

Different forms of construction and sustainability construction essay



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1. Materials for Superstructure

Superstructure made of different kind of materials. The understanding of materials, its properties and use will help in achieve economy and efficient use of materials. In general 60% to 70% of the total costs of construction are gain by materials. Material usage depends on local circumstances and standard practise.

Selections of materials are varying to the constriction. Generally there are some major topics that consider when select materials.

? Cost

? Strength

? Durability

? Maintainability

? Functional requirements

? Aesthetic appearance

? Site location

? Availability

? Properties of Materials- physical, chemical, mechanical, thermal, electrical and acoustic properties

There are five major materials that use widely in construction and some other materials to improve the building value.

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1. 1 Reinforced Concrete

Concrete is the only main construction material that can be delivered to the site in a plastic condition. This unique quality makes concrete popular as a construction material since it can be moulded to practically any shape or form. Concrete use in generally construction work as reinforced with steel. There are mainly two types of concrete.

i. In situ reinforced concrete. Which means made in the construction site and cast in to mould or formwork till becomes solid.

Advantages;

? large scale of choice to design of the structures

? Less amount of space required to store

? No need of skilled labours

? No need of huge machinery like cranes

? Traffic will not affect to the construction programme

Disadvantages:

? Need more time to get solid

? More labours required

? Formwork required. Which means getting more time

? Difficult to control the quality

? Difficult to do modification after casting

? Hard to construct during rainy weather

ii. Precast Concrete. This type manufactured off site according to requirements, transport to the site and fix.

Pre cast beams at ICC, Piliyandala

Advantages;

? Increase the Speed of construction by saving the time without formwork and curing time

? Less labour force required

? Quality is high

? Weather situation do not influence

? Less space required because pre-cast concrete is on site while necessary.

Disadvantages;

? Costly than in situ concrete

? Skilled labours required

? Connections between items might be complicated

? Few design choices

? Need lot space in site to use heavy machines like cranes and it will costly

? Transportation for urban area will difficult during traffic

Recommendation;

I recommend in situ reinforced concrete rather than precast concrete. In Sri Lanka, few precast plants available and they are far away from Kandy city. Precast items are very huge and need wide and long vehicles to transport. It will very costly to transport them and since Kandy has narrow roads, heavy traffic will generate.

When we consider about site plan there are curve shapes in front of the hotel. It will get more time to manufacture such shapes in precast. Since client wants finish the construct soon as possible, it will fine idea to use in situ reinforced concrete for beams, columns and slabs.

1. 2 Steel

Structural steel is the trendiest framing material for structural in world. Steel members, commonly referred to columns and beams. Steel forms are suitable to speedy construction works.

Reinforcement bars are used in concrete. There are two types of reinforcement bars available, Tor steel bars and mild steel bars. Tor steel bars with outer surface deformations created by winding the steel after elongation. Surface of tor steel bars made good bond with concrete. Mild steel not stronger like tor steel because it neither twisted nor hard sur

Tor steel Mild steel

Advantages;

? Reinforcement bars gives tensile strength to concrete

? Strong in both compression and tension

? Flexibility foe designs

? Speedup the construction

? Modifications can be done even after erecting

? Sustainable material (reuse, recyclable)

? Durable

? Safe even in earthquakes

Disadvantages;

? Long, heavy and difficult to transport to the site in urban areas

? Subject to corrosion

? Low fire resistance

? Thermal expansion

1. 3. Timber

Hard, tough material that forms the trunks of trees and that has been used for as a construction material. Timber has provided with a wide range of building stuff and materials for construction.

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Advantages;

? Reduce energy use

? High thermal insulation when compared with other construction materials

? Good sound insulation

? Timber forms reduce the construction time

? Perfect aesthetic appearance

? Availability is high

? Has Low embedded energy

Disadvantages;

? Skilled labors required

? Storage in site need more space and some especial methods

? Low fire resistance

? Difficult to transport

? Moisture and temperature changes will effect to the durable

Recommendation;

For floor, staircases, doors, windows and for interior partitions I recommend timber usage. Timber will give nice impression to guests and for hotel timber

will enhance the comfort. Also, timber and skilled labors available in Kandy for low cost.

