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Indian Standard

RECOMMENDATIONS FOR MODULAR CO-ORDINATION IN BUILDING INDUSTRY : APPLICATIONS

(First Revision)

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
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Indian Standard

RECOMMNDATIONS FOR MODULAR CO-ORDINATION IN BUILDING INDUSTRY : APPLICATIONS

(First Revision)

0. FOREWORD

0.1 This Indian standard (First Revision) was adopted by the Indian Standards Institution on 27 February 1987, after the draft finalized by the Modular Co-ordination Sectional Committee had been approved by the Civil Engineering Division Council.

0.2 The word 'Module' originated from the Latin Word 'Modulus' meaning a small dimension. In the past, the word expressed a certain dimensional relationship among the varied elements of a building. The dimensional relationship was established on simple multiple of a module. A module is a unit of measurement, it may be measured in terms of any number of cubits or inches or centimetres. These units may be applied to width, depth and height of building components, or to a whole building. The system devised for planning and designing, and further developed to correlate the size of components, based on internationally agreed units of measurements in building industry, is widely known as a 'Theory of Modular Co-ordination'. The principle of dimensional relationship in building has been known in this country as quoted in vedic treatise *Bhrigu-shilpa Sanhita* and *Mansar-Vastu-Shastra*. In order to bring uniformity in thinking and execution of building project, it is necessary to lay down simple principles of modular co-ordination.

0.3 This standard is an amalgamated revision of IS : 6820-1972 and IS : 1233-1969*. This revision has been prepared incorporating the advancement made in the modular planning and application since more than a decade. The spatial reference system, choice of dimensions, horizontal and vertical coordination, dimensioning of modular components, etc have been elaborated and general concepts, design drawings, preferred sizes etc, have been included to make this standard comprehensive.

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*Recommendation for modular co-ordination of dimensions in building industry (*first revision*).

0.4 In the preparation of this standard, considerable assistance has been rendered by the National Buildings Organization, New Delhi.

0.5 In the formulation of this standard due weightage has been given to international co-ordination among the standards and practices prevailing in different countries in addition to relating it to the practices in the field in this country. This has been met by deriving assistance from the following:

a) AJ Metric Handbook. The Architectural Press, London (1969).

b) India, Ministry of Works & Housing. Development Group on Prefabrication and Modular Co-ordination in Building Report. 1978.

c) Henric Nissen. Industrialized Building and Modular design. Cement and Concrete Association, London (1972).

d) The Principles of Modular Co-ordination in Building (*revised*). CIBW-24, the International Modular Group, 1982.

1. SCOPE

1.1 This standard deals with application of modular co-ordination in planning and design of buildings and manufacture and assembly of building components.

2. AIMS

2.1 The aims of modular co-ordination are as follows:

a) Making planning simpler and clearer by distinct indication of the location of the building components in the building, both in relation to each other and to a modular grid;

b) Limiting the number of sizes of building components so as the linkage is based on modular measurement;

c) Simplifying site work; for example, in setting out of measurements, in assembling and location of modular building components;

d) Creating a basis for rationalization of both general and special building drawings for modular building components and assembly details;

e) Facilitating cooperation between designers, manufacturers, suppliers and builders; and

f) Providing practical and logical construction methods for the coordination of the position and dimensions of elements, components and spaces in building design which will contribute to.

   i) increased design freedom,

   ii) improved balance between quality and cost in manufacture and construction, and

   iii) greater interchangeability at design, construction and infield practices.

3. FIELD OF APPLICATION

3.1 Modular co-ordination shall be applied to the design, manufacture and assembly of building, components, their assemblies and installation.

3.2 Modular co-ordination shall ensure proper fittings of the components relative to the position and the dimensions with reduced material wastages and on site modifications.

3.3 Modular co-ordination shall be applied to a wide range of building technologies, ranging from building materials and components through partial prefabrication to rationalize traditional building methods.

4. TERMINOLOGY

4.1 In order to assure clarity and unambiguous expression in modular coordination principles, reference shall be made to the glossary of terms as given in IS : 4993-1983* and IS : 6408-1971†.

5. GENERAL CONCEPTS

5.1 A dual nomenclature exists in the building industry when referring to modular co-ordination; it is sometimes referred to as modular co-ordination while in other cases it is called dimensional co-ordination. The difference between the basic modular theory and modified version of dimensional co-ordination of preferred sizes of components lies in fact that the pure modular theory uses the Module (100 mm) as the only common dimensional denominator with no preferential treatment for any particular number of increments. This theory gives the desired unrestricted flexibility within pattern of 100 mm multiples.

5.2 Modular Co-ordination — The general concepts of modular co-ordination theory relates to the rationaltzation of building process and is detailed as follows:

a) Dimensional co-ordination employing the basic module or some whole multiple thereof.

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*Glossary of terms relating to modular co-ordination (*second revision*).

†Recommendation for modular co-ordination application of tolerance in building industry.

b) The three-dimensional modular reference system of points, lines and planes in which the dimensional increment is the basic module or some whole multiple thereof (*see* Fig. 1 and 2).

c) The basic module is the smallest modular increment in three dimensional reference system.

5.3 Dimensional Co-ordination

5.3.1 A convention for the co-ordination of dimensions of building components and the building incorporating basic module of 100 mm offers preferred sizes for their design, manufacture and assembly. In dimensional co-ordination theory, a preferential treatment of selected pattern of increment is given.

5.3.2 The increment in basic modular system establishes an hierarchy of preferred units. It conveys the relationship of dimensions of building components and building with increment of basic module.

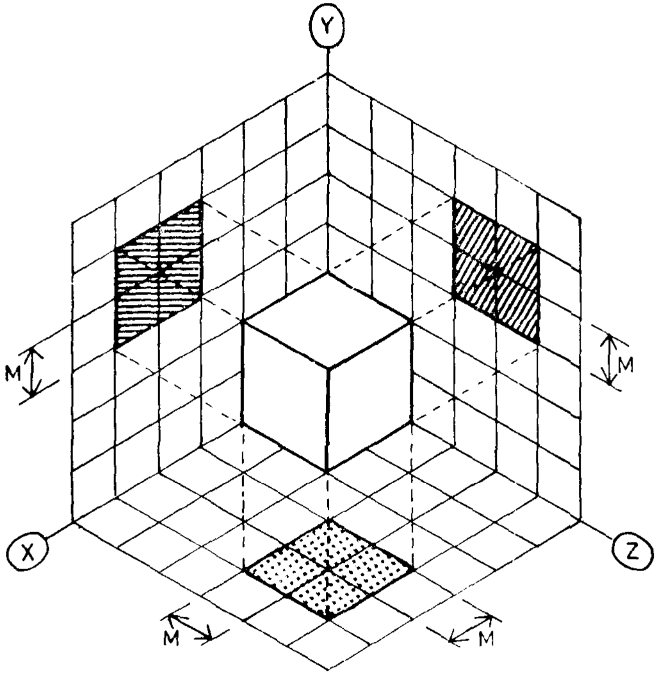

FIG. 1 MODULAR THREE-DIMENSIONAL REFERENCE SYSTEM

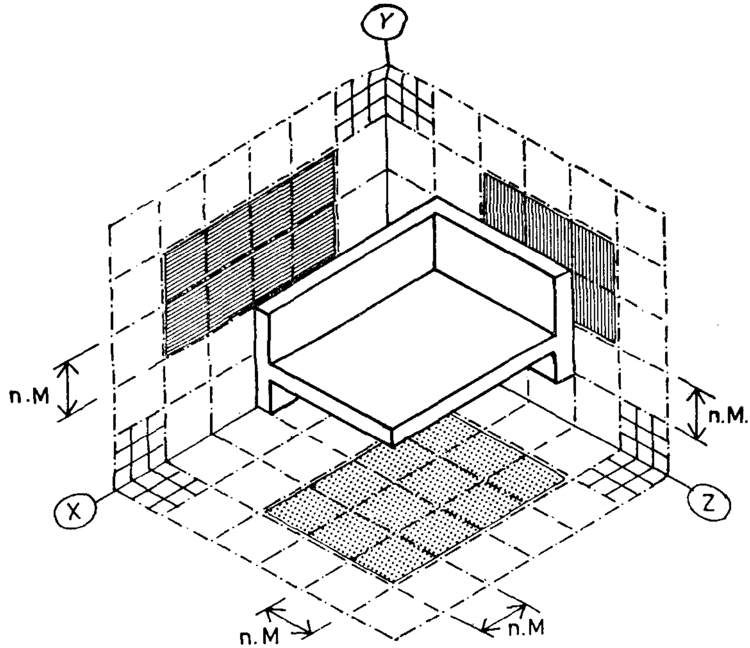

FIG. 2 MULTI-MODULAR THREE-DIMENSIONAL REFERENCE SYSTEM

5.3.3 The position and size of component, assembly or element shall be related to the three-dimensional reference system of points, lines and planes (*see* Fig. 1 and 2).

