

SHAMSUDDIN PIASH

Mechanical Engineering Graduate | Bangladesh University of Engineering and Technology (BUET)

Specialization: Structural Mechanics · Functionally Graded Materials · Computational Optimization · FEA

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Education

Bangladesh University of Engineering and Technology (BUET)

Graduated: March 2025

Dhaka, Bangladesh

Bachelor of Science in Mechanical Engineering (Student ID: 1910125)

- **Core Coursework:** Solid Mechanics, Finite Element Analysis (FEA), Mechanical Vibrations, Fluid Mechanics, Heat Transfer, Machine Design I & II, Mechanics of Machinery, Metallurgy & Materials Science, Numerical Analysis, Thermodynamics.

Research Interests

- **Mechanics & Materials:** Functionally Graded Materials (FGM), Advanced Composite Structures, Solid Mechanics, Fracture Mechanics, Fatigue Analysis, Interfacial Stress & Shear Transfer.
- **Computational Modeling & Optimization:** Finite Element Analysis (FEA), Coupled Simulation, Mesh Refinement & Convergence, Multi-Objective Optimization, Physics-Informed ML (PIML), Lightweight Design.

Undergraduate Thesis & Research

Multi-Objective Optimization of Connecting Rods: A Coupled Thermal-Structural Approach

2024 – 2025

BUET

Undergraduate Thesis · Supervisor: Prof. Dr. Md. Afsar Ali, Dept. of Mechanical Engineering

- Modeled an industrial heavy-duty connecting rod (Wärtsilä 20 engine geometry) in **SolidWorks** and conducted coupled steady-state thermal and high-pressure mechanical FEA in **ANSYS Workbench** (82,500+ nodes, 29,500+ elements).
- Formulated and executed a multi-objective optimization framework via **Sum of Squared Errors (SSE)** minimization across **45 material configurations** incorporating structural steel (AISI 4340), aluminum alloy (Al 7075-T6), and titanium alloy (Ti-6Al-4V).
- Evaluated component mass, static factor of safety, fatigue factor of safety, and manufacturing cost to identify optimal bimaterial configurations delivering maximum strength-to-weight performance.
- Applied **Rule of Mixtures (ROM)** homogenization approximations and evaluated interfacial shear stress distributions across critical bimaterial transition zones under peak combustion compressive loadings.

Transition-Layer Design & Optimization of Functionally Graded Material (FGM) Connecting Rods

2024 – Present

BUET

Follow-up Research Project · Computational Structural Mechanics

- Designed an innovative **Functionally Graded Material (FGM) transition layer** (8.85 mm interface) connecting an Aluminum Alloy shank to Structural Steel bearing ends to eliminate abrupt interface stiffness jumps and delamination risk.
- Implemented and comparatively analyzed **5 spatial gradation laws** $V_1(x)$: Linear, Exponential ($\beta \in [0.2, 2.0]$), Sigmoid, Logarithmic, and Trigonometric ($V(x) = \frac{1}{2}[1 + \cos(\pi x/h)]$) volume fraction formulations.
- Quantified **10 distinct structural and fatigue performance metrics** in ANSYS FEA: equivalent von Mises stress, total deformation, elastic strain, strain energy, static safety factor, fatigue life, fatigue damage, fatigue safety factor, and biaxiality.
- Identified localized stiffness mismatch phenomena in stepped FGM layers and executed geometric fillet optimizations, achieving a **14.88% enhancement** in structural safety factor (5.29 vs. 4.61) through validated multi-layer stress convergence.

Scholarly Activity & Publications

Multi-Objective Structural and Material Optimization of Bimaterial Mechanical Components

Submitted 2025

ASME JMD

Co-Author · Submitted to ASME Journal of Mechanical Design (Under Review)

- **Authors:** Shamsuddin Piash, Md. Jahidul Hasan, Khan Yishtiaq Raatul, Dr. Md. Afsar Ali.
- Details coupled thermal-structural finite element formulation, interfacial shear analysis, and SSE multi-objective optimization algorithms for high-performance bimaterial engine structural components.

State-of-the-Art in Functionally Graded Material Gradation Laws and Computational Optimization

2025 – Present

In Prep

Lead Author · Target: Q1 Materials/Mechanics Journal

- Comprehensive state-of-the-art review synthesizing analytical gradation functions, homogenization theories (Voigt, Reuss, Mori-Tanaka), finite element formulations, and multi-objective optimization algorithms for structural FGM components.

