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APPLICATION OF MODULAR COORDINATION CONCEPT IN CONSTRUCTION INDUSTRY

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ABSTRACT:

The modular coordination system is the process of organizing the dimensions which can be applied to the traditional as well as partially prefabricated or totally prefabricated or industrialized building. Modular coordination which comprises Interrelated Concept for building and construction process. This can be applied comprehensively or partly depending upon the particular circumstances. The modular system can be applied to determine the size of building components and assemblies, installation and service systems to the design of the building. This can be achieved by application of the internationally agreed 100mm Module. Modular Coordination provides the easy grasped layout of the positioning of the building components in relation to each other and to the building and facilitate collaboration between planners, manufactures, distributors and contractors.

Keywords: Modular Coordination, Module, Construction, Building, Standardization

INTRODUCTION

Modular coordination is a concept of coordination of dimension and space, in which building components are dimensioned and positioned in a term of a basic unit or module, which is also known as 1M and which is equivalent to 100 mm. MC is internationally accepted by the International Organization for Standardization (ISO) and many other countries as well as Malaysia.

A module is a unit of measurement and it means Standardized and easily fit components. Generally the word Module is derived from Latin Word 'MODULUS' meaning a small dimension. MC is the International system of dimensional standardization in building. The smallest Module is generally used to coordinate Position and Size of Components, Elements and their Installations. Smaller Dimensions should be more clearly distributed than larger dimensions

BACKGROUND

Modular coordination was first explored as an aid to design shortly after the introduction of prefabrication in the construction industry in the industrialization. It was conceived as a further step in the development of systematic design and construction of the building. This subject has been discussed and attempted in an actual building experiment in practically every developed country.

Modular coordination was first studied in Singapore in the early seventies. The housing and development board implemented the concept in 1973 in the new generation flats. Prefabrication and standard components were subsequently introduced. Modular blocks and bricks were introduced in 1983. There are merits to extend the use of modular coordination in other components as well.

AIMS AND OBJECTIVES OF MODULAR COORDINATION

1. The principle objectives of modular system is to provide practical and coherent solutions for coordination of the position and dimensions of elements, components and space in building design.
2. This process can contribute to increase design freedom and improved balance between quality and cost in manufacture and construction.

BASIC PRINCIPLE OF MODULAR COORDINATION

The main purpose of Modular Coordination is to achieve the Dimensional Compatibility between the Building Dimensions, Span or Spaces and the Size of Components and Equipments by using related Modular Dimensions.

Modular Coordination generally provides the easy grasped layout of the positioning of the building components in relation to each other and to the building and facilitate collaboration between planners, manufactures, distributors and contractors.

PRINCIPLE OF MODULAR COORDINATION

- Basic Module
- Modular Dimension
- Planning Module
- Placing Of Components
- Modular Grid
  - Basic Modular Grid
  - Square Grid
  - Rectangular Grid
  - Multi-Modular Planning Grid
  - Tartan Grid
- Preferred Dimensions
- Tolerance

Basic Module: It is a fundamental unit of size.The term module is derived from the Latin modules which in English means "Small dimension".

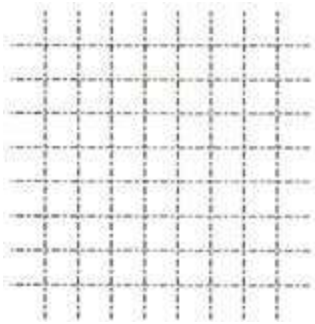
Modular Dimension: Traditionally designers have trained to use simple whole number ratios. Modular coordination provides a sound basis for an ordered selection of dimensions and accommodates a proportional flexibility that satisfies the needs of architectural aesthetics.

Planning Module and Placing of Components: There are different methods of locating components within dimensional frame mark of the building the distribution is made between load bearing walls, slap components vertically and horizontally. The placement of components either made on axial to the boundary planning.

