

# COMPARATIVE STUDY OF SUSTAINABLE AND CONVENTIONAL MATERIAL USE IN INFRASTRUCTURE PROJECTS

Kuldeep. R .Siddhapura<sup>1\*</sup>, Ujjaval.N.Shah<sup>2</sup>

<sup>1,2</sup>Department of Construction Engineering and Management, S.N. Patel Institute of Technology & Research Centre, UmraKh, Gujarat, India

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**Abstract** - Infrastructure projects consume a significant amount of our natural resources and have a wide range of environmental impacts. Selecting sustainable materials and methods are one way to minimize a project's economical impact. In fact, cost reductions in the construction and operation of buildings, or Infrastructure offers one of the most significant opportunities to reduce financial and economical cost in infrastructure projects. The main objective of this research is illustrated how the sustainable or green buildings benefits and impact on the projects and also research the comparison between sustainable material and conventional material use in infrastructure projects.

**Key Words:** Sustainable material, conventional material, fly ash brick,

## 1. INTRODUCTION

India is the second largest country in population in the world. At present the cost of infrastructure and expansion of cities in India is haphazard. In order to extricate from the present scenario India must follow the principles of sustainability. There is a dire need to protect the environmental resources. Green building is one of the important solutions of sustainable development.

The property material is formed typically for natural or recycled materials and its production needs a little quantity of energy. And it makes restricted use of non-renewable resources and incorporates a low environmental impact. galore presently used acoustic materials can't be thought of property in terms of the energy consumption and greenhouse gases emissions. varied materials may be harmful for human health. For example, mineral wools square measure wide used for thermal and sound insulation, thanks to their smart performance and price (low-cost) cost. However, rock wool fibres, once inhaled, will lay down within the respiratory organ alveoli, and may cause skin irritation. [1, 2].

The breath taking rise in urban population has resulted in the fast evolution of infrastructures all over the world and the construction industry has become one of the most increasing sectors in today's world [3]. Due to the limited sources and the importance of environmental issues, sustainable lifestyle is forecast to become an important trend these days [4]. Fly ash (FA) is a by-product of the ignition of pulverized coal in thermal power plants. It has been broadly used to attain sus-

tainability in the cement and concrete industry for many years [5,6]. In addition to its environmental benefits [7,8], the proven technical benefits of using Fly ash to substitute cement in concrete include advancement in workability, reduce of bleeding, reduce in the temperature rise in hardened concrete, reduction of drying shrinkage, reduction of reinforcement rust in reinforced concrete [9,10,11], and overall increase in toughness [12,13].

AAC (Autoclaved aerated concrete) was developed in 1924 by a Swedish architect, who was looking for an alternate building material with properties alike to that of wood – good thermal insulation, solid structure and easy to work with but without the drawback of combustibility, decay and termite damage. In line with the raise trend of green building development, the industry of green materials and services is also expanding in India. Thus preference is now being given to greener and valuable building materials and AAC (Autoclaved Aerated Concrete) is one such green material. AAC (Autoclaved aerated concrete) proposal both material and performance aspects from a sustainability perspective.

The use of earth blocks as walling units is routine in most rural parts of Ghana. In recent past, the fall down of buildings as a result of poor nature of earth blocks used has been considerable in developing countries [14]. Though adobes are most used for slightly loaded single and two-storey residential buildings, adobes have also been used to construct 10-storey high rise buildings in Yemen [15].

One thanks to increase the insulation capability of the brick is to come up with consistency within the clay body. Incendiary, organic kinds of pore-forming additives square measure most free- oftentimes used for this purpose. Solid concrete blocks area unit oftentimes used, that area unit large in weight and made from thick mixture. they're terribly robust and provides smart stability to the structures. thus for giant work of masonry like for load bearing walls these solid blocks area unit desirable. they're accessible in massive sizes compared to bricks.

## 2. NEED OF SUSTAINABLE MATERIALS :

First, you want to build something that lasts. When choosing building materials, it's necessary to examine the lifespan of a material, from its origin to its discarding.

Sustainable style is that the essence of recent discipline style nowadays. Any systems and strategies that may higher health, welfare or safety are a part of this mission. Energy savings, strategies to reinforce the life-cycle of a structure are high worth goals for designers. Decrease the general life cycle prices of a building or structure are half and parcel of this arrange.

The harvest of property materials ends up in way cut back waste than alternative kinds of materials, like plastics, that means slighter lowland waste, less energy consumption, and fewer impact on the surroundings as an entire. In short, natural wood encompasses a lower life cycle price than alternative materials.

There are many materials that improve a homes air quality—such as natural wool carpeting, air systems that bring refreshing outdoor air indoors, insulation that prohibits mould growth, and laminates that don't use toxic glues.