1. 4 Bricks and Blocks

For construct the wall, bricks or blocks are using.

? Bricks

Brick is a clay structural material that is made by pressing clay into blocks and burning them to get the required hardness in a kiln.

Advantages;

? Thermal gathering ability to store temperature bricks absorb heat during the daytime and little by little releasing it at night-time, ensuring interior temperatures are steady during the day and night. The outcome is comfortable and healthy environment.

? Sustainable material (recyclable)

? Low weight

? Resistance to fire is high

Disadvantages;

? deteriorate with time

? High initial cost

? Wastage is high. Lot of bricks are wasting during loading, transport and unloading

? Blocks

Blocks are made with a mix of Portland cement, water and aggregate

Advantages;

? Low cost

? long lasting

? availability

? High strength

? Wastage is low

? High fire resistance

Disadvantages;

? Heavy weight to the foundation

? Poor sound insulation

Recommendation;

I recommend bricks for hotel walls. Initial cost might be high. But it has better thermal insulation and it will reduce the energy cost of hotel in future.

It gives good comfort and fire resistance if needed. Bricks are available in Kandy at most of the time for low cost.

1. 4 Glass

Glass is one the most versatile substance on earth, used in many construction applications and in a large range of forms.

Advantages;

- ? Better aesthetic appearance
- ? Good heat insulation. Saves energy of HVAC
- ? Transparent ability helps to get natural lightning

Disadvantages;

- ? Cost is high
- ? Security and privacy will be affected
- ? Maintenance cost is high
- ? Brittleness is high even in small impact
- ? Melt under very high temperature.

Recommendation;

I recommend toughen glass structure for above 3rd floor to roof access. It will give fine appearance to the hotel.

Other than above major superstructure materials there is three more materials use in construction

1) Water proofing materials

2) Acoustic materials

3) Heat insulation materials

2-Forms of Construction

When beams, columns, girders, trusses, and spandrels joined to one another it called construction form and it must have stability to the structure. Roof panels and floors which not connected to the columns (secondary members) are not taken into account of the structural frame. There are various types of forms using in construction.

The Simple Cage Forms

Most common material for this type of form is steel. Steel forms have many advantages and some disadvantages.

Advantages;

? Steel are more strong and lightweight.

? Can achieve very quick build time. Because the fabrication is all done previously.

? Steel also flexible and lightweight material which allows designed for atypical types.

? Steel is one of the most long-lasting materials presented, and it has the highest strength-to-weight ratio of all construction metals. This means that a lesser amount of steel is required to erect a structure which means savings in building expenses.

? It is unlikely to deform, fracture, crack, bend, or expand with weather.

? Steel has sustainability. Which means Steel is 100% recyclable.

Disadvantages;

? Can be complex and costly to shield efficiently

? Not very good-looking or predictable for residential use emergence

? Maximum five stories can be approach because it may be complicated to met high wind load requirements

? Generally limited to widths 60' otherwise narrower. wider than 70` wide are difficult to set up and would involve heavy equipments

? Difficult to transport in urban areas

? Less fire Protection

The Beam and Slab forms (in situ concrete)

This type is mostly use in world. With reinforced concrete it can get more efficient.

Advantages;

? Reinforced concrete can hold more load and does not wear easily

? Cost effective for medium size constructions

? Higher fire resistance capability

? Can get any architectural view as client need

? Easily construct even in urban areas because of in situ concrete

? Can bear heavy wind load when consider high rise buildings

Disadvantages;

? Slow speed of construction. Because it takes more days to cure the concrete

? Also, slow construction speed means Higher expenditure to labour

? Suitable for small and medium type constructions. Because it can't get long span in form

Wholly Precast Concrete Forms

Precast concrete form casting concrete in a reusable mould or “form” which cured in a controlled background, transported to the construction site and fit into place.

