sana'a, Fig. 11.2.13 in Taiz and Fig. 11.2.14 in Hodeidah.

(C) Traffic Sign Boards

Traffic sign boards are used to achieve the smooth and safe flows of road traffic while also aiming at the maximum use of the roads. Traffic signs are classified into information, warning, regulation and direction signs. While they are all important for the management of traffic, the number of the existing road signs is insufficient. This number must be increased to achieve traffic safety.

With regard to regulation signs, "stop", "non-parking" and "one-way" signs in particular are low in number. The number of "Road" signs showing place names, etc. and direction signs are again a few in number. However, Sana'a Capital Office has recently installed approximately 70 posts on the

Fig. 11.2.12 Guard Fences in Sana'a

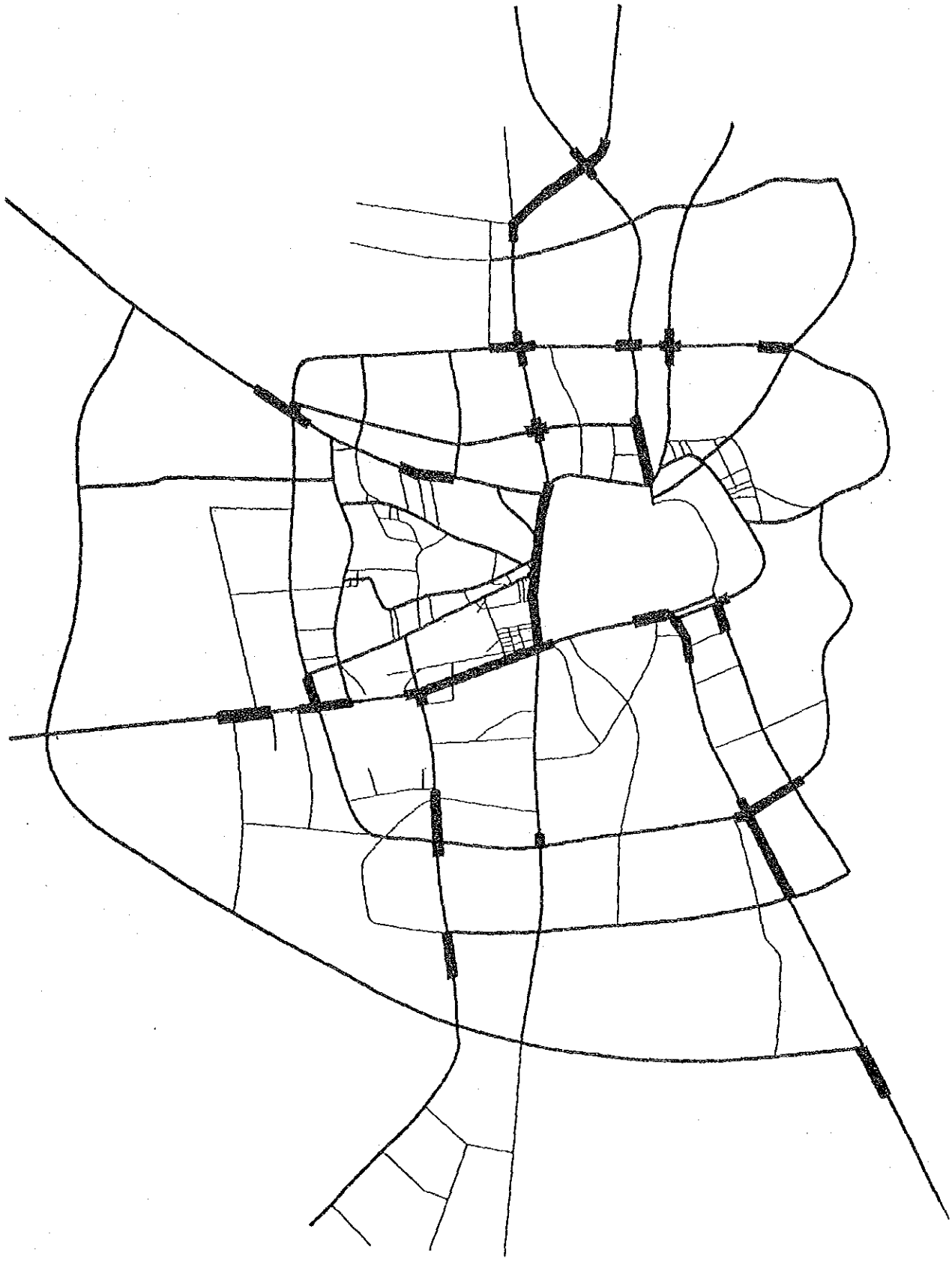


Fig. 11.2.13 Guard Fences in Taiz

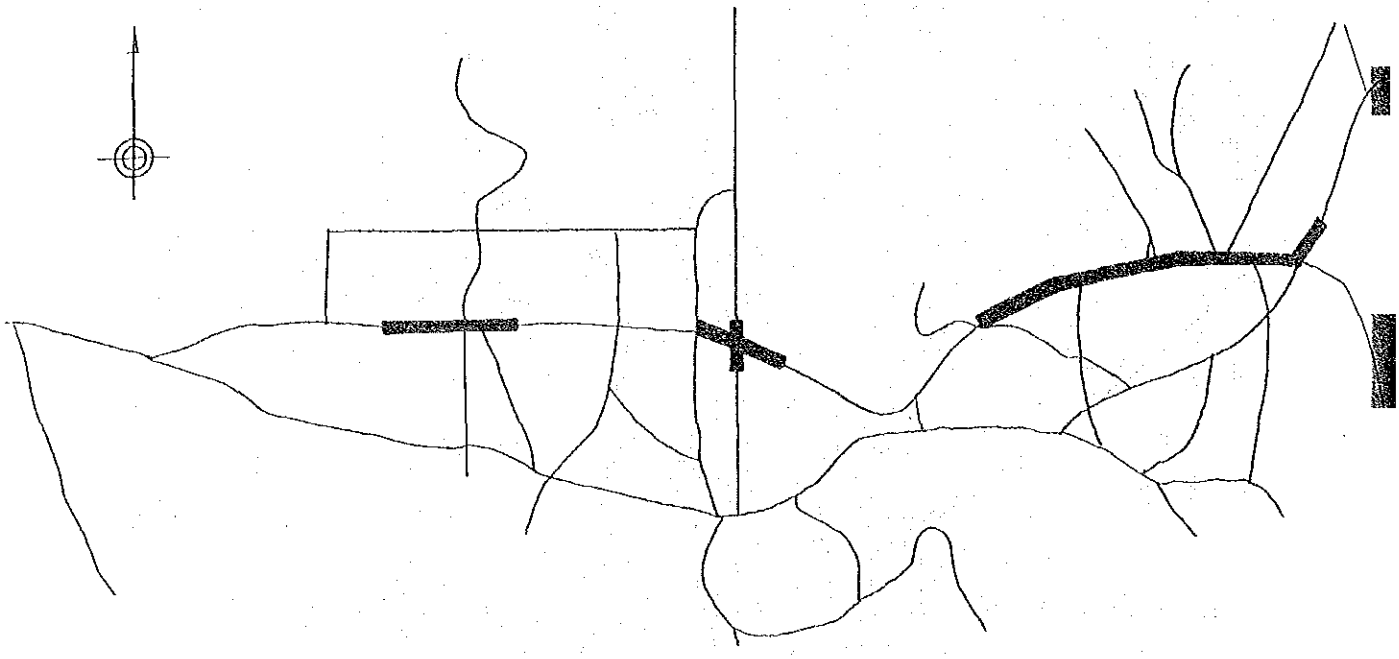
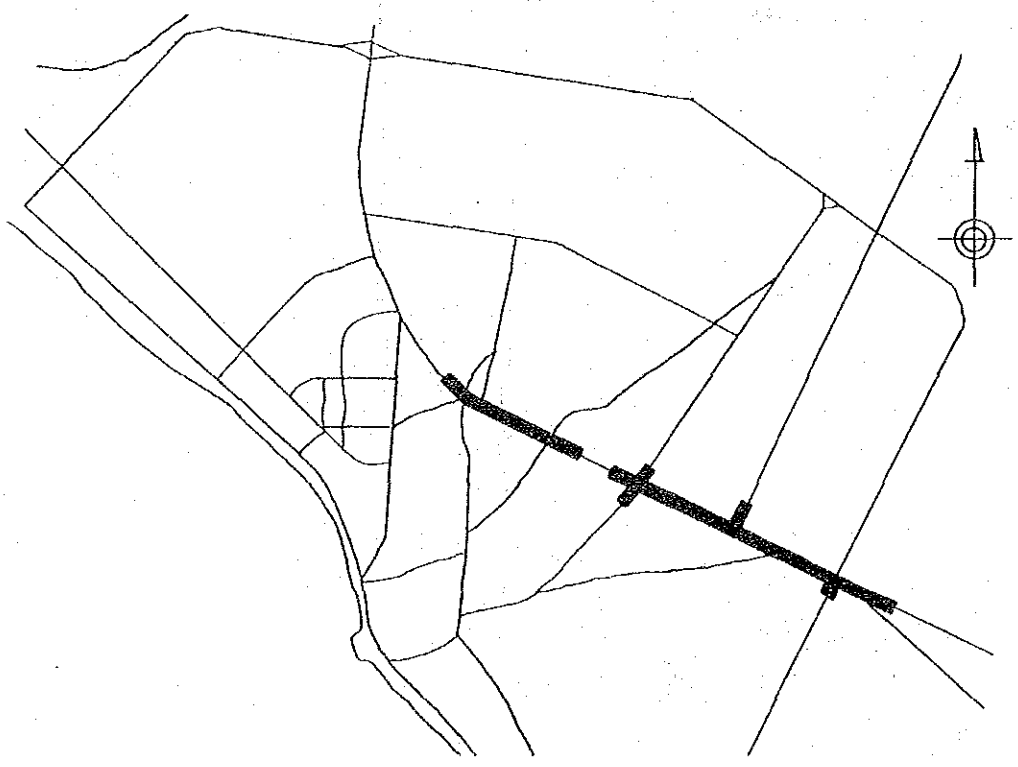


Fig. 11.2.14 Guard Fences in Hodeidah



intersections of major roads including Ring roads. They show the direction by arrow and road name in Arabic and English. Among various regulation signs, parking regulation sign will be installed at the rate of at least 8 per block for the restricted area, namely the central district surrounded by Ring road. A total of some 203 signs should be installed on the main roads in the city. Main intersections of arterial or semi-arterial roads with secondary roads or at intersections where there is a high rate of accidents, some 50 "stop" signs should be installed. There are marked on the drawings in Vol. III.

