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An Application and Management of Green Technology in Construction Projects

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ABSTRACT

As the construction activities increase rapidly day by day, construction industries provides huge contribution to the global warming because the activities of construction involve the usage of fossil fuels which emits a lot of toxic gases which is very harmful to humans and the environment. Furthermore, the buildings and projects constructed also contribute greatly to the global warming because these buildings need power, and most of them are powered by conventional power plants which use also highly polluting fossil fuels such as coal and oil. This mix of environmental impact from the actual building construction itself and from the operation of these buildings after construction is one of many human activities that lead to the emission of greenhouse gases, especially the carbon dioxide (CO2).

The aim of this project is to minimize the environmental impact of construction process and maximize both economic viability and the social benefits of construction works, by providing proper management in construction projects. With the help of proper management in construction projects we can reduce the effect of global warming to humans and the environment.

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In this project, we deal with the Application of green technology in the construction projects. Also it deals with the project management approaches required for delivering a successful green construction project with the concepts of a conventional constructional project. By performing the analysis of different management knowledge areas for managing green projects, we can deliver a cost-conscious successful green constructions. Our project also deals with the Environmental benefits of green technology in construction projects.

INTRODUCTION

In today's world of climate change and high energy prices, it is critical that buildings use as few fossil fuels (including coal generated electricity) as possible to "future proof" the home against unpredictable and rapidly rising prices.

Fossil fuels currently provide 95 percent of the world's commercial energy supply, whereas renewable energy sources supply less than three percent. If we are going to approach our future with foresight, it would be wise to reduce our consumption of fossil fuels and invest in renewable energy at home as soon as possible. The green innovations embraced in infrastructural offices underline on the "three R's" or RRR of natural preservation viz., lessen, reuse and reuse. At this stage it is critical to recognize what is implied by "Green Technology in Construction Projects".

According to **International Journal of Engineering Research & Management Technology** global energy uses by different sectors are as follows:

The maximum amount of energy consumption is done by Building sector i.e. 45%. Thus, In order to reduce such consumption of energy, It become very essential for us to use Green Technology instead of Conventional Techniques.

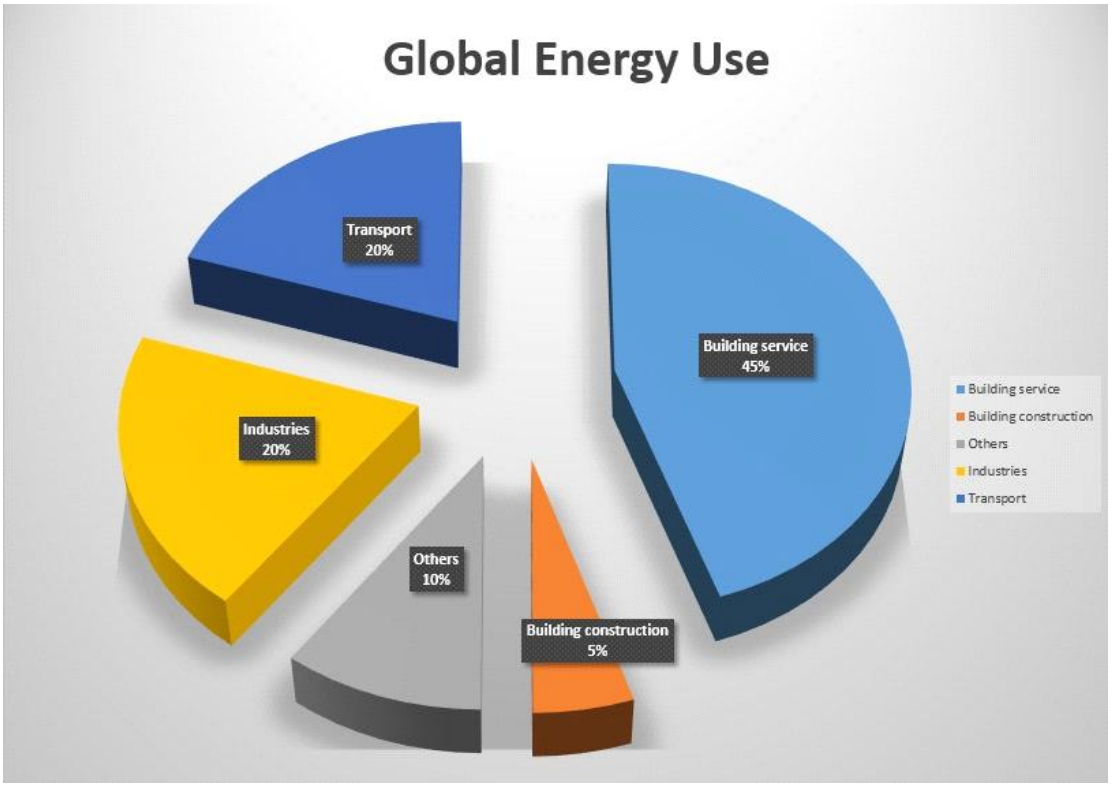

FIG 1.1 Energy used by Different Sectors

1.2 Green Technology in Building Construction

The term green technology refers to technology that is considered environmentally friendly based on its production process or supply chain; a means of energy production that is less harmful to the environment than more traditional ways of generating energy, such as burning fossil fuels.

Green technology has become one of the hottest trends in construction. Green technology makes the structure more energy-efficient and sustainable, so they have a lower carbon footprint and a reduced impact on the environment. The advantages of a green innovation application in development are extensive and far reaching offering critical favorable position when utilized as a part of new facilities and additionally in existing facilities.

As we know that buildings also produce Carbon Dioxide (CO2) emissions, but this sector receives less attention compared to other pollution contributors such as the transportation and industry sectors. In addition to green technology measures in construction works would be an advantage to the building sector as it will reduce the carbon dioxide emissions.

The basic principles of sustainable design or 'green design' as it is popularly known, are to aim for maximum resource conservation, to enhance efficient utilization of non-renewable resources by adopting efficient systems and to maximize use of renewable forms of energy as well as to recycle and reuse resources. These principles need to be applied throughout the building life-cycle e.g. during the site planning and development stage, building planning and construction, and building operation and maintenance.

GREEN BUILDING is one that incorporates the use of clean and renewable energy, efficient use of water and use of recycled or recyclable materials, and provides for healthy indoor air quality. Buildings are responsible for 40 per cent of the world's energy consumption. The green building concept helps to conserve energy. Today the world requires high performance, low energy buildings offering long-term sustainability.

TECHNOLOGY USED IN GREEN CONSTRUCTION

The different technologies used in green building construction are as follows:

1.2.1.1. Rain Water Harvesting in Building:

Rainwater harvesting (RWH) is one of the most efficient process of collecting and storing rainwater that falls on a catchment surface for use, independent from, or supplemental to the mains water supply. This reduces demand on the mains supply and offers some resilience from local supply problems and ultimately reduces the amount of energy used for water treatment and transportation.

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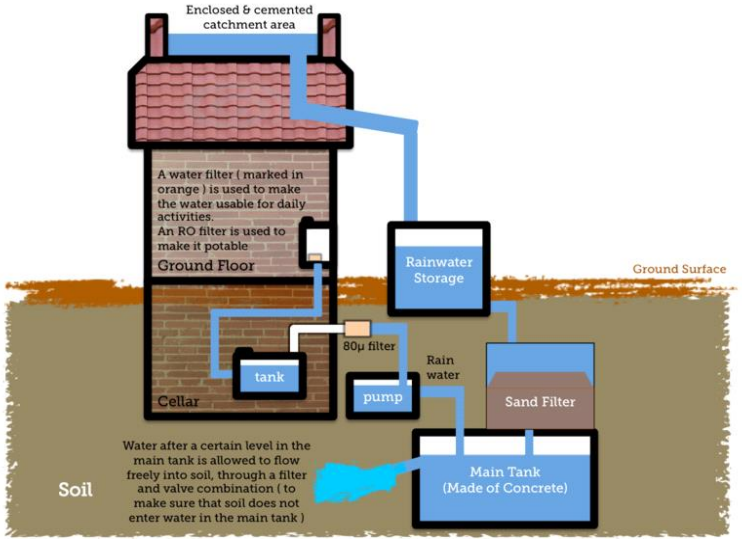

Fig 1.2.1.1. Rain water harvesting

1.2.1.2 Green Insulation:

Green insulation is one of the best way to insulate a building and to have a well-defined thermal boundary. The thermal boundary produced in green insulation, separates the conditioned (heated or cooled) spaces from outdoor or unconditioned areas. A building ought to be protected ceaselessly around the warm limit, including corners and edges.

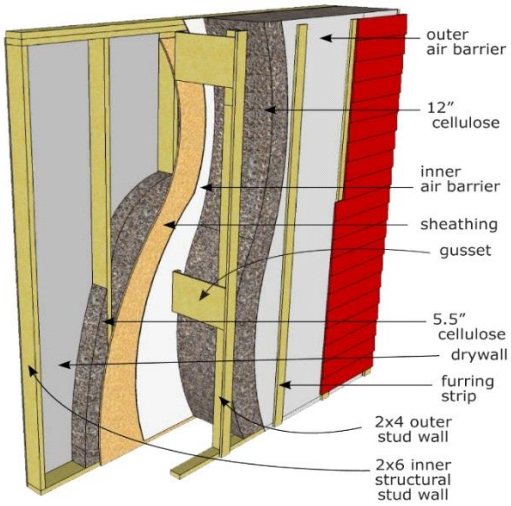

Fig 1.2.1.2. Cellulose Insulated Walls

The surface of ducts and furnace cabinets present outside the thermal boundary, generally in an unfinished basement, also get insulated. An extremely basic issue that by and large emerges while making a warm limit is warm connecting, which happens when conductive materials traverse over an obstruction and enable warmth to spill out of one side to the next. If an insulation is placed between wooden studs but not covering the studs, the wood will continue to conduct heat through the wall. To limit the warm crossing over for the most part conductive materials, for example, wood, steel, and aluminum is being utilized, or by including warm breaks so conductive materials are not in contact with each other.

In order to minimize such issue cellulose insulation is generally used. Cellulose insulation often consists of 75 to 85 percent recycled material, which is greater than fiberglass' i.e. 30 to 40 percent, and cellulose is even better at preventing airflow than fiberglass. Cellulose and cotton are definitely better choices when it comes to green insulation.

1.2.1.3. Geothermal Heating:

Geothermal heating is an efficient renewable energy resource that's far more environmentally friendly than coal-powered electricity or natural gas. In this technology, A water mixture is pumped through pipes lied underground to collect thermal energy and then this water is routed to a heat pump and takes that energy and puts it to use to heat or cool your house. To power the heat pump generally electricity is being used, the efficiency of the geothermal system means that we will get far more energy from the pump than we pour into it.

1.2.1.4. Solar power:

Solar energy is one of cleanest, renewable energy sources available which is the largest current energy source for earth surface. Solar energy is generally classified into two categories i.e. Passive solar power and Active solar power.

Passive solar home design simply uses the sun's rays to heat a home by directly falling the rays through windows. In order to warm the home, large sets of windows let in solar energy, and a heat-absorbing surface such as dark wall retains this heat.

While Active solar systems obviously provide very large amount of heat than passive solar design. In this technique, solar panels absorb the sun’s radiation and use the heat to warm air or water, cutting down on gas or electricity consumption. The efficiency of solar panels depend upon the size of the system and the surrounding climate. In any case, given the correct

conditions, a solar system will compensate for the in advance expenses of establishment over the long haul with long periods of free vitality.

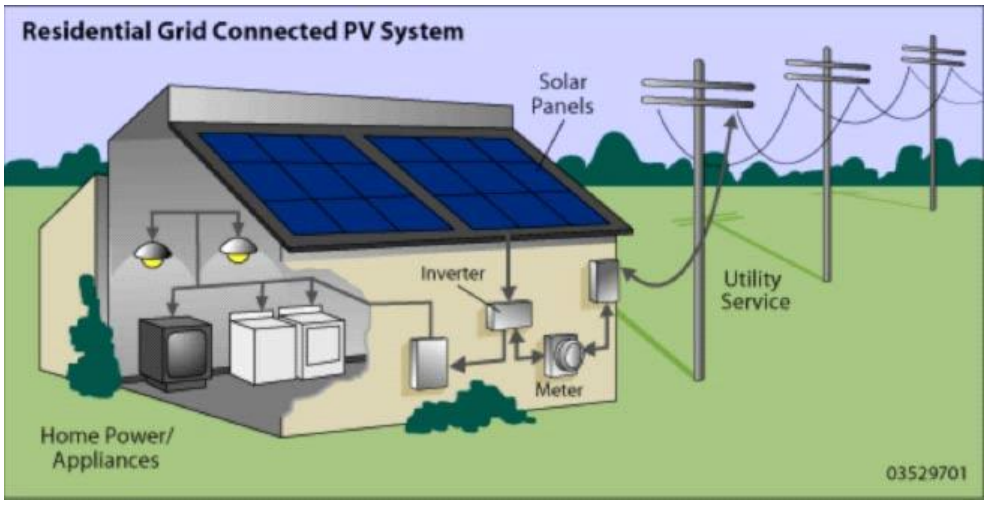

Fig 1.2.1.4. Solar Power in Green Building

1.2.1.5. Electro chromic glass:

Smart glass, or electro chromic glass is one of the efficient green technique in which the glass uses a tiny burst of electricity to charge ions on a window layer and change the amount of light it reflects. While low-emittance windows that stops a portion of the sun's radiation as of now exist, savvy glass enables you to pick how much light you need to square. Integrated with savvy building control systems, skyscrapers could have a huge number of windows tint consequently amid crest hours and come back to finish straightforwardness in the nighttimes. Brilliant glass designers expect a 25 percent diminishment in HVAC costs because of the dynamic windows. Electro chromic glass is as yet being idealized for business utilize, yet hope to see a greater amount of the glass in the coming a very long time as contending engineers convey this keen vitality sparing innovation to the market.

