



STATE OF CONNECTICUT

CONNECTICUT SITING COUNCIL

Ten Franklin Square, New Britain, CT 06051

Phone: (860) 827-2935 Fax: (860) 827-2950

E-Mail: siting.council@ct.gov

Web Site: portal.ct.gov/csc

VIA ELECTRONIC MAIL

October 12, 2022

Victoria Masse
Northeast Site Solutions
420 Main Street #2
Sturbridge, MA 01566
victoria@northeastsitesolutions.com

RE: **EM-T-MOBILE-135-220913** - T-Mobile notice of intent to modify an existing telecommunications facility located at 555 East Main Street, Stamford, Connecticut.

Dear Victoria Masse:

The Connecticut Siting Council (Council) is in receipt of your correspondence of October 7, 2022 submitted in response to the Council's October 7, 2022 notification of an incomplete request for exempt modification with regard to the above-referenced matter.

The submission renders the request for exempt modification complete and the Council will process the request in accordance with the Federal Communications Commission 60-day timeframe.

Thank you for your attention and cooperation.
Sincerely,

A handwritten signature in dark ink, appearing to read "Melanie Bachman".

Melanie Bachman
Executive Director

MAB/IN/laf

From: Victoria Masse <victoria@northeastsitesolutions.com>

Sent: Friday, October 7, 2022 3:09 PM

To: Robidoux, Evan <Evan.Robidoux@ct.gov>; Deborah Chase <deborah@northeastsitesolutions.com>

Cc: CSC-DL Siting Council <Siting.Council@ct.gov>; Denise Sabo <denise@northeastsitesolutions.com>; Matt Bandle <matt@northeastsitesolutions.com>

Subject: Re: Council Incomplete Letter for EM-T-MOBILE-135-220913 (555 East Main Street, Stamford)

Good Afternoon Council,

Please find attached to this email the structural analysis for the building as requested.

Thank you

Building Structural Analysis Report

Everest Site ID: 638283
Everest Site Name: Stamford #1 CO
T-Mobile Site ID: CT11410A

Site Address: 555 Main St
Stamford, CT 06901

Client:



Carrier:



Date: 06/17/2022

Scope of Work:

Centerline Communications was authorized by Everest Infrastructure Partners to perform an analysis of the building structure to determine its capacity to support the proposed T-Mobile equipment/appurtenances listed in this report.

Proposed T-Mobile Appurtenances (Tower):

- (3) Ericsson Air 6449 B41 Panel Antenna
- (3) APXVAALL24_43-U-NA20 Panel Antenna
- (3) Ericsson 4480 B71+B25 RRU
- (3) Ericsson 4415 B25 RRU

Existing T-Mobile Appurtenances (Tower):

- (3) Ericsson Air 32 KRD901146-1_B66A_B2A
- (3) Ericsson Generic Twin Style 1B-AWS

Proposed T-Mobile Equipment (5th Floor):

- (1) Power 6230 Cabinet
- (1) 19" Rack

Existing T-Mobile Equipment (5th Floor):

- (1) RBS 3206 Equipment Cabinet
- (1) Battery Cabinet
- (1) 19" Rack
- (1) Transformer

Design Criteria:**Design Codes:**

2018 Connecticut State Building Code

2015 International Building Code

ASCE 7-10

TIA-222-G Standards

Ultimate Design Wind Speed (V_{ult})	120 mph
Wind Speed with Ice	50 mph
Ice Thickness	0.75 in.
Ground Snow Load	30 psf
Exposure Category	B
Topographic Category	1
Risk Category	II
Site Soil Class (Assumed)	D – Stiff Soil
Seismic Design Category	B
Spectral Response Acceleration Parameter at a Short Periods, S_s	0.179 g
Spectral Response Acceleration Parameter at a Period of 1 Second, S_1	0.064 g

***Refer to calculations for additional design criteria.**

Conclusion:

Original building plans were not available and could not be obtained for our reference. A limited survey and mapping of the building columns supporting the tower was performed on June 1, 2022. The tower support frame is being supported by (2) exterior columns and (2) interior columns as shown in the attached partial roof plan. Since the reinforced concrete column properties and reinforcement are unknown, it is assumed that the building columns meet the minimum ACI code requirements.

The results of the analysis concluded that the existing building structure *is adequate* to support the proposed T-Mobile equipment loading.

	Stress Ratio	Overall Result
6 th Floor Column (Interior)	49.3%	PASS
5 th Floor Column (Interior)	65.2%	PASS
4 th Floor Column (Interior)	76.2%	PASS
3 rd Floor Column (Interior)	92.3%	PASS
2 nd Floor Column (Interior)	70.8%	PASS
1 st Floor Column (Interior)	80.9%	PASS
G Floor Column (Interior)	90.9%	PASS
6 th Floor Column (Exterior)	46.0%	PASS
5 th Floor Column (Exterior)	54.4%	PASS
4 th Floor Column (Exterior)	59.0%	PASS
3 rd Floor Column (Exterior)	66.9%	PASS
2 nd Floor Column (Exterior)	50.0%	PASS
1 st Floor Column (Exterior)	55.4%	PASS
G Floor Column (Exterior)	60.7%	PASS

Reference Documents:

- Mapping Report by Centerline Communications, dated June 17, 2022
- Construction Drawings by Foresite LLC, dated December 29, 2021
- Structural Analysis by Tower Engineering Professionals, dated November 16, 2021

Assumptions and Limitations:

- The tower and structures were built and maintained with the manufacturer's specifications.
- The calculations performed by Centerline Communications are limited to the structural members in these calculations only.
- The analysis is only for the equipment loading listed in the report.
- The calculation assumes all structural members to be in good condition i.e. no damage, rust, or other defects.

Photos:



Existing Building and Tower



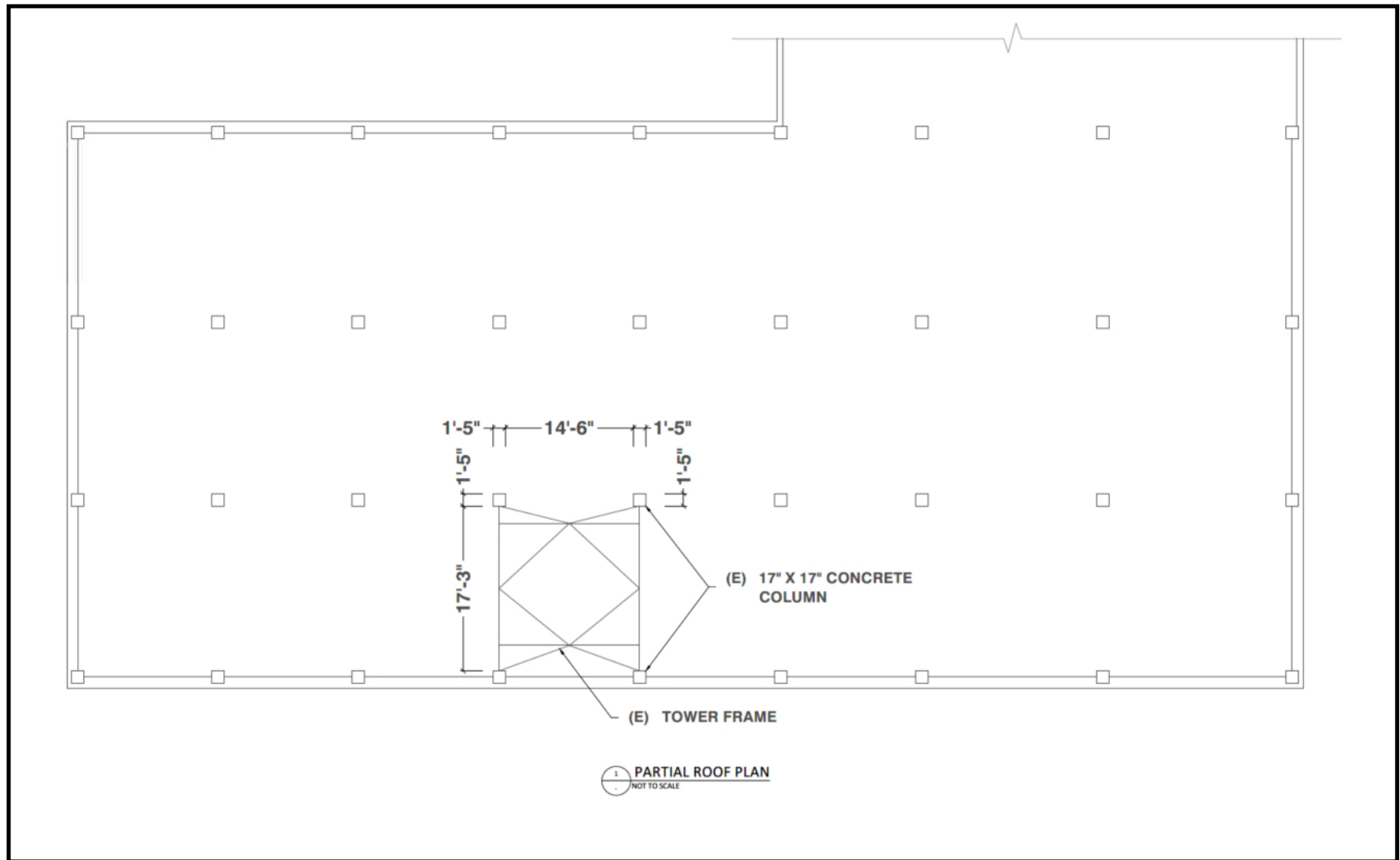
Existing Tower

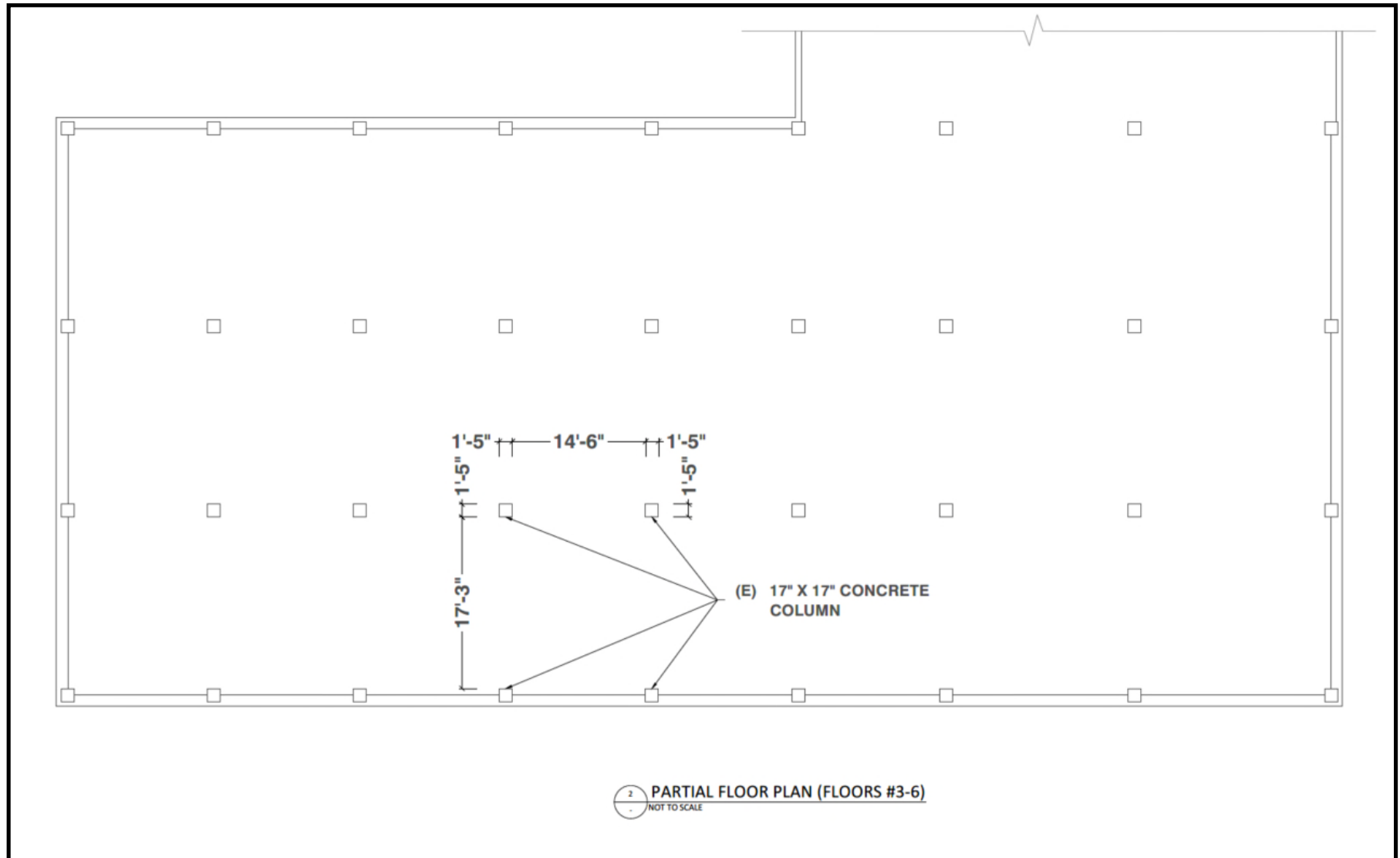


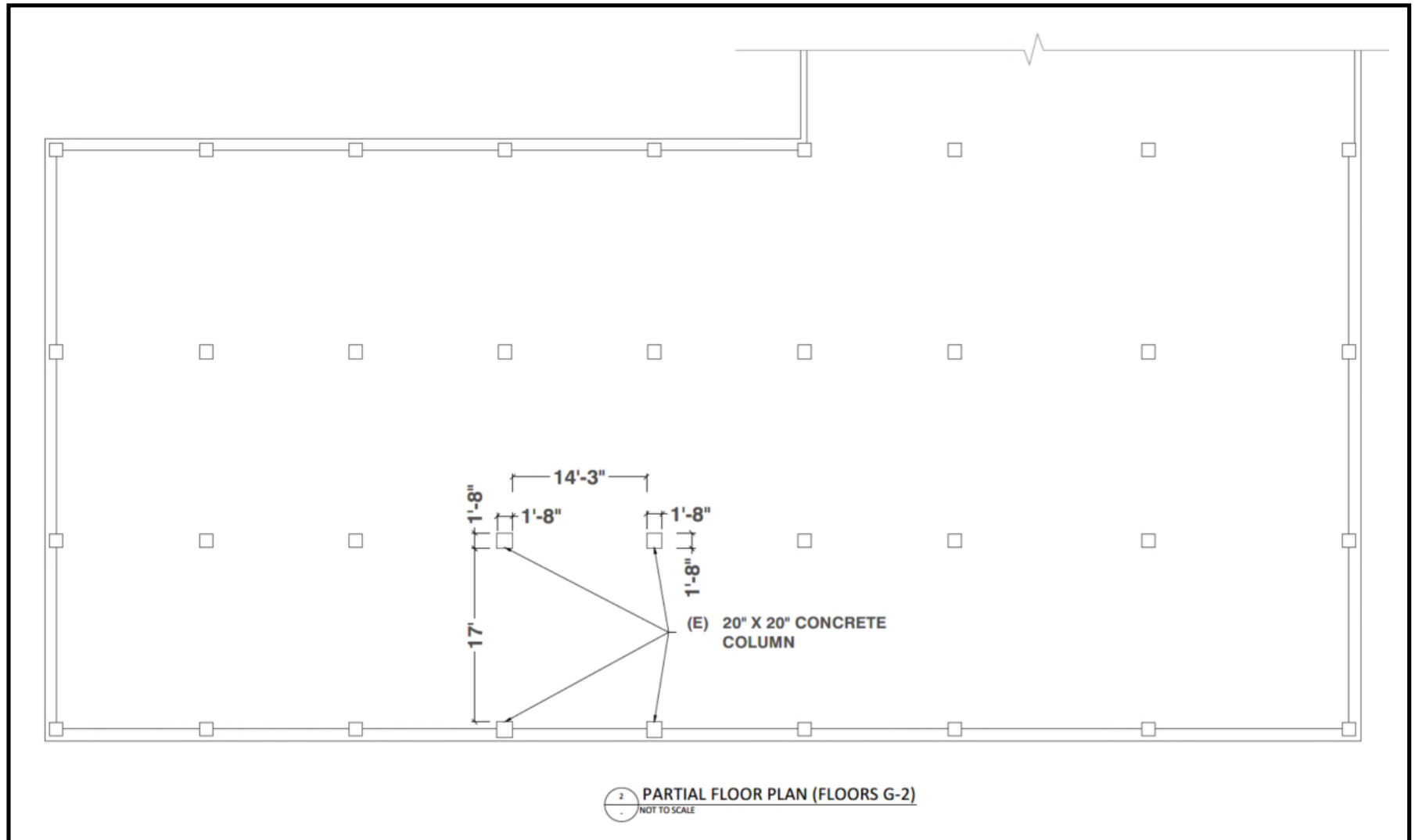
Building Construction (Interior Column)



Building Construction (Exterior Column)









Building Column Calculations (Interior)

Date: 06-17-2022
Project Name: Stamford #1 CO
Site ID: 638283
Designed By: AA Checked By: DC

Check Building Columns:

Interior Column at Tower:

Load Breakdown:

Tributary Area:
$$= \frac{((18.67 \text{ ft} / 2) + (18.67 \text{ ft} / 2)) * ((16.0 \text{ ft} / 2) + (16.0 \text{ ft} / 2))}{2} = 298.72 \text{ ft}^2$$

Live Loads

→ Snow
$$= \frac{30 \text{ psf} \times 298.7 \text{ ft}^2}{1000} = 8.96 \text{ kips}$$

→ Service (Roof)
$$= \frac{20 \text{ psf} \times 298.7 \text{ ft}^2}{1000} = 5.97 \text{ kips}$$

→ Service (Typical Floor)
$$= \frac{100 \text{ psf} \times 298.7 \text{ ft}^2}{1000} = 29.87 \text{ kips}$$

Dead Load

→ Roof
$$= \frac{100 \text{ psf} \times 298.7 \text{ ft}^2}{1000} = 29.87 \text{ kips}$$

***Assume 8" concrete deck (150 pcf)**

→ Floor (Typical Floor)
$$= \frac{125 \text{ psf} \times 298.7 \text{ ft}^2}{1000} = 37.34 \text{ kips}$$

***Assume 10" concrete deck (150 pcf)**

Date: 06-17-2022
 Project Name: Stamford #1 CO
 Site ID: 638283
 Designed By: AA Checked By: DC

Column Loading (Unfactor Loads)

	<u>Snow Load</u> <u>(Kips.)</u>	<u>Live Load</u> <u>(Kips.)</u>	<u>Dead Load</u> <u>(Kips.)</u>	<u>Dead Load</u> <u>Column (Kips.)</u>	<u>Total Load</u> <u>(Kips.)</u>
Tower Load	-	150.19	14.70	-	164.89
Roof	8.96	5.97	29.87	-	44.81
Total=	8.96	156.16	44.57	0.00	209.70
Sixth Floor (17"x17")	0.00	29.87	37.34	4.34	71.55
Total=	8.96	186.03	81.91	4.34	281.25
Fifth Floor (17"x17")	0.00	29.87	37.34	4.34	71.55
Total=	8.96	215.91	119.25	8.68	352.80
Fourth Floor (17"x17")	0.00	29.87	37.34	4.34	71.55
Total=	8.96	245.78	156.59	13.02	424.35
Third Floor (17"x17")	0.00	29.87	37.34	4.94	72.16
Total=	8.96	275.65	193.93	17.97	496.51
Second Floor (20"x20")	0.00	29.87	37.34	6.49	73.70
Total=	8.96	305.52	231.27	24.46	570.21
First Floor (20"x20")	0.00	29.87	37.34	6.01	73.22
Total=	8.96	335.39	268.61	30.47	643.43
G Floor (20"x20")					

***Reference the structural analysis by Foresite LLC, dated December 29, 2021 for tower reactions.**

Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. #: KW-06013597

DESCRIPTION: Sixth Floor Column

Code References

Calculations per ACI 318-14, IBC 2015, CBC 2016, ASCE 7-10

Load Combinations Used : IBC 2015

General Information

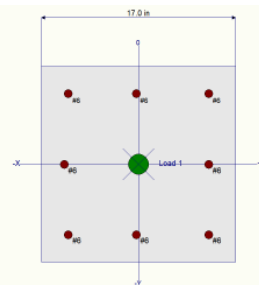
f'_c : Concrete 28 day strength = 4.0 ksi
 E = 3,605.0 ksi
Density = 150.0 pcf
 β = 0.850
 f_y - Main Rebar = 60.0 ksi
 E - Main Rebar = 29,000.0 ksi
Allow. Reinforcing Limits *ASTM A615 Bars Used*
Min. Reinf. = 1.0 %
Max. Reinf. = 8.0 %

Overall Column Height = 14.420 ft
End Fixity **Top & Bottom Pinned**
Brace condition for deflection (buckling) along columns :
X-X (width) axis :
Unbraced Length for buckling ABOUT Y-Y Axis = 14.420 ft, K = 1.0
Y-Y (depth) axis :
Unbraced Length for buckling ABOUT X-X Axis = 14.420 ft, K = 1.0

Column Cross Section

Column Dimensions : 17.0in Square Column, Column Edge to Rebar Edge Cover = 2.0in

Column Reinforcing : 4 - #6 bars @ corners,, 1 - #6 bars top & bottom between corner bars, 1 - #6 bars left & right between corner bars



Applied Loads

Entered loads are factored per load combinations specified by user.

Column self weight included : 4,341.02 lbs * Dead Load Factor

AXIAL LOADS ...

Roof + Tower Loads: Axial Load at 14.420 ft above base, D = 44.570, LR = 5.970, L = 150.190, S = 8.960 k

BENDING LOADS ...

Tower Load: Lat. Point Load at 14.420 ft creating Mx-x, W = 14.375 k

DESIGN SUMMARY

Load Combination **+1.20D+1.60L+0.50S**
Location of max.above base **14.323 ft**
Maximum Stress Ratio : 0.493 : 1
Ratio = $(P_u^2 + M_u^2)^{.5} / (\phi P_n^2 + \phi M_n^2)^{.5}$
 P_u = 303.477 k $\phi * P_n$ = 614.55 k
 M_{u-x} = 0.0 k-ft $\phi * M_{n-x}$ = 0.0 k-ft
 M_{u-y} = 28.072 k-ft $\phi * M_{n-y}$ = 55.969 k-ft
 M_u Angle = 90.0 deg
 M_u at Angle = 28.072 k-ft ϕM_n at Angle = 56.998 k-ft

P_n & M_n values located at P_u-M_u vector intersection with capacity curve

Column Capacities ...

P_nmax : Nominal Max. Compressive Axial Capacity **1,181.83 k**
P_nmin : Nominal Min. Tension Axial Capacity **k**
 ϕP_n , max : Usable Compressive Axial Capacity **614.55 k**
 ϕP_n , min : Usable Tension Axial Capacity **k**

Maximum SERVICE Load Reactions . .

Top along Y-Y **0.0 k** Bottom along Y-Y **0.0 k**
Top along X-X **14.375 k** Bottom along X-X **0.0 k**

Maximum SERVICE Load Deflections . .

Along Y-Y **0.0 in** at **0.0 ft** above base
for load combination :
Along X-X **0.0 in** at **0.0 ft** above base
for load combination :

General Section Information . ϕ = 0.650 β = 0.850 θ = 0.80

ρ : % Reinforcing **1.218 %** Rebar % Ok
Reinforcing Area **3.520 in²**
Concrete Area **289.0 in²**

Governing Load Combination Results

Governing Factored Load Combination	Moment		Dist. from base ft	Axial Load k		Bending Analysis k-ft						Utilization	
	X-X	Y-Y		Pu	ϕ * Pn	δ x	δ x * Mux	δ y	δ y * Muy	Alpha (deg)	δ Mu	ϕ Mn	Ratio
+1.40D		M2,min	14.32	68.48	614.55			1.000	6.33	90.000	6.33	57.00	0.111

Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: Sixth Floor Column

Governing Load Combination Results

Governing Factored Load Combination	Moment		Dist. from base ft	Axial Load k		Bending Analysis k-ft					Utilization		
	X-X	Y-Y		Pu	ϕ * Pn	δ x	δ x * Mu _x	δ y	δ y * Mu _y	Alpha (deg)	δ Mu	ϕ Mn	Ratio
+1.40D	M2,min		14.32	68.48	614.55	1.000	6.33			0.000	6.33	57.06	0.111
+1.20D+0.50Lr+1.60L		M2,min	14.32	301.98	614.55			1.000	27.93	90.000	27.93	57.00	0.491
+1.20D+0.50Lr+1.60L	M2,min		14.32	301.98	614.55	1.000	27.93			0.000	27.93	57.06	0.490
+1.20D+1.60L+0.50S		M2,min	14.32	303.48	614.55			1.000	28.07	90.000	28.07	57.00	0.493
+1.20D+1.60L+0.50S	M2,min		14.32	303.48	614.55	1.000	28.07			0.000	28.07	57.06	0.493
+1.20D+1.60Lr+0.50L		M2,min	14.32	143.34	614.55			1.000	13.26	90.000	13.26	57.00	0.233
+1.20D+1.60Lr+0.50L	M2,min		14.32	143.34	614.55	1.000	13.26			0.000	13.26	57.06	0.233
+1.20D+1.60Lr+0.50W		M2,min	14.32	68.25	614.55			1.000	6.31	90.000	6.31	57.00	0.111
+1.20D+1.60Lr+0.50W	M2,min		14.32	68.25	614.55	1.000	6.31			0.000	6.31	57.06	0.111
+1.20D+0.50L+1.60S		M2,min	14.32	148.12	614.55			1.000	13.70	90.000	13.70	57.00	0.241
+1.20D+0.50L+1.60S	M2,min		14.32	148.12	614.55	1.000	13.70			0.000	13.70	57.06	0.241
+1.20D+1.60S+0.50W		M2,min	14.32	73.03	614.55			1.000	6.76	90.000	6.76	57.00	0.119
+1.20D+1.60S+0.50W	M2,min		14.32	73.03	614.55	1.000	6.76			0.000	6.76	57.06	0.119
+1.20D+0.50Lr+0.50L+W		M2,min	14.32	136.77	614.55			1.000	12.65	90.000	12.65	57.00	0.222
+1.20D+0.50Lr+0.50L+W	M2,min		14.32	136.77	614.55	1.000	12.65			0.000	12.65	57.06	0.222
+1.20D+0.50L+0.50S+W		M2,min	14.32	138.27	614.55			1.000	12.79	90.000	12.79	57.00	0.225
+1.20D+0.50L+0.50S+W	M2,min		14.32	138.27	614.55	1.000	12.79			0.000	12.79	57.06	0.225
+1.20D+0.50L+0.70S		M2,min	14.32	140.06	614.55			1.000	12.96	90.000	12.96	57.00	0.228
+1.20D+0.50L+0.70S	M2,min		14.32	140.06	614.55	1.000	12.96			0.000	12.96	57.06	0.227
+0.90D+W		M2,min	14.32	44.02	614.55			1.000	4.07	90.000	4.07	57.00	0.072
+0.90D+W	M2,min		14.32	44.02	614.55	1.000	4.07			0.000	4.07	57.06	0.071
+0.90D		M2,min	14.32	44.02	614.55			1.000	4.07	90.000	4.07	57.00	0.072
+0.90D	M2,min		14.32	44.02	614.55	1.000	4.07			0.000	4.07	57.06	0.071

Maximum Reactions

Note: Only non-zero reactions are listed.

Load Combination	X-X Axis Reaction		k	Y-Y Axis Reaction		Axial Reaction	My - End Moments		k-ft	Mx - End Moments	
	@ Base	@ Top		@ Base	@ Top		@ Base	@ Top		@ Base	@ Top
D Only						48.911					
+D+L						199.101					
+D+Lr						54.881					
+D+S						57.871					
+D+0.750Lr+0.750L						166.031					
+D+0.750L+0.750S						168.274					
+D+0.60W					8.625	48.911					
+D+0.750Lr+0.750L+0.450W					6.469	166.031					
+D+0.750L+0.750S+0.450W					6.469	168.274					
+0.60D+0.60W					8.625	29.347					
+0.60D						29.347					
Lr Only						5.970					
L Only						150.190					
S Only						8.960					
W Only					14.375						

Maximum Moment Reactions

Note: Only non-zero reactions are listed.

Load Combination	Moment About X-X Axis			Moment About Y-Y Axis	
	@ Base	@ Top		@ Base	@ Top
D Only			k-ft		k-ft
+D+L			k-ft		k-ft
+D+Lr			k-ft		k-ft
+D+S			k-ft		k-ft
+D+0.750Lr+0.750L			k-ft		k-ft
+D+0.750L+0.750S			k-ft		k-ft
+D+0.60W			k-ft		k-ft
+D+0.750Lr+0.750L+0.450W			k-ft		k-ft
+D+0.750L+0.750S+0.450W			k-ft		k-ft
+0.60D+0.60W			k-ft		k-ft
+0.60D			k-ft		k-ft

Concrete Column

Lic. # : KW-06013597

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

DESCRIPTION: Sixth Floor Column

Note: Only non-zero reactions are listed.

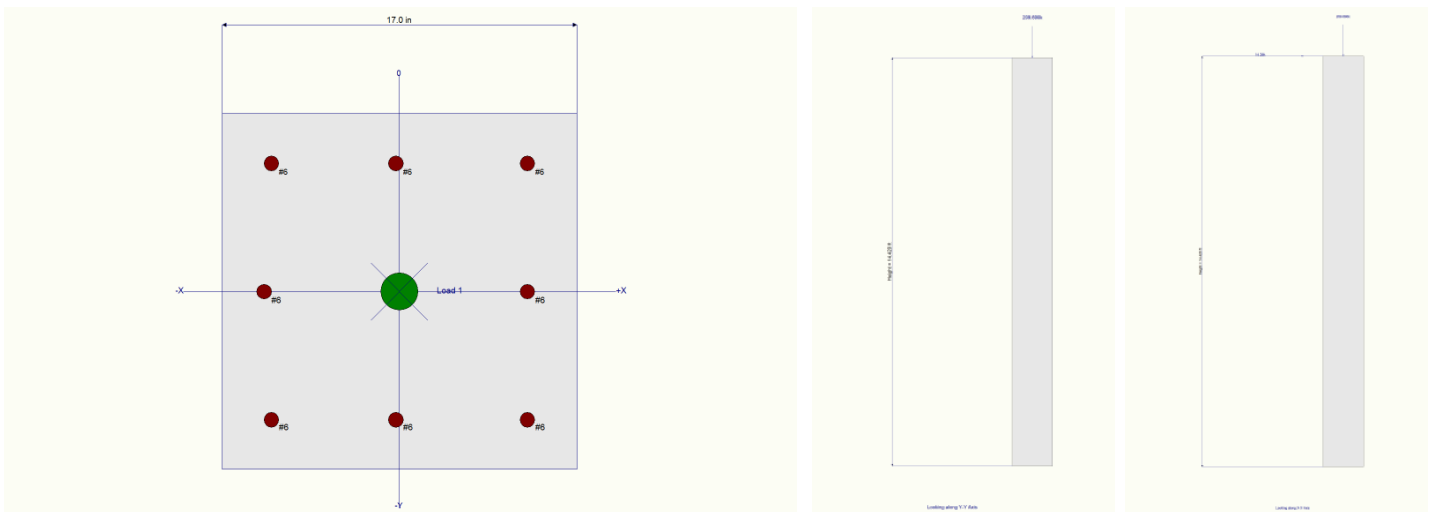
Maximum Moment Reactions

Load Combination	Moment About X-X Axis		Moment About Y-Y Axis	
	@ Base	@ Top	@ Base	@ Top
Lr Only		k-ft		k-ft
L Only		k-ft		k-ft
S Only		k-ft		k-ft
W Only		k-ft		k-ft

Maximum Deflections for Load Combinations

Load Combination	Max. X-X Deflection		Distance		Max. Y-Y Deflection		Distance	
D Only	0.0000	in	0.000	ft	0.000	in	0.000	ft
+D+L	0.0000	in	0.000	ft	0.000	in	0.000	ft
+D+Lr	0.0000	in	0.000	ft	0.000	in	0.000	ft
+D+S	0.0000	in	0.000	ft	0.000	in	0.000	ft
+D+0.750Lr+0.750L	0.0000	in	0.000	ft	0.000	in	0.000	ft
+D+0.750L+0.750S	0.0000	in	0.000	ft	0.000	in	0.000	ft
+D+0.60W	0.0000	in	0.000	ft	0.000	in	0.000	ft
+D+0.750Lr+0.750L+0.450W	0.0000	in	0.000	ft	0.000	in	0.000	ft
+D+0.750L+0.750S+0.450W	0.0000	in	0.000	ft	0.000	in	0.000	ft
+0.60D+0.60W	0.0000	in	0.000	ft	0.000	in	0.000	ft
+0.60D	0.0000	in	0.000	ft	0.000	in	0.000	ft
Lr Only	0.0000	in	0.000	ft	0.000	in	0.000	ft
L Only	0.0000	in	0.000	ft	0.000	in	0.000	ft
S Only	0.0000	in	0.000	ft	0.000	in	0.000	ft
W Only	0.0000	in	0.000	ft	0.000	in	0.000	ft

Sketches



Interaction Diagrams

Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. #: KW-06013597

DESCRIPTION: **Sixth Floor Column**

Concrete Column P-M Interaction Diagram



Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. #: KW-06013597

DESCRIPTION: **Sixth Floor Column**

Concrete Column P-M Interaction Diagram



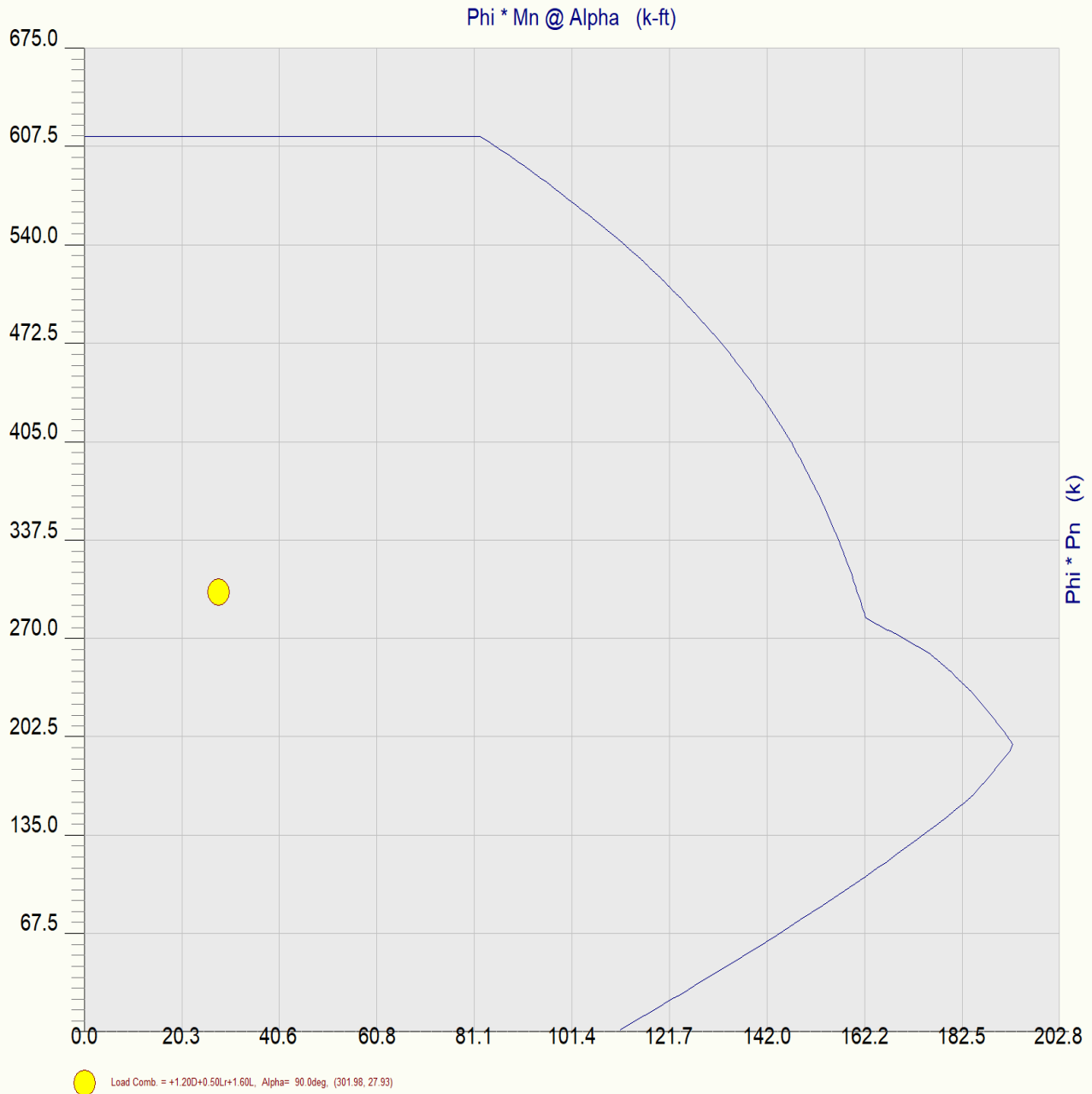
Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Sixth Floor Column**

Concrete Column P-M Interaction Diagram



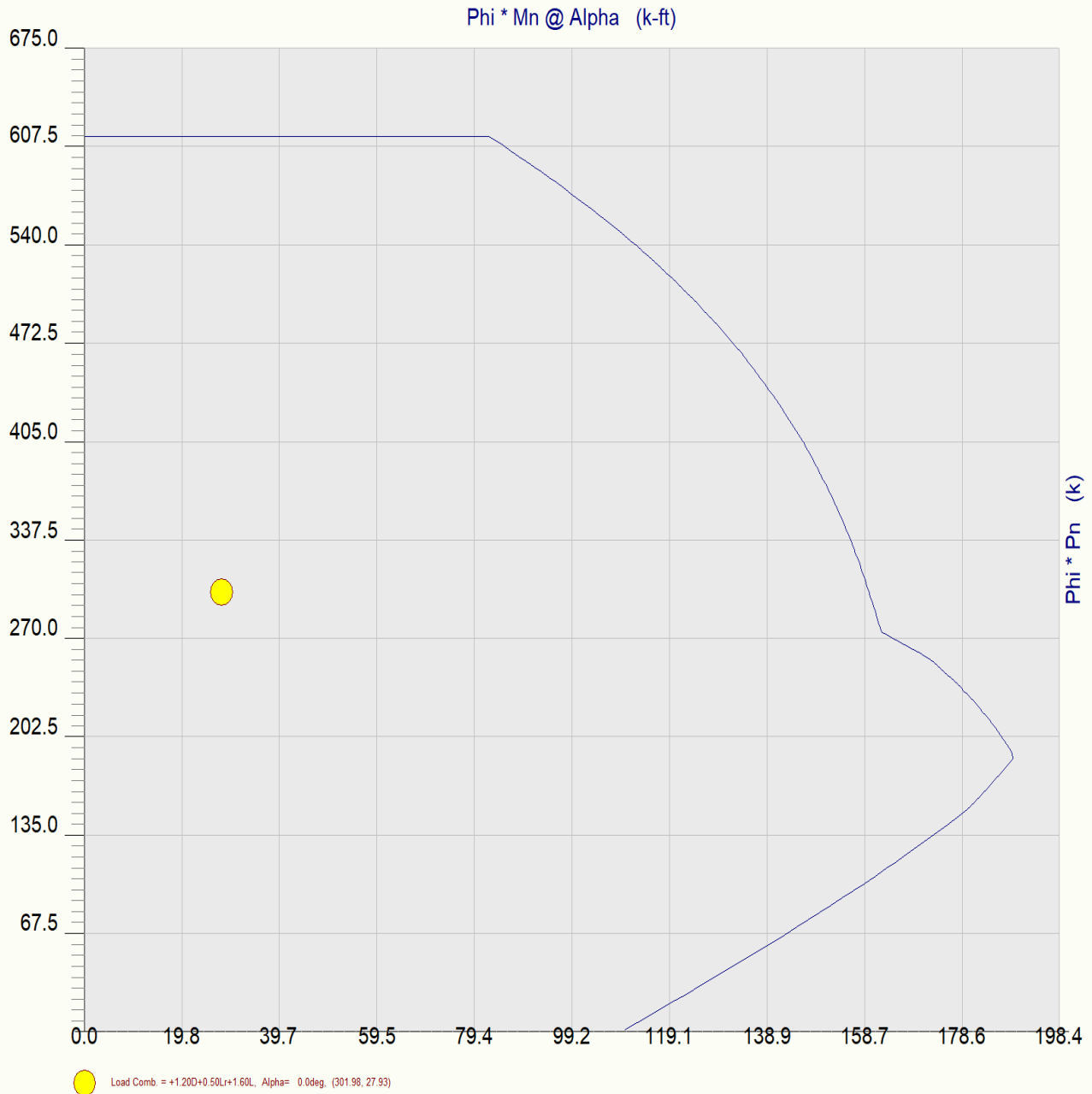
Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Sixth Floor Column**

Concrete Column P-M Interaction Diagram



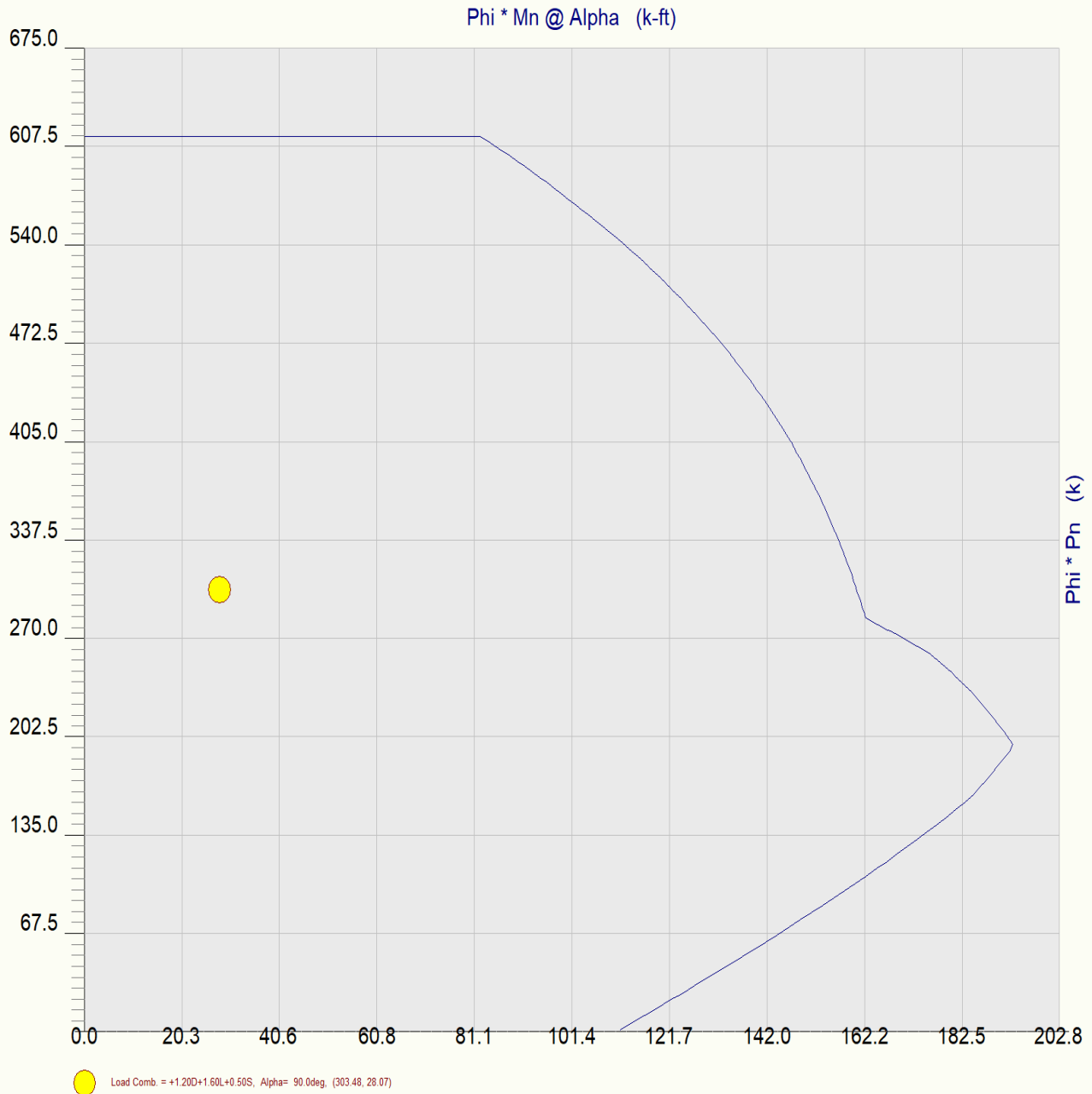
Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. #: KW-06013597

DESCRIPTION: **Sixth Floor Column**

Concrete Column P-M Interaction Diagram



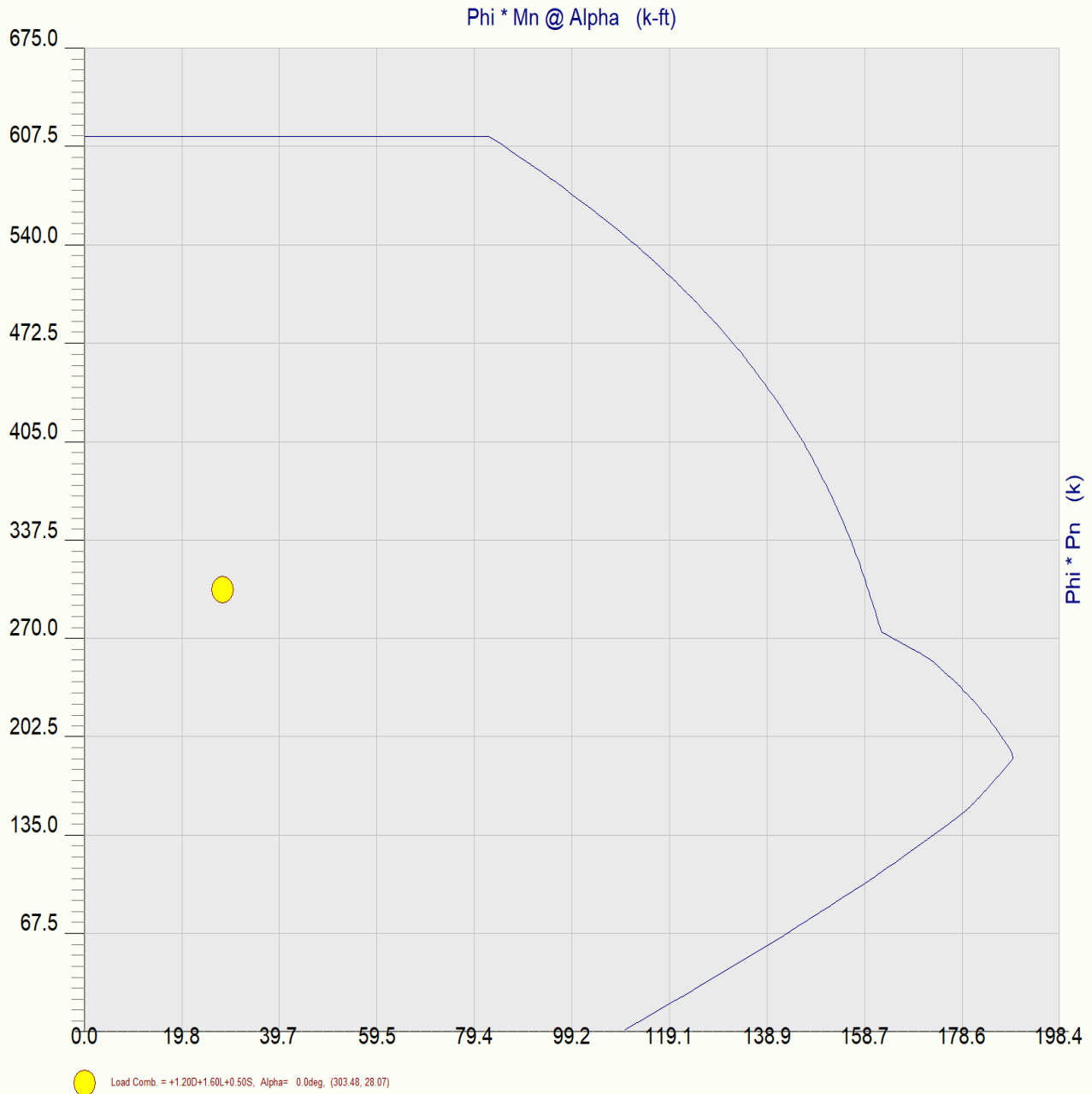
Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Sixth Floor Column**

