# CONSTRUCTION OF RESIDENTIL BUILDINGS AND ITS IMPACT ON ENVIRONMENT

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**Abstract**
A close coordination between environmental engineers and the construction industry has resulted in an environmental profiling system that enables designers and constructors to select materials and components with the lowest environmental impact. Construction has long been recognised as one of the most resource-hungry and the least sustainable industries in the world. However we continue to depend on buildings of all kinds – our homes, offices, hospitals, shops, cultural centres and more. Despite increasing awareness of the need to develop a sustainable approach within the construction industry, this proved difficult without a reliable method of evaluating and comparing the environmental impacts of different construction materials.
**Key words:** Buildings, Construction materials, Transportation, Environmental impacts.

## Introduction

The construction and property industry is one of the most energy and resource consuming sectors in the world. Around 40 percent of the world's resource and energy usage is related to the constructing and property industry. The sector is challenged to contribute to a sustainable future by becoming more resource efficient, causing a smaller environmental impact and at the same time achieving a good and healthy environment for its tenants and customers.

While buildings and development provide countless benefits to society, they also have significant environmental and health impacts. This paper presents some basic facts about those impacts. It's important to understand how buildings have traditionally hurt the environment It's not just the methods and materials used to construct a building that affects the environment. How it's built to operate has a huge impact as well.

The materials used in building construction also have a serious impact on the environment. Many of the materials used in the construction of buildings are produced in a non-sustainable way. The factories that make the materials produce damaging $CO_2$ emissions. Materials that are not produced locally are often transported from across the country. The transportation required for these materials has a considerable impact on air quality. There is a huge environmental impact associated with the extraction and consumption of raw materials for the use of building materials.

The destruction and renovation of buildings result in a large amount of waste. Building waste often includes concrete, metals, glass, plastics, wood, asphalt, bricks and more. This waste is often disposed of in either landfills or incinerators. Not only does this pollute the land and the air, but the transportation required to remove such waste has a major impact on the environment as well.

The design, construction, operation and maintenance of buildings have a great impact on the environment. The challenge is to have buildings that minimise pollution and increase the comfort, health and safety of the occupants. Traditional building practices often overlook the interrelationships between a building, its components, its surroundings, and its occupants. On an average, buildings consume more natural resources than necessary, have a negative environmental impact and generate a large amount of waste. However, there are many ways to alter this trend. Installing energy and water efficient products can conserve resources while Minimizing construction waste can also ease the impact on landfills and resources.

**Foundations**

- For most of the fine grained soils (containing silt and clays) it might be sufficient to use simple spread footings, it is largely depending on the magnitude of the load. The location of the foundations in relation to the soil (need to be aware of foundation walls and hydrostatic pressure as moisture is present in the soil).

- If the soil is poor and structure loads are relatively heavy, then alternate methods are required.

- Pile foundations might be required in some cases where fine cohesive silt and clay soil is present.

- Sometimes it might be desirable and economically feasible to over excavate remove such soils that are not of bearing capacity; can remove compact and fill back or import other engineered soil.

- The geotechnical engineer based on borings will recommend suitable foundations systems or alternative solutions, also beating capacity, minimum depths, and special design or construction procedures might be established.

- Bedrock has the highest safe bearing capacity.

**Foundation Types:**

**Spread Footings:**

- Used for most buildings where the loads are light and / or there are strong shallow soils.
- At columns there are single spot square pads where bearing walls have an elongation form. These are almost always reinforced.
- These footing deliver the load directly to the supporting soils.
- Area of spread footing is obtained by dividing the applied force by the soils safe bearing capacity (f=P/A).
- Generally suitable for low rise buildings (1-4 Stories).
- Requires firm soil conditions that are capable of supporting the building on the area of the spread footings.
- When needed footings at columns can be connected together with grade beams to provide more lateral stability in earthquakes.
- These are most widely used because they are most economical.
- Depth of footings should be below the top soil, and frost line, on compacted fill or firm native soil.
- Spread footings should be above the water table.
- Concrete spread footings are at least as thick as the width of the stem.

