AUTOLAB

Wanitch Wanitcharurntham

A Thesis Submitted in Partial
Fulfillment of the Requirements
for the Degree of

Bachelor of Architecture

Department of Architecture School of Architecture and Design
ASSUMPTION UNIVERSITY

2016

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2016

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This project starts from my background of interest. I am interested in the architecture that supports automobile facilities, such as car museums, test tracks, research and development centers, Also development of automotive industry in Thailand.

I found that, nowadays, automobile industry in Thailand is growing fast, the number of automobile produced in Thailand is increasing every year. Automobile industry became one of the main income of country, and also added value to Thailand. Thailand becomes the main automobile producer in ASEAN.

Therefore, the idea of this project is an automobile research and development center that provide a space for research and self-learning, laboratory for testing auto-parts, and also a testing track for automobile testing, provide for automobile manufacturer, auto-parts manufacturer, engineering student, and other people that interested in automobile. This project will give an useful knowledge and experience for automobile and auto-part manufacturers, students, and other people interested in automobile.

Acknowledgement

Author would like to thanks to A. Peerapong Suntinanond (A.Joe), for advising, guiding, and pushing me to generate good quality of works, and also motivate me to work harder and thinking out of the box. And I would like to thanks A. Pim and A. Benjarit for giving me a helpful comment in every presentation. I would like to thanks my family for always supporting, and understanding me. I would like to thanks my friends for helping me to making model, and others works when I cannot finish them alone. And thanks all of my friends that give me a good friendship, helping each other, and sharing experience for fifth years. I would like to thanks many of failures that come along the way of this project, these things give me a lesson and push me to make better works every time. Last of all, I want to thanks myself for being patient, work hard, and not give up on this project. Thank you.

Wanitch Wanitcharurntham

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Chapter 1: Thesis Introduction

1.1 Background of Interest

I am interested in the architecture that supports automobile facilities, such as car museums, test tracks, research and development centers, and architectural design principle that supports automobile. I found that, nowadays, automobile industry in Thailand is growing fast and the number of automobile produced in Thailand is increasing every year. Automobile industry became one of the main incomes of the country, and also added value to Thailand. Thailand becomes the main automobile producer in ASEAN.

Figure 1.1.1 Global automobile production in 2014[1]

1.1.1 Global Automotive Industrial

In the last 10 years, many countries in the world increase the amount of automobile production every year. The number of automobile production increased from 69 million to 80 million from 2006 to 2011 (16 %). It is obviously that the global automotive industry is growing continuously. Even in developed countries, domestic markets are constantly growing.

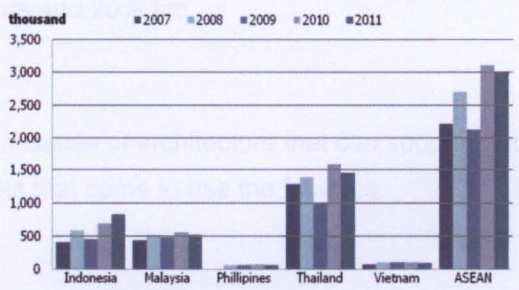

Figure 1.1.2 Automobile production in ASEAN 2007 to 2011[2]

[1] "Global automobile production in 2014." Sciencepark. Accessed October 15, 2016. www.sciencepark.or.th/documents/downloads/Presentation 1.3.

[2] "Automobile production in ASEAN." Thaiauto. Accessed October 15, 2016. www.thaiauto.or.th/.

1.1.2 ASEAN Automotive Industrial

Automobile production countries in ASEAN include Indonesia, Malaysia, Philippines, Vietnam, and Thailand. In 2007 to 2011 the CAGR (Compound Annual Growth Rate) was 7 percent. Thailand was the second in production country.

Since 2007, the number of automobile production in ASEAN grew continuously. In 2009 the number decreased because of ~~the~~ America's economic problem that reflected on the global economic. In 2010 the number of production returned to regular.

In 2011 the number decreased because of Tsunami disaster.

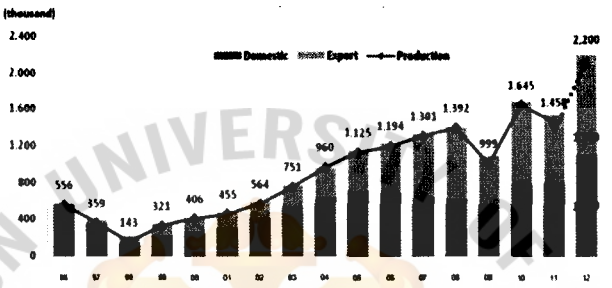

Figure 1.1.3 Number of automobile export and production in Thailand[3]

1.1.3 Thailand Automotive Industry

After 1998, the number of Automobile Production in Thailand increased continuously. In 2009, this was the first year that Thailand could produced 1 million cars. The infrastructure of automobile production in 2000 - 2006 was to support domestic sale more than export, in the ratio of 65 : 45 . After 2007, the production for export increased to 50 : 50 . This clearly shows that Thailand is one of the main production country.

Apart from being the main country for auto- mobile production, Thailand is also the main producers of auto-parts. The direction of auto-parts production also grew with the automobile production.

In 2011, the value of Thai exported auto-parts was about 4 million baht included 68% car parts, 6% motorcycle parts and 26% tire.

1.2 Issue of Interest

I am interested in issues of architecture that can support automotive facilities and relate with user's activities that come to use the facilities.

The issues are:

1. Building type of research and development.
2. Design principles, and design process of research and development center.

[3] " Number of automobile export and production in Thailand " Thaiauto. Accessed October 15, 2016. www.thaiauto.or.th/.

3. Programming arrangement and circulation that relate with privacy and activity of users.

4. Landscape design for automobile such as, parking or proving ground design for automotive testing.

1.3 Objective of Proposal

To study the above issues in reason of integrating to this project, developing, and designing the architecture for automobile research and development facilities. Moreover, I intend to analyze and collect useful informations for other people who want to study and create projects about architecture for automobile facilities.

1.4 Hypothesis of Proposal

This project will work as research and development center that automobile and auto-part manufacturers, automotive engineering students, and other peoples who are interested in automobile can come to research, study, experiment, and develop their automotive work. The architecture also motivated people to work and learn better.

1.5 Thesis Statement

This project is an automobile research and development center that provides a space for research and self-learning, laboratory for testing auto-parts, and also a testing track for automobile testing. This project will give many useful knowledges and experiences for automobile and auto-part manufacturers, students, and other people who are interested in automobile.

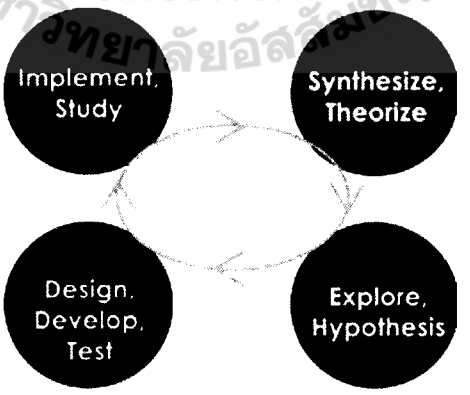

Figure 1.5.1 Diagram of research and development center

Chapter 2: Literature Review

My project is inspired from my interests which are development of automobile and auto-parts production in Thailand, and masterplan of Thailand automotive institute that planning to create automobile filed testing in Chachoengsao in reason of making Thailand become a center of automobile production in ASEAN. The vision of this masterplan is "Thailand is a global green automotive production base with strong domestic supply chains which create high value added for the country"[4]. I have studied this planning and develop the project to an automobile research, development, and testing center.

This project will serve automobile and auto-parts manufacturer in Thailand to test, evaluate, and develop their products, and also providing facilities for automobile engineering students and other people that are interested in automobile to conduct self-study. The facilities in this building mostly serve automotive testing, also providing space for storing automobile, and space for car circulation more than pedestrian circulation. In the testing facilities of this project, the facilities will be a laboratory for automobile and auto-parts testing in many categories, and also providing space for a proving ground, the track for a drive test. Therefore, I have studied the information and design principle of automobile testing facilities included testing laboratories and proving ground.

2.1 Automobile Testing

Automobile industry in each continent has their own standard for automobile production in order to produce a good quality of product and abilities for competition with other countries. In Thailand, automobile and auto-parts manufacturers have to follow the standard of EURO IV standard (ECE R83), and TIS (Thailand industrial standard) 1997-2011 standard. Automobile testing can be divided into 2 categories.

2.1.1 Laboratory testing

Laboratory testing is an indoor testing by using equipment such as machine for test. Laboratory testing can test overall car, sub system such as brake system, transmission system, and parts testing such as tire, spring, and plastic. I have collect a list of automobile testing and equipment for testing that will applied in my project.

2.1.2 List of automobile testing and equipment

[4] "Masterplan of automobile industry 2012 - 2016." Sciencepark. Accessed October 15, 2016. www.sciencepark.or.th/documents/downloads/Presentation 1.3.

Automobile and auto-parts testing in laboratories can be divided into 4 main categories. There are mechanical resistance test of material or components, environmental resistance test, combined mechanical and environmental test, and chemical analysis test.

Table 2.1.1 list of auto-parts and testing equipment [5]

Automobile safety glassed testing

test	equipment
thickness	ball micromitor
general characteristics	light source 1000lux
light transmission	haze guard plus
Impact resistance	drop tester
broken type	blueprint developer
secondary image classification	light box
image distortion	light projection test
light color identify	traffic signal light test
impact with head	simulation head impact

Safety belt test

webbing test	universal testing machine
buckle test	buckle durability tester, compression tester
corrosion test	salt spray tester
heat resistance	temperature humidity chamber
for plastic material	
automatic locking retractor test,	automatic lock tester
emergency locking retractor test	wind round force tester
	winder durability tester
	tensile testing machine
tensile strength of bolt,	universal testing machine
static load testing	

Automobile exhaust muffler

material	micrometer
corrosion(chemical)	fumace
coating durability	mandrel
sound level	sound level meter
air leak	air leaktester

Tyre test

size	venier caliper,
balance test	digit depth micrometer
	balancing equipment
breaking energy	plunger testing machine
bead unsealing test	bead unseating machine
tyre endurance test	endurance tester
endurance test at high speed	

Inner tyre test

leak of valve	compressor air
mechanical properties	universal tensile testing machine
valve	digital caliper
using between rubber	rim
inner tube	

Autoparts (Rubber, Plastic, Textile)

heat resistance	temperature oven
temperature and humidity	high-low temp and humidity chamber
thermal shock resistance	thermal shock resistance
flamability test	horizontal flame tester
fogging test for interior parts	fogging tester
gloss test for color ur coating	gloss meter
simulate light/weathering test	xenon whether meter
UV light effect on laminated glass	UV light stability tester
temperature test cycle test	big chamber, small
and vibration test	chamber, infrared lamp

Car seat test

seat frame endurance test	seat frame testing

Exhaust emission test

exhaust emission test for gasoline	gasoline engine vehicle emission laboratory
exhaust emission test for light diesel	light duty diesel engine vehicle emission laboratory

Mechanical test for Heavy material

tensile,compress,bending test	universal testing machine
impact test	pendulum impact tester
vicker hardness test	vickers hardness tester
brinell hardness test	brinell hardness tester
rock well hardness test	rockwell hardness tester
friction test	friction testing machine
vibration test	vibration tester
durability test	hydrolic actuator testing
leak test for exhaust	air leak tester
chemecal composition	emission spectrometer
stress-strain	EDX200A

Mechanical test for Light material

tensile,compress,bending test	universal testing machine
impact test	pendulum impact tester
hardness for rubber	hardness tester
hardness for rubber, plastic, foam	durometer hardness tester
scrach, adhesion test	mar/scrape tester
impact test for colour coating	dupont impact
thermostatic test	thermostatic chamber
ozone aging test	ozone aging tester
micro hardness test	micro hardness tester
thickness	ultrasonic
deflection of plastic	HDT VICAT AUTO

Precision measurement calibration

dimension check for small	profile projector
dimension check for very small	toolmaker microscope
roughness test	digital roughness tester
3 dimension check	coordinate measuring
3 dimension check and scan	3D scan
sound analysis	sound meter tester
data record analyser	KYOWA model EDX
calibration micrometer	Gauge block
calibration vernier caliper	

Corrosion test group

water spray test	water spraying chamber
basic corrosion test	salt spray test
advance corrosion test	cyclic corrosion test
coating thickness test	multilayer coating thickness analyser

Spring test

tension compression	digital system coil spring
tension compression for small	testing machine

Non-destructive test

coating thickness test	coating thickness measure
radiographic examination	radiographic examination

Chemical test

hazadous substance test	energy dispersive x-ray
chemical test	inductive coupled plasma
hexavelent chromium test	UV-VIS spectrophotometer
VOC test	gas chromatography
prepare example	microwave digestion

[5] "List of automobile testing facilities." Thaiauto. Accessed October 17, 2016. http://www.thaiauto.or.th/2012/th/services/testingservice/default.asp.

2.1.3 Crash test laboratory

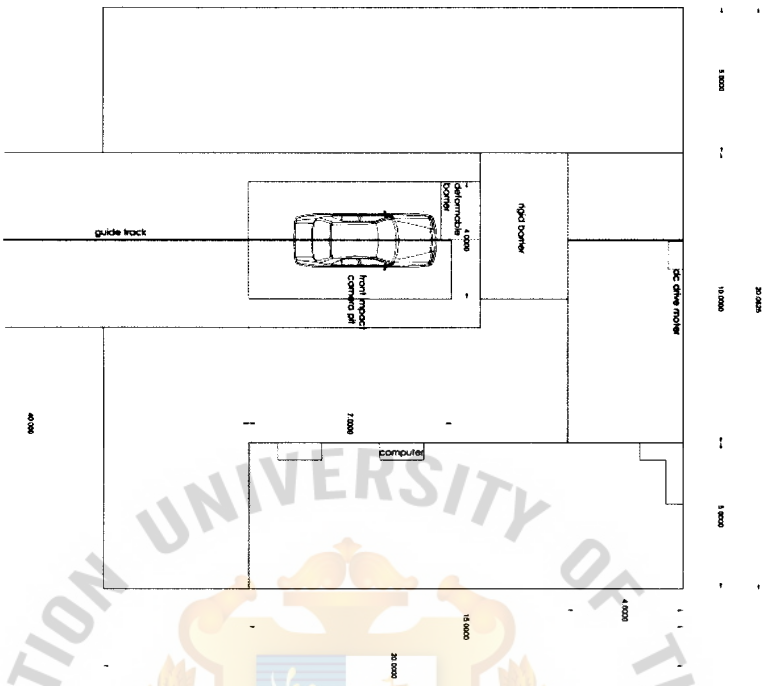

Figure 2.1.1 Crash test laboratory detail[6]

The information of crash test laboratory from Euro NCAP (European New Car Assessment) that has international standard of testing states 4 protection issues of crash testing.

1. Adult occupant protection – testing for evaluating the safety of driver and passenger included 3 types of crash test frontal impact, side impact, and pole impact.
2. Child occupant protection – testing to evaluate the safety of child passenger, the testing methods are the same as adult occupant protection.
3. Pedestrian protection – testing to evaluate the safety of pedestrians, the car will crash with leg and head of human model in 40 km/h.
4. Safety assist – testing in issue of safety assistant in car, electronic stability control, and speed limitation device.

