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Public utilities system for housing development in Thailand (PUSHD)

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Abstract

Legal provisions of the public utilities system for housing development have been enacted in primary laws such as the Land Development Act, B.E. 2543 (2000), an announcement by the Central Land Development Commission, and 77 stipulations issued by the Provincial Land Development Commission. This includes other laws and standards. Several issues can cause complexity in the understanding and application of land development designers, inspectors, and house buyers. This article aims to gather relevant laws, acts, and legal provisions and categorize them for the convenience of making references and applications. Further, we identify the differences, analyze the appropriateness of applying legal provisions of the public utilities system, and present lists of infrastructure systems that housing development would have. The methodology consisted of gathering documents from relevant laws, acts, legal provisions, other standards, and references, including collecting comments from experts to analyze the appropriateness of the public utilities system. The results of this work show the three categories of public utilities systems: 10 issues of central property and fundamental public utilities systems, six issues of public utilities systems for safety, and three issues of other public utilities systems. Each type of public utilities system is classified as shown in Table. The research also presented 19 issues of the public utilities system, of which ten have been mentioned in the Land Development Act, B.E. 2543 (2000), and other laws, nine of which should be provided with the standard for safety and appropriateness in various terms.

Keywords

Infrastructure system, public utilities system, housing development, Land

Development Act, Legal provisions of public utilities system.

Introduction

In Thailand, the government enacted the primary law related to the construction of a housing society, the Land Development Act B.E. 2543 (2000) (LDA)^[1] Land Development Act (Issue 2) B.E. 2558 (2015)^[2], and Building Control Act B.E. 2522 (1979) (BCA)^[3]. This is the main law related to the housing project, however LDA has been used for more than 22 years, but nowadays, there are still many problems in the implementation of the law, and one of those issues is "Public utilities."

LDA commandment in clause 43 states that "public utilities that the land developer has provided for the allocation of land according to the plans and projects allowed such as roads, gardens, playgrounds." It is defined in clause three as "Public utilities refer to the facilities that land developers provide for buyers of the developed land to use together. According to the contract or plan of the permitted project, what is considered a utilities may vary from project to project, depending on whether that project is specified in the project plan that is permitted by the utilities of that project. While this provision clarifies what utilities are in a project, it may cause an overlap in the list and standard levels of utilities across projects, including current utilities

requirements. It also deals with many other laws, such as the Town Planning Act of B.E. 2528 (1985). National Environmental Quality Enhancement and Conservation Act B.E. 2535 requirements for the allocation of land for residential and commercial purposes in Bangkok B.E. 2550 (2007)^[4] requirements on the allocation of land in different provinces. This makes it challenging to use in design and validation, which may cause the consumer to not get the best benefit due to the non-standard design and is not suitable for actual use. In the past, there have been complaints and lawsuits to relevant government agencies, such as the Department of Land and Office of Consumer Protection.

Research Objectives

The purpose of this research is to collect laws related to public utilities systems for housing development (PUSHD), organize them into categories, and indicate differences in land allocation requirements in 77 provinces.

Scope of study

In this study, only the laws relating to land allocation and PUSHD in Thailand are studied.

Public Utilities requirements for housing development.

The requirements for public utilities for housing development are contained

in many laws and standards as follows:

Announcement of the Land Allocation Committee Subject: The land Allocation Policy for Residential and Commercial Purposes B.E. 2544 (2001)[5] set a land allocation policy for the Bangkok Land Development Board and Provincial Land Development Board as criteria for issuing regulations:

1. The size of the land allocation project includes small, medium, and large.
2. Determine the size of land sub-plots for the allocation of land with single-detached houses, twin houses, row houses or commercial buildings.
3. Road systems, standard walkways, and sidewalk external connections.
4. Drainage, wastewater treatment, and sewage disposal.
5. Systems and standards of public utilities and services necessary to preserve the environment and promote living conditions and community administration.

Land allocation regulations in Bangkok (LARB) and land allocation regulations for the other 76 provinces have stipulated eight categories of land allocation, which differ in the details of each category:

Section 1. Criteria for making plans, projects, and land allocation methods by prescribing general criteria for land allocation.

Section 2. Size and area of allocated land: The size of the allocated land is determined into three sizes: small, medium, large, and the size of sub-plots for specific land allocation, land with single-detached houses, twin houses, row houses, or commercial buildings.

Section 3. Requirements for Public Health Benefits by specifying the disposal of solid waste and sewage.

Section 4. Requirements for preserving environmental quality by specifying the drainage system and wastewater treatment system.

Section 5. Requirements for the benefit of transportation, traffic, and safety by determining the size of the road of the allocated land, the size of the public road that is the entrance and exit of the allocation project walkways and bridge footpaths, pipe bridges, and culverts, and installing traffic sign lighting systems and fire hydrants.

Section 6. Requirements for utilities benefits by specifying the electrical, water supply, and telephone systems.

Section 7. The requirements for the benefits of town planning stipulate the use of land under the provisions of the law on town planning.

