# Department of Civil Engineering
# Jamia Millia Islamia

(A Central University by an Act of Parliament)

NAAc Accredited A++ Grade

**Magazine Vol. 8 2024**

Taameer تعمیر


# جامعہ کا ترانہ

دیار شوق میرا دیار شوق میرا
شہر آرزو میرا شہر آرزو میرا

ہوئے تھے آ کے یہیں خیمہ زن وہ دیوانے    اٹھے تھے سن کے جو آواز رہبران وطن
یہیں سے شوق کی بے ربطیوں کو ربط ملا    اسی نے ہوش کو بخشا جنوں کا پیراہن
یہیں سے لالۂ صحرا کو یہ سراغ ملا    کہ دل کے داغ کو کس طرح رکھتے ہیں روشن
دیار شوق میرا، شہر آرزو میرا

یہ اہل شوق کی بستی یہ سرپھروں کا دیار    یہاں کی صبح نرالی، یہاں کی شام نئی
یہاں کی رسم و رہ مے کشی جدا سب سے    یہاں کے جام نئے، طرح رقص جام نئی
یہاں پہ تشنہ لبی مے کشی کا حاصل ہے    یہ بزم دل ہے یہاں کی صلائے عام نئی
دیار شوق میرا، شہر آرزو میرا

یہاں پہ شمع ہدایت ہے صرف اپنا ضمیر    یہاں پہ قبلہ-ایماں کعبہ دل ہے
سفر ہے دین یہاں، کفر ہے قیام یہاں    یہاں پہ راہ روی خود حصول منزل ہے
شناوری کا تقاضہ ہے نو بہ نو طوفاں    کنار موج میں آسودگی ساحل ہے
دیار شوق میرا، شہر آرزو میرا


# Jamia Millia Islamia

Jamia Millia Islamia originated as a movement of struggle for education and cultural renaissance against the colonial regime and evolved into a national culture for the common Indian. Its foundation is to promote patriotism and national integration among Indians and to prepare the children of the masses in general and Muslims in particular to be the masters of the future in different subjects or disciplines of their choice.

Jamia Millia Islamia was founded in 1920 and is now a Central University with 22,000+ students, 800+ faculty members, and a 230-acre lush green campus. Jamia, which ranks 3rd in the "university" category and 13th in the "overall" category in NIRF2022, is an ensemble of a multi-layered educational system that covers all aspects of schooling, undergraduate, and postgraduate education.

The university recognises that teaching and research are complementary activities that can advance its long-term interests. It has 10 faculties of studies: Natural Sciences, Social Sciences, Engineering and Technology, Education, Humanities and Languages, Architecture and Ekistics, Fine Arts, Law, Dentistry, and Management Studies. Jamia has over thirty research centers, which are pioneering in critical research in a variety of areas and interdisciplinary fields.

The objective of the university is to disseminate and advance knowledge by providing instructional, research, and extension facilities in such branches of learning as it may deem fit, and the university shall endeavour to provide to students and teachers the necessary atmosphere and facilities for the promotion of innovations in education leading to the restructuring of courses, new methods of teaching and learning, and the integral development of personality.

जामिया मिल्लिया इस्लामिया
( केन्द्रीय विश्वविद्यालय )
मौलाना मोहम्मद अली जौहर मार्ग, नई दिल्ली-११००२५

JAMIA MILLIA ISLAMIA
( A Central University )
Maulana Mohammed Ali Jauhar Marg, Jamia Nagar, New Delhi-110025
(NAAC Accredited 'A++' Grade)

جامعہ ملّیہ اسلامیہ
(مرکزی یونیورسٹی)
مولانا محمد علی جوہر مارگ، نئی دہلی۔110025

Tel.: 011-26984650, 26985180 | E-mail: vc@jmi.ac.in | Web: www.jmi.ac.in

प्रोफ़ेसर मज़हर आसिफ़
कुलपति

Prof. Mazhar Asif
Vice Chancellor

پروفیسر مظہر آصف
شیخ الجامعہ

## Vice-Chancellor's Message

It gives me immense pleasure to present the departmental magazine "Tameer-2024" brought out by students of Civil Engineering. This is a platform that showcases the talent, creativity, and academic endeavors of our vibrant student community.

I commend the editorial team for their dedication and creativity.

Let this magazine be a source of inspiration, a reflection of your aspirations, and a reminder of the endless possibilities that lie ahead.

Wishing you all the best in your academic and personal endeavors.

(Prof. Mazhar Asif)
Vice-Chancellor

JAMIA MILLIA ISLAMIA जामिया मिल्लिया इस्लामिया
(A Central University Accreditted Grade 'A++ by NAAC))

**Faculty of Engineering and Technology**

Maulana Mohammad Ali Jauhar Marg, New Delhi-110025
Phone No.: 26985831 Extn.: 2201, 2202, 2203 & 2204
Email:fet@jmi.ac.in

**Prof. Mini Shaji Thomas**
**Dean**

## Message from the Dean

I Congratulate the Department of Civil Engineering for bringing out another edition of the magazine. This magazine serves not only as a platform to showcase the academic and extracurricular accomplishments but also as a reflection of the collective spirit, dedication, and passion that define our community.

I appreciate the efforts of the faculty members who have continued to set high standards with their outstanding work, while our students have shown exceptional creativity and resilience in their endeavours, whether in the classroom, laboratory, or on the stage of competitions.

I encourage everyone to continue embracing a culture of curiosity, inclusivity, and excellence. Let us remain committed to learning, growing, and contributing to the world in meaningful ways. Together, we can make a difference, and together, we will achieve greatness.

I extend my appreciation to the editorial team for their hard work and dedication in bringing this publication to life.

With best wishes,

Prof. Mini S. Thomas
Dean

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(A Central University by an Act of Parliament)
Maulana Mohammed Ali Jauhar Marg, New Delhi-110025

दूरभाष : 26985227, 26981717
एक्सटेंषन : 2310, 2312,
ई-मेल : civil@jmi.ac.in
वेबसाइट : www.jmi.ac.in

सिविल इंजीनियरिंग विभाग

**Department of Civil Engineering**

# Message from the Head

With India progressing towards becoming a developed nation by 2047, Viksit Bharat@2047. It poses a great challenge for the Civil Engineers to develop the infrastructure appropriate for a developed country. “Tameer” is a platform dedicated to highlight the innovations in the field of civil engineering to match the infrastructure for a modern society. Every issue depicts the hard work and team spirit of the department.

Our shared knowledge stands as one of our most valuable assets, and this magazine acts as an essential resource for promoting collaboration, igniting fresh ideas, and keeping us ahead of industry developments. As we encounter new obstacles in our profession, I urge you to dive into the articles, engage with the research, and provide your insights.

Together, let’s keep innovating, inspiring, and advancing the field of civil engineering. A heartfelt thank you to all who contributed to this edition.

Best regards,

Farhan Ahmad Kidwai
Head, Department of Civil Engineering

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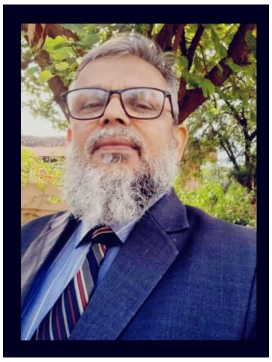
Department of Civil Engineering

# Message from Editor



It gives me immense pleasure to present eighth issue of "TAMEER" a civil engineering magazine brought out by the students and faculty. I congratulate the team of students and the editors for their tireless efforts that have come to the fruition in the form of this magazine. Such magazine provides an opportunity to the members of the departmental fraternity to express their latent talent in the form technical article and their practical experiences. I wish it all success and hope that this tradition that has been set by the current student will be carried through by the following generations of student to come. Hence it gives me immense pleasure to bring out "TAMEER" 2024. A special thanks to honorable vice chancellor, Head of department and Jamia administration for their encouragement and support. Also, I would like to thank all my students and colleagues.

Best regards,

Prof. Nazrul Islam
Editor

# Faculty of Engineering & Technology

The Faculty of Engineering and Technology was established in the year 1985 with the objective of providing outstanding engineering education directed at enriching the quality of life in an emerging knowledge-based society for a Self-reliant (Atmanirbhar) nation.

It is home to over 2000 students and over 200 academic, administrative, and technical staff. There are seven departments, namely: - Civil, Mechanical, Electrical, Electronics & Communication, Computer Engineering, Environmental Sciences and Applied Sciences & Humanities and all the departments also offer PG and PhD programmes along with 5 UG programmes in the five fields of engineering. With over 2,000 students, the University Polytechnicis also a part of the Faculty of Engineering and Technology.

The FET has more than 120 faculty members who not only mentor the students for academic excellence but also guide them to be good human beings. Faculty members hold Ph.D. degrees from institutes of repute in India and abroad and are all actively involved in research and consultancy projects of national importance.

The university strictly adheres to a no-ragging policy and is a no-smoking campus. The Faculty of Engineering & Technology Campus and the entire University campus, including hostels, are equipped with wi-fi.

All the B Tech programs of the Faculty are NBA Accredited. The placements of B Tech and M Tech students have seen a surge in recent years, with almost 75% of the 2022 batch being placed in reputed companies. Many students opt for higher studies in India and abroad.

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AYESHA SIDDIQUI
M.TECH (EARTHQUAKE ENGINEERING)
Jamia Millia Islamia, New Delhi

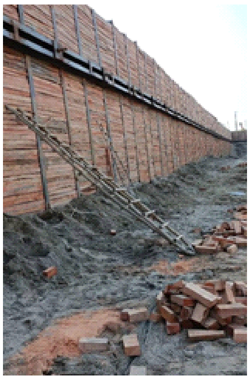
# Protection of Sites Under Deep Excavation

Deep excavation is essential in modern urban construction, especially in densely populated metro cities like New Delhi, Mumbai, Bangalore, Kolkata, Chennai etc. where multi-level basements, underground infrastructure, and foundations for high-rise buildings are increasingly common. However, deep excavation poses significant risks, including soil collapse, subsidence, and damage to surrounding structures. To mitigate these risks, various engineering techniques, such as soldier piling, contiguous piling, secant piling, diaphragm walls etc. are employed to ensure the safety and stability of the excavation site and the adjacent environment. This article explores these techniques, their need, application, and their benefits in ensuring site protection during deep excavation.