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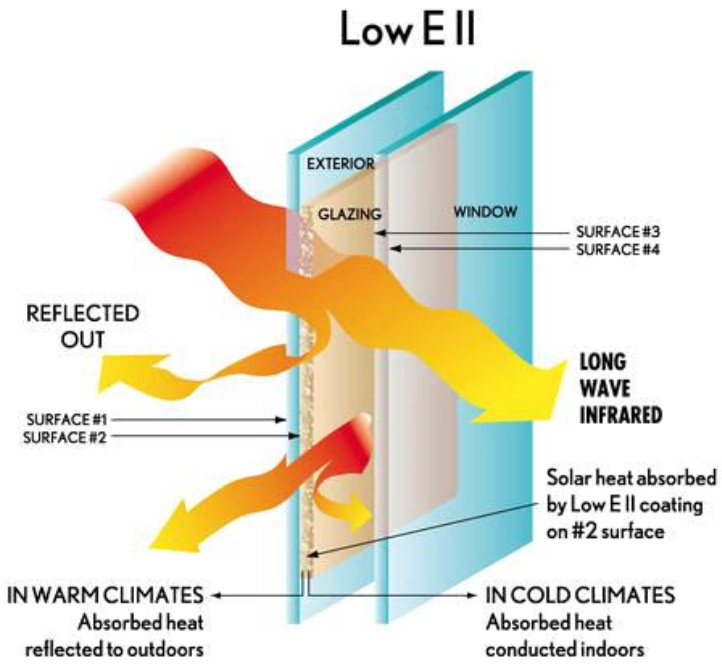

Fig.1.2.1.5. Electro chromic glass

2. METHODOLOGY

2.1. Process of Methodology

The process of methodology consist of seven steps is given in figure 3.1,

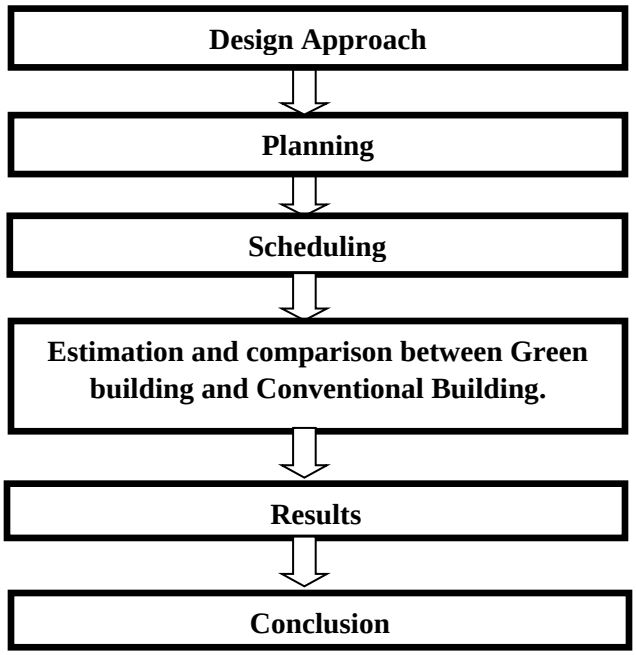

Fig.4.1 Methodology Process

2.2. Design Approach

The idea goes for creating plan type of a working to incorporate the three fundamental components of atmosphere i.e. light, air and water into the manufactured condition. This three components of nature, upon their incorporation into the constructed shape have their useful and in addition tasteful effect. Their useful part is much critical in current circumstance as a cutting edge building isn't just among the most exceedingly awful polluter of atmosphere yet additionally the biggest purchaser of vitality.

Instinctive approach – Intuitions are the considerations and inclinations that ring a bell rapidly, in light of a specific winning condition, absent much reflection upon the scientific information or systematic estimations. When outlining a building, a creator does not begins with all the diagnostic information that is accessible, however the fashioner takes after a few instincts to build up a frame, most appropriate to the nearby climatic conditions, required spatial association, practical appropriateness, advancement of shape and stylish interest.

Madhya Pradesh is a landlocked state at the core of India, having "hot dry and composite" climatic conditions. The difficulties in planning for sweltering dry and composite atmosphere are: warm is welcome in winter yet avoidable in summer; wind is welcome amid sticky months however avoidable amid winters and sweltering summers. The central point that influence an atmosphere responsive outline could be recognized as-

1. Shape
2. Orientation
3. Heat
4. Air
5. Water
6. Light

2.2.1. Shape:

State of any building creates from a base frame one essential rule for choosing the base shape is surface territory to volume proportion. It depends on the idea that diverse geometric shapes with same volume have distinctive surface territories. This proportion is especially critical in the situations where the climatic mediation is significant factors in planning. The last building structure develops from this reasonable base-shape. A building structure having low S/V

proportion picks up warms amid summers and daytime and correspondingly loses lesser warmth amid winters and night. Low s/v proportion is viewed as ideal for hot dry and composite atmospheres as it lessens the warmth pick up and warm misfortune, which thus decreases the cooling and warming heap of building. The s/v proportion shows warm execution of fundamental shapes as opposed to complex ones. The most reduced symmetrical building would be a solid shape. In any case, for day lighting and ventilation, extensive zones presented to outside surfaces are viewed as great. Subsequently 3D shape is extended to expand its surface region and frame cuboids, which is a square shape in design. The bargain made with the thermal performance of the external envelop can be compensated by using insulating material in outside texture. The effectiveness accomplished through legitimate day lighting and ventilation by expanded surface region is an extra preferred standpoint. The warm execution could be balanced by appropriate introduction of building square.

2.2.2 Orientation:

In the wake of choosing the base shape, the subsequent stage is to situate the square. In northern side of the equator, north exterior of the building does not get any immediate sun oriented radiation, though southern façade gets immediate radiation in winter however next to no in summer. Additionally sunlight got from north is viewed as best as light from north is diffused light which needs glare. Henceforth longer façade ought to be situated towards north-south. East and west dividers get most extreme solar radiation, particularly when the sun is low in height. Sun based pick up on west and south-west part can be especially troublesome as its greatest force harmonizes with most sizzling piece of the day. Along these lines, shorter veneer of the building shall face east west course.

To acclimatize the atmosphere into the constructed condition, it is basic to bring the light, air and water into the building so occupants get the chance to feel these components from outer veneers as well as from inside the building. Patio brings the indigenous habitat inside as well as controls the inner condition and serves the need of the occupants. It works as a convective indoor regulator and gives insurance from extraordinary impacts of sweltering summers and chilly winters. It additionally makes inclinations with shifting level of lights and shades and with them the feel of abode. Now, there is a rectangular block facing north-south, with central opening i.e. courtyard. To join light, air and water, it is required to additionally build up the arrangement frame. Right off the bat, separating the current square into four littler squares and adjusting each square in such away so as the altered type of each square fills a particular need.

Destinations for advance alteration of each square are-

1) To limit sun based radiation.

2) To bring air into building and enable it to go through the texture, ideally after humidification.

3) To put a water body in windward side, with the goal that it serves practically and helps in convective cooling of the building.

4) To acquire most extreme north light into work zones.

2.2.3 Heat:

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Sun oriented radiations from west and south-west bearing are most awkward and troublesome as the radiation power from these headings is greatest when the day is generally warmed. To limit these radiations, north western square is evacuated and south-western square is slanted with shorter façade confronting south west. Subsequently, just little surface gets immediate radiation and remaining appearances gets lesser radiation. This further diminishes the warmth pick up into the building. Littler face that gets immediate radiation can be protected utilizing empty squares or cavity dividers with extra screen dividers. In addition, these spaces can be utilized for non-adapted uses as toilets, stairs, stores and so forth that demonstration as buffer between habitable territories and appalling regions.

2.2.4 Air:

Air development is a pivotal factor for human solace. To carry the air into the structure, the most vital thing is to know the overarching wind course for the neighborhood, in the event of Raipur, is from south-west. To utilize this breeze, giving an opening in the southern veneer isn't sufficient. Alongside the south western square, that redirects the air towards the building, a distension of south-eastern square is required to trap this air. This makes a channel with wide mouth welcoming immense volume of air and tight back end pressurizing the air caught, consequently making a high weight zone. The courtyard, being under low pressure, attracts the pressurized air, which ventilates the premises byVenturi-impact.

2.2.5 Water:

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Stylishly, water anyplace around the building or all around the building looks outwardly satisfying. Be that as it may, from useful perspective in hot-dry and composite atmosphere, its arrangement ends up critical. If there should be an occurrence of Indore, the breeze originating from south-west is generally hot and dry and south west segment is additionally most warmed piece of the building. In this manner, south-west corner is right area for putting any water body. This water continues dissipating, cools and humidifies the in-streaming hot dry breeze, before it enters

the imprisonments of the structure. South western square could be stilted to extend water body into the courtyard and also allow air to pass through from under the stilted block.

2.2.6 Light

Most positive normal light for better working condition in insides is diffused north light giving longer north veneer and patio at Center permits abundant sunlight from both, outside façade and additionally inside yard confronting exteriors. For most extreme north light, northern and eastern squares are given with opening child north face. These squares can be the most possessed work region as these are slightest heated blocks with maximum north exposure. Northern facade is further modified form being straight to U-formed, bringing about expanded accessible window region.

2.3 Planning

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The numbers of plans of building are collected as per requirements, suitable in plan, design, analysis and execution. Among those plans sorting was done which fit into our requirements and are suitable in our climatic conditions. The sorted plans were observed, studied and also obtained new other ideas that can be adopted. The study of different plans gave the base of the plan. From the sorted plans the feasible parts of building is got selected and practiced to get a new creative plan. For this creation, lot many parts of plans are examined and clubbed all plans together creating a better plan. For planning the Institutional building the different shapes were considered which used before or can be adopted newly like orthodox, curves, and studied their features, effect, advantages and disadvantages. The effects of shapes also studied and analyzed are follows:

- **Effect of shapes**

The shape of a building has a significant effect on cost Seeley. The complex the state of a building the more costly its unit cost will be. In addition, structures with entangled or sporadic blueprints prompt an expanded border/floor region proportion which thusly results to a higher unit cost. A Building with complex outline will also result to an increased cost due to the fact that setting-out, ground work, and drainage work may be more complicated and uneconomical. The Block work and rooftop work will likewise be costly because of the mind boggling nature of the building delineated. Square molded structures are said to be the easiest arrangement shape which is more affordable to construct, despite the fact that it isn't generally a reasonable recommendation as there might be a trouble in arranging the inside design of huge square building. Border to-floor proportion, unit development cost and general task cost are influenced by variety fit as a fiddle many-sided quality or abnormality. The less difficult (or more muddled) the arrangement shape, the lower (or higher) the unit development cost will be. This is because of the way that the state of the building impacts essentially by number of building components, for example, establishments, dividers, roofs, floors or the rooftop.

- **Regular and irregular Shapes**

The simplest plan shape, that is a square building will be the most economical to construct. Square shaped structures would not generally be a practicable suggestion, since in abodes, littler workplaces, schools and healing centers structures an incredible significance is joined to the attractive quality of anchoring sufficient normal day lighting to most piece of the building. A perplexing (sporadic) structure would contain territories in the focal point of the building which would need sufficient common lighting. Additionally there might be a trouble in the arranging and inner design of the building.On account of circular structures, the encasing floor territory for the smallest edge is uneconomical and brings about major interior arranging issues. Comparing two buildings of rectangular and irregular shape, each of which has same floor area. Irregular shaped building where there is 6% more external walls to enclose the same floor area, setting out are increased by about 50% excavation cost about 20% and drainage cost by approximately 25%. The additional cost do not finish there as brick work and roofing will also be more costly due to the work being more complicated.