Section 8. Requirements for the benefit of other matters necessary for preserving the environment, promoting living conditions, and community administration are defined in terms of gardens, playgrounds, sports fields, kindergarten schools, and space for a juristic person office.

Announcement of the Central Land Development Board Subject: Land Allocation Policy for Residential and Commercial Purposes Issue 11 (B.E. 2562) (2019)^[6], which is effective until December 31 B.E. 2565 (2022), has set the size

and area of the land to be allocated one more type, which is small (special).

Ministry announcement of Natural Resources and Environment: Types and sizes of projects or activities requiring reporting environmental impact analysis and criteria, methods, regulations, and guidelines for preparing environmental impact assessment reports^[7] determined that the allocation of land for residential or commercial purposes according to the law on land allocation with the number of subdivisions from 500 plots or more than 100 rai(160,000 square meters), which is a large land allocation project, an environmental impact assessment report must be prepared according to announcement No.3, 28th place, in the table of documents attached to announcement No.1.

- 1.1 The ministry determines the specific qualifications of inspectors, criteria for registration and revocation of registration as an auditor, and building inspection criteria B.E.2548 (2005)^[8] classified the types of system work that must be inspected in clause 17. (B/๗) and (C/๙). which are health and environment systems and fire protection and suppression systems, respectively.
- 1.2 The BCA^[3], which was established, was superseded by other applicable regulations in Clause 3, while the BCA and Building Control Act Issue 3 (B.E. 2543) (2000)^[9] were created to increase proficiency and steps in terms of control of stability, protection, fire prevention, public health, conservation of environmental quality, urban planning, architecture, and facilitating traffic. Furthermore, the Building Control Act Issue 2 (B.E. 2535) (1992)^[10] included a stipulation on informing local authorities prior to the construction, modification, demolition, or relocation of buildings, instead of seeking authorization for convenience and faster (clause 39 bis), as well as improving the powers and responsibilities of local officials in enforcing this Act.

As part of the BCA related to the public utilities system, including clause 8, the minister, with the advice of the Building Control Committee, has the power to issue ministerial regulations as follows:

- (1) Type, nature, shape, proportion, size, area, and location of the building.
- (2) Forms and methods related to installing water supply, gas, electricity, mechanical, fire safety, or other disasters. and protection from danger when there is chaos.
- (3) Type and the number of bathrooms and toilets.
- (4) Building environment management systems such as lighting systems, ventilation, air conditioning, air purification, drainage, wastewater treatment, and solid waste and sewage disposal.
- (5) Characteristics, level, height, and space outside the building or building line.
- (6) The distance or level between the building and other people's buildings or land areas or between a building and a road, alley, sidewalk, walkway, or public place.
- (7) Area for a car park, a U-turn, car entrance and exit, and the nature and size

- of the area or the building.
- 1.3 Ministerial Regulation Issue 33 (B.E. 2535) (1992)^[11] was issued under the BCA set a protection system against danger from lightning for tall buildings.
 - 1.4 Ministerial Regulation Issue 39 (B.E. 2537) (1994)^[12] was issued under the BCA. It specified the definitions of a twin room, row building, townhouse, twin house, and mixed residential structure with regard to the design and installation of a fire protection system, types and number of bathrooms and toilets, illumination and ventilation systems. Further an emergency power supply system for safety, fire mitigation, public health, environmental protection, and urban planning comprising Section 1, forms and procedures related to the installation of fire protection systems, and Section 3, lighting and ventilation systems.
 - 1.5 Ministerial Regulation Issue 41 (B.E. 2534) (1991)^[13] was issued under the BCA there are restrictions on parking and parking buildings.
 - 1.6 Ministerial Regulation Issue 47 (B.E. 2540) (1997)^[14] was issued under the BCA has been defined about stairs and doors to the fire escape.
 - 1.7 Ministerial Regulation Issue 55 (B.E. 2543) (2000)^[15] was created under the BCA. This decree delimits the significance of twin rooms, row buildings, townhouses, twin houses, and combined residential edifices. With respect to the formation and method of installation, ratio, area, placement of the construction, tier, extent of space beyond the edifice or construction line, and the distance or tier between the construction and building or land area. Also, between construction and roads, sidewalks, or common areas, to promote security, safety, fire prevention, public health, environmental quality conservation, urban planning, architecture, and traffic convenience.
 - 1.8 Bangkok regulations with building control B.E. 2544 (2001) (BRBC)^[16] specify building properties, such as Section 1, and analyze words. Section 3 describes the building characteristics. In Section 4, the stairs and fire escape. Section 5 presents building streaks and distances. Section 7 describes the lighting system ventilation, drainage, waste, and sewage disposal. Section 8 presents the forms and methods related to the installation of the water supply, electricity, gas, and fire protection systems. Section 9 discusses parking buildings, parking lots, U-turns, and entrances and exits.
 - 1.9 Metropolitan Electricity Authority Regulations Regarding tariffs for using electricity B.E. 2536 (1993)^[17] , prescriptions relating to the electrical system, which is Part 1. Requests for the use of low-voltage electricity in general cases. Part 2. Application of low-voltage electricity in this case. Part 3. Requests for use of a high-voltage electricity system, voltage 12,000 or 24,000 volts, etc.
 - 1.10 Thai electrical code 2013 B.E. 2556 (2013)^[18] have established electrical system guidelines for Thailand, as The Metropolitan Electricity Authority and the provincial electricity authority use it as a guiding standard.

