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USING EXPANDED CLAY AGGREGATE (ECA)

IN REINFORCED CEMENT CONCRETE.

Why Expanded Clay Aggregate (ECA) Is Used?:

- This presentation is to show the significance of using Expanded Clay Aggregate (ECA) in reinforced cement concrete.
- A research was carried out at Building & Housing Research Center, which is the research center for Ministry of Housing in Iran.
- The most significant way for constructing building in reinforced cement concrete is by using Expanded Clay Aggregate. This type of concrete was discovered in 1917.
- In different countries of the world, lightweight aggregate has been produced and named differently and paid attention with increasing rate. In Iran, this aggregate is named LECA or manufactured aggregate. LECA is abbreviated form of light expanded clay aggregate

Why Expanded Clay Aggregate (ECA) Is Used?:

- We will determine the compressive strength for Expanded Clay Aggregate (ECA) reinforced concrete while noting the advanced technology in producing reinforced concrete.

- In the research carried out, it was found that using Expanded Clay Aggregate (ECA) in the construction of reinforced cement concrete structures, the structures tends to exhibit the following properties:
  - High compressive strength
  - High Tensile strength
  - Lower bond strength of reinforcement to concrete
  - High durability
  - Resistance freezing and thawing
  - Great chemical resistance
  - Reduce or no drying shrinkage
  - Excellent thermal and acoustical properties.

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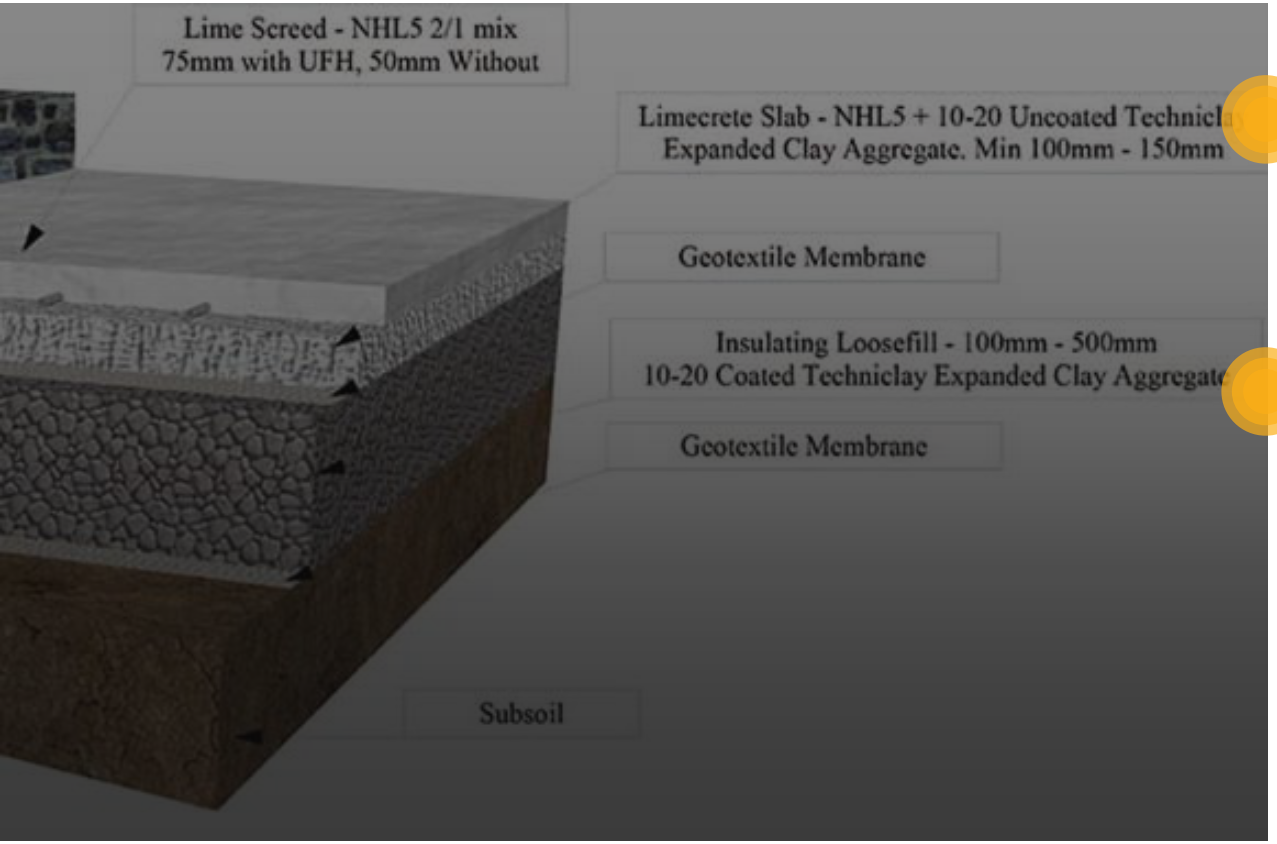
Why Expanded Clay Aggregate (ECA) Is Preferred To Other Aggregates?:



