

A CASE STUDY ON EDUCATING ENGINEERING STUDENTS ON THE CHALLENGES OF URBANIZED AT-GRADE INTERSECTIONS

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Concept for Educating Engineers

- Senior-Level Undergraduate Professional Practices for Engineering course
 - Open to all engineering majors, but primarily civil engineers take it
- Professional Partners
 - Real stakeholders, real problem to solve, and a real community impacted
- Objective of Case Study
 - Engage undergraduates in feasibility study and design concept

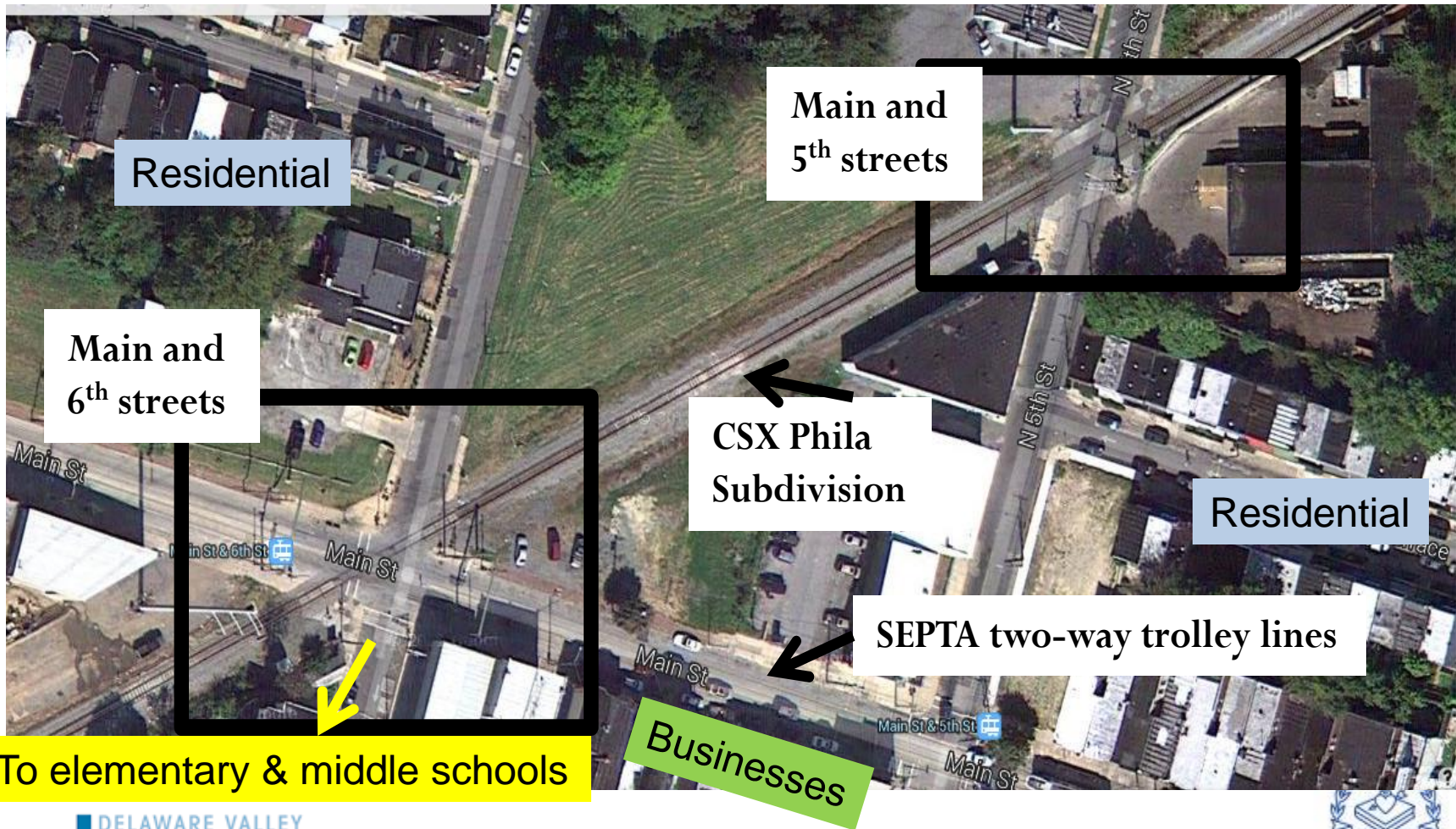
Concept for Educating Engineers

- Why expose engineering students to complexities of urbanized at-grade crossings?????
- ABET accreditation requirements
 - Outcome f
an understanding of professional and ethical responsibility
 - Outcome h
ability to understand the impact of engineering solutions in a global, economic, environmental, and societal context
 - Outcome j
knowledge of contemporary issues

