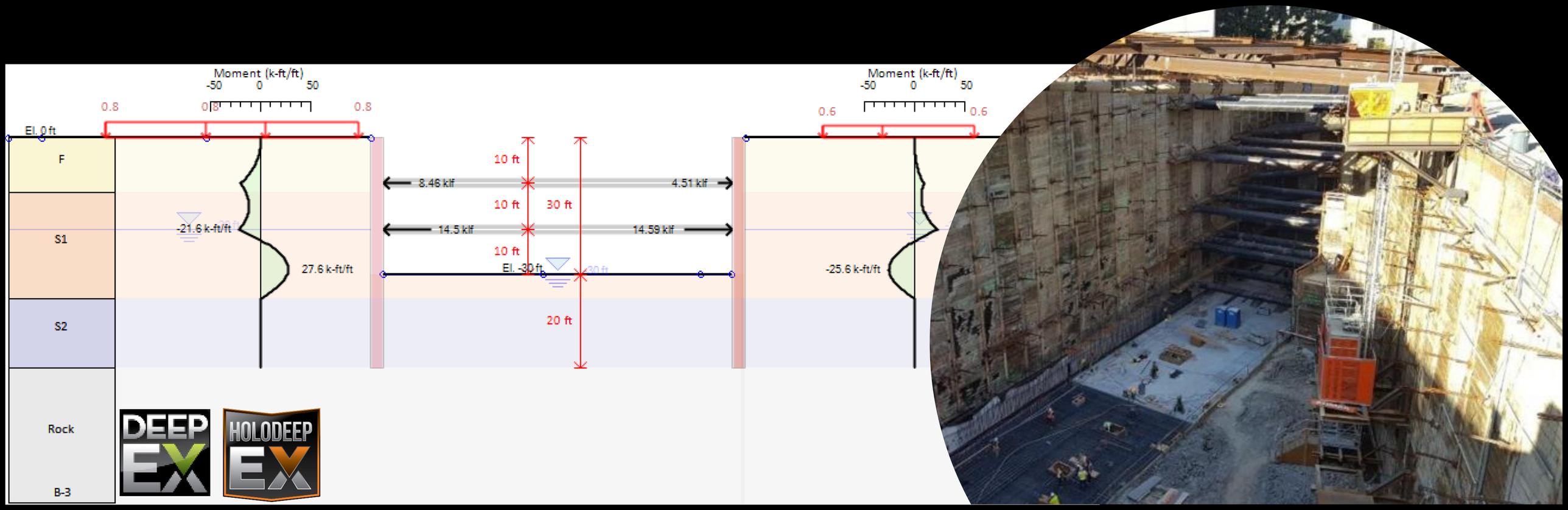
Design of Deep Excavations - Methods and Software Application

Presentation: Dimitrios Mamoglou, Senior Engineer, Deep Excavation LLC
mamoglou@deepexcavation.com - T: +1-206-279-3300



Our Company

Deep Excavation LLC
240 W 35th Street, Suite 1004
New York, NY, 10001
USA

Websites:
www.deepexcavation.com
www.deepex.com

Contact Information:
sales@deepexcavation.com
training@deepexcavation.com

- Software solutions for excavation and foundation professionals
- Consulting Services – Design of deep excavations and pile foundations
- Virtual Reality applications for geotechnical engineers and contractors

DeepEX | HoloDeepEX | DeepFND | HelixPile | SnailPlus | QuayWalls | SiteMaster

PART 1: DeepEX Software Features and Analysis Methods

More information:

Click here to learn more:
DeepEX – Software Features and Capabilities

www.deepexcavation.com
www.deepex.com

sales@deepexcavation.com
training@deepexcavation.com
T: +1-206-279-3300

DEEP EXCAVATION
GEOTECHNICAL SOFTWARE AND ENGINEERING

DeepEx - Shoring Design Software

Full Structural and Geotechnical Design of any Deep Excavation Model

Wall Types in DeepEX

- ✓ Soldier Pile and Lagging Walls
- ✓ Sheet Pile Walls
- ✓ Secant / Tangent Pile Walls
- ✓ Concrete Diaphragm Walls (Slurry Walls)
- ✓ Soldier Pile and Tremied Concrete Walls
- ✓ Combined Sheet Pile Walls (King Piles)
- ✓ Box Sheet Pile Walls
- ✓ Custom Walls

Support Systems in DeepEX

- ✓ Anchored Walls (Tiebacks and Helical Anchors)
- ✓ Braced Excavations (Steel Struts and Rakers)
- ✓ Top/Down Excavations with Concrete Slabs
- ✓ Dead-man Walls
- ✓ Bin-Type Walls
- ✓ Cofferdams
- ✓ Circular Shafts
- ✓ Cantilever Walls

ANALYSIS METHODS: LIMIT EQUILIBRIUM ANALYSIS

Soil Pressures: Active/Passive, At-rest, Apparent Pressures (FHWA, Peck, Adaptive, Custom Trapezoidal +more)

Beam Analysis: Blum's, FHWA Simple Span, CALTRANS +more

NON-LINEAR ANALYSIS (SOIL SPRINGS)

Moments and Reactions from Spring Analysis

Cumulative Results from Stages

Realistic Displacements

FINITE ELEMENT ANALYSIS

Moments and Reactions from Finite Elements

Full Soil-Structure Interaction

Calculate Surface Settlements

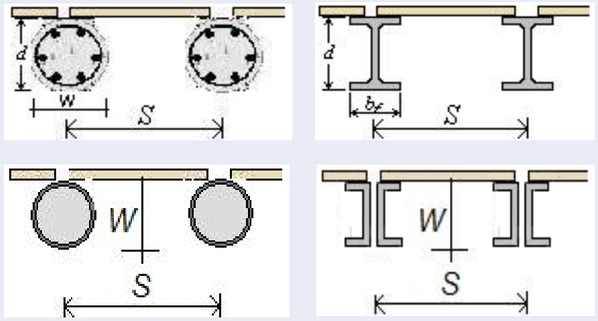
RELIABLE GEOEXPERTISE

www.deepexcavation.com
www.deepex.com

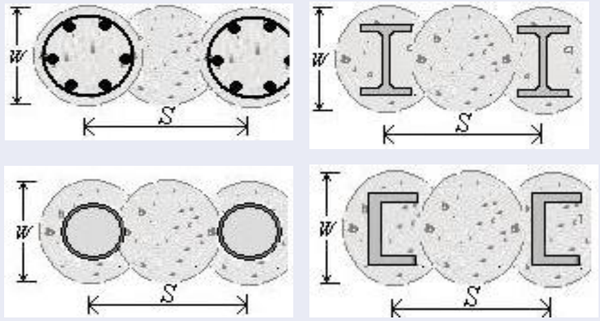
sales@deepexcavation.com
training@deepexcavation.com
T: +1-206-279-3300

DeepEx Software - Wall Types

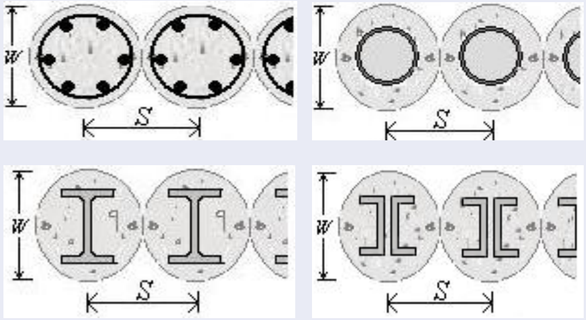
Soldier pile and lagging walls



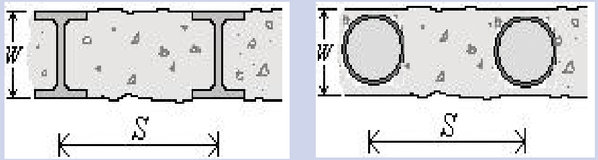
Secant pile walls



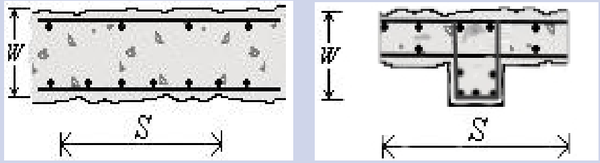
Tangent pile walls



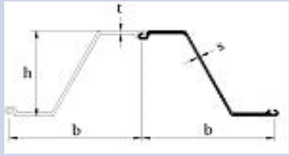
SPTC walls



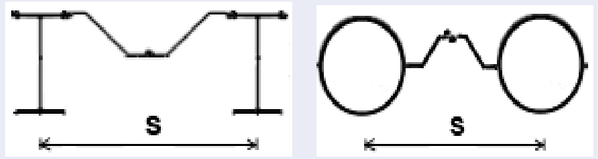
Diaphragm (slurry) walls



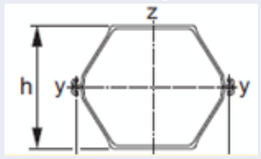
Sheet pile walls



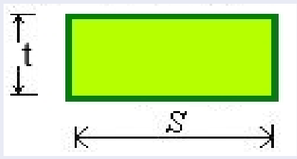
Combined sheet pile walls



Box sheet pile walls



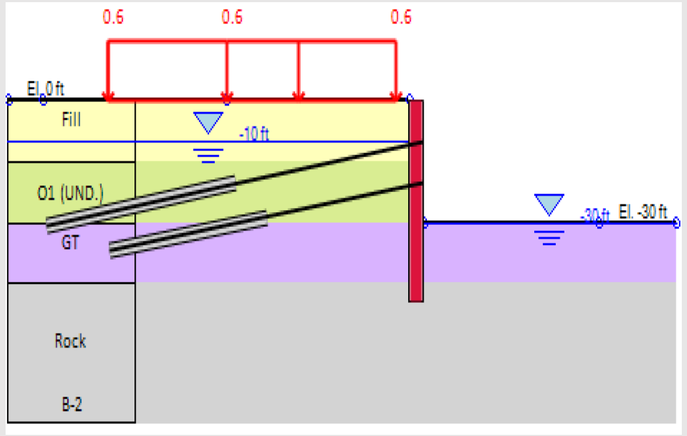
Custom walls



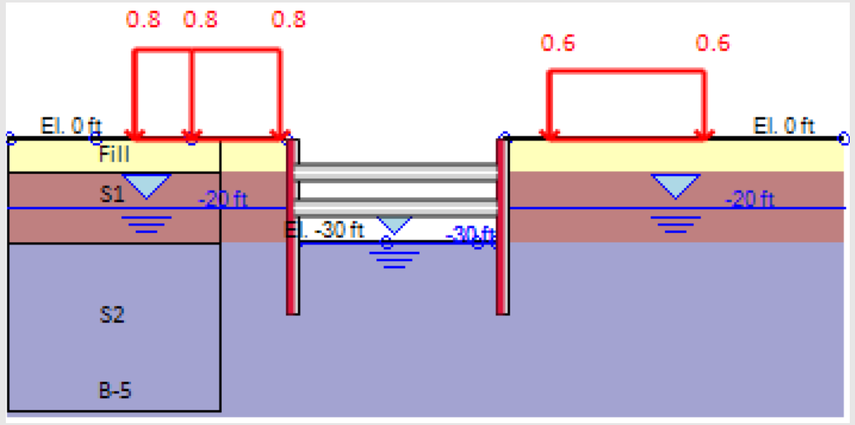
DEEP EXCAVATION
GEOTECHNICAL SOFTWARE AND ENGINEERING

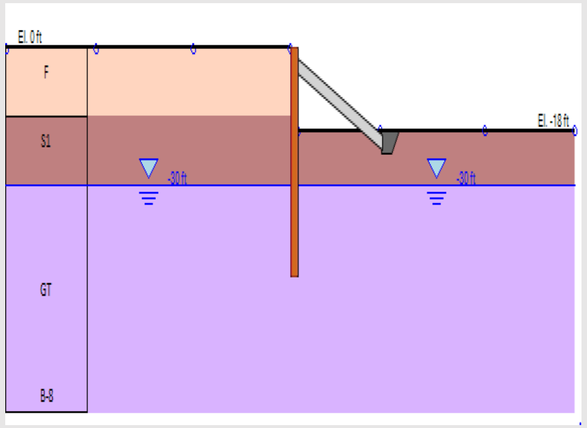
DeepEx Software - Support Systems

Anchored Walls (Tiebacks)

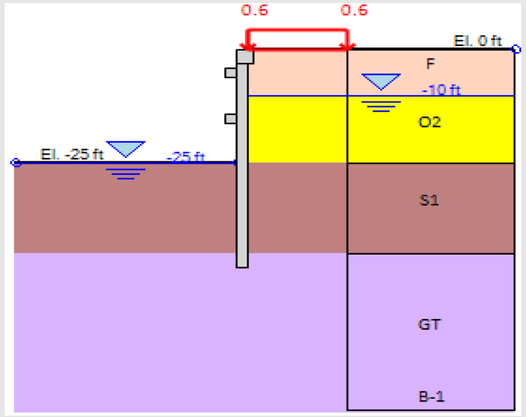


Braced Excavations (Struts and Rakers)

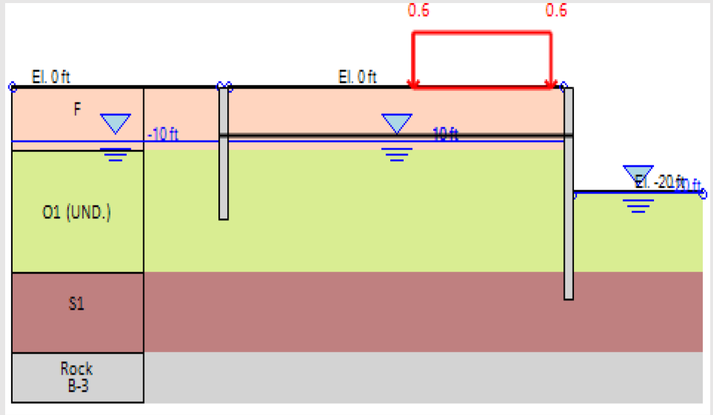




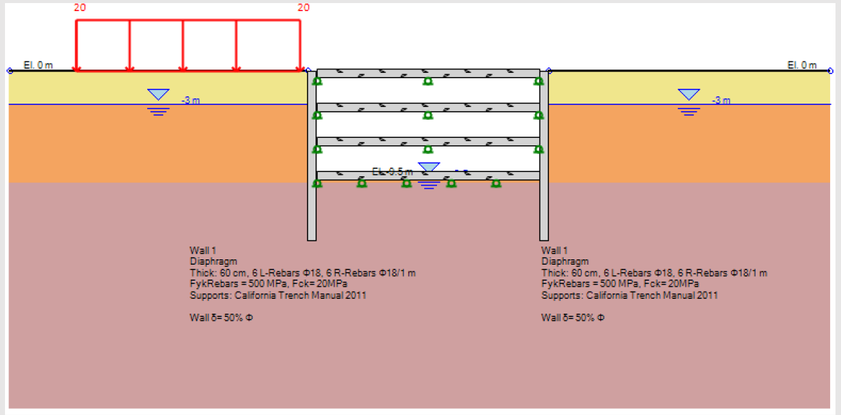
Circular Shafts (Ring Beams)



Dead-man Walls (Tierods)



Top-Down Excavations (Concrete Slabs)



