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PRESENTATION

Streetcar Design

Integrating Streetcars into Dense Urban Environments – Luke Olson, PE

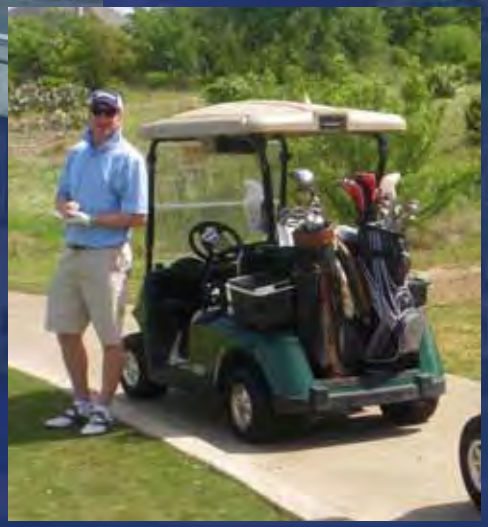
06/19/2010

URS

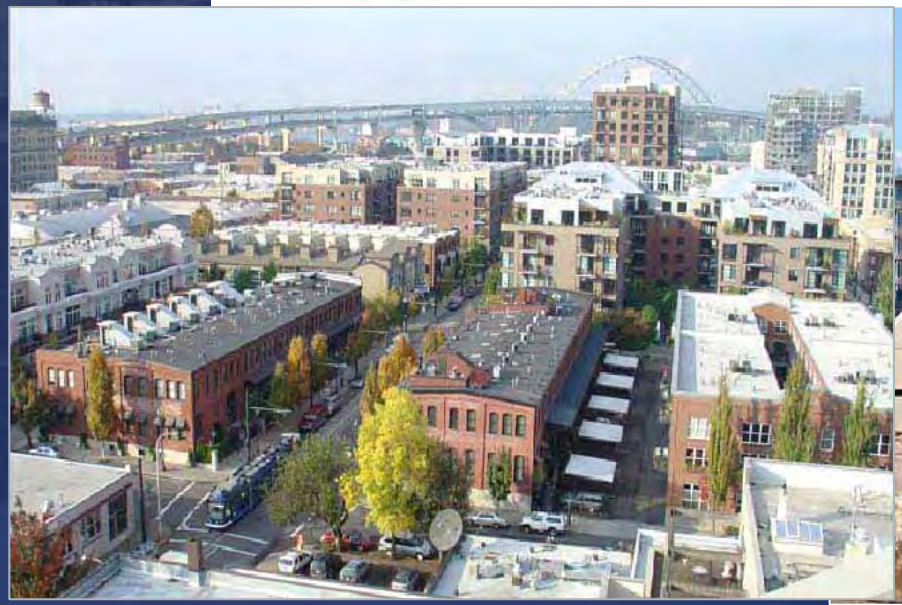
URS Corporation – Austin

Speaker Background

- Engineer of Record for Portland Streetcar "Loop"
- Lead Track Engineer for Tucson Streetcar
- Other Streetcar Studies:
  - Austin, TX
  - Ft. Worth, TX
  - Boise, ID
  - Albuquerque, NM
  - San Francisco, CA
  - Brooklyn, NY
  - Detroit, MI
  - Minneapolis, MN
  - Baltimore, MD
  - Charlotte, NC



Why Streetcar?



Take-Away Points

- Anatomy of a successful streetcar project
  - Early agreement of design approach and concepts
  - Understanding streetcars and streetcar design
  - Planning ahead to save money
  - Challenging issues: Is the benefit worth the cost of the solution?

