FHWA's Future Scour Design Approach

presented at the

Bridge Scour Technology Transfer Workshop
in
Dimondale, Michigan

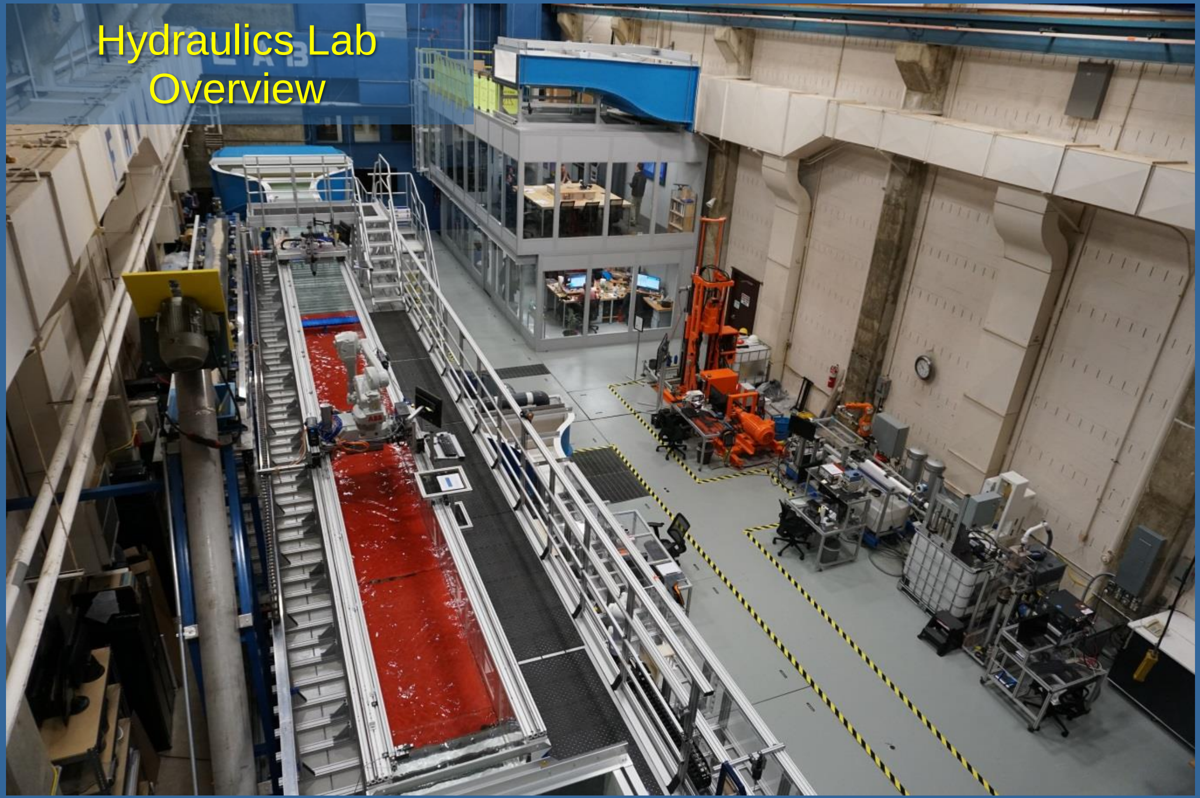
by

Kornel Kerenyi

Hydraulic Engineering

U.S. Department of Transportation
Federal Highway Administration

2017		
	Physical Modeling	40 %
	Numerical Modeling	60 %

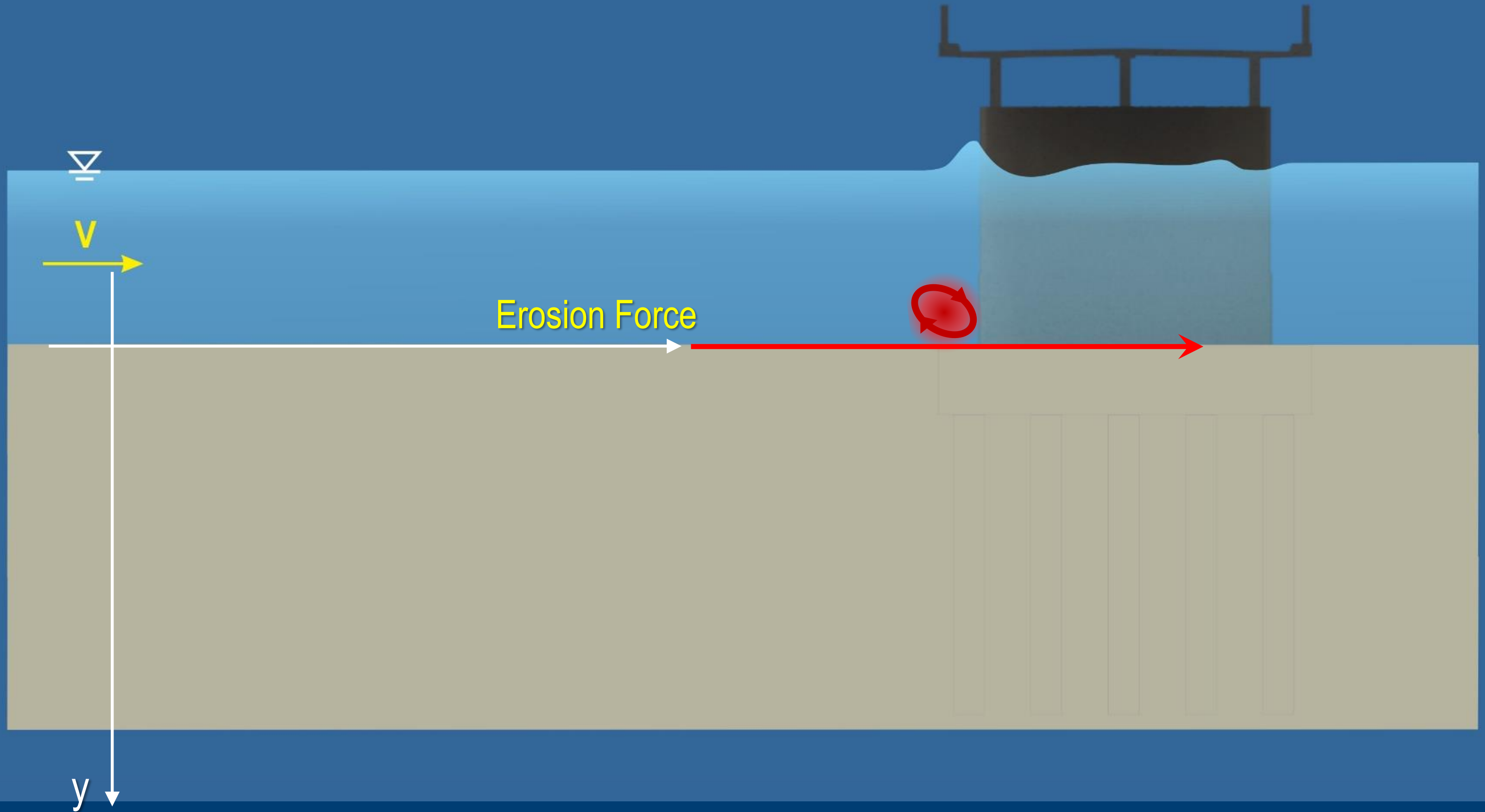


Live Bed Bridge Scour
Experiments

Robotic Arm
Carriage System

2018	Physical Modeling	35 %
	Numerical Modeling	65 %

Concept of Hydraulic loading and Erosion force Decay Function



2018	Physical Modeling	35 %
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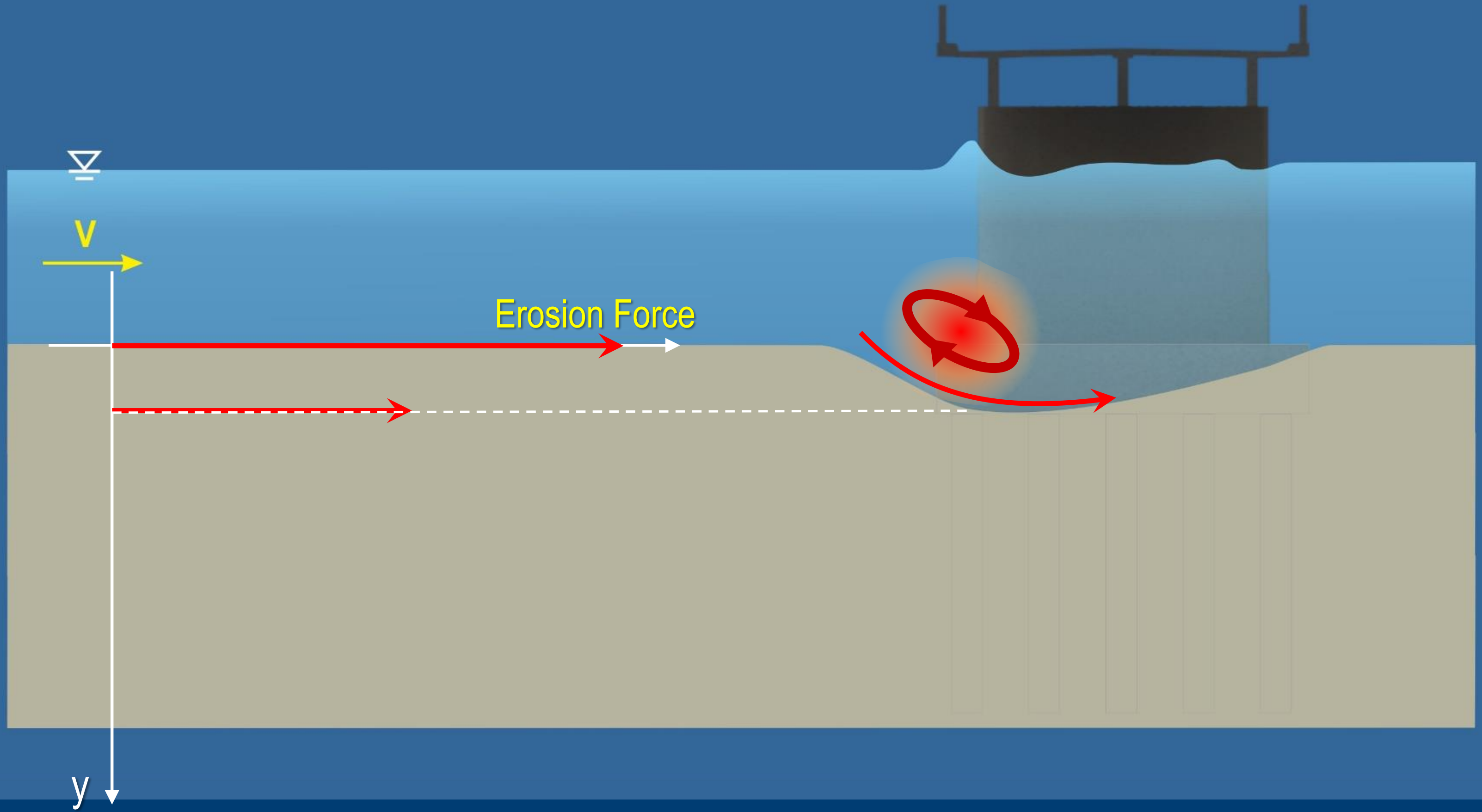
Concept of Hydraulic loading and Erosion force Decay Function



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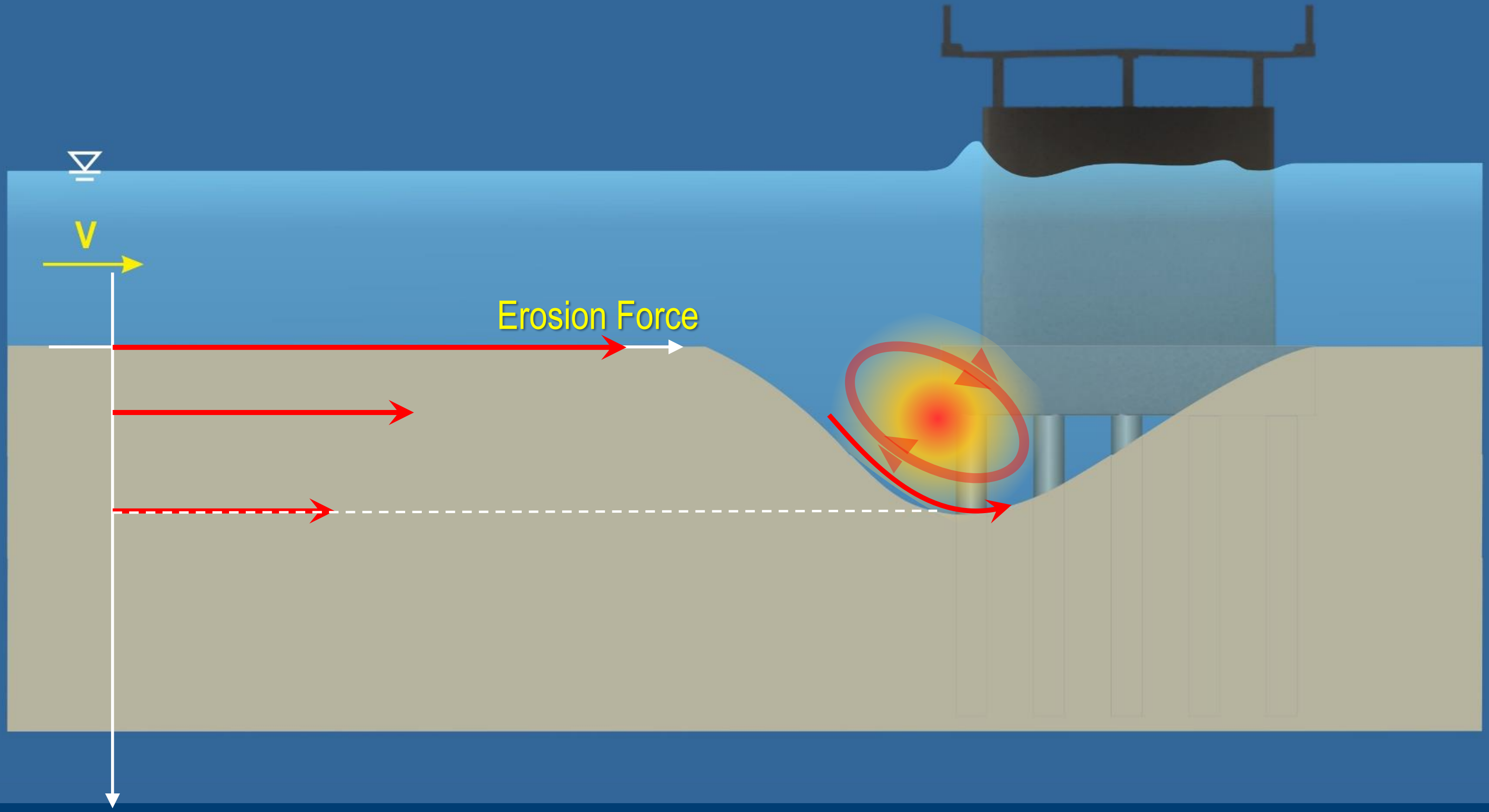
Concept of Hydraulic loading and Erosion force Decay Function



