

**ARCHITECTURE DEPARTMENT**

**CHINESE UNIVERSITY OF HONG KONG**

MASTER OF ARCHITECTURE PROGRAMME 1996-97

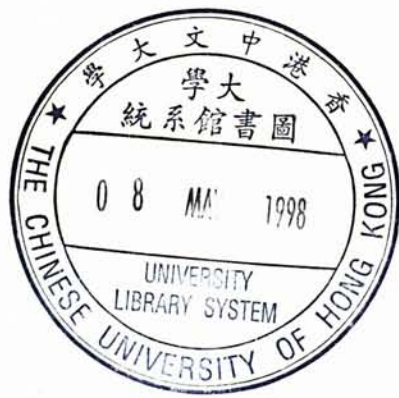
DESIGN REPORT



## **AUTOMOBILE DISTRIBUTION CENTER**

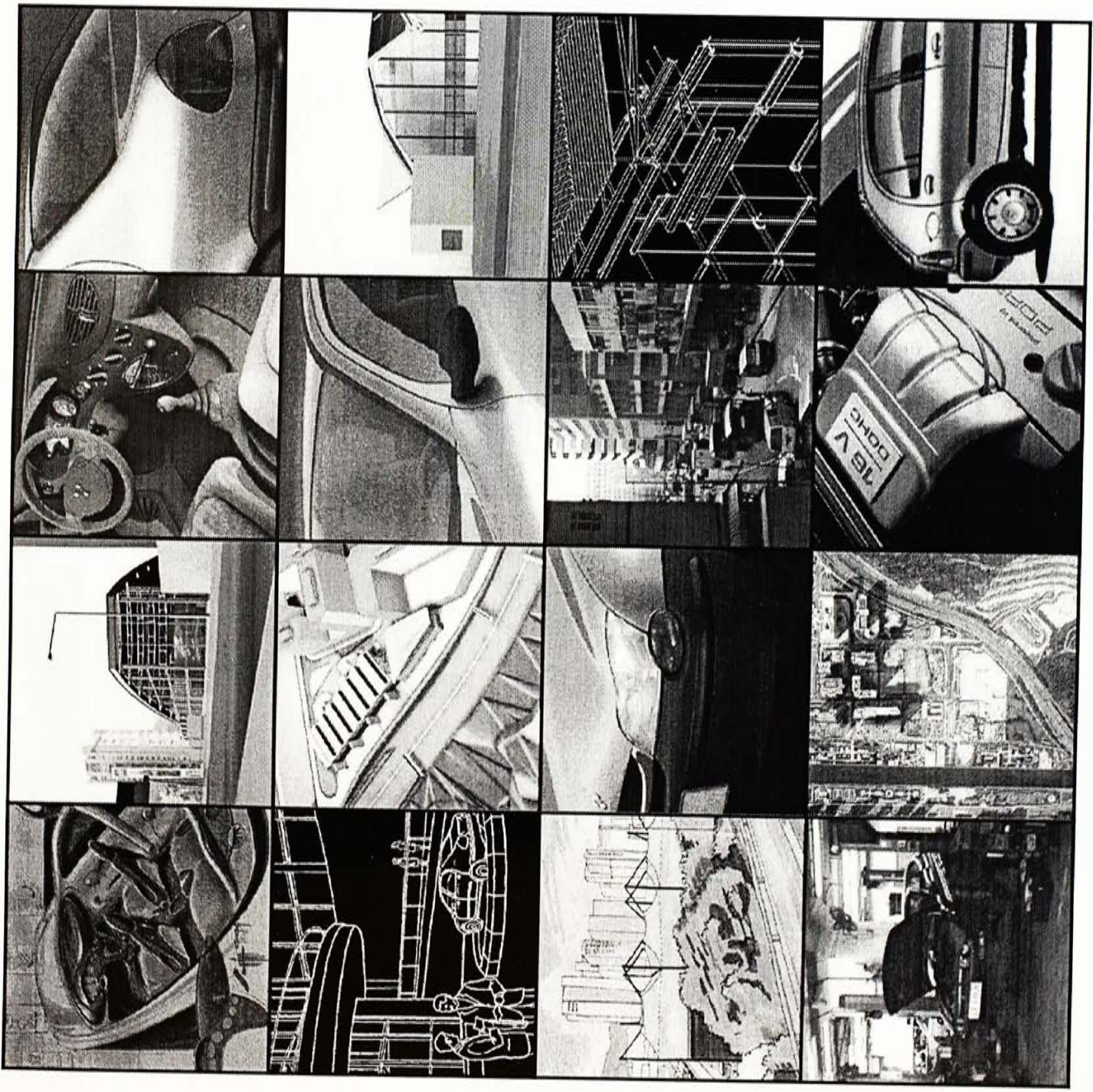
TZE Kin Hung Alfred

April 1997



Automobile Distribution Center  
Design Report

Arc6020  
Advanced Architectural Design Studio  
Tze Kin Hung Alfred  
95033840





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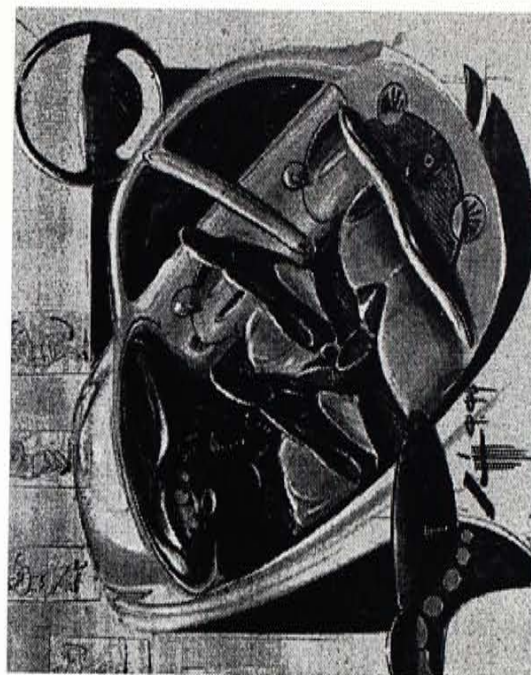
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## 1. Background

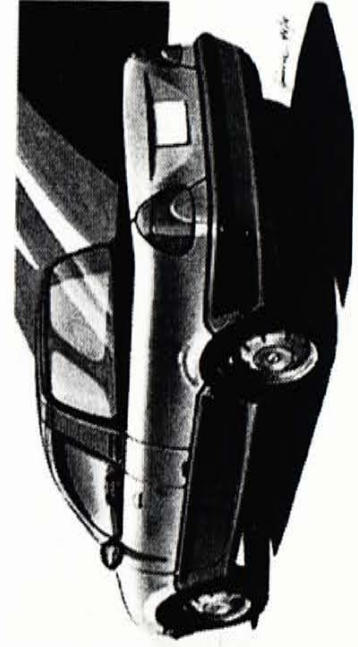
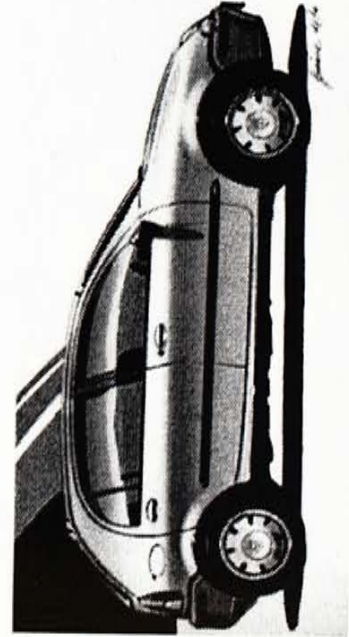
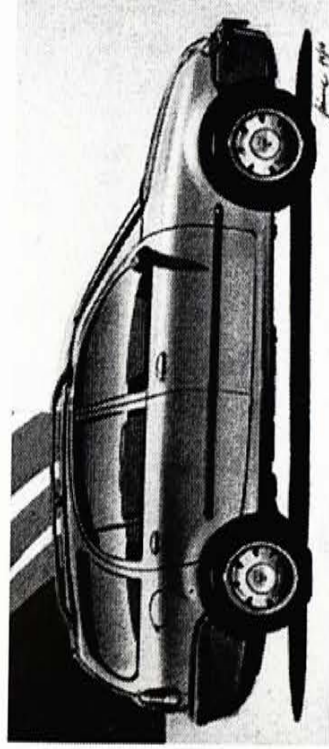
### 1.1 Introduction

In the past, Chinese automobile industry has developed at a very slow pace. Chinese automobiles have not been able to enter the world market. As the economy and market of China continue to grow, tremendous amount of money will be drawn away if China does not have its own automobiles. To catch up with the world's automobile standard, China has announced a strategy for the future development of automobile industry. The project claimed that there would be a distribution center as a headquarters for exportation. The center will be located in Hong Kong. The center will consist of three major elements:

**Warehouse:** Store spare temporarily from importation and exportation.

**Maintenance center:** Provide excellent after-sale service for the sold C88 and Porsche in Hong Kong.

**Showroom:** Promote C88 in Hong Kong.





### 1.2 Porsche Crisis and C88

Porsche is one of the famous performance car manufacturers. However Porsche had suffered from financial deficit for 10 years. From 1986 to 1993, Porsche had lost over US\$ 200 million<sup>1</sup>. To save Porsche from the crisis, Wendelin Wiedeking, the chairman of Porsche AG since 1993, have set up a long-term strategy. Firstly in short term, the company has to cut the cost down. He hired a Japanese consultant and made the whole production much more effective. For example the production time of Porsche 911 has dropped from 120hrs to 74. Porsche has also developed economic model such as the latest Boxster. The model will share a lot of components with other models to reduce the cost. All the policies have made Porsche more economic and have increased the sale.



C88 will have different versions. The first versions will be a 3-door hatchback. The price will be expected to be 45,000RMB (renminbi: the unit of Chinese money). The second version will be a 2-door and 4-door fastback. The third one will be a 4-door luxury sedan. This version will be ready for export and the price will be 80,000 RMB. This version will also meet the world's safety and exhausted gas emission standard. The proposed annual production of C88 will be 300,000 to 500,000. Although C88 is mainly cater for the Chinese local market, it is proposed that about 3-5% (15,000) of the annual production will be exported. The production line will be adjusted from time to time to provide the greatest amount of flexibility to match the demand.



Performance car, however, is still a small crowded market and the sale greatly depends on the global economy. To alleviate the dependence of sport car market, Porsche proposed a project called C88 to extend its product market. C88 is a passenger car developed by Porsche and Chinese experts. C is meant China and 88 in Chinese technical staff. Then the trained staff will go to Germany and design C88 with the Germans experts. It is proposed that in the beginning of the 21st century C88 will be able to go into the production.

<sup>1</sup> Salvation in Stuttgart, Forbes, 11/Sept/1994, p154-155

### 1.3 Programme Brief

#### Phase I

In the early production stage of C88, Germany will supply most of the parts. It is because China still will not acquire this kind of high technology to produce the parts. C88 is still unable to be manufactured in China completely instead the operation will be of assembly only. The role of the Automobile Distribution Center (ADC) at the first stage proposed will act as a C88 promotion center and a maintenance center catering for Hong Kong local market of both C88 and Porsche products.

#### Phase II

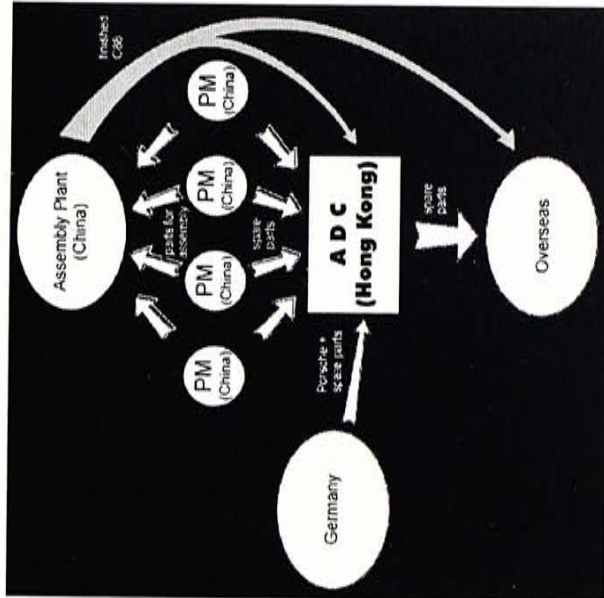
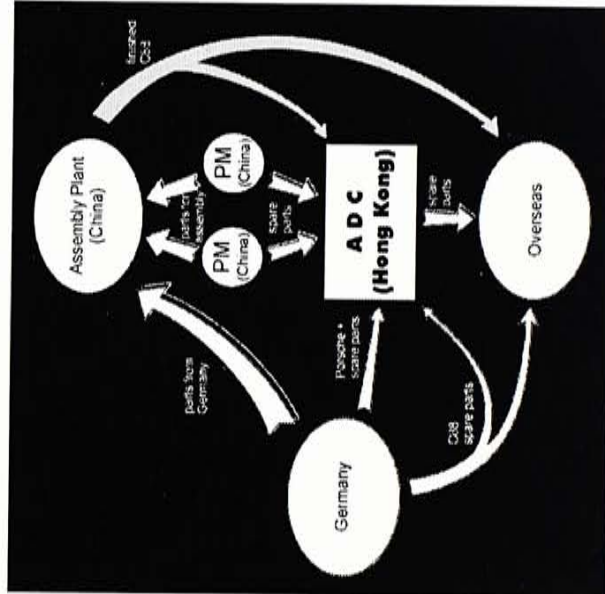
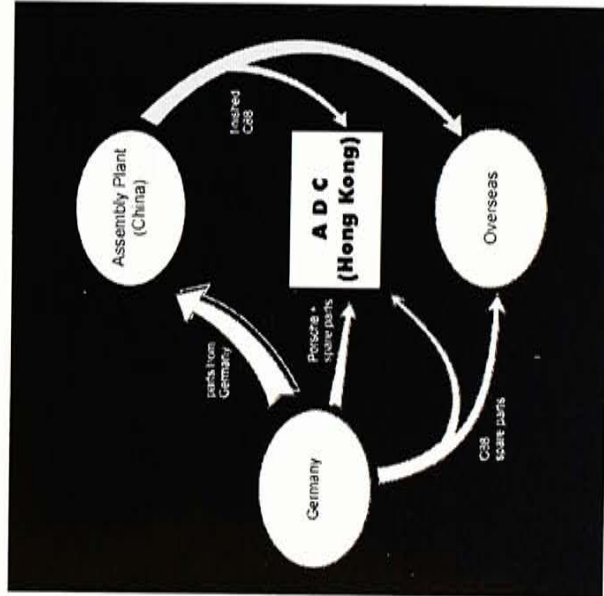
The project assumes that Porsche will be responsible to increase the technological standard of the Chinese automobile industry. It is achieved by transferring the advanced technology to the mainland parts manufacturers.

At the last stage of the project C88 will be manufactured in China completely by means of this kind of localization. At this stage the parts are not no longer transported from Germany. The role of importation distribution center in ADC will be becoming smaller gradually. On the country, the role of ADC will change to exportation center. As mentioned before, the parts are manufactured by different manufacturers in China. It will be very complicated for the foreign dealers to request spare parts. They may have to contact different manufacturer to get all the items. It will waste a lot of time as well as money.

ADC will act as a coordinator to coordinate the request from different dealers and the exported items from the local manufacturers. The parts will be transported to the ADC first. The center will sort and arrange those parts that different dealers requested and then transported to them by shipping. Therefore the role of ADC will be changed as

the project proceeded at different stages.

In conclusion, ADC will consist of 3 major elements: warehouse to coordinate and store the spare parts; maintenance center to provide regular service to the local customer; showroom to promote C88. The warehouse and the maintenance center are required to have a flexible-planning layout and be able to extend readily. Moreover the center is required an administration office to operate those three elements. The office has to consist of a flexible layout office area, staff canteen, training school and changing room.



**1.4 Schedule of accommodation****1.4.1 Phase I****(1) Maintenance center**

Place	l x w x q	area
a, main work space:		
i, service stall	6 x 3 x 8	144m <sup>2</sup>
ii, body/paint stall	7 x 4 x 3	84m <sup>2</sup>
iii, front/end stall	7 x 4 x 3	84m <sup>2</sup>
iv, compressor	3.5 x 3 x 1	10.5m <sup>2</sup>
v, generator	7 x 4 x 1	28m <sup>2</sup>
vi washing rack	7 x 4.5 x 1	31.5m <sup>2</sup>
vii, engine unit repair	7 x 5 x 1	35m <sup>2</sup>
viii, internal circulation	6.5 x 4.5 x 30	877.5m <sup>2</sup>
ix, internal parking	5 x 2.4 x 7	84m <sup>2</sup>
x, warehouse		450m <sup>2</sup>
	total:	1828.5m <sup>2</sup>
b, office (maintenance center)		
i, workspace		200m <sup>2</sup>
ii, reception		25m <sup>2</sup>
	total:	225m <sup>2</sup>
	total:	<b>2053.5m<sup>2</sup></b>

**(2) Showroom**

Place	area
a, exhibition area	750m <sup>2</sup>
b, education center	750m <sup>2</sup>
c, cafe	100m <sup>2</sup>
d, theater	150m <sup>2</sup>
e, negotiation area	50m <sup>2</sup>
f, control room	50m <sup>2</sup>

g, vestibule	50m <sup>2</sup>
h, circulation	300m <sup>2</sup>
	<b>total:</b>
	<b>2200m<sup>2</sup></b>

**(3) Office**

Place	area
a, administration office	
i, cellular office	165m <sup>2</sup>
ii, open plan office	700m <sup>2</sup>
iii, reception	50m <sup>2</sup>
iv, conference room	45m <sup>2</sup>
	<b>total:</b>
	<b>960m<sup>2</sup></b>
b, training school	
i, classroom	7 x 7 x 2
ii, storage	98m <sup>2</sup>
	<b>total:</b>
	<b>123m<sup>2</sup></b>
c, canteen	
i, dining area	400m <sup>2</sup>
ii, kitchen	300m <sup>2</sup>
iii, loading/unloading	50m <sup>2</sup>
	<b>total:</b>
	<b>750m<sup>2</sup></b>
d, changing room/toilet	
	100m <sup>2</sup>
	<b>total:</b>
	<b>1933m<sup>2</sup></b>

**(4) Miscellaneous**

Place	area
a, toilet (male/female)	25 x 5
b, mechanical area	1000m <sup>2</sup>
c, customer carpark	810m <sup>2</sup>
	<b>total:</b>
	<b>2185m<sup>2</sup></b>

total area of the center

7371.5m<sup>2</sup>



1.4.2 Phase II

(1) Maintenance center

Place	l x w x q	area
a, main work space:		
i, service stall	6 x 3 x 16	288m <sup>2</sup>
ii, body/paint stall	7 x 4 x 6	168m <sup>2</sup>
iii, front/end stall	7 x 4 x 12	336m <sup>2</sup>
iv, compressor	3.5 x 3 x 1	10.5m <sup>2</sup>
v, generator	7 x 4 x 1	28m <sup>2</sup>
vi washing rack	7 x 4.5 x 1	31.5m <sup>2</sup>
vii, engine unit repair	7 x 5 x 1	35m <sup>2</sup>
viii, internal circulation	6.5 x 4.5 x 40	1170m <sup>2</sup>
ix, internal parking	5 x 2.4 x 14	168m <sup>2</sup>
x, warehouse		450m <sup>2</sup>
	total:	2685m <sup>2</sup>
b, office (maintenance center)		
i, workspace		200m <sup>2</sup>
ii, reception		25m <sup>2</sup>
	total:	225m <sup>2</sup>
	total:	2910m <sup>2</sup>

(2) Warehouse

Place	area
a, warehouse	
i, main storage space	2700m <sup>2</sup>
ii, special storage (inflammable material)	250m <sup>2</sup>
iii, sorting/handling	600m <sup>2</sup>
iv, truck charging room	200m <sup>2</sup>
	total:
	3750m <sup>2</sup>
b, loading/unloading	750m <sup>2</sup>
	total:
	4500m <sup>2</sup>

(3) Showroom

Place	area
a, exhibition area	750m <sup>2</sup>
b, education center	750m <sup>2</sup>
c, cafe	100m <sup>2</sup>
d, theater	150m <sup>2</sup>
e, negotiation area	50m <sup>2</sup>
f, control room	50m <sup>2</sup>
g, vestibule	50m <sup>2</sup>
h, circulation	300m <sup>2</sup>
	total:
	2200m <sup>2</sup>

(4) Office

Place	area
a, administration office	
i, cellular office	165m <sup>2</sup>
ii, open plan office	700m <sup>2</sup>
iii, reception	50m <sup>2</sup>
iv, conference room	45m <sup>2</sup>

b, training school

i, classroom	7 x 7 x 2	98m <sup>2</sup>
ii, storage		25m <sup>2</sup>
	total:	123m <sup>2</sup>

c, canteen

i, dining area		400m <sup>2</sup>
ii, kitchen		300m <sup>2</sup>
iii, loading/unloading		50m <sup>2</sup>
	total:	750m <sup>2</sup>

d, changing room/toilet

	total:	100m <sup>2</sup>
	total:	1933m <sup>2</sup>

(5) Miscellaneous

Place	area	
a, toilet (male/female)	25 x 7	175m <sup>2</sup>
b, mechanical area		1200m <sup>2</sup>
c, customer carpark		810m <sup>2</sup>
	total:	2185m <sup>2</sup>

total area of the center

13728m<sup>2</sup>



## 1.5 Site Selection and Analysis

### 1.5.1 Site selection criteria

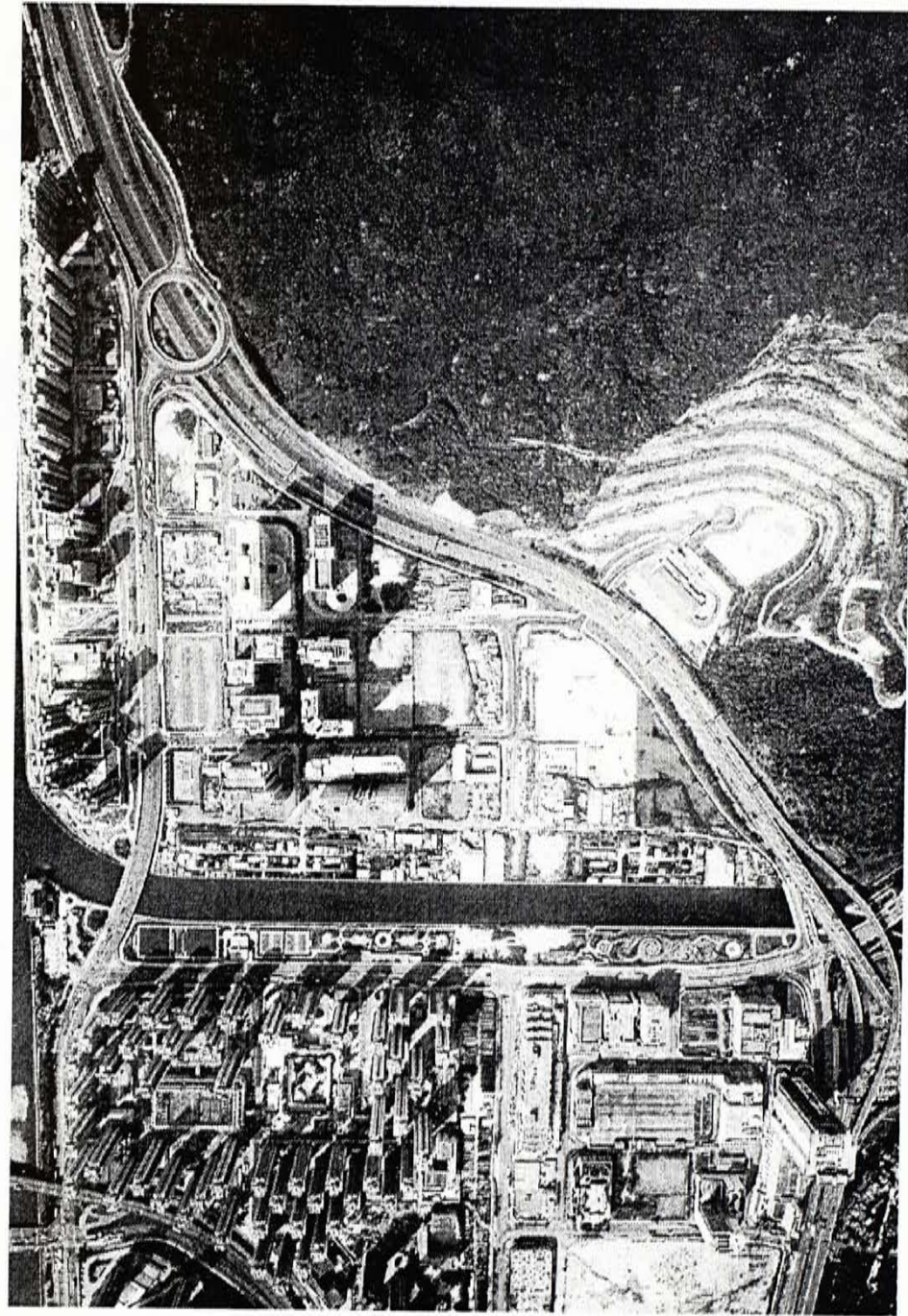
The site is chosen based on four criteria:

- (1) *Transportation:*  
The center should have a good highway network to connect mainland and the container terminal. It will minimize the time of transportation and money.
- (2) *Advertising potential:*  
The center can act as an eye-catching point for the promotion of the car. It should be near the highway or railway so that it can have a great advertising potential for the customer.
- (3) *Price of the land:*  
The price of the land is very important for this development because it requires a large piece of land. It will raise the total cost drastically if the cost/m<sup>2</sup> is very high.
- (4) *Future extension:*  
The possibility of extension for the site is determined by whether the site is big enough and the surrounding is newly developed.

There are 5 potential new towns site in Hong Kong: Tuen Mun, Fo Tan, Yuen Long, Shek Mun, Tai Po. Since Shek Mun have the strongest visual connection and can be easily approached from the Tate's Cairn HighwayMOre over Shek Mun is a new planning area, it may command a lower premium on land price and will provide flexibility for extension. Therefore Shek Mun is consider to be the most suitable site for Center.

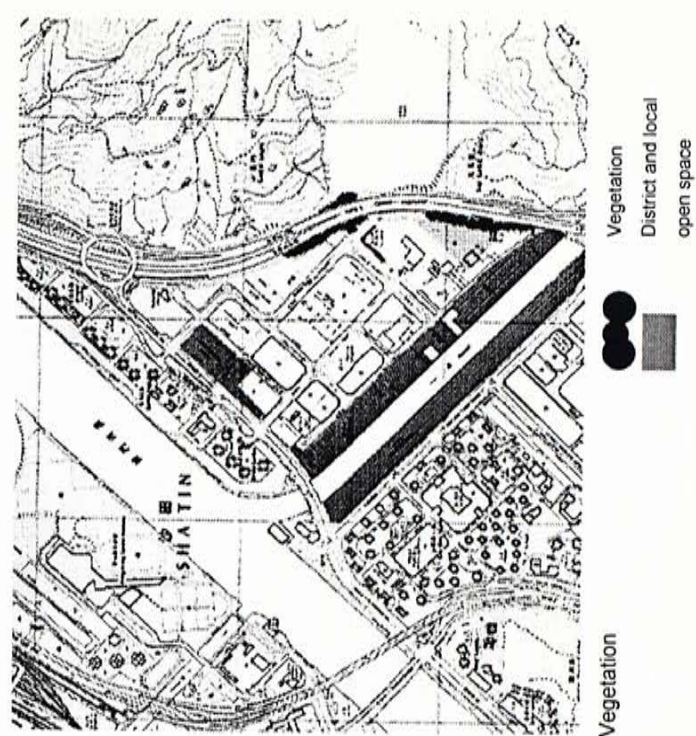
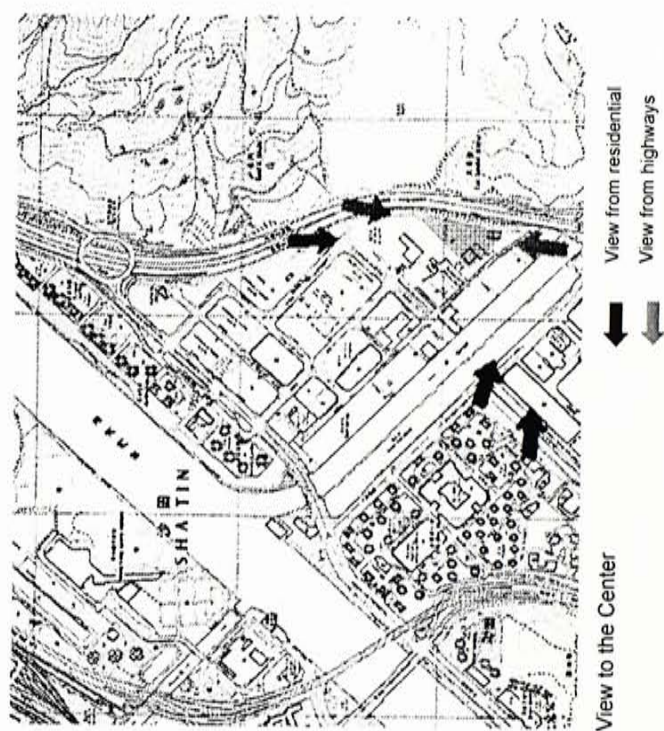
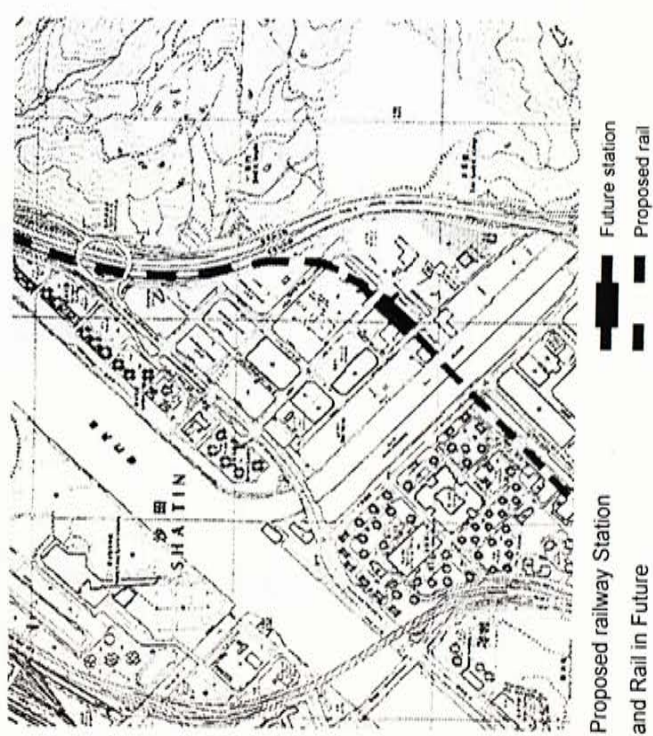
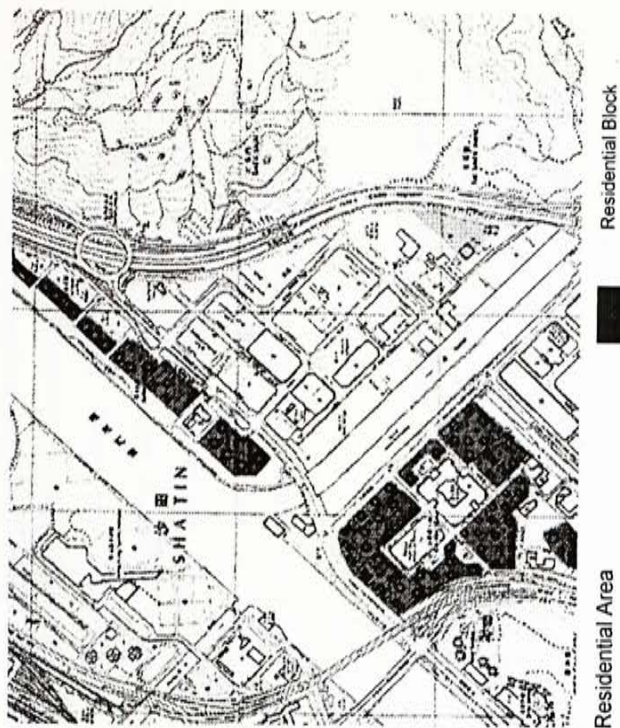
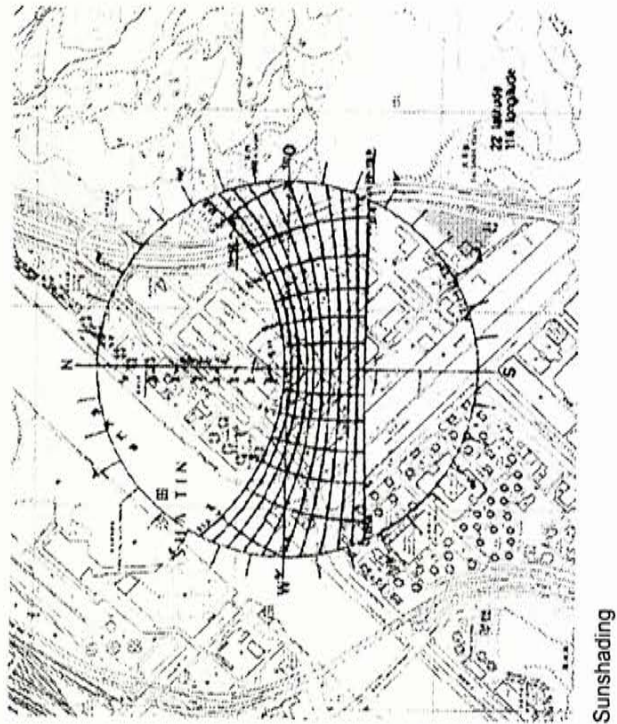
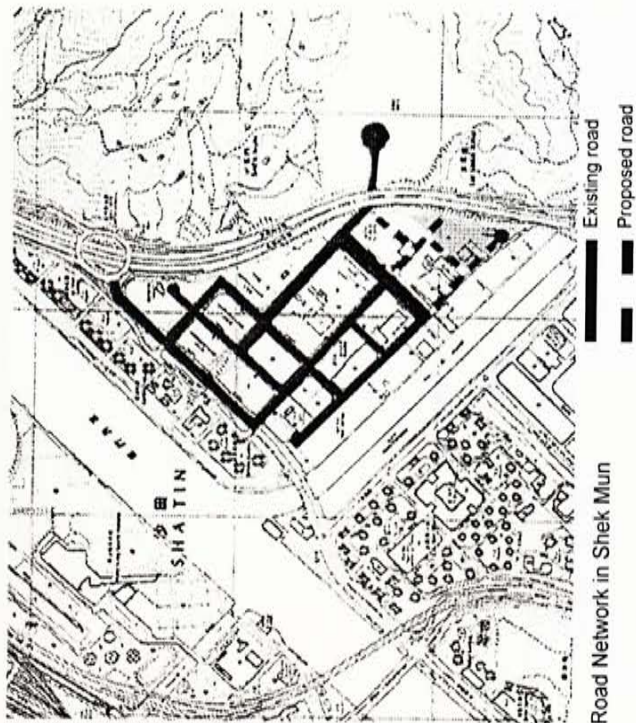
### 1.5.2 Site Information

Site:	Shek Mun Industrial Area	G.F.A. Permitted:	~61852.70m <sup>2</sup>
Site Area:	~12370.54m <sup>2</sup>	Lease Conditions:	Nil
Zoning:	Industrial (Group A): Light industry propose	The site is surrounded by:	On Luk Road On Lai Road Tate's Cairn Highway
Plot Ratio:	5		





### 1.5.3 Site Analysis Diagram



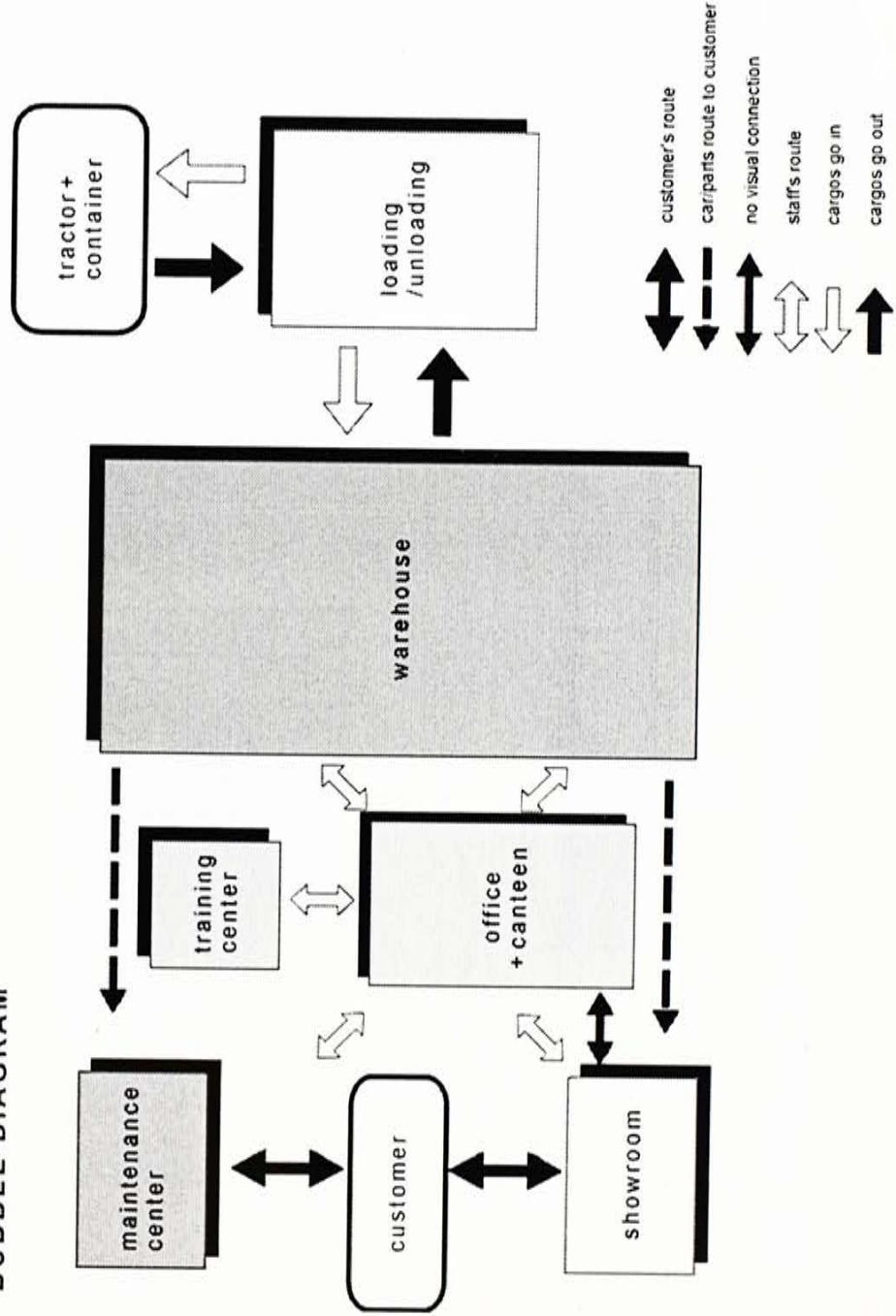


## 2. Design Process

### 2.1 Design Philosophy

Since the center will carry the symbolic meaning of C88, it will be a good advertising poster if the center has an eye-catching/expressive image. The effect is now more conscious since the site is beside the Tate's Cairn Highway. How the center attracts people are to be considered by several way: Building form, building structure, building material audio-visual or even the car itself.

BUBBLE DIAGRAM



Due to the level difference between the highway and the site, it is quite different to notify this low-rise building from the highway. To make the building noticeable from the highway, the building has been separated into two layers. The lower layer is the warehouse located all the ground floor level. It is because the warehouse is relatively functional as it is more convenient for loading/unloading. The maintenance center and the showroom are located on the upper layer where they can be easily noticed from the highway. It will give an illusion that the showroom is just beside the highway.

From the function point of view, typical maintenance centers and warehouses usually offer not the best environment. They are always located on the busy-traffic industrial area. The interior is usually very dark and the air is heavily polluted. People working inside those areas are suffering from bad health. Therefore in this project those two areas have been treated with sufficient lighting and ventilation to improve the environment.

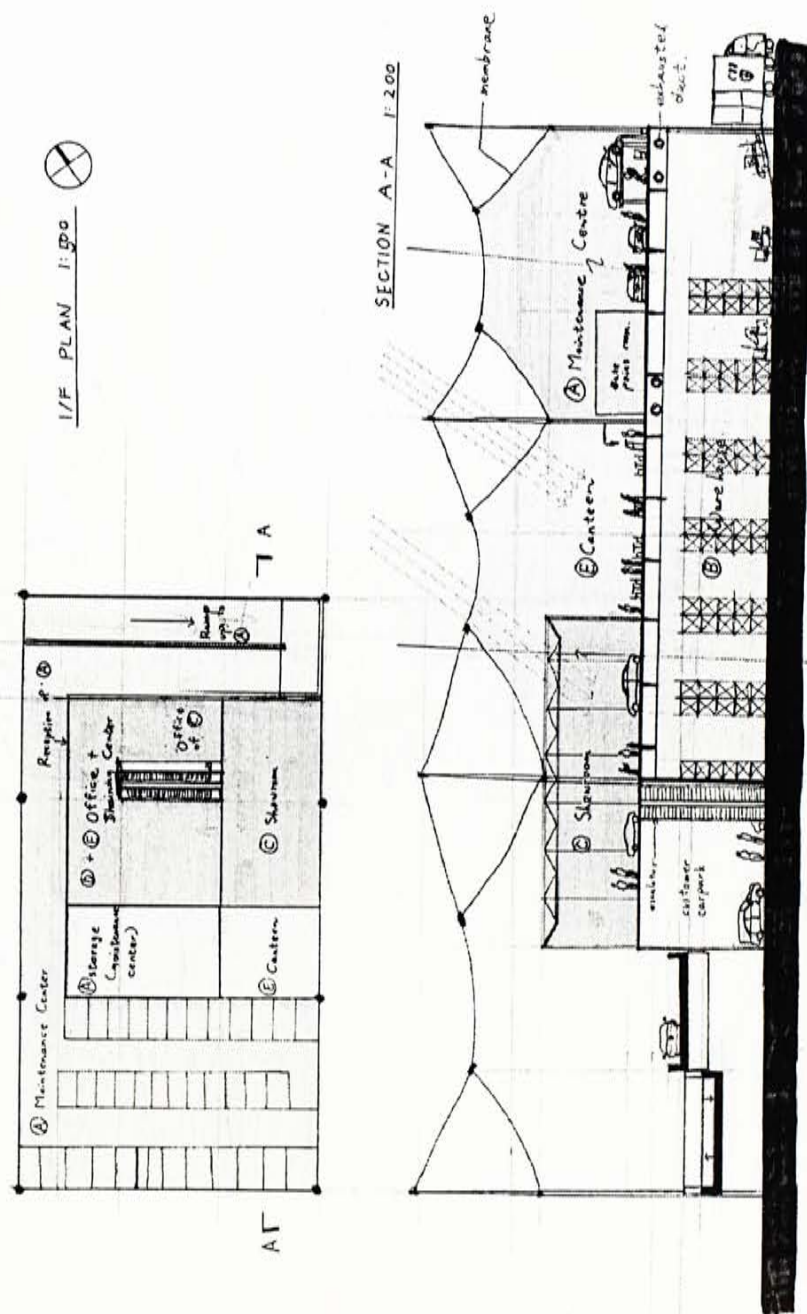


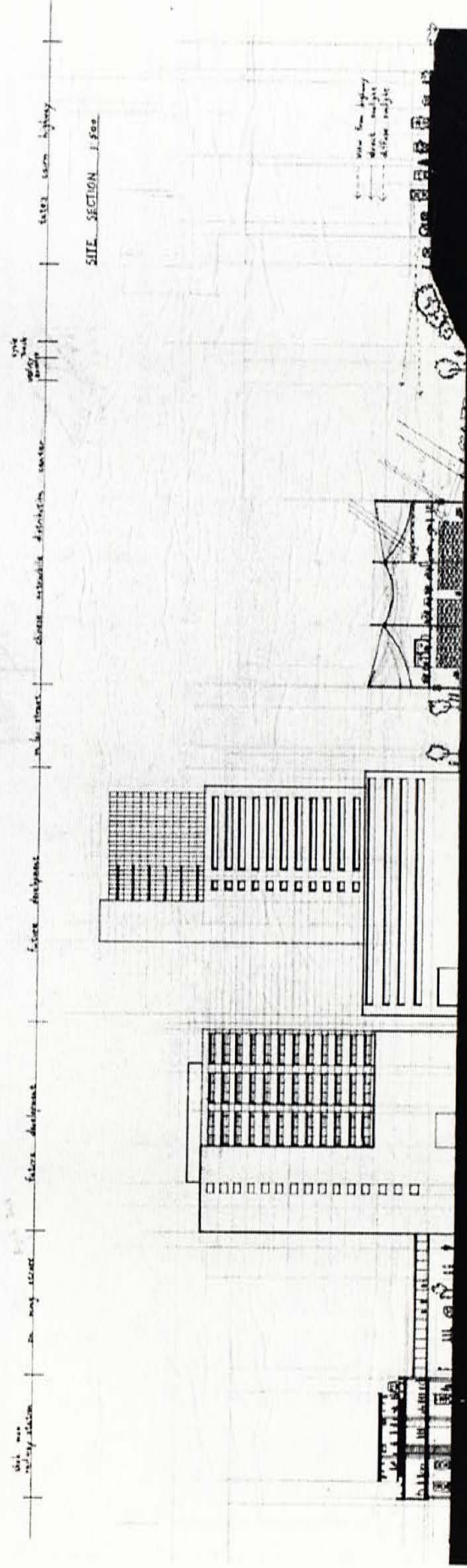
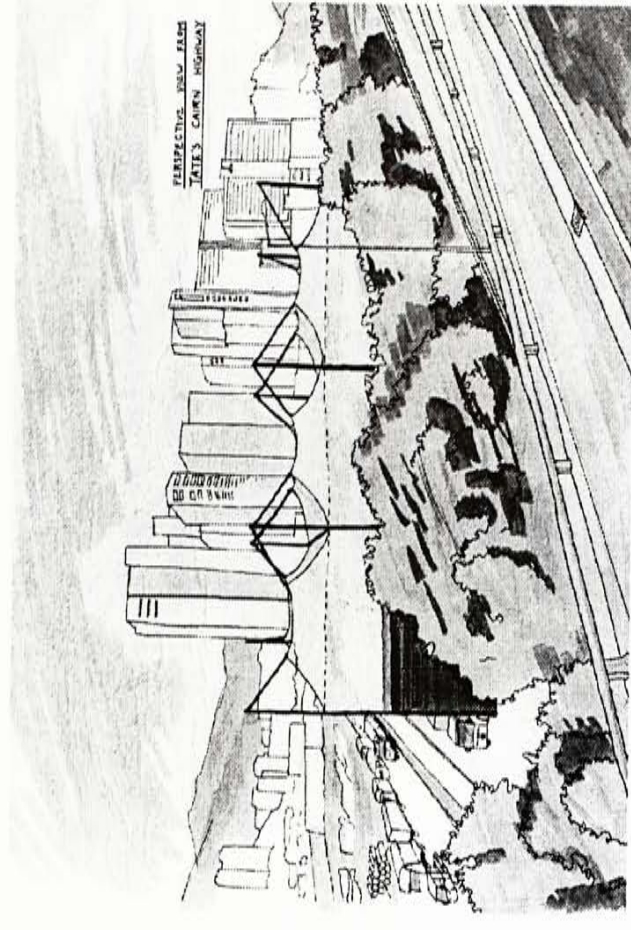
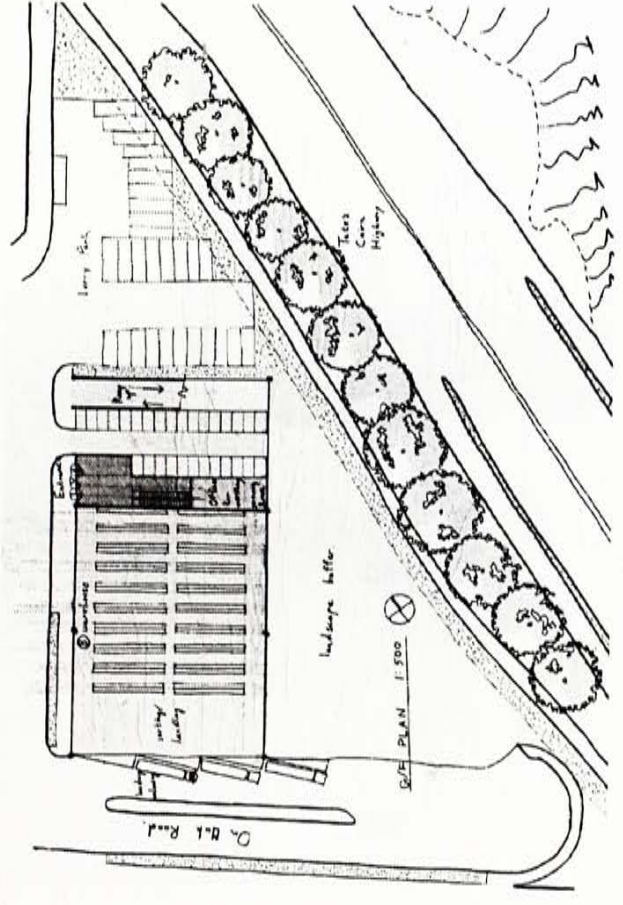
## 2.2 Design Evolution

### 2.2.1 Scheme 1

In the first scheme, the center used a 16 x 32 structural grid to provide the greatest flexibility on planning the center. 16m span was chosen because it was considered to be the most suitable span for internal arrangement of both the maintenance center and the warehouse.

