

**UPDATED
STRUCTURAL CALCULATIONS
FOR
PERMANENT SOLDIER PILE SHORING WALL
FOR
THE MURRAY RESIDENCE
FOREST WAY
MERCER ISLAND, WA 98040**

April 10, 2023

BNT JOB NO. 18156

ARCHITECT:

RF ARCHITECTURE

7421 214TH AVE E

BONNEY LAKE, WA 98391

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Materials

Weight of water (pcf) =	62.4	# of pile ϕ active pressure is effective over =	1
Weight of soil (pcf) =	125	# of pile ϕ passive pressure is effective over =	2
Steel Design Strength Fy (KSI) =	50	Factor of Safety for Pile Embedment (permanent) =	1.00
Allowable soil bearing @ bottom of pile (PSF) =	0	Factor of Safety for Pile Embedment (temporary) =	1.00
Allowable pile skin friction to reduce end brg. =	1,000		
Depth of soil to neglect for skin friction (ft) =	20	(below ex grade)	

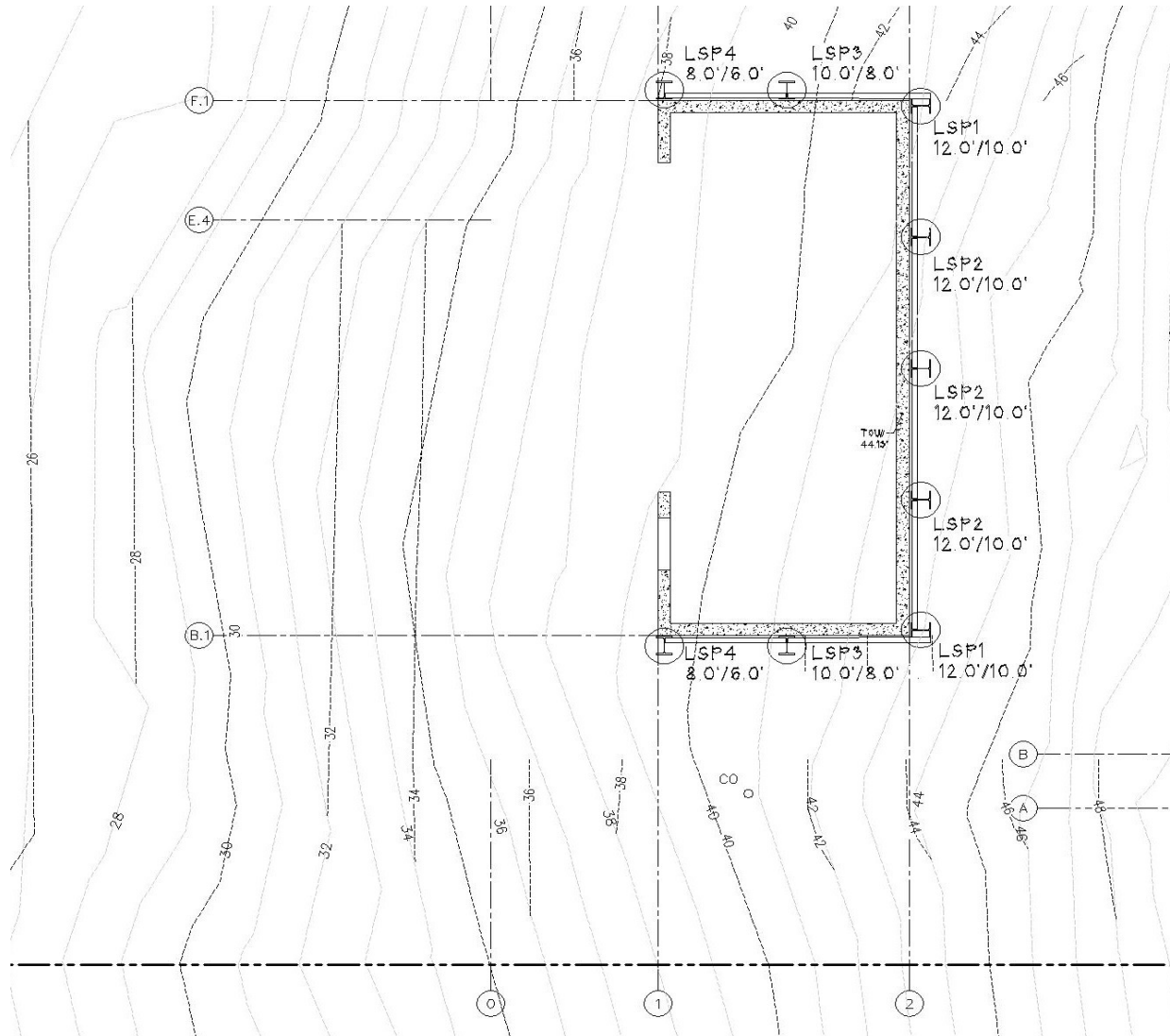
Equivalent Fluid Pressures

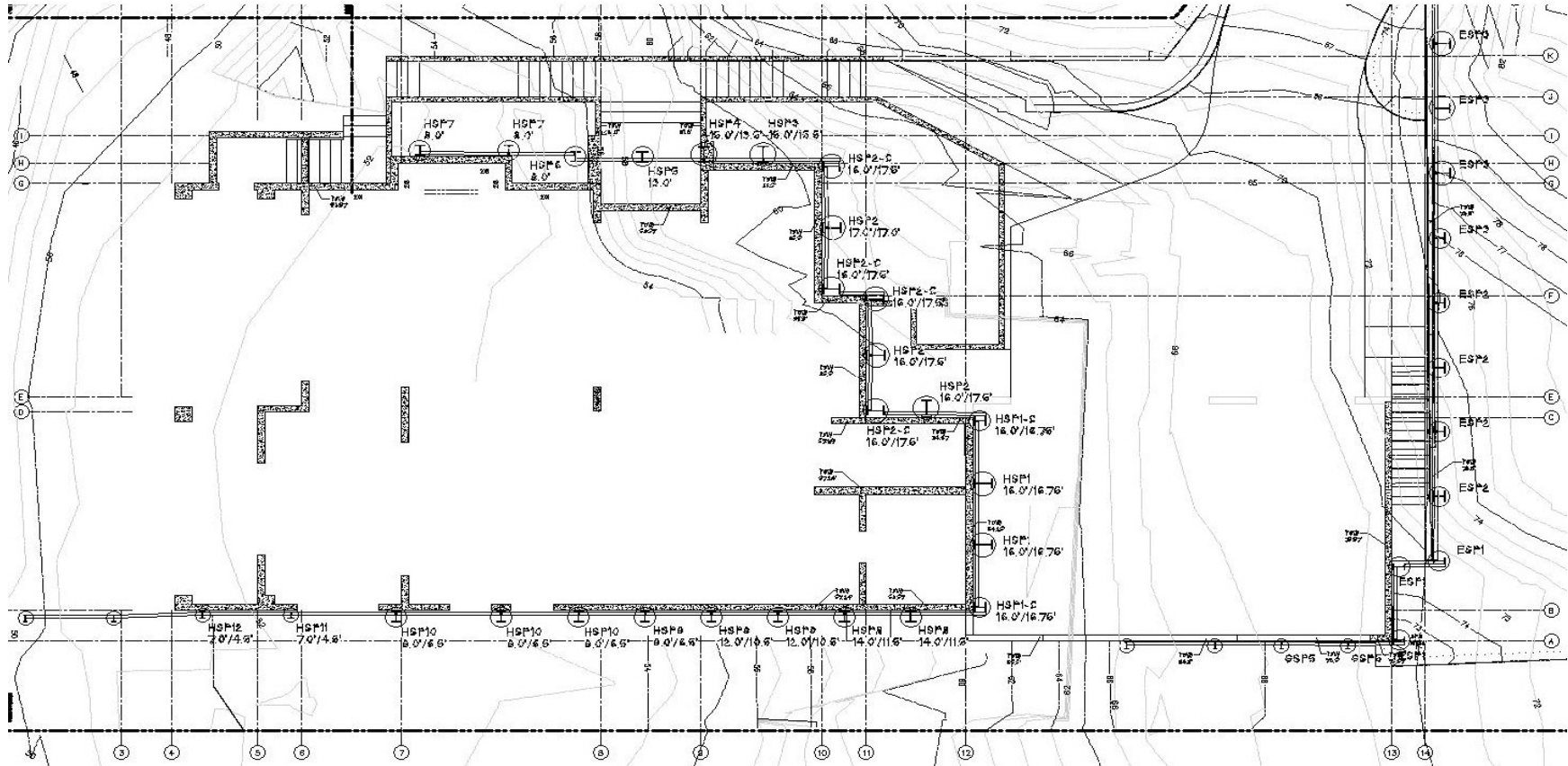
	Permnt	Temp
Active Above Dredge Line - ka1 (pcf) =	45	40
Active Above Dredge Line - ka1 SLOPED (pcf) =	55	50
Active Below Dredge Line - ka2 (pcf) =	45	40
Active Below Dredge Line - ka2 SLOPED (pcf) =	55	50
Passive Below Dredge Line - kp1 (pcf) =	267	267
Depth of soil to neglect for passive at bottom of wall (ft) =	0.0	0.0
Neglected soil height used for passive surcharge (ft) =	0.0	0.0

Seismic Factor = **8** X H

Timber Lagging Hem Fir, pressure treated

Width (in) =	3.5 or 5.5
Depth (in) =	11.25
fb (psi) =	950
fv (psi) =	75
Allowable Load Reduction (%) =	50







SIZE	MARK	EMBEDMENT (ft)	Augered Pile Diameter (in) (available sizes = 14", 16", 18", 20", 24" & 30")
W18X158	SP0	30	30
W18X130	SP1	28	30
W18X106	SP2	26	30
W18X86	SP3	24	30
W12X87	SP4	24	24
W12X72	SP5	23	24
W12X65	SP6	22	24
W12X58	SP7	20	24
W12X53	SP8	20	24
W12X35	SP9	17	24
W8X24	SP10	18	18
W8X15	SP11	18	18

Pile	GRID / LOCATION	Maximum Ht of Retainage (ft)	Temporary or Permanent Shoring?	Pile Spacing	Augered Pile Diameter (in) (available sizes = 14", 16", 18", 20", 24" & 30")	Backfill Level or Sloped?	Pile Size	MinSx (in^3)	Min bf (in)	Min d (in)	Required Pile Embedment (ft)	Pile Mark	Chosen Pile Embedment (ft)	Additional Pile Length (ft)	Embedment Okay?
ESP1	GRID 14	11.50	P	3.00	24.00	LEVEL	W12X35	45.6	6.56	12.50	16.00	SP9	17.00	0.0	okay
ESP2	GRID 14	11.50	P	6.35	24.00	LEVEL	W12X72	97.4	12.00	12.30	21.30	SP5	23.00	0.0	okay
ESP3	GRID 14	12.50	P	6.35	30.00	SLOPED	W18X86	166	11.10	18.40	23.00	SP3	24.00	0.0	okay
ESP4	UPPER DRIVEWAY	9.00	P	6.42	24.00	SLOPED	W12X53	70.6	10.00	12.10	18.20	SP8	20.00	0.0	okay
ESP5	UPPER DRIVEWAY	5.00	P	3.21	24.00	SLOPED	W12X53	70.6	10.00	12.10	7.90	SP8	20.00	0.0	okay
GSP5	GARAGE - GRID A	5.50	T	6.00	24.00	LEVEL	W8X15	11.8	4.01	8.11	8.10	SP11	18.00	0.0	okay
HSP1-C	HOUSE - GRID 12	16.75	P	3.00	24.00	LEVEL	W12X87	118	12.10	12.50	23.30	SP4	24.00	0.0	okay
HSP1	HOUSE - GRID 12	16.75	P	6.10	30.00	LEVEL	W18X130	256	11.20	19.30	28.00	SP1	28.00	0.0	okay
HSP2-C	HOUSE - GRIDS 12, C, 11 & 10	17.50	P	3.00	30.00	LEVEL	W18X86	166	11.10	18.40	22.30	SP3	24.00	0.0	okay
HSP2	HOUSE - GRIDS 12, C, 11 & 10	17.50	P	6.00	30.00	LEVEL	W18X158	310	11.30	19.70	29.10	SP0	30.00	0.0	okay
HSP3	HOUSE - GRID H	15.50	P	5.33	30.00	LEVEL	W18X106	204	11.20	18.70	24.50	SP2	26.00	0.0	okay
HSP4	HOUSE - GRID H	13.50	P	5.50	30.00	LEVEL	W18X86	166	11.10	18.40	21.70	SP3	24.00	0.0	okay
HSP5	HOUSE - GRID H	13.00	T	5.92	24.00	LEVEL	W12X87	118	12.10	12.50	23.00	SP4	24.00	0.0	okay
HSP6	HOUSE - GRID H	9.00	T	6.00	24.00	LEVEL	W12X35	45.6	6.56	12.50	13.20	SP9	17.00	0.0	okay
HSP7	HOUSE - GRID H	9.00	P	6.00	24.00	LEVEL	W12X53	70.6	10.00	12.10	13.20	SP8	20.00	0.0	okay
HSP8	HOUSE - GRID B	11.50	P	6.00	24.00	LEVEL	W12X72	97.4	12.00	12.30	20.90	SP5	23.00	0.0	okay
HSP9	HOUSE - GRID B	10.50	P	6.00	24.00	LEVEL	W12X58	78	10.00	12.20	19.10	SP7	20.00	0.0	okay
HSP10	HOUSE - GRID B	8.00	P	9.50	24.00	LEVEL	W12X53	70.6	10.00	12.10	17.60	SP8	20.00	0.0	okay
HSP11	HOUSE - GRID B	4.50	T	8.00	18.00	LEVEL	W8X24	20.9	6.50	7.93	10.50	SP10	18.00	0.0	okay
HSP12	HOUSE - GRID B	3.50	T	8.00	18.00	LEVEL	W8X15	11.8	4.01	8.11	6.60	SP11	18.00	0.0	okay
LSP1	LOGGIA - GRID 2	10.00	P	3.67	24.00	SLOPED	W12X53	70.6	10.00	12.10	12.10	SP8	20.00	0.0	okay
LSP2	LOGGIA - GRID 2	10.00	P	7.33	24.00	SLOPED	W12X72	97.4	12.00	12.30	21.10	SP5	23.00	0.0	okay
LSP3	LOGGIA - GRID B.1	8.00	P	6.50	24.00	LEVEL	W12X53	70.6	10.00	12.10	15.10	SP8	20.00	0.0	okay
LSP4	LOGGIA - GRID B.1	6.00	P	3.50	24.00	LEVEL	W12X53	70.6	10.00	12.10	9.00	SP8	20.00	0.0	okay

Pile	Total Wt of Pile (lb)	fb (Ksi)	WF okay for Stress?	WF Δ (in)	4x Lagging rqr'd Bending stress (KSI)	6x Lagging rqr'd Bending stress (KSI)	TW Roof (ft)	TW Floor (ft)	TW Residence Slab (ft)	TW Garage Slab (ft)	HT of Wall (ft)	Wall thickness (in)	Additional Load (lb)	Super-imposed Gravity Load on Pile (K)	F.S. Bearing @ Bottom of Pile	Pile Okay for end bearing?	NOTES
ESP1	998	30.88	okay	0.429	0.17	0.07	0.00	0.00	0.00	0.00	12.50	8.00	0.00	3.75	4.19	okay	4.94 in. clr. if WF is centered in pile
ESP2	2,484	35.13	okay	0.433	0.76	0.31	0.00	0.00	0.00	0.00	12.50	8.00	0.00	7.94	4.29	okay	3.4 in. clr. if WF is centered in pile
ESP3	3,139	30.72	okay	0.273	0.98	0.40	0.00	0.00	0.00	0.00	12.50	8.00	0.00	7.94	4.51	okay	4.25 in. clr. if WF is centered in pile
ESP4	1,537	28.60	okay	0.192	0.72	0.29	0.00	0.00	0.00	0.00	11.00	8.00	0.00	7.06	3.14	okay	4.15 in. clr. if WF is centered in pile
ESP5	1,325	2.16	okay	0.005	0.10	0.05	0.00	0.00	0.00	0.00	7.00	8.00	0.00	2.25	2.42	okay	4.15 in. clr. if WF is centered in pile
GSP5	353	15.44	okay	0.050	0.25	0.10	0.00	0.00	0.00	0.00	0.00	8.00	0.00	0.00	2.49	okay	7.53 in. clr. if WF is centered in pile
HSP1-C	3,545	36.89	okay	1.083	0.25	0.10	10.00	20.00	5.00	5.00	16.00	8.00	0.00	14.27	4.48	okay	3.3 in. clr. if WF is centered in pile
HSP1	5,818	37.62	okay	0.662	1.02	0.41	10.00	20.00	5.00	5.00	16.00	8.00	0.00	29.01	3.51	okay	3.84 in. clr. if WF is centered in pile
HSP2-C	3,569	28.95	okay	0.652	0.26	0.11	10.00	20.00	5.00	0.00	16.00	8.00	0.00	12.53	5.00	okay	4.25 in. clr. if WF is centered in pile
HSP2	7,505	34.74	okay	0.652	1.03	0.42	10.00	20.00	5.00	0.00	16.00	8.00	0.00	25.05	3.95	okay	3.64 in. clr. if WF is centered in pile
HSP3	4,399	31.87	okay	0.506	0.72	0.29	10.00	20.00	5.00	0.00	16.00	8.00	0.00	22.25	3.69	okay	4.1 in. clr. if WF is centered in pile
HSP4	3,225	26.86	okay	0.327	0.67	0.27	10.00	20.00	5.00	0.00	14.00	8.00	0.00	21.86	3.21	okay	4.25 in. clr. if WF is centered in pile
HSP5	3,219	20.06	okay	0.236	0.56	0.23	0.00	0.00	0.00	0.00	0.00	8.00	0.00	0.00	7.35	okay	3.3 in. clr. if WF is centered in pile
HSP6	910	17.51	okay	0.099	0.40	0.17	0.00	0.00	0.00	0.00	0.00	8.00	0.00	0.00	4.23	okay	4.94 in. clr. if WF is centered in pile
HSP7	1,537	11.31	okay	0.066	0.40	0.17	10.00	20.00	5.00	0.00	12.00	8.00	0.00	22.65	1.68	okay	4.15 in. clr. if WF is centered in pile
HSP8	2,484	32.81	okay	0.410	0.68	0.28	10.00	20.00	5.00	0.00	12.00	8.00	0.00	22.65	2.53	okay	3.4 in. clr. if WF is centered in pile
HSP9	1,769	31.18	okay	0.327	0.62	0.25	10.00	20.00	5.00	0.00	12.00	8.00	0.00	22.65	1.95	okay	4.11 in. clr. if WF is centered in pile
HSP10	1,484	26.75	okay	0.148	1.18	0.48	0.00	0.00	0.00	0.00	12.00	8.00	0.00	11.40	2.25	okay	4.15 in. clr. if WF is centered in pile
HSP11	540	13.94	okay	0.036	0.47	0.19	0.00	0.00	0.00	0.00	0.00	8.00	0.00	0.00	2.22	okay	4.09 in. clr. if WF is centered in pile
HSP12	323	6.04	okay	0.007	0.28	0.12	0.00	0.00	0.00	0.00	0.00	8.00	0.00	0.00	1.39	okay	4.53 in. clr. if WF is centered in pile
LSP1	1,590	8.65	okay	0.069	0.17	0.07	0.00	40.00	6.50	0.00	12.00	8.00	0.00	17.84	2.18	okay	4.15 in. clr. if WF is centered in pile
LSP2	2,376	33.44	okay	0.265	1.04	0.42	0.00	40.00	6.50	0.00	12.00	8.00	0.00	35.63	1.67	okay	3.4 in. clr. if WF is centered in pile
LSP3	1,484	16.78	okay	0.101	0.55	0.23	0.00	5.00	6.50	0.00	12.00	8.00	0.00	16.06	1.86	okay	4.15 in. clr. if WF is centered in pile
LSP4	1,378	3.39	okay	0.013	0.12	0.05	0.00	5.00	6.50	0.00	12.00	8.00	0.00	8.65	1.94	okay	4.15 in. clr. if WF is centered in pile

ESP1

	INPUT		
Soil Wt. =	125		pcf *
Active EFP =	45		pcf *
Passive EFP =	267		pcf *
Additional Uniform Load [rectangular] =	0		psf *
Seismic factor =	8		x "H"
# of pile ϕ active pressure is effective over =	1		below lagging *
# of pile ϕ passive pressure is effective over =	2		below lagging *
Effective Concrete Pile ϕ =	2.00		ft.
Pile spacing =	3.00		ft.
Surcharge =	0		psf
Retained (lagging) height "H" =	11.50		ft.
Height of Tieback from Bottom of Excavation =	0.00		ft.
Height of influence from additional Uniform Load =	0		ft.
Trial WF size =	W12X35		
WF Fy =	50		ksi
Required WF clearance within pile =	2		in. (all around)
For Passive resistance neglect top	0		ft.* of soil (lower grade)
Neglected soil ht. used for passive surcharge	0		ft.* of soil (lower grade)
Max.active pressure used for lagging design =	50		% * @ lower grade
Allowable soil bearing @ bottom of pile =	0		psf *
Allowable pile skin friction to reduce end brg. =	1,000		psf *
Guardrail impact load per pile =	0		kips
Guardrail height above upper grade hg =	0		ft.
Duration increase for passive pres. w/ impact =	1.00		Guardrail impact (Range 1.00 to 1.33)

OUTPUT

Effective surcharge height "hs" = **2.044** ft. (upper grade)
 Moment max. = **117.4** k-ft.
 Sx (provided) = **45.6** in.³
 Ix (provided) = **285** in.⁴
 E_{WF} = **29000** ksi
 bf = **6.56** in.
 d = **12.50** in.

NOTE : -

- 1.) d1 range is from "H" to "6H only".
- 2.) * = Per soils engineer's requirements, including appropriate Factors of safety.