Advantages;

? Quick build time of form erection.

? It has design flexibility. Which means construct any shape, size, and texture. Precast form allow for irregular lengths and widths.

? Low cost in construction. The manufacturing of the major form components of the structure off-site reduce the site labour factor significantly, which reduce site expenditure and time.

? Higher fire resistance

? Strong and better durability.

Disadvantages;

? Weight and volume of the individual components are more. Because of that, transportation is difficult when site in urban area.

? Sometimes cranes may use for assemble. If site doesn t have enough site access and if site is small it may arise some inconvenience

? In urban areas some safety issues may occurs, because of risk of public safety. When try to manage the safety it become more costly.

Cantilever Forms

Cantilever is an engineering expression referring to a structural form method in which load is passed to a column by tough mounting tip. Cantilever construction allow for long structures without external column.

Advantages;

? Architects and engineers use cantilever form structures for the overhang designs to provide aesthetic view.

? save horizontal space

? Effective when the soil bearing capacity is low. Because there are no need of ground floor

Disadvantages;

? Can't use for high rise buildings because it's difficult to bear the wind load

Propped Cantilever Forms

This type of forms can bear wind load more with the double stanchions and the end of the cantilever is less weight comparing with above.

Advantages;

? Made for bear wind load (Lateral loads)

? Able to apply for high rise buildings

Disadvantages;

? Because of heavy steel the cost is high

Parallel (continuous) Beam forms

With primary and secondary beams, these types of forms are developed.

Advantages;

? Almost several width or height can be achieve and column location can be different

? Enough space to run cables and service ducts through slab

? May be use with other systems together with block, conventional steel.

Disadvantages;

? Total building height will be raise because, the slab thickness is high

? Cost is high because of more steel usage

? Less aesthetic appearance

When we consider about forms with steel, there are some more selections with relate with simple cage forms, cantilever forms, propped cantilever forms and parallel beam forms.

Non-composite Upper Floors

Two types of non composite upper floors presented;

i. Precast Hollow Core Concrete Planks

Also famous as a voided slab or hollow core plank is a precast slab of pressurised concrete.

Advantages;

? Hollow core slabs are scratch to lengths to suit the structure design before leaving the plant, resulting in safe and fast construction and with less cost

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? Hollow core slabs get long span (4m to 8m), resulting in flexible space with smaller quantity of beams, supporting columns and walls.

? Costly formwork and temporary props are reducing.

? Have a 1 hour fire resistance.

? Holes are reducing the weight and it can use to accommodates services, like ducts, pipes, cables

Disadvantages;

? Skilled labours and cranes are required to fit the planks and it will costly

? Joints between planks are complicated and more expensive

? Transportation will be difficult in urban areas and site must have enough space to hold crane

ii. In Situ Reinforced Concrete Slabs Built off Permanent Formwork

In this system in situ reinforce concrete put on metal deck and the formwork (metal deck) does not remove later. Usually depth of slab between 100mm to 225mm. This approach can cover 4m to 7.5m.

Advantages;

? Temporary formwork not required. It reduce time waste

? Metal deck act as additional reinforcement to the concrete

? Durable and high strength

Disadvantages;

? The connections are more complex and the decking is more complicated

Composite Upper Floors

There are four types of methods available

i. Precast Hollow Core Concrete Planks

When steel and Precast Hollow Core Concrete Planks lying together, it becomes composite upper floor. Steel nails are using for combine both. It can cover 12m span.

Advantages and Disadvantages are same as non- composite upper floors. But this type is stronger and more durable than non-composite. Also much expensive than non- composite.

ii. In Situ Reinforced Concrete Slabs Built off Permanent Formwork

The combination of in situ reinforced concrete and steel beams, by steel nails called as composite upper floor. This type can cover 12m span.