Results obtained from this study shows that making reinforced building components from lightweight Expanded Clay Aggregate (ECA) concrete is possible.

in fact it is more economical to use Expanded Clay Aggregate (ECA) reinforced cement concrete rather than ordinary reinforced concrete in constructing building since lighter weight of building also includes:

- Easy transportation
- Less reinforcement
- Reduction in dimensions of foundation.

Why Expanded Clay Aggregate (ECA) Is Preferred To Other Aggregates?:

With increasing density of Expanded Clay Aggregate (ECA) reinforced concrete it's strength gets higher; this type of concrete is used for, retaining walls, slopping drainage and thermal resisting elements with low density (400-1000 Kg/m3), non-structural elements with medium density (1000-1300 Kg/m3) and load resisting structural elements with high density (1300-1800 Kg/m3).

Reinforced structural components made of Expanded Clay Aggregate (ECA) concrete have been used in America for the past fifty years.

Why Expanded Clay Aggregate (ECA) Is Preffered To Other Aggregates?:

Expanded Clay Aggregate (ECA) reinforced concrete with compressive strength of higher than 70.3 Kg/cm2 is considered usable in building construction. Expanded Clay Aggregate (ECA) reinforced concrete, comparing with other lightweight concrete, possesses a very high strength to density ratio.

Lightweight reinforced concrete can be used in making structural elements and save money, specially, in:

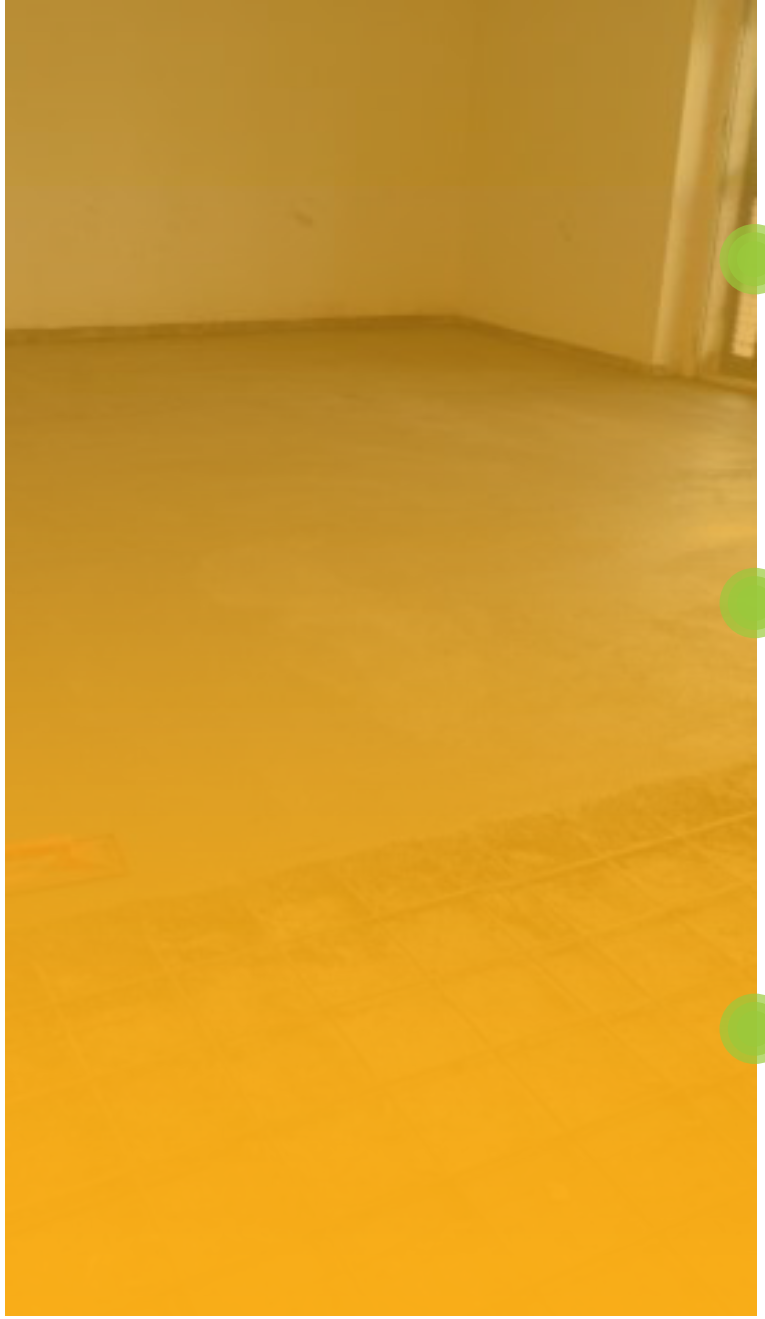
- High-rise building
- Building on a low strength soil
- Where there are not sufficient coarse aggregate mines.