In reality, these numbers are not enough to have a diciplined traffic movement. Although they are not marked on the Drawing, other 253 sign boards are proposed to be installed on the minor intersections and merging/diverting points. The cost is estimated for the total of 506 signboards in association with the main road network.

There are a number of intersections on unpaved secondary and communnity roads. Provision of sign boards, one-way rules, paint marks, etc. should be decided when their road priority and surface work are determined. Traffic sign boards on minor streets are not included is this study.

(D) Road Marking and Reflectors

Road markings and reflectors will be installed at intersections, pedestrian crossings, center lines where a median is not installed (an example is Old Airport road from Zubayri Int. to Ring road) and at places where there is a need to attract the attention of drivers. Roads with a high frequency of traffic accidents will be given priority. Marking on roads is indicated on Fig. 11.2.15 for Sana'a, Fig. 11.2.16 for Taiz and Fig. 11.2.17 for Hodeidah.

Fig.11.2.15 Marking Location, Sana'a

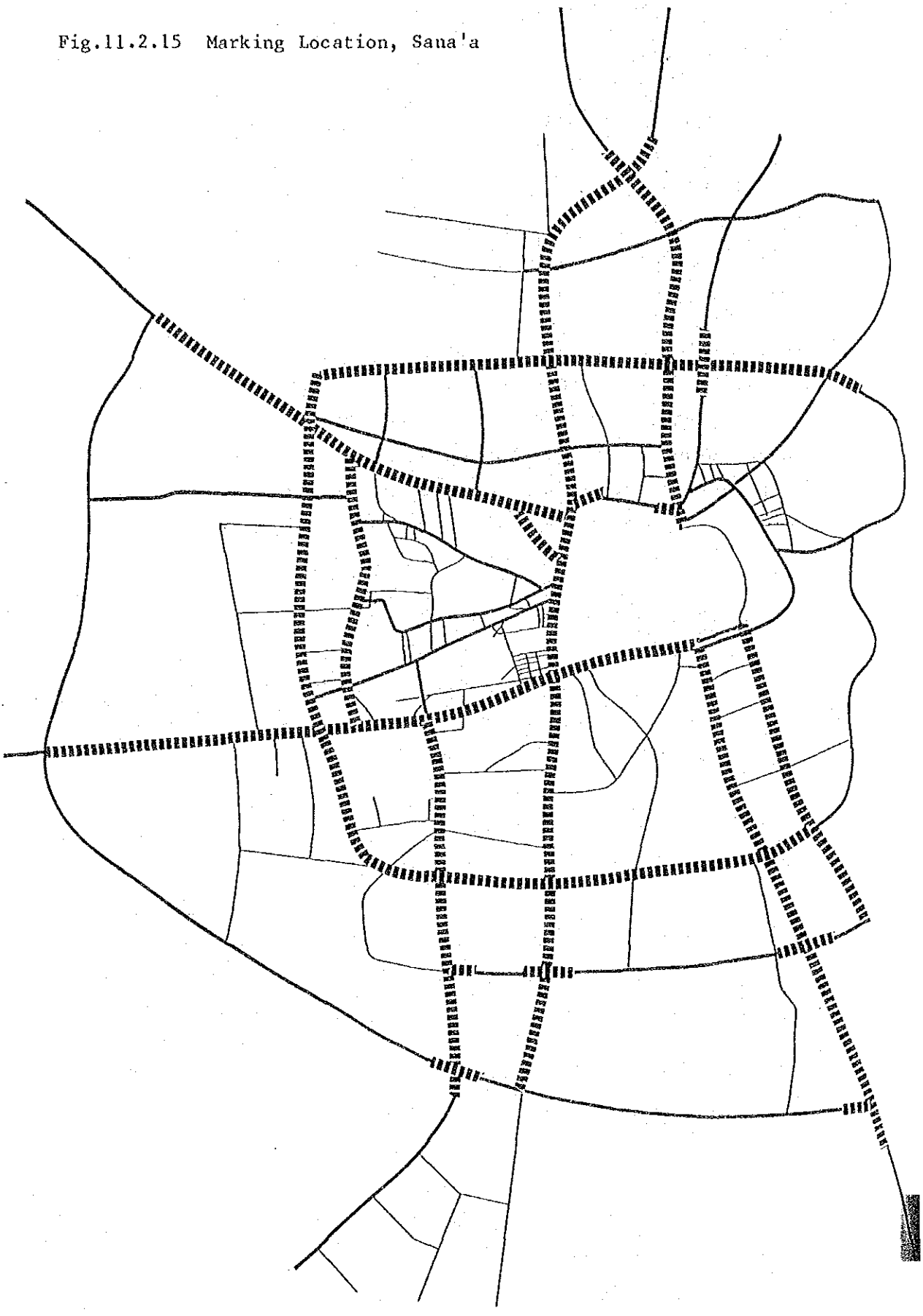


Fig. 11.2.16 Marking Locations, Taiz

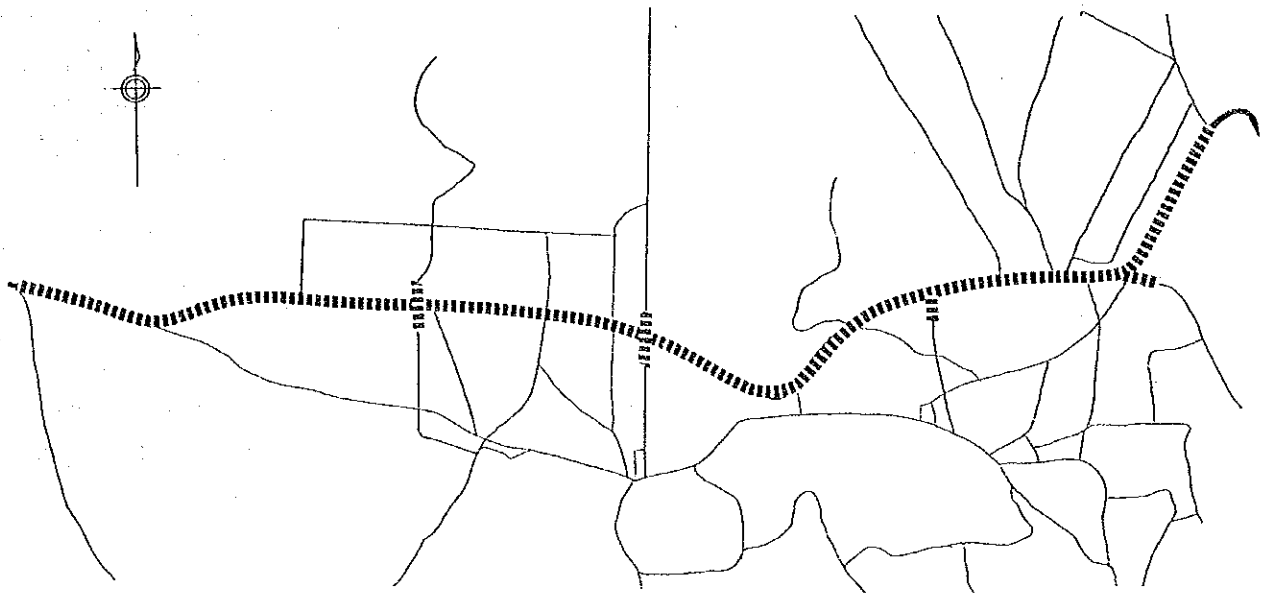
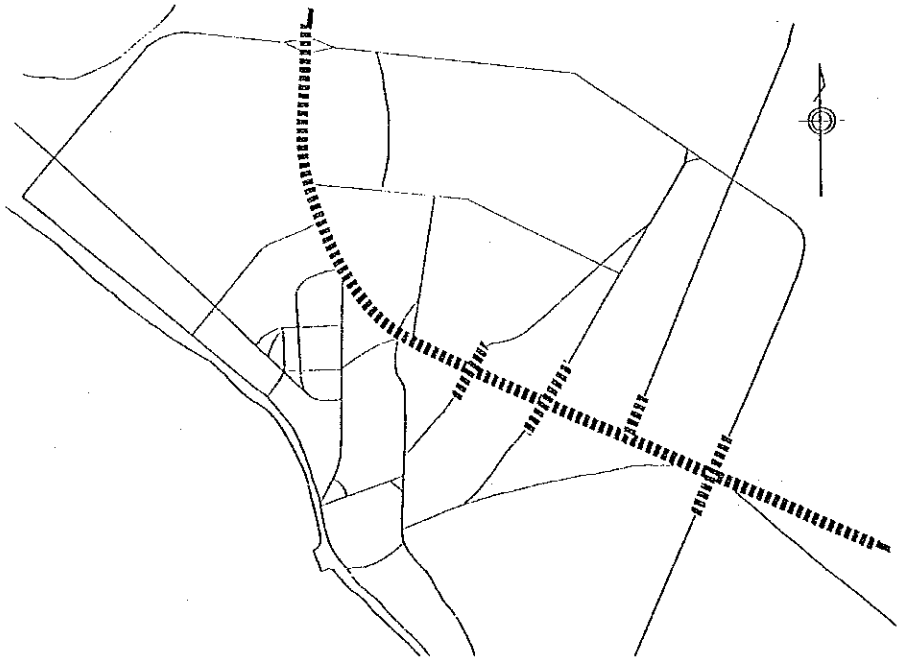


Fig. 11.2.17 Marking Locations, Hodeidah



11.2.4 Traffic Regulation Plan

1) Basic Policy

The traffic regulation plan is a supplementary measure with the purpose of improving the efficiency of the existing road system. It intends the mitigation of traffic congestion and the reduction of traffic accidents. The main subjects will be the regulation of parking.

2) Plan Conditions

Of those areas that have been identified as heavily congested areas by the analysis of current conditions (where the average speed is 20 km/hr or less), those locations where the curb parking density is 50% or more will be subject to parking regulations.

3) Description of the Plan

A. Parking Regulation

When an arterial street is congested, the congestion tends to spread from the arterial street to the access roads that connect to it. Road side parking is often chaotic on these streets, making it necessary to control curb parking. This control is necessary to minimize the capacity reduction and a high incidence of accidents at intersections.

