

Modular Coordination: To Design An Ideal Module For Housing

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 DOI: 10.47750/pnr.2023.14.502.27

Abstract

In the area of contemporary construction the modules of each material and the units are very different. If harmony can be introduced lots of wastage can be avoided. Because in this era of climate change the construction industry is one of the biggest unsustainable and pollutant industries. This paper aims to discuss the unit of the least module for contemporary construction. The study is supported by standards and case studies and various practicing modules. Drawings are made to prove the least module for construction of housing of LIG, MIG, and HIG units.

INTRODUCTION: In Europe, Sweden led the way in developing prefabrication and rationalized approaches to building. However, it was the European productivity agency (EPA) that set out the case for industrialization and dimensional standardization in their first report on project no. 174, published in 1956, and entitled modular coordination in building (EPA 1956). For most in this was the “modular society” founded in 1953, which sought to bring about the idea of a dimensionally related building industry vernacular, through a series of ground rules, the most crucial one being the use of “basic modular” of 4” or 100 mm all component sizing.

The most interesting of all the test projects is the second EPA project in the Greek submission. In the reconstruction of 600 houses on the land of “there, Greece” after an earthquake modular concrete blocks were needed to produce houses that were Greek in style rest of the houses were constructed with hollow concrete blocks and reinforcement. In the report, it was pointed out that the vaults were a common traditional element in the area.

THEORY EVOLVED

1962-1963: the first founder, first secretary and driving force of the modular society mark Hartland Thomas; with the publication of “modular quarterly” “To make modular coordination in building design more popular and specific.

In modern architecture, the history of modular coordination began in the year prior to World War II when Albert Farwell Bemis, in 1936, proposed a module for a mass-produced building with a size of 4 inches. In reality, the concept of modules is very ancient, and the introduction of modules as tools of composition and dimensional coordination can be seen to date back to classical Graeco-Roman architecture. In this regard, some studies have demonstrated the recurrent presence of the module, as the regulator of dimensional ratios between the parts of architectural constructions, in Roman buildings.

However, the modern concept of modular coordination, while taking into account the appropriateness of the module as a sizing tool, is strictly linked to the industrialization of the building industry. This explains the fact, relatively recent, or renewed interest it has now aroused. In the World War II years and the immediate postwar period, some proposals concerning the value of the module when taken as a basis for coordination were put forward:

1. In Germany, Ernst Neufert, proposed a module of 1/8 m = 12.5 cm, giving origin to the so-called "octameric system";
2. In France, Jean Pierre Paquet, proposed a module of 10 cm which approximated (being slightly less than) the value

of 4 inches proposed by Bemis;

3. In Sweden, Lennart Bergwall arrived at the same proposal as that of Paquet;

Only in 1953 did the "European Productivity Agency - E.P.A.", the technical body of the "Organization for European Economic Co-operation - O.E.E.C.", launch a systematic study of modular coordination with the project E.P.A. 174. From the work carried out in that project, in which participated delegations from eleven nations of Western Europe, a general theory of modular coordination was pronounced, agreed upon on the basis of the exchange of information and ideas among the participating delegates.

The general agreement, reached in 1955 with the Munich Convention, called for the adoption of a module with base $M = 10$ cm, as a common denominator for correlating the dimensions of all elements involved in architecture and building. In 1959, with the establishment of a study group operating within the context of the "Council for Mutual Economic Aid - C.M.A.", the countries of Eastern Europe also began to collaborate on the development of the E.P.A. 174 project.

From the work of these groups came the first indications sent to the "International Organization for Standardization - I.S.O." and, in particular, to Committee TC/59 "Building" which, since 1953, has established a subcommittee for the standardization of building components. A fact of decisive importance, for concentrating the coordination action still further, took place in 1960, with the establishment of the "International Modular Group - I.M.G." in which participated those who had worked on Project E.P.A. 174 and the studio group within the C.M.A.

SALIENT FEATURES OF MODULAR CO-ORDINATIONED DESIGN:

1. It provides practical and logical construction solutions which will lead to an increased balance between quality and loss in construction.
2. It simplifies the work; for e.g., in setting out measurements, and in assembling and locating modular building components.
3. Making planning simpler and clearer by distinct indication of the building components in the design both in relation to each other and to a modular grid.
4. Facilitating cooperation between designers, manufacturers, suppliers, and builders.
5. Greater interchangeability at design, construction, and infield practices.

RELEVANCE OF MODULAR COMPONENTS IN MODULAR-DESIGNED MASS CONSTRUCTION

1. The modular components, which have an actual size a little less than the modular, size which after assembly gives the exact size of the modular component.
2. It saves time, and specification and estimation also become easy.

In mass construction, due to the standardized materials, it becomes easy to save at 6 the cost factor. Thus, it is economical.

HOUSING: PERSPECTIVE

It is clear that people have a variety of background, which influences their behavior, and plans based on some sound theoretical principles may if the customs need, and desires, as well as the educability, of the subject population, are not fully understood.

The housing cycle approach to development programmers recognizes four distant periods of typical housing need, which are

1. A couple forms a family, thus needing a modest rental or ownership unit, the need is usually for a rental unit.
2. The couple has children and their housing needs increase in size and include child-oriented space and location parameters.
3. The children mature and leave the couple as "empty nesters" so housing needs to change again.
4. The remaining couple (and survivor) attains retirement and requires a smaller dwelling, perhaps in a new location.

An understanding must be drawn from the architecture of the various types of residential structures and their relationship with owner time to users' wants and needs, including siting, relationships between units, and requirements for supporting facilities. It must be remembered that beauty can be good business.

