

# NAZRUL ISLAM, PH. D.

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## **EDUCATION**

**Ph. D.**, Structural Mechanics, May 2018

**North Carolina State University (NCSU)**, Raleigh, NC, USA

- Specialization: Mechanics and Materials
- Thesis title: Advanced Constitutive Model Development for Structural Integrity Analysis
- Research focus: Constitutive Modeling, Continuum Damage Mechanics, Finite Element Analysis
- Supervisor: Professor Dr. Tasnim Hassan
- Relevant courses: Constitutive Modeling, Numerical Methods, Inverse Modeling, Optimization, Advanced Strength of Materials, Mechanical Behavior of Engineering Materials

**M. Sc. Engineering**, Civil Engineering, Sep 2010

**Bangladesh University of Engineering and Technology (BUET)**, Dhaka, Bangladesh

- Specialization: Structural Engineering
- Thesis title: Global Optimization of Design Parameters of Network Arch Bridges
- Supervisor: Professor Dr. Raquib Ahsan
- Relevant courses: Finite Element Methods, Structural Dynamics & Seismic Design, Design of Steel Structures, Concrete Structures, Design of Tall Buildings, Wave Motion and Soil-Structure Interaction

**B. Sc. Engineering**, Civil Engineering, June 2007

**Bangladesh University of Engineering and Technology (BUET)**, Dhaka, Bangladesh

- Specialization: Structural Engineering
- Thesis topic: Dynamic Amplification Factor in the Cantilever Part of Box Girder Bridges
- Supervisor: Professor Dr. Khan Mahmud Amanat

**Higher Secondary Certificate**, June 2001

**Notre Dame College**, Dhaka, Bangladesh

**Secondary School Certificate**, June 1999

**Comilla Zilla School**, Comilla, Bangladesh

## **SKILLS**

- **Technical:** Computational mechanics, continuum damage mechanics, constitutive modeling, creep-fatigue-ratcheting, viscoplasticity, high-temperature materials, pressure-vessel-piping, boiler-header, structural analysis, finite element analysis, FE implementation of advanced constitutive models using UMAT and USERMAT, structural analysis and design.
- **Computer:** ANSYS (expert), ABAQUS (expert), CSI Software (SAP, ETABS, SAFE) (expert), Autodesk Products (AutoCAD, Revit) (intermediate), SolidWorks (intermediate), MATLAB (expert), FORTRAN (intermediate), Python (basic), C++ (basic).

## **RESEARCH EXPERIENCE**

**Graduate Research Assistant, Mechanics and Materials**, Jan 2013 to Dec 2017

Dept. of Civil, Construction, and Environmental Engineering, North Carolina State University, Raleigh, NC

**Advanced Constitutive Modeling of Grade 91 Coupled with Tertiary Creep Behavior and Damage.**  
**(Funded by the Babcock & Wilcox Company)**

- A unified viscoplastic model coupled with continuum damage mechanics (CDM) is developed to address the creep-fatigue interaction of Grade 91 boiler headers. The constitutive model is implicitly implemented in UMAT subroutine of ABAQUS for design-by-analysis (DBA) of header components.
- The constitutive model is experimentally validated for a wide range of Grade 91 steel databases including low cycle fatigue (LCF), cyclic softening, rate dependence, short-term stress relaxation, long-term creep and creep-fatigue interaction.
- Several continuum damage mechanics (CDM) approaches are proposed to address the influence of triaxiality on long-term creep and creep-fatigue interaction. Notch creep tests are simulated and validated using the developed UMAT.
- A *time-temperature-stress* relationship for Grade 91 steel is developed based on NIMS creep data and evaluated against API 579-1, STP-NU-019 and Welding Research Council database.

- HRSG boiler headers under flexible operation condition are investigated using proposed continuum damage methods.
- A benchmark thick cylinder thermal transient test is currently under investigation to validate the proposed modeling approaches in contrast to the ASME code-based approaches.

**Creep-Fatigue and Creep-Ratcheting Failures of Alloy 617: Experiments and Unified Constitutive Modeling towards Addressing the ASME Code Issues. (Funded by NEUP, US DOE)**

- A unified viscoplastic model is developed to address high-temperature creep, uniaxial and multiaxial ratcheting of Inconel 617. The experimentally validated constitutive model is implemented in ANSYS using USERMAT subroutine for better design of critical structural components like heat exchangers.
- An implicit radial return algorithm is developed for the implementation of the unified constitutive model in the FE software packages.