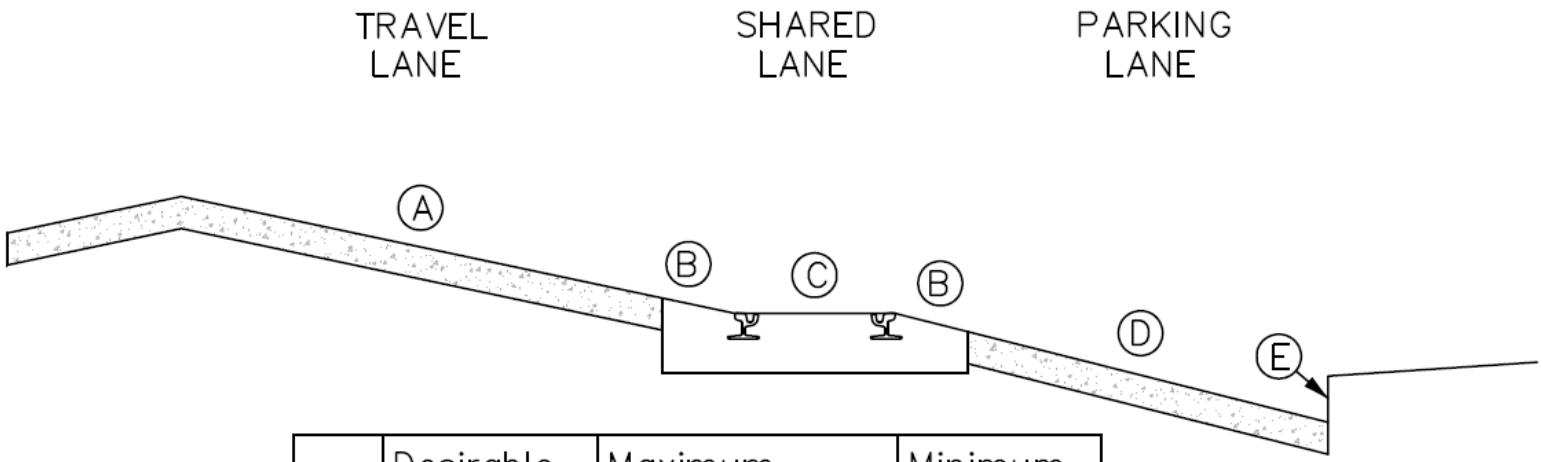
Project Development – Early Stages

- Basis of Design – Project Approach
  - Design Standards
  - Project Goals
  - Project Requirements Vs. Betterments
  - Stakeholder Consensus

