JAMIA MILLIA ISLAMIA

Jamia was established in 1920 by a group of nationalist Muslim intelligentsia at Aligarh, Uttar Pradesh during the khilafat and Non-Cooperation Movement in response to Gandhiji's cell to boycott government-supported educational institutions. Among those who enthusiastically responded to this call were Shaikhul Hind Maulana Mahmud Hasan, Maulana Mohammed Ali Jauhar, Hakin Ajmal Khan, Dr. Mukhtar Ahmad Ansari, Abdul Majeed Khwaja and Dr. Zakir Husain and others. In 1925, its campus shifted from Aligarh to Delhi and the foundation stone of the present campus was laid on 1st March 1930. Since then, it has been continuously growing, always refurbishing its methods and branching out from time to time to meet new needs. True to the ideals of its founders, it has, over the years, tried to enhance the physical and mental development of its students, and has become known as a premier educational institution of the country. Recognizing its contributions in the field of teaching, research and extension work Jamia Millia Islamia was declared a Deemed University under Section 2 of University Grants Commission (UGC) Act in 1962. Jamia was declared a Central University, as per Jamia Millia Islamia Act 1988, which was passed by the Parliament on 26th December 1988.

Jamia Millia Islamia is an ensemble of a multi layered educational system which covers all aspects of schooling, undergraduate and postgraduate education and research. The University recognizes that teaching and research are complementary activities that can advance its long-term interests. It has Natural Sciences, Social Sciences, Engineering & Technology, Education, Humanities & Languages, Architecture & Ekistics, Fine Arts, Law and Dentistry Faculties. It also has the well-known Centre namely the AJK Mass Communication Research Centre besides several other research Centers that have given an edge to Jamia in terms of critical research and programmes that can offer opportunities to its students and teachers to expand the horizons. Jamia Millia Islamia conducts Undergraduate, Postgraduate, M. Phil. and Ph.D. as well as Diploma and Certificate courses.

Jamia Millia Islamia has been declared a "Minority Institution" by National Commission for Minority Educational Institutions on February 22, 2011 under Article 30 (1) of the Constitution of India read with Section 2 (G) of the National Commission for Minorites Institutions Act.

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

JAMIA MILLIA ISLAMIA
(Central University)
Maulana Mohammad Ali Jauhar Marg, New Delhi-110025
(ACCREDITED "A" GRADE BY NAAC)

جامعه مليه اسلاميه
(مرکزی یونیورسٹی)
مولانا محمد علی جوہر مارگ، نئی دہلی ۔۱۱۰۰۲۵

Tel. : 011 - 26984650, 26985180, Fax : 0091-11-26981232 | Email: vc@jmi.ac.in | Web: jmi.ac.in

प्रोफेसर नजमा अख़्तर
कुलपति

Professor Najma Akhtar
Vice Chancellor

پروفیسر نجمه اختر
شيخ الجامعه

Vice Chancellor's Message

It gives me immense pleasure to present, TA'MEER, a magazine brought out by Department of Civil Engineering, Jamia Millia Islamia. It opens a window of opportunity for the students to express their creativity, perceptions, innovations and scholarly appreciation of innovative activities and works, enumerating the impressive strides made by Department of Civil Engineering. It aspires to showcase the latest growth, development and innovations, engaging the students pursuing their curriculum, researches and investigations, reflecting the ethos and aspirations of Department of Civil Engineering, its students and faculty members.

With its spectacular performance in NIRF Rankings, Jamia Millia Islamia figures among top six Universities of India. It has been providing accessible and affordable quality education since its inception. Committed to delivering the best experiential education and keeping abreast of changing trends and paradigm shift in pedagogy, technology and innovation, it fosters creativity, inspires critical thinking and pursuit of excellence.

I congratulate the Head, Department of Civil Engineering, the Editor, editorial team, students and faculty members on bringing out such a wonderful issue of TA'MEER.

Wishing a resounding success!

Najma Akhtar

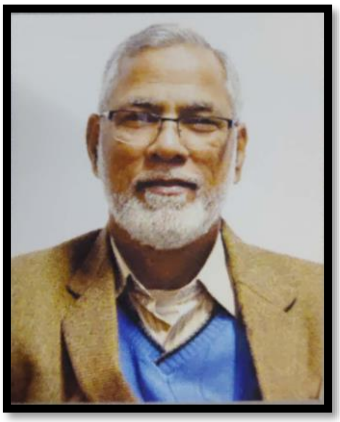
(Prof Najma Akhtar)

Message from Dean

Prof. Ibraheem

Nurturing creativity and inspiring innovation are two of the key elements of a successful education, and a civil engineering department magazine is the perfect amalgamation of both. It gives me great pleasure to know that ‘TAMEER’ is a college magazine of 2020 is ready for publication. The Title of the magazine 'TAMEER' may seem difficult; but it just means "to construct"; a clear vision of civil engineers.

I take this opportunity to congratulate the editorial board for bringing out this magazine as per schedule, which in itself is an achievement considering the effort and time required. May all our students soar high in uncharted skies and bring glory to the world and their profession with the wings of education.



Message from Head of Department

Prof. Shamshad Ahmad

To encourage creativity and innovation among the students has always been a foremost objective of the department. The departmental magazine provides the students a platform to share their creative ideas in the form of articles with fellow students and faculty members. Tameer, the departmental magazine of students, has gained popularity among the students and faculty because of its thought provoking and analytical articles.

I convey my best wishes for the current issue of Tameer. I also congratulate the editorial board of Tameer for publishing the magazine for last four years on a regular basis.

Message from Editor

Prof. Nazrul Islam

It gives me immense pleasure to present fourth 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" 2020. A special thanks to honorable vice chancellor and Jamia administration for their encouragement and support. Also, I would like to thank all my research scholars and my colleagues.

About Civil Engineering Department

Department of Civil Engineering the Department of Civil Engineering (DCE) offers two undergraduate courses in Civil Engineering and Master's program with specializations in Environmental Engineering and Earthquake Engineering. More than 80 Ph. D. scholars including foreign students from different countries are currently working in the Department on emerging research areas. DCE also renders technical advice to various Government and Private Sector companies on consultancy basis. DCE has many collaboration programs with foreign universities including University of Applied Sciences, Erfurt, Germany; Wessex Institute, UK; University of Waterloo, Canada; Asian Institute of Technology, Bangkok. DCE regularly organizes international and national conferences, seminars and workshops on current themes. This international conference is a sequel to the earlier conferences held on the themes of sustainability and development and is an endeavor of the DCE to focus on the emerging areas of smart city development.