**GOALI: Continuous-Bending-Under-Tension Studies to Enhance the Formability of Advanced Steels and Aluminum Alloys. (Funded by University of New Hampshire through NSF)**

- Worked on DP590 and 6022-T4 materials to understand their behavior in tension-compression-tension (TCT) experiments and determined material parameters for component analysis.

**Long and Short Radius Elbows: Experiments and Constitutive Modeling.**

- Developed a detail FE model of pressurized elbow experiments and analyzed multiaxial ratcheting phenomenon using modified Chaboche model which is implemented in ANSYS using USERMAT.
- Showed that Chaboche model has significant shortcomings in predicting ratcheting of pressurized components that can be significantly improved by utilizing modified Chaboche model.
- Developed manufacturing and welding residual stress simulation for the elbow components. I also studied residual stress effect on ratcheting responses of elbows.

**Constitutive Model Development for Structural Steels with Yield Plateau.**

- A novel two surface yield plateau model for structural steels (A992, A572, A36) has been developed and implemented in FE software ANSYS using USERMAT.

**MSc Research in Civil Engineering, Nov 2007 to Sep 2010**

Dept. of Civil Engineering, Bangladesh University of Engineering and Technology, Dhaka, Bangladesh

- A simulation-driven-optimization architecture is proposed for the FE software package ANSYS.
- A black box interface between ANSYS and global optimization algorithm EVOP is developed for structural optimization of network arch bridges.
- Design variables including geometry, shape and hanger arrangement of a typical arch bridge are globally optimized to minimize the cost of the structure, and it has been shown that 36-40% of the total structural cost can be saved if the proposed method is utilized.

**TEACHING EXPERIENCE**

**Lecturer/ Assistant Professor, Civil Engineering, Aug 2008 to Present**

Dept. of Civil Engineering, Bangladesh University of Engineering and Technology, Dhaka, Bangladesh

- Taught theory and laboratory courses such as structural analysis & design, mechanics, drawing.
- Evaluated construction material quality and structural design integrity of critical structures, 2008-2018.

**Graduate Teaching Assistant, Mechanics and Materials, Spring 2013, Fall 2014, Spring 2017, Fall 2017**

Dept. of Civil, Construction, and Environmental Engineering, North Carolina State University, Raleigh, NC

- Graded quizzes, held office hours
- Courses: Engineering Mechanics, Advanced Strength of Materials

**CONSULTANCY**

**Member, Bureau of Research, Testing and Consultancy**

Dept. of Civil Engineering, Bangladesh University of Engineering and Technology, Dhaka, Bangladesh

- Remedial Solution for the Broken Foundations of Fuel Storage Tanks, Chittagong, Bangladesh, 2012.
- Vetting of Structural Design on Plot No. 16, Road no 4, Dhanmondi R/A, Dhaka, Bangladesh, 2012.
- Quality Assessment of Foundation, Column, Floor, etc. of Extension Building for Permanent Campus of BUBT, Dhaka, Bangladesh, 2012.

- Retrofitting of 78, Gulshan, Marriott Hotel, Dhaka, Bangladesh, 2012.
- Structural Design Check of 12 Storied Residential Building at Plot-46 A, Road-6/A, Dhanmondi R/A, Dhaka, Bangladesh, 2012.
- Structural Design Check of Maolana Bhashani Science & Technology University Academic Building, Dhaka, Bangladesh, 2012.
- Member, Project of Supervision Services for Installation of Eight nos. 20m-90m Self Standing Tower (SST) for Bangladesh Police, 2009.

