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Dr. Ayyub is a Professor of Civil and Environmental Engineering, Director of Center for Technology and Systems Management at the University of Maryland, College Park, and Co-Director, International Joint Research Center for Resilient Infrastructure, Tongji University, China. He is affiliate of Center for Risk and Reliability; Disaster Resilience Center; Maryland Robotics Center; Applied Mathematics and Scientific Computation Program; and Institute of Systems Engineering. He was a visiting fellow at the National Security Analysis Department of the Applied Physics Laboratory of the Johns Hopkins University (2015-16). He was a chair professor at Tongji University (2016-18). He received the ASEE Fellowships ONR-funded for sabbatical leaves at U. S. Navy (USN) from 1993, 2000 and 2007, and was also a USN consulting professor during this period. He is the president of BMA Engineering, Inc., and angel investor and entrepreneur, and served on the board of several startup companies. Professor Ayyub is a distinguished member of ASCE and an honorary member of ASME. He is also a fellow of the Society of Naval Architects and Marine Engineers (SNAME), the Structural Engineering Institute (SEI), and the Society for Risk Analysis (2017-18 Treasurer), and a senior member of IEEE. Dr. Ayyub completed his doctorate degree from the Georgia Institute of Technology in 1983.

Dr. Ayyub's main research interests and work are in probabilistic risk analysis, resilience, sustainability, uncertainty and decision analysis, applied to civil, infrastructure, energy including renewables, defense and maritime fields, climate/hazard-resilient infrastructure, natural infrastructure, environmental/ecological concerns, and risk finance.

Dr. Ayyub completed research and development projects for governmental and private entities including NSF, DOD, DOT, NIST, DHS, and leading insurance and multinational corporations worldwide including Chevron, United Technology, Ford, Bechtel, Hartford, Hyundai, etc. Dr. Ayyub is the recipient of several awards, most recently the 2018 ASCE Alfredo Ang Award on risk analysis and management of civil infrastructure, 2019 ASCE President Medal for many efforts to bring adaptive design to the profession to help address a changing climate, 2019 ASCE Le Val Lund Award for contributions to resilience enhancement and risk reduction for lifeline-networked systems through measurement science and associated economics toward informing policy and decision-making practices, 2018 ENR Newsmaker award for passionate effort to give engineers their first formal guidance when designing infrastructure to be more resilient to weather extremes, and 2016 ASNE Solberg Award significant engineering research and development accomplishments in the field of ship survivability. He is the author and co-author of more than 650 publications, and the founding editor-in-chief of the ASCE-ASME Journal on Risk and Uncertainty in Engineering Systems. In addition to 15 edited books including Thoughts and Conversations of Buildings and Other Structures (CreateSpace 2020), his eight textbooks include the following (http://amzn.to/zs03ma): Uncertainty Modeling and Analysis for Engineers and Scientists (Chapman & Hall/CRC 2006 with G. Klir), Risk Analysis in Engineering and Economics (Chapman & Hall/CRC 2003, 2014), Elicitation of Expert Opinions for Uncertainty and Risks (CRC Press 2002), Probability, Statistics and Reliability for Engineers and Scientists, Third Edition (Chapman & Hall/CRC 2011 with R. H. McCuen), and Numerical Methods for Engineers (Prentice Hall 1996 with McCuen, 2nd edition Chapman & Hall/CRC 2016).