Today, Jamia Millia Islamia is "A" grade Central University accredited by NAAC. Jamia Millia Islamia Continues to cater to the interests of students from all communities, but also aims to meet the particular needs of the disadvantaged sections of the Muslim society. True to the legacy of its founders, it continues to support measures for affirmative action and foster the goals of building a secular and modern system of integrated education.

The Leaning Tower of Pisa: A Structural Failure

Shreeja Kacker

The Leaning Tower of Pisa, Italy was constructed in 1173 AD at the heart of the city's cathedral called "Piazza dei Miracoli" or the Square of Miracles, as a bell tower called the "Campanile".

The tower, with a projected height of 58m and 7 levels, was intended to be round with a base 16m in diameter. However, in 1178 AD, by the time the third floor was completed, it was observed that the tower was leaning slightly to the northwest. The work was stopped and resumed over the next few centuries, due to the increasing tilt of the tower, till it was finally completed in 1372 AD. Figure 1 shows the Leaning Tower of Pisa.

However, in spite of all constructional measures taken to overcome the tilt including the designing of the upper stories in such a way that they had one side slightly taller than the other, it was observed in the 16th century, that the tower continued to lean and was 3° off the vertical.

In the year 1911, a group of structural engineers studied the lean of the building and realized that the tower continued tilting at the rate of 0.05 inch per year towards the South. In the year 1934, Mussolini, the dictator, thought that the tilt was an insult to his Fascist ideology, and tried to fix the problem by injecting 200 tonnes of concrete under the foundation. This worsened the problem and by 1989, the tower had tilted by 5.5°. The area was evacuated, the building was closed to visitors and a team of expert engineers was put together to study the structure.

Figure 1: The Leaning Tower of Pisa

A Structural Study of the Tower

In order to understand the structural failure, the engineers first studied the root cause. The leaning of the tower was caused by the differential settling of the foundation of the structure, in the soft ground.

The foundation of the tower was built on soil having alternate layers of sand, clay and silts from Arno and Serchio rivers that surround the city of Pisa, which resulted in a poor bearing capacity and high compressibility of the soil. Figure 2 below shows the different layers of soil beneath the tower structure.

Furthermore, due to weather fluctuations, the depth of water table changes continuously. It was observed that the water level increased more on the northern side of the tower, leading to higher settlement towards the southern side.

However, the reason why the tower never completely fell over was because the construction was stopped and resumed over long periods of time. These delays gave the structure time to settle and the soil to get compacted.

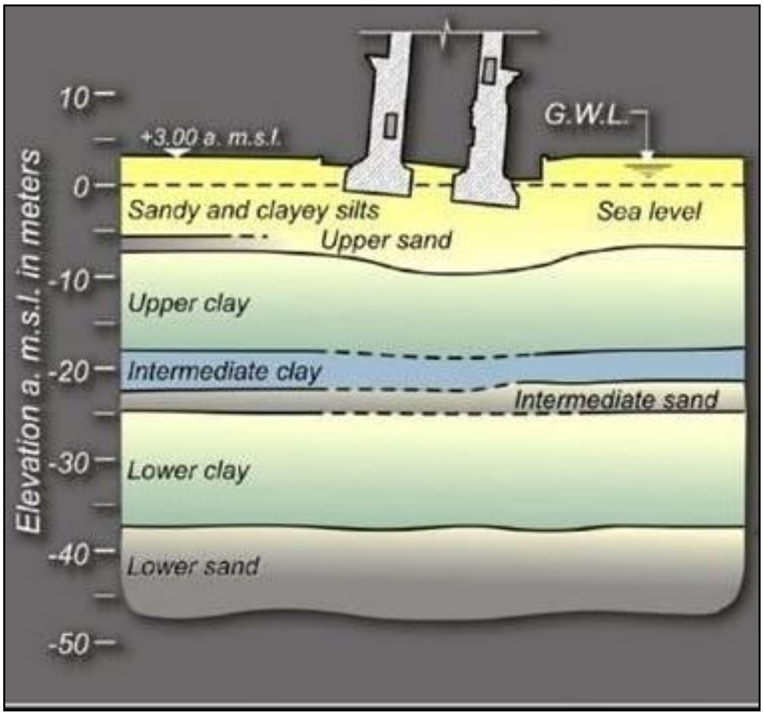


Figure 2: Layers of Soil below the Leaning Tower of Pisa

Remedial Measures for Stabilization

John Burland, a soil mechanics specialist, suggested that removing soil from under the structure's foundation at the northern side might help reduce the tilt. After carrying out various numerical and computational analyses, the team decided that this strategy could be safely adopted. However, to prevent the structure from collapsing while the work was carried out, various temporary measures were taken.

The tower was subject to two main failures: firstly, the structural failure of the fragile masonry, and secondly, the collapse due to breaking-up of the subsoil around the foundations. The following measures were taken to prevent these failures:

In order to support the masonry, steel bands were wrapped around the first floor of the tower.

To counter-balance the weight of the structure leaning towards the southern side, 827 tons of lead weights were placed on the northern side of the tower.

A concrete ring was then placed at the third level and was connected to heavy steel cables anchored in the ground to keep the structure from any further movement in the southern direction.

Lastly, the 7 massive bells that were housed in the tower were removed to decrease the total load on the structure.

A hole at an angle was then drilled under the northern side of the tower to remove some earth from underneath it.

This procedure was followed over a number of years and the tilt kept reducing. A total of 41 holes were made and 77 tons of soil was removed, causing the tower to move backwards to a more stable position.

These remedial measures can be seen in Figure 3. By 2001, the tower had the same lean that it had in the 1930's and it was safe to be opened to the visitors.

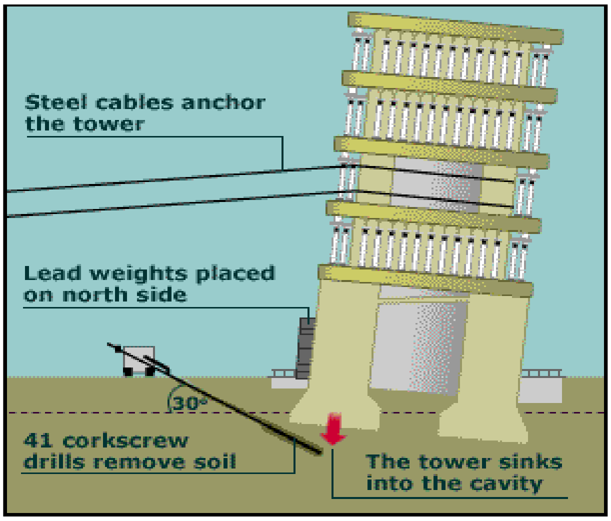


Figure 3: Remedial Measures for Structural Stabilization

It was never intended to straighten the tower completely, and hence it still leans about 4° from the vertical. It is however, believed to be safe for centuries. The cables and other temporary measures were removed.

