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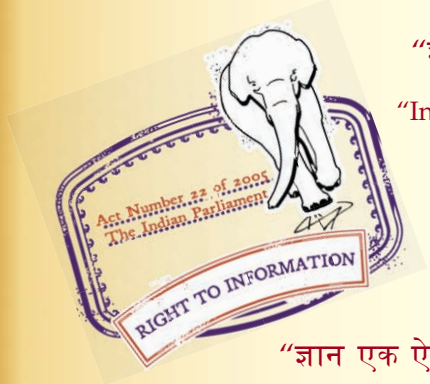
IS 875 (Part 2) (1987, Reaffirmed 2008): Code of Practice for Design Loads (Other Than Earthquake) For Buildings and Structures. Part 2: Imposed Loads (Second Revision). UDC 624.042.3 : 006.76



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IS : 875 (Part 2) - 1987
(Reaffirmed 2008)

Indian Standard

CODE OF PRACTICE FOR DESIGN LOADS (OTHER THAN EARTHQUAKE) FOR BUILDINGS AND STRUCTURES

PART 2 IMPOSED LOADS

(Second Revision)

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
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TO
IS 875 (PART 2) : 1987 CODE OF PRACTICE FOR DESIGN LOADS (OTHER THAN EARTHQUAKE) FOR BUILDINGS AND STRUCTURES

PART 2 IMPOSED LOADS

(Second Revision)

(*Page* 17, *Appendix* A, *clause* **A-1**, *line* 5) — Delete the word 'design'.

(*Page* 17, *Appendix* A, *clause* **A-1**, *last sentence*) — Delete.

(*Page* 17, *Appendix* A, *clause* **A-1.1**, *line* 2) — Insert 'imposed' before 'floor'.

(*Page* 17, *Appendix* A, *clause* **A-1.1**) — Insert the following at the end:

'The discounted loading shown is only indicative of the principle. The actual design load for the column must be based on analysis.'

(*Page* 18, *Fig.* 1) — Substitute the following for the second heading:

'Imposed Floor
Load on Columns at
Different Floors, kN'

(*Page* 18, *Fig.* 1) — Substitute the following for the third heading:

'Discounted Imposed Loading
on Columns, kN'

(CED 37)

Indian Standard

CODE OF PRACTICE FOR DESIGN LOADS (OTHER THAN EARTHQUAKE) FOR BUILDINGS AND STRUCTURES

PART 2 IMPOSED LOADS

(Second Revision)

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CONTENTS

Indian Standard

CODE OF PRACTICE FOR DESIGN LOADS (OTHER THAN EARTHQUAKE) FOR BUILDINGS AND STRUCTURES

PART 2 IMPOSED LOADS

(Second Revision)

0. FOREWORD

0.1 This Indian Standard (Part 2) (Second Revision) was adopted by the Bureau of Indian Standards on 31 August 1987, after the draft finalized by the Structural Safety Sectional Committee had been approved by the Building Division Council.

0.2 A building has to perform many functions satisfactorily. Amongst these functions are the utility of the building for the intended use and occupancy, structural safety, fire safety; and compliance with hygienic, sanitation, ventilation and day light standards. The design of the building is dependent upon the minimum requirements prescribed for each of the above functions. The minimum requirements pertaining to the structural safety of buildings are being covered in this Code by way of laying down minimum design loads which have to be assumed for dead loads, imposed loads, snow loads and other external loads, the structure would be required to bear. Strict conformity to loading standards recommended in this Code, it is hoped, will not only ensure the structural safety of the buildings which are being designed and constructed in the country and thereby reduce the hazards to life and property caused by unsafe structures, but also eliminate the wastage caused by assuming unnecessarily heavy loadings.

0.3 This Code was first published in 1957 for the guidance of civil engineers, designers and architects associated with the planning and design of buildings. It included the provisions for the basic design loads (dead loads, live loads, wind loads and seismic loads) to be assumed in the design of buildings. In its first revision in 1964, the wind pressure provisions were modified on the basis of studies of wind phenomenon and its effects on structures, undertaken by the special committee in consultation with the Indian Meteorological Department. In addition to this, new clauses on wind loads for butterfly type structures were included; wind pressure coefficients for sheeted roofs, both curved and sloping, were modified; seismic load provisions were deleted (separate code having been prepared) and metric system of weights and measurements was adopted.

0.3.1 With the increased adoption of the Code, a number of comments were received on the provisions on live load values adopted for different occupancies. Simultaneously live load surveys have been carried out in America and Canada to arrive at realistic live loads based on actual determination of loading (movable and immovable) in different occupancies. Keeping this in view and other developments in the field of wind engineering, the Sectional Committee responsible for the preparation of the Code has decided to prepare the second revision of IS : 875 in the following five parts :

Part 1 Dead loads

Part 2 Imposed loads

Part 3 Wind loads

Part 4 Snow loads

Part 5 Special loads and load combinations

Earthquake load is covered in a separate standard, namely IS : 1893-1984* which should be considered along with above loads.

0.3.2 This Code (Part 2) deals with imposed loads on buildings produced by the intended occupancy or use. In this revision, the following important changes have been made:

a) The use of the term 'live load' has been modified to 'imposed load' to cover not only the physical contribution due to persons but also due to nature of occupancy, the furniture and other equipments which are a part of the character of the occupancy.

b) The imposed loads on floors and roofs have been rationalized based on the codified data available in large number of latest foreign national standards, and other literature. Further, these values have been spelt out for the major occupancies as classified in the National Building Code of India as well as the various service areas appended to the major occupancies.