## **PEER REVIEWED PROCEEDINGS AND JOURNALS**

- **Islam, N.**, and Hassan, T., July 15-20, 2018, "Uniaxial Fatigue, Creep and Ratcheting Response Simulations of Alloy 617 using Damage Coupled Viscoplastic Model," Proceedings of Pressure Vessel and Piping, ASME PVP2018-84756, Prague, Czech Republic.
- **Islam, N.**, and Hassan, T., "Explicit and Implicit Integration Schemes for FE Implementation of a Modified-Chaboche Based Elastoplastic Model," Submitted to Finite Elements in Analysis and Design, Elsevier.
- **Islam, N.**, Dewees, D., Cooch, M., and Hassan, T., July 16-20, 2017, "Creep and Fatigue Damage Evaluation of Modified Grade 91 Headers Using Damage Coupled Unified Viscoplastic Model," Pressure Vessel and Piping, ASME PVP2017-65851, Hawaii, USA.  
<http://proceedings.asmedigitalcollection.asme.org/proceeding.aspx?articleid=2660497>
- **Islam, N.**, Dewees, D., and Hassan, T., July 16-20, 2017, "Unified Viscoplastic Model Coupled with Damage for Evaluation of Creep-Fatigue of Grade 91 Steel," Pressure Vessel and Piping, ASME PVP2017-65849, Hawaii, USA.  
<http://proceedings.asmedigitalcollection.asme.org/proceeding.aspx?articleid=2660697&resultClick=3>
- **Islam, N.**, and Hassan, T., July 16-20, 2017, "Influence of Initial and Welding Residual Stress on Low Cycle Fatigue and Ratcheting Response Simulations of Elbows," Pressure Vessel and Piping, ASME PVP2017-65847, Hawaii, USA.  
<http://proceedings.asmedigitalcollection.asme.org/proceeding.aspx?articleid=2660855&resultClick=3>
- **Islam, N.**, and Hassan, T., May 16-17, 2017, "Structural Integrity of Grade 91 Steel Components under Creep-Fatigue Loading Conditions," Proceedings of Engineering Structural Integrity Assessment, ESIA14-ISSI2017, Manchester, UK.
- Hassan, T., Ahmed, R., Barrett, P.R., **Islam, N.**, and Morrison, M.L., 2017, "Unified Constitutive Modeling towards Enhanced Structural Integrity," Applied Mechanics and Materials, Trans Tech Publications, Vol. 853, pp. 127-131.  
(<https://www.scientific.net/AMM.853.127>)
- **Islam, N.**, Dewees, D., and Hassan, T., July 17-21, 2016, "Unified Viscoplasticity Modeling Features Needed for Simulation of Grade 91 Creep and Fatigue Responses," Pressure Vessel and Piping, ASME PVP2016-63578, Vancouver, BC, Canada.  
(<http://proceedings.asmedigitalcollection.asme.org/proceeding.aspx?articleID=2590484>)
- **Islam, N.**, and Hassan, T., July 17-21, 2016, "Improving Simulations for Low Cycle Fatigue and Ratcheting Responses of Elbows," Pressure Vessel and Piping, ASME PVP2016-63353, Vancouver, BC, Canada.  
(<http://proceedings.asmedigitalcollection.asme.org/proceeding.aspx?articleid=2590383>)
- **Islam, N.**, Fenton, M., and Hassan, T., July 19-23, 2015, "Long and Short Radius Elbows Experiments and Constitutive Modeling to Simulate the Responses," Pressure Vessel and Piping, ASME PVP2015-45688, Boston, MA, USA.  
(<http://proceedings.asmedigitalcollection.asme.org/proceeding.aspx?articleid=2472385>)
- **Islam, N.**, Quayyum, S., and Hassan, T., July 20-24, 2014, "A Unified Constitutive Model for High-Temperature Multiaxial Creep-Fatigue and Ratcheting Response Simulation of Alloy 617," Pressure Vessel and Piping, ASME PVP2014-28789, Anaheim, CA, USA.  
(<http://proceedings.asmedigitalcollection.asme.org/proceeding.aspx?articleid=1938126>)
- **Islam, N.**, Rana, S., Ahsan, R., and Ghani S.N., 2014, "An Optimized Design of Network Arch Bridge using Global Optimization Algorithm," Advances in Structural Engineering, 17(2) pp. 197-210.  
(<http://journals.sagepub.com/doi/pdf/10.1260/1369-4332.17.2.197>)
- Rana, S., **Islam, N.**, Ahsan, R., and Ghani S.N., 2013, "Application of Evolutionary Operation to the Minimum Cost Design of Continuous Prestressed Concrete Bridge Structure," Engineering Structures, 46(0) pp. 38-48.  
(<http://www.sciencedirect.com/science/article/pii/S0141029612003781>)