Besides more strong, durable and high cost, this type has same advantages and disadvantages of non-composite upper floors.

iii. Slim floor or Slim deck

The key difference of this assembly is that the supporting beams are containing inside the depth of the concrete slab. This is achieved via supporting the slab off the base flanges of the beams.

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This type helps to reduce the building height and very economical than other types. It can cover up to 9m span.

iv. Cellular Composite Beam floors and Composite Truss Floors

Commercial buildings and factories are using this type. The beam depth is high and beams act as truss. Self weights of beams are low because there are holes in beams and it leads the span up to 18m.

Slab Construction

The last frame construction is slab construction. There are six types of slab construction methods.

i. Flat Slab

This type does not have any beams and uses the in situ reinforced concrete. Table forms and flying forms are used as formwork. Can get span up to 11m and reduce building height because slab thickness is low

Advantages;

? Can use for fast construction

? Easy to concrete when using table forms or flying forms. Time is not wasting

? Economical

Disadvantages;

? Poor in strength. It very unlikely to the punching shear forces because there are no beams

ii. Solid Slab With Drops

In this type slab has drops on bottom every column. Can get span 5m to 10m.

Advantages;

? It can bear punching shear force more than flat slab

? can get good aesthetic appearance by decorating or moulding the drops

? long span(5m to 10m) reduce the column cost.

Disadvantages;

? Speed of construction is less than flat slab because drops require some extra time.

? Expensive than flat slab

iii. Ribbed Slab

Band and conventional beams are in this type. This slab system can cover up to 8m span.

Advantages;

? Useful for accommodates services, like ducts, pipes, cables through slab

Disadvantages;

? Weight of the slab is higher. Therefore the columns and foundation sizes must meet slab requirements

? Expensive

? Construction speed is low since lot of formwork

iv. Troughed Slab With Integral Beams

In this type slab thickness is low and it have span up to 12.5m. table form can be use as formwork

Advantages;

? Strength is high

? Gain long span

Disadvantages;

? Construction will be slow since formwork

? Expensive

v. Waffle Slab

This type is a reinforced-concrete ceiling and roof construction employing a rectangle grid of deep ribs with coffer in the interstices. This type can cover even 16m span

Advantages;

? No beams required

? fine appearance

? No need of suspended ceiling

vi. Tunnel Forms

There are no columns in this type forms. Using for hotel, residential constructions. All the load bear by vertical walls instead for columns.

Advantages;

? High fire resistance

? Isolation from neighbouring room give more privacy

? Fast construction because of uncomplicated formwork

Disadvantages;

? Expenditure is high

Recommendation:-

I recommend the beam and slab form and wholly precast concrete form .
When consider about client need for above hotel construction project he need the building as soon as possible. Wholly precast concrete form will suit for fast construction, but because of heavy traffic during day time, it will be difficult to transport precast items and steel frames. Since of those facts the

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most suitable type is beam and slab form. Because of in situ concrete, there will be no considering about traffic. But construction time will be effected. Building cost will be low than precast concrete form and saved expenditure can be use for roof construction in further.

3. Flat Roof Construction

Any roof when the pitch less than 5` is called a flat roof. A flat roof does not have the improvement of gravity to get rid of water from the roof. , therefore it s important to include a layer that will provide a damp barrier, as well as a system to drag the water off of the roof after rain.

There are many types of flat roof construction;

1) Built-up Roofing

A built-up roof is consist of laying down a number of layers of bitumen and water resistant materials and followed by gravel cover. Gravel for fire protection as well as guard from foot passage and the sun. The putting in process commonly needs apply hot bitumen to bond between layers.

Multi-layered system offer extra shield, reducing the threat for water leaks. It also easier to install because, it does not have complex structure. Built-up roof is long last because it include mat of glass fibre reinforcement and bitumen make grate combination between layers. This type is very economical and easy to repair and maintain though it have high initial cost.

