Integrated Graphical User Environment for Dynamic Analysis and PBEE of Bridge-Ground Systems

(Progress Report)

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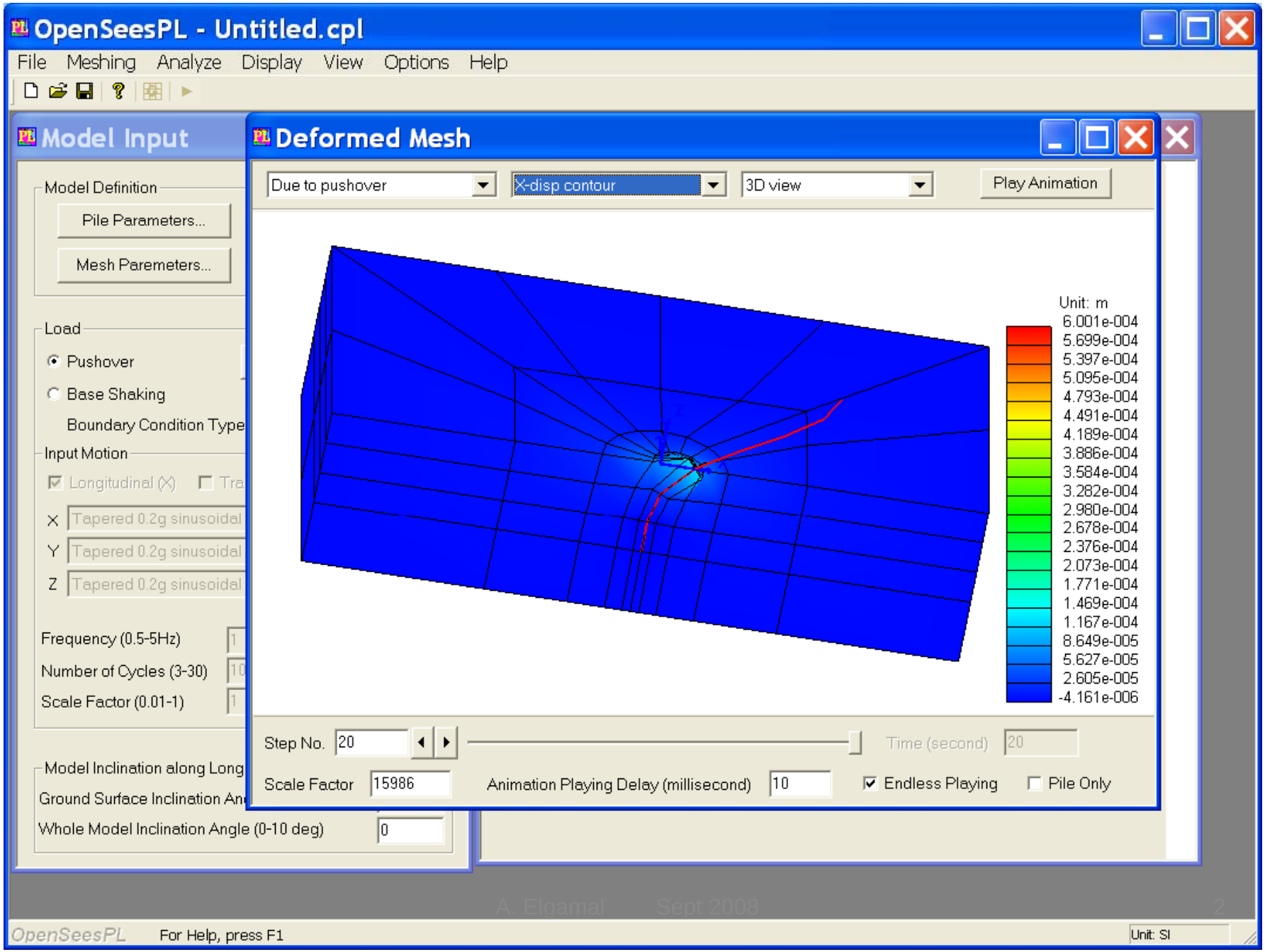
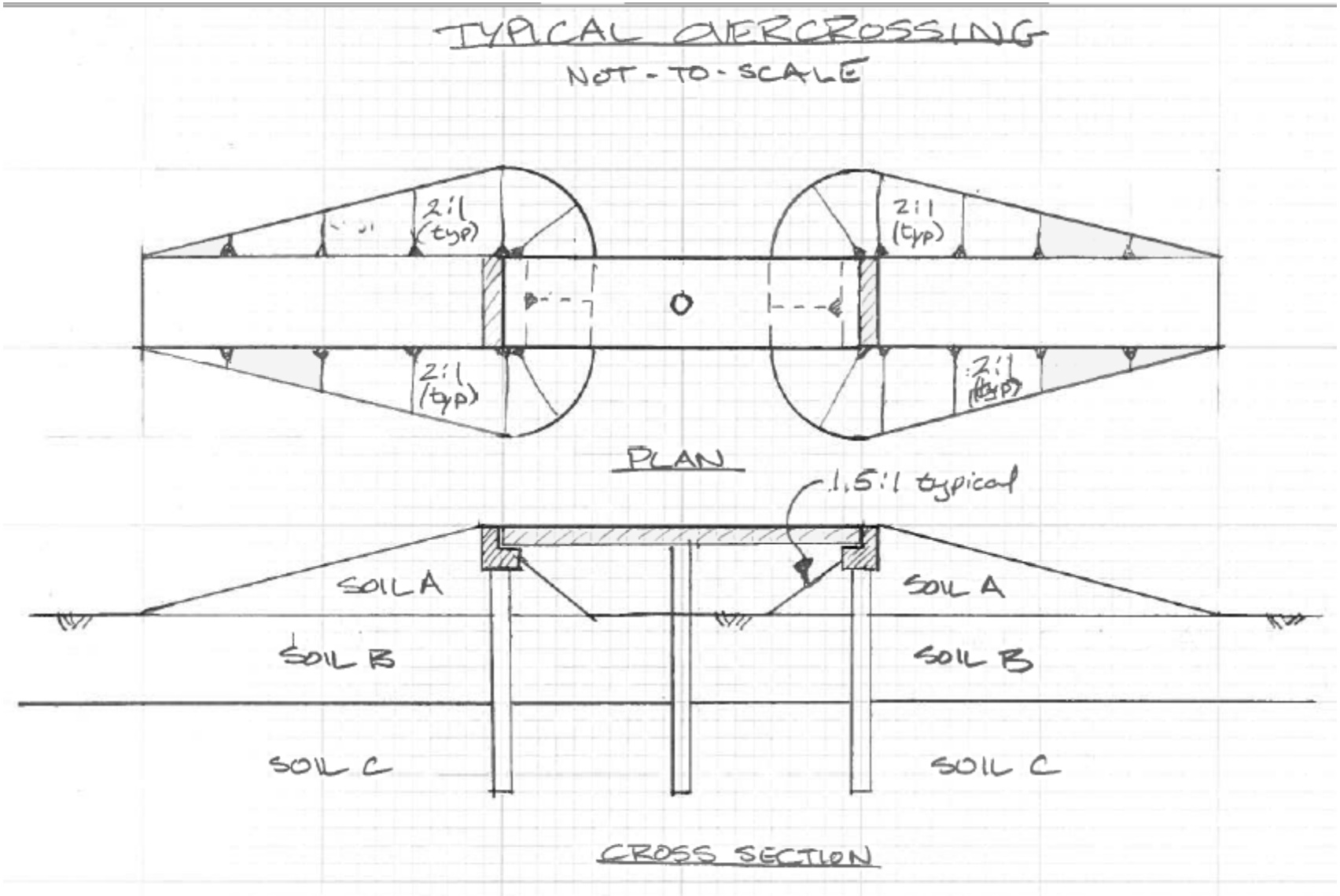
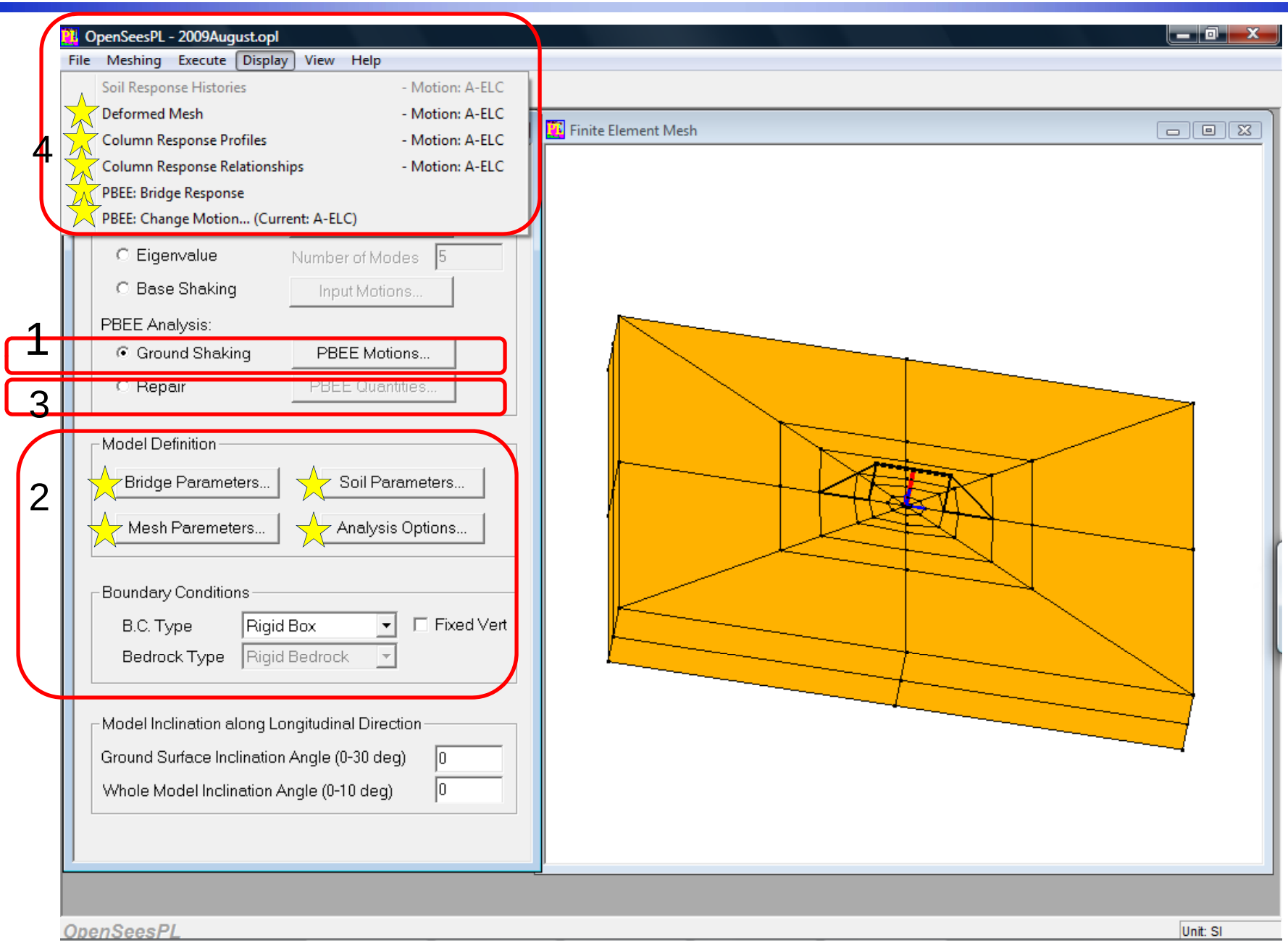
OpenSeesPL: http://cyclic.ucsd.edu/openseespl



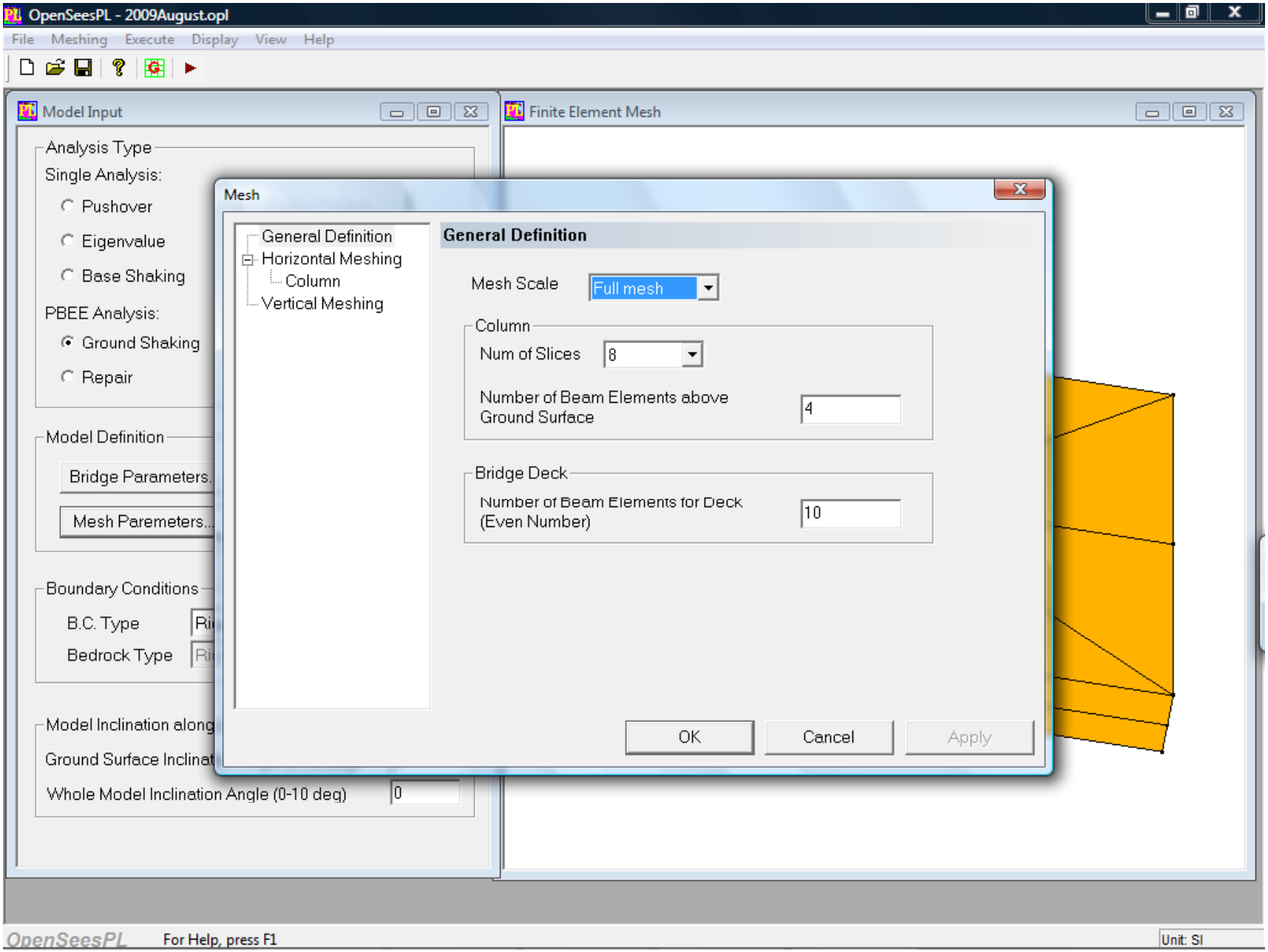
Typical Cross-Section for User-Interface (underway)



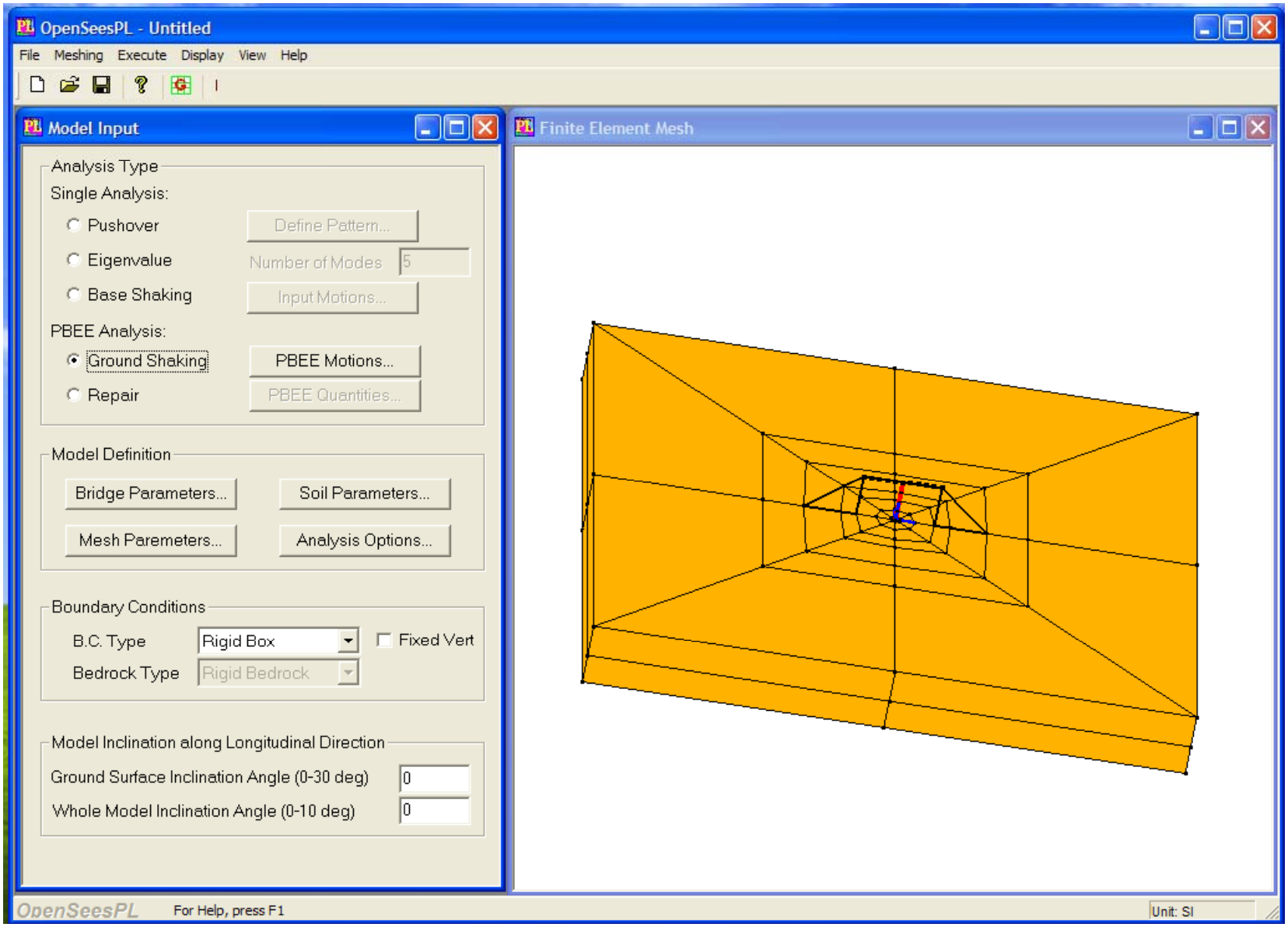
User Interface: Integrated System Components

