Excavated Soil from Construction Site as a Green building material in Structural Brick Masonry

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***Abstract*— Brick, cement, steel, aluminium, plastic products, paints, polished stone, ceramic products etc are the commonly used material of construction today. These materials are energy intensive and are transported over large distance before being used for construction. The following points require attention, regarding the use of modern building materials. Energy consumed in the manufacturing process- energy intensity; Problems of long distance transportation. Natural resources and raw material consumed; Recycling, biodegradable environmental and sustainability with respect to future demand need to be addressed during the manufacture and use of any new building materials. So that by using of excavated soil from construction site as a green building material by making bricks of excavated soil by using cement and fly ash as admixtures, and using that brick in intermediate walls and partition walls.**

***Keywords*—excavated soil; biodegradable; flyash; admixture; intermediate walls; partition walls;**

I. INTRODUCTION

Masonry is one of the main items of construction in a building and needs careful consideration. It comprises masonry unit such as brick stone, concrete block laid in mortar. Main consideration in choosing a particular unit are : availability, strength requirement, durability, dimensional stability and resistance to rain penetration, fire rating, thermal properties, style of architecture and economy in cost. The first masonry structures were unreinforced and intended to support mainly gravity loads. The weight of these structures stabilized them against lateral loads from wind and earthquakes. Fired clay bricks become the principal building material in United States during the middle of 1800's.Concrete masonry was introduced to construction during the early 1900's along with clay masonry, expected in use to all types of structures. The word "masonry" is a general term that implies to construction using hand-placed units of clay, concrete structural clay tile, glass block, natural stones and the like one or more types of masonry units are bounded together with mortar, metal tiles, reinforcement and accessories to form. The material other than gypsum and element constructed as stated in this definition are considered masonry construction. This term identifies the building element of plain (reinforced) masonry, reinforced masonry, grouted masonry, glass unit masonry and masonry veneer. Masonry units are natural stone units or manufactured units of fired clay, shale, cementitious material or glass. Choice of masonry is generally made from the consideration of (a) local availability, (b) compressive strength,(c) durability,(d) cost and ease of construction. Bricks has the advantages over stone that it lends itself easy to construction require less labour or laying. Earth as mud bricks has been used in the construction of shelters for thousands of years, and approximately 30% of the world present populations still live in earthen structures. Earth is a cheap, environmental friendly and abundantly available building material. It has been used extensively for wall construction around the world particularly in developing countries. Roofing system using brick masonry vaults and domes were used extensively in India till the emergence of British rule. Both burnt brick and stabilized mud blocks were used for building vaults and domes.

The main aim of this technical paper is to compare the strength of red bricks with earthen excavated bricks which can used in partition walls of w.c and bath and in alternate layers of intermediate walls.

II. USE OF EXCAVATED SOIL AS A GREEN BUILDING MATERIAL

A. Green Building Material

Green building has now become a flagship of sustainable development in this century that takes the responsibility for balancing the long-term economic, environment and social health. It offers an opportunity to create environment environmentally efficient building by using an integrated approach of design so that the negative impact of building on the environment and occupants is reduced. It can also be used as a management tool to organize and structure environmental concerns during the design construction and operation phases. Green building assessment tool is a multi dimensional method respect different environmental, social and economical issues. Therefore, the process of building weighing system for indicators should be comprehensive and flexible. Green building approach should consider three dimensions-environmental, social and economical. Therefore the assessment tool necessarily to take three dimension into consideration – Site selection, energy, water resources material and components, environmental loadings, transport emission waste and other can define environment aspects. Comfort health, Indoor environmental quality, access to facilities, participation, control education, safety and other can define social aspects. Finally economical aspects can be introduced through economy, efficiency of use, ongoing costs, operation costs, durability, adaptability, maintenance and others.

B. Excavation

Excavation is a simple process involving the removal of mass of soil and water. With this removal there are changes in stress conditions in the ground including the ground water regime. One of the most important effects of this process is soil movements below the excavation as well as surrounding the excavation. Prevention and minimizing the damages to surrounding is o utmost concern to the design engineer and the construction for any excavation work. Site characterization is the first major step to be taken by geotechnical engineer. Most common practices tend to greatly simply the soil profile and to select the design parameters. E.g. strength and compressibility as the basis of simple laboratory tests. On the other hand, in analyzing and designing the retaining system, sophisticated mathematical models are quite often assumed. It must be pointed out that compatibility between soil characterization and method of analysis must be observed. Many of the analytical method, particularly those for estimating soil movements are based on semi-empherical approach. The applicability of local experience of data needs to be examined carefully. There are many factors which affect the soil movements. Among them, the more important ones are soil properties, groundwater conditions and control dimensions of excavation, supporting system excavation and bracing sequence, nearby structure facilities, transit load and time. Since soil deformation is time dependent the importance of timely installation of support and bracing system preloading cannot be over-emphasized. Many investors have presented case studies to illustrate and discuss these factors. Since deep excavation is a total technique proper co-ordination and integration of design and construction are of utmost importance. The inter-relationship among the various phases of work in carrying out an excavation. Due to the limitation in the state of current knowledge in soil mechanics and the complex nature of soil behavior, design of excavation including supporting system, still heavily relies on semi-empherical approaches. Furthermore, most excavation work and supporting system is temporary in nature. Low factor of safety are often adopted. Use of instrumentation to monitor the performance of excavation work should be considered as an essential element of the total technique.