- **Effects of Plan Shapes on Total Cost of a Building.**

  The shape of a building has an important effect on construction cost of a building. Variation in plan shapes have a direct effect on the horizontal and vertical components of the building, example, walls portions, beams and columns with their associated finishing and decorations. Irregular shapes will also have effect on the construction cost in the aspect of services, therefore the number of subsidiary items which could be affected by a change in the shape of the building includes;

  Longer services and waste pipes to supply sanitary appliances depending on the plan shape.

Possibility of high roof cost due to increased number of corners which causes material wastage.

The Possibility of additional cost in applying finishing and decoration. The running cost of the completed building may also be affected by such factors as higher heat losses (windows and walls), window cleaning and painting. A junior organization of Royal institute of Chartered surveyors (RICS) in (1970) set up a research team to consider the effect of height and shape on building construction costs. This team studied a number of buildings with different shapes and height but the buildings all had a gross floor area of 95m2. The conclusions of the study of the research team were two in fold;

1. The total construction cost increases with increase in the perimeter wall length in relation to the floor area.

2. The expanded cost turns out to be very much articulated when the stature of the building is being expanded with extra floors without modifying the total floor area.

- **Effect of Plan Shape on Cost of Substructure**

The nature of the soil determines the strength of the soil. The strength of soil-lime mixture is dependent on many variables such as soil types, lime content, curing time, water content, method of compaction and cost. It is discovered that increase in temperature on curing lime soil lead to increase strength. If the soil is swampy there will be increase in cost because of the type of foundation will be changed from strip foundation to deep strip foundation which will increase the cost of substructure. If the soil is a rocky area, it depends on the depth to which the rock is located, if the rock is located at the surface, that calls for little explosion before construction commence. If otherwise then there will not be increase in cost of explosion. In 1970, Building research establishment has reported that foundation as a proportion of total building cost can vary from 8 to 18% and tend to decrease with increases in the number of storey. Adequate information on subsoil condition is vital before a decision can be made as to the most economical type of foundation.

- **Effect of Plan Shape on Cost of Superstructure**

The costs of superstructure vary considerably depending on block designs, and this element result to an additional construction cost of multi-storey projects over a traditional housing. The need for fire protecting walls, ceiling, floors and staircases in multi-storey buildings also leads to an increased construction costs. As described earlier, increased circulation ratios with multi-storey blocks will also produce higher unit usable floor space costs. In general three storey flats were about 30% more expensive that two-storey buildings, with costs related to a specific unit of floor area such as the square meter. Increasing the heights of blocks of flats from 3-5 storey raised cost by about 12% (6% per storey). This trend continued when the total height was further increased to 6-8 stories, with a further rise in costs of about 17%. The rate of increase in costs appeared surprisingly to flatten above eight stories in height to about a 2% addition per floor.

- **Effects of Plan Shape on Cost of Block work**

The significance of blocks in housing and construction in general cannot be over emphasized, as it is the most accepted walling unit by the public because of its peculiar resistance to fluctuating weather condition. As reported by that apart from availability and cheapness of building materials, quality of such materials are measured in line with durability, size, shape and strength. Walls and partition with associated windows and doors constitute a major item of expenditure of a building. For low rise buildings, cavity walls are generally, the lowest long term cost solution, provided satisfactory detailing and workmanship are secured. Stone facings are very expensive and care is needed to select a stone which is suitable for the particular environment.

- **Effect of Plan Shape on Cost of Frame Structure**

A frame may not be necessary in low-rise building, but generally costs tend to rise rapidly over the first few storey as the frame takes the loads imposed by a succession of upper floors. As for the foundation, the total frame cost will change at rates determined by two separate factors, that is, the vertical and horizontal loading. 1. The addition of upper floors requiring supporting beams will vary at the rate of change in the ratio of upper floor area to total floor area: The additional loading on the columns will require strengthening of columns or reducing bay sizes as the number of floors carried increase. If the total floor area remains constant, then the smaller building on plan will create more perimeter frame conditions and this will add a further cost factor. Moreover, on an irregularly shaped design, it may be easier to design a frame using steel in order to accept the disadvantages of irregularly sized columns and beam casings. Such design would also be possible in concrete, but the irregularity may also result in high costs for the framework.

- **Effect of Plan Shape on Cost of Roof work**

A cost investigation of low pads found that level rooftops were reliably higher than similar pitched rooftops, the additional cost summing all things considered to around 30%. With pitched rooftops sporadic formed squares brought about impressively expanded cost. For a multi-story building outline (where the aggregate rooftop cost is shared by a bigger number of abodes), a diminishment in rooftop development cost per staying unit is not out of the ordinary. On account of 3-4 story fabricating, the rooftop is frequently of comparative development to that utilized for 2-story structures. Material expenses of conventional block two-story structures ran from fourteen to eighteen percent of aggregate cost (the base being for a low pitched rooftop with low quality covering, and the most extreme for a piercing rooftop with superb covering).

- **Effect of Plan Shape on Cost of Services**

The main considerations that regularly have impact on human solace incorporate; rain, wind, temperature, mugginess, radiation, air volume and development, air virtue and ionization. Shittu et al. (2013) portrayed how structures and their natural administrations have turned out to be more mind boggling and the scope of decisions keeps on expanding. Specifically, ecological prerequisites are frequently viewed as excessively late in the plan procedure for them to make a positive commitment to the last outline. This is uneconomical when seen against the staggering expense of administrations establishments which may add up to as much as 25% of the aggregate expenses on a cutting edge lodging plan and half on a doctor's facility venture. Along these lines, there is a crucial requirement for incorporated plan arrangement with all masters contributing at each phase of the outline procedure. Also, take note of that administration expenses will increment with a seize three or four story when it ends up important to introduce a lift, despite the fact that the impact will diminish as extra story are included given the zone per floor is financially served. Likewise, structures with more mind boggling shapes require an extra course of action for acoustics, lightning and ventilation, most particularly a multi-story building.

- **Effect of Plan Shape on Cost of Finishes**

The impact of completing on the cost of structures in customary block two story structures, floors, stair and completions represent around 8-11% of the aggregate cost. With pads and maisonettes, floor completes by and large record for around 6% of aggregate expenses. Floor completes likewise shift impressively in unit cost and the thickness of ground surface can impact basic cost as a thick wrap up. The Economic particular of building arranged by Construction Section of Nigerian building and Road Research Institute (NABRRI, 1989) uncovered that 10%-15% cost is spared by putting with enhanced strategy utilizing triangular trowel and corner completing contraptions, concrete, paint, or distemper on dividers, steel and timber with indigenously made paint. After studying the effect of shapes on various criteria, the different shapes of building are analyzed. The different shapes taken into considerations are as follows:

Circular/Roundabout Shape

Previously, round structures were considerably more typical. Conventional roundabout safe houses incorporate igloos, tipis, African mud block cottages, yurts and British and European round structures. They were the state of decision since they were solid, vitality productive, useful for ventilation and air flow, less defenseless in solid breezes and they utilized minimal measure of materials with respect to floor territory.

Round structures accompany numerous advantages:

Less epitomized vitality

With regards to building outline, the principal decide is that a basic shape is significantly more supportable than an intricate shape. Of any shape, the circle has the most limited limit in respect to its zone. This implies for any given floor zone a round building has less divider length and along these lines less materials. The following most effective space is a square took after by a square shape.

Energy Efficient

Since round structures have less surface zone, in respect to floor space, there is less surface coming into contact with the climate outside. Accordingly, it takes less vitality to keep up their insides to agreeable temperatures. Round structures are additionally more streamlined and in this way, concede less drafts which likewise makes them more vitality productive.

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Seismic tremor and wind obstruction

In a round working there are many interconnected focuses which give the building an interesting mix of adaptability and quality – characteristics which make them fundamentally more secure in quakes.

The streamlined properties additionally make round structures more impervious to typhoon level breezes (and torrents so far as that is concerned). These same breezes, however, beat emphatically against the substance of conventional homes, in the end devastating these habitations if the breezes are sufficiently solid. Round structures are a decent option in zones inclined to powerful breezes and sea tempests. A rounded roof is less affected by wind planning which is when a strong wind lifts the roof structure up – and sometimes off the building.

More affordable

Round structures can cost fundamentally less to develop. Conventional structures, with their different surfaces, are confused structures. Round structures, however, are moderately basic, they utilize less materials and set aside less opportunity to manufacture. They utilize 15 to 20% less materials for every square meter (or square foot) than a rectangular plan! Less surface zone implies they are additionally less exorbitant to keep up after some time.

Better acoustics

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Sounds are gentler inside the building making it perfect for rest and reflection, yet in addition for mingling and playing music. The shape additionally opposes commotion infiltrating all things considered. Sound waves disseminate as they fold over the building, protecting the inside from boisterous clamor outside.

Rectangular shapes

For the most part, most structures embraced rectangular shape as there is ease in arranging, specifying, plan and furthermore for development. Prior quicker and more prudent to construct spaces inside rectangular shape are additionally more advantageous to determine. Absolutely, filling plot productively is the most evident reason, alongside making it less demanding to fit standard furniture and fitting. Anything non-symmetrical dangers winding up more costly to outfit or fit out. Taking in perspective of bending, plumbing line in the dividers.

With arrive restricted and significant, fitting a building effectively in a plot isn't just a characteristic tasteful choice however spare cash also. More noteworthy plot of building plots are rectangular or fit as fiddle, so developing in that kind of plot will give near model building. These are the most traditionalist and powerful ways to deal with collect a building; odd shape will be more confounded to create and cost more. This is considered down to business strategy for fitting in furniture and other inside things, which by chance seek most part in rectangular or square shape too. Adjusted game plans used more material, more resource and are costly to keep up; so rectangular or square shapes are better. Keeping in the perspective, the rectangular or square can be joined to make fascinating shapes like 'L, H, or T.'

E-shaped building

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Advantages of E-molded Building are as per the following:

Ventilation

It is watched that present development extends in the city were not giving great measure of ventilation in homes. A tad of research told that how helpful a very much ventilated building can be for the general population who live in it. In standard building outlines, it can give the same. Taking a gander at the plan, E molded structures give a great deal of degree to make vertical houses more ventilated, having a consistent stream of regular air.

Garden View

In consistent structures, not all structures get the advantage of having the garden see. Some of them confront the opposite side, which in the long run makes them troubled about the place they are remaining in. There is require an outline that satisfies everybody's longing to have a working with an excellent garden see. The E shape configuration was an ideal fit in that necessity also. Alongside ventilation, it likewise offers extension to give everybody an excellent garden see.

Daylight

The advantages of daylight are not escaped anybody. At the point when there is a working with enough daylight, it brings inspiration, as well as other medical advantages also. Amid daytime, it's a wonderful sight to see the rooms loaded with characteristic light. It diminishes the general utilization of power and its bills. With E shape outline, there's sufficient measure of space for

each home to have satisfactory measure of daylight, bringing about more Vitamin D and better invulnerable arrangement of the general population.

Returning to the roots

Investigating the idea of E-molded building, it looks like intensely with the structures that used to be in before times. Obviously the look and execution style is present day, however the center takes after to the structures our ancestors more likely than not lived in. In prior circumstances, building had a yard at the focal point of it with every one of the rooms looking towards it. This idea was one major motivation behind why individuals of prior circumstances has better wellbeing, and lived longer. We trust an E molded building is an advanced type of those old structures that gave a solid living.

Octagonal shape

More Interior Space

One preferred standpoint of an octagonal plan is that it gives around 20 percent more indoor space than a square building that has a similar border, on the grounds that an octagon encases more space than a square. The inside space likewise has less space-squandering corners. Early octagonal homes were regularly worked without corridors, depending rather on a focal hall for access to inside rooms. This expanded the usable space inside the octagon.

Construction and Energy

An octagon building was cheaper to build. Its shape consumed less exterior space and therefore required fewer construction materials. The space was more affordable to warm in winter since rooms opened into each other around focal anterooms. The building was less demanding to cool on the grounds that the windows gave cross ventilation.