Why Expanded Clay Aggregate (ECA) Is Preffered To Other Aggregates?:

Expanded Clay Aggregate (ECA) reinforced concrete can be used also instead of ordinary concrete in making:

- Casting concrete for making: bridges, buildings, roads.
- Pre-casting: joists, walls in different sizes, floor and roof panels and other structural components.
- Production of: hollow and solid blocks of load bearing and non-load bearing units.

Preparation Of Expanded Clay Aggregate (ECA) Reinforced Cement Concrete:



- Expanded Clay Aggregate (ECA) reinforced cement concrete like ordinary one can be prepared by mixing aggregate (ECA or ECA and Sand), cement and water.
- In Expanded Clay Aggregate (ECA) reinforced concrete instead of using ordinary aggregates one uses ECA aggregate or ECA and ordinary sand. Heating wetted and formed clay soil at 12000C -1300 0C in a kiln produces ECA aggregate.
- In heating process, the gasses are produced, condensed, escaped from aggregate and finally causes voids inside aggregates.

Preparation Of Expanded Clay Aggregate (ECA) Reinforced Cement Concrete:

- Production of Expanded Clay Aggregate (ECA) is accomplished by different means. In India, they are produced by expansion of moist clay soil in a rotary kiln.

- Substituting ordinary sand for some light fine aggregate results to increase the strength of concrete obtained. This increase of strength is noticeable with this reason:
  - Water absorption in light fine aggregates with angular and rough surface is more than in ordinary fine aggregate with round and smooth surface.

Cement Requirement:

- The cement requirement for specific strength of concrete depends on type of lightweight aggregate used.
- In fact, the amount of cement required for specific strength of concrete depends on the modulus of deformation and strength of aggregate used and also on the amount of free water and required workability.
- With increasing amount of cement, the strength of reinforced concrete increases.

Cement Requirement:

- To ensure an excellent durability, suitable workability, protection of reinforcement from rusting and adequate bond strength between concrete and reinforcement, it is advisable to use more than 300 Kg cement per one cubic meter of concrete.

- Increasing amount of cement in the mixture results to increase: shrinkage, creep, danger of cracking of concrete, and heat of hydration of cement, therefore, less than 500 Kg of cement per one cubic meter of concrete must be used.

Water Requirement:

- The amount of water in lightweight concrete includes: effective or free water between aggregates and water in pores of aggregates.
- Effective water, which is the major part of water in the mixture, is in the cement paste, and this is the amount of water that determines the strength and workability.
- Amount of free water depends on the maximum size of aggregate, amount of slump for required workability, shape and texture of aggregate and with less percent on the amount of cement used in the mixture.

