

Department of Civil Engineering, SoS, Engg. & Tech., GGV, Bilaspur (C. G.)

M. Tech. Session 2024-25

S.N o.	Roll No.	Name of Student	Title
1	230251 01	Amit Kumar	Performance Evaluation of Concrete with Partial Replacement of Fine Aggregate by Glass powder and Silica Sand
2	230251 02	Anchal Jaiswal	Study on Blast furnace slag-based Concrete
3	230251 03	Anil Patel	Study on Lime stone and calcined clay cement concrete in conjunction with Superplasticizers
4	230251 04	Anjali Tiwari	Experimental Investigation on Synergistic Effects of Micro and Nano Silica on Strength Properties of fly ash based concrete
5	230251 06	Ashutosh Shukla	Experimental Study on standard and High Strength One part Geo polymer concrete
6	230251 10	Gaurav Prajapati	Study on synergetic effect of polyvinyl Alcohol and Polypropylene Fibers on the strength parameter of the engineered cementitious composites
7	230251 12	MD. Ashar Tanwir	Performance Evaluation of Hybrid Fiber Reinforced Concrete using Optimizes Glass and Steel Fibers
8	230251 14	Pranjoy Kumar Biswas	Dynamic Analysis of Transmission Line tower
9	230251 20	Udit Soni	Sustainable concrete development using sugarcane bagasse Ash: A study on fresh property and performance evaluation of M30 and M60 grade



Performance Evaluation of Concrete with Partial Replacement of Fine Aggregate by Glass Powder and Silica Sand

**Project Report Submitted in Partial Fulfilment of
Academic Requirement for the Award of Degree of**

MASTER OF TECHNOLOGY in STRUCTURAL ENGINEERING

Submitted By

AMIT KUMAR

(Roll no. 23025101)

Under The Guidance of

Dr. Ashish Kumar Parashar

Associate Professor



**DEPARTMENT OF CIVIL ENGINEERING
SCHOOL OF STUDIES IN ENGINEERING AND TECHNOLOGY,
GURU GHASIDAS VISHWAVIDYALAYA, BILASPUR(C.G.)**

(A Central University Established by the Central University Act 2009 No. 25 of 2009)

SESSION 2024-25



DEPARTMENT OF CIVIL ENGINEERING
SCHOOL OF STUDIES IN ENGINEERING AND TECHNOLOGY,
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CERTIFICATE

This is to certify that the Dissertation entitled “Performance Evaluation of Concrete with Partial Replacement of Fine Aggregate by Glass Powder and Silica Sand” is a bona fide work done by **Amit Kumar** in the Department of Civil Engineering, Guru Ghasidas Vishwavidyalaya, Bilaspur under the guidance of **Dr. Ashish Kumar Parashar**, Associate Professor, in partial fulfilment of requirement for the award of **Master of Technology in Structural Engineering**.

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Prof. M. Chakradhara Rao
Head of Department
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ABSTRACT

The construction sector in India plays a pivotal role in driving economic growth but also imposes significant environmental burdens, primarily due to the overexploitation of natural resources such as river sand. Simultaneously, the disposal of non-biodegradable glass waste presents pressing sustainability concerns. This study explores the feasibility of incorporating Glass Powder (GP) and Silica Sand (SS) as partial replacements for fine aggregate in M25, M40, and M60 grade concretes, focusing on their impact on both fresh and hardened properties of concrete. GP and SS were combined at replacement levels ranging from 0% to 30% by weight of fine aggregate. The results revealed substantial performance enhancements, particularly with the inclusion of GP. In M25 concrete, GP addition improved ultrasonic pulse velocity (UPV) by 6.51%, reduced water absorption by 8.97%, and increased compressive and tensile strengths by 10.05% and 22.58%, respectively. For the M40 mix (1:1.466:2.82:0.38), tensile strength increased by 19.32% and UPV improved by 13%. In M60 concrete, GP incorporation enhanced UPV by 14.32%, tensile strength by 10.52%, and compressive strength by 7.02%, although with a slight increase in water absorption. Conversely, SS in the M60 mix achieved a marginally higher compressive strength (7.47%) but exhibited lower tensile strength and UPV. While higher replacement levels of GP and SS reduced the workability of concrete due to their angular shape and increased surface area—leading to greater water demand—their pozzolanic reactivity and improved particle packing significantly enhanced the compressive strength and crack resistance. Present study concludes that the sustainable incorporation of GP and SS in concrete not only supports resource conservation but also enables the production of durable, high-performance concrete suitable for diverse structural applications.