Presentation Elements

- Introduction to case study's crossing project
- Description of case study's course format
- Educational aspects of case study project
- Technical aspects of case study project
- Outcomes on technical aspects
- Outcomes on educational aspects
- Conclusions on educational value

Introduction to case study's crossing project



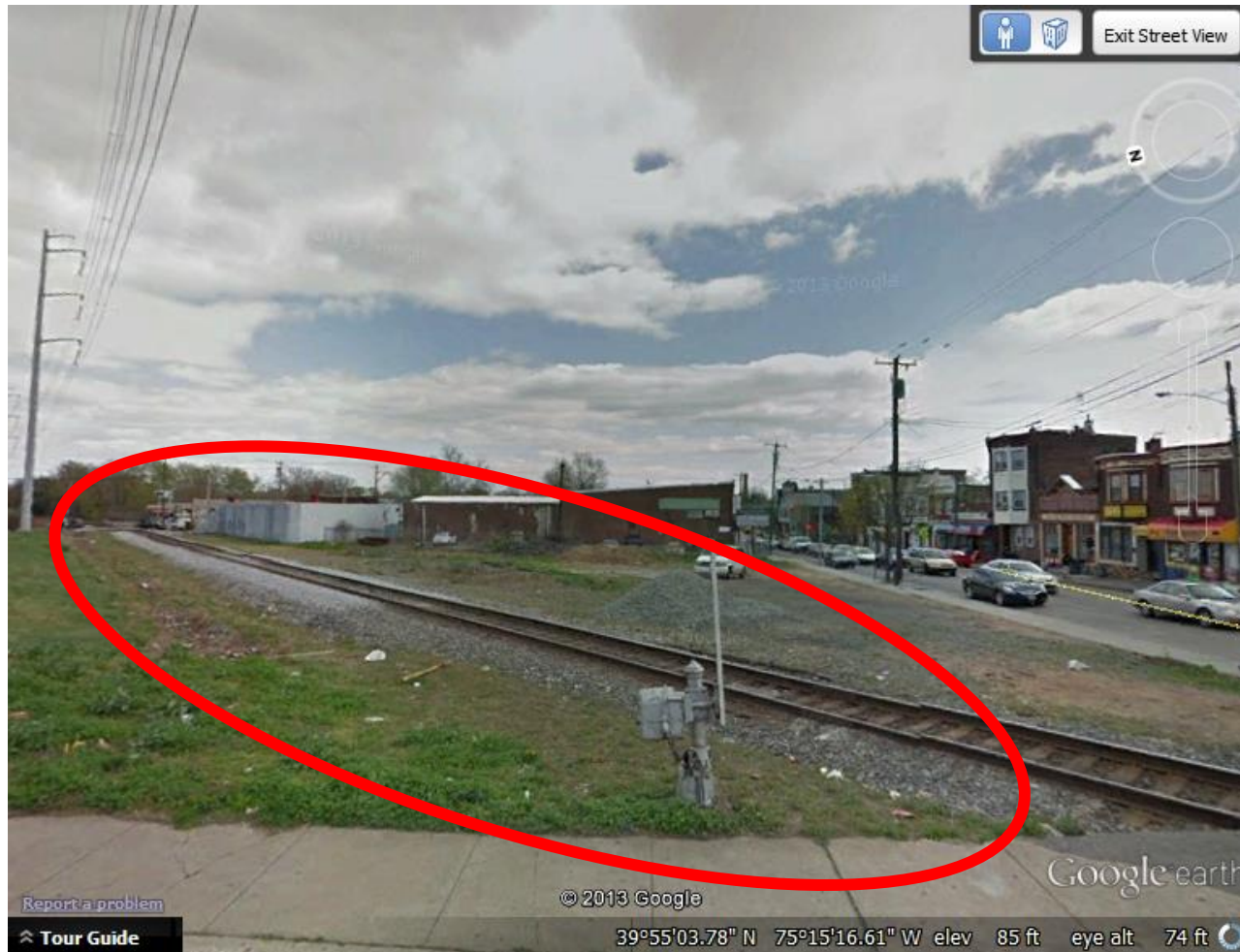
Current Site Conditions at Grade Crossing



