

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

THE PEOPLE'S GOVERNMENT OF CHENGDU, SICHUAN PROVINCE, PEOPLE'S REPUBLIC OF CHINA
SICHUAN PROVINCIAL SCIENCE & TECHNOLOGY DEPARTMENT, PEOPLE'S REPUBLIC OF CHINA

Study for Public Transportation Improvement in Chengdu City in The People's Republic of China

FINAL REPORT
SUMMARY

JULY 2001

ALMEC Corporation
CHODAI Co., Ltd.

EXCHANGE RATES USED (30-9-2000)

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PREFACE

In response to the request from the Government of the People's Republic of China, the Government of Japan decided to conduct a study on public transportation improvement in Chengdu City and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA selected and dispatched a study team headed by Mr. Takashi Shoyama of ALMEC Corporation and consist of ALMEC Corporation and Chodai Co., Ltd. to China, twice between March 2000 and July 2001. In addition, JICA set up an advisory committee headed by Prof. Dr. Saburo Nakagawa, Ashikaga Institute of Technology between March 2000 and July 2001, which examined the study from specialist and technical points of view.

The team held discussions with the officials concerned of the Government of the People's Republic of China and conducted field surveys, a series of transportation/traffic analyses, transportation demand forecast, transportation planning and identification of priority projects at the study area. Upon returning to Japan, the team conducted further studies and prepared this final report.

I hope that this report will contribute to the improvement of public transportation in Chengdu and to the enhancement of friendly relationship between our two countries.

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of the People's Republic of China for their close cooperation extended to the study team.

July 2001



Kunihiko Saito
President
Japan International Cooperation Agency

July 2001

Mr. Kunihiko Saito
President
Japan International Cooperation Agency

Letter of Transmittal

Dear Sir,

We are pleased to formally submit herewith the final report of “The Study for Public Transportation Improvement in Chengdu City in the People’s Republic of China”.

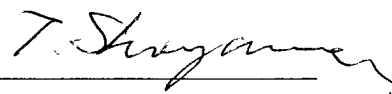
This report compiles the results of the study which was undertaken both in China and Japan, from March 2000 to July 2001 by the study team, organized jointly by ALMEC Corporation & Chodai Co., Ltd.

We owed a lot to many people for the accomplishment of this report. First, we would like to express our sincere appreciation to all those who extended their kind assistance and cooperation to the study team, in particular, the People’s Government of Chengdu and the Sichuan Provincial Commission of Science & Technology.

We also acknowledge the officials of your agency, the JICA Advisory Committee and the Embassy of Japan in China for their valuable advice and cooperation given to us throughout the course of the study.

We wish the report would contribute to Chengdu’s public transportation development in the near future.

Very truly yours,



Takashi Shoyama

Team Leader,
The Study Team for
Public Transportation
Improvement in Chengdu City
in the People’s Republic of
China

EXECUTIVE SUMMARY

Objectives and Outline of the Study

The objectives of the Study were:

- (1) To formulate a public transport system development plan, with emphasis on bus service, in order to promote the patronage of public transport (Target Year is 2010);
- (2) To conduct feasibility studies on the high-priority project(s) selected by the said plan;
- (3) To transfer technology in relation to data processing, demand forecast and planning to the counterpart staff of Chengdu during the course of the Study.

The Study started in March 2000 and was completed in July 2001 with the submission of the Final Report.

In the earlier stage of the Study, the focus was placed on the identification of important issues and the formulation of the Master Plan in relation to the public transport system of Chengdu, and in the later stage feasibility studies were conducted for two selected key projects: 1) the East-west Primary Busway Project and 2) Bus Privatization Project.

Study Area

The Study Area covers the six (6) Central Districts (including Gaoxin Sub-District as its part) and neighboring five towns located inside the Outer Ring Road.

Future Transport Demand

In summary, the traffic demand forecast indicates that the growth of economic levels will inevitably increase the trip rate (the amount of trips per person) and popularize motorized private transport. The current number of daily trips per person is 2.6, which will increase by 12% by 2010. The total number of trips of citizens within the Study Area will increase to 10,091 thousand (1.27 times that of 2000).

If bus services were maintained in the same level as now (Do-Nothing Case), the modal share of car would increase from 17% to 25% because of the increase in its popularity. The bicycle's share will decrease with expanding average travel distance, because of the expansion of the city wherein new inhabitants live in the suburbs. The number of trips by public transport will also increase, but the modal share remains stable because of the lower speed caused by the increasing number of cars.

If buses travel faster and number of bus transfers in the whole region is reduced to once only, the modal share will increase by a large margin, from 14% to 27%. The subway will play an important role in city traffic. However, until 2010, buses will continue to have a principal part in city traffic and the demand for bus transport will be still dominant.

Future Socio-economic Development Framework

	Year 2000	Year 2005	Year 2010
Population (000)	3,090.0 (100)	3,290.0 (106)	3,500.0 (113)
GDP (RMB, billion)	62.5 (100)	94.5 (151)	143.0 (229)
Per Capita GDP (RMB)	20,222 (100)	28,734 (144)	40,850 (212)

Source: JICA Study Team

Projected Traffic Demand

	Year 1987*	Year 2000**	Year 2010**	2010/2000
Population (000)	1,820	3,090	3,500	1.13
Number of trips (000 trips)	-	7,923	10,091	1.27
Individual Transportation Mode (000)				
Bicycle	-	1,997	1,700	0.85
Motorcycle	-	166	320	1.92
Car	-	134	400	2.99

Source: JICA Study Team

Notes *: Old city administrative area of the year 1987 (95km²), **: Area of this study (586 km²)

Change in Modal Share of Transport Modes ¹

Means of Transportation	Year 2000	Year 2010 (Do-Nothing Case)		Year 2010 (the public services have been improved)	
		No subway	With subway	No subway	With subway
On foot	19.6	20.2	20.2	20.2	20.2
Bicycle ²	49.2	40.2	36.5	33.1	33.1
Automobile ³	16.9	25.1	22.4	19.3	19.3
Buses ⁴	10.2	14.5	13.6	27.4	23.1
Subway	-	-	7.3	-	4.3
Total	100.0	100.0	100.0	100.0	100.0

Source: JICA Study Team

¹ The number of trips does not include those that occur within a zone.

² Bicycle: includes bicycle, tricycle and motorcycle.

³ Automobile: includes car, taxi and freight car.

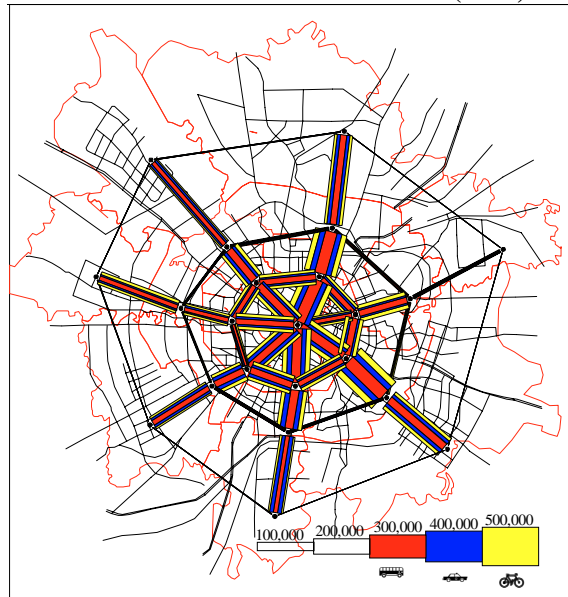
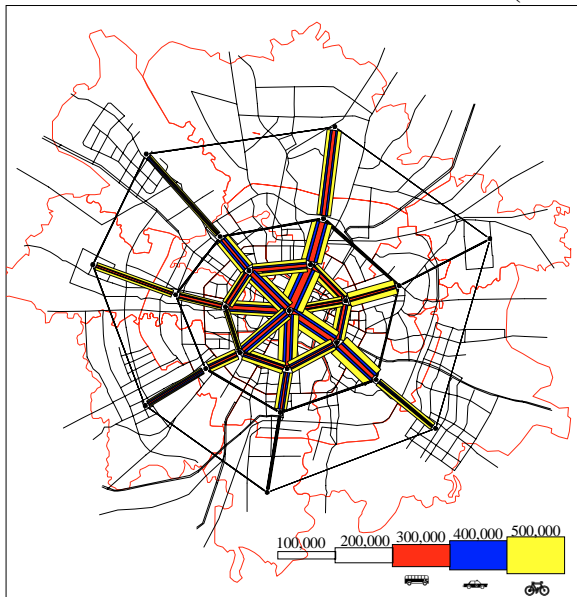
⁴ Buses: include common public bus and mini bus.

Traffic Volume on Road

In the Do-nothing Case, the average travel speed of car and bus increases on slightly due to the completion of existing road development plans. In Do-improvement Case, the travel speed of bus will be much higher than the present level.

By 2010, traffic demand will remarkably increase on the main radial and ring roads of Chengdu. It is noted that the distribution of heavily trafficked sections will move outward considerably from within the First Ring Road to between the First and Second Ring Road by 2010. As the City expands, the traffic demand in suburban areas grows significantly.

Current Traffic Demand in the Corridors (2000) Future Traffic Demand in the Corridors (2010)



Identified Issues to Improve Public Transport System

A. Inadequate Transport Administration

In Chengdu, the Public Utilities Bureau regulates traffic within the city proper, while the Transportation Bureau regulates traffic in outer districts of the city. With the expansion of the city, urban traffic has extended to the outskirts. This problem occurs between the 3rd Ring Road and the Outer Ring Road. Since the responsibility of carrying passengers will lag behind the development of the city, the administrative system should be defined again.

B. Financial Deficit of State-owned Public Transport Companies

The financial report of the Chengdu Public Transport Company in 1998 shows that its income is equal to about 75% of its expenses. Subsidies make up for the deficit. This means that the total income cannot cover operation costs. If the deficit will continue to be covered by subsidies, the amount of subsidies will increase largely in the next 10 years.

C. Low Service Quality in Public Transport

Public transport facilities, to be effective, should meet the following conditions: speed, frequency, punctuality, comfort, and density of service network. These conditions, except for the last, will be negatively affected by increasing traffic. The increase in the number of taxis and cars will particularly lead to the decreased service quality in public transport. In the future, when the planned subway construction begins, the lower service quality in public transport will become more prominent compared with the current situation.

D. Increased Traffic Accidents

With the increase in traffic volume, the incidence of traffic accidents also increases, posing a serious social problem. Accidents are caused by mixed traffic consisting of conventional bicycles, an increasing number of cars and other transport means of different sizes. They frequently occur at intersections. It is very important to enhance traffic safety, so comprehensive measures to deal with traffic accidents should be considered, including traffic management at intersections and carriageways, safety-related facilities and safety education among drivers.

E. Deterioration of Living Environment

Pollution from bus exhaust poses a threat to the environment. To reduce this threat, CNG (compressed natural gas which cause little harm to the environment) bus should be prioritized when buying new buses to replace old fleet.

Basic Strategies for Public Transport System Development

The proposed subway lines will open to public use after 2010. Particularly in the North-South Corridor where subway line No. 1 is proposed, the role of bus should be carefully examined to smoothly shift from bus to subway. The general strategies common to all major corridors are:

- Bus services should be improved in terms of speed, comfort, service frequency and punctuality to promote the modal shift from car and bicycle to bus.
- Bus routes should be extended to the peripheral areas in the suburbs of the City and the satellite cities. In this context, bus terminals planned around the Third Ring Road should serve transfer passengers conveniently.
- Bus, bicycle and other vehicles should be segregated as much as possible. Bus exclusive/priority lanes should be provided where appropriate.
- Traffic management should be strengthened to ensure safety and to alleviate traffic congestion particularly at intersections.

The Master Plan

Considering the magnitude of future transport demand, physical characteristics of major corridors (i.e. condition of existing roads) and effectiveness of varied combinations of necessary measures, the Master Plan for public transport improvement in Chengdu has been formulated.

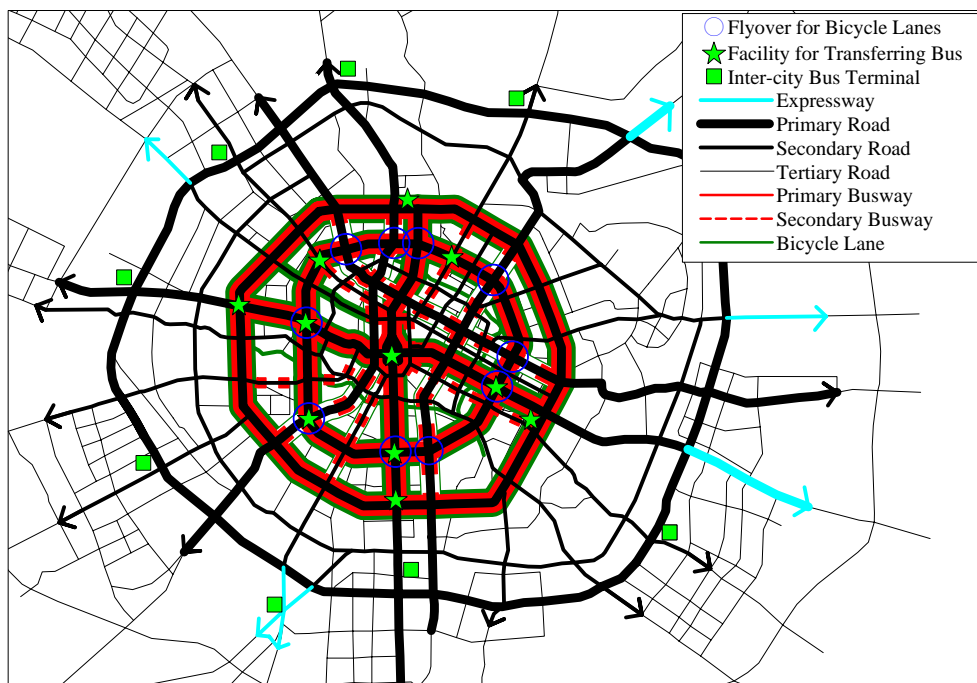
- **Project List**

A project list has been prepared after categorizing the projects of similar characteristics into project packages. In the Master Plan, there are 23 projects thus categorized.

- **Project Cost**

The total cost of the listed projects accounts for RMB 1,196 million, of which RMB 599 million or 50% of the total is for the Primary Busway Project (bus exclusive lane development). The Secondary Busway Project (bus priority lane development) shares RMB285 million or 24% of the total. The rest is for Auxiliary Bus Facilities Project and Traffic Control System Project. No cost was assumed for Policies and Management System Project.

Master Plan for the Development and Improvement of Public Transport (2010)



Effect of the Master Plan

The targets of the Master Plan are to increase the modal share of the bus, to increase the bus travel speed and to decrease the cross-city travel time. Based on the analysis of the Study Team, the effect of the Master Plan on the above targets is calculated as follows;

A. Modal Share of Bus

10% (2000) to 27% (2010)

B. Bus Travel Speed

12 km/h (2000) to 17 km/h (2010)

C. Cross-City Travel Time (2nd Ring Road to 2nd Ring road)

45 minutes (2000) to 30 minutes (2010)

The result of the analysis shows that the public transport system of Chengdu will be remarkably improved by implementing the proposed Master Plan.

List of Public Transport Projects in the Master Plan

Plan	Project	Contents of Project	Project Cost (RMB 000)
1. Primary busway (Exclusive Bus Lane)	1-1 East-west primary busway	* change in cross-section from 4-lane use to 6 lane use	112,528
	1-2 North-south primary busway	* introduction of exclusive bus lane	92,209
	1-3 1st Ring Road primary busway	* improvement of bus terminals	288,318
	1-4 2nd Ring Road primary busway	* improvement of intersections and signals * improvement of bicycle lanes * improvement of bus transfer facilities * improvement of bus operation system	105,773
2. Secondary busway (Bus Priority Lane)	2-1 Bus Priority Lane in Xinnan Lu-Hongxing Lu	* introduction of bus priority lane * improvement of bus terminals	99,796
	2-2 Bus Priority Lane in Wuhouci Da-Jie-Beizhan Lu	* improvement of intersections and signals * increase of traffic signal	42,616
	2-3 Bus Priority Lane in Shuanglin Lu-Shawan Lu	* improvement of bicycle lanes * improvement of bus transfer facilities	42,886
	2-4 Bus Priority Lane in the Northern Traffic Corridor	* improvement of bus operation system	24,759
	2-5 Bus Priority Lane in Northwest traffic corridor		22,815
	2-6 Bus Priority Lane in Southwest Traffic Corridor		33,155
	2-7 Bus Priority Lane in East Traffic Corridor		19,353
3. Auxiliary Bus Facilities	3-1 Intercity bus terminal project	* improvement of bus terminal	296,429
	3-2 Bus transfer facility project ¹⁾	* improvement of function, organization and operation of bus operator	(8,940) ²⁾
	3-3 Bus stop project	* expansion of bus terminals * improvement of bus facilities	(36,570) ²⁾
4. Traffic Control System	4-1 Intersection improvement project	* grade separation at major intersections (for bicycles) * channelization * signals control	(269,100) ²⁾
	4-2 Bicycle lane project	* bicycle lane in primary road * bicycle lane in secondary road	15,469
	4-3 One-way system improvement project	* improvement of traffic control system in central area	_____
	4-4 Pedestrian environment improvement project	* pedestrian mall project	_____
5. Policies and Management System	5-1 Privatization of public transport business	* privatization of bus business * legal system improvement	_____
	5-2 CNG promotion	* CNG filling stations	_____
	5-3 Revision of public bus fare system	* revision of bus fare system * introduction of pre-paid card system	_____
	5-4 Improvement of bus vehicles	* CNG bus * introduction of one-man bus	_____
	5-5 Introduction of wide-area public transport administration	* integration of bus-related administration agencies and rationalization	_____

Note: 1) Eleven (11) sites are proposed while 10 out of 11 are included in the cost estimate excluding the Tianfu Square because it is a part of the Subway No. 1 project.

2) Project cost in parentheses are included in either primary or secondary busway project and should be excluded from the total.

Evaluation of the Master Plan

● **Economic Evaluation**

Although the economic benefits are limited only to the most direct ones, the internal rate of return of the Master Plan reaches 25.5%, far exceeding the economic discount rate (12%). Thus, the Master Plan is judged to be highly feasible economically. The net present value is estimated at about RMB 2,000 million, which is about double of the investment amount. As per sensitivity tests, this high feasibility is very rigid, not affected much by cost increase or benefit decrease.

In the same way as used for evaluation of the entire Master Plan, each project of primary and secondary busways is evaluated individually. All the projects are economically feasible, showing the internal rate of return over 12%. The economic returns of the East-west busway and the Wuhouci Lu – Beizhan Lu busway are especially high.

Individual Evaluation of Projects

Unit: IRR (%), NPV (RMB 000)

Plan	Project		Evaluation Index		
			IRR	B/C	NPV
1. Primary Busway (Exclusive Bus Lane)	1-0	Entire Primary Busway Projects	27.6	2.8	1,468,617
	1-1	East-west Primary Busway	36.8	4.1	449,198
	1-2	North-South Primary Busway	35.3	2.7	202,265
	1-3	1st Ring Road Primary Busway	19.8	1.9	310,464
	1-4	2nd Ring Road Primary Busway	27.4	2.8	357,478
2. Secondary Busway (Priority Bus Lane)	2-0	Entire Secondary Busway Projects	24.0	2.5	666,245
	2-1	Bus Priority Lane in Xing Nan Lu-Hongxing Lu	12.7	1.1	7,598
	2-2	Bus Priority Lane in Wuhouci Lu-Beizhan Lu	33.5	4.3	232,602
	2-3	Bus Priority Lane in Shuangling Lu-Shawan Lu	22.6	2.3	92,310
	2-4	Bus Priority Lane in North Traffic Corridor	24.4	2.6	62,107
	2-5	Bus Priority Lane in Northwest Traffic Corridor	17.0	1.5	18,688
	2-6	Bus Priority Lane in Southwest Traffic Corridor	21.6	2.2	71,838
	2-7	Bus Priority Lane in East Traffic Corridor	12.5	1.0	1,387

● **Initial Environmental Evaluation**

Environmentally, the anticipated negative effect is limited to the displacement of residents/informal settlers in the widened road sections and the traffic management difficulties during the construction. The proposed projects are rather considered to bring about a large environmental benefit to Chengdu in terms of air pollution due to the model shift from car to bus.

Implementation Schedule

In consideration of the results of project evaluation, time required for implementing each project and the recent policy directions in Chengdu (i.e. project readiness), the implementation schedule of the proposed projects was prepared. In principle, the projects with higher EIRRs are commenced earlier, and for the projects with high cost or foreseen difficulties in implementation, the period for implementation was set longer. Since this Master Plan is for the transition period from bus to subway, all the proposed projects should be implemented as soon as possible.

Selection of the Projects for Subsequent Feasibility Study

The East-West primary busway project was selected as suitable for the conduct of a feasibility study due to:

- Its EIRR is the highest at 37% among the projects economically evaluated.
- The project includes some intersection improvement projects, bicycle lane projects and pedestrian environment improvement projects that have been highly evaluated. Therefore, the result of the feasibility study could be utilized as a model to be applied for the whole city.

In addition, the project “Privatization of public transport business” was also taken up for the subsequent feasibility study as a “software” project in contrast to the “hardware” project of busway mentioned above. This project would be one of the key policies to improve the public transport system of Chengdu.

East-West Primary Busway Project

A. Project Framework

- (1) **Implementation Period and Project Life:** This project should be started immediately. Project implementation schedule indicates project approval and design in 2001; funding arrangement, bidding and commencement of construction in 2002; completion of construction in 2003; and start of operation in 2004. The project life of exclusive bus lanes is assumed to be 10 years.
- (2) **Implementing Body:** The proposed exclusive bus lanes will be used mainly by existing routes either partially or entirely for the whole stretch of the project. The private sector can not be involved by, for instance, introducing a toll system for the bus exclusive lanes.
- (3) **Bus Operating Body:** The existing bus companies shall operate the bus routes. For the proposed new route, Jinsha Bus Terminal-Wuguiqiao, however, the bidding process may be applied to determine the operator of the new route.
- (4) **Premium Bus:** It is assumed that ordinary buses shall operate on the proposed exclusive bus lanes. However, for the proposed route Jinsha Bus Terminal-Wuguiqiao, it is possible to adopt premium services such as air-conditioned buses, soft-seat buses which may be effective for the promotion of public over private transport mode.

