



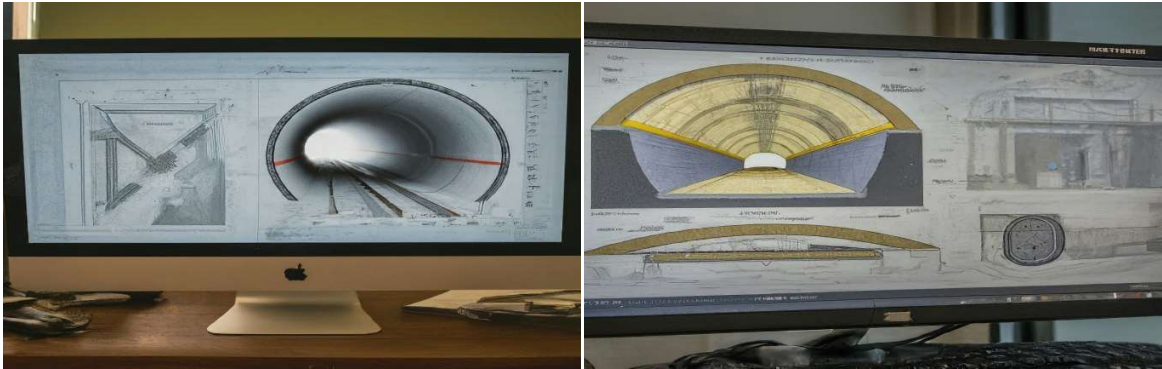
## Case Study: Streamlining Tunnel Design with BIM and Civil 3D in Seattle, USA



### **Project Information:**

Capstone Engineering played a pivotal role in the design of a critical **5-mile tunnel project in Seattle, Washington**. They leveraged Building Information Modeling (BIM) and **Autodesk Civil 3D software** to deliver a comprehensive and efficient design solution. This project aimed to improve traffic flow, freight transportation, etc. by constructing a new underground tunnel with associated infrastructure.

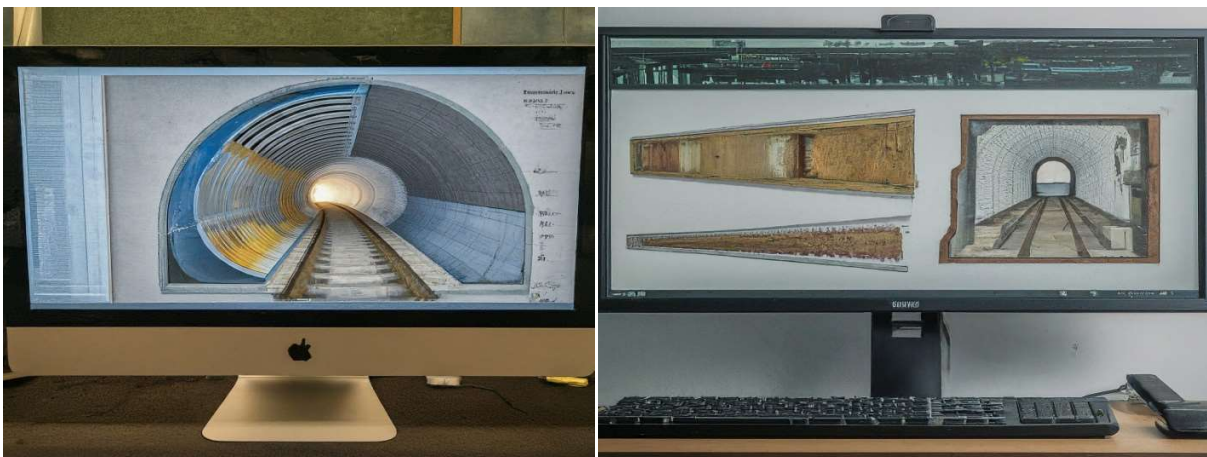
### **Scope of Work:**



The project scope encompassed the following key deliverables:

- Establishment of the horizontal alignment (centerline) and vertical profile of the tunnel.
- Design of typical cross-sections for the tunnel structure.
- Creation of a 3D BIM model of the tunnel using Civil 3D's corridor and assembly features.
- Integration of geological data from geotechnical investigations into the model.
- Calculation of excavation volumes for different geological layers.
- Design of a construction pit with optimized grading for safe and efficient tunnel construction.

**Project Challenges and Solutions by Capstone Engineering:**



**1. Challenge: Precise Alignment and Profile Design:**

**Solution:** Civil 3D's alignment creation tools and profile management features facilitated the creation of an accurate horizontal and vertical alignment that met strict design standards. This ensured optimal tunnel placement and minimized construction complexity.

2. **Challenge: Efficient Cross-Section Design:**

**Solution:** Capstone Engineering utilized Civil 3D's assembly tools to create detailed and reusable cross-sections for the tunnel structure. Subassembly Composer further streamlined the process, allowing for quick modification and updates to the cross-section design.

3. **Challenge: Integrating Geological Data:**

**Solution:** Civil 3D's borehole importer enabled the seamless integration of geotechnical data into the BIM model. This allowed for the creation of a 3D geological representation within the tunnel corridor, facilitating informed decision-making regarding excavation strategies and potential challenges.

4. **Challenge: Accurate Volume Calculations:**

**Solution:** By leveraging Civil 3D's data shortcuts, sample lines, and material volume tables, Capstone Engineering achieved highly accurate volume calculations for different geological layers encountered during tunnel excavation. This facilitated precise material estimation and cost optimization (estimated **15% reduction in excavation cost**).

**Workflow:**

The project followed a well-defined BIM workflow utilizing Civil 3D's capabilities:

1. **Establish Horizontal and Vertical Geometry:** Alignment creation tools and profile management features were used to define the tunnel's centerline and elevation.
2. **Design Cross-Sections:** Assemblies and Subassembly Composer facilitated the creation and modification of detailed tunnel cross-sections.
3. **Create 3D Tunnel Model:** The corridor tool combined different assemblies to create a comprehensive 3D model of the tunnel.

4. **Integrate Geological Data:** Borehole importer and surface creation tools enabled the integration of geotechnical data into the model.
5. **Calculate Excavation Volumes:** Sample lines, section views, and material volume tables provided accurate volume calculations for different geological layers.
6. **Design Construction Pit:** Feature Line and Grading tools were used to design a safe and efficient construction pit with optimized grading.

#### **Value Addition:**

Beyond overcoming design challenges, BIM with Civil 3D delivered significant value:

- **Enhanced Collaboration:** The BIM model facilitated seamless collaboration between engineers, geologists, and construction teams, fostering a unified approach to project execution.
- **Improved Design Accuracy:** Integration of geotechnical data and clash detection capabilities minimized design errors and ensured constructability.
- **Reduced Construction Costs:** Accurate volume calculations and optimized excavation strategies led to cost savings (estimated **15% reduction**).
- **Increased Project Predictability:** BIM facilitated proactive identification and resolution of potential issues, enhancing project predictability and minimizing delays.

#### **Conclusion:**

This case study demonstrates the effectiveness of BIM with Civil 3D for optimizing tunnel design projects. By leveraging Civil 3D's comprehensive tools and functionalities, Capstone Engineering achieved a high level of design accuracy, improved collaboration, and cost-effective solutions, paving the way for a successful tunnel construction project in Seattle.