



Comparative Analysis Of Conventional And Special Concretes: A Review

¹Amit Prasad, ² Ahmad Isar Makhdoomi, ³ Architesh Kumar Shubham, ⁴ Rohit Sharma, ⁵ Krishna Murari

¹ Assistant Professor, ² Assistant Professor & Dean Admin

³ Assistant Professor, ⁴ Assistant Professor, ⁵ Assistant Professor,

^{1, 2, 3, 4 & 5} Department of Civil Engineering

¹ RVS College of Engineering & Technology, Jamshedpur, Jharkhand, India

Abstract

Concrete is the most widely used construction material due to its durability, versatility, and cost-effectiveness. With advancements in material science, special concretes have been developed to meet specific structural and environmental needs. This review paper presents a comparative analysis of conventional concrete and special concretes, including high-performance concrete (HPC), self-compacting concrete (SCC), fiber-reinforced concrete (FRC), geopolymer concrete (GPC), and others. The study focuses on mechanical properties, durability, sustainability, and economic considerations. The findings suggest that while conventional concrete remains dominant in general construction, special concretes offer significant advantages in terms of performance, sustainability, and specific applications.

Keywords Conventional concrete, Special Concrete, Durability, Sustainability

1. Introduction

Concrete is a composite material composed of cement, aggregates, water, and admixtures. The traditional form, known as conventional concrete (CC), has been widely used for centuries in construction projects. However, limitations such as shrinkage, permeability, and strength variations have led to the development of special concretes tailored to modern engineering demands. Special concretes include materials engineered to enhance performance, sustainability, and workability. This review examines the differences between conventional and special concretes in terms of properties, applications, advantages, and limitations.

2. Conventional Concrete (CC)

2.1 Composition and Properties

Conventional concrete is made of Portland cement, fine and coarse aggregates, water, and sometimes admixtures.

It is characterized by compressive strength typically ranging from 20 to 45 MPa.

It has moderate workability, requiring vibration for compaction.

Its Durability is influenced by mix design, curing, and environmental conditions.

2.2 Applications

- Residential and commercial buildings
- Roads and pavements
- Foundations and retaining walls

2.3 Limitations

- Susceptibility to cracking and shrinkage
- Higher permeability leading to durability issues
- Limited strength enhancement beyond a certain threshold

3. Special Concretes

Special concretes are developed to address specific construction challenges. The most commonly used types are discussed below.

3.1 High-Performance Concrete (HPC)

Characteristics:

- Higher strength (>70 MPa)
- Enhanced durability and resistance to environmental factors
- Lower water-cement ratio ($w/c < 0.35$)

Applications:

- Bridges and high-rise buildings
- Marine structures, tunnels

Advantages & Limitations:

The main advantage of HPC is increased strength and durability whereas the drawback is higher material cost.

3.2 Self-Compacting Concrete (SCC)

Characteristics:

- High fluidity, eliminating the need for vibration
- Improved surface finish and reduced labor costs

Applications:

- Complex and congested reinforcement areas
- Precast concrete elements

Advantages & Limitations:

- Faster construction and better workability is the main advantage.
- Requirement of precise mix design and quality control are the two drawbacks.

3.3 Fiber-Reinforced Concrete (FRC)

Characteristics:

- Contains steel, glass, or synthetic fibers
- Improved toughness and crack resistance

Applications:

- Industrial floors and pavements
- Earthquake-resistant structures

Advantages & Limitations:

- Advantage: Higher tensile strength and impact resistance
- Limitation: Can be expensive and difficult to mix uniformly

3.4 Geopolymer Concrete (GPC)

Characteristics:

- Cement-free, made using industrial by-products (fly ash, slag)
- Low carbon footprint and high resistance to chemical attacks

Applications:

- Sustainable construction
- Waste utilization projects

Advantages & Limitations:

- Advantage: Environment friendly and durable
- Limitation: Limited large-scale adoption due to unfamiliarity

3.5 Other Special Concretes

- Lightweight Concrete: Used for reducing dead loads.
- High-Strength Concrete (HSC): Strength >70 MPa, used in skyscrapers.

4. Comparative Analysis

Property	Conventional Concrete	Special Concretes
Strength	Moderate (20-45 MPa)	Higher(>50 MPa in HPC,FRC)
Durability	Moderate	Enhanced (SCC,GPC)
Workability	Requires Vibration	SCC and GPC improve workability
Environmental Impact	Higher CO ₂ emissions	GPC and HPC are more sustainable
Cost	Lower initial cost	Higher due to special materials
Applications	General Construction	Specialized Structures

5. Sustainability and Economic Considerations

Special concretes like GPC and HPC reduce environmental impact by using industrial by-products. Although special concretes are costlier, their durability leads to lower maintenance costs over time. SCC and FRC improve construction speed and reduce labor costs.

6. Conclusion

The comparative analysis shows that while conventional concrete remains widely used, special concretes offer significant advantages in performance, sustainability, and workability. The selection of concrete type depends on project requirements, budget constraints, and long-term benefits. Future research should focus on optimizing special concretes for cost-effectiveness and large-scale application.

7. References

1. Shetty M.S. 2005 Concrete Technology- theory and practice, S.Chand & co.,
2. Shanthakumar, A.S. 2014 Concrete Technology, Oxford University Press
3. IS 456: 2000, Indian Standard plain and reinforced concrete code of practice, BIS, New Delhi
4. EFNARC 2002, specification and guidelines for self-compacting concrete, farnham.
5. Chatterjee A.K. 1997, CEMENT in high performance concrete- as seen from the manufacturer's position, in proceedings of TCDC international workshop on advances in HPC technology & application.
6. European project group (EPG) 2005, the European guidelines for self-compacting concrete
7. kulkarni, P.D., R.K. Ghosh and Y.R.Phull 1998, Textbook of concrete technology, 2nd edn., New age international publishers.