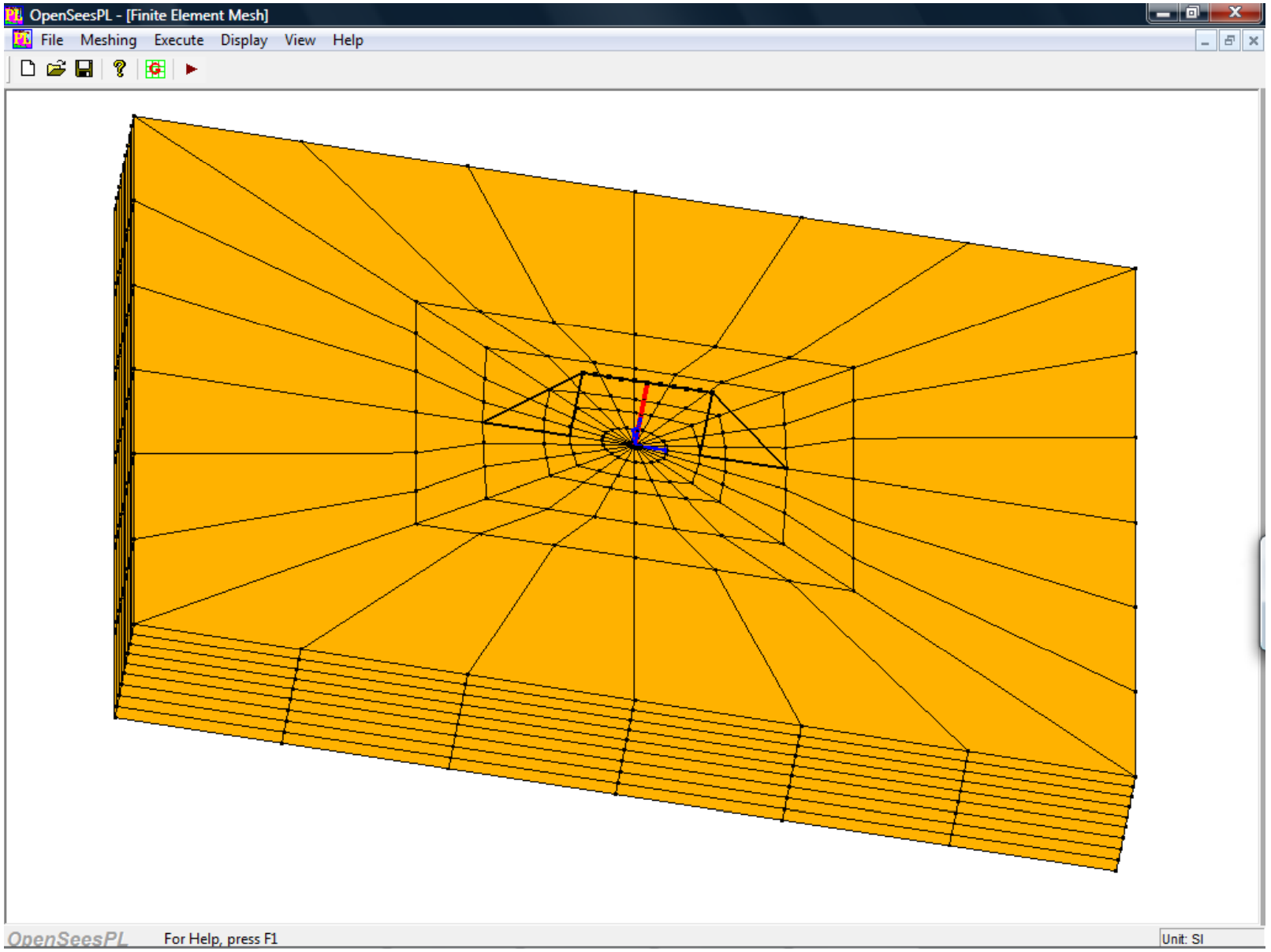


Definition of Geometry and Mesh Refinement



Main Window


OpenSeesPL - Untitled
File Meshing Execute Display View Help
Model Input
Analysis Type
Single Analysis:
Pushover
Define Pattern...
Eigenvalue
Number of Modes
5
Base Shaking
Input Motions...
PBEE Analysis:
Ground Shaking
PBEE Motions...
Repair
PBEE Quantities...
Model Definition
Bridge Parameters...
Soil Parameters...
Mesh Paremeters...
Analysis Options...
Boundary Conditions
B.C. Type
Rigid Box
Fixed Vert
Bedrock Type
Rigid Bedrock
Model Inclination along Longitudinal Direction
Ground Surface Inclination Angle (0-30 deg)
0
Whole Model Inclination Angle (0-10 deg)
0
Finite Element Mesh
OpenSeesPL
For Help, press F1
Unit: SI


OpenSeesPL - [Finite Element Mesh]
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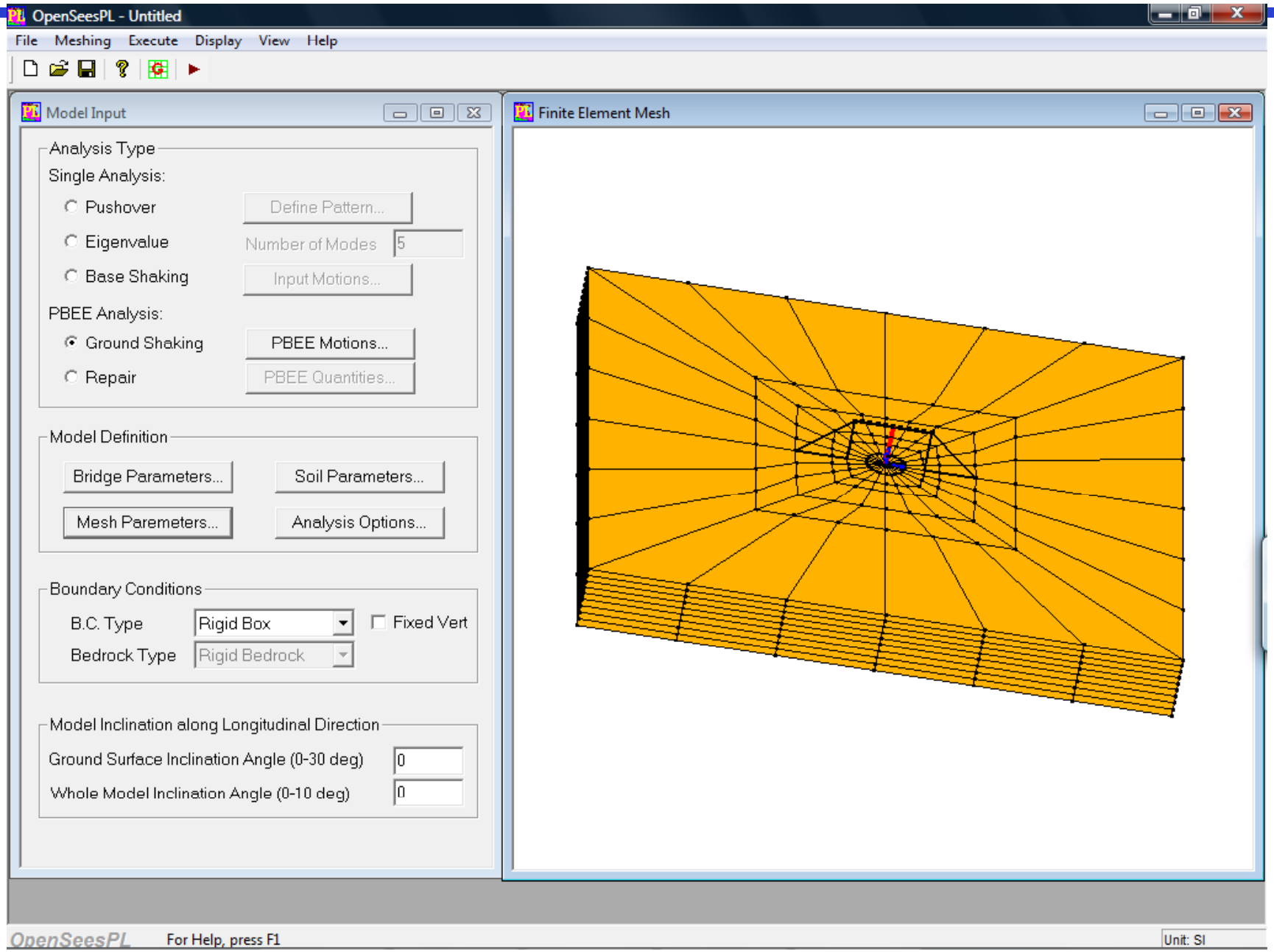
For Help, press F1
Unit: SI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Rigid Bedrock
Model Inclination along Longitudinal Direction
Ground Surface Inclination Angle (0-30 deg)
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Whole Model Inclination Angle (0-10 deg)
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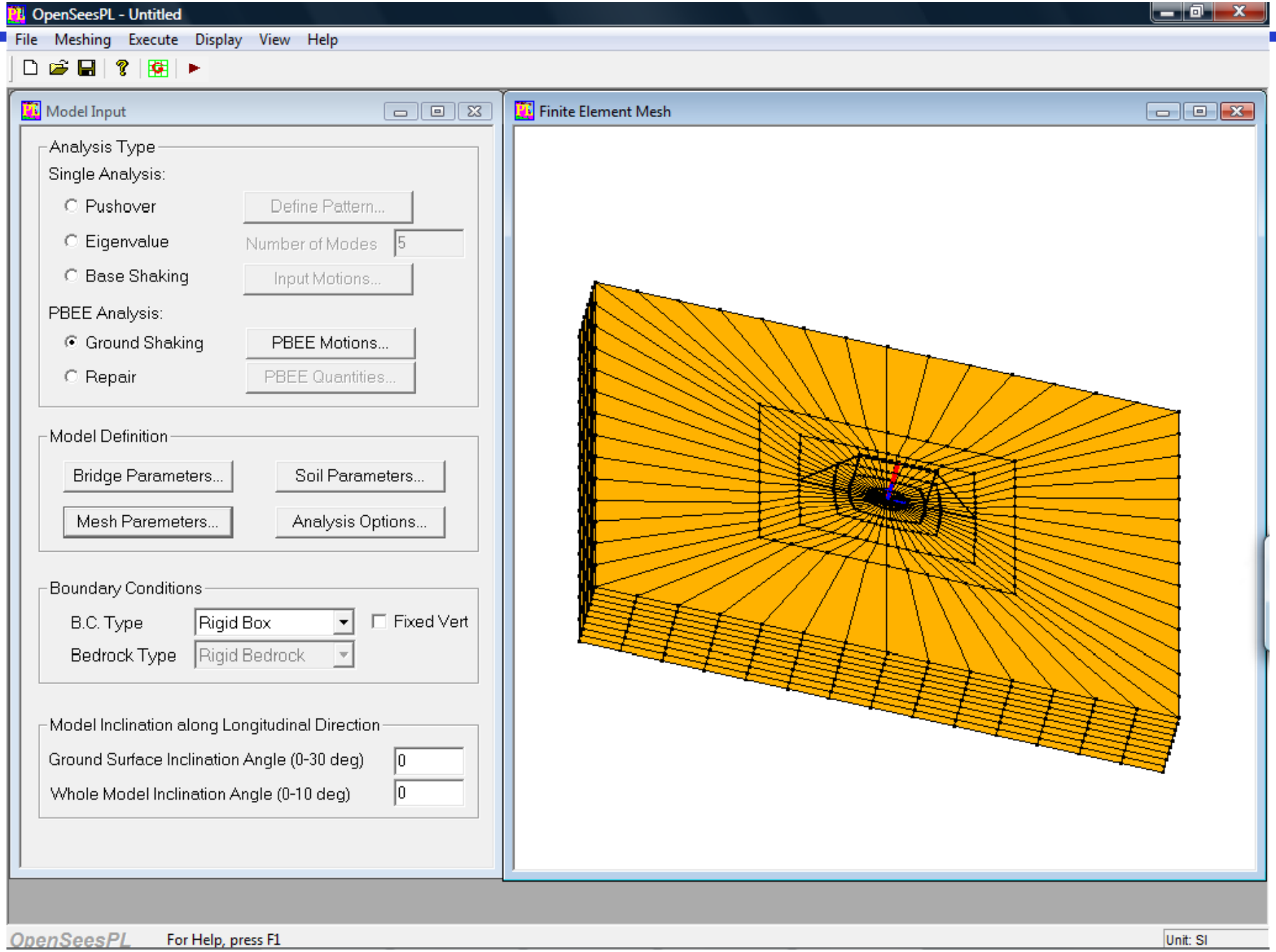
Finite Element Mesh
OpenSeesPL
For Help, press F1
Unit: SI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Eigenvalue
Number of Modes
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PBEE Motions...
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Ground Surface Inclination Angle (0-30 deg)
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Whole Model Inclination Angle (0-10 deg)
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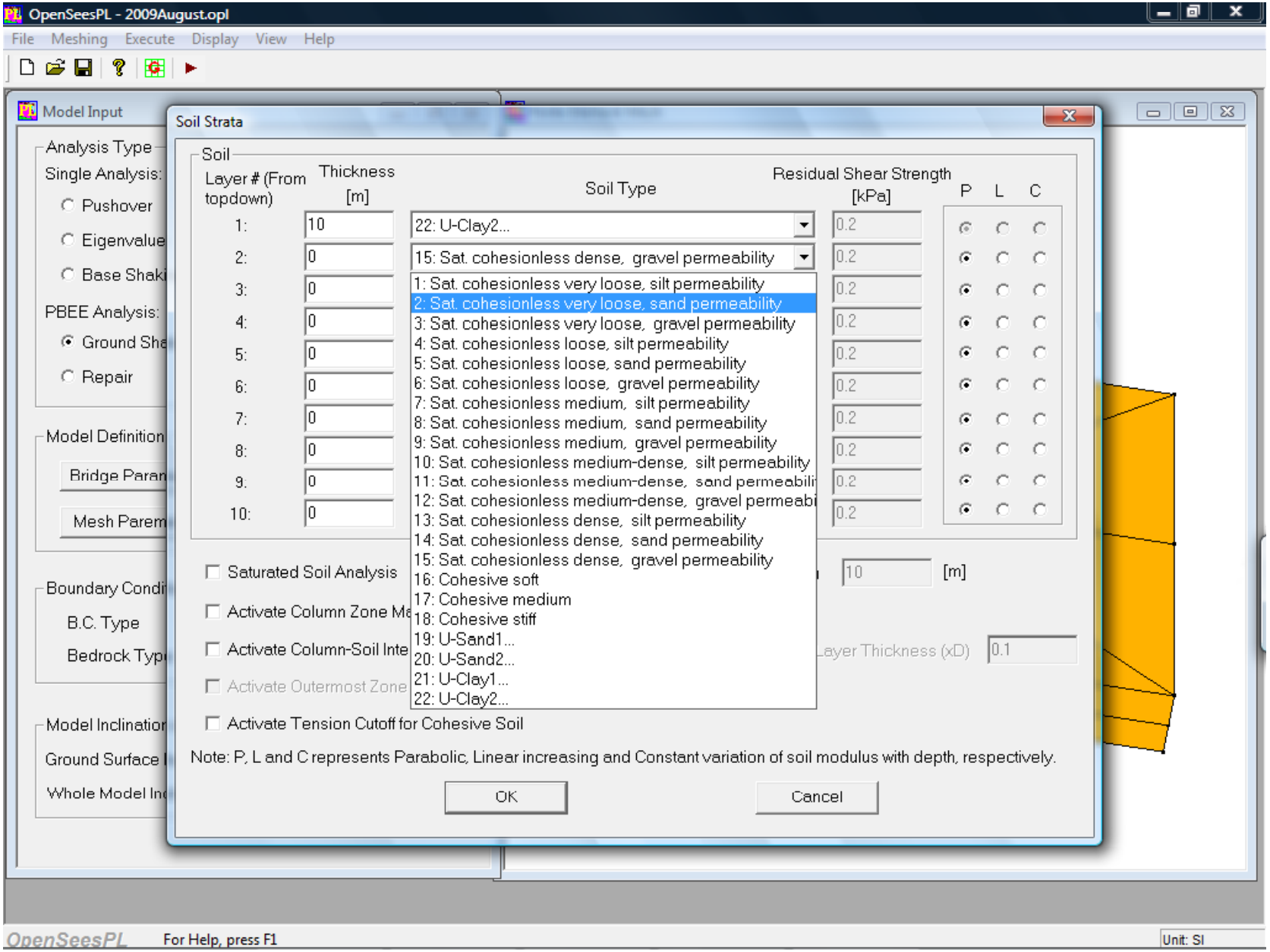
Finite Element Mesh
OpenSeesPL
For Help, press F1
Unit: SI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File Meshing Execute Display View Help
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Ground Surface I
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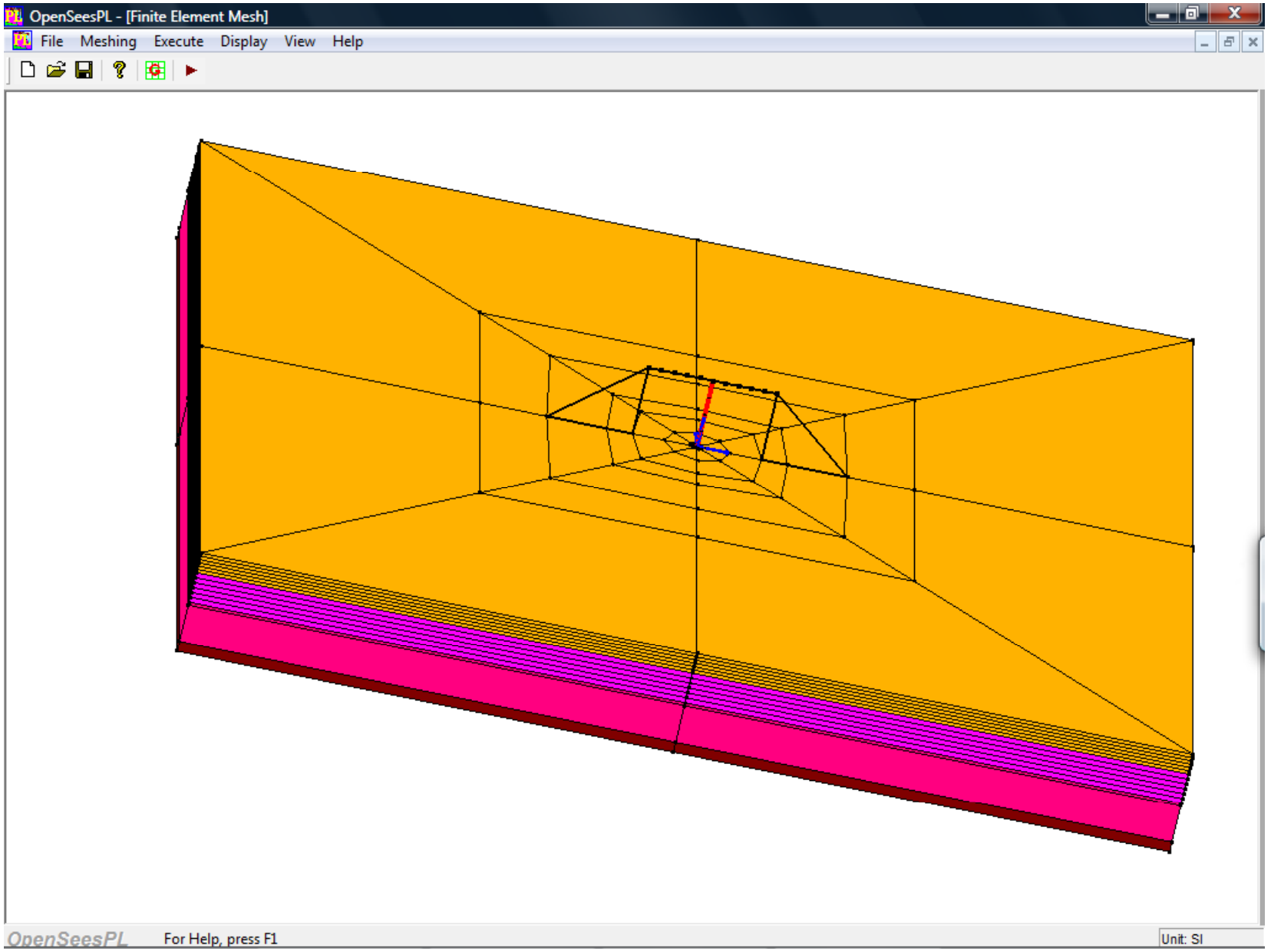
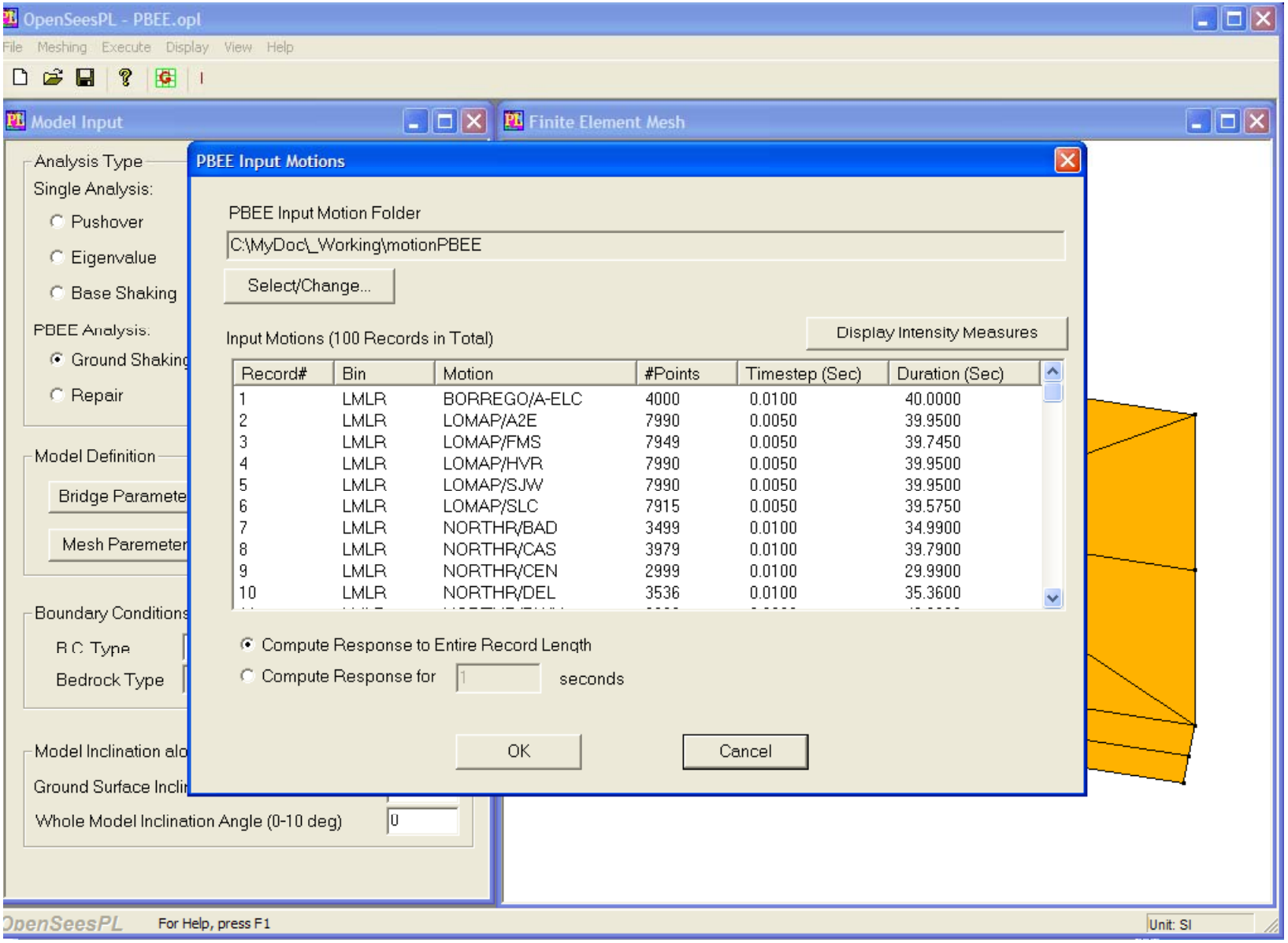
Soil Strata
Soil
Layer # (From topdown)
Thickness [m]
Soil Type
Residual Shear Strength [kPa]
P L C
1: 10 22: U-Clay2... 0.2
2: 0 15: Sat. cohesionless dense, gravel permeability 0.2
3: 0 0.2
4: 0 0.2
5: 0 0.2
6: 0 0.2
7: 0 0.2
8: 0 0.2
9: 0 0.2
10: 0 0.2
1: Sat. cohesionless very loose, silt permeability
2: Sat. cohesionless very loose, sand permeability
3: Sat. cohesionless very loose, gravel permeability
4: Sat. cohesionless loose, silt permeability
5: Sat. cohesionless loose, sand permeability
6: Sat. cohesionless loose, gravel permeability
7: Sat. cohesionless medium, silt permeability
8: Sat. cohesionless medium, sand permeability
9: Sat. cohesionless medium, gravel permeability
10: Sat. cohesionless medium-dense, silt permeability
11: Sat. cohesionless medium-dense, sand permeabili
12: Sat. cohesionless medium-dense, gravel permeabi
13: Sat. cohesionless dense, silt permeability
14: Sat. cohesionless dense, sand permeability
15: Sat. cohesionless dense, gravel permeability
16: Cohesive soft
17: Cohesive medium
18: Cohesive stiff
19: U-Sand1...
20: U-Sand2...
21: U-Clay1...
22: U-Clay2...
Saturated Soil Analysis
Activate Column Zone Ma
Activate Column-Soil Inte
Activate Outermost Zone
Activate Tension Cutoff for Cohesive Soil
10 [m]
Layer Thickness (xD) 0.1
Note: P, L and C represents Parabolic, Linear increasing and Constant variation of soil modulus with depth, respectively.
OK
Cancel
OpenSeesPL
For Help, press F1
Unit: SI

