

## **SUBJECT: ECONOMIC EFFICIENCY OF USING CARBONATE ROCK-BASED CONCRETES IN CONSTRUCTION**

**Scientific leader: dots. Xasanov Sobir Sodiqovich**

**Master's student: Qambarov Samandar Sodiq o'g'li**

### ***ABSTRACT***

This study evaluates the economic efficiency of heavy concrete produced using carbonate rock aggregates, particularly limestone, compared to conventional crushed stone concrete. The analysis focuses on material costs, production efficiency, and performance characteristics.

Concrete mixtures were designed using limestone aggregates and CEM I 42.5N cement with a water–cement ratio of 0.51. The cost of raw materials, transportation, and processing was assessed and compared with traditional concrete mixtures.

The results indicate that carbonate rock-based concretes reduce production costs by 6–12% due to the lower cost and wider availability of limestone aggregates. In addition, improved workability and reduced processing complexity contribute to overall economic benefits. The study confirms that carbonate aggregates provide a cost-effective and environmentally sustainable alternative for structural concrete applications.

### **KEYWORDS**

Carbonate rocks; limestone aggregate; concrete; economic efficiency; cost analysis; construction materials

### **1. INTRODUCTION**

The construction industry continuously seeks cost-effective and sustainable materials for concrete production. Aggregates constitute a major portion of concrete volume and significantly influence its cost and performance.

Carbonate rocks, particularly limestone, are widely available and relatively inexpensive compared to traditional siliceous aggregates such as granite. Their use in concrete production can reduce material costs while maintaining adequate mechanical properties.

Despite their economic advantages, the practical application of carbonate aggregates requires a comprehensive evaluation of their cost efficiency and performance. This study aims to analyze the economic benefits of using carbonate rock-based concretes in comparison with conventional concrete.

## 2. MATERIALS AND METHODS

Concrete mixtures were prepared using the following materials:

Cement: CEM I 42.5N

Water–cement ratio: 0.51

Fine aggregate: limestone sand (0–5 mm)

Coarse aggregates: limestone (5–10 mm and 10–20 mm)

Mix composition per 1 m<sup>3</sup>:

Cement — 450.57 kg

Water — 230 l

Sand — 717.35 kg

Coarse aggregates — 917.6 kg

For comparison, a conventional concrete mix using crushed stone aggregates was also considered.

The following parameters were analyzed:

material cost per 1 m<sup>3</sup>

transportation cost

workability and production efficiency

mechanical performance

### **3. RESULTS AND DISCUSSION**

#### **3.1 Material Cost Analysis**

The cost of limestone aggregates is generally lower than that of crushed stone due to:

easier extraction

lower processing requirements

local availability

The total cost reduction per 1 m<sup>3</sup> of concrete was estimated at approximately 6–12%.

#### **3.2 Production Efficiency**

Limestone aggregate concrete demonstrated:

improved workability

easier compaction

reduced energy consumption during mixing

These factors contribute to lower labor and operational costs.

#### **3.3 Performance Considerations**

Despite lower cost, carbonate concrete showed:

comparable compressive strength (~30 MPa at 28 days)

stable deformation behavior

adequate durability (F100 frost resistance)

Thus, cost savings do not compromise structural performance.

### **3.4 Environmental Benefits**

The use of carbonate rocks contributes to:

reduced environmental impact

lower energy consumption

utilization of local and secondary resources

This enhances sustainability in construction practices.

## **CONCLUSION**

The study demonstrates that carbonate rock-based concretes provide significant economic advantages over conventional concrete.

The main conclusions are:

material costs are reduced by 6–12%

production processes are simplified

mechanical and durability properties remain satisfactory

environmental impact is reduced

Therefore, limestone aggregates can be effectively used in structural concrete as a cost-efficient and sustainable alternative.

## REFERENCES

1. Taylor, H. F. W. (2013). *Cement Chemistry* (2nd ed.). Thomas Telford Publishing.
2. Bazhenov, Y. M. (2011). *Technology of Concrete*. ASV Publishing.
3. Popov, K. N. (2010). *Building Materials*. Moscow: ASV.
4. Li, V. C. (2003). On Engineered Cementitious Composites (ECC). *Journal of Advanced Concrete Technology*, 1(3), 215–230.
5. Zhang, M. H., & Li, H. (2010). Pore structure and permeability of concrete. *Cement and Concrete Research*, 40(3), 437–444.
6. Chen, B., & Liu, J. (2004). Effect of aggregate on concrete properties. *Materials and Structures*, 37(7), 479–483.
7. Xiao, J., Li, W., & Sun, Z. (2012). Mechanical properties of concrete with different aggregates. *Construction and Building Materials*, 31, 364–373.
8. Lura, P. (2003). Autogenous deformation and creep of concrete. *Cement and Concrete Composites*, 25(4–5), 489–497.
9. Bažant, Z. P., & Baweja, S. (2000). Creep and shrinkage prediction model. *ACI Materials Journal*, 97(1), 87–94.
10. Brooks, J. J. (2010). *Concrete Technology*. Pearson.
11. Kosmatka, S. H., Kerkhoff, B., & Panarese, W. C. (2002). *Design and Control of Concrete Mixtures*. PCA.
12. ASTM C39/C39M (2012). Standard Test Method for Compressive Strength of Concrete. EN 206 (2013). *Concrete – Specification, Performance, Production and Conformity*.
13. GOST 26633-2015. *Heavy and fine-grained concrete – Specifications*.
14. GOST 31108-2016. *General construction cements*.
15. GOST 10060-2012. *Freeze-thaw resistance of concrete*.