5.3.4 The basic arrangement of components within grid lay out is dimensionally co-ordinated; it allows a maximum use of standardized components.

5.3.5 The first preference is 300 mm, second preference is 100 mm, the third preference is 50 mm up to a maximum 300 mm and fourth preference is 25 mm up to a maximum 300 mm and fifth preference of 20 mm up to a maximum 300 mm (*see* Fig. 3) (*see* also **7.2.3**).

6. BUILDING FITS AND TOLERANCES

6.1 The dimensional relationship between a component and the space intended to accommodate it with due regard to the practical limit within the size and position, shall be in harmony. The space allocated shall be over-sized and component shall be under-sized (*see* Fig. 4).

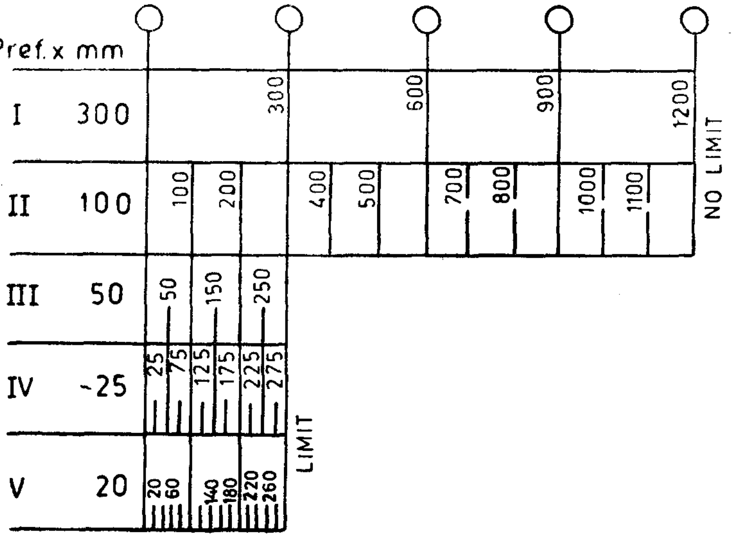

FIG. 3 PREFERRED UNITS

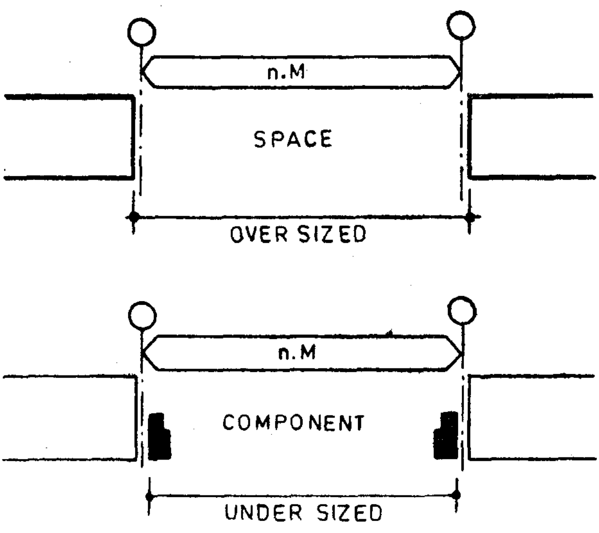

FIG. 4 RELATIONSHIP OF DIMENSIONS

6.2 The modular dimensions shall provide a convenient means of describing components in catalogues and for allocating spaces for them on design drawing.

7. BASIC MODULE, MULTIMODULE AND SUBMODULAR INCREMENTS (SPACE MODULE)

7.1 Basic Module

7.1.1 The basic module is the fundamental unit of a size in modular co-ordination, and for general application to buildings and components the size of basic module is 100 mm. It is represented by the letter 'M' (*see* IS : 10316-1986*).

7.1.2 The basic module is considered to be large enough to effect some variety reduction in range of component size and small enough to provide a flexible unit of measure for purpose of design.

7.2 Space Module/Multimodule/Submodular Increment

7.2.1 Space module, multimodule and sub-modular increment are certain multiples or sub-multiples of the basic module.

7.2.2 Certain whole simple multiples of basic module, usually expressed as M with numerical prefix, such as 2M and 3M are referred to as multimodules.

7.2.3 Certain submultiples of the basic modules which are whole simple fractions shall be chosen when it is absolutely necessary for an increment smaller than the basic module for practical consideration. This sub-modular increment shall be expressed as M with fractional prefix such as 1/5 M, 1/4 M and 1/2 M (*see* IS : 10316-1986*).

7.3 Applications of Modules

7.3.1 *Space Module* — The space modules shall be selected for a particular application to determine horizontal and vertical dimensions for components and buildings.

7.3.2 *Multimodule* — The multimodule shall be used for:

a) spans,
b) room sizes,
c) storey heights,
d) room heights,
e) space allocation,

*Recommendations for modular co-ordination : Basic module and sub-modular increments (*first revision*).

f) sizes for components,

g) relative displacement of planning grids for specific reasons, and

h) sizes of modular components which are larger than 1M and require to be sized in increments smaller than 1M to fulfil specific functional needs.

7.3.2.1 The multimodular grid provides flexible solution to determine reference point, line or plane at finished floor level or at structural slab level in case of known modular floor and wall thicknesses located within modular zones (*see also* **12.2**).

7.3.3 *Submodular Increments* — Submodular increments shall be used where there is a need for an increment smaller than the basic module (*see* IS : 10316-1986* for details).

8. CHOICE OF DIMENSIONS

8.1 Designers have a trend to select simple whole number ratios, such as double or triple, to express relationship in set of dimensions. Sometimes the system of geometrical proportions established on human body measurments and frequently proportional relationship based on 'Golden Section' are also used. The designers may select any of system of proportion, the same purpose is being served that is, of establishing an intrinsic order in terms of relationship of component or space dimensions through modular co-ordination dimensions to satisfy the needs of architectural aesthetics.

8.1.1 Some of the essential features of preferred dimensions are as follows:

a) all dimensions shall be whole multiple of M(100 mm),

b) all dimensions in the system shall be divisible by greater possible number of smaller dimensions,

c) all dimensions shall be obtained by multiple or addition of the smaller dimensions, and

d) smaller dimensions shall be more densely distributed than the larger.

9. SPATIAL REFERENCE SYSTEM

9.1 In modular co-ordination, the term spatial reference system is defined as the three-dimensional system of orthogonal space co-ordinates within which the position and size of components, assemblies and element are related by reference to points, lines or planes.

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*Recommendations for modular co-ordination : Basic module and sub-modular increments (*first revision*).

9.2 Within this spatial reference system dimensional increments shall be in terms of basic module or some multiple thereof.

9.3 In general, buildings comprise elements of construction which are either load bearing or non-load bearing and include an external envelope of horizontal and vertical elements which subdivide the enclosed space. This system shall act as a tool to correlate the main elements of construction and the intervening spaces.

9.4 Certain essential reference planes shall be identified which locate the main vertical and horizontal elements of construction; for example, floors, roofs, walls and columns. These planes shall delimit the modular height, length and width dimensions of built spaces such as activity spaces, zones, etc (*see* Fig. 5).

9.5 A zone in this context shall be modular or non-modular space between reference planes which is provided for a component or group of components which do not necessarily fill the space or which may be left empty (*see* Fig. 6).

9.6 The spatial reference system shall be represented on drawings by means of two dimensional modular grids which are applied in plan and section at the design stage.

9.7 The dimensional increments of such grids shall be basic module or some multiple thereof. The increment may differ for each of the two dimesions of the grid.

9.8 This system shall be used as a planning tool.

9.9 Due to some economic or other reasons, need may arise to accommodate non-modular elements, components or assemblies within a modular space by introducing additional reference planes to represent the co-ordinating reference planes of such elements, components or assemblies (*see* Fig. 7).

10. GRIDS

10.1 There are various types of grid patterns developed for building design. The grids which are most frequently used are explained in Fig. 8.

10.2 Grid Lines

10.2.1 Grid lines representing the modular reference planes shall define the co-ordinating spaces for elements of construction, building components and assemblies.