Computational & Engineering Projects

Interactive Atwood Machine Physics Simulation

2024

Deployed on Vercel Cloud

Computational Mechanics Simulator · GitHub: piashoverflow

- Engineered an interactive, cloud-deployed computational mechanics simulator modeling multi-body kinematics, string tension dynamics, and rotational inertia via numerical ODE integration.
- Implemented continuous differential equation solvers via 4th-order Runge-Kutta (RK4), facilitating real-time parametric sweeps (varying mass ratios, pulley friction, and gravitational acceleration).

Verification of Mechanical Energy Conservation in Oscillatory Systems

2023 – 2024

Independent Study

Classical Mechanics & Numerical Analysis · Python / NumPy

- Formulated analytical derivations and numerical verification scripts analyzing mechanical energy conservation across diverse oscillatory regimes in Simple Harmonic Motion (SHM).
- Generated phase space (p - q) trajectory portraits and implemented error-bounded algorithms to evaluate kinetic-to-potential energy exchanges under linear and non-linear damping.

Solid-State Magnetism & Magnetic Hysteresis Characterization

2023

Academic Research

Electromagnetism & Materials Science Pedagogy

- Designed an analytical framework and visual experimental demonstrations detailing magnetic domain theory, ferromagnetism, paramagnetism, diamagnetism, and magnetic hysteresis (B - H loop) energy dissipation.
- Modeled macroscopic magnetization curves and coercivity/remanence characteristics for soft and hard ferromagnetic materials.

Teaching & Science Communication Experience

Udvash-Unmesh Academic & Admission Care

2020 – Present (~5 Years)

Academic Content Contributor & Physics Instructor

Dhaka, Bangladesh

- Conducted large-scale academic seminars and masterclasses for audiences of **1,000–1,200 students**, delivering rigorous, intuitive breakdowns of advanced physics and competitive engineering problem-solving.
- Designed and presented conceptual demonstration lessons for the prominent ***Golpe Golpe Physics*** (Physics through Stories) video curriculum, elucidating fluid mechanics, buoyancy, electromagnetic induction, and mechanics via tabletop experiments.
- Authored specialized conceptual problem sets and curricular modules for the elite ***“Tukhor”*** batch, preparing top-performing students for competitive engineering admissions.
- Mentored and tutored over **5,000 secondary and higher-secondary students** across Physics, Mathematics, Chemistry, and ICT, focusing on first-principles understanding over rote learning.
- Contributed educational technology UX and pedagogy recommendations (gamification frameworks, student XP progression, and structured learning pathways) for Udvash’s online smart-learning ecosystem.

Technical Skills & Competencies

- Computational Solid Mechanics:** Finite Element Analysis (FEA), Structural Optimization, Fracture & Fatigue Analysis, Linear/Nonlinear Mechanics, Multi-layer FGM Modeling, Rule of Mixtures (ROM) Homogenization, Mesh Convergence.
- Simulation & CAD Packages:** ANSYS Workbench (Static Structural, Steady-State Thermal, Fatigue Analysis Module), SolidWorks (3D Parametric Solid Modeling, Assembly Analysis, Motion Simulation, Technical Drafting).
- Programming & Scientific Computing:** Python (NumPy, SciPy, Matplotlib), MATLAB (Numerical Linear Algebra, ODE Solvers), LaTeX Typesetting, Git/GitHub Version Control, Linux/Bash Scripting.
- Emerging Research Focus:** Physics-Informed Machine Learning (PIML), Data-Driven Mechanical Modeling, Multi-Objective Optimization (SSE Minimization, Evolutionary Algorithms).
- Science Communication & Leadership:** Large-Audience Public Lecturing, Conceptual Demonstration Design, Scientific & Technical Writing, STEM Curriculum Architecture, Student Mentorship.

Honors, Leadership & Outreach

- Invited Keynote Seminar Speaker:** Invited speaker and masterclass instructor for nationwide academic outreach seminars organized by Udvash-Unmesh, presenting to audiences exceeding 1,000 students per session (2022 – Present).
- Undergraduate Admission Merit:** Secured top-tier national merit rank in the highly competitive BUET Undergraduate Engineering Admission Examination among over 12,000 nationwide candidates (2019).
- STEM Educational Outreach:** Designed and recorded online conceptual physics demonstration lectures achieving widespread engagement across student learning communities in Bangladesh.

Languages & Academic Objectives

- Languages:** English (Full Professional & Academic Working Proficiency), Bengali (Native).
- Academic Objectives:** Seeking research-oriented Ph.D. / M.S. graduate admission (RA/TA) in Mechanical Engineering; focusing on Structural Mechanics, Computational Mechanics, FGM/Composites, and Data-Driven Optimization.