Water Requirement:

- Expanded Clay Aggregate (ECA) which is produced in rotary kiln, because of their round and smooth surface, their water absorption is much less than that of light weight aggregates with angular and rough surface.
- Amount of the slump of concrete mixture depends on: the type of structural component and the facilities and method for compacting the concrete mixture.

Using Expanded Clay Aggregate (Eca) In Reinforced Cement Concrete And Its Area Of Application:

Expanded Clay Aggregate (Eca) Reinforced Conrete Tile For Animal Production Facility:

- The use of Expanded Clay Aggregate (ECA) in light concrete with proper mixing order can be used for modeling of roof tiles with perfect geometry, according to the technical and comfort demands of animal.
- A research was conducted by constructing poultry houses at a scale of 1 ratio 12 and the buildings were erected east-west.
- The buildings were made with three (3) different roofing materials, namely:
  - Roofing tiles of Expanded Clay Aggregate (ECA) concrete
  - Roofing tiles of fiber-cement
  - Ceramic roofing tiles.

Using Expanded Clay Aggregate (Eca) In Reinforced Cement Concrete And Its Area Of Application:

- Several parameters were evaluated which includes: Relative Humidity (RH), Black Globe Temperature (BGT), Dry Bulb Temperature (DBT), Black Globe Temperature-Humidity (BGTH) and Thermal Radiation (TH).

- At the end of the research, it was found that the result of all the parameters were different across all the tiles used. It was found out that the building with roofing tiles made from ECA showed the best performance.

Use Of Eca Aggregate On Properties Of Roller Compacted Concrete (Rcc):

- Roller Compacted Concrete (RCC) is concrete that has no forms, no slump, no finishing, no reinforcing steel, and is wet enough to support compaction by vibratory rollers.
- Due to the effectiveness of curing on properties and durability, the main aim of this research is to find out the effect of various curing methods (7-days water curing, air curing, permanent water curing, and emulsified asphalt curing) and ECA (lightweight aggregate).
- With different replacement percentages of fine aggregate (volumetric replacement) on RCC and to explore the possibility of introducing practical RCC for road pavement with a minimum requirement of curing.

Use Of Eca Aggregate On Properties Of Roller Compacted Concrete (Rcc):

- Results show that using 7% ECA improved Roller Compacted Concrete (with air curing) as compared to Roller Compacted Concrete with permanent water curing by percentages ranging from 0.5 to 1.9, 3.6 to 29.1, and 16.9 to 43.3% for bulk density, flexural strength, and water absorption, respectively.

Structural Behaviour Of Reinforced Concrete Beams Using Expanded Clay Aggregate (Eca):

- Nowadays, ECA are utilized in concrete to reduce the demand of natural resources as well as for environmental safety.
- This research deals with the structural behavior of reinforced concrete beams made with ECA. The research was conducted in two different phases; total eighteen (18) numbers of beams were tested.

Structural Behaviour Of Reinforced Concrete Beams Using Expanded Clay Aggregate (Eca):

- In first phase, the ultimate failure load of conventional reinforced concrete beams (CRCB) and ECA based reinforced concrete beams (LCB) were compared.
- After noticing the higher load carrying capacity of LCB than that of CRCB, in second phase only LCBs were considered to observe the effect of span length and tension reinforcement ratio on its structural properties.
- The ultimate flexural strength, shear strength, short-term deflection, and crack widths were observed and compared with the predicted values obtained from IS 456 and EUROCODE 2.

Structural Behaviour Of Reinforced Concrete Beams Using Expanded Clay Aggregate (Eca):

- It has been observed that both Indian and European standards were well predicted the flexural capacity of LCB.
- They were more conservative to predict the shear capacity of LCB. The short-term deflection and crack width under service load has satisfied well, the requirement of the design code.

Benefits Of Using Expanded Clay Aggregate (Eca) In Reinforced Cement Concrete:

- High compressive strength
- High Tensile strength
- Lower bond strength of reinforcement to concrete
- High durability
- Resistance freezing and thawing
- Great chemical resistance
- Reduce or no drying shrinkage
- Excellent thermal and acoustical properties.

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