

CPBR

PIPELINE TRESTLE DESIGN

Team 14: TRED Engineering
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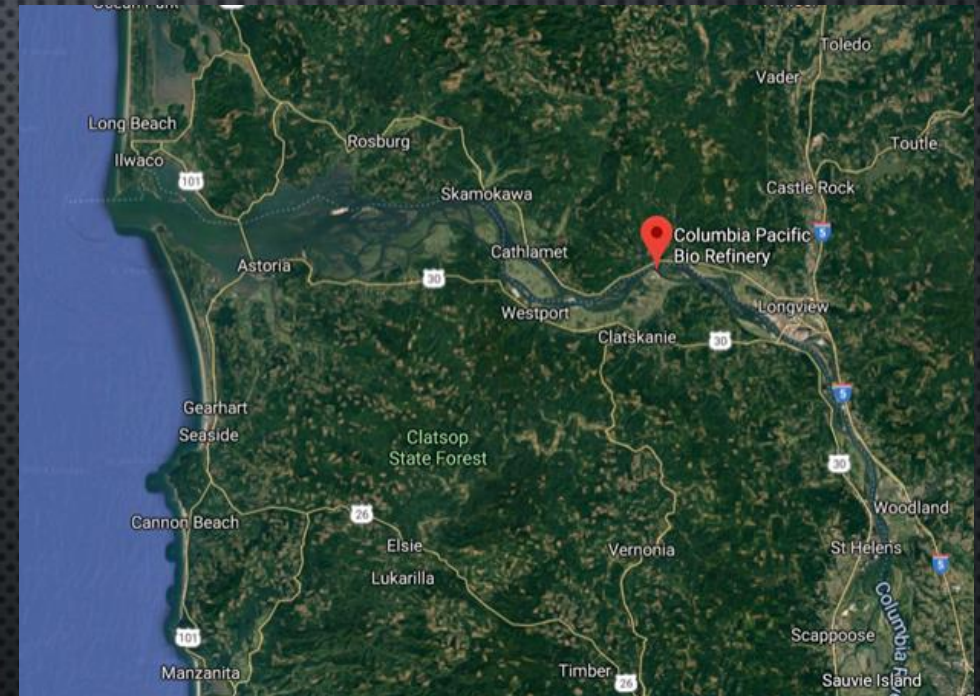
PROJECT SPONSOR: ZACK JENKINS, P.E., COLLINS ENGINEERS

FACULTY ADVISOR: DR. ROBERT HENRY, P.E.



BACKGROUND

- LOCATION: COLUMBIA PACIFIC BIO REFINERY, CLATSKANIE, OREGON
- OPENED IN 2008:
 - ETHANOL PRODUCTION
- IN 2012 OIL DISTRIBUTION BEGAN
- SOLD IN 2013 TO GLOBAL PARTNERS LP
- CURRENT FUNCTION: PRODUCTION AND DISTRIBUTION OF ETHANOL
- WANT TO DISTRIBUTE BOTH ETHANOL AND CRUDE OIL



Google Earth, earth.google.com/web/.

PURPOSE

- DESIGN PIPELINE TRESTLE
 - CONDITIONS ON SITE
 - DUAL PRODUCT LOADING
 - LARGER SHIPS
- FEASIBILITY ANALYSIS OF THE PROPOSED DESIGN



Google Earth, earth.google.com/web/.

PROJECT SCOPE

- OBTAIN BACKGROUND INFORMATION
- DESIGN PIPELINE TRESTLE
- DEVELOP NECESSARY DESIGN LOADS
 - MODEL DYNAMIC LOADS AS PSEUDO STATIC LOADS
- ADDRESS FOUNDATION CONCERNS ASSOCIATED WITH LIQUEFACTION IN DEEP FOUNDATIONS
- EVALUATE ALTERNATIVE DESIGN
- FEASIBILITY ANALYSIS FOR DESIGN
- MAINTAIN A RECORD OF PROJECT COMMUNICATIONS
- DEVELOP A SCHEDULE

