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Global Infrastructure Demands Can Only Be Met Through AI-First Approaches

(/pdf?id=yNZZrViaM0)

NeurIPS 2025 Position Paper Track Submission567 Authors

22 May 2025 (modified: 28 Oct 2025) Submitted to NeurIPS 2025 Position Paper Track
Position Paper Track, Area Chairs, Reviewers, Authors Revisions (/revisions?id=yNZZrViaM0)
BibTeX

Keywords: AI for Infrastructure Oversight, ML for Safety-Critical Systems, Societal Impact of ML, Regulatory Technology, Document Understanding, Failure Analysis, Public Sector ML

TL;DR: We argue that only AI-first regulatory transformation can prevent catastrophic infrastructure failures and scale public safety oversight, and we demonstrate concrete ML opportunities across permitting, design, and environmental review.

Abstract:
Infrastructure development faces an urgent global crisis threatening public safety across developed and developing nations. While developing regions require rapid urbanization at unprecedented scale, wealthier nations confront aging assets and climate adaptation needs. The critical bottleneck lies in regulatory oversight, the only mechanism balancing the harm asymmetry between builders and residents who bear catastrophic failure risks. The World Bank has proposed expanding regulatory oversight, but such reforms are unworkable given critical shortages of qualified professionals, accelerating climate-driven code changes, and fragmented workflows that fail to incorporate failure feedback. Recent infrastructure failures resulting in significant loss of life demonstrate regulatory system breakdown. We argue that only AI-first regulatory transformation can enable safe infrastructure delivery at the required scale and speed. Through analysis of catastrophic failures and regulatory bottlenecks across multiple jurisdictions, we demonstrate clear opportunities for machine learning throughout the infrastructure lifecycle to accelerate delivery while enhancing safety. We call on the NeurIPS community to treat infrastructure oversight as a critical frontier for socially impactful machine learning.

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Paper Decision

Decision by Program Chairs 25 Sept 2025, 21:01 (modified: 17 Oct 2025, 12:38) Everyone
Revisions (/revisions?id=2mD2Gbp7Gu)

Decision: Reject

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Official Review of Submission567 by Reviewer E8CT

Official Review by Reviewer E8CT 05 Aug 2025, 13:09 (modified: 15 Aug 2025, 14:47)

Program Chairs, Area Chairs, Reviewers Submitted, Reviewer E8CT, Authors

Revisions (/revisions?id=2yjWqz9GNM)

Ethics: NO or VERY MINOR ethics concerns only
Position: Yes, the paper argues for or against a position related to machine learning.
Summary:
The paper argues that AI-first strategy regulatory transformation is crucial for delivering safe and scalable infrastructure projects. By analyzing failures in recent infrastructure developments, they demonstrate that current regulatory systems are insufficient to handle the complexity and demands of modern infrastructure systems. The study concludes that only by embedding advanced machine learning techniques at pivotal points throughout the infrastructure lifecycle can regulators achieve the necessary level of oversight.

Author Identification: No.
Support: 2: fair
Significance: 3: good
Presentation: 3: good
Context: 2: fair
Discussion: 3: possibly
Alternative Position: Yes, and alternative positions are well-considered and named but not addressed
Strengths:
This paper makes a strong case for using AI as a primary tool to overhaul how we regulate infrastructure construction and maintenance. It shows why our current ways of overseeing things just aren't cutting it by looking at actual cases where structures have failed. This topic is especially relevant to the NeurIPS community, as it highlights a societally important application of AI.

Weaknesses:

- The paper would benefit from outlining more detailed strategies for actually putting AI into regulatory systems. This includes talking about practical hurdles like making sure the data is good quality, understanding how the AI makes decisions (interpretability), and managing ethical concerns.
- Lacking discussion around the legal, social, and organizational challenges that come with adopting AI in regulatory processes

Questions:
Have you considered less radical approaches, such as incrementally adding automation to existing regulatory systems or developing hybrid models that combine human expertise with AI insights? What were the key reasons or criteria beyond scalability that led you to prioritize a full AI-first transformation over these more gradual or blended options?

Agreement: 3: neither agree nor disagree
Rating: 5: Borderline accept: The paper presents a relevant position, and the reasons to accept outweigh reasons to reject, e.g., unclear reasoning or limited support for the claims.
Confidence: 4: You are confident in your assessment, but not absolutely certain. It is unlikely, but not impossible, that you did not understand some parts of the submission or that you are unfamiliar with some pieces of related work.
Thoroughness: 5: You read the paper and appendices rigorously and checked all of the details carefully, including references and proofs (if present).
Code Of Conduct Acknowledgement: Yes

Add: **Official Comment**

Official Review of Submission567 by Reviewer jEn6

Official Review by Reviewer jEn6 26 Jul 2025, 07:05 (modified: 15 Aug 2025, 14:47)

Program Chairs, Area Chairs, Reviewers Submitted, Reviewer jEn6, Authors

Revisions (/revisions?id=eV6su7PxB5)

Ethics: NO or VERY MINOR ethics concerns only
Position: Yes, the paper argues for or against a position related to machine learning.
Summary:
The paper argues that the only feasible way to meet global infrastructure demands while ensuring safety is through an AI-first regulatory transformation. It presents a systematic failure analysis of recent infrastructure disasters and identifies opportunities for applying machine learning to enhance regulatory oversight in permitting, geotechnical investigations, and structural design review.