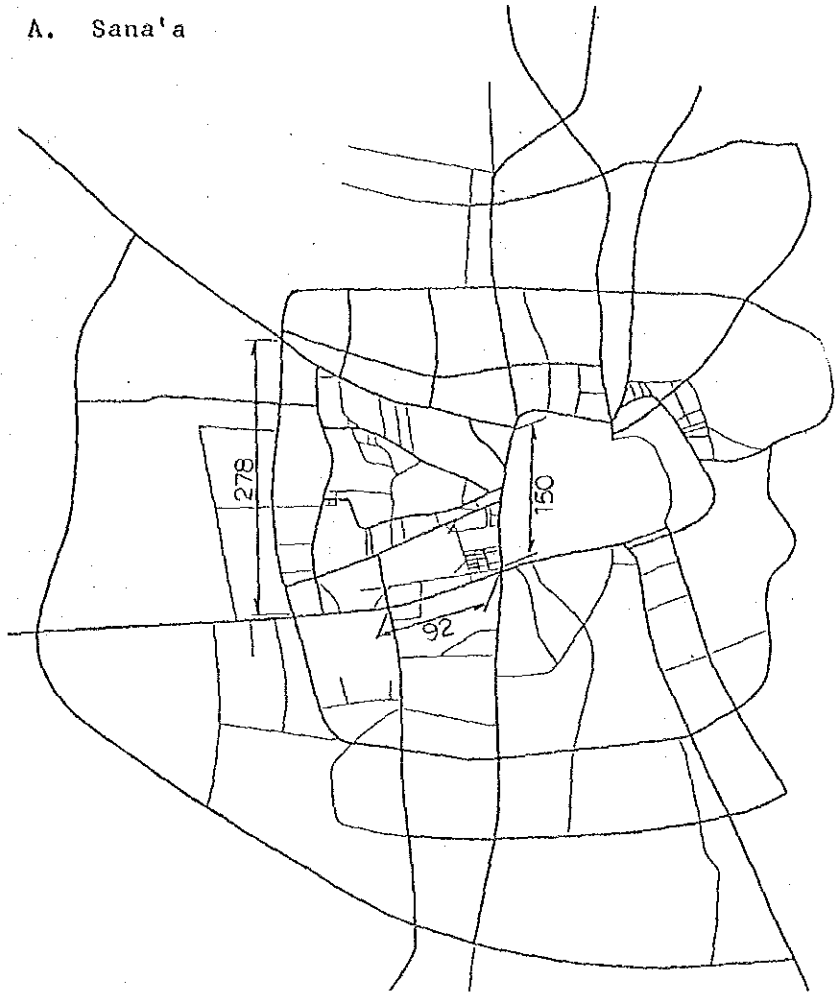
The areas subject to parking control and construction of park space in Sana'a are in the following. (See Fig. 11.2.18A)

a. Ring road; Section Wadi Dahr Rd - Az Zubayri St.

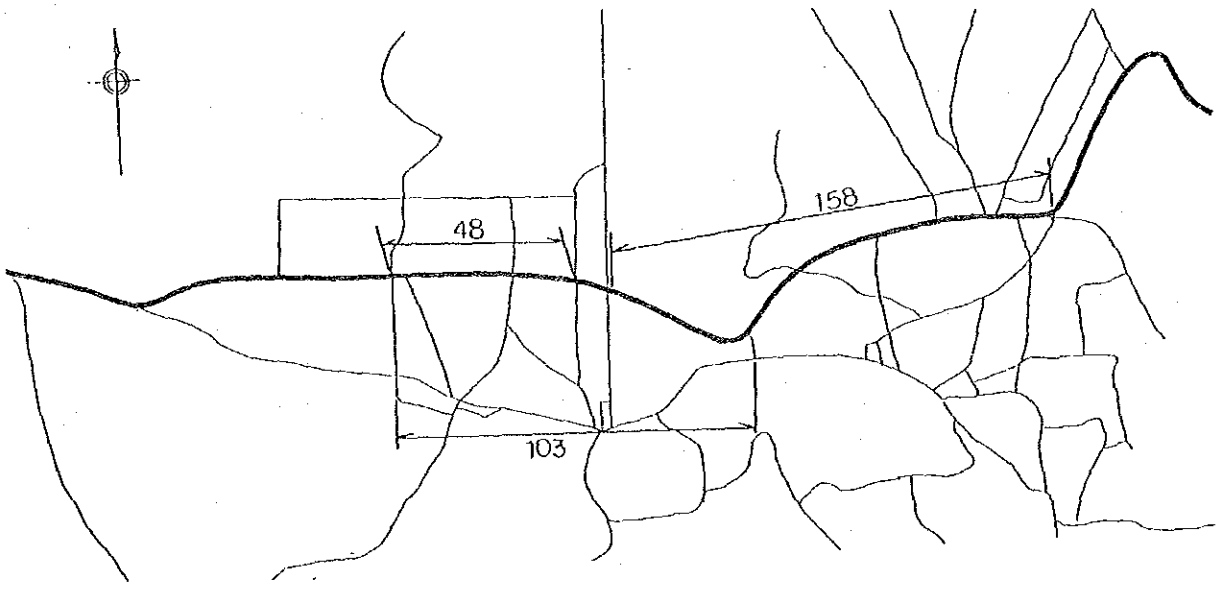
Vehicles park on curbs or any available space including sidewalks for pedestrians. There are unsurfaced streets in the adjacent area which could be surfaced and designed for use as parking lots. Vehicles could easily find parkable places on those surfaced streets and lots, resulting in less parking on Ring road. (28 m^2/veh x 278 = 7,780 m^2 is required for parkings spaces)

Fig.11.2.18 Shoulders Regulating Vehicle Parking

A. Sana'a



B. Taiz



b. Az Zubayri St.; Section Ali Abdul Munghni - Haddah St.
If parallel parking is enforced on the curbs in stead of the current 60 degree angle parking and/or double parking, a parking area of 2,570 m^2 would be necessary (28 m^2/veh x 92 = 2,570 m^2).

c. Ali Abdul Munghni St.; Section Wadi Dahr Rd - Az Zubayri St.
If parallel parking is enforced on the curbs instead of the current 60 degree parking and/or double parking, a parking lot of 4,200 m^2 (28 m^2/veh x 150 veh) is requested.

The areas subject to parking control in Taiz are in the following. (See Fig. 11.2.18.B)

a. Jamal St.: Section As Samil St. - Ali Uthman St.
28 m^2 x 206 veh = 5,760 m^2

b. Jaynai St.: 26th Sept. St.; Section As Samil St. - Ali Uthman St. 28 x 103 = 2,880 m^2.

Situation in Hodeidah is not much severe as in other two cities.

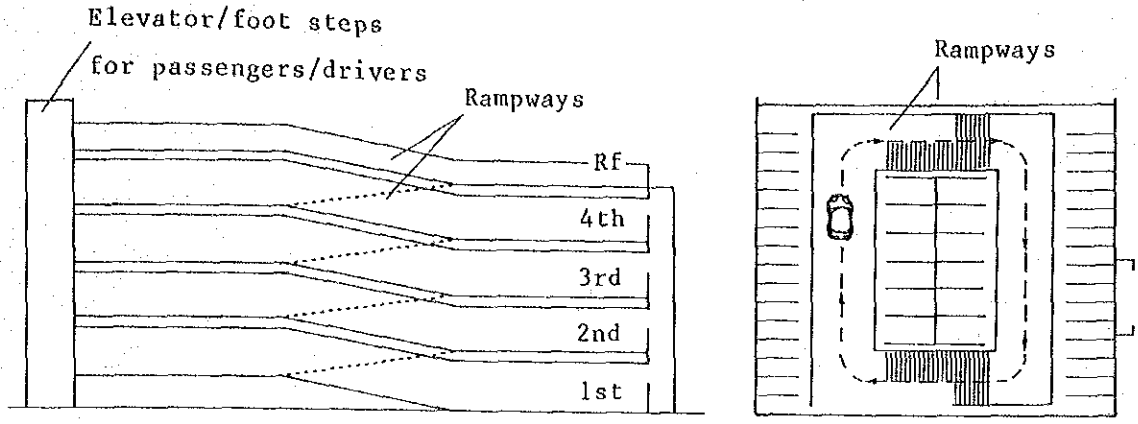
The type of parking control, i.e. time limited control/all day control, etc. should be decided for each specific area.

Based on the present parking conditions, the time limited control will be classified into the following 2 categories.

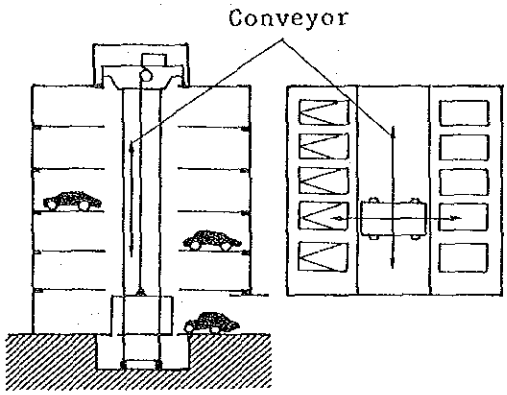
- Curb parking permitted time should be determined by its hourly traffic pattern of the location: 15, 30, 45, 60 minutes and so on.
- No curb parking zones between 08.00 - 20.00 hours.

A parking garage building is another alternative. Examples of parking buidling are shown below. A is a multi story parking building. Vehicles simply drive up ramps to find a parking spot. Example B is a mechanized system where vehicles are moved up and placed at a spot by conveyors.

A. Parking Building



B. Mechanized Parking Building



It should be a legal requirement for all buildings including residences. Those having vehicles must provide for parking within their compound.

4) One-way Regulation

Inside the Ring road, there are some one-way regulated road-sections. This study considers those regulated streets should remain as they are and police enforcement should be strengthened together with addition of sign boards and marking.

CHAPTER 12 COST ESTIMATION

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12.1 Estimation Method

12.1.1 Precondition for Project Cost Estimation

1) Contract Method

MMH has been constructing roads by either closed tender or the direct force account method. Direct construction method is used only for small maintenance or gravel road work. MMH usually introduces closed tender for projects of roads and other infrastructure. However, in view of the fact that a rather short time is available for work with the target completion year of 1991 and also because the subject plan includes technical experience necessary to introduce traffic signal systems, it is assumed for the purpose of present cost estimation that all the subject projects be completed under a contract base through international tendering.

