CONTENT

UNIT 1

Chapter 1

Residential and Commercial Space Design

Understanding Residential and Commercial Building

In India, the real estate market is mostly composed of buyers and sellers, with both commercial and residential real estate considered as great investment options and both these have a great impact on the total net worth. However, a vast majority of people only prefer residential properties for investments rather than commercial.

1. **Residential:** The definition stems from the word "reside" or to "live in" the property. A residential building is defined as the building which provides more than half of its floor area for dwelling purposes. In other words, residential building provides sleeping accommodation with or without cooking or dining or both facilities. Could be a house, a condo, a tiny home, etc. It can be one house, several condos in one building and so forth. The purpose must be to live and sleep there.

Residential Building

Site Selection for Residential Buildings

Selection of site for any building is a very important and experts' job and should be done very carefully by an experienced engineer. The requirements of site for buildings with different occupancies are different. Following are some of the important factors which should be considered while selecting site for any residence.

1. The site should be in fully developed area or in the area which has potential of development.
2. There should be good transport facilities such as railway, bus service, for going to office, college, market, etc.
3. Civic services such as water supply, drainage sewers, electric lines, telephone lines, etc. should be very near to the selected site so as to obtain their services with no extra cost.

4. The selected site should be large enough; both to ensure the building abundant light and air to prevent any over dominance by the neighbouring buildings.
5. The ground water table at the site should not be very high.
6. Nearness of schools, hospitals, market, etc. are considered good for residential site but these facilities do not carry any significance in the selection site for other public buildings.
7. Good foundation soil should be available at responsible depth. This aspect saves quite a bit in the cost of the building.
8. The site should command a good view of landscape such a hill, river, lake, etc.
9. Residential house site should be located away from the busy commercial roads.
10. Residential site should not be located near workshops, factories, because such locations are subjected to continuous noise.
11. Orientation of the site also has some bearing on its selection. Site should be such in our country that early morning sun and late evening sun is accepted in the building in summer and maximum sun light is available in most of winter.

2. Commercial Buildings

Commercial building is used for commercial use like office buildings, restaurants, warehouses, retail or dental or medical buildings…. the main thing is that no one lives in the structure. It is not to reside. In urban locations, a commercial building often combines functions, such as an office on levels 2-10, with retail on floor one. Local authorities commonly maintain strict regulations on commercial zoning, and have the authority to designate any zoned area as such. A business must be located in a commercial area or area zoned at least partially for commerce. It is to create industry or income producing businesses for "commercial purposes."

Commercial Building

3. **Mixed Use:** This is exactly what it says. It is a mix of residential and commercial. For example, it might be a building, usually newer construction but it might be a massively remodelled building too, where the main floor has offices or work-related spaces. Someone can have a

4. restaurant, a grocery store, pet store - again, an income producing purpose. Above that level, often a developer will add 4–20 floors of residential housing units in the form of apartments or condos, even studio spaces but with a sleeping quarters element for the artists who need work space. The commercial space tends to be companies who rent that space, not a single person or a couple to take the space. One can see large grocery stores on the main floor. This is highly desirable in my area as there is little space to build more housing, so a "shared" footprint on the land which has both a commercial and residential element, often works out well.

5. **Live/Work:** This is the latest wave that has been growing in some of areas. Again, a large house would be torn down that might have been located on a busy street. Instead of one house, the builder will create 3–10 "towers" or "townhouses" (depending on how big the land is where the house used to sit), which are built side by side, sharing the walls between them like townhouses. The main floor at street level would be used for a studio space for an artist, a small store, a sewing or alterations sort of store, an accountant who prepares tax reports - some reason for people to come visit and spend money. It's that "commerce" part. Above that store would be the living quarters for the person who owns that part of the townhouse. For buildings like this that are in neighbourhoods located along busy streets, this is a perfect solution. Neighbours can purchase items or services, and the owner lives upstairs!

Differences between Commercial and Residential Construction

Commercial construction and **residential construction** vary in nearly every way from the building materials used to the equipment required, and even the way funding is secured. The differences start with the way residential properties are used as compared to commercial properties.

Residential refers to buildings that are designed to be lived in. Residential includes:

1. Single Family, Detached Homes
2. Duplex, Triplex, Fourplex
3. Townhouse
4. Some housing co-operatives
5. Condominiums

Apartment Buildings are designed for residential use, large-scale apartment complexes are considered commercial property because space is leased out to others as part of a rental business.

Commercial buildings are much more varied than residential properties. While residential properties are exclusively used for private living quarters, commercial refers to any property used for business activities.

Popular types of commercial property include the following:

1. Land investments
2. Large-scale multifamily housing
3. Hospitals
4. Assembly plants
5. Office buildings (spaces)
6. Retail SPACE or shopping centers
7. Storage units or warehouses
8. Industrial building
9. Any other location for a business enterprise

Commercial and Residential properties have significant key differences including building materials, codes, cost, construction equipment, and construction time.

Difference Between Commercial and Residential Buildings

There are various factors that determine the differences between residential and commercial real estate. They are:

- Cash Flow
- Rentals
- Tenants
- Property value
- Lease documents
- Financing
- Knowledge of investor

Based on the factors above, let's look at why residential and commercial properties are not the same.

1. **Residential**

- Residential tenants are available regardless of the economic condition. This is because most people want to live and rent in places close to their friends, families, job location, educational institutions, etc.
- Investing in rental homes also guarantees available cash flow and easier to rent. Even if a tenant leaves, there are always new tenants coming in.
- Furthermore, it is easy to sell houses than commercial lots because demand from buyers is always there.

- House rentals are determined by comparable market rates of similar houses in the area. Tenants pay their rents on a weekly or monthly basis depending on different countries.
- The value of a residential property is calculated by comparing the market price of similar properties in that location. An appraiser is responsible for estimating the value of a house.
- It is possible to buy a residential property with a small down payment and getting 90 per cent or more mortgage financing from the bank.
- Rental lease is fairly standard, short and easy to understand. Landlords and tenants should not have difficulty in understanding these documents.
- Residential and commercial properties tend to have different lease periods. The length of the lease for residential is short (1 to 2 years) and tenants can extend their stay or leave when the lease expires.
- The problem with some residential tenants is that they don't pay their rents on time. Besides, some won't even leave when they are asked to. This makes the eviction process a little difficult.

2. Commercial

- Commercial properties tend to be more lucrative than residential because of steady returns and better cash flow.
- Tenants in commercial properties usually pay expenses such as repairs and maintenance. This is because tenants want to run their businesses as good as possible.
- The lease period is longer than residential, which translates into guaranteed long-term cash flow. Landlords can lease to a tenant for a specific length of time (e.g. 5 years) and then have the option exercised by the tenant to renew the lease for another period of 5 years.
- The lease document itself is quite long and contains many clauses. You need to study the lease carefully and understand the terms with the help of a competent lawyer.
- Unlike residential, leases are very important as these documents determine the price, value, and most importantly the rents of a commercial property. Tenants who have long-term leases can significantly improve the value of the property.
- Besides, the leases are reviewed at the end of each period for either renewal or termination. Except for unforeseen circumstances like bankruptcy and poor sales that lead to tenants leave, most are willing to renew for long periods.
- Another advantage for commercial leases is that you can add clauses and conditions when necessary, provided the condition benefits both you and the tenant.
- Since most commercial tenants run their premises for business purposes, a drop in the economy may cause many problems, resulting in loss of income and eventually loss of businesses. When that happens, they leave and landlords need to find new tenants while covering the outgoing costs during vacancy for quite a long period. Therefore, vacancy rates for commercial properties are higher.
- Most banks are willing to loan more for the housing market (around 75% or more) but less on commercial market (60% or less).

- When it comes to mortgages, residential and commercial loans are also different with various financing options catering for each type of investment. Therefore, investors need to have greater knowledge, experience, and enough cash reserves to invest in commercial properties because of higher risks.
- Commercial leases are also powerful when it comes to rent payments. Unpaid rents can result in rent penalty and consequently eviction.
- Both residential and commercial property owners can experience some bad tenants, except that the latter has the upper hand. When it comes to eviction, the landlord has the right to remove the tenant by performing specific actions (e.g., changing locks, seize premise) according to the lease document.

Overall, both residential and commercial properties tend to have their own strengths and weaknesses. In general, most real estate investors started investing in residential before stepping into the commercial arena.

Key Differences Between Residential and Commercial Construction

The construction industry comprises of a wide range of activities including both residential and commercial construction. So, how do residential construction and commercial construction differ? It is wise to get to grips with the differences so that you select the ideal construction specialists for your next project. Differences between residential and commercial construction are-

1. **Equipment:** Typically, commercial development is a much larger project and much larger building. This means the equipment for residential and commercial projects will vary considerably. For example, commercial properties will typically need high-powered machinery, large cranes and other specialist pieces of equipment.

   On the other hand, residential projects will not require such extensive machinery or large-scale equipment. As equipment needs specially trained personnel to operate it, you will typically only see this type of machinery, and these team members, on large commercial projects. This is because the cost of commercial projects can justify the equipment and additional specialist workforce.

2. **Materials:** Commercial buildings typically have a steel frame while residential construction projects will predominantly focus on timber. The primary reason for this is commercial projects can justify the cost and investment of using steel. However, residential construction needs to be more affordable as small-scale projects and timber is a cheaper material to use.

Typically, construction firms in the commercial sector will have long-term relationships with suppliers which means that materials are consistent in projects. However, residential projects may have more choice when it comes to selecting the right materials. Furthermore, small projects will have more

flexibility in the materials to use. However, this may cost more due to the tenuous relationships with suppliers.

3. **Use:** Commercial construction is used by businesses and involves projects such as the building of offices, industrial facilities and other business establishments. Residential construction, on the other hand, will be in places where people live, such as in apartment, houses and other homes.

Property owners or tenants will typically instruct residential construction projects. Commercial construction will come from business decisions. With this in mind, residential builders will usually have one point of contact while a commercial building company may have to liaise with multiple people or a board of stakeholders.

4. **Permits required:** While both residential and commercial construction both require permits and adherence to building regulations, typically commercial construction has a greater range of codes and permits due to the use and makeup of the building. Commercial properties will typically be more complex construction projects including aspects such as lift access, complex power solutions and parking areas and garages. However, a residential project will usually have fewer elements to consider.

5. **Pace of work:** Often, commercial construction companies will have a large workforce and a requirement to work at speed to meet business deadlines and to ensure maximum efficiency for greater profits. Businesses will typically have more stringent expectations for timelines compared to the average homeowner. Furthermore, commercial construction projects operate in a multi-task environment while residential projects may not have the resources or space to do so.

   Residential projects usually operate at a much slower pace of work as compared to commercial construction project this is due to less efficient equipment and a smaller workforce. However, commercial projects will usually take longer complete due to the complexity and extent of the work involved.

6. **Functionality:** Another aspect that shows the difference between commercial and residential construction is the functionality of the building. While residential projects will have limited functionality purposefully for domestic uses, the functionality of commercial premises can be extensive.

   Commercial construction may include shops, warehouses, factories, clinical laboratories, hospitals, theatres, sports venues, local authority buildings and much more. With the increased functionality, there'll be a greater need for specific services such as the installation of fire protection equipment, escalators and lifts, security, access control, data and server rooms, lighting and HVAC.

7. **Funding:** Commercial and publicly funded construction projects will usually command a higher price than a domestic construction project which will have to be cheaper to suit the budget of the homeowner. As the typical domestic client will have a stricter limit on what they are willing to pay for projects, builders need to price accordingly for both sectors. As the size of the project is much smaller for the domestic client.

Residential Building

A residential building is one that's designed and accordingly built for inhabitants to ***live in*** and call **House.** Inhabitants can either be a family, single, a couple, roommates or even a group.

The buildings in which sleeping accommodation is provided for normal residential purposes, with or without cooking or dining or both facilities are grouped as residential buildings. However, the buildings classified under institutional group are excluded from this group.

There are many different types of construction involved in different types of residential buildings and it is considered to be one of the most popular types of construction. While these different types could include anything from townhouses, condos, regular family homes and apartments to name a few, each one is structured differently and include a market of their own.

The residential construction industry is the one of the biggest and highest in demand due to the fact that nearly every person needs to invest in some kind of residence in their life. A residential building has basically:

- A living room/space
- A sleeping room (bedroom)/space
- Conveniences (as in toilet and bath)
- Cooking room/area (kitchen)

All of these functions can either be in shared rooms or spaces or have exclusive rooms per function. This depends on the ***type*** of residential building it is.

Different Types of Residential Building Types

Classification of residential structures

Several classification of housing units are possible. The census enumeration is based on detached and attached structures.

1. Detached house or Single-Family Home: The detach house, sometimes called the single-family dwelling is freestanding from other structural units with open space on all four sides and is designed for occupancy by one family from ground to roof. A single dwelling not attached to any other dwelling or structure (except its own garage or shed). A single-detached house has open space on all four sides, and has no dwellings either above it or below it. A one-unit structure is detached even if it has an adjoining shed or private garage. A mobile home fixed permanently to a foundation is also classified as a single-detached house.

The advantages of this type of dwelling, generally includes freedom and privacy for the family and for its members; access on all four sides to sunlight, to outer air, and to the ground, with space for lawn, garden and play area where desired for children, fewer risks from off property hazards, and probability of home ownership with the attendant promises of a permanent family home. These homes also come with front and back yards, as well as allow individual to get creative and express himself/herself with design in his/her own home. These types of homes can also resell at much better value than purchased.

The disadvantages of the detached house include higher construction costs than are involved in corresponding floor space in a multiunit structure. Living in a detached house usually implies some responsibility for the oversight and care of the property and if owned, repairs and upkeep of the surrounding lot. Because the detach housing unit requires more land other types it also necessitates a greater length of street and more provision for utilities per unit.

2. Single-family attached/Attached house: An attach structure, on the other hand, has one or more vertical walls dividing it from other adjoining structures. When two families live in separate housing units in the same structure, the unit is either attached or multiunit depending upon whether the units are, in the former case, side by side or, in the later, one over the other.

- **Two-family** or **duplex**: two living units, either attached side-by-side and sharing a common wall (in some countries, called **semi-detached**) or stacked one atop the other (in some countries, called a **double-decker**)
- **Three-family** or **triplex**: three living units, either attached side-by-side and sharing common walls, or stacked (in some countries, called a **three-decker** or **triple-decker**)
- **Four-family** or **quadplex** or **quad**: four living units, typically with two units on the first floor and two on the second, or side-by-side

3. Semi-detached house: A semi-detached house is a single-family dwelling house built as one of a pair that share one common wall. Often, each house's layout is a mirror image of the other.

One of two dwellings attached side by side (or back-to-back) to each other, but not attached to any other dwelling or structure (except its own garage or shed). A semi-detached dwelling has no dwellings either above it or below it, and the two units together have open space on all sides.

4. Row house/ Terraced-house: Terraced or **terrace house** (UK) or **townhouse** (US) exhibits a style of medium-density housing that originated in Europe in the 16th century, where a row of identical or mirror-image houses share side walls. They are also known in some areas as **row houses** (especially in New York City, Philadelphia, Baltimore and Washington). One of three or more dwellings joined side by side (or occasionally side to back), such as a townhouse or garden home, but not having any other dwellings either above or below. Townhouses attached to a high- rise building are also classified as row houses

5. Apartments or Flats: A residential building or housing block with several self-contained household units on each floor is called an **apartment block/complex** in the USA. The equivalent building is called a **block of flats** in the United Kingdom. The self-contained unit which is only a part of the building is called an apartment or flat respectively.

A structure that contains only one housing unit is a **single unit structur**e, while a structure containing two or more housing units is a **multiunit structure.** The later includes structure with two housing units, one over the other. Up to ten or more units are usually referred to as apartments or flats. An apartment is defined by the number of rooms it contains, especially the number of bedrooms.

Therefore, whether it's a 1-, 2- or 3-bedroom apartment, it is assumed to have a kitchen, living area and bathroom.

- A low-rise apartment block has a maximum of 4 storeys
- A mid-rise apartment block has 4 to 7 storeys
- A high-rise apartment has more than 7 storeys.

Apartment or flat in a duplex: One of two dwellings, located one above the other, may or may not be attached to other dwellings or buildings.

6. **Studio Apartment/Bachelor Flat:** A studio apartment is a small self-contained unit where the only rooms are the main room and the bathroom. The main room functions as the bedroom, kitchen, dining and living room. The kitchen area will have built-in kitchen cupboards and sink. Built-in wardrobes are found in the bedroom area. This type of dwelling is also known as a bachelor flat or studio flat. It is known by different names around the world. Lower-priced flats are smaller and occupants may share a bathroom with one or more neighbours in the apartment complex.

7. **Duplex House:** A residential building unit on two floors with connected by stair often with one main entrance on the ground floor.

A duplex house has two identical household units attached to each other, and separated by a wall, floor, double garage, staircase, lobby, hall or corridor. When the household's units are separated by a floor, it

becomes a double storey duplex house. Household units which are arranged side by side may be separated by a wall, double garage, hall or common entrance. Instead of a common entrance, the units may have their own entrances. It all depends on the architectural specification. Note that the household units forming a duplex house can be double-storey units. So, you will have two double-storey units in a duplex house.

8. **Townhouse:** Best described as a combination between a condo and a family home, a townhouse is known for having a few floors with a few walls and sometimes even include a small yard on a deck. These are usually bigger than condos, but a lot smaller than a family home. Townhouses also offer a lot more privacy and lower costs involved due to proper maintenance agreements. These are known for being quite charming and are especially perfect for one to two people.

9. **Multi-family home:** Choosing to rent or buy a multi-family home is a big responsibility and costs are much higher than with any other type of residential building. That is also why it is a much less common option. These are usually structured as either a two-story house or have a row-style set up of rooms. The house usually won't have more than 4 units within its space.

10. **Condominium:** More popularly known as condos, these are single units inside a larger building and most commonly share a wall on either side with two neighbours' units. These will always require you to pay monthly or yearly fees and are mostly found in high-density, urban-like areas. The one positive factor about these is that the homeowner doesn't have the responsibility of contributing to the maintenance of the condo. Any maintenance costs will usually be shared amongst you and the other residents. Condos are ideal constructive living spaces that usually include a pool and gym that can be shared amongst everybody in the building.

11. **Co-op:** Short for cooperatives, co-ops are known for having a similar construction set up than a condo but is different in the sense that you won't just own your space within the unit you're living in, but you'll own the building together with everyone else. In order to obtain a co-op, there is an interview process involved before you will be accepted to do so. Co-op's are much less expensive than condos.

12. **Movable dwelling:** Includes mobile homes and other movable dwellings such as houseboats and railroad cars.

Apart from detached houses, semi-detached houses, duplex type and flats, lodging and hotels are also considered residential buildings with the following definitions:

13. **Lodging:** These are the buildings in which under the same management, separate sleeping accommodation for a total of not more than 40 persons is provided. The accommodation may be on transit or permanent basis and it may be with or without dining facilities. However, there should not be cooking facility on individual basis.

14. **Hotels**: These are the buildings under single management in which sleeping accommodation with or without dining facility is provided for more than 15 persons who are primarily transient. Examples of such buildings are hotels, inns, clubs and motels.

Some other types of residential buildings include:

1. **Bungalow:** A typical bungalow is a single-storey house with a rectangular plan, wide eaves and long wide veranda on the front face. Normally, the roof for this type of building is either pitched, hipped or side gabled with a dormer window on the sloping side, especially the front end. The bungalow design is derived from a traditional house built in the Asia Pacific region of Bengal.

2. **Villa:** A villa is a large luxurious house or mansion located on a large private estate or plot in the countryside, by the beach or vacation resort. Villas are usually owned by affluent members of society, hospitality companies and property moguls. A villa is characterized by a free-standing residence surrounded by extensive landscaping and gardens. In ancient Rome, villas were grand residences for the high class, featuring courtyards and surrounded by servant quarters and fields.

   Villas can be found all over the world, from coastal areas to the countryside. They offer exclusivity and complete privacy because you have the entire plot to yourself.

3. Chalet: Originally from Switzerland, the modern chalet is a small cabin-like holiday home with alpine roof style. This vacation home is common at beach resorts, mountain resorts, ski resorts and holiday camps. Although small in size, a chalet can be a self-contained unit with a mini kitchen, bedroom and bathing room. The building materials are either wood or bricks.

4. Patio Home: A single storey residential unit that forms part of a cluster of similar closely spaced homes divided by walls. Each unit has space for parking as well as a backyard patio that may be roofless, shaded or roofed. This clustered community is characterized by common areas which may be extensively landscaped depending on the specification. Patio homes are sometimes known as clustered or cluster homes. They are popular with the middle class in the suburban areas of US towns and cities. In South Africa, this type of dwelling can be found in most low and medium-density suburbs. These are the high income and middle-income groups respectively.

5. **Chattel house**: a small wooden house occupied by working-class people on Barbados. Originally relocatable; personal chattel (property) rather than fixed real property.

6. **Mobile home**, **park home**, or **trailer home**: a prefabricated house that is manufactured off-site and moved by trailer to its final location (but not intended to be towed regularly by a vehicle).

Travel trailer or camper

7. **Recreational vehicle** or **RV**: a motor vehicle or trailer that can be used for habitation
    - **Travel trailer**, **camper** or **caravan**: a trailer designed to be used as a residence (usually temporarily), which must be towed regularly by a vehicle and cannot move under its own power
    - **Tiny house**: a trailer, often 500 square feet (46 m^2) or smaller, built to look like a small house and suitable for long-term habitation
8. **Houseboat** includes **float houses**: a boat designed to be primarily used as a residence
9. **Tent**: a temporary, movable dwelling usually constructed with fabric covering a frame of lightweight wood or other locally-available material

    - **Tipi**: a conical tent originating in North America
    - **Yurt**: a round tent with a conical roof originating in Central Asia

Commercial Buildings

Commercial buildings are buildings that are used for commercial purposes, and include office buildings, warehouses, and retail buildings (e.g. convenience stores, 'big box' stores, and shopping malls). In urban locations, a commercial building may combine functions, such as offices on levels 2-10, with retail on floor 1. When space allocated to multiple functions is significant, these buildings can be called multi-use. Local authorities commonly maintain strict regulations on commercial zoning, and have the authority to designate any zoned area as such; a business must be located in a commercial area or area zoned at least partially for commerce.

Below is a list of the different types of commercial properties and their subcategories.

1. **Industrial:** These buildings typically have considerable square footage, loading docks for trucks, several HVAC units, and several points of electrical distribution, an easily accessible flat roof, and other installed features. Some industrial buildings may also have large refrigerated spaces. Subcategories includes:

a) **Manufacturing Facility:** This type of building is used to produce goods or materials and is categorized as either a **heavy manufacturing facility** or a **light assembly facility**. A heavy manufacturing facility tends to make heavy-duty products and has large machinery and equipment. These facilities are typically renovated and customized for specific owners and tenants. A light assembly facility tends to be smaller and simpler than a heavy manufacturing facility. These facilities also produce smaller goods.

b) **Warehouse:** This type of building is used for general storage and distribution of goods. The layout tends to be an open space, where the ceilings open to the roof's interior structure. This helps to accommodate high freestanding or installed rack systems. Some warehouse spaces may be dedicated truck terminals, where goods are loaded from one truck to another, and have less square footage for storage space.

c) **Flex:** A building that combines more than one use in a single facility is considered a flex commercial property. An example is an office space combined with and a light manufacturing facility. The identifying factor for this type of property is the amount of office space. There is always more office space in flex buildings than in other types of industrial properties.

2. **Retail:** This type of property is where goods and/or services are sold to customers. An inspection of this kind of property could entail evaluating just one unit or an entire retail complex. Most retail spaces have ample parking areas and bordering sidewalks, while some may have escalators, elevators, and covered parking structures. Subcategories include:

   a) **Mall:** This type of retail space is an enclosed shopping center that has many different outlets that may include department stores, food courts, and movie theatres.

   b) **Shopping Center:** This is type of property is also commonly referred to as a shopping plaza or strip mall and can vary greatly in size and tenant type. These are open storefronts that have several units under one roof or within one complex. Shopping centers are often home to big-box stores (like Home Depot and Target), along with other smaller shops, restaurants, and convenience stores.

   c) **Pad Site:** A pad site is a standalone building, commonly in front or within a shopping center, and its business types often include fast food chains, banks, and restaurants.

3. **Office:** A commercial office is a property that is used by business professionals, medical and dental professionals, tech firms, and more. A standard office space is divided into separate rooms, and typically includes restrooms, and a possibly a residential-style kitchen. Subcategories include:

   a) **Office Building:** This type of space is designed for higher occupancy and can range in size from a single-story building to a high-rise. It can contain several electrical and HVAC systems, and if the building has multiple levels, then at least one staircase, and perhaps also an elevator.

   b) **Suite or Condominium:** These structures are generally built with the concept that the exterior, roof and common areas are maintained by the owner or property manager, while the various interior spaces are owned or leased and maintained separately by their tenants. These separate areas could be a unit, a floor, or a wing of the building. It could also be a unit within a shopping center or industrial complex.

c) **Medical or Dental Office Suite:** This is generally a larger space that's divided into several smaller spaces, including offices and exam or treatment rooms. There are typically also a waiting room, restroom(s), HVAC unit and controls, electrical system, and multiple plumbing basins or points of plumbing distribution. The size and complexity of such spaces can vary greatly, and it is also common for these spaces to contain customized and permanently installed structures.

4. **Multi-Dwelling Unit (MDU):** This includes residential properties such as condominiums, apartment buildings and town homes. The interior of each individual dwelling unit may be familiar to a home inspector, but a commercial inspection for this type of property will require you to inspect more than one dwelling unit and possibly its common areas, which may include a communal pool and spa, and parking structure. The intricacy of this project will vary and depend on the size of the property and the scope of work for the inspection. However, this type of commercial inspection will likely come more naturally to a home inspector.
5. **Luxury Home or Estate:** Although a luxury home or estate is still technically a residential property, these properties may be designed and built with commercial applications or contain commercial features, such as substantial square footage, multiple HVAC systems, and commercial kitchen equipment. This type of property inspection may also require you to provide your services with great discretion, as your client may be a public figure, professional athlete, or celebrity. In this situation, confidentiality is of the utmost importance. For example, posting photos of the property or using any portion of your inspection report as a sample report on your website would violate the norms of discretion.

6. **Hotel and Lodging:** Similar to a multi-dwelling unit, this type of property will entail several individual residential units. The biggest difference is that lodging is designed for temporary occupancy, and will usually include a large commercial kitchen or on-site restaurant. Before inspecting a commercial kitchen, check your E&O insurance policy because commercial kitchens are often excluded in a home inspector's insurance coverage. Some units, however, may be suites that include multiple rooms, a kitchenette and/or a wet bar, and possibly also an in-room Jacuzzi or spa. It's likely an elevator will be present.
7. **Restaurant:** This type of property will vary in size and complexity but will generally include a

large kitchen with commercial appliances, a storage room or pantry, a refrigerated space (such as a walk-in refrigerator and/or freezer), an office, the dining area, and public restrooms. Before inspecting a restaurant, check your E&O insurance policy because restaurants are often excluded in a home inspector's insurance coverage.

Some commercial properties may not fall into any of these categories and are considered special-purpose buildings. For instance, casinos, churches, schools, airports, and bowling alleys are categorized as special-purpose buildings. Additionally, a commercial inspector may be hired to evaluate a multi-use property that is a commercial property type that includes both commercial and residential space.

UNIT 1

Chapter 2

Space Planning

Houses are built for people; therefore, all parts of a house must be built to scale keeping its occupants or users in mind. Architectural graphic standards need to be considered for furniture sizes, appliances and standard spaces required for functional work requirements by people.

Let us first understand and analyze the space use of different rooms for specific functions in a house. We shall realize that in a house, all the rooms required by a family may be possible only if the plot area is big. This means that the house will require about 10 rooms. Since it is not possible for everyone to have a house with so many rooms, therefore, we have to manage with fewer rooms by combining and overlapping the use of spaces.

The needs and desires of occupants need to be included in planning right at the initial phase. Some of the considerations are:

1. Size of the family
2. Income group of the family
3. Culture or religion of the family
4. Family composition including age, sex, number of bedrooms etc.
5. Number of automobiles in the house
6. Social habits of the family like formal lifestyle or informal, social status of the family, extent of social interaction among the members
7. Furniture and appliances already owned by the family
8. Special interests and hobbies of the family members
9. Ideas of the family members for space use and presentation

There could be many more considerations specific to a family that may be incorporated. Let us find out the common activities and furniture required along with clearance spaces for different rooms such as Living room, dining room, kitchen, bath and w. c.

Entrance:

Entrance is a great convenience. Some houses may have front door opening directly into the living area. Entry may be completely walled or set off by room dividers, or it may be an extension of the living, family or dining room.

Living Room: Living room should be fairly closer to the front door but should not be a passageway to other parts of the house. As for as possible, should be kept away from the bedrooms.

It requires furniture for conversation, reading, writing, playing indoor games, recreation watching television etc.

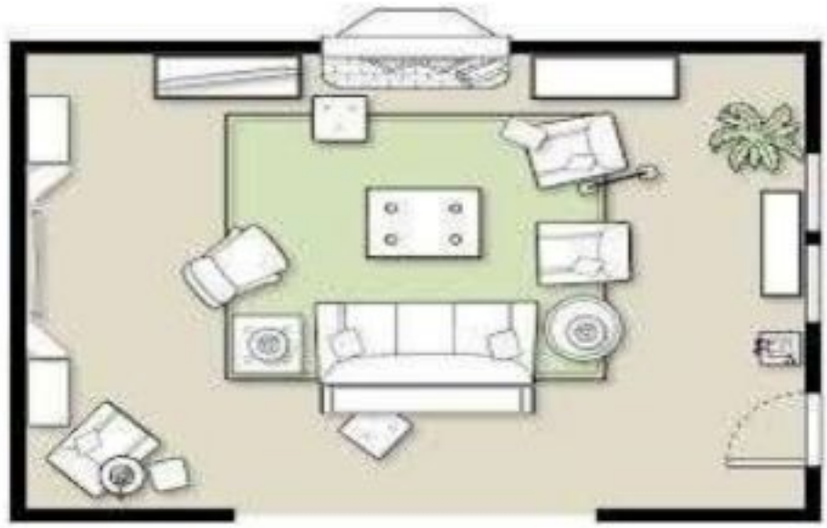
We may include furniture designed specifically for each of these tasks, but the space and financial constraints may be equally important. If there is limited space, then we may go for multi-use furniture, like for seating we may have a minimum of two long sofas or about five chairs, a coffee table and a desk of moderate size that may cover most of the activities.

Common sizes of Living room furniture (in mm)

Furniture	Dimensions (in mm)
A three-seater sofa	2100 x 750mm
Single-seater sofa	950 x 750
Stereo unit	750 x 375
Round coffee table	750
Rectangular coffee table	750 x 750
Television set	900 x 525

Along with provision of appropriate furniture, its arrangement should provide freedom of movement in the room. For free movement following minimum clearances are required.

- A minimum clearance of 90 cm from any wall facing the edge of a table to enable the person using the chair to push it back when leaving.
- A minimum clearance of 45 cm between the chair and the table. If there is a cupboard, then 60-75 cm space is required.
- Doors should not be located at the center of the wall, as otherwise the furniture units have to be grouped on either side of the passage.
- Provide a minimum clearance of 100cm between the writing desk and other seating units.
- Allow a minimum distance of 360cm between the television and viewing seats
- A minimum distance of 180cm necessary between seating units facing each other.



Furniture Arrangement in Living Room

Dining Room:

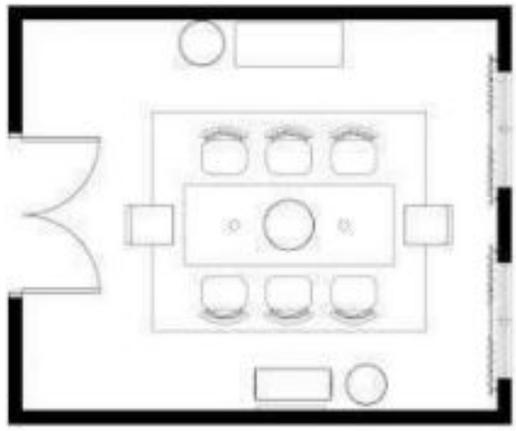
The Dining area could be part of the family room or living room. It should preferably be closer to the kitchen for ease of serving and hospitality. Number of persons to be seated at a time and the requirement of space for other movement and furniture for storage of crockery, cutlery, dishes and table linen would depend upon number of family members and their living pattern.

Common sizes of Dining room furniture (in mm)

Furniture	Dimensions (in mm)
Dining table for four persons	750 x 1200
Dining table for six	900 x 1800
Dining chair	450 x 450
Sideboard for storage	900 x 450
Trolley	750 x 450
Stool	375 x 375

Minimum clearances required

- Passage of a minimum width of 56cm is required behind the dining chair for easy movement while serving food.
- 15cm space is required between the wall and the chair, if chair is near a wall to push it back when leaving the table.
- Minimum height of the dining table should be about 70cm. Height of the dining table is generally 75cm.



Furniture Arrangement in Dining Room

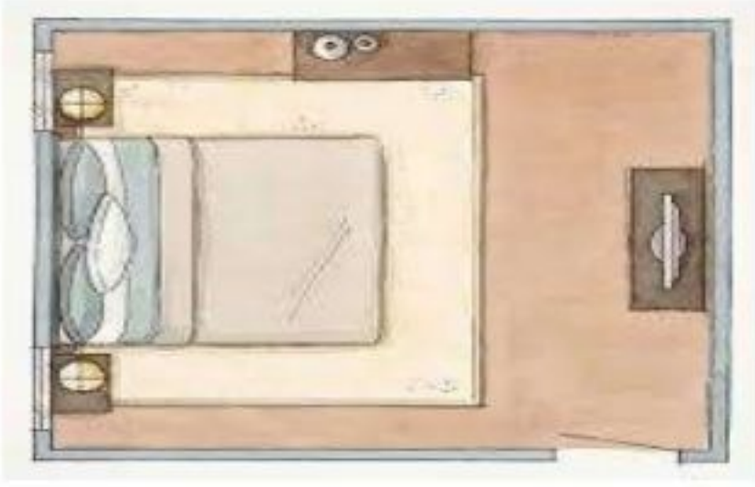
Bedroom:

Bedroom preferably should be isolated from the noisy areas of the house and arranged closer to or adjoining to bathrooms and wardrobe. Size of the bedroom should be sufficient to accommodate the number of beds required along with other furniture like writing desk with chair, beside tables for keeping telephones, table clock, reading lamp etc. dressing table with stool and bedroom chairs.

Common sizes of bed room furniture (in mm)

Furniture	Dimensions (in mm)
Double bed + two bedside	(1800x2000) +(450 x 450)
Two single beds +one bedside table	(1800x900) + (450 x 450)
Wardrobe	900 x 600
Writing desk	900 x 450
Dressing table	750 x 300

Minimum clearances required around the bed is 60cm clear space for walking.



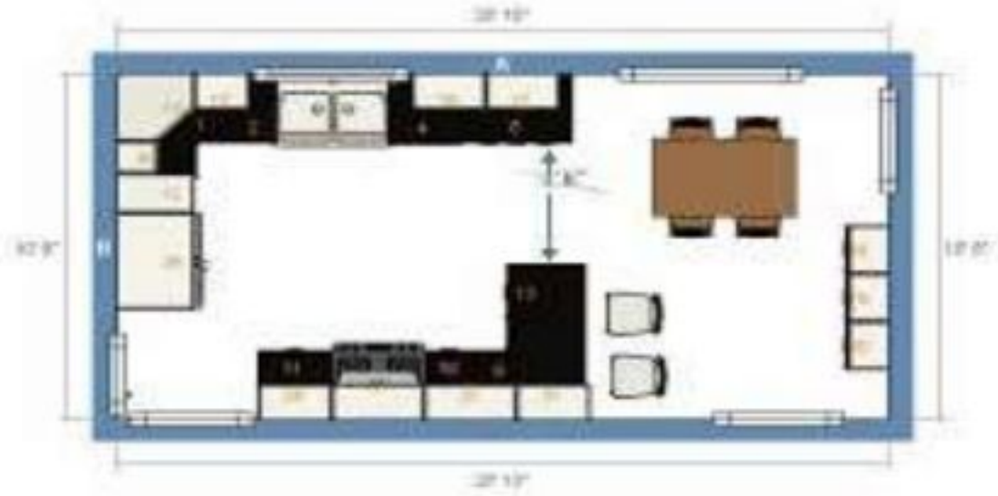
Furniture arrangement in a bedroom

Kitchen:

Kitchen is used for meal preparation and occasionally for dining also. It may include a refrigerator, cooking range or gas stove, dishwasher, mixer, toaster, oven etc. Besides these devices a cooking platform is more useful to avoid strain during cooking range or gas stove should be at the same level as cooking platform.

Common sizes of Kitchen furniture and utilities (in mm)

Furniture	Dimensions (in mm)
Kitchen sink	500 x 600
Dustbin	300
Refrigerator	600 x 450
Ironing board	900 x 375
Cooking range	300 x 500 for two burners 500 x 500 for four burners
Washing machine	750 x 525



Kitchen furniture and utilities

Minimum clearances required for the kitchen

- The cooking platform should be minimum 40cm in width and not more than 60cm wide
- Height of the cooking platform may vary from 75cm to 86cm from floor. Top surface of the platform should be smooth for ease in cleaning.
- To keep the kitchen clean, wall area above the platform should be covered with wall tiles, up to 45cm above the platform.

- Space below cooking platform may be used for storage of heavy items. Storage cabinets above the platform could be used for keeping small items and therefore, may be about 20cm deep. The height of storage shelves could range between 48" to 72" above the floor for convenient access.
- Cooking platforms could be U shaped, L shaped or corridor type, depending on the kitchen shape and size.