EXISTING CONDITIONS

- EXISTING PIPER AND PIPELINE STILL IN PLACE
- RECENT UPGRADES TO PIER FOR LARGER SHIPS
- POTENTIAL FOR SEISMIC EVENTS
- LOCATION OF PIPELINE
 - LOADING POINTS SPECIFIED ALONG PIER
 - SPECIFIC STARTING POINT



FACTORS TO BE CONSIDERED

- SEISMIC ACTIVITY
 - PILE FOUNDATIONS
 - SOIL LIQUEFICATION
 - SETTLEMENT
- DISTRIBUTION CONDITIONS
 - PIPE CAPACITIES
 - TWO PRODUCT DISTRIBUTION
- ENVIRONMENTAL CONDITIONS:
 - THERMAL EXPANSION



<https://www.indiamart.com/shreeshaktiengineering/pipe-roller-and-rotators.html>

ALTERNATIVE TRESTLE DESIGNS

- HOW PIPELINE WILL REST ON THE STRUCTURE
 - CATENARY – PIPE HANGING BELOW
 - TRADITIONAL TRESTLE – RESTING ON
- PILES PART OF TRESTLE
- MATERIALS
 - TIMBER
 - FIBERGLASS
 - STEEL



<https://www.bridgemeister.com/imgp0a/poetnewhavenpipe1.jpg>



<https://c8.alamy.com/comp/BBK3DE/a-pipeline-across-the-canadian-river-for-the-distribution-of-natural-BBK3DE.jpg>

CONFIGURATION OF PROPOSED PIPELINE

ALLOWING FOR THE EASIEST CONSTRUCTION

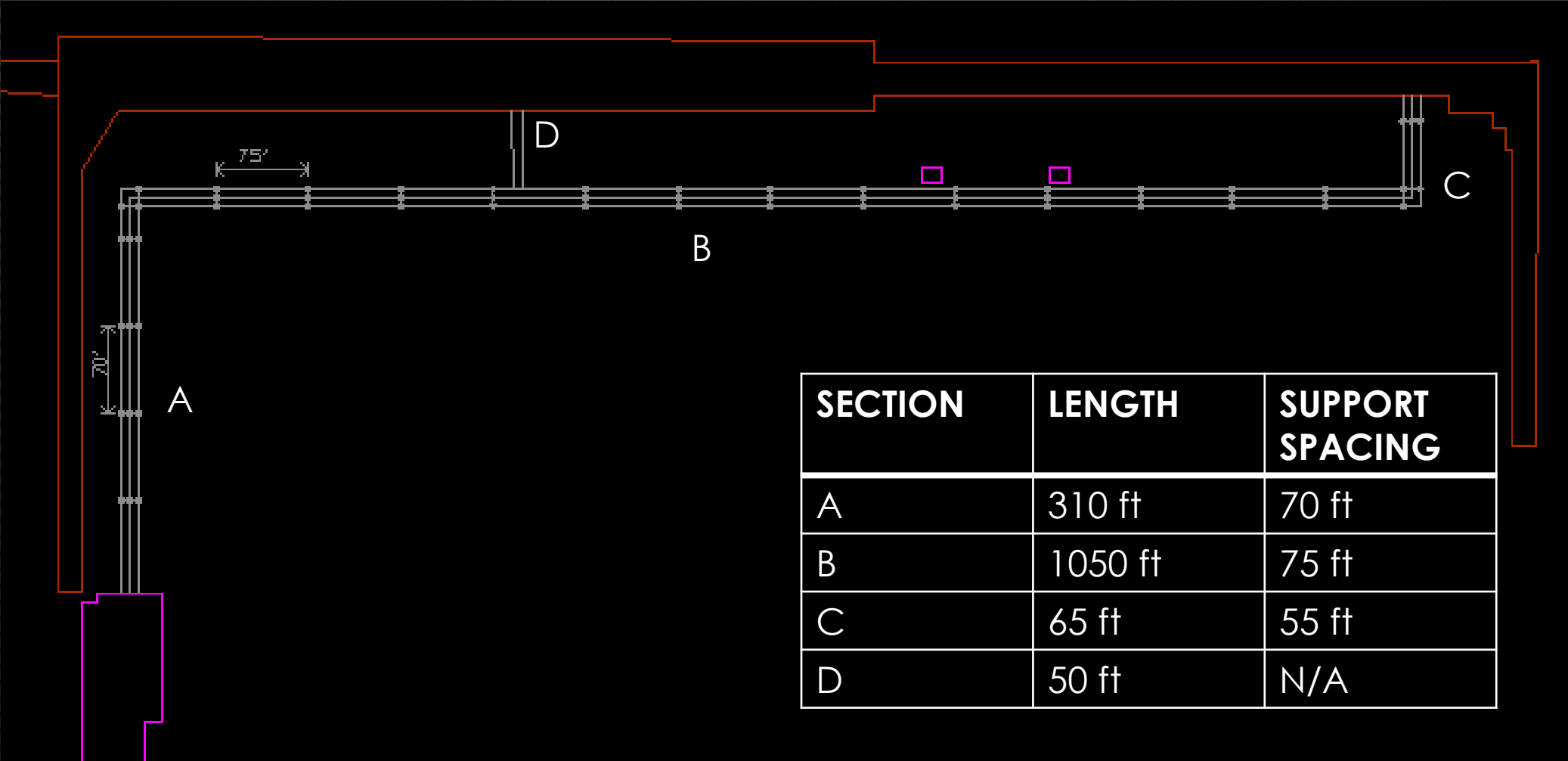
- ON EXISTING PIER
- NEW TRESTLE SUPPORT SYSTEM
 - ON WATER LINE
 - FOLLOWING PIER (IN YELLOW)
 - ON LAND LINE (ORANGE)
- WATER LINE CONFIGURATION SELECTED