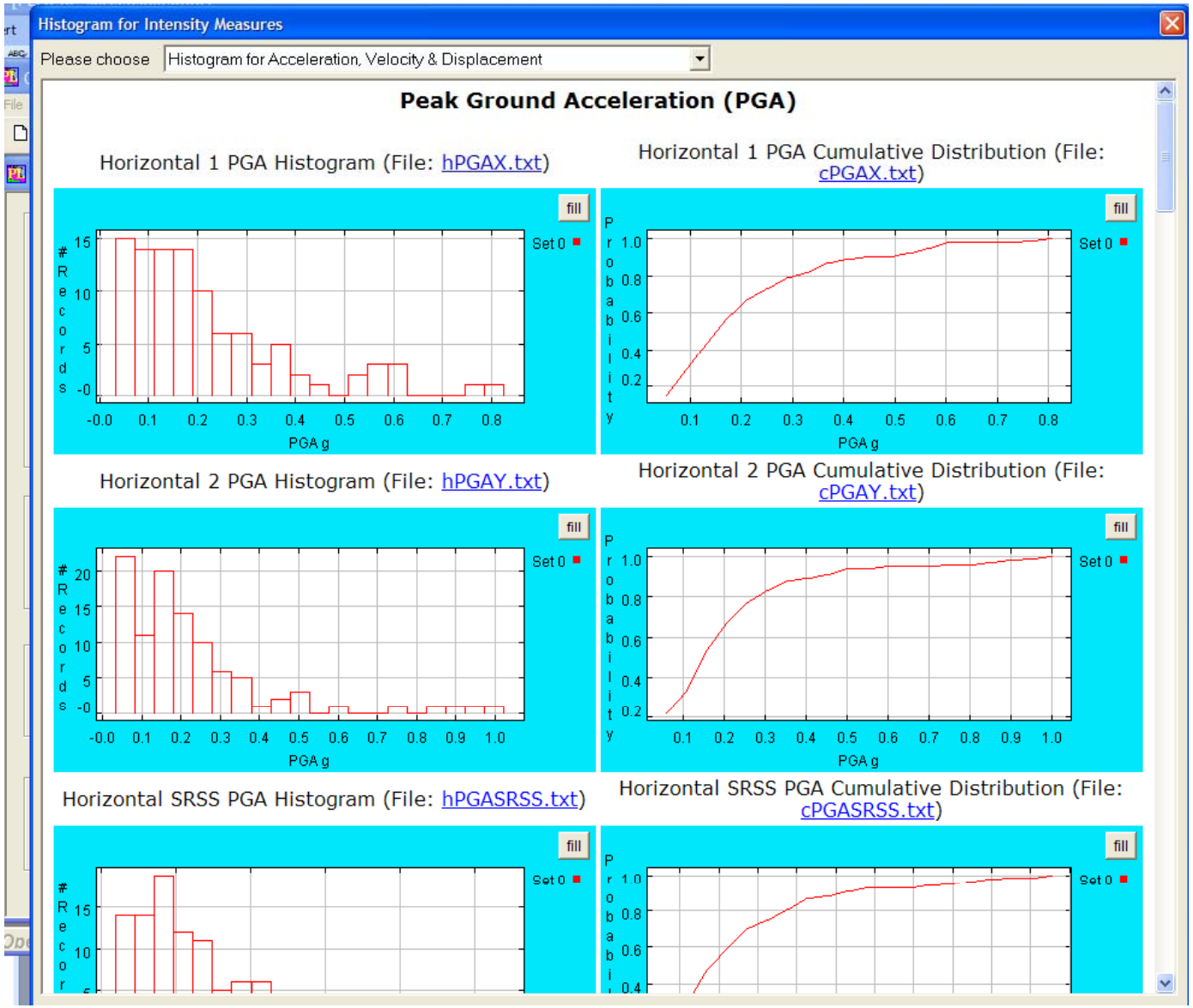
Definition of Soil Profile



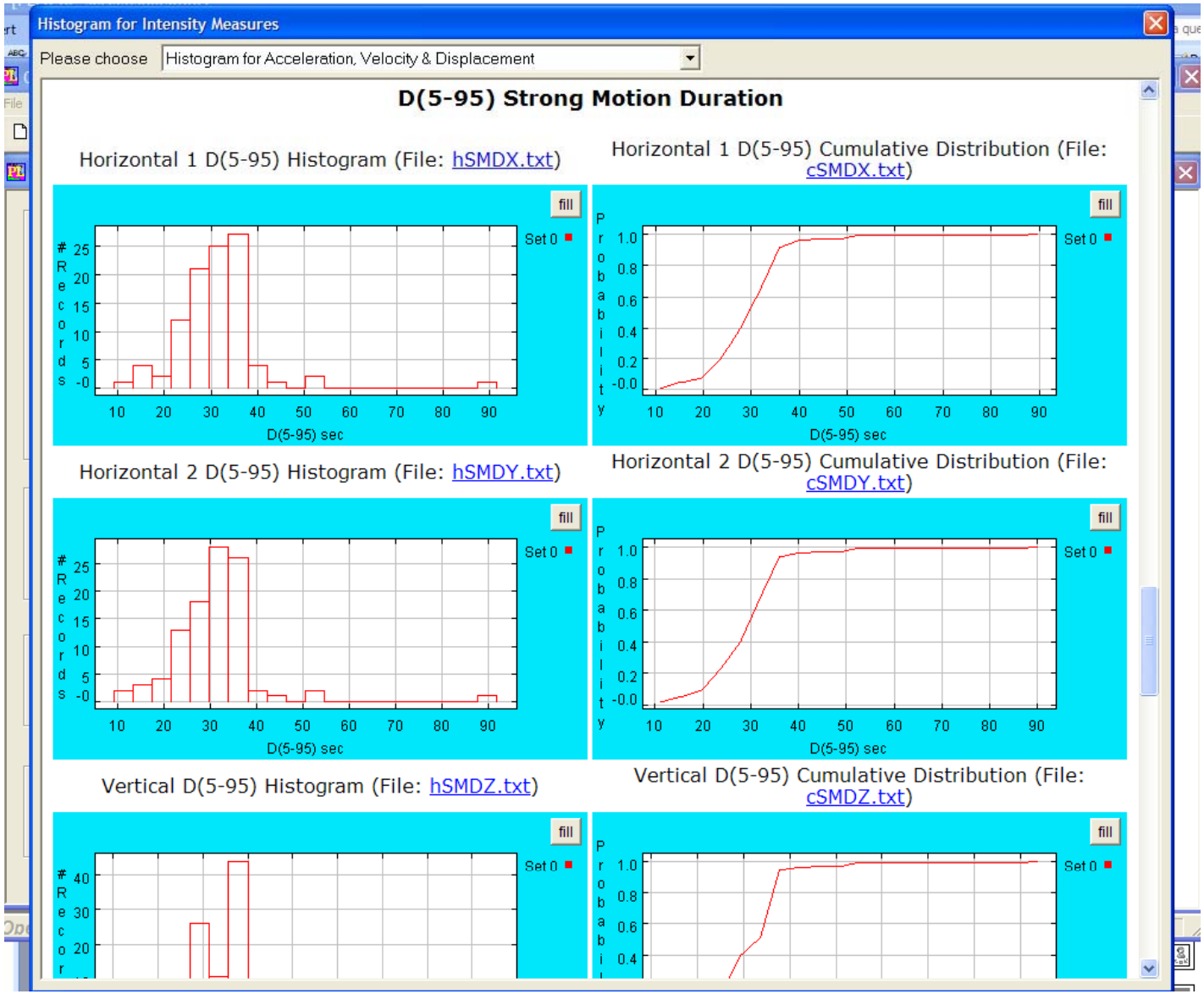
Input Motions



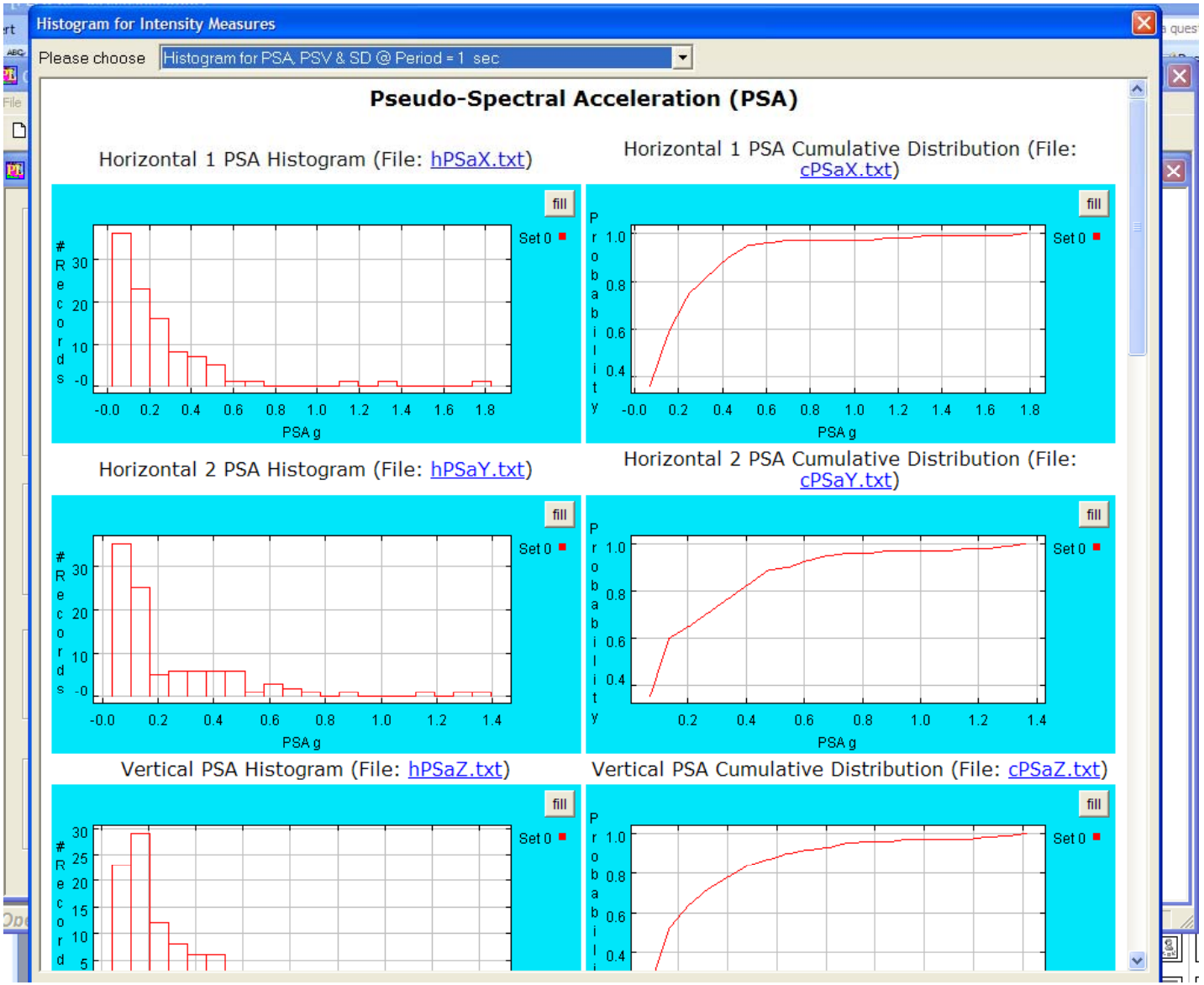
Histogram and Cumulative Distribution



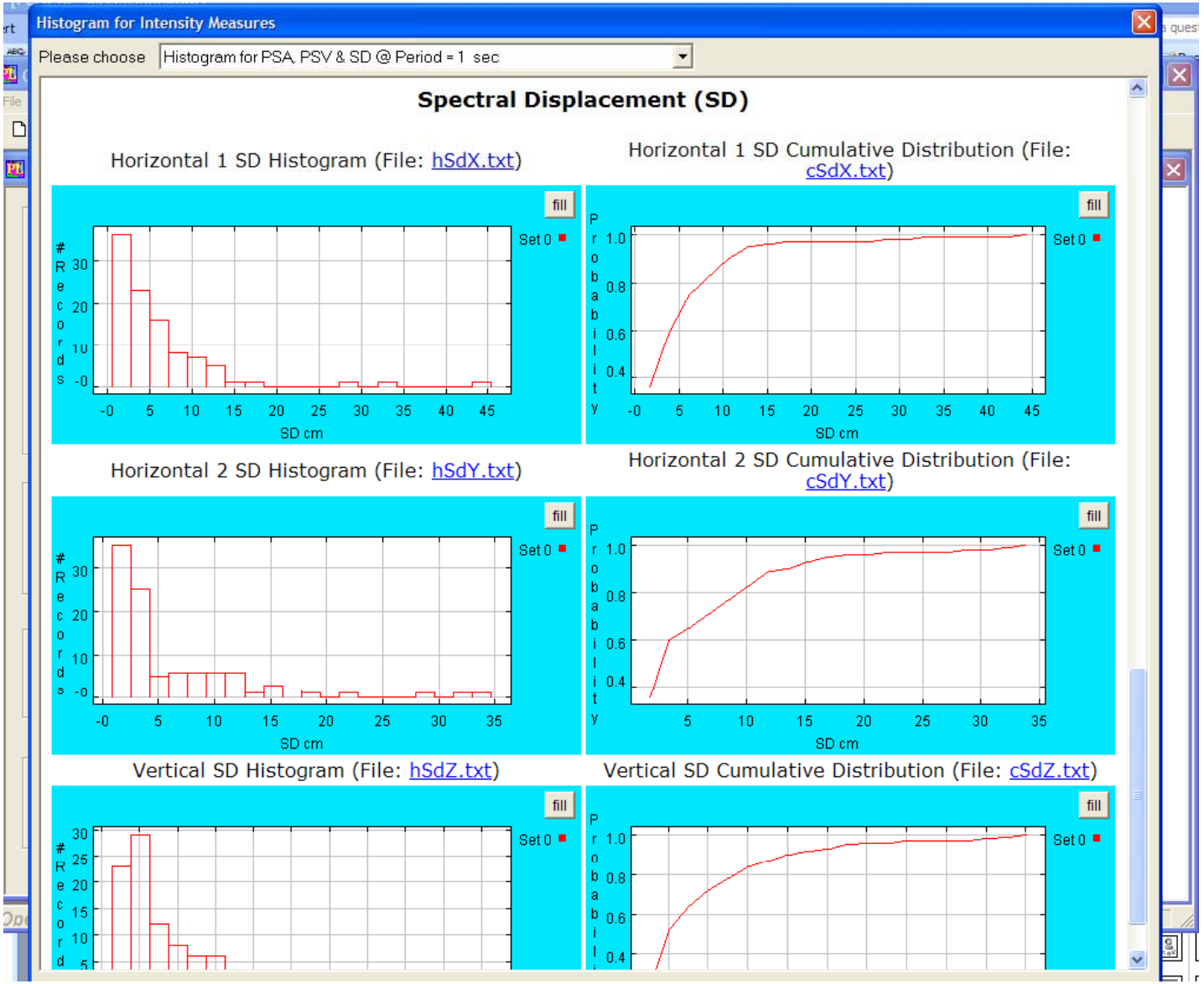
Histogram and Cumulative Distribution (Con't)



