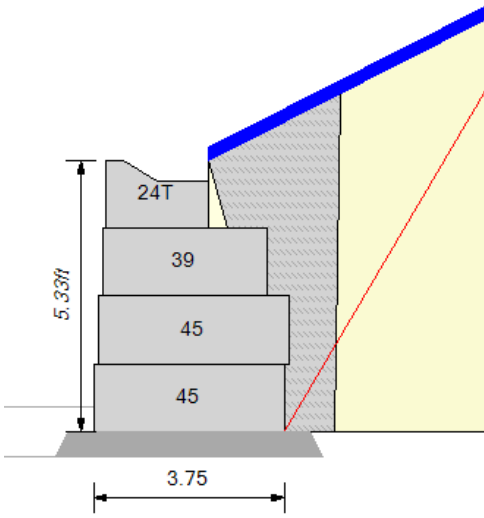
ReCon Wall

Project:	Wall Replacement
Location:	7 Fairlawn Ave
Designer:	AGB
Date:	7/14/2021
Section:	Section 1
Design Method:	NCMA_09_3rd_Ed
Design Unit:	ReCon



Seismic Acc: 0.180

SOIL PARAMETERS	φ	coh	γ	
Retained Soil:	30 deg	0psf	125pcf	
Foundation Soil:	30 deg	0psf	120pcf	
Leveling Pad:	40 deg	0psf	135pcf	Crushed Stone

Crushed Stone Interface is true, φ = 2deg

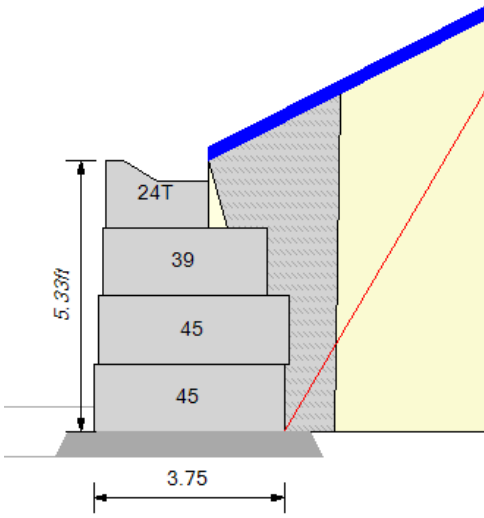
GEOMETRY

Design Height:	5.33ft	Live Load:	100psf	Spec Load:	150ft
Wall Batter/Tilt:	3.60/ 0.00 deg	Live Load Offset:	0.00ft	Spec Load Offset:	25ft
Embedment:	0.50ft	Live Load Width:	50ft	Spec Load Width:	15ft
Leveling Pad Depth:	0.50ft	Dead Load:	0psf		
Slope Angle:	27.0 deg	Dead Load Offset:	0.0ft		
Slope Length:	20.0ft	Dead Load Width:	0ft		
Slope Toe Offset:	0.0ft	Leveling Pad Width:	4.75ft		

Vert δ on Single Dpth

FACTORS OF SAFETY (Static / Seismic)

Sliding:	1.50 / 1.125	Overturning:	1.50 / 1.125
Bearing:	2.00 / 1.5		



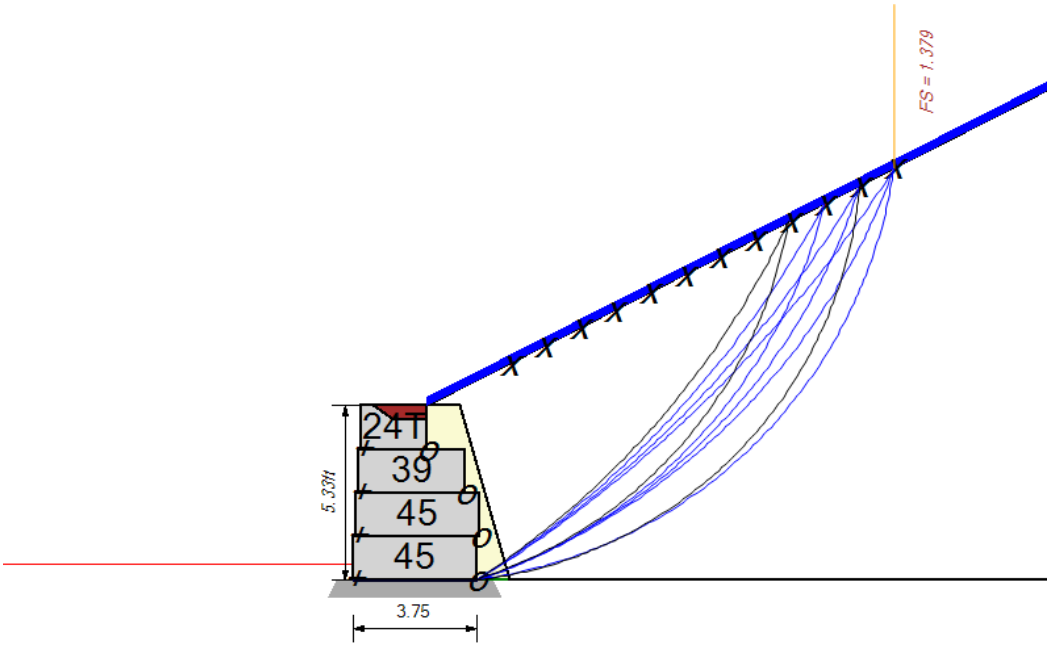
RESULTS (Static / Seismic)

FoS Sliding:	1.68 (lvlpd) / 1.26	FoS Overturning:	2.89 / 1.92
Bearing:	1149.61 / 1275.14	FoS Bearing:	6.00 / 5.41

Name	Elev.	ka	kae	Pa	Pae	Pir	Paq	Paq2	PaT	FSsl	FoS OT	siesFSsl	FoS SeisOT
24T	4.00	0.543	0.916	60	101	27	72	0	132	58.06	6.85	58.69	5.84
39	2.67	0.488	0.835	216	370	72	153	0	369	21.90	5.94	18.10	4.21
45	1.33	1.071	1.874	1069	1871	124	428	0	1497	8.59	4.17	6.38	2.89
45	0.00	0.880	1.513	1562	2686	175	469	0	2031	1.68[100.00]	1.92	1.26[1.26]	

Column Descriptions:

ka: active earth pressure coefficient
kae: active seismic earth pressure coefficient
Pa: active earth pressure
Pae: dynamic earth pressure
Pir: inertia force
Paq: live surcharge earth pressure
Paq2: live load 2 surcharge earth pressure
Paqd: dead surcharge earth pressure
(PaC): reduction in load due to cohesion
PaT: sum of all earth pressures
FSsl(lvl Pad): factor of safety for sliding at each layer. (FS sliding below the leveling pad)
FSot: factor of safety of overturning about the toe.


FS = 1.379
24T
39
45
45
5.33H
3.75

COMPOUND RESULTS

Compound stability is a global analysis (Bishop) with the failure planes originating at the top of the slope / wall and exiting out through the face of the wall. For MSE walls, the resistance of the geogrid reinforcement is included in the analysis and the shear resistance of the face units is included.

ID	Enter Point X	Enter Point Y	Exit Point X	Exit Point Y	Center X	Center Y	Radius	FoS
3	16.48	12.58	3.75	0.00	-3.25	19.81	21.01	1.379
2	16.48	12.58	3.75	0.00	-17.67	34.40	40.52	1.384
3	15.41	12.03	3.75	0.00	-2.31	17.53	18.55	1.425
2	15.41	12.03	3.75	0.00	-15.27	30.09	35.60	1.426
4	16.48	12.58	3.75	0.00	1.79	14.71	14.84	1.464
2	14.34	11.49	3.75	0.00	-13.04	26.10	31.04	1.478
3	14.34	11.49	3.75	0.00	-1.44	15.42	16.27	1.481
4	15.41	12.03	3.75	0.00	2.25	13.11	13.20	1.527
2	13.28	10.95	3.75	0.00	-10.97	22.43	26.83	1.540
3	13.28	10.95	3.75	0.00	-0.66	13.46	14.17	1.557

RETAINING WALL UNITS

STRUCTURAL PROPERTIES:

N is the normal force [or factored normal load] on the base unit
The default leveling pad to base unit shear is 0.8 tan(φ) [AASHTO 10.6.3.4] or
may be the manufacturer supplied data. φ is assumed to be 40 degrees for a stone leveling pad.

Unit	Ht (in)	Width (in)	Depth (in)	Concr_Vol (cf/ft)	Concr_Density (pcf)	CG (in)
Cap 6.5	6.50	48.00	24.00	1.08	145.00	12.00, 3.25
Cap 8	8.00	48.00	24.00	1.33	145.00	12.00, 4.00
24Top Block	16.00	48.00	24.00	2.01	145.00	10.68, 8.00
39Top Block	16.00	48.00	39.00	2.25	145.00	16.00, 8.00
024(060cm)	16.00	48.00	24.00	2.50	145.00	11.64, 8.00
039(100cm)	16.00	48.00	39.00	3.88	145.00	18.60, 8.00
045(115cm)	16.00	48.00	45.00	4.38	145.00	21.26, 8.00
060(150cm)	16.00	48.00	60.00	5.52	145.00	27.64, 8.00
066(165cm)	16.00	48.00	66.00	5.93	145.00	30.10, 8.00
072(180cm)	16.00	48.00	72.00	6.35	145.00	32.70, 8.00
078(200cm)	16.00	48.00	78.00	6.78	145.00	35.30, 8.00
084(215cm)	16.00	48.00	84.00	7.20	145.00	38.00, 8.00

FORCE DETAILS

The details below shown how the forces are calculated for each force component. The values shown are not factored. All loads are based on a unit width (ppf / kNpm).

Layer	Block Wt	Soil Fill Wt	Soil Wt
1	291	79	30
2	562	54	0
3	634	74	0
4	634	74	

Block Weight (Force v (Block Wt + Infill Soil)) = 2403ppf X-Arm = 1.70ft
Soils Block Weight (Force v) = 30ppf X-Arm = 2.38ft

Active Earth Pressure Pa = 1562ppf
Pa_h (Force H) = Pa cos(δ - batter) = 1562 x cos(26.3 - (-15.7)) = 1162ppf
Y-Arm = 1.78ft
Pa_v (Force V) = Pa sin(δ - batter) = 1562 x sin(26.3 - (-15.7)) = 1044ppf
X-Arm = 3.25ft

Live Load Pq = 469ppf
Pq_h (Force H) = Pq cos(δ - batter) = 469 x cos(26.3 - -15.7) = 349ppf
Y-Arm = 2.66ft
Pq_v (Force V) = Pq sin(δ - batter) = 469 x sin(26.3 - -15.7) = 313ppf
X-Arm = 3.00ft

CALCULATION RESULTS

OVERVIEW

ReCon Wall Systems calculates stability assuming the wall is a rigid body. Forces and moments are calculated about the base and the front toe of the wall. The base block width is used in the calculations. The concrete units and granular fill over the blocks are used as resisting forces.

EARTH PRESSURES

The method of analysis uses the Coulomb Earth Pressure equation (below) to calculate active earth pressures. Wall friction is assumed to act at the back of the wall face. The component of earth pressure is assumed to act perpendicular to the boundary surface. The effective δ angle is δ minus the wall batter at the back face. If the slope breaks within the failure zone, a trial wedge method of analysis is used.

EXTERNAL EARTH PRESSURES

Effective δ angle (3/4 retained phi)	δ =26.3 deg
Coefficient of active earth pressure	ka =0.880
External failure plane	ρ = 59 deg
Effective Angle from horizontal	α =74.30 deg
Coefficient of passive earth pressure: kp = (1 + sin(φ)) / (1 - sin(φ))	kp =3.00

FORCES AND MOMENTS

The program resolves all the geometry into simple geometric shapes to make checking easier. All x and y coordinates are referenced to a zero point at the middle of the base block for eccentricity calculations.

UNFACTORED LOADS

Name	Factor γ	Force (V)	Force (H)	X-len	Y-len	Mo	Mr
Face Blocks(W1)	1.00	2122	--	1.70	--	--	3598
Soil Fill(W0)	1.00	281	--	2.31	--	--	651
Soil Wedge(W2)	1.00	30	--	2.38	--	--	71
Pa_h	1.00	--	1162	--	1.78	2064	--
Pa_v	1.00	1044	--	3.25	--	--	3395
Pq_h	1.00	--	349	--	2.66	929	--
Pq_v	1.00	313	--	3.00	--	--	941
Sum V / H	1.00	3791	1511		Sum Mom	2994	8655

W0: stone within units W1: facing units
W2: soil wedge behind the face
X-Len: is measured from the center of the base (+) Driving, (-) Resisting.
Pa_h: horizontal earth pressure Pa_v: vertical earth pressure
Pq_h: horizontal surcharge pressure Pq_v: vertical surcharge pressure

BEARING LOADS: NCMA

Name	Factor γ	Force (V)	Force (H)	X-len	Y-len	Mo	Mr
Soil Fill(W0)	1.00	281	--	-0.44	--	--	-123
Face Blocks(W1)	1.00	2122	--	0.18	--	380	--
Soil Wedge(W2)	1.00	30	--	-0.50	--	--	-15
Pa_h	1.00	--	1162	--	1.78	2064	--
Pa_v	1.00	1044	--	-1.38	--	--	-1436
Pq_h	1.00	--	349	--	2.66	929	--
Pq_v	1.00	313	--	-1.13	--	--	-353
Sum V / H	1.00	3791	1511		Sum Mom	3373	-1927

BASE SLIDING

Sliding at the base is checked at the block to leveling pad interface between the base block and the leveling pad.

