Know your National Building Code

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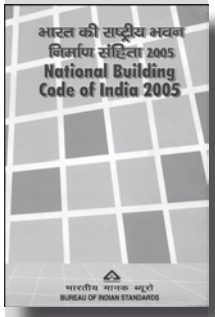
The National Building Code of India is a single document in which, like a network, the information contained in various Indian Standards is woven into a pattern of continuity and cogency with the interdependent requirements of Sections carefully analysed and fitted in to make the whole document a cogent continuous volume. It is a national instrument for helping in controlling the building construction activity across the length and breadth of the country to ensure safe and orderly development. Report I of this 4-part report, outlined the historical development of the National Building Code, while Reports 2 and 3 described the important modifications in NBC 2005. Continuing from Report 3, this report highlights the safety aspects covered by NBC 2005.

8 – The safe building imperative – Relevance of NBC 2005

Standards in Civil Engineering make an enormous contribution for enabling a safer world. Safety considerations have immense importance, which need to be kept in mind and built-in at all stages such as planning, designing, construction, operation and maintenance of civil engineering projects. During the above stages, the aspects like orientation, lighting and ventilation; fire safety provisions; safety through structural design; safety during construction and safety in electrical/other services related aspects; etc, need to be taken care of. A series of Indian Standards have been developed to cover the whole gamut of safety considerations and necessary recommendations have been provided therein for guidance and implementation by all concerned.

The aspects like orientation, lighting and ventilation and functionality have a bearing on hygiene and health of people including workers in industrial units, for which a number of Indian Standards have been formulated covering aspects like day lighting, ventilation, noise reduction, facilities for physically challenged, etc as applicable to various building occupancy types. Fire safety is assuming an increasing importance in view of complexities now encountered in buildings and installations



Report 4 of the 4-part report

built to meet the challenging requirements of today. Indian Standards have, therefore, been developed in the vast area of fire safety covering provisions and guidelines on fire safety of buildings of various types including residential, educational, industrial, etc and their further sub-categories. Structural design of buildings and other structures takes care of various possible loads, forces and effects likely to be encountered during life cycle of building/structure, affecting strength, stability and safety. Loading Codes and Design Codes have, therefore, been developed providing comprehensive guidance to design a structure taking cognizance of dead load, imposed load, wind load, snow load, seismic forces, cyclone resistance and landslide control. Such comprehensive Design Codes are made available for design of stable structures using various material streams like concrete, steel, timber, bamboo, masonry and even using prefabricated construction techniques. Safety during construction is another area which has been given the attention it deserves and a number of Indian Standards covering aspects like safety during excavation, blasting work, tunneling work, deep foundation work, while working at height, handling of materials likely to cause harm, etc, have been formulated. Safety from electrical and allied installations has also been dealt with in number of standards developed in the field. Similarly the standards on drainage and sanitation have an important role to play as regards health and hygiene of occupants/users of buildings. Equally important are the provisions laid down regarding gas supply for ensuring safety.

Specific to buildings, all the above and many other aspects and details have also been in-built and interwoven in the National Building Code of India 2005 (NBC 2005), which can be effectively used as an instrument for regulating the building activity in the country and thereby ensuring implementation of safety aspects dealt with in Indian Standards. The whole Code has been built around the four pillars of safety, namely (i) structural safety, (ii) health safety, (iii) fire safety, and (iv) public safety (encompassing electrical safety and safety during construction). The various provisions of NBC 2005 have been specified after checking them against these safety requirements. Particularly, NBC 2005 provides administrative provisions for implementing the various provisions specially the safety related provisions. The continuous thread of `preplanning' woven itself contributes considerably safety in the construction of building and thereafter in safety of building and its occupants during its use.

The highlights of some of the basic safety provisions are given at **Annex 3**.

Annex 3 – Highlights of safety provisions in NBC 2005

1 Introduction

The safety aspects have been covered mainly in **Part 4** (which comprehensively deals in fire safety aspects for various types of buildings), **Part 6** (which deals in safe structural design of buildings), **Part 7** (which deals in constructional practices and safety) and **Part 8/Section 2** (deals with the safety issues related to electrical and allied services). **Part 9** deals with the public safety by way of provisions for water supply, drainage and sanitation (including solid waste management) and gas supply. **Part 3** of NBC provides the development control rules and general building requirements which have immediate bearing on health, hygiene and safety. **Part 2** covers the provisions for the administration and implementation of the provisions of all the parts of NBC 2005.