Histogram and Cumulative Distribution (Con't)



Histogram and Cumulative Distribution (Con't)



Intensity Measures

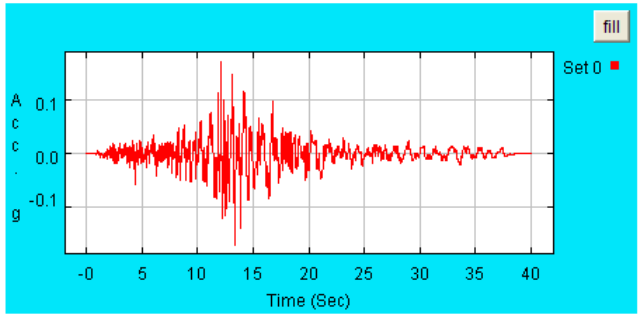
Motion: A2E

Intensity Measures

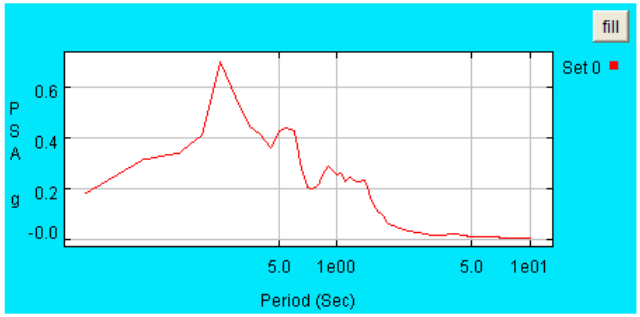
	Horizontal 1	Horizontal 2	Horizontal SRSS	Vertical
PGA (g)	0.170558	0.138501	0.181953	0.095212
PGV (cm/sec)	13.712202	11.527482	17.248343	3.759779
PGD (cm)	3.891637	5.643364	5.753599	2.382868
D(5-95) (sec)	31.530000	30.845000		36.905000
CAV (cm/sec)	616.701389	508.981512		323.320389
Arias Intensity (cm/sec)	40.190139	27.553230		9.283904

Acceleration Time Histories and Pseudo-Spectral Acceleration (PSA)

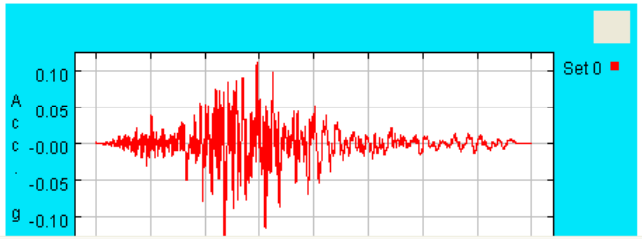
Horizontal 1 Acceleration (g) (Motion File: A2E000.AT2.data)
(File: motionX.txt)



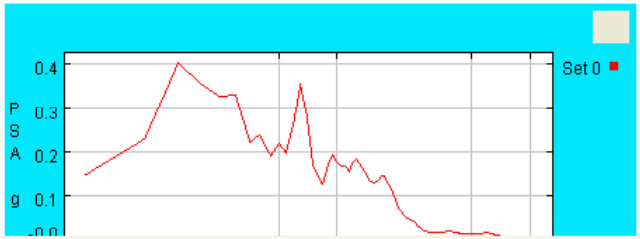
Horizontal 1 Pseudo-Spectral Acceleration (g) (File: spectralAccX.txt)



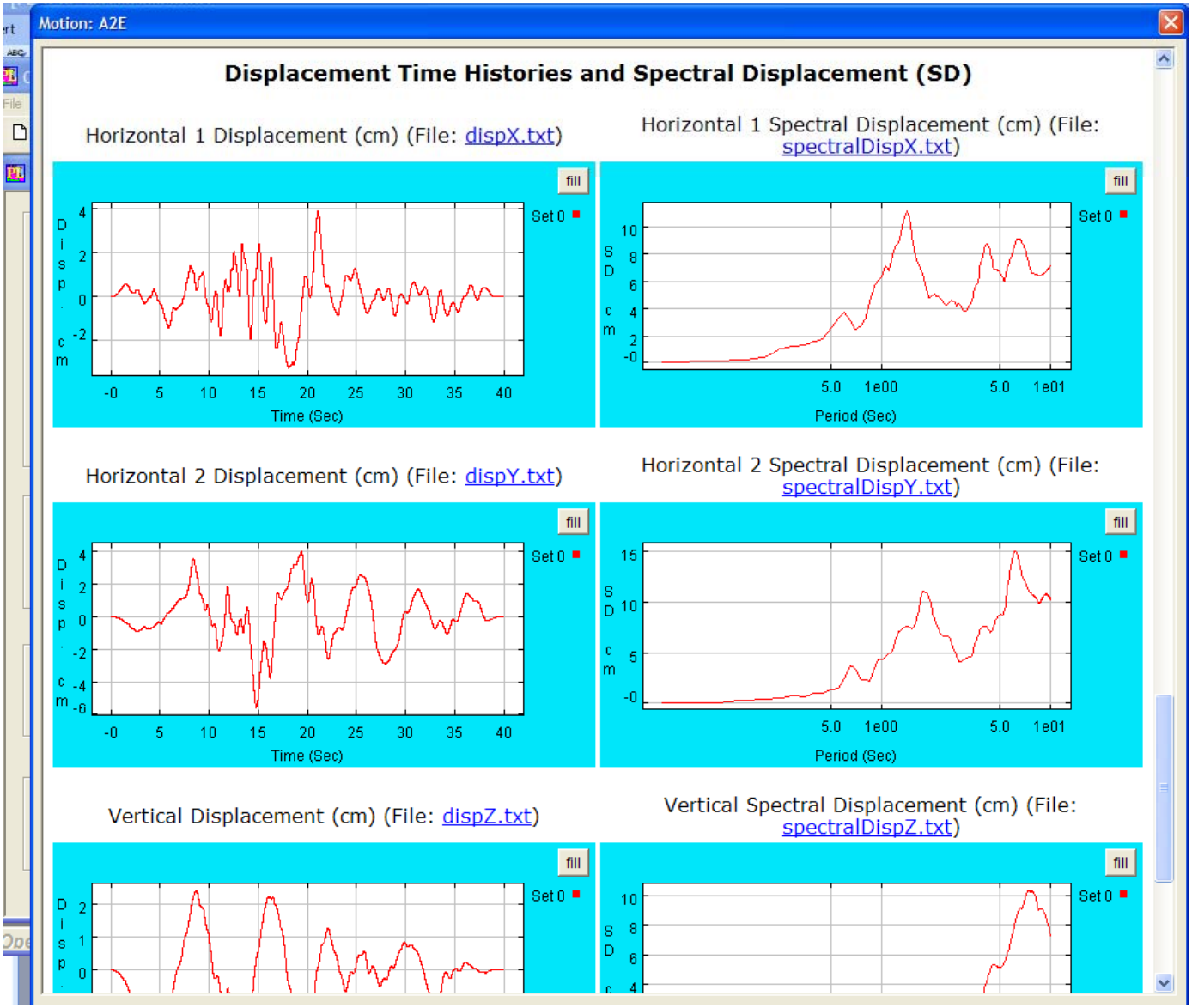
Horizontal 2 Acceleration (g) (Motion File: A2E090.AT2.data)
(File: motionY.txt)



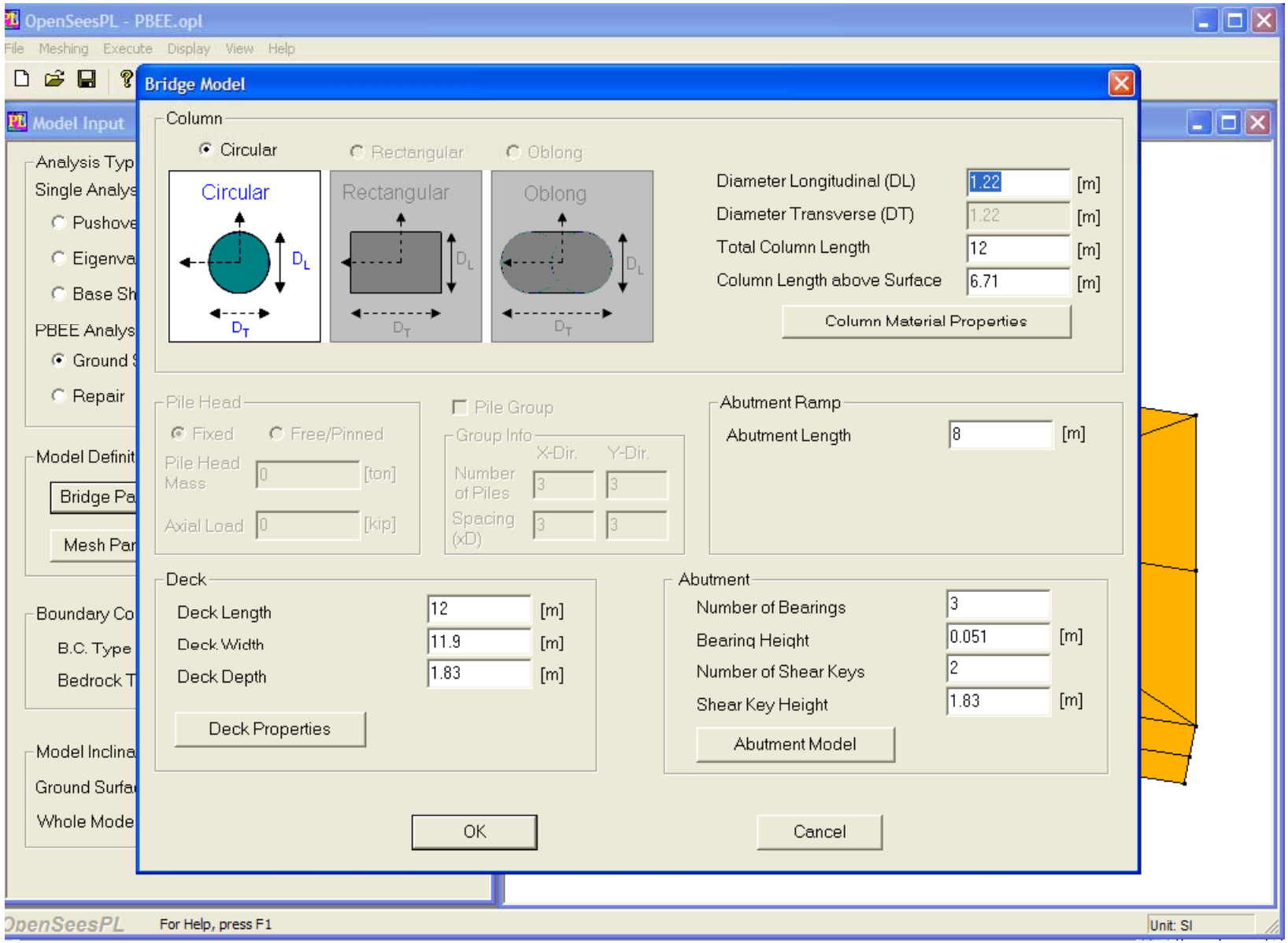
Horizontal 2 Pseudo-Spectral Acceleration (g) (File: spectralAccY.txt)



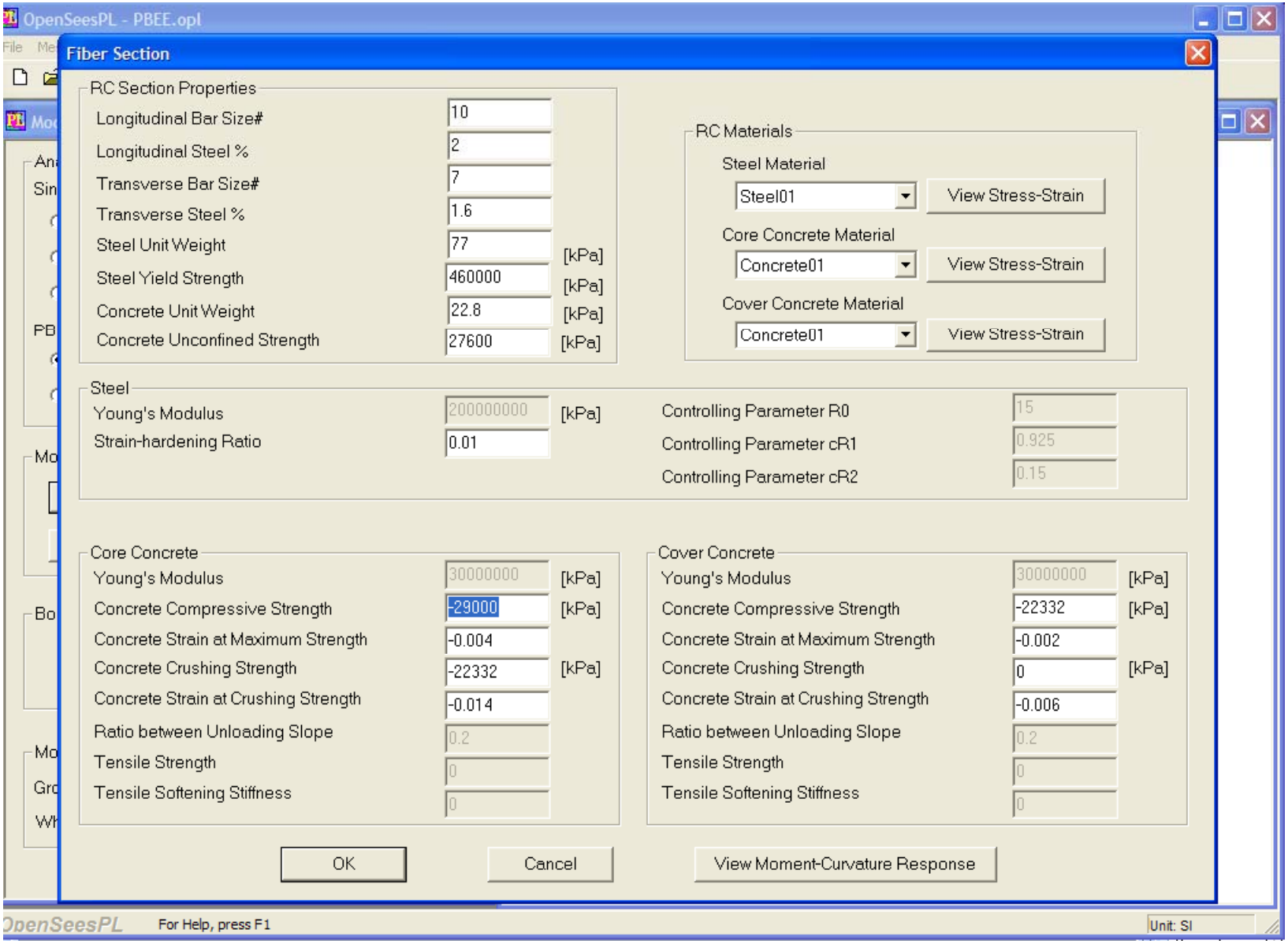
Intensity Measures (Con't)