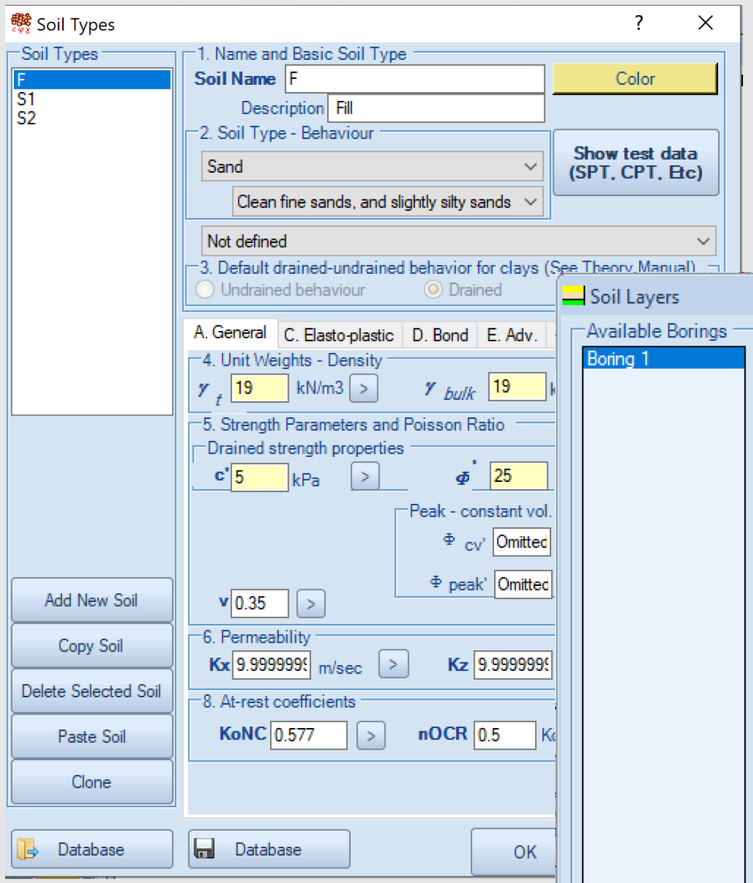
RELIABLE GEOEXPERTISE

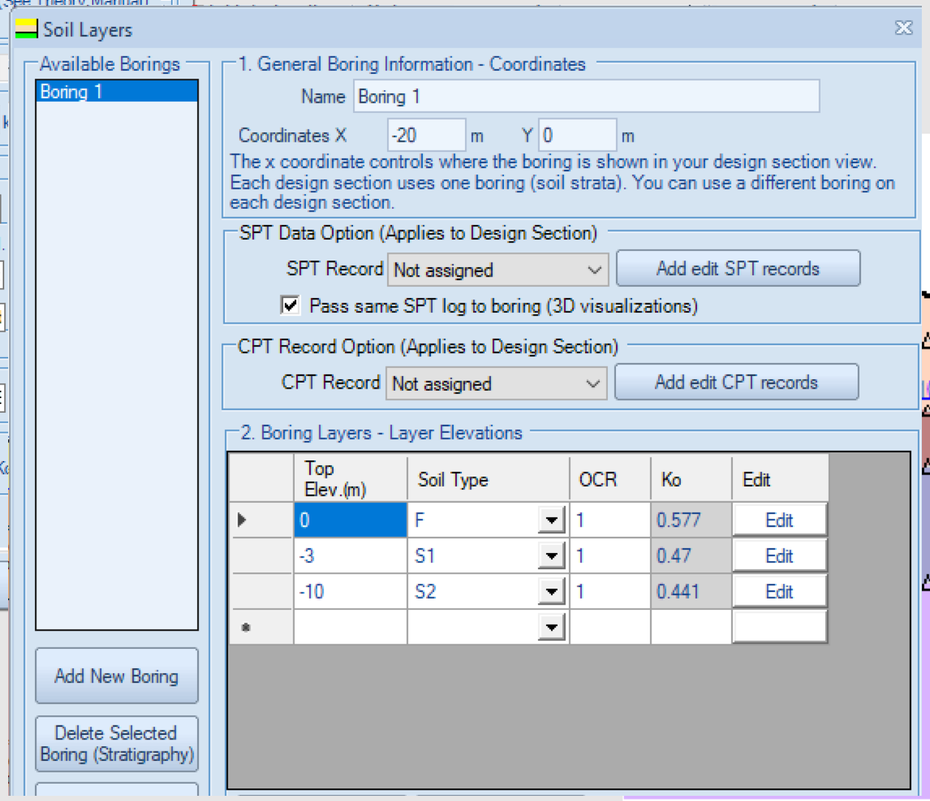
www.deepexcavation.com
www.deepex.com

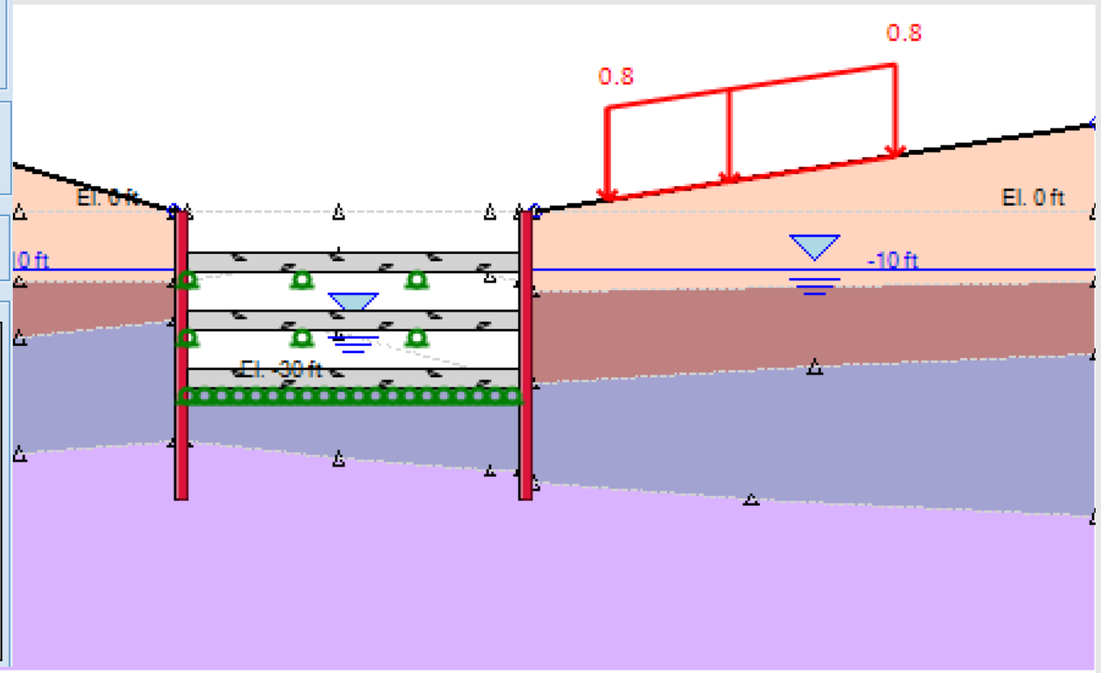
sales@deepexcavation.com
training@deepexcavation.com
T: +1-206-279-3300

DEEP EXCAVATION
GEOTECHNICAL SOFTWARE AND ENGINEERING

Soils and Stratigraphy in DeepEX







- ✓ Create multiply soil types and define soil properties
- ✓ Soil properties estimation tools (NSPT values - test data)
- ✓ Create multiple borings and define the horizontal stratigraphy
- ✓ Add CPT logs and SPT Records - Estimate properties from records
- ✓ Custom Layer mode: Create inclined soil layers
- ✓ Soil Change Commands: Change soil properties through stages

RELIABLE GEOEXPERTISE

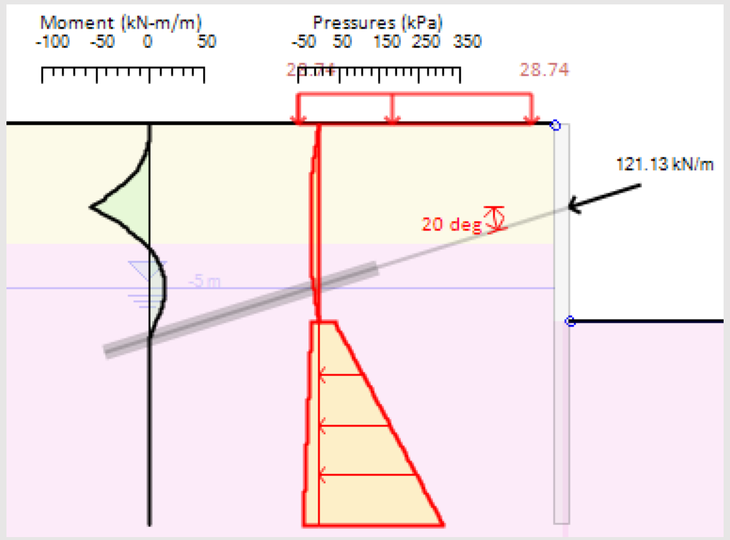
www.deepexcavation.com
www.deepex.com

sales@deepexcavation.com
training@deepexcavation.com
T: +1-206-279-3300

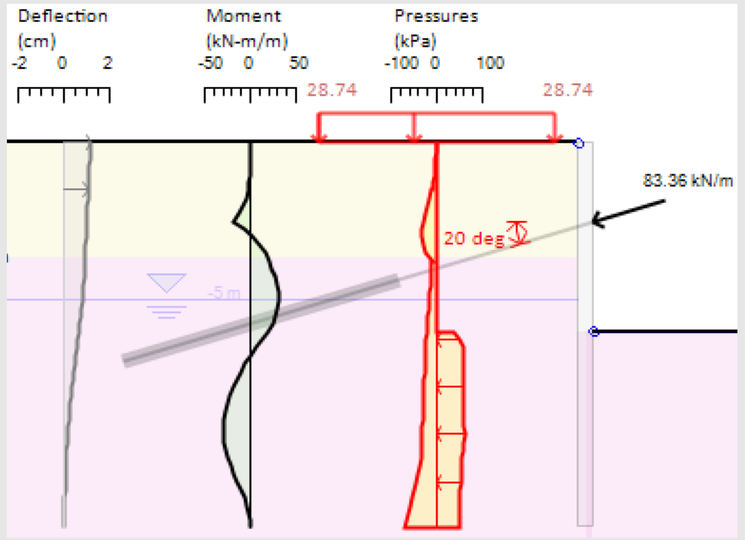
DEEP EXCAVATION
GEOTECHNICAL SOFTWARE AND ENGINEERING

Analysis Methods and Design Standards in DeepEX

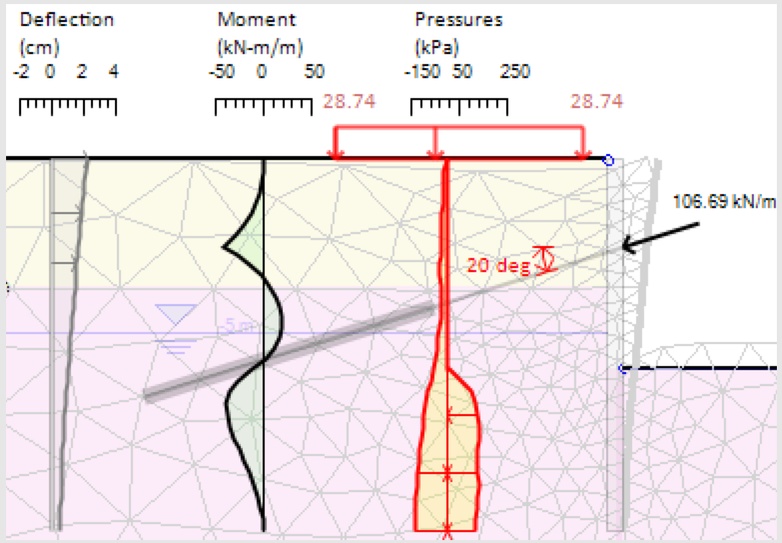
Limit Equilibrium Analysis (LEM)



Non-Linear Analysis (NL) (Elastoplastic Springs)



Finite Element Analysis (FEM)



Structural Codes: Eurocodes 1,2 & 8, ACI, LRFD, AISC, AS 3600 & 4100, CN (China) + more

Design Standards: Eurocode 7, DIN, BS, XP, AASHTO LRFD, CALTRANS, CN (China) + more

RELIABLE GEOEXPERTISE

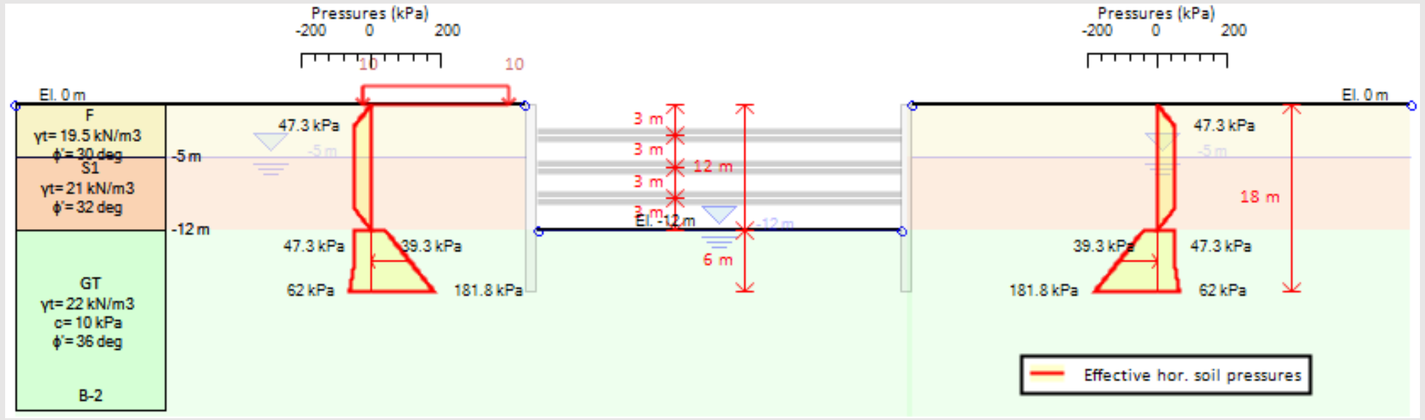
www.deepexcavation.com
www.deepex.com

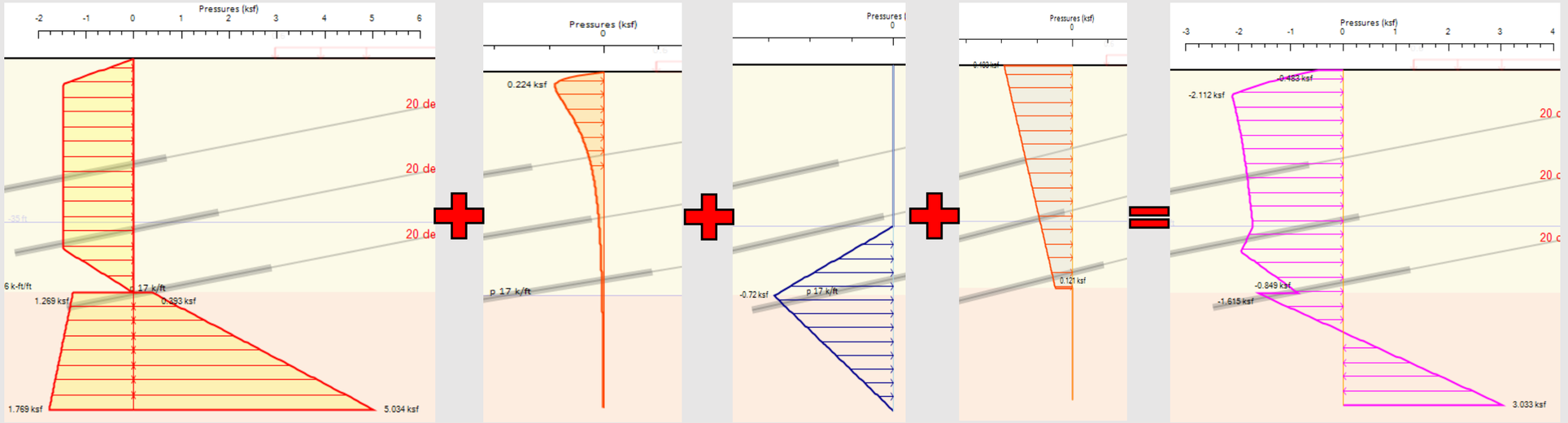
sales@deepexcavation.com
training@deepexcavation.com
T: +1-206-279-3300

DEEP EXCAVATION
GEOTECHNICAL SOFTWARE AND ENGINEERING

Limit Equilibrium Analysis Concept (LEM)

- ✓ Assume lateral earth pressures.
- ✓ Determine fixity locations for forces at subgrade.
- ✓ Analyze wall beam with assumed loads.
- ✓ Advantages: Easy method to verify. Gives a back check for more rigorous methods.
- ✓ Disadvantages: Soil-structure interaction ignored.





Soil Pressures | Surcharge | Water Pressures | Seismic Pressures | Net Pressures

RELIABLE GEOEXPERTISE

www.deepexcavation.com
www.deepex.com

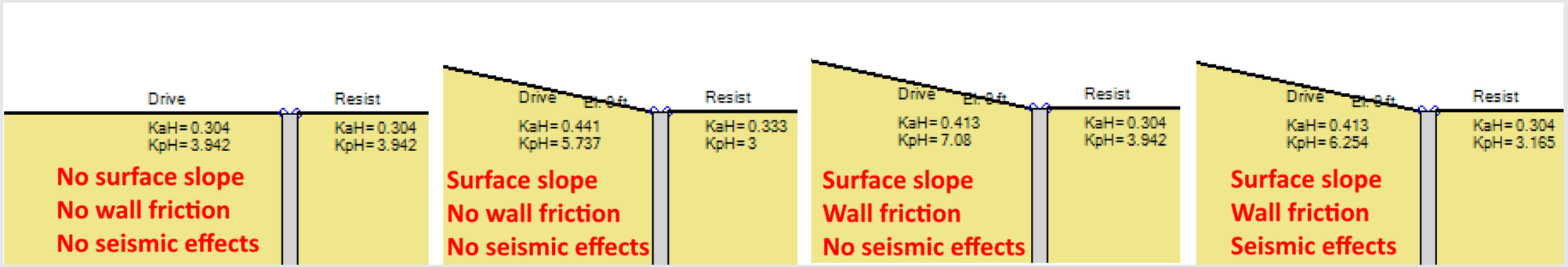
sales@deepexcavation.com
training@deepexcavation.com
T: +1-206-279-3300

Earth Coefficients in DeepEX Software

DeepEX Automatic Method Selection According to Project Parameters

Active Coefficient Ka				
Parameters	Horizontal Surface	Inclined Surface	Wall Friction Considered	Seismic Effects Applied
Method	**Rankine**	**Coulomb**	**Coulomb**	**No Effect**

Passive Coefficient Kp				
Parameters	Horizontal Surface	Inclined Surface	Wall Friction Considered	Seismic Effects Applied
Method	**Rankine**	**Coulomb**	**Caquot-Kerisel**	**Lancelotta**



www.deepexcavation.com
www.deepex.com

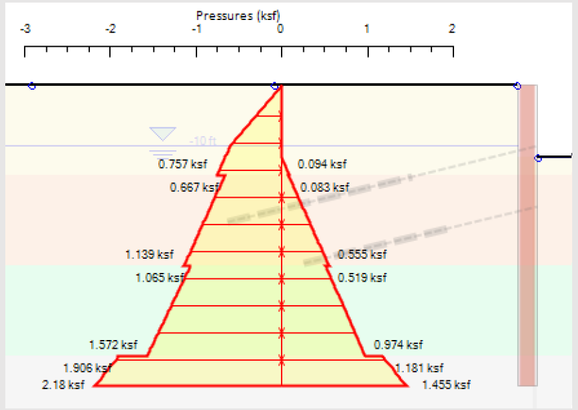
sales@deepexcavation.com
training@deepexcavation.com
T: +1-206-279-3300