Current Site Conditions at Grade Crossing



Current Site Conditions at Grade Crossing



Current Site Conditions at Grade Crossing



Current Site Conditions at Grade Crossing



Summary of Intersection Issues

- Very little or clear signage at entry points or in advance of intersection
 - One stop sign for entire intersection
- Tracks outside of intersection are open to public entry
- Cars often stopped on tracks
 - Four Quadrant gates suggested
- Unsafe Crosswalks
 - Pedestrians aren't guided to use crosswalks

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Description of Course Format

Focus:

- Project format - holistic, broad, and conceptual in nature and can be described more as the conceptual design (30% complete) stage of a more traditional Capstone design project
- Railway engineering - broader initiative at Villanova University to integrate more railway engineering into various parts of the undergraduate civil engineering curriculum

Student Task Guidance for Project

- Identify primary at-grade intersection issues
- Identify Benefits
- Identify Costs
- Quantify the Benefit-Cost Ratio
- Envision stakeholder roles and responsibilities
- Public Survey – (initiated by students, not required)
- Identify Challenges

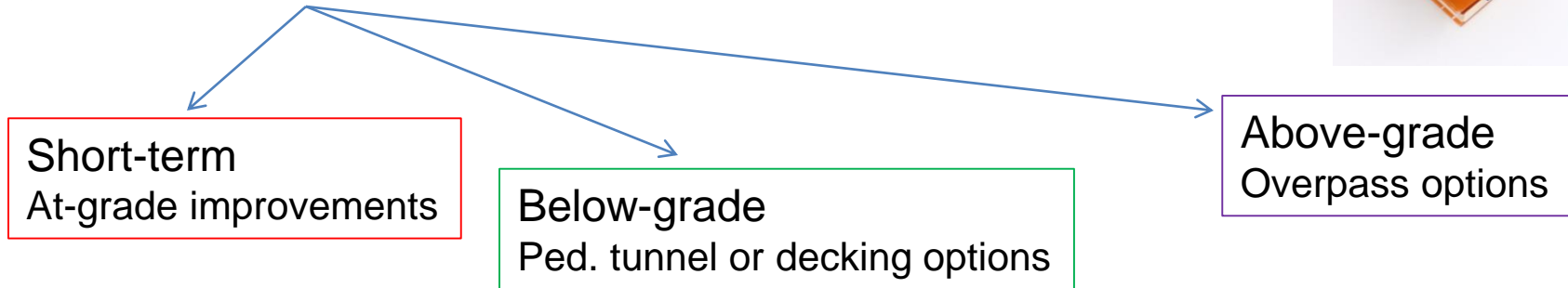
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Educational Aspects



3 student teams



3 groups per team, 4 - 5 people per group

Group A

What is the
how will it be
Who is resp

Group B

What will the
How will pe

Group C

What must be addressed & overcome before the improvements can be advanced?
Consider funding composition & marketing/visibility issues.
Will it be a single improvement or part of an overall railroad corridor program?