Maximum Bending Stress on WF Pile:

fb (actual) = **30.88** ksi WF O.K. for stress
 Fb = .76 Fy = **38.00** ksi AISC 9th Edition pg. 5-155
 WF diagonal = **14.12** in. **4.94 in. clr. if WF is centered in pile**
 WF Δ = **0.429** in. (at top of pile due to loading above lower grade)

W12X35 O.K. for stress

Lagging Design:

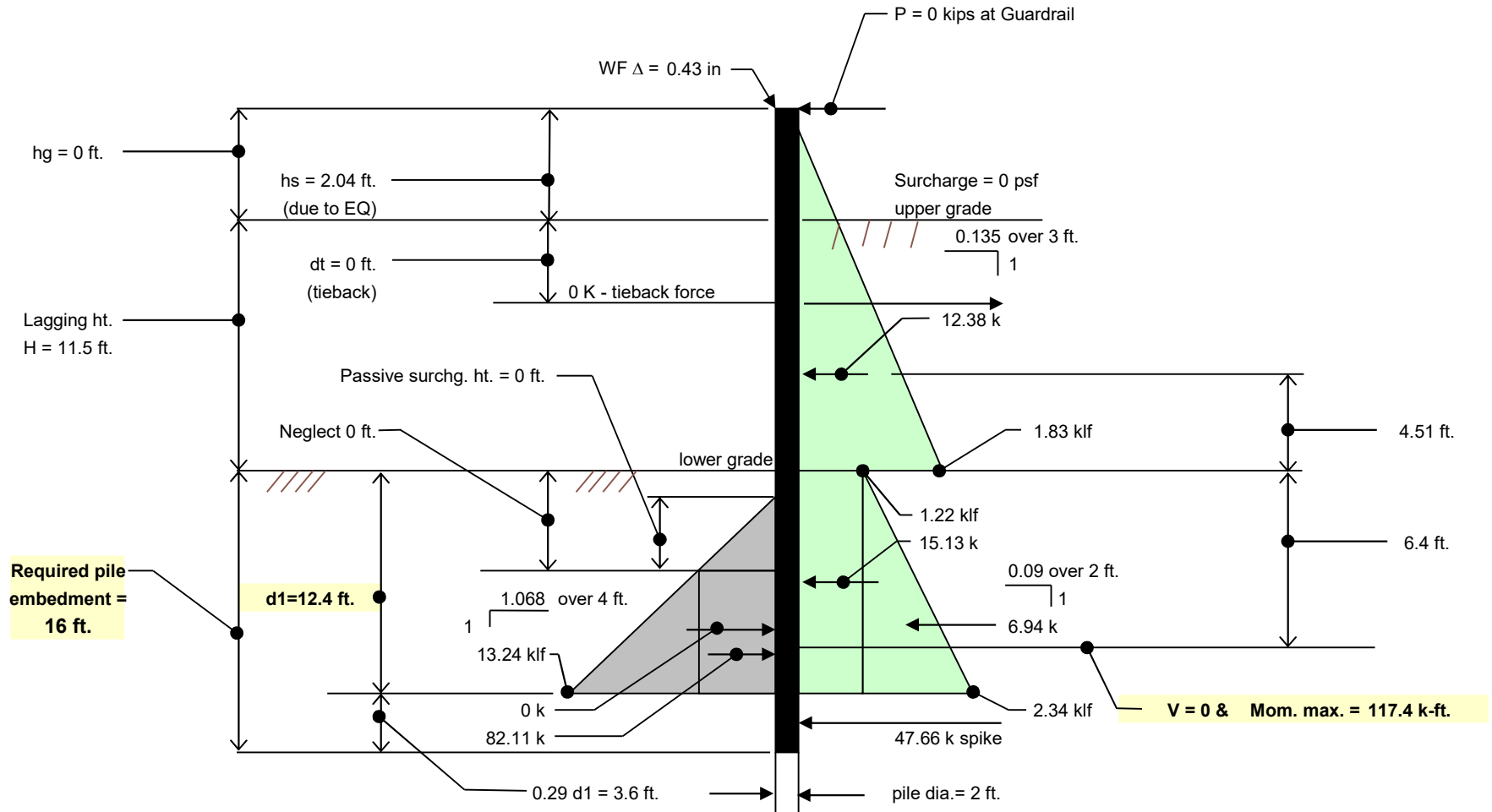
Lagging moment = **0.34** k-ft./ft.
 Lagging required bending stress = **0.17** ksi (for 3-1/2 in. thick pressure treated lagging at 50% full active EFP)
 Lagging required bending stress = **0.07** ksi (for 5-1/2 in. thick pressure treated lagging at 50% full active EFP)

Combined Pile Skin Friction & End Bearing:

Weight per lineal foot of WF:	35	plf		
Total length of pile:	28.50	ft.		
wt =	1.00	kips		
Concrete:	3.14	area	depth to consider for skin friction =	8.50 ft.
Total Length of concrete:	17.00	ft.	surface area of pile =	53.41 sq.ft.
wt =	8.01	kips	skin friction capacity =	53.41 kips
Superimposed Load on Pile =	3.75	kips	bearing capacity =	0.00 kips
Sum Pile DL =	12.76	kips	sum vertical capacity =	53.41

F.S. bearing = 4.19

Combined pile skin friction & end bearing is **O.K.**



Pile ESP1: **W12X35**

SOLDIER PILE DESIGN ILLUSTRATION FOR 11.5 FT. WALL

ESP2

	INPUT		
Soil Wt. =	125		pcf *
Active EFP =	45		pcf *
Passive EFP =	267		pcf *
Additional Uniform Load [rectangular] =	0		psf *
Seismic factor =	8		x "H"
# of pile ϕ active pressure is effective over =	1		below lagging *
# of pile ϕ passive pressure is effective over =	2		below lagging *
Effective Concrete Pile ϕ =	2.00		ft.
Pile spacing =	6.35		ft.
Surcharge =	0		psf
Retained (lagging) height "H" =	11.50		ft.
Height of Tieback from Bottom of Excavation =	0.00		ft.
Height of influence from additional Uniform Load =	0		ft.
Trial WF size =	W12X72		
WF Fy =	50		ksi
Required WF clearance within pile =	2		in. (all around)
For Passive resistance neglect top	0		ft.* of soil (lower grade)
Neglected soil ht. used for passive surcharge	0		ft.* of soil (lower grade)
Max.active pressure used for lagging design =	50		% * @ lower grade
Allowable soil bearing @ bottom of pile =	0		psf *
Allowable pile skin friction to reduce end brg. =	1,000		psf *
Guardrail impact load per pile =	0		kips
Guardrail height above upper grade hg =	0		ft.
Duration increase for passive pres. w/ impact =	1.00		Guardrail impact (Range 1.00 to 1.33)

OUTPUT

Effective surcharge height "hs" = **2.044** ft. (upper grade)
 Moment max. = **285.2** k-ft.
 Sx (provided) = **97.4** in.³
 Ix (provided) = **597** in.⁴
 E_{WF} = **29000** ksi
 bf = **12.00** in.
 d = **12.30** in.

NOTE : -

- 1.) d1 range is from "H" to "6H only".
- 2.) * = Per soils engineer's requirements, including appropriate Factors of safety.

Maximum Bending Stress on WF Pile:

fb (actual) = **35.13** ksi WF O.K. for stress
 Fb = .76 Fy = **38.00** ksi AISC 9th Edition pg. 5-155
 WF diagonal = **17.19** in. **3.4 in. clr. if WF is centered in pile**
 WF Δ = **0.433** in. (at top of pile due to loading above lower grade)

W12X72 O.K. for stress

Lagging Design:

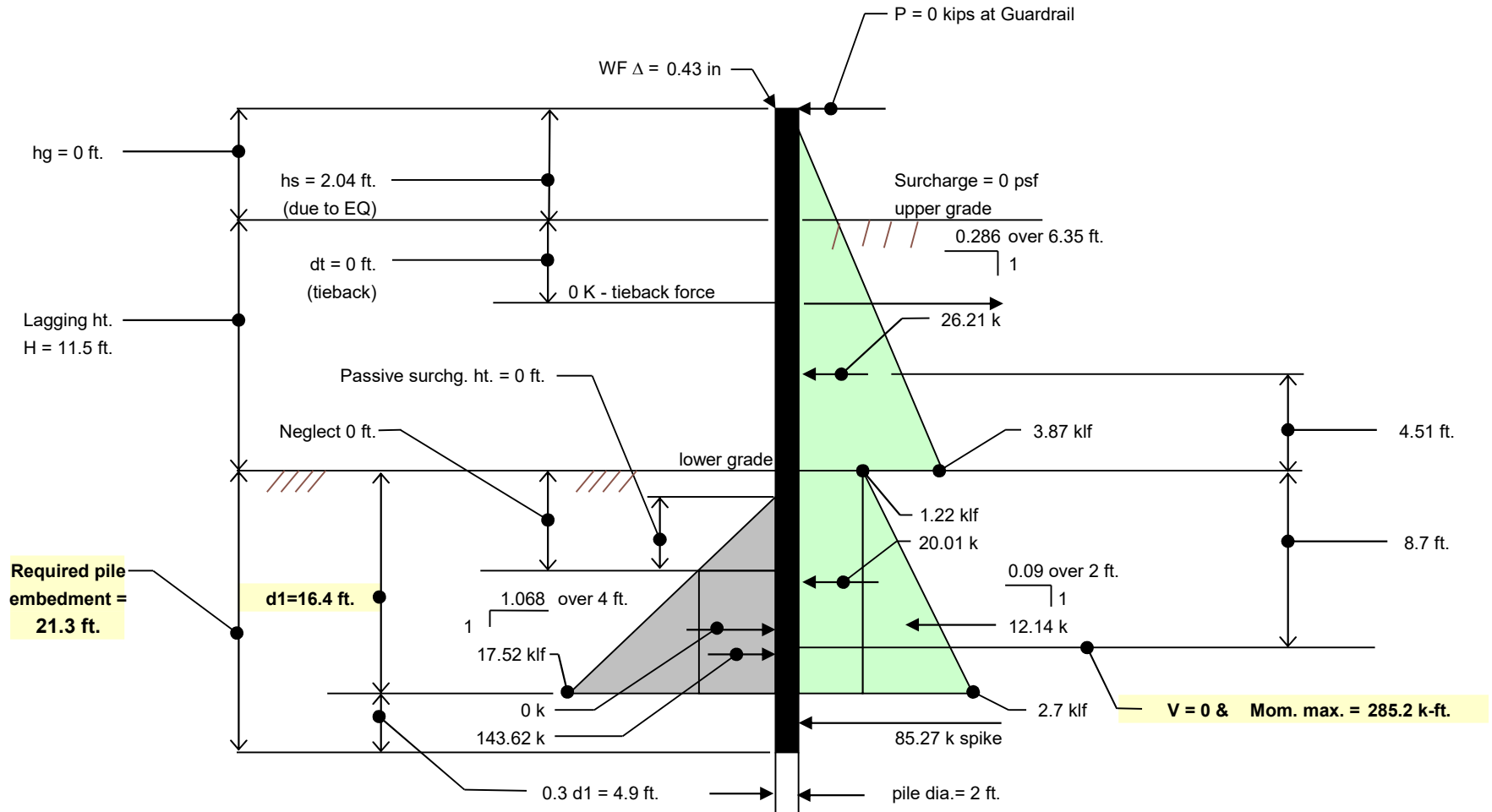
Lagging moment = **1.54** k-ft./ft.
 Lagging required bending stress = **0.76** ksi (for 3-1/2 in. thick pressure treated lagging at 50% full active EFP)
 Lagging required bending stress = **0.31** ksi (for 5-1/2 in. thick pressure treated lagging at 50% full active EFP)

Combined Pile Skin Friction & End Bearing:

Weight per lineal foot of WF:	72	plf		
Total length of pile:	34.50	ft.		
wt =	2.48	kips		
Concrete:	3.14	area	depth to consider for skin friction =	14.50 ft.
Total Length of concrete:	23.00	ft.	surface area of pile =	91.11 sq.ft.
wt =	10.84	kips	skin friction capacity =	91.11 kips
Superimposed Load on Pile =	7.94	kips	bearing capacity =	0.00 kips
Sum Pile DL =	21.26	kips	sum vertical capacity =	91.11

F.S. bearing = 4.29

Combined pile skin friction & end bearing is **O.K.**



Pile ESP2: **W12X72**

SOLDIER PILE DESIGN ILLUSTRATION FOR 11.5 FT. WALL

ESP3

	INPUT		
Soil Wt. =	125		pcf *
Active EFP =	55		pcf *
Passive EFP =	267		pcf *
Additional Uniform Load [rectangular] =	0		psf *
Seismic factor =	8		x "H"
# of pile ϕ active pressure is effective over =	1		below lagging *
# of pile ϕ passive pressure is effective over =	2		below lagging *
Effective Concrete Pile ϕ =	2.50		ft.
Pile spacing =	6.35		ft.
Surcharge =	0		psf
Retained (lagging) height "H" =	12.50		ft.
Height of Tieback from Bottom of Excavation =	0.00		ft.
Height of influence from additional Uniform Load =	0		ft.
Trial WF size =	W18X86		
WF Fy =	50		ksi
Required WF clearance within pile =	2		in. (all around)
For Passive resistance neglect top	0		ft.* of soil (lower grade)
Neglected soil ht. used for passive surcharge	0		ft.* of soil (lower grade)
Max.active pressure used for lagging design =	50		% * @ lower grade
Allowable soil bearing @ bottom of pile =	0		psf *
Allowable pile skin friction to reduce end brg. =	1,000		psf *
Guardrail impact load per pile =	0		kips
Guardrail height above upper grade hg =	0		ft.
Duration increase for passive pres. w/ impact =	1.00		Guardrail impact (Range 1.00 to 1.33)

OUTPUT

Effective surcharge height "hs" = **1.818** ft. (upper grade)
 Moment max. = **425.0** k-ft.
 Sx (provided) = **166** in.³
 Ix (provided) = **1530** in.⁴
 E_{WF} = **29000** ksi
 bf = **11.10** in.
 d = **18.40** in.

NOTE : -

- 1.) d1 range is from "H" to "6H only".
- 2.) * = Per soils engineer's requirements, including appropriate Factors of safety.

Maximum Bending Stress on WF Pile:

fb (actual) = **30.72** ksi WF O.K. for stress
 Fb = .76 Fy = **38.00** ksi AISC 9th Edition pg. 5-155
 WF diagonal = **21.49** in. **4.25 in. clr. if WF is centered in pile**
 WF Δ = **0.273** in. (at top of pile due to loading above lower grade)

W18X86 O.K. for stress

Lagging Design:

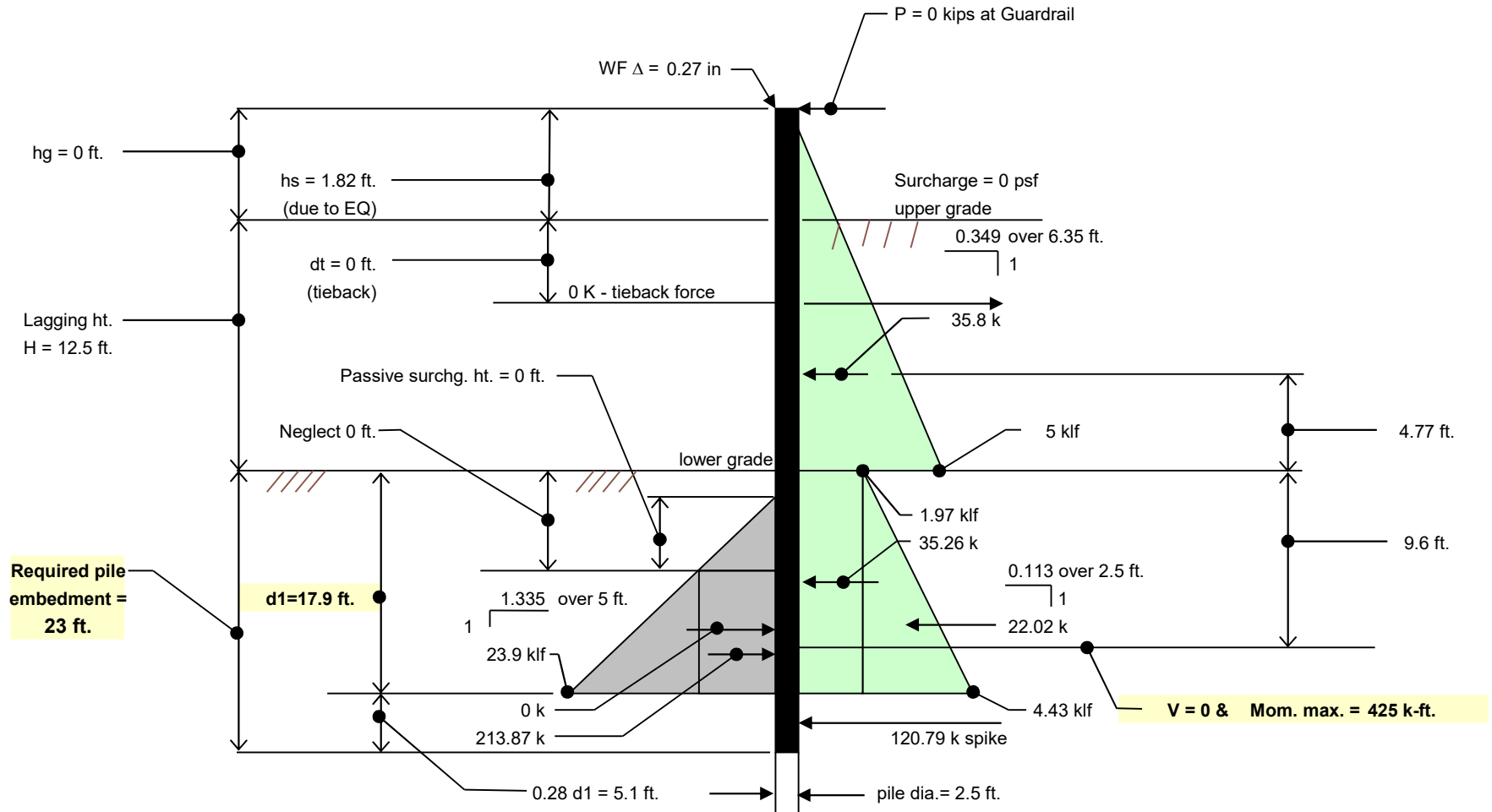
Lagging moment = **1.98** k-ft./ft.
 Lagging required bending stress = **0.98** ksi (for 3-1/2 in. thick pressure treated lagging at 50% full active EFP)
 Lagging required bending stress = **0.40** ksi (for 5-1/2 in. thick pressure treated lagging at 50% full active EFP)

Combined Pile Skin Friction & End Bearing:

Weight per lineal foot of WF:	86	plf		
Total length of pile:	36.50	ft.		
wt =	3.14	kips		
Concrete:	4.91	area	depth to consider for skin friction =	16.50 ft.
Total Length of concrete:	24.00	ft.	surface area of pile =	129.59 sq.ft.
wt =	17.67	kips	skin friction capacity =	129.59 kips
Superimposed Load on Pile =	7.94	kips	bearing capacity =	0.00 kips
Sum Pile DL =	28.75	kips	sum vertical capacity =	129.59

F.S. bearing = 4.51

Combined pile skin friction & end bearing is **O.K.**



Pile ESP3: **W18X86**

SOLDIER PILE DESIGN ILLUSTRATION FOR 12.5 FT. WALL

ESP4

	INPUT		
Soil Wt. =	125		pcf *
Active EFP =	55		pcf *
Passive EFP =	267		pcf *
Additional Uniform Load [rectangular] =	0		psf *
Seismic factor =	8		x "H"
# of pile ϕ active pressure is effective over =	1		below lagging *
# of pile ϕ passive pressure is effective over =	2		below lagging *
Effective Concrete Pile ϕ =	2.00		ft.
Pile spacing =	6.42		ft.
Surcharge =	0		psf
Retained (lagging) height "H" =	9.00		ft.
Height of Tieback from Bottom of Excavation =	0.00		ft.
Height of influence from additional Uniform Load =	0		ft.
Trial WF size =	W12X53		
WF Fy =	50		ksi
Required WF clearance within pile =	2		in. (all around)
For Passive resistance neglect top	0		ft.* of soil (lower grade)
Neglected soil ht. used for passive surcharge	0		ft.* of soil (lower grade)
Max.active pressure used for lagging design =	50		% * @ lower grade
Allowable soil bearing @ bottom of pile =	0		psf *
Allowable pile skin friction to reduce end brg. =	1,000		psf *
Guardrail impact load per pile =	0		kips
Guardrail height above upper grade hg =	0		ft.
Duration increase for passive pres. w/ impact =	1.00		Guardrail impact (Range 1.00 to 1.33)

OUTPUT

Effective surcharge height "hs" = **1.309** ft. (upper grade)
 Moment max. = **168.2** k-ft.
 Sx (provided) = **70.6** in.³
 Ix (provided) = **425** in.⁴
 E_{WF} = **29000** ksi
 bf = **10.00** in.
 d = **12.10** in.

NOTE : -

- 1.) d1 range is from "H" to "6H only".
- 2.) * = Per soils engineer's requirements, including appropriate Factors of safety.

Maximum Bending Stress on WF Pile:

fb (actual) = **28.60** ksi WF O.K. for stress
 Fb = .76 Fy = **38.00** ksi AISC 9th Edition pg. 5-155
 WF diagonal = **15.70** in. **4.15 in. clr. if WF is centered in pile**
 WF Δ = **0.192** in. (at top of pile due to loading above lower grade)

W12X53 O.K. for stress

Lagging Design:

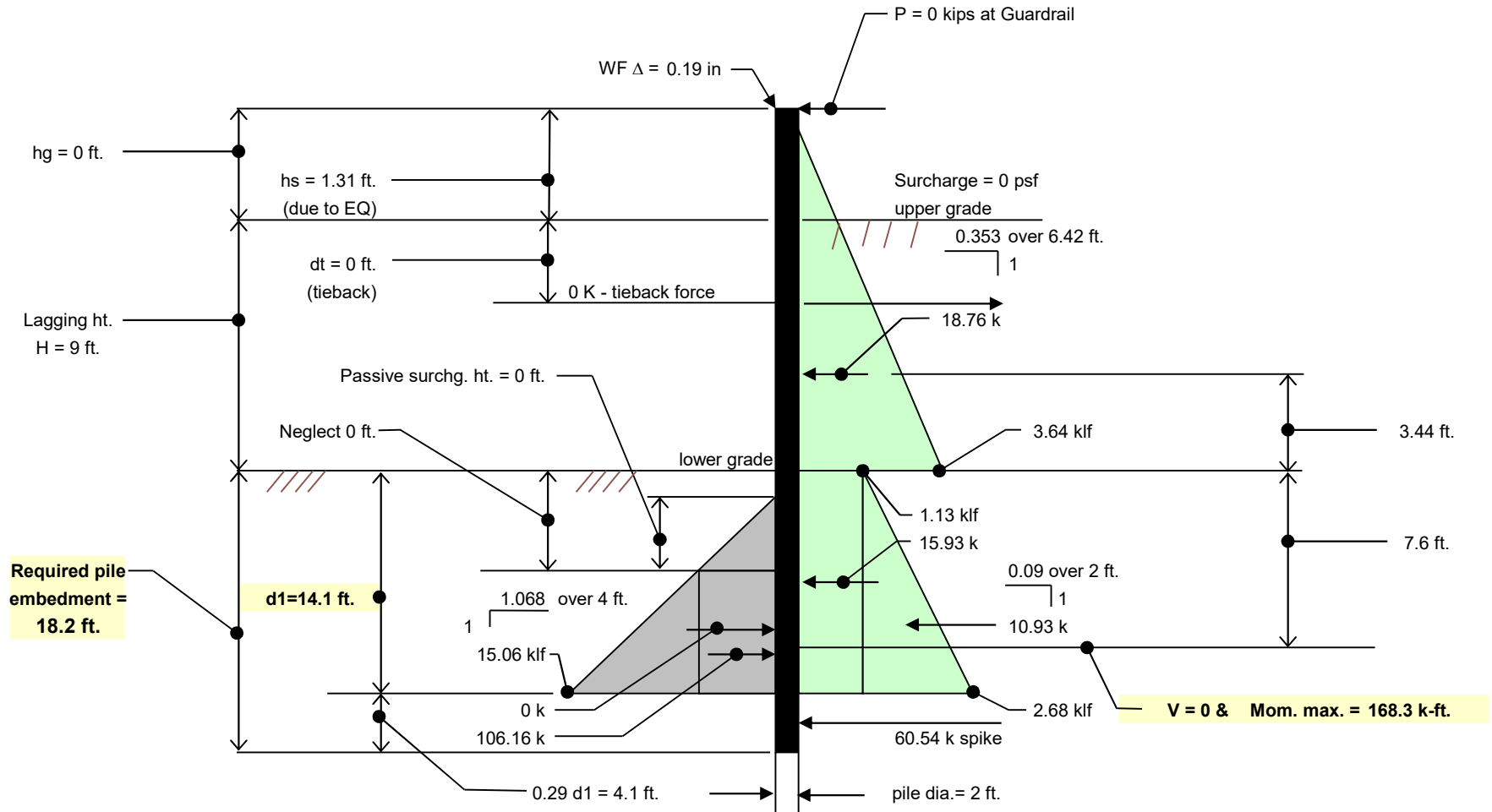
Lagging moment = **1.46** k-ft./ft.
 Lagging required bending stress = **0.72** ksi (for 3-1/2 in. thick pressure treated lagging at 50% full active EFP)
 Lagging required bending stress = **0.29** ksi (for 5-1/2 in. thick pressure treated lagging at 50% full active EFP)

Combined Pile Skin Friction & End Bearing:

Weight per lineal foot of WF:	53	plf		
Total length of pile:	29.00	ft.		
wt =	1.54	kips		
Concrete:	3.14	area	depth to consider for skin friction =	9.00 ft.
Total Length of concrete:	20.00	ft.	surface area of pile =	56.55 sq.ft.
wt =	9.42	kips	skin friction capacity =	56.55 kips
Superimposed Load on Pile =	7.06	kips	bearing capacity =	0.00 kips
Sum Pile DL =	18.02	kips	sum vertical capacity =	56.55

F.S. bearing = 3.14

Combined pile skin friction & end bearing is **O.K.**



Pile ESP4: **W12X53**

SOLDIER PILE DESIGN ILLUSTRATION FOR 9 FT. WALL

ESP5

	INPUT		
Soil Wt. =	125		pcf *
Active EFP =	55		pcf *
Passive EFP =	267		pcf *
Additional Uniform Load [rectangular] =	0		psf *
Seismic factor =	8		x "H"
# of pile ϕ active pressure is effective over =	1		below lagging *
# of pile ϕ passive pressure is effective over =	2		below lagging *
Effective Concrete Pile ϕ =	2.00		ft.
Pile spacing =	3.21		ft.
Surcharge =	0		psf
Retained (lagging) height "H" =	5.00		ft.
Height of Tieback from Bottom of Excavation =	0.00		ft.
Height of influence from additional Uniform Load =	0		ft.
Trial WF size =	W12X53		
WF Fy =	50		ksi
Required WF clearance within pile =	2		in. (all around)
For Passive resistance neglect top	0		ft.* of soil (lower grade)
Neglected soil ht. used for passive surcharge	0		ft.* of soil (lower grade)
Max.active pressure used for lagging design =	50		% * @ lower grade
Allowable soil bearing @ bottom of pile =	0		psf *
Allowable pile skin friction to reduce end brg. =	1,000		psf *
Guardrail impact load per pile =	0		kips
Guardrail height above upper grade hg =	0		ft.
Duration increase for passive pres. w/ impact =	1.00		Guardrail impact (Range 1.00 to 1.33)

OUTPUT

Effective surcharge height "hs" = **0.727** ft. (upper grade)
 Moment max. = **12.7** k-ft.
 Sx (provided) = **70.6** in.³
 Ix (provided) = **425** in.⁴
 E_{WF} = **29000** ksi
 bf = **10.00** in.
 d = **12.10** in.