Google Earth, earth.google.com/web/.

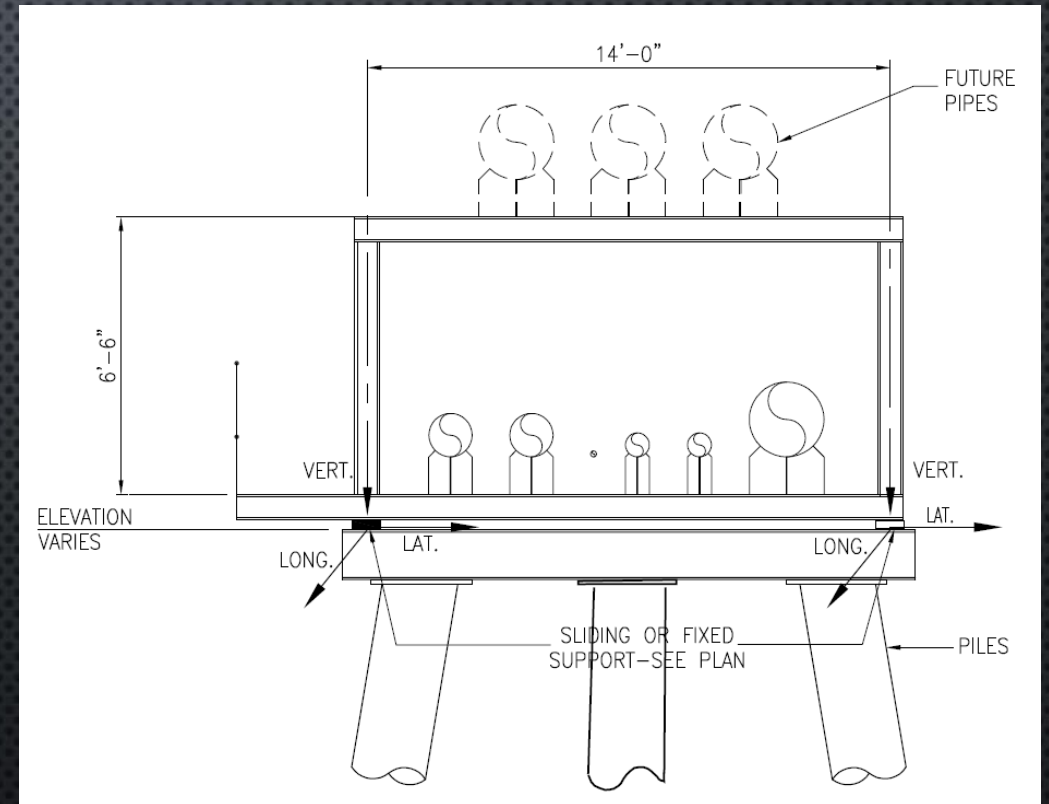
Green = Recent Upgrades
Red = Loading points