2.1.4 Field testing

Field testing is a drive test in real situation. Field testing can be on public roads, and/or proving grounds. A proving ground is a track designed to support car testing, there are

[6] "Testing facilities." MGA research corporation. Accessed October 18, 2016. http://mgaresearch.com/facilities-and-equipment/facilities/.

many different tracks for test in many purposes. Many of automobile and auto-parts manufacturers have their own proving ground for testing their prototype car and auto-parts. In Thailand, only Nissan brand has proving ground.

2.1.5 Proving ground design

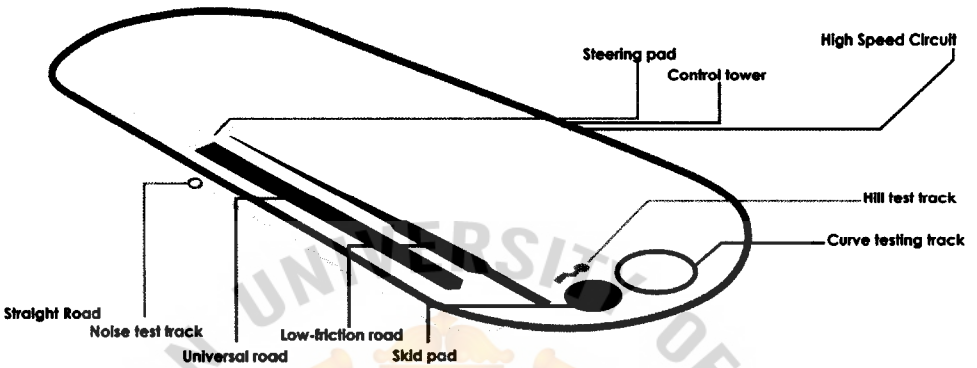

Figure 2.1.2 Proving ground diagram

2.1.6 Proving ground specification

Table 2.1.2 tracks, specification, and application[7]

TITLE	SPECIFICATION	APPLICATION AREA
High speed circuit	Total Length 5,040m, Width 21.2~25.7m(4-lane), Curve radius 360m, Max angle 42 Max Speed 250km/h (Designed Speed 180km/h)	Maximum speed test, high speed tolerance test, high speed braking test
Straight-line track	Total Length 2,000m(2-lane), Straight Line Section 1,609m, Safety speed in the turning point : 60km/h	Fuel efficiency test under normal speed, quick-check, driving noise test
Noise test area	Background noise 10ã difference, Radius 50m / Thick Asphalt Pavement	Certification tests related to driving moise, and Emissions noise
Universal track	Length 900m, Width 65m / Asphalt Pavement	Various braking tests, acceleration capability, steering performance test, noise and vibration test, tire burst test
Steering pad	Asphalt Pavement	High-speed normal cornering test, Minimum curve radius test, J-turn test, brake test during cornering
Low friction track	Ceramic, Basalt, Bridged Pable, high-friction asphalt pavement	Braking performance, ABS, Tire special feature assessment test
Skid pad	Concrete Pavement	Steering system , tire test, steering corresponding test
Hill test track	30%, 20%, 12% ramp / Asphalt Pavement	Climbing capability test, parking braking capability test
Curve test road	Length 880m, Width 9m, Radius 316m / Asphalt Pavement , Curved and circle test road	R & D test on guide sign facilities ant skid-proof pavement

2.2 Case Study: Integrate track into Architecture

[7] "Proving Ground." TS Korea Transportation. Accessed October 17, 2016. http://www.ts2020.kr/eng/html/kat/Proving.do.

I have studied many of architecture that have automobile facilities, and I got some case studies that integrate automobile track such car track or production line into architecture to create a new atmosphere and activities in that space.

2.2.1 Santa Monica Car Showroom, Fajer AlQATTAN, John TORPY, & Victor NUNEZ

Figure 2.2.1 Santa Monica car showroom [8]

Project facilities include: car showroom, display and sales of automobiles. It also serves as an educational resource to create awareness of Hydrogen Fuel Cell cars.

They interweave pedestrian circulation with an interior vehicle test track to create a dynamic and interactive exhibit of HFC vehicles. These "circuits" provide a logical means for filtering pedestrians into the building at ground level and also form the conceptual basis for the building's form.

2.2.2 BMW Central Building, Zaha Hadid

Figure 2.2.2 BMW Central building [9]

Project facilities: offices and meeting rooms for the company's design, management and administrative staff

[8] "Santa Monica Car Showroom." Suckerpunch. Accessed October 15, 2016. http://www.suckerpunchdaily.com/2013/09/06/santa-monica-car-showroom/.

[9] "Zaha Hadid's BMW Central Building is "a radical piece of thinking," says Amanda Levete." Dezeen. Accessed October 15, 2016. https://www.dezeen.com/2016/06/26/video-interview-amanda-levete-zaha-hadid-bmw-central-building-radical-piece-of-thinking-movie/.

She put the car assembly track over the office area. The integration of the production line with management and administrative facilities broke down barriers between blue- and white-collar workers.

2.2.3 Porsche's Atlanta headquarters, HOK

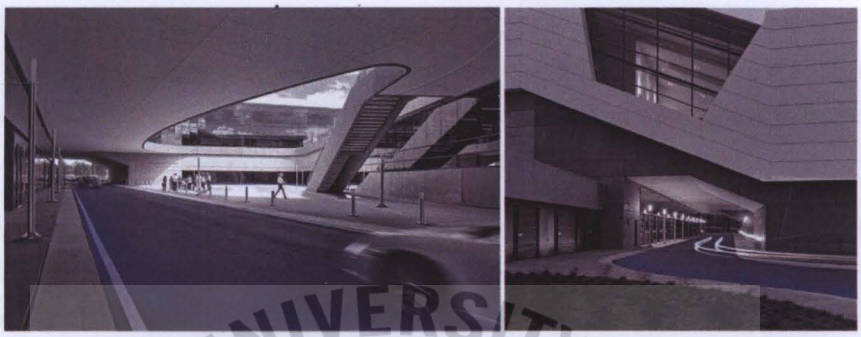

Figure 2.2.3 Porsche's Atlanta headquarters [10]

Project facilities: experience center, headquarters, office, training and driving programs. They integrate 1.6 miles circuit into the lower level of building. The track runs through the facility's courtyard, including different models of classic and modern Porsches on display in the adjacent gallery.

2.3 Case study: Thesis project: Automobile and Alternative Energy Learning Center

Figure 2.3.1 Entrance hall[11]

[10] "Porsche North America Experience Center and Headquarters." Archdaily. Accessed October 15, 2016. http://www.archdaily.com/788043/porsche-north-america-experience-center-and-headquarters-hok.

I have studied his project about the background and inspired of doing this project. Also how he presents the knowledge of alternative energy car in term of architectural space. This is a thesis project of Mr. Pawan Srisa-ard, Interior Architecture student, Technology Rachamongkol Thanyaburi University. This project is an Automotive Learning Center that presents its term of learning museum about automobile, energy, and alternative automotive energy. Collected knowledges in library, and providing exhibition. The objective of this project is to be the center of learning and collective knowledge about automobile and alternative energy, to inspire and motivate users to create, imagine real automobile and to generate experiment that can generate works and development.

Nowadays, there are many alternative energy automobiles because of high cost of gasoline. Government also has policy to support alternative energy researches but development of innovation must start with learning. Currently, there are courses of alternative energy and automobile technology but there are not university that combine both of the courses. Therefore, he has an idea to create learning center for young people because learning only in the classroom is not enough and not response to society, inspite of this issue is very important and high competition. This project is located in building B of Ministry of Energy, Energy complex company.

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[11] Srisa-add, Pawan. *Alternative energy automobile learning center.* Rachamonkol Thunyaburi Technology University, 2010.

Chapter 3: Contextual Proposition

3.1 District Selection

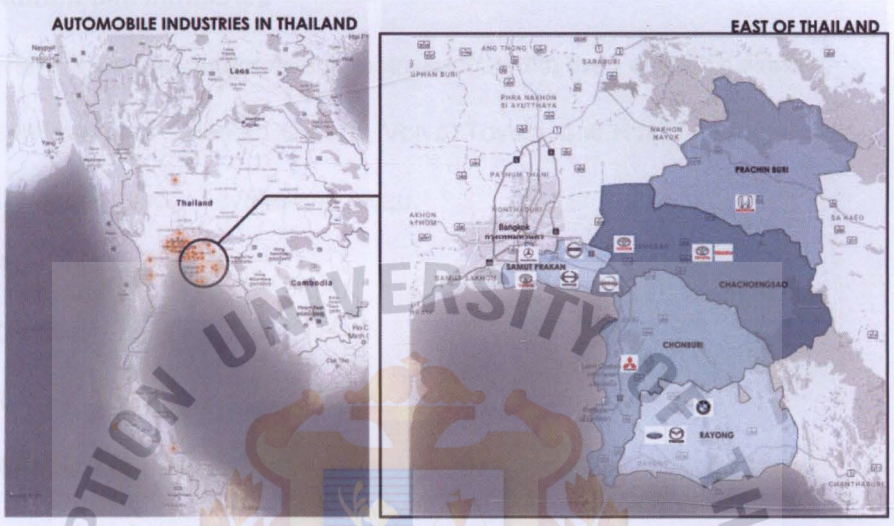


Figure 3.1.1 Diagram map of automobile industries in Thailand

Eastern of Thailand is the main area of automobile industries. Automobile industries are located in Chachoengsao, Chonburi, Rayong, Prachinburi, Samutprakan, and Bangkok. Chachoengsao is the central area of automobile industries that many industrial provinces can access easily. It is also adjacent to Suvarnbhumi Airport and East ports. These ~~things~~ factors make Chachoengsao easy for transportation, export, and connects with ASEAN countries.

3.2 Site Selection and Site Analysis

3.2.1 Macro scale site analysis

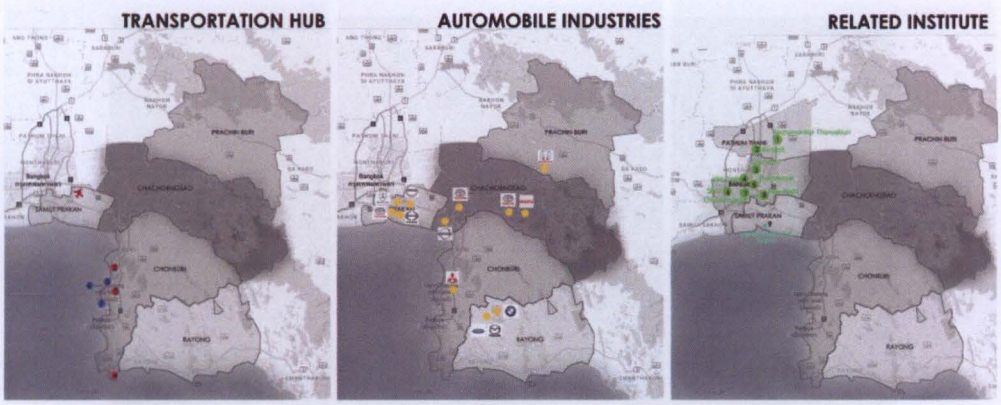


Figure 3.2.1 Diagram map of transportation hub, automobile industries, and related university

Transportation Hub

Chachoengsao is 23 km. away from Suvarnabhumi airport in Samut Prakarn, and close to Bang Phra airport, Siracha airport, and Satthahip airport in Chonburi. It is also near Kohloy port, Kohsrichang port, and Aou-udom port in Chonburi.

Automobile Industries

There are many automobile industries located in the East of Thailand

Samuprakarn: Mercedes Benz, Volvo, Toyota, and Hino

Chachoengsao: Toyota, and Isuzu

Prachinburi: Honda

Chonburi: Mitsubishi

Rayong: BMW, Ford, and Mazda

Related Institute

- Rachamonkol Thanyaburi University
- Rangsit University
- Sripratum University
- KMUTNB
- Thammasat University
- Siam University
- Chulalongkorn University
- Thai-Nichi Technology Institute
- Thailand Automotive Institute

3.2.2 Site Selection

Figure 3.2.2 Site 1

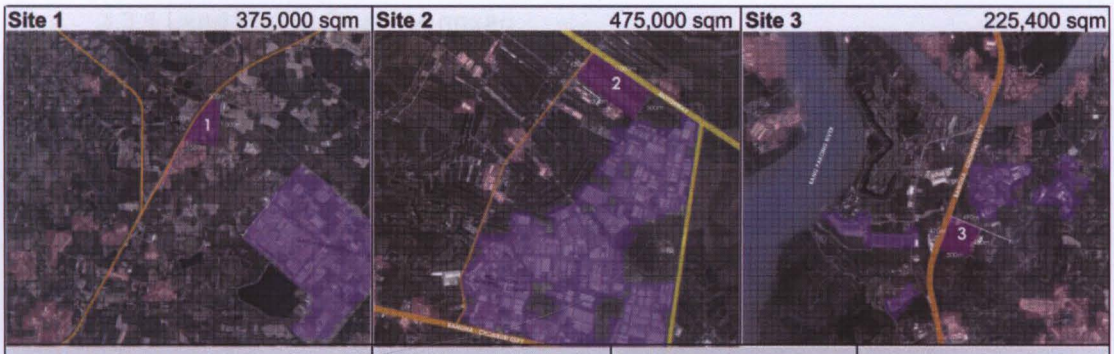
Site 1: The advantages of this site are; first it is close to industrial estate. Secondly, it is surrounded by empty space with opportunities for future expansion. Disadvantages of this site are first, too far from communities, second, this site is not close to main road that will affect accessibility.

Figure 3.2.3 Site 2

Site 2 : the advantages of this site are first, close to industrial estate, second, adjacent with motorway, third, easy to access for user, fouth, not too far from communities, and fifth, close to Chonburi and Samutprakarn. Disadvantage of this site is the lack of area for future expansion.

Figure 3.2.4 Site 3

Site 3 : the advantages of this site are first, it is adjacent with Bangna Chonburi express way), second, it is close to river and port, and third, it is close to Chonburi. Disadvantages of this site are first, surrounded with high density of residential, and second, does not have much area for future expansion.