B. Total Project Cost

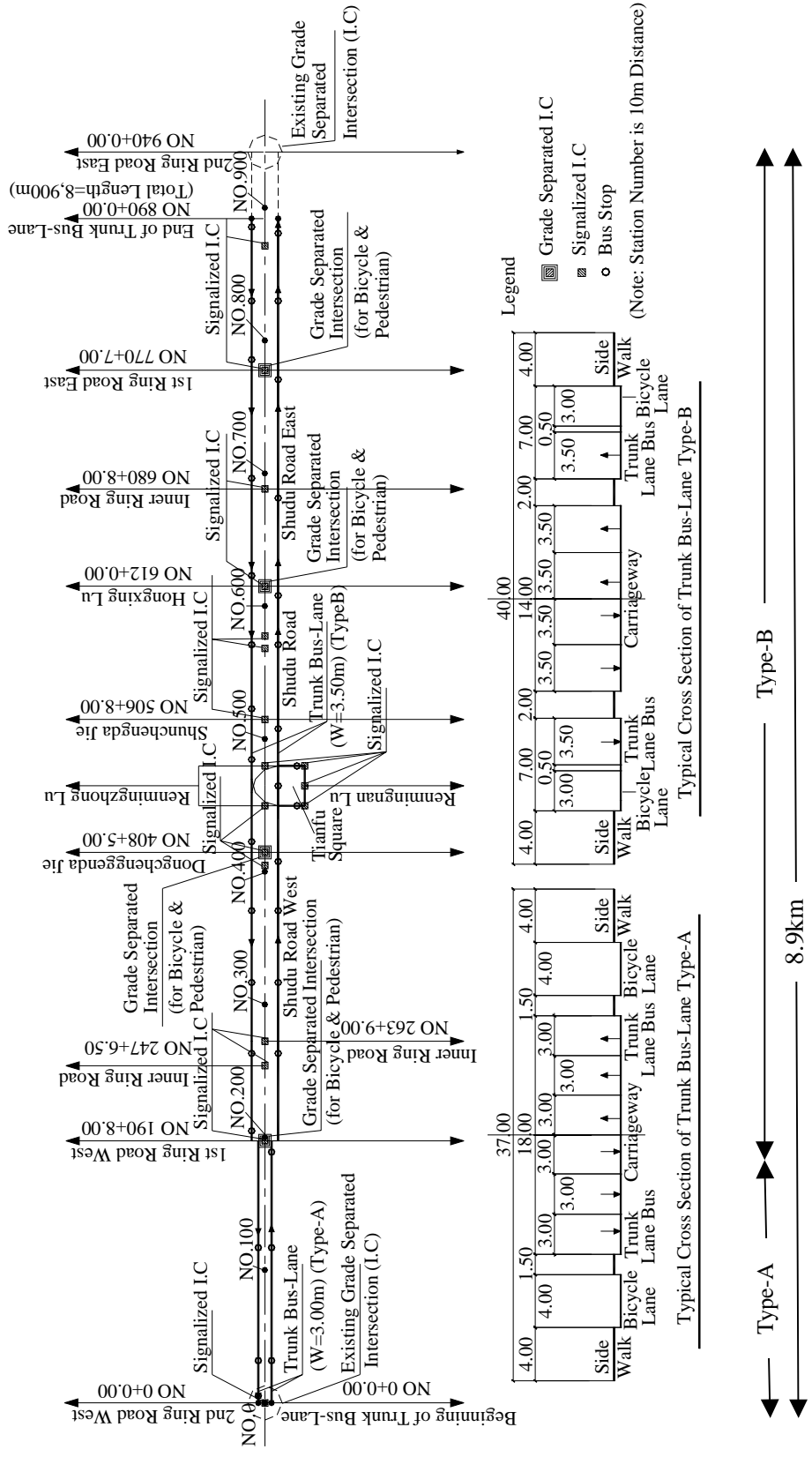
Based on the preliminary design, construction plan was formulated and work quantity was estimated. Then, the total project cost has been calculated by summing up for each of the work items. The total project cost is RMB 146 million, including related ancillary projects, of which RMB 46 million or 31% of the total is the foreign portion.

C. Economic Evaluation

The economic internal rate of return (EIRR) was calculated at 49.1% (*). The proposed project is proven to be highly feasible economically. The benefit/cost ratio (BCR) is 3.4, and the net present value (NPV) is 231.1 million which is more than double of the total investment.

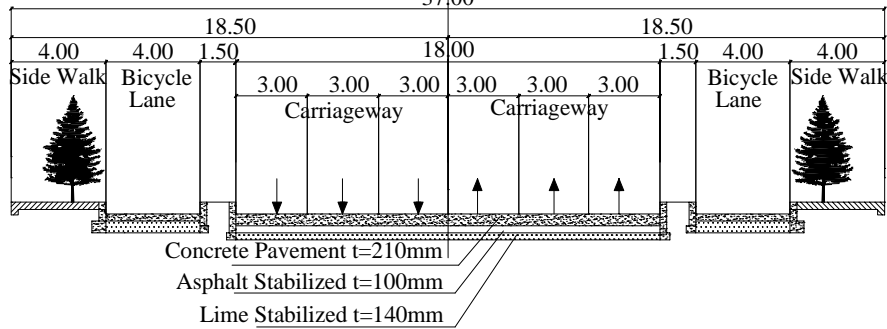
* This value is different from that of the Master Plan due mainly to the different assumptions on the existence of other projects.

Project Outline

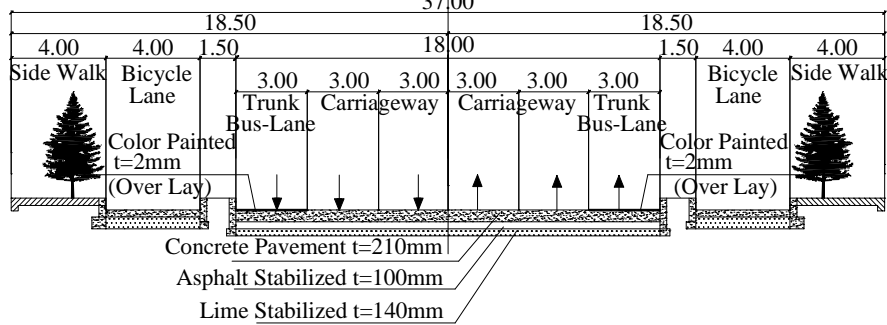


Typical Cross Section Type A

Typical Cross Section of Existing Road (6-Lane Dual Carriageway)
(Road Section between 2nd Ring Road West and 1st Ring Road West)
37,00

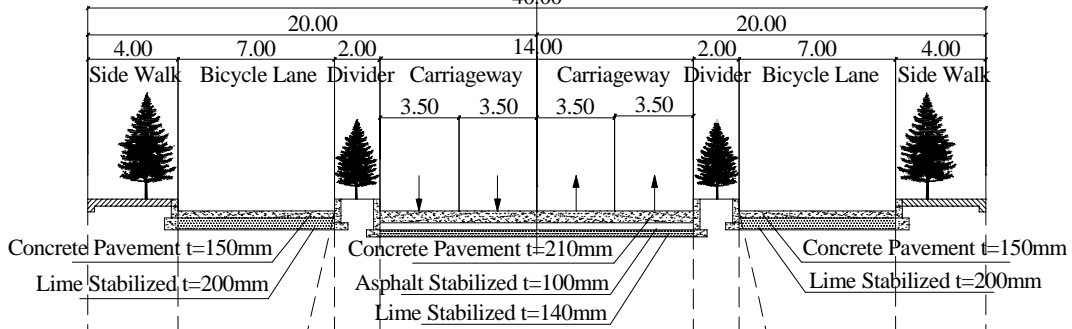


Typical Cross Section of Trunk Bus-Lane Introduced (Type-A)
(Road Section between 2nd Ring Road West and 1st Ring Road West)
37,00

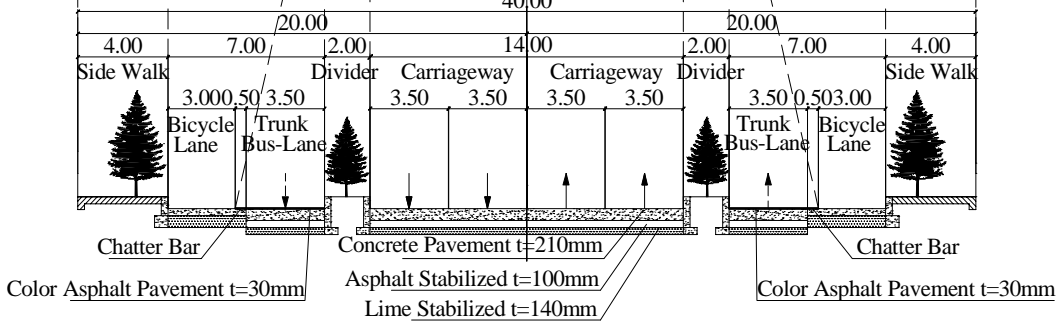


Typical Cross Section Type-B

Typical Cross Section of Existing Road
(Road Section between 1st Ring Road West and 2nd Ring Road East)
40,00



Typical Cross Section of Bus-Lane Introduced (Type-B)
(Road Section between 1st Ring Road West and 2nd Ring Road East)
40,00



The proposed project focuses on the modification of the cross-section of existing roads. Its characteristics are rather of a “Software”. Thus it does not require a huge investment on physical infrastructure while its impact on traffic flows is remarkable. This is the reason why the economic evaluation of the Project resulted highly favorable.

This evaluation was conducted by comparing the “With Project” case and the “Without Project” case. The “Without Project” case is the same as the “Without Project” case of the Master Plan.

Chengdu Bus Privatization Project

As the affiliated bus companies of No. 2, 3 and 6 have been already incorporated into Yunxing Transport Company, the focal point is to analyze if the remaining three companies of No. 1, 4 and 5 can be financially viable after being privatized. It is assumed in this analysis that the remaining three companies will be privatized all together into one company which is referred to as the New Bus Company.

Based on the result of financial analysis, the following are concluded.:

- The three companies by themselves are very difficult to be privatized, even with a supportive measure such as 5--year tax exemption. If they are subsidized with more than RMB 180 million for the first five years, it can survive in the long run.
- If the New Bus Company is established as a public-private joint company by introducing a private capital over RMB 130 million, the company can be financially feasible. Without any supportive measures, however, the company is not so attractive to the private sector.
- New Bus Company will be viable if it joins with a private company, introducing private capital, and it is properly subsidized for a certain period.

As such, it was considered necessary to take a step-by-step approach in Chengdu. Having the present situation as the First Stage, the subsequent stages are:

Second Stage: Preparation of Bus Privatization Plan and Transformation of Bus Operation Business to a Self-Financing Structure (2002-2004)

The main task of the second stage is to work out a bus privatization plan to explain the plan to and enrich the understanding on these policies of bus entrepreneurs, relevant enterprises, bus-users and potential investors. As for bus enterprises and the relevant enterprises, they must strive for survival under the new policies.

Third Stage: Restrictive Competition Environments under a Transitional Period (2005-2007)

This stage is a transition period in the process of introducing route-licensing policy into bus operation business. In this stage, related reforms should be pursued continuously.

Fourth Stage: Completion of Bus Privatization with Competitive Environments (2008-2010)

The fourth stage is the final stage of the bus privatization project in Chengdu. This will take the form of a route license system under a competitive environment principle. This will provide reliable bus services and shall take advantage of benefits of privatization such as cost reduction and service improvement.

Conclusion and Recommendations

A. Conclusion

- Chengdu City is the center of the South-Western Region of China having a population of about 10 million. The central government is presently shifting the development target from the coastal region to the inland region. The Study Area is the central part of the City and is expected to play a key role in accelerating the achievement of this policy goal. For this purpose, the current transport system of Chengdu needs to be upgraded to support varied social and economic activities.
- The current road system of Chengdu is relatively well developed. Its theoretical capacity is enough to accommodate the traffic volume of the present level, and, with the completion of road projects proposed in the existing plans, will be sufficient even for the forecasted traffic volume in 2010. However, there still remain a number of problems hindering the full use of existing road space. These are, among others, existence of bottleneck sections in built-up area, insufficient intersection management, too many traffic accidents and poor traffic discipline.
- The present public transport system of Chengdu is dominated by bus (excluding taxi which is considered a semi-private mode of transport). There is no major problem in relation to bus operation at present. Most of major roads are covered by bus service and the service is more or less satisfactory during working hours with a relatively low fare level. Its modal share, however, is still low at 10% in 2000, and there are a considerable percentage of bicycle and car users who would shift to bus use if its service level is improved considerably.

The largest problem in relation to bus operation is rather administrative or managerial. Bus industry in Chengdu is dominated by a state-owned company, and its group (including affiliated bus companies) has been producing a huge financial loss every year. The City has to cover the deficit by providing subsidy from its general budget. In the light of the current policies of the central government promoting deregulation and the recent movements of some advanced cities in China towards privatization of public transport, it is the time for Chengdu to take the next steps.

- In the long run, the Chengdu public transport system will focus on the subway network. By 2030, the subway network will be completed. The period from 2000 to 2030 will be a transition period to develop a public transport system consisting mainly of railways and buses. Buses will become the main public transport for a certain period and then will provide some auxiliary services. It is projected that only the subway's Line 1 will be completed around 2010, so the main mode of public transport is still buses until 2010. In formulating the plans to improve public transport by 2010, however, the subway network should be taken into account. In order to enhance the bus service in Chengdu to encourage the use of public transport (favorable also for subway), the busway system is very effective. It is a combination of segregated bus exclusive lanes and priority lanes using the existing Right-of-Way of major urban roads. Although various construction works are needed, it does not require a large-scale investment for constructing new infrastructure. This busway network, however, should be supported by a series of measures including bus terminal/stop improvement, modification of bus routes, upgrading/improvement of major intersections,

segregation of bicycle and pedestrian flows and implementation of other traffic management schemes.

- By implementing these plans, the future traffic situation will be remarkably improved; the modal share of bus will increase from the present 10.2% to 27.4% in 2010, the travel speed of bus from 12.0 km/h to 16.9 km/h and the average volume/capacity ratio of roads will decrease from 0.43 to 0.25. If no measures are taken, the improvement of traffic situation is quite marginal only due to the completion of existing road development projects.

B. Recommendations

- The projects proposed in the Master Plan should be implemented according to the implementation schedule. They are 4 Primary Busway Projects (segregated bus exclusive lanes), 7 Secondary Busway Projects (segregated bus priority lanes), 3 Auxiliary Bus Facilities Projects (7 intercity bus terminals, 10 intra-city bus transfer points and 230 bus stops), 4 Traffic Control System Projects (intersection improvement, bicycle lane development, etc.) and 5 Policies and Management System Projects. In addition, the Master Plan is judged to be highly feasible economically.
- In addition, it is proposed that a single traffic administrative body be responsible for traffic management in Chengdu. This setup will integrate management of city traffic including public bus (intercity and intra-city), taxi and subway systems.
- Regarding the two key projects analyzed by the feasibility studies, the following recommendations are made:

East-West Primary Busway Project

Segregated bus exclusive lanes should be developed on Shudu Road within the Second Ring Road. This project aims to make a maximum use of the existing Right-of-Way without reducing the traffic capacity for other vehicles only by rearranging the cross-section. In parallel to this, other supportive measures including grade separation of major intersections, improvement of bicycle/pedestrian facilities should be taken. The total cost is estimated at RMB 146 million. The effect of the Project is large in improving traffic flows. The Project is highly feasible economically with an EIRR of 49%. The project also contributes to improve environment, while no major negative impact is foreseen. It is strongly recommended to implement this project as early as possible.

It is desirable for the City to approve the Project and start design work in 2001, to arrange finance and bidding and start construction in 2002, and to complete construction within 2003. As this project is conducted within the existing Right-of-Way, the private sector should not be involved. It should be financed by the general budget of the City and the construction would be conducted by the Primary Road Control Department of the City. Operation and management of the busway should be taken care of by the Public Utilities Bureau of the City. In addition, the busway should be free of charge.

Chengdu Bus Privatization Project

Although the business of city bus operation has been already privatized partially in 2000 (the Yunxing Company), the remaining part should be also privatized in a few years. This is needed in light of policy directions of the central government of China as well as to improve bus services in terms of quality and quantity and to reduce the financial burden of the City.

However, it is difficult to privatize the bus business remaining in the public sector (the Chengdu Public Transportation Company and its affiliated Bus Company No. 1, No. 4 and No. 5) under the current financial condition. It is required to introduce a private capital corresponding to 150% or more of the owned fixed assets to materialize the privatization. Prior to this, however, a certain level of profitability, satisfactory for the private capital, must be secured. Although this becomes possible in the long run due to the increase of bus traffic demand, it is almost impossible for a private capital to raise a profit in the short term taking into account the necessary replacement and increase of bus fleet. Thus some incentive measures should be adopted for at least 5 years, such as tax exemption/reduction, subsidy for bus units and public assistance for surplus manpower. During this transition period, the privatized company should strengthen its financial base towards a complete financial independence by 2010.

The headquarters of the Chengdu Public Transportation Company should be reorganized as a stock holding company for the Yunxing Company and the new companies to be privatized, and it will be responsible as a public organization in monitoring and supervision of bus operation, planning and approval of bus routes, etc.

**STUDY FOR PUBLIC TRANSPORTATION IMPROVEMENT
IN CHENGDU CITY IN THE PEOPLE'S REPUBLIC OF CHINA**

**FINAL REPORT
SUMMARY**

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1. INTRODUCTION

Study Background

Chengdu City is the center of the South-Western Region of China having a population of about 10 million. The city is not only the center of commerce, business, finance, administration, science and technology but also of culture and history. The central government is presently shifting the development target from the coastal region to the inland region.

The city government of Chengdu has decided to strengthen its public transport system. The public transport system of Chengdu comprises of bus (including minibus) and taxi. Bus, however, is not fully utilized due to a number of reasons including competition with bicycle and low levels of service. Traffic congestion has been aggravated particularly in the city center due to rapidly increasing vehicles. Enhancement of public transport service coupled with traffic management measures is required in addition to the development of road infrastructure.

Although the city government of Chengdu implements and plans the varied countermeasures to improve public transport service as well as urban traffic situation, the problems are yet to properly addressed. Under these circumstances, the Government of China requested the Japanese government to conduct a public transport study for Chengdu based on the transport surveys. In response to this request, the Japanese government dispatched a preparatory study team to Chengdu in December 1999. Based on this discussion, the Scope of Work for this technical study has been signed by both governments.

Objectives and Outline of the Study

The objectives of the Study were:

- (1) To formulate a public transport system development plan, with emphasis on bus service, in order to promote the patronage of public transport (Target Year is 2010);
- (2) To conduct feasibility studies on the high-priority project(s) selected by the said plan; and
- (3) To transfer technology in relation to data processing, demand forecast and planning to the counterpart staff of Chengdu during the course of the Study.

The Study started in March 2000 and was completed in July 2001 with the submission of the Final Report.

In the earlier stage of the Study, the focus was placed on the identification of important issues and the formulation of the Master Plan in relation to the public transport system of Chengdu, and in the later stage feasibility studies were conducted for two selected key projects: 1) the East-west Primary Busway Project and 2) Bus Privatization Project.

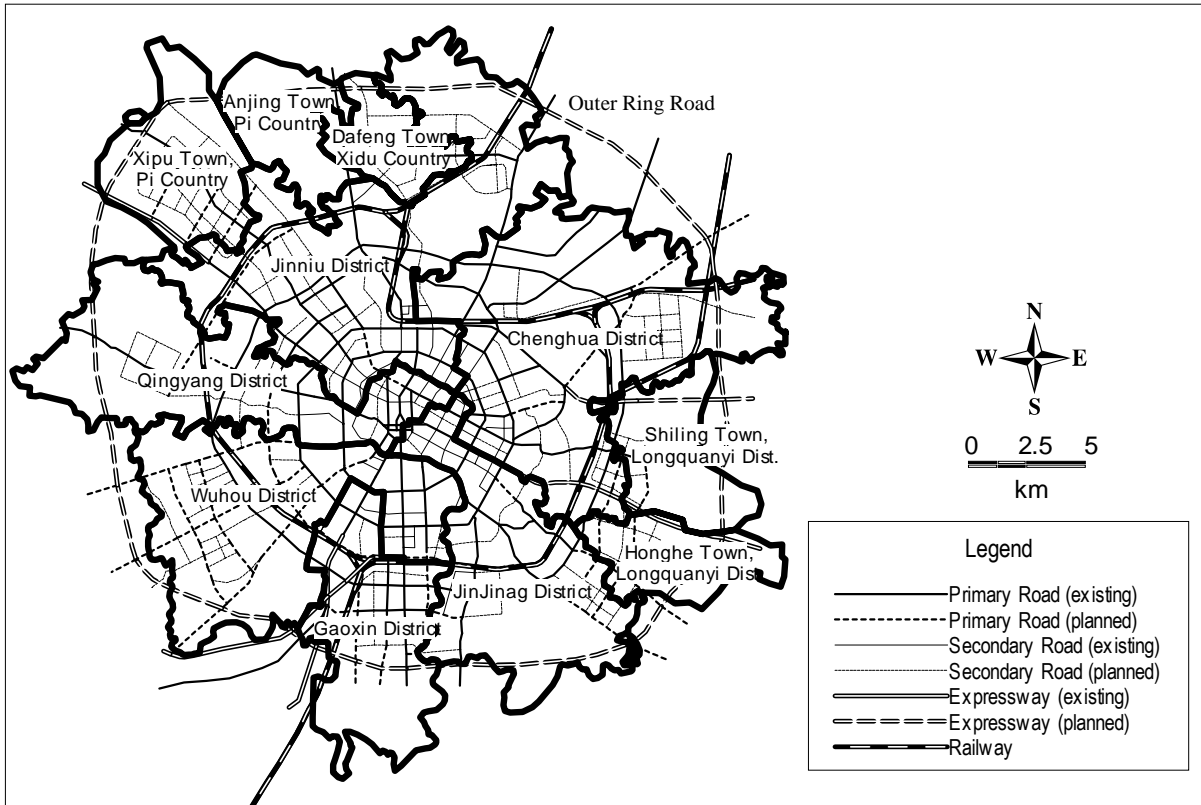
Study Area

The Study Area covers the six (6) Central Districts (including Gaoxin Sub-District as its part)and neighboring five towns located inside the Outer Ring Road.

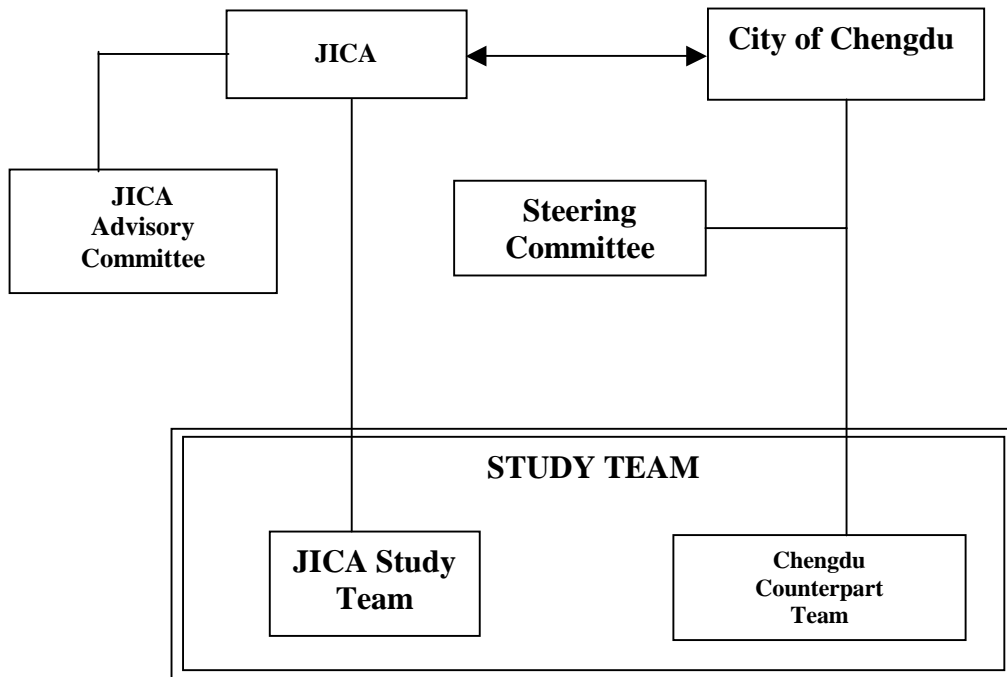
Study Organization

The study organization is composed of the JICA Advisory Committee and the JICA Study Team on the Japanese side and the Steering Committee and the Counterpart Team on the Chengdu side.