Forces Resisting sliding = W0 + W1 + W2 + Pav + Pqv
281 + 2122 + 30 + 1044 + 313 N =3791ppf

Resisting force at pad = (N * 0.8 * tan(slope) + intercept x L)
3791 x0.8 x tan(40.0) + 0.0 Rf =2,544

Driving force is the horizontal component of
Pah + Pqh
1162 + 349 Df =1,511

FSsl = Rf / Df FSsl =1.68

OVERTURNING ABOUT THE TOE

Overturning at the base is checked by assuming rotation about the front toe by the block mass and the soil retained on the blocks. Allowable overturning can be defined by eccentricity (e/L). For concrete leveling pads eccentricity is checked at the base of the pad.

Moments Resisting Overturning = M0 + M1 + M2 + MPav + MPqv
651 + 3598 + 71 + 3395 + 941 Mr =8655ft-lbs

Moments causing Overturning = MPah + MPqh
2064 + 929 Mo =2994ft-lbs

FSot = Mr / Mo
FSot =8655 / 2994 FSot =2.89

ECCENTRICITY AND BEARING

Eccentricity is the calculation of the distance of the resultant away from the centroid of mass. In wall design the eccentricity is used to calculate an effective footing width.

Calculation of Eccentricity

SumV = W0 + W1 + W2 + Pav + Pqv

281 + 2122 + 30 + 1044 + 313 — SumV = 3791

Moment Resisting — Mr = -1927

Moment Driving — Md = 3373

e = (SumMr + SumMd)/(SumV)

e = (1446 /3790.51) — e =0.381ft

Calculation of Bearing Pressures

Qult = c * Nc + q * Nq + 0.5 * γ* (B') * Ng

where:

Nc =30.14

Nq =18.40

Ng =22.40

c =0.00psf

q = 120.00psf(soil weight above base of leveling pad)

B' = B - 2e + lvlpad = 3.49ft

Gamma =120pcf

Calculate Ultimate Bearing, Qult — Qult =6896psf

Bearing Pressure = (SumVert / B') + (LP width * gamma) — sigma =1149.61psf

Calculated Factors of Safety for Bearing — Qult/sigma =6.00

SEISMIC CALCULATIONS

The loads considered under seismic loading are primarily inertial loadings. The wave passes the structure putting the mass into motion and then the mass will try to continue in the direction of the initial wave. In the calculations you see the one dynamic earth pressure from the wedge of the soil behind the reinforced mass, and then all the other forces come from inertia calculations of the face put into motion and then trying to be held in place.

Design Ground Acceleration	A =0.180
Horizontal Acceleration [kh = A/2]	kh =0.073
Vertical Acceleration	kv =0.000

INERTIA FORCES OF THE STRUCTURE

Face (Pif) = (W1)*kh(ext) = 2121.51 *0.073

Pif =175.31ppf

SEISMIC THRUST

Kae	Kae =1.513
D_Kae = Kae - Ka = (1.513 - 0.000)	D_Kae =0.633
Pae = 0.5*gamma*(H)^2*D_Kae	Pae =1123.76ppf
Pae_h = Pae*cos(δ)	Pae_h =835.76ppf
Pae_v = Pae*sin(δ)	Pae_v =751.24ppf

TABLE OF RESULTS FOR SEISMIC REACTIONS

SEISMIC SLIDING

The target factor of safety for seismic is 75% of the static value. Live loads are ignored in these analysis based on the basic premise that the probability of the maximum acceleration occuring at the exact same instant as the maximum live load is small.

Details are only shown for sliding at the base of blocks, a check is made at the foundation level with the answer only shown.

The vertical resisting forces is W0 + W1 + W2 + Pav + Paev	
281 + 2122 + 30 + 1044 + 751	SumVs = 4228
Resisting force = SumVs * tan(phi) + intercept x L	FRe =2838ppf
Driving force = Pa_h + Pae_h + Pif	
=1162 +836 +175	FDr =2173ppf
FOS = FRe/FDr	FoS =1.26

SEISMIC OVERTURNING

Overturning is rotation about the front toe of the wall. Eccentricity is also a check on overturning

Resisting Moment = M0 + M1 + M2 + MPav + MPaev	
651 + 3598 + 71 + 3395 + 2442 +	SumMrS =10156ftppf
Driving Moment = MPah + MPaeh + MPif	
2064 + 2673 + 561	SumMoS = 5297.47ftppf
Factor of Safety = SumMrS/SumMoS	FoS = 1.92

SEISMIC BEARING

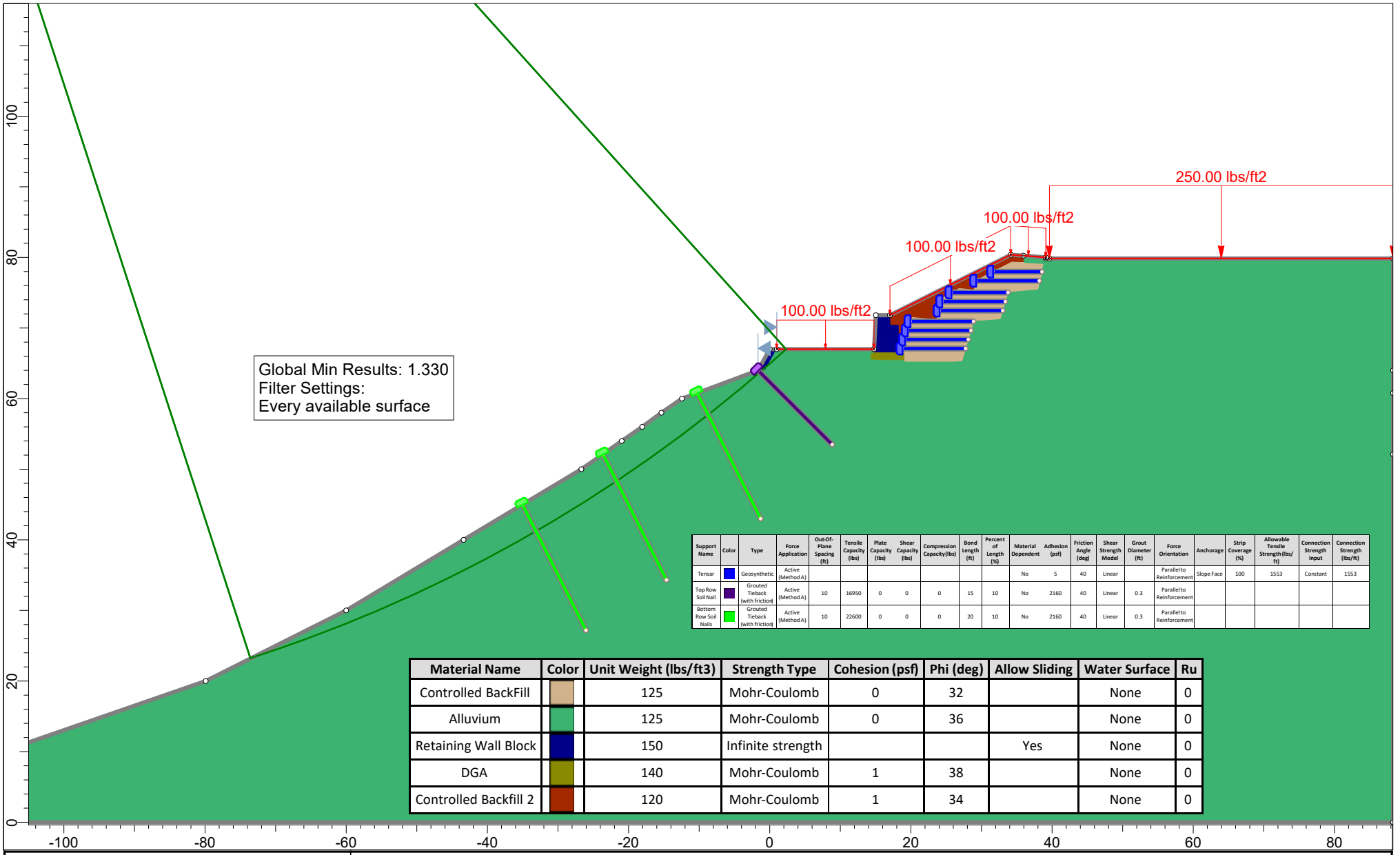
Bearing is the ability of the foundation to support the mass of the structure.

Qult = c*Nc + q*Nq + 0.5*gamma*(B')*Ng

where:

Nc = 30.14
Nq = 18.40
Ng = 22.40
c = 0.00psf
q = 120.00psf

Calculate Ultimate Bearing, Qult (seismic)	Qult = 6895.57psf
eccentricity (e)	e =0.726
Equivalent Footing Width, B' = L - 2e + lvl pad	B' =3ft
Bearing Pressure = sumVs/B'	sigma =1275psf
Factor of Safety for Bearing = Qult/Bearing	FoS =5



Support Name	Color	Type	Force Application	Out-Of-Plane Spacing (ft)	Tensile Capacity (lbs)	Plate Capacity (lbs)	Shear Capacity (lbs)	Compression Capacity(lbs)	Bond Length (ft)	Percent of Length (%)	Material Dependent	Adhesion (psf)	Friction Angle (deg)	Shear Strength Model	Grout Diameter (ft)	Force Orientation	Anchorage	Strip Coverage (%)	Allowable Tensile Strength (lbs/ft)	Connection Strength Input	Connection Strength (lbs/ft)
Tensar		Geosynthetic	Active (Method A)								No	5	40	Linear		Parallel to Reinforcement	Slope Face	100	1553	Constant	1553
Top Row Soil Nail		Grouted Tieback (with friction)	Active (Method A)	10	16950	0	0	0	15	10	No	2160	40	Linear	0.3	Parallel to Reinforcement					
Bottom Row Soil Nails		Grouted Tieback (with friction)	Active (Method A)	10	22600	0	0	0	20	10	No	2160	40	Linear	0.3	Parallel to Reinforcement					

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Allow Sliding	Water Surface	Ru
Controlled BackFill		125	Mohr-Coulomb	0	32		None	0
Alluvium		125	Mohr-Coulomb	0	36		None	0
Retaining Wall Block		150	Infinite strength			Yes	None	0
DGA		140	Mohr-Coulomb	1	38		None	0
Controlled Backfill 2		120	Mohr-Coulomb	1	34		None	0

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SLIDEINTERPRET 9.017

Project	SLIDE - An Interactive Slope Stability Program		
Group	Proposed	Scenario	Master Scenario
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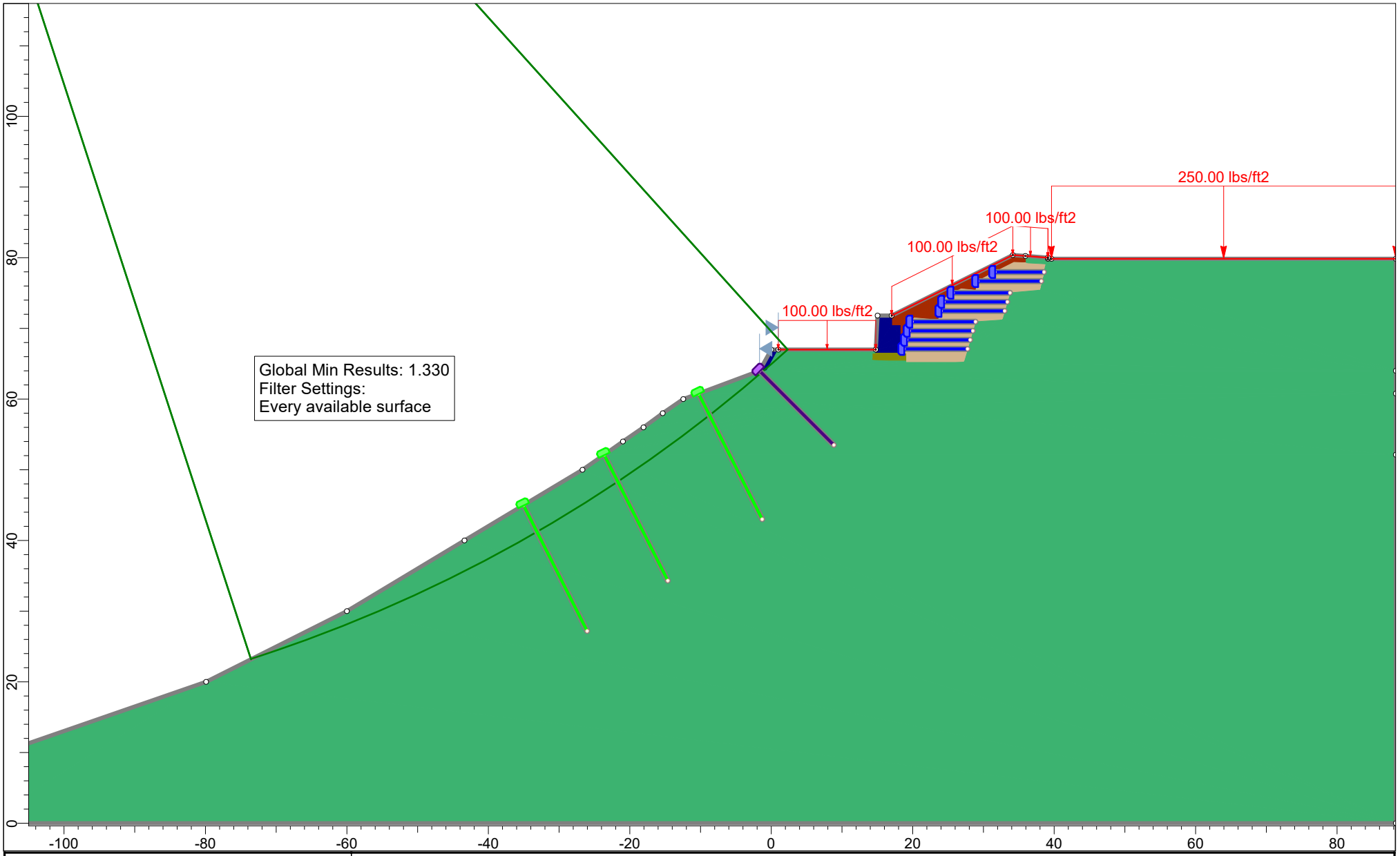