## NEED FOR SITE PROTECTION

Deep excavation is essential for constructing deep basements, underpass, subways, underground metros etc. Protecting the excavation site is crucial to maintaining stability and safety throughout the project, without proper site protection, there are increased risks of Soil collapse, damage to existing sewerage and storm water lines, and damage to the other surrounding structures. The following are various Engineering techniques that are utilized to protect the site under deep excavation:

## SOLDIER PILING



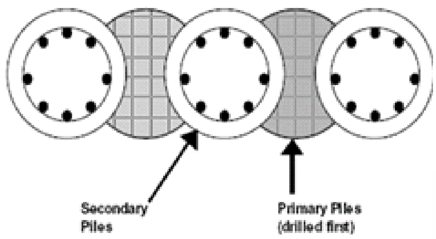
This method utilizes I-section steel bars known as Soldier pile and wooden wedges. This method involves driving Soldier piles into the ground at regular intervals, to an adequate depth, with wooden lagging placed horizontally between the piles, and supported by soldier pile flanges at its ends to retain the backfill. Soldier piles and lagging is another common method of supporting deep excavations, particularly in projects with variable soil conditions. It is a cost-effective way of protecting the site and also is easy to install. This method is suitable for smaller excavation sites or temporary lateral support. This method also allows for flexibility in excavation depth and width. Soldier piles and lagging systems are commonly used in combination with other reinforcement techniques, such as anchors or tiebacks, to provide additional stability and prevent lateral soil movement.

## CONTIGUOUS PILING

Contiguous piled walls consist of a row of successive unconnected cast-in-situ concrete piles constructed with small gaps between the adjacent piles. The gap between the pile ranges from 50mm to 150mm. Compared to other lateral soil supporting systems, contiguous pile walls are a more simple and economical method. It provides a solid barrier to prevent soil movement. Such piling also minimizes water seepage into the excavation site. This method is suitable for excavation in densely populated areas with nearby buildings. Contiguous piling offers flexibility in terms of pile spacing and depth, making it adaptable to a wide range of project requirements.

## SECANT PILING

Secant pile walls consist of reinforced and non-reinforced piles overlapping each other to form structural or cutoff walls and achieve the required water tightness. Secant piling is a technique that involves creating a retaining wall by interlocking a series of concrete piles, alternating between hard (reinforced) and soft (unreinforced) piles. The overlapping piles form a watertight retaining wall, making secant piling highly effective for projects near water bodies or with high groundwater levels. The reinforcement in the secondary piles can be provided by installing reinforcement cages, steel channel sections, I-beams or H-beams. This is an excellent method for water control, as it forms an impermeable barrier. This method also provides significant lateral support for deep excavations, even in weak or unstable soils. Secant piling is often used in projects where soil conditions or groundwater pose significant challenges, offering both stability and water control.



## DIAPHRAGM WALL

A diaphragm wall (D-wall) is a reinforced concrete structure constructed in situ panel by panel. D-walls are often used on congested sites that are close to existing structures. Anchors are also provided to provide more lateral support. This technique is widely used in large-scale projects, such as metro stations, basements, and tunnels, where high lateral loads and deep excavation depths are involved. In this method, excavation is carried out in sections or panels, firstly the reinforcement cages are placed, and concrete is poured into the panels to form a continuous wall. Diaphragm walls are also often combined with waterproofing systems to prevent groundwater infiltration. Diaphragm walls are ideal for deep excavation projects with tight site constraints, as they provide strong, permanent structural support for both the excavation and the final construction. It is the most expensive technique but it compensates the cost as retaining wall is not required and slab and beam of the basements, can be directly rested on the diaphragm wall using couplers to connect the reinforcement bars to the Dwall.

## CONCLUSION

Ensuring the safety of deep excavation sites requires careful planning and the application of suitable protective techniques such as contiguous piling, secant piling, diaphragm walls, and soldier piles etc. These methods help stabilize the surrounding soil, prevent collapses, and safeguard adjacent structures. Given the increasing need for deep excavation in various metro cities of India, the use of these techniques has become essential to ensuring the successful completion of construction projects while maintaining site safety and minimizing disruption. By employing the right combination of protective measures, engineers can mitigate the risks associated with deep excavation and ensure the long-term stability of the construction site.

2


ANAS KAFEEL

B.Teech (Civil) 6th Semester

Jamia Millia Islamia, New Delhi


# Revolutionizing Construction With 3D Concrete Printing

In the realm of modern engineering, **3D printing** is making waves across multiple industries, including aerospace, automotive, and medicine. The study titled **"Development of Test Bench for 3D Printing of Concrete Structures"** is aiming to explore how 3D printing technology can transform the construction sector by improving efficiency, reducing waste, and supporting sustainable development.

***An example of 3D printing technology in construction.***
***Source: https://www.bdcnetwork.com/blog/basics-3d-printing-and-possible-effects-construction***

## THE PROMISE OF 3D CONCRETE PRINTING (3DCP)

3D Concrete Printing (3DCP) is an advanced method that prints concrete layer by layer using a computer-controlled machine. This approach enables the creation of complex and intricate structures that would be challenging or impossible to build with traditional construction techniques. Beyond allowing for creative architectural designs, 3DCP has practical benefits that make it particularly attractive in today's world:

- **Reduced labor costs:** Automated printing minimizes the need for manual labor.

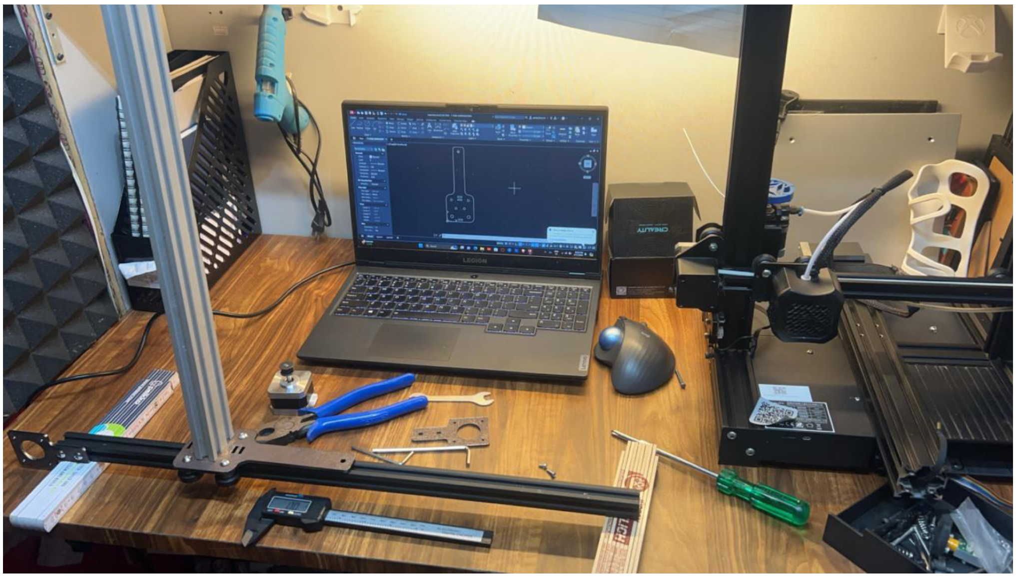
- **Decreased material waste:** By placing material precisely where needed, 3D printing minimizes waste.
- **Faster construction times:** Buildings can be constructed more quickly, addressing the urgent need for housing and infrastructure development.

These benefits are critical in countries like India, where rapid urbanization, environmental concerns, and resource limitations are driving the need for smarter and faster construction methods. **3DCP** aligns perfectly with this trend, offering a scalable and sustainable solution for the construction industry.

## STUDY GOALS AND OBJECTIVES

The main goal of this study is to develop a test bench for 3D printing concrete structures. The test bench serves as a platform for experimenting with different concrete mixtures and testing the performance of the custom-built 3D printer. The study also aims to formulate an economical concrete-cement mixture that is tailored to Indian environmental and construction conditions.

The key objectives of the study are:
- Developing a **3D printer** capable of printing concrete structures with precision.
- Creating a **specialized concrete mix** that balances printability, workability, and strength.
- Conducting thorough **testing and evaluation** of the 3D printed models to ensure structural integrity.



***Custom-built 3D printer specifically for concrete structures under development.***

## METHODOLOGY: BUILDING THE 3D PRINTER AND OPTIMIZING THE CONCRETE MIX

At the heart of this study is a custom-built 3D printer designed specifically for concrete structures. The printer is equipped with precision controls and advanced motion systems that allow it to lay down concrete layers accurately. Key components of the printer include:

- **Extruder:** The part of the printer responsible for depositing the concrete mixture layer by layer.
- **Stepper Motors and Lead Screws:** These ensure precise movements during the printing process.
- **Real-Time Monitoring:** Allows the team to adjust printing parameters based on real-time data, optimizing the build quality.

To complement this cutting-edge machine, the team is also formulating a **specialized concrete mix**. The concrete must flow smoothly through the printer's nozzle while maintaining its shape after being printed. The mix includes **Ordinary Portland Cement (OPC)**, fine aggregates like sand, and various admixtures such as **superplasticizers** and **nano-silica**. These additives enhance the concrete's workability, strength, and printability.

***Complex structures can be printed layer by layer using specially designed concrete mixes***
***Source: The Comeback of Craftmanship and Artisanal Aesthetics in 3D Printing | ArchDaily***

## TESTING AND EVALUATION

Once the concrete structures are printed, they undergo rigorous testing to assess their strength, durability, and overall performance. Some of the key tests include:

- **Compressive Strength:** A measure of how much load the printed structure can bear before failing.
- **Flexural Strength:** This test assesses the material's ability to resist bending.
- **Porosity and Permeability:** These characteristics determine how much water or air can pass through the material, which is crucial for ensuring the durability of the structure.

By analyzing these results, the team aims to fine-tune both the printing process and the concrete mixture, ensuring that the final product is both cost-effective and reliable for large-scale construction.