Study Area



Study Organization



2 PRESENT SITUATION OF THE STUDY AREA

2.1 Natural Condition

Topography

The topography of Chengdu City is characterized mainly by a mountainous region with an elevation of 5,364 meters and a basin region with the lowest elevation at 387 meters. The basin consists mainly of flat lands with an average height of 500 meters above the sea level as well as partly hilly and terrace lands.

The ground water resource is abundant in Sichuan Basin with volumes reaching 66.9 hundred million tons per year. There is a 10 to 20 meters thick water vein, which is rich in CaCO_3 ¹(Ministry of Geology and Mineral Resource), at about 20 meters deep underground.

Geology

The geological structure of Chengdu area consists mainly of the Cenozoic Quaternary deposit. In Chengdu, bearing stratum, which can be the foundation of large buildings and structures, is distributed in shallow layers. The layers of dense and very-dense boulder stone in the west, and the layers of Quaternary early diluvial deposit clay in the east are considered suitable as the bearing strata.

Climate

Chengdu City is partly of a subtropical zone with humid monsoon climate and with clear four seasons. It is warm and humid throughout the year with a yearly average temperature of 16.4°C. The average temperature in January is 4.6°C-6.0°C and 24.5°C-27°C in July. The yearly average humidity is 82.3%. Therefore it is hot and humid in the summer and warm in winter. Its frost-free period averages 300 days or more a year. Annual average rainfall is 900-1300mm. Rainy season is from June to September with July having more rainfalls. In a year, the number of cloudy days averages to 255 days or more. There are more sunny days in spring and in autumn. Owing to the basin topography of the area, there are many foggy days reaching about 60 days a year particularly in autumn and winter due to heat radiation.

Monthly Climatic Variation of Chengdu (1998)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Average
Temperature (°C)	6.1	8.8	11.3	21.3	21.5	24.1	26.2	25.0	22.7	18.5	14.7	8.4	17.4
Rainfall (mm)	2.7	17.2	15.3	41.9	71.2	122.8	320.1	166.7	110.8	10.5	9.4	17.1	905.7
Average wind speed.(m/s)	1.4	1.2	1.6	1.7	1.6	1.4	1.4	1.3	1.3	1.12	1.0	1.1	1.4
No. of rainy days	12.0	15.0	13.0	10.0	23.0	19.0	24.0	22.0	13.0	12.0	5.0	10.0	178.0
No. of foggy days	4.0	1.0	1.0				1.0	1.0	3.0	1.0	9.0	7.0	28.0
Sunshine time (hours)	43.1	37.8	53.9	168.1	91.2	120.9	104.7	112.7	93.6	23.1	72.2	40.1	961.4

Source: Chengdu City Statistics Yearbook 1999

2.2 Socio-Economic Profile

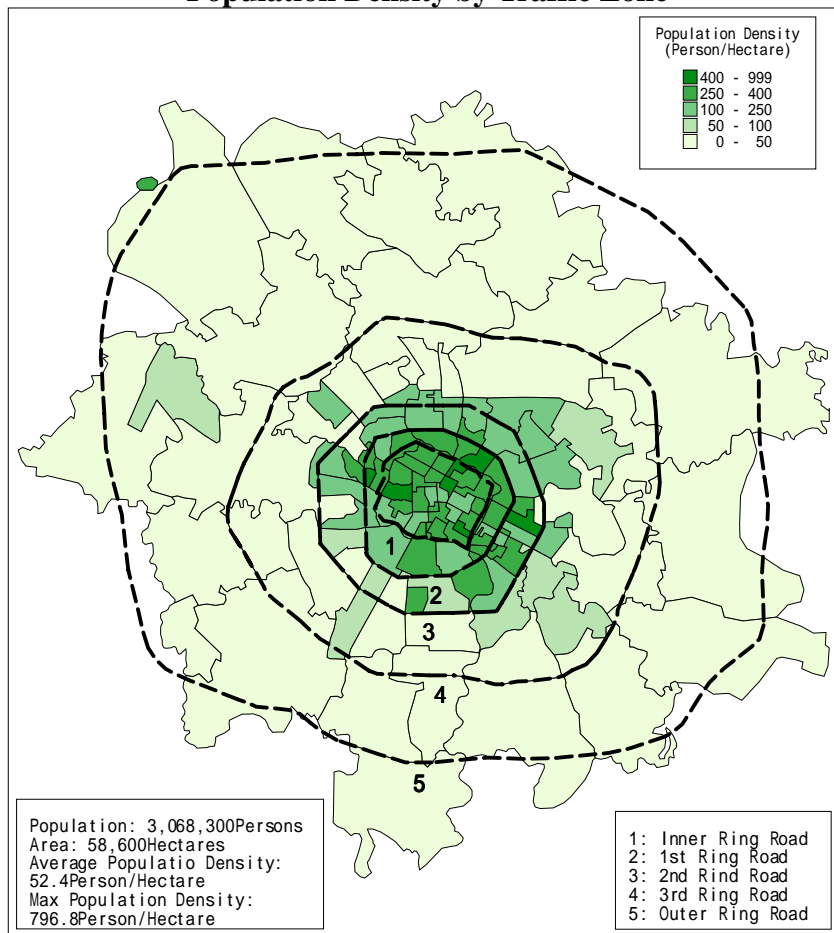
Population

The 1999 population of 2,427,200 living in the Central 6 Districts accounted for 24.2% of the entire city's population of 10,035,600. This share has been increasing in the past years. During the period from 1997 to 1999, the average annual increase rate in the Central Districts was 1.49%. Population growth rates in Jinjiang and Qingyang District recorded negative in recent years, while that of Gaoxin District has been very high.

The recent birth rate experienced at the Central 6 Districts has been 7 to 8‰ and the death rate is 4.5 to 5.5‰, resulting the natural increase rate of about 2.5‰. In 1998, the natural increase rate of China as a whole was 9.53 ‰ (with a birth rate of 16.03‰ and a death rate of 6.50‰). On the other hand, the natural increase rate of Chengdu City (including rural areas) was 3.03‰ (with a birth rate of 9.17‰ and a death rate of 6.14‰) and that of the Central Districts was 2.61‰ (with a birth rate of 8.00‰ and a death rate of 5.39‰), which are very low compared with that of the whole country. The annual natural increase of population in the Central Districts is 5,000 to 6,000 persons and the annual net migration is about 30,000 persons. From these facts, it is clear that 80-85% of the increase of population in the Study Area is attributed to the net migration.

Of the total population of about 3 million, there are 750,000 living between the 1st and the 2nd Ring Road that accounts for a quarter of the total. Within the Inner Ring Road and between the Inner and 1st Ring Road, there are 960,000, with 490,000 living in the former and 470,000 living in the latter. Although the distribution of population in each ring is not even, the size of population does not vary much. Accordingly, population density is highest in the inner area. Population density within the 2nd Ring Road is much higher than that of the outer area. Population density of the inner area exceeds 360 persons per hectare.

Population Density by Traffic Zone



GDP

The GDP of the Central six (6) Districts in 1999 is RMB 54,483 million, accounting for 45.8% of the total GDP of the whole Chengdu City. The share of tertiary sector is 55.2%, accounting for more than half of the whole city's. Per Capita GDP of the Central Districts is RMB 22,613 per person, which is 1.9 times higher than that of the whole Chengdu City of RMB 11,897 per person. In terms of the growth rates during the period of 1998 to 1999, the primary sector posted a negative growth and the other sectors had low increases compared with the whole Chengdu City. The economy of Chengdu City is recently growing outside the Central Districts. The growth rate of the Per Capita GDP was 8.4%.

GDP of the Central Districts and the Entire Chengdu City (1999)

		1999			1998 to 1999
		Amount (RMB million, at current prices)	Share by Sector (%)	Ratio of the Central Districts to the Whole City (%)	Growth rate (% at constant prices)
Chengdu City	Total of GDP	119,003	100.0	100.0	10.2
	Primary sector	12,374	10.4	100.0	3.4
	Secondary sector	53,239	44.7	100.0	10.3
	Tertiary sector	53,390	44.9	100.0	11.7
	Per Capita GDP (RMB per person)	11,897			9.4
Central Districts	Total of GDP	54,483	100.0	45.8	9.9
	Primary sector	877	1.6	7.1	-16.4
	Secondary sector	24,129	44.3	45.3	9.8
	Tertiary sector	29,477	54.1	55.2	11.1
	Per Capita GDP (RMB per person)	22,613			8.4

Source: Calculated by the Study Team based on the Chengdu City Statistics

Note: In 1998, the GDP of Chengdu City accounted for about 1.4% of entire China. Its Per Capita GDP was 1.74 times of the national average.

Vehicle Ownership

There are 647,800 vehicles in Chengdu City in 1999. An annual average increase rate is 19.5% through the 1990s. The numbers by type of vehicle are: truck 77,700, bus and passenger car 187,900 and others 382,200. "The others" include motorcycle, tractor and special use car. The number of motorcycles is 292,000, which is a considerable large number under the present restriction of motorcycle ownership.

Increase in the Number of Vehicles by Type (1990 to 1999)

Type of vehicle	Number of vehicles				Annual increase rate (%)			
	1990	1995	1998	1999	1990-95	1995-99	1998-99	1990-99
Truck	29,800	45,200	69,600	77,700	8.69	15.48	11.64	11.24
Large type	16,900	17,100	22,800	25,200	0.24	10.06	10.53	4.54
Bus and passenger car	19,400	84,500	162,900	187,900	34.22	24.46	15.35	28.70
Small type			156,200	180,200			15.36	
Others	81,200	136,700	307,000	382,200	10.98	30.96	24.50	18.78
Total	130,400	266,400	539,500	647,800	15.36	26.52	20.07	19.50

Source: Chengdu City Statistics Yearbook, 2000

Since 1990 the bicycle ownership increased till 1996 in urban areas and till 1995 in rural areas, and recently it is decreasing in both areas. In 1998, urban households owned 2.33 bicycles per household, 1.4 times that of rural households of 1.65. As for the Study Area, the Person Trip Survey shows that there are 3,393,200 bicycles, with an ownership of 1.52 units per household in 2000. The number of households interviewed in the Survey includes temporary resident households of which smaller percentages might own bicycles.

3 PRESENT CONDITION OF ROADS AND TRANSPORT

3.1 Roads and Road Traffic

Road Network

The existing primary road network in the study area considers the Chengdu Sports Center Square as its center and is made up of ring roads and radial roads. There are 5 ring roads including existing roads and roads under construction. They are the Inner Ring Road with a radius of 2 km, the 1st Ring Road with a radius of 3 km, and the 2nd Ring Road with a radius of 4 km, in addition to the two roads under construction, namely the 3rd Ring Road with a radius of 7 km, and the Outer Ring Road with a radius of 11 km. It is expected that the 3rd Ring Road and the Outer Ring Road will be finished by 2001 and 2002, respectively.

Traffic Volume

Among various different transport modes, people prefer bicycle the most. Its volume is very substantial especially on major trunk roads of the CBD and outskirts of CBD, ranging from 60,000 to 70,000, and it reaches 10,000 even in the suburban areas. This would be equivalent to 35,000 cars or 3,500 buses provided average occupancy is 2 persons for a car and 20 persons for a bus.

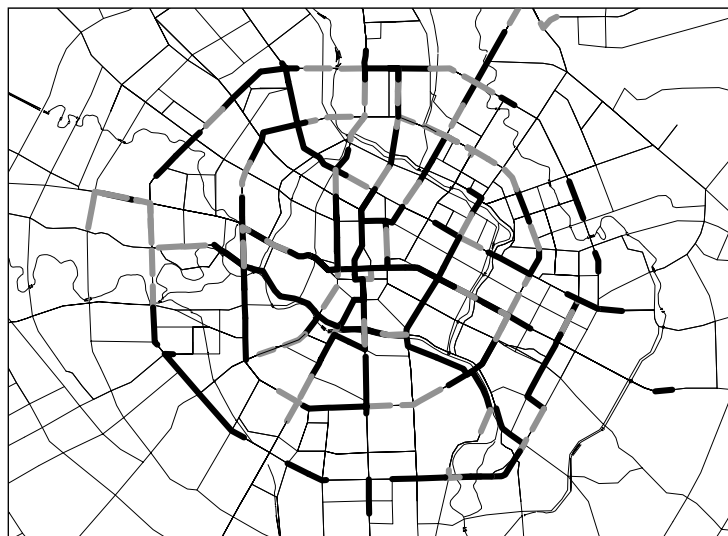
Regarding car traffic, intersection directional traffic count survey reveals that traffic volume amounts to 3,800 cars per hour at maximum in the Shuncheng Lu. In terms of daily traffic, about 25,000 cars appear on the radial trunk roads and about 30,000 cars on the 1st Ring Road. Judging from the size of the city, the usage of car has been at a low level but the potential for the increase in car traffic is high.

Problems in Relation to Roads

Based on road surveys and observations, the problems of roads at present are:

- Road cross-section not developed according to road hierarchy.
- Shortage of grade-separated intersections.
- Shortage of traffic safety facility.
- Inadequate bus stop facilities.
- Poor traffic discipline.

Road Sections with Bus Speed Below 20 km/h



Bus Speed

- below 20Km/h,Every Peak Hours
- below 20Km/h,Some Peak Hours

3.2 Public Transport System

Public Transport in the City

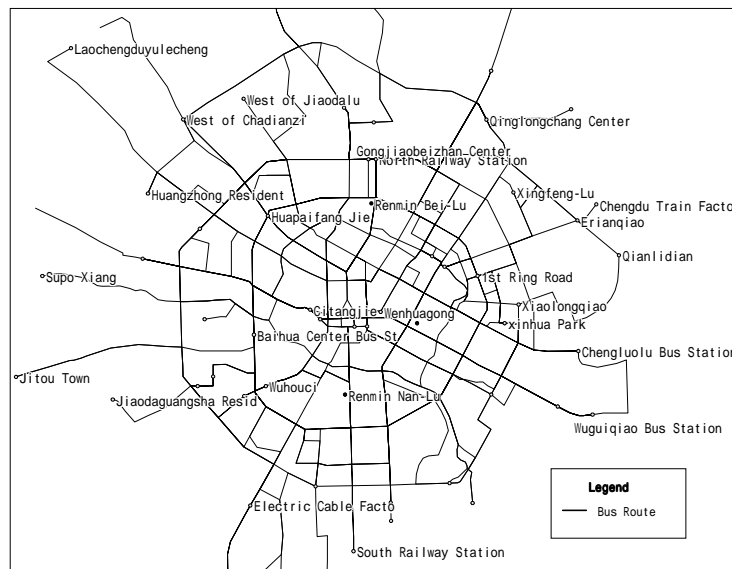
As of the year 2000, there is no railway system and buses and taxis are the dominant mode of public transportation in Chengdu. In some parts of the city, the tricycles and motorized tricycles serve local trips. Buses are classified by their structure and capacity into: the articulated buses, the double-deckers, the ordinary buses, the medium-sized buses and the mini buses.

Buses run on fixed routes. The urban buses start from and arrive inside the areas surrounded by the 3rd Ring Road. The suburban buses start from and arrive at the areas out of the 3rd Ring Road but in Chengdu. The intercity buses serve the areas outside of Chengdu. The Section of Transportation Management in the Public Utilities Bureau is in charge of the urban buses. The Chengdu Transportation Bureau takes charge of the suburban buses, while the Sichuan Transportation Bureau takes charge of the intercity buses. The suburban buses and the intercity buses set out from the bus terminals around the 2nd Ring Road but cannot go into the city center.

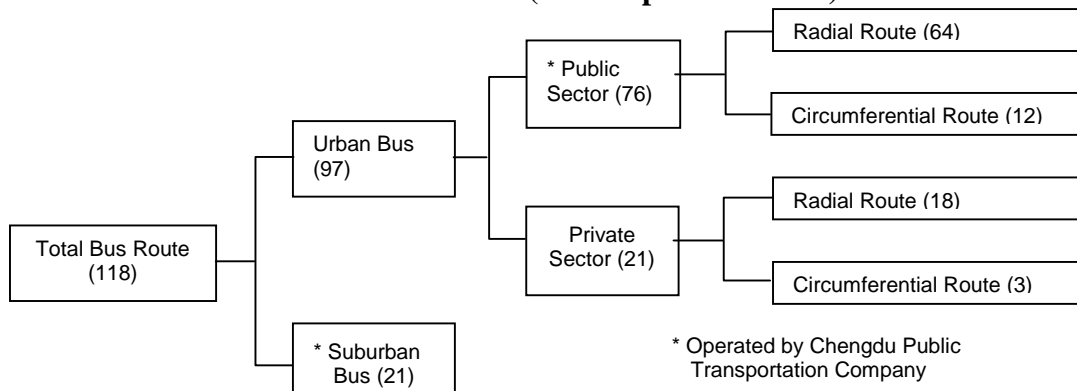
Bus Routes

The Chengdu Public Transportation Company (partially privatized at present) operates 97 bus lines as of September 2000. Of these, there are 76 urban lines and 21 suburban lines. Other than these lines, there are 21 mini-bus routes operated by the private sector. Bus network covers most of the primary and secondary roads in the central part of Chengdu City.

Bus Route Coverage of the Chengdu Public Transportation Company (as of Sep. 2000)



Number of Bus Routes (as of September 2000)



Bus Operation

According to the Chengdu Public Transportation Company, 1,121 buses are distributed in 97 lines serving a total of 2,235km. The number of buses dispatched daily is 7,679 buses and the total length of operation is 188,580km as of October 1999, including the urban and the suburban ones. On the average, a bus makes seven (7) one-way trips and operates 170km a day, which means 8.5 hours of operation, assuming an average travel speed of 20km/hour. The frequency differs much by line and the maximum is 200 buses a day in one direction. The minimum is 10~20 buses except for the suburban buses. The operating time is from 5:00~7:00 to 19:00~22:00. However, some routes stop operating at 17:00~18:00, which is comparatively early.

Bus Fare

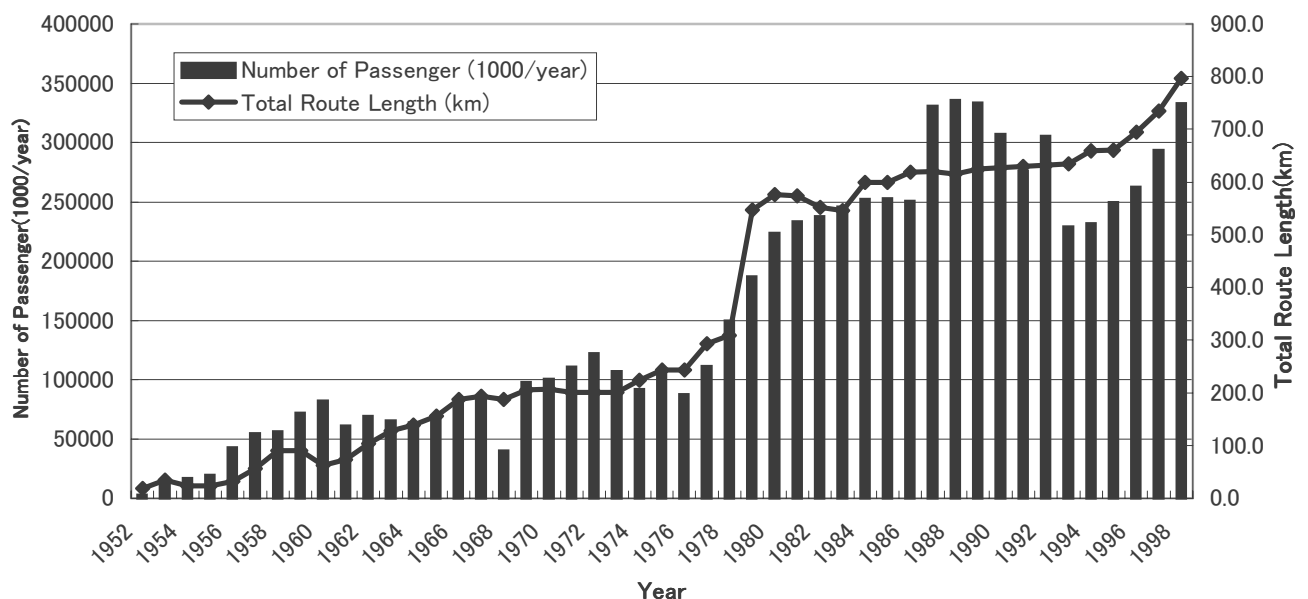
The fare was increased to RMB 1 since April 1, 2000. Prior this date, the fare was RMB 0.5 within 5 bus-stops and RMB 1.0 for a longer ride. There is no discount for students and for rides at night. Rides are free for the blind and disabled servicemen approved by government and persons below 1.1m tall. Passengers must prepare the exact fare when they take a non-conductor bus.

A monthly ticket costs RMB 35 for adults and RMB 15 for students. It is sold by the calendar month and cannot be bought in the middle of a month. The ticket is valid for all lines except Route 301 and 302, which are served by tourist buses (with fare of RMB 2.0), and lines served by mini-buses. The ticket can be bought at ticket offices located at 15 places in the city, by showing an identification card and with a photo.

Ridership

The annual passenger ridership shows an increasing trend in parallel with the increase in total operation length. The number of passengers was 330 million at the end of the 1980s but dropped to 230 million in 1990-1993. In the later part of the 1990s, the number climbed back to 330 million.