DEEP EXCAVATION
GEOTECHNICAL SOFTWARE AND ENGINEERING

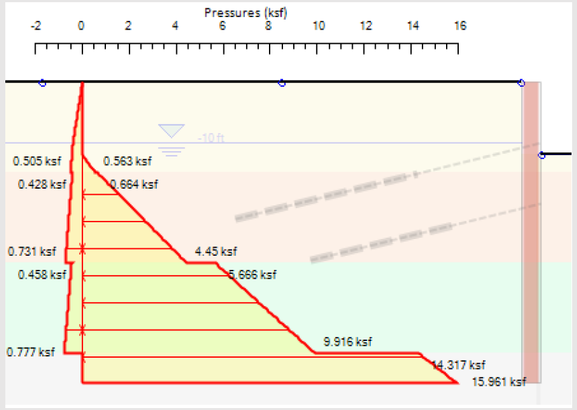
LEM: Soil Pressures Methods

Cantilever Excavations

At-Rest Pressures

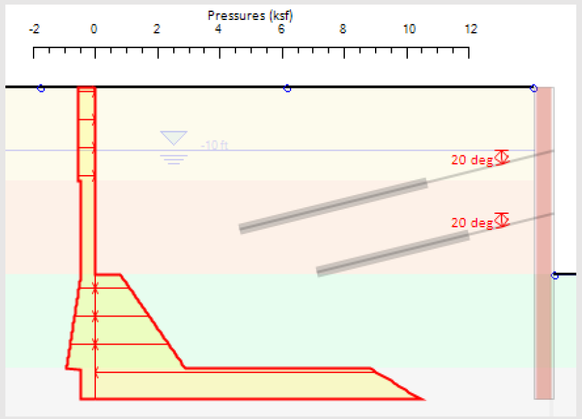


Active - Passive Pressures

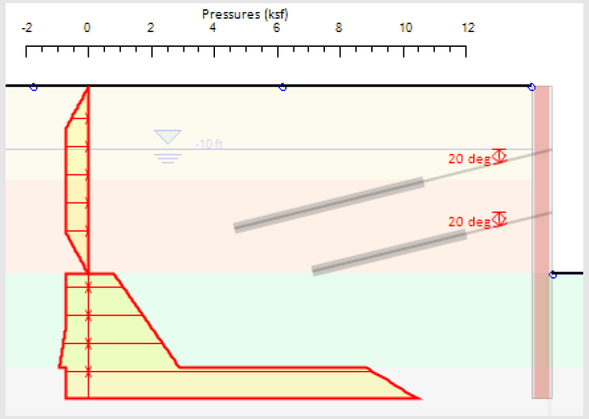


Construction Stages with multiple support levels

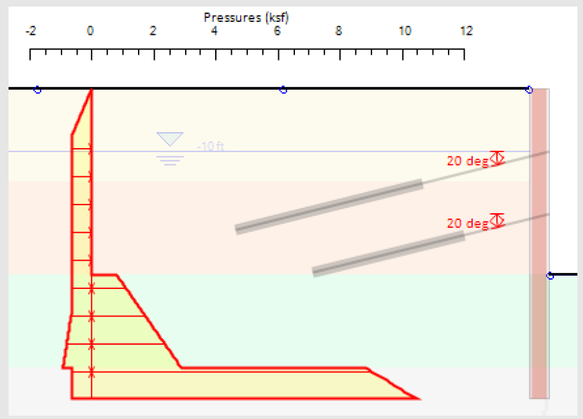
Peck 1969 Pressures



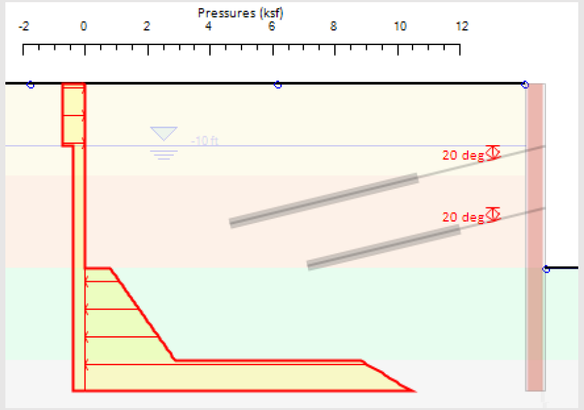
FHWA Apparent Pressures



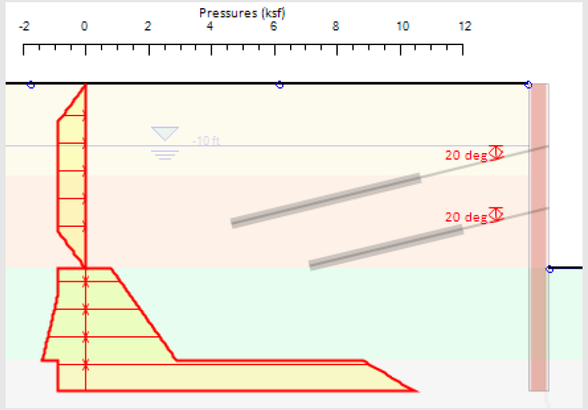
Custom Trapezoidal Pressures



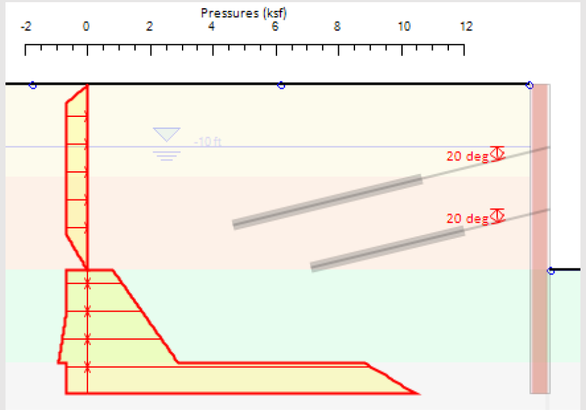
Two-Step Rectangular Pressures



WMATA Pressures



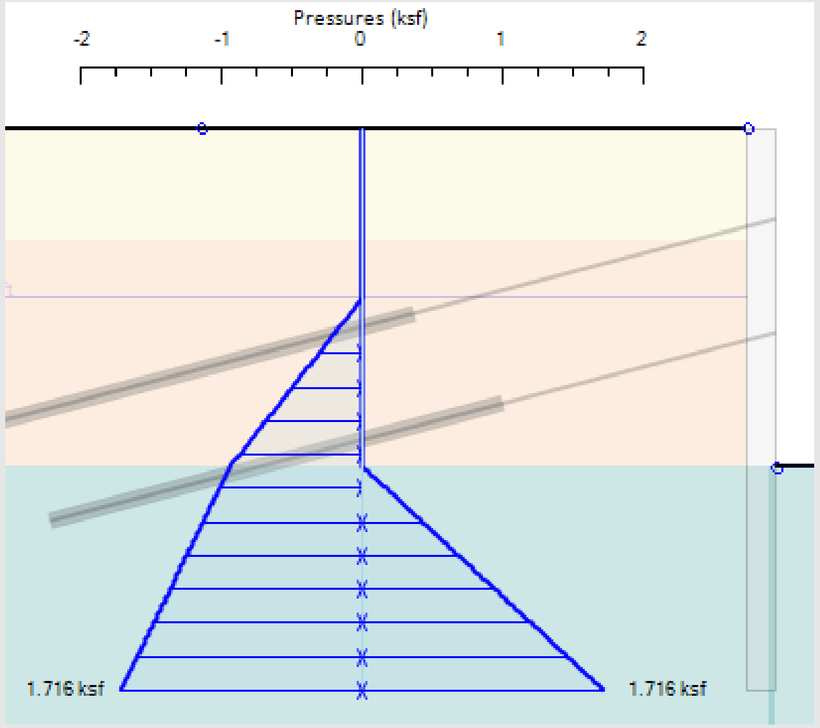
New York City DEP Pressures



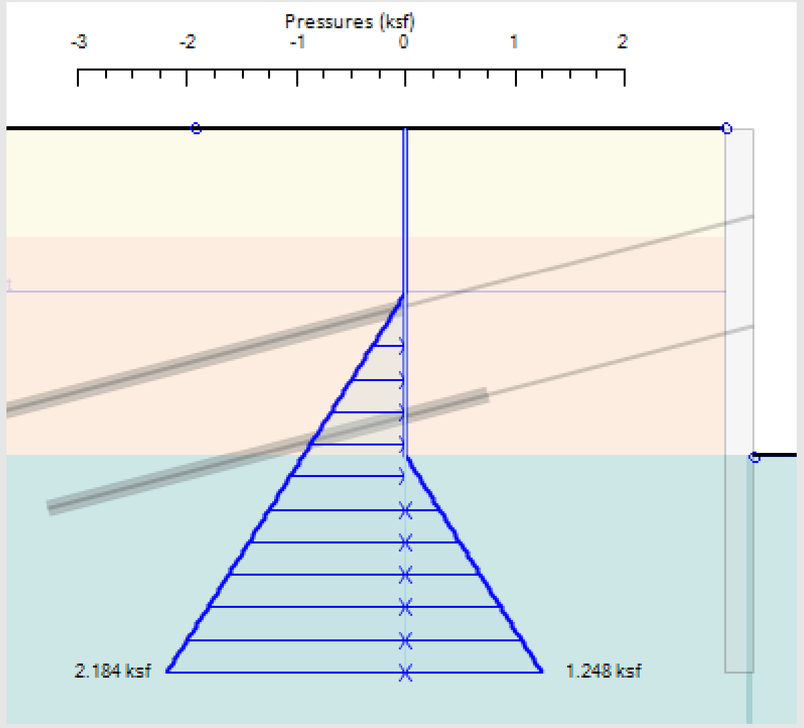
DEEP EXCAVATION
GEOTECHNICAL SOFTWARE AND ENGINEERING

Water Pressure Methods in DeepEX Software

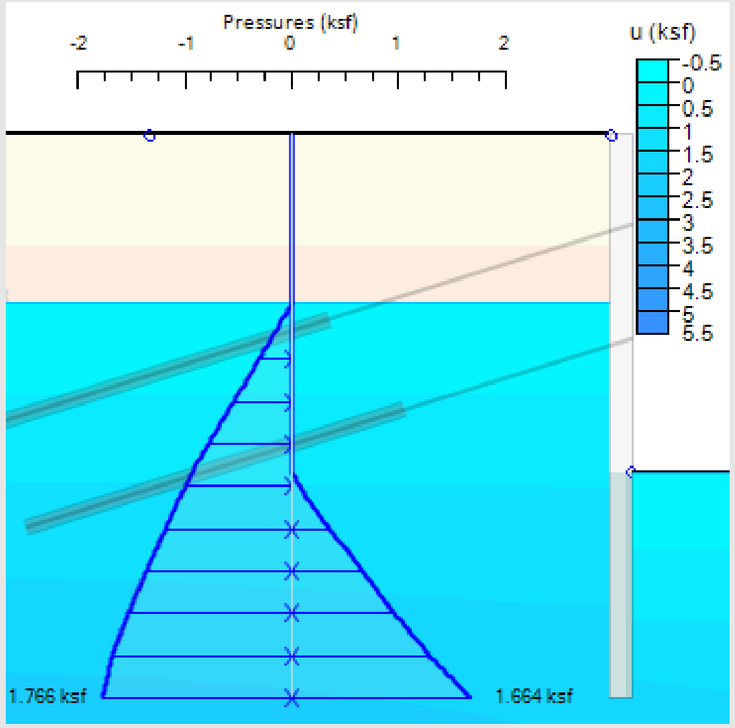
Simplified Flow



Hydrostatic



Full Flownet Analysis



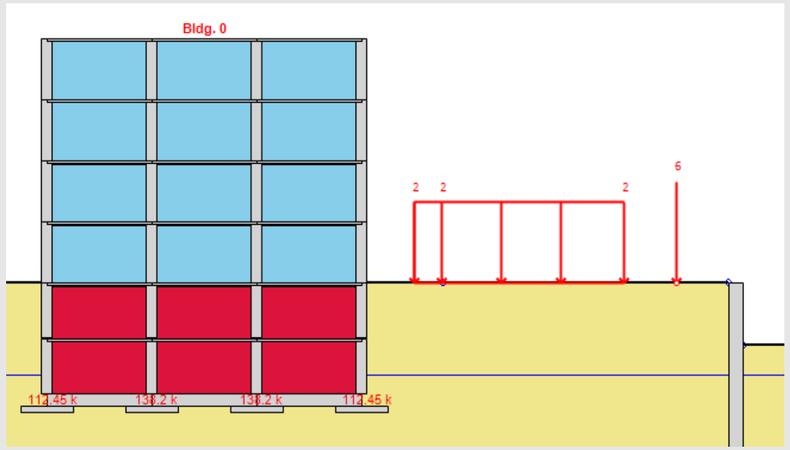
RELIABLE GEOEXPERTISE

www.deepexcavation.com
www.deepex.com

sales@deepexcavation.com
training@deepexcavation.com
T: +1-206-279-3300

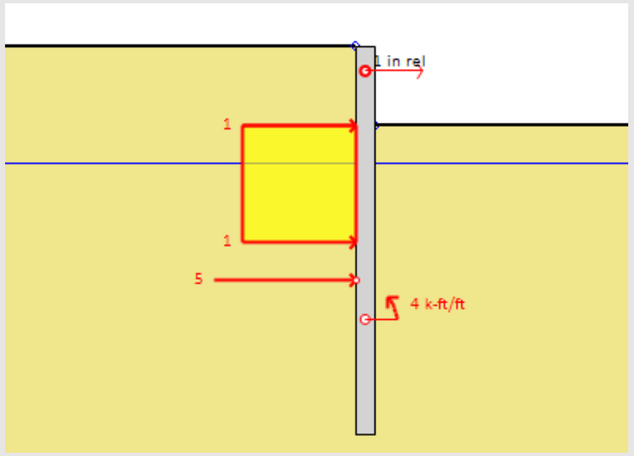
DEEP EXCAVATION
GEOTECHNICAL SOFTWARE AND ENGINEERING

External Loads in DeepEX: Types and Pressure Methods



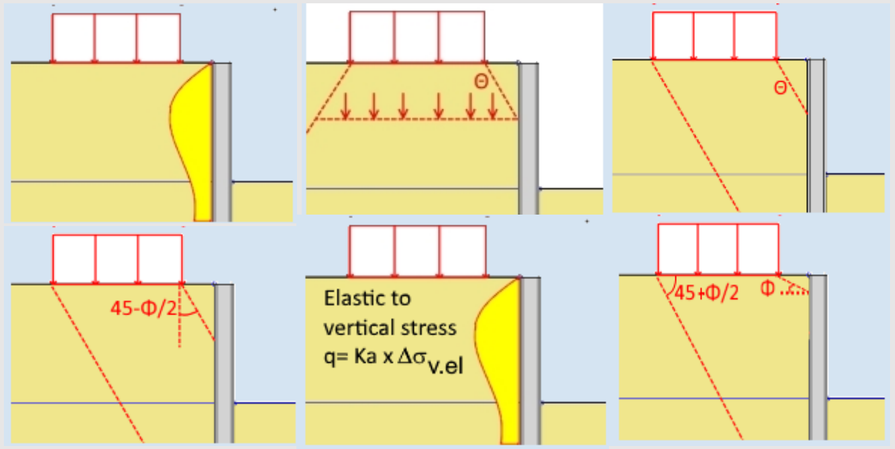
Loads on ground surface:

- ✓ Strip surcharges
- ✓ Linear loads
- ✓ 3D loads (buildings, footings, 3D surface loads



Loads on the wall:

- ✓ Strip surcharges
- ✓ Linear loads
- ✓ External moments
- ✓ Prescribed displacements

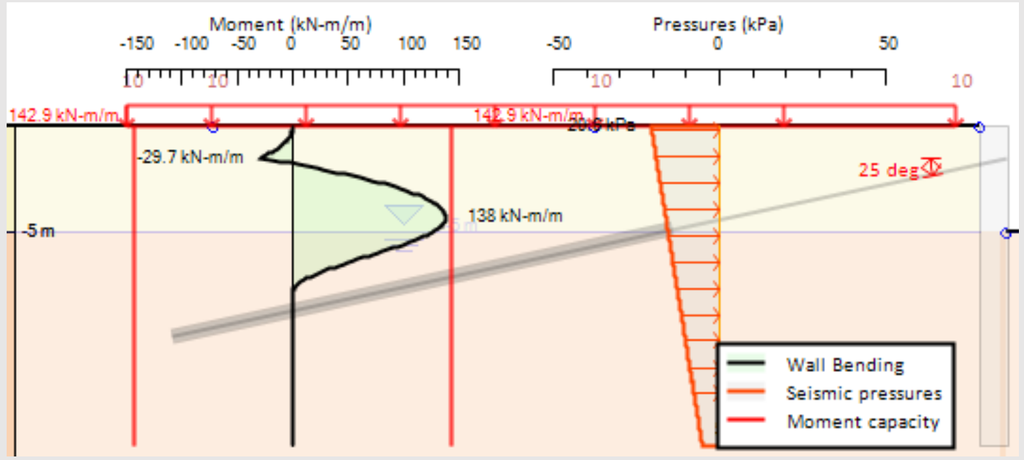


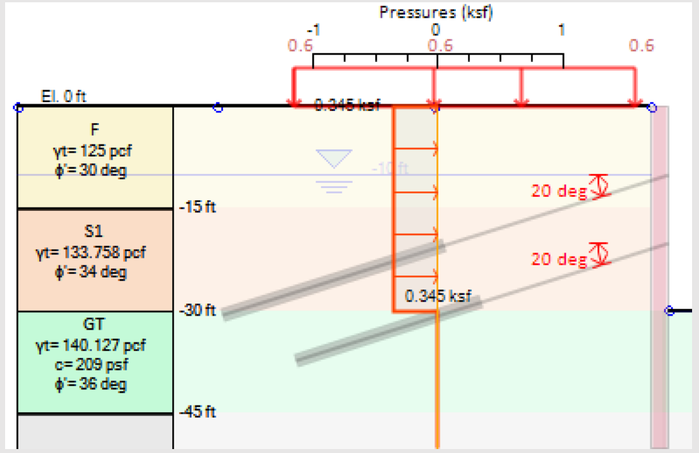
Load modeling options:

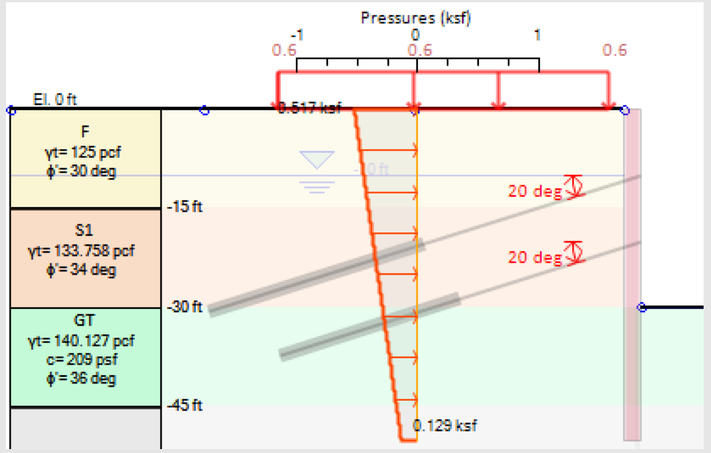
- ✓ Elasticity equations
- ✓ Two-way distribution angle
- ✓ One-way distribution angle
- ✓ One-way distribution angle from soil friction
- ✓ Elasticity to vertical stress x Ka (or Ko)
- ✓ CIRIA Special Pub 95 - 1993

DEEP EXCAVATION
GEOTECHNICAL SOFTWARE AND ENGINEERING

Seismic Pressure Methods in DeepEX Software







Procedure in DeepEX

- Define Seismic Accelerations Ax and Az
- Select Seismic Pressures Calculation Method
- Select a Seismic Design Standard

Seismic Pressure Methods

- ✓ Semirigid
- ✓ Mononobe-Okabe (frictional soils)
- ✓ Wood Automatic
- ✓ Wood Manual

Semirigid Method

- Total Vertical Stress at Bottom of Wall x B
- B = 0.75 in DeepEX
- Rectangular Pressure Diagram

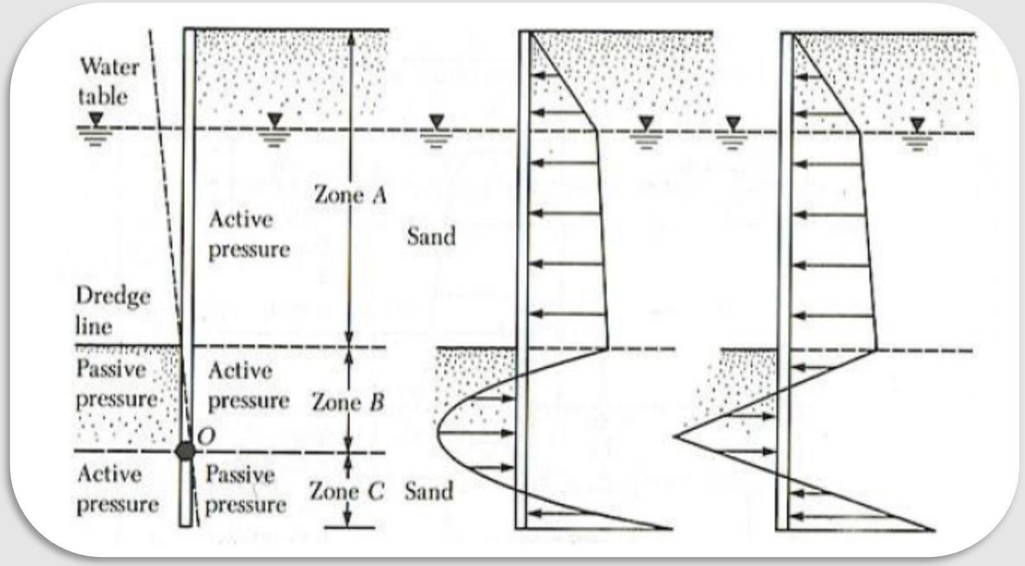
Mononobe-Okabe Method (Frictional Soils)

- Extension of the Coulomb Static Theory
- Accelerations added to a Coulomb Wedge
- Seed & Whitman (1970) Seismic Thrust Redistribution
- Inverse Trapezoid Pressure Diagram