## EXPECTED OUTCOMES AND FUTURE APPLICATIONS

By the end of this study, the team expects to achieve several key outcomes:

1. **Development of a robust 3D printing test bench** for concrete structures.
2. **Formulation of a concrete-cement mix** that is optimized for Indian conditions.
3. **Comprehensive analysis** of 3D printed models to ensure they meet the necessary structural standards.

This research has the potential to bring 3DCP technology into mainstream construction in India, significantly reducing study times and costs while promoting sustainable building practices. Beyond housing and infrastructure, this technology could be applied to everything from bridges to intricate architectural elements.

## IMPACT ON THE CONSTRUCTION INDUSTRY

The introduction of 3D printing into the construction industry could be revolutionary. By reducing the need for traditional formwork and manual labor, this technology significantly cuts down on costs. Moreover, with growing concerns about resource scarcity and environmental degradation, 3D printing's ability to minimize waste and energy consumption makes it an attractive option for future construction studys.

In a country like India, where the demand for quick and affordable housing is high, **3DCP** could play a vital role in addressing these challenges. The success of this study could pave the way for widespread adoption of 3D printing technology in construction, contributing to sustainable development goals while addressing the needs of rapidly growing urban populations.

## CONCLUSION

The **Development of a Test Bench for 3D Printing of Concrete Structures** study highlights the innovative potential of modern construction technology. By pushing the boundaries of 3D printing in construction, this initiative is driving a future where buildings can be designed and constructed more quickly, cost-effectively, and with a lower environmental impact. With further research and refinement, **3D Concrete Printing (3DCP)** could soon become a standard tool in the construction industry, helping to shape the cities of tomorrow.

3

SHREEJA KACKER

PhD Scholar, CED

Jamia Millia Islamia, New Delhi

# Building the Future: The Marvels of Modular Construction

## WHAT IS MODULAR CONSTRUCTION?

In the realm of construction innovation, modular construction emerges as a transformative methodology, revolutionizing the very essence of building design and assembly. A symphony of precision, efficiency, and structural ingenuity, modular construction involves the orchestrated creation of buildings using pre-fabricated modules, meticulously crafted off-site, and seamlessly assembled at the construction site. At the forefront of this architectural renaissance stands the Modular Building Institute (MBI), the eminent international non-profit trade association established in 1983. Branded as the Voice of Commercial Modular Construction, MBI has been a vanguard, propelling the utilization of offsite and modular construction through its dedication to innovation, education, and the celebration of excellence in modular design and facilities.

Modular construction involves creating buildings using pre-fabricated sections, or modules, which are manufactured off-site and then transported to the construction site for assembly. These modules are essentially building blocks designed to seamlessly fit together, ensuring a swift and efficient construction process.

*Figure 1 : Ongoing Construction of Modular Structure (left) and Constructed Modular Building (right)*

Joints play a crucial role in modular construction, acting as the connective tissue that ensures the integrity, stability, and functionality of the assembled structure. The design and engineering of joints determine how effectively these modules come together, influencing the overall strength and durability of the final structure.

Well-designed joints not only facilitate efficient assembly but also contribute to the building's resilience against external forces such as wind, seismic activity, and other environmental stresses. The precision and reliability of joints are paramount in achieving a seamless and cohesive construction process, reinforcing the significance of meticulous attention to joint design in the success of modular construction projects.

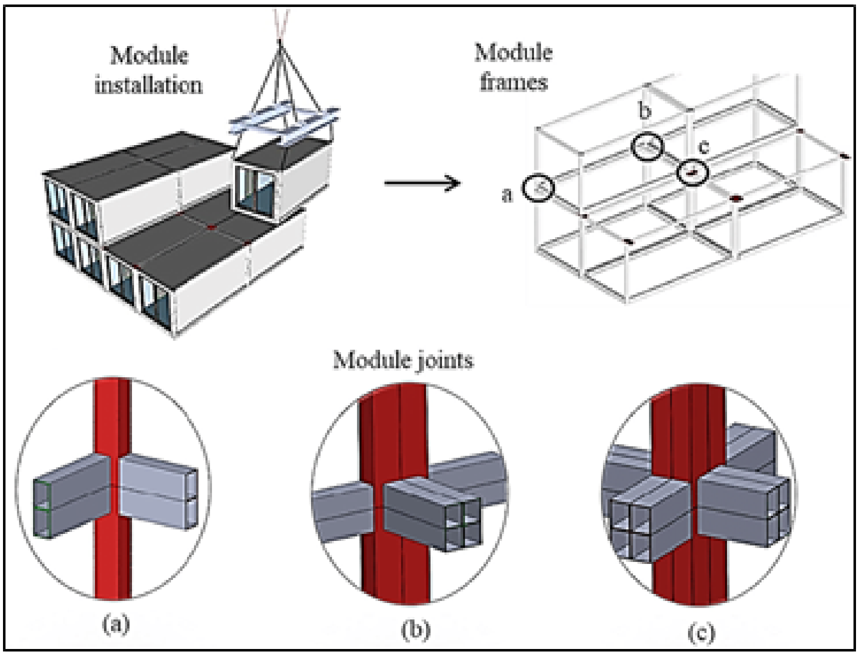



***Figure 2 : Joints in Modular Construction***

## MODULE SIZE AND CONSTRUCTION

### Module Size:

- Standardization is key in modular construction. Modules are typically designed to standard sizes, with dimensions such as 10 feet in width, 30 feet in length, and 12 feet in height for certain residential projects [^1].
- This standardization ensures seamless assembly on-site, allowing for efficient stacking and integration.

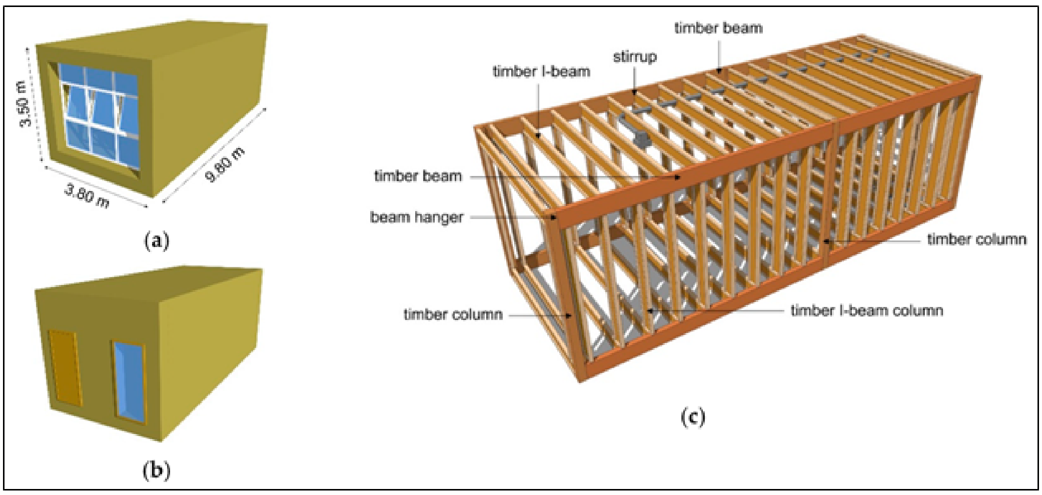



***Figure 3 : Size of Modules***

### Construction Process:

- Modules are manufactured in controlled factory environments, guaranteeing precision and quality.
- The construction process involves assembling the structural components, including walls, floors, and ceilings, within the modules.
- Quality control measures are implemented at each stage, ensuring that every module meets stringent standards before leaving the factory.

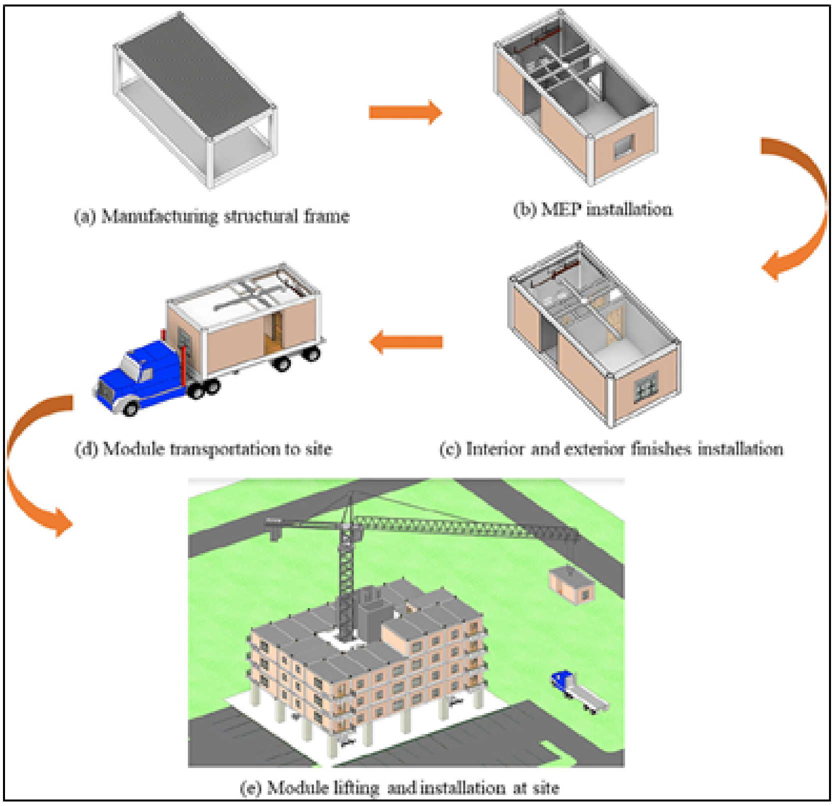



*Figure 4 : Construction Process of a Modular Structure*

## ADVANTAGES

**Speedy Construction:** The use of modular construction in the T30 Hotel in China reduced construction time by 30%, showcasing the potential for rapid project completion [^2].