Criteria	Site 1	Site 2	Site 3
Large area	☆☆	☆☆☆	☆
Private area	☆☆☆	☆☆	☆
Easy to access	☆	☆☆☆	☆☆☆
Connect to main road	-	☆☆☆	☆☆☆
Close to Automobile industrial	☆☆☆	☆☆☆	☆☆☆
Close to community	☆	☆☆	☆☆☆
Close to other province	-	☆☆	☆
Close to Airport	-	☆	-
Close to Port	-	-	☆
Density of Surrounding	☆	☆☆	☆☆☆

choose site 2

Figure 3.2.5 Site Scoring

3.3 Law and Regulation

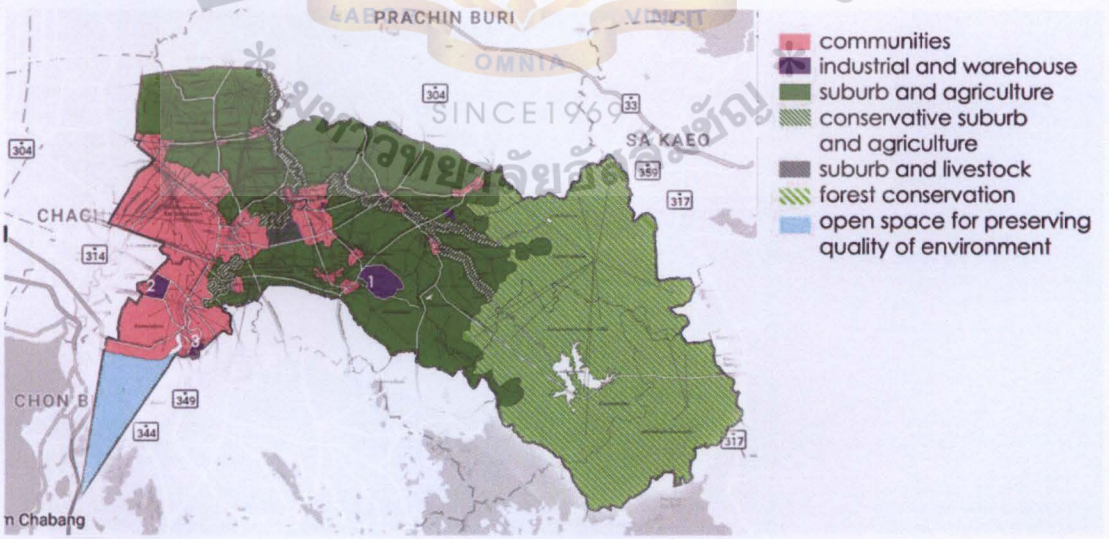


Figure 3.3.1 Chachoengsao landuse[12]

[12] "Chachoengsao Landuse." Chachoengsao office of public work and town. Accessed October 18, 2016. http://www.dpt.go.th/chachoengsao/main/.

3.3.1 Land use of Chachoengsao

Purple area: Industrial and warehouse area, allowed to build Industry, Warehouse, Government institutions, Public utility, and Public assistance disallowed to build Animal farming for business, Tomb, Commercial building, Residential building, Nursery and Eldery care. If the area is close to canal or public water resource it must be setback at least 6 meters. Except building for water transportation, irrigation, and public advantages. Other type of building must have at least 70% open space of total area

3.3.2 Large building type

Building that has total area or one floor area more than 2,000 sqm but not more than 10,000 sqm, or Building that higher than 15m and has total area or one floor area more than 1,000 sqm but not more than 2,000 sqm. Building height is measured from ground level to roof top, for hip or gable roof building is measured from ground level to the highest edge of the wall.

Building must be setback 6m from main road, and 12m from public water source. Building height must not be more than 2H (H = length from building to opposite road side)

FAR 10 : 1 for Factory, OSR 30% , for Factory 10%, and material should be fire resistance.

Chapter 4: Potential Design Response

4.1 Design Scope

This project is an automobile research and development center for automobile auto-parts manufacturers and student to research, test drive, and test auto-parts.

4.2 Programing Analysis

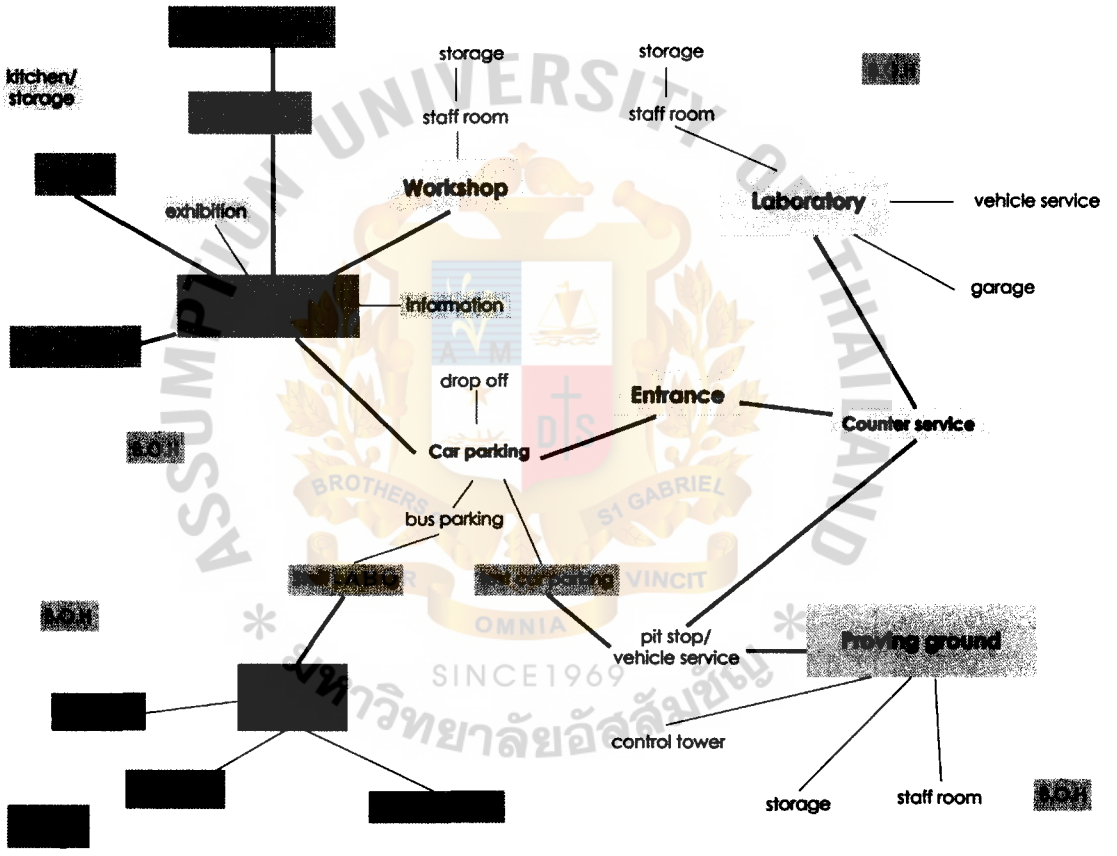


Figure 4.2.1 Relationship diagram of programs

Programs in this project are separated into four parts including public, semi-public, semi-private, and private area. Public area includes entrance hall, auditorium, café, lobby, and exhibition area those are provided for general people. Semi-public area provided for student for research and study including, learning area, information center, library, and multimedia room. Semi-private area is for automobile and auto-parts manufacturer for testing, including laboratory and proving ground. Private area is the office for staff.

4.2.1 Area requirement

Table 4.2.1 Area requirement[13]

	PRIVACY			NUMBER OF USER	UNITS	AREA (sqm)	TOTAL (sqm)
	PUBLIC	SEMI	PRIVATE				
entrance hall/Reception	☆			100	1	130	130
multipurpose area/ Exhibition	☆			-	1	40	40
cafe	☆			40	1	80	80
kitchen/ storage			☆	-	-	16	16
library	☆			40	1	160	160
media center	☆			40	1	185	185
auditorium		☆		50	1	65	65
wood workshop		☆		20	1	48	48
paper workshop		☆		20	1	36	36
plastic workshop		☆		20	1	36	36
metal workshop		☆		20	1	48	48
staff room			☆	4	1	16	16
storage			☆	-	1	72	72
Total							**932**
office			☆	30	1	58.5	58.5
small meeting room			☆	8	3	20	60
big meeting room			☆	30	1	57	57
lounge			☆	25	1	55	55
canteen			☆	50	1	100	100
kitchen/storage			☆	-	-	20	20
mechanic/technician office			☆	26	1	50	50
storage			☆	-	1	295	295
entrance/counter service		☆		20	1	26	26
vehicle service		☆		8	1	400	400
garage		☆		12	1	240	240
Total							**1,361.5**
laboratory							
crash test		☆		-	1	610	610
exhaust emission test		☆		-	2	80	160
heavy mechanical test		☆		-	1	115	115
light mechanical test		☆		-	1	115	115
measurement and calibration		☆		-	1	88	88
corrosion test		☆		-	1	60	60
spring test		☆		-	1	34	34
car seat test		☆		-	1	25	25
exhaust muffler test		☆		-	1	60	60
tyre test		☆		-	1	60	60
safety glass test		☆		-	1	115	115
safety belt test		☆		-	1	105	105
rubber, plastic, fabric parts		☆		-	1	125	125
pit stop		☆		18	2	360	720
control tower	☆		☆	-	1	130	130
staff room			☆	8	1	32	32
Total	☆						**2,554**
proving ground	☆	☆				81,000-182,000	182,000
drop off					5	62.5	
car parking					85	1,062.5	
Bus parking					10	280	
staff parking			☆		50	625	
test car parking			☆		20	250	
Total openspace							**184,265**
B.O.H.			☆				1,454.25
Circulation			☆				1,260.25
Total building space							**7,562**

[13] Neufert, E., Neufert, P., Baiche, B., & Walliman, N. (2000). *Architects' data*. Oxford: Blackwell Science.

4.3 Organization Structure

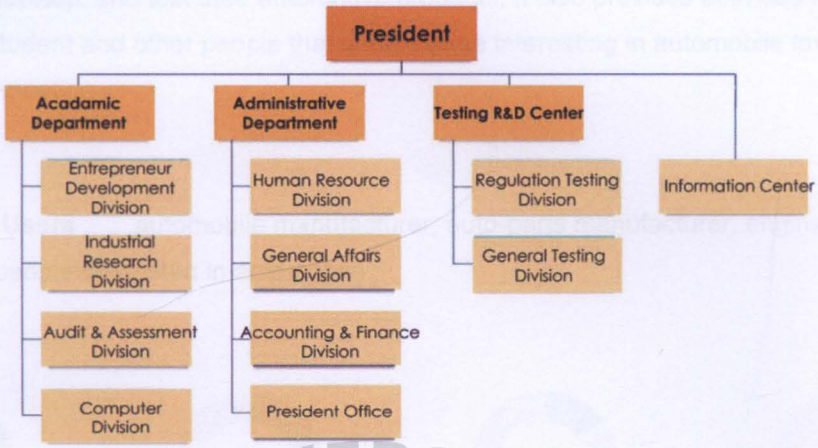


Figure 4.3.1 Organization chart[14]

Automobile research, development, and testing center is developed from the masterplan project of Thailand Automotive Institute, therefore the organization is organized and controlled by Thailand Automotive Institute. There are four main sections, which are academic department, administrative department, testing research and development center, and information center.

4.4 Activities / Spaces

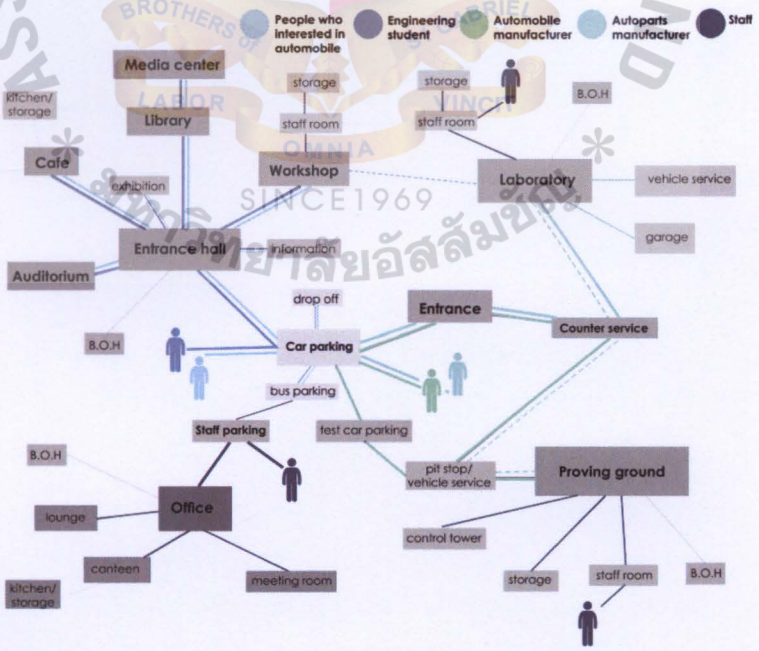


Figure 4.4.1 Activities diagram

[14] "Organization Chart." Thaiauto. Accessed October 15, 2016. http://www.thaiauto.or.th/2012/th/about-us/the-institution.asp.

The activities in this center are provided for automobile and auto-parts manufacturer to research, develop, and test their automotive products. It also provides activities for engineering student and other people that seems to be interesting in automobile for research, learning, and meeting.

4.4.1 Users automobile manufacturer, auto-parts manufacturer, engineering student, and people interested in automobile

Figure 4.4.2 Type of users

Users of this project can divide into four types, main users are automobile and auto-parts manufacturer. Others users are engineering student and other people who are interested in automobile.

4.5 Space Summary

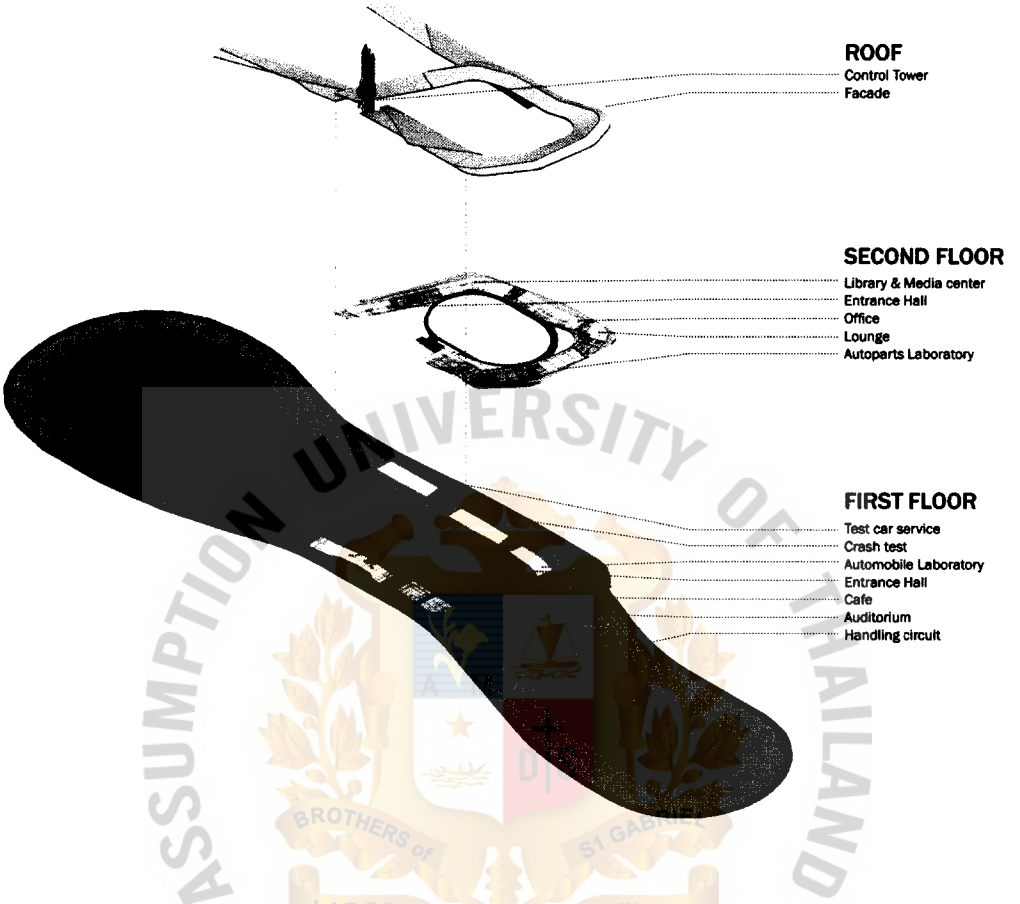


Figure 4.5.1 Facilities diagram

Main facilities of this project are provided for automobile and auto-parts manufacturer, engineering students, and people that are interested in automobile to study, synthesize, explore, test, and develop automobile and auto-parts. On the first floor, those facilities that visitor will encounter are entrance hall, exhibition area, and parking area. Next to the entrance hall are café and auditorium entrance hall. On the back side of building is automobile testing laboratories which includes emission laboratory, crash test laboratory, and other testing facilities.