Educational Aspects

Educational Goal:
encourage student a
findings

Outcome of Goal
Foster student comf
allow information fro

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points

CEE 4601 Professional Practices in Engineering

Railway Engineering

CRASH COURSE
CRASH COURSE

Watch these recorded lectures from the graduate course, CEE 7300 Railway Engineering, to learn more about the following topics that will help you in the technical aspects of your semester project:

<http://153.104.46.173/engineeringDE/Catalog/pages/catalog.aspx?catalogId=a440c126-1372-481f-8c58-21838f3e4cc8>

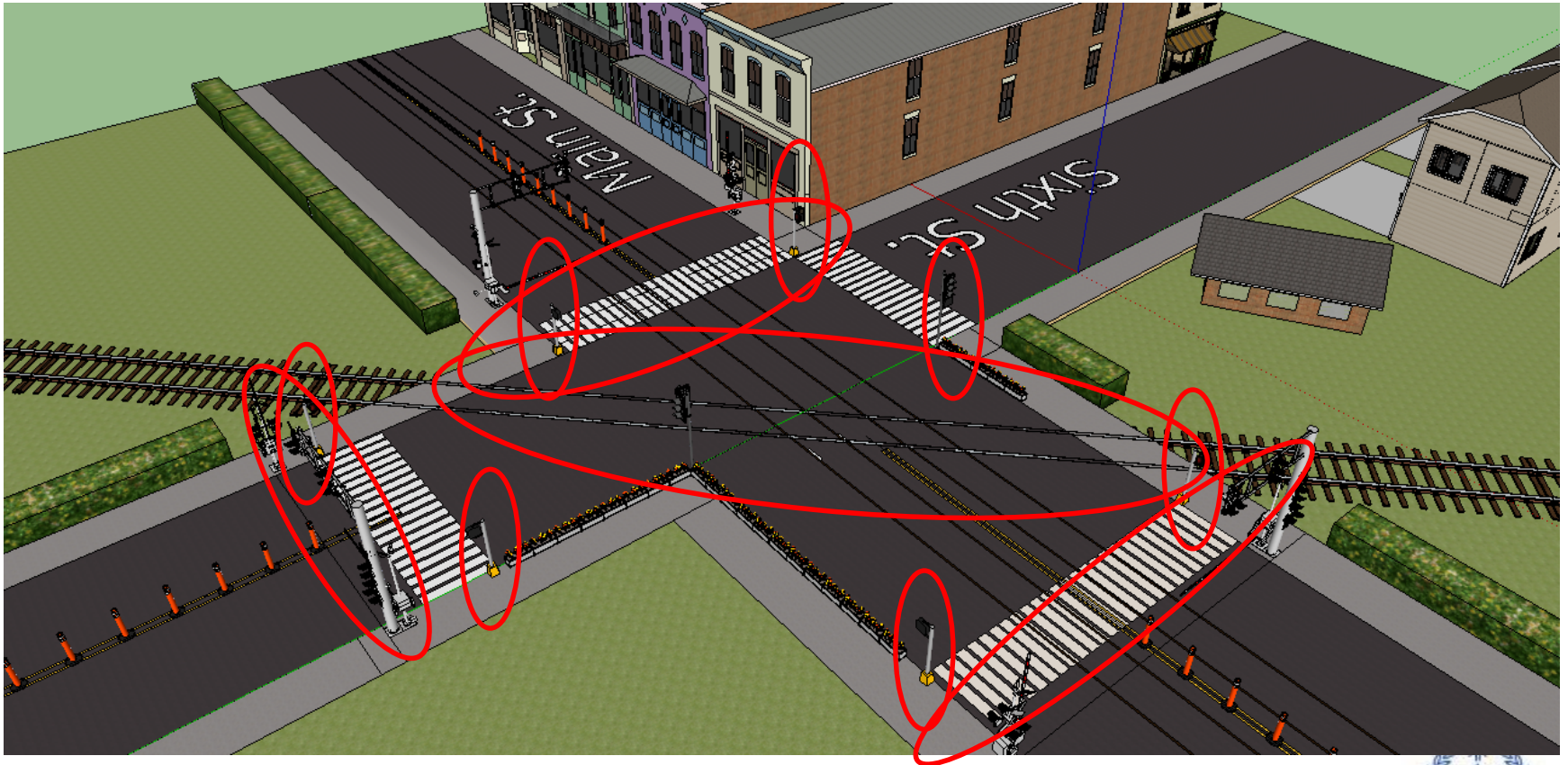
Railroad Infrastructure: [CEE 7300 Lecture 2](#), Dr. Leslie McCarthy, Monday, June 04, 2012