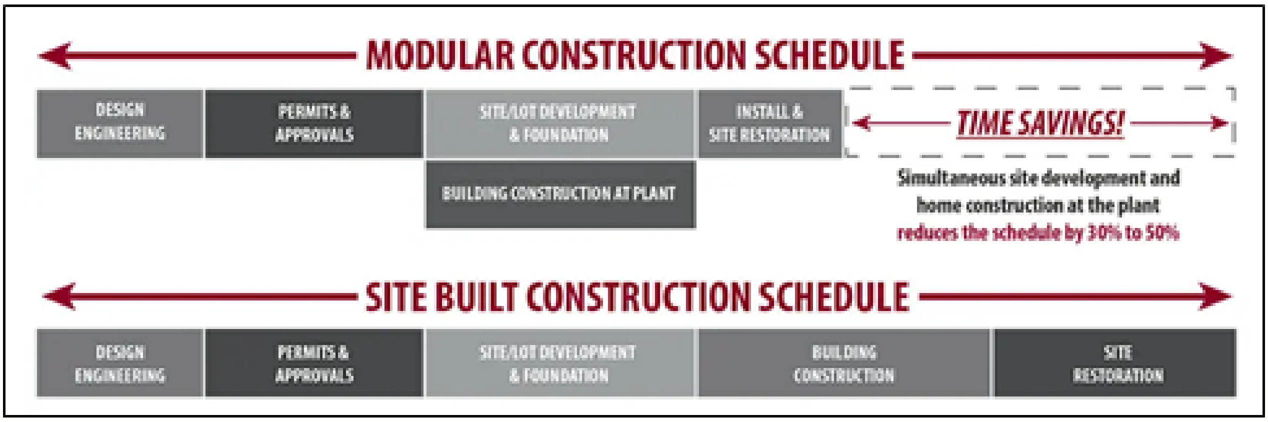



*Figure 5 : Graphical Representation of Time Savings in Modular Construction*

**Cost-Efficiency:** The Brock Commons Tallwood House in Canada demonstrated cost-efficiency through modular construction, reducing construction costs by 31% compared to traditional methods [^3].

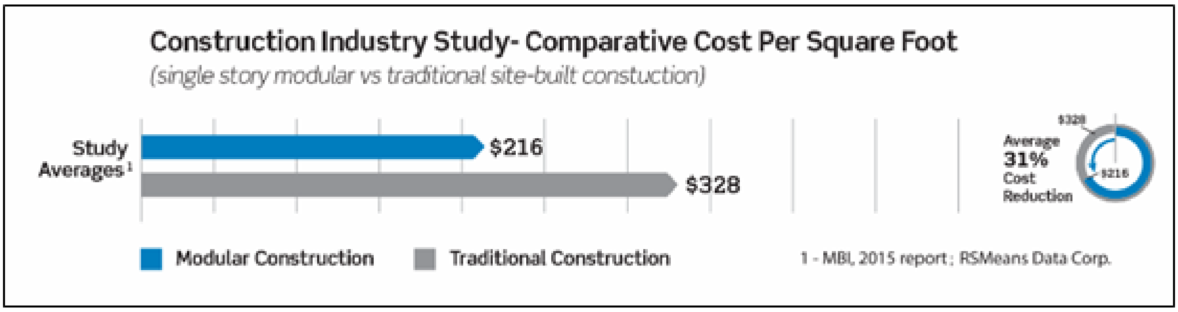



*Figure 6 : Graphical Representation of Cost Savings in Modular Construction*

**Sustainability:** The integration of recycled materials in modular construction exemplifies the environmental sustainability of this building method, showcasing a commitment to eco-friendly practices [^4].

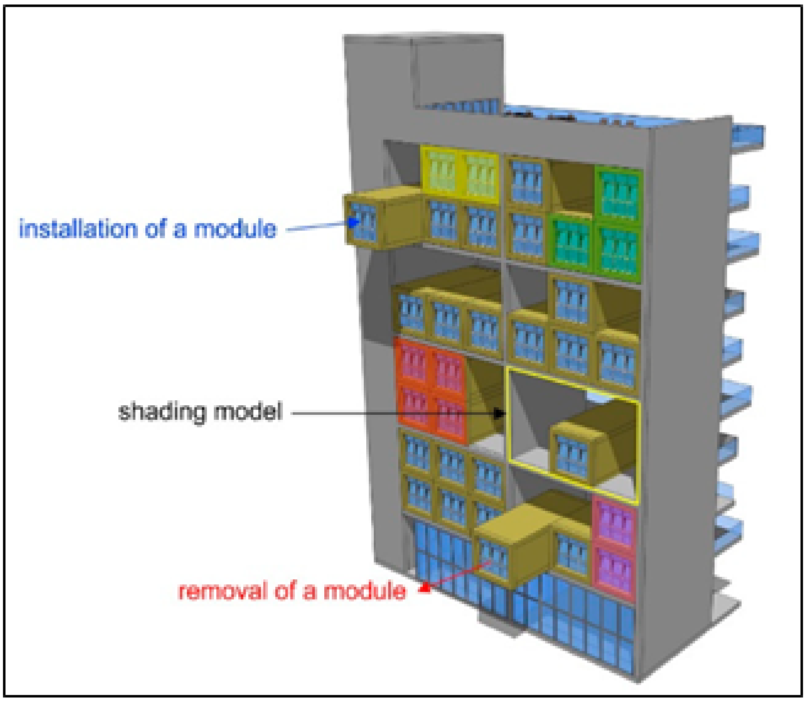



*Figure 7 : 3D View of the Front Facade*

## DISADVANTAGES

**Design Limitations:** Modular construction faces challenges when dealing with intricate designs, revealing limitations in handling complex architectural structures [^5].

**Transportation Challenges:** Oversized module transportation presents logistical difficulties, emphasizing complexities in the transport of large modular components [^6].

**Limited Customization:** Modular construction encounters constraints in customization due to the standardized nature of modules, indicating challenges in tailoring designs to specific needs [^7].

## CONCLUSION

In conclusion, modular construction, spearheaded by organizations like the Modular Building Institute (MBI), stands as a revolutionary force in the realm of construction, embodying precision, efficiency, and environmental consciousness. The standardized module sizes, exemplified by dimensions like 10 feet in width, 30 feet in length, and 12 feet in height, ensure seamless on-site assembly, fostering both speed and cost-efficiency. The T30 Hotel in China and Brock Commons Tallwood House in Canada substantiate this efficiency, showcasing a remarkable 30% reduction in construction time and 31% reduction in costs.

Despite these advantages, challenges such as design limitations and transportation complexities persist, emphasizing the need for continued innovation. Modular construction's commitment to sustainability, with the integration of recycled materials, echoes a promising eco-friendly future. As the architectural landscape evolves, modular construction emerges as a transformative force, redefining how we build the structures of tomorrow.

## INTERESTING FACTS

- The modular construction of SkyCity One in Changsha, China, set a remarkable record by completing a 57-story skyscraper in just 19 days. This groundbreaking project, completed in 2015, showcased the unprecedented speed achievable with modular construction methods.
- ICON, a construction technology company, has introduced 3D-printed modular homes. Using robotics and sustainable materials, they can construct a 350-square-foot home in 48 hours. This blend of modular and 3D printing technologies represents the cutting edge of efficient and futuristic construction methods.
- In 2012, a 10 storey building was constructed in Mohali, India, in a span of 48 hours, with the advent of modular construction techniques and high-end on-site assembly systems.

## REFERENCES


[^1]: Modular Building Institute. "Modular Construction Standard Sizes." https://www.modular.org/htmlPage.aspx?name=Standard_Sizes

[^2]: World Architecture. "T30 Hotel, China." https://worldarchitecture.org/architecture-projects/eabev/t30-hotel-by-jd-palmer-and-yun-dil-seoul-korea.html

[^3]: Acton Ostry Architects. "Brock Commons Tallwood House, Canada." https://actonostry.ca/project/brock-commons-tallwood-house/

[^4]: Sellen Construction. "Cyrene Apartments, Seattle." https://www.sellen.com/projects/cyrene-apartments/

[^5]: Ateliers Jean Nouvel. "Louvre Abu Dhabi." https://www.jeannouvel.com/en/desktop/projet/louvre-abu-dhabi-2/

[^6]: The B1M. "Ark Hotel, China." https://www.theb1m.com/video/how-chinas-ark-hotel-was-built-in-6-days

[^7]: DeSimone Consulting Engineers. "CitizenM Hotel, New York." https://www.de-simone.com/projects/citizenm-bowery-hotel/

[^8]: Smith, J., et al. (2018). "Modular Construction: A State-of-the-Art Review." Journal of Construction Engineering and Management.

[^9]: Wang, C., et al. (2020). "Life Cycle Assessment of Modular Construction and Traditional Construction." Sustainability.

[^10]: Chen, Z., et al. (2019). "Optimization of Modular Construction Schedule Considering Transportation Limitations." Journal of Construction Engineering and Management

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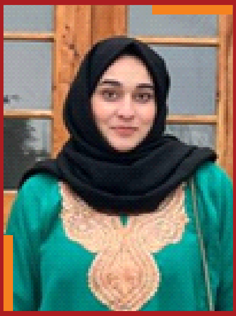
HYFA HANIEF
B.Tech. (Civil) 8th Sem
Jamia Millia Islamia, New Delhi



# Prediction of Concrete Grade Using Machine Learning

The construction industry heavily relies on concrete, known for its strength, durability, and versatility. The ability to predict concrete compressive strength is critical for ensuring structural integrity. Traditionally, laboratory tests have been used for this purpose. However, these tests are often time-consuming and expensive. In response, this project explores the application of machine learning (ML) techniques, specifically Artificial Neural Networks (ANN), to predict concrete compressive strength more efficiently. Our goal is to develop an ANN model that can predict the concrete grade using a dataset from various experimental tests.

This project was completed by Hyfa Hanief, Mohammed Naved, Sania Shakil, Mohd Asad Naqvi, and Mohd Faizan under the mentorship of Prof. Akil Ahmed, Department of Civil Engineering, Faculty of Engineering and Technology, Jamia Millia Islamia, New Delhi.

Concrete's compressive strength is influenced by numerous factors such as the water-cement ratio, water content, the type of cement used, and environmental conditions during curing. Traditionally, predicting concrete strength has required extensive laboratory testing, which can be expensive and labour-intensive, especially for high-performance concrete (HPC). Machine learning techniques, offer an alternative by leveraging large datasets to predict outcomes based on the relationships between these variables. This approach saves time and resources and improves the accuracy of predictions.