Cantilever Wall Analysis Concept

Fixed earth method

Balances out Moment and Shear



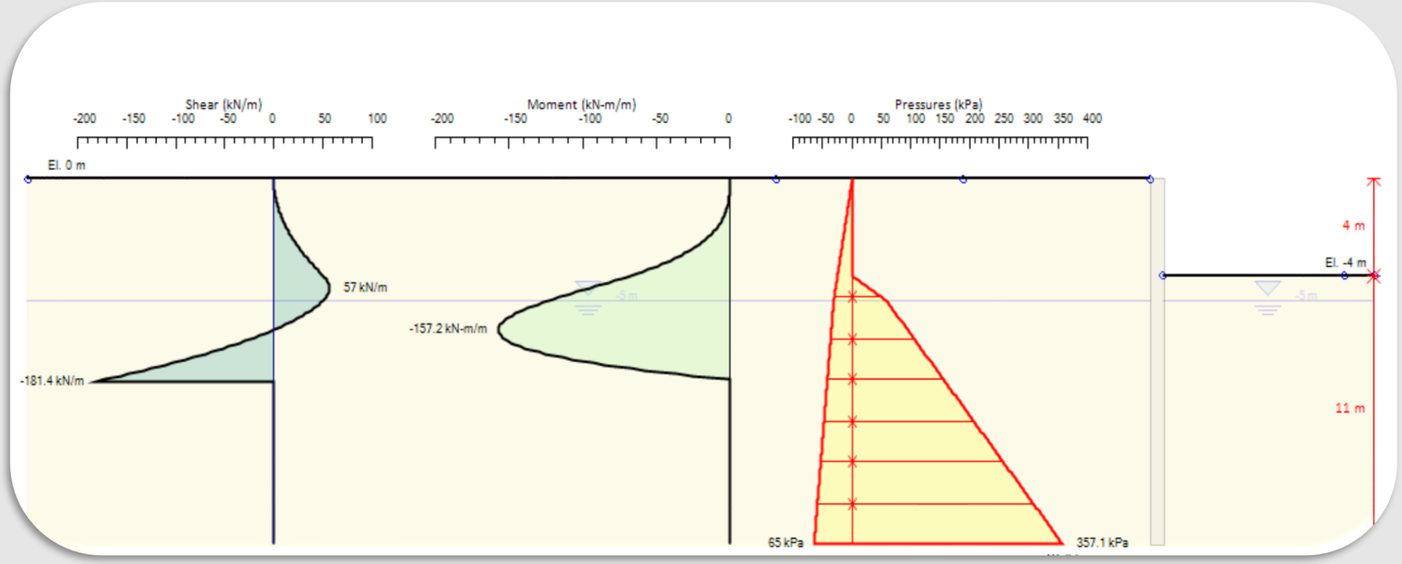
Free earth method

Balances out moment

Shear not balanced

Increase length by 1.2 to get FS 1.0

Then apply additional safety factors



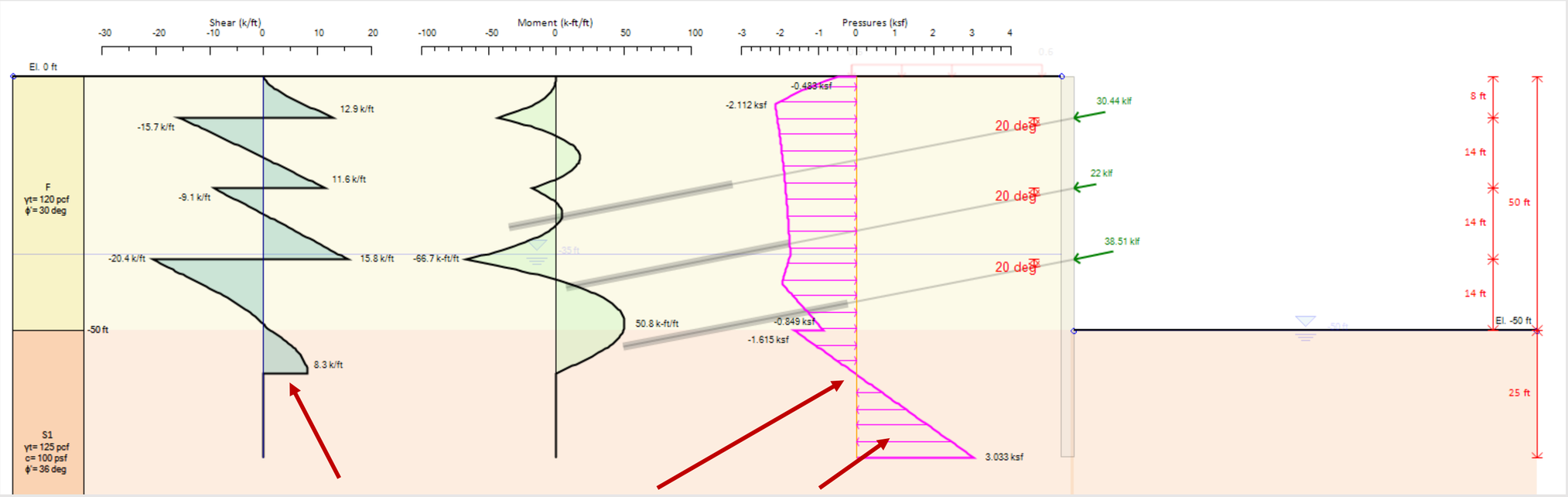
Beam Analysis - Blum's Method

Pinned supports – continuous beam

Point of zero net soil shear below subgrade.

Use point of zero shear as a virtual support.

Shear **Moments** **Net loading**



Reaction for embedment Fxb

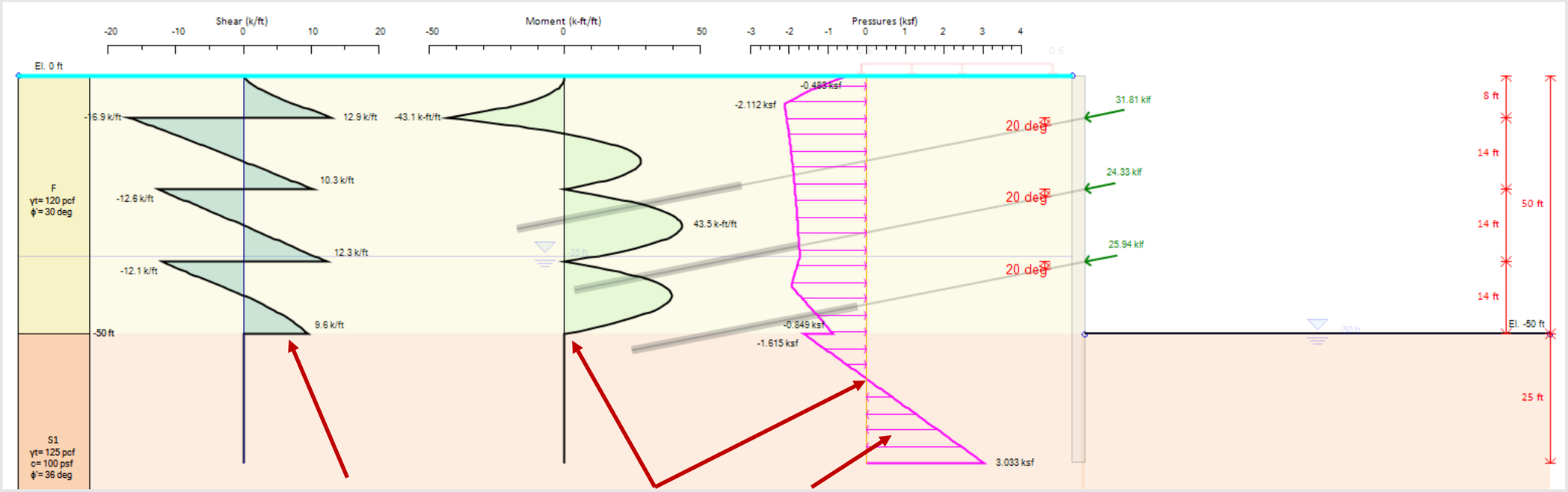
Virtual support

Available resistance Rx

FS.passive= $\frac{Rx}{Fxb}$

Beam Analysis - FHWA Simple Span Approach

Pin support at excavation base, simple spans



Reaction for embedment Fxb

Virtual support

Available resistance Rx

FS.passive= $\frac{Rx}{Fxb}$

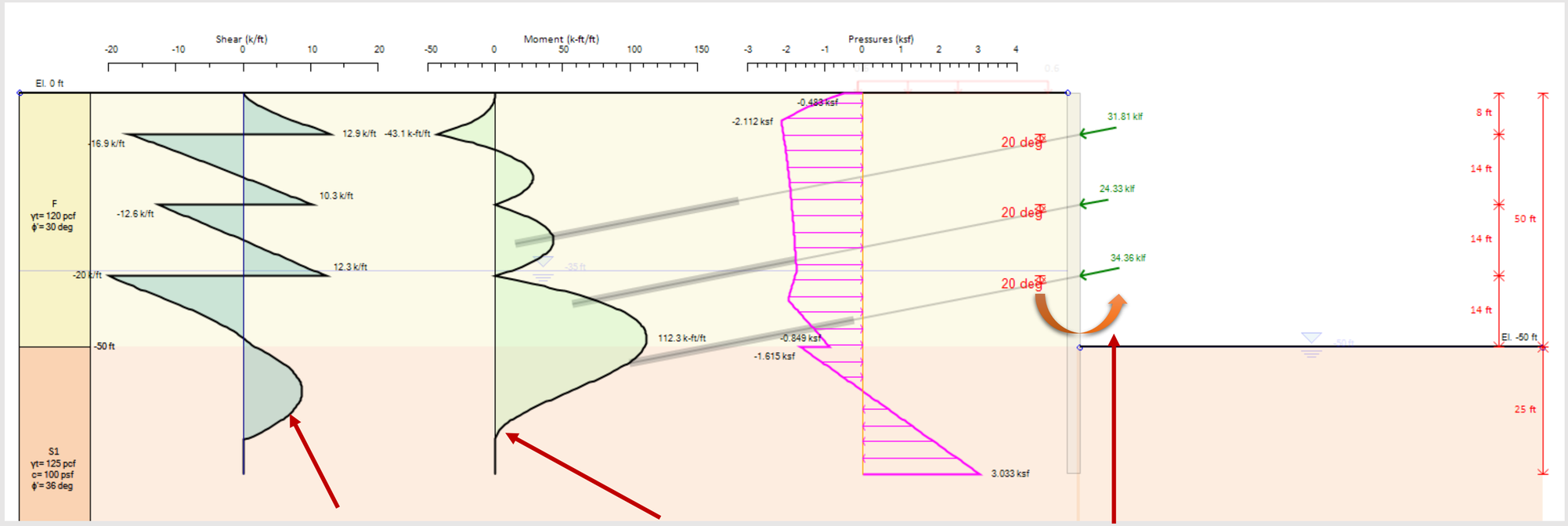
Beam Analysis - CALTRANS Approach

Pinned supports – simple span

Base at point of zero moment below bottom support

Shears and moments balance out

Shear **Moments** **Net loading**

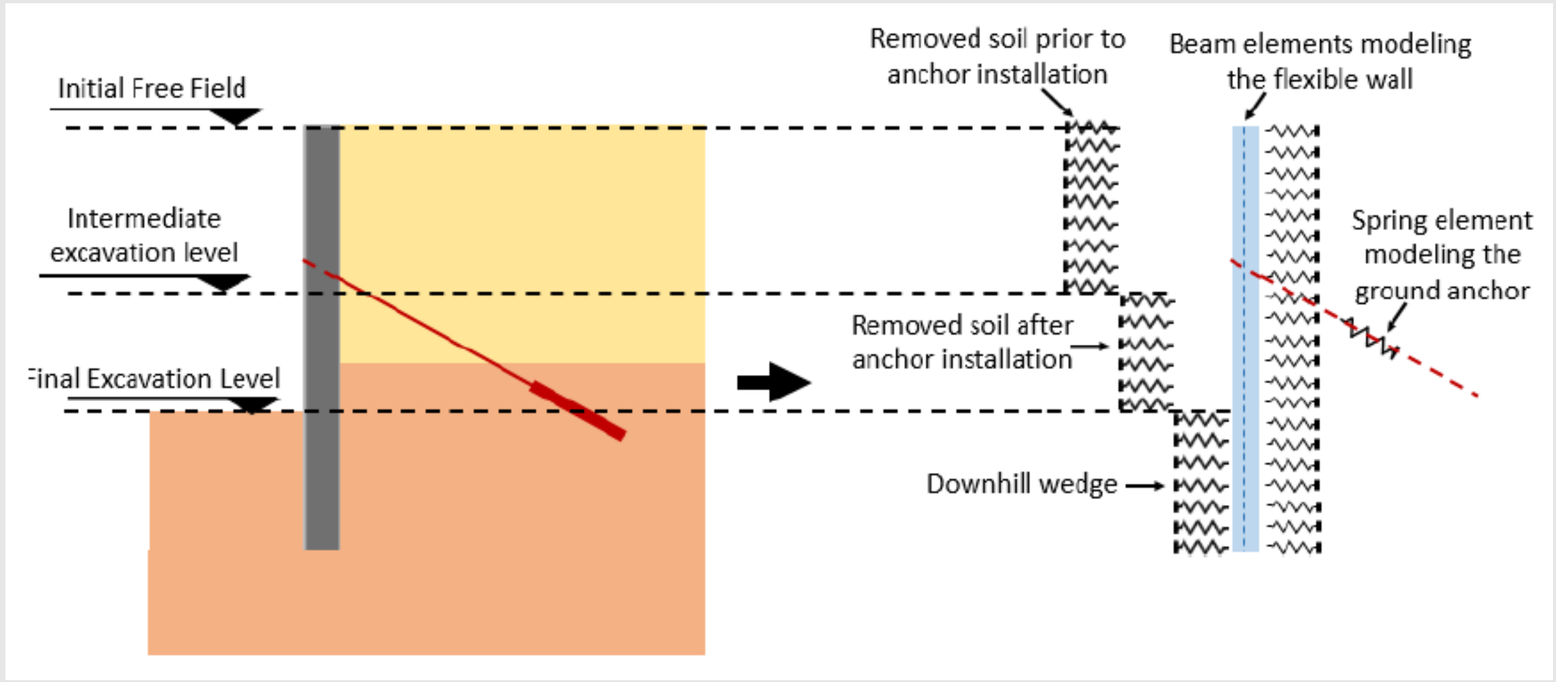


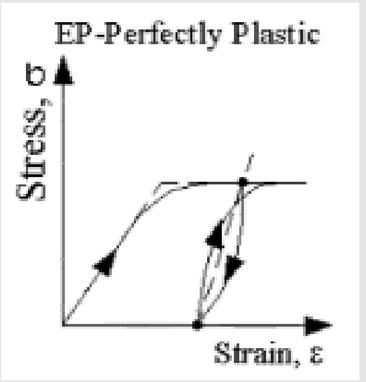
No Embedment Reaction

Virtual support

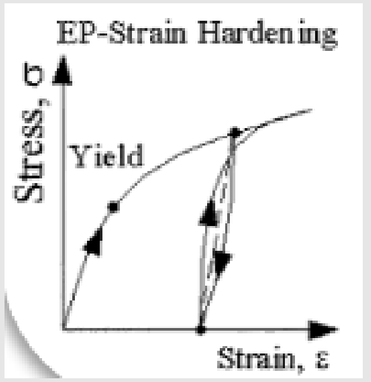
$$\text{FS.rotation} = \frac{Fresist}{Fdrive}$$

Non-Linear Analysis Concept (Soil Springs)





Elastoplastic model



Exponential model

Soil Models

- Linear elastic perfectly plastic
- Exponential

$$E = Evc[(\alpha_V \sigma'_v + \alpha_H \sigma'_h)/pref]^n$$

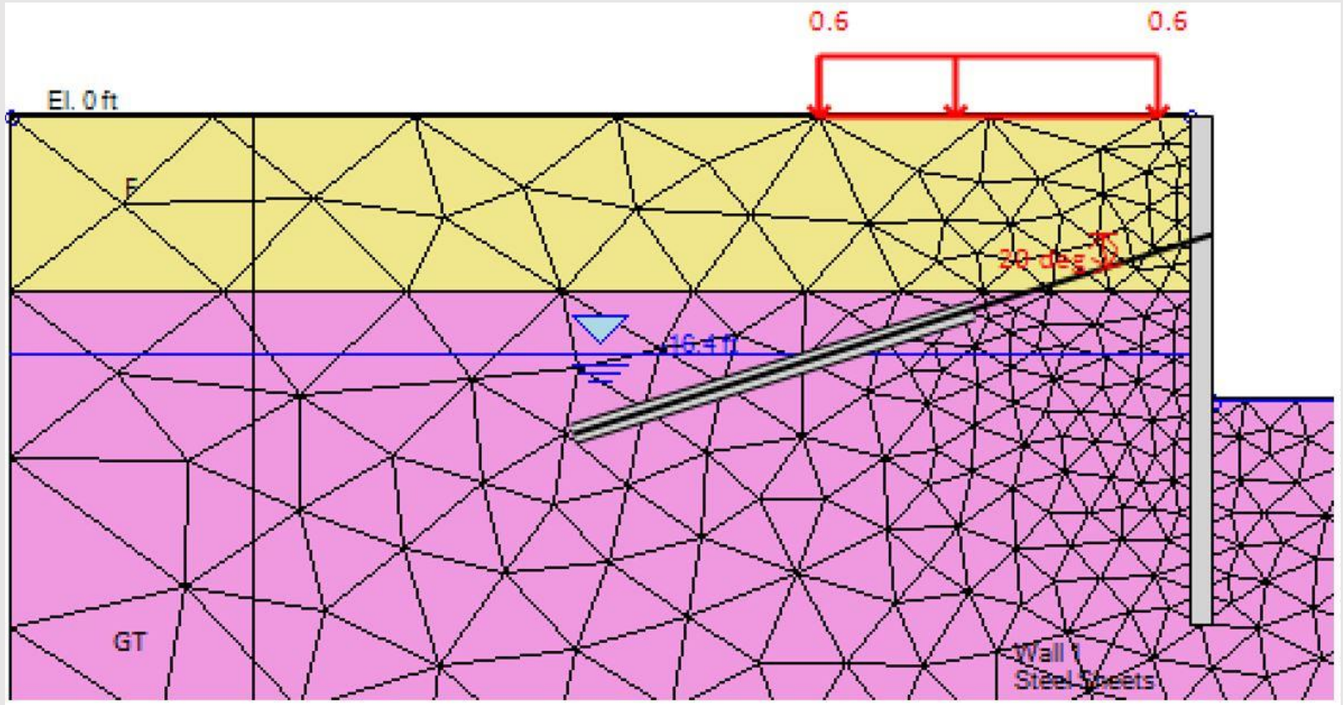
- Subgrade modulus
- Small strain hardening