2) Mastic Asphalt Flat Roofing

Combination of clay and bitumen is used for this type of flat roof. Asphalt in that it forms a very thick solid-surface material under typical temperature circumstances. This one is mainly long-lasting flat roofing. Mastic asphalt is a durable water proofing membrane. It is very flexible as well. Mastic asphalt is non-toxic, recyclable, and odourless and can bear up excessive temperature.

Mastic asphalt is proper for many roof constructions only if the deck does not bend too much. It is the perfect material for block and beam, concrete, wood fibre slab and properly constructed timber roofs.

It is generally laid in two coats on a separating membrane of black outer layer felt. If there is whichever insufficient fall on the roof, mastic asphalt can be laid to get rid of standing water. It is fine to guard the asphalt from U. V. degradation and warm build-up by applying a solar absorbed paint.

3) Single-Ply roofing

Single-ply roofing uses a plastic membrane to give waterproofing for the roof. The membrane can be mechanically fixed firmly to the roof, fully adhered with an adhesive, or ballasted. One disadvantage of this type is it requires more labour cost to construct.

4) Liquid Coatings

Liquid coatings are mostly used for commercial and large roofs or where a normal single-ply roof will not be adequate. The liquid roof coatings can be applied to various materials including felt, concrete, asbestos, metal and more. The Liquid roof coating will present a long lasting shielding result. This type is easy to apply, even for the water areas and economical. The durable
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is high and it reduce the maintain cost. But impossible to obtain uniformed thickness.

5) Green roof

A green roof is a roof of a structure that is to some extent or totally roofed with vegetation and soil, planted above a waterproofing membrane. It may also contain additional layers such as a root barrier and drainage and irrigation systems. It supplies aesthetic benefits, better air quality and protection from UV. The initial cost and maintain cost is very high.

Green roof has two types;

i. Intensive (active) green roof

Intensive (active) green roofs include deep growing heavy trees that support a mixture of landscape look and growth. It accessible and used as entertaining space

ii. Extensive (passive) green roof

Extensive green roof have a thin growing plants and the landscaping is designed to be more economically, requiring less maintain than an intensive green roof system. Extensive green roof is are not as much of expensive like intensive system, because they are lighter and need less structural sustain and need less regular maintenance.

Recommendation:-

I recommend extensive type green roof system for above hotel project.

Mainly because it will increase aesthetic appearance of the hotel and guests will more like the latest type. Green roof will adopt fresh look to the hotel because in Kandy, otherwise in Sri Lanka green roof is uncommon type. Initial cost may be high but, maintenance cost will be less because raining and smooth sun light is common climate in Kandy. According to the building plan, green roof can construct the top of the rooms 10 to 18. It will give fresh air to mentioned rooms and above 3rd floor reception area can covered with glass structure for natural lightning and access for the roof.

4. Sustainability while construction

The expression sustainable (telling the idea of stable, lasting or continuous) is translated to some language as durable. So, sustainable structure can be identified as a durable construction . Sustainable construction has special approach and different priorities in different countries. Some of them recognize cost-effective and social, cultural aspects as part of their sustainable construction outline, hence, sustainable construction also is illustrate as a division of sustainable development, which includes plan, tendering, site arrangement, and organization, material selection, recycling, and waste minimization.

There are some principles for sustainable construction,

Minimization of resource consumption

Maximization of resource reuse

Use renewable and recyclable resources

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Protect the natural environment

Create a healthy and non-toxic environment

Pursue quality in creating the built environment.

When starting hotel construction in urban area like Kandy, there are many things to consider. The key area where the sustainable construction can be enhanced by judgment carefully about the integrated plan of the entire project. Every part of a construction task has an effect on each task. The sustainable design of a task ought to consider all the related elements that interested in the orientation, structure, location, construction.

