Ministry of Construction

No: 439/BXD - CSXD

REPUBLIC SOCIALIST OF VIETNAM
Independence - Freedom - Happiness

Hanoi, 25 September, 1997

DECISION OF MINISTER OF CONSTRUCTION
On Promulgating The Buiding Code Of Vietnam Volume II and Volume III

MINISTER OF CONSTRUCTION

- Pursuant to Decree N^{O} 15/CP dated 4 March, 1994 of the Government regulating on Functions, Duties, Powers and Organization Structures of Ministry of Construction;

- Pursuant to Decree N^{O} 42/CP dated 16 July, 1996 of the Government promulgating the Regulation on Investment and Construction Management and Decree N^{O} 92/CP dated 28 August 1997 of the Government on amendment of and addition to some articles of Regulation on Investment and Construction Management promulgated in conjunction with Decree No 42/CP dated 16 July 1996 of the Government ;

- In consideration of requests on planning and construction management, on proposal from Head of Department for Construction Policy, Head of Department for Science and technology, Head of Department for state Inspection on Construction work Quality, Head of Department for Architecture and Planning Management, Director of Institute for architecture Researching ;

DECIDES

Article 1: To promulgate in attachment with this decision the Building Code of Vietnam - Volume II and Volume III

Article 2: This Decision takes effect from 1 November, 1997 and is applied in the Whole Country.

Article 3: Ministries, ministerial level Bodies, Bodies under Government, People's Committee of provinces and cities under direct Central Authority shall be responsible to organize the implementation of this Decision.

Ngo Xuan Loc
Minister of Construction
(Signed and Sealed)

Vietnam Building Code

on

Civil and Industrial Buildings

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CHAPTER 8
GENERAL PROVISIONS ON CIVIL AND INDUSTRIAL BUILDINGS

Objective

The objective of this Chapter is to ensure that all civil and industrial buildings satisfy the requirements set out in Article 1.4 Chapter 1 of Building Code of Vietnam (BCV).

Article 8.1. Scope of Application

Part III of BCV sets out the minimum mandatory technical requirements for design and construction of civil and industrial buildings which include cases of new construction, renovation and extension.

Article 8.2. Definitions

For the purpose of this Part of BCV, the under-mentioned terms shall have the following meanings:

1. Fire resistance levels of buildings
   means fire-resistance ratings of buildings which are determined by the fire-resistance limits of principal building elements.

2. Power failure emergency lighting
   means lighting using a stand-by power source in the event of main power failure in the building.

3. Civil and industrial buildings
   include all types of residential, public and industrial buildings as specified in Appendices 8.1

4. Special civil buildings
   are buildings of special cultural, historical, economic, social, defence and diplomatic importance as specified by the Government.

5. Floor area of a storey
means the floor area of the storey measured over the enclosing walls (or that part of any common wall located within the building) and the area of the loggia, balconies, shafts, chimneys.

6. Usable (occupied) area
is the total area of habitable parts (of dwelling houses) or working area (of public buildings) and service areas.
(See provisions on habitable, work and service areas in Appendices 8.2.)

7. Enclosed electric cabling
means the power or control line imbedded in or covered by the building elements (e.g. inside a wall or floor).

8. Exposed electric cabling
means the power or control line installed outside the surface of building elements (e.g. being exposed on the surface of a wall, ceiling, frame or pipe).

9. Automatic sprinkler system
means a system fitted with sprinkler heads or blowguns which are normally kept closed on stand-by mode and will be automatically activated when a pre-determined temperature of the ambient atmosphere is reached, for the purpose of extinguishing a fire over a certain specified area.

10. Electrical equipment in a building consists of:
    a) electrical cabling
    b) connectors, power consuming equipment and appliances, protection devices, measurement and monitoring instruments

    from the connecting points on main power supply line to the power consuming instruments in the building.

11. Fire compartment
means the total space of the building or any part thereof separated from the remainder by fire isolating structures each having appropriate Fire-resistant level (FRL) and where any opening in the separating construction is protected in accordance with the relevant Part.

12. Safety area
means a place in the proximity of the building from where people can evacuate in safety after they have escaped from the danger of a fire or any other hazard.

13. Fire monitoring place
means the place from which a fire can be observed and fire-fighting and rescue operations can be monitored and directed.

14. Atrium
means a space within a building that connects two or more storeys, and wholly or substantially enclosed at the top by a floor or roof and includes any adjacent part of the building not separated by bounding construction (but does not include a stairwell, rampwell or the space within a shaft).

15. Escape
means the evacuation of people from danger areas to safe area via exits.

16. Fire load
means the amount of heat (Kilojoules) calculated in Kj / m2 (Kilojoules) per square meter of floor), generated when all the structural components, furniture and products contained in a building are burnt.

17. Special load
means the special load generated in such events as earthquakes, explosions.

18. Temporary load (or live load)
means loads that exist for a certain period of time during construction and use of a building.

19. Permanent load (or dead load)
means loads that are permanent during construction and use of a building.

20. Fire-resistance periods of materials and structures
mean the intervals calculated from the start of a fire-resisting capability testing of a material or a member (under standard heat and load conditions) to the moment when one of the following conditions develops:

a) a crack or hole develops through which the burnt material (fire, smoke, toxic gas) may escape.

b) the temperature on the surface which is indirectly exposed to the heat source, of the tested sample exceeds the permissible limits as follows:

i)the average surface temperature exceeds by140°C compared with the pre-test temperature reading; or

ii) temperature at any point on the surface exceeds by 180°C compared to the pre-test temperature reading, or rises over 220 °C.

c) the structure cannot maintain its stability and collapses.

21. Amenity
means the facilities including equipment and fixtures used to ensure environmental, sanitation, hygiene and independent activities of the users.

22. Durability
means the life span of a structure (of a building or part thereof) calculated from the date of use till it reaches its limiting state.

23. Limit state
means any limiting condition after which a structure of a building no longer satisfies the ascribed requirements.

Article 8.3. Requirements for Civil and Industrial buildings

Civil and industrial buildings must be so designed and constructed to ensure that the following requirements are to be complied with:

8.3.1. Planning and architectural criteria

include requirements for planning, architecture, environmental protection provided for in Chapters 3, 4, 7 and 9 and all relevant provisions concerning fire safety, sanitation, safety and energy saving stipulated in Chapters 11 and 12 and paragraphs 8.3.5 and 8.3.6 of Chapter 8.

8.3.2. Structural requirements
include provisions in Chapters 3 and 10.

8.3.3. Fire safety requirements

include provisions on:

1. Fire separation distance for fire safety stipulated in Art. 4.12, Chapter 4;
2. Fire water supply and fire-fighting access stipulated in Art. 5.16, Chapter 5;
3. Fire safety in the building as stipulated in Chapter 11 and Art.14.13 of Chapter 14.

8.3.4. Amenity and safety requirements

include requirements regarding: ventilation, lighting, access and egress, signs, protection against excessive noise, thermal protection, water proofing measures, protection against lightning, falling prevention measures, protection against intoxication caused by building materials, protection against harmful biological substances, sanitary facilities, water supply and drainage, and power safety measures as stipulated in Chapters 3, 12, 13 and 14.

8.3.5. Requirements for access by and amenity for people with disabilities

1. The following classes of buildings must provide access and amenity for people with disabilities:
   a) International hotels, international airports;
   b) Schools, sanitariums, clinics and hospitals for the aged and disabled persons.
2. The following classes of buildings must provide access for persons on wheelchairs: important government offices, libraries, museums, entertainment and cultural buildings, theaters and public parks.
3. An accessible path of travel for the disabled must be continuous and must meet the standards for road construction for the relevant types of disabilities.

8.3.6. Requirements with respect to efficient use of energy

Buildings must be so designed and constructed to ensure the efficient use of energy, the following solutions are to be adopted in order to:

1. take advantage of the favourable natural conditions and minimize the adverse conditions, giving full scope to natural ventilation, lighting or shading as provided for in Art. 3.2 and 3.10 of BCV;

2. use good insulating materials for walling and coverings to minimize heat exchange between indoors and outdoors.

3. use energy-efficient equipment in lighting, ventilation, air-conditioning, water boiling and room heating as well as in production and for other equipment such as lifts.

Article 8.4. Classification of Civil and Industrial Buildings

8.4.1. Classification of Civil Buildings

1. Civil buildings are divided into four classes according to their respective qualities for use and construction qualities as per Table 8.4.1.

Table 8.4.1 Classification of Civil Buildings

Classes of Buildings	Qualities of Use	Qualities of Construction	
		Service life	Fire Resistance Levels
Class I	High (Grade 1)	Over 100 years (Grade 1)	I or II
Class II	Relatively High (Grade 2)	50 -100 years (Grade 2)	III
Class III	Average (Grade 3)	20 - 50 years (Grade 3)	IV
Class IV	Low (Grade 4)	Under 20 years (Grade 4)	V

Note:
(1) Qualities of Use are stipulated in 8.4.1.2
(2) Fire Resistance Levels are stipulated in Table 11.4.1 Chapter 11.

2. Quality of use of a building is determined on the basis of intended uses/occupancies, room areas and volumes, qualities of sanitation facilities, water supply and sewage, electric power equipment and facilities, fixtures, interior and exterior decoration finishes and fittings specified in Table 8.4.2.

Table 8.4.2.
Qualities of Use of a Dwelling House

Qualities	Levels of amenity	Interior and exterior finishing	Electrical and water utilities
Grade I	**High:** complete with bed rooms, dinning, lounge rooms, kitchen, en-suite toilets on the same floor.	**High:** Using high quality finishing materials (rendering, plastering, tiling), decoration	**High:** - complete with power, water and sanitation facilities -high quality fixtures
Grade II	**Relatively High:** bed rooms, living rooms, kitchen, en-suite toilets on the same floor.	**Relatively High:** Using some decorative and tiling materials	**Relatively High:** - complete with power, water and sanitation facilities - relatively high quality fixtures
Grade III	**Average:** - bed rooms, living rooms, kitchen on the same floor - toilets used in common by many occupants who may be from other floors	**Average**	**Average:** - Power, water supply to every apartment and room. - average quality sanitary facilities
Grade IV	**Minimum:** - only one or two rooms used in common - Kitchen and toilets shared between many apartments.	**Low:** With rendering, plastering, whitewashing without tiling	**Minimum:** - Electric lighting for every room. - water supply to kitchen and shared toilets only. -Low quality sanitation facilities

8.4.2. Classification of Industrial Buildings

Industrial buildings are classified as follows:

1. Classification according to qualities of use (exploitation) and construction provided for by TCVN 2748 - 91 "Classification of buildings and construction works - General principles".

2. Classification according to the levels of environmental impact specified in Appendix 4.8 of BCV.

3. Classification according to the types of production activities and levels of fire, explosion risks as specified in Art. 11.3 of BCV.

Appendix 8. 1 Classification of Civil and Industrial Buildings

Civil and Industrial Buildings:

***1. Civil Buildings** include:*

***1.1. Dwelling Houses including**:*

a) *Sole occupancy dwelling houses including:*
   - *Villas*
   - *Row houses (street houses)*
   - *Other detached houses.*

b) *Residential Blocks (students residences)*
c) *Apartment Houses \ Blocks of flats(Condominium)*
d) *Hotels, hostels*
e) *Guest Houses*
f) *Buildings and accommodation facilities for people who need special care*

***1.2. Public Buildings**:*

a) Cultural Buildings:
- *Libraries*
- *Museums, exhibition buildings*
- *Cultural houses, clubs*
- *Entertainment centres, theatres, cinemas, circus buildings,*
- *Radio, television studios*
- *Zoological and botanical gardens, public parks and resorts.*

b) Education buildings:
- *Child-care centres*
- *Kindergartens, pre-school centres*
- *Primary and secondary schools*
- *Higher education institutions and colleges*
- *Secondary Technical Schools*
- *Vocational education and technical worker' s schools*
- *Professional education institutions*
- *Other educational institutions.*

c) Hospitals and medical buildings:

- *Clinics*
- *General and specialised hospitals from the central down to the local levels.*
- *Regional general and specialised clinics.*
- *Maternity clinics.*
- *Sanitarium, old people homes,*
- *Public health institutions: centres for the prevention and eradication of epidemics and diseases.*

d) Sports buildings:

- *Stadiums, sports grounds, football pits,*
- *Gymnasiums, sports halls,*
- *Outdoor and indoor or roofed swimming pools, spectators stands, platforms.*

e) Commercial and service buildings:

- *Market places,*
- *Shops, shopping centres, supermarkets,*
- *Restaurants, bars, cafeteria,*
- *Service and catering shops: laundry, hair-dressing, tailoring, repair shops ....*

g) Office buildings.

i) Public safety buildings:

- *Fire stations ...*

k) Postal and communication buildings: post offices, postal services, communication equipment buildings.

l) Transport buildings:

- *stations ...*

m) Other public assembly buildings: (e.g. religious buildings)

***2. Industrial buildings** include:*

a) Factories, workshops,
b) Ancillary buildings
c) Warehouses,
d) Technical support and utilities units and structures.

Appendix 8. 2 Defining area in a dwelling house and a public building

1. Dwelling houses

1.1 *Usable area*

i) Usable area consists of habitable and service areas.

ii) Area of a room or parts thereof shall be calculated by clear net dimensions allowing for rendering or plastering outer layers and base-boards but excluding areas of garbage chutes, chimneys, ventilation ducts, electric wire ducts, plumbing ... installed in the room or its parts.

1.2 *Habitable area*

is the total area of main rooms for habitation which consists of all habitable rooms (dining rooms, bedrooms, living rooms, lounge rooms...) including cupboards, walk-in wardrobes, cabinets with doors opening outwards inside the room and closets under staircase within the room with the minimum clearance of 1.60 meters.

1.3 *Service area*

is the total area of rooms and parts thereof which include:

a) Storage, kitchen, bathroom, laundry, water closet, toilets including passage ways in buildings with toilets for use in common.

b) Corridors, hallways, passage ways connecting apartments or habitable rooms,

c) Lobby, anteroom of a kitchen, bathroom, laundry, toilet for use in common.

d) Half of loggia and balcony areas;

e) Built-in wardrobes, cupboards, cabinets with doors open inwards the ancillary rooms or their parts.

2. Public buildings

2.1 *Usable area*

i) is the total area of working area and service area.

ii) The areas of the rooms and their parts are calculated according to the formulas provided for in 1.1.b of Appendix 8.2.

2.2 *Working area*

is the total area of the main and ancillary working rooms (excluding staircase, corridors, anterooms and the mechanical service rooms).

2.3 *Service area*

includes : staircases, corridors, ..., technical support rooms.

Note:

(1)Working areas include:

(a) areas of corridors or hall ways used as classrooms in schools, or as waiting or leisure areas in hospitals, sanitariums, theatres, cinemas, clubs...

(b) areas of sound equipment rooms, control rooms, electric panels rooms, telephone exchanges, cubicles attached to a stage, stages, podiums, projector rooms, ...

(2) Mechanical service rooms are the places where technical support equipment is installed such as boilers, pumps, transformers, ventilation and air-conditioning equipment, people and goods service lifts.

Appendix 8. 3 Volume and floor plan areas of a dwelling house

1. Floor plan area ratio K

is the ratio of habitable area to constructed area or of habitable area of the building to the total floor area of the building;

$$K = \frac{\text{Habitable area}}{\text{Constructed area (floor area)}}$$

2. Floor plan area ratio K_1

is the ratio of the habitable area to the total useable area;

$$K_1 = \frac{\text{Habitable area}}{\text{Useable area}}$$

3. Volume ratio K_2

is the ratio of contracted volume of a building (or an apartment) to the total habitable area;

$$K_2 = \frac{\text{Constructed volume of a building (Apartment)}}{\text{Habitable area}}$$

CHAPTER 9
ARCHITECTURAL DESIGN

Objective

The objective of this Chapter is to ensure that a civil or industrial building shall adopt sound architectural features.

Article 9.1. Architectural design

9.1.1. Architectural design requirements

Architectural design for civil and industrial buildings must satisfy the following requirements:

1. Planning controls

   The position and the architectural design of a building must comply with the controls and requirements of the general and detailed planning schemes of the relevant urban areas and zones and the provisions on planning specified in Chapters 4,5,6 and 7 of BCV.

2. Requirements for a building

   Architectural design of a building must satisfy all the requirements for its functional use, interior and exterior space layout of a building, construction methods and technology, and in provision of physical facilities and amenities.

   a) For dwellings: architectural designs must ensure the convenient communication between bedrooms, dinning rooms, lounge rooms and the service (amenities) rooms (kitchen, toilets, storage rooms), at the same time taking advantage of the favourable natural conditions (ventilation and lighting ...) for the main rooms.

b) For public buildings: Their architectural designs must conform to the intended use of a building (educational, cultural, medical purposes ...), target service areas (i.e. to serve a residential block, a district or the entire urban area) and must ensure comfort in use and ease of management.

c) for industrial buildings: architectural designs must ensure effective production activities and use of technological process and the rational arrangement of and the connections among the workshops, the principal and auxiliary production buildings (workshops) as well as the technical support units and facilities units, the efficient use of the technical and physical infrastructure of an industrial zone.

3. Environmental and landscaping requirements.

Architectural design of a building must:-

a) deal effectively the relationships between the building and the environment and the landscape, abide by the legislation and regulations on environmental protection, the protection of scenic places and historical and cultural relics provided for in Chapter 4 of BCV;

b) taking full advantage of the natural position and conditions of the building such as greenery and water surface to enhance architectural beauty of the building; and

c) be in conformity with the climatic conditions of the area in which the building is to be built.

4. Socio-economic requirements.

In addition to meeting the functional requirements, architectural designs must also ensure that the building conform to the economic and physical conditions of the locality, customs and habits of the population and must satisfy the aesthetic requirements and preserve the cultural characters of the locality as well as of the nation.

9.1.2. Deemed - to - Satisfy design solutions

Architectural designs meeting the following regulations and standards are deemed to satisfy the requirements:-

1) a dwelling house or group houses designed in accordance with the various levels provided for in Art. 5.7 "Planning for residential areas" of BCV and Standards TCVN 4451-87 "Dwelling houses - Main principles for design";

2) public buildings designed in accordance with Article 5.8 "Planning for public buildings" of BCV and Standards 20 TCN 13-91 "Classification of buildings and civil buildings and structures";

3) civil buildings designed for mixed uses and functions (residential and public services, residential and production, or other public purposes ...) in one building but each functional component is so designed to meet the requirements for the relevant type of that building or part thereof;

4) Industrial buildings so designed to conform to Article 5.2 on planning for "Industrial and storage areas" of BCV and classification of buildings under Standard TCVN 2748-91 on "Classification of buildings - General principles" in accordance with the levels of investment and qualities of the buildings.

Note:

Vietnamese standards on design of civil and industrial buildings are listed in Appendix 9.1

Article 9.2. Architectural designs for special civil buildings

1) Architectural designs for special civil buildings must satisfy particular requirements (on quality, aesthetics, national characters, modernity, durability, levels of physical amenities and facilities) and must be approved by the competent authorities.

2) Except for exemptions, architectural designs for special buildings must be subjected to selection contests.

Appendix 9. 1 Design Standards for Civil and Industrial Buildings

1) Dwelling houses (including hotels)

TCVN 4451 - 87 Dwelling houses - Main principles for design
TCVN 4450 - 87 Dwelling Unit - Design Standards
TCVN 4391 - 86 Hotels - Classifications
TCVN 5065 - 90 Hotels - design standards

2) Houses and public buildings

TCVN 4319 - 86 Houses and public buildings - Main principles for design

a) Cultural buildings

TCVN 5577 - 91 Cinemas - Design Standards

b) Education buildings

TCVN 3907 - 84 Kindergartens-preschool centers - design standards
TCVN 3978 - 84 Primary and Secondary schools - design standards
TCVN 3981 - 85 Higher Education institutions - design standards
TCVN 4602 - 88 Technical secondary schools - design standards
TCVN 60 - 74 Vocational schools - design standards

c) Medical buildings

TCVN 4470 - 95 General hospitals - design standards

d) Sports buildings

TCVN 4205 - 86 Sport stadiums - design standards
TCVN 4260 - 86 Swimming pools - design standards
TCVN 4529 - 86 Gymnasiums - design standards

e) Commercial buildings

TCVN 4515 - 88 Common dining halls - design standards

g) Office buildings

TCVN 4601 - 88 Office buildings - design standards

3) Industrial buildings

TCVN 4514 - 88 Factories - Total plan areas - design standards
TCVN 4604 - 88 Factories - Production buildings - design standards
TCVN 4317 - 86 Warehouses - design standards

CHAPTER 10
STRUCTURES

Objective

The objective of this Chapter is to ensure that a structure or building element during construction and use:

1. shall not collapse, deflect, crack, or be eroded or deformed to such an extent that can result in adverse impact on its serviceability and endangering life and property;

2. is durable enough to ensure serviceability of the building without the need for major undue repair or maintenance throughout its intended life; and

3. does not cause damage (sagging, cracks) to adjacent buildings during construction and use.

Article 10.1. Requirements for structures

A structure or member must ensure safety and serviceability during its construction and service life and must satisfy the following requirements:

10.1.1. Strength

The strength of a building must be so calculated to take into account building types and all physical conditions impacting on the building including:-

1. the most disadvantageous combination of loads, including loads that can result in progressive destruction; and

2. other impacts, including time scale impacts

10.1.2. Normal serviceability

The building and its parts and the materials used must be designed and constructed to maintain normal serviceability by controlling or limiting deformation, vibration or excessive deterioration of its properties.

10.1.3. Durability

Materials used for constructing a building must be durable enough to ensure the structure and its members meet the requirements for durability without the need of major repair within the period provided for its living.

Article 10.2. Design principles for structures

10.2.1. Deemed-to-satisfy design

A structure is deemed to satisfy the requirements specified in 10.1 if it is so designed to comply with the following:

1) Calculation and design methods.

A structure including its foundation is calculated according to limit states.

2) Fire resistance.

The structure after its calculation is to be tested for fire resistance and must comply with the provisions in Art. 11.4 of BCV.

3) Protection against corrosion, rotting and from termites and woodeaters.

Where the building is subject to corrosion and humidity, appropriate protective measures must be taken against these hazards.

10.2.2. Instructions

10.2.2.1. *Limit states*

Limiting states are divided into 2 types :

1. Type 1:
Includes limit states resulting in failure of a structure to maintain its strength or serviceability due to:-

a) damage caused by load or impact;
b) losing stability in form or position;
c) damage caused by fatigue

2. *Type 2:*
Includes limit states resulting in failure to maintain serviceability of a structure, because the structure is subject to excessive levels of:

a. deformation: deflection, rotation, sliding;

b. fluctuation; or

c. cracking (mainly in respect of concrete structures).

10.2.2.2. Calculation according to the first limit state

1) The structure is calculated according to its load bearing ability (strength) under the following condition:

$$T \leq T_{td} \qquad (1)$$

of which :

T - Critical value of each internal force or by simultaneous action of some internal forces;

T_{td} - Minimum limit of load bearing ability (calculated by a fixed and safe probability) of the cross-section

The value of T is determined according to a calculated load and chosen among internal force combinations relative to the dangers to the serviceability of the structure in terms of both the values and directions of the internal forces.

The value of T_{td} is determined according to geometrical characters of the cross- section and calculation methods applied to the material.

2. Condition (1) must be met by all components, all cross-sections of the structure, responding to all stages of its (intended) service life.

10.2.2.3. Calculation according to the second limit state.

A structure can be calculated according to the second limit state which includes the following procedures:

1. Deformation testing as per the following condition:

$$f \leq f_{gh} \qquad (2)$$

of which:

f - Deformation (deflection, rotation, expansion...) of the structure caused by loading or impact.

f_{gh} - Limiting value of deformation depending on the nature, the working environment to which the structure is exposed, working conditions of workers, equipment, human psychological states and aesthetic standards.

2) Crack control

a) For a structure to which cracks are acceptable:

the width a crack is controlled as per the following condition :

$$a_n \leq a_{gh} \qquad (3)$$

of which :

a_n *- width of the crack of the structure caused by standard load, impact*

a_{gh} *- limiting width of the crack*

b) For a crack-free structure (i.e. cracks are not acceptable)

Non-cracking is controlled as per the following condition:

$$T_1 \leq T_n \qquad (4)$$

of which :

T_1 *- Internal force used for controlling, caused by standard values of loading and impact.*

T_n *- crack resistance ability of the cross-section*

3) The first limit state may not be applicable if by means of testing or actual use, a similar structure (prototype) proves that: the crack width at any stage will not exceed the limiting value and the robustness of the structure during the intended service life, and so safety requirements are satisfied.

***10.2.2.4.** Schematic drawings, assumptions and data for calculation*

***1.** Schematic drawings (or scale models) and basic assumptions for calculation must closely suitable for actual service conditions of the structure and the limit state under consideration.*

***2.** Calculation data*

The following factors should be taken into account in calculation:

a) The most disadvantageous possible aspects of materials and soil conditions that may develop relevant to certain levels of certainty.

b) Combinations of loads, and impacts

i) Calculation of a structure must be carried out for all stages of manufacture, transport, construction, use and repair.

ii) Climatic heat factor must be taken into account where the structure is directly exposed to and is not protected from solar radiation

iii) Expulsive water pressure must be taken into account where the structure submerges in or in contact with water.

iv) When calculating load bearing capacity (strength) of a structure, unexpected effects that may result in changes in impact or structure arrangement must be taken into consideration.

In relevant cases, dimensional deviations, conditions of construction and service of the structure and other special performance conditions of the structure must also be taken into account.

Article 10.3. Loads and impacts

10.3.1. Deemed to satisfy solutions

A structure is deemed to satisfy the requirements for loads and impacts if all the data used for the design of the structure including its foundation and foundation conform with the following standards:

- TCVN 2737-95 "Load and impact - Design Standards".

Note :

1) The specifications stated in TCVN - 2737 - 95 is quoted in clause 10.3.2..

2) The following loads are not prescribed in TCVN-2737-95, but shall be subject to separate regulations:

a. Loads caused by :

i) railways and roads.
ii) sea waves, currents
iii) earthquake
iv) storms and whirlwinds
v) temperature
vi) goods handling
vii) dynamic components of manufacturing equipment and transport means.

b. Loads for especially important buildings

c. Loads for specific buildings and structures such as: transport, water works, post and telecommunication buildings.

10.3.2. Instructions

10.3.2.1 Various kinds of loads and load combination.

1. A building or a structure must be so designed to take into account loads that are generated during the following stages:
   a) construction of the building
   b) service and use of the building.
   c) manufacturing, storage and transport of the structures.
2. Various kinds of loads
   Various kinds of loads and their composition are stated in appendix 10.1

3. Load combination
   a) A structure must be calculated based on the most disadvantageous combination of loads in cases when the structure simultaneously bears 2 or more temporary loads,
   b) Composition of loads in the load combination is prescribed in Appendix 10.2 with Coefficient of load combination ψ described in Appendix 10.3.

10.3.2.2. *Calculated loads*

Calculated loads are the result of standard loads multiplied by the coefficient of load reliability γ (also called coefficient of surplus load)

10.3.2.3. *Standard loads*

1) Determination of values standard loads
Methods for determining values of standard loads are prescribed in Table 10.3.1

Table 10.3.1.