## PROJECT GOALS AND APPROACH

The primary objective of this project was to develop machine learning models that accurately predict the grade of concrete based on its composition and age. Specific objectives include:

1. Analysing a dataset of compressive strength tests.
2. Developing an ANN model to predict the grade of concrete.
3. Evaluating the model's performance using various metrics such as Mean Squared Error (MSE), Mean Absolute Error (MAE), and R-squared values.

The dataset used for this project was obtained from Kaggle.com, comprising 1,030 observations with variables including cement content, slag, fly ash, water, superplasticizers, coarse and fine aggregates, age, and compressive strength. The project methodology involved three key phases:

**1. Data Analysis:** Using Python libraries such as Pandas, NumPy, Matplotlib, and Seaborn, we analysed the dataset. Visual tools like heatmaps, pair plots, and box plots were employed to identify patterns and correlations between the input variables and the target variable—compressive strength.

**2. Model Development:** We developed several ANN models, each designed to predict compressive strength based on input features. The models included different activation functions and hyperparameters to improve prediction accuracy.

**3. Performance Evaluation:** The performance of the models was evaluated using MSE, MAE, and R-squared metrics. The models were trained on 70% of the dataset, with the remaining 30% used for testing.

## RESULTS

Three Artificial Neural Network (ANN) models were developed to predict the compressive strength of concrete, each employing a distinct approach to enhance predictive accuracy. The first model utilized the original dataset, which comprised 1,030 observations of various concrete mixes, incorporating all available data points without any preprocessing. This baseline model provided a fundamental understanding of the relationship between the input features and the compressive strength of concrete.

In contrast, the second model focused on refining the dataset by removing extreme outliers, specifically compressive strength values that were less than 10 $N/mm^2$ or greater than 60 $N/mm^2$. By filtering out these extreme values, the second model aimed to create a more representative training set, thus minimizing the impact of anomalous data points that could skew the learning process. As a result, this model demonstrated superior performance, achieving a Mean Squared Error (MSE) of 18.68 and an R-squared value of 0.88 for the training data. These metrics indicate that the model accounted for approximately 88% of the variance in compressive strength, showcasing its efficiency in capturing the underlying trends of the dataset.

The third model took a further step by integrating the filtered dataset from the second model with results obtained from laboratory cube tests. This combination enriched the training data with additional, reliable information, which significantly improved the model's predictive accuracy. The incorporation of laboratory test results provided a more comprehensive understanding of the factors influencing compressive strength, ultimately leading to enhanced model robustness.

Among the three models, the second model showed the best performance across multiple evaluation metrics. Its focused approach to excluding extreme outliers streamlined the training process and also fostered a more accurate prediction of concrete compressive strength. This highlights the importance of data preprocessing in machine learning applications, particularly in areas where the quality of the input data can significantly affect the results.

# CONCLUSION

This project successfully demonstrated the application of machine learning in predicting concrete compressive strength. By utilizing ANN models, we were able to improve the accuracy and efficiency of predictions compared to traditional methods. The use of machine learning has the potential to transform the construction industry by reducing the reliance on costly and time-consuming laboratory tests, making the process more efficient and scalable. Future work could explore the integration of other ML techniques and expand the dataset to further enhance model accuracy.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IQRA MANZOOR
PhD Scholar, CED
Jamia Millia Islamia, New Delhi

# Cold Plasma Technology for Removal of Hexavalent Chromium ($cr^{+6}$) from Tannery Wastewater

## INTRODUCTION

Tannery wastewater is a significant contributor to water pollution due to its high complexity and the presence of various pollutants, including heavy metals. Among these heavy metals, hexavalent chromium (Cr+6) stands out as a particularly hazardous element. Hexavalent Chromium (Cr+6) is known for its toxic nature, carcinogenic properties, and detrimental impact on both human health and the environment. The discharge of hexavalent chromium (Cr+6) into water bodies, often originating from tannery operations, can lead to serious ecological imbalances and health risks for communities relying on these water sources. Traditional approaches to eliminate hexavalent chromium from industrial wastewater, encompassing methods like chemical precipitation, ion exchange, adsorption, and membrane filtration, are not without their constraints. These methods can be costly, generate sludge as a byproduct, and struggle to effectively treat low concentrations of hexavalent chromium (Cr+6). This has spurred the exploration of novel, sustainable technologies to address this challenge. The leather tannery sector has been identified as one of the seventeen categories of highly polluting industries by the Central Pollution Control Board. In the leather tanning industry's effluent, the United States Environmental Protection Agency permits a maximum release of 0.15 grams of chromium per kilogram. Hexavalent chromium is widely used across various industries, including chrome plating, textiles, and leather tanning. Tanning, a process that converts raw hides or skins into leather, involves the use of hexavalent chromium (Cr+6), which is recognized as toxic. Hexavalent Chromium (Cr+6) is notably a hundred times more toxic than (Cr+3), and it also possesses higher water solubility. The toxicological concern associated with hexavalent chromium (Cr+6) emanates from its potent oxidative properties, capable of generating free radicals with potential carcinogenic effects on cells. Research documents indicate that chromium salts are extensively employed in tanning processes, yet only 60-70% of total chromium salts react with the hides. In other words, approximately 30-40% of the chromium content remains within the solid and liquid waste components, particularly within spent tanning solutions.

One such innovative strategy involves the application of a cold plasma technique to eliminate hexavalent chromium from wastewater. The application of cold plasma to remove hexavalent chromium (Cr+6) involves intricate chemical reactions and physical interactions. Reactive species present within the plasma can directly engage with hexavalent chromium (Cr+6) ions, leading to their reduction into less harmful trivalent chromium (Cr+3) form. To realize the full potential of the cold plasma technique for hexavalent chromium removal, several critical factors must be considered.

These include the specific parameters of the plasma discharge, the initial concentration of hexavalent chromium (Cr+6), solution pH, treatment duration, and the design of plasma generation equipment. Optimization of these factors is vital to achieving efficient removal of hexavalent chromium while minimizing energy consumption and undesirable byproduct formation.

Cold plasma, or non-equilibrium plasma, is a unique state of matter containing various reactive components like ions, electrons, radicals, and excited molecules. It can be generated at or near room temperature and has shown promise in diverse environmental applications. While cold plasma has been explored for wastewater treatment purposes, its application specifically for hexavalent chromium removal from tannery wastewater remains relatively unexplored. Investigating the intricate interaction mechanisms between cold plasma and hexavalent chromium (Cr+6) ions under various experimental conditions is pivotal for developing a robust and scalable treatment process.

## FUNDAMENTALS AND MECHANISMS OF PLASMA-BASED WATER TREATMENT

In recent years, discharge plasma has been explored for its efficiency in removing harmful organic compounds, such as synthetic dyes and pharmaceuticals, and eradicating pathogenic bacteria from wastewater. This technology has seen continuous advancement and expansion due to its powerful electrical field and the generation of high-energy charged particles. These include various reactive oxidizing and reductive species, as well as aqueous electrons, contributing to its effectiveness.

Plasma technology not only produces these reactive species but also generates ultrasound, UV light, electrohydraulic cavitation, and shockwaves as part of its multifaceted mechanism. These features enhance its capacity to break down complex pollutants, making it a promising solution for wastewater treatment.

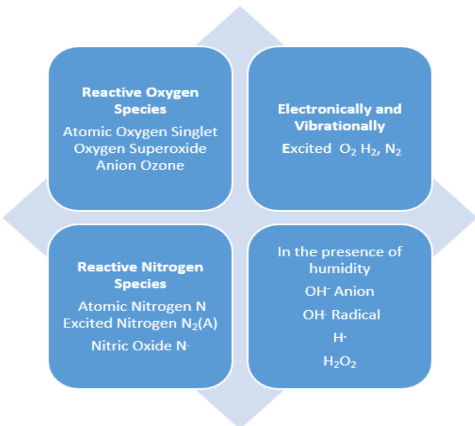


*Figure 1: Generation of Reactive Species in Discharge Plasmas.*

Discharge plasma in contaminated water treatment can produce two main effects: (1) the direct impacts from electron collisions and (2) the secondary effects arising from chemically active species generation. These species include ionic and molecular agents like hydrogen peroxide, oxygen, and ozone, as well as reactive radicals such as hydroxyl (.OH) and atomic oxygen (O.). These oxidants and reactive species have varying oxidation potentials and lifetimes, contributing to their efficacy in breaking down pollutants.

Plasma can also facilitate the reduction of pollutants through reactive species like aqueous electrons and hydrogen radicals, which possess significant reduction potentials. Electrical discharges in liquids prompt various chemical and physical transformations crucial for eliminating microorganisms and ensuring water safety. Key mechanisms include electro-compression that disrupts bacterial cell membranes, shock waves that deform cell structures, and UV radiation that induces genetic mutations.

The application of plasma in an aqueous medium involves several considerations. The initiation of plasma generates a rapid temperature increase, with heating rates around 10^9 K/s, and creates high pressures (up to 10^7 MPa). If the liquid medium were compressible, these pressures would produce shock waves, facilitating plasma generation. Research has shown that combining high-voltage discharge with an electromagnetic field is highly effective for sterilizing water and wastewater.

Pyrolysis can occur due to shockwaves from high-voltage discharges, while electrohydraulic discharge indirectly triggers chemical reactions within the liquid. There are three main methods for applying high-voltage discharge in wastewater treatment, each based on the type of reactor operation or plasma-phase distribution: (1) discharge in the gas phase above the liquid surface, (2) direct discharge in the liquid phase, and (3) discharge in hybrid gas-liquid systems.