Change in Ridership and Route Length



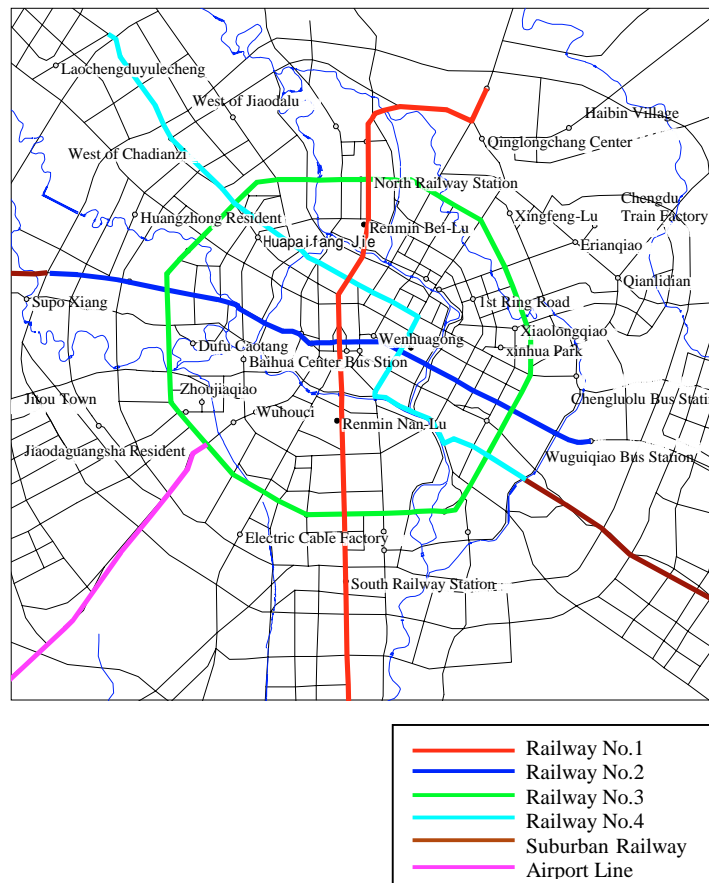
Source: Chengdu city Construction statistics, 1998

3.3 Plan for Subway Development

Long-Term Network Plan

There is no formal and authorized plan of the Chengdu subway although different agencies studied different routes. The Planning and Designing Institute proposes to build up 6 railway lines of 75 km long by the year 2020. All the lines are planned as an underground subway within the 3rd Ring Road and as an elevated or surface railway beyond that road.

Rail Transit Network Plan



Line No.1

This line is proposed for the North-South axis of the City. It is 14.7 km with 14 stations.

No.1 line has been already approved by the Chengdu City Government. The proposal has been recently submitted to the Central Planning Committee. A feasibility study will be needed after its ratification. Afterwards the Planning Department will design and implement the project. The Chengdu City Government has entrusted the Second Supervision and Planning Institute to investigate its feasibility. The city organized the Promotion Section for the Subway in 1999 in order to promote No.1 line. The Promotion Section is to take the procedure to get the approval of the Central Government and prepare the tender documents.

The No.1 line is presumed to be completed by the year 2010 at the latest. Assuming the same type of a subway as in Shanghai, overall speed is planned at 33 km/hr, and its construction cost is considered to be about RMB 2 billion.

4 EXISTING TRANSPORT DEMAND

4.1 Outline of Person Trips

Total Number of Person Trips

The number of trips traveled by residents in the Study Area and non-residents was estimated by the Person Trip Survey. Total person trips per day are 8.5 million and person trips traveled by residents in the study area are 7.9 million or 93.6 percent of the total. The number of person trips crossing the Cordon Line is 940 thousand (or 11%) of which, 867 thousand trips are by road transport and 73 thousand trips are by train.

Number of Trips in the Study Area, 2000

Trip Distance	Mode	Trips by Residents in the Study Area (000/day)	Trips by Non-Residents (000/day)	Total (000/day)
Inside Study Area	Road	7,528.9	-	7,528.9
Between Study Area and Outer Area	Road	383.0	484.0	867.0
	Railway	12.6	60.1	72.7
Total		7,924.5	544.1	8,468.6

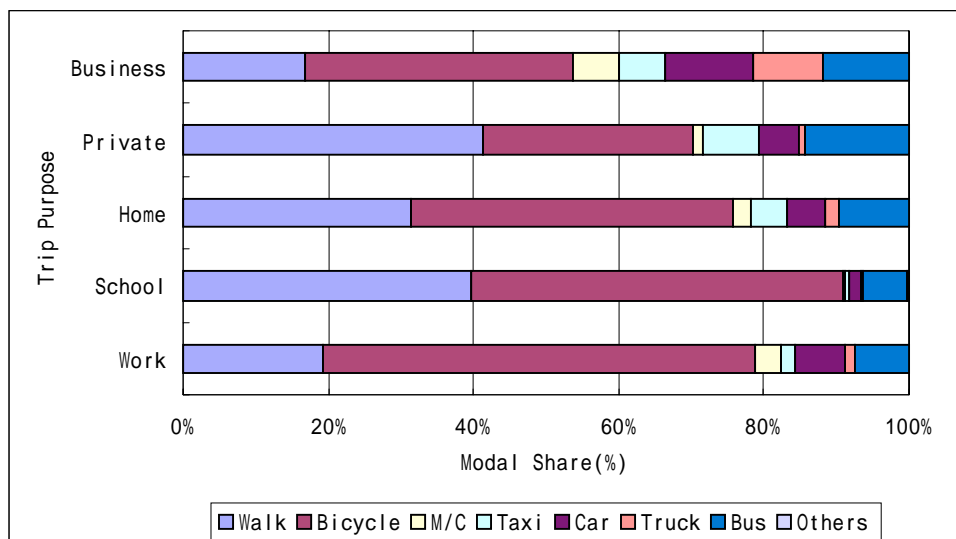
Note: including pedestrians

A trip production rate of 2.56 was calculated by dividing the total number of trips by the total population of 3,089.9 thousand (registered population: 2,615.4 thousand, temporary population: 474.5 thousand). This figure is significantly higher than the trip production rate of 2.16 by the person trip survey conducted in 1987.

Modal Choice

Based on the person-trip survey, walk trips account for 31% and bicycle trips 44% (excluding tricycle and motorcycle). Both account for 75% or 5,909 thousand trips. The share of trips by bus is very small at 10% or 807 thousand trips, by car and taxi about 10% and the number of motorcycle trips is only 206 thousand trips. The share of commuting and going to school trips by bicycle is more than 50% meanwhile the share of private purpose trips by bicycle is lower at 30%. This shows that bicycles are used in peak hours and public transport is used in off-peak hours.

Modal Choice by Trip Purpose, 2000



4.2 Trip Generation and Attraction

Outline of Trip Generation/Attraction

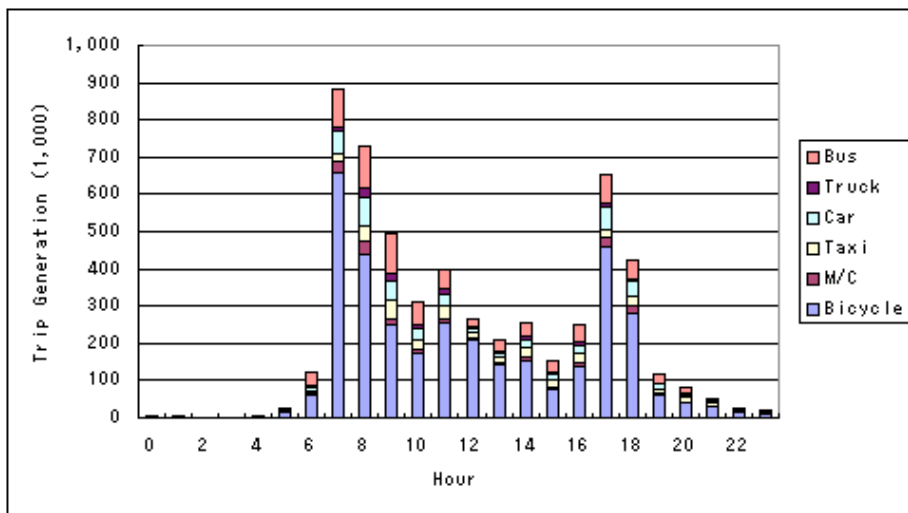
Many of the person trips are often generated in the "belt" area surrounded by the Inner Ring and the Second Ring Road. Trips are also generated outside the Second Ring Road.

On the other hand, person trips often concentrate within the central areas and the southern areas inside the First Ring Road. A lot of trips by car and bus concentrate in the area inside the Inner Ring Road, where the share of private trip is relatively high. The share of trip by motorcycle is high in the zones in the belt area between the Third Ring Road and the Outer Ring Road.

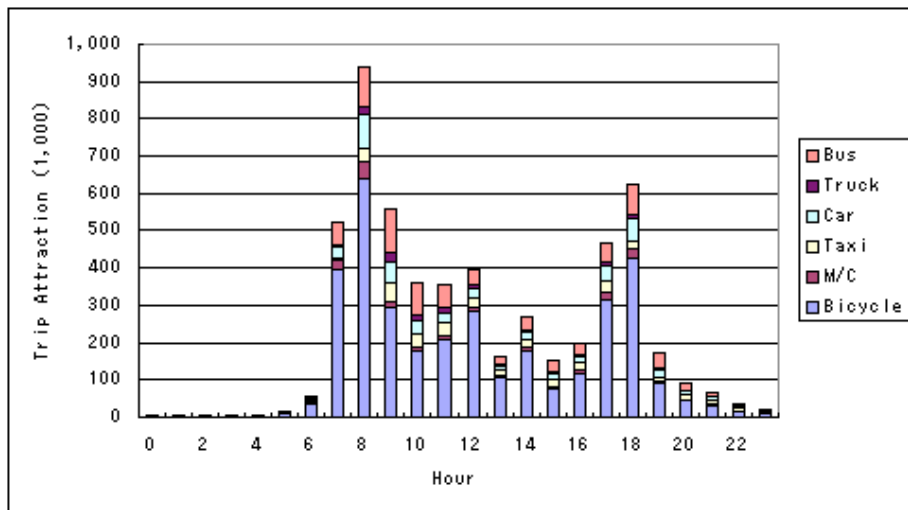
Generation/Attraction by Hour

The number of attracted trips is highest between 8 am and 9 am and the peak hour ratio is calculated at 17%. On the other hand, the peak hour of trip generation for bicycle is between 7 am and 8 am, for motorcycle, car and bus between 8 am to 9 am. More than 90% of the total trips are generated and attracted between 7 am and 7 pm while the trips made during the rest of the period is very few.

Trip Generation by Mode and by Hour



Trip Attraction by Mode and by Hour

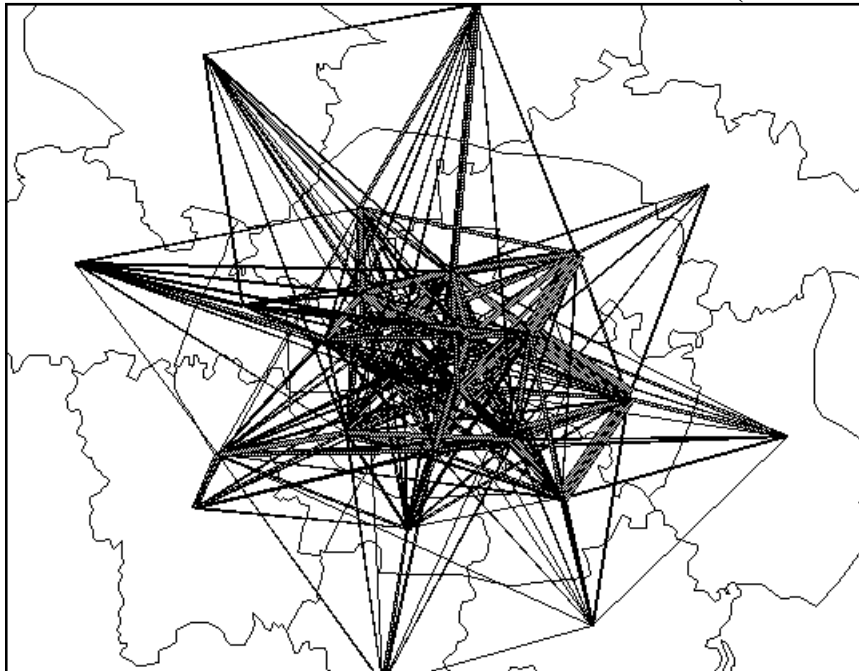


4.3 Transport Demand Distribution

Trip Distribution

The zones between the Inner Ring Road and the Second Ring Road attracted 430,000 “work” trips which is twice the number of trips that concentrated in the zones inside the Inner Ring Road. There are 210,000 “work” trips generated from zones outside the Third Ring Road and more than 3/4 of these trips don’t commute inside the Third Ring Road. Considering origin and destination zones of “work” trips, majority of OD is within zones between the Inner Ring Road and the Second Ring Road.

Distribution of Traffic Demand between Medium Zones (Work Trip)



Travel Time

Travel time of walk trips is almost less than 30 minutes. More than 97% of bicycle trips are within 60 minutes. The share of bus trips rises from 30 to 45 minutes. The share of car trips becomes higher from around 60 minutes of travel time. The average travel time of bus is the longest at 53 minutes followed by that of car (42 minutes).

Average Travel Time by Mode of Transport

Mode	No. of Trips by Travel Time (1,000)										Total	Average Travel Time (min.)
	0-5	5-10	10-15	15-30	30-45	45-60	60-75	75-90	90-120	120-		
Walk	169	802	428	837	84	37	8	8	2	1	2,376	21
Bicycle	87	620	564	1,529	309	207	35	27	10	2	3,389	28
M/C	11	46	25	83	16	12	2	2	1	3	200	30
Taxi	1	25	32	193	73	25	4	4	3	5	365	36
Car	8	48	38	181	72	62	17	13	10	13	464	42
Truck	1	19	11	51	17	22	7	9	6	5	147	46
Bus	2	15	15	214	168	201	71	60	31	18	797	53
Others	0	0	1	1	1	0	0	0	0	0	4	63
Total	280	1,576	1,114	3,088	741	566	144	123	63	48	7,743	

4.4 Notable Characteristics of Bus, Bicycle and Private Car Users

Bus

The bus trip share of the registered population is 9.5% while that of temporary population 15.0 %. This clearly shows that temporary residents tend to make trips depending on public transport since they have private transportation to a lesser extent.

Bus Trip Share of Registered/Temporary Population

Population	Number of Trips by Bus (1,000)	Number of Trips (1,000)	Bus Trip Rate (%)
Registered	657	6,922	9.5
Temporary	149	998	15.0

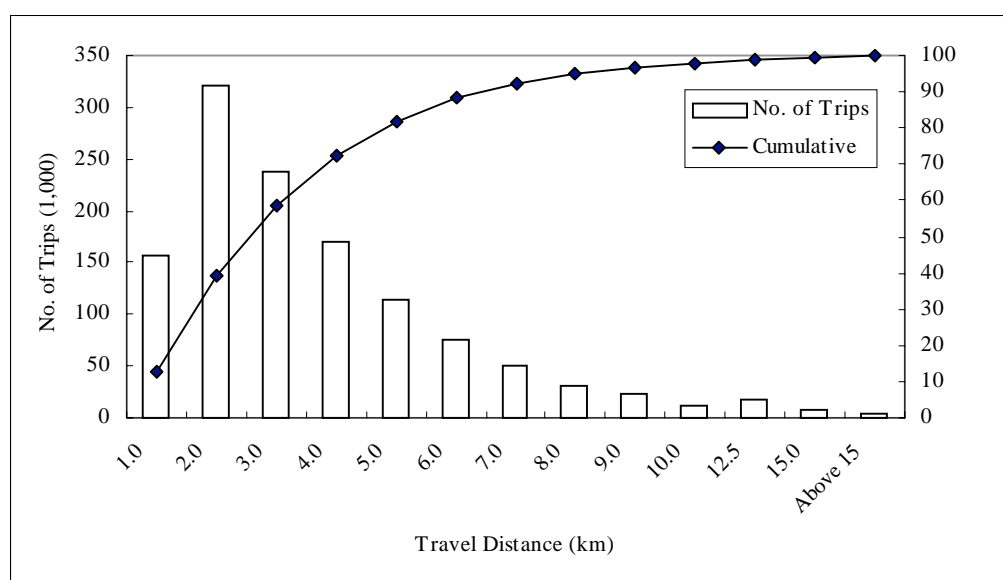
According to the bus users interview survey for reason of bus use, the biggest reason is “the cost is cheap” (33%) and the next is “there are no other means than bus” (14%). About 10% users raised the reason “the bus is safe”.

Bicycle

Unlike bus passengers, the rate of usage of bicycle was generally high among people between 10 to 50 years old. People aged 50 years old and over seldom take bicycle trips.

Compared with the travel distance of bus trips, that of bicycle trips is shorter. About 1/4 of bicycle trips travel between 1 km and 2 km. From the cumulative distribution, 80% tile value is 4.8 km, and 90% tile value is 6.4 km.

Distribution of Bicycle Trips by Travel Distance



Car User Perception on Buses

A car user interview survey was conducted to ask the reasons why they deny buses. Most reasons focus on spending too much time (39%), disliking of buses (35.4%); Being crowded in buses (24%) also ranks high. It’s evident that people attach great importance to the comfort of buses.

5 TRANSPORT DEMAND FORECAST

5.1 Future Socio-Economic Framework

Setting Methodology

The future socio-economic framework of the study is set for 2010 as the target year with 2005 as the medium-term year and 2000 as the base year.

In setting the future framework, the target figures for 2010 in the Chengdu City Development Plan (15-year plan) and the Integrated Master Plan for the Central Area of Chengdu City are used as the basis. However, since the 15-year plan has not been released yet, the GDP forecast was determined through discussions with the counterpart team and with considerations based on the recent economic trend and the forecast by related development projects.

Population and GDP

Population and GDP of the Study Area were determined for 2010 as follows:

- Population will increase from 3,090,000 to 3,500,000 (1.13 times);
- Population inside the First Ring Road will decrease by 100,000, and population outside the First Ring Road will increase by 500,000, especially in the southeast and south;
- GDP will increase from RMB 62,500 million to RMB 143,000 million (2.29 times);
- The share of the primary industry to total GDP will go down, while the shares of the secondary and the tertiary industries will go up; and
- Per capita GDP will increase from RMB 20,222 to RMB 40,850 (2.02 times).

The area inside the 2nd Ring Road is already fully urbanized consequently the future urbanization will occur outside 2nd Ring Road. Built-up areas will be expanded from 16,674 hectares in 2000 to 22,050 hectares (1.32 times the present one) in 2010. The population within the Inner Ring Road will be reduced to 0.7 million or to about 74% of the present. The population between 1st and 2nd Ring Roads will remain almost the same. The population between 2nd and 3rd Ring Roads will be 1.4 times of the present. In the area outside the 3rd Ring Road, a residential area with a population of 1.1 million (or 1.5 times the present) will emerge.

Future Socio-economic Development Framework

		Year 2000	Year 2005	Year 2010
Population (000)	Registered Population	2,620.0 (100)	2,730.0 (104)	2,880.0 (110)
	Temporary Population	470.0 (100)	560.0 (119)	620.0 (132)
	Total	3,090.0 (100)	3,290.0 (106)	3,500.0 (113)
GDP (RMB, billion)	Primary Sector	0.9 (100)	0.6 (62)	0.4 (43)
	Secondary Sector	27.9 (100)	41.1 (147)	60.2 (215)
	Tertiary Sector	33.7 (100)	52.8 (157)	82.4 (244)
	Total	62.5 (100)	94.5 (151)	143.0 (229)
Per Capita GDP (RMB)		20,222 (100)	28,734 (142)	40,850 (202)

5.2 Demand Forecast Methodology

JICA STRADA

Basically, future traffic demand was projected using the conventional four-step model, namely: trip generation and attraction model, distribution model, modal split model and assignment model. JICA STRADA is a synthetic model developed on the basis of this four-step method. It was used to develop the forecasting model in this study. The JICA STRADA was also used to estimate the traffic volume for trains and bus routes.

Trip Generation/Attraction Model

This model consists of trip production model, and trip generation and attraction model. The trip production model forecasts the total number of trips in the whole Study Area by using trip rate of specific personal attribute, which can be obtained through the analysis of the person trip data. The trip generation and attraction model is used to calculate trip generation and attraction by traffic zone, based on the regression relationship between trip generation and attraction, and socio-economic indicators by traffic zone.

Distribution Model

A distribution model is a model to calculate the trip distribution between traffic zones (OD matrix). The variables of the gravity model are trip generation and attraction, and the impedance between traffic zones, such as distance, time and generalized cost. The parameters can be calculated by analyzing the relationship between the volume of trip distribution and these variables.

Modal Split Model

A modal split model was constructed using the binary choice methodology. First, all trips are divided into walk trips and other trips. Then the other trips are divided into passenger car trips and the other trips, which is shared by the public transport (buses, subways) and the other transport (bicycles, motorcycles). This transport-sharing model is a logit model, which calculates the share of public transportation according to the service level (travel time, travel cost, etc.). The calculation is done separately for car owner and non-car owner.

Assignment Model

A traffic assignment model assigns the OD matrix generated according to the modal split model (or distribution model) on the transport network, and calculates the traffic volume on each link in the network. Every link of roads in the transport network has the data reflecting their respective information about transport facilities and the data reflecting the service level of transport system. The travel speed on every link varies because of the difference of traffic volume. Then, the shortest time between origin and destination zones is found, and the trips between the specific zones is assigned on the shortest route.

5.3 Future Transport Demand

Overall Transport Demand

In summary, the traffic demand forecast indicates that the growth of economic levels will inevitably increase the trip rate (the amount of trips per person) and popularize motorized private transport. The current number of daily trips per person is 2.6, which will increase by 12% by 2010. The total number of trips of citizens within the Study Area will increase to 10,091 thousand(1.27 times that of 2000).

The bicycle is the most commonly used mode of individual transport but is expected to be gradually replaced by motorcycles and cars as income levels improve. If the future volume of motorcycles and cars is projected based on their current ownership ratios at all income levels and the projected economic improvement, it is estimated that the number of motorcycles would go up twice or so of the current level, and that of cars will increase by about three times. On the other hand, the number of bicycles will go down by about 15%.

Projected Traffic Demand

	Year 1987*	Year 2000**	Year 2010**	2010/2000
Population (000)	1,820	3,090	3,500	1.13
Number of trips (000 trips)	-	7,923	10,091	1.27
Individual Transportation Mode (000)				
Bicycle	-	1,997	1,700	0.85
Motorcycle	-	166	320	1.92
Car	-	134	400	2.99

Notes * : Old city administrative area of the year 1987 (95km²), **: Area of this study (586 km²)

Modal Split

If bus services were maintained in the same level as now (Do-Nothing Case), the modal share of the automobile would increase from 17% to 25% because of the increase in its popularity. The bicycle's share will decrease with expanding average travel distance, because of the expansion of the city wherein new inhabitants live in the suburbs. The number of trips by public transport will also increase, but the modal share remains stable because of the lower speed caused by the increasing number of cars. The subway will play an important role in city traffic. However, until 2010, buses will continue to have a principal part in city traffic and the demand for bus transport will be still dominant.

Change in Modal Share of Transport Modes

Means of Transportation	Year 2000	Year 2010 (Do-Nothing Case)	
		No subway	With subway
On foot	19.6	20.2	20.2
Bicycle ¹	49.2	40.2	36.5
Automobile ²	16.9	25.1	22.4
Buses ³	10.2	14.5	13.6
Subway	-	-	7.3
Total	100.0	100.0	100.0

Note: The number of trips does not include those that occur within a zone.

¹ Bicycle: includes bicycle, tricycle and motorcycle.

² Automobile: includes car, taxi and freight car.

³ Buses: include common public bus and mini bus.

Traffic Volume on Road

In the Do-nothing Case, the average travel speed of car and bus increases on slightly due to the completion of existing road development plans.