On the second floor, facilities on the left side of building are public facilities which include reception area, information center, library, and media center. On the top side of building are private facilities which include office area, meeting room, storage, service elevator, staff lounge. On the right side of building are facilities for automobile and auto-parts manufacturer which include manufacturer lounge, auto-parts laboratory, and auditorium.

For the open space and architectural feature spaces in each floor, On the first floor, at the center of building is a relaxing garden that every user can access and have interactions

with each other. The front entrance core of building is connected to the tower for staff to watch and control all testing on the tracks, and for users and the media for watching and broadcasting. On second floor, the floor plate on the left and the right have different level of floor that is appropriated to sit as an amphitheater to watch a car testing in handling circuit. In the center of the second floor is the bicycle and walk route that is connected to each facilities on second floor and garden on first floor, to create more convenient for staff to cycling to work and observe in every function of building. And create an outdoor walking space for user to walk and access the center garden.

The roof and façade of the building were designed to related with the concept of the project. The building skin is connected to the roof, and the roof connects to the tower skin to the top of the tower.

Chapter 5: Building Technology

5.1 Building Structure

This project is a large building that requires big clear space for machine testing and automobile circulation. The height of the building is about 2 - 3 floor, not a very high building, so the structure that can support this purpose must be a long span structure.

5.1.1 Long span structure

Long span structure can provide unobstructed space, column-free spaces about 12meters to over 30 meters, for a variety of functions. In this project's facilities also includes activities for large audiences such as auditorium, exhibition halls, and laboratory.

5.1.2 Material

Long span roofs can be construct with many types materials, such as steel, aluminium alloy, timber, reinforced concrete and prestressed concrete. Steel is often preferred due to its high strength and because it will not spread fire over its surface.

5.1.3 Roof form: Truss

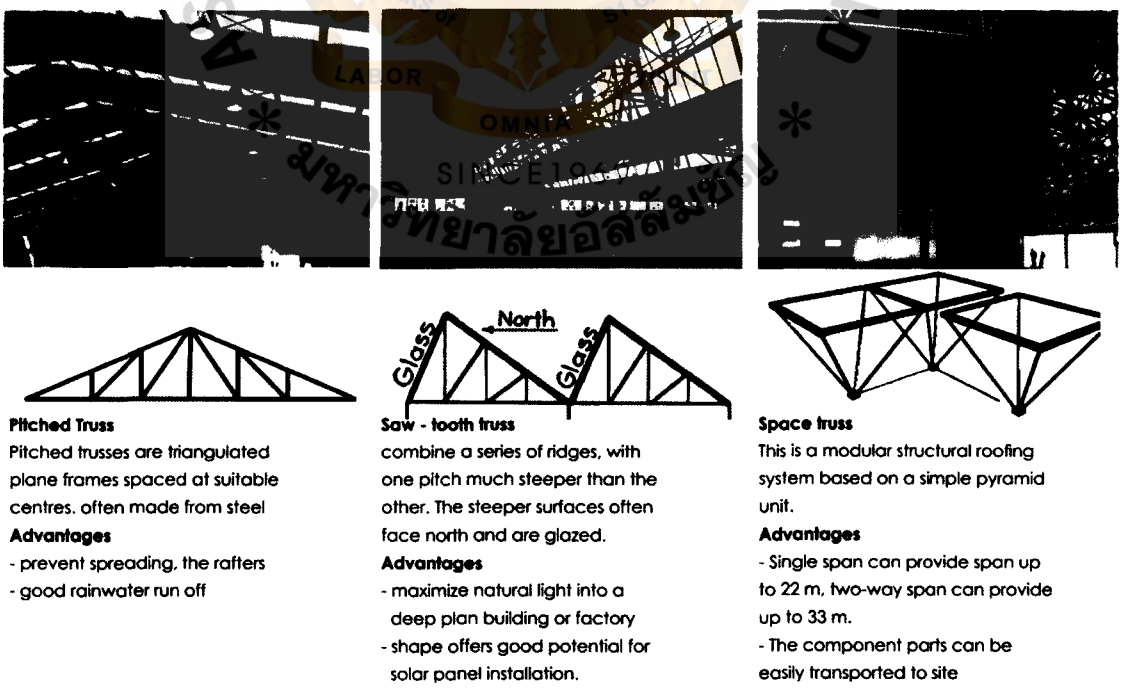


Figure 5.1.1 Truss roof form[15]

[15] "Trusses." Steel Construction. Accessed October 19, 2016. http://www.steelconstruction.info/Trusses.

5.1.4 Foundation: Strong floor/ for support vibration

For the laboratory, in this facility has many machines for automobile and auto-parts testing, so the foundation should be supported to endure the vibration from those testings.

Strong floor is a universal system that can be used for many type of laboratory. this system features can be design for specific application of laboratory, strong floor integrated well with centralized hydrolic system and piping, large area can be converted into strong floor for future test application.

5.1.5 Noise Protection

Protecting noises of proving ground testing from disturb nearby communities

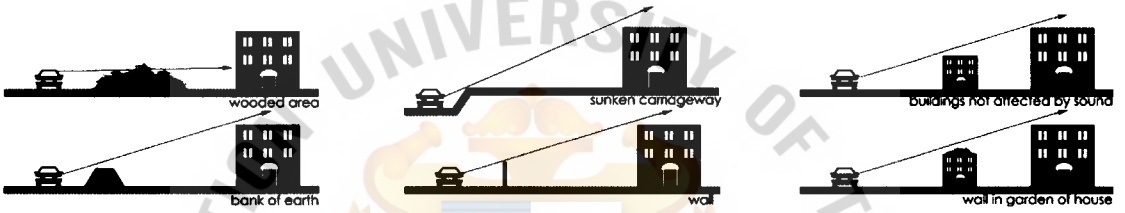


Figure 5.1.2 Noise protection diagram[16]

5.1.6 Structural Detail

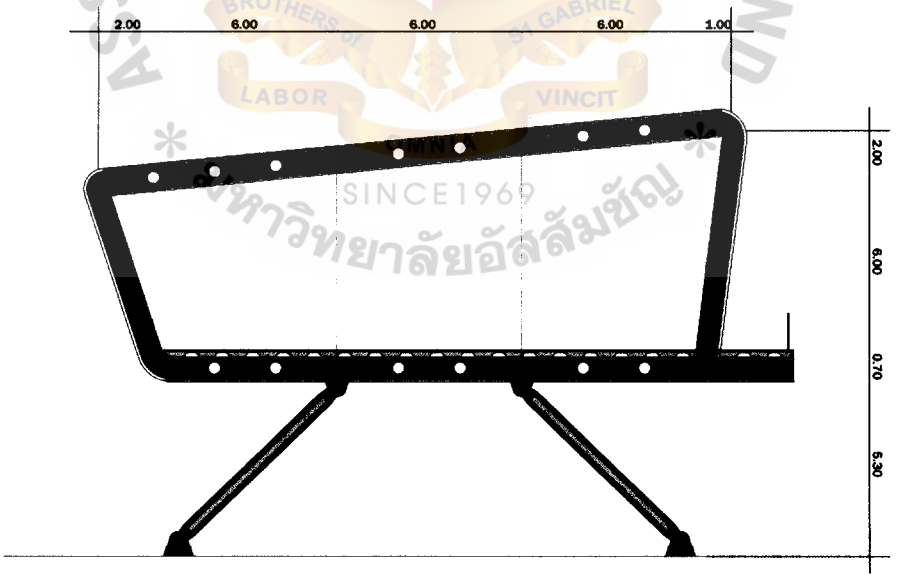


Figure 5.1.3 Structural detail

[16] Neufert, E., Neufert, P., Baiche, B., & Walliman, N. (2000). *Architects' data*. Oxford: Blackwell Science.

The main structure of this building is space truss, that includes precast I-beam custom made in same grid 18x6 meter but has a different shape and height, and connect to other frame with round iron on 8 edges. The distance between each I-beam frame is 8 meters. For the frame that elevate from ground floor also has a column to support.

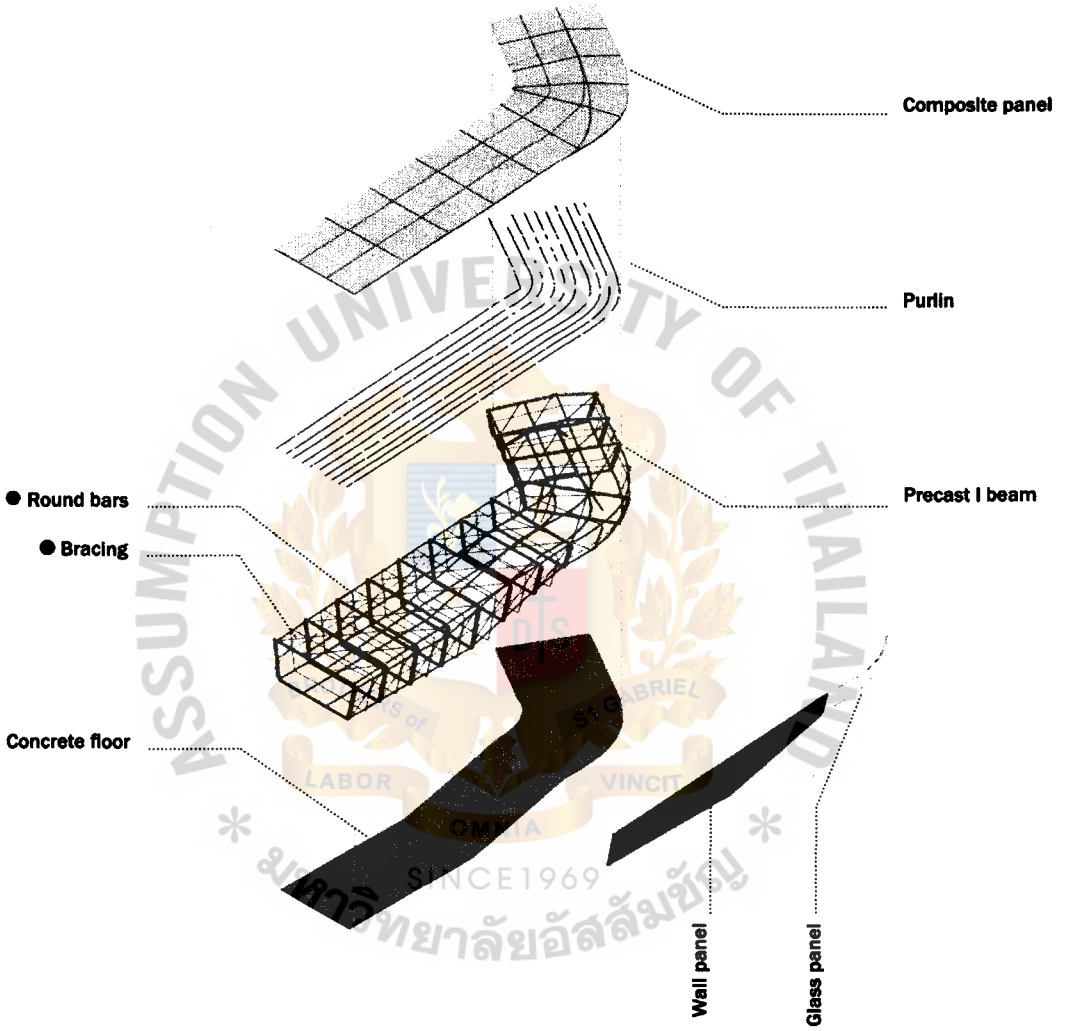


Figure 5.1.4 Structural detail 2

This diagram shows each element of the building structure, start from the I-beam frame, yellow lines are connected to each other with round iron, blue lines on 8 edges of frame, and connected with steel bracing, red line. Floor plate is a lightweight concrete combine with metal deck placing on the space truss. The roof and façade materials are composite panel placing with steel frame on space truss.