*Criteria for earthquake resistant design of structures (*fourth revision*).

c) The reduction of imposed loads for design of vertical supporting members in multi-storeyed buildings has been further increased from 40 to 50 percent.

d) Provision has been included for sign posting of loads on floors in view of the different loadings specified for different occupancies and to avoid possible misuse in view of conversion of occupancies.

e) The value of loads on parapets and balustrades have been revised with its effect taken both in the horizontal and vertical directions.

f) In the design of dwelling units planned and executed in accordance with IS : 8888-1979*, an imposed load of 1·5 kN/m² is allowed.

g) SI Units have been used in the Code.

0.3.3 The buildings and structural systems shall provide such structural integrity that the hazards associated with progressive collapse such as that due to local failure caused by severe overloads or abnormal loads not specifically covered therein are reduced to a level consistent with good engineering practice.

0.3.4 Whenever buildings are designed for future additions of floor at a later date, the number of storeys for which columns/walls, foundations, etc, have been structurally designed may be posted in a conspicuous place similar to posting of floor capacities and both could be placed together.

0.4 The Sectional Committee responsible for the preparation of this Code has taken into account the prevailing practices in regard to loading standards followed in this country by the various municipal authorities and has also taken note of the developments in a number of countries abroad. In the preparation of this Code, the following national standards have been examined :

a) BS 6399 : Part 1 : 1984 Design Loading for Buildings Part 1: Code of Practice for Dead and Imposed Loads. British Standards Institution.

b) AS : 1170, Part I-1983 — SAA Loading Code, Part I Dead and Live Loads. Australian Standards Institution.

c) NZS 4203-1976 New Zealand Standard General Structural Design and Design Loading for Building. Standards Association of New Zealand.

d) ANSI. A 58.1 — 1982 American Standard Building Code Requirements for Minimum Design Loads in Buildings and Other Structures.

e) National Building Code of Canada (1977) Supplement No. 4. Canadian Structural Design Manual.

f) DIN 1055 Sheet 3 — 1971 Design Loads for Buildings — Live Load (West German Loading Standards).

g) ISO 2103-1986 Loads due to use and occupancy in residential and public buildings.

h) ISO 2633-1974 Determination of Imposed Floor Loads in Production Buildings and Warehouses. International Organization for Standardization.

*Guide for requirements of low income housing.

1. SCOPE

1.1 This standard (Part 2) covers imposed loads* (live loads) to be assumed in the design of buildings. The imposed loads, specified herein, are minimum loads which should be taken into consideration for the purpose of structural safety of buildings.

1.2 This Code does not cover detailed provisions for loads incidental to construction and special cases of vibration, such as moving machinery, heavy acceleration from cranes, hoists and the like. Such loads shall be dealt with individually in each case.

2. TERMINOLOGY

2.0 For the purpose of this Code, the following definitions shall apply.

*The word 'imposed load' is used through out instead of 'live load' which is synonymous.

2.1 **Imposed Load** — The load assumed to be produced by the intended use or occupancy of a building, including the weight of movable partitions, distributed, concentrated loads, load due to impact and vibration, and dust load but excluding wind, seismic, snow and other loads due to temperature changes, creep, shrinkage, differential settlement, etc.

2.2 **Occupancy or Use Group** — The principal occupancy for which a building or part of a building is used or intended to be used; for the purpose of classification of a building according to occupancy, an occupancy shall be deemed to include subsidiary occupancies which are contingent upon it. The occupancy classification is given from 2.2.1 to 2.2.8.

2.2.1 *Assembly Buildings* — These shall include any building or part of a building where groups of people congregate or gather for amusement, recreation, social, religious, patriotic, civil, travel and similar purposes, for example, theatres, motion picture houses, assembly halls, city halls,

marriage halls, town halls, auditoria, exhibition halls, museums, skating rinks, gymnasiums, restaurants (also used as assembly halls), places of worship, dance halls, club rooms, passenger stations and terminals of air, surface and other public transportation services, recreation piers and stadia, etc.

2.2.2 *Business Buildings* — These shall include any building or part of a building, which is used for transaction of business (other than that covered by 2.2.6); for the keeping of accounts and records for similar purposes; offices, banks, professional establishments, court houses, and libraries shall be classified in this group so far as principal function of these is transaction of public business and the keeping of books and records.

2.2.2.1 *Office buildings* — The buildings primarily to be used as an office or for office purposes; 'office purposes' include the purpose of administration, clerical work, handling money, telephone and telegraph operating and operating computers, calculating machines; 'clerical work' includes writing, book-keeping, sorting papers, typing, filing, duplicating, punching cards or tapes, drawing of matter for publication and the editorial preparation of matter for publication.

2.2.3 *Educational Buildings* — These shall include any building used for school, college or day-care purposes involving assembly for instruction, education or recreation and which is not covered by 2.2.1.

2.2.4 *Industrial Buildings* — These shall include any building or a part of a building or structure in which products or materials of various kinds and properties are fabricated, assembled or processed like assembly plants, power plants, refineries, gas plants, mills, dairies, factories, workshops, etc.

2.2.5 *Institutional Buildings* — These shall include any building or a part thereof, which is used for purposes, such as medical or other treatment in case of persons suffering from physical and mental illness, disease or infirmity; care of infants, convalescents of aged persons and for penal or correctional detention in which the liberty of the inmates is restricted. Institutional buildings ordinarily provide sleeping accommodation for the occupants. It includes hospitals, sanitoria, custodial institutions or penal institutions like jails, prisons and reformatories.

2.2.6 *Mercantile Buildings* — These shall include any building or a part of a building which is used as shops, stores, market for display and sale of merchandise either wholesale or retail. Office, storage and service facilities incidental to the sale of merchandise and located in the same building shall be included under this group.

2.2.7 *Residential Buildings* — These shall include any building in which sleeping accommodation is provided for normal residential purposes with or without cooking or dining or both facilities (except buildings under 2.2.5). It includes one or multi-family dwellings, apartment houses (flats), lodging or rooming houses, restaurants, hostels, dormitories and residential hotels.