HISTORICAL REVIEW

Villages composed of manmade structures date from Neolithic times. In Mohenjo-Daro, Pakistan (2500-1500 B.C.) the heights of the building were proportioned in relation to street width, and there is evidence that disposal lines from dwellings were connected to the underground sewer system later c. 1750 B.C., The codes of Hammurabi heralded the dawn of building regulations. He decreed in Babylon, that if a building should fall and with the son of the occupant, the builder's son would be put to death. Babylon consisted largely of 3 to 4-story dwellings in the 6th and 5th century B.C.

In the latter part of the 5th cent B.C. the Greek architect Hippocampus advanced the gridiron street system to new levels of sophistication in Olynthus, for e.g., streets were oriented and blocks proportioned so that maximum advantage was taken of winter solar heating potential later, tonus included underground storm drainage. Greek building regulations typically restricted projections of upper floors of buildings over the streets, and windows were not permitted to open on the street. Moreover, house water drains were not allowed to empty into the street.

During the 5th and 4th cent B.C., few Greek towns exceeded 10,000 people. Athens had a population of fewer than 150,000 including slaves and foreigners.

The Romans' development of technology is well known. Their achievement in the design of roads, Water supply, distribution systems drainage, and heating systems needs no detail here. Not so familiar is the fact that Rome was largely composed of tall residential apartments. Caesar had to restrict building heights to 70'-0 (21.3m) to Control land speculators. By the 4th cent A.D., there were over 46000 blocks of apartments, compared to fewer than 2000 private houses in Rome.

In the Middle Ages, housing conditions in European cities were worse than in Rome a thousand years earlier. Half the urban population was decimated by the Black Death plague in the 14th cent. It was not connected to dwellings in London. This innovation was no doubt also stimulated by the fire hazards caused by several aspects of housing cents, though neither water nor some fire prevention regulations were enough to put out this great fire in London in 1666.

During the Renaissance urban residential areas were opened up a little the avenues and plazas, but behind these open spaces, many cities continued to lack water distribution and sewer systems for their high-density population.

The industrial revolution in the 19th Cent occasioned further development of water and sewer systems and initiated significant advances in transportation, Communication, light, and power. It also spanned neighborhoods of factory tenements. In 1867, with a population density of over 300 people per acre, New York adopted its first law to regulate tenement housing later, in 1916 the city adopted the first comprehensive zoning ordinance, which built height to street width.

Meanwhile, pressures such as population growth and high land lasts were forcing the urban dweller farther than farther from the city center. The eventual results were the development of suburban facilities having the character of satellite communities early was a widespread commitment to the philosophy amongst the majority of architects.

But how modular coordination became a fashionable and more practical solution in the building industry in Europe?

The formation of the modular society in 1953 was an impartment acceptance of the ideas. The founder, first secretary, and driving force of the modular society were MARK HARTLAND THOMAS.

A brief section on the dimension of a German system based upon a planning grid of 1.25m (4'-1"). He was also very skeptical of attempts to Co-coordinated heights around a module to Co-coordinated heights around a module.

Apart forms the Basic module' itself other related aspects of the Modular idea are these: -

- 1) **Reference Grids:** A grid of lines, which assists the location of buildings and components, similar to the grid used on a map.

- 2) **Basic Modular Grids:** This is a grid spaced at 4 (100 mm) in each direction and component sizing and component assembly. It is emphasized that the component must 'must' on the grid. That is they must always be located within grid lines so that their perimeter takes always end up relating to a grid line.
- 3) **Modular Planning grid:** Such grids are used for planning of spaces and for layout purposes and sizing components – ml. i.e., multiple of the basic module.
- 4) **Modular structural grid:** Column, walls, beams.

Against the myths of rigidity, although it should be a multiple of the basic Module it is not necessary for it to be a multiple of the planning grid. In this way, components may be 'freed' from the tyranny imposed by the more normal use of the structural grid as in the HERTFORDSHIRE 8'-3" (2.5m) system or as in the buildings of MIES VAN DER ROHE.

How Modular Coordination is superior to the conventional Method?

The Modular Reference Grid, on the other hand, "Allows for the Interchangeability of Different types of Structure and the Location of components in a variety of positions – Hence an "Open System".

The Conventional Method of Coordination dimensions is to relate the centerlines of all components to the planning grid, using this also to determine components sizes but taking no account of their thickness. The end result is 'The closed system' Applicable to the only type of structure.

HOUSING IN RAIPUR

Need.

DATA NO.1- RAIPUR: HOUSING SHORTAGE				
S.NO.	Description	Total Dus	%Per replacement	Dus reg
1.	Backlog up to 1987	-----	-----	12748
2.	Houses unfit for human habilitation	19972	@40%	7990
3.	Houses requiring replacement	-----	@ 20%	11844
4.	Total dus required including the backlog (1981)		-----	173575

Source: Town & Country planning, Raipur, Chhattisgarh, India

It is almost clear that by the year 2005, the estimated housing requirement is 1.73 lakhs and this requirement is going to shoot up as time passes by.

RELEVANCE OF MODULAR COORDINATION IN HOUSING

HOUSING: GENERAL

In general; Housing is the basic need of human settlement and habitation, but thinking vice-versa. Housing is one of the key Sectors, which offers tremendous opportunity for the growth of urban economy.

Housing is the context, of city structure bears relation to work centers, Industrial areas and access to various facilities.