Railroad Geometric Alignment: [CEE 7300 Lecture 7b](#), Dr. Leslie McCarthy, Weds, June 27, 2012

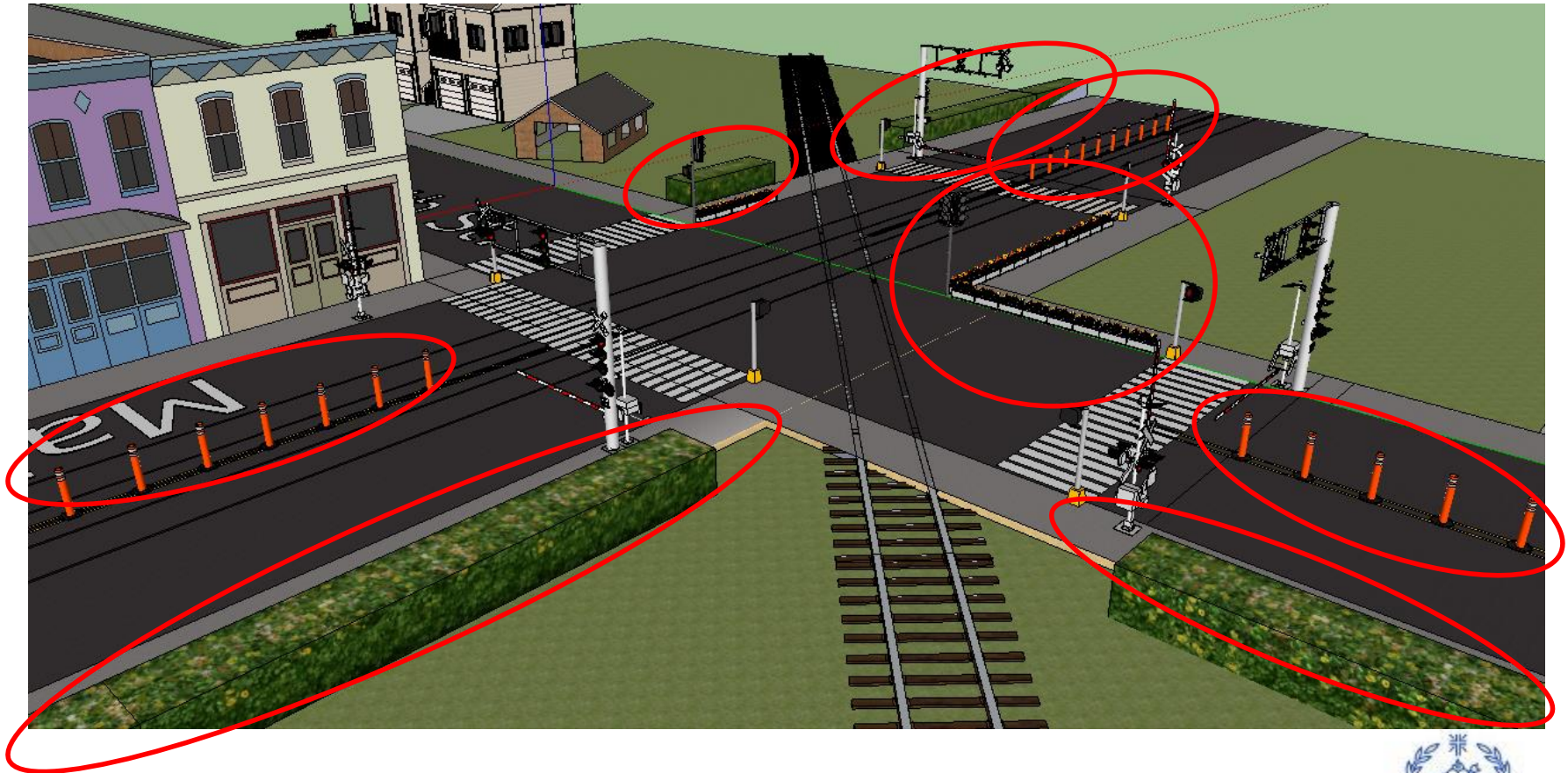