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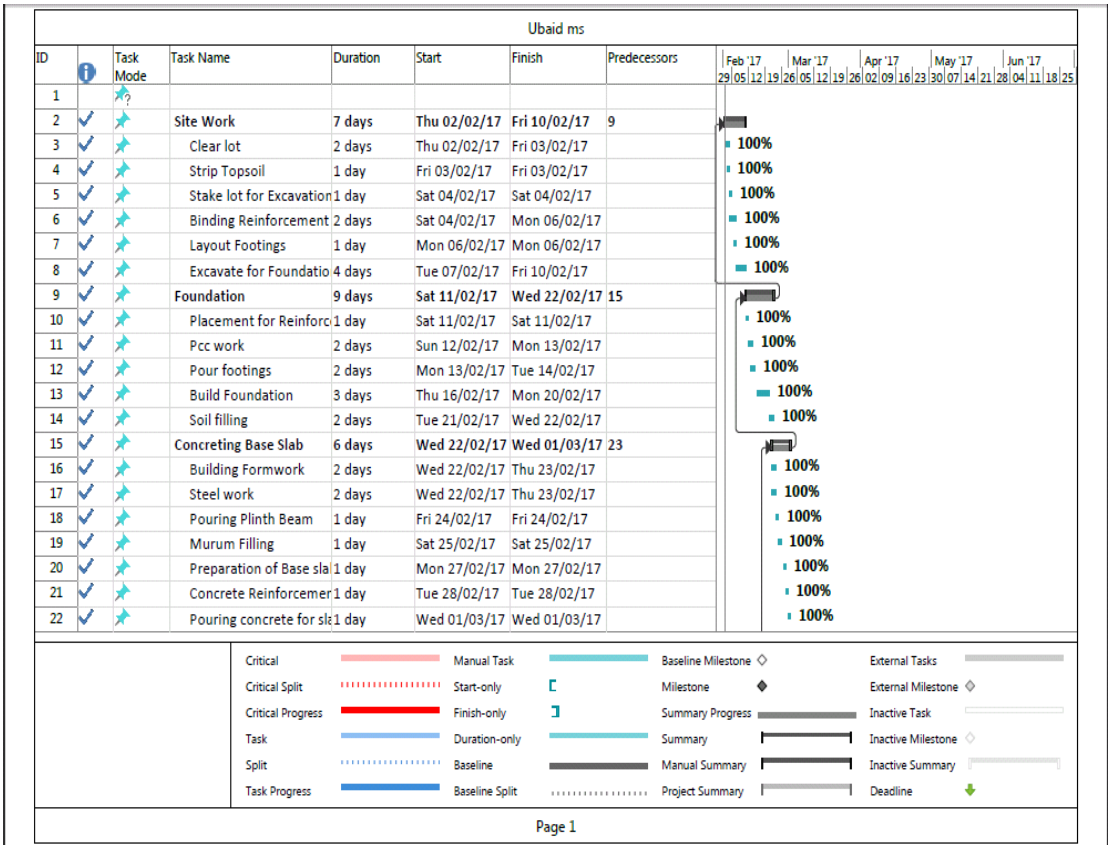
After critically studying the sorted data, the data collected for the project study was analyzed for our residential building. The plan of I-shaped building is observed and thought for the shape adoption which is suitable for our residential building.

2.4 Scheduling

The scheduling of our residential building is done through MS Project. The scheduling involve in our project are as follows:



ID	Task Mode	Task Name	Duration	Start	Finish	Predecessors
1						
2		Site Work	7 days	Thu 02/02/17	Fri 10/02/17	9
3		Clear lot	2 days	Thu 02/02/17	Fri 03/02/17	
4		Strip Topsoil	1 day	Fri 03/02/17	Fri 03/02/17	
5		Stake lot for Excavation	1 day	Sat 04/02/17	Sat 04/02/17	
6		Binding Reinforcement	2 days	Sat 04/02/17	Mon 06/02/17	
7		Layout Footings	1 day	Mon 06/02/17	Mon 06/02/17	
8		Excavate for Foundatio	4 days	Tue 07/02/17	Fri 10/02/17	
9		Foundation	9 days	Sat 11/02/17	Wed 22/02/17	15
10		Placement for Reinforc	1 day	Sat 11/02/17	Sat 11/02/17	
11		Pcc work	2 days	Sun 12/02/17	Mon 13/02/17	
12		Pour footings	2 days	Mon 13/02/17	Tue 14/02/17	
13		Build Foundation	3 days	Thu 16/02/17	Mon 20/02/17	
14		Soil filling	2 days	Tue 21/02/17	Wed 22/02/17	
15		Concreting Base Slab	6 days	Wed 22/02/17	Wed 01/03/17	23
16		Building Formwork	2 days	Wed 22/02/17	Thu 23/02/17	
17		Steel work	2 days	Wed 22/02/17	Thu 23/02/17	
18		Pouring Plinth Beam	1 day	Fri 24/02/17	Fri 24/02/17	
19		Murum Filling	1 day	Sat 25/02/17	Sat 25/02/17	
20		Preparation of Base sla	1 day	Mon 27/02/17	Mon 27/02/17	
21		Concrete Reinforcemer	1 day	Tue 28/02/17	Tue 28/02/17	
22		Pouring concrete for sl	1 day	Wed 01/03/17	Wed 01/03/17	

FIG 2.4.1 Scheduling

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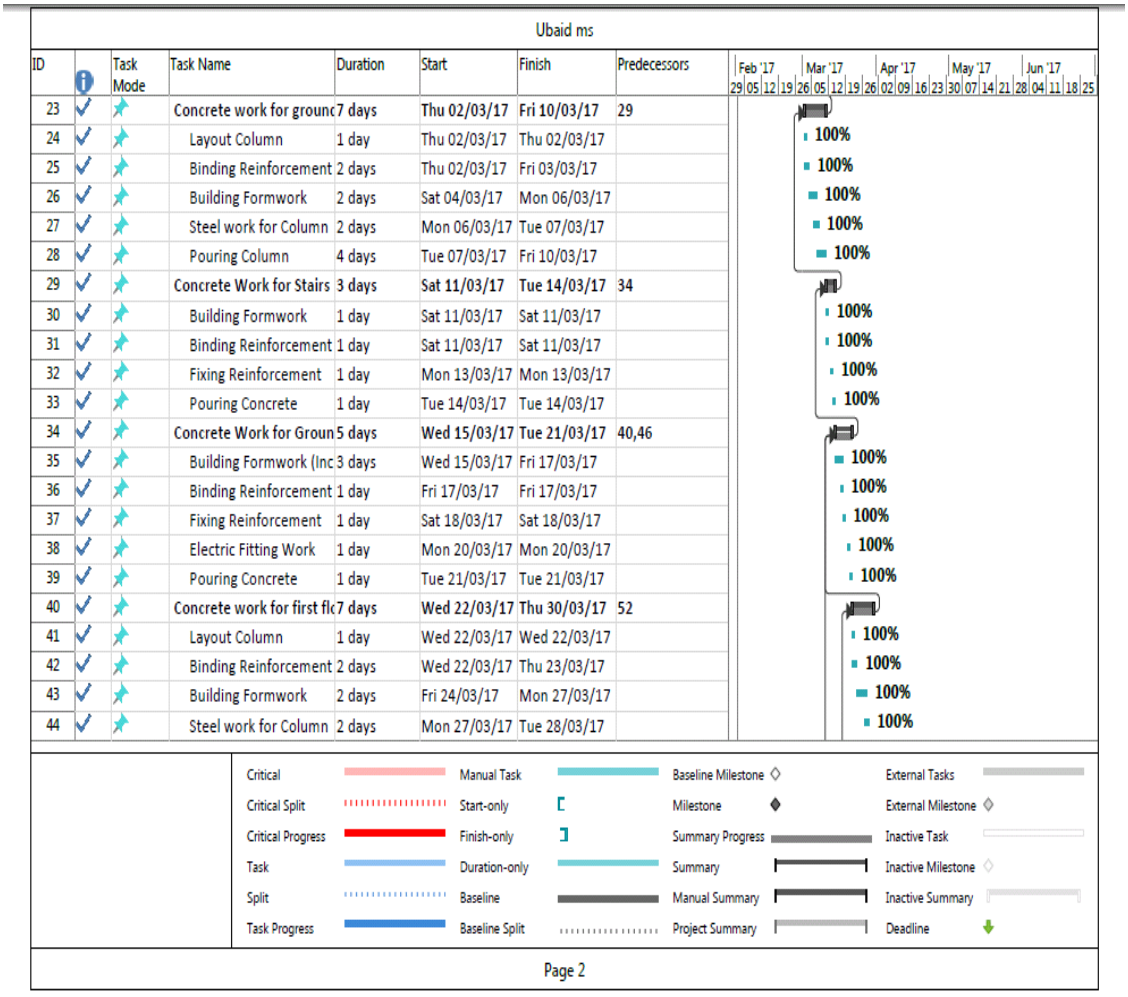

ID	Task Mode	Task Name	Duration	Start	Finish	Predecessors
23		Concrete work for ground	7 days	Thu 02/03/17	Fri 10/03/17	29
24		Layout Column	1 day	Thu 02/03/17	Thu 02/03/17	
25		Binding Reinforcement	2 days	Thu 02/03/17	Fri 03/03/17	
26		Building Formwork	2 days	Sat 04/03/17	Mon 06/03/17	
27		Steel work for Column	2 days	Mon 06/03/17	Tue 07/03/17	
28		Pouring Column	4 days	Tue 07/03/17	Fri 10/03/17	
29		Concrete Work for Stairs	3 days	Sat 11/03/17	Tue 14/03/17	34
30		Building Formwork	1 day	Sat 11/03/17	Sat 11/03/17	
31		Binding Reinforcement	1 day	Sat 11/03/17	Sat 11/03/17	
32		Fixing Reinforcement	1 day	Mon 13/03/17	Mon 13/03/17	
33		Pouring Concrete	1 day	Tue 14/03/17	Tue 14/03/17	
34		Concrete Work for Groun	5 days	Wed 15/03/17	Tue 21/03/17	40,46
35		Building Formwork (Inc	3 days	Wed 15/03/17	Fri 17/03/17	
36		Binding Reinforcement	1 day	Fri 17/03/17	Fri 17/03/17	
37		Fixing Reinforcement	1 day	Sat 18/03/17	Sat 18/03/17	
38		Electric Fitting Work	1 day	Mon 20/03/17	Mon 20/03/17	
39		Pouring Concrete	1 day	Tue 21/03/17	Tue 21/03/17	
40		Concrete work for first fl	7 days	Wed 22/03/17	Thu 30/03/17	52
41		Layout Column	1 day	Wed 22/03/17	Wed 22/03/17	
42		Binding Reinforcement	2 days	Wed 22/03/17	Thu 23/03/17	
43		Building Formwork	2 days	Fri 24/03/17	Mon 27/03/17	
44		Steel work for Column	2 days	Mon 27/03/17	Tue 28/03/17	

FIG 2.4.2. Scheduling

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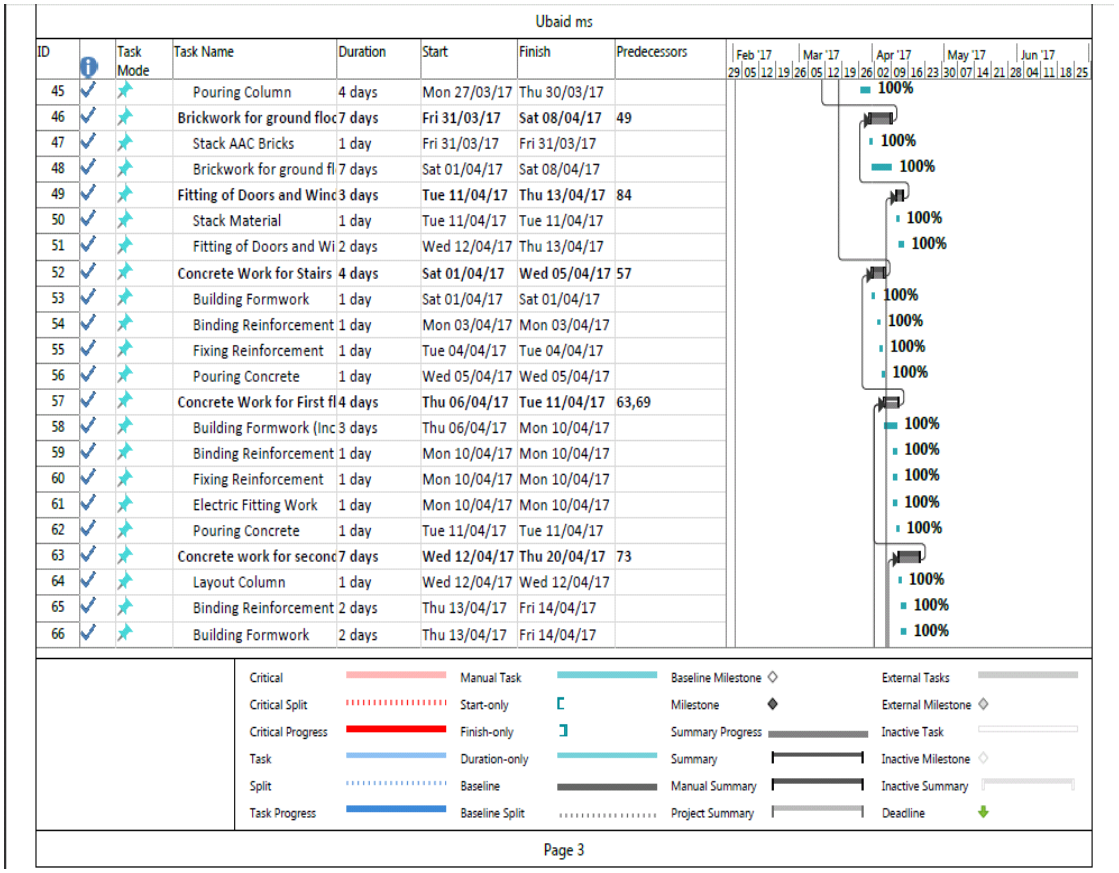