1. Affordable Housing space with the scope for the needs of the family and its allocation on easy terms.
2. Provision of services such as water, electricity waste disposal, and access to affordable intercity and intercity transport.
3. Provision of social facilities such as education, health, and recreation.
4. Provision of space for the promotion of community organization and social interaction.
5. Provision of housing in the proposed time frame so as to avoid backlog and housing shortage.

From the above-highlighted points it is clear that if the salient features of modular design are implemented in the housing scheme, we can overcome the backlog in building design and construction management and can play a vital role in many ways such as reduction of building cost, building time, the ease at handling the projects, precise estimate and speedy process in the production of drawing.

CASE STUDY: PHYSICAL SURVEY QUALITATIVE- 1

At the dwelling unit level

Activities in most houses' observation & Qualitative surveys

S. N.	Activity	Possible Space Allocation
A.	Entering & Leaving a House -Main Entrance -Back Entrance	Lobby, Front Verandah, Living Room, Back Verandah, Kitchen, Courtyard
B. * * *	Leisure -Reception & Entertainment of casual visitors -Guests -Rest & Relaxation -Conversation -News or Light reading -Recreation Children Play Listening to radio Hobbies	Living room, Verandah & Drawing room Drawing room, Living room, Study library or verandah. Front Verandah, Living room, and Courtyard. Living room, Verandah Verandah, Nursery or any Enclosed space. Drawing room, Living room, Lounge Bedroom
C.	Cooking -Dining, Usual Meals -Parties	Space Allocation depends on the nature of the hobby. Attached kitchen. Kitchen cum dining.
D.	Sleeping -Winter -Monsoon -Summer	Kitchen cum Dining Dining cum Living Dining cum Drawing Combination of Drawing & Dining or also lawn or courtyard.
E.	Study -Children -Adult	Bedroom. Terrace, Courtyard, Lawn, Bedroom
F.	Contemplation Prayer	Children's Bedroom, Study, Dining room office, Study, Library. Any quiet place-subjected to the Design of House.
G.	Storage	A scheduled place preferably a separate room

LITERATURE STUDY

INTRODUCTION: Men started introduction-man started living in caves and also took shelter under the trees but there was no safety as such. Because the wind animal could approach the caves and trees with natural inspiration, he found that living in the trees is safer and he started off the ground.

Also due to heavy floods in the resign like the Indus valley, China Babylonia, etc. Men started living off the ground to save their lives against such natural forces. So, he builds the huts on stilts and today also find such types of huts in many places.

When there are no danger men started living on the ground or off the ground as he linked, the use of a ground level as well as upper level according to his convenience, and a concept of two-level living comes forward.

People found that as they go up for a living become safer. In the olden days, people of one community or tribe used to protect their leader for this reason a high-level living place was offered to the leader. In the passage of time, it become an on-set rule that one who lives on the higher level is a dominant person and a feeling of self-dominance was associated with the height of residence.

As time passed, men realized the importance of an "enclosure" only living for free is not safe, but if the living area has certain enclosures all around like caves. It becomes safer and well-protected against not only wild animals but natural climates also. He started building huts on trees the course of time he found that the flat roof is more feasible and the great idea of "multistory" was involved.

Men have got inherent affection for ground and, therefore by nature he like to live on the ground. But due to fast urbanization and shortage of land. People have to build houses one over the other. The extreme has reached now that the “after effects” have come to light after the people have lived in houses touching the sky⁵.

REASONS FOR VERTICAL HOUSING ARE APPARENTLY

1. Shortage of land
2. Traffic hazards
3. Overcrowding due to concentration on certain urban areas.
4. Air pollution
5. High density
6. Health and sanitation conditions
7. Light and air ventilation problem
8. Dust and dirt
9. Sun glare
10. Urge for privacy

TO DESIGN APARTMENT HOUSES

It is a ready-made house where there is access to 3 or more houses by a common lobby. Climatologically it is not suitable if placed in the proper orientation. No alternation or improvements could be made to the type of houses. From the economical point of view types of housing are categorized for different income

Types of housing - income level per year (in Rs.)

EWS (economically weaker section) <25200

LIG (low-income group) 25201-54000

MIG (middle-income group) 54001-87600

HIG (high-income group) 876001<

The neighborhood unit defined

The neighborhood unit is not the same sociological phenomenon and is embracing no particular theories of social science. It is simply a physical environment in which a mother knows that the new child will have no traffic streets to cross on his way to school, a school which is within easy walking distance from home. It is an environment in which the housewife may have an easy walk to a shopping center where she may obtain the daily household goods, and the employed person may find convenient transportation to and from work. It is an environment in which a well-equipped playground is located near the home where the children may play safely with their friends the parents may not care to maintain an intimate friendship with neighbors, but children are so inclined and they need the facilities of recreation for the healthy development of their minds and spirits.

Hence in the concepts of Stein and Perry, the cities are viewed as social meeting places and not merely a collection of houses, workplaces, and roads network with the provision of physical infrastructures. The whole city is divided into several neighborhoods, each accommodating a considerable population (say 5000), and providing community facilities, each neighborhood is segmented to accommodate different income groups, and no high-speed vehicles are allowed to cross the neighborhood but pass only from the peripheries.

DATA FROM LITERATURE-

LAYOUT OF RESIDENTIAL UNIT-

A residential unit has five zones are public (road), semipublic (front open space of the garden.), selective private (living room), absolutely private (bedroom), private but open area (back open space which acts as a buffer from other houses or another public space).