Products Most Closely Related to the Proposed Project

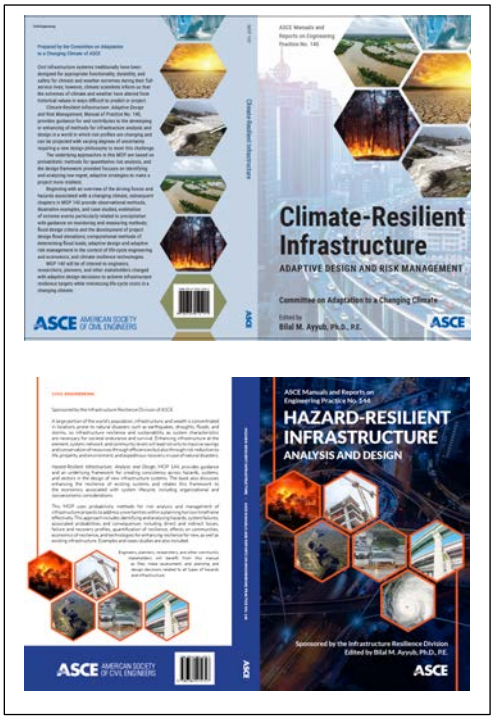
1. Ayyub, B. M., and Klir, G. J., 2006. Uncertainty Modeling and Analysis in Engineering and the Sciences, Chapman & Hall/CRC, Press Boca Raton, FL.
2. Ayyub, B. M., Risk Analysis in Engineering and Economics, 2nd Ed, Chapman & Hall, 2014
3. Ayyub, B.M., Walker, D., 2022, "The Case for Actionable Information to Support Climate-resilient Design and Operations," As I see It Editorial in the ASCE GeoStrata of the Geo-Institute, June-July 2022, pages 18-19, https://www.geoinstitute.org/publications/geostrata
4. Zhang, Y., Ayyub, B.M., and Fung, J. F., 2022, "Projections of Corrosion and Deterioration of Infrastructure in United States Coasts Under a Changing Climate," Resilient Cities and Infrastructure, 1, 98-109, Elsevier, https://doi.org/10.1016/j.rcns.2022.04.004.
5. Hamed, M., Mao, Y., Ayyub, B.M., Elsibaie, M., and Omar, T., 2022, "Connectedness Efficiency Analysis of Weighted U. S. Freight Railroad Networks," ASCE-ASME Journal of Risk and Uncertainty in Engineering Systems Part B: Mechanical Engineering, https://doi.org/10.1115/1.4054326.
6. Wang, C., and Ayyub, B. M., 2022, "Time-dependent Resilience of Repairable Structures Subjected to Non-stationary Load and Deterioration for Analysis and Design," ASCE-ASME Journal of Risk and Uncertainty in Engineering Systems, Part A: Civil Engineering, ASCE.
7. Zhang, Y., and Ayyub, B. M., 2020, "Projecting Heat Waves Temporally and Spatially for Local Adaptations in a Changing Climate: Washington D.C. as a Case Study," Natural Hazards, Springer, https://doi.org/10.1007/s11069-020-04008-6
8. Zhang, Y., and Ayyub, B. M., 2020, "Electricity System Assessment and Adaptation to Rising Temperatures in a Changing Climate with Washington Metro Area as a Case Study," ASCE J. Infrastructure Systems, https://doi.org/10.1061/(ASCE)IS.1943-555X.0000550
9. Hu, H., and Ayyub, B. M., 2019 "Machine Learning for Projecting Extreme Precipitation Intensity of Short Periods," Geosciences, Open Access Special Issue by MPDI, 9(5), 209; https://doi.org/10.3390/geosciences9050209
10. Ayyub, B. M., "Systems Resilience for Multi-Hazard Environments: Definition, Metrics and Valuation for Decision Making," Risk Analysis J., DOI: 10.1111/risa.12093, 2013.
11. Lombardo, F. and Ayyub, B. (2014). "Analysis of Washington, DC, Wind and Temperature Extremes with Examination of Climate Change for Engineering Applications." ASCE-ASME J. Risk Uncertainty Eng. Syst., Part A: Civ. Eng., 10.1061/AJRUA6.0000812, 04014005.
12. Ayyub, B. (2015). "Practical Resilience Metrics for Planning, Design and Decision Making" ASCE-ASME J. Risk Uncertainty Eng. Syst., Part A: Civ. Eng.
13. Gilbert, S., and Ayyub, B., 2016. "Models for the Economics of Resilience," ASCE-ASME J. Risk Uncertainty Eng. Syst., Part A: Civil Eng., DOI: 10.1061/AJRUA6.0000867.
14. Saadat, Y., Ayyub, B. M., Zhang, Y., Zhang, D., and Huang, H., 2020, "Resilience-based Strategies for Topology Enhancement and Recovery of Metrorail Transit Networks," ASCE-ASME J. Risk Uncertainty Eng. Syst., Part A: Civ. Eng., ASCE. 2020, 6(2): 04020017 https://doi.org/10.1061/AJRUA6.0001057
15. Saadat, Y., Ayyub, B. M., Zhang, Y. J., Zhang, D. M., and Huang, H. W. 2019. "Resilience of Metrorail Networks: Quantification with Washington D.C. as a Case Study," ASCE-ASME J. Risk Uncertainty Eng. Syst., Part B: Civ. Eng., doi:10.1115/1.4044038
16. Ayyub, B. M., McGill, W. L., Foster, J., Jones, H. W., 2009, "Risk Analysis of a Protected Hurricane-Prone Region II," ASCE Natural Hazards Review.