2.2.7.1 *Dwellings* — These shall include any building or part occupied by members of single/multi-family units with independent cooking facilities. These shall also include apartment houses (flats).

2.2.8 *Storage Buildings* — These shall include any building or part of a building used primarily for the storage or sheltering of goods, wares or merchandize, like warehouses, cold storages, freight depots, transity sheds, store houses, garages, hangers, truck terminals, grain elevators, barns and stables.

3. IMPOSED LOADS ON FLOORS DUE TO USE AND OCCUPANCY

3.1 Imposed Loads — The imposed loads to be assumed in the design of buildings shall be the greatest loads that probably will be produced by the intended use or occupancy, but shall not be less than the equivalent minimum loads specified in Table 1 subject to any reductions permitted by 3.2.

Floors shall be investigated for both the uniformly distributed load (UDL) and the corresponding concentrated load specified in Table 1 and designed for the most adverse effects but they shall not be considered to act simultaneously. The concentrated loads specified in Table 1 may be assumed to act over an area of 0·3 × 0·3 m. However, the concentrated loads need not be considered where the floors are capable of effective lateral distribution of this load.

All other structural elements shall be investigated for the effects of uniformly distributed loads on the floors specified in Table 1.

NOTE 1 — Where in Table 1, no values are given for concentrated load, it may be assumed that the tabulated distributed load is adequate for design purposes.

NOTE 2 — The loads specified in Table 1 are equivalent uniformly distributed loads on the plan area and provide for normal effect of impact and acceleration. They do not take into consideration special concentrated loads and other loads.

NOTE 3 — Where the use of an area or floor is not provided in Table 1, the imposed load due to the use and occupancy of such an area shall be determined from the analysis of loads resulting from:

a) weight of the probable assembly of persons;

b) weight of the probable accumulation of equipment and furnishing;

c) weight of the probable storage materials; and

d) impact factor, if any.

TABLE 1 IMPOSED FLOOR LOADS FOR DIFFERENT OCCUPANCIES

(*Clauses* 3.1, 3.1.1 *and* 4.1.1)

Sl No.	Occupancy Classification	Uniformly Distributed Load (UDL)	Concentrated Load
(1)	(2)	(3)	(4)
		kN/m²	kN
i)	RESIDENTIAL BUILDINS		
	a) Dwelling houses:		
	1) All rooms and kitchens	2·0	1·8
	2) Toilet and bath rooms	2·0	—
	3) Corridors, passages, staircases including fire escapes and store rooms	3·0	4·5
	4) Balconies	3.0	1·5 per metre run concentrated at the outer edge
	b) Dwelling units planned and executed in accordance with IS : 8888-1979* only:		
	1) Habitable rooms, kitchens, toilet and bathrooms	1·5	1·4
	2) Corridors, passages and staircases including fire escapes	1·5	1·4
	3) Balconies	3·0	1·5 per metre run concentrated at the outer edge
	c) Hotels, hostels, boarding houses, lodging houses, dormitories, residential clubs:		
	1) Living rooms, bed rooms and dormitories	2·0	1·8
	2) Kitchens and laundries	3·0	4·5
	3) Billiards room and public lounges	3·0	2·7
	4) Store rooms	5·0	4·5
	5) Dining rooms, cafeterias and restaurants	4·0	2·7
	6) Office rooms	2·5	2·7
	7) Rooms for indoor games	3·0	1·8
	8) Baths and toilets	2·0	—
	9) Corridors, passages, staircases including fire escapes, lobbies — as per the floor serviced (excluding stores and the like) but not less than	3·0	4·5
	10) Balconies	Same as rooms to which they give access but with a minimum of 4·0	1·5 per metre run concentrated at the outer edge
	d) Boiler rooms and plant rooms — to be calculated but not less than	5·0	6·7

(*Continued*)

TABLE 1 IMPOSED FLOOR LOADS FOR DIFFERENT OCCUPANCIES — *Contd*

Sl No.	Occupancy Classification	Uniformly Distributed Load (UDL)	Concentrated Load
(1)	(2)	(3)	(4)
		kN/m²	kN
	e) Garages:		
	1) Garage floors (including parking area and repair workshops) for passenger cars and vehicles not exceeding 2·5 tonnes gross weight, including access ways and ramps — to be calculated but not less than	2·5	9·0
	2) Garage floors for vehicles not exceeding 4·0 tonnes gross weight (including access ways and ramps) — to be calculated but not less than	5·0	9·0
ii)	EDUCATIONAL BUILDINGS		
	a) Class rooms and lecture rooms (not used for assembly purposes)	3·0	2·7
	b) Dining rooms, cafeterias and restaurants	3·0†	2·7
	c) Offices, lounges and staff rooms	2·5	2·7
	d) Dormitories	2·0	2·7
	e) Projection rooms	5·0	—
	f) Kitchens	3·0	4·5
	g) Toilets and bathrooms	2·0	—
	h) Store rooms	5·0	4·5
	j) Libraries and archives:		
	1) Stack room/stack area	6·0 kN/m² for a minimum height of 2·2 m + 2·0 kN/m² per metre height beyond 2·2 m	4·5
	2) Reading rooms (without separate storage)	4·0	4·5
	3) Reading rooms (with separate storage	3·0	4·5
	k) Boiler rooms and plant rooms — to be calculated but not less than	4·0	4·5
	m) Corridors, passages, lobbies, staircases including fire escapes — as per the floor serviced (without accounting for storage and projection rooms) but not less than	4·0	4·5
	n) Balconies	Same as rooms to which they give access but with a minimum of 4·0	1·5 per metre run concentrated at the outer edge
iii)	INSTITUTIONAL BUILDINGS		
	a) Bed rooms, wards, dressing rooms, dormitories and lounges	2·0	1·8
	b) Kitchens, laundries and laboratories	3·0	4·5