NOTE : -

- 1.) d1 range is from "H" to "6H only".
- 2.) * = Per soils engineer's requirements, including appropriate Factors of safety.

Maximum Bending Stress on WF Pile:

fb (actual) = **2.16** ksi WF O.K. for stress
 Fb = .76 Fy = **38.00** ksi AISC 9th Edition pg. 5-155
 WF diagonal = **15.70** in. **4.15 in. clr. if WF is centered in pile**
 WF Δ = **0.005** in. (at top of pile due to loading above lower grade)

W12X53 O.K. for stress

Lagging Design:

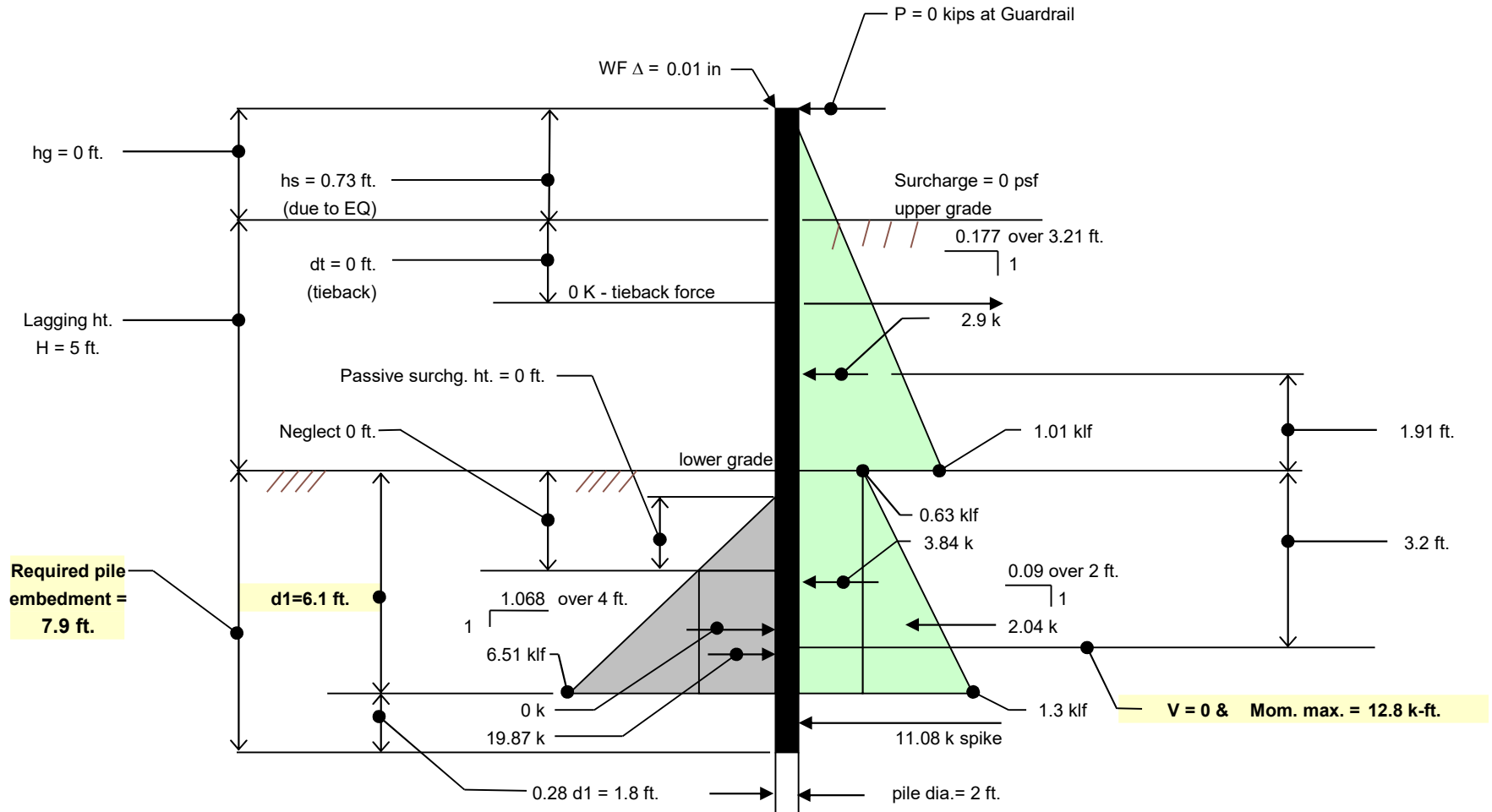
Lagging moment = **0.20** k-ft./ft.
 Lagging required bending stress = **0.10** ksi (for 3-1/2 in. thick pressure treated lagging at 50% full active EFP)
 Lagging required bending stress = **0.05** ksi (for 5-1/2 in. thick pressure treated lagging at 50% full active EFP)

Combined Pile Skin Friction & End Bearing:

Weight per lineal foot of WF:	53	plf		
Total length of pile:	25.00	ft.		
wt =	1.33	kips		
Concrete:	3.14	area	depth to consider for skin friction =	5.00 ft.
Total Length of concrete:	20.00	ft.	surface area of pile =	31.42 sq.ft.
wt =	9.42	kips	skin friction capacity =	31.42 kips
Superimposed Load on Pile =	2.25	kips	bearing capacity =	0.00 kips
Sum Pile DL =	13.00	kips	sum vertical capacity =	31.42

F.S. bearing = 2.42

Combined pile skin friction & end bearing is **O.K.**



Pile ESP5: **W12X53**

SOLDIER PILE DESIGN ILLUSTRATION FOR 5 FT. WALL

GSP5

	<u>INPUT</u>		
Soil Wt. =	125		pcf *
Active EFP =	40		pcf *
Passive EFP =	267		pcf *
Additional Uniform Load [rectangular] =	0		psf *
Seismic factor =	0		x "H"
# of pile ϕ active pressure is effective over =	1		below lagging *
# of pile ϕ passive pressure is effective over =	2		below lagging *
Effective Concrete Pile ϕ =	2.00		ft.
Pile spacing =	6.00		ft.
Surcharge =	0		psf
Retained (lagging) height "H" =	5.50		ft.
Height of Tieback from Bottom of Excavation =	0.00		ft.
Height of influence from additional Uniform Load =	0		ft.
Trial WF size =	W8X15		
WF Fy =	50		ksi
Required WF clearance within pile =	2		in. (all around)
For Passive resistance neglect top	0		ft.* of soil (lower grade)
Neglected soil ht. used for passive surcharge	0		ft.* of soil (lower grade)
Max.active pressure used for lagging design =	50		% * @ lower grade
Allowable soil bearing @ bottom of pile =	0		psf *
Allowable pile skin friction to reduce end brg. =	1,000		psf *
Guardrail impact load per pile =	0		kips
Guardrail height above upper grade hg =	0		ft.
Duration increase for passive pres. w/ impact =	1.00		Guardrail impact (Range 1.00 to 1.33)

OUTPUT

Effective surcharge height "hs" = **0.000** ft. (upper grade)
 Moment max. = **15.2** k-ft.
 Sx (provided) = **11.8** in.³
 Ix (provided) = **48** in.⁴
 E_{WF} = **29000** ksi
 bf = **4.01** in.
 d = **8.11** in.

NOTE : -

- 1.) d1 range is from "H" to "6H only".
- 2.) * = Per soils engineer's requirements, including appropriate Factors of safety.

Maximum Bending Stress on WF Pile:

fb (actual) = **15.44** ksi WF O.K. for stress
 Fb = .76 Fy = **38.00** ksi AISC 9th Edition pg. 5-155
 WF diagonal = **8.94** in. **7.53 in. clr. if WF is centered in pile**
 WF Δ = **0.050** in. (at top of pile due to loading above lower grade)

W8X15 O.K. for stress

Lagging Design:

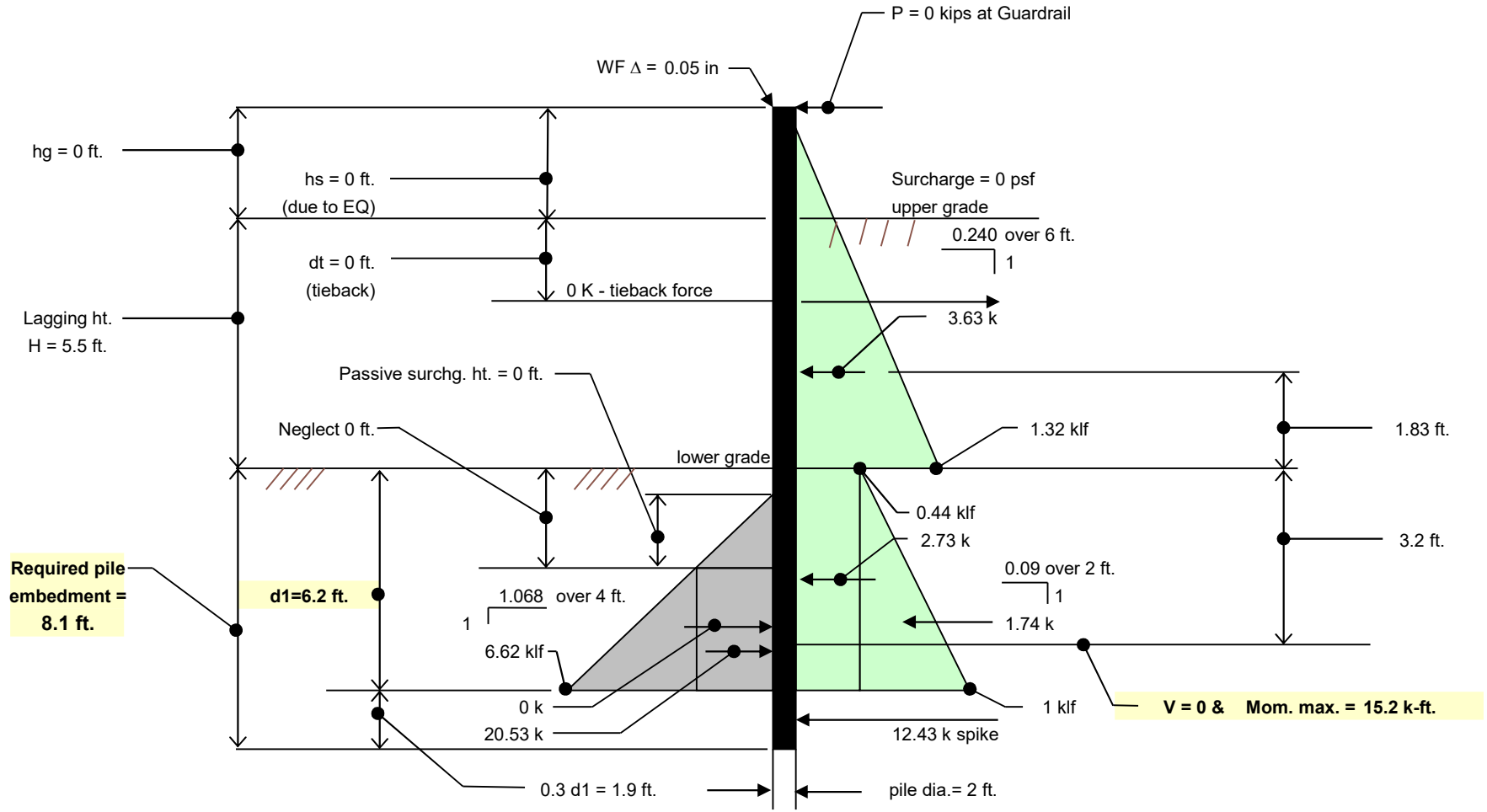
Lagging moment = **0.50** k-ft./ft.
 Lagging required bending stress = **0.25** ksi (for 3-1/2 in. thick pressure treated lagging at 50% full active EFP)
 Lagging required bending stress = **0.10** ksi (for 5-1/2 in. thick pressure treated lagging at 50% full active EFP)

Combined Pile Skin Friction & End Bearing:

Weight per lineal foot of WF:	15	plf		
Total length of pile:	23.50	ft.		
wt =	0.35	kips		
Concrete:	3.14	area	depth to consider for skin friction =	3.50 ft.
Total Length of concrete:	18.00	ft.	surface area of pile =	21.99 sq.ft.
wt =	8.48	kips	skin friction capacity =	21.99 kips
Superimposed Load on Pile =	0.00	kips	bearing capacity =	0.00 kips
Sum Pile DL =	8.83	kips	sum vertical capacity =	21.99

F.S. bearing = 2.49

Combined pile skin friction & end bearing is **O.K.**



Pile GSP5: **W8X15**

SOLDIER PILE DESIGN ILLUSTRATION FOR 5.5 FT. WALL

HSP1-C

		<u>INPUT</u>	
Soil Wt. =	125	pcf *	
Active EFP =	45	pcf *	
Passive EFP =	267	pcf *	
Additional Uniform Load [rectangular] =	0	psf *	
Seismic factor =	8	x "H"	
# of pile ϕ active pressure is effective over =	1	below lagging *	
# of pile ϕ passive pressure is effective over =	2	below lagging *	
Effective Concrete Pile ϕ =	2.00	ft.	
Pile spacing =	3.00	ft.	
Surcharge =	0	psf	
Retained (lagging) height "H" =	16.75	ft.	
Height of Tieback from Bottom of Excavation =	0.00	ft.	
Height of influence from additional Uniform Load =	0	ft.	
Trial WF size =	W12X87		
WF Fy =	50	ksi	
Required WF clearance within pile =	2	in. (all around)	
For Passive resistance neglect top	0	ft.* of soil (lower grade)	
Neglected soil ht. used for passive surcharge	0	ft.* of soil (lower grade)	
Max.active pressure used for lagging design =	50	% * @ lower grade	
Allowable soil bearing @ bottom of pile =	0	psf *	
Allowable pile skin friction to reduce end brg. =	1,000	psf *	
Guardrail impact load per pile =	0	kips	
Guardrail height above upper grade hg =	0	ft.	
Duration increase for passive pres. w/ impact =	1.00	Guardrail impact (Range 1.00 to 1.33)	

OUTPUT

Effective surcharge height "hs" = **2.978** ft. (upper grade)
 Moment max. = **362.7** k-ft.
 Sx (provided) = **118** in.³
 Ix (provided) = **740** in.⁴
 E_{WF} = **29000** ksi
 bf = **12.10** in.
 d = **12.50** in.

NOTE : -

- 1.) d1 range is from "H" to "6H only".
- 2.) * = Per soils engineer's requirements, including appropriate Factors of safety.

Maximum Bending Stress on WF Pile:

fb (actual) = **36.89** ksi WF O.K. for stress
 Fb = .76 Fy = **38.00** ksi AISC 9th Edition pg. 5-155
 WF diagonal = **17.40** in. **3.3 in. clr. if WF is centered in pile**
 WF Δ = **1.083** in. (at top of pile due to loading above lower grade)

W12X87 O.K. for stress

Lagging Design:

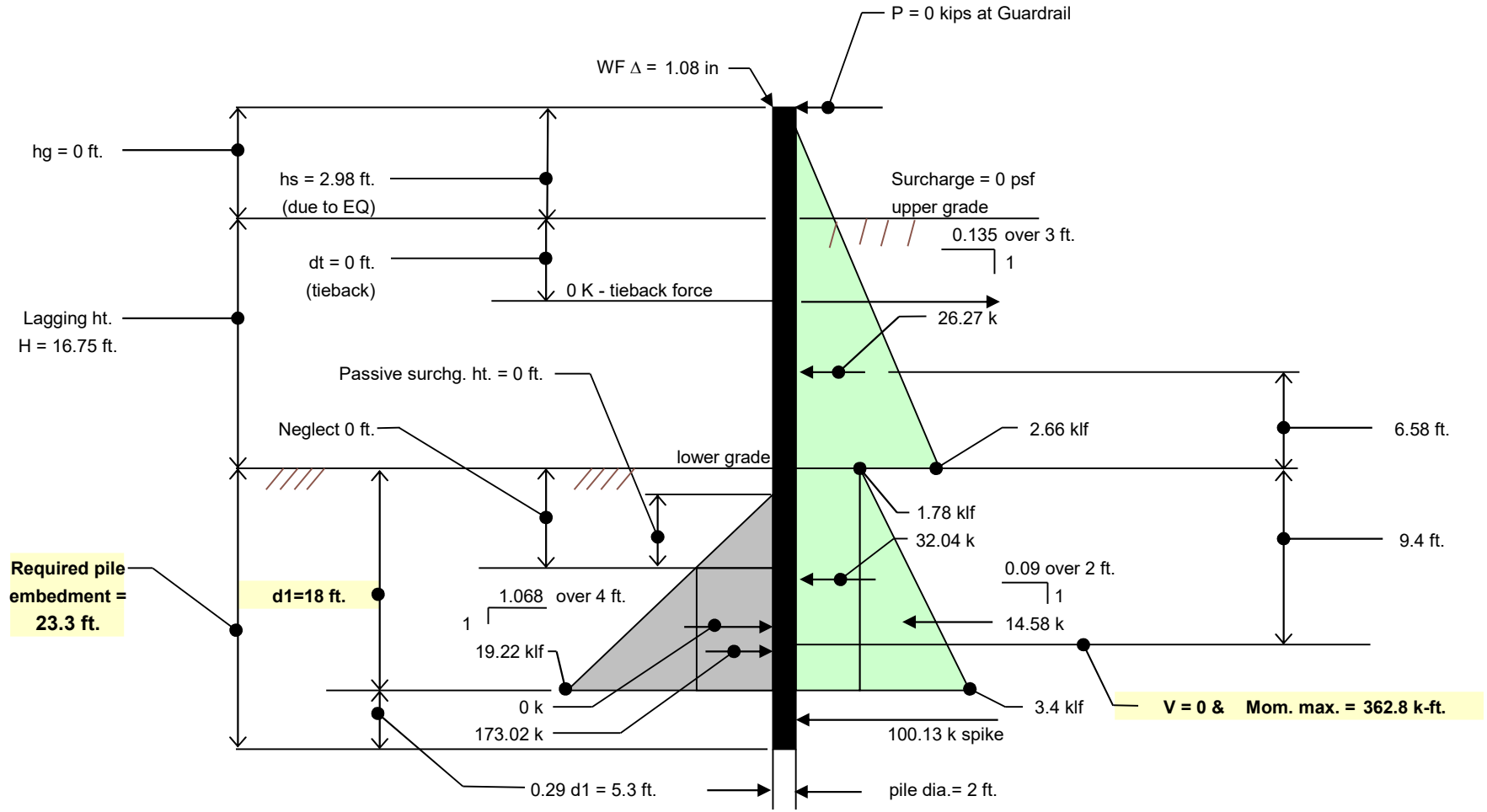
Lagging moment = **0.50** k-ft./ft.
 Lagging required bending stress = **0.25** ksi (for 3-1/2 in. thick pressure treated lagging at 50% full active EFP)
 Lagging required bending stress = **0.10** ksi (for 5-1/2 in. thick pressure treated lagging at 50% full active EFP)

Combined Pile Skin Friction & End Bearing:

Weight per lineal foot of WF:	87	plf		
Total length of pile:	40.75	ft.		
wt =	3.55	kips		
Concrete:	3.14	area	depth to consider for skin friction =	20.75 ft.
Total Length of concrete:	24.00	ft.	surface area of pile =	130.38 sq.ft.
wt =	11.31	kips	skin friction capacity =	130.38 kips
Superimposed Load on Pile =	14.27	kips	bearing capacity =	0.00 kips
Sum Pile DL =	29.12	kips	sum vertical capacity =	130.38

F.S. bearing = 4.48

Combined pile skin friction & end bearing is **O.K.**



Pile HSP1-C: **W12X87**

SOLDIER PILE DESIGN ILLUSTRATION FOR 16.75 FT. WALL

HSP1

	INPUT		
Soil Wt. =	125		pcf *
Active EFP =	45		pcf *
Passive EFP =	267		pcf *
Additional Uniform Load [rectangular] =	0		psf *
Seismic factor =	8		x "H"
# of pile ϕ active pressure is effective over =	1		below lagging *
# of pile ϕ passive pressure is effective over =	2		below lagging *
Effective Concrete Pile ϕ =	2.50		ft.
Pile spacing =	6.10		ft.
Surcharge =	0		psf
Retained (lagging) height "H" =	16.75		ft.
Height of Tieback from Bottom of Excavation =	0.00		ft.
Height of influence from additional Uniform Load =	0		ft.
Trial WF size =	W18X130		
WF Fy =	50		ksi
Required WF clearance within pile =	2		in. (all around)
For Passive resistance neglect top	0		ft.* of soil (lower grade)
Neglected soil ht. used for passive surcharge	0		ft.* of soil (lower grade)
Max.active pressure used for lagging design =	50		% * @ lower grade
Allowable soil bearing @ bottom of pile =	0		psf *
Allowable pile skin friction to reduce end brg. =	1,000		psf *
Guardrail impact load per pile =	0		kips
Guardrail height above upper grade hg =	0		ft.
Duration increase for passive pres. w/ impact =	1.00		Guardrail impact (Range 1.00 to 1.33)

OUTPUT

Effective surcharge height "hs" = **2.978** ft. (upper grade)
 Moment max. = **802.6** k-ft.
 Sx (provided) = **256** in.³
 Ix (provided) = **2460** in.⁴
 E_{WF} = **29000** ksi
 bf = **11.20** in.
 d = **19.30** in.

