

Materials for constructing a multi- storey building



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When dealing with a multi-storey building it is important to get the right materials as these materials will hold the structure together, the multi-storey building itself is very large and will be constantly in use as it is a hotel so the building will be subjected to different loads and situations.

Loadings on beams, columns, frames, pads and floors can cause many structural differences the behave and performance of the material may change due to stress and strain on them, the materials I am going to look at are steel and concrete, these materials are used throughout the construction industry and loads on these materials are important as if the material is not up to the job and does not fulfil the need the beam, column, frame, pad or floor could collapse and cause many injuries and be a health and safety danger so it is important to use the materials in the right way.

both materials steel and concrete have the advantages and disadvantages when used, when dealing with a multi-storey building it is important that the material can withstand the pressure it is put under so it would not collapse or break, if this does occur the knock on effect would result in the building to collapse and cause large injury's to civilians within and around the building, to stop this the material's which are used and put under a subject of tests such as being compressed and stretched rapidly any faults such as the material does not meet to the UK standard would be out lined and amended or discharged from use on site, this is also done for health and safety reasons.

First looking at concrete it is used often through put construction it is used due to its durability and workability, to get to a workable mix the concrete

needs to be cured and portioned first, it is important that the concrete meets the needs this could be the concrete is used to construct a concrete beam and this beam is put under a lot of loads; therefore the beam would need to be able to receive the load and distributed.

Every material has Strength this is the ability of the material to resist the forces set up within them by the applied load, when a load is applied movement is made so therefore Stability is needed stability is the ability of the structure to resist overall movement, any load (force) tends to move to a downward direction for the material to keep to its state it should maintain a equilibrium this is done by the material resisting the equal and opposite force, any load that is applied is called a active force, this force can also be distributed this is when the load is applied over full length or area of a structural member this would be used in a pad foundation, also other loads may be called can be concentrated or point where the load is put to a single point or over a very restricted area this is used with conjunction of columns and beams.

When the load is put to a material in a form of a beam, column, frame, pad or floor the structural material may be affected in the following ways:

- Stretch - called the tensile force, tend to stretch the material
- Compress - called the compressive force , which tends to squeeze a material
- Shear force - when the force causes one part to slide past the other force which tends to make surfaces of a material slide.
- Torsional force - causes the member to twist

If the load is not distributed this can result in the beam could form cracks and collapse due to the load it is receiving this works in vice versa if the beam is being crushed for example the building could encounter an earth quake and the beam is being crushed the beam needs to withstand this to help keep the structure of the building; so therefore tests are made up such as a crushing test this is at the stage where the concrete is being made/ produced (mixing/curing), the concrete is mixed and cured (curing can take weeks) depending on the ratio used in the mix, the crushing test is the mix is set into cubes and at different curing stages, each cube is put under a load at which could be put on the multi-storey structure, once the results of each cube are collected the results are analysed and then a decision is made in which grade of concrete to work with for the build, the formula for the test is:

These tests are made to find of the:

- Shear forces
- Bending moment
- Deflected shape
- Reactions at supports

As you can see from the example I have given as time goes on the crunching load has increased, this shows that the concrete cube has become more diverse in strength by every week, from these crushing loads the different concrete grade can be used at different points in in construction.

Stress is derived by dividing the load applied by the cross-sectional area of the member

$$\text{Stress (f)} = \text{Load/ Area} = W/A = \text{N/mm}^2$$

Strain is measured by dividing the change in length by the original length

Strain = change in length

Original length

The purpose of beams, columns, frames, pads and floors are to:

- Resist loads imposed upon it.
- Transfer loads to the foundation.
- Provide vertical and lateral stability to the structure.
- Resist bending.

A Beam is a horizontal structural member resting on two or more supports.

Beams can be in many forms such as:

- Simply supported - where the beam is resting on two supports.
- Fixed - where the ends firmly built in and do not move
- Cantilever - where one is firmly built in at one end and the other end is free
- Continuous - where the beam is resting on three or more supports.

A Column is a vertical structural member used in the construction industry to transmit imposed loads to other members or to the foundation.