The “HUMAN SCALE” is very important in zoning the residential layout. A designer must try to get a defined ‘enclosure’ in the residential layout. Various enclosures have distinct relationships with the height of the building and the volume of space it encompasses.

If the width of the open area is ½ of that of the building height the open area acts like a street. If the width of the open area is equal to the height of the building, a very dominant enclosure feeling is got. If the ratio of the height of the open area is 1:2, a courtyard feeling is obtained. If the ratio increases to 1:4 it is optimum for the vertical and horizontal

relationship. If the courtyard moves more than 4 times the height the feeling of the enclosure is lost. So while designing a courtyard amongst a cluster of building the width of the courtyard must be restricted but the width must not exceed (61 m. 200')

Bye-laws in NBC of India 1983

Open space (within a plot)

Every open space provided either interior or exterior shall be kept free from any erection thereon and shall be open to the sky.

1. Cornice roof of weather shade, not more than 0.75 m. wide.
2. Sunshade over window/ventilation or other openings, not more than 0.75 m. wide.
3. Canopy at first-floor land but not to be used as a sit-out with clearance of 1.5 m between the plot boundary and the canopy.
4. Projected backing at a higher floor width, not more than 0.9 m.
5. Projecting rooms/balconies at alternates floors such that rooms on the lower floor get light and air and the projection is not more than the height of the story immediately below.

SUNSHADES OVER WINDOWS AND VENTILATORS

Projection of sunshades over windows or ventilators in existing buildup congested areas.

No sunshade shall be permitted over the road or any drain an over and portion outside the boundaries of the site below a height of 2.8 m. from the road level outside the boundary should be 2.8 m high. sunshade above 2.8 m. should be 60m wide of road exceed 1m in width.

No sunshade over roads less than 1 m.area and height limitation: -For residential development on a public street of at least (1m) width. It is 1.5m for the Raipur building and should not be above 30m in height.

RESTRICTIONS IN THE VICINITY OF AERODROMES

For buildings in the vicinity of the aerodrome, the max height of such buildings shall be decided in consultation with civil aviation authorities.

Distance from Aerodromes	Height of the Building
2438 to 3048	12 m height
3048 to 3658	24m height etc.

Street, parking space-spaces to be left out for off-street parking are rows of car parking in front open space of 12 m without reducing the clean vehicular access way to less them 6m. 50% of the open spaces required around the building may be utilized for parking or loading or unloading space, provided that min.

The minimum distance of 3.6m around the building shell is kept free from any parking loading or unloading spaces. Parking space for vehicles-

For cars	13.75 sq. m.
For a scooter	1.25 sq. m
For cycle	1 sq. m

LIGHT & VENTILATION IN A ROOM: There should be more than ventilators or windows which should open to wards open air or such verandah which should have a minimum width of 2.4m.

LIFT: The provision of lifts should be there for buildings above 15m in height.

STAIRCASE: The minimum width of the stair is 1.0m. The minimum clear headroom in any stair shall be 2.2m. The minimum width of tread without nosing shall be 250mm for residential buildings. The maximum height of rise shall be 190mm for residential buildings.

MINIMUM SIZE OF ROOMS: Habitable room- Bedroom, living room, drawing room, dining room, and study room, shall not be less than 9.5 square m. area.

Height- The height of all rooms for the human habitation hall is not less than 2.75m.

Kitchen- Not less than 2.75m. Height and area not less than 5 square m.

WC & Bathroom- The height of the Bathroom or WC shall not be less than 1.5*1.2m or 1.80 square meters

The floor area of the WC shall be 1.1 square m. with a minimum width of 0.9m.

DATA FROM CASE STUDY

SPACES	INDUSTRIAL HOUSING NAGPUR						SURYA AP. RAIPUR	
	No. Of	LIG	No of	MIG	No of	HIG	No of	HIG
Bed Room	1	8.25m ²	2	9.75 m ²	-	-	-	-
Master bedroom	-	-	-	-	1	13.20 m ²	1	12.90 m ²
Children's bedroom	-	-	-	-	1	14.12 m ²	-	-
Guest bed room	-	-	-	-	1	9.21 m ²	1	10.0 m ²
Living room/Drawing	1	8.25 m ²	1	13.12 m ²	1	14.55 m ²	1	13.2m ²
Drawing room		-	-	-	-	-	-	-
Dining room	-	--	-	-	-	-	-	-
Toilet	1	1.8 m ²	1	2.76 m ²	2	5.02 m ²	2	48 m ²
Bath room	1	1.73 m ²						
W.C.	1	0.81 m ²	-	-	-	-	-	--
Balcony	-	-	-	-	1	2.5 m ²	1	2 m ²

