

AI-Powered Verification for Roadway Alignment Design Standards



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Outline

Introduction

Standards / Criteria Applied in Roadway Alignments

Demo of AI-Powered Verification of Roadway Design Standards

Brief Introduction of Other AI-Powered Applications

Summary and Key Takeaways

Q&A Session

Introduction

Common Critical Project Pain Points:

1. Tight Scheduling
2. Limited Alternative Solutions
3. Cross-Discipline Coordination and Communication
4. Resource Allocation
5. Criteria and Standards
6. Experience
7. Technology Learning Curve
8. Limited Automation
9. Data Collection and Analysis
10. Unbalance Workload and Manpower

Introduction

This presentation introduces a cutting-edge AI-powered solution that revolutionizes alignment verification. By automating the process, this technology can check and validate over 20 design criteria in minutes, regardless of project size. Key benefits include:

Instant Verification

Automatically re-verify alignments after every design change, ensuring accuracy without added effort.

Time Savings

Reduce verification time from weeks to minutes, accelerating project timelines.

Enhanced Consistency

Eliminate human error and ensure alignments consistently meet design standards.

Standards / Criteria Applied in Roadway Alignments

1. Min Horizontal Curve Length ($L_{min} = 3V$)
2. Maximum Algebraic Difference Without Horizontal Curve(%)
3. K Value By Design Speed
4. Maximum Algebraic Difference Without Vertical Curve(%)
5. Min Grade (%)
6. Max Grade (%)
7. Min Vertical Curve Length (ft) ($L_{min} = 3V$)
8. Minimum Horizontal Curve Radius
9. Drainage Issue - Profile Grade $< 0.3\%$ and Cross Slope $= 0\%$
10. Vertical Headlight Sight Distance
11. Ratio of Flatter and Sharper Radius in Compound Curve (2:1)
12. Broken Back Curve Exists
13. Minimum Length of Circular Arcs for Compound Curve Radii
14. Minimum Edge-of-Pavement Grade (Curb $=0.5\%$, Uncurb $=0.2\%$)
15. Desired Maximum Relative Gradient
16. Short Tangent on A Crest between Two Horizontal Curves
17. Sharp Angle Appearance May Exist(AASHTO page 383 case E)
18. Disjointed Effect May Exist(AASHTO page 384 Case M)
19. Horizontal Alignment Curve Radius Round to
20. Vertical Alignment VPI Round to
21. Vertical Alignment Curve Length Round to
22. Stationing Goes from South to North or West to East

Demo of AI-Powered Verification of Roadway Design Standards

Interface of Validation

Project Size: ~ \$1B

Alignments: 50

Time Spend: ~ 1 min.

Total Time: ~ 10 min.

Alignment and Profile Validation

ProjectInterchange 1

ValidateSavePrintClose

Criteria

Select	Name	Threshold Value
<input checked="" type="checkbox"/>	Min Horizontal Curve Length (ft)	
<input checked="" type="checkbox"/>	Maximum Algebraic Difference Without Horizontal Curve(%)	1
<input checked="" type="checkbox"/>	K Value By Design Speed	
<input checked="" type="checkbox"/>	Drainage Issue - Profile Grade < 0.3% and Cross Slope = 0%	
<input checked="" type="checkbox"/>	Maximum Algebraic Difference Without Vertical Curve(%)	0.2
<input checked="" type="checkbox"/>	Min Grade (%)	
<input checked="" type="checkbox"/>	Max Grade (%)	
<input checked="" type="checkbox"/>	Min Vertical Curve Length (ft) (L min = 3V)	
<input checked="" type="checkbox"/>	Vertical Headlight Sight Distance	

Alignment

Select	Alignment	Profile
<input checked="" type="checkbox"/>	820NMEA	
<input checked="" type="checkbox"/>	820NMEA	820NMEAP
<input checked="" type="checkbox"/>	CRAIG	
<input checked="" type="checkbox"/>	CRAIG	CRAIGP
<input checked="" type="checkbox"/>	I820NBFRS1	
<input checked="" type="checkbox"/>	I820NBFRS1	I820NBFRS1P
<input checked="" type="checkbox"/>	I820S1	
<input checked="" type="checkbox"/>	I820S1	I820S1P
<input checked="" type="checkbox"/>	I820SBFRS1	
<input checked="" type="checkbox"/>	I820SBFRS1	I820SBFRS1P