Methods of determining values of standard loads

Types of loads	*Methods of determining values of standard loads*
1. Weight of structure, soil (dead loads)	*- In accordance with TCVN, catalogues or designed dimensions* *- Actual humidity must be taken into account in the process of construction, service and use of the building.* *- Actual humidity, load of stored materials, equipment and transport vehicles impacting on the soil must be taken into account when determining soil load.*
2. Loads caused by equipment, people, stored materials, products	*2.1. Loads caused by stored equipment and materials:* *a. The most disadvantageous cases must be taken into consideration.* *b. When actual load imposing on the floor is replaced by equivalent evenly distributed loads:* *i. Each component of the floor is separately determined.* *ii. Minimum equivalent evenly distributed loads for industrial buildings, warehouses:* *300 daN/m^2 for slabs and auxiliary beams* *200 daN/m^2 for main beams, columns, foundation* *c. Loads caused by equipment will be based on machinery arrangement for operation, but avoiding reinforcement of bearing structures for moving and installing of equipment.* *d. For machines with dynamic loads: Different standards are to be used.* *e. Action of vertical load caused by handling equipment or vehicles can be calculated equal to 1.2 of standard dead loads.*

	2.2. Evenly distributed loads *a. Standard even loads imposing on floors and stairs: Calculated according to Table 10.3.2 (cases permitted to reduce loads : see note 1)* *b. Weight of temporary partition walls is determined by:* *- actual weight; or* *- even load determined by planned arrangement of partitions, but not less than 75 daN/m^2.* *c. Eaves, awnings, gutters, consoles:* *i. calculated with concentrated vertical load on outer edge with standard value equal to 75 daN/m^2 along the wall (but not less than 75 daN), =1.3* *ii. re-examined according to even load with standard value of 75 daN/m^2 (clause 19b of Table 10.3.2)*
	2.3. Concentrated loads and loads imposing on balustrade *a. Concentrated loads :* *Conditioned vertical load is concentrated on the structure at the disadvantageous points, on a square area not exceeding 100 cm^2, that is necessary for examining the structures stated in note 2* *b. Lateral loads imposed on handrails of stairs, balcony, parapets: see note 3*
3. Wind loads	*According to clause 10.3.7*
4. Loads caused by cranes, bridge cranes	*According to part 5 of TCVN 2737 - 95*

Note:

(1) Including cases permitted to reduce loads prescribed in appendix 10.4.

(2) Structural weight is the sum of weights of all structures of a building including finishing materials.

(3) Minimum values of concentrated vertical loads imposed on balustrade are described in the following table:

Types of structures	*Floor, stairs*	*Attic floors, roofs, terrace, balcony*	*Roofs accessible by a staircase leaning close and against a wall*
Minimum values of concentrated loads (daN)	*150*	*100*	*50*

(4) Lateral loads acting on handrails of stairs and balcony are described in the following table:

Types of buildings	*Values of load (daN/m)*
a. Dwelling houses, kindergartens, sanitarium, hospitals	*30*
b. Spectator stands, gymnasiums	*150*
c. Houses and rooms for special use.	*80*
d. Operating platforms, gangways, gantry ways and decking designed to withstand several people	*30*

2) Even loads imposing on floors and stairs

Even loads imposing on floors and stairs used for calculation shall not be below the values prescribed in table 10.3.2.

Table 10.3.2.
Standard load distributed evenly on floors and stairs

Types of rooms	Building types and features	Standard loads		
		Unit	Full	Longterm members
1. Bedrooms	a) Hotels, hospitals, prisons	daN/m 2	200	70
	b) Dwelling houses, crèche', kindergartens, boarding schools, resort houses, sanitarium...	daN/m 2	150	30
2. Dining-rooms, lounge rooms, bathrooms, toilets	a) in a dwelling house	daN/m 2	150	30
	b) In crèches, kindergartens, schools, resort houses, old people homes, sanitarium, hotels, hospitals, prisons, office buildings and factories	daN/m 2	200	70
3. Kitchens, laundry rooms	a) Dwelling house	daN/m 2	150	130
	b) Crèches, kindergartens schools, resort houses, old people homes, sanitarium, hotels, hospital, prisons office buildings and factories	daN/m 2	300	100
4. Offices. laboratory	Office buildings, schools, hospitals, banks, research institutions	daN/m 2	200	100
5. Boiler rooms, engines and fan-rooms including machines	Multi-storey buildings, office buildings, schools, resort houses, retired people homes, sanitarium, hotels, hospitals, prisons research institutions	daN/m 2	750	750

6. Reading rooms	a. With book shelves	daN/m 2	400	140
	b. Without book shelves	daN/m 2	200	70
7a. restaurants		daN/m 2	300	100
7b. Exhibitions, showrooms		daN/m 2	400	140
8. Meeting - halls dancing-halls, waiting-rooms, auditoriums, concert halls, gymnasiums, spectator stands	a. With fixed seats	daN/m 2	400	140
	b. Without fixed seats	daN/m 2	500	180
9. Stages		daN/m 2	750	270
10. Warehouses	a) Archives (fully loaded)	daN/1 m high of stacks	480	480
	b) Book stores in a library		240	240
	c) Paper stores		400	400
	d) Freezing stores		500	500
11. Class rooms	In schools	daN/m 2	200	70
12. Factories, workshops	a) Foundry	daN/m 2	2.000	as per engineering designs
	b) Garages servicing vehicles with weight ≤2500 kg	daN/m 2	500	
	c) Large workshops with machines and ways	daN/m 2	400	

13. Attic room	On the area without equipment, materials	daN/m 2	70	as per engineering designs
14. Balcony, loggia	a) Loads distributed evenly at intervals in the area of 0.8m wide along balustrade, balcony, loggia.	daN/ strip of 0.8m wide	400	140
	b) Loads distributed evenly on the whole area of balcony, loggia (to be taken into consideration if its action is more disadvantageous than that specified in section a)	daN/m 2	200	70
15. Entrance hall, lobby, corridors connecting to other rooms	a. Office, laboratory, bedroom, kitchen, laundry, toilet, mechanical rooms.	daN/m 2	300	100
	b. Reading room, restaurant, meeting hall, dancing hall, lounge -room, auditorium, concert hall, gymnasium, storage room, balcony, loggia.	daN/m 2	400	140
	c. Stage	daN/m 2	500	180
16. Mezzanine		daN/m 2	75	as per engineering design
17. Livestock farms	a. Small livestock	daN/m 2	200	70
	b. Cattle	daN/m 2	500	180
18. Decking or roofs which can be used or walked on.	a. part of a roof that can accommodate a crowd of people (coming from a production workshop, lecture hall or a large hall)	daN/m 2	400	140
	b. part of a roof used for relaxation	daN/m 2	150	50
	c. other parts	daN/m 2	50	as per engineering design

19. Non - walk-on roofs	a. Tile roof, fibrocement roof, steelsheeting roof and similar, straw & mortar ceiling, cast concrete ceiling not for people walking on it for repair, excluding water, power, ventilating equipment, if any.	daN/m 2	30	as per engineering design
	b. Reinforced concrete deck-roof, sloped roof, gutter, abatement, assembled concrete ceiling not for people walking on it except for maintenance workers, excluding water, power, ventilating equipment, if any.	daN/m 2	75	as per engineering design
20. Platforms of railway stations, underground - stations		daN/m 2	400	140
21. Garage	Motorways with ramps used for cars, buses and light trucks with total weight 2500 kg	daN/m 2	500	180

Note:
The loads stated in item 14 of table 10.3.2 are used for calculating bearing structures of a balcony and loggia. When calculating structure of a wall, column, foundation supporting a balcony or a loggia, the loads imposing on balcony, loggia for analysis are equal to those on the main adjoining rooms and they could be reduced according to the instructions in Appendix 10.4.

10.3.2.4. *Coefficient of surplus load* γ

Coefficient of surplus load of various kinds of loads is prescribed in table 10.3.3.

Table 10.3.3. Coefficient of surplus load γ

Types of calculation	Types of loads	Coefficient of surplus load
Calculation of strength and stability	1.1. Weight of structure : a. Steel structure (1) b. Structure of brick, stone, brick-stone with steel reinforcement c. Concrete structure of over 1.600 kg/m^3 d_1 Concrete structure of 1.600 kg / m^3 density and under partition material, plastering and finishing layer: i. Manufactured at the factory ii. Manufactured in situ	 1.05 1.1 1.1 1.2 1.3
	1.2. Weight, pressure of the ground (2) a. Virgin soil b. Filled-up soil	 1.1 1.15
Calculation of strength and stability	1.3 Loads caused by equipment, people, stored goods : Weight of : a) fixed equipment b) separating layer of fixed equipment c) material contained in equipment, tank, pipes: i. liquid ii. Bulk materials, sludge, suspended materials d) handling equipment, vehicles e) loads caused by material adsorbing moisture or water	 1.05 1.2 1.0 1.1 1.2 1.3
	1.4. Loads distributed evenly on floor, stair when:- a) standard load is : i) less than 200 daN/m^2 ii) not less than 200 daN/m^2 b) weight of partition is:	 1.3 1.2 as per 1.1

	1.5. Concentrated loads and loads on balustrade	*1.2*
	1.6. Load of cranes, bridge cranes	*1.1*
	1.7. Wind loads : *ssumed service life of the structure:* *50 years* *40 years* *30 years* *20 years* *10 years* *5 years*	 *1.2* *1.15* *1.1* *1.0* *0.9* *0.75*
2) Calculating fatigue strength		*1.0 as for bridge crane beams*
3) Calculation as per deformation and displacement		*1.0* *(unless otherwise specified)*

Note:

1) In case, the stability (safety) of the structure will be reduced when permanent load is reduced (such as antidumping stability when the weight of structure and soil is reduced), coefficient of reliability to be taken must be to 0.9.

2) For a steel structure, if stress caused by specific weight exceeds that of common stress by 0.5, coefficient of reliability to be taken must be to 1.1.

3) When calculating a structure of foundation and foundation as per loads generated in construction process, short-term calculated load must be reduced by 20%.

4) When calculating fire resistance of a structure which is subject to explosion influence, the coefficient of surplus load to be taken is equal to 1 for all types of loads.

5) When calculating strength under condition of actions caused by crane and bridge crane impacting on rail barriers, coefficient of reliability to be taken is to 1 for all types of loads.

10.3.2.5. *Wind load*

Wind loads including static and dynamic elements are calculated as follows :

1) *Static element :*

a) *Standard value of static element of the wind load at height level Z compared with the benchmark will be determined as per the following formula:*

$$W = W_O \times k \times c$$

of which :

W_O *- Value of wind pressure, as per clause 10.3.5.1.b below.*

k - Coefficient allowing for variance of wind pressure according to elevations and topographical terrain (as per Table 5, TCVN 2737 - 95).

c- Aerodynamic coefficient (as per Table 6, TCVN 2737 - 95)

Method of determining benchmark : according to Appendix 6, TCVN 2737 - 95)

b) *Value of wind pressure according to Zoning Maps and Administrative Topography Schedule prescribed in TCVN - 2737 - 95 and specified in BCV volume 3.*

2) *Dynamic component*

a) *It is not necessary to calculate the dynamic component when determining the pressure on inner surface of a building which is constructed in topography areas forms A and B (exposed and relatively exposed, as specified in Article 6.5 of TCVN 2737-95) and have the following characteristics:*

i) a mufti -storey building under 40m high.

ii)/ a single floor industrial building under 36m high, the ratio of height to a span is less than 1.5.

b) *Method of determining the dynamic component of wind load is prescribed in Article 6.11 to 6.16 of TCVN 273 -95 "Loads and Actions - Design Standard".*

10.3.2.6. *Earthquake load*

As per provision in article 3.6. of this BCV.

Article 10.4. Reinforced concrete structure

10.4.1. Deemed-to-satisfy design

A reinforced concrete structure is deemed to satisfy if it meets the following Vietnamese standards and requirements:

1) Design:

- TCVN 5574-91 *"Reinforced concrete structure-Design Standard"*

Note:

(1) TCVN 5574-91 is not applicable to the following types of structures:

(a) Structure working in special environment :-

i. high temperature environment : usually over 70^{o}C, or

ii. low temperature environment : under minus 40^{o}C or

iii. highly corrosive environment for concrete

(b) Special structure designed according to industry-specific specifications.

(c) Structure built with special types of concrete:

i. extra heavy concrete : with specific volume of over 2,500 kg/m^{3}

ii. extra light concrete : with specific volume under 800 kg/m^{3}.

iii. fine aggregate concrete : with diameter under 5 mm.

iv. concrete using special aggregate and binder such as plastics.

(2) Important instructions in TCVN 5574-91 is quoted in 10.4.2.

2) Anti corrosion and water proof:

- TCVN 3993-85 Anti corrosion in buildings-
  Concrete and reinforced concrete structure - design principles
- TCVN 5718-93 Reinforced concrete roofs and floors in buildings -
  Water proofing technical requirements

3) Construction and take-over:

- TCVN 4452-87 Assembled concrete and reinforced concrete structures-
  Construction and taking-over procedures.
- TCVN 4453-95 Block/mass concrete and reinforced concrete structures-
  Construction and taking-over procedures and standards
- TCVN 5592-91 Heavy concrete - Natural humidity curing requirements.

Note:
Standards on materials and testing methods are listed in Appendix 10.5

10.4.2. Instructions

10.4.2.1. Reinforced concrete must be so designed (structure drawing, section dimensions and reinforcement arrangement) to ensure strength, stability and robustness in its entirety as well as its separate components throughout its construction and service life.

10.4.2.2 Crack control

1) Abilities of crack-resistance of structures are divided into 3 grades depending on their service conditions and types of reinforcement to be used :

a) Grade I : Crack is not allowed;

b) Grade II : Short - term cracks with limited width are allowed when the structure bears disadvantageous temporary load but the crack must close up when the structure ceases to bear such temporary load;

c) Grade III : Cracks with limited width are allowed.

2) Grades of crack-resistance and crack width allowances are stipulated in Table 10.4.1.

Table 10.4.1. Grades of crack-resistance and crack width allowances

Types of structures	Grades of crack resistance and crack allowances (mm) relative to types of reinforcement		
	Steel rod/wires	high tensile steel wire d≥ 4 mm	high tensile steel wire d≥ 3 mm
1. Structure under liquid or gas pressure 2. Structure under water table level	Grade 1	Grade 1	Grade 1
3 . Structure under direct weight of bulk materials	Grade 3 0.25	Grade 2 0.10	Grade 2 0.05
4. Structure in open air or underground but above the underground water level	Grade 3 0.30	Grade 2 0.15	Grade 2 0.05
5. Structure under cover	Grade 3 0.35	Grade 3 0.15	Grade 2 0.15

Note:

1) Width allowances of cracks given in the table correspond to the actions of the full loads, both long - term and short - term. For the structure under Grade 3, when only long - term load is examined, the allowance of the crack in question must be reduced by 0.05 mm.

2) In salt water environment, the allowance of the crack must be reduced by 0.1 mm for Grade 3, and 0.05 mm for Grade 2. If after being reduced, the crack width equals to zero, the structure can be reclassified as belonging to Grade 1.

3) For a temporary structure with a service life of under 20 years, the crack allowance can be increased to 0.05 mm.

10.4.2.3. Requirements for deformation.

Critical values of deformation are stipulated in Table 10.4.2

Table 10.4.2. Critical values of deformation f_{gh}

Types of structures	*Deflection limits*
1. Bridge crane beams :	
a. Manually operated bridge crane	*1/500L*
b. Electric bridge crane	*1/600L*
2. Floor with flat ceiling, suspended structure of roof and curtain wall (when calculating wall slabs) when:-	
a. span L < 6m	*(1/200)L*
b. 6 ≤ L ≤ 7.5m	*3 cm*
c. L > 7.5m	*(1/250)L*
3. Floor with ceiling having frame and stairs when:	
a. span L < 5m	*(1/200)L*
b. 5 ≤ L ≤ 10m	*2.5 cm*
c. L > 10m	*(1/400)L*

Note:

1. *L is the calculated span of a beam or plate resting on 2 bearings. For consoles, L = $2L_1$ is used, L_1 being the reach of a console.*

2. *When a pre-deflected structure is designed, this deflection can be subtracted during testing, if there are no special controls.*

3. *For other structures not stated in the table, the limit of deflection will be determined based on their service nature and intended uses but this limit shall not exceed by 1/150 of beam L or 1/75 of the console reach.*

4. *When a deflection value is determined without reference to requirements of production technology and structure but by aesthetic requirements, only long-term loads need to be taken into consideration when f is calculated.*

10.4.2.4. Assembled reinforced concrete structure

1) When an assembled structure that bears action of internal forces generated during transport, lifting and assembling is calculated, the load caused by the structure dead weight must be multiplied by a dynamic coefficient as follows: 1.8 during transport, 1.5 during lifting or assembly. In this case, the coefficient of surplus load by its dead weight need not be taken into account.

2) Partly-assembled structures and mass structures must be calculated according to 2 working stages as follows :

a. Before newly placed concrete reaches required strength: assembled components or rigid carcasses that bear actions of the load caused by the newly placed concrete mass and action of all other loads in the process of concrete placing must be calculated

b. After newly placed concrete attains required strength : a structure including assembled parts or rigid carcasses together with newly placed concrete that will bear the loads caused by subsequent process of construction and service of the structure must be considered.

10.4.2.5 Spans between temperature-elastic joints

1) For structures not exposed to constant and direct impact of rain and sunlight

For structures not exposed to constant impact of rain and sunlight the permissible lengths between temperature-elastic joints shall not exceed the values given in Table 10.4.3.

In cases where longer distance are required, such longer distance must be determined by way of calculation on a case-to-case basis.

Table 10.4.3.
Maximum distance permissible between temperature - elastic joints without the need for calculation (for structures not exposed to constant and direct impact of rain and sunlight)

Structures	Maximum distance allowed between temperature - elastic joints (m)
1. Assembled frames (including metal or wooden flat roofs)	70
2. Structures assembled by compact slabs	60
3. Mass or partly-assembled frames	60
4. Mass, compact slabs or partly-assembled structures	50

2) Structures exposed to constant and direct impact of rain and sunlight

The permissible distance between temperature and humidity elastic joints of structures including roof surfaces, balcony, road pavement which are exposed to constant and direct impact of rain and sunlight must conform to Vietnamese Standard TCVN 5718-93 "Roof and reinforced concrete floor - water proofing requirements." (Table 10.4.4.)

Table 10.4.4
Maximum distance between temperature and humidity elastic joints, between opposite sides (from side to side)
(applied to structures exposed to constant and direct impact of rain and sunlight)

Structures	Maximum lengths
- Water-proofing concrete layer of roof without a heat-proof layer - Reinforced concrete balustrade on roof	9
- water proofing concrete layer of a roof with heat-proof layer in conformity with Article 4 of TCVN 5718-93. Other reinforced concrete structures under direct solar radiation	18

Article 10.5. Brick-stone and reinforced brick-stone structure.

10.5.1. Deemed to satisfy solutions

A brick-stone or reinforced brick-stone structure is deemed to satisfy if it conforms to the following standards and requirements:

1) Design:

- TCVN 5573-91 "Brick-stone and reinforced brick-stone structures- design standard".

Note:
Important instructions in TCVN 5573-91 are provided for in Clause 10.5.2

2) Construction and hand-over:

- TCVN 4085-85 "brick-stone structure - construction and hand-over procedures".

Note:
Standards on materials, testing methods are described in Appendix 10.5

10.5.2. Instructions

1.5.2.1 Strength of walls, columns, awnings and other structures should be controlled in construction and use.

1.5.2.2 Components with large dimensions (such as wall panels, big masonry blocks...) must be controlled by ways of calculation in the process of manufacturing and erection as provided for in Clause 10.4.2.4.

1.5.2.3 The minimum requirement of bonding in compact/solid masonry or stone block with perfectly regular shapes (except panel of vibration bricks) is as follows :

a) For a brickwork with thickness of up to 65 mm - one header row for six longitudinal brick rows; for a masonry block of hollow bricks with thickness of up to 65 mm - one header row for 4 longitudinal brick rows.

b) For a stonework with average height of each layer of 200 mm or less, one header row for 3 longitudinal rows.

10.5.2.4 Distances between temperature joints

The maximum distances between temperature gaps of non-reinforced outer walls are prescribed in table 10.5.1.

Table 10.5.1
The maximum distances between temperature joints

Kinds of brickwork	Distances (m) relative to mortar strength grades	
	#50 or more	#25 or less
1. Brickwork of clay bricks, ceramic bricks, stone and concrete blocks	100	120
2. Brickwork of silicate, concrete bricks or blocks	70	80
3. Stone rubble concrete wall	35	

Note:
With respect to constructions using stones, such distance shall be equal to half of the values prescribed in the table

Article 10.6. Steel structure

10.6.1. Deemed - to - satisfy design

A steel structure is deemed to satisfy the requirement if it conforms to the following requirements and Vietnamese standards:

1) Design:
- TCVN 5575 - 91 "Steel structure - Design Standard" must be satisfied

Note:
Important instructions of TCVN 5575-91 are quoted in Clause 10.6.2.

2) Construction and Take-over

- 20 TCN 170-89 "Steel structure - processing, assembly and take-over - Technical requirements".

10.6.2. Instructions

10.6.2.1. A steel structure must be designed in such a manner to:-

1) ensure stability and geometrical (spatial) shape in its entirety and its components in the process of assembly and use including the use of a bracing system;

2) eliminate adverse effects caused by deformation and surplus stress;

3) eliminate bristling effect on the structure caused by welding; during the process of assembly and use

4) ensure the structure be given protection against corrosion.

10.6.2.2. Deflection and declination of structure

1) Deflection of a structure is determined as per standard loads but not including cross-section attenuation caused by rivet or bolt holes or dynamic factors.
For a structure with constituent deflection, vertical deflection is taken as the difference between total deflection and constituent deflection.

2) Relative vertical deflection of a structure must not exceed the values prescribed in Table 10.6.1.
Relative deflection of structures not included in Table 10.6.1 shall be determined separately but must not exceed 1/150 of the beam span or twice the length of the out-stretching part of a console.

3) Relative horizontal deflection of a vertical bar, lateral beam or panel of a curtain wall shall not exceed 1/300 and of the supporting beam of a glass window shall not exceed 1/200 of a span length.

4) Relative horizontal deflection of a column of the upper wing of a bridge crane beam with the number of load action cycles from 2×10^6 upward shall not exceed 1/2000 of the span.

Table 10.6.1 Relative deflection of structures

Components of the structure	Relative deflection (for L span)
1. Beam and frame of bridge crane : - Light-duty operation (including bridge crane, electric tackle arm and tackle). - Medium-duty operation - Heavy and very heavy duty operation	 1/400 1/500 1/600
2. Beams of working platform in factory with rail tracks. - Large gauge - Narrow gauge	 1/600 1/400
3. Beams of working platform in factory without rail tracts and floor beams between floors. - Main beam - Other beams and stringers - Steel floor	 1/400 1/250 1/150
4. Beams and trusses of roofs and floors - With overhead hoist or engineering equipment - Without overhead equipment - Collar beam - Forming floor	 1/400 1/250 1/200 1/150
5. Components of wall frame - Cross beam - Beam supporting glass windows	 1/300 1/200

Note:
1) For console of span L, the deflection taken shall equal 2 times of the console out-stretching part.
2) When there is a plaster layer, deflection of the floor beam caused by temporary load only shall not exceed 1/350 of the span length.

10.6.2.3. The distances between temperature joints

The maximum distances between temperature joints of a steel frame of a single storey house and other structures are prescribed in Table 10.6.2.

Table 10.6.2 Maximum distances between temperature joints (m)

Features of building	Maximum distances (m)		
	Between temperature joints		From temperature joint or the extremity of the house to the axis of the nearest vertical bracing system
	Along the length of house	Along the width of house	
Weather-proof building	230	150	90
Hot workshops	200	120	75
Open viaduct	130	-	50

Note:
When within the temperature section of a building and there are 2 vertical bracing systems, the distances (from axis to axis) between these bracings shall not exceed the values for a building of 40 to 50m; or for an open viaduct of 25 to 30m.

***2)** When a distance exceeds by 50% of a value given in Table 10.6.2. or rigidity of the frame is increased by a wall or other structures, temperature action causing non-elastic deformation of the structure and plasticity of knots should be taken into account*

Article 10.7 : Timber structures

10.7.1. Deemed to satisfy design
A timber structure is deemed to satisfy if it conforms to the following requirements and Vietnamese Standards:

1) Design:
- TCXD 44-70 "Design code for timber structures"

Note:
Important instructions of TCXD 44-70 are quoted in 10.7.2.

2) Materials:

- TCVN 1072-71 "Timber Classification by physico-mechanical features"

Note:
Standards and testing methods are listed in Appendix 10.5.

10.7.2. Instructions

10.7.2.1. Service conditions for timber structures and rot and wood worm control measures

1) Service conditions:

a) A timber structure should only be used in normal temperature and humidity environment.

b) A timber structure should not be used in environment characterised by constantly high degree of humidity, poor ventilation or being inflammable.

2) Treatment and maintenance of timber structures:

a) A timber structure made of timber under Groups 2 to 5 need not undergo impregnating or chemical treatment. Such important parts as wooden cushions, pins if not made of timber from Group 2 must be treated against rot.

b) Structures made of timber from Group 6 or below (7 or 8) must undergo chemical impregnating treatment before use;

Note:
(1) Timbers mentioned in 10.7.2.1/2) are classified into 8 Groups depending on their properties and functions as follows:

Groups	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*
Properties	*valuable*	*iron wood*			*Good rose wood*	*Poor rose wood*	*white mixed*	*white mixed*

(2) The above-mentioned classification is different from the classification based on physico-mechanical properties in 10.7.2.5.

10.7.2.2. *Clear indications must be included in the construction design regarding timber groups, moisture content, types of components, machining methods, steel specifications and methods used in machining steel components which are to be used in a timber structure.*

10.7.2.3. *Elasticity of materials should be assumed in calculating internal force in timber components and linkages but not including deformation and allowed stress caused by temperature change or shrinkage or expansion of timber.*

10.7.2.4. The permissible relative deflection values of a bending component are prescribed in Table 10.7.1.

Table 10.7.1 Relative deflection (f/L) of bending components

Components	Deflection
Floor	1 : 250
Roof beam, collar beam, rafter	1 : 200
Purling, batten, roof plank	1 : 150

Note:
In calculating deflection, a longitudinal elastic modulus of timber is determined as follows:

(a) Under normal temperature and humidity conditions, a longitudinal elastic modulus of all types of timber subject to actions of permanent and temporary loads will be taken as :

$E = 100{,}000\ daN/cm^2$

(b) Under high temperature and humidity conditions or when a timber structure is subject to only actions of long-term loads, the value E must be multiplied by coefficients stipulated in Table 10.7.2.

Table 10.7.2. Coefficients of service conditions of a structure working in high humidity or temperature environment or just controlled by permanent loads

Service conditions	*Coefficient*
- Wood which has been wet for a short time, then becomes dry again (the building is not weather-proof, or the structure is subject to short-term humidity in aproduction house)	*0.85*
- Wood which has been was wet for a long-time (in water, ground, or the structure is subject to long-term humidity in a production house)	*0.75*
- The structure is subject to air temperature of 35°C - 50°C (in a production house)	*0.80*
- The structure is calculated only by permanent loads	*0.80*

10.7.2.5. Physical properties of timber

1) Standard TCVN 1072-71 " Timber classification based on physical properties" prescribes:

a) load bearing timbers which are classified into 6 groups as per Appendix 10.6.

b) permissible stresses calculated for each timber group as per Table 10.7.3.