2 Administration of the code

2.1 NBC 2005 gives a comprehensive treatment to the requirements for health, hygiene and safety aspects, some of which are given briefly under subsequent paras. However, a well defined system of implementation of such provisions can only ensure that safety is given its due place right from conceptualization till completion of a building project and thereafter during the occupancy life cycle of the constructed/occupied building. NBC 2005, therefore, in its Part 2 Administration gives administrative aspects of the Code, such as applicability of the Code, organization of building department for enforcement of the Code, procedure for obtaining development and building permits, role and responsibilities of the professionals and the owner, etc.

2.2 Sanction for building project

Keeping in view safety considerations, the NBC 2005 provides that for multi-storeyed buildings which are 15 m or more in height and for special buildings like educational, assembly, institutions, industrial, storage and hazardous and mixed occupancies with any of the aforesaid occupancies having covered area more than 500 m^2, the building sanction shall be done in following two stages:

Stage 1 : First stage for planning clearance

Stage 2 : Second stage for building permit clearance.

In Stage 1, apart from submitting the usual plan and details for the sanction of the Authority, a series of details/information has to be submitted such as regarding access for fire vehicles; width/details of existways; location/details of lift enclosures, fire lifts, smoke stop lobby/door, refuse chutes/chambers, service ducts, vehicular parking space generator, transformer and switchgear room; details/location of building services; location/details of fire fighting installations; etc. After obtaining the sanction, for planning (stage 1) from the Authority, a complete set of structural plans, sections, details and design calculations duly signed by engineer/structural engineer along with complete set of details duly approved in Stage 1, shall have to be submitted. The building plans/details shall be deemed sanctioned for the commencement for construction only after obtaining the permit for Stage 2 from the Authority.

NBC 2005 also provides that the plans for sanction shall be accompanied by structural sufficiency certificate signed by engineer/structural engineer and the owner jointly to the effect that the buildings safe against various loads, forces and effects including due to natural disasters, such as, earthquake, landslides, cyclones, floods, etc as per Part 6 Structural Design of NBC 2005 and other relevant Codes. The engineer/structural engineer shall also have the details to substantiate his design. Further, the NBC 2005 provides that the request for sanction shall be accompanied by a certificate from the building professional undertaking the supervision to the effect that the work shall be carried out under his supervision in accordance with the sanctioned plans.

2.3 Inspection

When inspection of any construction operation reveals that any lack of safety precautions exist, the Authority shall have right to direct the owner to stop the work immediately until the necessary remedial measures to remove the violation of safety precautions are taken.

2.4 Execution of Work as per Structural Safety Requirements and Responsibility of Owner

The owner along with the registered engineer/structural engineer shall certify that the building has been constructed according to sanctioned plan and structural design (one set of drawings as executed to be enclosed), which incorporates the provisions of structural safety as specified in Part 6 Structural Design of NBC 2005 and other relevant Codes; and that the construction has been done under their supervision and guidance and adheres to the drawings and specifications submitted and records of supervision have been maintained.

Any subsequent changes made from the completion drawings shall be the responsibility of the owner.

2.5 Periodic Occupancy Renewal Certificate

NBC 2005 provides for periodic occupancy renewal of high rise residential or of special buildings having covered area more than 500 m^2 through physical inspection from safety considerations. Fire Authority shall inspect the building from fire and life safety point of view in accordance with the Provisions given in NBC 2005:Part 4 Fire and Life Safety. Similarly a Team of Multi-Disciplinary Professionals of Authority or by the professionals to whom the Authority may outsource such work, shall inspect the building to ensure compliance to byelaws, natural lighting and ventilation requirements, besides structural and electrical safety. If any shortcoming/deficiencies or violations are noticed during inspection, the Authority shall ensure the compliance of these within a specified time-frame of six months. If not complied with the building shall be declared unsafe. The period of inspection shall usually be 3 to 5 years but in any case not more than 5 years.

2.6 Unsafe Building and Demolition of Building

All unsafe buildings constitute danger to public safety and need to be restored by repairs or demolished or dealt with as otherwise directed by the Authority. NBC 2005 provides detailed provisions as regards examination of unsafe building, notice to owner/occupier, cases of emergency, demolition of building, etc.

