

CE49X: AI IN CIVIL ENGINEERING - FINAL REPORT

Project Title: Trends, Applications, and Maturity Analysis of AI in AEC

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1. Executive Summary

This report presents a comprehensive analysis of Artificial Intelligence (AI) adoption within the Architecture, Engineering, and Construction (AEC) industry. By analyzing a corpus of 576 articles, the study identifies **Structural Engineering** as the leader in total article volume, while **Construction Management** shows the most diverse application of technologies. The primary finding suggests that AI is no longer a futuristic concept but a functional tool currently optimizing site safety (via Computer Vision) and structural health monitoring (via Predictive Analytics).

2. Methodology

The research followed a multi-stage Data Science pipeline:

- **Data Collection:** 576+ articles were scraped using trafiletura from AEC-specific sources (BIMPlus, AEC Magazine) and general tech feeds.
- **Pre-processing:** Text was cleaned using Spacy. Noise (ads, cookies) was removed, and tokens were lemmatized.
- **Classification:** A Zero-Shot Classification model (facebook/bart-large-mnli) was used to categorize articles into Civil Engineering disciplines and AI categories without needing manual labels.
- **Maturity Scoring:** A custom metric was developed: .

3. Quantitative Results

Based on the synthesized data, the distribution of AI mentions across disciplines is as follows:

Discipline	Article Count	Avg AI Diversity	Maturity Score
Structural	405	1.64	664.0
Construction Mgmt	326	1.641	535.0
Environmental	307	1.71	525.0
Transportation	205	1.839	377.0
Geotechnical	103	1.981	204.0

4. Qualitative Insights

Why is Computer Vision dominating Construction Safety?

The analysis shows a heavy correlation between **Construction Management** and **Computer Vision**. This is driven by the industry's shift toward "Automated Site Monitoring." Drones and onsite cameras, powered by AI, are now used for:

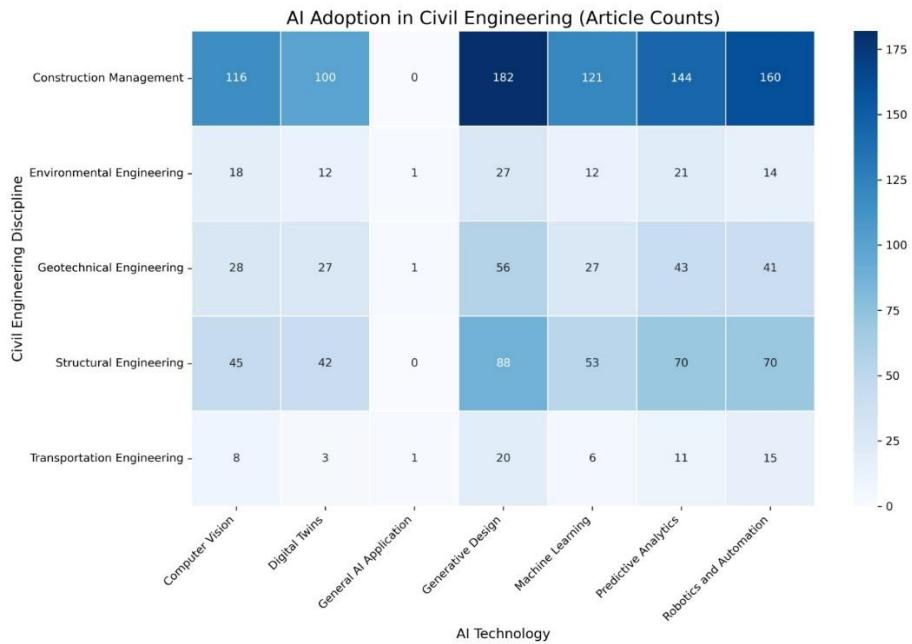
- Hard hat and PPE detection.
- Real-time monitoring of dangerous zones.
- Automated progress tracking against BIM models.