SESI CONSULTING ENGINEERS	*Project*	SLIDE - An Interactive Slope Stability Program	
	Group	Proposed	*Scenario* Backyard to Slope
	File Name	2021_0601_Global.slmd	*Company* SESI Consulting Engineers
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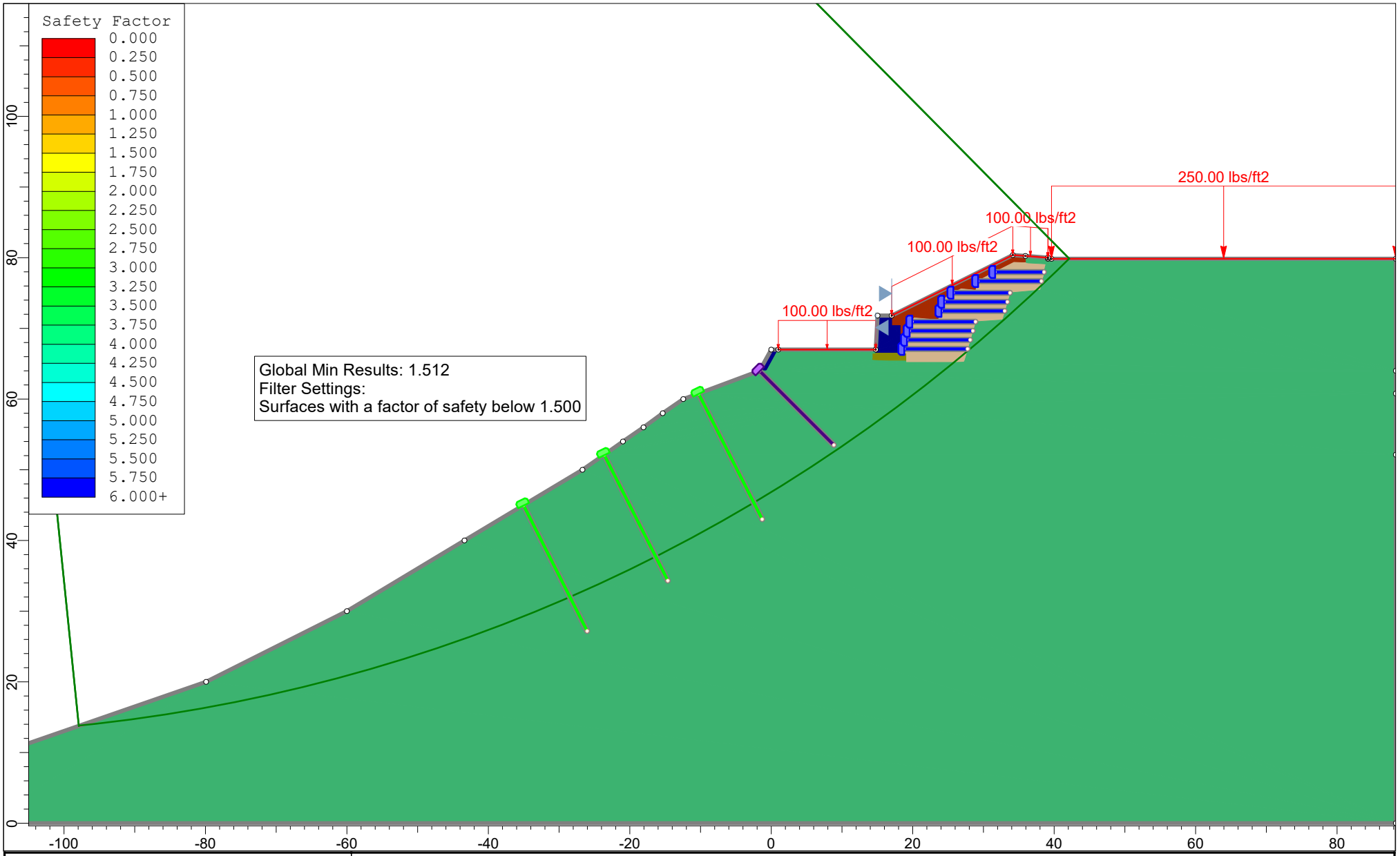

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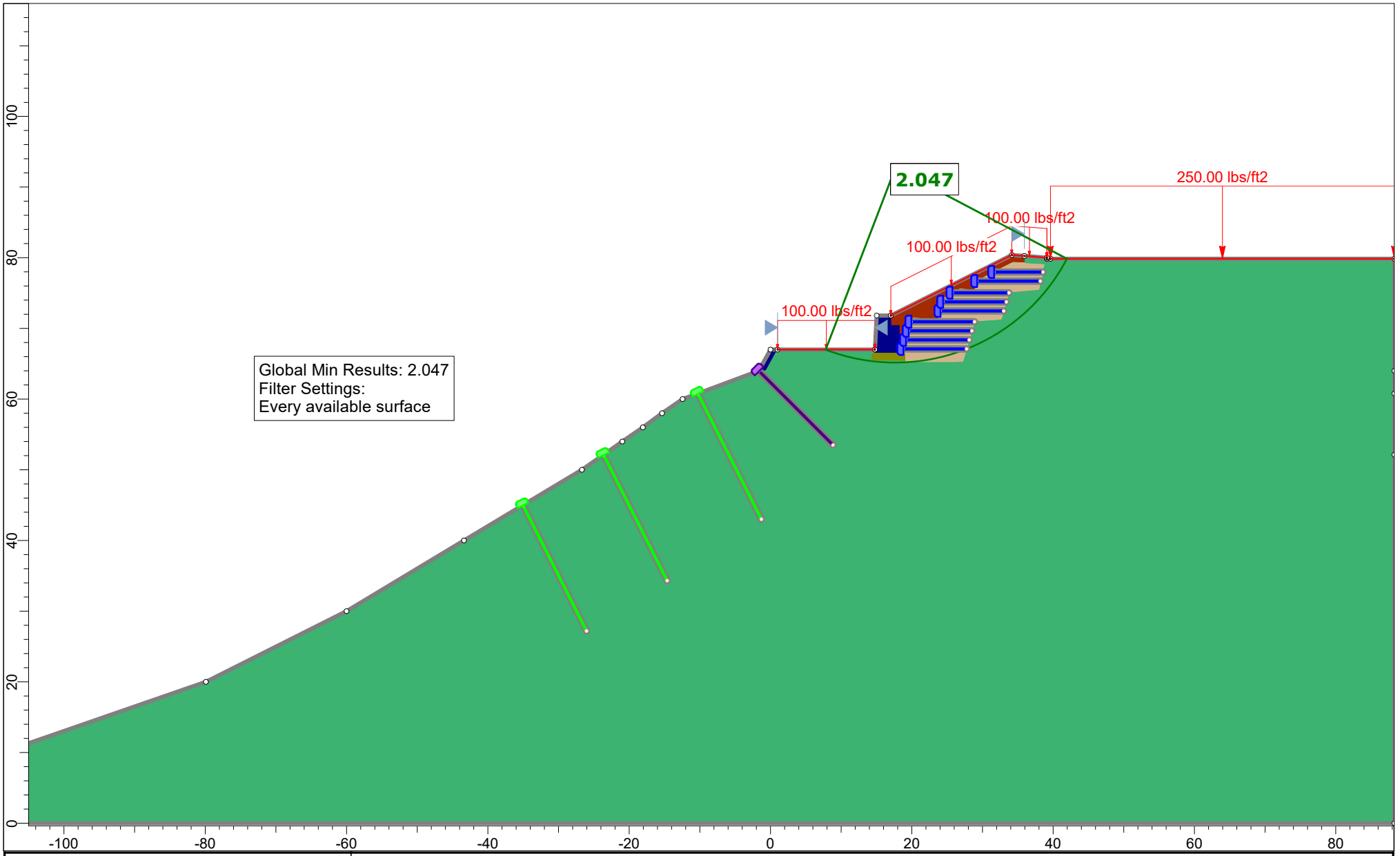

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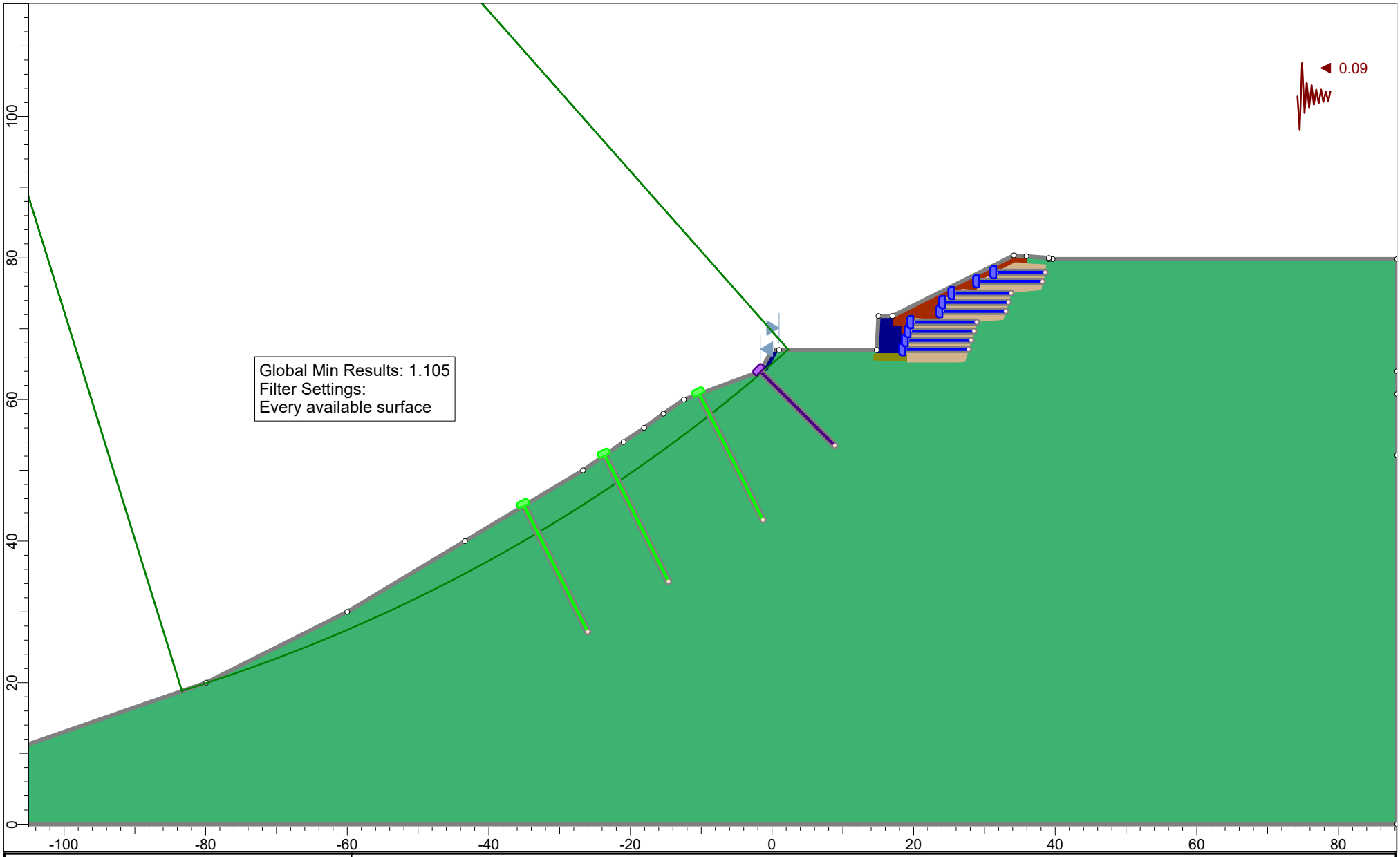