2018	Physical Modeling	35 %
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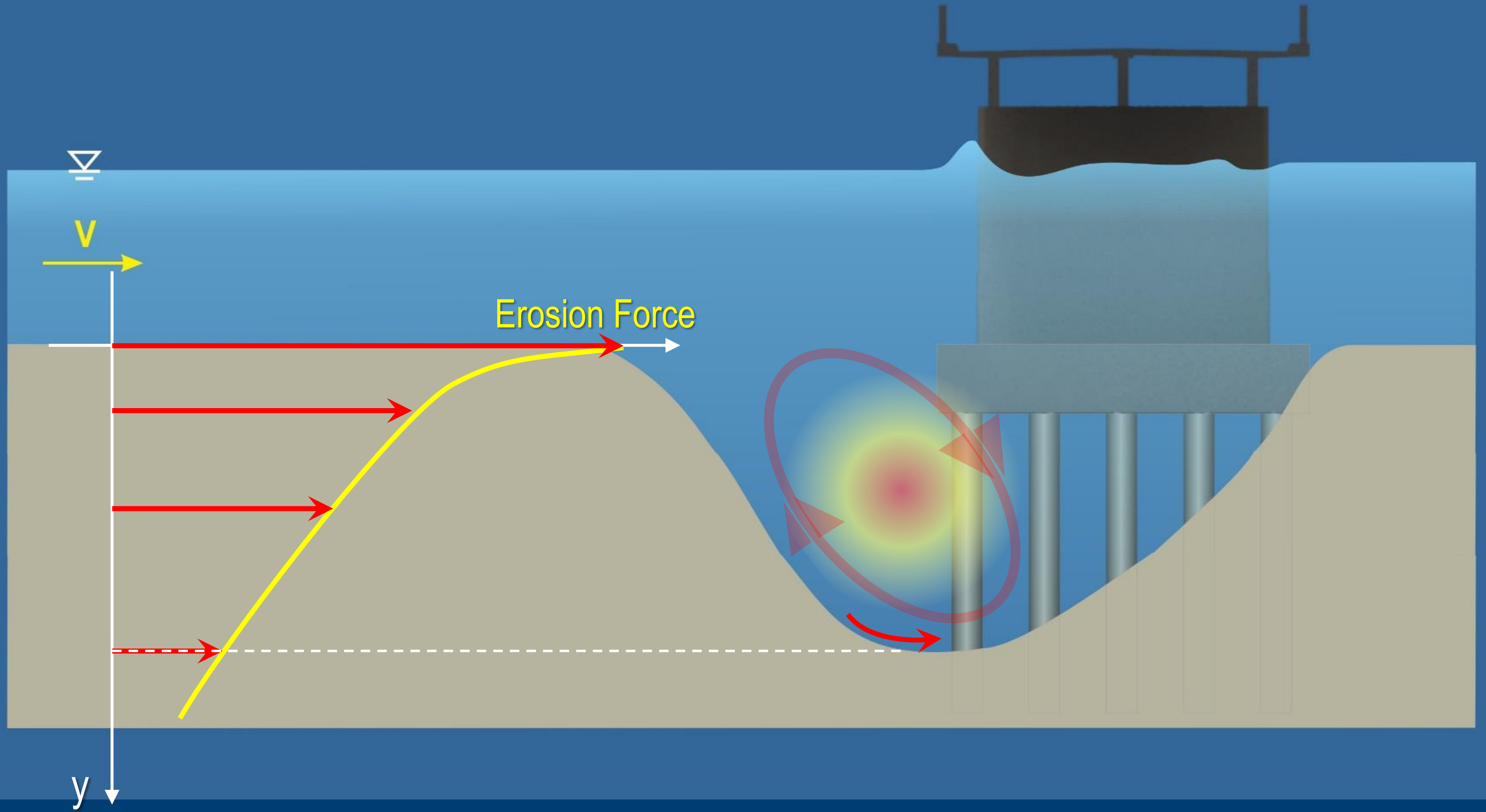
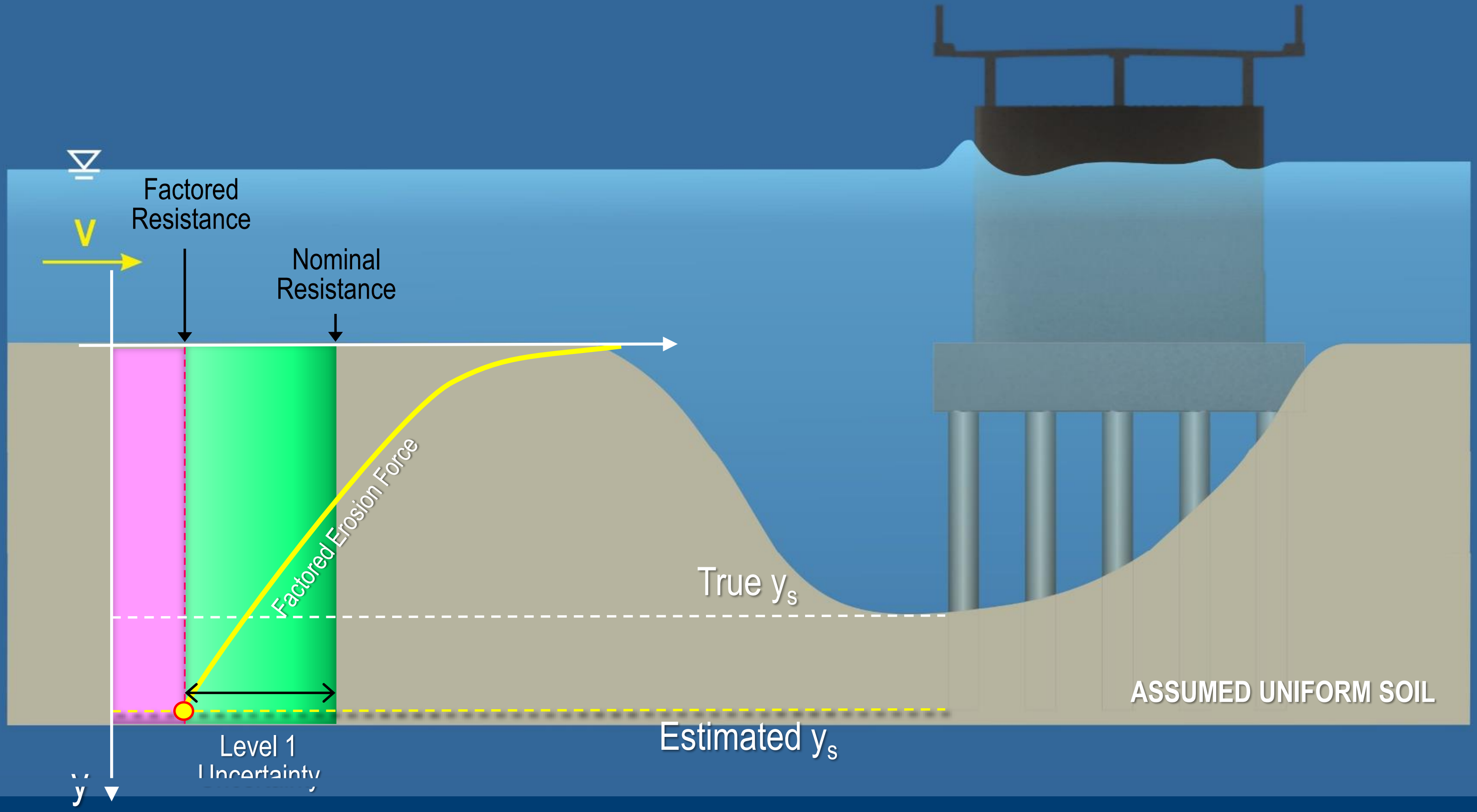
Concept of Hydraulic loading and Erosion force Decay Function



2018	Physical Modeling	35 %
	Numerical Modeling	65 %

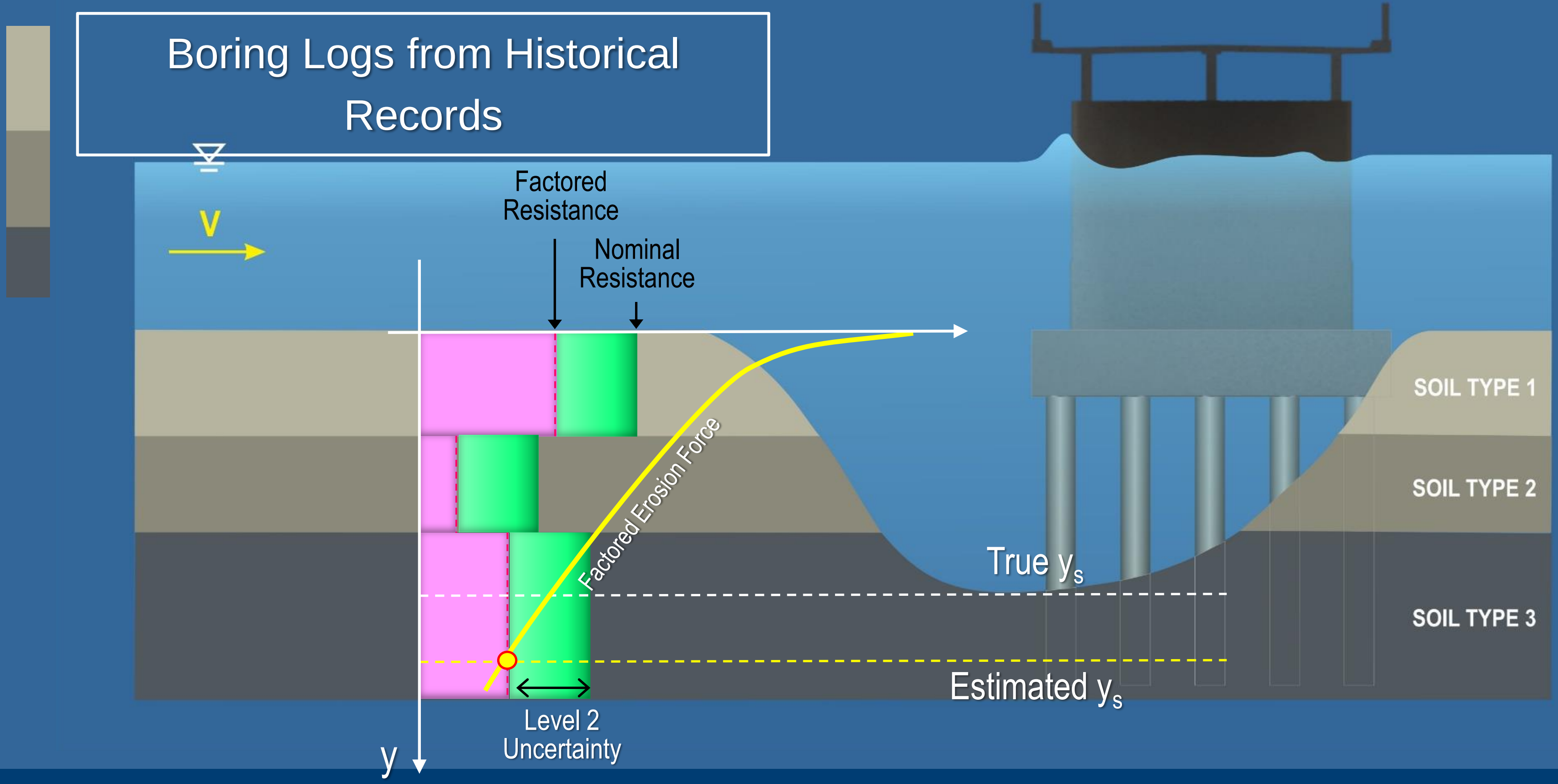
Concept of Soil Erosion Resistance

Level 1: Using current assumptions of uniform soil (e.g. D_{50})