Appropriate Design Standards

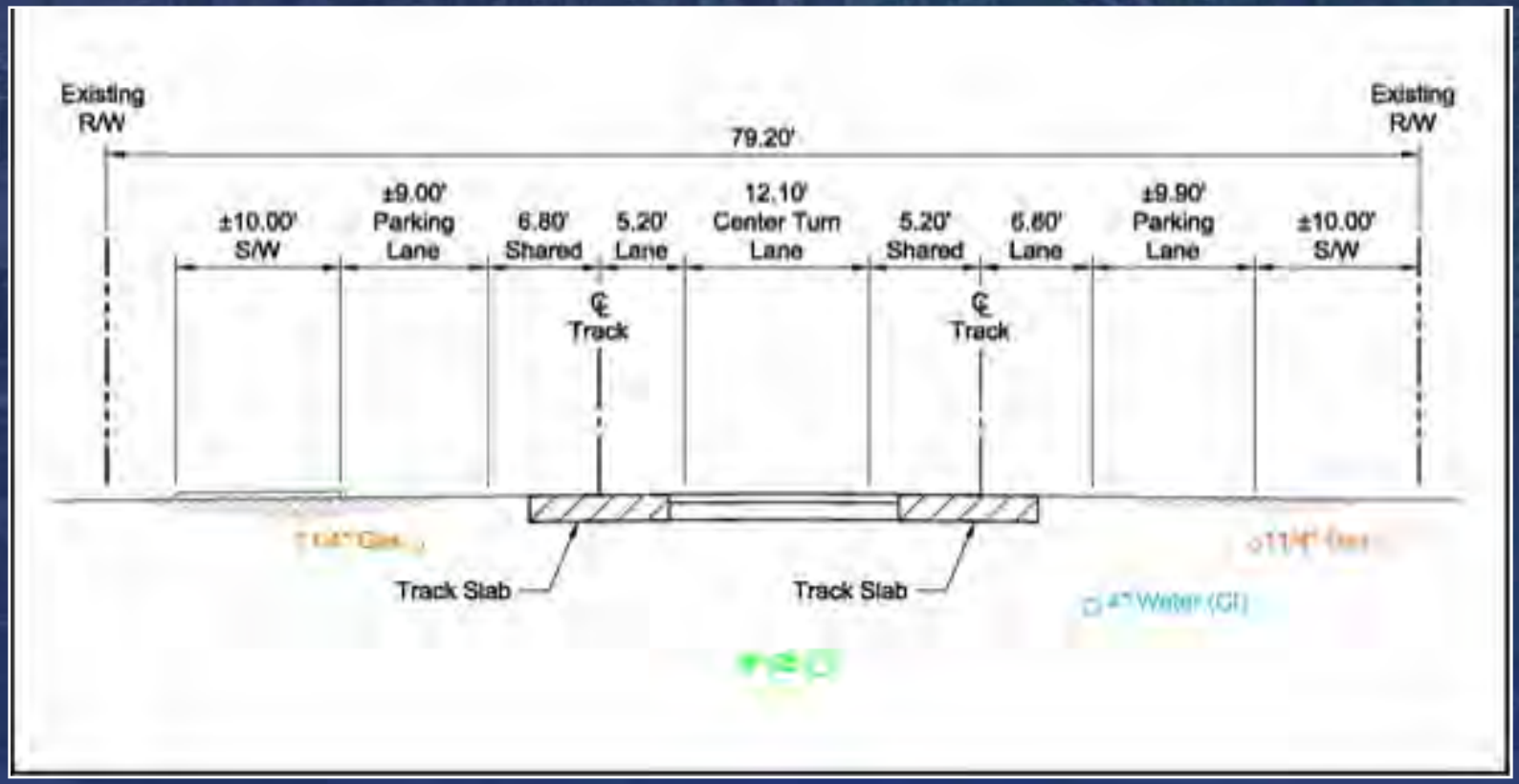
Streetcar Design - Roadway

PROPOSED ROADWAY CROSS SLOPES FOR USE IN FINAL DESIGN

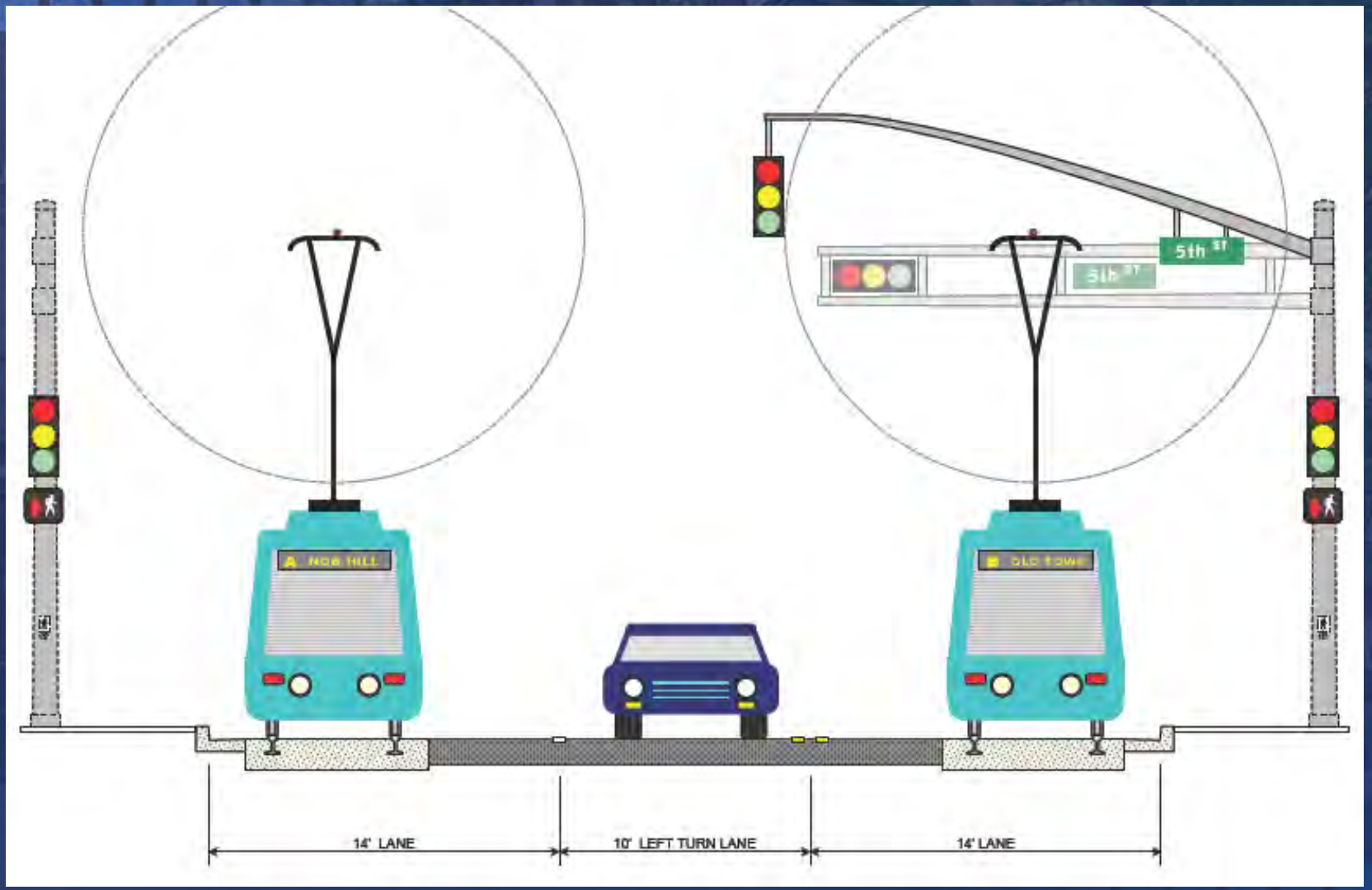


	Desirable	Maximum	Minimum
A	2%	3% or Existing	
B	0%	3%	
C	0%		
D	4–6%	7%	
E	6”		4”