NOTE : -

- 1.) d1 range is from "H" to "6H only".
- 2.) * = Per soils engineer's requirements, including appropriate Factors of safety.

Maximum Bending Stress on WF Pile:

fb (actual) = **37.62** ksi WF O.K. for stress
 Fb = .76 Fy = **38.00** ksi AISC 9th Edition pg. 5-155
 WF diagonal = **22.32** in. **3.84 in. clr. if WF is centered in pile**
 WF Δ = **0.662** in. (at top of pile due to loading above lower grade)

W18X130 O.K. for stress

Lagging Design:

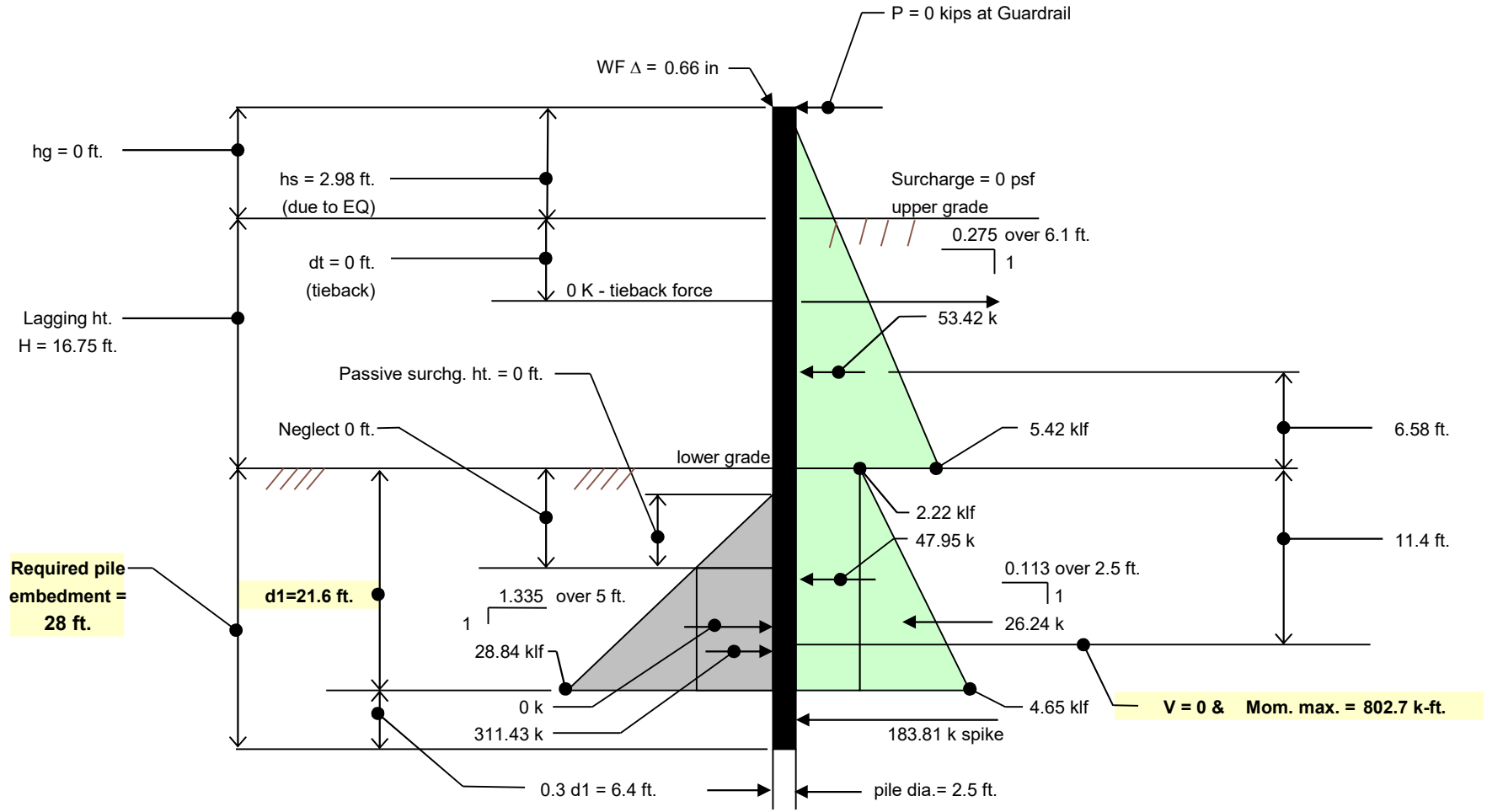
Lagging moment = **2.06** k-ft./ft.
 Lagging required bending stress = **1.02** ksi (for 3-1/2 in. thick pressure treated lagging at 50% full active EFP)
 Lagging required bending stress = **0.41** ksi (for 5-1/2 in. thick pressure treated lagging at 50% full active EFP)

Combined Pile Skin Friction & End Bearing:

Weight per lineal foot of WF:	130	plf		
Total length of pile:	44.75	ft.		
wt =	5.82	kips		
Concrete:	4.91	area	depth to consider for skin friction =	24.75 ft.
Total Length of concrete:	28.00	ft.	surface area of pile =	194.39 sq.ft.
wt =	20.62	kips	skin friction capacity =	194.39 kips
Superimposed Load on Pile =	29.01	kips	bearing capacity =	0.00 kips
Sum Pile DL =	55.44	kips	sum vertical capacity =	194.39

F.S. bearing = 3.51

Combined pile skin friction & end bearing is **O.K.**



Pile HSP1: **W18X130**

SOLDIER PILE DESIGN ILLUSTRATION FOR 16.75 FT. WALL

HSP2-C

INPUT

Soil Wt. =	125	pcf *
Active EFP =	45	pcf *
Passive EFP =	267	pcf *
Additional Uniform Load [rectangular] =	0	psf *
Seismic factor =	8	x "H"
# of pile ϕ active pressure is effective over =	1	below lagging *
# of pile ϕ passive pressure is effective over =	2	below lagging *
Effective Concrete Pile ϕ =	2.50	ft.
Pile spacing =	3.00	ft.
Surcharge =	0	psf
Retained (lagging) height "H" =	17.50	ft.
Height of Tieback from Bottom of Excavation =	0.00	ft.
Height of influence from additional Uniform Load =	0	ft.
Trial WF size =	W18X86	
WF Fy =	50	ksi
Required WF clearance within pile =	2	in. (all around)
For Passive resistance neglect top	0	ft.* of soil (lower grade)
Neglected soil ht. used for passive surcharge	0	ft.* of soil (lower grade)
Max.active pressure used for lagging design =	50	% * @ lower grade
Allowable soil bearing @ bottom of pile =	0	psf *
Allowable pile skin friction to reduce end brg. =	1,000	psf *
Guardrail impact load per pile =	0	kips
Guardrail height above upper grade hg =	0	ft.
Duration increase for passive pres. w/ impact =	1.00	Guardrail impact (Range 1.00 to 1.33)

OUTPUT

Effective surcharge height "hs" = **3.111** ft. (upper grade)
 Moment max. = **400.5** k-ft.
 Sx (provided) = **166** in.³
 Ix (provided) = **1530** in.⁴
 E_{WF} = **29000** ksi
 bf = **11.10** in.
 d = **18.40** in.

NOTE : -

- 1.) d1 range is from "H" to "6H only".
- 2.) * = Per soils engineer's requirements, including appropriate Factors of safety.

Maximum Bending Stress on WF Pile:

fb (actual) = **28.95** ksi WF O.K. for stress
 Fb = .76 Fy = **38.00** ksi AISC 9th Edition pg. 5-155
 WF diagonal = **21.49** in. **4.25 in. clr. if WF is centered in pile**
 WF Δ = **0.652** in. (at top of pile due to loading above lower grade)

W18X86 O.K. for stress

Lagging Design:

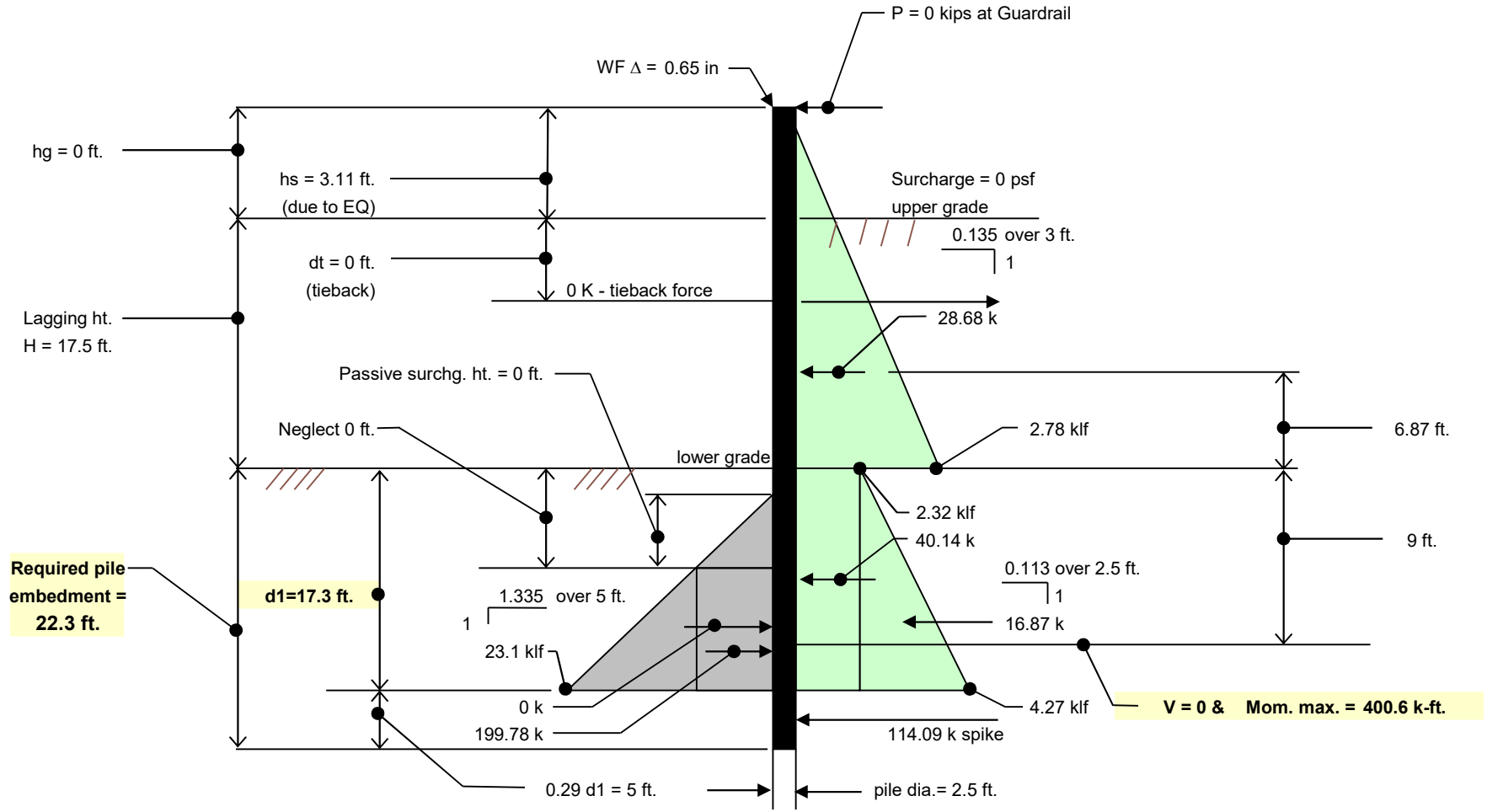
Lagging moment = **0.52** k-ft./ft.
 Lagging required bending stress = **0.26** ksi (for 3-1/2 in. thick pressure treated lagging at 50% full active EFP)
 Lagging required bending stress = **0.11** ksi (for 5-1/2 in. thick pressure treated lagging at 50% full active EFP)

Combined Pile Skin Friction & End Bearing:

Weight per lineal foot of WF:	86	plf		
Total length of pile:	41.50	ft.		
wt =	3.57	kips		
Concrete:	4.91	area	depth to consider for skin friction =	21.50 ft.
Total Length of concrete:	24.00	ft.	surface area of pile =	168.86 sq.ft.
wt =	17.67	kips	skin friction capacity =	168.86 kips
Superimposed Load on Pile =	12.53	kips	bearing capacity =	0.00 kips
Sum Pile DL =	33.77	kips	sum vertical capacity =	168.86

F.S. bearing = 5.00

Combined pile skin friction & end bearing is **O.K.**



Pile HSP2-C: **W18X86**

SOLDIER PILE DESIGN ILLUSTRATION FOR 17.5 FT. WALL

HSP2

	INPUT		
Soil Wt. =	125		pcf *
Active EFP =	45		pcf *
Passive EFP =	267		pcf *
Additional Uniform Load [rectangular] =	0		psf *
Seismic factor =	8		x "H"
# of pile ϕ active pressure is effective over =	1		below lagging *
# of pile ϕ passive pressure is effective over =	2		below lagging *
Effective Concrete Pile ϕ =	2.50		ft.
Pile spacing =	6.00		ft.
Surcharge =	0		psf
Retained (lagging) height "H" =	17.50		ft.
Height of Tieback from Bottom of Excavation =	0.00		ft.
Height of influence from additional Uniform Load =	0		ft.
Trial WF size =	W18X158		
WF Fy =	50		ksi
Required WF clearance within pile =	2		in. (all around)
For Passive resistance neglect top	0		ft.* of soil (lower grade)
Neglected soil ht. used for passive surcharge	0		ft.* of soil (lower grade)
Max.active pressure used for lagging design =	50		% * @ lower grade
Allowable soil bearing @ bottom of pile =	0		psf *
Allowable pile skin friction to reduce end brg. =	1,000		psf *
Guardrail impact load per pile =	0		kips
Guardrail height above upper grade hg =	0		ft.
Duration increase for passive pres. w/ impact =	1.00		Guardrail impact (Range 1.00 to 1.33)

OUTPUT

Effective surcharge height "hs" = **3.111** ft. (upper grade)
 Moment max. = **897.4** k-ft.
 Sx (provided) = **310** in.³
 Ix (provided) = **3060** in.⁴
 E_{WF} = **29000** ksi
 bf = **11.30** in.
 d = **19.70** in.

NOTE : -

- 1.) d1 range is from "H" to "6H only".
- 2.) * = Per soils engineer's requirements, including appropriate Factors of safety.

Maximum Bending Stress on WF Pile:

fb (actual) = **34.74** ksi WF O.K. for stress
 Fb = .76 Fy = **38.00** ksi AISC 9th Edition pg. 5-155
 WF diagonal = **22.72** in. **3.64 in. clr. if WF is centered in pile**
 WF Δ = **0.652** in. (at top of pile due to loading above lower grade)

W18X158 O.K. for stress

Lagging Design:

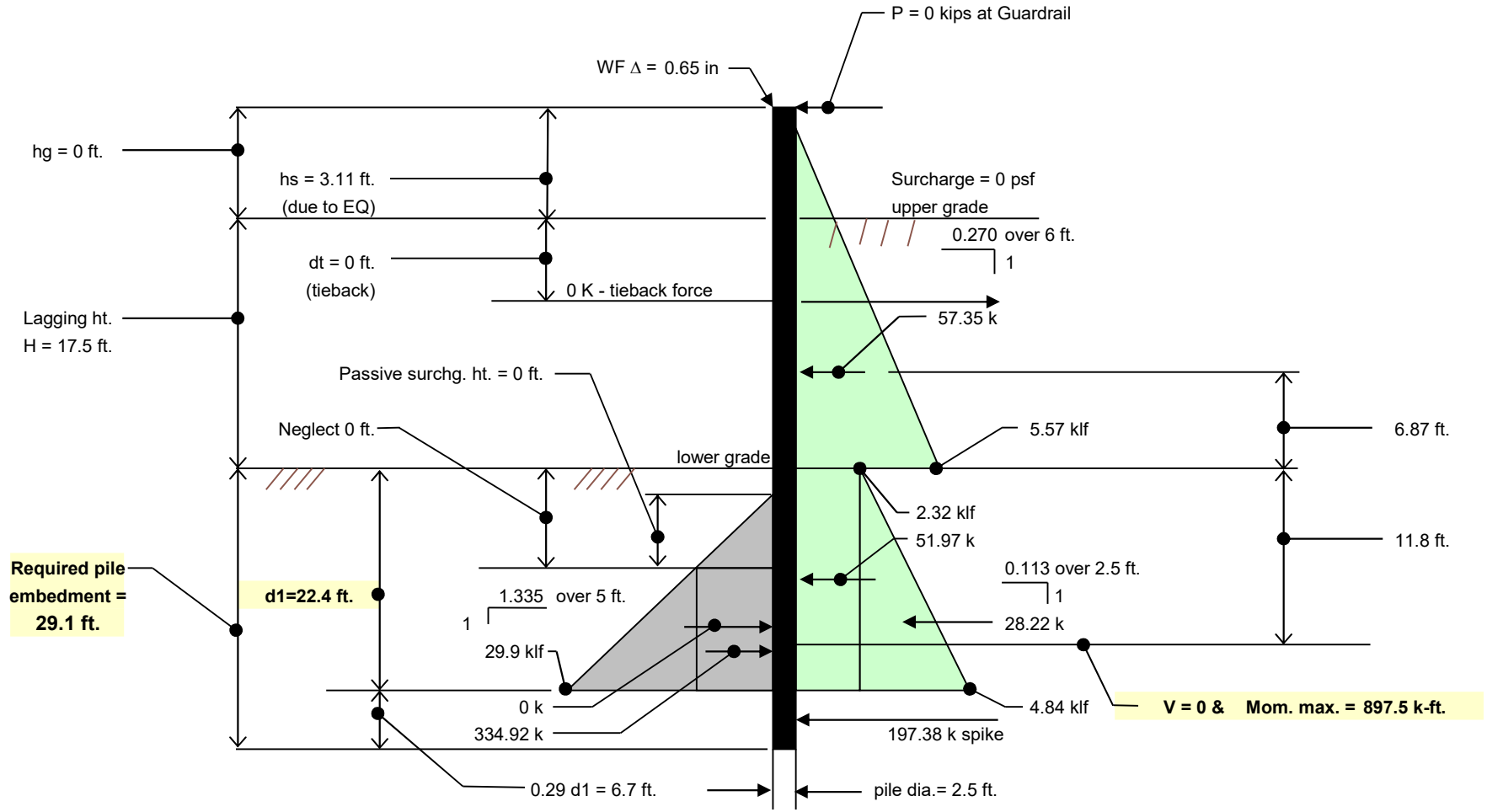
Lagging moment = **2.09** k-ft./ft.
 Lagging required bending stress = **1.03** ksi (for 3-1/2 in. thick pressure treated lagging at 50% full active EFP)
 Lagging required bending stress = **0.42** ksi (for 5-1/2 in. thick pressure treated lagging at 50% full active EFP)

Combined Pile Skin Friction & End Bearing:

Weight per lineal foot of WF:	158	plf		
Total length of pile:	47.50	ft.		
wt =	7.51	kips		
Concrete:	4.91	area	depth to consider for skin friction =	27.50 ft.
Total Length of concrete:	30.00	ft.	surface area of pile =	215.98 sq.ft.
wt =	22.09	kips	skin friction capacity =	215.98 kips
Superimposed Load on Pile =	25.05	kips	bearing capacity =	0.00 kips
Sum Pile DL =	54.65	kips	sum vertical capacity =	215.98

F.S. bearing = 3.95

Combined pile skin friction & end bearing is **O.K.**



Pile HSP2: **W18X158**

SOLDIER PILE DESIGN ILLUSTRATION FOR 17.5 FT. WALL

HSP3

	INPUT		
Soil Wt. =	125		pcf *
Active EFP =	45		pcf *
Passive EFP =	267		pcf *
Additional Uniform Load [rectangular] =	0		psf *
Seismic factor =	8		x "H"
# of pile ϕ active pressure is effective over =	1		below lagging *
# of pile ϕ passive pressure is effective over =	2		below lagging *
Effective Concrete Pile ϕ =	2.50		ft.
Pile spacing =	5.33		ft.
Surcharge =	0		psf
Retained (lagging) height "H" =	15.50		ft.
Height of Tieback from Bottom of Excavation =	0.00		ft.
Height of influence from additional Uniform Load =	0		ft.
Trial WF size =	W18X106		
WF Fy =	50		ksi
Required WF clearance within pile =	2		in. (all around)
For Passive resistance neglect top	0		ft.* of soil (lower grade)
Neglected soil ht. used for passive surcharge	0		ft.* of soil (lower grade)
Max.active pressure used for lagging design =	50		% * @ lower grade
Allowable soil bearing @ bottom of pile =	0		psf *
Allowable pile skin friction to reduce end brg. =	1,000		psf *
Guardrail impact load per pile =	0		kips
Guardrail height above upper grade hg =	0		ft.
Duration increase for passive pres. w/ impact =	1.00		Guardrail impact (Range 1.00 to 1.33)

OUTPUT

Effective surcharge height "hs" = **2.756** ft. (upper grade)
 Moment max. = **541.9** k-ft.
 Sx (provided) = **204** in.³
 Ix (provided) = **1910** in.⁴
 E_{WF} = **29000** ksi
 bf = **11.20** in.
 d = **18.70** in.

NOTE : -

- 1.) d1 range is from "H" to "6H only".
- 2.) * = Per soils engineer's requirements, including appropriate Factors of safety.