In the early design development, several options of the roof structure have been explored and the use of fabric roof has been looked at. The advantage of the fabric roof is that it can allow large amount of sunlight penetrate into the interior by its translucent property. To support the fabric tensile structure were considered. By using these two expressive elements the center would acquire an expressive building form compared with the surrounding building. Using this kind of structure, large degree of the building materials are required to be pre-fabricated. It will shorten the construction time and reduce the cost.



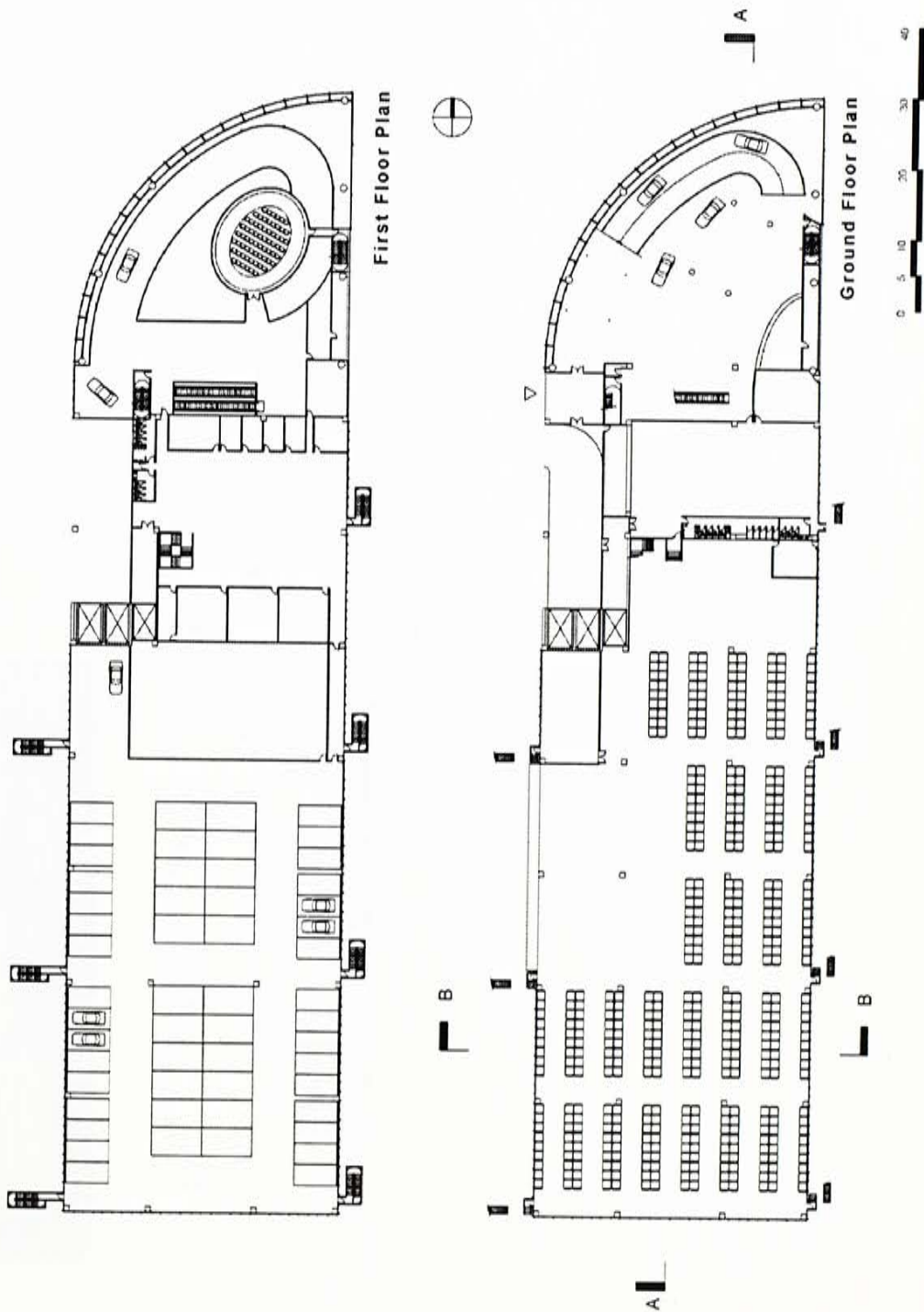


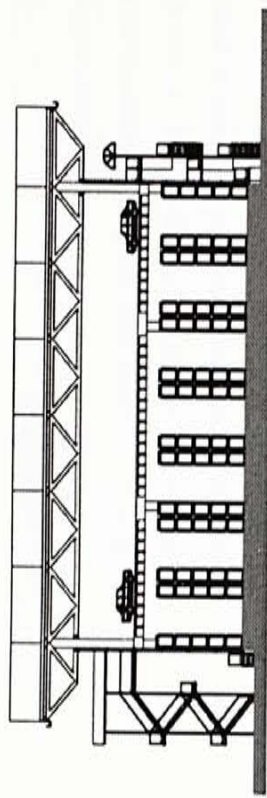
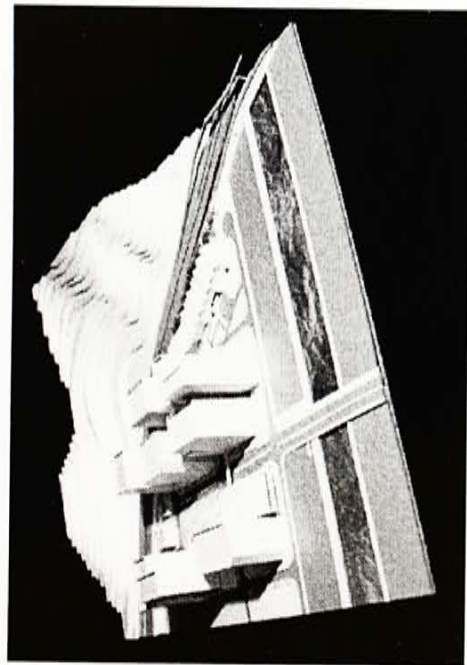
### 2.2.2 Scheme 2

Since the modular structural grid of the first scheme did not fit well with the acute triangular site. The relationship between the highway and the center are not very strong, too. On the second scheme, the center is placed along the highway to extend the experience with the center. The showroom are separated from the maintenance center and is given a separate structure. The center becomes the focal point of the center.

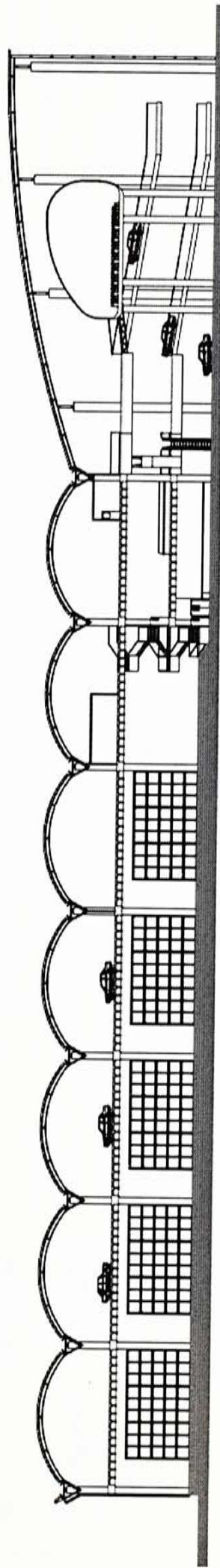
The roof material has also been changed from fabric to steel. The change is due to maintenance problem and the service system arrangement of the center. The other reason is that now the showroom and the maintenance center have different building form. If the maintenance center use the expressive tensile structure it will compete with the showroom and then the whole building mass will become unclear.

Another change is that large piece of land have left vacant to provide sufficient space for loading/unloading. The land can also create a large buffer zone to facilitate natural ventilation of the maintenance center.

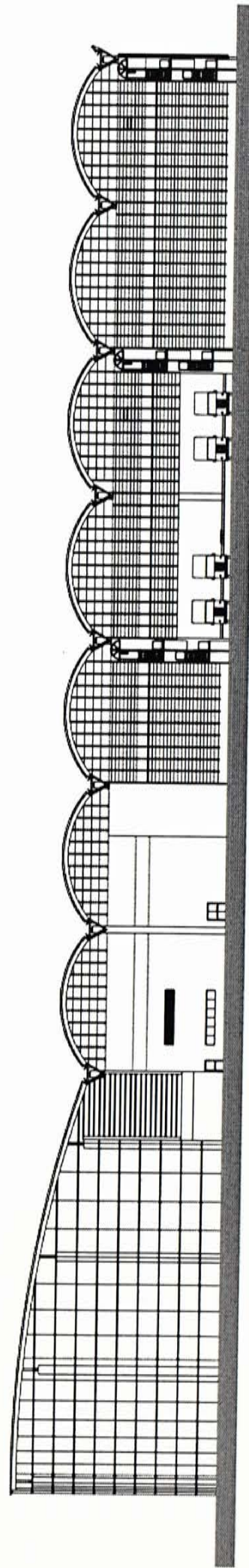




Section B-B



Section A-A



West Elevation

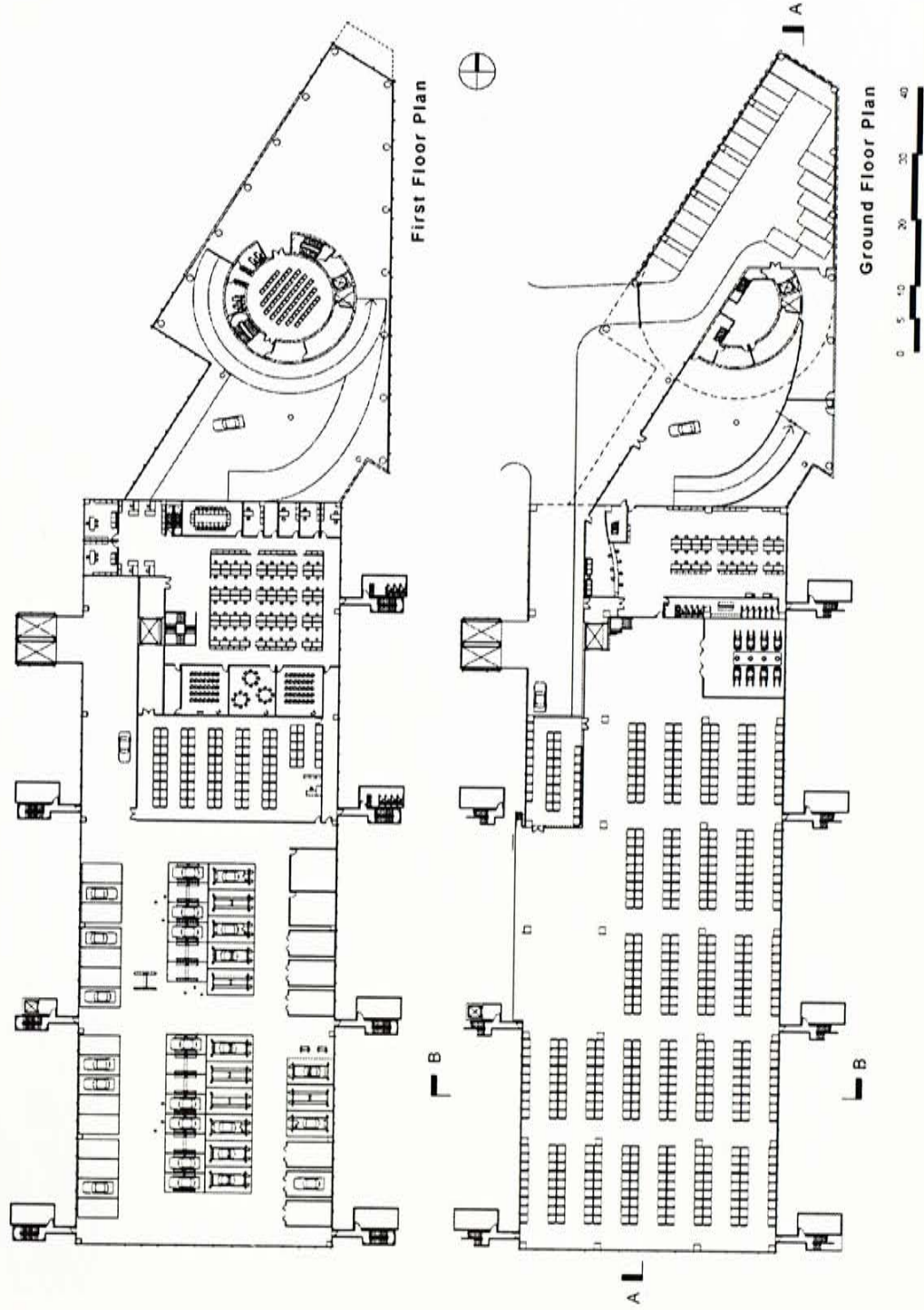


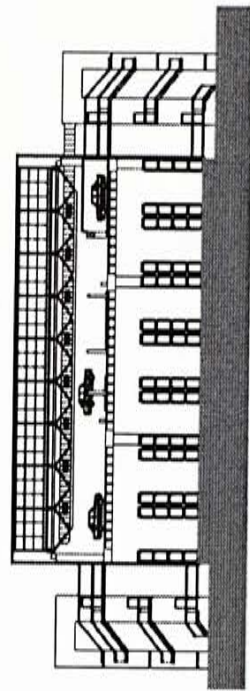
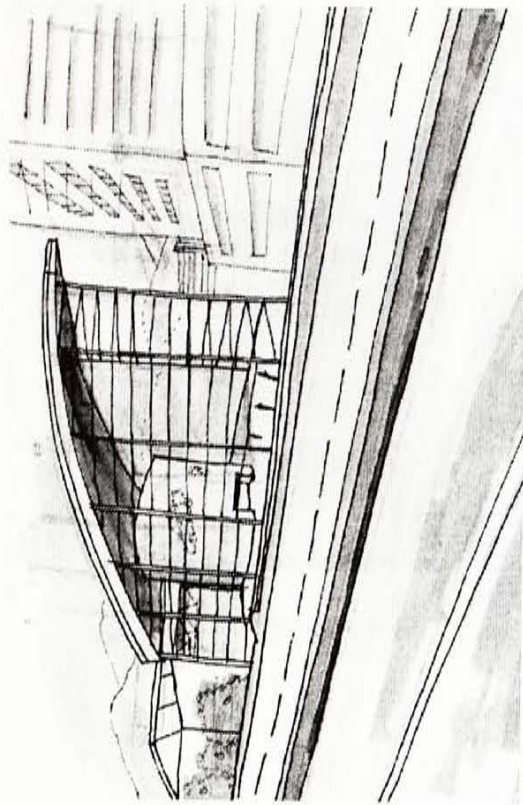
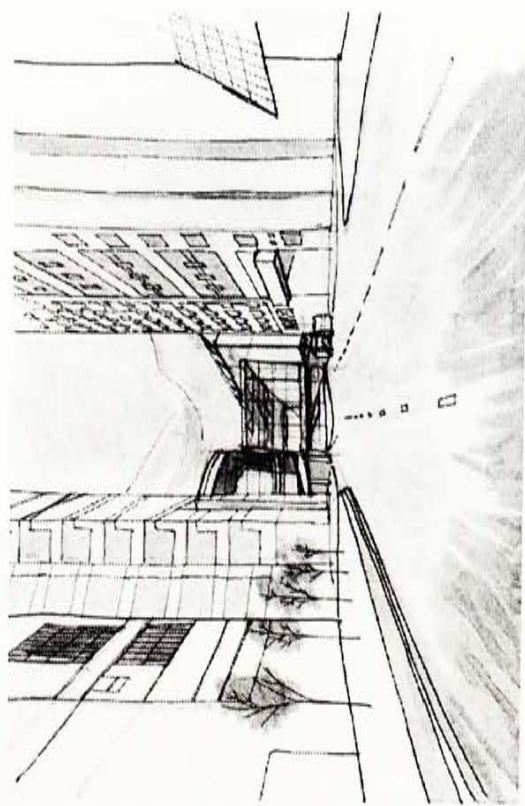


2.2.3 scheme 3

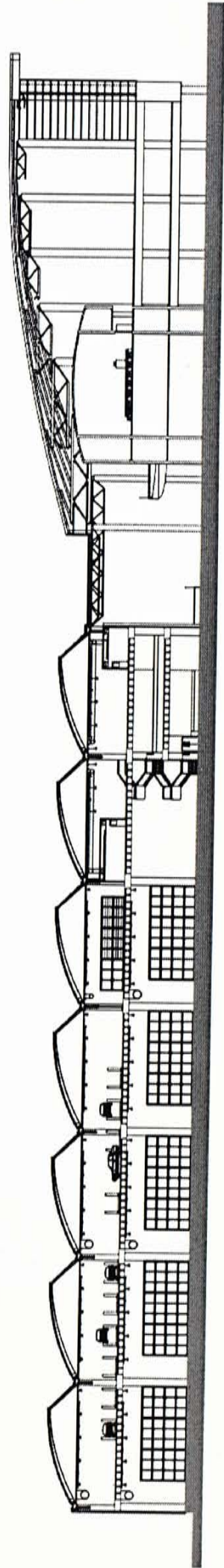
Scheme 3 is developed as a refinement from scheme 2. The form of the showroom has been changed to be more expressive and to suit the triangular site. A new glazed entrance showroom facing the On Lai Street is proposed. The entrance showroom is intended to act as a 'handshaking point' with the client with abandon of the daylight and the interior display.

The design of the maintenance center has almost been finalised. Services have been put outside of the building mass so that it creates a large and great flexibility to the maintenance center.





Section A-A

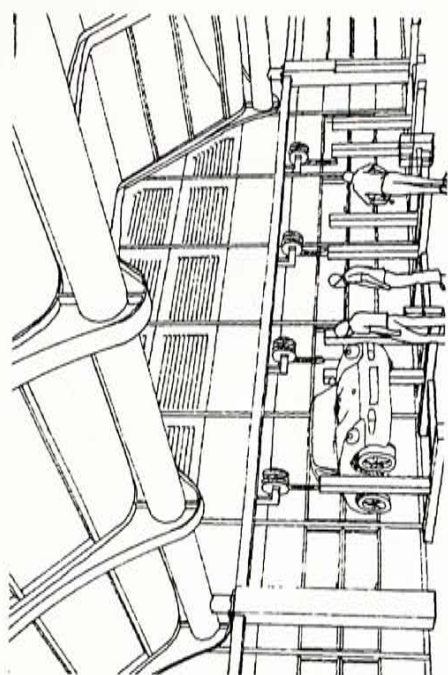
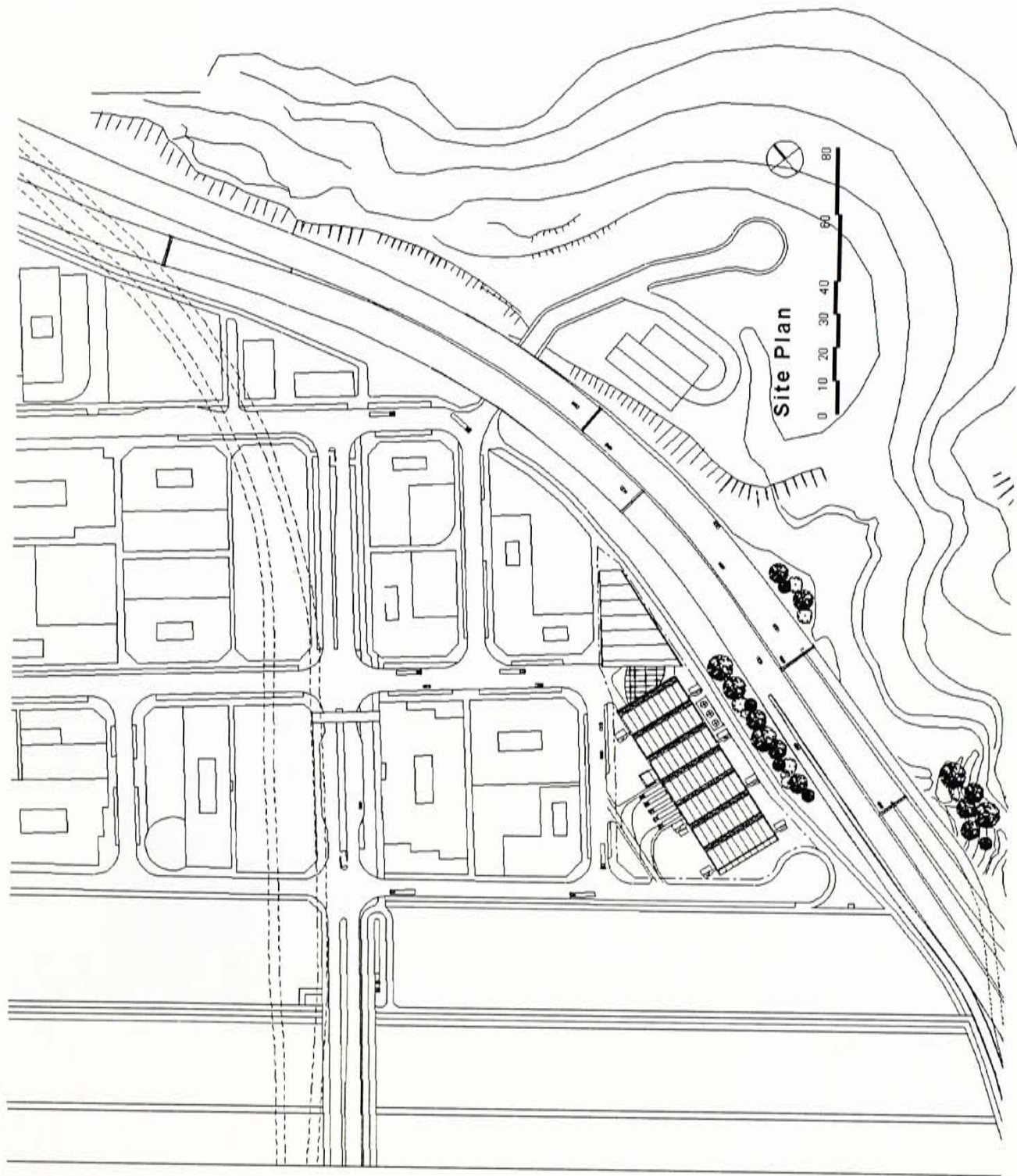


Section B-B

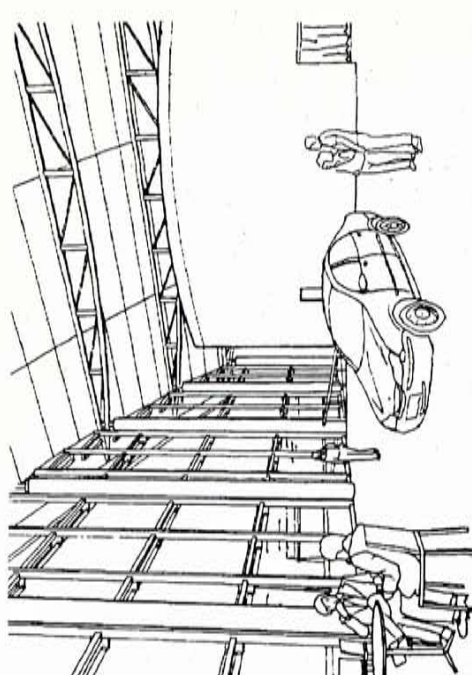




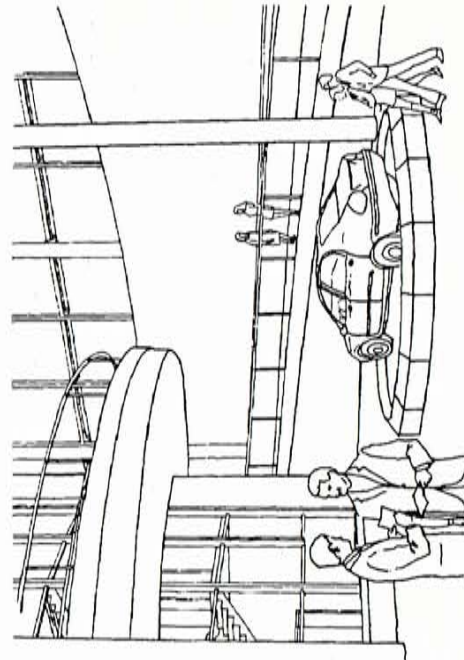
### 2.3 Final Scheme



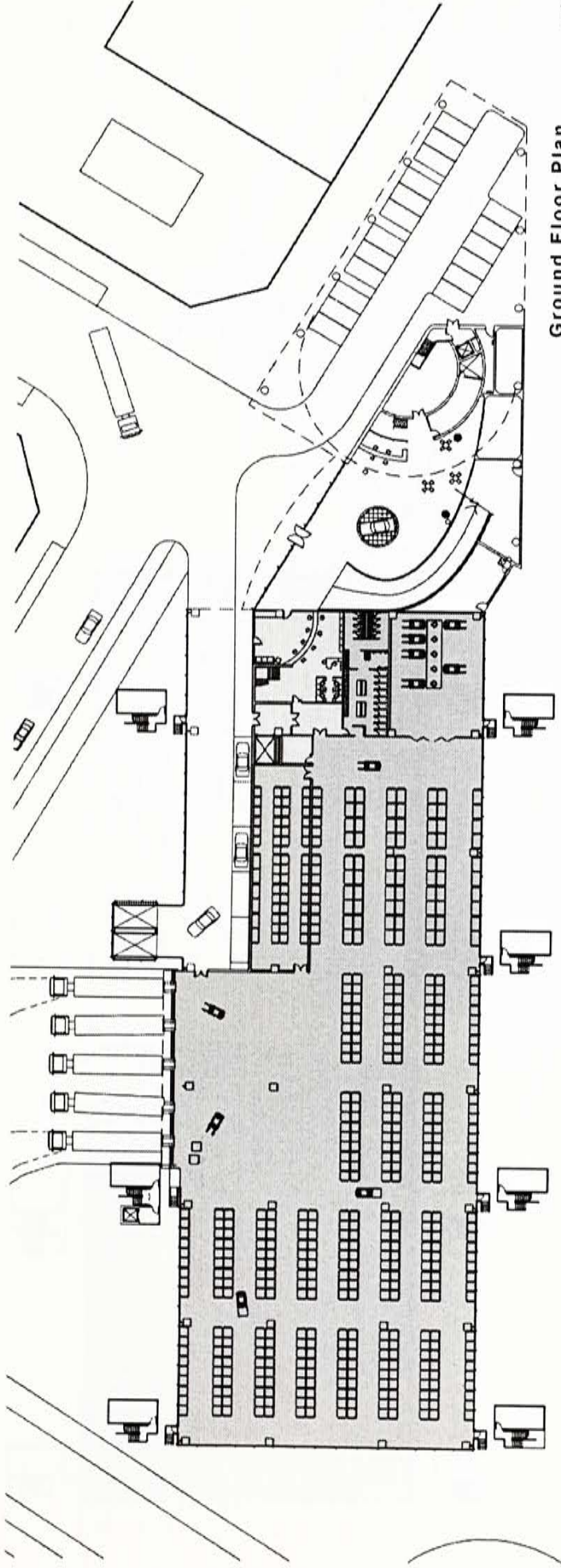
Interior Space of maintenance center



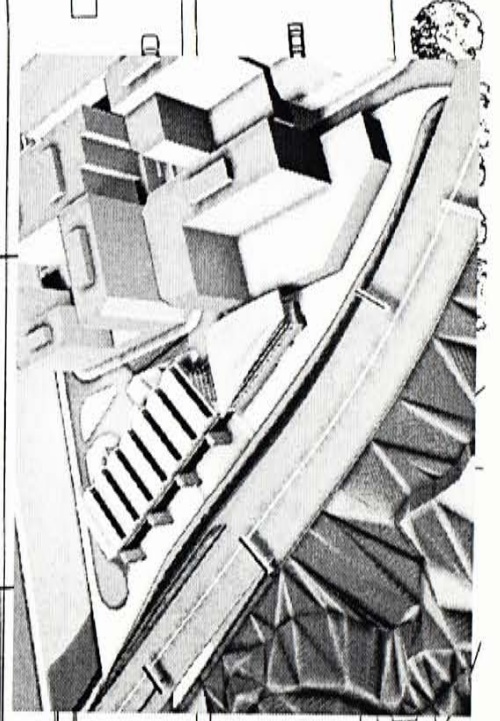
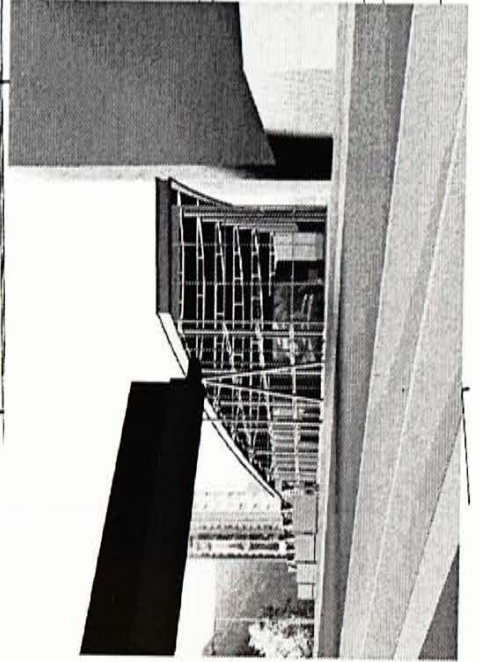
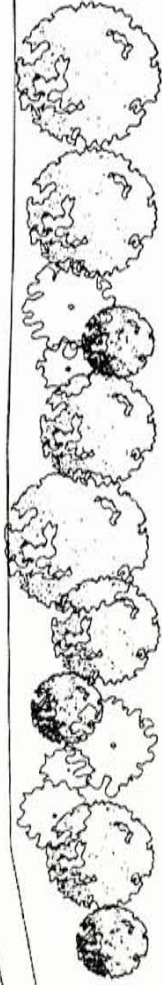
Interior Space of showroom

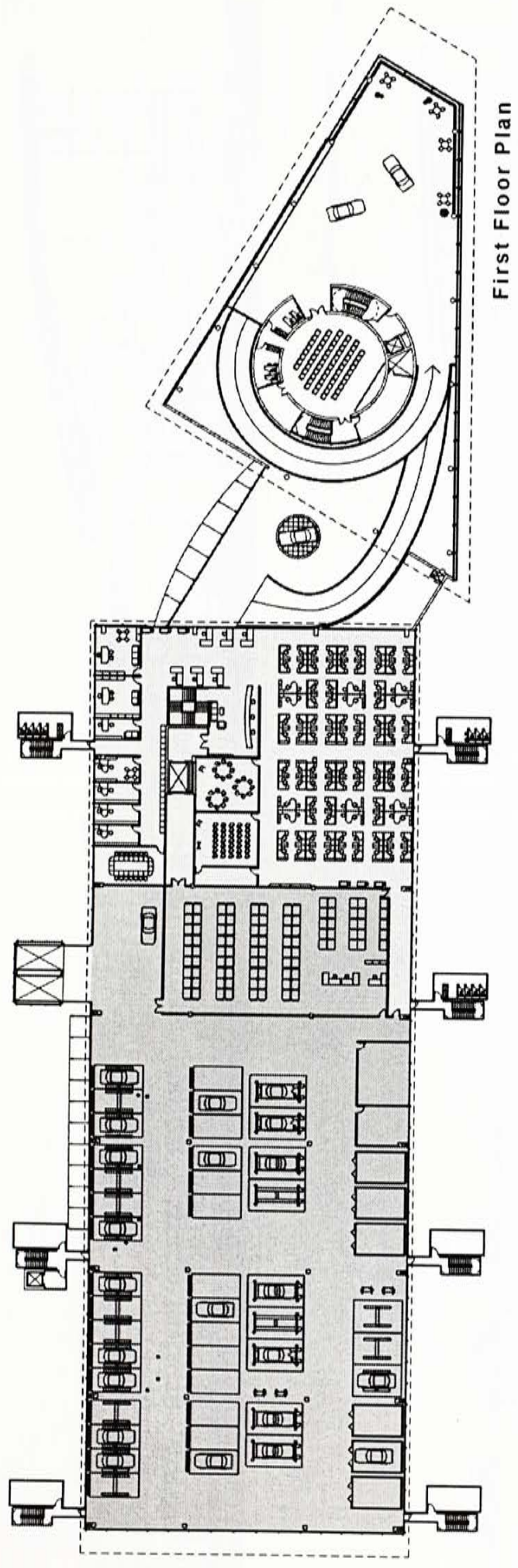


Interior Space of entrance showroom

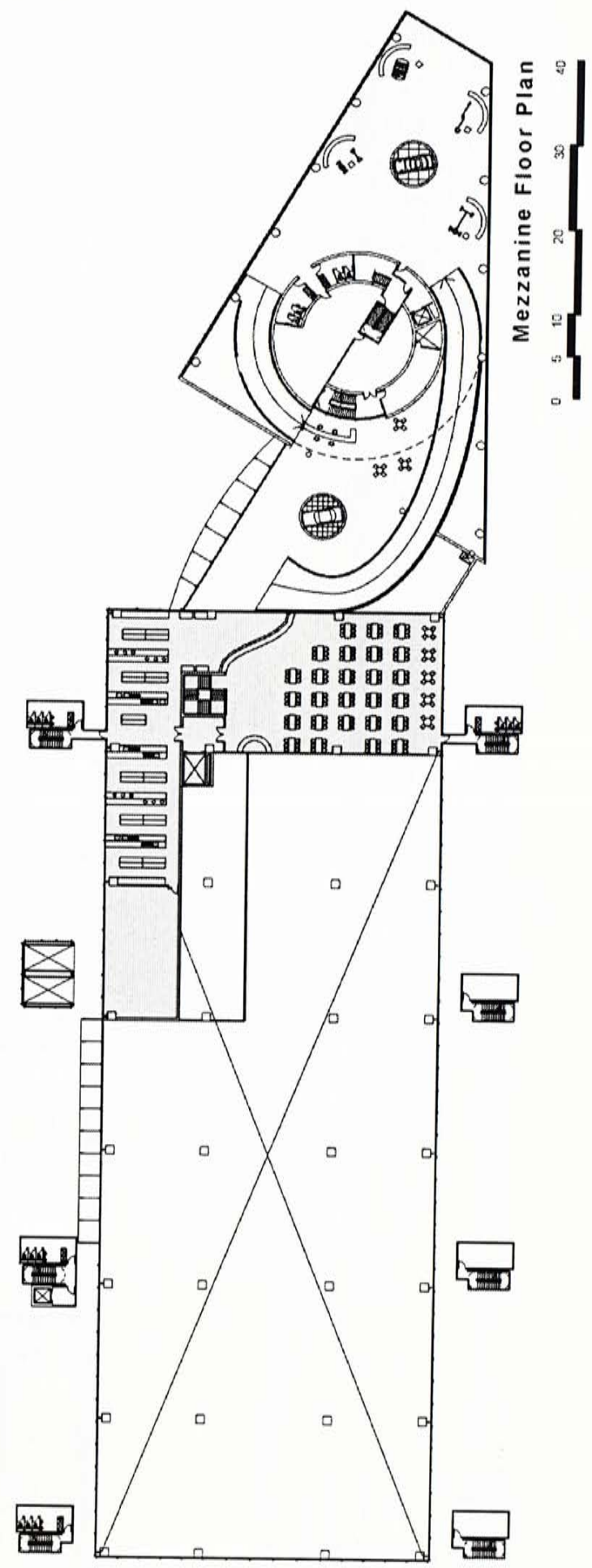


Ground Floor Plan



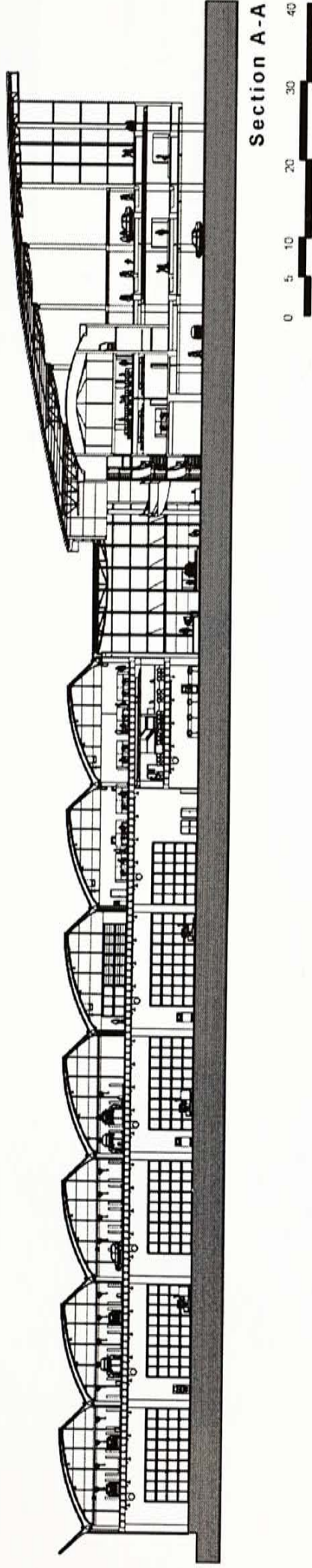


First Floor Plan

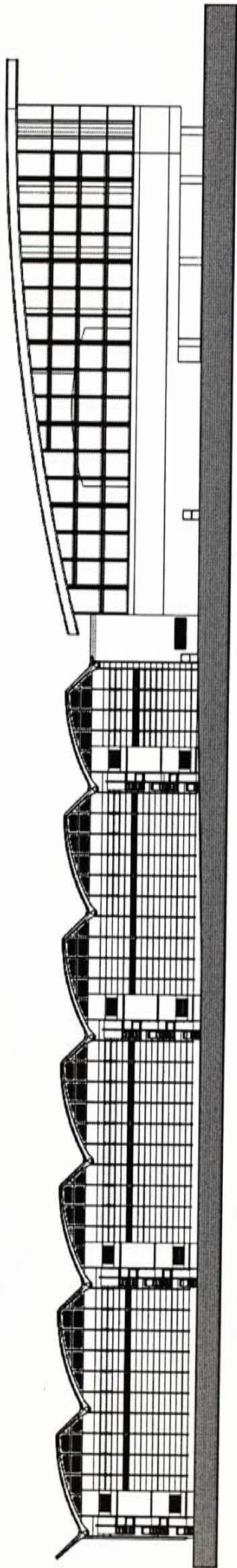


Mezzanine Floor Plan

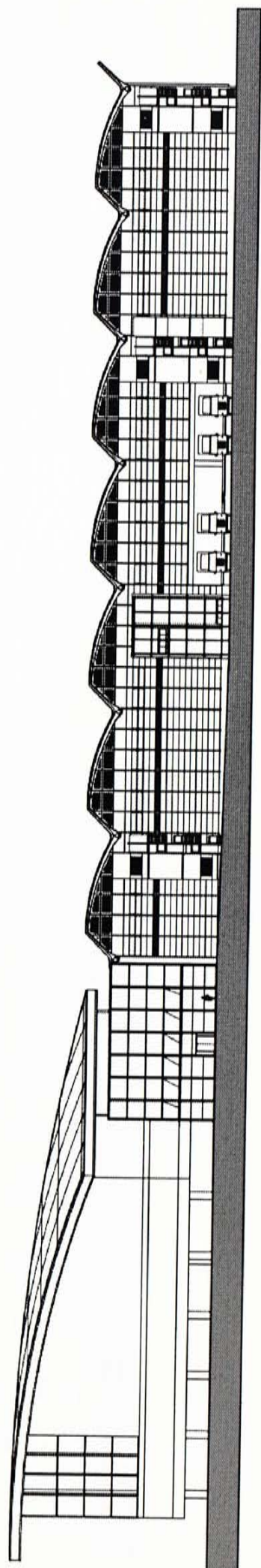




Section A-A



East Elevation

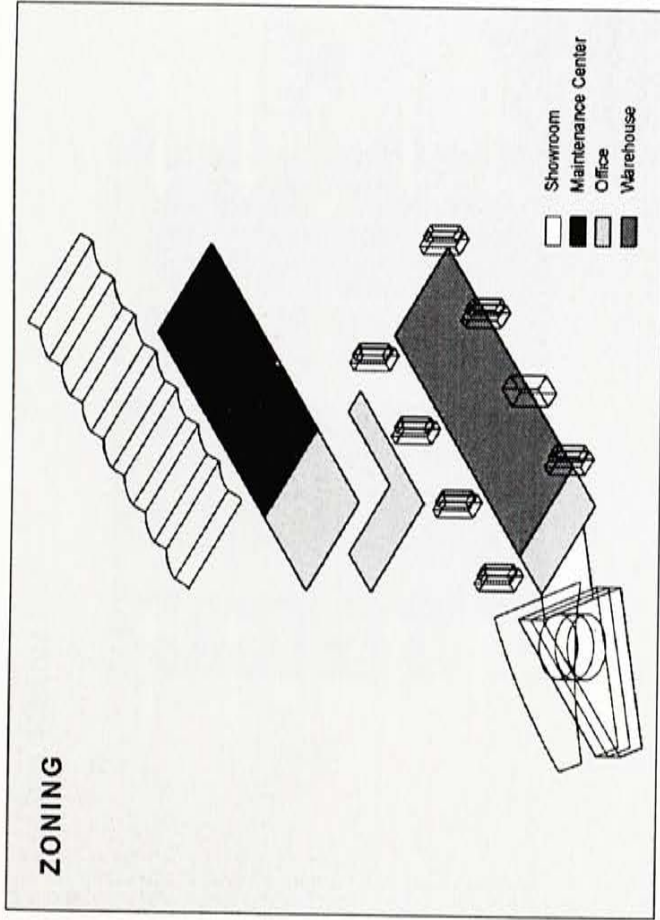


West Elevation

### 3. Zoning/Layout

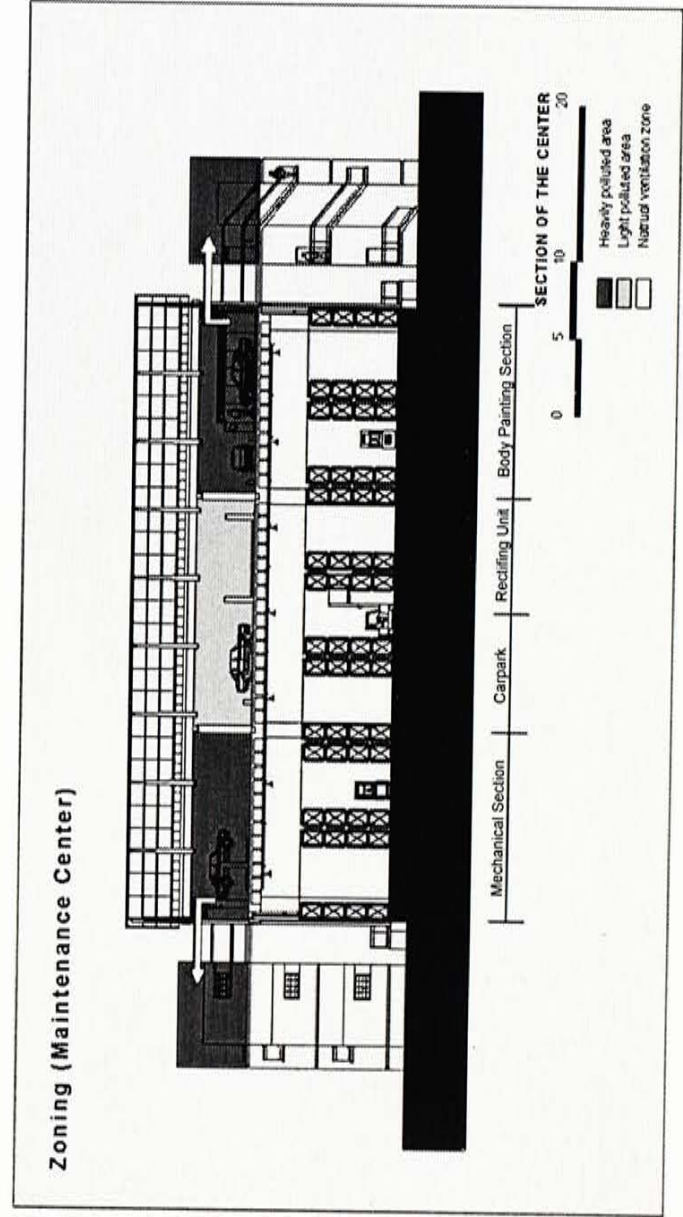
#### 4.1 Zoning

The center is using a layering concept that divided the center into two major. The ground floor level is the warehouse where is an pure functional space. The ground level loading/unloading area provide a great convenient to the tractors. The maintenance center and the showroom where have expressive building forms are put on the upper level so that the people traveling the highway can be easily to appreciate the center. The administration office is located in the middle part of the center where act as a brain to coordinate different elements operation.