2) Construction Method

In the cost estimation, a construction method to use labor intensive methods is assumed since improvement work at each intersection is small in scale and physical conditions in surrounding urban area do not have enough opening to the full use of machines.

3) Base Year for Cost Estimation

Cost calculation of materials, labor, and machinery, is based on the prices in March 1988.

12.1.2 Estimation

Following the generally used estimation methodology, each construction cost item (e.g. earthwork, foundation work, pavement, etc.), consisting of materials, machinery, and labor cost components, is calculated by the product of unit price and quantity. These cost items are totaled to the total direct

construction cost. Then, added to the direct cost is the indirect cost consisting of temporary facilities, field office maintenance and overhead, each prorated to the individual direct cost item. The total of direct and indirect cost, thus obtained, gives the unit contract price of each cost item. Total direct and indirect construction cost plus engineering service cost and allowances for contingencies are summed to the total construction cost. The Total Project Cost consists of total construction cost, compensation cost, and land acquisition costs (see Fig. 12.1.1 for the cost estimation process).

1) Labor Cost

Labor cost is classified into five categories, such as driver, foreman, operator, skilled and unskilled labor. The average unit wage for each category can be determined by data from private companies.

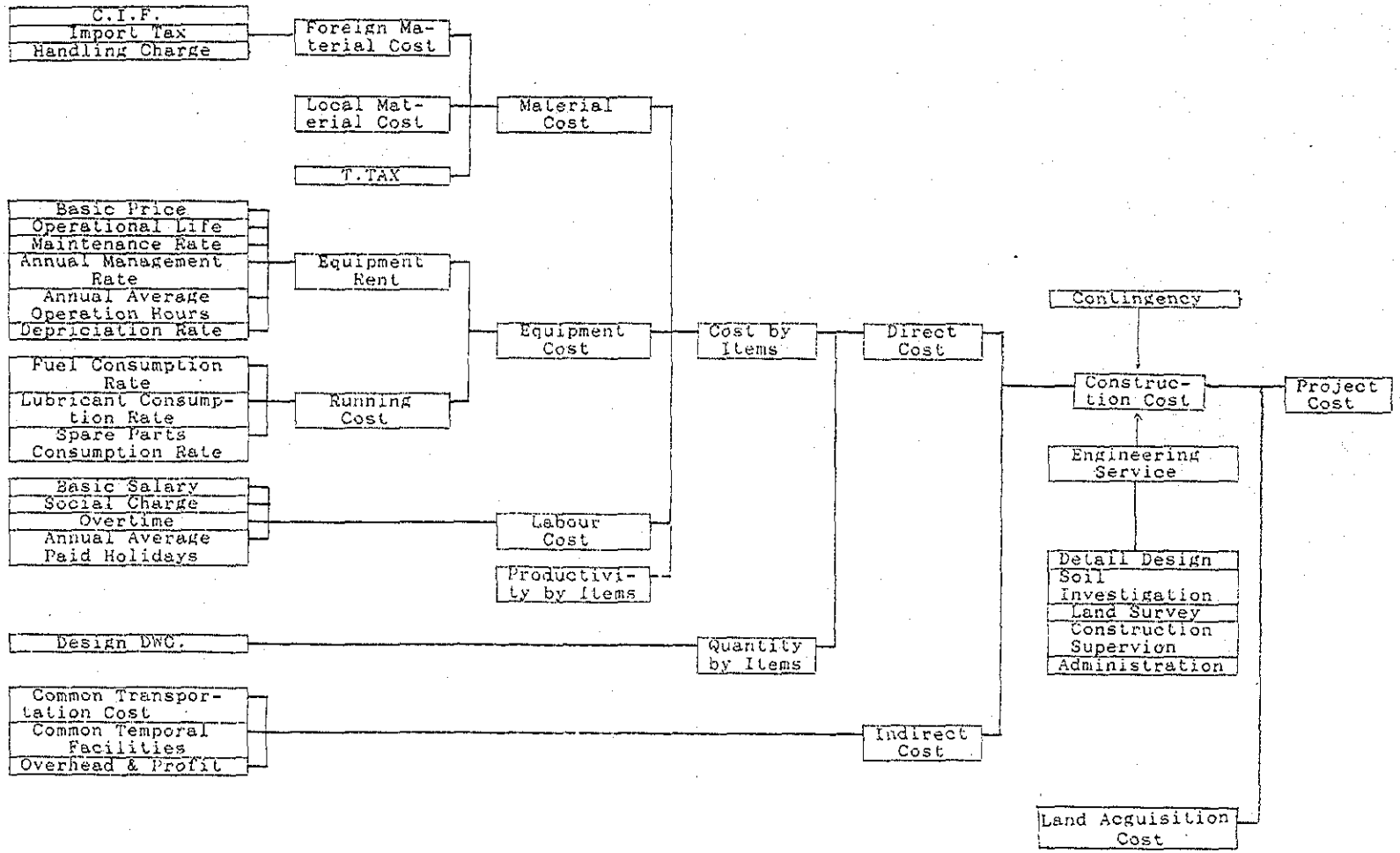
Labor cost includes the social charges like social insurance, retirement fund, educational allowance, bonus, vacations, national holidays, license fee, overtimes charges and so on. These charges amount to 43% of the base wage for full-time workers of private companies, being shown in Tables 12.1.1 and 12.1.2.

2) Machinery Cost

Machinery cost is broken down into rental and operation cost. The machinery rental cost is estimated by the base price of the machine, its operational life, residual value, annual operation hours, and annual maintenance rate. The machinery operation cost consists of fuel consumption, lubricant and spare parts. The machinery basic price was referred to the data obtained from Highway Authority and from prices in Japan. The hourly machinery cost is calculated from the numbers of the machinery operation life and the annual operation hours which were taken from the rental calculation table for construction equipment in Japan, issued by The Japan Mechanization Association.

This estimation method allows the use of same equipment for more than one project, and the rental is paid only for the hours the equipment is operated. Therefore, equipment may be brought into

Fig. 12.1.1 Cost Estimation Process



Y.A.R. without import tax, provided that the equipment is brought out upon work completion (or the tax is paid only when the equipment is sold in Y.A.R). Cost for transporting the equipment may not be attributed to any particular unit price item for unit price contracting and, therefore, is included in common temporary work cost as a part of indirect cost. Table 12.1.3 shows the machinery costs, and Appendix Note 12.1 presents the calculation method of machine cost.

Table 12.1.1 Social Charge and Overhead

Description	Rate per Salary (%)
Social Insurance	9.75
Retirement Fund	5.67
Educational Allowance	1.25
Bonus 1/	9.81
Vacation	11.35
National Holidays	2.97
Licence Fee	2.62
Total	43.42

Table 12.1.2 Labor Data

Labour Name	Unit	Basic Wage	Social Insurance Rate (%)	Monthly Overtime Work (h)	Overtime Charge Rate	Total Wage Foreign	Local Financial	Local Economic
Driver	hour	21.50	43.42	40	1.25	0.00	31	31
Foreman	hour	32.50	43.42	40	1.25	0.00	47	47
Operator	hour	32.50	43.42	40	1.25	0.00	47	47
Skilled Labour	hour	26.00	43.42	40	1.25	0.00	37	37
Unskilled Labour	hour	19.50	24.83	0	1.25	0.00	24	22

Table 12.1.3 Machine Costs

Equipment Name	Basic Price	Operational Life	Residual Value	Annual Operate Hour	Maintenance Rate (%)	Annual Manage Rate (%)	Diesel Oil (l/h)	Electricity (kw/h)	Lubricant (%)	Foreign Financial	Local Financial	Local Economic
Asp. Finisher 3m	74500	7	10.00	550	50.00	7.00	3.26	0.00	30.00	35.19	23	3
Batching Plant	480000	7	10.00	950	60.00	7.00	20.80	78.00	30.00	147.37	188	80
Belt Con. 0.35*10m	1500	2	10.00	600	55.00	5.00	1.37	0.00	30.00	2.03	3	1
Belt Con. 0.6*15m	14900	4	10.00	600	55.00	5.00	1.50	0.00	30.00	9.81	9	2
Bulldozer 11t	65000	7	10.00	1500	65.00	7.00	8.50	0.00	30.00	13.26	19	9
Compressor 4.6m^3	17000	6	10.00	1000	50.00	5.00	6.00	0.00	30.00	5.55	11	6
Compressor 9.6m^3	27000	6	10.00	1000	50.00	5.00	10.17	0.00	30.00	8.92	18	11
Concrete Cutter 0.3m	7000	6	10.00	680	25.00	5.00	0.48	0.00	30.00	2.48	1	1
Conc. Breaker 30kg	550	2	10.00	960	20.00	5.00	0.00	0.00	30.00	0.33	0	0
Conc. Bucket	1800	5	10.00	560	55.0	5.00	0.00	0.00	30.00	1.02	1	0
Crawlor Crane 35t	261000	7	10.00	1000	70.00	7.00	6.50	0.00	30.00	73.81	59	7
Distributer 4kl	25000	6	10.00	530	40.00	7.00	0.67	0.00	30.00	13.01	7	1
Dump Truck 11t	62000	4	10.00	1550	60.00	10.00	6.30	0.00	30.00	18.86	20	7
Dump Truck 2t	13000	4	10.00	1550	55.00	10.00	6.36	0.00	30.00	4.72	11	7
Dump Truck 6t	3000	4	10.00	1550	60.00	10.00	5.00	0.00	30.00	9.46	12	5
Earth Oager 0.45	50000	4	10.00	950	35.00	7.00	2.11	0.00	30.00	19.57	12	2
Hand Hammer 1.1m^3	1200	2	10.00	1280	20.00	5.00	0.00	0.00	30.00	0.54	0	0
Line Marker 90kg	42000	5	10.00	1200	30.00	5.00	3.88	0.00	30.00	10.39	9	4
Mac. Roller 12t	50000	7	10.00	750	50.00	7.00	5.40	0.00	30.00	17.96	16	6
Motor Grader 3.7m	97000	6	10.00	850	50.00	7.00	7.80	0.00	30.00	34.03	29	8
Road Sweeper 1.8m	112000	5	10.00	950	50.00	7.00	8.70	0.00	30.00	40.38	35	9
Soil Compacter 0.05t	1800	3	10.00	800	45.00	5.00	0.30	0.00	30.00	1.11	1	0
Soil Compacter 0.2t	2800	3	10.00	800	45.00	5.00	0.48	0.00	30.00	1.73	2	1
Spray Gun	25500	5	10.00	1440	85.00	7.00	0.96	0.00	30.00	7.00	7	1
Sprayer 0.3kl	2200	3	10.00	1360	25.00	5.00	0.34	0.00	30.00	0.73	1	0
Surf. Vibrater 1.5*0	1800	4	10.00	530	65.00	5.00	0.43	0.00	30.00	1.45	2	0
Tendem Roller 10t	90000	7	10.00	650	45.00	7.00	5.57	0.30	30.00	35.59	25	6
Tire Roller 15t	120000	7	10.00	750	50.00	7.00	5.58	0.00	30.00	41.86	30	6
Truck 5t	20000	4	10.00	1250	55.00	10.00	4.50	0.00	30.00	7.72	10	5
Truck 8t	28000	4	10.00	1400	55.00	10.00	6.00	0.00	30.00	9.71	13	6
Truck Crane 11t	102000	7	10.00	900	35.00	7.00	3.00	0.00	30.00	27.55	15	3
Truck Crane 16t	160000	7	10.00	1000	35.00	7.00	5.00	0.00	30.00	39.02	22	5
Truck Crane 5t	67000	7	10.00	900	35.00	7.00	2.30	0.00	30.00	18.15	10	2
Truck Mixer 3m^3	47000	5	10.00	950	45.00	7.00	8.40	0.00	30.00	17.35	20	9
Vibrater	960	3	10.00	1280	35.00	5.00	0.00	0.30	30.00	0.36	0	0
Vib-Roller 3.5t	28000	7	10.00	600	45.00	7.00	1.70	0.00	30.00	11.95	8	2
Watering Cart 5.5kl	40000	5	10.00	1000	50.00	7.00	5.00	0.00	30.00	14.05	14	5
Wheel Loader 1.4m^3	76800	6	10.00	1200	60.00	7.00	8.45	0.00	30.00	20.51	1893	479