Maximum Bending Stress on WF Pile:

fb (actual) = **31.87** ksi WF O.K. for stress
 Fb = .76 Fy = **38.00** ksi AISC 9th Edition pg. 5-155
 WF diagonal = **21.80** in. **4.1 in. clr. if WF is centered in pile**
 WF Δ = **0.506** in. (at top of pile due to loading above lower grade)

W18X106 O.K. for stress

Lagging Design:

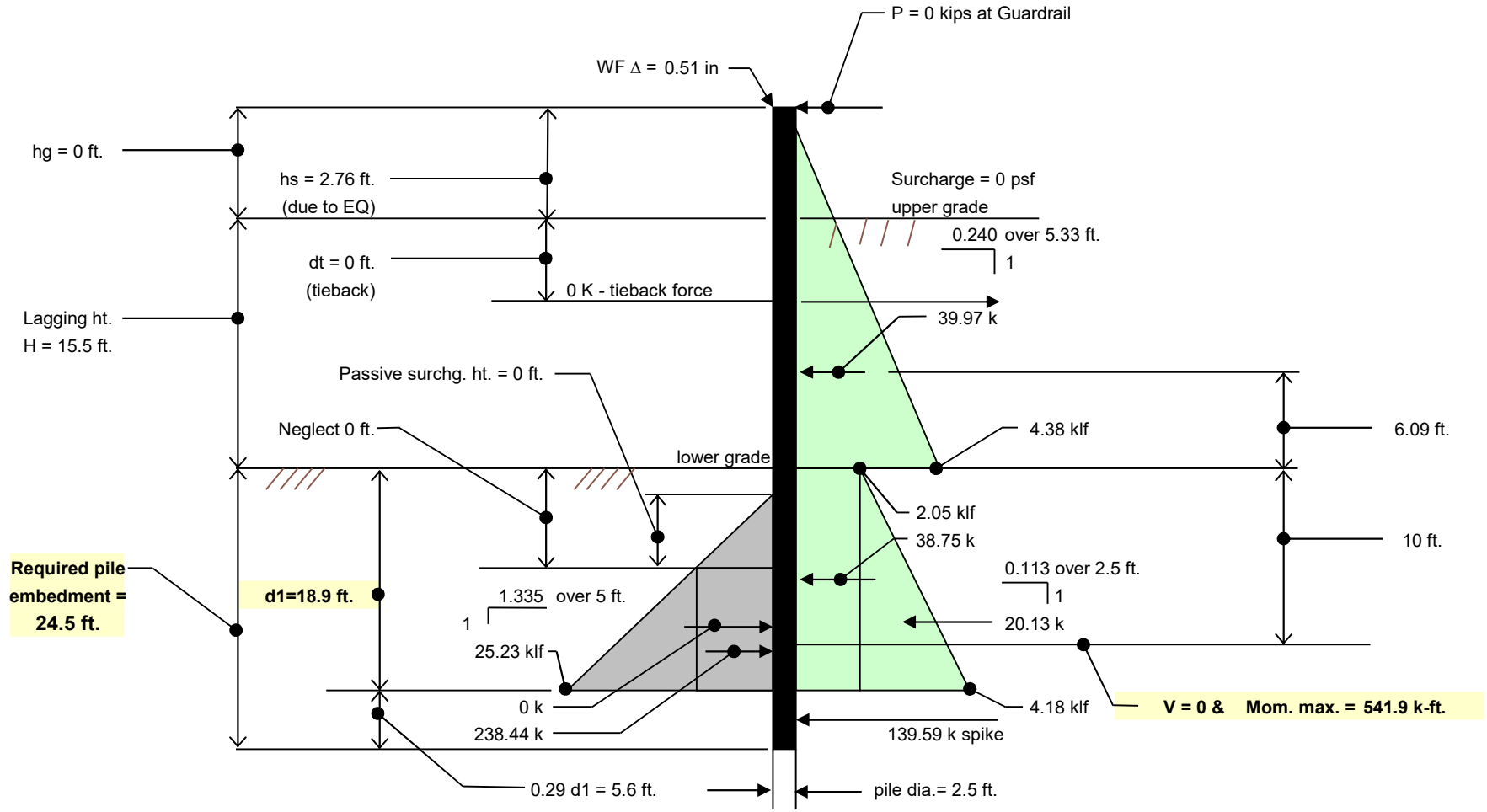
Lagging moment = **1.46** k-ft./ft.
 Lagging required bending stress = **0.72** ksi (for 3-1/2 in. thick pressure treated lagging at 50% full active EFP)
 Lagging required bending stress = **0.29** ksi (for 5-1/2 in. thick pressure treated lagging at 50% full active EFP)

Combined Pile Skin Friction & End Bearing:

Weight per lineal foot of WF:	106	plf		
Total length of pile:	41.50	ft.		
wt =	4.40	kips		
Concrete:	4.91	area	depth to consider for skin friction =	21.50 ft.
Total Length of concrete:	26.00	ft.	surface area of pile =	168.86 sq.ft.
wt =	19.14	kips	skin friction capacity =	168.86 kips
Superimposed Load on Pile =	22.25	kips	bearing capacity =	0.00 kips
Sum Pile DL =	45.80	kips	sum vertical capacity =	168.86

F.S. bearing = 3.69

Combined pile skin friction & end bearing is **O.K.**



Pile HSP3: **W18X106**

SOLDIER PILE DESIGN ILLUSTRATION FOR 15.5 FT. WALL

HSP4

		<u>INPUT</u>	
Soil Wt. =	125	pcf *	
Active EFP =	45	pcf *	
Passive EFP =	267	pcf *	
Additional Uniform Load [rectangular] =	0	psf *	
Seismic factor =	8	x "H"	
# of pile ϕ active pressure is effective over =	1	below lagging *	
# of pile ϕ passive pressure is effective over =	2	below lagging *	
Effective Concrete Pile ϕ =	2.50	ft.	
Pile spacing =	5.50	ft.	
Surcharge =	0	psf	
Retained (lagging) height "H" =	13.50	ft.	
Height of Tieback from Bottom of Excavation =	0.00	ft.	
Height of influence from additional Uniform Load =	0	ft.	
Trial WF size =	W18X86		
WF Fy =	50	ksi	
Required WF clearance within pile =	2	in. (all around)	
For Passive resistance neglect top	0	ft.* of soil (lower grade)	
Neglected soil ht. used for passive surcharge	0	ft.* of soil (lower grade)	
Max.active pressure used for lagging design =	50	% * @ lower grade	
Allowable soil bearing @ bottom of pile =	0	psf *	
Allowable pile skin friction to reduce end brg. =	1,000	psf *	
Guardrail impact load per pile =	0	kips	
Guardrail height above upper grade hg =	0	ft.	
Duration increase for passive pres. w/ impact =	1.00	Guardrail impact (Range 1.00 to 1.33)	

OUTPUT

Effective surcharge height "hs" = **2.400** ft. (upper grade)
 Moment max. = **371.6** k-ft.
 Sx (provided) = **166** in.³
 Ix (provided) = **1530** in.⁴
 E_{WF} = **29000** ksi
 bf = **11.10** in.
 d = **18.40** in.

NOTE : -

- 1.) d1 range is from "H" to "6H only".
- 2.) * = Per soils engineer's requirements, including appropriate Factors of safety.

Maximum Bending Stress on WF Pile:

fb (actual) = **26.86** ksi WF O.K. for stress
 Fb = .76 Fy = **38.00** ksi AISC 9th Edition pg. 5-155
 WF diagonal = **21.49** in. **4.25 in. clr. if WF is centered in pile**
 WF Δ = **0.327** in. (at top of pile due to loading above lower grade)

W18X86 O.K. for stress

Lagging Design:

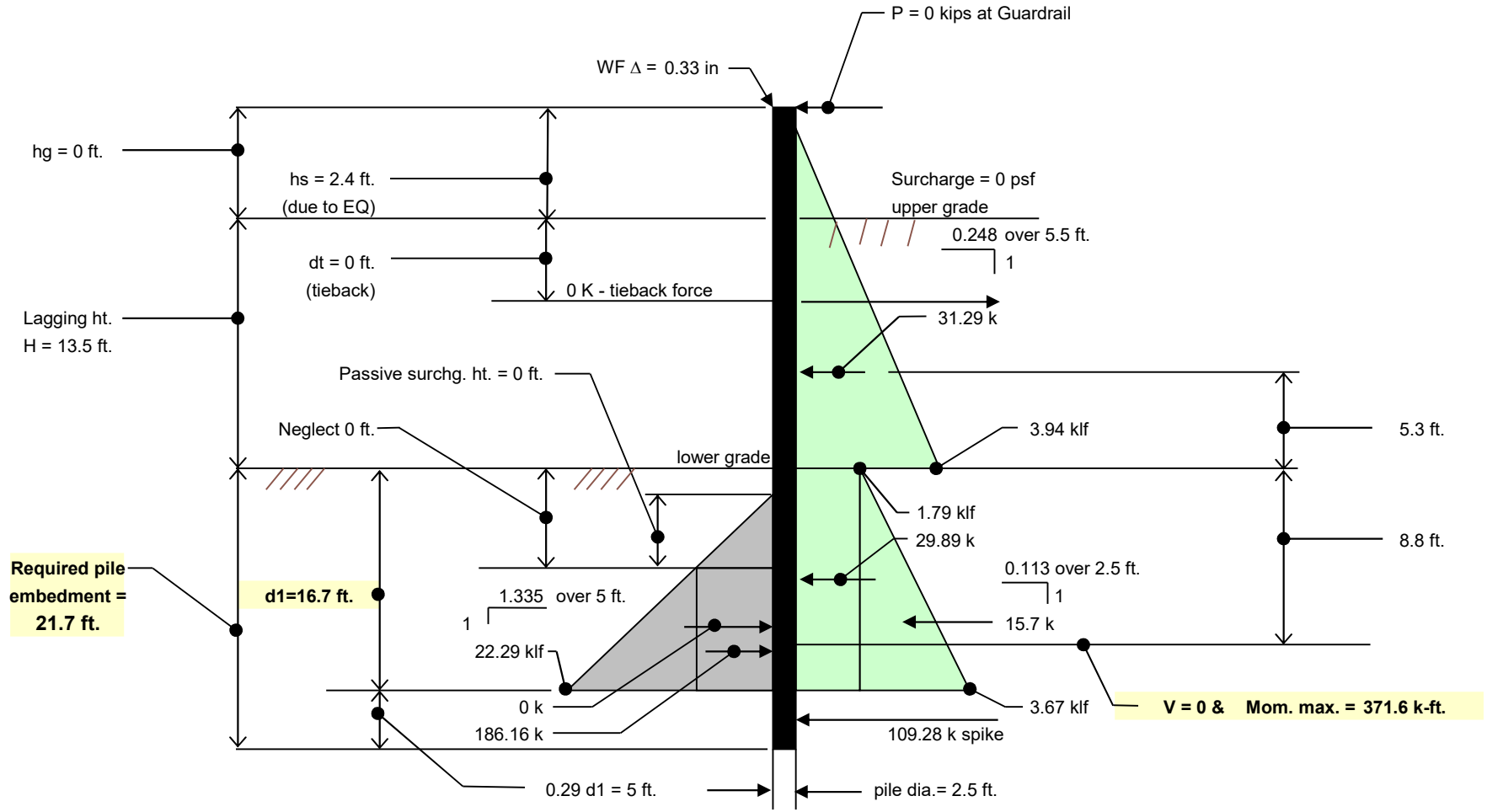
Lagging moment = **1.35** k-ft./ft.
 Lagging required bending stress = **0.67** ksi (for 3-1/2 in. thick pressure treated lagging at 50% full active EFP)
 Lagging required bending stress = **0.27** ksi (for 5-1/2 in. thick pressure treated lagging at 50% full active EFP)

Combined Pile Skin Friction & End Bearing:

Weight per lineal foot of WF:	86	plf		
Total length of pile:	37.50	ft.		
wt =	3.23	kips		
Concrete:	4.91	area	depth to consider for skin friction =	17.50 ft.
Total Length of concrete:	24.00	ft.	surface area of pile =	137.44 sq.ft.
wt =	17.67	kips	skin friction capacity =	137.44 kips
Superimposed Load on Pile =	21.86	kips	bearing capacity =	0.00 kips
Sum Pile DL =	42.76	kips	sum vertical capacity =	137.44

F.S. bearing = 3.21

Combined pile skin friction & end bearing is **O.K.**



Pile HSP4: **W18X86**

SOLDIER PILE DESIGN ILLUSTRATION FOR 13.5 FT. WALL

HSP5

		<u>INPUT</u>	
Soil Wt. =	125		pcf *
Active EFP =	40		pcf *
Passive EFP =	267		pcf *
Additional Uniform Load [rectangular] =	0		psf *
Seismic factor =	0		x "H"
# of pile ϕ active pressure is effective over =	1		below lagging *
# of pile ϕ passive pressure is effective over =	2		below lagging *
Effective Concrete Pile ϕ =	2.00		ft.
Pile spacing =	5.92		ft.
Surcharge =	0		psf
Retained (lagging) height "H" =	13.00		ft.
Height of Tieback from Bottom of Excavation =	0.00		ft.
Height of influence from additional Uniform Load =	0		ft.
Trial WF size =	W12X87		
WF Fy =	50		ksi
Required WF clearance within pile =	2		in. (all around)
For Passive resistance neglect top	0		ft.* of soil (lower grade)
Neglected soil ht. used for passive surcharge	0		ft.* of soil (lower grade)
Max.active pressure used for lagging design =	50		% * @ lower grade
Allowable soil bearing @ bottom of pile =	0		psf *
Allowable pile skin friction to reduce end brg. =	1,000		psf *
Guardrail impact load per pile =	0		kips
Guardrail height above upper grade hg =	0		ft.
Duration increase for passive pres. w/ impact =	1.00		Guardrail impact (Range 1.00 to 1.33)

OUTPUT

Effective surcharge height "hs" = **0.000** ft. (upper grade)
 Moment max. = **197.3** k-ft.
 Sx (provided) = **118** in.³
 Ix (provided) = **740** in.⁴
 E_{WF} = **29000** ksi
 bf = **12.10** in.
 d = **12.50** in.

NOTE : -

- 1.) d1 range is from "H" to "6H only".
- 2.) * = Per soils engineer's requirements, including appropriate Factors of safety.

Maximum Bending Stress on WF Pile:

fb (actual) = **20.06** ksi WF O.K. for stress
 Fb = .76 Fy = **38.00** ksi AISC 9th Edition pg. 5-155
 WF diagonal = **17.40** in. **3.3 in. clr. if WF is centered in pile**
 WF Δ = **0.236** in. (at top of pile due to loading above lower grade)

W12X87 O.K. for stress

Lagging Design:

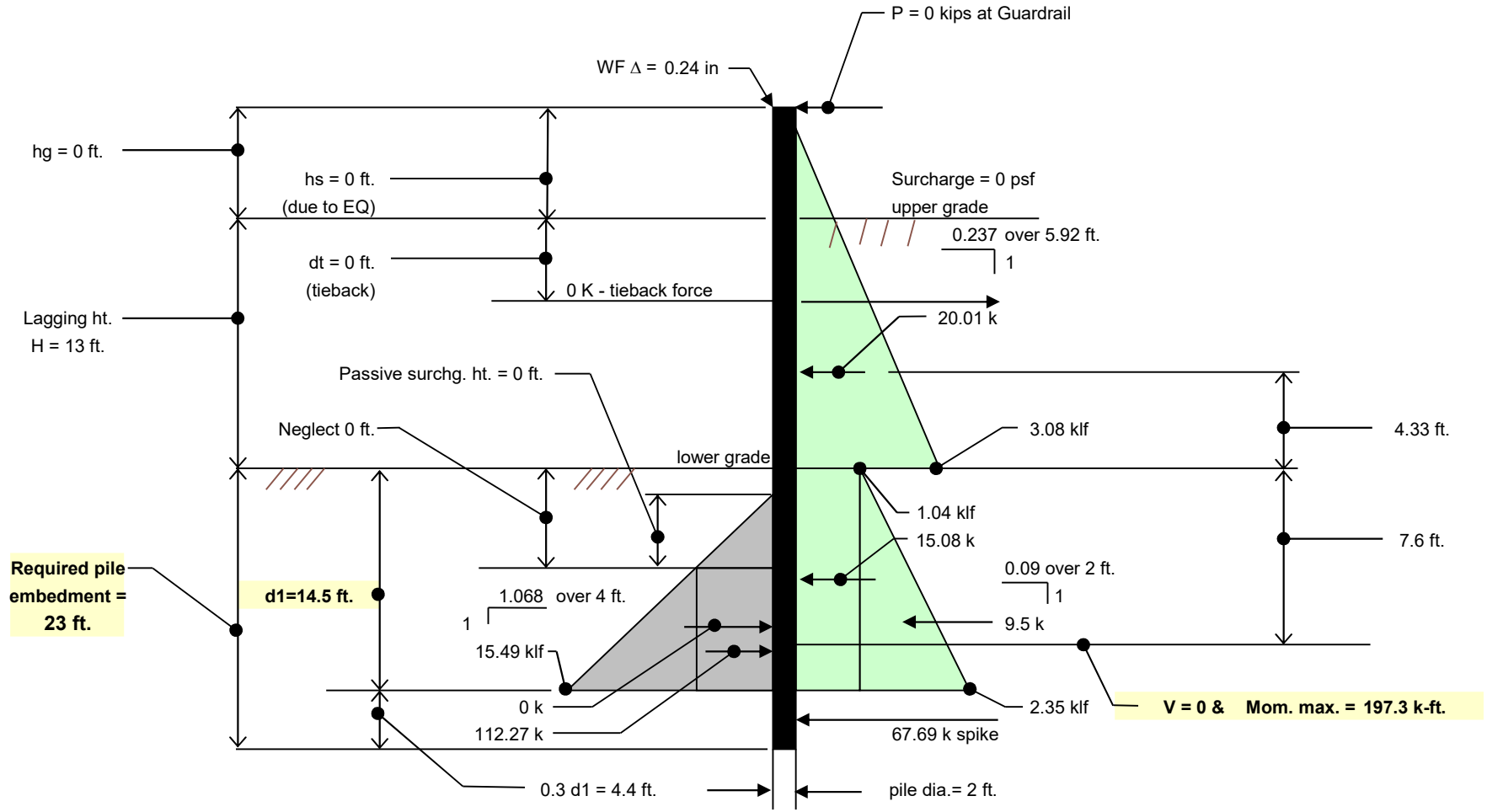
Lagging moment = **1.14** k-ft./ft.
 Lagging required bending stress = **0.56** ksi (for 3-1/2 in. thick pressure treated lagging at 50% full active EFP)
 Lagging required bending stress = **0.23** ksi (for 5-1/2 in. thick pressure treated lagging at 50% full active EFP)

Combined Pile Skin Friction & End Bearing:

Weight per lineal foot of WF:	87	plf		
Total length of pile:	37.00	ft.		
wt =	3.22	kips		
Concrete:	3.14	area	depth to consider for skin friction =	17.00 ft.
Total Length of concrete:	24.00	ft.	surface area of pile =	106.81 sq.ft.
wt =	11.31	kips	skin friction capacity =	106.81 kips
Superimposed Load on Pile =	0.00	kips	bearing capacity =	0.00 kips
Sum Pile DL =	14.53	kips	sum vertical capacity =	106.81

F.S. bearing = 7.35

Combined pile skin friction & end bearing is **O.K.**



Pile HSP5: **W12X87**

SOLDIER PILE DESIGN ILLUSTRATION FOR 13 FT. WALL

HSP6

		<u>INPUT</u>	
Soil Wt. =	125	pcf *	
Active EFP =	40	pcf *	
Passive EFP =	267	pcf *	
Additional Uniform Load [rectangular] =	0	psf *	
Seismic factor =	0	x "H"	
# of pile ϕ active pressure is effective over =	1	below lagging *	
# of pile ϕ passive pressure is effective over =	2	below lagging *	
Effective Concrete Pile ϕ =	2.00	ft.	
Pile spacing =	6.00	ft.	
Surcharge =	0	psf	
Retained (lagging) height "H" =	9.00	ft.	
Height of Tieback from Bottom of Excavation =	0.00	ft.	
Height of influence from additional Uniform Load =	0	ft.	
Trial WF size =	W12X35		
WF Fy =	50	ksi	
Required WF clearance within pile =	2	in. (all around)	
For Passive resistance neglect top	0	ft.* of soil (lower grade)	
Neglected soil ht. used for passive surcharge	0	ft.* of soil (lower grade)	
Max.active pressure used for lagging design =	50	% * @ lower grade	
Allowable soil bearing @ bottom of pile =	0	psf *	
Allowable pile skin friction to reduce end brg. =	1,000	psf *	
Guardrail impact load per pile =	0	kips	
Guardrail height above upper grade hg =	0	ft.	
Duration increase for passive pres. w/ impact =	1.00	Guardrail impact (Range 1.00 to 1.33)	

OUTPUT

Effective surcharge height "hs" = **0.000** ft. (upper grade)
 Moment max. = **66.5** k-ft.
 Sx (provided) = **45.6** in.³
 Ix (provided) = **285** in.⁴
 E_{WF} = **29000** ksi
 bf = **6.56** in.
 d = **12.50** in.

NOTE : -

- 1.) d1 range is from "H" to "6H only".
- 2.) * = Per soils engineer's requirements, including appropriate Factors of safety.

Maximum Bending Stress on WF Pile:

fb (actual) = **17.51** ksi WF O.K. for stress
 Fb = .76 Fy = **38.00** ksi AISC 9th Edition pg. 5-155
 WF diagonal = **14.12** in. **4.94 in. clr. if WF is centered in pile**
 WF Δ = **0.099** in. (at top of pile due to loading above lower grade)

W12X35 O.K. for stress

Lagging Design:

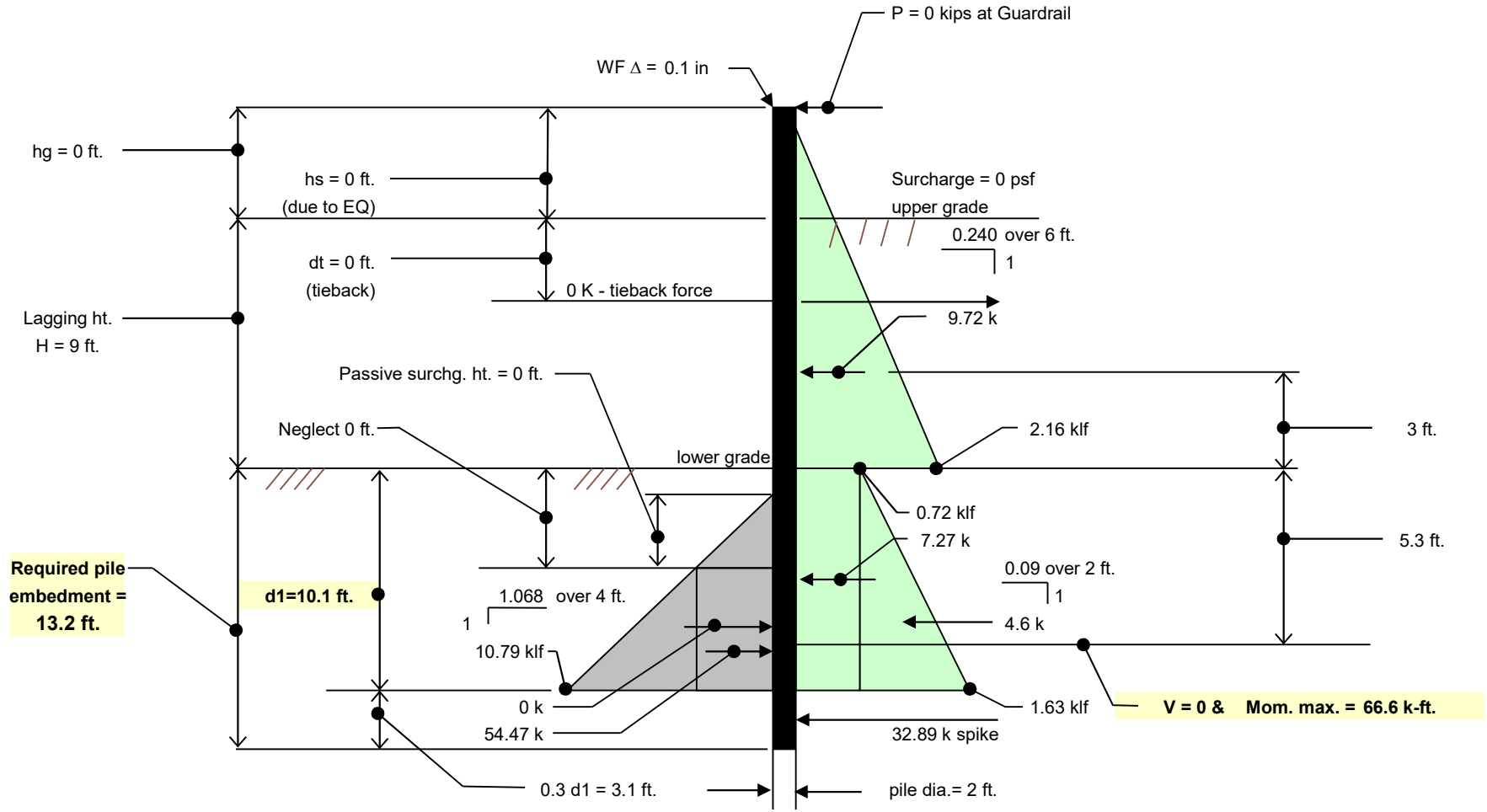
Lagging moment = **0.81** k-ft./ft.
 Lagging required bending stress = **0.40** ksi (for 3-1/2 in. thick pressure treated lagging at 50% full active EFP)
 Lagging required bending stress = **0.17** ksi (for 5-1/2 in. thick pressure treated lagging at 50% full active EFP)

Combined Pile Skin Friction & End Bearing:

Weight per lineal foot of WF:	35	plf		
Total length of pile:	26.00	ft.		
wt =	0.91	kips		
Concrete:	3.14	area	depth to consider for skin friction =	6.00 ft.
Total Length of concrete:	17.00	ft.	surface area of pile =	37.70 sq.ft.
wt =	8.01	kips	skin friction capacity =	37.70 kips
Superimposed Load on Pile =	0.00	kips	bearing capacity =	0.00 kips
Sum Pile DL =	8.92	kips	sum vertical capacity =	37.70

F.S. bearing = 4.23

Combined pile skin friction & end bearing is **O.K.**



Pile HSP6: **W12X35**

SOLDIER PILE DESIGN ILLUSTRATION FOR 9 FT. WALL

HSP7

	INPUT		
Soil Wt. =	125		pcf *
Active EFP =	40		pcf *
Passive EFP =	267		pcf *
Additional Uniform Load [rectangular] =	0		psf *
Seismic factor =	0		x "H"
# of pile ϕ active pressure is effective over =	1		below lagging *
# of pile ϕ passive pressure is effective over =	2		below lagging *
Effective Concrete Pile ϕ =	2.00		ft.
Pile spacing =	6.00		ft.
Surcharge =	0		psf
Retained (lagging) height "H" =	9.00		ft.
Height of Tieback from Bottom of Excavation =	0.00		ft.
Height of influence from additional Uniform Load =	0		ft.
Trial WF size =	W12X53		
WF Fy =	50		ksi
Required WF clearance within pile =	2		in. (all around)
For Passive resistance neglect top	0		ft.* of soil (lower grade)
Neglected soil ht. used for passive surcharge	0		ft.* of soil (lower grade)
Max.active pressure used for lagging design =	50		% * @ lower grade
Allowable soil bearing @ bottom of pile =	0		psf *
Allowable pile skin friction to reduce end brg. =	1,000		psf *
Guardrail impact load per pile =	0		kips
Guardrail height above upper grade hg =	0		ft.
Duration increase for passive pres. w/ impact =	1.00		Guardrail impact (Range 1.00 to 1.33)

OUTPUT

Effective surcharge height "hs" = **0.000** ft. (upper grade)
 Moment max. = **66.5** k-ft.
 Sx (provided) = **70.6** in.³
 Ix (provided) = **425** in.⁴
 E_{WF} = **29000** ksi
 bf = **10.00** in.
 d = **12.10** in.