- 1.11 Public electrical standards^[19] prepared by the Department of Local Administration ministry of interior has set standards to be used for public electrical installations.
- 1.12 Land Excavation and Landfilling Act B.E. 2543 (2000) (Land Excavation and Landfilling Act)^[20] has set about excavation and land filling.
- 1.13 Ministerial Regulations prescribe other structures as buildings according to the building control law B.E. 2544 (2001)^[21] has been defined regarding the definition of "building".
- 1.14 Lightning Protection Standard Part 1 General Requirements^[22] said about lightning damage preventive measures and basic criteria for the protection of buildings and utilities.
- 1.15 Ministerial Regulations Prescribing Facilities in Buildings for people with disabilities or handicapped and the elderly B.E. 2548 (2005) ^[23] have set up facilities in buildings for people with disabilities or handicapped and the elderly so that such people have the opportunity to participate in various activities in society.

Research Methodology

- 5.1. An investigation of 141 records relevant to PUSHHD, comprising laws, requirements, edicts, declarations, rules, norms, handbooks, benchmarks, referring to and associated with ideas, theories, and statistical information such as LDA Regulations on land allotment in 77 provinces, Proclamation of the Central Land Advancement Board, Building Control Act, BCBC By laws Building Control, etc.
- 5.2. Collected opinions from 14 experts appointed by the Engineering Institute of Thailand to be members of the Public Utilities Standards Subcommittee for housing development the year B.E. 2564 (2021).
- 5.3. Gathering data sorted into various classifications to more readily access and incorporate. In addition to distinguishing between the regulations, laws, and guidelines, the appropriateness of implementing the criteria for each type of service system is evaluated, and a compilation of amenities that should be offered to designated towns is suggested.

Results

- 5.4. The results of this study can be classified into three categories of public utilities work for housing development as follows:

Section 1. The basic utilities system consists of 12 items

1. Road and sidewalk systems, bridges, culverts.
2. Drainage system and flood protection system.
3. Electricity System.
4. Water supply and sanitation system.

5. Telephone and Communication Systems.
6. Wastewater treatment system.
7. Public Lighting
8. Fire protection and suppression system.
9. Solid waste management system.
10. Project fence.
11. Garden, playground, sports field, multipurpose area.
12. Other utilities.

Section 2. Safety utilities system consists of 4 items which are

1. Ventilation system.
2. Security system.
3. Escape system.
4. Lightning protection.

Section 3. Other utilities systems consist of 3 items which are

1. Television systems, satellite and cable TV.
2. Excavation, land filling and retaining walls.
3. Car park, connecting walkway, facilities for handicapped.
- 5.5. Requirements, details and classification of each type of utilities system.

Road and sidewalk systems, bridges, culverts.

The study found a difference in the width of the road and the traffic surface used as an entrance and exit of sub-plots of land. The number of plots of land does not exceed, and the number of plots according to the size of the land allocation of each province can be divided into 25 groups from a total of 77 provinces. There are examples of these differences, as shown in Table 1. It was also found that there were differences in the provisions regarding the allocation of all 77 provinces in terms of bridges, pipe bridges, or culverts, according to the width of the canal or public canal through which the road was cut. Furthermore, it can be separated into seven groups of provinces from a total of 77 provinces, as shown in Table 2. The request for permission to build such bridges depends on agencies that oversee public water sources, such as the Marine Department in Bangkok. Metropolitan Waterworks Authority or the Royal Irrigation Department, etc.

Drainage system and flood protection system.

Drainage system.

The study found land allocation regulations in 76 provinces, excluding land allocation regulations. The LARB has similar requirements for the design of drainage systems:

(1) Drainage through activities and rainwater must be properly designed according to technical principles.

(2) The water drainage from the project must have permission from the person responsible for the wastewater source.

(3) The amount of rain is based on the amount of rain in the past 5 years of that province and coefficient of rainwater runoff, the average value of sub-plots of land must not be less than 0.6

(4) The amount of wastewater used was not less than 95% of the water used, but not less than 1 cubic meter per household per day.

(5) The amount of water flowing into the sewer system per day must not be less than 20 cubic meters per 1 km drain length.

(6) The inner diameter of the smallest drainage pipe was not less than 40 cm, in accordance with the regulations on land allocation in Bangkok and 72 provinces more and not less than 60 cm in Nonthaburi, Pathum Thani, and Chonburi provinces, but for Nakhon Nayok Province, the drain size was not set.