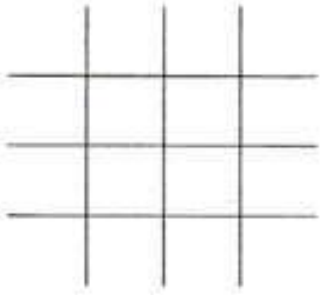
Modular Grids: To simplify the design process a mesh of lines, which have preferred space dimension, are plotted in three directions for all types of buildings.

Basic Modular Grid

The fundamental modular grid, is that in which the intervals between consecutive parallel lines is equal to the basic module, smallest planning grid.

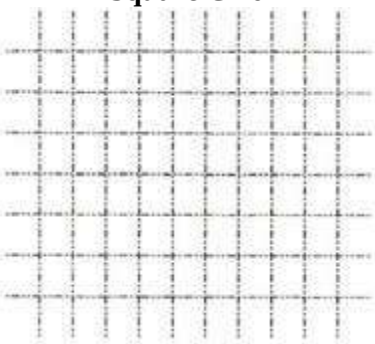


Basic Grid

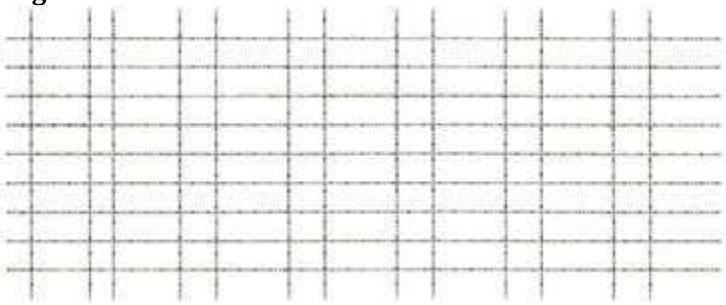


Square Grid

Rectangular Grid



Multi - Modular Planning Grid



Tartan Grid

Figure 1: Types of Modular Grid

Multi - Modular Planning Grid: In addition to the basic modular grid, multi-modular grids in which the intervals between consecutive lines are a multi-modular may be used.

Tartan Grid

It is used to describe an interrupted modular planning grid in which the intervals or bands of interruption are regularly spaced in both directions and are of the different modular order of the general modular planning grid.

Preferred Dimensions

A preferred size is a modular or multi-modular size for a specific purpose, which shall be selected, is advance of all others.

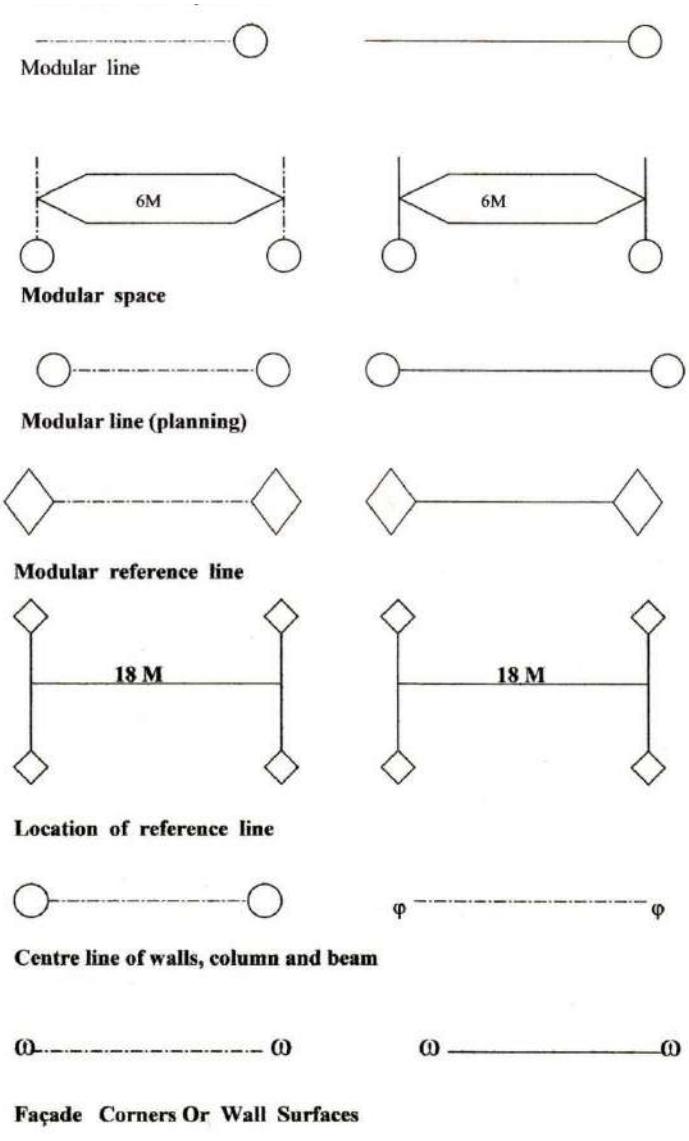
- A preferred size is a modular or multi-modular size for a specific purpose, which shall be selected in advance of all others.
- The preferred horizontal sizes shall primarily be intended for sizing components.Assemblies and spaces.
- The preferred multi-modular sizes shall be multiplied of the basic module with arithmetical values of 2 or 3.
- The preferred size shall provide a flexible choice of multi-modular dimensions in line with the characterizations of conventional design practice adopted in the building.