#### 4.2 Internal Layout

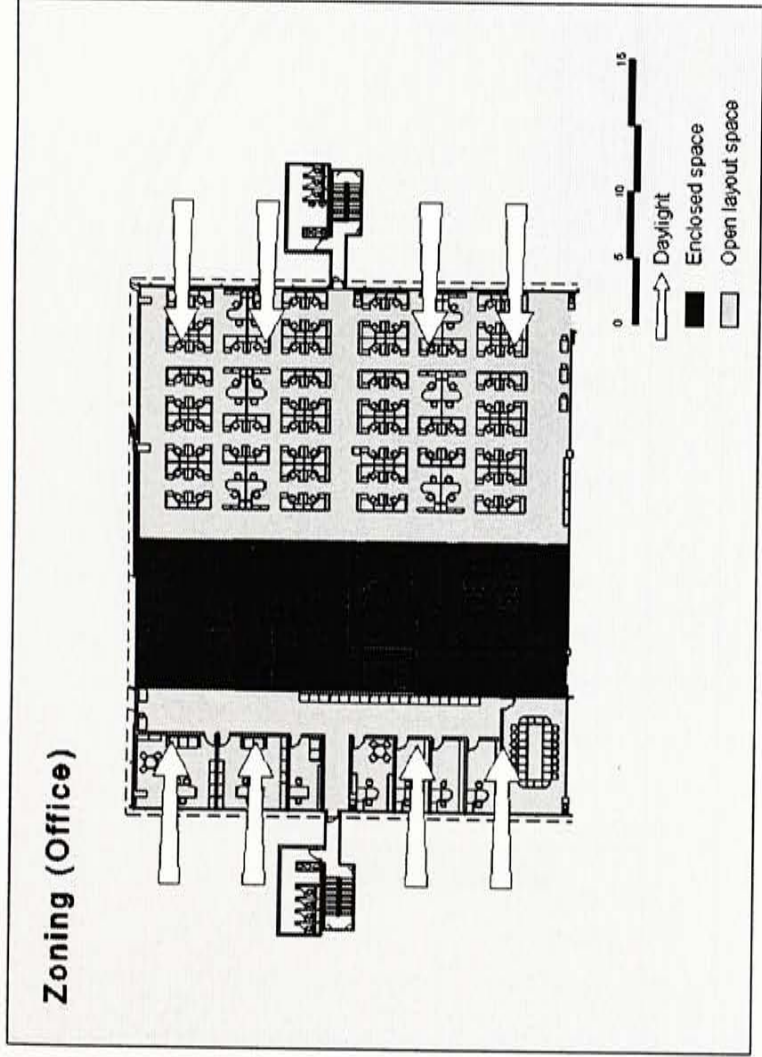
The internal layout of the maintenance center basically is divided into 2 zoning. On the East side is the body painting section and the west side is the mechanical section. Since both of the section will emitted a large amount of the exhausted of odour gas, They are located on the periphery of the center. The gas emitted can be extracted to the fan rooms outside the building envelop and then exhausted to the outside environment before they are purified. In the middle part is the temporary carpark and the body rectifying system. Those are the sections that will not emitt heavily polluted gas and induced ducts work system are not necessary installed. This arrangement will reduced the amount of the ducts works installed in the maintenance center and increase the efficiency of the of





the ventilation system. Moreover using this layout the ducts are located mainly on the periphery of the center. It will have a clear ceiling layout and are able to allow more diffuse sunlight into the center through the skylight.

The layout of the administration office use the similar concept that the enclosed room space like the reception area and the training school are located in the middle of the space. The open layout office are on the east side and the cellular offices are on the west side. This arrangement will allow greatest amount of sunlight going into the office and hence reduce energy use of artificial lighting.







# 4. Structure

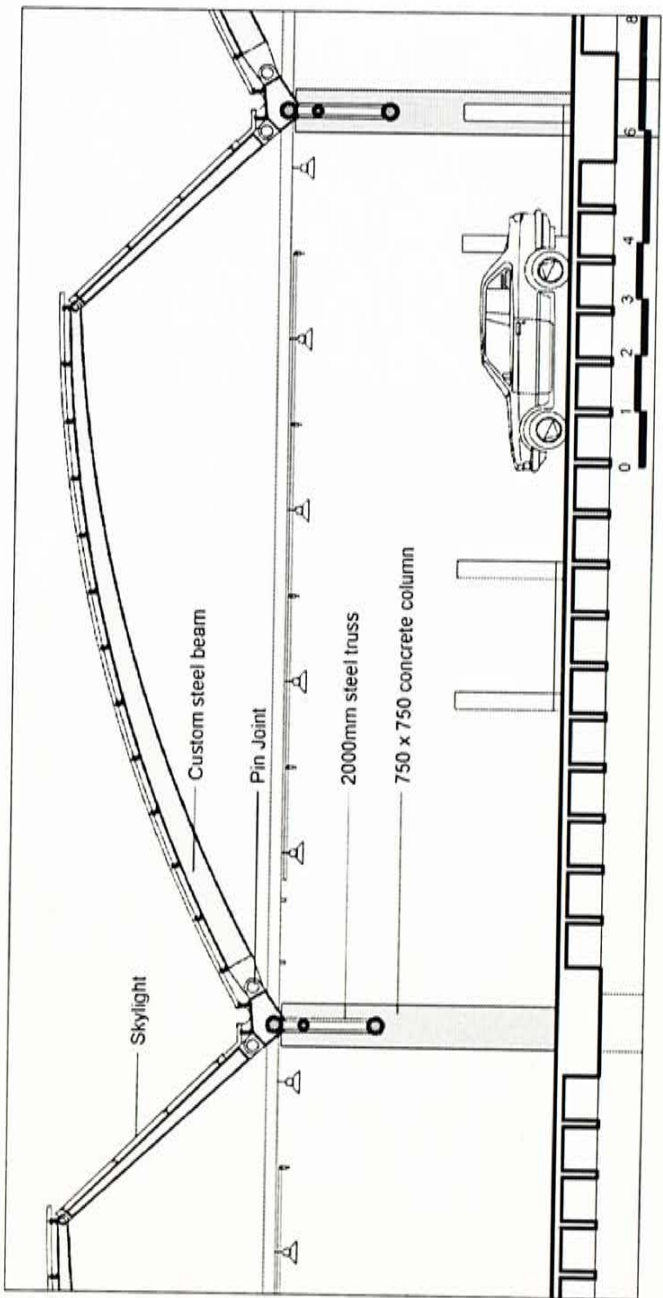
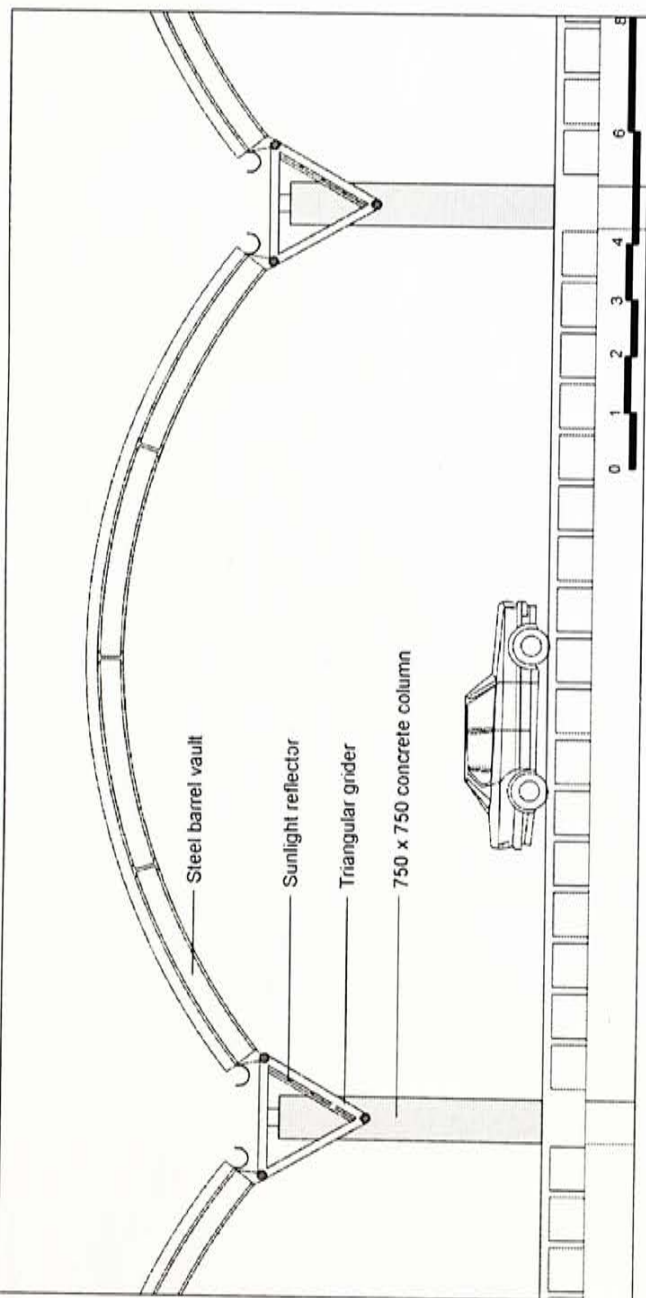
## 4.1 Structure evolution

"Structure is the giver of light"

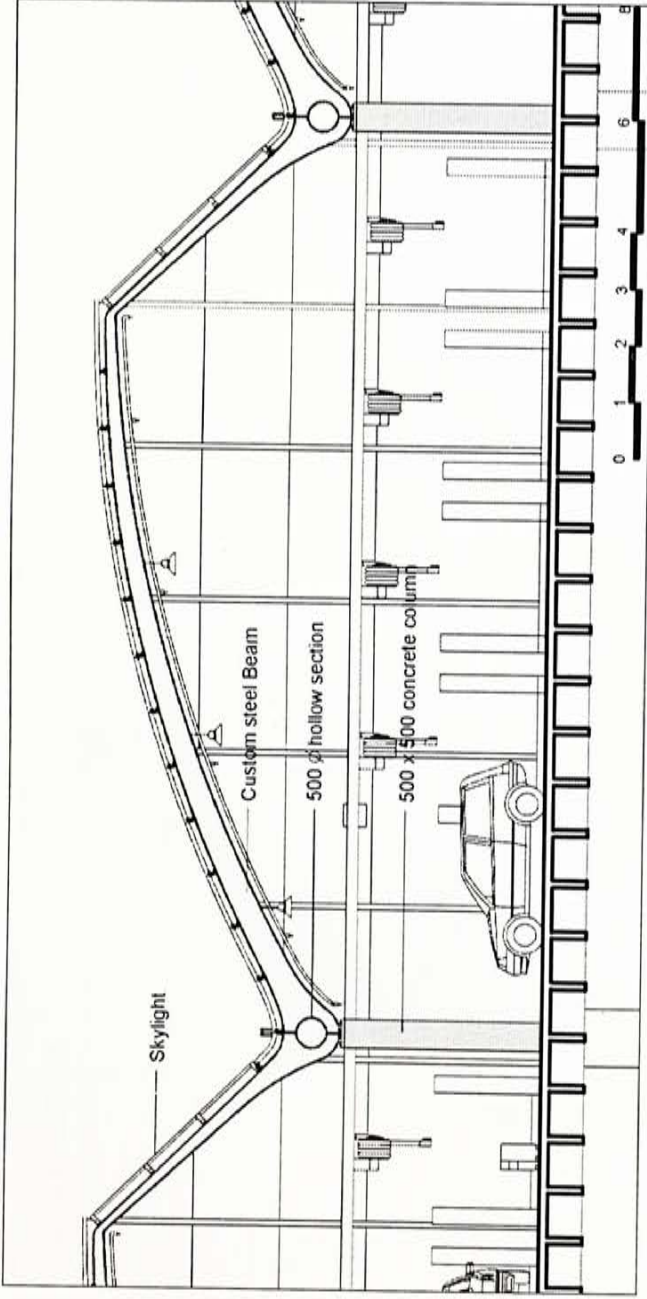
Louis I. Kahn

The external envelop of the maintenance center has changed from the fabric to steel skylight although both have the same design intention of providing sufficient natural sunlight to the center and hence improve the environment of the center. In the first scheme the structure employs triangular girder and barrel vault to support the roof. In side the girder there are sunlight reflectors to reflected the sunlight in to interior.

In the second scheme the girder roof structure have been changed to a steel trussed structure. Daylight is introduced into the center by the skylight only. The roof form is becoming more dynamic and has the similar silhouette of a performance car. The joint between the steel truss and the steel beam by 3 point pin joints.



In the final scheme, structural consultant advised that the use of 2m-depth steel truss for spanning 38m single storey space is not very efficient. The structure is divided into 12, 14, 12 m span, so that the structure can be slimmer and pin joint is not necessary. It will make the structure more elegant, easy to construct and reduce the cost.



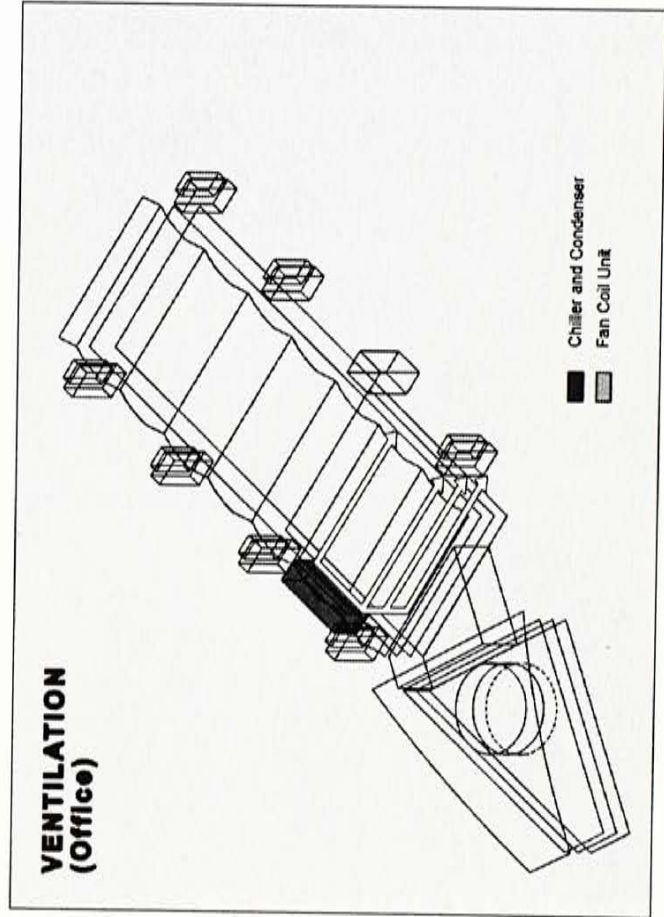
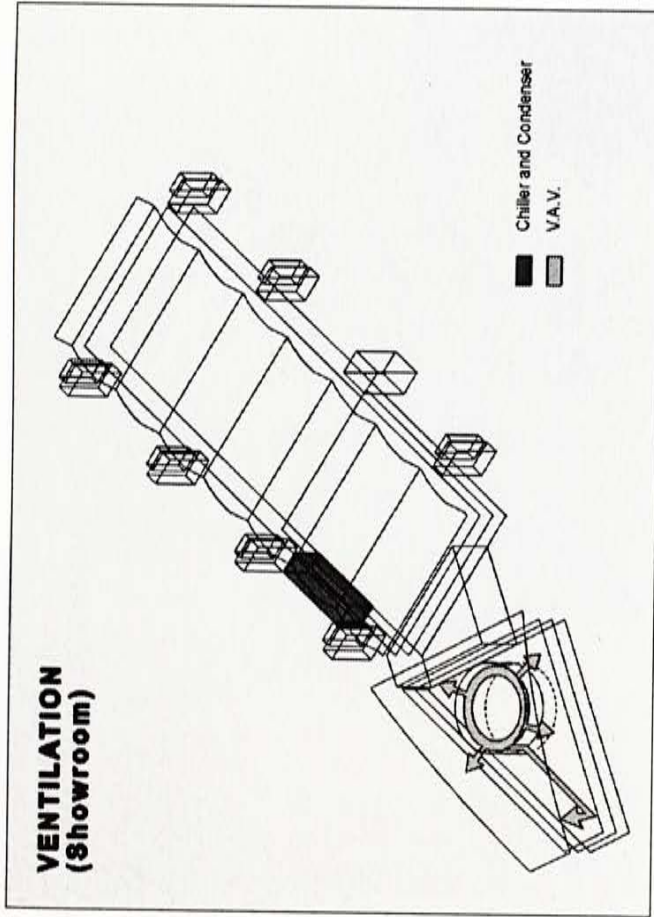


## 5. Services

### 5.1 Ventilation

The ventilation strategy of the center can be divided into 3 parts: Showroom, Office, and Maintenance center. For the showroom, due to the large volume of space C.A.V. system is applied. Cool air is emitted from the circular core. The area near the glazing area there are ducts pass through the under ground of the first floor level and then emit from the grills on the periphery of the ground. Return air will raised to the upper part of the showroom and be collected on the top of the circular core. The office is using the fan coil unit system. The cool air is emitted from the north side of the wall and then collected on the south side of the wall. The chiller and the condenser for both systems are located on the area between the cycle track and the warehouse to minimize the disturbance the operation of the center.

Natural ventilation and induced exhausted system are employed on the maintenance center. At the upper level of the maintenance center louvers panels are installed on the both sides so that air can be easily ventilated. For the heavily polluted air like the exhausted gas from the vehicles it is extracted to the fan room on the outside periphery and then filtered before they extracted to the external environment.

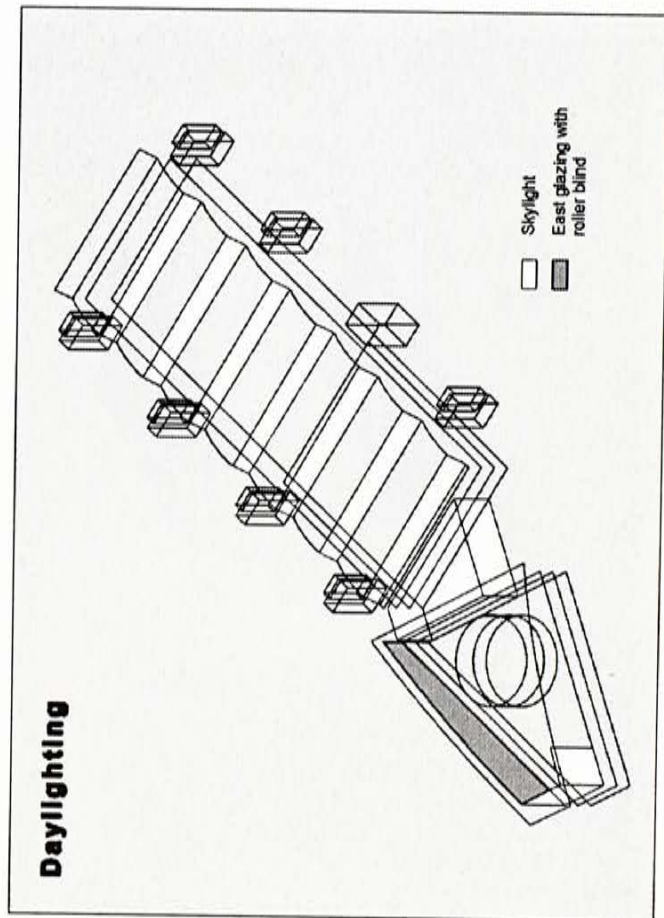
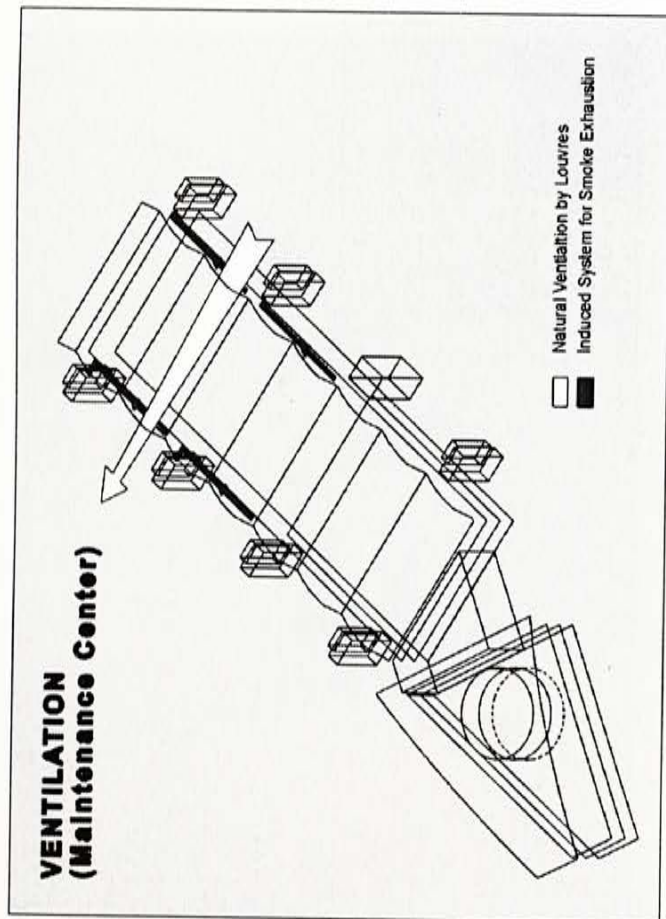




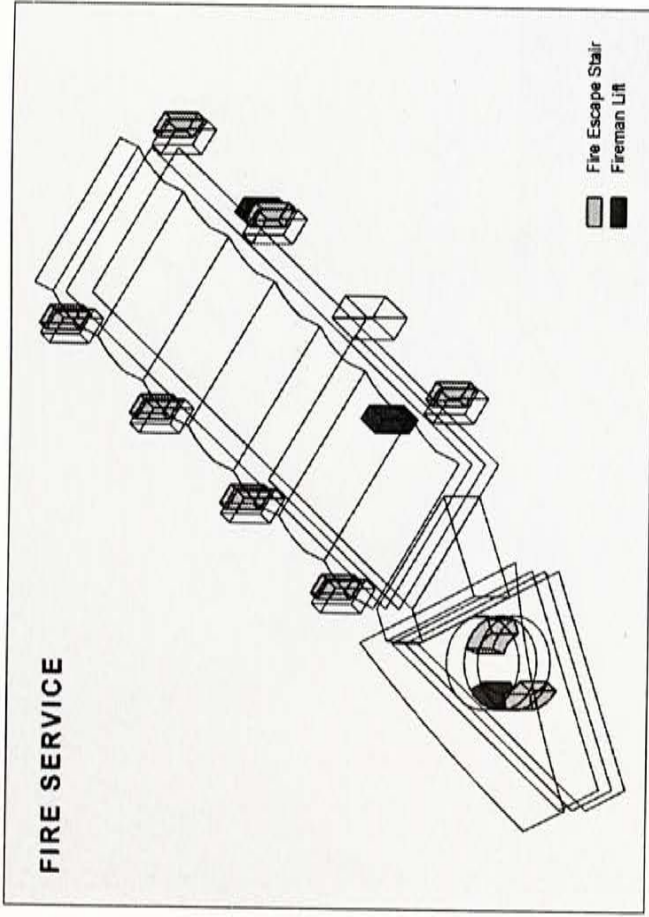
### 5.2 Daylight

To maximize the day-lighting intensity of the center, glazed wall have been fully utilized. In the maintenance center, northern skylights have been applied so that diffuse sunlight can be go into the space to increase the lighting and reduced the energy used.

In the showroom, full height glazing is applied on the elevation facing the highways. It is to maximize the lighting intensity as well as providing visual communication between the showroom and the highway. On the other hand, the elevation is facing east; it will receive a large amount of direct sunlight during the morning. It will make the showroom exceeding thermal comfort greatly due to the green house effect. During the morning the elevation will be covered by a roller blind system. It can shield the direct sunlight and then maintain the thermal comfort of the showroom and the theater. Details of the system will further be explained in a lighting study of the showroom in the special study chapter.



**FIRE SERVICE**



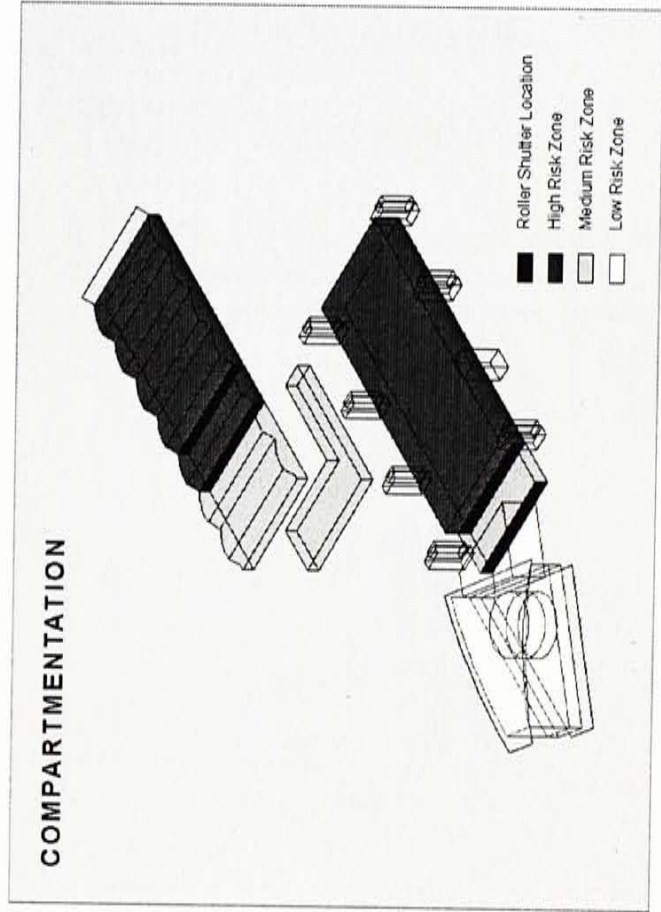
**5.3 Life Safety**

There are a total of 9 fire staircases in the center. There are 2 internal staircases located inside the circular core. The rest of them are located on the periphery of the maintenance center. The 2 fire stairs on the same elevation are 32m apart and the 2 stairs on the opposite elevation are 40m apart. This arrangement can provide the greatest flexibility to the space. There are 3 fireman/service lifts located on the showroom, office and the maintenance center respectively.

In terms of zoning the center can be divided into 8 zone. Since none of the volume of each zone exist the compartmentation of 28000m<sup>3</sup>, there are each zone is not necessary to be sub-divided. From the diagram shown there are roller shutters installed between each zone. The floor area and volume of the each zone are shown below for reference:

Zone	Floor area	Volume
Warehouse:	3175m <sup>2</sup>	28050m <sup>3</sup>
Maintenance center:	2600m <sup>22</sup>	16820m <sup>3</sup>
Warehouse (MC):	440m <sup>2</sup>	3000m <sup>3</sup>
Open plan office:	850m <sup>2</sup>	6000m <sup>3</sup>
Canteen:	730m <sup>2</sup>	2740m <sup>3</sup>
Showroom:		
G/F	330m <sup>2</sup>	
1/F	1358m <sup>2</sup>	
total volume:		23340m <sup>3</sup>
Exhibition area (M/F):	1358m <sup>2</sup>	5090m <sup>3</sup>
Theater	330m <sup>2</sup>	1815m <sup>3</sup>

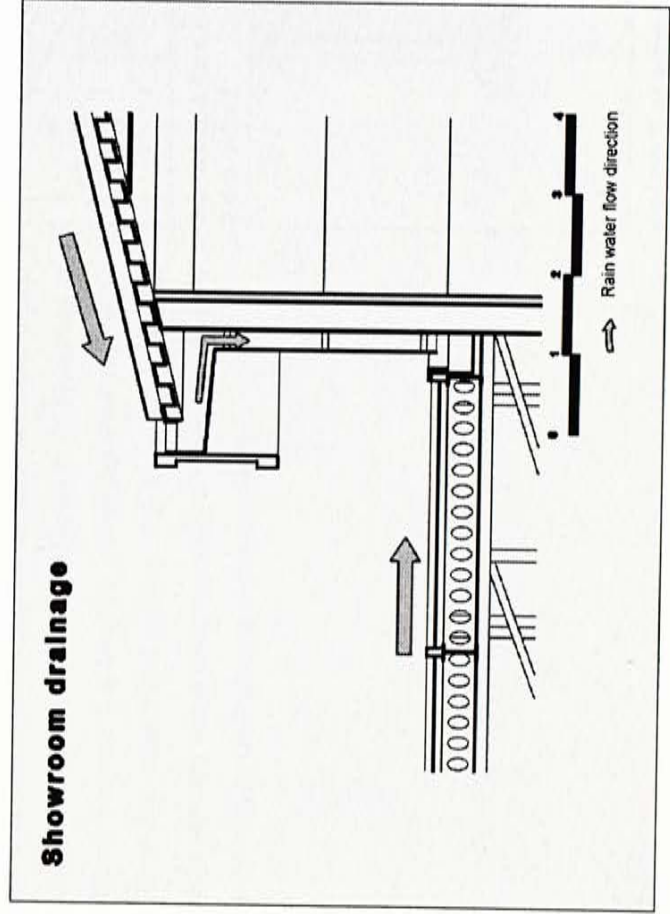
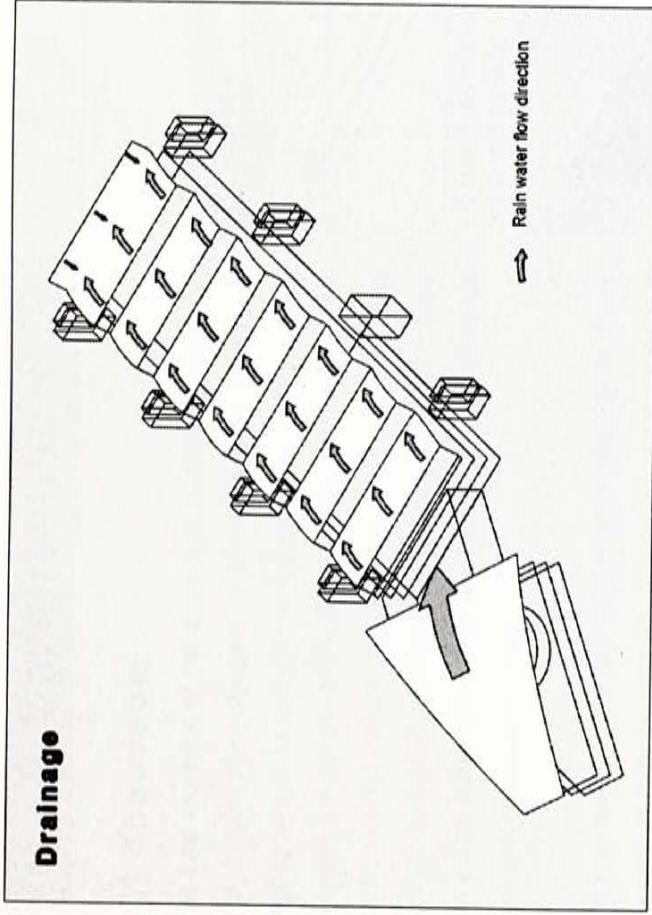
**COMPARTMENTATION**



### 5.4 Drainage

The main feature of drainage the maintenance center is the use of the siphonic duct system located below the skylight. The ducts are concealed beside the columns. The advantages of siphonic ducts is to reduce the duct size by half and have the ability of self-cleaning.

The drainage strategy of the showroom is to direct the rainwater to the south part of the roof by means of the steel decking. There are a drainage feature concealed behind the capping of the roof that will collect the rainwater to the level of the entrance showroom. Then the rainwater will be drained to the ground by a 400mm-diameter rain water pipe located behind the entrance showroom.



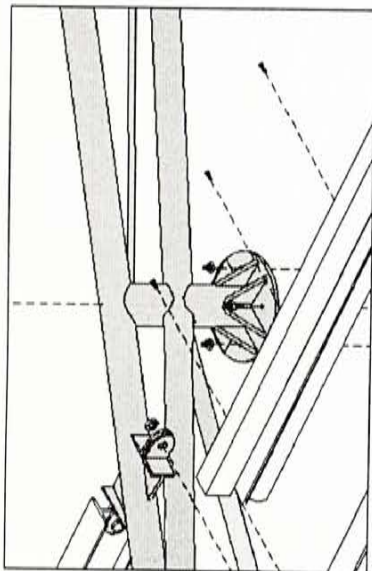


## 6. Construction

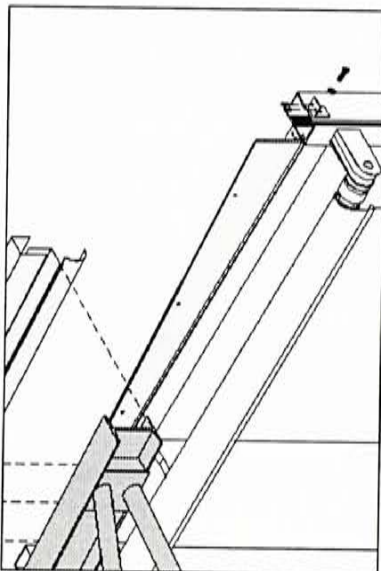
### 6.1 Showroom

The east elevation of the showroom is a fully glazing wall with a roller blind system. In this schem the envelop is kept as simple as possible to increase the communication between the people in the highway and the interior. The function of the roller blind system is to screen the direct sunlight during the morning. The surface of the roller blind can act as a big poster. The glazing wall is using the stick system for easy construction.

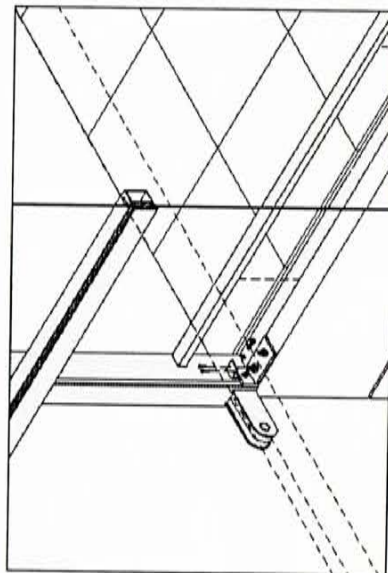
The roof construction use double steel decking to make the roof as light as possible. The roof is supported by a truss system with different spanning. Between the truss a 300mm I-beam section is used for bracing and support the support the eaves. The depth of the eaves is 1500mm because it is used to screen the different height level of the roller blind ending. So from the elevation people can only see a clear elevation of eaves and blind in the morning or clear glazing in the afternoon.



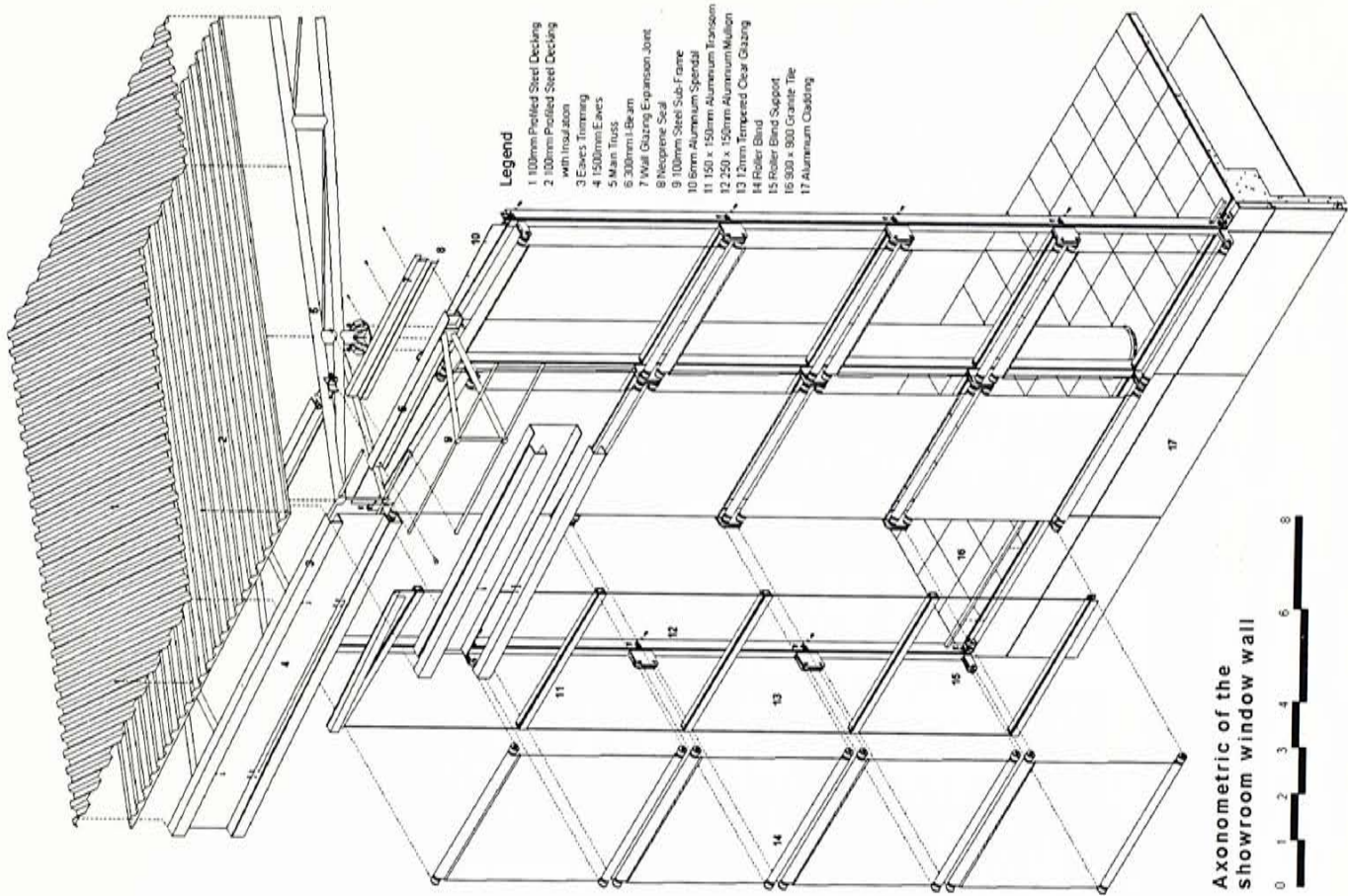
Joint between main truss and column



Joint between glazing wall and roof



Joint between glazing wall and floor



**Legend**

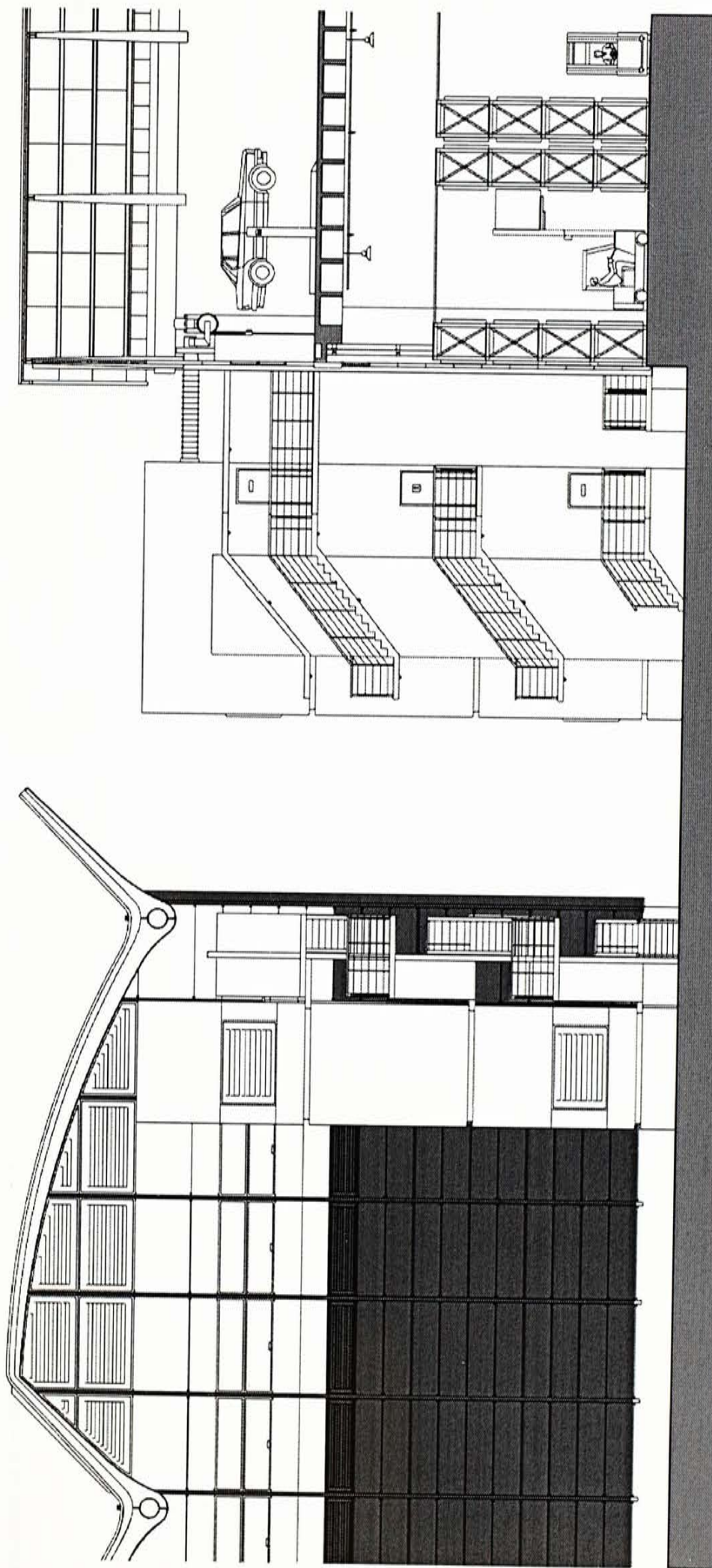
- 1 100mm Profiled Steel Decking
- 2 100mm Profiled Steel Decking with Insulation
- 3 Eaves Trimming
- 4 150mm Eaves
- 5 Main Truss
- 6 300mm I-Beam
- 7 Wall Glazing Expansion Joint
- 8 Neoprene Seal
- 9 100mm Steel Sub-Frame
- 10 8mm Aluminum Spigot
- 11 150 x 150mm Aluminum Truss
- 12 250 x 150mm Aluminum Mullion
- 13 12mm Tempered Clear Glazing
- 14 Roller Blind
- 15 Roller Blind Support
- 16 800 x 800 Granite Tile
- 17 Aluminum Chabing

Axonometric of the showroom window wall





### 6.2 Maintenance Center



Detail Elevation (maintenance center)

Detail Section (maintenance center)

0 5 10 15



## 7. Cost

### 7.1 Sources of Finance

Since the automobile distribution center is cater for the Porsche C88, all the construction and maintenance costs be bearred by Porsche AG. After completion, the center is the property of Porsche AG.

### 7.2 Cost Analysis

**Site Area:** 12370.54 m<sup>2</sup>

**Building area:**

The building area can be divided into 3 categories:

Industrial: warehouse, maintenance center and mechanical area 10334.26m<sup>2</sup>

Commercial: office, staff canteen, toilet and showroom.

4728.05m<sup>2</sup>

**Carparks:** 810m<sup>2</sup>

**Total:** 15872.31 m<sup>2</sup>

**Plot ratio:** 1.28

**Proposed date start working:** 7/1997

**Construction period:** 18months

**Proposed date of completion:** 1/1999

According to the Davis Langdon & Seah handbook 1996, the construction cost per m<sup>2</sup> for industrial building range from 6500-8500. Let's take 8500 for safety. By the time of the tendering, the construction cost will be raised to:

$$8500 \times (1 + 1.2\%)^{22}$$

$$= 11050\text{HK\$/m}^2$$

The construction cost per m<sup>2</sup> for commercial development range from 8500-9500. Let's take 9500 for safety. By the time of the date of completion, the construction cost will be raised to:

$$9500 \times (1 + 1.2\%)^{22}$$

$$= 12350\text{HK\$/m}^2$$

The construction cost per m<sup>2</sup> for aboveground carparks range from 3500-4000. Let's take 4000 for safety. By the time of the date of completion, the construction cost will be raised to:

$$4000 \times (1 + 1.2\%)^{22}$$

$$= 5200\text{HK\$/m}^2$$

Therefore the construction cost for the industrial category will be:

$$11050 \times 10334.26$$

$$= \text{HK\$}114.19\text{M}$$

The construction cost for the commercial development category will be:

$$12350 \times 4708.25$$

$$= \text{HK\$}58.15\text{M}$$

The construction cost for the aboveground carparks will be:

$$5200 \times 810$$

$$= \text{HK\$}4.21\text{M}$$

As a result the total construction cost for the automobile distribution center at the date of completion:

$$114.19 + 58.15 + 4.21$$

$$= \text{HK\$}176.55\text{M}$$

## 8. Special Studies: Lighting

### 8.1 Daylight

Lighting is very crucial on the design the car showroom. Good lighting design can provoke the beauty of the car. In this project, the showroom has a east glazing wall and has a large amount of direct sunlight during the morning. However excessive amount of sunlight is a great problem on both the lighting quality and air-conditioning. As a result in the final scheme external roller blind is applied on the east elevation. This study is to compare the lighting quality by using different material of blind.

#### 8.1.1 Scheme1

Fig.1 the lighting quality of the showroom when the roller blind is rolled up. It clearly show that the showroom on the left hand side have a large amount of lighting and have a clear shadow casted by the window frame. Compared with the left hand side the west side if the showroom have not enough lighting especially the space behind the theater. Moreover the contrast is too great to make people very uncomfortable.