SESI CONSULTING ENGINEERS	*Project*	SLIDE - An Interactive Slope Stability Program	
	Group	Proposed	*Scenario* Backyard to Lower Slope - Seismic
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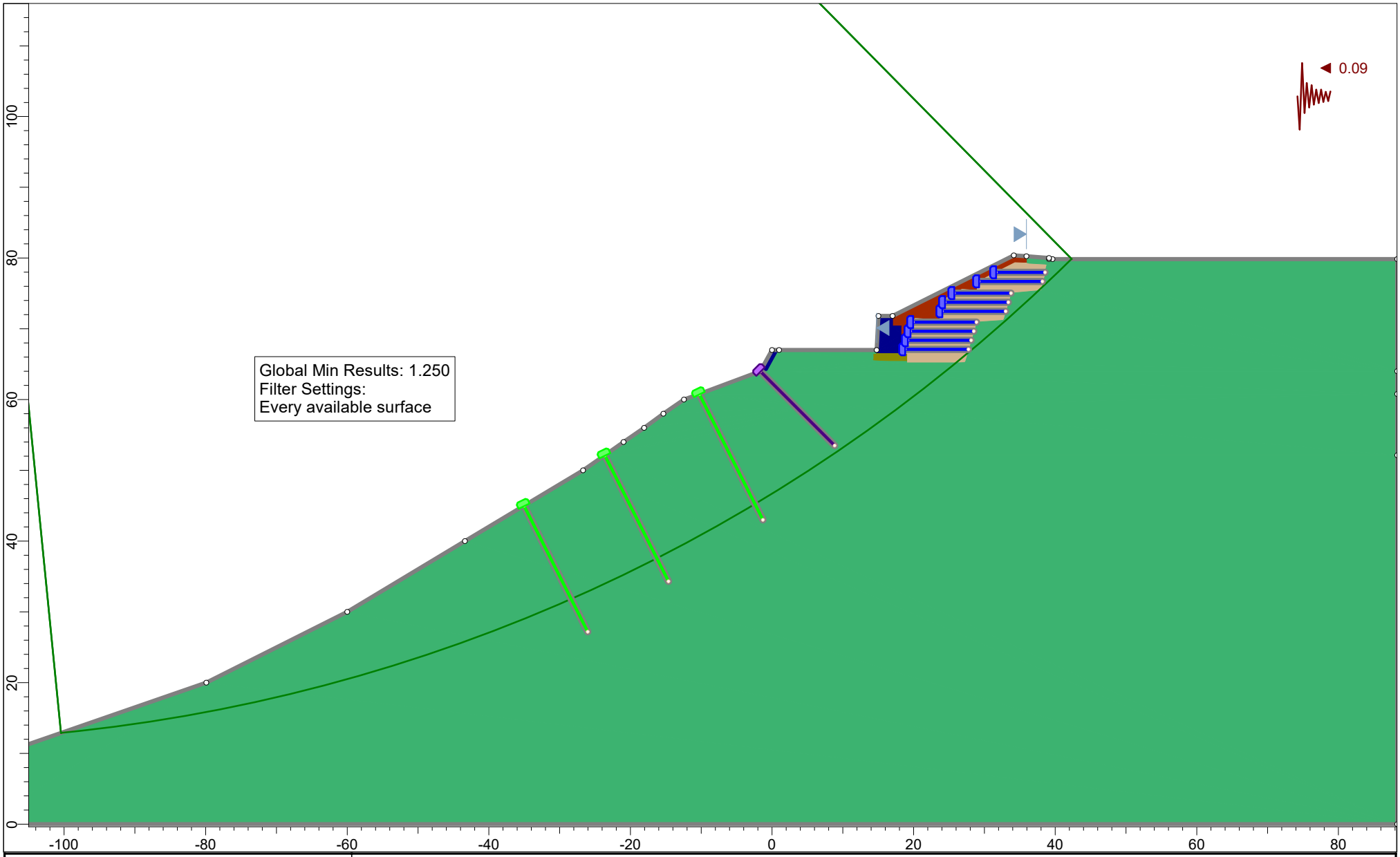

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	Group	Proposed	*Scenario* Street to Slope - Seismic
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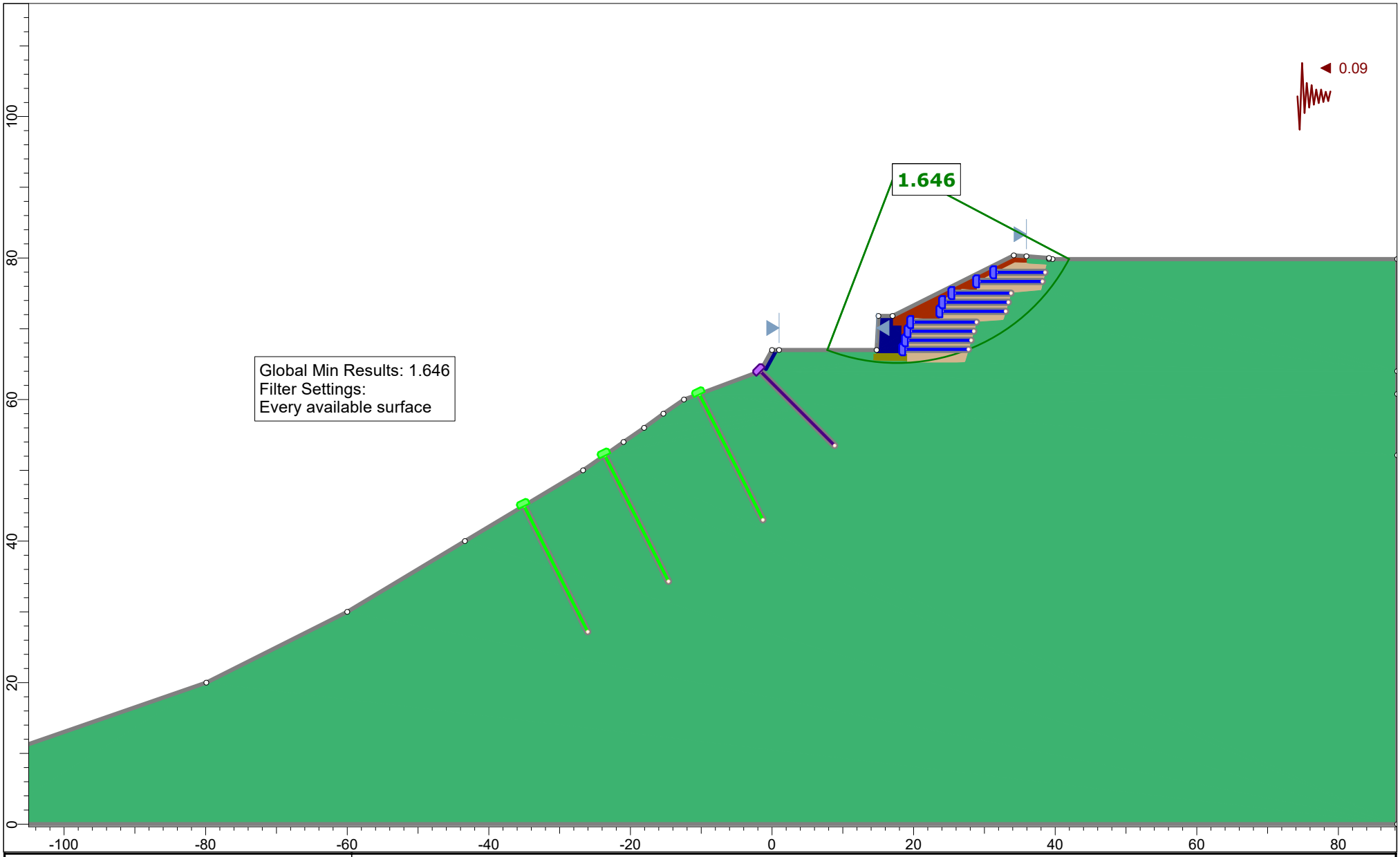

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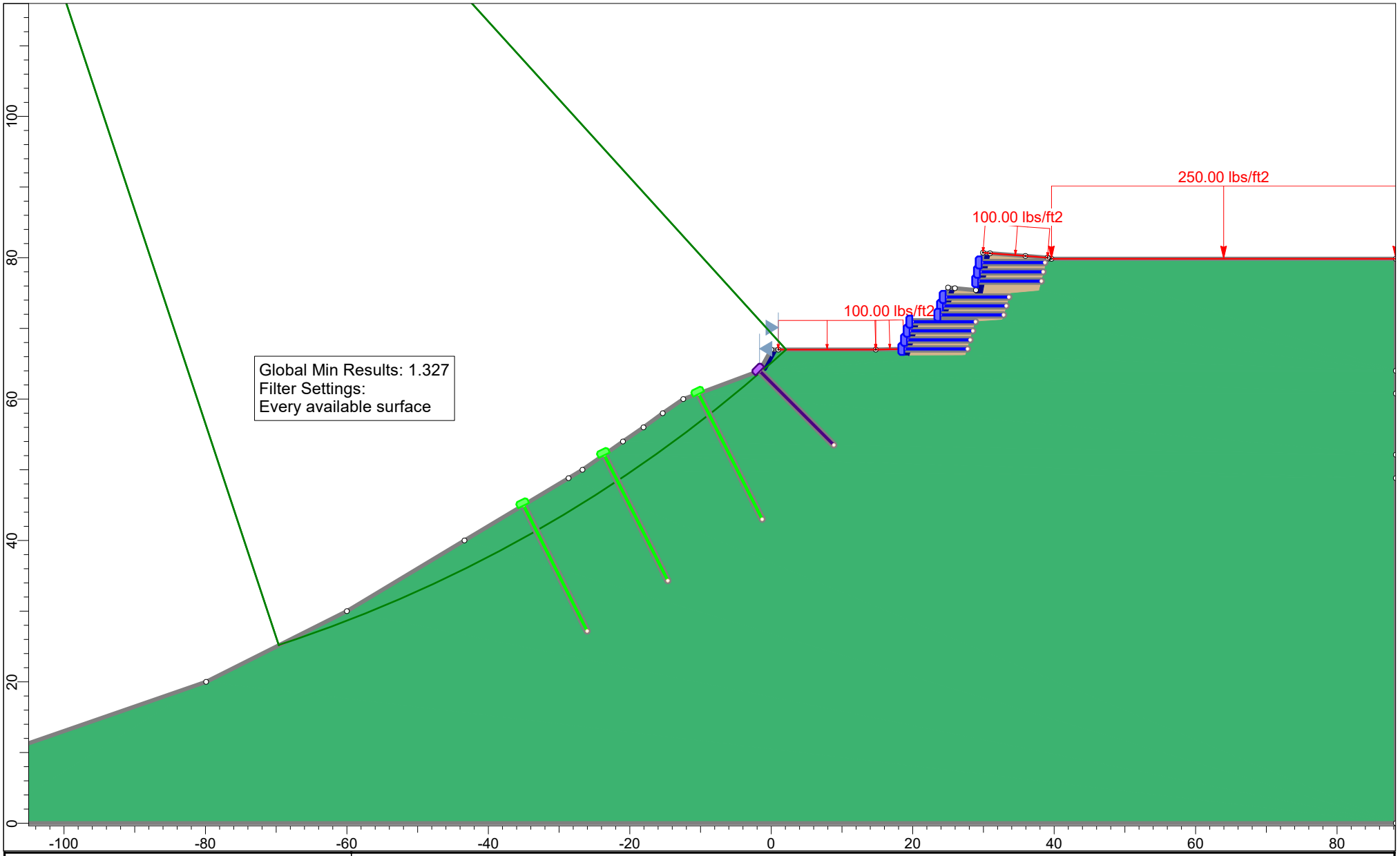