FINAL SITE PLAN



LOADING CONSIDERATIONS

- 5 DIFFERENT LOADING POINTS DEPENDING ON POSITION
- WORST LOAD CASES FOUND
 - ASCE 7-10
 - SEISMIC DESIGN OF PIERS AND WHARVES ASCE 61-14
- PIPE CONTENT AS A LOAD



Pipeline cross section- Collins Engineers -Dwg no.52401

HAZARD LEVEL DEFINITIONS

Table 1: ASCE 61-14 SEISMIC HAZARD LEVEL DEFINITIONS

Seismic Hazard Level in Accordance with ASCE 61-14	Definition of Seismic Hazard Level (High Design Classification)	Performance Level (High Design Classification)
Operating Level Earthquake (OLE)	Defined as an event with a 50% probability of exceedance within a 50-year period (72-year recurrence interval)	Minimal Damage
Contingency Level Earthquake (CLE)	Defined as an event with a 10% probability of exceedance within a 50-year period (475-year recurrence interval)	Controlled and Repairable Damage
Design Earthquake (DE)	Defined as $\frac{2}{3}$ of the Maximum Considered Earthquake (MCE) in accordance with ASCE 7-05. The MCE is based on an event with a 2% probability of exceedance within a 50-year period (2,475-year recurrence interval)	Life Safety

SOIL CONDITIONS

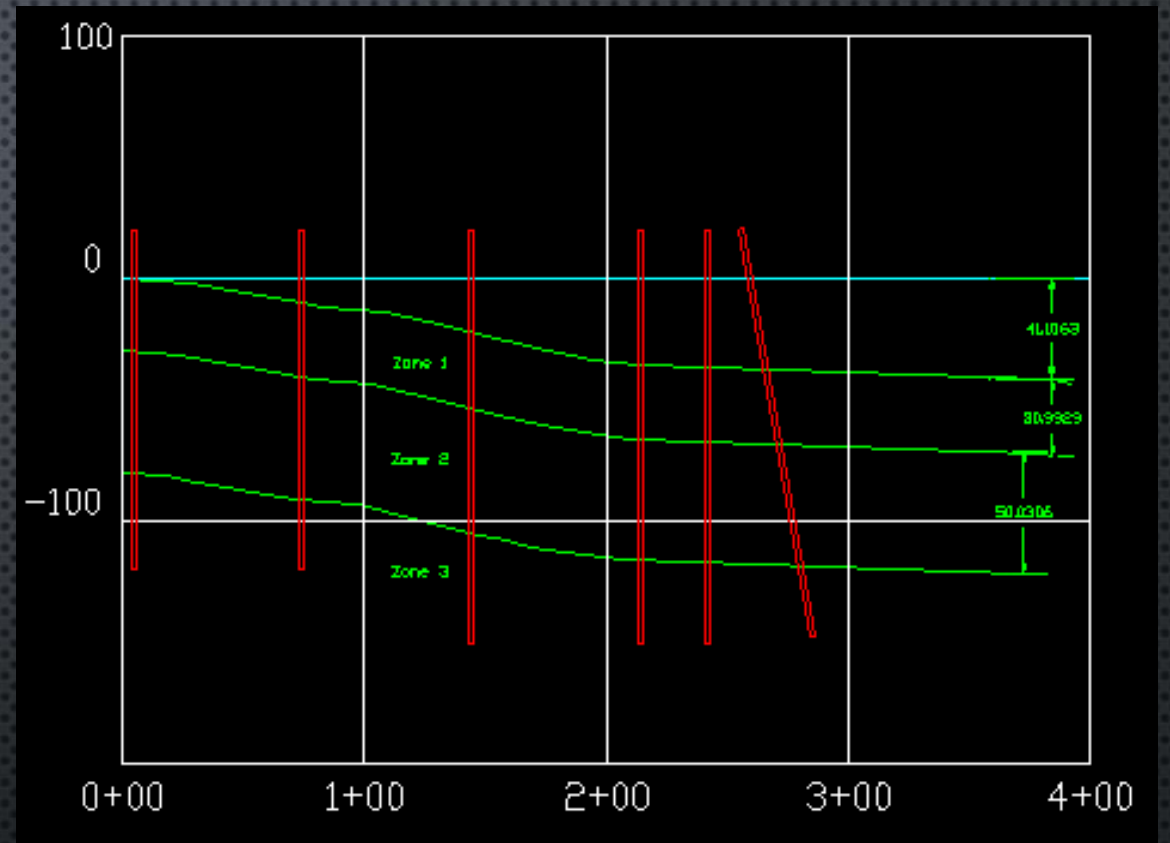
- SOILS ON THE SITE ARE INFLUENCED BY LIQUEFACTION
- THREE MAIN ZONES OF SOIL
 - ZONE 1: LOOSE TO MEDIUM SAND. EXTENDS 30 FEET BELOW MUDLINE (RIVER BED)
 - ZONE 2: MEDIUM DENSE SAND TRACE SILT. EXTENDS FROM 30 FEET TO 80 FEET BELOW MUDLINE
 - ZONE 3: MEDIUM DENSE TO DENSE SAND. EXTENDS 80 FEET AND DEEPER BELOW MUDLINE