(7) The regulations concerning the allocation of land in Bangkok are further different from other provincial regulations, which is the calculation of drainage capacity of the drain in general. The Manning equation in clause 14.5 (4) of its specification shall apply.

Table 1 Sizes of road zones and traffic surfaces of each size of allocated lan

Allocated land	Sizes of land	The size of the width of the boundary (traffic surface width, meters) that is used as an entrance and exit to sub-plots of land. where the number of subplots does not exceed the number of plots according to the size of land allocation and according to the land allocation requirements for each province					
		Announcement of the Central Allocation Committee ^[4]	Nonthaburi ^[24] and 12 other provinces	Sa Kaew ^[25] and 5 other provinces	Bangkok ^[3] and 9 other provinces	Udon Thanj ^[26]	Chan thaburi ^[27]
Small size (special)	-	8(6)	8 (6)	8(6)	8 (6)	8(6)	8 (6)
Small size	Not over 99 plots	8 (6)	8 (6)	8(6)	9 (6)	9 (6)	10 (6)
Medium size	100-299 plots	12 (6)	12 (8)	12 (8)	12 (8)	12 (8)	12 (8)
	300-499 plots	16 (6)	16 (12)	16 (12)	16 (12)	16 (12)	16 (12)
Large size	More than 500 plots	16 (6)	18(13)	20 (15)	18 (13)	20 (15)	20 (15)

Flood protection system

The results of the study showed that only in Bangkok have regulations regarding the flood protection system, such as if the system employed an enclosed area (Polder System) to construct a permanent dyke higher than the maximum water level that had occurred in the past, it must have a height of no less than 30

cm. In the case of an embankment, a roadway at least 3 m wide must go around the land allotment project area. Such embankments must be considered public utilities of land development projects and must be inspected to ensure that their functioning is at least equal to their original condition.

In the case of other provinces that are not defined in the flood protection system, in addition to using the regulations on land allocation in Bangkok as a model, the researcher presents IEAT regulations. Regarding public utilities standards, which is the case where an area is located in a marshy area with flooding, an embankment must be built around the project area to prevent flooding. The embankment must be higher than the highest flood level in the past 10 years but must not be less than 50 cm or if the area is located in an area prone to flooding. The dike must have been higher than the highest flood level in the past 70 years, with a height allowance (Free Board) of less than 50 cm to be applied.

Table 2 - Types of bridges, pipe bridges or culverts that go through the width of the tracks and canals that the road passes through.

provincial group	Canal or canal width	Type of bridge or culverts that must be made	Provincial group
1	Not defined about the bridge	-	Nakhon Nayok Province ^[28]
2	Less than 2 meters	Bridge or bridge pipe	Phichit ^[29] and Lopburi ^[30]
	More than 2 meters	Bridge	
3	Less than 2 meters	Culverts	Bangkok ^[3] and 37 other provinces
	From 2 to 5 meters	Bridge or bridge pipe	
	More than 5 to 10 meters	Single span bridge	
	More than 10 meters	Bridge	
4	Less than 3 meters	Bridge or bridge pipe	Pathum Thani Province ^[31] and 21 other provinces
	More than 10 meters	Bridge	
5	Less than 10 meters	Bridge or pipe bridge with a diameter of not less than 100 centimeters	Chanthaburi Province ^[27] and 11 other provinces
	More than 3 meters	Bridge	
6	Less than 4 meters	Bridge or bridge pipe	Prachuap Khiri Khan Province ^[32]
	More than 4 meters	Bridge	
7	Less than 5 meters	Bridge or bridge pipe	Chonburi Province ^[33]
	More than 5 meters	Bridge	

Electricity System

The study found that regulations on land allocation in 77 provinces mentioned in categories 6 only that "Electrical system. The land allocator must arrange for an electrical system and proceed according to the layout plan approved by the government agency or a state organization with a duty to control electricity. Therefore, the researcher proposed the following additional references to the regulations of the Metropolitan Electricity Authority^[15] :

- (1) Minimum electrical meter size as shown in Table 3.
- (2) Size of the main cable entering the building and overcurrent protection device.
- (3) Standards for electrical cables and electrical equipment.
- (4) Grounding and,
- (5) Light intensity according to the Ministerial Regulation Issue 39 as shown in Table 4.

Table 3 - Set for the minimum electric meter size for allocated land used for construction of residential buildings

Number	The size of the plot divided (square meters)	Electric meter	
		Ampere	Number of phases
1	Not over 60	5 (15)	1
2	61-100	15 (45)	1
3	101-200	30 (100)	1
4	More than 200	50 (150)	1

Table 4 - Light intensity

Number	Location (type of use)	Unit of light intensity (lux)
1	Parking	50
	Parking and parking buildings (BRBC)	100
2	Corridors inside residential buildings.	100
3	A hotel room or shared housing building	100
4	Bathrooms, toilets of factories, schools, hotels, offices or residential buildings.	100

Water supply and sanitation system

From the study, it was found that present In preparing the water supply system for the land allocation:

(1) The size of the water meter for each type of house, such as a single house, twin house, row house, and commercial building. the metropolitan waterworks authority does not have a minimum size requirement for designing or requesting to use the water meter but usually the size that the owner allocates the land for or the people request to install the water meter will be the size $\frac{1}{2}$ inch and size $\frac{3}{4}$ inch, the deciding factors are water consumption and installation costs, is the key point.