A lot of sustainable building materials use salvage or recycled materials. It is simple—the more we re-use products, the less we get new products and deplete world resources.

### 3. SUSTAINABLE MATERIAL :

Sustainable materials are materials used throughout our consumer and industrial economy that can be produced in required volumes without depleting non-renewable resources and without disrupting the established steady-state equilibrium of the environment and key natural resource systems.

Sustainable materials:

- ☑ Fly ash bricks
- ☑ AAC blocks
- ☑ Compressed stabilized interlocking earth blocks

Utilization of sustainable materials:

- A sustainable material used in a building generally benefits the humans and also the general environment.
- Does not deplete non- renewable (natural) resources.
- Has no un favourable impact on the environment when used.
- Using reclaimed, preferably than new materials.
- Using materials with low embodied energy.
- Drawing and constructing for ease of reuse and recycling at end-of-life.

### 3.1 FLYASH BRICK USE AS SUSTAINABLE MATERIALS:



**Figure 1: Fly Ash Brick**

FAB (Fly ash brick) is created from the burned coal ash. it's a inexperienced material having terribly little impact on the setting. If we tend to burn coal for creating ash brick there an enormous environment issue however we tend to don't do this. We tend to use ash created by burning coal for power generation. Fly ash is a by-product of the thermal power generation. Burning of coal will generate fly ash. In the past, fly ash was mainly used as a pozzolanic additive for concrete. Due to the Superior surface area match - up with the cement, fly ash is used as a substitution to the cement.

Comparison between the bond strength of Fly ash Bricks to mortar and that of comparable shaped and commonly used solid clay bricks showed that the Fly ash Bricks have a bond that is 44% higher than the standard clay brick. The process of manufacture of Fly ash Bricks indicate clearly that there is much savings to be done during the making of the bricks. These savings arise mainly from the uniformity of the raw material and the reduction in firing time as well as from doing away with whole processes of mining, transporting, mixing and grinding, that are necessary in the case of the clay and shale based.

### 3.2 AAC BLOCKS USE AS SUSTAINABLE MATERIALS:



**Figure 2: AAC Block**

Autoclaved Aerated Concrete (AAC) is an ultra-light concrete masonry product. it can weight as little as 1/5 as much as

ordinary concrete due to its well defined cellular structure featuring millions of tiny pockets of trapped air [22,23,24]. AAC blocks are 7 times bigger than the size of the conventional bricks. Bigger size means less number of joints. Less joints results in lesser quantity of mortar for building. There is overall 60% reduction in use of Mortar.

It is apparent that masonry units with the least or no clay content (i.e. AAC blocks which contains waste material such as Fly Ash have low impact. Density also influences raw material impact, thus AAC blocks resulting from the aerated nature (approximately 80% air) have lower raw material impact. Larger block size reduces the quantity of mortar wastage on construction site. Additionally, the raw materials that are consumed are generally abundant and found in most geographic regions, allowing them to be locally sourced. Furthermore, much of the raw materials used in AAC production may consist of recycled materials, including copper mine tailings and fly ash, a by-product of coal-fired power plants.

AAC blocks/panels are a high quality product with high insulating capabilities – their use would lead to lower energy consumption at the air conditioning end of the construction building and would partly help the building in achieving the green building status. Its low density properties would enable the building structure to be light weight and thus would require less deep foundations.

- **Why AAC block consider as sustainable materials:**

**Fire and pest resistance:**

Another necessary aspect that makes autoclaved aerated concrete blocks a sustainable material is its extraordinary resistance to fire and pests. It's inorganic, non-combustible and does not actually burst in any conditions. No doubt, these are quite for the fire-rated applications. Even AAC blocks also come with fire ratings depending on the thickness of the blocks or panels, which can withstand fire up to 6 hours of direct subjection. Due to its structural composition AAC blocks are not damaged by termites and other pests. Simultaneously, it does not attract rodents or other pests.

**Structural capability:**

The compressive strength of AAC is very good. Although it is one-fifth of the density of the normal concrete, AAC blocks come with double bearing strength and load-bearing capacity. Again it is way lighter than the traditional bricks, therefore, simple and cheaper to transport. Usage of AAC blocks significantly Decrease overall dead load of a building, thereby allowing construction of high rise buildings at ease.

**Non-toxicity and breathability:**

Being aerated, the nature of the AAC blocks facilitates breathability and there is no toxic substance present in the

final product. As a result, AAC blocks are ideal material for homes for the chemically sensitive [25].

