STATE RAILWAY OF THAILAND
MINISTRY OF TRANSPORT

กรุงเทพฯ
Bangkok
ฉะเชิงเทรา
Chachoengsao
ชลบุรี
Chon Buri
ระยอง
Rayong

# THE HIGH-SPEED RAIL LINKING THREE AIRPORTS PROJECT

# REQUEST FOR PROPOSAL

## VOLUME 3 : OUTLINE SPECIFICATIONS

## VOLUME 3/2 : OUTLINE SPECIFICATIONS FOR TRANSIT-ORIENTED DEVELOPMENT

จีน
China
อินเดีย
India
ประเทศอื่นๆในกลุ่มอาเซี
Other ASEAN Countries
ประเทศไทย
Thailand


AEC Sasin

Asian Engineering Consultants Corp., Ltd.
TEAM Consulting Engineering and Management Co., Ltd.
Sasin Graduate Institute of Business Administration of Chulalongkorn University

JUNE 2018

STATE RAILWAY OF THAILAND
MINISTRY OF TRANSPORT

## *THE HIGH-SPEED RAIL LINKING THREE AIRPORTS PROJECT*

# *REQUEST FOR PROPOSAL*

## *VOLUME 3 : OUTLINE SPECIFICATIONS*

## *VOLUME 3/2 : OUTLINE SPECIFICATIONS FOR TRANSIT-ORIENTED DEVELOPMENT*

AEC Sasin

***Asian Engineering Consultants Corp., Ltd.***
***TEAM Consulting Engineering and Management Co., Ltd.***
***Sasin Graduate Institute of Business Administration of Chulalongkorn University***

***JUNE 2018***

# OUTLINE DESIGN SPECIFICATIONS

## 1. Technical Specifications

### 1.1 Specification for Public Utilities

The Private Co-Investor shall arrange and manage for the public utilities in the development project as follows:

#### 1.1.1 Electrical Power Systems

The Private Co-Investor shall provide electrical power systems and provide and installation of lightning system in public areas throughout the project areas. There shall be minimum specifications designated below.

(1) Substation is required to receive power from the Metropolitan Electricity Authority (MEA) or Provincial Electricity Authority (PEA) for use in the buildings and in compliance with MEA's or PEA's standards for materials and installation.

(2) **Public lighting system** shall be supplied. There shall the installation of street lamps and throughout public areas in the project areas utilizing energy saving light bulbs. The public lighting system shall meet the standards of the Metropolitan Electricity Authority (MEA) or Provincial Electricity Authority (PEA) and the Bangkok Metropolitan or Municipality.

#### 1.1.2 Waterworks Systems

The Private Co-Investor shall design the waterworks systems at least in according to specifications and standards designated below.

**(1) General Specification**

(2.1) Survey and collect information on waterworks which provide service within the project area.

(2.2) Evaluate water consumption demand of each building and component within the project area.

(2.3) Information analysis to determine design approach for waterworks and pipeline construction within the project area.

**(2) Co-investors must comply with all relevant applicable laws, regulations and standards, as follows, but not limited to:**

(2.1) The Building Control Act of B.E. 2522 and subordinate laws

(2.2) Standard of Engineering of Thailand Under the Royal Patronage (VCD)

(2.3) Standards of Metropolitan Waterworks Authority (MWA) or Provincial Waterworks Authority (PWA).

(2.4) The Implementation of Environmental Impact Assessment Report on Building, Land Allocation And community service at provincial level by the resolution of the National Environment Board, 2/2557 on 25 September B.E. 2557.

(2.5) Bangkok Regulations on Building Control B.E. 2544

**(3) Technical Specifications**

(3.1) Construction of the water storage and distribution system as appropriate and capable of providing the water supply throughout the project area and all buildings. Firefighting systems must be provided in accordance with the relevant requirements.

(3.2) Responsible for the connection of the tap water system of the Metropolitan Waterworks Authority (MWA) or the Provincial Waterworks Authority (PWA) to the water tank of the building.

(3.3) The main water supply system out of the building's water tank must be provided with an Isolation valve and the Valve must be installed in a non-public area or closed area. If the valve is installed outside the building, it shall be installed at the Valve Chamber and prevent seeing in the public. If the Valves are installed in a specific room, the pipes must be installed through the external wall to the project and must not connect the pipes from the underground through the floor or foundation.