NOTE : -

- 1.) d1 range is from "H" to "6H only".
- 2.) * = Per soils engineer's requirements, including appropriate Factors of safety.

Maximum Bending Stress on WF Pile:

fb (actual) = **11.31** ksi WF O.K. for stress
 Fb = .76 Fy = **38.00** ksi AISC 9th Edition pg. 5-155
 WF diagonal = **15.70** in. **4.15 in. clr. if WF is centered in pile**
 WF Δ = **0.066** in. (at top of pile due to loading above lower grade)

W12X53 O.K. for stress

Lagging Design:

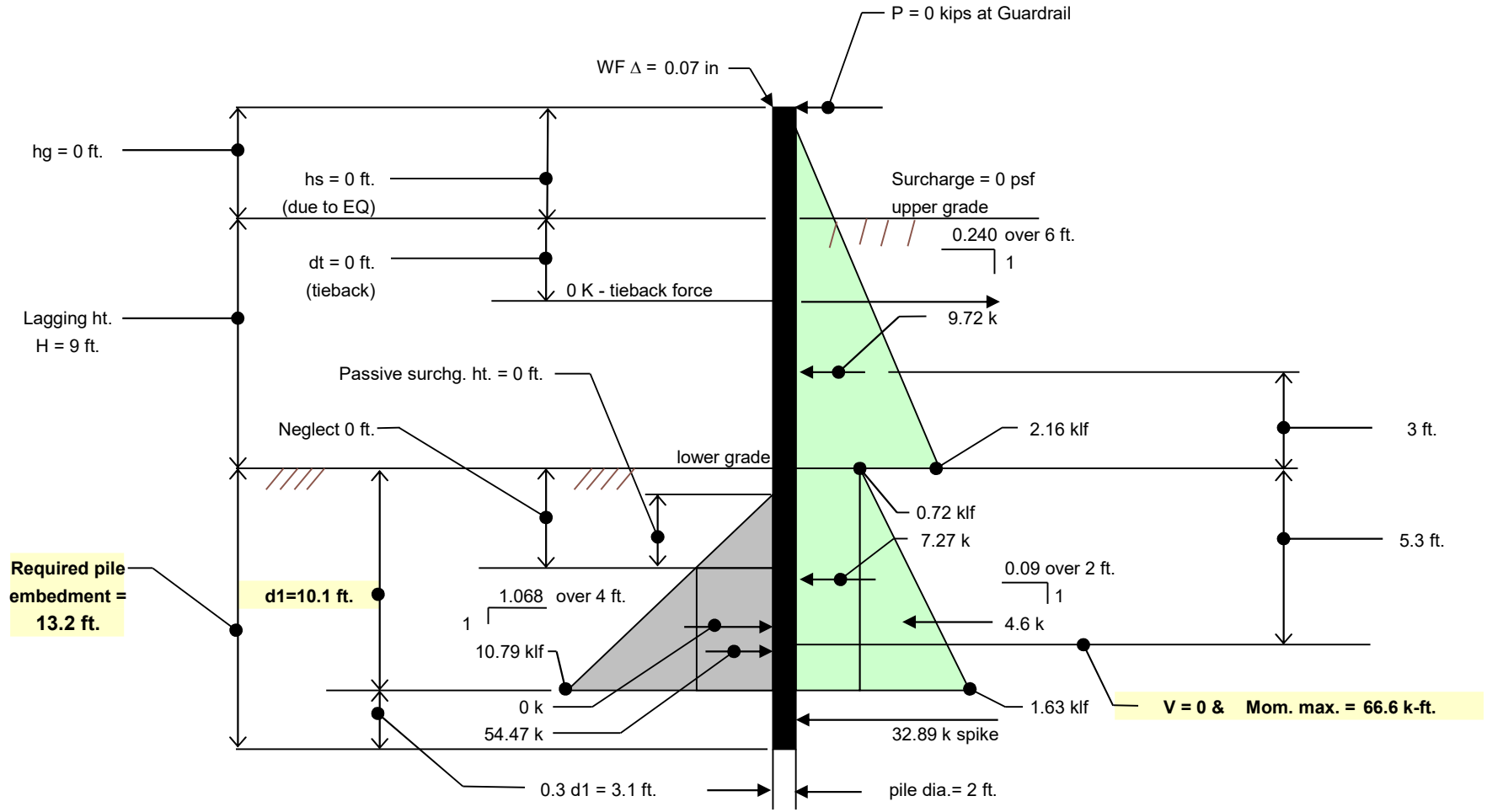
Lagging moment = **0.81** k-ft./ft.
 Lagging required bending stress = **0.40** ksi (for 3-1/2 in. thick pressure treated lagging at 50% full active EFP)
 Lagging required bending stress = **0.17** ksi (for 5-1/2 in. thick pressure treated lagging at 50% full active EFP)

Combined Pile Skin Friction & End Bearing:

Weight per lineal foot of WF:	53	plf		
Total length of pile:	29.00	ft.		
wt =	1.54	kips		
Concrete:	3.14	area	depth to consider for skin friction =	9.00 ft.
Total Length of concrete:	20.00	ft.	surface area of pile =	56.55 sq.ft.
wt =	9.42	kips	skin friction capacity =	56.55 kips
Superimposed Load on Pile =	22.65	kips	bearing capacity =	0.00 kips
Sum Pile DL =	33.61	kips	sum vertical capacity =	56.55

F.S. bearing = 1.68

Combined pile skin friction & end bearing is **O.K.**



Pile HSP7: **W12X53**

SOLDIER PILE DESIGN ILLUSTRATION FOR 9 FT. WALL

HSP8

	<u>INPUT</u>		
Soil Wt. =	125		pcf *
Active EFP =	45		pcf *
Passive EFP =	267		pcf *
Additional Uniform Load [rectangular] =	0		psf *
Seismic factor =	8		x "H"
# of pile ϕ active pressure is effective over =	1		below lagging *
# of pile ϕ passive pressure is effective over =	2		below lagging *
Effective Concrete Pile ϕ =	2.00		ft.
Pile spacing =	6.00		ft.
Surcharge =	0		psf
Retained (lagging) height "H" =	11.50		ft.
Height of Tieback from Bottom of Excavation =	0.00		ft.
Height of influence from additional Uniform Load =	0		ft.
Trial WF size =	W12X72		
WF Fy =	50		ksi
Required WF clearance within pile =	2		in. (all around)
For Passive resistance neglect top	0		ft.* of soil (lower grade)
Neglected soil ht. used for passive surcharge	0		ft.* of soil (lower grade)
Max.active pressure used for lagging design =	50		% * @ lower grade
Allowable soil bearing @ bottom of pile =	0		psf *
Allowable pile skin friction to reduce end brg. =	1,000		psf *
Guardrail impact load per pile =	0		kips
Guardrail height above upper grade hg =	0		ft.
Duration increase for passive pres. w/ impact =	1.00		Guardrail impact (Range 1.00 to 1.33)

OUTPUT

Effective surcharge height "hs" = **2.044** ft. (upper grade)
 Moment max. = **266.3** k-ft.
 Sx (provided) = **97.4** in.³
 Ix (provided) = **597** in.⁴
 E_{WF} = **29000** ksi
 bf = **12.00** in.
 d = **12.30** in.

NOTE : -

- 1.) d1 range is from "H" to "6H only".
- 2.) * = Per soils engineer's requirements, including appropriate Factors of safety.

Maximum Bending Stress on WF Pile:

fb (actual) = **32.81** ksi WF O.K. for stress
 Fb = .76 Fy = **38.00** ksi AISC 9th Edition pg. 5-155
 WF diagonal = **17.19** in. **3.4 in. clr. if WF is centered in pile**
 WF Δ = **0.410** in. (at top of pile due to loading above lower grade)

W12X72 O.K. for stress

Lagging Design:

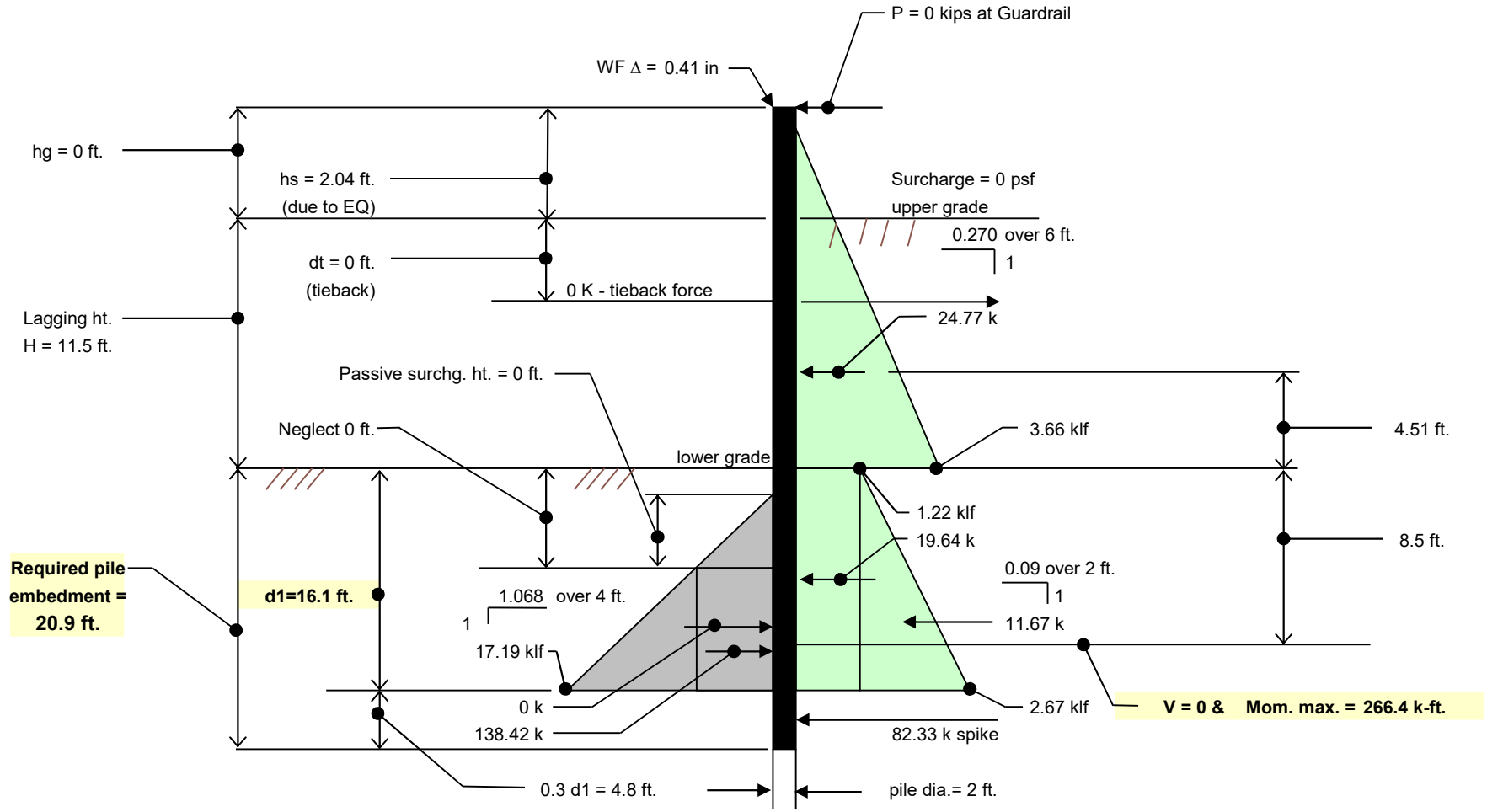
Lagging moment = **1.37** k-ft./ft.
 Lagging required bending stress = **0.68** ksi (for 3-1/2 in. thick pressure treated lagging at 50% full active EFP)
 Lagging required bending stress = **0.28** ksi (for 5-1/2 in. thick pressure treated lagging at 50% full active EFP)

Combined Pile Skin Friction & End Bearing:

Weight per lineal foot of WF:	72	plf		
Total length of pile:	34.50	ft.		
wt =	2.48	kips		
Concrete:	3.14	area	depth to consider for skin friction =	14.50 ft.
Total Length of concrete:	23.00	ft.	surface area of pile =	91.11 sq.ft.
wt =	10.84	kips	skin friction capacity =	91.11 kips
Superimposed Load on Pile =	22.65	kips	bearing capacity =	0.00 kips
Sum Pile DL =	35.97	kips	sum vertical capacity =	91.11

F.S. bearing = 2.53

Combined pile skin friction & end bearing is **O.K.**



Pile HSP8: **W12X72**

SOLDIER PILE DESIGN ILLUSTRATION FOR 11.5 FT. WALL

HSP9

	INPUT		
Soil Wt. =	125		pcf *
Active EFP =	45		pcf *
Passive EFP =	267		pcf *
Additional Uniform Load [rectangular] =	0		psf *
Seismic factor =	8		x "H"
# of pile ϕ active pressure is effective over =	1		below lagging *
# of pile ϕ passive pressure is effective over =	2		below lagging *
Effective Concrete Pile ϕ =	2.00		ft.
Pile spacing =	6.00		ft.
Surcharge =	0		psf
Retained (lagging) height "H" =	10.50		ft.
Height of Tieback from Bottom of Excavation =	0.00		ft.
Height of influence from additional Uniform Load =	0		ft.
Trial WF size =	W12X58		
WF Fy =	50		ksi
Required WF clearance within pile =	2		in. (all around)
For Passive resistance neglect top	0		ft.* of soil (lower grade)
Neglected soil ht. used for passive surcharge	0		ft.* of soil (lower grade)
Max.active pressure used for lagging design =	50		% * @ lower grade
Allowable soil bearing @ bottom of pile =	0		psf *
Allowable pile skin friction to reduce end brg. =	1,000		psf *
Guardrail impact load per pile =	0		kips
Guardrail height above upper grade hg =	0		ft.
Duration increase for passive pres. w/ impact =	1.00		Guardrail impact (Range 1.00 to 1.33)

OUTPUT

Effective surcharge height "hs" = **1.867** ft. (upper grade)
 Moment max. = **202.7** k-ft.
 Sx (provided) = **78** in.³
 Ix (provided) = **475** in.⁴
 E_{WF} = **29000** ksi
 bf = **10.00** in.
 d = **12.20** in.

NOTE : -

- 1.) d1 range is from "H" to "6H only".
- 2.) * = Per soils engineer's requirements, including appropriate Factors of safety.

Maximum Bending Stress on WF Pile:

fb (actual) = **31.18** ksi WF O.K. for stress
 Fb = .76 Fy = **38.00** ksi AISC 9th Edition pg. 5-155
 WF diagonal = **15.78** in. **4.11 in. clr. if WF is centered in pile**
 WF Δ = **0.327** in. (at top of pile due to loading above lower grade)

W12X58 O.K. for stress

Lagging Design:

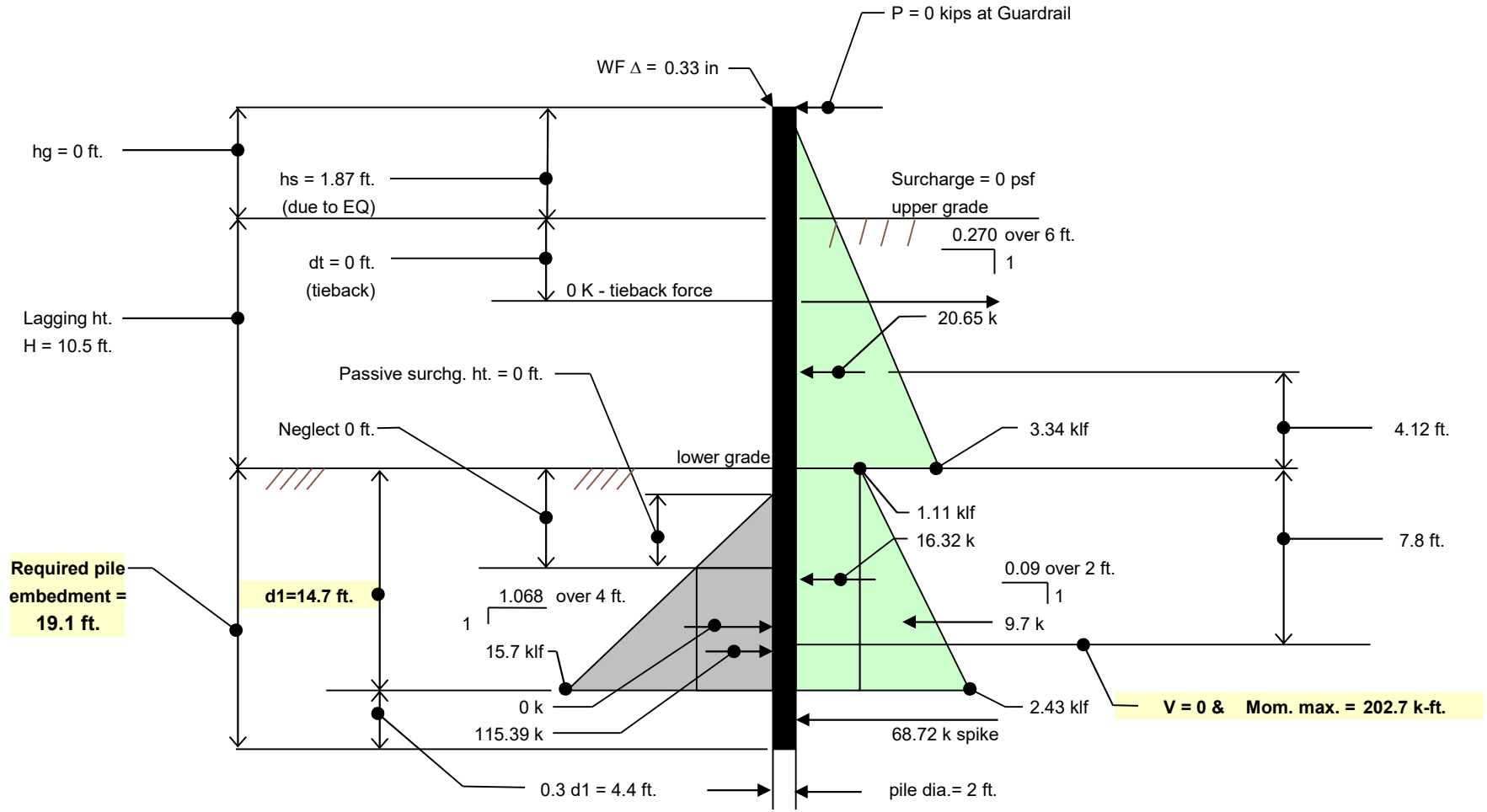
Lagging moment = **1.25** k-ft./ft.
 Lagging required bending stress = **0.62** ksi (for 3-1/2 in. thick pressure treated lagging at 50% full active EFP)
 Lagging required bending stress = **0.25** ksi (for 5-1/2 in. thick pressure treated lagging at 50% full active EFP)

Combined Pile Skin Friction & End Bearing:

Weight per lineal foot of WF:	58	plf		
Total length of pile:	30.50	ft.		
wt =	1.77	kips		
Concrete:	3.14	area	depth to consider for skin friction =	10.50 ft.
Total Length of concrete:	20.00	ft.	surface area of pile =	65.97 sq.ft.
wt =	9.42	kips	skin friction capacity =	65.97 kips
Superimposed Load on Pile =	22.65	kips	bearing capacity =	0.00 kips
Sum Pile DL =	33.85	kips	sum vertical capacity =	65.97

F.S. bearing = 1.95

Combined pile skin friction & end bearing is **O.K.**



Pile HSP9: **W12X58**

SOLDIER PILE DESIGN ILLUSTRATION FOR 10.5 FT. WALL

HSP10

		<u>INPUT</u>	
Soil Wt. =	125	pcf *	
Active EFP =	45	pcf *	
Passive EFP =	267	pcf *	
Additional Uniform Load [rectangular] =	0	psf *	
Seismic factor =	8	x "H"	
# of pile ϕ active pressure is effective over =	1	below lagging *	
# of pile ϕ passive pressure is effective over =	2	below lagging *	
Effective Concrete Pile ϕ =	2.00	ft.	
Pile spacing =	9.50	ft.	
Surcharge =	0	psf	
Retained (lagging) height "H" =	8.00	ft.	
Height of Tieback from Bottom of Excavation =	0.00	ft.	
Height of influence from additional Uniform Load =	0	ft.	
Trial WF size =	W12X53		
WF Fy =	50	ksi	
Required WF clearance within pile =	2	in. (all around)	
For Passive resistance neglect top	0	ft.* of soil (lower grade)	
Neglected soil ht. used for passive surcharge	0	ft.* of soil (lower grade)	
Max.active pressure used for lagging design =	50	% * @ lower grade	
Allowable soil bearing @ bottom of pile =	0	psf *	
Allowable pile skin friction to reduce end brg. =	1,000	psf *	
Guardrail impact load per pile =	0	kips	
Guardrail height above upper grade hg =	0	ft.	
Duration increase for passive pres. w/ impact =	1.00	Guardrail impact (Range 1.00 to 1.33)	

OUTPUT

Effective surcharge height "hs" = **1.422** ft. (upper grade)
 Moment max. = **157.4** k-ft.
 Sx (provided) = **70.6** in.³
 Ix (provided) = **425** in.⁴
 E_{WF} = **29000** ksi
 bf = **10.00** in.
 d = **12.10** in.

NOTE : -

- 1.) d1 range is from "H" to "6H only".
- 2.) * = Per soils engineer's requirements, including appropriate Factors of safety.