Reloading stiffness linear 3 to 5 x loading E

www.deepexcavation.com
www.deepex.com

sales@deepexcavation.com
training@deepexcavation.com
T: +1-206-279-3300

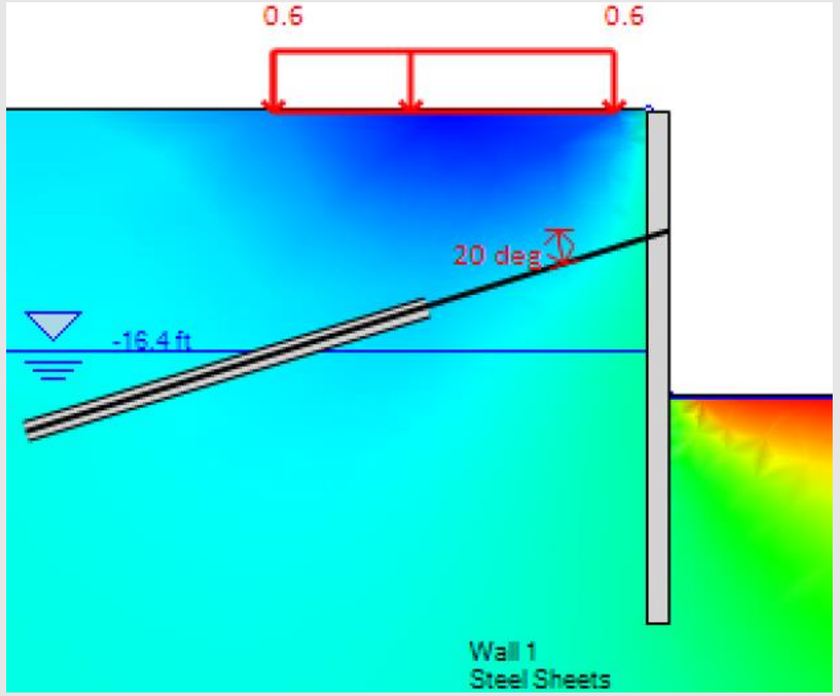
Finite Element Analysis in DeepEX (Additional Module)



- ✓ Moments and reactions calculated with Finite Elements
- ✓ Consider full soil-structure interaction
- ✓ Calculate surface settlements
- ✓ Design Tiedowns, Foundation Piles and Steel Columns

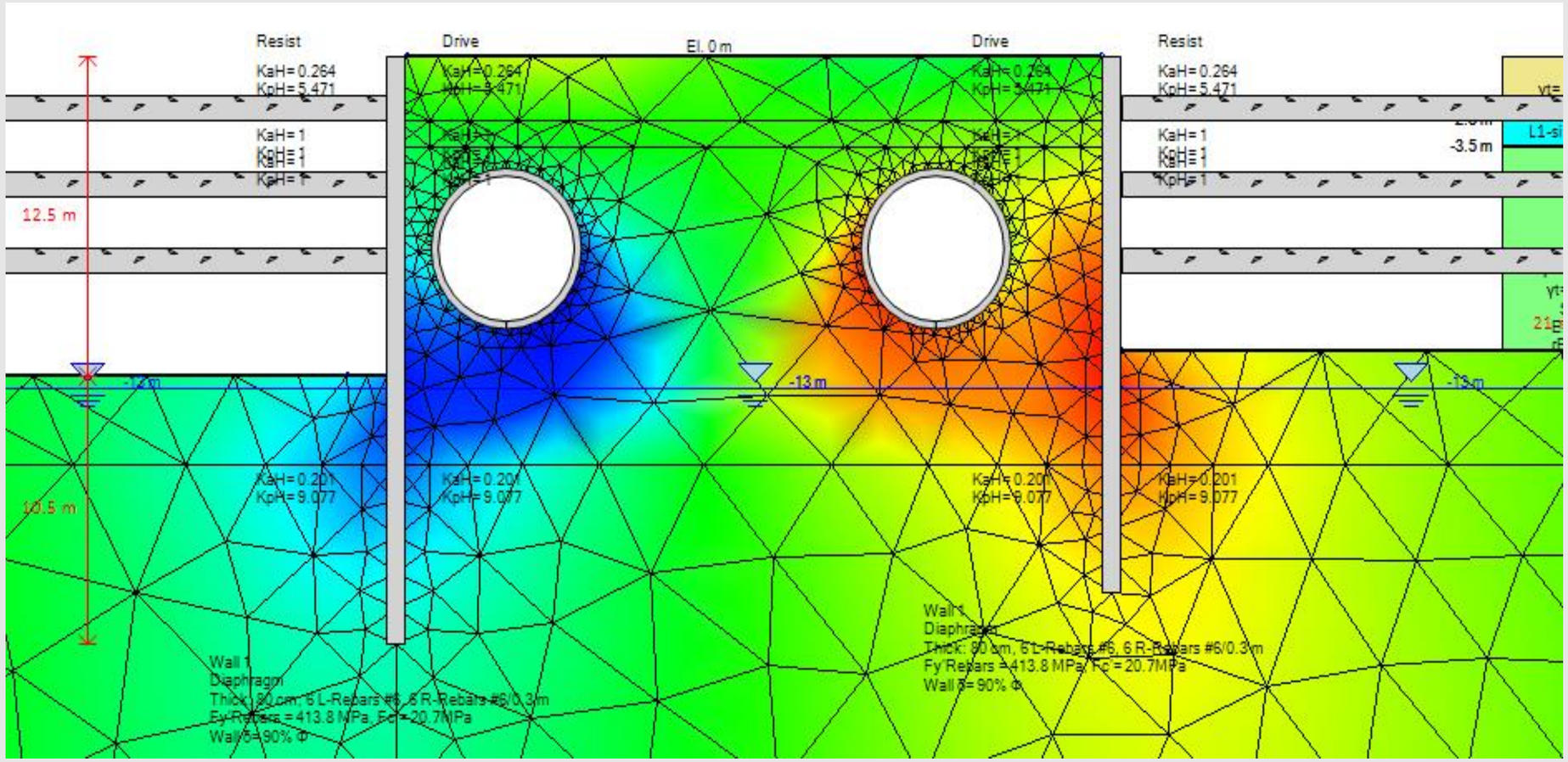
Soil Models:

- ✓ Elastoplastic Model
- ✓ Exponential (Hyperbolic) Model (approximate solution)
- ✓ Exponential (Hyperbolic) Model (complete solution): Soil hardening model



www.deepexcavation.com
www.deepex.com
sales@deepexcavation.com
training@deepexcavation.com
T: +1-206-279-3300

Finite Element Analysis in DeepEX (Additional Module)

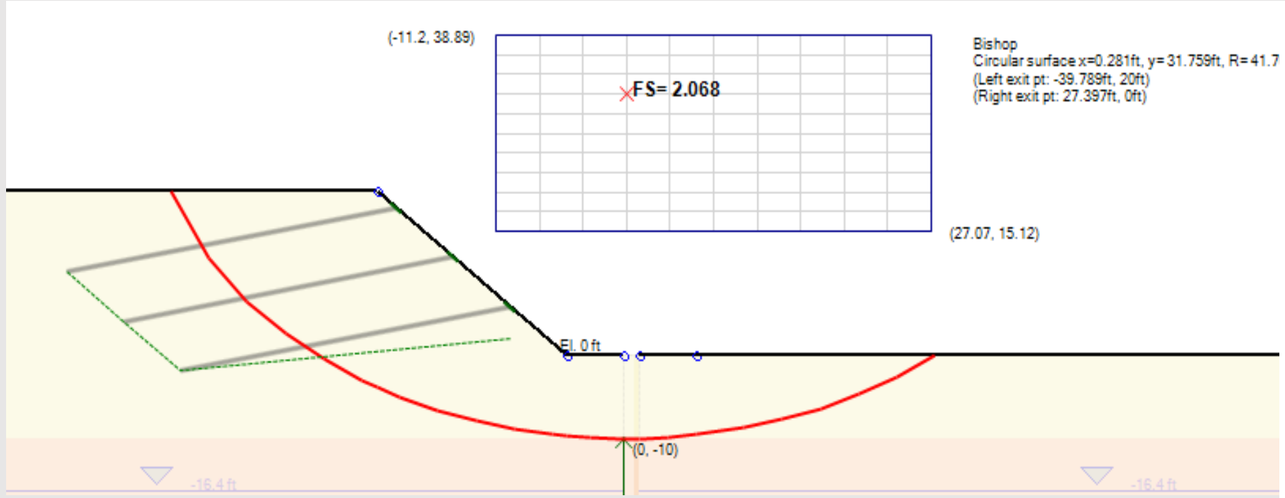


Tunnel Options:

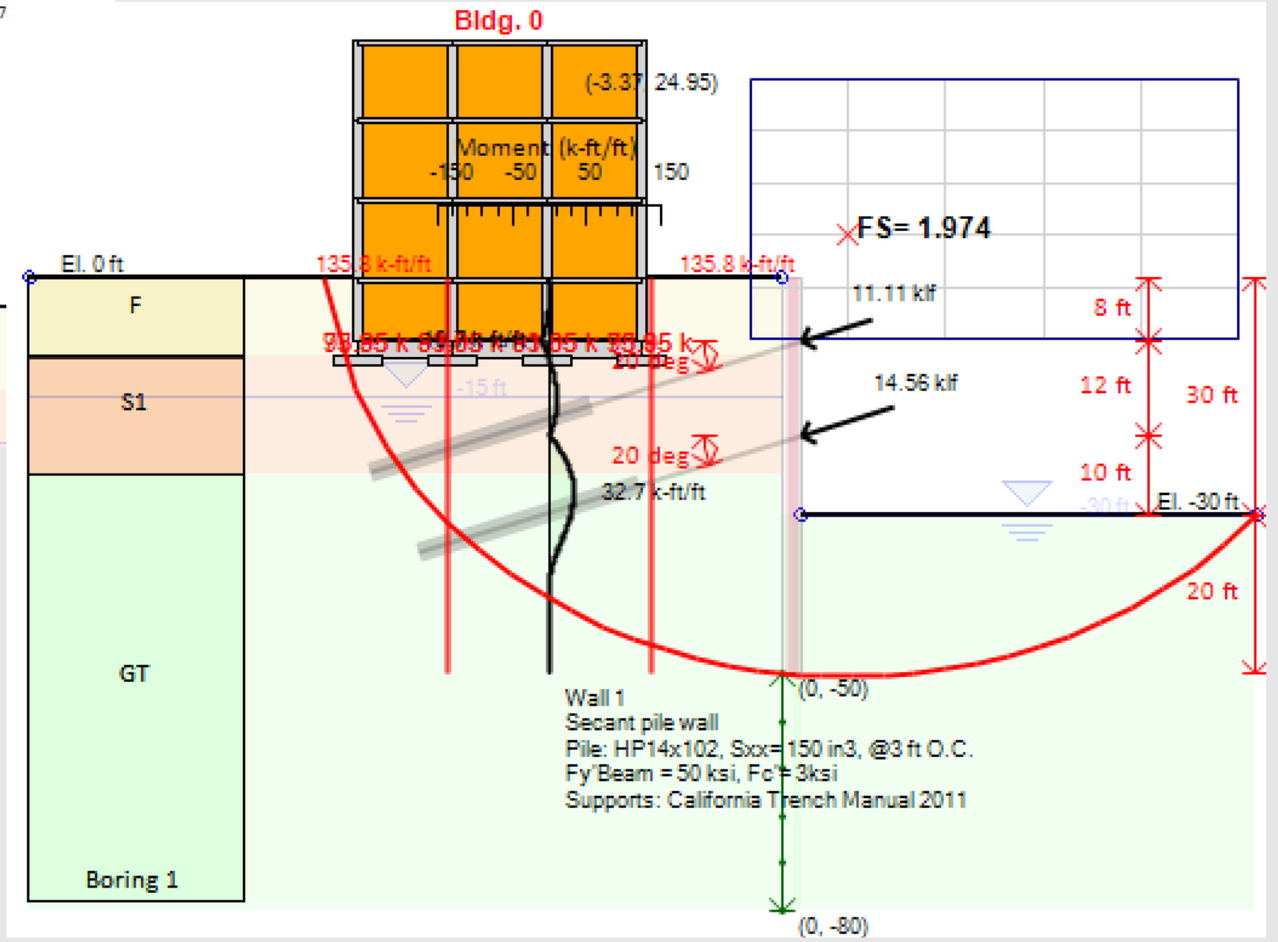
- ✓ Tunnel Analysis with FEM
- ✓ TBM Tunnels
- ✓ NATM - SEM Tunnels
- ✓ Oval and Complex Tunnel Shapes
- ✓ Tunnel Model Wizard
- ✓ Cut-and-Cover Tunnels

DEEP EXCAVATION
GEOTECHNICAL SOFTWARE AND ENGINEERING

Slope Stability Analysis and Soil Nails in DeepEX



- ✓ Bishop Method
- ✓ Morgenstern Price Method (G.L.E.)
- ✓ Spencer Method
- ✓ Ordinary (Swedish) Method
- ✓ Automatic Slope Search Method
- ✓ Single Point Slope Center
- ✓ Rectangular Slope Center
- ✓ Define Radius Search Limits
- ✓ Clouterre Standards for Soil Nails



RELIABLE GEOEXPERTISE

www.deepexcavation.com
www.deepex.com

sales@deepexcavation.com
training@deepexcavation.com
T: +1-206-279-3300

PART 2: Projects Designed with DeepEX

More information:

Click here to learn more:
DeepEX – Project Gallery

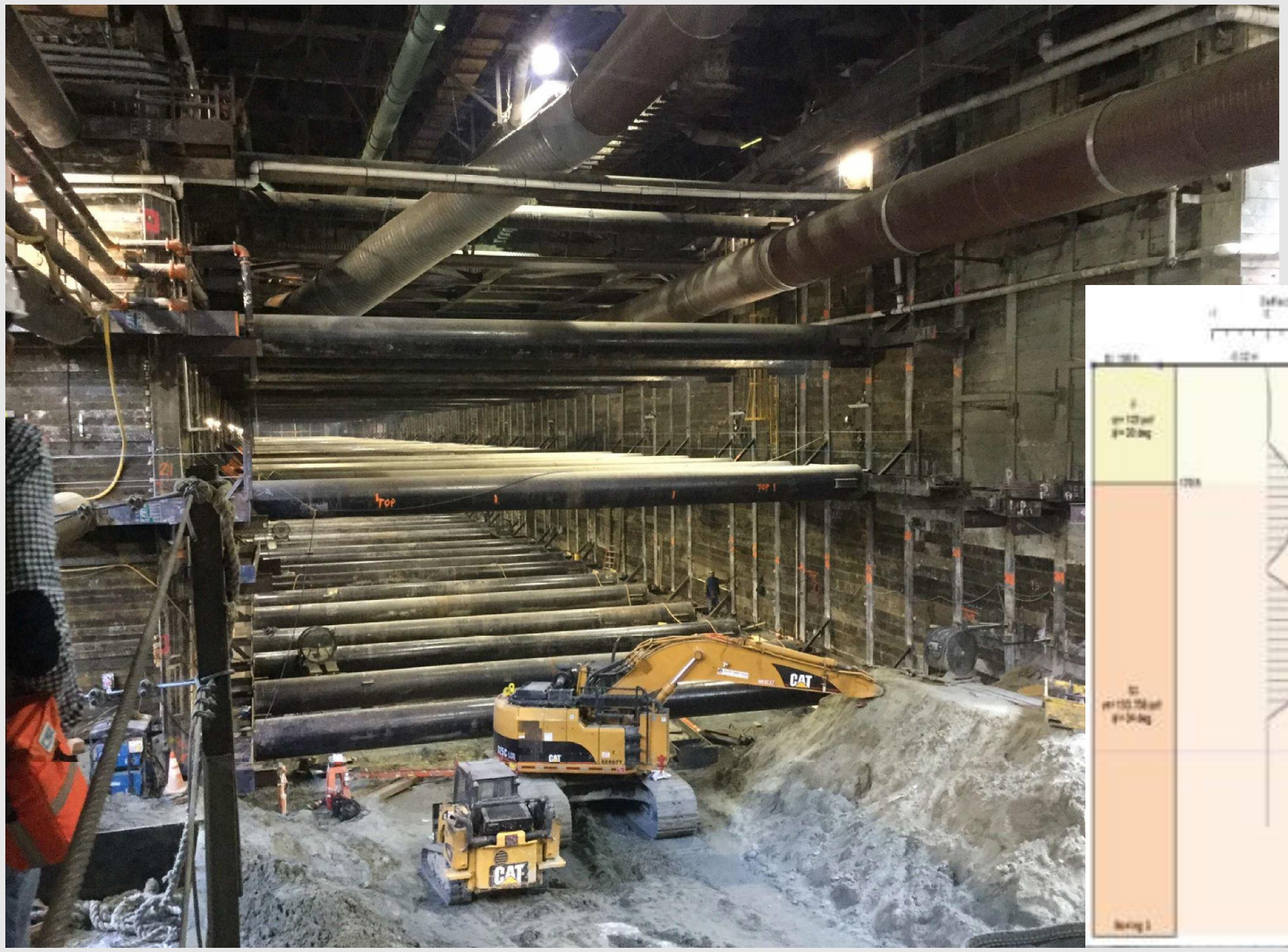
2000+ users – more than 10000 projects worldwide!

www.deepexcavation.com
www.deepex.com

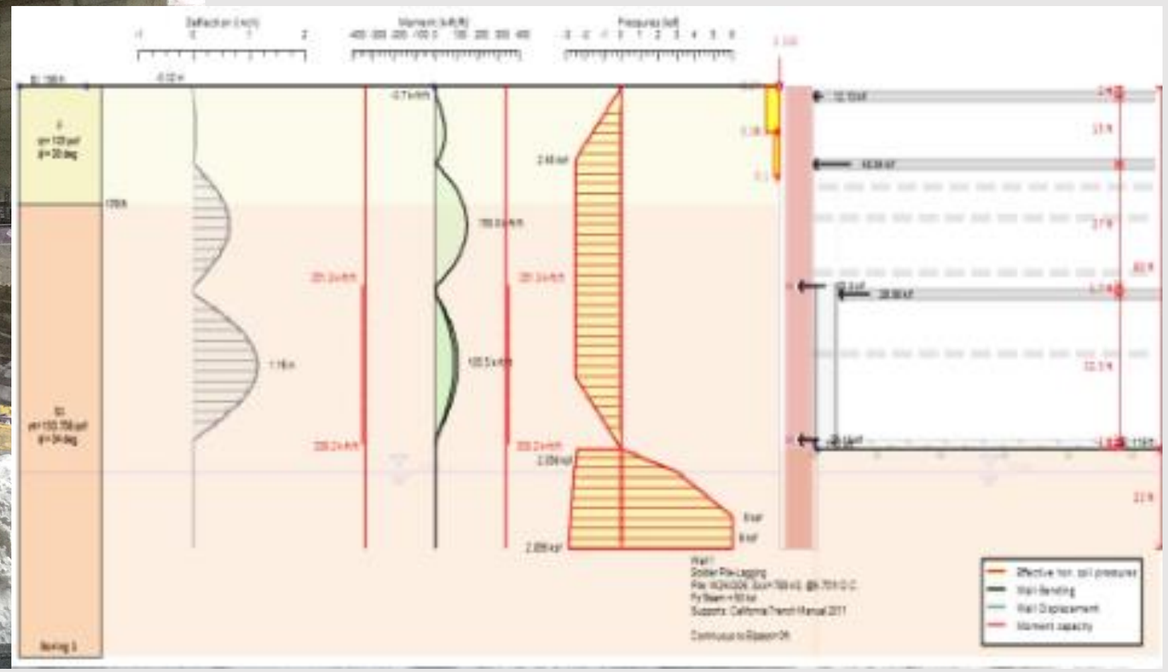
sales@deepexcavation.com
training@deepexcavation.com
T: +1-206-279-3300