(3.4) Water tanks must be provided for storage of water for consumption and consumption within the project not less than one business day or as prescribed by relevant laws in the future. By painting or any chemical. To prevent seepage, only apply outside the tank.

(3.5) The water tank must be designed to provide a standby tank for maintenance or for use during the internal cleaning of the water tank during maintenance for avoiding any impact on the water use within the project in any case.

(3.6) The pump must be installed in the pump room to supply the required water as needed.

(3.7) Design and install equipment such as float valves, internal water tanks, and fire water tanks, that is designed for easy service without going into the water tank, especially when changing the entire needed.

(3.8) Water meters must be installed from the Metropolitan Waterworks Authority (MWA) or the Provincial Waterworks Authority (PWA) in areas where there is no risk of damage to the meter. In risky area, the Private Co-Investor must also provide the meters' protection.

### 1.1.3 Specification for telecommunication system and information technology

General specification in designing telecommunication system and information technology, including computer network, the proposer/ project investor must provide a modern and appropriate network and main equipment in good condition to provide enough service to the project customers, such as:

(1) Prepare infrastructure for core network and cooperation with telecommunication service provider or network operator in order to find an appropriate and effective technology for the project, such as FTTS technology (Fiber to the X) which X means point that fiber optic will connect for usage, for example, FTTB is connecting fiber optic to building while FTTH or FTTP is connecting fiber optic to home or premises, and must prepare a communications room, telecommunications room, and equipment which is interfaced with fiber optic.

(2) Install multi-services access node (MSAN) or optic line terminal (OLT) to distributing signals to various areas.

(3) Provide internet protocol private branch exchange (IP PBX) to support IP phone, SIP server and VOIP

(4) Provide main distribution frame (MDF) to distribute to area which require analog phone and FAX as well as coaxial cable for ATM machine, public telephone and credit card.

(5) Install wireless access point at required area to thoroughly support Wi-Fi usage and Hi-speed internet, such as office building, shopping center, hotel, hospital.

(6) Provide building automation system (BAS), to facilitate in information collection, monitoring and management, for effective energy usage by select prevalent and internationally accepted.

(7) Preparing the project infrastructure to support ICT system, which will lead to smart city and ubiquitous society in the future, including digital signage system.

### 1.1.4 Drainage Systems

The Private Co-Investor shall design water drainage systems in accordance with specification and standard for water drainage design as specify by law such as follow:

**(1) General specification**

(1.1) Survey and collect information on current water drainage within the project area and its surrounding area including level and slope of the project area

(1.2) Evaluate potential precipitation

(1.3) Information assessment for drainage construction design within the project area and select appropriate drainage system to area and layout

(1.4) Consider the draining rainwater from the project area without any effect to old drainage system around the project area

**(2) Current laws and designing standard, such as**

(2.1) Practical Guideline for consideration of environmental impact assessment report concerning building, land development and provincial community service

(2.2) Bangkok ordinance re: building control, B.E. 2544

**(3) Technical specification**

(3.1) The criteria for determining the maximum flow rate design for the building design and drainage along the project line will be determined by the return period at 10 years

(3.2) Designing the outlet's cross-sectional area of the opening of the outlet to be able to drain water more than the maximum flow rate of water that flows from the catchment area

(3.3) Designing must include water channel and pipeline for prevention of flooding and not reaching the maximum water level in manner of channel flow not exceeding 80 millimeters. The drainage from rail platform must be coherent with rail equipment and fire pipeline.

(3.4) At the point which bend, turn or warp that might be affected from overlap land subsidence, the vibration might cause pipe leakage thus the design must use flexible joint and durable materials which will last for as long as possible

(3.5) Size of underground drainpipe must have at least a diameter of 0.60 meters with manhole that are spaced in accordance with Bangkok standard or not exceed 12 meters.