10.2.2 The co-ordinating spaces are deemed to include allowance for deviations and joint clearances.

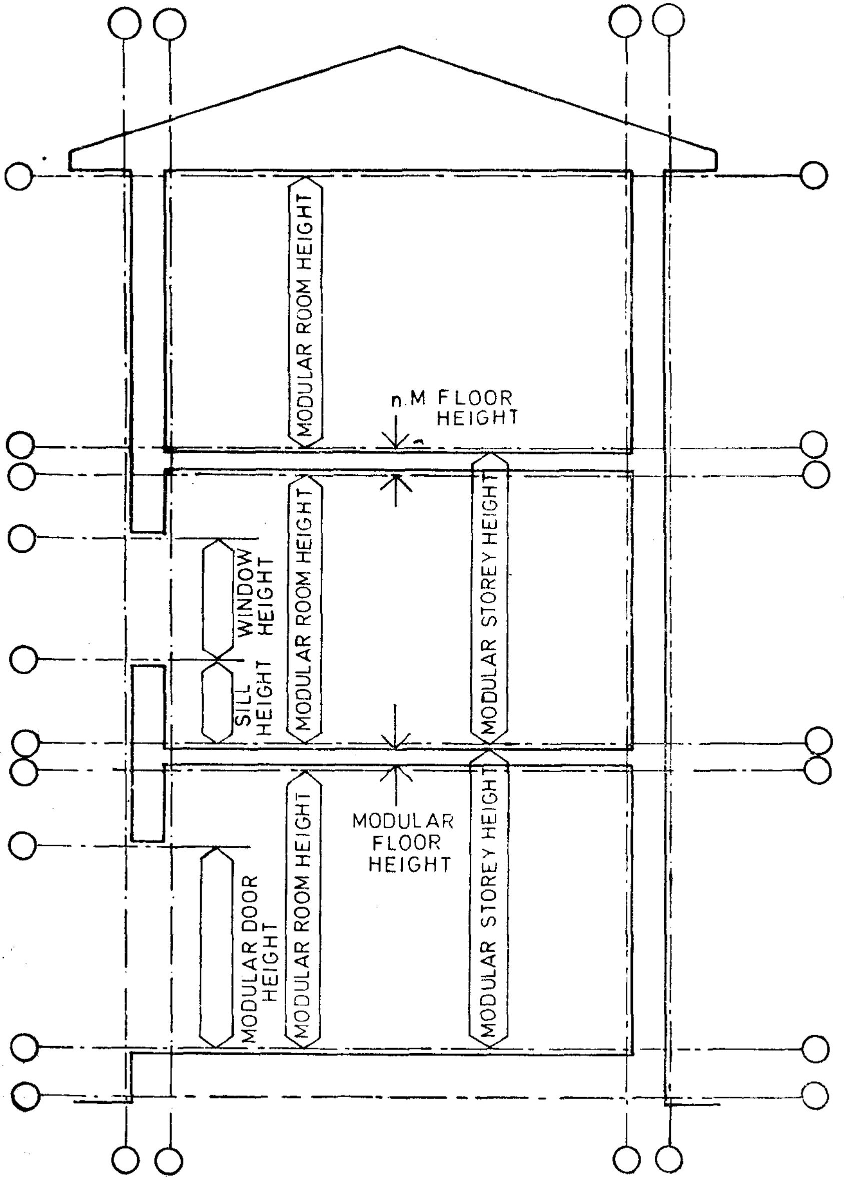
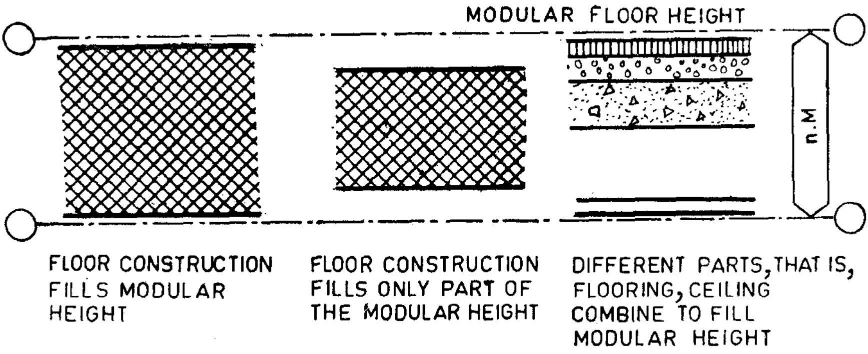
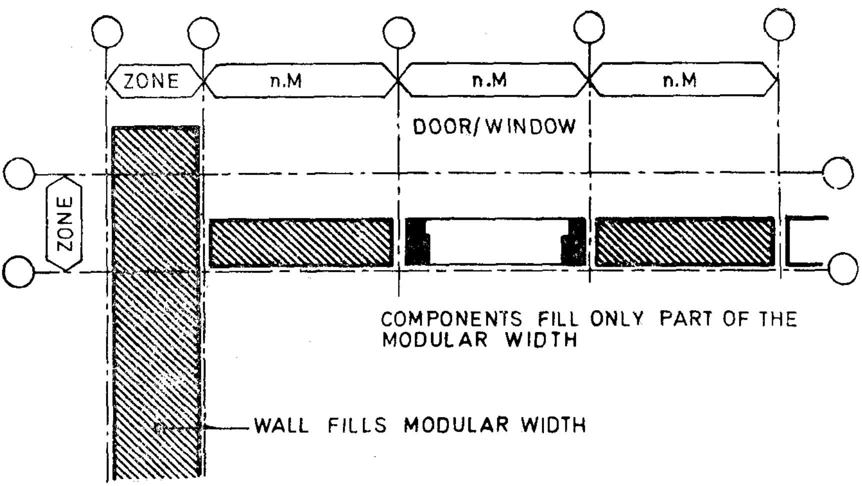


FIG. 5 MODULAR HEIGHT

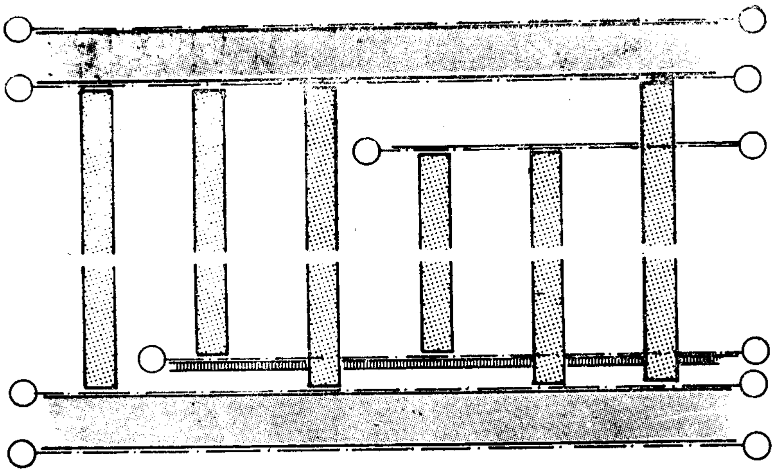


6A Floor Zone (Vertical Section)

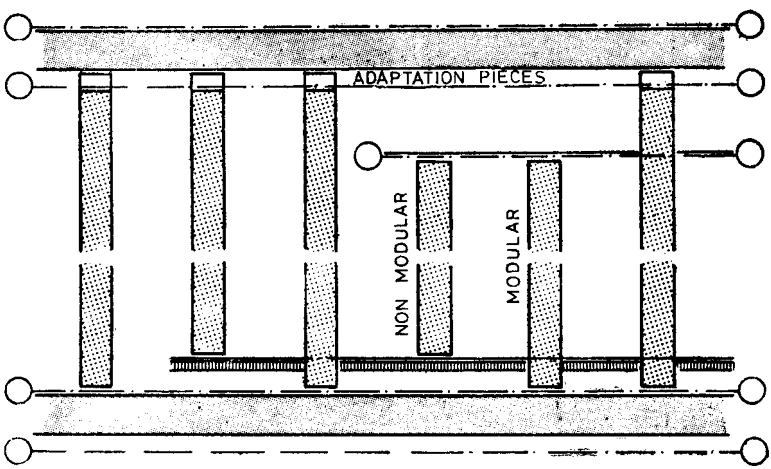


6B Wall Zone (Horizontal Section)

FIG. 6 ZONES



7A Modular Storey Height and Modular Floor Height Tends to Modular Partition Height



7B Modular Storey Height and Nonmodular Floor Height Tends to Adaptation Pieces and Nonmodular Heights

FIG. 7 MODULAR AND NONMODULAR PARTITION HEIGHTS
(VERTICAL PART SECTION)