3 Development control rules and general building requirements

The requirement of minimum safe distances say from high tension line and open spaces, roads/streets, between adjacent building envelopes, and in and around buildings provide important planning considerations for health safety of occupants of buildings by providing not only safety from electricity, fire, etc but also from the point of view of adequate lighting and ventilation. Similarly, the general building requirements, i.e. the minimum dimensions of various parts of the buildings from functionality point of view, as provided in the Code, have a tremendous contribution in health safety of occupants throughout the life cycle of building.

4 Fire safety provisions

a) For the purpose of fire safety provisions/ requirements, the buildings have been classified as follows, which have been further sub-classified:

   i) Residential (Group A)

   ii) Educational (Group B)

   iii) Institutional (Group C)

   iv) Assembly (Group D)

   v) Business (Group E)

   vi) Mercantile (Group F)

   vii) Industrial (Group G)

   viii) Storage (Group H)

   ix) Hazardous (Group J)

b) As per NBC 2005, a building of height 15 m or above has been classified as high rise building.

c) For high rise buildings noncombustible materials should be used for construction and the internal walls of staircase enclosures should be with minimum of 2 h rating.

d) A building or portion of the building may be occupied during construction, repairs, alterations or additions only if all means of exit and fire protection measures are in place and continuously maintained for the occupied part of the building.

e) A high rise building during construction shall be provided with the following fire protection measures, which shall be maintained in good working condition at all the times:

   i) Dry riser of minimum 100 mm diameter pipe with hydrant outlets on the floors constructed with a fire service inlet

   ii) Drums filled with water of 2 000 litres capacity with two fire buckets on each floor;

f) Smoke venting facilities for safe use of exits in windowless buildings, underground structures, large area factories, hotels and assembly buildings (including cinema halls) shall be automatic in action with manual controls in addition.

g) Natural draft smoke venting shall utilize roof vents or vents in walls at or near the ceiling level; such vents shall be normally open, or, if closed, shall be designed for automatic opening in case of fire, by release of smoke sensitive devices.

h) Where smoke venting facilities are installed for purposes of exit safety, these shall be adequate to prevent dangerous accumulation of smoke during the period of time necessary to evacuate the area served, using available exit facilities with a margin of safety to allow for unforeseen contingencies.

i) An exit may be a doorway; corridor; passageway(s) to an internal staircase, or external staircase, or to a verandah or terrace(s), which have access to the street, or to the roof of a building or a refuge area. An exit may also include a horizontal exit leading to an adjoining building at the same level.

j) Every exit, exit access or exit discharge shall be continuously maintained free of all obstructions or impediments to full use in the case of fire or other emergency.

k) Every building meant for human occupancy shall be provided with exits sufficient to permit safe escape of occupants, in case of fire or other emergency.

l) Exits shall be clearly visible and the route to reach the exits shall be clearly marked and signs posted to guide the occupants of the floor concerned. Signs shall be illuminated and wired to an independent electrical circuit on an alternative source of supply.

m) To prevent spread of fire and smoke, fire doors with 2 h fire resistance shall be provided at appropriate places along the escape route and particularly at the entrance to lift lobby and stair well where a 'funnel or flue effect' may be created, inducing an upward spread of fire.

n) All exits shall provide continuous means of egress to the exterior of a building or to an exterior open space leading to a street.

o) Exits shall be so arranged that they may be reached without passing through another occupied unit.

p) Notwithstanding the detailed provision for exits, the following minimum width shall be provided for staircases –

i) Residential buildings (dwellings) 1.0 m

ii) Residential hotel buildings 1.5 m

iii) Assembly buildings like auditorium, theatres and 2.0 m cinemas

iv) Educational buildings up to 30 m in height 1.5 m

v) Institutional buildings like hospitals 2.0 m

vi) All other buildings 1.5 m

q) The minimum width of tread without nosing shall be 250 mm for internal staircase of residential buildings. This shall be 300 mm for assembly, hotels, educational, institutional, business and other buildings. The treads shall be constructed and maintained in a manner to prevent slipping.

r) The maximum height of riser shall be 190 mm for residential buildings and 150 mm for other buildings and the number shall be limited to 15 per flight.