DeepEX Software - Project - Braced Excavation

LaBrea Metro Station, Los Angeles, California, USA



- ✓ 100 ft (30.5 m) Excavation
- ✓ Soldier Piles and Lagging
- ✓ Lateral Bracing (Struts)
- ✓ Full Design with DeepEX
- ✓ 5 Stations designed and under construction

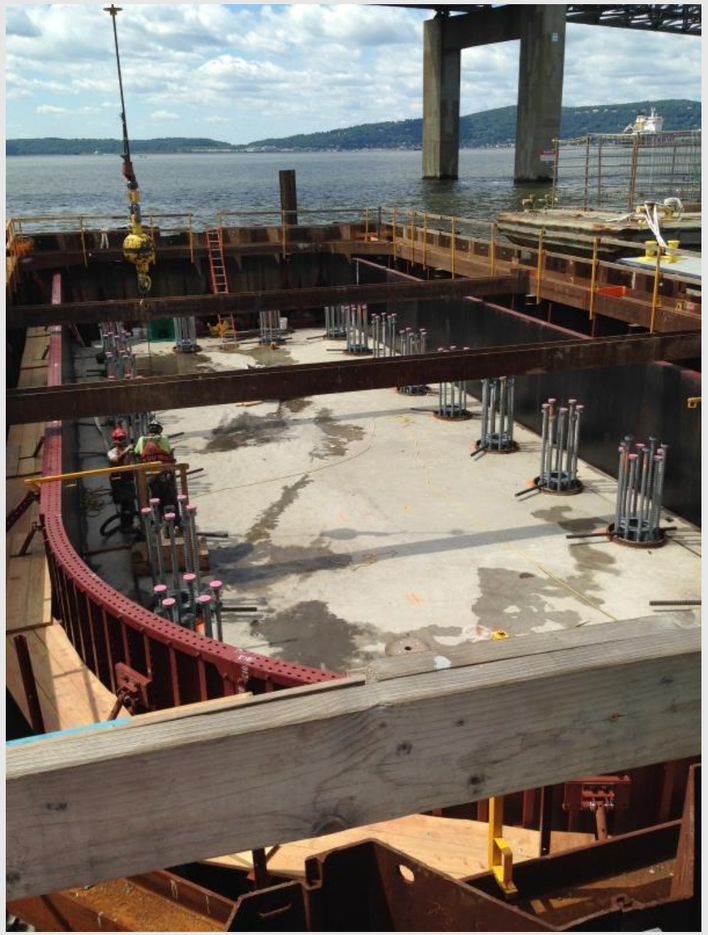


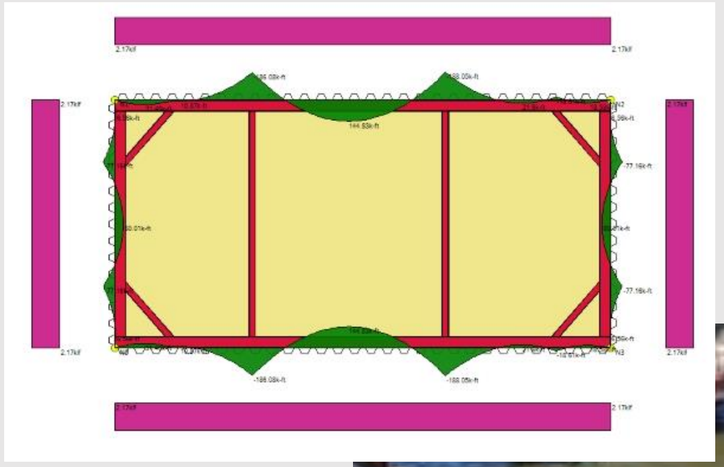
www.deepexcavation.com
www.deepex.com

sales@deepexcavation.com
training@deepexcavation.com
T: +1-206-279-3300

DeepEX Software - Project - Cofferdam

New Tapan Zee Bridge Cofferdams, New York, USA





- ✓ $3.9 billion project
- ✓ 90x45ft (27.5x13.7m) Cofferdams
- ✓ Lateral Bracing (Struts)
- ✓ Full Design with DeepEX

www.deepexcavation.com
www.deepex.com

sales@deepexcavation.com
training@deepexcavation.com
T: +1-206-279-3300

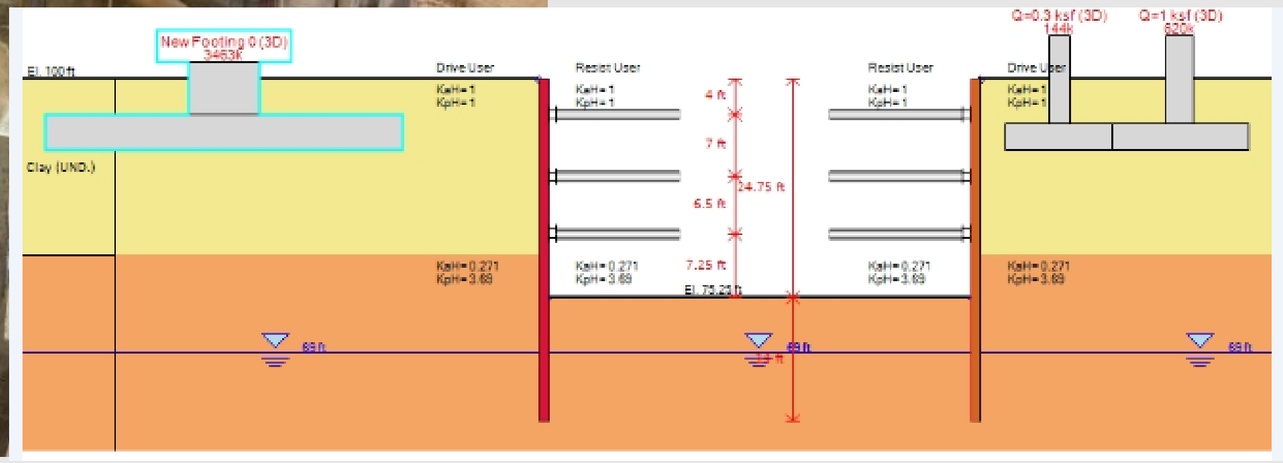
DeepEX Software - Project - Braced and Anchored Walls

Soldier Pile Excavation Pits with Diagonal Struts and Tiebacks, Arkansas, USA

- ✓ 90 ft (27.5m) Excavation
- ✓ Soldier Piles and Lagging
- ✓ Pipe Struts
- ✓ 9 rows of Tiebacks

DeepEX Software - Project - Braced Excavation

Soldier Pile Excavation Pits with Diagonal Struts, Arkansas, USA



- ✓ 24 ft (7.3m) Excavation
- ✓ Soldier Piles and Lagging
- ✓ Pipe Struts
- ✓ Full Design with DeepEX

DeepEX Software - Project - Cofferdam

All American Canal, Imperial Irrigation District, Yuma, Arizona

- ✓ Cofferdam
- ✓ Water Wall Design
- ✓ Water Depth up to 20’ (6m)
- ✓ Sheet Pile System
- ✓ Post Tension cable Ties
- ✓ Full Design with DeepEX

www.deepexcavation.com
www.deepex.com

sales@deepexcavation.com
training@deepexcavation.com
T: +1-206-279-3300

PART 3: DeepEX Additional Modules and Standard Packages

More information:

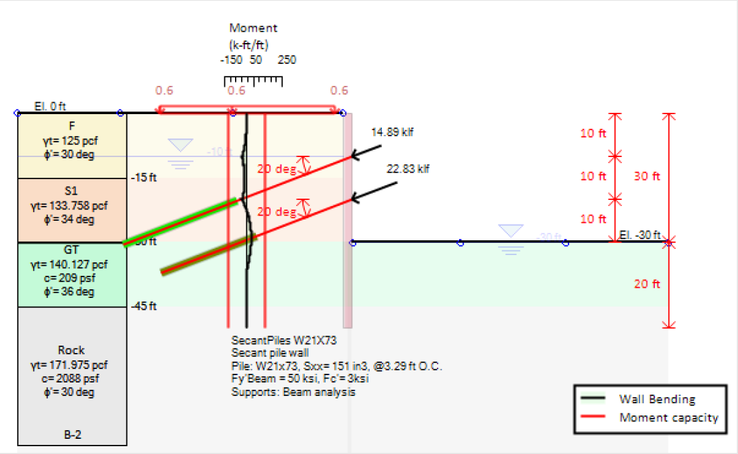
Click here to learn more:
DeepEX – Software Versions

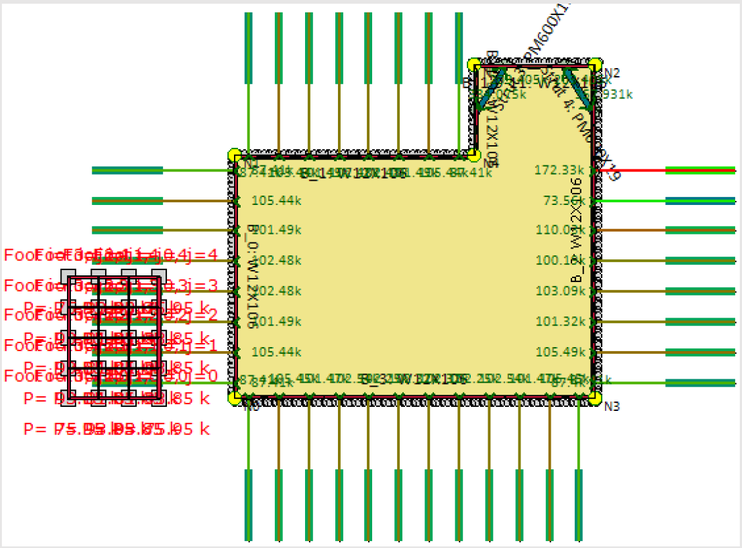
www.deepexcavation.com
www.deepex.com

sales@deepexcavation.com
training@deepexcavation.com
T: +1-206-279-3300

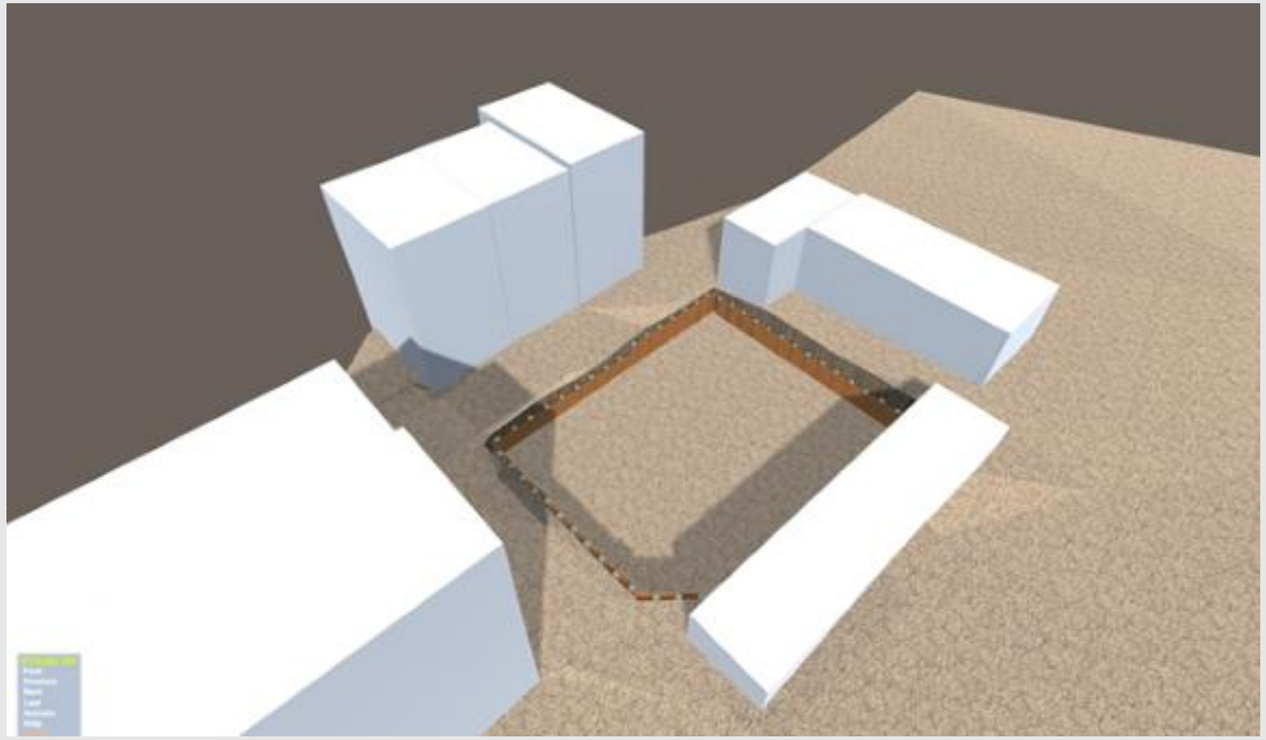
DEEP EXCAVATION
GEOTECHNICAL SOFTWARE AND ENGINEERING

2D Sections and 3D Models Design - Export Holograms





- ✓ Full Design - 2D Sections and 3D Model
- ✓ Structural & Geotechnical design of Tiebacks and Struts
- ✓ 3D Building Loads
- ✓ Full Model Optimization (Walls and Supports)
- ✓ Virtual Reality Model Visualization - Export Model to HoloDeepEX



RELIABLE GEOEXPERTISE

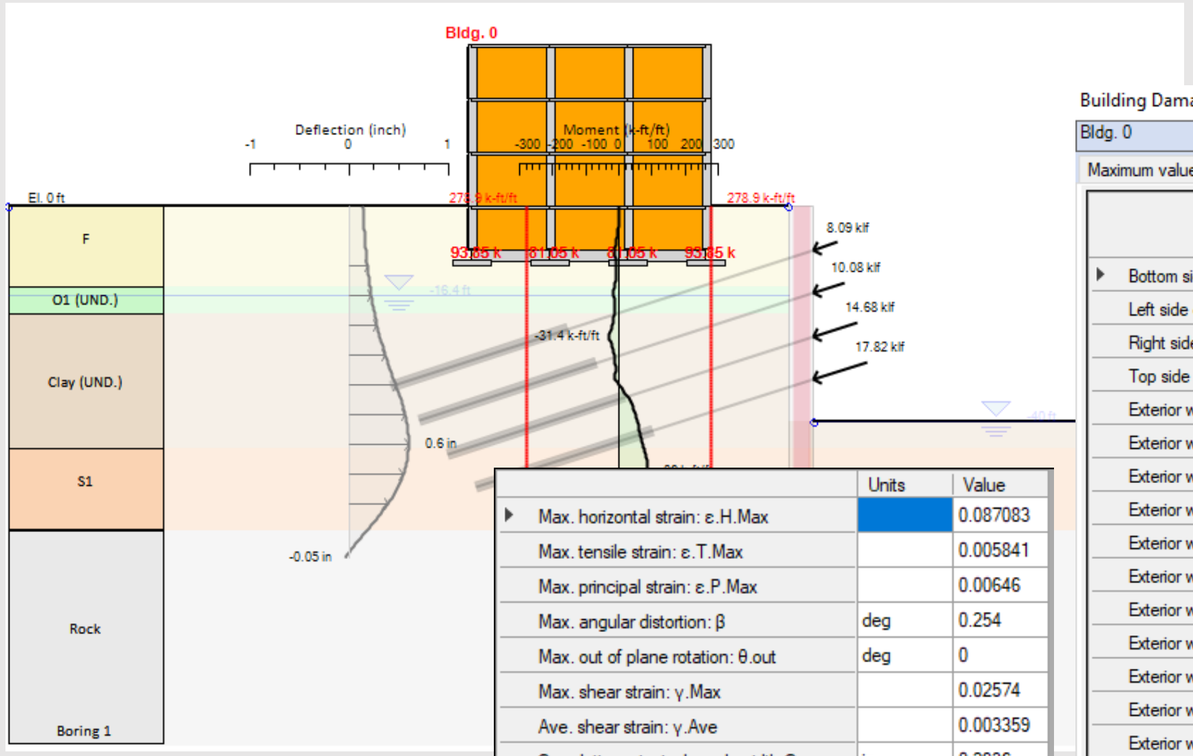
www.deepexcavation.com
www.deepex.com

sales@deepexcavation.com
training@deepexcavation.com
T: +1-206-279-3300

DEEP EXCAVATION
GEOTECHNICAL SOFTWARE AND ENGINEERING

Building Damage Assessment - Additional Module to DeepEX 3D

- ✓ Perform Damage Assessment of all Buildings close to an excavation site
- ✓ Review Crack widths, Damage Categories, Strains etc. for all building walls.