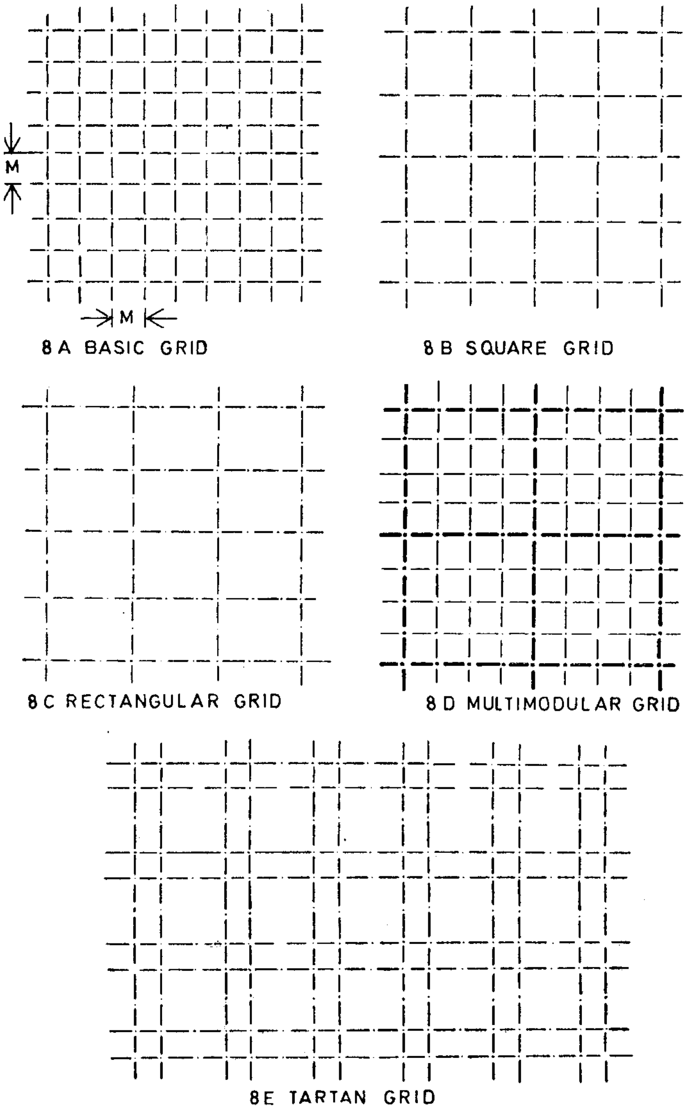


Fig. 8 Grid Pattern

10.2.3 Such grid points, lines and planes are essentially design tools; these shall not necessarily be shown on the drawings which are part of the production information. However, certain modular reference planes shall be selected to indicate the basis for dimensioning drawing of a project and positioning building elements and components on the site.

10.2.4 In such cases, care shall be taken to ensure that building setting out system is effectively related to the selected reference points, lines and planes.

10.2.5 In addition, care shall also be taken in marking dimensions on drawings and to clearly distinguish between modular dimensions and work sizes expressed in millimetres.

10.3 Basic Modular Grid

10.3.1 The fundamental modular grid is that in which the interval between consecutive parallel lines equals to the basic module. This is the smallest planning grid. It shall be used as the basis for developing other grids.

10.3.2 The basic modular grid shall normally be shown only on large scale drawings to clarify the interrelationship between components.

10.4 Multimodular Planning Grid

10.4.1 In addition to the basic modular grid, multimodular grids in which the interval between consecutive lines is a multimodule shall be used.

10.4.2 This multimodule may differ for each of the two direction of the grid (*see* Fig. 9).

10.4.3 Multimodular planning grids shall be based upon selected multiple of the basic module adopted for specific applications.

10.4.4 Such grids shall be used to determine the layout of building complexes, buildings and/or position of main structural features.

10.4.5 Such grids shall be used to ensure consistant co-ordination of components in relation to specific use of activity spaces which they enclose.

10.4.6 These grids shall normally be used in the earlier design stages on a small scale general location drawings.

10.4.7 Modular grids shall preferably be without interruption for the whole of the building plan.

10.4.8 The modular grids may be interrupted at consistant intervals by bands of different modular dimensions or in certain cases non-modular dimensions (*see* Fig. 10).

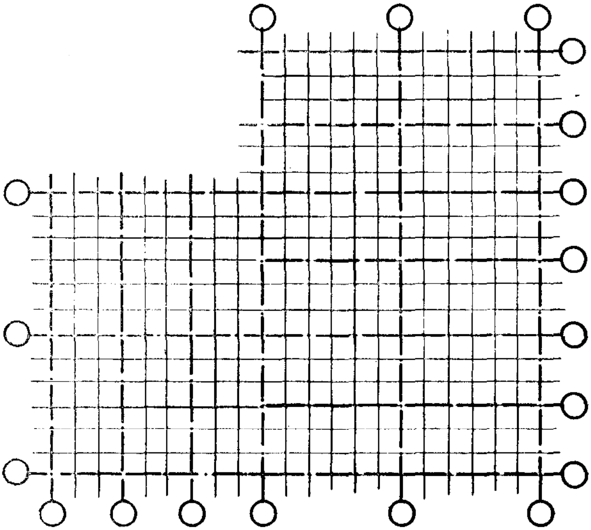


FIG. 9 MODULAR GRID AT CHANGE IN DIRECTION

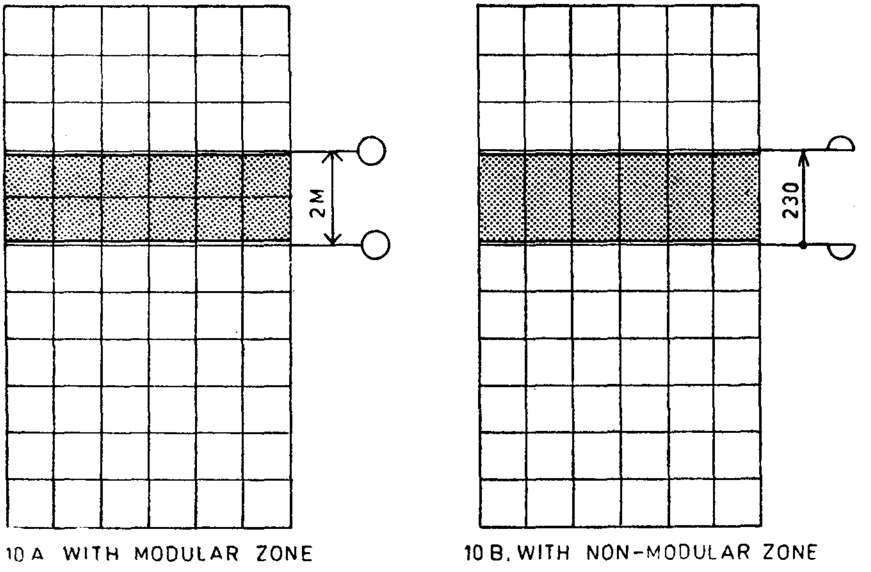


FIG. 10 INTERRUPTED GRID

10.4.9 A multimodular grid may be interrupted to facilitate the design of joint movement in the structure.

10.4.10 Multimodular grids may be super-imposed one upon another at various stages of planning process. Multimodular planning grids may be displaced in relation to one another to accommodate the size of nonmodular components (*see* IS : 7921-1987*).

11. 5-mm RULE

11.1 5-mm Rule for Horizontal and Vertical Dimensions — Sizes of building components, room dimensions and buildings are based on preferred horizontal modules. The wall, which is the structural part of the vertical division, shall be placed one joint proportion on the boundaries of a modular plane, that is, the actual dimension as a rule for the structural elements shall be 5 mm less on all modular boundary plane. This rule is called as 5-mm rule for all horizontal dimensions.

The floor slab, which is a structural part of horizontal division, is placed one joint proportion under a modular plane. This rule is called 5-mm rule for all vertical dimensions. All other vertical dimensions shall be taken from this plane.

12. HORIZONTAL CO-ORDINATION

12.1 Traditionally, at sketch design stage and working drawing stage of the building project, the drawings are prepared by two methods; first illustrating internal clear dimensions of activity spaces; and secondly at working drawing stage, introducing centre line dimensions for elements of constrnction. In modular co-ordination theory, it is recognized as boundary planning and axial planning respectively. In practice, however, such clear cut distinction does not exist.

12.2 The modular grid shall establish the primary reference. The boundary planning is the first point, line or plane for positioning components and elements of construction in relation to such grid (*see* Fig. 11).