Author Identification: No.
Support: 2: fair
Significance: 3: good
Presentation: 3: good
Context: 2: fair
Discussion: 3: possibly
Alternative Position: Yes, and alternative positions are well-considered and named but not addressed
Strengths:

1. The paper takes a bold and well-defined position, asserting that AI-first regulatory transformation is the only viable solution to address the growing infrastructure demands while maintaining safety. The topic is of high societal relevance, as infrastructure failures have historically resulted in large-scale loss of life and economic damage.
2. By analyzing and categorizing multiple catastrophic failures, the paper effectively highlights systemic shortcomings of current oversight systems, lending credibility to its central argument.
3. It identifies several concrete AI application opportunities, such as using RAG for document-heavy regulatory tasks, aggregating geotechnical data for public use, and supporting anomaly detection in construction workflows.

Weaknesses:

1. Despite advocating for AI-first oversight, the paper lacks a practical plan for validating AI outputs in safety-critical regulatory contexts, where deterministic correctness, transparency, and auditability are indispensable.
2. Many critical regulatory checks rely on advanced physics-based simulations (e.g., finite element models, seismic analyses, soil–structure interaction studies) that current AI methods cannot verify or reproduce. Without integrating physics-informed AI or solver-audit pipelines, AI-first oversight would be infeasible for complex technical designs.
3. The paper underestimates the challenges of applying RAG in real regulatory workflows. Infrastructure design submissions typically consist of complex CAD drawings, BIM models, tables, and jurisdiction-specific codes and standards. Converting these heterogeneous, multimodal inputs into structured data for AI processing would require significant pre-processing pipelines and domain-specific multimodal ML models—issues that are largely overlooked in the current manuscript.

Questions:

1. How do you envision validating AI outputs in safety-critical regulatory contexts?
2. How would AI handle verification of advanced physics-based simulations (e.g., FEM, seismic, soil-structure models)?
3. Do you foresee a phased adoption strategy combining AI tools with existing regulatory processes?

Agreement: 2: disagree
Rating: 4: Borderline reject: The paper presents a position, but the reasons to reject, e.g., unclear reasoning or limited support for the claims, outweigh reasons to accept.
Confidence: 4: You are confident in your assessment, but not absolutely certain. It is unlikely, but not impossible, that you did not understand some parts of the submission or that you are unfamiliar with some pieces of related work.
Thoroughness: 4: You read the paper and appendices and checked most of the details, including references..
Code Of Conduct Acknowledgement: Yes

Add: **Official Comment**

Official Review of Submission567 by Reviewer wXzy

Official Review by Reviewer wXzy (Vivek Kumar Mishra (/profile?id=~Vivek_Kumar_Mishra1))

22 Jul 2025, 07:50 (modified: 15 Aug 2025, 14:47)

Program Chairs, Area Chairs, Reviewers Submitted, Reviewer wXzy, Authors

Revisions (/revisions?id=wPRZ7A3F1t)

Ethics: NO or VERY MINOR ethics concerns only
Position: Yes, the paper argues for or against a position related to machine learning.
Summary:
This position paper argues that global infrastructure demands, driven by rapid urbanization and climate challenges, overwhelm traditional regulatory systems, leading to delays and catastrophic failures. It proposes AI-first regulatory transformation to ensure safe, scalable infrastructure delivery. Analyzing recent structural collapses, it highlights regulatory bottlenecks like fragmented workflows and expert shortages. The paper suggests machine learning applications—e.g., automated permitting, anomaly detection, and geotechnical data integration—to enhance safety and efficiency. It aligns with World Bank and UN frameworks but emphasizes AI's role in overcoming human limitations. Contributions include identifying AI opportunities across the infrastructure lifecycle and urging the NeurIPS community to develop these solutions.

Author Identification: No.
Support: 3: good
Significance: 4: excellent
Presentation: 3: good
Context: 4: excellent
Discussion: 4: very likely
Alternative Position: Yes, and alternative positions are well-considered and addressed by the argument
Strengths:
The paper excels at identifying a critical global issue—regulatory failures in infrastructure—and proposing AI-first solutions to enhance safety and efficiency. It's well-researched, with over 80 references linking to real-world failures (e.g., Grenfell, Rana Plaza) and frameworks like the World Bank's. The lifecycle analysis clearly maps AI opportunities, like automated permitting and geotechnical data integration. Its focus on urgent societal issues makes it highly relevant to NeurIPS, likely sparking research into applied AI for infrastructure.

Weaknesses:
The paper could improve by including specific AI case studies or pilot projects to make its proposals more concrete. Its technical jargon may limit accessibility, and some points (e.g., regulatory silos) are repetitive. An alternative position not fully explored is expanding human expertise through training rather than relying heavily on AI, which could be viable in some regions. It could also discuss the cost and scalability of AI systems for smaller jurisdictions.

Questions:
What specific ML models or datasets do you recommend for automating permitting or geotechnical analysis?

Agreement: 4: agree
Rating: 8: Strong Accept: The paper presents a strong argument about an important issue that ought to be discussed and is of importance to a sub-area within the NeurIPS community.
Confidence: 4: You are confident in your assessment, but not absolutely certain. It is unlikely, but not impossible, that you did not understand some parts of the submission or that you are unfamiliar with some pieces of related work.
Thoroughness: 4: You read the paper and appendices and checked most of the details, including references..
Code Of Conduct Acknowledgement: Yes

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