III. Sustainable Building Technologies

Building material and technologies and building practices have evolved through ages. Housing and building conditions reflect the living standards of society. Stones, mud, thatch/leaves timber represent the earliest building material used for construction. Durability of the material are directly derived from natural material are directly derived from natural materials like soil, thatch/leaves, timber etc is questionable. India construction industry is one of the largest in terms of economic expenditure, value of raw material/ natural resources consumed volume of material and products manufactured, employed generated, environmental impacts etc. Large variety of material are manufactured and consumed in construction industry. Production levels and energy expenditure some of the building materials consumed in bulk quantities. It has been estimated 22% of green house gas emission is contributed by the construction sector in India. Steel, cement, glass, aluminum bricks etc are energy-intensive materials commonly used for building construction. Generally these materials are transported over great distances. Extensive use of these material can drain the energy resources and adversary affect the environment on the other hand it is difficult to meet the ever growing demand for building by adopting only energy efficient traditional materials like mud, thatch, timber etc and construction methods

A. Energy Conservation

Energy conservation; Minimize the use of high energy materials; concern for environment friendly technologies; minimize transportation and maximize the use of local materials and resources; Decentralized production and maximum use of local skills; Utilization of industrial and mine wastes or the production of building material; Recycling of building wastes and use of renewable energy sources. Building technologies manufactured by meeting these principles could become sustainable and facilitate sharing the resources more efficiently causing minimum damage to the environment

B. Energy in building material

- Clear understanding of the sector wise demand and growth of the Indian construction scenario.Table 3.2
- Estimating current building stock and the contribution of unorganized sector in manufacture and supply of energy intensive materials.
- Assessing the availability (region wise) of local resources, raw materials/ traditional materials for developing and manufacture of building product.
- Developing alternative building technologies to meet the region- specific needs/ demand for buildings [2].

C. Comparission of energy and Carbon dioxise emission of common building materials

Selection of technologies and material have significant role for the satisfaction of occupants, without any adverse impacts on environment. The emission of green house gases like CO_2 is gradually increasing day by day, due to implementation of modern technology and energy uses which have adverse effect on the environment. Construction sector is responsible for the significant amount of CO_2 emission. To minimize the emission of CO_2 through building construction, It is necessary to construct building by the use of Adobe, mud, cow dung , straw and other local material i.e. low energy intensive material. In this study the assessment of the embodied energy in three different types of building is done. For estimation of embodied energy consumed for the entire production process is considered.

The amount of energy required to produce a material and supply it to building construction site is called embodied energy. Embodied energy mainly depends upon the maintenance cost of building material and transportation cost. Building techniques has significant role for estimation of embodied energy

D. Embodied energy in building material

- Embodied energy required in the manufacturing of building material
- Energy consumed for transportation of the building material to the site.
- Energy required for assembling the various material to construct the building. Table 3.4.1

- The total energy required to construct the burnt clay masonry is about 580.193 GJ. A 12.30% reduction is observed in the building construction. If brick masonry is replaced by Hollow concrete masonry. Table 3.4.2
- When brick masonry is replaced by stabilized soil brick masonry than 36.22% reduction in embodied energy is observed. The additional advantage of using stabilized soil block is low cost easy availability of such material. Table 3.4.3
- Less emission of green house like CO_2 and do not require additional insulation for thermal comfort. Table 3.4.4

IV. Optimization of Energy in Public Buildings

The public buildings which include schools, colleges, and offices consume a considerable amount of energy and other natural resources. Building in India consumes a considerable amount of energy and other natural resources. Building in India consumes about 20% of the country's total electricity and have a significant impact on the environment and resources indicating the need to develop green building. Our country is witnessing tremendeous growth in construction sector so here it is considered to be one of the largest economic activities which grow at an average rate of 9.5% as compared to global average rate of 5%. Use of those construction material which are posing threat to the environment are also growing at a alarming rate.

A. Reduce energy consumed by materials

The use of fly ash bricks if replaced by clay bricks saves around 1288825 MJ and reduce consumption of energy by around 74.6% and also cost decreases by 14% and reduction in carbon emission by 26.6%

AAC block reduce energy consumption by 45% but cost increases by 39%. The use of PPC over OPC reduces energy consumption by 33% and carbon emission by 13%. The use of Kota stone reduces energy consumption by 7% carbon emission by 1.6% when compared to terrazzo tile with increase in cost by 13%.

B. Comparision of embodied energy with masonry walls

The embodied energy, for the exterior masonry walls are 34% to 23% less than conventional building techniques while for interior walls they are 56% to 45% lower. It is relevant to note that the differences are mainly due to the absence of reinforced concrete columns in the masonry walls. Building in seismic areas can be built with ceramic blocks upto 2 or 4 stories, depending upon the seismic classification of the areas. In non- seismic areas this contribution can be multiplied as the boundaries only depend on the dimensions of the structure moreover this study shows planner how to conduct a more environment friendly design and construction. [5]

C. Figures and Tables

Table 3.1 Energy Consumed by materials

Types of Materials	Energy Consumed
Mud (Excavated from site itself)	0.00
Cement	4.2
Steel	36
Brick	5
Glass	15.9
Aluminium	236.8

Table 1.3.2 Embodied energy and carbon emission of bricks

Sr. No.	Types of Bricks	Carbon emission (CO2 / Kg)	Embodied energy (MJ/M3)
1	Clay Bricks	96.11	3950
2	Autoclaveaerated concrete bricks	131.067	2150
3	Fly ash	96.11	1020

Table 1.3.3 Embodied energy and carbon emission of cement

Sr. No.	Type of Cement	Carbon emission (Kg/ CO2)	Embodied energy value (MJ/Sqm)
1	OPC	939.555	840
2	PPC	818.332	565

B. Conclusion

Earthern bricks are cheaper than Red bricks and Cost effective in use and environment friendly. Earthern bricks is low value and high intensity Product. Rate of bricksi is very less as compared to nominal Or traditional bricks. These bricks can be used in walls of W.C and bath and in the alternate layers of internal walls.

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