2. **Specification for structural engineering systems**

The Private Co-Investor shall design the buildings in complying with laws, regulations, and standards of building design, at least as follows:

**2.1 Foundation Design**

**(1) General Specifications**

The Private Co-Investor shall design structure of the buildings correctly and in accordance with the laws, regulations, standards, and applying good practices for the design as follows:

(1.1) Structural stability
(1.2) Safety
(1.3) Economize
(1.4) Environment

**(2) Standards and Regulations**

The Private Co-Investor shall conduct the detailed design complying with applicable laws, regulations, and related restrictions to which includes domestic laws and practices accepted locally and internationally as specified below:

(2.1) Building Control Act, B.E. 2522

(2.2) The standard for building design of the Engineering Institute of Thailand

(2.3) Ministerial regulation re specification for load, resistance and durability of building and its supporting ground in earthquake vibration resistance, B.E 2550

(2.4) The standard for building the design in earthquake vibration resistance Mor Yor Phor. 1302

(2.5) The standard for wind loads calculation and building responses Mor Yor Phor. 1311-50

(2.6) Bangkok ordinance

(2.7) Building Code Requirements for Structural Concrete, ACT-318-99

(2.8) Specification for Structural Steel Buildings, AISC-360-05

(2.9) International Building Code, IBC 2006

(2.10) Minimum Design Loads for Buildings and Other Structures, ASCE7-05

(2.11) British Standard – Guide to Human Exposure to Vibrations in Buildings (1Hz to 80Hz), BS6472: 1992

(2.12) Structural Use of Concrete, Design and Construction BS8110: Part 1: 1997

(2.13) Council on Tall Buildings and Urban Habitat: Recommendations for the Seismic Design of Tall Buildings 2008

**(3) Specific Conditions for Foundation Design**

The Private Co-Investor shall deliberate the design of foundation complying with these following specifications:

(3.1) The standards and requirements of concerned designs, or design code

(3.2) Structural Performance Criteria

(3.15.1) *Design Life*

In design building foundation, the Private Co-Investor must consider design life for not less than 50 years.

(3.15.2) *Reinforced Concrete Considerations*

For reinforced concrete, the Private Co-Investor must design concrete covering to reach reinforced concrete as specified to control crack width by the external environment and must control and regulate the minimum quantity of cement in the

cement contents by design code ( BS8110) for the building durability.

(3.3) Structural Analysis

- *Design Software*
  The Private Co-Investor must consider applying software which is appropriate, effective and copyright.

- *Analysis Mode*
  The Private Co-Investor shall conduct structural analyze by applying 3D finite elements and more modern method and have acceptable standard both domestic and international.

- *Second order effects:*
  The Private co-investor shall consider and analyze factors that might cause the long-term effect to the foundation that need to be considered in the design phase, such as Creep, Shrinkage, and Settlement.
  1) Foundation Flexibility
     The Private Co-Investor must consider foundation thickness to have enough rigidity as not to increase building curvature from foundation deflection
  2) Settlement, Shortening, and Creep
     The Private Co-Investor must consider the result of uneven foundation subsidence for internal force calculation
  3) Construction Ability
     The Private Co-Investor must design building structure that can save cost and time.

(3.4) If there is an existing building close to the construction area, the Private Co-Investor must provide protection measure for existing building including a measure to prevent or reduce impact from construction to existing activities.

## 2.2 Specification for Structural Engineering Systems

The Private Co-Investor must design by specification and standard of building design as follow:

### (1) General specification

For building structure design, the Private Co-Investor must strictly comply with specification, standard and SRT's specification by adhering to design principles as follow:

(1.1) Structural stability
(1.2) Safety
(1.3) Serviceability
(1.4) Economize
(1.5) Environment

**(2) Standard and regulation**

The Private Co-Investor must design by latest standard and regulation which recognized locally and internationally, such as

(2.1) Building Control Act, B.E. 2522
(2.2) The standard for building design of the Engineering Institute of Thailand
(2.3) Ministerial regulation re specification for load, resistance and durability of building and its supporting ground in earthquake vibration resistance, B.E 2550
(2.4) The standard for building the design in earthquake vibration resistance Mor Yor Phor. 1302
(2.5) The standard for wind loads calculation and building responses Mor Yor Phor. 1311-50
(2.6) Bangkok ordinance
(2.7) Building Code Requirements for Structural Concrete, ACT-318-99
(2.8) Specification for Structural Steel Buildings, AISC-360-05
(2.9) International Building Code, IBC 2006
(2.10) Minimum Design Loads for Buildings and Other Structures, ASCE7-05
(2.11) British Standard – Guide to Human Exposure to Vibrations in Buildings (1Hz to 80Hz), BS6472: 1992
(2.12) Structural Use of Concrete, Design and Construction BS8110: Part 1: 1997
(2.13) Council on Tall Buildings and Urban Habitat: Recommendations for the Seismic Design of Tall Buildings 2008