- The preferred size shall normally be used for smaller dimensional increments in the vertical plane than in the case of the horizontal plane.
- The preferred sizes of modular components share a common factor (3M) for example 3M, 6M, and 12M etc. and only the spaces which are a multiple of that common factor shall be filled.

- The non-modular component size do not share a common factor. They shall be combined beyond a certain point to fill all multiple of 1M. The point in question is referred to as the critical number. Thus, if components 3M & 4M long are selected they can be combined to fill all spaces that are multiple of 1 M from 6M upward.
  30 M = 3 X 10
  60 M = 3 X 20

The smaller dimensions should be more clearly distributed than larger.
3M, 6M, 12M, 15M, 30M, 60M
In above series smaller dimensions more densely distributed than higher dimensions.

Notation and Symbols:



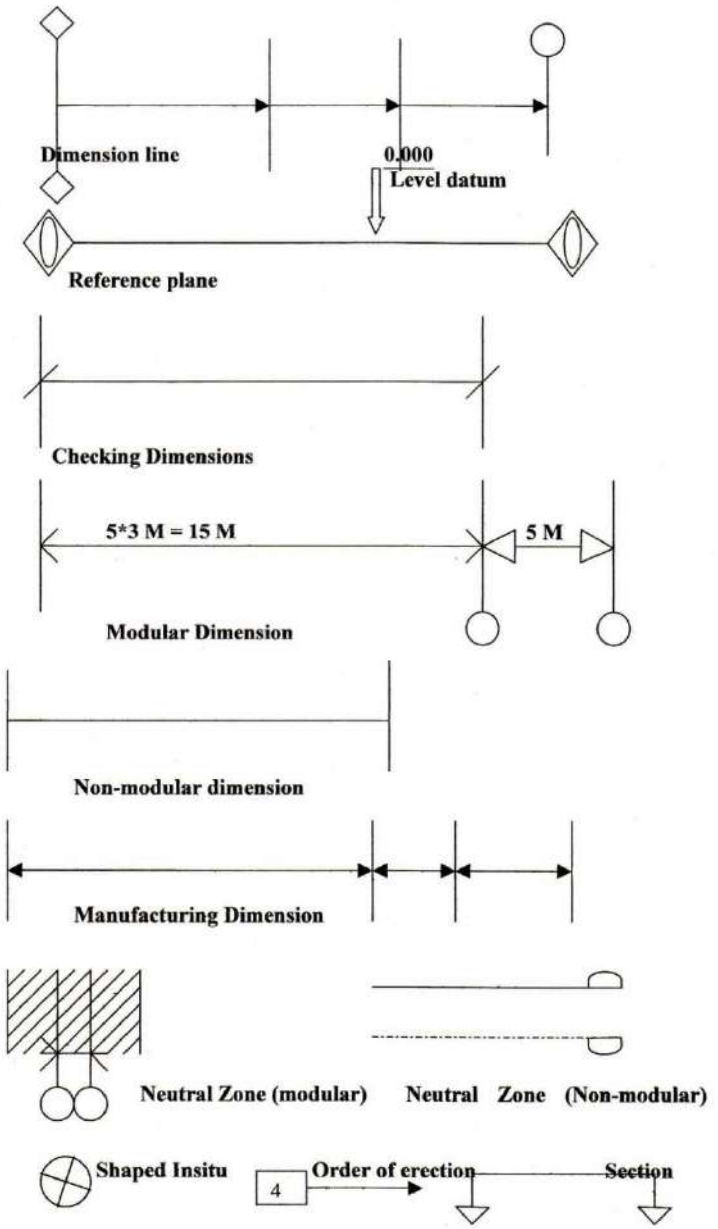


Figure 2: Notation and Symbols

The drawings prepared by the designers should illustrate the application of dimensional co-ordination at various stages of the design process.

A standard system of notations and symbols is recommended for use on drawings. The notations & symbols are for indented for direct communication among the designers, the manufactures and builders.

Tolerance

In traditional building, the craftsman takes care of dimensions in the ordinary course of his work.

The modular dimensions provide a convenient means of describing components in a catalogues & for allocating the spaces for them on design drawings.
Three types of tolerance are generally considered in modular coordination in building.

- Manufacturing tolerance, which limits the dimensional deviation in the manufacture of components.
- Positional tolerances, which limit the deviation of position for, erected components from their designated position.
- Joint tolerances or gaps, which limit the variations of joint thickness.