(*Continued*)

TABLE 1 IMPOSED FLOOR LOADS FOR DIFFERENT OCCUPANCIES — *Contd*

Sl. No.	Occupancy Classification	Uniformly Distributed Load (UDL)	Concentrated Load
(1)	(2)	(3)	(4)
		kN/m²	kN
	c) Dining rooms, cafeterias and restaurants	3·0†	2·7
	d) Toilets and bathrooms	2·0	—
	e) X-ray rooms, operating rooms, general storage areas — to be calculated but not less than	3·0	4·5
	f) Office rooms and OPD rooms	2·5	2·7
	g) Corridors, passages, lobbies and staircases including fire escapes — as per the floor serviced but not less than	4·0	4·5
	h) Boiler rooms and plant rooms — to be calculated but not less than	5·0	4·5
	j) Balconies	Same as the rooms to which they give access but with a minimum of 4·0	1·5 per metre run concentrated at the outer edge
iv)	ASSEMBLY BUILDINGS		
	a) Assembly areas:		
	1) with fixed seats‡	4·0	—
	2) without fixed seats	5·0	3·6
	b) Restaurants (subject to assembly), museums and art galleries and gymnasia	4·0	4·5
	c) Projection rooms	5·0	—
	d) Stages	5·0	4·5
	e) Office rooms, kitchens and laundries	3·0	4·5
	f) Dressing rooms	2·0	1·8
	g) Lounges and billiards rooms	2·0	2·7
	h) Toilets and bathrooms	2·0	—
	j) Corridors, passages, staircases including fire escapes	4·0	4·5
	k) Balconies	Same as rooms to which they give access but with a minimum of 4·0	1·5 per metre run concentrated at the outer edge
	m) Boiler rooms and plant rooms including weight of machinery	7·5	4·5
	n) Corridors, passages subject to loads greater than from crowds, such as wheeled vehicles, trolleys and the like. Corridors, staircases and passages in grandstands	5·0	4·5
v)	BUSINESS AND OFFICE BUILDINGS (*see also* 3.1.2		
	a) Rooms for general use with separate storage	2·5	2·7
	b) Rooms without separate storage	4·0	4·5

(*Continued*)

TABLE 1 IMPOSED FLOOR LOADS FOR DIFFERENT OCCUPANCIES — *Contd*

Sl No.	Occupancy Classification	Uniformly Distributed Load (UDL)	Concentrated Load
(1)	(2)	(3)	(4)
		kN/m²	kN
	c) Banking halls	3·0	2·7
	d) Business computing machine rooms (with fixed computers or similar equipment)	3·5	4·5
	e) Records/files store rooms and storage space	5·0	4·5
	f) Vaults and strong room — to be calculated but not less than	5·0	4·5
	g) Cafeterias and dining rooms	3·0†	2·7
	h) Kitchens	3·0	2 7
	j) Corridors, passages, lobbies and staircases including fire escapes — as per the floor serviced (excluding stores) but not less than	4·0	4·5
	k) Bath and toilet rooms	2·0	—
	m) Balconies	Same as rooms to which they give access but with a minimum of 4·0	1·5 per metre run concentrated at the outer edge
	n) Stationary stores	4·0 for each metre of storage height	9·0
	p) Boiler rooms and plant rooms — to be calculated but not less than	5·0	6.7
	q) Libraries	*see* Sl No. (ii)	
vi)	MERCANTILE BUILDINGS		
	a) Retail shops	4·0	3·6
	b) Wholesale shops — to be calculated but not less than	6·0	4·5
	c) Office rooms	2·5	2·7
	d) Dining rooms, restaurants and cafeterias	3·0†	2.7
	e) Toilets	2·0	—
	f) Kitchens and laundries	3·0	4·5
	g) Boiler roooms and plant rooms — to be calculated but not less than	5·0	6·7
	h) Corridors, passages, staircases including fire escapes and lobbies	4·0	4·5
	j) Corridors, passages, staircases subject to loads greater than from crowds, such as wheeled vehicles, trolleys and the like	5·0	4·5
	k) Balconies	Same as rooms to which they give access but with a minimum of 4·0	1·5 per metre run concentrated at the outer edge

(*Continued*)

TABLE 1 IMPOSED FLOOR LOADS FOR DIFFERENT OCCUPANCIES — *Contd*

Sl No.	Occupancy Classification	Uniformly Distributed Load (UDL)	Concentrated Load
(1)	(2)	(3)	(4)
		kN/m²	kN
vii)	INDUSTRIAL BUILDINGS		
a)	Work areas without machinery/ equipment	2·5	4·5
b)	Work areas with machinery/equipment§		
	1) Light duty) To be calculated but not less than	5·0	4·5
	2) Medium duty)	7·0	4·5
	3) Heavy duty)	10·0	4·5
c)	Boiler rooms and plant rooms — to be calculated but not less than	5·0	6·7
d)	Cafeterias and dining rooms	3·0†	2·7
e)	Corridors, passages and staircases including fire escapes	4·0	4·5
f)	Corridors, passages, staircases subject to machine loads, wheeled vehicles — to be calculated but not less than	5·0	4·5
g)	Kitchens	3·0	4·5
h)	Toilets and bathrooms	2·0	—
viii)	STORAGE BUILDINGS ‖		
a)	Storage rooms (other than cold storage) warehouses — to be calculated based on the bulk density of materials stored but not less than	2·4 kN/m² per each metre of storage height with a minimum of 7·5 kN/m²	7·0
b)	Cold storage — to be calculated but not less than	5·0 kN/m² per each metre of storage height with a minimum of 15 kN/m²	9·0
c)	Corridors, passages and staircases including fire escapes — as per the floor serviced but not less than	4·0	4·5
d)	Corridors, passages subject to loads greater than from crowds, such as wheeled vehicles, trolleys and the like	5·0	4·5
e)	Boiler rooms and plant rooms	7·5	4·5

*Guide for requirements of low income housing.