Toilets:

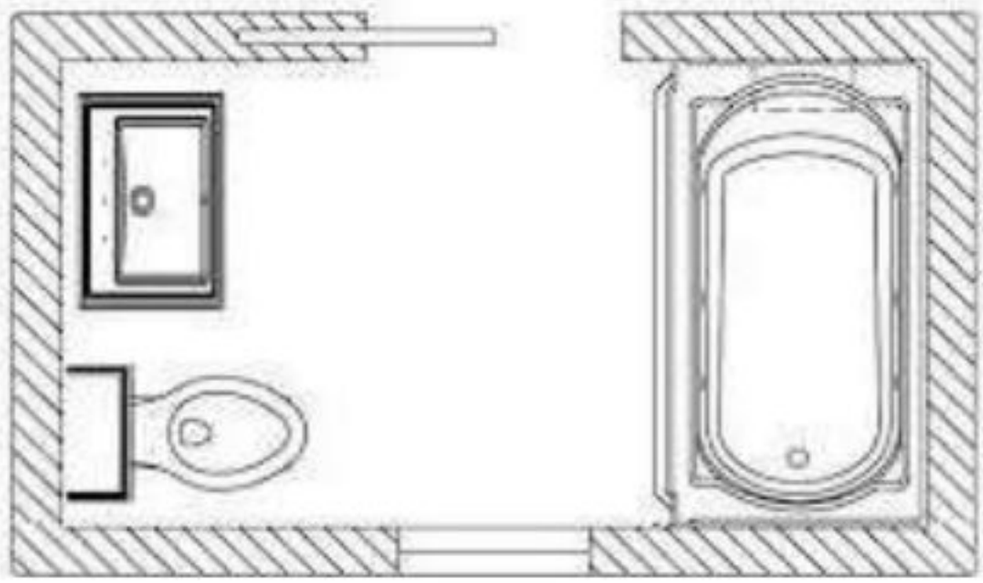
The bath and water closet may be either provided separately or could be combined as one unit. A separate bath may include a sink along with the bathing area or sink may be provided with a sink may be provided outside the bath and water closet. Combined bath and water closet could be provided with a sink, a toilet seat either western or Indian type and some shelves for keeping toiletries.

Common sizes of toilet furniture and fittings (in mm)

Furniture	Dimensions (in mm)
Water closet (WC)	750 x 450 / 750 x 525
Bath tub	1500 x 750 /1800 x 450
Refrigerator	400 x 400/ 500x500

Minimum clearances required

The lobby or passage leading to toilets should not be less than 90cm. The size of the toilet should be such that there is enough space for opening or closing the door while you are inside it.



Arrangement of Bath and WC

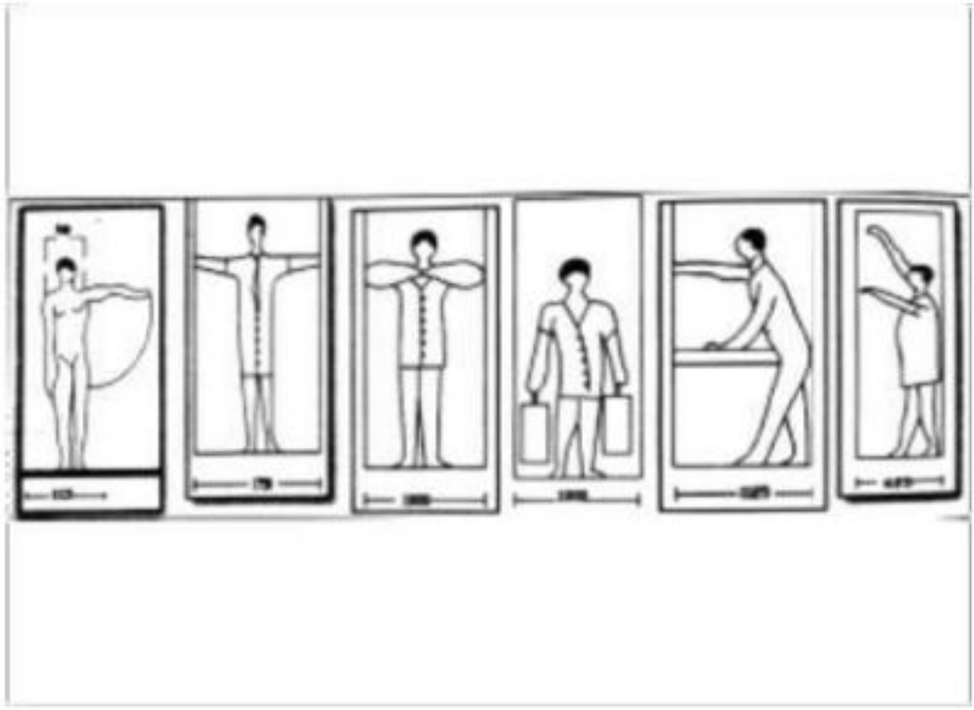
Decoration of the interiors greatly depends upon the built-in furniture to focus on the structural curves of the walls. Choice of furnishing fabrics, interiors colour finishes and design of window and floor style of light fixtures should not only be acceptable but also appealing-should flow with the architectural design and with its contemporary spirit.

Another aspect in space planning is Human dimension and space design.

It is important to consider while planning spaces that we need spaces to accommodate are-

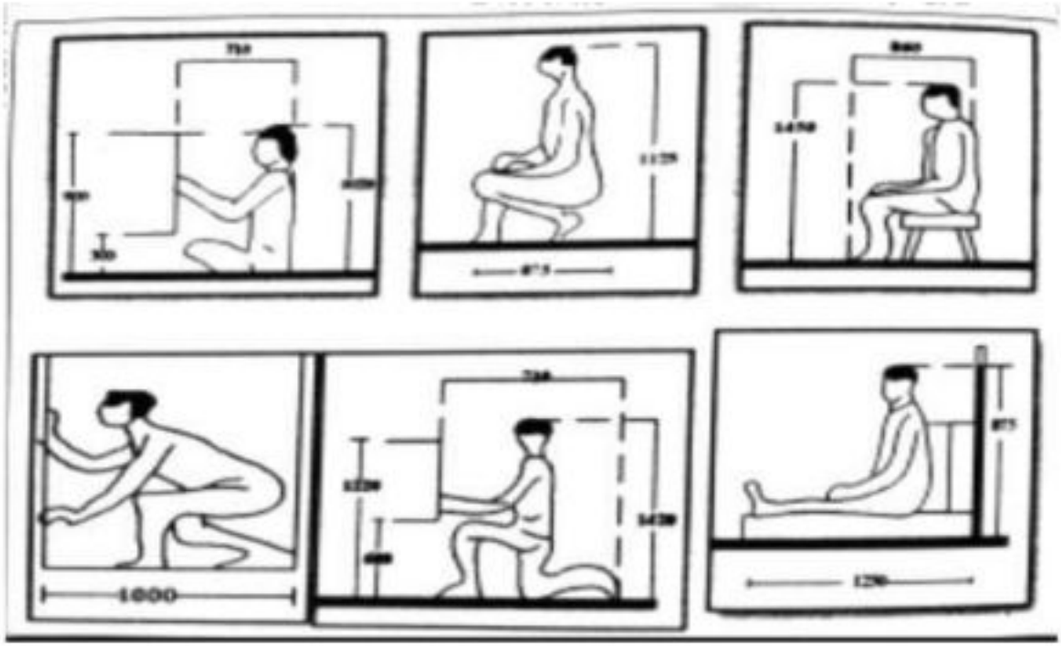
1. Fixed structural spaces like a counter attached to a wall
2. Furniture, fittings and fixtures like sofa, table, beds, cupboards, water closet, taps etc.
3. Movement of people in a space for carrying out specific activities like walking around the centre table to serve refreshments to guests in the living room.
4. Dimension of human body in different positions during work or a carrying out activities.

We have understood spaces needed for fixed structures, furniture, fittings and fixtures and clearances required to accommodate movement of people during the activity.

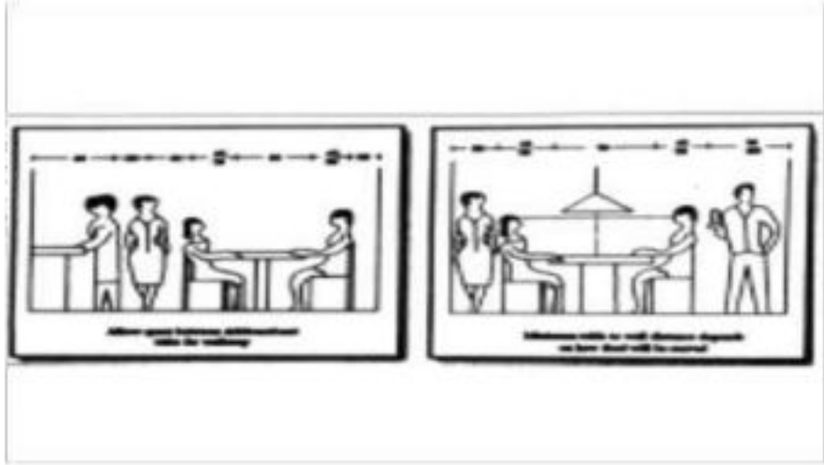


Standing with one arm extended, standing with both arms extended, hands folded in standing position as if carrying something close to body, walking with baggage in both hands, standing and reaching to storage on the wall, standing and reaching out to shelves high on the wall

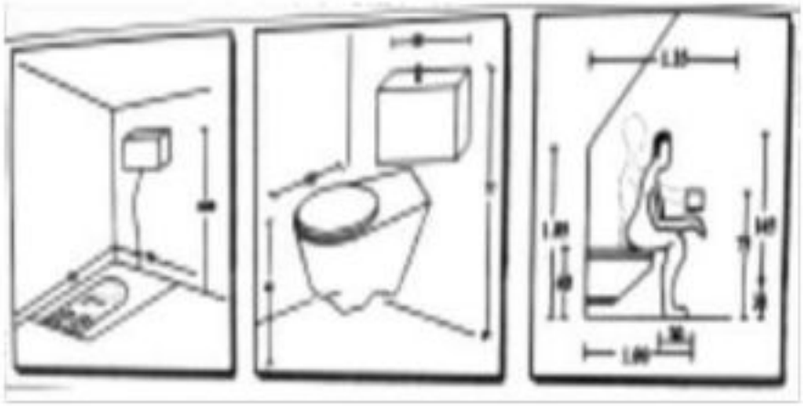
Let us now understand spaces used to accommodate the dimensions of people in different positions while performing the activity.



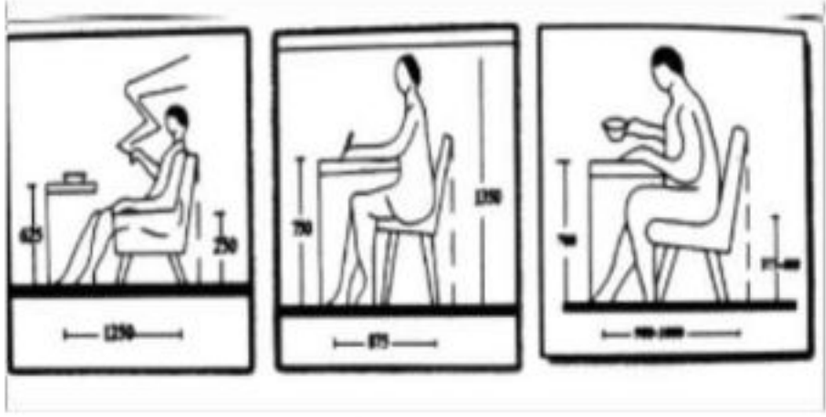
Squatting on the floor to reach out to lower shelves in the cupboard, sitting with support of the legs above the ground, sitting idle on a stool, reaching out to storage above the ground in semi-sitting position, kneeling down to access cupboards below the counter sitting



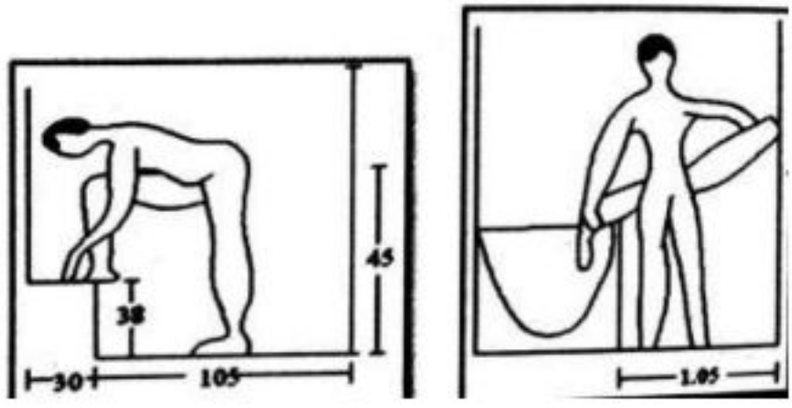
Walking behind a person working at the table, walking with a tray behind a person working at the table, space for opening drawers while working behind a seated person



Dimensions of French type toilet; western style toilet fixed on the wall with cistern; space needed by a person using western style toilet seat



Sitting in different positions using chair and desk



Space for body movement in the shower, recommended clearance for wiping

Structuring Spaces:

Structuring spaces means organizing spaces and allocating a specific space for a specific task. It helps to locate related tools and equipment for a specific activity at the space of use and make the entire work more organized and less stressful.

To make a plan functional understand how activities flow. For example, when guests arrive, they must be able to go directly into the living room or drawing room. From there the hosts should be able to access the kitchen close by to serve them water and refreshments. Sometimes we may like to serve these in the dining room, so should be located close by. If guests want to freshen up, the toilets or wash rooms should be directly accessible from the living room without disturbing inmates in their bedrooms. Structuring of spaces would require analysis of various aspects such as

- Number of occupants in a house
- Minimal spaces required for performing various activities or movements in a space
- Minimum spaces recommended for hygienic conditions for healthful living.
- Relationship of different spaces with one another

Number of occupants will determine the space required in a room. There are norms for floor area per person, so when there are more people using a space, the same norm could be multiplied. Normally, two people should be provided with one room. Therefore, for a family of four members two rooms are required, six members three rooms are required, and so on.

However, numbers of rooms in a house are dependent on the economic status of the family that is a high-income group family may have four rooms as compared to a low-income group family that may have one room for five members. However, if planning general or public places normally the space requirement per person is considered for planning. These norms we shall discuss in context of specific areas.

Minimum space requirements for different activities indicate the minimum space required by an average worker, who is handling either some tools/equipment or is using some furniture in different postures. Kindly note that space is required to accommodate the human dimensions in a space along with the other fittings and fixtures used for work. A fat worker will require more space as compared to a thin worker. Knowledge of minimum spaces will be a handy for designing functional work areas considering human movement as well as requirements of the furniture and fittings in a space.

Minimum spaces recommended for hygienic conditions for healthful living indicate that the health aspect is very important while considering space requirements. Minimum standards are formulated considering the social and physical environment rather than the cost of the space. United Nations Technical Mission on Housing, Seminars and conferences on Housing and Town planning and Environmental hygienic committee recommended a two-roomed house as a minimum accommodation for a family of four members.

Another concept necessary for incorporating all the functional spaces is by combining or overlapping space or rooms in the given number of rooms of the house.

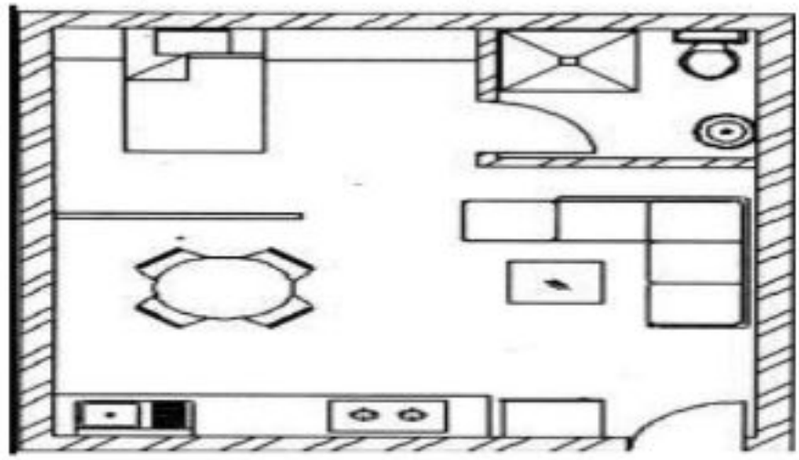
Combining space or rooms means that two different rooms with certain common features could be compressed into one room. For example, study room and children's room may not be two separate rooms but the children's bedroom may have provision of study in it, by including a book shelf along with a study table.

Overlapping use of space or rooms refers to using the same space or room for different purposes at different times of the day. For example, if the children's room is small and cannot accommodating the study, children can study on the dining table, or on the center table in the lobby or living room when these rooms are not in use.

Some families may be living in yet smaller houses comprising of single-roomed houses. Compressing all the activities into one room is also referred to as a multipurpose room/studio apartment. There would be a lot of combining and overlapping use of space. The studio apartments offer enormous challenge to the skill and imagination of the designer. One room must provide a

functional sleeping area, dining area, storage units that act as room dividers, stackable tables and chairs for parties, collapsible table tops to use for dining or study, folding chairs, etc.

The figure below indicates space use of a one-roomed apartment room.



Layout of one room apartment

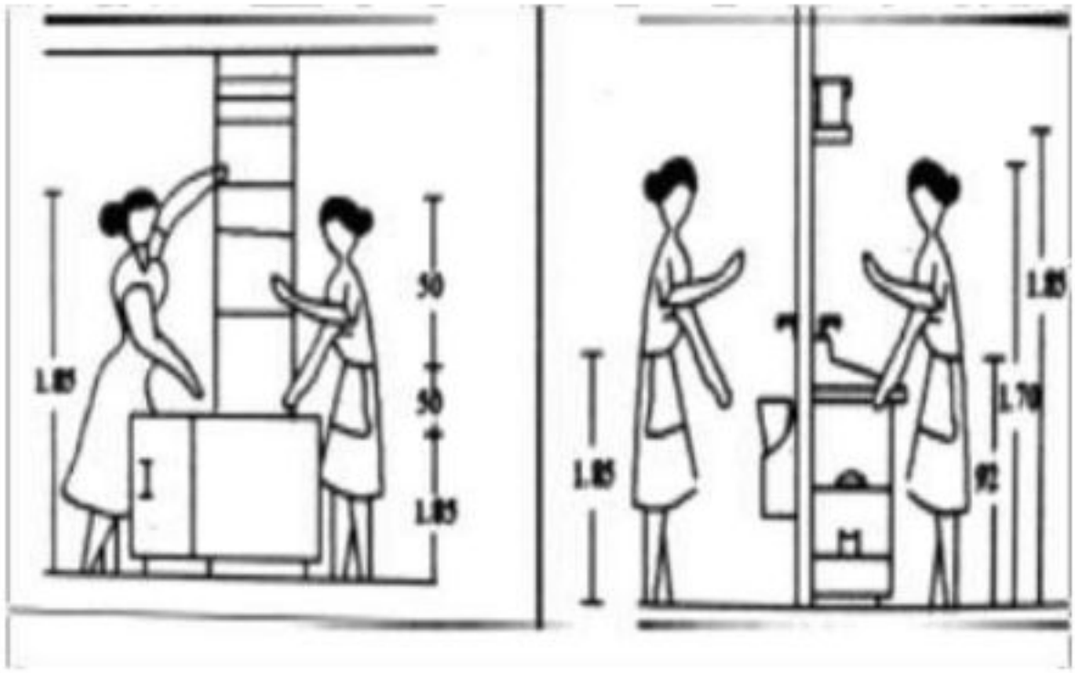
It may be noted that in one roomed apartment, a small house, in event of occasional activities, there is spill over to the outside open space. For example, in the event of a birthday or any other party, the family would invite guests, who would be seated outside the home due to limited space available inside. It may not be routine situation, however, the certain celebrations for the family may be inevitable. Some families, who may live in small houses but are otherwise economically sound may like to hire outside venues in the nearby areas.

There are circulation areas consisting of halls, stairs, entrance doors access is required from the main entrance to the interior, from central lobby to different rooms in the building and from private rooms to the toilets.

It is important that there is independent access from the main entrance to different parts of the building. Circulation lobby or corridor should be of appropriate dimensions. Internal circulation within a building includes corridors, stairs/ramps/escalators and lifts.

The width of corridors in buildings is governed by the fact that it should allow two persons to pass in opposite directions, therefore, should be about 1.2m wide. The width of staircase, lobby and corridor used as an escape route should not be less than the width of the exit that precede into it.

Any stairway, ramp and escalator shall provide a landing at the top and bottom of any stairway or ramp, landing should have leveled surface and no obstruction, stairway or ramp should provide clear headroom not less than 2m measured vertically from pitch line or top surface of ramp landing and If a flight or ramp is subdivided into sections, the width of each section shall not be less than 1m and a handrail shall be provided between adjacent sections.



Shelves in vertical space in divider between kitchen and dining; kitchen sink with high shelves above

Developing Plans Suitable for Different Income Groups - LIG, MIG AND HIG

In developing country like India, the growing concentration of population especially in urban areas has shown leading problems of shortage of land, housing shortfall and congested transit. These problems are also stressed the existing basic amenities namely water, electricity and land. Therefore, government has taken initiation to provide "housing for all" system primarily economically weaker group.

Affordability:

Affordability is measured in terms of nonrefundable. Affordability, the term holds different meaning for different categories of demographics. Further, there are also several socio-economic variables governing a city or locations are involved. Generally, 'affordable housing' denotes to residences that have been especially designed for the Economically Weaker Section (EWS) and Low-Income Group (LIG) who are looking for the same comfort and security of a self-owned property/home that the more fortunate middle class enjoys.

In India, the EWS and LIG categories did not get much attention to their needs in the earlier years of real estate development. However, with changes in administration and especially with the government in power, significant amount of changes has taken place in this respect. These two sections make up the thickest segment of the demographic for India, and form the base of the country's economy.

Why is affordable housing important?

Creating affordable housing is not just about helping a certain demographic to achieve their dream of home ownership. True, from a political viewpoint it is obviously important to cater to the demands of a massive vote bank. But there is an important economic angle to be considered, as well - the working class must have a good- enough reason to not move out of their city to be able to work and earn. It is important to understand that we are not just talking about people living on below or on the edge of the poverty line.

The people who fall under both these categories are extremely important for the country's economic progress. They provide myriad services which our cities can simply not do without, but are very prone to migrating out of cities which do not support their needs. For them, as for everyone else, home ownership provides not only a strong psychological anchor but also financial security and a better lifestyle - important incentives to stay put rather than migrate elsewhere.

What about affordable housing for the middle class?

Affordable housing also comes under the ambit of a much wider local meaning, wherein it constitutes homes that are affordable to the maximum segment of demographics. It can also apply to the local population in a city which, despite being more economically fortunate and flexible than the EWS and LIG segments, are sensitive to high home prices within their city.

Such buyer groups will have sufficient funds to buy a decent-sized property on the outskirts, but face challenges when buying a home closer to the employment hubs and conveniences available within the city limits. Another way to understand this situation is the deficiency of properties within the city locations for buyers in the budget groups of Rs 35-50 lakh. Thus, a city would be said to be deficient of affordable housing even if it has enough homes in the outskirts within a price range of Rs 20 lakhs. In this case, the potential buyers are those who can pay beyond Rs 20 lakhs and are not interested in living on the outskirts.

Affordable housing as a whole is a profitable business because of its high rate of absorption. However, such housing also advances socio-economic growth both at a locality and city level, because it invites in higher earning groups. Overall, if the majority of a city's working class does not find suitable homes meeting both their needs and budgets, it can be said that there is a dearth of affordable homes.

Affordable is depending on following four criteria:

1. **Minimum volume of habitation:** Due to pressure on urban land increases, all agricultural forms are converted into residential and commercial. So that, the designer thinks providing housing as vertical planning rather than horizontal planning.
2. **Cost of the house:** The affordability of housing not only including the purchase costs but also maintenance costs of dwelling unit. Therefore, affordable housing project, lower operational and maintenance costs using sustainable features are the main key aspects public and private subsidies

are offered to LIG and EWS for buying a house, but high operational costs are feasible to the

3. **Provision of basic amenities:** Even with the availability of adequate area and minimum cost, the basic amenities such as sanitation, adequate water supply and power to the dwelling unit is very crucial. Also, the Paper Code and Title: H01RS Residential Space Designing Module Code and Name: H01RS08 Developing plans suitable for different income groups - LIG, MIG and HIG Name of the Content Writer: Dr. R. Nithya facilities includes community space such as parks, schools and healthcare facilities, these are all desirable depending on the size and location of the housing project.
4. **Location of house:** An affordable housing project unit, it should be located within reasonable distances from workplaces and it should be connected adequately through public transport. In case if housing is developed for away from the city, the transportation cost may be increased whilst, price of dwelling unit might be low due to lower land costs. The industrial development in the outskirts of the city may sometimes serves as workplace hubs.

Definition of Different Income groups

At a very broad level, households can be classified on an economic basis in India the broad classifications are low income, middle income and high-income groups (LIG, MIG and HIG). This economic categorization is relevant as it allows us to map the affordability level of the household with the type of housing (defined by cost, size, amenities, tenure and location) that will be demanded. Naturally, there are other considerations that will determine demand – e.g. size of household, age demographics, or which tier of city a household lives in. The classification of different income groups namely Economically Weaker Section (EWS), Low Income Group (LIG), Middle Income Group (MIG) and High-Income Group (HIG) are defined by KPMG professional service company and Ministry of Housing and Urban Poverty Alleviation (MHUPA).

Definition by **KPMG** is given as follows-

Income group level	**Income level**	**Size of dwelling unit**	**Affordability**
EWS	<R1.5 lakhs per annum	Up to 300sq.ft	EMI to monthly income 30% to 40%
LIG	INR 1.5-3 lakhs per annum	300-600sq.ft	house price of annual income ratio: less 5:1
MIG	INR 3-10lakhs per annum	600-1200sq.ft	

Definition of Affordable housing-MHUPA (2011)

EWS	• Minimum of 300sq.ft super built up area • Minimum of 269sq.ft carpet area	

LIG	• Minimum of 500sq.ft super built up area • Maximum of 517sq.ft carpet area	Not exceeding 30 to 40% Of gross a monthly income
MIG	• Minimum of 600- 1200sq.ft super built up area • Maximum of 861sq.ft carpet area	

Source: guidelines for affordable housing in partnership (amended) MHUPA, 2011.

Irrespective of different income group housing the following are the main factors should be considered in construction of dwelling unit.

1. Orientation of building which enhances the exposure to sunlight, degree of slopes and accessibility in the form of distance travelled
2. Minimum requirements of the people and the conservation principle.
3. Flexibility in norms and standards to accommodate situations guided by difficult hill terrain and its geology
4. Work-place and residence relationship
5. Energy needs
6. Alternative mode of transportation communication network
7. Mobile and emergency facilities
8. Water facility

Sizes of EWS and LIG Dwelling Units and method of measurement (Carpet Area):

The Task Force recommends that to establish the minimum size of a habitable EWS dwelling unit, the absolute minimum size of areas as presented in the NBC code should be followed. The recommendations on the size of Affordable Housing Dwelling Units are as follows:

For Economically Weaker Section (EWS): 21- 27sq.m Carpet Area.

For Lower Income Group (LIG-A): 28-40 sq.m Carpet Area.

For Upper Lower Income Group (LIG-B): 41-60 sq.m Carpet Area.

The Task Force also recommends that these ranges, especially if subsidies are tied to them should have an admissible marginal variation of 10%. Therefore, while the minimum area of the EWS would be fixed at 21 sq.m and the maximum for LIGB would be fixed at 60 sq.m, the EWS maximum area could be between 25.2 and 30.8 sq.m and the maximum area for LIGB could be between 36.9 and 45.1 sq.m. This would give states the flexibility to decide the final area specifications for projects within their particular situations. While the BIS Code IS 3861 : 2002, disallows the use of Super Built-up area, but in practice sale price calculations by developers are based on varying methods of measurement of the Super Built-up area and is therefore directly linked to the income segment to which the dwelling unit is affordable. The Task Force therefore recommends that considering general practices, feedback from developers and local bodies and as per actual calculation of dwelling units

of EWS and LIG category, a 25% loading is recommended as the maximum permissible loading on carpet area to calculate Built-up Area and 40% to calculate Super-built-up area.

At reasonable cost, it is crucial to attain success of all housing programmes with the provision of developed land on an adequate scale; Besides low income group housing, sites have to be provided for private individuals, for co-operatives and for private businesses. Private construction, especially amongst people of small or moderate means is likely to make greater progress if developed sites can be made available by local authorities at low rates, which may be subject to appropriate conditions regarding resale. High land values and a general scarcity of plots are an important reason for the slow progress of housing in recent years, especially in towns which have grown rapidly. It would therefore, appear desirable to provide assistance to State Governments and local authorities for developing sites for sale to persons who have low incomes and wish to build houses for their own use, whether or not they are applicants for loans under the specific low-income group housing scheme which is being implemented. It is further suggested that a proportion of funds available under the scheme for low income housing might be used for land development on a planned basis, special attention being given to those towns where considerable congestion exists and to towns which are likely to develop more rapidly on account of development programmes to be undertaken during the second five-year plan. State Governments may examine in consultation with individual local authorities how far action can be pursued along these lines. Sites might also be developed for lease as distinguished for sale.

Based on the cost of the house, the norms for approved plans as per the Indian standard requirements of low-income group (IS 8888 (part -1): 1993 urban areas is given as follows:

- The standard is given guidelines for LIG houses having a maximum plinth area of $40m^2$.
- The provisions mentioned in the code are applicable to public and private agencies/ government bodies.

Planning

Type of development

LIG housing shall have plot / flat development as row or group housing on cluster pattern.

Layout pattern

Based on the need of LIG, the mixes of plot of different sizes are accommodated in a dwelling unit. For example 75 percent of the plots may be the size less than or up to $60m^2$ per dwelling unit in metropolitan towns and other towns and hilly areas may have $100m^2$. And remaining 25 percent may have more than $60m^2$.

Plot area

Plot size: The minimum plot size with ground coverage shall not be less than $40m^2$ in small and medium towns and not less than $30m^2$ in metropolitan cities.

Minimum frontage: The minimum of 3.6 m width should be given at frontage.

Height: The total height of the building should not exceed 15m. Lifts should not be provided if the building height is 15m. Ground plus one floor is preferable for LIG.

Size of room

Habitable room: Every house should be provided with minimum two rooms. The size of the first room should not be less than $9m^2$ with width of 2.5m and the second room should be provided with not less than $6.5m^2$ with minimum width of 2.1m. The total area of both rooms should not be less than $155m^2$.

Size of the bathroom and water closet (WC)

Area:

- The size of the separate WC should be 0.9 m^2 with the minimum width of 90 cm and bathroom size of $1.2m^2$ with minimum width of 1m.
- For the combined bathroom and WC, the size shall be $1.8m^2$ with minimum width of 1m.

Kitchen:

A cooking area having direct access from the main room without any inter- communicating room is said to be cooking alcove the size of a cooking alcove shall not be less than $2.4m^2$ with minimum width of 1.2m. In case of kitchen shall not be less than $3.3m^2$ with minimum width of 1.5m.

Height of rooms:

The minimum height for habitable and kitchen shall be 2.6m and 2.1m for bathroom and corridor.

Circulation area:

Inclusive of staircase all circulation area shall not be more than $8m^2$. Housing characteristics and affordability are the main aspects vary the concept of development of building plans in three different income of groups. Quality of dwelling and affordability depends on number of storeys, privacy, and design of houses, emphasis on open space, circulation area, sewage lines and including all other basic services.

MIG and HIG Planning

In the creation of planning of MIG and HIG households, three related aspects such as physical, social and symbolic are mainly considered and are to be incorporated in street plans or layouts, architectural style of buildings. The specifications for these types of income groups are mainly based on the National Building codes. HIG housings are established with more comforts including swimming pool, sewage treatment plant, gymnasium, conference hall, park etc.,

UNIT 1

Chapter 3

Design and Space Organization Analysis of Independent House of Different Income Groups

Design and space in its pure sense is void. In this state, it remains non appalling to mind and eyes and calls upon for modified and affect. Interior designers with aesthetic taste take optimum advantage of space to express beauty with the use of elements and design principles. Deigning is the arrangement of various components or unit of building in a systematic manner so as to form a meaningful and homogeneous structure to meet its functional purpose.

Planning of Residential Building is the arrangement of various components or units of a building in a systematic manner so as to form a meaningful and homogeneous structure to meet its functional purpose.

Building planning is a graphical representation of what a building will look like after construction. It is used by builders and contractors to construct buildings of all kinds. Building planning is also useful when it is essential to estimate how much a project will cost and for preparing project budgets building planning is also useful. The basic objective of planning of the building is to arrange all the units of building on all floors at a given level according to their functional requirements. By doing this, one can make the best use of space available for building. In building planning, privacy can be obtained by judicious planning of the building with respect to grouping, the position of doors and windows, mode of the hanging of doors, location of entrance and pathways, drives, etc. sometimes, provision of lobbies, corridors, screens, etc.

Factors Influencing the Design of Buildings

Type of building: Each type of building has many different requirements. It varies in building form and appearance, space planning for different utilities, furniture specification, lighting arrangement, materials and finishes, indoor climate, building codes and standards. The functions and goals of the business are just some of the many factors that influence the interior design based on the type of facility in the required in the building

Location: The design of project may be located in a small town or in an urban area; as a total building and part of a building. The cost of project or money spent on the building design and

interior finishes will be influenced by project location. Expectations of the customer will be greater when the business is located in an urban location.

Nature of Activity: Type of project will be influenced by the nature of Activity. In case of a Food service business, it may be a simple bakery or exclusive coffee shop, a motel or an five star hotel. In the case of retail stores, it could be ready-made garment showroom or florist store or a foot ware store. The activities to be performed in each of these businesses will influence the amount space, type of furniture and equipment, safety, support services etc. The kind of ambience desire in each of these business outlets will be based on the anticipated customers and its location.

Customers: Satisfaction of customers in any business environment will be indication of profit. In a business of restaurant, the customers may be neighbourhood residents or tourists. Customer's likes and dislikes, culture, living styles, affordability to pay for service will influence the interior designers design decision.

Client: Very crucial member in the society who provides funds for creating projects and depends on the services of architects and interior designers. Each client has different goals for the business, and the interior designer is challenged to satisfy all their unique demands.

Factors Affecting Design and Space Organization

1. Function of building
2. Shape and Size of the plot
3. Topography
4. Climatic Condition
5. Building Bye Laws

Principles of Planning of Residential Building are as follows:

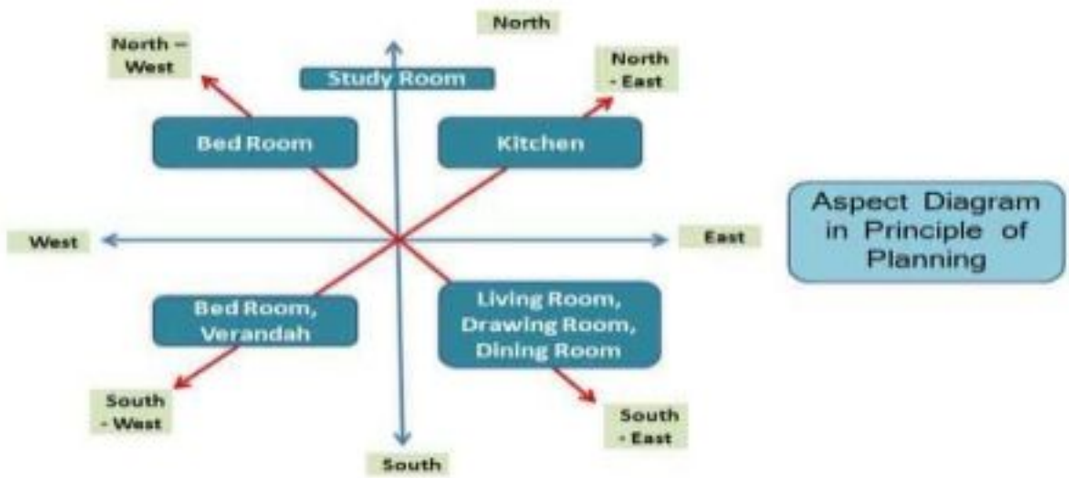
1. **Aspect**
2. **Prospect**
3. **Furniture Requirements**
4. **Roominess**
5. **Grouping**
6. **Circulation**
7. **Sanitation**
8. **Elegance**
9. **Privacy**
10. **Flexibility**

11. **Economy**
12. **Practical Consideration**

1. **Aspect:** Aspect means the peculiarity of the arrangement of doors and windows in the external walls of a building with respect to four directions which permits the occupants to enjoy the gifts of nature viz sun, breeze, outside scenery etc. Aspects gains special significance in case of residential buildings. This provision is necessary to ensure proper comfort conditions in the room and it also helps in providing hygienic conditions in the room as the sun rays destroy the insects and also impart cheerful living conditions in the room. A room which receives light and air from particular side is termed to have aspect of that direction. Needless to emphasize that different rooms/areas in the dwelling need particular aspect.

   A room receiving light and air from any particular direction is said to have the aspect of that direction. All the rooms of a dwelling need a particular aspect. Some necessary aspects of commonly constructed rooms are listed below:

1. **Living Room:** It should have a southern or south-east aspect. The sun is towards the south during winter and north during summer which will provide sunshine during winter and cooler during summer time.
2. **Bedroom:** It should have a west or south-west aspect, as the breeze required particularly in summer would prevail from this side.
3. **Kitchen:** It should have an eastern aspect so as to admit morning sun refresh and purify the air.
4. **Gallery or Verandah:** It should be north or north-east aspect.
5. **Classroom, reading room:** It should be laid with the north aspect as light received from the north will be diffused and evenly distributed.



Aspect Diagram

2. **Prospect:** Prospect is the term used to highlight the architectural treatment given to a building so as to make it aesthetically pleasing from outside and arranging external doors and windows in such a manner that the occupants are able to enjoy the desired outside views from certain rooms like a flower garden, mountains or sea. Prospect is basically governed by the peculiarities of the selected site. Hence. like aspect, prospect of a building also requires the deposition of external doors and windows in a building at particular places and in particular manner so as to expose the notable and pleasant features of the openings in the external facade of the building and concealing the undesirable views in a given site. Hence, both aspects as well as prospect demand proper disposition of doors and windows in the external walls at particular places and in particular manner. Certain projecting windows or a blind face of the bay with window openings at sides would help for concealment of inside views of a building.

Aesthetic Appearance

3. Furniture Requirements: The furniture requirements of a room or an important depends upon the functions required to be performed there in. The furniture requirements of a living rooms in a dwelling will be different from that of a class room in a school or an operation theatre in a nursing home/hospital. There are no rigid rules which govern the furniture requirements of a particular room in a dwelling. It should be sufficient to accommodate the normal needs of maximum number of persons who can use the room without overcrowding. In case of buildings, other than residential, it should be adequate to meet the requirements of the particular functions. The space requirements of non-residential building are planned paying regard to the furniture, equipment and other fittings or fixtures which are essential to meet the need of the particular functions required to be performed in the building. In case of residential buildings, normally not much thought is given to the furniture requirements. It is however, desirable to prepare a sketch plan indicating required furniture as well as its located in different rooms (viz. drawing room, bedroom, kitchen etc.). So as to ensure that doors, windows, cupboards and circulation spaces do not prevent the placement of required number of furniture items in the room.

A room should have enough space to accommodate all the furniture required for the maximum number of people without overcrowding.