5.1.7 Structural Diagram

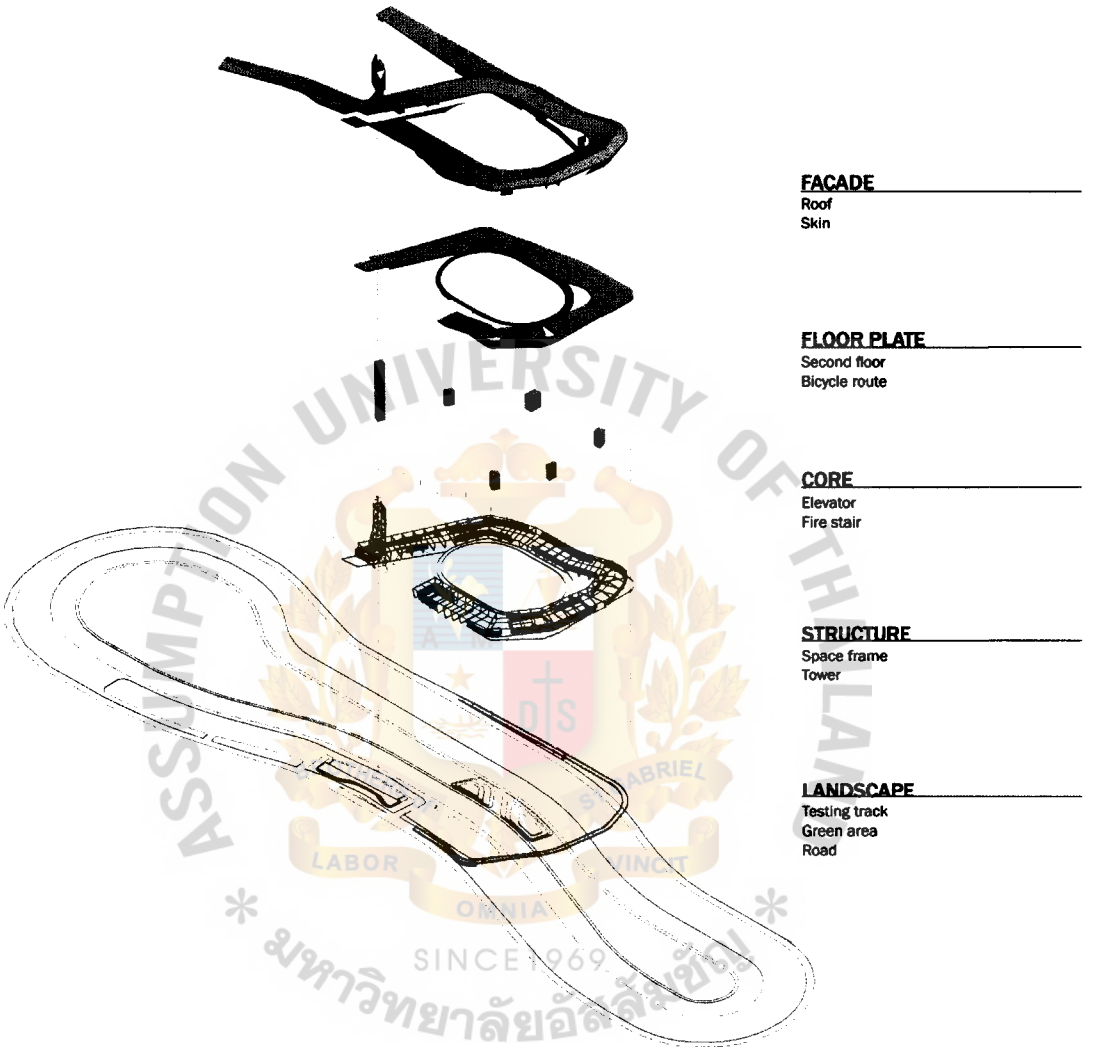


Figure 5.1.5 Structural diagram

The landscape of the building is a handling circuit for car testing, and at the center is a green area that will provide contour and tree for creating a garden. The building is placed covering the handling circuit. The overall structure of this building is a space truss that is connecting every part of building. The building has 6 cores, 2 low-rise elevators includeing service elevator, and 1 high-rise elevator that connects to the top of the tower. The floor plate is a lightweight concrete on metal deck placing on the space truss. Façade and roof of the building is a composite panel installing on the space truss's frame.

5.2 Building System

5.2.1 Air conditioning system

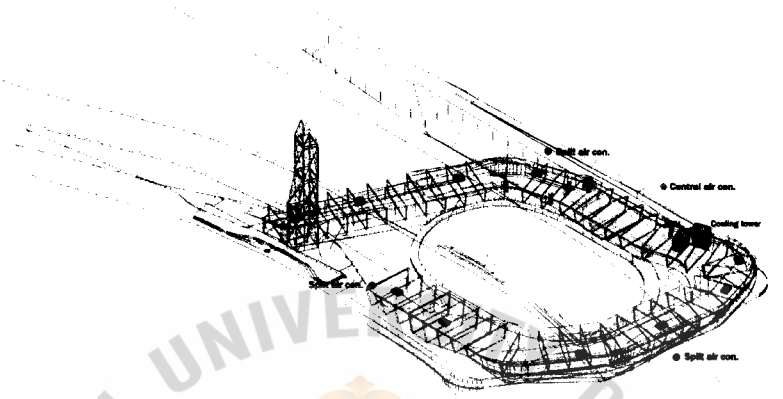


Figure 5.2.1 Air conditioning diagram

Almost all the circulations of this building are an open-air circulation except the office area that provides central air conditioning system, and other facilities such as information center, library, media center, and auto-parts laboratory will be provided with split type air condition.

5.2.2 Water system

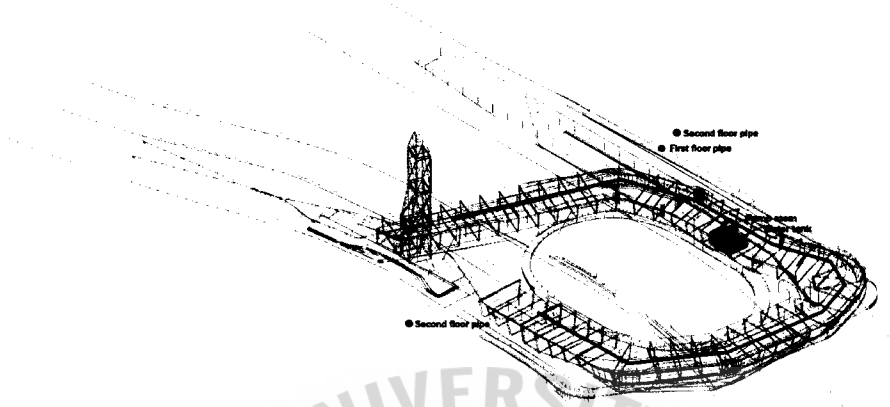


Figure 5.2.2 Water system diagram

The water system of this building is an up-feed water system, because this project has only 2 floors.

5.2.3 Core system

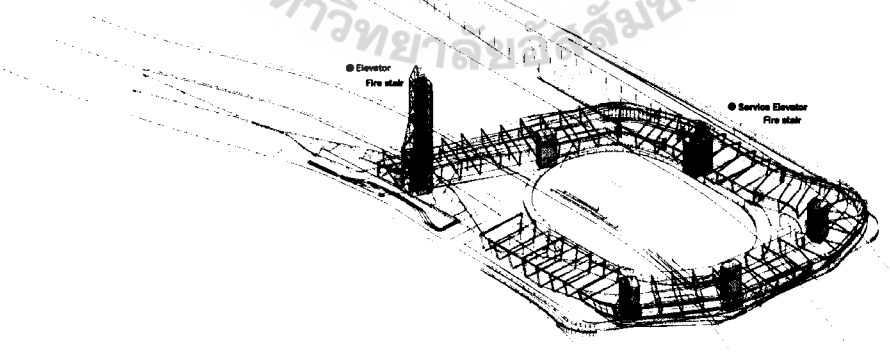


Figure 5.2.3 Core system diagram

This building has 6 cores, including 6 fire stairs, 2 low-rise elevators, 1 high-rise elevator on the entrance side to access to the tower, 1 service elevator that connects laboratory on first floor to office on the second floor.

Chapter 6: Design Schematics

6.1 Concept Development

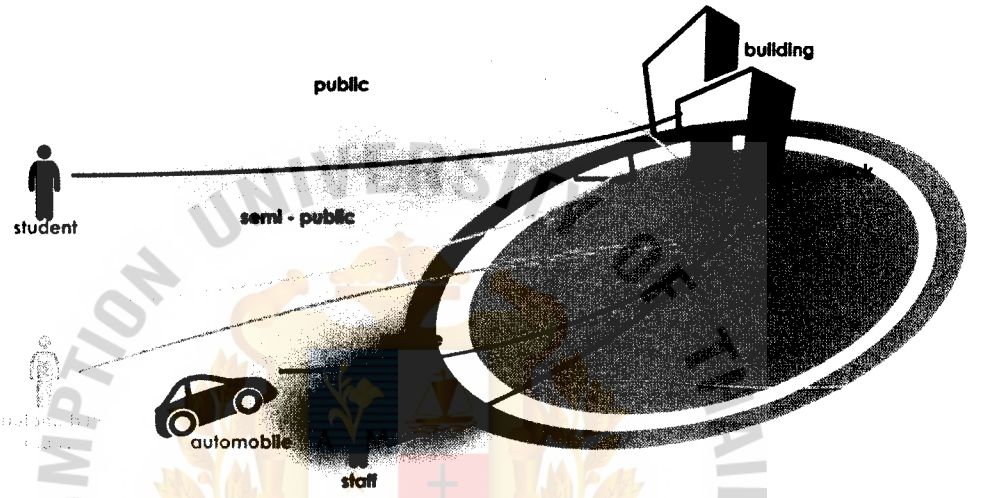


Figure 6.1.1 Concept development

According to the facility of this project is research and development center, laboratory, testing track, and office, so the design concept of this project is related with the issues of privacy for each user, arrangement of programing, and circulation for each type of users and automobile. The architecture must provide proper space for automobile circulation and human circulation in any privacy, also the landscape of the project must be designed to keep project's privacy and reduce noise pollution that disturb surrounding communities.

6.1.1 Concept Diagram

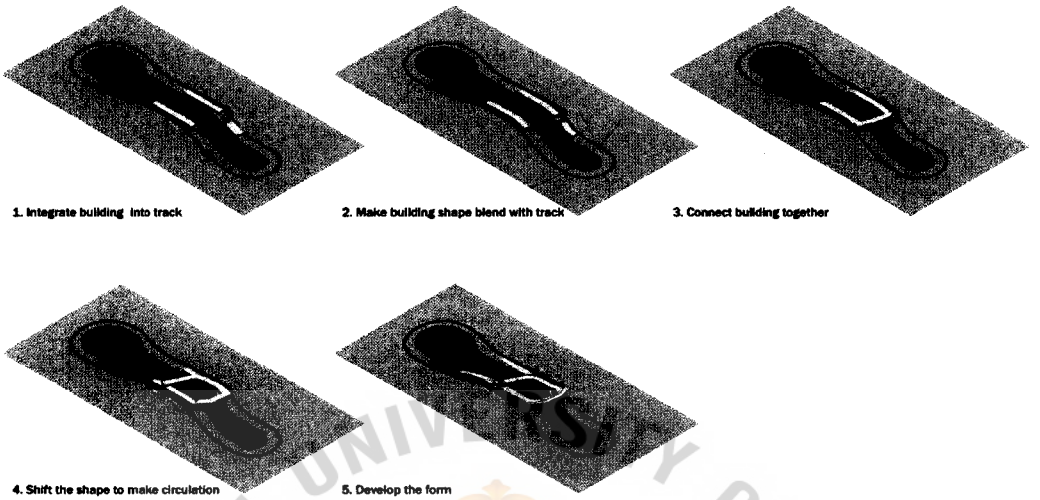


Figure 6.1.2 Concept diagram

The concept of this project was inspired from testing track that does not has the ending of circulation or endless, so this project will provide an endless circulation for car route and walk route. The building will be placed covering the test track and the building shape is also blended with the track. In this diagram, First, 3 main facilities were put near the test track. Second, adjust the shape of building to blend with the shape of the test track. Third, connect 3 buildings together. Fourth, shift the building's shape to make an endless circulation. Last, develop the building's mass.

6.1.2 Circulation diagram

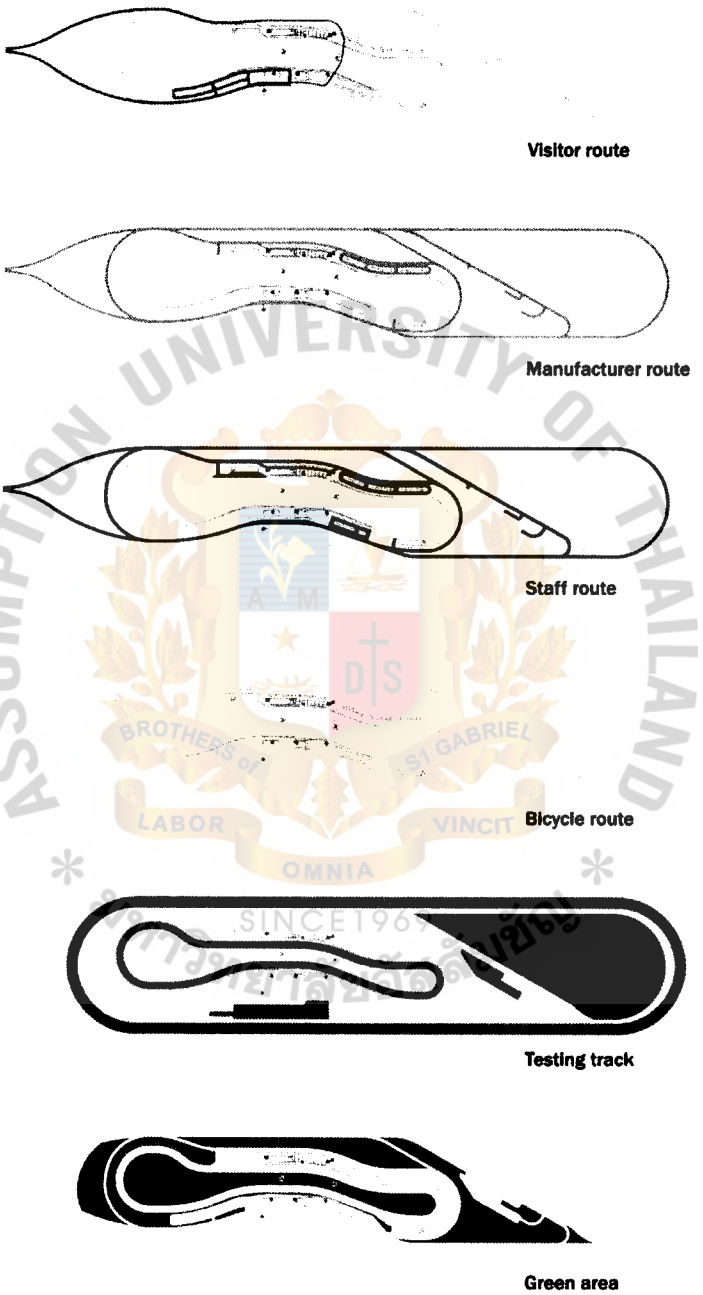


Figure 6.1.3 Circulation diagram

6.2 Design Development

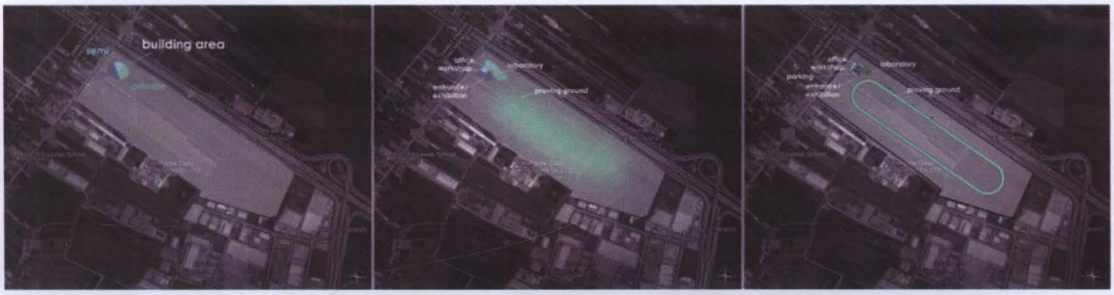


Figure 6.2.1 Zoning diagram

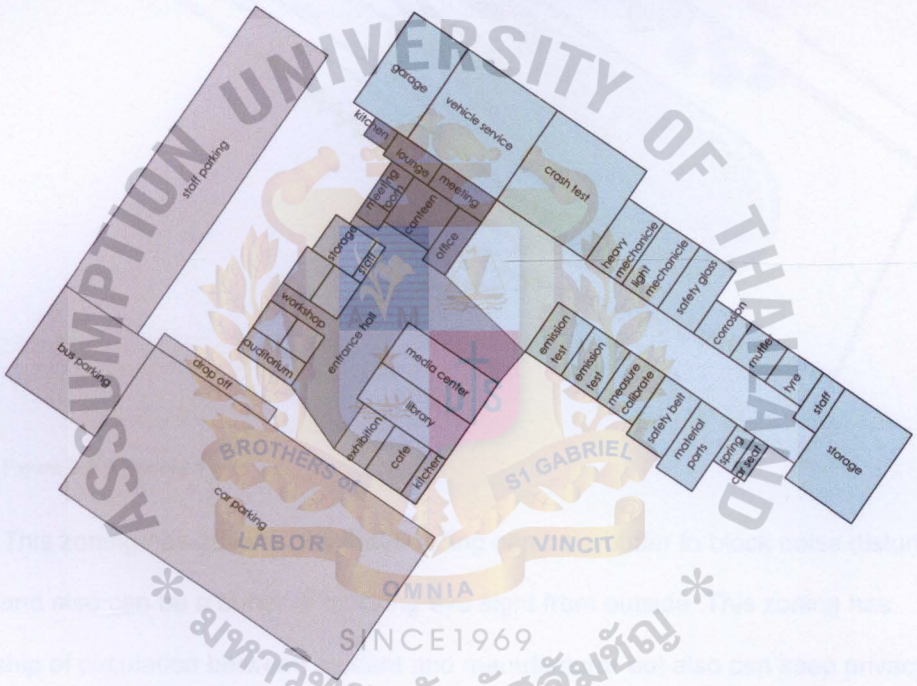


Figure 6.2.2 Schematic

Grey area (open space) included: drop off, car parking, bus parking, and staff parking.