Concrete Column P-M Interaction Diagram



Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. #: KW-06013597

DESCRIPTION: **Sixth Floor Column**

Concrete Column P-M Interaction Diagram



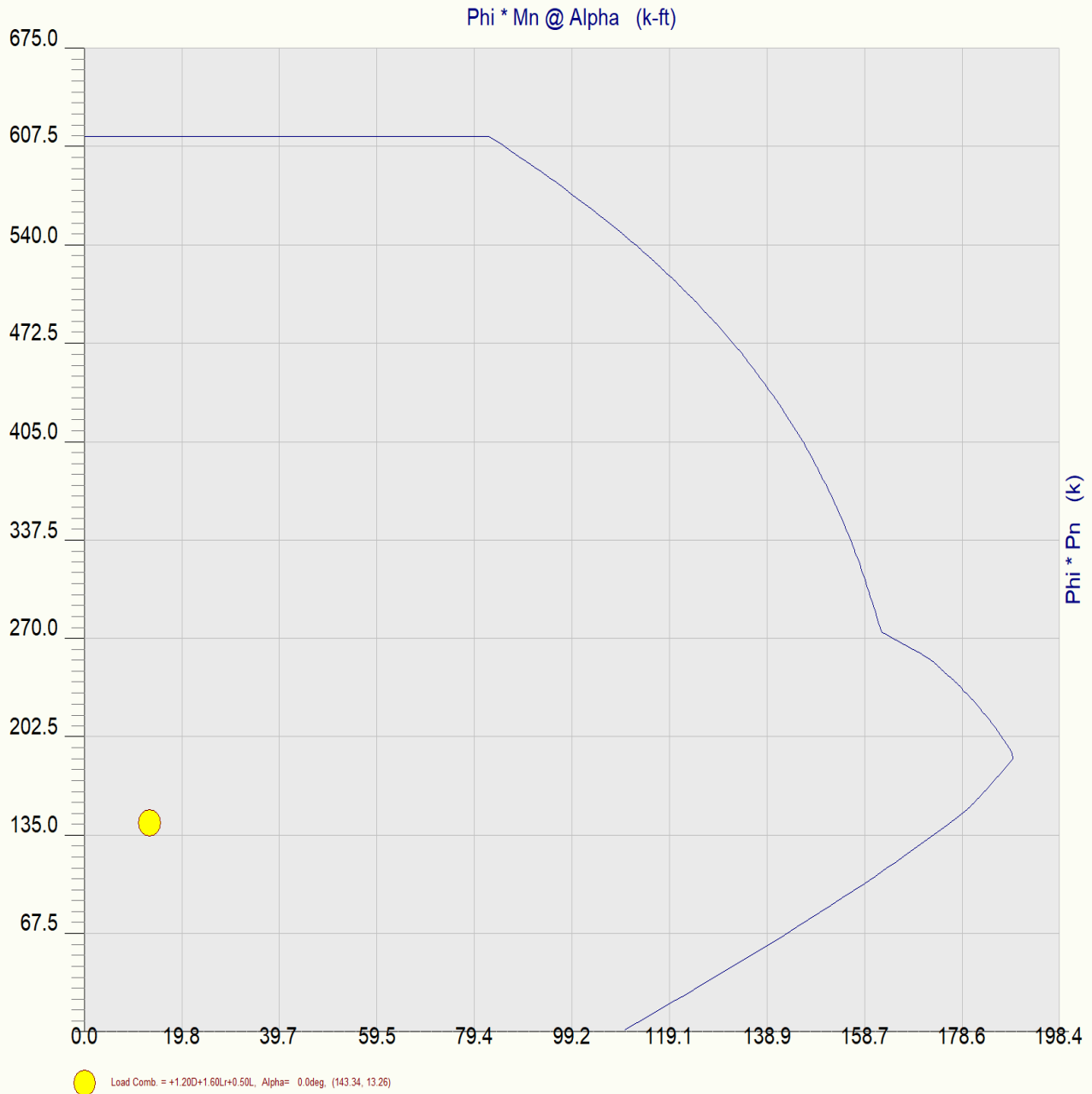
Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. #: KW-06013597

DESCRIPTION: **Sixth Floor Column**

Concrete Column P-M Interaction Diagram



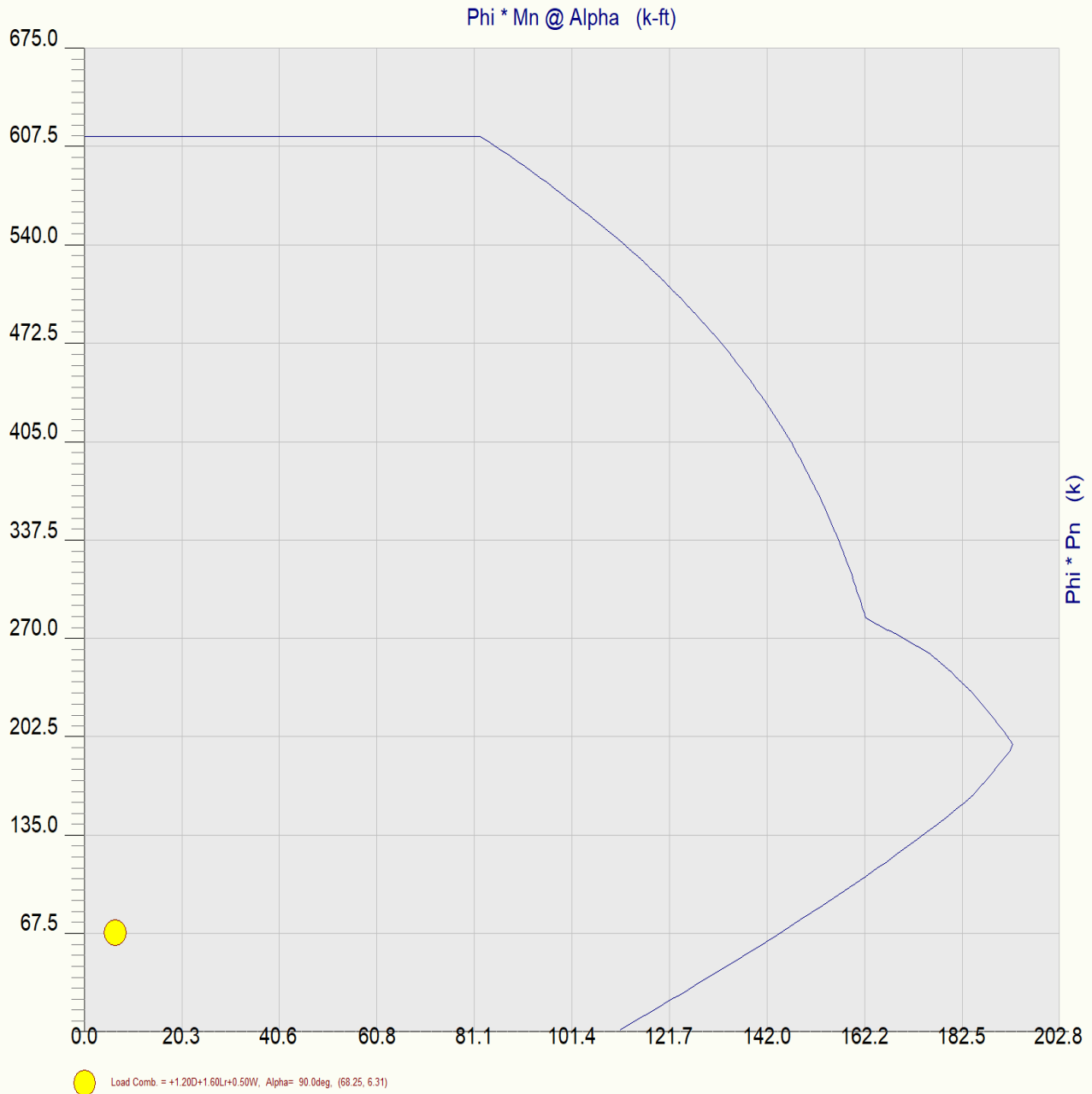
Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Sixth Floor Column**

Concrete Column P-M Interaction Diagram



Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. #: KW-06013597

DESCRIPTION: **Sixth Floor Column**

Concrete Column P-M Interaction Diagram



Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. #: KW-06013597

DESCRIPTION: **Sixth Floor Column**

Concrete Column P-M Interaction Diagram



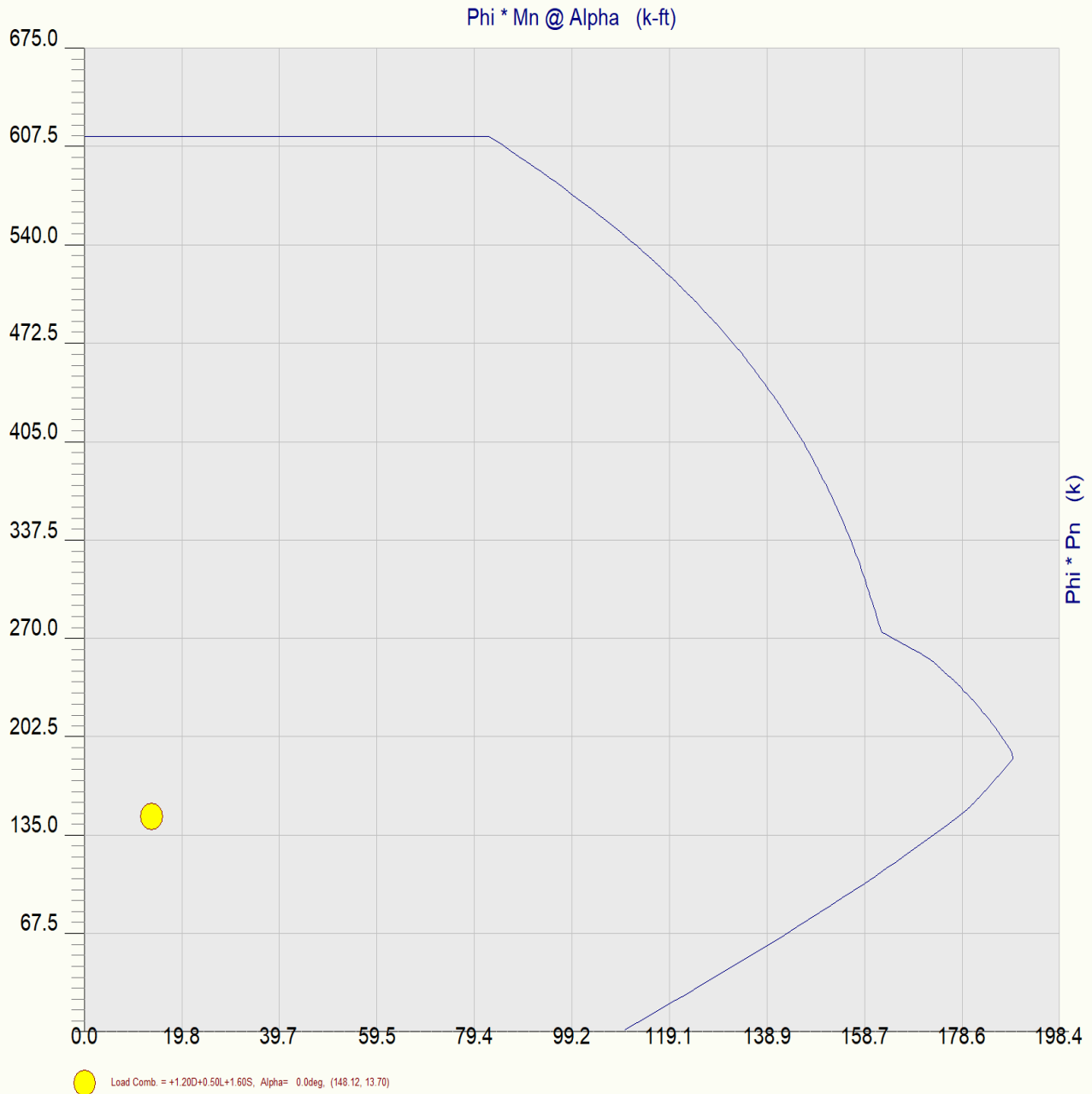
Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. #: KW-06013597

DESCRIPTION: **Sixth Floor Column**

Concrete Column P-M Interaction Diagram



Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. #: KW-06013597

DESCRIPTION: **Sixth Floor Column**

Concrete Column P-M Interaction Diagram



Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Sixth Floor Column**

Concrete Column P-M Interaction Diagram



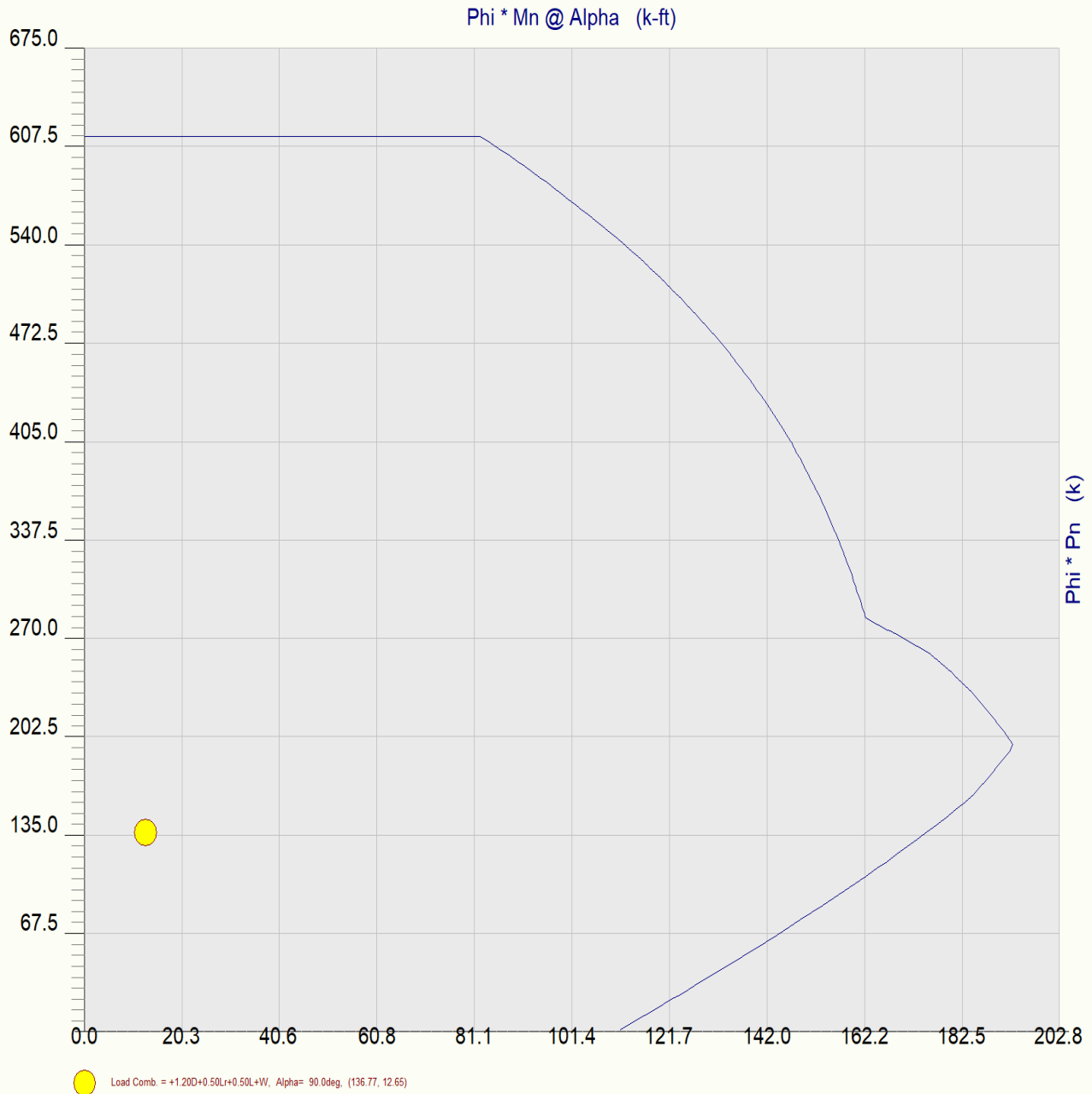
Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. #: KW-06013597

DESCRIPTION: **Sixth Floor Column**

Concrete Column P-M Interaction Diagram



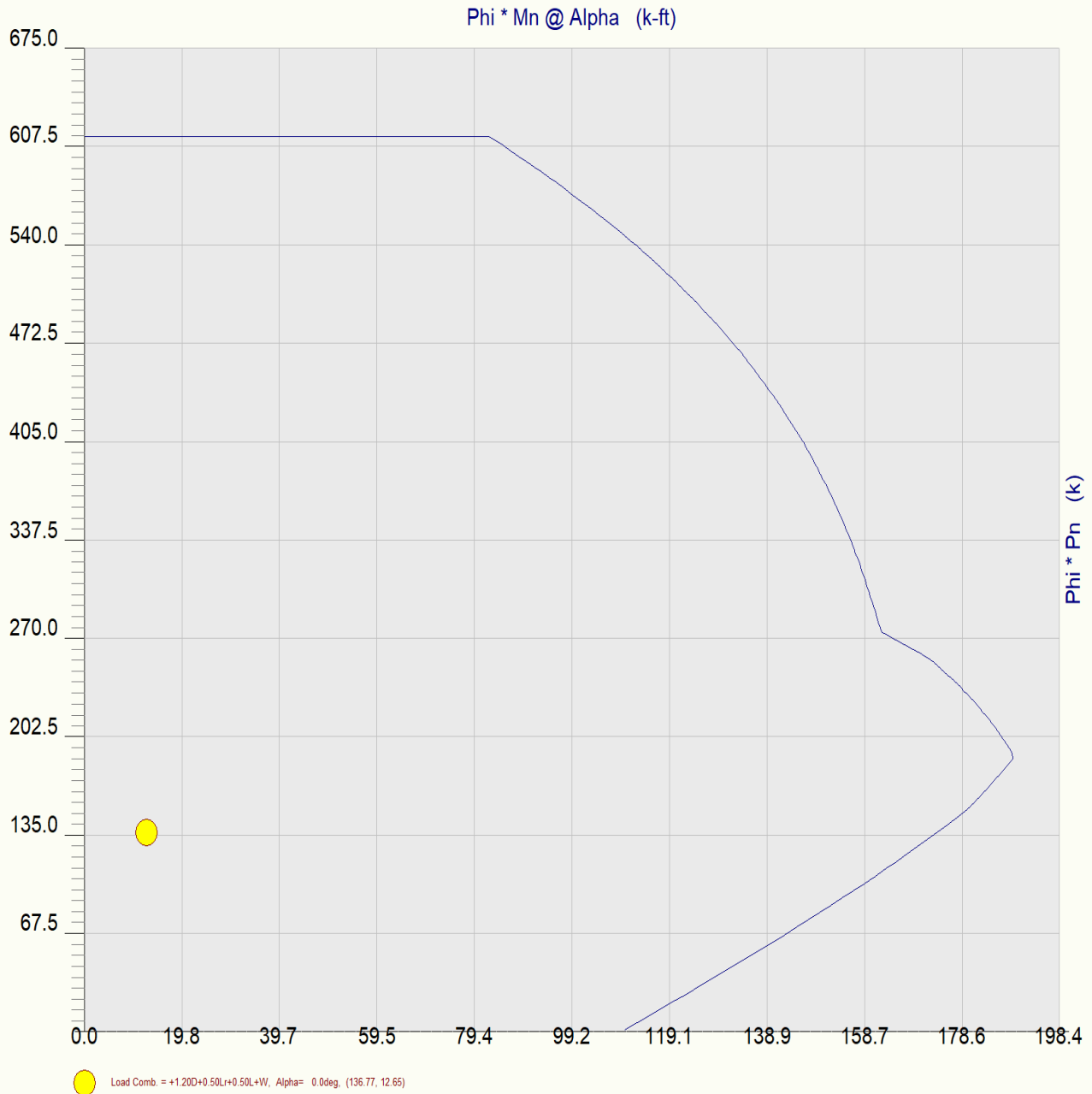
Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. #: KW-06013597

DESCRIPTION: **Sixth Floor Column**

Concrete Column P-M Interaction Diagram



Concrete Column

Lic. #: KW-06013597

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

DESCRIPTION: Fifth Floor Column

Code References

Calculations per ACI 318-14, IBC 2015, CBC 2016, ASCE 7-10
Load Combinations Used : IBC 2015

General Information

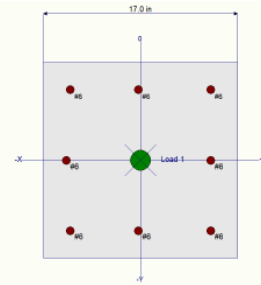
f'_c : Concrete 28 day strength = 4.0 ksi
 E = 3,605.0 ksi
Density = 150.0 pcf
 β = 0.850
 f_y - Main Rebar = 60.0 ksi
 E - Main Rebar = 29,000.0 ksi
Allow. Reinforcing Limits *ASTM A615 Bars Used*
Min. Reinf. = 1.0 %
Max. Reinf. = 8.0 %

Overall Column Height = 14.420 ft
End Fixity **Top & Bottom Pinned**
Brace condition for deflection (buckling) along columns :
X-X (width) axis :
Unbraced Length for buckling ABOUT Y-Y Axis = 14.420 ft, K = 1.0
Y-Y (depth) axis :
Unbraced Length for buckling ABOUT X-X Axis = 14.420 ft, K = 1.0

Column Cross Section

Column Dimensions : 17.0in Square Column, Column Edge to Rebar Edge Cover = 2.0in

Column Reinforcing : 4 - #6 bars @ corners,, 1 - #6 bars top & bottom between corner bars, 1 - #6 bars left & right between corner bars



Applied Loads

Entered loads are factored per load combinations specified by user.

Column self weight included : 4,341.02 lbs * Dead Load Factor

AXIAL LOADS ...

Roof + Tower Loads: Axial Load at 14.420 ft above base, D = 86.250, LR = 5.970, L = 180.060, S = 8.960 k

DESIGN SUMMARY

Load Combination **+1.20D+1.60L+0.50S**
Location of max. above base **14.323 ft**
Maximum Stress Ratio : 0.652 : 1
Ratio = $(P_u^2 + M_u^2)^{.5} / (\Phi P_n^2 + \Phi M_n^2)^{.5}$
 P_u = 401.285 k $\Phi * P_n$ = 614.55 k
 M_{u-x} = 0.0 k-ft $\Phi * M_{n-x}$ = 0.0 k-ft
 M_{u-y} = 37.119 k-ft $\Phi * M_{n-y}$ = 55.969 k-ft
 M_u Angle = 90.0 deg
 M_u at Angle = 37.119 k-ft ΦM_n at Angle = 56.998 k-ft

P_n & M_n values located at P_u-M_u vector intersection with capacity curve

Column Capacities ...

P_{nmax} : Nominal Max. Compressive Axial Capacity **1,181.83 k**
 P_{nmin} : Nominal Min. Tension Axial Capacity **k**
 ΦP_n , max : Usable Compressive Axial Capacity **614.55 k**
 ΦP_n , min : Usable Tension Axial Capacity **k**

Maximum SERVICE Load Reactions . .

Top along Y-Y **0.0 k** Bottom along Y-Y **0.0 k**
Top along X-X **0.0 k** Bottom along X-X **0.0 k**

Maximum SERVICE Load Deflections . .

Along Y-Y **0.0 in** at **0.0 ft** above base
for load combination :
Along X-X **0.0 in** at **0.0 ft** above base
for load combination :

General Section Information . Φ = 0.650 β = 0.850 θ = 0.80

ρ : % Reinforcing **1.218 %** Rebar % Ok
Reinforcing Area **3.520 in²**
Concrete Area **289.0 in²**

Governing Load Combination Results

Governing Factored Load Combination	Moment		Dist. from base ft	Axial Load k		Bending Analysis k-ft					Utilization		
	X-X	Y-Y		P_u	$\Phi * P_n$	δx	$\delta x * M_{ux}$	δy	$\delta y * M_{uy}$	Alpha (deg)	δM_u	ΦM_n	Ratio
+1.40D		M2,min	14.32	126.83	614.55			1.000	11.73	90.000	11.73	57.00	0.206
+1.40D	M2,min		14.32	126.83	614.55	1.000	11.73			0.000	11.73	57.06	0.206
+1.20D+0.50Lr+1.60L		M2,min	14.32	399.79	614.55			1.000	36.98	90.000	36.98	57.00	0.650

Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. #: KW-06013597

DESCRIPTION: Fifth Floor Column

Governing Load Combination Results

Governing Factored Load Combination	Moment		Dist. from base ft	Axial Load k		Bending Analysis k-ft								Utilization	
	X-X	Y-Y		Pu	ϕ * Pn	δ x	δ x * Mu _x	δ y	δ y * Mu _y	Alpha (deg)	δ Mu	ϕ Mn	Ratio		
+1.20D+0.50Lr+1.60L	M2,min		14.32	399.79	614.55	1.000	36.98			0.000	36.98	57.06	0.649		
+1.20D+1.60L+0.50S		M2,min	14.32	401.29	614.55			1.000	37.12	90.000	37.12	57.00	0.652		
+1.20D+1.60L+0.50S	M2,min		14.32	401.29	614.55	1.000	37.12			0.000	37.12	57.06	0.652		
+1.20D+1.60Lr+0.50L		M2,min	14.32	208.29	614.55			1.000	19.27	90.000	19.27	57.00	0.338		
+1.20D+1.60Lr+0.50L	M2,min		14.32	208.29	614.55	1.000	19.27			0.000	19.27	57.06	0.338		
+1.20D+1.60Lr		M2,min	14.32	118.26	614.55			1.000	10.94	90.000	10.94	57.00	0.192		
+1.20D+1.60Lr	M2,min		14.32	118.26	614.55	1.000	10.94			0.000	10.94	57.06	0.192		
+1.20D+0.50L+1.60S		M2,min	14.32	213.08	614.55			1.000	19.71	90.000	19.71	57.00	0.346		
+1.20D+0.50L+1.60S	M2,min		14.32	213.08	614.55	1.000	19.71			0.000	19.71	57.06	0.346		
+1.20D+1.60S		M2,min	14.32	123.05	614.55			1.000	11.38	90.000	11.38	57.00	0.200		
+1.20D+1.60S	M2,min		14.32	123.05	614.55	1.000	11.38			0.000	11.38	57.06	0.200		
+1.20D+0.50Lr+0.50L		M2,min	14.32	201.72	614.55			1.000	18.66	90.000	18.66	57.00	0.328		
+1.20D+0.50Lr+0.50L	M2,min		14.32	201.72	614.55	1.000	18.66			0.000	18.66	57.06	0.328		
+1.20D+0.50L+0.50S		M2,min	14.32	203.22	614.55			1.000	18.80	90.000	18.80	57.00	0.330		
+1.20D+0.50L+0.50S	M2,min		14.32	203.22	614.55	1.000	18.80			0.000	18.80	57.06	0.330		
+1.20D+0.50L+0.70S		M2,min	14.32	205.01	614.55			1.000	18.96	90.000	18.96	57.00	0.333		
+1.20D+0.50L+0.70S	M2,min		14.32	205.01	614.55	1.000	18.96			0.000	18.96	57.06	0.333		
+0.90D		M2,min	14.32	81.53	614.55			1.000	7.54	90.000	7.54	57.00	0.132		
+0.90D	M2,min		14.32	81.53	614.55	1.000	7.54			0.000	7.54	57.06	0.132		

Maximum Reactions

Note: Only non-zero reactions are listed.

Load Combination	X-X Axis Reaction		k	Y-Y Axis Reaction		Axial Reaction @ Base	My - End Moments		k-ft	Mx - End Moments	
	@ Base	@ Top		@ Base	@ Top		@ Base	@ Top		@ Base	@ Top
D Only						90.591					
+D+L						270.651					
+D+Lr						96.561					
+D+S						99.551					
+D+0.750Lr+0.750L						230.114					
+D+0.750L+0.750S						232.356					
+0.60D						54.355					
Lr Only						5.970					
L Only						180.060					
S Only						8.960					

Maximum Moment Reactions

Note: Only non-zero reactions are listed.

Load Combination	Moment About X-X Axis			Moment About Y-Y Axis		
	@ Base	@ Top		@ Base	@ Top	
D Only			k-ft			k-ft
+D+L			k-ft			k-ft
+D+Lr			k-ft			k-ft
+D+S			k-ft			k-ft
+D+0.750Lr+0.750L			k-ft			k-ft
+D+0.750L+0.750S			k-ft			k-ft
+0.60D			k-ft			k-ft
Lr Only			k-ft			k-ft
L Only			k-ft			k-ft
S Only			k-ft			k-ft

Maximum Deflections for Load Combinations

Load Combination	Max. X-X Deflection		Distance		Max. Y-Y Deflection		Distance	
D Only	0.0000	in	0.000	ft	0.000	in	0.000	ft
+D+L	0.0000	in	0.000	ft	0.000	in	0.000	ft
+D+Lr	0.0000	in	0.000	ft	0.000	in	0.000	ft
+D+S	0.0000	in	0.000	ft	0.000	in	0.000	ft
+D+0.750Lr+0.750L	0.0000	in	0.000	ft	0.000	in	0.000	ft
+D+0.750L+0.750S	0.0000	in	0.000	ft	0.000	in	0.000	ft
+0.60D	0.0000	in	0.000	ft	0.000	in	0.000	ft

Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

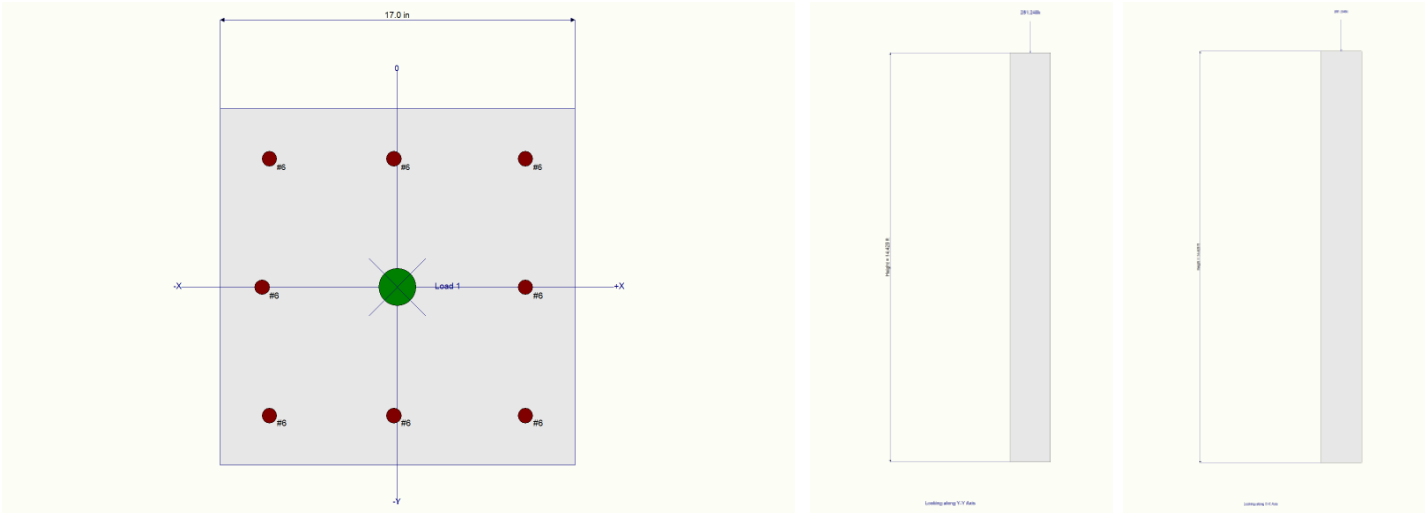
Lic. # : KW-06013597

DESCRIPTION: **Fifth Floor Column**

Maximum Deflections for Load Combinations

Load Combination	Max. X-X Deflection		Distance		Max. Y-Y Deflection		Distance	
Lr Only	0.0000	in	0.000	ft	0.000	in	0.000	ft
L Only	0.0000	in	0.000	ft	0.000	in	0.000	ft
S Only	0.0000	in	0.000	ft	0.000	in	0.000	ft

Sketches



Interaction Diagrams

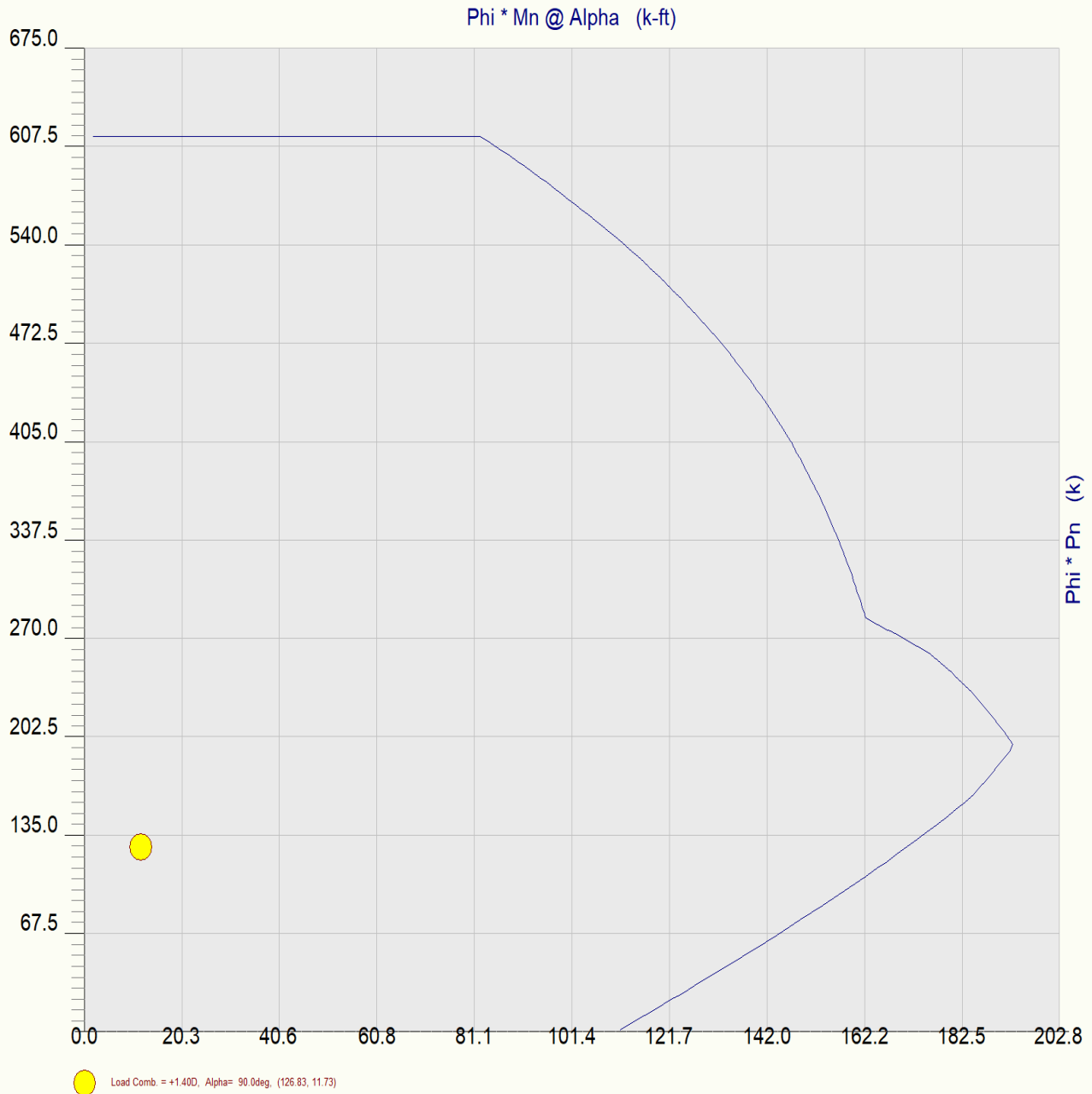
Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. #: KW-06013597

DESCRIPTION: **Fifth Floor Column**

Concrete Column P-M Interaction Diagram



Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Fifth Floor Column**

Concrete Column P-M Interaction Diagram



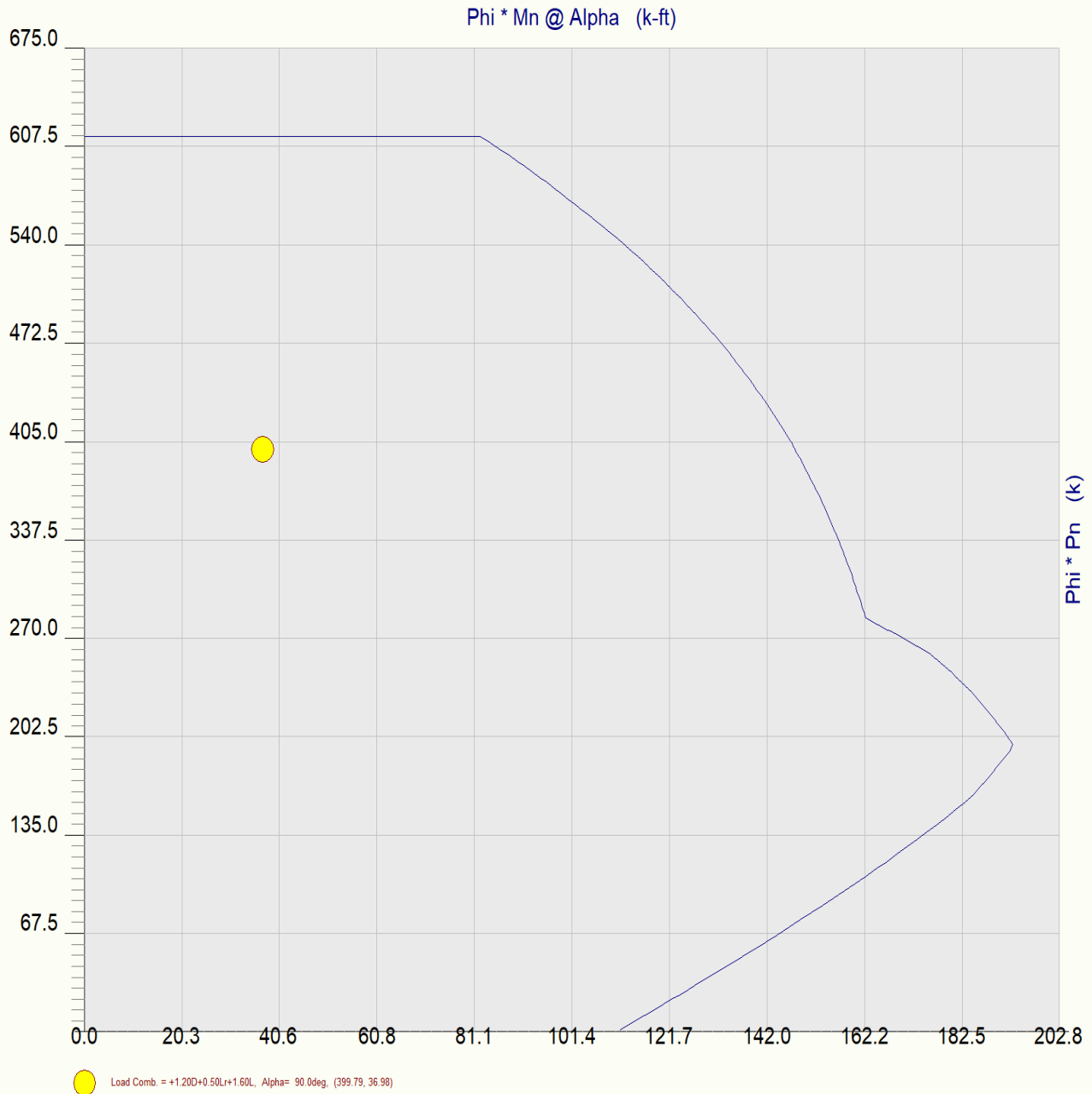
Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. #: KW-06013597

DESCRIPTION: **Fifth Floor Column**

Concrete Column P-M Interaction Diagram



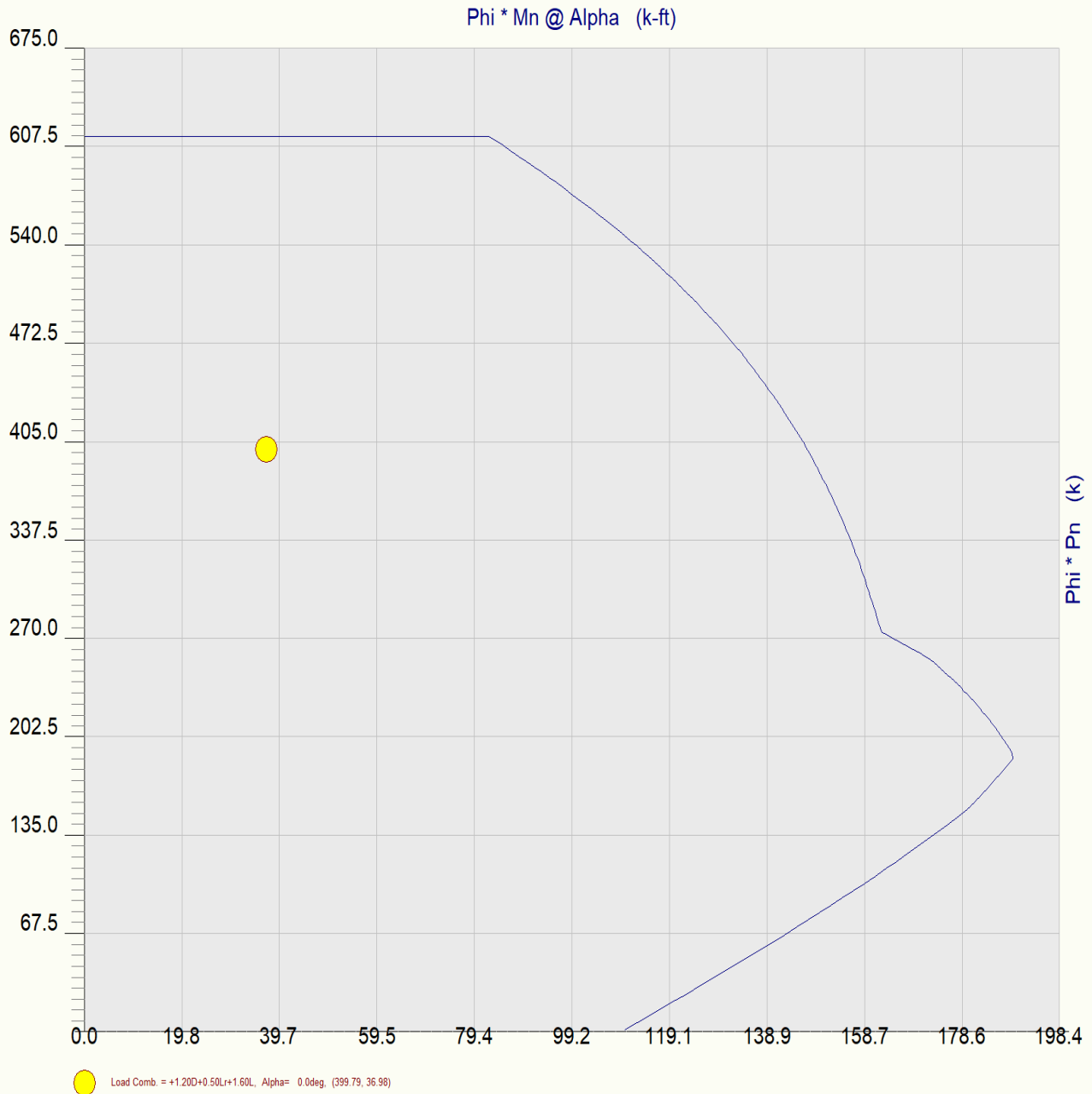
Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Fifth Floor Column**

Concrete Column P-M Interaction Diagram



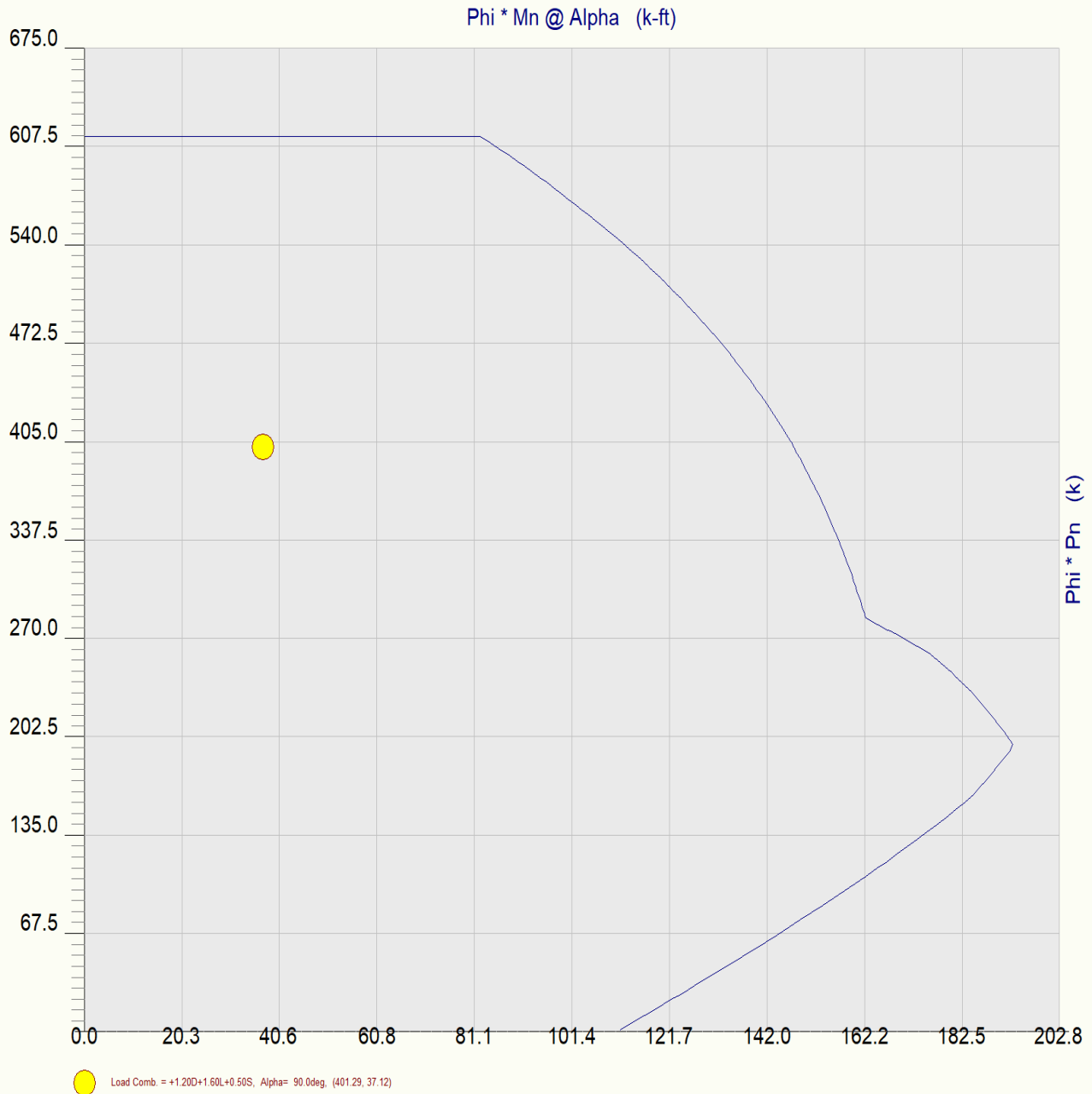
Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. #: KW-06013597