Proper Furniture Placement

4. Roominess: The effect produced by deriving the maximum benefit from the minimum dimensions of a room is termed as roominess. Roominess is the accomplishment of economy of space without cramping of the plan. By using every nook and corner of the building advantage of roominess is derived. Particularly in case of residential buildings where considerable storage space is needed for various purpose, adequate provision of wall cupboards, lofts wooden/R.C.C shelves etc., should be made to make maximum use of every nook and corner of the building.

Following points should be kept in view for creating desirable impression regarding roominess:

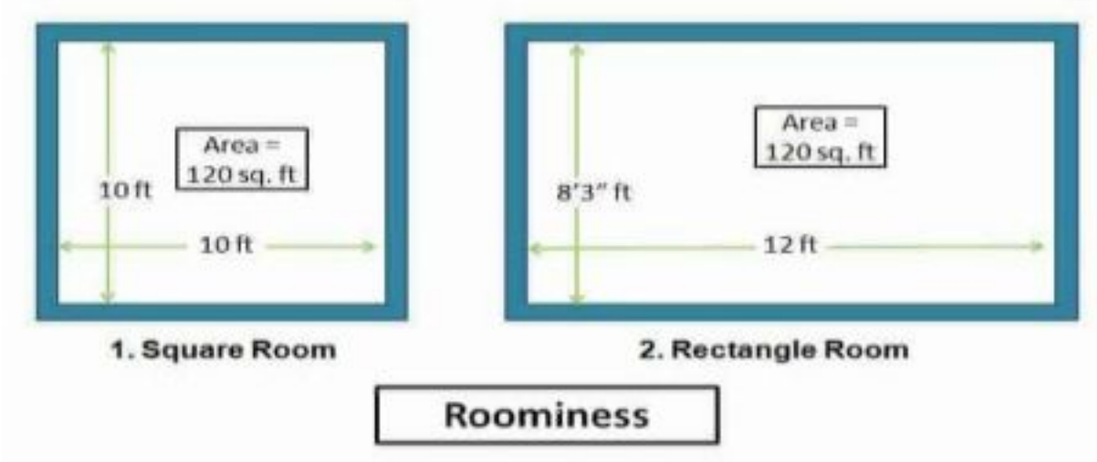
(a) A room square in plan appears relatively smaller than a rectangular room of same area. It is also considered relatively smaller from utility point of view as compared with rectangular room of the same area. Length of beam proportion for a good room is taken as 1.2 to 1.5. If the ratio of length to breadth exceed 1.5 it creates an undesirable effect. A small room having its length more than 2 times its width is objectionable, as it creates tunnel effect.

(b) A small room with high walls appears relatively smaller than its actual size and as such small rooms should have the maximum permissible height as per bye-laws.

(c) The location of doors, windows and built in cupboard etc., should be such that they permit easy approachability and do not obstruct the placement of furniture etc.

(d) It requires skill and serious thinking in making best use of the accommodation provided by suitable, arrangement of rooms, by locating doors and passages in such a way that the liveability, utility, privacy and exterior appearance are not adversely affected.

(e) The design of the building should be evolved in such a manner that its floors, walls and ceiling create a sense of uninterrupted surfaces carried consistently through.



5. Grouping: We know that every apartment in a building has got a definite function and there is some inter-relationship of sequence in between them. Grouping consists in arranging various rooms in the layout plan of the building in such a manner that all the rooms are placed in proper co-relation to their functions and in proximity with each other. The basic aim of grouping of the apartments is to maintain the sequence of their function according to their inter-relationship with least interference. For instance, in a residential building dining room should be close to the kitchen. The kitchen on the other hand, should be kept away from drawing room or living room to avoid smoke or smell from kitchen spreading in these rooms. The water closet should be located away from the kitchen. Main bedrooms should be so located that there is independent and separate access from each room towards the water closet directly or through other un-important rooms. In case of office buildings, hospitals etc., administrative department should be located centrally for convenience and economy in the cost of providing services. Thus, the concept of grouping plays a very important role in planning of buildings of all types.

Grouping of a residential building:

- The dining room should be close to the kitchen.
- The kitchen should be kept away from the main living room.
- Main bedrooms should have independent and separate access from each room towards the sanitary units.

- In an office building, hospitals, etc. the administrative department should be located centrally for convenience and economy of services.

6. Circulation: Circulation means internal through fares or access providing in a room or between rooms on the same floor. Passage, halls and lobbies perform the function of circulation on the same floor. Such provisions are termed as **horizontal circulation**. On the other hand, stairs, lifts, ramps etc., which serves the purpose of providing means of access between different floors get covered under the category of the term **vertical circulation.**

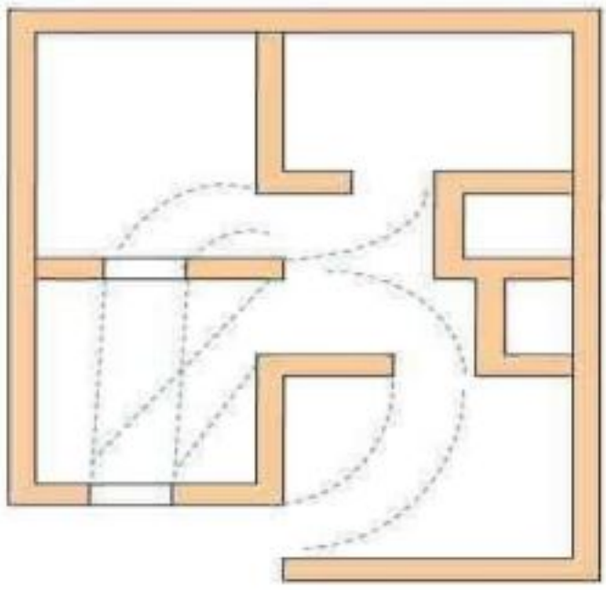
Following aspects should be kept in view to achieve good circulation:

(a) For comfort and convenience, all passages, corridors, halls etc., on each floor should be short, straight, well ventilated and sufficiently lighted.

(b) The location of entrance passages and staircase which serve as link between various rooms and floors, need careful consideration right at the initial stage of planning.

(c) In a multi-storeyed building, the staircase, which perhaps serve the only unfailing means of vertical circulation, should be planned paying due regard to the size of tread and riser, width of stair and landing, light and ventilation etc. Staircase should be also located that they do not intro-due upon privacy of any room or cause disturbances in the horizontal circulation.

(d) Toilets, should be planned near the staircase block for easy accessibility.



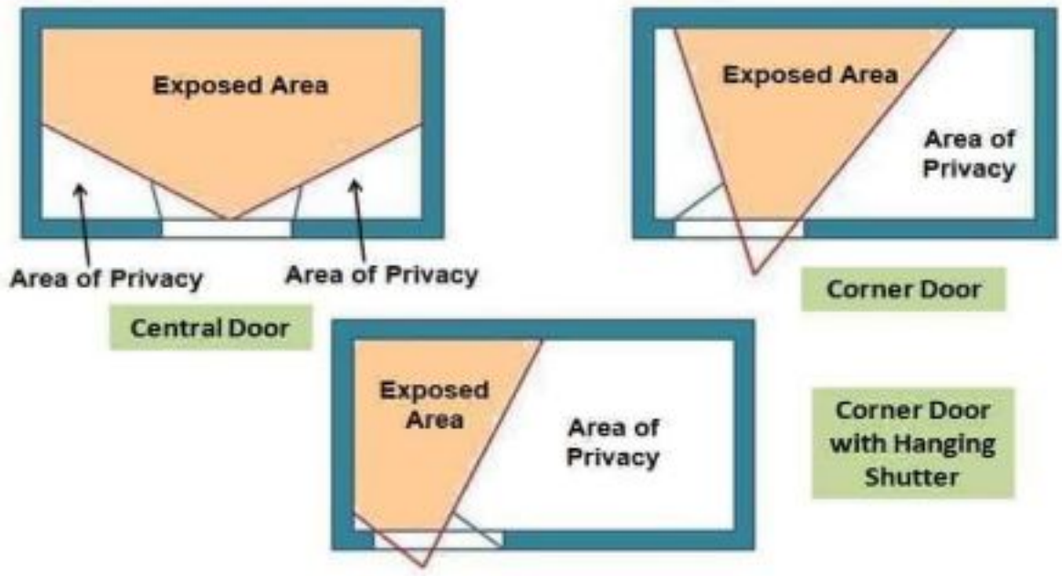
Easy Circulation in House

7. Sanitation: The term sanitation of the building not only associated with sanitary convenience like water closet, urinals, bath rooms, wash basins etc., but also proper and adequate lightning ventilation and facilities for general cleaning of the building. Washing closet, lavatories, urinals, bathrooms like

sanitary conveniences should be installed adequate in number in relation to the occupant load. From hygienic considerations, all parts of the building should be well ventilated and lighted. The lighting of the interior of the building may be done by natural lighting, assisted natural lighting or by artificial lighting. Uniform distribution of light in necessary, especially in offices, schools, factories and other similar buildings where number of persons work in the same premises and each individual has to work at specified place. For ensuring sun light for greater length of time it is desirable to provide vertical windows. For proper lighting the area of windows in a room should not be less than $1/10^{th}$ of the floor area which may be increased to $1/5^{th}$ for buildings like schools, offices, workshops, factories etc.

8. Elegance: Elegance is the term used to express the effect produced by the elevation and general layout of the building. Hence, for good elegance of a building it is better if elevation is developed first and then the plan is adjusted accordingly. Selection of site or open plot for the construction of building greatly affects the elegance. Building located in depression will give bad elegance whereas building on an elevated spot gives an impressive appearance. Buildings located on backward sloping upwards ground give good elevation and elegance.

9. Privacy: Privacy is considered to be one of the most important principle of planning in all buildings specially in residential buildings. Privacy may be one part to another part of the same building or it may be the privacy of all parts of the building from neighbouring buildings, public streets or bye ways etc. The extent of privacy of a building from the street, bye ways or neighbouring buildings depends mainly upon the functions performed in the building. Many a time privacy of only a part of building is necessary from **exterior** whereas the remaining building as a whole may be required to be exposed to view. This is achieved by proper layout of streets, approach roads, entrances, provision of trees, creepers etc.



Privacy within Rooms

The privacy within the building means screening interior of one room from other rooms. Screening of all the apartments or some of them from entrance, corridors etc., gets covered under the term privacy of part of building from exterior. In case of residential buildings, privacy can be achieved by judicious planning of the building with respect to grouping, disposition of doors and windows, mode of hanging of doors, location of entrance pathways, drives etc. Sometimes, provision of lobbies, corridors, screens. curtains etc., is also made to achieve **internal** privacy. Importance of privacy requires special consideration in case of bedrooms, toilets, lavatories, water closet, urinals etc. All these services should have an independent access from every bedroom without disturbing the others. Doors with single shutter are desirable for such rooms.

10. Flexibility: Flexibility means designing certain rooms required for specific purpose in such a manner that they may be used for overlapping functions as and when desired. This concept is particularly important for designing houses where areas cannot be increased from consideration of cost yet the provision of additional facilities is desired during functions or other occasions of social gatherings. It is therefore desirable to plan drawing room and dining room with a removal partition wall or screen in between them so that a large room can be obtained by removing the partition screen to accommodate large gathering.

11. Economy: Economy is one of the very important factors which is required to be kept in view while involving any scheme. Every unit of the built-up area is a function of cost and as such the architect has to make sure that the building planned by him can be completed within the funds available for the project. To fit the proposed scheme within the limitations of the resources and funds certain alterations and omissions in the original plan have to make. But while considering the economy, the required strength and durability of the structure should not be compromised. Some simple economy achieving approaches in buildings are:

1. Conceive simple elevation, dispensing of porches, lobbies etc. without ornamental work.
2. Steeper rise to the stair, wider steps in stair.
3. Reducing the storey height to bare-minimum.
4. Standardize the size of various components and material.
5. Do not use rich specification for internal and external finishes.
6. Specify use of locally available materials to the extent possible.
7. Do not use timber for doors/windows frames. Use R.C.C. frames and L-iron steel frames instead.
8. Adopt single stack system for plumbing.

12. Practical Consideration: Besides all the fundamentals of planning discussed, the following practical points should be additionally considered:

1. Strength, stability, convenience and comfort of the occupants of the building, should be considered first.
2. Provisions for future extensions without dismantling should be made in the planning.
3. The building should be strong and capable to withstand the likely adverse effects of natural agencies (earthquake, flood, storm etc.)
4. Elevation should be simply yet attractive. Too many porches may give good elevation for some time, but in the end, simple designs fit better for generations.
5. Larger size of the room should always be considered as far as possible as it can be shortened by providing partitions but smaller rooms cannot be enlarged easily.

Essential Elements of Planning of Residential Building:

Followings are the required elements for planning of residential building:

1. **Integrated Design:**
   Landscape and architectural designs should be integrated with all project design disciplines in order to enhance the building performance and aesthetics. Enhancing performance and functional objectives that impact building orientation, massing, space adjacencies, material selections and assemblies.
2. **Performance Measures and Functional Objectives:**
   Planning shall ensure that the design supports quality-based performance measures for customer satisfaction, energy consumption, and reduced operation and maintenance. It should also identify all expectations and establish alternative features that support attainment.
3. **Environmental Sensitivity:**
   The natural setting of the site, its contours lines and vegetation shall be viewed as assets to be preserved in the design as much as possible. In settings including historic buildings and other infrastructure, adjoining historic properties, or nearly located historic properties that will not be affected by construction.
4. **Urban Context:**
   Design facilities and orientation must be consistent with existing and planned development patterns and nearby uses. The exterior of the building should be consistent with existing local design guidelines as per standards. Where appropriate, the project team should help to develop design guidelines for the project and neighbouring undeveloped sites

Design Organization

Every object that is designed to create beauty should be organized well in the interior there are two aims of organization – form follows function and variety in unity.

Form Follow Function: the basic principle behind the creation of an item for intended purpose. Utility is one of the several functions basic to design. The study of the functions of any object can inspire quite different solution to any design problem.

Variety in Unity: the diversity of materials, forms, colours, textures and contrasts of all sorts are some of the major ways and means of attaining variety. Variety arouses and holds interest as well as brings vitality through friendly differences. Unifies effect of the objects and ideas brings corrections between one object to another and creates a harmonious, balanced proportional rhythmic and emphatic effect to the arrangement.

Room	Location in house
Bed room	North or NW
Verandah	South or West
Store room, study room	North
Kitchen	East
Rooms mostly used during day	North or East
Staircase and garage	West
Direction of longer outer walls	North-South direction
Direction of shorter outer walls	East–West direction
South side wall	Must have chhajja
West side wall	No chhajja but verandah
Window	Towards East and South
Best facing of the house	Towards North

Space organization elements:

1. **Repetition:** Repeating elements such as colour, shape or texture can help to unify a space and create a consistent visual experience. Mismatching carpets, different colour schemes or pick 'n' mix windows all create confusion in a space.
2. **Balance:** The definition of balance is 'the even distribution of weight leading to steadiness or evenness'. A balanced design does exactly that; it creates equality and symmetry that the eye loves. But as with most of these principles, if applied too rigidly it can become boring. Enhance your balance with other aspects of design to make it a little less formal.

3. **Harmony:** This principle is used to put a person at ease within their environment and create unity, thereby eliminating any feelings of disquiet.
4. **Scale:** Scale refers to the relationship between two or more objects. Scale is key in architecture and interior design as these disciplines work with several standardised measurements such as bench heights, hallway widths and chair sizes. Offsetting these standard-sized elements with other elements in differing sizes and heights can create some really fun visual interest in a space.
5. **Proportion:** Proportion usually goes hand in hand with scale, but is subtly different. Where scale describes the comparison of objects to one another, proportion is more about the way furniture and objects look in a space, as well as in relation to one another.

Residential House designs based on income groups

1BK

2BK

3BK

4BK

Ideas for Small Space Organizing and Storage

Looking for bedroom organization ideas or living room storage ideas or even if you're house isn't exactly on the 'small' side though, there are still plenty of great ideas.

1. **When it comes to seeking out storage, go high whenever you can:** You may not have a ton of floor space, but usually there's no shortage of vertical space. Installing a simple set of brackets and a piece of plywood is an affordable and easy way to bring order to closets and living areas. Add cute boxes and baskets to hide winter clothes, unused toys, and guest linens.

3. **Can't go high? Go low:** One of the easiest solutions for home organization is to add storage *under* your furniture, especially when it comes to bedroom organization ideas. But under the bed storage doesn't necessarily mean those clear plastic bins you can pick up at Target or The Container Store (although those are great options if you want to keep things hidden). To up the aesthetics, try cool woven containers or wood crates instead of clear plastic bins, and you won't even have to hide them away.

Take advantage of that wall space: Hang some of your favourite items on the walls instead of taking up valuable closet or floor space. Hanging wall organizer can be used in many different ways – in your office or craft space to organize supplies, in an entryway for mail and keys, even in your closet for shoes and accessories.

4. **Head over the bed:** Most of the space over the bed is reserved for headboards and artwork. Headboard shelving from floor to ceiling built-ins can be used for to keep bedtime reading more organized.

5. **Maximize unexpected spaces:** One of the most overlooked places for added storage is the back of the door and the side of the fridge. Adding hanging shelves or towel racks, etc to these areas can help cut down on clutter, especially in the smallest of spaces.

6. Mix hidden storage with open storage: Try combining storage with doors along with open shelving, so you can hide the practical stuff, but not loose character in your space.

Pro organizer tip: One of the keys to success when it comes to small space organizing, is keeping the stuff you use most often in the easiest place to get to. Take the image above for example… A good spot for things you use all the time, might be the shelf behind those closed doors that's at you eyeline or it might be the baskets underneath that you can quickly pop in and out.

7. Check behind the mirror: There are so many modern bathroom storage solutions that can help keep your vanity clear and organized, like this sliding storage mirror.

8. Stick with small footprints: If you're going to use some of that precious floor space, keep it as small and tall as possible.

Blanket ladders, don't require much space and are a great way to display your favorite textiles. They're also a good solution for the not-dirty-enough-for-the-wash-not-clean-enough-for-the-closet clothes that tend to land on the bedroom floor.

9. Work in dual-purpose furniture whenever possible: Swap out traditional seating for a trendy storage bench. There're tons of room for anything that you want to hide away, plus a cute place to sit and read or take a nap.

UNIT 1

Chapter 4

Plans

For organisation of residential or commercial space conceptual drawings (plans) are required:

1. **Site plan**
2. **Floor plan**
3. **Service plans**
4. **Cross-section plan**
5. **Elevation plan**
6. **Perspective plan**
7. **Landscape plan**

The site plan, floor plan, cross-section plan and elevation plan are necessary plans which has to be submitted to Local Authorities to seek permission for constructing a house. The perspective plan and landscape plan are prepared by the architects to show to their clients how the building will look like and how the space around the building can be landscaped.

1. Site plan

A site plan consists of a plan drawn to scale to show the location of the particular building in the plot with reference to the surrounding plots and the nearest street or road from which there is access to the building plot. In short it establishes the location of your plot. This plan has to be secured from the local authorities it's survey number. According to National Building Code 1970 the site plan should be drawn on 1: 1000 scale and depict following information:

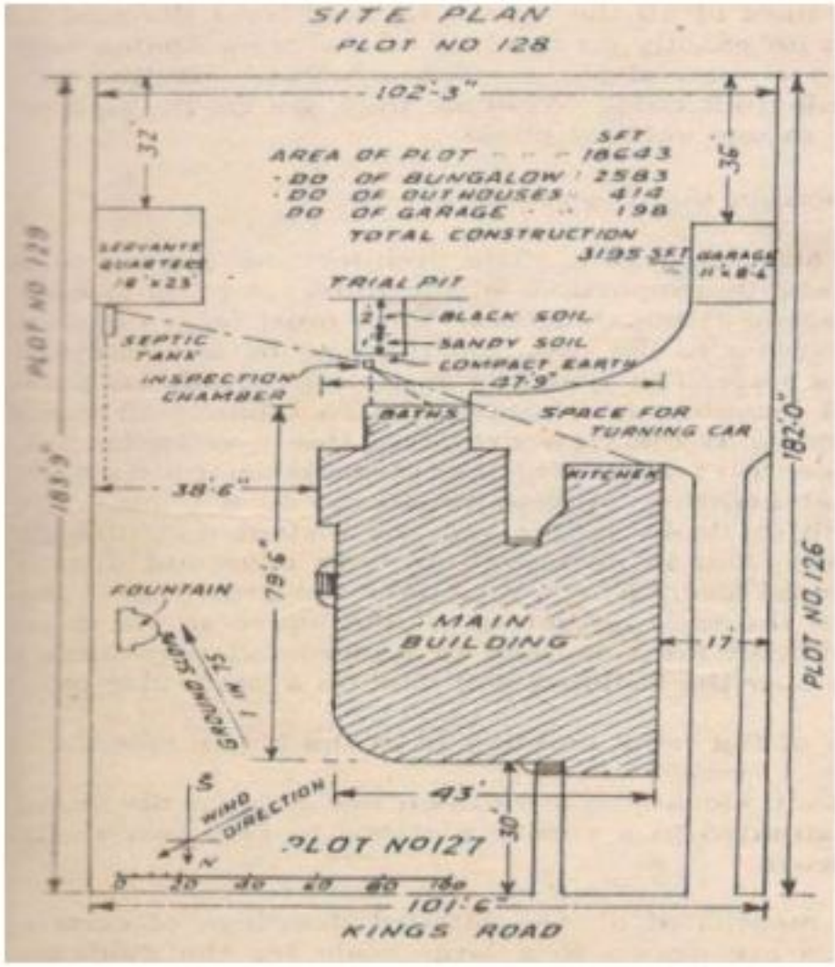
(a) Lengths of the boundaries of the plot an outline of the said plot.
(b) Distinguishing mark or number such a survey number of the said plot.
(c) The plots on the all sides of the said plot with their numbers.
(d) The nearest street, road or lane giving access to the plot is also shown.
(e) The north direction is marked by an arrow with 'N' at the head of the arrow.
(f) The exact location of the proposed building, out-houses servant quarters or any other permanent structures are shown in the plot. The structures are clearly showing with red lines.
(g) The space proposed to be left on all sides between the building and boundaries is also shown.
(h) The proposed drainage lines, with inspection chambers are also shown with red lines. The places where they are finally joining the municipal street gutter or a nalla are specified, with the help of commonly accepted symbols.
(i) The main source from where water supply will be obtained has to be specified.

All these details are necessary for submitting the plans to the municipal authorities. In addition to these some other details must be provided to the architects and builders so that they can plan the building properly.

(a) The direction of prevailing wind is shown by another arrow inclined to the arrow showing North direction.

(b) The direction an amount of downward slope of the ground surface are shown by an arrow for example 1 feet to 60 feet, which means that the ground slopes down one foot after every 60 feet of space.

(c) The trial pit results are also shown indicating type of soil and its depth. It gives information about the type of foundations that are available and at what depth. It helps in designing the foundations of the building. If the strata of soil below ground level are uniform then only one or two pits in diagonally opposite direction are sufficient but if it varies then a pit in all corners have to be dug.



Site Plan

Source: Deshpande R S (1984) Build Your Own Home

2. Floor Plans

A floor plan or house plan is a simple two-dimensional (2D) line drawing showing a structure's walls and rooms as though seen from above. In a floor plan, what you see is the PLAN of the FLOOR. The floor plans have to be prepared for all the floor in a building if they vary in design. Floor plan is

developed at 1: 100 scale. If the same floor plan is repeated one over the other, as in case of multi-storied buildings then only one plan is sufficient. The floor plans give following information:

(a) General arrangement of different rooms

(b) Lengths and breadths of each room

(c) Wall thickness

(d) Location and position of doors, windows and cupboards

(e) Any other details which can be seen in horizontal plane, such as lofts or projections and recesses

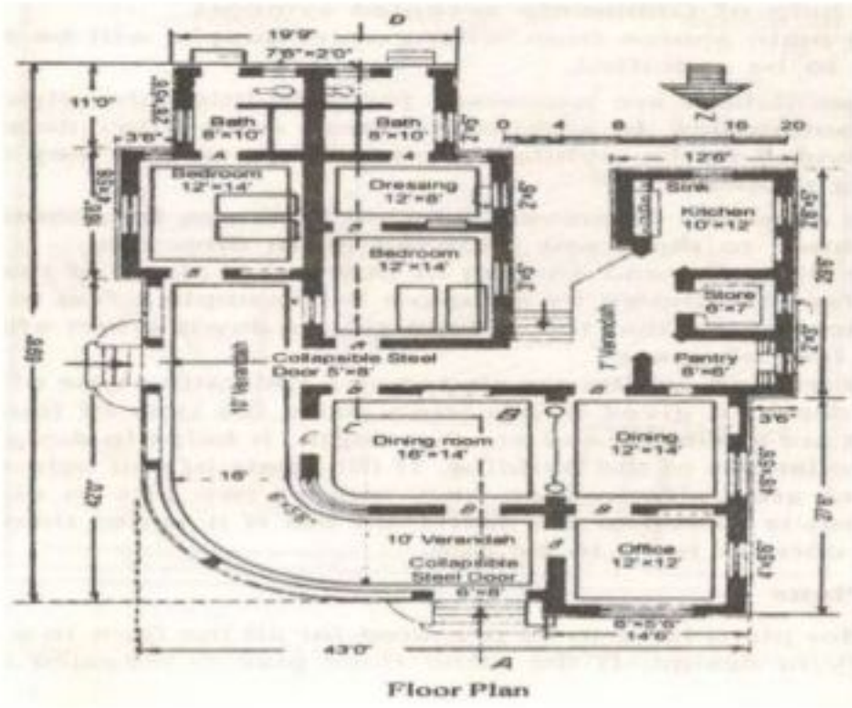
(f) Each individual room is shown with respect to the major furniture and fittings for example in bedroom the position of bed or beds is marked along with position of wardrobe, dressing table, study table, chair, side tables etc. The sanitary fittings of the bathroom are also shown.

(g) In getting the placement of various centres such as range, sink, mix center and refrigerator may be shown.

(h) The placement of electrical fittings such as wall bracket, pendant lamp, buzzer or bell, telephone, fans, A.C. etc. may also be shown.

(i) It is important to show the direction in which the door and windows open and also placement of beams and trusses are shown with the help of accepted symbols.

Floor Plan



Source: Deshpande R S (1984) Build Your Own Home

3. Service Plans

Service plan is also submitted with the other plans. Service plan includes water pipe and plumbing details, sewer lines, electrical fittings, etc. This plan is drafted on 1:200 scale. The service lines for ground floor and first floor are indicated in different colours. Red color is used to depict sewer line connection, whereas, blue color is used to represent fresh water connections, the drainage of water, sewer trap, sewer pipes, main-hole, rain water drainage, W.C. (water closet) connections etc. The service plan clearly shows the slope of the land, drainage and pipe connections.

Residential Plumbing Plan

Residential Electricity Plan

4. Cross- Section Plans

A cross-section plan records the vertical lines of all the details from roof to foundation. This plan is very important for the contractor and supervisor who is looking after the construction work at the site. The architects give the constructional details in these plans. This is actually the plan of house in vertical plane. It shows:

(a) Height of the windows and doors

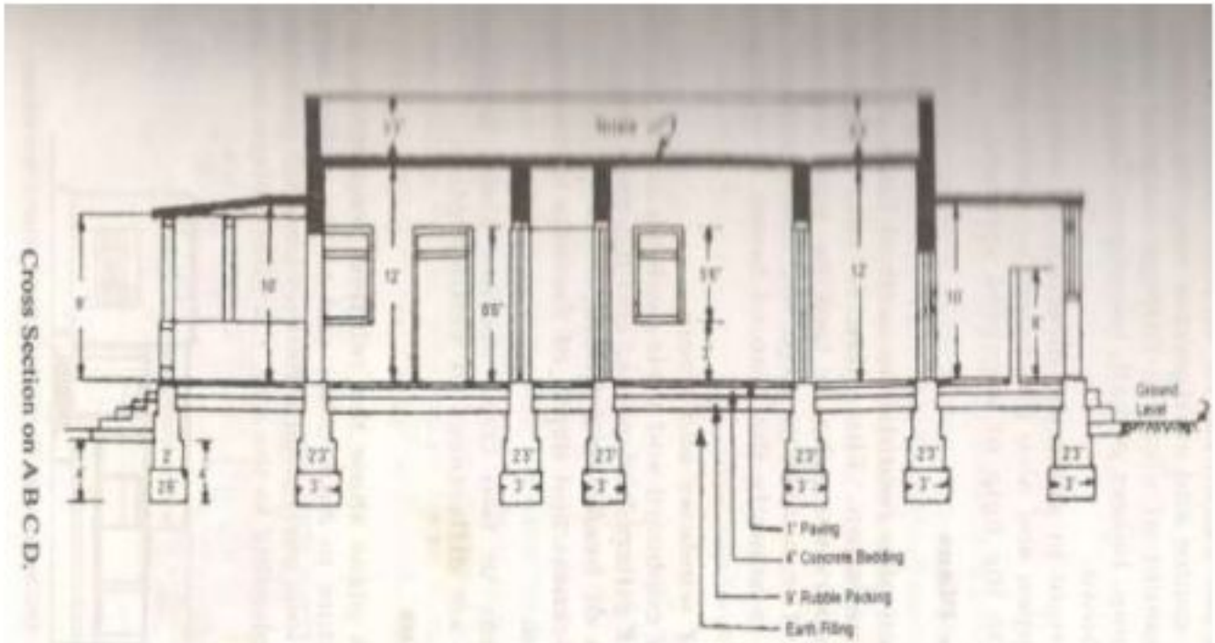
(b) Heights of cupboards and position above the floor level

(c) Heights of pillars and posts, ceiling, roof etc.

(d) Thickness of beams and floors

(e) Width, thickness and depth of footings of foundation below the ground

There may one or two cross sections plans prepared by the architect if there are differences in vertical plane.



Source. Deshpande R. S. (1984) Build your Own Home.

5. Elevation Plan

It is drawn on 1: 100 scale and it reflects the exterior design of the house. The elevation plan shows the relative proportions of different parts of the structure to each other and to the entire façade of the structure. The various parts should harmonize with each other to give a form, which is pleasing to the eye. Elevation plans are usually flat, they do not show the perspective. The near and distant objects are drawn to their actual size.

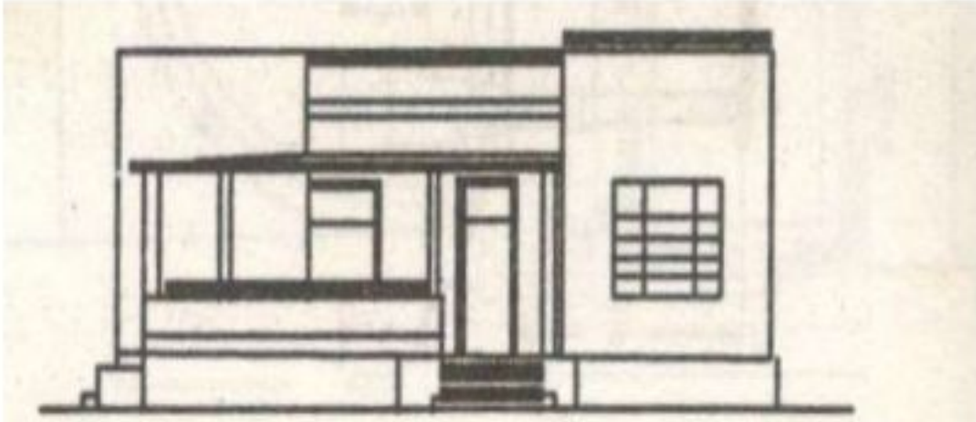
The outer side of the home is drawn according to the scale. It shows:

(a) Type and location of windows

(b) Placement of doors

(c) Design and location of balconies

(d) The roof lines



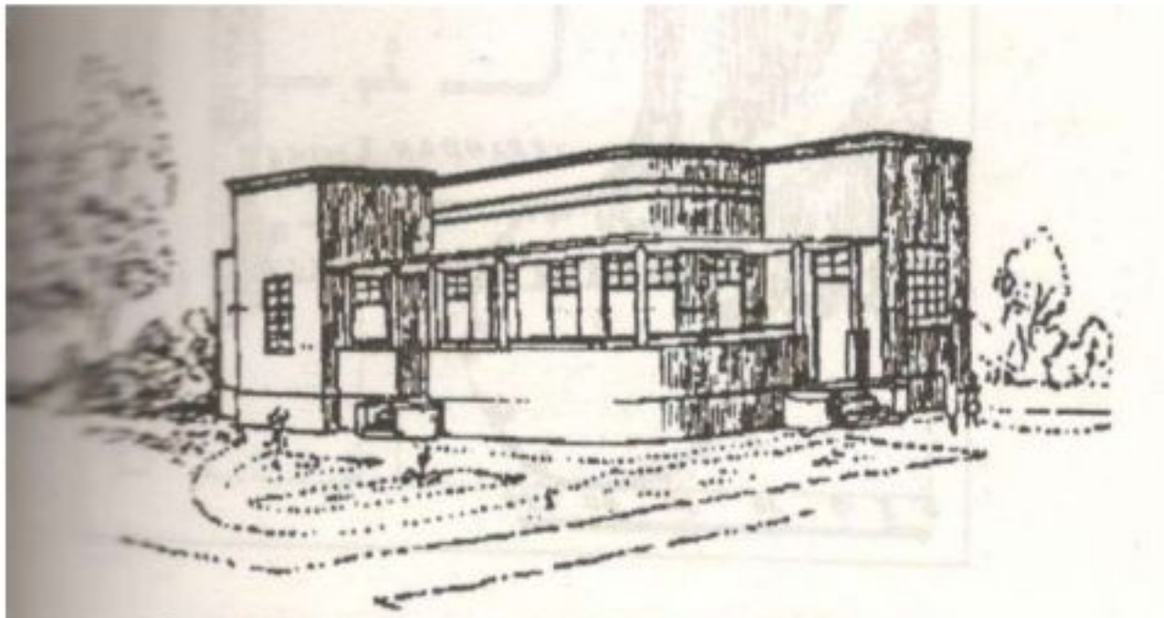
Source. Deshpande R. S. (1984) Build your Own Home.

When the house is important elevation is drawn not only of the front but also of sides, example, a house in a corner plot has two sides facing the roads therefore both the façade should look pleasing and the designer takes care to see that the house looks beautiful from both sides. Two elevation plans are prepared to show how the house would look from both the sides.

The details of some intricate an important part is also shown on a large scale for guidance and clarity of the person who supervises the work and the artisans who execute the work.

6. Perspective Plan

A perspective plan gives a pictorial view of the proposed house. It gives a photographic representation of how the house would look. These plans are prepared by architects, because very few can visualize from the working drawings how the house would look when it is finished. Even the flat elevation plans cannot show the true picture. In these plans the nearer objects would look larger than the distant ones although they may be of same size. It gives depth to the plan and shows how the house will look from outside.



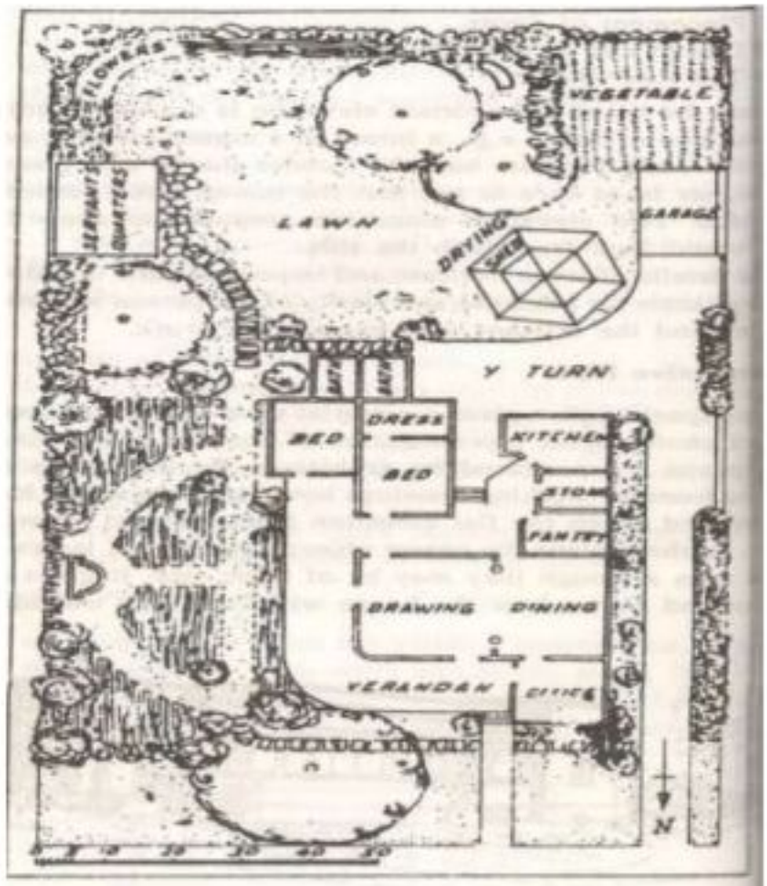
Source. Deshpande R. S. (1984) Build your Own Home.

7. Landscape plan

It gives details about the plan for the land surrounding the house on all the free sides. It shows:

(a) Path and car drives
(b) Plants
(c) Trees
(d) Water bodies
(e) Rockery
(f) Outdoor games
(g) Lawn and flower beds

The landscape plan is designed to enhance the beauty of the house and its surrounding. It creates an atmosphere which reflects the taste of the people. The environment around the house has to be planned in such a way as to give a feeling of neatness and beauty and elevates the surrounding of the house above normal. A preconceived landscape helps to place the house in appropriate position. So that the house and the landscape complement each other.



Source. Deshpande R. S. (1984) Build your Own Home.

Thus, the plans are prepared to transmit the idea of those who have conceived and designed them to those who have the responsibility of executing these plans and give the plans their material form. The plans express the information and ideas which cannot be adequately explained through words full stop the symbols used are universally accepted and hence it can be understood by people who work with them.

UNIT 2

Chapter 1

Design and Space Organization Analysis of Apartments and Flats

Design Organization involves the creation of roles, processes and structures to ensure that the organization's goals can be realized.