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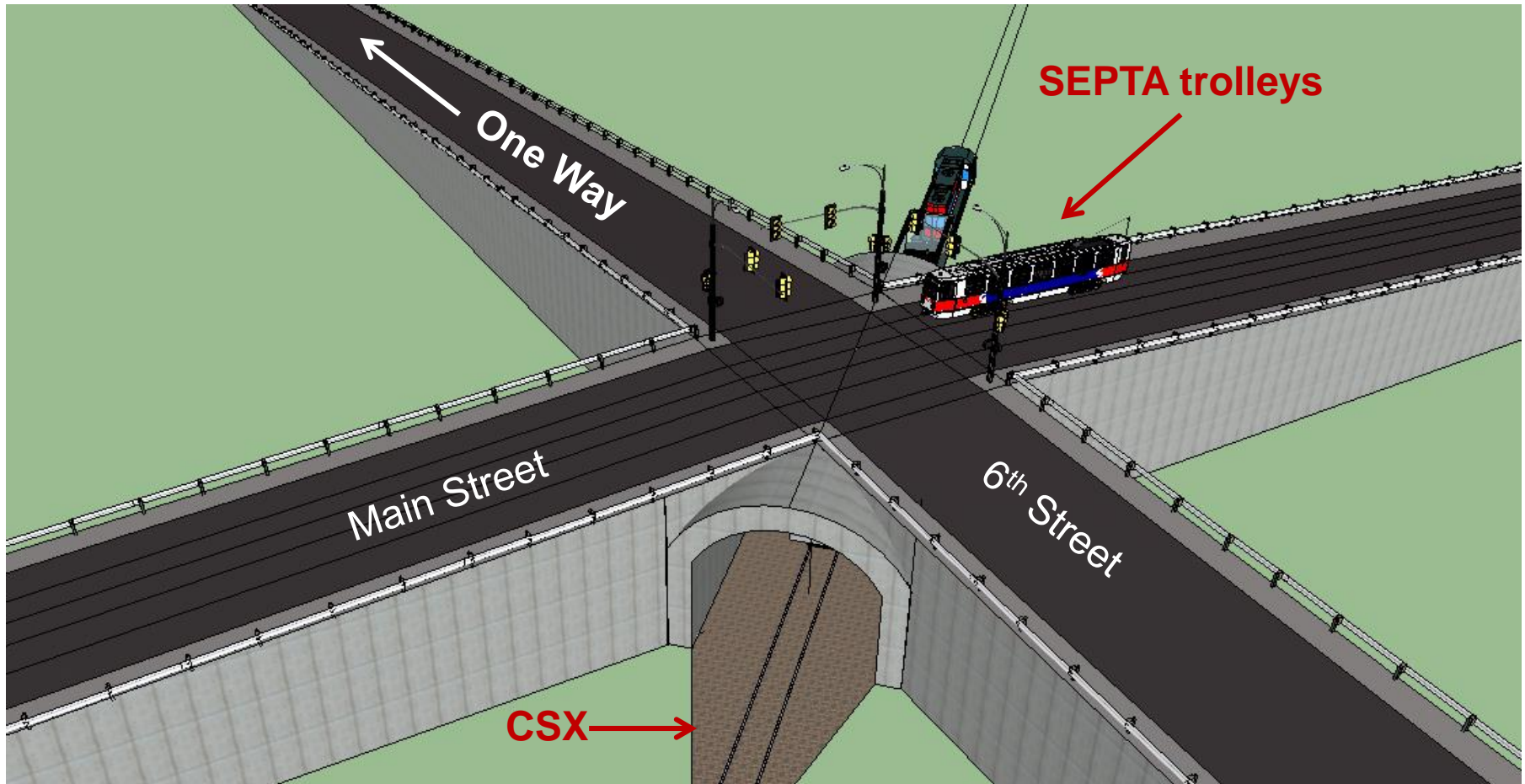
Student Team 1: Conceptual Design for At-Grade Improvements