Summary of Traffic Assignment Result

Vehicle Type	Indices	Unit	2000	2010
				Do-nothing Case
Car	Total Travel Distance	1,000 PCU*km	4,405.3	9,463.9
	Total Travel Time	1,000 PCU*h	108.1	171.9
	Average speed	km/h	40.8	55.1
Bus	Total Travel Distance	1,000 PCU*km	259.7	443.9
	Total Travel Time	1,000 PCU*h	21.6	35.8
	Average speed	km/h	12.0	12.4
Total	Total Travel Distance	1,000 PCU*km	4,665.0	9,907.7
	Total Travel Time	1,000 PCU*h	129.7	207.7
	Average speed	km/h	36.0	47.7
	Capacity	1,000 PCU*km	10,765.9	25,462.9
	Volume/capacity ratio		0.43	0.39

Future Assigned Traffic Volume (Do-nothing Case)



Traffic Demand for Subway No. 1

The demand for Line 1 will be 25.9 thousand during the peak hour. The peak hour OD table was prepared assuming a peak hour ratio of 10%. Thus, daily demand is expected at about 260 thousand. On the other hand, the bus demand will decrease only by 1.3% because of some bus users shifting to subway, while many others use bus in order to transfer to subway.

6 POLICY DEVELOPMENT FOR PUBLIC TRANSPORT SYSTEM

6.1 Identified Issues to Improve Public Transport System

Inadequate Transport Administration

In Chengdu, the Public Utilities Bureau regulates traffic within the city proper, while the Transportation Bureau regulates traffic in outer districts of the city. With the expansion of the city, urban traffic has extended to the outskirts. This problem occurs between the 3rd Ring Road and the Outer Ring Road. Huayang, Xingdu, Wenjiang, Longquan, and Pixian have developed into satellite cities and the ridership of the bus routes between these areas and the city will increase by 30,000. Since the responsibility of carrying passengers will lag behind the development of the city, the administrative system should be defined again.

Financial Deficit of State-owned Public Transport Companies

The financial report of the Chengdu Public Transport Company in 1998 shows that its income is equal to about 75% of its expenses. Subsidies make up for the deficit. This means that the total income cannot cover operation costs. If the deficit will continue to be covered by subsidies, the amount of subsidies will increase largely in the next 10 years.

Low Service Quality in Public Transport

Public transport facilities, to be effective, should meet the following conditions: speed, frequency, punctuality, comfort, and density of service network. These conditions, except for the last, will be negatively affected by increasing traffic. The increase in the number of taxis and cars will particularly lead to the decreased service quality in public transport. In the future, when the planned subway construction begins, the lower service quality in public transport will become more prominent compared with the current situation.

Increased Traffic Accidents

With the increase in traffic volume, the incidence of traffic accidents also increases, posing a serious social problem. Accidents are caused by mixed traffic consisting of conventional bicycles, an increasing number of cars and other transport means of different sizes. They frequently occur at intersections. It is very important to enhance traffic safety, so comprehensive measures to deal with traffic accidents should be considered, including traffic management at intersections and carriageways, safety-related facilities and safety education among drivers.

Deterioration of Living Environment

Pollution from bus exhaust poses a threat to the environment. To reduce this threat, CNG (compressed natural gas which cause little harm to the environment) bus should be prioritized when buying new buses to replace old fleet.

6.2 Required Strategies

Role of Public Transport

As mass transit modes, railway (including subway) and bus are suitable on heavily trafficked radial roads and in the CBD. On the other hand, minibus and taxi meet small and diversified demand, particularly within the CBD, where various public transport services are necessary to support the economic activities.

Expected Roles of Public Transport

Means + Location		Mass Transportation			Middle to Small Transportation	Individual Transportation		On Foot
		Railway	Busway	Buses	Minibuses	Taxis	Tricycles	
Main Routes	Radial Routes	⊙	⊙	○	△	—	—	—
	Circle Routes	△	○	⊙	○	△	—	—
Branch Routes	Main Routes	—	—	○	⊙	○	—	—
	Other Routes	—	—	—	○	△	○	○
District	Center	○	○	⊙	⊙	⊙	○	⊙
	Outskirts	—	—	○	○	○	○	○

Notes: ⊙ Very important role, ⊙ Important role, ⊙ Auxiliary role and _ Limited or negligible role

Proposed Strategies

In the long run, the Chengdu public transport system will focus on the subway network. By 2030, the subway network will be completed. The period from 2000 to 2030 will be a transition period to develop a public transport system consisting mainly of railways and buses. Buses are the main public transport for a certain period and then will provide some auxiliary services after the completion of subway network. It is projected that only the subway's Line 1 will be completed before 2010, so the main component of the public transport is still buses until 2010. In formulating the plans to improve public transport by 2010, however, the subway network should be taken into account. It is planned that high-quality services will be provided after the completion of the subway, which will encourage citizens to travel by subway instead of other public transportation. The basic strategies proposed in the Study are:

- A) Prepare plan for the transition period from bus-based to rail-based public transport system
- B) Prioritize bus transport on trunk roads
- C) Reorganize bus route network
- D) Introduce a market economy principle
- E) Optimize cost-sharing in public transport (beneficiaries-pay principle)
- F) Enhance traffic safety and environmental protection

6.3 Associated Policies on Urban Traffic Management

Necessity of Traffic Management

With economic development, the number of people's trips will increase, the city's development will be accelerated and motorization will develop by a large margin. On the other hand, bicycles will still have an important place in all kinds of traffic. To improve the convenience and comfort of the public transport system and to build an attractive urban traffic system, the following measures are necessary:

- Dealing with a large number of bicycle traffic;
- Improving traffic signals and giving buses preferential use;
- Expanding the space for pedestrians in connection with public transport;
- Controlling automobile traffic;
- Redistributing road space.

Approach to Private Vehicles

There are three methods of controlling car transport, namely: (1) controlling the ownership of cars; (2) controlling the use of cars; and (3) controlling the parking of cars. It is obvious that controlling car ownership, especially those for private use, is a basic strategy. However, it is not appropriate to enforce this method considering the present policy to promote car industry of the Chinese Government, the current low income level and low ownership rate. Controlling car usage (e.g. increase fuel tax and road user charges) is more important than controlling ownership in improving the quality of life and in supporting the car industry. However, the regulation of garage allocation should be implemented to remedy the disorderly parking in the city.

Approach to Bicycles

The bicycle is a growing concern as an alternative to car in developed countries. It is considered important because it causes no pollution. Many countries are in fact trying to improve the living environment by encouraging bicycle use. In contrast, the share of bicycles in Chengdu is the highest (49.2%) among the transport modes. With economic development, bicycle use will gradually shift to car use. Nevertheless, the bicycle is and will continue to be an important transport means in Chengdu, making it necessary to improve the environment for bicycle use.

The strategies for improving the environment for bicycle transport includes the (1) enhancement of the network of bicycle lanes and (2) distribution of bicycle parking lots.

Approach to Pedestrian

Walking plays an important role in urban traffic. Countries all over the world do research and implement ways to organize pedestrian space, such as building elevated ("skywalk") or underground structures, keeping traffic situation in order and designating districts strictly for residential purpose.

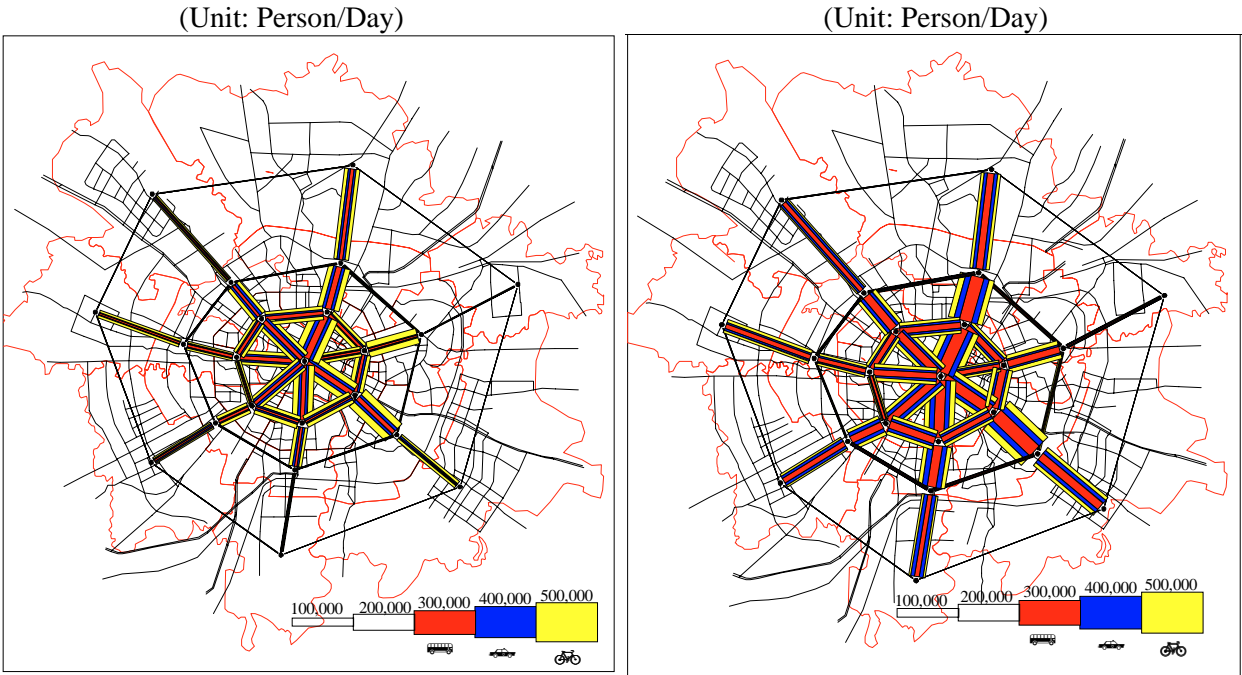
Safety belts in the city center, including special squares and roads, should be set up to prohibit cars from entering the city center, create a good space for pedestrians and stimulate commerce. The pedestrian mall in commercial streets with large pedestrian traffic, for example, can be set up as "special roads" for pedestrian use only. Another example is an exclusive pedestrian path. In small, unpaved streets, one measure that can be taken is controlling vehicle speed to ensure safe traffic.

6.4 Public Transport Development Strategies by Corridor

Increase of Traffic Demand

By 2010, traffic demand will remarkably increase on the main radial and ring roads of Chengdu. It is noted that the distribution of heavily trafficked sections will move outward considerably from within the First Ring Road to between the First and Second Ring Road by 2010. As the City expands, the traffic demand in suburban areas grows significantly.

Current Traffic Demand in the Corridors (2000) Future Traffic Demand in the Corridors (2010)



Basic Strategies

The proposed subway lines will open to public use after 2010. Particularly in the North-South Corridor where subway line No. 1 is proposed, the role of bus should be carefully examined to smoothly shift from bus to subway. The general strategies common to all major corridors are:

- Bus services should be improved in terms of speed, comfort, service frequency and punctuality to promote the modal shift from car and bicycle to bus.
- Bus routes should be extended to the peripheral areas in the suburbs of the City and the satellite cities. In this context, bus terminals planned around the Third Ring Road should serve transfer passengers conveniently.
- Bus, bicycle and other vehicles should be segregated as much as possible. Bus exclusive/priority lanes should be provided where appropriate.
- Traffic management should be strengthened to ensure safety and to alleviate traffic congestion particularly at intersections.

7 DEVELOPMENT PLANS OF BUS LANES AND RELATED FACILITIES

7.1 Development of Bus Lanes

Future Bus Traffic Demand

The distribution characteristics of future bus traffic demand are:

Number of Necessary Bus Lanes

Names of Roads	Traffic capacity per hour on 1-min departing interval (standard buses) (A)	Traffic capacity per hour on 30-sec departing interval (standard buses) (B)	Passenger demand for year 2010 (the number of passengers per hour per direction) (C)	(C)/(A)	No. of necessary bus lanes (the number of bus lanes per direction)
Renmin Bei-Lu	6,000	12,000	13,000	2.1	1-2
Renmin Nan-Lu	6,000	12,000	7,200	1.2	1
Jiefang Lu	6,000	12,000	3,300	0.6	1
Fuqing Lu	6,000	12,000	5,400	0.9	1
Shudu Road East	6,000	12,000	8,100	1.4	1-2
Shudu Road West	6,000	12,000	13,400	2.2	1-2
Xin Renmin Nan-Lu	6,000	12,000	6,200	1.0	1
Hongxing Lu	6,000	12,000	6,200	1.0	1
Shuanglin Lu	6,000	12,000	8,100	1.4	1
Inner Ring Road	6,000	12,000	5,600	0.9	1
1st Ring Road	6,000	12,000	11,000	1.8	1-2
2nd Ring Road	6,000	12,000	6,900	1.2	1
Wuhouci Da-Jie	6,000	12,000	5,400	0.9	1
Chadianzi Lu	6,000	12,000	10,300	1.7	1-2

Note: Bus routes are assumed to be basically the same as at present.

Structure of Bus Lanes

Primary bus lanes:

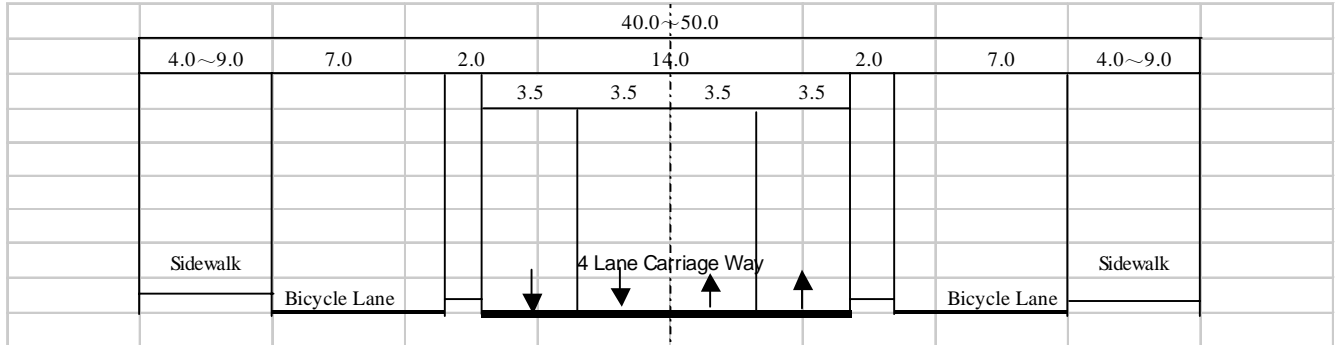
- a) There is basically one bus exclusive lane for every direction.
- b) Outer lanes are converted into bus lanes.
- c) Private vehicle lanes and bus lanes are separated by different pavement constructions with different colors.
- d) When there is not enough space for private vehicles traffic because of the bus lanes, initially four bus lanes will be converted to six lanes within the present space of roads. (The width of car lanes, bicycle lanes and pavements shall be reduced.)

Secondary bus lanes:

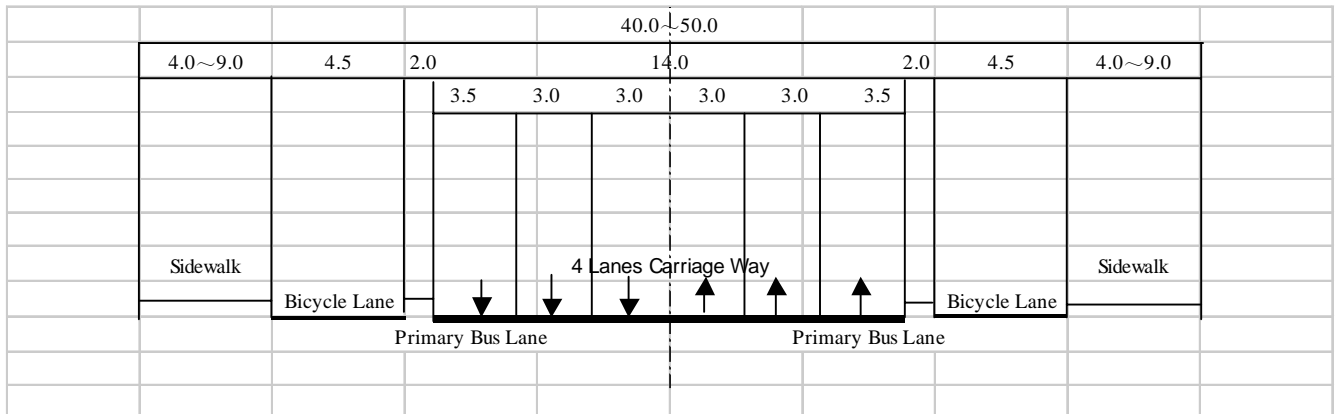
- a) There is basically one bus priority lane per direction.
- b) Outer lanes are covered into bus lanes.
- c) Bus lanes are operational during morning and evening peak hours (for 2-3 hours of every period). Buses and private vehicles can be separated by simple movable facilities.

Location of Primary Bus Lane on Existing Road Cross Section

1. Cross Section of Existing four-lane road



2. Cross Section of Primary Bus Lane Introduced



Possible Projects

The existing roads for the primary bus lanes are as follows:

- a) East-West Primary Road (Shudu Road L=9.0km)
- b) North-South Primary Road (L=8.0km)
- c) 1st Ring Road (L=19.0km)
- d) 2nd Ring Road (L=27.0km)

The existing roads for the secondary bus lanes are as follows.

- a) Xin Nan-Lu — Hongxing Lu (L=8.0km)
- b) Shuanglin Lu — Shawan Lu (L=8.0km)
- c) Wuhouci Da-Jie — Dongchenggen Jie (L=8.0km)
- d) Ximianqiao Jie (L=4.0km)
- e) Dashi Xi-Lu (L=4.0km)
- f) Jiefang Lu (L=4.0km)
- g) Chadianzi Lu Extension (L=4.0km)
- h) Dong Da-Jie (L=4.0km)

7.2 Improvement of Bus Transfer / Terminal Facilities

Bus Transfer Points Development Plan

For introducing transfer facilities, intersections of radial and ring roads inside the Second Ring Road were selected because they expect a substantial increase in demand due to the exclusive or priority bus lanes and subway operation.

As many as 300,000 passengers already exist around the Tianfu Square at present and the demand will reach about 530,000 passengers in the future. Likewise, the demand is expected to be beyond 100,000 passengers in the following areas: 1) Jiuyanqiao along the 1st Ring Road, 2) Gaoshengqiao, 3) North Railway Station along the Second Ring Road, and 4) Niushikou. The demand will increase at an alarming pace around Tianfu Square and North Railway Station due mainly to introduction of subway line.

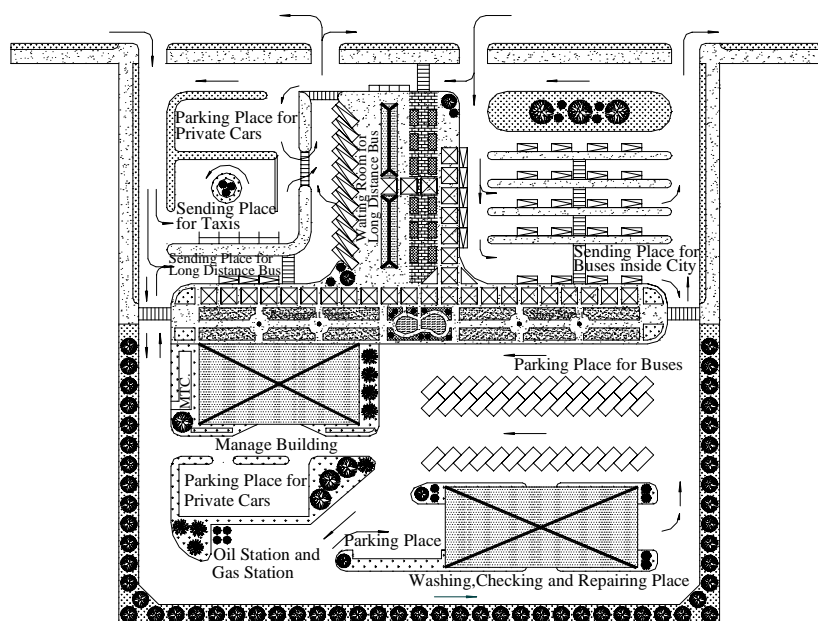
Based on these needs for bus transfers, and possible future configuration of bus routes, 11 transfer points are proposed for development in this study.

Intercity Bus Terminals Development Plan

Intercity bus terminal development is proposed at present at 14 sites. One project has been completed, and another one is under construction. The objective of these projects is to move intercity bus terminal from along the First Ring Road to around the Third Ring Road. As the city expands, the bus route network tends to expand as well. Moving the present intercity bus terminal to the suburban area is in accordance with the city expansion and effective operation of bus transport system based on Chengdu City's development plan until the year 2010.

In Chengdu City's plan, intercity bus terminals are planned to be set up towards different directions accordingly. Existing facilities can be utilized in some areas where future demand is not so significant, such as: Longtansi Bus Terminal, Cheng-Nan Highway Bus Terminal and Baliqiao Bus Terminal. As a result, 7 terminals are proposed to be improved up to 2010 in the light of the magnitude of demand.

Conceptual Development Plan for Intercity Terminal



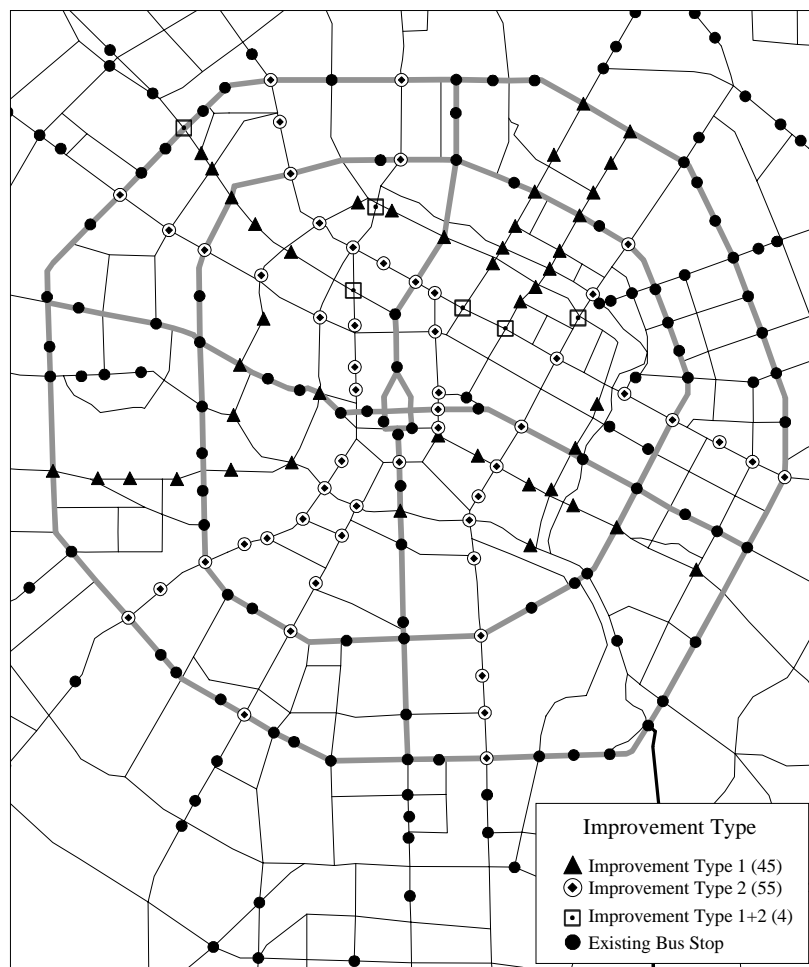
7.3 Bus Stop Improvement Plan

Proposed Improvement

- 1) Improvement of bus stops by bus bay in the outer lanes of the four-lane roadway, with no dedicated bicycle lane (Type 1) or with dedicated bicycle lane (Type 2).
- 2) Set lines with 3.0m width for bus bay.
- 3) To accommodate the lane for bus stops in the existing roads, the width of the four-lane roads should be reduced from 3.25m to 2.75m ($4 \times 0.50 = 2.00\text{m}$), and the width of footpath should be reduced from 4.50m to 4.00m ($2 \times 0.50 = 1.00\text{m}$).
- 4) Bus stop are installed within existing sidewalks.
- 5) Bicycle path is cancelled, and bicycles will use existing bicycle roads or new bicycle roads.
- 6) The existing trees at footpath will be transferred and replanted 0.5 m inside of the footpath.