Light blue area (public space) included: entrance hall, exhibition area, auditorium, café, library, media center, and workshop.

Dark blue area (private space) included: office, canteen, lounge, and meeting room.

Green area (semi-private space) included: laboratories, garage, vehicle service, staff room, and storage

6.2.1 Zoning

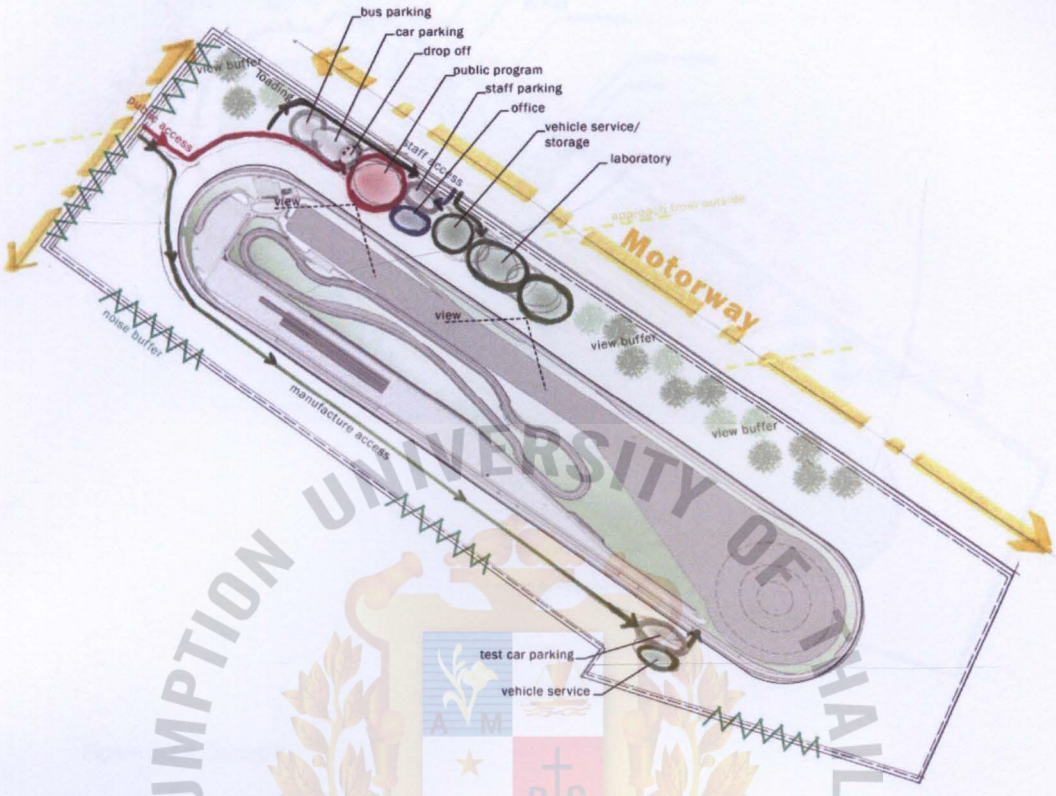


Figure 6.2.3 Zoning 1

This zoning has advantages that building can be a buffer to block noise disturbing to outside and also can be a buffer of blocking eye sight from outside. This zoning has relationship of circulation between student and manufacturer but also can keep privacy between laboratory and public programs. The disadvantages of this zoning are test car service is far from service and loading area, there will be some complexity of circulation in staff access area.

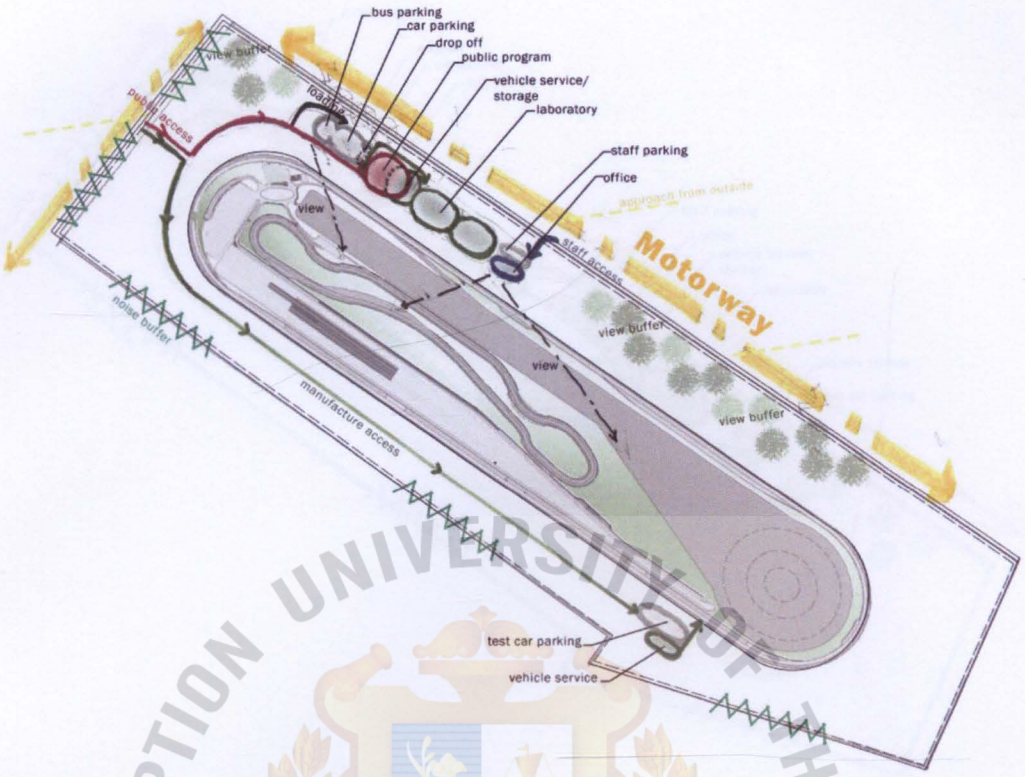


Figure 6.2.4 Zoning 2

This zoning has advantages that the building can be a buffer to block noise disturbing to outside and also can be a buffer of blocking eye sight from outside. Staff access is isolated from other access, and having a relationship between public and laboratory facility. Disadvantages of this zoning are test car service is far from service and loading area, office is far from other facilities to control.

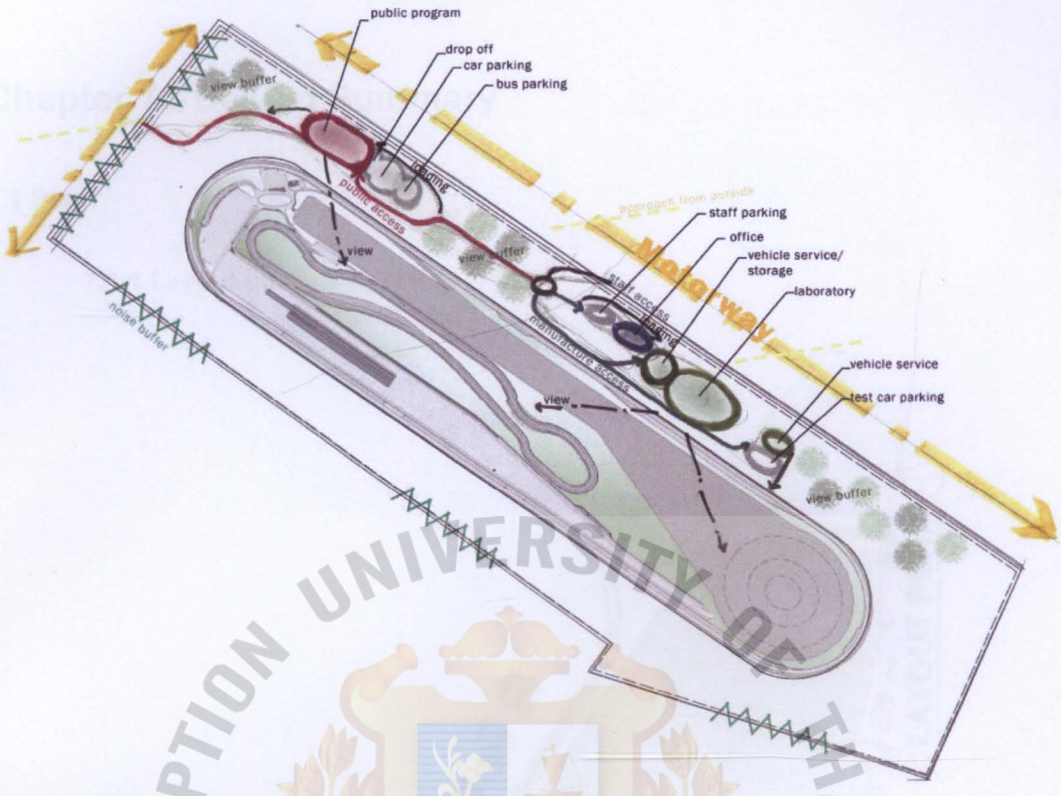


Figure 6.2.5 Zoning 3

This zoning has advantages that building can be a buffer to block noise disturbing to outside and also can be a buffer of blocking eye sight from outside more than zoning 1 and 2, laboratory has more privacy. Disadvantage of this zoning is there are less relationship between public facilities and laboratory facility.