(2) Water distribution pipes in land allocation projects for the metropolitan waterworks authority to implement the design. be the operator of the water pipe laying in the land allocation project itself, under the form, specification and standard of the metropolitan waterworks authority the owner of the land allocation project is responsible for the expenses.

Telephone and Communication Systems.

The study found that there are currently many operators providing landline telephones and other communication services, and each of those operators will invest in various telephone and other communication systems. These include high-speed Internet within the housing project itself without being a burden or expense of the project owner, and the organizer of the project is only a coordinator.

Wastewater treatment system

The study found that differences in sewage water drainage system requirements can be classified into 7 groups from a total of 77 provinces, consisting as:

Group 1: 1 province

Group 2: 54 provinces

- Group 3: 1 province
- Group 4: 16 provinces
- Group 5, 1 province
- Group 6, 1 province and,
- Group 7: 3 provinces

Most of the terms are the same for group 2, while the difference in other groups will be more or less the requirements depending on each group; for group 2 requirements, the requirements can be summarized as follows:

1. Water that has been used from all activities in the allocated land plots is considered wastewater that must be treated to qualify according to the notification of the Ministry of Science Technology and Environment or other applicable laws so that it can be discharged into the source of the wastewater.
2. A wastewater treatment system can be either an independent treatment system specific to each land plot or a central treatment system that collects wastewater to treat one or more points.
3. Every type of wastewater treatment system must have an effluent quality inspection pond that can be accessed to inspect effluent quality at all times.
4. Every type of wastewater treatment system must have an effluent quality inspection pond that can be accessed to inspect the effluent quality at all times.
5. Wastewater quality must be in accordance with the announcement of the Ministry of Natural Resources and Environment on the standard setting for controlling the discharge of wastewater from allocated land B.E. 2564 (2021)^[34] as shown in Table 5.

Table 5 -Wastewater quality index (Parameter)

Parameter	Unit	Size of Land Development.		
		Large	Medium	Small
1. PH	-	5.5-9.0		
2. BOD	mg./l.	≤ 20	≤ 30	≤ 40
3. Total Suspended Solids	mg./l.	≤ 30	≤ 40	≤ 50
4.Total Dissolved Solids	mg./l.	≤ 1,000		≤ 1,300
5.Sulfide	mg./l.	≤ 1.0		
6.Total Kjeldahl Nitrogen	mg./l.	≤ 35		
7.Oil and Grease	mg./l.	≤ 20		

Solid waste management system

The analysis revealed that the disposal of strong waste and sewage in the land assignment venture and directions for land allotment in 77 provinces were resolved in accordance with nearby regulations. Determine the sum of strong waste created in structures utilized for private purposes. The rate of utilization is determined as the measure of strong waste is not under 2.40 liters per person per day, for the directions of Bangkok, concerning building control or the measure of strong waste and sewage 2.67 liters per individual per day.

Project fence

The study found that land allocation regulations in 77 provinces do not

specify fences. However, fences built close to the public are considered "buildings" according to clause 4 of the Building Control Act. According to the Ministerial Regulation Issue 55:

(1) A fence or wall built adjacent to or farther from the public road is less than the height of the fence and can be constructed at the height of not more than 3 m above the level of a sidewalk or public road.

(2) A fence or wall dividing a boundary at the corner of a public road with a width of 3 meters or more and a declination angle of fewer than 135 degrees must be cut off the corner of the fence or wall dividing that boundary, with the corner cutout having a distance of not less than 4 meters and at an equal angle with the public line. and,

(3) Row houses must have a fence in front, the back, and the dividing line between each row house, according to the regulations of Bangkok regarding building control, which is No. 3 should be contrary to the Ministerial Regulation Issue 55, No. 36, because row houses must have space behind the building of not less than 2 meters for the benefit of fire protection.