**Combined footing:**

A combined footing supports two columns. They are required when the two individual footings overlap or when a foundation is built close to an existing building or property line, there may not be sufficient space for equal projections on the sides of exterior column. The footing is proportioned such that the center of gravity of the footing lies on the line of action of the resultant of the column loads. The pressure distribution thus becomes uniform. It may be rectangular or trapezoidal.

**Drilled Piers or Caissons**:

- For expansive soils with low to medium loads, or high loads with rock not too far down, drilled caissons (piers) and grade beams can be used.
- The caissons might be straight or belled out at bottom to spread the load.
- The grade beam is designed to span across the piers and transfer the loads over to a column foundation.
- Caissons deliver the load to soil of stronger capacity which is located not too far down.

**Piles:**

- For expansive soils or soils that are compressive with heavy loads where deep soils cannot take the building load and where soil of better capacity if found deep below.
- There are two types of piles.

1. Friction piles – used where there is no reasonable bearing stratum and they rely on resistance from skin of pile against the soil.
2. End bearing – which transfer directly to soil of good bearing capacity.

- The bearing capacity of the piles depends on the structural strength of the pile itself or the strength of the soil, whichever is less.
- Piles can be wood, steel, reinforced concrete, or cast in place concrete piles.
- Cast in place piles are composed of hole drilled in earth and then filled with concrete, it is used for light loads on soft ground and where drilling will not cause collapse. Friction type, obtained from shaft perimeter and surrounding earth.

**Mat Foundations:**

- Reinforced concrete raft or mats can be used for small light load buildings on very weak or expansive soils such as clays.
- They are often post tensioned concrete.
- They allow the building to float on or in the soil like a raft.
- Can be used for buildings that are 10-20 stories tall where it provides resistance against overturning.

- Can be used where soil requires such a large bearing area and the footing might be spread to the extent that it becomes more economical to pour one large slab (thick), more economical – less forms.
- It is used in lieu of driving piles because can be less expensive and less obtrusive (i.e. less impact on surrounding areas).
- Usually used over expansive clays, silts to let foundation settle without great differences.

**Methods and Materials**

**Site Clearance**

The very first step is site clearance which involves removal of grass and vegetation along with any other objections which might be there in the site location.

**Demarcation of Site**

The whole area on which construction is to be done is marked so as to identify the construction zone.

**Excavation:**

Excavation was carried out mechanically. Many earth excavators (JCB's) were used for excavating the soil. Adequate precautions are taken to see that the excavation operations do not damage the adjoining structures. Excavation is carried out providing adequate side slopes and dressing of excavation bottom. Proper shoring and strutting was provided at the sides.

The work covers operations in connection with building construction like

(a) Clearing and rubbing
(b) Grading
(c) Excavation including removal of topsoil.
(d) Filling and back filling
(e) Hard stone soiling to floors and paving
(f) Anti-termite treatment to foundation and floors.

Exact level of all floors was set. All rubbish and vegetation was removed from site. All sludge and slush was cleared out before laying foundation. Excavation of rocks was carried out by chiseling, crowbars, or burning. Excavated materials were not placed within 1.5m of edges of trench or half the depth of trench, whichever was more.

Accumulated water was pumped out from excavation. During excavation care was taken to avoid damage to drains, water mains, electrical mains, underground work and services. Pits and trench was smoothened and tightly rammed. Shoring and strutting was provided to protect adjacent ground.

Fill material was hard and free from all soft and spongy material. Fill under floor, terraces, and concrete bed was free of saltpeter, white ants etc. Fill material consisted of either sweet earth available from excavation work or brought from outside. Coarse sand was used as filling material in trenches and plinth. The fill was spread in layers not exceeding 230mm and each layer was watered and thoroughly consolidated with a roller. The fill was then flooded with water for 24 hrs allowed to dry and then rammed and consolidated again. The finish was formed to correct lines, levels, slopes, shapes etc. as required. Finish grading was done with fertile soil. All debris, rubbish, brick bats, sand and similar material was removed before commencing fill.

**Cement**

Portland cement is composed of calcium silicates, aluminates and aluminoferrite. It is obtained by blending predetermined proportions limestone clay and other minerals in small quantities which is pulverized and heated at high temperature – around 1500 deg centigrade to produce 'clinker'. The clinker is then ground with small quantities of gypsum to produce a fine powder called Ordinary Portland Cement (OPC). When mixed with water, sand and stone, it combines slowly with the water to form a hard mass called concrete. In presence of moisture it undergoes chemical reaction termed as hydration.