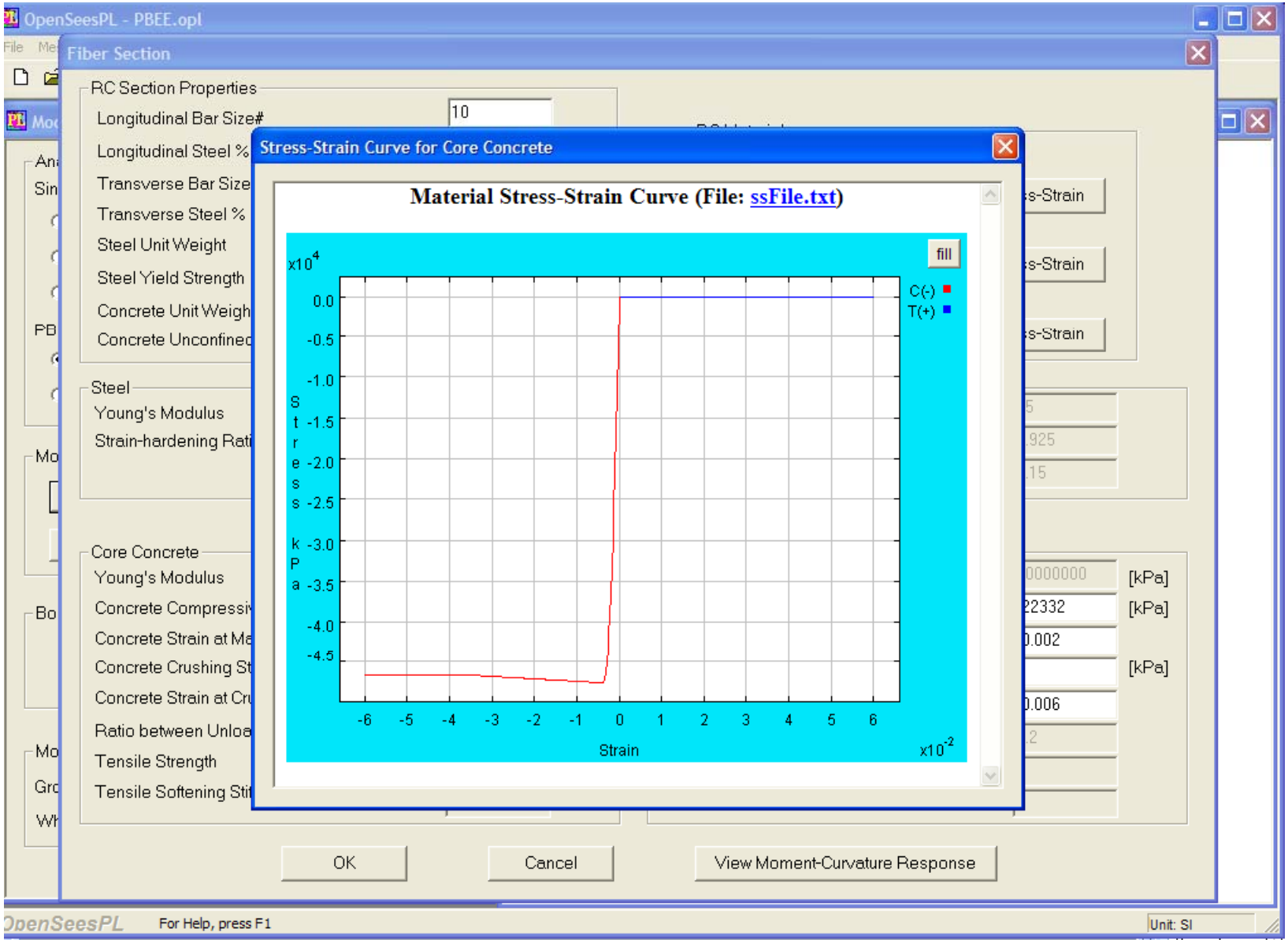
Bridge Model



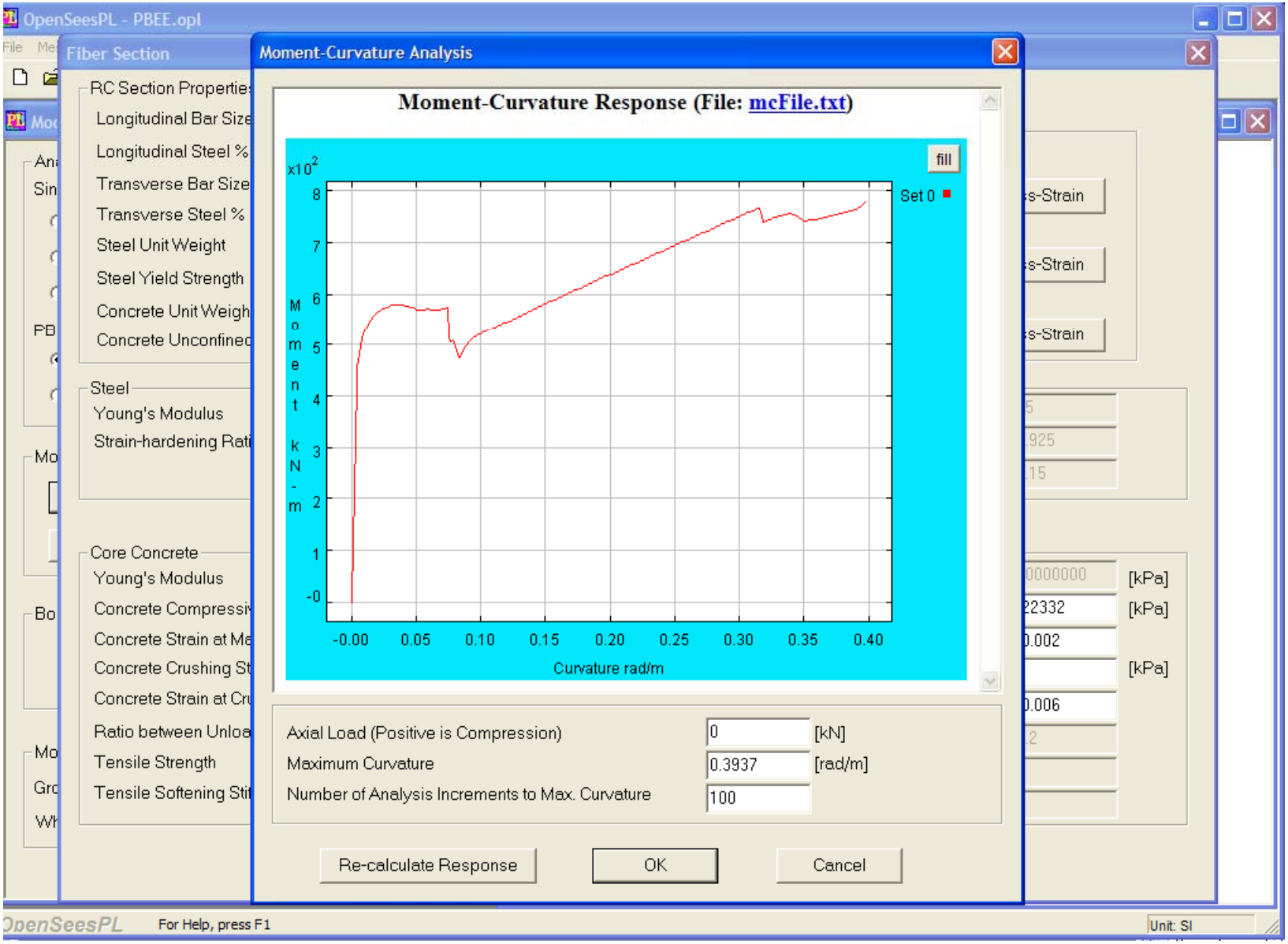
Column Material Properties



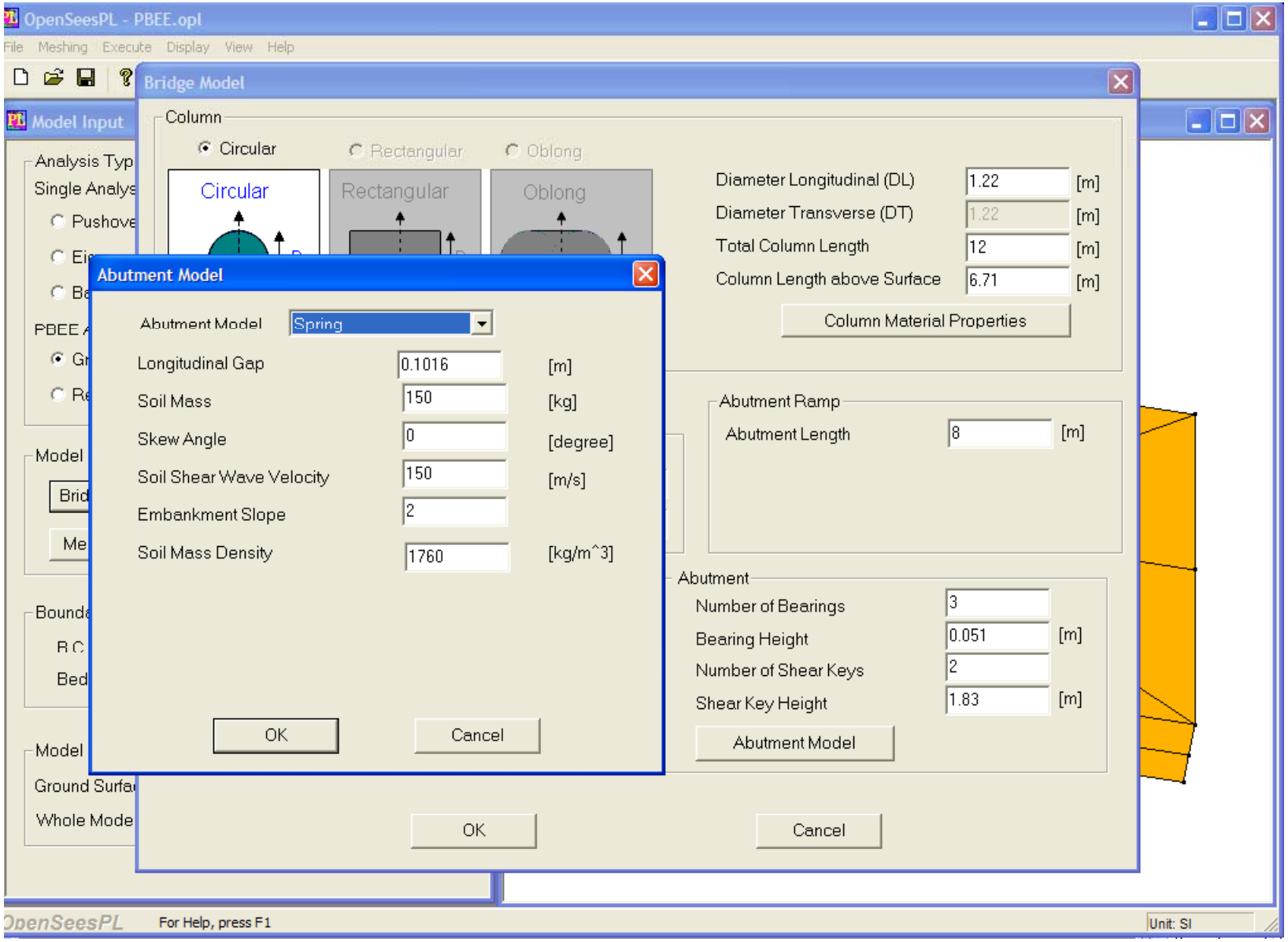
Material Stress-Strain Curve



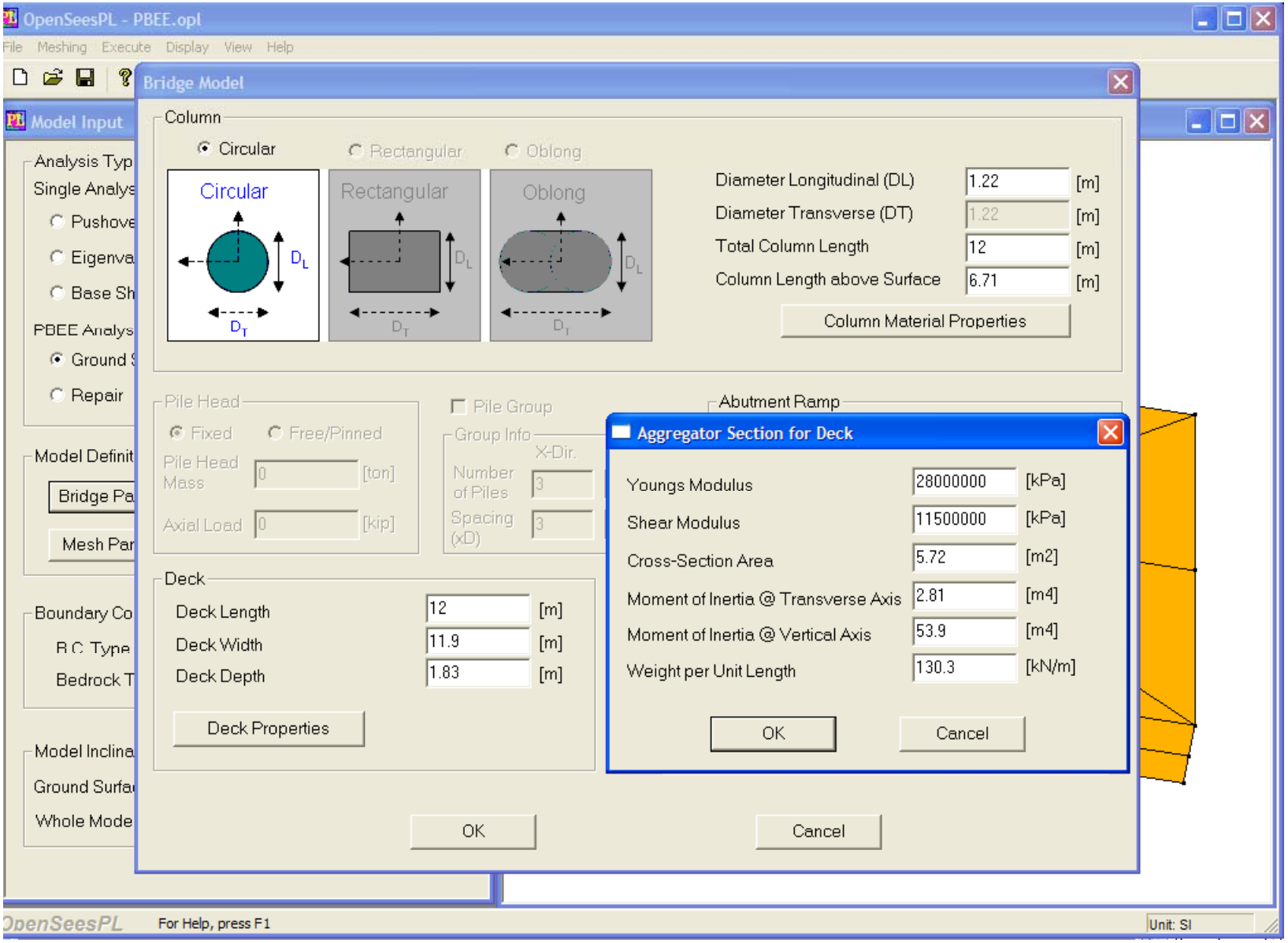
Moment-Curvature Response for Column



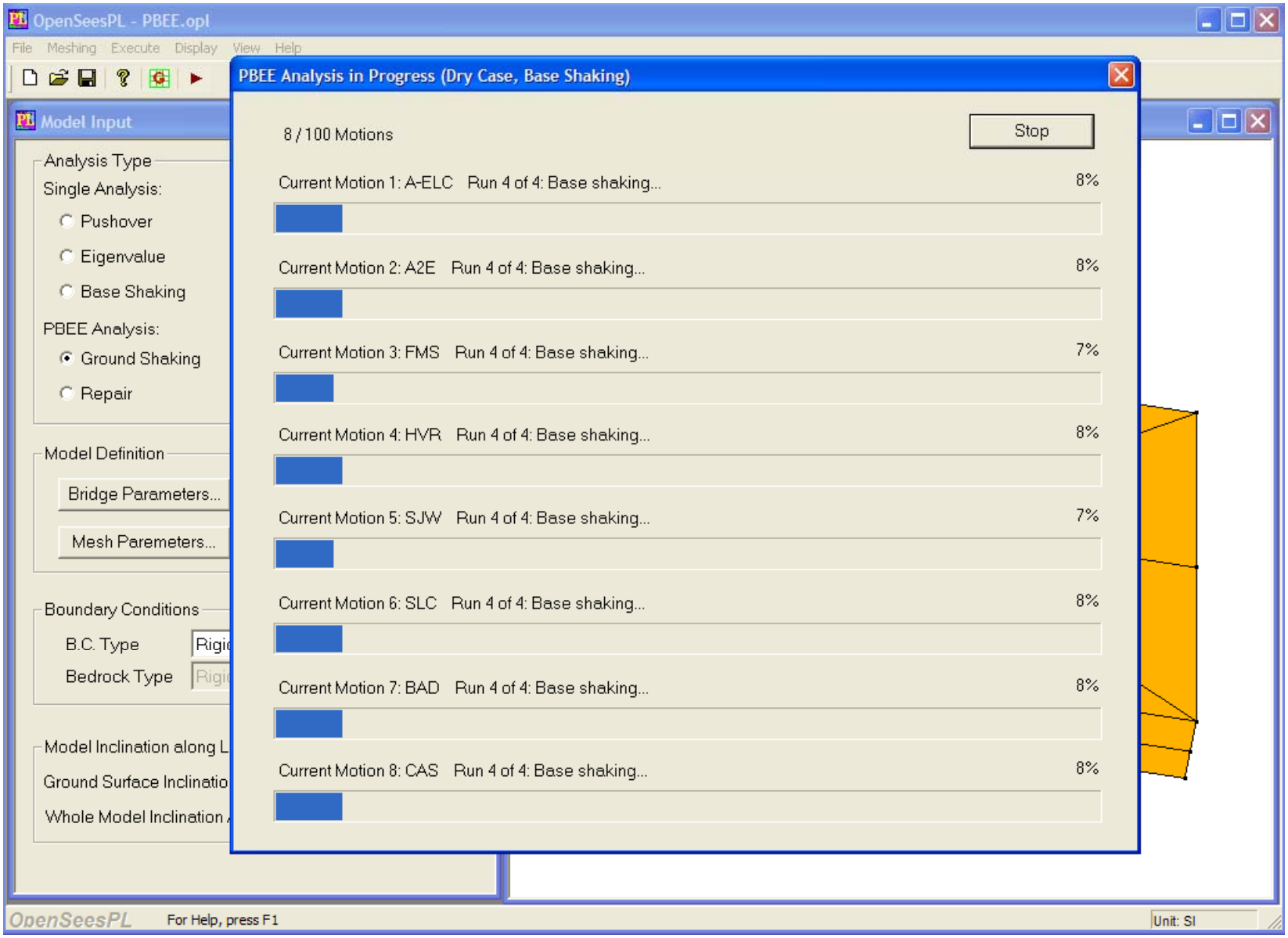
Abutment Model



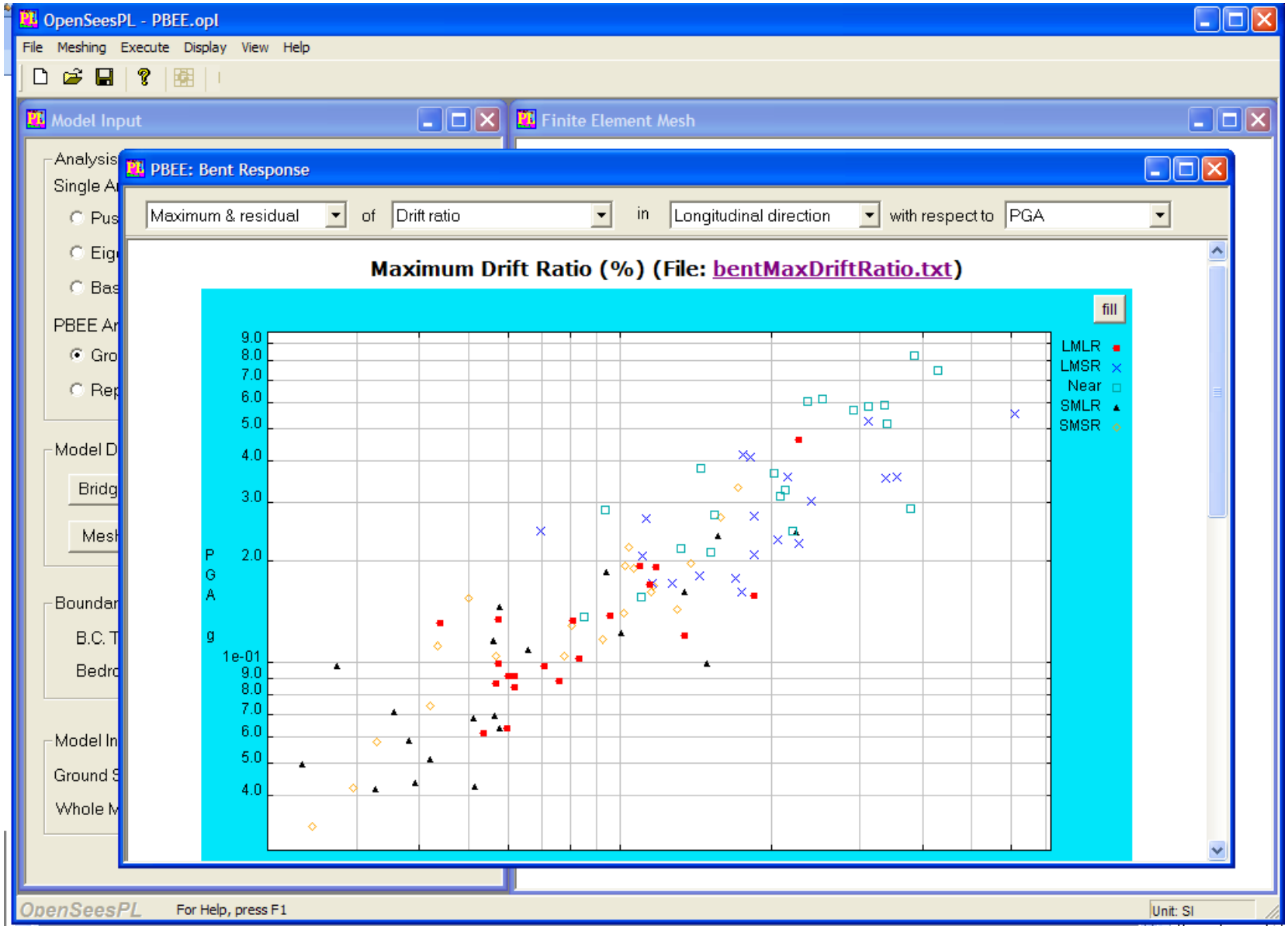
Deck Properties



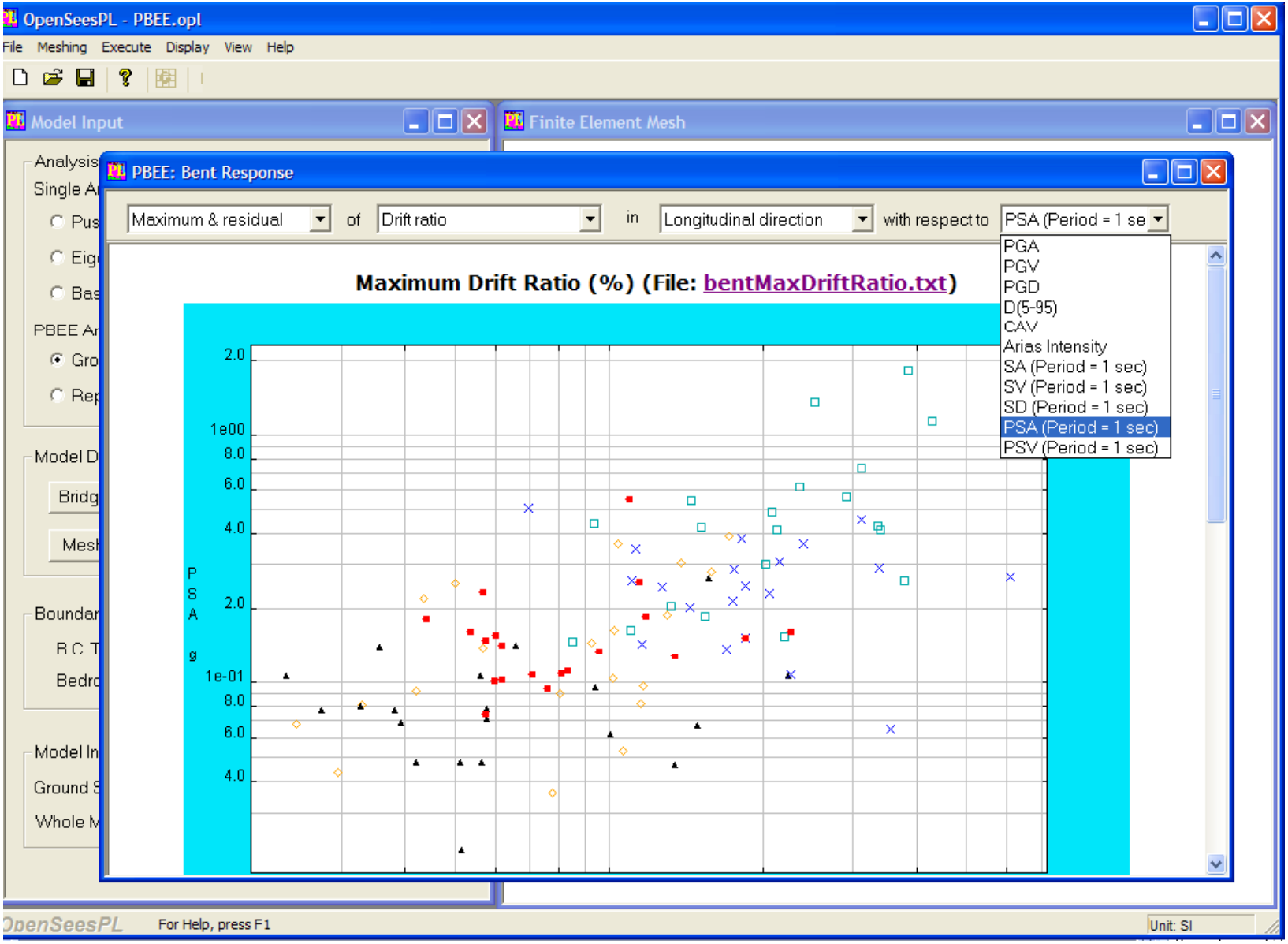
Running Multiple Records at the Same Time