UNESCO World Heritage Site

In 1987, the tower was declared UNESCO World Heritage Site and was also called one of the Seven Wonders of the Medieval World. This was particularly because even though the area around Pisa was prone to earthquakes, the tower withstood more than four major earthquakes.

Professor George Mylonakis, University of Bristol, suggested that it was because the same soil which was a cause for the tilting of the tower was also responsible for preventing its seismic failure. The stiffness of the tower combined with the softness of the soil prevented the seismic waves from resonating into the structure during an earthquake, thereby protecting it from damage.

From the study of the Leaning Tower of Pisa, the following leanings can be acquired:

The foundation of the structure is its most important part. When building a structure over soft soils, it may be necessary to excavate down past the soft strata and place a deeper footing on hard soil with adequate bearing capacity. Build a larger footing and reinforce it with additional steel.

Preferably construct an end load bearing pile foundation or friction pile foundation for deep foundations.

Compact the ground thoroughly before carrying out any construction.

Influence of Traffic Loadings on the Seismic Reliability of Highway Bridge

Mohd Bilal Khan

In recent years traffic volume on the roads has significantly increased. Traffic load on the bridge has a stochastic nature hence to predict an exact loading on a bridge is almost impossible. Traffic load is a moving load hence it is important to understand dynamic behaviour and possible effects from moving vehicles. The dynamic load is time varying and depend on various criteria like: vehicle type, vehicle weight, axle configuration, bridge material, bridge span length, road roughness and transverse position of the truck on the bridge. Research on the dynamic response of bridges due to moving loads has received considerable attention in recent years.

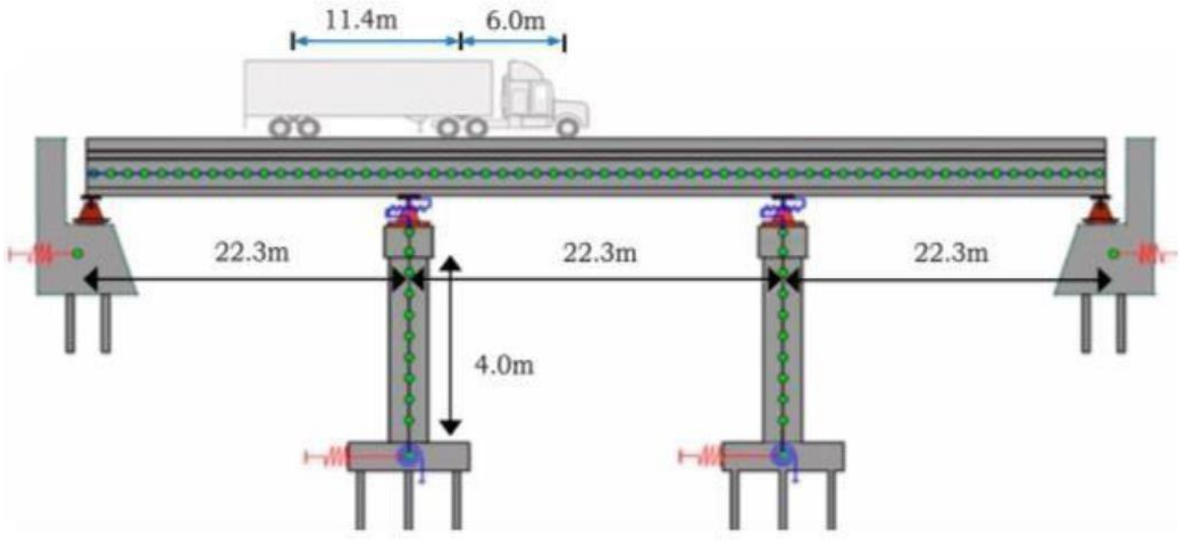


Figure 1 (http://creativecommons.org/licenses/by-sa/3.0/ deed.en)

The first research concentrated on the development of analytical solutions for simple cases of mobile forces. Dynamic vehicle load will bring bridges a greater effect on structural stress and deformation compared with the static vehicle load, and this response amplification phenomenon of stress and deformation caused by vehicle dynamic load is called the impact effect. In recent decades, seismic analysis of highway bridge structures has emerged as a powerful tool for vulnerability assessment of bridges located in earthquake-prone regions. The functionality of highway bridges is threatened by a range of stressors including natural hazards, such as earthquakes, aging, deterioration, and demands from heightened traffic loads. Traditionally, seismic fragility models for highway bridges investigate the impact of the ground motion hazard alone on bridge-component and system-level vulnerability. Only recently have researchers extended this notion to vulnerability assessments of bridges under joint threats or multiple hazards.

When the earthquake hits the bridge structure causing damage to the structure leading to the problem of traffic progression . In recent years there was an exploration of dynamic loading due to moving loads but there were no studies of how to solve the problems of traffic progression due to earthquake damage to the bridge .Very clear example of those challenges is the assessment of the damage state which is imposed on the structure after earthquakes of different intensity. Existing researches have analyzed the dynamic response of under vehicle dynamic load considering road roughness and vehicle velocity, and the variation rule of vehicle load caused by structural parameters of bridge and vehicle speed has been investigated as well. In order to determine the operability of the structure, traffic and its resistance to earthquake, a thorough knowledge is required.

Many studies and researches have been performed for estimating the risk level of structures in the past few years. For characterizing the damage in a structure or of a region, the relationship between earthquake ground motion severity and structural damage are very well used. I have a strong interest in exploring how to ensure serviceability of the traffic progression due to seismic response of a bridge under dynamic loading through adaptation of appropriate actions.

GENERAL DESIGN PROVISIONS

Basic Design Principles

The superstructure, substructure- piers and abutments, bearings, expansion joints, backfill in abutments, bridge approach, foundation and founding soil are vulnerable to damage due to vibratory effects of earthquake motion. The earthquake resistant design measures shall consider these effects on the bridge components arising due to three orthogonal components of ground motions in order to minimize damage. In this section 'Basic Design Principles' for seismic design of various bridge components are laid down.