†Where unrestricted assembly of persons is anticipated, the value of UDL should be increased to 4·0 kN/m².

‡'With fixed seats' implies that the removal of the seating and the use of the space for other purposes is improbable. The maximum likely load in this case is, therefore, closely controlled.

§The loading in industrial buildings (workshops and factories) varies considerably and so three loadings under the terms 'light', 'medium' and 'heavy' are introduced in order to allow for more economical designs but the terms have no special meaning in themselves other than the imposed load for which the relevant floor is designed. It is, however, important particularly in the case of heavy weight loads, to assess the actual loads to ensure that they are not in excess of 10 kN/m²; in case where they are in excess, the design shall be based on the actual loadings.

For various mechanical handling equipment which are used to transport goods, as in warehouses, workshops, store rooms, etc, the actual load coming from the use of such equipment shall be ascertained and design should cater to such loads.

NOTE 4 — While selecting a particular loading, the possible change in use or occupancy of the building should be kept in view. Designers should not necessarily select in every case the lower loading appropriate to the first occupancy. In doing this, they might introduce considerable restrictions in the use of the building at a later date and thereby reduce its utility.

NOTE 5 — The loads specified herein which are based on estimations, may be considered as the characteristic loads for the purpose of limit state method of design till such time statistical data are established based on load surveys to be conducted in the country.

NOTE 6 — When an existing building is altered by an extension in height or area, all existing structural parts affected by the addition shall be strengthened, where necessary, and all new structural parts shall be designed to meet the requirements for building thereafter erected.

NOTE 7 — The loads specified in the Code does not include loads incidental to construction. Therefore, close supervision during construction is essential to ensure that overloading of the building due to loads by way of stacking of building materials or use of equipment (for example, cranes and trucks) during construction or loads which may be induced by floor to floor propping in multi-storeyed construction, does not occur. However, if construction loads were of short duration, permissible increase in stresses in the case of working stress method or permissible decrease in load factors in limit state method, as applicable to relevant design codes, may be allowed for.

NOTE 8 — The loads in Table 1 are grouped together as applicable to buildings having separate principal occupancy or use. For a building with multiple occupancies, the loads appropriate to the occupancy with comparable use shall be chosen from other occupancies.

NOTE 9 — Regarding loading on machine rooms including storage space used for repairing lift machines, designers should go by the recommendations of lift manufacturers for the present. Regarding the loading due to false ceiling the same should be considered as an imposed load on the roof/floor to which it is fixed.

3.1.1 *Load Application* — The uniformly distributed loads specified in Table 1 shall be applied as static loads over the entire floor area under consideration or a portion of the floor area whichever arrangement produces critical effects on the structural elements as provided in respective design codes.

In the design of floors, the concentrated loads are considered to be applied in the positions which produce the maximum stresses and where deflection is the main criterion, in the positions which produce the maximum deflections. Concentrated load, when used for the calculation of bending and shear are assumed to act at a point. When used for the calculation of local effects, such as crushing or punching, they are assumed to act over an actual area of application of 0·3 × 0·3 m.

3.1.2 *Loads Due to Light Partitions* — In office and other buildings where actual loads due to light partitions cannot be assessed at the time of planning, the floors and the supporting structural members shall be designed to carry, in addition to other loads, a uniformly distributed load per square metre of not less than 33⅓ percent of weight per metre run of finished partitions, subject to a minimum of 1 kN/m², provided total weight of partition walls per square metre of the wall area does not exceed 1·5 kN/m² and the total weight per metre length is not greater than 4·0 kN.

3.2 Reduction in Imposed Loads on Floors

3.2.1 *For Floor Supporting Structural Members* — Except as provided for in 3.2.1.1, the following reductions in assumed total imposed loads on floors may be made in designing columns, load bearing walls, piers, their supports and foundations.

Number of Floors (Including the Roof) to be Carried by Member under Consideration	*Reduction in Total Distributed Imposed Load on all Floors to be Carried by the Member under Consideration (Percent)*
1	0
2	10
3	20
4	30
5 to 10	40
Over 10	50

3.2.1.1 No reduction shall be made for any plant or machinery which is specifically allowed for, or in buildings for storage purposes, warehouses and garages. However, for other buildings where the floor is designed for an imposed floor load of 5·0 kN/m² or more, the reductions shown in 3.2.1 may be taken, provided that the loading assumed is not less than it would have been if all the floors had been designed for 5·0 kN/m² with no reductions.

NOTE — In case if the reduced load in the lower floor is lesser than the reduced load in the upper floor, then the reduced load of the upper floor will be adopted.

3.2.1.2 An example is given in Appendix A illustrating the reduction of imposed loads in a multi-storeyed building in the design of column members.

3.2.2 *For Beams in Each Floor Level* — Where a single span of beam, girder or truss supports not less than 50 m² of floor at one general level, the imposed floor load may be reduced in the design of the beams, girders or trusses by 5 percent for each 50 m² area supported subject to a maximum reduction of 25 percent. However, no reduction shall be made in any of the following types of loads:

a) Any superimposed moving load,

b) Any actual load due to machinery or similar concentrated loads,

c) The additional load in respect of partition walls, and

d) Any impact or vibration.

NOTE — The above reduction does not apply to beams, girders or trusses supporting roof loads.