Compression, Tension and Shear

When the force on a structural member stretches called the tensile force tends to stretch the material.

When a force squashes or compresses the member, this is called compressive force, which tends to squeeze the material

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When the force causes one part to slide past the other force which tends to make surfaces of a material slide. This is called a shear force

Bending, Buckling and Deflection

this is most common in columns, columns are mostly made of concrete or steel due to their strength properties, timber may also be used but if a large load is put on the Column buckling could occur (bend sideways).

A beam could be affected by deflection if a large load is put on it, the beam could be made of either steel or timber.

A bending moment is occurs when the material resists a force this occurs with beams.

concrete is a mixture of cement, fine aggregate, coarse aggregate and water when these are mixed at a good ratio to each other when set it will form a hard solid mass or artificial stone, there is a rule which is used in construction ' the greater the proportion of cement, the stronger strength of the aggregate' , but the water content in the cement is important this process happens in curing the cement over a couple of weeks, as there is more water the cement may not be able to be at its full strength, due to the strength, workability and density of concrete it can be easily made and humans have the ability to create concrete with very specific properties, therefore this material is used allot in design and construction where the manufacture produces a mix when set concrete produced will have desired properties needed.

The multi-storey building is made of concrete would consist of:

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- Slabs
- Columns
- Shear walls
- Foundations
- Reinforced concrete suspended floors
- Ribbed floors
- Hollow pot floors
- Beams
- Precast concrete floors

Concrete is easy to maintain, the first and up most important thing to do is to allow proper curing of the mix as this will allow maximum design characteristics of the concrete mix to be achieved, the concrete when set can be covered in a water resistance paint this will protect the set concrete from water as water is concrete's worst enemy; if water sits on the concrete this can stain the surface, allow cracks to form and mold spores to develop making the concrete slippery, this could cause major defects in the construction itself, the most important thing is to look at temperature when dealing with concrete as concrete can expand and contract, which can force cracking and leave the concrete exposed to increased water intrusion so if cracks do occur these should be filled in and dealt with straight away.

Concrete helps to minimise the amount of energy that a building consumes and ensure that the building maintains a level of thermal comfort that is appropriate for its occupants. Concrete helps buildings to achieve this, as a heavyweight material, concrete acts as a store (or buffer) during the heating

season by utilising free heat gains, concrete can It can only be renewed if it is crushed down and grinded into sand.

Steel is made up of alloy of iron and carbon, steel can be very useful to the industry of construction, it is used from protective shoes to large beams to small nails, the material is so versatile due to its melting and strengths properties but yet it is lightweight for easy handling this means economical shipping.

Precise measurements can be taken meaning very precise cuts of steel can be made so less wastage is made, steel acts as Great protection against the worst weather conditions, Installation is fast and simple, Steel is also recyclable so it is environmentally friendly the steel can be easily melted down and re used for another purpose, to maintain steel it would need to be cleaned regularly and checked for any defeats, when using steel in construction it is important to take in account energy efficiency; if a whole home was built of steel it would be less energy efficient than a wooden house, insulation would be needed to keep in heat this is because metal transfers heat to a colder area more quickly than wood sometimes up to 400 times more rapidly steel studs can create a thermal bridge to the outside of the house, to stop this when the house is being constructed the steel can be warped in insulating board this would help to keep in heat and reduce the thermal bridge, but also one advantage of steel is the fact that steel can be recycled with ease it can be melted down with not a lot of hassle and the steel can be used to make other things.

The sustainability of steel is very good as this material allows, rapid construction on site (therefore reducing site activity) and disruption to neighbors, steel can be pre-cut and delivered in so a system called 'just-in-time' can be used this will reduce site congestion, steel structures are inherently adaptable and extendable, and also steel is multi-cyclable, being 100% recyclable without down cycling.

Steel is located in the ground so it would need to be dug out to be used as it is made of carbon and iron, When it is all finished there will be no more. That is why recycling steel is so important.

Steel is widely used in construction, due to its properties it is used for mostly columns frames, these would be made of entirely of steel; this is good as steel is very strong but when a load is put on steel from both ends such as a column the column could compress and buckling effect could happen, also if the load is great enough column could break (snap).