SESI CONSULTING ENGINEERS	*Project*	SLIDE - An Interactive Slope Stability Program	
	Group	Existing Condtions	*Scenario* Backyard to Slope
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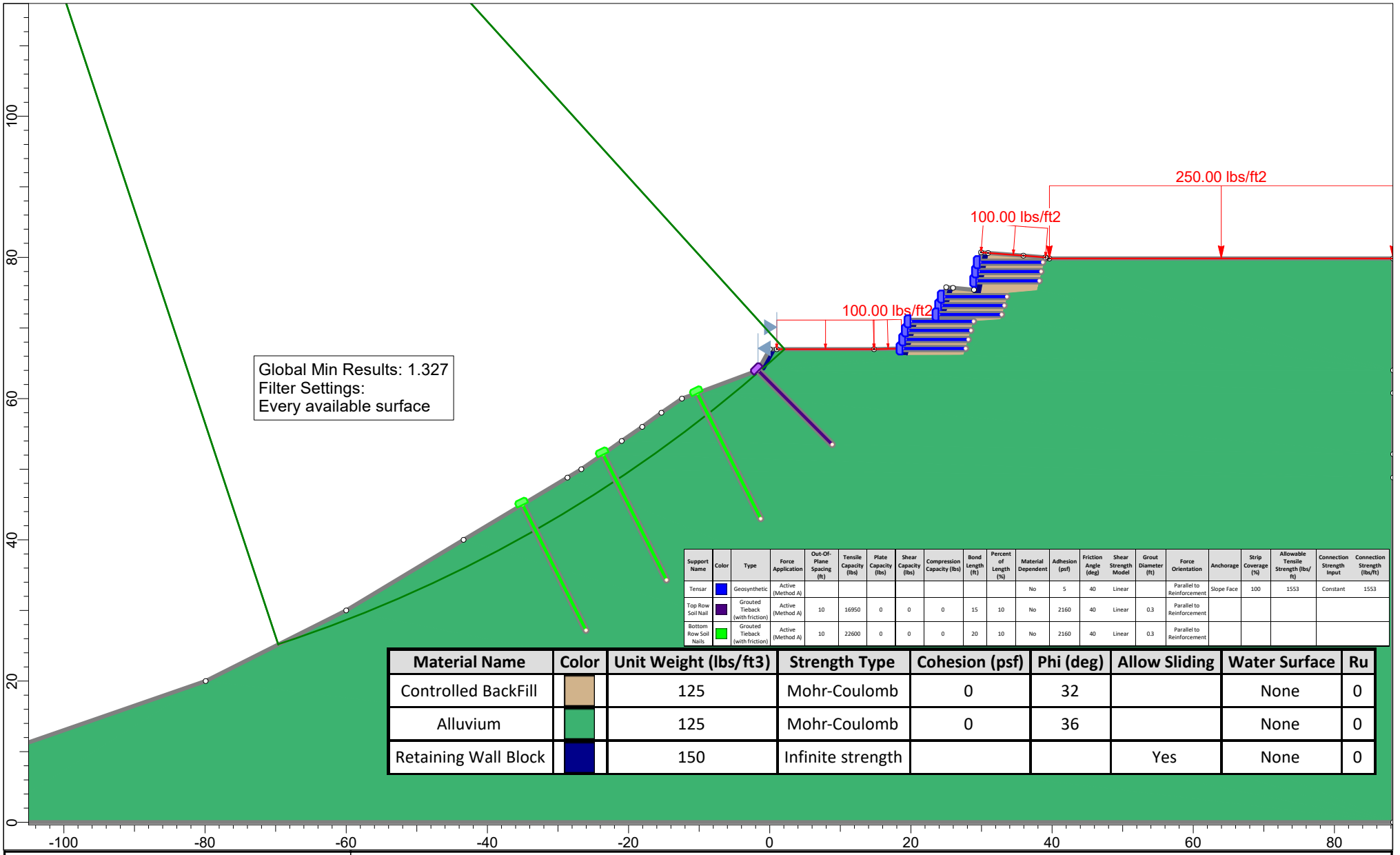

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Tensar		Geosynthetic	Active (Method A)								No	5	40	Linear		Parallel to Reinforcement	Slope Face	100	1553	Constant	1553
Top Row Soil Nail		Grouted Tieback (with friction)	Active (Method A)	10	16950	0	0	0	15	10	No	2160	40	Linear	0.3	Parallel to Reinforcement					
Bottom Row Soil Nails		Grouted Tieback (with friction)	Active (Method A)	10	22600	0	0	0	20	10	No	2160	40	Linear	0.3	Parallel to Reinforcement					

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Allow Sliding	Water Surface	Ru
Controlled BackFill		125	Mohr-Coulomb	0	32		None	0
Alluvium		125	Mohr-Coulomb	0	36		None	0
Retaining Wall Block		150	Infinite strength			Yes	None	0

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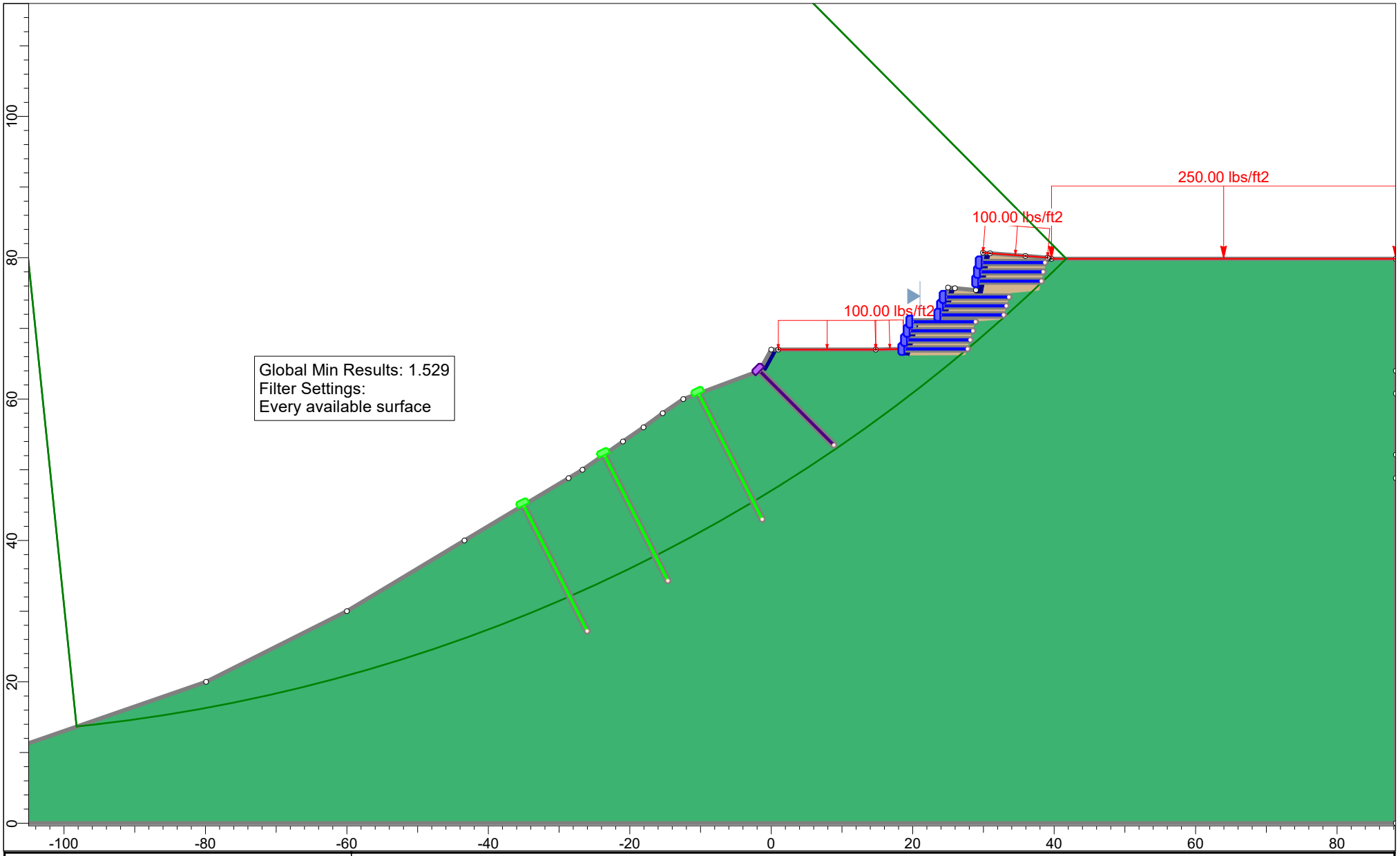

SESI CONSULTING ENGINEERS	*Project*	SLIDE - An Interactive Slope Stability Program	
	Group	Existing Condtions	*Scenario* Street to Slope
	File Name	2021_0601_Global.slmd	*Company* SESI Consulting Engineers
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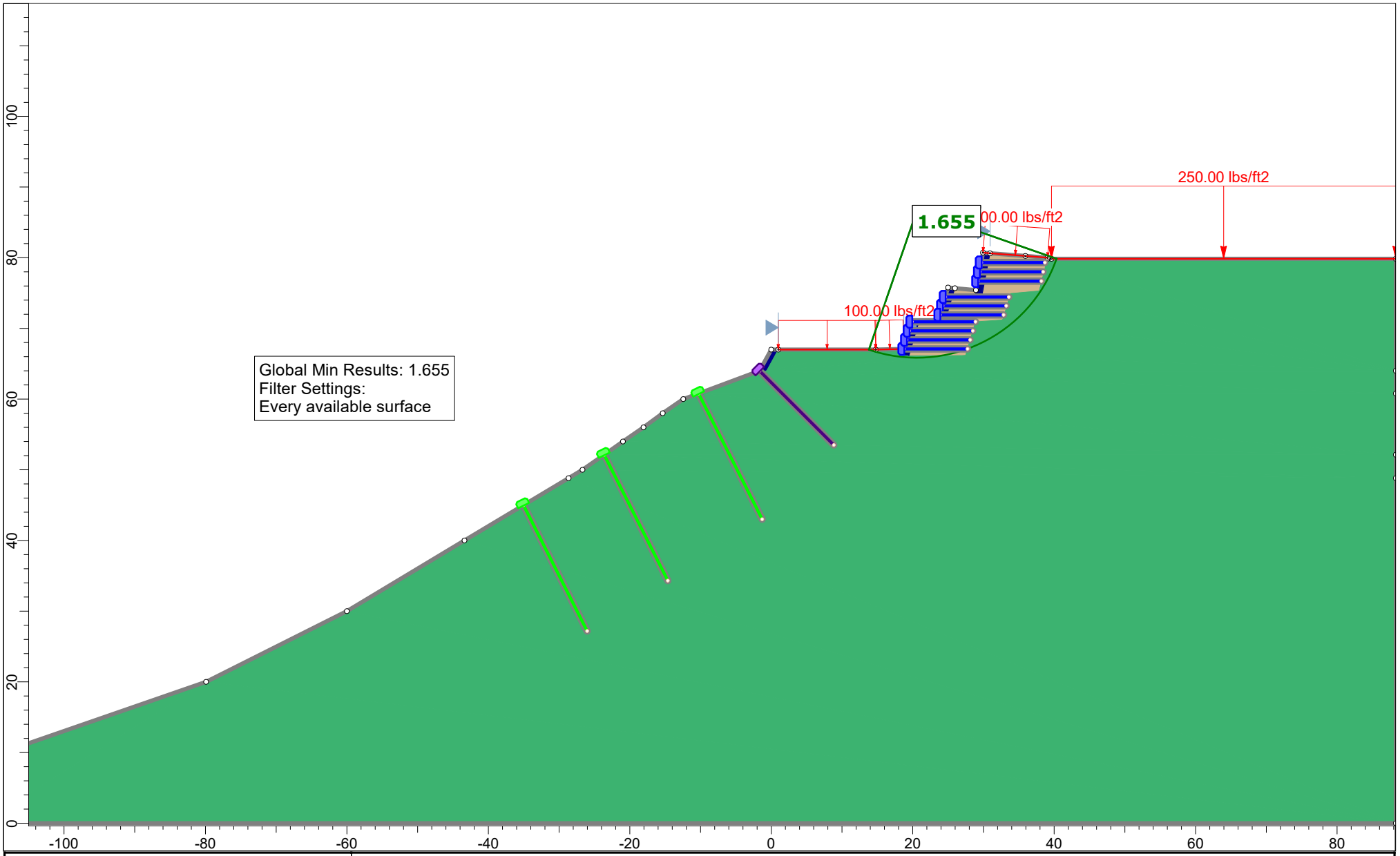