2018 Physical Modeling 35 %
Numerical Modeling 65 %

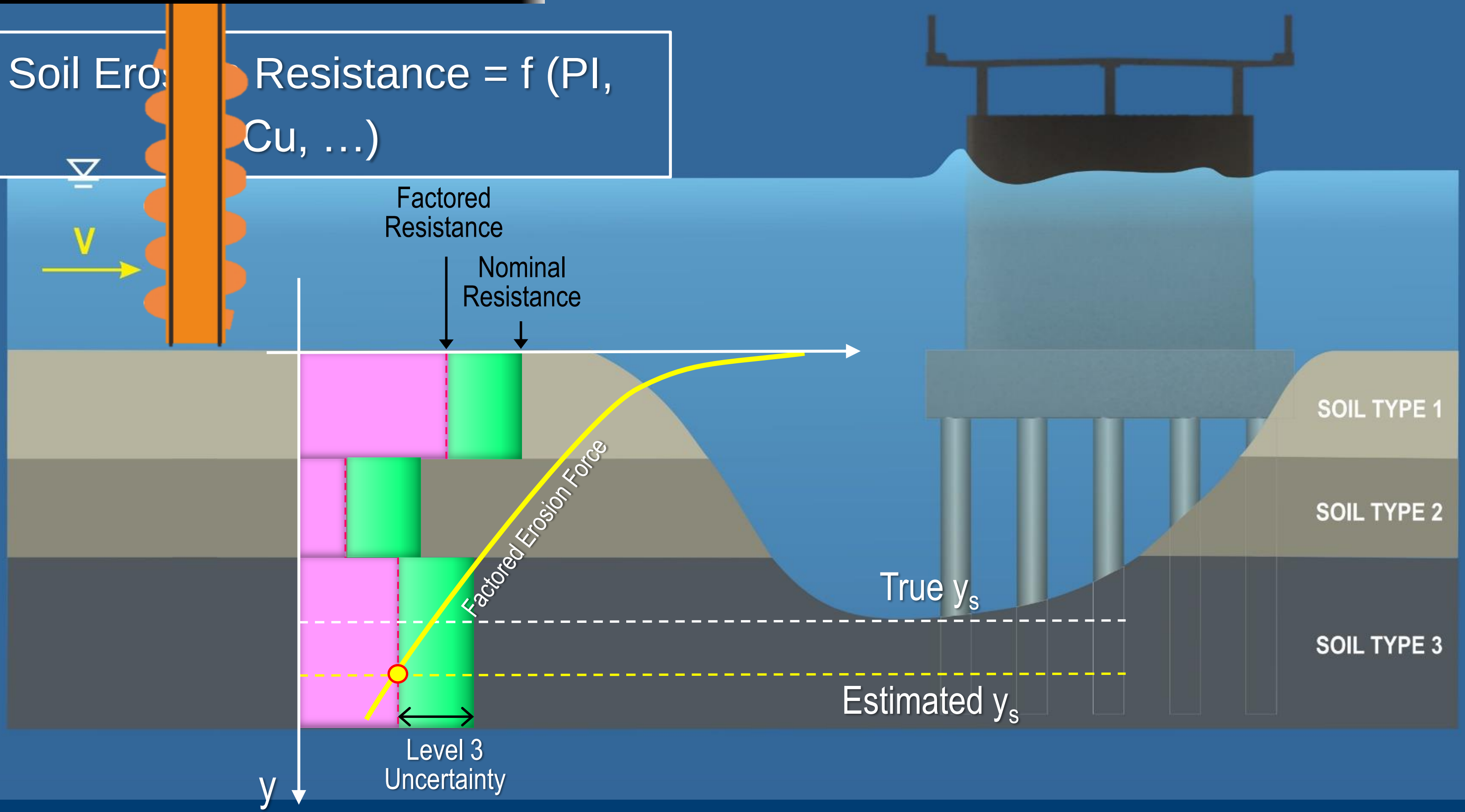
Concept of Soil Erosion Resistance
Level 2: Soil Erosion Resistance Data from Historical Records



2018	Physical Modeling	35 %
	Numerical Modeling	65 %

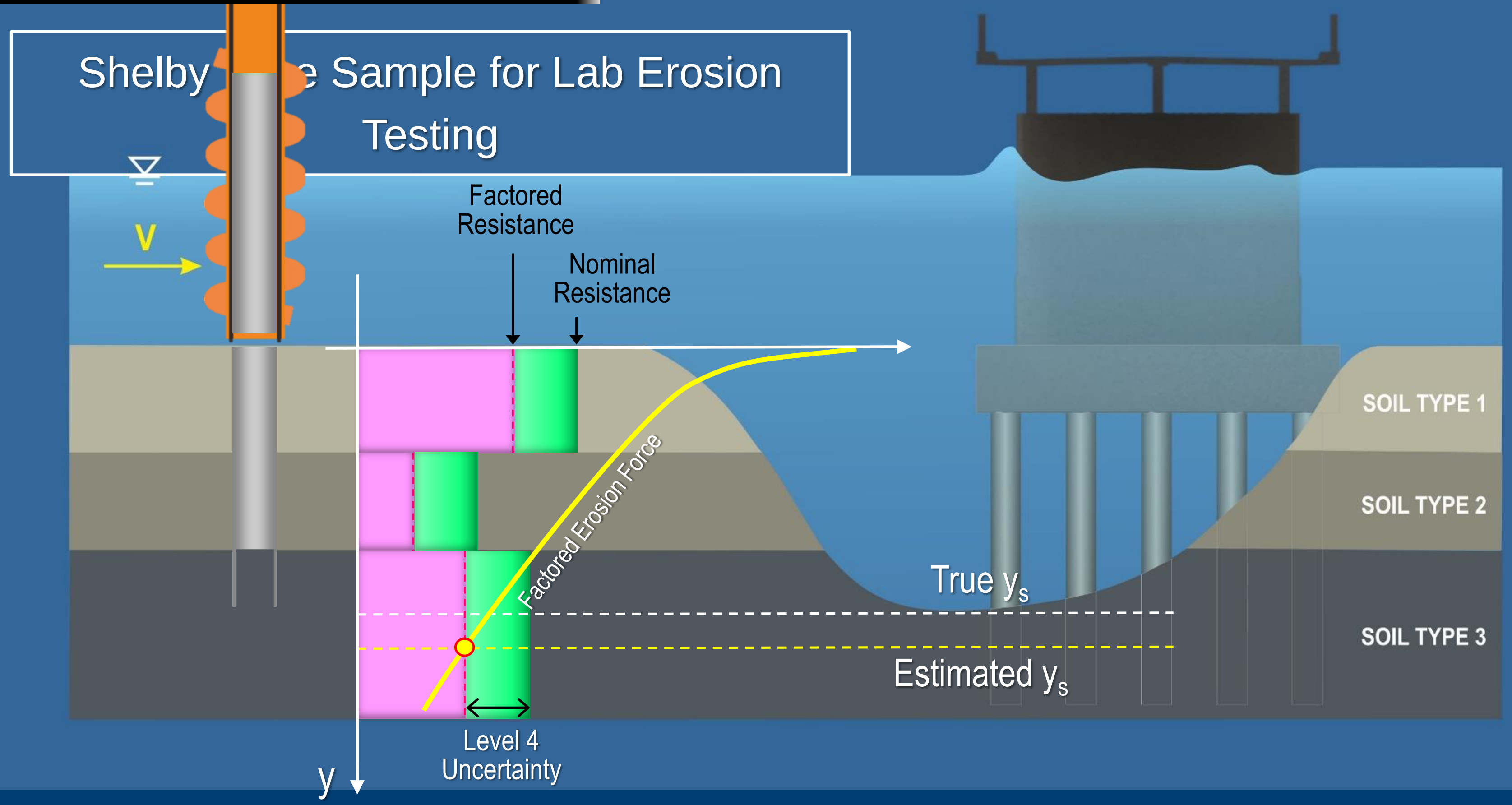
Concept of Soil Erosion Resistance
Level 3: Soil Erosion Resistance from Geotechnical Properties

Soil Erosion Resistance = f (PI, Cu, …)



2018	Physical Modeling	35 %
	Numerical Modeling	65 %

Concept of Soil Erosion Resistance
Level 4: Soil Erosion Resistance from Lab Erosion Testing



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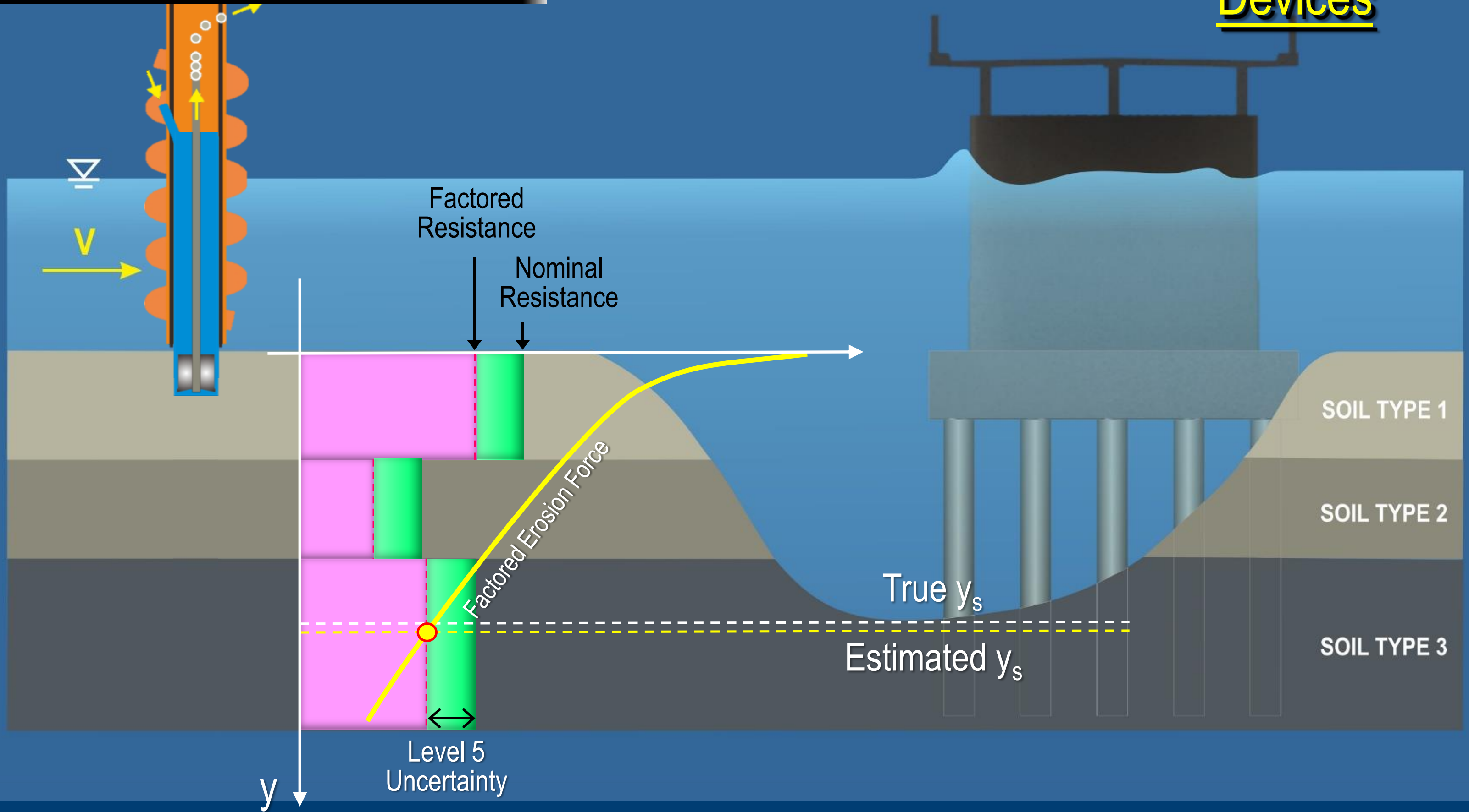
2018	Physical Modeling	35 %
	Numerical Modeling	65 %

Concept of Soil Erosion Resistance
Level 5: Soil Erosion Resistance from In-situ Scour Testing Devices