STUDY ON BLAST FURNACE SLAG BASED CONCRETE

**Project Report Submitted in Partial Fulfilment of
Academic Requirement for the Award of Degree of**

MASTER OF TECHNOLOGY

In

STRUCTURAL ENGINEERING

Submitted by

ANCHAL JAISWAL

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Under The Guidance of

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SCHOOL OF STUDIES OF ENGINEERING AND TECHNOLOGY,
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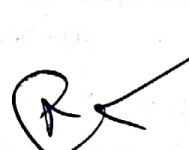
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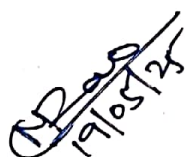
Certified that the project report entitled “**STUDY ON BLAST FURNACE SLAG BASED CONCRETE**” submitted by ANCHAL JAISWAL in partial fulfillment of the requirements of the award of degree of Master of Technology in Structural Engineering, Department of Civil Engineering, School of Studies of Engineering and Technology, Guru Ghasidas Vishwavidyalaya, Bilaspur, is accorded to the student’s work, carried out by him in the Department of Civil Engineering during session 2024-2025 under my supervision.


15/05/25

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Department of Civil Engineering,
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PROF. M. CHAKRADHARA RAO

Head of Department,
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ABSTRACT

The use of cement in construction industry increases the emission of CO₂, which may be decreased by the use of supplementary cementitious material (SCM) in place of cement. Ground granulated blast furnace slag (GGBS) is one SCM which is obtained by quenching molten iron slag from a blast furnace in wet condition. It is then dried and ground into a fine powder which is highly cementitious due to the presence of C-S-H (calcium silicate hydrates) which may increase strength and durability of concrete. In the present study, first M40 and M60 grade concrete cubes and cylinders were cast with Ordinary Portland Cement (OPC). Then for the M40 grade concrete, the OPC was partially replaced with GGBS by percentages ranging from 45% to 70%. Similarly, for the M60 grade concrete, the OPC was partially replaced with GGBS by percentages ranging from 5% to 70%. Comparison between the OPC based concrete and the GGBS based concrete was done by investigating the mechanical properties like compressive strength and split tensile strength. Non-destructive tests like Ultrasonic Pulse Velocity (UPV) tests were also carried out for investigating the properties of both grades of concrete in their hardened state. For the M40 grade concrete, the maximum compressive strength was obtained at 60% GGBS replacement whereas, for M60 grade concrete, the maximum compressive strength was obtained at 25% GGBS replacement.

STUDY ON LIMESTONE AND CALCINED CLAY CEMENT CONCRETE IN CONJUNCTION WITH SUPERPLASTICIZERS

**Project Report Submitted in Partial Fulfilment of
Academic Requirement for the Award of Degree of**

**MASTER OF TECHNOLOGY
in
STRUCTURAL ENGINEERING**

**Submitted By
ANIL PATEL
(Roll no. 23025103)**

**Under The Guidance of
Mr. ROCHAK PANDEY
Assistant Professor**



**DEPARTMENT OF CIVIL ENGINEERING
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SESSION 2024-25



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(A Central University Established by the Central University Act 2009 No. 25 of 2009)

CERTIFICATE

This is to certify that the Dissertation entitled “STUDY ON LIMESTONE & CALCINED CLAY CEMENT CONCRETE IN CONJUNCTION WITH SUPERPLASTICIZERS” is a bona fide work done by **ANIL PATEL** in the Department of Civil Engineering, Guru Ghasidas Vishwavidyalaya, Bilaspur under the guidance of **Mr. ROCHAK PANDEY** Assistant Professor, in partial fulfilment of requirement for the award of Master of Technology in Structural Engineering.