Table 10.7.3 Permissible stresses relative to timber groups
(used for load-bearing structures in buildings)

Timber groups	Stresses 10^5 N/m^2 (or daN/cm^2)			
	Compression parallel to grain	Permanent bending	Tension parallel to grain	Shearing parallel to grain
I	630	1300	1395	125
II	525	1080	1165	105
III	440	900	970	85
IV	365	750	810	70
V	305	625	675	60
VI	205	425	460	45

Note:
Timber groups in this table are classified as per Appendix 10.6.

2) The following values may be used in calculating timber structures:

a) Calculated strength

Calculated strength of timber structures which are subject to permanent and temporary loads under normal temperature (below 35° C), and normal humidity (W=15-18%) conditions are specified in Table 10.7.4.

Table 10.7.4 Calculated strength of timber (daN/cm^2)

States of stresses	Symbol	Group	When humidity W =	
			15%	18%
Compression parallel to the grain	R_n	4	150	135
		5	155	135
		6	130	115
		7	115	100
Tension parallel to the grain	R_k	4	115	110
		5	125	120
		6	100	95
		7	85	80
Bending	R_u	4	170	150
		5	185	165
		6	135	120
		7	120	100
Compression and surface compression perpendicular to the grain	R_{n90}	4	25	24
		5	28/25	25/22
	R_{em90}	6	20/20	18/18
		7	15/15	13/13
Sliding along the grain	R_{tr}	4	29	25
		5	30	25
		6	24	21
		7	22	19

Note:
Timber groups in this table are from classification in 10.7.2.1.1.b

b) Factors of service conditions

Under abnormal service conditions, a strength value described in Table 10.7.4 must be multiplied by a relevant coefficient specified in Tables 10.7.5, 10.7.6 and 10.7.7.

Table 10.7.5 Coefficient of service conditions of components and linkages under bending, tension, compression and sliding

Types stresses	*Values*
1. Lateral bending	
a. Board, bar with one section edge < 15cm	*1.00*
b. Bar with width of cross section ≥ 15 cm, with section height not exceeding 50 cm	*1.15*
c. Round timber without slit in calculated section.	*1.20*
2. Tension parallel to grain	
Component having attenuation in calculated section	*0.80*
3. Compression perpendicular to grain (local)	
a. Bearing surface of the structure	*1.30*
b. Mortise joint and wedge	*1.70*
c. Compressing under the shim plate (reclining angles ranging from 90° to 60°)	*2.20*
d. Compressing on part of span L_{cb} (cm), when the length of the part without loading is not less than the length of compression parallel to the grain L_{cb} and the thickness of component (except cases stated in 3a, 3b and 3c)	*$1+8/(L_{cb}+1.2)$*

Note:
Coefficient of service condition of bent round timber with slit in calculated section are taken as rectangular section of sawn timber corresponding to attenuated size.

Table 10.7.6.
Coefficient of working condition for structures bearing short-term loads

Type of loads	*Coefficient*	
	All types of intensity, except surface compression perpendicular to grain	*Surface compression perpendicular to grain*
Wind or erection	*1.2*	*1.4*
Earthquake	*1.4*	*1.6*

Table 10.7.7
Coefficient of service conditions for bent components

Stresses status of component	*Coefficient with ratio r/a equal to*				
	125	*150*	*200*	*250*	*≥ 500*
Compression and bending	*0.7*	*0.8*	*0.9*	*1.0*	*1.0*
Tension	*0.5*	*0.6*	*0.7*	*0.8*	*1.0*

Note:
r : Bending radius of the component
a : Section dimensions of a bent wooden board or bar taken as per the direction of bending radius.

Article. 10.8. Foundations and subbase of building

10.8.1. Requirements for foundation and subbase of a building

10.8.1.1 The foundation of a building must be designed and constructed to ensure:

1) Foundation deformation must not exceed the permissible limiting values that ensure the normal intended use of the building.
The simultaneous permissible limiting values of foundation and the building are prescribed in 10.8.1.2

2) The foundation must have sufficient load bearing strength to ensure stability and avoid damage to the foundation itself.

10.8.1.2. Permissible deformation of a foundation and the building are determined according to its intended use and requirements for stability, durability and crack-control of the structure

In cases where structures on foundation are not calculated corresponding to uneven deformation of the foundation or there are no special requirements for the building, permissible deformation values of foundation and building are prescribed in Table 10.8.1.

Table 10.8.1
Permissible deformation of foundation and building

Types and specifications of Structures	Deformation limiting values			
	Relative deformation		Min. and max. absolute sagging (cm)	
	Types	value	Types	value
1. Residential and industrial multi-storey buildings with frames				
1.1. Reinforced concrete frames: - with covering walls	relative sagging and differences	0.002	max. absolute sagging S_{igh}	8
- without covering walls		0.001		8
1.2. Steel frames: - with covering walls		0.004		12
- without covering walls		0.002		12
2. Buildings without extra internal forces caused by uneven sagging				
	ditto	0.006	ditto	15
3. Multi-storey buildings without frames, with walls bearing lateral loads				
3.1. Big slabs	deflection or relative deflection	0.0007	average sagging S_{ghtb}	10
3.2. big blocks built of bricks: - without reinforcement		0,001		10
- with reinforcement or bracing		0,0012		15
3.3. independing on walling materials	Lateral inclination I_{gh}			

4. High-rise and rigid structures				
4.1. Mechanical lifting equipment on reinforced concrete base				
a) Production building and silo on the same foundation - Single block structure - Fabricated structure b) Stand-alone silo: - Single block - Fabricated	Lateral & vertical inclination igb	0.003 0.003 0.004 0.004	Average sagging S_{ghtb}	40 30 40 30
c) Separated production building	Lateral inclination	0.003		25
	vertical inclination	0.004		
4.2. Chimneys with heights (H)				
H ≤ 100 m	Inclination I_{gh}	0.005	Average sagging S_{ghtb}	40
100 < H ≤ 200 m		1/2H		30
200 < H ≤ 300 m		1/2H		20
H > 300 m		1/2H		10
4.3. Other structures, 100 m high and rigid				
	ditto	0.004	ditto	20

10.8.1.3. A structure must be designed to take into consideration the structural characteristics, geological and hydro-geological survey data from the location and experiences from construction of a similar structure under similar geological conditions.

10.8.2. Deemed - to - satisfy solutions

10.8.2.1. Solutions

Survey and design solutions are deemed to satisfy if they abide by the following Vietnamese standards:

1) Survey

- TCVN 4419-87 — Survey in construction - Main principles
- TCXD 194-1997 — High-rise buildings - Geo-technical survey
- TCXD 196-1997 — High-rise buildings - Dead state testing and quality control of .... piles
- 20 TCN 80-80 — Soil in construction - Field testing methods by dead loads
- 20 TCN 174-89 — Soil - Dead state penetration testing method
- 20 TCN 160-87 — Geo-technical survey for design and construction of piles
- 20 TCN 88-82 — Piles - Filed testing methods
- 20 TCN 112-84 — Instructions on survey practices using equipment (funded by PNUD) and the use of documents in design.

2) Foundation design

TCXD 45-78 — Building and foundation design standard

TCXD 195-1997 — High-rise buildings- .... Piles design

20 TCN 21-86 — Piled foundation - design standard

Note:

(1) Standards for determining physico-mechanical features of soil in the laboratory are listed in Appendix 10.7.

(2) some important requirements of TCXD 45-78 are quoted and summarized in 10.8.2.2.

10.8.2.2. Instructions

1) When a foundation is designed, consideration must be given to:-

a) the characteristics of the building which is to be built, its structures, loads imposed on the foundation and the intended use or occupancy. Consideration must also be given to the loads caused by the stored materials, equipment placed near the foundation on the wall footing slopes/ramp and on a floor slab directly built on the ground;

b) Adverse effects by the ambient environment including actions by rain and underground water, the seasonal changes of the underground water (at the surface stratum) and changes during construction and use of the building. In case when there is underground or surface water or discharge from factories that may corrode the foundation materials, consideration must also be given to the protective measures against corrosion of the foundation.

2) *The foundation should be calculated according to limit states.*

3) *A foundation is analysed according to the first limit state (strength and stability)*

a) *The foundation is calculated according to the first limit state to ensure* the stability and damage resistance of the foundation.

b) *The strength of a foundation must be calculated to take account of the main and special load combinations.*

c) *The first limit state can be used to analyse a foundation in the following instances:-*

i) The building is subject to constant lateral loads transferred to the foundation such as earth embankments, hydro-power dams.

ii) building built on the edge of batter or near a soil layer with great inclination;

iii) the foundation is of hard stone;

iv) the foundation is of saturated clay or turfy soil

4) The foundation is analysed according to the first limit state: deformation

a) Calculation according to the second limit state is to ensure that deformation shall not exceed the permissible limits and its serviceability and aesthetically requirements of the building.

Calculation according to the tested conditions:

$$S \leq S_{gh} \qquad (10.8.1)$$

$$\Delta S \leq \Delta S_{gh} \qquad (10.8.2) \qquad i \leq i_{gh} \qquad (10.8.3)$$

of which:-

S - Maximum or average sagging magnitudes
ΔS - Relative deflection and unevenness for a framed building, for a building with bearing walls; relative deflection or camber
i - lateral or vertical inclination of a high-rise or rigid building,
S_g, ΔS_{gh}, i_{gh} - the permissible values of the relevant forms of deformation mentioned above and prescribed in 10.8.1.2.

b) The foundation is analysed according to the main load combinations not including the internal forces cased by temperature.

c) A foundation should be calculated when it is not made of hard stone.

d) deformation calculation is deemed to satisfy if average real pressure on the foundation does not exceed calculated pressures on buildings prescribed in Table 10.8.2 which are built on the soils specified therein.

Table 10.8.2 Buildings of which sagging need not be considered

Types of buildings	*Geological conditions*
Buildings with total width of separate strip foundation under bearing structures or the total area of cylindrical foundation not more than twice the difference and satisfy the following conditions:	*The soil consists of horizontal multi strata in the foundation (inclination value not exceeding 0.1) and belongs to one of the following soil types:*
1. Factories and production buildings *with loads on floor not more than 2 ton / M2 and belong to one of the following types:* *- Single-story building not prone to uneven sagging (1), or* *- Multi storey building (up to 6 storey) with column grid with measurements of not more than 6 x 9 m.*	*1. Coarse soil with sand content less than 40% and clay less than 30%* *2. Sand of any coarseness, except compact and semi-compact dust sand.* *3. Compact sand of any coarseness.*
2. Dwelling houses and public buildings *with rectangular floor area without stepped floor, with frames or frames supported by bearing walls or slabs or blocks and:* *- long building consisting of blocks up to 9 storeys high.* *- Tower-type building with total frames up to 14 storey*	*4. Normal-compact sand of any coarseness.* *5. Semi sand, semi-clay and clay with liquid density Ls < 0.5 and porosity e varying between 0.4 - 0.9.* *6. As per type 5 with porosity e ranging from 0.5 to 1*
3. Agricultural buildings and structures *(any forms, number of storey and layout)*	*7. Sandy soil with e < 0.7 with neozen based clay with e < 0.7 and Ls < 0.5 not dependent on the soil profile.*

Note:
(1) For example, steel or concrete frames on single foundation with floor supported by hinges and braces, including crane of 50 ton weight

Appendix 10 1 Different types of loads

Types of loads	*Load composition*
1. Permanent (dead) loads	*1.1. Weight of load-bearing and covering structures of a building*
	1.2. Weight and pressure of soil (filled, embanked) pressure caused by mining activities.
	1.3. Self-induced stress or existing in the structure or foundation, including pre-stress. (For calculation, they will be taken as stress caused by permanent loads).
2. Temporary, long-term loads	*2.1 Evenly distributed loads on floor and staircases: a) In dwelling houses, public buildings, production and agriculture buildings; b) Caused by stored materials and equipment platforms in store room*
	2.2. Weight of : a. Temporary partition, soil and concrete lining under equipment. b. Fixed equipment c. Liquid, solid substances contained in equipment in the operating process d. Water contained in the roof for insulation purpose. e. Dust layer clinging to the structure.
	2.3. Pressure of a. gas, liquid and loose materials in storage tanks and piping system during operation
	b. Surplus pressure and air depression arising as a result of ventilation (e.g. in mining shafts).
	2.4. Vertical load caused by cranes or overhead cranes.
	2.5. Actions of industrial heat caused by fixed equipment.
	2.6. Action caused by moisture changing, shrinkage and magnetic variations of materials.
	2.7. Action caused by foundation deformation without accompanying change of soil structure.

3. Temporary short- term loads	*3.1. Loads caused by:* *a. maintenance equipment , weight of people, materials, and repairing tools.* *b. manufacturing, transport, erection and installation of structures, including loads caused by :* *i) weight of finished products, construction materials temporarily stored.* *(excluding loads at places designated for warehouse or storing purpose).* *ii) temporary loads caused by filled-up soil.* *c. assembling and transport of equipment.*
	3.2. Loads caused by: *a. equipment when being started, stopped, being removed or test-run;* *b. movement of lifting equipment (crane, overhead crane, electric tackle, loading machine...) used during construction and use of building..* *c. goods handling, including goods in warehouses.*
	3.3. Even loads imposing on dwelling house, public house, production house and agricultural house.
	3.4. Wind load
4. Special temporary loads	*Loads caused by :* *4.1. Earthquake* *4.2. Explosion or collision* *4.3. Production incidents, mechanical break - downs* *4.4. action caused by foundation deformation as a result of changing of soil structure (sliding, collapses, sagging, wet...), Caster phenomenon in the area having ground cracks (cleavages) or mining activities.*

Appendix 10 2 Load composition in a load combination

Types of load combination	*Composition of loads in the load combination*			
	Permanent loads	*Temporary long-term loads*	*Temporary short - term loads*	*Special loads*
1. Basic load combination	*Permanent loads*	*Temporary long-term loads*	*Temporary short-term loads*	
2. Special load combination	*Permanent loads*	*Temporary long - term loads*	*Potential temporary short-term loads*	*one of special loads*
2a. caused by explosion or vehicular crashes			*Temporary short -term loads stated in App. 10.1 may be excluded*	
2.b. caused by earthquake			*wind loads excluded*	

Appendix 10 3 Coefficient of load combination ψ

Types of load combination	*Coefficient of load combination ψ when the number of temporary loads is*	
	1	*≥ 2*
Basic load combination	*ψ= 1 for temporary load (Taking full values of temporary loads)*	*ψ = 0.9 for temporary loads (as for a temporary short term load, influence of each load on internal force, displacement is analyzed with:- ψ=1 for load with maximum influence ψ=0.8 for load with second-order influence ψ=0.6 for the load with third-order influence)*
Special loads	*ψ=1 for temporary load (Taking full values of temporary loads)*	*ψ=1 for special load ψ=0.95 for temporary long-term load ψ=0.80 for temporary short-term load (unless other wise stipulated under other regulations)*

Appendix 10.4 Coefficient of load reduction φ

Types of rooms	Types of loads	
	Full loads acting on main and auxiliary beams, floor slab, column, foundation	Longitudinal force used for calculating column, wall, foundation bearing loads of 2 floors or more
Bedroom, dining-room, toilet, kitchen, office, laboratory, boiler, engine room, fan rooms (see 1,2,3,4,5, in Table 10.3.2) with area $A > A_1 = 9m^2$	$\varphi_{A1}=0.4+0.6/(A/A_1)^{0.5}$	$\varphi_{n1}=0.4+(\varphi_{A1}- 0.4)/n^{0.5}$
Reading - rooms, restaurant, exhibition, meeting room, spectator stand, store, workshop, balcony (see 7,8,10, 12,14 in Table 10.3.2) with area $A>A_2 = 36m^2$	$\varphi_{A2}=0.5+0.6/(A/A_1)^{0.5}$	$\varphi_{n2}=0.5+(\varphi_{A2}- 0.5)/n^{0.5}$ (n : number of floors with loads on the section under consideration)

Note:
Load on a bearing wall of a floor can be reduced depending on the bearing area A of the structure (slab, floor, beam) resting on the wall.

Appendix 10 5 List of Standards of materials and testing methods

1. Cement

TCVN 2682-92	*Portland cement*
TCVN 3736-82	*Cement - quick methods for determining strength limits under compression*
TCVN 4029-85	*Cement - physico-mechanical testing methods.*
TCVN 4032-85	*Cement - quick methods for determining strength limits under bending and compression*
TCVN 4787-89	*Cement - specimen selection and preparation*

2. Core materials: sand, stone, pebble

TCVN 1770-86	*Sand used for construction - technical requirements*
TCVN 342-86	*Sand - methods for determining particle (grain) composition and sizes.*
TCVN 1771-87	*Gravel, broken pebble and pebbles used for construction - technical requirements.*
TCVN 1772-87	*Stone and pebbles used for construction*

3. Concrete

TCVN 5540-91	*Concrete - testing and assessment of strength - general provisions.*
TCVN 3105-93	*Heavy-weight concrete mix and heavy concrete - sampling, making and maintaining specimen.*
TCVN 3106-93	*Heavy weight concrete - methods of determining sagging*
TCVN 3107-93	*Heavy-weight concrete mix - Veber method of determining strength*
TCVN 3109-93	*Heavy-weight concrete mix - methods of testing separation of mortar and water.*
TCVN 3113-93	*Heavy-weight concrete - methods of determining water absorbency.*
TCVN 3114-93	*Heavy-weight concrete - methods of determining wearing*
TCVN 3116-93	*Heavy-weight concrete - methods of determining water-proofing*
TCVN 3117-93	*Heavy-weight concrete - methods of determining shrinkage*
TCVN 3118-93	*Heavy-weight concrete - methods of determining compression strength (intensity)*
TCVN 3119-93	*Heavy-weight concrete - methods of determining tension under bending*
TCVN 5726-93	*Heavy - weight concrete - methods of determining prism strength and elastic modulus under static compression.*

4) Steel reinforcement

TCVN 1651-85	*Hot rolled steel reinforcement*
TCVN 3101-79	*Low carbon steel wire reinforcement*
TCVN 3100-79	*prestressed steel wire reinforcement*
TCVN 1765-75	*normal structure carbon steel - strength grading and technical qualifications*

5) Bonding

TCVN 2231-89	*calcium lime for construction*
TCVN 2682-92	*Portland cement*
TCVN 3736-82	*Cement - quick methods for determining strength limits under compression*
TCVN 4029-85	*Cement - physico-mechanical testing methods.*
TCVN 4032-85	*Cement - quick methods for determining strength limits under bending and compression*
TCVN 4787-89	*Cement - specimen selection and preparation*

6) Water

TCVN 4506-87	*water for concrete and mortar*

7) Mortar

TCVN 4314-86	*Mortar - technical specifications*
TCVN 3121-79	*mortar and mortar mix - physico-mechanical tests.*

8) Bricks

TCVN 1450-86	*Hollow clay bricks*
TCVN 1451-86	*solid clay bricks*
TCVN 246-86	*bricks - compression strength tests*
TCVN 247-86	*Bricks - bending strength tests*

9) Timber

TCVN 1072-71	*timber classification by physico-mechanical properties*
TCVN 0356-70	*Sampling - physico-mechanical testing requirements*
TCVN 0358-70	*moisture determination methods in physico-mechanical tests*
TCVN 0363-70	*Timber- tests of strength limits under compression*
TCVN 0364-70	*Timber- tests of strength limits under tension*
TCVN 0365-70	*Timber- tests of strength limits under static bending*
TCVN 0367-70	*Timber- tests of strength limits under sliding and searing*
TCVN 0368-70	*Timber- tests of split - resistance*
TCVN 0369-70	*Timber- tests of stiffness*
TCVN 0370-70	*Timber- tests of elastic deformation specifications*
TCVN 1553-74	*Timber- tests of traction (holding capacity) of nails and screws*
TCVN 5505-91	*Timber maintenance - general requirements*
TCVN 3135-79	*Timber maintenance - the use of BQG1 in the protection of wooden furniture against termites and woodeaters*

Appendix 10 6 Classification of timber groups by stress specifications (TCVN 1072-71)

No.	Vietnamese names	Latin names
	Group 1	
	A	
1	Gie cuong	Quercus pseudocomea A.Cher
2	Soi da	Lithocarpus sp.
	B	
3	Khuong tau	(Ha Tinh)
4	Lim xanh	Erythrophloeum fordii Oliver
5	Sen	Madhuca pasquieri H.J.Lam
6	Vang anh	Saraca dives Pierre
7	Tau muoi	Vatica fleuryana Tardieu
	C	
8	Binh linh	Vitex pubescens Vahl
9	Kien kien	Hopea pierrel Hance
10	Ninh	Crudia chrysantha pierre
11	Vap	Mesua Ferrea Linn
12	Xoay	Dialium cochinchinensis Pierre
	Group II	
	A	
1	Ca oi	Castanopsis Tribuloides (Lindl) A. DC.
2	Cong chim	(Ha Tinh)
3	Gie den	Castanopsis sp.
4	Gie thom	Quercus sp.
5	Gie soi	Quercus sp.
6	Han	(Yen Bai)
7	Ke	Nephelium sp.
8	May coong	(Tuyen Quang)
9	Vay oc	Calophyllum sp.
10	Vat xanh	(Tuyen Quang)
11	Xoan nhu	Spondias sp.
	B	
12	Dinh vang	Markhamia sp.
13	Goi gac	Aphanamixis grandifolia Bl.
14	Gie qua cau	Quercus platycalyx Hickel et A. Camus
15	Gie mo ga	Pasania echidnocarpa Hickel et A. Camus
16	Ke da	Markhamia sp.
17	Lo nghe	(Ha Tinh)

	C	
18	Gioi	Talauma gioi A. chev
19	Huynh	Tarrietia javanica Bl.
20	Sang ot	Xanthophyllum sp.
21	Vai thieu	Nepbelium lappaceum linn
	Group III	
	A	
1	Cha san	(Tuyen Quang)
2	Chong bong	(Ha Tinh)
3	Cho chi	Parashorea stellata Kurz
4	Hong mang	Pterospermum diversifolium Bl.
5	Khao vang re	(Tuyen Quang)
6	Long bang	Dillenia sp.
7	Ma noi	(Hoa Binh)
8	Mo do	(Tuyen Quang)
9	Que rung	Cinnamomum sp.
10	Sang	Pometia tomentosa Teysm. et Binn.
11	Vang kieng	Nauclea purpurea Roxb.
12	Vai guoc	Nephelium sp.
	B	
13	Bo hon	Sapindus mukorossi Gaertn.
14	Gom	(Ha Tinh)
15	Gom ac	(Ha Tinh)
16	Gie gai	Castanopsis sp.
17	Hoang linh da	Peltophorum sp.
18	Lom com	Elaeocarpus sp.
19	Nang	(Ha Tinh)
20	Nhoi	Bischofia trifoliata (Rooxb). Hook.f.
21	Voi thuoc	Schima sp.
	C	
22	Boi loi vang	Litsea vang H. Lec.
23	Cong tia	Calophyllum saigonensis Pierre
24	Cho vay	Shorea thorelii Pierre
25	Goi tia	Amoora gigantea Pierre
26	Re mit	Actinodaphne sp.
27	Vai thieu	Nephelium lappaceum linn.
	Group IV	
	A	
1	Bo quan	Flacourtia cataphracta Roxb.
2	Hoang linh xo	Peltophorum sp.
3	Cang lo	Betula alnoides Ham.

4	Cheo tia	Engeldhartia chrysolepis Hance
5	Dung san	Symplocos sp.
6	Dung giay	Symplocos sp.
7	Gie trang	Quercus poilanei Hickel et Camus
8	Gat huong	Dysoxylum caulifilorum Hiern
9	Goi te	Dysoxylum sp.
10	Ke lua	Markhamia sp.
11	Khao	Lindera sp.
12	Khoai da	(Tuyen Quang)
13	Ma	Vitex glabrata R. Br.
14	Mau cho la nho	Knema corticosa Lour.
15	Mi	Lysidice rhodostegia Hance
16	Nao	(Yen Bai)
17	Nhe	Cryptocarya sp.
18	Re xanh	(Tuyen Quang)
19	Soi phang	Castanopsis sp.
20	Sau tia	Dracontomelum duperreanum Piesre
21	Xoan dao	Pygeum arboreum Endl et Kurz
22	Goi nep	Aglaia sp.
23	Phay	Duabanga sp.
	B	
24	Goi trang	Aphanamixis sp.
25	Ngat	Gironniera subaequalis Planch.
26	Re gung	Cinnamomuni sp.
	C	
27	Cong	Calophyllum balansae Pitard
28	Sang dao queo	Hopea ferrea Pierre
29	Viet	Payena sp.
	Group V	
	A	
1	Bo ket	Gleditschia australis
2	Don	(Ha Tinh)
3	Hoa	(Tuyen Quang)
4	Khao luay	Machilus sp.
5	Xoan moc	Toona Febrifuga Roem.
6	Phop	(Tuyen Quang)
7	Rang rang mit	Ormosia balansae Drake
8	Thoi chanh	Marlea begoniaefolia
9	Thoi ba	Alangium sinensis Rehd
10	Tram canh	Canarium sp.
11	Tram den	Canarium nigrum Engi.
12	Tram	Syzygium brachyatum Miq.

13	Vang trung	Endospermum sinensis Benth
14	May thu lu	Schima wallichii choisy
15	Muong trang	Cassia sp.
	B	
16	Rang rang hom	Ormosia sp.
17	Tram trang	Canarium album Roeusch
18	Trut	(Ha Tinh)
	C	
19	Thong vang	Podocarpus imbricatus Bl
20	Re do	Cinnamomum tetragonum A. Chev.
21	Sang trang	Lophopetalum Duperreanum
	Group VI	
	A	
1	Dua	-
2	Gang	Randia sp.
3	Lai nha	Aleurites moluccana (Linn) Willd
4	Mac nieng	Eberhardtia tonkinensis H. Lee.
5	Mau cho la to	Knema conferta Warbg
6	Nuc nac	Oroxylum indicum (Linn) Vent.
7	Sang vi	-
8	Sung ve	Ficus sp.
9	Thanh that	Ailanthus malabarica DC.
	B	
10	Dong den	Mallotus sp.
11	Re tanh	-
	C	
12	Sung	Ficus sp.
13	Coi	Pterocarya tonkinensis Dode
14	Dau gia xoan	Allcspondias lakonensis (Pierre) Stapf
15	Gon	Ceiba pentandra (Linn) Gaertn.
16	Re huong la be	Cinnamomum albiflorum Nees
17	Sang mau	Knema sp.
18	Bung	Tetrameles nudiflora R. Br.
19	Hu	Mallotus sp.