12.3 Axial planning shall normally be adopted to decide, only position of certain structural components like, columns, cross walls beams, etc, and may be referred to IS : 7921-1987*.

12.4 Boundary planning shall be combined with axial planning for positioning structural elements (*see* Fig. 12 and Fig. 13).

12.5 Boundary planning shall be a deciding factor for position and a size of components, assemblies and elements of construction.

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*Recommendation for modular co-ordination in building industry: Horizontal co-ordination (*first revision*).

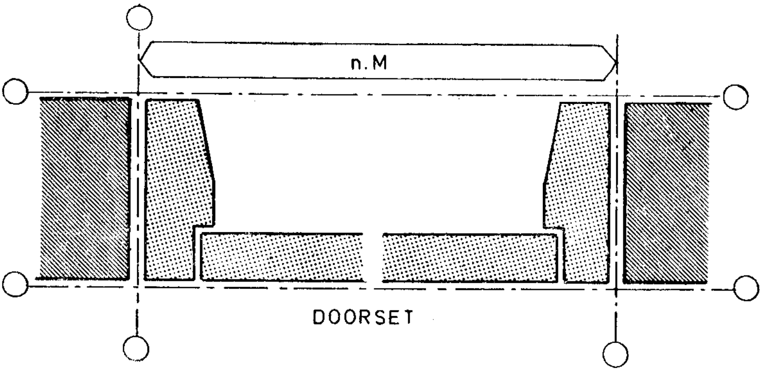


FIG. 11 BOUNDARY PLANNING FOR COMPONENTS

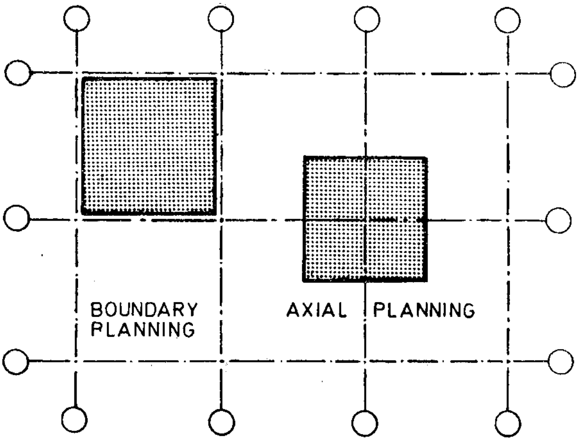


FIG. 12 REPRESENTATION OF BOUNDARY PLANNING AND AXIAL PLANNING

13. VERTICAL CO-ORDINATION

13.1 In vertical section, the modular floor plane is the reference plane from which modular dimensions shall be taken (*see* Fig. 14).

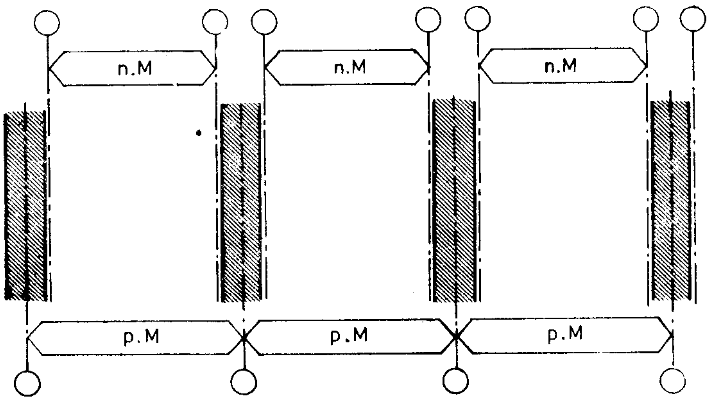


FIG. 13 COMBINATION OF BOUNDARY AND AXIAL PLANNING

13.2 A horizontal modular plane continuous over the whole of each storey of a building and coinciding with upper surface of floor covering, the upper surface of the base floor or the upper surface of the structural floor shall be selected as a reference point, line or plane (*see* Fig. 15).

13.3 At a particular storey level, changes in the level may require to accommodate the specific functional need of structure which may be met by further reference point or line or plane. This auxiliary reference plane shall be shown in Fig. 16.

13.4 In the vertical section, only the main reference planes of the controlling zone containing external envelope and interval elements of construction which subdivides the building horizontally and vertically, shall be identified on drawings of vertical sections like modular storey height, modular room height and modular floor height along with modular doorset height, windowset height, window sill height, etc (*see* IS : 7922-1987*).

14. PREFERRED SIZES

14.1 A preferred size is a modular or multimodular size for specific purposes which shall be selected in advance of all others.

14.2 The preferred horizontal multimodular sizes shall primarily be intended for sizing components, assemblies and spaces.

*Recommendation for modular co-ordination in building industry : Vertical co-ordination (*first revision*).

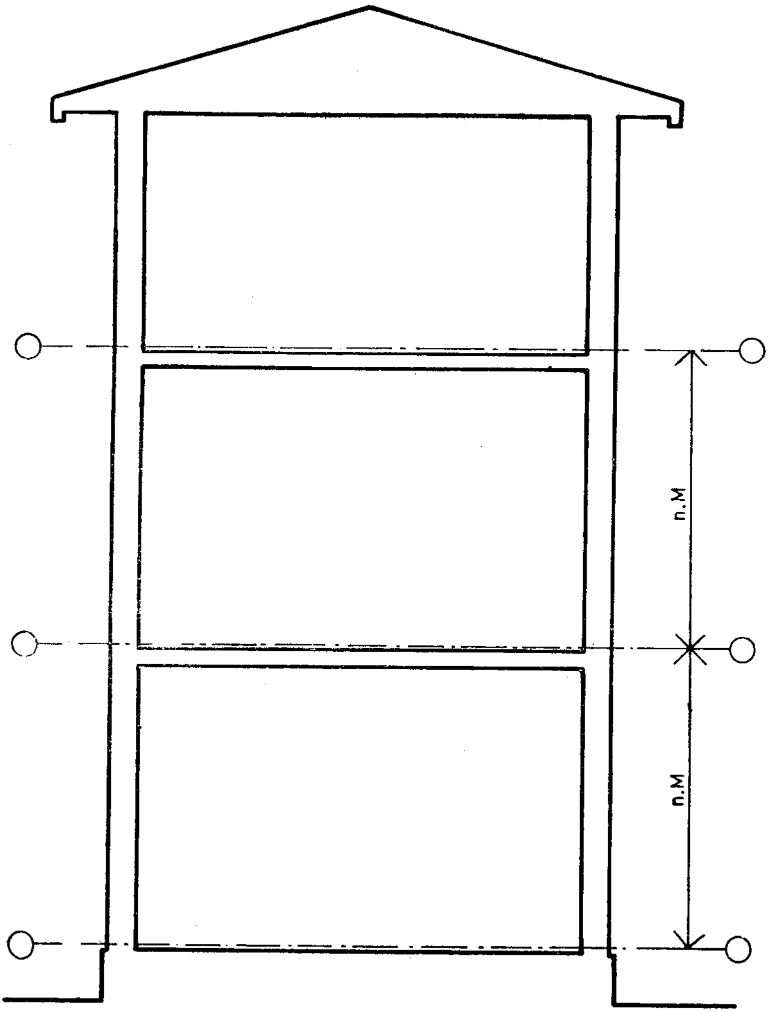
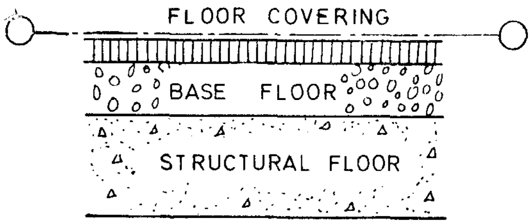
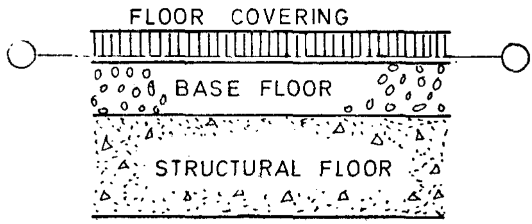


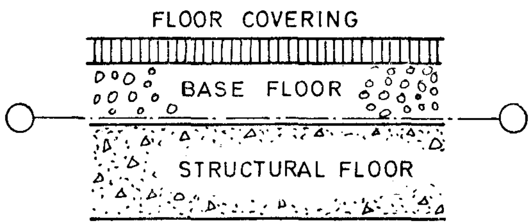
FIG. 14 REFERENCE PLANS IN NORMAL STOREY HEIGHTS