DESCRIPTION: **Fifth Floor Column**

Concrete Column P-M Interaction Diagram



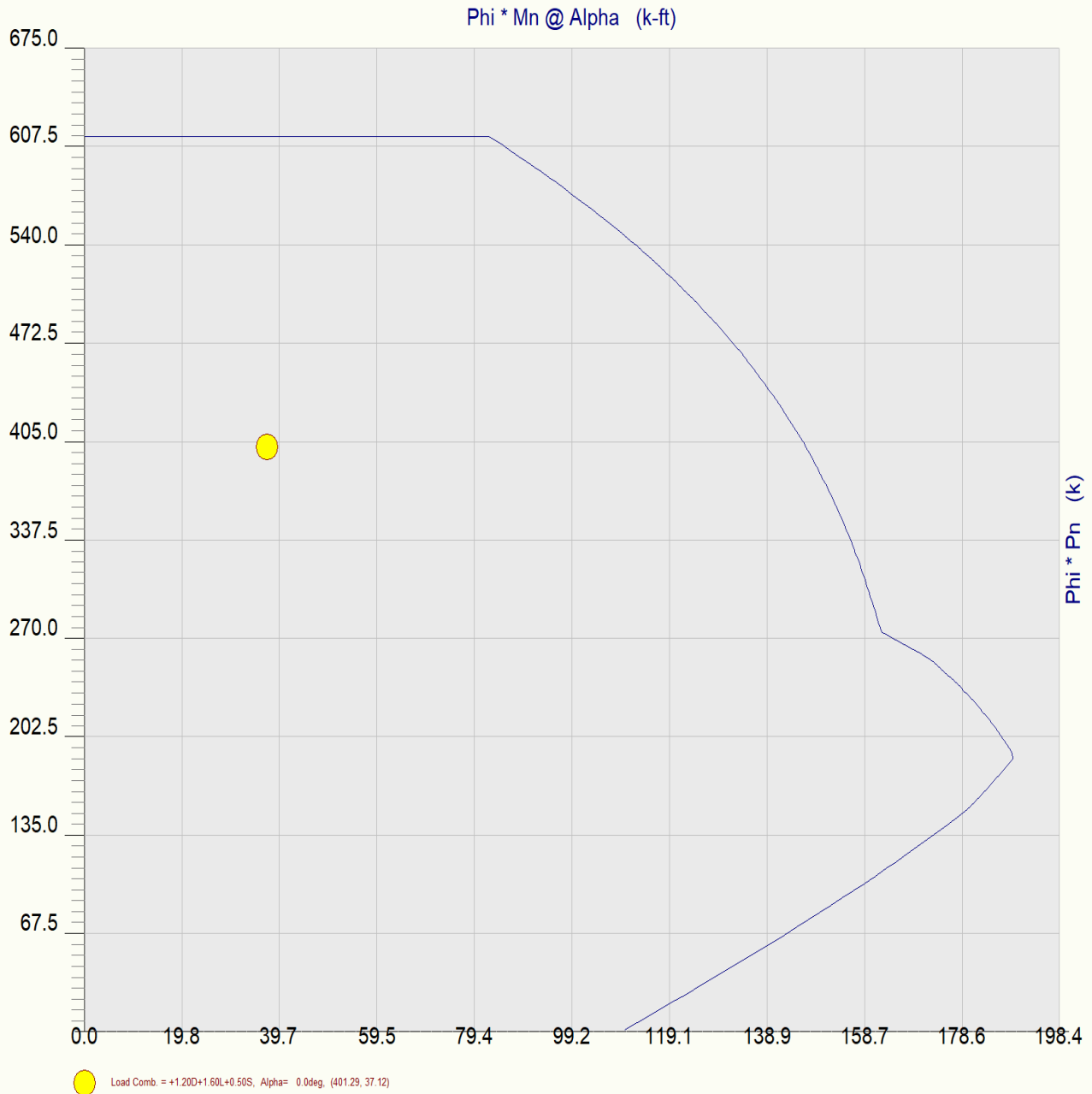
Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Fifth Floor Column**

Concrete Column P-M Interaction Diagram



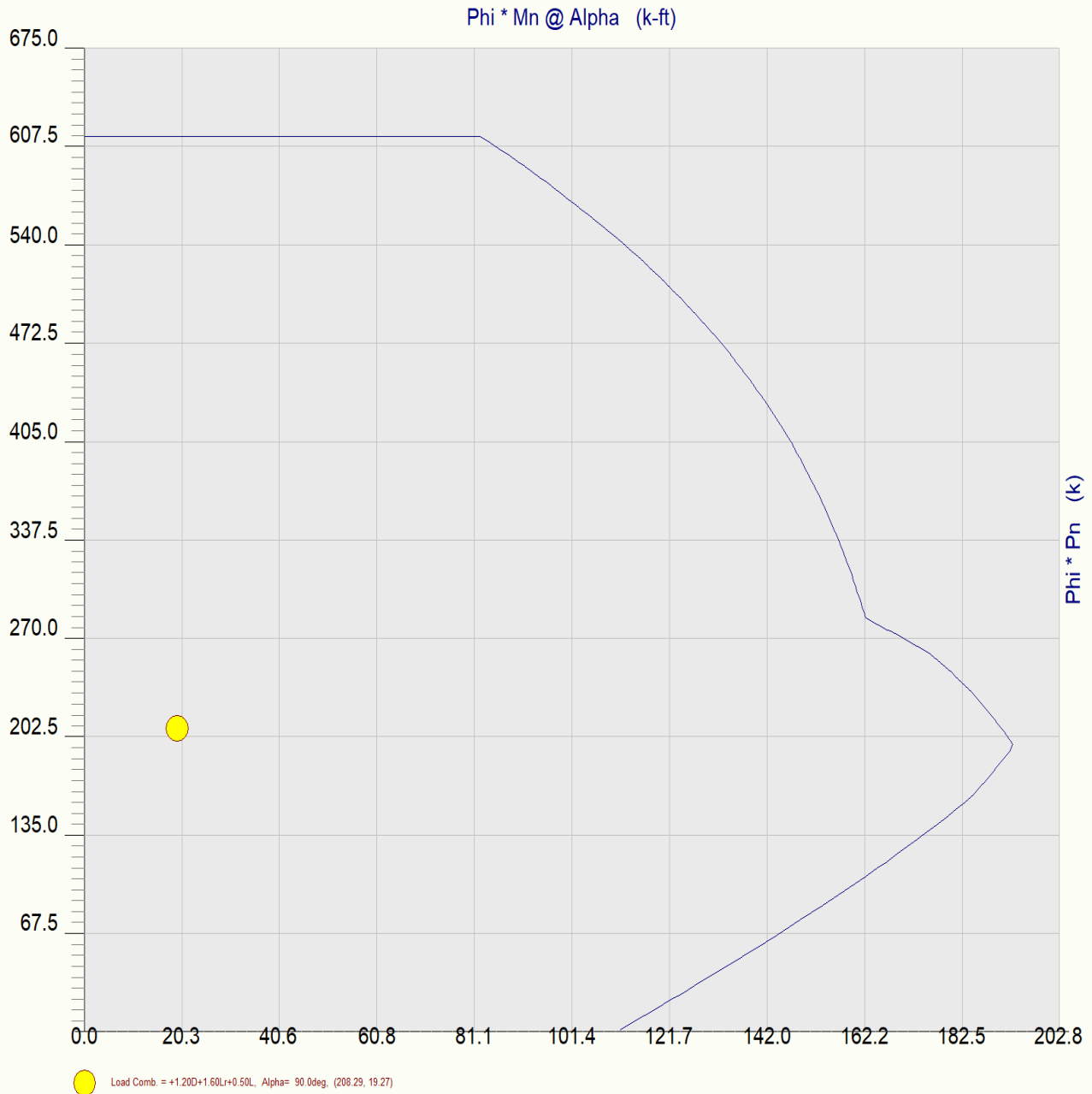
Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. #: KW-06013597

DESCRIPTION: **Fifth Floor Column**

Concrete Column P-M Interaction Diagram



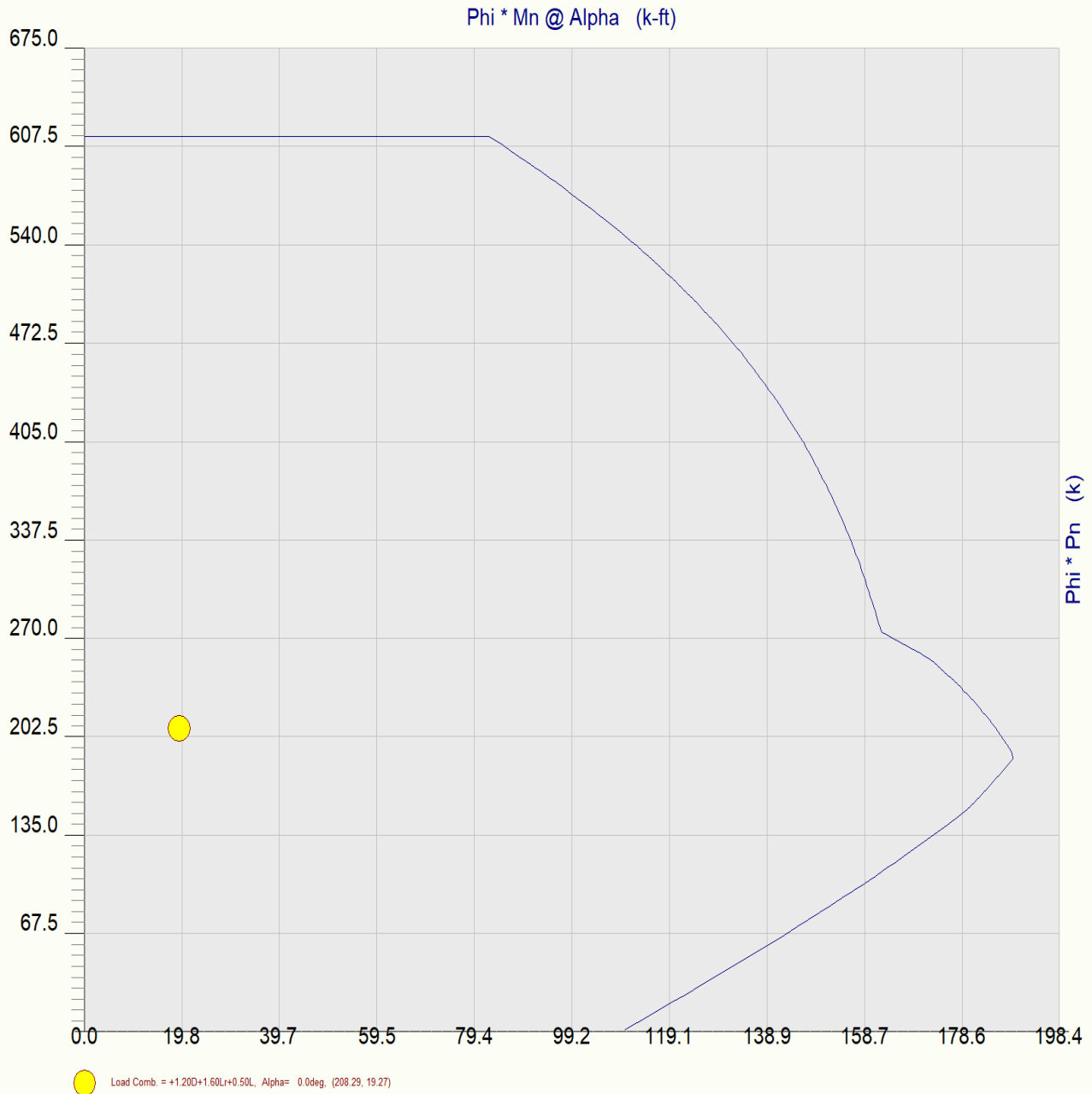
Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. #: KW-06013597

DESCRIPTION: **Fifth Floor Column**

Concrete Column P-M Interaction Diagram



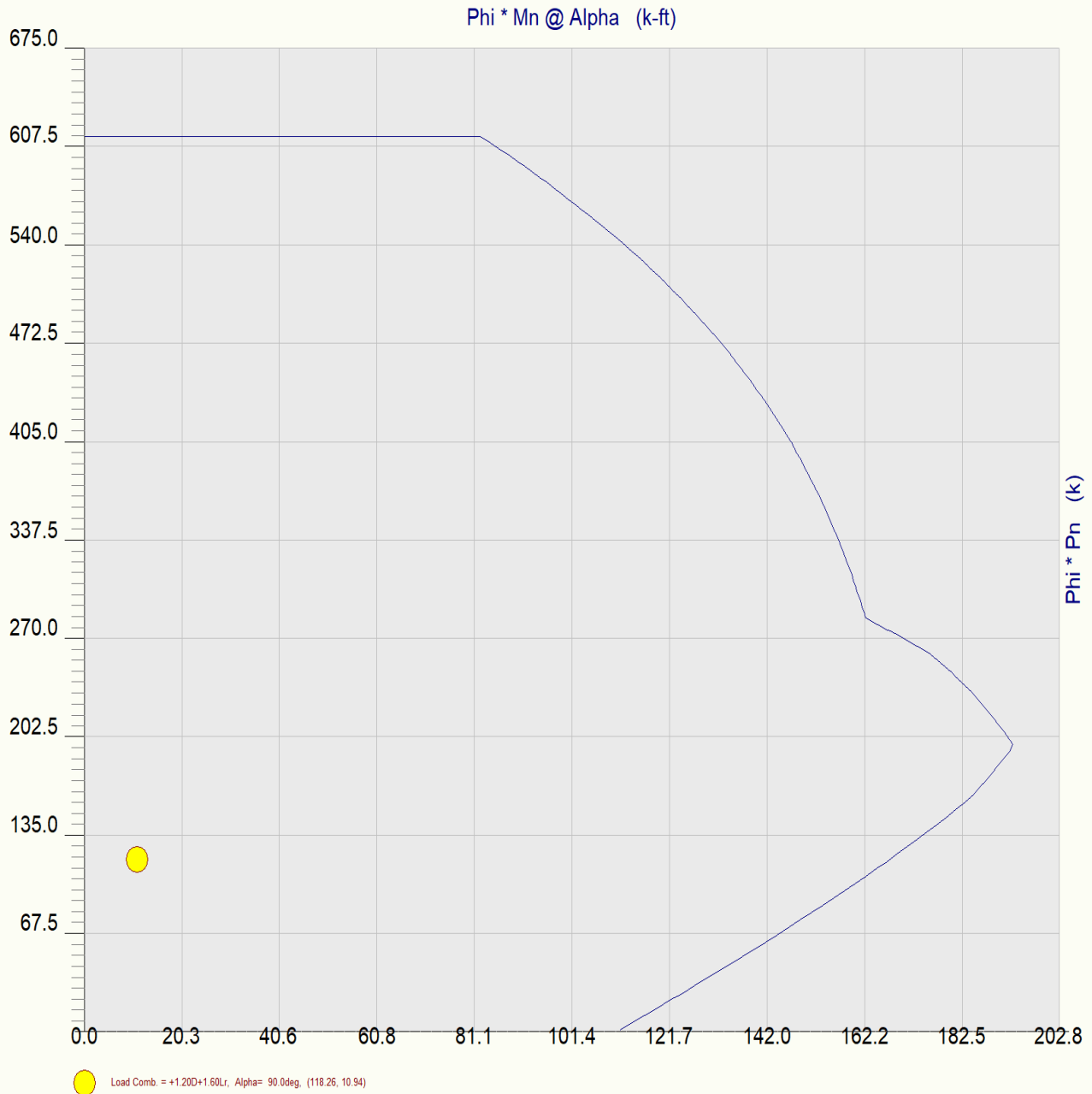
Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. #: KW-06013597

DESCRIPTION: **Fifth Floor Column**

Concrete Column P-M Interaction Diagram



Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Fifth Floor Column**

Concrete Column P-M Interaction Diagram



Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Fifth Floor Column**

Concrete Column P-M Interaction Diagram



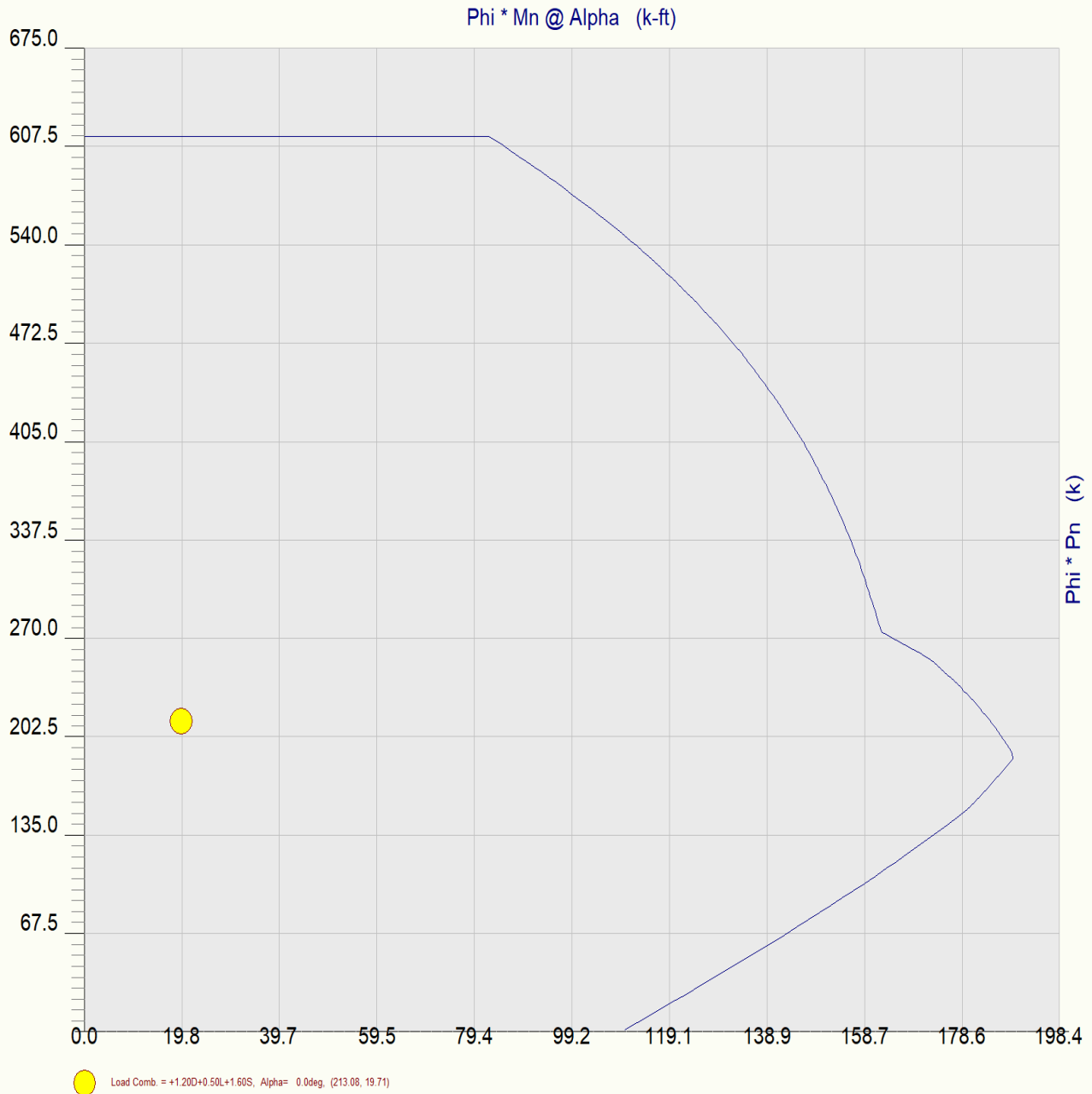
Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. #: KW-06013597

DESCRIPTION: **Fifth Floor Column**

Concrete Column P-M Interaction Diagram



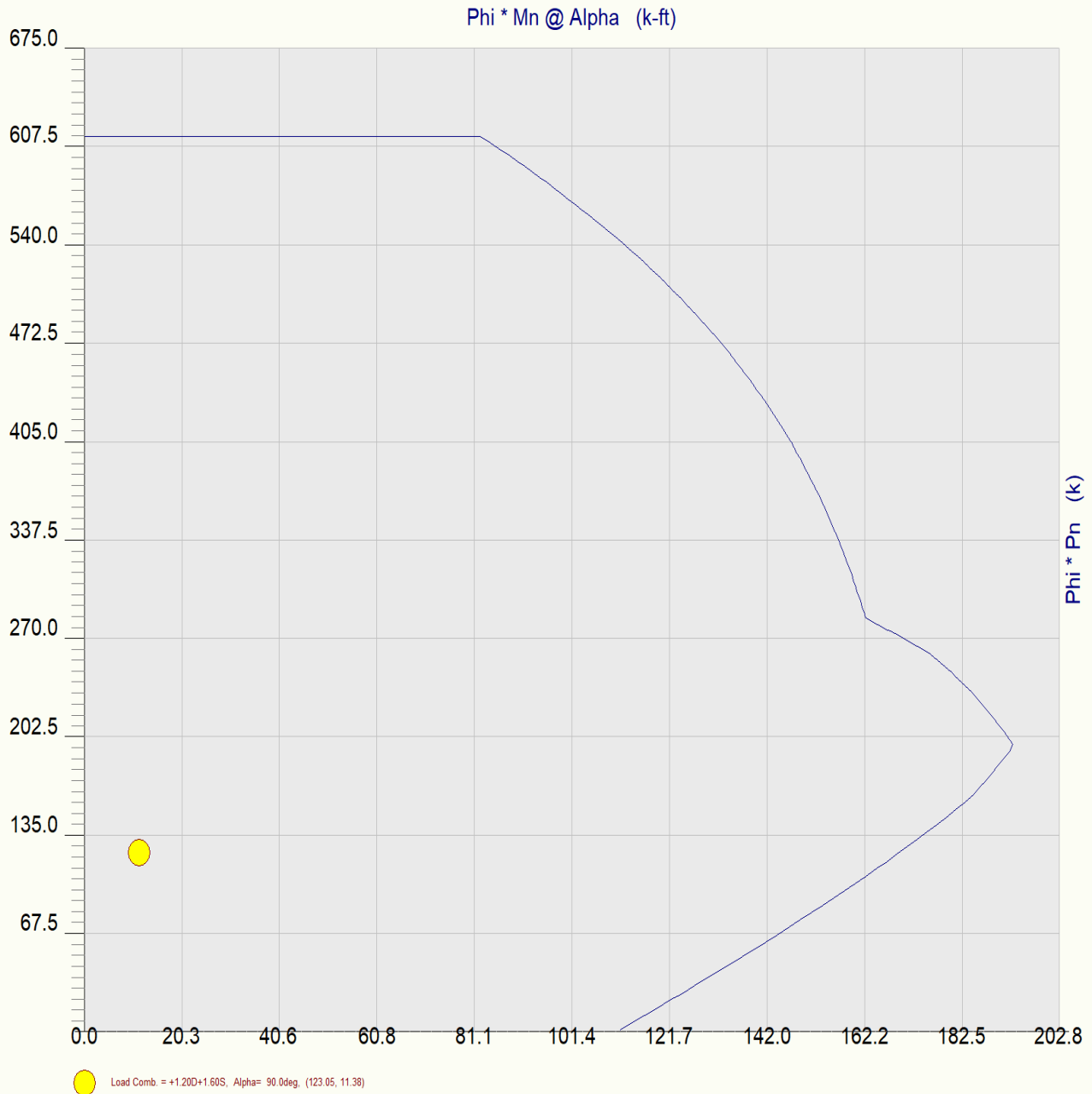
Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. #: KW-06013597

DESCRIPTION: **Fifth Floor Column**

Concrete Column P-M Interaction Diagram



Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Fifth Floor Column**

Concrete Column P-M Interaction Diagram



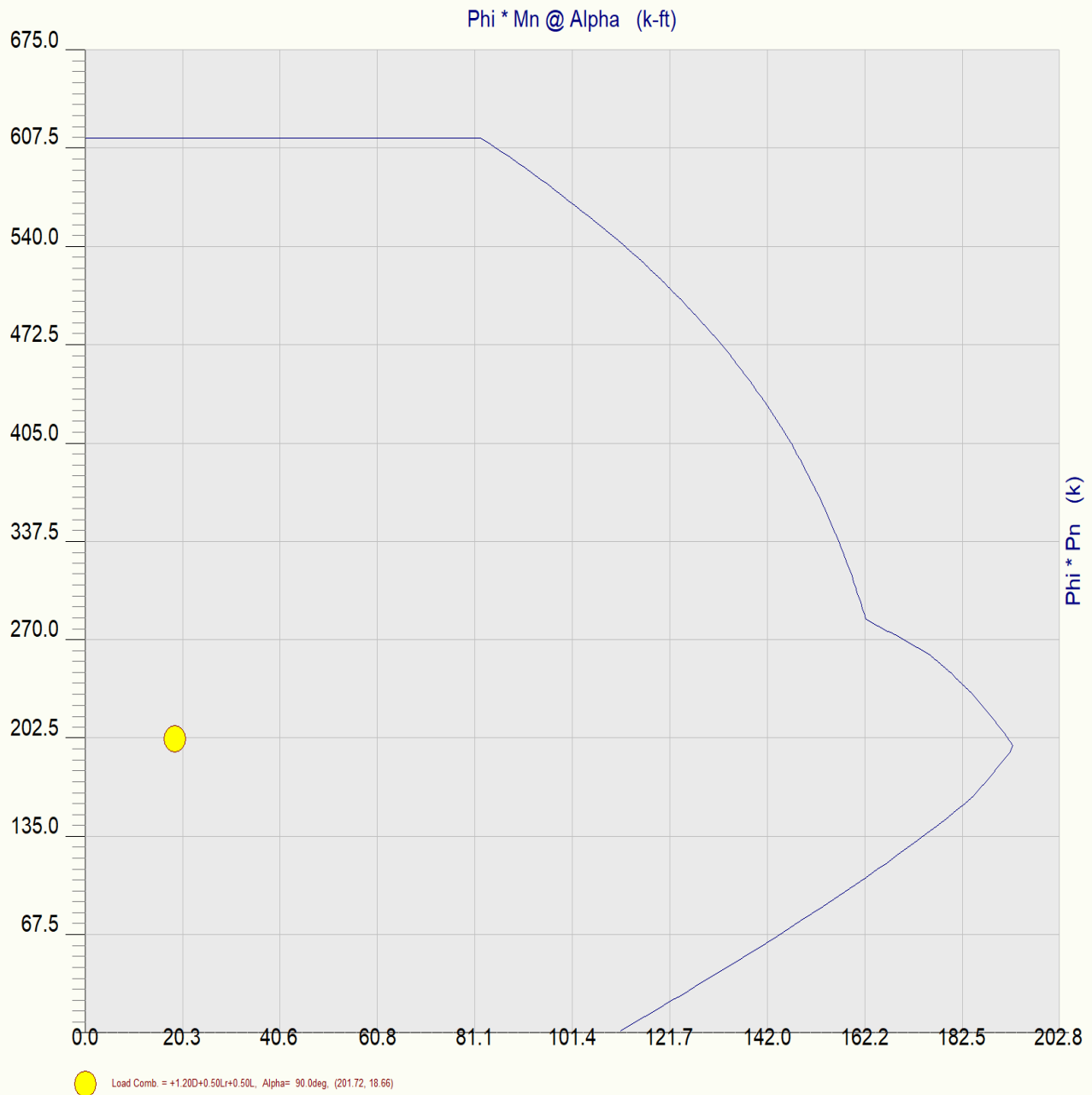
Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. #: KW-06013597

DESCRIPTION: **Fifth Floor Column**

Concrete Column P-M Interaction Diagram



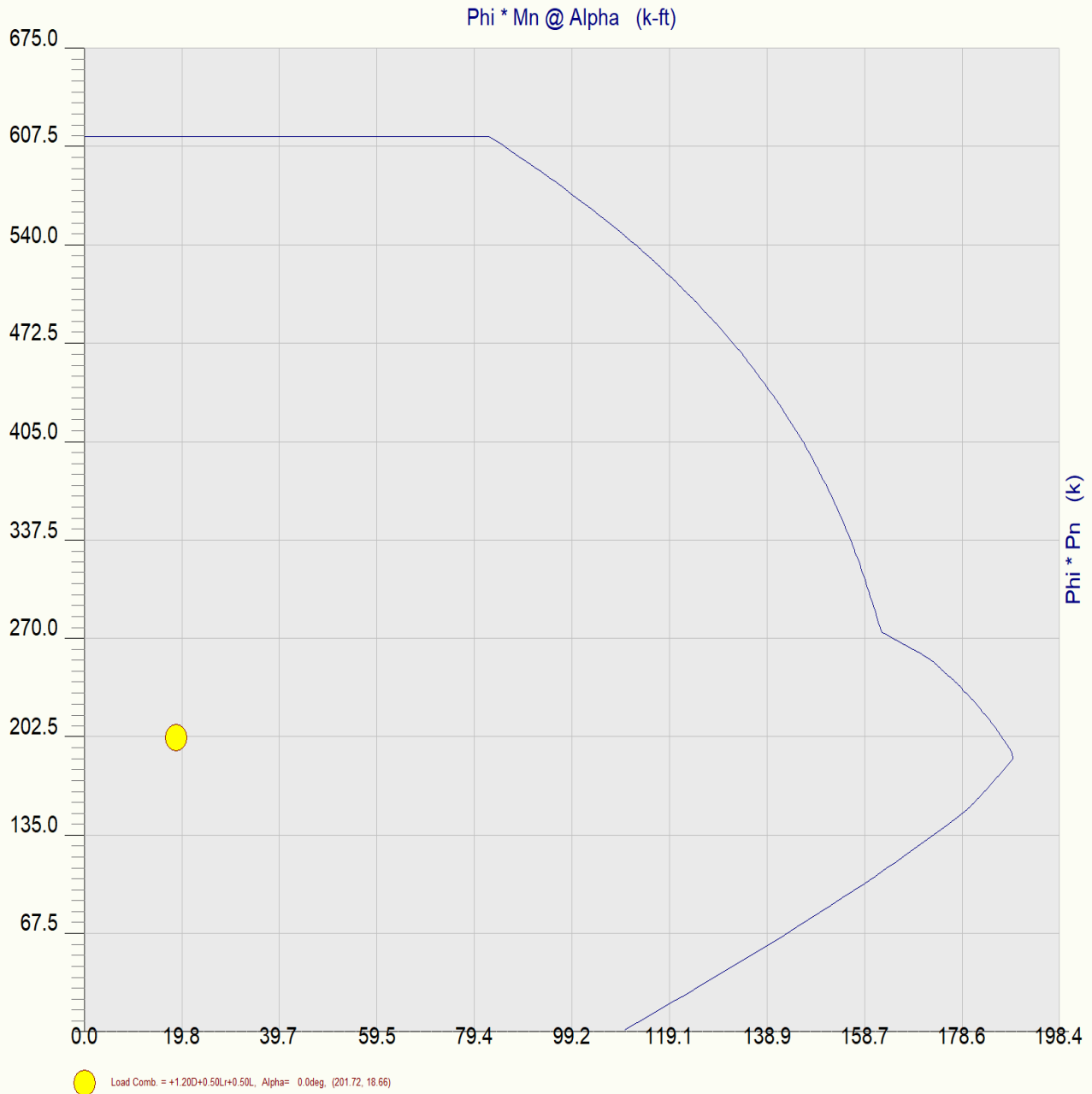
Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Fifth Floor Column**

Concrete Column P-M Interaction Diagram



Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. #: KW-06013597

DESCRIPTION: Fourth Floor Column

Code References

Calculations per ACI 318-14, IBC 2015, CBC 2016, ASCE 7-10

Load Combinations Used : IBC 2015

General Information

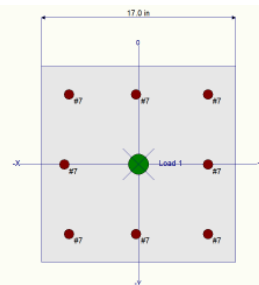
f'_c : Concrete 28 day strength = 4.0 ksi
E = 3,605.0 ksi
Density = 150.0 pcf
 β = 0.850
 f_y - Main Rebar = 60.0 ksi
E - Main Rebar = 29,000.0 ksi
Allow. Reinforcing Limits *ASTM A615 Bars Used*
Min. Reinf. = 1.0 %
Max. Reinf. = 8.0 %

Overall Column Height = 14.420 ft
End Fixity **Top & Bottom Pinned**
Brace condition for deflection (buckling) along columns :
X-X (width) axis :
Unbraced Length for buckling ABOUT Y-Y Axis = 14.420 ft, K = 1.0
Y-Y (depth) axis :
Unbraced Length for buckling ABOUT X-X Axis = 14.420 ft, K = 1.0

Column Cross Section

Column Dimensions : 17.0in Square Column, Column Edge to Rebar Edge Cover = 2.0in

Column Reinforcing : 4 - #7 bars @ corners,, 1 - #7 bars top & bottom between corner bars, 1 - #7 bars left & right between corner bars



Applied Loads

Entered loads are factored per load combinations specified by user.

Column self weight included : 4,341.02 lbs * Dead Load Factor

AXIAL LOADS ...

Roof + Tower Loads: Axial Load at 14.420 ft above base, D = 127.930, LR = 5.970, L = 209.940, S = 8.960 k

DESIGN SUMMARY

Load Combination **+1.20D+1.60L+0.50S**
Location of max. above base **14.323 ft**
Maximum Stress Ratio : 0.762 : 1
Ratio = $(P_u^2 + M_u^2)^{.5} / (\Phi P_n^2 + \Phi M_n^2)^{.5}$
 P_u = 499.109 k $\Phi * P_n$ = 652.23 k
 M_{u-x} = 0.0 k-ft $\Phi * M_{n-x}$ = 0.0 k-ft
 M_{u-y} = 46.168 k-ft $\Phi * M_{n-y}$ = 59.753 k-ft
 M_u Angle = 90.0 deg
 M_u at Angle = 46.168 k-ft ΦM_n at Angle = 60.858 k-ft

P_n & M_n values located at P_u-M_u vector intersection with capacity curve

Column Capacities ...

P_{nmax} : Nominal Max. Compressive Axial Capacity **1,254.28 k**
 P_{nmin} : Nominal Min. Tension Axial Capacity **k**
 ΦP_n , max : Usable Compressive Axial Capacity **652.23 k**
 ΦP_n , min : Usable Tension Axial Capacity **k**

Maximum SERVICE Load Reactions . .

Top along Y-Y **0.0 k** Bottom along Y-Y **0.0 k**
Top along X-X **0.0 k** Bottom along X-X **0.0 k**

Maximum SERVICE Load Deflections . .

Along Y-Y **0.0 in** at **0.0 ft** above base
for load combination :
Along X-X **0.0 in** at **0.0 ft** above base
for load combination :

General Section Information . Φ = 0.650 β = 0.850 θ = 0.80

ρ : % Reinforcing **1.661 %** Rebar % Ok
Reinforcing Area **4.80 in²**
Concrete Area **289.0 in²**

Governing Load Combination Results

Governing Factored Load Combination	Moment		Dist. from		Axial Load		Bending Analysis k-ft						Utilization	
	X-X	Y-Y	base	ft	Pu	ϕ * Pn	δ x	δ x * Mux	δ y	δ y * Muy	Alpha (deg)	δ Mu	ϕ Mn	Ratio
+1.40D		M2,min	14.32		185.18	652.23			1.000	17.13	90.000	17.13	60.86	0.283
+1.40D	M2,min		14.32		185.18	652.23	1.000	17.13			0.000	17.13	60.91	0.282
+1.20D+0.50Lr+1.60L		M2,min	14.32		497.61	652.23			1.000	46.03	90.000	46.03	60.86	0.759

Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. #: KW-06013597

DESCRIPTION: Fourth Floor Column

Governing Load Combination Results

Governing Factored Load Combination	Moment		Dist. from base ft	Axial Load k		Bending Analysis k-ft						Utilization	
	X-X	Y-Y		Pu	ϕ * Pn	δ x	δ x * Mu _x	δ y	δ y * Mu _y	Alpha (deg)	δ Mu	ϕ Mn	Ratio
+1.20D+0.50Lr+1.60L	M2,min		14.32	497.61	652.23	1.000	46.03			0.000	46.03	60.91	0.759
+1.20D+1.60L+0.50S		M2,min	14.32	499.11	652.23			1.000	46.17	90.000	46.17	60.86	0.762
+1.20D+1.60L+0.50S	M2,min		14.32	499.11	652.23	1.000	46.17			0.000	46.17	60.91	0.761
+1.20D+1.60Lr+0.50L		M2,min	14.32	273.25	652.23			1.000	25.28	90.000	25.28	60.86	0.417
+1.20D+1.60Lr+0.50L	M2,min		14.32	273.25	652.23	1.000	25.28			0.000	25.28	60.91	0.417
+1.20D+1.60Lr		M2,min	14.32	168.28	652.23			1.000	15.57	90.000	15.57	60.86	0.257
+1.20D+1.60Lr	M2,min		14.32	168.28	652.23	1.000	15.57			0.000	15.57	60.91	0.257
+1.20D+0.50L+1.60S		M2,min	14.32	278.03	652.23			1.000	25.72	90.000	25.72	60.86	0.424
+1.20D+0.50L+1.60S	M2,min		14.32	278.03	652.23	1.000	25.72			0.000	25.72	60.91	0.424
+1.20D+1.60S		M2,min	14.32	173.06	652.23			1.000	16.01	90.000	16.01	60.86	0.264
+1.20D+1.60S	M2,min		14.32	173.06	652.23	1.000	16.01			0.000	16.01	60.91	0.264
+1.20D+0.50Lr+0.50L		M2,min	14.32	266.68	652.23			1.000	24.67	90.000	24.67	60.86	0.407
+1.20D+0.50Lr+0.50L	M2,min		14.32	266.68	652.23	1.000	24.67			0.000	24.67	60.91	0.407
+1.20D+0.50L+0.50S		M2,min	14.32	268.18	652.23			1.000	24.81	90.000	24.81	60.86	0.409
+1.20D+0.50L+0.50S	M2,min		14.32	268.18	652.23	1.000	24.81			0.000	24.81	60.91	0.409
+1.20D+0.50L+0.70S		M2,min	14.32	269.97	652.23			1.000	24.97	90.000	24.97	60.86	0.412
+1.20D+0.50L+0.70S	M2,min		14.32	269.97	652.23	1.000	24.97			0.000	24.97	60.91	0.412
+0.90D		M2,min	14.32	119.04	652.23			1.000	11.01	90.000	11.01	60.86	0.182
+0.90D	M2,min		14.32	119.04	652.23	1.000	11.01			0.000	11.01	60.91	0.182

Maximum Reactions

Note: Only non-zero reactions are listed.

Load Combination	X-X Axis Reaction		k	Y-Y Axis Reaction		Axial Reaction @ Base	My - End Moments		k-ft	Mx - End Moments	
	@ Base	@ Top		@ Base	@ Top		@ Base	@ Top		@ Base	@ Top
D Only						132.271					
+D+L						342.211					
+D+Lr						138.241					
+D+S						141.231					
+D+0.750Lr+0.750L						294.204					
+D+0.750L+0.750S						296.446					
+0.60D						79.363					
Lr Only						5.970					
L Only						209.940					
S Only						8.960					

Maximum Moment Reactions

Note: Only non-zero reactions are listed.

Load Combination	Moment About X-X Axis			Moment About Y-Y Axis		
	@ Base	@ Top		@ Base	@ Top	
D Only			k-ft			k-ft
+D+L			k-ft			k-ft
+D+Lr			k-ft			k-ft
+D+S			k-ft			k-ft
+D+0.750Lr+0.750L			k-ft			k-ft
+D+0.750L+0.750S			k-ft			k-ft
+0.60D			k-ft			k-ft
Lr Only			k-ft			k-ft
L Only			k-ft			k-ft
S Only			k-ft			k-ft

Maximum Deflections for Load Combinations

Load Combination	Max. X-X Deflection		Distance		Max. Y-Y Deflection		Distance	
D Only	0.0000	in	0.000	ft	0.000	in	0.000	ft
+D+L	0.0000	in	0.000	ft	0.000	in	0.000	ft
+D+Lr	0.0000	in	0.000	ft	0.000	in	0.000	ft
+D+S	0.0000	in	0.000	ft	0.000	in	0.000	ft
+D+0.750Lr+0.750L	0.0000	in	0.000	ft	0.000	in	0.000	ft
+D+0.750L+0.750S	0.0000	in	0.000	ft	0.000	in	0.000	ft
+0.60D	0.0000	in	0.000	ft	0.000	in	0.000	ft

Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

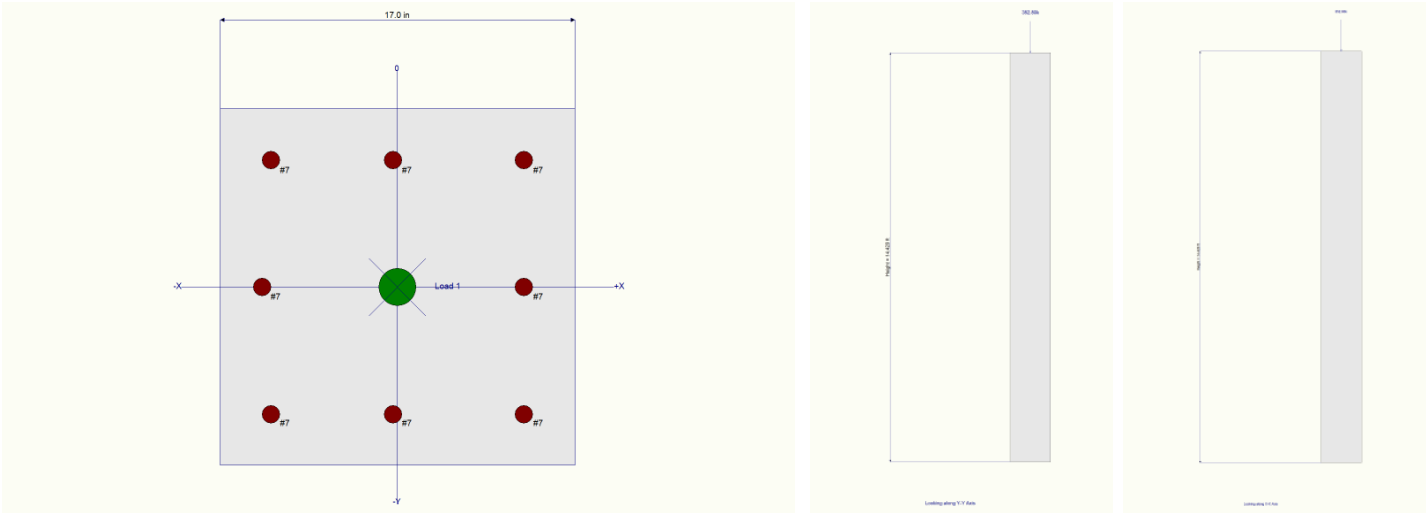
Lic. # : KW-06013597

DESCRIPTION: **Fourth Floor Column**

Maximum Deflections for Load Combinations

Load Combination	Max. X-X Deflection		Distance		Max. Y-Y Deflection		Distance	
Lr Only	0.0000	in	0.000	ft	0.000	in	0.000	ft
L Only	0.0000	in	0.000	ft	0.000	in	0.000	ft
S Only	0.0000	in	0.000	ft	0.000	in	0.000	ft

Sketches



Interaction Diagrams

Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Fourth Floor Column**

Concrete Column P-M Interaction Diagram



Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. #: KW-06013597

DESCRIPTION: **Fourth Floor Column**

Concrete Column P-M Interaction Diagram



Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. #: KW-06013597

DESCRIPTION: **Fourth Floor Column**

Concrete Column P-M Interaction Diagram



Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Fourth Floor Column**

Concrete Column P-M Interaction Diagram



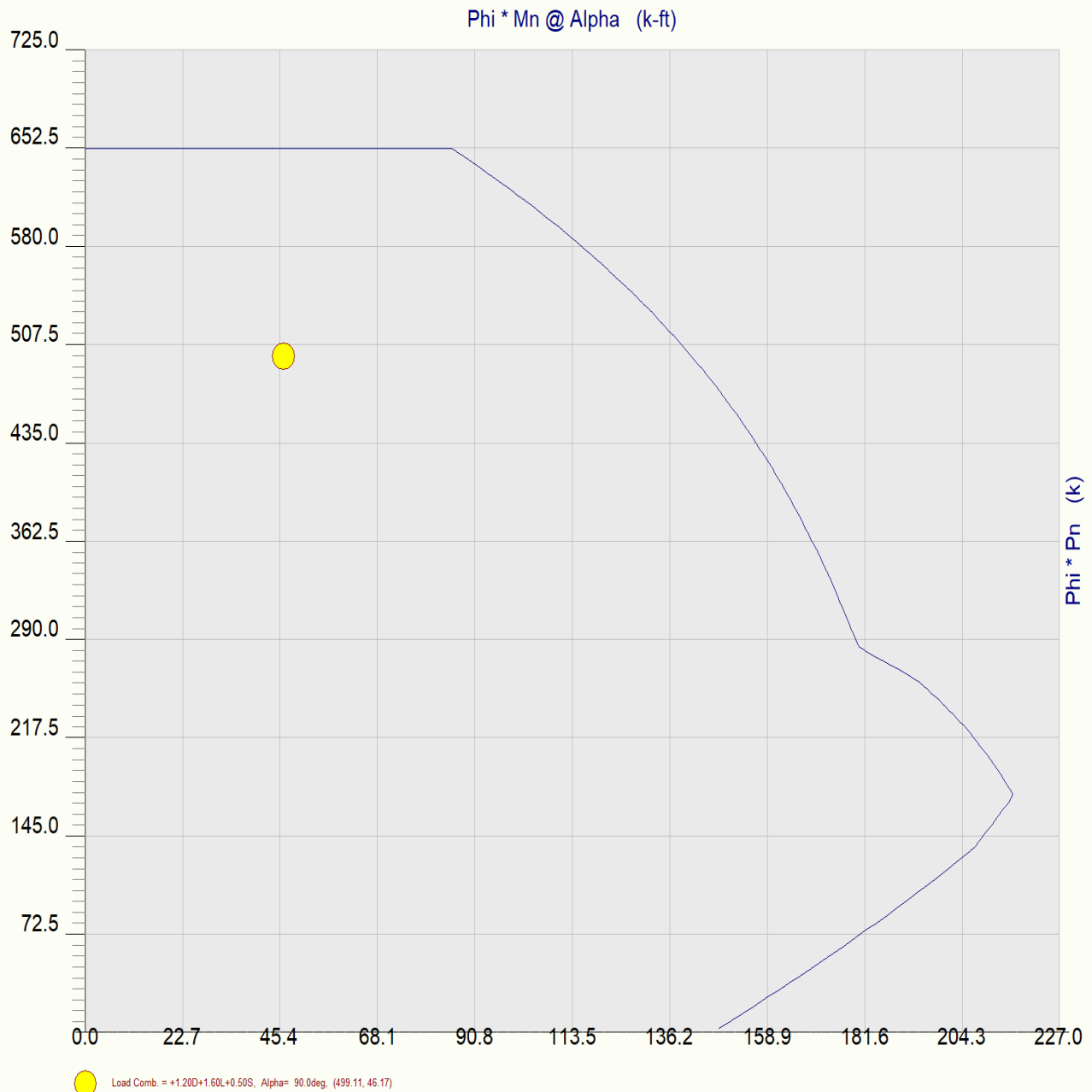
Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. #: KW-06013597