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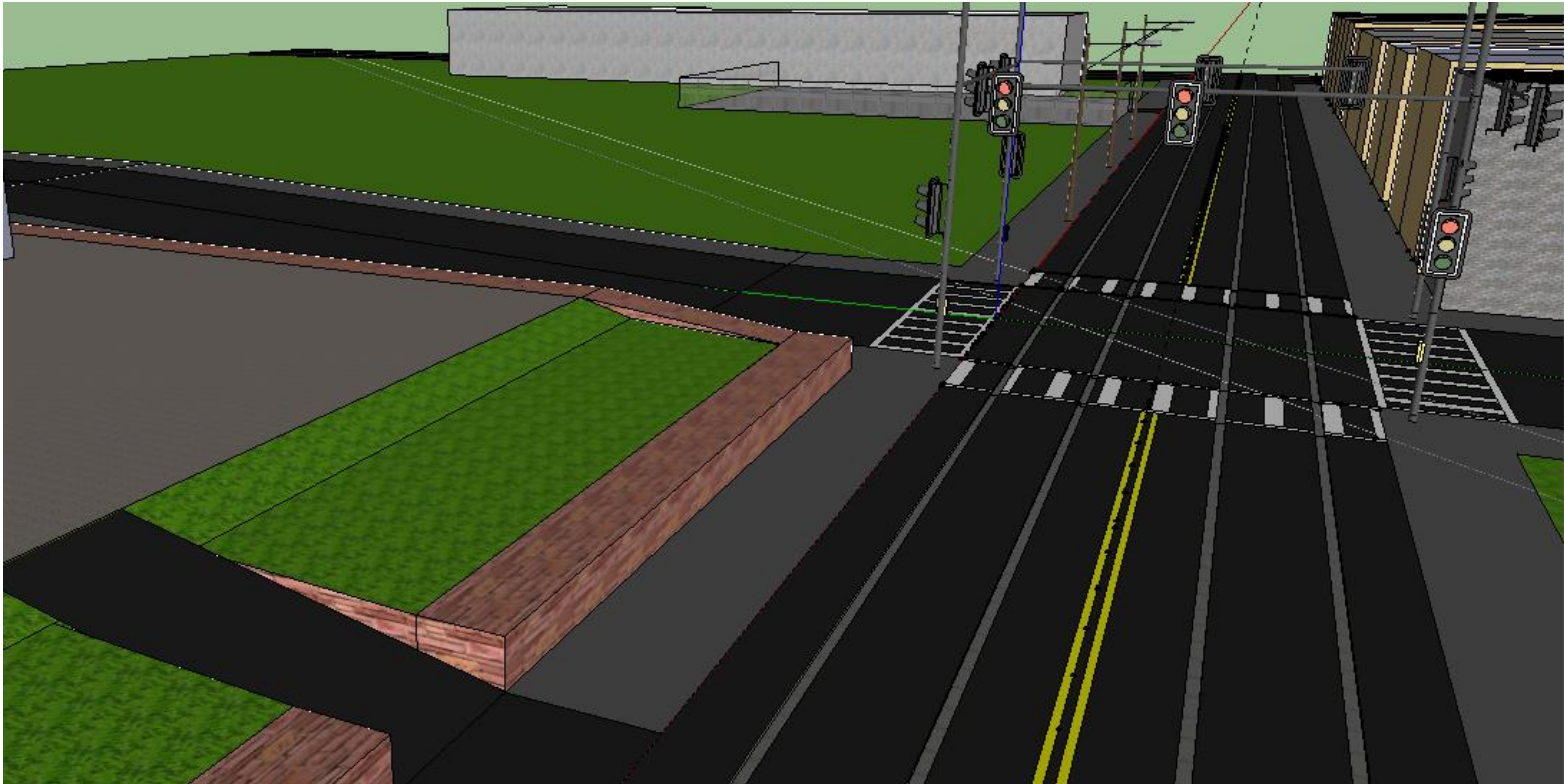