**(3) Specific Conditions for Foundation Design**

The Private Co-Investor must consider and design building foundation by as follow:

(3.1) Design code on the topics above

(3.2) Fire rating

Designing main structure, namely column, shear wall, beam, and floor, must be able to resist fire not less than specific by law. As for reinforced concrete, it will be controlled by the thickness of steel used to reinforce, while structural steel will be controlled by its cladding material or fire protection color.

(3.3) Loading Loading for building design must not be less than specify by law and be in accordance with customer usage for special usage area, namely archives or safe box room

(3.4) Dead load will be calculated from unit weight of material general constant weight

(3.5.1) Concrete is 2,400 kilograms per square meter

(3.5.2) Steel is 7,850 kilograms per square meter

(3.5) Superimpose Dead Loads, namely floor finishing, interior walls, external walls, ceiling and hanging of building equipment systems

(3.6) Live Loads must be postulated not less than specify by specific law and might reduce live load in calculate the vertical force, namely column, beam and foundation in accordance with Design Code for safety and cost-saving structure.

(3.7) Wind loads will normally be considered by applying standard for wind loads calculation and building responses (Mor Yor Phor. 1311-50) of Department of Public Works and Town and Country Planning. If the structure height is more than specify or have complicate building shape, there must be structural test in wind tunnel for wind load that most consistent with such building.

(3.8) Seismic loads will normally be considered by applying standard for building design in earthquake vibration resistance (Mor Yor Phor. 1302 of Department of Public Works and Town and Country Planning which is in accordance with the ministerial regulation B.E. 2550

(3.9) Hydrostatic and buoyancy loads for basement slab must be considered in accordance with the depth of underground structure.

(3.10) Earth pressure loads for basement wall must be considered in accordance with the depth of underground structure.

(3.11) Thermal loads, as Bangkok temperature range is between 18°C to 38°C, the design must consider temperature changing range ±15°C. Internal force from temperature changing relate to building length, which normally will not exceed 100 meters. If the building length is more than 100 meters, there must separate building structure using expansion joint.

(3.12) Impact loads for parking level structure must design building structure, such as column or wall, to resist impact from car crashing into building structure

(3.13) Pattern loading for building design must considered live loads in a manner that there is the most force exerted on the building structure.

(3.14) Load combinations must be in accordance with ultimate design for designing reinforced concrete

(3.15) Structural Performance Criteria

(3.15.1) *Design Life*: Structural design normally will have design life at 50 years in relation with building durability and usage

(3.15.2) *Reinforced concrete considerations*

Reinforced concrete structure must have concrete covering up to steel be in accordance with crack width control specification depending to outside environment and must control the minimum amount of cement within cement contents as specify by design code ( BS8110) for building durability.

(3.15.3) Structural steel considerations
Structural steel must be durable with rust preventive or fire retardant coatings as specified by design code

(3.15.4) Vertical deflection limits
Control deflection in building the structure, namely beam and floor, to not exceed specified a limit by design code (ACI-318)

(3.15.5) Floor vibration
Floor vibration must be under the threshold of human perception by calculating response factor by BS Code

(3.15.6) Wind and seismic deflections
Building a horizontal movement from wind and seismic deflections must not exceed the allowed maximum value as specified by design code

(3.16) Structural Analysis

(3.16.1.) Design Software
Using software that is appropriate, effective and copyright

(3.16.2.) Tower global analysis mode

*a) Analysis Method*
Using 3D finite element for analysis of primary structure concerning wind and seismic deflections

*b) S*econd order effects: consider and analyze factors that might cause the long-term effect to the foundation that need to be considered in the design phase, such as Creep, Shrinkage, and Settlement.