Streetcar Design - Utilities



Streetcar Design - Signals



Streetcar Design – Joint Use Poles

Streetcar Design – Minimizing Poles

Streetcar Design – Pole Foundation - Getting Creative

Streetcar Design – Transit Only Phase

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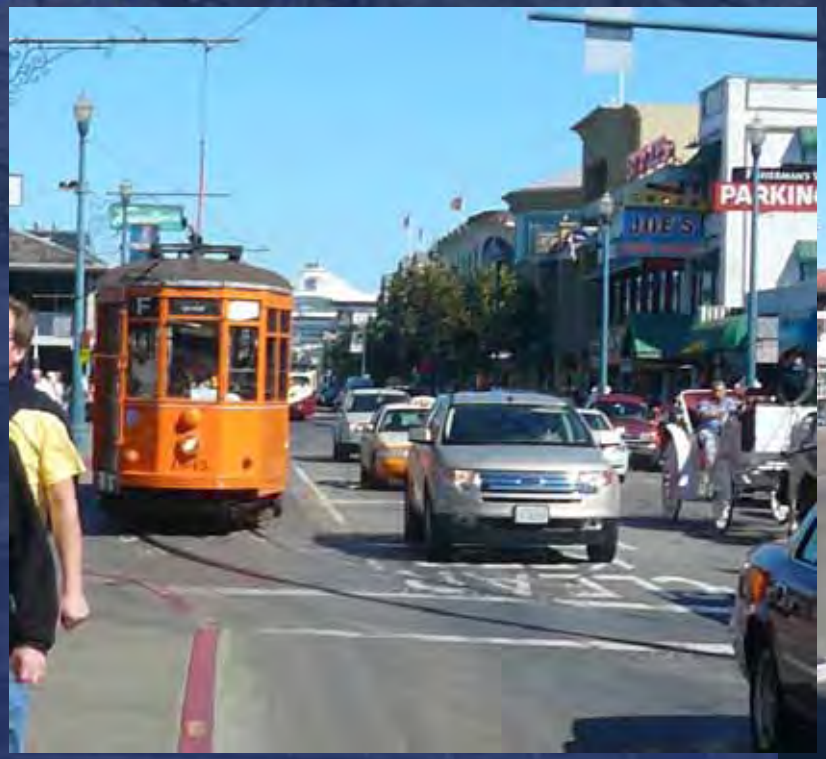
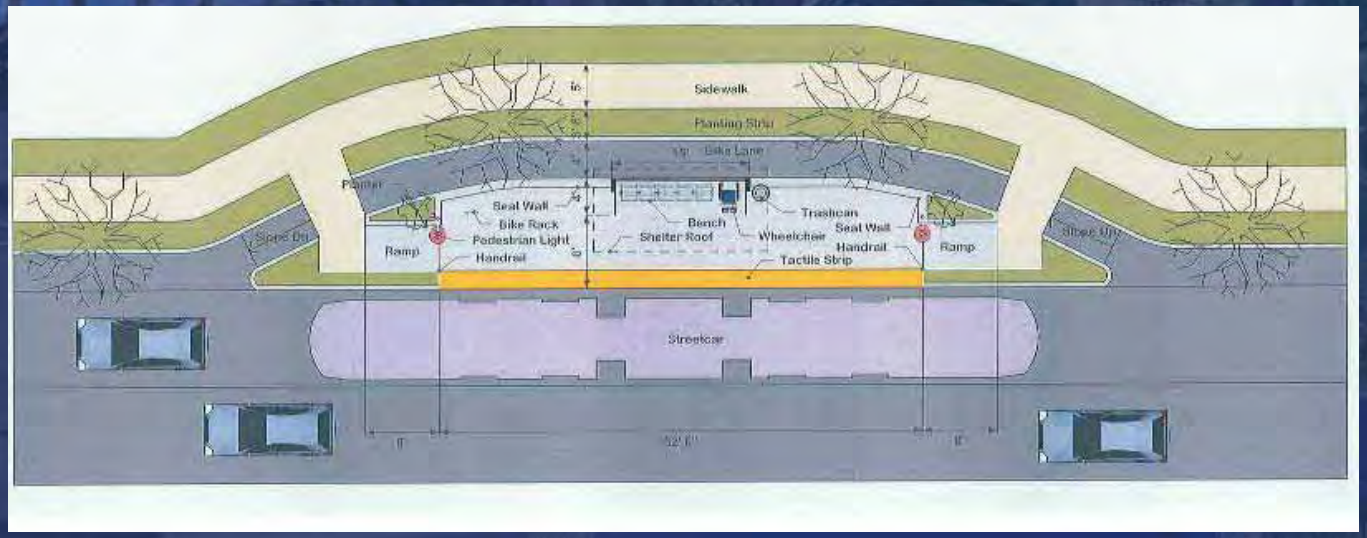


Streetcar Design – Type of Operation (Sharing the road)