3) Material Cost

Prices for domestic construction materials were referred to the data obtained from private companies, to which the 12% of defence and local taxes was applied. Those material prices which are unavailable in Y.A.R. were assumed based on prices of similar materials in neighboring countries or in Japan.

Most domestically manufactured products are processed from imported raw materials (for instance, gasoline and diesel oil are partly refined from imported crude oil and reinforcement bars are fabricated from imported ingot), and a few are made completely from domestic raw materials.

The price of materials for which raw materials are available in Y.A.R. such as sand, aggregate and cement represent small part of the cost while other part is for operation of equipment or the plant for their processing. Therefore, a certain part of these domestically available construction material cost is assumed to include a foreign currency portion. The assumed percentages are in Table 12.1.4 where the foreign currency portion for imported materials was determined from the data of import tax rate, market price and handling charges. Table 12.1.5 shows material and equipment cost.

Table 12.1.4 Foreign Currency Portion in Raw Material

Description	Foreign Portion %	Local Portion Financial %	Local Portion Economic %
Cement	60	40	29
Sand	60	40	29
Crushend Stone	60	40	29
Filler	60	40	29
Reinforcement	60	40	29
Gasoline	50	50	30
Diesel Oil	50	50	30

No cost difference is assumed between the mono and the multi signals. There are several sets of coordinated signals in the plan. It is not a sophisticated one but a quite simple system. The cost of link cable installation and the machine is estimated higher by 20% for the case of coordinated one. All positions of traffic sign boards cannot be shown in drawings in Vol III. Those at main points are marked there. Additionally, same number of sign boards are necessary. In the cost estimate, the total of 506 sign boards is taken into account. Directional guide posts are not included in the cost estimate since they were installed in March - June 1988 and seem to be sufficient in number and design.

Examples of cost calculation of works in asphalt and signal are shown in Appendix Note 12.2.

Table 12.1.5 Material & Equipment Cost

Material Name	Sales Per	Unit Unit	FOB Price	Tariff Fixed Rate	Sales Tax (%)	Weight (kg)	Total Price Foreign	Total Price Local Financial	Total Price Local Economic	Unit Price Foreign	Unit Price Local Financial	Unit Price Local Economic
Asphalt 80-100	1.00	TON	116.46	10.00	12.00	1000.00	116.460	1023	760	116.460	1023	760
Asphalt Emulsion-2	1.00	Lit	0.18	10.00	12.00	1.00	0.180	1	1	0.180	1	1
Cat Eye	1.00	PCS	14.25	10.00	12.00	1.00	14.250	33	1	14.250	33	1
Chatter Bar	1.00	PCS	52.80	10.00	12.00	2.00	52.800	121	2	52.800	121	2
Separater	1.00	PCS	63.00	10.00	12.00	2.00	63.000	144	2	63.000	144	2
Cement	1.00	TON	60.47	0.00	12.00	0.00	60.470	410	291	60.470	410	291
Crusher Run	1.00	CUM	4.23	0.00	0.00	0.00	4.230	29	20	4.230	29	20
Curing Mat	1.00	SQM	3.01	10.00	12.00	0.20	3.010	7	0	3.010	7	0
Curing Material	1.00	kg	3.85	10.00	12.00	1.00	3.850	9	1	3.850	9	1
CV Cable 14A	1.00	LM	1.69	10.00	12.00	1.00	1.690	5	1	1.690	5	1
Filler	1.00	CUM	3.18	0.00	0.00	1000.00	3.180	760	760	0.160	38	38
Guard Rail	1.00	LM	55.20	15.00	12.00	12.90	55.200	165	10	55.200	165	10
Hand Rail 2.0*0.8	1.00	LM	66.70	15.00	12.00	12.90	66.700	197	10	66.700	197	10
Pozolis	1.00	Kg	1.77	10.00	12.00	1.00	1.770	5	1	1.770	5	1
PVC Conduit	1.00	LM	5.58	15.00	12.00	1.64	5.580	17	1	5.580	17	1
Reinforcement	1.00	ton	480.00	15.00	12.00	1000.00	480.000	2108	760	480.000	2108	760
Release Material	18.00	lit	38.00	35.00	5.00	18.00	38.000	168	14	2.110	9	1
Sand	1.00	CUM	7.86	0.00	0.00	0.00	7.860	53	38	7.860	53	38
Scaffolding	1.00	PCS	10.58	10.00	0.00	0.00	10.580	10	0	10.580	10	0
Screened Crusher	1.00	CUM	15.12	0.00	0.00	0.00	15.120	102	73	15.120	102	73
Sealing Sheet	1.00	SQM	2.69	10.00	12.00	0.20	2.690	6	0	2.690	6	0
Signal (Ve.)	1.00	SET	2300.00	35.00	5.00	30.00	2300.000	9385	23	2300.000	9385	23
Signal (Arrow)	1.00	SET	790.00	35.00	5.00	10.00	790.000	3223	8	790.000	3223	8
Signal (Ped.)	1.00	SET	1200.00	35.00	5.00	10.00	1200.000	4892	8	1200.000	4892	8
Stabilizer	1.00	PCS	61.50	35.00	5.00	5.00	61.500	254	4	61.500	254	4
Steel Form 03*1.5	1.00	PCS	0.83	15.00	12.00	0.00	0.830	2	0	0.830	2	0
Steel Wire #10	1.00	ton	650.00	15.00	12.00	1000.00	650.000	2585	760	650.000	2585	760
Steel Wire #20	1.00	ton	842.00	15.00	12.00	1000.00	842.000	3124	760	842.000	3124	760
Controller (Ped.)	1.00	SET	9400.00	35.00	5.00	0.00	9400.000	38264	0	9400.000	38264	0
Controller (Link)	1.00	SET	12500.00	35.00	5.00	0.00	12500.000	50883	0	12500.000	50883	0
Controller (center)	1.00	SET	22500.00	35.00	5.00	0.00	22500.000	91589	0	22500.000	91589	0
Taper Pole	1.00	PCS	861.00	15.00	12.00	52.00	861.000	2457	40	861.000	2457	40
Tile	1.00	SQM	4.74	0.00	12.00	0.00	4.740	31	23	4.740	31	23
Traffic G-Bead	1.00	Kg	1.42	10.00	12.00	1.00	1.420	4	1	1.420	4	1
Traffic Paint	1.00	lit	5.60	10.00	12.00	1.00	5.600	13	1	5.600	13	1
Traffic Sign 3'	1.00	SET	115.00	35.00	5.00	0.00	115.000	468	0	115.000	468	0
Traffic Sign 4'*6'	1.00	SET	160.00	35.00	5.00	0.00	160.000	651	0	160.000	651	0

4) Land Acquisition Cost

There are few examples of land acquisition for public facilities in Sana'a City. Therefore land acquisition cost in financial terms is referred to market prices which are obtained from private companies. The cost is assumed at half in the net economic and shadow priced costs.

5) Indirect Cost

Common temporary work cost includes transportation of commonly used heavy equipment and field plants, mobilization and demobilization, installation and removal of such temporary facilities as power supply, underground water conservation, safety facilities, quality and progress control, utilities, and field office maintenance. Field management cost includes wages, office supplies, and other expenses incurred at field offices, while, general administration overhead is that which is incurred at the contractor's head office.

Unlike direct construction cost, these indirect costs can vary substantially from one contractor to another, and a number of assumptions must be made for their estimation. Therefore, the ratio of indirect cost to direct cost in consultants experience is used. The foreign currency portion and the local currency portion of indirect costs are estimated at 22% and 14% of the direct costs, respectively, or 36% combined, being shown in Table 12.1.6.

6) Engineering Cost

The cost of design and construction supervision is estimated assuming that such work will be contracted out, following the usual MMH practice. Based on previous experiences in Y.A.R, the engineering service cost is estimated at 10% of the total of direct and indirect cost. Of the estimated engineering cost, 80% is allocated to the foreign currency portion and 20% to local.

An additional 2% of total direct and indirect costs is included in the local currency portion to cover the administration cost of MMH for bid processing and contracting.

7) Contingency

Contingency consists of both physical contingency which includes unexpected costs and price contingency which includes price inflation. In view of the fact that the subject projects are to be implemented in urban areas where unexpected difficulties are highly possible, 15% of the total construction cost plus the engineering cost is taken here.

8) Annual and Periodic Maintenance Cost

Maintenance cost of the subject projects is determined as in Table 12.1.7. In the economic evaluation, annual maintenance of 5.9% of the initial investment and remarking in every 3 years are assumed.