s) The design of staircase shall also take into account the following:

i The minimum headroom in a passage under the landing of a staircase and under the staircase shall be 2.2 m.

ii) For building 15 m in height or more, access to main staircase shall be through a fire/ smoke check door of a minimum 2-hour fire resistance rating. Fire resistance rating may be reduced to 1 h for residential buildings (except hotels and starred hotels).

iii) No living space, store or other fire risk shall open directly into the staircase or staircases.

iv) External exit door of staircase enclosure at ground level shall open directly to the open spaces or through a large lobby, if necessary.

v) The main and external staircases shall be continuous from ground floor to the terrace level.

vi) No electrical shafts/AC ducts or gas pipes, etc, shall pass through or open in the staircases. Lifts shall not open in staircase.

vii)No combustible material shall be used for decoration/wall paneling in the staircase.

viii) Beams/columns and other building features shall not reduce the head room/ width of the staircase.

ix) The exit sign with arrow indicating the way to the escape route shall be provided at a suitable height from the floor level on the wall and shall be illuminated by electric light connected to corridor circuits. All exit way marking signs should be flush with the wall and so designed that no mechanical damage shall occur to them due to moving of furniture or other heavy equipment. Further, all landings of floor shall have floor indicating boards prominently indicating the number of floor as per byelaws.

The floor indication board shall be placed on the wall immediately facing the flight of stairs and nearest to the landing. It shall be of size not less than 0.5 m x 0.5 m.

x) Individual floors shall be prominently indicated on the wall facing the staircases.

xi) In case of single staircase it shall terminate at the ground floor level and the access to the basement shall be by a separate staircase. The second staircase may lead to basement levels provided the same is separate at ground level by ventilated lobby with discharge points to two different ends through enclosures.

t) *Pressurization of Staircases (Protected Escape Routes)* - Though in normal building design and compartmentation plays a vital part in limiting the spread of fire, smoke will readily spread to adjacent spaces through the various leakage openings in the compartment enclosure, such as cracks, openings around pipes ducts, airflow grills and doors, as perfect sealing of all these openings is not possible. It is smoke and toxic gases, rather than flame, that will initially obstruct the free movement of occupants of the building through the means of escape (escape routes). Hence the

exclusion of smoke and toxic gases from the protected routes is of great importance.

Pressurization is a method adopted for protected escape routes against ingress of smoke, especially in high-rise buildings. In pressurization, air is injected into the staircases, lobbies or corridors, to raise their pressure slightly above the pressure in adjacent parts of the building. As a result, ingress of smoke or toxic gases into the escape routes is prevented. The pressurization of staircases shall be adopted for high rise buildings and building having mixed occupancy/multiplexes having covered area more than 500 m^2.

u) The staircase of basements shall be of enclosed type having fire resistance of not less than 2 h and shall be situated at the periphery of the basement to be entered at ground level only from the open air and in such positions that smoke from any fire in the basement shall not obstruct any exit serving the ground and upper floors of the building.

v) In multi-storey basements, intake ducts may serve all basement levels, but each basement levels and basement compartment shall have separate smoke outlet duct or ducts.

w) Use of basements for kitchens working on gas fuel shall not be permitted, unless air conditioned.

x) All floors shall be compartmented with area not exceeding 750 m^2 by a separation wall with 2 h fire rating, for floors with sprinklers the area may be increased by 50 percent. In long building, the fire separation walls shall be at distances not exceeding 40 m. For departmental stores, shopping centers and basements, the area may be reduced to 500 m^2 for compartmentation. Where this is not possible, the spacing of the sprinklers shall be suitably reduced. When reducing the spacing of sprinklers, care should be taken to prevent spray from one sprinkler impeding the performance of an adjacent sprinkler head.

y) From fire safety point of view, electrical services shall conform to the following:

   i) The electric distribution cables/wiring shall be laid in a separate duct. The duct shall be sealed at every floor with non-combustible materials.

   ii) Separate circuits for fire fighting pumps, lifts, staircases and corridor lighting and blowers for pressurizing system shall be provided directly from the main switch gear panel and these circuits shall be laid in separate conduit pipes, so that any fire in one circuit does not affect the others.