Interior Design principles

- **Repetition:** Repeating elements such as colour, shape or texture can help to unify a space and create a consistent visual experience. Mismatching carpets, different colour schemes or pick 'n' mix windows all create confusion in a space.
- **Balance:** The definition of balance is 'the even distribution of weight leading to steadiness or evenness'. A balanced design does exactly that; it creates equality and symmetry that the eye loves. But as with most of these principles, if applied too rigidly it can become boring. Enhance your balance with other aspects of design to make it a little less formal.
- **Harmony:** This principle is used to put a person at ease within their environment and create unity, thereby eliminating any feelings of disquiet. Harmony, in a sense, provides the 'full stop' to any interior design – when harmony is in effect, the space should feel complete because all its parts relate to, and complement, each other. This feeling is the result of balance, scale, proportion and repetition all being used in the right amounts. Harmony is the measure by which we judge whether a space works or not.
- **Scale:** Scale refers to the relationship between two or more objects. Scale is key in architecture and interior design as these disciplines work with several standardised measurements such as bench heights, hallway widths and chair sizes. Offsetting these standard-sized elements with other elements in differing sizes and heights can create some really fun visual interest in a space.
- **Proportion:** Proportion usually goes hand in hand with scale, but is subtly different. Where scale describes the comparison of objects to one another, proportion is more about the way furniture and objects look in a space, as well as in relation to one another. Getting proportion right is tricky and is quite often chalked up to someone having an 'eye for design' that results in a feeling of comfort and harmony.

Apartments/ Flats design

- New and varied apartment types contribute to greater stability in the long run as they balance the supply of homes for larger and smaller families and are designed to meet occupants' changing needs.

- A mix of apartment types, sizes and tenures within a development provides greater housing choice for a more diverse range of households. A mix of types also contributes to community safety, with the potential for more apartments to be occupied throughout the day.
- Apartments are becoming an increasingly viable form of housing for larger groups of people, including families, largely because of their relative affordability. Families, in particular those with young children, pose the biggest design challenge.

- Designing for families is a key part of ensuring that apartments are seen as a long term home ownership solution, and not just for rental or shorter term accommodation.
- Where apartment developments are located close to schools it is even more important to ensure that the development provides some larger apartments and outdoor areas that are suitable for children to play.

Apartment Layout

- The internal layout of an apartment establishes how functional and enjoyable an apartment is to live in.

- Aspects such as access to sun and daylight, natural ventilation and acoustic and visual privacy, directly contribute to the health and wellbeing of occupants, their ability to easily carry out normal household functions, socialise and to feel safe and secure.

- A feeling of spaciousness within an apartment can be created through a high standard of design and layout and does not rely on apartment size alone. This includes providing adequate storage space, and providing for services such as laundry airing. Apartment layout considerations also include how the private outdoor space associated with an apartment relates to interior spaces.
- Flexibility (the potential to use the rooms of a home in a variety of ways) and adaptability (the potential to modify spaces) are key considerations in the layout design. Flexibility will be influenced by the amount of space, the number of rooms and the layout.

Apartment Design Guide

1. Provide enough space to meet the needs of the residents by:

- Allowing enough space for standard sized beds, circulation and storage in the bedrooms.
- Providing enough room for all members of the household to sit down to the dinner table together.
- Providing enough room in the living room for all the residents to sit and watch television.
- Providing a deck large enough for the occupants to sit outside together around a table.
- Allowing sufficient circulation space for ease of movement between all the rooms. Furniture should not have to be moved to gain access or for residents to pass from one space to another.
- Providing enough storage for the full range of day-to-day items.

2. Plans must show standard sized furniture in all rooms, sufficient to illustrate the points above.

A well-designed building will need less space, and a poorly design building will need more.

Ensure flexibility by providing for a range of furniture layouts in living and bedrooms, and easy furniture removal.

Ensure circulation by stairs, corridors and through rooms is planned as efficiently as possible, to maintain the maximum amount of usable floor space. Circulation should be integrated into

living spaces except at entrances, where maintaining privacy is critical, and the front door should be screened from living areas.

3. **Configure spaces to exploit principal views and north facing aspect, and ensure orientation to the street.**

Provide private outdoor space for every apartment (balcony, terrace, patio, garden, courtyard), ensuring this is directly accessible from the apartment living area. Upper floor apartments should also have easy access to communal spaces.

4. **Ensure a good standard of natural light and ventilation is provided to all habitable spaces.**

This is most easily achieved with dual aspect apartments.

5. **Provide adequate storage space for everyday items (e.g., cleaning items) and those with occasional use (e.g. suitcases).**
   Consider additional secure storage at ground or basement level for bicycles and large sports equipment, and storage for outdoor equipment for apartments with gardens.

Apartment space

1. The apartments are functional, well organised and have enough space to meet the needs of the intended number of occupants

2. The layout is flexible and adaptable and allows for a variety of household activities

The apartments are functional, well organised and have enough space to meet the needs of the intended number of occupants

3. Adequate space is the basis for good apartment design. Well-sized apartments will enable greater flexibility and adaptability for their occupiers throughout their lifetimes, and thus support the widest range of lifestyles and life stages for those that own and live-in them.

Buildings and neighbourhoods that provide only small apartments limit their market to a very narrow range of potential buyers and investors. Smaller apartments tend to be attractive to younger residents, who move on with job commitments, or as they evolve into a family, which creates transient buildings and neighbourhoods.

Such 'mono-cultural' developments are less resilient to change, and do not grow their value as strongly as buildings and neighbourhoods that support a diversity of residents throughout their life stages.

Better Design Practice

- **Ensure the spatial arrangements of habitable rooms are informed by the intended number of occupants and possible furniture layouts.**

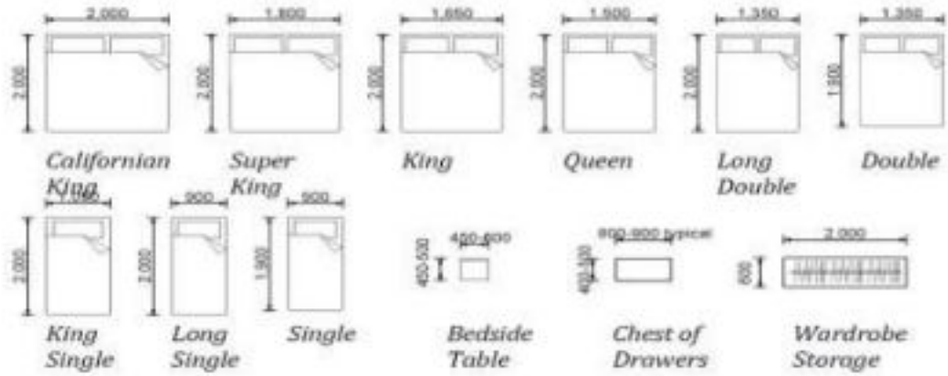
  Provide an 'easy-live' environment for occupants, with sufficient space to cater for adaptability and changes in family circumstances over time.

  Allow for a variety of household activities and occupants' needs by considering requirements for individual rooms.

- **Provide spaces for social gathering (both indoors and outdoors) as well as space for privacy and quiet.**

Consider providing offices, studies, en-suites and utility rooms. These are a commercial decision and will require additional floor area beyond the minimums discussed here.

BEDROOMS



- ***A 3.2m overall dimension allows space for secondary furniture, allows more flexibility and room to walk around beds.***
- ***All bedrooms should have an external window.***

- **Bedrooms should be designed so that two people per bedroom (and two people for a studio), apartment fittings and furniture can all be accommodated comfortably.**

Bedrooms should be large enough for at least a Queen size bed with circulation on both sides of the bed. A well designed bedroom will also allow for a wide range of other activities - studying, reading and for children to play.

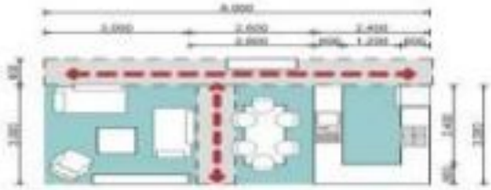
LIVING AND DINING

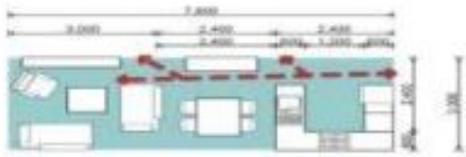
- **Apartments tend to combine dining, kitchen and living areas into open-plan layouts, and this is often considered desirable by occupants.**

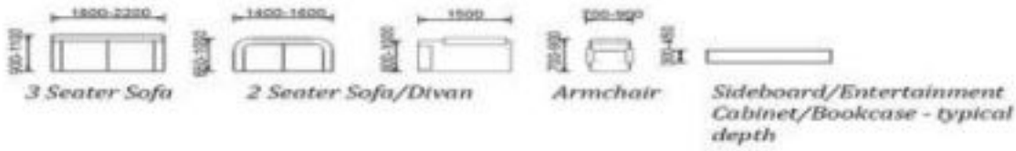
However, where apartments are being designed for specific cultural needs it may be preferable to separate the kitchen from the living and dining rooms, or other combinations.

This guidance combines the areas required for living rooms and dining rooms (which are usually located adjacent to kitchens), to allow freedom to plan these spaces in different ways.

A key design outcome is to ensure that the target occupancy level (two people per bedroom), apartment fittings and furniture can all be accommodated comfortably, so that the occupants can carry out normal daily activities in a convenient and relaxed manner.







- **Providing a clear, 800mm wide area for circulation allows more flexibility for laying out furniture, and makes the spaces more usable.**

- **If the principal living room within a dwelling has a 3m minimum for any dimension excluding cupboards and other storage space, the effect of circulation across the living space, as well as the intended number of occupants (and/or bedrooms) should be taken into account:**

  Additional space may be required to make circulation around the area more comfortable.
  It is preferable that access to bedrooms and bathrooms does not cross the living spaces, but is around the edges of the sitting spaces.

- **All living spaces should have external windows, and the windows in living areas should be a minimum 800 to 1000mm (glazing height to maximum sill height) above floor level to maintain views out while seated.**

  Living spaces should also provide for:
  A wide screen television, including cable routing for future satellite dish and UHF aerial.
  Multiple power points for accommodating appliances and computers.
  A wall mounted or free-standing heater or mechanical heating and cooling.

Dining Rooms

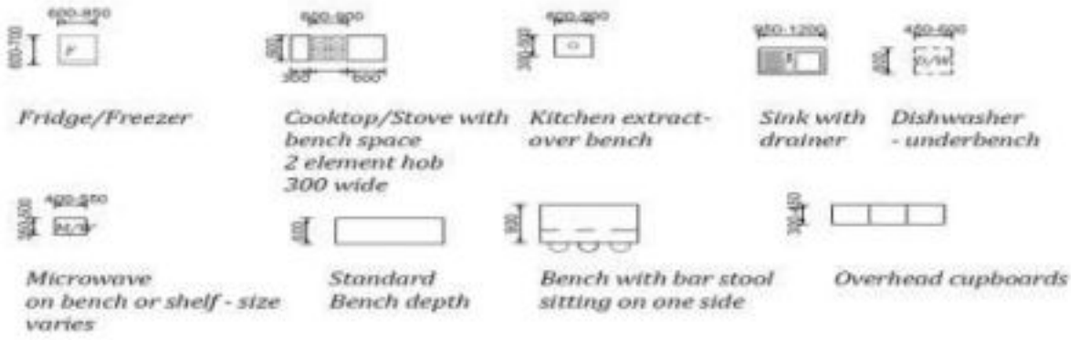
Access around a dining table should be a minimum 600-700mm where the space adjoins a bench or other furniture.

Increased circulation space may contribute to greater comfort if the table is not accessible from both ends or if the space is bounded by walls, rather than adjacent open living space.

KITCHEN

- **Kitchen and cooking space, fittings and furniture should be provided in each apartment so that two people can circulate safely and carry out activities hygienically and conveniently**

  Kitchens should have 1.2m access space in front of the base kitchen units. This can overlap with circulation space provided for living/dining areas and be reduced to 700mm (i.e. overlap by 500mm).



Some examples of typical kitchen layouts

Rules of Thumb

The following space for new apartment developments should be met and considered as a minimum. The guidance provides for apartments ranging from studios to four-bedroom (six person) apartments. For occupancy greater than six people, allow approximately 10sqm per extra person.

- Studio apartments, up to two persons 40sqm
- One-bedroom apartments, two persons 50sqm
- Two-bedroom apartments, four persons 75sqm
- Three-bedroom apartments, six persons 100sqm

Bedroom layout should provide for the following as a minimum:

- A bed space 2m long by 1.6m (minimum) wide, or - two bed spaces side-by-side 2m long by 900mm wide.

Bedroom layout should provide a wardrobe with a minimum dimension of 2m long x 0.6m deep with adequate access space in front (e.g. taking clothes from a wardrobe drawer or chest of drawers requires a space of 710 - 990mm).

Bedroom layouts should provide for a desk / study or dressing table space of at least 800mm wide by 500mm deep with 500mm width access space in front. An access space from the entry door to the foot of the bed no less than 800mm wide.

Note: Access space requirements for different elements in bedroom spaces may overlap.

A bed space should be available at the entry level of a multi-level apartment.

Convenient wheelchair access should be available between a main bedroom and the bathroom.

Storage and utility space design

1. Provide adequate storage for everyday household items within the apartment
2. Suitable space is provided for a washing machine, for drying clothes, and for waste and recycling bins within the home
3. Provide storage for sporting, leisure, fitness and hobby equipment in an easily accessible space elsewhere in the apartment building
4. Provide readily accessible space (internal or external, depending on the circumstances) for equipment associated with children such as pushchairs and bicycles

Satisfaction surveys show that a lack of storage space is a major dislike for apartment dwellers. Providing storage space for items ancillary to people's living needs, both 'every day' items such as cleaning equipment and 'occasional use' items such as suitcases, is important.

The size of this space should be proportional to the number of occupants intended for an apartment. 1.5sqm per two person apartment and 0.5sqm for each additional occupant is recommended.

Storage space should also be provided outside the apartment for large items such as sporting and garden equipment or bicycles.

Suitable space for utilities (washing, drying, waste, recycling) should be designed into the apartment so that it does not negatively impact on any habitable rooms. For example, laundry cupboards can be incorporated into kitchens.

Storage space must be considered early in the design stages of a development. This is especially true of garage or remote lockup space. Ideally, storage spaces should be built-in as this allows for the most efficient use of available space in each apartment.

Owner-supplied freestanding storage units must also be allowed for in the apartment plan, including units for audio-visual equipment and personal effects.

Better Design Practice

The majority of required storage space should be provided within the apartment and should be easily accessible.

This is best provided by designed-in storage cupboards located in entry ways, hallways or in the living space.

Provide utility areas that are well ventilated or that otherwise allow for drying clothes.

Consider providing dedicated storage rooms on each floor within the development, which can be used or leased by residents as required.

Provide secure storage outside the apartment.

Dedicated storage rooms or spaces within internal or basement car parks are convenient for sports equipment as this is usually transported by car and may be difficult to move upstairs.

Rules of Thumb

Bedroom wardrobes should be a minimum 600mm deep internally and 2m wide.

In addition to kitchen cupboards and bedroom wardrobes, provide internal storage facilities of the following sizes:

- Studio apartments (one to two people) 6m3
- One-bedroom apartments (one to two people) 6m3
- Two-bedroom apartments (three to four people) 8m3
- Three plus bedroom apartments (five to six people) 10m3

Storage outside of apartments should be adequately sized to accommodate bicycles.

Minimum dimensions for an audio-visual unit should be 450mm deep and 900mm wide.

Principles for bedroom layout and design

1. The number and size of bedrooms should be in proportion to the other rooms that make up the home.
2. Bedrooms need good natural light and ventilation.
3. Bedrooms need to be located to provide privacy and peace. Think about visual privacy from the bedroom door and the windows and noise coming into the bedrooms from outside the home and within the home (think about noise traveling between floors as well).
4. Design a bedroom with the furniture in mind. Make sure there's sufficient room for circulation around the bed, space for dressing (unless you're planning a separate dressing-room) and room for desk (often found in kids' bedrooms) or dressing table (adults' rooms).
5. Think about how the view from lying or sitting in bed. Lowered window sills can enhance the experience of lying in bed a huge amount by providing a view (provided that the view is pleasant and there aren't any privacy issues).
6. Think about how the doors (entry to the bedroom and perhaps to closet and en-suite bathroom) work with the position of the bed and other furniture. I always find that I prefer it if the pillow end of the bed isn't in direct line with the door. That is to say that ideally the bedroom doors should be beyond the foot of the bed or onto the side of the bed. There are a few pictures below to illustrate this idea.
7. I think this has something to do with feeling protected when in bed. I know that the practice of Fang Shui dictates that the bed should be in a position where it is protected from energy flowing into the room.
8. Have a look at the door placement and think about what your impression is when you walk into the room (isn't it nicer to see the from the foot or middle of the bed with the pillows) and how it would feel to be in bed (it's nicer to feel protected and away from the door). If the door is directly at the foot of the bed this generates a slightly uncomfortable feeling - particularly if the door is open. It means there's a view from the bed straight out of the door. If the door is at the head you don't get a nice view of the bed when you enter the room and you don't feel as protected in a space when the door is behind you.
9. Think about how the windows will work with the furniture. If the bed head should go where the window needs to go think about how the windows might work with the bed. Windows can be split to go either side of the bed or raised above bed head level.
10. If there are several kids in a bedroom, think about ways that privacy can be designed into the room with partition walls and maybe interesting bunk bed layouts. Bedroom Design Mistakes: Just stick to the principles of good design. I think the most common bedroom design mistake is when bed placement is in conflict with door and window placements.

❖ **Bedroom organization tips for apartments:**

- Bedroom organization in your small apartment is really important. I don't know about you, but I find it difficult to sleep when I know my bedroom is a mess. Not only that, but too much clutter can be a fire hazard. Under the bed organization rack under bed organization for apartments. This under the bed organization rack is really great for things you want stored out of sight. Keep in mind you need to have at least 8.5 inches of clearance under your bed, but this would work for most beds. It comes with rolling wheels and has a large, open design. This makes it pretty easy to store a variety of things, all while giving you quick access to your stuff when you need it.
- **Heavy duty laundry hamper:** laundry hamper for apartment organizing. This heavy duty laundry hamper is something everyone should own. This kind of laundry basket will save you a lot of time since you'll be sorting your clothing right away; instead of having to wait until you're doing laundry. The bags are made from thick cotton-polyester canvas bags and can hold up to ten pounds of laundry. They are also durable and machine-washable.
- **Bed with storage:** Bed with storage to create more living space, if you are sold on having storage space under your bed, this bed with storage is another great option. I think this bed looks really nice. It's modern and upholstered with linen. It comes with four different drawers that lock into place, as well as centre legs and metal side rails that provide additional support and stability.
- **Fabric closet organizer shelf:** Fabric closet organizer shelf perfect for small spaces. This fabric closet organizer is a great all-in-one clothing option that works perfectly in small spaces. The four cloth cubbies are large and allow for a lot of flexibility. This product could be used for your sweaters, purses, and other accessories. This product only works if you have something to hang it on. It has loops ready for a closet rod, and most rooms have some space where you could attach one.
- **Chain links:** creative hacks for organizing small homes, if you are short on storage space in your bedroom, consider grabbing some of these quick links. Attach these chain links to a strong hanger in your closet area. You can then hang multiple shirts on a length of chain that runs vertically. These specific chains are 2" long, 7/8" wide, and they open 1/4".
- **Organizing your apartment entryway:** First impressions count. Your entryway is one of the most common places you will see clutter, but it's also one of the easiest places to declutter. And, bear in mind that these organization tips for apartments also apply to small homes.
- **Wall mounted display shelf and clothing rod:** Wall mounted display shelf and clothing rod; this wall mounted shelf comes with a clothing rod already installed. The clothing rod is a great place to hang hats and coats, and the shelf allows for a little decor. The rod is made of industrial-style metal, and the shelf is made from lightly distressed wood. Although it would probably look best with modern or eclectic home decor, it's neutral enough that it could go with most

home decor styles. If you decide to add one to your entryway, you should also consider putting one in the kitchen or bathroom for additional storage.

- **Key rack organizer:** Key rack organizer for small homes, this letter holder key rack is nice to have around, and a great way to keep keys from going missing. This particular key holder features one basket and five key hooks. It is made of steel with a bronze finish, but you do have a variety of colours to choose from including black, silver, white and several others. It has a cute floral design that makes it a pretty good fit for your entryway, kitchen, or mudroom.
- **3-Tier closet organizer:** his 3-tier closet storage organizer has a multitude of uses. It struck out as a good option for doorway organization, as the two shelves can be used for shoe storage. It also comes with two drawers underneath, which could be used to store things like hats, gloves, and purses. This is a great price point for what the product is. It can be easily moved around and could be used in multiple spaces throughout your house.
- **Vintage entryway coat rack and shelf:** This vintage wall mounted shelf and rack is another great option if you are looking for better space-saving ideas for your entryway. This shelf has an additional perk, as it also has coat hooks attached. This essentially gives you three different organizational spaces. It's versatile and neutral and overall is more likely to go with a multitude of decor styles.

❖ **Living room apartment organization:** Your living room is where you do the most entertaining (usually) so it's a good idea to get a few organization systems down. For many who live in an apartment, it's the room you spend the most time in.

- **Decorative tray:** Decorative trays (like these ones) are a great accessory to have in the living room. Most of us have multiple TV remotes (and other small things) and a tray is a stylish solution to keeping it organized. These trays are made from black walnut and are 100% handmade. It's a simple and elegant design that can double as a serving tray
- **Ottoman bench:** Ottoman bench to organize your stuff and reduce clutter. An ottoman bench like this one has multiple uses. Not only do you have a place to rest your feet while vegging on the couch, but you also get an extra (comfy) place to sit, as well as ample storage space. And, lately, many have been using ottomans as their coffee tables. The particular ottoman comes in four different colors and is made of faux leather. This faux leather ottoman is stylish and cleans very easily with a damp cloth.
- **Nesting baskets:** Nesting baskets for better storage and organization. This set of nesting baskets comes with five pretty baskets. For your living room, consider putting them on a bookshelf or storing them under a coffee table. Each basket stacks perfectly inside of another basket, which helps minimize its space when it's not in use. The baskets are also lined with a soft white cloth, which will match most modern homes.

- **Sofa armrest organizer:** Arm rest organizer for living rooms This sofa armrest organizer is another great option for organizing and keeping track of your TV remotes. It is designed to fit phones, tablets, books, magazines, and remotes. It's durable and waterproof, and can be cleaned easily with a wet towel. You have a choice between almost twenty different colors, so it's likely you will find something that goes with your decor.

❖ **Kitchen apartment organization:** Although it may be easy to keep a kitchen looking nice on the outside, many of us are guilty of stuffing everything in cupboards. And, we all know that apartment kitchen are notoriously small (and some smaller apartments don't even come with dishwasher). These products aim to help make organize your kitchen space better.

- **Glide ware cookware organizer:** cookware organization for kitchen cabinets. This glide ware cookware organizer is a neat contraption that will make organization of your pots and pans much easier. This organizer is heavy duty and is made to accommodate up to 100 pounds of cookware. It also fully extends out of the cabinet, and it accommodates many sizes and shapes of cookware. Installation is easy and only requires four screws. With a lifetime warranty, this is a great product.
- **Foldable dish rack:** Foldable dish rack for organizing your apartment kitchen. Even if you use a dishwasher the majority of the time, a foldable dish rack would still come in handy. We all have those special dishes that aren't dishwasher-safe or times where the dishwasher is already full. This means that sometimes you will have to hand wash, and having a dish rack makes it a lot easier. The problem with most dish racks is that they tend to take up a lot of space. That's why this foldable dish rack is not only unique but just a great practical option. This kitchen item also comes with a lid organizer, plate rack lid holder, and a fruits and veggies drainer rack.
- **Over the cabinet door organizer:** Over cabinet organization. An over the cabinet door organizer can be used for many things in your kitchen. An organizer like this allows you to fully utilize the space in your cabinet, and they can be used on every cabinet in your kitchen. This specific organizer has an ultra-thin hook that is EVA foam padded to fit and protect your cabinet door. It can fit approximately 4 to 5 regular cutting boards.
- **Under sink expandable shelf: Under sink organizer -** perfect for small kitchens, under the sink is one of the more difficult places to keep organized in a kitchen. That's why we really liked this expandable shelf organizer rack. It comes with an expandable rail (15 to 25 inches) and can be adjusted to four different height levels. It also includes three large panels and four small ones. If you are looking for something to organize your space under the sink, this is definitely one of the best products for that.

❖ **Bathroom apartment organization:** Your bathroom is usually the smallest room in your house, so it becomes easily cluttered if you don't have a specific place for things.

- **Floating shelves:** Floating shelves to organize bathrooms. Floating shelves (like these 3-tier ones) can be used in any room of the house, but I find they are most useful in the bathroom. This is because there aren't a lot of practical things you can keep on shelves throughout the house, as they are usually used for decor. Pick up a few shelves and keep towels, q-tips, and storage baskets on them. The storage baskets will keep it from looking cluttered, while still keeping everything within arm's reach.
- This makes a great organizer for your vanity, as it's small enough to fit on top of your counter but big enough to keep things like makeup and nail polish organized.
- **4-tier shelf:** Shelving for bathrooms in apartments. This multipurpose shelf display comes in multiple colours and sizes and looks to be of higher quality than the price would suggest. Making use of vertical space, you can keep your guest towels neatly organized. Consider grabbing some wicker baskets to put on the top two shelves so that any "clutter" is out of sight. This particular shelving unit can hold up to 25 lbs. on each shelf, and is made of durable wood.
- **Bath cabinet:** This over the toilet cabinet is an excellent space saving option for your bathroom. This particular cabinet comes with cubbyhole storage with two adjustable shelves so you can easily store all of your bathroom necessities. If you don't have anything over your toilet right now, this is something I would seriously consider investing in.
- **Wrapping up apartment organization:** Organization for small spaces. Decluttering a small space can seem difficult at first, especially if you have a lot of stuff. Sometimes buying a bunch of organization products has the opposite result in your attempt to declutter. By buying more things, you are at risk of adding to the mess instead of fixing it. Before you spend time and money on getting your small space to appear larger and more organized, purge the belongings you don't need anymore. It is difficult to throw things away, especially without knowing whether it is something that will be needed again.

UNIT 2

Chapter 2

Apartment Or Independent House, Which One Is Better?

Let us list the pros & cons of both Apartment or Independent house. It will surely help an Independent investor to decide which one is suitable for them as per their own priorities.

Apartments

Apartments nowadays are a need of the hour. Apartments available are built with all the luxurious facilities for a comfortable stay for its residents. With the hectic lifestyle, apartments spacious space has become an ideal type of living for many couples.

The Benefits of Living in An Apartment Are-

- **Worry-free Maintenance** – Maintenance cost is generally lower as the expenses fall upon the shoulder of the landlord/owner. Besides, due to the small spaces in an apartment, there is easy maintenance.
- **Amenities** – Apart from Individual houses, Apartments have amenities like pools, gyms, convenience stores, laundry at the premises, or at least in very close proximity.
- **Safety** – Although homeowners often invest in some form of home security system or another, apartment complexes also invest in the overall safety of its residents.
- **Low cost/ Savings** – When you rent an apartment, you pay the rent. That's it! When you buy a home, you have to come up with the down payment, appraisal fees, inspection, and closing costs.

Disadvantages of Living in An Apartment –

- One cannot do any type of construction in an apartment.
- You are bound by the decisions taken by the Owner
- One has no control over the quality of material used in an apartment.
- Lack of spaces in apartments.

The Benefits of Living in An Independent House-

- One can design their house according to their preference and likes.
- Living in an Independent house result in more privacy and space
- The owner of an Independent house can extend their interior or exteriors according to their future needs.

- If you have small children, large and spacious places are necessary for good growth.

Disadvantages of Living in An Independent House –

- Security can be at risk if you wish to line in an Independent house.
- If you want to have amenities like a pool, gym, etc in your own house, then you must have to spend a large amount of money on these amenities.
- You need to spend an amount on sports facilities and external clubs if you are in an independent home.

Design and Space Analysis of Independent House and Apartment/Flat-

S. No.	Independent House	Apartment/ Flat
1.	**Horizontal expansion**- independent house can be expanded horizontally if there is space available on the plot. House can be two three storeys only.	**Vertical expansion**- houses are built vertically. There are number of storeys and many units on each floor.
2.	**Construction-** Building an individual house involves not just designing, but finding the right contractor for the construction. And it doesn't end there, as sanctions and approvals for utility connections will still have to be tackled	**Construction-** Building an individual house prove a deterrent, especially when apartment complexes and villas with state-of-the-art facilities are available.
3.	**Construction as per taste-** Building an individual house involves not just designing, but finding the right contractor for the construction. And it doesn't end there, as sanctions and approvals for utility connections will still have to be tackled.	**Uniform Construction-** Building an individual house prove a deterrent, especially when apartment complexes and villas with state-of-the-art facilities are available.
4.	**Flexibility of expansion and design-** When building an independent house, you can restrict it to the size that you want. This is because you always have the flexibility of adding to what has been built. More floors, rooms can be added. There is always provision of expansion of the house. You have spacious rooms, separate drawing,	**No flexibility of expansion and design-** When investing in a flat, you might be forced to buy a bigger house in anticipation of an expanding family whereas when building an independent house, you can restrict it to the size that you want. In apartment room sizes are small, drawing and dining are combined, more of balconies,

	dining, garden and parking space. You keep setbacks as per bye laws. Also, an independent house can be designed the way you want. You can practically sketch your dream house on a paper and an architect can have it made for you. You can design your interior and exterior as per your choice and taste. You will have to design the plumbing, electricity etc. and make it a self-sustaining unit. As far as an independent house is concerned, it can be rebuilt to suit changing tastes and requirements, at any point of time, adding that the house can be expanded horizontally if space permits, or vertically, by adding more floors. These are impossible in a unit in an apartment.	lift etc. are provided. There is no roof or ground floor of your own. You will not have to design the plumbing, electricity etc. because in an apartment building the developer constructs all flats uniformly. You cannot design your interior and exterior as per your choice and taste. The quality of construction of flats are bad, especially the plumbing and electricity.
5.	**Costlier-** In any metropolitan or tier I city, buying a plot of land and building a house will prove to be more expensive. Primarily because there is a scarcity of land and hence, whatever land is available is bound to be highly-priced. Moreover, add to this the cost of labour, interior designer, architect etc; which again are costly.	**Less costly-** Apartment building is less costly than independent house. You save-on a lot of these costs because the developer takes care of it for you, even the construction-permissions and legalities of it all.
6.	**Security–** An independent house also has issues of security and maintenance. At the same time, there is more privacy in an independent house vis a vis a flat where residents might face intrusion.	**Gated Security–** A flat provides you with more security because it is located in a gated community that will have a 24×7 surveillance, in all likelihood. Some of the societies even have a different pedestrian area where cars are not allowed. In an independent house, this can be a challenge as

		you kids cannot be left alone on the road with the cars speeding by or the elderly need to be more careful.
7.	**Amenities and Facilities–** An independent house does not normally come with amenities unless you pay to create them. In fact, just to create the basic power back up will cost you money. An independent property needs extra effort for setting up of security such as enough parking spaces, power back-up, water systems and fire safety mechanism these services. This would also include an extra cost. It is estimated that one needs to spend 2-3 per cent of the total property value on these amenities around an independent villa property. This would include setting up of a small power back-up in the form of an inverter or a generator set, and your own water mechanism. Security will still remain a constraint. In case your villa property is located in a colony of such villas, the inhabitants can form a Residents' Welfare Association (RWA). The RWA can then look after security and other such issues.	**Amenities and Facilities–** In a flat, however, various amenities are provided by the developer like a clubhouse, sports facilities, technological advancements etc. are a parcel of the developer is offering. Moreover, in an apartment property comes with added values, such as security, enough parking spaces, power back-up, water systems and fire safety mechanism. On the contrary, in an apartment society, the developer provides all these in advance for the first 2 to 3 years. Later, the management of services is taken over by the RWA.
8.	**Upkeep and Maintenance**- Upkeep of buildings involves a lot more than just housekeeping and cursory maintenance. one can see the pathetic state of maintenance of even noted residential	**Upkeep and Maintenance**- Maintenance of complexes extends to upkeep service not only includes housekeeping and emergency maintenance but also include a host of items that require a fully functional office. It

	complexes in posh areas like Ferozeshah Road. Some of the most prestigious residential complexes are in an appalling state when you go inside. But these negative aspects fail to deter a customer, as maintenance of individual houses, especially large ones with a garden, is increasingly becoming a problem. With increasing commercialization, residential areas are fast becoming unliveable and this is especially so while living in an independent house.	requires beautification and maintenance of gardens and common areas. The services are typically managed by manager and office personnel complete with a wireless network to track field staff on call round-the clock. The community living also acts as an incentive, providing plenty of interaction for all ages. Add to this the common maintenance facility and round-the clock security.
9.	**Less Noise Pollution-** In independent house noise pollution is less as compared to apartment.	**More Noise Pollution-** Due to closeness of the apartments and many units on one floor noise pollution is there.
10.	**Land Availability-** The fact that fresh land for individual houses is no more available within the capital again acts as a dampener.	**Land Availability-** Getting the desired location is a further incentive for homebuyers to opt for gated communities or apartment complexes,
11.	**Difficulty in Loan Availability-** Banks sanction loans for independent properties only after strict scrutiny of borrowers. The lending is difficult in the case of independent properties also because of the share of unaccounted cash component. Moreover, it is difficult to ascertain the value of an independent house. In case you plan to buy a plot, be aware of the fact that banks in India provide only 60-70 per cent of the total plot value. You will have to arrange the rest of the amount, including that for the stamp duty and registration charges. However, banks do provide	**Easy Loan Availability-** In case you are buying the property by taking a home loan, it is easier to get the loan for an apartment than an independent property. Lending banks often prepare a list of sanctioned projects where a buyer can easily get his loan approved.

	construction loan over and above this amount.	
12.	**Saleability-** Among all the asset classes, property as an asset class takes more time to resell. And the task may become a Herculean one if it is an independent property. Industry estimates suggest that apartments are now more in demand. Even Tier-II cities are witnessing such developments. Developers are now bringing apartment projects with a mix of plotted developments. If you decide to sell your property at a later stage, it would be easier to sell an apartment. Within apartments, two-bedroom and three-bedroom apartments are the most in demand.	**Saleability-** Industry estimates suggest that apartments are now more in demand. Even Tier-II cities are witnessing such developments. Developers are now bringing apartment projects with a mix of plotted developments. If you decide to sell your property at a later stage, it would be easier to sell an apartment. Within apartments, two-bedroom and three-bedroom apartments are the most in demand.

UNIT 3

Understanding on Building Regulations and Specifications Essential for Building and Service Management

What are building bye laws?

According to the definition, building bye laws are the norms set forth by the government authorities such as Ministry of Urban Development Affairs (MUDA), City Corporation and Developing Authorities, for instance, Bangalore Development Authority (BDA) in Bangalore. These norms are legal tools that regulate architectural and construction aspects of buildings to achieve orderly development in an area. They are crucial to protect buildings against fire, earthquake and structural failures. The development authority does not approve a building plan which fails to adhere to the bye laws.

Do building bye laws differ from city to city?

However, these bye laws may differ from one property to other. For instance, rules set for construction of a commercial property may differ with the bye laws essential for the development of a residential or an educational building.

Also, building bye laws vary from one region to other. For example, a construction norm applicable in a rural area may not be followed in urban realms.

Purpose of building bye laws

- Ensure uniform development of buildings in a society, town and prevent haphazard development
- Affirm public safety against noise, fire, health hazards and structural failures
- Ensure optimum utilisation of space
- Follow approaches which safeguard complete health, safety and comfort of residents such as proper ventilation, air, light and other essentials

Building bye laws include norms related to the following:

- Floor Area Ratio (FAR) and ground coverage

- Density
- Basement and parking spaces
- Setbacks and projections
- Area and its usage
- Building height and other service spaces
- Provision for lifts and basement area
- Site design and service design –sewerage, electrical design, water etc.
- Building line
- Amalgamation

Holistically, building bye laws are a set of rules that define the construction limits of a structure within a province/city/state. For those desirous to get a property constructed or those who belong to the construction industry, it is important to delve into the building bye laws prevalent in the area of construction. Any deviation from the set rules might result in the property to be deemed illegal in the future.

Building Byelaws for Residential Buildings

Building Bye laws: A bye law is a local corporate law outlined by a secondary authority. The **building *bye laws for residential buildings*** are set forth in such a way that, it should meet all the standards and specifications designed to necessary protections not only to the labourers before starting, during construction to the health and safety point of view but also to the general public and visitors.

Building *Bye laws and Regulations:* The **building *bye laws*** oversee the following rules and regulations of building features.

1. Set back or building line
2. Floor Area Ratio (FAR) or Floor Space Index (FSI) or Total built-up area
3. Open space requirements all over the building
4. Plan showing internal dimensions of rooms, kitchen, living etc.
5. Cross sectional details showing height of building and floor height.
6. Lighting and ventilation of rooms.
7. Structural details and designs

Building plan showing setbacks, FAR, internal dimensions etc. as per Regulations of Building Bye laws

1. ***Set back or building line***: Set back is nothing but the open space available between the front of the building and road. The merits of the setbacks are as follows.
   - The open space left in front of the building is highly advantage under the circumstances of widening of road in near future. Governmental body will acquire this space as per rules and regulations.
   - If all the buildings parallel to the road follows the setback rules and construct accordingly the aesthetic of the locality will improve (E.g., Plots situated in many gated communities).
   - The air, ventilation and light of the buildings is sufficient if setbacks maintained to the plots.
   - The open space can be utilized for gardening or vehicle parking purpose.
   - The marginal distance always helpful for the building in case of heavy traffic and other nuisance.
   - The possibilities of fire accidents will reduce due to the increased distance between opposite sides of buildings.

Houses in Gated Community as Per Building Bye Laws Regulations

2. ***Floor Area Ratio (F.A.R) or Floor Space Index (F.S.I) or Total built-up area***:

Total Built-up area = Total Site area – All Open spaces area

Floor Area Ratio (F.A.R) = Sum of All floors area ÷ Area of the site

Floor Area = Built-up area – Area of wall thickness

The local authority or the secondary authority is responsible for governing the value of F.A.R, is different for different zones and type of buildings in the locality. The F.S.I can be utilized for checking the density of the population. Example. if the plot area is 1200 Sqft and if the allowable F.S.I is 0.8, then the maximum built-up area allowed for the plot is 960 Sqft. As per the National Building Code (NBC-2016) for clear understanding, the built-up area versus plot area is as follows.

S.No.	Plot Area	Max. Allowable built-up area
1	Less than 200 sq. m	60% with 2 storied structure
2	From 200 – 500 sq.m	50 % of the plot area
3	From 500 – 1000 sq.m	40% of the plot area
4	Above 1000 sq.m	33.33% of the plot area

SL. NO.	Plot Area	Max. Allowable built-up area
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3. ***Open space requirements all over the building:*** As per NBC, the open space for different heights of buildings is listed below.