Table 12.1.6 Indirect Cost Component

Description	Foreign Portion %	Local Portion %	Total %
1. Common Temporary Facilities			
1-1 Transportation	1.06	0.12	1.18
1-2 Mobilization and Demobilization	0.38	1.07	1.45
1-3 Temporary Facilities	0.40	0.60	1.00
1-4 Safety Facilities	0.32	1.38	1.70
1-5 Public Services Charge	-	1.00	1.00
1-6 Quality Control	0.44	0.44	0.88
1-7 Field Office Maintenance	0.72	0.89	1.61
Subtotal	3.32	5.52	8.82
2. Field Management	3.40	9.22	12.62
3. General Management	15.00	-	15.00
Total	21.72	14.72	36.44

Note: Unit; Percent to the direct cost

Table 12.1.7 Maintenance Cost Estimate

Description	Frequency	Cost Ratio	Cost/Year (%) Foreign	Local
1. Routine Maintenance				
1-1 Traffic Signal Repair	1 Time/10 Year	3.10	65	35
1-2 Signal Lamp Change	1 Time/ 3 Year	0.30	65	35
1-3 Hand Rail Repair	1 Time/10 Year	0.62	76	23
1-4 Traffic Sign	1 Time/10 Year	0.02	64	36
2. Periodic Maintenance				
2-1 Resurfacing	1 Time/10 Year	0.55	54	46
2-2 Marking	1 Time/ 3 Year	1.13	63	36
2-3 Reflector	1 Time/10 Year	0.18	80	20
	Total	5.90	65	35

Note: Unit; Percent to the project cost.

12.2 Project Cost

12.2.1 Total Cost

The net total project cost excluding pedestrian bridges and parking lots is estimated at YR 199.7 million of which 79% (US$ 16.1 million or YR 157 million equivalent) is in foreign component and the remaining 21% is in local portion (YR 42.2 million). If customs and duties are added, the total financial cost is YR 248.9 million.

If the cost of pedestrian bridges and parking lots are added, the total net cost is YR 407.6 million. The cost of land acquisition is very high; it is assessed at YR 163.7 million and included in the total. In the case of financial cost including custom duty and tax, the total is YR 628.1 million.

The total net cost of YR 199.7 million is divided into the following component, including indirect cost, engineering service and contingencies. The cost is also shown in Table 12.2.1.

(In YR million of 1988 prices)

	Sana'a	Taiz	Hodeidah	Total	
Project					
-1. Engineering services	16.8	1.4	1.4	19.6	
				10%	
-2. Construction					
a. Signals	59.9	6.3	7.4	73.6	(49%)
b. Intersections	45.2	0.9	-	46.1	(31%)
c. Guard fences	14.4	1.5	1.2	17.1	(11%)
d. Marking	5.1	0.7	0.8	6.6	(5%)
e. Traffic signboards	1.5	0.4	0.2	2.1	(1%)
f. Reflectors	3.0	0.5	0.5	4.0	(3%)
g. Total	129.1	10.3	10.1	149.5	(100%)
				75%	
-3. Contingencies	26.4	2.1	2.1	30.6	
				15%	
-4. Total	172.3	13.8	13.6	199.7	
	86%	7%	7%	100%	
(YR1.00 = J.yen 13.80)	JY2,377.7	JY190.4	JY187.7	JY2,755.8	
Ped. bridges	20.0	-	-	20.0	
Park lots	19.4	4.8	-	24.2	
Land for lots	76.9	86.8	-	163.7	
G. Total	288.6	105.4	13.6	407.6	
	71%	26%	3%	100%	

Table 12.2.1 Summary of Cost:
(1) Without Parking Lots and Pedestrian Bridges

	Direct Cost					Indirect Cost				
	Foreign	Local	Local	Total	Total	Foreign	Local	Local	Total	Total
	Foreign	Financial	Economic	Financial	Economic	Foreign	Financial	Economic	Financial	Economic
Sanaa City	US$	Y.R.	Y.R.	Y.R.	Y.R.	US$	Y.R.	Y.R.	Y.R.	Y.R.
Project 1	340.5	1620.1	538.7	4940.0	3858.6	109.9	727.2	334.1	1800.1	1486.1
Project 2	961.5	4987.2	1847.3	14361.8	11221.9	319.6	2114.1	972.8	5233.4	4009.3
Project 3	584.2	3480.4	1688.9	9176.4	7384.9	204.2	1350.8	699.8	3343.9	2691.8
Project 4	330.1	1773.8	714.6	4991.5	3933.1	111.1	734.7	358.1	1818.9	1433.2
Project 5	677.7	3497.7	1281.2	10105.3	7888.8	224.9	1487.5	681.8	3682.4	2874.7
Project 6	854.8	5652.8	3171.5	13979.3	11498.8	311.1	2057.8	1156.4	5094.1	4189.9
Project 7	1008.9	6087.4	3107.3	15924.2	12944.1	354.4	2344.8	1261.3	5802.8	4716.8
Project 8	651.8	4284.9	2329.2	10632.2	8676.5	236.6	1565.1	854.5	3874.4	3161.7
Project 9	433.3	2164.7	688.3	6389.4	4913.8	142.2	940.5	403.8	2328.3	1790.3
Project 10	529.2	3465.6	1835.7	8625.3	6995.4	192.8	1269.6	677.4	3143.1	2549.1
Project 11	408.9	2115.9	624.4	6102.7	4611.2	135.8	898.3	356.8	2223.8	1680.3
Project 12	457.4	2362.6	853.1	6822.3	5312.8	151.8	1004.2	455.5	2486.8	1936.8
Project 13	154.8	905.2	405.1	2406.7	1906.6	53.6	354.3	172.5	877.8	694.8
Project 14	522.2	3211.4	1554.5	8302.9	6646.8	184.8	1222.2	620.1	3025.6	2421.8
Total Sanaa	7912.9	45688.9	20639.8	122759.7	97798.6	2732.2	18878.2	8996.8	44733.6	35634.9
Taizz City	678.2	3327.2	1128.2	9861.7	7662.7	219.5	1451.6	652.3	3593.6	2792.3
Hudaidah City	688.4	3305.8	982.8	10017.7	7693.9	223.8	1474.6	629.8	3658.4	2803.7
All Project	9271.5	52241.9	22750.8	142639.8	113147.1	3174.6	20996.5	10278.1	51977.7	41230.8

	Engineering Cost					Contingency Cost				
	Foreign	Local	Local	Total	Total	Foreign	Local	Local	Total	Total
	Foreign	Financial	Economic	Financial	Economic	Foreign	Financial	Economic	Financial	Economic
Sanaa City	US$	Y.R.	Y.R.	Y.R.	Y.R.	US$	Y.R.	Y.R.	Y.R.	Y.R.
Project 1	55.3	269.6	138.2	808.8	677.4	75.9	334.5	201.3	1074.2	1051.9
Project 2	160.8	783.8	414.2	2351.4	1981.8	216.3	1009.9	657.8	3118.7	3082.1
Project 3	102.7	500.8	251.1	1502.4	1252.7	133.7	684.8	454.1	1988.1	1952.9
Project 4	55.9	272.4	156.7	817.2	701.5	74.6	356.3	269.4	1083.3	1185.5
Project 5	113.1	551.5	306.5	1654.5	1409.5	152.4	709.8	495.9	2194.6	2284.2
Project 6	156.5	762.9	395.4	2288.8	1921.3	198.2	1090.5	802.9	3023.3	3025.7
Project 7	178.3	869.1	447.2	2607.2	2185.3	231.2	1194.8	837.1	3449.4	3429.9
Project 8	119.8	580.3	294.3	1740.8	1454.8	151.8	827.4	585.1	2299.7	2278.2
Project 9	71.5	348.7	174.6	1046.1	872.8	97.1	442.8	251.9	1388.3	1348.2
Project 10	96.6	470.7	320.7	1412.2	1262.1	122.7	669.8	666.7	1865.8	2042.8
Project 11	68.3	333.1	158.7	999.2	824.9	92.8	428.7	219.3	1325.3	1258.3
Project 12	76.4	372.3	181.8	1117.8	926.5	102.8	478.8	272.5	1481.6	1425.7
Project 13	26.9	131.3	83.8	394.8	345.7	35.2	178.6	156.8	521.5	551.3
Project 14	93.8	453.1	226.2	1359.4	1132.5	128.8	628.8	413.8	1797.9	1759.2
Total Sanaa	1374.3	6699.7	3548.7	20099.2	16948.1	1882.9	9833.2	6283.8	26611.6	26498.9
Taizz City	118.4	538.2	289.1	1614.6	1365.5	158.8	688.3	442.8	2143.8	2124.8
Hudaidah City	112.1	546.7	264.8	1648.2	1357.5	153.5	681.1	356.8	2178.8	2078.2
All Project	1596.9	7784.7	4101.8	23354.8	19671.2	2186.4	10394.7	7082.6	30932.6	30781.1

	Land Cost		All Project Cost				
	LAND	Local	Foreign	Local	Local	Total	Total
	Financial	Economic	Foreign	Financial	Economic	Financial	Economic
Sanaa City	Y.R.	Y.R.	US$	Y.R.	Y.R.	Y.R.	Y.R.
Project 1	0.0	0.0	581.6	2951.4	1149.0	8623.1	6819.7
Project 2	0.0	0.0	1658.2	8894.9	3665.7	25865.4	19833.2
Project 3	0.0	0.0	1024.8	6016.8	3025.1	16810.8	13017.2
Project 4	0.0	0.0	571.6	3136.5	1372.5	8718.9	6945.9
Project 5	0.0	0.0	1168.1	6245.7	2554.5	17636.7	13943.5
Project 6	0.0	0.0	1519.9	9563.9	5418.0	24385.5	20228.8
Project 7	0.0	0.0	1772.8	10495.3	5511.3	27783.6	22796.3
Project 8	0.0	0.0	1157.7	7257.6	3988.0	18547.0	15275.2
Project 9	0.0	0.0	744.1	3895.9	1448.9	11152.1	8695.8
Project 10	0.0	0.0	940.4	5875.8	3153.5	15046.3	12322.3
Project 11	0.0	0.0	705.0	3776.0	1381.1	10650.9	8174.9
Project 12	0.0	0.0	788.5	4218.8	1705.8	11906.8	9392.4
Project 13	0.0	0.0	269.7	1569.4	736.1	4199.3	3365.5
Project 14	0.0	0.0	919.9	5514.7	2751.8	14485.7	11720.4
Total Sanaa	0.0	0.0	13822.3	79412.1	37763.8	214204.1	172531.2
Taizz City	0.0	0.0	1150.1	5997.4	2336.1	17212.8	13549.6
Hudaidah City	0.0	0.0	1177.8	6008.3	2143.3	17486.3	13619.4
All Project	0.0	0.0	16149.4	91417.7	42243.2	248903.3	199700.2