Maximum Bending Stress on WF Pile:

fb (actual) = **26.75** ksi WF O.K. for stress
 Fb = .76 Fy = **38.00** ksi AISC 9th Edition pg. 5-155
 WF diagonal = **15.70** in. **4.15 in. clr. if WF is centered in pile**
 WF Δ = **0.148** in. (at top of pile due to loading above lower grade)

W12X53 O.K. for stress

Lagging Design:

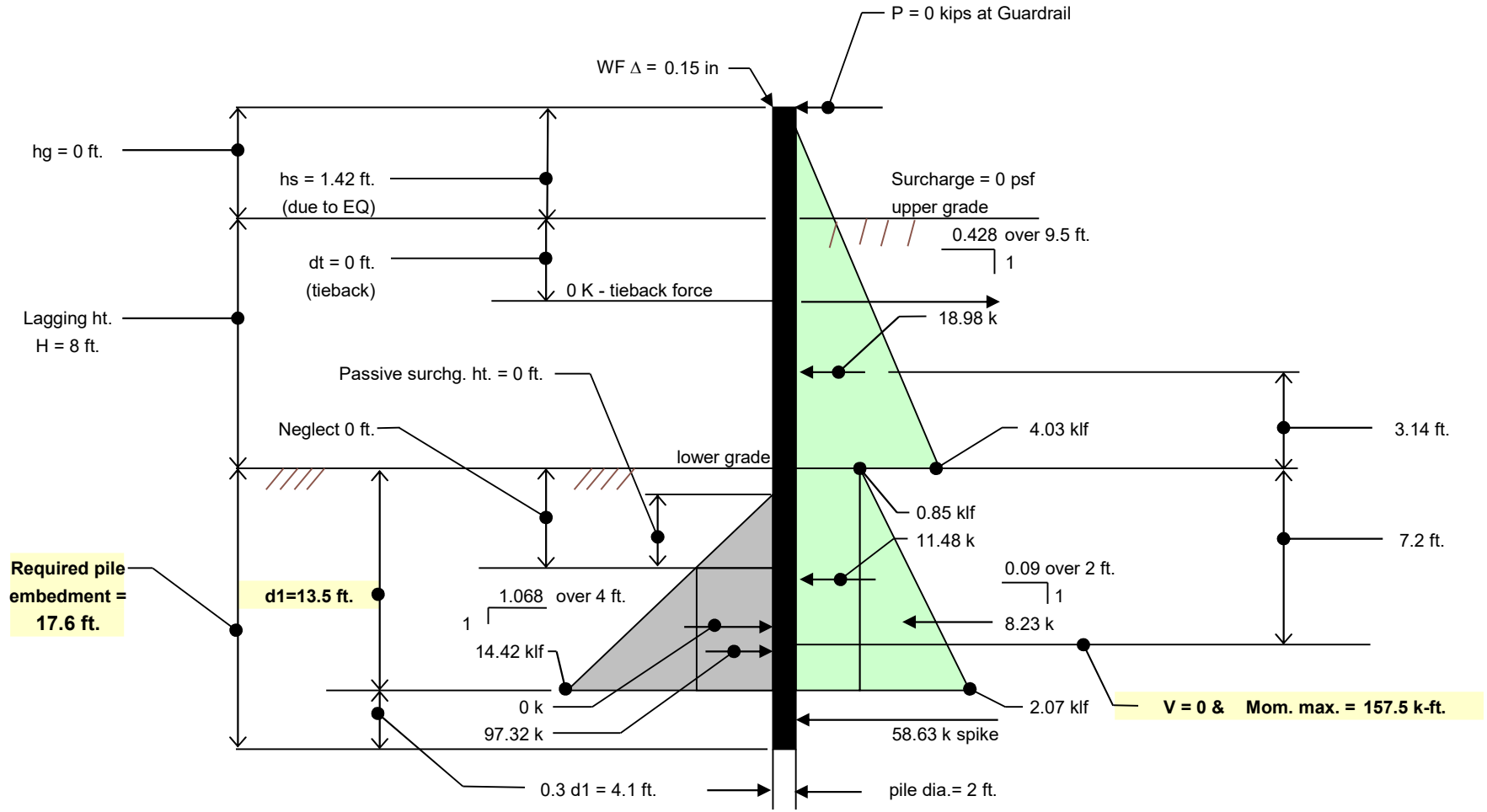
Lagging moment = **2.39** k-ft./ft.
 Lagging required bending stress = **1.18** ksi (for 3-1/2 in. thick pressure treated lagging at 50% full active EFP)
 Lagging required bending stress = **0.48** ksi (for 5-1/2 in. thick pressure treated lagging at 50% full active EFP)

Combined Pile Skin Friction & End Bearing:

Weight per lineal foot of WF:	53	plf		
Total length of pile:	28.00	ft.		
wt =	1.48	kips		
Concrete:	3.14	area	depth to consider for skin friction =	8.00 ft.
Total Length of concrete:	20.00	ft.	surface area of pile =	50.27 sq.ft.
wt =	9.42	kips	skin friction capacity =	50.27 kips
Superimposed Load on Pile =	11.40	kips	bearing capacity =	0.00 kips
Sum Pile DL =	22.31	kips	sum vertical capacity =	50.27

F.S. bearing = 2.25

Combined pile skin friction & end bearing is **O.K.**



Pile HSP10: **W12X53**

SOLDIER PILE DESIGN ILLUSTRATION FOR 8 FT. WALL

HSP11

	INPUT		
Soil Wt. =	125		pcf *
Active EFP =	45		pcf *
Passive EFP =	267		pcf *
Additional Uniform Load [rectangular] =	0		psf *
Seismic factor =	8		x "H"
# of pile ϕ active pressure is effective over =	1		below lagging *
# of pile ϕ passive pressure is effective over =	2		below lagging *
Effective Concrete Pile ϕ =	1.50		ft.
Pile spacing =	8.00		ft.
Surcharge =	0		psf
Retained (lagging) height "H" =	4.50		ft.
Height of Tieback from Bottom of Excavation =	0.00		ft.
Height of influence from additional Uniform Load =	0		ft.
Trial WF size =	W8X24		
WF Fy =	50		ksi
Required WF clearance within pile =	2		in. (all around)
For Passive resistance neglect top	0		ft.* of soil (lower grade)
Neglected soil ht. used for passive surcharge	0		ft.* of soil (lower grade)
Max.active pressure used for lagging design =	50		% * @ lower grade
Allowable soil bearing @ bottom of pile =	0		psf *
Allowable pile skin friction to reduce end brg. =	1,000		psf *
Guardrail impact load per pile =	0		kips
Guardrail height above upper grade hg =	0		ft.
Duration increase for passive pres. w/ impact =	1.00		Guardrail impact (Range 1.00 to 1.33)

OUTPUT

Effective surcharge height "hs" = **0.800** ft. (upper grade)
 Moment max. = **24.3** k-ft.
 Sx (provided) = **20.9** in.³
 Ix (provided) = **82.7** in.⁴
 E_{WF} = **29000** ksi
 bf = **6.50** in.
 d = **7.93** in.

NOTE : -

- 1.) d1 range is from "H" to "6H only".
- 2.) * = Per soils engineer's requirements, including appropriate Factors of safety.

Maximum Bending Stress on WF Pile:

fb (actual) = **13.94** ksi WF O.K. for stress
 Fb = .76 Fy = **38.00** ksi AISC 9th Edition pg. 5-155
 WF diagonal = **9.82** in. **4.09 in. clr. if WF is centered in pile**
 WF Δ = **0.036** in. (at top of pile due to loading above lower grade)

W8X24 O.K. for stress

Lagging Design:

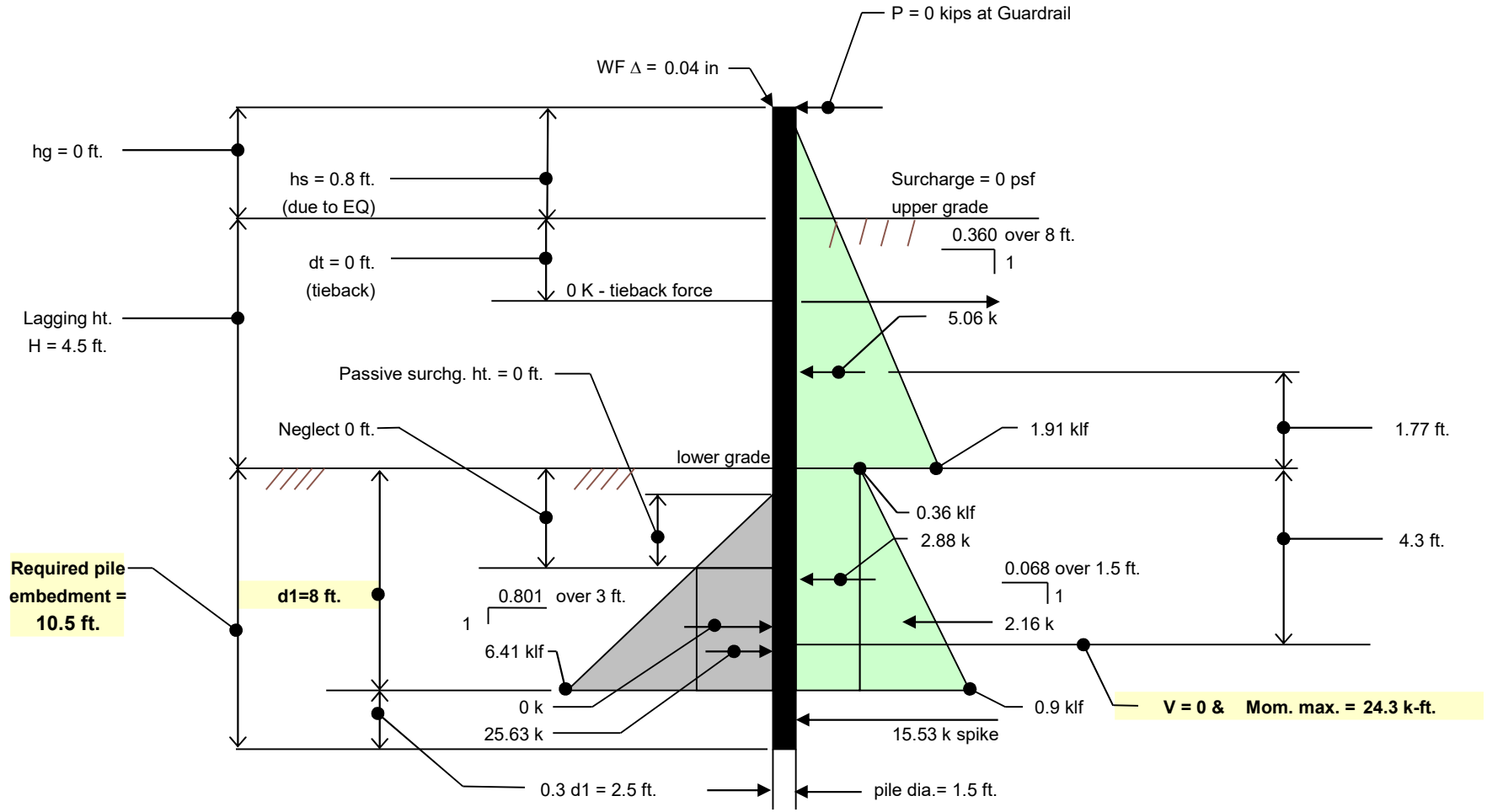
Lagging moment = **0.95** k-ft./ft.
 Lagging required bending stress = **0.47** ksi (for 3-1/2 in. thick pressure treated lagging at 50% full active EFP)
 Lagging required bending stress = **0.19** ksi (for 5-1/2 in. thick pressure treated lagging at 50% full active EFP)

Combined Pile Skin Friction & End Bearing:

Weight per lineal foot of WF:	24	plf		
Total length of pile:	22.50	ft.		
wt =	0.54	kips		
Concrete:	1.77	area	depth to consider for skin friction =	2.50 ft.
Total Length of concrete:	18.00	ft.	surface area of pile =	11.78 sq.ft.
wt =	4.77	kips	skin friction capacity =	11.78 kips
Superimposed Load on Pile =	0.00	kips	bearing capacity =	0.00 kips
Sum Pile DL =	5.31	kips	sum vertical capacity =	11.78

F.S. bearing = 2.22

Combined pile skin friction & end bearing is **O.K.**



Pile HSP11: **W8X24**

SOLDIER PILE DESIGN ILLUSTRATION FOR 4.5 FT. WALL

HSP12

		<u>INPUT</u>	
Soil Wt. =	125	pcf *	
Active EFP =	40	pcf *	
Passive EFP =	267	pcf *	
Additional Uniform Load [rectangular] =	0	psf *	
Seismic factor =	0	x "H"	
# of pile ϕ active pressure is effective over =	1	below lagging *	
# of pile ϕ passive pressure is effective over =	2	below lagging *	
Effective Concrete Pile ϕ =	1.50	ft.	
Pile spacing =	8.00	ft.	
Surcharge =	0	psf	
Retained (lagging) height "H" =	3.50	ft.	
Height of Tieback from Bottom of Excavation =	0.00	ft.	
Height of influence from additional Uniform Load =	0	ft.	
Trial WF size =	W8X15		
WF Fy =	50	ksi	
Required WF clearance within pile =	2	in. (all around)	
For Passive resistance neglect top	0	ft.* of soil (lower grade)	
Neglected soil ht. used for passive surcharge	0	ft.* of soil (lower grade)	
Max.active pressure used for lagging design =	50	% * @ lower grade	
Allowable soil bearing @ bottom of pile =	0	psf *	
Allowable pile skin friction to reduce end brg. =	1,000	psf *	
Guardrail impact load per pile =	0	kips	
Guardrail height above upper grade hg =	0	ft.	
Duration increase for passive pres. w/ impact =	1.00	Guardrail impact (Range 1.00 to 1.33)	

OUTPUT

Effective surcharge height "hs" = **0.000** ft. (upper grade)
 Moment max. = **5.9** k-ft.
 Sx (provided) = **11.8** in.³
 Ix (provided) = **48** in.⁴
 E_{WF} = **29000** ksi
 bf = **4.01** in.
 d = **8.11** in.

NOTE : -

- 1.) d1 range is from "H" to "6H only".
- 2.) * = Per soils engineer's requirements, including appropriate Factors of safety.

Maximum Bending Stress on WF Pile:

fb (actual) = **6.04** ksi WF O.K. for stress
 Fb = .76 Fy = **38.00** ksi AISC 9th Edition pg. 5-155
 WF diagonal = **8.94** in. **4.53 in. clr. if WF is centered in pile**
 WF Δ = **0.007** in. (at top of pile due to loading above lower grade)

W8X15 O.K. for stress

Lagging Design:

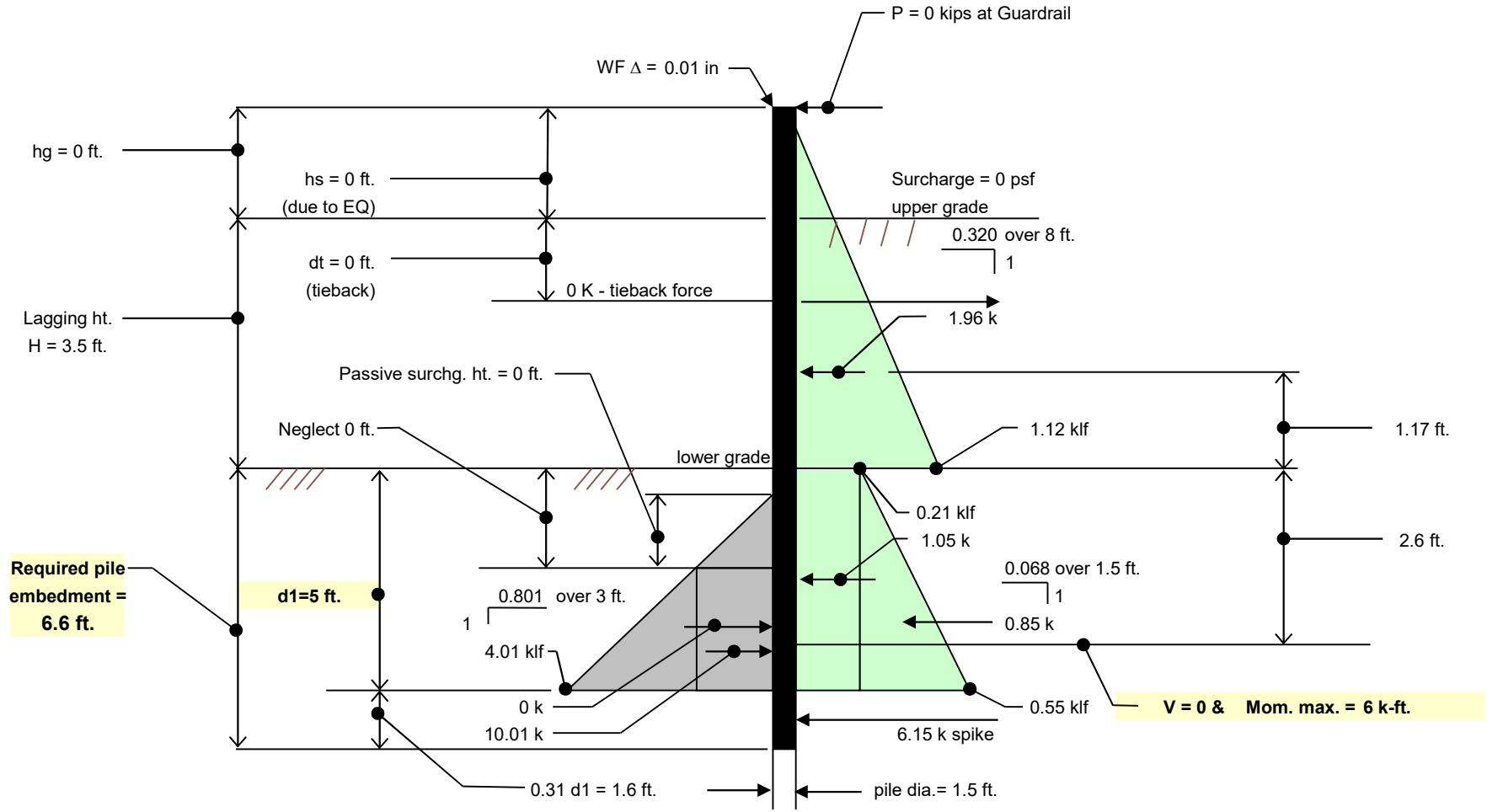
Lagging moment = **0.56** k-ft./ft.
 Lagging required bending stress = **0.28** ksi (for 3-1/2 in. thick pressure treated lagging at 50% full active EFP)
 Lagging required bending stress = **0.12** ksi (for 5-1/2 in. thick pressure treated lagging at 50% full active EFP)

Combined Pile Skin Friction & End Bearing:

Weight per lineal foot of WF:	15	plf		
Total length of pile:	21.50	ft.		
wt =	0.32	kips		
Concrete:	1.77	area	depth to consider for skin friction =	1.50 ft.
Total Length of concrete:	18.00	ft.	surface area of pile =	7.07 sq.ft.
wt =	4.77	kips	skin friction capacity =	7.07 kips
Superimposed Load on Pile =	0.00	kips	bearing capacity =	0.00 kips
Sum Pile DL =	5.09	kips	sum vertical capacity =	7.07

F.S. bearing = 1.39

Combined pile skin friction & end bearing is **O.K.**



Pile HSP12: **W8X15**

SOLDIER PILE DESIGN ILLUSTRATION FOR 3.5 FT. WALL

LSP1

	INPUT		
Soil Wt. =	125		pcf *
Active EFP =	40		pcf *
Passive EFP =	267		pcf *
Additional Uniform Load [rectangular] =	0		psf *
Seismic factor =	0		x "H"
# of pile ϕ active pressure is effective over =	1		below lagging *
# of pile ϕ passive pressure is effective over =	2		below lagging *
Effective Concrete Pile ϕ =	2.00		ft.
Pile spacing =	3.67		ft.
Surcharge =	0		psf
Retained (lagging) height "H" =	10.00		ft.
Height of Tieback from Bottom of Excavation =	0.00		ft.
Height of influence from additional Uniform Load =	0		ft.
Trial WF size =	W12X53		
WF Fy =	50		ksi
Required WF clearance within pile =	2		in. (all around)
For Passive resistance neglect top	0		ft.* of soil (lower grade)
Neglected soil ht. used for passive surcharge	0		ft.* of soil (lower grade)
Max.active pressure used for lagging design =	50		% * @ lower grade
Allowable soil bearing @ bottom of pile =	0		psf *
Allowable pile skin friction to reduce end brg. =	1,000		psf *
Guardrail impact load per pile =	0		kips
Guardrail height above upper grade hg =	0		ft.
Duration increase for passive pres. w/ impact =	1.00		Guardrail impact (Range 1.00 to 1.33)

OUTPUT

Effective surcharge height "hs" = **0.000** ft. (upper grade)
 Moment max. = **50.9** k-ft.
 Sx (provided) = **70.6** in.³
 Ix (provided) = **425** in.⁴
 E_{WF} = **29000** ksi
 bf = **10.00** in.
 d = **12.10** in.

NOTE : -

- 1.) d1 range is from "H" to "6H only".
- 2.) * = Per soils engineer's requirements, including appropriate Factors of safety.