Note:
Each group is devided by parts: A,B,C for distinguishing the accurate data

Appendix 10 7 Vietnamese standards for soil mechanics tests

TCVN 683-79	*Soil in construction - specimen collection, packing, transport and safe-keeping*
TCVN 4195-86	*Soil for construction - Gravity density tests in laboratory*
TCVN 4196-86	*Soil for construction - Laboratory tests for moisture and absorbency*
TCVN 4196-86	*Soil for construction - laboratory tests for plasticity and yield limits*
TCVN 4198-86	*Soil for construction - Laboratory tests for grain composition*
TCVN 4199-86	*Soil for construction - Laboratory tests for searing -resistance on sectional searing machine*
TCVN 4200-86	*Soil for construction - Laboratory tests for compression and sagging without horizontal (side) expansion*
TCVN 4201-86	*Soil for construction - Laboratory tests for standard compactness*
TCVN 4202-86	*Soil for construction - Laboratory tests for volume density*
20 TCN 74-87	*Soil for construction - methods of editing, statistics, identifying characteristics*

CHAPTER 11
FIRE PROTECTION

Objective

The objective of this Chapter is to :-
1. safeguard the occupants of a building in case of fire;
2. facilitate and to ensure safety for the effective fire-fighting and rescue operations; and
3. contain and minimize the possible damage of the fire to the adjoining buildings and the surrounding environment.

Article 11.1. General provisions for fire safety

11.1.1. A building is to be constructed to ensure safety in fire prevention and fighting which include:

a) fire-resistance of structures;
b) fire-separation;
c) evacuation; and
d) fire safety and control systems.

Note:
Provisions on fire resistance, separation, evacuation, fire safety and control systems are provided for in 11.4.1, 11.5.1.,11.6.1., 11.7.1., 11.8.1. and 11.9.1.

11.1.2. A fire safety approval from a competent fire authority is required for the appraisal and approval of design for a building which has a high fire or explosion hazard or accommodates a large number of people, or for a big building.

Article 11.2. Deemed-to-satisfy solutions

11.2.1. A design that is found to be in conformity with the following Vietnamese standards shall be deemed to satisfy the requirements for fire safety:

- TCVN 2622 - 95 " Fire safety for buildings and construction works - Design requirements'

Note:
The important prescriptions in TCVN 2622-95 are quoted as deemed-to-satisfied solutions in clauses 11.3 to 11.4 below.

11.2.2. International standards, designs and equipment must be adopted as regards buildings which need special fire safety requirements such as buildings with rise of 10 storeys or more, important office buildings, international hotels

Article 11.3. Building classification according to fire safety requirements

Buildings are classified according to their respective fire safety requirements in Table 11.3.1.

Table 11.3.1.Building classification according to fire safety requirements

Building functions	Building characteristics	Group
Dwelling house : - Sole occupancy - Condominium - hotel, guest-house		 1a 1b 1c
Commercial buildings: - Market, shop, restaurant		 2
Cultural buildings: theater, cultural house, meeting hall cinema	300 seats or less 300 - 800 800 seats or more	3a 3b 3c
Medical buildings: hospital, maternity hospital, clinic, sanitarium	 50 beds or less 50 beds or more	 4a 4b
Educational buildings	- Nursery, kindergarten -School, vocational training school, University.	5a 5b

Building functions	Building characteristics	Group
Office buildings		6
Production buildings warehouses	buildings in which inflammable and explosive materials are used or stored with varying degrees of risk as follow: - fire and explosion - fire and explosion - fire - Without risk of fire : under heated condition under cold condition - explosion	 7A 7B 7C 7D 7E 7F

Note:
(1) Classification of fire and explosion risks is specified in table 11.3.2

Table 11.3.2 Classification of production buildings, warehouses according to levels of risk of fire and explosion

Building groups	Production classes	Characteristics of substances and materials in the production process
7A	A: Risk of fire and explosion	1) When liquid and gaseous substances mentioned below may form explosive compound with volume exceeding 5% of air volume contained in the room : a)substances, when fired, have flammable explosive concentration lower level less than or equal to 10% of air volume, and b) Liquids with flash temperature less than 28°C 2) Substances which may cause explosion and fire when they react with each other, or with water or with atmospheric oxygen.
7B	B Danger of fire, explosion	When liquid, gaseous, dusty or fibre substances may form explosive compound with volume exceeding 5% of air volume contained in the room : a. Substances, when they are fired, have lower limit of concentration of flammable, explosive less than or equal to 10% of air volume, and b. Liquid with flash temperature from 28 to 61°C

Building groups	Production classes	Characteristics of substances and materials in the production process
		c. Liquid substances are heated in production condition to the temperature equal to and higher than the flash temperature. d. Flammable dust or fibre accumulated to lower explosive limit equal to or less than 65g/m^3
7C	C Danger of fire	a. Various types of liquid with flash temperature higher than 61^oC b. Flammable dust or fibre with lower explosive limit, higher than 65 g/m^3, c. Flammable solid substances materials, d. Substances only cause fire when they react with water, air or react with each other.
7D	D Without danger of fire in hot state	a. Non - flammable substances and materials in hot, red - hot or melting state, that create spark and flame in machining process accompanying heat radiation b. Solid, liquid and gaseous substances are fired or used as fuel.
7E	E without danger of fire in cold state	Substance and materials non-flammable in cold state
7F	F Danger of fire, explosion	a. Flammable gases have not been liquefied. b. Dust with danger of explosion has quantity that can create explosive compound with volume exceeding 5% of volume of air contained in the room where only explosion (not accompanying fire) can happen. c. When explosive substances (not accompanying fire) react with each other or with water or oxygen contained in the air

Article 11.4. Fire resistance of buildings

11.4.1. Fire resistance requirements

11.4.1.1. In the event of fire, building elements must maintain stability longer than the time stipulated for evacuation, escape, rescue and fire fighting operations.

11.4.1.2. Fire resistance provision in 11.4.1.1. must meet the following requirements:

a) Fire resistance levels of buildings must be suitable to the functions, scales and the risks of fire and explosion;
b) Building elements must:
   i) have fire resistance periods appropriate to the fire resistance levels of the building and the building elements;
   ii) fire resistance periods of load bearing structures must not be lower than those of the structures they support;
   iii) the collapse of elements of lower fire resistance periods must not result in the subsequent collapse of elements of higher fire resistance periods.

11.4.2. Deemed - to - satisfy design

11.4.2.1. *Fire resistance levels of buildings*

Fire resistance levels of buildings are classified into 5 levels appropriate to the fire resistance periods of building elements as follows (Table 11.4.1).

Table 11.4.1.
Fire Resistance Levels of Buildings

Building elements	***Fire Resistance periods (minute) with fire resistance levels***				
	I	***II***	***III***	***IV***	***V***
Bearing column and wall, staircase wall	*150*	*102*	*120*	*30*	-
Floor (bearing components)	*60*	*60*	*45*	*15*	-
Bearing structures of the roof	*30*	*15*	-	-	-
Covering wall, partition	*30*	*15*	*15*	*15*	-
Stairs	*60*	*60*	*60*	*15*	

Note:
a) Fire resistance levels of other buildings are mentioned in Appendix 11.1
b) Fire resistance periods are determined according to:
   i) international standard testing; or
   ii) approved test results produced by international standard laboratories.
c) Fire resistance periods of other building elements are specified in Appendix 11.2.

11.4.2.2. *The maximum rise of a building appropriate to its fire resistance level*

The mximum rise of a building must be appropriate to its fire resistance level, function and scale as specified in Table 11.4.2.

Table 11.4.2 Maximum number of storeys of buildings appropriate to their fire resistance levels

Building types	*Group*	*Maximum number of storeys & FRL*				
		I	*II*	*III*	*IV*	*V*
Commercial buildings	*2*			*3*	*2*	*1*
Cultural buildings:						
- 300 seats or less	*3a*				*1*	*1*
- 300 - 800 seats	*3b*			*2*		
- 800 seats or more	*3c*		*N/A*			
Medical buildings/hospitals						
- 50 beds or less	*4a*		*N/A*		*1*	*1*
- 50 beds or more	*4b*		*N/A*	*2*		
Creche / Kindergartens	*5a*					
- 50 pupils or less					*1*	*1*
- 50 pupils or more			*2*	*2*		
Educational buildings /schools	*5b*					
- less than 360 seats						
- 360 -720 seats						
	7A	*6*	*6*			
	7B	*6*	*6*			
	7C	*N/A*	*N/A*	*3*	*1*	*1*
Production buildings, warehouses	*7D*	*N/A*	*N/A*	*3*	*1*	*1*
	7E	*N/A*	*N/A*	*3*	*1*	*1*
	7F	*Load bearing elements must be fire-proof*				

Note:
N/A means Non-Applicable

Article 11.5 Fire separation

11.5.1. Fire separation requirements

11.5.1.1. A building must be so designed and constructed to ensure, in the event of fire, the effective prevention of vertical and horizontal spread of fire and smoke to adjoining fire compartments or buildings within a specified period of time so that: -

a) occupants have adequate time to evacuate safely without being harmed by fire and smoke;
b) fire brigade personnel have adequate time to undertake search and rescue and fire fighting operations safely and effectively;
c) adjoining buildings and property shall not be damaged; and
d) the toxic and harmful substances contained in the building shall not leek or escape to the outside environment when they catch fire.

11.5.1.2. Fire compartmentation

For fire separation purpose, a building can be divided into fire compartments separated by fire separating elements and with floor areas appropriate to the intended use, fire hazard, fire resistance level of the building and the sprinkler system to be installed within the building.

11.5.2. Deemed - to - Satisfy solutions

11.5.2.1. Maximum floor areas of fire compartments

Maximum floor areas $F_{max.}$ of fire compartments of buildings are prescribed in Table 11.5.1

Table 11.5.1
Maximum floor area $F_{max.}$ (m^2) of a fire compartment

Types of buildings	No of storeys	Building groups	Fire resisting levels					Remarks
			I	II	III	IV	V	
Civil buildings								
Dwelling houses, public buildings	Any 1 2	1,2,3, 4,5,6	2.200		1.800	 *1.400* *1000*	 *1.000* *1800*	
Factories								
- Class A and B (excluding chemical s, petrol and gas processing and production)		7A, 7B	N/A	N/A				*Area Fmax is increased by 100%. If sprinkler system is installed*
Class A (chemicals, petrol)	1 2 ≥ 3	7A	N/A N/A N/A	N/A 5.200 3.500				*$F_{max.}$ increased by 25% if fire detector is installed*
Class B (chemical petrol)	1 2 ≥ 3	7B	N/A N/A N/A	N/A 10400 7.800				
Class C	1 2 ≥ 3	7C	N/A N/A N/A	N/A N/A N/A	5.200 3.500 2.600	*2.600* *2.600* *2.600*	*1.200* *1.200* *1.200*	
Class D	1 2 ≥ 3	7D	N/A N/A N/A	N/A N/A N/A	6.500 3.500 1.500	*3.500* *3.500* *3.500*	*2.500* *2.500* *2.500*	
Class E	1 2 ≥ 3	7E	N/A N/A N/A	N/A N/A N/A	7.800 6.500 3.500	*3.500* *3.500* *3.500*	*2.600* *2.600* *2.600*	
Class F		7F	N/A					

Note :

N/A : Area of fire - compartment is not prescribed.

11.5.2.2. Fire resistance periods of fire separating elements

Fire separating elements must be made of fire-proof materials with minimum fire resistance periods as prescribed i table 11.5.2.

Table 11.5.2.
Minimum fire resistance periods of fire separating elements

Fire separating elements	Minimum FRP (minutes)
- Fire separating wall - Openings on fire - separating wall	150 70
- Fire separating partition	45
- Openings in fire separating partition - Fire separating door of the buffer room in production building of class A, B, C - Door of attic, fire - protection femerell	40 40 40
- Fire protection floor in buildings with FRLs of: - Level I - levels II, III, IV	 60 45

11.5.2.3. Structures of fire separating walls

Fire separating walls must: -

a) extend from the subbase or foundation to the top of the building, and is carried through all structures and must have a vertical projection over the roof of at least:

Materials of roof elements and attic	The over-projection height of walls
- there is one combustible element - there is one non-combustible element - Roof is non-combustible	60 cm 30 cm 0

Note:
Fire separating walls can be built directly on the building frame provided FRP of supporting frame must not be lower than FRP of fire walls.

b) be carried through to the outer walls and project out at least by 30 cm if walls are made of combustible or not easily combustible materials. No horizontal projection is required if walls are made of non-combustible materials.

c) maintain stability in the event of damage from one side of wall caused by fire on the floor, roof or other structures.

11.5.2.4. Fire wall elements

a) Openings on a wall adjoining a fire wall must be positioned at least 4 m horizontally away from the adjoining line and a door or window leaf must have FRP of at least 150 minutes.

b) Smoke and air ducts can be installed inside a fire wall if the contact point between the wall and pipes or ducts must be sealed by motar and FRP of the wall must not be less than 150 minutes.

11.5.2.5. Fire separating floor

A fire separating floor must:

a) be tightly sealed from external walls by non-combustible materials; or

b) be carried through walls or glass parts if external walls can spread fire.

11.5.2.6. Openings

a) Fire separating openings (door, window, gate, doorway) and fire protections valves can be installed in fire separating elements.

b) The total areas occupied by openings in a fire separating element must not exceed 25% of the total area of that element.

c) Doorway and fire door must be self- or automatic closing. A fire window must not be automatically opening.

11.5.2.7. Fire separation in service ducts and shafts

a) Ducts, shafts or pipes used for the transportation of flammable and combustible substances and materials (gas, liquid, solid or particles) must not be installed in fire walls, floor or fire separating areas.

b) Ducts, shafts or pipes used for the transportation of flammable substances and materials (excluding water and steam pipelines) cutting through fire separating walls, floors or areas must be installed with automatic shutters to prevent the spread of fire through those ducts and shafts in the event of fire.

c) The building elements covering the lift shaft or lift mechanical room, the service ducts or wells must have fire walls, floor or partition with FRP of more than 100 minutes. If covering walls for a lift shaft cannot be installed, a buffer chamber must be built with fire walls of FRP of at least 45 minutes.

11.5.2.8. Fire separation in mechanical service rooms and fire control places

Mechanical service and fire control rooms must be separated from other parts of the building by fire walls and floor with FRP of 120 minutes and must have direct exit to the outside.

Article 11.6. Escape

11.6.1. Provision for escape

11.6.1.1. A building must have exit(s) to ensure:-

a) All occupants of a building can have adequate time to evacuate to a safe place without difficulty;

b) fire fighting personnel can undertake rescue and fire fighting operations without obstruction.

11.6.1.2. the number of exits and the distances from exits to assembly place must be appropriate to: -

a) Fire hazards of the building;
(Building groups according to fire safety requirements)

b) Height and FRL of the building; and

c) The fire alarming and distinguishing systems to be installed in the building.

11.6.1.3. Emergency exits must:

a) be rationally and dispersally positioned and must have appropriate lengths and width to ensure safe and speedy evacuation of occupants;
b) be safely and easily operated without any obstruction in the course of escape;
c) be easily located and installed with visible signs, and if required, an audible sound device; and
d) be adequately lit and ventilated.

11.6.1.4. Warning signs installed at exits must : -

a) be highly visible at appropriate places to ensure that the occupants be warned of dangers;
b) be easy to understand, showing escape route to safety;
c) be visible even in the event of main power failure in the lighting system.

11.6.1.5. Emergency lighting

Luminance of at least one Lux at the floor level must be maintained along the entire escape route for 1.5 times the time needed for all occupants to escape to safety.

11.6.1.6. Smoke control

a) Measures must be taken to ensure that smoke caused by a fire shall not interfere with the whole escape passage to safety places;
b) If air conditioning and mechanical ventilation systems are installed, they must ensure the effective prevention of possible circulation of smoke and flame in the fire compartment.

11.6.2. Deemed - to - satisfy solutions

11.6.2.1. Number of and distances to exits

a) the number of exits must not be less than 2 except for Group 1a buildings. If a sprinkler system is installed, only one exit is required.

b) the maximum distances to exits are prescribed in tables 11.6.1 and 11.6.2.

Table 11.6.1 Maximum distances from assembly point to the nearest exit in residential buildings and ancillary buildings in factories (m)

Types of buildings	Building group	From a room between 2 escape-ways with FRL				From room to a central corridor or a blind hallway			
		I&II	III	IV	V	I&II	III	IV	V
1.Dwelling Houses	1b 1c	40	30	25	20	25	20	15	10
2. Public buildings									
Hospitals	4	30	25	20	15	25	15	12	10
Nursery, kindergarten	5a	20	15	12	10				
Others		40	30	25	20				
3. Ancillary buildings in factories		50	30	25	20				

Table 11.6.2
Maximum distances from work places to nearest exits in a workshop (m)

Features of factories		Group	Max. distances relative to FRL			
Class	No of storeys		I or II	III	IV	V
Class A	1 storey ≥ 2	7A	50 40			
Class B	1 storey ≥ 2	7B	100 75			
Class C	1 storey 2 ≥ 3	7C	Non- Applicable	80 60 60	50 30 -	50 - -
Class D	1 storey 2 ≥ 3	7D		100 60 60	50 40 -	60 - -
Class E	1 storey 2 ≥ 3	7E		100 75 75	60 50 -	50 40 -
Class F	1 storey 2 ≥ 3	7F	100 m 80 m 75 m			

Note:
For a room opening to a blind hallway, the path of travel from the room door to the exit to the outside or to a lobby or staircase must not be longer than 25 meters.

11.6.2.2. Width of escape-ways

a) Minimum width of escape-ways
The minimum clear width of escape-ways are prescribed in Table 11.6.3.

Table 11.6.3. Minimum clear width of passageways

Escape-ways	Minimum clear width (m)	Remarks
Passageways	1	The width of passageway leading to the separate working place can be reduced to 0.7m
Corridor/hallway	1.4	- In a dwelling house : can be reduced to 1.2m when the length of corridor section does not exceed 40m.
		- In hotels, schools : The width of central corridor must not be less than 1.60m.
Doorway	0.8	
Stairway	1.05	- Between parallel stairways there must be minimum gap of 100 mm.
		- The width of a stairway, landings to a basement or attic floor and escape stairway used for less than 60 people, can be reduced to 0.90 m.
Stair landings	equal to the width of the stairway	The width of a landing in hospitals, maternity hospitals shall not be less than 1.90m. The width of stair landing leading to the lift with shutter shall not be less than 1.60m.
Outdoor fire staircase used as a second escape-way	0.7	Must have handrail, and its gradient shall not be less than 60^{o} to ensure easy and safe landing by people.

b) The maximum number of occupants on a building floor (excluding ground floor) must be taken into account when determining the total width of exit door, staircase and passageway in a public building or factory according to the requirements in table 11.6.4.

Table 11.6.4 Requirements for the total width of exit door, staircase and escape-ways in a public building and factory

Building types	Min. width m wide / 100 people
Public buildings, factories: - two storeys or less - more than two storeys	 0.8 1,0
Auditorium: - FRL I, II - FRL III, IV, V	 0.55 0.8

c) The calculated width of an escape-way is the central corridor taken as its width less 0.5 time the width of the door leaf if the door is on either side of corridor or less 1.0 time the width of a door leaf if there are doors on both sides of corridor.

11.6.2.3. The height of escape-ways

The clear height of a door on the escape-way must not be less than 2 meters. The minimum height of doorways and passageways leading to a basement, mechanical room or an unoccupied room can be 1.9 meters.

11.6.2.4 Positioning of exits

a) In a room or compartment requiring two or more exits, the exits must be properly spaced out, each having equal escape probability.

b) In a workshop :

i) escape-ways must not go through buildings or workshops under classes A or B or their buffer rooms;

ii) glass cubicles must not be constructed on the escape-way, except buildings under classes D and E with FRL II.

11.6.2.5 On the escape-way, it is not permitted to construct:

a) Spiral stairway, tapered treads;
b) Sliding, roller shutter, tilt-up or revolving doors;
c) build-in cabinets, except for service boxes, hydrant boxes.

11.6.2.6. Escape staircase

a) In an escape staircase, it is not permitted to construct:
i) any room for any purpose;
ii) gas, steam, flammable liquid piping and power lines, except for power supply line for staircase and corridor lighting.

b) On the walls of staircase, it is not permitted to build:
i) any protruding objects below the 2.2 meters point calculated from the treads, landings except for handrails and balustrades.
ii) any opening except doors and windows for ventilation and lighting purposes.

c) Fixed glass cubicles can be built on the outer wall of staircase but there must be windows with areas not less than 1.2 square meters for each storey.

11.6.2.7. Doorways and doors on escape-ways;

a) doors must be open in the direction of egress;

b) The following types of doors can be open in the direction of access:

i) door that is open to a balcony, courtyard, landing of an outside escape staircase,
ii) passageway from a room accommodating not more than 15 people,
iii) passageway of a warehouse of not more than 200 square meters,
iv) passage way of a sanitary room.

c) An exit door to the outside of a building must not be fitted with locks or latches on the outside. It must be openable from inside without a key.

d) Doors providing access to a common corridor, an exit staircase must be fitted with automatically closing devices.

11.6.2.8. Smoke control

a) A building must operate as a smoke control system under fire conditions to allow smoke to escape along pre-determined ducts to minimize the spread of smoke to compartments not affected by fire or escape-ways to facilitate evacuation and fire-fighting operations..

b) *Smoke control can be done by means of:-*

i) natural ventilation allowing for smoke and hot air to escape through window and air ventilation openings;
ii) air handling and supply systems using controlled valves, smoke exhaust fans and ducts.
iii) pressure control and anti-smoke system

c) Natural smoke vents must be evenly positioned and easily operated. Smoke vents on the ground floor must be easily smashed.

d) For buildings of more than 10 storeys, their corridors must be divided compartments of not more than 60 meters long with separation partitions of FRP of at least 15 minutes. Corridors, buffer rooms, lobbies must be fitted with ventilation systems and automatic smoke valves.

e) Smoke exhaust vents must not be positioned in places that may create turbulent whirl wind.

Article 11.7. Decorative, finishing and insulating materials

Interior decorative and finishing materials used for walls, ceilings, and floors and any suspended elements of a building must be able to prevent the spread of fire and the generation of toxic gases, smoke or heat appropriate to:-

a) the length of the exit path of travel;
b) the number occupants frequently in the building;
c) fire hazard levels; and
d) fire safety and fighting equipment and system.

Article 11.8. Fire alarm systems

11.8.1. Requirements for fire detection and alarm systems

A fire alarm system must: -

1. be appropriate to the function, the height and floor area of a building.

2. immediately detect a fire and send audible or clear warnings to occupants so that they can act in an appropriate way;

3. operate accurately and reliably under all circumstances, i e :

   a) to ensure trouble free operations, free from interference from other systems or equipment; and

   b) to operate without partial or complete failure caused by fire prior to generating fire alarms.

11.8.2. Deemed - to - satisfy solutions

11.8.2.1. Solutions in conformity with the following standards are deemed to satisfy the requirements for fire detection and alarm.

- TCVN 5738 - 93 "Fire alarm systems - Technical requirements"

Note:
The prescriptions of TCVN 5738 - 93 are referred to in clauses 11.8.2.2. to 11.8.2.4. below

11.8.2.2. A central fire alarm board must:

a) have reserved channels and areas not less than 10%;

b) be located at places which are always attended by fire superintendents 24 hours a day. In the absence of fire personnel, the central fire alarm board must be able to transmit fire and emergency warnings to a 24 hours day manned center and measures must be taken to prevent interference with its normal operation by unauthorised person(s);

c) have direct telephone connection to a fire brigade or fire monitoring center;

d) have different tones for the fire alarm system and mechanical fault warnings of equipment ;

e) fire detection sensors connected to the fire alarm board must be compatible to the whole system with respect to the input voltage, forms of signaling, methods of detection, and circuit monitoring devices ...; and

g) must be properly earthen.

11.8.2.3. A break-glass fire alarm points must:

a) be located at 1.5 meters from the ground or floor level;
b) be located inside a building along escape-ways (corridors, stairways, passageways) or even in rooms at intervals of not more than 50 meters; and
c) be located outside a building at intervals of not more than 150 meters and must have highly visible signs and be properly lit by artificial lighting.

11.8.2.4. A fire detection and alarm system must have back-up battery of capacity sufficient to maintain normal operation of the equipment for at least 24 hours on stand-by mode and three hours under fire conditions.

Article 11.9. Fire control system

11.9.1. General requirements

A fire control system must be able to control and extinguish a fire effectively in accordance with the following requirements:

A fire control system must:-

1) be in conformity with -

a) fire hazards;
b) nature of fire;

c) volume of combustible or flammable materials contained in the building; and
d) building use, functions and FRLs

2) ensure -

a) adequate discharge rates appropriate to the flammable and fire extinguishing materials and areas and volume under fire to be extinguished;
b) adequate pressure to conduct fire extinguishing agents to the fire source;
c) required level of reserved fire fighting agents.
d) complete coverage of fire extinguishing agents over the materials and areas under fire and adequate density for volume fire;
e) uninterrupted operation powered by continuous mains or stand-by power supply.

3) be regularly maintained and trial tested to ensure fire control effectiveness and readiness as required.

11.9.2. Requirements on portable fire extinguishers

1. Portable fire extinguishers must be installed inside the buildings in conformity with the fire safety requirements.
2. Portable fire extinguishers must be installed near access and egress points and at easily identified and accessible places and must have clear indications even without other lighting.

11.9.3. Fire water supply inside buildings

1. Fire water supply must be installed inside buildings specified in Table 11.9.1.
2. Fire hydrants.
   Fire hydrants must be so installed to ensure the following requirements:

   a) uniform diameters of fire hoses and couplings and length of hose reels are used within a building;

   b) fire hydrants must be installed at highly visible and easily accessible places (e.g. near entrances, landings, lobby, corridors) at least 1.25 meters from the floor level.

Table 11.9.1 Fire water supply in buildings

Type of buildings	Fire water supply required	Fire water supply **not** required
Dwelling houses: - private - condominium Hotel, restaurant Office School Theatre, cinema, meeting hall, club Nursery, kindergarten, hospital	 ≥ 3 storeys ≥ 5 storeys ≥ 5 storeys ≥ 6 storeys ≥ 3 storeys ≥ 300 seats ≥ 5.000m^3 volume	
Factory	except cases specified in the right column	- flammable or explosive materials when in contact with water - FRL I, II with equipment, materials, semi-finished products and finished products of non-flammable materials. - FRL III, IV, V, classes of production O, E, and ≤ 1000m^3 volume. without mains water supply, supply water for living and water intake from lake and river
Warehouse, Ancillary buildings in factories	≥5.000m^3 volume	- Warehouses made of non-combustible materials, and containing non-flammable goods. - Without mains water supply and located near lake or river - pump and water treatment stations. - Public bath and laundry

11.9.4. Outdoor fire-fighting water supply systems

As per provision in Article 5.16 Chapter 5

11.9.5. Deemed - to -satisfied solution

11.9.5.1. *Fire extinguishing agents*

Agents effective for various fire sources are identified in table 11.9.2

Table 11.9.2
Effectiveness of fire-extinguishing agents with respect to types of fire

Type of fire		*Fired substances*	*Fire-fighting substance*					
			Water	*Light foam*	*medium heavy foam*	CO_2 *gas*	*BC powder*	*ABCD powder*
A	*A1*	*Smoldering solid substance (wood, paper, coal, cloth)*	+	+	+	-	-	+
	A2	*Non -smouldering solid substance (plastics)*	+	+	-	-	-	+
B	*B1*	*Liquid indissoluble in water (gasoline, ether, oil, paraffin)*	-	+	++	++	+	++
	B2	*Liquid dissoluble in water (alcohol, methanol, glycerin)*	-	-	+	++	+	
C		*Gaseous substance (methane, hydrogen, propane)*	-	-	-	+		++
D	*D1*	*Light metal (aluminium, magnesium)*	-	-	-	-	-	++
	D2	*Alkali metal (Natrium, potassium...)*	-	-	-	-	-	-
	D3	*Organic compound containing metal*	-	-	-	-	-	-

Note:

++	*: Very effective*	*Light foam :*	*Foam with high multiple of dilatation*
+	*: Suitable*	*Average foam :*	*Foam with average multiple of dilatation*
-	*: Unsuitable*	*Heavy foam:*	*Foam with low multiple of dilatation*
		BC powder :	*Powder used for fighting the fire with symbol B,C*
		ABCD :	*Powder used for fighting the fire with symbol A,B,C,D.*

11.9.5.2. Indoor fire fighting systems

a) Fire fighting water flow
Fire water flow must meet the following requirements:

i) each point in a building must be reached at least by 1 or two hydrants as prescribed in table 11.9.3

ii) The required flow for each hydrant is 2.5 l/second;

iii) water pressure at each hydrant must be able to maintain a continuous water jet of 6 m long at the furthest and highest point in the room.