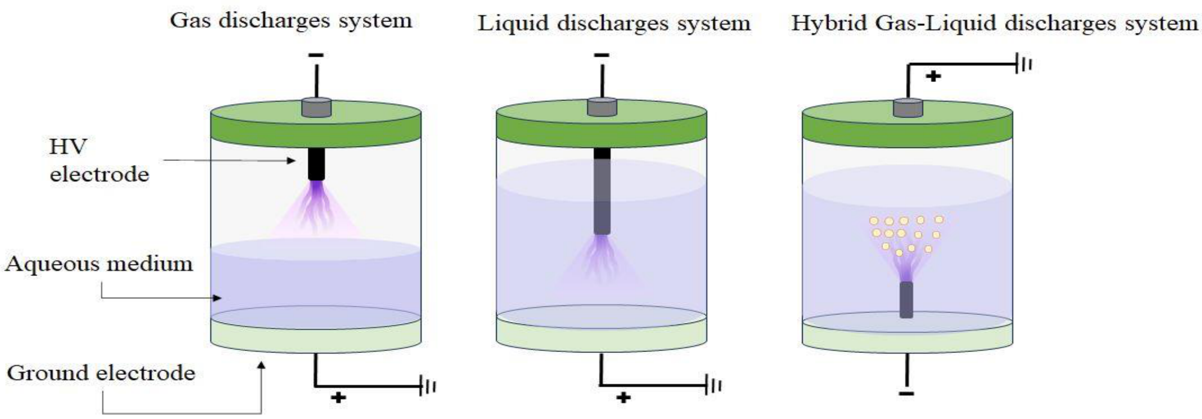


*Figure 2: Schematic Illustrations of Various Discharge Plasma Systems for Water Treatment..*

## METHODOLOGY

The methodology for investigating Cold Plasma-Mediated Hexavalent Chromium Cr+6 Removal includes the following steps:

- **Cold Plasma Setup:** Install a cold plasma system with suitable electrodes and power source. Choose gas mixture and flow rate for plasma generation.
- **Sample Collection and Characterization:** Collect representative tannery wastewater samples. Measure initial Cr+6 concentration and relevant parameters.
- **Experimental Design:** Develop experiments matrix with varied parameters: plasma power, exposure time, initial hexavalent chromium (Cr+6) concentration, and pH levels. Systematically plan trials to cover the range of conditions.
- **Cold Plasma Treatment:** Introduce wastewater samples into plasma reactor. Apply predetermined experimental parameters to each trial.

- **Analysis and Interpretation:** Collect post-treatment samples for analysis. Quantify hexavalent chromium (Cr+6) concentration using appropriate techniques (e.g., UV-Vis spectroscopy, ICP-MS). Analyze pH, conductivity changes, and relevant parameters.
- **Data Evaluation and Conclusions:** Compile and analyze data, including hexavalent chromium (Cr+6) removal efficiency. Apply statistical methods to understand variable impacts. Interpret results, discuss findings, and draw conclusions regarding cold plasma's efficacy under diverse conditions.

## ADVANTAGES OF COLD PLASMA TECHNOLOGY

- **Effective Disinfection:** Cold plasma generates reactive species like hydroxyl radicals and ozone that effectively eliminate bacteria, viruses, and pathogens from water.
- **Chemical-Free:** Unlike traditional disinfection methods involving chlorine or other chemicals, cold plasma does not leave harmful chemical residues, making it an environmentally friendly option.
- **Broad Spectrum Contaminant Removal:** It can degrade various organic pollutants, including pesticides, pharmaceuticals, and endocrine-disrupting chemicals.
- **Energy Efficiency:** Compared to thermal plasmas, cold plasma operates at lower temperatures and can be energy-efficient for specific applications.
- **Fast Treatment Process:** Cold plasma can quickly react with contaminants, making the treatment process relatively rapid.
- **Scalability:** The technology can be adapted for different scales, from small systems for point-of-use applications to larger water treatment plants.
- **Minimal By-Products:** It often produces fewer harmful by-products compared to some conventional chemical treatments.

## REFERENCES


1. Electronic Code of Federal Regulations, Environmental Protection Agency. Protection of Environment, Part 425—Leather Tanning and Finishing Point Source Category. (Accessed on 2 May 2020).
2. Kleber, R.J.; Helz, G.R. Indirect Photo reduction of Aqueous Chromium (VI). Environ. Sci. Technol. 1992, 26, 307–312.
3. Saha, R.; Nandi, R.; Saha, B. Sources and toxicity of hexavalent chromium. J. Coord. Chem. 2011, 64, 1782–1806.
4. Megharaj, M.; Avudainayagam, S.; Naidu, R. Toxicity of hexavalent chromium and reduction by bacteria isolated from soil contaminated with tannery waste. Curr. Microbiol. 2003, 47, 51–54.

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MANISH SHARMA

PhD Scholar, CED

Jamia Millia Islamia, New Delhi

# Seismic Potential Parameter for Concrete Gravity Dam

## ABSTRACT

In recent years new methodologies have been evolved for the seismic safety assessment of concrete gravity dams. These methodologies are in general, based on the criterion related to the structural response of concrete gravity dam. The legitimate response of such a structure under seismic loading condition not only depends upon the parameters like dam-water-foundation interaction, quality of the material, local site condition but also on the ground motion characteristics. Seismic events are characterized by different seismic damage potential parameters also known as earthquake damage potential parameters. However, the most challenging problem is the selection of reasonable seismic potential parameter of ground motion due to lack of indicatory criteria in the selection of various seismic potential parameter of ground motion. Hence it is very important to choose an appropriate and comprehensive seismic potential parameter to achieve an accurate correlation with the structural performance of concrete gravity dam during earthquake. Therefore, this study is conducted on a typical concrete gravity dam for finding out the most relevant seismic potential parameter for its seismic safety assessment. In this work, a set of seven seismic potential parameters was examined using correlation analysis on fifteen ground motion records. The properties and usefulness of such seismic potential parameters are also explored, and appropriate seismic potential parameters are recommended as a result. The study also investigates the relationship between existing seismic potential parameters and the seismic response of a non-linear dynamic analysis of a concrete gravity dam.

**Keywords:** Concrete Gravity Dam, Seismic Potential Parameter, Dynamic Seismic response, Correlation Analysis.

## 1. Introduction

Dams have always played a vital part in the evolution of civilization. Concrete gravity dams are one of the most essential hydraulic structures for meeting rising demand for electricity generation, irrigation, flood control, home and industrial water supply, and water resource conservation, among other things M.K Bharti et. al.[7]. The horizontal thrust of the water is totally resisted by the weight of concrete gravity dams. They utilize their weight to keep the water in the reservoir from overflowing. Seismic demand is primarily influenced by three criteria in seismic design: the peak value of ground motion, the characteristics of the earthquake spectrum, and the duration. An earthquake intensity index of ground motions is commonly utilized as a critical scaling element in seismic analysis and design. Rocio Segura et al.[1] discuss potential metamodels for seismic assessment of gravity dams for application in fragility analysis. Lieping et al.[2] The relationship between existing earthquake intensity indexes and the seismic responses of elastoplastic SDOF and MDOF systems was investigated. Elenas, A., and Meskouris, K.[3] used peak ground motion, spectral, and energy metrics to define seismic excitation. Dong An et al. [4] optimize the seismic ground motion intensity index selection in the seismic fortification of urban shallow-buried rectangular tunnels. Liang Li et al. [5] present a method for selecting the filtering frequency range that is compatible with the structural properties of NPPs.

## 2. Methodology

### 2.1. Finite element model description

The configuration of a non-overflow monolith 2D cross-section of an existing dam is studied in this study. Only the stiffness of the foundation is included in the finite element model of dam-foundation interaction by assuming a block with the appropriate dimensions, as shown in Figure 1. A general-purpose finite element Programme known as ABAQUS is used to model the section of the dam and the finite foundation domain using CPS4R elements (4-node bilinear plane stress solid continuum elements). The nodes at the dam body's base and corresponding nodes along the foundation are linked, and the model assumes no sliding. The damage-plastic model is used to simulate the concrete (J. Lee and G. L Fenves,1998). The foundation block's bottom is assumed to be fixed, and rollers are attached along the block's vertical sides. The dam and foundation domains have 396 and 468 elements, respectively. For the time integration of equations of motion, the explicit central difference approach is used.

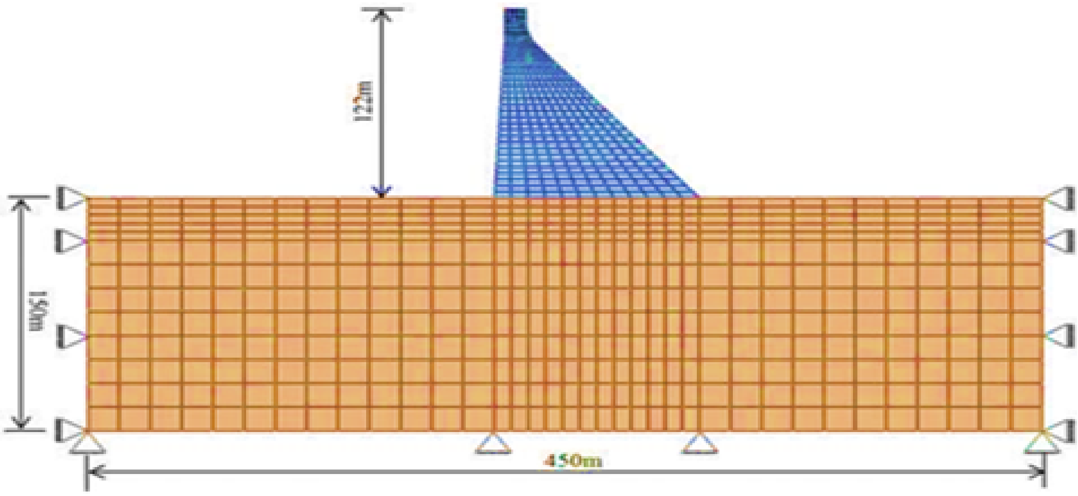



***Figure 1 :*** Finite element model of dam foundation system

### 2.2. Parametric Details and Loading Conditions

A concrete gravity dam has a height of 122 meters, while the neck has a height of 102.10 meters. The base width of the dam is 96.80 meters, while the crest width is 9.8 meters. It has a 150-meter-deep, 450-meter-long foundation with a 103-meter-deep reservoir. The dam's unit length is taken into account. In finite element analyses, loading on the dam section is applied in two steps:

i. Hydrostatic and Gravity Loads.

ii. Hydrodynamic and inertia loads are calculated by taking the horizontal component of each time history into account. The additional mass technique of Westergaard (1933) is used to apply the hydrodynamic load distribution as follows Sharma and Ansari [8]

$$H(y) = \frac{7}{8}\rho_w\sqrt{h(h-y)} \quad (1)$$

Where, H(y) = The hydrodynamic pressure at height y above the reservoir bottom, h = The depth of the reservoir, $\rho w$ = The mass density of water, y = Height measured from base of dam.