3.3 Posting of Floor Capacities — Where a floor or part of a floor of a building has been designed to sustain a uniformly distributed load exceeding 3·0 kN/m² and in assembly, business, mercantile, industrial or storage buildings, a permanent notice in the form as shown in the label, indicating the actual uniformly distributed and/or concentrated loadings for which the floor has been structurally designed shall be posted in a conspicuous place in a position adjacent to such floor or on such part of a floor.

DESIGNED IMPOSED FLOOR LOADING

DISTRIBUTED.....kN/m²

CONCENTRATED.....kN

LABEL INDICATING DESIGNED IMPOSED FLOOR LOADING

NOTE 1 — The lettering of such notice shall be embossed or cast suitably on a tablet whose least dimension shall be not less than 0·25 m and located not less than 1·5 m above floor level with lettering of a minimum size of 25 mm.

NOTE 2 — If a concentrated load or a bulk load has to occupy a definite position on the floor, the same could also be indicated in the label above.

4. IMPOSED LOADS ON ROOFS

4.1 Imposed Loads on Various Types of Roofs — On flat roofs, sloping roofs and curved roofs, the imposed loads due to use or occupancy of the buildings and the geometry of the types of roofs shall be as given in Table 2.

4.1.1 Roofs of buildings used for promenade or incidental to assembly purposes shall be designed for the appropriate imposed floor loads given in Table 1 for the occupancy.

4.2 Concentrated Load on Roof Coverings — To provide for loads incidental to maintenance, unless otherwise, specified by the Engineer-in-Charge, all roof coverings (other than glass or transparent sheets made of fibre glass) shall be capable of carrying an incidental load of 0·90 kN concentrated on an area of 12·5 cm² so placed as to produce maximum stresses in the covering. The intensity of the concentrated load may be reduced with the approval of the Engineer-in-Charge, where it is ensured that the roof coverings would not be transversed without suitable aids. In any case, the roof coverings shall be capable of carrying the loads in accordance with 4.1, 4.3, 4.4 and snow load/wind load.

4.3 Loads Due to Rain — On surfaces whose positioning, shape and drainage systems are such as to make accumulation of rain water possible, loads due to such accumulation of water and the imposed loads for the roof as given in Table 2 shall be considered separately and the more critical of the two shall be adopted in the design.

4.4 Dust Load — In areas prone to settlement of dust on roofs (example, steel plants, cement plants), provision for dust load equivalent to probable thickness of accumulation of dust may be made.

4.5 Loads on Members Supporting Roof Coverings — Every member of the supporting structure which is directly supporting the roof covering(s) shall be designed to carry the more severe of the following loads except as provided in 4.5.1 :

a) The load transmitted to the members from the roof covering(s) in accordance with 4.1, 4.3 and 4.4; and

b) An incidental concentrated load of 0·90 kN concentrated over a length of 12·5 cm placed at the most unfavourable positions on the member.

NOTE — Where it is ensured that the roofs would be traversed only with the aid of planks and ladders capable of distributing the loads on them to two or more supporting members, the intensity of concentrated load indicated in (b) may be reduced to 0·5 kN with the approval of the Engineer-in-Charge.

4.5.1 In case of sloping roofs with slope greater than 10°, members supporting the roof purlins, such as trusses, beams, girders, etc, may be designed for two-thirds of the imposed load on purlins or roofing sheets.

5. IMPOSED HORIZONTAL LOADS ON PARAPETS AND BALUSTRADES

5.1 Parapets, Parapet Walls and Balustrades — Parapets, parapet walls and balustrades together with the members which give them structural support shall be designed for the minimum loads given in Table 3. These are expressed as horizontal forces acting at handrail or coping level These loads shall be considered to act vertically also but not simultaneously with the horizontal forces. The values given in Table 3 are minimum values and where values for actual loadings are available, they shall be used instead.

5.2 Grandstands and the Like—Grandstands, stadia, assembly platforms, reviewing stands and the like shall be designed to resist a horizontal force applied to seats of 0·35 kN per linear metre

along the line of seats and 0·15 kN per linear metre perpendicular to the line of the seats. These loadings need not be applied simultaneously. Platforms without seats shall be designed to resist a minimum horizontal force of 0·25 kN/m² of plan area.

6. LOADING EFFECTS DUE TO IMPACT AND VIBRATION

6.0 The crane loads to be considered under imposed loads shall include the vertical loads, eccentricity effects induced by vertical loads, impact factors, lateral and longitudinal braking forces acting across and along the crane rails respectively.

6.1 Impact Allowance for Lifts, Hoists and Machinery — The imposed loads specified in 3.1 shall be assumed to include adequate allowance for ordinary impact conditions. However, for structures carrying loads which induce impact or vibration, as far as possible, calculations shall be made for increase in the imposed load, due to impact or vibration. In the absence of sufficient data for

TABLE 2 IMPOSED LOADS ON VARIOUS TYPES OF ROOFS

(*Clause* 4.1)

Sl No.	Type of Roof	Uniformly Distributed Imposed Load Measured on Plan Area	Minimum Imposed Load Measured on Plan
(1)	(2)	(3)	(4)
i)	Flat, sloping or curved roof with slopes up to and including 10 degrees		
	a) Access provided	1·5 kN/m²	3·75 kN uniformly distributed over any span of one metre width of the roof slab and 9 kN uniformly distributed over the span of any beam or truss or wall
	b) Access not provided except for maintenance	0·75 kN/m²	1·9 kN uniformly distributed over any span of one metre width of the roof slab and 4·5 kN uniformly distributed over the span of any beam or truss or wall
ii)	Sloping roof with slope greater than 10 degrees	For roof membrane sheets or purlins-0·75 kN/m² less 0·02 kN/m² for every degree increase in slope over 10 degrees	Subject to a minimum of 0·4 kN/m²
iii)	Curved roof with slope of line obtained by joining springing point to the crown with the horizontal, greater than 10 degrees	($0·75 - 0·52\gamma^2$) kN/m² where $\gamma = h/l$, h = the height of the highest point of the structure measured from its springing; and l = chord width of the roof if singly curved and shorter of the two sides if doubly curved. Alternatively, where structural analysis can be carried out for curved roofs of all slopes in a simple manner applying the laws of statistics, the curved roof shall be divided into minimum 6 equal segments and for each segment imposed load shall be calculated appropriate to the slope of the chord of each segment as given in (i) and (ii) above	Subject to a minimum of 0·4 kN/m²

Note 1 — The loads given above do not include loads due to snow, rain, dust collection, etc. The roof shall be designed for imposed loads given above or for snow/rain load, whichever is greater.