## **JOURNALS UNDER PREPARATION**

- **Islam, N.**, Ahmed, R., and Hassan, T., "An Implicit Integration Algorithm for FE Implementation of Continuum Damage Coupled Viscoplastic Model," To be submitted to International Journal for Numerical Methods in Engineering.
- **Islam, N.**, and Hassan, T., "Low Cycle Fatigue and Ratcheting Response Simulations of SS304 Elbows Using Advanced Constitutive Model," To be submitted to International Journal of Solid and Structures.
- **Islam, N.**, and Hassan, T., "High-Temperature Uniaxial Fatigue, Creep and Ratcheting Response Simulation of Alloy 617 using CDM coupled Viscoplastic Model," To be submitted to International Journal of Solid and Structures.
- **Islam, N.**, and Hassan, T., "Unified Viscoplastic Model for Multiaxial Fatigue-Ratcheting Response Simulation of Alloy 617," To be submitted to International Journal of Solid and Structures.
- **Islam, N.**, Dewees, D., and Hassan, T., "Unified and Non-Unified Constitutive Models for Predicting Creep-Fatigue Responses of Grade 91 Steel," To be submitted to International Journal of Pressure Vessel and Piping.
- **Islam, N.**, Dewees, D., and Hassan, T., "Damage Coupled Unified Viscoplastic Model for Elevated Temperature Application of Grade 91 Steel," To be submitted to International Journal of Plasticity.
- **Islam, N.**, Dewees, D., and Hassan, T., "Creep-Fatigue Damage Evaluation of Grade 91 Header under Flexible Operation Condition using CDM Coupled Viscoplastic Model," To be submitted to International Journal of Pressure Vessel and Piping.

## **THESIS**

- **Islam, N.**, May 2018, "Advanced Constitutive Model Development for Structural Integrity Analysis," Ph.D. Thesis, North Carolina State University, Raleigh, NC, USA.
- **Islam, N.**, September 2010, "Global Optimization of Design Parameters of Network Arch Bridges," M.Sc. Thesis, Bangladesh University of Engineering and Technology, Dhaka, Bangladesh.
- **Islam, N.**, June 2007, "Dynamic Amplification Factor in the Cantilever Part of Box Girder Bridges," B.Sc. Thesis, Bangladesh University of Engineering and Technology, Dhaka, Bangladesh.

## **SEMINAR AND SYMPOSIUM**

- **Islam, N.**, March 21, 2016, "Advanced Constitutive Modeling for Structural Integrity Analysis," Nineteenth Structural Engineering & Research Symposium, NC State University, Raleigh, NC, USA.
- **Islam, N.**, Oct 24, 2014, "Advanced Constitutive Modeling for Improved Simulation of Structural Responses," Fifteenth Structural Engineering & Research Symposium, NC State University, Raleigh, NC, USA.

## **FINAL REPORT**

- **Islam, N.**, and Hassan, T., January 26, 2017, "Final Report on Advanced Constitutive Modeling of Grade 91 Steel Coupled with Tertiary Creep Behavior and Damage," Submitted to the Babcock and Wilcox Company, 20 S. Van Buren Ave, Barberton, OH 44203.

## **WORKSHOP**

- **Islam, N.**, Quayyum, S., and Hassan, T., July 17-21, 2016, "Constitutive Model Development for Simulation of Multiaxial Ratcheting Responses of Alloy 617," EPRI Creep-Fatigue Workshop, ASME Pressure Vessel and Piping Conference, EPRI-4, ASME PVP2016-63282, Vancouver, BC, Canada.

## **REVIEWER**

- Proceedings of ASME Pressure, Vessel and Piping (PVP)

## **ACADEMIC RECOGNITION AND AWARDS**

- 24th Rudy Scavuzzo Student Paper Finalist Award, ASME PVP2016, July 2016, Vancouver, BC, Canada
- Paul Zia Graduate Fellowship, NC State University, September 2015, Raleigh, USA
- 22nd Rudy Scavuzzo Student Paper Finalist Award, ASME PVP2014, July 2014, Anaheim, CA, USA
- University Grant Commission Merit Scholarship, 2008, Bangladesh
- Dean's List Award (in each academic year of study), 2002-2007, BUET, Dhaka, Bangladesh

- Academic Merit Scholarship (in each academic semester), 2002-2007, BUET, Dhaka, Bangladesh

### **PROFESSIONAL MEMBERSHIP**

- Member, American Society of Mechanical Engineers (#100739646)
- Member, American Society of Civil Engineers (#9185807)
- Member of Experimental Mechanics Group, SEM (#70666)

### **REFERENCE**

- Dr. Ishtiaque Ahmed, Professor, Department of Civil Engineering, Bangladesh University of Engineering and Technology, iahmed87@gmail.com, +880 1819133797.
  - Dr. Kerry Havner, Professor, Department of Civil, Construction, and Environmental Engineering, North Carolina State University, Raleigh, NC, havner@ncsu.edu, 919-515-7632.
  - Dr. Kumar Mahinthakumar, Professor, Department of Civil, Construction, and Environmental Engineering, North Carolina State University, Raleigh, NC, gmkumar@ncsu.edu, 919-515
  - Dr. Tasnim Hassan, Professor, Department of Civil, Construction, and Environmental Engineering, North Carolina State University, Raleigh, NC, thassan@ncsu.edu, 919-515-8123.
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