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19/05/25
Prof. M. Chakradhara Rao
Head of Department
Department of Civil Engineering
GGV, Bilaspur

ABSTRACT

Combination of Limestone & Calcined Clay, to be used as partial replacement of Ordinary Portland Cement (OPC) is an eco-friendly alternative to traditional cement, designed to reduce the environmental impact of construction. By replacing part of the clinker in OPC with calcined clay and finely ground limestone, lower carbon dioxide emissions, up to 40%, can be achieved, as the production of clinker is highly energy-intensive. The calcined clay, created by heating clay at moderate temperatures, along with limestone, not only reduces the environmental footprint but also maintains or improves the strength & durability of the Concrete. This makes Limestone & Calcined Clay, a viable option for a wide range of construction projects. The construction industry can make significant strides toward reducing greenhouse gas emissions and promoting sustainable building practices, supporting global efforts to reduce the environmental impact of cement production. From the experimented mixes, a mixture of 70% OPC, 5% limestone, and 25% calcined clay proved to be the most effective mix composition for producing an enhanced concrete with improved properties & with the lower environmental imprint. The proposed combination paves the path for environmentally conscious constructions by striking a balance between durability, mechanical strength, and environmental benefits. The use of superplasticizers, including lignosulphonate and polycarboxylic ether, in varying dosages (0.5%, 1.0%, 1.5%, and 2.0%) further optimizes workability and mechanical performance. These admixtures enhance the rheological behavior of the mix, ensuring superior flow ability and compaction while maintaining strength. The production process for this blended cement requires only minor modifications to existing manufacturing facilities, making it a scalable and practical solution for the construction industry. Overall, this combination offers a viable path toward low-carbon construction, balancing mechanical strength, durability, and sustainability.

A
DISSERTATION
on
Experimental Investigation on
Synergistic Effects of Micro and Nano Silica
on Strength Properties of Fly Ash-Based Concrete
Submitted in partial fulfilment of
Academic requirement for the Award of the Degree of
MASTER OF TECHNOLOGY
in
STRUCTURAL ENGINEERING

Submitted by
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Under the Guidance of
Dr. R. K. Choubey
(Professor, Civil Engineering)
and
Dr. V.V.S Surya Kumar Dadi
(Associate Professor, Civil Engineering)



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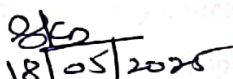
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GURU GHASIDAS VISHWAVIDYALAYA, BILASPUR (C.G.)
SESSION:2024-25



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SCHOOL OF STUDIES IN ENGINEERING AND TECHNOLOGY
GURU GHASIDAS VISHWAVIDYALAYA

CERTIFICATE

This is to Certify that, the Dissertation report entitled, “**Experimental Investigation on Synergistic Effects of Micro and Nano Silica on Strength Properties of Fly Ash-Based Concrete**” is a Bonafide work done by **Ms. Anjali Tiwari**, in the Department of Civil Engineering, Guru Ghasidas Vishwavidyalaya, Bilaspur, under our joint guidance, in partial fulfilment of the requirements for the award of degree of **Master of Technology**, in Structural Engineering.