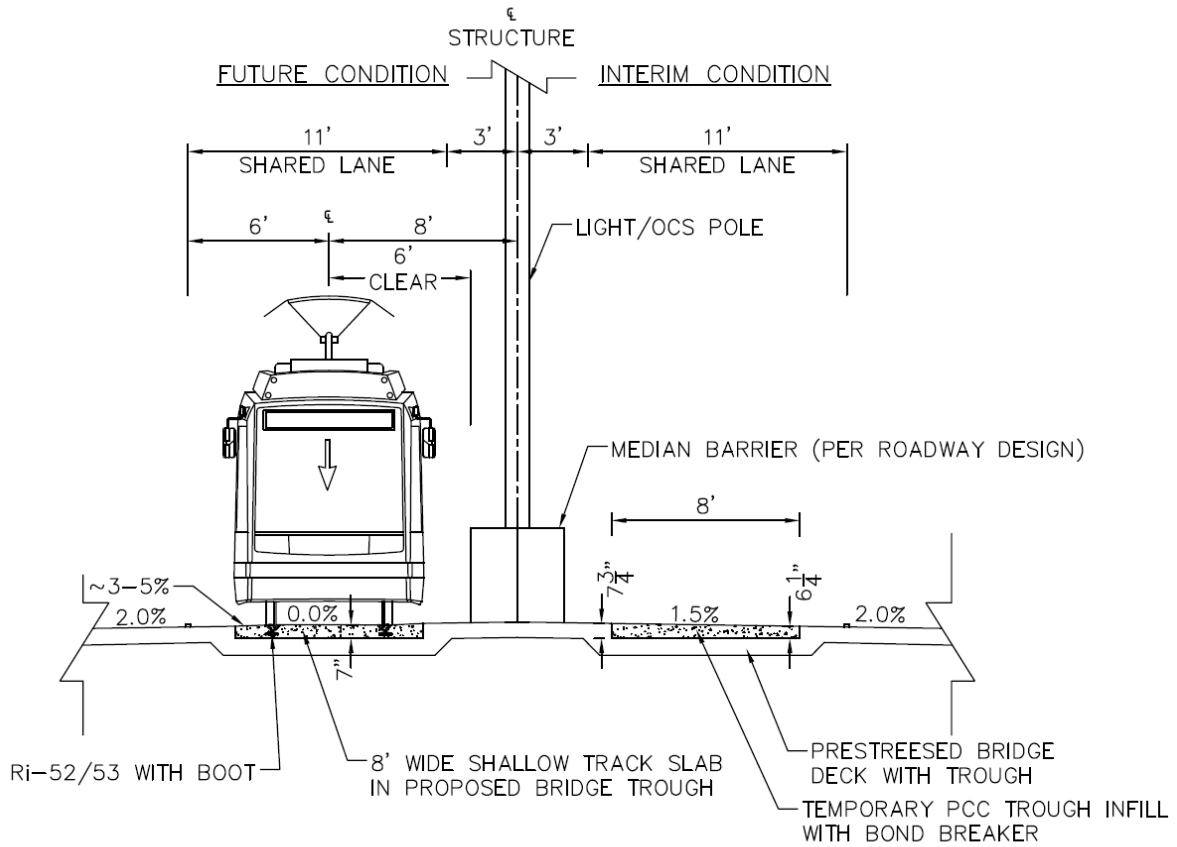
Streetcar Design - Type of Operation (Semi-Exclusive)

Streetcar Design: Accommodating Cyclists



Streetcar Design –Pedestrian Access at Stops

Planning Ahead – Anticipated Future Streetcar



7TH STREET BRIDGE SECTION
N.T.S.