Student Team 2: Road Overpass of Rail



Student Team 3: Decking Rail Below Grade

Scope: Place CSX tracks below grade while leaving vehicle intersection and pedestrian crossway at grade



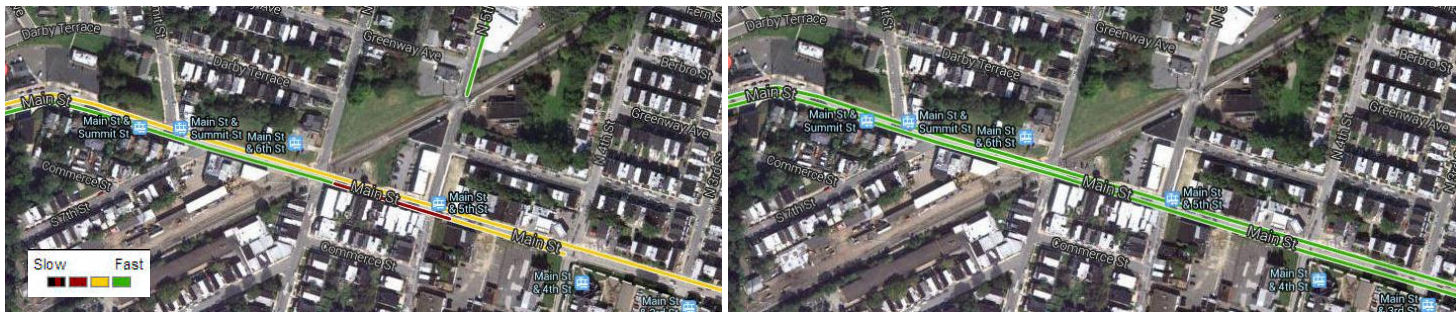
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Final Design Benefit Quantifications

- Pedestrian Safety: \$4.3 million
- Traffic Safety: \$150,000
- Traffic Flow: \$3.5 million
- Local Economy: \$360,000
- Time Effectiveness: \$480,000

TOTAL: \$8.8 Million



Final Design Costs

• Pedestrian Safety

- Traffic Signals: \$293,500/signal (includes labor, setup costs, striping)
- Crosswalks: \$110,500/crossing
- Sidewalk Improvements: \$25,000/crossing (ADA compliance)
- Signage: \$30/directional sign, (30" by 24", high intensity)
- Signage: \$93/directional sign (18" by 24")
- Signage: \$400/uniform traffic control device
- Signage: \$40 total for bolts
- Hedges, Planters: \$25/ft
- Quadrant Gates: \$50,000/gate
\$10,000/yr for maintenance
- Striping: \$6/ft

TOTAL COSTS: \$1.8 Million

Benefit/Cost Ratio (Final Design)

- With all potential design implementations considered, the initial vs. final benefit-cost ratios result in:

	Benefits	Costs	BCR
Initial Design	8.8 million	3.4 million	2.59
Final Design	8.8 million	1.8 million	4.89

Challenges of Final Design Implementation

- Avoid extreme traffic congestion during construction
- Provide effective alternative to disrupted trolley service
- Work around CSX trains to avoid delays and increased costs
- Divide responsibilities accordingly among various stakeholders
- Secure necessary funding

Community Outreach

- Survey administered by Villanova students mid-semester
- Four basic questions
 - Which aspects are most important?
 - What to do with new open space?
 - How important is parking/access to businesses?
 - Additional thoughts and concerns

Survey Results from Darby Borough

- 22 responses
- The most important aspects of the project were determined to be:
 - 1. Pedestrian safety
 - 2. Vehicular safety
 - 3. Minimize traffic congestion
 - 4. Visual appeal
 - 5. Minimize noise at crossing

Survey Results

- If the CSX line was to be moved below grade, the newly created open space should be:
 - Turned into a park (10)
 - Turned into a playground (6)
 - Used for businesses or stores (4)
 - It should remain uncovered (2)
- Parking directly in front of stores and businesses is very important

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Outcome on Educational Aspects

- Performance Assessment for ABET sub-outcomes

ABET Sub-outcome	Complete Mastery of Concept	Mastery of Concept	Satisfactory	Limited Attainment	Unsatisfactory
f – understanding of...ethical responsibility	98%	2%	0%	0%	0%
h – impacts of engineering in...societal context	67%	33%	0%	0%	0%
j – knowledge of contemporary issues	79%	14%	7%	0%	0%

Conclusions

- Teaching the objectives of course through the context of the contemporary and significant issue of an at-grade crossing was effective
 - Student feedback and ABET assessment support conclusion
 - Planned future course in 2014 to use similar format