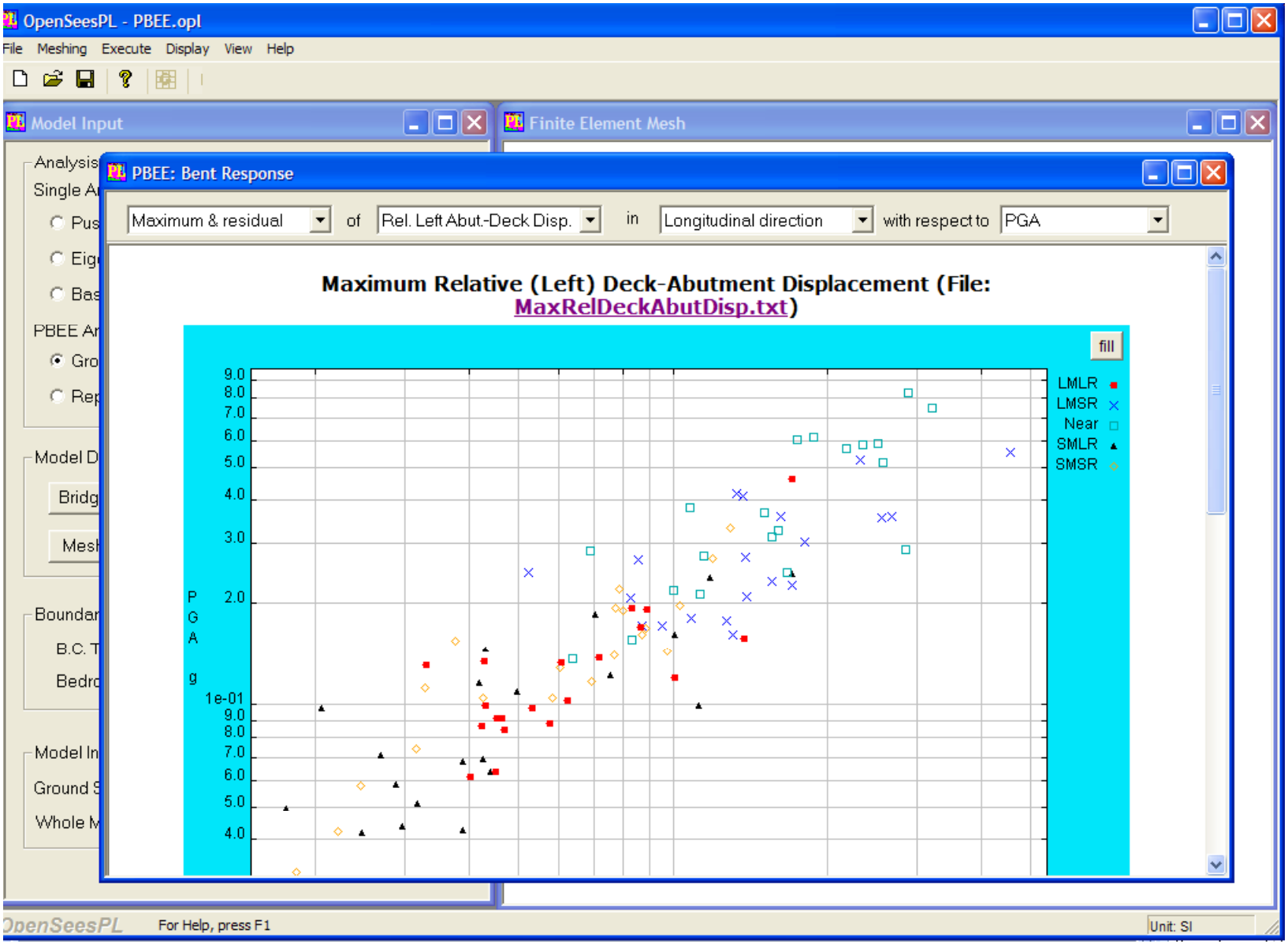
Bridge Response



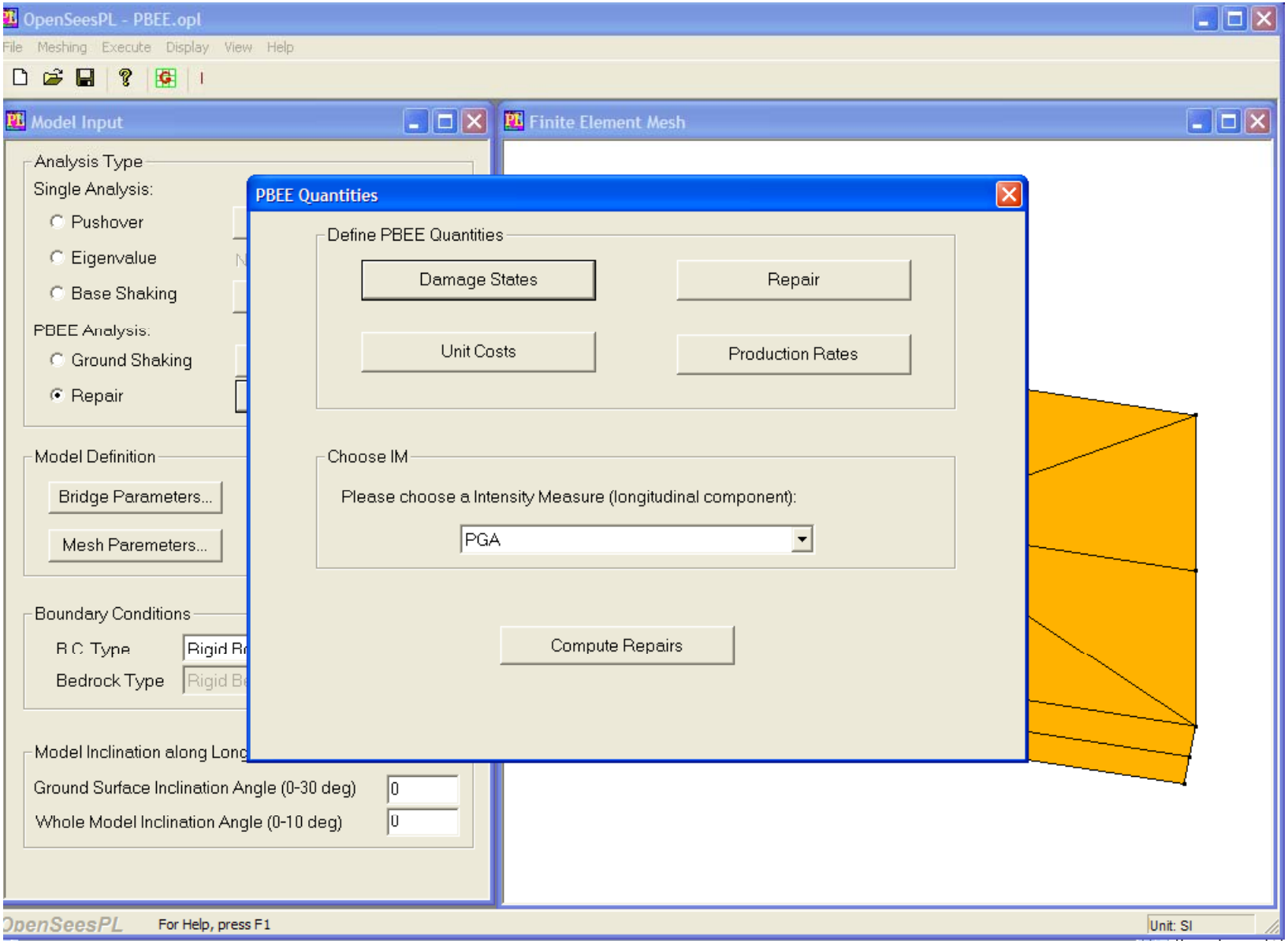
Max Drift with respect to IM



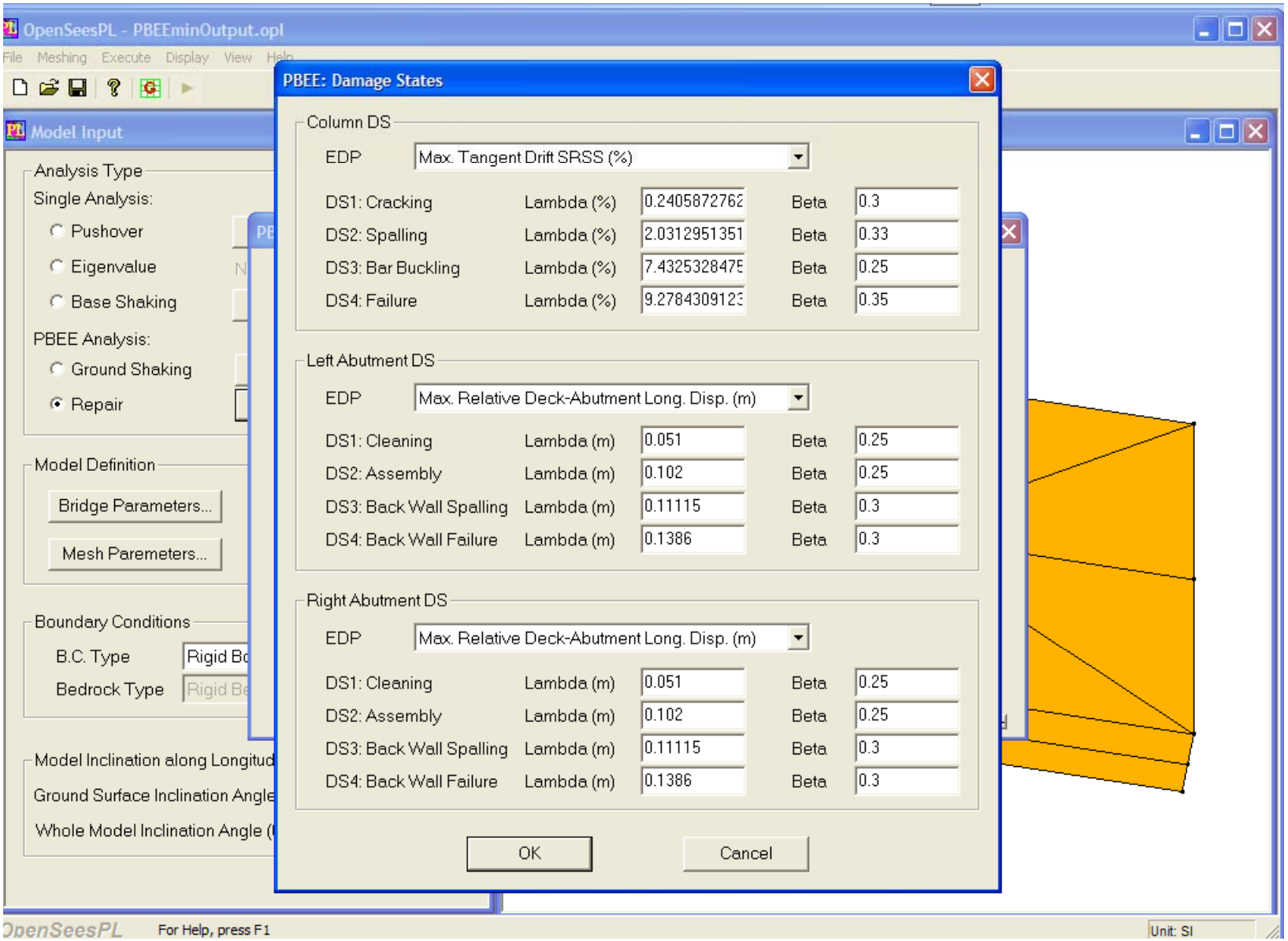
Max Rel. Deck-Abutment Displacement



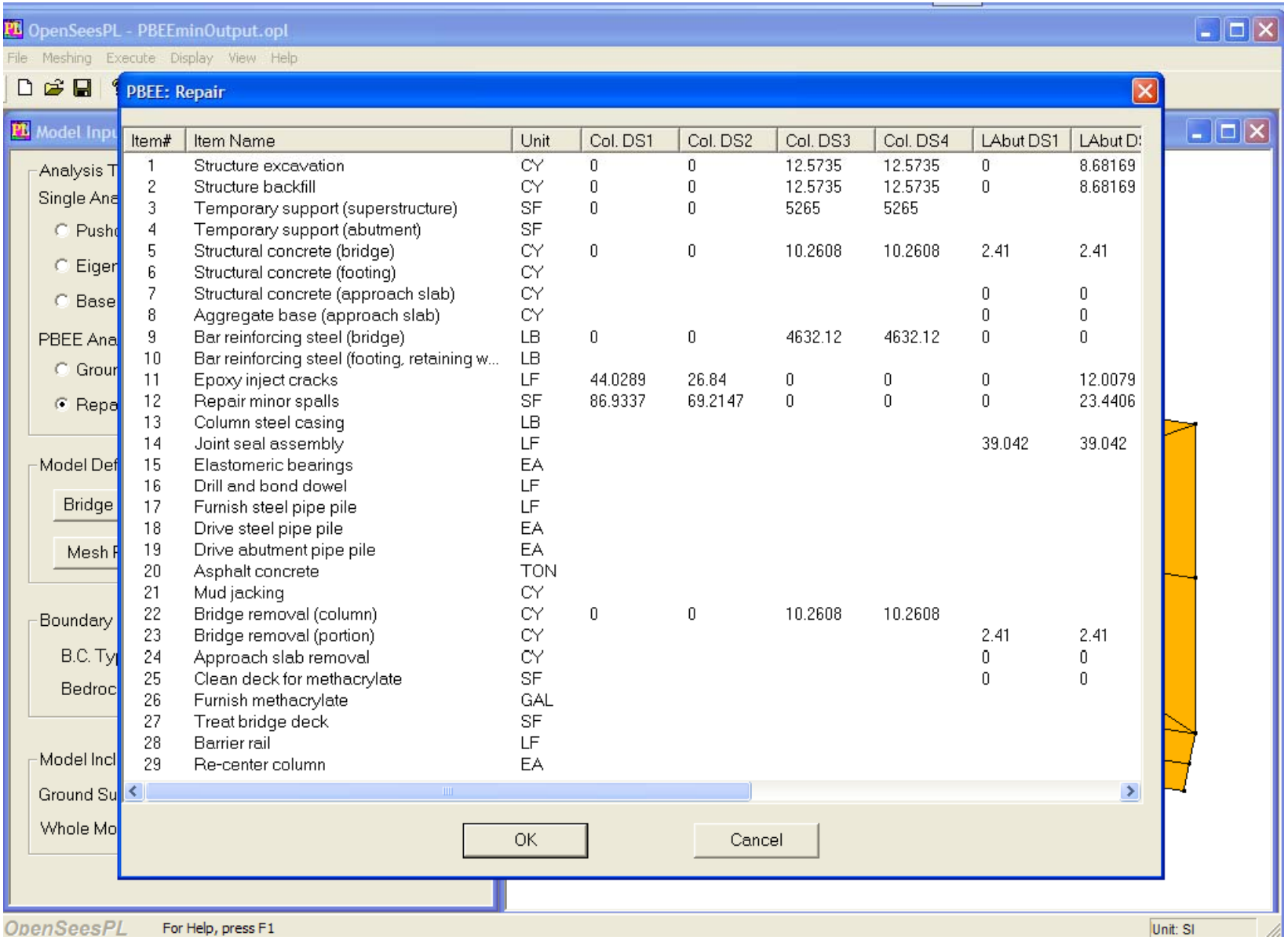
PBEE Quantities



Damage States

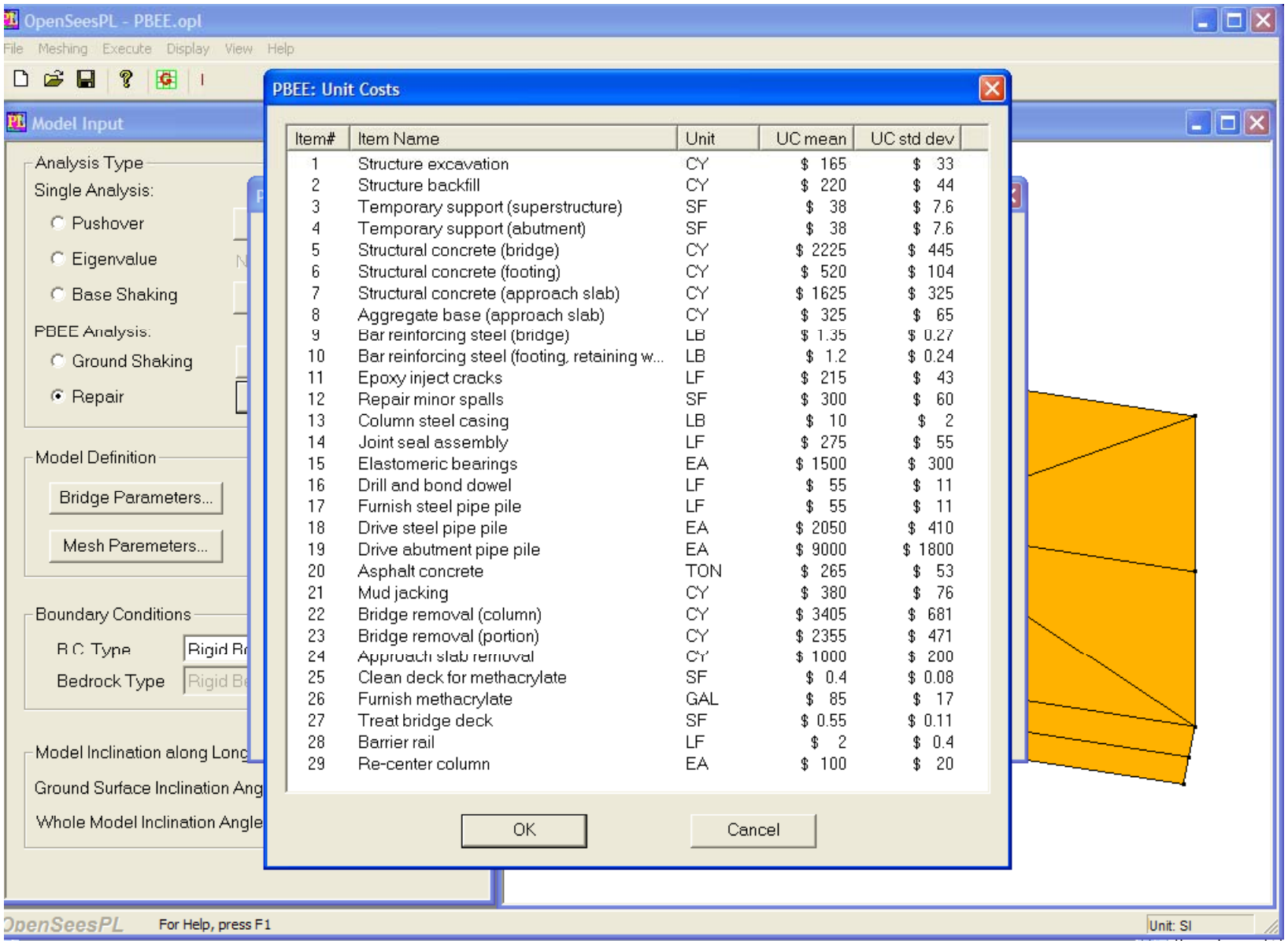


Repair Quantities



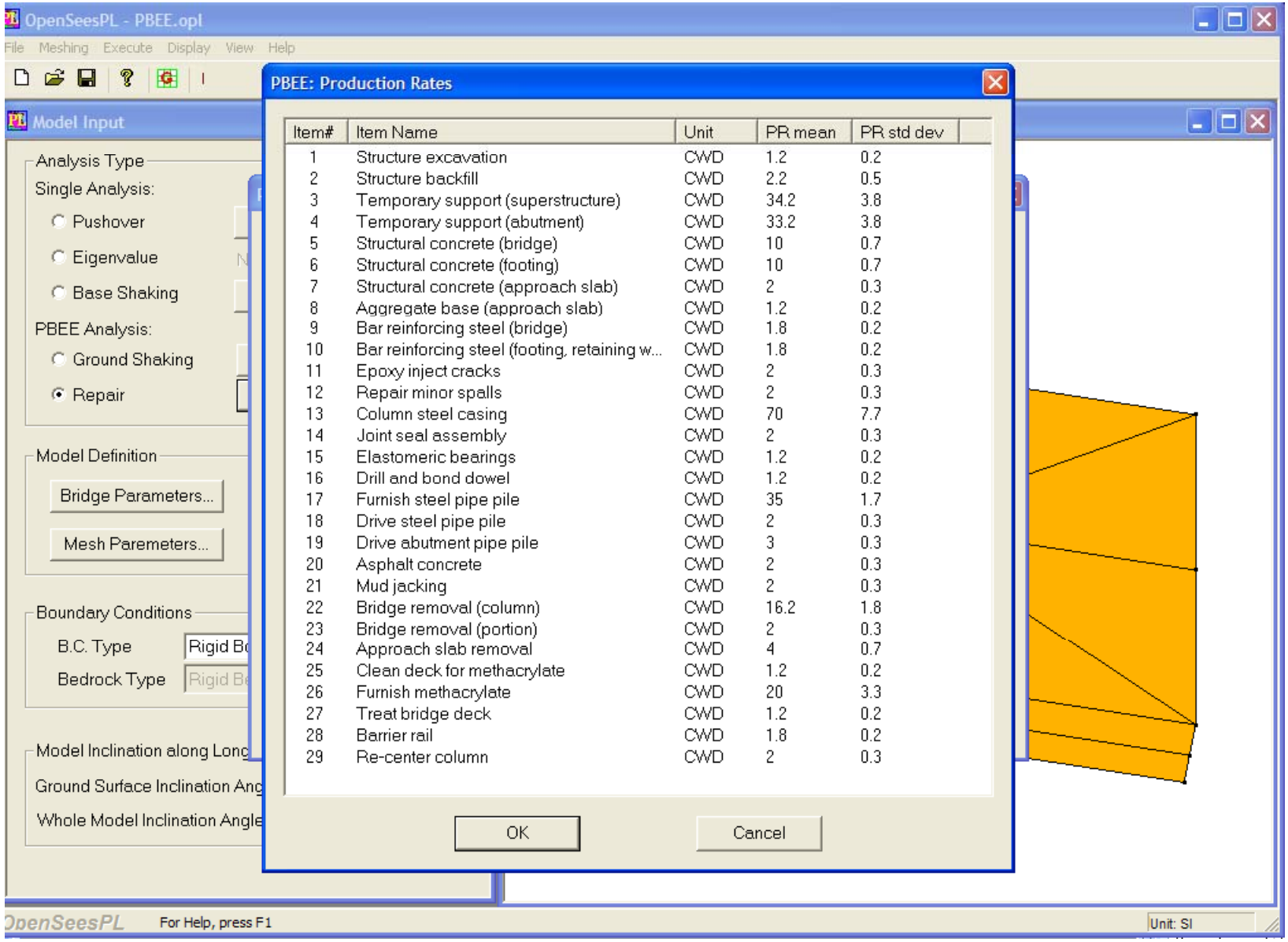
Item#	Item Name	Unit	Col. DS1	Col. DS2	Col. DS3	Col. DS4	LAbut DS1	LAbut DS
1	Structure excavation	CY	0	0	12.5735	12.5735	0	8.68169
2	Structure backfill	CY	0	0	12.5735	12.5735	0	8.68169
3	Temporary support (superstructure)	SF	0	0	5265	5265		
4	Temporary support (abutment)	SF						
5	Structural concrete (bridge)	CY	0	0	10.2608	10.2608	2.41	2.41
6	Structural concrete (footing)	CY						
7	Structural concrete (approach slab)	CY					0	0
8	Aggregate base (approach slab)	CY					0	0
9	Bar reinforcing steel (bridge)	LB	0	0	4632.12	4632.12	0	0
10	Bar reinforcing steel (footing, retaining w...	LB						
11	Epoxy inject cracks	LF	44.0289	26.84	0	0	0	12.0079
12	Repair minor spalls	SF	86.9337	69.2147	0	0	0	23.4406
13	Column steel casing	LB						
14	Joint seal assembly	LF					39.042	39.042
15	Elastomeric bearings	EA						
16	Drill and bond dowel	LF						
17	Furnish steel pipe pile	LF						
18	Drive steel pipe pile	EA						
19	Drive abutment pipe pile	EA						
20	Asphalt concrete	TON						
21	Mud jacking	CY						
22	Bridge removal (column)	CY	0	0	10.2608	10.2608		
23	Bridge removal (portion)	CY					2.41	2.41
24	Approach slab removal	CY					0	0
25	Clean deck for methacrylate	SF					0	0
26	Furnish methacrylate	GAL						
27	Treat bridge deck	SF						
28	Barrier rail	LF						
29	Re-center column	EA						

Unit Costs



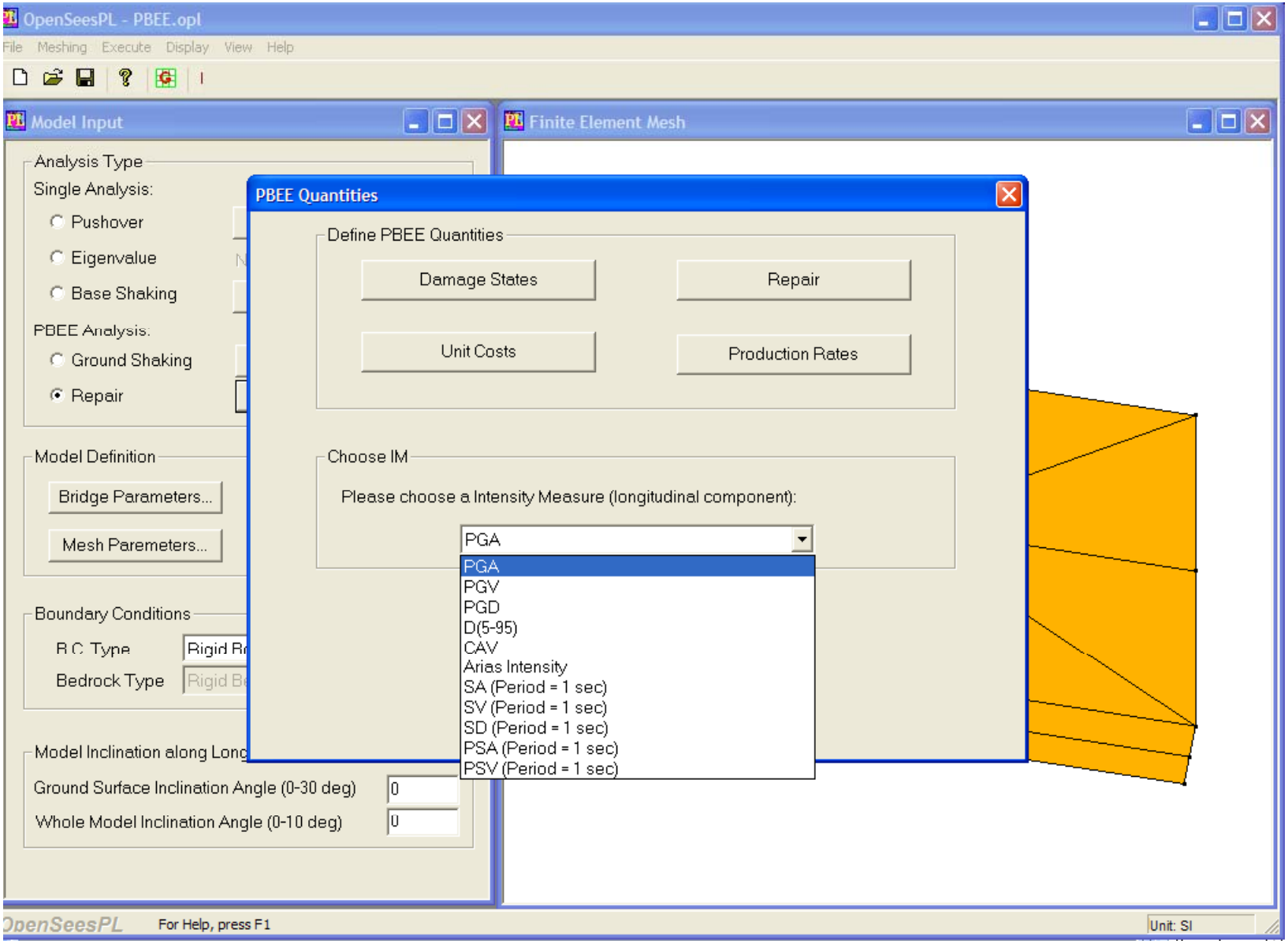
Item#	Item Name	Unit	UC mean	UC std dev
1	Structure excavation	CY	$ 165	$ 33
2	Structure backfill	CY	$ 220	$ 44
3	Temporary support (superstructure)	SF	$ 38	$ 7.6
4	Temporary support (abutment)	SF	$ 38	$ 7.6
5	Structural concrete (bridge)	CY	$ 2225	$ 445
6	Structural concrete (footing)	CY	$ 520	$ 104
7	Structural concrete (approach slab)	CY	$ 1625	$ 325