- *Foundation Flexibility* -- Considering of foundation thickness to have enough rigidity as not to increase building curvature from foundation deflection
- *P- Delta analysis* -- Considering of the structure by apply P- Delta method to examine any spindly column
- Settlement, Shortening, and Creep
  - Considering the result of uneven foundation subsidence for internal force calculation
  - Considering the result of column shortening and creep between podium and tower to find weight different which might cause uneven retraction of column thus increase the internal force

- *Cracking* -- Considering of cross section cracking which might affect building structure stiffness
- *Construction Ability* -- The Private Co-Investor must design building structure that can save cost and time

(3.17) If there is an existing building close to the construction area, the Private Co-Investor must provide protection measure for existing building including a measure to prevent or reduce impact from construction to existing activities.

(3.18) If Private Co-Investor wants to change building usage, they must design building renovation by law and regulation concerning the new usage.

## 2.3 Specifications for Electrical and Communication Engineering Systems

The Private Co-Investor must design and provide equipment for electrical and communication system in accordance with general specification and related standard and regulation as stated below:

**(1) General specification**: designing electrical system and installing of electrical equipment must be in accordance with appropriate standard, specification and regulation that used in design and install within Thailand by adhere to:

(1.1) Safety of staff, electrical equipment and premises

(2.1) The Stability, reliability and efficiency of electrical systems

(3.1) Flexible to escalation or expanding of electricity demand in the future and convenience to maintenance including energy saving and no environmental impact

**(2) Standards and Regulations**: Design must comply with standards and regulations enforce in Thailand and others international accepted standards, such as

(2.1) Building Control Act, B.E. 2522

(2.2) Enhancement and Conservation of Energy Act, B.E. 2535 and 2550

(2.3) Standard for electric system installation in Thailand by the Engineering Institute of Thailand, under H.M. the King's patronage, (For Sor Thor) 2001-2556

(2.4) Standards of MEA

(2.5) Standards of International Electro-Technical Commission (IEC)

(2.6) Standards of International Commission on Illumination (CIE)

(2.7) Standards of National Fire Protection Association (NFPA)

(2.8) Standards of Thai Industrial Standards Institute (TISI)

(2.9) Standards of Underwriters Laboratories Inc. (UL)

(2.10) Standards of American Nation Standard Institute (ANSI)

(2.11) Standards of National Electrical Manufacturing Association (NEMA)

(2.12) Standards of British Standard (BS)

**(3)** Private Co-Investor must provide electrical and communication system in each building with at least:

(3.1) High voltage system and switchgear

(3.2) Distribution transformer

(3.3) Main distribution board

(3.4) Emergency power system

(3.5) Lighting and receptacle system

(3.6) Emergency light and fire exit sign

(3.7) Lighting control system

(3.8) Grounding system

(3.9) Lightning protection

(3.10) Fire alarm system

(3.11) Telephone system

(3.12) Security system

(3.13) Closed circuit TV system

(3.14) Master antenna TV system

(3.15) Sound system

(3.16) Local area network

## 2.4 Specification for mechanical engineering systems

**(1) Mechanical engineering systems must comply with latest laws and standards as follow:**

(1.1) Building Control Act, B.E. 2522

(1.2) Ministerial regulation re: enhancement and conservation of energy, B.E. 2552

(1.3) Standard of air conditioning and ventilation system by the Engineering Institute of Thailand, under H.M. the King's patronage

(1.4) Standards by Thai Industrial Standards Institute

(1.5) Standards of fume control by the Engineering Institute of Thailand, under H.M. the King's patronage

(1.6) Ministerial regulation re: enhancement and conservation of energy, B.E. 2552

(1.7) American society of heating refrigerating and air-conditioning engineers (ASHRAE)

(1.8) Sheet metal and air conditioning contractors' national association (SMACNA)

(1.9) National fire protection association (NFPA90, 90A)

(1.10) Air movement and control association (AMCA)

(1.11) Cooling tower institute (CTI)

(1.12) Underwriters Laboratories Inc. (UL)

(1.13) Factory Mutual (FM)

(1.14) American national standards institute (ANSI)

(1.15) American society for testing and materials (ASTM)

(1.16) American society of mechanical engineers (ASME)

(1.17) American welding Society (AWS)

(1.18) Air-conditioning and refrigeration institute (ARI)

(1.19) Lift and service lifts (EN81)

(1.20) Safety code for elevators and escalators (ASME A17.1)

(1.21) Inspector's manual for elevators and escalators (ASME A17.2)

(1.22) Size of car and hoist ways of elevators (JIS a3401)

(1.23) National electrical code (NEC, NFPA 70)

(1.24) International building code (IBC)

**(2) Air-Conditioning and Ventilation Systems**

The Private Co-Investor must provide air-conditioning and ventilation systems that is appropriate in accordance with Thai laws and international standard. The air-conditioning and ventilation system must be high efficiency for energy saving and sustainable energy including chilled liquid system that used with air-conditioning system must be environmental friendly while ventilation system must have both natural system and mechanical system as specify by Thai laws and international standards.