Ubaid ms

ID	Task Mode	Task Name	Duration	Start	Finish	Predecessors
45		Pouring Column	4 days	Mon 27/03/17	Thu 30/03/17	
46		**Brickwork for ground floc**	**7 days**	**Fri 31/03/17**	**Sat 08/04/17**	49
47		Stack AAC Bricks	1 day	Fri 31/03/17	Fri 31/03/17	
48		Brickwork for ground fl	7 days	Sat 01/04/17	Sat 08/04/17	
49		**Fitting of Doors and Winc**	**3 days**	**Tue 11/04/17**	**Thu 13/04/17**	84
50		Stack Material	1 day	Tue 11/04/17	Tue 11/04/17	
51		Fitting of Doors and Wi	2 days	Wed 12/04/17	Thu 13/04/17	
52		**Concrete Work for Stairs**	**4 days**	**Sat 01/04/17**	**Wed 05/04/17**	57
53		Building Formwork	1 day	Sat 01/04/17	Sat 01/04/17	
54		Binding Reinforcement	1 day	Mon 03/04/17	Mon 03/04/17	
55		Fixing Reinforcement	1 day	Tue 04/04/17	Tue 04/04/17	
56		Pouring Concrete	1 day	Wed 05/04/17	Wed 05/04/17	
57		**Concrete Work for First fl**	**4 days**	**Thu 06/04/17**	**Tue 11/04/17**	63,69
58		Building Formwork (Inc	3 days	Thu 06/04/17	Mon 10/04/17	
59		Binding Reinforcement	1 day	Mon 10/04/17	Mon 10/04/17	
60		Fixing Reinforcement	1 day	Mon 10/04/17	Mon 10/04/17	
61		Electric Fitting Work	1 day	Mon 10/04/17	Mon 10/04/17	
62		Pouring Concrete	1 day	Tue 11/04/17	Tue 11/04/17	
63		**Concrete work for seconc**	**7 days**	**Wed 12/04/17**	**Thu 20/04/17**	73
64		Layout Column	1 day	Wed 12/04/17	Wed 12/04/17	
65		Binding Reinforcement	2 days	Thu 13/04/17	Fri 14/04/17	
66		Building Formwork	2 days	Thu 13/04/17	Fri 14/04/17	

FIG 2.4.3 Scheduling

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ID	Task Mode	Task Name	Duration	Start	Finish	Predecessors
67		Steel work for Column	2 days	Sat 15/04/17	Mon 17/04/17	
68		Pouring Column	4 days	Mon 17/04/17	Thu 20/04/17	
69		**Brickwork for First floor**	6 days	**Mon 10/04/17**	**Mon 17/04/17**	71
70		Brickwork for First floo	6 days	Mon 10/04/17	Mon 17/04/17	
71		**Fitting of Doors and Winc**	2 days	**Tue 18/04/17**	**Wed 19/04/17**	86
72		Fitting of Doors and Wi	2 days	Tue 18/04/17	Wed 19/04/17	
73		**Concrete Work for Stairs**	3 days	**Fri 21/04/17**	**Tue 25/04/17**	78
74		Building Formwork	1 day	Fri 21/04/17	Fri 21/04/17	
75		Binding Reinforcement	1 day	Sat 22/04/17	Sat 22/04/17	
76		Fixing Reinforcement	1 day	Mon 24/04/17	Mon 24/04/17	
77		Pouring Concrete	1 day	Tue 25/04/17	Tue 25/04/17	
78		**Concrete Work for Secon**	4 days	**Wed 26/04/17**	**Mon 01/05/17**	92
79		Building Formwork (Inc	3 days	Wed 26/04/17	Fri 28/04/17	
80		Binding Reinforcement	1 day	Fri 28/04/17	Fri 28/04/17	
81		Fixing Reinforcement	1 day	Fri 28/04/17	Fri 28/04/17	
82		Electric Fitting Work	1 day	Fri 28/04/17	Fri 28/04/17	
83		Pouring Concrete	1 day	Mon 01/05/17	Mon 01/05/17	
84		**Plastering Work (Internal**	3 days	**Sat 29/04/17**	**Tue 02/05/17**	86
85		Plastering Work (Intern	3 days	Sat 29/04/17	Tue 02/05/17	
86		**Plastering Work (Internal**	3 days	**Wed 03/05/17**	**Fri 05/05/17**	88
87		Plastering Work (Intern	3 days	Wed 03/05/17	Fri 05/05/17	
88		**Brickwork for Second floo**	6 days	**Tue 02/05/17**	**Tue 09/05/17**	90

FIG. 2.4.4 Scheduling

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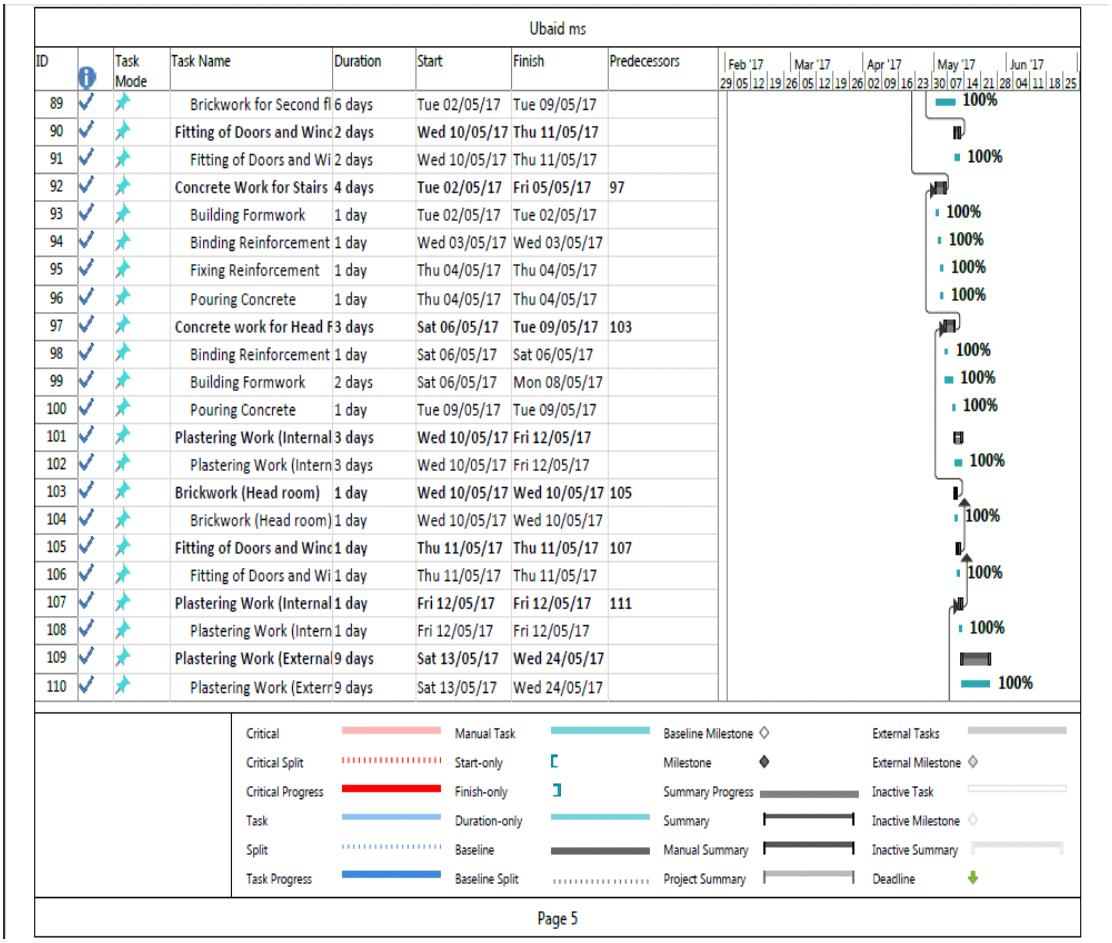

FIG. 2.4.5 Scheduling

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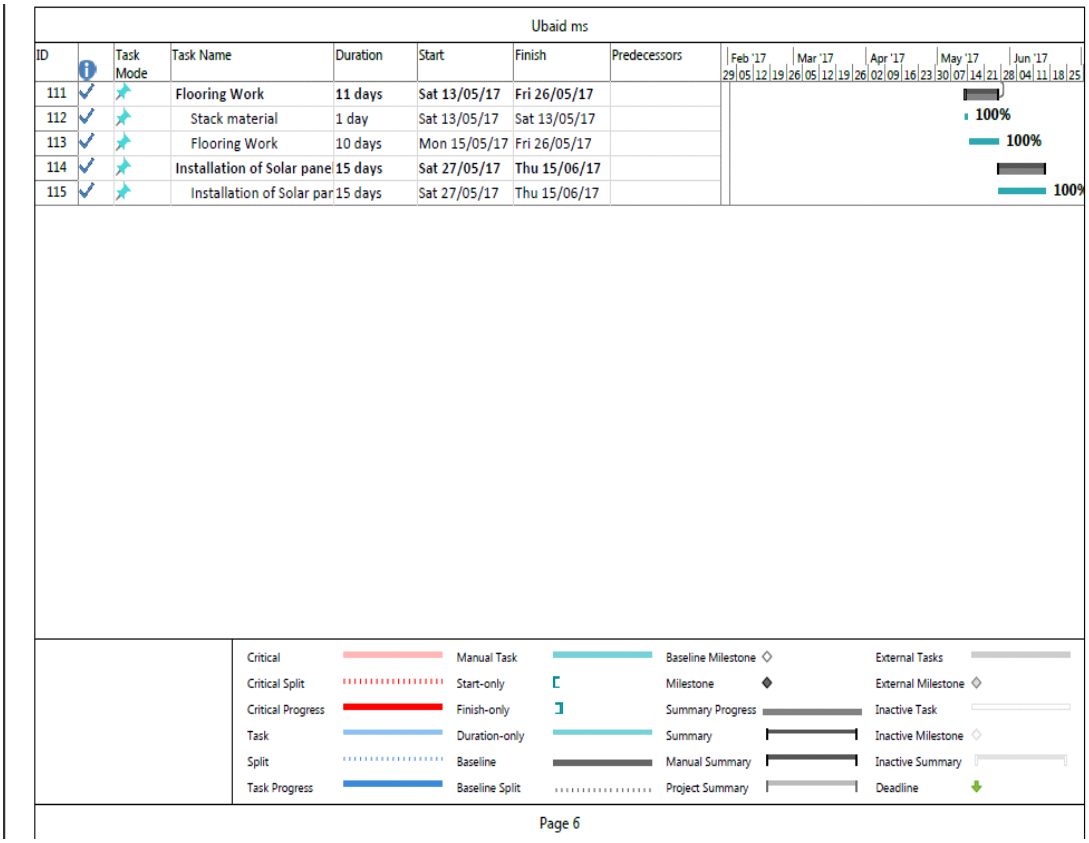

FIG. 2.4.6 Scheduling

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2.5. Comparison of Estimate between Conventional Building And Green Building

MATERIAL REPLACED IN GREEN BUILDING:

The table below shows different type of materials used in Conventional and Green building respectively for different items:

S.No.	ITEM	CONVENTIONAL MATERIAL	GREEN MATERIAL
1.	Flooring	Vitrified and Glazed tiles and China Mosaic	PVC Flooring, Glazed tiles and China Mosaic
2.	Doors	Pine wood	Engineering Wood
3.	Windows and Openings	Aluminum paneled Plain Glasses	Insulated (IG units) or Electro-chromic Glass
4.	Lighting Fixtures	Tube Lights and CFLs	Low Watt LED Tube Lights and Bulbs
5.	Plumbing Fixtures	Conventional Fixtures	Special green Fixtures
6.	Paints	Plastic VOC	Plastic Non VOC
7.	Bricks	Clay Bricks	AAC Bricks
8.	Cement	OPC	PPC
9.	Installation of Rain Harvesting System	Not Provided	Provided
10.	Installation of Solar Panel	Not Provided	Provided

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DETAIL OF G+1 R.C.C STRUCTURE:

A plan is proposed for estimate a G+2 storied R.C.C. framed residential building on a plot admeasuring 750 sq. ft. (69.70 sq. m.) The plot is fronting of on 7.0 m wide road. The key plan of the plot is enclosed is as shown in drawing. After leaving side margins as per general development control regulation the footprint of the building will be of the size of 15ft. X 42 ft. (I.e. 4.57m. X 12.80m.).