DESCRIPTION: **Fourth Floor Column**

Concrete Column P-M Interaction Diagram



Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Fourth Floor Column**

Concrete Column P-M Interaction Diagram



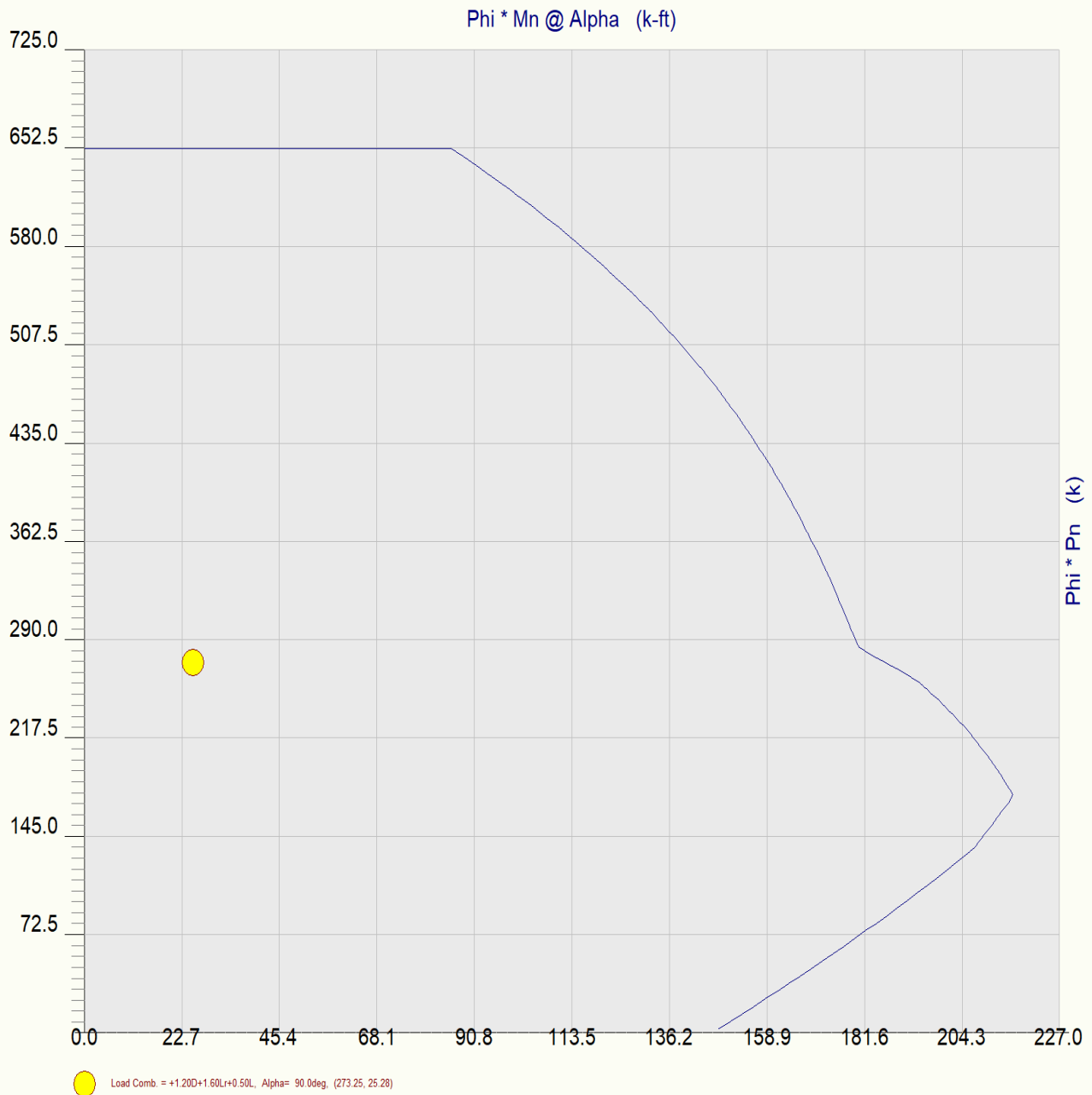
Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. #: KW-06013597

DESCRIPTION: **Fourth Floor Column**

Concrete Column P-M Interaction Diagram



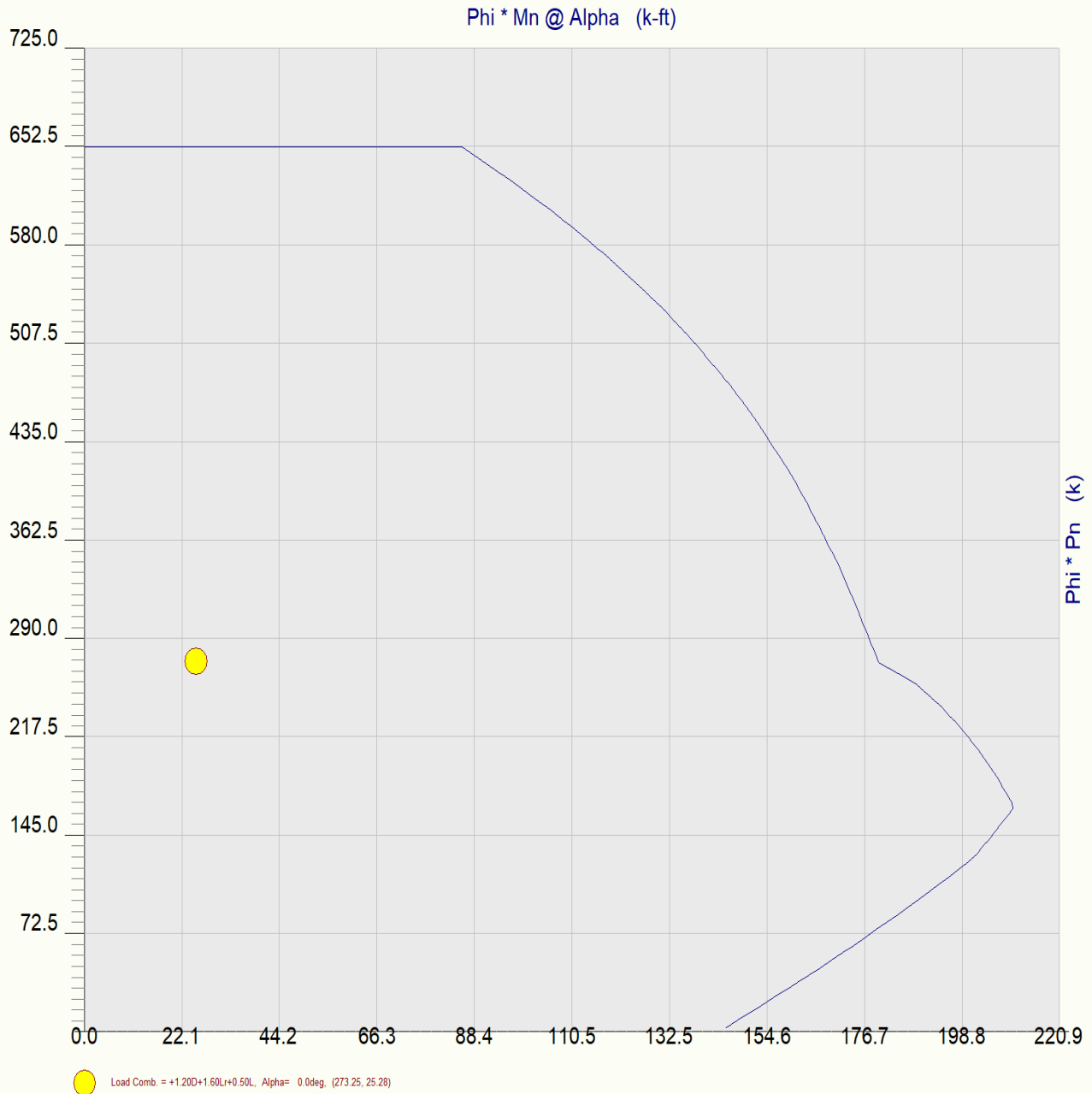
Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Fourth Floor Column**

Concrete Column P-M Interaction Diagram



Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Fourth Floor Column**

Concrete Column P-M Interaction Diagram



Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Fourth Floor Column**

Concrete Column P-M Interaction Diagram



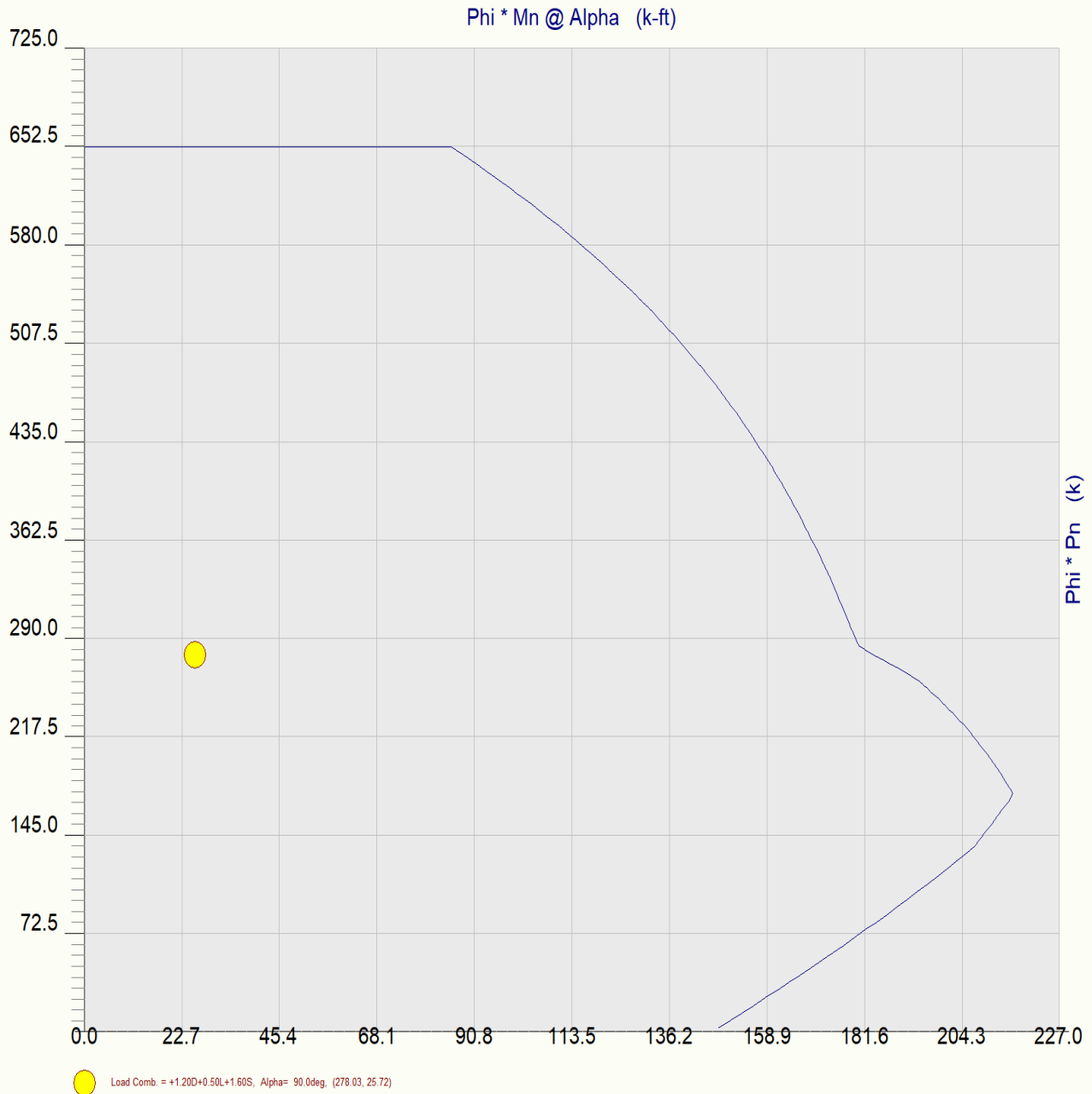
Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. #: KW-06013597

DESCRIPTION: **Fourth Floor Column**

Concrete Column P-M Interaction Diagram



Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Fourth Floor Column**

Concrete Column P-M Interaction Diagram



Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. #: KW-06013597

DESCRIPTION: **Fourth Floor Column**

Concrete Column P-M Interaction Diagram



Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Fourth Floor Column**

Concrete Column P-M Interaction Diagram



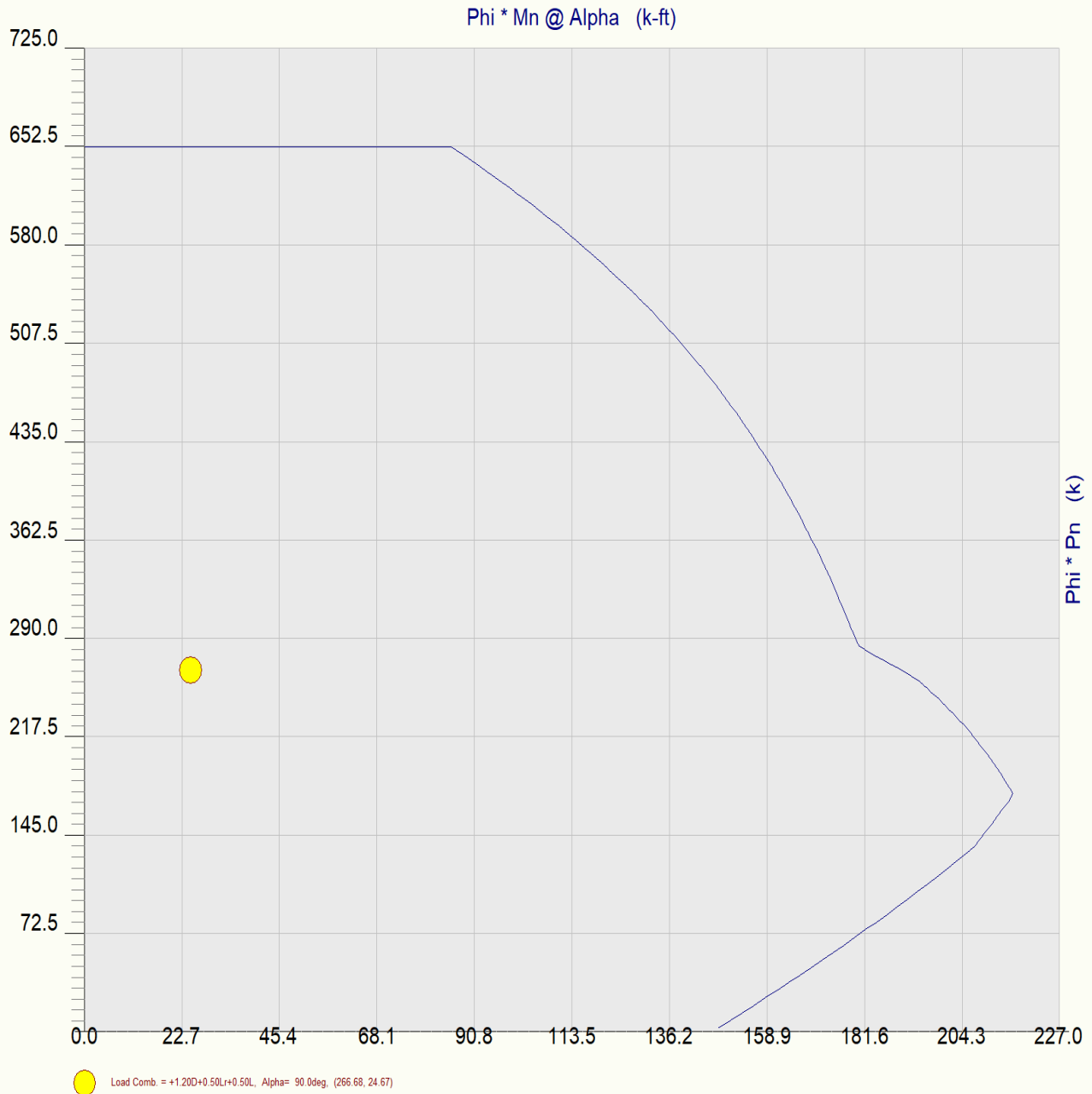
Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. #: KW-06013597

DESCRIPTION: **Fourth Floor Column**

Concrete Column P-M Interaction Diagram



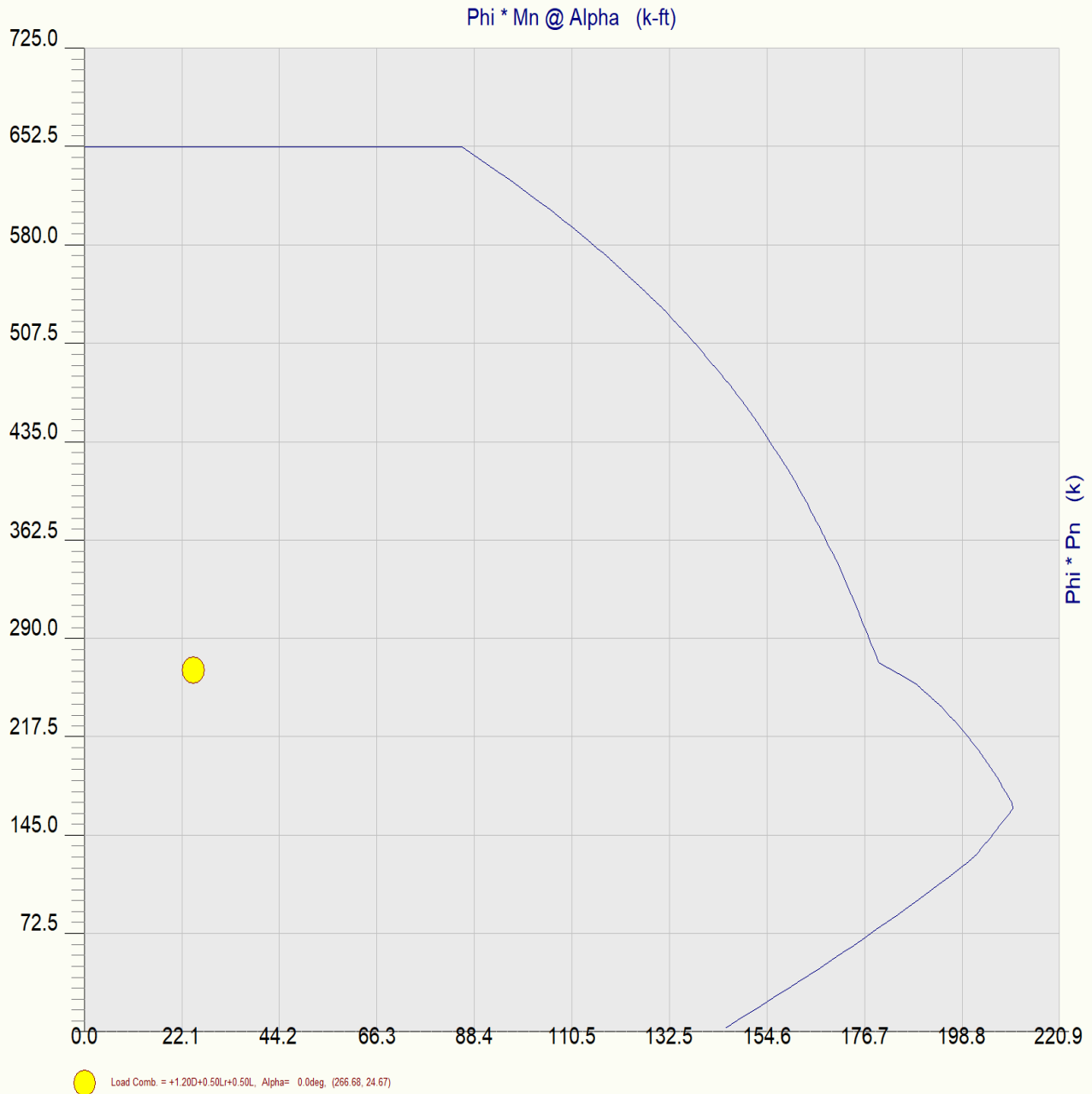
Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Fourth Floor Column**

Concrete Column P-M Interaction Diagram



Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. #: KW-06013597

DESCRIPTION: Third Floor Column

Code References

Calculations per ACI 318-14, IBC 2015, CBC 2016, ASCE 7-10

Load Combinations Used : IBC 2015

General Information

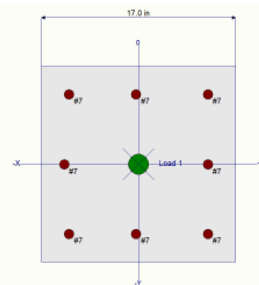
f'_c : Concrete 28 day strength = 4.0 ksi
E = 3,605.0 ksi
Density = 150.0 pcf
 β = 0.850
 f_y - Main Rebar = 60.0 ksi
E - Main Rebar = 29,000.0 ksi
Allow. Reinforcing Limits *ASTM A615 Bars Used*
Min. Reinf. = 1.0 %
Max. Reinf. = 8.0 %

Overall Column Height = 16.420 ft
End Fixity **Top & Bottom Pinned**
Brace condition for deflection (buckling) along columns :
X-X (width) axis :
Unbraced Length for buckling ABOUT Y-Y Axis = 16.420 ft, K = 1.0
Y-Y (depth) axis :
Unbraced Length for buckling ABOUT X-X Axis = 16.420 ft, K = 1.0

Column Cross Section

Column Dimensions : 17.0in Square Column, Column Edge to Rebar Edge Cover = 2.0in

Column Reinforcing : 4 - #7 bars @ corners,, 1 - #7 bars top & bottom between corner bars, 1 - #7 bars left & right between corner bars



Applied Loads

Entered loads are factored per load combinations specified by user.

Column self weight included : 4,943.10 lbs * Dead Load Factor

AXIAL LOADS ...

Roof + Tower Loads: Axial Load at 16.420 ft above base, D = 169.610, LR = 5.970, L = 239.810, S = 8.960 k

DESIGN SUMMARY

Load Combination **+1.20D+1.60L+0.50S**
Location of max. above base **16.310 ft**
Maximum Stress Ratio : 0.923 : 1
Ratio = $(P_u^2 + M_u^2)^{0.5} / (\Phi P_n^2 + \Phi M_n^2)^{0.5}$
 P_u = 597.64 k $\Phi * P_n$ = 652.23 k
 M_{u-x} = 0.0 k-ft $\Phi * M_{n-x}$ = 0.0 k-ft
 M_{u-y} = 66.301 k-ft $\Phi * M_{n-y}$ = 70.572 k-ft
 M_u Angle = 90.0 deg
 M_u at Angle = 66.301 k-ft ΦM_n at Angle = 71.587 k-ft

P_n & M_n values located at P_u-M_u vector intersection with capacity curve

Column Capacities ...

P_{nmax} : Nominal Max. Compressive Axial Capacity **1,254.28 k**
 P_{nmin} : Nominal Min. Tension Axial Capacity **k**
 ΦP_n , max : Usable Compressive Axial Capacity **652.23 k**
 ΦP_n , min : Usable Tension Axial Capacity **k**

Maximum SERVICE Load Reactions . .

Top along Y-Y **0.0 k** Bottom along Y-Y **0.0 k**
Top along X-X **0.0 k** Bottom along X-X **0.0 k**

Maximum SERVICE Load Deflections . .

Along Y-Y **0.0 in** at **0.0 ft** above base
for load combination :
Along X-X **0.0 in** at **0.0 ft** above base
for load combination :

General Section Information . Φ = 0.650 β = 0.850 θ = 0.80

ρ : % Reinforcing **1.661 %** Rebar % Ok
Reinforcing Area **4.80 in²**
Concrete Area **289.0 in²**

Governing Load Combination Results

Governing Factored Load Combination	Moment		Dist. from		Axial Load		Bending Analysis k-ft						Utilization	
	X-X	Y-Y	base	ft	Pu	ϕ * Pn	δ x	δ x * Mu _x	δ y	δ y * Mu _y	Alpha (deg)	δ Mu	ϕ Mn	Ratio
+1.40D		M2,min	16.31		244.37	652.23			1.000	22.60	90.000	22.60	60.86	0.373
+1.40D	M2,min		16.31		244.37	652.23	1.000	22.60			0.000	22.60	60.91	0.373
+1.20D+0.50Lr+1.60L		M2,min	16.31		596.14	652.23			1.196	65.97	90.000	65.97	71.59	0.919

Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. #: KW-06013597

DESCRIPTION: Third Floor Column

Governing Load Combination Results

Governing Factored Load Combination	Moment		Dist. from base ft	Axial Load k		Bending Analysis k-ft						Utilization	
	X-X	Y-Y		Pu	ϕ * Pn	δ x	δ x * Mu _x	δ y	δ y * Mu _y	Alpha (deg)	δ Mu	ϕ Mn	Ratio
+1.20D+0.50Lr+1.60L	M2,min		16.31	596.14	652.23	1.196	65.97			0.000	65.97	71.60	0.919
+1.20D+1.60L+0.50S		M2,min	16.31	597.64	652.23			1.199	66.30	90.000	66.30	71.59	0.923
+1.20D+1.60L+0.50S	M2,min		16.31	597.64	652.23	1.199	66.30			0.000	66.30	71.60	0.922
+1.20D+1.60Lr+0.50L		M2,min	16.31	338.92	652.23			1.000	31.35	90.000	31.35	60.86	0.517
+1.20D+1.60Lr+0.50L	M2,min		16.31	338.92	652.23	1.000	31.35			0.000	31.35	60.91	0.517
+1.20D+1.60Lr		M2,min	16.31	219.02	652.23			1.000	20.26	90.000	20.26	60.86	0.334
+1.20D+1.60Lr	M2,min		16.31	219.02	652.23	1.000	20.26			0.000	20.26	60.91	0.334
+1.20D+0.50L+1.60S		M2,min	16.31	343.70	652.23			1.000	31.79	90.000	31.79	60.86	0.524
+1.20D+0.50L+1.60S	M2,min		16.31	343.70	652.23	1.000	31.79			0.000	31.79	60.91	0.524
+1.20D+1.60S		M2,min	16.31	223.80	652.23			1.000	20.70	90.000	20.70	60.86	0.341
+1.20D+1.60S	M2,min		16.31	223.80	652.23	1.000	20.70			0.000	20.70	60.91	0.341
+1.20D+0.50Lr+0.50L		M2,min	16.31	332.35	652.23			1.000	30.74	90.000	30.74	60.86	0.507
+1.20D+0.50Lr+0.50L	M2,min		16.31	332.35	652.23	1.000	30.74			0.000	30.74	60.91	0.507
+1.20D+0.50L+0.50S		M2,min	16.31	333.85	652.23			1.000	30.88	90.000	30.88	60.86	0.509
+1.20D+0.50L+0.50S	M2,min		16.31	333.85	652.23	1.000	30.88			0.000	30.88	60.91	0.509
+1.20D+0.50L+0.70S		M2,min	16.31	335.64	652.23			1.000	31.05	90.000	31.05	60.86	0.512
+1.20D+0.50L+0.70S	M2,min		16.31	335.64	652.23	1.000	31.05			0.000	31.05	60.91	0.512
+0.90D		M2,min	16.31	157.10	652.23			1.000	14.53	90.000	14.53	60.86	0.240
+0.90D	M2,min		16.31	157.10	652.23	1.000	14.53			0.000	14.53	60.91	0.240

Maximum Reactions

Note: Only non-zero reactions are listed.

Load Combination	X-X Axis Reaction		k	Y-Y Axis Reaction		Axial Reaction @ Base	My - End Moments		k-ft	Mx - End Moments	
	@ Base	@ Top		@ Base	@ Top		@ Base	@ Top		@ Base	@ Top
D Only						174.553					
+D+L						414.363					
+D+Lr						180.523					
+D+S						183.513					
+D+0.750Lr+0.750L						358.888					
+D+0.750L+0.750S						361.131					
+0.60D						104.732					
Lr Only						5.970					
L Only						239.810					
S Only						8.960					

Maximum Moment Reactions

Note: Only non-zero reactions are listed.

Load Combination	Moment About X-X Axis			Moment About Y-Y Axis		
	@ Base	@ Top		@ Base	@ Top	
D Only			k-ft			k-ft
+D+L			k-ft			k-ft
+D+Lr			k-ft			k-ft
+D+S			k-ft			k-ft
+D+0.750Lr+0.750L			k-ft			k-ft
+D+0.750L+0.750S			k-ft			k-ft
+0.60D			k-ft			k-ft
Lr Only			k-ft			k-ft
L Only			k-ft			k-ft
S Only			k-ft			k-ft

Maximum Deflections for Load Combinations

Load Combination	Max. X-X Deflection		Distance		Max. Y-Y Deflection		Distance	
D Only	0.0000	in	0.000	ft	0.000	in	0.000	ft
+D+L	0.0000	in	0.000	ft	0.000	in	0.000	ft
+D+Lr	0.0000	in	0.000	ft	0.000	in	0.000	ft
+D+S	0.0000	in	0.000	ft	0.000	in	0.000	ft
+D+0.750Lr+0.750L	0.0000	in	0.000	ft	0.000	in	0.000	ft
+D+0.750L+0.750S	0.0000	in	0.000	ft	0.000	in	0.000	ft
+0.60D	0.0000	in	0.000	ft	0.000	in	0.000	ft

Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

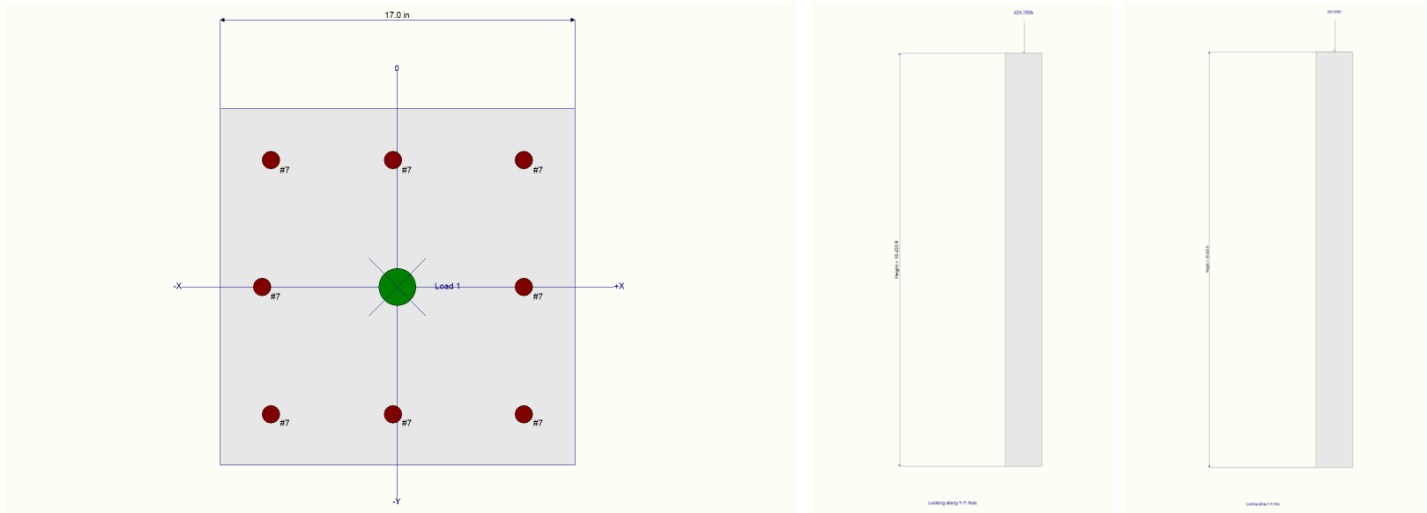
Lic. # : KW-06013597

DESCRIPTION: Third Floor Column

Maximum Deflections for Load Combinations

Load Combination	Max. X-X Deflection		Distance		Max. Y-Y Deflection		Distance	
Lr Only	0.0000	in	0.000	ft	0.000	in	0.000	ft
L Only	0.0000	in	0.000	ft	0.000	in	0.000	ft
S Only	0.0000	in	0.000	ft	0.000	in	0.000	ft

Sketches



Interaction Diagrams

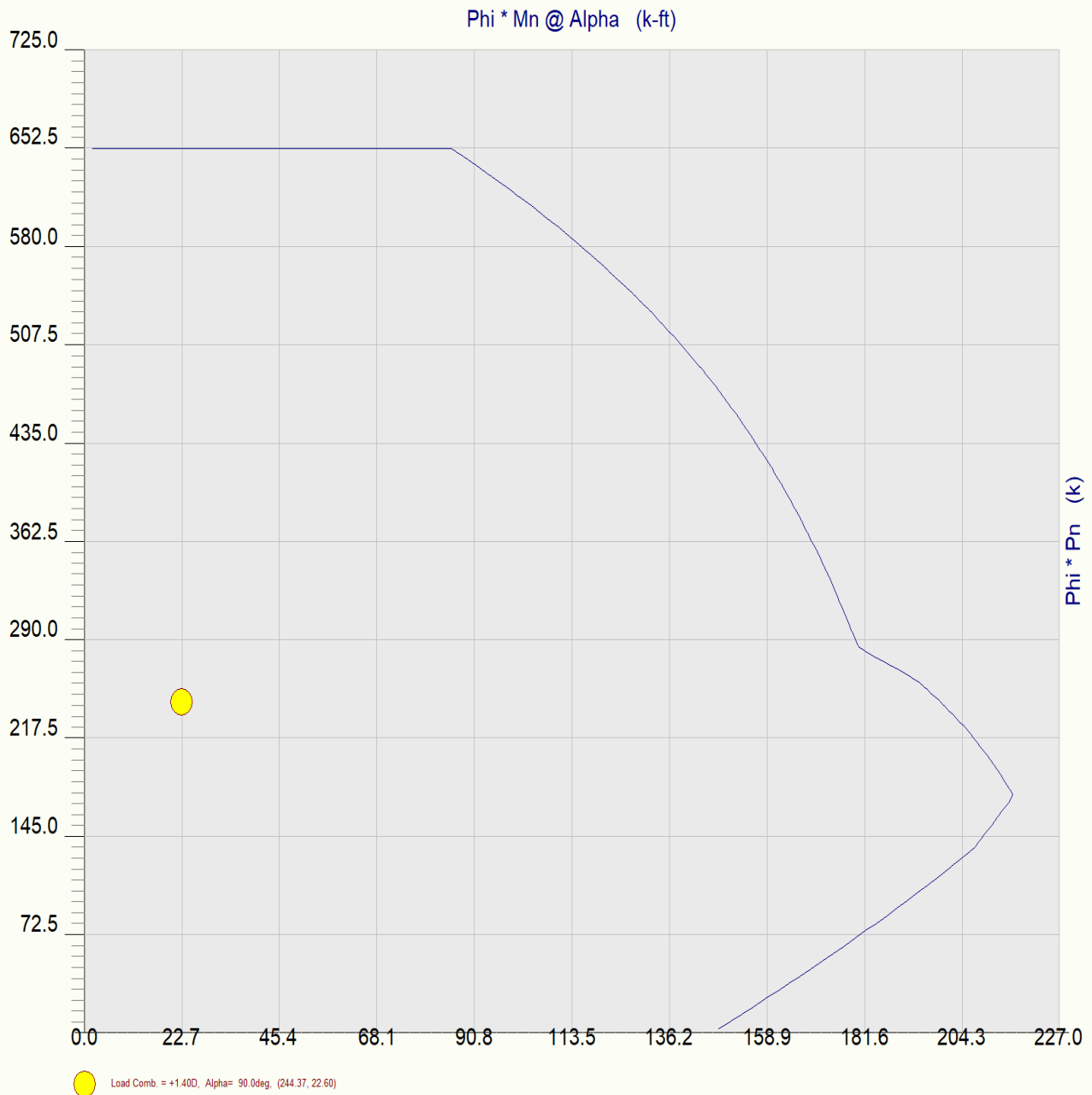
Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Third Floor Column**

Concrete Column P-M Interaction Diagram



Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Third Floor Column**

Concrete Column P-M Interaction Diagram



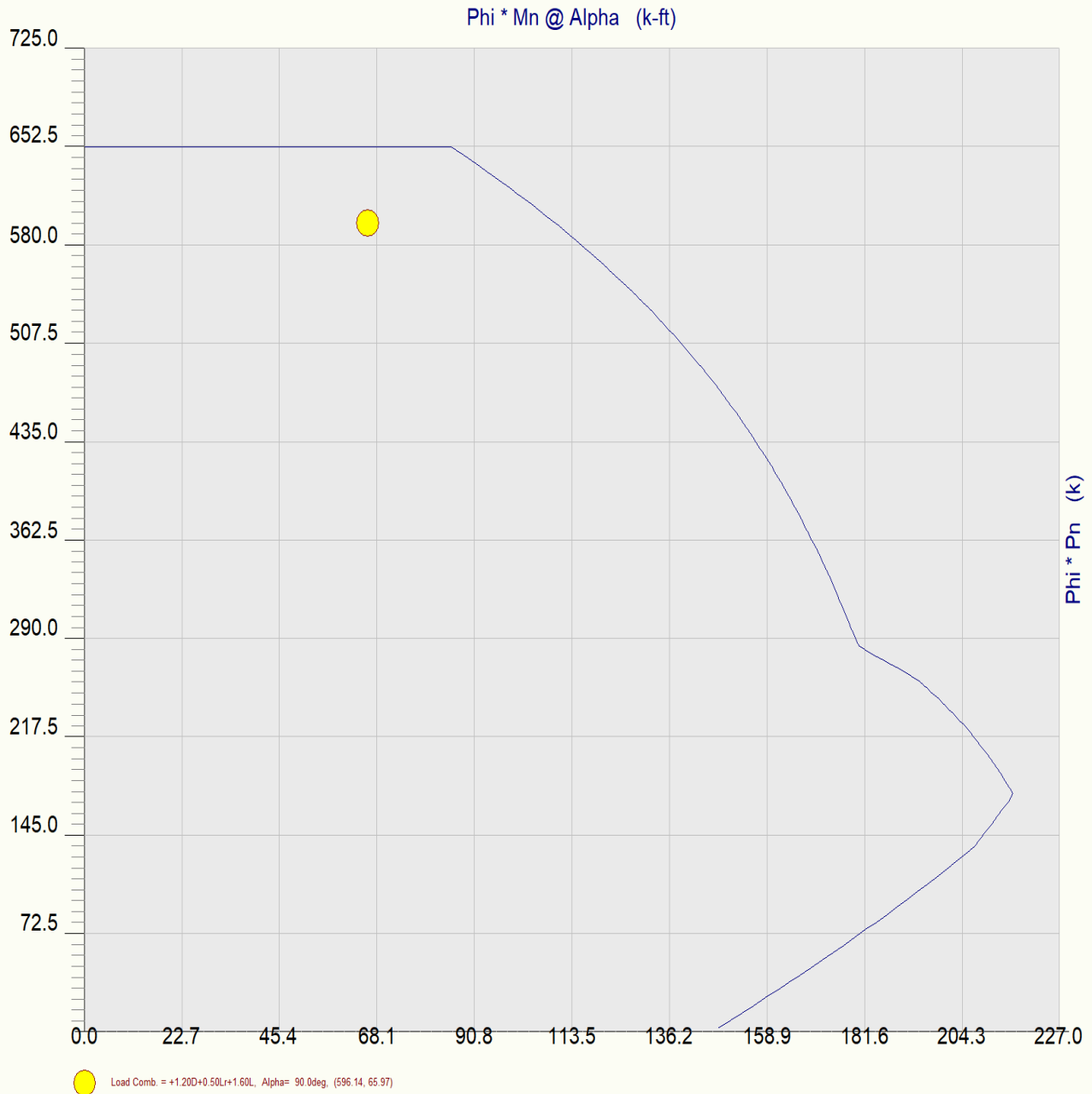
Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Third Floor Column**

Concrete Column P-M Interaction Diagram



Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Third Floor Column**

Concrete Column P-M Interaction Diagram



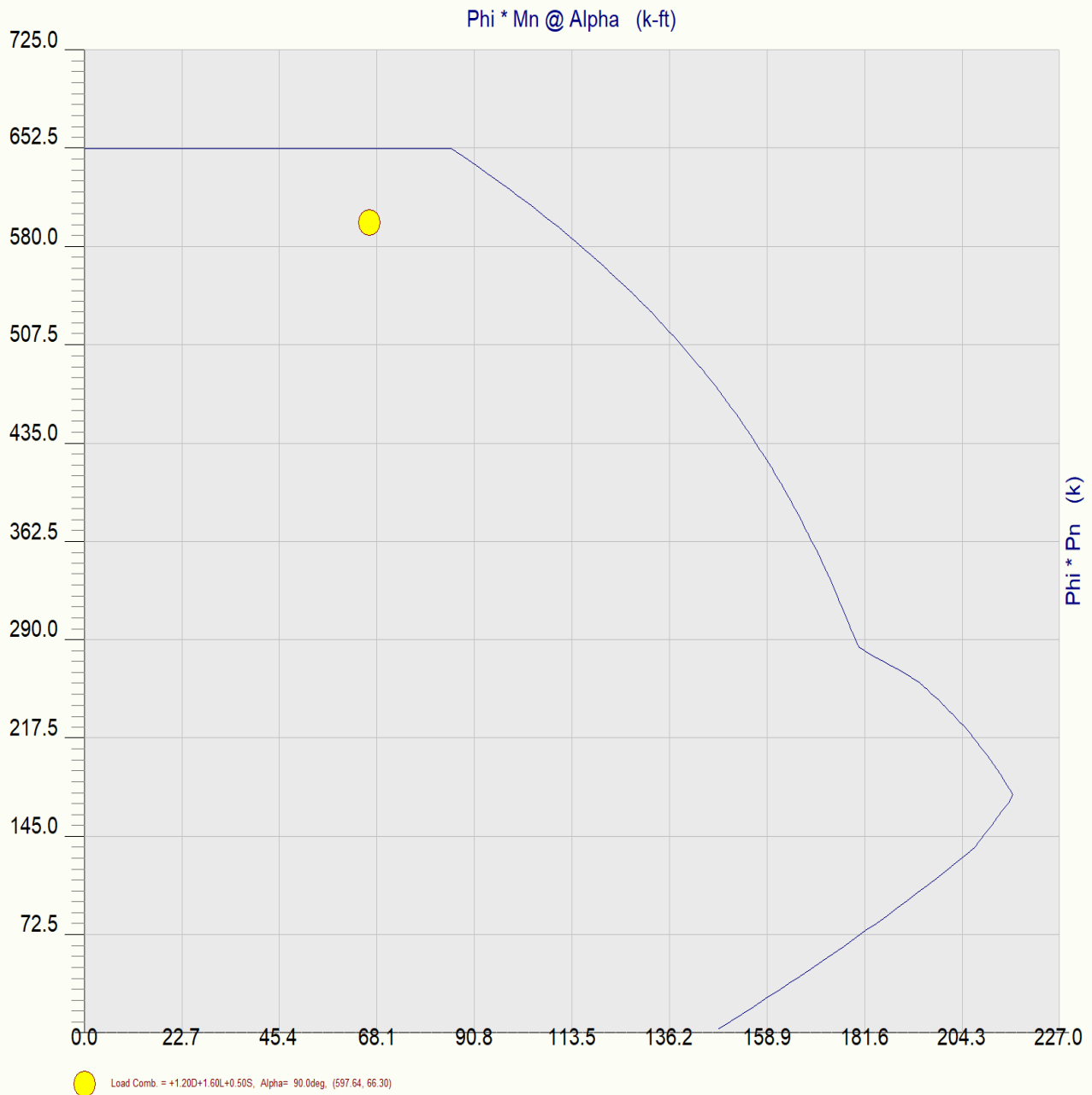
Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Third Floor Column**

Concrete Column P-M Interaction Diagram



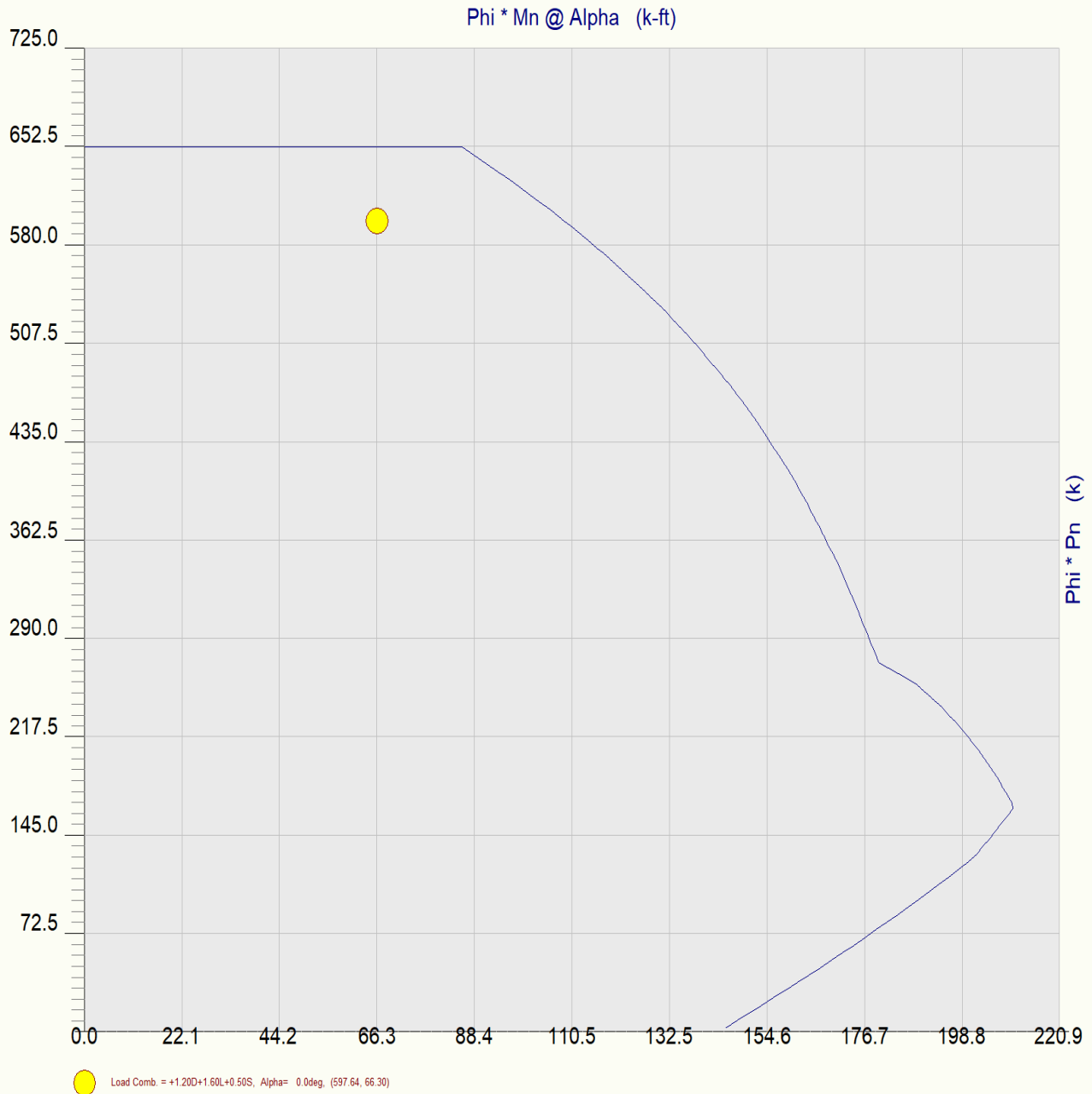
Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Third Floor Column**