	Units	Value
Max. horizontal strain: ε.H.Max		0.087083
Max. tensile strain: ε.T.Max		0.005841
Max. principal strain: ε.P.Max		0.00646
Max. angular distortion: β	deg	0.254
Max. out of plane rotation: θ.out	deg	0
Max. shear strain: γ.Max		0.02574
Ave. shear strain: γ.Ave		0.003359
Cumulative principal crack width C.p	in	0.2936
Cumulative tensile crack width C.t	in	0.3409
Max principal crack width Cr.p.Max	in	0.1957
Max tensile crack width Cr.t.Max	in	0.2273
Max. damage category		Moderate
Damage category crack width		Moderate
Damage category Boscardin Cording		Moderate

Building Damage Results

Bldg. 0

Maximum values | All elements | Individual elements | Horizontal movement | Settlement | Boscardin-Cording Chart | Hogging Chart (Burland 1979)

		θ.out	γ.Max	γ.Ave	C.p (in)	C.t (in)	Cr.p (in)	Cr.t (in)	Damage Cat	Dam. Crack width	Dam. Boscardin
Bottom side continuous basement wall	203	0	0.005103	0.002551	0	0	0	0	Moderate	Negligibe	Moderate
Left side continuous basement wall	277	0	0.000752	0.000376	0	0	0	0	Negligibe	Negligibe	Negligibe
Right side continuous basement wall	926	0	0.002511	0.001256	0	0	0	0	Negligibe	Negligibe	Negligibe
Top side continuous basement wall		0	0	0	0	0	0	0	Negligibe	Negligibe	Negligibe
Exterior wall at floor 1El. 0, (-10.67, 30 to -20.67,30)	407	0	0.025554	0.001561	0.2327	0.3337	0.1551	0.2225	Moderate	Moderate	N/A
Exterior wall at floor 1El. 0, (-20.67, 70 to -10.67,70)		0	0	0	0	0	0	0	Negligibe	Negligibe	N/A
Exterior wall at floor 1El. 0, (-20.67, 30 to -30.67,30)	872	0	0.022453	0.002095	0.0798	0.0299	0.0532	0.0199	Slight	Slight	N/A
Exterior wall at floor 1El. 0, (-30.67, 70 to -20.67,70)		0	0	0	0	0	0	0	Negligibe	Negligibe	N/A
Exterior wall at floor 1El. 0, (-30.67, 30 to -40.67,30)	558	0	0.014831	0.001949	0	0	0	0	Negligibe	Negligibe	N/A
Exterior wall at floor 1El. 0, (-40.67, 70 to -30.67,70)		0	0	0	0	0	0	0	Negligibe	Negligibe	N/A
Exterior wall at floor 1El. 0, (-10.67, 40 to -10.67,30)	439	0	0.02574	0	0.153	0.2154	0.102	0.1436	Slight	Slight	N/A
Exterior wall at floor 1El. 0, (-40.67, 30 to -40.67,40)	34	0	0.007772	0.001901	0	0	0	0	Negligibe	Negligibe	N/A
Exterior wall at floor 1El. 0, (-10.67, 50 to -10.67,40)	169	0	0.02417	0	0.2936	0.1803	0.1957	0.1202	Slight	Slight	N/A
Exterior wall at floor 1El. 0, (-40.67, 40 to -40.67,50)	391	0	0.002266	0	0	0	0	0	Negligibe	Negligibe	N/A
Exterior wall at floor 1El. 0, (-10.67, 60 to -10.67,50)	336	0	0.013545	0	0.0476	0	0.0317	0	Very slight	Very slight	N/A
Exterior wall at floor 1El. 0, (-40.67, 50 to -40.67,60)		0	0	0	0	0	0	0	Negligibe	Negligibe	N/A
Exterior wall at floor 1El. 0, (-10.67, 70 to -10.67,60)		0	0	0	0	0	0	0	Negligibe	Negligibe	N/A
Exterior wall at floor 1El. 0, (-40.67, 60 to -40.67,70)		0	0	0	0	0	0	0	Negligibe	Negligibe	N/A
Exterior wall at floor 2El. 10, (-10.67, 30 to -20.67,30)	407	0	0.025554	0.001561	0.1975	0.2805	0.1317	0.187	Slight	Slight	N/A
Exterior wall at floor 2El. 10, (-20.67, 70 to -10.67,70)		0	0	0	0	0	0	0	Negligibe	Negligibe	N/A
Exterior wall at floor 2El. 10, (-20.67, 30 to -30.67,30)	872	0	0.022453	0.002095	0.1566	0.2011	0.1044	0.1341	Slight	Slight	N/A

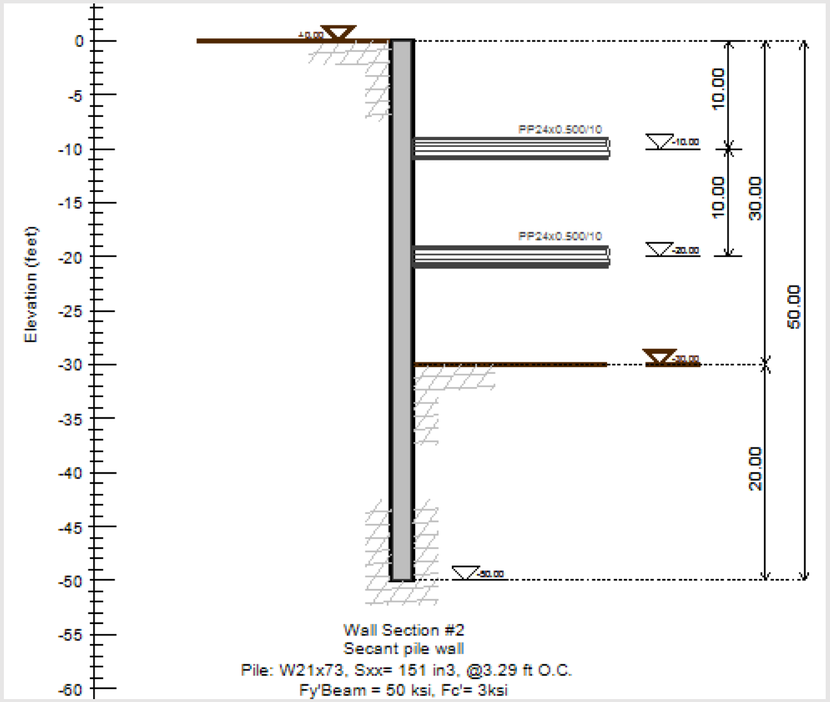
RELIABLE GEOEXPERTISE

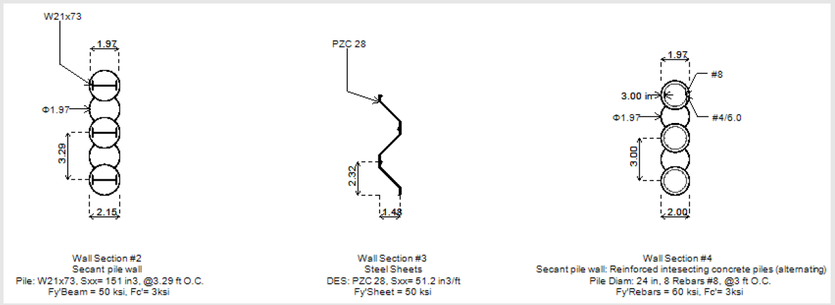
www.deepexcavation.com
www.deepex.com

sales@deepexcavation.com
training@deepexcavation.com
T: +1-206-279-3300

DEEP EXCAVATION
GEOTECHNICAL SOFTWARE AND ENGINEERING

Export All Project Sketches to DXF



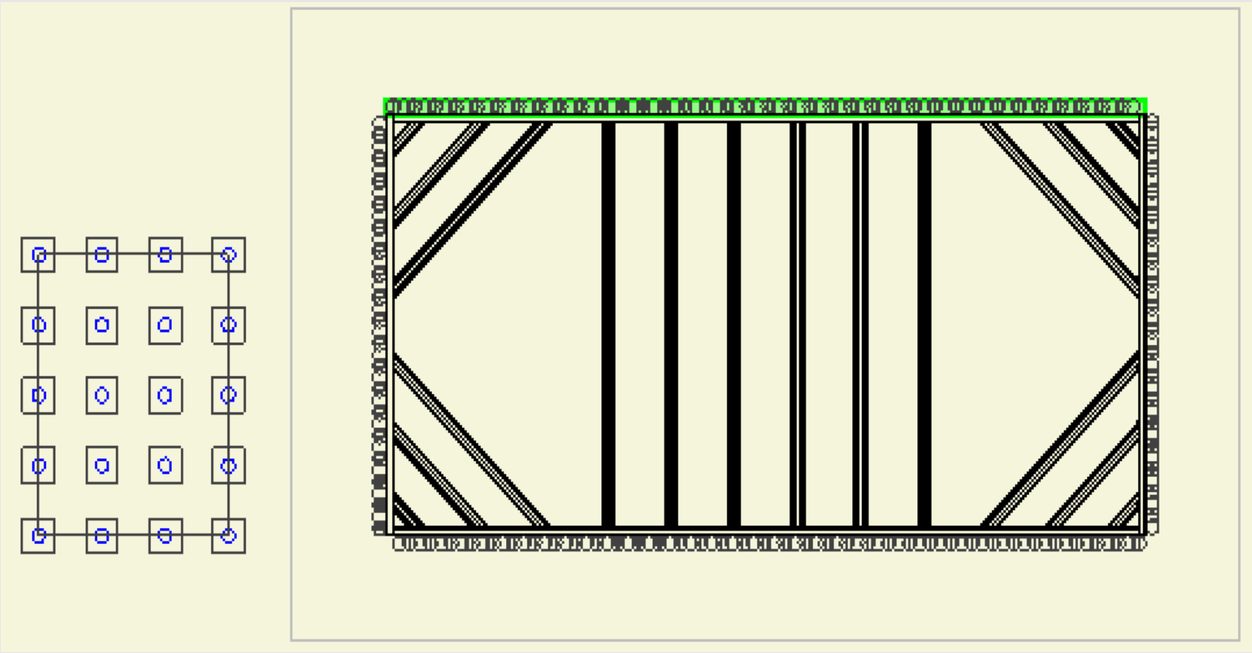


2D Sections:

- ✓ Export all 2D Sections Sketches for each Construction Stage
- ✓ Export Wall Section Details
- ✓ Export 2D Sections with Result Diagrams

3D Models:

- ✓ Export all 2D Sections and Wall Details
- ✓ Export Full Project Plan Sketches
- ✓ Export Elevation Sketches for each Project Wall



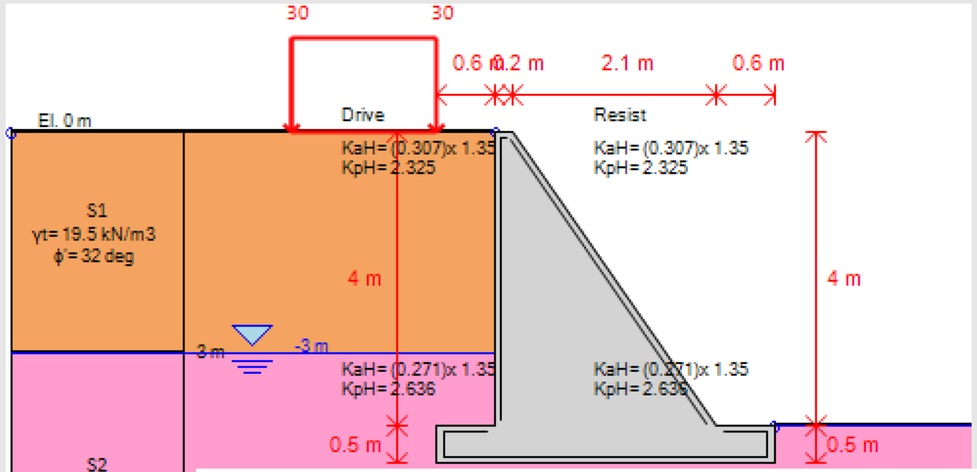
RELIABLE GEOEXPERTISE

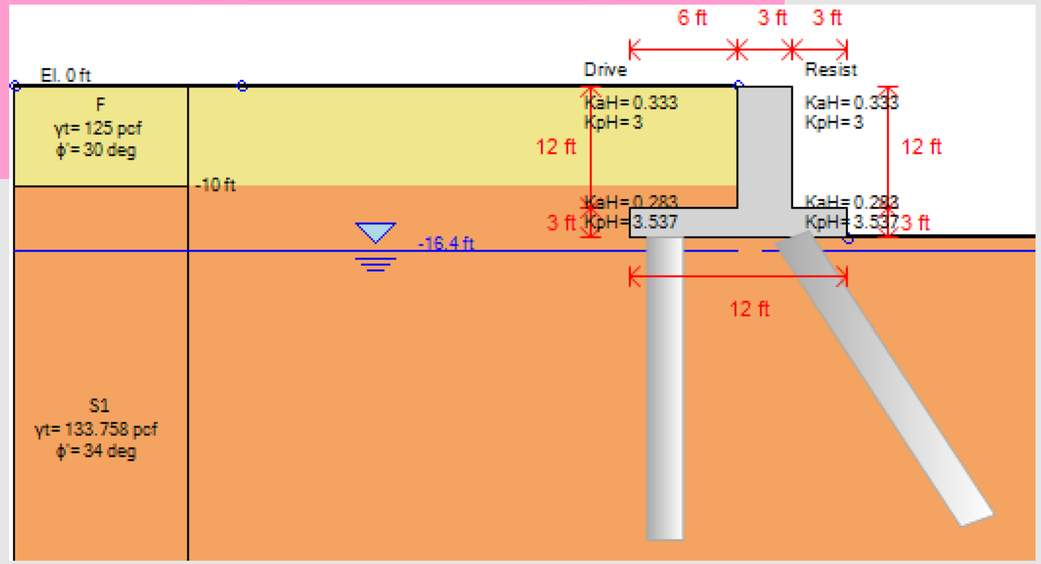
www.deepexcavation.com
www.deepex.com

sales@deepexcavation.com
training@deepexcavation.com
T: +1-206-279-3300

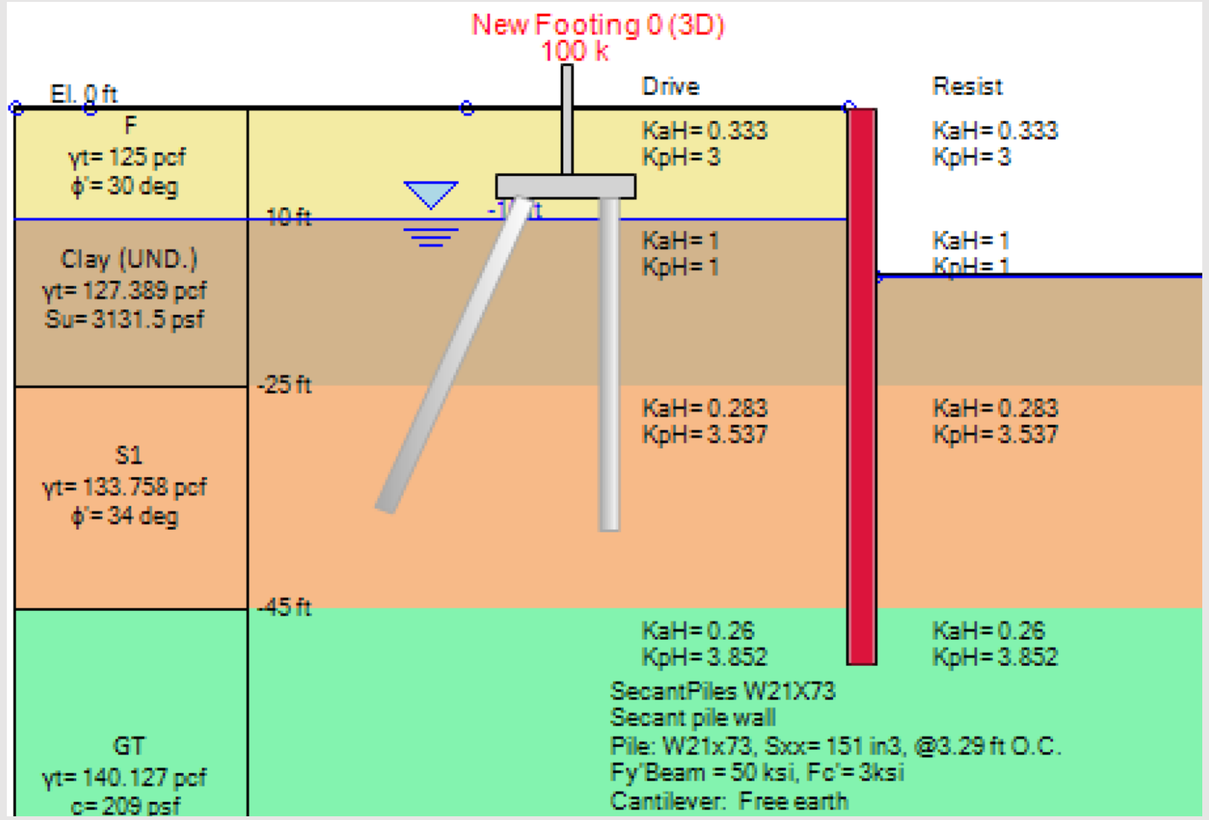
DEEP EXCAVATION
GEOTECHNICAL SOFTWARE AND ENGINEERING

Gravity Walls and Pile Supported Abutments



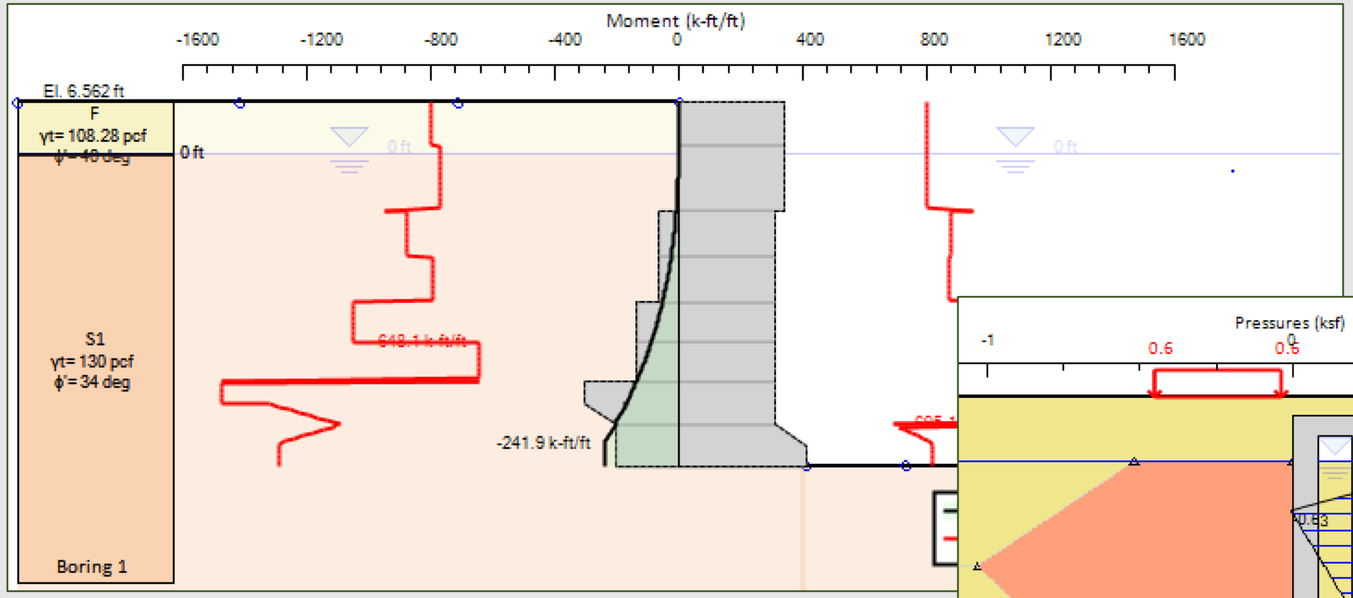


- ✓ Design gravity walls (any shape)
- ✓ Design pile supported abutments
- ✓ Use footings (3D loads) and design the foundation piles