Examples of 0.3 M design module IN LIG MIG AND HIG Housing

AREA STATEMENT

LIG 1

Maximum no of Floors - 3 = Ground floor +2 Storied

Proposed number of flats in

Ground Floor - 2 Flats

First Floor - 2 Flats

Second Floor - 2 Flats

Total flats in LIG one block- 2+2+2 = 6

Area of one flat

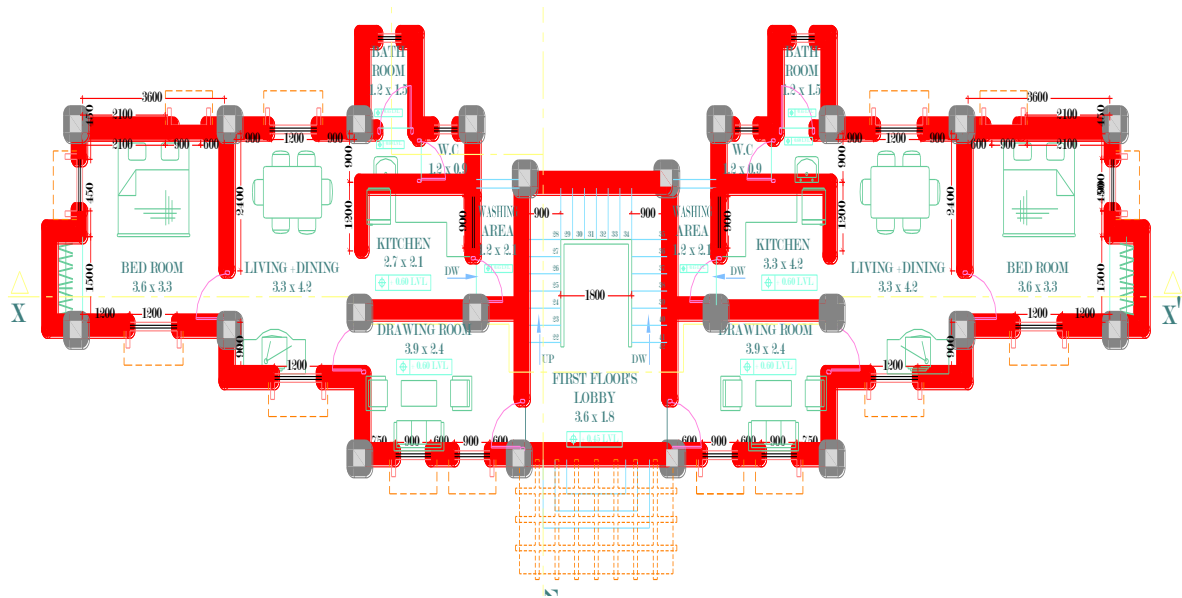
Drawing Room - 3.9 X 2.4 - 9.36 M SQ

Kitchen - 2.7 X 2.1 - 5.67 M SQ

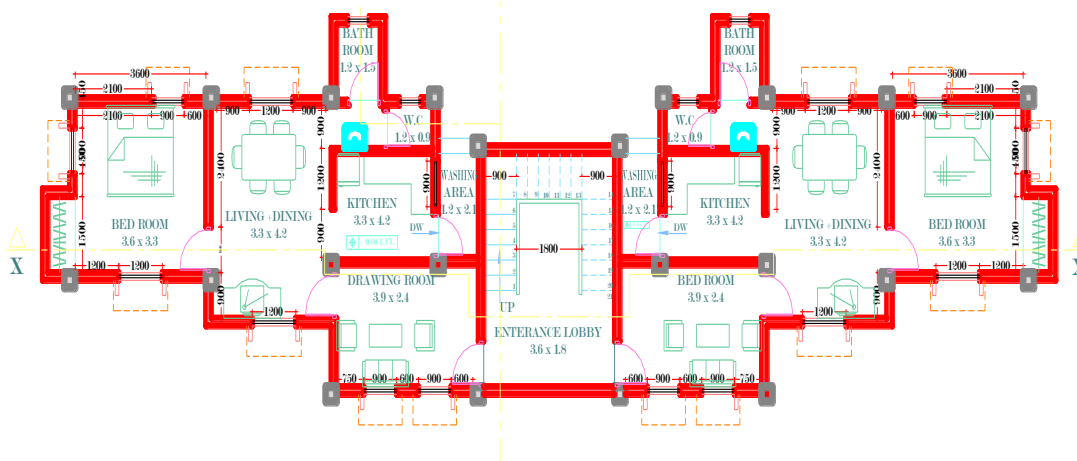
Living + Dining - 3.3 X 4.2 - 13.86 M SQ

Bed Room	- 3.6 X 3.3 - 11.88 M SQ
Bath	- 1.2 X 1.5 - 1.80 M SQ
W.C	- 1.2 X 0.9 - 1.08 M SQ
Total Area - 47.5M SQ	