Concrete Column P-M Interaction Diagram



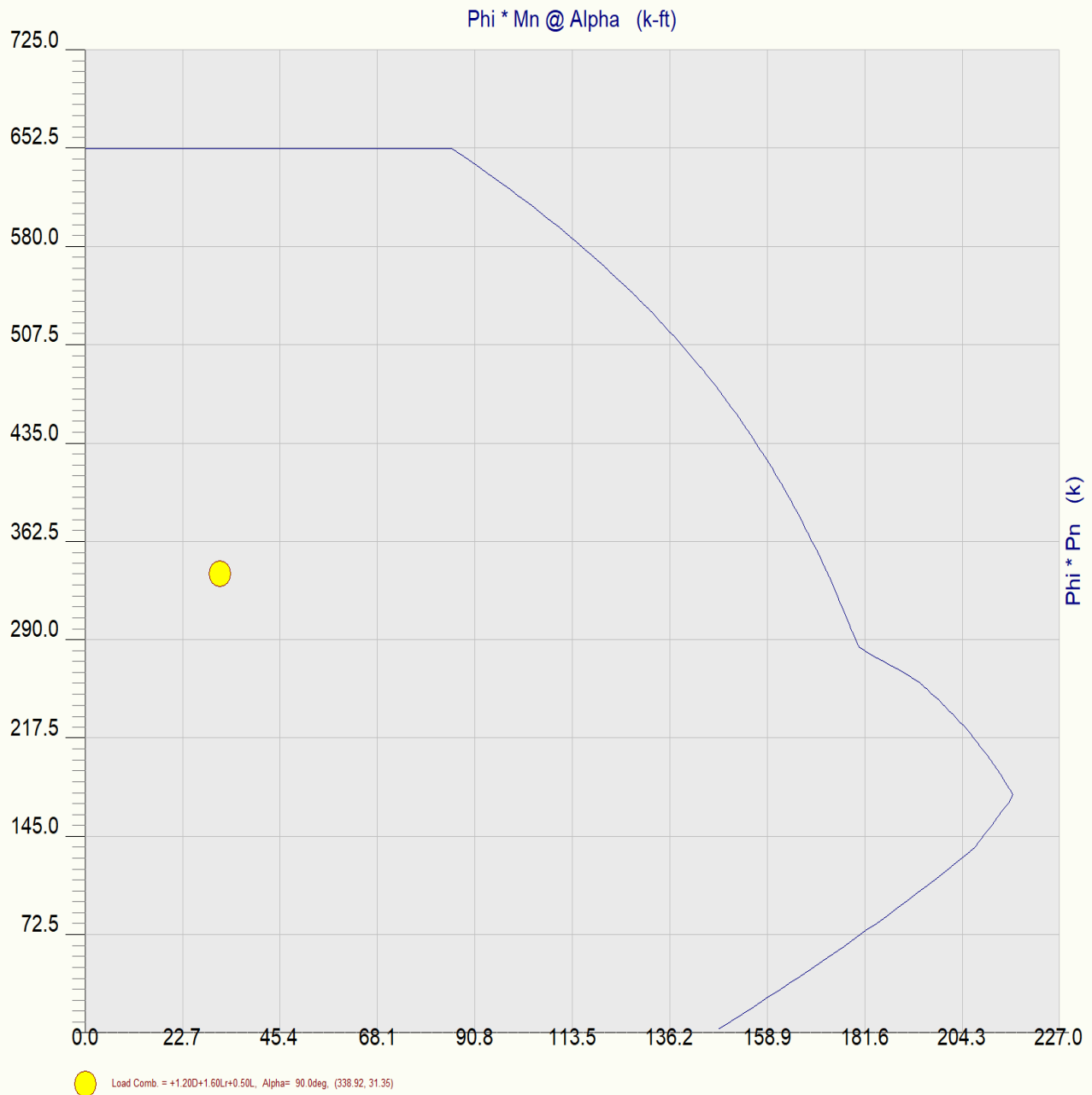
Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Third Floor Column**

Concrete Column P-M Interaction Diagram



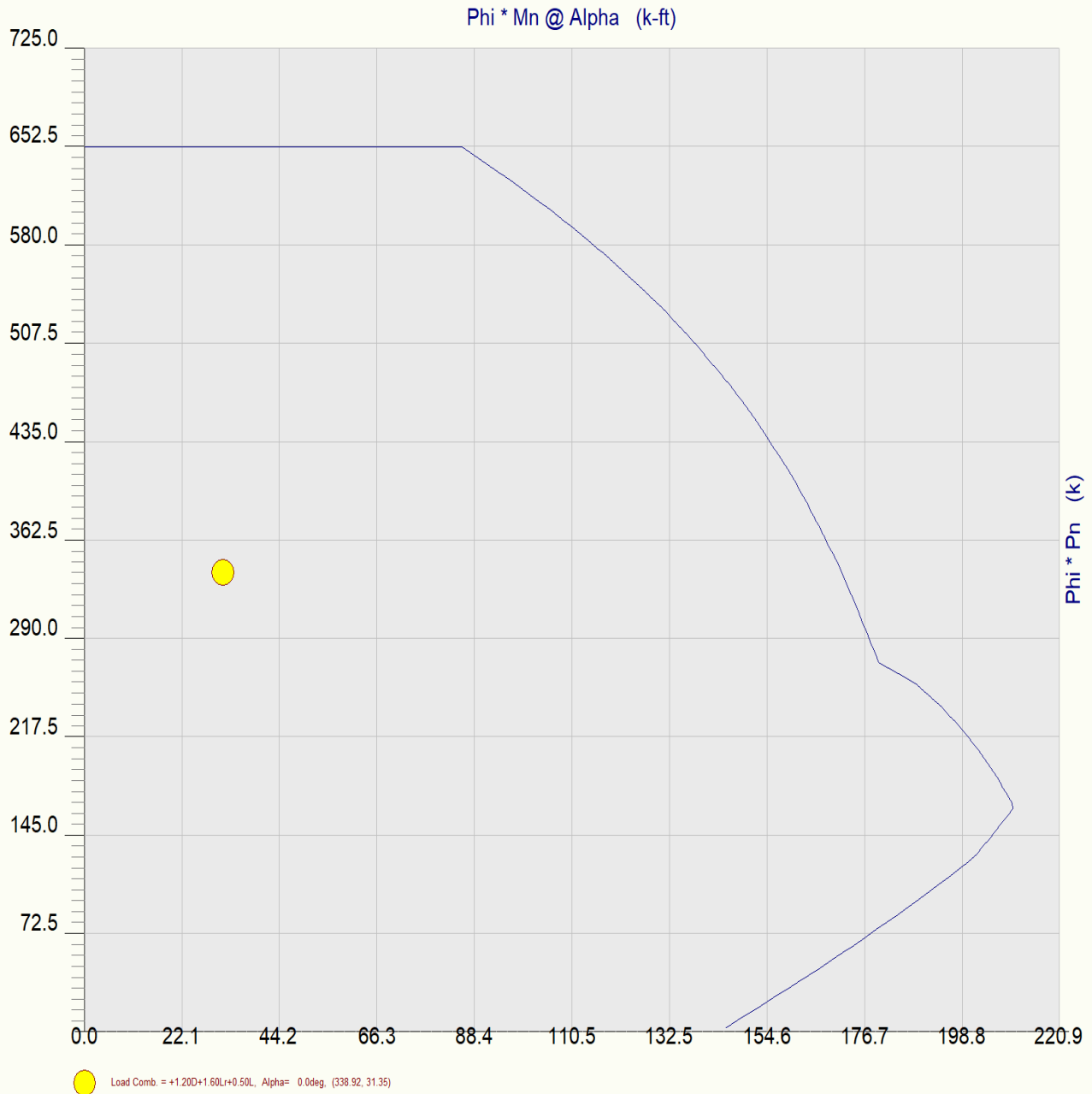
Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Third Floor Column**

Concrete Column P-M Interaction Diagram



Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Third Floor Column**

Concrete Column P-M Interaction Diagram



Concrete Column

Lic. # : KW-06013597

File: 638283 Interior Column Analysis.ec6

Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24

Centerline Communications

DESCRIPTION: **Third Floor Column**

Concrete Column P-M Interaction Diagram



Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Third Floor Column**

Concrete Column P-M Interaction Diagram



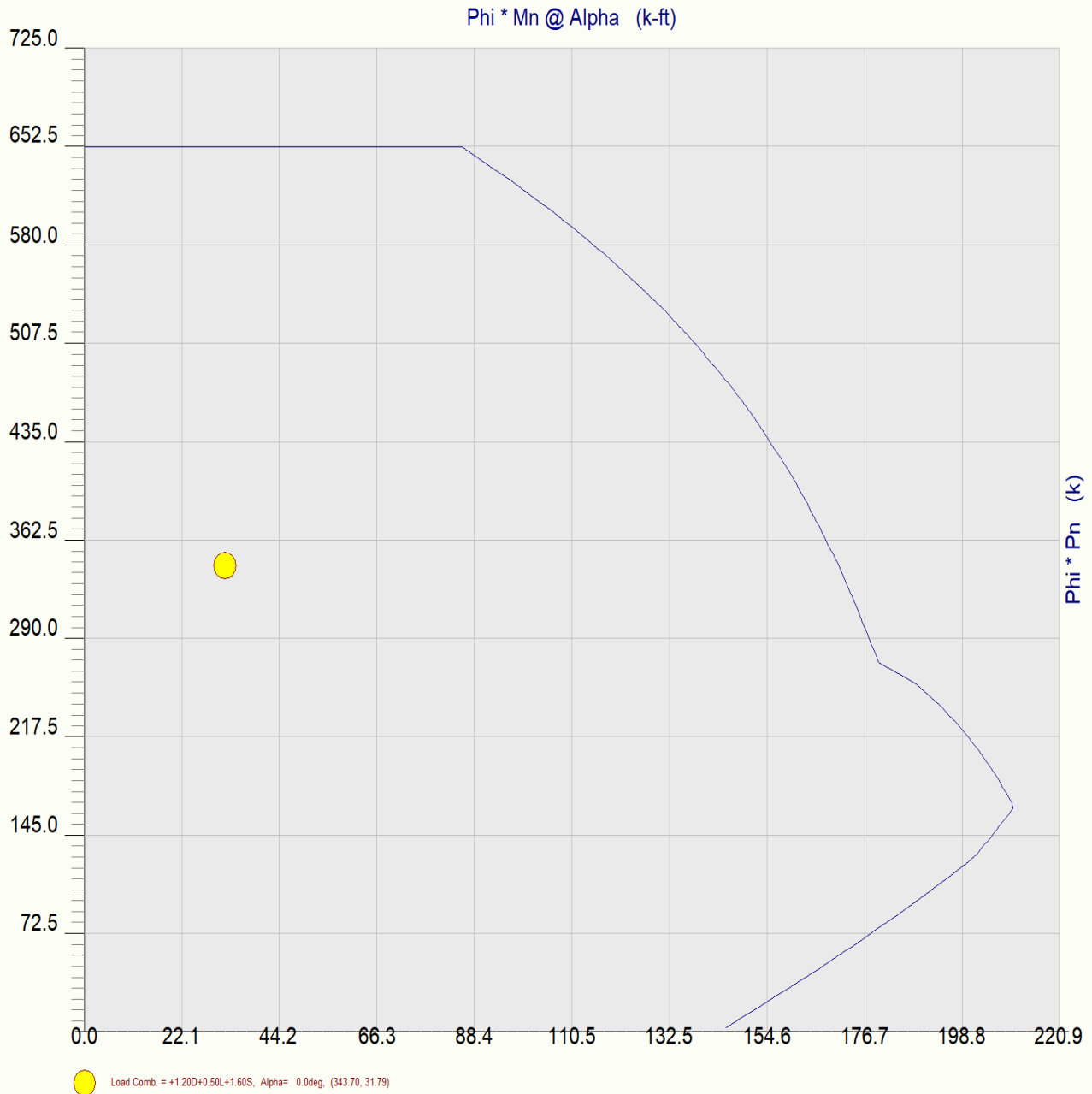
Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Third Floor Column**

Concrete Column P-M Interaction Diagram



Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Third Floor Column**

Concrete Column P-M Interaction Diagram



Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Third Floor Column**

Concrete Column P-M Interaction Diagram



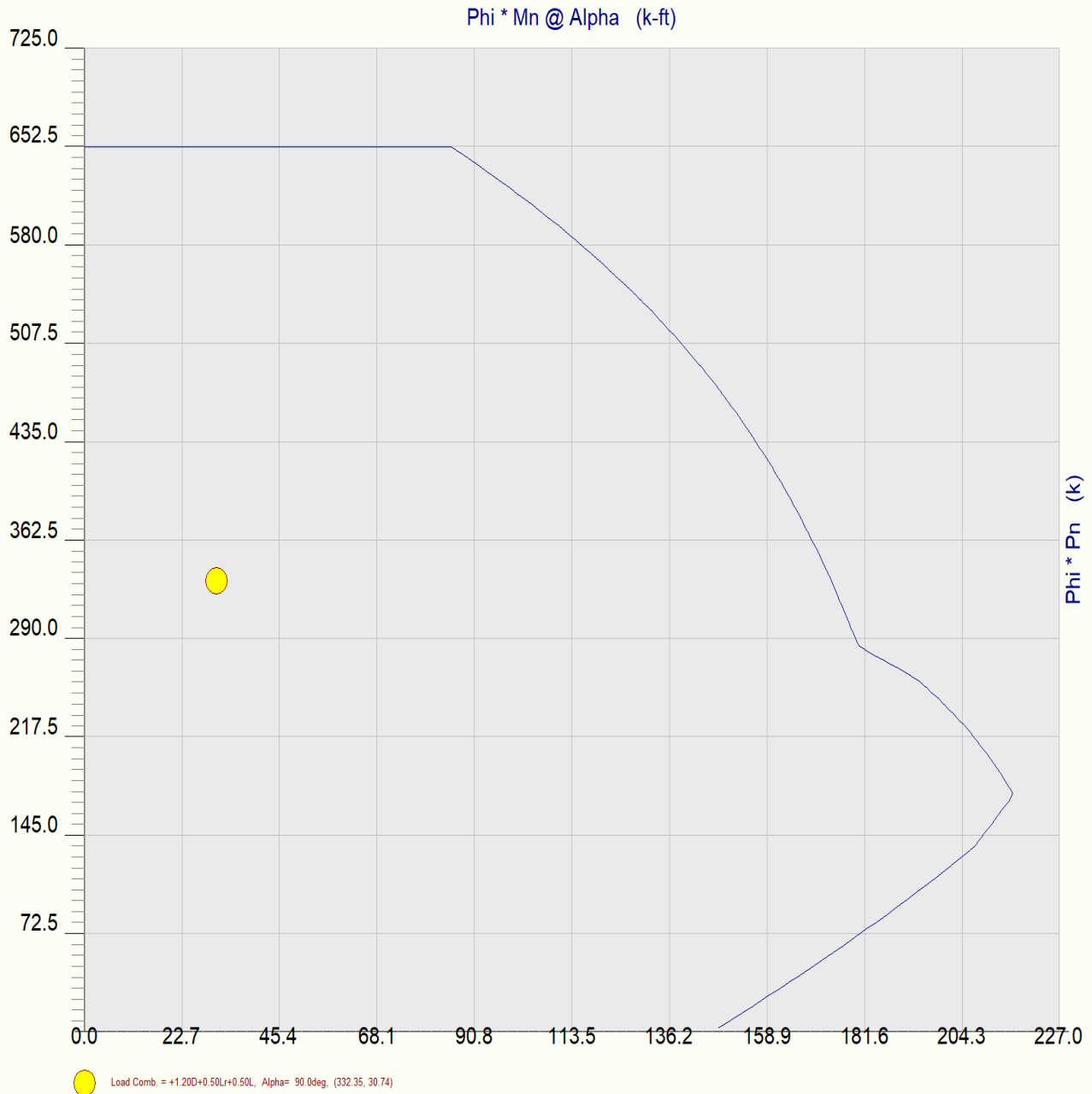
Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Third Floor Column**

Concrete Column P-M Interaction Diagram



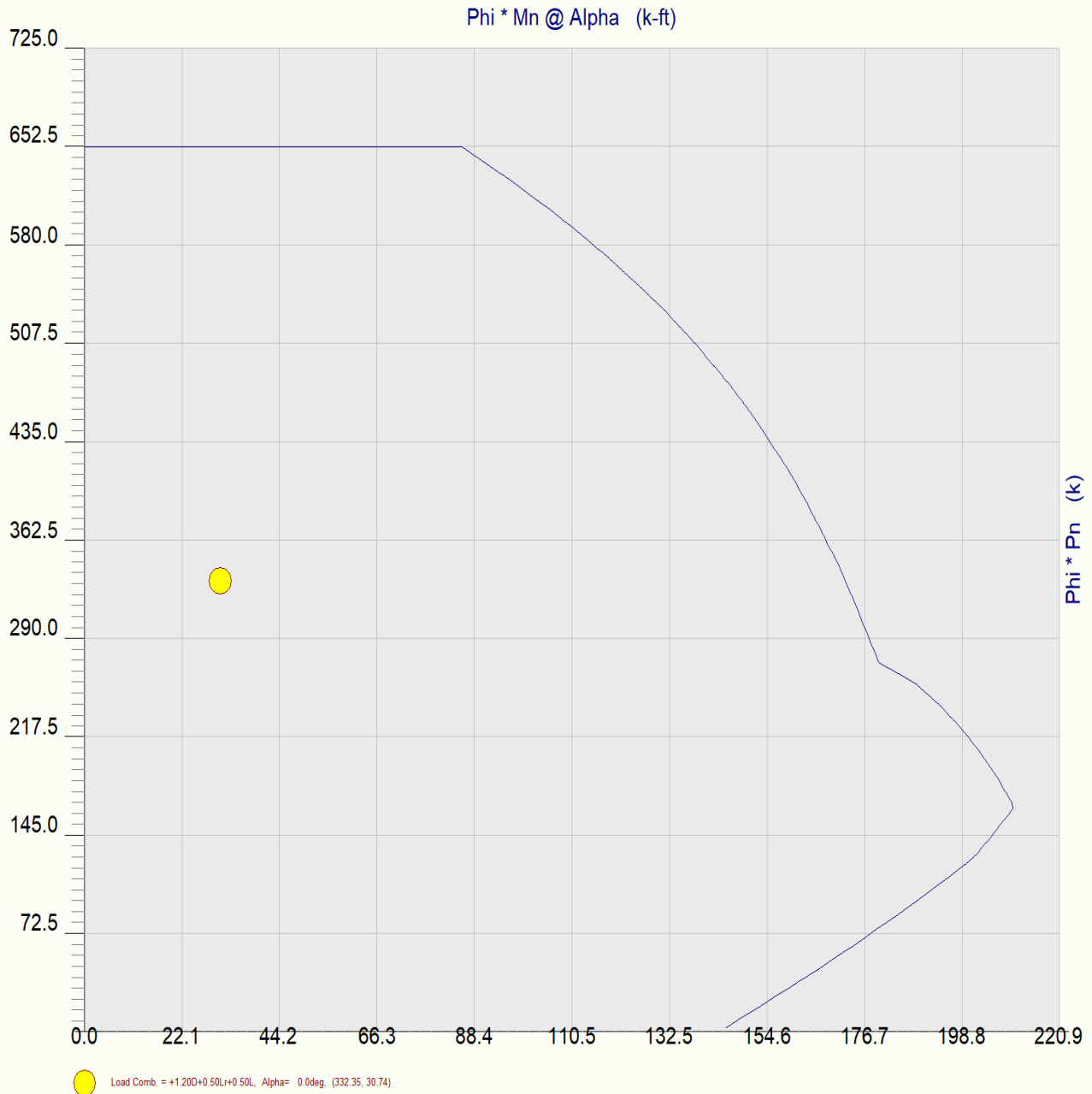
Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Third Floor Column**

Concrete Column P-M Interaction Diagram



Concrete Column

Lic. # : KW-06013597

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

DESCRIPTION: Second Floor Column

Code References

Calculations per ACI 318-14, IBC 2015, CBC 2016, ASCE 7-10
Load Combinations Used : IBC 2015

General Information

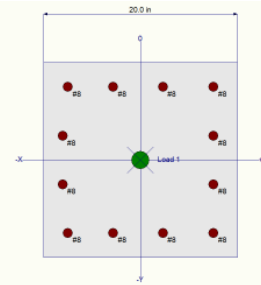
f'_c : Concrete 28 day strength = 4.0 ksi
 E = 3,605.0 ksi
Density = 150.0 pcf
 β = 0.850
 f_y - Main Rebar = 60.0 ksi
 E - Main Rebar = 29,000.0 ksi
Allow. Reinforcing Limits *ASTM A615 Bars Used*
Min. Reinf. = 1.0 %
Max. Reinf. = 8.0 %

Overall Column Height = 15.580 ft
End Fixity **Top & Bottom Pinned**
Brace condition for deflection (buckling) along columns :
X-X (width) axis :
Unbraced Length for buckling ABOUT Y-Y Axis = 15.580 ft, $K = 1.0$
Y-Y (depth) axis :
Unbraced Length for buckling ABOUT X-X Axis = 15.580 ft, $K = 1.0$

Column Cross Section

Column Dimensions : 20.0in Square Column, Column Edge to Rebar Edge Cover = 2.0in

Column Reinforcing : 4 - #8 bars @ corners,, 2 - #8 bars top & bottom between corner bars, 2 - #8 bars left & right between corner bars



Applied Loads

Entered loads are factored per load combinations specified by user.

Column self weight included : 6,491.67 lbs * Dead Load Factor
AXIAL LOADS ...

Roof + Tower Loads: Axial Load at 15.580 ft above base, $D = 211.90$, $LR = 5.970$, $L = 269.680$, $S = 8.960$ k

DESIGN SUMMARY

Load Combination **+1.20D+1.60L+0.50S**
Location of max. above base **15.475 ft**
Maximum Stress Ratio : 0.708 : 1
Ratio = $(P_u^2 + M_u^2)^{0.5} / (\Phi P_n^2 + \Phi M_n^2)^{0.5}$
 $P_u = 698.04$ k $\Phi * P_n = 986.22$ k
 $M_{u-x} = 0.0$ k-ft $\Phi * M_{n-x} = 0.0$ k-ft
 $M_{u-y} = 0.0$ k-ft $\Phi * M_{n-y} = 0.0$ k-ft
 M_u Angle = 0.0 deg
 M_u at Angle = 0.0 k-ft ΦM_n at Angle = 0.0 k-ft

P_n & M_n values located at P_u - M_u vector intersection with capacity curve

Column Capacities ...

P_{nmax} : Nominal Max. Compressive Axial Capacity **1,896.57** k
 P_{nmin} : Nominal Min. Tension Axial Capacity k
 ΦP_n , max : Usable Compressive Axial Capacity **986.22** k
 ΦP_n , min : Usable Tension Axial Capacity k

Maximum SERVICE Load Reactions ...

Top along Y-Y **0.0** k Bottom along Y-Y **0.0** k
Top along X-X **0.0** k Bottom along X-X **0.0** k

Maximum SERVICE Load Deflections ...

Along Y-Y **0.0** in at **0.0** ft above base
for load combination :
Along X-X **0.0** in at **0.0** ft above base
for load combination :

General Section Information . $\Phi = 0.650$ $\beta = 0.850$ $\theta = 0.80$

ρ : % Reinforcing **2.370** % Rebar % Ok
Reinforcing Area **9.480** in²
Concrete Area **400.0** in²

Governing Load Combination Results

Governing Factored Load Combination	Moment		Dist. from		Axial Load	Bending Analysis k-ft						Utilization		
	X-X	Y-Y	base	ft	Pu	ϕ * Pn	δ x	δ x * Mux	δ y	δ y * Muy	Alpha (deg)	δ Mu	ϕ Mn	Ratio
+1.40D			15.48		305.75	986.22					0.000			0.310
+1.20D+0.50Lr+1.60L			15.48		696.54	986.22					0.000			0.706
+1.20D+1.60L+0.50S			15.48		698.04	986.22					0.000			0.708

Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: Second Floor Column

Governing Load Combination Results

Governing Factored Load Combination	Moment		Dist. from base	ft	Axial Load		Bending Analysis k-ft						Utilization	
	X-X	Y-Y			Pu	ϕ * Pn	δ x	δ x * Mux	δ y	δ y * Muy	Alpha (deg)	δ Mu	ϕ Mn	Ratio
+1.20D+1.60Lr+0.50L			15.48		406.46	986.22					0.000			0.412
+1.20D+1.60Lr			15.48		271.62	986.22					0.000			0.275
+1.20D+0.50L+1.60S			15.48		411.25	986.22					0.000			0.417
+1.20D+1.60S			15.48		276.41	986.22					0.000			0.280
+1.20D+0.50Lr+0.50L			15.48		399.90	986.22					0.000			0.405
+1.20D+0.50L+0.50S			15.48		401.39	986.22					0.000			0.407
+1.20D+0.50L+0.70S			15.48		403.18	986.22					0.000			0.409
+0.90D			15.48		196.55	986.22					0.000			0.199

Maximum Reactions

Note: Only non-zero reactions are listed.

Load Combination	X-X Axis Reaction		k	Y-Y Axis Reaction		Axial Reaction	My - End Moments		k-ft	Mx - End Moments	
	@ Base	@ Top		@ Base	@ Top		@ Base	@ Top		@ Base	@ Top
D Only						218.392					
+D+L						488.072					
+D+Lr						224.362					
+D+S						227.352					
+D+0.750Lr+0.750L						425.129					
+D+0.750L+0.750S						427.372					
+0.60D						131.035					
Lr Only						5.970					
L Only						269.680					
S Only						8.960					

Maximum Moment Reactions

Note: Only non-zero reactions are listed.

Load Combination	Moment About X-X Axis			Moment About Y-Y Axis	
	@ Base	@ Top		@ Base	@ Top
D Only			k-ft		k-ft
+D+L			k-ft		k-ft
+D+Lr			k-ft		k-ft
+D+S			k-ft		k-ft
+D+0.750Lr+0.750L			k-ft		k-ft
+D+0.750L+0.750S			k-ft		k-ft
+0.60D			k-ft		k-ft
Lr Only			k-ft		k-ft
L Only			k-ft		k-ft
S Only			k-ft		k-ft

Maximum Deflections for Load Combinations

Load Combination	Max. X-X Deflection		Distance		Max. Y-Y Deflection		Distance	
D Only	0.0000	in	0.000	ft	0.000	in	0.000	ft
+D+L	0.0000	in	0.000	ft	0.000	in	0.000	ft
+D+Lr	0.0000	in	0.000	ft	0.000	in	0.000	ft
+D+S	0.0000	in	0.000	ft	0.000	in	0.000	ft
+D+0.750Lr+0.750L	0.0000	in	0.000	ft	0.000	in	0.000	ft
+D+0.750L+0.750S	0.0000	in	0.000	ft	0.000	in	0.000	ft
+0.60D	0.0000	in	0.000	ft	0.000	in	0.000	ft
Lr Only	0.0000	in	0.000	ft	0.000	in	0.000	ft
L Only	0.0000	in	0.000	ft	0.000	in	0.000	ft
S Only	0.0000	in	0.000	ft	0.000	in	0.000	ft

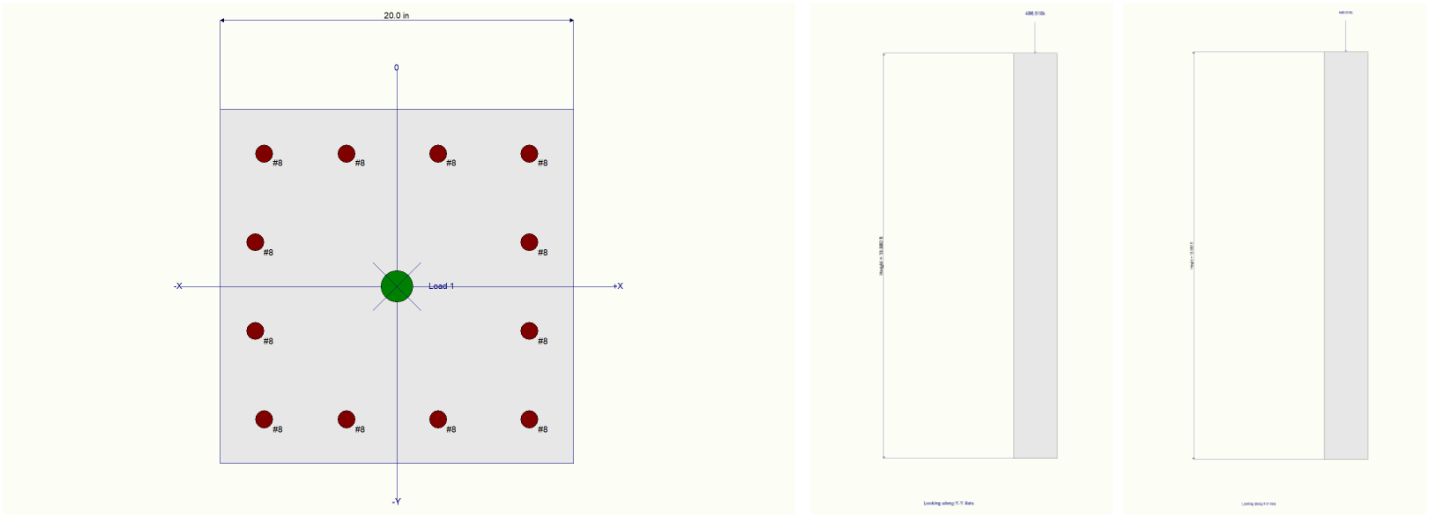
Concrete Column

Lic. # : KW-06013597

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

DESCRIPTION: **Second Floor Column**

Sketches



Interaction Diagrams

Concrete Column

Lic. # : KW-06013597

File: 638283 Interior Column Analysis.ec6

Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24

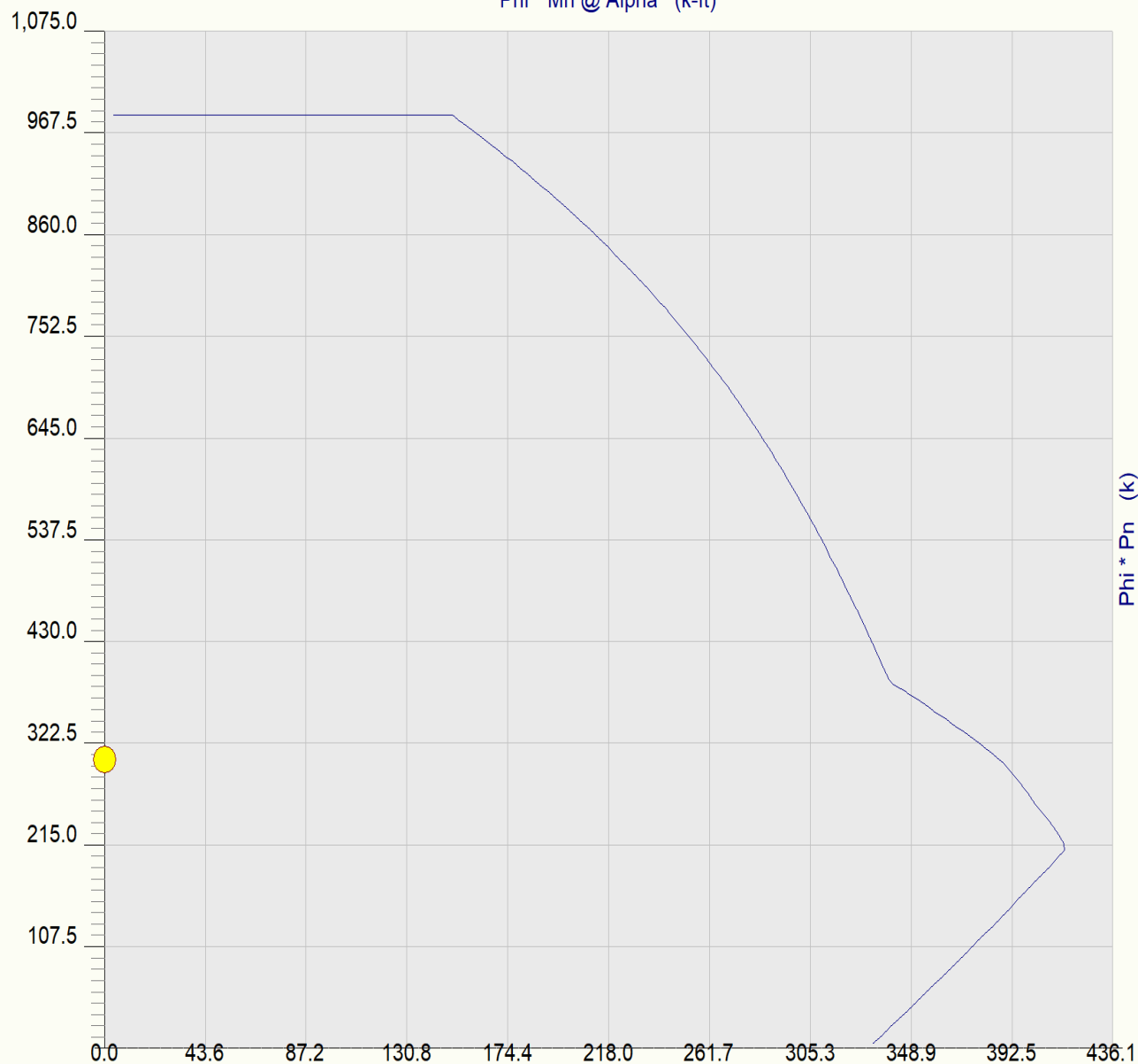
Centerline Communications

DESCRIPTION: **Second Floor Column**

Concrete Column P-M Interaction Diagram

$\Phi * M_n @ \alpha$ (k-ft)

$\Phi * P_n$ (k)



Load Comb. = +1.40D, Alpha= 0.0deg, (305.75, 0.00)

Concrete Column

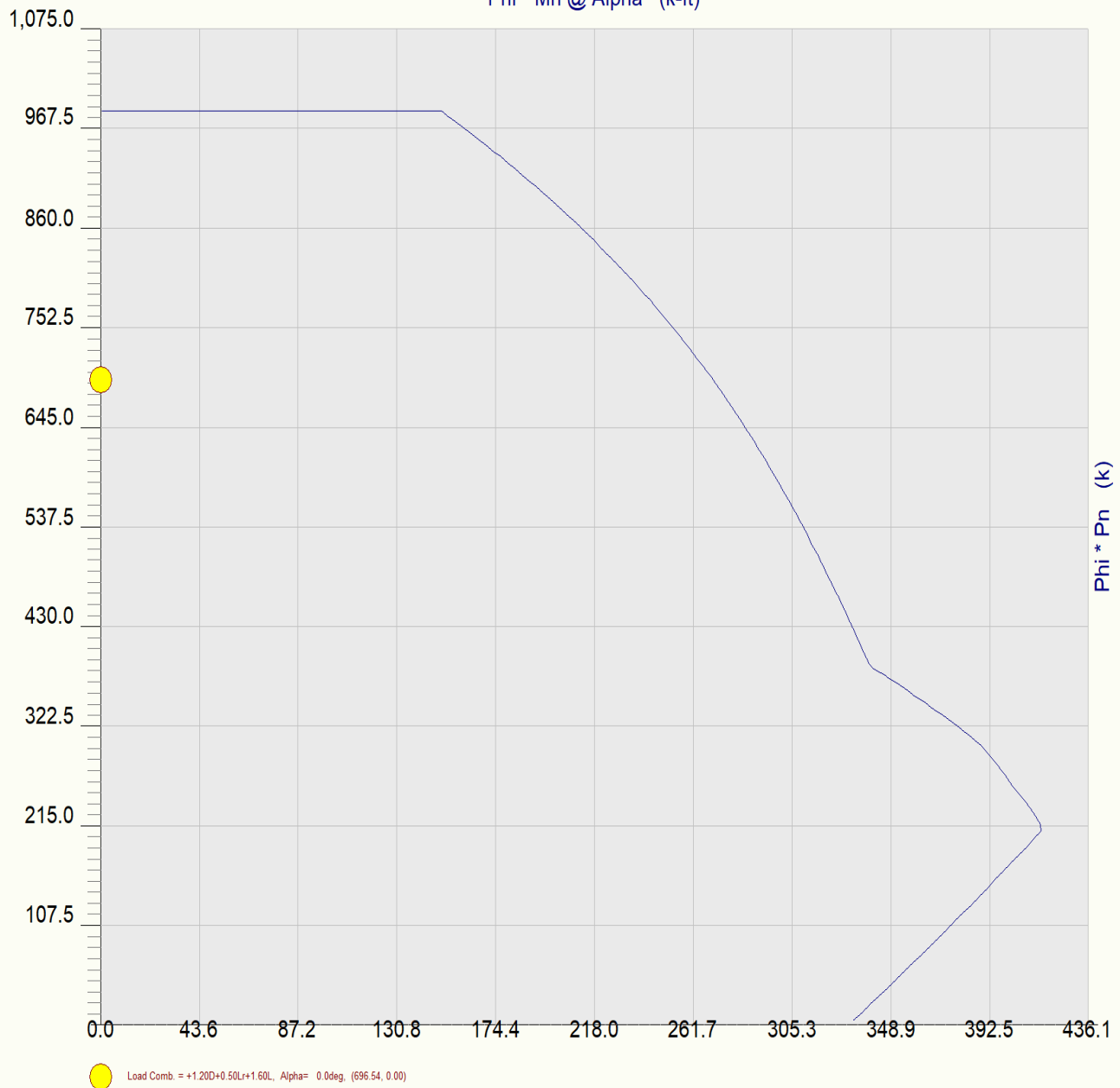
File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Second Floor Column**

Concrete Column P-M Interaction Diagram

Phi * Mn @ Alpha (k-ft)



Concrete Column

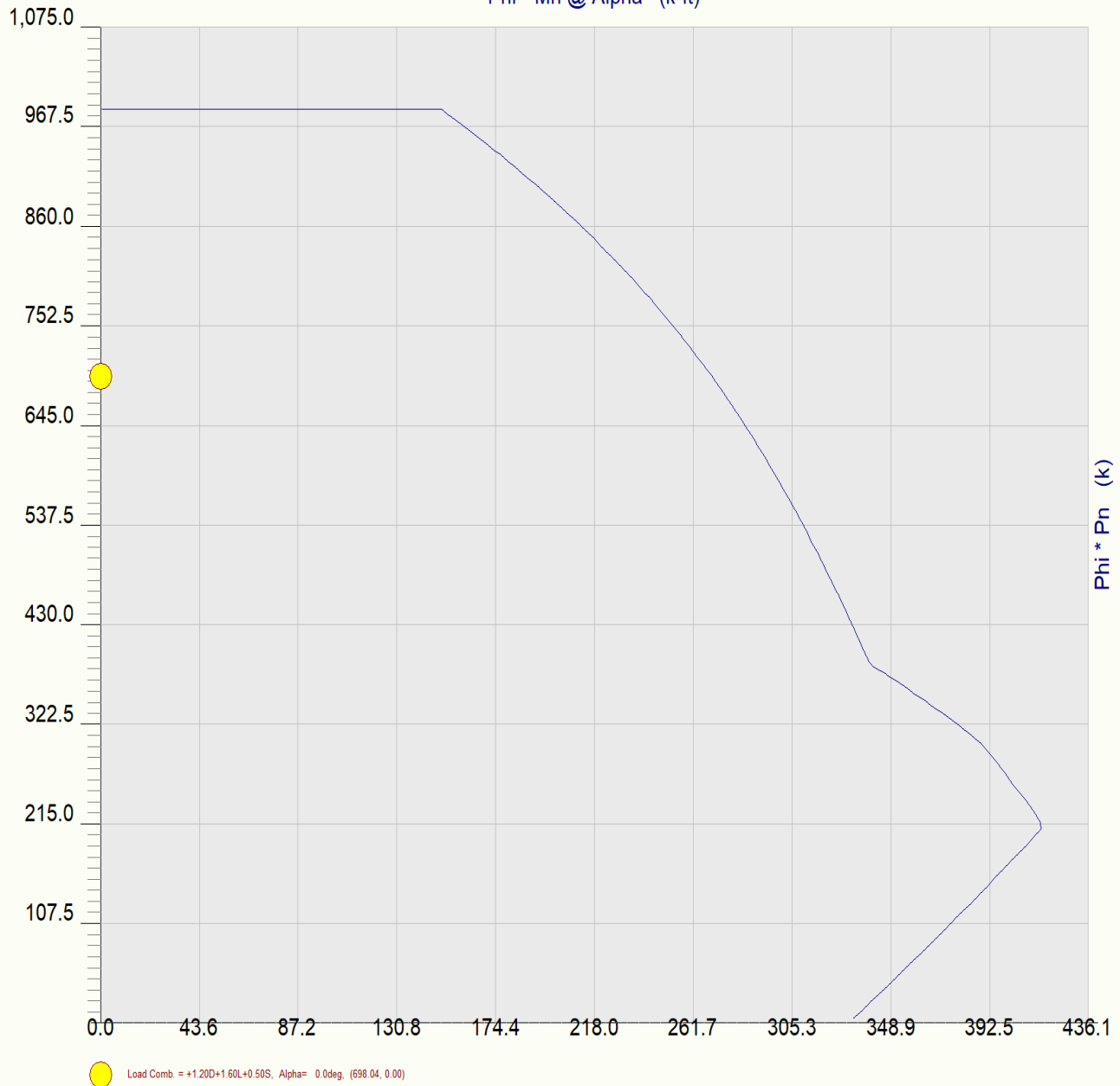
File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Second Floor Column**

Concrete Column P-M Interaction Diagram

Phi * Mn @ Alpha (k-ft)



Concrete Column

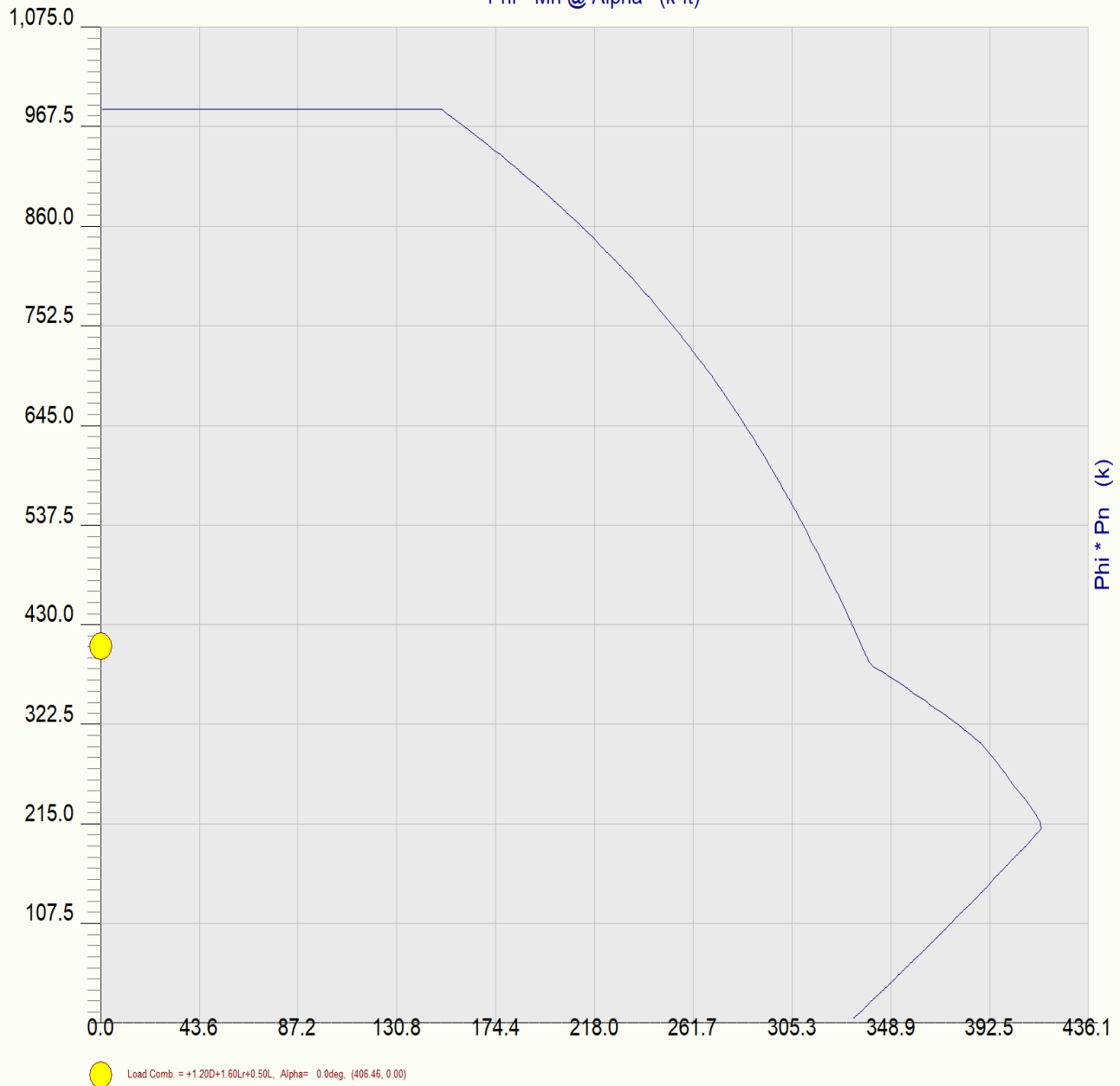
File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Second Floor Column**

Concrete Column P-M Interaction Diagram

Phi * Mn @ Alpha (k-ft)



Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

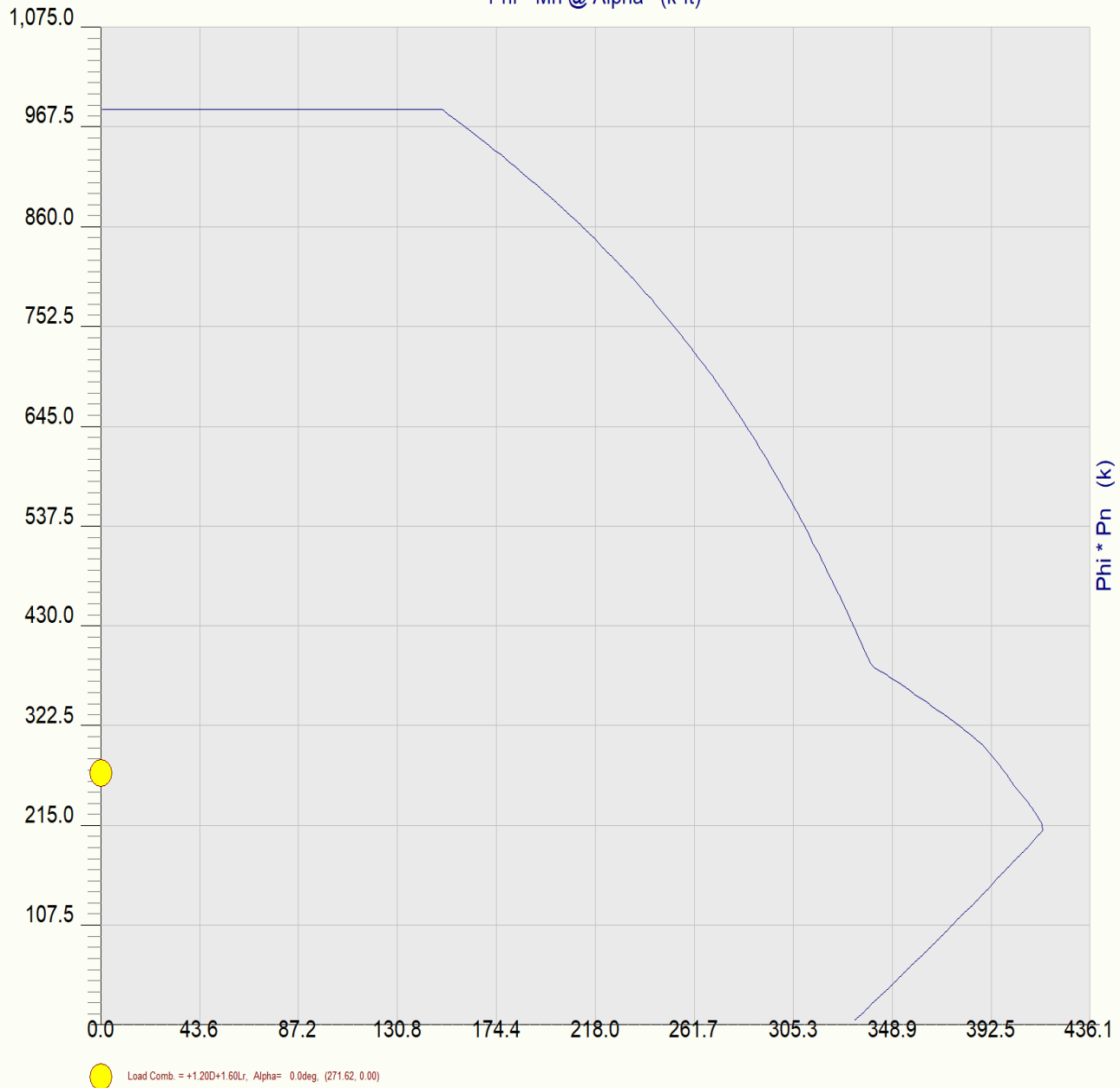
Lic. # : KW-06013597

DESCRIPTION: **Second Floor Column**

Concrete Column P-M Interaction Diagram

$\Phi * M_n @ \alpha$ (k-ft)

$\Phi * P_n$ (k)



Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Second Floor Column**

Concrete Column P-M Interaction Diagram

$\Phi * M_n @ \alpha$ (k-ft)