Table 12.2.1 Summary of Cost: (2) With Parking Lots and Pedestrian Bridges

	Direct cost Total					Indirect Cost				
	Foreign	Local	Local	Total	Total	Foreign	Local	Local	Total	Total
	Foreign	Financial	Economic	Financial	Economic	Foreign	Financial	Economic	Financial	Economic
Sanaa City	US$	Y.R.	Y.R.	Y.R.	Y.R.	US$	Y.R.	Y.R.	Y.R.	Y.R.
Project 1	384.1	1953.9	771.0	5698.9	4516.6	126.8	838.9	409.2	2078.7	1645.0
Project 2	1171.0	6643.3	2972.4	18060.6	14389.7	402.0	2658.5	1324.4	6581.3	5243.6
Project 3	584.2	3480.4	1688.9	9176.4	7384.9	204.2	1350.8	699.8	3343.9	2691.8
Project 4	485.9	2965.3	1546.3	7782.8	6283.8	171.4	1133.9	618.3	2806.9	2299.8
Project 5	911.2	5701.7	2786.7	14585.9	11670.9	324.6	2147.0	1087.7	5315.1	4252.9
Project 6	896.0	5974.7	3396.1	14710.7	12132.1	327.4	2165.4	1228.7	5360.6	4420.9
Project 7	1063.4	6584.7	3398.4	16872.9	13766.6	375.5	2483.7	1355.1	6140.5	5016.5
Project 8	651.0	4284.9	2329.1	10632.2	8676.4	236.6	1565.1	854.5	3874.4	3161.7
Project 9	475.4	2486.6	912.8	7121.8	5548.0	158.5	1048.3	476.3	2595.2	2021.7
Project 10	1021.9	8830.1	5579.8	18793.6	15543.3	418.3	2766.4	1585.8	6848.4	5664.0
Project 11	408.9	2115.9	624.4	6102.7	4611.2	135.8	898.3	356.0	2223.8	1680.3
Project 12	457.4	2362.6	853.1	6822.3	5312.8	151.8	1004.2	455.5	2486.0	1936.0
Project 13	278.7	1859.1	1078.3	4576.4	3787.6	101.9	673.6	387.1	1667.6	1380.2
Project 14	522.1	3211.4	1554.4	8301.9	6644.9	184.8	1222.8	619.9	3025.2	2421.4
Total Sanaa	9311.2	58374.6	29484.3	149158.8	120268.5	3319.7	21956.2	11458.4	54353.5	43825.8
Taizz City	849.4	4876.2	2107.1	13157.9	10388.8	292.8	1936.8	930.4	4794.7	3785.7
Hudaidah City	688.4	3305.8	992.0	10017.7	7693.9	223.0	1474.6	629.8	3650.4	2803.7
All Project	10849.0	66556.6	32573.4	172334.4	138351.2	3835.5	25367.6	13018.6	62798.6	50415.2

	Engineering Cost					Contingency Cost				
	Foreign	Local	Local	Total	Total	Foreign	Local	Local	Total	Total
	Foreign	Financial	Economic	Financial	Economic	Foreign	Financial	Economic	Financial	Economic
Sanaa City	US $	Y.R.	Y.R.	Y.R.	Y.R.	US $	Y.R.	Y.R.	Y.R.	Y.R.
Project 1	63.8	311.0	147.9	933.1	769.9	86.2	397.4	199.3	1237.9	1165.9
Project 2	202.2	985.7	471.2	2957.0	2442.5	266.3	1320.0	715.2	3916.2	3700.8
Project 3	102.7	500.8	241.8	1502.4	1243.4	133.7	684.8	394.6	1988.1	1893.4
Project 4	86.2	420.4	205.6	1261.2	1046.5	111.5	580.7	355.6	1668.2	1606.2
Project 5	163.3	796.0	382.2	2388.1	1974.3	209.9	1111.3	638.5	3157.6	2991.6
Project 6	164.7	802.9	397.3	2408.6	2003.0	208.2	1151.0	753.3	3181.1	3097.9
Project 7	188.9	920.9	450.8	2762.6	2292.5	244.2	1273.3	780.6	3654.0	3518.4
Project 8	119.0	580.3	284.1	1740.8	1444.6	151.0	827.4	520.2	2299.7	2213.2
Project 9	79.7	388.7	181.7	1166.0	959.0	107.0	582.6	235.6	1546.3	1435.9
Project 10	210.4	1025.7	509.0	3077.0	2560.3	247.6	1631.7	1151.2	4045.6	3927.2
Project 11	68.3	333.1	151.0	999.2	817.1	92.0	428.7	169.7	1325.3	1200.8
Project 12	76.4	372.3	174.0	1117.8	918.6	102.0	478.8	222.4	1481.6	1375.5
Project 13	51.2	249.8	124.0	749.3	623.6	64.8	358.1	237.2	989.6	963.4
Project 14	92.9	453.1	217.6	1359.2	1123.8	120.0	628.0	358.8	1797.7	1704.8
Total Sanaa	1669.8	8140.5	3938.3	24421.5	20219.2	2145.1	11373.9	6732.1	32288.8	30784.3
Taizz City	147.3	718.1	340.2	2154.3	1776.4	193.4	966.6	586.7	2852.5	2675.5
Hudaidah City	112.1	546.7	251.9	1640.2	1345.4	153.5	681.1	279.6	2178.0	2001.8
All Project	1929.3	9405.3	4530.4	28216.0	23341.0	2492.1	13021.6	7518.4	37319.4	35460.8

	Land Cost		Total Project Cost				
	Local	Local	Foreign	Local	Local	Total	Tottal
	Financial	Economic	Foreign	Financial	Economic	Financial	Economic
Sanaa City	Y.R.	Y.R.	US$	Y.R.	Y.R.	Y.R.	Y.R.
Project 1	2400.0	1200.0	668.9	5981.1	2728.0	12346.5	9172.2
Project 2	52000.0	26000.0	2041.4	63687.5	31483.3	83515.0	51387.1
Project 3	0.0	0.0	1024.8	6016.8	3025.1	16810.8	13017.2
Project 4	0.0	0.0	855.1	5100.3	2725.9	13439.1	11063.2
Project 5	88400.0	44200.0	1609.0	98156.1	49095.1	113846.7	64782.7
Project 6	2400.0	1200.0	1596.3	12494.0	6975.4	28061.0	22539.4
Project 7	0.0	0.0	1872.0	11182.6	5985.0	29437.9	24236.9
Project 8	0.0	0.0	1157.7	7257.6	3987.9	18547.0	15275.0
Project 9	0.0	0.0	820.7	4426.2	1806.3	12429.2	9807.9
Project 10	4800.0	2400.0	1898.2	19053.9	11225.7	37564.7	29732.8
Project 11	0.0	0.0	705.0	3776.0	1381.1	10650.9	8174.9
Project 12	0.0	0.0	788.5	4218.0	1705.0	11906.8	9392.4
Project 13	2400.0	1200.0	496.6	5540.6	3018.7	10383.0	7860.1
Project 14	0.0	0.0	919.0	5514.5	2750.7	14484.0	11718.5
Total Sanaa	152400.0	76200.0	16445.9	252245.2	127813.1	412622.6	288168.6
Taizz City	175000.0	87500.0	1483.0	183497.7	91384.3	197959.4	185843.4
Hudaidah City	0.0	0.0	1177.0	6008.3	2143.3	17486.3	13619.4
All Project	327400.0	163700.0	19105.9	441751.2	221340.8	628068.3	487623.4

Table 12.2.1 Summary of Cost: (3) Direct Costs

	Parking Direct Cost					Bridge Direct Cost				
	Foreign Foreign	Local Financial	Local Economic	Total Financial	Total Economic	Foreign Foreign	Local Financial	Local Economic	Total Financial	Total Economic
Sanaa City	US $	Y.R.	Y.R.	Y.R.	Y.R.	US $	Y.R.	Y.R.	Y.R.	Y.R.
Project 1	0.0	0.0	0.0	0.0	0.0	43.6	333.8	232.8	758.9	657.9
Project 2	53.5	462.4	292.2	984.0	813.0	156.8	1192.3	831.6	2711.4	2350.7
Project 3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Project 4	0.0	0.0	0.0	0.0	0.0	156.8	1192.3	831.6	2711.4	2350.7
Project 5	171.1	1725.5	1171.6	3393.7	2039.8	62.3	476.9	332.6	1084.3	940.8
Project 6	0.0	0.0	0.0	0.0	0.0	42.1	321.9	224.5	732.4	635.0
Project 7	0.0	0.0	0.0	0.0	0.0	54.5	417.3	291.1	948.7	822.5
Project 8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Project 9	0.0	0.0	0.0	0.0	0.0	42.1	321.9	224.5	732.4	635.0
Project 10	421.0	4810.0	3361.6	8920.8	7466.4	71.7	548.5	382.5	1247.6	1081.6
Project 11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Project 12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Project 13	0.0	0.0	0.0	0.0	0.0	124.6	953.0	665.3	2168.7	1880.2
Project 14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Sanaa	645.6	7003.9	4825.4	13298.5	11120.0	752.5	5758.7	4016.5	13095.6	11353.4
Taizz City	179.2	1549.0	978.9	3296.2	2726.1	0.0	0.0	0.0	0.0	0.0
Hudaidah City	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
All Project	824.8	8552.9	5804.3	16594.7	13846.1	752.5	5758.7	4016.5	13095.6	11353.4