Synergistic Activities

1. Dr. Ayyub's team is presently engaging with NOAA and ASCE to convene workshops in the Fall 2022 on climate-related hazards and codes/standards focusing on rainfall/flooding, temperature, linear wind, and coastal hazards with participation from NIST. The results of these workshops and other

pursuits will feed in a planned ASCE-NOAA leadership summit planned for Feb 2023. Dr. Ayyub is chairing the summit, and it will be presided by the ASCE President and NOAA Administrator.

2. Dr. Ayyub worked in the summer of 2022 on climate-related heat waves, wildfire and power distribution for California IOUs. The focus was primarily on the economics of risk management strategies.
3. Dr. Ayyub is co-leading an effort for DOE-DOI on Ocean Energy Safety focusing on O&G, Wind and Marine energy. We are the strategic planning phase for this 5-year effort, and the development of a research program.
4. Dr. Ayyub has ongoing grant funded by the Federal Railroad Administration (FRA) on railroad network topology resilience which is coming to an end in 2022 with a potential for a second phase of funding. A paper based on this work will be presented and eventually published in ASME journals on "Weighted Rail Network Topological Analysis by Waybill Commodity Volumes. This analysis can be extended to assess impacts of a changing climate on railroad networks.
5. Ayyub's edited the 2021 ASCE Manual of Practice (MOP) 144 on Hazard-Resilient Infrastructure has been recognized among the 42st Annual SIAA AM&P Network 2022 EXCEL Award Winners. The book won a bronze award in the Technical books category at https://siia.net/excel/2022-excel-winners/, and 2018 ASCE MOP 140 on Climate-Resilient Infrastructure that received the 2019 ASCE President Medal and 2017 ENR Excellence Award.



6. Dr. Ayyub was appointed to the Board on Environmental Change and Society (BECS), Division of Behavioral and Social Sciences and Education (DBASSE), National Academies of Sciences, Engineering, and Medicine, Washington, DC. (2022-present)
7. With the support of the National Institute of Standards and Technology, the research group of Dr. Ayyub developed metrics for resilience and sustainability and respective economic frameworks.
8. Recently, Dr. Ayyub has been researching global catastrophic risks including climate change, and focusing mainly on risk, uncertainty and decision analysis, and systems engineering applied to infrastructure and maritime fields.
9. Dr. Ayyub is the FY2019 chair of the ASCE Committee on Technical Advancement (CTA), FY2017-18 chair of the ASCE Infrastructure Resilience Division and FY2017 Chair of ASCE Committee on the Adaptation to a Changing Climate, and Founding Editor (2014-2021) of the ASCE-ASME J. of Risk and Uncertainty in Engineering Systems: Part A Civil Engineering, and Part B Mechanical Engineering. He is currently on the editorial boards of several journals, and chaired several ASCE and non-ASCE conferences and workshops.
10. As an educator, Dr. Ayyub advised many undergraduate and graduate students on varied research topics. Also, he mentored postdocs and visiting scholars. Several of his advisees and collaborators received best paper awards and recognitions. Also, he developed new courses on risk analysis in engineering and economics, and uncertainty analysis and modeling.

The following are example projects completed by BMA Engineering, Inc. (BMA):

1. KPMG – Economics of wildfire and power utilities, 2021-22
2. Private sector – Hazards and impacts for climate change on waste storage in coastal areas, 2016.

3. Bechtel – Risk Studies on LNG Facilities in Australia, 2009-12 (several projects).
4. NIST – Economics of Community Disaster Resilience, 2014-15.
5. USCG – Life Expectancy Analysis of the National Security Cutter, 2014-19 (several projects).
6. ASCE – Development of the 2018 MOP 140 on Climate-Resilient Infrastructure, and 2021 MOP 144 on Hazard-Resilient Infrastructure, 2017-2021.
7. Others risk studies and projects funded by Navy, Air Force, Army Corps, Coast Guard, DARPA, Hartford Insurance, United Technology, Chevron, ASME, etc.

BMA has the experience and ability to handle sensitive information on critical infrastructure, such as information associated with railroads. BMA completed several studies in the homeland security area on the protection of critical infrastructure that required handling sensitive information. This unique capability might be needed for the purposes of this project.