$\Phi * P_n$ (k)



Load Comb. = +1.20D+0.50L+1.60S, Alpha= 0.0deg, (411.25, 0.00)

Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

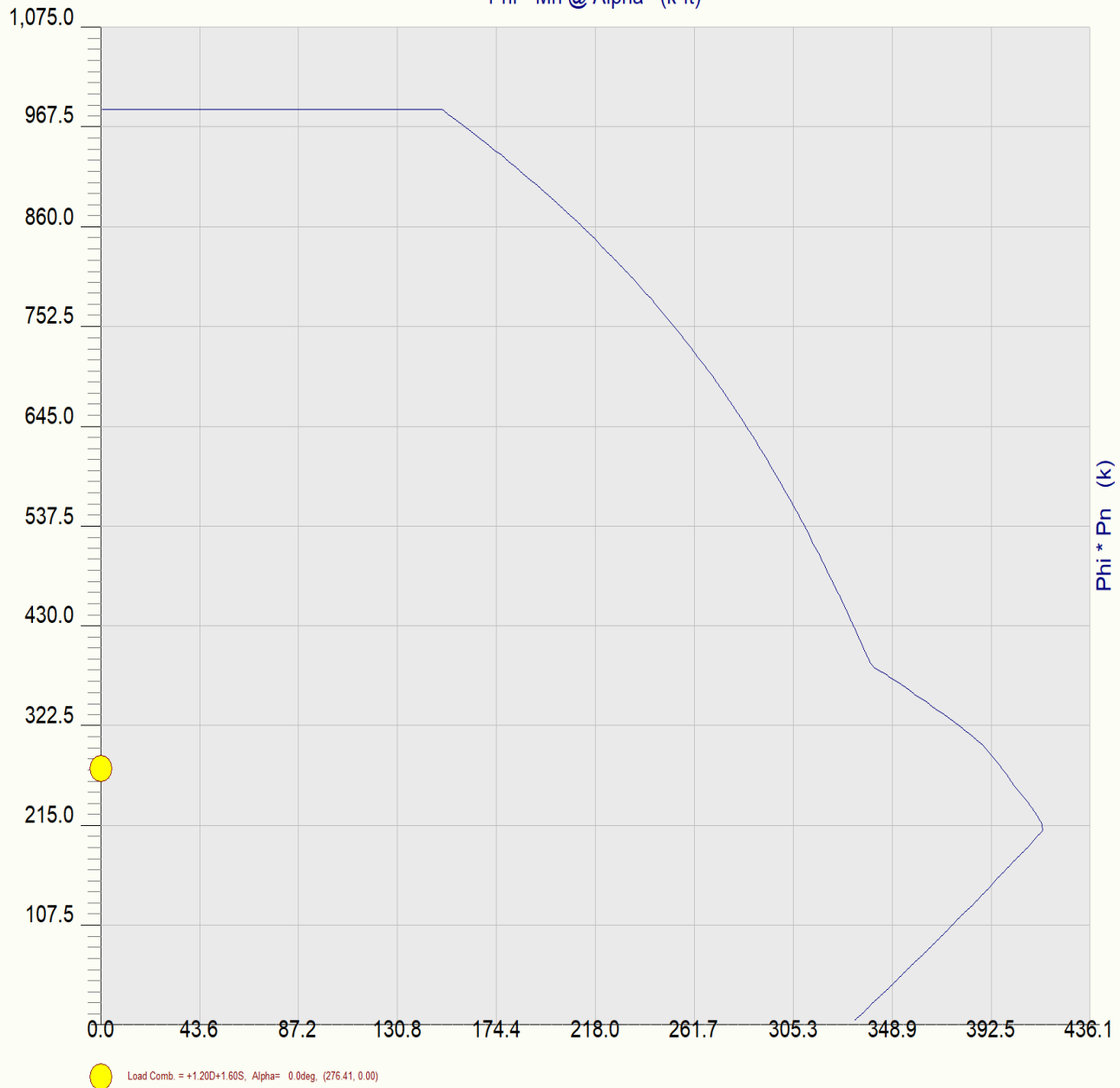
Lic. # : KW-06013597

DESCRIPTION: **Second Floor Column**

Concrete Column P-M Interaction Diagram

$\Phi * M_n @ \alpha$ (k-ft)

$\Phi * P_n$ (k)



Concrete Column

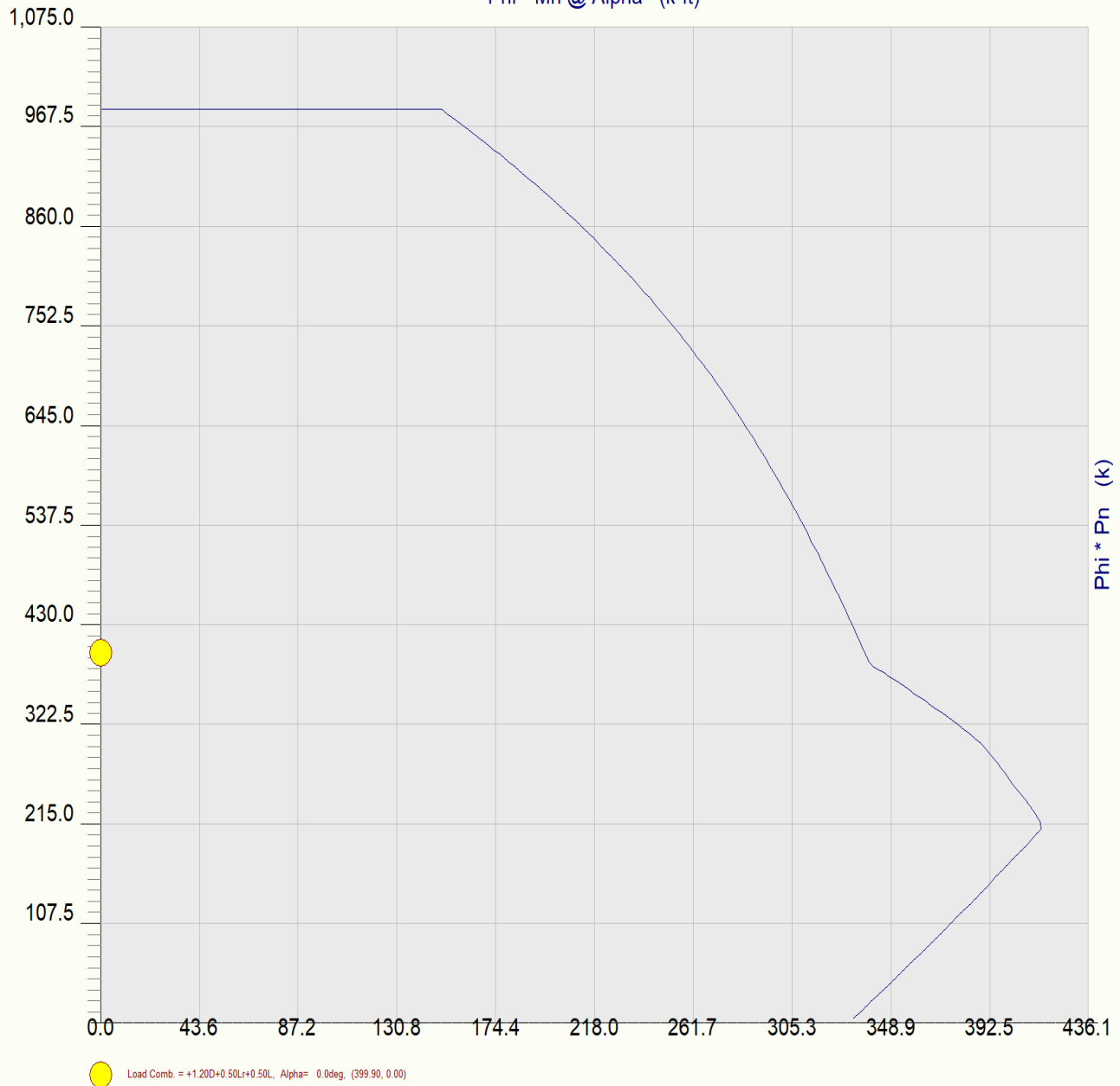
File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Second Floor Column**

Concrete Column P-M Interaction Diagram

Phi * Mn @ Alpha (k-ft)



Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Second Floor Column**

Concrete Column P-M Interaction Diagram

$\Phi * M_n @ \alpha$ (k-ft)

$\Phi * P_n$ (k)



Load Comb. = +1.20D+0.50L+0.50S, Alpha= 0.0deg, (401.39, 0.00)

Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Second Floor Column**

Concrete Column P-M Interaction Diagram

$\Phi * M_n @ \text{Alpha}$ (k-ft)

$\Phi * P_n$ (k)



Load Comb. = +1.20D+0.50L+0.70S, Alpha= 0.0deg, (403.18, 0.00)

Concrete Column

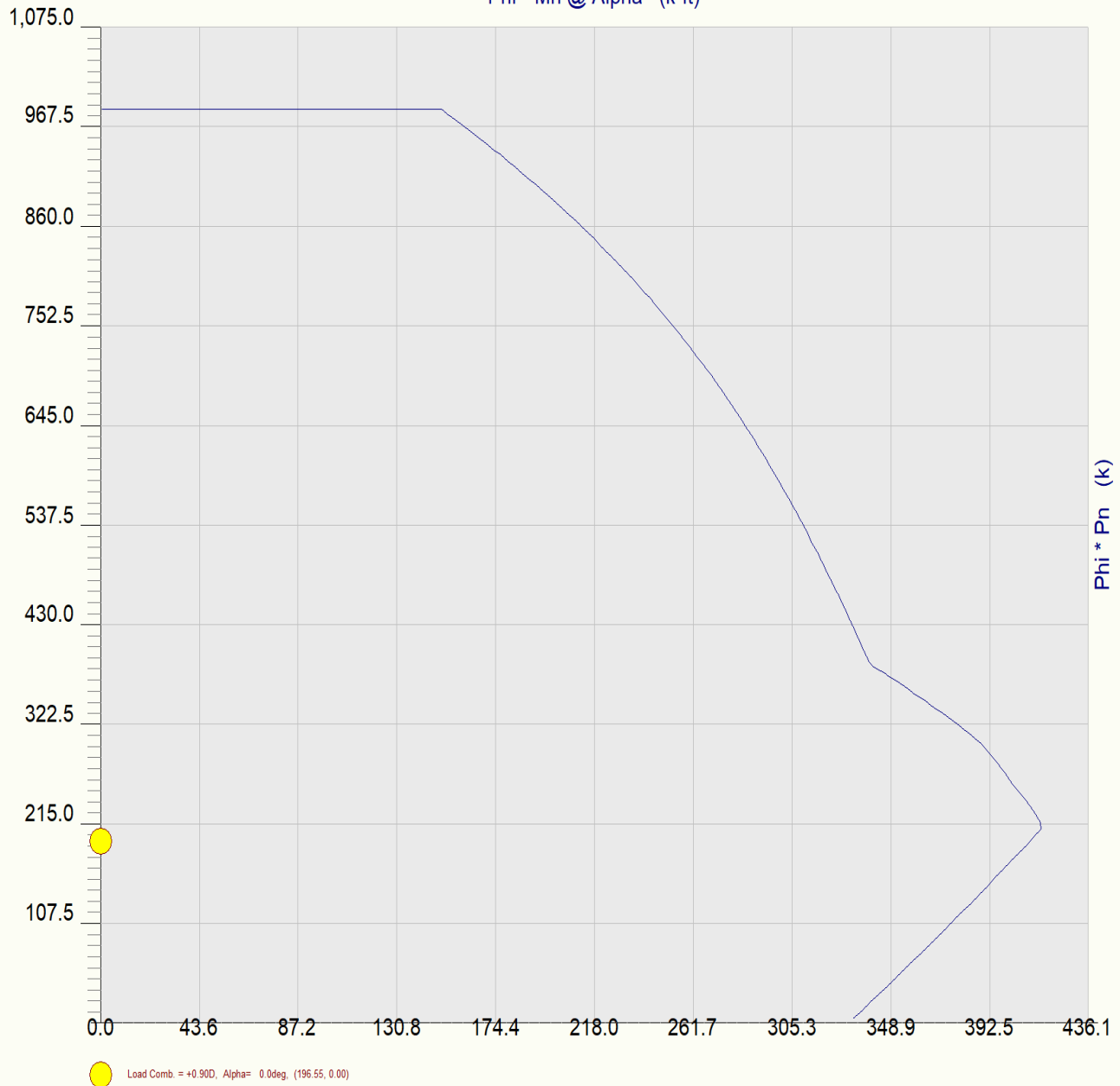
File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Second Floor Column**

Concrete Column P-M Interaction Diagram

Phi * Mn @ Alpha (k-ft)



Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. #: KW-06013597

DESCRIPTION: First Floor Column

Code References

Calculations per ACI 318-14, IBC 2015, CBC 2016, ASCE 7-10

Load Combinations Used : IBC 2015

General Information

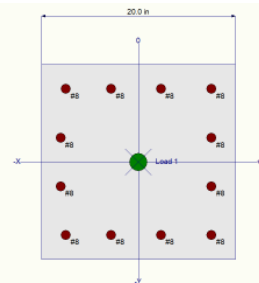
f'_c : Concrete 28 day strength = 4.0 ksi
E = 3,605.0 ksi
Density = 150.0 pcf
 β = 0.850
 f_y - Main Rebar = 60.0 ksi
E - Main Rebar = 29,000.0 ksi
Allow. Reinforcing Limits *ASTM A615 Bars Used*
Min. Reinf. = 1.0 %
Max. Reinf. = 8.0 %

Overall Column Height = 14.420 ft
End Fixity **Top & Bottom Pinned**
Brace condition for deflection (buckling) along columns :
X-X (width) axis :
Unbraced Length for buckling ABOUT Y-Y Axis = 14.420 ft, K = 1.0
Y-Y (depth) axis :
Unbraced Length for buckling ABOUT X-X Axis = 14.420 ft, K = 1.0

Column Cross Section

Column Dimensions : 20.0in Square Column, Column Edge to Rebar Edge Cover = 2.0in

Column Reinforcing : 4 - #8 bars @ corners,, 2 - #8 bars top & bottom between corner bars, 2 - #8 bars left & right between corner bars



Applied Loads

Entered loads are factored per load combinations specified by user.

Column self weight included : 6,008.33 lbs * Dead Load Factor

AXIAL LOADS ...

Roof + Tower Loads: Axial Load at 14.420 ft above base, D = 255.730, LR = 5.970, L = 299.550, S = 8.960 k

DESIGN SUMMARY

Load Combination **+1.20D+1.60L+0.50S**
Location of max. above base **14.323 ft**
Maximum Stress Ratio : 0.809 : 1
 $\text{Ratio} = (P_u^2 + M_u^2)^{.5} / (\Phi P_n^2 + \Phi M_n^2)^{.5}$
 $P_u = 797.85 \text{ k}$ $\Phi * P_n = 986.22 \text{ k}$
 $M_{u-x} = 0.0 \text{ k-ft}$ $\Phi * M_{n-x} = 0.0 \text{ k-ft}$
 $M_{u-y} = 0.0 \text{ k-ft}$ $\Phi * M_{n-y} = 0.0 \text{ k-ft}$
 $M_u \text{ Angle} = 0.0 \text{ deg}$
 $M_u \text{ at Angle} = 0.0 \text{ k-ft}$ $\Phi M_n \text{ at Angle} = 0.0 \text{ k-ft}$

P_n & M_n values located at P_u-M_u vector intersection with capacity curve

Column Capacities ...

P_nmax : Nominal Max. Compressive Axial Capacity **1,896.57 k**
P_nmin : Nominal Min. Tension Axial Capacity **k**
 ΦP_n , max : Usable Compressive Axial Capacity **986.22 k**
 ΦP_n , min : Usable Tension Axial Capacity **k**

Maximum SERVICE Load Reactions ...

Top along Y-Y **0.0 k** Bottom along Y-Y **0.0 k**
Top along X-X **0.0 k** Bottom along X-X **0.0 k**

Maximum SERVICE Load Deflections ...

Along Y-Y **0.0 in** at **0.0 ft** above base
for load combination :
Along X-X **0.0 in** at **0.0 ft** above base
for load combination :

General Section Information . $\phi = 0.650$ $\beta = 0.850$ $\theta = 0.80$

ρ : % Reinforcing **2.370 %** Rebar % Ok
Reinforcing Area **9.480 in²**
Concrete Area **400.0 in²**

Governing Load Combination Results

Governing Factored Load Combination	Moment		Dist. from base	Axial Load k		Bending Analysis k-ft						Utilization	
	X-X	Y-Y		Pu	ϕ * Pn	δ x	δ x * Mux	δ y	δ y * Muy	Alpha (deg)	δ Mu	ϕ Mn	Ratio
+1.40D			14.32	366.43	986.22					0.000			0.372
+1.20D+0.50Lr+1.60L			14.32	796.35	986.22					0.000			0.807
+1.20D+1.60L+0.50S			14.32	797.85	986.22					0.000			0.809

Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. #: KW-06013597

DESCRIPTION: First Floor Column

Governing Load Combination Results

Governing Factored Load Combination	Moment		Dist. from base ft	Axial Load k		Bending Analysis k-ft						Utilization	
	X-X	Y-Y		Pu	$\phi * P_n$	δx	$\delta x * M_{ux}$	δy	$\delta y * M_{uy}$	Alpha (deg)	δM_u	ϕM_n	Ratio
+1.20D+1.60Lr+0.50L			14.32	473.41	986.22					0.000			0.480
+1.20D+1.60Lr			14.32	323.64	986.22					0.000			0.328
+1.20D+0.50L+1.60S			14.32	478.20	986.22					0.000			0.485
+1.20D+1.60S			14.32	328.42	986.22					0.000			0.333
+1.20D+0.50Lr+0.50L			14.32	466.85	986.22					0.000			0.473
+1.20D+0.50L+0.50S			14.32	468.34	986.22					0.000			0.475
+1.20D+0.50L+0.70S			14.32	470.13	986.22					0.000			0.477
+0.90D			14.32	235.56	986.22					0.000			0.239

Maximum Reactions

Note: Only non-zero reactions are listed.

Load Combination	X-X Axis Reaction		k	Y-Y Axis Reaction		Axial Reaction	My - End Moments		k-ft	Mx - End Moments	
	@ Base	@ Top		@ Base	@ Top		@ Base	@ Top		@ Base	@ Top
D Only						261.738					
+D+L						561.288					
+D+Lr						267.708					
+D+S						270.698					
+D+0.750Lr+0.750L						490.878					
+D+0.750L+0.750S						493.121					
+0.60D						157.043					
Lr Only						5.970					
L Only						299.550					
S Only						8.960					

Maximum Moment Reactions

Note: Only non-zero reactions are listed.

Load Combination	Moment About X-X Axis			Moment About Y-Y Axis		
	@ Base	@ Top		@ Base	@ Top	
D Only			k-ft			k-ft
+D+L			k-ft			k-ft
+D+Lr			k-ft			k-ft
+D+S			k-ft			k-ft
+D+0.750Lr+0.750L			k-ft			k-ft
+D+0.750L+0.750S			k-ft			k-ft
+0.60D			k-ft			k-ft
Lr Only			k-ft			k-ft
L Only			k-ft			k-ft
S Only			k-ft			k-ft

Maximum Deflections for Load Combinations

Load Combination	Max. X-X Deflection		Distance	Max. Y-Y Deflection		Distance
D Only	0.0000	in	0.000 ft	0.000	in	0.000 ft
+D+L	0.0000	in	0.000 ft	0.000	in	0.000 ft
+D+Lr	0.0000	in	0.000 ft	0.000	in	0.000 ft
+D+S	0.0000	in	0.000 ft	0.000	in	0.000 ft
+D+0.750Lr+0.750L	0.0000	in	0.000 ft	0.000	in	0.000 ft
+D+0.750L+0.750S	0.0000	in	0.000 ft	0.000	in	0.000 ft
+0.60D	0.0000	in	0.000 ft	0.000	in	0.000 ft
Lr Only	0.0000	in	0.000 ft	0.000	in	0.000 ft
L Only	0.0000	in	0.000 ft	0.000	in	0.000 ft
S Only	0.0000	in	0.000 ft	0.000	in	0.000 ft

Centerline Communications
750 West Center Street, Suite 301
West Bridgewater, MA 02379
781.713.4725

Project Title: **Stamford #1 CO**
Engineer: **DC**
Project ID: **638283**
Project Descr: **Interior Concrete Column Analysis**

Printed: 17 JUN 2022, 8:55AM

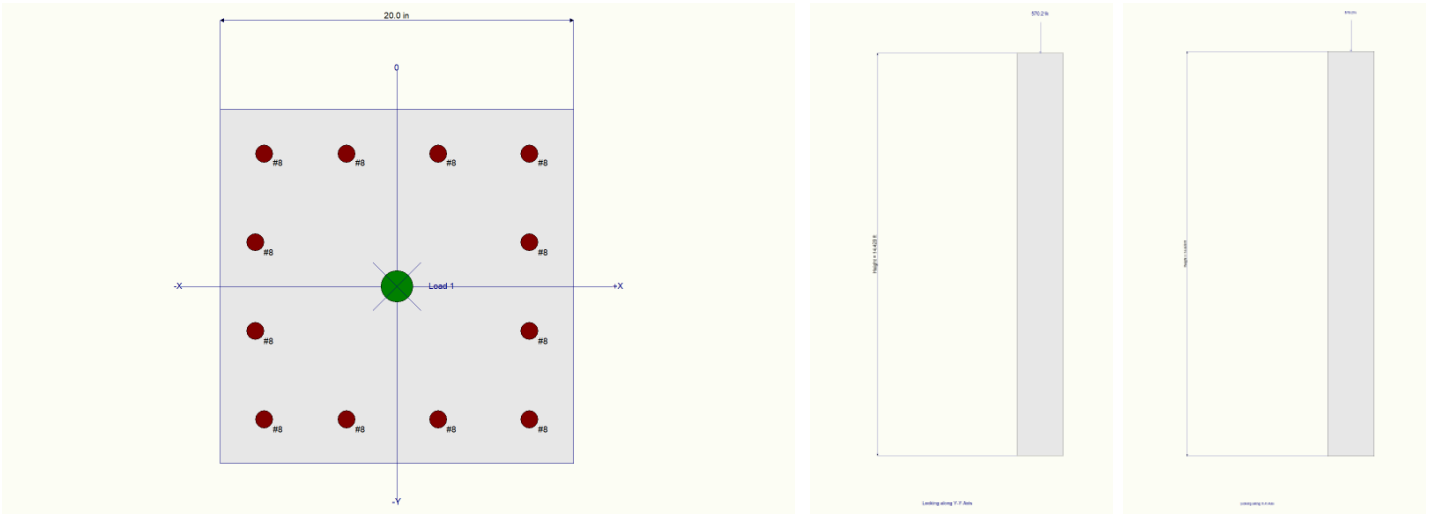
Concrete Column

Lic. # : KW-06013597

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

DESCRIPTION: **First Floor Column**

Sketches



Interaction Diagrams

Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

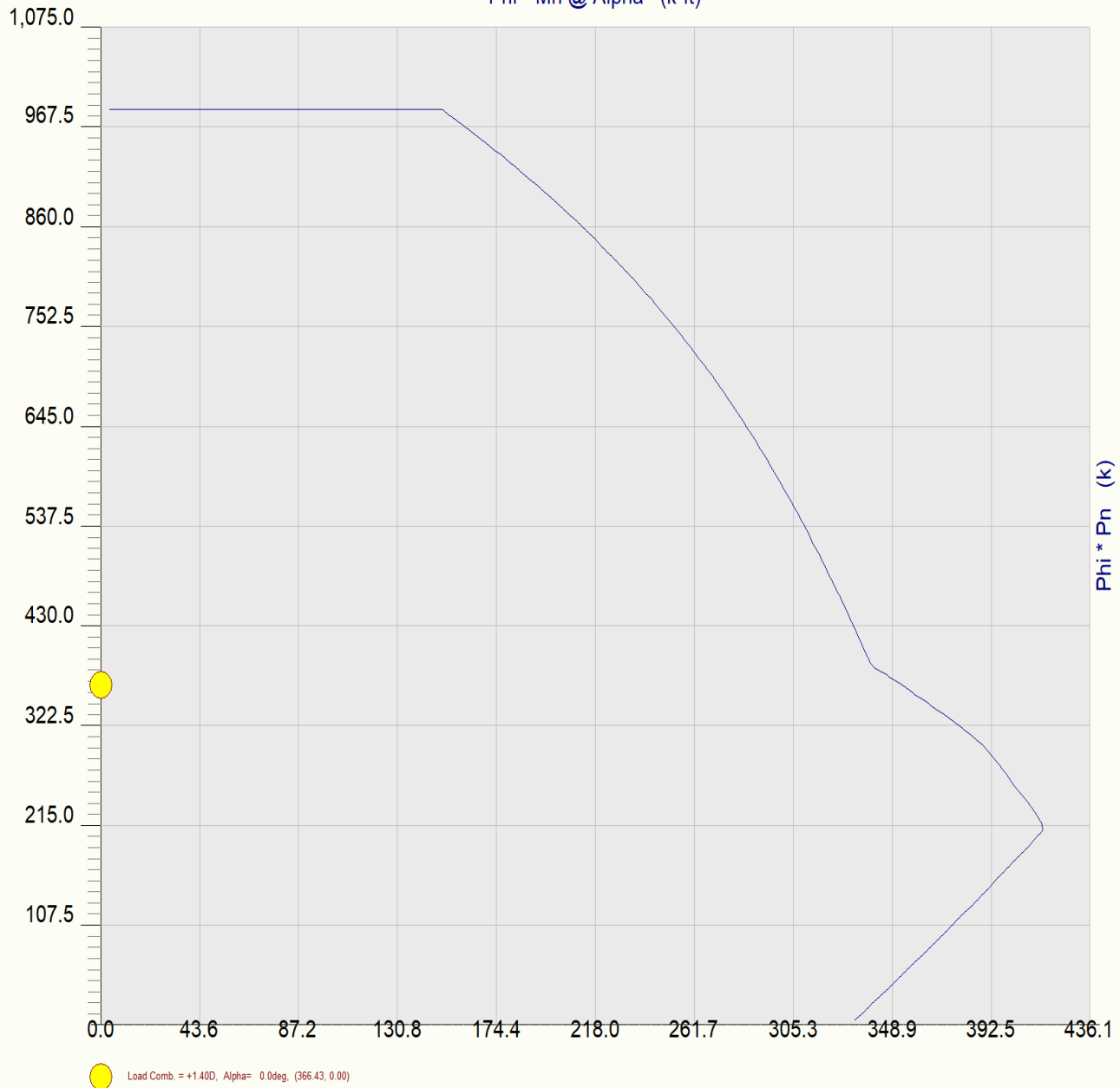
Lic. # : KW-06013597

DESCRIPTION: **First Floor Column**

Concrete Column P-M Interaction Diagram

$\Phi * M_n @ \alpha$ (k-ft)

$\Phi * P_n$ (k)



Concrete Column

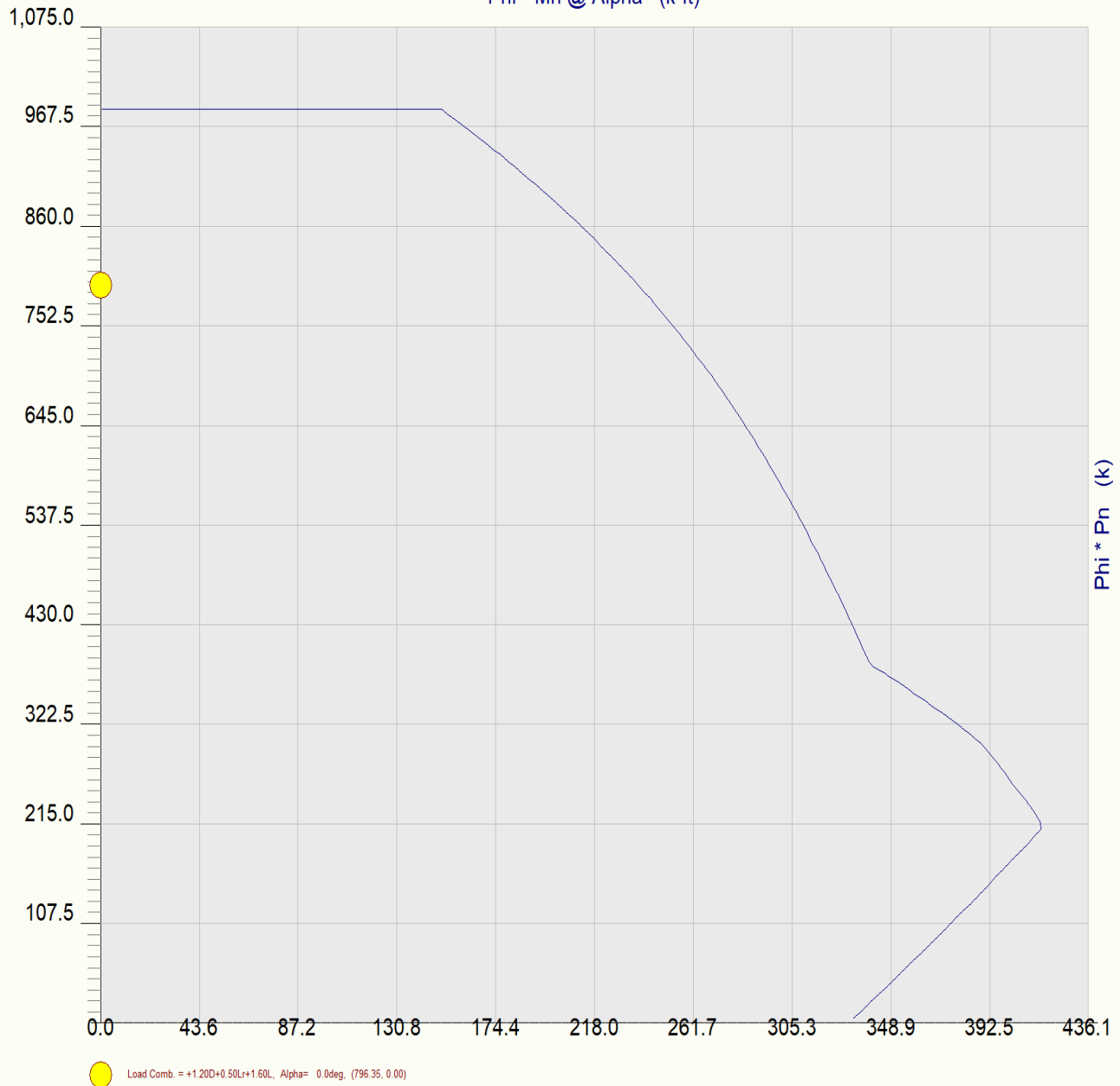
File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **First Floor Column**

Concrete Column P-M Interaction Diagram

Phi * Mn @ Alpha (k-ft)



Concrete Column

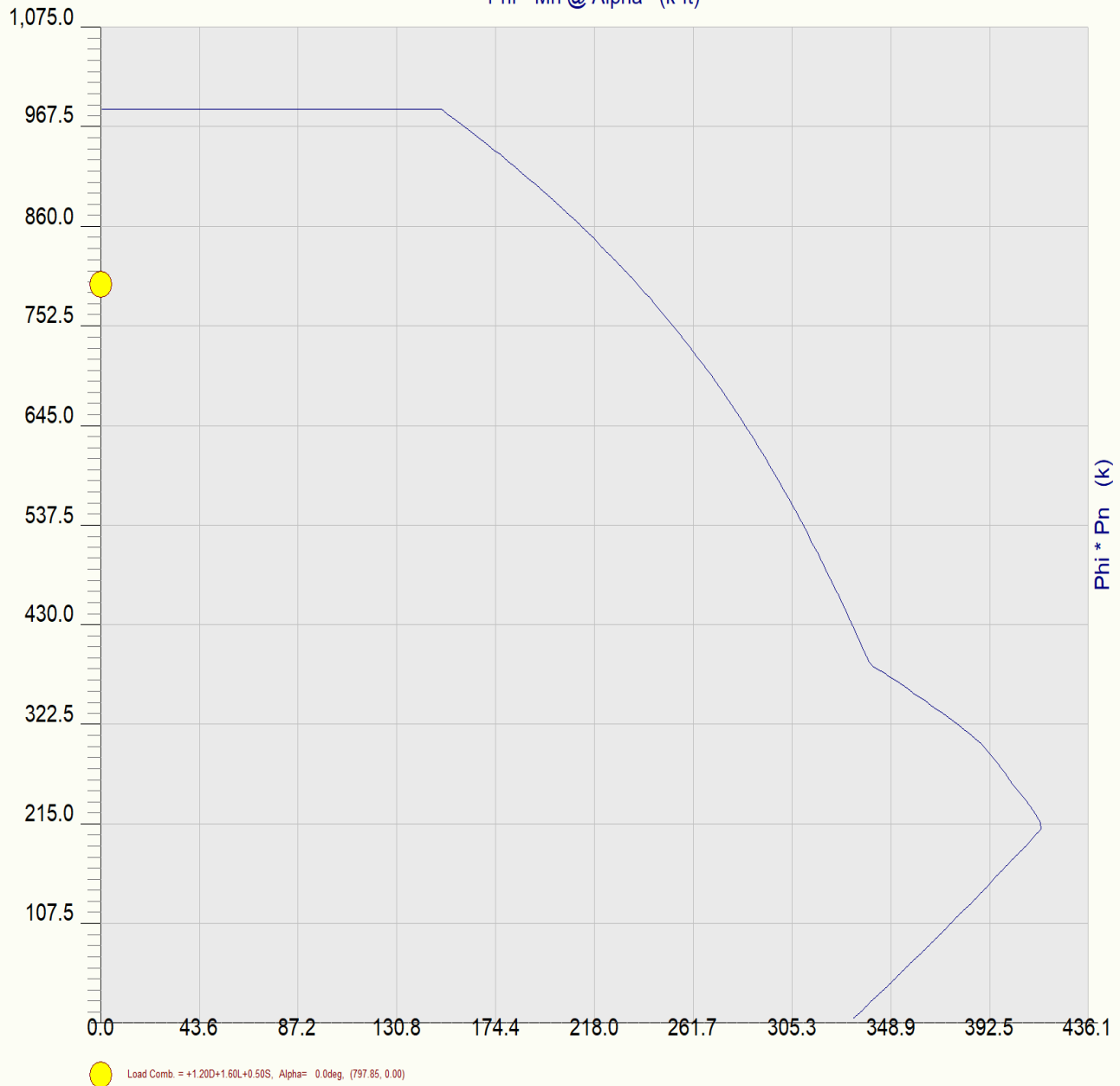
File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **First Floor Column**

Concrete Column P-M Interaction Diagram

Phi * Mn @ Alpha (k-ft)



Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

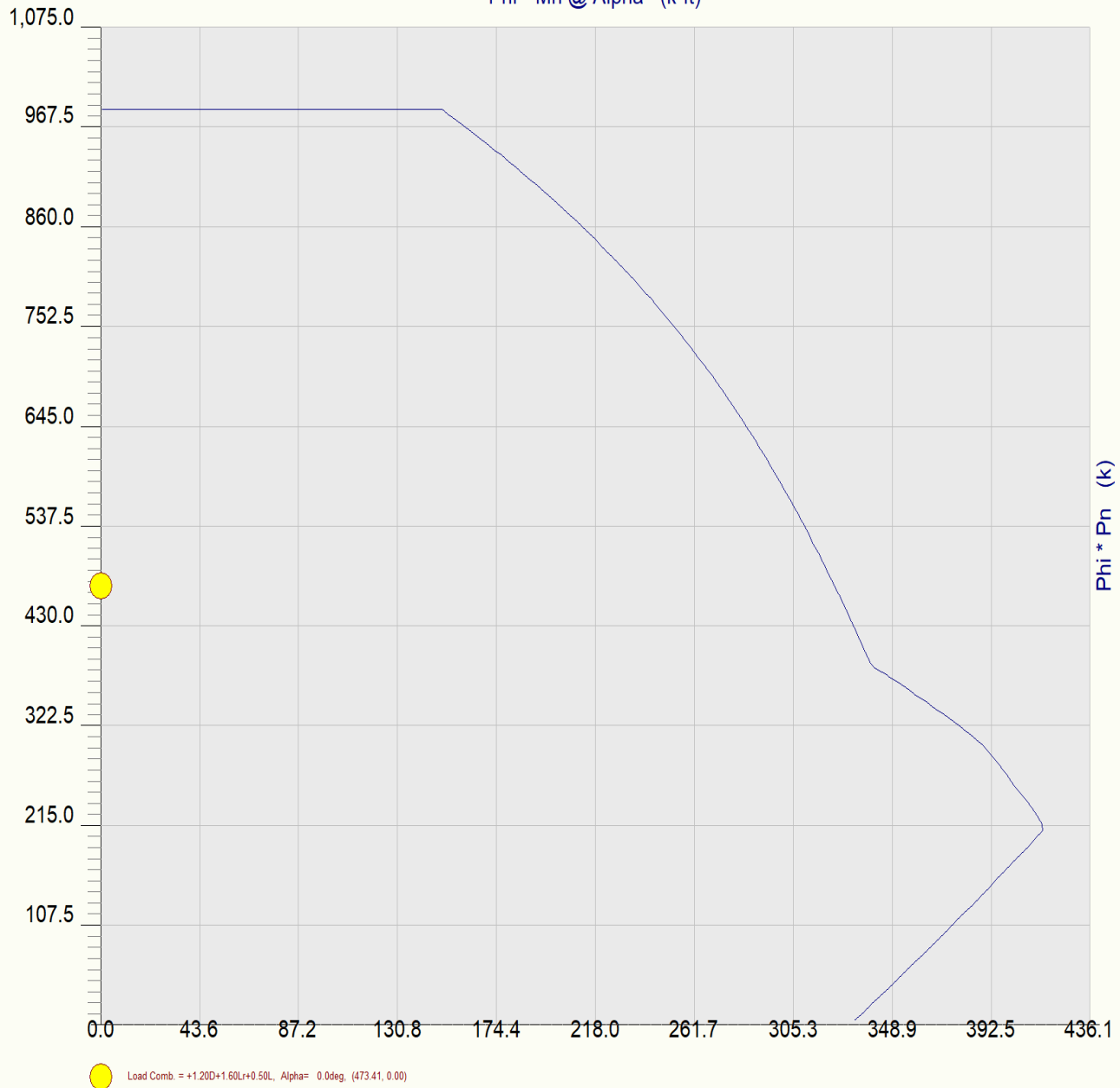
Lic. # : KW-06013597

DESCRIPTION: **First Floor Column**

Concrete Column P-M Interaction Diagram

Phi * Mn @ Alpha (k-ft)

Phi * Pn (k)



Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

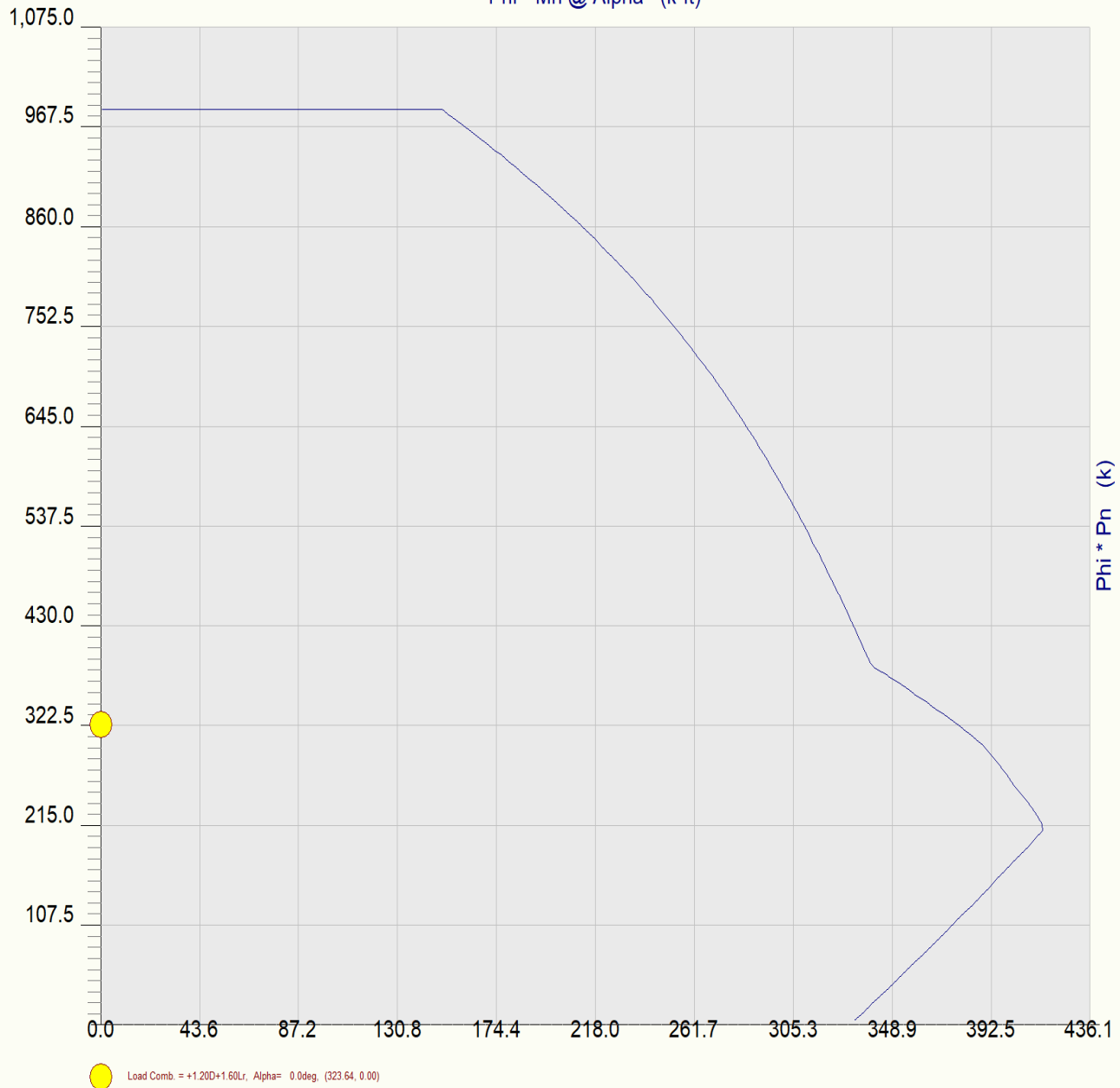
Lic. # : KW-06013597

DESCRIPTION: **First Floor Column**

Concrete Column P-M Interaction Diagram

Phi * Mn @ Alpha (k-ft)

Phi * Pn (k)



Concrete Column

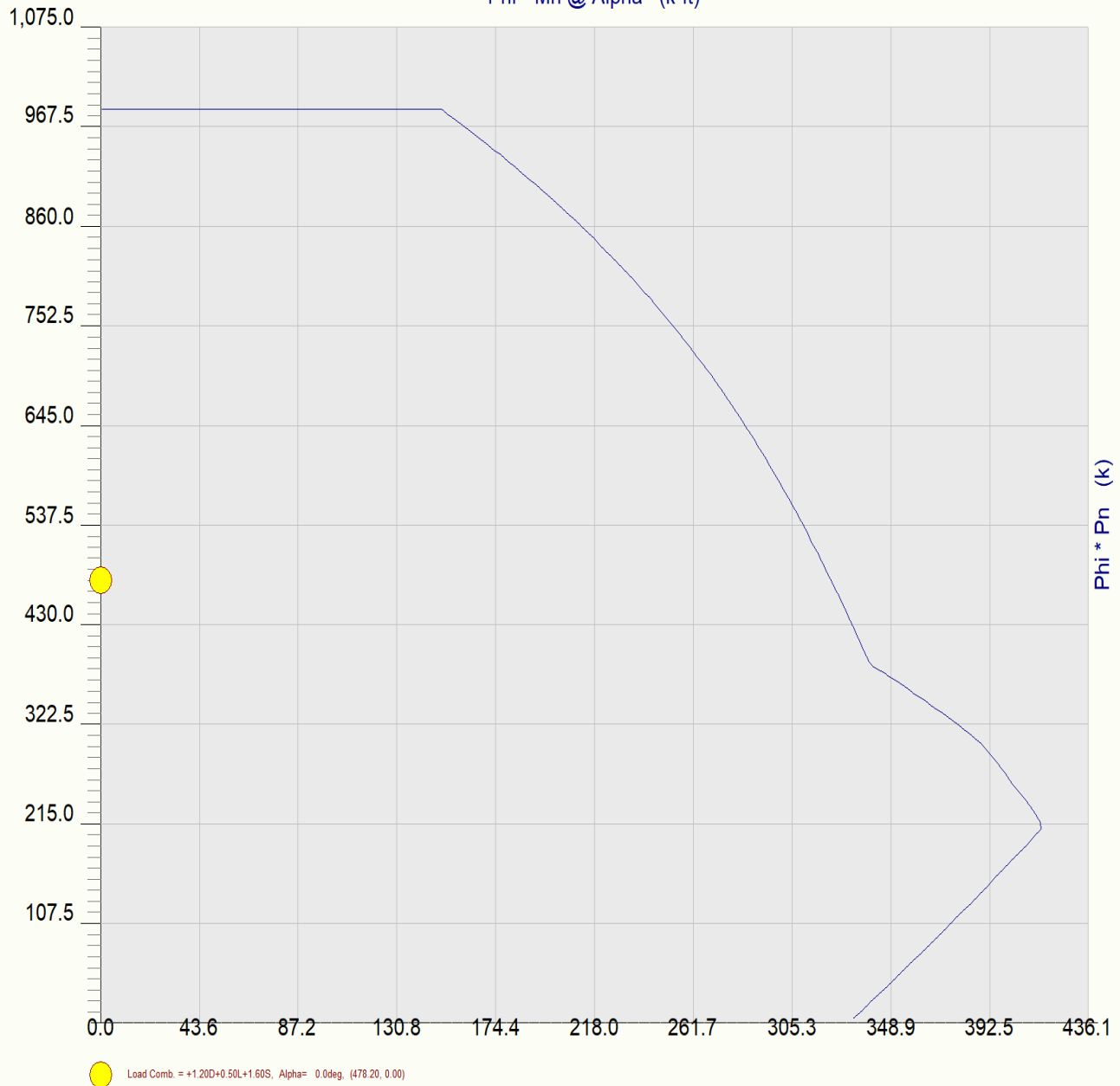
File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **First Floor Column**

Concrete Column P-M Interaction Diagram

Phi * Mn @ Alpha (k-ft)



Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

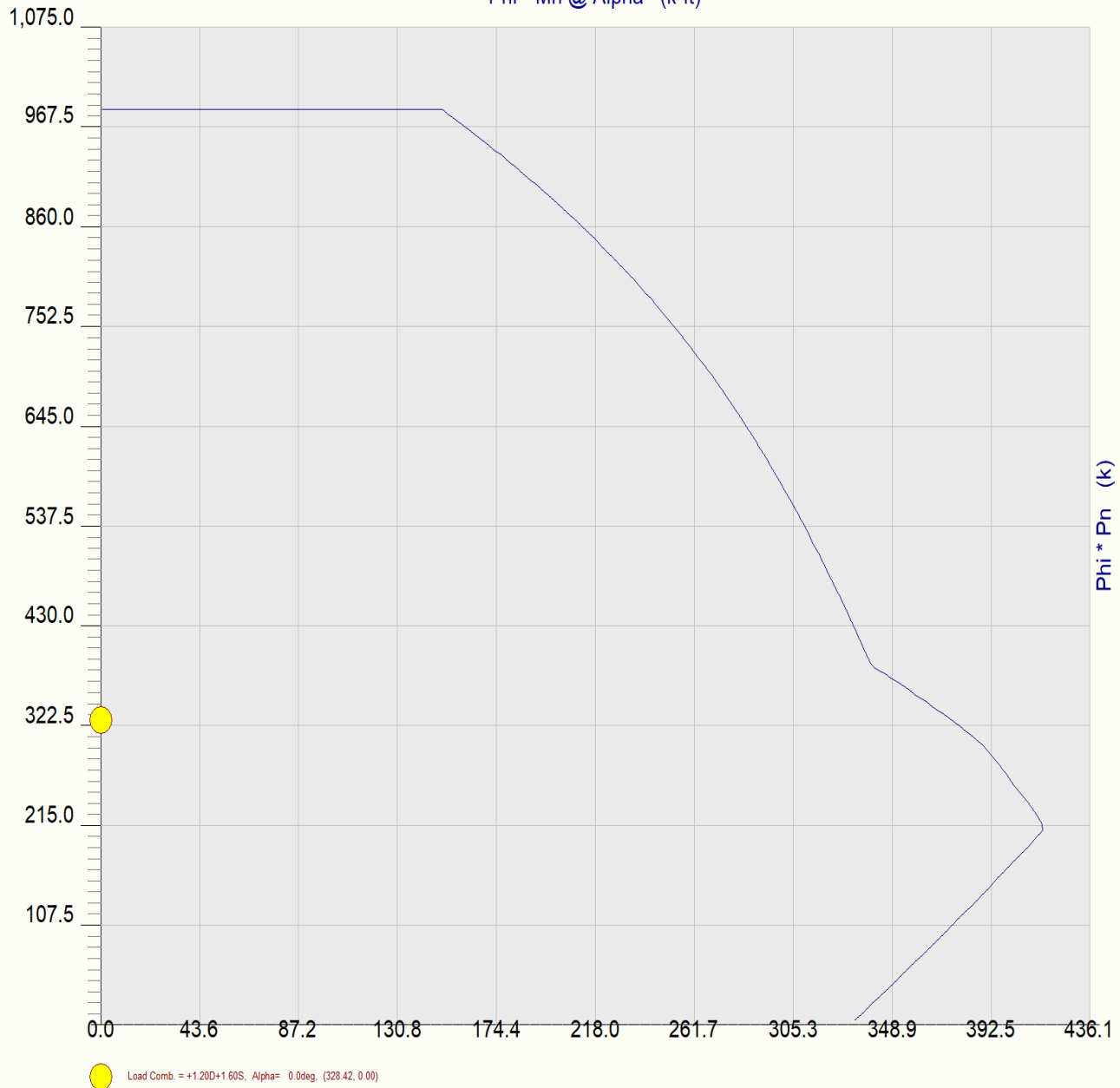
Lic. # : KW-06013597

DESCRIPTION: **First Floor Column**

Concrete Column P-M Interaction Diagram

$\Phi * M_n @ \alpha$ (k-ft)

$\Phi * P_n$ (k)



Concrete Column

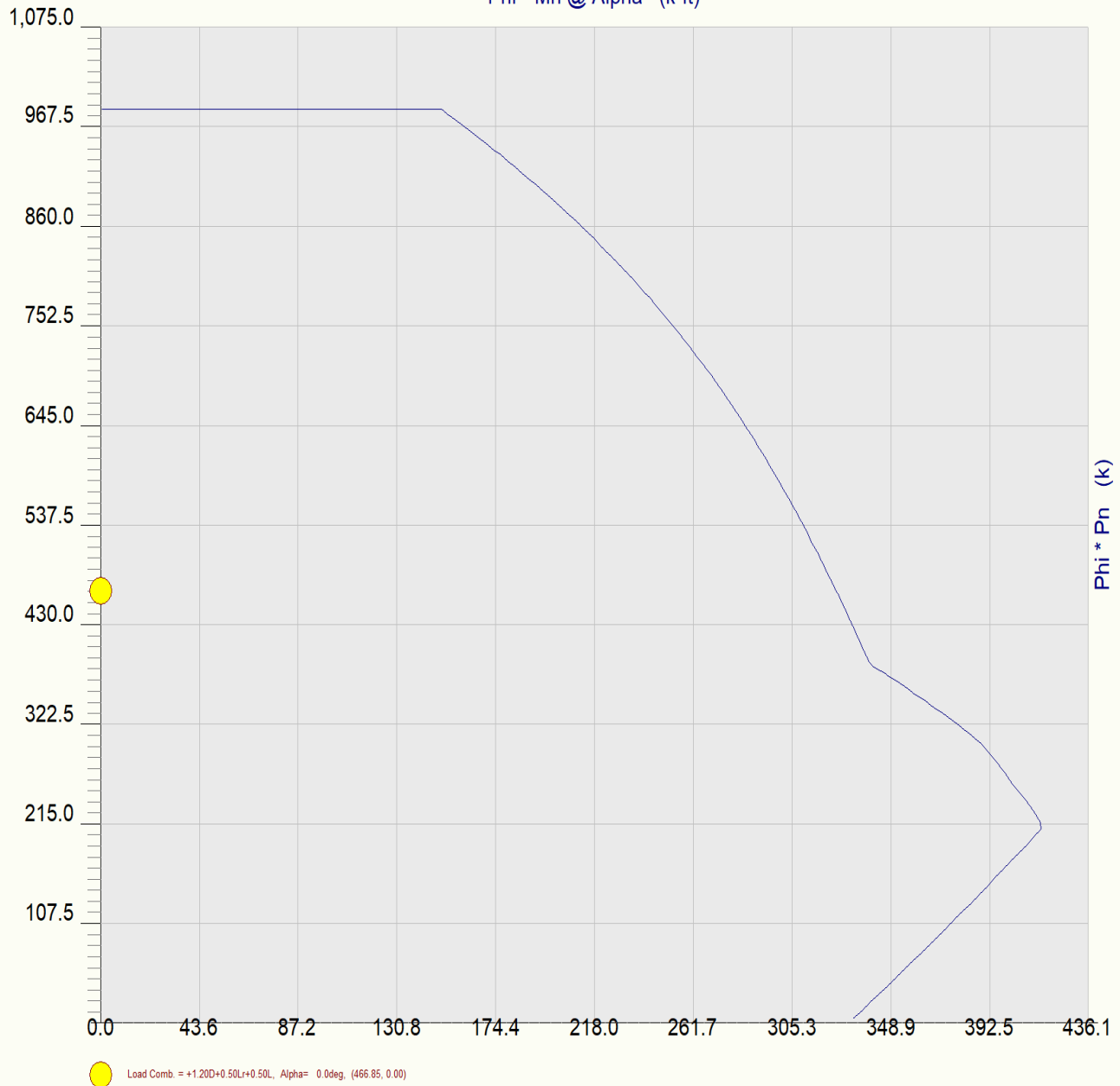
File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **First Floor Column**

Concrete Column P-M Interaction Diagram

Phi * Mn @ Alpha (k-ft)



Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

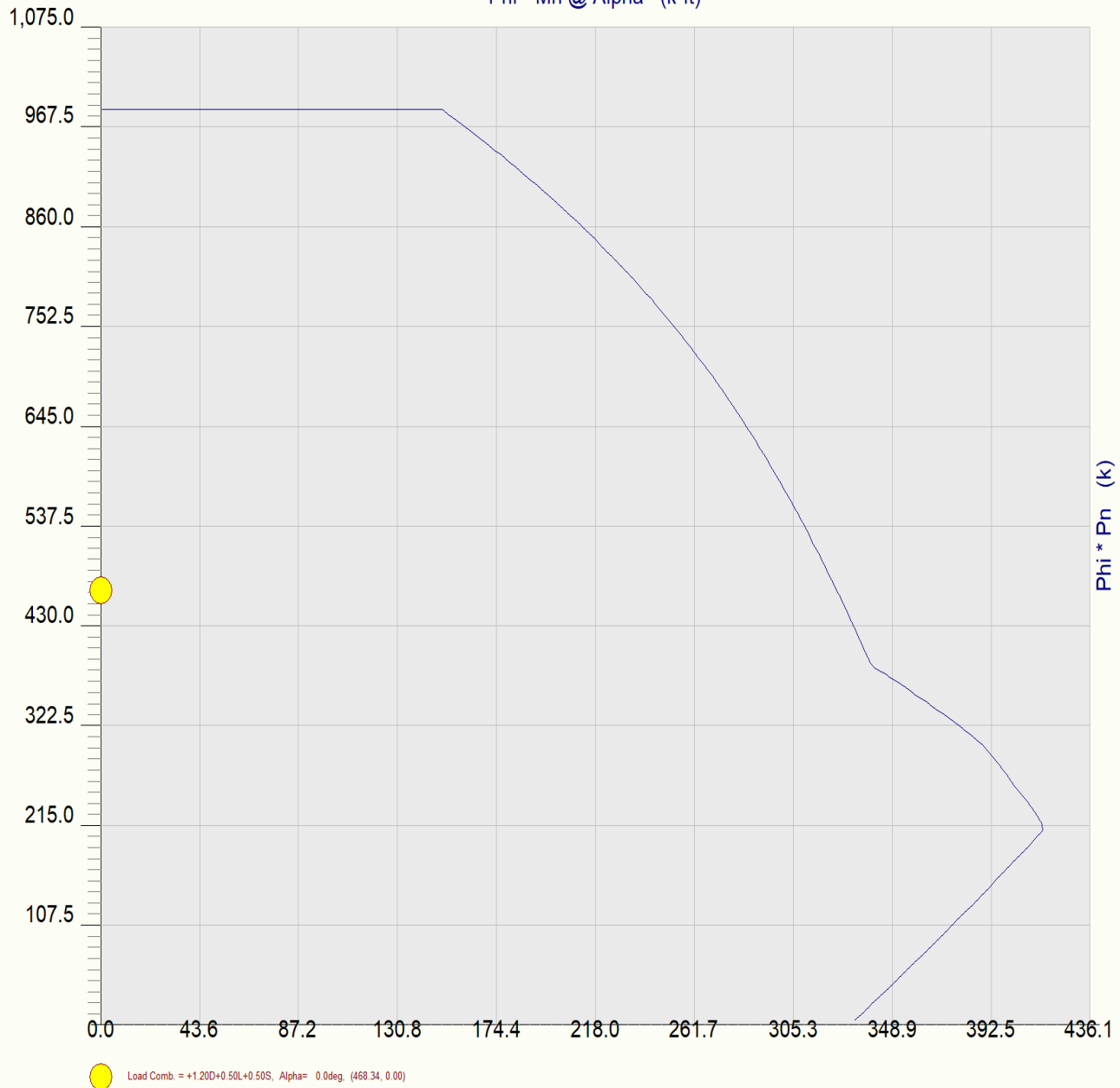
Lic. # : KW-06013597

DESCRIPTION: **First Floor Column**

Concrete Column P-M Interaction Diagram

Phi * Mn @ Alpha (k-ft)

Phi * Pn (k)



Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

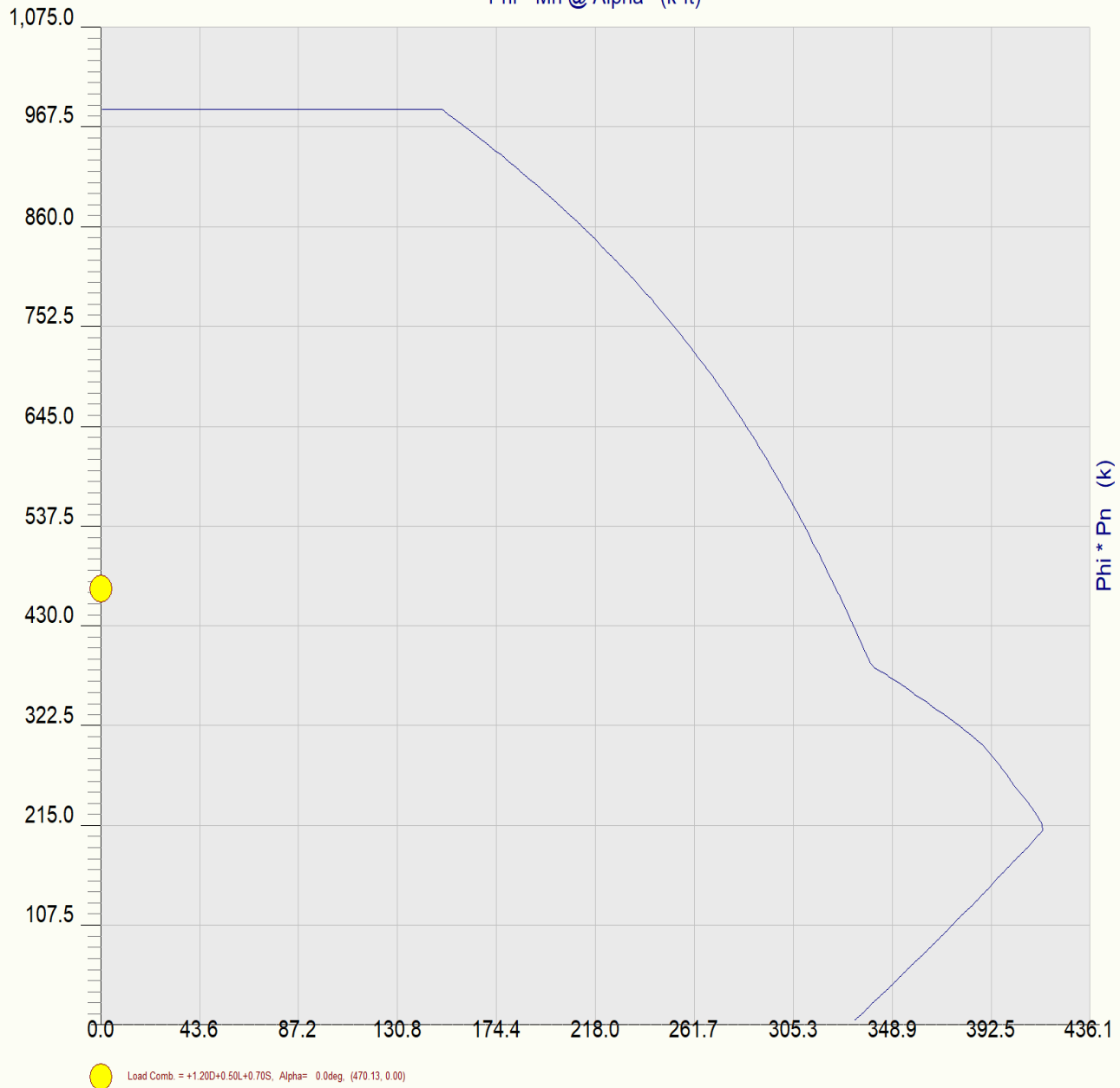
Lic. # : KW-06013597

DESCRIPTION: **First Floor Column**

Concrete Column P-M Interaction Diagram

Phi * Mn @ Alpha (k-ft)

Phi * Pn (k)



Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **First Floor Column**

Concrete Column P-M Interaction Diagram

$\Phi * M_n @ \alpha$ (k-ft)

$\Phi * P_n$ (k)



Load Comb. = +0.90D, Alpha= 0.0deg, (235.56, 0.00)

Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. #: KW-06013597

DESCRIPTION: G Floor Column

Code References

Calculations per ACI 318-14, IBC 2015, CBC 2016, ASCE 7-10

Load Combinations Used : IBC 2015

General Information

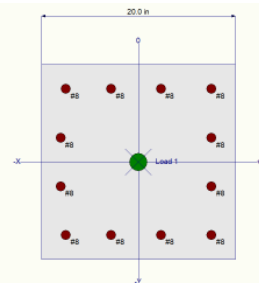
f'_c : Concrete 28 day strength = 4.0 ksi
E = 3,605.0 ksi
Density = 150.0 pcf
 β = 0.850
 f_y - Main Rebar = 60.0 ksi
E - Main Rebar = 29,000.0 ksi
Allow. Reinforcing Limits *ASTM A615 Bars Used*
Min. Reinf. = 1.0 %
Max. Reinf. = 8.0 %

Overall Column Height = 12.340 ft
End Fixity **Top & Bottom Pinned**
Brace condition for deflection (buckling) along columns :
X-X (width) axis :
Unbraced Length for buckling ABOUT Y-Y Axis = 12.340 ft, K = 1.0
Y-Y (depth) axis :
Unbraced Length for buckling ABOUT X-X Axis = 12.340 ft, K = 1.0

Column Cross Section

Column Dimensions : 20.0in Square Column, Column Edge to Rebar Edge Cover = 2.0in

Column Reinforcing : 4 - #8 bars @ corners,, 2 - #8 bars top & bottom between corner bars, 2 - #8 bars left & right between corner bars



Applied Loads

Entered loads are factored per load combinations specified by user.

Column self weight included : 5,141.67 lbs * Dead Load Factor

AXIAL LOADS ...

Roof + Tower Loads: Axial Load at 12.340 ft above base, D = 299.110, LR = 5.970, L = 329.420, S = 8.960 k

DESIGN SUMMARY

Load Combination **+1.20D+1.60L+0.50S**
Location of max. above base **12.257 ft**
Maximum Stress Ratio : 0.909 : 1
Ratio = $(P_u^2 + M_u^2)^{0.5} / (\Phi P_n^2 + \Phi M_n^2)^{0.5}$
 $P_u = 896.65$ k $\Phi * P_n = 986.22$ k
 $M_u - x = 0.0$ k-ft $\Phi * M_n - x = 0.0$ k-ft
 $M_u - y = 0.0$ k-ft $\Phi * M_n - y = 0.0$ k-ft
 M_u Angle = 0.0 deg
 M_u at Angle = 0.0 k-ft ΦM_n at Angle = 0.0 k-ft

P_n & M_n values located at P_u-M_u vector intersection with capacity curve

Column Capacities ...

P_nmax : Nominal Max. Compressive Axial Capacity **1,896.57** k
P_nmin : Nominal Min. Tension Axial Capacity k
 Φ P_n, max : Usable Compressive Axial Capacity **986.22** k
 Φ P_n, min : Usable Tension Axial Capacity k

Maximum SERVICE Load Reactions . .

Top along Y-Y **0.0** k Bottom along Y-Y **0.0** k
Top along X-X **0.0** k Bottom along X-X **0.0** k

Maximum SERVICE Load Deflections . .

Along Y-Y **0.0** in at **0.0** ft above base
for load combination :
Along X-X **0.0** in at **0.0** ft above base
for load combination :

General Section Information . $\Phi = 0.650$ $\beta = 0.850$ $\theta = 0.80$

ρ : % Reinforcing **2.370** % Rebar % Ok
Reinforcing Area **9.480** in²
Concrete Area **400.0** in²

Governing Load Combination Results

Governing Factored Load Combination	Moment		Dist. from base ft	Axial Load k		Bending Analysis k-ft						Utilization Ratio	
	X-X	Y-Y		P _u	$\Phi * P_n$	δx	$\delta x * M_{ux}$	δy	$\delta y * M_{uy}$	Alpha (deg)	δM_u	ΦM_n	Ratio
+1.40D			12.26	425.95	986.22					0.000			0.432
+1.20D+0.50Lr+1.60L			12.26	895.16	986.22					0.000			0.908
+1.20D+1.60L+0.50S			12.26	896.65	986.22					0.000			0.909

Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: G Floor Column

Governing Load Combination Results

Governing Factored Load Combination	Moment		Dist. from base	ft	Axial Load k		Bending Analysis k-ft						Utilization	
	X-X	Y-Y			Pu	$\phi * P_n$	δx	$\delta x * M_{ux}$	δy	$\delta y * M_{uy}$	Alpha (deg)	δM_u	ϕM_n	Ratio
+1.20D+1.60Lr+0.50L			12.26		539.36	986.22					0.000			0.547
+1.20D+1.60Lr			12.26		374.65	986.22					0.000			0.380
+1.20D+0.50L+1.60S			12.26		544.15	986.22					0.000			0.552
+1.20D+1.60S			12.26		379.44	986.22					0.000			0.385
+1.20D+0.50Lr+0.50L			12.26		532.80	986.22					0.000			0.540
+1.20D+0.50L+0.50S			12.26		534.29	986.22					0.000			0.542
+1.20D+0.50L+0.70S			12.26		536.08	986.22					0.000			0.544
+0.90D			12.26		273.83	986.22					0.000			0.278

Maximum Reactions

Note: Only non-zero reactions are listed.

Load Combination	X-X Axis Reaction		k	Y-Y Axis Reaction		Axial Reaction	My - End Moments		k-ft	Mx - End Moments	
	@ Base	@ Top		@ Base	@ Top		@ Base	@ Top		@ Base	@ Top
D Only						304.252					
+D+L						633.672					
+D+Lr						310.222					
+D+S						313.212					
+D+0.750Lr+0.750L						555.794					
+D+0.750L+0.750S						558.037					
+0.60D						182.551					
Lr Only						5.970					
L Only						329.420					
S Only						8.960					

Maximum Moment Reactions

Note: Only non-zero reactions are listed.

Load Combination	Moment About X-X Axis			Moment About Y-Y Axis		
	@ Base	@ Top		@ Base	@ Top	
D Only			k-ft			k-ft
+D+L			k-ft			k-ft
+D+Lr			k-ft			k-ft
+D+S			k-ft			k-ft
+D+0.750Lr+0.750L			k-ft			k-ft
+D+0.750L+0.750S			k-ft			k-ft
+0.60D			k-ft			k-ft
Lr Only			k-ft			k-ft
L Only			k-ft			k-ft
S Only			k-ft			k-ft

Maximum Deflections for Load Combinations

Load Combination	Max. X-X Deflection		Distance		Max. Y-Y Deflection		Distance	
D Only	0.0000	in	0.000	ft	0.000	in	0.000	ft
+D+L	0.0000	in	0.000	ft	0.000	in	0.000	ft
+D+Lr	0.0000	in	0.000	ft	0.000	in	0.000	ft
+D+S	0.0000	in	0.000	ft	0.000	in	0.000	ft
+D+0.750Lr+0.750L	0.0000	in	0.000	ft	0.000	in	0.000	ft
+D+0.750L+0.750S	0.0000	in	0.000	ft	0.000	in	0.000	ft
+0.60D	0.0000	in	0.000	ft	0.000	in	0.000	ft
Lr Only	0.0000	in	0.000	ft	0.000	in	0.000	ft
L Only	0.0000	in	0.000	ft	0.000	in	0.000	ft
S Only	0.0000	in	0.000	ft	0.000	in	0.000	ft

Centerline Communications
750 West Center Street, Suite 301
West Bridgewater, MA 02379
781.713.4725

Project Title: **Stamford #1 CO**
Engineer: **DC**
Project ID: **638283**
Project Descr: **Interior Concrete Column Analysis**

Printed: 17 JUN 2022, 8:52AM

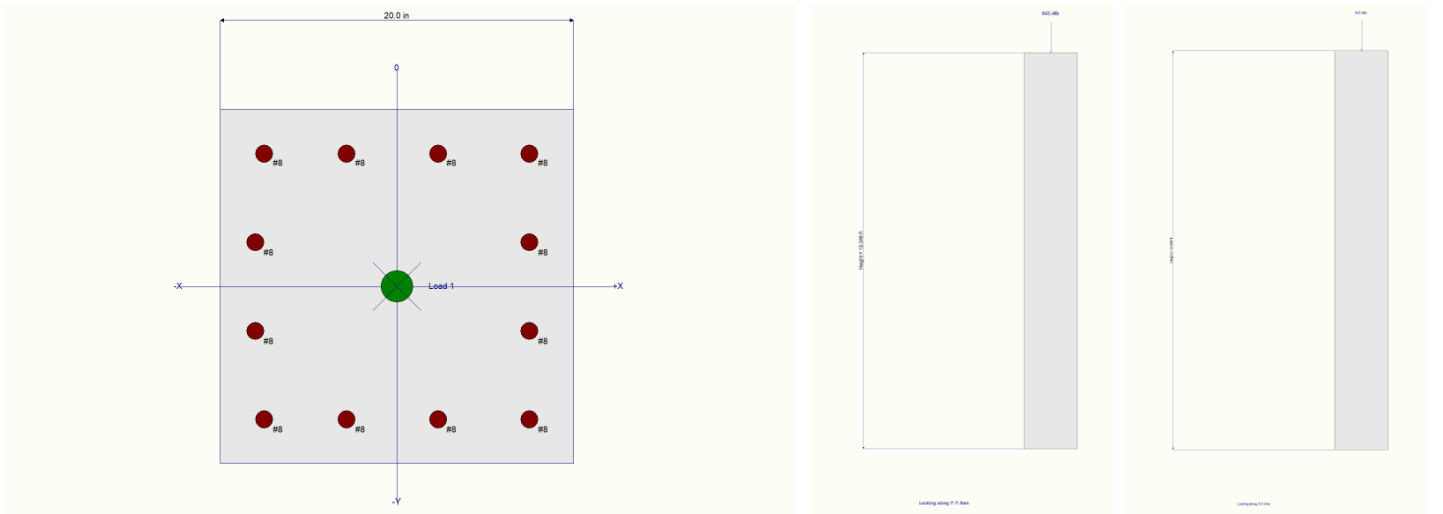
Concrete Column

Lic. # : KW-06013597

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

DESCRIPTION: **G Floor Column**

Sketches



Interaction Diagrams

Concrete Column

File: 638283 Interior Column Analysis.ec6

Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24

Centerline Communications

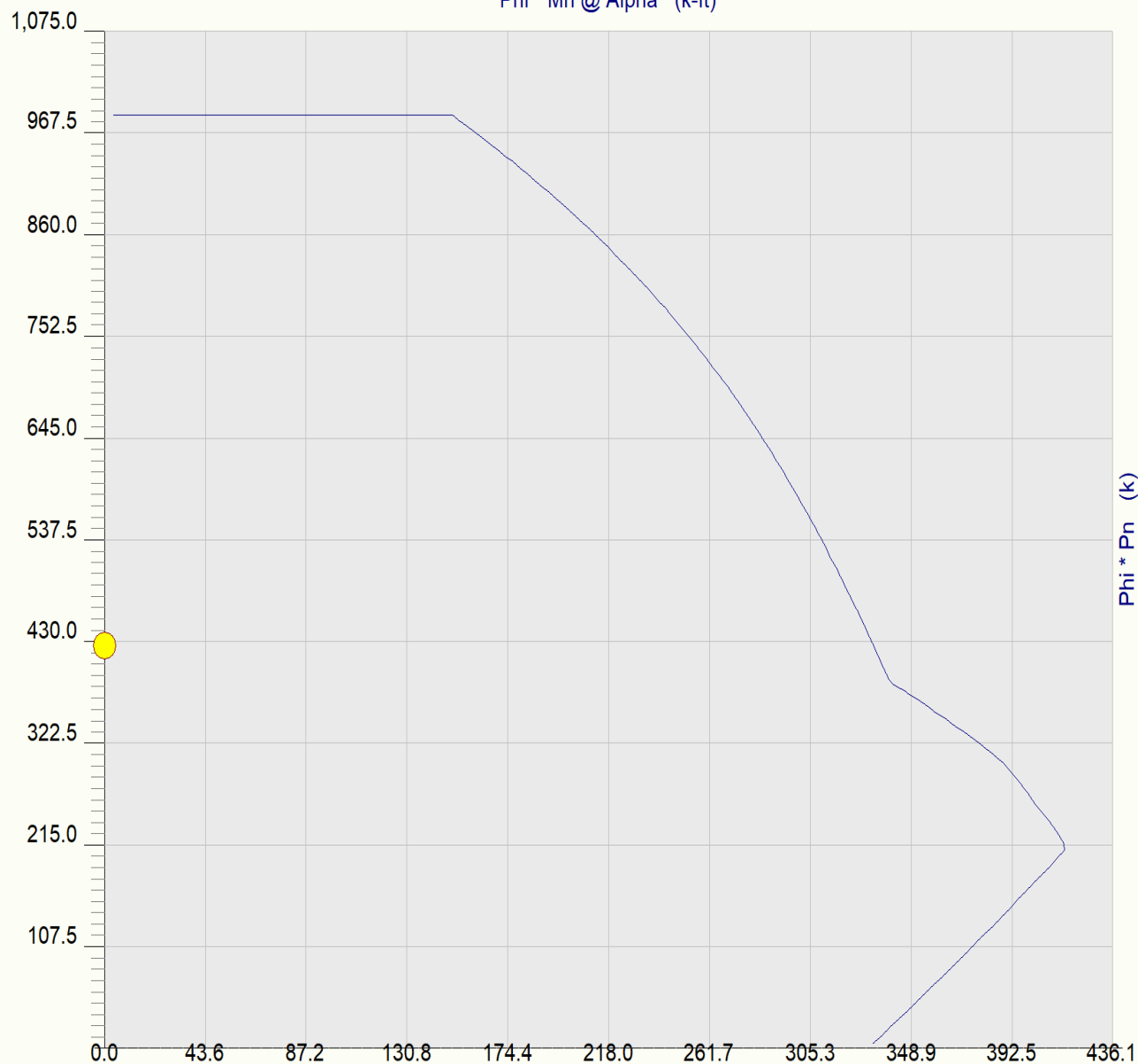
Lic. # : KW-06013597

DESCRIPTION: **G Floor Column**

Concrete Column P-M Interaction Diagram

$\Phi * M_n @ \alpha$ (k-ft)

$\Phi * P_n$ (k)



Load Comb. = +1.40D, Alpha= 0.0deg, (425.95, 0.00)

Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. #: KW-06013597

DESCRIPTION: **G Floor Column**

Concrete Column P-M Interaction Diagram

Phi * Mn @ Alpha (k-ft)

Phi * Pn (k)



Load Comb. = +1.20D+0.50L+1.60L, Alpha= 0.0deg, (895.16, 0.00)

Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

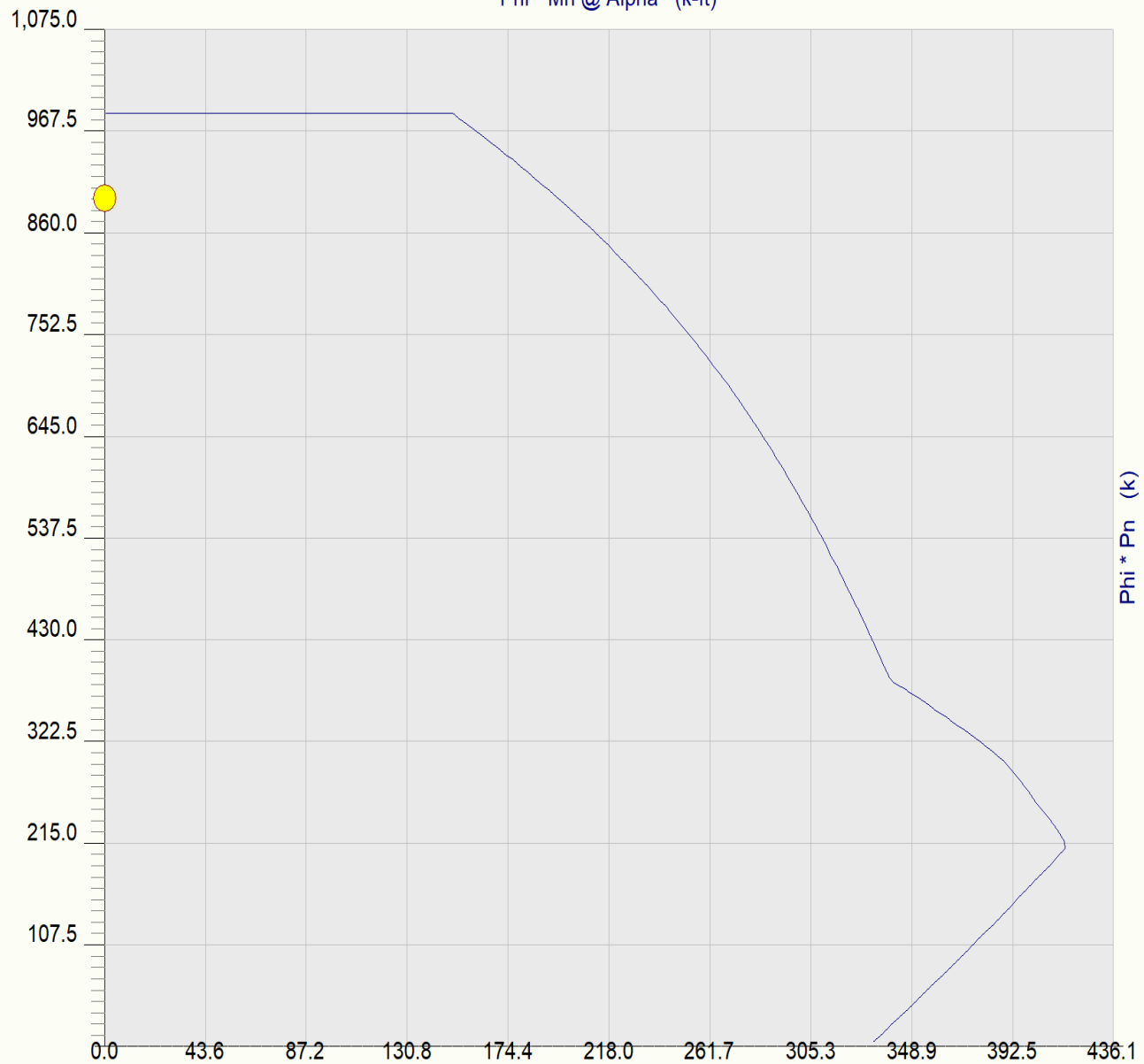
Lic. #: KW-06013597

DESCRIPTION: **G Floor Column**

Concrete Column P-M Interaction Diagram

$\Phi * M_n @ \alpha$ (k-ft)

$\Phi * P_n$ (k)



Load Comb. = +1.20D+1.60L+0.50S, Alpha= 0.0deg. (896.65, 0.00)

Concrete Column

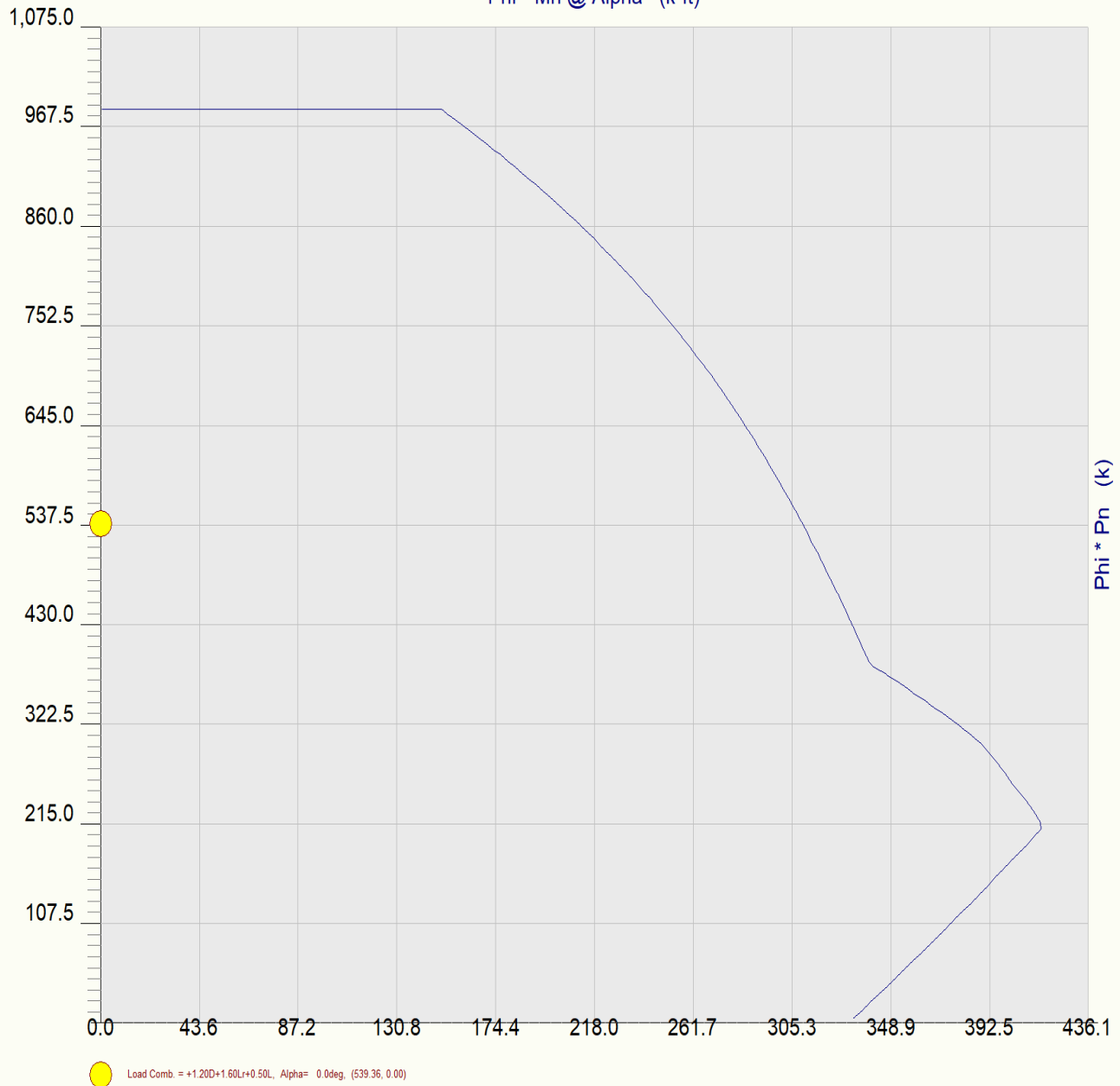
File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **G Floor Column**

Concrete Column P-M Interaction Diagram

Phi * Mn @ Alpha (k-ft)



Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

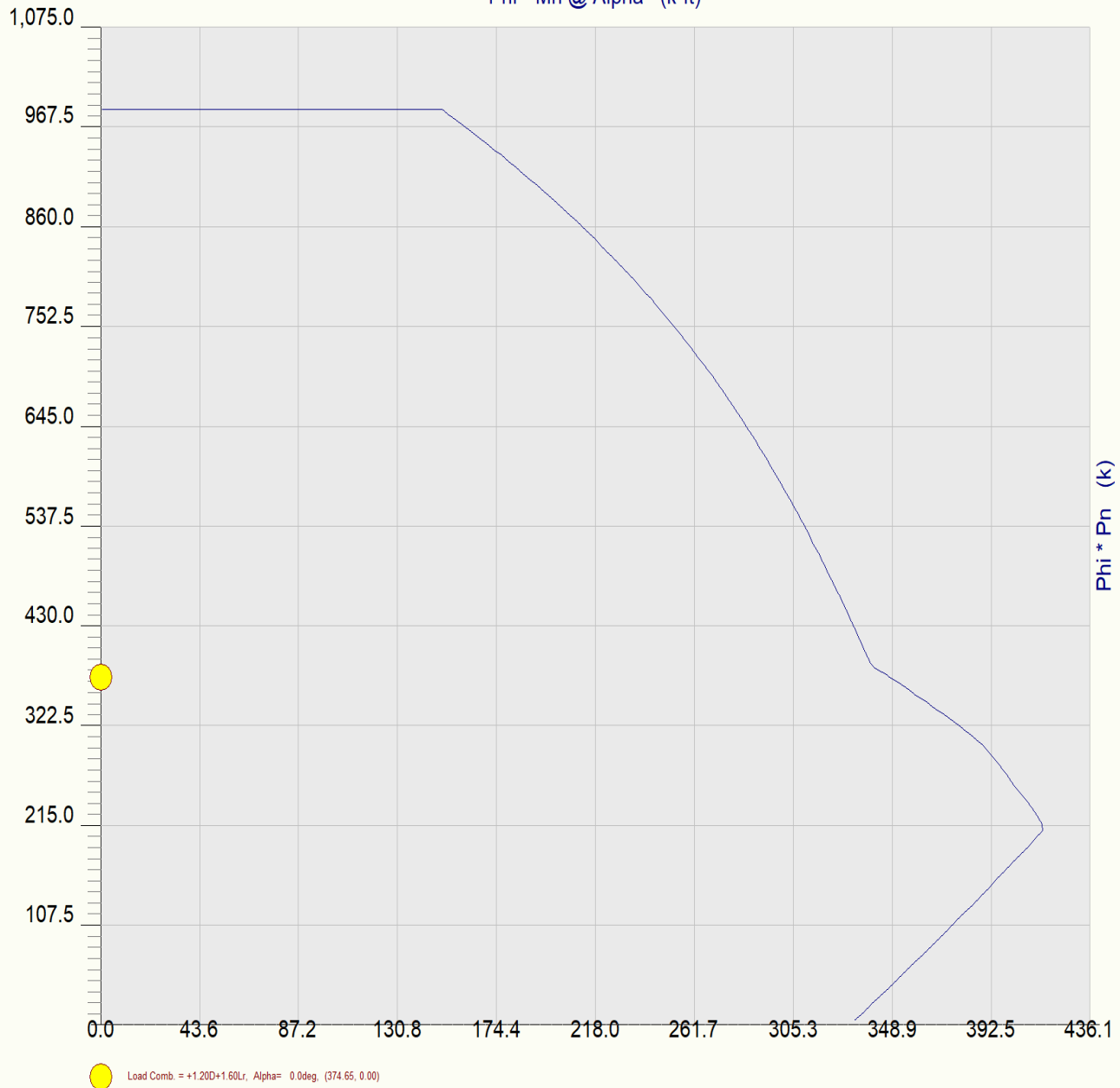
Lic. # : KW-06013597

DESCRIPTION: **G Floor Column**

Concrete Column P-M Interaction Diagram

$\Phi * M_n @ \text{Alpha}$ (k-ft)

$\Phi * P_n$ (k)



Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

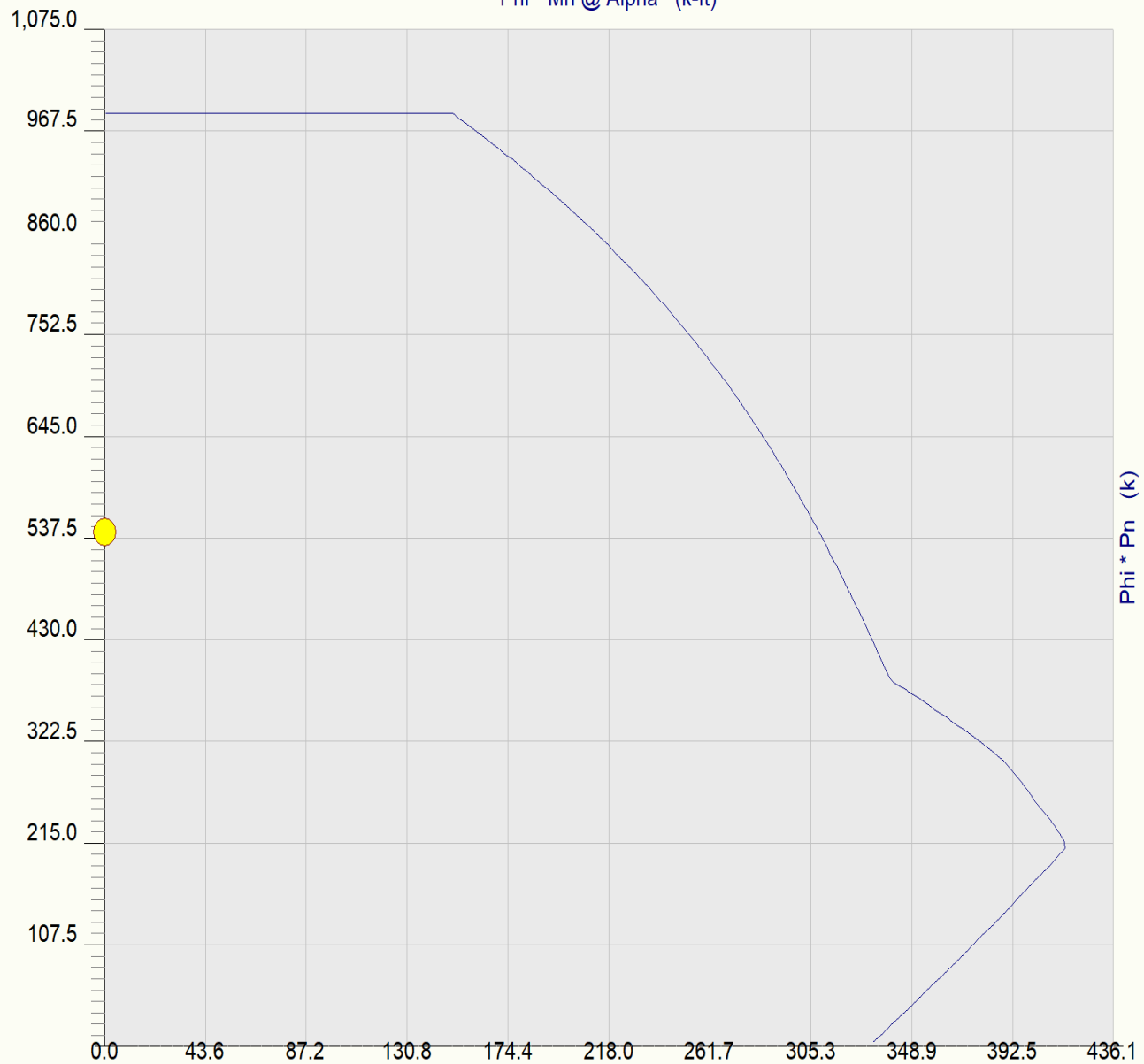
Lic. # : KW-06013597

DESCRIPTION: **G Floor Column**

Concrete Column P-M Interaction Diagram

$\Phi * M_n @ \alpha$ (k-ft)

$\Phi * P_n$ (k)



Load Comb. = +1.20D+0.50L+1.60S, Alpha= 0.0deg, (544.15, 0.00)

Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **G Floor Column**

Concrete Column P-M Interaction Diagram

$\Phi * M_n @ \alpha$ (k-ft)

$\Phi * P_n$ (k)



Load Comb. = +1.20D+1.60S, $\alpha = 0.0 \text{ deg.}$ (379.44, 0.00)

Concrete Column

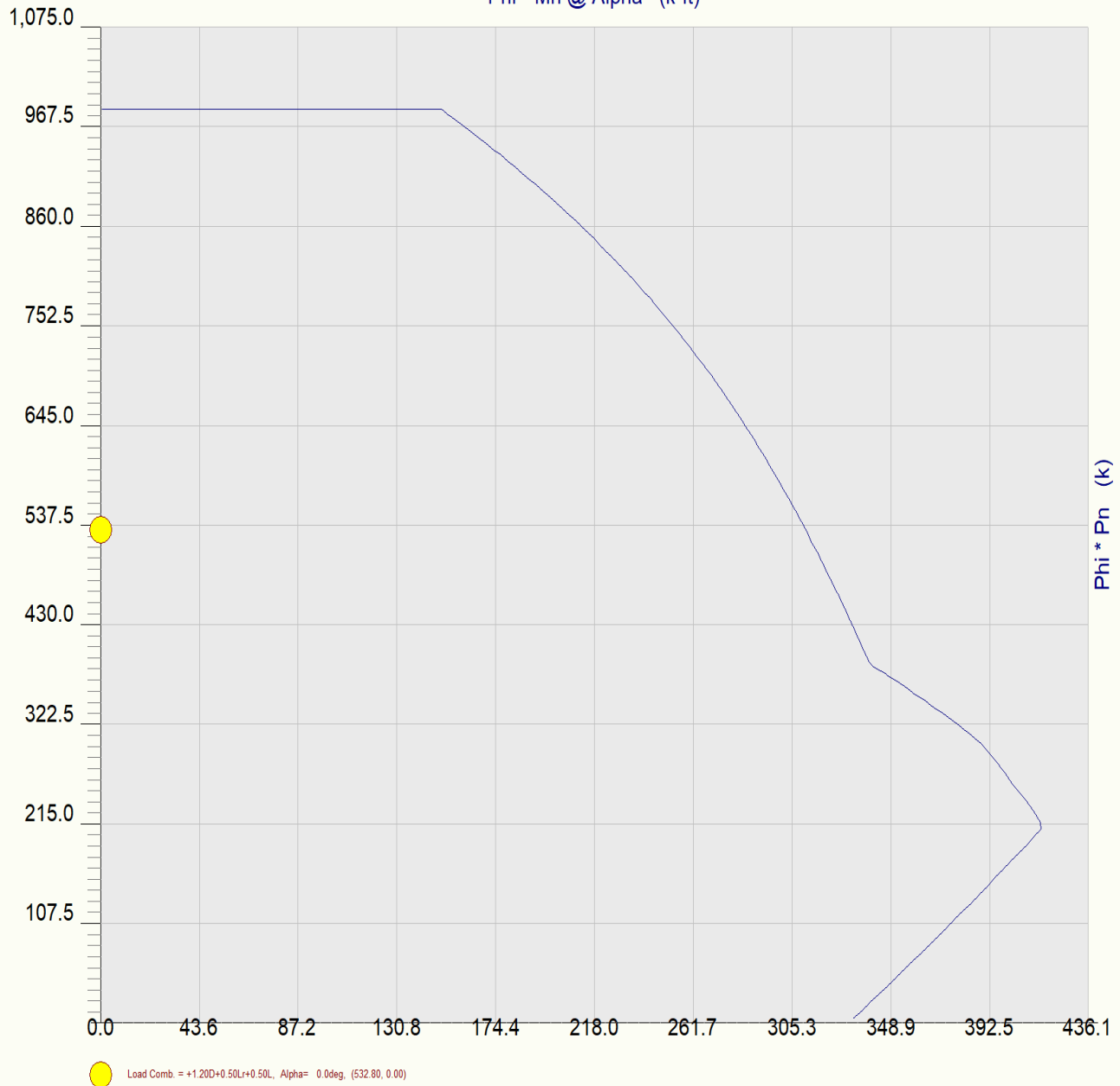
File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. #: KW-06013597