**(3) Fume control engineering systems**

The Private Co-Investor must provide fume control engineering system in accordance with Thai laws and international standards, such as stair pressurized system, fireman lift pressurized system, confined spaces and atriums and large opened area, for building on top of the platform but provide fume ventilation system for space under the platform in accordance with Thai laws and international standards.

**(4) Elevators and escalators engineering systems**

The Private Co-Investor must provide elevators, escalators and fireman lift systems as specify by Thai laws and international standard. These systems must support usage of people with disabilities. All device must be modern, effective, durable, energy saving, time saving and maintenance cost saving.

## 2.5 Specification for sanitary systems

(1) Sanitary systems must comply with latest laws and standards as follows:

(1.1) Standards of the Engineering Institute of Thailand, under H.M. the King's patronage

(1.2) Standards of Metropolitan Waterworks Authority (MWA)

(1.3) Bangkok ordinance re: building control B.E 2522

(1.4) Standards by Thai Industrial Standards Institute

(1.5) Standards by Wastewater Management Authority (Ministry of Natural Resources and Environment)

(1.6) Notification of Ministry of Science, Technology and Environment re: specification of standard for discharging wastewater from some type and size of building

(1.7) Office of National Environment Board

(1.8) ASPE: American society of plumbing engineers

(1.9) AWWA: American water work association

(1.10) NFPA: National fire protection association

(1.11) UPC: Uniform plumbing code

(1.12) National plumbing code (U.S.A)

(2) Sanitary engineering systems will consist of systems as follows:

(2.1) Wastewater system

(2.2) Soil system

(2.3) Trapping smell system

(2.4) Vent system

(2.5) Re-used water system

(2.6) Storm drainage system

(2.7) Cold water supply system

(2.8) Hot water system

The Private Co-Investor must provide sanitary engineering systems appropriate to each building usage in accordance with Thai laws and international standards. Equipment used in these systems must be safety, modern, high efficiency and durable for saving of energy, time and maintenance cost for conservation and sustainable use of natural resources, thus wastewater treatment and re-used of treated wastewater is very important to this project and imperative for Private Co-Investor to prepare.

## 3.6 Specification for Waste Management Systems

Waste management for buildings shall be in accordance with specification and standard of building design which consist of:

### (1) General specification

(1.1) The Private Co-investor shall conduct a survey and collect information on Bangkok's waste collect and dispose system for the project area and related Bangkok ordinance

(1.2) Evaluate potential segregated waste of each building

(1.3) Design waste management system under related laws

(1.4) Propose a waste segregation idea (if)

### (2) Applicable laws and design standards

the Private Co-Investor shall comply with these following laws:

(2.1) Building Control Act, B.E. 2522

(2.2) Bangkok ordinance re: building control, B.E. 2544

(2.3) Enhancement and Conservation of Environment Act, B.E. 2535

(2.4) Standards of the Engineering Institute of Thailand, under H.M. the King's patronage

(2.5) Practical guide for consideration of environmental impact concerning building, land development and provincial community service.

### (3) Technical specification

(3.1) Shape and size of waste storage area must comply with standards of Building Control Act and Bangkok ordinance re: building control B.E. 2544, which is not less than three time of daily waste.

(3.2) The waste storage area of each building or group of the building must be in an area which Bangkok can easily access, via road, by a garbage truck.

(3.3) The waste storage area must have drainage gutter and discharge wastewater from waste into the treatment system including install faucet for cleaning.

(3.4) Waste storage must have rainproof roof and ventilation system.

(3.5) Assign area for waste segregation.