Chapter 7: Design Summary

7.1 Plan

7.1.1 Layout plan

Figure 7.1.1 Layout plan

7.1.2 First floor plan

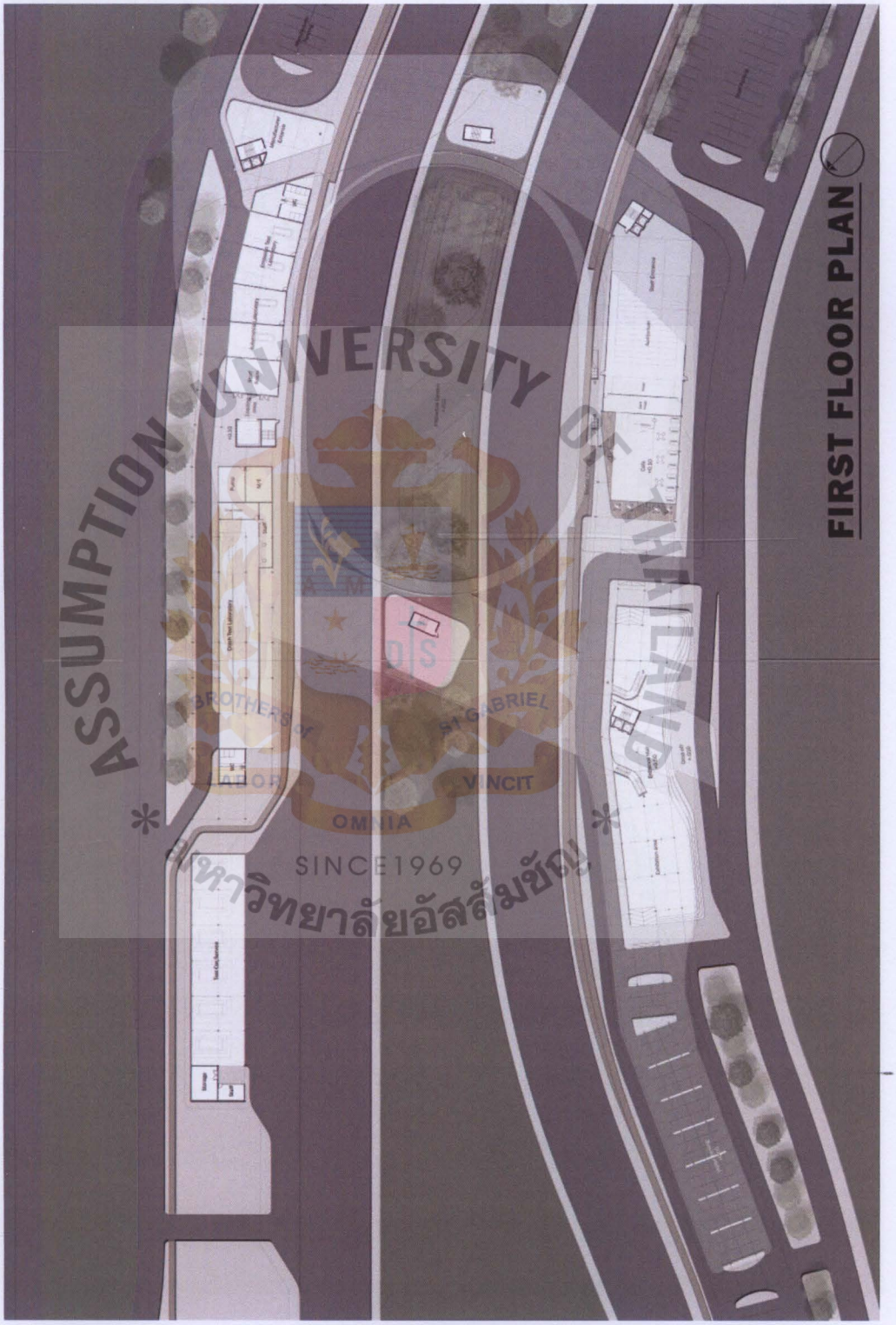


Figure 7.1.2 First floor plan

7.1.3 Second floor plan

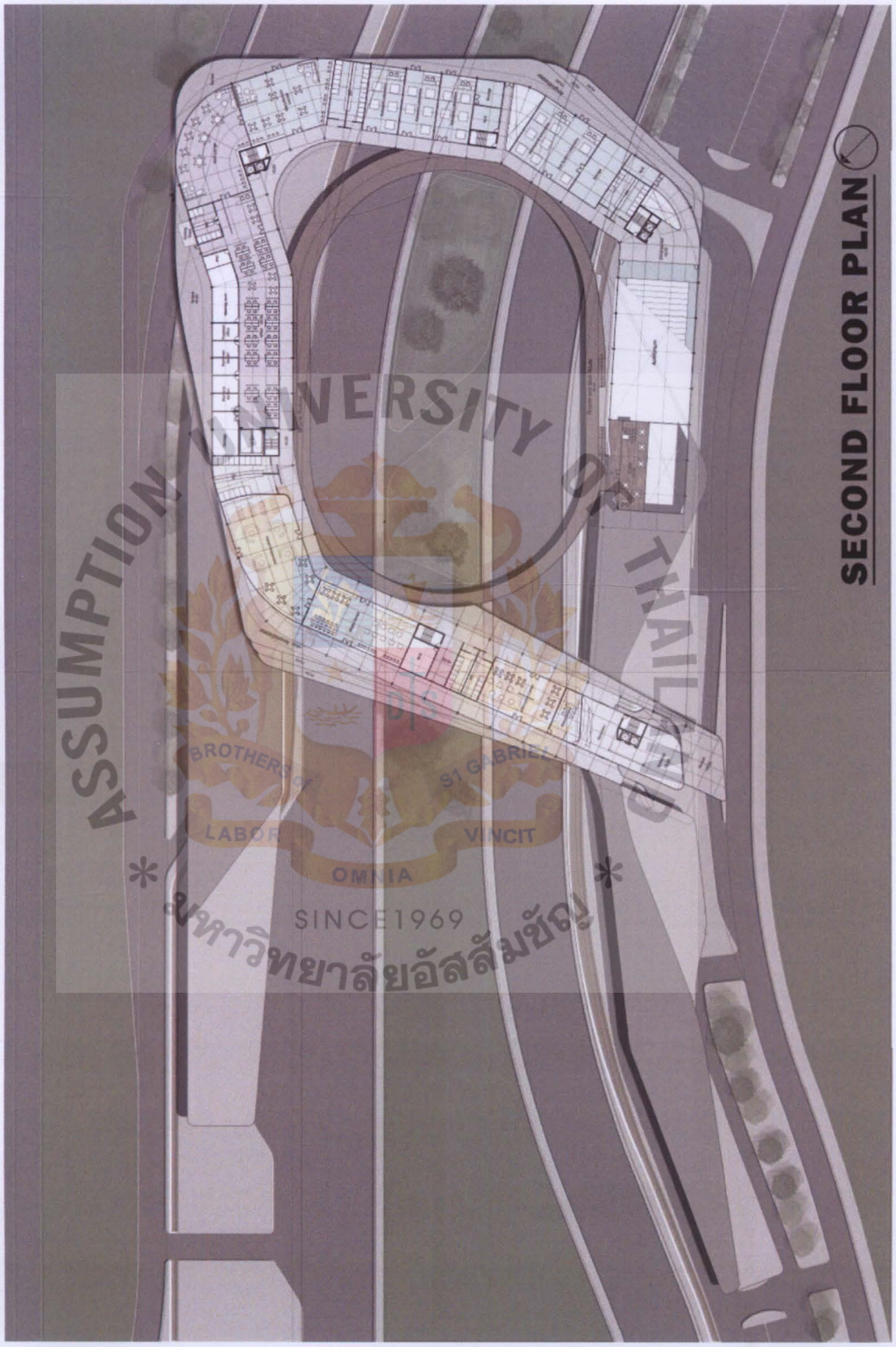


Figure 7.1.3 Second floor plan

7.2 Elevation

Figure 7.2.1 Elevation

7.3 Section

Figure 7.3.1 Section

7.4 Perspective

7.4.1 Exterior Perspective

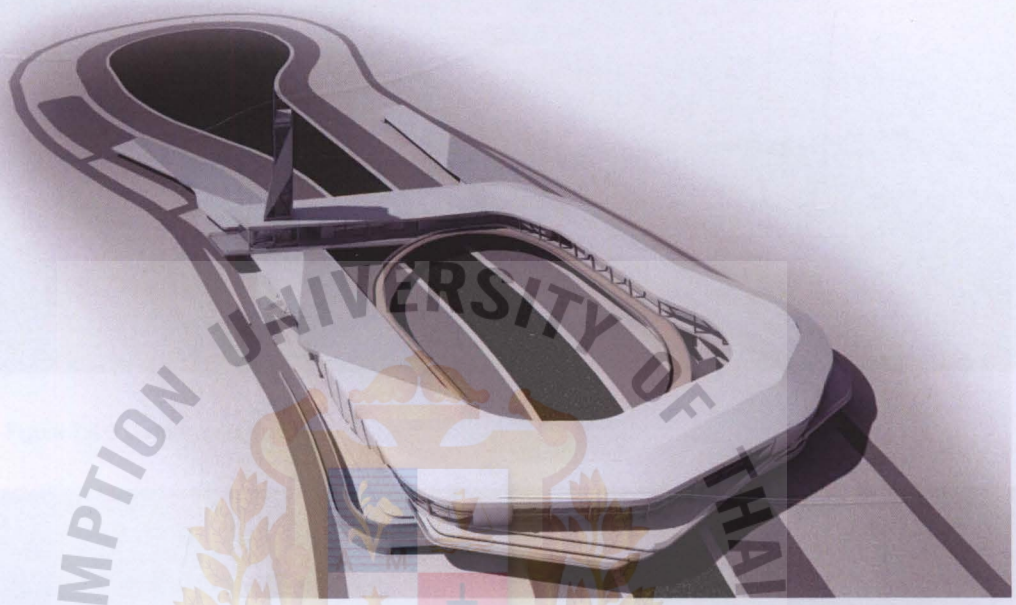


Figure 7.4.1 Bird eye perspective

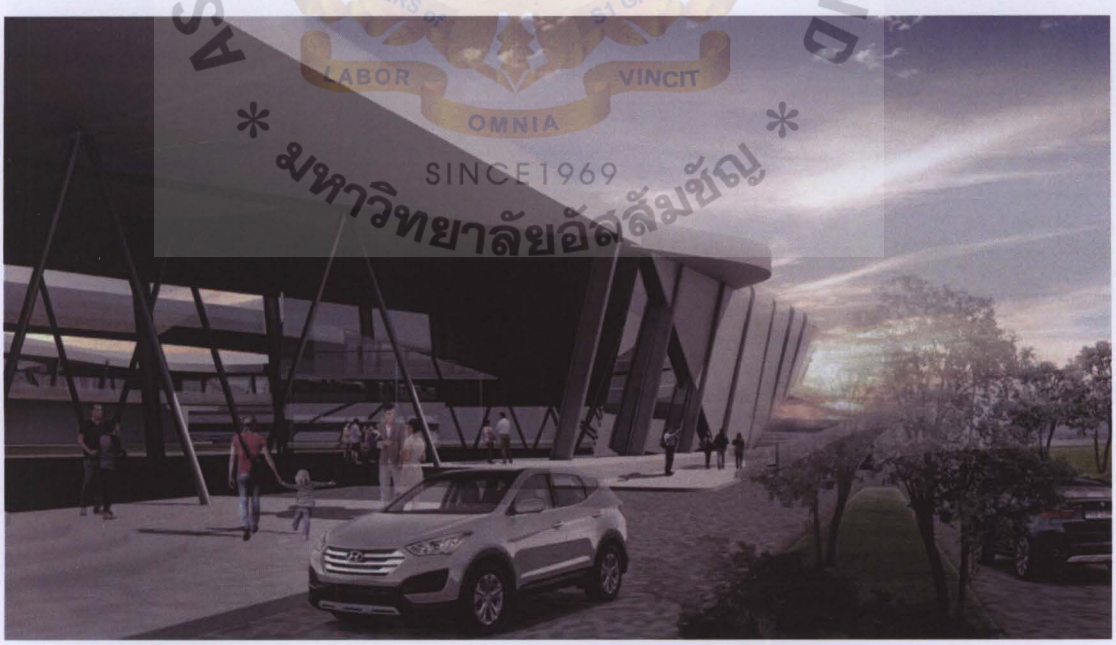


Figure 7.4.2 Entrance perspective

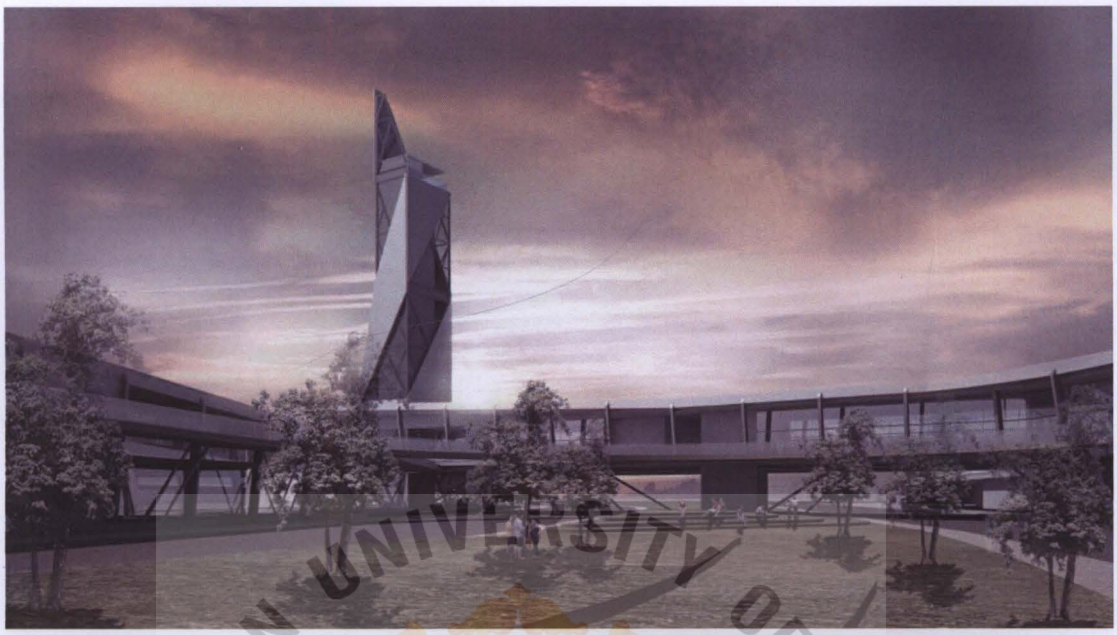


Figure 7.4.3 Garden perspective

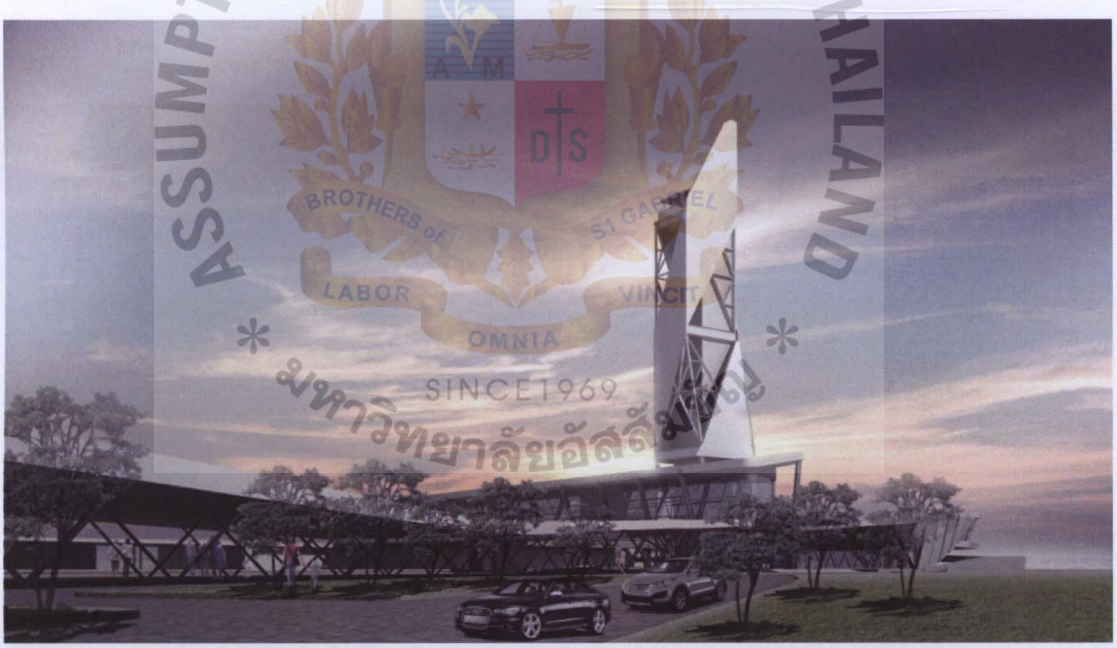


Figure 7.4.4 Entrance perspective 2

7.4.2 Interior Perspective

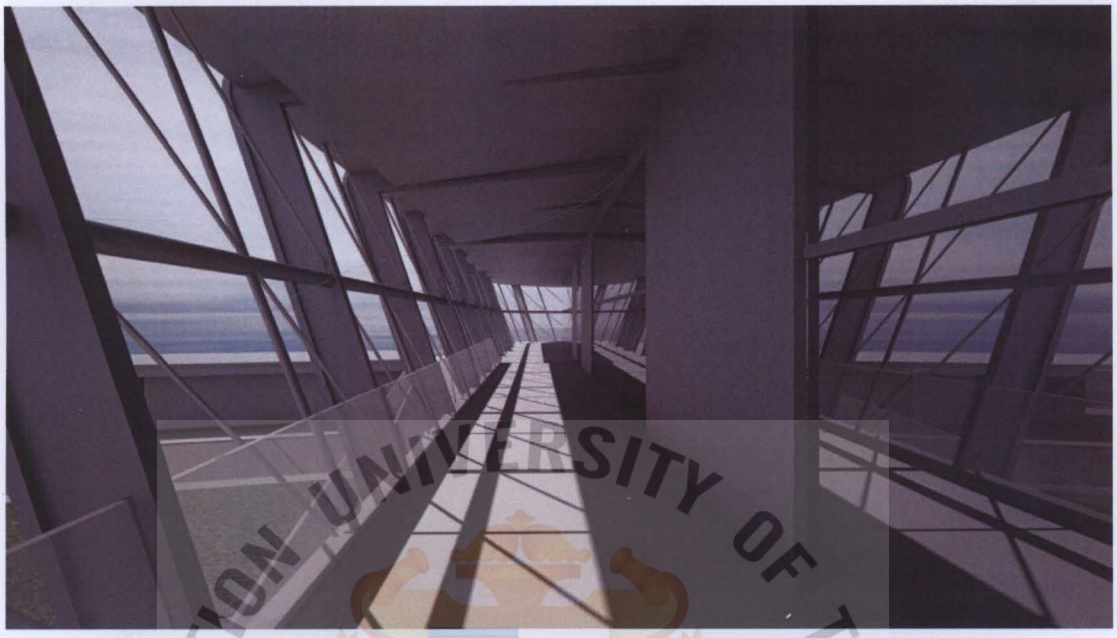


Figure 7.4.5 Corridor perspective

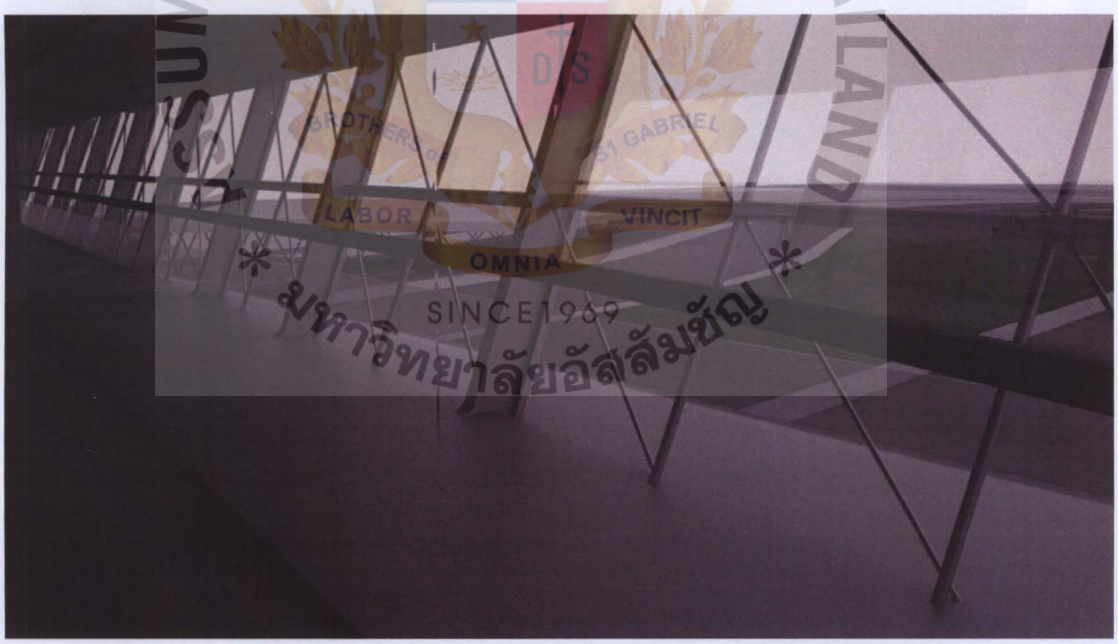


Figure 7.4.6 Corridor perspective 2

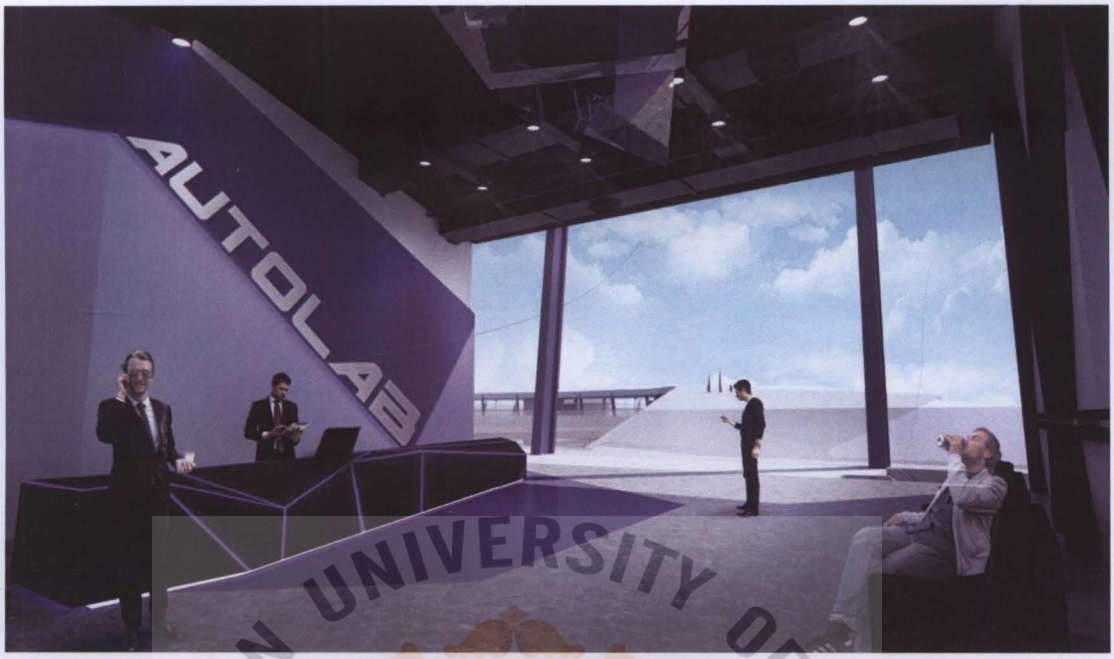


Figure 7.4.7 Reception perspective

Figure 7.4.8 Cafe perspective

Figure 7.4.9 Automobile laboratory perspective

7.5 Model Pictures

7.5.1 Site Model

Figure 7.5.1 Site model

7.5.2 Blow up Model

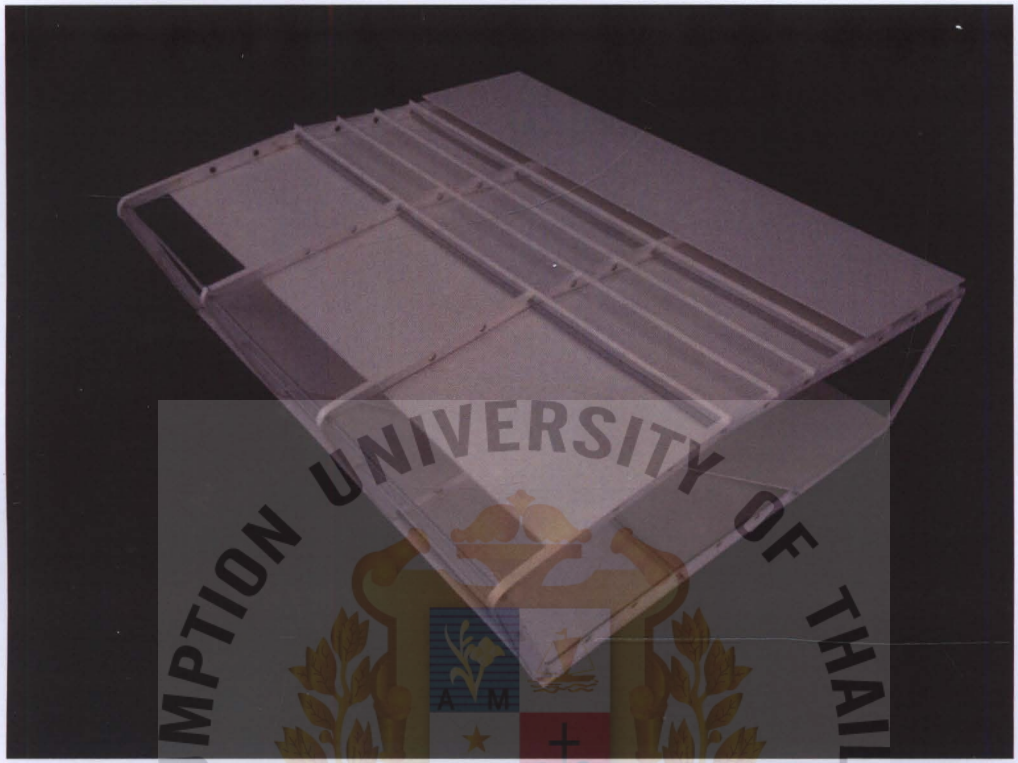


Figure 7.5.2 Blow up model image 1

Figure 7.5.3 Blow up model image 2

7.5.3 Final Model

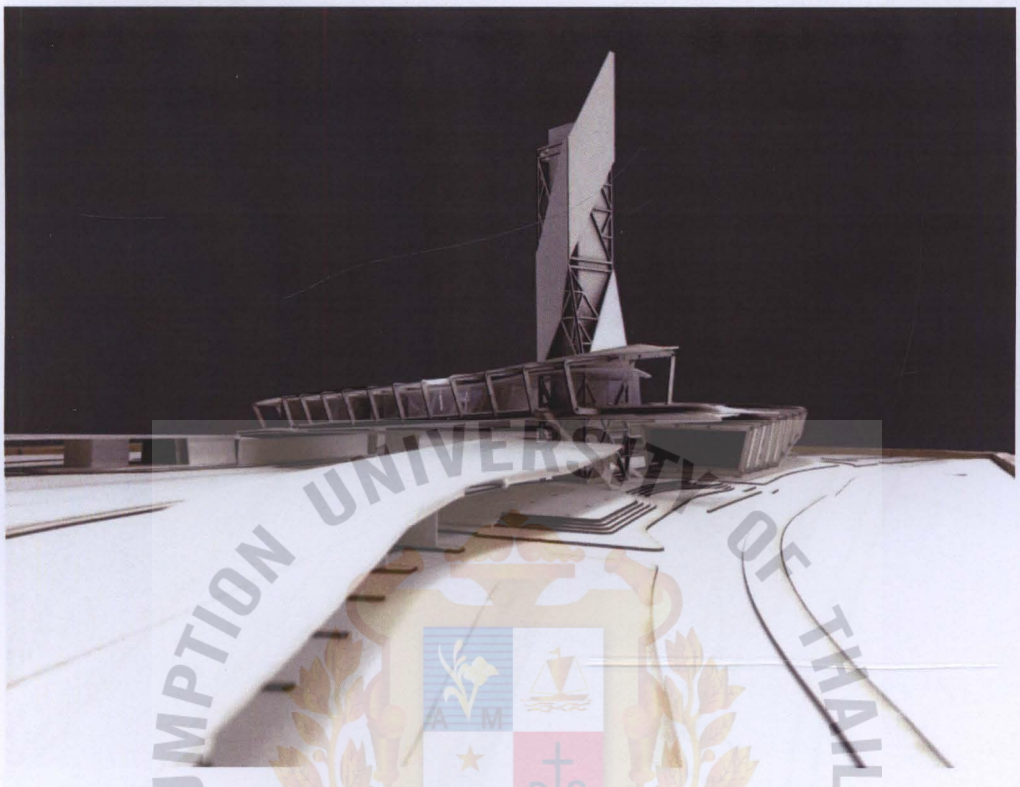


Figure 7.5.4 Final model image 1

Figure 7.5.5 Final model image 2

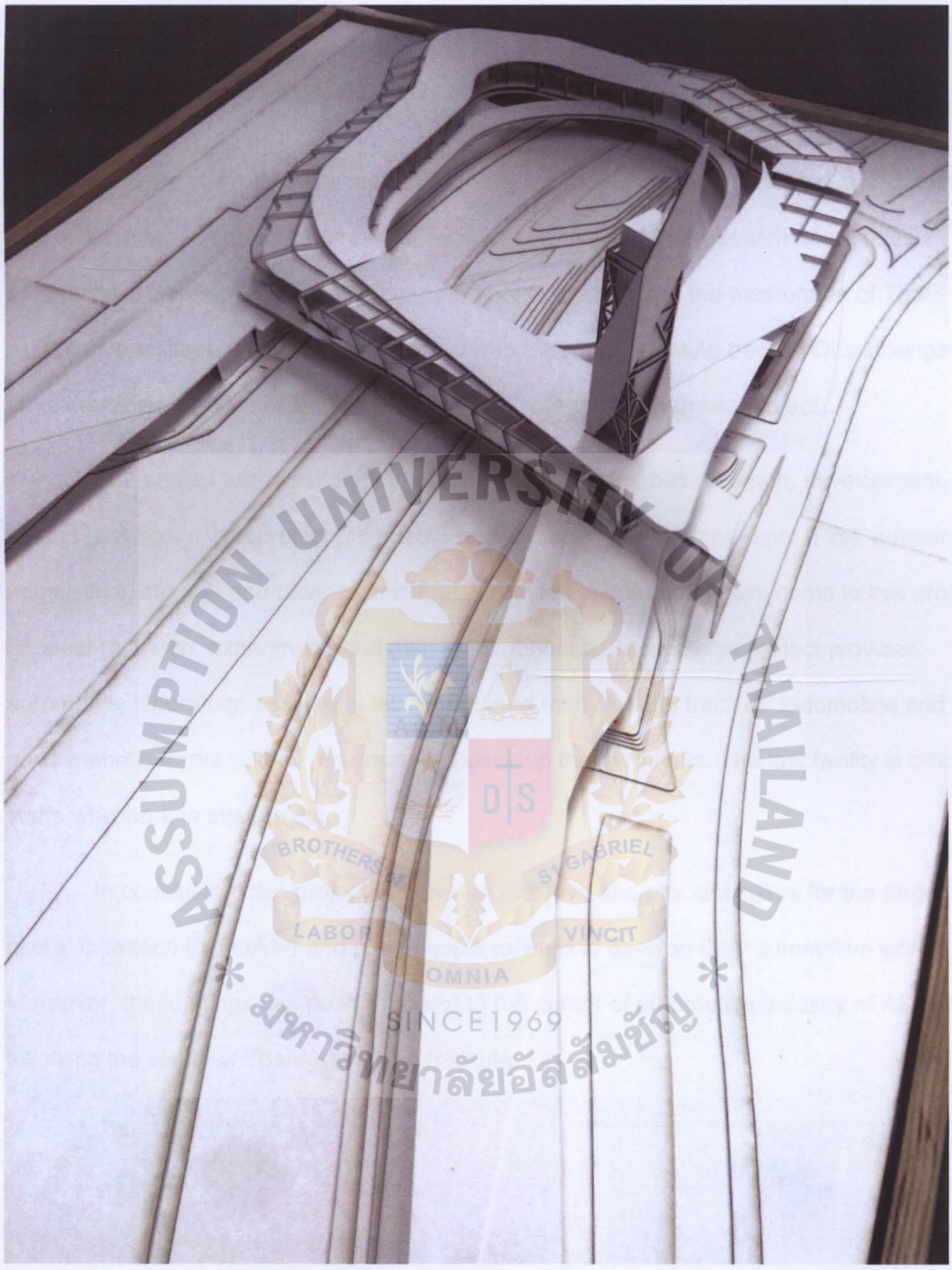


Figure 7.5.6 Final model image 3

Chapter 8: Thesis Conclusion

This thesis project was started from my interests that I am interested in architecture that is designed to support automobile facilities, so I started the research about many architectural facilities that is related to automobile, then I found the masterplan of Thai Automotive Institute that they planned to create automobile testing track in Chachoengsao. I have developed this plan, facilities, and site to create my own thesis project.

The project name Autolab, that comes from automobile research, development, and testing laboratory. The project provided 3 main facilities for different users. First, automotive engineering student and other people that interested in automobile can come to this project to conduct research, experiment, and gain an experience. Second, this project provides automobile laboratory, auto-parts laboratory, and many testing track for automobile and auto-parts manufacturers to test, research, and develop their products. The last facility is office for staffs who work in this project.

In conclusion, this project will give an effective and efficient space for the target users, in reason to inspired and push people forward to develop their automotive works. Moreover, these things can push Thailand to the center of automotive industry of ASEAN, following the vision of Thai Automotive Institute.

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