Note 2 — For special types of roofs with highly permeable and absorbent material, the contingency of roof material increasing in weight due to absorption of moisture shall be provided for.

TABLE 3 HORIZONTAL LOADS ON PARAPETS, PARAPET WALLS AND BALUSTRADES

(*Clause* 5.1)

Sl No.	Usage Area	Intensity of Horizontal Load, kN/m Run
(1)	(2)	(3)
i)	Light access stairs gangways and the like not more than 600 mm wide	0·25
ii)	Light access stairs, gangways and the like, more than 600 mm wide; stairways, landings, balconies and parapet walls (private and part of dwellings)	0·35
iii)	All other stairways, landings and balconies, and all parapets and handrails to roofs except those subject to overcrowding covered under (iv)	0·75
iv)	Parapets and balustrades in place of assembly, such as theatres, cinemas, churches, schools, places of entertainment, sports, buildings likely to be overcrowded	2·25

Note — In the case of guard parapets on a floor of multi-storeyed car park or crash barriers provided in certain buildings for fire escape, the value of imposed horizontal load (together with impact load) may be determined.

such calculation, the increase in the imposed loads shall be as follows:

Structures	*Impact Allowance*
	Min
For frames supporting lifts and hoists	100 percen
For foundations, footings and piers supporting lifts and hoisting apparatus	40 percent
For supporting structures and foundations for light machinery, shaft or motor units	20 percent
For supporting structures and foundations for reciprocating machinery or power units	50 percent

6.2 **Concentrated Imposed Loads with Impact and Vibration** — Concentrated imposed loads with impact and vibration which may be due to installed machinery shall be considered and provided for in the design. The impact factor shall not be less than 20 percent which is the amount allowable for light machinery.

6.2.1 Provision shall also be made for carrying any concentrated equipment loads while the equipment is being installed or moved for servicing and repairing.

6.3 **Impact Allowances for Crane Girders** — For crane gantry girders and supporting columns, the following allowances shall be deemed to cover all forces set up by vibration, shock from slipping or slings, kinetic action of acceleration, and retardation and impact of wheel loads:

Type of Load	*Additional Load*
a) Vertical loads for electric overhead cranes	25 percent of maximum static loads for crane girders for all classes of cranes
	25 percent for columns supporting Class III and Class IV cranes
	10 percent for columns supporting Class I and Class II cranes
	No additional load for design of foundations
b) Vertical loads for hand operated cranes	10 percent of maximum wheel loads for crane girders only

(*Continued*)

c) Horizontal forces transverse to rails:	
1) For electric overhead cranes with trolley having rigid mast for suspension of lifted weight (such as soaker crane, stripper crane, etc)	—10 percent of weight of crab and the weight lifted by the cranes, acting on any one crane track rail, acting in either direction and equally distributed amongst all the wheels on one side of rail track For frame analysis this force shall be applied on one side of the frame at a time in either direction.
2) For all other electric overhead cranes and hand operated cranes	—5 percent of weight of crab and the weight lifted by the cranes, acting on anyone crane track rail, acting in either direction and equally distributed amongst the wheels on one side of rail track For the frame analysis, this force shall be applied on one side of the frame at a time in either direction
d) Horizontal traction forces along the rails for overhead cranes, either electrically operated or hand operated	—5 percent of all static wheel loads

Forces specified in (c) and (d) shall be considered as acting at the rail level and being appropriately transmitted to the supporting system. Gantry girders and their vertical supports shall be designed on the assumption that either of the horizontal forces in (c) and (d) may act at the same time as the vertical load.

NOTE—*See* IS : 807-1976* for classification (Classes 1 to 4) of cranes.

6.3.1 *Overloading Factors in Crane Supporting Structures* — For all ladle cranes and charging cranes, where there is possibility of overloading from production considerations, an overloading factor of 10 percent of the maximum wheel loading shall be taken.

6.4 **Crane Load Combinations** — In the absence of any specific indications, the load combinations shall be as indicated in the following sub-clauses.

6.4.1 *Vertical Loads* — In an aisle, where more than one crane is in operation or has provision for more than one crane in future, the following load combinations shall be taken for vertical loading:

a) Two adjacent cranes working in tandem with full load and with overloading according to 6.3(a); and

b) For long span gantries, where more than one crane can come in the span, the girder shall be designed for one crane fully loaded with overloading according to 6.3(a) plus as many loaded cranes as can be accommodated on the span but without taking into account overloading according to 6.3(a) to give the maximum effect.

6.4.2 *Lateral Surge* — For design of columns and foundations, supporting crane girders, the following crane combinations shall be considered:

a) *For single-bay frames* — Effect of one crane in the bay giving the worst effect shall be considered for calculation of surge force, and

b) *For multi-bay frames* — Effect of two cranes working one each in any of two bays in the cross-section to give the worst effect shall be considered for calculation of surge force.

6.4.3 *Tractive Force*

6.4.3.1 Where one crane is in operation with no provision for future crane, tractive force from only one crane shall be taken

6.4.3.2 Where more than one crane is in operation or there is provision for future crane, tractive force from two cranes giving maximum effect shall be considered.