18/05/2025
Co-Supervisor:

Dr VVS Surya Kumar Dadi

Associate Professor

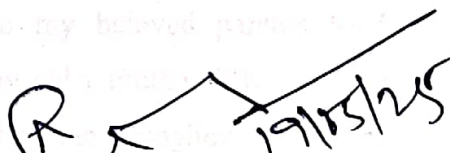
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Supervisor:

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External Examiner:


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Head of Department

Prof. M. Chakradhara Rao

Department of Civil Engineering

ABSTRACT

Concrete is a versatile construction material that is constantly being refined to function under various conditions. Researchers are exploring new chemical admixtures and additive cementitious materials, such as fly ash, silica fume, granulated blast furnace slag, and steel slag. The most important of these is nano silica, which reacts with cement phases C3S and C2S to form calcium silicate hydrate (C-S-H gel), resulting in stronger, denser material with improved performance in most applications. The study aims to compare the M40 and M60 grade concrete for its mechanical properties viz compressive strength, split tensile strength, UPV, and water absorption test for OPC concrete when the cement is replaced to its maximum allowable 30 %. The synergistic effect of micro silica and nano silica (optimal values) on concrete has been explored by the partial cement replacement with fly ash.

The first phase of the study examined the strength properties of M40 & M60 grade concrete with partial cement replacement (10%, 15%, 20%, 25%, and 30%) with Class F Fly Ash. The second phase evaluated the performance of concrete (having 30% cement replaced with fly ash) for various percentages (13%, 14%, 15% and 16%) of Micro Silica addition, to get the highest strength properties. The third phase evaluated the strength performance of M40 grade of concrete (having 30% cement replaced with fly ash and 15% Micro Silica added) by adding Nano Silica (1%, 2%, 3% and 4%) to yield the improved strength performance. Further for M60 grade of concrete (having 30% cement replaced with fly ash and 14% Micro Silica added) by adding Nano Silica (1%, 2%, 3% and 4%) to yield the improved strength performance.

The results showed that the 30% fly ash mixture and addition with 15% micro silica and 3% nano silica combination significantly influenced better compressive strength of M40 grade concrete. Additionally, the 30% fly ash mixture and addition with 14% micro silica and 3% nano silica combination significantly influenced better compressive strength of M60 grade concrete. The work indicates that a good mechanical property of high-performance concrete can be obtained using the optimal compositions of these materials.

Keywords: Fly-ash, Micro silica, Nano silica, Compressive test, Split tensile test, UPV test and Water absorption test.

EXPERIMENTAL STUDY ON STANDARD AND HIGH STRENGTH ONE PART GEOPOLYMER CONCRETE

**Project Report Submitted in Partial Fulfilment of Academic Requirement for the
Award of Degree of**

MASTER OF TECHNOLOGY in STRUCTURAL ENGINEERING

Submitted by

ASHUTOSH SHUKLA

(23025106)

Under The Guidance of

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Professor



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(A Central University Established by the Central University Act 2009 No. 25 of 2009)

SESSION 2024 - 2025



DEPARTMENT OF CIVIL ENGINEERING
SCHOOL OF STUDIES OF ENGINEERING AND TECHNOLOGY
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(A Central University Established by the Central University Act 2009 No. 25 of 2009)

CERTIFICATE

Certified that the project report entitled “**Experimental Study on Standard and High Strength One Part Geopolymer Concrete**” submitted by **ASHUTOSH SHUKLA** in partial fulfilment of the requirements of the award of degree of Master of Technology in Structural Engineering, Department of Civil Engineering, School of Studies of Engineering and Technology Guru Ghasidas Vishwavidyalaya Bilaspur is accorded to the student’s own work, carried out by him in the Department of Civil Engineering during session 2024-2025 under my supervision and guidance.

Sign.....

Dr. M. Chakradhara Rao
Professor
Department of Civil Engineering

Sign.....