As a whole, a total of 230 bus stops are proposed for improvement (118 for Type 1 and 112 for Type 2).

**Bus Stops After Improvement
(Central Part Only)**



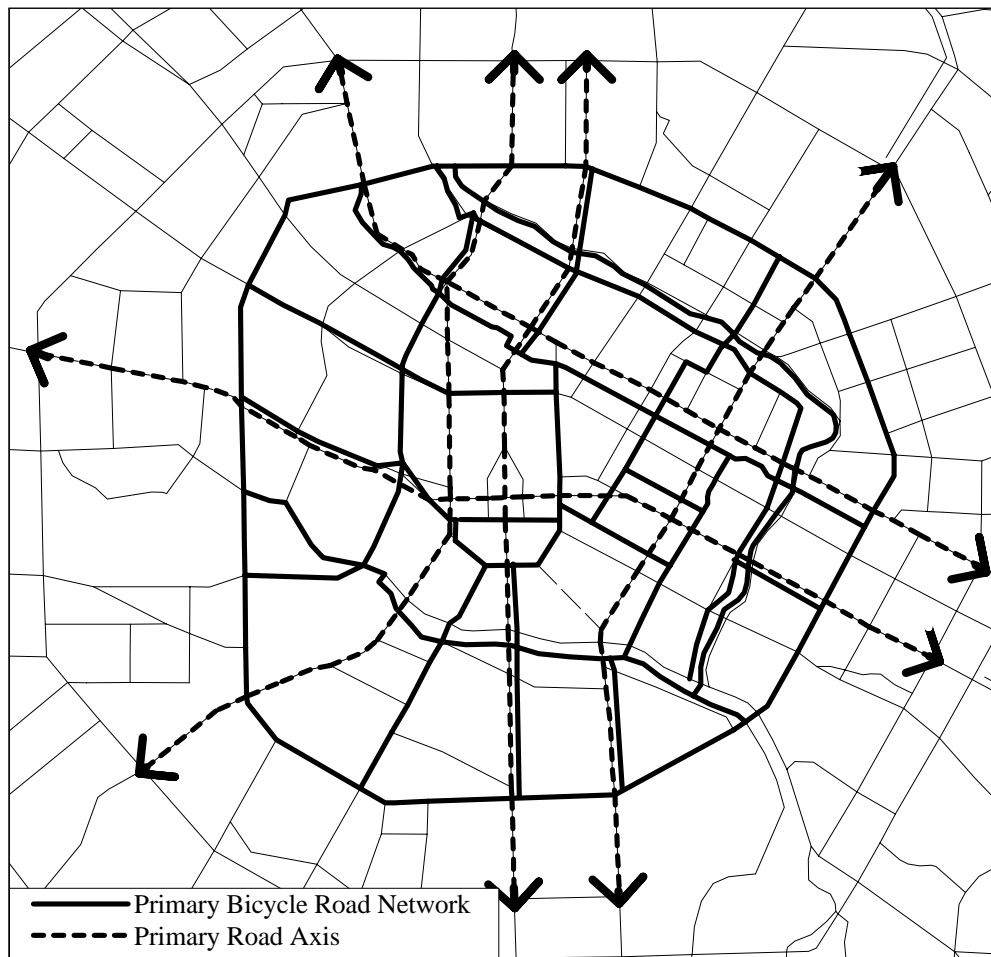
7.4 Bicycle Road Development

Separation of Bicycle Road from Main Roads

For the narrow primary road in the city center, it is necessary to place bicycle lanes in other roads to improve the function of the primary road. This strategy can be implemented in Hongxing Lu, Xinhuan Da-Dao, Dongchenggen Jie, and Dong Da-Jie.

As economic development proceeds, motorized vehicle traffic will increase dramatically. It is hard to meet the traffic demand in the future if the current main roads continue to be mixed with bicycle lanes. Therefore, it is necessary to create new spaces by making use of roads in residential areas and traffic management measures such as one-way road, etc.

Separation of Bicycle Roads from Main Roads



7.5 Improvement of Traffic Management

Intersection Improvement

In order to improve the current traffic situation, utilize the current intersections and ensure the convenience and safety of public transportation system and bicycle traffic, the following actions should be taken:

(1) Grade-separation projects to enhance the traffic function on the trunk road network

To meet the increasing demand of vehicles in the future, grade-separation projects should be set up gradually at main intersections of radial and ring roads. Especially, the improvement of traffic function of ring roads plays an important role in promoting the effective traffic flow.

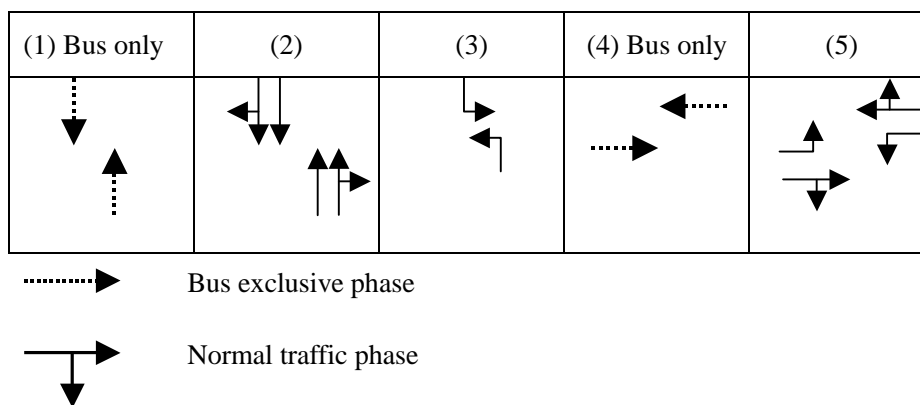
(2) Bicycle lane grade-separation projects to form bicycle road network

To ensure the safety of bicycle traffic in Chengdu, grade-separation projects should be set up in bicycle lanes (non-motorized vehicle lanes). Grade-separation projects to separate only bicycle (non-motorized vehicle) traffic, as in the intersection of Shuncheng Jie and Xiyulong Jie, are under way.

(3) Bus (priority) lanes and signal management project

In designing a public transportation system, exclusive or priority bus lane should be considered an important factor. When it is coupled with bus priority signals, the effect is remarkable.

Signal Phasing at Intersections with Bus Lanes



Traffic Safety

In addition to various traffic management measures such as intersection improvement and signal installation, there are still many things to do for enhancing traffic safety in relation to traffic safety education and campaign. An extensive, organized and well-planned promotional campaign for traffic safety using appropriate and effective media shall be carried out to improve the people's knowledge, consciousness and behavior with regards to traffic rules and safety. For example, the television may be used to present the desired information campaign for families. Information from and coordination with the local police station as well as schools may also be explored so as to make traffic safety campaign available to everybody.

8 BUS OPERATION BUSINESS IMPROVEMENT PLAN

8.1 Policy Directions for the Improvement of the Bus Operation Business

Needs for New Administrative System for Bus Transport

In Chengdu, the Public Utilities Bureau (PUB) is in charge of city transportation, while the Traffic Bureau handles suburban transportation. Chengdu has the same system, under which the PUB and Traffic Bureau share the work of increasing the routes and improving the facilities including bus stations. They however work independently because of different budget sources.

It is proposed that a single traffic administrative body be responsible for traffic management in Chengdu. This setup will integrate management of city traffic including public bus (intercity and intra-city), taxi and subway systems.

Importance of Privatization and Deregulation

The subsidy has reached RMB 68 million in 1999. Roughly speaking, the subsidy will reach RMB 136 million in 2010, assuming that the number of bus units doubles and that the subsidy increases in proportion to the number of bus fleet. This subsidy will be a huge financial burden on the budgetary system of Chengdu since the proposed subway also requires a huge public investment.

Private bus companies in Chengdu are profitably operated although this may be attributed partially to the characteristics of the routes they operate. Thus it is obviously reasonable that public business be downsized while private sector be encouraged.

By the establishment of new joint companies of the Chengdu Public Transportation Company and private investors, it is expected to introduce a new money source into the public transport industry.

To achieve privatization which is partly ongoing in Chengdu¹, restrictions should be lightened, with deregulation cultivating a competitive environment that is more efficient and providing demand-oriented services. However, based on the experience of other advanced cities, a phased deregulation is more viable.

¹ Chengdu Public Transportation Company has already taken the first step for its privatization process. Actually, a Yunxing Company was newly established in 1999 by introducing private capital and absorbing the affiliated Bus Companies of No. 2,3 and 6. As of March 2001, however, no operational and financial data of the new company is available.

8.2 Steps Towards Privatization

Role of Chengdu City Government

In a competitive world, success can be achieved by providing preferential prices and better services. The primary condition for sound competition is to publicize information and promote competition, an atmosphere that the government must ensure. The result will be decreased cost and improved service. The role of the City Government includes:

- (1) Converting from government control system to approval system
- (2) Ensuring continued service of a certain level
- (3) Regulating fare ceiling
- (4) Amending laws prior to the reorganization of Chengdu Public Transportation Company
- (5) Preparation to ensure smooth privatization

Role of Chengdu Public Transportation Company

The aim of privatization is to promote efficiency through competition. If Chengdu Public Transportation Company is privatized without any change in form, a private-owned monopoly will take its place. It is thus necessary to break up the company into smaller firms when privatizing it.

The company would become a stock holding company owning the certain shares of the privatized companies, which together with individual stockholders will own the rest of the shares.

8.3 Supporting Measures

Promotion of CNG Use

From the viewpoint of environmental protection, the use of CNG is significant for two reasons. One, the main composition of CNG is methane. Thus waste gas emission is much less. In addition to this, CNG engine is greatly attractive to vehicle owners due to the following reasons:

- It is more economical than diesel or gasoline even taking conversion cost into account.
- It is at par with other engines in terms of repair costs.
- Horsepower and torque are equal to diesel engine.

Bus Fare System

Chengdu is advised to adopt a fixed fare system based on the calculation of charging 0.15 RMB per km after the first 12 km. This will add to the cost burden of short-distance passengers using long-distance routes. Thus, the bus traveling only part of its normal route should be introduced when changing fares. (The buses traveling within a 12km distance charge one RMB only). With regard to air-conditioned buses, it is advisable to assign the same number of air-conditioned and non-air-conditioned buses on the same route, and the fare at present shall be maintained. The monthly ticket price is 40 RMB with a discount rate of roughly 50% as of the end of October 2000. This discount rate seems to be too high. In the future, the monthly ticket will be limited to certain routes and operating companies shall decrease discount rate gradually to prepare for the future reform.

The major problem in self-service buses is the need to respond to the passengers' request for change. One way of addressing this is to install a vending machine that can give change. Another is to introduce prepaid cards and refluxing tickets. The 11 bulk-paid tickets equal to the cost of 10 cards can be issued or a prepaid card worth 50 RMB can be used 55 times.

Bus Unit Improvement

Measures to be taken in improving buses are as follows: adopting self-service and card system; converting to CNG; integrating bus model (scrapping double-deckers or articulated buses); widening bus door; decreasing bus height; installing higher-capacity seats, slanting door, priority seats, fixed fittings for wheelchairs, buzzers to indicate getting off; improving air-conditioning and information system inside buses; and bus location system. They can contribute to curtail costs, increase transportation capacity and improve passengers' convenience.

9 EVALUATION OF THE MASTER PLAN ON PUBLIC TRANSPORT SYSTEM

9.1 Projects Proposed in the Master Plan

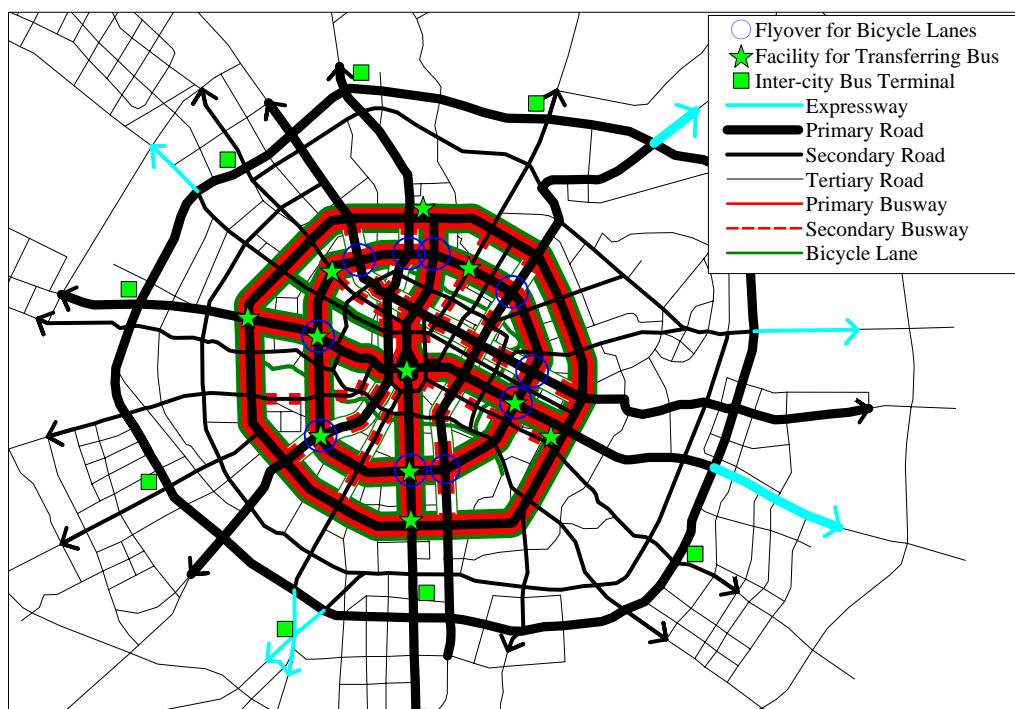
Project List

A project list has been prepared after categorizing the projects of similar characteristics into project packages. In the Master Plan, there are 23 projects thus categorized.

Project Cost

The total cost of the listed projects accounts for RMB 1,196 million, of which RMB 599 million or 50% of the total is for the Primary Busway Project (bus exclusive lane development). The Secondary Busway Project (bus priority lane development) shares RMB285 million or 24% of the total. The rest is for Auxiliary Bus Facilities Project and Traffic Control System Project. No cost was assumed for Policies and Management System Project.

Master Plan for the Development and Improvement of Public Transport (2010)



Effect of the Master Plan

The targets of the Master Plan are to increase the modal share of the bus, to increase the bus travel speed and to decrease the cross-city travel time. Based on the analysis of the Study Team, the effect of the Master Plan on the above targets is calculated as follows;

- A. **Modal Share of Bus ;** 10% (2000) to 27% (2010)
- B. **Bus Travel Speed ;** 12 km/h (2000) to 17 km/h (2010)
- C. **Cross-City Travel Time (2nd Ring Road to 2nd Ring road) ;**
45 minutes (2000) to 30 minutes (2010)

The result of the analysis shows that the public transport system of Chengdu will be remarkably improved by implementing the proposed Master Plan.

List of Public Transport Projects in the Master Plan

Plan	Project	Contents of Project	Project Cost (RMB 000)
1. Primary busway (Exclusive Bus Lane)	1-1 East-west primary busway	* change in cross-section from 4-lane use to 6 lane use	112,528
	1-2 North-south primary busway	* introduction of exclusive bus lane	92,209
	1-3 1st Ring Road primary busway	* improvement of bus terminals	288,318
	1-4 2nd Ring Road primary busway	* improvement of intersections and signals * improvement of bicycle lanes * improvement of bus transfer facilities * improvement of bus operation system	105,773
2. Secondary busway (Bus Priority Lane)	2-1 Bus Priority Lane in Xinnan Lu-Hongxing Lu	* introduction of bus priority lane * improvement of bus terminals	99,796
	2-2 Bus Priority Lane in Wuhouci Da-Jie-Beizhan Lu	* improvement of intersections and signals	42,616
	2-3 Bus Priority Lane in Shuanglin Lu-Shawan Lu	* increase of traffic signal * improvement of bicycle lanes	42,886
	2-4 Bus Priority Lane in the Northern Traffic Corridor	* improvement of bus transfer facilities * improvement of bus operation system	24,759
	2-5 Bus Priority Lane in Northwest traffic corridor		22,815
	2-6 Bus Priority Lane in Southwest Traffic Corridor		33,155
	2-7 Bus Priority Lane in East Traffic Corridor		19,353
3. Auxiliary Bus Facilities	3-1 Intercity bus terminal project	* improvement of bus terminal	296,429
	3-2 Bus transfer facility project ¹⁾	* improvement of function, organization and operation of bus operator	(8,940) ²⁾
	3-3 Bus stop project	* expansion of bus terminals * improvement of bus facilities	(36,570) ²⁾
4. Traffic Control System	4-1 Intersection improvement project	* grade separation at major intersections (for bicycles) * channelization * signals control	(269,100) ²⁾
	4-2 Bicycle lane project	* bicycle lane in primary road * bicycle lane in secondary road	15,469
	4-3 One-way system improvement project	* improvement of traffic control system in central area	
	4-4 Pedestrian environment improvement project	* pedestrian mall project	
5. Policies and Management System	5-1 Privatization of public transport business	* privatization of bus business * legal system improvement	
	5-2 CNG promotion	* CNG filling stations	
	5-3 Revision of public bus fare system	* revision of bus fare system * introduction of pre-paid card system	
	5-4 Improvement of bus vehicles	* CNG bus * introduction of one-man bus	
	5-5 Introduction of wide-area public transport administration	* integration of bus-related administration agencies and rationalization	

Note: 1) Eleven (11) sites are proposed while 10 out of 11 are included in the cost estimate excluding the Tianfu Square because it is a part of the Subway No. 1 project.

2) Project cost in parentheses are included in either primary or secondary busway project and should be excluded from the total.

Development Policy of Public Transport Network

- (1) To strengthen the bus network, priority should be given to the East-west and the North-south primary busways with large demand and high return and based on the experience of those two routes, other busways and bus priority lanes should follow. New bus lanes are to be introduced, to serve entire sections of each busway and bus lines competing against the new lines should be abolished or rerouted.
- (2) Bus routes should be extended to inter-city bus terminals as they are constructed near the Third Ring Road. When the City grows expanding its urbanized area beyond those terminals, bus routes should be extended further toward the Outer Ring Road. However, in case the demand is not enough in the suburban area outside the terminals, feeder buses should be introduced instead of extension, to offer circulating services in such areas.
- (3) When a railway transit line like subway is open in the future, bus lines competing against the railway line should be abolished or rerouted. At the same time, feeder bus lines from/to the railway stations are to be reinforced.

Based on the future demand and effect of the Masterplan projects, the following schedule is recommendable for busways and bus priority lane development.

Implementation Schedule of Proposed Projects

Range of Project	Name of Project	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
1. Primary busway(Exclusive Bus Lane)	1-1 East-west primary busway			■	■	■	■	■	■	■	■	■
	1-2 North-south primary busway			■	■	■	■	■	■	■	■	■
	1-3 1st Ring Road primary busway							■	■	■	■	■
	1-4 2nd Ring Road primary busway				■	■	■	■	■	■	■	■
2.Secondary busway(Bus PriorityLane)	2-1 Bus Priority Lane in Xinnan Lu-Hongxing Lu					■	■	■	■	■	■	■
	2-2 Bus Priority Lane in Wuhouci Da-Jie-Beizhan Lu			■	■	■	■	■	■	■	■	■
	2-3 Bus Priority Lane in Shuanglin Lu-Shawan Lu					■	■	■	■	■	■	■
	2-4 Bus Priority Lane in the Northern Traffic Corridor				■	■	■	■	■	■	■	■
	2-5 Bus Priority Lane in Northwest traffic corridor								■	■	■	■
	2-6 Bus Priority Lane in Southwest Traffic Corridor								■	■	■	■
	2-7 Bus Priority Lane in East Traffic Corridor									■	■	■

Note: 1) Main Project ■ Preparing, Appending Project —

- 2) The north-south primary busway project should be coordinated with the subway No.1 project. If the subway construction starts in the near future, implementation of the busway will become impossible and unnecessary.

9.2 Economic Evaluation

Economic Cost

The project cost can be divided into material costs, equipment and machinery costs and labor costs. Value added tax (17%) and sales tax (10%) were imposed on material and equipment/ machinery costs. By deducting these taxes, economic cost of the proposed project were estimated from their financial cost.

Economic Benefit

Economic benefit of the proposed projects was estimated as a sum of the savings in vehicle operating cost and passenger time cost.

Result of Economic Evaluation of the Master Plan

Although the economic benefits are limited only to the most direct ones, the internal rate of return of the Master Plan reaches 25.5%, far exceeding the economic discount rate (12%). Thus, the Master Plan is judged to be highly feasible economically. The net present value is estimated at about RMB 2,000 million, which is about double of the investment amount. As per sensitivity tests, this high feasibility is very rigid, not affected much by cost increase or benefit decrease.

Economic Evaluation by Project

In the same way as used for evaluation of the entire Master Plan, each project of primary and secondary busways is evaluated individually. All the projects are economically feasible, implying the internal rate of return over 12%. The economic returns of the East-west busway and the Wuhouci Lu – Beizhan Lu busway are especially high.

Individual Evaluation of Projects

Unit: IRR (%), NPV (RMB 000)

Plan	Project		Evaluation Index		
			IRR	B/C	NPV
1. Primary Busway (Exclusive Bus Lane)	1-0	Entire Primary Busway Projects	27.6	2.8	1,468,617
	1-1	East-west Primary Busway	36.8	4.1	449,198
	1-2	North-South Primary Busway	35.3	2.7	202,265
	1-3	1st Ring Road Primary Busway	19.8	1.9	310,464
	1-4	2nd Ring Road Primary Busway	27.4	2.8	357,478
2. Secondary Busway (Priority Bus Lane)	2-0	Entire Secondary Busway Projects	24.0	2.5	666,245
	2-1	Bus Priority Lane in Xing Nan Lu-Hongxing Lu	12.7	1.1	7,598
	2-2	Bus Priority Lane in Wuhouci Lu-Beizhan Lu	33.5	4.3	232,602
	2-3	Bus Priority Lane in Shuangling Lu-Shawan Lu	22.6	2.3	92,310
	2-4	Bus Priority Lane in North Traffic Corridor	24.4	2.6	62,107
	2-5	Bus Priority Lane in Northwest Traffic Corridor	17.0	1.5	18,688
	2-6	Bus Priority Lane in Southwest Traffic Corridor	21.6	2.2	71,838
	2-7	Bus Priority Lane in East Traffic Corridor	12.5	1.0	1,387

9.3 Environmental Evaluation of the Master Plan

Air Pollution

The emissions will significantly increase unless any measures are taken in the future. The introduction of CNG will result in the substantial reduction of pollutant emissions all over the city. Likewise, the proposed Master Plan has a large effect to improve air quality. The combination of these two measures will maintain gas emissions at almost the same level as at present.