Maximum Bending Stress on WF Pile:

fb (actual) = **8.65** ksi WF O.K. for stress
 Fb = .76 Fy = **38.00** ksi AISC 9th Edition pg. 5-155
 WF diagonal = **15.70** in. **4.15 in. clr. if WF is centered in pile**
 WF Δ = **0.069** in. (at top of pile due to loading above lower grade)

W12X53 O.K. for stress

Lagging Design:

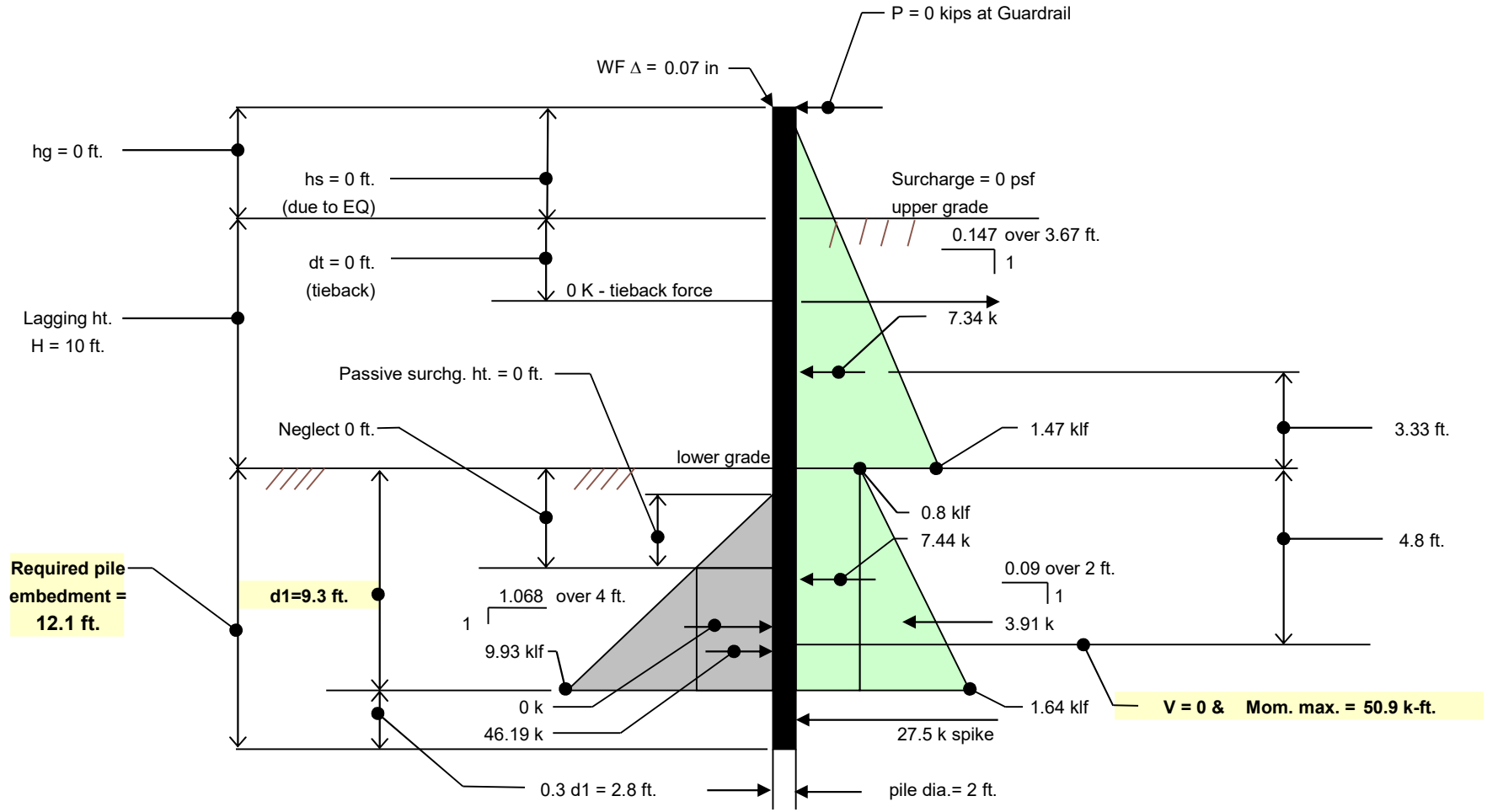
Lagging moment = **0.34** k-ft./ft.
 Lagging required bending stress = **0.17** ksi (for 3-1/2 in. thick pressure treated lagging at 50% full active EFP)
 Lagging required bending stress = **0.07** ksi (for 5-1/2 in. thick pressure treated lagging at 50% full active EFP)

Combined Pile Skin Friction & End Bearing:

Weight per lineal foot of WF:	53	plf		
Total length of pile:	30.00	ft.		
wt =	1.59	kips		
Concrete:	3.14	area	depth to consider for skin friction =	10.00 ft.
Total Length of concrete:	20.00	ft.	surface area of pile =	62.83 sq.ft.
wt =	9.42	kips	skin friction capacity =	62.83 kips
Superimposed Load on Pile =	17.84	kips	bearing capacity =	0.00 kips
Sum Pile DL =	28.86	kips	sum vertical capacity =	62.83

F.S. bearing = 2.18

Combined pile skin friction & end bearing is **O.K.**



Pile LSP1: **W12X53**

SOLDIER PILE DESIGN ILLUSTRATION FOR 10 FT. WALL

LSP2

	INPUT		
Soil Wt. =	125		pcf *
Active EFP =	55		pcf *
Passive EFP =	267		pcf *
Additional Uniform Load [rectangular] =	0		psf *
Seismic factor =	8		x "H"
# of pile ϕ active pressure is effective over =	1		below lagging *
# of pile ϕ passive pressure is effective over =	2		below lagging *
Effective Concrete Pile ϕ =	2.00		ft.
Pile spacing =	7.33		ft.
Surcharge =	0		psf
Retained (lagging) height "H" =	10.00		ft.
Height of Tieback from Bottom of Excavation =	0.00		ft.
Height of influence from additional Uniform Load =	0		ft.
Trial WF size =	W12X72		
WF Fy =	50		ksi
Required WF clearance within pile =	2		in. (all around)
For Passive resistance neglect top	0		ft.* of soil (lower grade)
Neglected soil ht. used for passive surcharge	0		ft.* of soil (lower grade)
Max.active pressure used for lagging design =	50		% * @ lower grade
Allowable soil bearing @ bottom of pile =	0		psf *
Allowable pile skin friction to reduce end brg. =	1,000		psf *
Guardrail impact load per pile =	0		kips
Guardrail height above upper grade hg =	0		ft.
Duration increase for passive pres. w/ impact =	1.00		Guardrail impact (Range 1.00 to 1.33)

OUTPUT

Effective surcharge height "hs" = **1.455** ft. (upper grade)
 Moment max. = **271.5** k-ft.
 Sx (provided) = **97.4** in.³
 Ix (provided) = **597** in.⁴
 E_{WF} = **29000** ksi
 bf = **12.00** in.
 d = **12.30** in.

NOTE : -

- 1.) d1 range is from "H" to "6H only".
- 2.) * = Per soils engineer's requirements, including appropriate Factors of safety.

Maximum Bending Stress on WF Pile:

fb (actual) = **33.44** ksi WF O.K. for stress
 Fb = .76 Fy = **38.00** ksi AISC 9th Edition pg. 5-155
 WF diagonal = **17.19** in. **3.4 in. clr. if WF is centered in pile**
 WF Δ = **0.265** in. (at top of pile due to loading above lower grade)

W12X72 O.K. for stress

Lagging Design:

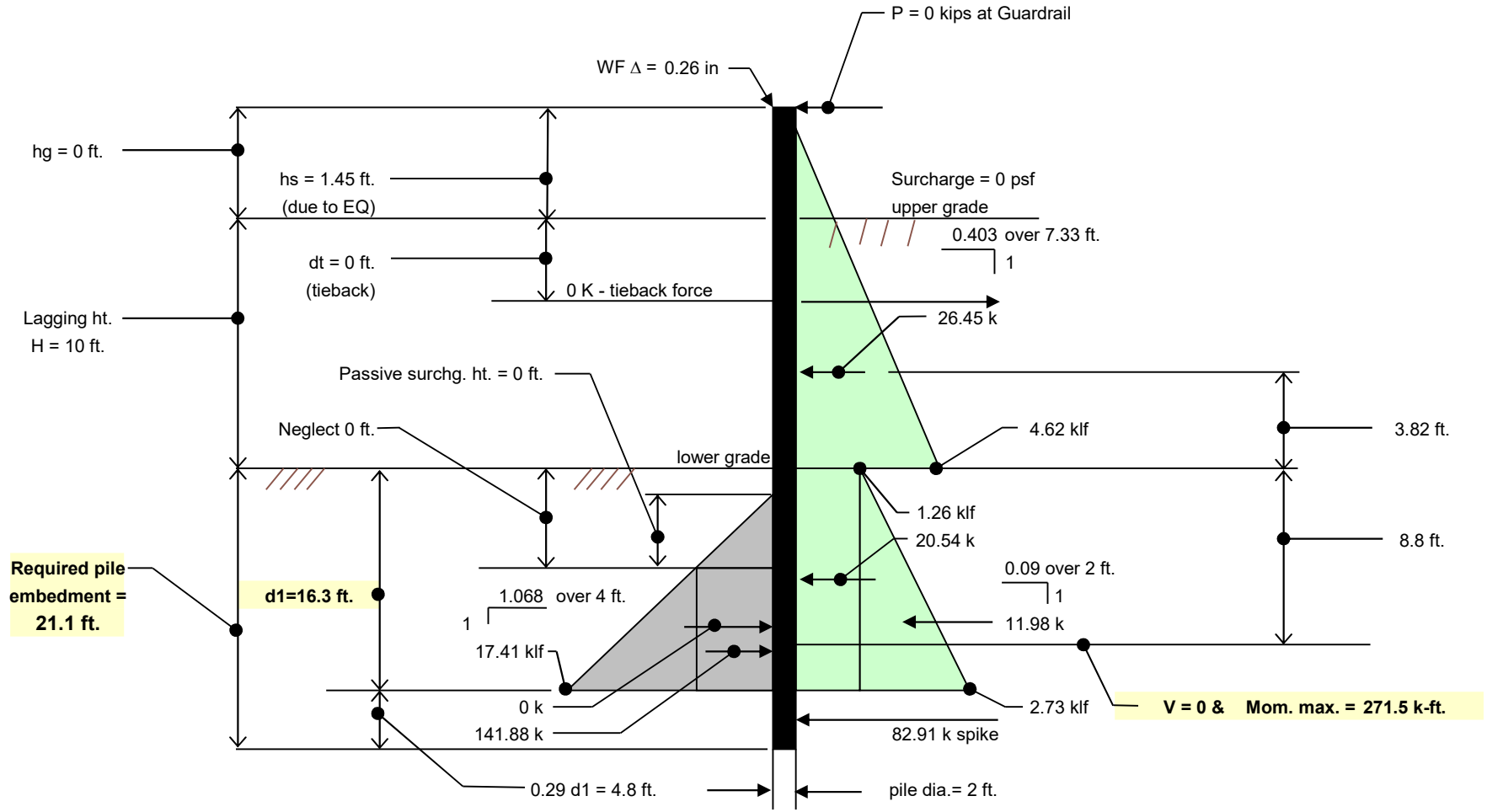
Lagging moment = **2.12** k-ft./ft.
 Lagging required bending stress = **1.04** ksi (for 3-1/2 in. thick pressure treated lagging at 50% full active EFP)
 Lagging required bending stress = **0.42** ksi (for 5-1/2 in. thick pressure treated lagging at 50% full active EFP)

Combined Pile Skin Friction & End Bearing:

Weight per lineal foot of WF:	72	plf		
Total length of pile:	33.00	ft.		
wt =	2.38	kips		
Concrete:	3.14	area	depth to consider for skin friction =	13.00 ft.
Total Length of concrete:	23.00	ft.	surface area of pile =	81.68 sq.ft.
wt =	10.84	kips	skin friction capacity =	81.68 kips
Superimposed Load on Pile =	35.63	kips	bearing capacity =	0.00 kips
Sum Pile DL =	48.85	kips	sum vertical capacity =	81.68

F.S. bearing = 1.67

Combined pile skin friction & end bearing is **O.K.**



Pile LSP2: **W12X72**

SOLDIER PILE DESIGN ILLUSTRATION FOR 10 FT. WALL

LSP3

	INPUT		
Soil Wt. =	125		pcf *
Active EFP =	45		pcf *
Passive EFP =	267		pcf *
Additional Uniform Load [rectangular] =	0		psf *
Seismic factor =	8		x "H"
# of pile ϕ active pressure is effective over =	1		below lagging *
# of pile ϕ passive pressure is effective over =	2		below lagging *
Effective Concrete Pile ϕ =	2.00		ft.
Pile spacing =	6.50		ft.
Surcharge =	0		psf
Retained (lagging) height "H" =	8.00		ft.
Height of Tieback from Bottom of Excavation =	0.00		ft.
Height of influence from additional Uniform Load =	0		ft.
Trial WF size =	W12X53		
WF Fy =	50		ksi
Required WF clearance within pile =	2		in. (all around)
For Passive resistance neglect top	0		ft.* of soil (lower grade)
Neglected soil ht. used for passive surcharge	0		ft.* of soil (lower grade)
Max.active pressure used for lagging design =	50		% * @ lower grade
Allowable soil bearing @ bottom of pile =	0		psf *
Allowable pile skin friction to reduce end brg. =	1,000		psf *
Guardrail impact load per pile =	0		kips
Guardrail height above upper grade hg =	0		ft.
Duration increase for passive pres. w/ impact =	1.00		Guardrail impact (Range 1.00 to 1.33)

OUTPUT

Effective surcharge height "hs" = **1.422** ft. (upper grade)
 Moment max. = **98.7** k-ft.
 Sx (provided) = **70.6** in.³
 Ix (provided) = **425** in.⁴
 E_{WF} = **29000** ksi
 bf = **10.00** in.
 d = **12.10** in.

NOTE : -

- 1.) d1 range is from "H" to "6H only".
- 2.) * = Per soils engineer's requirements, including appropriate Factors of safety.

Maximum Bending Stress on WF Pile:

fb (actual) = **16.78** ksi WF O.K. for stress
 Fb = .76 Fy = **38.00** ksi AISC 9th Edition pg. 5-155
 WF diagonal = **15.70** in. **4.15 in. clr. if WF is centered in pile**
 WF Δ = **0.101** in. (at top of pile due to loading above lower grade)

W12X53 O.K. for stress

Lagging Design:

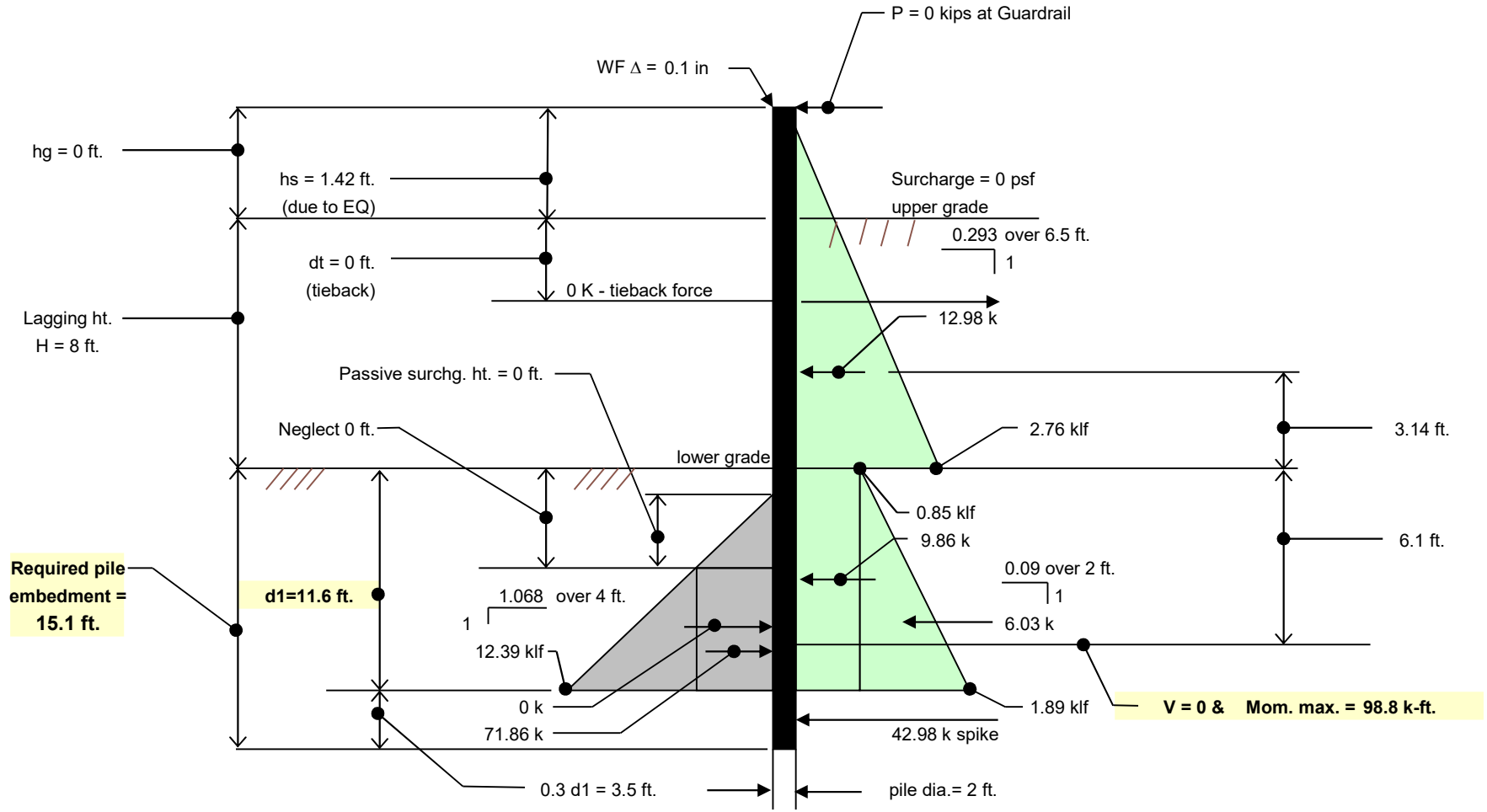
Lagging moment = **1.12** k-ft./ft.
 Lagging required bending stress = **0.55** ksi (for 3-1/2 in. thick pressure treated lagging at 50% full active EFP)
 Lagging required bending stress = **0.23** ksi (for 5-1/2 in. thick pressure treated lagging at 50% full active EFP)

Combined Pile Skin Friction & End Bearing:

Weight per lineal foot of WF:	53	plf			
Total length of pile:	28.00	ft.			
wt =	1.48	kips			
Concrete:	3.14	area	depth to consider for skin friction =	8.00	ft.
Total Length of concrete:	20.00	ft.	surface area of pile =	50.27	sq.ft.
wt =	9.42	kips	skin friction capacity =	50.27	kips
Superimposed Load on Pile =	16.06	kips	bearing capacity =	0.00	kips
Sum Pile DL =	26.97	kips	sum vertical capacity =	50.27	

F.S. bearing = 1.86

Combined pile skin friction & end bearing is **O.K.**



Pile LSP3: **W12X53**

SOLDIER PILE DESIGN ILLUSTRATION FOR 8 FT. WALL

LSP4

	INPUT		
Soil Wt. =	125		pcf *
Active EFP =	45		pcf *
Passive EFP =	267		pcf *
Additional Uniform Load [rectangular] =	0		psf *
Seismic factor =	8		x "H"
# of pile ϕ active pressure is effective over =	1		below lagging *
# of pile ϕ passive pressure is effective over =	2		below lagging *
Effective Concrete Pile ϕ =	2.00		ft.
Pile spacing =	3.50		ft.
Surcharge =	0		psf
Retained (lagging) height "H" =	6.00		ft.
Height of Tieback from Bottom of Excavation =	0.00		ft.
Height of influence from additional Uniform Load =	0		ft.
Trial WF size =	W12X53		
WF Fy =	50		ksi
Required WF clearance within pile =	2		in. (all around)
For Passive resistance neglect top	0		ft.* of soil (lower grade)
Neglected soil ht. used for passive surcharge	0		ft.* of soil (lower grade)
Max.active pressure used for lagging design =	50		% * @ lower grade
Allowable soil bearing @ bottom of pile =	0		psf *
Allowable pile skin friction to reduce end brg. =	1,000		psf *
Guardrail impact load per pile =	0		kips
Guardrail height above upper grade hg =	0		ft.
Duration increase for passive pres. w/ impact =	1.00		Guardrail impact (Range 1.00 to 1.33)

OUTPUT

Effective surcharge height "hs" = **1.067** ft. (upper grade)
 Moment max. = **19.9** k-ft.
 Sx (provided) = **70.6** in.³
 Ix (provided) = **425** in.⁴
 E_{WF} = **29000** ksi
 bf = **10.00** in.
 d = **12.10** in.

NOTE : -

- 1.) d1 range is from "H" to "6H only".
- 2.) * = Per soils engineer's requirements, including appropriate Factors of safety.

Maximum Bending Stress on WF Pile:

fb (actual) = **3.39** ksi WF O.K. for stress
 Fb = .76 Fy = **38.00** ksi AISC 9th Edition pg. 5-155
 WF diagonal = **15.70** in. **4.15 in. clr. if WF is centered in pile**
 WF Δ = **0.013** in. (at top of pile due to loading above lower grade)

W12X53 O.K. for stress

Lagging Design:

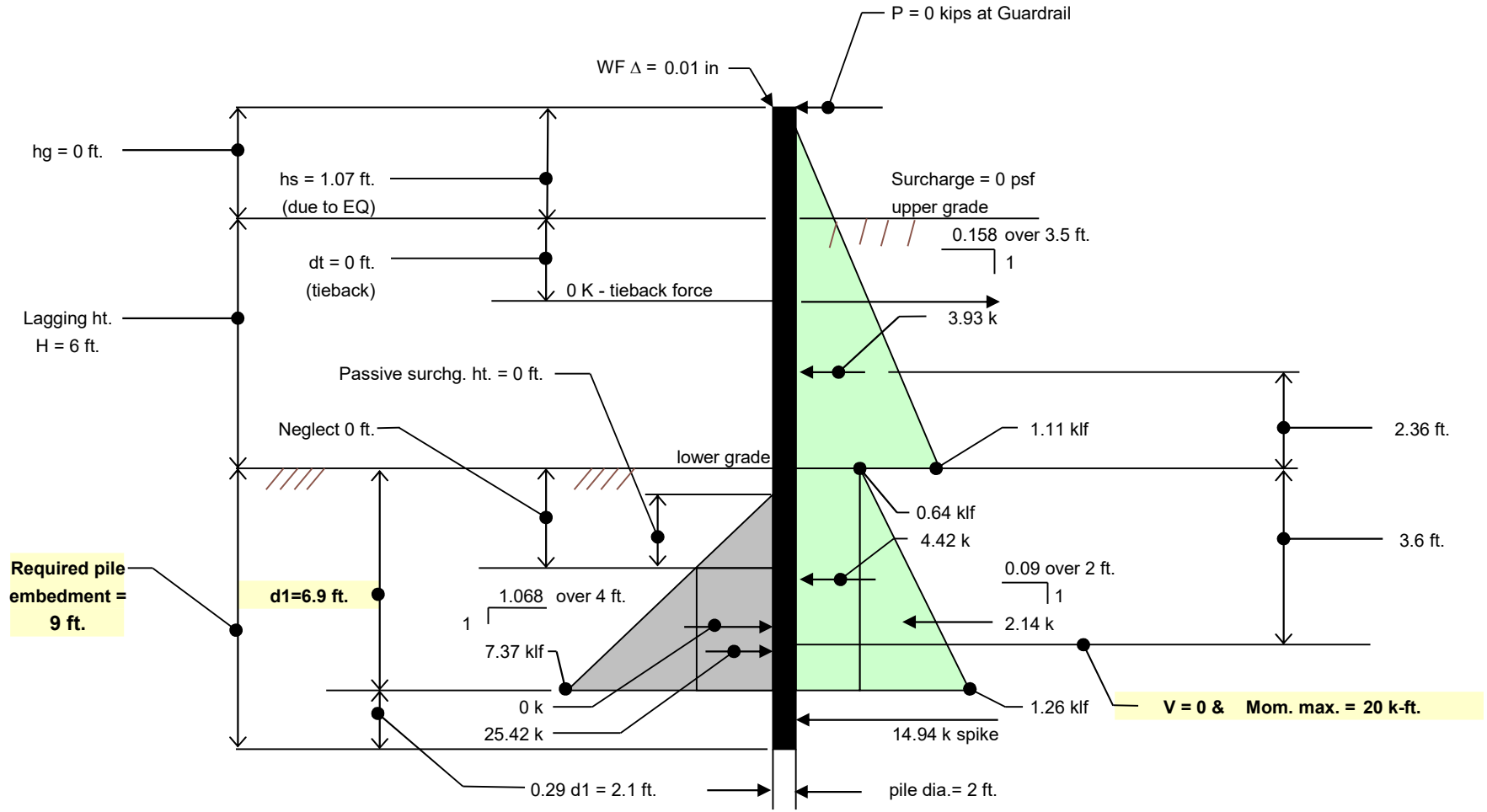
Lagging moment = **0.24** k-ft./ft.
 Lagging required bending stress = **0.12** ksi (for 3-1/2 in. thick pressure treated lagging at 50% full active EFP)
 Lagging required bending stress = **0.05** ksi (for 5-1/2 in. thick pressure treated lagging at 50% full active EFP)

Combined Pile Skin Friction & End Bearing:

Weight per lineal foot of WF:	53	plf		
Total length of pile:	26.00	ft.		
wt =	1.38	kips		
Concrete:	3.14	area	depth to consider for skin friction =	6.00 ft.
Total Length of concrete:	20.00	ft.	surface area of pile =	37.70 sq.ft.
wt =	9.42	kips	skin friction capacity =	37.70 kips
Superimposed Load on Pile =	8.65	kips	bearing capacity =	0.00 kips
Sum Pile DL =	19.45	kips	sum vertical capacity =	37.70

F.S. bearing = 1.94

Combined pile skin friction & end bearing is **O.K.**



Pile LSP4: **W12X53**

SOLDIER PILE DESIGN ILLUSTRATION FOR 6 FT. WALL