Table 11.9.3. Number of hydrants reaching a certain point in the building

Building groups	one hydrant for each point	two hydrants for each point
1	25,000 m^3 or less volume m^3	25,000 m^3 or more volume m^3
2		
4		
5		
6 (*)		
3	Less than 800 seats (sub-group 3a, 3b)	More than 800 seats (sub-group 3c)
7	-7C with volume of up to 1,000m^3 -7D, 7E	Remaining cases

Note:
(*) There must be at least two hydrants for each point in laboratories and research institutions

11.9.2.3. Outdoor fire fighting systems

a) Fire fighting water flow for outdoor systems is prescribed in table 11.9.4.

Table 11.9.4 Water flow for outdoor fire-fighting system

Building group	FRLs	Water flow (l/s) relative to building volumes ($1000m^3$)				
		Up to 3	3 - 5	5 - 20	20 - 50	Over 50
1,2,3,4,5,6 7A, 7B, 7C	I and II	10	10	15	20	30
1,2,3,4,5,6, 7C	III	10	15	20	30	40
	IV and V	15	20	25		
7D. 7E	III	5	10	15	25	35
7D. 7E. 7F	I and II	5	5	10	10	15
7E. 7F	IV and V	10	15	20	30	

b) Water pressure

i) Water pressure for outdoor fire-fighting must ensure free pressure at hydrant orifice at the highest and furthest point of the building not less than 10m of the water head.

ii) In low-pressure water supply system (in the event, mobile pumps or pumping trucks are used to intake water from an outdoor fire-fighting hydrant to create necessary water pressure), free pressure at an hydrant should not be less than 10m of water head.

c) Water piping and hydrants

The location and installation of waster supply piping and hydrants must conform to the provision of Article 5.16, Chapter 5 of BCV.

11.9.2.4. Water reserve and restoration for fire fighting

a) Water reserve:

i) There must be sufficient reserve of water for fire-fighting purpose in case of failure to obtain access to the mains water supply or water flow and pressure at the site cannot meet fire fighting requirements and the water reserve must also be safely and easily accessed by fire fighting equipment.

ii) The required level of water reserve is taken as the maximum volume of water needed for three hours of fire fighting allowing for simultaneously replenishing intake. If the volume of water reserve is more than 1000 cubic meters, it must be stored in two tanks;

iii) The pressurised water tank must be able to supply water for at least 10 minutes' fire fighting operation inside and outside of a residential building and 10 minutes operation of fire fighting equipment inside an industrial zone.

b) Water restoring duration

Maximum allowable duration for water restoration for fire fighting purpose are prescribed in Table 11.9.5.

Table 11.9.5 Maximum allowable duration for water restoration for fire fighting purpose

Building classes	**Max. duration (hours) relative to water flow**	
	Less than 25 l/s	25 l/s or more
Residential buildings	24	
Industrial buildings		
Classes A and B	24	
C	36	24
D and F	36	36
E	48	36

Article 11.10 Fire monitoring and control

1. There must be a fire control room for a building of over ten storeys and shop, hospital, garage, factory and warehouse with an area of 18,000 square meters or more.
2. A fire control room must: -
   a) have an area of not less than 10 square meters and the length of each side must not be less than 2.5 meters;
   b) have two exits, one to the open space outside of the building, the other to the main exit corridor;
   c) not have uneven elevation on the floor of more than 300 mm.
3. A fire control room must be fitted with:
   a) communication equipment and fire alarm terminals connecting to all parts of the building;
   b) Fire fighting equipment control panel, smoke control pumps;
   c) Fire fighting equipment layout diagram.

Appendix 11. 1 Materials of building members appropriate to FPLs

<table>
<tr><td rowspan="2">Building members</td><td colspan="5">Materials of members relative to their FRLs</td></tr>
<tr><td>I</td><td>II</td><td>III</td><td>IV</td><td>V</td></tr>
<tr><td>Bearing column, wall</td><td colspan="3">Brick, stone, concrete, reinforced concrete</td><td rowspan="7">Wood with protecting layer</td><td rowspan="7">Wood without protecting layer</td></tr>
<tr><td>Floor and attic floor</td><td colspan="2">Brick, reinforced concrete dome</td><td>Wooden floor with mortar on steel beam</td></tr>
<tr><td>Roof (without attic)</td><td>Reinforced concrete</td><td>Steel with protecting layer</td><td>Wood with protecting layer</td></tr>
<tr><td>Covering wall</td><td colspan="3">Brick, concrete</td></tr>
<tr><td>Partition wall</td><td colspan="2" rowspan="2">Non-flammable material</td><td>Wood with</td></tr>
<tr><td>Ceiling</td><td>protecting layer</td></tr>
<tr><td>Fire separating wall</td><td colspan="3">Brick, stone, concrete, reinforced concrete</td></tr>
</table>

Note:
Building Class II - single storey with fibro cement walls

Appendix 11. 2 Fire resistance levels of building members with normal materials

Building members	Materials	Min. thickness or cross-section (cm)	Fireproof limit-time (minute)
Wall	Brick (Silicate brick, cavity clay brick)	6 11 22 33	45 150 330 660
	Natural stones, light concrete	6 11 22 33	30 90 240 420
	Concrete Reinforced concrete	5 6 11 15	36 45 150 222
	Light concrete cavity concrete	12 20	270 360
	Amiant cement sheet (flat or corrugated) with steel frame		15
	Gypsum Gypsum slag Fibre gypsum (Organic content: 8% volume)	5 8 10	78 132 162
	Cavity glass blocks	6 - 10	15
Column	Bricks, cross-section (cm) 22x22 22x33 33x33 33x45 45x45		 150 180 270 315 390
	Concrete, Reinforced concrete (Cross section) 20x20 20x30 20x40 20x30 and 20x50 30x50 40x40		 75 105 150 180 210 240

Building members	Materials	Min. thickness or cross-section (cm)	Fireproof limit-time (minute)
Column	Steel without protecting coating with min. thickness (mm): to 12 13 - 20 21 - 30 31-50		 15 18 20 24
	solid timber, with cross section not less than 20x30 cm with 2cm thick protective coating		60
	Reinforced concrete Slab with thickness from the lowest edge to the centre of reinforcement under traction (mm) 20 30 40 50	 10 - - -	 64 - 78 78 - 114 108 - 174 144 - 222 (depending on reinforcement)
Floor, roof	Non-flammable sheet on steel beam or raft without protective coating		15
	Wooden floor with protecting layer of 2cm thickness		45
	Fibro-cement roof, metal sheeting roof on steel beams or raft without protection.		15
	Lath cement without protection on underside	2cm	36
Stair	Steel stair with beam protected by protective coating of 1 cm thickness		90

Appendix 11. 3 Fire safety requirements for special buildings

	Requirements	Remarks
FRL	*Level I*	
Fire separation	*Vertical fire separation:* *- Between floors; and* *- Around shafts to the floors*	
Escape-way	*- Number of escape-ways ≥ 2* *- Path of travel to a staircase will not exceed permissible limit.* *- Emergency lighting backed up by battery*	
Fire detection	*- smoke detectors installed (distance 15 x 15m)* *- Fire control room.*	
Smoke control	*- equipment installed to regulate pressure for altrium, staircase.*	
Fire-fighting equipment	*- Portable fire-extinguishers.* *- Hydrant and hose reels* *- sprinkler system with pressurizing pump underground water tank.* *- Hydrants and sprinkler in staircase on every floor.*	*Building with 17 storeys or more, must have 2 water supply systems for fire-fighting with different pressure :* *a. 1 system serving the lower half of the building with separate water tank placed on the middle floor.* *b. 1 system serving the upper half of the building.* *c. Each system serving 30 floors maximally.*
Lift	*- At least 1 lift reserved for fire-fighting operation by fire-brigade*	*Building with 40 storeys or more must have 2 lifts, and 2 separate systems of emergency power supply:*
Emergency power supply	*- Ensure power supply for fire-fighting equipment, evacuation including lifts*	*a. One system serving the lower half of the building* *b. One system serving the upper half of the building.*

Objective

The objective of this Chapter is to:

1) ensure healthy living conditions and environment, amenity and safety for the occupants of a building; and
2) protect the building and property within from damage caused by fire, explosion, flooding, water penetration, moisture, damp, mold ....

Article 12.1. Minimum room sizes

12.1.1. Requirements

The sizes of the rooms within a residential or public building must be adequate for their use and purposes in order to take full advantage of natural ventilation and lighting.

12.1.2. Deemed - to - satisfy solutions

The size of a room within a building must have minimum clear dimensions as prescribed in Table 12.1.1

Table 12.1.1. Minimum clear dimensions of rooms

Room types	Minimum dimensions		
	Height (m)	width (m)	Area (m)
1) Dwelling house, hotel:			
a) Habitable rooms (bedroom, living room)			
+ natural ventilation	*3.0*	*2.4*	*8.0*
+ Artificial ventilation	*2.7*		
b) Kitchen	*2.4*	*1.5*	*3.5*
c) Toilet, bath, basement	*2.4*	-	-
d) Storage room	*1.8*	-	-
2) Public building:			
a) Office and lounge room	*3.3*	-	-
b) meeting room			
+ Small (25 seats or less)	*3.3*	-	-
+ Medium (25 to 75 seats)	*3.6*	-	-
+ Large (75 seats or more)	*4.2*	-	-
c) Dining room (hotel)	*4.2*	-	-
d) Gymnasium	*6.0*	-	-
e) Catering room	*2.7*	-	-
g) Cloak room, parking room	*2.4*	-	-

Article 12.2. Lighting

12.2.1. Requirements

There must be adequate lighting inside as well as outside of a building appropriate to its use and function as provided for as follows:

1) Natural lighting

a) the rooms in a building especially habitable and sanitary rooms must be provided with adequate natural light through openings to open space outside.

b) office spaces must be designed to provide natural light at least for haft of the daytime with natural luminance adequate to the visual requirements provided for in table 12.2.1.

Table 12.2.1
Minimum natural luminance requirements

Levels of natural light required	Visual requirements		Minimum Natural lighting intensity (Lux)	Minimum natural lighting luminance (%)
	Accuracy	Sizes of objects (mm)		
I	Extra accurate	$d \leq 0.15$	300-500	5
II	Very accurate	$0.15 < d \leq 0.3$	200-300	3
III	Accurate	$0.3 < d \leq 1.0$	100-200	2
IV	Average	$1.0 < d \leq 5.0$	50-100	1
V	Lower	$d > 5.0$	20-50	0.5

2) Artificial lighting

a) Work area lighting
There must be adequate artificial lighting in buildings to ensure normal activities of occupants in case there should be no or inadequate natural light.

b) Incident lighting
Incident lighting must be provided in the following cases:

i) Emergency lighting: to be fitted along escape passages in fire, explosive and intoxification hazardous places;
ii) Continuous lighting: to be provided in places where blackouts can jeopardize safety, security or cause damages to property and endanger human lives (in operation and emergency rooms); and
iii) security lighting; to be fitted outside or along boundary of buildings for the purposes of security or the protection of property.

c) External lighting should be designed to avoid interference with transport or architectural requirements.

d) Requirements for illuminance of artificial lightning are prescribed in Tables 12.2.2 and 12.2.3.

Table 12.2.2.
Artificial lighting inside dwelling houses and public buildings - Minimum illuminance on working surface and objects

Visual needs levels	Room types	Minimum illuminance (Lux) in cases:					
		a		b		c	
		(1)	(2)	(1)	(2)	(1)	(2)
I.	Working room : office, class-room, designing room, laboratory	400	200	300	150	150	75
II.	- Dining room - Shop - Exhibition	300	150	200	100	100	50
III.	- Meeting hall - Theatre, cinema	150	75	100	50	75	30

Note:
(1) Visual identification levels:

Visual Levels	*Identification needs*	*Sizes of objects (mm)*
I	*Accurate work on working surface*	*0.15 - 0.3*
II	*Objects to be identified from various directions*	*0.30 - 0.50*
III	*All round observation*	*> 0.5*

(2) Legends:

Visual requirements:

(a): Continuous
(b): Periodic
(c): Instant

Kinds of lamps

(1): Fluorescent
(2): Filement

Table 12.2.3 Incident and artificial lighting outside a building

Types of lighting	Minimum illuminance (Lux)		Remarks
	Indoor	Outdoor	
1. Incident lighting - On working surface - Operating room - On escape way (On floor surface, passage, stairs)	 2 150 1	 1 - 2 (on floor and treads)	Filement lamps must be used
2. Security lighting (on the ground surface)		1 (on ground)	
3. Outdoor - entrance gate - strolling road & yard - sports and playground		 3 2 4	

12.2.2. Deemed - to - Satisfy solutions

1. *Natural lighting*

Compliance with the following standards and solutions is deemed to satisfy the requirements for natural lighting:

a) *Standard 20 TCN 029 - 91 "Natural lighting in civil buildings - design standards".*

b) *solutions:*

i) *window areas:*
to be taken as 1/5 of room area (for ground floor)
to be taken as 1/6 of room area (for first floor and up)

ii) *The depth of the part that receives natural light from one side must not be higher than 2.5 times of the room height.*

iii) *Light well and skylight space:*
- in row houses: a row house more than 18 meters long must have a central light well of at least 2 by 3 meters dimensions.
- in condominiums: a light well must be built in semi-detached houses, with sizes prescribed in Table 12.2.4.

Table 12.2.4. Sizes of light wells in condominium

No of storeys	Sizes of light wells	
	Area F (m2)	Width B(m)
<3	12	3
4-5	20	4
6	24	5
> 6	33	1/4 height of building

2) Artificial lighting

Compliance with the following standards shall be deemed to satisfy the requirements for artificial lighting:

20 TCN 16 - 86 — *Artificial lighting for civil buildings*
20 TCN 95 - 83 — *Artificial lighting outside civil buildings*

TCVN 3743 - 83 — *Artificial lighting for industrial buildings and works*
TCVN 3257 - 86 — *Artificial lighting for clothing factories*
TCVN 2062 - 86 — *Artificial lighting for textile mills*
TCVN 2063 - 86 — *Artificial lighting for engineering factories*
TCVN 4213 - 86 — *Artificial lighting for latex processing factories*
TCVN 3258 - 86 — *Artificial lighting for ship yards*

Article 12.3. Ventilation and air conditioning

12.3.1. Requirements

1. General requirements
   a) Buildings must be adequately ventilated to ensure air circulation between within and outside the building.
   b) moisture, bad odors, dust, smoke. toxic and combustible gases ... generated from the kitchen, sanitary, laundry areas, equipment or from fire must be collected and discharged and, if required, be treated before discharge.
   c) if air conditioning equipment is used, measures must be taken to ensure health and safety. The lowest temperature allowed for cooling is 25°C. The highest degree allowed for heating must not exceed 20°C.

2. Natural ventilation
Provision must be made for the maximum use of natural ventilation for buildings

3. Artificial ventilation (mechanical ventilation)
   a) Ventilation equipment must be fitted at appropriate places and can be used in conjunction with air conditioning;
   b) A mechanical ventilation system must be designed, installed and maintained so that: -
      i) it will not cause contamination of the air in the building by harmful bacteria;
      ii) the discharged air shall not produce bad odour or cause damage or harm to human beings and adjacent property;
      iii) it shall not make excessive noise in operation; and
      iv) it shall not spread smoke or flame in the case of fire.
   c) A ventilation or air-conditioning system shall not circulate air if it is found to contain:
      i) toxic, harmful substances;
      ii) explosive, combustible substances;
      iii) harmful micro-organism (bacteria, viruses, fungi);
      iv) substances that produce bad odour.

4. Emergency ventilation:
   a) Emergency ventilation is the additional ventilation in the event of an emergency during the process of production that produces a sudden increase in the volume of harmful, explosive or flammable substances.
   b) Airflow for emergency ventilation
      The required volume of air exchange produced by the simultaneous operation of both the normal and emergency ventilation systems must be based on calculation and must not be less than 8 times the total volume of the room for one hour of operation.
   c) the exhaust fan and exhaust opening must be positioned having regard to the characteristics of the air to be collected (its relative gravity to the normal air, explosive hazard).
   d) An exhaust vent must be so positioned to avoid affecting people outside a building and adjacent air intakes and not to cause fire or explosion (to be kept away from fire sources and chimneys)

12.3.2. Deemed - to - satisfy solutions

1. Natural ventilation
   In row houses and condominiums, natural ventilation can be achieved together with natural lighting via open courts or light wells. (See 12.2.2.1)
2. Mechanical ventilation
   Solutions complying with the following standard shall be deemed to satisfy the requirements for mechanical ventilation:
   TCVN 5687 - 92 "Ventilation, air conditioning, heating - design standard"

Article 12.4. Access and egress

12.4.1. Requirements

1. Access and egress must be designed to ensure:
   a) safety and amenity for people (including people with disabilities) in entry into and exit out of a building or a storey (including attic), or a room under normal and emergency conditions.
   Access and egress for people with disabilities are provided for in Article 8.3, Chapter 8 of this BCV.
   b) safety and ease of operation for vehicular access, turning and parking.
   c) they are easy to find;
   d) they have adequate sizes appropriate to their use;
   e) they shall not be obstructed by fixed or mobile objects that may cause harm to the people;
   f) they shall not have slippery surface;
   g) they shall have gradients, going and riser dimensions appropriate to their uses;
   h) they must have protective railings or balustrades if required; and
   i) they must have constant risers and goings throughout in one flight, if there are differences they must be easily identified by colour indication or they must use three risers landing;

2. Vehicular access, egress and parking
   Vehicular access, egress and parking must have:
   a) adequate dimensions appropriate to their use;
   b) adequate areas for vehicles to access and egress, to turn or park;
   c) adequate room for drivers to observe to ensure safety.

3. Stairway

A staircase must:

a) be installed even if there is a lift;

b) ensure safety for escape as provided for in Article 11.6, Chapter 11 of this BCV;

c) have constant gradient, goings and risers throughout in one flight;

d) have landings of appropriate areas at appropriate places;

e) must have balustrades, if required, which:

i) must be high enough to ensure convenient handhold

ii) must be sturdily constructed complying to structural requirements

iii) must have smooth handrail.

4. Lifts

a) A lift must be installed for a building of six storeys or more. In buildings where access by people of disabilities is required as stipulated in Article 8.3. , the lift must be designed, installed to facilitate access by people with disabilities;

b) A goods service lift in a factory must not be installed sharing a landing with a passenger lift.

c) Lifts must be rationally positioned in groups or within a group.

5. Lifts and escalators must comply with the following requirements:

a) They must ensure safe operation in transporting people whose total allowable weight shall not exceed 1.25 times the designed load of the lift.

b) they must operate at a constant speed without sudden acceleration or decrease.

c) They must ensure safety and comfort for the users: against falling, slipping, jamming or knocking against movable parts or sharp objects under normal or expected emergency conditions.

d) There must be signs indicating the position of the lift if it is of an enclosed type and there are more than two stops.

e) There must be adequate lighting and ventilation in the lift cabin for both normal and emergency operations.

f) Care must be taken to avoid jarring or knocking between parts of the lift and those of the building.

g) There must be safety devices in case the lift is overloaded or breaks down.

h) The lift must be installed to facilitate maintenance, inspection.

i) The door to the lift shaft must not built near the shaft to avoid fire.

6. Emergency lifts

An emergency lift must be fitted with the following additional devices:

a) External communication emergency phone;

b) protection of the passengers from fire, smoke, toxic gas ...

c) safe evacuation of people from the lift.

d) allowing authorised personnel to operate without following normal procedures (applicable to lifts serving heights of 15 meters or more).

12.4.2. Deemed - to - satisfy solutions

Solutions complying with the following standards are deemed to satisfy the requirements:

1) Specifications for access and egress in dwelling houses and public buildings as provided for in table 12.4.1.

2) TCVN 5744-1993 "Lifts - safety requirements in installation and operation'.

Table 12.4.1. Specifications for access and egress in dwelling houses and public houses

Types of buildings	*Minimum width (m)*				*Gradient of stairs*	*Remarks*
	Corridor	*Door*	*Passage*	*Flight*		
1. Dwelling houses, flats	*1.4*	*0.8*	*1.0*			
- Main stairway						
+ 2 storeys building				*0.9*	*1 : 1.5*	
+ 2 storeys or more				*1.0*	*1 : 1.75*	
+ With motorbike leading strip				*1.0*	*1 : 2.5*	
- Auxiliary stair (Leading to roof, in the apartment)				*0.9*	*1 : 1.25*	
2. Public buildings	*1.4*	*0.8*	*1.0*	*1.05*		
3. Nursery, kindergarten	*1.4*	*0.8*	*1.0*	*1.05*	*24o*	*Handrail height : 0.5-0.6m*

Types of buildings	Minimum width (m)				Gradient of stairs	Remarks
	Corridor	Door	Passage	Flight		
4. School	1.8		1.2			
- main stair:			from courtyard			
+ ≤ 200 pupils				1.8		
+ > 200 pupils				2.1		
- Auxiliary stair				1.2		
5. Hospital						
- Lobby						
+ Without waiting place:						
Side corridor	2.4					
Central corridor	2.7					
+ With waiting place	3					
+ For staff	1.5					
- Stair						Landings
+ Main				1.5	1 : 2	
+ Auxiliary				1.2	1 : 1	1,4
- Leading strip, ramp					1 : 10	1,9
- Door						
+ No stretcher		1.0				
+ With stretcher		1.2				
+ Operating room		1.5				
6. Cinema	1.4	2.4	1.0			
7. Offices						
- Outside corridor	1.8					
- Side corridor						
+ single storey	1.4					
+ Two storeys or more	1.6					

Article 12.5. Signs

12.5.1. Requirements

1. There must be signs giving important information such as access and egress signs, exit, escape signs, fire, explosive, electric hazard warning signs, inflammable, sanitary facility, telephone, communication, fire safety equipment signs....
2. Signs must be displayed at prominent places and must be clearly visible. In hazardous areas, warning signs must be installed in appropriate positions so that people can easily identify before entering such areas.
3. The wording of signs must be easily understood conforming to international standards to facilitate quick, accurate interpretation.
4. Exit and emergency exit signs must be lit by emergency lighting with luminance of not less than 1 Lux.

12.5.2. Deemed - to - Satisfy solutions

The designs of signs must conform to international standards (ISO) and Vietnamese standards as follows:

- *ISO 386 - 1984 Safety colours and Safety signs*
- *ISO 630 - 1987 Fire protection - Safety signs*
- *TCVN 4879 -89. Fire Safety - safety signs*
- *ISO 700 -1990 Public Information symbols*

Article 12.6. Noise insulation

12.6.1. Requirements

1) provision must be made to ensure noise in the residential area shall not exceed the limits prescribed in:

a) Chapter 4 of this BCV;
b) the following standards:

- 20 TCN 126 - 84 Permissible noise level in dwelling houses - Design standard
- 20 TCN 175 - 90 Permissible noise level in public buildings - Design standard.

2) For noise insulation, the following solutions should be associated :

a) Solution of planning : selection of quiet position, planting green.

b) Measure of sound insulation for a building :

i) Sound insulation for separated structures: fitting the gap around windows, doors ...

ii) Sound insulation for equipment, pipelines.

iii) Using sound insulation materials, absorbing sound to resist against vibration when necessary, however, requirement for fire-protection must be ensured.

12.6.2. Deemed - to - satisfy solutions.

Solutions complying with the following standards are deemed to satisfy the requirements for noise insulation.

- *20-TCN 150 - 86 "Noise insulation in dwelling houses - Design standard".*

Article 12.7 Waterproof.

12.7.1. Requirements

In order to protect human health and to ensure durability of a building, waterproofing for the building must be carried-out, that includes :

1) Waterproofing from outside :

Must ensure that :

a) Roof, external walls of the building will not be impregnated, leaked by rain water.

b) Wall, floor and structures contacting ground will not be impregnated by ground water.

2) Waterproofing from inside :

Must ensure that :

a) Walls, floor will not be impregnated by water from areas of kitchen, toilet, bathroom in the building as well as from adjacent apartments.

b) Areas of kitchen, toilet, bathroom in a building must be ventilated, with waterproofing structures of wall, floor and ease to - clean.

c) Water overflowing from hygiene equipment must be drained out, without overflowing or impregnating to surrounding rooms.

12.7.2. Deemed - to - satisfy solutions.

Solutions complying with the following standards are deemed to satisfy requirements for waterproof of reinforced concrete floor, roof :

- TCVN.5718 - 93 "Reinforced concrete roof and floor - Technical requirements for waterproof".

Article 12.8. Lightning protection.

12.8.1. Requirements.

Construction works must ensure requirements for lightning protection as provided for in article 3.9, Chapter 3 of this BCV.

12.8.2. Deemed - to - satisfy solutions.

Solutions complying with the following standards are deemed to satisfy requirements for lightning protection.

- *20 TCN 46 - 84 "Lighting protection for construction works".*

Article 12.9. Falling prevention.

12.9.1. Requirements.

1) Shielding balustrade must be arranged at the places as follows :

a) At places where people are able to fall down from more than 1m high, for instance : from the roof with permanent passage of going up and down, from the places with openings of wall, floor or at places with height changing suddenly.

b) At places where children (under 10 years of age) should be prevented, such as access to a swimming pool, water tank of more than 0.4m deep.

2) The balustrade must have appropriate height (normally from 1.1m or more), must be sturdily constructed to ensure safety.

12.9.2. Deemed - to - satisfy solutions.

Solutions complying with the following standards are deemed to satisfy requirements for a balustrade preventing falling down.

- *TCVN 4431 - 87 "Safe balustrade - Technical conditions".*

Article 12.10. Prevention of jeopardy caused by construction material.

12.10.1. Requirements.

1) In normal atmosphere conditions, harmful substances and stench must not be created on the surface of construction materials used in buildings.

2) In public buildings, there must be signs for transparent, fragile materials at the places where people are able to pass through.

3) Glass and fragile materials must

a) Be durable enough, bear impact, or :

b) Be protected from breakup, or

c) not to endanger when they are broken by impact.