DESIGN



GROUND FLOOR PLAN



TYPICAL FLOOR PLAN



FRONT ELEVATION

LIG 2

Maximum no of Floors - 3 = Ground floor +2 Storied

Proposed number of flats in

Ground Floor - 2 Flats

First Floor - 2 Flats

Second Floor - 2 Flats

Total flats in LIG one block- 2+2+2 = 6

Area of one flat

Kitchen - 2.1 X 3.0 - 6.30 M SQ

Living + Dining - 3.0 X 6.6 - 19.80 M SQ

Bed Room - 3.0 X 3.3 - 9.9 M SQ

Bath - 1.2 X 1.5 - 1.80 M SQ

W.C - 1.2 X 0.9 - 1.08 M SQ

WASHING AREA-1.5 X 1.5- 2.25 M SQ

Total Area - 47.3M SQ

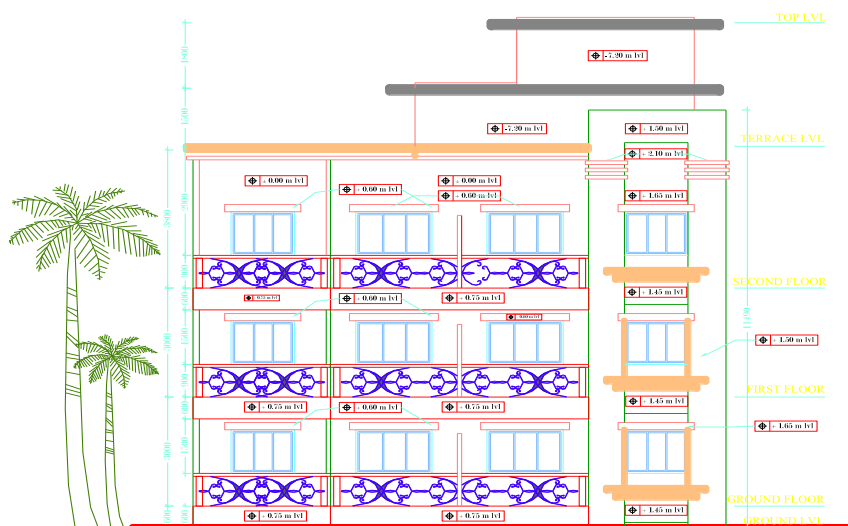
DESIGN



GROUND FLOOR PLAN



TYPICAL FLOOR PLAN



FRONT ELEVATION

MIG 1

Maximum no of Floors - 3 = Ground floor +2 Storied

Proposed number of flats in

Ground Floor - 2 Flats

First Floor - 2 Flats

Second Floor - 2 Flats

Total flats in LIG one block- 2+2+2 = 6

Area of one flat

DRAWING ROOM -5.1 X 3.9 – 19.89 M SQ

Kitchen – 3.0 X 2.4 – 7.20 M SQ

Living + Dining – 3.3 X 6.0 – 19.80 M S

Bed Room – 3.0 X 3.9 X 2 – 23.4 M SQ

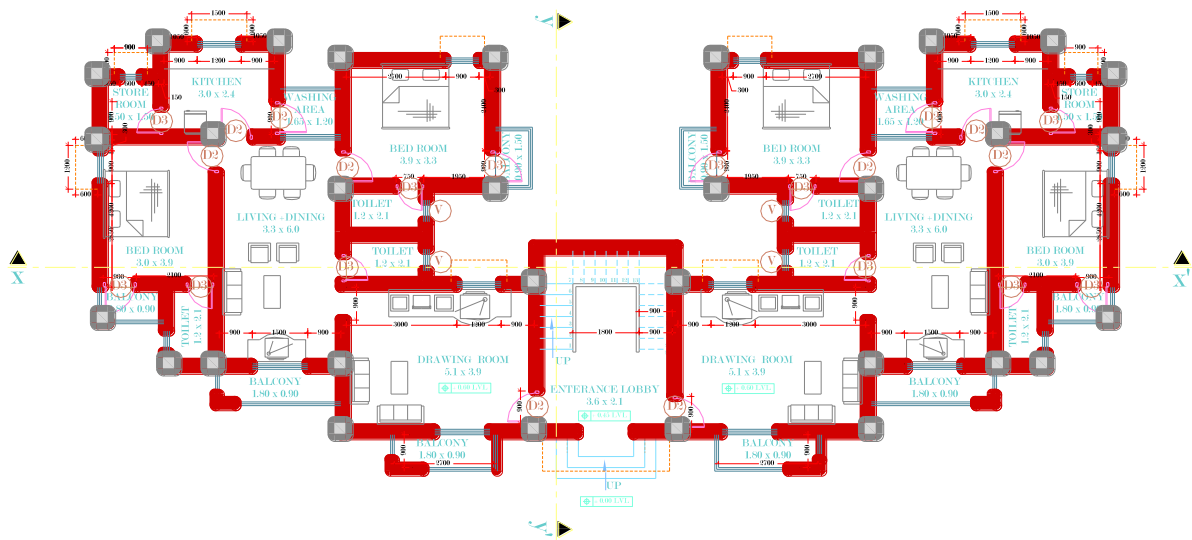
STORE – 1.5 X 1.5 – 2.25 M SQ

TOILET – 1.2 X 2.1 X 3 – 7.56 M SQ

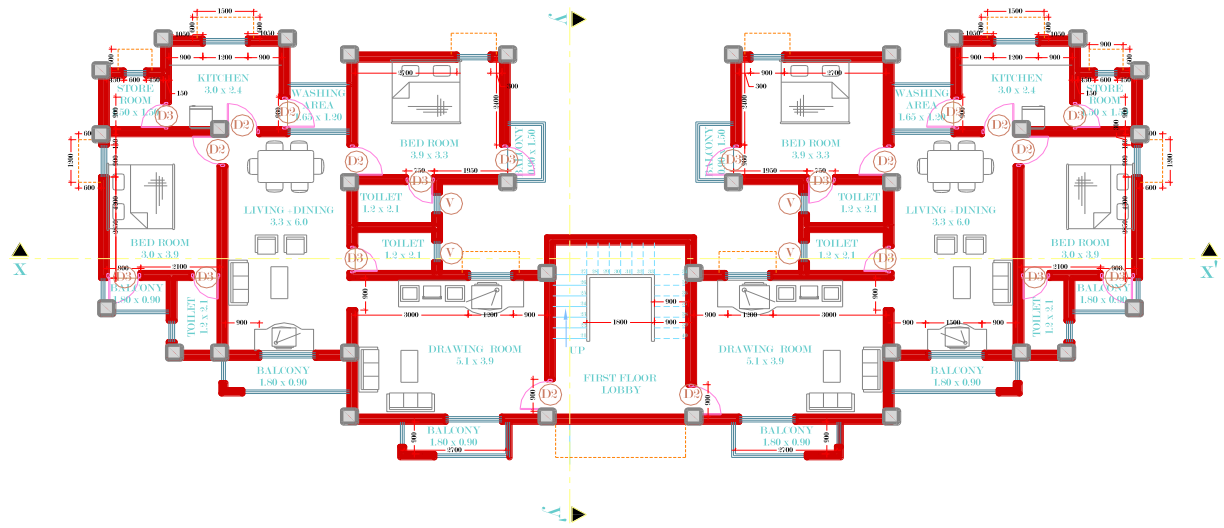
WASHING AREA-1.5 X 1.5- 2.25 M S

Total Area - 77.3M SQ

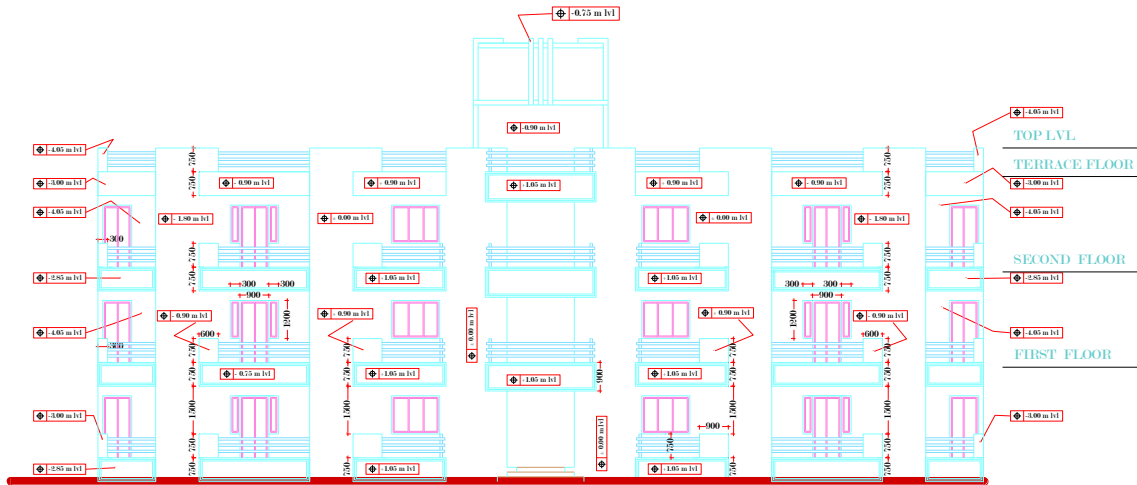
DESIGN



GROUND FLOOR PLAN



TYPICAL FLOOR PLAN



FRONT ELEVATION

HIG 1

Maximum no of Floors - 4 = Ground floor +3 Storied

Proposed number of flats in

Ground Floor - 2 Flats

First Floor - 2 Flats

Second Floor - 2 Flats