The three tolerances are interrelated and therefore must be determined accordingly.

5 mm RULE:

This rule is applied to all structural parts of building & components. The wall, slab & components, elements which are the structural part of the vertical and horizontal division are placed one joint proportion on the boundaries of a modular plane, that is the actual dimension as a rule for the structural elements are '5 mm' less on all modular boundary plane. This rule is called as the 5 mm rule for all horizontal & vertical dimensions.

If the size of the grid is n_1 M x n_2 M
Component size = (n_1-10 mm) M x (n_2 -10 mm) M
The 5 mm rule is given by IS code, it is due to tolerance because tolerance is required to fit the component into available grid space.

Prefabrication:

Modular co-ordination and prefabrication are two sides of the same coin. They are complementary to each other.

Prefabrication requires the cooperation of architects, suppliers and builders regarding the size of basic modular units.

Another prefabricated unit widely used in light construction is the roof truss.

Advantages and benefits of prefabrication:

- Mass produced in an assembly line so can be made in short time.
- For lower cost than conventional method of construction.
- Savings in material cost.
- Savings in time.
- Material that has become highly specialized with attendant fluctuation in price and availability can be stockpiled at prefabrication shop or factory.
- Standardization of building components makes it possible for construction to take place where the raw material is least expensive.

MODULAR COORDINATION DESIGN RULE:

Basic module → 1 M = 100 mm

Horizontal planning module → M_H = 3M (300mm)

Vertical planning module → M_V = M (100mm)

The other multi modules are 3M , 6M , 9M , 12M.

Planning modules for main dimensions of framework especially the span (horizontal dimensioning) are shown in figure