4) Flooring materials must ensure anti-slipping.

Article 12.11. Prevention of infection from foodstuff and damaging organisms

12.11.1. Requirements.

1) Foodstuff processing place must ensure :

   a) Having measures to control insect, pathogenic organism (cockroach, rat ...)

   b) Having surface - smooth, waterproofing, without corner containing dust and easy-to-clean.

   c) Construction materials must not contain harmful substance.

   d) Kitchen within public buildings must have adequate equipment suited to washing and cooking foodstuff.

2) Measures must be taken to control damaging organism (such as : mold, moss, fungus, termite, wood-boring worm ...).

12.11.2. Deemed - to - satisfy solutions.

Solutions complying with the following standards are deemed to satisfy requirements for moth and termite control :

- *QPVN 16 - 79* *"Temporary code of moth and termite control for construction works".*

CHAPTER 13.
INDOOR WATER SUPPLY AND DRAINAGE SYSTEM

Objective

The objective of this chapter is :

1) To meet the demand for water use inside the building for living, production and fire-fighting activities.

2) To protect people from illness, minimize environment pollution by measures : draining fully sewage, sewage treatment complying with environment standard.

3) To ensure safety for the operator of supply and drainage system.

Article 13.1. General regulation for indoor water supply and drainage system.

13.1.1. Requirements for indoor water supply and drainage system.

1) Indoor water supply and drainage system that must be installed in the building suited to its function and features and econo-technical conditions.

2) Indoor water supply and drainage system must ensure the following requirements :

   a) Requirement for hygiene equipment provided for in Clause 13.2.1, Article 13.2.

   b) Requirement for water supply system as provided for in Clause 13.3.1., Article 13.3.

   c) Requirement for water drainage system provided for in Clause 13.4.1, Article 13.4.

13.1.2. Deemed - to - satisfy solutions.

Solutions complying with the following standards are deemed to satisfy requirements for water supply and drainage system :

- *TCVN 4513 - 88 "Indoor water supply - Design standard".*
- *TCVN 4474 - 87 "Indoor water drainage - Design standard".*
- *TCVN 4519 - 88 "Indoor water supply and drainage system - Taking-over standard".*

Article 13.2. Hygiene equipment.

13.2.1. Requirements for hygiene equipment (HE).

Indoor hygiene equipment must ensure :

1) Quantity of HE.

Quantity and type of HE must meet requirements of use, be suited to the function, size of the building and quantity of users accounting for their sec, age and people with disabilities (if any, as provided for in Article 8.3).

2) Quality of HE.

HE must :

a) Have solid structure, and

b) Ensure hygiene : draining water fully, without dust sticking, without arising stench.

3) HE installation.

HE installation must ensure :

a) convenient and safe use, suitable for the users.

b) convenient in cleaning, repairing and replacing.

c) without leaking water to the floor, without happening water flowing backward from HE to water supply system.

13.2.2. Deemed - to - satisfy solutions.

Solutions complying with the following regulations and standards are deemed to satisfy requirements for hygiene equipment :

1) Quantity of HE.

a) Type and quantity of HE installed inside the building must be suited to its function and size as provided for in Table 13.2.1.

b) Hygiene area for people with disabilities as provided for in Article 8.2.

Table 13.2.1 Minimum quantity of HE within public building

Type of building & Hygiene area	Calculating criteria	Minimum quantity of HE			
		Water-closet	Urinal	Washing tap	Bathing
1. School : Hygiene area of					
- Male pupil	40 pupils	1	2	1	1
- Female pupil	40 pupils	1	2	1	1
- Male teacher	10 teachers	1	1	1	1
- Female teacher	10 teachers	1	1	1	1
2. Hostel of student					
- Man toilet	15 students	1	2	1	1
- Women toilet	15 students	1	2	1	1
3. Nursery & Kindergarten	1. Children group, or 1. Nursery class (20-25 children)	4		5	1
4. Restaurant	100 seats				
- Man toilet		1	2	1	
- Woman toilet		1	2	1	
5. Audience room :	100 seats				
- Man toilet.		1	2	1	
- Women toilet		1	2	1	
6. Hospital Hygiene area for patients	2 - room of illness or 15 - patients	1	1	1	1

Note:

For nursery, kindergarten, restaurant, hospital, the quantity of HE should becalculated separately, not given in the table.

2) Quality of HE.

Quality of HE must reach technical standards.

For ceramic HE they must reach the standard :

- *TCVN 6073 - 95 "Ceramic hygiene product - specification".*

3) HE installation.

HE installation must ensure the following requirements :

a) The height of HE installation must be suited to the users and structure of equipment (table 13.2.2). For hospital, sanitarium, attention should be paid to the users that are old and weak people, people with disabilities, and patients from whom disease samples are taken.

b) Measures must be taken to prevent water overflowing from HE to the floor that makes hygiene area wet.

c) HE must be provided with siphon to prevent stench spreading into the building.

Table 13.2.2. The height of HE installation

(from the floor surface to the upper edge of the vessel)

Name of appliance	*Height from the floor surface (mm) for*		
	Nursery kindergarten	*School*	*Other*
1. Face washbasin	*400÷450*	*650*	*800*
2. Hand washbasin, various kinds of washbasin	*450*		*750*
3. Urinal suspended on the wall	-	-	*600*
4. Water- closet	*200*	-	*as per equipment (600-650)*

Article 13.3. Water supply system.

13.3.1. Requirements for water supply system.

Water supply system must ensure :

1) Quality of supplied water : must meet the requirement for the purpose of use.

   Water used for drinking and living must reach the standard as provided for in Article 4.15, Chapter 4 of this BCV.

2) The flow rate and pressure of supplied water must meet the requirement for using water at every water in-taking point within the building.

   Water supplied for living must meet the requirement of minimum free pressure at HE and maximum pressure. Water used for fire-fighting must ensure the requirement of pressure for fire-fighting as provided for in Article 11.9, Chapter 9 of BCV.

3) Pipeline, equipment of water supply system.

   Pipeline, equipment of water supply system must :

   a) not cause infection, contamination for water supplied.

   b) be installed firmly, without leaking, causing noise and vibration when operating, without flowing back when the pipeline is decompressed and lost water.

4) In the case of hot water supply.

   must ensure safety for the user not to be burnt by too hot water, leakage of hot steam, not to be in danger by explosion of the heater or subjected to electric shock.

13.3.2. Deemed - to - satisfy solutions.

Water supply system ensuring the following regulations is deemed to satisfy the requirements as provided for in Clause 13.3.1. :

1) Ensuring requirements of water use includes :

a) Water used for living : according to the standard quantity of water used maximally in one day of the year within the dwelling house, public building. Production building as prescribed in Appendix 13.1.

b) Water used for fire-fighting inside the building as provided for in Article 11.9, Chapter 11 of this BCV.

2) Water pressure.

Water pressure in water supply system must ensure :

a) Minimum free water pressure at any time is of 3m of water head.

b) Working pressure in water supply network for living must not exceed 60m (*if higher, the network pressure must be regionalized*).

Note:
In order to avoid difference of pressure between a multi-storey building floors, a reducing valve should be installed in the distribution pipeline, one valve for every 4 - 6 floors.

3) Pressurization.

a) When water pressure is not sufficient for water reaching the floor, solution of pressurization should be taken : designing pressurizing station with underground water tank and water storage tank on the roof.

b) Installing a pump directly in the pipeline to suck water is strictly forbidden. *The pressurizing station must suck water through the water storage tank.*

c) Capacity of the water storage tank must be suited to the need of water use, the cycle of replenishing waters and the way to arrange the distributing pipeline.

d) The pressuring pump can not be arranged near the room, that need quietness such as apartment, nursery - kindergarten, class room, lecture hall, therapeutic room of hospital. Measure of sound insulation must be taken : *installing the pump on a rubber or soft woodbase, suction pipe and ascending pipe must be lined by anti-vibration cushion of at least 1m long.*

e) Ensure to supply power continuously to the water supply pump.

4) The pipeline.

a) Water supply pipeline may be of galvanized steel pipe or plastic pipe.

b) The pipeline is not allowed causing noise and vibration when operation. *The velocity of water flowing in the pipe may not exceed 2m/s and water pressure must not exceed 60m of water head.*

5) Hot water supply.

a) Water heater.

Water heaters must ensure technical specification of safety and they must be installed so that :

i) Water shall not be contaminated;

ii) They are convenient for maintenance, repair;

iii) They are equipped with safety device to control pressure and temperature;

iv) Hot water temperature shall not exceed 50°C

b) Hot water pipeline.

Installation of hot water pipeline must ensure :

i) Prevent the steel pipeline conducting hot water from corrosion, and it must be insulated.

ii) Prevent the pipeline from expansion.

iii) Air-escape cock must be mounted to the high point of the main vertical pipe supplying hot water and the heat-booster.

iv) Painting exposed hot water pipe with red colour for its identification.

c) Installation of heating system supplying hot water to the boiler and heater to boil water up to the temperature of 115°C, and the boiler with pressure higher than 0.7 da N/cm^2 must observe safety standard for steam and hot water conducting pipeline.

Article 13.4. Water drainage system.

13.4.1. Requirement for water drainage system.

Water drainage system must ensure :

1) Draining water completely.

2) Without leaking, blockage and ease-to clear off and repair.

3) Without smelling stench the surrounding environment.

4) Without the risk of breaking and dinting for the pipeline.

5) Not to discharge water directly to the sidewalk, and the standard of sewage before being discharged provided for in Articles 4.17, 5.17, 6.13 and 7.18 of this BCV.

6) Convenient for operating water treatment works and ensures labour safety.

13.4.2. Deemed - to - satisfy solutions.

Water drainage system ensures the following provisions is deemed to satisfy requirements stated in Clause 13.4.1 :

1) Draining out all kinds of sewage (dirty water from hygiene equipment, from living and production activities, and rain water from the roof) from inside of the building into the outside drainage system by closed pipeline. The pipeline gradient must be higher than the minimum gradient and ensures the self-cleaning speed of the flow.
2) Discharging pipeline must be waterproofing, without leaking, blocking, erosion (for wasted water from production) and it could be of cast-iron, ceramic or plastic pipe.

3) There must be sewage shallow *(with minimum diameter of 50mm)* to collect quickly sewage on the floor of bathroom and toilet.

   A laterally discharging pipe must be arranged separately for each bathsink with minimum gradient of 0.01 - 0.03.

4) Hygiene appliances and sewage collecting instruments must be equipped with siphon. The level of water retained in the siphon must be of 5cm at least and its inner surface must be smooth.

5) A check pipe or blockage clearing hole must be arranged on the by-pass pipeline. The blockage clearing orifice is placed at the end of the lateral discharging pipe and at the foot of the vertical pipe, without hindering the flow and convenient for blockage cleaning operation.

6) The by-pass pipeline discharging water must not be exposed on the ceiling of the lower rooms.

7) Water from water closets and urinals, before being discharged into the common drainage system must be treated through a cesspool reaching technical standard.

8) Breather.

a) The breather of drainage pipeline could not be connected to the air and smoke ventilating pipe.

b) The main breather must be placed vertically and projecting from the roof 0.7m, and its diameter is prescribed in table 13.4.1.

Table 13.4.1. Minimum diameter of the breather

Diameter of vertical draining pipe (mm)	*50*	*75*	*100*	*150*
Minimum diameter of the breather (mm)	*40*	*50*	*75*	*100*

c) In order to avoid the phenomenon of lowering the level of water retained in the siphon, auxiliary breather must be placed.

9) The minimum diameter of the vertical draining pipe is of 75mm, in case of draining sewage from toilet, this diameter is of 100mm.

10) Draining rain-water from the roof.

a) Rainfall intensity used for calculation of rain-water draining system in the localities will be taken from Appendix 13.2.

b) It is permitted to calculate preliminarily as per the calculated flow rate for one rain-water swallow and one vertical pipe as prescribed in table 13.4.2.

Table 13.4.2 Flow rate calculated for one rain-water swallow and one vertical pipe.

Diameter of a swallow or vertical pipe (mm)	*80*	*100*	*120*	*200*
Calculated flow rate (l/s) for :				
- 1 rain-water swallow	*5*	*12*	*35*	*-*
- Vertical rain-water pipe	*10*	*20*	*50*	*80*

Appendix 13. 1 The Norm of maximum daily water consumption in the year

Type of water consumption	Unit	Daily consumption norm (l/day)
(1)	(2)	(3)
Dwelling house, in each apartment with 1 water tap jointly used for living need.	1 person	From 80 to 100
Dwelling house equipped with hygiene appliances bathing, washing tap in 1 closed apartment	1 person	From 100 to 150
Dwelling house in each apartment equipped with hygiene appliance : shower, bath tap, special water closet.	1 person	From 150 to 200
Dwelling house in each apartment with bathsink and local hot water supply	1 person	From 350 to 400
Condominium, hostel with common toilet and bathing-washing tap in various floors	1 person	From 75 to 100
Condominium with toilet, bathing-washing tap separate for each room.	1 person	From 100 to 120
Hotel : - Class III - Class II - Class I - Special class	 1 person 1 person 1 person 1 person	 From 100 to 120 From 150 to 200 From 200 to 250 From 250 to 300
Hospital, sanitarium, rest house (with common bathsink and shower)	1 bed	From 250 to 300
Sanitarium, rest house with bathsink in every room.	1 bed	From 300 to 400
Medical station, policlinic examination room	1 patient	15
Public bathroom with shower	1 person	From 125 to 150
Hand laundry	1kg of clothes	40
Machinery laundry	1kg of clothes	From 60 to 90
Catering company, restaurant a. Processing foodstuff on the spot b. Processing foodstuff brought home	 1 dish 1 dish	 12 10

(1)	(2)	(3)
Collective dining house	1 person/meal	From 18 to 25
Swimming pool for 1 day and night		
a. Replenish overflow water	% fool capacity	10
b. Athlete (including bath)	1 athlete	50
c. Spectator	1 seat	3
Nursery		
a. In day time	1 child	75
b. In both day & night	1 child	100
Office of administrative organ	1 official	From 10 to 15
Cinema	1 seat	From 3 to 5
Club	1 seat or 1 spectator	10
Theatre		
a. Spectator	1 seat	10
b. Performer	1 performer	40
School, general education school	1 pupil or 1 teacher	From 15 to 20
Stadium, Sport competition building		
a. Competitor (including bath)	1 competitor	50
b. Spectator	1 seat	3
Watering		
a. Watering stadium, playground, tribune and open sport works, green trees, internal roads in stadium.	1m2	1.5
b. Watering surface of football stadium	1m2	3
Servant of public house	1 person/shift	25

Note:

(1) For dwelling house, daily used water for living is taken from public tap in the street or sub-quarters, norm of average water consumption per capita will be 40 to 60 l/ day.

(2) The Norm of water consumption for 1 patient bed in hospital, sanitarium, rest house and 1 pupil in the boarding school, including the volume of water used for dining house and laundry.

(3) The Norm of water consumption for 1 official working in the office of administrative organ, including the volume of water used for guests. Water for dining-house should be calculated additionally.

Appendix 13. 2 Rainfall intensity for 5 minutes in various localities of Vietnam

Station	q_5 (l/s ha)	Remark
Bac Can	421.90	
Bac Giang	433.30	
Bao Loc	506.26	
Buon Me Thuot	387.70	
Bac Quang	611.14	Ha Tuyen
Ca Mau	507.40	
Cua Tung	384.28	
§o Luong	450.30	
§a Lat	416.20	Lien Khuong
§a Nang	370.60	
Hoa Binh	384.60	
Hai Duong	450.40	
Ha Giang	390.00	
Hong Gai	478.90	
Ha Nam	433.30	
Hue	370.60	
Hung Yen	450.40	
Ha Noi	484.60	Lang
Lao Cai	450.40	
Lai Chau	391.20	
Mong Cai	524.50	
Ninh Binh	507.40	
Nam §inh	433.30	
Nha Trang	281.68	
Phu Lien	461.80	
Play Cu	392.26	
Phan Thiet	326.14	
Quy Nhon	342.10	
Quang Ngai	416.20	
Quang Tri	421.90	
Ho Chi Minh City	496.00	

Objective

The objective of this chapter aims at ensuring electric system installed in the building to comply with its function, and it will be designed, installed strictly in accordance with technical requirements, safety in construction operation during its using time.

Article 14.1. Scope of application.

1) This chapter applies to designing, installing of electric system, including electric line and equipment with voltage not exceeding 1000V, inside civil and industrial buildings (hereafter called works), that are newly built as well as improved and expanded.

2) Installation of special electric equipment such as testing instruments, illness examining and treating equipment, fire-warning facilities, anti-thief, models in museum, exhibition, electric billboards must comply with special requirements as the case may be.

Note:
Explanation of some technical glossaries of electric technique are given in Appendix 14.1.

Article 14.2. Requirement for the Indoor electric system.

Designing, installation of the indoor electric system must :

1) Ensure safety for human and property, works, including :

a) Ensure safety for human without risk caused by :

i) contacting electric carrying parts of electric equipment during normal operation, and prevent normal metal parts not carrying electricity of electric equipment, or parts of the works contacting mass when incident happens.

ii) Touching a part with overly high temperature caused by electric equipment operating unusually or caused by electric current exceeding its calculated level.

iii) Electro-motive force of electric equipment caused by the current exceeding its calculated level.

b) Ensure safety for electric system working in a determined environment, without generating spark in the environment with the risk of fire, explosion.

c) Protect parts of the works from the risk of fire, attenuation of technical specifications caused by temperature increased by heat transmitting or electric arc.

2) Convenient and safety use.

If it is foreseen that there are people with disabilities in the house, lamp switches and sockets must be arranged in the place easy for them to access and use.

3) Ensure stable and continuous operation of the electric network during the time suitable to the function and size of the works, except the reasons caused by the local electric network.

4) Be able to separate in electricity from the electric supply system.

a) At the inlet, there must be a common electric breaker to protect the outdoor electric system, when accident happens.

b) Protective breakers must be chosen in order that they act under selective hierarchy.

Article 14.3. Deemed - to - satisfy solutions.

The indoor electric system that is designed, installed in accordance with the following Vietnamese standards are deemed to satisfy the requirements as stated in Article 14.2.

- *20 TCN 25 - 91* *"Installation of electric line inside dwelling house and public building - Design standard".*
- *20 TCN 27 - 91* *"Installation of electric equipment inside dwelling houses and public buildings - Design standard".*

- *11 TCN 18 - 84 to 11 TCN 21 - 84* *"Electric equipment Code".*
- *TCVN 4756 - 89* *"Electric equipment grounding and "null" connecting Code".*

Note : Some important clauses in the standards stated above are quoted from Article 14.4 to 14.4 below.

Article 14.4. Transformer station

14.4.1. Location of transformer station (TS)

1) For dwelling house, hospital, school :

It is forbidden to arrange TS adjacent to living rooms, patient rooms, classrooms and working rooms.

2) For industrial building and other public building :

TS is permitted to place inside or adjacent to the building, but it must ensure permissible noise level and there must be fire-preventing wall isolated from the adjacent room, and egress connected directly to the outside open space.

3) *The transformer station should be arranged at the ground floor, and there must be the passage lending directly out to the street according to the requirement for fire-protection.*

14.4.2. Arrangement of transformer station.

1) The room where distribution equipment with voltage up to 1000 V is placed and the manager of consuming household can access to, is not permitted to connect to the room where high-voltage distribution equipment and transformer are placed.

2) The floor where transformer is placed must be at the level higher than the highest flood level of the area.

3) Transformer and distribution equipment room could not be arranged at :

a) Under wet places such as : bathroom, toilet, wet production area. When it is duly necessary, waterproofing measure must be taken.

b) Right under and above the room with 50 people gathered for more than an hour. This requirement does not apply to the room of dry transformer or non-flammable substance cooling transformer.

4) Arrangement and installation of TS must comply with regulations prescribed in 11 TCN - 21 - 84 "Electric equipment Standard".

Article 14.5. Input equipment - panel, distributor cabinet - protective equipment.

14.5.1. Requirement for arrangement of input equipment (IE).

1) At the inlet of the building, input equipment (IE) must be arranged.

2) Before leading to the building, it is forbidden to place a separate joint box to divide indoor and outdoor electric network. This division must be carried - out in the main distributing cabinet (MDC) or the main control - panel (MCP).

14.5.2. Arrangement of input equipment, main control panels, cabinets and group electric panel, cabinet (IE, MCP, MDC, GEC).

1) Place to install equipment.

a) Equipment must be installed at a place easy to access to and easy to control, to turn on/ off, repair (e.g. stair room, dry basement ...). *For the building without stair room, it is permitted to install IE on the external wall, but steps should be taken to protect it properly without impact on the structure and beauty of the building.*

b) It is permitted to install IE, MCP and GEC, GEC in other rooms, dry basement, or technical floor, when the manager can get there easily; or in a separate room of the building having non-flammable wall with fireproofing time not less than 45 minutes.

c) It is forbidden to place electric panel (box, cabinet) in the rooms containing chemicals or in places usually wet such as : under or inside toilet, bathroom, kitchen, hand washing place, laundry.

2) Arrangement of equipment.

a) IE, MCP, GEC must be installed in the room to place electric panel (cabinet) or in electric cabinet with lock.

b) In places easy to be flooded, IE and MEP; GEC must be arranged at the place higher than the highest level of flood, that can happen.

c) The room to place electric panel (cabinet)

i) must have its door opening outward and have the lock, be ventilated by natural wind and lighted by electric lighting.

ii) it is not allowed :

- to place combustible gas pipes, combustion substance conducting pipe through the room where electric panel (box, cabinet) is placed.

- arranging covers, valves, flanges, prospecting door, hose of pipe lines, technical box (conducting water, ventilation, hot steam ...) passing through the room where electric panel (box, cabinet) is placed, except the case, this room needs them.

14.5.3. Short - circuit protection.

1) Electric network must be protected when short-circuit happens for the shortest time and selective cut.

2) Protecting equipment must ensure to selectively cut off the section where accident of electric network happens.

3) Nominal current of protecting equipment.

The nominal current of the fuse melting wire and the set current of breaker used for protecting separate line sections must,

a) be taken as per calculated current of these electric networks, but it must ensure that the protecting equipment will not cut off when there is short-term overload (starting current, technological peak load, self-starting current...)

b) in case, the electric network needs only short-circuit protection, without requirement for overload protection, protecting equipment must have a multiple of protecting current compared with the permissible permanent current of the protected line (I_d) equal to :

i) not over 3 times for the fuse wire

ii) not over 1.5 times for the cut current in the releasing part of the breaker with adjustment according to inverse ratio with characteristic current.

iii) not over 4.5 times for release current of the breaker with maximum releasing part that act instantly (quick release)

14.5.4. Overload protection.

1) Overload must be protected for various kinds of electric networks below:

a) Using insulated wire with flammable and exposed cover, openly placed.

b) Using wire that is protected or inserted in a conduit, in non-flammable structures... in following cases :

i) Electric lighting network of dwelling house, public building, ship, living service house of industrial enterprises; electric network of portable or mobile electric appliances (e.g. iron, electric cooker, fridge, electric sewing machine...), as well as in flammable production halls.

ii. Electrodynamic network in industrial enterprises, dwelling-house, public building, shop, when technological process or operation system of the network may cause long-term overload in electric wire and cable.

iii. Various types of electric network in the houses containing explosive substance.

2) Overload protection should be according to the conditions as follows :

a) Fusible wire of fuse or releasing part of breaker must be taken according to the calculated current taking into account of peak load current so that power would not be cut in case of short-term overload (e.g. starting current, technological peak load, automatic starting current...) as prescribed in Table 14.5.1.

b) Permissible continuous current of the electric wire [I]
The value of permissible continuous current of the electric wire is prescribed in Table 14.2.

Table 14.5.1. Overload protection for electric network

Type of electric wire, cable	Permissible continuous current of the electric wire (I_d)
Insulated wire with similar heat-resistant characteristic.	1.25 times greater than nominal current value of fuse wire or the current of breaker with only releasing part that acts momentarily.
Electric cable with paper insulation	Equal to the nominal current of fuse wire or releasing current of breaker with only maximum releasing part that acts momentarily.
Various types of electric wire	Equal to 100% of nominal current of the releasing part of breaker with time depending characteristic that could not be adjusted (not depending on releasing part whether it acts quickly or not).
Electric wire and cable covered by rubber or other material with similar heat-resistant characteristic	Equal to 100% of starting current of releasing part of breaker with adjustable time depending characteristic.
Insulated cable	Equal to 80% of starting current of releasing part of breaker with adjustable time depending characteristic.
Branch wire leading to squirrel-cage rotor motor set in the project without risk of explosion.	Equal to 100% of nominal current of electric motor.

3) The branch line leading to a squirrel-cage motor set separately and protected from overload by breaker or fuse, overload is protected by magnetic starter or breaker with electric switch.

a) For fuse (to ensure not cutting the current in case of overload)

$$I_{dc} \geq I_{kd} / k$$

k = 1.6 for motor with heavily starting condition
k = 2.5 for motor with lightly starting condition.

b) For breaker $I_c \geq 1.25\ I_{kd}$

of which :

I_{dc} : nominal current of fusible wire (ampe)
I_c : releasing current of breaker (ampe)
I_{kd} : starting current of squirrel-cage motor (ampe)

4) For electric lines supplying power to heavy-duty filament lamps (500 - 2000W) and gas discharge lamps (125-1000W) when choosing breaker to protect the line, the starting current should be taken into account.

a) For breaker with magnetic releasing part only :

$$I_c \geq 1.25\ I_{kd}$$

b) For breaker with heat releasing part only :

$$I_{dd} \geq 1.5\ I_N$$

of which :

I_c and I_{kd} - as above
I_{dd} - nominal current (ampe)
I_N - working current of the line (ampe)

Multiple of starting current for a heavy-duty filament lamp ranges from 7 ~ 12 and for high-pressure discharge lamp ranges from 2 ~ 3.

Article 14.6. Arrangement of indoor electric network.

14.6.1. Electric network of indoor lighting group.

1) Nominal current of protecting equipment (fuse or breaker) must :

a) not be higher than 25A ; or

b) be permitted not exceeding 63A for the line of group supplying power to gas-discharge lamp with capacity of 125W each, or higher, filament lamp with capacity of 500W each, or higher.

2) Quantity of lamps connected to each phase of the indoor lighting group must :

a) Not exceeding 20 lamps including sockets; for filament lamp, fluorescent lamp, high-pressure mercury lamp and sodium lamp.

b) Be permitted up to 50 lamps for the line supplying power to lamps of various types of reflector, light ceiling, light raft, fluorescent lamp.

c) Not be limited for the line supplying power to chandeliers.

d) Permitted up to 60 filament lamps with capacity of 60W each, connected to each phase of the line lighting stair, lobby, landing, halls, technical floor, attic floor.

e) For lamp with capacity of 10KW and higher, it is permitted to connect to each phase having not more than one lamp.

14.6.2. Method of arranging electric line.

1) The vertical section supplying power to an apartment must be arranged along the stair room, must not run through the rooms.

Permitted to arrange jointly the line supplying power to apartments with the line lighting the common stair and lobby of the building in a common channel, wire inserting box made of non-flammable material.