NOTE — Lateral surge force and longitudinal tractive force acting across and along the crane rail respectively, shall not be assumed to act simultaneously. However, if there is only one crane in the bay, the lateral and longitudinal forces may act together simultaneously with vertical loads.

7. OTHER LOADS

7.1 **Dead Load** — Dead load includes the weight of all permanent components of a building including walls, partitions, columns, floors, roofs, finishes

*Code of practice for design, manufacture, erection and testing (structural portion) of cranes and hoists (*first revision*).

and fixed permanent equipment and fittings that are an integral part of the structure. Unit weight of building materials shall be in accordance with IS : 875 (Part 1)-1988.

7.2 Wind Load — The wind load on buildings/ structures shall be in accordance with IS : 875 (Part 3)-1988.

7.3 Seismic Load — Seismic load on buildings/ structures shall be in accordance with IS : 1893-1984*.

7.4 Snow Load — Snow loading on buildings shall be in accordance with IS : 875 (Part 4)-1988.

7.5 Special Loads and Load Combinations — Special loads and load combinations shall be in accordance with IS : 875 (Part 5)-1988.

*Criteria for earthquake resistant design of structures (*fourth revision*).

APPENDIX A

(*Clause* 3.2.1.2)

ILLUSTRATIVE EXAMPLE SHOWING REDUCTION OF UNIFORMLY DISTRIBUTED IMPOSED FLOOR LOADS IN MULTI-STOREYED BUILDINGS FOR DESIGN OF COLUMNS

A-1. The total imposed loads from different floor levels (including the roof) coming on the central column of a multi-storeyed building (with mixed occupancy) is shown in Fig. 1. Calculate the reduced imposed load for the design of column members at different floor levels as given in 3.2.1. Floor loads do not exceed 5·0 kN/m².

A-1.1 Applying reduction coefficients in accordance with 3.2.1, total reduced floor loads on the column at different levels is indicated along with Fig. 1.

Floor No. from Top Including Roof	Actual Floor Load Coming on Columns at Different Floors, kN	Loads for which Columns are to be Designed, kN
1	30	
2	40	30
3	50	(30 + 40) (1 — 0·1) = 63
4	50	(30 + 40 + 50) (1 — 0·2) = 96
5	40	(30 + 40 + 50 + 50) (1 — 0·3) = 119
6	45	(30 + 40 + 50 + 50 + 40) (1 — 0·4) = 126
7	50	(30 + 40 + 50 + 50 + 40 + 45) (1 — 0·4) = 153
8	50	(30 + 40 + 50 + 50 + 40 + 45 + 50) (1 — 0·4) = 183
9	40	(30 + 40 + 50 + 50 + 40 + 45 + 50 + 50) (1 — 0·4) = 213
10	40	(30 + 40 + 50 + 50 + 40 + 45 + 50 + 50 + 40) (1 — 0·4) = 237
11	40	(30 + 40 + 50 + 50 + 40 + 45 + 50 + 50 + 40 + 40) (1 — 0·4) = 261
12	55	(30 + 40 + 50 + 50 + 40 + 45 + 50 + 50 + 40 + 40 + 40) (1 — 0·5) = 237·5 < 261 ∴ adopt 261 for design
13	55	(30 + 40 + 50 + 50 + 40 + 45 + 50 + 50 + 40 + 40 + 40 + 55) (1 — 0·5) = 265
14	70	(30 + 40 + 50 + 50 + 40 + 45 + 50 + 50 + 40 + 40 + 40 + 55 + 55) (1 — 0·5) = 292·5
15	80	(30 + 40 + 50 + 50 + 40 + 45 + 50 + 50 + 40 + 40 + 40 + 55 + 55 + 70) (1 — 0·5) = 327·5
		(30 + 40 + 50 + 50 + 40 + 45 + 50 + 50 + 40 + 40 + 40 + 55 + 55 + 70 + 80) (1 — 0·5) = 367·5

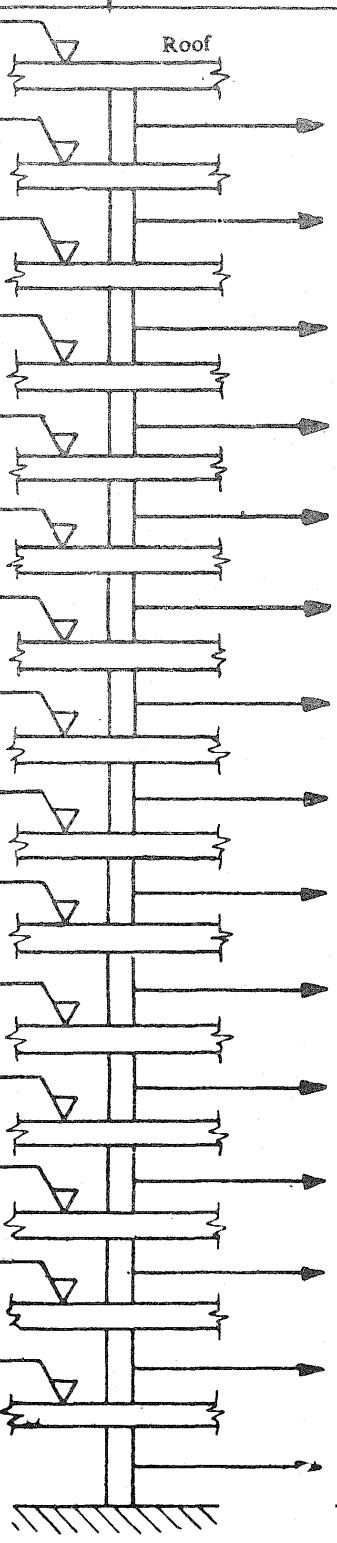

FIG. 1 LOADING DETAILS