Specification of G+2 Building

TYPE OF STRUCTURE	G + 1 R.C.C. FRAMED STRUCTURE
General floor to floor height	3.1 m
No. of storied	G + 2
Plot Area	69.70 sq. m.
Built-up area	58.49 sq. m.
Carpet area	51.38 sq. m
Soil bearing capacity	300KN/m3
Flooring	PVC Flooring, Glazed tiles and China Mosaic
Thickness of wall	.10 m
Thickness of slab	.15 m
Plinth Height	.6 m

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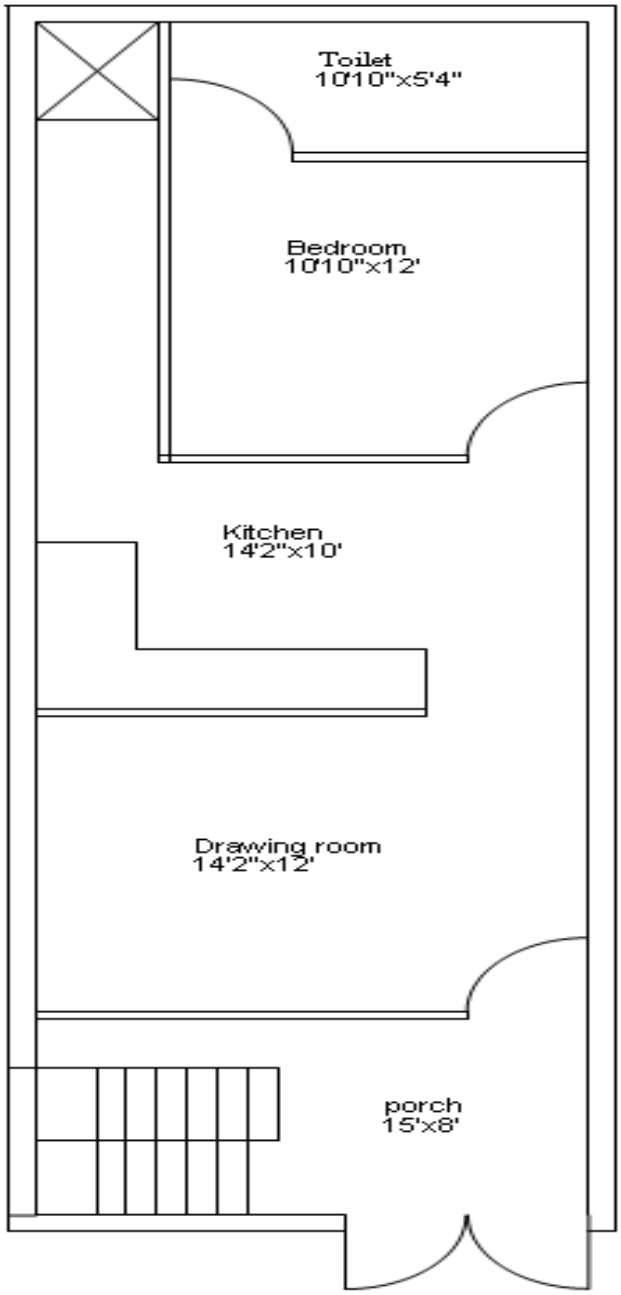

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FIG 2.5.1 GROUND FLOOR

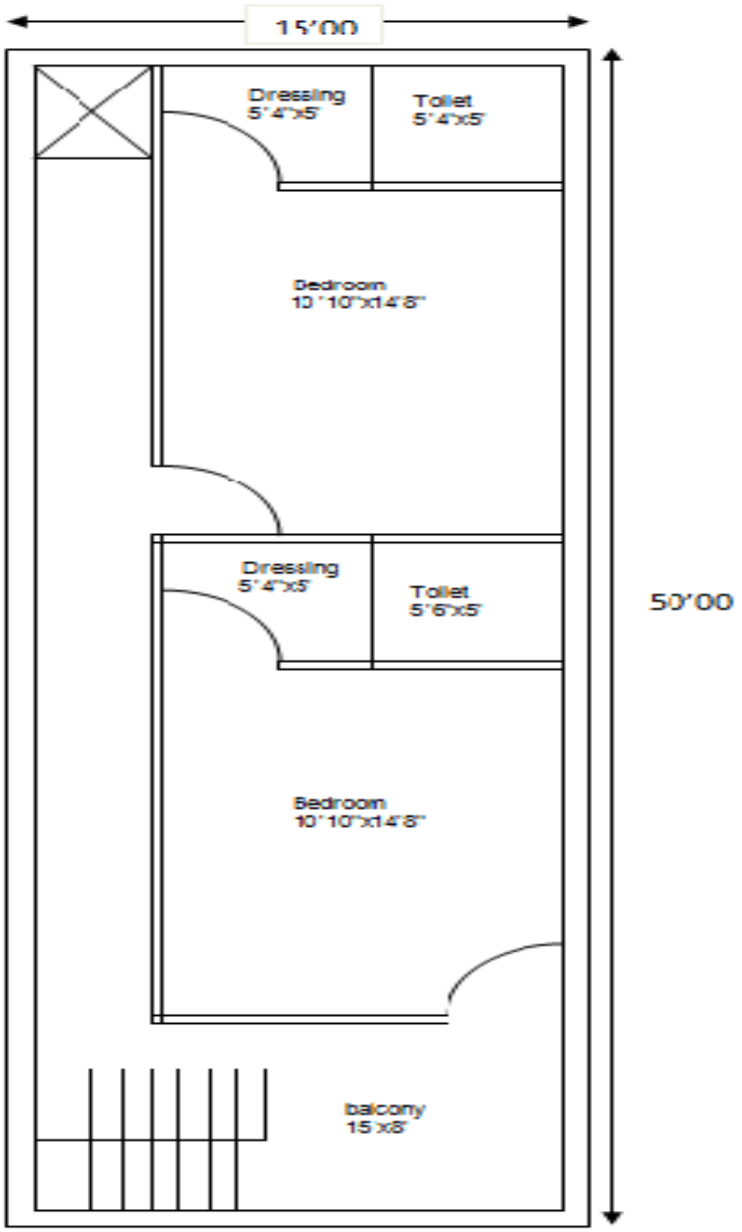

FIG 2.5.2. FIRST FLOOR

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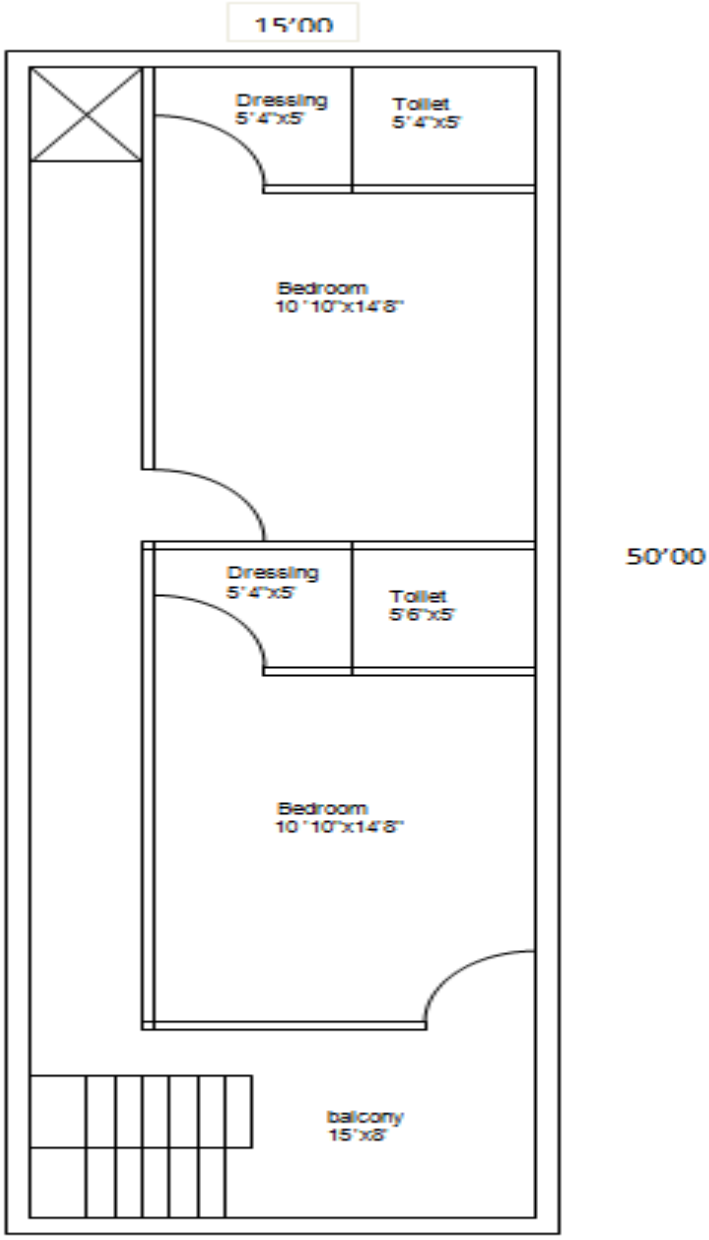

Second Floor

FIG 2.5.3. SECOND FLOOR

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S.NO	DESCRIPTION WORK			NOS	L	B	D	QTY	RATE	AMOUNT
1	**Earth work excavation in hard**									
	Soil for all column on Plinth Beams.									
	columns	1	x	8	3.00	0.3	0.3	2.16	300	648
	Sundries							0.71	300	213
							say	**2.87**	**300**	**861**
2	**Sand filling in foundation for**									
	columns	1	*	8	3.00	0.3	0.3	**2.16**	**400**	**864**
3	**P.C.C 1:5:10 using 40mm**									
	Metal as Flooring Concrete									
	and Flooring Concrete:									
	living	**1**	*	1	4.32	3.65	0.1	1.58	3500	5530
	kitchen	**1**	*	1	4.32	3.048	0.1	1.32	3500	4620
	bedroom	**1**	*	1	3.65	3.07	0.1	1.12	3500	3920
	toilet	**1**	*	1	3.07	1.64	0.1	0.5	3500	1750
								4.52	**3500**	**15820**
4	**Brickwork in CM1:5 using**									
	best quality country bricks									
	for Super Structure									
	Ground Floor									
	All walls	1	x	1	11.98		3	35.94	500.00	17970
	All walls	1	x	1	14.41		3.00	43.23	500.00	21615
	Partition walls	1	x	1	3.65		3.00	10.95	500.00	5475
	Partition walls	1	x	1	5.29		3.00	15.87	500.00	7935
	Partition walls	1	x	1	4.32		3.00	12.96	500.00	6480
	Lintel wall	1	x	1	4.32		3.00	12.96	500.00	6480
	First Floor									
	All walls	1	x	1	11.34		3.00	34.02	500.00	17010
	All walls	1	x	1	8.94		3.00	26.82	500.00	13410
	Partition walls	1	x	4	3.07		3.00	36.84	500.00	18420
	Partition walls	1	x	2	4.47		3.00	26.82	500.00	13410
	Partition walls	1	x	1	4.32		3.00	12.96	500.00	6480

	Second Floor									
	All walls	1	x	1	11.34		3.00	34.02	500.00	17010
	All walls	1	x	1	8.94		3.00	26.82	500.00	13410
	Partition walls	1	x	4	3.07		3.00	36.84	500.00	18420
	Partition walls	1	x	2	4.47		3.00	26.82	500.00	13410
	Partition walls	1	x	1	4.32		3.00	12.96	500.00	6480
	Deduction									
	Door-D	1	x	2	1.20		2.10	5.04	500.00	2520
	Door-D1	1	x	2	1.20		2.10	5.04	500.00	2520
	Window-W1	1	x	2	1.80		1.40	5.04	500.00	2520
	Window-W2	1	x	1	0.90		1.40	1.26	500	630
	Ventilator-V	1	x	1	1.20		0.60	0.72	500	360
	Sundries							0.71	500	355
								424.64	**500**	**212320**
5	**R.C.C 1:1.5:3 using 20mm metal**									
	for Columns roof Slab Lintel									
	BeamSunshades,Stair case etc.,									
	Ground Floor									
	Columns	1	x	8	3.00	0.3	0.3	2.16	3900	8046
	Plinth Beam	1	x	11	1.50	0.3	0.4	1.98	3700	7326
	Lintel	1	x	3	1.20	0.2	0.25	0.18	3700	666
	Staircase	1	x	1	2.80	1.8	3	15.12	3900	58968
	Cantilever	1	x	3	1.64	0.2	0.3	0.30	3700	1092.24
	Roof	1	x	1	10.67	4.57	0.125	6.10	3725	22704.76
	temple roof	1	x	1	1.21	1.21	0.1	0.15	3700	541.717
	First Floor									
	Columns	1	x	7	3.00	0.3	0.3	1.89	3900	7371
	Lintel	1	x	3	1.50	0.2	0.25	0.23	3700	832.5
	Staircase	1	x	1	2.80	1.8	3	15.12	3900	58968
	Roof	1	x	1	10.67	4.57	0.125	6.10	3725	22704.76
	Second Floor									
	Columns	1	x	7	3.00	0.3	0.3	1.89	3900	7371
	Lintel	1	x	3	1.50	0.2	0.25	0.23	3700	832.5
	Staircase	1	x	1	2.80	1.8	3	15.12	3900	58968
	Roof	1	x	1	10.6	4.57	0.125	6.10	3725	22704.76