   iii) The inspection panel doors and any other opening in the shaft shall be provided with air-tight fire doors having fire resistance of not less than 2h.

   iv) Medium and low voltage wiring running in shafts, and within false ceiling shall run in metal conduit. Any 230 V wiring for lighting or other services, above false ceiling, shall have 660 V grade insulation.

   v) Suitable circuit breakers shall be provided at the appropriate points.

z) From fire safety point of view, gas supply shall conform to the following:

   i) Town Gas/L.P.Gas Supply Pipes – Where gas pipes are run in buildings, the same shall be run in separate shafts exclusively for this purpose and these shall be on external walls, away from the staircases. There shall no interconnection of this shaft with the rest of the floors.

   ii) All wiring in fume hoods shall be duly insulated. Thermal detectors shall be installed into fume hoods of large kitchens for hotels, hospitals, and similar areas located in high rise buildings. Arrangements shall be made for automatic tripping of the exhaust fan in case of fire; if LPG is used, the same shall be shut off. The voltage shall be 24 V or 100 V dc operated with external rectifier. The valve shall be of the hand re-set type and shall be located in an area segregated from cooking ranges. Valves shall be easily accessible. The hood shall have manual facility for steam or carbon dioxide gas injection, depending on duty condition;

aa) All high rise buildings shall be equipped with manually operated electrical fire alarm (MOEFA) system and automatic fire alarm system.

5 Safety through structural design

Safety through structural design lies in the proper planning and design for the following condition and the combination thereof:

a) Soil liquefaction study and stabilization;

b) Soil shear strength and safe bearing capacity;

c) Load during construction and during the service life. The various loads which need to be considered as applicable and with appropriate load factors for the safety shall be

   i) Dead load or Self weight of building/ structure

   ii) Imposed load

   iii) Earthquake load

   iv) Wind load

   v) Snow load

   vi) Cyclone load

   vii) Landslides

   viii) Loads and effects due to equipments and machinery;

d) Adequate selection of building materials and quality control;

e) Adequate construction and erection techniques; and

f) Quality construction and supervision.

Taking the above into cognizance, the Part 6 of the NBC 2005, through its seven sections provides provisions and good practices for structural adequacy of buildings to deal with both internal and external environment, and provide guidance to engineers/structural engineers for varied usage of material/technology types for building design.

6 Construction safety

The safety of personnel engaged in building construction should be ensured through a well planned and well organized mechanism. For this, depending on the size and complexity of building construction project, as per Part 7 of NBC 2005, safety committee shall be constituted to efficiently manage all safety related affairs. The site in-charge or his nominee of a senior rank shall head the committee and a safety officer shall act as member-secretary. The meetings of the safety committee shall be organized regularly depending on the nature of the project, however, emergency meetings shall be called as and when required. The safety committees shall deal with all the safety related issues through well structured agenda, in the meetings and all safety related measures installed at the site and implementation thereof shall be periodically reviewed. Following safety provisions need to be taken care of:

a) Safety during excavation,

b) Safety during drilling and blasting,

c) Safety during piling and deep foundations,

d) Safety during tunneling,

e) Safety during road making,

f) Safety during site transport,

g) Safety at floor and wall opening,

h) Safety during demolition,

i) Safety during structural steel erection,

j) Safety in construction of concrete framed structure,

k) Safety during material handling,

l) Safety while working in compressed air,

m) Safety in use of tools,

n) Safety in use of construction machinery, and

o) Safety from common hazards.

Particularly persons working at heights may use safety belts and harnesses. Provision of cat-walks, wire mesh, railings reduces chances of fall-ladder and scaffoldings, staging etc should be anchored on firm footing and should be secured and railing should be provided as far as possible. All accesses should be barricaded to prevent

accidental fall. Also, during demolition operation, it should be ensured that:

a) On every demolition job, danger signs shall be conspicuously posted all around the structure and all doors and openings giving access to the structure shall be kept barricaded or manned except during the actual passage of workmen or equipment. However, provisions shall be made for at least two independent exits for escape of workmen during any emergency.

b) During nights, red lights shall be placed on or about all the barricades.

c) All the necessary safety appliances shall be issued to the workers and their use explained. It shall be ensured that the workers are using all the safety appliances while at work.

d) The power on all electrical service lines shall be shut off and all such lines cut or disconnected at or outside the property line, before the demolition work is started. Prior to cutting of such lines, the necessary approval shall be obtained from the electrical authorities concerned. The only exception will be any power lines required for demolition work itself.

e) Adequate natural or artificial lighting and ventilation shall be provided for the workmen.