Creating sustainable construction start with suitable site selection.

Evaluation of the orientation of the structure, involves how the construction will relate to weather conditions. It s fine if the constructor can leave most of the vegetation, specially large trees which can be use for hotel attractiveness. It is more environments friendly if increase use of labours, without always using vehicles to transport in site. It reduces the air pollution.

Waste management is a key factor for sustainable design. If contaminated chemical or solid matters mix with the water it will lead to environmental hazard of the area. The main important factor should be the minimum impact to the environment.

The energy using when construct the hotel, an energy efficient methods can minimize energy costs and reduce harmful impact to the environment. Also using less embodied energy sources for the construction, and using

alternative energy sources instead of fuel or other energy sources which pollute environment.

When choosing the materials for the hotel construction, use of less embodied materials can lead the construction to be sustainable during pre building phase. Using reuse materials, less wastage of materials, and proper storage of material can gain the high material efficiency. By innovative methods and modern construction methods, the hotel will gain better sustainability.

5. Safety of the Construction Site

The construction industry identified out from other employments as having one of the maximum worker injury and casualty rates. Construction consists of a very little proportion of the overall labour force. So far, the rate for non-fatal injuries and illnesses exceed that of several other industries. Some studies have revealed that a rather large proportion of construction accidents can be stop, reduced, or avoided by assembly better choices in the design and setting up stages of a project. When deal with construction safety in the design and scheduling phase, as a result, can have a large impact on reducing injuries and the cost related with safety.

Making policies, well organizing, Planning and put into operation, performance measuring and reviewing is key factors which lead to successful in health and safety management.

As according to the CDM regulation 2007, there are some essential steps to make risk assignment which help to reduce hazards in hotel construction site.

1) Discovering the hazards

Identifying what are the hazards in site. When;

? Slips, trips and falls

? Fall when working at height

? Fire

? Mobile plant and vehicles

? Dust

? Chemical

? Low or high temperature

? Machines operating

? Noise and Vibration

? Manual handling

2) Who will be affect and how?

Every person has some risk when they working in site. Workers during working hours, contactors and office staff during site visit and supervision. Etc.

3) Risk Evaluation

After identified the risk, there must have some action to prevent them. It may be an action of totally eliminate the hazard or control of hazard.

? Eliminate the hazard

For example, instead of using acids to unblock drains, use drain rods. It prevent chemical hazard.

? Control the hazard

Example is using water suppression to control dust.

Provide personal protective equipments

Such as goggles (eye protectors), ear protectors, safety helmets, gloves, face visors, boots

Working at height

Sign boards and notice

Most hazards can control by providing training to workers. Training should include correct ways of erecting and using scaffoldings, ladders, equipments, etc.

4) Recording the findings

By recording hazards which already happen, it will help to prevent or control it in further.

5) Reviewing of records and revising them if need

If hazard occur again or when bring new equipments, machinery, materials, people or new method to site, review of early ones will help to prevent or control hazarders.

Alternative Energy Sources for the construction work

There is some main alternative energy sources use now days,

? Solar power

? Wind power

? Geothermal power

? Tidal power

? Hydro electric power

As an energy source, fuel enhance pollution and some time it is risky to workers when fire. Above hotel construction in Kandy solar power is an alternative energy sources instead of fuel.

? Solar power

In Kandy area sun light is often most of the time. Solar electricity can be use for work some small electrical machines

Mobile solar panels

6. Modification of Buildings

When new building connects to an old one there are some basic factors which should consider.

? Forms of construction.

The new part of the building should connect with same material which has old building. In current subject old structure built with beam and slab form, and new structure also should be that method to success modification.

? Slapping

The new part of the building should not disturb old ones visual. Outdoor openings should maintain

? Weather tightness

New part must have weather and water proofing as same as old one.

? Variation in floor level

It is a better to follow same floor levels in new part with old part. If not there will some extra expen