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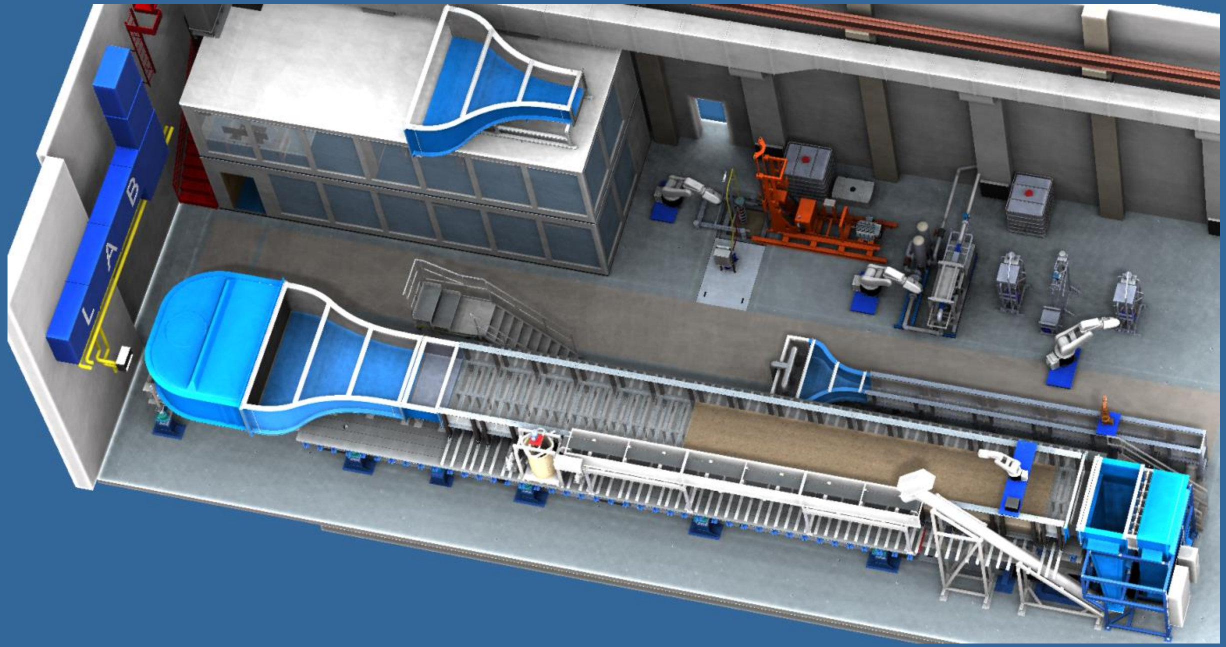
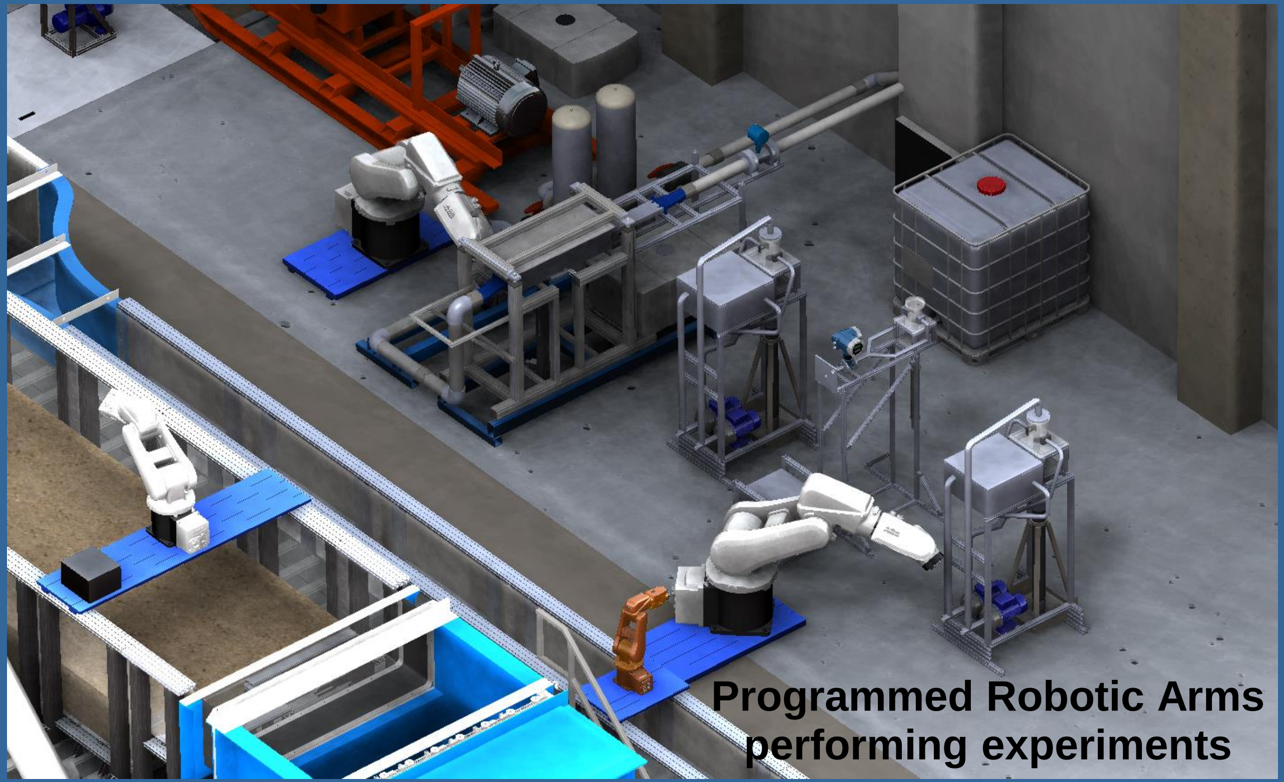
2020		
	Physical Modeling	30 %
	Numerical Modeling	70 %

Hydraulics Lab Overview

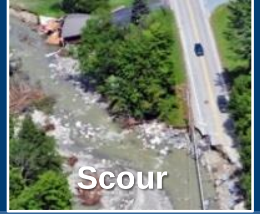


Automation of Soil Erosion Resistance Experiments



2030		
	Physical Modeling	20 %
	Numerical Modeling	80 %

Potential Future Procedure for Determining Soil Erosion Resistance

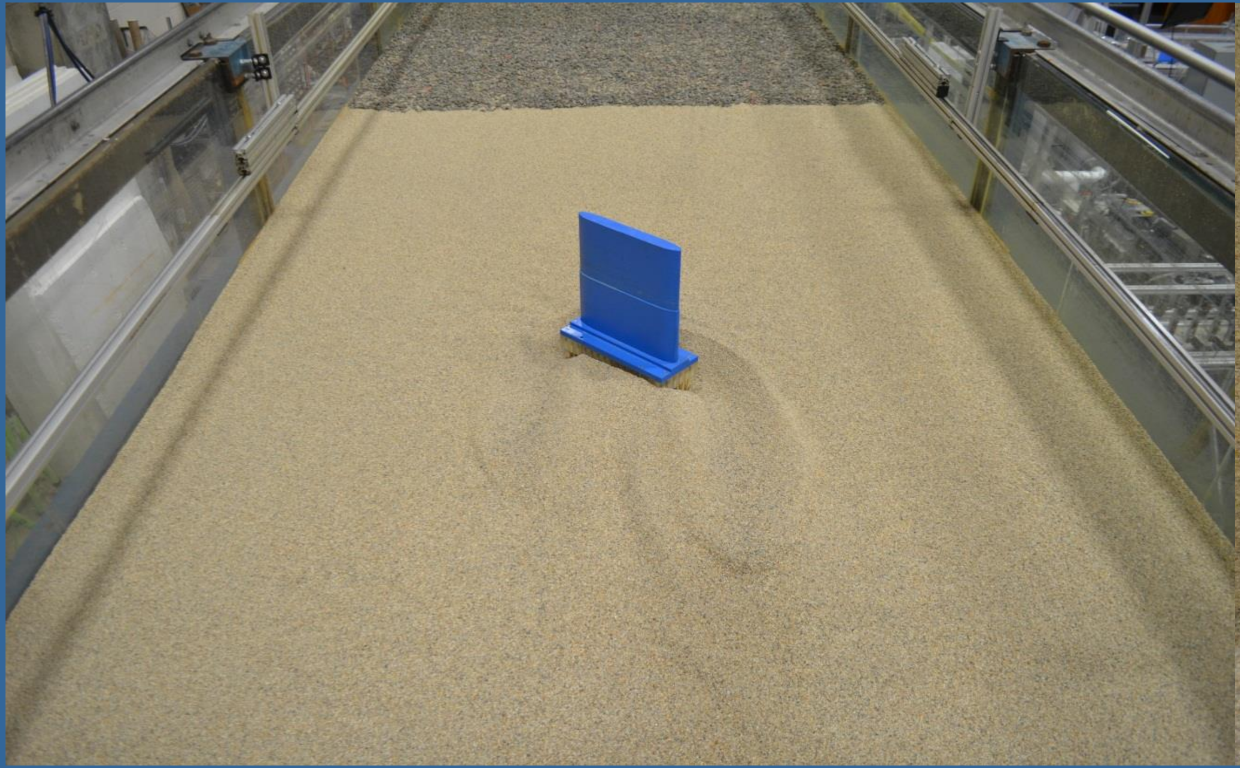


Hydraulic Loads

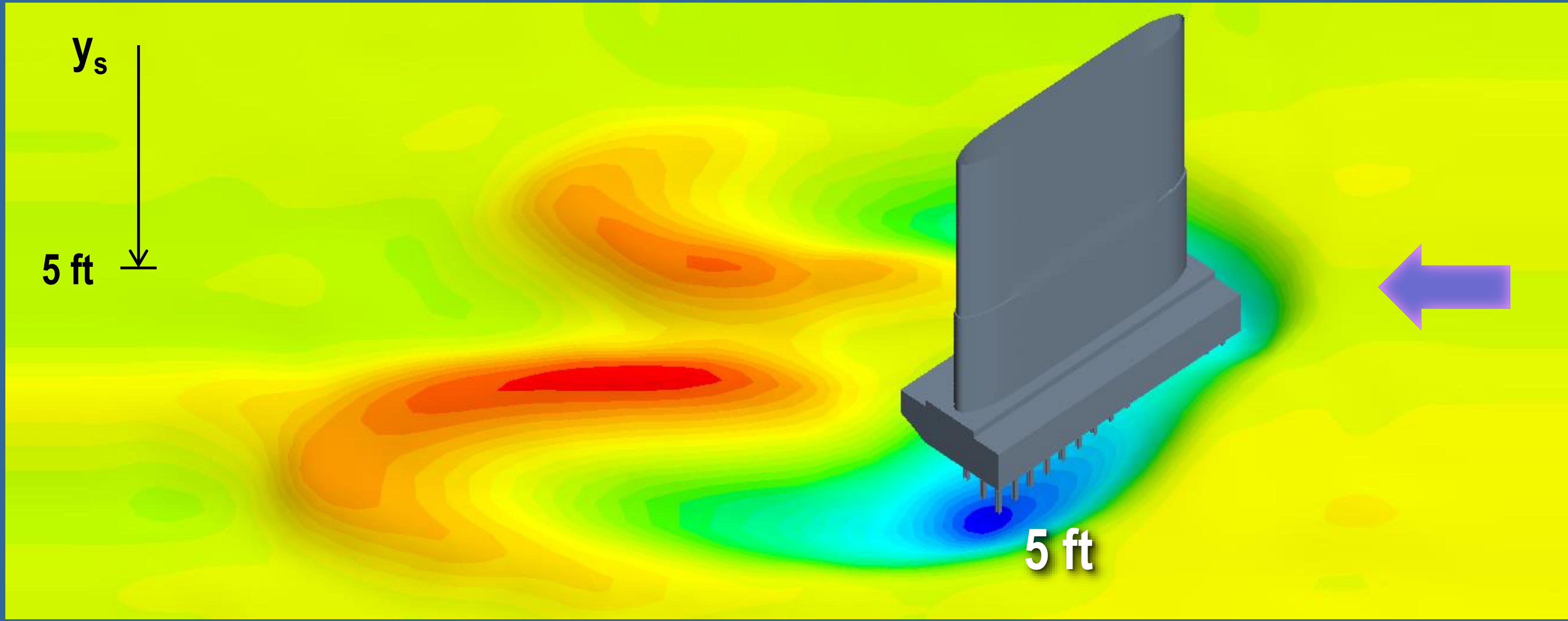
MFS and CFD to Determine Shear Erosion Forces