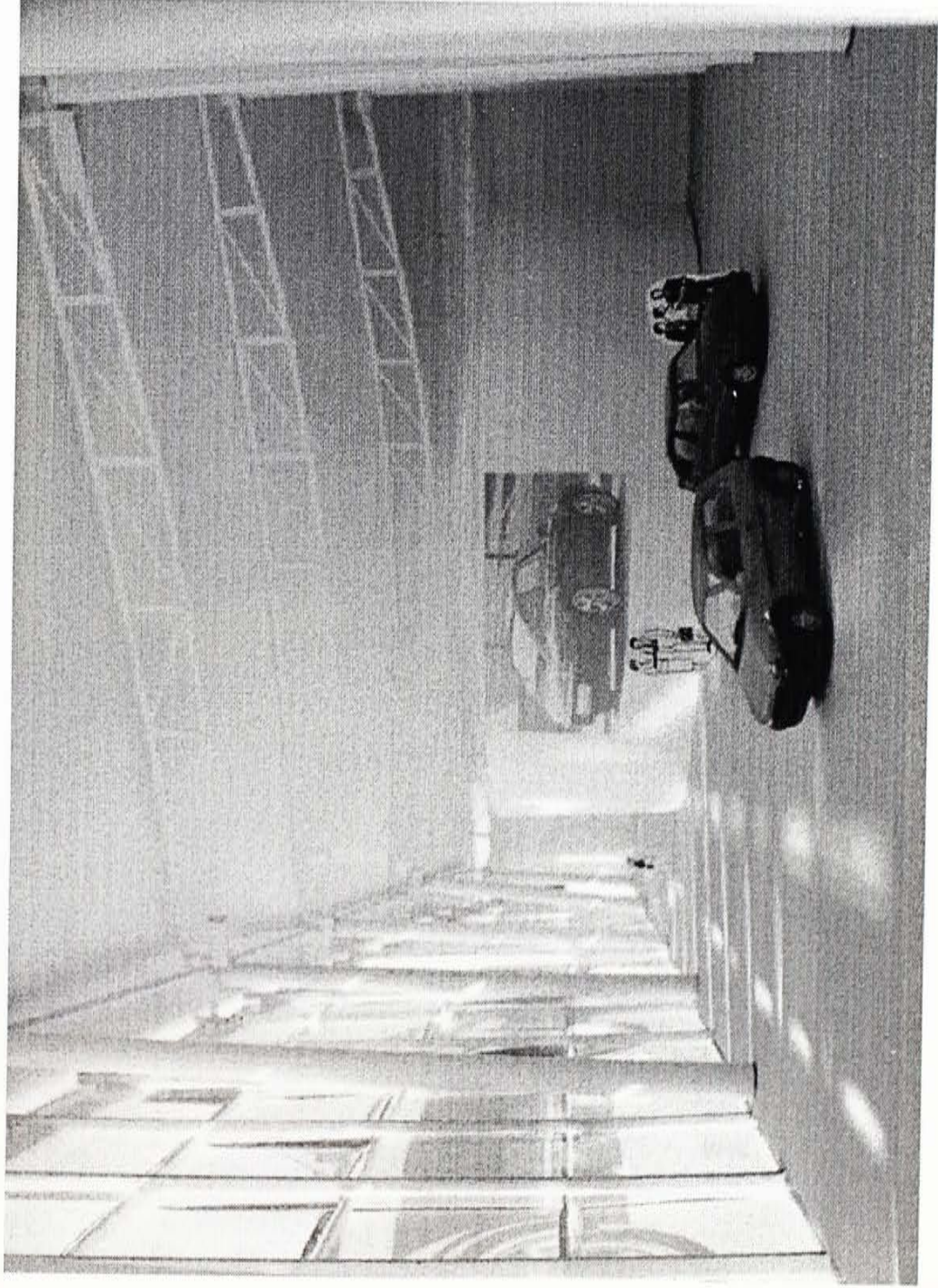
At this situation, it will be very difficult to have a good effect on car display. The interior lighting will be varied much as the weather changed. It have to use a large amount of artificial lighting to compensate the contrast and hence waste a lot of energy.



### 8.1.2 Scheme 2

Fig. 2 is the showroom when the blind has been pulled down. The blind have been black-out and have a high opacity. The showroom have a lot of light beam casted on the floor due to the gaps between the blinds. Although it create a quite dramatic effect to the interior, it is not suitable for the general lighting of car showroom. The lighting pattern will compete with the spot lighting for the car display. It will also have a glare problem when people look out to the exterior.

Since the blind will screen out most of the direct sunlight the interior lighting will be depends on the artificial lighting. It will increase the energy use and cannot take the advantage of the natural sunlight. The result is still not satisfactory.



### 8.1.3 Scheme 3

Fig. 3 is the showroom when the blind has also been pulled down. The blind at this case is a translucent material with low opacity. The problem of light beam is alleviated due to the low contrast between the shadow and the direct sunlight. The general lighting level of the showroom is better than the others. It is because the translucent blind deflect the sunlight and the sunlight can illuminate the whole showroom. This will reduce the loading of the general artificial lighting and hence reduce the energy consumption.



## 8.2 Artificial Lighting

In this project, the lighting quality during the daytime is greatly depends on the natural lighting and artificial lighting is only the supplement. However during the night time, artificial lighting becomes the prime factor to control the lighting quality of the showroom. An excellent lighting strategy can create a dramatic effect on both exterior and interior and thus increase the advertising potential of the center. The second part on the study is to explore different artificial settings and compare each effect.

The lighting strategy of the showroom is divided into two levels. For macro general lighting level is intended to reduce the usage of the direct downlight. All the lamps illuminate the roof and the whole showroom is illuminated by the reflected light. For micro the car is illuminated by the spot light at a lower level.

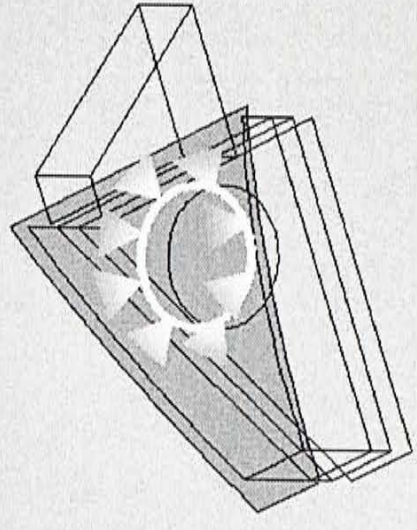
### 8.2.1 First scheme

The floodlight is located on the roof of the circular theater and create a light ring to illuminate the roof. The lighting quality of the scheme is not satisfactory because the lighting level of the roof is very uneven. The direction of the lamp is difficult to control because of the different shape of the circular theater and the trapezoid roof. From the exterior view we can see most of the light have been illuminate the east glazing and the west wall.





Lighting Arrangement  
(Scheme 1)

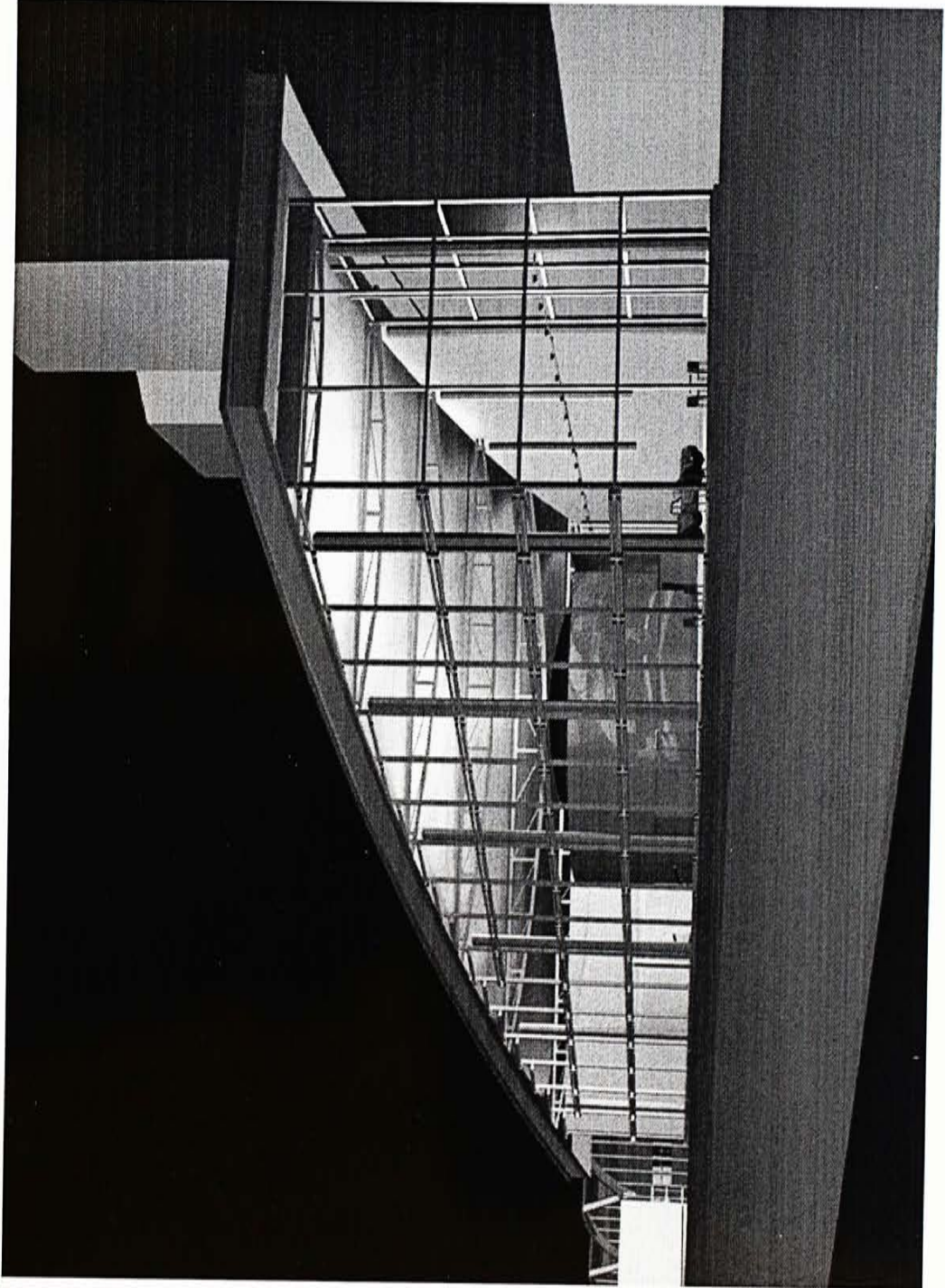


Floodlight



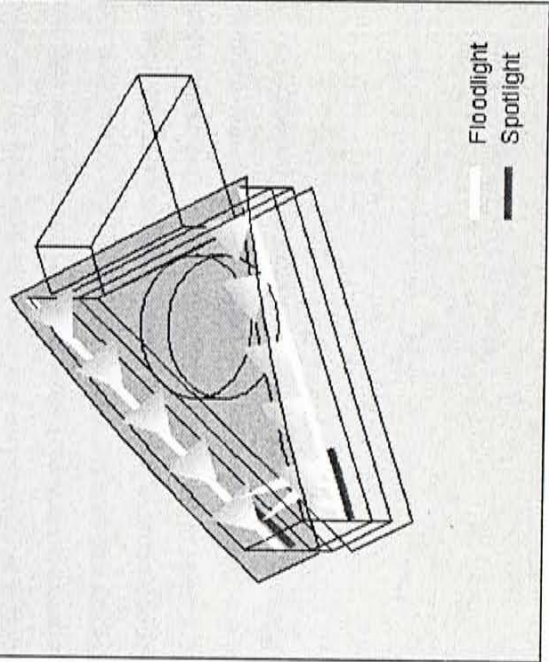
### 8.2.2 Second scheme

The floodlight is located on the two side of the wall at the level of the second transoms. The floodlights and the spotlights are suspended on the track mount on the columns and the wall. From both the exterior and interior, the lighting on the roof in this scheme is much evenly distributed. The spotlight for the car display have a closer distance and hence have a better illumination. Since the lamps are installed on the two side of the showroom it have the minimum disturbance of the interior space.





Lighting Arrangement  
(Scheme 2)





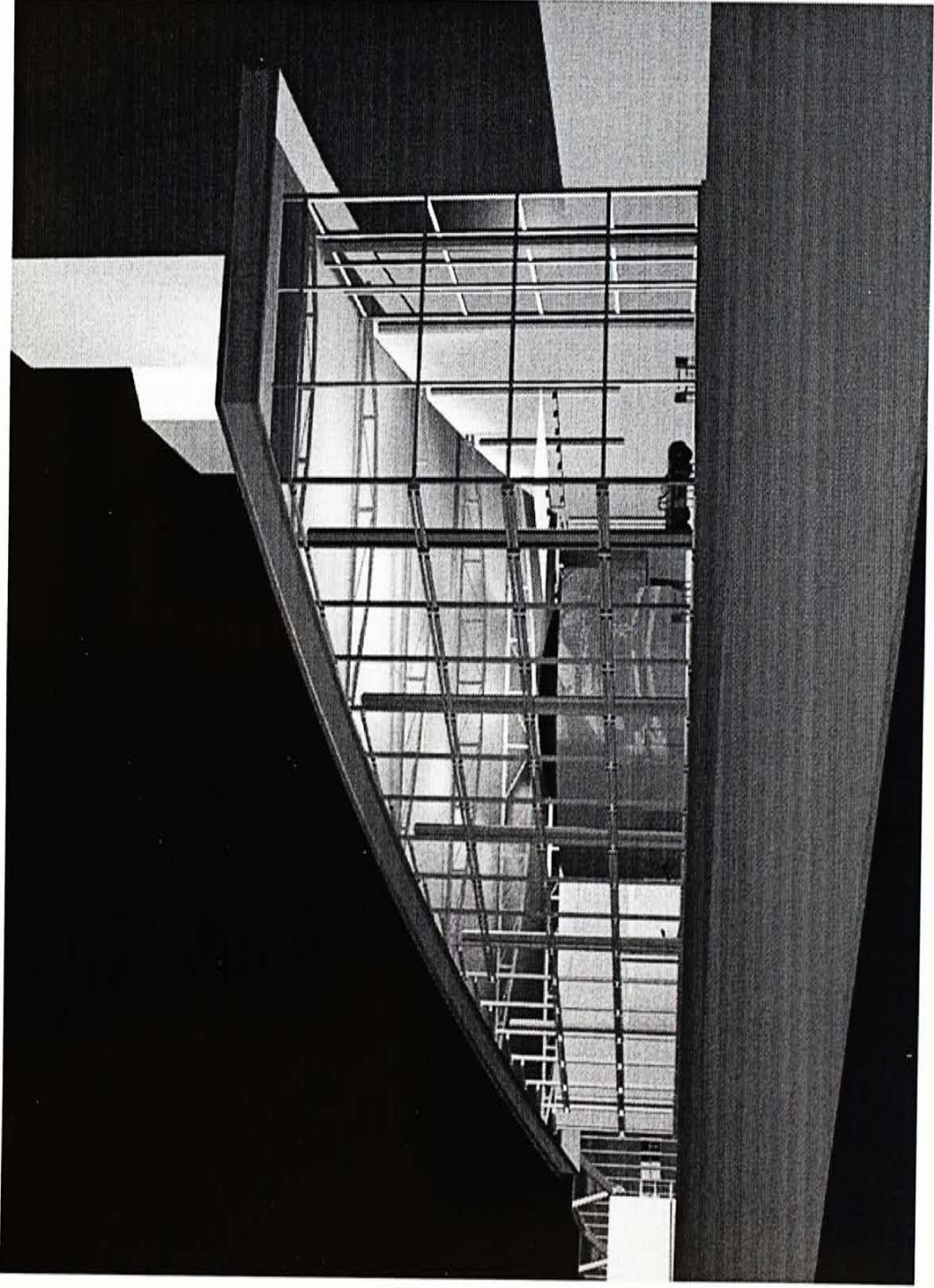
### 8.2.3 Third Scheme

On the third scheme there is a structure suspended on the middle of the space. Both the floodlights and the spotlight are installed on the structure. the spotlights firstly illuminated the fabric in the middle of the structure and then the indirect light reflected from the fabric illuminate the display car. Using the similar concept on the upper part of the structure the floodlight illuminate the roof and then the front part of the showroom.

The back part of the showroom is illuminated by the floodlight installed on the roof of the circular theater. The arrangement is similar to the first scheme but at this scheme the floodlights are to be adjusted to a more vertical direction due to the help of the external structure at front.

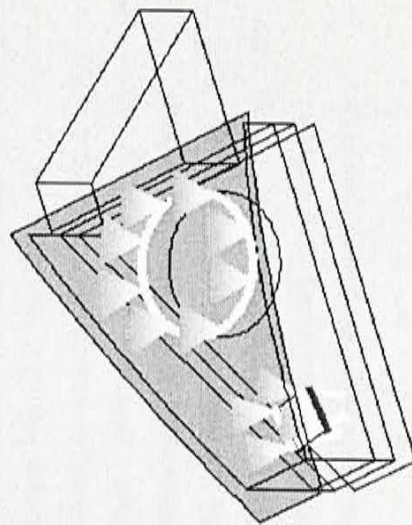
### 8.2.4 Conclusion

Both the second and third scheme have a quite good lighting distribution on the roof. The structure on the third scheme is very eye-catching but it may compete with the display car and the interior space. On the other hand the second scheme have the lowest disturbance of the interior so it seen to be a better lighting design. The combination of the two scheme with a better design of the external structure is also an potential design on this project.





Lighting Arrangement  
(Scheme 3)



— Floodlight  
— Spotlight

## 9. Acknowledgments

I wish to appreciate the assistance and information I received from the following persons and institution.

Mr. Kelvin Chan, Senior City Planner.  
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Mr. Alan Lam, Senior Designer  
Edges Design Ltd.

Mr. Gary Ng, Technical Training Officer  
Mazda Motors (HK) Ltd.

Mr. Kwong Yiu Kong, Manager (Maintenance Center)  
Dah Chong Hong (Kowloon Bay)

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Evolving Architecture:

Chinese Automobile Distribution Center

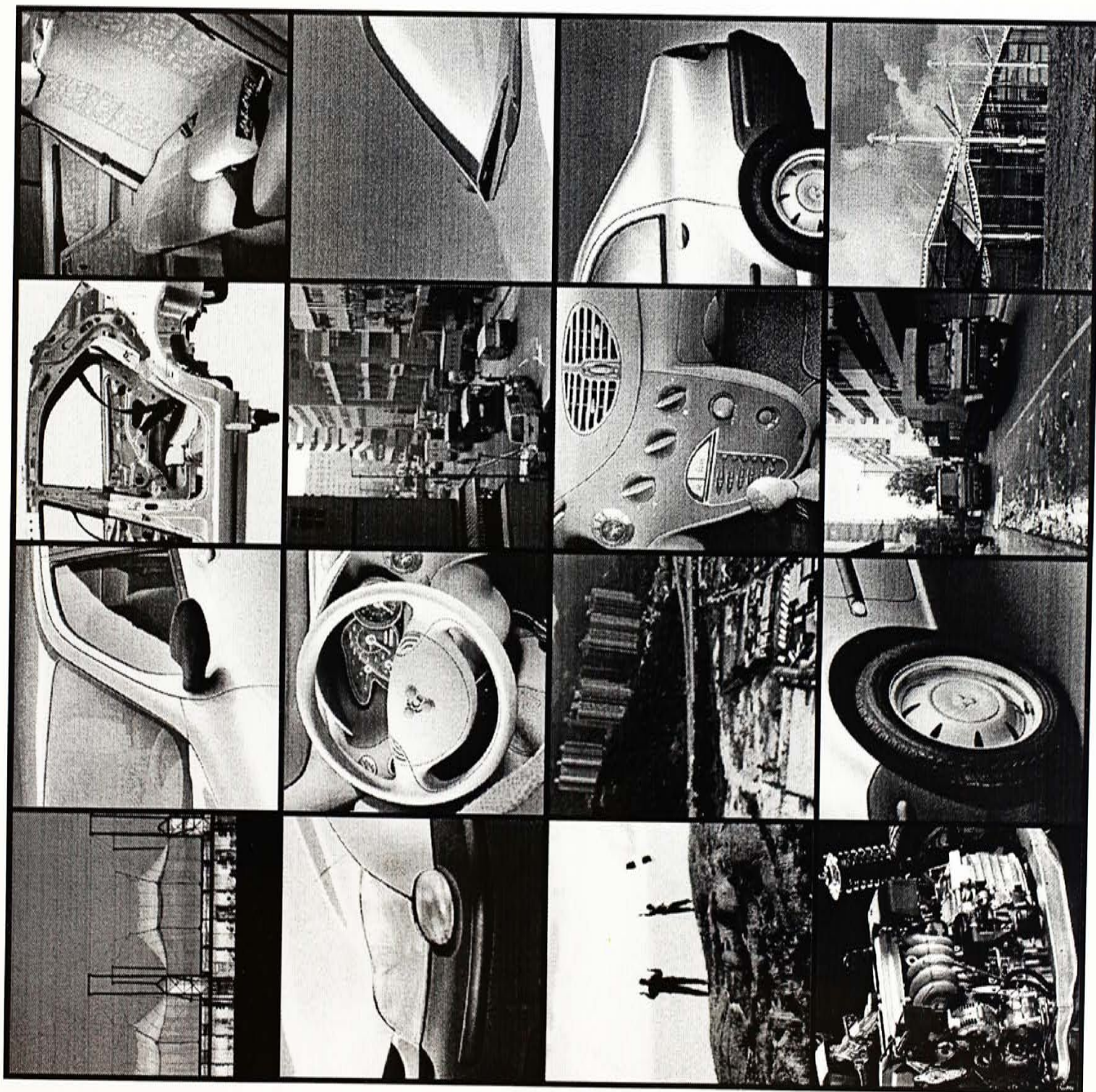
Thesis Report

ARC 6010

M. Arch 2

Name: Tze Kin Hung Alfred

I.D.: 95033840





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*Handwritten notes in Chinese:*

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## 2. Introduction

### Chinese Automobile Distribution Center

In the past, Chinese automobile industry has developed at very slow pace. Chinese automobiles are not able to jump into the world market. As the economy and market of China continue to grow and open respectively, tremendous amount of money will be flow away if China doesn't have the ability to produce automobiles. To catch up with the world's automobile standard, China announced an objective for the future development of automobile industry. In this project, it claimed that in the future there will be a distribution center as a headquarters for exportation. It will be located in Hong Kong. The center will consists of three major components:

**Warehouse:** Store spare parts temporarily for import and export.

**Maintenance:** Provide excellent aftersale service for the sold C88 in Hong Kong.

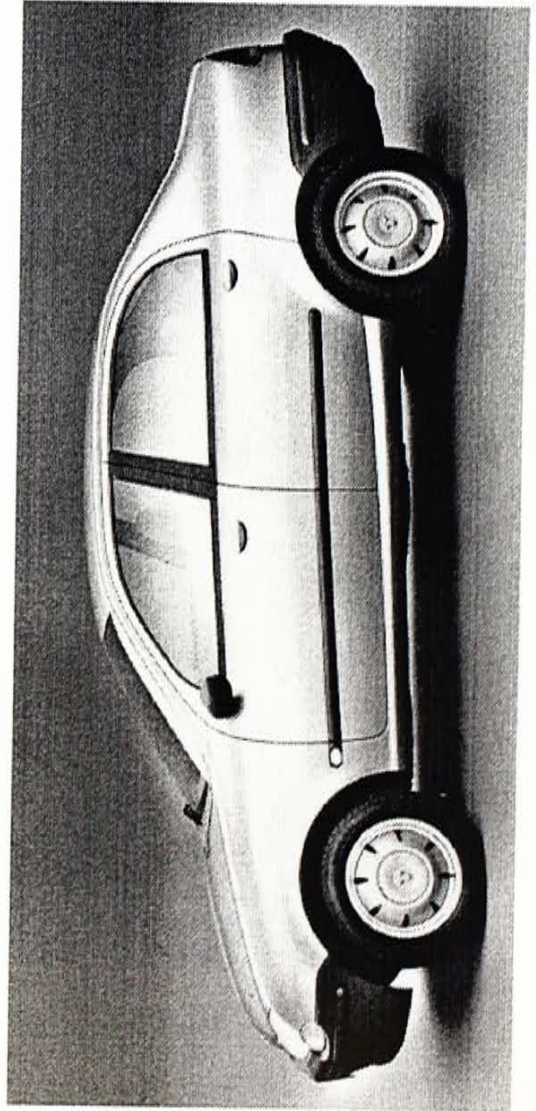
**Showroom:** Promote C88 in Hong Kong.

#### The objective of the thesis is to:

- Explore a new building type and for Hong Kong future Industrial Area.
- To create an ideal working environment for both 'white collar' and 'blue collar' workers.
- To improve the environment of industrial area.

#### Study will focus on the following issues:

- Interior organization and operation of the warehouse, maintenance center and showroom.
- Explore the new possibility of service system.
- Explore the new structural system cater for the center.



### 3. Synopsis

#### 3.1 History of Chinese Automobile Industry

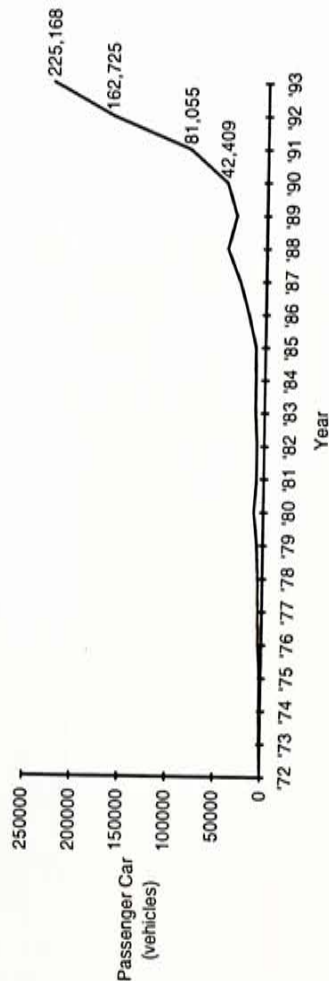
As the economy of the China is rapidly growing, the demand of the passengers' cars has greatly increased. There are up to now 124 automobile manufacturers in China in 1992<sup>1</sup>. The production of automobiles has been increased dramatically, but the demand of the passengers' car is still fulfilled by importation (Graph 1 and Graph 2). It is because that the automobiles that made in China are far from the world's standard. The manufacturers cannot to compete with the automobiles from the rest of the world. Actually most of the manufacturers are only able to produce one to two specific parts. Few number of assembly plant that are able to have an annual production above 100,000. It will be a great economical lost for both the local and foreign markets. Nowadays China protects its own market and industry by means of taxation only.

Actually Chinese automobile has a long history and can be divided into two periods. The first period started since the new China found till the Mao's death. China mainly manufactured heavy and medium size truck for agricultural development. There are also a few number of passengers for the Chinese leaders. At this time all of they were developed by the Chinese themselves or cooperate with the East-European countries like USSR. They are much less advanced compared with the West-European models. In additions the economy of China was suffering because of the different political campaigns so that the market of automobiles was very small and the development of automobile was very slow.

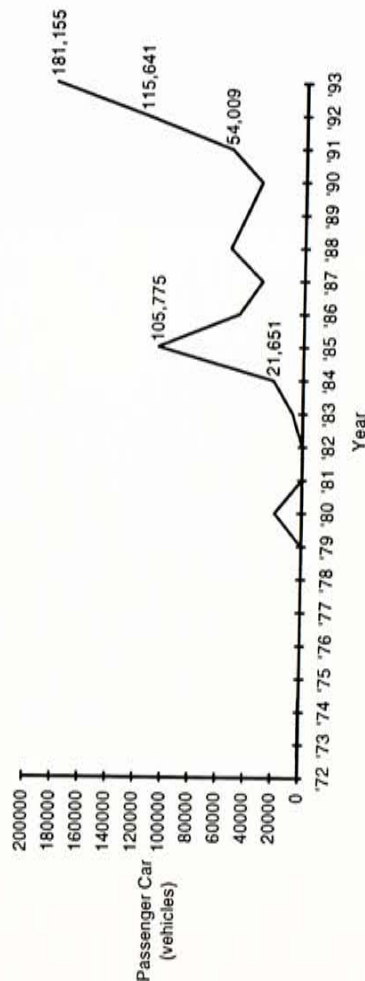
The second period started since the early 80's. Due to the open policy Chinese become more rich and are able to afford a passenger car. Foreign investors cooperate with the Chinese manufacturer to established different joint venture like Shanghai Volkswagen, Beijing Cherokee, etc. They are very popular and got a great proportion of market share in China. It is because they are not only very economic but also 'made in China.' The joint ventures are not only to produce automobiles and put them into the market but also help to improve the standard of the China automobiles by localization of the components. The Chinese automobiles at this period, however, have a common characteristic that most of the models manufactured are the out-dated models of the foreign partners. Therefore all of them are still much less advanced than the latest models around the world. They only are able to sale inside the local market. Negligible number of automobiles are exported to the other developing countries. Chinese automobiles still no chance to compete with neither the Japanese nor European models.

For the future development of Chinese automobile industry, Chinese authorities have set up two objectives. At 2000 90% of the market will be fulfilled by Chinese automobile. The passenger car production will be half of the total automobile production. To achieve this objective, the Chinese government have set a schedule. From 1996, Chinese government will support 2 to 3 automotive assembly plant that allow them to meet the world's standard. At the beginning of 21<sup>st</sup> century, China will have had its own manufacturer dealers and they have the ability to design and manufacture own automobiles.

Graph 1: Annual Passenger Car Production, 1972-93



Graph 2: Annual Passenger Car Import, 1972-93



Sources: China's automobiles industry, Policies, Problems and Prospects, p28

Sources: China's automobiles industry, Policies, Problems and Prospects, p30

<sup>1</sup> China's automobiles industry, Policies, Problems and Prospects, p.94.

### 3.2 Porsche Crisis and the Project C88

Porsche is one of the world famous performance car manufacturer. However Porsche had suffer from financial deficit for 10 years. In 1986 Porsche delivered 53,000 of its sports car but the figure dropped to 12,000 in 1993. The company had lost over US\$ 200 million.<sup>2</sup> To save Porsche from this crisis, Wendelin Wiedeking, who become the chairman of Porsche AG in 1993, have set up a long term strategy. Firstly in short term, the company has to be cut the cost down. Porsche had always been expensive, as Mr. Wiedeking said "We solved everything by raising price."<sup>3</sup> He hired a Japanese Consultant and made the whole production much more effective. For example the production time of automobile has dropped from 120 hours to 74. Porsche has also developed economic model such as the latest Boxster. This model will share a lot of components with other models to reduce the cost. All the policies done are to make Porsche not too expensive and increase the sale.

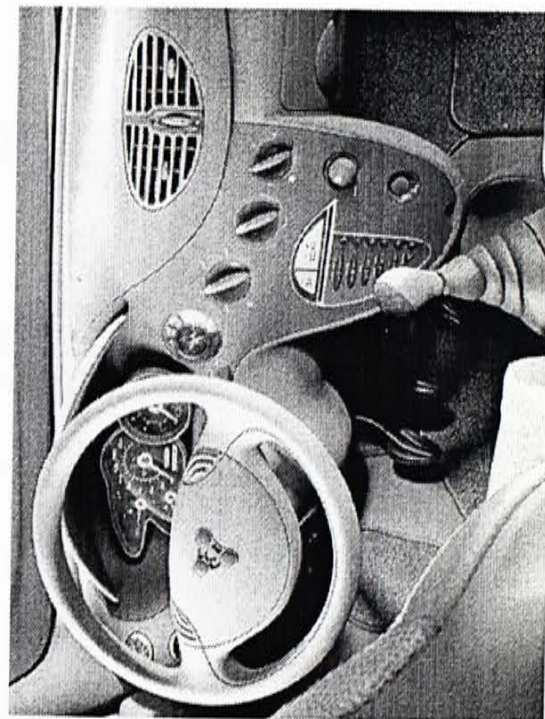
Performance car, however, is still a small crowded market and the sale greatly depends on the world economy. To alleviate the dependence of sport car market, Porsche proposed a project called C88 to extend its product items. Project C88 is to design automobiles which is cater for the Chinese market. At the beginning of the project, Porsche will be responsible for training a large number of Chinese technical staff to world's standard. Then the trained staff will develop C88 with the Germans experts. It is proposed that at the beginning of the 21<sup>st</sup> century C88 will be going to the production.

C88 will have three versions. The first version will be a 3-door hatchback. The price will be expected to be about 45,000 RMB (renminbi: the unit of Chinese money). The second version will be a 2-door and 4-door fastback. The third one will be a 4-door luxury sedan. This version will be ready for export and the price will be 80,000 RMB. This version will also meet the world's safety and exhausted gas emission standard. The proposed annual production of C88 will be 300,000 to 500,000. Although C88 is mainly cater for the Chinese local market, it is proposed that about 3-5% (~15,000) of the annual production will be exported. The production line will be adjusted from time to time to provide the greatest amount of flexibility to match the demand.

<sup>2</sup> Salvation in Stuttgart, *Forbes*, 11/Sept/1994, p154-155  
<sup>3</sup> Porsche Turns, *Forbes*, 1/Febr/1993, p104



C88: The hope of future Chinese Automobile Industry and Porsche.



Interior view of C88



### 3.3 Porsche: Performance car or family car manufacturer?

Porsche is one of the world famous sport car manufacturer. Porsche 356 and 911 are the famous models of Porsche and play a very important role in the history of automobile. Most will think that Porsche is represented performance, existing, elegant, wealth, etc. Is it very strange that Porsche is going to invest and manufacture family car in China? In fact Porsche is very suitable for manufacturing family car from the historic and business point of view.

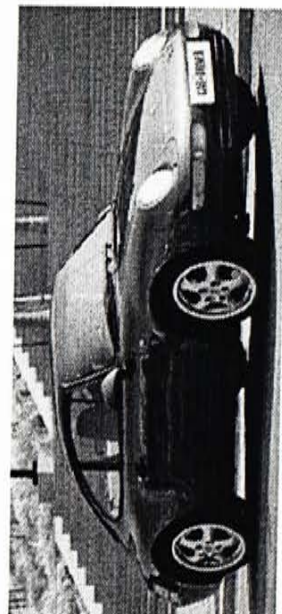
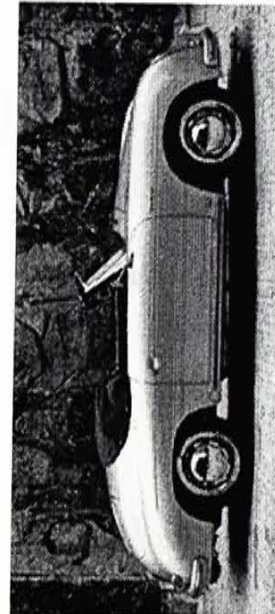
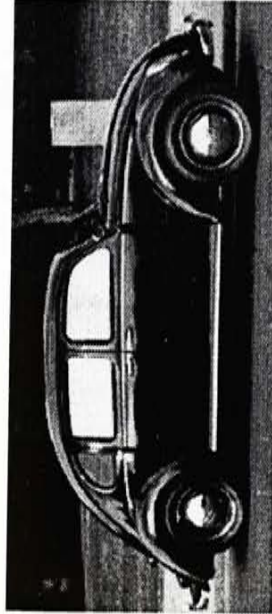


Dr. Ferdinand Porsche: The founder of Porsche AG and the father of Volkswagen Beetle.

Dr. Ferdinand Porsche, the founder of Porsche AG, was also the chief designer of the world's most successful automobile: Volkswagen Beetle. To design a car for the modest was the vision of Dr. Porsche. In 1920's, when he was the chief engineers of Daimler-Benz, he had proposed a mass-produced Benz for the modest. Unfortunately the proposal was turned down and Dr. Porsche quit. After getting financial support from investors, Porsche had the chance to develop the prototype and eventually become the Volkswagen.<sup>4</sup> (In Germans it means 'People's Car')

Volkswagen Beetle is an "honest, simple car, made better than it had to be, yet using technology years ahead of the times."<sup>5</sup> Ferdinand Porsche use aircraft material like aluminum and magnesium to reduce the weight, integrated the engine and gear box as a simple unit over the rear wheels to make the interior roomy, and shaped the body for better aerodynamic. So the car was economical, easy to repair and become the world's most successful automobile: The total production of Volkswagen up to now is 21 million and remains in production in Latin America. Even the later models like Porsche 356, Porsche 911 are also evolve from the Volkswagen Beetle. They have got the same philosophy and concept: light, advanced and aerodynamic. Therefore, Porsche actually has a long history and experience producing family car.

From the business point of view, Porsche is also very suitable to produce family by project C88. Since C88 are going to be manufactured in China, it can be put into market by using different brand name. Hence it can be clearly distinguished from the super car manufactured in Germany. It will not have any conflict on the corporate image of Porsche. As a result, Porsche has take the advantages of cheap Chinese labour force as well as widens its model series. On the other hand China is able to manufacture their own designed automobiles.



From Top to Below: Volkswagen Beetle, Porsche 356, latest version of Porsche 911. They have the same concept: Light, Advanced and Aerodynamic.

<sup>4</sup> <http://www.porsche-usa.com/Peh2.html>  
<sup>5</sup> <http://www.vw.com/museum/page02.html>



### 3.4 Role of the Chinese Automobile Distribution Center

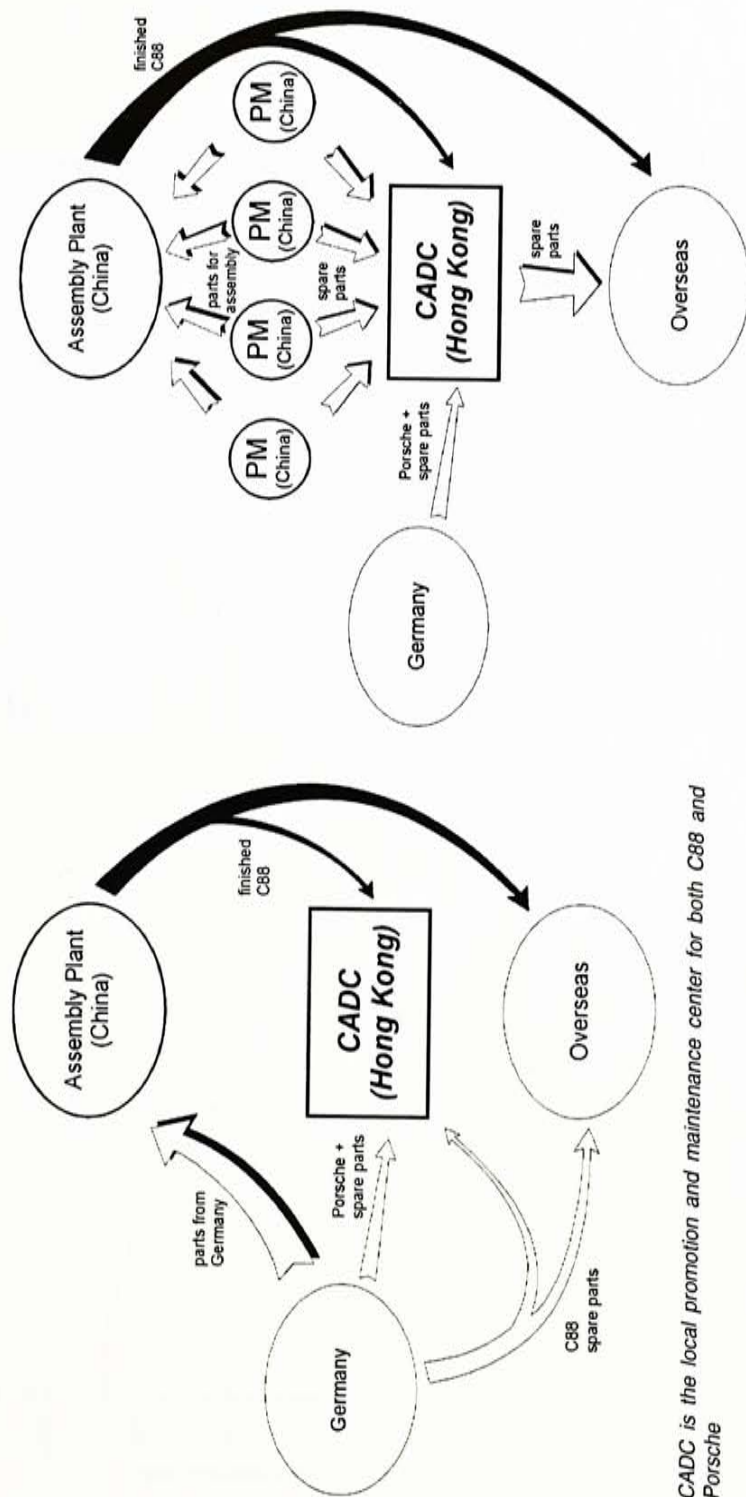
#### Phase I

In the early production stage of C88, most of the parts are supplied by the Germany. It is because China still has not gotten this kind of high technology to produce the parts. C88 is still unable to be manufactured in China completely instead of only assembly. The role of the Chinese Automobile Distribution Center (CADC) at the first stage will act as a C88 promotion center and a maintenance center catering for Hong Kong local market of both C88 and Porsche.

#### Phase II

The project claimed that Porsche is responsible to increase the technological standard of the Chinese automobile industry. It is achieved by transferring the advanced technology to the mainland parts manufacturers. At the last stage of the project C88 will be manufactured in China by means of this kind localization. At this stage the parts are not no longer transported from Germany. The role of importation distribution center in CADC will be becoming smaller gradually. On the contrary, The role of CADC will change to exportation center. As mentioned before, the spare parts are produced by different manufacturers in China. It will be very complicated for the foreign dealer to request spare parts. They may have to contact different manufacturer to get those items. It will waste a lot of time as well as money.

Therefore CADC can act as a coordinator to coordinate the requests from different dealers and the exported items from the local manufacturers. The parts will be transported to the CADC at first. It will sort and arrange those parts that different dealers requested and then transported to them by shipping. Therefore the role of CADC will be changed as the project proceeded at different stages.

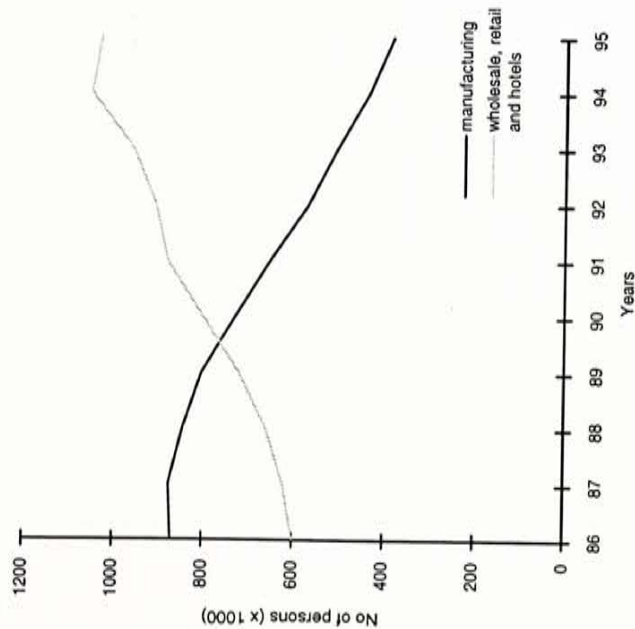


CADC as the exportation center of parts when China is fully mature to produce C88

CADC is the local promotion and maintenance center for both C88 and Porsche

## 4. New Era of Hong Kong Industry

Graph 3: Number of persons engaged by selected industry group in 86-95



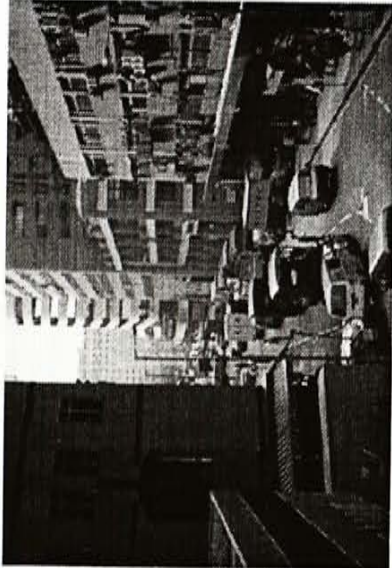
Source: Hong Kong 1996, 93, 90, 87. Appendix 21

### 4.1 Industrial Area: Past and Future

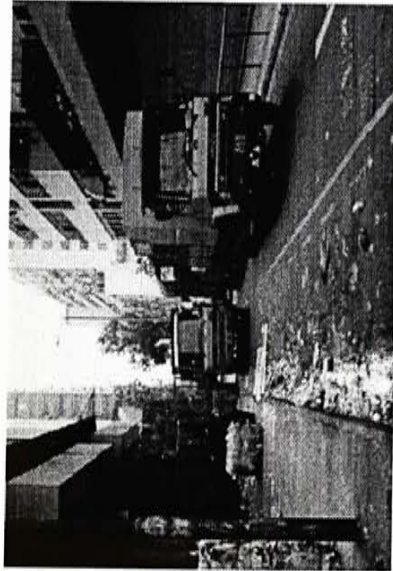
Industry plays a crucial role in the development of Hong Kong. In 70's and 80's, textile, toys, electronics industries are the major income of Hong Kong. A lot of factories are established on the Kwun Tong, Cheung Sha Wan, etc. Industrial area is also an important component in the planning of new towns to provide job opportunities for the local residents, for example, Fo Tan in Shatin, Tung Tau in Yuen Long, etc. As the economic growth of Hong Kong in last twenty years, Hong Kong is turning from a society of production towards a society providing services. A lot of the factories have been moved to the mainland due to the low land cost and the cheap labour force. A large number of light industry workers lost their jobs (Graph 3) and the industrial buildings in Hong Kong become vacant. In the future development of Hong Kong the role of industrial land will be changed. It will not be for not constructing industrial building only but has more and more possibilities.

The environment of the existing industrial area is very bad and industrial estate has become a synonym for ugliness. The existing industrial area road networks are very narrow. Those areas do not provide enough space to allow the lorries to turn to the building's loading/unloading area. As a result the lorries have to use a lot of road space to turn and hence cause a serious traffic problem. Different kinds of irritating and poison gases emitted from the factories. Due to the traffic congestion, the lorries and the tractors will exhausted more gas. The problem will becoming worse by the poor ventilation inside the area. Moreover there are few good quality restaurants and most of them are just along the dirty roads or even make a shelter beside the construction site. People have to not only work but also walk and eat under this bad environment. The whole streetscape of the industrial area is extremely ugly and harmful to the people working there.

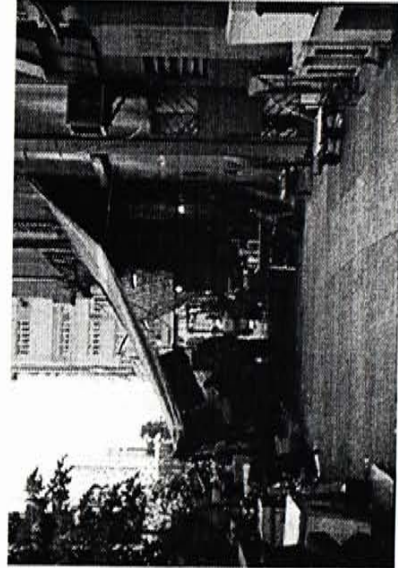
The establishment of Chinese Automobile Distribution Center can act as a precedent for the future industrial land use and explore the solution to tackle the environment of industrial area. By the role of the export center of CADC, it will also strengthen the character of Hong Kong as a gateway of mainland China.



The road network in the existing industrial area is full of lorries and cause a serious traffic and air quality problem.