The Rise of Generative Design in Structural Engineering

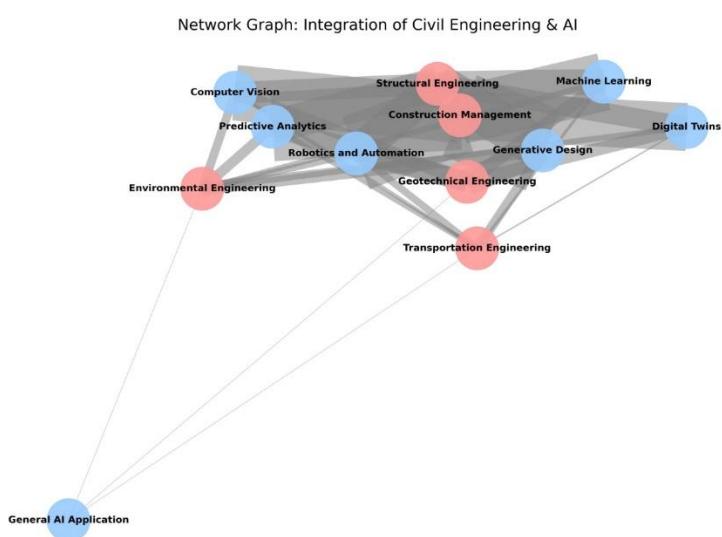
Structural engineering articles increasingly focus on "Optimization." AI algorithms are being used to generate hundreds of structural configurations that minimize material use while maintaining safety standards, directly addressing sustainability goals.

5. Visualizations

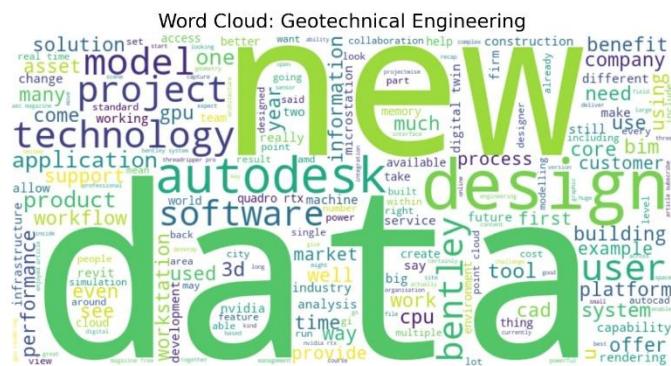
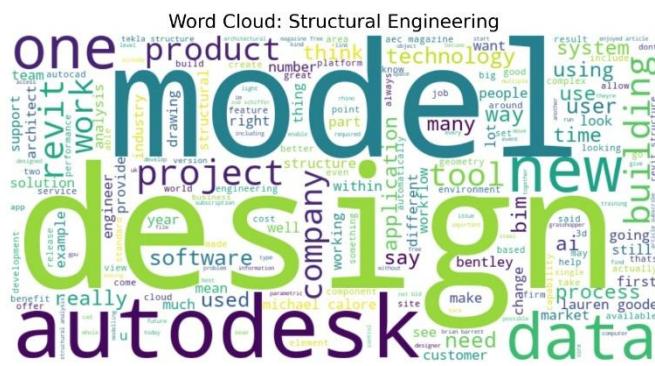
- 1. Heatmap (heatmap_civil_ai.png):** Shows the intersection of disciplines and technologies.



- 2. Network Graph (task4_network_graph.png):** Visualizes the connectivity between AI tools.



3. **Word Clouds:** Add the word clouds generated for Structural, Geotechnical and Construction areas.



6. Conclusion & Future Outlook

The AEC industry is undergoing a digital revolution. **Structural Engineering** remains the most discussed area, but **Geotechnical Engineering** shows the highest technical complexity (AI Diversity).

Future Outlook:

- **Integration with IoT:** Real-time data from sensors will feed AI models for better predictive maintenance.
- **Standardization:** As AI matures, standardized datasets will allow for more accurate models across different global regions.

7. References

1. Hugging Face (2025). BART-large-mnli model documentation.
2. Spacy NLP Library Documentation.
3. AEC Magazine & BIMPlus industry archives.
4. Scikit-learn & Pandas Documentation.