Example: Feather River Bridge, Sacramento, CA, Scour Study

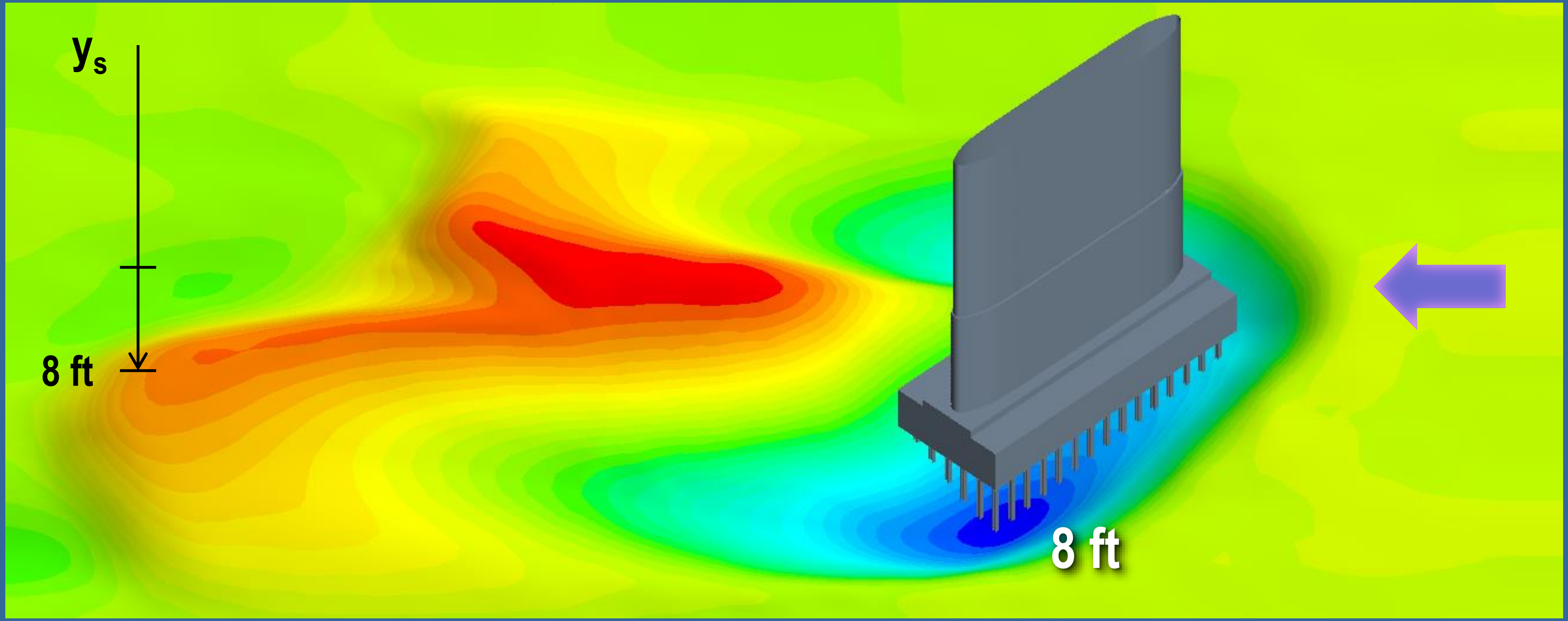
MFS and CFD to Determine Shear Erosion Forces (cont'd)



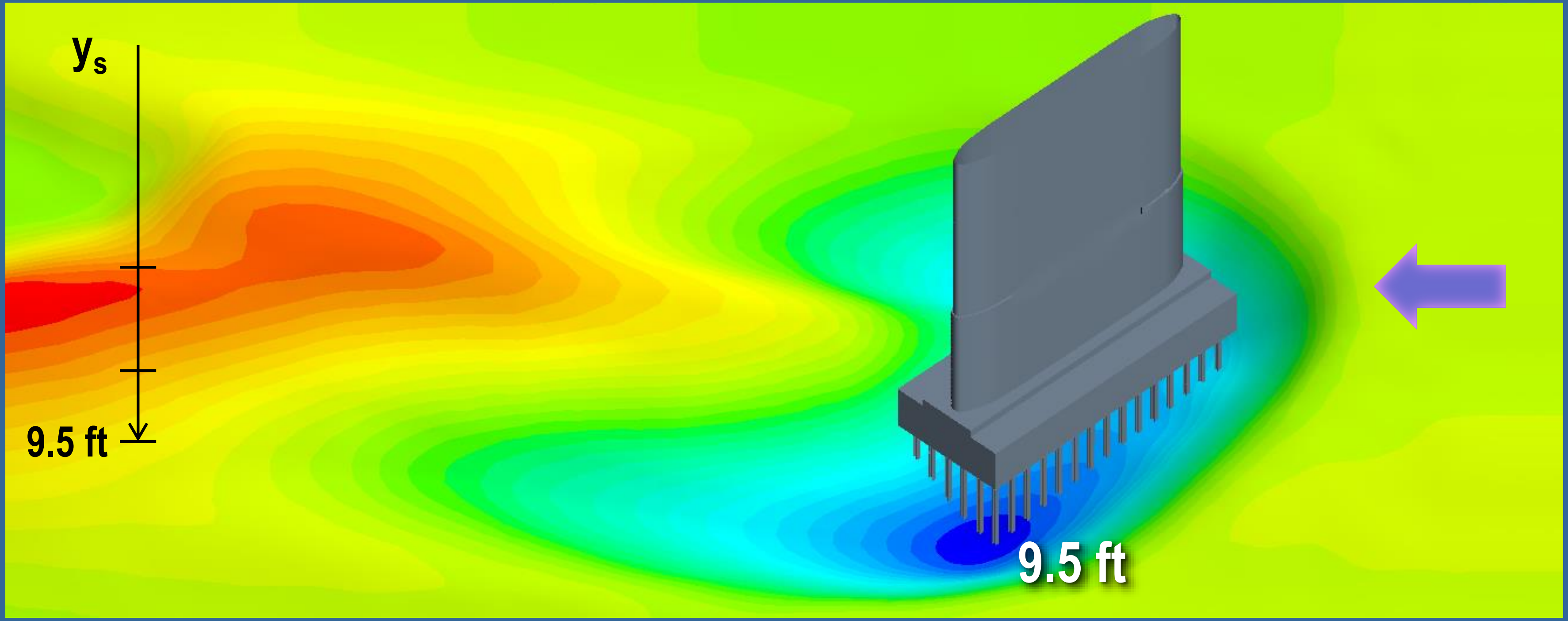
Digitized Scour Bathymetry



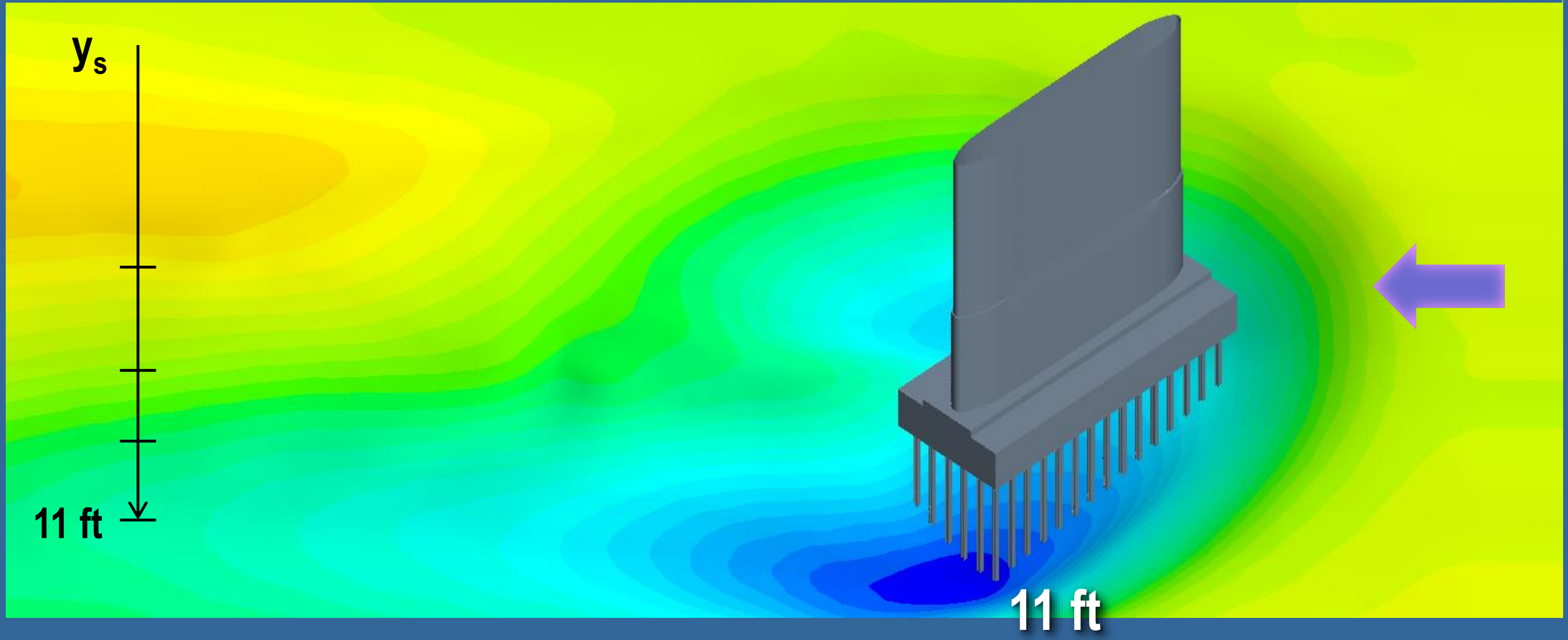
Digitized Scour Bathymetry (cont'd)



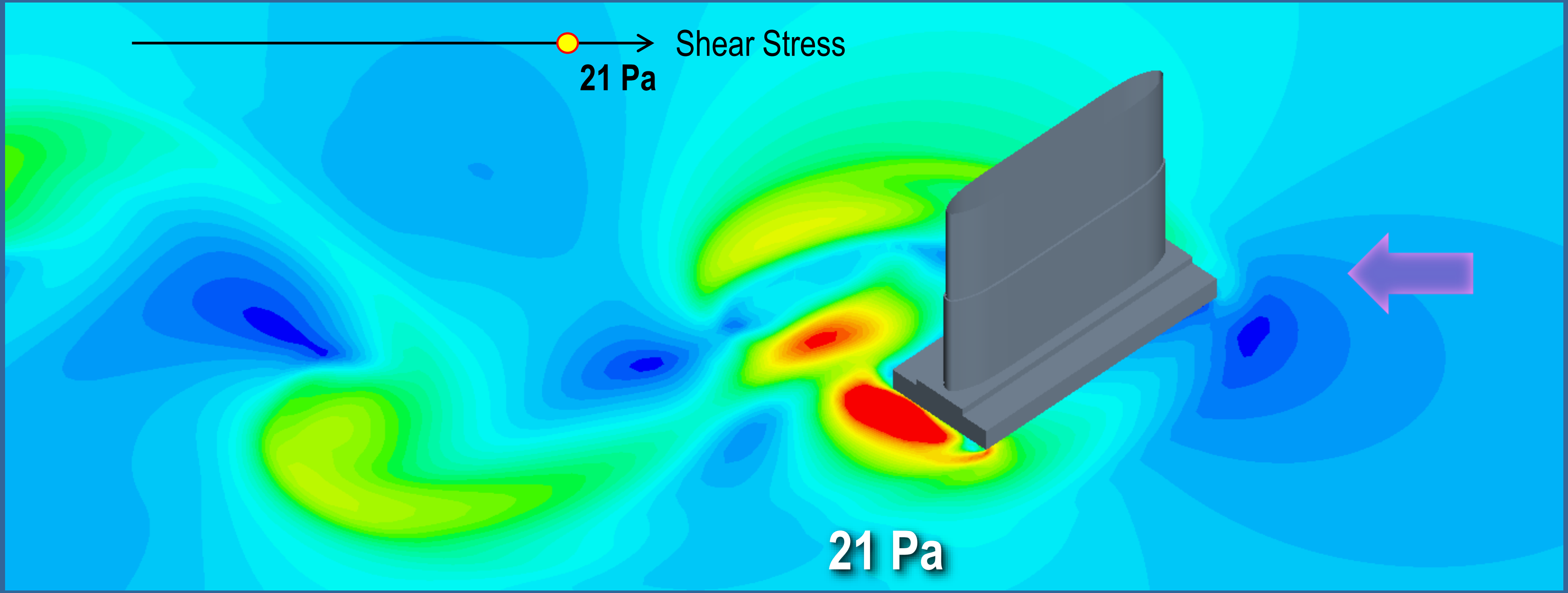
Digitized Scour Bathymetry (cont'd)



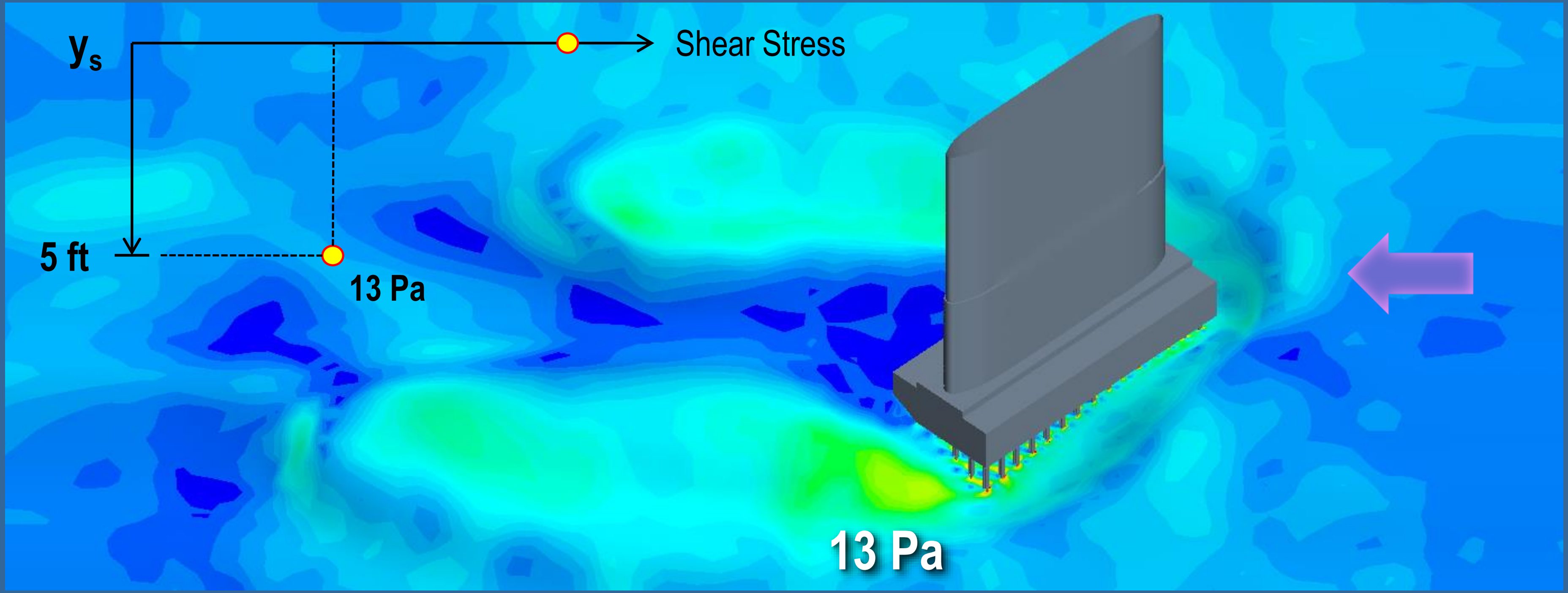
Digitized Scour Bathymetry (cont'd)