Challenging Issues – Creative Solutions

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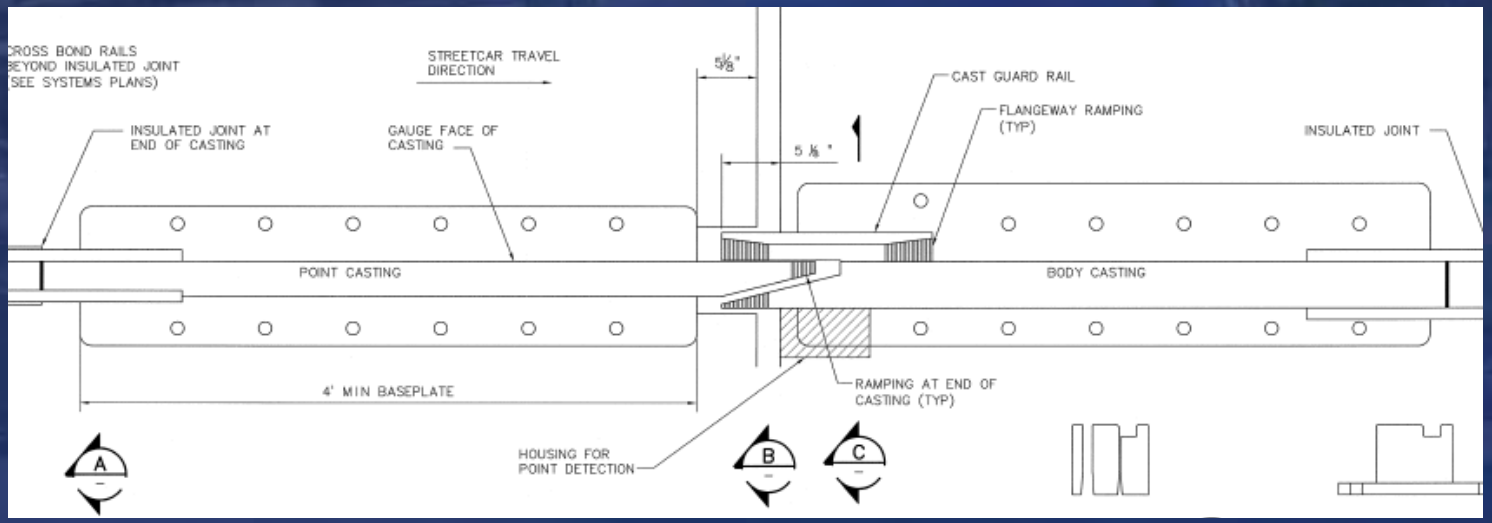
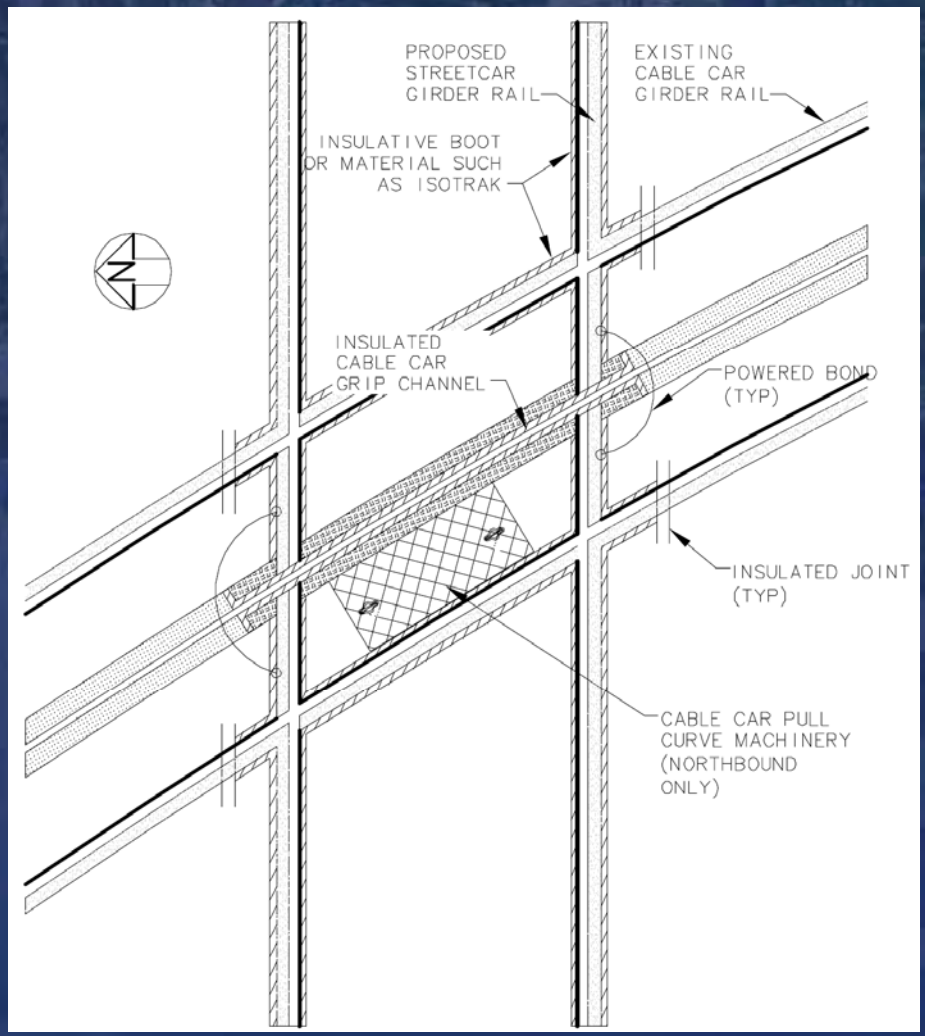
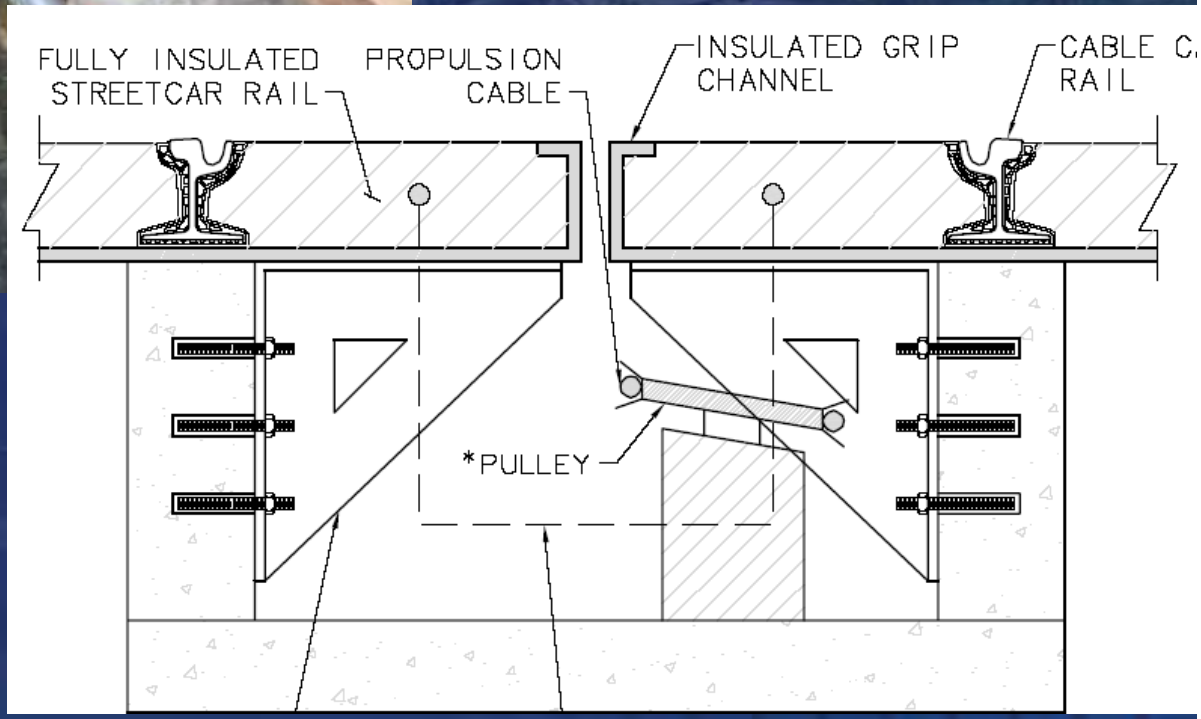