Seismic Design Aspects

Strength, ductility and energy dissipation

The beneficial effect of bridge flexibility, damping characteristics, energy dissipation and isolation by using seismic protection /isolation devices and ductility in seismic response reduction should be duly accounted in seismic analysis and design.

The seismic design of the bridge is achieved by providing adequate strength and ductility in the members resisting seismic action under design earthquake motion. The horizontal strength and stiffness of substructure should not vary significantly along the bridge length. The likely location of plastic hinge regions in the event of major earthquakes should be pre identified.

Unless external seismic isolation /protection devices are used to reduce the seismic demand on structure, the majority of energy dissipation in the structure takes place due to inelastic action in plastic hinges occurring in major earthquakes. The ductility provisions in plastic hinge regions should therefore be ensured as required by seismic codes.

The capacity protected regions of substructure/foundation can be designed elastically without ductility provisions.

Capacity Design

Force demands for essentially elastic components adjacent to ductile components should be determined by capacity-design principle, that is, joint-force equilibrium conditions; considering plastic hinge capacity at hinge location multiplied by over strength factor. The over strength factors should not be used where plastic hinges are not likely to be formed. Force demands calculated from linear elastic analysis should not be used in capacity protected regions.

Over strength Factor

The over strength factor is a multiplying factor to plastic moment capacity at hinge location. This factor represents various sources of over strength such as unintentional increase in material properties, post-yield strain hardening, rounding off dimension of members and providing excess reinforcement than required.

Ductility Capacity and Demand

The global displacement capacity of structure should not be less than the estimated displacement demands under a design earthquake and local displacement capacity of its individual members. The ductility capacity should be greater than ductility demand.

Design Provisions

Superstructure

i. The superstructures with simply supported spans on bearings are vulnerable to damage because these are prone to being unseated or toppled from their supporting sub-structures due to either shaking or differential support movement associated with ground motion. In such cases, provision such as larger seat widths, using unseating prevention devices, holding-down devices or interlinking of spans by linkages should be made to prevent spans dislodgement off their supports. ii. The superstructure should remain elastic even when the plastic hinge location in columns/piers reach their plastic moment capacity.

iii. In order to ensure elastic behaviour in superstructure capacity design principle shall be adopted.

Substructure

Plastic hinges should develop in columns rather than in capping beams or superstructures under seismic conditions. The locations of potential plastic hinges in piers should be pre-selected so as to ensure their accessibility for inspection and repair.

The shear failure in columns should be avoided by ductile design and detailing practice. The pier shall be capable of resisting shear corresponding to over strength plastic moment developed in plastic hinge region. This shall be ensured by ductile design and detailing practices.

The number of piers and abutments that will resist seismic force in longitudinal or transverse directions should be pre-selected

Bearings and Expansion Joints

The inertia forces generated on superstructure due to seismic effects should preferably be transferred to piers/abutments through fixed bearings capable of withstanding horizontal loads.

Wherever the fixed bearings are used, they shall be designed for the design seismic action determined through capacity design. Alternatively, linkages shall be used to withstand seismic action.

The out of phase motion between two piers due to various causes such as different soil properties under pier foundations, wave travel time effect in longer spans and different stiffness of piers due to unequal heights or cross- sectional dimensions shall be considered in working out design seismic displacement in bearings & expansion joints.

Wherever movable bearings are used, they shall allow seismic displacements due to possible out of phase motion of piers. Additionally, these bearings should be provided with displacement limiting devices such as stoppers, linkages etc. Wherever the elastomeric bearings are used, these bearing shall accommodate imposed deformations and normally resist only non-seismic actions. The resistance to seismic action is provided by structural connections of the deck to piers or abutments through suitable means.

In case, in-plane horizontal seismic forces are to be transmitted using these elastomeric bearings, they shall be checked using minimum dynamic frictional value and minimum vertical loads, including combined effect of vertical and horizontal components of earthquake. In such cases suitable devices for preventing dislodgement of superstructure shall be provided.

Foundation

i. Force demands on foundations should be based on capacity design principle that is, plastic capacity of bases of columns/piers multiplied with an appropriate over strength factor. Foundation elements should be designed to remain essentially elastic. Pile foundations may experience limited inelastic deformations; in such cases these should be designed and detailed for ductile behaviour.

ii. In case of well and pile foundations, the foundations should be taken deeper into soil layers where liquefaction is not likely to occur.

CONCLUSION

It is likely that bridges are more fragile during a seismic event if traffic loading is considered. However, the increased fragility (reduced median PGA) can be small once the probabilities of truck presences and GVWs are taken into account. Indeed, unless the sitespecific GVW distribution is significantly different from the present case study, even for high flow rates, the truck traffic does not have a significant effect on the seismic fragility. It should be noted that only one-truck presences are considered in this work, and the truck is considered to be positioned at the determined critical location for the duration of the earthquake. In reality, the Probability of the truck being at this location could also be considered, as well as other variables such as the duration of its traverse, the position of the truck at the time of arrival of the earthquake, the dynamic interaction of the moving truck with the bridge, and finally the height of the truck GVW above the bridge deck. Notwithstanding these possible refinements, the presented methodology provides a basis for incorporating the consideration of truck loads in the seismic fragility estimation of bridges. Further studies are required to explore the generalization of these conclusions to other bridge geometries and traffic loading conditions. Additionally, this framework can offer the basis for future investigation of reliability-based load factors for the case of combined earthquake and live loads by posing a method to compute the joint fragility for these event occurrences.

Vehicle-Bridge Interactions (VBI) in High-Speed Rail Corridors

Mirza Aamir Baig

It has been known for decades that vehicles and bridge interact dynamically and the dynamic response of the bridge during vehicular movement is more than the static response. The vehicle and bridge are two elastic systems which interact dynamically during vehicular movement through contact forces. The dynamic properties of vehicle and bridge such as modal frequency, damping and stiffness as well as velocity of the vehicle significantly affect the structural response of bridge during vehicular movement.

The conventional approach to bridge design for dynamic effects is based on amplifying the static effects on bridge by a factor called Dynamic Impact Factor (DIF). Most of the design codes of practice specify the value of DIF based on bridge length or first natural frequency of flexural mode of vibration of the bridge. In this approach, various parameters that affect the dynamic response of the bridge such as:

The Train speed across the bridge.

The span length of the bridge and its structural configuration.

The mass of the bridge structure.

The natural frequency of the entire structure.

The number of train axles, their loads and distribution.

The damping of the structure.