15A Upper Surface of Floor Covering

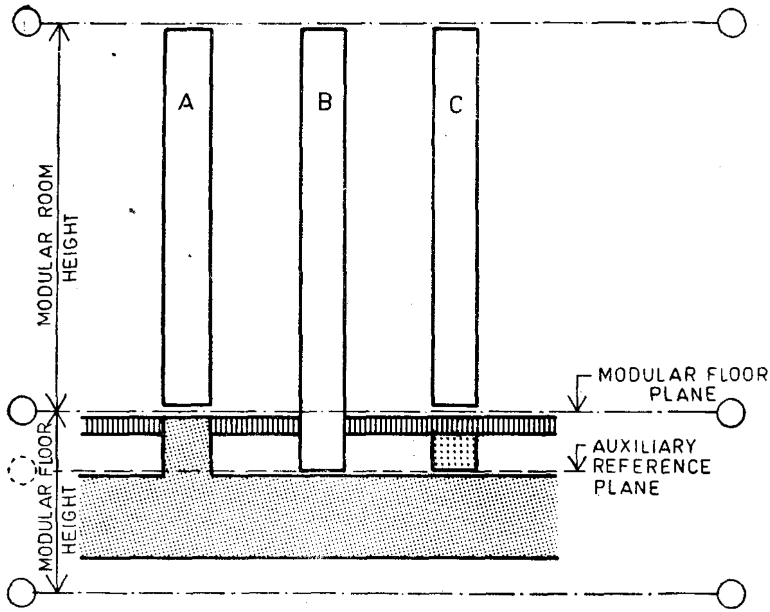


15B Upper Surface of Base Floor



15C Upper Surface of Structural Floor

FIG. 2 MODULAR FLOOR PLANE



A — an upstand on structural slab reaches up to the modular floor plane.

B — the wall shows positive boundary condition in order to reach down to the auxiliary reference plane at the upper surface of the structural slab.

C — an adaptation piece fills the space between the modular floor plane and the auxiliary reference plane.

NOTE — Vertical section shows modular floor height, modular room height and modular floor plane at upper surface of floor covering.

FIG. 16 AUXILIARY REFERENCE PLANE

14.3 The preferred multimodular sizes shall be multiple of basic module with arithmetical value of 2 or 3.

14.4 The preferred size shall provide a flexible choice of multimodular dimensions in line with the characteristics of conventional design practices adopted in buildings.

14.5 The preferred sizes shall normally be used for smaller dimensional increments in vertical plane than in the case of horizontal plane.

14.6 The preferred sizes of modular components share a common factor. (3M), for example 3M, 6M, 12M, etc and only the spaces which are a multiple of that common factor shall be filled.

14.7 The nonmodular component sizes do not share common factor. They shall be combined beyond a certain point to fill all multiples of 1M. As such, the selection of sizes shall be based on critical number. The following formulae shall be used to determine the critical number (*CN*) :

a) *For Pairs of Component Sizes*

$$CN = (a - 1)(b - 1)$$

where a and b are component sizes.

Example :

$$a = 5\text{ M}$$
$$b = 6\text{ M}$$
$$CN = (5 - 1)(6 - 1)$$
$$= 4 \times 5$$
$$= 20$$

Therefore, the components can be combined to fill all the spaces of 1M from 20M upwards (*see* Fig. 17).

b) *For Triplets of Components Sizes which are Consecutive Multiples of Basic Module*

1) $$CN = (a^2 \div 2)$$

where a is the smallest size and is an even number

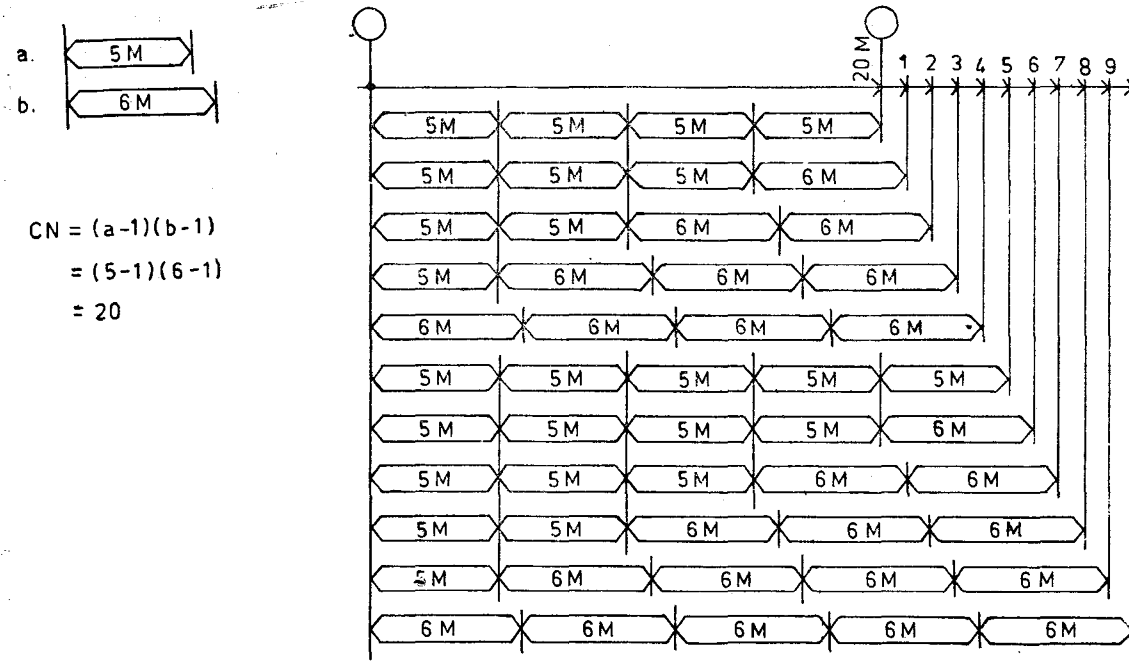
Example :

$$a = 4\text{ M}$$
$$b = 5\text{ M}$$
$$c = 6\text{ M}$$

The smallest size is 4M which is an even number

$$CN = 4 \times 4 \div 2$$
$$= 16 \div 2$$
$$= 8$$

Therefore, these components can be combined to fill all the spaces of 1M from 8M upward (*see* Fig. 18).



$$CN = (a-1)(b-1)$$
$$= (5-1)(6-1)$$
$$= 20$$

Fig. 17 Critical Point (Pair of Components)

2) $$CN = [\, a\,(\,a - 1\,) \div 2\,]$$

where *a* is the smallest size and is an odd number

Example :

$$a = 5\ M$$
$$b = 6\ M$$
$$c = 7\ M$$

The smallest size is 5 M which an odd number.

$$CN = 5\,(\,5 - 1\,) \div 2$$
$$= 5 \times 4 \div 2$$
$$= 10$$

Therefore, these components can be combined to fill all the spaces of 1 M from 10 M upwards (*see* Fig. 19).

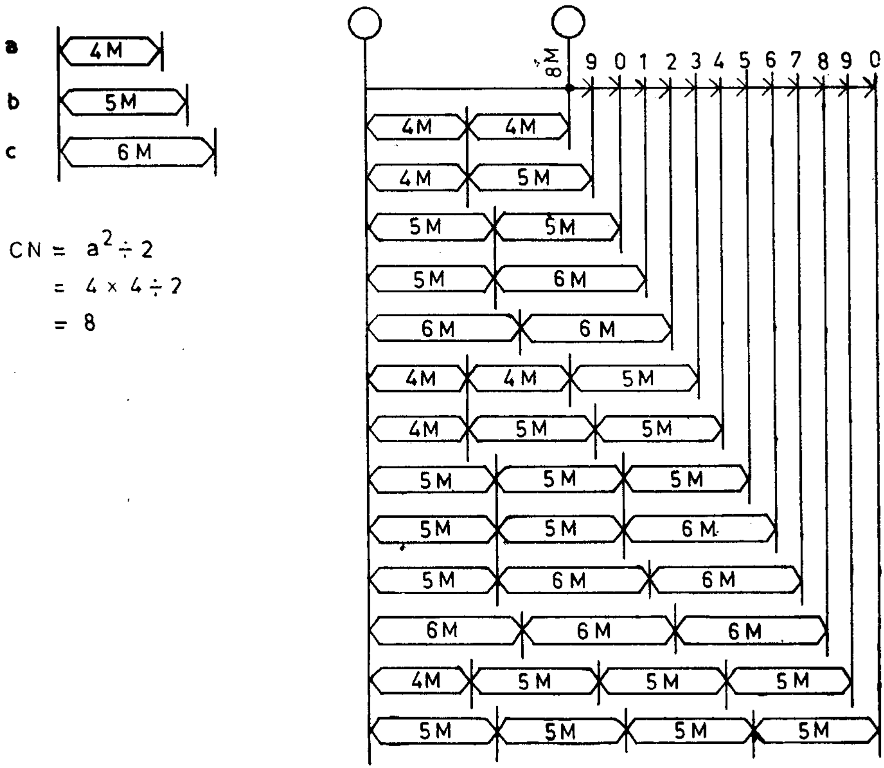


FIG. 18 CRITICAL POINT (TRIPLET OF COMPONENTS WITH SMALLEST DIMENSION EVEN)