Most of the lorries are just put down their goods along the road. This will worsen the problem and throw a lot of rubbish on the road.



Most of the cooked food are located on the back lane and have a very bad environmental conditions.



#### 4.2 Selection of Site

The site of Chinese Automobile Distribution Center will be chosen based on four criteria:

1. *Transportation:*

Since the center act as a warehouse that will temporarily store the spare parts manufactured in China and then exports to overseas, a good physical connection with the mainland and the container terminal will be the most important criterion on site selection. The center should have a good highway network system to connect to those areas.

2. *Advertising power:*

The center can act as a landmark for promotion of the car. It is determined by if the center has visual connection by the local residents or even other new town residents. For example, It will has a great advertising power if the site is located beside highways or railways.

3. *Price of the land:*

The price of the land is important since the center requires a quite large area. It will raise the total cost drastically if the cost/m<sup>2</sup> is very high. The price will be judged by whether it has been developed by several small industrial buildings or a new planning area. If the lot has been developed, it will be more difficult to purchase the whole land from the original clients.

4. *Future extension:*

The possibility for extension of the site is determined by whether the site is big enough and the surrounding is newly developed.

During the site selection, Industrial areas in new towns are to be considered only and urban area like Kwun Tong, Kowloon Bay are excluded. It will be based on two main reasons:

1. The highway system in new towns connected to the mainland and the container terminals are much more developed the urban area and cause less impact on the whole Hong Kong traffic.
2. The demands of automobiles in new towns are greater than the urban area. People living in the new town are so remote from their working places that having their own passengers' car can provide a greater convenience for the residents.

In the potential urban industrial area, Kwai Chung are excluded, too. It is because it is too near to the container terminal. Due to the fact that there are a tremendous number of containers go to the container terminals, moreover there are a lot of distribution type warehouse in the surroundings, the traffic congestion problem are very serious and difficult to solve. If the center are located in the area near the container terminals, it will further increase the loading of traffic around Kwai Chung although it will help the center in coordinating the shipping schedule. In the proposal the center are located in new town. As a result parts of the activities like loading/unloading and storage will be put away from the those area. Hence it will decrease the frequency of the activities take place and help to alleviate the traffic problem in Kwai Chung.

There are 5 potential new town site in Hong Kong. They are:

1. Nam Fung industrial Estate in Tuen Mun
2. Fo Tan industrial area in Sha Tin
3. Tung Tau industrial area in Yuen Long
4. Shek Mun industrial area in Sha Tin
5. Tai Po industrial estate in Tai Po.

In the following pages it will illustrate the advantages and the disadvantages for the potential sites. It will also show the relationship between the site and the highways system nearby.

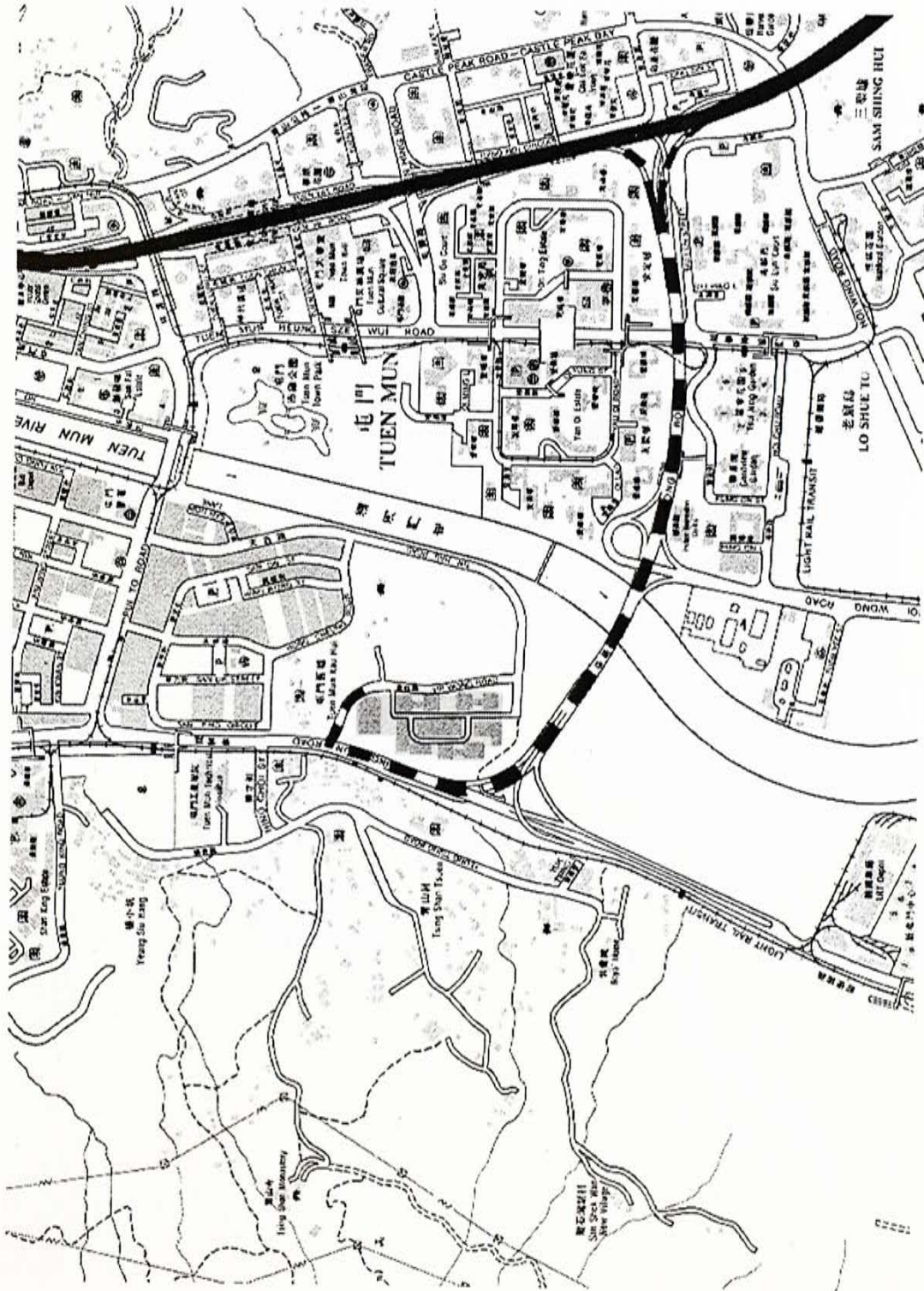
4.2.1 Nam Fung Industrial Estate, Tuen Mun

Advantage

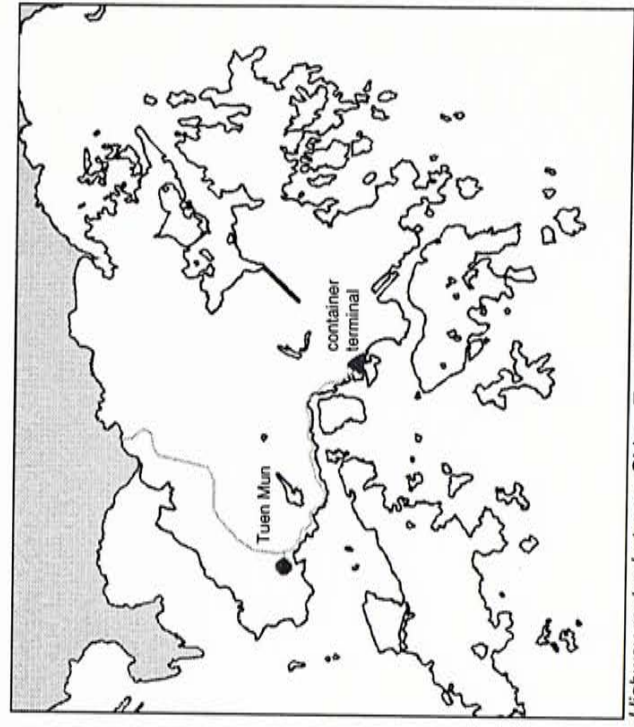
1. One client, easy to purchase and re-developed
2. Lot size is appropriate.
3. Good transportation network for both container terminal and mainland when No.3 is opened.

Disadvantages

1. Traffic in Tuen Mun is very bad until Route no.3 is opened.
2. Far away from the Tuen Mun Highway, low advertising power in terms of other new town residents.
3. Impact to local traffic is great because the containers have to pass through the town center.



Map of Tuen Mun (Nam Fung Industrial Estate) new town 1:10,000



Highway routes between China, Tuen Mun and container terminal

4.2.2 Fo Tan, Sha Tin (Railway)

Advantage

1. Best Advertising power because the lot is beside the railway station.
2. High transportation capacity from railway.
3. Easy for Loading/Unloading.

Disadvantages

1. Lot is developed and owned by different clients: difficult to purchase.
2. Surrounding is developed, difficult for future extension.
3. Transportation to Container Terminal is not well connected by railway.

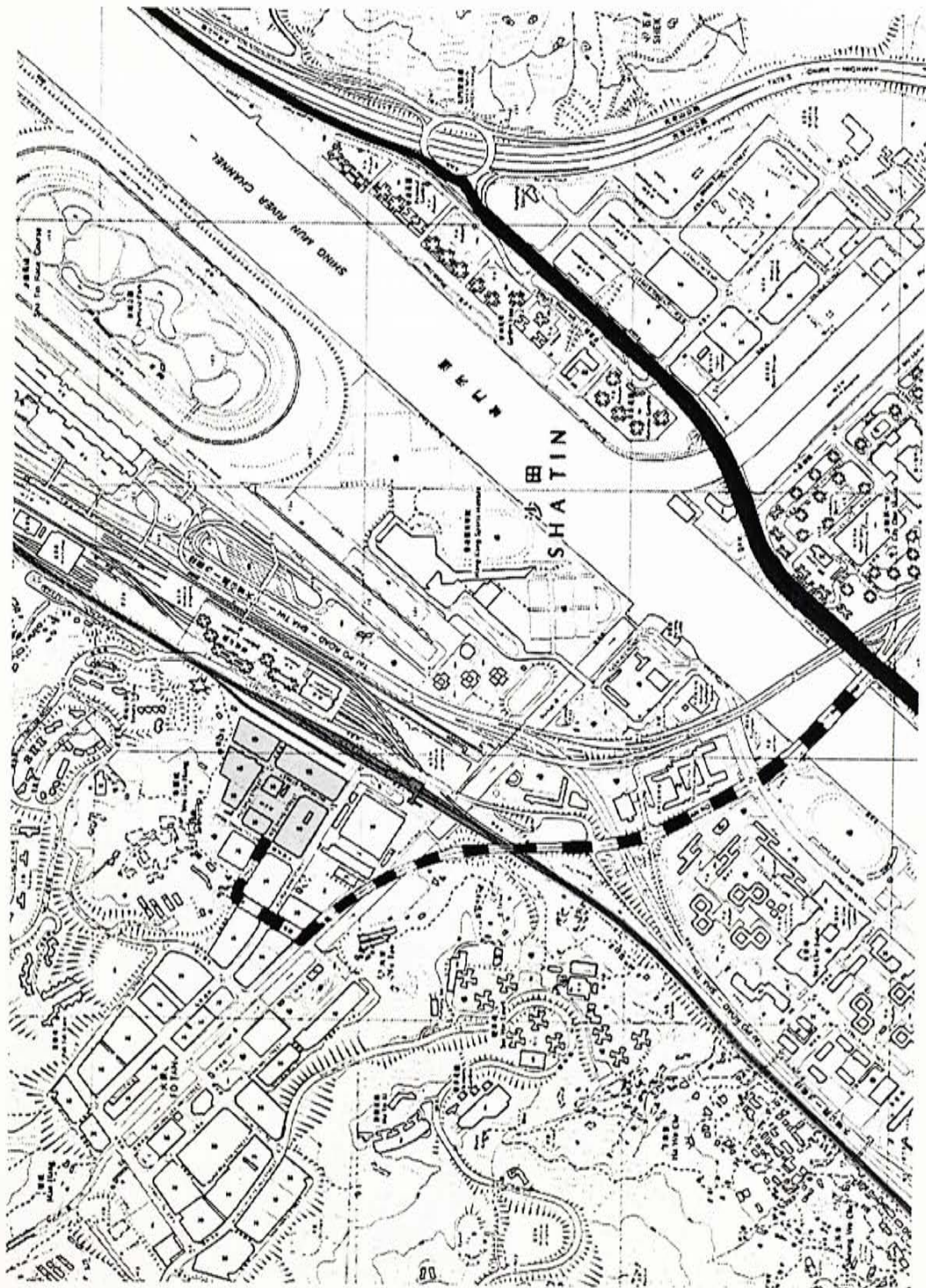
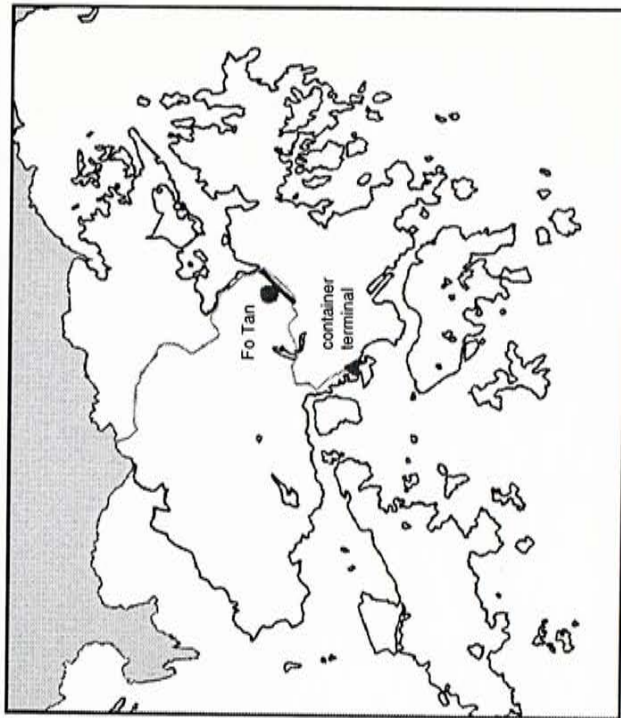
Fo Tan, Sha Tin (Highway)

Advantage

1. Best Advertising power because the lot is beside the railway station.

Disadvantages

1. Road network is not well planned in Fo Tan.
2. Impact on the local traffic is great because the containers cannot go to Fo Tan directly and have to pass through different regions of Shatin.



Map of Shatin (Fo Tan Industrial Area) new town

1:10,000

- 7.061
- legend:
- : site
  - : railway
  - : highway
  - : roads connect highway and the site

Highway routes between China, Fo Tan and container terminal

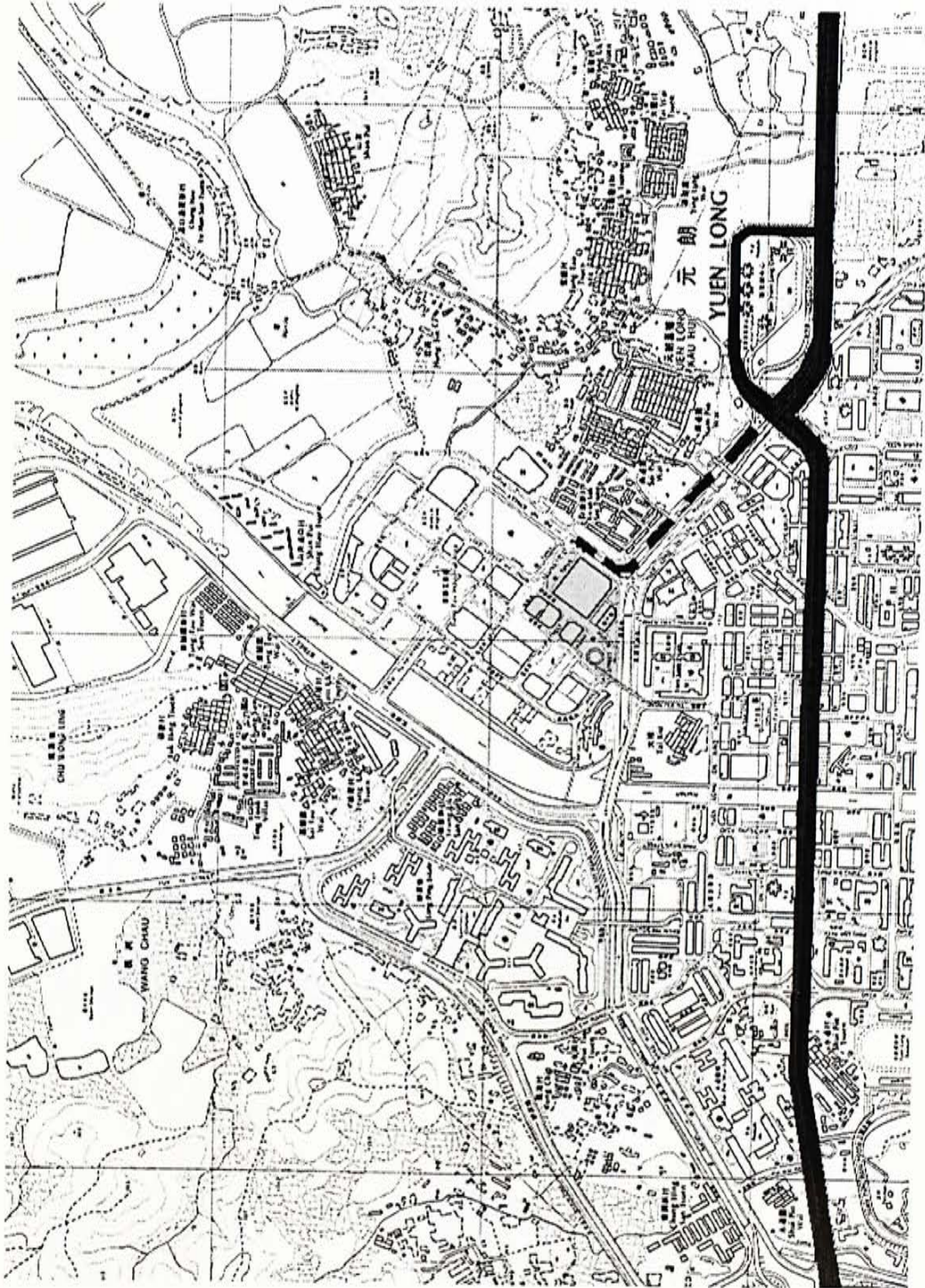
4.2.3 Tung Tau Industrial Area, Yuen Long

Advantage

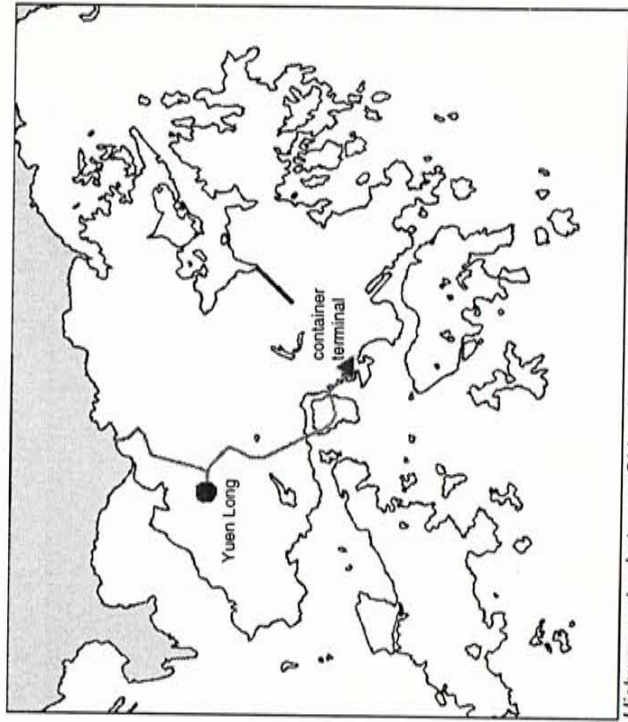
1. Best transportation network for both mainland and container terminal if Route no.3 is opened.

Disadvantages

1. Lot is developed and owned by different clients: difficult to purchase.
2. Surrounding is developed, difficult for future extension.
3. Bad transportation network to container terminal nowadays.
4. Far away from the highway, low advertising power in terms of others new towns' residents.



Map of Tuen Mun (Tung Tau Industrial Area) new town 1:10,000



Highway routes between China, Yuen Long and container terminal

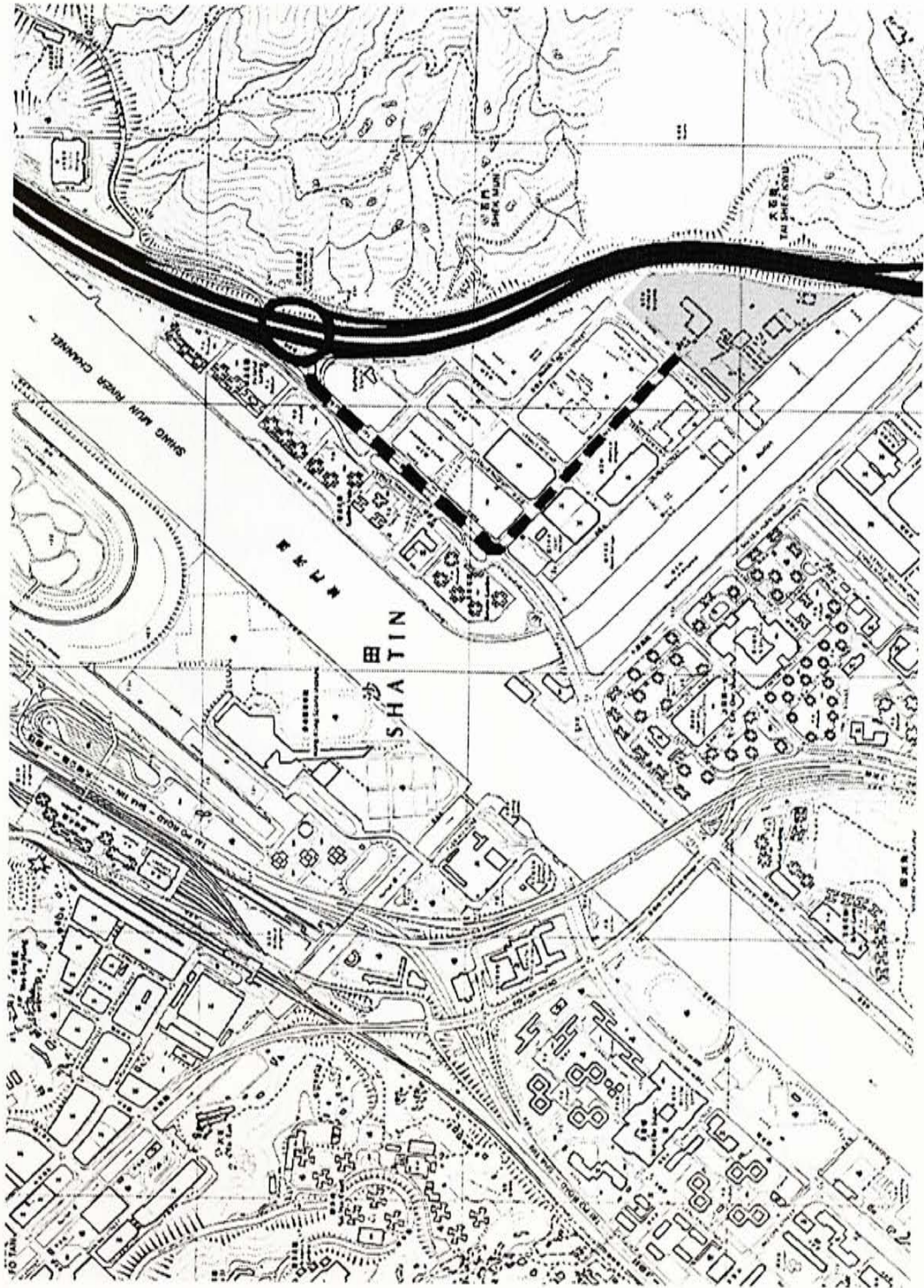
4.2.4 Shek Mun Industrial Area, Sha Tin

Advantage

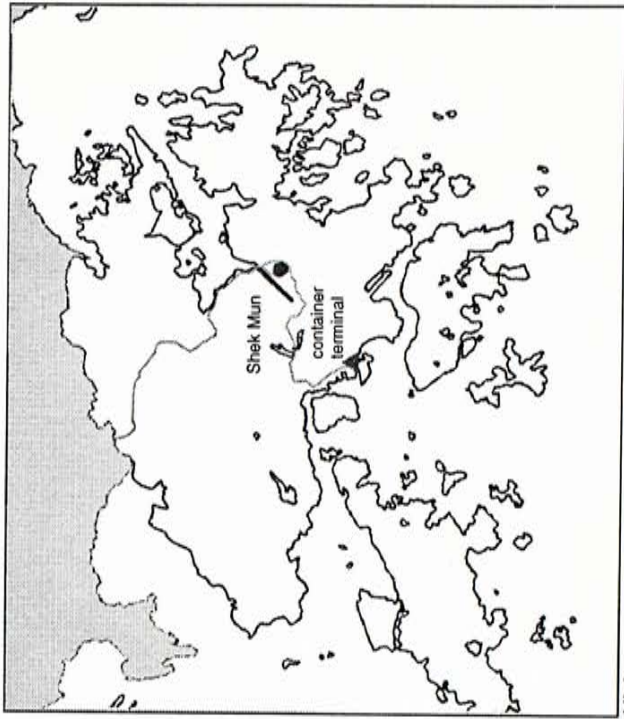
1. Beside Tate's Cairn Highway, good advertising power.
2. Easy to go the highway network, convenient for transportation.
3. New planning Area in Sha Tin, economical and good for future extension.
4. Near residential area (City One Shatin), high advertising power in terms of local residents.

Disadvantages

1. Increase the load of Tolo Highway.
2. Have no direct connection with the container terminal. Increase the load of Shing Mun Tunnel.



Map of Shatin (Shek Mun Industrial Area) new town 1:10,000



Highway routes between China, Shek Mun and container terminal



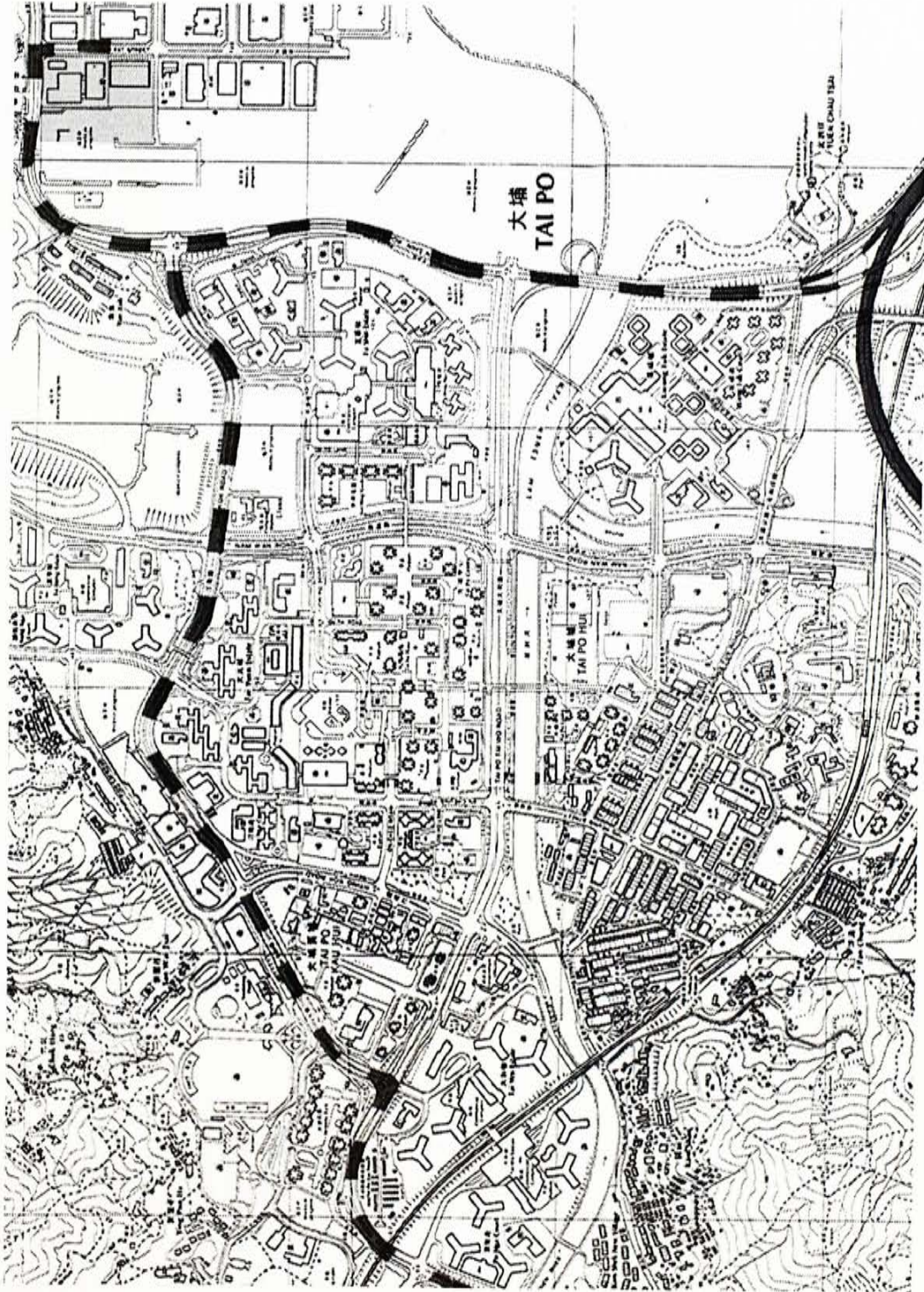
4.2.5 Tai Po Industrial Estate, Tai Po

Advantage

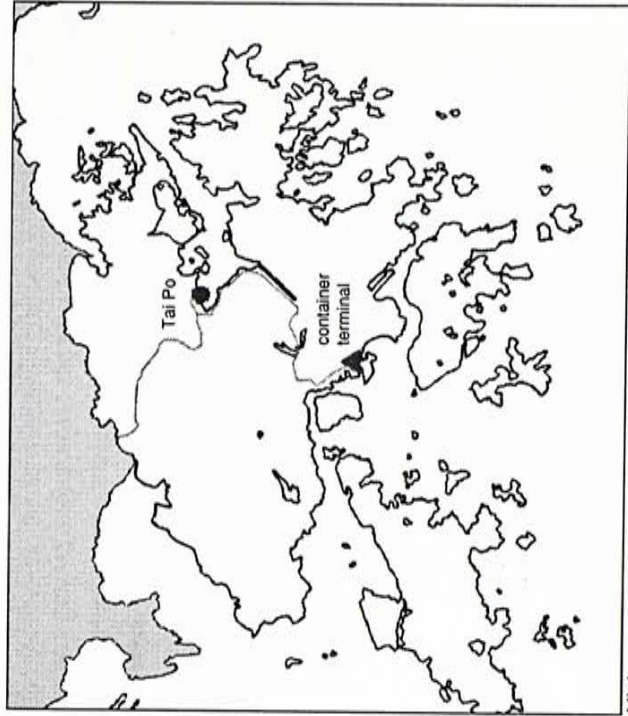
1. The lot is owned by one client, easy to purchase and developed.
2. The surrounding of the lot is not developed yet, good for future extension.

Disadvantages

1. The site is far away from the highway system and the containers have to pass through the town center. Hence cause a great traffic problem to the town.
2. The site is far away from the highways, people travelling the Tolo's Highway are difficult to notice the centre.
3. The site is remote from the town center, low advertising power to the local residents.



Map of Tai Po (Tai Po Industrial Estate) new town 1:10,000



Highway routes between China, Tai Po and container terminal



Table 1: Matrix system showing the characteristic of different site

		Transportation with:		Advertising Power	Price	Future Extension	Total
		Mainland China	Container Terminal				
Fo Tan Sha Tin	railway	5	2	5	2	2	16
	highway	2 (Tolo Highway)	3 (Shing Mun Tunnel)				
Nam Fung Ind. Area Tuen Mun		4 (Castle Peak Road)	4 (Tuen Mun Highway)	2	3	3	16
Tung Tau Yuen Long		5 (Castle Peak Road)	5 (Route No.3)	3	2	2	17
Shek Mun Shatin		4 (Tolo Highway + Tate's Cairn Highway)	4 (Shing Mun Tunnel)	5	4	4	21
Tai Po Ind. Estate Tai Po		4 (Tai Po Road + Ting Kok Road)	3 (Tolo Highway + Shing Mun Tunnel)	2	3	3	15

legend: 5 best 1 worst

#### 4.2.6 Conclusion

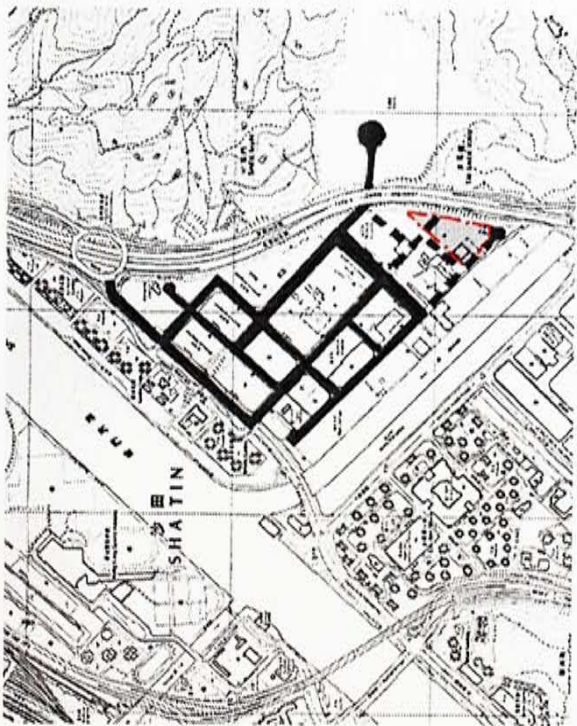
Shek Mun have the strongest visual connection and can be easily approached from the Tate's Cairn Highway. Due to the fact that Shek Mun is a new planning area, so that it can have a lower price and get a bigger flexibility for extension. Therefore it will take the highest score in the table and hence Shek Mun is the most suitable site for the Distribution Center.





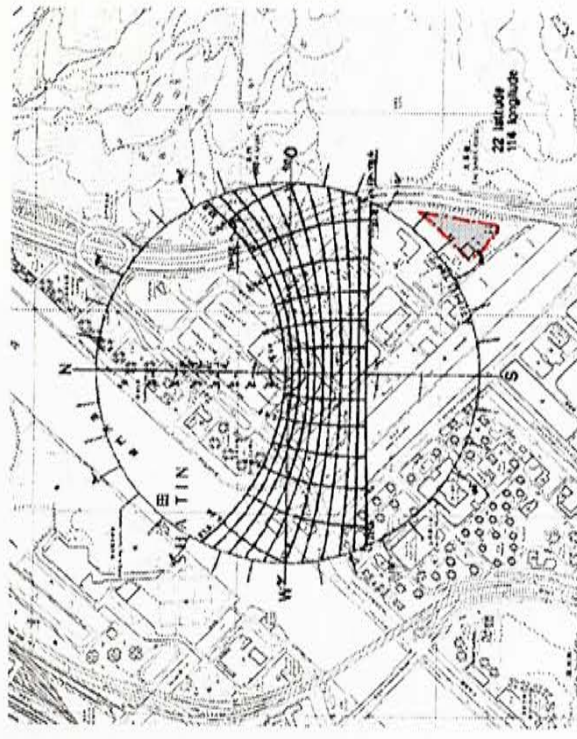


4.3.2 Site Analysis Diagram



Road Network in Shek Mun

Existing road  
Proposed road



Sunshading



Residential Area

Residential block



Proposed Railway Station and Rail in Future

Future station  
Proposed railway



View to the Center

View from residential  
View from highways

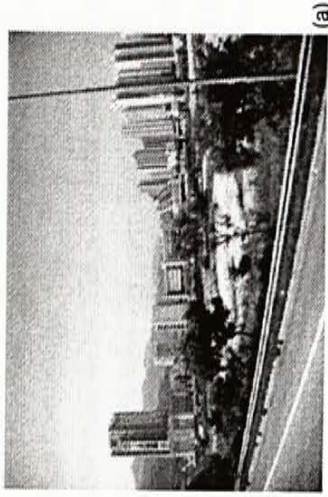
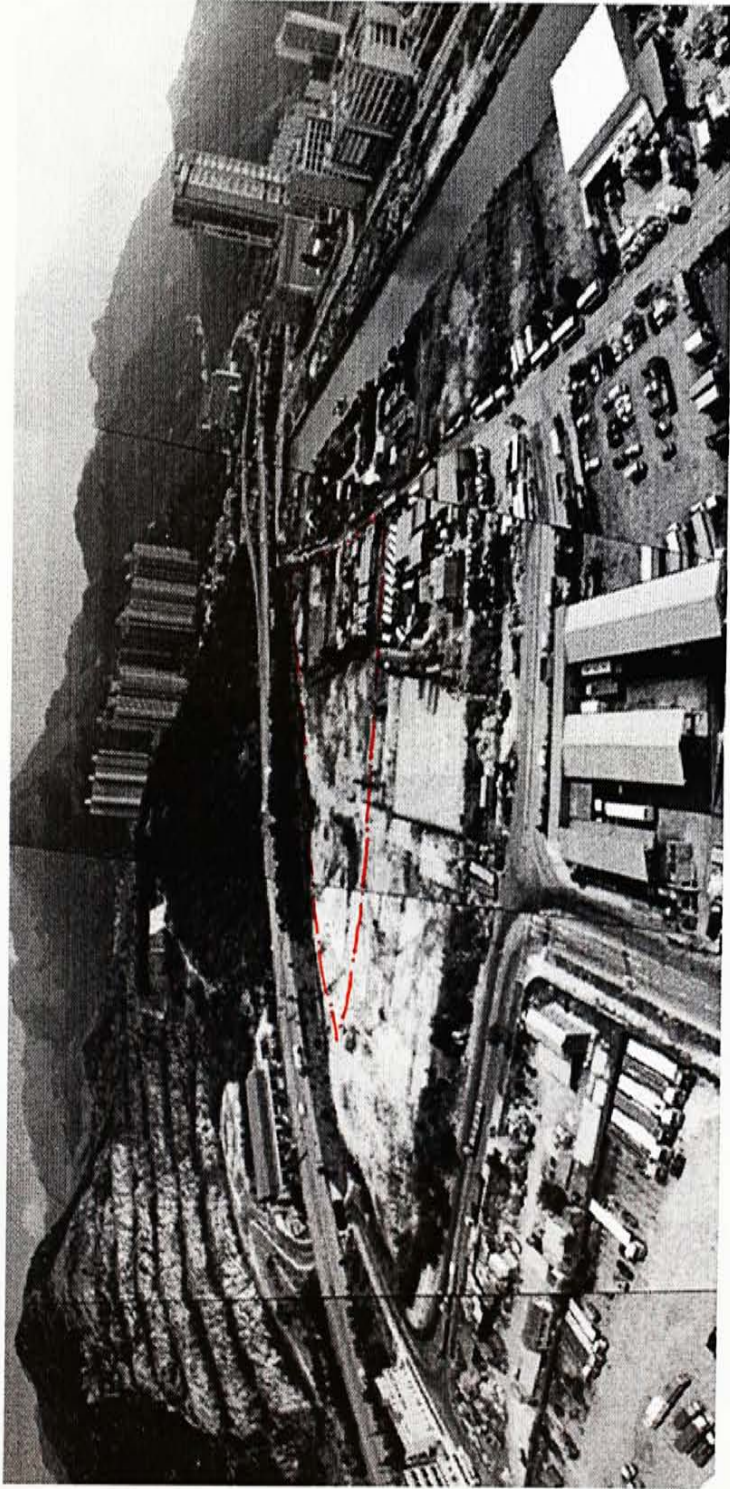


Vegetation

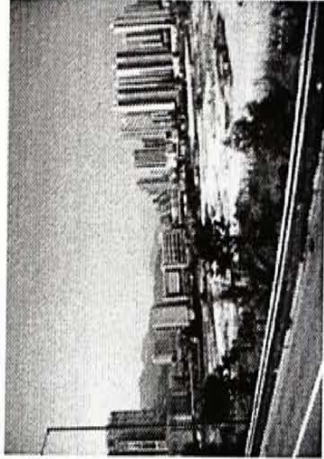
Vegetation  
District and local open space

Not 2009 E-20254 expand on this form.

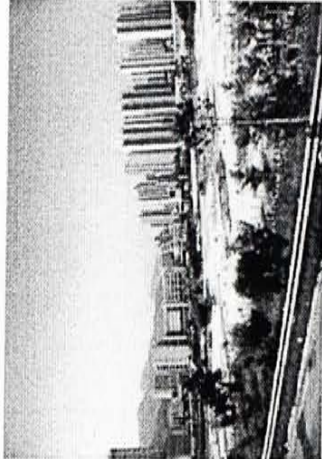
4.3.3 Site Photos



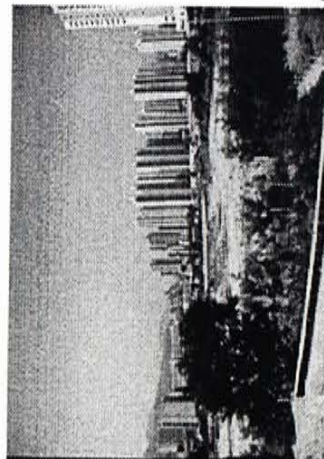
(a)



(b)

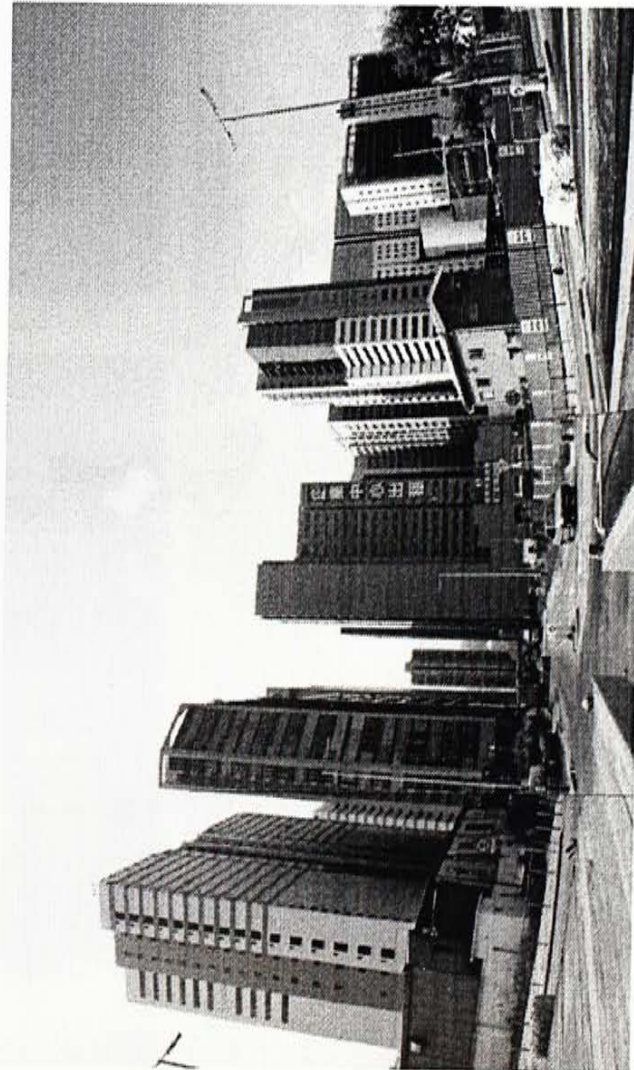


(c)

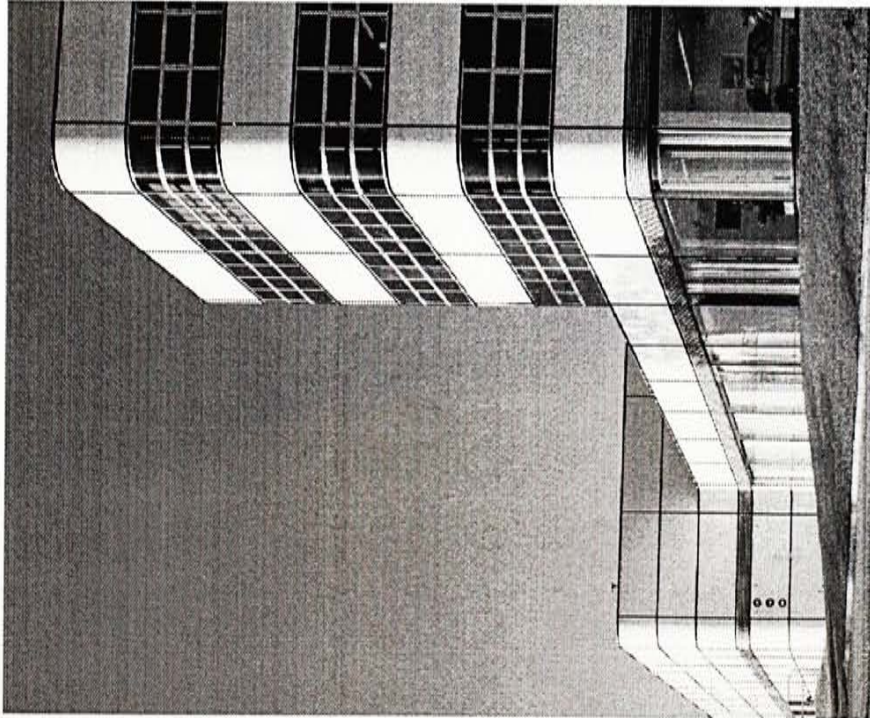


(d)

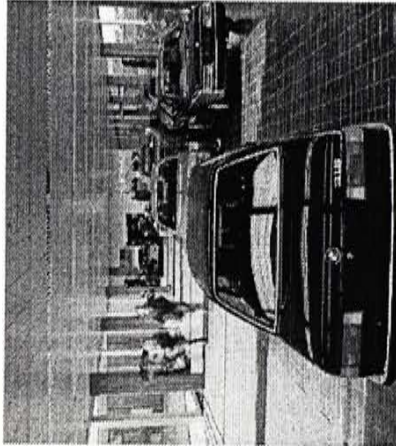
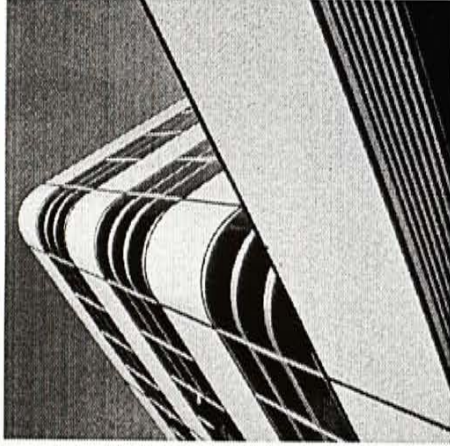
Above:  
Aerial View of Shek Mun industrial area.  
Left:  
Existing Industrial buildings that will face the future center  
Right:  
Series of views looking to the site from Tate's Cairn Highway.