IMPACTS OF LIQUEFACTION

- NO ZONE IS SUSCEPTIBLE TO LIQUEFACTION AT OLE HAZARD LEVEL.
- ZONE 3 IS NON-LIQUEFIABLE AT ALL HAZARD LEVELS
- SOILS IN ZONE 1 AND 2 POTENTIALLY LIQUEFIABLE AT CLE AND DE HAZARD LEVELS
- LATERAL SPREADING:
 - HIGH POTENTIAL FOR LATERAL SPREADING IN ZONE 1
- SEISMICALLY INDUCED SETTLEMENT:
 - POTENTIAL FOR SETTLEMENT IN ZONES 1 AND 2

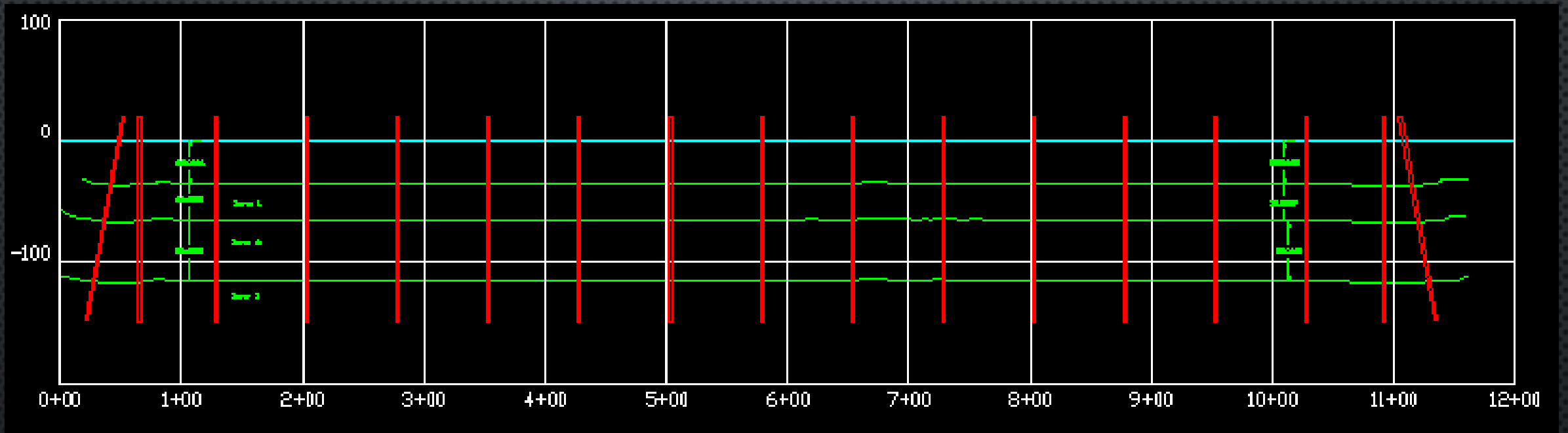
FOUNDATION DESIGN

- DEEP PILE FOUNDATION
 - 24-INCH OPEN ENDED STEEL PIPE PILES
 - 120 FEET TO 170 FEET LONG
 - DRIVEN INTO NON-LIQUEFIABLE SOIL ZONE
 - BEARING PILES DESIGNED FOR CLE HAZARD LEVEL