8	Aggregate base (approach slab)	CY	$ 325	$ 65
9	Bar reinforcing steel (bridge)	LB	$ 1.35	$ 0.27
10	Bar reinforcing steel (footing, retaining w...	LB	$ 1.2	$ 0.24
11	Epoxy inject cracks	LF	$ 215	$ 43
12	Repair minor spalls	SF	$ 300	$ 60
13	Column steel casing	LB	$ 10	$ 2
14	Joint seal assembly	LF	$ 275	$ 55
15	Elastomeric bearings	EA	$ 1500	$ 300
16	Drill and bond dowel	LF	$ 55	$ 11
17	Furnish steel pipe pile	LF	$ 55	$ 11
18	Drive steel pipe pile	EA	$ 2050	$ 410
19	Drive abutment pipe pile	EA	$ 9000	$ 1800
20	Asphalt concrete	TON	$ 265	$ 53
21	Mud jacking	CY	$ 380	$ 76
22	Bridge removal (column)	CY	$ 3405	$ 681
23	Bridge removal (portion)	CY	$ 2355	$ 471
24	Approach slab removal	CY	$ 1000	$ 200
25	Clean deck for methacrylate	SF	$ 0.4	$ 0.08
26	Furnish methacrylate	GAL	$ 85	$ 17
27	Treat bridge deck	SF	$ 0.55	$ 0.11
28	Barrier rail	LF	$ 2	$ 0.4
29	Re-center column	EA	$ 100	$ 20

Production Rates

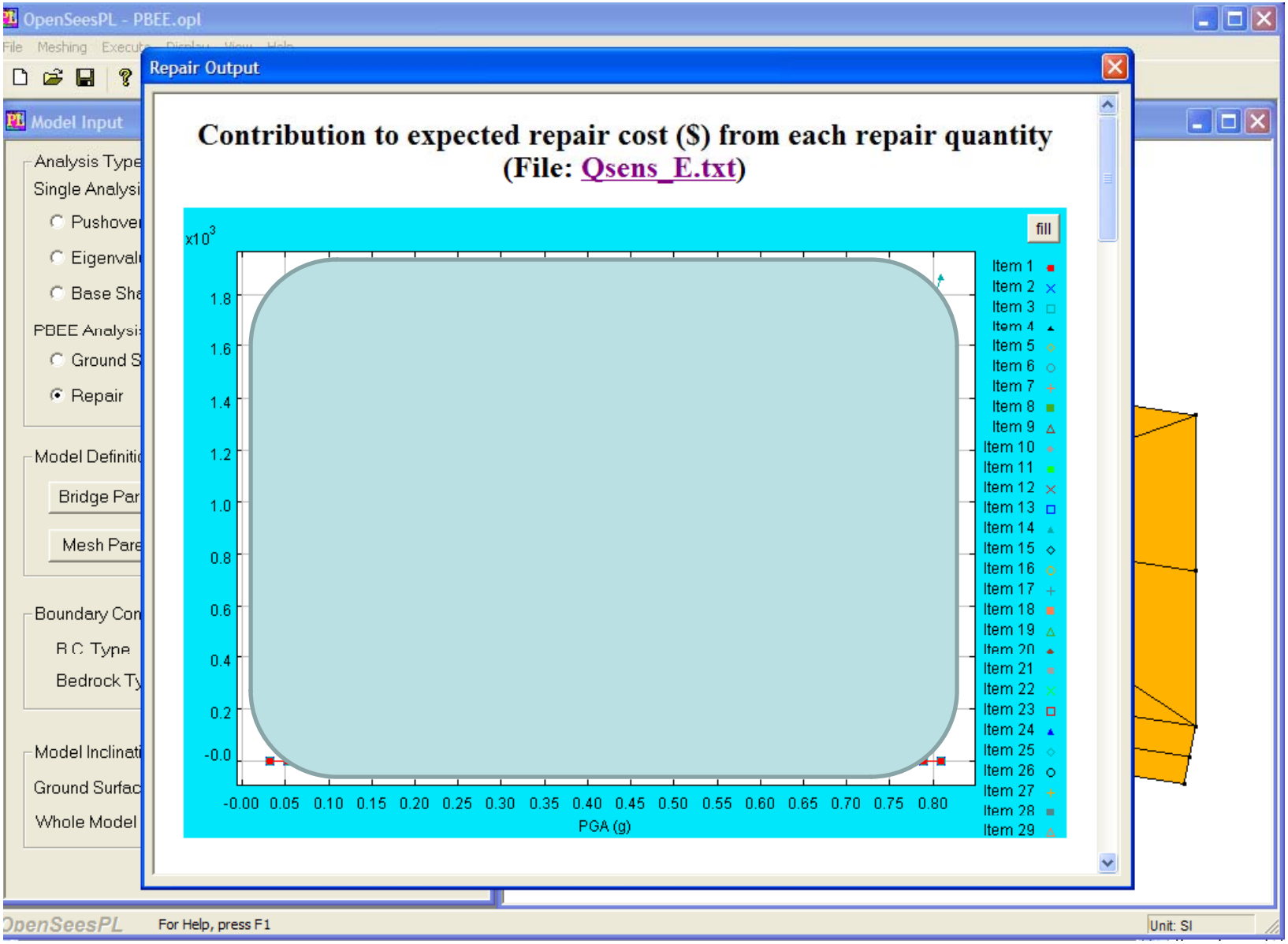


Item#	Item Name	Unit	PR mean	PR std dev
1	Structure excavation	CWD	1.2	0.2
2	Structure backfill	CWD	2.2	0.5
3	Temporary support (superstructure)	CWD	34.2	3.8
4	Temporary support (abutment)	CWD	33.2	3.8
5	Structural concrete (bridge)	CWD	10	0.7
6	Structural concrete (footing)	CWD	10	0.7
7	Structural concrete (approach slab)	CWD	2	0.3
8	Aggregate base (approach slab)	CWD	1.2	0.2
9	Bar reinforcing steel (bridge)	CWD	1.8	0.2
10	Bar reinforcing steel (footing, retaining w...	CWD	1.8	0.2
11	Epoxy inject cracks	CWD	2	0.3
12	Repair minor spalls	CWD	2	0.3
13	Column steel casing	CWD	70	7.7
14	Joint seal assembly	CWD	2	0.3
15	Elastomeric bearings	CWD	1.2	0.2
16	Drill and bond dowel	CWD	1.2	0.2
17	Furnish steel pipe pile	CWD	35	1.7
18	Drive steel pipe pile	CWD	2	0.3
19	Drive abutment pipe pile	CWD	3	0.3
20	Asphalt concrete	CWD	2	0.3
21	Mud jacking	CWD	2	0.3
22	Bridge removal (column)	CWD	16.2	1.8
23	Bridge removal (portion)	CWD	2	0.3
24	Approach slab removal	CWD	4	0.7
25	Clean deck for methacrylate	CWD	1.2	0.2
26	Furnish methacrylate	CWD	20	3.3
27	Treat bridge deck	CWD	1.2	0.2
28	Barrier rail	CWD	1.8	0.2
29	Re-center column	CWD	2	0.3