The suspension characteristics of the vehicle.

The vertical irregularities of the track.

The wheel defects.

The transport infrastructure is developing at a rapid pace throughout the world. In developing countries, new bridges are being constructed while in developed countries, repair and rehabilitation of existing bridges is being undertaken.

Currently, only developed countries like America, European countries, Japan, China and Far east countries are having high speed rail corridors. Whereas in current situation, high speed rail corridors are very much required in developing countries like India due to below benefits:

Increase in economic activity

Reduces Congestion and Boosts Productivity

Reduces the Nation’s Dependence on Foreign Oil

Expands Travel Choices and Improves Mobility

Due to above benefits, cost optimised structures are the need of the hour to meet the demand of evergrowing population. Therefore, it is required to develop complex bridge modelling to accurately predict dynamic response of bridges leading to cost optimisation of new bridges.

Dynamic Impact Factors (DIF) specified in various design codes may not be accurately able to forecast the maximum dynamic response of the bridge especially different type of bridges with various types of trains. Hence, it is imperative to conduct a detailed structural analysis on such bridges to precisely understand its response to moving loads.

The dynamic response of a various types of bridges under high-speed trains currently being used in India for high-speed rail projects like RRTS (Delhi to Meerut and other corridors) and High-speed rail project from Mumbai to Ahmedabad to accurately assess the VBI effects in bridges under the effect of different governing factors (vehicle speed, vehicle load, bridge superstructure type, etc). This study could be beneficial in upcoming projects of high-speed rail as it is our future need.

Mumbai-Ahmadabad proposed corridor Delhi to Jammu proposed corridor

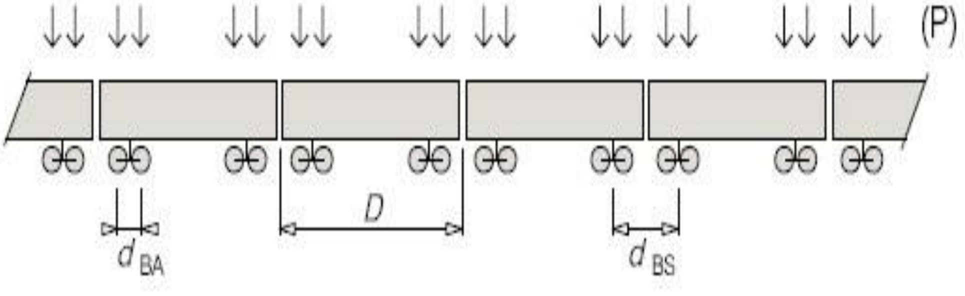
1.2 Codal Provisions for Dynamic Impact Factor General

The various codal provisions for evaluating dynamic impact factor (DIF) of bridges in highspeed rail corridors. Due to presence of significant number of high-speed rail corridors in Europe, most widely codes are European codes.

Before elaborating the codal provisions of European code, we first need to understand about the need of Dynamic analysis.

1.2.1 What is Dynamic Phenomenon?

We know that at lower speeds, structural deformation of the bridge due to moving live load is quite similar to static deformation due to live load. However, as train crosses a bridge at a certain speed, the deck will deform as a result of excitation generated by the moving load. At higher speed, deformation of structure exceeds as compared to static deformation due to regular excitation generated by evenly spaced axial loads.



1.2.2 Why is it Required?

In 1995 the problem was found in the high-speed lines in EUROPE, in particular high vertical acceleration was observed which cause discomfort to passengers in train. Therefore, dynamic analysis is required to control and assess the following:

To control excessive high vertical acceleration.

To avoid matching of structural frequency with natural frequency (Resonance).

Under the loads of high speed, the bridges are subjected to high dynamic impact and they should be designed accordingly.

In Indian context, our Railway design code i.e., IRS bridge rule does not provide Impact factor for speed more than 160km/h for BG and 100km/h for MG. Therefore, for trains having speed more than that we need to refer international codes to evaluate dynamic effects. As per Euro code, dynamic analysis is required for below conditions:

As per EURO Code maximum line speed at site > 200km/h

Frequent operating speed of a real train equal to resonant speed of the structure.

1.2.3 Codes for Dynamic Analysis

BS EN 1990:2002 - Basis of structure design

BS EN 1991-2:2003 - PART-2 traffic load on the bridges

NA to BS EN 1991-2:2003

UIC 776-2 - Design Requirement of rail-bridges based on interaction phenomena between train, track and bridge

1.3 Codal Provisions

Speed

Speed > 200km/h

In Dynamic analysis speed to be considered = 1.2 x maximum line speed at site.

Individual project may vary the definition of maximum line speed and it can be increased for future rolling stock.

For analysis Speed to be considered from 40m/sec (144km/h) to 1.2 times of maximum speed in the step of 5km/h to10km/h.

Spanish Code (IAPF 2007) indicates that calculations should be made from 20 km/h up to 1.2 times of maximum Line Speed with speed steps of 10 km/h.

Acceleration

In the first high speed line built in France (Paris & lyon) track deformation appeared due to high vertical acceleration. Usually, ballast starts to lose its integrity in ballasted track when acceleration is greater than 0.7g to 0.8g (Report ERRI-214, experiment done by SNCF and confirmed by UIC). Also, loss of wheel rail contact in ballast less track occurs when acceleration is greater than 1.0g.

Offshore Structures: A Challenge for Civil Engineers

Ali Hamza

Offshore platforms are subjected to variety of forces during their life period. To resists all kinds of forces, the structural elements should be designed properly to have safety and economy. In order to fulfil this purpose, the structure should be analyzed with great care.

As the improvement of oil and gas moves into more profound water, in any case, taller stages with longer periods are fabricated that react all the more powerfully to extraordinary waves. Expectation of the dynamic reaction of such structures in extraordinary ocean states is in this way an essential plan thought. Standard waves have all their vitality lumped at a couple of particular frequencies and can, in this manner, cause wrong powerful enhancements, particularly if these frequencies happen to be near the regular frequencies of the structure. In any case, waves in the ocean are exceptionally sporadic and can be best depicted as directional range, which indicates the appropriation of wave vitality as for recurrence and heading, and is most appropriate for the examination of structure in recurrence space technique. For this situation the nonlinear drag is linearized and utilized in the Morison's condition. This guess is proper for the littler, operational sort waves considered in weariness counts, in light of the fact that the powers because of these waves are overwhelmed by the direct idleness part. Various kinds of investigations related with the coat stage ought to be performed to figure the reaction of the structure and measurement the components of the structure. Here an endeavor has been made to complete various examinations to comprehend the dynamic conduct of coat stages subject to different stacking conditions in various ecological conditions. Coat set up investigation was performed, both static and dynamic hypothetically fixed base stage.