Total flats in LIG one block- 2+2+2+2= 8

Area of one flat

Kitchen - 3.3 X 3.0 - 9.90 M SQ

Living + Dining - 7.8 X 3.3 - 25.74 M SQ

Bed Room - 3.9 X 3.3 - 12.87 M SQ

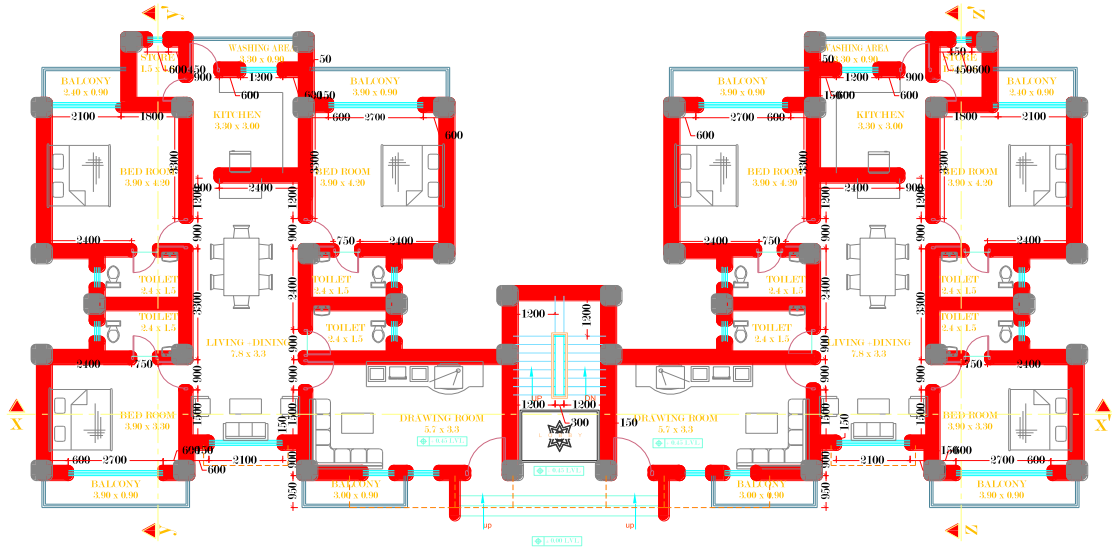
Bed Room - 3.9 X 4.2 X 2 - 32.76 M SQ

Toilet - 2.4 X 1.5 X4 - 14.40 M SQ

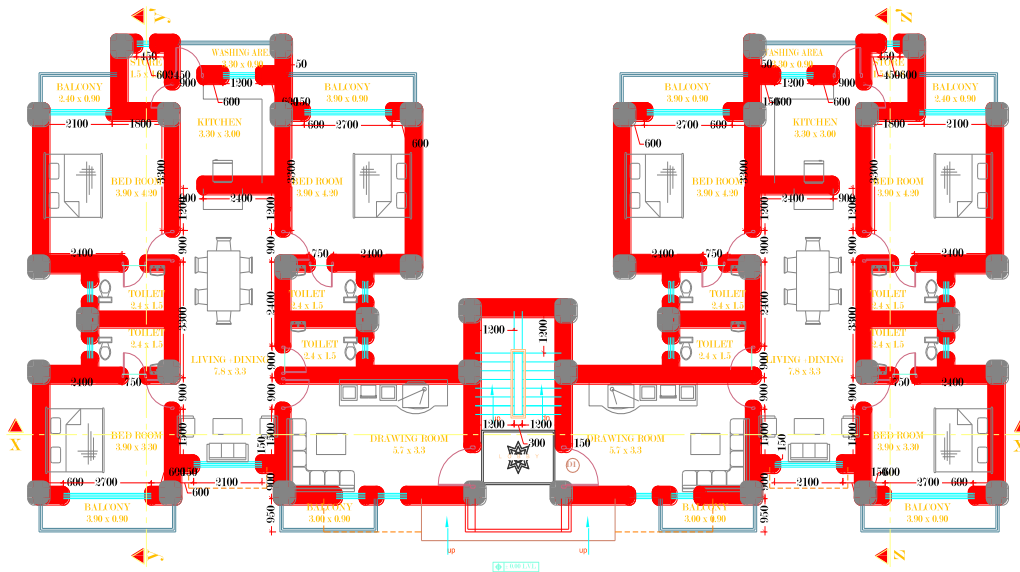
Store - 1.5 X 1.5 - 2.25 M SQ

Total Area - 116.75 M SQ

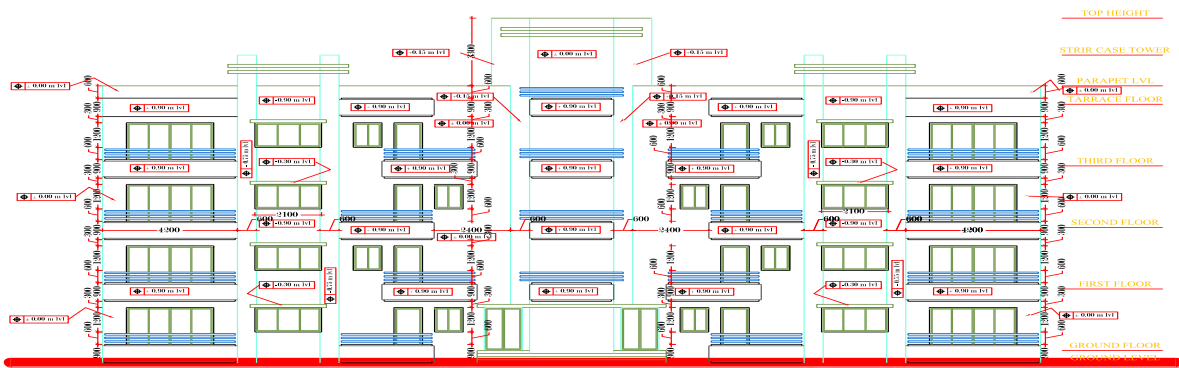
DESIGNS



GROUND FLOOR PLAN



TYPICAL FLOOR PLAN



FRONT ELEVATION

CONCLUSION

It becomes necessary to make modular coordination more popular in the building industry and to find out the most sustainable technological application through rapid research and development because modular coordination provides a vision of approach towards the building industry.

Thus, Modular coordination should be adapted to utilize various features given below...

The use of industrial material that will enhance the prototype mass production and standardization of components is going to reduce the cost and make the design orientation universal

The use of industrial waste in making building materials is going to reduce the cost and be eco-friendly thus creating industrial pollution into a productive environment

The use of a design approach i.e., the study of planning and vertical module at the minute level becomes necessary and more research is needed in this field since this also reduces the construction cost. Infield felicity and interchangeability by using the various dimension and scales to reach the optimum space required (it is almost approached through rigorous analysis on the paper under this topic)