EXAMINER(S)

Prof. M. Chakradhara Rao
Head

Civil Engineering Department,
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ABSTRACT

The report focuses on producing high-strength, one-part geopolymer concrete (GPC) as a sustainable alternative to ordinary Portland cement (OPC) concrete to reduce environmental contamination. OPC production significantly contributes to global carbon dioxide (CO₂) emissions, accounting for about 7% of total emissions, which pose a severe threat to climate change. Geopolymer concrete offers a promising solution by using industrial by-products, such as fly ash, ground granulated blast furnace slag (GGBS), Alcofine, metakaolin, micro silica etc., which significantly lower the carbon footprint compared to OPC. Unlike traditional "two-part geopolymers" that require liquid alkali activators like sodium hydroxide, this study focuses on "one-part geopolymers," which use less hazardous alkali materials such as sodium carbonate powder. This approach reduces safety risks, simplifies handling, and further minimizes environmental impacts. Despite its superior engineering properties, GPC has not yet achieved widespread adoption due to safety concerns and handling challenges. The research emphasizes improving the mechanical strength and durability of one-part GPC while addressing these barriers, making it a safer, eco-friendly, and practical alternative for sustainable construction.

This research uses a one-part geopolymer technique to examine the mechanical and durability properties of both standard and high-strength geopolymer concrete. This study aims to develop M30 and M70 grades of geopolymer concrete with different proportions of fly ash, GGBS, alcofine, metakaolin and micro silica. the entire experimental program was carried out in three phases. In the first phase of developing M30 and M70 GPC, the fly ash was partially replaced with 10%, 20%, 30% and 40% GGBS and with constant 6% micro silica. In the second phase, M30 grade GPC was developed by replacing the fly ash partially with 5%,10%,15% and 20% alcofine. In the third phase an attempt is made to develop M30 and M70 grades of GPC using different proportion of fly ash and metakaolin with constant 30% GGBS and 6% micro silica. In this phase for M70 GPC, the fly ash was replaced with 0%,10%,20%,30%,40% and 46% metakaolin with constant 30% GGBS and 6% micro silica. Whereas, for M30 GPC, the fly ash was replaced with 0%,10%,20%,30%,40% and 52% metakaolin and in each mix 30% GGBS was kept constant. Sodium silicate and sodium carbonate powder are utilized at 9% and 9%, respectively, in all the mixtures. All mixes undergo curing at room temperature. the fresh concrete property such as workability and the hardened concrete properties including compressive strength, split tensile strength, UPV, and water absorption are conducted. Studies are carried out on control concretes of the same grade i.e. M30 and M70 with OPC as the binder for comparison.

The experimental results show that the geopolymer concrete has better mechanical and durability qualities when fly ash is replaced by 30% GGBS with 6% micro silica. Further, it is obtained an optimum percentage of replacement of Fly ash with alcofine as 15% which shows a better result of mechanical properties Increased investigations were

A
DISSERTATION
on
**Study on Synergistic Effects of Polyvinyl Alcohol and
Polypropylene Fibres on the Strength Parameters of
Engineered Cementitious Composites**

Submitted in partial fulfilment of
Academic requirement for the Award of the Degree of

**MASTER OF TECHNOLOGY
in
STRUCTURAL ENGINEERING**

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Under the Guidance of
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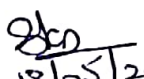
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SESSION: 2024-25

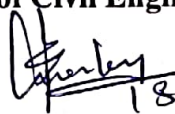


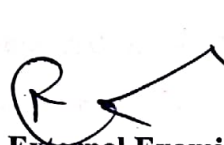
**DEPARTMENT OF CIVIL ENGINEERING
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CERTIFICATE

This is to Certify that, the Dissertation report entitled, “Study on Synergistic Effects of Polyvinyl Alcohol and Polypropylene Fibres on the Strength Parameters of Engineered Cementitious Composites” is a bona fide work done by Mr Gaurav Prajapati, in the Department of Civil Engineering, Guru Ghasidas Vishwavidyalaya, Bilaspur, under our joint guidance, in partial fulfilment of the requirements for the award of degree of Master of Technology, in Structural Engineering.


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Head of Department
Prof. M. Chakradhara Rao
Department of Civil Engineering

ABSTRACT

Engineered Cementitious Composites (ECC), commonly known as bendable concrete, represent a major advancement in high-performance fibre-reinforced materials. ECC offers superior ductility, strain-hardening behaviour, and crack resistance compared to conventional concrete. The present work is focused to study the mechanical properties of M30-grade ECC by incorporating polyvinyl alcohol (PVA) and polypropylene (PP) fibers and also the synergistic effect of the above fibers to enhance strength performance of ECC.