Sl. No.	Height of building	Open space (setback) requirement
1.	< 10 m	**a) Front setback or open space width:** i) For a building with front road – min. 3 m. ii) For a building with roads on 2 or more sides – Average 3 m and in no case < 1.8 m **b) Rear setback** – Average 3 m and in no case < 1.8 m **c) Side setback** – Min. 3 m for every detached & semi-attached building **d) Distance from the centerline of any road** – In no case < 7.5 m or as determined by the local authority
2.	From 10 m – 25 m	Requirement as per above item no. 1 is increased at the rate of 1 m for every 3 m or fraction thereof.
3.	From 25 m – 30 m	Minimum 10 m.
4.	> 10 m	Min. 10 m. is increased by at the rate of 1 m for every 5 m or fraction thereof subject to a max. 16 m

Section: As per table 2 of section 8.2.3.1 of part III of N.B.C.

SL. No	Height of building in Meters	Exterior open spaces/setbacks to be left on *all* sides. Minimum in meters
1.	Above 9.5 up to 12	4.5

2.	Above 12 up to 15	5.0
3.	Above 15 up to 18	6.0
4.	Above 18 up to 21	7.0
5.	Above 21 up to 24	8.0
6.	Above 24 up to 27	9.0
7.	Above 27 up to 30	10.0
8.	Above 30 up to 35	11.0
9.	Above 35 up to 40	12.0
10.	Above 40 up to 45	13.0
11.	Above 45 up to 50	14.0
12.	Above 50	16.0

4. Plan showing internal dimensions of rooms, kitchen, living, etc.: As per NBC the minimum areas or sizes for individual rooms and apartments are listed below.(Ref. Fig)

Sl. No.	**Type of room**	**Minimum area**
1	One habitable room	9.5 sq.m, Min. width – 2.4 m
2	Two habitable rooms	Min. area of 1 room 9.5 sq.m & of other 7.5 Sq.m with min. width of 2.4 m
3	Kitchen only	4.5 sq.m, Min. width 1.8 m

4	Kitchen with store room	5.5 sq.m, Min. width of the kitchen – 1.8 m
5	Kitchen cum dining room	9.5 sq.m, Min. width 2.4 m
6	Bathroom	1.8 sq.m or Min. size 1.5 m x 1.2 m
7	Water closet (WC)	1.1 sq. m Floor Area
8	Bath & WC combined	2.8 sq.m (Floor area) – Min. width 1.2 m
9	Mezzanine floor (Living room)	9.5 sq.m (> 1/3rd of the plinth area of the Building)

Three-dimensional Plan showing all rooms, kitchen, living etc. as per regulations of Building bye laws

5. Cross-sectional details showing the height of the building and floor height:

As per NBC the height of the building with respect to its road width is listed below.

Sl. No.	Height of the building	Width of the Road
1	General criteria – 1.5 times the width of the road	–
2	Not more than 12 m	Above 8 m or Equal to 12 m
3	Not more than road width and not > 24m	Above 12 m

6. Lighting & ventilation of rooms:

In order to get proper air and ventilation to the rooms of building, all openings such as windows, ventilators or direct openings are provided at suitable places.

Sl. No.	Openings of the building	The floor area of the room
1	For dry and hot climate excluding door areas	Min. $1/10^{th}$ of floor area
2	For Wet hot climate excluding door areas	Min. $1/6^{th}$ of floor area
3	The total doors, windows, and ventilators	< than $1/7^{th}$ of floor area

8. **Structural details and designs:** The detail structural design analysis and calculations for each and every component of the building has to be done and considering all forces of loads, earthquake, SBC etc. by applying appropriate IS codes. However the general thumb rules are considered as follows.

a) Depth of foundation	0.75 – 1.0 m for one storied building below GF 1.00 – 1.3 m for two storied building below GF
b) Width of the foundation wall	2 times the thickness of the wall just above the plinth + 30 cm
c) Concrete in the foundation wall	$5/6^{th}$ of the thickness of the wall above the plinth

Types of Construction Specifications

According to the American Institute of Architects (AIA) Document A201-2007, the Contract Documents for a construction project consist of "the Agreement, Conditions of the Contract, Drawing, Specifications, Addenda…", as well as other miscellaneous documents associated with the contract between the project Owner and the Contractor hired to complete the work. Construction specifications, as noted, become a part of the legal documents of the agreement and form a cornerstone of the project design. In fact, in most cases, the construction specifications override the project drawings in the event of conflicting information.

The purpose of construction specifications is to delineate the requirements regarding the materials, products, installation procedures and quality aspects involved with execution of the work and fulfilment of the contract. Specifications can be divided into three primary categories: performance, prescriptive and proprietary, which are described below.

1. **Performance Specifications**

A performance specification is a document that specifies the operational requirements of a component or installation. Simply put, a performance specification tells the contractor what the final

installed product must be capable of doing. The contractor is not instructed as to how to accomplish the task of meeting the performance specification requirements - only as to how the component must function after installation. For example, a performance specification may be used in the construction of an industrial pumping system. The specification would provide a required pumping rate (say 500 gallons per minute), a required pressure (20 psi) and the difference in height between the pump and the final destination (+40 feet). The specification will also state that the liquid to be pumped will be at a temperature of 140°F and is corrosive (pH of 3). It is up to the contractor to provide pumping equipment that meets or exceeds the requirements stated in the specification. In many cases the contractor will also be required to test equipment to make sure that is operating properly, and will provide operations manuals.

The general concept behind the performance specification is for the architect or engineer to describe what they need, and the contractor to determine the best way to get there. The performance specification focuses on the outcome and shifts the selection of materials and methods, as well as a portion of the design work, onto the shoulders of the contractor. This approach can provide incentives for innovation and flexibility in the construction approach, but also reduces the amount of control that the architect or engineer has over the project./p>

2. Prescriptive Specifications

Prescriptive specifications convey the requirements of a project through a detailed explanation of the materials that the contractor must use, and the means of installing those materials. This type of specification will typically be formatted in a manner similar to the following sections:

- **General:** This section will typically contain references to national/international standards, design requirements, a list of required submittals from the contractor to the architect/engineer, quality control requirements and product handling requirements.
- **Products:** This section will describe, in detail, the various products required for the task covered by the specification along with the individual structural and performance requirements of each product.
- **Execution:** This section will explain how to prepare the materials and conduct the installation, including the testing requirements to be followed.

Prescriptive specifications shift more of the project design control onto the shoulders of the architect or engineer and away from the contractor by establishing a set of rules that is to be followed for each project component. This type of specification provides more certainty regarding the final product composition than the performance specification, and is very frequently used for highly complex portions of a project.

3. Proprietary Specifications

Proprietary specifications are those that require the use of a single approved product type for any particular installation. Proprietary specifications are often used in cases where there is existing equipment or installations already on site. In these cases the owner may want to maintain consistency of materials or possibly simply prefers a specific type of product. Also, in highly complex installations where there is only one specific piece of equipment that will accomplish a specified task, a proprietary specification is required.

Architects and engineers typically try to avoid utilizing proprietary specifications except when absolutely necessary, and will usually allow the contractor to select from a list of approved suppliers. Requiring the use of one specific product type can lead to the perception of favoritism towards a certain manufacturer and may eliminate competition during the bid phase, which may increase the project cost.

Construction Specification Standards

Construction specifications used in the United States typically conform to the guidelines of the Construction Specifications Institute (CSI), who have created a specifications index entitled Master Format. The Master Format Index groups specification sections into easily identifiable disciplines using a six-digit system with digits in groups of two, such as: 01 24 30.

The first two digits denote the primary section (of which there are 48 sections). For example, all the items regarding concrete start with the digits 03.

The second two digits identify the main headings and subheadings. In this case, we look at main headings Concrete Reinforcing (03 20 00) and Cast-in-Place Concrete (03 30 00) which can be broken down into Reinforcement Bars (03 21 00) and Structural Concrete (03 31 00).

The breakdown continues further with the final two digits, for example: Plain Steel Reinforcement Bars (03 21 11) and Heavyweight Structural Concrete (03 31 13).

Use of Master Format allows professional and construction personnel alike the ability to use a common system to reference and group materials and equipment when utilizing specifications, pay applications, estimating programs, etc. For a list of sections, refer to our MasterFormat Specification Divisions article.

In addition, CSI also maintains UniFormat Specifications, which are used for the early phases of a project. UniFormat allows construction teams to begin investigating project schedules and costs without the detail of MasterFormat.

Specification for Residential Building

S.No.	Item	Specification	Spec. No.	Provision in Type of Building	Unit	Rate
1	2	3	4	5	6	7
1- Foundation & Plinth						
1.1	Plinth Filling	150mm thick local sand filling in plinth	NBO No. 4.24	Type All		
1.2	Foundation concrete	Cement concrete 1:4:8(1 cement 4 coarse sand 8 stone aggregate 40mm nomical size)	CPWD 4.1.8	Type All		

1.3	oundation plinth masonry	Brick work in 1:6(1 cement 6 coarse sand with class M-15 bricks or cement concrete blocks/fly ash blocks.	Detail spec. 6.1 revised	Type All		
1.4	Height of plinth	Minium 600mm or as per requirement at site.		Type All		
2- Super Structure						
2.1.1	Damp proof course	40mm thick cement concrete consisting of one part cement 2 part approved coarse sand and 4 part graded stone aggregate 12.5 mm nominal size and including water proofing (ISI Mark) materials in the proportion as specified by the manufacturer. (DPC shall not be provided over RCC plinth band)		Type All		
2.1.2	Water proof coating	Bituminous coating or polymer modified cementious water proof coating over DPC/ RCC		Type All		
2.2	Plinth	15mm thick plaster with cement and coarse sand mortar 1:4 shall be done both side of brick work inner side 15cm below plinth and out side 15cm below GL		Type All		
2.3	Super Structure masonry	1:6 cement and coarse sand mortar or other equivalent specification only up to three stories using M-10 Bricks in framed structures & M-15 brick in load bearing structures as per design or cement concrete blocks/Fly ash blocks	Detail spec. 6.1 revised	Type All		
2.4.1	Slab columns and beam	RCC Slab columns and beams in Min M-20 grade mix concrete.	Detail spec. 5.6 revised	Type All		
2.4.2	Lintels	RCC lintel in min M-20 grade Mix concrete/ prefabricated RCC lintels up to 10 cm thickness as	Detail spec. 5.6 revised	Type All		

		per design.				
2.4.3	RCC Shelves	25 mm thick RCC in min M-20 grade Mix concrete with neat cement top/Prefabricated shelves as per requirement.	Detail spec. 5.6 revised	Type All		
2.6	Clear height of finalized chief architect	(a) 3 meter height		Type 1,2,3		
		(b) 3.3 meter height		Type 4,5		
3- Door/ Window Frames						
3.1	Frames for doors	(a) Angle iron 35x35x5mm meant for door Chaukhat including 4 hinges up to 2.5 sqm area of door shutter	Detail spec. 9.1 revised	Type 1,2,3		
S.No.	**Item**	**Specification**	**Spec. No.**	**Provision in Type of Building**	**Unit**	**Rate**
1	**2**	**3**	**4**	**5**	**6**	**7**
		(b) Angle iron 40x40x5mm meant for door Chaukhat including 4 hinges up to 2.5 sqm area of door shutter	Detail spec. 9.1 revised	Type 4		
		(c) Sal wood Chaukhat frame in Double door section 60x120mm and single door section 60x100mm wood section to be provided.	Detail spec. 9.1 revised	Type 5		

3.2	Frames for windows	(a) Z-Section windows (ISI Mark)/ MS Tubular Box section window made of cold rolled formed continuous seam welded M.S. tubular box section made from corrosion resistant coated conforming to IS 513.-1973 size of welded tubular Z-profile and T-profile are 50x23 mm x16gauge with suitable flush but welded and lugs 100mm long of 19x3 mm size embedded in cement concrete blocks 150x100x100mm of 1:3:6 (1cement 3coarse sand 6 stone aggregate 20mm nominal size) or with plugs and screws of with Rawal plugs and screws required including providing and fixing of 4mm thick glass panes with glazing and special metal sash putty of approved make complete including MS oxidised casement fastener (125 mm length weighing not less than 100 gms.) MS Oxidised Peg stay (200mm length weighing not less than 240gms) and box type hinges 65 mm length and of 2.5mm thick Galvanised pin of 6mm dia and applying a priming of approved steel primer.	Detail spec. 9.1 revised	Type 1,2,3		
		(b) same as above but with double door attachment 14x26gauge stainless steel jali on inner side and glazed door attachment on outer side.	Detail spec. 9.1 revised	Type 4		
		(c) Sal wood Chaukhat frame in Double door section 60x120mm and single door section 60x100mm wood section to be provided.	Detail spec. 9.1 revised	Type 5		
4- Door & Window						

Shutter						
4.3	A- Doors shutter	(a) 30mm thick flush door shutters (ISI Marked)	Detail spec. 9.2 revised	Type 1		
		(b) Flush door shutters 30mm thick (ISI Marked) Door of kitchen shall be of Jali.	Detail spec. 9.2 revised	Type 2, 3		
		(c) Flush door shutters 35mm thick (ISI Marked) with both side decorative veneering laminated (1mm), Door of kitchen shall be of Jali.	Detail spec. 9.2 revised	Type 4, 5		
	Mosquito proof door shutters	(a) Outer doors to be with 30mm thick pressed ply jali shutters with 14x26 gauge jali on windows or Stainless steel jali shutter with angle iron frame.	Detail spec. 9.6 revised	Type 1,2,3		
		(b) Outer doors to be with 35mm thick pressed ply jali shutters with 14x26 gauge jali on windows or Stainless steel jali shutter with angle iron frame.	Detail spec. 9.6 revised	Type 4		
		(c) 35mm thick 2nd class teak shutter with 14x26 gauge staninless steel jali.	Detail spec. 9.6 revised	Type 5		
	C- Latrine or bathroom and court yard shutters	(a) 30mm thick flush door shutters (ISI Marked) with 1mm thick lamination both side shall be provided work stainless steel nails or Solid PVC door shutters or cement based particle board panelled doors and B.P. sheet panel door for court yard.	Detail spec. 9.2 revised	Type 1,2,3		
S.No.	**Item**	**Specification**	**Spec. No.**	**Provision in Type of Building**	**Unit**	**Rate**
1	**2**	**3**	**4**	**5**	**6**	**7**
		(b) 35mm thick flush door shutters (ISI Marked) with 1mm thick lamination both side shall be provided work stainless steel nails	Detail spec. 9.2 revised	Type 4, 5		

		or Solid PVC door shutters or cement based particle board panelled doors and B.P. sheet panel door for court yard.				
4.4	Window shutter & Grill	(a) Z-Section windows (ISI Mark) shutter with the iron safety bars of 10mm square bar or as per Architectual design.	Detail spec. 9.2 revised	Type 1,2,3		
		(b) Window shutters to be of 35mm thick pressed ply with one side teak veneer or 2nd class teak wood jali shutters with 14x26 gauge jali or Stainless steel jali shutter with MS Tubular section and windows with a provision of A.C. instalation in master bed room with safety grills as per design & drawing.	Detail spec. 9.2 revised	Type 4		
		(c) Window shutters to be of 35mm thick 2nd class teak wood jali shutters with 14x26 gauge jali or Stainless steel jali shutter with MS Tubular section and on windows with a provision of A.C. instalation in all bed room and drawing room with safety grills as per design & drawing.	Detail spec. 9.2 revised	Type 5		
4.5	Door/Window fittings	(a) Oxidized iron fitting (ISI Markes)		Type 1,2,3		
		(b) Stainless Sheet or Aluminium Anodized fittings		Type 4		
		(c) Brass fittings.		Type 5		
5- Miscellaneous items						
5.1	Curtain Rod	(a) Curtain Rod with clamp		Type 1,2,3		
		(b) Drapery Rods		Type 4,5		

5.2	Ventilator	(a) Z-Section windows (ISI Mark)/ MS Tubular Box section window made of cold rolled formed continuous seam welded M.S. tubular box section made from corrosion resistant coated conforming to IS 513. 1973 size of welded tubular Z-profile and T-profile are 50x23 mm x16gauge with suitable flush but welded and lugs 100mm long of 19x3 mm size embedded in cement concrete blocks 150x100x100mm of 1:3:6 (1cement 3coarse sand 6 stone aggregate 20mm nominal size) or with plugs and screws of with Rawal plugs and screws required including providing and fixing of 4mm thick glass panes with glazing and special metal sash putty of approved make complete including MS oxidised casement fastener (125 mm length weighing not less than 100 gms.) MS Oxidised Peg stay (200mm length weighing not less than 240gms) and box type hinges 65 mm length and of 2.5mm thick Galvanised pin of 6mm dia and applying a priming of approved steel primer.	Detail spec. 9.1 revised	Type 1,2,3		
S.No.	**Item**	**Specification**	**Spec. No.**	**Provision in Type of Building**	**Unit**	**Rate**
1	**2**	**3**	**4**	**5**	**6**	**7**
		(b) same as above but with double door attachment 14x26gauge stainless steel jali on inner side and glazed door attachment on outer side.	Detail spec. 9.1 revised	Type 4		
		(c) Sal wood Chaukhat frame in Double door section 60x120mm and single door	Detail spec. 9.1 revised	Type 5		

		section 60x100mm wood section to be provided.				
5.3	Enclosing front veranda New	Enclosing front veranda New		Type All		
5.4	Enclosing back veranda New	(a) To be enclosed with expanded metal and stainless mosquito proof jali.		Type 3		
		(b) Back and front veranda with wire stainless mosquito proof jali and giazed shutter with grills as per drawing.		Type 4,5		
5.5	Shutter in Almirah	(a) 25mm thick flush door shutter (one side laminated) to be provided.	Detail spec. 9.2 revised	Type 1,2,3,4		
		(b) 25mm thick flush door shutter (both side laminated) to be provided.	Detail spec. 9.2 revised	Type 5		
5.6	Rain water pipe new	110mm OD 6 kg/cm^2 pressure SWR Pipe.		Type All		
5.7	Plastering	12-15 mm thick in 1:6 (1 Cement : 6 Sand with not less than FM 1.25) mortar.	Detail spec. 13.5.1 revised	Type All		
6- Flooring						
6.1	Floors	(a) All 40mm thick CC floors, except WC and bath 300x300mm Antishid/matt finished ceramic tiles over 20 mm thick 1:4 Cement mortar and green stone/ Kota stone in kitchen.	Detail spec. 14.6 revised	Type 1,2,3		
		(b) 600x600mm Vitrified tile flooring over 20mm thick 1:4 Cement sand mortar in all rooms, kota stone flooring over 20mm thick 1:4 cement sand mortar in lobby, gallery common space etc and 300x300mm Antisked/matt finished ceramic tiles over 20mm thick 1:4 cement mortar in WC, bath	Detail spec. 14.6 revised	Type 4,5		

		and kitchen.				
7- Dado & Skirting						
7.1	Dado skirting	(a) 200x300mm ceramic tiles over 12 mm thick 1:3 cement mortar 90cm. High in WC and 1.5 mt high in Bath area.	Detail spec. 14.6 revised	Type 1,2,3		
		(b) 300x450mm ceramic tiles over 12 mm thick 1:3 cement mortar up to lintel level in WC, bath, wash area.	Detail spec. 14.6 revised	Type 4,5		
7.2	Apron	60cm wide 25mm thick in 1:2:4 cement concrete over 75mm 1:4:8 cement concrete and 75 cm to 90cm wide for more than 2 storey.	Detail spec. 14.6 revised	Type All		
7.3	Finish on wall of cooking plate form	(a) 200x300mm ceramic tiles over 12 mm thick 1:3 cement coarse sand mortar up to 600 mm high and 18 (+/- 2) mm thick polished kota stone over kitchen top plateform.	Detail spec. 14.10.1 revised	Type 1,2,3		
		(b) 300x450mm ceramic tiles over 12 mm thick 1:3 cement coarse sand mortar up to 600 mm high and 18 (+/- 2) mm thick polished Granite stone over kitchen top plateform.	Detail spec. 14.10.1 revised	Type 4,5		
7.4	Court yard	(a) 40mm thick 1:2:4 CC floor with glass strips of 5 mm thick up to 200 Sq.ft area.		Type 1,2		
S.No.	**Item**	**Specification**	**Spec. No.**	**Provision in Type of Building**	**Unit**	**Rate**
1	**2**	**3**	**4**	**5**	**6**	**7**
		(b) Same as above but with a provision of water line for washing machine at a suitable place.		Type 3		
		(c) courtyard 40 mm thick 1:2:4 CC		Type 4,5		

		flooring or cement tiles.				
8- Finishing						
8.1	Outer finish	(a) 3 coat water proof cement paint		Type 1,2,3		
		(b) Two coats Sintex/Apex/Premium acylic smooth exterior paint with sillicone additives over one primer coat.		Type 4,5		
8.2	Internal finish	(a) White wash 3 coats		Type 1		
		(b) Colour wash/White wash 3 coats		Type 2		
		(c) Oil bound distemper		Type 3		
		(d) same as typy-III but drawing room and master bed room, lobby with plastic emulsion paint on treated surface with cement base putty		Type 4,5		
9- Water Supply & Sanitary Fittings						
9.1	Sanitary fitting W.C.	(a) Orrisa pan 580mm with low level PVC cistern (ISI marked)		Type 1,2		
		(b) Orrisa pan/European pan 580mm with low level PVC cistern (ISI marked)		Type 3		
		(c) same as type-III but one seat may be Anglo Indian type.		Type 4		
		(d) same as type-III but two seats may be European or Anglo Indian type.		Type 5		
9.2	Wash Basin	(a) One WHB 450x300 mm size.		Type 1,2,3		
		(b) Wash Basin 550x400mm size two numbers or three in case both the bath rooms		Type 4		

		are combined.				
		(c) 4 WHB of size 550x400mm size in both the bath rooms.		Type 5		
9.3	Shower	(a) To be provided one in bathroom		Type 3		
		(b) To be provided each bathroom		Type 4,5		
9.4	Sink and drain board in kitchen	(a) White Glazed fire clay sink of 450x300x150mm size.		Type 1,2		
		(b) Same as type1 with a provision of water purifier point for water supply.		Type 3		
		(c) Stainless steel sink with drain board with a provision of water purifying point for water supply.		Type 4,5		
9.5	Soap Tray	(a) One concealed of china ware with every WHB including glazed tiles in 600 mm height.		Type All		
9.6	Towel rail	(a) Towel Ring		Type 1,2,3		
		(b) Towel rail with each wash basin		Type 4,5		
9.7	Looking Mirror	One with each WHB		Type All		
9.8	Flushing Cistern	Low level cistern to be provided		Type All		
9.9	Hot water connection point and mixer from geyser for WHB & Bath	(a) In all bathroom		Type 3		
		(b) In all bathrooms and kitchen		Type 4,5		
	Water proofing Treatment Over Roof					

S.No.	Item	Specification	Spec. No.	Provision in Type of Building	Unit	Rate
1	2	3	4	5	6	7
10.1	Water proofing treatment with brick bat coba	In terrace, in sunken protion of kitchen & toilets above ground floor.		Type All		

Specification for Non-residential Building

Class A: Circuit house, Medical College, District Hospital, Tourist Resort, Court Room and Degree College

Class B: Inter College, Hospital, Treasury Building, Fertilizers Godown, Office Blocks, P.H.C, Regional F.P. Center

Class C: Primary School, Junior High School , Gang Hut and other small building, Sub Center

1- Foundation and Plinth						
1.1	Foundation Concrete	As per residential building				
1.2	Foundation Black cotton soil, lose or filled up soil.	Raft foundation as design required				
1.3	Brick masonry in foundation, super structure in plinth, sand filling in plinth, DPC, Slab, Colum's, Beams, Lintels and Rain water down pipe	As per residential building				
3- Floors						
3.1	Floors specification	(a) Vitrified tile flooring in rooms, Antiskid/matt finished vitrified tile flooring in common circulation area. Polished granite stone flooring in entrance hall/ reception and stair case. Ceramic antiskid/matt finished tile in toilets and Premix vacuum 75mm thick cement concrete flooring in basement.		Class A		
		(b) Vitrified tile flooring in rooms, Kota stone flooring in common circulation area/stair case area. Polished granite stone flooring in entrance hall/ reception, . Ceramic antiskid/matt finished tile in toilets and Premix vacuum 75mm thick cement concrete flooring in basement.		Class B		
		(c) 40 mm thick 1:2:4 cement concrete flooring, ceramic antiskid/matt finished tile in toilets and Premix vacuum 75mm thick cement concrete flooring in basement.		Class C		

S.No.	Item	Specification	Spec. No.	Provision in Type of Building	Unit	Rate
1	2	3	4	5	6	7
4.3	Window shutter & Grill	(a) Aluminum window shutter with grill in ground floor and without grill on other floor or as specified.		Class A		
		(b) Z-section windows shutter with grill in ground floor and without grill on other floor or as specified.		Class B, C		
4.4	Door and Window fitting	(a) Stainless steel fittings		Class A, B		
		(b) Oxidized iron fittings		Class C		
	5- Finishing					
5.1	Plastering	12-15 mm thick in 1:6 (1 Cement: 6 Sand with not less than FM 1.25) mortar.		Class All		
5.2	Outer finish	(a) Premium acrylic smooth exterior paint with silicon additives two coat with one coat of priming coat over smooth base of cement-based wall putty.		Class A, B		
		(b) Three coats of water proof cement paint.		Class C		
5.3	Internal finish	(a) Two coat of Plastic emulsion paint with one coat of priming coat over smooth base of cement based wall putty.		Class A		
		(b) Two coat of Oil bound distemper with one coat of priming coat over smooth base of cement based wall putty.		Class B, C		

5.4	Painting & varnishing New	Two coats of synthetic enamel paint over one priming coat.		Class All		
	6- Miscellaneous					
6.1	Curtain Rod	Drapery Rod		Class All		
6.2	Apron	90 cm wide 25mm thick in 1:2:4 cement concrete over 75 mm 1:4:8 base concrete.		Class All		
6.3	Electrification	Concealed wiring with copper wire		Class All		
6.4	Water Supply	Concealed G.I. Type (B Class)/ CPVC pipe		Class All		
6.5	Sanitary installations	6kg/cm2 pressure SWR Pipe or as specified.		Class All		
6.6	Railing	Stainless steel railing		Class All		
6.7	Stair Case/ Circulation area	(a) Lift Facia stair case and circulation area polished granite stone.		Class A		
		(b) Polished granite stone on Lift Facia and Kota stone stair case and circulation area.		Class B		
		(c) Lift Facia, stair case and circulation area Kota stone.		Class C		
7- Provisions on demand by client department						
7	Extra Provisions (not included in plinth area rate & shall be permitted on request of client department)	1- ACP sheeting or dry stone cladding or structured glass and spectrum in combination on facia 2- False ceiling		Class A		

UNIT 4

Selecting Materials and Finishing Schemes for Interiors

At the prehistoric age, human beings-built huts in order to defend themselves from environmental factors and other living creatures. They were the first architectural samples. In order to build these huts simple materials, which can be gathered easily from the environment, were used. Afterwards different construction techniques developed and the building materials also improved and evolved. At the beginning, construction and strength of the building were of prime importance and space phenomenon did not develop. After the improvement of new building techniques, interior space gained importance. In order to create an aesthetic and durable interior space, some factors had to be taken into consideration. These are environmental effects (heat, water, moisture, noise, light, etc.), mechanical effects and aesthetic requirements. The layer which was created to provide these features is called "finishing layer". Finishing layer has to be aesthetic, durable and strong. Also, in recent years, ecology of the building and finishing materials have gained importance in order to protect the user health and ecological balance of the world.

Interior Finishing Materials

Finishing can be defined as the final layer which protect and fix the surface of the building elements. This layer plays an important role in visual and psychological definition of interior space. At the period of traditional building techniques; buildings were usually produced by traditional materials such as stone, wood and adobe. They were used uncoated or sometimes plastered. After the transition to modern building techniques; the building section got thinner and new layers had to be added in order to provide comfort requirements. Consequently, finishing layers were needed. The main purpose of finishing layer is to fix the surface. Also, it is essential to coat wall, floor and ceiling in order to create a suitable appearance and to protect the construction from effects of water, heat, moisture, abrasion.

1. **Wall finishing**

The prior function of wall is to separate spaces from each other vertically, but depending on the structural system of the building it may also carry loads. Wall has to protect the space against the effects of water, moisture, heat, noise, light, fire, etc. Wall section can be analyzed in three layers; interior coating, core and exterior coating (Figure 1). Some walls can be formed by one layer while some of them are formed by three layers. For instance, exposed concrete is formed by one layer, but brick walls are formed by three

layers.

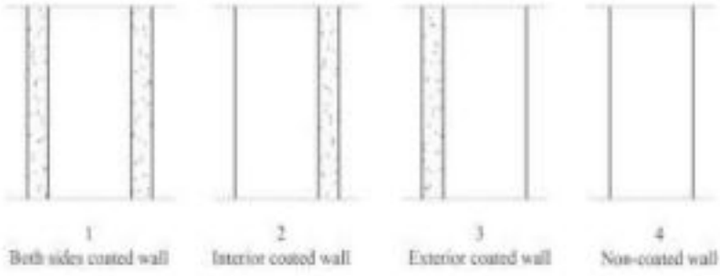


Figure 1: Types of wall sections

Core is the structural part of the wall and its primary function is load-bearing. At solid masonry buildings, wall core has to carry all the loads which effect building. At skeleton systems; wall has to carry its own load and transfer it to the system. Other functions such as; heat, water, moisture, noise, light and fire resistance are shared by all layers. If a function stands out in design process, an appropriate detail solution has to be created.

Functions of the coatings can change depending on its position on the wall. Exterior coating takes a role in forming the architectural character of the building. Also, it has to be resistant to atmospheric, mechanical and chemical effects and easy to clean. Interior coating can also be named as interior finishing. It doesn't have direct contact with water and also doesn't come across with great temperature changes; therefore, it doesn't have heat and water problems. Although the core solves the problems about noise, finishing has to be porous enough to emit the noise and provide the acoustic balance. Interior finishing has to be nonflammable, vapor permeable and non-toxic. In addition, interior finishing has to be compatible with the function of the space by appearance, color and texture.

Different building materials can be used as interior finishing. Plaster, paint, wood, gypsum panel, sandwich panel, ceramic, natural stone, artificial stone, glass and metal can be used as wall finishing materials.

2. Floor finishing

Floor is the horizontal structural element of the building. The prior function of floor is load-bearing. It increases the strength by connecting the walls in solid masonry systems. At skeleton systems it has to carry its own load and transfer it to the system. It also has to be resistant to some effects such as; heat, water, moisture and noise, according to its location in building. Floor's section can be analyzed in four layers; floor coating, base, structural system and ceiling coating (Figure 2). The most important layer is structural system and the others support it. Floor and ceiling coatings are finishing layers and have to

create a visually and functionally favorable impact.

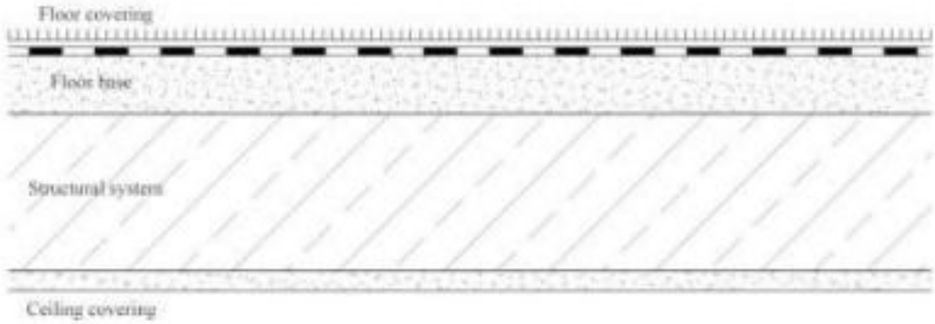


Figure 2: Floor section

Floor coating is the upper layer of the floor. It has to protect the layers below and has to be appropriate with the function of the space. Therefore, while choosing floor coating; primarily the function of the space and user requirements has to be determined and the selection has to be made by taking these factors into consideration.

Screed (cement, magnesia, gypsum based), terrazzo, natural and artificial stone, ceramic, glass, cork, wood, polymers and metal can be used for floor coating.

3. Ceiling finishing

Ceiling is the lower part of the floor. If it does not have any equipment, such as HVAC or installation, it is usually straight and can be solved easily. But if the ceiling has an acoustic, HVAC, lighting or sprinkler system equipment on it, a suspended ceiling has to be created in order to hide the system.

Suspended ceilings are usually composed by a hanging system and a finishing material. Hanging system is installed primarily and then the finishing material is installed to the system (Figure 3, 4). Hanging system is usually composed from metal. Finishing material can be gypsum, metal, wood, ceramic, glass, etc.

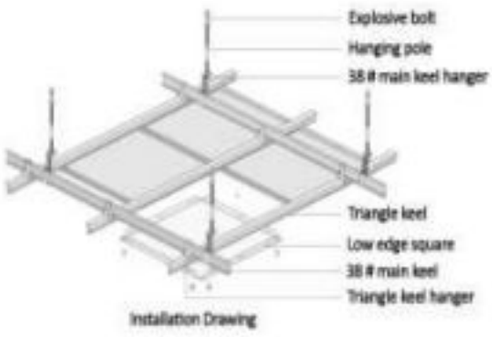


Figure 3: Suspended ceiling detail **Figure 4: Installation of suspended ceiling**

Performance Criterion Required for Interior Finishing Materials

Generally, the most important criterion for a finishing material is to have appropriate visual appearance with the function of the space and proper texture and color with the user's requirements. Besides there are

some other criteria they should have.

Finishing materials are usually affected by the mechanical factors because of the direct contact with the user. Floors and walls can be damaged by the furniture or objects. Therefore, finishing materials have to be resistant to mechanical effects and the selection has to be done according to the material's strength properties. In order to protect surface properties and user's safety, finishing materials must have a sufficient compressive strength, impact resistance and walking safety. Also, it has to be non- flammable and it shouldn't emit toxic gas during fire.

Figure 5: Internal insulation application

In order to provide the comfort conditions, finishing materials have to be resistant to some physical effects. It has to ensure thermal comfort if the core doesn't have enough insulation properties. An internal insulation layer has to be added in such cases (Fig. 5).

Generally interior finishing materials don't have direct contact with water. But the behavior of material against water gain importance in wet areas. Water-resistant and easy cleanable materials should be used in wet areas such as kitchen, bathroom and WC.

Interior finishing materials have to allow vapor movement to prevent condensation and mold problems, and if necessary, a vapor barrier has to be added. Also, additional precautions have to be taken to prevent water intrusion from the interface of the materials (Fig. 6).

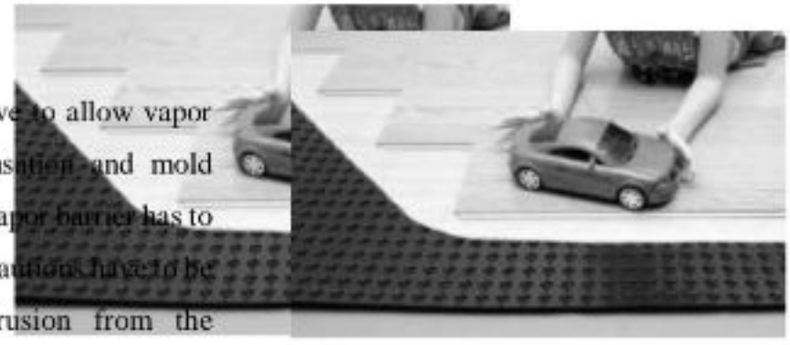


Figure 6: Vapor barrier on floor

Interior finishing materials should absorb the noise and provide the acoustic balance of interior space. Appropriate detail solutions have to be suggested at crowded spaces such as theaters, schools and offices. Usually porous and soft materials are used for acoustic solutions to increase absorbance. Due to their soft structural properties they can easily be damaged. For this reason they must be installed from a certain height in acoustically important places such as conference rooms and theaters. In places where the acoustic does not have prior importance, such as schools and offices, suspended ceilings can be installed by using sound absorbing materials (gypsum board, rock wool).

Finishing materials also have to be dimensionally stable, resistant to chemicals and sunlight, easy cleanable and durable. Recently due to the environmental concerns it is recommended to use sustainable, local and recyclable materials in order to reduce energy and consumption of natural resources.

Interior Finishing Materials and Installation Techniques

Interior finishing materials visually identify and reflect the character of the space. A lot of materials had been used for this purpose for centuries. Although these materials were limited before the Industrial Revolution, they have increased with the development of modern technologies. Today there are hundreds of products which can be used for this purpose.

1. **Cement-based materials**

Cement is the most common binding material nowadays. According to various sources; natural cement was produced BC 7000 and artificial cement was produced BC 5600. But the cement used today is based on 1824.

Specific proportions of lime and clay are mixed and baked at high temperatures in the production of Portland cement. During the baking process clay and lime components forms cement clinker. Two to three per cent of gypsum is added into clinker in order to adjust the setting time and then the mixture is grinded to obtain Portland cement.

Cement-based finishing materials are composed of mortar by mixing cement, aggregates, and water. They can be continuous or in tiles. Terrazzo is cement-based continuous material; while cement, terrazzo and concrete tiles are products in tiles.

Terrazzo floor is formed from a mixture of small stone pieces and cement mortar created from marble flour and color pigments. When the mixture is ready it is installed to a well leveled screed powder. Installation has to be done quickly in two layers. The upper layer's abrasion resistance is higher than the other. Crack detailing is necessary to prevent the transmission of fractures in the concrete. After it sets the surface of terrazzo is polished.

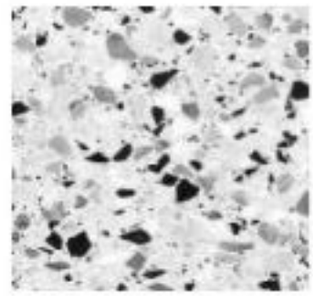


Figure 7.

Terrazzo floor

Cement tile, is a layered tile produced from cement, sand and oxide paint. The upper layer is paint. Desired colors and patterns can be created with the oxide paint. The second layer below paint has a high cement factor; the last layer is produced from a regular cement mortar.

Figure 8. Cement floor tiles

Cement tile is installed on a well leveled clean surface with adhesive mortar. While positioning the tiles a thin gap is left for the joint. After the installation, joints are filled with grouting (Figure 8). The terrazzo tiles are formed by white and colored stones/glass, cement, paint, marble powder and water. It has an abrasion layer of approximately 1 cm and below that it has a regular mortar layer. It is installed just like cement tile and should be periodically polished.

Concrete tile is formed by cement, polymeric resin, fine aggregate and water. It is installed with cement adhesive mortar.