2) From the control panel of the floor leading to the control panel of the apartment, it must be put in separate channel or conduit (box).

Article 14.7. General provisions on arrangement of electric line

14.7.1. Electric line system

Electric line system must ensure :

a) Independence in mechanics, electricity from other systems;

b) Easy to replace, repair.

c) Connecting or branching point of electric wire, cable line must ensure sufficient standard of conductivity as a continuous wire, cable line that can not bear the impacting force from outside.

14.7.2. Wiring

1) *It is permitted to arrange jointly electric supply line (except reserving case) in steel conduit or other kinds of pipe with mechanical strength in closed channel and trench, in structures of the building, when :*

a) All circuits belong to the same power using group.

b) Dynamic and control circuits of some electric panels, boxes, control panel and table have technological relation.

c) Circuit supplying power to complex lamp.

d) Circuit of some groups belong to the same lighting form (work lighting and incident lighting) with the number of conductors not exceeding 8.

2) Stand-by circuits as well as working lighting and incident lighting circuits shall not be put jointly in one conduit, box or trench.

3) When placing two electric wires or more in the same conduit, its internal diameter must not be less than 11mm.

4) If nominal load of the alternative current is higher than 25A of single phase, it is not allowed to place the wire in steel conduit pipes and steel-insulation conduit pipes.

5) Connecting and branching wire in closed box (can not be opened), in conduit, in flexible metal conduit placed openly or closely, must be carried out in connecting or branching box. *Inside of the box with demountable cover and in permissibly connecting and branching tray, the electric wire is clamped by special clip with insulated cover to ensure continuous insulation.*

14.7.3. Material of transmission line.

1) Core of the electric wire.

Copper core wire and cable must be used in the following places :

a) In coastal region or areas of chemical active medium with the risk of fire, explosion.

b) In moving parts or vibrating machines.

c) In portable or mobile electric appliances.

d) In important building and apartments that need first class confidence of power supply.

2) Cover of the transmission line :

a) Rubber, lead, aluminum, plastic covered cable is permitted to arrange in wet rooms, or room with the risk of fire and room with temperature not exceeding 40°C.

b) In places with temperature of 40°C or higher, wire and cable with high temperature - resistant insulation and cover must be used or their load must be reduced (according to reducing coefficient stated in Appendix 14.3).

14.7.4. Size of transmission line

1) The permissible continuous current of covered wire and cable must not exceed the values prescribed by the manufacturers and ambient temperature, wiring method should be taken into consideration.

2) Minimum section of the electric wire core

Minimum section of the electric wire core must not less than the values prescribed in Appendix 14.4.

Note:
With 3 phase 4 -wire electric network, when the section of phase wire up to $16mm^2$ (copper) and $25mm^2$ (aluminum), the neutral wire of the vertical line section must have its section equal to the phase wire section. If the phase wire section is greater than these above values, the neutral wire section must not be less than 50% of the phase wire section.

14.7.5. Solution of wiring :

1) Wiring solution must be suited to environment condition, using nature and structural feature, requirements for safety technique and fire-protection.

2) Method of wiring :

a) Electric wire should be placed exposed in the following places :

i) in technical floors, basement, without placing heating equipment, rooms with ventilating machine.

ii) wet rooms such as water pumping station, toilet, bathroom.

b) In toilets, electric wire should be placed open, and covered wire or cable must be used, and it is forbidden to insert covered wire in metal conduit.

c) The line must be enclosed (in the wall, under plaster coat, in conduit or box...) in the rooms with high requirement for hygiene such as nursery, foodstuff processing room, operating room, serum preparing room.

3) Electric grid placed in suspended ceiling without passing people must be considered as closed electric grid, and will be arranged as follows :

a) For the ceiling made of flammable material : inserted in metal conduit (box).

b) For the ceiling made of non-flammable or uninflammable material : inserted in plastic conduit (box), or using cable and wire protected by cover made of uninflammable material, but they must ensure ability of electric line replacement, repair.

4) Connection and branching :

All wire and cable connection and branching must be carried out in joint box and branch box.

5) The line section penetrating through foundation, wall, ceiling, floor, sagging gap, expansion joint.

a) Cable or wire section penetrating through foundation, wall, ceiling and floor of the building must :

i) be placed in steel conduit or pipe with similar rigidity;

ii) internal diameter of the pipe must be of 1.5 times higher than external diameter of the wire or cable.

b. For the section penetrating through a sagging gap, expansion joint : steps should be taken to protect wire, cable from damage.

Article 14.8. Placing indoor open transmission line

Covered wire without protection is placed exposed directly on the surface of pulley, insulator supporting suspended clamp under a taut wire, on a frame, in a tray... must be installed according to the regulations as follows :

14.8.1. Minimum level of wire, tray

1) Minimum level of electric wire compared with the floor surface or working plane must be as follows :

a) 2m : when voltage is over 42V in a dry room and when voltage is up to 42V in wet rooms.

b) 2.5m : when voltage is over 42V, in wet room.

2) *Level is not stipulated for :*

a) Line leading down to lamp switch, socket and device controlling and protecting other electric equipment mounted on the wall,

b) Insulated wire with protecting cover, wire inserted in metal covered insulation conduit, wire and cable inserted in steel pipe, flexible metal pipe as well as flexible rubber cover. At any part of wire and cable that could be mechanically damaged must be protected additionally.

c) The rooms where only trained employees are permitted to come in and go out.

3) In wet rooms, the elevation from floor surface to the soffit of the box, tray must not be less than 2m.

4) Within crane spans, insulated wire without protecting cover must be placed at elevation of at least 2.5m from the crane surface. If this level can not be reached, protecting measure should be taken to avoid carelessly touching the wire (such as placing the wire in pipe, tray).

14.8.2. Protecting the vertical line from mechanical impact.

1) Protection from mechanical impact to the level of at least 1.5m from the floor surface or working plane must be carried out for :

a) Electric cable penetrating through the floor and placed open in vertical (or oblique) direction along the wall.

b) Wire leading down to switch, socket, electric instrument and panel in production building.

2) *Without need of protection from mechanical damage :*

In living service house of enterprise, dwelling house and public building, the wire leading down above said does not need protection from mechanical damage.

14.8.3. *It is permitted to place exposed electric cable with lead cover, aluminium cover, rubber cover, plastic cover in the places where the line will not be destroyed by rodent, without physisco mechanical impact, without corrosive substances.*

14.8.4. Separation between exposed placed wire and structure surface :

The gap between structure surface and the cover of exposed electric wire, cable must be not less than 10mm :

14.8.5. Supporting, suspending wire

1) The conduit of electric wire, cable, protected wire of transmission line must be fixed firmly on a holder.
The distance between the holders is of 0.8 - 1m for the conduit, and 0.5 - 0.7m for protected wire, cable.

2) When using steel wire to suspend electric cable

a) Only allow the suspending wire to bear a force not exceeding 1/4 of stress that breaks this steel wire.

b) The distance between the points of steel wire suspending insulated wire, or cable without steel armoured cover, must not be more than :

i) 1m for electric wire, cable with 1mm core section of $1mm^2$.

ii) 1,5m for electric wire or cable with core section of $1.5mm^2$ or more.

14.8.6. Conduit of wire and cable, joint box, branch box

Conduit of wire and cable, joint box, branch box must ensure :

a) Easy to insert and replace electric wire, cable;

b) Water condensed in the conduit, box can escape outward, and insect can not creep into the conduit, box.

14.8.7. Electric transmission line and other technical pipe lines :

At the cross or parallel intersection between transmission line and technical pipe lines, must :

1) Ensure the distance between covered wire or cable and other pipe line as prescribed in table 14.8.1.

When the distance between the electric line crossing the pile line could not be ensured as prescribed in the table, this electric wire, cable section must be protected from physic-mechanical impact, with the minimum distance of 250mm in each direction of the pipe line.

Table 14.8.1.
Minimum distance between covered wire or cable and other pipe lines

Correlation between electric line and pipe line	Minimum distance between electric line (mm) and :	
	Pipe line conducting fuels, flammable liquid or combustible gas	Other types of pipe line
Crossing each other	100	50
Parallel with each other	400	100

2) Be protected from high temperature for electric lien crossing or paralleling with the heat conducting pipe.

Article 14.9. Installing enclosed electric cabling.

1) Placing enclosed electric cabling in conduit, box and flexible metal pipe must be carried out according to regulations stated in Article 14.8.

2) On the surface of wall, ceiling and flammable structure, insulated conduit and special electric wire must be covered by a layer of amiant sheet of at least 3mm thick or a plaster layer not less than 3mm thick and projecting from the electric wire edge at least 5mm to each direction.

3) Forbid :

a) placing electric wire, cable without protecting cover enclosed directly in or under plaster layer of wall, ceiling and at the places where nail could be driven or hole could be bored.

b) placing pipe line of electric wire buried in a bearing wall, and the depth of the buried trench exceeds 1/3 of the wall thickness.

Article 14.10. Electric line in the attic floor

14.10.1. The form of placing electric line

Its is permitted to place electric line in the attic floor in the forms as follows :

1) Exposed wiring for :

a) Electric wire, cable inserted in the conduit as well as wire, cable with protecting cover made of non - flammable material are installed at any level.

b) Covered single core wire without protecting cover fixed to a ceramic pulley or supporting insulator must be placed at the level not less than 2,5m.

When placing at the level under 2.5m, it must be protected from impacts.

2) Exposed wiring in wall and ceiling built of non-flammable material, including wiring under or in the plastered mortar layer at any level.

3) Electric wire, cable penetrating through a ceiling built of non - flammable material to the attic floor must be inserted in a pipe insulated by non - flammable material.

14.10.2. Material of electric line

1) When placing exposed wire in attic floor, copper core wire, cable must be used.

2) It is permitted to use aluminium core wire, cable only in building with ceiling and roof built of non - flammable material provided that they must be placed in a steel pipe or buried in the wall and roof built of non - flammable material.

3) Wire connecting, branching

a) In attic floor, the electric line is permitted branching to equipment placed outside, but steel pipe must be used, placed exposed or enclosed in the wall and roof built of non - flammable material.

b. In attic floor, wire connecting or branching must be carried - out in metal joint box or branch box made of non-flammable material.

4) Equipment :

Equipment controlling, protecting lighting lamps and other equipment of the attic floor must be installed outside.

Article 14.11. Outdoor electric line

14.11.1. Outdoor electric line must be arranged, or covered in order to ensure safety for people, as stipulated below :

1) The distance between the exposed line and building parts and ground surface must ensure regulations stated in table 14.11.1.

2) If the line is suspended on the pole near the building to lead into the building, the distance between the line and balcony, window in case of maximum deviation caused by wind must not be less than 1.5m.

Table 14.11.1. Minimum distance between the outdoor electric line and building parts, ground surface.

Building part	Minimum distance (m) when the line is placed	
	Horizontally	Vertically
Roof	- above the roof : 2.5m	
Balcony	- above the balcony : 2.50m - under the balcony : 1.00m	1.00m
Window	- above the window : 0.50m - under the window : (from the sill) 1.00m	0.75m
Ground surface	- Above ground surface : 2.75m	

3) The distance from the electric line to the road surface when the line is crossing the motorway, must not be less than 4.5m.

4) The distance between the electric lines at their inlet accessing to the building as well as from the nearest lines to the projecting part (cornice) of the building must not be less than 200mm.

5) For single - story buildings (shop, kiosk, traveling house...), without people accessing to the roof, the distance from electric line accessing to the building and branching to the roof must not be less than 0.5m and the distance from the line to the ground surface must not be less than 2.75m.

14.11.2. In the case, the distance prescribed in Table 14.11.1 are not ensured; the electric wire must be inserted in a conduit, or covered cable must be used.

14.11.3. Inlet entering into the building

1) The inlet penetrating through the wall must be inserted into non-flammable insulated pipe with structure to avoid stagnant water flowing into the building.

2) The inlet entering into the building is permitted to penetrate through the roof but the distance from the supporting insulator of the inlet wire to the roof must not be less than 2.75mm.

14.11.4. The outdoor electric wire, cable placed in steel pipe, box... must be in accordance with regulations stated in Article 14.8. Underground steel pipe must be applied with anti - rust goudron.

Article 14.12. Arrangement of electric lamps

14.12.1. Voltage

1) Voltage supplying to the lamps of common lighting

Voltage supplying to the lamps of common lighting could not exceed :

a) 380/220V for alternative current electric grid with directly earthen neutral.

b) 220 V for separate neutral alternative current grid and direct current electric grid.

2) 3 - phase voltage not exceeding 220 V must be used to supply power to normal lamps.

3) Voltage of fixed filament lamps used for local lighting.

a) In the rooms with little danger, voltage not more than 200V must be used;

b) In the dangerous or very dangerous rooms, the voltage shall not exceed 42V.

c) In dangerous (but not very dangerous) rooms, it is permitted to use a voltage up to 220V for incident lighting system from a power source independent with various kinds of lamps having special structure.

4) Fluorescent lamp used for local lighting.

a) The fluorescent lamp with voltage of 127 - 220V is permitted to use for local lighting, but its electric carrying part must not be touched casually.

b) Fluorescent lamp with special structure is permitted to use for wet rooms with active environment.

5) Voltage supplied to traveling lamps used for local lighting is prescribed as follows :

a) For various kinds of hand - hold lamps

i) It is forbidden to use voltage exceeding 42V in dangerous and very dangerous rooms.

ii) When working in especially disadvantageous conditions such as wet and crowded working place easy to touch a large metal surface with grounding ...voltage not exceeding 12V must be used.

b) For traveling lamps with suspension clip, table lamp, floor lamp... voltage of fixed lamp for local lighting could be used.

14.12.2. Structure to suspend lamp must bear the load equal to 5 times of the lamp weight for 10 minutes without damage and deformation. For public buildings, except special cases, the lamp weight of 15 kg must be counted.

14.12.3. Electric lamps and their components must be installed in such a way they could be maintained easily and safety by normal technical instruments. When this requirement can not be met, specialized equipment such as extension ladder, traveling tower... must be planned. Normal ladder could be used only for the lamp installed at the distance not exceeding 5m from the floor.

Article 14.13. Installing indoor electric equipment

14.13.1. Indoor electric equipment must be selected to comply with the voltage of electric supply network, environment nature and using requirement.

14.13.2. Arrangement of switch, socket

1) The elevation to install socket, switch

a) In the rooms of dwelling house, socket and switch must be fixed at the level of 1.5m apart from the floor, and near the door (to the side of door wing handle), and socket, at 0.3 - 0.5m from the floor, if it is not installed together with the switch in the same panel.

b) In the rooms of public building, socket is permitted to fix at the minimum level of 0.3m from the floor depending on technical requirement, using requirement and interior arrangement.

c) In general education schools, nursery and kindergarten and the places reserved for children, socket and switch must be fixed at the level of 1.7m from the floor.

2) In the shops, restaurants, public services, switches of lamps used for work lighting, incident lighting in the crowded rooms must be fixed at the place where only the manager could control.

3) Sockets fixed in toilets, bathrooms must ensure safety for the users.

14.13.3. Arrangement of electric motor in dwelling house and public building.

1) Electric motor installed in dwelling house and public building must be of enclosed type.

Electric motors of exposed type are permitted to place only in separate room with wall, ceiling and floor built by non-flammable material, and they must be installed apart from flammable parts of the house at least 0.5m.

2) Electric motors jointly used for dwelling house and public works (water pump, ventilating fan, lift...) and their controlling, protecting devices must be arranged in the place where only the manager can access to.

3) Press buttons controlling lift, fire - fighting system, ventilation, water pump... must be fixed at the place convenient for operation, and labels must be put on them for easy identification.

4) Electric motor is permitted to place in attic floor, but not in living rooms, working rooms that must ensure permissible noise.

14.13.4. Supplying power to lift.

1) One electric line just supplies power to not more than 4 lifts arranged at different lift rooms.

2) When a lift room has 2 lifts or more with the same using nature, power must be supplied from different electric lines, directly from MDC. MCP. In this case, the number of lifts connected to each electric line is not limited.

14.13.5. Fire-fighting pump.

1) Electric motor of fire - fighting pump

a) Must be supplied with power as per confidence of power supply to electric consuming household of class I.

b) When there is no stand - by electric motor, the motor of working fire - fighting pump must be supplied with power from two electric lines, one of them must be connected directly to the electric distribution panel of TS, MDC, MDP. Switching from this electric line to the other could be carried - out manually or automatically.

2) Fire - fighting pump control

a) At each indoor fire - fighting jet; turn - on button for fire - fighting pump must be fixed.

b) If the turn-on button is not fixed at water in-taking throat; an water current relay or pressure relay must be installed in the fire-fighting water pipeline to turn-on the water pump automatically when one of these fire-fighting jets is opened.

c) When using remote control for the fire - fighting pump, only switch box is installed at control place, but at place of water pump, both press button box and turn - on/off box must be installed.

14.13.6. Arrangement of electric motor in industrial building.

1) In industrial buildings and production halls of other buildings, when installing electric motors must ensure that water or lubricant will not drop into the winding and joint box, or a type of motor with special protection must be selected.

2) The serving gangway between foundations or motor covers, between the motor and parts of the building or foundation could not be less than 1m wide. At the place where the gangway is narrowed locally by projecting parts of motor, equipment or building parts, this value is permitted to reduce to 0.3m. When there has been a passage at one side, the clear distance between the motors and the wall, or between the motors installed parallelly could not be less than 0.3m.

3) Each electric motor must have its own control device.

For a group of electric motors serving 1 machine or a series of machines with the same technological process, a common starting device or a combined starting device is permitted to use, if they meet the requirement for convenient or safety operation.

4) When electric motor is controlled from some different places, some apparatuses (breaker, switch breaker) must be placed, in order to eliminate the ability of sudden starting the machine that is being repairs.

5) Circuits controlling electric motors must be supplied with power from the main electric circuit. *In case of need and permitted by technical condition, they can be supplied with power from other sources. In order to avoid starting motor suddenly when voltage is restored in the main electric circuit (when sudden starting is not permitted), interlocks must be placed to ensure automatic release of the main electric circuit in all cases of power - cut.*

Article 14.14. Grounding, null connecting.

1) Electric equipment of civil and industrial buildings must be connected to the ground and null as required by the following standards.

- TCVN 4756 - 89 "Electric equipment grounding and null connecting code".
- TCVN 5556 - 91 "Low voltage equipment - General requirement for anti-electrocution".

2) Electric equipment supplied with power from electric system with voltage up to 1000V, having directly earthen neutral, or from single phase power source with directly earthen outlet termination, as well as from DC - 3 line network with directly earthen neutral, must be "null" connected.

3) In the electric system with voltage up to 1000V with isolated neutral or single phase power network with outlet termination isolated from earth, as well as DC electric system with its neutral isolated from earth, used

to supply power to electric equipment in case of requirement for high electric safety (such as traveling electric equipment used for mining).

Electric equipment must be earthen in combination with inspection of insulation of the network or using breaker for protection.

4) The following parts should be earthen or "null" connected.

a) Cover of electric machine, cover of transformer, electric instrument, lighting equipment.

b) Driving parts of electric equipment.

c) Secondary winding of measuring transformer.

d) Frame of electric distribution cabinet, control panel and box, as well as demountable or open parts, if electric equipment has been installed above them.

e) Metal structures of distributing equipment, structure to place cable, metal connection of cable, metal cover of power cable and controlling cable, metal cover of electric wire, metal conduit to insert electric wire, cover and holder of busbar, tray, box, steel cable, and steel bars supporting electric wire and cable (excluding electric wire, cable and bars to place cable, where metal cover or cover has been earthen or "null" connected) as well as other metal structures on which electric equipment is mounted.

g) Metal cover of traveling or hand-hold electric machines.

h) Electric equipment mounted in moving parts of machine and structures.

5) In bathroom, the metal cover of bathsink must be connected to metal water pipe by metal wire.

6) In the rooms with suspended ceiling having metal structure, metal cover, suspended electric lamp or lamps installed in the ceiling, must be "null" connected.

7) In working rooms, when there are steam heater and other metal structures, metal cover of mobile or hand-hold electric appliances, must be "null" connected.

Appendix 14. 1 Definitions

1) Electric equipment and facilities in the building include the whole
   - electric lines (including electric wire and cable)
   - electric using equipment, protecting and measuring instruments from the input to electric consuming households.

2) Transformer station (TS) :
   is the works used for electric power converting and distributing, that includes:
   - transformers, or other electric converters,
   - electric distributors,
   - control apparatuses and auxiliary facilities.

INPUT EQUIPMENT, ELECTRIC DISTRIBUTING PANEL - CABINET, PROTECTING APPARATUS.

3) Input equipment (IE)
   are all structures and equipment placed at the input point of the electric line supplying power to the building.

4) Electric distributing panel, cabinet (EDP, EDC)
   is apparatus used for distributing, controlling and protecting the electric network.
   a) If EDP, EDC is used for the entire building, it is called the main electric distributing panel, cabinet (MDP, MDC)
   b) If it is used for a part, a floor of the building, it is called a group distributing panel, cabinet (GDP, GDC)

   (Called as "panel", when the electric apparatus is arranged open on a panel made of electric isolation material exposed placed. Called as "cabinet", when the electric apparatus is arranged in a steel cabinet).

5) Protecting apparatus
   is an apparatus used for automatically releasing the electric circuit protected in abnormal operating mode.

ELECTRIC LINE, ELECTRIC NETWORK.

6) Electric line
is an assemble of electric wire and cable together with structures and accessories used for fixing and protecting them.

7) Power supply line
is a line from the TS or a line branched from the transmission line to input equipment (IE).
- The main electric line is the line from input equipment (IE) or MCP, MDC to the group control panel, cabinet (GCP, GCC).
- Apartment control panel (ACP) is a group control panel installed in the department.

8) Group electric network
is electric lines from GCP, GCC to electric consuming equipment.

9) Vertical section
is a section placed vertically in the electric network, placed in one building to supply power to its floors.

10) Box
is a structure to place electric wire and cable, placed in a room.

11) Covered wire with protective insulation
is a wire whose insulation surface is covered to protect it from mechanical damage. (Cover of wire with small braided threads is not deemed to be protected).

12) Covered wire without protection
is a wire whose insulation has not a special cover to avoid mechanical damage.

13) Exposed electric cabling
is an electric line exposed to the surface of structural parts (placed on the wall, ceiling, frame, tray ...).
The open electric line can be fixed, traveling and mobile (portable).

14) Enclosed electric cabling
is an electric line buried in structural parts of the building (in the wall, ceiling, floor and roof).

15) Outdoor electric line
is a low-voltage line placed outside the building and serving it. (placed along the external wall surface, under the roof, as well as an electric line connecting the buildings with each other, placed on electric poles, not more than 4 pole spans of not more than 25m each span).

GROUNDING, NULL CONNECTING.

16) Directly grounding neutral
is the neutral of a transformer or generator connected directly to a grounding apparatus or grounded through a small resistance (e.g. through a current converter).

17) Isolation neutral
is the neutral of a transformer or generator that is not connected to a grounding apparatus or connected to a grounding apparatus through a signal transmitter, measuring and protecting apparatus, arc coil that has been grounded and through other similar apparatus with greater resistance.

18) Grounding
is connection of any part of electric equipment to the grounding system.

19) Operation grounding
is grounding of certain point belonging to a conductive part of electric equipment in order to ensure the operation mode of the electric equipment.

20) Grounding system (called grounding apparatus also)
includes all grounding poles and grounding wires

a) Grounding pole includes conductive objects or a group of conductive objects linked each other and contacting directly the ground.

b) Grounding-wire is a conductive wire used to connect the parts that need to be connected to the grounding pole.

21) "Null" - wire protects electric equipment with voltage up to 1000V, it is used for connecting the parts that need to be "null" connected to the neutral directly grounding of transformer or generator in 3-phase electric network; or to the output terminal directly grounded in 1-phase electric source; or to the directly grounded neutral of a DC power source.

22) Operating "Null" wire

is an electric line supplying power to electric equipment. In 3-phase electric network, this electric line is connected to the directly grounding neutral of the generator or transformer. In 1-phase power source, it is connected to the output terminal directly grounded, and in DC electric network, it is connected to the directly grounded neutral.

Appendix 14. 2 Permissible continuous current of electric wire and cable

Table PL 14.2.1.

Copper core, rubber or PVC covered wire

Core section mm^2	Permissible current A					
	Open wire	Jointly inserted in the same conduit				
		2 wires with one core	3 wires with one core	4 wires with one core	1 wire with two cores	1 wire with three cores
0,50	11	-	-	-	-	-
0,75	15	-	-	-	-	-
1,00	17	16	15	14	15	14
1,50	23	19	17	16	18	15
2,50	30	27	25	25	25	21
4,00	41	38	35	30	32	27
6,00	50	46	42	40	40	34
10,00	80	70	60	50	55	50
16,00	100	85	80	15	80	70
25,00	140	115	100	90	100	85
35,00	170	135	125	115	125	100
50,00	215	185	170	150	160	135
70,00	270	225	210	185	195	175
95,00	330	275	255	225	245	215
120,00	385	315	290	260	295	250
150,00	440	360	330	-	-	-
185,00	510	-	-	-	-	-
240,00	605	-	-	-	-	-
300,00	695	-	-	-	-	-
400,00	830	-	-	-	-	-

Table PL 14.2.2.

Copper core - rubber covered wire in metal protecting cover and copper core-rubber covered wire in lead, PVC or rubber cover, with or without steel band

Core section mm^2	Permissible current A(1) Wire & cable				
	One core	Tow cores		Three cores	
	When arranging				
	Overhead	Overhead	Buried	Overhead	Buried
1,5	23	19	33	19	27
2,5	30	27	44	25	38
4	41	38	55	35	49
6	50	50	70	42	60
10	80	70	105	55	90
16	100	90	135	75	115
25	140	115	175	95	150
35	170	140	210	120	180
50	215	175	265	145	225
70	270	215	320	180	275
95	325	260	385	220	300
120	385	300	445	260	385
150	440	350	505	305	435
185	510	401	570	350	500
240	605	-	-	-	-

(1) For electric wire & cable with or without grounded core

Table PL. 14.2.3.

Aluminium - core, rubber or PVC covered wire

Core section mm^2	Permissible current A					
	Open wire	Wires jointly inserted in one conduit				
		2 wires with one core	3 wires with one core	4 wires with one core	1 wire with two cores	1 wire with three cores
2,5	24	20	19	19	19	16
4	32	28	28	23	25	21
6	33	36	32	30	31	26
10	60	50	47	39	42	38
16	75	60	60	55	60	55
25	105	85	80	70	75	65
35	130	100	95	85	95	75
50	165	140	130	120	125	105
70	210	175	165	140	150	135
95	255	215	200	175	190	165
120	295	245	220	200	230	190
150	340	275	255	-	-	-
185	390	-	-	-	-	-
240	465	-	-	-	-	-
300	535	-	-	-	-	-
400	645	-	-	-	-	-

Table PL 14.2.4 : Aluminium core, rubber or PVC covered cable with lead PVC or rubber cover - with or without steel band

Core section mm^2	Permissible current A				
	Wires jointly inserted in one conduit				
	2 wires with one core	3 wires with one core	4 wires with one core	1 wire with two cores	1 wire with three cores
2.5	23	21	34	19	29
4	31	29	42	27	38
6	38	38	55	32	46
10	60	55	80	42	70
16	75	70	105	60	90
25	105	90	135	75	115
35	130	105	160	90	140
50	165	135	205	110	175
70	210	165	245	140	210
95	250	200	395	170	255
120	295	230	340	200	295
150	340	270	390	235	335
185	390	310	440	270	385
240	465	-	-	-	-

Table PL 14.2.5. : Open copper - core cable insulated by pine resin and non-flammable oiled paper, lead or aluminium cover.