## 5. Precedent Studies



The office, training center and the warehouse is integrated by using the same cladding system and detail.



The interior view of the showroom where can successfully express the identity of BMW: sophisticated, advanced, full of driving pleasure.

### 5.1 Headquarters for BMW, Bracknell, England

#### Short Construction Time

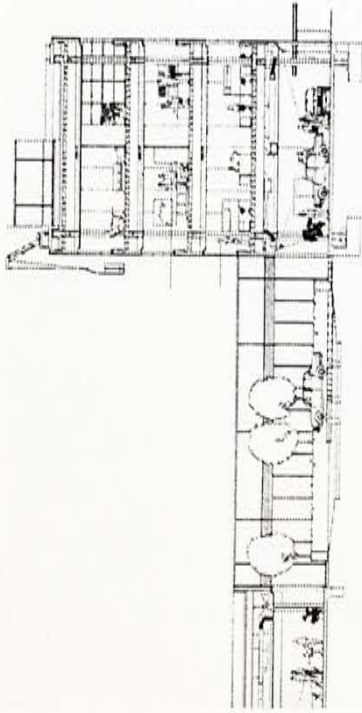
BMW chose the "design and build" method for the project to speed up the construction. The centre is using simple and high repetitive prefabricated cladding system. The structure is a simple 2 way steel column and beams for warehouse and single-bay portal frame for office. The time consumed for the project was only 15 months from the design stage to finished.

#### Unity of the Center

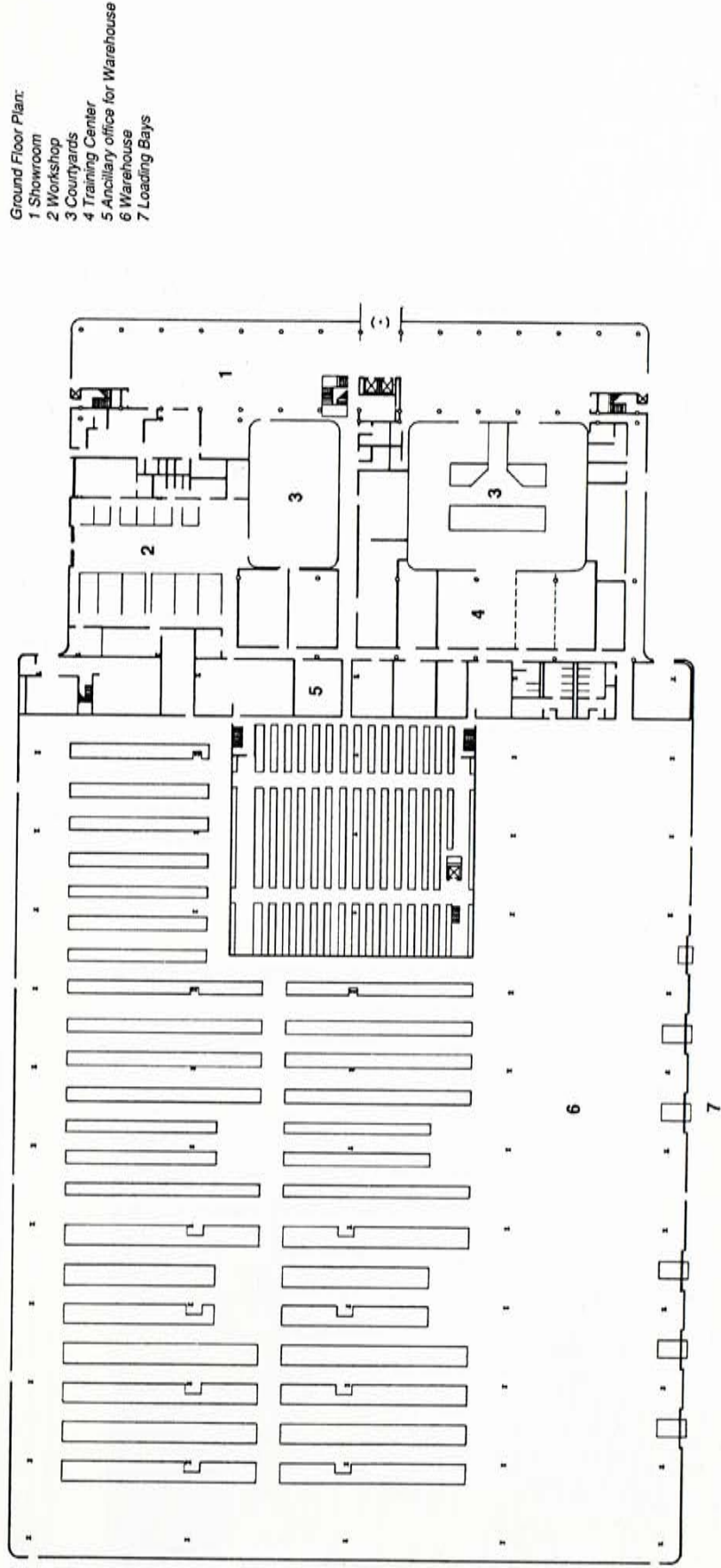
The building consists of three distinct parts: office, warehouse and showroom. They are united by using common system cladding, material and detail.

#### Office Block

The office block is a four storey one way span steel frame. It can be arranged in either open plan and cellular for greatest amount of flexibility. There are two landscaped courtyards inside the centre that allow the staff in the office to overlook.



Section showing the four storey block and the courtyard.



Ground Floor Plan:  
 1 Showroom  
 2 Workshop  
 3 Courtyards  
 4 Training Center  
 5 Ancillary office for Warehouse  
 6 Warehouse  
 7 Loading Bays

Name: Headquarters for BMW, Bracknell  
 Architect: Nicholas Grimshaw and Partners  
 Year of Completion: 1980  
 Technical Data:  
 Warehouse area: 10,200m<sup>2</sup>  
 height: 6.8m  
 span: 10 x 20m  
 Training Center area: 1,750m<sup>2</sup>  
 Office: 4,000m<sup>2</sup>

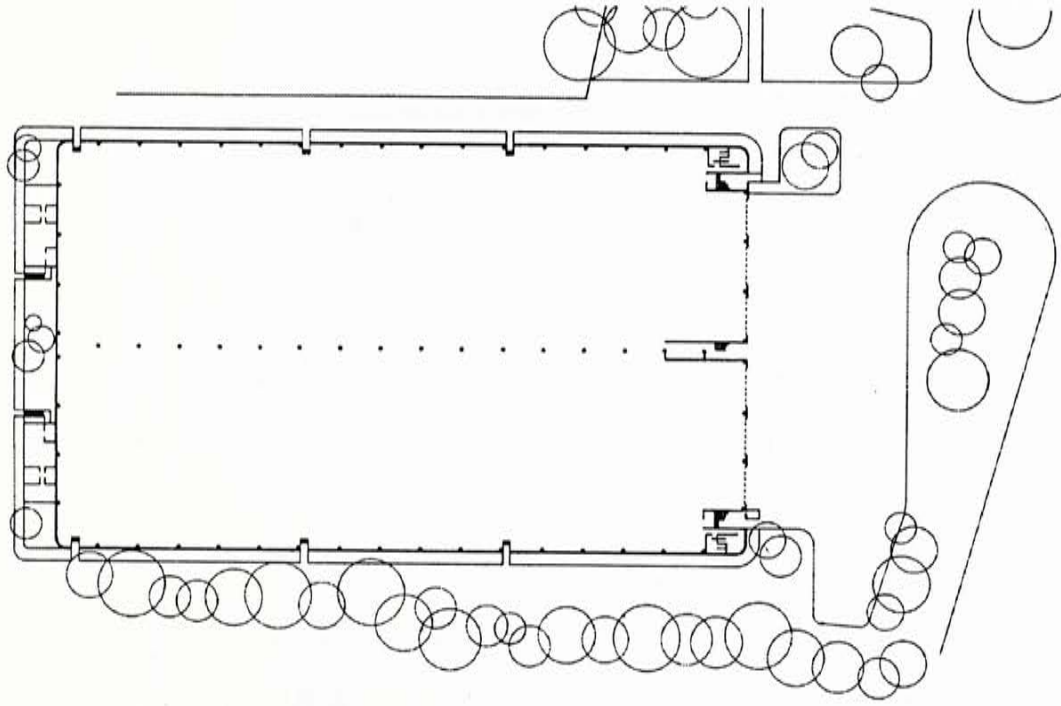
## 5.2 Citroen Warehouse, Runnymede, England

### Structural System

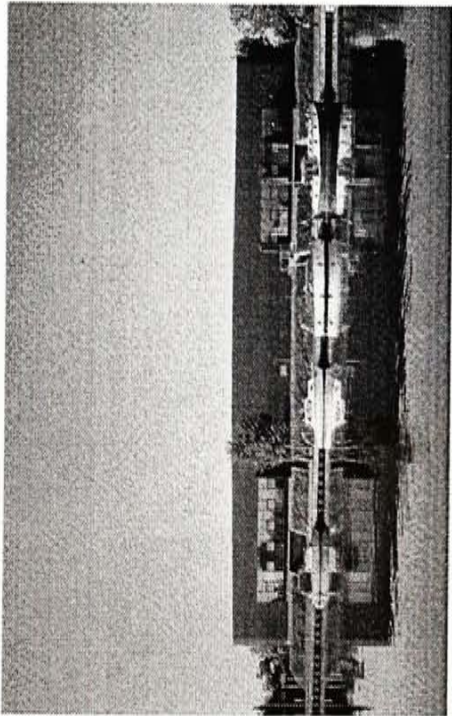
A single line of columns were erected at mid span which supported variable cross section cantilever steel. This solution can meet the client's requirement; the lowest cost, the longest span and the lowest overall roof height.

### Harmonic With The Surrounding

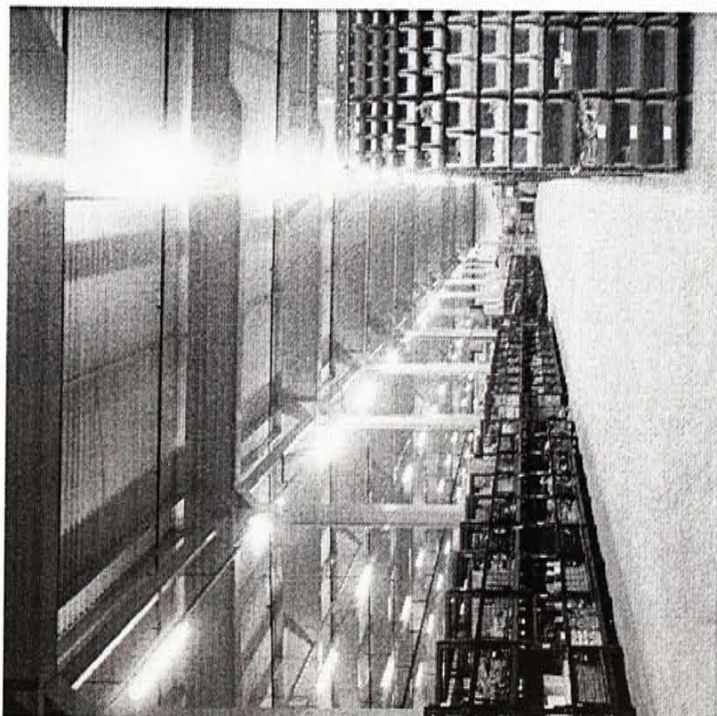
Since the site is along a riverside, it is crucial to be unobstructive and friendly to the environment. This is achieved by using olive green and bronze for the colour of the cladding and roof material. A grass bank at bottom and the boxy residential units on the north elevation helps to reduce the scale the building.



Ground floor plan showing the single rows of columns running down the middle of the warehouse.



The grass bank and the boxy residential units to reduce the scale of the north elevation.



Interior of the main warehouse showing the center columns and the variable cantilever beams to the edges of the building.

Name: Citroen Warehouse, Runnymede.  
 Architect: Nicholas Grimshaw and Partners  
 Years of Completion: 1972  
 Technical Data:  
 Warehouse Area: 4,700m<sup>2</sup>  
 height: 7m  
 span: 6.28 x 33m  
 Office: 930m<sup>2</sup>



### 5.3 Renault Distribution Center, Swindon, England

#### Square Umbrella Structural Module

The Center is using the square module as the main structural organization. The intention of architect is to bring office and warehouse together in a single envelope.

The modularity allows maximum flexibility for various functions to expand or contract. It also allows a high degree of off-site prefabrication and hence fulfills the client's requirement of shortest construction time.

#### Setback Elevation

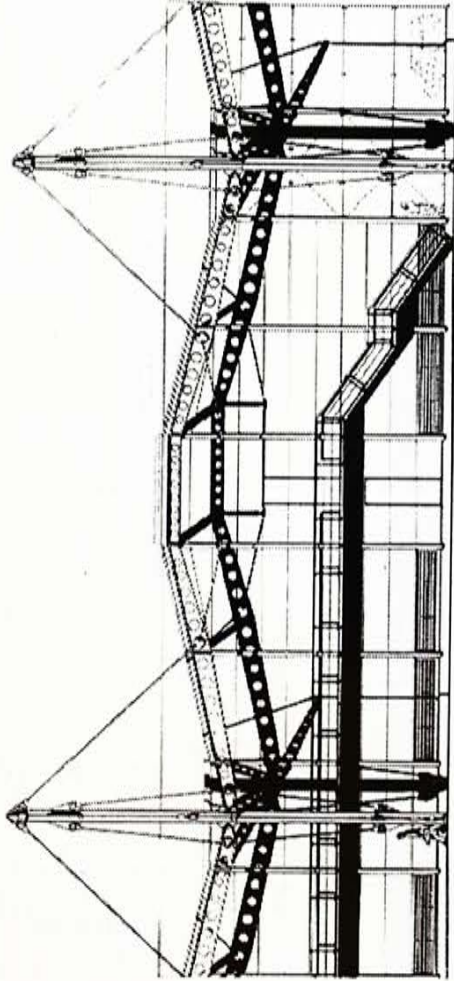
The elevation is setback 3m from the structure to enhance the express of the structure. There is another reason that it will increase the if the elevations are directly attached to the structure. So that the periphery structures have to be strengthened and then lost the concept of modularity.

#### Natural Sunlight

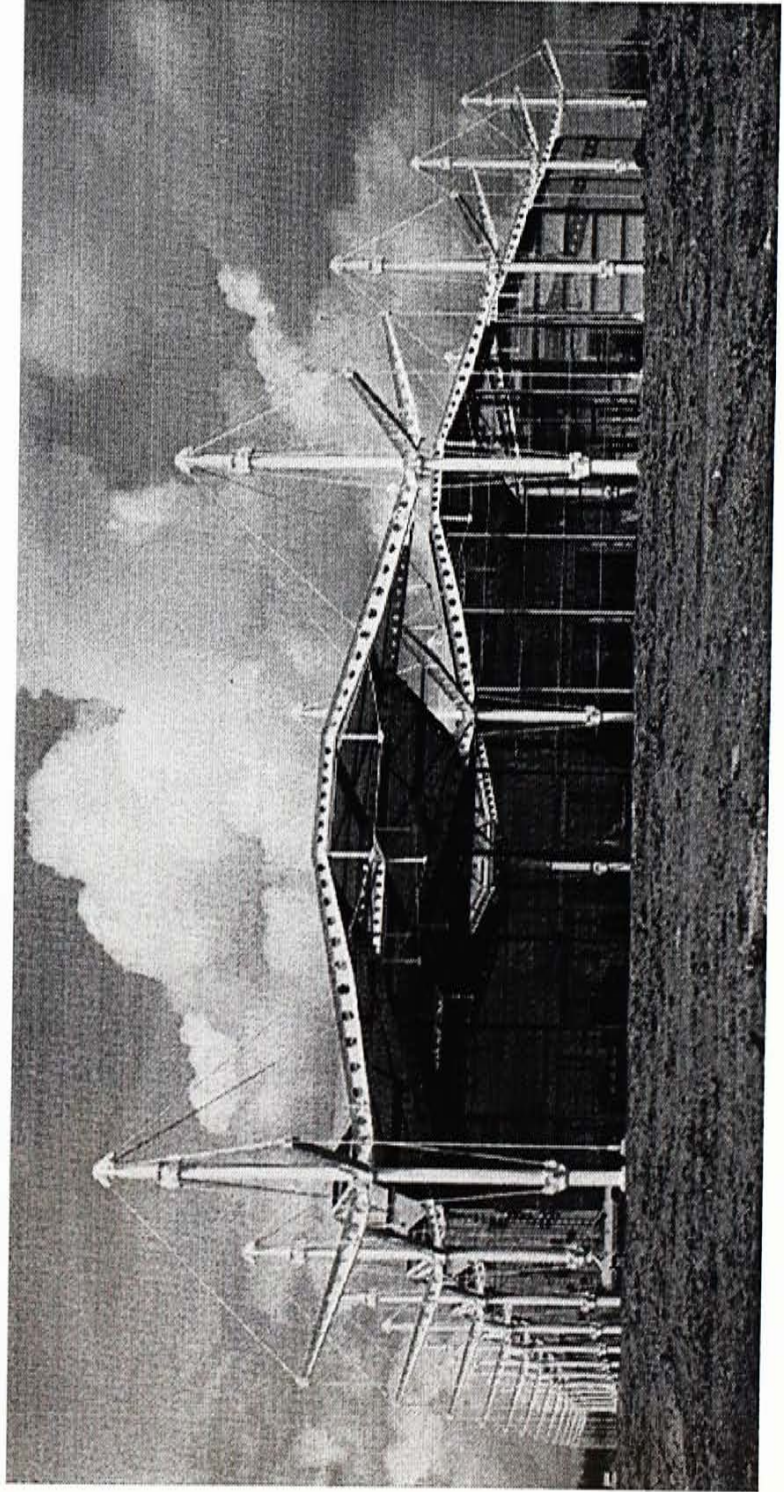
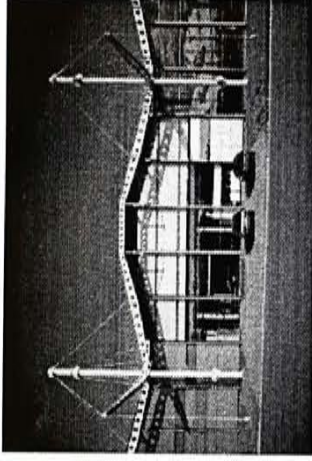
environment of the warehouse has been changed dramatically. People working inside are able to not only aware the outside weather but also appreciate the dynamic roof structure.

#### Structural Expression

The beams are tapered and drilled lines of holes to reduce the weight as well as express how the structure works.

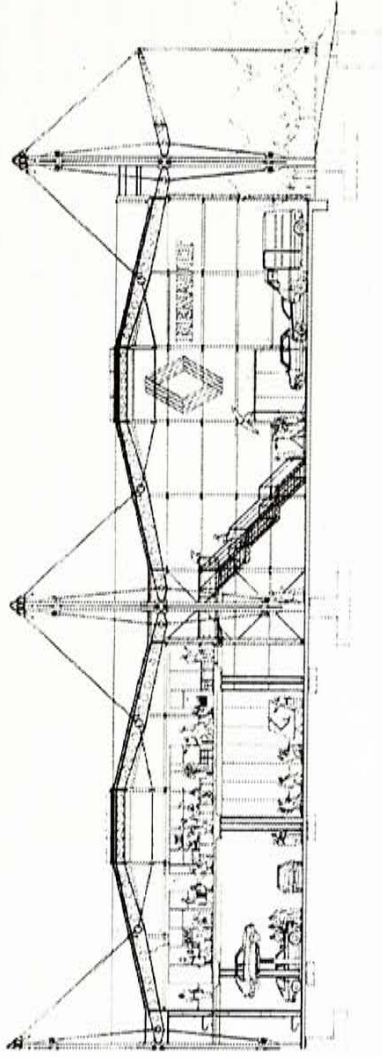


*Presentation drawing and the real elevation of the Center. It clearly shows the expression of the structure by the setback elevation. It also clearly show the dramatic effect of the three side glazed gallery.*



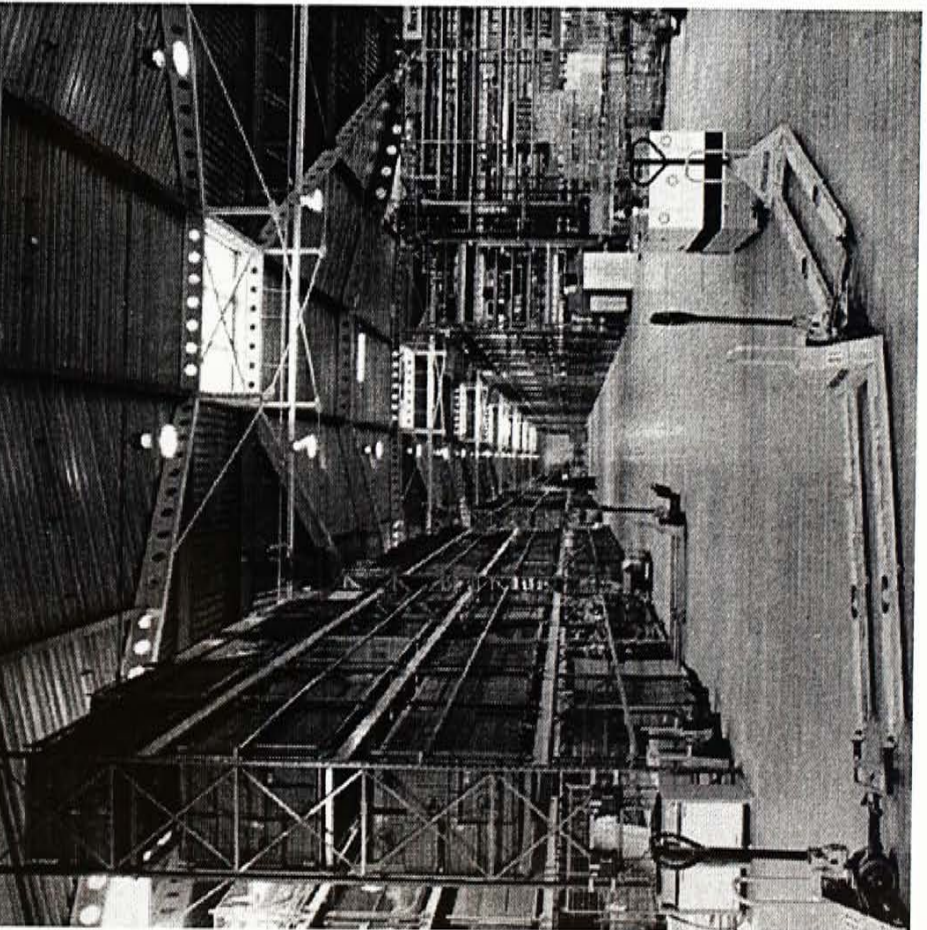
*"The structure clearly express the gravity forces working on the roof. But it doesn't give a very clear expression of the wind uplift forces."*

Nic Bailey



Above left:

Ground floor plan of the center. The center is composed by 42 structural module while 36 modules are the warehouse which contains LUL area (1), fireproof store (2), and the main warehouse (3). 3 modules are training school and office on mezzanine level (4). The last 3 modules are the gallery (5) and 'porte cochere'.



Interior of the warehouse. The warehouse accommodates a central service plant area, an enclosed fire-resistant area for inflammable products, secure store, battery changing facilities and lavatories. Distribution is using the robot trailer system.

Section of the center cut through the gallery on right, concrete mezzanine office and the training center.

Name: Renault Distribution Center  
 Architect: Foster Associates  
 Years of Completion: 1983  
 Technical Data:  
 Warehouse Area: 20,000m<sup>2</sup>  
 height: 8m  
 span: 24 x 24m  
 Office + Training center: 4,000m<sup>2</sup>



# 6. Design Criteria

## 6.1 Performance requirement

### 6.1.1 Maintenance Center (A)

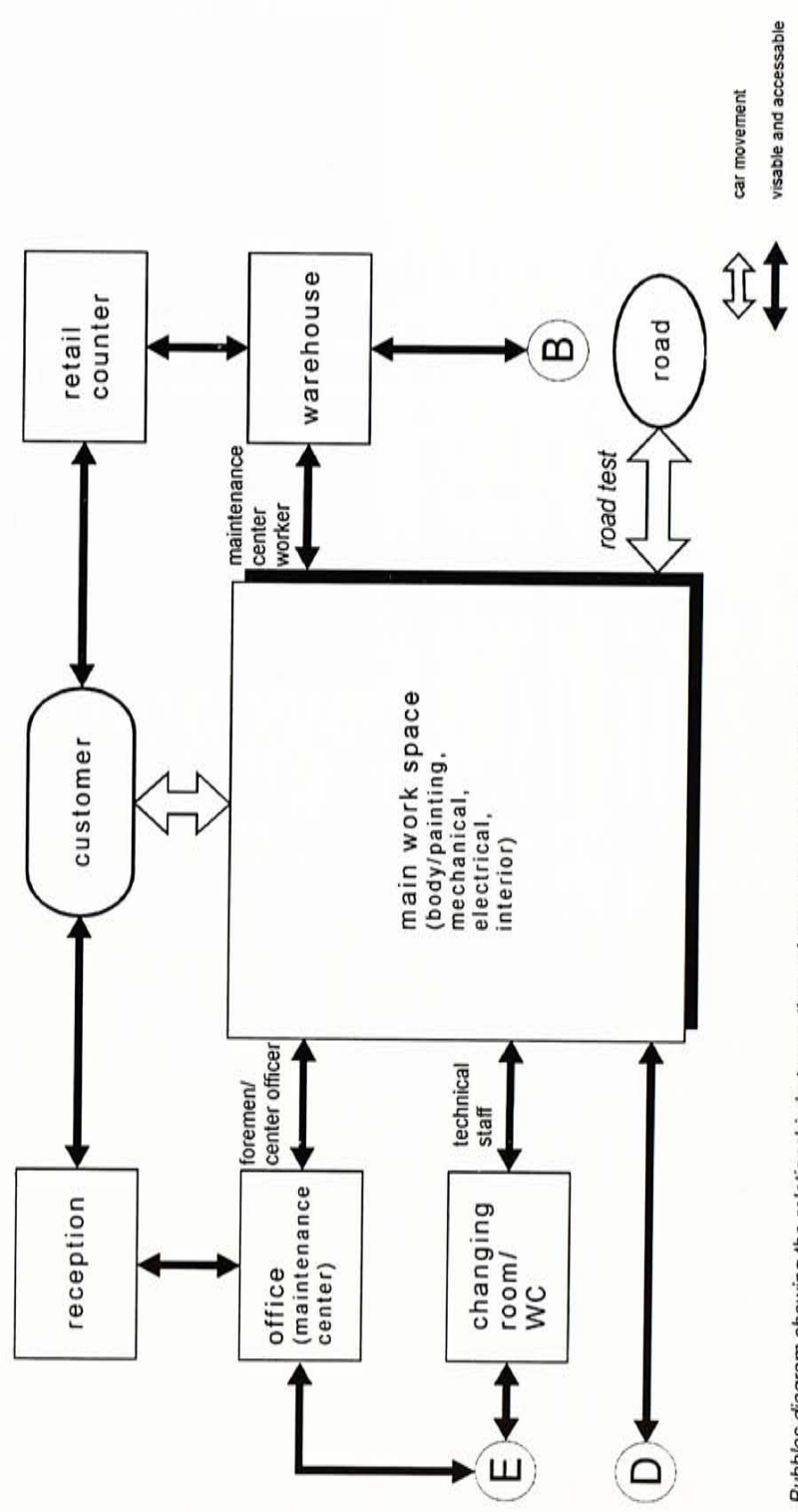
The maintenance center perform three major function: providing regular maintenance service , car repairing and retailing of genuine spare parts. The first two are similar in nature but first is more important. It can not only enhance the durability of the car but also allows drivers to enjoy driving in the safest way. An excellent service can also increase the confident to the owners. Basically the maintenance center are composed of a main working space, office and reception and a spare storage.

### Mechanical and Electrical Service

For the maintenance service it can divide into four working area: body/painting, mechanical, electrical and interior. Mechanical checking included the engine checking, transmission system, braking system and steering system. The staff will check the components whether they normally unction. They will change the parts such as filter, lubricant and adjust the setting like valve clearance, steering wheel free play. Electrical checking include battery, generator, air conditioner and headlamp. The procedures are similar to the mechanical checking. Most of the time the cars will be driven to the hoist during the service. The hydraulic hoist will raised the car to allows the mechanical staff the check the bottom of the car like exhaust system or the braking system. For overhauling repair the major component such as engine and the gear box will be detached and moved to the heavy-duty room. This room will be enclosed and air-conditioned to provide a low-dust environment.

### Body/Painting Service

Body/painting work generally fall into the field of car-repairing. Most of the car transported to here after road accidents. The classic will firstly re-shaped by the dedicated type rectifying system. The body are then be re-shaped by hammering or changing the whole piece such as the windscreen and the headlamps. After all the whole body or bumper only will be baked painted. Installment of baked painted is necessary Certain amount of space will be used for paint drying.



Bubbles diagram showing the relationship between the maintenance center and the whole complex

**Interior Service**

Excluded electrical service, basically there is no necessary to have a specific service stall for the interior fitting. Any repairing on the interior such as leather seating or plastic components, maintenance center will call tailor to fix it. This kind of service is not frequently used.

**Architectural Space Requirement**

Architecturally a large space is required for a smooth operation to the maintenance center. The circulation have to be well planned so that each service stall can be easily be approached. Besides service stall, about one-fourth of space will be occupied by the interior parking. The function of the interior parking are allow the car waiting for the service or the owner to take away after the service.

Ventilation is the prime consideration on designing the maintenance center. It is because a bad ventilation system will trap the exhausted air and the odour of the paint inside the area that will badly harmful to the technical staff's health. Lighting is the second design issue. Sufficient lighting enable the staff to working more efficient. Conventional maintenance center depends on larger degree of artificial lighting that cannot provide a ideal lighting quality as well as energy wasting. Natural lighting can fulfill the two criteria mentioned. Drainage is also another consideration on designing a maintenance center . It is used for drains out the wastes engine oil or water during the repairing.

Beside the main working space, the office and reception are necessary to provide a nice environment for the customer to approach. They have to be easily be approached by the customer on the other hand have a close contact with the main working space. A warehouse store the spare parts that located near the main working space is very important for providing a good service. It can reduced the time for the maintenance center to request the spare parts. The warehouse also have to near the reception so that the customer can purchase the spare parts.

The main working area in Dah Chong Hong (Kowloon Bay). The car in the center will be driven to specific area for maintenance, either they will be driven to the hoist for the bottom checking or general working space. Cabinets will be provided to each technicians for storing general hand tools.



The reception and office in Dah Chong Hong (Kowloon Bay). It create a nice environment for the customer to feel comfortable.

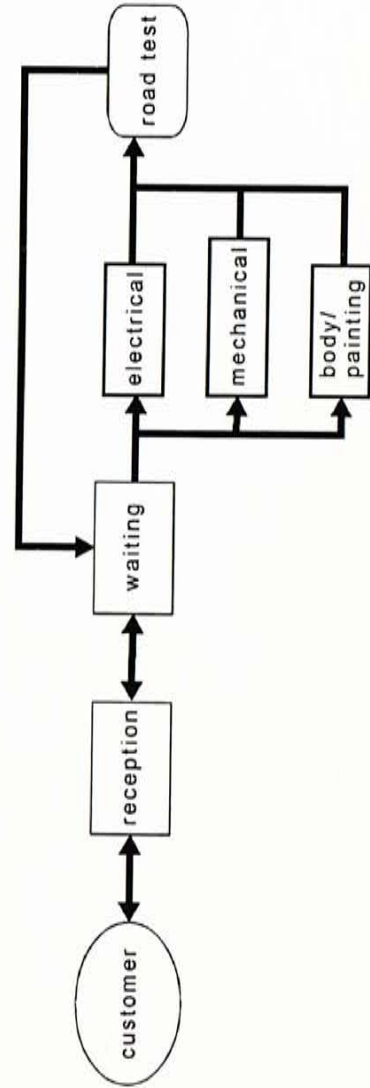


Diagram showing the procedure of a regular maintenance service



### 6.1.2 Warehouse (B)

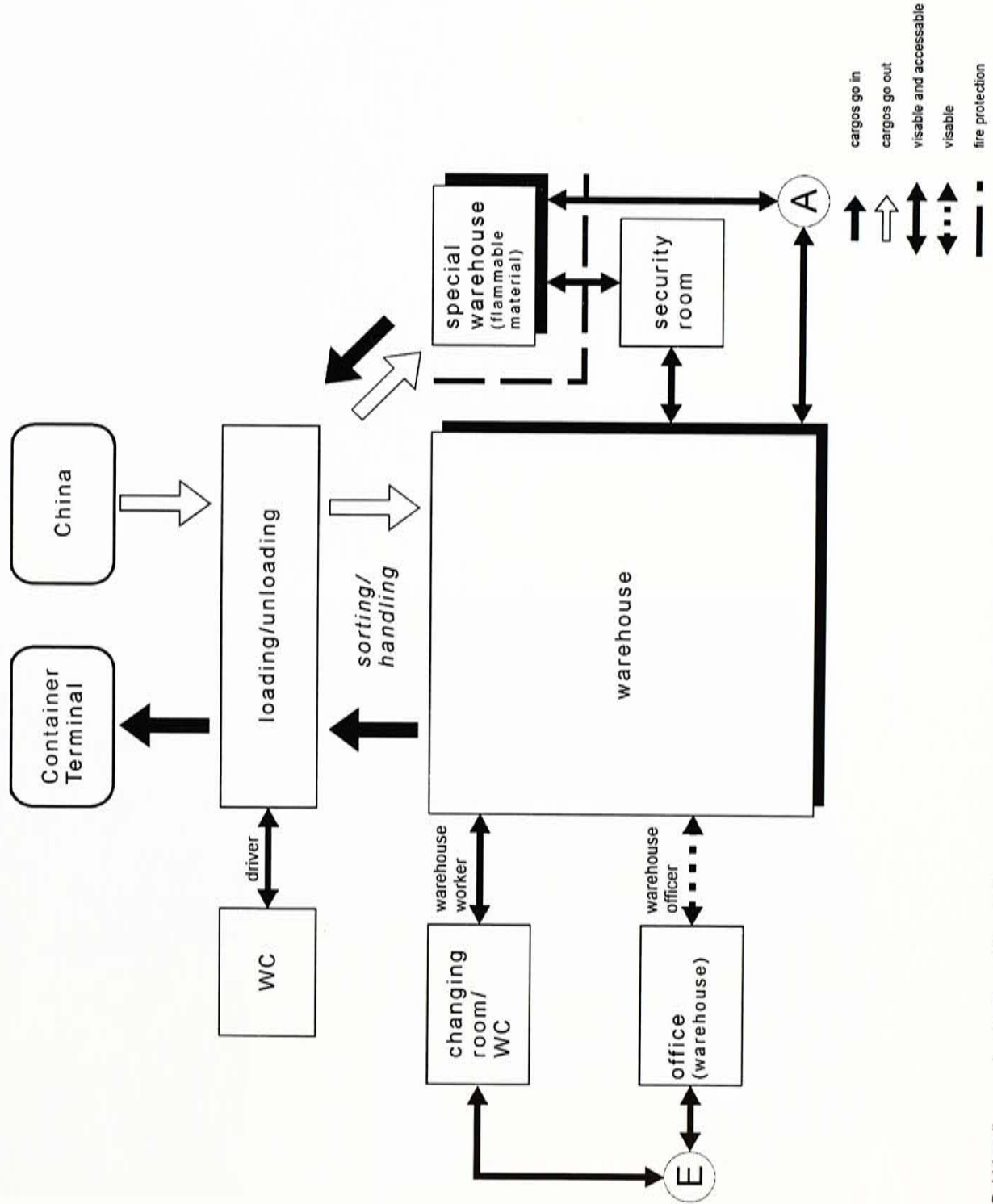
Generally a warehouse perform six kind of activities:

- (1) *Transfer*: This include the function, from the reception of goods to their storage and from the retrieval of goods to their delivery at a point where the expedition processes starts to their destination.
- (2) *Receiving*: In the receiving area, replenishment items arrive at the warehouse usually by rail; or in trucks. The major function are the loading of stock, unpacking, verification of the unloaded quantities against the invoice, inspection of the material for damage, and entering the material into the warehouse inventory.
- (3) *Storage*: Identifies the location where goods are deposited are held there for a certain period of time, until they are demanded for stage or expedition purposes. This is the main line of warehousing activities.
- (4) *Handling*: concerns the operations directly related to the storage place and those linking one part of the storage system to another in the process of exploiting the warehousing facilities.
- (5) *Expediting*: The activities involved in expediting fall into two broad categories: a, expediting in a material handling sense, from the warehouse to the business environment; b, the preparation of all information documents connected with expediting.
- (6) *Packing*: Packaging is an important element of the expediting functions. In most warehouse it is found to be an integral part of the responsibility assigned to warehousing.

### Architectural Requirement

It is very important to have a careful consideration in the planning stage of warehouse design. The space provided is greatly depended on the nature of the storage items, the handling system and the storage system. In the center the nature of the item are the automobile components from China. Therefore the center will use the fork-lift truck handling system and the pallet in rack storage system. Detail decision will be discussed in Chapter 7.

The structure of the warehouse should be simple and easily be constructed. Complicated structure may cause long construction time and spend lots of money. It will also be not convenient for future extension. Generally prefabricated structure can fulfill those requirement but in Hong Kong site cast concrete construction performed very fast. Therefore the main structure can be a combination of two.



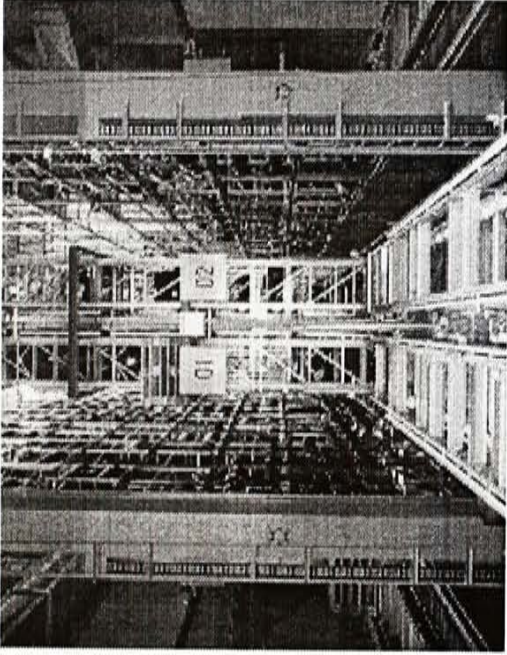
Bubbles diagram showing the relationship between the warehouse and the whole complex

The building envelope of the building should be opaque. Although a highly transparent facade can create a visual interest from the outside to the building that can enhance the image of the company, it will highly increase the construction and maintenance cost and cause a serious security problem. To enhance the security, lighting are necessary to provide on the periphery of the building envelope. So that it can convenient the security unit and it can an opportunities to create a interesting night view to the building.

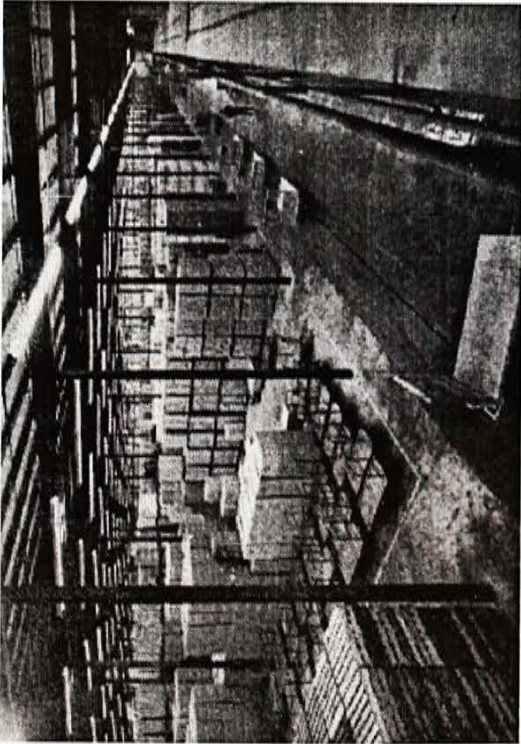
The office of the warehouse management should be located near the main storage space so that it can have a visual contact and can be directly accessed for the convenient of security. A security room should also be provided inside the warehouse so that overnight inspection is allowed.

The loading/unloading area should be located the area that used for the future extension. It should also provide sufficient internal circulation for the trailer to turn and drive the loading/unloading area. The entrance should be wide enough to allow the trailers to drive to the area smoothly. Otherwise it will cause a traffic congestion on the region. Actually in the existing industrial area, the loading/unloading are too closed to the traffic road so that the trailer and the lorries have to be queue up and cause a serious traffic problem.

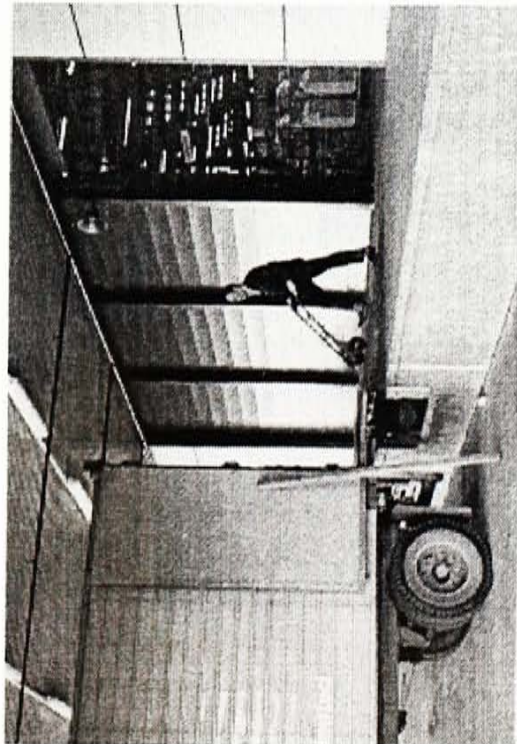
Basically the architectural spatial quality is not the prime criteria inside the warehouse but it can increase the productivity indirectly. As Henry Ford, said, "When you have lots of light, you can put the machines closer together. From the business standpoint the brighter is one of the very best investment."<sup>6</sup> It is a bonus to provide sufficient lighting and ventilation in the warehouse so that it can increase the capacity of the warehouse and hence the productivity.



Fully automatic transportation system. It is suitable for large scale warehouse.



The warehouse space using the stacking system. Typically it is suitable of the store items that are not frequently change and they will be stored for a period of time. It is generally a large enclosed space with artificial lighting and hence the internal environment is very bad.



The loading/unloading area of a warehouse. It have a raised platform so that it can be same level with the container so convenient in loading/unloading.

<sup>6</sup> Industrial Architecture in Europe, Constructec-Preis 94, p16

6.1.3 Showroom (C)

Identification

The first criteria of the showroom is to let the customer to identify the character of C88. It could be clearly express the character of the car: friendly, high technology and "made in China." To have the greatest advertising power, it is very important for the showroom to be identified from a distance, especially from the Tate's Cairn's Highway. It can be achieved by a expressive pylon or fascia. the structure of the center is also an effective element to do the job.

Entrance

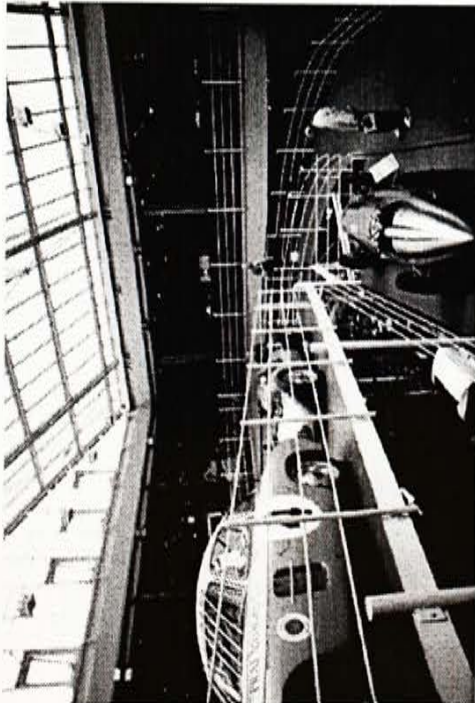
The entrance to a building is like a handshake. People immediately know whom you are meeting. The first requirement is of course for the entrance to be located where the visitor expects it to be, and to be clearly identified as such. This is best achieved with the aid of an expressive architectural elements such as a porch, gable roof. The entrance is quite distinct from the rest of the frontage and can be identified by the visitor at a glance.

Atmosphere

The atmosphere of the showroom must be primarily customer-oriented. It can create a atmosphere in which customers feel "at home. Transparency in layout is very important inside the showroom. It can encourage visitors to examine the surrounding showrooms and functional areas. The exhibition area should have sufficient space for the car to exhibit individually.

Lighting

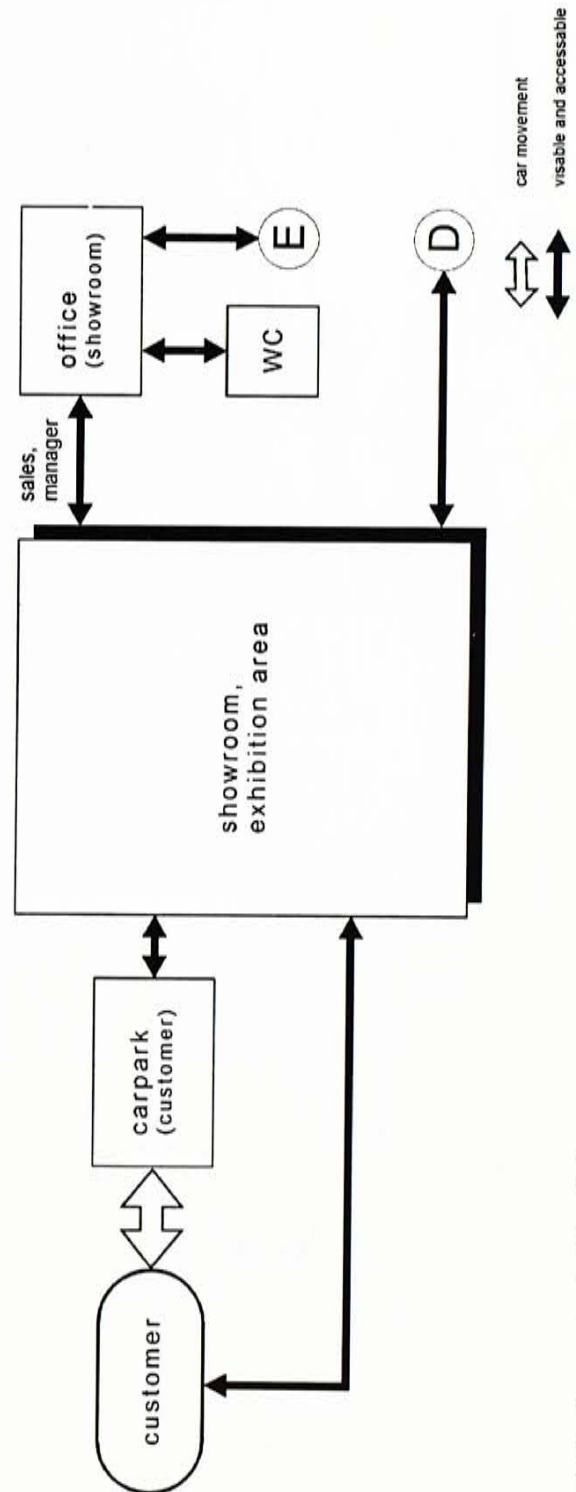
Cars looks desirable when displayed in ideal lighting conditions. Basically natural light can illuminate them at the best since their shapes and colours are expressed in their purity. Customer and visitor zones, a warmer light is a better choice.