	Traffic Signal Direct Cost					Improvement Direct Cost				
	Foreign Foreign	Local Financial	Local Economic	Total Financial	Total Economic	Foreign Foreign	Local Financial	Local Economic	Total Financial	Total Economic
Sanaa City	US $	Y.R.	Y.R.	Y.R.	Y.R.	US $	Y.R.	Y.R.	Y.R.	Y.R.
Project 1	183.7	945.6	272.8	2736.7	2003.9	21.4	211.0	153.5	419.7	362.2
Project 2	627.7	3520.4	1257.5	9640.5	7377.6	40.5	459.7	352.0	854.6	746.9
Project 3	261.1	1346.9	391.4	3892.6	2937.1	226.7	1828.0	1220.8	4038.3	3431.1
Project 4	181.8	942.3	276.1	2787.1	2048.9	68.3	532.2	372.1	1120.1	960.8
Project 5	437.8	2487.4	912.3	6756.8	5180.9	27.1	271.2	194.7	535.4	458.9
Project 6	236.1	1236.3	368.8	3538.3	2670.8	487.4	3821.7	2631.2	8673.9	7383.4
Project 7	294.8	1523.8	443.2	4397.3	3317.5	475.6	3751.6	2475.4	8388.7	7112.5
Project 8	242.8	1343.7	471.4	3783.2	2830.9	348.0	2728.3	1786.8	6113.3	5179.8
Project 9	317.3	1638.4	471.9	4732.1	3565.6	18.8	186.5	134.6	369.8	317.9
Project 10	263.5	1412.5	447.8	3981.6	3016.1	191.8	1761.8	1287.2	3623.3	3149.5
Project 11	481.1	2873.2	602.3	5983.9	4513.8	0.0	0.0	0.0	0.0	0.0
Project 12	227.8	1874.5	232.8	3286.5	2454.8	121.9	985.8	516.7	2093.5	1705.2
Project 13	110.1	704.1	312.8	1777.6	1386.3	1.4	13.7	9.8	27.4	23.4
Project 14	299.5	1565.9	464.7	4486.8	3384.8	145.6	1351.8	985.8	2771.4	2405.5
Total Sanaa	4083.6	21814.2	6924.2	61629.3	46739.3	2165.7	17913.7	12128.7	39829.3	33236.3
Taizz City	423.1	2223.8	674.5	6349.8	4799.7	33.2	329.3	237.5	653.8	561.2
Hudaidah City	506.3	2583.9	714.9	7528.3	5651.3	0.0	0.0	0.0	0.0	0.0
All Project	5013.0	26621.9	8313.6	75498.7	57190.4	2198.9	18243.0	12358.2	39682.3	33797.5

	Guard Fence Direct Cost					Marking Di				
	Foreign Foreign	Local Financial	Local Economic	Total Financial	Total Economic	Foreign Foreign	Local Financial	Local Economic	Total Financial	Total Economic
Sanaa City	US $	Y.R.	Y.R.	Y.R.	Y.R.	US $	Y.R.	Y.R.	Y.R.	Y.R.
Project 1	95.8	298.3	24.1	1224.4	958.2	18.9	109.8	75.6	293.3	259.9
Project 2	288.9	633.5	53.7	2670.3	2090.5	33.4	203.6	145.8	529.3	471.5
Project 3	21.3	64.5	5.3	272.2	213.0	14.1	78.2	52.6	215.7	190.1
Project 4	83.9	103.5	16.1	816.5	639.1	11.2	61.1	41.1	170.3	150.3
Project 5	162.7	493.9	42.2	2088.2	1628.5	38.2	159.1	103.6	453.6	398.1
Project 6	73.8	223.6	18.6	943.2	738.1	31.3	191.8	137.8	497.8	442.2
Project 7	176.1	533.2	44.2	2258.2	1761.2	32.1	179.7	122.8	492.7	435.8
Project 8	27.6	83.8	6.9	352.9	276.8	15.8	81.3	52.4	235.3	206.4
Project 9	73.8	223.6	18.6	943.2	738.1	14.2	74.9	48.8	213.3	187.2
Project 10	36.9	111.8	9.3	471.6	369.1	18.4	99.8	66.6	279.2	246.8
Project 11	0.0	0.0	0.0	0.0	0.0	4.4	20.4	12.8	63.3	54.9
Project 12	73.8	223.6	18.5	943.1	738.8	18.3	104.8	72.1	283.2	250.5
Project 13	14.3	43.1	3.5	182.5	142.9	21.5	100.8	59.7	310.4	269.3
Project 14	39.6	120.4	9.9	506.5	396.8	22.2	121.9	81.7	338.4	298.1
Total Sanaa	1068.5	3238.8	270.9	13656.7	10688.8	286.8	1586.4	1071.8	4374.9	3859.5
Taizz City	104.4	316.8	26.2	1333.9	1044.1	38.7	174.7	102.1	552.8	479.4
Hudaidah City	87.3	264.4	21.9	1115.6	873.1	38.3	250.5	186.5	623.9	559.9
All Project	1260.2	3819.2	319.0	16106.2	12606.8	363.8	2011.6	1359.6	5550.9	4898.9

	Traffic Sign Direct Cost					Reflector Direct Cost				
	Foreign Foreign	Local Financial	Local Economic	Total Financial	Total Economic	Foreign Foreign	Local Financial	Local Economic	Total Financial	Total Economic
Sanaa City	US $	Y.R.	Y.R.	Y.R.	Y.R.	US $	Y.R.	Y.R.	Y.R.	Y.R.
Project 1	3.7	24.3	11.0	60.4	47.1	17.0	39.9	1.8	205.6	187.6
Project 2	11.9	78.9	35.7	194.9	151.7	39.3	92.5	3.9	475.7	387.1
Project 3	4.9	32.4	14.6	80.2	62.4	56.1	130.4	4.2	677.4	551.2
Project 4	2.8	18.2	8.2	45.5	35.5	16.9	25.7	1.1	132.0	107.4
Project 5	9.5	62.7	28.4	155.3	121.0	10.5	25.0	1.3	127.4	103.7
Project 6	4.6	30.4	13.7	75.3	58.6	20.7	49.0	2.3	250.8	204.1
Project 7	6.7	44.5	20.1	109.8	85.4	23.6	55.4	2.4	285.5	232.5
Project 8	3.4	22.3	10.1	55.5	43.3	14.2	33.5	1.5	172.8	140.8
Project 9	4.6	30.4	13.7	75.3	58.6	4.6	10.9	0.7	55.8	45.6
Project 10	8.3	54.6	24.7	135.5	105.6	11.1	25.9	0.9	134.1	109.1
Project 11	3.4	22.3	10.1	55.5	43.3	0.0	0.0	0.0	0.0	0.0
Project 12	4.3	28.3	12.8	70.2	54.7	11.2	26.4	1.0	135.6	110.2
Project 13	6.4	42.5	19.2	104.9	81.6	0.4	1.1	0.0	5.0	3.9
Project 14	3.7	24.3	11.0	60.4	47.1	11.5	27.1	1.2	139.2	113.3
Total Sanaa	78.2	516.1	233.3	1278.6	995.8	231.1	542.8	22.3	2796.0	2275.5
Taizz City	26.7	179.6	82.6	439.3	342.9	44.1	104.4	5.3	534.4	435.3
Hudaidah City	18.6	117.9	54.8	299.3	236.2	37.8	89.1	3.9	457.7	372.5
All Project	123.5	813.0	370.7	2017.1	1574.8	313.0	736.3	31.5	3788.1	3083.3

12.2.2 Direct Construction Cost

Direct net construction cost is divided into machinery, material and labour. It is summarized as follows:

Machinery	:	YR 12.4	(11.0%)
Material	:	YR 89.6	(79.2%)
Labour	:	YR 11.1	(9.8%)
Total		YR 113.1 million	(100%)

12.2.3 Currency Portion

In the case of currency composition estimate, the following figures are calculated.

(In millions of 1988 prices)

	Foreign	Local	Total
Projects			
- Construction	$ 12.4 (YR 118.5) (79%)	YR 31.0 (21%)	YR 149.5 (100%)
- Engineering	$ 1.6 (YR 15.5) (79%)	YR 4.1 (21%)	YR 19.6 (100%)
- Contingencies	$ 2.1 (YR 23.5) (77%)	YR 7.1 (23%)	YR 30.6 (100%)
- Total net cost	$ 16.1 (YR 157.5) (79%)	YR 42.2 (21%)	YR 199.7 (100%)
(YR 1.00 = J Yen 13.80)	JY 2,173.5	JY 582.4	JY 2,755.9
Financial total	$ 16.1 (YR 157.5) (63%)	YR 91.4 (37%)	YR 248.9 (100%)
Total net including Ped. Br & parking	$ 19.1 (YR 186.3) (46%)	YR 221.3 (54%)	YR 407.6 (100%)
Fin. Total including Ped. Br & parking	$ 19.1 (YR 186.3) (30%)	YR 441.7 (70%)	YR 628.0 (100%)

12.2.4 Projects

When action plans are grouped into projects, the total cost is summarized as follows.

Excluding Parking lots and Ped. bridges

Project		Foreign	Local	Total	F/T(%)
		(Net cost in YR'000 of 1987 prices)			
Sana'a	1	5670.7	1149.0	6819.7	83.2
	2	16167.5	3665.7	19833.2	81.5
	3	9992.1	3025.1	13017.2	76.8
	4	5573.4	1372.5	6945.9	80.2
	5	11389.0	2554.5	13943.5	81.7
	6	14818.8	5410.0	20228.8	73.3
	7	17285.0	5511.3	22796.3	75.8
	8	11287.2	3988.0	15272.2	73.9
	9	725.9	1440.9	8695.8	83.4
	10	9168.8	3153.5	12322.3	74.4
	11	6873.8	1301.1	8874.9	84.1
	12	7687.4	1705.0	9392.4	81.8
	13	2629.4	736.1	3365.5	78.1
	14	8969.4	2751.0	11720.4	76.5
S. Total		134766.4	37763.8	172531.1	78.1
Taiz	P-15	11408.3	2336.1	13549.6	84.2
Hod	P-16	11476.1	2143.3	13619.4	84.3
Total		157651.8	42243.1	199700.1	78.9

Notes: F/T means the percent ratio of cost in foreign/total.
: There are minor differences in the total with other tables and quotings because of rounding the number.

The net cost when the projects are grouped is shown below in YR million of 1987 prices.

without Ped. Br & P.L.	US$ (YR)	YR	Total YR
Project 1, 2, 4, 7	4.58 (44.66)	25.48	70.14
Project 5, 10	2.11 (20.57)	5.71	26.28
Project 13, 14	1.19 (11.60)	3.49	15.09
Project others	8.27 (80.63)	7.56	88.19
Project total	16.15 (157.65)	42.24	199.70