6.2.9 Garden, playground, sports field, multipurpose area.

(1) From the study, it was found that the land allocation requirements in 77 provinces were defined as follows: (1) Set aside space for gardening, playgrounds, and sports fields by calculating from the distribution area of not less than 5 percents, which must have a suitable location, size, and plot shape. This should be convenient for utilization and have a distance of at least 10 meters on each side and not be divided into many sub-plots, except for the protection of each area at least one rai and planting perennial plants at least 25% of the garden area. According to the academic principles of landscape architecture, green areas should be increased by at least 9 square meters per person for the excellent health of the people, which meets the World Health Organization's urban green space requirements,

From the study, it was found that the regulations on land allocation in 77 provinces mentioned in No. 28 only that fire hydrants had to be installed following the standards of the Metropolitan Waterworks Authority, Ministerial Regulation Issue 55, and Ministerial Regulation Issue 39 specified fire prevention, including:

(2) In the case of a large land allocation, the land allocator must set aside an area for the location of one kindergarten with an area of not less than 200 square wa (800 square meters) and must provide an additional area for every 500 plots or every 100 rai.(160,000 square meters)

Ventilation system

The study found that land allocation regulations in 77 provinces do not stipulate ventilation systems, but the Ministerial Regulation Issue 39 set out the following:

(1) In the case that natural ventilation is provided in every room in every

type of building, the door, windows, or vents on the side next to the outside air are not less than 10 percent of the area of the room. This does not include the area of the door and window and vents that connect to other rooms or corridors within the building and,

(2) In the case of providing mechanical ventilation in the building, it is as follows: Table 6

Table 6 - Mechanical ventilation rate

Number	Places/Locations	The ventilation rate is not less than the number of times the volume of the room in 1 hour
1	Bathroom, toilet of a residence or office.	2
2	Bathrooms, toilets of public buildings.	4
3	Parking below ground level.	4
4	Commercial building.	4
5	Hotel room or condominium.	7
6	kitchen and living places.	12
7	Kitchens and food and beverage outlets.	24

Public Lighting

From this study, it was found that the land allocation regulations in 77 provinces mentioned in No.28 only that the lighting system must be provided. Lighting requirements standards for street lighting and public areas by referring to the Public Electricity Standard^[20] to be used as a specification for public lighting systems for housing development are listed in Table 7.

Table 7 - Lighting requirements for street lighting and public areas

Road type	Mean illuminance measured in minimum horizontal direction (lux)
1. Main Road	15
2. Secondary Road	10
3. Intersection	22
4. Roundabout without traffic lights.	15
5. Park	10
6. Play ground	50
7. Public parking lot	15
8. Community sports field	50
9. Bridge	30
10. Pedestrian path (footpath)	7

Security system

The study found that the land allocation regulations in 77 provinces did not mention the security system. The researcher presented the security system according to the IEAT regulations on public utilities standards^[19] and other standards or manuals as follows:

(1) There must be a sign indicating the boundary line, boundary or fence, office buildings, and security personnel to inspect and maintain security within the area where it is necessary and entrances and exits regularly at all times. Surveillance must be provided to prevent misfortune that may occur and cause damage 24 hours a day, which may consider increasing the number of security personnel or equipment for protection, caution, or other security measures such as CCTV and radio communication.

(2) Use a pass card to enter the village by member's vehicle, use the pass card attached to the electronic reader, and let the barrier open and close automatically. Outsiders to enter the village must exchange the pass with consent to the baggage inspection and vehicles from security personnel. When returning to the outsider must bring a pass with the house number stamped and bring it back to the security guard with the consent to inspect the vehicle and baggage once again.

(3) Members must provide fire insurance and other perils related to the property in the land allocated according to the actual market price to ensure damage that may occur to other allocated plots of land.

Fire protection and suppression system

Columns, beams, floors, stairs, and walls of buildings with a height of three or more stories must be made of permanent refractory materials.

The walls of a townhouse or townhouse must be made with permanent refractory materials.

Townhouse, row building, or row house built next to each other: There must be a firewall at every distance, not more than five booths.

Indoor kitchens must have floors and walls made of permanent fire-resistant material.

There must be methods related to fire prevention, as specified in Ministerial Regulation Issue 39, as shown in Table 8.

Townhouses, row buildings, row houses, and twin houses with heights of no more than two floors must have at least one fire alarm system installed in the building for every unit. If the height exceeds two floors, a fire alarm system must be installed within the building. Building at least one machine on every floor and every booth, and

The equipment of the building should be checked for fire protection and suppression systems, including fire escape stairs and fire escape emergency exit signs and lights, fire alarm system, fire extinguishing equipment installation system, fire water supply system, fire pump, and sprinkler heads, according to the Ministerial Regulations and building inspection criteria.

Table 8 - Types and sizes of hand-held fire extinguishers

Type or categories of row building	Type of fire extinguisher	Packing size which not less than the following:
(1) A row house, row house, row house, and twin house with a height of not more than 2 floors must be equipped with one hand-held fire extinguisher of the specified type and size, one per booth.	(1) Pressurized water	10 liters
	(2) Acid Soda	10 liters
	(3) Chemical foam	10 liters
	(4) Carbon dioxide	3 kilograms
	(5) Dry chemical powder	3 kilograms
	(6) Halon (HALON 1211)	3 kilograms
(2) Other buildings, which are: Commercial buildings, Residential buildings with 4 units or more, dormitories, and buildings with a height of 3 floors or more, must be equipped with one hand-held fire extinguisher according to the type and size specified in No. (1), number of each booth is 1 device and for fire extinguishing caused by the type of materials that are available in each floor, 1 device per building area not exceeding 1,000 square meters, every distance not exceeding 45 meters, but not less than 1 device per floor.	(1) Chemical foam	10 liters
	(2) Carbon dioxide	4 kilograms
	(3) Dry chemical powder	4 kilograms
	(4) Halon (HALON 1211)	3 kilograms

Escape system

The study found that the regulations on land allocation in 77 provinces did not specify the escape system. In contrast, the Building Control Act, The Ministerial Regulation Issue 55, specifies the escape system as follows:

(1) Buildings four stories or more and not more than 23 meters in height, or three-story buildings with a roof deck above the third floor with an area exceeding 16 square meters, there must be at least one fire-escape staircase made of refractory materials.