Use enhances the process to reach the optimum shortage and backlogs as it is time effective too, which again further enhances the economy. Since most of the building materials are manufactured off-site better production process and reduced production costs and also the reduced lab cost on site is

The conclusion of this study is that .3m is an ideal module for housing (LIG, MIG)

References

1. MODULAR COORDINATION: AN APPLICATION IN CONSTRUCTION INDUSTRY Saiyed Farhana, Jayeshkumar Pitroda, J.J.Bhavsar, Dr S.K.Dave, International Conference on: "Engineering: Issues, opportunities and Challenges for Development".
2. APPLICATION OF MODULAR COORDINATION CONCEPT IN CONSTRUCTION INDUSTRY Khushbu Patelia, Prof. Jayeshkumar Pitroda, Prof J. J. Bhavsar, Proceedings of National Conference CRDCE13, 20-21 December 2013, SVIT, Vasad
3. Opportunities and Challenges of Modular Coordination: A Review Vinay S. Prajapati¹, Dr. J. R. Pitroda², Prof. C. S. Raichura³, International Research Journal of Engineering and Technology (IRJET)
4. Ernst and peter neufert's
5. Time saver standards for architectural design data.
6. National building code.2005
7. www.ibsmodularbulletin.com
8. Indian standard code.
9. The five fundamentals of modular drafting by: Demarest William
10. The Modular Housing Handbook By Simon Bayliss, Rory Bergin