 - USE OF VERTICAL AND BATTER PILES



PROFILE OF SEGMENT A

FOUNDATION DESIGN



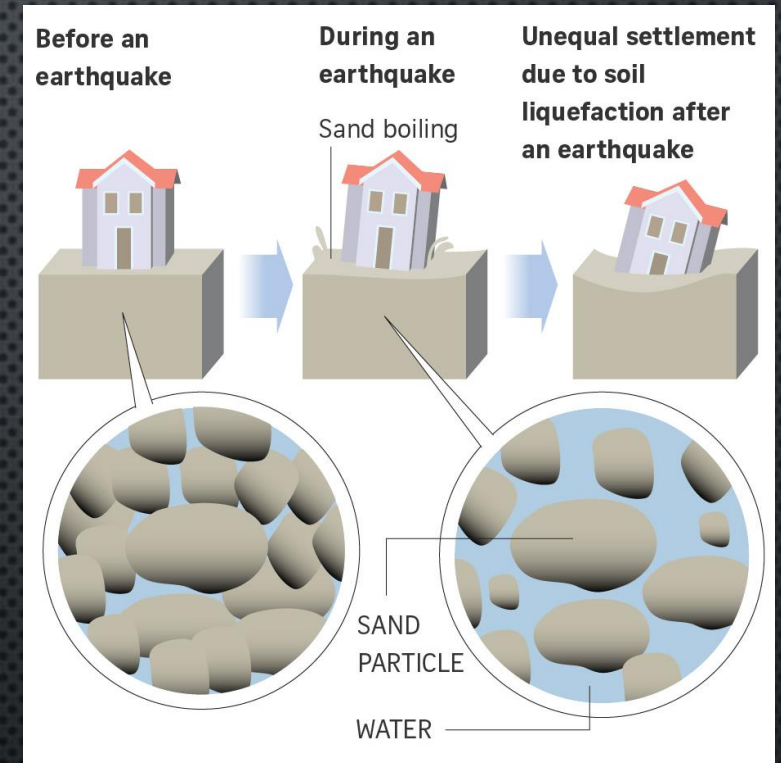
PROFILE OF SEGMENT B

PROJECT COST

- PROJECT BUDGET: \$500/SQ.FT.
- ESTIMATED BUDGET: \$10 MILLION

CHALLENGES ENCOUNTERED

- UNDERSTANDING APPROPRIATE LOAD COMBINATIONS
- COMPREHENSION OF BATTER PILES
- UNDERSTANDING FULL GEOTECHNICAL ASPECTS
 - SEISMIC IMPACTS ON FOUNDATION AND STRUCTURAL DESIGN



<https://www.straitstimes.com/>

DELIVERABLES

- APRIL 24TH: PRESENTATION
- MAY 8TH: FINAL REPORT
- DATE TBD: ZOOM CALL FOR QUESTIONS

THANK YOU