					7					
							TOTAL	**72.67**		**279097.26**
6	**Fabrication of Steel For all**									
	R.C.C works							**35,000**	**50.00**	**1750000**
7	**Woodwork in best quality teak**									
	wood for all doors and									
	Windows									
	Door-D	1	x	8	1.20		2.1	20.16	2500.00	50400
	Door-D1	1	x	3	0.90		2.1	5.67	1800.00	10206
	Window-W1	1	x	6	1.80		1.4	15.12	1200.00	18144
	Window-W2	1	x	3	0.90		1.4	3.78	1200	4536
	Ventilator-V	1	x	3	1.20		0.6	2.16	1000	2160
	Sundries							0.29	1000	290
								47.18		**85736**
8	**Wall Plastering CM 1:5 for**									
	both Outer and Inner walls									
	Ground Floor									
	Living	1	x	2	4.32		3	25.92	150.00	3888
	Living	1	x	4	3.65		3	43.80	150.00	6570
	Kitchen	1	x	2	4.32		3	25.92	150.00	3888
	Kitchen	1	x	2	3.05		3.00	18.29	150.00	2743.2
	Bed	1	x	2	3.65		3.00	21.90	150.00	3285
	Bed	1	x	2	3.07		3	18.42	150.00	2763
	Toilet	1	x	2	3.07		3	18.42	150.00	2763
	Toilet	1	x	2	1.64		3	9.84	150.00	1476
	Passage	1	x	2	5.29		3	31.74	150.00	4761
	Passage	1	x	2	3.00		3	18.00	150.00	2700
	Passage	1	x	1	2.40		3	7.20	150.00	1080
	Staircase	1	x	2	2.80		3	16.80	150.00	2520
	First Floor									
	bed room1	1	x	3	3.30		3.00	29.70	150.00	4455

	bed room1	1	x	3	4.47		3.00	40.23	150.00	6034.5
	bed room	1	x	2	3.30		3.00	19.80	150.00	2970
	bed room	1	x	3	4.47		3.00	40.23	150.00	6034.5
	Toilet	1	x	2	3.30		3	19.80	150.00	2970
	Toilet	1	x	1	1.52		3	4.57	150.00	685.8
	Toilet	1	x	3	3.30		3	29.70	150.00	4455
	Toilet	1	x	1	1.52		3	4.57	150.00	685.8
	Passage	1	x	2	4.57		3	27.43	150.00	4114.8
	Passage	1	x	2	15.24		3	91.44	150.00	13716
	Second Floor									
	bed room1	1	x	3	3.30		3.00	29.70	150.00	4455
	bed room1	1	x	3	4.47		3.00	40.23	150.00	6034.5
	bed room	1	x	2	3.30		3.00	19.80	150.00	2970
	bed room	1	x	3	4.47		3.00	40.23	150.00	6034.5
	Toilet	1	x	2	3.30		3	19.80	150.00	2970
	Toilet	1	x	1	1.52		3	4.57	150.00	685.8
	Toilet	1	x	3	3.30		3	29.70	150.00	4455
	Toilet	1	x	1	1.52		3	4.57	150.00	685.8
	Passage	1	x	2	4.57		3	27.43	150.00	4114.8
	Passage	1	x	2	15.24		3	91.44	150.00	13716
								871.19	**150.00**	**130678.5**
9	**Ceiling Plastering in CM**									
	1:3 for 12mm thickness									
	Ground Floor									
	Living	1	x	1	4.32		0.125	0.54	120.00	64.8
	Living	1	x	1	3.65		0.125	0.46	120.00	54.75
	Kitchen	1	x	1	4.32		0.125	0.54	120.00	64.8
	Kitchen	1	x	1	3.05		0.125	0.38	120.00	45.72
	Bed	1	x	1	3.07		0.125	0.38	120.00	46.05
	Bed	1	x	1	3.65		0.125	0.46	120.00	54.75
	Toilet	1	x	1	3.07		0.125	0.38	120.00	46.05
	Toilet	1	x	1	1.64		0.125	0.21	120.00	24.6
	Passage	1	x	1	0.90		0.125	0.11	120.00	13.5
	Passage	1	x	1	2.65		0.125	0.33	120.00	39.75
	First Floor									
	bed room	1	x	1	3.3		0.125	0.41	120.00	49.5
	bed room	1	x	1	4.47		0.125	0.56	120.00	67.05

	bed room	1	x	1	3.3		0.125	0.41	120.00	49.5
	bed room	1	x	1	4.47		0.125	0.56	120.00	67.05
	Toilet	1	x	1	1.676		0.125	0.21	120.00	25.14
	Toilet	1	x	1	3.3		0.125	0.41	120.00	49.5
	Toilet	1	x	1	1.676		0.125	0.21	120.00	25.14
	Toilet	1	x	1	3.30		0.125	0.41	120.00	49.5
	Passage	1	x	1	0.19		0.125	0.02	120.00	2.91
	Passage	1	x	1	12.81		0.125	1.60	120.00	192.15
	Sundries							0.61	120.00	73.2
	Second Floor									
	bed room	1	x	1	3.3		0.125	0.41	120.00	49.5
	bed room	1	x	1	4.47		0.125	0.56	120.00	67.05
	bed room	1	x	1	3.3		0.125	0.41	120.00	49.5
	bed room	1	x	1	4.47		0.125	0.56	120.00	67.05
	Toilet	1	x	1	1.676		0.125	0.21	120.00	25.14
	Toilet	1	x	1	3.3		0.125	0.41	120.00	49.5
	Toilet	1	x	1	1.676		0.125	0.21	120.00	25.14
	Toilet	1	x	1	3.30		0.125	0.41	120.00	49.5
	Passage	1	x	1	0.19		0.125	0.02	120.00	2.91
	Passage	1	x	1	12.81		0.125	1.60	120.00	192.15
	Sundries							0.61	120.00	73.2
							Total	**14.62**	**120.00**	**1754.4**
10	**Flooring Using marble**									
	Ground Floor									
	Living	1	x	1	4.32		0.1016	0.44	600	263.3472
	Living	1	x	1	3.65		0.1016	0.37	600	222.504
	Kitchen	1	x	1	4.32		0.1016	0.44	600	263.3472
	Kitchen	1	x	1	3.05		0.1016	0.31	600	185.8061
	Bed	1	x	1	3.07		0.1016	0.31	600	187.1472
	Bed	1	x	1	3.65		0.1016	0.37	600	222.504
	Toilet	1	x	1	3.07		0.1016	0.31	600	187.1472
	Toilet	1	x	1	1.64		0.1016	0.17	600	99.9744
	Passage	1	x	1	0.90		0.1016	0.09	600	54.864
	Passage	1	x	1	12.65		0.1016	1.29	600	771.144

	First Floor									
	bed room	1	x	1	4.47		0.1016	0.45	600	272.4912
	bed room	1	x	1	3.3		0.1016	0.34	600	201.168
	bed room	1	x	1	4.47		0.1016	0.45	600	272.4912
	bed room	1	x	1	3.3		0.1016	0.34	600	201.168
	Toilet	1	x	1	1.67 6		0.1016	0.17	600	102.169
	Toilet	1	x	1	3.3		0.1016	0.34	600	201.168
	Toilet	1	x	1	1.67 6		0.1016	0.17	600	102.169
	Toilet	1	x	1	3.30		0.1016	0.34	600	201.168
	Passage	1	x	1	0.90		0.1016	0.09	600	54.864
	Passage	1	x	1	12.6 5		0.1016	1.29	600	771.144
	Passage	1	x	1	4.57		0.1016	0.46	600	278.7091
	Passage	1	x	1	2.43 8		0.1016	0.25	600	148.6205
	Second Floor									
	bed room	1	x	1	4.47		0.1016	0.45	600	272.4912
	bed room	1	x	1	3.3		0.1016	0.34	600	201.168
	bed room	1	x	1	4.47		0.1016	0.45	600	272.4912
	bed room	1	x	1	3.3		0.1016	0.34	600	201.168
	Toilet	1	x	1	1.67 6		0.1016	0.17	600	102.169
	Toilet	1	x	1	3.3		0.1016	0.34	600	201.168
	Toilet	1	x	1	1.67 6		0.1016	0.17	600	102.169
	Toilet	1	x	1	3.30		0.1016	0.34	600	201.168
	Passage	1	x	1	0.90		0.1016	0.09	600	54.864
	Passage	1	x	1	12.6 5		0.1016	1.29	600	771.144
	Passage	1	x	1	4.57		0.1016	0.46	600	278.7091
	Passage	1	x	1	2.43 8		0.1016	0.25	600	148.6205
								13.81	**600**	**8286**
12	**White & Color wash using two**									**120000**
	coats of apex exterior ace primer									0
	including putty work, door window									0
	polishing and painting									0
	[both inner and outer]				_ _	L.S	_ _ __			0

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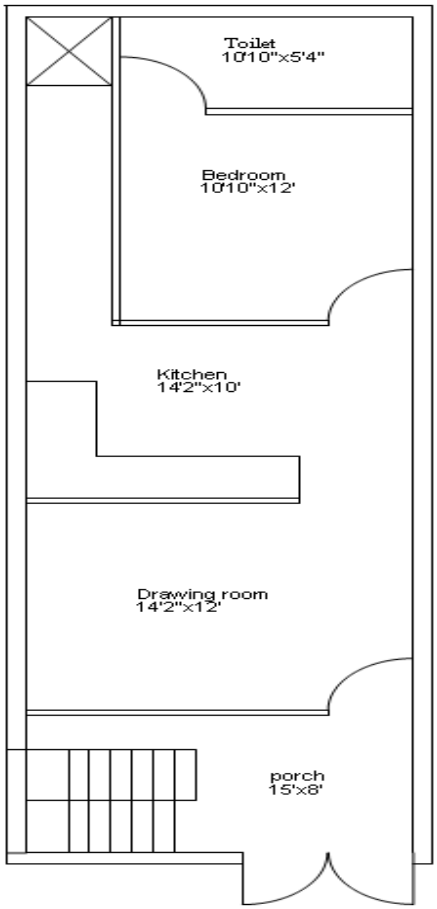
					– – – – – –					
						TOTAL COST			**26,05,417.16**	
						CONTIGENCY			5%	
						WCE			2.50%	
						SURVEY AND DESIGN3%			3%	
						SUPERVISION			5%	
						TOTAL COST OF ESTIMATE RS			**30,54,257**	



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	DETAILED ESTIMATE OF GREEN BUILDING									
S.NO	**DESCRIPTION OF WORK**			**NOS**	**L**	**B**	**D**	**QTY**	**RATE**	**AMOUNT**
1	**Earth work excavation in hard**									
	Soil for all column on Plinth Beams.									
	Columns	1	x	8	3.00	0.3	0.3	2.16	300	648
	Sundries							0.71	300	213
							say	**2.87**	**300**	**861**
2	**Sand filling in foundation for**									
	Columns	1	*	8	3.00	0.3	0.3	**2.16**	**400**	**864**
3	**P.C.C 1:5:10 using 40mm**									
	Metal as Flooring Concrete									
	and Flooring Concrete:									
	Living	**1**	*	1	4.32	3.65	0.1	1.58	2860	5530
	Kitchen	**1**	*	1	4.32	3.048	0.1	1.32	2860	4620
	Bedroom	**1**	*	1	3.65	3.07	0.1	1.12	2860	3920
	Toilet	**1**	*	1	3.07	1.64	0.1	0.5	2860	1750
								4.52	**2860**	**12972.2**
4	**Brickwork in CM1:5 using**									
	best quality country bricks									
	for Super Structure									
	Ground Floor									
	All walls	1	x	1	11.98		3	35.94	450	16173
	All walls	1	x	1	14.41		3.00	43.23	450	19453.5