Vehicle Emissions for “Do-Nothing” Case in 2010
(1,000 ton/year)

Emission Pollutant	Present Situation (2000)	“Do-Nothing” Case in 2010	Difference
CO	70	174	104
CO ₂	2,387	5,932	3,546
THC	32	80	48
NO _x	9	22	13

Vehicle Emissions for Improvement of Public Transport (Master Plan) in 2010
(1,000 ton/year)

Emission Pollutant	“Do-Nothing” Case in 2010	CNG Introduction in 2010	Difference
CO	174	134	41
CO ₂	5,932	4,550	1,382
THC	80	61	19
NO _x	22	17	5

Vehicle Emissions for Introduction of CNG in 2010
(1,000 ton/year)

Emission Pollutant	“Do-Nothing” Case in 2010	Public Transport Improvement in 2010	Difference
CO	174	119	56
CO ₂	5,932	4,033	1,899
THC	80	54	26
NO _x	22	15	7

Vehicle Emissions for Combination of CNG Introduction and Public Transport Improvement (Master Plan) in 2010
(1,000 ton/year)

Emission Pollutant	“Do-Nothing” Case in 2010	Combination of Two Measures in 2010	Difference
CO	174	70	104
CO ₂	5,932	2,380	3,553
THC	80	32	48
NO _x	22	9	13

Projects that Need EIA

Exclusive or priority bus lanes don't accompany any large-scale construction but make full use of existing main roads. Therefore, little impact is anticipated on residents' environment and historical heritage sites, even though it could have minor positive or negative impact on economic or urban activity, transport and public facility and solid waste. With respect to pollution, it is expected that the project could somewhat have negative impact around the project sites on air quality, noise, vibration and bad odor but no impact on underground water and ground sinking.

Bus related projects could bring a lot of people to specific areas and have negative impact on solid waste, health and sanitation. Also, it could have negative impact on transport and public facility and positive impact on economic and urban activities. However, no impact will take place by bus terminal project excluding those of intercity bus terminal, which could have negative impact on air pollution, noise, vibration and underground water.

Although no serious environmental impact is foreseen in any of the proposed project, EIA will be required for all the projects that entail construction works of a certain scale according to the environmental administration system of China.

9.4 Comprehensive Evaluation of the Proposed Projects

Summary of Project Evaluation

Major conclusions of the evaluation are:

- The proposed plans do not include large-scale new infrastructure development, thus having a relatively lower cost. Therefore, the economic and environmental advantages are large, and the projects foresee no serious technical difficulties.
- The anticipated negative effect is limited to the displacement of residents/informal settlers in the widened road sections and the traffic management difficulties during the construction.
- All the proposed projects are economically feasible.

Selection of the Projects for Subsequent Feasibility Study

Based on the above consideration, East-West primary busway project was selected as suitable for the conduct of a feasibility study due to:

- Its EIRR is the highest at 37% among the projects economically evaluated.
- Although the EIRR is also high for the North-South primary busway project, the role of busway is not so clear because a subway is scheduled to be implemented by 2010.
- The project includes some intersection improvement projects, bicycle lane projects and pedestrian environment improvement projects that have been highly evaluated. Therefore, the result of the feasibility study could be utilized as a model to be applied for the whole city.

In addition, the project “Privatization of public transport business” was also taken up for the subsequent feasibility study as a “software” project in contrast to the “hardware” project of busway mentioned above. This project would be one of the key policies to improve the public transport system of Chengdu.

9.5 Implementation Schedule

In consideration of the results of project evaluation, time required for implementing each project and the recent policy directions in Chengdu (i.e. project readiness), the implementation schedule of the proposed projects was prepared. In principle, the projects with higher EIRRs are commenced earlier, and for the projects with high cost or foreseen difficulties in implementation, the period for implementation was set longer.

As for annual investment amount required to implement the proposed project according to this schedule, in the peak year of 2006 about RMB 215 million is required, and from 2001 to 2005 the necessary investment reaches RMB 140 to 170 million. These amounts correspond to 32-48% of the investment on roads of RMB 444 million in 1999 and to 1.4-2.2% of the tax revenue of RMB 9,865 million of Chengdu City in the same year. Though not impossible, various financial arrangements including the subsidy from the central government are certainly needed, particularly when the subway construction is taken into account. In this Master Plan, it is recommended to curtail the subsidy to bus operation of about RMB 60 million a year in relation to the privatization of bus business. In addition to this, various measures should be tested such as increase of road user charges.

10 EAST-WEST PRIMARY BUSWAY PROJECT

10.1 Major Conditions for the Study

Project Framework

- (1) **Implementation Period and Project Life:** This project should be started immediately. The project life of exclusive bus lanes is assumed to be 10 years.
- (2) **Implementing Body:** The proposed exclusive bus lanes will be used mainly by existing routes either partially or entirely for the whole stretch of the project. The private sector can not be involved by, for instance, introducing a toll system for the bus exclusive lanes. The City of Chengdu should take the charge of implementation.
- (3) **Bus Operating Body:** The existing bus companies shall operate the bus routes. For the proposed new route, Jinsha Bus Terminal-Wuguizhao, however, the bidding process may be applied to determine the operator of the new route.
- (4) **Premium Bus:** It is assumed that ordinary buses shall operate on the proposed exclusive bus lanes. However, for the proposed route Jinsha Bus Terminal-Wuguizhao, it is possible to adopt premium services such as air-conditioned buses, soft-seat buses which may be effective for the promotion of public over private transport mode.

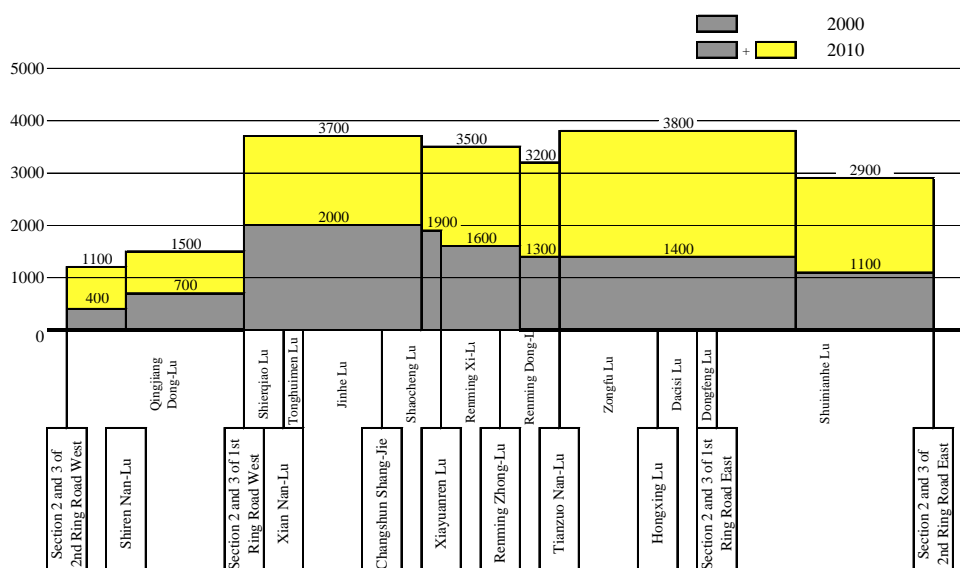
Bus Routes on Shudu Road

As of July 2000, 11 bus routes were operated on Shudu Road (section inside the Second Ring Road). There is no existing route running through the whole section of Shudu Road inside the Second Ring Road. After the completion of the proposed busway, it is necessary to create a new route operating on the proposed exclusive bus lanes having origin and destination at Jinsha Terminal and Wuguizhao Center Terminal, respectively.

Bus Traffic Volume on Shudu Road

As urban development is being promoted in the future in the eastern suburbs, bus traffic volume will increase remarkably by nearly 3 times on Zongfu Lu and Dacisi Lu in the east of Tianfu Square.

Bus Traffic Volume on Shudu Road



10.2 Preliminary Design

Horizontal Alignment

There is a 100-meter minimum horizontal curvature at the crossing of Shudu Road and Citang Street. According to geometric standards of inclined road, buses can operate at a speed of 50 km/hr on lines with a 100-meter curvature. Therefore, there is no need to change the horizontal alignment of present roads.

Vertical Alignment

The present longitudinal grade on Shudu Road is built on plain terrain. Thus, introduction of exclusive bus lanes will not be requiring improvement on the longitudinal grade of the present road. However, since the present minimum longitudinal grade is only 0.1%, attention should be given on the drainage system.

Grade-Separated Intersection

For purposes of traffic safety, this plan proposes building of four grade-separated intersections with safe separation structure connecting Shudu Road with primary roads, as follows:

- 1) Intersection between Shudu Road and the First Ring Road west
- 2) Intersection between Shudu Road and Dongchenggen Road
- 3) Intersection between Shudu Road and Hongxing Road
- 4) Intersection between Shudu Road and the First Ring Road east

At-Grade Intersection

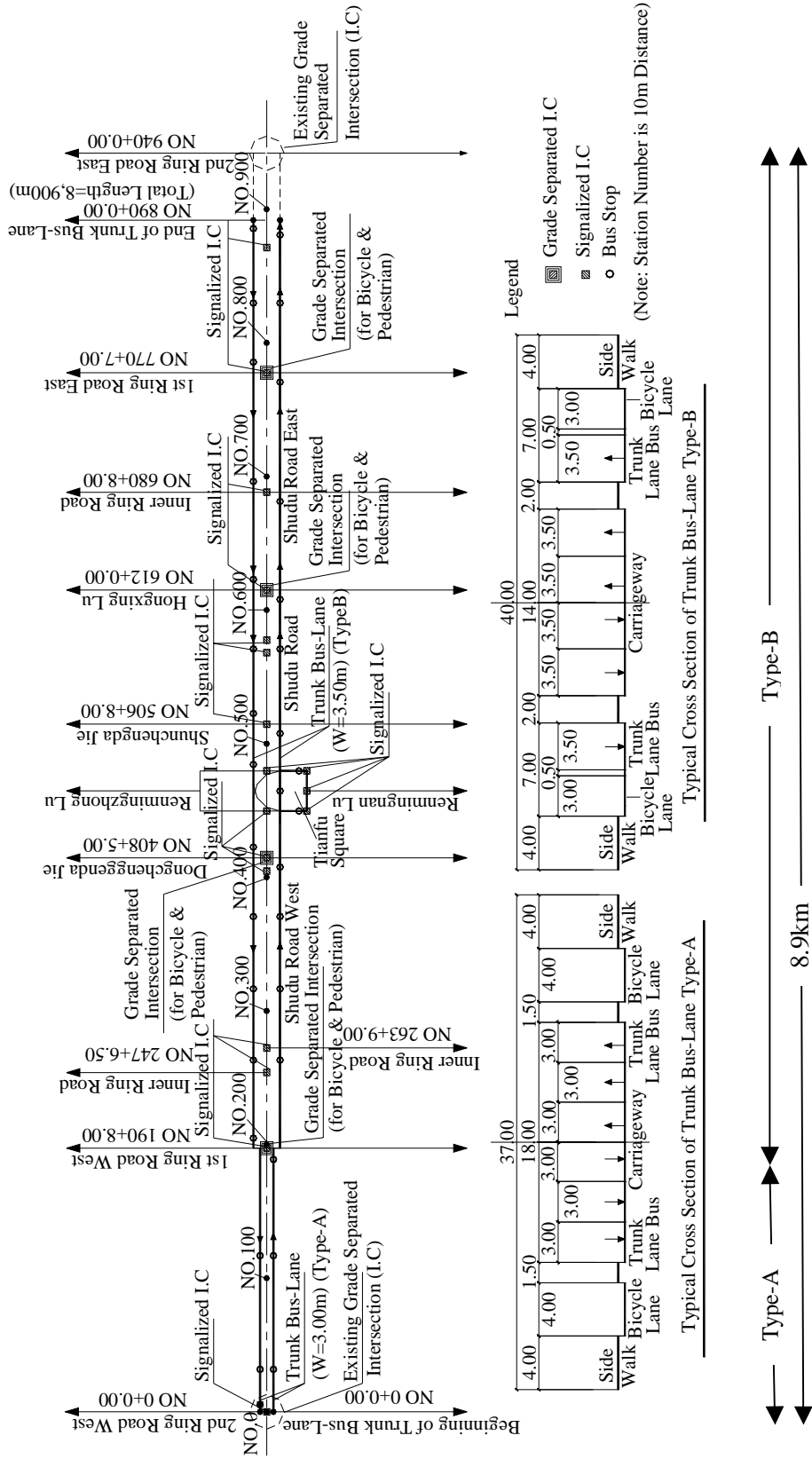
Similarly, there are six major intersections connecting to Shudu Road and other primary road. Four of these intersections should be reconstructed. Major considerations are:

- 1) New signals only for bus traffic should be set up so that bus traffic can go straight or turn easily.
- 2) To improve traffic situation, a left-turning lane should be set up.
- 3) Road markings should be clear, such as stopping lines, zebra lines and separation signals, etc.
- 4) Make the area of crossings as small as possible and keep every traffic flow in order.
- 5) Protect the trees on the side streets.

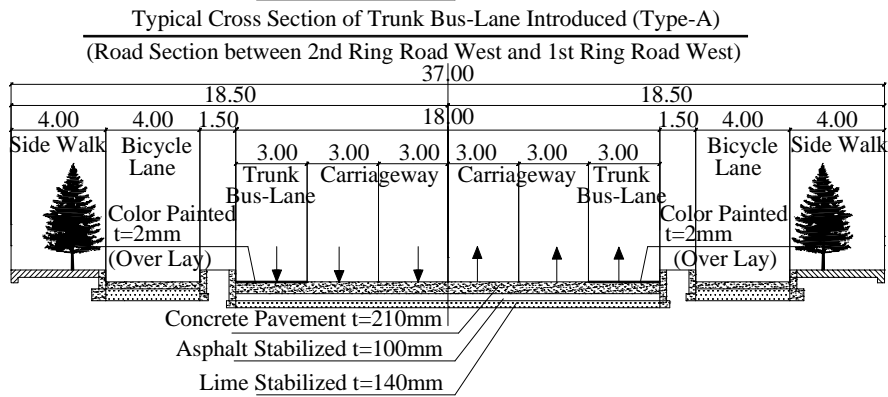
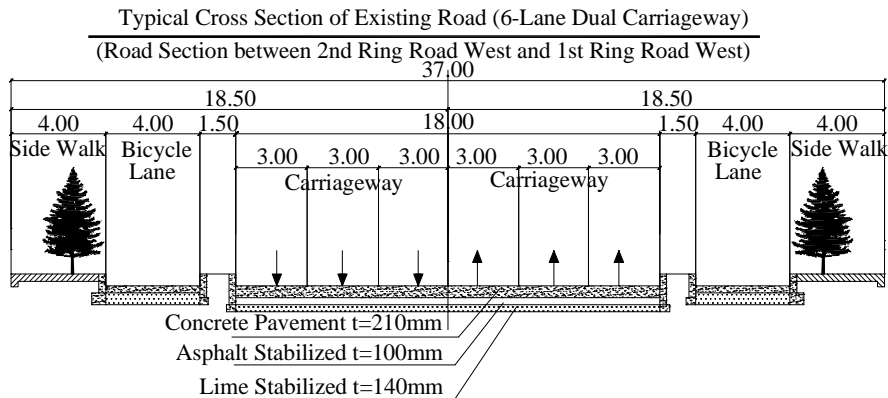
Bus Stop

The length from the intersection of Shudu Road and the Second Ring Road west to that of Shudu Road and the Second Ring Road is 8.9 kilometers. It has 32 bus stops and most of these bus stops have a 2.0-meter divider. Two types of bus stop facilities are proposed: Type A and Type B. Type A is set up on the outer lane of the existing 6 lanes using the outer median. Type B is set up using a half of bicycle lines, the original width of which is 7.0 meters. Considering the road facilities, 7.0 meters put forward.

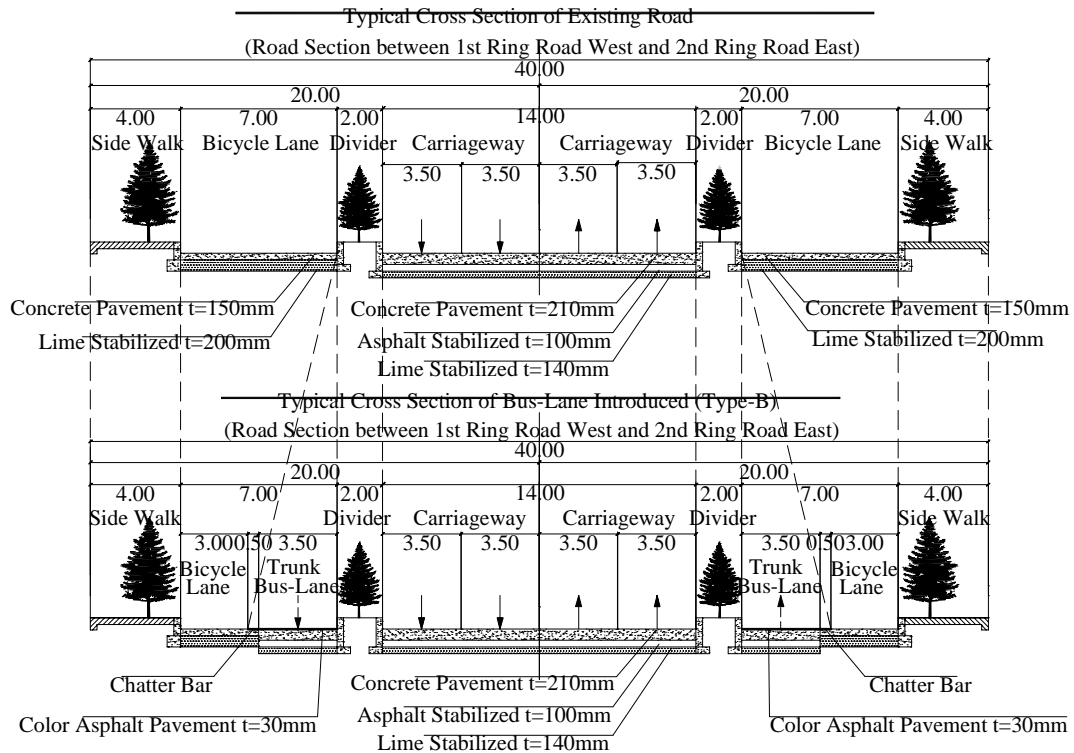
Project Outline



Typical Cross Section Type A



Typical Cross Section Type-B



10.3 Project Cost

Total Project Cost

Based on the preliminary design, construction plan was formulated and work quantity was estimated. Then, the total project cost has been calculated by summing up for each of the work items. The total project cost is RMB 146 million of which RMB 46 million or 31% of the total is the foreign portion.

Summary of Project Cost

(RMB 000)

Item	Unit	Total Cost	Local Portion	Foreign Portion	Remark
I.Direct Construction Cost	each	97,749	60,749	37,000	
Road Work	each	(19,643)	(12,277)	(7,366)	
Incidental Road Work	each	(12,522)	(8,882)	(3,640)	
Underpass	each	(58,156)	(34,480)	(23,676)	
Pedestrian Bridge	each	(5,137)	(3,276)	(1,861)	
Other Work	each	(2,291)	(1,834)	(457)	transplanting, demolition work
2.Construction Equipment Cost	3.0%	2,932	2,932	0	(1)*ratio%
3.Project Profit	4.0%	3,910	3,910	0	(1)*ratio%
4.Tax	3.41%	3,467	3,467	0	(1+3)*ratio%
5.Construction Cost(1+2+3+4)		108,058	71,058	37,000	
6.Administration Cost	10.0%	10,806	9,725	1,081	(5)*ratio%
7.Other Cost	10.0%	10,806	8,104	2,701	boring, material test and other engineering service (5) *ratio%
8.Contingency	15.0%	16,209	11,346	4,863	(5)*ratio%
Project Cost(5+6+7+8)		145,878	100,233	45,645	

Note: Project cost is different from that of the Master Plan due to the inclusion of other related projects.

Implementation Schedule

This project should be commenced as early as possible. Project approval and design shall start in 2001, funding arrangement and bidding is for the first half of 2002, construction should start in the middle of 2002, completion in 2003 and opening for public use in the beginning of 2004. Since the project comprises a number of construction and management works of different characteristics, coordination between various organizations related to the Project is essential.

COST EFFICIENCY OF THE PROPOSED BUSWAY

- The estimated cost of the proposed East-West Primary Busway Project is RMB 145,878,000. The unit cost per km is RMB 16,391,000. However, this cost includes the cost needed for constructing other related facilities such as grade separation of major intersections, sidewalk improvement, construction of major intersections, sidewalk improvement, construction of pedestrian bridges and bicycle parkings, etc. If these ancillary projects are excluded, the project cost reduces to RMB 35,676,000 with a unit cost of RMB 4,009,000 per km. This is quite economical compared to other modes of public transport.
- The following table compares transport capacity, scheduled speed and construction cost of various public transport modes in Japan. Although the level of prices is different by country, subway is usually the most expensive followed by other guideway transit systems.

The proposed busway in Chengdu is very economical due to the fact that the project is basically a re-arrangement of the existing roadway without land acquisition or large-scale infrastructure development.

Comparison of Transport Capacity, Scheduled Speed and Construction Cost of Public Transport Modes in Japan

	Subway	Urban Monorail & New Transit System	Guideway Bus	Street Car	Busway Proposed in Chengdu ¹⁾
Transport Capacity (000 passengers/hour/direction)	40-50	10-20	3-10	5-15	6
Scheduled Speed (km/h)	25-30	15-30	15-25	10-25	20
Construction Cost (RMB million/km)	1,500-2,300	400-1,200	230-460	80-230	16 (4) ²⁾

Source: Japan Monorail Association, 2000

Note: ¹⁾ Estimate of this study.

²⁾ Figures in parenthesis exclude the cost of related facilities.

10.4 Environmental Impact Assessment

Social Environment

Economic Activities: The project to introduce an exclusive bus lane will have positive impact on economic and urban activities.

Transport: It is expected that there will be no serious impact on such transport concerns. However, the experience in many countries demonstrates the importance of assuring space for both bicycle and pedestrian temporarily specially during construction period. The proposed project will accompany the supply of new off-street parking facility for bicycle and secure the pedestrian's movement and safety. For this reason, the project is expected to bring substantial benefit especially to the pedestrians.

Historical Heritage: As the project to introduce exclusive bus lane is planned to make full use of existing transport facility, impact of the project on the historical heritage will be quite marginal.