A high heat input is required in the production of cement; therefore, the process causes a large amount of carbon emission and consumption of some non-renewable

mineral and water resources. Different environment friendly combinations of alternative materials are recommended in recent years. For this purpose; blast furnace slag and industrial waste are recommended as aggregate.

a. Earth-based materials

Earth-based materials are used in the building because they can easily be found since the prehistoric times. Ceramics which are baked at high degrees are used as the earth-based finishing materials at the building. The most significant property of the baked earth-based materials is their high heat insulating ability. In addition, they are light and resistant to chemicals and high temperature. The biggest disadvantage of the material is their fragility.

Ceramics are divided into three groups according to their porosity; porous, semi- porous and non-porous ceramics. The approximate cooking degree is 900°C for porous ceramics, 1150°C for semi-porous ceramics and 1400°C for non-porous ceramics. Compression strength of porous ceramic is low when compared to non-porous ceramic. Therefore, its heat insulation ability is higher. Nonetheless, the compression strength of non-porous ceramics is quite high. While non-porous ceramics cannot be used for floor coating, porous kinds can be used both on walls and floorings.

Ceramic is usually glazed to decrease its water absorption and to create a smooth surface. Glaze is composed by the transition of metal-oxides on the surface of the ceramic. The abrasion resistance of glaze is low and also its slippery surface reduces the walking safety. Therefore, glazed ceramics should not be used at floors with high traffic.

Baked earth-based materials are frequently used as wall and floor coatings. Ceramics are preferred to create easy cleanable surfaces and prevent condensation by controlling the vapor movement. Installation is done with cement-based adhesive mortar. Joints are left between the tiles to allow the ceramics expanse.

Grouting is applied after the mortar is dried (Fig. 9).

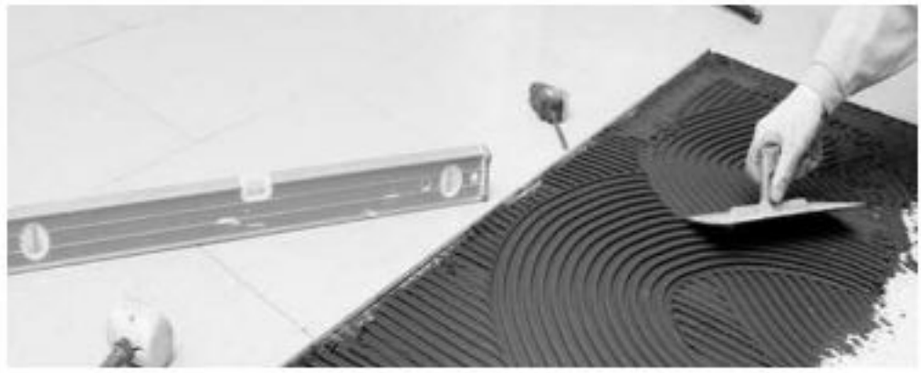


Figure 9. Ceramic tile application

Another earth-based material used for interior floor coating is terracotta tile. It is produced by baking a clay-rich ceramic dough above 1000°C degrees. Due to its high baking degree it has a low porosity and impermeability. To increase the adhesion surface, grooves are opened under tiles. They are installed with cement-based adhesive mortar. Joints are left between the tiles and after they are dried grouting is applied. Because of the high baking degrees, ceramics have high carbon emissions and are harmful to the environment. Also, the elements which are used in the production of ceramic such as arsenic and lead give damage to the environment.

b. Glass

Glass is used since prehistoric times and it is defined as a kind of ceramic. It had been used for producing ornaments in prehistoric times. Later it has started to be used as structural purposes. Glass was first used in the windows to make the connection between interior and exterior spaces. Later, with the emerging technologies, it has started to be used in large sizes and for different features in different parts of the structures.

Glass is formed by melting the ingredients together at high temperatures, shaping and annealing of the material. Usually floating method is used for shaping the structural glass. Glass is used in interior spaces as glass brick walls, floor tiles and mosaics. Also, glass foam can be used on walls for acoustic purposes.

Glass brick is created by pressing the molten glass into a mold. Then the glass machine slowly reheats two blocks until the edges melts to join the two pieces. The molten edges of two blocks fuse forming a single block with a remaining gap between them. Glass bricks have a high thermal insulation property, it is light permeable and esthetic. Cement-based mortar is used in installation of glass bricks and grout is applied to joints after drying (Fig. 10).

Figure 10. Glass block wall

The transparency can be changed and glass can be produced opaque during production. Opaque glass tiles are installed by cement-based adhesive mortar and after the mortar is dried grouting is applied to joints. Tempered and laminated large glass panels can also be used at floor voids. Tempering is a process applied to increase the heat and impact resistance of glass. This process is based on heating the glass to a high temperature and then cooling it quickly. Lamination is combining the two sides of the glass with an adhesive foil. When laminated glass is cracked, it does not break into pieces and also retains its surface integrity because of the adhesive in between. Glass panels are placed into floor voids with adhesives and sealing profiles.

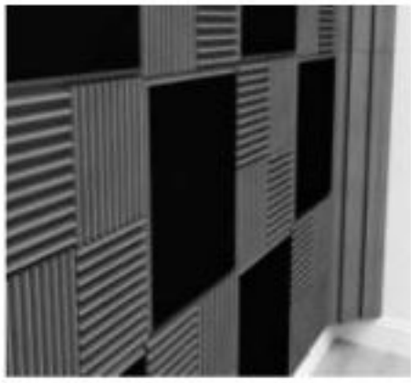


Figure 11. Acoustic foam wall covering

Glass foam is obtained by treatment of glass components with carbon dioxide. Glass foam is nonflammable, light, thermally resistant and dimensionally stable. It is used on interior surfaces for acoustic purposes. It is used in sound studios, shooting ranges and movie theaters (Fig. 11).

When glass is evaluated ecologically; it can be said that glass is an environment friendly material.

Sand which is the raw material of glass is economic and easily be found. It is also a highly recyclable material. The biggest concern is the large amounts of energy spend during the manufacturing process. In addition to this, the treatment of glass with acid and sand is harmful to the environment.

c. Metals

Metals are resistant and shiny materials obtained from the mines. Metal has a high heat and electric conductivity due to its regular atomic structure. This also leads to a high compression and tension strength value. The most important problem about metal is corrosion reasoned from water vapor and oxygen. This can be solved by periodic painting or using alloys. Alloys are obtained by melting and mixing two or more metals in order to increase the strength and resistance of metal.

Metal is known since ancient times, but its industrial production started in the 19th century. It became widespread as a building material since the beginning of the 20th century. In ancient times iron is burned with charcoal and copper to obtain metal and used as a coating material.

Metal is preferred due to its structural strength and esthetic appearance in interior spaces. It is used as wall and floor coating material in panel or tile form. Metals can also be used at the ceilings as suspended ceiling material.

Metal wall cladding panels are usually produced from aluminum in different dimensions. They are installed on metal profiles. Ceramic-like metal tile and mosaics are produced from stainless steel, copper, aluminum, and zinc. They are installed like ceramics.

Metal floor coating materials have a high temperature, friction, abrasion and impact resistance. This type of floor coatings are often used in steel constructions.

Figure 12. Metal tile

They have glossy or lined surfaces and are placed on the floor with cement-based mortar. Their surface is roughened in production stage in order to increase the walking safety. The material has to be painted to prevent corrosion.

Metal can also be used on the ceiling as a suspended ceiling material. It is used at both hanging system and finishing material. Metal profiles, screws, straps and strips are used for the hanging system. Different sized and formed metal panels are used as finishing materials.

Metal is a non-renewable source; its embodied energy is high and also it causes a great amount of carbon emission during production. For this reason, it is harmful to the environment. But in recent years, with some changes in production methods (melting the material by electric ovens) its damage to the environment has decreased. Metals can also be used for many years in non-corrosive environments and are recycled at high rates.

d. Polymers (Plastics)

Plastic is produced by processing carbon (C) with hydrogen (H), oxygen (O), nitrogen (N) and other organic or inorganic elements. Plastic is not found in nature, but obtained by the treatment of natural elements. Plastics were firstly produced and used in the late 19th century. The high resistance against environmental factors, low cost and the unlimited production forms has increased its usage area and production amounts. Polymers are divided into two groups according to their thermal behavior; thermosets and thermoplastics. Thermosets doesn't soften and melt when they are heated, after a certain temperature they begin to break down. They can only be formed during polymerization. Thermoplastics are solid at room temperature. They soften and melt when they are heated without breaking down.

Plastics are used as panels, sandwich panels, stretch ceilings, polymer and epoxy floors in interior space. Polymer panels can be produced in desired width and color from PVC, acrylic and polycarbonate. They are installed to a construction system. Sandwich panel is a structure made of three layers. It has a low-density core inserted between two relatively thin layers. It has a high mechanical performance. The sandwich panels are often used in prefabricated buildings. Sandwich panels are applied in a similar manner with the other interior coating panels.

Figure 13. PVC tile application

Polymer floor coatings are manufactured as tiles or rolls. They are installed to a fine leveled surface with glue (Fig. 13). Epoxy is a mixture of synthetic resin, aggregate and pigment. They are applied onto smooth surfaces in two separate layers.

Stretch ceilings are usually created with PVC fabric and installed to an aluminum ceiling mounted frame.

The lightness, easy installation and light transmission features increase its frequency of use. Although plastics can easily be produced, have a high product range and prevalence of use; still it cannot dissolve in nature and is a non-ecologic material. Also, it causes a high carbon emission during production and use. The best method for producing environment friendly plastic is biodegradable plastic. This material easily decomposes in nature. Recently biological materials such as corn and starch are used in order to produce biodegradable plastics.

e. Natural stone

Natural stones are obtained by cutting the solid layer under the soil. It has been used as a structural and coating material in building for centuries. It is preferred because it is resistant to environmental factors, has a high abrasion resistance, impact strength and has a low absorption rate.

Natural stones are used as wall and floor coating material in interior space. Two different methods are used in wall installation. At the first method the material is directly installed to the wall with cement mortar, the second is applied to a metal supporting system. In interior coatings direct installation is preferred. Porous stone types such as travertine and sandstone have to be used in order to increase adherence. Precautions should be taken to prevent the stones from falling before the mortar has hardened.

Natural stones used as floor coating has 2-5 cm thickness. 2 cm tiles can be used in normal floors,

3 cm tiles can be used in borders and 4 cm tiles can be used in stair coating. Stone selection should be done according to the circulation of the space. Hard stones such as granite, andesite, basalt, diabase and porphyry should be preferred in spaces which has high human traffic.

On the other hand, in spaces where there is low human traffic, softer stones can be preferred such as marble and limestone. Installation is made with cement- based mortar. After the coating is dried, grouting is applied to joints and then polished.

Figure 14. Marble tile application

Natural stones are environment friendly materials which have a low embodied energy. But long-distance transportation and acid treatments damage the nature. It is recommended the use local and less processed natural stones.

f. Textiles

Textile is used as carpets and upholstery fabric for furniture and curtains. For this purpose, wool, cotton, linen, leather are used; polymers such as nylon and perlon can also be used.

Carpet is used for floor coating in the residential and working spaces. The carpets are divided in two different groups; woven and non-woven carpets. In recent years polymer-based non-woven carpets are preferred for their high sound absorption values and economic reasons. They are produced in rolls or tiles and applied to the floor with glue.

Figure 15. Carpet application

Woven carpets are made of various threads and they are thicker. This type is applied in the same way with the non-woven carpets. Dirt can easily penetrate into the material because of its thickness. For this reason, woven carpets are not recommended at places where hygiene is important.

Appearance, comfort, safety and cost features are important in the selection of textile. Also' ecological properties during the use and the production are important. Polymer-based materials are harmful to the environment during the production and use. Natural origin material can be preferred.

g. Wood and wood composites

From the prehistoric times wood is preferred due to its strong, lightweight, easily processed structure. It is mentioned at various sources that wood has been used for different purposes in ancient Egyptian, Greek, Roman and Chinese civilizations. It had been used as construction, coating and furniture material in forestry regions; and in less frequent regions it has been used as door, wall panel and furniture.

Wood is the material obtained by sawing tree trunk. The properties of the wood are directly affected by many things such as the geographic area where the tree is grown, climate, orientation, amount of the water in the soil. Therefore, each material produced from wood has its own characteristics.

The trunk's section consists of bark, cambium layer and annual rings. When the annual ring is examined microscopically, different cell types can be seen. These cells are tracheids, parenchyma, fibers and rays. Coniferous trees have a simple and broad- leaved trees have a complex cell structure. The simple cell structure seen in coniferous wood makes it more flexible, homogeneous, smooth and slightly fibrous. Such trees are especially used in building construction and in paper production. The complex cell structure of broad-leaved trees causes different appearance alternatives on wood. Therefore, they are used for decorative purposes such as furniture and coatings.

Wood is an organic material and may deteriorate due to environmental factors. These factors are divided into three groups; physical, chemical and biological factors. Due to its organic structure wood is a food source for many organisms. Thus, biological factors are the most influential of all these factors.

The organisms settle into wood and decrease its strengt
Wood should be dried properly; strong species should b
selected and chemically treated wood should be used i
order to prevent biological deterioration. Chemic
treatment can be defined as saturation of wood wi
chemicals. The life of wood can be increased from 8 yea
to 20 years by chemical treatment.

Figure 16. Non-treated and acetylated wood under biological attack

Wood can be used in the structure as solid or composite wood. In many different sectors wood is used in a large amount and this brings consumption problems. Therefore, in recent years the use of composite wood is more common. Although VOC (volatile organic compound) of composite materials is harmful to the environment it is preferred because it's economic and it uses wood more efficiently. Composites used in interior space are; fiber boards, particle boards, OSB and plywood.

Wood is one of the most common coating materials in interior space. It can be used in different dimensions of panels on the wall. Solid wood panels are often produced in 8-12 cm dimensions (Fig.

17). They are used in small dimensions because of the movement of wood. However, it is possible to manufacture large sized composite wood panels. They can be produced from fiberboard and particleboard. Both panels are installed on metal or wood strips. Wood floorings are divided into two groups; tongue- grooved wood floors and parquet floors.

Tongue-grooved wood floors are applied by nailing the pieces on furring strips. Parquets are divided into several groups such as solid wood, engineered wood and laminate wood parquet. Solid wood parquet is derived directly from wood, produced in different sizes and are applied in two different ways. In the first installation, wood parquets are laid onto wood joists with nails.

The other installation is made by fixing th parquets on screed by glue (Fig. 18). Engineere wood floor materials, first began to be produce in Northern Europe in the 70s. The advantage o engineered wood is to reduce the consumptio of source.

Figure 17. Wood paneling

Its thickness changes between 12-15 mm ar consists of three solid wood layers. The top layer aesthetic and has high quality; other layers have relatively poor quality. Engineered wood floor applied with glue on screed. Laminate parquet found in late 70's and became popular because it economic. Usually fiberboard and particle board a used to produce the core of laminate wood floo Engineered wood parquet is often mixed wi laminate flooring.

Figure 18. Application of solid wood parque

The obvious difference is; engineered wood parquet consists of three solid layers of wood, while laminate parquet core is obtained from fiberboard or particleboard. Laminate wood parquet is not glued on the floor surface. It is laid over a mattress to provide sound insulation and joined to each other by glue. Wood can be used on the ceiling as solid wood, fiberboard and particleboard. It can be directly installed to the ceiling or installed to a previously created hanging system.

Table 1. Embodied energy of different building materials

Embodied Energy of Materials	MJ/kg
Machine dried, cut softwood	2,0
Air-dried hardwood	0,5
Plywood	10,4
Plastic	90,0
Synthetic rubber	110,0
Stabilized earth	0,7
Imported granite	13,9
Local granite	5,9
Clay bricks	2,5
In-Situ concrete	1,7
Mild steel	34,0
Aluminum	170,0

When wood is ecologically evaluated it can be indicated that; it is the only renewable building material on earth. It is sustainable if planting is more than the amount of chopped tree. Wood usage in buildings is preferred to reduce the embodied energy of the building and to reduce the use of environmentally harmful materials.

Embodied energy can be defined as the amount of energy wasted during the production of the material.

A selection of different materials and finishes

Interior Design Materials and finishes are those things that make up the finished design of a project. Choosing the right ones will mean the difference between an ordinary look and one that is unique and stylish. Some examples of Interior Design materials and finishes, and which are discussed in this article include...

- Painting Techniques and Finishes
- Floor Coverings
- Fabrics and Fibres

Interior Design Painting Techniques & Finishes:

Faux painting with its eloquent styles and numerous techniques can transform the entire ambience of a space. As the name suggests, faux painting techniques are made to resemble something else. Faux finishes have many benefits, which even a good wallpaper, panelling, or application of an elegant paint can't match. The major benefit of a faux painting is its versatility of use. Faux painting last longer than any wallpaper and unlike wallpapers, faux painted walls have no seams and it won't ever peel off. Every home has some wall that just doesn't look good, and one or more walls have holes, cracks and depressions at places that these paint techniques can improve, hiding these imperfections and adding style and uniqueness at the same. The condition and the nature of the surface will determine which technique to use. If the wall is rough and old the use of the rag rolling technique will make any imperfection in the wall disappear.

Chalkboard Paint: Chalkboard paint is a type of paint which dries to a finish resembling that of a chalkboard. Once chalkboard paint has been applied to a surface, it can be used just like a regular chalkboard. For people feeling creative this paint can also be made at home. One of the advantages of homemade chalkboard paint is that it allows people to create their own colours. With homemade chalkboard paint a layer of primer should be applied to the surface beforehand. For every 250 ml (approx) of paint, two tablespoons of powdered tile grout can be added before the mixture is thoroughly stirred and then applied.

Colour Washing: Colour Washing is a popular technique in faux painting using paint thinned out with glaze to create a wash of colour over walls. Colour washing is an easy to create form of faux finishing as there is no set outcome it is hard to go wrong. Colour washing can be done in any colour of paint and is generally applied with a soft cloth or sponge over a solid paint color, using long circular motions, as if you were washing the wall (hence the name), to blend the glaze colors together. Continue this wiping technique until
the entire surface is covered.

Dry-Brushing: Dry-Brushing is a painting technique in which a paint brush that is relatively dry, but still holds paint, is used. The resulting brush strokes have a characteristic scratchy or linear look that adds depth and texture to the wall surfaces in contrast to the more common smooth appearance that washes or blended paint commonly have. The technique is often used as part of a colour layering decorative process and in model painting to apply highlights to miniatures.

Crackle Effect: Crackle Effect painting is a technique used to age a surface so that it looks older or antique in style. It can be used on walls, or on furniture or porcelain to give them an antique appearance. When used on walls it is often used alongside other paint techniques such as colour washing to enhance the worn look. First you apply the base coat of paint, the colour that you want to show through the cracks. After it has dried, apply two coats of crackle glaze. The last coat should be applied in vertical strokes if it is a wall, or should go with the wood grain if on wooden furniture. On top of this apply the final coat, this should be a flat interior paint, not glossy. The colour is once again your choice.

Ragging: Ragging or rag rolling is a decorative painting technique created by rolling a point covered rag over the still moist surface to leave a random and unique patterned effect which can replicate the appearance of marble or crushed velvet. The subtle and rich finish achieved mimics that associated with the most expensive wallcoverings. Firstly, Apply your base paint colour to the walls and allow it to dry. Next cover a rag completely with the paint of your secondary colour, squeezing out any excess paint. Finally squeeze the rag into a rough ball and dab and roll the rag ball over the wall to create the desired textured pattern.

Sponging: Sponging adds the look of texture and depth to walls by dabbing or rolling a natural sea sponge to dab or roll onto the wall in a r andom pattern, leaving a thin coat of glaze on the surface of the under coat of paint. Always choose a base coat and glaze colour that are close in tone as too much contrast will result in a splotchy, spotted look which you obviously will not want. Also don't forget to wear plastic or rubber gloves, as you'll get the glaze all over your hands. Tip: Use the corners of the sponge to gently dab the paint into the
corners of the wall or ceiling.

Striae: Striae is a striped effect that can help make ceilings look higher and rooms look larger. It can be done in any colour, using two tones of the same colour or a single colour alongside an off-white colour. You will require a specialist stria brush to achieve this effect. Firstly, paint the desired undercoat colour on the wall, giving it two coats, applying the second only after the first has dried. Next pour latex glaze into a mixing bucket and add the darker shade of paint with a ratio of five parts glaze to one part paint ensuring to mix the paint thoroughly. Now paint the darker shade on in vertical strokes if you are painting vertical striae or horizontally for horizontal striae. Finally, while the paint

is still wet, put the striae brush flat against the wall and pull down the paint in a single motion, from the ceiling to the floor. As the paint is still wet, you will need to wipe off the striae brush between each run.

Interior Design Floor Coverings:

Floor covering is a term to generically describe any finish material applied over a floor structure to provide a walking surface. Materials almost always classified as floor covering include carpet, area rugs, linoleum, vinyl flooring, wood flooring, ceramic tile, stone, terrazzo, and various seamless chemical floor coatings. The choice of material for floor covering is affected by factors such as cost, endurance, noise insulation, comfort and cleaning effort. Some types of flooring must not be installed below ground level, and laminate or hardwood should be avoided where moisture or condensation is present in the air.

Natural Wood: Natural Wood is wear-resistant, long-lasting, provides a warm natural look which may darken with age but can be refinished or retouched as your needs change. However, it is vulnerable to water, damp and moisture while softer woods, such as pine, may dent easily and are difficult to repair. When putting down a wood floor be aware that it may shrink and expand, creating gaps or warping so it is advisable to remove skirting boards first and leave room for expansion or shrinking that can be covered by the skirting boards afterwards. To keep wooden floors at their best place mats at entrances to catch dirt and put protective pads on the bottoms of chair and table legs to prevent scratches when moving furniture.

Engineered Wood: Engineered Wood is artificially manufactured but still consists almost entirely of real wood. It shrinks and expands less than solid wood and is designed for quicker installation time often using the 'tongue and groove' approach. It generally comes prefinished so the stain and protective finishes are already completed and will be more consistent and resistant to wear and tear than natural wood. As with natural wood though, it is recommended that you place mats at entrances to catch dirt and put protective pads on the bottoms of chair and table legs to prevent scratches when moving furniture around the room.

Linoleum: Linoleum, commonly called lino, is an artificial material but is made of natural raw materials. It usually made to mimic other materials such as tiles to offer a more affordable solution to a customer's needs. It is more durable than vinyl and unlike vinyl its colour penetrates through the entire material. As it is a softer material it is easier to cut which is good for DIY installations. This soft nature means it needs to be resealed on an annual basis and it cannot be left wet. Therefore, to keep it at its best clean up all spills immediately and only damp-mop when needed using clean, warm water.

Tiles: Tiles are a durable, hard wearing, long lasting, water and stain resistant material. As a sensually cold material they are best suited to kitchens or bathrooms. Tiles are also a very commonly used material and therefore there is high demand for them which means they can be obtained at a relatively low cost and selected from a wide range of colours, textures, and shapes. On the flip side grout lines and textured tiles can be hard to clean and low-quality tiles are liable to chip while fragile items dropped on high quality tiles will probably break. Tip: Always keep some spare tiles after installations as if a tile gets chipped it is easier to replace one rather than try to repair one.

Carpet: Carpet is a soft, quiet and warm underfoot and is best used in bedrooms and living spaces. Carpet is the easiest and most cost-effective floor covering to replace and upgrade which is just as well as most carpet types are not very durable and will age, wear and stain more easily than any other floor covering (although there are stain-resistant fibres available). The warmth, comfort and texture that a carpet brings to a space cannot be achieved by other floor coverings even is wood, tile or stone covered floors carpet mats are often used to add some of these qualities to the space. To keep a carpet

at its best it is recommended that you clean any spills immediately, vacuum regularly and use a deep-cleaning hot water extraction cleaning system every 18 months.

Stone: Stone is the most durable of all floor materials (Some varieties, such as marble and limestone, actually absorb stains and dirt). It is a timeless and classic design choice which can add a beautiful and natural aesthetic to a space. Although it has a higher cost than many flooring materials it will outlast them all, especially if sealed. Sealing the floor essentially involves painting it with a protective glue-based coating which prevents dust from the stone rising and reduces the natural be slippiness of some glossy stones. Despite its hard-wearing nature avoid cleaners that are abrasive or contain vinegar, lemon juice, or harsh chemicals as they can stain the stone.

Interior Design Fabrics & Fibres

Natural fabrics are made of natural supplements and can be expensive to purchase. However, as its name suggests natural fabric is more durable, soft, luxurious and resilient. Some of the commonly used natural fibres used to make fabric are linen, cotton, silk, hemp, jute, wool, horsehair, cashmere,

mohair and camelhair. Artificial fibres are obtained from different engineered processes or alterations of existing natural fibres. The market of artificial fibres has widened due to modern techniques. Some of the popular artificial fibres used to create fabrics are acetate, rayon, triacetate and modified rayon, some of which are also explained below. Synthetic fibre is again man-made fibre that is used to improve the quality of natural and artificial fibres. Some of the improved synthetic fibres are acrylic, nylon and polyester.

Linen: Linen is a natural fibre derived from the flax plant which provides tough yarn that is slight glossy and smooth in appearance. The fabric made from linen fibre is moth resistant and hard wearing. It can be easily washable and is also strong when wet. Linen tends to crease quite easily yet it makes a good choice for homeowners when it comes to a fabric for curtains. The collective term "linens" is still often used generically to describe a class of woven and even knitted bed, bath, table and kitchen textiles. The name linens is retained because traditionally, linen was used for many of these items.

Silk: Silk is also a natural fibre and it is obtained from the cocoon of the silkworm moth. Silk is prized for its fragility and luxury and can be very expensive. Silk is popular among the luxury items due to its unique texture and lustrous appearance. It requires frequent dry cleaning and hand washing is strictly prohibited for silk. It also gets creased and can be damaged if exposed in sunlight. Thus, silk must be carefully handled. Silk's absorbency makes it comfortable to wear in warm weather. Its low conductivity keeps warm air close to the skin during cold weather. It is often used for clothing such as shirts, ties, blouses, formal dresses, high fashion clothes, lingerie, pyjamas, robes, dress suits and sun dresses.

Wool: Wool is another natural fibre, it is fleeced from sheep and further processed through various refinements. Wool comes in natural colours but it can be dyed any other colour. It is considered to be a good insulator and is used in clothing in colder areas to protect against cold winds. In addition to clothing, wool has been used for blankets, horse rugs, saddle cloths, carpeting, felt, wool insulation and upholstery. Wool is used to absorb odours and noise in heavy machinery and stereo speakers. Wool is very versatile and can be blended with synthetics to create an improved fabric.

Cotton: Cotton is obtained from the plant of the same name and is a very strong and tough fabric. Cotton is preferred by homeowners for its numerous properties as it is durable, economical and airy. These properties also serve it well as a commonly used clothing fabric, although it can shrink when wet. Cotton is used to make a number of textile products which include highly absorbent bath towels and robes, denim for blue jeans and corduroy, bed sheets, socks, underwear, and most T-shirts are made from cotton. Cotton is also widely used for decorative fabrics as it doesn't fade away easily.

Rayon: Rayon is produced from processed wood pulp and is valued for its hardness, strength and high absorbency although it does lose its strength when wet and can shrink more than cotton. It is also more prone to burning and can rapidly catch fire. Some major rayon fibre uses include blouses, dresses, jackets, lingerie, linings, scarves, suits, neckties, hats, socks, bedspreads, bedsheets, blankets, window treatments, upholstery, slipcovers, medical surgery products, non-woven products, tire cord, feminine hygiene products, diapers and towels. Rayon is widely used because it is economical and has excellent drapery properties and is a common substitute for a variety of natural fibres.

Acetate: Acetate also known as Cellulose acetate fibre, is also obtained from wood pulp but is low in absorbency and strength. As a very valuable manufactured fibre that is low in cost and the properties of acetate have promoted it as the 'beauty fibre' as satins, brocades, and taffetas to accentuate lustre, body, drape and beauty. It is moth resistant and is therefore widely used for drapery. After rayon, acetate is common substitute for a variety of natural fibres as it is versatile and inexpensive. It is further used in the making of satins and other fibres.

Acrylic: Acrylic is made from the polymerization of free radicals and is lightweight, soft and warm. Acrylic doesn't crease easily, is shrink resistant and highly resilient. This fibre is also moth resistant but is sensitive when exposed to sunlight. Acrylic can also be made to mimic other fibres, such as cotton, when spun on short staple equipment. Its fibres are very resilient compared to other synthetics

and natural fibres. Some acrylic is used in clothing as a less expensive alternative to cashmere, due to the similar feeling of the materials. Some acrylic fabrics may also fuzz easily. Acrylic takes dying and colouring well, is washable, and is generally hypoallergenic. Uses include socks, hats, gloves, scarves, sweaters, home furnishing fabrics, and awnings.

Polyester: Polyester is a by-product of petroleum, it is considered to be very strong and can be hand washed. Other characteristic of this synthetic fibre are that it is shrink resistant, moth resistant, crease resistant and it retains its shape well. Polyester is often mixed with natural fibres in order to create more improved fibres which are extremely strong and durable for use in furnishing and upholstery. Fabric balls knitted from polyester thread or yarn are used extensively from shirts and pants to jackets and hats, bed sheets, blankets and computer mouse mats. Industrial polyester fibres, yarns and ropes are used in tyre reinforcements, fabrics for conveyor belts, safety belts, coated fabrics and plastic reinforcements with high-energy absorption.

Nylon (Polyamide): Nylon (Polyamide) is formed with tar, coal and petroleum. Nylon, nicknamed as it was created by scientists from New York and London, is tough, resilient fibre with high elasticity. Nylon is non-shrinkable, crease resistant and easily washable. Nylon is valued for all these characteristics and has proved to be the most durable synthetic fibre available. Nylon fibres are used in many applications, including fabrics, bridal veils, carpets, musical strings, and rope. Nylon was intended to be a synthetic replacement for silk and it was substituted for many different products after silk became scarce during World War II. It replaced silk in military applications such as parachutes and flak vests, and was used in many types of vehicle tires.

UNIT 5

Estimation of Cost of Fittings, Fixtures, Furniture, Lighting and Materials for Interior Finishing

Estimating is the technique of calculating or computing the various quantities and the expected expenditure to be incurred on a particular work or project. In case the funds available are less than the estimated cost the work is done in part or by reducing it or specifications are altered, the following requirement are necessary for preparing an estimate.

a) Drawings like plan, elevation and sections of important points.

b) Detailed specifications about workmanship and properties of materials etc.

c) Standard schedule of rates of the current year.

Need for Estimation and Costing

1. Estimate gives an idea of the cost of the work and hence its feasibility can be determined i.e. whether the project could be taken up with in the funds available or not.
2. Estimate gives an idea of time required for the completion of the work.
3. Estimate is required to invite the tenders and Quotations and to arrange contract.
4. Estimate is also required to control the expenditure during the execution of work.
5. Estimate decides whether the proposed plan matches the funds available or not.

Procedure of Estimating or Method of Estimating

Estimating involves the following operations:

1. Preparing detailed Estimate.
2. Calculating the rate of each unit of work
3. Preparing abstract of estimate

Data Required to Prepare an Estimate

1. Drawings i.e. plans, elevations, sections etc.
2. Specifications.
3. Rates.

Drawings: If the drawings are not clear and without complete dimensions the preparation of estimation become very difficult. So, it is very essential before preparing an estimate.

Specifications:

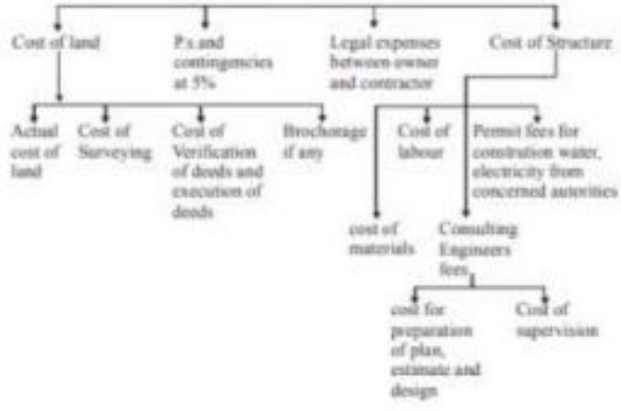
a) General Specifications: This gives the nature, quality, class and work, and materials in general terms to be used in various parts of wok. It helps no form a general idea of building.

b) Detailed Specifications: These gives the detailed description of the various items of work laying down the Quantities and qualities of materials, their proportions, the method of preparation workmanship and execution of work.

Rates: For preparing the estimate the unit rates of each item of work are required.

1. For arriving at the unit rates of each item.
2. The rates of various materials to be used in the construction.
3. The cost of transport materials.
4. The wages of labour, skilled or unskilled of masons, carpenters, Mazdoor, etc.,

Complete Estimate: Most of people think that the estimate of a structure includes cost of land, cost of materials and labour, but many other direct and indirect costs included and are shown below:



Lumpsum: While preparing an estimate, it is not possible to work out in detail in case of petty items. Items other than civil engineering such items are called lump sum items or simply L.S. Items. The following are some of L.S. Items in the estimate.

1. Water supply and sanitary arrangements.
2. Electrical installations like meter, motor, etc.,
3. Architectural features.
4. Contingencies and unforeseen items.

In general, certain percentage on the cost of estimation is allotted for the above L.S. Items even if sub estimates prepared or at the end of execution of work, the actual cost should not exceed the L.S. amounts provided in the main estimate.

Work Charged Establishment: During the construction of a project considerable number of skilled supervisors, work assistance, watch men etc., and are employed on temporary basis. The salaries of these persons are drawn from the L.S. amount allotted towards the work charged establishment. That is, establishment which is charged directly to work. An L.S. amount of 1½ to 2% of the estimated cost is provided towards the work charged establishment.

Units of Measurements:

The units of measurements are mainly categorised for their nature, shape and size and for making payments to the contractor and also. The principle of units of measurements normally consists the following:

1. Single unit's works like doors, windows, trusses etc., are expressed in numbers.
2. Works consists linear measurements involve length like cornice, fencing, hand rail, bands of specified width etc., are expressed in running metres (RM)
3. Works consists areal surface measurements involve area like plastering, white washing, partitions of specified thickness etc., are expressed in square meters (m^2)
4. Works consists cubical contents which involve volume like earth work, cement concrete; Masonry etc are expressed in Cubic metres.

Sl.No.	Particulars of Item	Unit of Measurement	Unit of Payment
I	**Earth work**: 1. Earth work in Excavation 2. Earthwork in filling in foundation trenches 3. Earth work in filling in plinth	 cum cum cum	 Per%cum Per%cum Per%cum

II	**Concrete:**	cum	percum
	1. Lime concrete in foundation	cum	percum
	2. Cement concrete in Lintels	cum	percum
	3. R.C.C.in slab	cum	percum
	4. C.C. or R.C.C. Chujja, Sunshade	sqm	per sqm
	5. L.C. in roof terracing		
	(thickness specified)	cum	per cum
	6. Cement concrete bed	cum	1rm
	7. R.C. Sunshade (Specified Width & Height		
III			
	Damp Proof Course (D.P.C)	sqm	persqm
	(Thickness should be mentioned)		
IV	**Brick work**:	cum	percum
	1. Brickwork in foundation	cum	percum
	2. Brick work in plinth	cum	percum
	3. Brick work in super structure	sqm	percum
	4. Thin partition walls	cum	percum
	5. Brick work in arches	cum	percum
V	6. Reinforced brick work (R.B. Work)		
	Stone Work:	cum	percum
VI	Stone masonry		
	Wood work:	cum	percum
	1. Door sand windows frames or chowkhats,		
	rafters' beams	sqm	persqm
	2. Shutters of doors and windows (thickness		
	specified)	Number	per number
	3. Doors and windows fittings (like hinges,		
VII	tower bolts, sliding bolts, handles)		
	Steel work	Quintal	per quintal
	1. Steel reinforcement bars etc. in R.C.C.		
	and R.B. work. quintal	Quintal	per quintal
	2. Bending, binding of steel Reinforcement	Quintal	per quintal
	3. Rivets, bolts, & nuts, Anchor bolts, Lewis		
	bolts, Holding down bolts.	Quintal	per quintal

	4. Iron hold fasts	Quintal	per quintal
	5. Iron railing (height and types specified)	Sqm	per sqm
VIII	6. Iron grills		
	Roofing	Cum	per cum
	1. R.C.C. and R.B. Slab roof (excluding steel)	Sqm	per sqm
	2. L.C. roof over and inclusive of tiles or	sqm	per sqm
	brick or stone slab etc. (thickness specified)	sqm	per sqm
	3. Centring and shuttering form work		
	4. A.C. Sheet roofing		
IX		sqm	per sqm
	Plastering, points & finishing		
	1. Plastering-Cement or Lime	sqm	per sqm
	Mortar (thickness and proportion specified)	sqm	per sqm
	2. Pointing		
	3. White washing, colour washing, cement	sqm	per sqm
	wash (number of coats specified)	sqm	per sqm
	4. Distempering (number of coats specified)		
	5. Painting, varnishing (number of coats specified)		
		sqm	per sqm
X	**Flooring**		per sqm
	1. 25mm cement concrete over 75mm lime	sqm	per sqm
	concrete floor (including L.C.)	sqm	
	2. 25mm or 40mm C.C. floor		
XI	3. Doors and window sills (C.C. or cement mortar plain)	1RM	per RM
XII	**Rain water pipe /Plain pipe**	1No	per 1No
XIII	**Steel wooden trusses**	Sqm	per sqm
XIV	**Glass panels (supply)**	No.	per no.
	Fixing of glass panels or cleaning		

Rules for Measurement:

The rules for measurement of each item are invariably described in IS1200. However, some of the general rules are listed below.

1. Measurement shall be made for finished item of work and description of each item shall include materials, transport, labour, fabrication tools and plant and all types of overheads for finishing the work in required shape, size and specification.
2. In booking, the order shall be in sequence of length, breadth and height or thickness.
3. All works shall be measured subject to the following tolerances.
   i. Linear measurement shall be measured to the nearest 0.01m.
   ii. Areas shall be measured to the nearest 0.01 sq.m
   iii. Cubic contents shall be worked-out to the nearest 0.01 cum
4. Same type of work under different conditions and nature shall be measured separately under separate items.
5. The bill of quantities shall fully describe the materials, proportions, workmanships and accurately represent the work to be executed.
6. In case of masonry (stone or brick) or structural concrete, the categories shall be measured separately and the heights shall be described:
   a) From foundation to plinth level
   b) From plinth level to first floor level
   c) From fist floor to second floor level and so on.