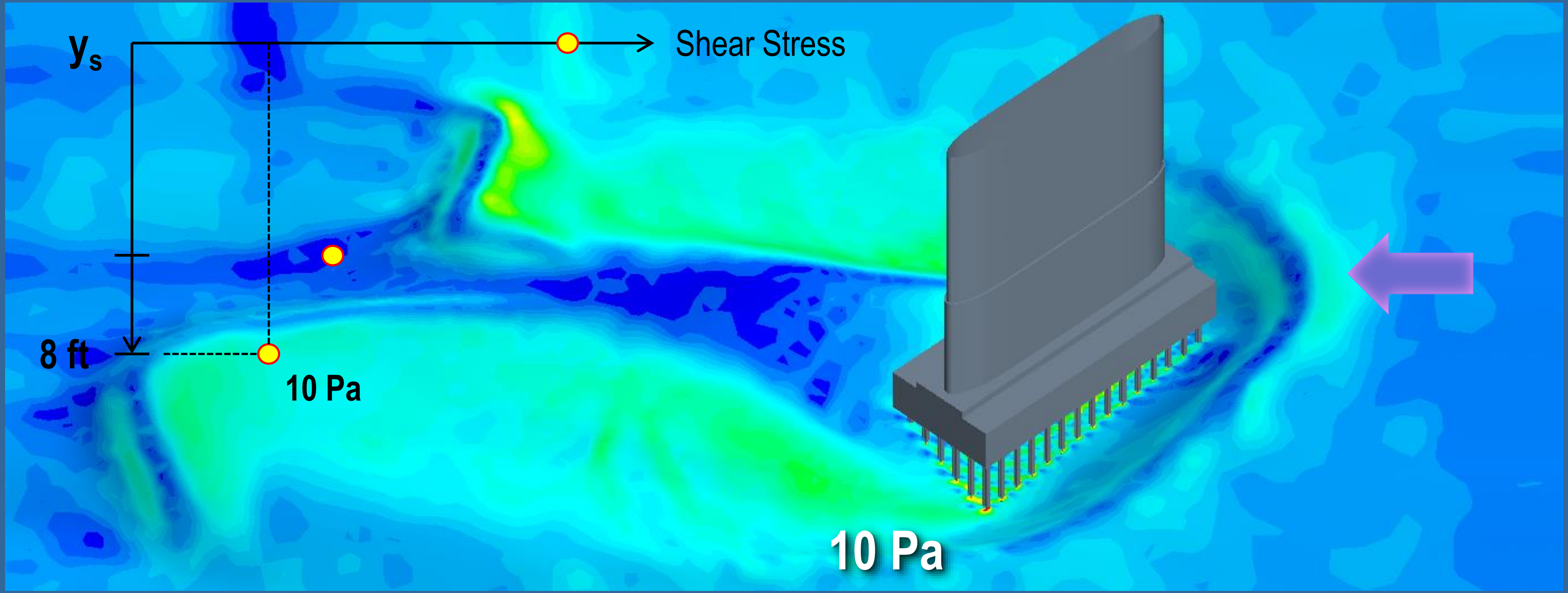
CFD for Computing Decay of Shear Erosion Forces



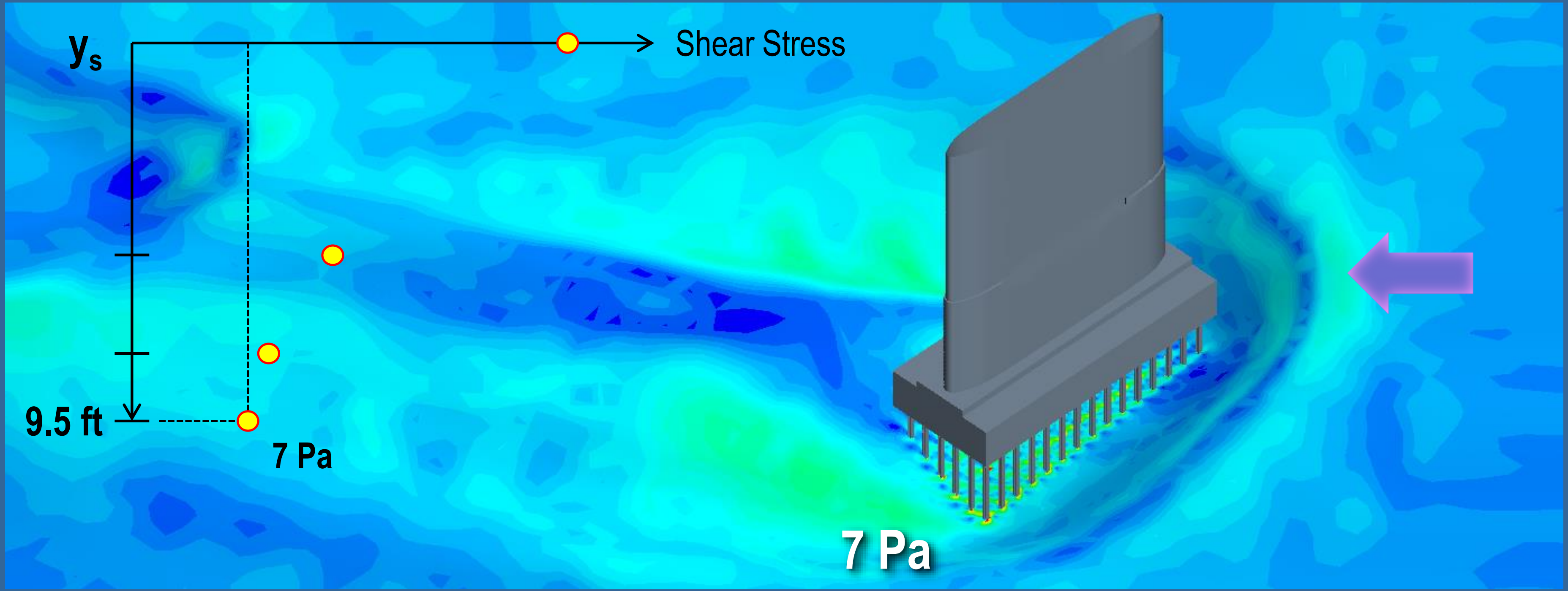
CFD for Computing Decay of Shear Erosion Forces (cont'd)



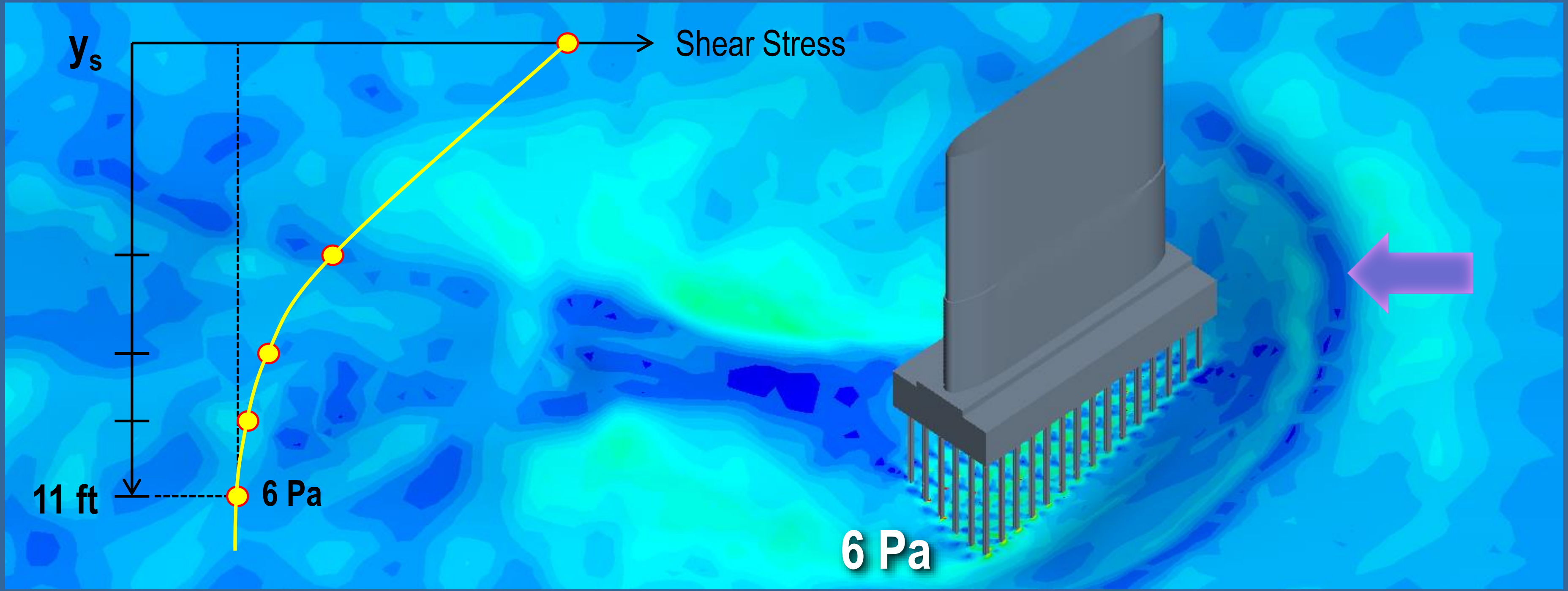
CFD for Computing Decay of Shear Erosion Forces (cont'd)



CFD for Computing Decay of Shear Erosion Forces (cont'd)



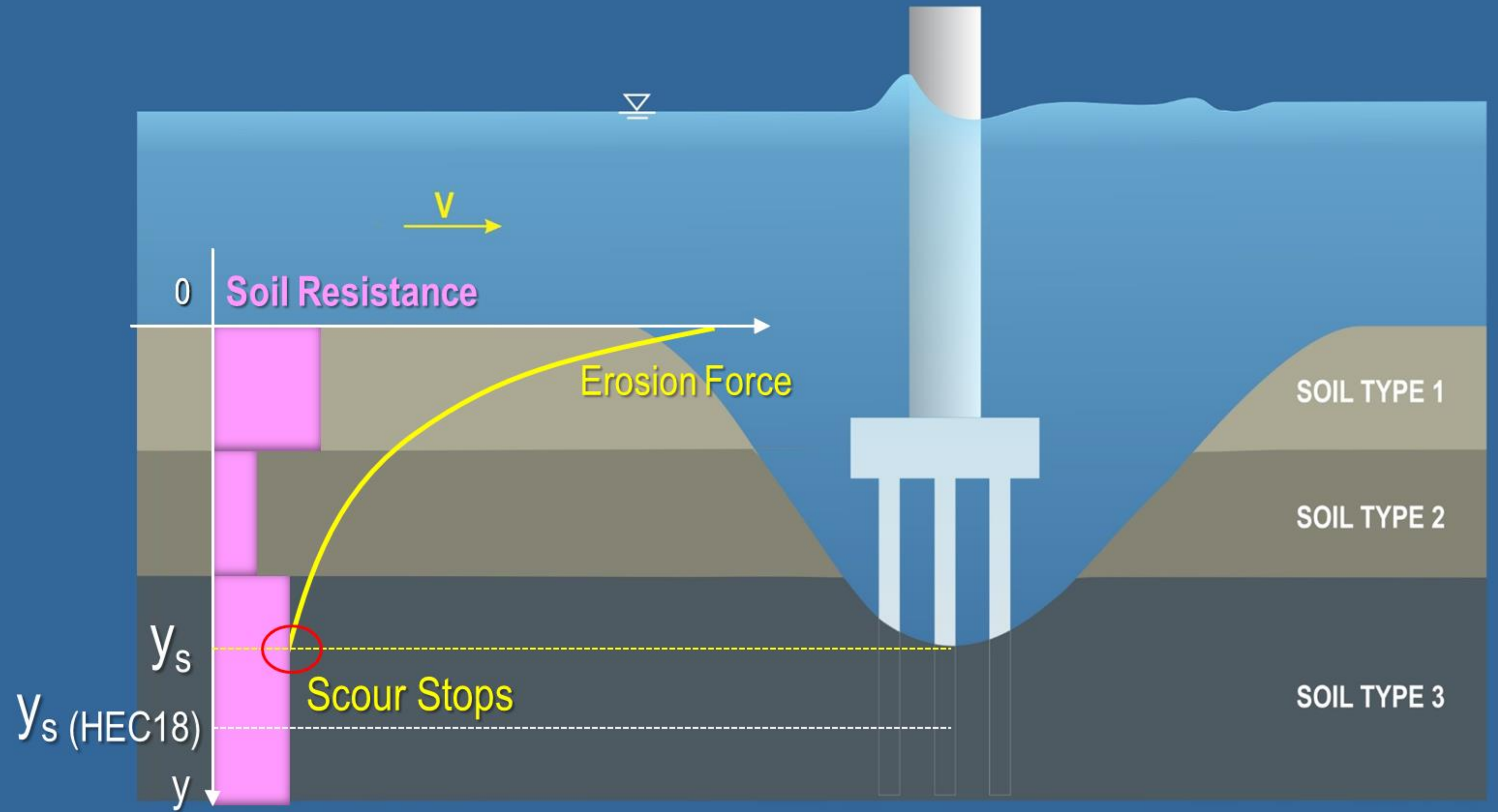
CFD for Computing Decay of Shear Erosion Forces (cont'd)