With the ongoing imaginative thoughts of investigation utilizing programming, it is presently simpler for the seaward architects to do disentangled and sensible assessment of the static operational and extreme point of confinement state qualities of format or coat stages, which are exposed to different ecological conditions. The essential auxiliary parts of coat type seaward structures including topsides, coat, heaps and the encompassing soil are viewed as utilizing SACS programming various types of investigations identified with coat stage according to API code prerequisite.

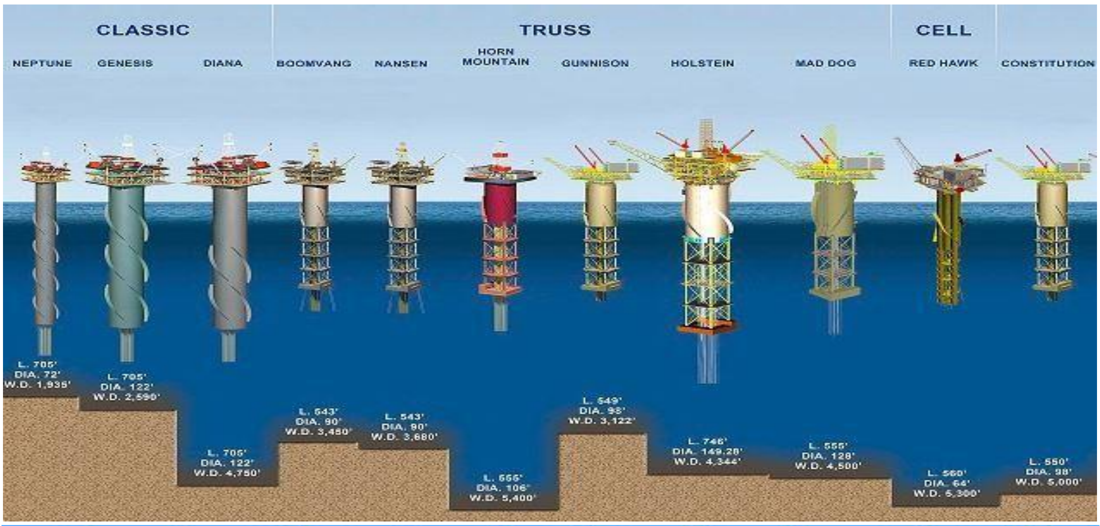
Offshore platforms have numerous utilizations including oil investigation and generation, route, deliver stacking and emptying, and to help scaffolds and thoroughfares. Seaward oil generation is one of the most unmistakable of these applications and speaks to a huge test to the plan engineer. These seaward structures must capacity securely for plan lifetimes of twenty years or more and are liable to exceptionally brutal marine conditions. Some significant plan contemplations are pinnacle burdens made by tropical storm wind and waves, weakness burdens created by waves over the stage lifetime and the movement of the stage. The stages are once in a while exposed to solid flows which make stacks on the securing framework and can instigate vortex shedding. Seaward stages are tremendous steel or solid structures utilized for the investigation and extraction of oil and gas from the world's hull. Seaward structures are intended for establishment in the vast ocean, lakes, inlets, and so forth., numerous kilometres from shorelines. These structures might be made of steel, strengthened cement or a blend of both. The seaward oil and gas stages are commonly made of different evaluations of steel, from gentle steel to high-quality steel, albeit a portion of the more established structures were made of fortified cement.

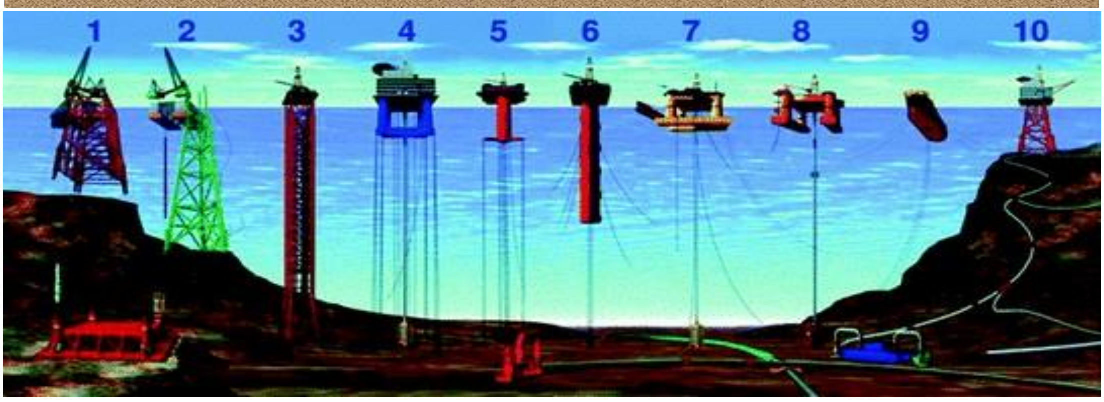
Inside the classification of steel stages, there are different sorts of structures, contingent upon their utilization and basically on the water profundity where they will work.

The oil and gas are isolated at the stage and shipped through pipelines or by tankers to shore.

The Increasing interest for vitality has driven people to look for oil and gas past its property bolted properties. Uncovering for oil in seaward regions has started for quite a long while. This industry depends on seaward structures as a component of their reality. Steel stages are one of the most widely recognized kinds of auxiliary frameworks at present utilized for oil abuse purposes. These structures are commonly intended to oppose ecological loads in particular, utilitarian loads and loads because of waves, flows, wind just as seismic tremor excitations.

Stage structures are generally used for different purposes including seaward boring, preparing and backing of seaward activities. Coat type structures are alluring in generally shallow water locales. A coat is a supporting structure for deck offices balanced out by leg heaps through the seabed. The size of a coat is reliant on deck size, heap measurements and ecological burdens.





Loads on offshore structures are gravity loads and environmental loads. Gravity loads are arising from dead weight of structure and facilities either permanent or temporary. Seismic loads are arising from gravity loads and is a derived type. Environmental loads play a major role governing the design of offshore structures. Before starting the design of any structure, prediction of environmental loads accurately is important. Various environmental loads acting on the offshore platform is listed below.

a. Gravity Loads - Structural Dead Loads, Facility Dead Loads, Fluid Loads, Live Loads and Drilling Loads

b. Environmental loads - Wind Loads, Wave Loads, Current Loads, Buoyancy Loads, Ice Loads Mud Loads

c. Seismic Loads- Seismic response control of structure using Hybrid Tuned Mass & Magnetorheological dampers.