Car museum of Mercedes Benz in Stuttgart. The whole space is linked by a ramp that visitor walk along the ramp to see the cars and walk through the history of Mercedes Benz. The whole space is naturally lit so that a soft and static environment is created.



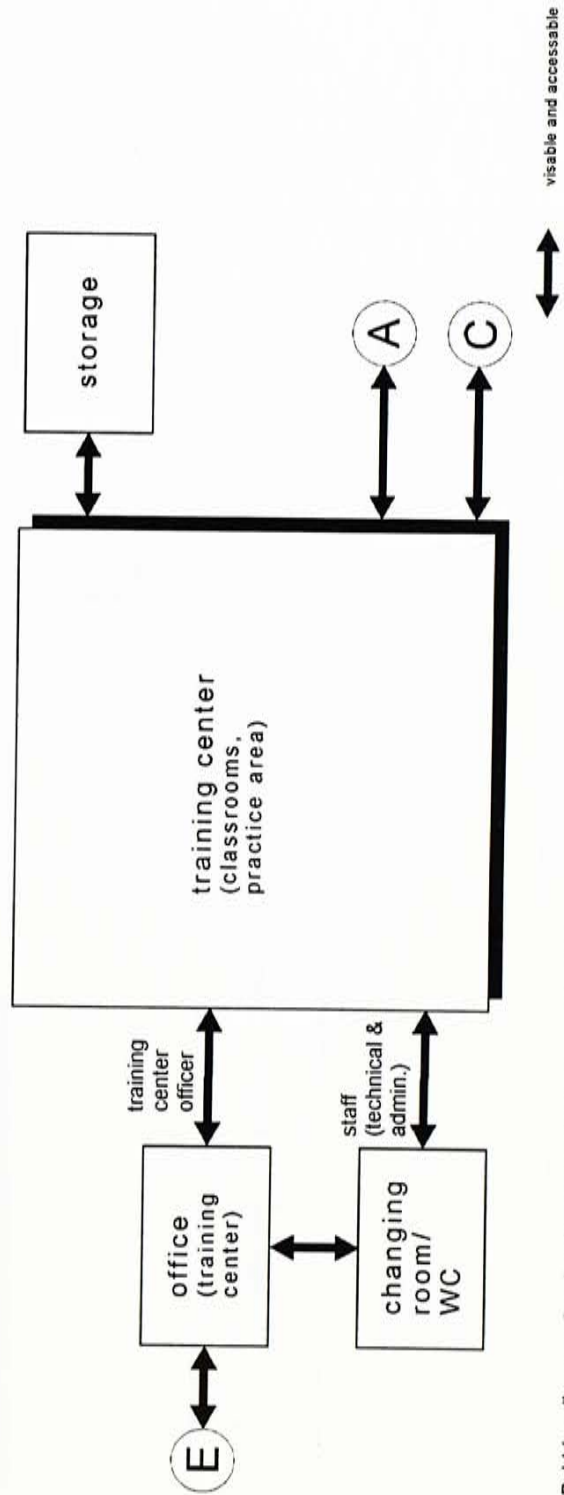
Car museum of BMW in Munich. The whole museum is in a bowl-shaped building and internally it is linked by a circular ramp. The lighting is artificial lit and create a dynamic atmosphere.



Bubbles diagram showing the relationship between the showroom and the whole complex

6.1.4 Training Center (D)

The training center provides two type of training: The first type is the sales and promotion skill and the second type is the maintenance and repairing C88 and Porsche. The first type is cater for the salesman and the second one is cater for the technical staff in the maintenance center. The classroom should provide a quiet environment so that it will not be disturbed by the outside environment. Instead of the classrooms, storage is also the major component for the training center. A larger storage is required for the maintenance course due to the installment of the large stimulation board. Moreover the maintenance classroom should be easy to access to the practice area.



Bubbles diagram showing the relationship between the training center and the whole complex



6.1.5 Miscellaneous (E)

Canteen

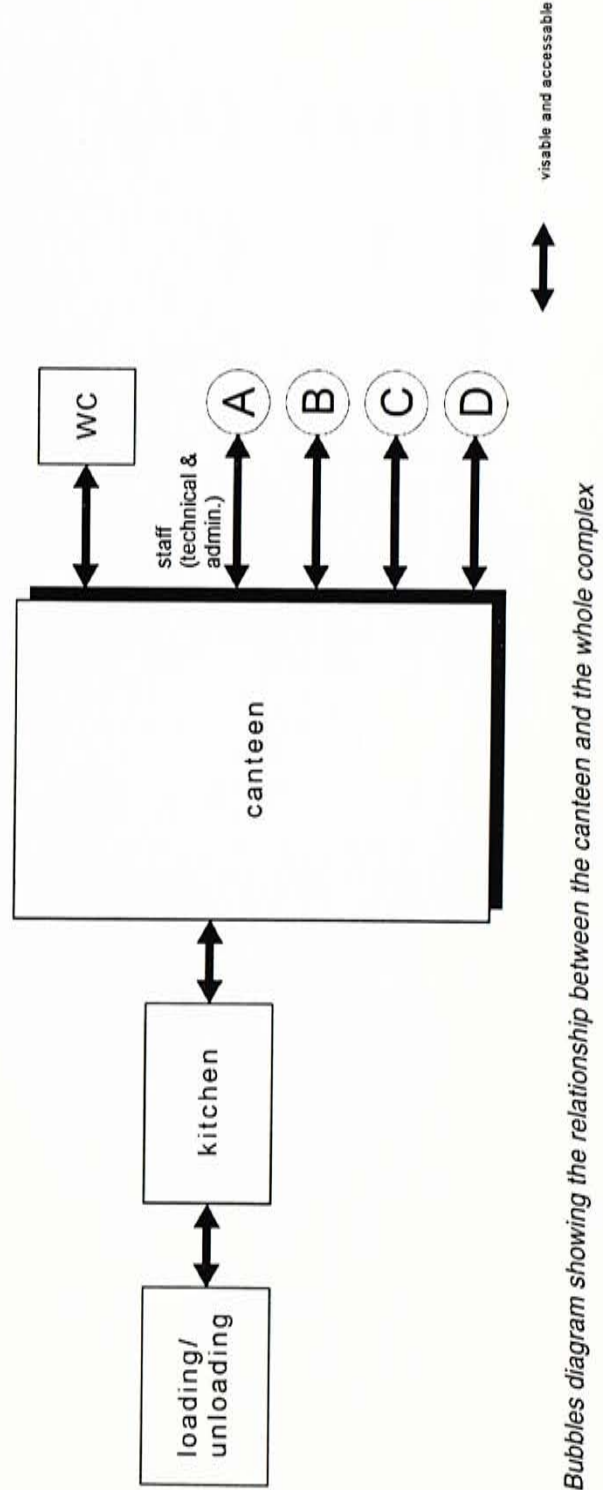
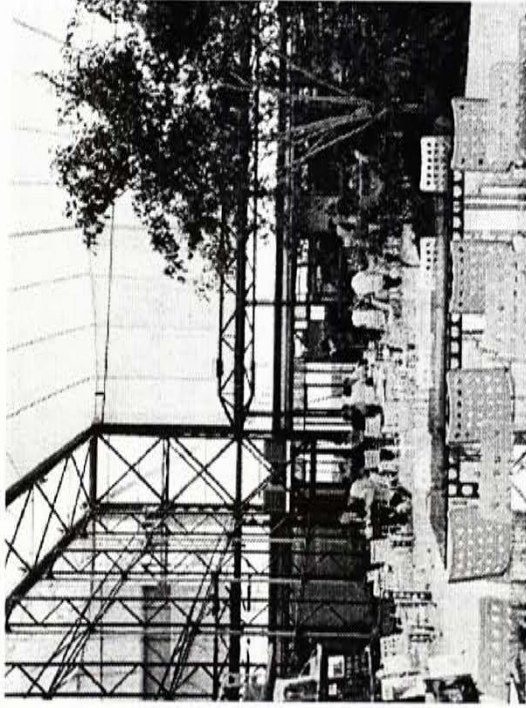
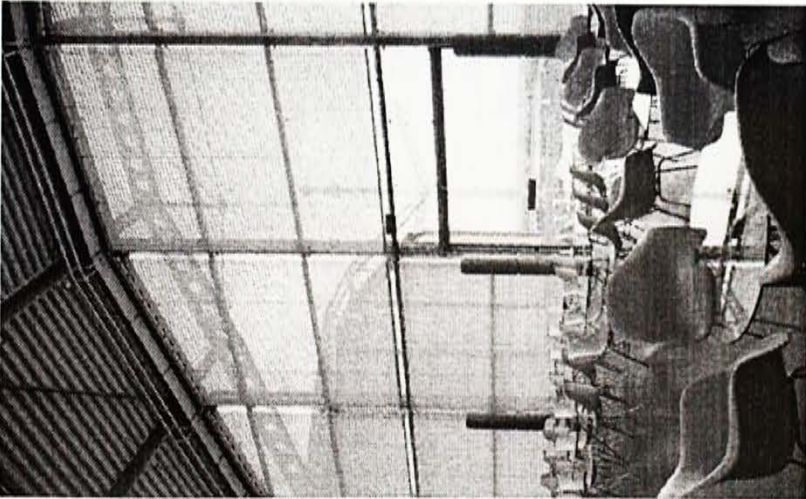
Canteen is the main meeting place that allows all the staff to meet. It is available as a place of relaxation throughout the day. It could be the best that the canteen is located in the central part of the center so that all the staff can take the advantage of the canteen without passing through a long distance. Since the kitchen has to load the food from time to time, it should have an extra loading/unloading area which can be distinguished from the warehouse loading/unloading area.

Administration Office

Each department inside the center should have a special office for management. The offices which cater for the maintenance and the warehouse is better to be located near the related workspace. On the other hand, a centralized administration office is easier to provide a better working environment than separated one. Therefore it is quite a good solution to locate the office to the central part of the center. Lighting and ventilation are the primary criteria for a good work space. Work areas and discussion zones should be lit for maximum ergonomic effect. Glare must be reduced to increase the working efficiency.

Left: Canteen in Renault Distribution Center in Swindon. The architect intends to create a common space both all the staff, so he use a double storey space to create a relaxed atmosphere.

Below: Winter Garden in Schlumberger Research Center in Cambridge. The whole space is covered by a teflon coated membrane structure so that large amount of diffuse light can be transmitted to the space to create a comfortable atmosphere.



Bubbles diagram showing the relationship between the canteen and the whole complex

## 6.2 Schedule of accommodation

## 6.2.1 Phase I

## (1) Maintenance Center

<i>place</i>	<i>l x w x g</i>	<i>area</i>
a, main work space:		
i, service stall	6 x 3 x 8	144m <sup>2</sup>
ii, body/paint stall	7 x 4 x 5	140m <sup>2</sup>
iii, front/end stall	7 x 4 x 2	56m <sup>2</sup>
iv, compressor	3.5 x 3 x 1	10.5m <sup>2</sup>
v, generator	7 x 4 x 1	28m <sup>2</sup>
vi, washing rack	7 x 4.5 x 1	31.5m <sup>2</sup>
vii, engine unit repair	7 x 5 x 1	35m <sup>2</sup>
viii, internal circulation	6 x 2.4 x 15	216m <sup>2</sup>
ix, internal parking	5 x 2.4 x 10	120m <sup>2</sup>
	total:	781m <sup>2</sup>
b, storage (spare parts)		
i, warehouse		225m <sup>2</sup>
ii, retail counter		25m <sup>2</sup>
	total:	250m <sup>2</sup>
c, office (maintenance center)		
i, workspace		50m <sup>2</sup>
ii, reception		25m <sup>2</sup>
	total:	75m <sup>2</sup>
d, changing room/toilet		
		40m <sup>2</sup>
	total:	1,146m <sup>2</sup>

## (2) Training School

<i>place</i>	<i>area</i>	
a, classroom	40 x 3	
	120m <sup>2</sup>	
b, storage		
	25m <sup>2</sup>	
c, office		
	50m <sup>2</sup>	
d, practice area		
	75m <sup>2</sup>	
	total:	270m <sup>2</sup>

## (3) Showroom

<i>place</i>	<i>area</i>	
a, exhibition area	500m <sup>2</sup>	
b, educating center	500m <sup>2</sup>	
c, cafe	100m <sup>2</sup>	
d theater	150m <sup>2</sup>	
e, negotiation area	25m <sup>2</sup>	
f, office	50m <sup>2</sup>	
g, vestibule	50m <sup>2</sup>	
	total:	1,375m <sup>2</sup>

## (4) Miscellaneous

<i>place</i>	<i>area</i>	
a, administration office	100m <sup>2</sup>	
b, canteen		
i, dining area	200m <sup>2</sup>	
ii, kitchen	70m <sup>2</sup>	
iii, loading/unloading	50m <sup>2</sup>	
	total:	250m <sup>2</sup>
c, toilet (admin. office)		
i, male	30m <sup>2</sup>	
ii, female	30m <sup>2</sup>	
	total:	60m <sup>2</sup>
d, mechanical area	200m <sup>2</sup>	
e, circulation	145m <sup>2</sup>	
	total:	755m <sup>2</sup>

total area of the center

3,546m<sup>2</sup>



## 6.2.2 Phase II

## (1) Maintenance Center

place	area
a, main work space:	
i, service stall	6 x 3 x 16
ii, body/paint stall	7 x 4 x 10
iii, front/end stall	7 x 4 x 4
iv, compressor	3.5 x 3 x 1
v, generator	7 x 4 x 1
vi, washing rack	7 x 4.5 x 1
vii, engine unit repair	7 x 5 x 1
viii, internal circulation	6 x 2.4 x 30
ix, internal parking	5 x 2.4 x 20
	total: 1,457m <sup>2</sup>
b, storage (spare parts)	
i, warehouse	475m <sup>2</sup>
ii, retail counter	25m <sup>2</sup>
	total: 500m <sup>2</sup>
c, office (maintenance center)	
i, workspace	50m <sup>2</sup>
ii, reception	25m <sup>2</sup>
	total: 75m <sup>2</sup>
d, changing room/toilet	40m <sup>2</sup>
	total: 2,072m <sup>2</sup>

## (2) Warehouse (new in phase II, phase III)

place	area
a, warehouse	
i, main storage space	3,250m <sup>2</sup>
ii, special storage (flammable material)	500m <sup>2</sup>
iii, sorting/handling	1,250m <sup>2</sup>
	total: 5,000m <sup>2</sup>
b, loading/unloading	600m <sup>2</sup>
c, toilet (driver)	10m <sup>2</sup>
d, changing room/toilet	40m <sup>2</sup>
e, office (warehouse)	50m <sup>2</sup>
f, security room	20m <sup>2</sup>
	total: 5720m <sup>2</sup>

## (3) Training School

place	area
a, classroom	40 x 3
b, storage	120m <sup>2</sup>
c, office	25m <sup>2</sup>
d, practice area	50m <sup>2</sup>
	75m <sup>2</sup>
	total: 270m <sup>2</sup>

## (4) Showroom

place	area
a, exhibition area	500m <sup>2</sup>
b, educating center	500m <sup>2</sup>
c, cafe	100m <sup>2</sup>
d theater	150m <sup>2</sup>
e, negotiation area	25m <sup>2</sup>
f, office	50m <sup>2</sup>
g, vestibule	50m <sup>2</sup>
	total: 1,375m <sup>2</sup>

## (5) Miscellaneous

place	area
a, administration office	100m <sup>2</sup>
b, canteen	
i, dining area	200m <sup>2</sup>
ii, kitchen	70m <sup>2</sup>
iii, loading/unloading	50m <sup>2</sup>
	total: 250m <sup>2</sup>
c, toilet (admin. office)	
i, male	30m <sup>2</sup>
ii, female	30m <sup>2</sup>
	total: 60m <sup>2</sup>
d, mechanical area	200m <sup>2</sup>
e, circulation	145m <sup>2</sup>
	total: 755m <sup>2</sup>

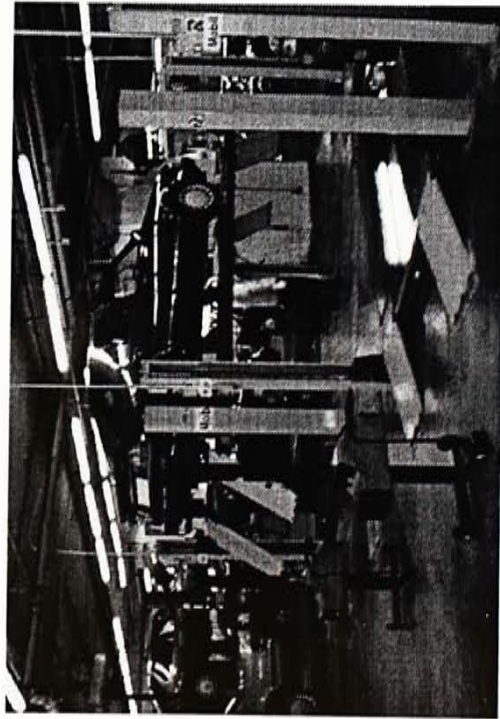
total area of the center :

10,192m<sup>2</sup>

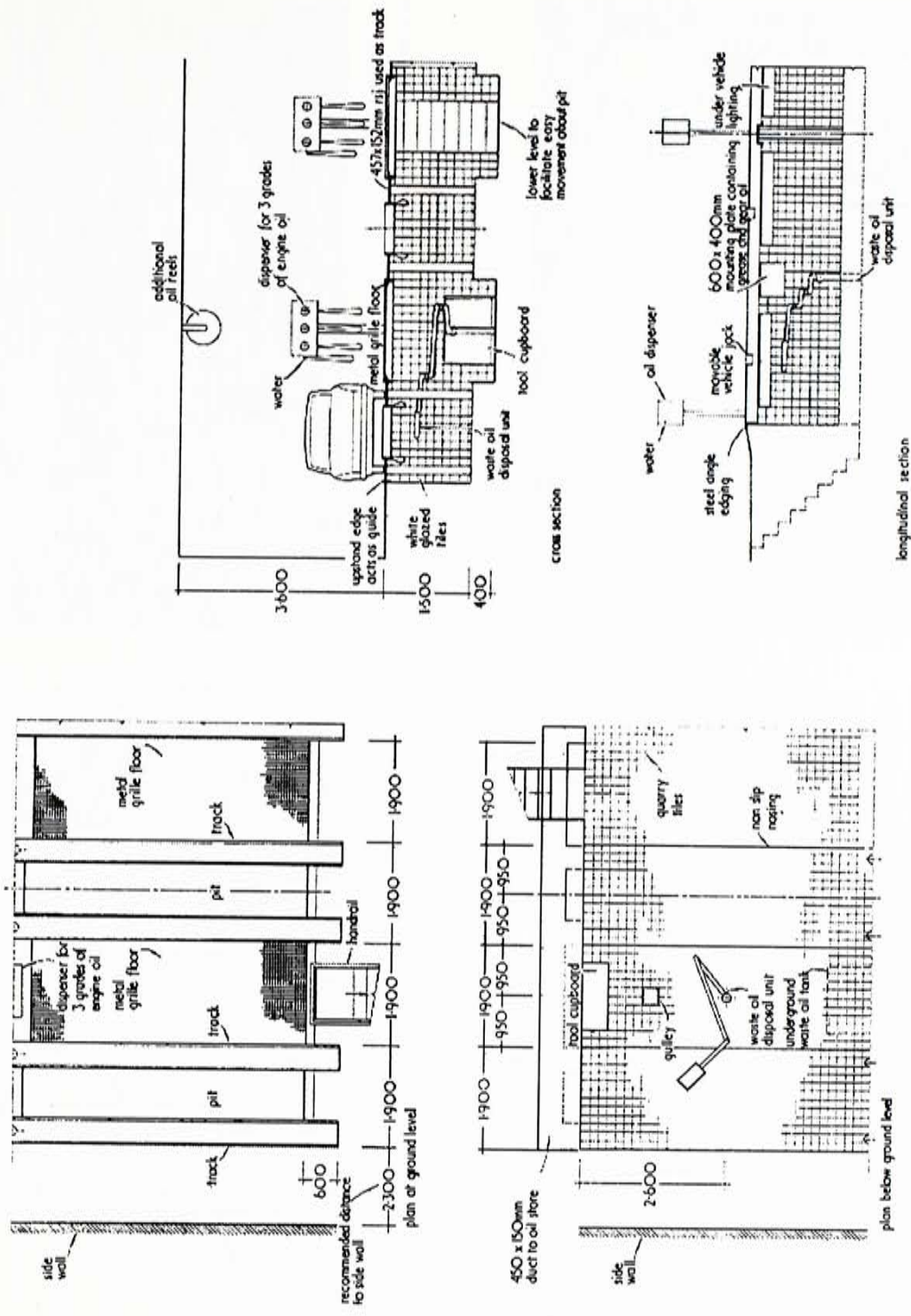
## 7. Technical Information

### 7.1 Maintenance center

#### 7.1.1 Hoist



Typical hoist in Dah Chong Hong (Kowloon Bay). The function of the hoist is to raise the car so that it can be checked the bottom of the car or the braking system by the technician.



Plans and sections showing the dimension of the service pits. It is quite different from the typical hoist in Hong Kong. It is because it required an underground performance which will increase the installation cost.

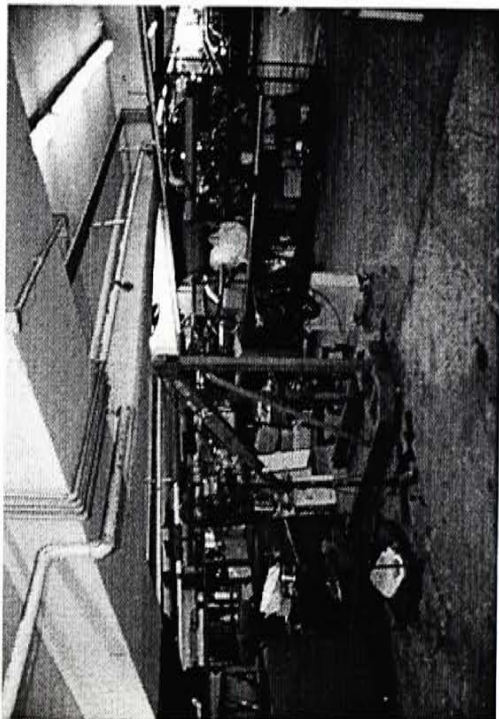
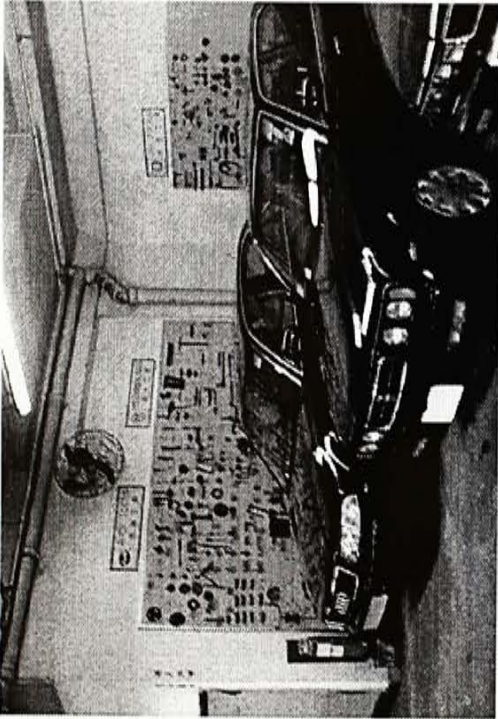


### 7.1.2 Ventilation duct



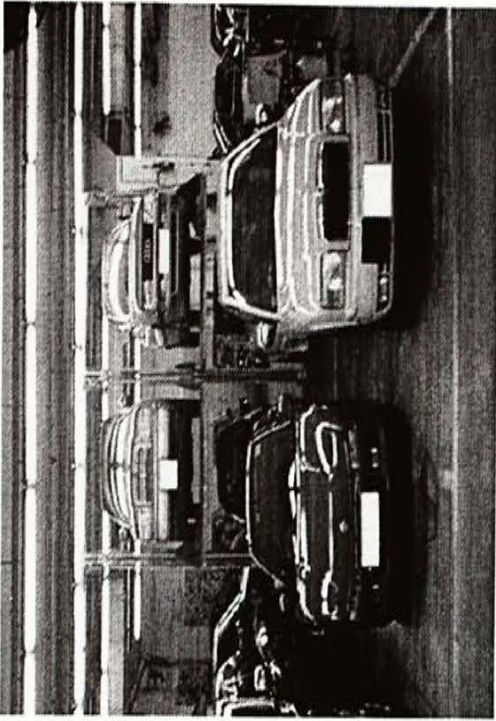
Ventilation Dust in Dah Chong Hong mechanical service. The duct suspended will be pulled down and connected to the exhausted duct of the vehicles. So that during the testing the exhausted air will be transported to the outside environment and will not pollute the internal environment. For the Body/Painting service the ventilation are much more large scale because the odour of the painting are much more harmful to people's health.

### 7.1.3 Tools and Storage



The hand tools are placed on the wall so that the technicians can easily to find them. The wall space for the storage for one set of hand tools are 2m x 3m. There are two set of tools on the wall because different manufacturers will have their specific tools catering for the own cars. In the CADDC since it will also cater for both C88 and Porsche, wall space for hands tool will be doubled for two different kind of car served. Large equipment will be stored on a storage. Typically the storage are just left-over space inside the center. Some of them will be difficult to find.

### 7.1.4 Carpark



In some case mechanical parking are required to increase the capacity of the waiting area in case of the peaking hour. The area for the installment of the two storey carpark is 6m x 3m and the minimum height is 2.5 m.

### 7.1.5 Brake Tester



The brake tester is used to check the efficiency of the braking system. The tester shown allow two vehicles to be tested at the same time. It required large floor area at 12m x 3.2m. There is another kind of break tester that are sunk into the ground and on the same floor level.

7.2 Warehouse

7.2.1 Trailer

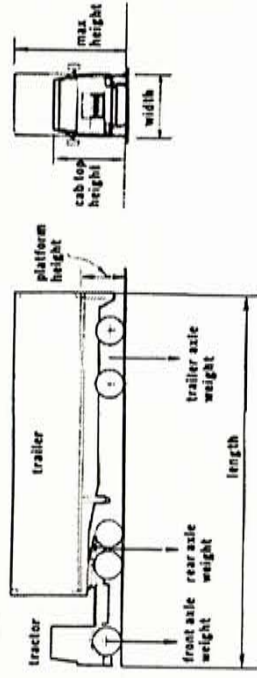
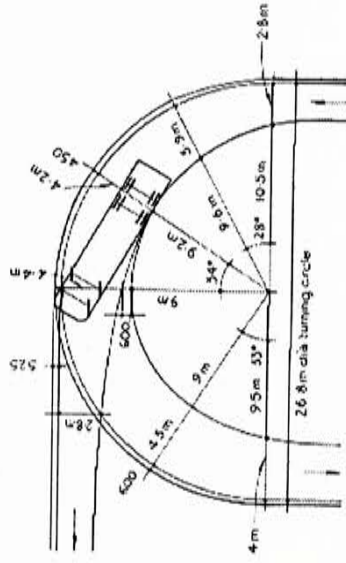
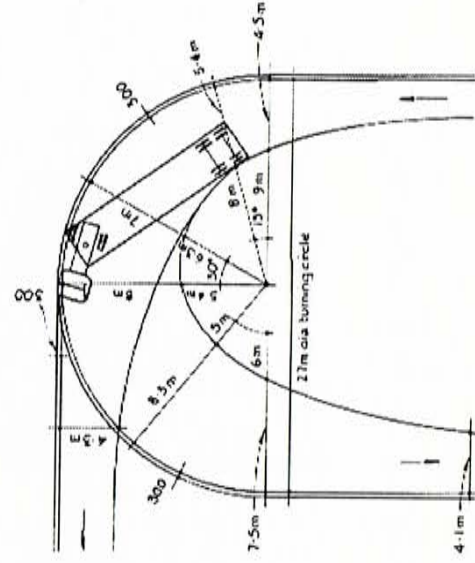


Diagram show the precise limits for European goods vehicles. For USA box trailer are usually 13.2m x 2.59m with 1.2m loading height.






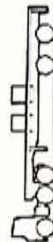


Turning and tracking dimensions for a four axle rigid vehicle; this type is popular for bulk transport.



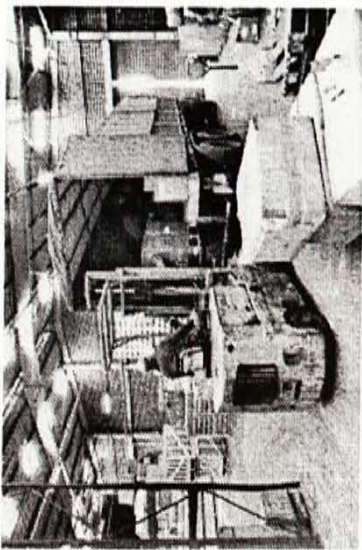
Turning and cut-in dimensions for a maximum-sized articulated vehicle: this is a typical tight turn at 5 to 10mph. In extreme circumstances the vehicles can fold to 90 and pivot about the center point of the trailer's axles; this manoeuvre causes pavement and tyre wear and should be avoided where possible.



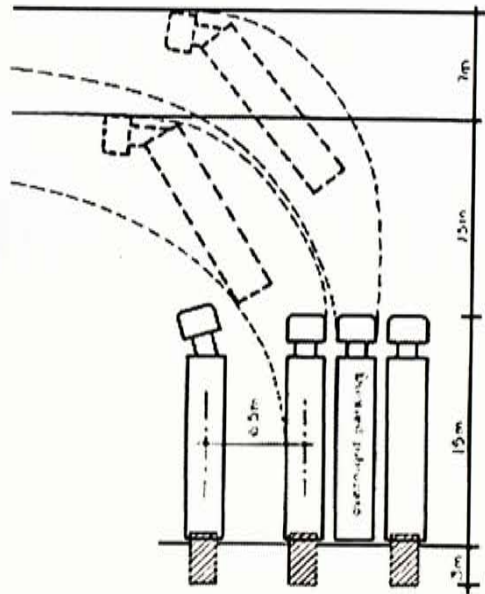
Table 2: Typology of the heavy goods vehicles:

Heavy goods vehicles	length (m)	Width (m)	Cab top height (m)	Maximum height (m)	Platform height (m)	Front axle weight (tonnes)	Rear tractor axle or bogie weight (tonnes)	Trailer axle or bogie weight (tonnes)	Gross combined weight (tonnes)	Turning circle diameter(m)
Five-axle articulated with 12.2 x 2.6m high container. End loading. 	15	2.5	2.75	4.2	1.2	5.5	10.1	16.9	32.5	24-30
Four axle articulated with curtain side trailer for packaging material. Side loading. 	15	2.5	2.75	4.5	1.2	5.5	10.1	16.9	32.5	24-30
Tractor with twin steer front bogie with flatbed trailer. Typically for steel bars: some extend to 18m length. 	15 (18)	2.5	2.5	4.2	1.2	8.2	9.7	14.6	32.5	24-30
Three-axle tractor with trailer for carrying steel coils. Overhead handling. 	15	2.5	2.75	3.2	1.2	3.7/3.9	10.1	14.8	32.5	24-30
Three-axle tractor with low loading trailer. Overhead or roll-on loading. For indivisible loads and plant deliveries. 	15	2.5	2.9	4.1	0.65	3.7	12.6	16.2	32.5	30
Articulated pantechicon van: high volume for light goods. End loading. Can be on open frame form for steel pressing. Side loading. 	15	2.5	2.55	4.5	0.45-0.85	4.5	9.9	9.9	24.3	24-30

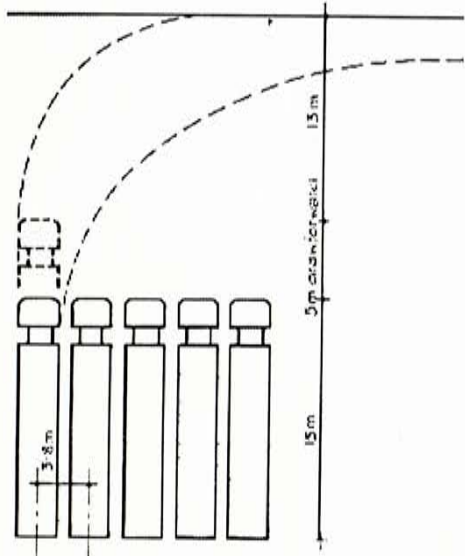
7.2.2 Loading/Unloading



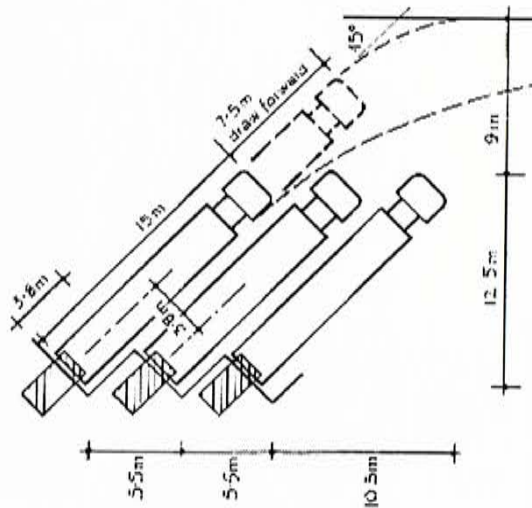
Buildings without loading docks often entail vehicles unloading inside the factory or warehouse: a waste of space and money.



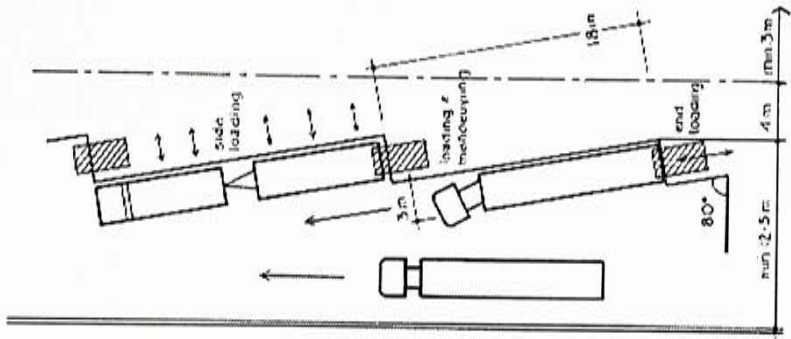
Loading bay spacing in relation to yard depth; raised dock. The diagram show a 6.5m loading bay spacing, suitable for rapid turnaround of maximum-size vehicles.



Minimum bay spacing or smooth operation: note deeper yard compared with the wider spacing, due to draw forward prior to turning.

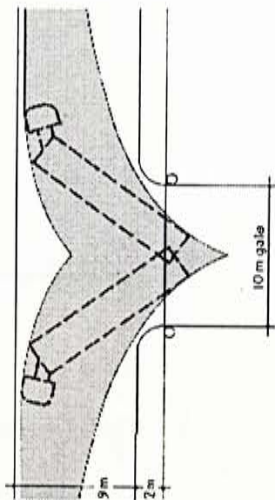
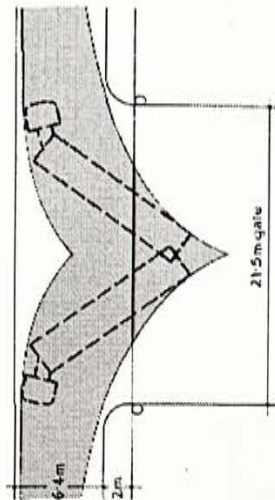


Maneuvering area required for angled dock.

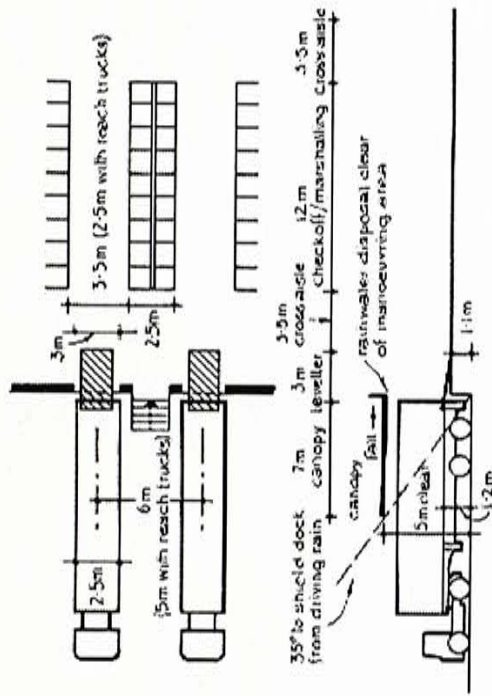


Where maneuvering depth is very limited and where rapid side and end loading are equally important, raised finger docks can provide an effective solution.

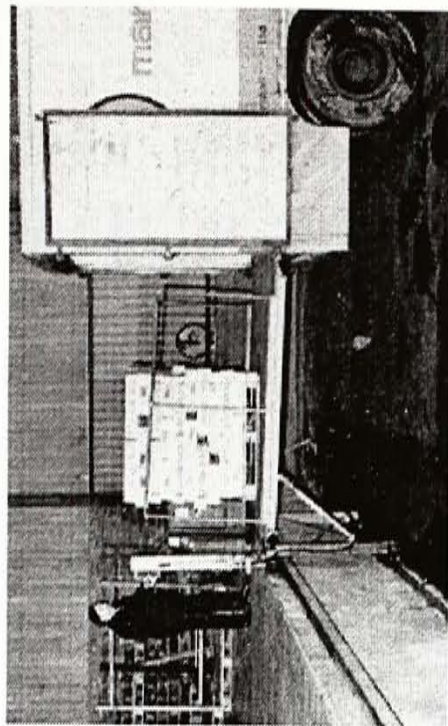




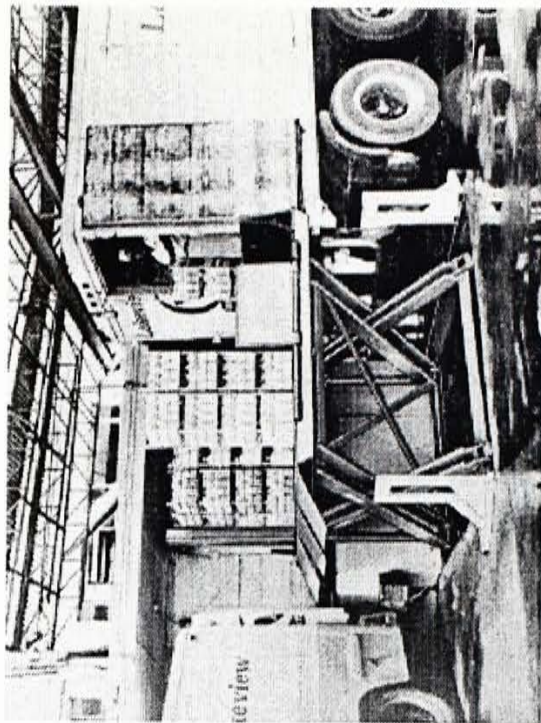
Where the carriageway is narrow the gateway must be wide to allow for cut- both directions. Vehicles have to swing into the opposite traffic lane which is acceptable in low use roads but can cause serious traffic problem for busy road. At least one vehicle length, at least 8m wide, should be provided inside the gate to allow swinging into the yard and lining up for turning out.



Raised end loading dock with check-off zone: for use with forklift trucks for rapid turnaround. In peak periods, one forklift will unload the vehicle into the marshalling area to one side of the aisle, with a second unit removing pallets to the store when checked. The area on the opposite side of the aisle would be reserved for the next vehicles.

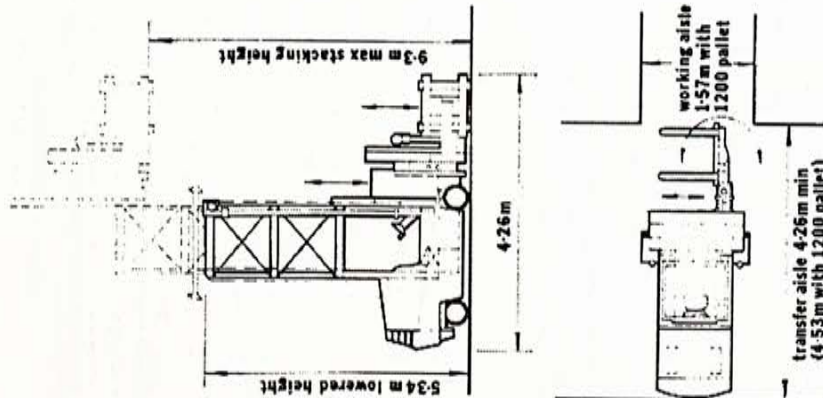


leveller on track on dock face. Truck does not have to be positioned so precisely as for a fixed leveller, and mobility allows one leveller to be used for several trucks.







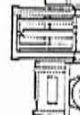

Typical existing premises with dock designed for a lower truck bed height. Scissor lift copes with height difference whereas a dock leveller would exceed 1:10 in the space available.

7.2.3 Forklifts



Free path stacker/order picker with elevating cab, fixed mast and rotating fork. The four-post mast gives extra stability. Out of one aisle can also be used as a fork-lift truck. The free lift on the fork carriage also allows differential movement between the pallet and the picking platform.

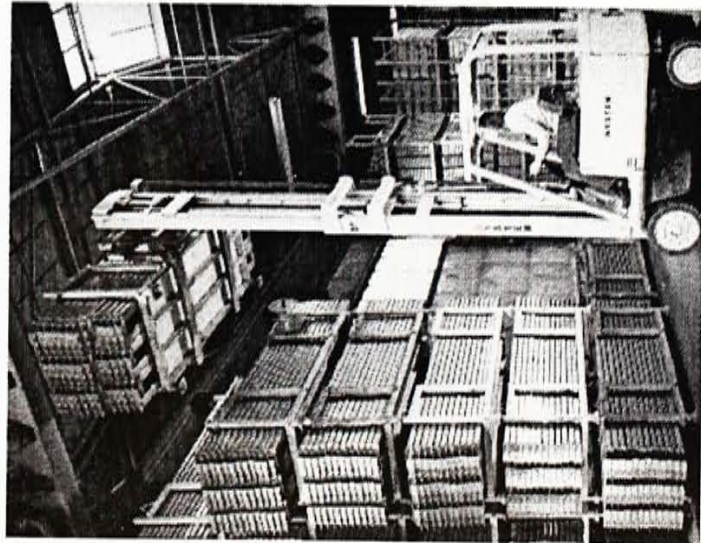
Table 3: Typology of forklifts and reach trucks used in loading bays

Capacity (kg)	Total length + forks (m)	Weight (unladen) (kg)	Maximum stacking lift (m)	Tilt (degree)		Extended mast height (m)	Lowered mast height (m)	Turning circle (m)		Aisle clearance (m)	
				f=forward	b=back			(inner)	(outer)		
2700kg-3500kg. Popular size of heavier standard forklift. Cushion-tired electric type for internal use.	3.9	5307	4.3	3f	10b	5.0	2.6	1.65	0.09	2.3	4.06
 900-1300kg. Popular size for the smaller operator or for light pallets. battery-electric	2.8	2132	3.7	2.5f	10b	4.2	2.25	0.9	0.05	1.7	3.15
 2040kg. Scissors or pantograph reach truck	1.95	2490	5.5	3f	5b	6.4	3.4	1.25	/	1.6	2.8
 2040kg. Galloway or moving mast reach truck	1.9	2800	8.3	2f	5b	9.1	2.1	1.15	/	1.8	2.8
 Heavy duty sideloaders. They usually use hydraulic stabilisers for lifts.	5.55	12610	6.1	/	/	7.6	4.5	2.6	0.84	5.4	3.2
 General purpose sideloaders of varying capacities.	4.3	6500	5.4	/	/	6.5	3.8	2.05	0.4	4.1	2.3
 4-way sideloader. These machines have wheels that all turn through 180°, allowing 90° direction changes and 'crabbing'.	3.2	5450	4.8	/	/	5.8	3.4	1.8	0.15	2.7	2.1

7.2.4 Stacking

Table 4: Typical internal clear height for storage areas

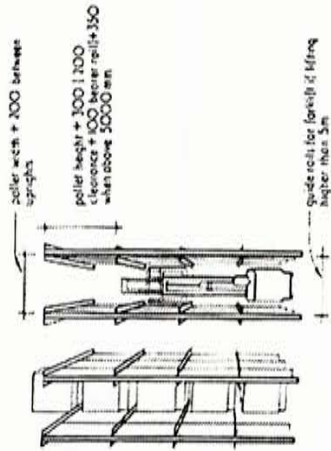
Minimum clear internal height (m)	Type of storage
5-5.5	Minimum cost low rise block stacking warehouse. Suitable for light industrial factory use
7.5	Minimum for any industrial storage building combining racking and block stacking
9+	When turret trucks are used
15-30	Fully automatic, computer controlled warehouses and stacker cranes are to be used



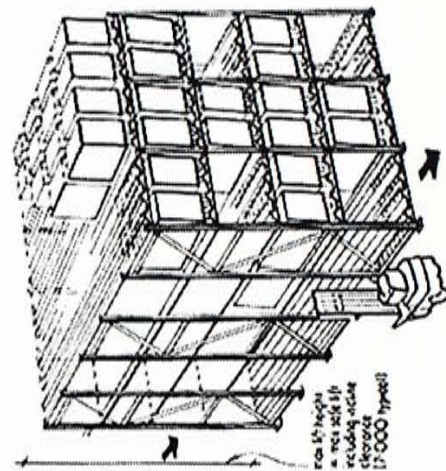
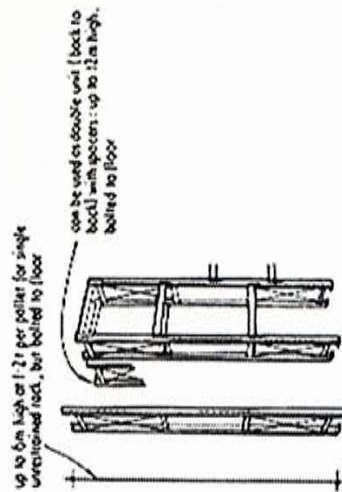
Components are packed as 1 unit in post pallets: note how the cupped feet nest on the uprights for a firm block stack.