PVA fibers (0–1.5%), PP fibers (0–1.5%), and its hybridization (in optimal range of above two fibers) incorporated in varying volume of mix and were studied separately in Six ECC mixes. Strength parameters viz compressive strength, split tensile strength, and flexural strength, were determined for the above mix reinforced with fibers & its hybridization. Also, workability, water absorption and ultrasonic pulse velocity (UPV) tests, were performed in the above mix/specimens.

The results observed has shown that the PVA fibers has significantly enhanced the tensile and flexural performance, with peak value at 1% fibre content with 41.46 MPa compressive strength and 3.77 MPa split tensile strength. PP fibers, were observed to improve the tensile strength less as compared to PVA, with optimal fibre dosage 0.75% and the compressive strength value is 39.17 MPa. The Hybridization (0.5% PVA and 0.75% PP mix) of the above two fibers demonstrated a synergistic effect, with the highest compressive strength as 42.44 MPa and tensile strength as 7.3 MPa, indicating enhanced fibre-matrix interaction. It is also observed that the workability was affected with increasing fibers content, necessitating the use of super plasticizers for mix consistency.

PERFORMANCE EVALUATION OF HYBRID FIBER REINFORCED CONCRETE USING OPTIMIZED GLASS AND STEEL FIBERS

**Project Report Submitted in Partial Fulfilment of Academic Requirement for the
Award of Degree of**

**MASTER OF TECHNOLOGY
In
STRUCTURAL ENGINEERING**

Submitted by
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Under The Guidance of
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SESSION 2024-25



DEPARTMENT OF CIVIL ENGINEERING
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Act 2009 No. 25 of 2009)

CERTIFICATE

Certified that the project report entitled "**PERFORMANCE EVALUATION OF HYBRID FIBER REINFORCED CONCRETE USING OPTIMIZED GLASS AND STEEL FIBERS**" submitted by MD ASHAR TANWIR in partial fulfilment of the requirements of the award of degree of Master's of Technology in Structural Engineering, School of Studies in Engineering and Technology, Guru Ghasidas Vishwavidyalaya, Bilaspur is accorded to the student's own work, carried out by him in the Department of Civil Engineering during session 2024-2025 under my supervision and guidance.

Sign.....

PROF. SHAILENDRA KUMAR

(Guide)

Sign.....

Examiners

PROF. M. CHAKRADHARA RAO

HEAD OF THE DEPARTMENT

Department of Civil Engineering

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ABSTRACT

This study investigates the performance of Glass Fiber Reinforced Concrete (GFRC) and Hybrid Fiber Reinforced Concrete (HFRC) across three concrete grades—M25, M35, and M45—by evaluating their mechanical and durability characteristics with varying amounts of glass and steel fibers.

In the initial phase, GFRC mixes were prepared by adding glass fibers in different percentages ranging from 0% to 2%, with a 0.25% interval. The optimal glass fiber content for compressive strength was found to be 1% for M25 and M35, and 1.25% for M45, leading to compressive strength increases of 10.33% for M25, 7.45% for M35, and 9.18% for M45 compared to control mixes. For split tensile strength, the best results were achieved with 1% glass fiber for all concrete grades, with improvements of 16.13%, 15.93%, and 15.46%, respectively. The Ultrasonic Pulse Velocity (UPV) values also showed increases of 5.77% for M25, 14.52% for M35, and 12.23% for M45, reflecting better concrete integrity. Furthermore, water absorption decreased by 10.06% for M25, 5.34% for M35, and 4.59% for M45, indicating enhanced durability.