Seismic Response Control of Structure using Hybrid Tuned mass & Magnetorheological dampers

Mohd Parvez Alam

Earthquakes are occasional forces on structures that may occur during the lifetime of buildings. As seismic waves move through the ground, they create a series of vibrations. These movements are translated into dynamic loads or inertial forces that cause the ground and anything attached to it to vibrate in a complex manner. These inertial forces cause damage to buildings and other structures. In regions where seismicity is insignificant, the conventional design approach aims at the design of structural members in such a way that static (gravitational) and dynamic loads (such as wind load) are withstood elastically. However, if this design approach was to be followed in cases where seismic excitation had to be taken into account, this might lead to energy inefficient and economically unacceptable design solutions. Moreover, this strategy leads to higher masses and hence higher seismic forces. Therefore, alternative design concepts are often chosen. Control strategies focus on reducing the effect of earthquake instead of increasing the strength of members.

The control of structural vibrations produced by earthquake can be done by various means such as modifying rigidities, masses, damping, or shape, and by providing passive or active counter forces. To date, some methods of structural control have been used successfully and newly proposed methods offer the possibility of extending applications and improving efficiency.

The selection of a particular type of vibration control device is governed by a number of factors which include efficiency, compactness and weight, capital cost, operating cost, maintenance requirements and safety.

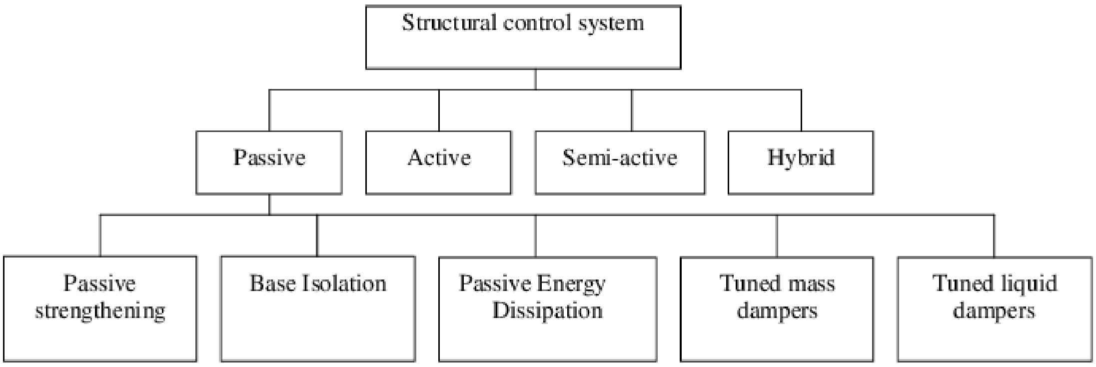


Figure 4 Rai, N. K., Reddy, G., Ramanujam, S., Venkatraj, V., & Agrawal, P. (2009).

Seismic Response Control Systems for Structures. Defence Science Journal, 59(3), 239-251. https://doi.org/10.14429/dsj.59.1517

2. TYPES OF DAMPERS ON STRUCTURAL BUILDINGS

1. Friction Dampers

The device proposed by Pall et al. (1980) for the seismic control of large-panelled structures joined brake pads between steel plates to provide a consistent response to force shifting. Friction dampers (FDs) generate the desired energy discharges via the friction produced by two solid bodies sliding relative to each other. This is a common process used in the engineering field. It can also be applied to seismic building structures. This friction can also be used, on a smaller scale, to absorb kinetic motion energy. As such, Pall et al. (1980) developed passive FDs to improve a structure's seismic responses. This was based on the resistance developed between two interfaces to remove a number of different input energies.

Figure 5 Saint Joseph Hospital, Patient Towers, Seattle, 40' Soft Story, Retrofitted with X-Brace PFDs

During seismic stimulation, the device was found to provide the desired amount of energy dissipation under a predetermined load. It was also found to be immune to thermal effects and have reliable performance and stable hysterical behaviour.

2.Tuned Mass Dampers

Tuned mass dampers (TMDs) are a type of passive device often used to control the response of buildings and bridges. A TMD consists of a mass–spring system attached to the main structure of a building or bridge and is usually installed on the roof of the structure to counteract the ground's motion to reduce the dynamic response of the structure. The dissipation of energy is achieved by the inertial damper forces acting on the structure. These systems are primarily efficient at controlling wind-generated vibrations in lean structures, such as towers and tall buildings. TMDs can be classified into three categories: tuned liquid dampers; TMDs; and tuned liquid column dampers.

Figure 3. Tuned mass damper applications: (a) 101-Taipei, Taipei—Taiwan; (b) Aspire Tower, Doha—Qatar; (c) Sanghai World Financial Center

3. Viscous Dampers

Fully active control systems apply both dissipative and non-dissipative forces to a structure. A properly designed fully active control system is capable of significantly increasing the damping in comparison with a passive system. However, controlling these devices requires a large amount of power and suffers from instabilities due to time delays. Moreover, these active systems will probably malfunction in the event of an electrical failure or damage as the control system ceases to operate and the damping device cannot change the system to a passive system. In this case, an active system provides a wider range of technologies.

3. MAGNETORHEOLOGICAL DAMPERS FOR STRUCTURAL BUILDINGS

Magnetorheological Fluids

When subjected to a magnetic field, magnetorheological fluids change their rheological behaviour in response to growing yield stresses. As such, MR fluids have great potential in the development of electromechanical devices as they provide a simple, responsive, quiet, and quick interface between mechanical and electronic control systems.

MR fluids were first discovered by Jacob Rabinow and have only grown in popularity since then. MR fluid is considered to be a multifunctional intelligent fluid as it can be rapidly modified and reversed in a short period of time (milliseconds) when a magnetic field is applied. In the absence of a magnetic field, MR fluids behave like Newtonian fluids. The magnetic field applied to MR fluids changes the arrangement of particles to form a chain-like shape. This chain-like shape modifies the fluid's rheological properties by drastically changing the value of the viscosity. This change in viscosity results in yield stress changes depending on the magnitude and direction of the applied magnetic field. The characterization of the rheological behaviour of these fluids occurs at two stages: pre-yield and post-yield.