	Partition walls	1	x	1	3.65		3.00	10.95	450	4327.5
	Partition walls	1	x	1	5.29		3.00	15.87	450	7141.5
	Partition walls	1	x	1	4.32		3.00	12.96	450	5832
	Lintel wall	1	x	1	4.32		3.00	12.96	450	5832
	First Floor									
	All walls	1	x	1	11.34		3.00	34.02	450	15304
	All walls	1	x	1	8.94		3.00	26.82	450	12069
	Partition walls	1	x	4	3.07		3.00	36.84	450	16578
	Partition walls	1	x	2	4.47		3.00	26.82	450	12069
	Partition walls	1	x	1	4.32		3.00	12.96	450	5832
	Second Floor									
	All walls	1	x	1	11.34		3.00	34.02	450.00	17010
	All walls	1	x	1	8.94		3.00	26.82	450.00	13410
	Partition walls	1	x	4	3.07		3.00	36.84	450.00	18420
	Partition walls	1	x	2	4.47		3.00	26.82	450.00	13410
	Partition walls	1	x	1	4.32		3.00	12.96	450.00	6480
	Deduction									
	Door-D	1	x	2	1.20		2.10	5.04	450	2268
	Door-D1	1	x	2	1.20		2.10	5.04	450	2268
	Window-W1	1	x	2	1.80		1.40	5.04	450	2268
	Window-W2	1	x	1	0.90		1.40	1.26	450	567
	Ventilator-V	1	x	1	1.20		0.60	0.72	450	324
	Sundries							0.71	450	319.5
								424.64	**450**	**191088**
5	**R.C.C 1:1.5:3 using 20mm metal**									
	for Columns roof Slab Lintel									
	BeamSunshades,Staircase etc.,									
	Ground Floor									
	Columns	1	x	8	3.00	0.3	0.3	2.16	2860	6177.6
	Plinth Beam	1	x	11	1.50	0.3	0.4	1.98	2860	5662.8
	Lintel	1	x	3	1.20	0.2	0.25	0.18	2860	514.8
	Staircase	1	x	1	2.80	1.8	3	15.12	2860	43243.2
	Cantilever	1	x	3	1.64	0.2	0.3	0.30	2860	858
	Roof	1	x	1	10.67	4.57	0.125	6.10	2860	17446
	temple roof	1	x	1	1.21	1.21	0.1	0.15	2860	429

	First Floor									
	Columns	1	x	7	3.00	0.3	0.3	1.89	2860	5405.6
	Lintel	1	x	3	1.50	0.2	0.25	0.23	2860	657.8
	Staircase	1	x	1	2.80	1.8	3	15.12	2860	43243.2
	Roof	1	x	1	10.67	4.57	0.125	6.10	2860	17446
	Second Floor									
	Columns	1	x	7	3.00	0.3	0.3	1.89	2860	5405.6
	Lintel	1	x	3	1.50	0.2	0.25	0.23	2860	657.8
	Staircase	1	x	1	2.80	1.8	3	15.12	2860	43243.2
	Roof	1	x	1	10.67	4.57	0.125	6.10	2860	17446
							TOTAL	**72.67**		**207836.6**
6	**Fabrication of Steel For all**									
	R.C.C works							**35,000**	**50.00**	**1750000**
7	**Woodwork in best quality teak**									
	wood for all doors and									
	Windows									
	Door-D	1	x	8	1.20		2.1	20.16	2500.00	50400
	Door-D1	1	x	3	0.90		2.1	5.67	1800.00	10206
	Window-W1	1	x	6	1.80		1.4	15.12	1200.00	18144
	Window-W2	1	x	3	0.90		1.4	3.78	1200	4536
	Ventilator-V	1	x	3	1.20		0.6	2.16	1000	2160
	Sundries							0.29	1000	290
								47.18		**85736**
8	**Wall Plastering CM 1:5 for**									
	both Outer and Inner walls									
	Ground Floor									
	Living	1	x	2	4.32		3	25.92	150.00	3888
	Living	1	x	4	3.65		3	43.80	150.00	6570
	Kitchen	1	x	2	4.32		3	25.92	150.00	3888
	Kitchen	1	x	2	3.05		3.00	18.29	150.00	2743.2

	Bed	1	x	2	3.65		3.00	21.90	150.00	3285
	Bed	1	x	2	3.07		3	18.42	150.00	2763
	Toilet	1	x	2	3.07		3	18.42	150.00	2763
	Toilet	1	x	2	1.64		3	9.84	150.00	1476
	Passage	1	x	2	5.29		3	31.74	150.00	4761
	Passage	1	x	2	3.00		3	18.00	150.00	2700
	Passage	1	x	1	2.40		3	7.20	150.00	1080
	Staircase	1	x	2	2.80		3	16.80	150.00	2520
	First Floor									
	bed room1	1	x	3	3.30		3.00	29.70	150.00	4455
	bed room1	1	x	3	4.47		3.00	40.23	150.00	6034.5
	bed room	1	x	2	3.30		3.00	19.80	150.00	2970
	bed room	1	x	3	4.47		3.00	40.23	150.00	6034.5
	Toilet	1	x	2	3.30		3	19.80	150.00	2970
	Toilet	1	x	1	1.52		3	4.57	150.00	685.8
	Toilet	1	x	3	3.30		3	29.70	150.00	4455
	Toilet	1	x	1	1.52		3	4.57	150.00	685.8
	Passage	1	x	2	4.57		3	27.43	150.00	4114.8
	Passage	1	x	2	15.24		3	91.44	150.00	13716
	Second Floor									
	bed room1	1	x	3	3.30		3.00	29.70	150.00	4455
	bed room1	1	x	3	4.47		3.00	40.23	150.00	6034.5
	bed room	1	x	2	3.30		3.00	19.80	150.00	2970
	bed room	1	x	3	4.47		3.00	40.23	150.00	6034.5
	Toilet	1	x	2	3.30		3	19.80	150.00	2970
	Toilet	1	x	1	1.52		3	4.57	150.00	685.8
	Toilet	1	x	3	3.30		3	29.70	150.00	4455
	Toilet	1	x	1	1.52		3	4.57	150.00	685.8
	Passage	1	x	2	4.57		3	27.43	150.00	4114.8
	Passage	1	x	2	15.24		3	91.44	150.00	13716
								871.19	**150.00**	**130678.5**
9	**Ceiling Plastering in CM**									
	1:3 for 12mm thickness									
	Ground Floor									
	Living	1	x	1	4.32		0.125	0.54	120.00	64.8
	Living	1	x	1	3.65		0.125	0.46	120.00	54.75
	Kitchen	1	x	1	4.32		0.125	0.54	120.00	64.8

	Kitchen	1	x	1	3.05		0.125	0.38	120.00	45.72
	Bed	1	x	1	3.07		0.125	0.38	120.00	46.05
	Bed	1	x	1	3.65		0.125	0.46	120.00	54.75
	Toilet	1	x	1	3.07		0.125	0.38	120.00	46.05
	Toilet	1	x	1	1.64		0.125	0.21	120.00	24.6
	Passage	1	x	1	0.90		0.125	0.11	120.00	13.5
	Passage	1	x	1	2.65		0.125	0.33	120.00	39.75
	First Floor									
	bed room	1	x	1	3.3		0.125	0.41	120.00	49.5
	bed room	1	x	1	4.47		0.125	0.56	120.00	67.05
	bed room	1	x	1	3.3		0.125	0.41	120.00	49.5
	bed room	1	x	1	4.47		0.125	0.56	120.00	67.05
	Toilet	1	x	1	1.676		0.125	0.21	120.00	25.14
	Toilet	1	x	1	3.3		0.125	0.41	120.00	49.5
	Toilet	1	x	1	1.676		0.125	0.21	120.00	25.14
	Toilet	1	x	1	3.30		0.125	0.41	120.00	49.5
	Passage	1	x	1	0.19		0.125	0.02	120.00	2.91
	Passage	1	x	1	12.81		0.125	1.60	120.00	192.15
	Sundries							0.61	120.00	73.2
	Second Floor									
	bed room	1	x	1	3.3		0.125	0.41	120.00	49.5
	bed room	1	x	1	4.47		0.125	0.56	120.00	67.05
	bed room	1	x	1	3.3		0.125	0.41	120.00	49.5
	bed room	1	x	1	4.47		0.125	0.56	120.00	67.05
	Toilet	1	x	1	1.676		0.125	0.21	120.00	25.14
	Toilet	1	x	1	3.3		0.125	0.41	120.00	49.5
	Toilet	1	x	1	1.676		0.125	0.21	120.00	25.14
	Toilet	1	x	1	3.30		0.125	0.41	120.00	49.5
	Passage	1	x	1	0.19		0.125	0.02	120.00	2.91
	Passage	1	x	1	12.81		0.125	1.60	120.00	192.15
	Sundries							0.61	120.00	73.2
							Total	**14.62**	**120.00**	**1754.4**
10	**Flooring using Vitrified Tiles**									
	Ground Floor									
	Living	1	x	1	4.32		0.1016	0.44	500	220

	Living	1	x	1	3.65		0.1016	0.37	500	185
	Kitchen	1	x	1	4.32		0.1016	0.44	500	220
	Kitchen	1	x	1	3.05		0.1016	0.31	500	155
	Bed	1	x	1	3.07		0.1016	0.31	500	155
	Bed	1	x	1	3.65		0.1016	0.37	500	188
	Toilet	1	x	1	3.07		0.1016	0.31	500	155
	Toilet	1	x	1	1.64		0.1016	0.17	500	85
	Passage	1	x	1	0.90		0.1016	0.09	500	45
	Passage	1	x	1	12.65		0.1016	1.29	500	645
	First Floor									
	bed room	1	x	1	4.47		0.1016	0.45	500	225
	bed room	1	x	1	3.3		0.1016	0.34	500	170
	bed room	1	x	1	4.47		0.1016	0.45	500	225
	bed room	1	x	1	3.3		0.1016	0.34	500	170
	Toilet	1	x	1	1.676		0.1016	0.17	500	850
	Toilet	1	x	1	3.3		0.1016	0.34	500	170
	Toilet	1	x	1	1.676		0.1016	0.17	500	850
	Toilet	1	x	1	3.30		0.1016	0.34	500	170
	Passage	1	x	1	0.90		0.1016	0.09	500	45
	Passage	1	x	1	12.65		0.1016	1.29	500	645
	Passage	1	x	1	4.57		0.1016	0.46	500	230
	Passage	1	x	1	2.438		0.1016	0.25	500	125
	Second Floor									
	bed room	1	x	1	4.47		0.1016	0.45	500	225
	bed room	1	x	1	3.3		0.1016	0.34	500	170
	bed room	1	x	1	4.47		0.1016	0.45	500	225
	bed room	1	x	1	3.3		0.1016	0.34	500	170
	Toilet	1	x	1	1.676		0.1016	0.17	500	850
	Toilet	1	x	1	3.3		0.1016	0.34	500	170
	Toilet	1	x	1	1.676		0.1016	0.17	500	850
	Toilet	1	x	1	3.30		0.1016	0.34	500	170
	Passage	1	x	1	0.90		0.1016	0.09	500	45
	Passage	1	x	1	12.65		0.1016	1.29	500	645
	Passage	1	x	1	4.57		0.1016	0.46	500	230

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	Passage	1	x	1	2.438		0.1016	0.25	500	125
								13.81	**500**	**6905**
11	**White & Color wash using two**									**135000**
	coats of apex exterior ace primer									0
	including putty work, door window									0
	polishing and painting									0
	[both inner and outer]				_ _ _ _ _ _	L.S	_ _ __			0
						TOTAL COST			**2523695.7**	
						CONTIGENCY				5%
						WCE				2.50%
						SURVEY AND DESIGN3%				3%
						SUPERVISION				5%
						TOTAL COST OF ESTIMATE RS			**29,14,868.53**	

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RESULTS

A proposed plan for estimate a G+2 storied R.C.C. framed residential building on a plot 750sq.ft. (69.70 sq. m.) The plot is fronting of on 7.0 m wide road. We have done Estimate and cost comparison between G+1 R.C.C. Conventional Building and Green Building by using central line method of estimate and the results as shown below:

S.NO.	Name of Item	Quantity	Conventional Building Cost	Green Building Cost
1.	Earth work (cu. m.)	2.87	861	861
2.	Concrete (cu. m.)	72.67	279097.26	207836.6
3.	Brickwork (cu. m.)	424.64	212320	191088
4.	Plinth filling (cu. m.)	2.16	864	864
5.	Fabrication of steel for all R.C.C works	35000	1,750,000	1,750,000
5.	Plastering (sq. m.)	563.72	84,558.6	84,558.6
6.	Ceiling	9.21	1,105.2	1,105.2

	plastering			
7.	Tile flooring (sq. m.)	13.81	8286	6905
8.	Skirting (m.)	12.87	7,722	6435
9.	Painting (sq. m.)	-	120,000	135,000
10.	Wood work for door frame (sq. m.)	47.18	85736	85,736
		Total Cost	**2,550,550.06**	**2,470,389.4**

Cost of green building is 3% less than conventional building. Total cost of conventional building is **2,550,550.06≈2550550**Rs. And total cost of green building is **2,470,389.4≈ 2470390** Rs. but in green building Solar panel, Cool roofs and Rain water harvesting is necessary to install and in conventional it is not necessary to install. Hence cost of green building is increases. However, the cost of conventional buildings faces depreciation from time to time but green buildings' cost increases day by day. Therefore this extra cost is also recovered within certain years.

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CONCLUSIONS

- Over the years, people have formed a wrong perception about green building. It is assumed that it is costly but in fact, it is efficient over conventional buildings.

- Generally, the cost of conventional buildings faces depreciation from time to time but green buildings' cost increase timely.

- Green buildings enhance eco-friendliness and energy efficiency.

- It also beneficial in water conservation as it installs rain water harvesting and other mechanism to avoid water wastage.

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