SESI CONSULTING ENGINEERS	*Project*	SLIDE - An Interactive Slope Stability Program	
	Group	Existing Condtions	*Scenario* Street to Backyard
	File Name	2021_0601_Global.slmd	*Company* SESI Consulting Engineers
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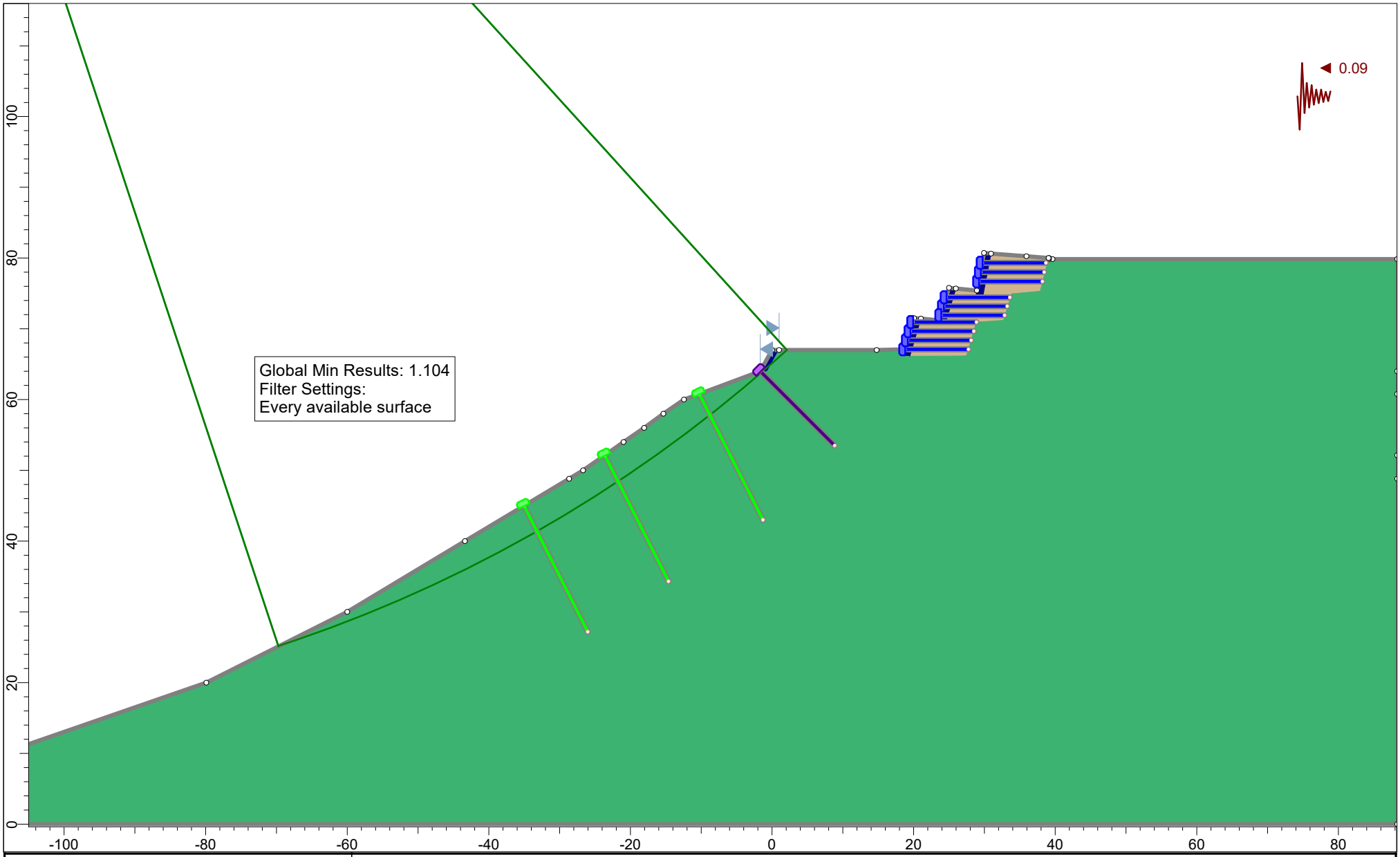

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Project	SLIDE - An Interactive Slope Stability Program		
Group	Existing Condtions	Scenario	Backyard to Slope - Seismic
File Name	2021_0601_Global.slmd	Company	SESI Consulting Engineers
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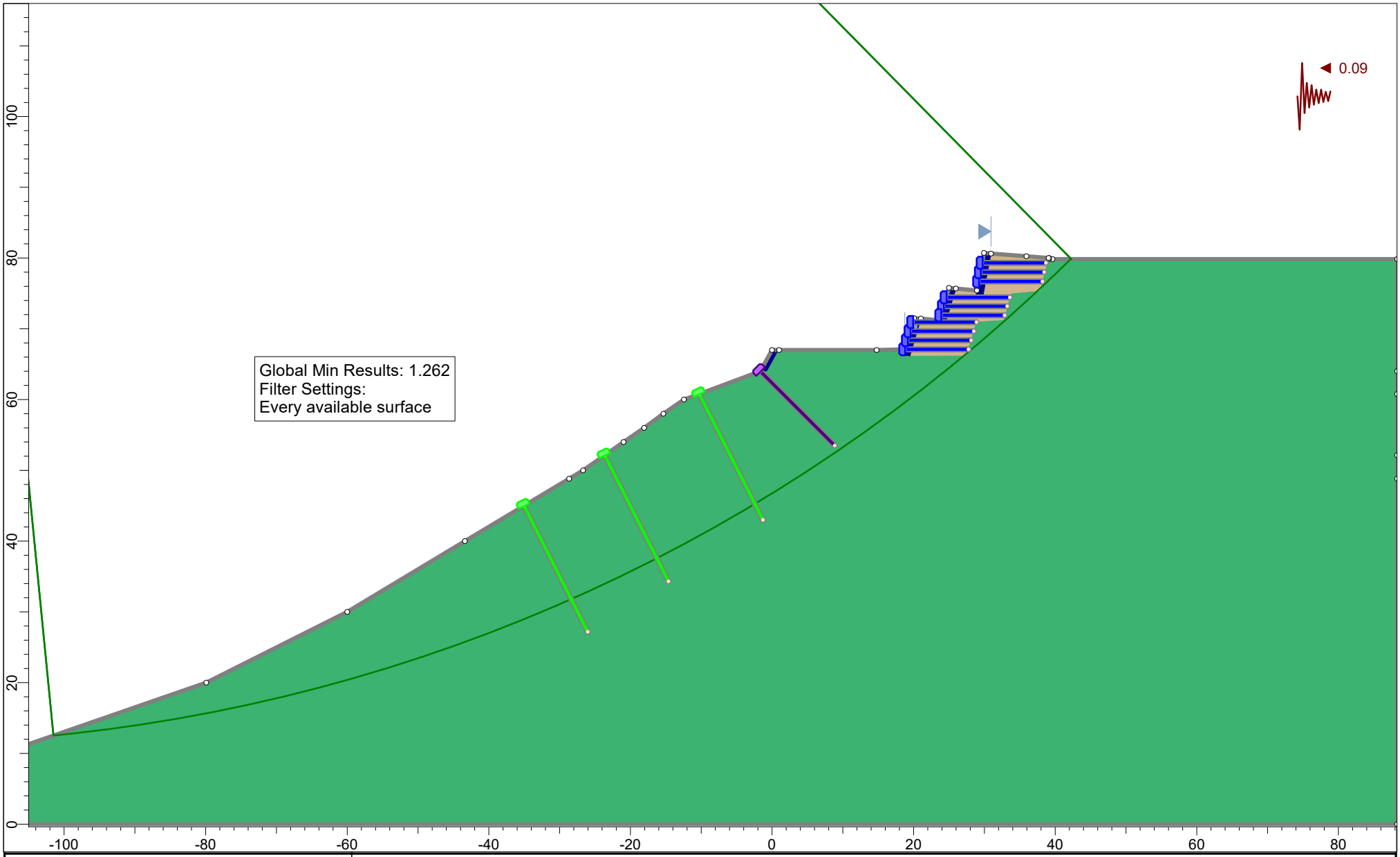

SESI CONSULTING ENGINEERS	*Project*	SLIDE - An Interactive Slope Stability Program	
	Group	Existing Condtions	*Scenario* Street to Slope - Seismic
	File Name	2021_0601_Global.slmd	*Company* SESI Consulting Engineers
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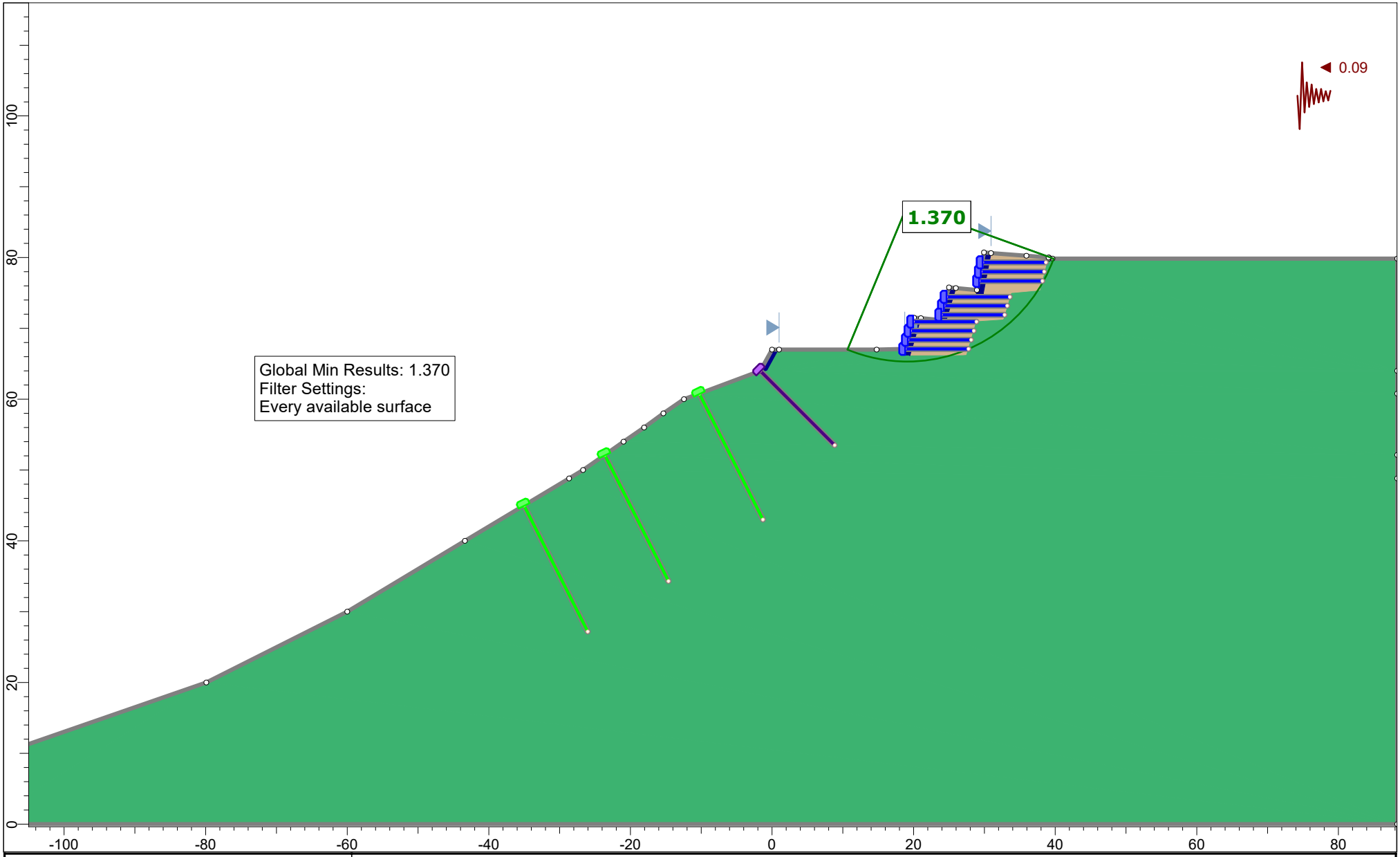

SESI CONSULTING ENGINEERS	Project	SLIDE - An Interactive Slope Stability Program	
	Group	Existing Condtions	Scenario: Street to Backyard - Seismic
	File Name	2021_0601_Global.slmd	Company: SESI Consulting Engineers
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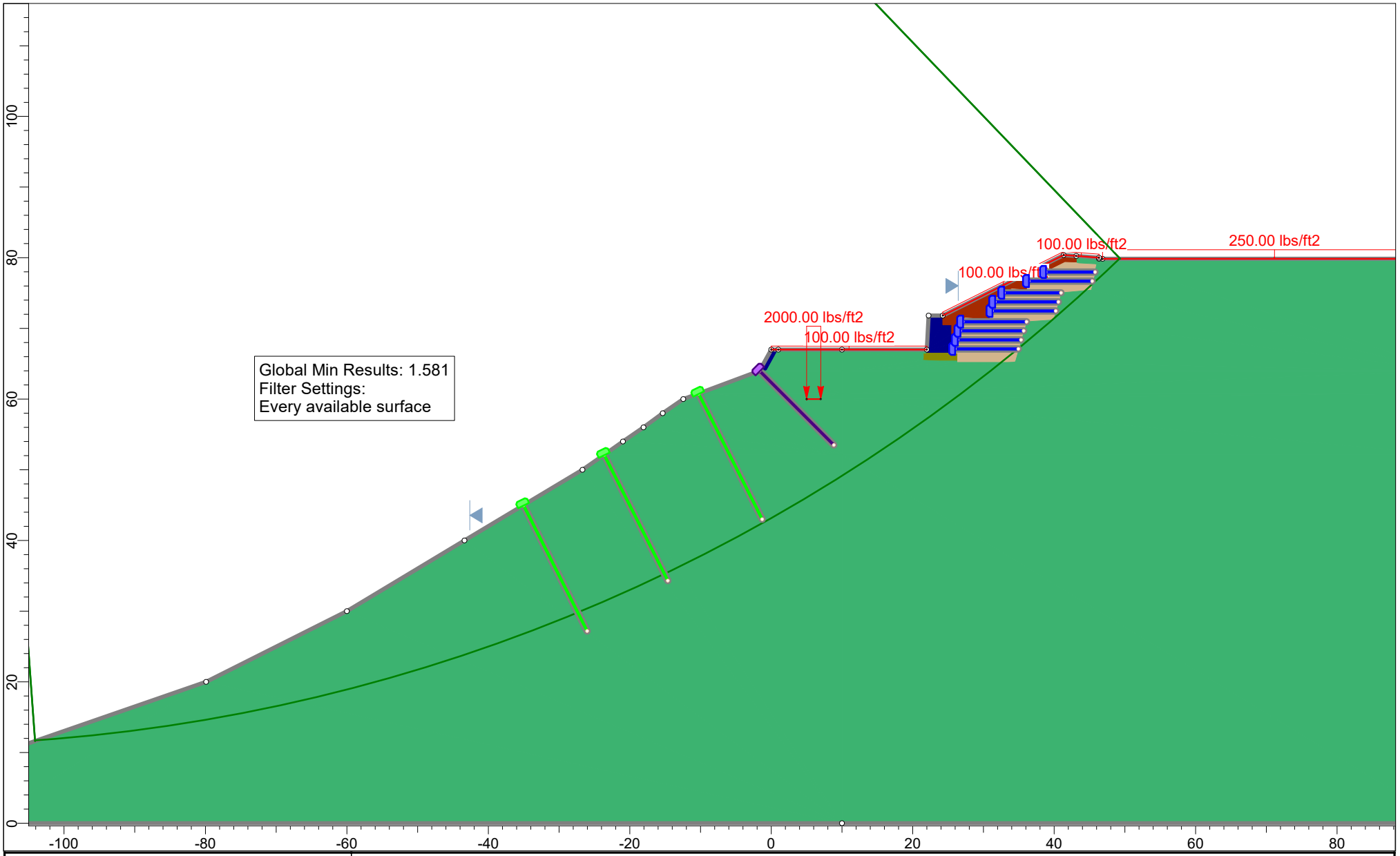