Result

Alignment	Profile	Station	Criteria	Threshold Value	Current Value
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Demo of AI-Powered Verification of Roadway Design Standards

Interface of Validation

Standard Criteria
Applied in the Project

Roadway Management

Project: Interchange 1

Roadway

Name
820N MEA Off Ramp
820SLAN
820SROS
HI 820 Segment 1
I820 NB Frontage Road
I820 SB Frontage Road
Lan820N
Mea 820S On Ramp
Rose820N

Basic Information | Segment Exception | Criteria Checklist | Preference Setting | Typical Sections

Name: Lan820N Set Road Limit? No

Roadway Characteristics

Category:	Ramp	Current Year:	2021	Design Vehicle:	WB-67
Function Class:	Collector	Current AADT:	3000	% Truck (current):	5
Terrian:	Flat	Design Year:	2041	Post Speed (mph):	45
Pavement Type:	Rigid	Design AADT:	3000	Design Speed (mph):	50

Geometric Design Criteria

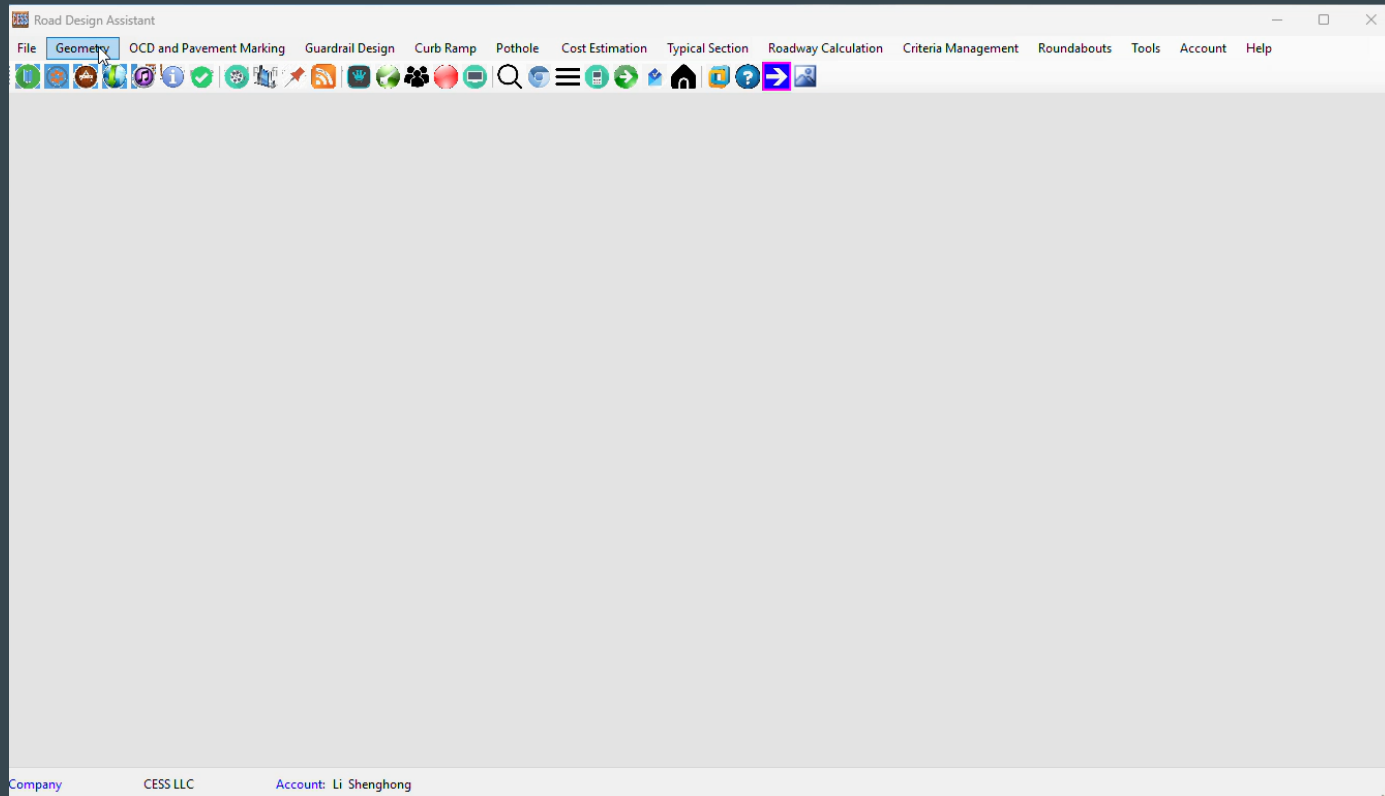
Criteria	Value
Horizontal Alignment Criteria	
Maximum Curvature (Minimum Radius) (ft)	833
Superelevation (e) Max (%)	6
Maximum Curvature (Minimum Radius) Without Superelevation (ft)	7870
Maximum Algebraic Difference Without Horizontal Curve (%)	1
Vertical Alignment Criteria	
Maximum Gradient (%)	5
Minimum Gradient (%)	0.5
Minimum K Value of Crest Vertical Curve	84
Minimum K Value of Sag Vertical Curve	96
Max Algebraic Difference w/o Vertical Curve (%)	0.5
Vertical Clearance - Roadway (ft)	16.5
Vertical Clearance - Railroad Underpass (ft)	16.5
Vertical Clearance - Railroad Overpass (ft)	23.5
Cross Section Criteria	
Rotation Lanes	0
Lane Widths (ft)	
Inside Shoulder Type *	
Inside Shoulder Width (ft)	
Outside Shoulder Type *	
Outside Shoulder Width (ft)	
Normal Cross Slope (%)	
Clear Zone Width (ft)	
Side Slope Within Clear Zone *	
Side Slope Outside Clear Zone *	
Curb and Barrier Offset (ft)	
Sidewalk Width (ft)	
Curb and Gutter Type (Typ.) *	
Curb and Gutter Width (ft)	