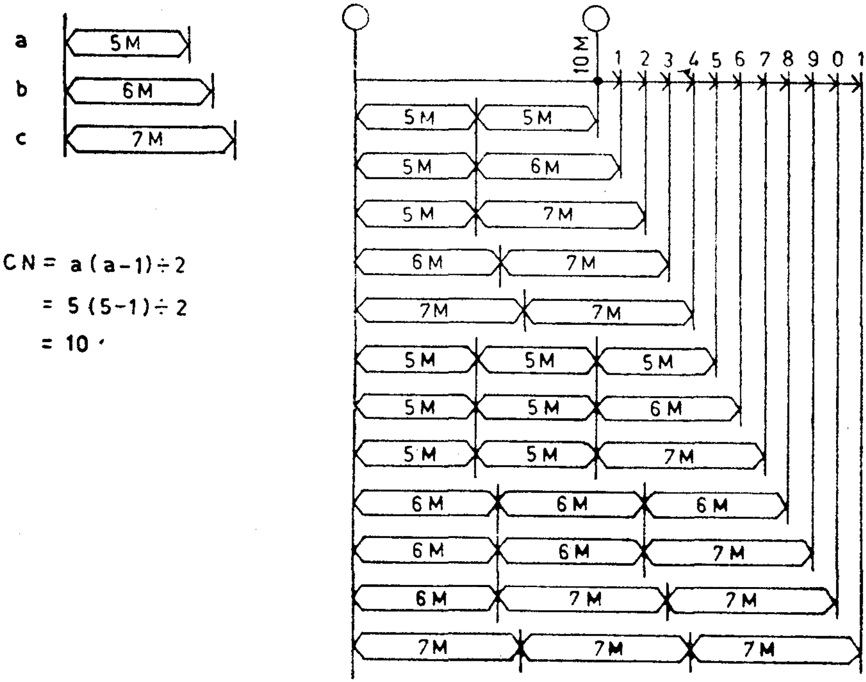


FIG. 19 CRITICAL POINT (TRIPLET OF COMPONENTS WITH SMALLEST DIMENSION ODD)

15. DIMENSIONS OF MODULAR COMPONENTS

15.1 In building component design, the application of spatial reference system as well as selection of preferred sizes for components and space dimensions is only the first step towards ensuring that the components as supplied can be assembled with case of fit.

15.2 The reference system enables designers to relate the position and size of components by means of modular planes. Such co-ordinating planes from the boundaries of modular component spaces inclusive of allowances for inaccuracy and the size clearances.

15.3 In modular design practice, therefore, these spaces will be defined by co-ordinating dimensions which are modular.

15.4 It is important to stress the essential theoretical nature of such dimensions in the context of building component manufacture.

15.5 The modular co-ordination shall provide co-ordinating length, width and thickness of interval dimension of components. It means it shall provide facility to ensure dimensional compatibility between the position of the different designed sub-systems comprising components, and position and dimensions of those fuctional sub-systems.

15.6 The modular sizes shall provide the basis only for determining the manufacturing sizes of components as explained in Fig. 20.

15.7 Deduction from the modular sizes shall require to be made to accommodate any allowance for joint end for the dimensional deviations that occur in production and erection.

15.8 The basic principles relating to the tolerances of component design, size and shape are embodied in IS : 6408-1971*.

16. DESIGN DRAWINGS

16.1 Designers are well familiar with three types of drawings:

a) Sketches,
b) Main drawings, and
c) Detail drawings for contract documents.

However, it is necessary to work with different types of working detail drawings, each serving its own purpose in the design process.

16.1.1 In addition to this, special drawings that are used to clarify the modular problems in the project shall be prepared for:

a) general modular drawings, and
b) modular detail drawings.

16.1.2 For partially or totally prefabricated buildings, where the working drawings are made as operational drawings, these shall be classified as follows:

a) Component drawings,
b) Assembly details,
c) Type drawings,
d) Lay-out for componets, and
e) Register of components.

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*Recommendation for modular co-ordination — Application of tolerances in building industry.

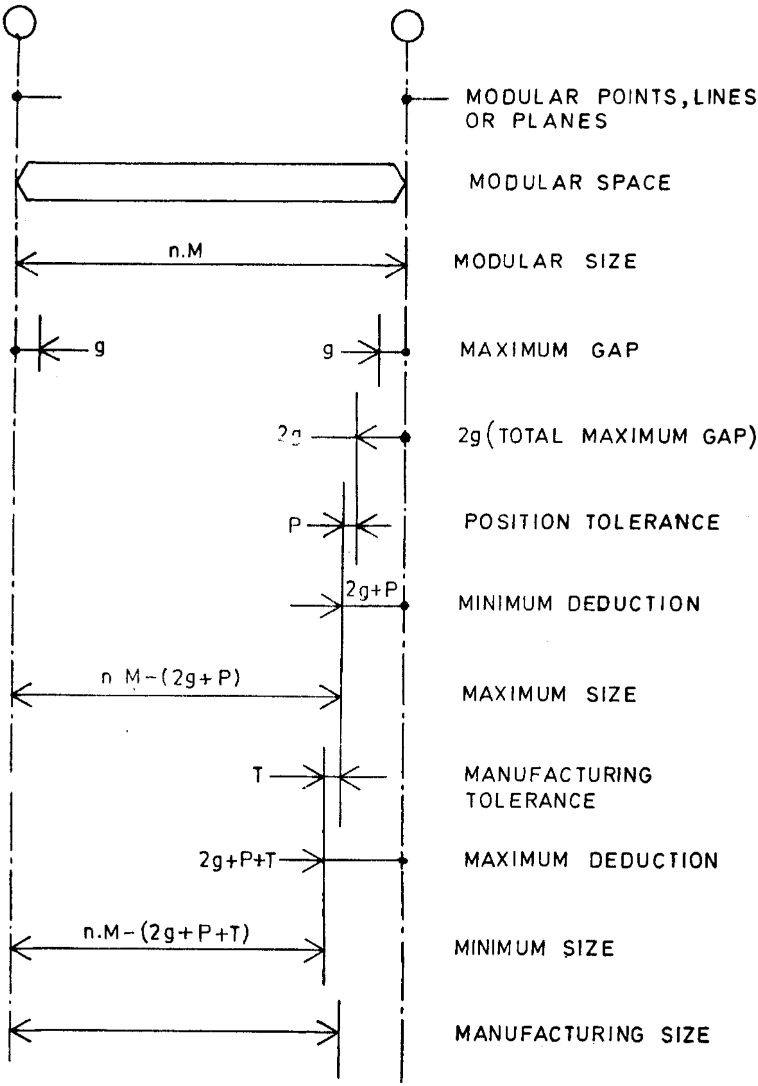


FIG. 20 RELATIONSHIP BETWEEN MODULAR SIZE AND MANUFACTURING SIZE

16.2 Sketches

16.2.1 During the preliminary design process, the main arrangements and dimensions of the building shall be determined in accordance with the building programme and prevailing building regulations, alongwith choice of structures, materials and techniques of construction.

16.2.2 The preliminary drawings for residential building shall be based on 3M planning module and scale 1 : 50. If modular paper with a suitable square grid, like 6 mm, is not available, 3M grid may be drawn on paper.

16.2.3 In the preliminary design, the load bearing walls building elements shall be placed in accordance with the axial principle as given in **16.3**, that is, with the centre line of the wall placed along planning modular line while the exterior walls are placed approximately in relation to the modular grid.

16.2.4 The exact placing of all the walls shall be first determined when all the details have been thoroughly worked out.

16.2.5 It shall not be necessary for placing of the monular lines in relation to the component of the structure.

16.3 Modular Details

16.3.1 The placing of the modular line in relation to the structure shall be determined on the basis of technical analysis of a structure.