In the second phase, the glass fiber content was fixed at 1% across all grades, and steel fibers were introduced in varying proportions (0% to 2%, in 0.5% increments) to form HFRC. The optimal hybrid mix was achieved with 1% glass fiber combined with 1% steel fiber. This combination significantly enhanced compressive strength by 18.99% for M25, 17.83% for M35, and 19.99% for M45. Split tensile strength increased by 20.05% for M25, 26.79% for M35, and 35.01% for M45, respectively. UPV values improved by 12.94% for M25, 16.88% for M35, and 12.23% for M45. Water absorption further decreased to 5.12%, 4.40%, and 2.95%, respectively.

Overall, HFRC demonstrated superior performance across all evaluated parameters—compressive strength, split tensile strength, UPV, and water absorption—when compared to GFRC. While GFRC provided significant improvements over the control mix, the addition of steel fibers in the HFRC mix resulted in even greater enhancements. The hybrid mix offered superior strength, improved internal quality of concrete, and notably better resistance to water absorption, ensuring enhanced durability. Consequently, HFRC emerged as the most effective and reliable material system, showing great promise for use in modern structural engineering applications that require high strength and longevity.

DYNAMIC ANALYSIS OF TRANSMISSION LINE TOWER

**Project Report Submitted in Partial Fulfilment of
Academic Requirement for the Award of Degree of**

MASTER OF TECHNOLOGY In STRUCTURAL ENGINEERING

**Submitted By
PARANJOY KUMAR BISWAS
(Roll No.: 23025113)**

**Under The Guidance of
PROF. SHAILENDRA KUMAR**



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GURU GHASIDAS VISHWAVIDYALAYA, BILASPUR (C.G.)**
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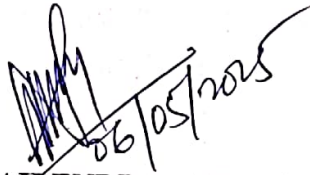
SESSION 2024-2025



DEPARTMENT OF CIVIL ENGINEERING
SCHOOL OF STUDIES OF ENGINEERING AND ECHNOLOGY,
GURU GHASIDAS VISHWAVIDYALAYA, BILASPU (C.G.)
(A Central University Established by the Central University Act, 2009 No. 25 of 2009)

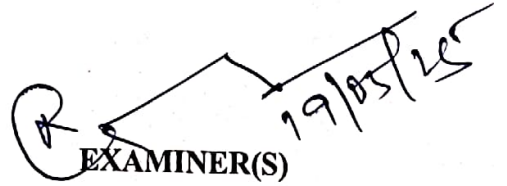
CERTIFICATE

Certified that the project report entitled “**DYNAMIC ANALYSIS OF TRANSMISSION LINE TOWER**” submitted by **PARANJOY KUMAR BISWAS** in partial fulfillment of the requirements of the award of degree of Master of Technology in Structural Engineering, Department of Civil Engineering, School of Studies of Engineering and Technology, Guru Ghasidas Vishwavidyalaya, Bilaspur, is accorded to the student’s work, carried out by him in the Department of Civil Engineering during session 2024-2025 under my supervision and guidance.


06/05/2025

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19/05/25
EXAMINER(S)


17/05/25

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ABSTRACT

Transmission line towers carry high-voltage electrical transmission lines at a suitable and safe height above the ground. Such towers constitute around 30 to 40 percent of the cost of the entire electricity transmission system. These towers must bear their own weight and the distress created by transmission line wires. In addition to that, they should also survive against all natural factors such as high velocity winds, cyclones, and earthquakes. For a safe and economic design, transmission line towers must be capable of resisting both static loads as well as dynamic loads. The collapse of a transmission tower due to an earthquake may cause electric grid failure in vast regions over prolonged durations. Loss of electricity may also directly affect rescue and relief operations in the earthquake-hit areas. As per the Indian Standard code recommendations, dynamic analysis of transmission line towers is mandatory if they lie in Seismic Zones III, IV, or V of India.