Solid Waste: Temporarily dumped waste soil on the construction site could negatively affect pedestrian's movement, deteriorate the neighboring environment and contaminate water source. The waste soil should be immediately disposed through a set of disposal processing such as excavating and immediate transporting by truck.

Health and Sanitation: Solid waste by residents would deteriorate the neighboring environment. It may be recommendable to fence the construction site. This is needed also to reduce negative impacts of noise and vibration during construction.

Natural Environment

Ecology: With the rearrangement of planting trees, sidewalks will be paved with new permeable material and this can provide better condition to the growth of the trees.

Underground Water: Project will have minor impact on the underground water.

Landscape: Permeable pavement will have positive impact on planting trees. It can also contribute to better landscape.

Air Pollution

Analysis results indicate that CO gas reduction is more effective on the Zongfu Lu and the west section of the Renmin Lu than on the Shudu Road. It is because the introduction of the exclusive bus lane brings substantial reduction of private cars on the section with heavy traffic whereas minor reduction or increase of private cars on the section with light traffic at present. The exclusive bus lane service has a potential to substantially reduce vehicle emissions in the future.

10.5 Economic Evaluation

Economic Cost

In the direct construction cost, material cost and machine/equipment cost share 66% and 22%, respectively in financial terms. As value-added tax of 17% and sales tax of 10% are included in these items, the economic cost was calculated by excluding these taxes. For the contingency which is 15% of the total construction cost, 50% was excluded to calculate the economic cost, as this is understood to be a reserve for price inflation (the remaining 50% is for changes on design). The total economic cost of the Project was consequently estimated at RMB 110.146 million or 76% of the total financial cost.

Economic Benefit

The economic benefit brought about by the Project is the savings of the total transport cost in the Study Area which is the sum of vehicle operating cost and passenger time cost. Only for the opening year of 2004, the economic benefit was estimated at RMB 143 thousand /day or RMB 52.3 million/year, which accounts for about one half of the total investment. The benefits will increase by 3 times in 2010. Out of the total benefit, 2/3 is owing to the reduction of vehicle operating cost and 1/3 to the reduction of passenger time cost.

Result of Economic Evaluation

The economic internal rate of return (EIRR) was calculated at 49.1% (*). The proposed project is proven to be highly feasible economically. The benefit/cost ratio (BCR) is 3.4, and the net present value (NPV) is 231.1 million which is more than double of the total investment.

* This value is different from that of the Master Plan due mainly to the different assumptions on the existence of other projects.

The proposed project focuses on the modification of the cross-section of existing roads. Its characteristics are rather of a “Software”. Thus it does not require a huge investment on physical infrastructure while its impact on traffic flows is remarkable. This is the reason why the economic evaluation of the Project resulted highly favorable.

This evaluation was conducted by comparing the “With Project” case and the “Without Project” case. The “Without Project” case is the same as the “Without Project” case of the Master Plan.

Sensitivity Analysis

The EIRR is still high at 34.6% and the Project is economically feasible, even if the project cost increases by 50%. The point when the Project becomes not economically feasible (i.e., the EIRR becomes less than 12%) is when the project cost soars by 238% (3.38 times). Likewise, the economic viability of the Project is guaranteed against the possible reduction of the economic benefit; the EIRR is higher than 12% if the benefit decreases by 50%, and goes down to 12% only when 70% of the estimated benefit is lost. The demand forecast of this study assumes a considerable percentage of bicycle and car users to shift to bus use. More specifically, 17% of bicycle trips and 22% of car trips are forecast to shift to bus use. If the assumed modal shift is not realized, the EIRR of the Project decreases to 26.9%. Although this is considerably lower than the base case, it is still higher than the 12% threshold. Thus, the economic viability of the proposed project is again guaranteed in this extreme case.

11 CHENGDU BUS PRIVATIZATION PROJECT

11.1 Planning Environment

Current Progress of Privatization in Chengdu

In response to the Government's advocacy for the reform of state-owned enterprises, the Chengdu Public Transportation Company has established a joint venture in 1999 by introducing a private capital from the Media Partner Internet (MPI) of Hong Kong in order to rationalize its organization. MPI is an affiliate of a major real property company. The duration of the joint venture is 3 years, and it will be listed in the Hong Kong stock market after that. MPI intends to obtain the capital gain as well as to enter the market of advertisement in Sichuan Province holding the bus as the media. The Chengdu Public Transportation Company transferred its affiliated Bus Companies No.2, No.3 and No.6, of which financial conditions are relatively good, to the newly created Yunxing Company. The joint venture was approved on July 20, 1999 and started operation in January 2000.

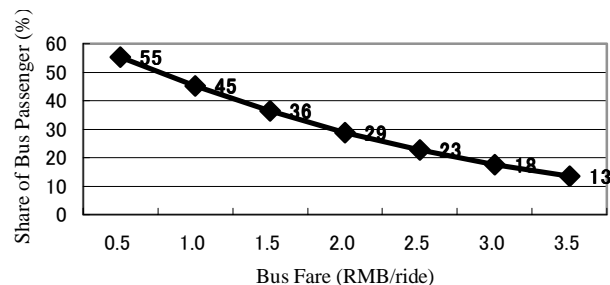
Financial Characteristics of the Chengdu Public Transportation Company

The fare revenue of the Public Transportation Company has increased by 1.9 times during 1996-1997 due to the increase of vehicle-km operated and fare amendment upward. On the other hand, its operating expenditure (excluding indirect cost) has increased only by 1.7 times. As such, the sales profit before deducting the administration cost (indirect cost of the Public Transportation Company and its affiliated Bus Companies) has been largely improved to about 13% of the fare revenue. Due, however, to the increase of the administration cost and its large percentage at 27% of the fare revenue (1999), the sales profit cannot cover the deficit corresponding to about 10% of the fare revenue. The deficit in operation and investment is supplemented by subsidy from the Government. Fare revenue per vehicle-km, which is an obvious indicator of financial performance, is RMB 3.5 on average with the best at 4.0 (No. 2 Company) and the worst at 2.7 (No. 4 Company). Each affiliated Bus Company produces a sales profit with fare revenue covering the direct expenses but is unable to cover the administration cost.

Assessment of Bus Fare System

The bus share will increase than predicted if bus fares are lowered in real terms, and will decrease on the real increase in bus fares.

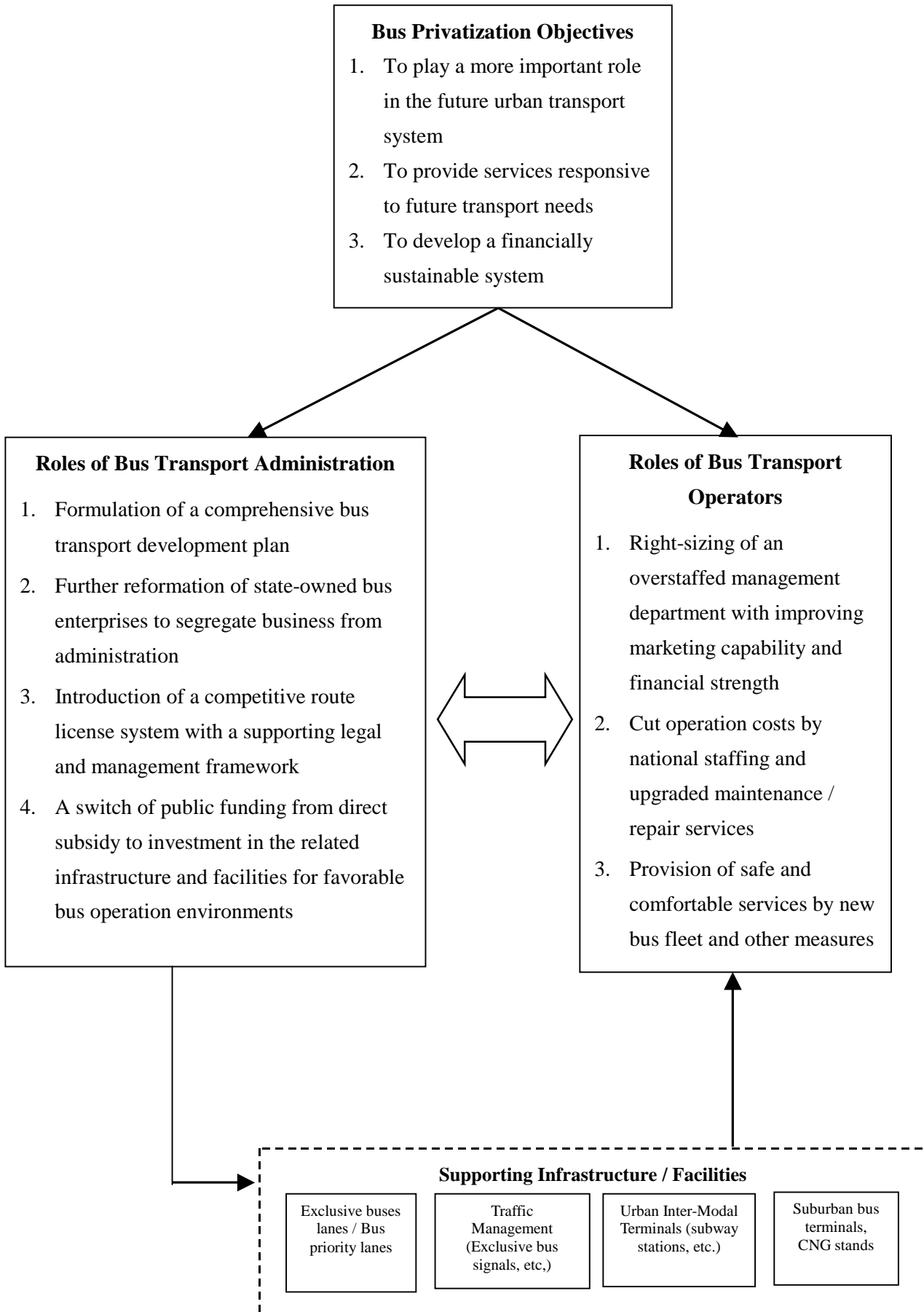
Bus Shares Estimated by the Modal Split Model (2010)



The total revenue becomes maximum at RMB 2/ride. However, the increase in fare revenue is only by 18% from the current bus fare level of RMB 1/ride. If bus fare is raised to this level, traffic congestion will be worse and parking problems will become serious due to the increase of bicycle and car use. Bus fare should not be raised easily from the current RMB 1/ride level only to increase the fare revenue.

11.2 Fundamental Framework to Guide Bus Privatization

Framework for Bus Privatization



11.3 Financial Analysis on the Chengdu Bus Privatization Project

Major Assumption

As the affiliated bus companies of No. 2, 3 and 6 have been already incorporated into Yunxing Transport Company, the focal point is to analyze if the remaining three companies of No. 1, 4 and 5 can be financially viable after being privatized. It is assumed in this analysis that the remaining three companies will be privatized all together into one company which is referred to as the New Bus Company.

Regarding the type of the New Bus Company, two cases are considered:

- Case 1: New Bus Company is established as a joint company with another private company by introducing private capital.
- Case 2: New Bus Company is established only with the own capital of the three companies.

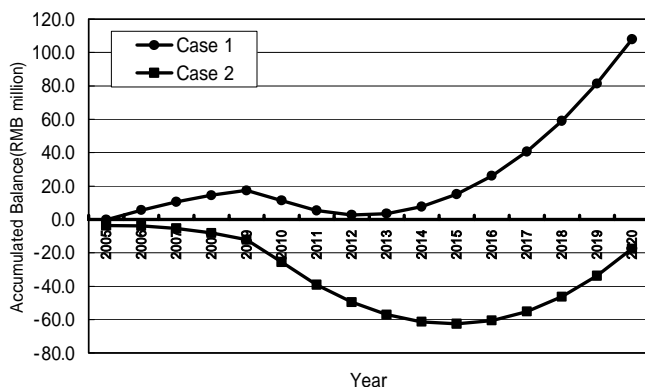
Result of Financial Analysis

Based on the result of financial analysis, the following are concluded.:

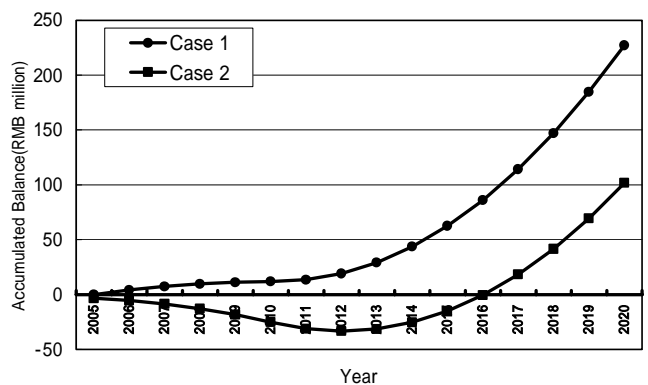
- The three companies by themselves are very difficult to be privatized, even with a supportive measure such as 5--year tax exemption. If they are subsidized with more than RMB 180 million for the first five years, it can survive in the long run.
- If the New Bus Company is established as a public-private joint company by introducing a private capital over RMB 130 million, the company can be financially feasible. Without any supportive measures, however, the company is not so attractive to the private sector.
- New Bus Company will be viable if it joins with a private company, introducing private capital, and it is properly subsidized for a certain period.

Trend of Accumulated Balance of New Bus Company

Five-years Tax Exemption and Subsidy to Separation Pay



Five-years Subsidy to Bus Acquisition



Note) Case 1: New Bus Company is established as a joint company with another private company by introducing private capital.

Case 2: New Bus Company is established only with the own capital of the three companies.

11.4 Supportive Measures for Bus Privatization

Route Licensing

The benefit of route license system is that it helps every route as one unit to carry out the city-bus policies and business plans made by the bus administration authorities (Public Utilities Bureau of the City, at present) and introduces competitive principles into the selection of entrepreneurs and process of supervision. Although there are a number of methods for route licensing, it is recommended that the government adopt the “Net Cost” method (operation cost quoted by the bidder) instead of the “Gross Cost” (operation cost quoted by the authority) to invite bids for the following reasons:

- 1) The “Net Cost” method is easier to understand for all the relevant personnel in the bus business in Chengdu (administration, enterprises and users). Although the contract of the recently founded JV bus company is using the corporation as a unit, it is closer to the “Net Cost” method.
- 2) Once the “Gross Cost” method is introduced, bus administration must burden much work on routes permitting and contracts managing. In addition, it will be quite difficult to work out systems that can supervise daily operation carefully and account the total amount of fare income efficiently in just a short time.

Institutional Reform Program

The institutional reform in association with urban bus privatization aims to improve the bus service, increase bus demand and foster competitiveness among the entrepreneurs. Having the present situation as the First Stage, the subsequent stages are:

Second Stage: Preparation of Bus Privatization Plan and Transformation of Bus Operation Business to a Self-Financing Structure (2002-2004)

The main task of the second stage is to work out a bus privatization plan to explain the plan to and enrich the understanding on these policies of bus entrepreneurs, relevant enterprises, bus-users and potential investors. As for bus enterprises and the relevant enterprises, they must strive for survival under the new policies. Additionally, the reform for state-owned public transportation enterprises will be accelerated.

Third Stage: Restrictive Competition Environments under a Transitional Period (2005-2007)

This stage is a transition period in the process of introducing route-licensing policy into bus operation business. On this stage, there will be a continuing implementation of the related reforms and policies.

Fourth Stage: Completion of Bus Privatization with Competitive Environments (2008-2010)

The fourth stage is the final stage of the bus privatization project in Chengdu. This will take the form of a route license system under a competitive environment principle. This will provide reliable bus services and shall take advantage of benefits of privatization such as cost reduction and service improvement.

12 CONCLUSION AND RECOMMENDATIONS

12.1 Conclusion

- Chengdu City is the center of the South-Western Region of China having a population of about 10 million. The central government is presently shifting the development target from the coastal region to the inland region. The Study Area is the central part of the City and is expected to play a key role in accelerating the achievement of this policy goal. For this purpose, the current transport system of Chengdu needs to be upgraded to support varied social and economic activities.
- The current road system of Chengdu is relatively well developed. Its theoretical capacity is enough to accommodate the traffic volume of the present level, and, with the completion of road projects proposed in the existing plans, will be sufficient even for the forecasted traffic volume in 2010. However, there still remain a number of problems hindering the full use of existing road space. These are, among others, existence of bottleneck sections in built-up area, insufficient intersection management, too many traffic accidents and poor traffic discipline.
- The present public transport system of Chengdu is dominated by bus (excluding taxi which is considered a semi-private mode of transport). There is no major problem in relation to bus operation at present. Most of major roads are covered by bus service and the service is more or less satisfactory during working hours with a relatively low fare level. Its modal share, however, is still low at 10% in 2000, and there are a considerable percentage of bicycle and car users who would shift to bus use if its service level is improved considerably.

The largest problem in relation to bus operation is rather administrative or managerial. Bus industry in Chengdu is dominated by a state-owned company, and its group (including affiliated bus companies) has been producing a huge financial loss every year. The City has to cover the deficit by providing subsidy from its general budget. In the light of the current policies of the central government promoting deregulation and the recent movements of some advanced cities in China towards privatization of public transport, it is the time for Chengdu to take the next steps.

- In the long run, the Chengdu public transport system will focus on the subway network. By 2030, the subway network will be completed. The period from 2000 to 2030 will be a transition period to develop a public transport system consisting mainly of railways and buses. Buses will become the main public transport for a certain period and then will provide some auxiliary services. It is projected that only the subway's Line 1 will be completed around 2010, so the main mode of public transport is still buses until 2010. In formulating the plans to improve public transport by 2010, however, the subway network should be taken into account. In order to enhance the bus service in Chengdu to encourage the use of public transport (favorable also for subway), the busway system is very effective. It is a combination of segregated bus exclusive lanes and priority lanes using the existing Right-of-Way of major urban roads. Although various construction works are needed, it does not require a large-scale investment for constructing new infrastructure. This busway network, however, should be supported by a series of measures including bus terminal/stop improvement, modification of bus routes, upgrading/improvement of

major intersections, segregation of bicycle and pedestrian flows and implementation of other traffic management schemes.

- By implementing these plans, the future traffic situation will be remarkably improved; the modal share of bus will increase from the present 10.2% to 27.4% in 2010, the travel speed of bus from 12.0 km/h to 16.9 km/h and the average volume/capacity ratio of roads will decrease from 0.43 to 0.25. If no measures are taken, the improvement of traffic situation is quite marginal only due to the completion of existing road development projects.

12.2 Recommendations

- The projects proposed in the Master Plan should be implemented according to the implementation schedule. They are 4 Primary Busway Projects (segregated bus exclusive lanes), 7 Secondary Busway Projects (segregated bus priority lanes), 3 Auxiliary Bus Facilities Projects (7 intercity bus terminals, 10 intra-city bus transfer points and 230 bus stops), 4 Traffic Control System Projects (intersection improvement, bicycle lane development, etc.) and 5 Policies and Management System Projects.

The total cost of the projects accounts for RM 1,196 million, of which RMB 599 million or 50% of the total is for the Primary Busway Project. The Secondary Busway Project shares RMB 285 million or 24% of the total. The rest is for Auxiliary Bus Facilities Project and Traffic Control System Project. No cost was assumed for Policies and Management System Project.

The internal rate of return of the Master Plan reaches 25.5%, far exceeding the economic discount rate (12%). Thus, the Master Plan is judged to be highly feasible economically. The net present value is estimated at about RMB 2,000 million, which is about double of the investment amount. As per sensitivity tests, this high feasibility is very rigid, not affected much by cost increase or benefit decrease. By project, all the proposed projects are economically feasible, showing an internal rate of return over 12%. The economic returns of the East-west busway and the Wuhouci Lu – Beizhan Lu busway are especially high.

In addition, no major negative impact is foreseen on the environment.

- In addition, it is proposed that a single traffic administrative body be responsible for traffic management in Chengdu. This setup will integrate management of city traffic including public bus (intercity and intra-city), taxi and subway systems.
- Regarding the two key projects analyzed by the feasibility studies, the following recommendations are made:

East-West Primary Busway Project

Segregated bus exclusive lanes should be developed on Shudu Road within the Second Ring Road. This project aims to make a maximum use of the existing Right-of-Way without reducing the traffic capacity for other vehicles only by rearranging the cross-section. In parallel to this, other supportive measures including grade separation of major intersections, improvement of bicycle/pedestrian facilities should be taken. The total cost is estimated at RMB 146 million. The effect of the Project is large in improving traffic flows. The Project is highly feasible economically with an EIRR of 49%. The project also contributes to improve environment, while no major negative impact is foreseen. It is strongly recommended to implement this project as early as possible.

It is desirable for the City to approve the Project and start design work in 2001, to arrange finance and bidding and start construction in 2002, and to complete construction within 2003. As this project is conducted within the existing Right-of-Way, the private sector should not be involved. It should be financed by the general budget of the City and the construction would be conducted by the Primary Road Control Department of the City. Operation and management of the busway should be taken care of by the Public Utilities Bureau of the City. In addition, the busway should be free of charge.

Chengdu Bus Privatization Project

Although the business of city bus operation has been already privatized partially in 2000 (the Yunxing Company), the remaining part should be also privatized in a few years. This is needed in light of policy directions of the central government of China as well as to improve bus services in terms of quality and quantity and to reduce the financial burden of the City.

However, it is difficult to privatize the bus business remaining in the public sector (the Chengdu Public Transportation Company and its affiliated Bus Company No. 1, No. 4 and No. 5) under the current financial condition. It is required to introduce a private capital corresponding to 150% or more of the owned fixed assets to materialize the privatization. Prior to this, however, a certain level of profitability, satisfactory for the private capital, must be secured. Although this becomes possible in the long run due to the increase of bus traffic demand, it is almost impossible for a private capital to raise a profit in the short term taking into account the necessary replacement and increase of bus fleet. Thus some incentive measures should be adopted for at least 5 years, such as tax exemption/reduction, subsidy for bus units and public assistance for surplus manpower. During this transition period, the privatized company should strengthen its financial base towards a complete financial independence by 2010.

The headquarters of the Chengdu Public Transportation Company should be reorganized as a stock holding company for the Yunxing Company and the new companies to be privatized, and it will be responsible as a public organization in monitoring and supervision of bus operation, planning and approval of bus routes, etc.

Members List (1)

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- 1) Mr. Di Ting Guo : Chairman, Vice Mayor of Chengdu City
- 2) Mr. Liu Yu Cheng : Vice Chairman, Head of Chengdu City Construction Committee
- 3) Mr. Yang Guo An : Vice Chairman, Head of Sichuan Provincial Science and Technology Department
- 4) Mr. Hoang Hou An : Vice Chairman, Vice Manager of Secretariat of Chengdu City
- 5) Mr. Zhang Jing Wen : Head of Science and Technology Committee of Chengdu City
- 6) Mr. Hu Jun Chu : Vice Manager of Planning Bureau of Chengdu City
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- 10) Mr. Sun Zhi Min : Vice Manager of Public Utilities Bureau of Sichuan Province
- 11) Mr. Ge Bo : Vice Manager of Traffic Management Division of Public Securities Bureau of Chengdu City
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- 14) Ms. Wang Rong Yan : Vice Manager of Environmental Protection Bureau of Chengdu City
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- 16) Mr. Takeshi KAGAJO : Coordination

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