(2) The fire escape stairs outside the building must have a net width of not less than 60 cm, and inside the building must have a net width of not less than 80 cm or width of not less than 90 cm. and not more than 150 cm, circular for the regulations of Bangkok building control.

(3) Fire escape stairs must have a slope of fewer than 60 degrees, except commercial buildings and row houses not above four floors can have a fire escape stair with a slope of more than 60 degrees. There must be a landing on every staircase or a commercial building or row house with no more than four floors or no more than 15 meters high from the street level. The fire escape stairs can be vertical, but there must be a landing on every floor, with a width of not less than 60 centimeters. The distance of the stairs step is at most 40 centimeters and can be installed in the empty corridor behind the building. The final staircase is 3.50 meters from the ground level to control the Bangkok Ordinance building.

(4) Fire doors must be made of fireproof materials, with a net width of not less than 80 centimeters, a height of not less than 1.90 meters, or a height of not less than 2.00 meters, following Ministerial Regulation Issue 47, which is in conflict.

(5) There must be an open space at the back of the building for a row room or townhouse. The width of 3 meters connects without any part of the building protruding into such an area. Except for constructing a fire escape ladder outside

the building that extends no more than 1.40 meters and between side rows of a townhouse or commercial buildings built up to ten booths or has a total length of up to 40 meters. There must be space between the side rows of that row house or row building, not less than 4 meters wide, as a gap throughout the depth of the rowing room or row building to connect with the space behind the building.

(6) A townhouse must have an open space in front between the fence or the land boundary line and the building wall. It should be at least 3 m wide. There must be an open space between the fence or the land boundary line and the building wall behind the building. The wall should not be less than 2 meters wide, and between the rows, on the side of a row of houses built up to ten booths, or having a total length of up to 40 meters, there must be space between the side rows of that row house, not less than 4 m wide, to be a gap throughout the depth of the townhouse.

(7) Twin houses must have a space at the front and back between the fence or the land boundary line and the building wall, a width of not less than 3 meters and 2 meters, respectively, and a space on the sides that is not less than 2 m wide.

(8) Performance checks of systems and equipment should be provided for buildings to evacuate building occupants. This includes the performance of fire escape stairs and routes, the performance of emergency exit signs and lights of the fire alarm system according to the Ministerial Regulations, and building inspection criteria.

Lightning protection

The study found that land allocation regulations in 77 provinces did not specify the lightning protection system or standard. Part 1 General Requirements has said that in addition to the loss of human life and lightning impact in the case of housing, electrical installations are punctured. There was a fire and material damage. The damage is done to an object exposed to the point of lightning or the passage of electric current and failure of electrical and electronic equipment and installed systems (for example, TV sets, computers, modems, telephones)

The researcher proposes to apply the requirements according to the Ministerial Regulation Issue 33, No. 13, which must have a lightning protection system. It consists of a pole, a lightning rod, a conductor, a grounding lead, and a grounding rod linked together as a system. For the lead to the ground, the size of the area must be the cross-section is comparable to not less than stranded copper wire, size 30 square millimeters. This grounding lead must be isolated from the other grounding system and the lightning protection system to meet the standards for electrical safety of the National Energy Agency by improving its suitability for use in residential buildings, commercial buildings, and PUSHD, especially buildings that are higher than two floors, including the parking area.

Satellite television system and cable TV

The study found that, nowadays, many operators provide television, satellite, and cable TV services, and each of these operators will have experts to carry out the installation for customers without being a burden or expense for the project owner. However, for the nice-looking building in the process of designing and constructing the building project operator, the support point for such devices should be provided with wiring within the building for those devices.

Excavation, land filling and retaining walls

The study found that the land allocation regulations in all 77 provinces did not specify land excavation work, landfilling, and retaining the wall. The Land Excavation and Landfilling Act has specified that:

(1) Any person wishing to excavate land with a depth of more than 3 m from the ground level or having an area at the top of the soil pit exceeding 10,000 square meters or having a depth or area as specified by the local official notified the local official.

(2) Digging a water well with an area at the top of the well that is at most 4 square meters, the land digger does not have to inform the local official.

(3) Excavation with a depth of not more than 3 m from the ground level when excavating soil near the boundary line of other people's land at a distance of fewer than two times the depth of the soil pit to be excavated must be managed to prevent soil erosion.