Notwithstanding the individual standards provisions in NBC 2005 on all the above aspects, Special Publication namely SP 70 `Handbook on Construction Safety Practices' has been prepared for providing guidance in this area.

7 Safety provisions for electrical installations

The safety provisions fo electrical installations have been dealt with in Section 2 of Part 8 Electrical and Allied Installations. Some of the provisions are given hereunder:

a) Location and Requirements of Substation

i) The substation should preferably be located in separate building and could be adjacent to the generator room, if any. Location of substation in the basement floors should be avoided, as far as possible.

ii) The ideal location for an electrical substation for a group of buildings would be at the electrical load centre on the ground floor.

iii) The floor level of the substation or switch room shall be above the highest flood level of the locality.

iv) Substations with oil filled equipment will require great consideration for the fire detection, protection and suppression. Oil cooled transformers require a suitable soak pit with gravity flow to contain the oil in the event of the possibility of oil spillage from the transformer on its failure. Substations with oil filled equipment shall not be located in any floor other than the ground floor or a semi basement. Such substations with high oil content may be housed in a separate service building or a substation building, which is not the part of a multi storeyed building.

v) In case electric substation has to be located within the main multistoreyed building itself for unavoidable reasons, then it should be located on the floor close to ground level, but shall have direct access from the street for operation of the equipment.

vi) Substations located within a multi-storeyed building shall not have oil filled transformers, even if it is at the ground level. Substations with very little combustible material, such as a Dry type transformer, with Vacuum (or SF_6) HT switchgear and ACB or MCCB for MV can be located in the basement as well as upper floors in a building with high load density in the upper floors.

vii) The power supply control to any such substation or transformer (located at basement levels or upper floors) shall be from a location on ground floor/first basement level having direct access from outside so that in case of fire, the electrical supply can be easily disconnected.

viii) Oil filled transformers may be used only in substations located in separate single or two storeyed service buildings outside the main building structure and there shall at least 6 meter clear distance between the adjoining buildings and substation such that fire tender is able to pass between the two structures.

b) Requirement for overhead lines and Cables

i) Any person responsible for erecting an overhead line will keep informed the authority(s) responsible for services in that area for telecommunication, gas distribution, water and sewage network and roads so as to have proper coordination to

ensure safety. He shall also publish the testing, energizing program for the line in the interest of safety.

ii) Any part of an overhead line which is not connected with earth and which is not ordinarily accessible shall be supported on insulators or surrounded by insulation.

iii) Any part of an overhead line which is not connected with earth and which is ordinarily accessible shall be:

1) made dead; or

2) so insulated that it is protected, so far it is reasonably practicable, against mechanical damage or interference; or

3) adequately protected to prevent danger

iv) Any bare conductor not connected with earth, which is part of a low voltage overhead line, shall be situated throughout its length directly above a bare conductor which is connected with earth.

v) No overhead line shall, so far as is reasonably practicable, come so close to any building, tree or structure as to cause danger.

vi) Every support carrying a high voltage overhead line, and every support carrying a low voltage overhead line incorporating bare phase conductors, shall have attached to it sufficient safety signs and placed in such positions as are necessary to give due warning of such danger as is reasonably foreseeable in the circumstances.

vii)Poles supporting overhead lines near the road junctions and turnings shall be protected by a masonry or earth fill structure or metal barricade, to prevent a vehicle from directly hitting the pole, so that the vehicle, if out of control, is restrained from causing total damage to the live conductor system, likely to lead to a hazardous condition on the road or foot path or building.

8 Water supply, drainage, sanitation and gas supply

This part provides important provisions with regard to supply of water which is potable and sufficient to meet the daily needs of occupants of various types of occupancies. It also provides guidelines for minimum standards of sanitation and facilities required therefor apart from solid waste management. It provides necessary provisions and recommendations for proper and efficient drainage. All these features have tremendous impact on health safety of people. A minimum set of safety provisions have also been laid down to safeguard the gas piping installation and the mode of operation in the interest of public safety.

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