Portland Pozzolana Cement (PPC) is obtained by either intergrinding a pozzolanic material with clinker and gypsum, or by blending ground pozzolana with Portland cement or by adding fly ash to it.

**Aggregates**

Coarse aggregate for the works should be river gravel or crushed stone .It should be hard, strong, dense, durable, clean, and free from clay or loamy admixtures or quarry refuse or vegetable matter. The pieces of aggregates should be cubical, or rounded shaped and should have granular or crystalline or smooth (but not glossy) non-powdery surfaces. Aggregates should be properly screened and if necessary washed clean before use.

Coarse aggregates containing flat, elongated or flaky pieces or mica should be rejected. The grading of coarse aggregates should be as per specifications of IS-383.After 24-hrs immersion in water, a previously dried sample of the coarse aggregate should not gain in weight more than 5%.Aggregates should be stored in such a way as to prevent segregation of sizes and avoid contamination with fines.

FINE AGGREGATE COURSE AGGREGATE

Aggregate which is passed through 4.75 IS Sieve is termed as fine aggregate. Fine aggregate is added to concrete to assist workability and to bring uniformity in mixture. Usually, the natural river sand is used as fine aggregate. Important thing to be considered is that fine aggregates should be free from coagulated lumps.

Grading of natural sand or crushed stone i.e. fine aggregates shall be such that not more than 5 percent shall exceed 5 mm in size, not more than 10% shall IS sieve No. 150 not less than 45% or more than 85% shall pass IS sieve No. 1.18 mm and not less than 25% or more than 60% shall pass IS sieve No. 600 micron

**Water**

The strength and durability of concrete depends also on the amount of water mixed with it. Too much or too little water can adversely affect the strength of concrete. After concrete is cast, water is used to cure it so that the temperature is controlled and concrete matures slowly. It is very important to use clean, potable water in quality concrete production. Brackish or salty water must never be used. Contaminated water will produce concrete mortars with lower durability, erratic set characteristics and inconsistent colour.

**Reinforcement Steel**

RCC stands for reinforced cement concrete. To enhance the load carrying capacity of the concrete it is reinforced with steel bars of different diameters provided in an appropriate manner. Such concrete is called reinforced concrete and the bars are called the reinforcement. These bare are provided at various locations to resist the internal forces, which are developed due to the loads acting on the structure. Reinforcing steel contributes to the tensile strength of the concrete. Concrete has low tensile, but high compressive strength. The tensile deficiency is compensated by reinforcing the concrete mass through insertion of plain or twisted mild steel bars. Both branded and unbranded bars are available. It is wise to buy good brands the names of which are marked on the steel. During construction make sure that steel reinforcement is provided exactly as the engineering design specification.

Reinforcement should be free from loose rust, oil paints, mud etc. it should be cut, bent and fixed properly. The reinforcement shall be placed and maintained in position by providing proper cover blocks, spacers, supporting bars, laps etc. Reinforcements shall be placed and tied such that concrete placement is possible without segregation, and compaction possible by an immersion vibrator

Transverse reinforcements are very important. They not only take care of structural requirements but also help main reinforcements to remain in desired position. They play a very significant role while abrupt changes or reversal of stresses like earthquake etc.

They should be closely spaced as per the drawing and properly tied to the main/longitudinal reinforcement. R.C.C. is according to IS code 456.

Reinforcement bars

**Form Work and Shuttering Work**

Forms or moulds or shutters are the receptacles in which concrete is placed, so that it will have the desired shape or outline when hardened. Once the concrete develops adequate strength, the forms are removed. Forms are generally made of the materials like timber, plywood, steel, etc.

**Shuttering:**

A proper lubrication of shuttering plates is also done before the placement of reinforcement. The oil film sandwiched between concrete and formwork surface not only helps in easy removal of shuttering but also prevents loss of moisture from the concrete through absorption and evaporation. The use of oil, which darkens the surface of the concrete, is not allowed. Oiling is done before reinforcement is placed and care taken that no oil comes in contact with the reinforcement while it is placed in position. The formwork is kept thoroughly wet during concreting and the whole time that it is left in place.