Challenging Issues – Creative Solutions

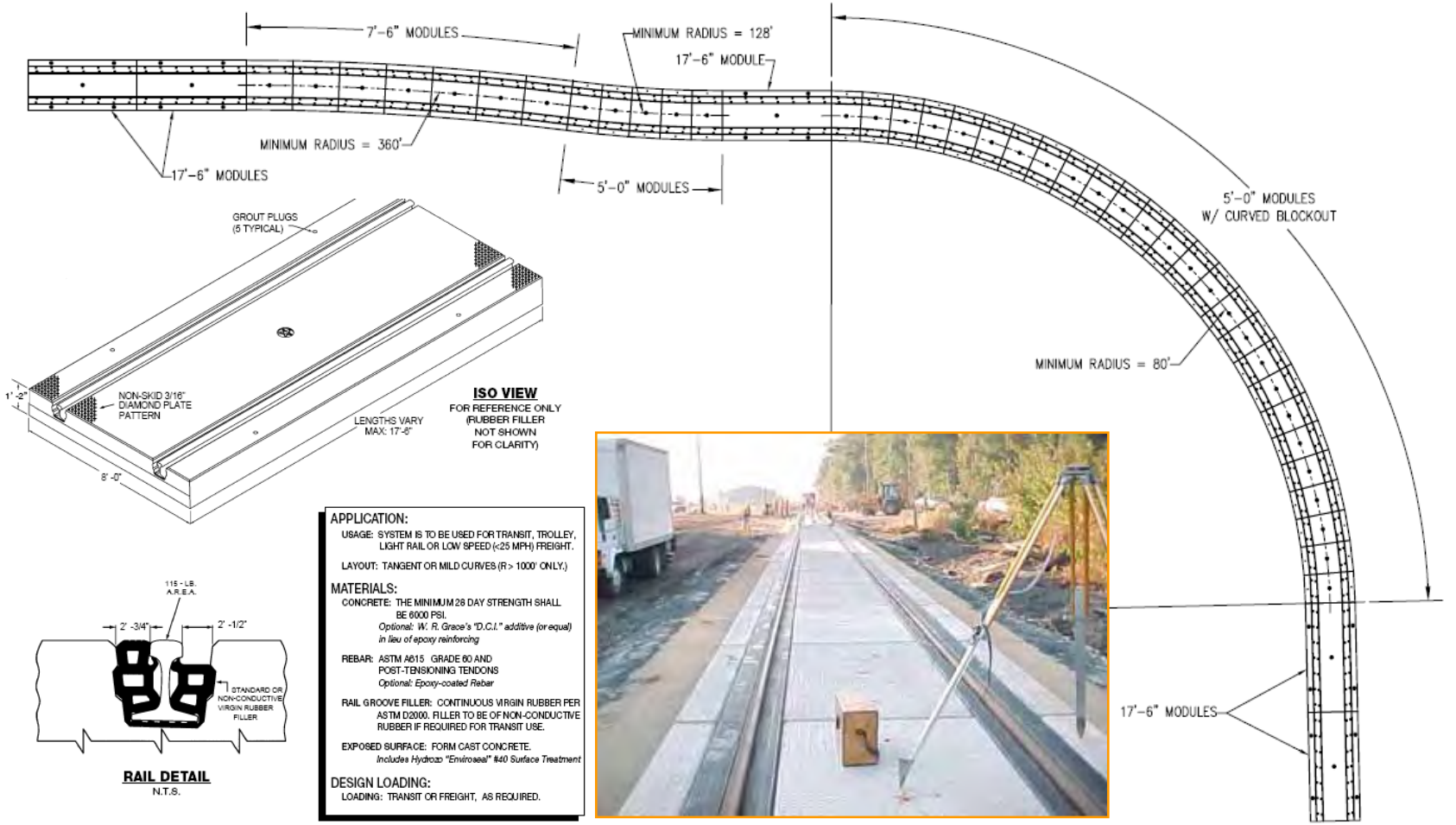


Challenging Issues – Creative Solutions



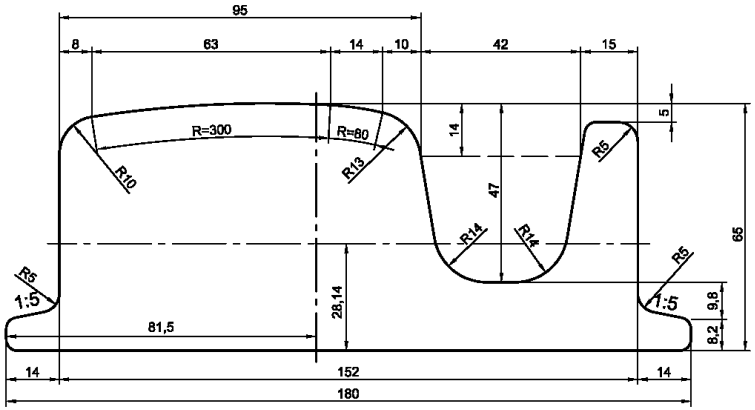
Creative Solutions: Access to Utilities

Removable Track ("Zipper Track")



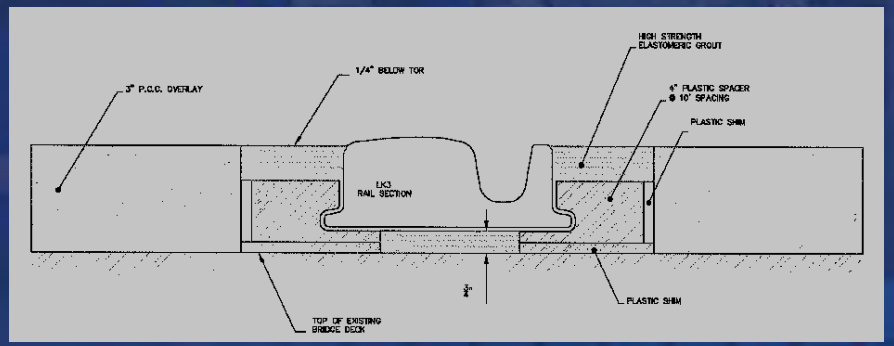
Creative Solutions: Shallow Utilities

Ultra Low Profile "Block Rail"



Grooved rail LK3 Weight: 63,91 kg/m Area: 8142 mm^2
Moment of inertia X-X: 271 cm^4
Y-Y: 165 cm^4
non dimensioned radiuses: 3 mm

Minimize dead load – 3" Section



Creative Solutions: Low Clearance

BQE Overpass at Atlantic Avenue

National Electric Safety Code

Nature of surface underneath wires, conductors, or cables	Trolley and electrified railroad contact conductors and associated span or messenger wires	
	0 to 750 V to ground (ft)	Over 750 V to 22 kV to ground (ft)
3. Driveways, parking lots, and alleys[23]	18.0[5]	20.0[5]
4. Other land traversed by vehicles, such as cultivated, grazing, forest, orchards, etc.[26]	—	—
5. Spaces and ways subject to pedestrians or restricted traffic only[9]	16.0	18.0

SOLUTIONS FOR UNDERCROSSINGS

- Create transit only lane
- Lower roadway profile
- Consider operating on battery power through underpass
- Prohibit trucks and install wire guards

Minimum Pantograph Operating Height

7. MINIMUM ASBUILT CONTACT WIRE HEIGHT	FT.	IN.
TRACK VERTICAL TOLERANCE	0	0.5
MAXIMUM VEHICLE PANTOGRAPH LOCKDOWN HEIGHT	13	0
MINIMUM PASSING CLEARANCE	0	3
VEHICLE VERTICAL BOUNCE	0	1
REQUIRED MINIMUM ASBUILT CONTACT WIRE HEIGHT UNDER ANY OPERATING CONDITION	13	4.5

Conclusion Take-Away Points

- Anatomy of a successful streetcar project
  - Early agreement of design approach and concepts
  - Understanding streetcars and what it takes
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Questions?

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