Roadway: Lan820N CAD File: D:\Test Data\H820\Working File\SEC-S1_RDWY_PAV.dgn

Demo of AI-Powered Verification of Roadway Design Standards

Demo

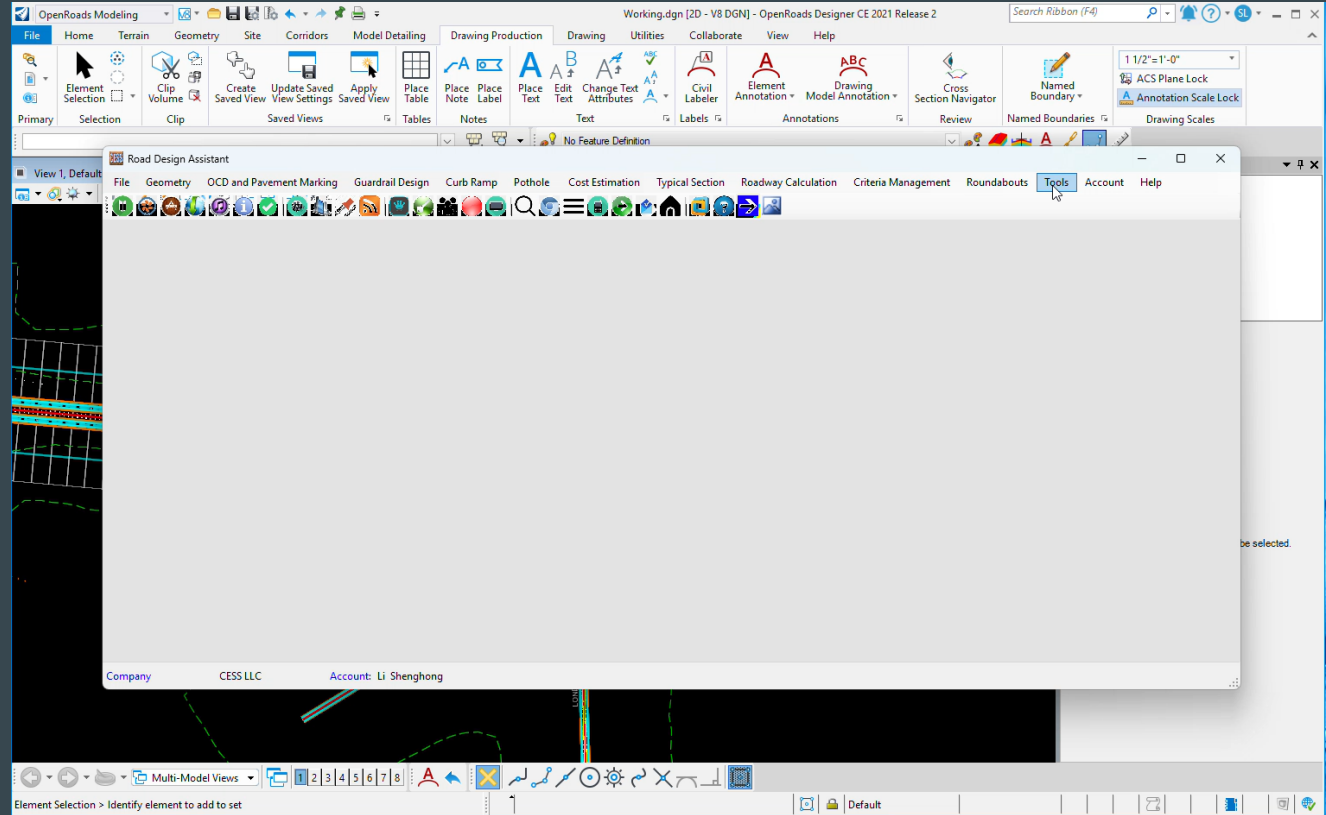
AI-Powered Validation
Process



Demo of AI-Powered Verification of Roadway Design Standards

Demo

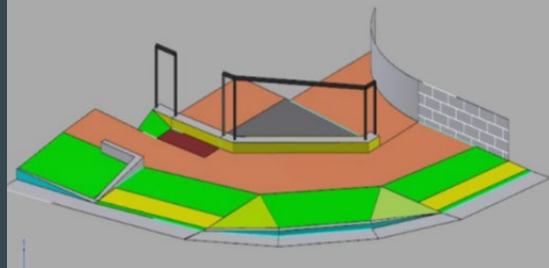
Real-Time Tracking
and Validating



ADA Curb Ramp Design

Time from 60 hours to 3 hours

Time from 60 hours to 3 hours



PERCENT SLOPE	1.00	2.00	3.00
EQUVALENT SLOPE	8000	500	200

SLOPE TABLE

STANDARD PLAN NO.	M-608-1	
		Sheet No. 1 of 10

Challenges Facing Civil Engineers in Embracing AI

1. Job Security Concerns

- Like it or not, AI is here to stay. The best way forward is to embrace its presence and adapt by learning to use it effectively. In the short term, AI cannot fully replace our work.

2. Resistance to Adopting New Technologies

- No solution.
- Just try!

3. Skepticism Toward AI Reliability

- Start with minor commitments to the idea you're skeptical about and assess the outcomes. This can build confidence without feeling overwhelming.

4. Skill and Knowledge Gaps

- Engineers may not want to be the first person or company to use AI until it becomes more widespread.

5. Economic Impact

- The use of AI could disrupt traditional business models, potentially affecting how firms monetize their expertise and services.

Solutions of Concerns and Worries

1. Job Security Concerns

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- The best way forward is to embrace its presence and adapt by learning to use it effectively. In the short term, AI cannot fully replace our work.

2. Resistance to Adopting New Technologies

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3. Skepticism Toward AI Reliability

- Start with minor commitments to the idea you're skeptical about and assess the outcomes.
- This can build confidence without feeling overwhelming.
- Apply logic and past experience to critically evaluate AI recommendations.
- For significant decisions, always reserve the option to rely on our own judgment.

Solutions of Concerns and Worries

4. Skill and Knowledge Gaps

- Through our demo, we can see that understanding how AI works isn't a prerequisite, as all the interfaces are designed to be userfriendly and easy to operate.

5. Economic Impact

- Adapt business strategies to seamlessly integrate AI while capitalizing on the distinct value of human expertise to sustain a competitive advantage

Questions?

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