The steel form work was designed and constructed to the shapes, lines and dimensions shown on the drawings. All forms were sufficiently water tight to prevent leakage of mortar. Forms were so constructed as to be removable in sections.

**R.C.C. Work**

Plain concrete is very strong in compression but its tensile strength is only about 1/10th of the strength in compression. So, the use of the plain concrete is limited to the structure in pure compression. Steel being equally strong in compression and tension, is, therefore, used to reinforce the concrete in a suitable way so that it can be used to build supporting structure where tension also develops. Concrete, thus reinforced is known as “reinforced concrete”. This combination is made because long steel bars can develops its full strength where it cannot carry equal amount of compressive force due to its buckling which is caused by the slenderness. Thus, the combination of concrete and steel bars has proved to be ideal, as the two materials are used to resist the stresses for which they are most suitable.

**Mixing of the Concrete**

After fixing the proportion of different ingredients of concrete for a particular work, the material C.A., F.A., cement and water measured out in batches for mixing. The process is known as **Batching.** This process of batching may be carried out by weight or by volume.

(i) Weight batching:- The unit of weight, for material of concrete, is usually Kilogram. The batching of material by weight is absolutely straightforward, the cement, sand and coarse aggregate being all weighed directly in Kilogram.

(ii) Volume batching:- In batching by volume, all ingredient i.e. water, cement, sand and coarse aggregate are measured in liters, where the resulting concrete (being) solid measured in cubic meters.
The batching of concrete is done at their own plant located at about two km. away from the site. The concrete is then transferred to site in concrete mixer from plant.

**Pouring of Concrete in Column**
Fresh Concrete should be stable and should not segregate or bleed during transportation and placing when it is subjected to forces during handling operations of limited nature. The mix should be cohesive and mobile enough to be placed in the form around the reinforcement and should be able to cast into the required shape without losing continuity or homogeneity under the available techniques of placing the concrete at a particular job. The mix should be amenable to proper and through compaction into a dense, compact concrete with minimum voids under the existing facilities of compaction at the site. A best mix from the point of view of compactibility should achieve a 99 percent elimination of the original voids present.

### COMPACTION

To make the concrete impervious & attain maximum strength all the entrapped air from the concrete mass was removed when it was still in plastic state. If the air is not removed completely, the concrete loses strength considerably. Compaction eliminates air bubbles and brings enough fine material both to the surface and against the forms to produce the desired finish. Use of mechanical vibrators is recommended. Mechanical compaction is done by the use of vibrators. Due to vibrations the particles occupy a more stable position and concrete fills all the space. The consistency of concrete depends of conditions of placing, type of mix, and the efficiency of vibrator.

Use of Needle Vibrator (Dia 45mm)

### Curing

Curing is the process of controlling the rate and extent of moisture loss from concrete during cement hydration. Since the hydration of cement does take time – days, and even weeks rather than hours – curing must be undertaken for a reasonable period of time if the concrete is to achieve its potential strength and durability. The curing period may depend on the properties required of the concrete, the purpose for which it is to be used, and the ambient conditions, ie the temperature and relative humidity of the surrounding atmosphere. Curing is designed primarily to keep the concrete moist, by preventing the loss of moisture from the concrete during the period in which it is gaining strength.

Curing should be started just after the surfaces begin to dry. Normally 7 to 15 days curing is adequate.

**Conclusions**

Buildings are the key components of urban areas and society as a complex system. The purpose of this paper is to analyse the environmental impacts from construction materials used in the construction of residential buildings. Construction materials and their mode of acquisition are harmful threats to the environment and these threats are increasing with the increase in population and consumption of construction materials. Forests are being degraded at a faster rate to acquire land for construction because of the pressure exerted by increased population on existing scarce land. The growing trends in extraction of natural construction materials are serious threats to the environment and unless suitable actions are taken by designers, engineers and legislators, there will be a serious impact on the environment. There is a need to reduce the consumption of construction materials which can be done through recycling and reuse of wastes. Communities should realized the dangers of environmental degradation which does not only include the negative effects on human beings but also on the entire eco system.

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