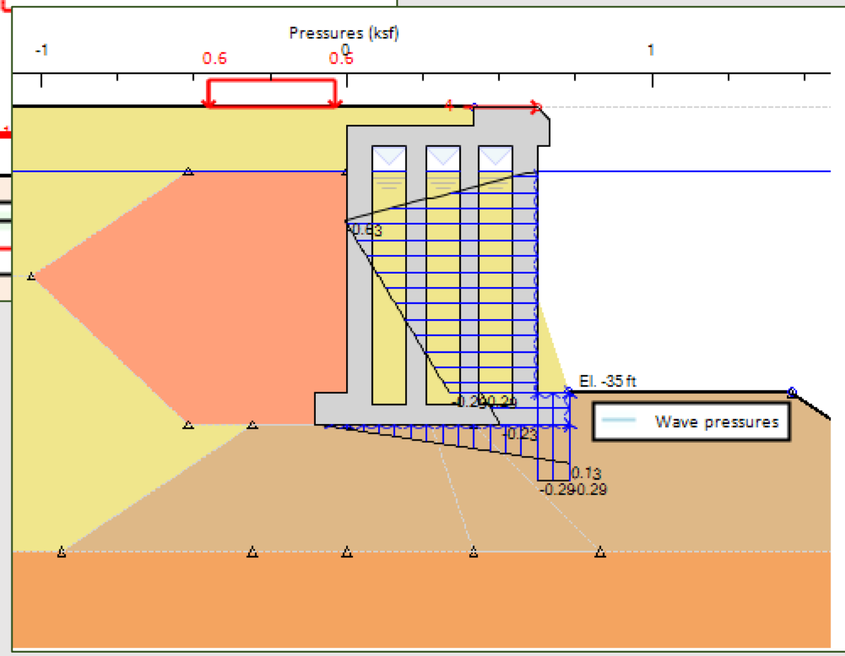


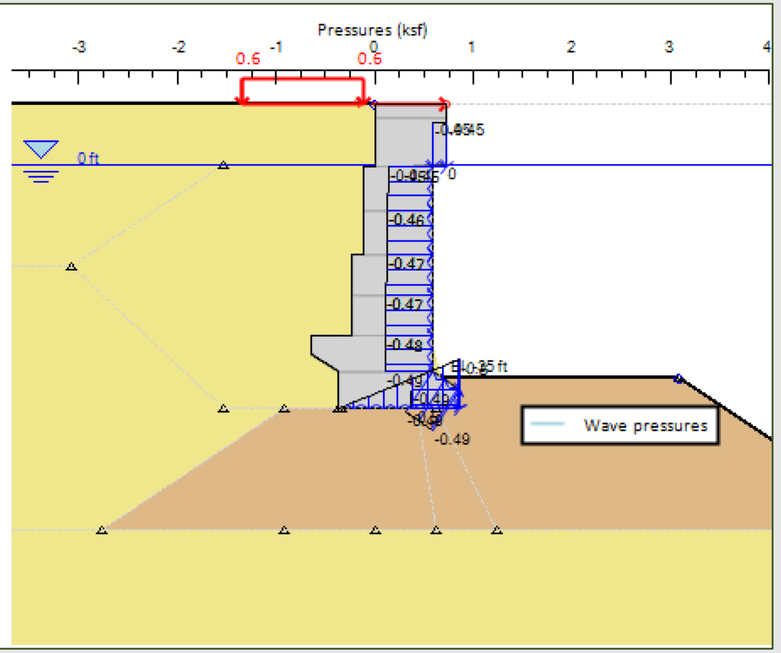
DEEP EXCAVATION
GEOTECHNICAL SOFTWARE AND ENGINEERING

Sea Walls - Quay Walls - Wave Pressures - Overtopping



- ✓ Load combinations for British Standards 6349 Parts 1-2 (Marine Structures-Quay Walls)
- ✓ Wave pressures with Sainflou, McConnel, Proverbs
- ✓ Average overtopping volume calculations
- ✓ Block/segmental walls with individual shear resistances and densities
- ✓ Quay caisson walls (3D) with infill zones. The program can calculate the 3D weight
- ✓ Quay wall wizard - Create a model in minutes



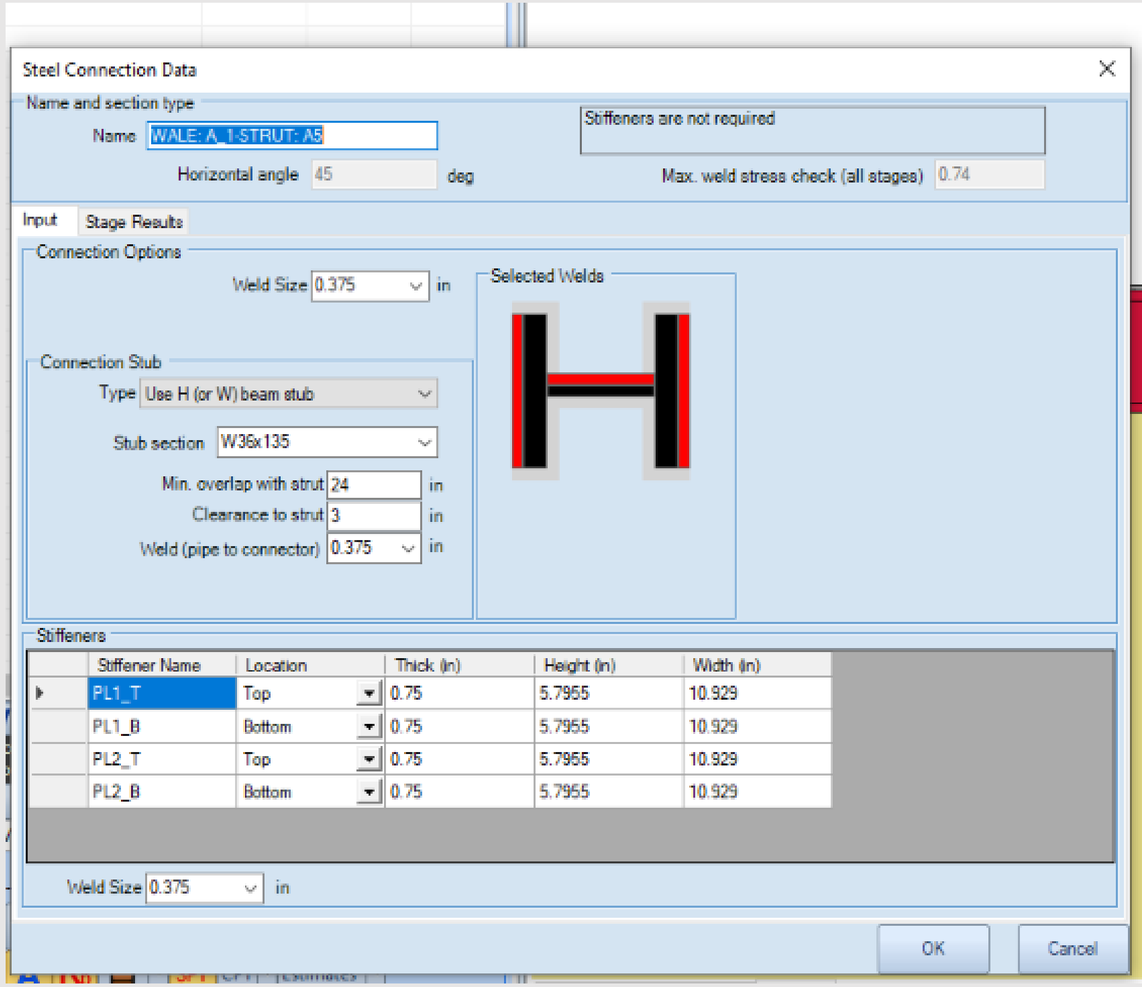


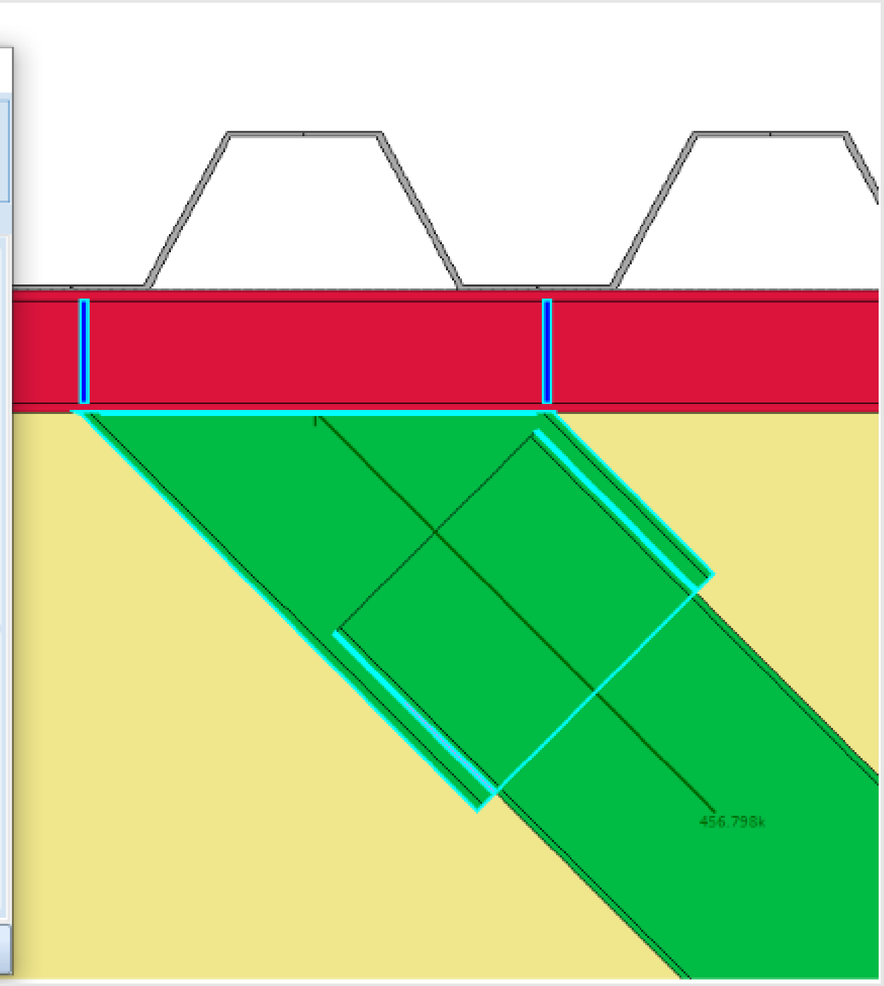
RELIABLE GEOEXPERTISE

www.deepexcavation.com
www.deepex.com

sales@deepexcavation.com
training@deepexcavation.com
T: +1-206-279-3300

Steel Connections





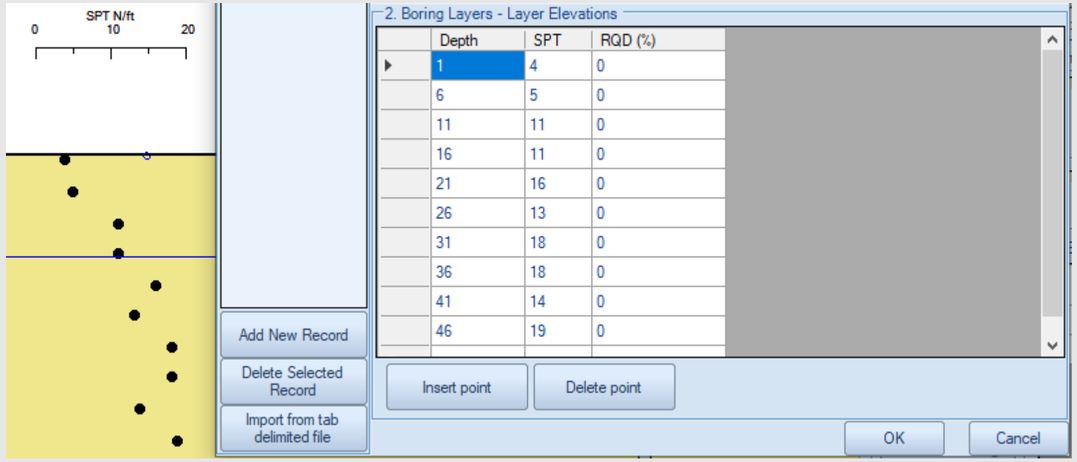
- ✓ Generate all steel connections
- ✓ Check Steel Connections (Struts and Walers)
- ✓ Optimize Steel Connections with a Click
- ✓ Adjust weld sizes and apply plate stiffeners

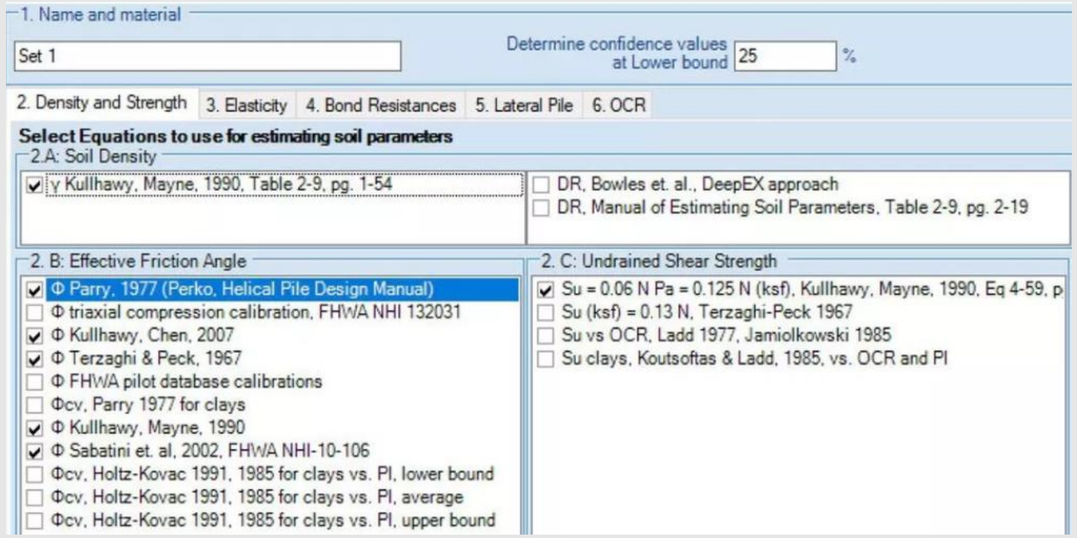
www.deepexcavation.com
www.deepex.com

sales@deepexcavation.com
training@deepexcavation.com
T: +1-206-279-3300

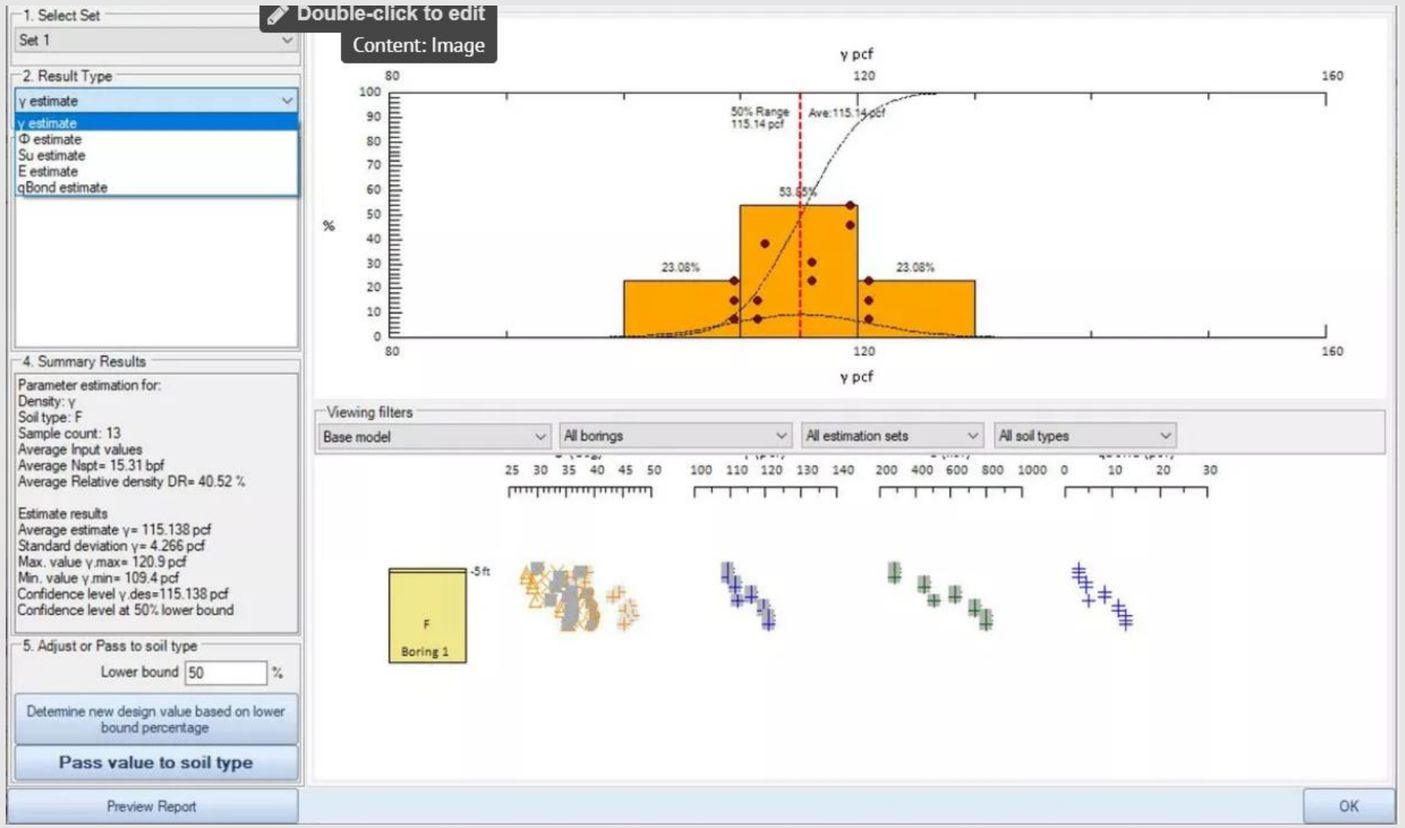
DEEP EXCAVATION
GEOTECHNICAL SOFTWARE AND ENGINEERING

Soil Estimation - Statistical Analysis





- ✓ Estimate Soil Properties with different methods
- ✓ Review a statistical analysis of the estimated properties
- ✓ Select the project values with a high level of certainty



DEEP EXCAVATION
GEOTECHNICAL SOFTWARE AND ENGINEERING

DeepEX - Standard Packages and Additional Modules

Standard DeepEX Software Packages

DeepEX 2D Basic Version
Design 2D Sections with LEM and NL Methods

DeepEX 2D + FEM
DeepEX 2D
+ Finite Element Analysis

DeepEX Marine Walls
DeepEX 2D
+ Gravity Walls
+ Sea Walls/Quay Walls
+ Soil Estimation

DeepEX 3D
DeepEX 2D
+ 3D Frame Analysis
+ Project Cost Estimation
+ Export 3D Holograms
+ Steel Connections

DeepEX 3D + FEM
DeepEX 3D
+ Finite Element Analysis

DeepEX 3D Advanced
DeepEX 3D
+ Finite Element Analysis
+ Building Damage Assessment

Available Additional Optional Modules – Expand the Standard Version Capabilities

- Finite Element Analysis Available Add on
- Gravity Walls & Pile Abutments Available Add on
- Gravity Walls & Sea Walls/Quay Walls Available Add on
- Soil Estimation & Statistical Analysis Available Add on
- Export Sketches to DXF Available Add on

DeepEX Licensing Options

- Single Licenses (activated in specific devices), Single USB Keys, Network USB Key Solutions
- 1 Year of full Technical Support (training, questions, file reviews) is included in any software purchase
- Optional Annual Maintenance options (after the first year)
- Discounts for Additional Licenses
- Additional Modules can be purchased and activated at any point in any software package

RELIABLE GEOEXPERTISE

www.deepexcavation.com
www.deepex.com

sales@deepexcavation.com
training@deepexcavation.com
T: +1-206-279-3300

THANK YOU!

DESIGN AND OPTIMIZE ANY DEEP EXCAVATION SYSTEM IN MINUTES AND GAIN A COMPETITIVE EDGE!

Learn tips and tricks of deep excavation design

BOOK HERE A FREE ONLINE PRESENTATION
E: training@deepexcavation.com

or Call Us at: +1 - 206-279-3300

Learn from examples, videos and case studies

TRAINING MATERIALS:
CLICK HERE FOR EXAMPLES & VIDEOS

Prices and Licensing Questions: sales@deepexcavation.com
Technical Support: support@deepexcavation.com

TRUSTED BY

ARUP, United Rentals, PB&A inc., HATCH, MOTT MACDONALD, KELLER, Jacobs, BERKEL SINCE1959, ATKINS, iLBANK, GZA, SAMSUNG C&T, RUSSO Est. 1956, Gulf Consult Saudi Arabia, AECOM, Al Ghurair, nscc International, e.construct, AUD, TEMELTAŞ "temelden gelen güç"