## 2.3. Material Parameters

This analysis took into account material nonlinearity. The damage-plastic model is used to simulate the concrete material. The concrete behaviour in uniaxial tension is controlled in this model by tension stiffening and tensile damage (dt), which take into account the degradation of material stiffness due to damage propagation in terms of cracking normal displacement Sharma et. al.[9] Rawat. et. al.[10] The computational model has a limitation in that it does not account for sliding displacements and does not examine the post-earthquake condition in a damaged state where uplift pressure can build up in cracks that have lost their cohesive properties. The constitutive model of concrete is obtained in the laboratory through uniaxial tests on concrete specimens Ansari and Agarwal [6] shown in fig.2.

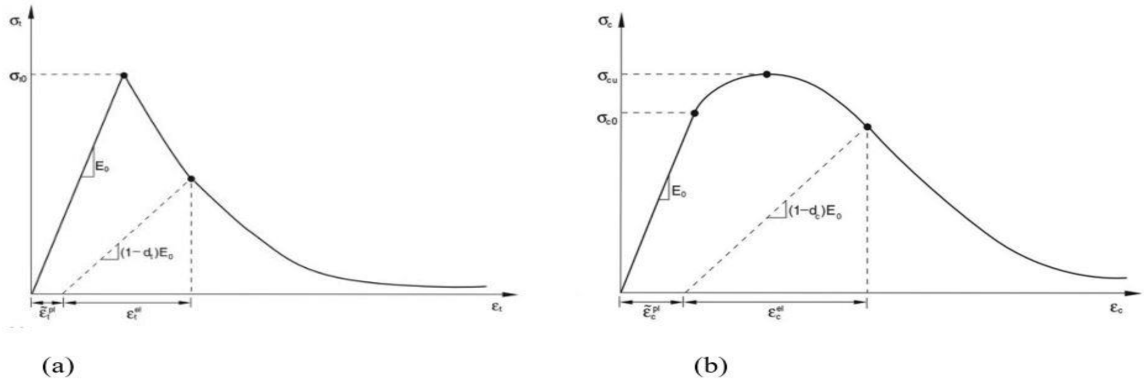



***Figure 2 :*** Behavior of concrete under uniaxial loading: (a) tension; (b) compression

## 3. Seismic potential parameter

The seismic potential destructiveness of ground shaking is recorded in earthquake records. Over the years, a number of ground motion parameters have been proposed to serve as indices of the motion's potential to cause structural damage. They are commonly referred to as "intensity measures," but we prefer the term "Seismic Potential Parameter" here. Their application is in response to the need for a quick assessment of the potential of recorded motions before a full analysis can be performed. Furthermore, predicting a Seismic potential Parameter from a relevant attenuation relation enables a direct assessment of the earthquake threat.

Seismic Potentials Parameter = f(MW, Rupture distance, site conditions) where MW denotes the moment magnitude of an earthquake and Rupture denotes the distance from the fault. Several such damage potential parameters are being tested here against the maximum crest displacement of a concrete gravity dam and the crack length at the base of an interaction between the dam body and the dam foundation caused by a ground motion. Which is listed in Table 1.

***Table 1.*** Seismic potential parameter used in study

| Sr. No. | Description of Seismic Potential Parameter | Symbol | Expression |
|---|---|---|---|
| 1 | Peak Ground Acceleration | PGA | $PGA = \max\lvert a(t)\rvert$ |
| 2 | Ratio of PGV/PGA | PGV/PGA | $\frac{v_{max}}{a_{max}} = \frac{\max\lvert v(t)\rvert}{\max\lvert a(t)\rvert}$ |
| 3 | Acceleration Spectrum Intensity (g*sec) | ASI | $ASI = \int S_a(\xi, T)\, Dt$ |
| 4 | A95 parameter (g) | A95 | — |
| 5 | Housner Intensity (m) | Ih | $Ih = \int_{0.1}^{2.5} Sv(\xi, T)dT$ |
| 6 | Arias Intensity: (m/sec) | Ia | $Ia = \frac{\pi}{2g}\int_0^{t_D} [a(t)]^2$ |
| 7 | Specific Energy Density (cm²/sec) | SED | $SED = (\beta_s \cdot \rho)/4 \int \dot{x}(t)dt$ |

## 4. Earthquake ground motion records

A set of fifteen (15) earthquake ground motions were chosen for this study using the PEER database. In general, the earthquake is recorded on stiff soil near the location of a concrete gravity dam. These actual records bear no resemblance to the USGS soil type. They have varying epicentral distances and large magnitudes, allowing them to cover the entire response range of the modelled dam-foundation systems.

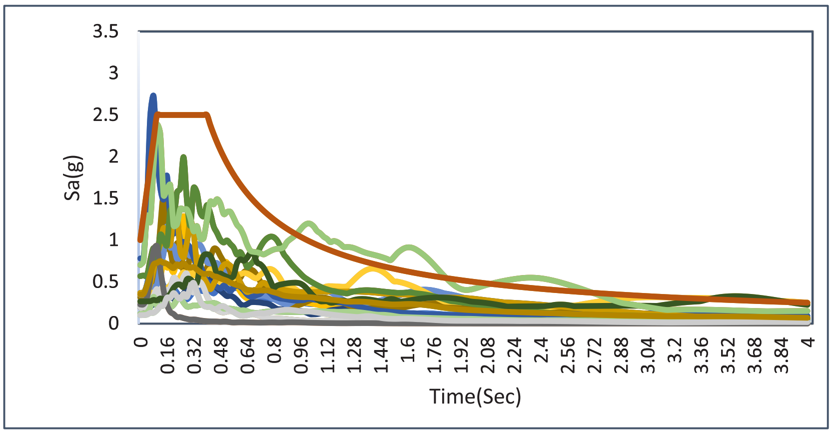



***Figure 1 :*** Acceleration response spectrum of selected ground motions with 5% damping

## 5. Correlation analysis

A Pearson correlation seeks to create a line of best fit through data from two variables, and the Pearson correlation coefficient (r) reflects how far these data points are from this line of greatest fit. The correlation coefficient has a range of values from -1 to +1. where 1 represents total positive linear correlation, 0 represents no linear correlation, and 1 represents total negative linear correlation in the sciences, it is commonly utilized. The correlation coefficient is also known as the Pearson Product-Moment Correlation Coefficient. The sample value is called r, and the population value is called ρ (rho).

## 6. Result and discussion

The dynamic analysis of a concrete gravity dam is influenced by a number of seismic potential parameters. To achieve an accurate correlation with the structural performance of concrete gravity dams during earthquakes, it is critical to select an acceptable and comprehensive seismic potential parameter. Seven seismic potential parameters are analyzed using correlation analysis and fifteen ground motion records in this study. In general, these techniques are based on structural response criteria for concrete gravity dams. The most appropriate and significant seismic potential criterion for seismic safety assessment of concrete gravity dams is crest displacement and fracture length at base. The potential association of structure reaction with various seismic potential characteristics of diverse ground motions is investigated in this work. For various ground motions, the crest displacement and crack length at the base were measured and shown in Table 3.

***Table 3:*** Crest Displacement and Crack length at base obtained for different ground motion

| Sr.No. | Earthquake Name | Recording Station | Max. crest displacement (m) | Crack Length at Base (m) |
|---|---|---|---|---|
| 1 | Northridge (USA) | 090 CDMG STATION 24278 | 1.68346 | 58.07952 |
| 2 | Kobe (Japan) | KAKOGAWA(CUE90) | 1.27685 | 6.4532 |
| 3 | Loma Prieta (USA) | 090 CDMG STATION 47381 | 1.61371 | 8.87326 |
| 4 | Landers (USA) | 000 SCE STATION 24 | 1.66373 | 17.74652 |
| 5 | Chi-Chi (Taiwan) | TCU045 | 0.291973 | 12.099 |
| 6 | Friuli (Italy) | TOLMEZZO(000) | 0.110968 | 0 |
| 7 | Hollister (USA) | USGS STATION 1028 | 1.51279 | 8.0666 |
| 8 | Imperial Valley (USA) | USGS STATION 5115 | 1.5279 | 8.0666 |
| 9 | Kocaeli (Turkey) | YARIMCA(KOERI330) | 1.25469 | 64.5328 |
| 10 | Trinidad (USA) | 090 CDMG STATION 1498 | 0.116813 | 0 |
| 11 | Kern County | LA - Hollywood Stor FF | 0.309479 | 8.0666 |
| 12 | Imperial Valley-02 | El Centro Array #9 | 0.110772 | 0 |
| 13 | Northern Calif-03 | Ferndale City Hall | 0.893344 | 59.69284 |
| 14 | El Alamo | El Centro Array #9 | 0.167932 | 0 |
| 15 | Borrego Mtn | El Centro Array #9 | 0.285681 | 8.0666 |

### 6.1. Crest displacement correlated with seismic potential parameters

Critical seismic potential parameter which showed relatively higher linear correlation with seismic response of concrete gravity dam on the basis of Pearson product-moment correlation coefficient are Shown in Figure.3.