(4) Any person wishing to fill the land with a height higher than the level of the neighboring land and the area, not more than 2,000 square meters or the area specified by the local official, sufficient drainage must be provided so as not to cause trouble to neighbor landowners or other persons.

(5) Landfilling that has an area of more than 2,000 square meters or an area that exceeds that announced by the local official drainage must be provided following No. (4) The landfilling must be notified to the local official according to the form prescribed by the local official.

(6) Retaining walls or waterproof walls that must withstand soil or water pressure with a height of 1.50 meters and above are considered "buildings" in clause 4 of the Building Control Act, following the Ministerial Regulations. Others are buildings according to the building control law B.E. 2522 (1979).

Parking, connecting walkway, facilities for the handicapped

From studies on other systems, it was found that:

(1) BRBC and building control have set rules on parking. It includes (a) A commercial building shall have at least one parking per unit; if one unit has an area of more than 240 square meters. There must be one parking per 120 square meters of building area. (b) Commercial buildings are provided with one parking

space per 60 square meters of building space. The size of the parking space must follow Ministerial Regulation Issue 41.

(2) The path connecting the entrance and exit of the housing development with the public road must ask for permission to connect the way with agencies responsible for those public roads, such as the Department of Highways, Department of Rural Roads Bangkok, Royal Irrigation Department, and local administrative organizations.

(3) For the facilities for the disabled, the study found that the land allocation requirements in 77 provinces were not defined, including ministerial regulations determining the facilities in the building for disabled people or disabilities and the elderly B.E. 2548(2005). It does not cover residential buildings. The study suggests that such Ministerial Regulations apply to the utilities system area for housing development. It includes signs showing facilities, ramps, stairs, parking lots, building entrances, and walkways between buildings, the passage between the doors, toilets, clubs, swimming pools, and fitness centers. Further on, signs show facilities, ramps, stairs, parking lots, entrances, and different surfaces for public areas.

Other public utilities

The study found that other public utilities, which includes:

Land or land with buildings where the housing development juristic person office is located.

- (2) Water barricades and flood protection systems.
- (3) Clubhouse, swimming pool, fitness facility.
- (4) Project sign.
- (5) land with buildings or systems built to provide security or surroundings and,
- (6) Any other assets transferred from the land allocator or assets that use the money of the housing development juristic person to be purchased later are intended for use or for the common benefit of members.

Discussion

In summary, this study categorizes PUSHD into three categories:

- (1) Basic utilities system: 12 items.
- (2) Safety utilities system four items and,
- (3) Other utilities of three items and classified the differences of the utilities according to the regulations on land allocation in each province. The utilities that differed between the regulations of different provinces consisted of road and sidewalk systems, bridges, culverts, drainage systems, and wastewater treatment systems. This research then presented a list of public utilities that should be available for 19 types of allocated villages. As for types 1 to 9, 11, 13 and 19 are defined in the LDA and the accompanying laws.

Furthermore, types 10, 12, 14, and 18, increasingly, are the type that should be provided and meet standards for safety and suitability in the following areas.

1. Road and sidewalk systems, bridges, culverts.
2. Drainage system and flood protection system.
3. Electricity System.
4. Water supply and sanitation system.
5. Television and communication system.
6. Wastewater treatment system.
7. Solid waste management system.
8. Project fence.
9. Garden, playground, sports field , multipurpose area.
10. Ventilation system.
11. Public Lighting system.
12. Security system.
13. Fire protection and suppression system.
14. Escape system.
15. Lightning protection system.
16. Television systems, satellite and cable TV.
17. Excavation, land filling and retaining walls.
18. Car park, connecting walkway, facilities for the handicapped.
19. Other utilities.

All 77 provinces of Thailand found details of the law on PUSHHD of 19, which was mentioned above in this research. There were several differences between the two groups. Therefore, in the preparation of the utilities system of such housing estates, those involved must be prepared according to LDA as a priority, according to the announcement of the Central Land Development Board, and subsequently, following the regulations on the allocation of land in the other provinces.

Conclusion

From the current study of laws related to PUSHHD, the details of the laws are scattered. The categories or lists must be clearly defined. Therefore, this research is organized into lists and categories for ease of use for preparing PUSHHD. It includes inspectors, such as project owners, designers, engineers, architects, supervisors, consumers, housing estate buyers, and government officials, whose duty is to inspect public utilities according to the law.

Although the law in Thailand lists is not required for PUSHHD, all 19 listed but good PUSHHD will make society livable, and there will be better relationships between people in the community to maintain a better environment. Including the safety of the new society arising from the housing estate, the researcher advises entrepreneurs to complete all the 19 utilities systems.

Financial factors are another essential part of preparing for PUSHHD, which this research is yet to study. The researcher suggests that those interested in

financial factors continuously affect the preparation of PUSHHD.

Each of the 19 PUSHHD priorities, such as economic, engineering, or social, is another topic that can be further researched to develop PUSHHD into a liveable society.

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