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Project	SLIDE - An Interactive Slope Stability Program		
Group	Proposed Footing - Master Scenario	Scenario	Master Scenario
File Name	2021_0601_Global.slmd	Company	SESI Consulting Engineers
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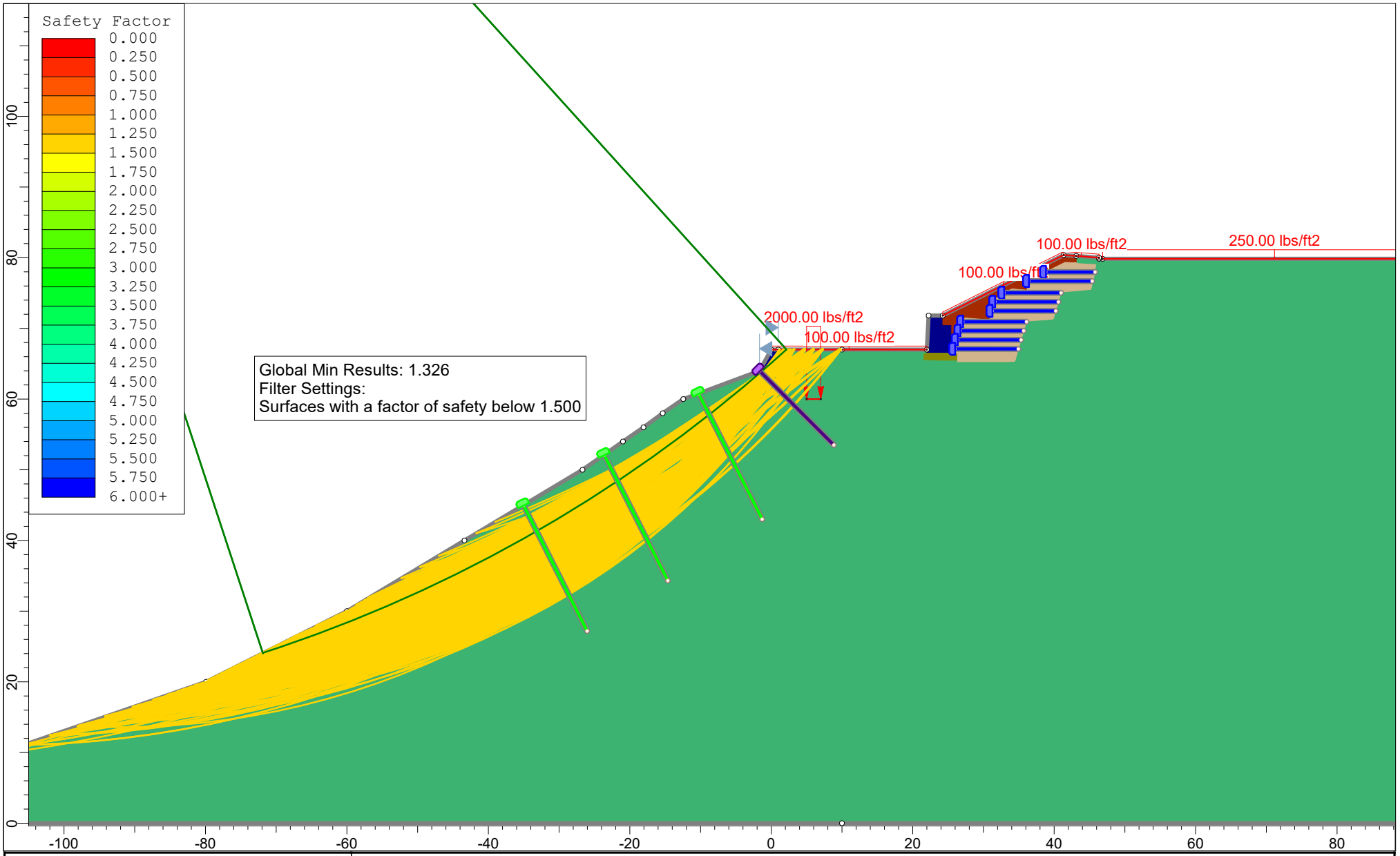

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SLIDEINTERPRET 9.017

Project	SLIDE - An Interactive Slope Stability Program		
Group	Proposed Footing - Master Scenario	Scenario	Backyard to Slope
File Name	2021_0601_Global.slmd	Company	SESI Consulting Engineers
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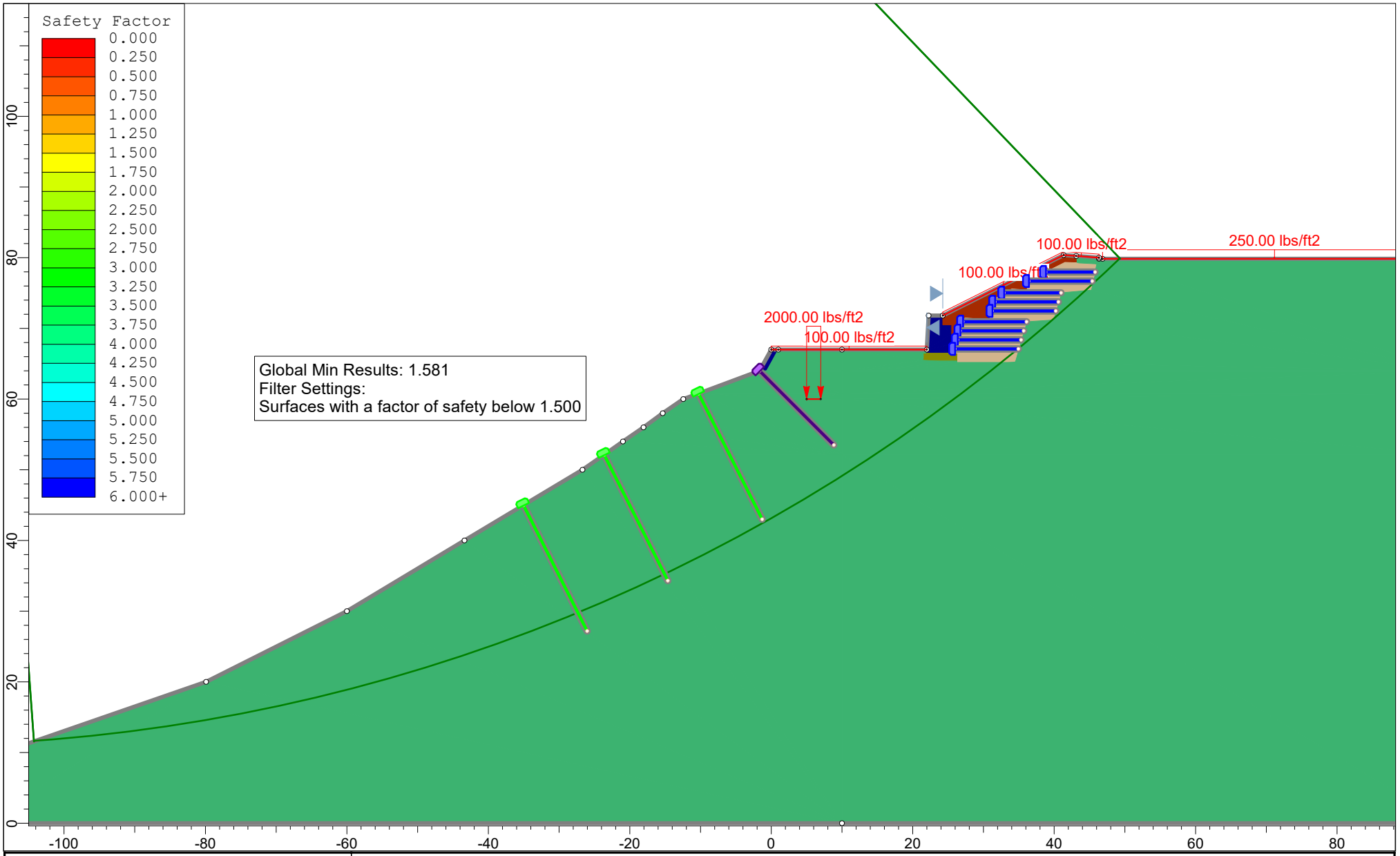

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Project	SLIDE - An Interactive Slope Stability Program		
Group	Proposed Footing - Master Scenario	Scenario	Street to Slope
File Name	2021_0601_Global.slmd	Company	SESI Consulting Engineers
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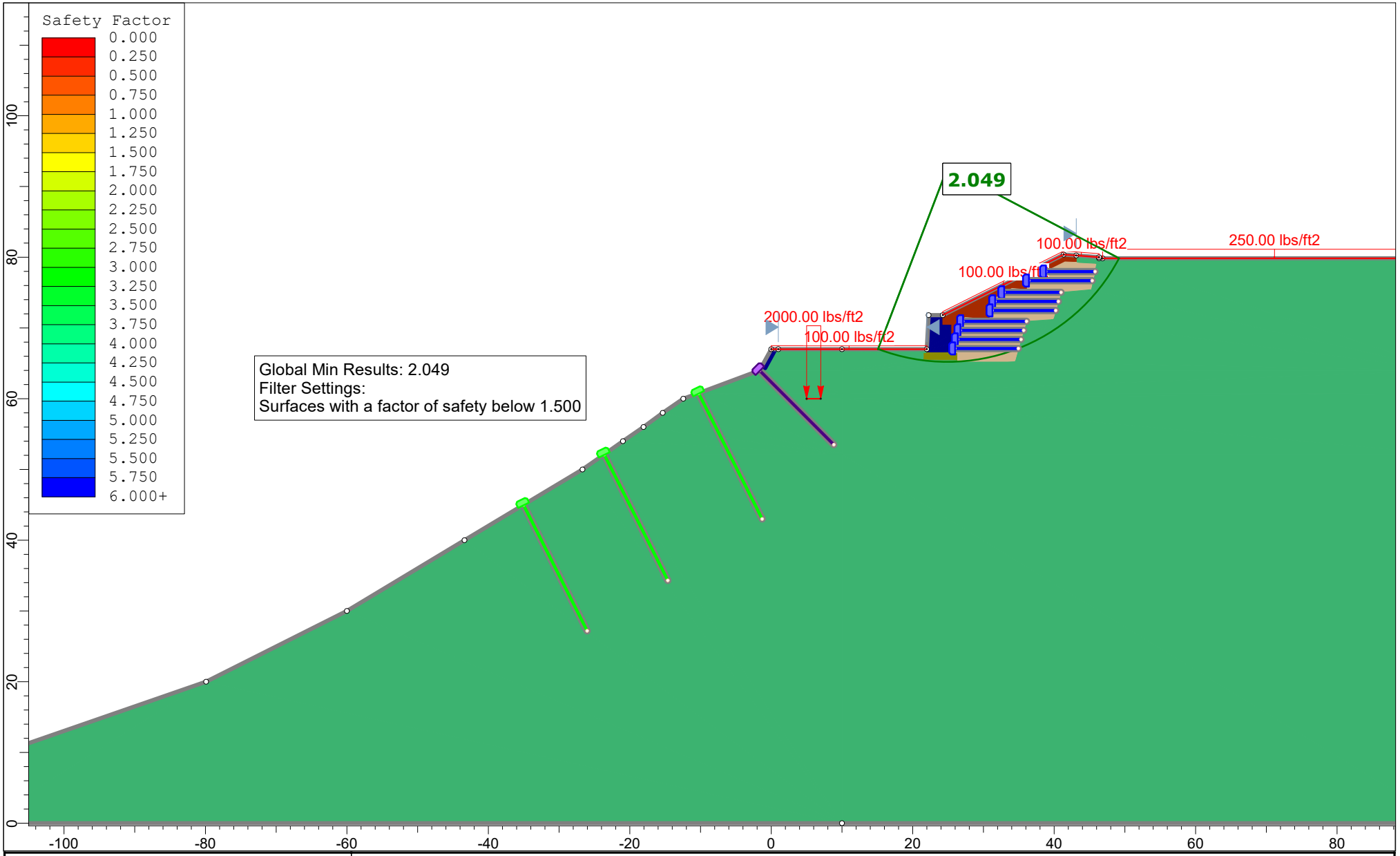