Table 5: Classification of materials for handling and storage as unit loads

Description	Examples	Storage method
Materials not strong enough to withstand crushing- not suitable as integral unit load	Automobile components, made-up textiles, electrical appliance components, chemists, sundries, light engineering products, glassware	On pallet in rack
Material strong enough to withstand crushing- suitable for unit loads	Casks and drums, swan and machined timber, sheet materials	On pallet, or self-palletised and block stowed
Irregular shaped materials, strong in themselves suitably packed into unit loads	Goods in cases, crates or cartons	On post pallets and stacked, on pallets in rack or self-palletised
Bagged materials which form a flat surface under load	Grain, powder, and similar	On pallet and block stowed
Bagged materials which do not form a flat surface under load or will not take pressure	Forgings, moulded or machined parts, nuts and bolts	On pallet in rack
Large irregular loose materials	Moulded plastics; sheet metal pressings	On post pallets and stacked
Small irregular loose materials	Machined and moulded parts, pressing, forgings	In cage pallets and stacked
Material hot from production processes	Casting and forgings	On post pallet and stacked
Material too long to be handled other than by side loader or boom	Steel sections, tubes, timber	Horizontally in tube or bar racks
Material strong enough to withstand crushing but subject to damage	Partly machined automotive parts, painted finished material, books	Steel box pallets with special partitions
Perishable goods	Frozen meat, vegetable, drink	Cartons, soft packs pallets, box pallets, etc.



Drive-in racking for fork-lift. A maximum depth of six pallets, with fluorescent lighting in the racking structure. four pallet depth is preferable.



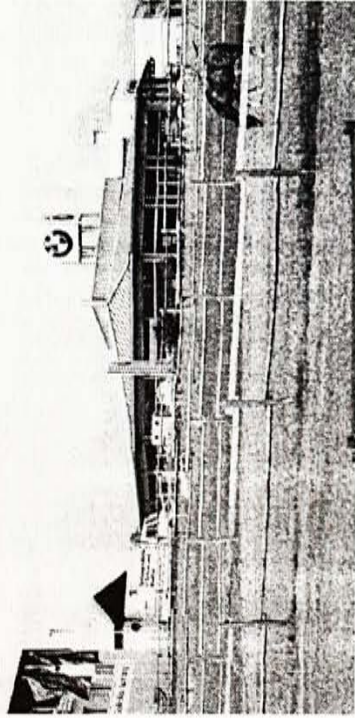
Roll-through racking





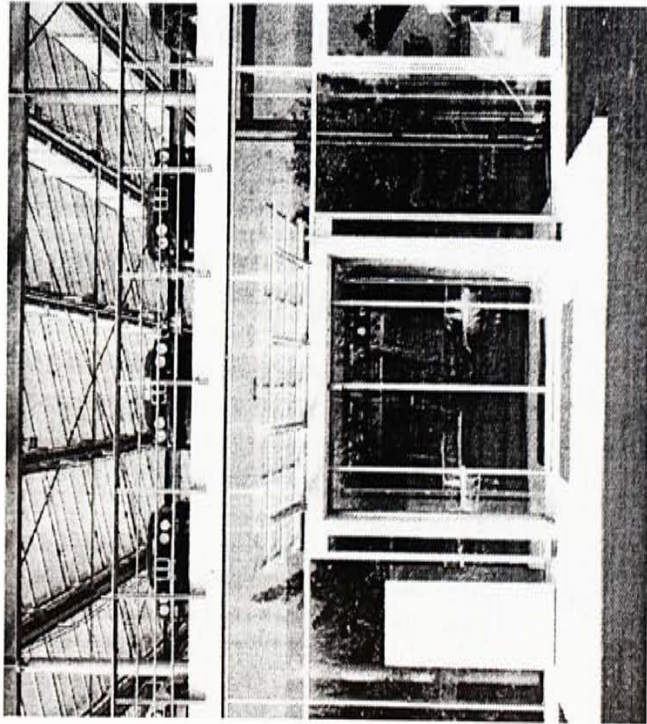
### 7.3 Showroom

#### 7.3.1 Long-distance Identification



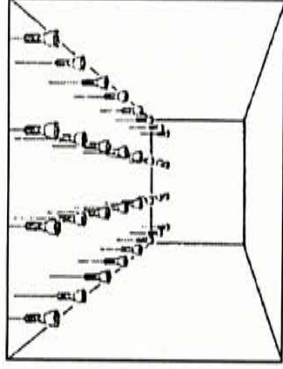
It is very important for the distance to identify the center from long distance. Conventional the pylon is an effective device to advertise the company.

#### 7.3.2 Entrance



A well-designed entrance has almost magical powers of attraction. It is like a handshake and give an good welcoming.

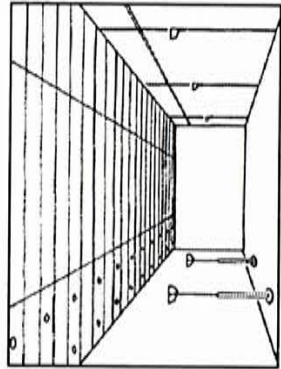
#### 7.3.3 Lighting



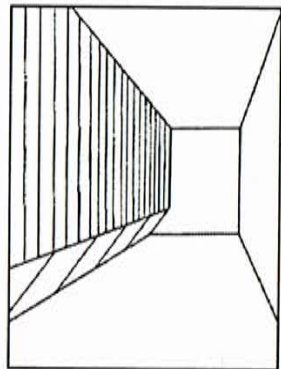
An exposed ceiling with suspended lights



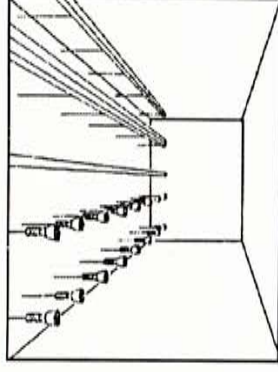
Today's standard: a suspended ceiling with built-in lights and lighting strips.



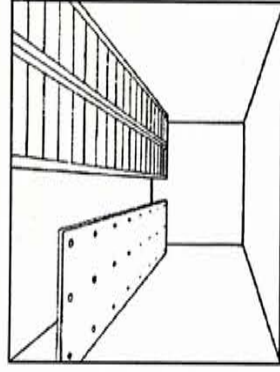
For an extremely exclusive effect: a reflective ceiling with built-in spotlights.



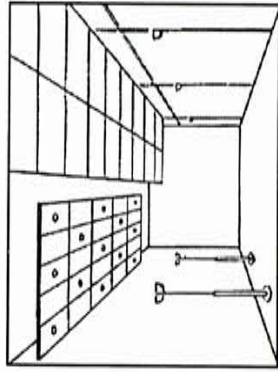
An advantage of the shed roof: the white wall is brightly lit and avoids reflections in the showroom windows which may prevent people from seeing in.



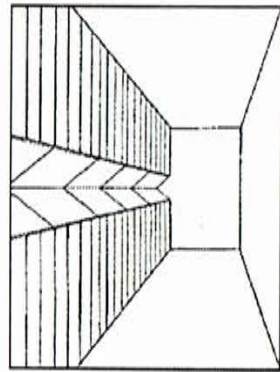
An exposed ceiling with both suspended lights and strip lighting.



An attractive, cost-effective alternative.



Sail panels below the ceiling.



Professionally planned roof glazing avoids excessive heat in summer and high heating cost in winter.

## 8. Design Development

### 8.1 First Review

#### 8.1.1 Option 1

##### Design Intention

Warehouse and the maintenance center are located on the upper level, temporary assembled carpark, showroom and office are on the lower level.

Central slab can act as a central service system that enhance the ventilation between two level.

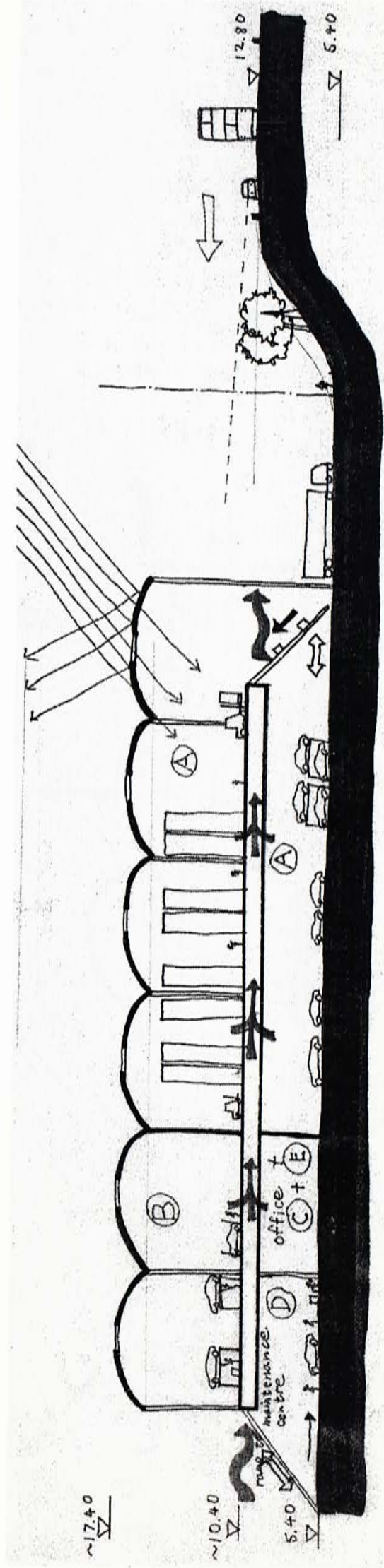
##### Analysis

##### Advantage

- large amount of natural daylight can be introduced to the maintenance center and warehouse where more human activities involved then in carpark.
- Integrated service system can be applied to the center.
- Transportation of the assembled car is easy due to the same floor level.

##### Disadvantage

- Small amount of lighting can be introduced to office, showroom where most human activities involved.
- Transportation of cargos is very difficult due to different level between warehouse and the loading/unloading.
- Extra circulation is required for the car to go to the maintenance center.



Section showing the relationship between the two level center and the Tate's Cairn Highway.

### 8.1.2 Option 2

#### Design Intention

Warehouse, maintenance center, and showroom are located on the ground level. The roof are flat slab for the temporary carpark. The office will be on the mezzanine level, above the training center and the canteen. The roof expression are able to have different varieties: flat slab, membrane structure or solid structure.

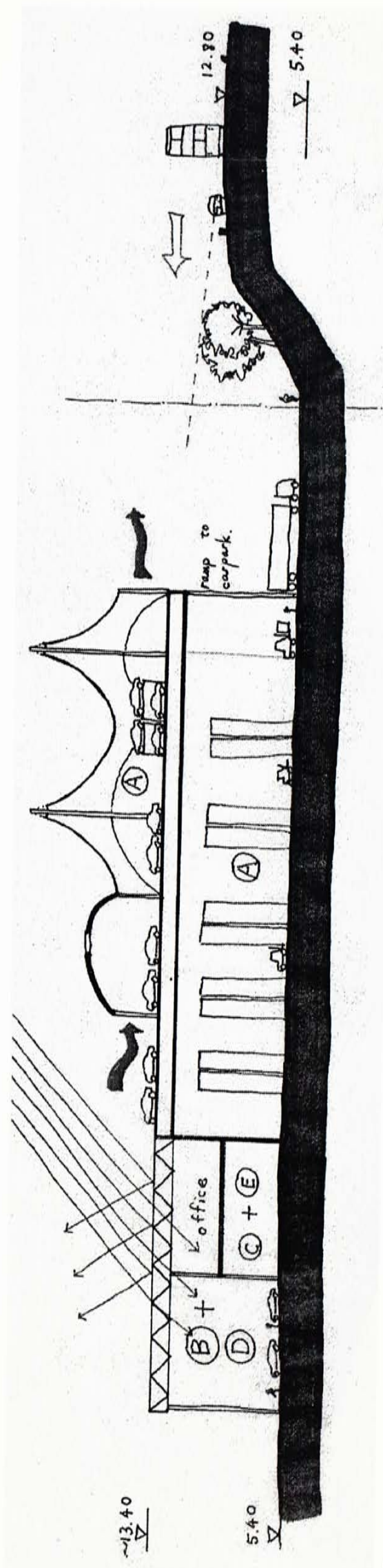
#### Analysis

##### Advantage

- Rational arrangement for both cargos and assembled car: economical.
- Structural expression is more flexible and have more varieties: flat slab, membrane structure, or solid cover.

##### Disadvantage

- Small amount of lighting can be introduced to warehouse, space inside there are not very good.
- Different service system are required on the different zoning: not integrated and ineffective.



Section showing the relationship between the two level center and the Tate's Cairn Highway.



### 8.1.3 Option 3

#### Design Intention

Warehouse, maintenance center, and showroom are located on the ground level and the office will be located on mezzanine level above the showroom. The temporary carpark will be located underground. It will create the lowest building height among the options.

Lighting can be introduced to the underground by using the ramp space.

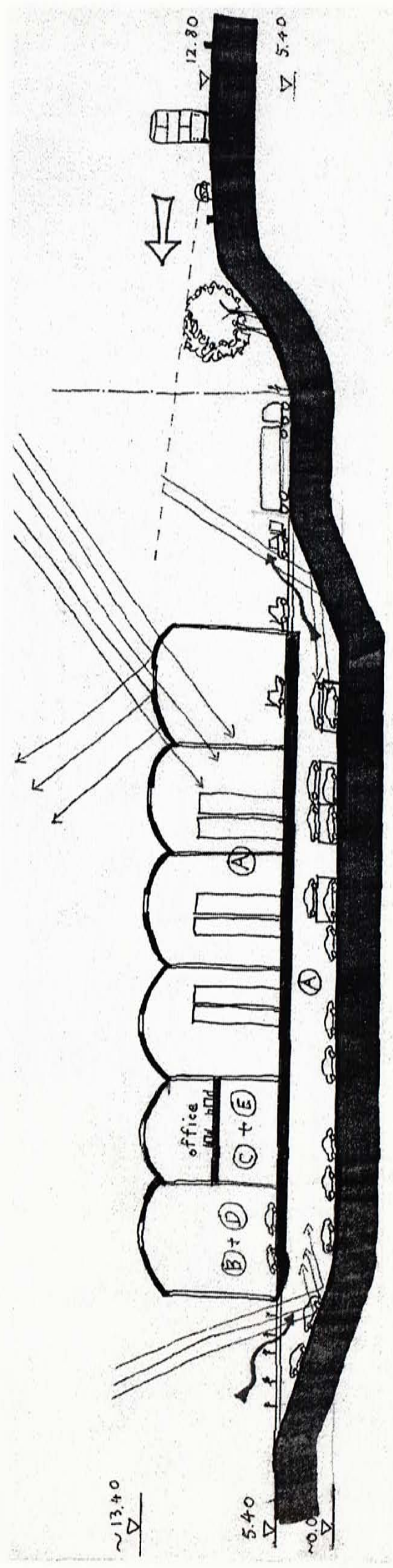
#### Analysis

##### Advantage

- Increase the efficiency on the warehousing management since the loading/unloading and the storage space are on the same ground level.
- Customer allowed to appreciate the cars from top, an exciting experience can be created inside the showroom.

##### Disadvantage

- Bad lighting and ventilation will be created inside underground carpark. Special attention have to be take on this issue.
- Create an underground carpark facilities will be very expensive. It will not be justified for carpark purpose.



Section showing the ground level warehouse and the underground carpark.



### 8.1.4 Option 4

#### Design Intention

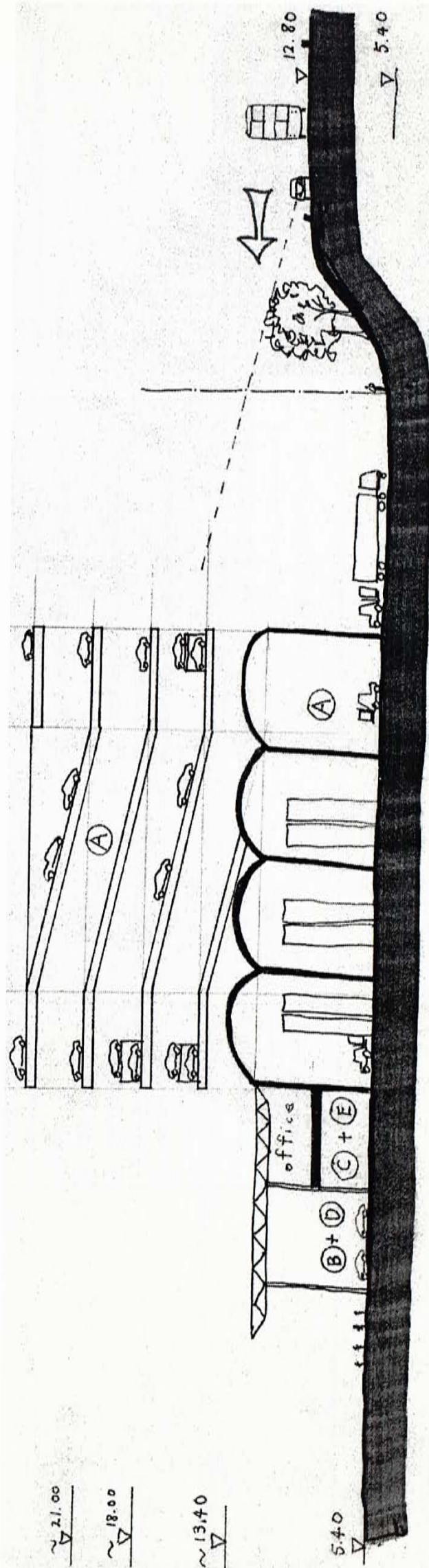
Warehouse and carpark are located on the same ground level therefore both loading/unloading can be the same. Maintenance center, showroom are located on the ground level and the office will be located on mezzanine level above the showroom.

#### Analysis

- Increase the efficiency on the warehousing management and carpark since the loading/unloading and the storage space are on the same ground level.
- The building height will be the highest so that it will be the most eye-catching and get the greatest advertising power.
- The carpark will be located on the south/west side so that it can act as a shading device to the warehouse

#### Disadvantage

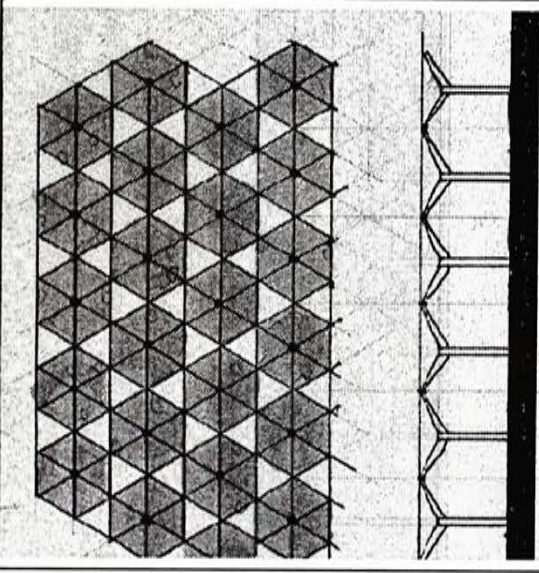
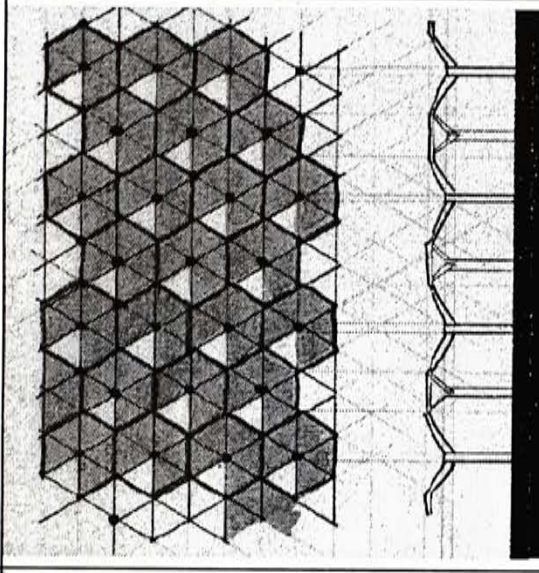
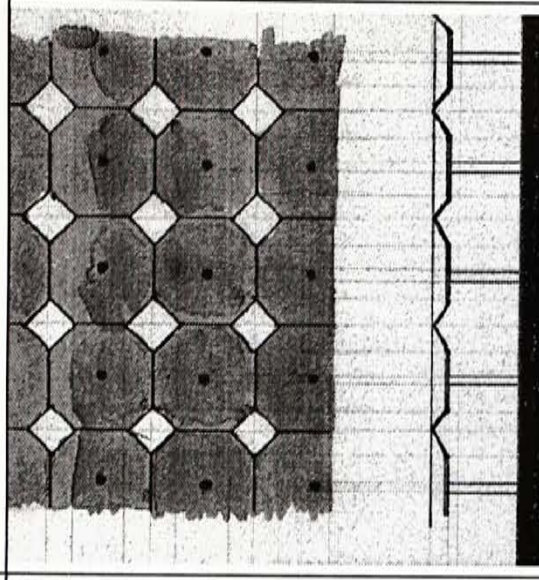
- Three components will have their own character, it is like three buildings grouped together and without unity.
- It is questionable that the carpark to be the most dominant part of the center.
- Separate service systems are required, it will increase the cost.

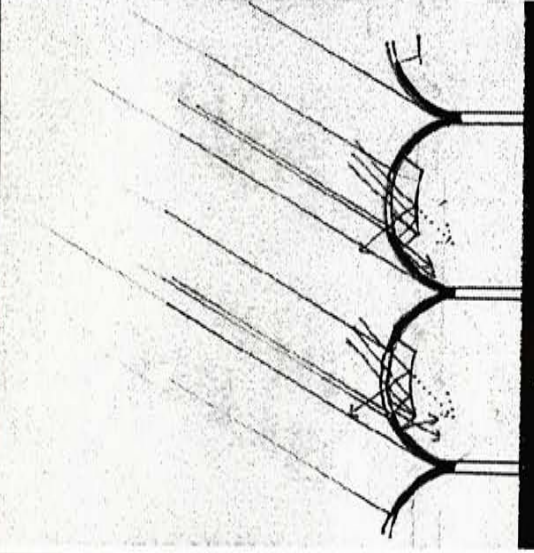
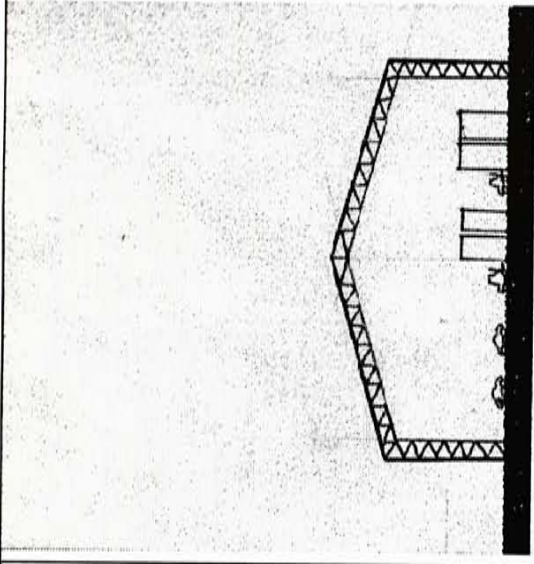
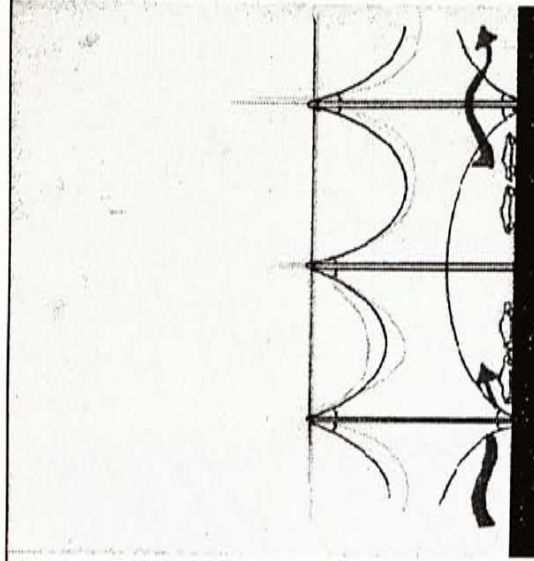


Section showing the multi-level carpark can be easily noticed on the Tate's Cairn Highway.



8.1.5 Roof Structure Typology

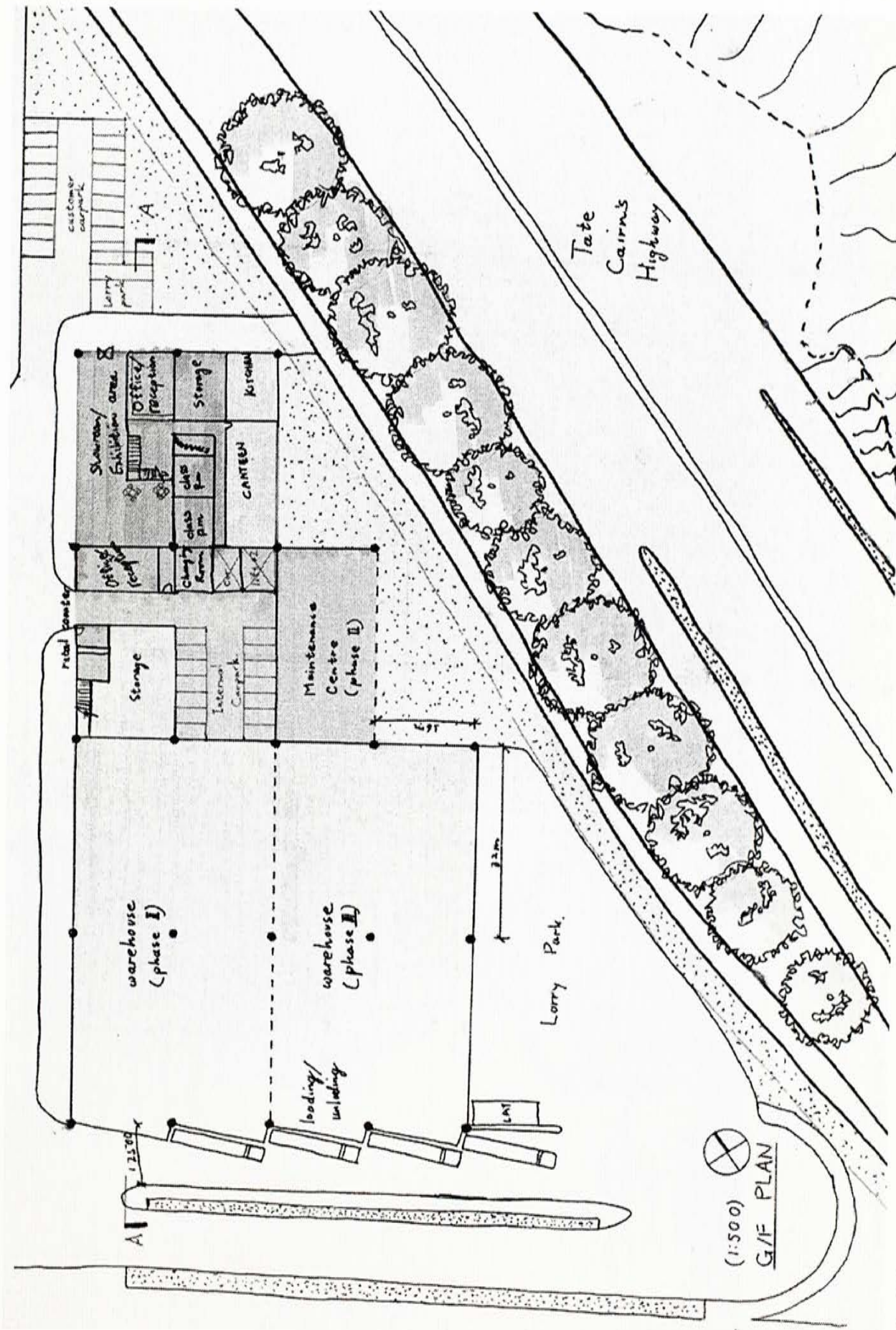
	(1) Hexagonal Module (A)	(2) Hexagonal Module (B)	(3) Octogonal Module
<b>Form</b>			
<b>Advantage</b>	<ul style="list-style-type: none"> <li>Expressive structure</li> <li>Natural sunlight can be introduced from skylight</li> <li>Triangular structure, allow a greater strength and span.</li> <li>Allow high degree of pre-fabrication: Speed up construction time</li> <li>Easy for future expansion due to the module structure.</li> </ul>	<ul style="list-style-type: none"> <li>Expressive Structure</li> <li>Skylight can be north-oriented avoid direct sunlight and favour diffuse sunlight to the interior.</li> <li>Triangular structure, allow a greater strength and span.</li> <li>Allow high degree of pre-fabrication: Speed up construction time</li> <li>Easy for future expansion due to the module structure.</li> </ul>	<ul style="list-style-type: none"> <li>The structure can be made of either concrete or steel: great flexibility.</li> <li>Large degree of natural sunlight can be introduced to the interior.</li> </ul>
<b>Disadvantage</b>	<ul style="list-style-type: none"> <li>Triangular column distribution: difficult for warehousing management or special management system is required: expensive in management cost.</li> <li>Complicated system; attention have to be pay on water drainage.</li> </ul>	<ul style="list-style-type: none"> <li>Triangular column distribution: difficult for warehousing management or special management system is required: expensive in management cost.</li> <li>Complicated system; attention have to be pay on water drainage.</li> </ul>	<ul style="list-style-type: none"> <li>Roof may be end up as a flat roof : not eye-catching</li> <li>Direct sunlight can be easily go into the interior: increase the inside temperature and create glare problem.</li> </ul>

	(1) Hexagonal Module (A)	(2) Hexagonal Module (B)	(3) Octogonal Module
<b>Form</b>			
<b>Advantage</b>	<ul style="list-style-type: none"> <li>• Convenient for long span structure in quite economical way.</li> <li>• Two way extension is possible.</li> <li>• Natural sunlight can be easily introduced by using reflector.</li> <li>• Can be constructed by using either concrete or steel and the envelope can have a lot of flexibility: concrete, metal cladding or membrane.</li> </ul>	<ul style="list-style-type: none"> <li>• Conventional structure, easy to construct.</li> <li>• Long span is possible, convenient for warehousing management.</li> </ul>	<ul style="list-style-type: none"> <li>• Expressive and eye-catching structure.</li> <li>• Good interior lighting</li> <li>• Good ventilation.</li> </ul>
<b>Disadvantage</b>	<ul style="list-style-type: none"> <li>• Column distance may be short in one way direction, Inconvenient in warehousing management.</li> </ul>	<ul style="list-style-type: none"> <li>• Conventional structure, Boring and not eye-catching.</li> <li>• Long Span structure so that it will be quite expensive.</li> <li>• On site construction is required so that long construction time is required and quality is difficult to control.</li> </ul>	<ul style="list-style-type: none"> <li>• Problem on rainfall and water leakage.</li> <li>• Long Term maintenance is a problem due to the short life span of membrane.</li> <li>• Extension is difficult on the periphery structure.</li> </ul>

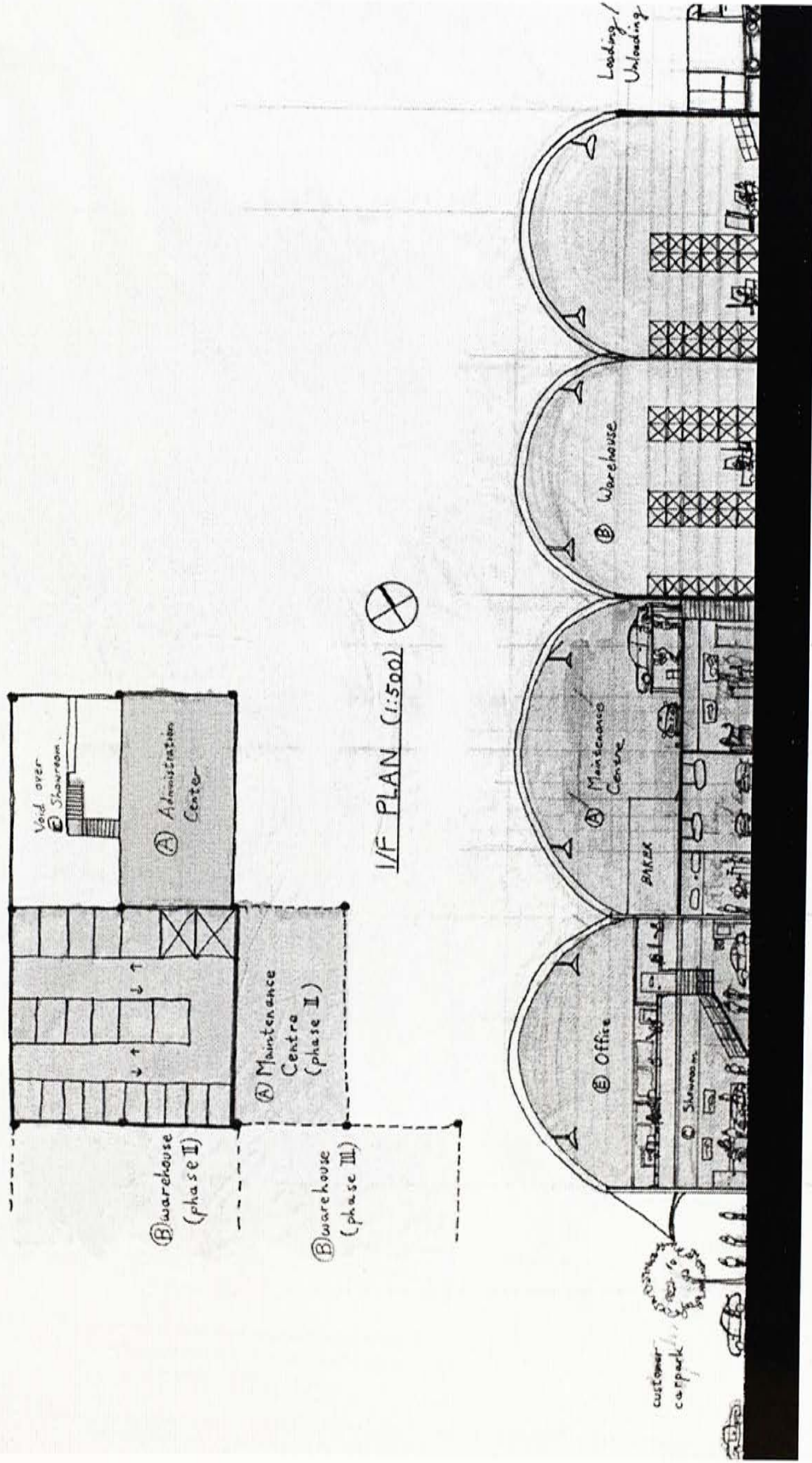


### 8.2 Second Review

#### 8.2.1 First Scheme



Ground floor plan of first scheme

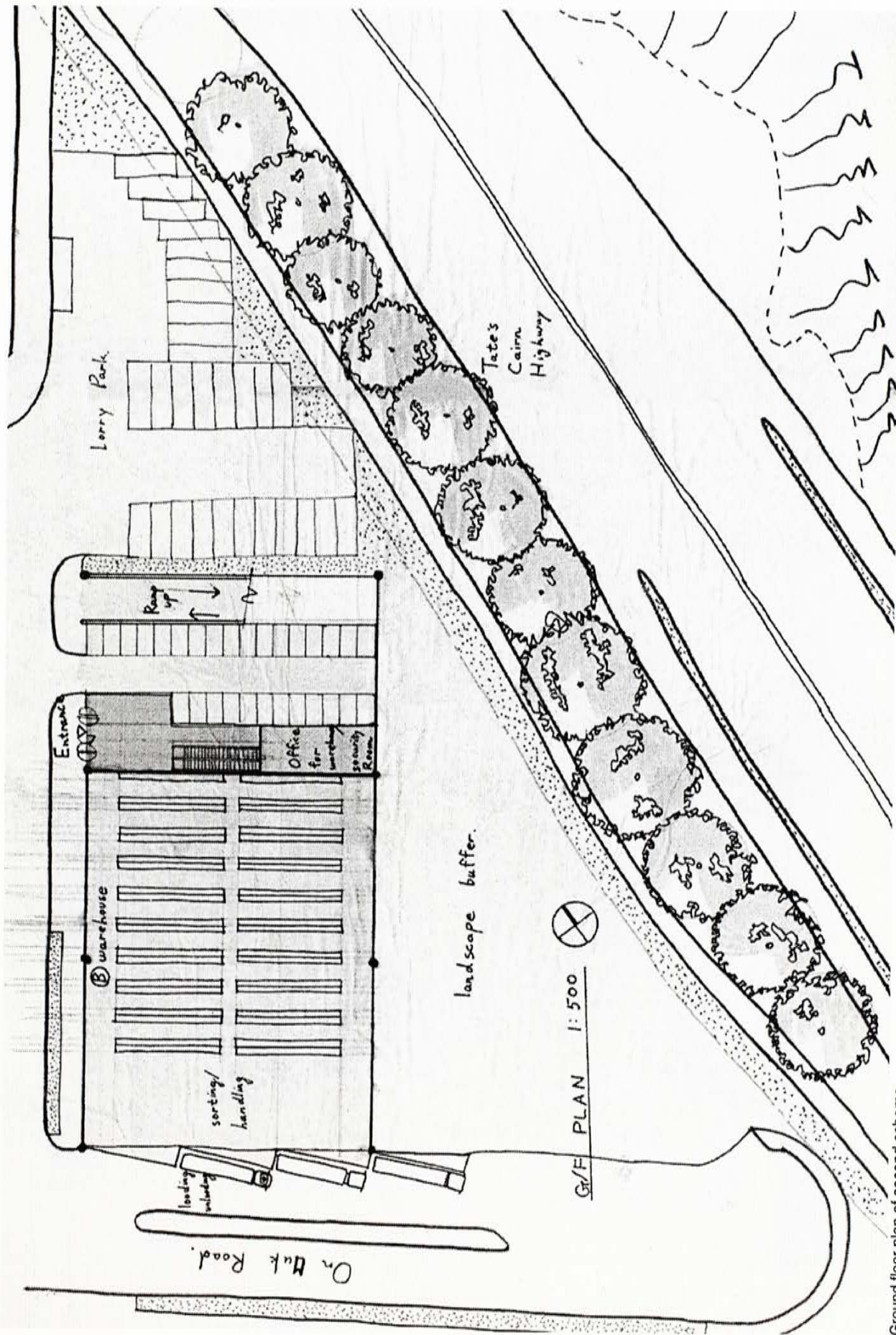


SECTION A-A (1:200)

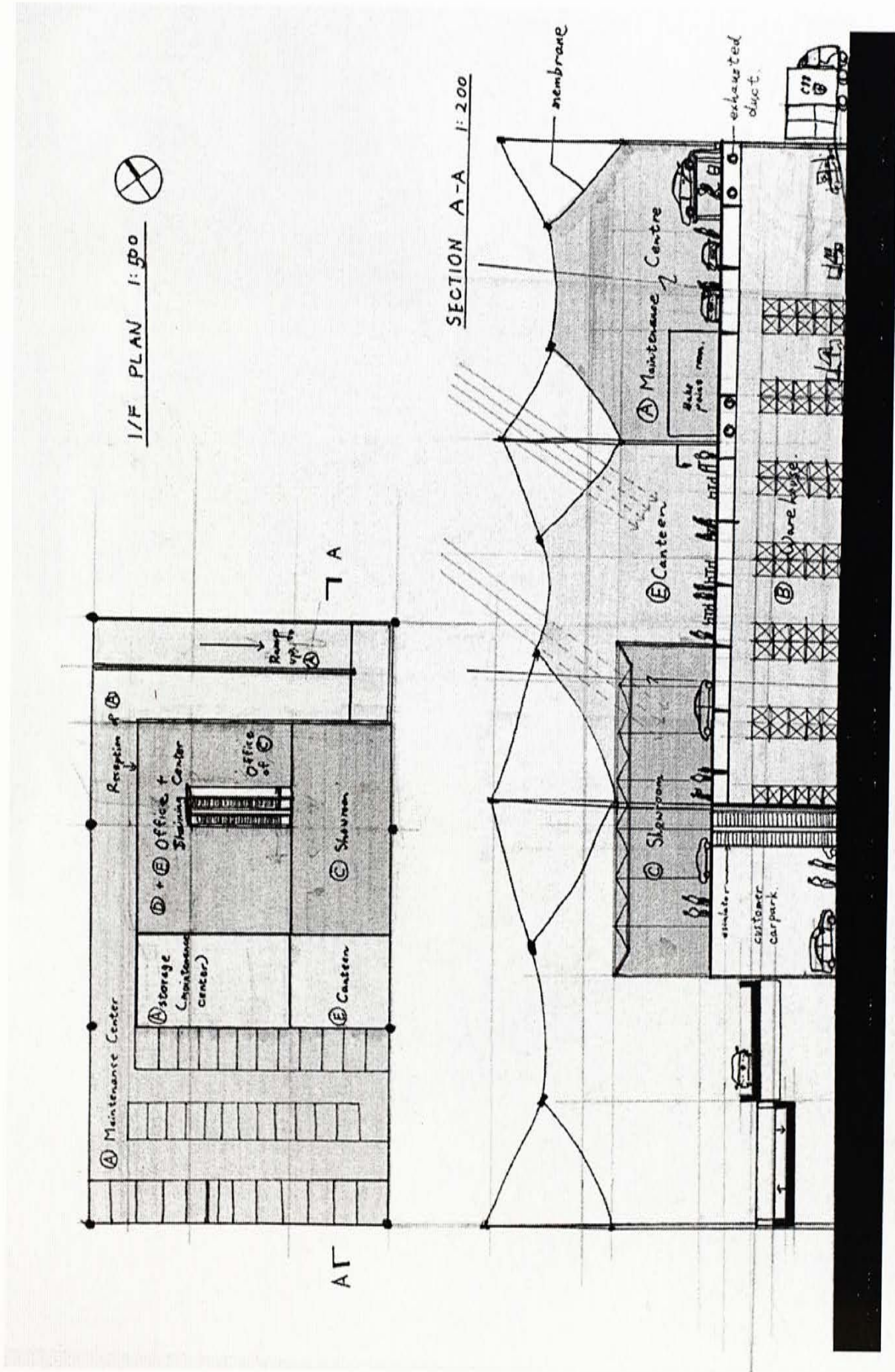
First Floor Plan and Section of first scheme



8.2.2 Second Scheme



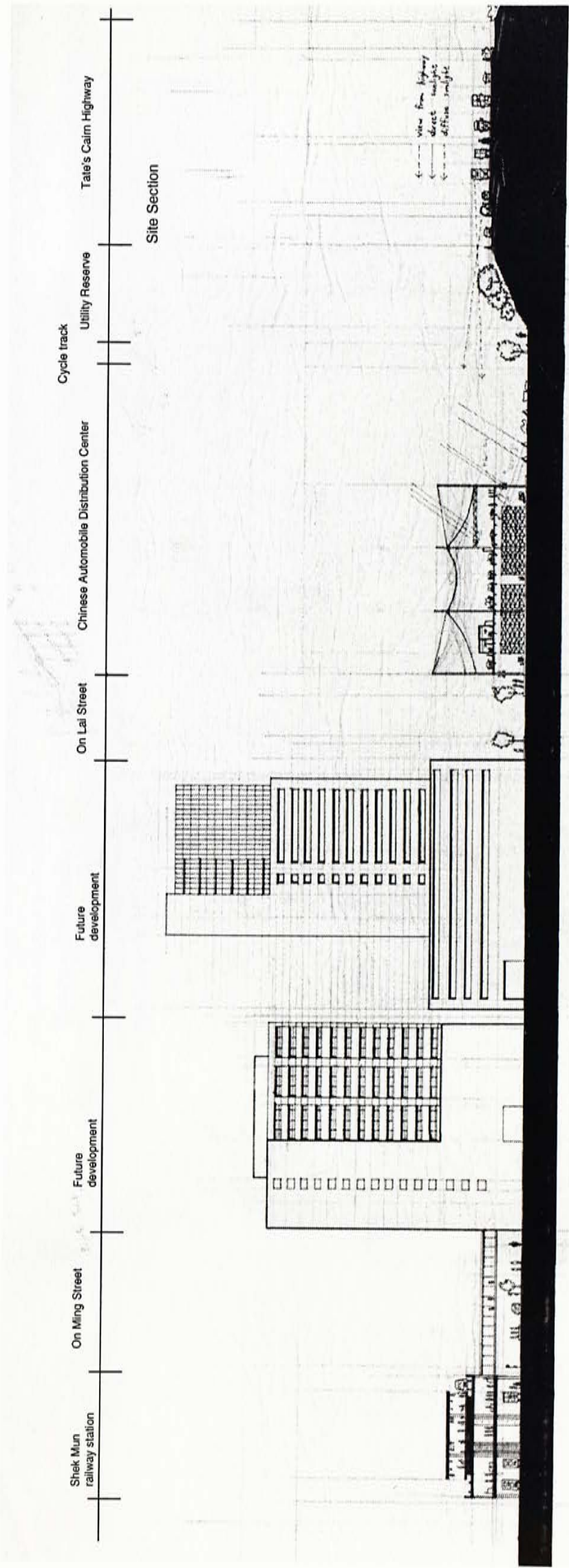
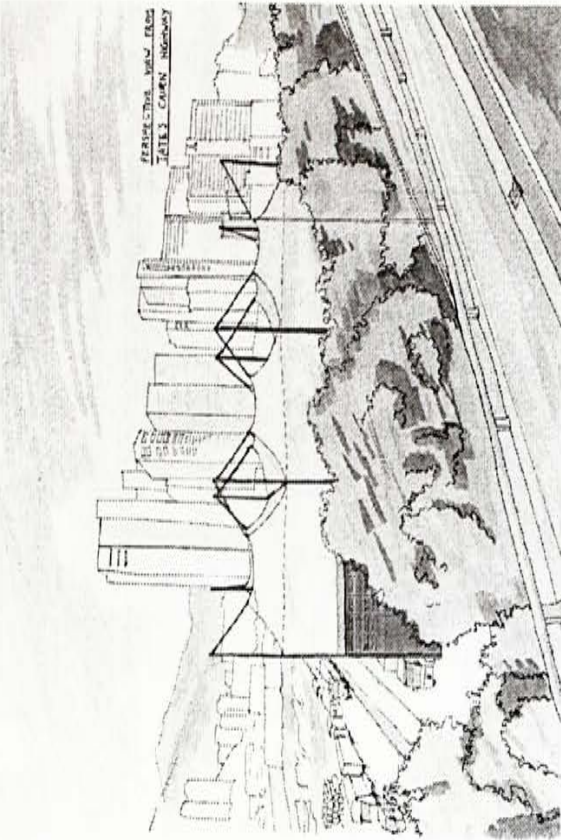
Ground floor plan of second scheme



First floor plan and section of second scheme.



Right:  
 Perspective view to the second scheme  
 from the Tate's Cairn Highway.  
 Below:  
 Site Section of the Shek Mun Industrial  
 Area, Shatin







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