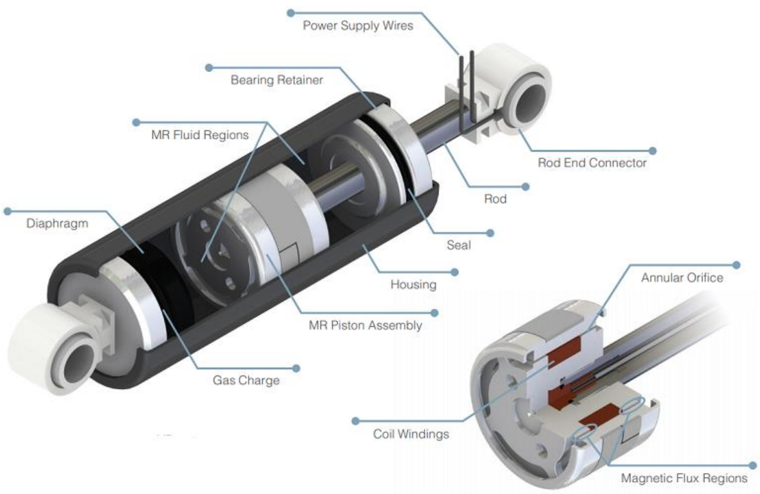


Figure43: A typical MR piston assembly (Courtesy of Maurer S¨ohne GmbH)

Due to the unique characteristics of MR fluids, the application of magnetic fields can dramatically change their rheological properties. MR fluids have been used to successfully develop various brake systems, dampers, and other devices. In most of these applications, the surface of the device is in contact with the MR fluid because it requires relative motion, such as linear motion in the case of shock absorbers, to operate. However, the surface of the device wears out more rapidly due to the abrasive nature of the iron particles in the MR fluid. As such, selecting the right surface material is essential to ensure high resistance to wear as well as durability.

The main components in a MR fluid formation are the carrier fluid, magnetic particles, and the additives. Carbonyl iron, with a purity of 99%, is often used to provide the magnetic particles due to its high magnetic permeability and magnetization saturation. Moreover, the chemical deposition of pentacarbonyl iron vapor produces carbonyl iron particles, which usually form into spheres, thereby reducing wear and tear on the walls of devices that use MR fluids. However, the findings of one study suggest that fiber particles provide better yield stresses with lower viscosities. In some applications, carbonyl iron particles range between 3 µm and 5 µm in size with particle concentrations between 20% and 40% depending on the volume. As such, the likelihood of wear from erosion and friction is nominal due to the particles' minute size.

Oils with low viscosity, such as silicone oil, mineral oil, and other synthetic oils, are used as carrier fluids as they are excellent at forming MR fluids due to their wide range of viscosity-changing objectives. However, the carrier liquid must be non-reactive with the iron particles. Silicone oil is often used as a carrier fluid in vibration control applications due to its high viscosity index, low vibration, high shear strength, and high flash point.

The additives used are usually surfactants that prevent agglomeration and reduce the deposition rate of the magnetic particles. This is essential as high-density particles tend to settle, which can render the device ineffective if left untreated. Additives such as oils, thixotropic agents, and Span® 80 and TWEEN® 80 emulsifiers are often used to improve the sedimentation stability, while organic acid and stearic acid are often used to increase the density of the carrier liquid and stabilize the sedimentation.

4. APPLICATION OF MR DAMPERS IN BUILDING STRUCTURES

Due to their superior quality, MR dampers are in high demand for use in scientific case studies and in several real-world industrial applications. Carlson and Weiss concluded that MR dampers provide good operating reliability as temperature fluctuations and impurities in the fluid did not affect the performance and functionality. However, a significant drawback was their nonlinear characteristics, which involve hysteresis (force vs. velocity and force vs. displacement). This makes accurately modelling MR dampers and developing an efficient algorithm for improved performance a challenge.Over the past 15 years, MR dampers have been widely used in a variety of fields for vi- bration control. These include, but are not limited to, building structures, bridges, suspension systems in automotive and high-speed trains, advanced artificial limb systems, large washing machines, landing gears for airplanes, commercial vehicle seats, complex mechanical systems, and rotor systems of helicopters. However, despite their many advantages, MR dampers are difficult to commercialize due to their complex structures and user-dependent configurations.

5. CONCLUSION

The MR damper is a smart semi-active device, which has some advantages over passive and active devices such as controllability of current supply to the damper, comparatively light weight, and low power consumption. The damper contains a smart fluid called MR fluid and works on different fluid flow modes. Various studies show that the MR damper is highly controllable in a manner that permits a designer to achieve different control objectives. Although Overcoming the limitation in the application because of a high cost mainly determined by MRF, a future damper should be operated in a way that a novel flow mode, miniature bypass valves, and dual hydraulic systems are concentrated on it. A very small amount of MRF is utilized to regulate a flow channel of conventional oil. Reducing the amount of MRF and a cost of itself, such excellent dampers will be widely accepted by more fields, thus promoting technical development further.

FACULTY / EXPERTISE

Dr. Shamshad Ahmed
Professor & HoD
Remote Sensing & GIS

Dr. Khalid Moin
Professor
Structural Engineering

Dr. Mehtab Alam
Professor & DSW
Structural Engineering

Dr. Mohammad Shakeel
Professor
Water Resources Engineering

Dr. Gauhar Mehmood
Professor
Engineering Geology

Dr. Farhan Ahmad Kidwai
Professor
Transportation Engineering

Dr. Nazrul Islam
Professor
Structural Engineering

Dr. Quamrul Hassan
Professor
Water Resources Engineering

Dr. Akil Ahmed
Associate Professor
Structural Engineering

Dr. Mohammed Umair
Assistant Professor
Structural Engineering

Dr. Ibadur Rehman
Assistant Professor
Structural Engineering

Mohd Izharuddin Ansari
Assistant Professor (Contractual)
Water Resources Engineering

Dr. Mohammad Sharif
Professor
Water Resources Engineering

Dr. Sirajuddin Ahmed
Professor
Environmental Engineering

Dr. Syed Mohammad Abbas
Professor
Geotechnical Engineering

Dr. Asif Husain
Professor
Structural Engineering

Dr. Naved Ahsan
Professor
Environmental Engineering

Dr. Azhar Husain
Professor
Water Resources 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. Abid Ali Khan
Assistant Professor
Environmental Engineering

Dr. Md. Imteyaz Ansari
Assistant Professor (Contractual)
Structural Engineering

Ms. Zoha Jafar
Assistant Professor (Contractual)
Structural Engineering