SESI CONSULTING ENGINEERS	Project	SLIDE - An Interactive Slope Stability Program	
	Group	Proposed Footing - Master Scenario	Scenario: Street to Backyard
	File Name	2021_0601_Global.slmd	Company: SESI Consulting Engineers
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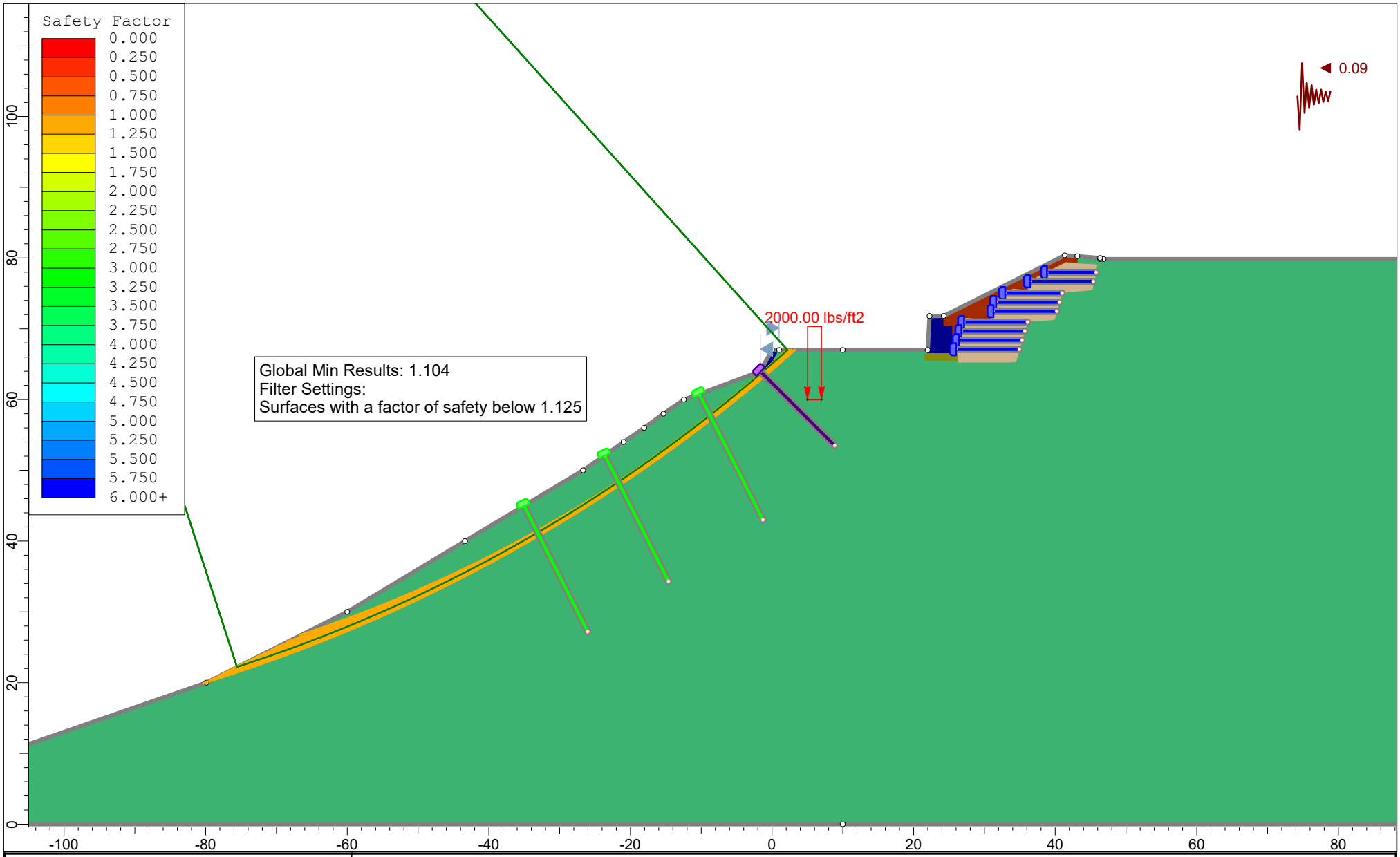

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SLIDEINTERPRET 9.017

Project	SLIDE - An Interactive Slope Stability Program		
Group	Proposed Footing - Master Scenario	Scenario	Backyard to Slope - Seismic
File Name	2021_0601_Global.slmd	Company	SESI Consulting Engineers
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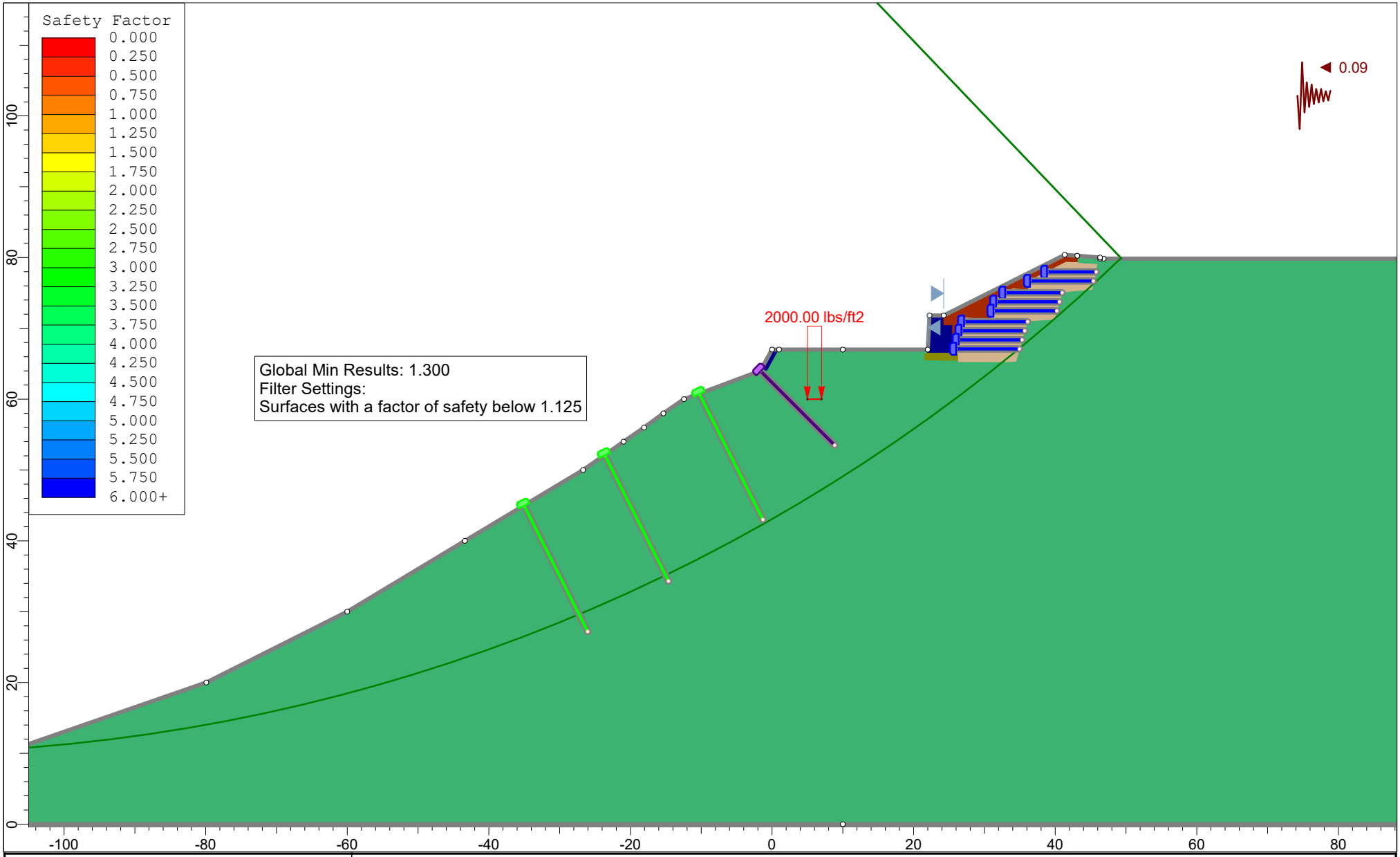

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SLIDEINTERPRET 9.017

Project	SLIDE - An Interactive Slope Stability Program		
Group	Proposed Footing - Master Scenario	Scenario	Street to Slope - Seismic
File Name	2021_0601_Global.slmd	Company	SESI Consulting Engineers
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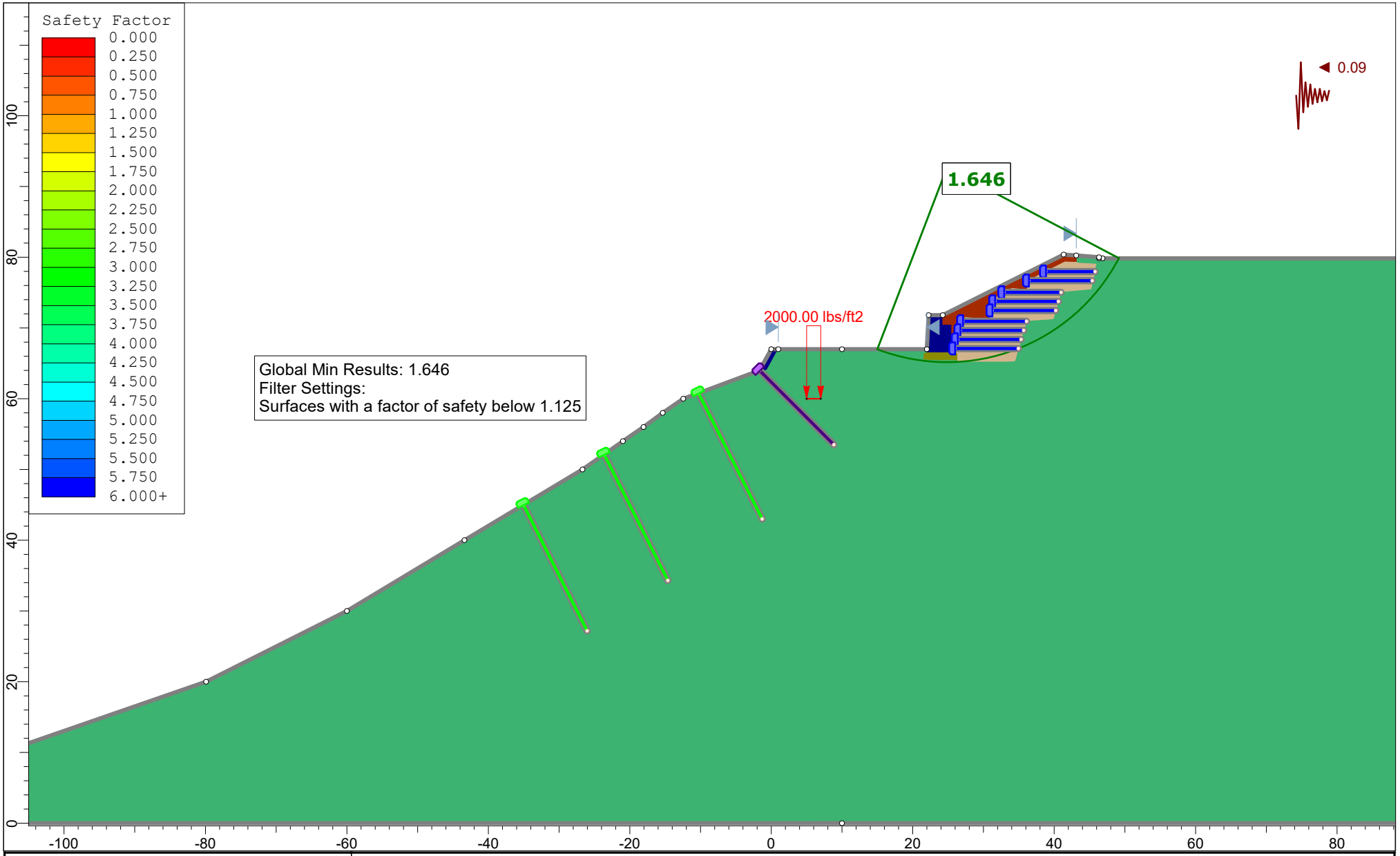

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SLIDEINTERPRET 9.017

Project	SLIDE - An Interactive Slope Stability Program		
Group	Proposed Footing - Master Scenario	Scenario	Street to Backyard - Seismic
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