(3.6) Away from kitchen or food storage for at least 10 meters

## 2.7 Specification for fire protection systems

Fire protection systems must be in accordance with latest laws and standards as follows:

(1) Building Control Act, B.E. 2522

(2) Standards by Thai Industrial Standards Institute

(3) Standards for fire protection system by the Engineering Institute of Thailand, under H.M. the King's patronage

(4) Standards of MWA

(5) Standard for portable fire extinguishers

(6) American national standard Institute (ANSI)

(7) American society of mechanical engineers (ASME)

(8) American society of testing and materials (ASTM)

(9) American welding Society (AWS)

(10) Underwriters' Laboratories Inc. (UL)

(11) Factory Mutual (FM)

The Private Co-Investor must provide fire protection systems as appropriate for building on top of the platform usage in accordance with Thai laws and international standard. Every equipment must be safety, modern, high efficiency and durable for saving of cost, time and maintenance cost.

## 3. TECHNICAL SPECIFICATION FOR TRAFFIC ENGINEERING

The Private Co-Investor shall conduct the designs by complying to technical specification for traffic engineering at minimum required by the Building Control Act and Bangkok ordinances on the Criteria for traffic impact from structure an entrance-exit for a car in a large building with more than 300 parking lots by the Traffic and Transportation Department, Bangkok, and its related orders as follows:

(1) Every entrance-exit point width and its location must not violate Bangkok ordinance re permission for curb cutting and lower and linkage construction in public area, B.E. 2531, the Ministerial regulation No.7 (B.E. 2517) and Bangkok ordinance re building control, B.E. 2544 section 89 and 91.

(2) Each project cannot have an entrance-exit point for a car more than 2 points as follows:

(2.1) If the applicant applies for one entrance-exit point for the car, the entrance-exit point width must not be less than 6 meters but not exceeding 8 meters

(2.2) If the applicant applies for two entrance-exit points for the car, the entrance-exit point width must be 6 meters for each point.

(2.3) If the applicant applies for an entrance-exit point but assign as an entrance or an exit at one point or both, each point width must be 4.5 meters.

(2.4) If the applicant applies for entrance-exit point by assign both entrance-exit points on the same side road, the center point of both entrance-exit points must be apart for more than 50.00 meters unless it is a one-way traffic with one entrance and one exit, however, the center of both entrance-exit points must be apart for at least 25.00 meters.

(3) Entrance-exit point for a car cannot beat joint-road, a crossroad or where the traffic island is open for U-turn. The center point of entrance-exit point must be apart from joint-road, crossroad or U-turn for at least 20.00 meters and be apart from the beginning of the curve of the road less than 50.00 meters, the consideration of appropriate and assign of entrance-exit point for car on a case by case basis but cannot be less than 20.00 meters.

(4) The applicant must assign a parking area for a taxi to pick up/drop off passengers for at least two cars in front of the project and must install lights with a sign for calling taxi into the project area.

(5) If building seeking permission will also install point for received and exchange permission card to enter-exit the project area, must install such point far from the entrance-exit point for at least 50.00 meters unless the building is a residential building which will require for such security card exchange point to be far from entrance-exit point, not less than 20.00 meters.

(6) The Private Co-Investor shall seek permission for an entrance-exit point must manage traffic within the project to be convenient and not affect public traffic.

(7) If location of entrance-exit point is near private road or public road that is not joint-road or crossroad, the permission consideration must be in accordance with Bangkok ordinance re permission for curb cutting and lowering and linkage construction in public area, B.E. 2531 and the Ministerial regulation No.7 (B.E. 2517), namely it must be far from such private road or public road not less than 20 meters. If it is necessary to be near to private road or public road because not enough width of the ground surface, it is all right to open entrance-exit point for car near a private road or public road with reasonable distance from the beginning point to the central point of the entrance-exit point that will not cause a traffic jam.

(8) Location of the entrance-exit point, its edge closet to land boundary must be far from such boundary not less than such entrance-exit point width, but it must not be less than 1.00 meter and not exceed 5.00 meters.

(9) Location of the entrance-exit point that already received approval, if such location affects traffic on the public road, Bangkok can order the licensee to adjust at all time. The licensee will defray all expense.

(10) If the consideration of entrance-exit point location is outside the scope of above specifications, bring such application to the meeting of the Traffic and Transportation Department's committee for consideration with the Department director as a president.