### **3.3 COMPRESSED STABILIZED INTERLOCKING EARTH BLOCKS USE AS SUSTAINABLE MATERIALS:**

Today, sustainability in construction has become a popular concept among construction professionals. Most Growing countries are moving towards a sustainable environment; one that encourages the preservation of the natural habitat advertise social well-being of the occupants and provides sensible economic stand for the investors. It is observed that this is as a result of discuss that the ever-rising population poses massive threat to the limited earth resources [16]. Compressed stabilized interlocking earth blocks, according to Adedeji and Fasakin has proven to be a sustainable material for building construction due to its adjustability to tropical climate, use of locally available raw material, cost effectiveness and tr aesthetic quality [17]. This paper focuses on the masonry work involved in the delivery of sustainable educational buildings. Masonry [18] is a general term that applies to construction using hand-placed units of clay, concrete, structural clay tile, glass block, natural stones and the likes. The seuni sare bonded together with mortar, metal ties, reinforcement and accessories to form walls and other structural elements. Several type of masonry construction has evolved over the years and one of such is the dry-stack masonry system, which replaces the conventional brick and mortar with interlocking blocks [19].

### **4. CONVENTIONAL MATERIALS:**

Conventional materials such as metals and ceramics have been replaced by polymers (homopolymers, copolymers, composites, complexes, blends of small molecules, and alloys), in electronic, microelectronic, and Nano electronic systems because of their complex molecular characteristics and attractive electrical, electronic, mechanical, physical, chemical, and optical properties.

types of conventional materials:

- Clay bricks
- Solid concrete block

#### **4.1 CLAY BRICKS USE AS CONVENTIONAL MATERIALS:**

Brick is a ceramic material mainly used in construction industry. Its production process involves forming of clay into rectangular blocks of standard size, followed by firing to temperature ranging from 900 - 1200°C. It is made of clay or shale and when given desired shape is dried and fired into a durable ceramic product. Brick is one of the most important building materials. Energy consumption and pollution are the two important environmental and cost concerns related to the brick industry. Clay bricks were amongst the first artificial

materials produced by men for building purposes that proved to be easy to produce, resistant, and durable, as attested by the numerous examples that can be seen all around the world that endured centuries of rough climacteric conditions and wars. Clay bricks are simply produced by mixing clay and water.

**4.2 SOLID CONCRETE BLOCKS USE AS CONVENTIONAL MATERIALS:**

Solid Concrete Blocks are ideal for construction of Chimney & Fire places, yet they equally excel at Non-load Bearing Walls & Garden Walls. Hollow Concrete Blocks are widely used for Exterior & Interior Load-bearing Walls, Partition Walls, Panel Walls, Boundary Walls, etc. Solid Concrete Blocks are rare in its day-to-day usage because of its added mass. It calls for special needs, wants & requirements, such as Higher Fire Resistance, where Sound Absorption is a criteria or where being impenetrable is of paramount importance. A block which has more than 75% of the total mass filled up with concrete, of the overall dimensions is categorised as Solid Concrete Block. It is also known as Concrete Brick.

**5. COMPARISON OF SUSTAINABLE AND CONVENTIONAL MATERIAL:**

**5.1 Comparison of fly ash brick and concrete block:**

PARAMETER	FLYASH BRICK	CONCRETE BLOCK
Compressive strength	10-12 N/mm <sup>2</sup>	4-5 N/mm <sup>2</sup>
Density	1700-1850 kg/m <sup>3</sup>	1800 - 2100 kg/m <sup>3</sup>
Water Absorption	12 %	15 %
Fire resistance	2 hours	3 hours
Weight of materials	2.6 KG	17-26 KG
Spacemen size	230mm x 110mm x 70mm	400 mm x 200 mm x 200 mm
Heat insulation	20% ~ 25%	35% higher
Sound resistance	40decibel	50-60decibel
Cost	4Rs	24Rs

**5.2 Comparison of AAC block and Clay brick:**

PARAMETER	AAC BLOCK	CLAY BRICK
Compressive strength	2.99 MPa	4.3-6.9 MPa
Density	550-650 kg/m <sup>3</sup>	2000 kg/m <sup>3</sup>
Water Absorption	-	Less than 7%
Fire resistance	Up to 1200°C	38°C - 204°C
Weight of materials	6-7 KG	3.5-3.8 KG
Spacemen size	600mm x 150mm x 200mm	229 mm x 102 mm x 76 mm
Heat insulation	30%	-
Sound resistance	45decibel	50-60decibel
Cost	40Rs	4 - 5.50Rs

**6. Conclusion**

This study aimed to choose sustainable construction materials and conventional materials. They mainly focused on sustainable material opinion to consider parameter and compare to choose sustainable and conventional material of a infrastructure projects as the most common internal and external wall. Thus it is logical to achieve different priorities and results under various condition and I observed to preferred the sustainable material is more benefit in infrastructure projects.

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