Methods of Taking Out Quantities:

The quantities like earth work, foundation concrete, brickwork in plinth and super structure etc., can be workout by any of following two methods:

a) Long wall - short wall method
b) Centre line method
c) Partly centre line and short wall method

a) Long wall-short wall method: In this method, the wall along the length of room is considered to be long wall while the wall perpendicular to long wall is said to be short wall. To get the length of long wall or short wall, calculate first the centre line lengths of individual walls. Then the length of long wall, (out to out) may be calculated after adding half breadth at each end to its centre line length. Thus, the length of short wall measured into in and may be found by deducting half breadth from its

centre line length at each end. The length of long wall usually decreases from earth work to brick work in super structure while the short wall increases. These lengths are multiplied by breadth and depth to get quantities.

b) Centre line method: This method is suitable for walls of similar cross sections. Here the total centre line length is multiplied by breadth and depth of respective item to get the total quantity at a time. When cross walls or partitions or verandah walls join with main all, the centre line length gets reduced by half of breadth for each junction. Such junction or joints are studied carefully while calculating total centre line length. The estimates prepared by this method are most accurate and quick.

c) Partly centre line and partly cross wall method: This method is adopted when external (i.e., all-round the building) wall is of one thickness and the internal walls having different thicknesses. In such cases, centre line method is applied to external walls and long wall-short wall method is used to internal walls. This method suits for different thicknesses walls and different level of foundations. Because of this reason, all Engineering departments are practicing this method.

Analysis of Rates: In order to determine the rate of a particular item, the factors affecting the rate of that item are studied carefully and then finally a rate is decided for that item. This process of determining the rates of an item is termed as analysis of rates or rate analysis.

The rates of particular item of work depend on the following:

1. Specifications of works and material about their quality, proportion and constructional operation method.
2. Quantity of materials and their costs.
3. Cost of labours and their wages.
4. Location of site of work and the distances from source and conveyance charges.
5. Overhead and establishment charges
6. Profit

Cost of materials at source and at site of construction: The costs of materials are taken as delivered at site inclusive of the transport local taxes and other charges. Purpose of Analysis of rates:

1. To work out the actual cost of per unit of the items.
2. To work out the economical use of materials and processes in completing the particulars item.

3. To work out the cost of extra items which are not provided in the contract bond, but are to be done as per the directions of the department.
4. To revise the schedule of rates due to increase in the cost of material and labour or due to change in technique.

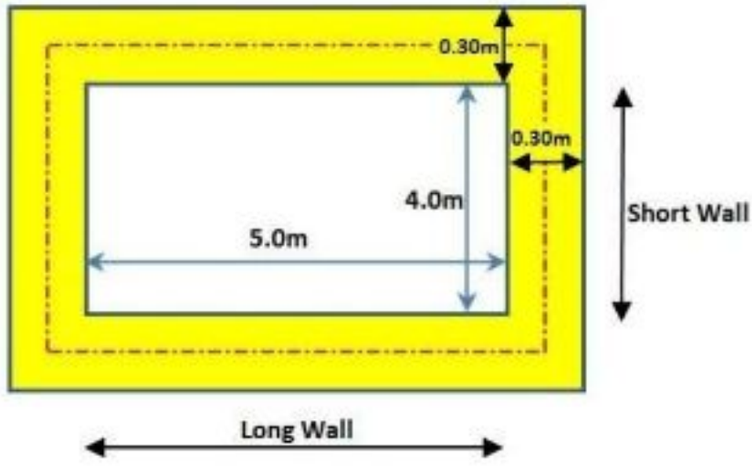
Cost of labour -types of labour, standard schedule of rates. The labour can be classified in to

1. Skilled 1st class
2. Skilled IInd Class
3. Un skilled

The labour charges can be obtained from the standard schedule of rates 30% of the skilled labour provided in the data may be taken as Ist class, remaining 70% as II class. The rates of materials for Government works are fixed by the superintendent Engineer for his circle every year and approved by the Board of Chief Engineers. These rates are incorporated in the standard schedule of rates.

Long Wall and Short Wall Method

For the calculating quantity of various construction item, long wall and short wall method is used. For measuring the long wall and short wall the external out-to-out length of walls running in the longitudinal direction generally is considered as "long wall" while the in-to-in internal length of walls running in the transverse direction is called as "short wall" or "cross wall". For calculating quantity multiply the length into the breadth and height of the wall. As shown in the figure we indicate long wall and short wall and centre line is indicated with red line. For finding out the length of long wall, simply add centre length of wall to the two times half breadth on one side of the wall which gives the out-to-out length of long wall.



Length of Long Wall = Centre to Centre Length of wall + Half Breadth on One Side + Half Breadth on the Other Side

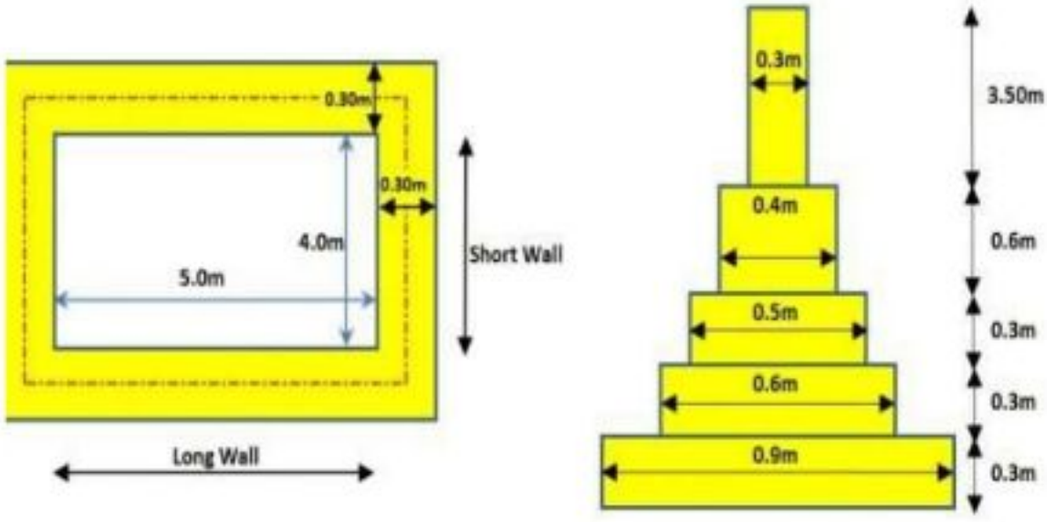
= Centre to Centre Length of wall + One Breadth

For finding out length of short wall or cross wall subtract from the centre length, so the one breadth of the wall, which gives the length of the short wall (in-to-in) (instead of adding).

Length of Short Wall = Centre to Centre Length – One breadth

Note: The length of the long wall usually decreases from earthwork to brickwork, and the length of the short wall is increased.

Example of long wall and short wall method



Using the above, you can first find the length of long wall and short wall.

Centre to Centre length of long wall = 5+ (1/2×0.30) + (1/2 x 0.30) = 5.30 m

Centre to Centre length of short wall = 4+ (1/2 x 0.30) + (1/2×0.30) = 4.30 m

After finding out the length of the long wall and short wall, now find the quantity of the various it which are used in construction.

Details of Measurement and Calculation of Quantities							
Sr no.	Item Description	No	Length	Breadth	Height/Depth	Quantity	Note
01	**Excavation** in Foundation						
	Long walls	2	6.20 m	0.90 m	0.90 m	10.04	Length = 5.30 + 0.90 = 6.20 m
	Short walls	2	3.40 m	0.90 m	0.90 m	5.51	Breadth = 4.30 - 0.90 = 3.40 m
					Total	**15.55 Cumt**	
02	**Concrete** in Foundation						
	Long walls	2	6.20 m	0.90 m	0.30 m	3.35	Length = 5.30 + 0.90 = 6.20 m
	Short walls	2	3.40 m	0.90 m	0.30 m	1.84	Breadth = 4.30 - 0.90 = 3.40 m
					Total	**5.18 Cumt**	
03	**Brickwork** in Foundation and Plinth						
	Long walls						
	1 st footing	2	5.90 m	0.60 m	0.30 m	2.12	Length = 5.30 + 0.60 = 5.90 m
	2 nd footing	2	5.80 m	0.50 m	0.30 m	1.74	Length = 5.30 + 0.50 = 5.80 m
	Plinth walls	2	5.70 m	0.40 m	0.60 m	2.74	Length = 5.30 + 0.40 = 5.70 m
	Short walls						
	1 st footing	2	3.70 m	0.60 m	0.30 m	1.33	Length = 4.30 - 0.60 = 3.70 m
	2 nd footing	2	3.80 m	0.50 m	0.30 m	1.14	Length = 4.30 - 0.50 = 3.80 m
	Plinth walls	2	3.90 m	0.40 m	0.60 m	1.87	Length = 4.30 - 0.40 = 3.90 m
					Total	**10.94 Cumt**	
04	**Brickwork** in Superstructure						
	Long walls	2	5.60 m	0.30 m	3.50 m	11.76	Length = 5.30 + 0.30 = 5.60 m
	Short walls	2	4.00 m	0.30 m	3.50 m	8.40	Length = 4.30 - 0.30 = 4.00 m
					Total	**20.16 Cumt**	

UNIT 6

Estimation of Cost of Fittings, Fixtures, Furniture, Lighting and Materials for Interior Finishing for Commercial Building

The term **commercial property** (also called commercial real estate, investment or income property) refers to buildings or land intended to generate a profit, either from capital gain or rental income. Commercial property includes office buildings, medical centres, hotels, malls, retail stores, farm land, multifamily housing buildings, warehouses and garages. In many states, residential property containing more than a certain number of units qualifies as commercial property for borrowing and tax purposes.

Types of commercial property: Commercial real estate is commonly divided into six categories:

- **Office Buildings –** This category includes single-tenant properties, small professional office buildings, downtown skyscrapers, and everything in between.
- **Retail/Restaurant –** This category includes pad sites on highway frontages, single tenant retail buildings, small neighbourhood shopping centres, and larger centres with grocery store anchor tenants, "power centres" with large anchor stores such as Best Buy, PetSmart, OfficeMax, and so on even regional and outlet malls.
- **Multifamily** – This category includes apartment complexes or high-rise apartment buildings. Generally, anything larger than a fourplex is considered commercial real estate.
- **Land** – This category includes investment properties on undeveloped, raw, rural land in the path of future development. Or, infill land with an urban area, pad sites, and more.

- **Miscellaneous** – This catch all category would include any other non-residential properties such as hotel, hospitality, medical, and self-storage developments, as well as many more.

Estimation cost of fittings and fixtures, furniture, lighting and materials for interior finishing and commercial building

- Estimates of large and/or complicated projects are prepared by specialists in these trades.
- The ability to compile a takeoff of plumbing, Heating, Ventilation and Air Conditioning (HVAC), and electrical work is also a useful skill for the builder's estimator

Measuring Fittings and Fixtures

- Connecting water lines to main are enumerated.
- Water and sewer pipes are described and measured separately in linear feet.
- Fittings and valves are described and enumerated.
- Hangers and supports are described and enumerated
- Fixtures and equipment are described and enumerated, including:
  Water meters, Gas meters, Water heaters, Lavatory basins, Water closets, Sinks, Laundry tubs,
  Bath tubs
- Items supplied by the builder and installed by the plumber are described and enumerated separately, including: Refrigerators, Garbage disposal equipment, Dishwashers
- Gas line piping is described and measured in linear feet.
- Permits for the work are described and enumerated.
- Pipe insulation is described and measured in linear feet.
- Cutting, drilling, and patching required for this work are described and enumerated.

Measuring HVAC

- Ductwork is described stating the size and it is measured in linear feet.
- Range, cooktop, laundry, and bath venting are described stating the size and it is measured in linear feet.
- Fittings, hangers, and sleeve frames are described and enumerated.
- Mechanical equipment is described and enumerated, including: Air handling units, Furnaces, Heat exchangers, etc
- Control wiring is described and measured in linear feet.

- Low voltage wiring is described and measured in linear feet.
- Electric and electronic controls are described and enumerated.
- Testing and balancing are each measured as items.
- Permits for the work are described and enumerated.
- Duct insulation is described and measured in square feet.
- Cutting, drilling, and patching required for this work are described and enumerated.
- Cleanup resulting from this work is measured as an item.

Measuring Electrical Work: Electricity Regulation of all wiring or rewiring of an installation or extension to an existing installation which shall be carried out by a contractor has to obtain the approval in writing from a license or supply authority. Prior to carrying out wiring work, the wireman/contractor should plan and determine the tasks to be undertaken so that the work carried out is tidy, neat and safe to be used. The wireman/contactor shall:

- Undertake a site visit
- Determine the consumer load requirements
- Calculate the maximum load demand
- Submit the plan, drawing and specifications

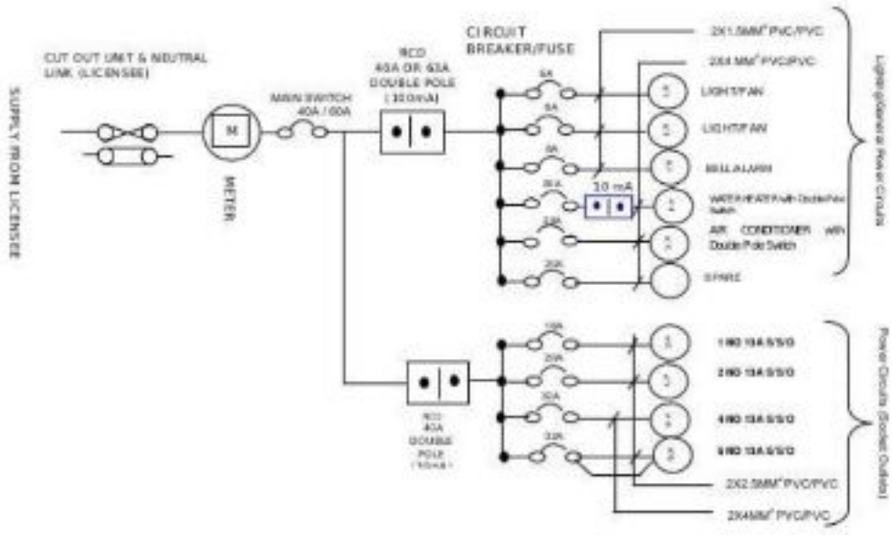
Site Visit: The purpose of the site visit is to determine:

- Electrical equipment suitable for use
- Maximum load demand
- Single or three phase incoming supply
- Type of wiring
- Equipment arrangement

Calculating Maximum Load Demand: The estimate of the maximum load demand is for determining the specification of the wiring equipment such as the cables and accessories and subsequently to prepare the electrical installation plans.

Features of Electrical Wiring: Electrical wiring composes of electrical equipment such as cables, switch boards, main switches, miniature circuit breaker (MCB) or fuses, lighting points, power points, lighting arrestors.

Single phase consumer electrical wiring



- Wire, cable, and conduits are described and measured in linear feet.
- Cable tray and bus duct systems are described and measured in linear feet.
- Hangers, sleeves, and supports are described and enumerated.
- Electrical equipment, fittings, and fixtures are described and enumerated, including: fire alarm systems, security systems, communication systems, etc.
- Installing appliances is described and enumerated, including: cooktops, microwave ovens, built-in ovens
- Permits for the work are described and enumerated.
- Testing and hot checking the entire system is measured as an item.
- Fire stops and flashings are described and enumerated.
- Cutting, drilling, and patching required for this work are described and enumerated.
- Clean-up resulting from this work is measured as an item.

UNIT 7

Appraisal on Space Needs in Commercial Buildings

Properties that have the potential to generate profit through capital gain or rental income. While you may know the basics, each sector comprises different types of properties.

1. **Office**: Office buildings are generally categorized into two types: urban or suburban. Urban office buildings are found in cities and include skyscrapers and high-rise properties — some may even total as much as a few million square feet in size. Suburban office buildings are usually smaller in stature and sometimes grouped in office parks. Office buildings can be multi-tenanted or single-tenanted, and many are build-to-suit. They're also ranked in three tiers: Class A, Class B, and Class C. The Building Owners and Managers Association International (BOMA) explains:
    - **Class A:** Most prestigious buildings competing for premier office users with rents above average for the area. Buildings have high-quality standard finishes, state-of-the-art systems, exceptional accessibility and a definite market presence.
    - **Class B:** Buildings competing for a wide range of users with rents in the average range for the area. Building finishes are fair to good for the area and systems are adequate, but the building does not compete with Class A at the same price.
    - **Class C:** Buildings competing for tenants requiring functional space at rents below the average for the area.

Medical office buildings are a specialty sub-sector in this space.

2. **Retail**: Retail comprises the properties that house the retailers and restaurants we frequent visit. They can be multi-tenanted (often with an anchor, or lead tenant, that serves to drive traffic to the property) or single-use, standalone buildings. The retail sector is complicated, as the type of shopping centre — for instance, a regional mall, community centre, strip centre or power centre — is dictated by many metrics, including the size, concept, types and number of tenants, and trade area. Single-tenanted buildings you may come across include big box centres (usually with a national chain like Target, Walmart, Best Buy, or Dick's Sporting Goods) or pad sites (single-tenanted buildings within a shopping centre, often a bank, restaurant, or drug store).

3. **Industrial:** Industrial buildings house industrial operations for a variety of tenants, and are mostly located outside of urban areas, especially along major transportation routes. The low-rise buildings can also be grouped into industrial parks. The properties are categorized into four types:
    - **Heavy manufacturing:** These buildings are heavily customized and house machinery manufacturers need to operate and produce goods and services.
    - **Light assembly:** These aren't as customized and may be used for product assembly or storage.
    - **Bulk warehouse:** These properties are usually large and are used as distribution centres.
    - **Flex industrial:** These properties contain a mix of both industrial and office space.
    - Research and development (R&D) facilities are a specialized type of industrial.

4. **Multifamily:** The multifamily sector covers all types of residential real estate outside of single-family, including apartments, condos, co-ops, and town homes. Like office buildings, multifamily properties are often classified into Class A, Class B and Class C. Apartment rental buildings, in particular, are split into multiple property types. Freddie Mac has separated them into six different buckets:
    - **High-rise:** A building with **nine or more floors** and at least one elevator.
    - **Mid-rise:** A multi-storey building with an elevator, typically in an urban area.
    - **Garden-style:** A one-, two-, or three-story apartment development built in a garden-like setting in a suburban, rural, or urban location; buildings may or may not have elevators
    - **Walk-up:** A four- to six-story building without an elevator.

- **Manufactured housing community:** A community in which the operator leases ground sites to owners of manufactured homes.
- **Special-purpose housing:** A multifamily property of any style that targets a particular population segment, including student housing, seniors housing, and subsidized (either low income or special need) housing.

5. **Hotel:** The hotel sector covers establishments providing accommodations, meals, and other services for travellers and tourists. The hotels may be independent (boutique) or flagged — the latter means its part of a major hotel chain, such as a Marriott or Sheraton. Real Capital Analytics splits them into six separate categories:
   - **Limited-service:** Does not have room service, on-site restaurant, or concierge.
   - **Full-service:** Includes room service and has on-site restaurant.
   - **Boutique:** Located in an urban or resort location, has full-service amenities, is not part of a national chain, and has fewer rooms.
   - **Casino:** Has a gaming component, such as video poker or slot machines.
   - **Extended-stay:** Limited-service with fully equipped kitchens in guest rooms and larger rooms for long stays.
   - **Resort:** Full-service, large amount of land, in a typical resort location and has an attached golf course, water park, or amusement facility.

6. **Special Purpose:** Special purpose real estate may be owned by commercial real estate investors, but don't fall into any of the sectors mentioned above. For instance, amusement parks, churches, self-storage, and bowling alleys are special-purpose facilities.

❖ **Commercial Property Appraisal** or property valuation is a process of establishing the worth of the property -usually the market value. These appraisals form the basis for mortgages, sales, mergers, taxation and so on. In most countries, these valuations are done by property 'valuers'. The market value of a property does not always equate to the cost to buy it. There are a lot of aspects that add up to the market value of a property. Overall, there are three methods used in Commercial Property Appraisal:

1. The Cost Approach
2. The Sales Comparison Approach
3. Income Capitalization Approach

- **The Cost Approach**: The cost approach for commercial property appraisal is not very popular these days. This method assumes that the value of the commercial property is equal to the cost incurred to construct it or the replacement cost. In short, the buyer will not have to pay anything more than what would be required to build an equivalent of that property. This means that any future cash flow or profits from that property are not estimated or accounted for in advance.

- **The Sales Comparison Approach**: This method involved selecting similar properties. These properties must be similar in characteristics and in the same market area. The value of the property is inferred from the sales data of a comparable property. It is also known as the market data approach. The properties that are subjected to comparison must have a considerable amount of similarity. It is not necessary that they be identical. This is exactly why this approach to property appraisal is not very reliable. It relies on the sales data of other similar properties.

- **The Income Capitalization Method**: The Income Capitalization method to value a commercial property assumes a positive relationship between the current value of the property and the expected cash flow that the property is expected to provide in the future. It also simultaneously assumes a negative relationship between the current value and the probable risks involved in achieving the expected future cash flow. In this method, the commercial real estate is typically valued in terms of their ability to generate a cash flow. The most important part of this method is that the analysis of the property must include its ability to provide returns on its capital investment.

❖ **Inspection of the property:** Contrary to the popular belief, inspection is only the beginning of this multi-faceted, complex process. The entire process may take several days and even extend to weeks depending on the size and the complexity of the property to be appraised.

❖ **Correct information:** It is crucial to give accurate and correct information to your real estate appraiser while going through the appraisal process. Misrepresenting any facts with the intention to manipulate the valuation process can affect your credibility and also affect the value of your property.

- **Correct documents: During the commercial real estate appraisal process, an appraiser might ask you to present** a variety of legal documents related to the commercial property. This can include leases and rent rolls, operating statements, property tax bill, diagrams of the property, title report, income statements, original drawings of the building, and many other relevant legal documents. The sole purpose of such demands is to make the process quicker and easier. You might not know the exact purpose of each document, but the more information you provide, the more swiftly and accurately the entire process will be concluded.

UNIT 8

Study of Commercial Interiors for Business Establishment, Hotels/Restaurants, Hospitals, Educational Buildings, Public Service Building

Public Buildings refers to the art and science of designing and erecting for specific utility. Architecture is both the process and product of planning, designing and constructing form, space and ambience that reflect functional, technical, social, and aesthetic considerations of the users. Architectural works are often perceived as cultural and political symbols and as works of art. The Design Methodology Movement involving people have resulted in more people-oriented building designs. Extensive studies on areas such as behavioural, environmental, and social sciences have established the relevance of design process in building design. Advancement in science and technology has brought in vast changes in the design of buildings and interiors. Human safety and health, comfort and convenience, lighting, aesthetics, indoor climate, building services and communication systems, energy conservation are major issues in user-friendly buildings.

Public Space Vs Private Space

Is commonly shared and created for open usage throughout the community, whereas private space is individually or corporately owned. A public space is accessible to everyone at all times. A private space is an area where accessibility is determined by one person or a small group of people. An open area, room or space may be conceived either as a more or less private place or as a public area, depending on the degree of accessibility, the form of supervision, who uses it, who takes care of it, and their respective responsibilities.

Public buildings

Are any type of building that is accessible to the public and is funded from public sources. Typically, public buildings are funded through tax money by the government or state or local governments. All types of governmental offices are considered public buildings. Public

buildings generally serve the purpose of providing a service to the public. This includes Government schools, stadiums, university, museums libraries, courthouses and post offices. Buildings meant for business operations are called commercial buildings. There are different types of commercial buildings worldwide, ranging from basic beauty salon to luxury hotels and commercial banks. Commercial buildings usually consist of more than 50 percent space available for public use, and adhere to a different set of safety standards.

Public buildings are recognized by the requirements to the users' safety, and the interior of the building demands thorough planning to obtain a satisfactory end result. Special consideration to fire and safety, acoustics, waste treatment, heat and ventilation are all critical. Efficiency-focused building designs reduce the use of materials and energy in building construction and operation. Planning buildings for efficiency can help save money and improve its performance.

Public Buildings Types

Buildings are designed and constructed to provide shelter, encourage productivity, embody our culture, and certainly play an important part in life of everyone on earth. Today's buildings extend life support systems, communication, centres of education, justice, and community, and so much more. Total design encompasses all of these issues and programs and is an essential way of approaching building projects. Understanding building design concepts will enable one to think and practice in an integrated fashion to meet the demands of today's as well as tomorrow's high-performance building projects.

Types of Buildings

- Agricultural buildings
- Commercial buildings
- Hospitality Buildings
- Educational buildings
- Government buildings
- Industrial buildings
- Military buildings
- Transit stations
- Parking Yard

- Religious buildings
- Recreational and Sports Buildings

Agricultural buildings

Agricultural equipment, machinery, livestock and feed are major investments that need to be protected from the elements. These shelters range from storage buildings to warehouses to green house to grinding mills to barn construction.

Designing and constructing agricultural buildings with efficiency in mind saves money, energy, and resources. Employing strategies such as natural ventilation, passive solar heating, and day lighting are some of the ways that building owners can put natural systems to work for them.

Agricultural buildings can be built from a range of local resource-efficient materials, whether that be for a temporary structure or a high-performance specialty building.

Commercial buildings

These are meant for commercial use and include office buildings, warehouses, or convenience stores, shopping malls. In urban locations, a commercial building often combines functions, such as an office on multi-levels. Local authorities commonly maintain strict regulations on commercial zoning, and have the authority to designate any zoned area as such.

These buildings require careful thought and planning. The size of a typical commercial building probably will require larger beams, more square footage of floor space, and room for a variety of activities beyond homebuilding.

Creating a commercial building design mandates knowledge of building materials beyond the scope of home building. Good research, along with guidance from experts, will make it possible for an individual to design a solid building for a variety of use.

Hospitality Buildings

This encompasses a wide range of types, from small and relatively simple medical clinics to large, complex, and costly, teaching and research hospitals. Large hospitals centres may include all the various subsidiary health care types that are often independent facilities. These facilities provide acute care services intended to treat patients for short periods of time, including emergency medical care, physician's office services, diagnostic care, ambulatory care, surgical care, and limited specialty services such as rehabilitation and cancer care. The design should be productive, efficient and functional to meet the specific needs.

Educational buildings

All those buildings which are meant for education from a nursery (or primary school) to the university are included in this group, for example, schools, colleges, Universities, Training Institutes, etc.

However, National Building Code of India recommends that these buildings should be used for education or for imparting instructions for more than 8 hours per week. These buildings provide facilities like class – rooms, staff cabins, drawing rooms, laboratories, administrative blocks, assembly halls for instructions or education, or recreation, library, playfields, gymnasium etc

Government buildings

These are constructed in order to conduct the legal and civic affairs of an organized community. Most cities or municipalities have a city hall, a courthouse and a post office.

The size and architectural form of each type of government building vary, depending on the size of the community. These buildings should be friendly to people with physical disabilities and senior citizens.

Handrails are integral part of any structure notably those that have slopes and stairs. They can be used indoor and outdoor to help people with difficulty walking or navigating around the place. The building's function strongly influences its design and construction.

Industrial buildings

Building structure used by the industry to store raw materials or for manufacturing products of the industry is known as an industrial building. Industrial buildings may be categorized as Normal type industrial buildings and Special type industrial buildings. Normal types of industrial building are shed type buildings with simple roof structures on open frames.

These buildings are used for workshop, warehouses etc. These building require large and clear areas unobstructed by the columns. The large floor area provides sufficient flexibility and facility for later change in the production layout without major building alterations.

The industrial buildings are constructed with adequate headroom for the use of an overhead traveling crane. Special types of industrial buildings are steel mill buildings used for manufacture of heavy machines, production of power etc. The function of the industrial building dictates the degree of sophistication.

Military buildings

A military building is any structure designed to house functions performed by a military unit.This include buildings for administrative facilities, ammunition storage commissary, correctional facilities, hospitals, housing, mess, military Intelligence facilities, museums, recreation facilities, training and research facilities, vehicle repair, maintenance, & storage facilities, weapons and ammunition production facilities.

Transit stations

Building Type Basics for Transit Facilities covers the essentials of designing transit facilities. Features innovative transit station designs, including light and heavy rail, airports, and cruise terminals.

Presents numerous illustrations with descriptive floor plans, diagrams, and photographs Provides need-to-know information for getting started in this complex area etc

Parking Yard

It is part of an overall transportation system is one of the crucial issues of our times. As the number of automobiles increases exponentially, the need to house them in close proximity creates a challenging design problem.

The parking yard must foremost deal with providing for safe and efficient passage of the automobile. This is a very complex challenge as automotive, engineering and traffic issues relative to site locations must be integrated to create the appropriate solution

Religious buildings

A religious building provides a place for worship. Temples, churches, mosques, synagogues, and pyramids - all are examples of one of the most ancient forms of architecture, the religious building.

The challenge of designing a religious building is to find the balance between glorifying the deity or deities celebrated and providing a path for the worshipper to connect with the divine presence. Symbols of simple geometric shapes into a design concept into a beautiful religious building.

Recreational and Sports Buildings

These buildings add value and functionality for communities. These establishments are meant for training and conducting sports events in stadiums, arenas, gymnasiums, swimming pools, Golf courts, soccer, and tennis sports and other sports and for recreation of all age groups.

Project features and layouts, luminaire details, construction and maintenance information are very specific to each of these buildings. Typically, this will include general and specialist building contractors, design builders, and construction management companies.

Building Space

There are many different types of spaces in a building, and each type of space has its own characteristics and requirements. Building space types are also linked to related building types and resource that explain strategies, technologies, and emerging issues relevant to those specific buildings. Any space defined for a particular utility should be accessible, aesthetics, economical, functional, productive, secure and safe, and sustainable. Their interrelationship to the building type must be understood, evaluated, and appropriately applied within the spaces. These may include atrium, lobby, auditorium, child care clinic, fitness centre, classroom, conference room, courtroom, food service courts, warehouse or storage, retail shop, laboratory, office, parking, private toilet and many more based on the purpose of building.

Atria

Are typically used as key architectural features in main entries, public circulation areas or as special destinations within a building. Atrium design often involves skylights and generous glazing areas that provide an infusion of natural light which make them a prominent building areas well suited to serve ceremonial and social functions.

Lobby space

Type includes foyers, entries to halls, and security screening areas at or near the entrance to a building or demarcated space, and are meant to welcome and direct tenants and visitors, control access, and provide exit ways from buildings. This space type is often designed with both secure and non-secure areas. The lobby space type does not include staircase, lift, escalator but lead to internal lobbies. Building lobbies often serve as the "public face" of building interiors.

Auditorium space

Type spaces are designed to accommodate large audiences. Auditorium facilities may include assembly halls, exhibit halls, auditoriums, and theaters. As such, they tend to have wide spans and

are multiple-stories high in order to accommodate seating, sightline, and acoustical requirements. These may include features such as sound reinforcement systems, audiovisual systems and projection screens.

Child Care spaces

Should be secure environments that provide a variety of learning experiences and meet the physical needs of the children. It should have space for indoor and outdoor play equipment and durable goods including cots and cribs, chairs and other seating devices, furniture, academic equipment, presentation equipment, audio-visual equipment, computer equipment, food service, and hygiene equipment.

Office Space

Type refers to a variety of spaces including meeting spaces integrated into the office environment, reception, office support spaces such as work rooms, storage rooms, file rooms, mail rooms, copier areas, service units pantry/coffee bar, and coat storage integrated into the office environment, and telephone and communications equipment rooms located in tenant suites containing tenant equipment. Office space plans can be arranged in several scenarios, such as fully closed or fully open or 80%-20% open or closed.

Clinic/Health Unit space

These are facilities where outpatient ambulatory health services are provided. It includes space for sub activities such as office, darkroom revolving door systems, or medical laboratory spaces, private toilets and storage areas.

Conference/Classroom space

Types are areas used for formal meeting, training, and teleconference activities. This space type requires flexibility, durable finishes, special equipment such as rear projection screens; special electronics control and ADP spaces for audiovisual recording broadcasting, and computer-assisted meetings or special acoustical design.

Courtrooms

Are spaces used to conduct formal judicial proceedings. Key design concerns in courtrooms include separate circulation patterns for public, prisoner, and judiciary members; special attention to acoustic and lighting levels; and aesthetic spaces.

Physical Fitness space

Is a space specifically designated for exercise, fitness training, and physical wellness activities. Also included are toilets, office, and general storage normally found in a Physical Fitness (Exercise Room) space to meet the regulations.

Food Service space

Type includes cafeterias, coffee shops, fast food retail, restaurants, hotel and other food services joints that involve the preparation and handling of food items for the consumer. This space type must accommodate several distinct areas such as food production, service, and dining; receiving and storage; and space for general circulation and other support areas each with specialized equipment and HVAC requirements and facilitate proper cleaning and sanitation of all spaces where food is handled.

Retail Store space

Are stores used for the sale of products and services. These may include news and book stands, flower shops, convenience stores, travel agencies, credit unions, dry cleaning services, shoe shine stands, barber and beauty shops, print shops, courier mail shops, retail of clothing or other hard goods, and similar applications. This space type is the integration of aesthetics into the entrances, windows, and retail areas for customers as commercial, and space accessible only to retail employees.

Laboratory space

Types are designed to accommodate project-specific work patterns and scientific equipment. The laboratories space type are analytical, bio-medical, clinical laboratories that may require accurate temperature and humidity control, dust control, and clean power.

Private Toilet space

Type refers to toilets for the exclusive use of a department, office or agency official. Private toilets are crucial in Child Care Centers, Health Clinics, Fitness Centers, Conference Centers, Auditoriums, and Food Service Dining Areas/Cafeterias. Ventilation and access are the two most important issues to consider in the design of Private Toilets. Careful selection of plumbing equipment and fixtures will help reduce water consumption within the facility. This may include no level change thresholds, installing grab bars, and providing appropriate wheelchair turning space.

Warehouse or Godown space

Type is designed to store goods and materials, as well as to allow for the regular circulation of occupants, vehicles, and machinery that are typically associated with the handling of these goods and materials.

Parking space

Type refers to parking structures—either basement, structured, or surface within an occupied building. These must provide for the safe and efficient passage of automobiles as well as visitors to and from their vehicles. Therefore, attention should be given to providing the maximum driver visibility possible at all turning points along the roadway.

Design Issues

Issues that have become the focus of public building design have developed as a result of the design community's response to the unique needs of the clients. These issues reflect the concerns that clients express to designers during all phases of the design process, from initial programming to post-occupancy evaluation.

- Accountability for the expenditure of public or private funding for the project.
- Compliance with all codes and regulations governing the project.
- Conformity with rules and regulations particular to the building needs.
- Durability of finishes, furniture, furnishings within the building environment.
- Flexibility to respond to changes is a mandate.
- Operations and Maintenance (O&M) within the context of the institutional facility.

In recent years, some of the most significant challenges for designers engaged in the practice of Public building design include aspects of design that reflect those issues of concern to their clients.

Accessible design: With the passage of the Public Disabilities Act (PDA), there has been an increased awareness for accommodation and universal design. For many years, designers have followed the National building Code and Standards, but the passage of PDA made designers more aware of the importance of publicly mandated guidelines.

Environmentally responsible design: Public and private institutions come under great scrutiny for responsible conduct. In recent years, institutions have become increasingly aware of the need to be good citizens of the world and address environmental issues. Since most of these facilities are very large and often operate continuously, issues concerning the use of energy and resources come into sharp focus.

Many institutions search for ways to limit waste, reduce energy consumption, recycle, and use recycled products in their facilities.

Facilities for operations and maintenance: Increased costs for operating and maintaining facilities necessitate specific plans that govern operations and maintenance (O&M) of institutional facilities. Interior designers work closely with facilities managers to specify products that are easily maintained and serviced. These concepts include planning for surplus stock of building products, specification of materials that are easily repaired, selection of on-site recoverable furniture and furnishings, and systematic planning of routine operations and maintenance practices as part of the overall facilities design.

Design to support emerging technologies: Rapid shifts in technology have required clients to plan for the future without knowing what the future technologies will bring. Institutional designers plan so that spaces may be easily reconfigured as organizations expand or reduce in size. How large institutional clients deal with emerging technology continues to affect the way their buildings are designed. Figuring prominently into the design efforts are creative use of spaces below finished floors and above finished ceilings as well as continued improvements in the delivery of electrical, mechanical and security systems. Technical drivers continue to be the

use of flat screen technology, the shift to fiber optic networks, and the advent of wireless technology in the workplace

Factors Influencing the Design of Buildings

Type of building: Each type of building has many different requirements. It varies in building form and appearance, space planning for different utilities, furniture specification, lighting arrangement, materials and finishes, indoor climate, building codes and standards. The functions and goals of the business are just some of the many factors that influence the interior design based on the type of facility in the required in the building

Location: The design of project may be located in a small town or in an urban area; as a total building and part of a building. The cost of project or money spent on the building design and interior finishes will be influenced by project location. Expectations of the customer will be greater when the business is located in an urban location.

Nature of Activity: Type of project will be influenced by the nature of Activity. In case of a Food service business, it may be a simple bakery or exclusive coffee shop, a motel or an five star hotel. In the case of retail stores, it could be ready-made garment showroom or florist store or a foot ware store. The activities to be performed in each of these businesses will influence the amount space, type of furniture and equipment, safety, support services etc. The kind of ambience desire in each of these business outlets will be based on the anticipated customers and its location.

Customers: Satisfaction of customers in any business environment will be indication of profit. In a business of restaurant, the customers may be neighbourhood residents or tourists. Customer's likes and dislikes, culture, living styles, affordability to pay for service will influence the interior designers design decision.

Client: Very crucial member in the society who provides funds for creating projects and depends on the services of architects and interior designers. Each client has different goals for the business, and the interior designer is challenged to satisfy all their unique demands.

Interior in Restaurants

The primary elements of restaurant interior design include the following: - Architecture and Design, Lighting, eating, Colours, Smell, Acoustic

Lighting: Technically there are three types of lighting- Ambient, Task and Accent lighting.

Ambient lighting defines the overall look and feel of your restaurant. Is your restaurant dimly lit or is it bright and heavy on the lights, this is the light that defines it.

Task lighting is the light used for performing tasks. These are the lights that enable servers to work and customers to read the menu and order. This light is to be used strategically so that it does not kill the objective of the ambient light, but at the same time performs its function well, especially in fine dining restaurants.

Accent lights are lights used for that extra touch but mostly decorative purposes. There you can experiment with, but most wall lighting in this area is received better than overhead lighting.

Colours believe it or not play a huge role in your restaurant interior design: Some colours stimulate diet while others repress it. Warm colours like red and orange are considered strong stimulants, and so a lot of restaurants try to use red in their interior. At the same time, it is a strong colour, so it is best not to go overboard with it. Yellow is a happy colour and can bring out people's appetites by giving a lively feeling to the place. Blue, on the other hand, is a suppressant. The reason why blue is considered a suppressant is that it relaxes the diners and calms them hence they order less.