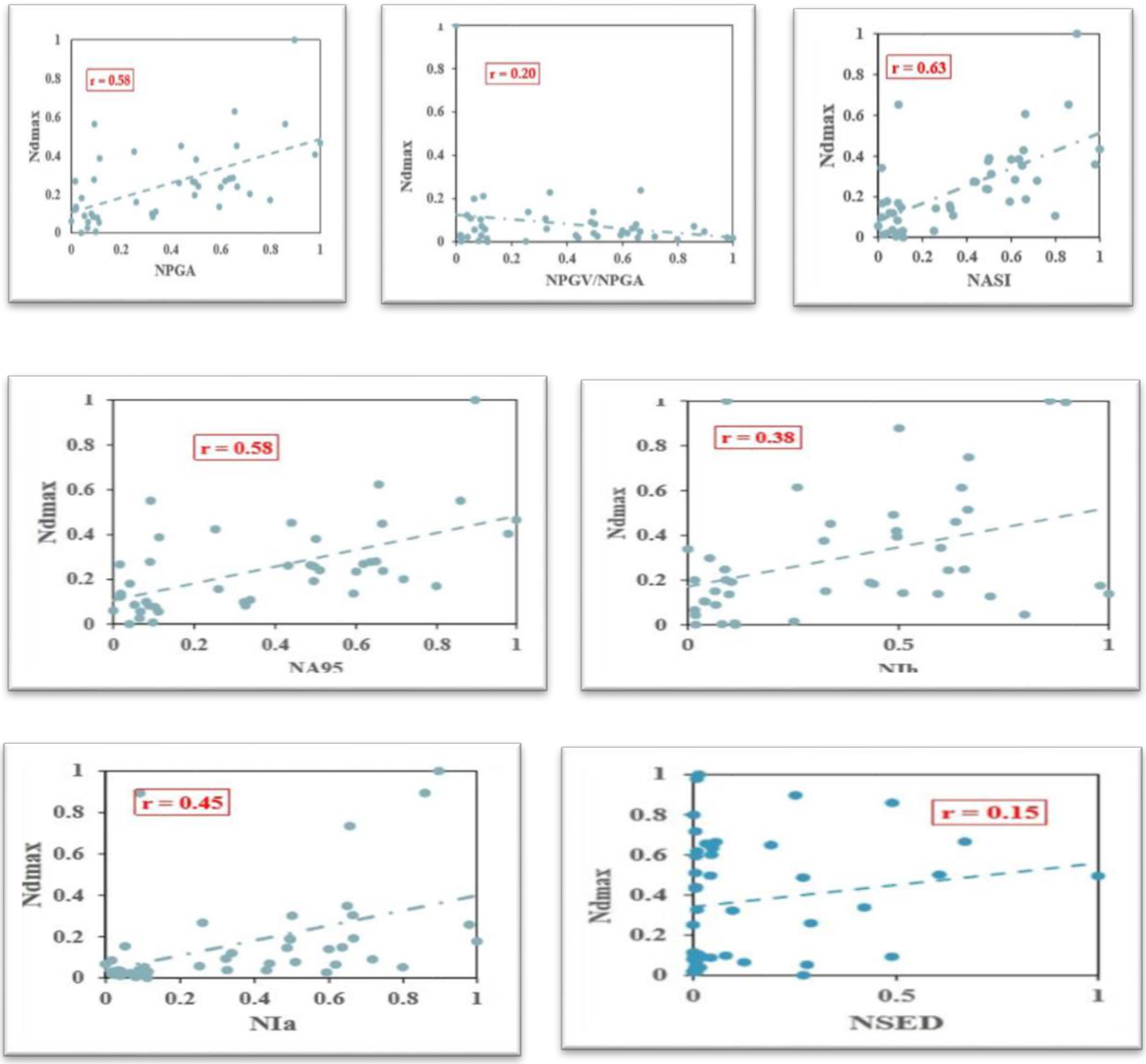



***Figure 2 :*** Pearson correlation coefficient corresponding various seismic potential parameter

### 6.2. Correlation between crack length and various seismic potential parameter

Crack length at base ,we chose as a structural response of concrete gravity dam. Pearson product-moment correlation coefficient obtained for which seismic potential parameter highly correlated with crest displacement.After Screening out of three critical seismic potential parameters with crest displacement as Shown in Figure.4.

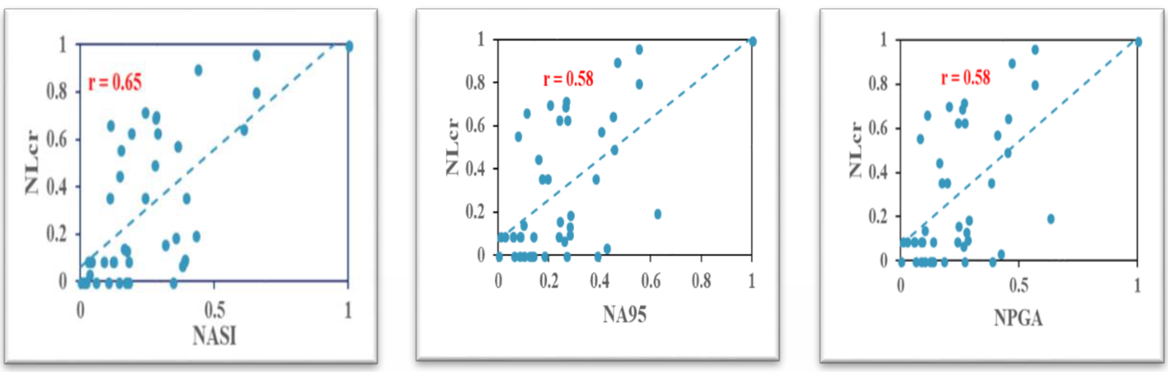



***Figure 3:*** Pearson correlation coefficient corresponding various seismic potential parameter

## 7. Conclusions and recommendations

The investigation is carried out on a conventional concrete gravity dam to determine its seismic safety using correlation analysis. The following are the study's principal findings.

- This work presents a methodology for seismic safety assessment of concrete gravity dams based on seismic potential characteristics and structural performance of concrete gravity dams.
- The Pearson product-moment correlation coefficient has been used to express the degree of association between seismic Potential characteristics and seismic reaction of concrete dam.
- The majority of the acceleration-based parameters (PGA, ASI, A95,) are fairly well correlated with the structural performance of concrete gravity dams. The Pearson correlation grade that corresponded to it was high.
- The seismic potential parameter (Ia,) has a medium correlation with the structural performance of the concrete gravity dam, while the seismic potential parameter (PGV/PGA, SED,) has a low correlation.
- All of these findings led to the conclusion that acceleration-based parameters are reliable descriptors of seismic damage potential and that they should be used as seismic potential descriptors for concrete gravity dams.

***Thrive 2.0 Technical Fest-2024 of CED organized by ASCE***

*Department visit to Germany (June 2024)*

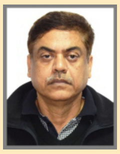

*Visit of German delegation to the department (September 2024)*

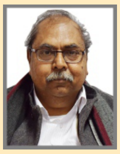
*Delegates of Erfurt university Germany meeting with JMI professors*


*Workshop on Analysis and Design of Bridges (04/05/2024)*

# FACULTY / EXPERTISE


**Dr. Farhan Ahmad Kidwai**
Professor & HoD
Transportation Engineering


**Dr. Khalid Moin**
Professor
Structural Engineering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Professor
Water Resources Engineering


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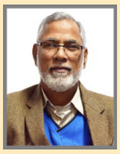
Professor
Engineering Geology


**Dr. Shamshad Ahmed**
Professor
Remote Sensing & GIS


**Dr. Nazrul Islam**
Professor
Structural Engineering


**Dr. Quamrul Hassan**
Professor
Water Resources Engineering


**Dr. Mohammad Sharif**
Professor
Water Resources Engineering


**Dr. Syed Mohammad Abbas**
Professor
Geotechnical Engineering


**Dr. Asif Husain**
Professor
Structural Engineering


**Dr. Naved Ahsan**
Professor
Environmental Engineering


**Dr. Kafeel Ahmad**
Professor
Environmental Engineering


**Dr. Azhar Husain**
Professor
Water Resources Engineering


**Dr. Akil Ahmed**
Professor
Structural Engineering


**Mr. Ziauddin Ahmad**
Associate Professor
Soil Mechanics


**Dr. Sayed Mohammad Muddassir**
Associate Professor
Urban Planning


**Dr. Syed Shakil Afsar**
Assistant Professor
Environmental Engineering


**Dr. Mohammad Umair**
Assistant Professor
Structural Engineering

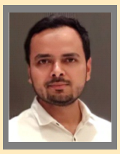

**Dr. Abid Ali Khan**
Assistant Professor
Environmental Engineering


**Dr. Ibadur Rahman**
Assistant Professor
Structural Engineering

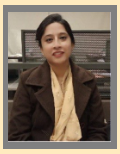
## CONTRACTUAL FACULTY


**Dr. Md. Imteyaz Ansari**
Assistant Professor
Structural Engineering


**Dr Nabeel Ahmad Khan**
Assistant Professor
Structural Engineering


**Dr. Mohd. Aamir Mazhar**
Assistant Professor
Environmental Engineering

## GUEST FACULTY


**Dr. Saba Shamim**
Guest Faculty
Structural Engineering


**Dr. Adnan Mateen Qadri**
Guest Faculty
Environmental Engineering


**Dr. Md. Arif Faridi**
Guest Faculty
Structural Engineering

# Vision of the Department

To emerge as centre of excellence for education and research in civil engineering and to produce professionally competent and ethically sound engineers of global standards, ready to serve the community and the nation with dedication.

# Mission of the Department

**M1** To provide rigorous hands-on civil engineering education through learner centric teaching pedagogy.

**M2** To establish state-of-the art facilities for teaching and research in civil engineering domain.

**M3** To motivate students to develop low-cost and sustainable ethical solutions to problems faced by the society.

**M4** To provide opportunities to students to enable them to develop leadership and interpersonal skills.

# Program Educational Objectives

**PEO 1** The graduates shall demonstrate the ability to use professional skills including software tools and computational methodologies for the analysis, design, and management of infrastructure projects.

**PEO 2** The graduates shall practice high ethical values and effective communication skills so as to participate as a member of a multidisciplinary team working on various projects.

**PEO 3** The graduates shall continue lifelong learning and take up leadership roles in professional and entrepreneurial settings.



## Department of Civil Engineering

**Faculty of Engineering & Technology**
**Jamia Millia Islamia, New Delhi - 110025**
**Tel: 011-26985227**
**Email: civil@jmi.ac.in**