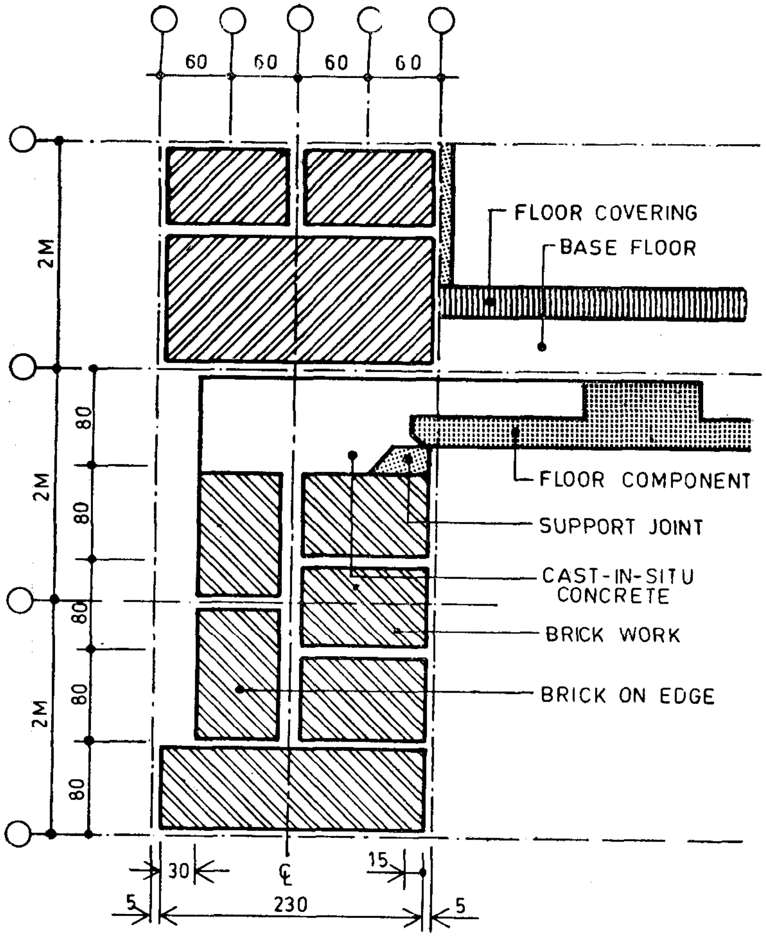
16.3.2 In order to achieve accurate dimensioning, large-scale modular detial drawings shall be made to indicate the placement of components/ elements in relation to each other and to the modular lines and shall be on scale of 1 : 1 or 1 : 2 so that all details regarding assembly and joint sizes are made absolutely clear.

16.3.3 Modular sketch details shall form the basis for assembly details which shall be a part of the operational drawing containing all specifications required for assembly at the site. This shall be drawn to a scale 1 : 2 and reduced to scale 1 : 5 or less, where so desired (*see* Fig. 21).

16.3.4 Subsequently, the modular dimensions and grids shall be replaced by basic dimensions and reference lines (*see* Fig 22).

16.4 General Modular Drawings

16.4.1 General modular drawings shall be prepared once the location of modular lines in relation to the various components has been determined on detail drawings, along with selection of all material specifications and components.

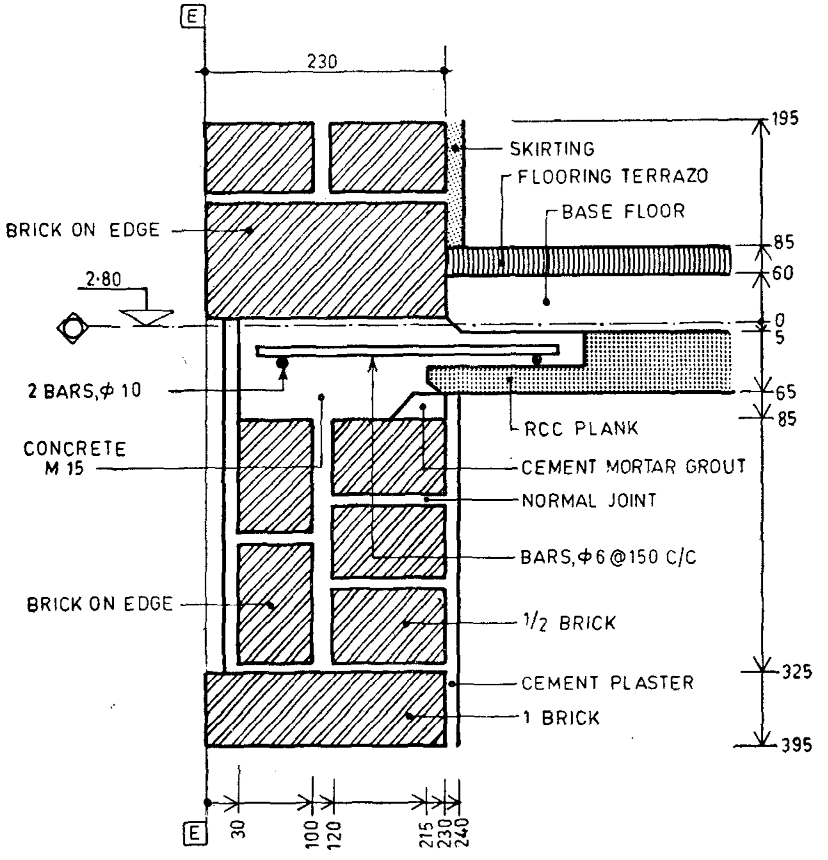


All dimensions in millimetres.

NOTE 1 — The drawing sets the components of the connection in their proper relationship to each other and to the modular lines.

NOTE 2 — The drawing is further used in the overall design for the preparation of operational drawings of the connection details (*see* Fig. 22).

FIG. 21 TYPICAL MODULAR DETAIL DRAWING SHOWING CONNECTION BETWEEN EXTERIOR WALL AND FLOOR (VERTICAL SECTION)



All dimensions in millimetres.

NOTE 1 — The drawing is prepared as an operational drawing under the overall design and contains all specifications required for assembly.

NOTE 2 — The modular dimensions and grid have been replaced by basic dimensions and reference lines (refer Fig. 21).

FIG. 22 TYPICAL OPERATIONAL DRAWING SHOWING CONNECTION BETWEEN EXTERIOR WALL AND FLOOR (VERTICAL SECTION)

16.4.2 These drawings shall show:

a) the modular components used in the project,

b) their location in relation to each other, and

c) their location in relation to modular lines.

16.4.3 The dimensions on the general modular drawings shall be mainly modular dimensions in terms of M.

16.4.4 These drawings shall mainly be used for drawing office. They are not intended for use at site, where unit of measurement is mm and not M.

16.5 Operational Drawings

16.5.1 Operational drawings shall be prepared for use in the factory, workshop and building site, such as excavation, concreting and brick-works.

16.5.2 The component drawing shall provide detailed data on all dimensions and quality requirement necessary for manufacture of the components, on the basis of structural analysis.

16.5.3 All dimensions shall be specified in millimetres and shall not include modular dimensions, even though principle dimensions are derived from modular dimensions.

16.6 Assembly Details

16.6.1 The usual detail drawings employed for site work shall also be made as operational drawing.

16.6.2 These drawings shall contain data on placement, jointing, possible joint reinforcement, flashing and insulation, etc.

16.6.3 The placing of the components forming a connection shall be shown in relation to the site reference lines; not necessarily selected modular reference lines of the project plan of the building.

16.6.4 The placing measurements and detail dimensions shall be specified in millimetres and again no modules appear on these drawings.

16.7 Assembly Drawings

16.7.1 The assembly drawings showing location of components shall be prepared on the basis of the general modular drawings.

16.7.2 The components shall be designated and numbered, and their location with relation to reference points lines or planes adopted on project site shall be indicated.

16.7.3 Horizontal or vertical component assembly drawings are working drawings. The measurements shall be specified in millimetres.

16.7.4 Assembly drawings shall also be provided with a register of components which shows the number of different components and shall include information on their modular dimensions and any special remarks.

16.7.5 The numbering of components shall be made with a four digit numbering system, indicating first two digits as length dimensions and last two digits as variants from 01 to 99 for different components with the same unit length.

17. NOTATIONS AND SYMBOLS

17.1 For notations and symbols used in the modular drawings, reference shall be made to IS : 11778-1986*.

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*Recommendation for modular co-ordination : Notations and symbols for modular drawings.

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