Interior in Cinema Hall

- Design a functioning Auditorium according to the type of performance and the number of the audience
- Keep the standard distance for a comfortable audience seating
- The stage is important: choose wisely
- Keep the scenery low for better visibility
- For greater intimacy with the audience, go with the Thrust Stage
- Keep your theatre flexible
- Sound quality is as important as visibility

Interior in Office

- **Purpose of an Office:** The purpose of an office is to derive maximum work from employees and maximum business from clients. To achieve this, minimum disturbance to employees and minimum inconvenience to clients should be the motto of the designer. Keep the standard distance for a comfortable audience seating
- **Pattern of Population of an Office Building:** The population of an office jumps from zero to maximum within a morning hour. And it declines likewise in the evening, only maintenance staff remaining there. So the entrance should be large enough to cope with this and at the same time should not intimidate the visitors. These are the two basic considerations before we start with designing an office, be it an Architect's Office or a Management Office. Keep the scenery low for better visibility.
- Office is a space where people are active the entire day. Keeping this in mind, we have to consider all the necessary factors that are essential for the design of a comfortable office space. Like for any other planning, adequate light, proper air circulation, controlled sound level, right work surface and storage for stationary, equipment and other sundry articles should be considered.

Interior in educational institute

There is an insignificant relationship between the physical environment of educational settings and how the design can not only influence the children but also the teachers and the staff. Thus, it is imperative for educational institutions to have the potential to substantially inspire both, students as well as teachers. Since most of the learning process takes place in schools and educational institutions, it is imperative to consider that poor setting can detract the learning process amongst students.

Meticulous interior design solutions for educational settings have proven to have a positive impact on the users and also on the overall environment inside the institution. This is achieved by addressing the interrelating social, aesthetic and economic matters within a school building.

The outcome of school designs should create spaces that are functional, safe, comfortable, and healthy. By creating healthy school environments, interior designers acknowledge the importance of health and learning.

With this standard, designers should craft spaces that elevate the design of space beyond the technical requirements and put emphasis on improvisation of the quality of one's experience in the space. This can be achieved by creating spaces that are healthy and exciting, so that students interact, thrive, and relish their school environments. Design strategies should be reactive to social connections that encourage communication and participation within the school structure, and are conducive to learning.

Air quality: Considering the substantial amount of time that students, teachers and staff spend indoors, Indoor air quality can have a major impact on their health. Poor quality of indoor air can have adverse effects on health including issues like headache, fatigue, shortness of breath, sinus congestion, cough, sneezing, eye, nose, throat irritation, etc. This could in-turn affect student learning and teacher's productivity. Use of planter beds, oleo phobic materials can help to improve indoor air quality.

Student friendly spaces: In order to provide for better spaces for learning and communication, it is essential that the learning spaces are not only aesthetically sound but are also ergonomically competent for children. Moreover, learning spaces are required to be intriguing to foster the learning process in educational institutions.

Visual appeal: The visual environment is a very important factor that contributes to the learning process. Thus, educational settings should have a WOW factor that would naturally attract students to come to school.

Lighting: Proper lighting is important in schools because occupants spend a majority of their time indoors. The designing process for an educational setting should inculcate the lighting aspect. Lighting is a fundamental feature of interior design that helps to create the visual appeal. Thus, effective integration of natural and artificial lighting is crucial to impact the quality of learning spaces. Effective planning of classrooms at the periphery would help to reap maximum natural light.

Acoustics: Enhanced acoustic system is a prerequisite for any learning space. An efficient acoustical environment is vital to facilitate good teacher-to-student and student-to-student communications. This eliminates the need for teachers to strain themselves in order to be audible and in this manner, students can learn effectively by communicating with each other and also with the teacher. Use of good sound absorbing materials would help to craft the right kind of learning spaces.

Ventilation: Ventilation – natural and artificial, is a very important feature the influences the air quality and also the energy efficiency of any space. Proper ventilation in an educational setting is extremely important as it control odour and inhibits the spread of respiratory diseases. Also, well ventilated clean air raises student performance by maintaining alertness and health. Orientation plays a major role in determining the natural wind flow inside the structure.

Thermal comfort: By providing thermal comfort, the intent is to provide a comfortable thermal environment that promotes occupant productivity and well-being in an educational setting or any other. The requirements include efficient designing of building systems which include: the thermal barrier, heating, ventilation, and air conditioning (HVAC).

Because school buildings are expected to support multiple activities, this requires the infrastructure to be accommodating for occupants' learning, performance, and engagement in productivity needs. Interior designers along with a set of technical expertise have the required skill set and experience to craft spaces that are effective for reading, communicating with others, and performing visual tasks associated with learning, teaching and other formative activities.

Interior in Hospital

Hospitals are the most complex of building types. Each hospital is comprised of a wide range of services and functional units. These include diagnostic and treatment functions, such as clinical laboratories, imaging, emergency rooms, and surgery; hospitality functions, such as food service and housekeeping; and the fundamental inpatient care or bed-related function. This diversity is reflected in the breadth and specificity of regulations, codes, and oversight that govern hospital construction and operations. Each of the wide-ranging and constantly evolving functions of a hospital, including highly complicated mechanical, electrical, and telecommunications systems, requires specialized knowledge and expertise. No one person can reasonably have complete knowledge, which is why specialized consultants play an important role in hospital planning and

design. The functional units within the hospital can have competing needs and priorities. Idealized scenarios and strongly-held individual preferences must be balanced against mandatory requirements, actual functional needs (internal traffic and relationship to other departments), and the financial status of the organization.

In addition to the wide range of services that must be accommodated, hospitals must serve and support many different users and stakeholders. Good hospital design integrates functional requirements with the human needs of its varied users.

The basic form of a hospital is, ideally, based on its functions:

- bed-related inpatient functions
- outpatient-related functions
- diagnostic and treatment functions
- administrative functions
- service functions (food, supply)
- research and teaching functions

The transportation systems are influenced by the building configuration, and the configuration is heavily dependent on the transportation systems. The hospital configuration is also influenced by site restraints and opportunities, climate, surrounding facilities, budget, and available technology. New alternatives are generated by new medical needs and new technology.

Building Attributes

Regardless of their location, size, or budget, all hospitals should have certain common attributes.

Efficiency and Cost-Effectiveness

An efficient hospital layout should:

- Promote staff efficiency by minimizing distance of necessary travel between frequently used spaces
- Allow easy visual supervision of patients by limited staff
- Include all needed spaces, but no redundant ones. This requires careful pre-design programming.

- Provide an efficient logistics system, which might include elevators, pneumatic tubes, box conveyors, manual or automated carts, and gravity or pneumatic chutes, for the efficient handling of food and clean supplies and the removal of waste, recyclables, and soiled material
- Make efficient use of space by locating support spaces so that they may be shared by adjacent functional areas, and by making prudent use of multi-purpose spaces
- Consolidate outpatient functions for more efficient operation—on first floor, if possible—for direct access by outpatients
- Group or combine functional areas with similar system requirements
- Provide optimal functional adjacencies, such as locating the surgical intensive care unit adjacent to the operating suite. These adjacencies should be based on a detailed functional program which describes the hospital's intended operations from the standpoint of patients, staff, and supplies.

Flexibility and Expandability

Since medical needs and modes of treatment will continue to change, hospitals should:

- Follow modular concepts of space planning and layout
- Use generic room sizes and plans as much as possible, rather than highly specific ones
- Be served by modular, easily accessed, and easily modified mechanical and electrical systems
- Where size and program allow, be designed on a modular system basis. This system also uses walk-through interstitial space between occupied floors for mechanical, electrical, and plumbing distribution.
- Be open-ended, with well-planned directions for future expansion; for instance, positioning "soft spaces" such as administrative departments, adjacent to "hard spaces" such as clinical laboratories.

Therapeutic Environment

Hospital patients are often fearful and confused and these feelings may impede recovery. Every effort should be made to make the hospital stay as unthreatening, comfortable, and stress-free as possible. The interior designer plays a major role in this effort to create a therapeutic environment. A hospital's interior design should be based on a comprehensive understanding of the facility's mission and its patient profile. The characteristics of the patient profile will determine the degree to which the

interior design should address aging, loss of visual acuity, other physical and mental disabilities, and abusiveness. Some important aspects of creating a therapeutic interior are:

- Using familiar and culturally relevant materials wherever consistent with sanitation and other functional needs
- Using cheerful and varied colors and textures, keeping in mind that some colors are inappropriate and can interfere with provider assessments of patients' pallor and skin tones, disorient older or impaired patients, or agitate patients and staff, particularly some psychiatric patients.
- Admitting ample natural light wherever feasible and using colour-corrected lighting in interior spaces which closely approximates natural daylight
- Providing views of the outdoors from every patient bed, and elsewhere wherever possible; photo murals of nature scenes are helpful where outdoor views are not available
- Designing a "way-finding" process into every project. Patients, visitors, and staff all need to know where they are, what their destination is, and how to get there and return. A patient's sense of competence is encouraged by making spaces easy to find, identify, and use without asking for help. Building elements, colour, texture, and pattern should all give cues, as well as artwork and signage.

Cleanliness and Sanitation

Hospitals must be easy to clean and maintain. This is facilitated by:

- Appropriate, durable finishes for each functional space
- Careful detailing of such features as doorframes, casework, and finish transitions to avoid dirt-catching and hard-to-clean crevices and joints
- Adequate and appropriately located housekeeping spaces
- Special materials, finishes, and details for spaces which are to be kept sterile, such as integral cove base. The new antimicrobial surfaces might be considered for appropriate locations.
- Incorporating O&M practices that stress indoor environmental quality (IEQ).

Accessibility

All areas, both inside and out, should:

- Comply with the minimum requirements of the Disability Act.

- In addition to meeting minimum requirements of Disability Act accessibility standards, be designed so as to be easy to use by the many patients with temporary or permanent handicaps
- Ensuring grades are flat enough to allow easy movement and sidewalks and corridors are wide enough for two wheelchairs to pass easily.
- Ensuring entrance areas are designed to accommodate patients with slower adaptation rates to dark and light; marking glass walls and doors to make their presence obvious.

Controlled Circulation

A hospital is a complex system of interrelated functions requiring constant movement of people and goods. Much of this circulation should be controlled.

- Outpatients visiting diagnostic and treatment areas should not travel through inpatient functional areas nor encounter severely ill inpatients
- Typical outpatient routes should be simple and clearly defined
- Visitors should have a simple and direct route to each patient nursing unit without penetrating other functional areas
- Separate patients and visitors from industrial/logistical areas or floors.
- Outflow of trash, recyclables, and soiled materials should be separated from movement of food and clean supplies, and both should be separated from routes of patients and visitors.
- Transfer of cadavers to and from the morgue should be out of the sight of patients and visitors
- Dedicated service elevators for deliveries, food and building maintenance services

Aesthetics

Aesthetics is closely related to creating a therapeutic environment (homelike, attractive.) It is important in enhancing the hospital's public image and is thus an important marketing tool. A better environment also contributes to better staff morale and patient care. Aesthetic considerations include:

- Increased use of natural light, natural materials, and textures
- Use of artwork
- Attention to proportions, colour, scale, and detail
- Bright, open, generously-scaled public spaces
- Homelike and intimate scale in patient rooms, day rooms, consultation rooms, and offices
- Compatibility of exterior design with its physical surroundings

Security and Safety

In addition to the general safety concerns of all buildings, hospitals have several particular security concerns:

- Protection of hospital property and assets, including drugs
- Protection of patients, including incapacitated patients, and staff
- Safe control of violent or unstable patients
- Vulnerability to damage from terrorism because of proximity to high-vulnerability targets, or because they may be highly visible public buildings with an important role in the public health system.

Sustainability

Hospitals are large public buildings that have a significant impact on the environment and economy of the surrounding community. They are heavy users of energy and water and produce large amounts of waste. Because hospitals place such demands on community resources, they are natural candidates for sustainable design.

Relevant Codes and Standards

Hospitals are among the most regulated of all building types. Like other buildings, they must follow the local and/or state general building codes. To be licensed by the state, design must comply with the individual state licensing regulations.

UNIT 9

Specifications Writing-Writing Detailed Clause by Clause

Specifications define the quality of any construction work. Therefore, specifications should be clear. Language for specifications should be such that no chance of ambiguity lefts. Specifications are the important part of contract and it has legal value. In case of any dispute, one can even consult with court. Most of disputes occur, only because of not properly explained specifications. Therefore, following principles of specifications should be considered while writing that prevent conflict and ambiguities.

1. **Description of Material:** It is very important to write in detail about the construction material. Type and size of construction material should be clearly mentioned. Besides this, ingredient ratio and mixing method of concrete and mortar should also be clearly defined. If treatment of any material required before use, then it should be mentioned in specifications.

2. **Workmanship:** Workmanship covers the method of construction, inspection of work, surface preparation, surface compaction and curing. Procedure of every single item should be mentioned in detail.

3. **Tools and Plants:** Different equipment, tools and plants required during construction should be clearly mentioned in specifications. Arrangement of machinery before construction is only possible, if it is mentioned in specifications. It should also be mentioned that either contractor has to arrange on its own or client will arrange equipment for the contractor.

4. **New Work Protection:** It should be clearly mentioned that how new work will be protected from rain water, temperature, freezing and other atmospheric changes. New work includes excavation, brick masonry, concrete pouring, plaster etc.

5. **Expression:** Expressions should be very clear. Specifications have legal value; therefore, sentences should be short and complete. For conveying complex information, short sentences should be used. It breaks up information into smaller and easier to process units. Long complicated sentences can confuse reader and doubtful the main point. Every single paragraph should only be limited to only one issue. Vocabulary should be such that it not creates a dual meaning. It should be such that every reader grasps the same meaning. Language, format and usage should be consistent. Beside this, specifications must also be consistently enforced. Specifications only remain effective, if it is consistently enforced. Without it even well written specifications become ineffective.

6. **Clauses of Specifications:** Clauses of specifications should be written in ascending order, in short follow the construction schedule. First thing come first. For Example: Clauses related to excavation should come before foundation or footing related clauses.

For writing specifications for construction contracts, care must be taken to ensure consistency of requirements throughout and conformity with what is written in other documents. This consistency can be promoted if one person drafts all the documents or, if parts are written by others, one person carefully reads through the whole finished set of documents. An inconsistency in the documents can give rise to a major dispute under the contract, having a serious effect on its financial outcome.

Writing Specifications for Construction Contracts: Some principle guidelines for writing specifications are as follows.

1. The layout and grouping of subjects should be logical. These needs planning out beforehand.
2. Requirements for each subject should be stated clearly, in logical order, and checked to see all aspects are covered.
3. Language and punctuation should be checked to see they cannot give rise to ambiguity.
4. Legal terms and phrases should not be used.
5. To define obligations the words 'shall' or 'must' (not 'should' or 'is to', etc.) should be used.
6. Quality must be precisely defined, not described as 'best', etc.
7. Brevity (briefness) should be sought by keeping to essential matters.

It is not easy to achieve an error-free specification. It is of considerable assistance to copy model clauses that, by use and modification over many previous contracts, have proved satisfactory in their wording. Such model clauses can be held on computer files so they are easy to reproduce and modify to make relevant to the particular project in hand. Copying whole texts from a previous specification which can result in contradictory requirements should not be adopted. Entirely new material is quite difficult to write and will almost certainly require more than one attempt to get it satisfactory.

The construction specification has to tell the contractor precisely:

- The extent of the work to be carried out
- The quality and type of materials and workmanship required
- Where necessary the methods he is required to use or may not use to construct the works.

Firstly, under this an informative description is given of what the contractor is to provide and all special factors, limitations, etc. applied. Second under these detailed requirements are set out. The extent of detail adopted should relate to the quantity and importance of any particular type of work in relation to the works required. Thus, the specification for concrete quality may be very extensive where much structural concrete is to be placed; but it may be quite short if concrete is only required as bedding or thrust blocks to a pipeline. A 'tailor-made' specification appropriate to the nature of the work in the contract should be the aim.

Types of Construction Contracts and Their Comparison

There are different types of construction contracts and their comparison is presented in this article. A construction contract is an agreement between two or more parties to execute the construction works as per certain terms and conditions. A construction contracts contains general and special conditions of agreement, details of construction project work, their specifications, time limits,

payments and penalties for delivery delays etc. and ensures every party's rights and obligations. A construction contract document is a valid document can be enforced under certain authority or law.

Following are the types of documents in a construction contract:

- General conditions
- Special conditions
- Drawings and specifications
- B.O.Q (bill of quantity)
- Letter of acceptance
- Contractor bid

Conditions of Construction Contract: Conditions of contract are terms which rule the relationships between the owner and the contractor, define each party's rights and obligations, specify method of payment and determine actions required when existing any disputes between the owner and the contractor.

Following are the conditions of contract for construction projects:

- General conditions of contract
- Special conditions of contract

General conditions of contract: They are standard terms that suit the majority of projects, they include:

- Definition of the project
- Contract components
- Rights and responsibilities for the owner and the contractor
- Project schedule
- Payment method
- Warranty and delay penalty

Special conditions of contract: They are the modifications required to suit the uniqueness of the project, make the contract flexible for the nature of the project and achieve project objectives.

Selection of Type of Construction Contracts

One of the characteristics of construction projects is uniqueness. Every project has its special circumstances, so it's important to select the contract type which suits the project. The process of

selecting the type of contract is developed by the owner. Factors which affect the selection of construction contract are:

1. **Project objectives:** The type of contract should meet with project objectives.
2. **Project constraints:** There isn't any construction project without constraints. Thus, project constraints should be considered while selecting type of construction contracts.
3. **Project delivery method**: Project delivery method determines the relationships between parties getting involved in the project and how they interact with each other from project initiation to project closure.

Types of Construction Contracts: There are many types of contracts used in construction. Each type has its advantages and disadvantages with respect to the owner and the contractor. They are categorized in two major groups as per method of payment to the contractor. Following are the types of construction contracts generally used in construction projects:

- **Lump sum contract:** In this type the contractor bids a single fixed price for overall activities in the project scope. The contractor is responsible for estimating project costs from drawings then adds overhead and his profit to determine the price of the project. All risks are assigned to the contractor, there isn't any risk carried by the owner. The contractor has incentive in this contract as he is rewarded for early finish and there is penalty for late finish. This contract is ideal when the project scope is well defined at the design stage because there is limited flexibility for modifying the design during construction period.

- **Unit price contract:** The total price of the project in unit price contract is based on the price of each item's unit. The contractor is paid as per the rates of items specified in the bill of quantity. The risk is shared with the contractor and the owner. This type of contract has more flexibility for design changing than the lump sum contract. The construction of the project can be started before finishing the designs so the total cost of the project will be uncertain at the early stages of the project.

- **Cost plus contract:** The contractor is paid based on the actual cost of the project including direct and indirect costs plus specific fee. This fee could be a fixed fee or percentage of costs. All risks are assigned to the owner and he gets involved with the contractor in the management of the project. The contractor has no risk in case of increasing the cost of the project; also, there isn't any incentive for early finish. This type of contract is ideal when the project scope is uncertain in the early stages of the project. The contractor can start the

execution of the project before finishing the design. It is impossible to estimate the cost of the project before the construction has been finished.

- **Target cost contract:** Target cost contract has mutual features of the lump sum and cost-plus contracts. The contractor is paid based on the actual costs plus a certain fee either fixed or percentage of total cost in case of the cost of the project doesn't exceed certain target cost specified by the owner. There is risk carried by the contractor in case of increase in cost of construction project. The contractor is also rewarded a percentage of any savings between target and actual cost.

Comparison between Different Types of Construction Contracts

S. No.	Point of Differentiation	Lump Sum Contract	Unit Price Contract	Cost Plus Contract	Target Cost Construct
1.	**Advantages with respect to the contractor**	Incentives for early finish	Low Risk	No Risk	Rewards for any savings between actual and target cost
2.	**Disadvantages with respect to the contractor**	High risk	No incentives for early finish	No incentives for early finish	Share risk with the owner
3.	**Advantages with respect to the owner**	No risk Total cost is defined at early stages	Share risk with the contractor	Can start project without finishing designs	Target cost is defined at early stages
4.	**Disadvantages with respect to the owner**	Contractor desire to decrease costs may be detriment quality	Total cost is uncertain at early stages	High risk Total cost is uncertain at early stages	Share risk with the contractor

5.	**Flexibility of design changing**	Limited flexibility	Has flexibility to change design	More flexible to design stages	Limited Flexibility

What is change order and why it is needed in construction contract?

A change order in construction contract is modification of a contract in writing. It is a change to the original contract that has been previously established and previously written.

Many times, a construction project requires some changes such as addition, deletion or modification of works, or can be changes in local laws related to construction works. These changes can be done by owners, contractors, architects, designers etc. at a later date after signing of the construction contract. These changes are incorporated in construction contracts through a written change order. A construction contract includes drawings, specifications, bill of quantities, clarifications and this is for any type of construction or of a building project. Any changes in these are notified to contractor with a change order.

Common Types of Change Order in Construction Contracts

Following are the common types of change orders and their reasons:

S.No.	Common types of change order	Common reasons and sources of change order
1.	Change in scope of project	Tenant agency has requested a design change
2.	Unforeseen conditions	Site conditions differ from the expected. Changes required by professionals or contractor
3.	Professional errors and omissions	Requested by contractor or professionals
4.	Errors	Errors in construction design plans and specifications
5.	Omissions	Omission of an item or element from the plan

Features of a Change Order in Construction Contracts

- **It should have a cost to it**: A change order should always have cost associated with it even if it does not cost the contractor for any changes. For example, if changes in colour of a product are required and related work has not started, then there can be two scenarios, such as, the product has been purchased by contractor and the product has not been purchased yet. In first case, the purchased product can be returned to supplier for a replacement with required colour of same product. This may cost or not cost the contractor. In second case, the contractor may not have to pay additional amount for change of colour. But contractor need to show the cost associated with this change order as zero or the actual cost.

- **It should be paid upfront**: If you are not getting that done, then you are not following the standards. Get that change order amount upfront. If client wants some change, contractor will accept the change and do that work and ask for extra payment. If the client changes the mind frequently as it happens in many projects and finally client came to a point where he doesn't want any further change but by that time large amount of changes have been done in the project, the change order got some hefty amount. It sometimes happens in contract that contractor makes more the money than the original contract value through this. This order could be generated by contractor in some unforeseen conditions, may be something wasn't anticipated initially and was excluded from the contract and now it has come into the picture, like If there is rain possibly it will delay the project. You also have change order if any change to the completion date. If change in the product, the product once you have selected those and have been priced, you are going to make a change order incorporating that price or specifications in your contract that would affect your contract value.

- **Notification of the change**: A change order once signed becomes part of your construction contract, it's very important that any change you had, must be informed to owner in written order, so that it gets covered in your contract agreement. Change order can be created in an excel spread sheet which most builders will be going to use unless they have some project management software. Some items to be changed may not be the part of plan or specifications or the construction contract, so scope of work mentioned in the contract is the key part of these orders.

- **Total price change of construction contract**: Another key part is the total price change. Every line in the change order shows the items wherever the price change in material or labour, then

there is subtotal and additions to overheads and profits, insurance tax and the builder fee and these all should be negotiated during the contract. Contractor needs to make it sure during contract phase to discuss change order with the builder, so you have all these items prepared and negotiated so no questions arise later. Sometimes contractor charges more fees for a change order because it does disrupt the normal construction process, so all that things needs to be discussed in contract upfront. Contractor should mention the number of change orders mentioning the original contract amount and the current contract amount due to these orders.

5 key components of change order in construction contracts:

1. Change in the original scope of the work
2. Change in contract value
3. Change in time
4. Signatures of both parties
5. Date of change

UNIT 10

Specifications of Material

Specifications describe the materials and workmanship required for a development. They do not include cost, quantity or drawn information, and so need to be read alongside other information such as quantities, schedules and drawings. Specifications vary considerably depending on the stage to which the design has been developed, ranging from performance specifications (open specifications) that require further design work to be carried out, to prescriptive specifications (closed specifications) where the design is already complete.

Pre-construction is the work done prior to the construction of the project. This includes designing the project, getting environmental clearance, bidding the project, etc. Post-Construction is the work done after the project is built. Typically, this is the administrative portion of the contract in which you make sure that you have all the correct quality control/ quality assurance paperwork in place to prove that the project was built to specifications. This seems to take longer than the pre-construction sometimes.

Tests: The testing of construction materials can be: physical, chemical, verifying quantity, checking for damage.

Testing may be necessary: As part of a quality control system.

- To verify that materials comply with the required specification.
- To achieve certification.
- To demonstrate compliance with legislative requirements, such as the building regulations.

Materials from suppliers will generally have been rigorously tested to the supplier´s own standards, will generally comply with the minimum recommendations of the appropriate British Standards, and may have third party accreditation to demonstrate their quality. Therefore, when they arrive on site,

the usual tests that are required are those that check the quantity received against the amount stated on the delivery note, ensuring quality is as ordered, and a visual inspection so that any damage can be flagged up straight away.

Different methods of Testing for various Materials

Testing timber

- **Oven dry testing:** This involves drying timber to a relatively constant weight in a ventilated oven at 102-105°C. It is possible to establish a very accurate original moisture content percentage (%MC) by drying a piece of timber in an oven for several hours, and testing it at regular intervals until its weight stops changing.
- Using a moisture meter

Testing bricks

- **Compressive strength test:** A sample brick is placed on a compression testing machine and pressure is applied until it fails.
- **Water absorption test:** Bricks are weighed in their normal dry condition and then immersed in fresh water for 24 hours. They are then weighed again. The difference between the weights indicates the amount of water that has been absorbed by the brick.
- **Efflorescence test:** is a crystalline, salty deposit that can occur on the surfaces of bricks. It is generally a white or off-white colour with a powdery appearance. To test for alkalis that may cause efflorescence, a brick is immersed in fresh water for 24 hours and then left to dry.
- **Hardness test:** The brick surface is scratched. If no impression is left then it is of good quality.
- **Size, shape and colour test:** Twenty bricks chosen at random are stacked lengthwise, width-wise and height-wise, and inspected for uniformity of shape, size and colour.
- **Soundness test:** Two bricks are held in each hand and struck together. They should not break and a clear metallic ringing sound should be made if they are good quality.
- **Structure test:** A sample brick is broken and carefully inspected. If it is good quality there should be no flows, cracks or holes on the broken face.

Testing Sand

- **Bulking test:** Sand can be tested when batching concrete by volume. A damp sand sample is placed in a straight-sided container, filling to around two-thirds. A rule is inserted to measure the depth of the damp sand (e.g. 150 mm). The damp sand sample is then removed from the container and set aside. Clean water is poured to half fill the container. The sand is then placed in the water in two halves and tamped down with a rod to remove any air. The rule is inserted to measure the depth of the saturated sand (e.g. 124 mm).

- **Silt test:** This test is used to measure the cleanliness of a sand sample by establishing the percentage of silt present. This is important as too much silt will weaken the concrete.

Testing Concrete

- **Slump test:** A steel slump cone should be filled to a quarter depth and tamped 25 times with a tamping rod. The filling and tamping should be repeated three more times until the cone is full and the top levelled off. The cone is then removed and the resulting slump measured. If the mix is consistent, the slump should remain the same for all the samples that are tested. The usual slump specification is 50-75 mm.
- **Test cubes:** These can be made and crushed in a laboratory to check that the cured concrete has obtained the required design strength. A standard 150 x 150 x 15 mm steel test cube mould is used, thinly coated inside with mould oil. A concrete sample is taken from the discharge outlet of mixer or from the point of placing on site. The mould is filled in three equal layers (50 mm each), each layer being well tamped with at least 35 strokes.

- **Rebound hammer test:** A Schmidt hammer (also known as a Swiss or rebound hammer) is used to measure the elastic properties or strength of concrete. The varying surface densities will affect the impact and propagation of stress waves which can be recorded on a numerical scale known as rebound numbers. These rebound numbers can be graphically plotted to correspond with compressive strength.

- **Penetration test:** test is used to determine the uniformity of concrete, specify the poor quality or deteriorated concrete zones, and evaluate the in-place strength of concrete. It is sometimes necessary to estimate the strength of concrete on-site for early form removal or to investigate the strength of concrete in place because of low cylinder test results.

- **Pull out test:** A number of circular bars of steel with enlarged ends are cast into a concrete sample. At the appropriate time, the bar and a piece of concrete are pulled out using a tension

jack. Although the concrete fails in tension and shear, the pull-out force can be correlated to the compressive strength of the concrete.

- **Vibration test:** This uses an ultrasonic pulse to measure vibrations through a concrete sample. The readings can then be used to correlate compressive strength.

Mode of Measurements

Measurement is the transformation of drawn information into descriptions and quantities, undertaken to value, cost, and price construction work, as well as enabling effective management. It is not just about a quantity surveyor producing a bill of quantities for contractors to price during tendering. It is used in both pre- and post-contract work, helping assess the likely cost of the works, and determining what contractors and subcontractors should be paid for work that has been completed.

Pre-contract measurement

During the early design stages, the quantity surveyor (or cost consultant) will measure the dimensions of the building to produce budget estimates, perhaps based on benchmarking against similar buildings. As the design develops, they will measure more detailed approximate quantities for cost planning purposes, ensuring that the design can be achieved within the budget. The quantity surveyor then measures the completed working drawings to produce a bill of quantities. Contractors tender for the job by pricing the work described in the bill of quantities.

Post-contract measurement: The contractor may use measurement for:

- Preparing a construction methodology.
- Ordering goods and materials.
- Procuring subcontract works.
- Calculating the effects of any variations.
- Assessing work done against the construction programme.
- Making payments to subcontractors.
- Preparing or assessing valuations of work completed for interim payments.

The quantity surveyor may undertake measurement for: Cost control, estimating the cost of variations to the work, calculating the value of nominated subcontractors' and suppliers' work, Preparing or assessing interim valuations to pay the contractor for work done.

List of Indian Standards

- **Cement**

1. Specification for 33 Grade ordinary portland cement IS 269 – 2015
2. Specification for Rapid hardening portland cement IS 8041 – 1990
3. Specification for portland Pozzolona cement IS 1489 (part 1&2) 1991
4. Methods of physical test for hydraulic cement IS 4031 – 1988
5. Method of chemical analysis of hydraulic cement IS 4032 – 1985

6. Method of sampling for hydraulic cement IS 3535 – 1986
7. Standard sand testing of cement IS 650 – 1991
8. Specification for 43 Grade OPC… IS 8112 – 2013
9. Specification for 53 Grade OPC… IS 12269-1987

- **Coarse / Fine Aggregate**
  1. Specification for coarse & fine aggregate IS 383-1970
  2. Methods of test for aggregate for concrete particle size and shape IS 2386 (Part I) 1963
  3. Methods of test for aggregate for concrete estimation of deleterious materials and organic impurities. IS 2386 (Part II) 1963
  4. Methods of test for aggregate for specific gravity, density, voids, absorption & bulking IS 2386 (Part III) 1963
  5. Methods of test for aggregate for Mechanical properties. IS 2386 (Part IV) 1963
  6. Methods of test for aggregate Soundness IS 2386 (Part V) 1963

7. Methods of test for aggregate measuring mortar making properties of fine aggregates.IS 2386 (Part VI) 1963
8. Methods of test for aggregate for alkali-aggregate reactivity IS 2386 (Part VII) 1963
9. Methods of test for aggregate for petrographic examination IS 2386 (Part VIII) 1963

- **Bricks**
  1. Method of sampling of clay building bricks IS 5454 – 1978
  2. Method of test for burnt-clay building bricks. IS 3495 (Parts I TO iv) 1976
  3. Common burnt clay building bricks. IS 1077 - 1992

- **Masonry Mortar**
  1. Specification for sand for masonry mortars. IS 2116 – 1980
  2. Code of practice for preparation and use of masonry mortar IS 2250 – 1981

- **Cement Concrete**
  1. Specification for coarse and fine aggregate. IS 383 – 1970
  2. Specification for compressive strength, Flexural strength IS 516 – 1959
  3. Code of Practices for Plain & reinforced concrete etc. IS 456 – 2000
  4. Methods of sampling and analysis of concrete IS 1199 – 1959
  5. Recommended Guide Lines for Concrete Mix Design IS 10262 – 1982

- **Curing Compound**
  1. Standard test method for water retention & daylight reflection test on concrete. ASTM-C-156809
  2. The standard method of test for the effect of organic materials in fine aggregate on strength of mortar. ASTM-C. 87-69
  3. Standard specification for liquid membranes forming compounds. ASTM C. 309-89

- **PVC Water Stops**
  1. Code of practice for the provision of water stops. IS 12200 – 1987
  2. Procedure for Testing Parts of IS 8543-19
  3. Standard Test Methods for Tensile Properties of Plastics. ASTM : D 638-1991
  4. Standard Test Methods for Thermoplastic Elastomers-Tension. ASTM : D 412-1992

- **HYSD BARS**
  1. Specifications for HYSD bars. IS 1786 – 1985
  2. Specification for Mild Steel and Medium Tensile steel bars. IS 432 (P II) 1966
  3. Method for Tensile testing of steel wires. IS 5121 – 1972
  4. Hard drawn steel wire for concrete reinforcement. IS 1566 – 1982
  5. Method for Tensile testing of Steel products IS 1608 – 1972
  6. Code of practice for bending & fixing of bars for concrete reinforcement IS 2502 – 1963

- **Pre cast R.C.C. Pipes**
  1. Specifications for pre cast concrete pipes. IS 458 – 1988
  2. Methods of Tests for concrete pipes. IS 3597 – 1985

- **Soil**
  1. Preparation of dry sample (soil) IS:2720 (Part .I) 1983
  2. Determination of water content (moisture content) IS:2720 (Part .III) 1980 Sect/1
  3. Determination of specific gravity of fine-grained soil IS: 2720 (Part. III) 1980 Sect/2
  4. Determination of specific gravity of fine, medium & coarse-grained soil. IS: 2720 (Part. III) 1980 Sect/2
  5. Grain size analysis IS:2720 (Part.4) 1985
  6. Determination of Liquid and plastic limit IS:2720 (Part.5) 1985
  7. Determination of shrinkage factors IS: 2720 (Part. VI) 1987
  8. Determination of water content - dry density relation using light compaction. IS: 2720 (Part. VII) 1980
  9. Determination of water content - dry density relation using heavy compaction.IS:2720 (Part.8) 1983
  10. Determination of water content - dry density relation using constant wt. soil method. IS:2720 (Part IX) 1971
  11. Determination of unconfined compressive strength IS: 2720 (Part. X) 1991
  12. Determination of shear strength parameters (tri-axial) without measurement of pore pressure parameters (Tri-axial compaction) IS:2720(Part. XI) 1971
  13. Determination of shear strength parameters (Tri-axial compaction) IS: 2720 (Part. XII) 1981
  14. Direct shear test IS: 2720 (Part. XIII) 1986
  15. Determination of Density Index (R.D) of cohesion less soil.IS:2720 (Part.14) 1983

16. Determination of consolidation properties IS:2720 (Part.15) 1986
17. Determination of permeability IS:2720 (Part.17) 1986
18. Determination of dry density of soils, in place by the sand replacement method. IS:2720 (Part.28) 1974
19. Determination of dry density of soils, in place by the core-cutter method.IS:2720 (Part.29) 1975
20. Laboratory vane shear test. IS:2720 (Part.30) 1980
21. Determination of the density in place by the ring and water replacement method.IS:2720 (Part.33) 1971
22. Determination of free swell index of soils IS: 2720 (Part. XI) 1977
23. Measurement of swelling pressure of soils. IS: 2720 (Part. XII) 1978
24. Classification and identification of soils for General Engineering purposes.IS:1498 1970

- **Soil Properties and its Testing**

1. IS 2720 (All Parts)

Public Safety Standards of the Republic of India

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IS 1200-1 (PDF)	1992	Methods of measurement of building and civil engineering works, Part 1: Earthwork
IS 1200-10 (PDF)	1973	Method of measurement of building and civil engineering works, Part 10: ceiling and linings

IS 1200-11 (PDF)	1977	Method of measurement of building and civil engineering works: Part11 paving, floor finishes dado and skirting
IS 1200-12 (PDF)	1976	Method of Measurement of Building and Civil Engineering Works, Part XII: Plastering and Pointing
IS 1200-13 (PDF)	1994	Method of measurement of building and civil engineering works, Part 13: Whitewashing, colour washing, distempering and painting of building surfaces
IS 1200-14 (PDF)	1984	Method of measurement of building and civil engineering works, Part 14: glazing
IS 1200-15 (PDF)	1987	Method of measurement of building and civil engineering works, Part 15: painting, polishing, varnishing etc
IS 1200-16 (PDF)	1979	Method of measurement of building and civil engineering works, Part 16: laying of water and sewer lines including appurtenant items
IS 1200-18 (PDF)	1974	Method of measurement of building and civil engineering works, Part 18: demolition and dismantling
IS 1200-19 (PDF)	1981	Method of Measurement of Building and Civil Engineering Works, Part XIX: Water Supply, Plumbing and Drains
IS 1200-2 (PDF)	1974	Method of measurement of building and civil engineering works, Part 2: concrete works
IS 1200-20 (PDF)	1981	Method of measurement of building and civil engineering works, Part 20: laying of gas and oil pipelines
IS 1200-21 (PDF)	1973	Method of measurement of building and civil engineering works, Part 21: wood-work and joinery
IS 1200-22 (PDF)	1982	Method of measurement of building and civil engineering works, Part 22: materials
IS 1200-23 (PDF)	1988	Method of measurement of building and civil engineering works, Part 23: piling
IS 1200-24 (PDF)	1983	Method of measurement of building and civil engineering works, Part 24: well foundations
IS 1200-25 (PDF)	1971	Method of measurement of building and civil engineering works, Part 25: tunnelling
IS 1200-26 (PDF)	1987	Method of measurement of building and civil engineering work, Part 26: Acid resistant lining

IS 1200-27 (PDF)	1992	Method of measurement of building and civil engineering works, Part 27: Earthwork done by mechanical appliances
IS 1200-28 (PDF)	1992	Methods of building and civil engineering works, Part 28: Sound insulation works
IS 1200-3 (PDF)	1976	Method of Measurement of Building and Civil Engineering Works, Part III: Brickwork
IS 1200-4 (PDF)	1976	Method of measurement of building and civil engineering works, Part 4: stone masonry
IS 1200-5 (PDF)	1982	Method of measurement of building and civil engineering works, Part 5: form work
IS 1200-6 (PDF)	1974	Method of measurement of building and civil engineering works, Part 6: refractory work
IS 1200-7 (PDF)	1972	Method of measurement of building and civil engineering works, Part 7: hardware
IS 1200-8 (PDF)	1993	Method of measurement of building and civil engineering works, Part 8: steel work and iron work
IS 1200-9 (PDF)	1973	Method of measurement of building and civil engineering works, Part 9: roof covering (including cladding)
IS 3861 (PDF)	2002	Method of Measurement of Plinth, Carpet and Rentable Area of Buildings
SP 27 (PDF)	1987	Handbook of Method of Measurement of Buildings Works

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