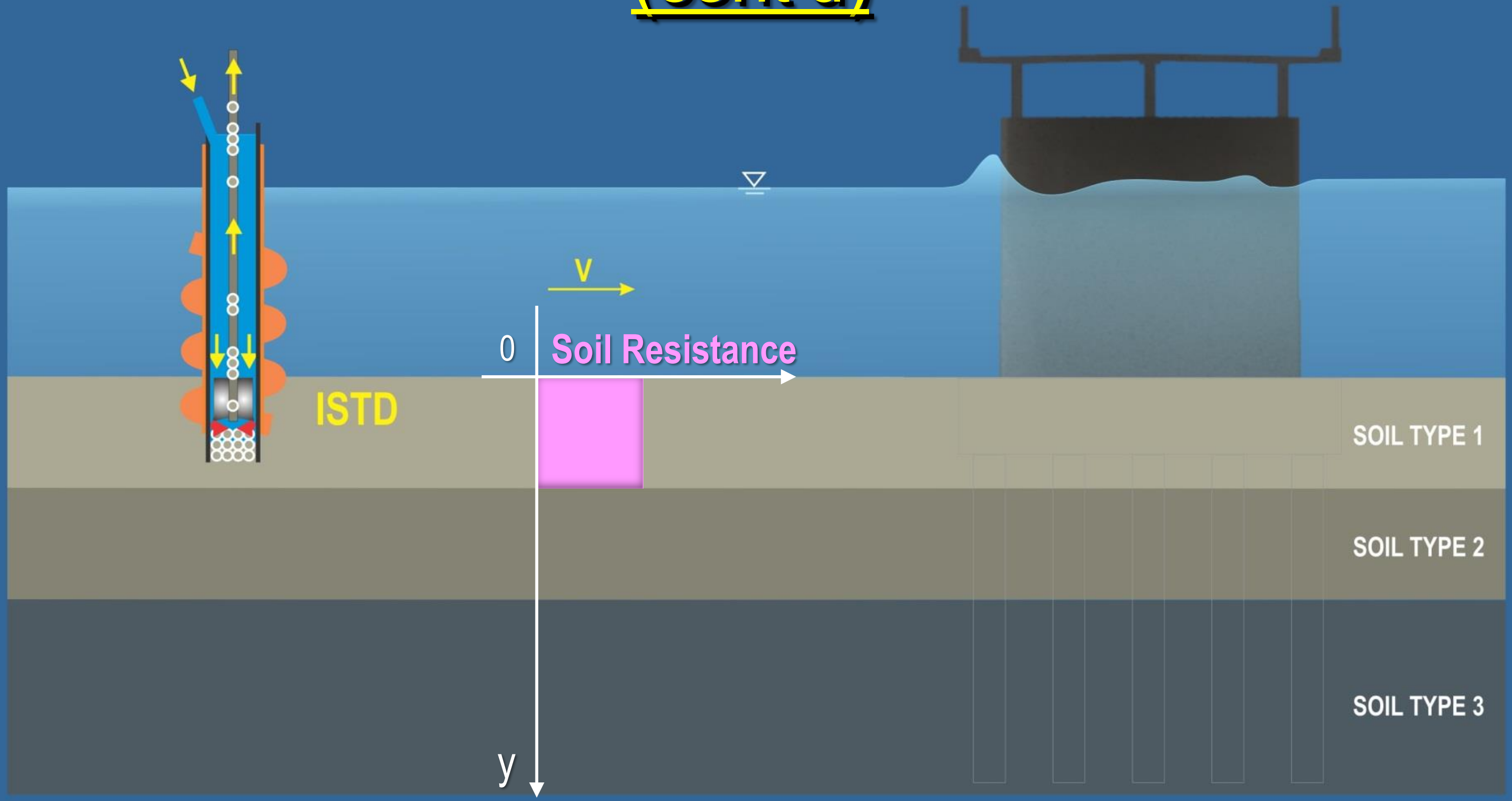
Soil Erosion Resistance – Testing

- In-situ Scour Testing Device

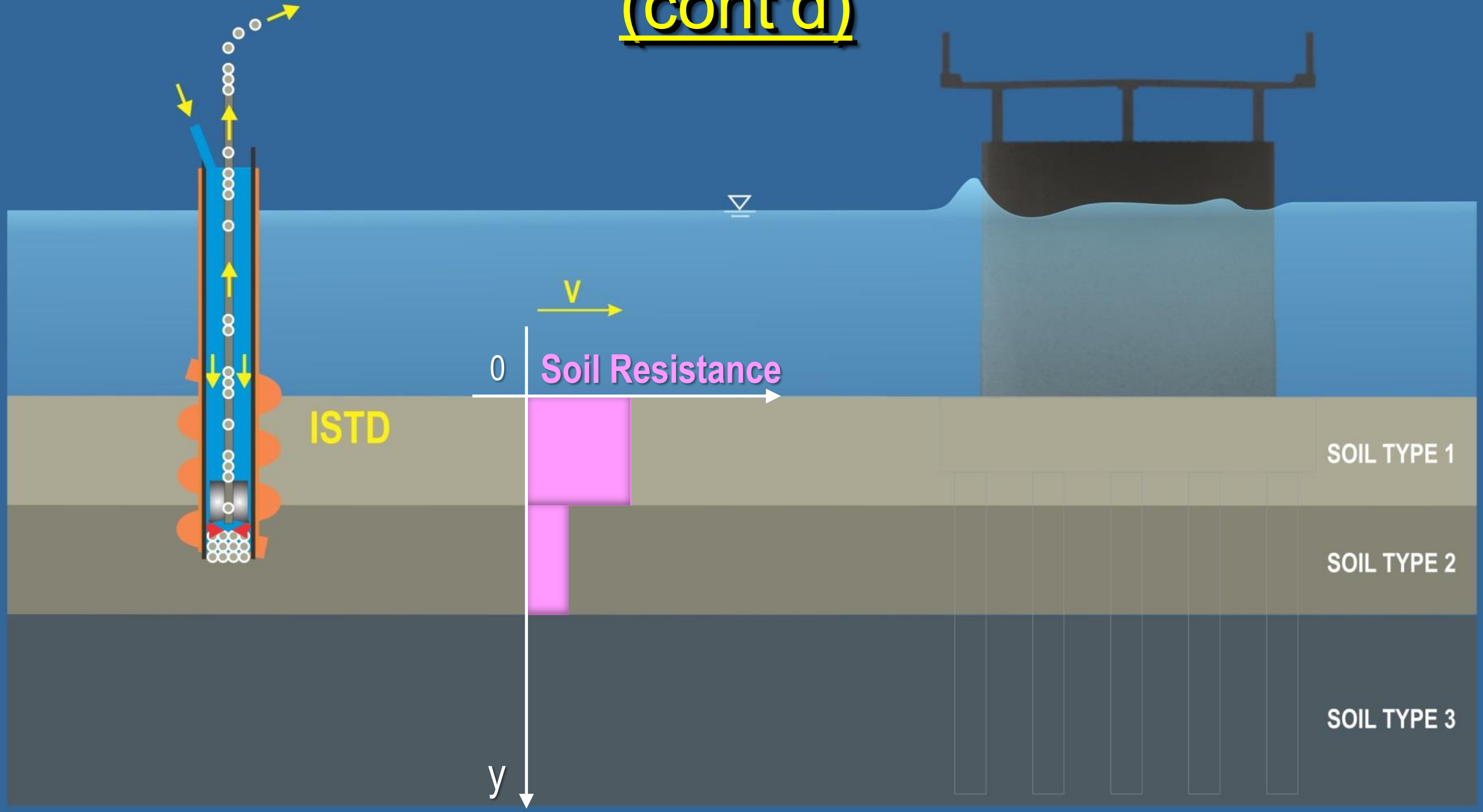
Proposed Future Scour Depth Design Method



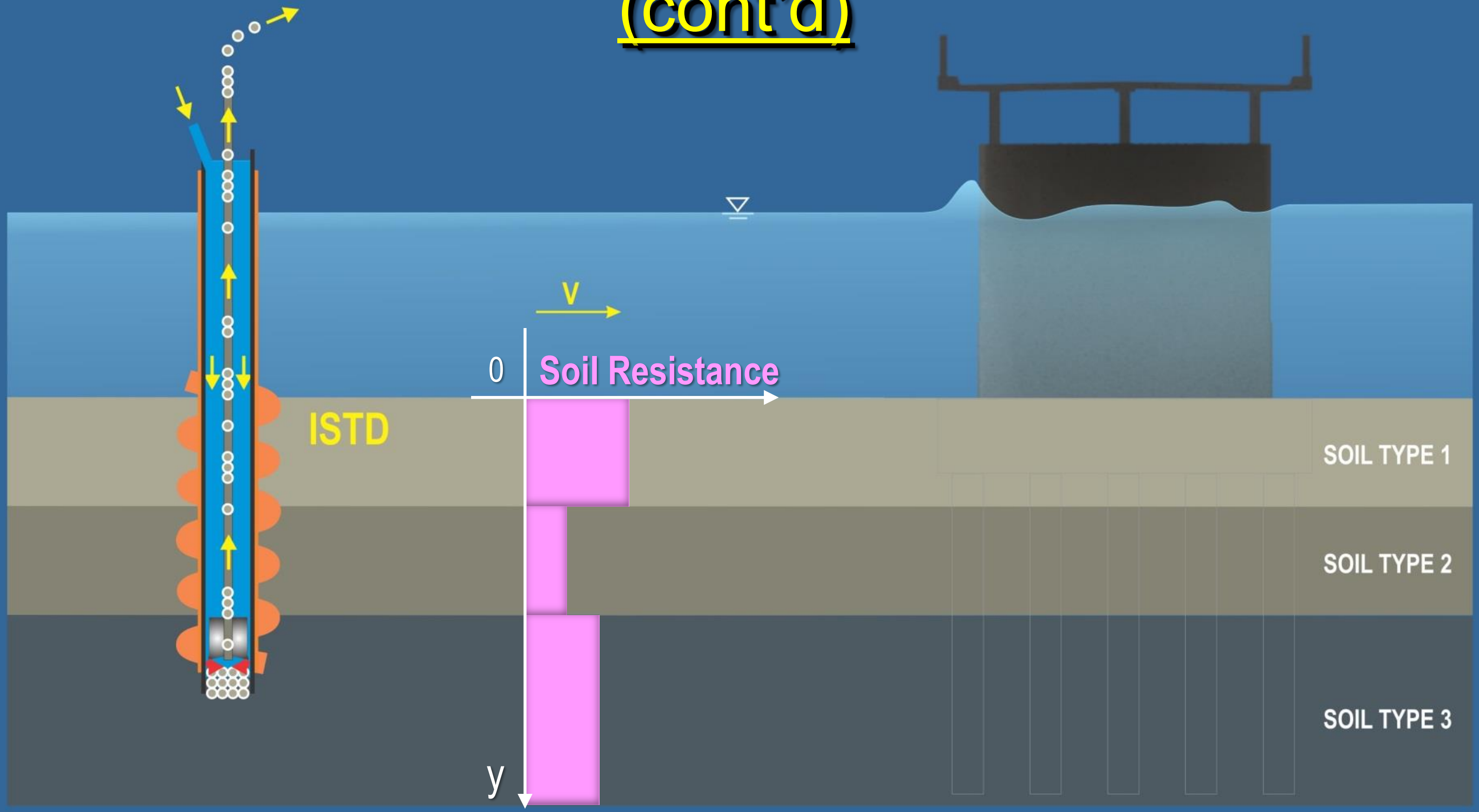
Proposed Future Scour Depth Design Method (cont'd)



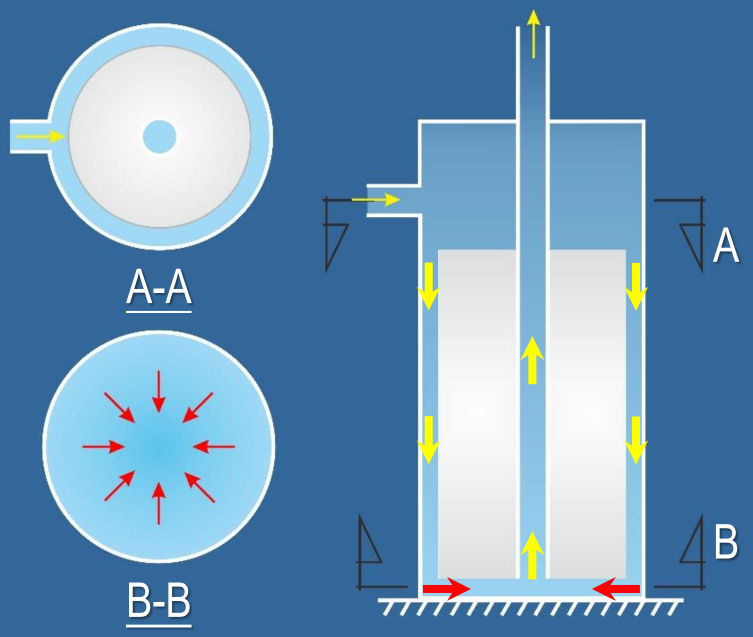
Proposed Future Scour Depth Design Method (cont'd)