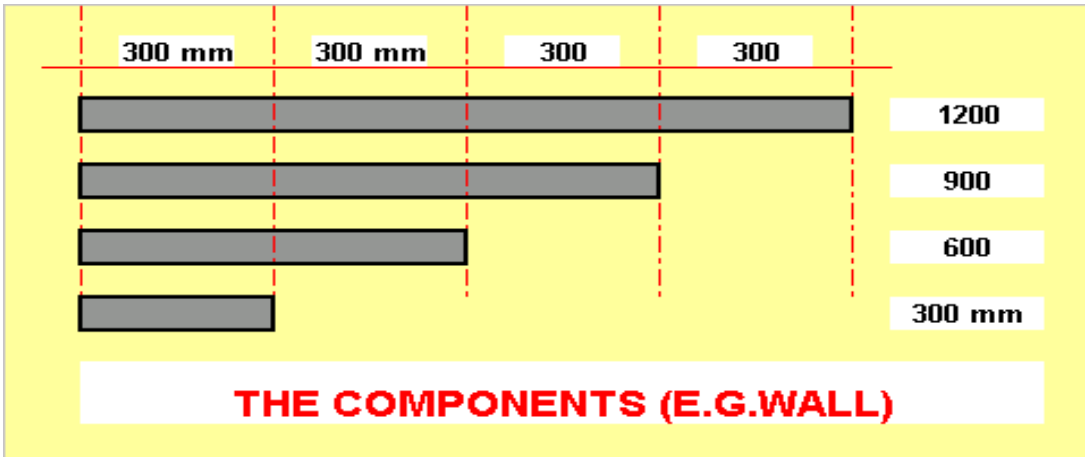


Figure 3: Horizontal Dimensioning of Framework

Modular Coordination System

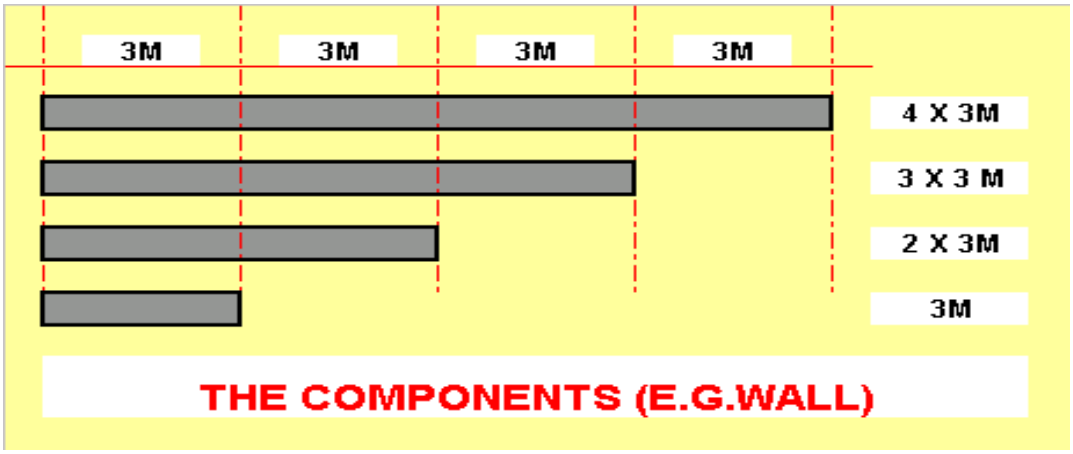


Figure 4: Modular Coordination System of Framework

ADVANTAGES OF MODULAR COORDINATION

- To facilitate collaboration between building designers, manufactures, distributors and contractors
- To permit the use of building components of standard size to construct the different types of building
- To optimize the member of standard sizes of building component
- MC increases the speed of construction
- Benefits through the increase use of computer aided design and drafting
- Reduction in manufacturing and installation cost
- MC minimize the wastage of materials, time and manpower in cutting and trimming on site
- Facilitate prefabrication
- MC improved the balance between Quality and Cost

DISADVANTAGES OF MODULAR COORDINATION

- Uniformity
- Can lead to problems when modules are linked because link must thoroughly test
- It is difficult to manufacture to produce components based on mm tolerance.

CONCLUSION

In this study the benefits of modular construction have demonstrated its ability to be cost effective against other methods of construction, and has led to financial savings and reduced disruption on site.

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REFERENCES

M M Mistry “Principles of Modular Co-Ordination in Building”, National Building Organization

Wan Ahmad Jailani Wan Mahmud “Modular Coordination Verification Scheme” Product Certification Unit

http://www.ncma.org/etek/Pages/ManualViewer.aspx?filename=TEK%2004-01A.pdf

http://www.bca.gov.sg/Publications/BuildabilitySeries/others/mcg_ch3.pdf

http://www1.unisg.ch/www/edis.nsf/SysLkpByIdentifier/3578/$FILE/dis3578.pdf

http://www.docstoc.com/docs/136085590/What-is-Modular-Coordination

http://www.designforhomes.org/wp-content/uploads/2012/03/ModularSteel.pdf

http://www.willscot.com/pdf/benefits-of-modular-construction.pdf