Core section mm^2	Permissible current A(1)					
	1- core cable up to 1 KV	2- core cable up to 1 KV	3-core cable			4-core cable
			up to 3KV	up to 6KV	up to 10KV	up to 1 KV
2,5	40	30	28	-	-	-
4	55	40	37	-	-	35
6	75	55	45	-	-	45
10	95	75	60	55	-	60
16	120	85	80	65	60	80
25	160	130	105	90	85	100
35	200	150	125	110	105	120
50	245	185	155	145	135	145
70	305	225	200	175	165	185
95	360	275	245	215	200	215
120	415	320	285	250	240	260
150	470	375	330	290	270	300
185	525	-	375	325	305	346
240	610	-	430	375	350	-
300	720	-	-	-	-	-
400	800	-	-	-	-	-
500	1020	-	-	-	-	-
625	1180	-	-	-	-	-
800	1400	-	-	-	-	-

(1) Current stipulated for 1 core cable when working with direct current

Table PL 14.2.6 : Copper-core cable insulated by pine resin and non-flammable oiled paper, lead or aluminium cover buried in the ground

Core section mm^2	Permissible current A(1)					
	1- core cable up to 1 KV	2- core cable up to 1 KV	3-core cable			4-core cable
			up to 3KV	up to 6KV	up to 10KV	up to 1 KV
2,5	-	45	40	-	-	-
4	80	60	55	-	-	50
6	105	80	70	-	-	60
10	140	105	95	80	-	85
16	175	140	120	105	95	115
25	235	185	160	135	120	150
35	285	225	190	160	150	175
50	360	270	235	200	180	215
70	440	325	285	245	215	265
95	520	380	340	295	265	310
120	595	435	390	340	310	350
150	675	500	435	390	355	395
185	755	-	490	440	400	450
240	880	-	570	510	460	-
300	1000	-	-	-	-	-
400	1220	-	-	-	-	-
500	1400	-	-	-	-	-
625	1520	-	-	-	-	-
800	1700	-	-	-	-	-

(1) Current stipulated for 1-core cable when working with direct current

Table PL 14.2.7 : Open aluminium - core cable insulated by pine resin and non - flammable oiled paper, lead or aluminium cover.

Core section mm^2	Permissible current A(1)					
	1- core cable up to 1 KV	2- core cable up to 1 KV	3 core cable			4 core cable
			up to 3 KV	up to 6KV	up to 10KV	up to 1 KV
2,5	31	23	22	-	-	-
4	42	31	29	-	-	27
6	55	42	35	-	-	35
10	75	55	46	42	-	45
16	90	75	60	50	46	60
25	120	100	80	70	65	75
35	155	115	95	85	80	95
50	190	140	120	110	105	110
70	235	175	155	135	130	140
95	245	210	190	165	155	165
120	320	245	220	190	185	200
150	360	290	255	225	210	230
185	405	-	290	250	235	260
240	470	-	330	290	270	-
300	555	-	-	-	-	-
400	675	-	-	-	-	-
500	785	-	-	-	-	-
625	910	-	-	-	-	-
800	1000	-	-	-	-	-

(1) Current stipulated for 1-core cable when working with direct current

Table PL 14.2.8 : Aluminium - core cable insulated by pine resin and non-flammable oiled paper, lead or aluminium cover buried in the ground

Core section mm^2	Permissible current A(1)					
	1- core cable up to 1 KV	2- core cable up to 1 KV	3- core cable			4- core cable up to 1 KV
			up to 3KV	up to 6KV	up to 10KV	
2,5	-	35	31	-	-	-
4	60	45	42	-	-	38
6	80	60	55	-	-	46
10	110	80	75	60	-	65
16	135	110	90	80	75	90
25	180	140	125	105	90	115
35	220	175	145	125	115	135
50	275	210	180	155	140	165
70	340	250	220	190	165	200
95	400	290	260	225	205	240
120	460	335	300	260	240	270
150	520	385	335	300	275	305
185	580	-	380	340	310	345
240	675	-	440	390	355	-
300	770	-	-	-	-	-
400	940	-	-	-	-	-
500	1080	-	-	-	-	-
625	1170	-	-	-	-	-
800	1310	-	-	-	-	-

(1) Current stipulated for 1- core cable when working with direct current

Appendix 14. 3 Coefficient of ground & air temperature correction, for loading current of cable, bare wire covered wire, bus bar

Calculated temperature of environment (°C)	Rated temperature of core (°C)	Coefficient of correction when actual temperature of environment is (°C)											
		-5	0	+5	+10	+15	+20	+25	+30	+35	+40	+45	+50
15		1.14	1.11	1.08	1.04	1.00	0.96	0.92	0.88	0.83	0.78	0.73	0.63
25	80	1.2	1.20	1.17	1.13	1.09	1.04	1.00	0.95	0.90	0.85	0.80	0.74
25	70	1.29	1.24	1.20	1.15	1.11	1.05	1.00	0.94	0.88	0.81	0.74	0.67
15	65	1.18	1.14	1.10	1.05	1.00	0.95	0.89	0.84	0.77	0.71	0.63	0.55
25		1.32	1.27	1.22	1.17	1.12	1.06	1.00	0.94	0.87	0.79	0.71	0.61
15	60	1.20	1.15	1.12	1.06	1.00	0.94	0.88	0.82	0.75	0.67	0.57	0.47
25		1.36	1.31	1.25	1.20	1.13	1.07	1.00	0.93	0.85	0.76	0.66	0.54
15	55	1.21	1.17	1.12	1.07	1.00	0.93	0.86	0.79	0.71	0.61	0.50	0.36
25		1.41	1.35	1.29	1.23	1.15	1.08	1.00	0.91	0.82	0.71	0.58	0.41
15	50	1.25	1.20	1.14	1.07	1.00	0.93	0.84	0.76	0.66	0.54	0.37	-
25		1.48	1.41	1.34	1.26	1.18	1.09	1.00	0.89	0.78	0.63	0.45	-

Appendix 14. 4 Minimum section of electric wire core

Name of the line	Minimum section of wire core (mm^2)	
	Copper	Aluminum
- Group line of electric lighting system without socket	1,5	2,5
- Group line of electric lighting system, with socket; dynamic electric system, electric grid supplying power to sockets	2,5	4
- Line leading to ADP and electric counter for each apartment.	4	6
- Vertical section in stair room to supply power to the apartments belonging to the intermediate stair area.	6	10

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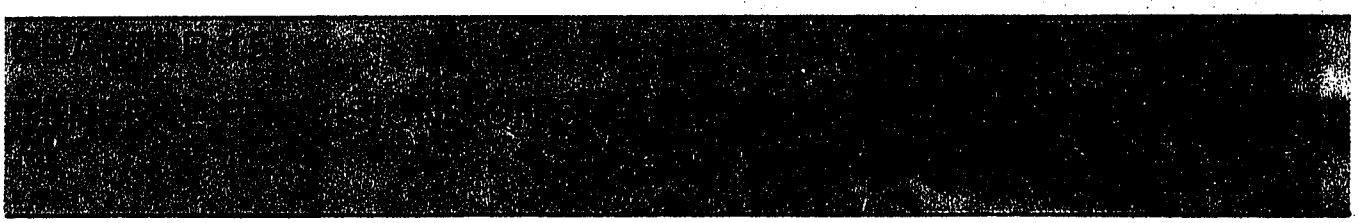

Objective

The objective of this chapter aims to guide designing specialized construction works to meet the requirements stated in Article 1.4. Chapter 1 of the Building Code of Vietnam.

Article 15.1. General requirement for specialized construction works.

Specialized construction works must meet the following requirements :

1) General provisions in the Building Code of Vietnam include :

   a) Chapter 1 : General provision on building code.

   b) Chapter 2 : Natural figures to be used in construction design.

   c) Chapter 3 : Technical condition for designing construction works.

   d) Chapter 4 : General provision on development planning.

2) Requirement for specialized construction works are prescribed in the Code and standard of specialized construction.

Note:
The list of current Vietnam Standards related to designing specialized construction works is given in Appendixes from 15.2. to 15.9 in conjunction with the code according to the framework of international classification standard ICC of the International Standardization Organization - ISO.

Article 15.2. Definitions.

In this Code, the following terms are understood as follows :

15.2.1. Specialized construction works.
are construction works not belonging to civil, industrial works as provided for in Appendix 15.1.

15.2.2. Specialized construction Code.

is a part of the Building Code of Vietnam, stipulating minimum technical requirements that are forced to achieve for specialized construction works, and solutions, standards used for meeting these requirements.

Appendix 15. 1 Classification of specialized construction works

Specialized construction works include, but not limited, the various types of the following works :

1. *Roadway works*
2. *Railway works*
3. *Waterway works*
4. *Airway works*
5. *Hydraulic, Hydro-power works*
6. *Agricultural works*
7. *Forestry works*
8. *Fishery culture works*
9. *Tele-communication works*
10. *Mineral construction works*
11. *Oil and gas exploitation works*
12. *Water supply works*
13. *Water drainage works*
14. *Solid waste treatment works*
15. *National security, defence works*

Appendix 15. 2 The list of current standards on design of specialized construction works

Note:
Code as per ICS is the Code according to the framework of international classification standard of the International standardization Organization ISO.

15.2.1. Traffic works (Code as per ICS : 93)

1) General standards for traffic works

22 TCN 221 - 95	*Traffic works in earthquake zone-Design standard*
22 TCN 220 - 95	*Calculating characteristic of flood flows.*
22 TCN 82 - 85	*Boring process for exploring engineering geology*

2) Roadway works.

TCVN 5729 - 93	*Highway - Design standard.*
TCVN 4054 - 85	*Motorway - Design standard.*
22 TCN 104 - 82	*Technical by-law for designing street, road, urban square.*
22 TCN 210 - 92	*Rural roads*
QPVN 0025 - 83	*By-law of designing motorway for forestry.*
22 TCN 218 - 94	*Technical requirement for vehicle rescue road*
22 TCN 210 - 92	*Hard revetment designing process*
22 TCN 211 - 93	*Soft revetment designing process*
22 TCN 20 - 84	*Process of survey, design, improvement, upgrading of motorway.*
22 TCN 171 - 87	*Process of engineering geology survey and designing solution to stabilize road embankment in area with land sliding and collapsing actions.*

3) Railway works.

TCVN 4117 - 85	*Railway of 1435mm gauge - Design standard.*
No. 433/QD-KT4	*Technical by-law for designing railway of 1000mm gauge.*

4) Bridge works

22 TCN 18 - 79	*Process of designing bridge, sewer according to limiting state.*

5) Tunnel works

TCVN 4527 - 88	*Railway tunnel and motorway tunnel - Design standard.*

6) Port, waterway works

22 TCN 219 - 94	*River harbour works - Design standard.*
22 TCN 207 - 92	*Sea harbour works - Design standard.*
22 TCN 86 - 86	*Process of designing ferry, pontoon bridge - Design standard.*
About to issue	*River waterway training works - Design standard.*

15.2.2. Hydraulic works (Code as per ICS : 93)

1) General standard on hydraulic, hydro-power works.

TCVN 5056 - 90	*Hydraulic works - Main provisions on design.*
TCVN 4116 - 85	*Concrete and reinforced concrete structure for water-power works - Design standard.*
TCVN 4253 - 86	*Footing of water-power works - Design standard.*
14 TCN 011 - 85	*Back filtering stratum, water-power works - Design - by law.*

2) Dam

14 TCN 056 - 88	*Designing concrete and reinforced concrete dam - Design standard*
14 TCN 058 - 88	*Designing underground listel of a dam on the non-stone subbase.*
14 TCN 007 - 85	*Spillway - Hydraulic calculation by-law.*

3) Tunnel, sewer

14 TCN 032 - 85	*Hydraulic tunnel - Design guidance.*
14 TCN 008 - 85	*Sewer in depth - Hydraulic calculation by-law.*

4) Irrigation canal

TCVN 4118 - 85	*Irrigation system - Design standard*

5) River bank protection works

14 TCN 084 - 91	*Anti-flood river bank protection works*

15.2.3. Agricultural, forestry works (Code as per ICS : 65)

1) **General standard**

TCVN 3906 - 84 Agricultural house - geometrical parameters

2) **Livestock-breeding farm**

TCVN 3772 - 83 Pig-breeding farm - Design requirement

TCVN 3773 - 83 Chicken farm - Design requirement

TCVN 3997 - 85 Cattle-breeding farm - Design requirement

3) **Agricultural station**

TCVN 3744 - 83 Rice-breeding station, class 1 - Design requirement

TCVN 4518 - 85 District agricultural engineering station, repairing workshop - Design standard.

TCVN 4089 - 85 District veterinary station - Design requirements.

4) **Agricultural warehouse, agricultural product processing station.**

TCVN 3996 - 85 Rice breed warehouse - Design requirement.

TCVN 3995 - 85 Dry mineral fertilizer warehouse - Design requirement

TCVN 3775 - 83 Farmyard manure compost house - Design requirement.

TCVN 5452 - 91 Abattoir - Hygiene requirement.

5) **Forestry works**

QPVN 0025 - 83 Forestry motorway design by-law

15.2.4. Electric power works (Code as per ICS : 29)

TCVN 3715 - 82 Complete transformer station with power up to 1.000KVA, with voltage up to 20KV - Technical requirement.

TCVN 46756 - 89 By-law for electric equipment grounding and null connection.
Symbolising by figures on electric diagram.

TCVN 1620 - 75	*Power plant and Electric station on power supply diagram.*

15.2.5. Communication works (Code as per ICS : 33).

TCVN 1629 - 75	*Symbolising by figures on electric diagram - Machine, switch and telephone post.*
TCVN 1628 - 75	*Symbolising by figures on electric diagram - Antenna.*

15.2.6. Oil and gas works (Code as per ICS : 75).

1) Exploiting and processing oil and gas.

TCVN 5654 - 92	*By-law for environment protection in crude oil delivering and receiving wharf in the sea.*
TCVN 5655 - 92	*By-law for environment protection in drilling rig for searching, exploring and exploiting oil and gas in the sea.*

2) Exploring and exploiting equipment.

from TCVN 5309-91 to TCVN 5319 - 91	*Offshore drilling platform - Decentralizing and manufacturing.*
TCVN 6171 - 96	*Fixed sea works - Regulations on technical supervision and decentralization.*

3) Oil and gas transportation.

TCVN 4090 - 85	*Main pipeline leading oil and oil product - Design standard.*
TCVN 5066 - 90	*Underground main pipeline leading gas, petrol and petrol product - General requirement for design and anti-corrosion.*

4) Petrol warehouse, station.

TCVN 5307 - 91	*Petrol and petrol products warehouse - Design standard.*
TCVN 4530 - 88	*Petrol supply station for vehicle - Design standard.*
TCVN 5684 - 92	*Safety of petrol works - General requirement.*

15.2.7. Health and environment protection works (Code as per ICS : 13 & 91)

1) Water supply works

20 TCN 33 - 85 *Water supply. Outdoor water supply system and the works. Design standard.*

2) Water drainage works

20 TCN 51 - 84 Water drainage. Outdoor drainage system and the works. Design standard.

Objective

The objective of this Chapter aims to ensure that the process of Construction and Installation implementation must :

1) Protect the environment and ensure safety, hygiene for the population living in the proximity.

2) Ensure safety and normal using condition of the building, technical infrastructure system, protect green trees, historical, cultural relics and famous landscape surrounding the construction site.

Article 16.1. General requirement for the construction site.

During the process of construction, installation, constructing units working in the site must :

1) Not to cause pollution exceeding the permissible level for the environment surrounding the site :

a) Discharge harmful elements such as dust, toxic gas, noise ...

b) Discharge water, mud, wasted materials, soil, sand into the population area, roads, ponds and lakes, planting field surrounding the site that cause bad impact on living and production of the population around.

2) Not to cause danger for the population living surrounding the site.

3) Not to cause sagging, eboulement, cracks, collapse for the surrounding houses, buildings and technical infrastructure (cable system, underground pipeline, sewer, ditches ...) surrounding the site.

4) Not to cause hindrance for traffic activities by encroaching roadway, sidewalk.

5) Not to let events of fire, explosion happening.

Article 16.2. Technical condition to break-ground.

The site will be break-ground only after implementing the following safety regulations.

16.2.1. Designing the construction plan.

Before carrying out construction, every site must design the construction plan.

The construction site must exhibit fully, clearly :

1) Measures to ensure safety, environmental hygiene, fire-protection.

2) Location of buildings will be constructed, the works serving construction, warehouses, yards, roads.

3) The area for arrangement of materials, structural components.

4) The area for gathering wasted materials, excess soil and stone.

5) The road used for traveling, transporting, power and water supply, serving construction and living.

6) Drainage system for rain-water, sewage in the site and treatment measure before discharging them into the public system.

Note:

For a small site, only simple construction plan should be prepared, depending on the works size and actual situation of the area.

16.2.2. Completion of covering, shielding work and signs

1) The site shall be opened only after implementing safety regulations on signs, shielding fence, coverage...

2) At insecure places and necessary places, there must be signs, signals. These signs and signals must be placed at positions easy to identify so that everybody can implement strictly according to the guidance content.

3) There must be a solid fence of more than 2m high surrounding the important or dangerous area.

4) Access and egress gates with guard houses, if necessary, must be arranged sufficiently for the purpose of warning and ensuring safety for people and property.

Article 16.3. Ensure hygiene, safety for the environment surrounding the construction Site.

16.3.1. Maintain hygiene and traffic safety.

1) For the sites located in urban area, transporting structural components, materials, etc. serving construction must observe the regulations issued by the local authority.

(For example: transport at night, truck wheels must be washed before running in the street, usually cleaning the streets surrounding the site...)

2) Transport means used for transporting materials, wasted materials such as soil, stone must have their body to be covered closely and bound firmly to avoid transported objects falling down the road.

16.3.2. Preventing dust, object from falling down at high level

1) When implementing construction of the works near the road or population area, they must be covered to prevent dust, object from falling down on the road or houses.

2) Transporting wasted material from the level of 3m down to the ground must ensure safety, hygiene by using chute or hoisting equipment, their discharge outlet must be at not more than 1m from the ground surface.

16.3.3. Preventing excessive noise, vibration

1) When using machinery construction means, construction solution must be selected suitably with feature, situation and location of the site.

2) For the building adjoining many people's houses and technical infrastructure, priority must be given to the solution that would minimize noise and vibration.

16.3.4. Fire and explosion protection during the construction process

1) Construction units must implement fully measures for fire and explosion protection within the entire site.

2) At places of the site containing flammable materials, petrol, gas bottle, pressure equipment etc. that must be stored apart from population area in accordance with the regulations on fire and explosion protection by arrangement of a separating fence and signs to forbid flame, and forbid people without responsibilities to access to, and at the same time, proper fire-fighting equipment and tools must be arranged and well maintained.

Article 16.4. Protection of technical infrastructure, green trees.

16.4.1. Protection of technical infrastructure.

1) During the construction process, the construction unit must not cause bad impact on the existing technical infrastructure.

2) For the site where technical infrastructure passes through, steps must be taken by the constructing unit to ensure normal operation of this system. The technical infrastructure is permitted to change or move only, after receiving the permit of its changing, moving issued by the infrastructure management agency that will provide with necessary guidance diagram of the entire system and agree with a temporary measure to maintain normal condition for living and production of the people in the area.

16.4.2. Protection of trees.

The constructing unit must be responsible for protecting all green trees existing inside and surrounding the site. Falling down trees must be permitted by the Green trees management agency.

Article 16.5. The end of the construction site.

Before the end of the site, constructing units must put the site in order, neat and clean; remove all excess materials, demolish temporary facilities, repair damaged parts of surrounding road, sidewalk, sewer and trench, technical infrastructure, houses and buildings ... caused by the construction process strictly in accordance with initial agreement or current regulations issued by the Government.

CHAPTER 17
LABOUR SAFETY IN CONSTRUCTION

Objective

The objective of this Chapter aims to ensure :

1) Safety for people, equipment, materials during the process of works preparation and construction.

2) Safety for the works being built and adjacent works.

Article 17.1. General requirement for labour safety in construction.

The contractor must ensure the following requirements for labour safety :

1) Commencement of construction is permitted only after setting up the construction plan as provided in Article 16.2., in which measures to ensure labour safety, labour hygiene, fire and explosion protection are exhibited.

2) Implementing fully policies, system for labour safety, including :

   a) Working and resting time;

   b) Working system for woman labour and juvenile labour;

   c) System of harmful refreshment;

   d) Safety equipment and clothings to protect individual.

3) Measure must be taken to improve working conditions for the workers.

   a) Reducing hard manual works;

   b) Preventing, minimizing the dangerous and harmful factors causing troubles, accidents that badly impact on the health or generate occupational disease.

4) Regulations on labour safety technique and hygiene code must be implemented. There must be labour safety book, and the system of statistics, report, investigation and analysis of the reasons that cause labour accident and occupational disease.

5) Workers that work in the site must meet the requirement of the allotted job in age, sex, health, qualifications of worker grade, and certificate of training on labour safety.

6) All workers working in the site must be provided with and use facilities to protect individual suitable to the nature of job, especially to the case of working in dangerous places such as at a high place, in the shaft, place with the risk of accident caused by electricity, fire, explosion, toxic gas ...

7) Ensuring amenities serving living needs of the worker : toilet, bathroom, rain and sunshine shelter, dining house and mid-shift rest house, first aid place for labour accident.

Article 17.2. Requirement for labour safety technics in construction and installation.

The construction site must ensure all requirements for labour safety, such as :

- Electric safety;
- Safety of fire, explosion with adequate fire-protection facilities;
- Safety of lightning-protection;
- Site hygiene, water drainage, typhoon and flood control;
- Ventilation, lighting, protection against toxic chemical pollution;
- Safety in traffic, road convenient for traveling and transporting with instruction signs, protection net, fence covering dangerous places;
- Labour safety in construction and installation;
- Safety for : driving parts, area under influence of debris flying out in machining process, area under influence of electric conductive parts, radiation sources, electric arc ...

Article 17.3. Technical solutions for labour safety in construction and installation

17.3.1. Solutions complying with the following standards and regulations are deemed to satisfy the requirements for labour safety in construction and installation.

- TCVN 5308 - 91 "Standard of safety technics in construction"
- TCVN 3985 - 85 "Noise - permissible level at working places".
- TCVN 4086 - 95 "Electric safety in construction-General requirement"
- TCVN 3254 - 89 "Safety of fire - General requirement".
- TCVN 3255 - 86 "Safety of explosion - General requirement"
- TCVN 3146 - 86 "Electric welding - General requirement for safety".
- TCVN 4245 - 85 "Standard of safety technics and hygiene technics in production, usage of acetylene, oxygen for metal machining".
- TCVN 3147 - 90 "Standard of safety in loading and unloading - General requirement".
- TCVN 2293 - 87 "Wood processing - General requirement for safety".
- TCVN 2292 - 78 "Painting work - General requirement for safety".
- TCVN 5585 - 91 "Rolling work - Requirement for safety".
- TCVN 4744 - 89 "Standard of safety technics in exploitation and processing exposed stone".
- TCVN 3146 - 86 "Standard of safety in storage, transport and use of explosive materials".
- QPVN 2 - 1975 "By-law of safety technics for pressure bottle".
- TCVN 4244 - 86 "Standard of safety technics for lifting equipment".
- TCVN 5863 - 95 "Lifting equipment - Requirement in installation and usage".

17.3.2. Guidance.

The list of regulations on safety for various kinds of works in construction and installation stated in the main standards of labour safety in construction: TCVN 5308 - 91 "Standard of safety technics in construction is given below" :

1) Safety in organizing construction site.
   TCVN 5308 - 91, Item 2

2) Electric safety :

a) TCVN 5308 - 91, Item 3 : Safety in installation and usage of electric power in construction.

b) TCVN 5308 - 91, Item 2 Installation of electric machines and equipment and electric network (electric machine, transformer, electric network, electric station).

3) Safety in handling and transportation :
TCVN 5808 - 91, Item 4.

4) Safety in using hand-hold tools :

TCVN 5308 - 91, Item 5.

5) Safety in using vehicles, construction machine :

TCVN 5308 - 91, Item 6.

6) Safety in drilling work :

TCVN 5308 - 91, Item 7

7) Safety in erecting, using and dismantling various kinds of scaffolding, support :

TCVN 5308 - 91, Item 8, including :

a) Bamboo scaffolding, wooden scaffolding.

b) Steel scaffolding.

c) Hanging scaffolding, hanging cradle.

d) Traveling elevating tower.

e) Support, console.

g) Ladder.

8) Safety in welding work :

TCVN 5308 - 91, Item 9 including electric welding and gas welding.

9) Safety in using machine in processing workshops.

TCVN 5308 - 91, Item 10.

10) Safety in the work of bitumen, mastic and separating layer.

TCVN 5308 - 91, Item 11.

11) Safety in earthwork.

TCVN 5308 - 91, Item 12, including :

a) Excavating ground with slope.

b) Excavating ground with casing.

c) Manual excavation.

d) Excavating soil by machine.

e) Excavating soil by excavator.

f) Excavating soil by bulldozer.

g) Excavating soil by scraper.

12) Safety in construction of foundation and lowering caisson.

TCVN 5308 - 91, Item 13, including :

a) Building wall foundation.

b) Building pile foundation.

c) Lowering caisson.

13) Safety in production of mortar and concrete.

TCVN 5308 - 91, Item 14, including :

a) Lime slacking.

b) Mixing mortar and concrete.

c) Transporting mortar and concrete.

14) Safety in masonry work.

TCVN 5308 - 91, Item 15, including :

a) Foundation.

b) Wall

c) Chimney

d) Furnace.

15) Safety in formwork, steel reinforcement and concrete work

TCVN 5308 - 91, Item 16, including :

a) Processing, erecting, assembling form.

b) Slip form.

c) Large board form.

d) Processing, erecting and assembling steel reinforcement.

e) Pre-stressed reinforcement.

f) Placing and ramming concrete.

g) Concrete curing.

h) Dismantling form board.

16) Safety in assembling structural components.

TCVN 5308 - 91, Item 17, including :

a) Assembling pre-cast concrete components.

b) Assembling steel works.

17) Safety in roof construction.

TCVN 5308 - 91, Item 18.

18) Safety in finishing work

TCVN 5308 - 91, Item 19, including :

a) Plastering.

b) Liming, painting.

c) Sticking poly-isobutylene.

d) Using sulfur cement and anhydrite paint.

e) Surfacing.

f) Glass.

g) Carpentry.

19) Safety in assembling technological equipment and pipeline.

TCVN 5308 - 91, Item 20, including :

a) Assembling and testing technological equipment.

b) Installing and testing pipe-line.

20) Safety in underground works construction.

TCVN 5308 - 91, Item 21.

21) Safety in demolishing, repairing, expanding buildings and works :

TCVN 5308 - 91, Item 23.