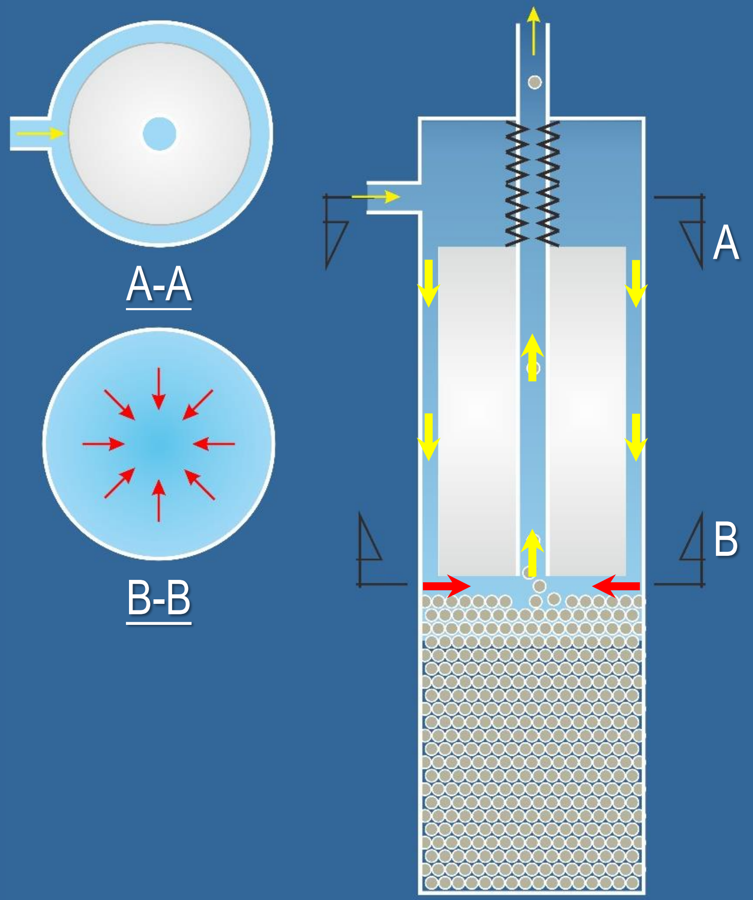
Proposed Future Scour Depth Design Method (cont'd)



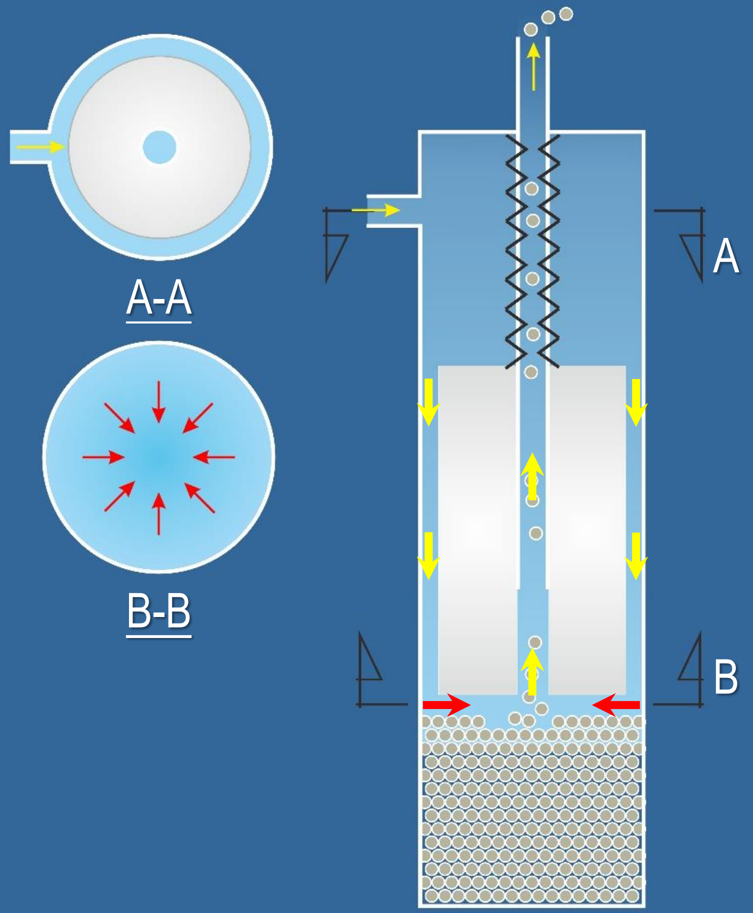
In-situ Scour Testing Device Concept (cont'd)



In-situ Scour Testing Device Concept (cont'd)



In-situ Scour Testing Device Concept (cont'd)




Hydrology


Drainage


Culverts


Bridges

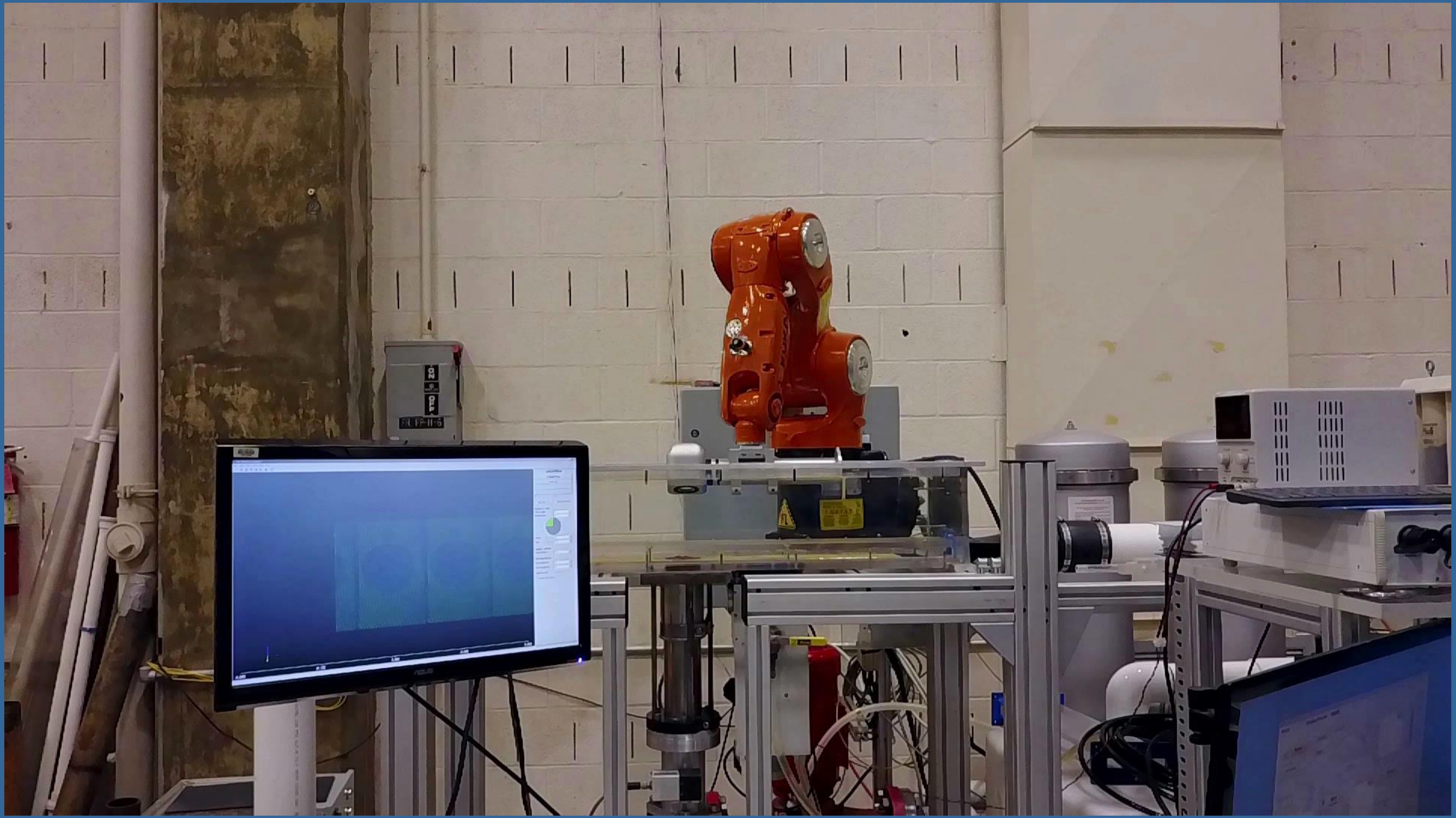

Scour


Coastal

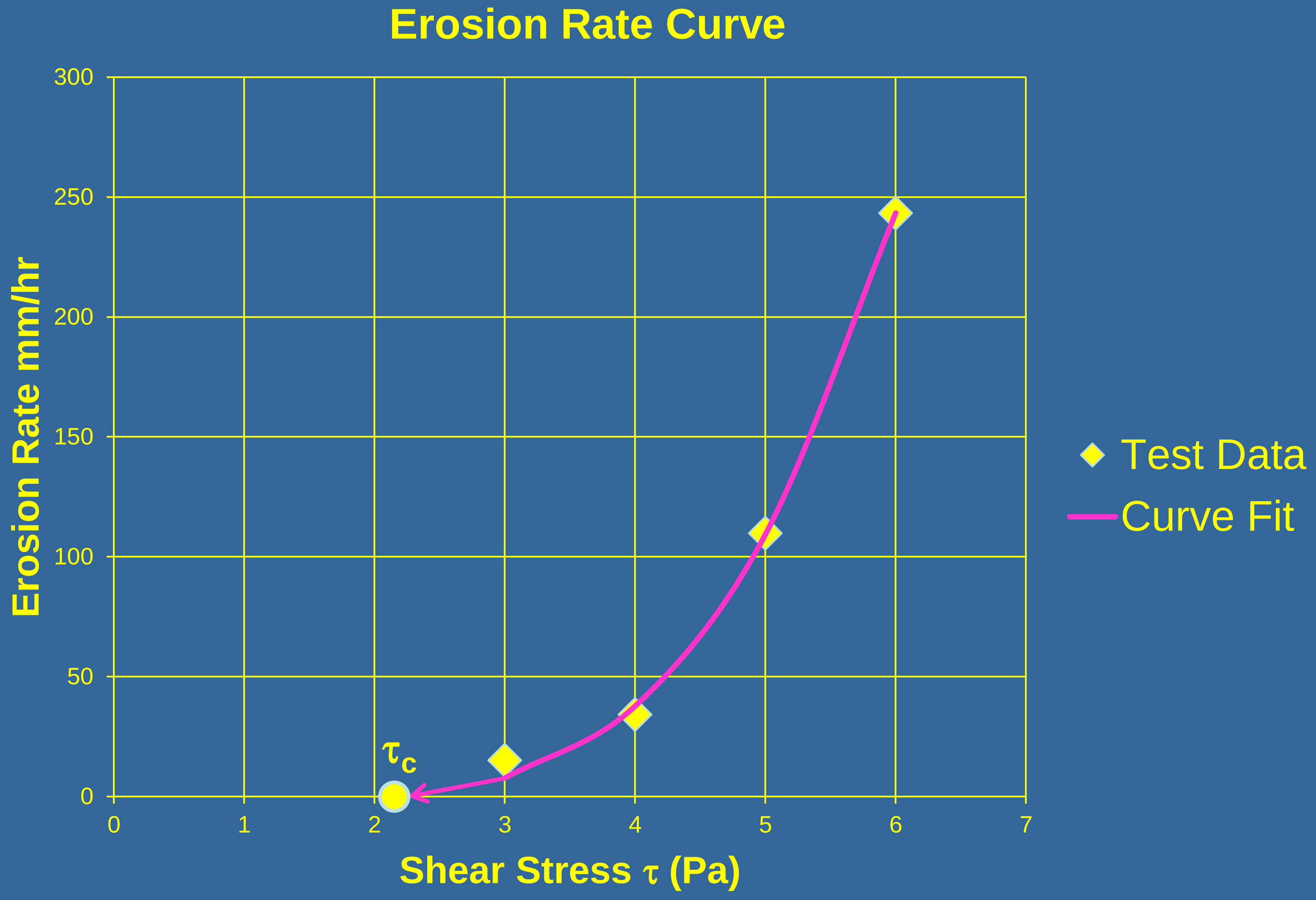

Step 1: Standard drilling using auger with casing

Soil Erosion Resistance - Testing

- Ex-situ Scour Testing Device



Erosion Rate Curve is used for determining the Critical Soil Erosion Resistance (τ_c)



Thank You