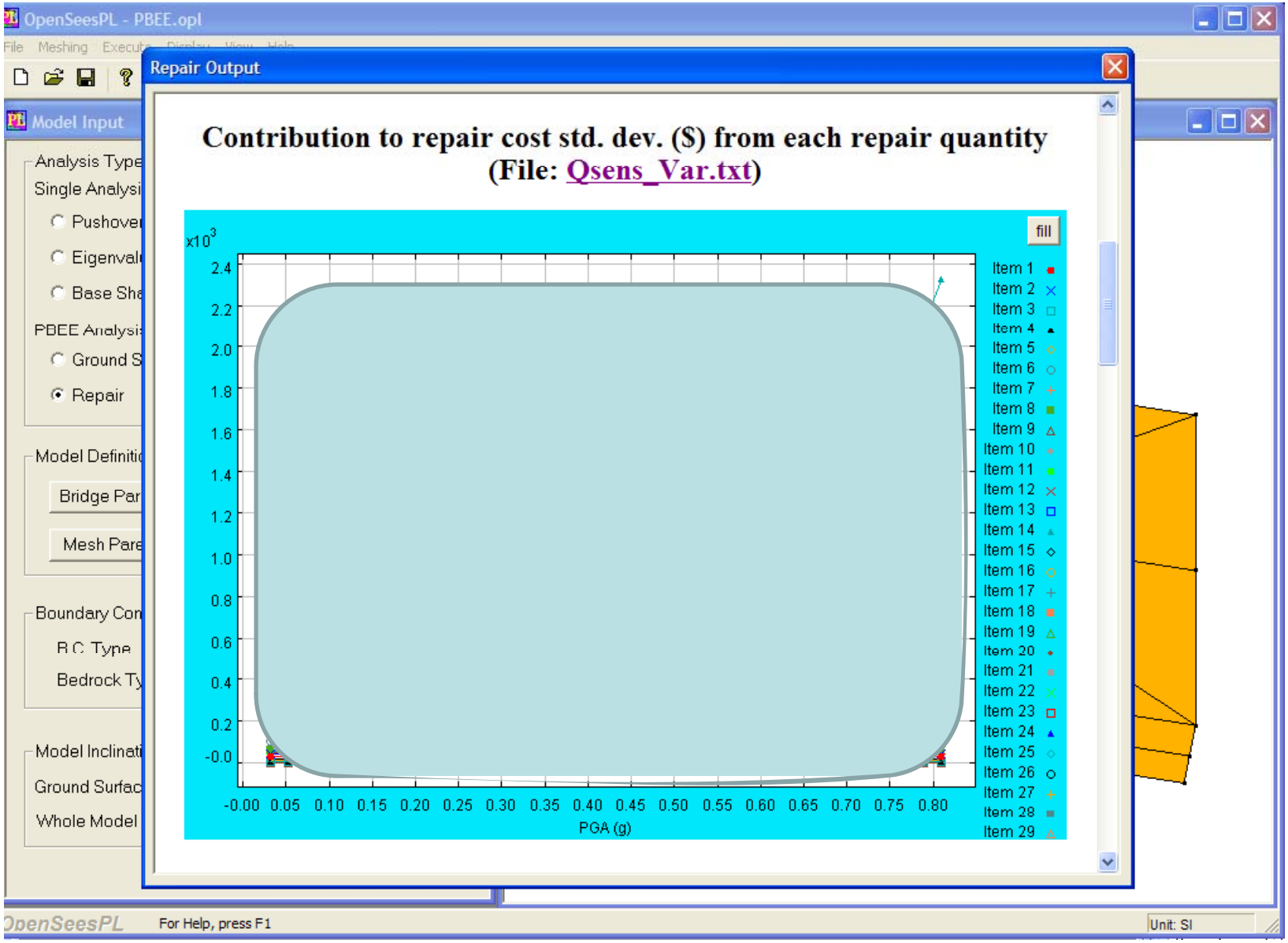
Compute Repairs (against IM)



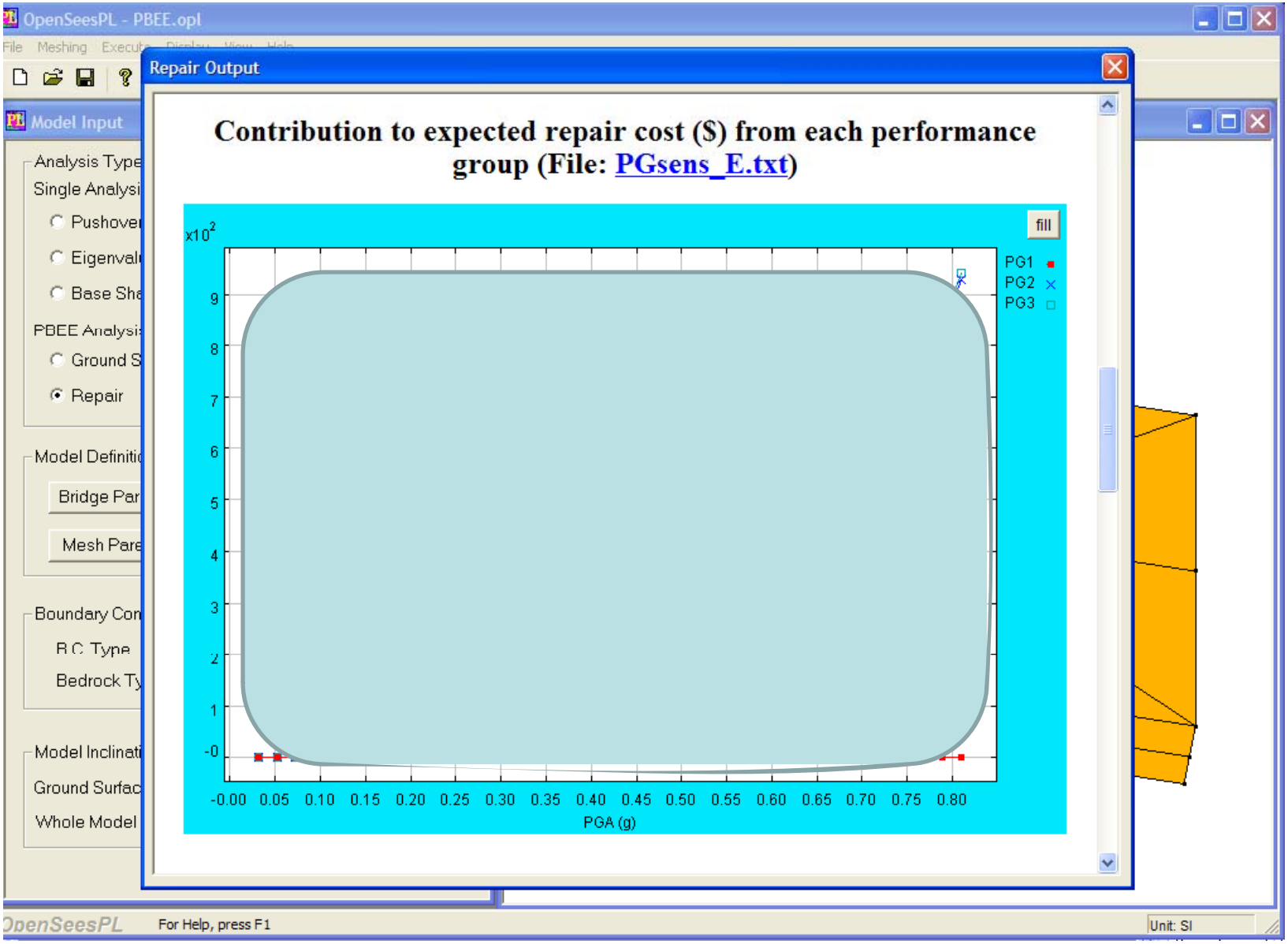
Repair Output



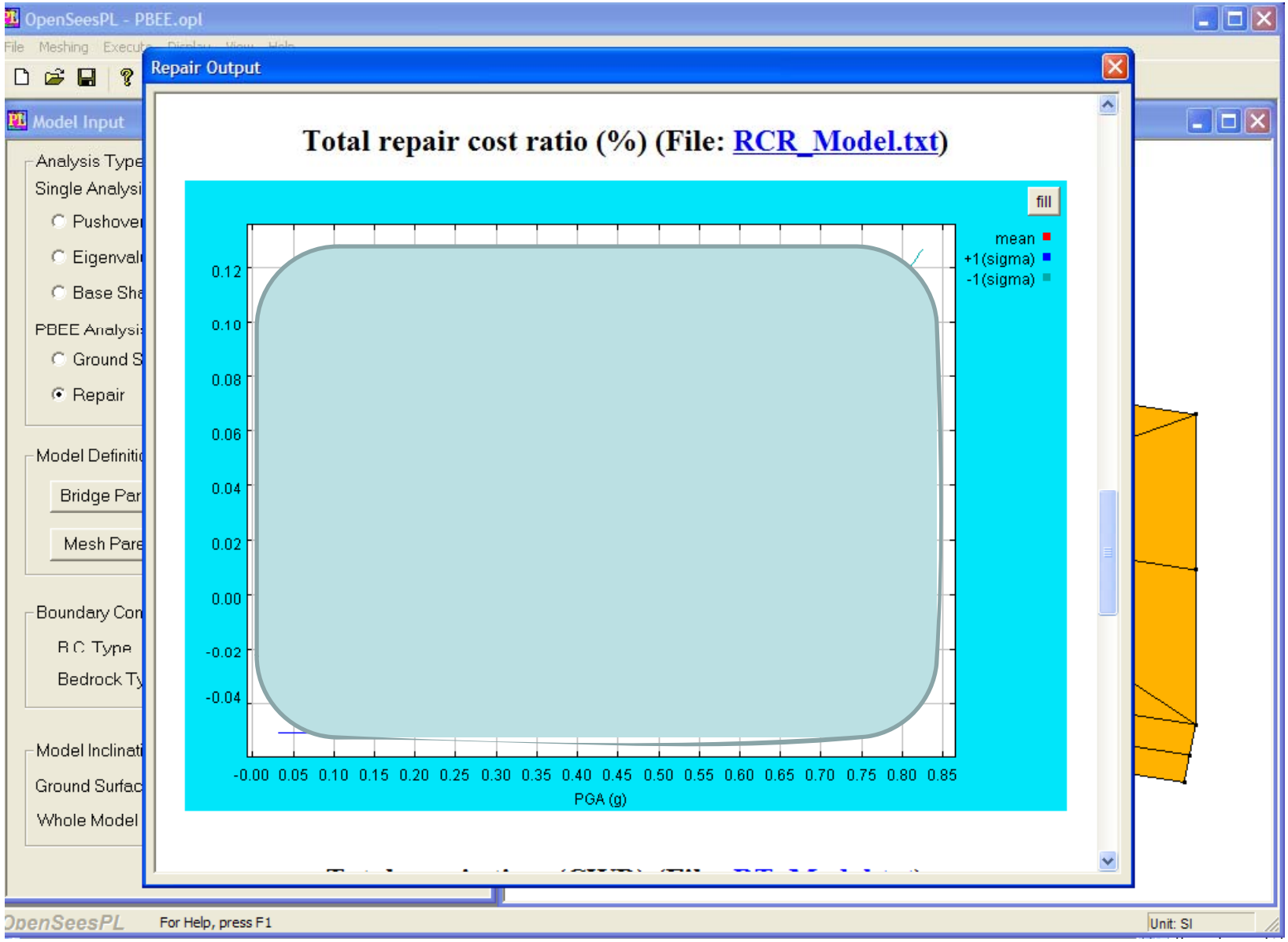
Repair Output (Con't)



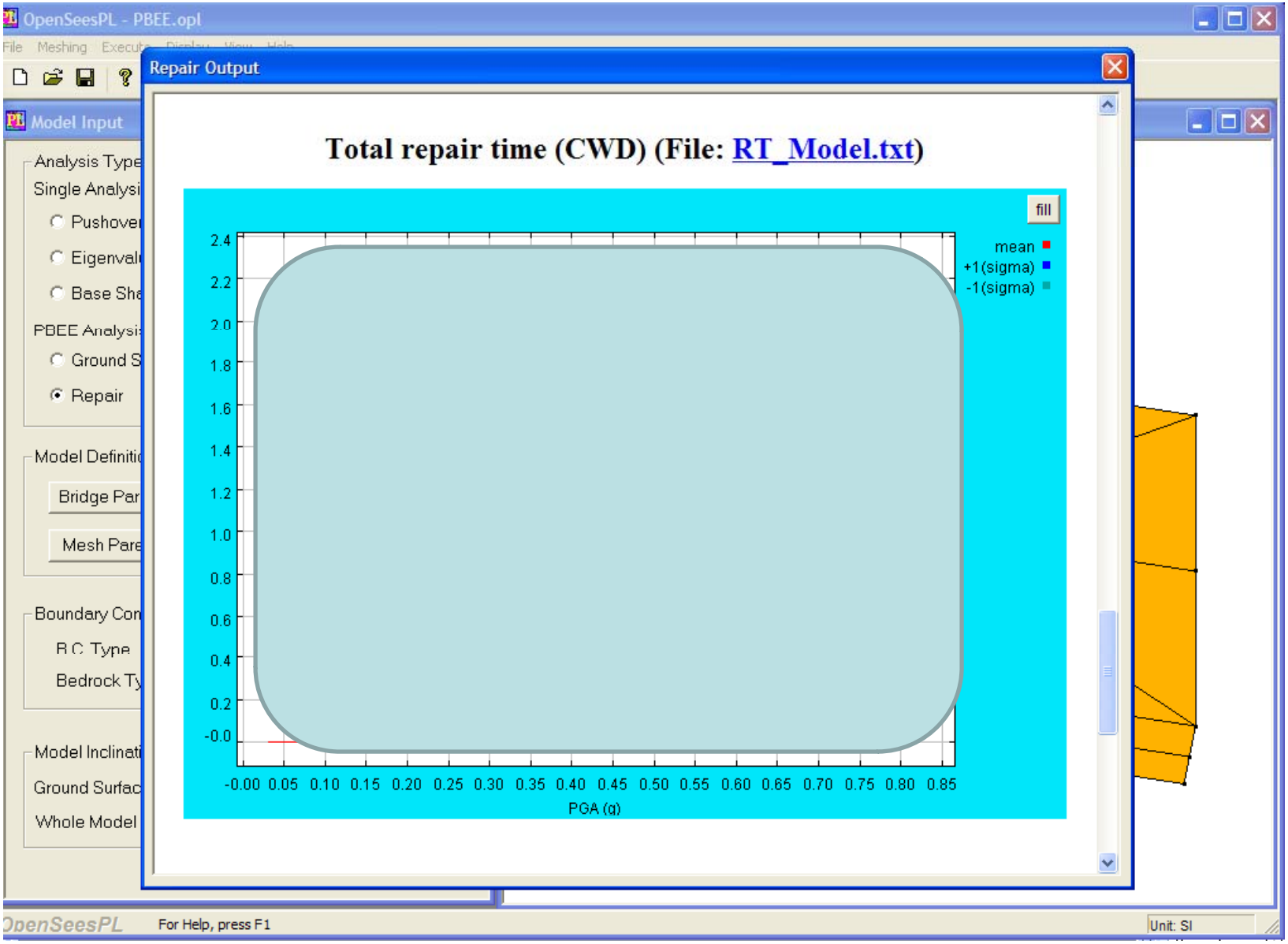
Repair Output (Con't)



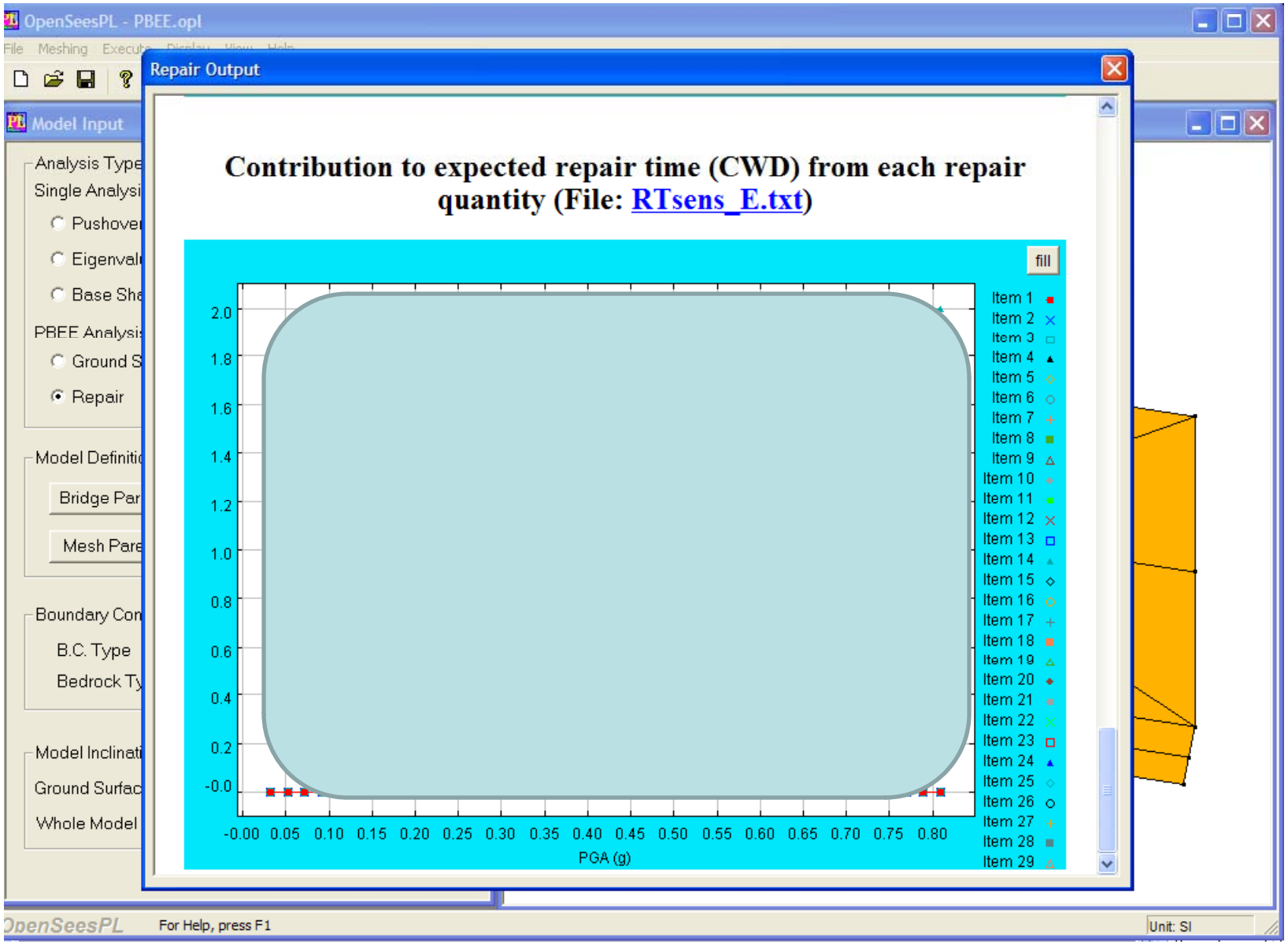
Repair Output (Con't)



Repair Output (Con't)



Repair Output (Con't)



Deformed Mesh