STAAD.Pro is one of the most widely used computer applications, used by structural engineers worldwide, for analysing and designing almost any kind of complex civil engineering structure. The computer program is well equipped for comprehensive dynamic analysis of transmission line towers, as per the requirements of Indian Standard codes.

In the present study, a 29.9 m tall, 220 kV, single-circuit, three-phase, tangent-type, self-supporting, three-legged transmission line tower has been modelled using mild steel angle members in STAAD.Pro Advanced environment and validated with existing literature. Dynamic analysis using the response spectrum method was carried out to investigate the behaviour of the tower structure in seismic zone III of India. The fundamental natural period of vibration was found to be 0.682 seconds, and 30 mode shapes were determined. Then, P-Delta analysis was carried out to determine additional displacements due to secondary forces generated in the structural members by the vertical loads acting on the structure in its deformed shape because of the laterally acting seismic forces. Due to such secondary effects, the displacement of the topmost point of the leg has been found to increase by 0.21 %. Finally, a parametric study was carried out by comparing towers made with mild steel angle sections and high tensile steel tubular sections. It was observed that the tower made with tubular sections results in a 27.44 % weight reduction.

Sustainable Concrete Development Using Sugarcane Bagasse Ash: A Study on Fresh Property and Performance Evaluation of M30 and M60 Grade Concrete

**Project Report Submitted in Partial Fulfilment of
Academic Requirement for the Award of Degree of**

MASTER OF TECHNOLOGY

In

STRUCTURAL ENGINEERING

Submitted By

UDIT SONI

(Roll No. 23025119)

Under the Guidance of

Ms. Preeti Singh

Assistant Professor



DEPARTMENT OF CIVIL ENGINEERING

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CERTIFICATE

This is to certify that the Dissertation entitled “Sustainable Concrete Development Using Sugarcane Bagasse Ash: A Study on Fresh Property and Performance Evaluation of M30 and M60 Grade Concrete” is a bona fide work done by **Udit Soni** in the Department of Civil Engineering, Guru Ghasidas Vishwavidyalaya, Bilaspur under the guidance of **Ms. Preeti Singh**, Assistant Professor, in partial fulfilment of requirement for the award of Master of Technology in Structural Engineering.

Sign.....

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Department of Civil Engineering
GGV, Bilaspur

Sign..... 19/05/25
External Examiner

Prof. M. Chakradhara Rao
19/05/25

Prof. M. Chakradhara Rao
Head of Department
Department of Civil Engineering
GGV, Bilaspur

ABSTRACT

This study explores the potential of sugarcane bagasse ash (SCBA) as a partial replacement for cement in both high-strength (M60) and medium-strength (M30) concrete. As an agricultural by-product, SCBA offers a promising path toward more sustainable and eco-friendly construction materials.

For M30 grade concrete, the optimum replacement level was found at 15% SCBA. Workability improved significantly, with a 20% higher slump than the control mix. Strength characteristics also benefitted, as compressive strength increased by 11% and split tensile strength by 19.86%. Durability followed the same positive trend, with a 21% reduction in water absorption and a noticeable improvement in UPV readings, reflecting better concrete quality and integrity.

In the case of M60 grade concrete, replacing 10% of cement with SCBA by weight showed the best results. The fresh concrete displayed better workability, with a 15.78% increase in slump compared to the control mix. Mechanical performance also improved—compressive strength rise by 5%, while split tensile strength saw a notable increase of 21.47%. Durability was enhanced as well, with water absorption reduced by 12.8% and ultrasonic pulse velocity (UPV) increasing by 10.5%, indicating a denser and more refined internal concrete structure.

Increasing SCBA content beyond these optimal levels resulted in a decline in both fresh and hardened properties, suggesting a performance threshold.

The findings demonstrate that SCBA can be effectively utilized as a partial cement replacement to improve the performance and sustainability of concrete. The enhanced mechanical strength, improved workability, and greater durability—all achieved with lower cement usage—highlight SCBA's value in developing greener construction materials without compromising quality.