DESCRIPTION: **G Floor Column**

Concrete Column P-M Interaction Diagram

Phi * Mn @ Alpha (k-ft)



Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

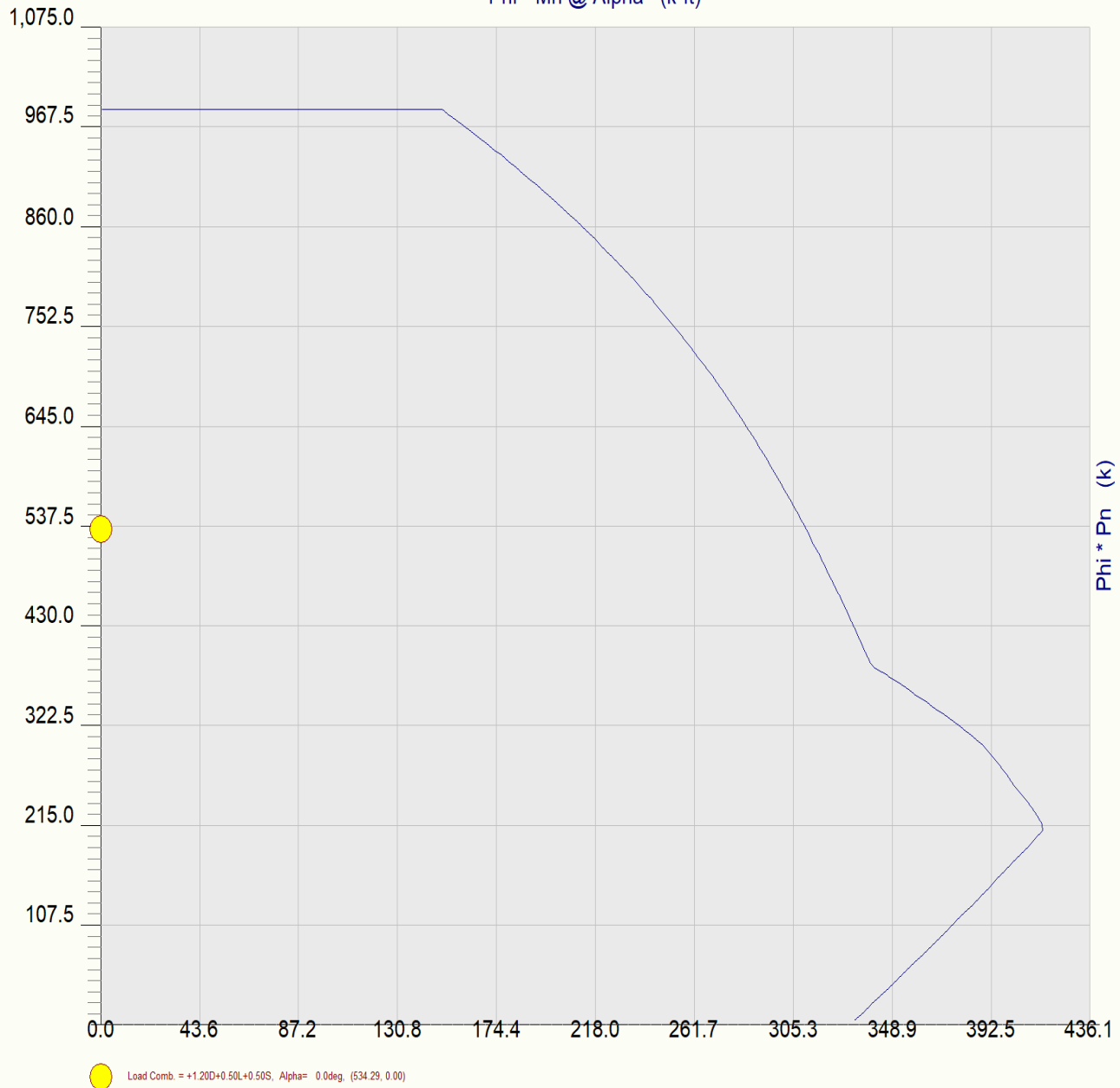
Lic. #: KW-06013597

DESCRIPTION: **G Floor Column**

Concrete Column P-M Interaction Diagram

$\Phi * M_n @ \alpha$ (k-ft)

$\Phi * P_n$ (k)



Concrete Column

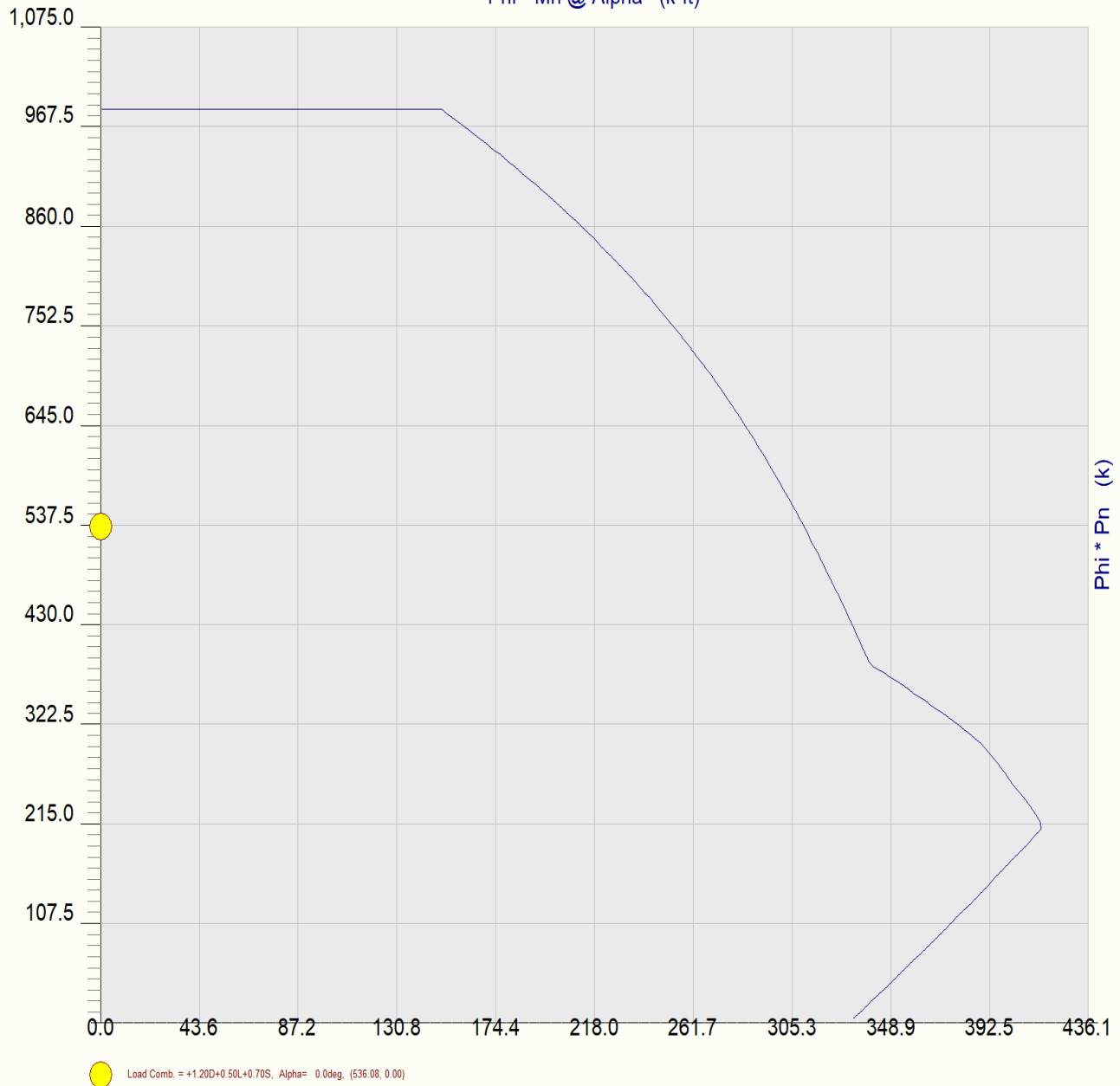
File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **G Floor Column**

Concrete Column P-M Interaction Diagram

Phi * Mn @ Alpha (k-ft)



Concrete Column

File: 638283 Interior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

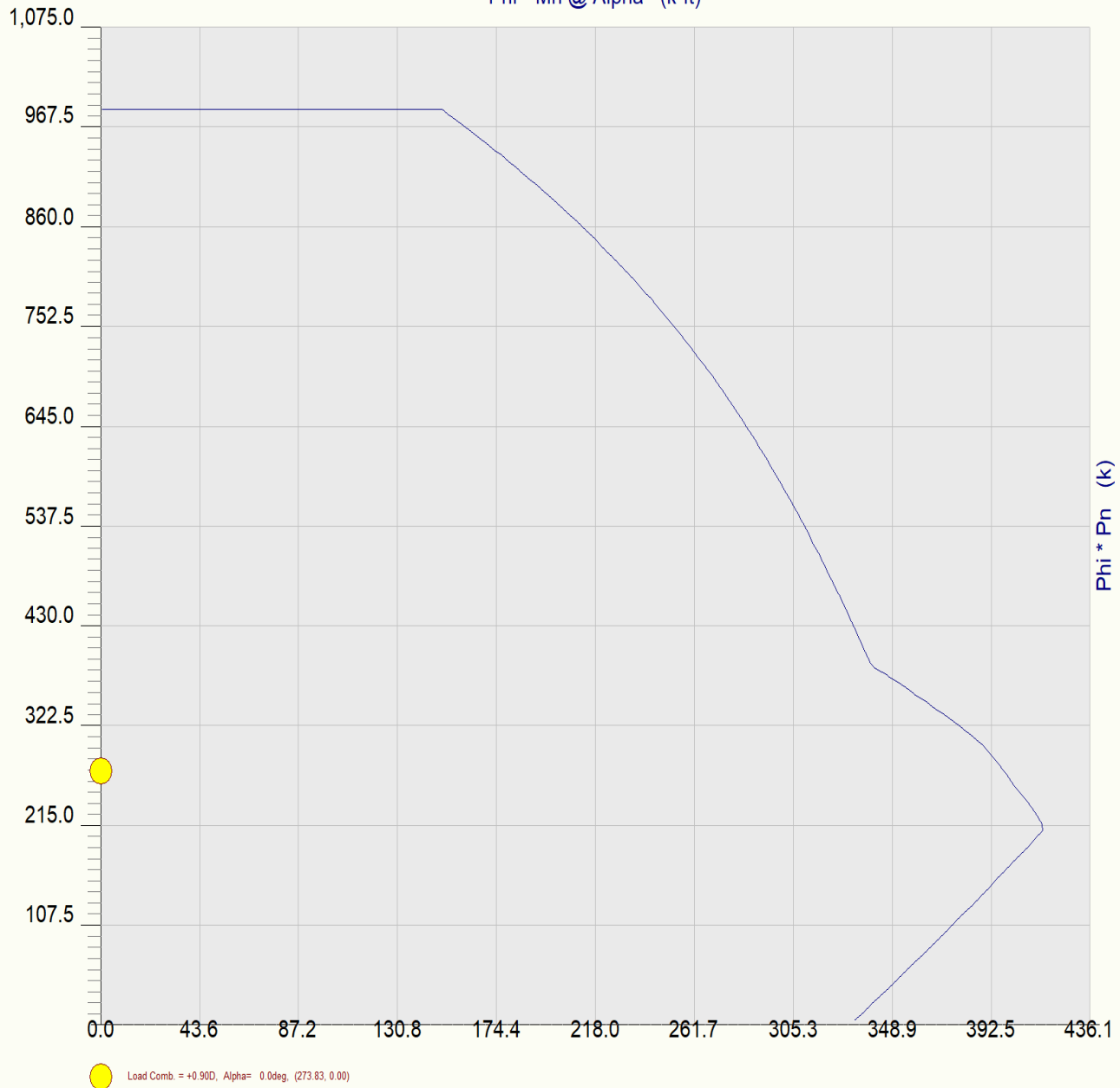
Lic. # : KW-06013597

DESCRIPTION: **G Floor Column**

Concrete Column P-M Interaction Diagram

$\Phi * M_n @ \alpha$ (k-ft)

$\Phi * P_n$ (k)



Building Column Calculations (Exterior)



Date: 06-17-2022
Project Name: Stamford #1 CO
Site ID: 638283
Designed By: AA Checked By: DC

Check Building Columns:

Exterior Column at Tower:

Load Breakdown:

Tributary Area: $(18.67 \text{ ft} / 2) * ((16 \text{ ft} / 2) + (16 \text{ ft} / 2))$
= 149.36 ft^2

Live Loads

→ Snow $30 \text{ psf} \times 149.36 \text{ ft}^2$
= **4.48 kips**

→ Service (Roof) $20 \text{ psf} \times 149.36 \text{ ft}^2$
2.99 kips

→ Service (Typical Floor) $100 \text{ psf} \times 149.36 \text{ ft}^2$
14.94 kips

Dead Load

→ Roof $100 \text{ psf} \times 149.36 \text{ ft}^2$
= **14.94 kips**

***Assume 8" concrete deck (150 pcf)**

→ Floor (Typical Floor) $125 \text{ psf} \times 149.36 \text{ ft}^2$
18.67 kips

***Assume 10" concrete deck (150 pcf)**

Date: 06-17-2022
 Project Name: Stamford #1 CO
 Site ID: 638283
 Designed By: AA Checked By: DC

Column Loading (Unfactor Loads)

	<u>Snow Load</u> <u>(Kips.)</u>	<u>Live Load</u> <u>(Kips.)</u>	<u>Dead Load</u> <u>(Kips.)</u>	<u>Dead Load</u> <u>Column (Kips.)</u>	<u>Total Load</u> <u>(Kips.)</u>
Tower Load	-	150.19	14.70	-	164.89
Roof	4.48	2.99	14.94	-	22.40
Total=	4.48	153.17	29.64	0.00	187.29
Sixth Floor (17"x17")	0.00	14.94	18.67	4.34	37.95
Total=	4.48	168.11	48.31	4.34	225.24
Fifth Floor (17"x17")	0.00	14.94	18.67	4.34	37.95
Total=	4.48	183.05	66.98	8.68	263.19
Fourth Floor (17"x17")	0.00	14.94	18.67	4.34	37.95
Total=	4.48	197.98	85.65	13.02	301.13
Third Floor (17"x17")	0.00	14.94	18.67	4.94	38.55
Total=	4.48	212.92	104.32	17.97	339.68
Second Floor (20"x20")	0.00	14.94	18.67	6.49	40.10
Total=	4.48	227.85	122.99	24.46	379.78
First Floor (20"x20")	0.00	14.94	18.67	6.01	39.62
Total=	4.48	242.79	141.66	30.47	419.39
G Floor (20"x20")					

***Reference the structural analysis by Foresite LLC, dated December 29, 2021 for tower reactions.**

Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. #: KW-06013597

DESCRIPTION: Sixth Floor Column

Code References

Calculations per ACI 318-14, IBC 2015, CBC 2016, ASCE 7-10
Load Combinations Used : IBC 2015

General Information

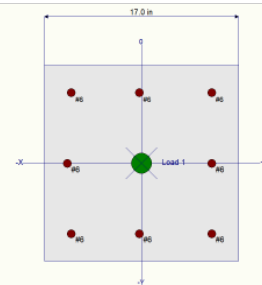
f'_c : Concrete 28 day strength = 4.0 ksi
E = 3,605.0 ksi
Density = 150.0 pcf
 β = 0.850
 f_y - Main Rebar = 60.0 ksi
E - Main Rebar = 29,000.0 ksi
Allow. Reinforcing Limits *ASTM A615 Bars Used*
Min. Reinf. = 1.0 %
Max. Reinf. = 8.0 %

Overall Column Height = 14.420 ft
End Fixity **Top & Bottom Pinned**
Brace condition for deflection (buckling) along columns :
X-X (width) axis :
Unbraced Length for buckling ABOUT Y-Y Axis = 14.420 ft, K = 1.0
Y-Y (depth) axis :
Unbraced Length for buckling ABOUT X-X Axis = 14.420 ft, K = 1.0

Column Cross Section

Column Dimensions : 17.0in Square Column, Column Edge to Rebar Edge Cover = 2.0in

Column Reinforcing : 4 - #6 bars @ corners,, 1 - #6 bars top & bottom between corner bars, 1 - #6 bars left & right between corner bars



Entered loads are factored per load combinations specified by user.

Applied Loads

Column self weight included : 4,341.02 lbs * Dead Load Factor
AXIAL LOADS . . .
Roof + Tower Loads: Axial Load at 14.420 ft above base, D = 29.640, LR = 2.990, L = 150.190, S = 4.480 k
BENDING LOADS . . .
Tower Load: Lat. Point Load at 14.420 ft creating Mx-x, W = 14.375 k

DESIGN SUMMARY

Load Combination **+1.20D+1.60L+0.50S**
Location of max. above base **14.323 ft**
Maximum Stress Ratio 0.460 : 1
Ratio = $(P_u^2 + M_u^2)^{0.5} / (\phi P_n^2 + \phi M_n^2)^{0.5}$
 P_u = 283.321 k $\phi * P_n$ = 614.55 k
 M_{u-x} = 0.0 k-ft $\phi * M_{n-x}$ = 0.0 k-ft
 M_{u-y} = 26.207 k-ft $\phi * M_{n-y}$ = 55.969 k-ft
 M_u Angle = 90.0 deg
 M_u at Angle = 26.207 k-ft ϕM_n at Angle = 56.998 k-ft

P_n & M_n values located at P_u-M_u vector intersection with capacity curve

Column Capacities . . .

P_nmax : Nominal Max. Compressive Axial Capacity **1,181.83 k**
P_nmin : Nominal Min. Tension Axial Capacity **k**
 ϕP_n , max : Usable Compressive Axial Capacity **614.55 k**
 ϕP_n , min : Usable Tension Axial Capacity **k**

Maximum SERVICE Load Reactions . .

Top along Y-Y **0.0 k** Bottom along Y-Y **0.0 k**
Top along X-X **14.375 k** Bottom along X-X **0.0 k**

Maximum SERVICE Load Deflections . . .

Along Y-Y **0.0 in** at **0.0 ft** above base
for load combination :
Along X-X **0.0 in** at **0.0 ft** above base
for load combination :

General Section Information . ϕ = 0.650 β = 0.850 θ = 0.80

ρ : % Reinforcing **1.218 %** Rebar % Ok
Reinforcing Area **3.520 in²**
Concrete Area **289.0 in²**

Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: Sixth Floor Column

Governing Load Combination Results

Governing Factored Load Combination	Moment		Dist. from base ft	Axial Load k		Bending Analysis k-ft								Utilization	
	X-X	Y-Y		Pu	$\phi * P_n$	δx	$\delta x * M_{ux}$	δy	$\delta y * M_{uy}$	Alpha (deg)	δM_u	ϕM_n	Ratio		
+1.40D		M2,min	14.32	47.57	614.55			1.000	4.40	90.000	4.40	57.00	0.077		
+1.40D	M2,min		14.32	47.57	614.55	1.000	4.40			0.000	4.40	57.06	0.077		
+1.20D+0.50Lr+1.60L		M2,min	14.32	282.58	614.55			1.000	26.14	90.000	26.14	57.00	0.459		
+1.20D+0.50Lr+1.60L	M2,min		14.32	282.58	614.55	1.000	26.14			0.000	26.14	57.06	0.459		
+1.20D+1.60L+0.50S		M2,min	14.32	283.32	614.55			1.000	26.21	90.000	26.21	57.00	0.460		
+1.20D+1.60L+0.50S	M2,min		14.32	283.32	614.55	1.000	26.21			0.000	26.21	57.06	0.460		
+1.20D+1.60Lr+0.50L		M2,min	14.32	120.66	614.55			1.000	11.16	90.000	11.16	57.00	0.196		
+1.20D+1.60Lr+0.50L	M2,min		14.32	120.66	614.55	1.000	11.16			0.000	11.16	57.06	0.196		
+1.20D+1.60Lr+0.50W		M2,min	14.32	45.56	614.55			1.000	4.21	90.000	4.21	57.00	0.074		
+1.20D+1.60Lr+0.50W	M2,min		14.32	45.56	614.55	1.000	4.21			0.000	4.21	57.06	0.074		
+1.20D+0.50L+1.60S		M2,min	14.32	123.04	614.55			1.000	11.38	90.000	11.38	57.00	0.200		
+1.20D+0.50L+1.60S	M2,min		14.32	123.04	614.55	1.000	11.38			0.000	11.38	57.06	0.200		
+1.20D+1.60S+0.50W		M2,min	14.32	47.95	614.55			1.000	4.43	90.000	4.43	57.00	0.078		
+1.20D+1.60S+0.50W	M2,min		14.32	47.95	614.55	1.000	4.43			0.000	4.43	57.06	0.078		
+1.20D+0.50Lr+0.50L+W		M2,min	14.32	117.37	614.55			1.000	10.86	90.000	10.86	57.00	0.191		
+1.20D+0.50Lr+0.50L+W	M2,min		14.32	117.37	614.55	1.000	10.86			0.000	10.86	57.06	0.191		
+1.20D+0.50L+0.50S+W		M2,min	14.32	118.11	614.55			1.000	10.93	90.000	10.93	57.00	0.192		
+1.20D+0.50L+0.50S+W	M2,min		14.32	118.11	614.55	1.000	10.93			0.000	10.93	57.06	0.192		
+1.20D+0.50L+0.70S		M2,min	14.32	119.01	614.55			1.000	11.01	90.000	11.01	57.00	0.193		
+1.20D+0.50L+0.70S	M2,min		14.32	119.01	614.55	1.000	11.01			0.000	11.01	57.06	0.193		
+0.90D+W		M2,min	14.32	30.58	614.55			1.000	2.83	90.000	2.83	57.00	0.050		
+0.90D+W	M2,min		14.32	30.58	614.55	1.000	2.83			0.000	2.83	57.06	0.050		
+0.90D		M2,min	14.32	30.58	614.55			1.000	2.83	90.000	2.83	57.00	0.050		
+0.90D	M2,min		14.32	30.58	614.55	1.000	2.83			0.000	2.83	57.06	0.050		

Maximum Reactions

Note: Only non-zero reactions are listed.

Load Combination	X-X Axis Reaction		k	Y-Y Axis Reaction		Axial Reaction	My - End Moments		k-ft	Mx - End Moments	
	@ Base	@ Top		@ Base	@ Top		@ Base	@ Top		@ Base	@ Top
D Only						33.981					
+D+L						184.171					
+D+Lr						36.971					
+D+S						38.461					
+D+0.750Lr+0.750L						148.866					
+D+0.750L+0.750S						149.984					
+D+0.60W					8.625	33.981					
+D+0.750Lr+0.750L+0.450W					6.469	148.866					
+D+0.750L+0.750S+0.450W					6.469	149.984					
+0.60D+0.60W					8.625	20.389					
+0.60D						20.389					
Lr Only						2.990					
L Only						150.190					
S Only						4.480					
W Only					14.375						

Maximum Moment Reactions

Note: Only non-zero reactions are listed.

Load Combination	Moment About X-X Axis			Moment About Y-Y Axis	
	@ Base	@ Top		@ Base	@ Top
D Only			k-ft		k-ft
+D+L			k-ft		k-ft
+D+Lr			k-ft		k-ft
+D+S			k-ft		k-ft
+D+0.750Lr+0.750L			k-ft		k-ft
+D+0.750L+0.750S			k-ft		k-ft
+D+0.60W			k-ft		k-ft
+D+0.750Lr+0.750L+0.450W			k-ft		k-ft
+D+0.750L+0.750S+0.450W			k-ft		k-ft

Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: Sixth Floor Column

Maximum Moment Reactions

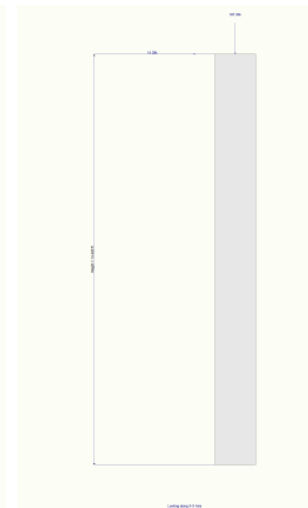
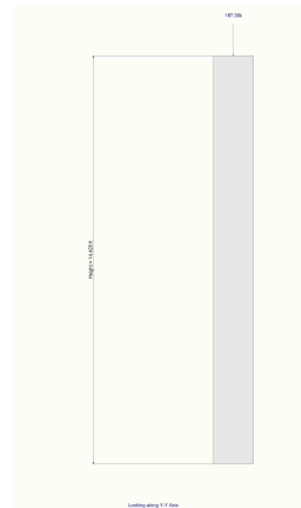
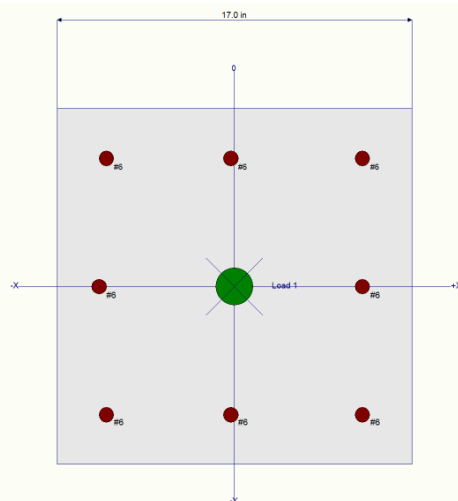
Note: Only non-zero reactions are listed.

Load Combination	Moment About X-X Axis		Moment About Y-Y Axis	
	@ Base	@ Top	@ Base	@ Top
+0.60D+0.60W		k-ft		k-ft
+0.60D		k-ft		k-ft
Lr Only		k-ft		k-ft
L Only		k-ft		k-ft
S Only		k-ft		k-ft
W Only		k-ft		k-ft

Maximum Deflections for Load Combinations

Load Combination	Max. X-X Deflection	Distance	Max. Y-Y Deflection	Distance
D Only	0.0000 in	0.000 ft	0.000 in	0.000 ft
+D+L	0.0000 in	0.000 ft	0.000 in	0.000 ft
+D+Lr	0.0000 in	0.000 ft	0.000 in	0.000 ft
+D+S	0.0000 in	0.000 ft	0.000 in	0.000 ft
+D+0.750Lr+0.750L	0.0000 in	0.000 ft	0.000 in	0.000 ft
+D+0.750L+0.750S	0.0000 in	0.000 ft	0.000 in	0.000 ft
+D+0.60W	0.0000 in	0.000 ft	0.000 in	0.000 ft
+D+0.750Lr+0.750L+0.450W	0.0000 in	0.000 ft	0.000 in	0.000 ft
+D+0.750L+0.750S+0.450W	0.0000 in	0.000 ft	0.000 in	0.000 ft
+0.60D+0.60W	0.0000 in	0.000 ft	0.000 in	0.000 ft
+0.60D	0.0000 in	0.000 ft	0.000 in	0.000 ft
Lr Only	0.0000 in	0.000 ft	0.000 in	0.000 ft
L Only	0.0000 in	0.000 ft	0.000 in	0.000 ft
S Only	0.0000 in	0.000 ft	0.000 in	0.000 ft
W Only	0.0000 in	0.000 ft	0.000 in	0.000 ft

Sketches



Interaction Diagrams

Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Sixth Floor Column**

Concrete Column P-M Interaction Diagram



Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Sixth Floor Column**

Concrete Column P-M Interaction Diagram



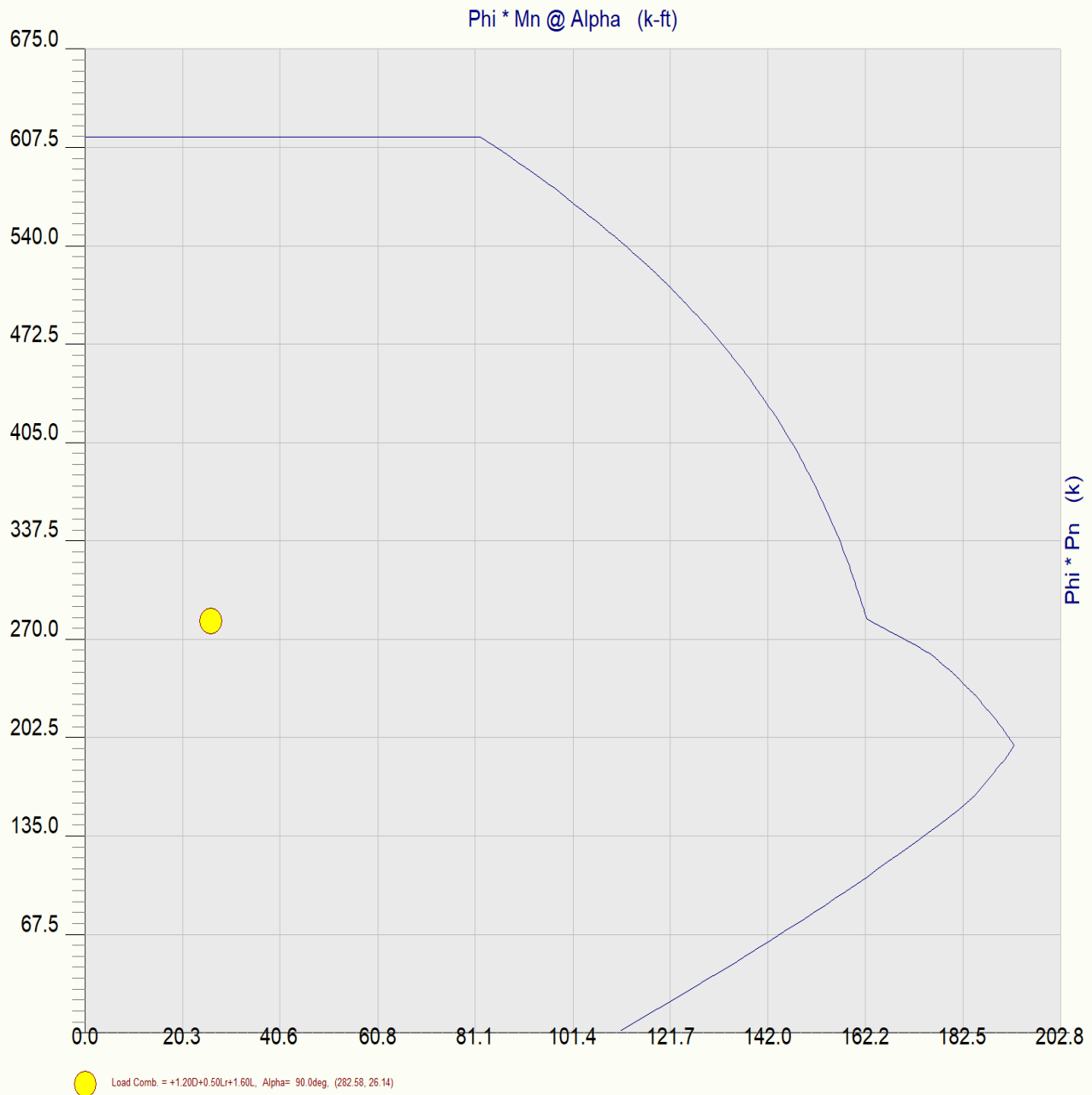
Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: Sixth Floor Column

Concrete Column P-M Interaction Diagram



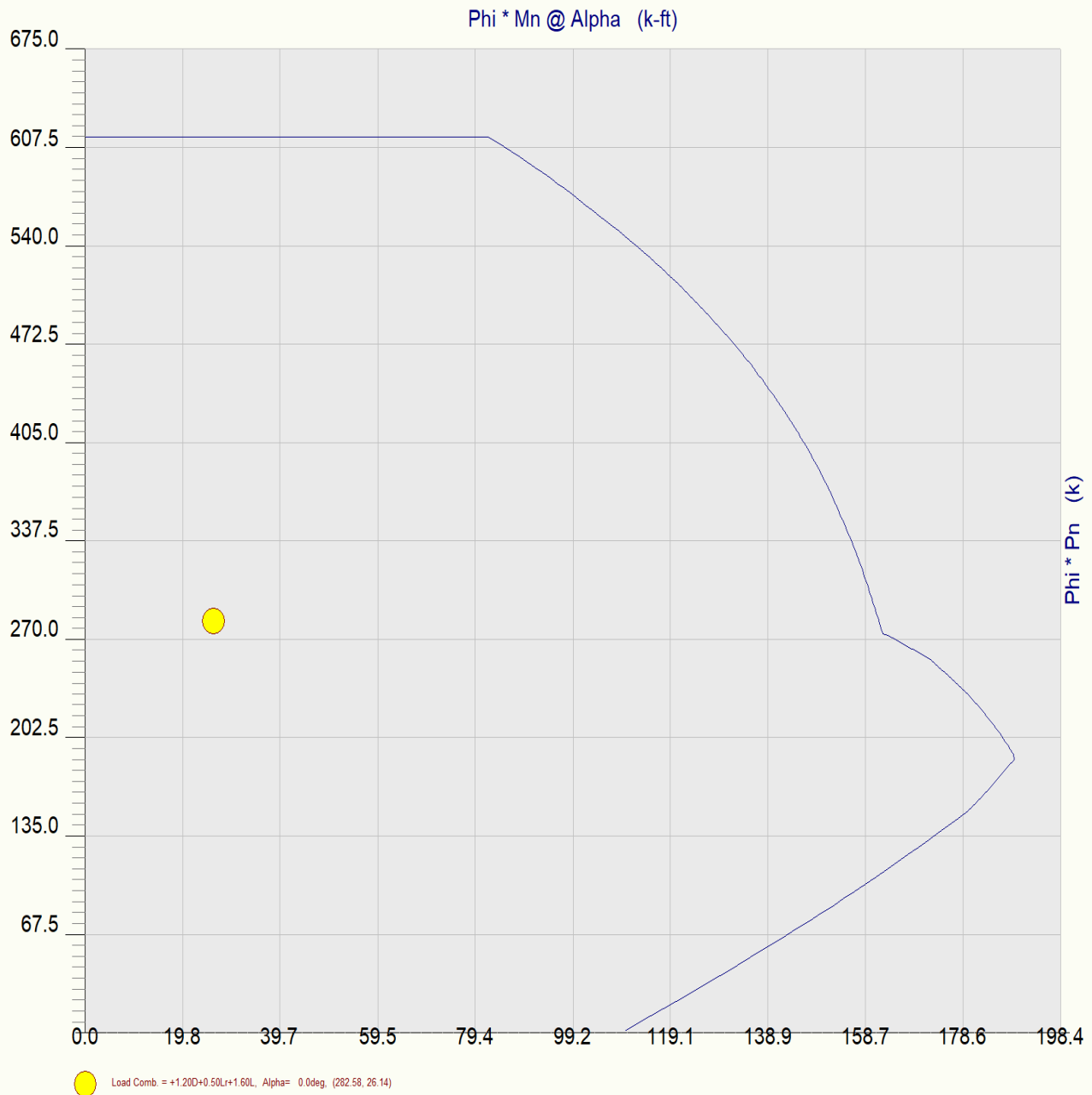
Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Sixth Floor Column**

Concrete Column P-M Interaction Diagram



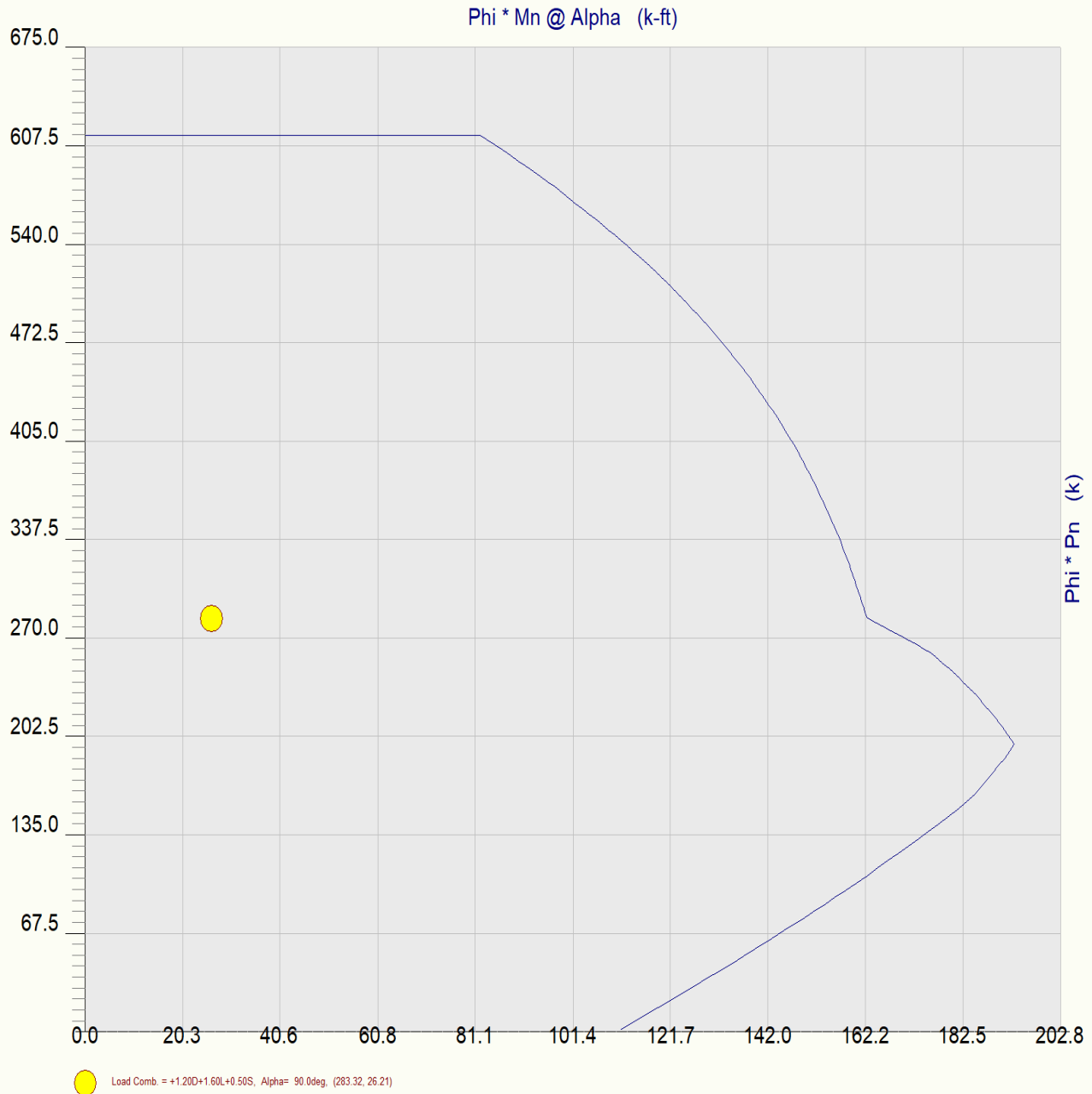
Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Sixth Floor Column**

Concrete Column P-M Interaction Diagram



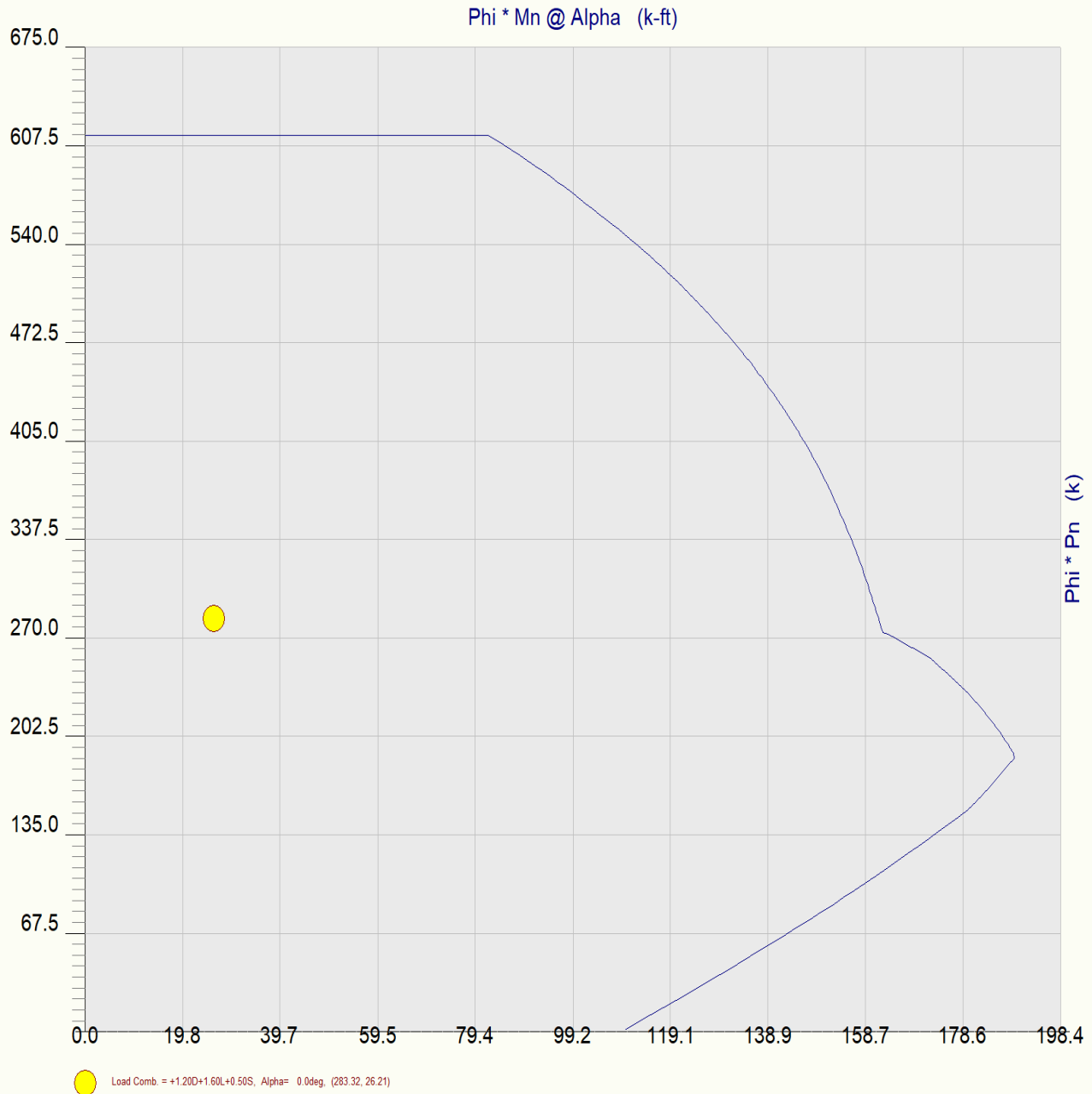
Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Sixth Floor Column**

Concrete Column P-M Interaction Diagram



Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Sixth Floor Column**

Concrete Column P-M Interaction Diagram



Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Sixth Floor Column**

Concrete Column P-M Interaction Diagram



Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Sixth Floor Column**

Concrete Column P-M Interaction Diagram



Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Sixth Floor Column**

Concrete Column P-M Interaction Diagram



Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Sixth Floor Column**

Concrete Column P-M Interaction Diagram



Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Sixth Floor Column**

Concrete Column P-M Interaction Diagram



Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Sixth Floor Column**

Concrete Column P-M Interaction Diagram



Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Sixth Floor Column**

Concrete Column P-M Interaction Diagram



Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Sixth Floor Column**

Concrete Column P-M Interaction Diagram



Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Sixth Floor Column**

Concrete Column P-M Interaction Diagram



Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. #: KW-06013597

DESCRIPTION: Fifth Floor Column

Code References

Calculations per ACI 318-14, IBC 2015, CBC 2016, ASCE 7-10
Load Combinations Used : IBC 2015

General Information

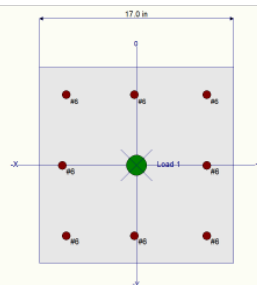
f'_c : Concrete 28 day strength = 4.0 ksi
E = 3,605.0 ksi
Density = 150.0 pcf
 β = 0.850
 f_y - Main Rebar = 60.0 ksi
E - Main Rebar = 29,000.0 ksi
Allow. Reinforcing Limits *ASTM A615 Bars Used*
Min. Reinf. = 1.0 %
Max. Reinf. = 8.0 %

Overall Column Height = 14.420 ft
End Fixity **Top & Bottom Pinned**
Brace condition for deflection (buckling) along columns :
X-X (width) axis :
Unbraced Length for buckling ABOUT Y-Y Axis = 14.420 ft, K = 1.0
Y-Y (depth) axis :
Unbraced Length for buckling ABOUT X-X Axis = 14.420 ft, K = 1.0

Column Cross Section

Column Dimensions : 17.0in Square Column, Column Edge to Rebar Edge Cover = 2.0in

Column Reinforcing : 4 - #6 bars @ corners,, 1 - #6 bars top & bottom between corner bars, 1 - #6 bars left & right between corner bars



Applied Loads

Entered loads are factored per load combinations specified by user.

Column self weight included : 4,341.02 lbs * Dead Load Factor

AXIAL LOADS . . .

Roof + Tower Loads: Axial Load at 14.420 ft above base, D = 52.650, LR = 2.990, L = 165.120, S = 4.480 k

DESIGN SUMMARY

Load Combination **+1.20D+1.60L+0.50S**
Location of max. above base **14.323 ft**
Maximum Stress Ratio 0.544 : 1
Ratio = $(P_u^2 + M_u^2)^{.5} / (\Phi P_n^2 + \Phi M_n^2)^{.5}$
 $P_u = 334.821$ k $\Phi * P_n = 614.55$ k
 $M_u-x = 0.0$ k-ft $\Phi * M_n-x = 0.0$ k-ft
 $M_u-y = 30.971$ k-ft $\Phi * M_n-y = 55.969$ k-ft
 M_u Angle = 90.0 deg
 M_u at Angle = 30.971 k-ft ΦM_n at Angle = 56.998 k-ft

P_n & M_n values located at P_u-M_u vector intersection with capacity curve

Column Capacities . . .

P_nmax : Nominal Max. Compressive Axial Capacity **1,181.83** k
P_nmin : Nominal Min. Tension Axial Capacity k
 ΦP_n , max : Usable Compressive Axial Capacity **614.55** k
 ΦP_n , min : Usable Tension Axial Capacity k

Maximum SERVICE Load Reactions . .

Top along Y-Y **0.0** k Bottom along Y-Y **0.0** k
Top along X-X **0.0** k Bottom along X-X **0.0** k

Maximum SERVICE Load Deflections . . .

Along Y-Y **0.0** in at **0.0** ft above base
for load combination :
Along X-X **0.0** in at **0.0** ft above base
for load combination :

General Section Information . $\phi = 0.650$ $\beta = 0.850$ $\theta = 0.80$

ρ : % Reinforcing **1.218** % Rebar % Ok
Reinforcing Area **3.520** in²
Concrete Area **289.0** in²

Governing Load Combination Results

Governing Factored Load Combination	Moment		Dist. from base ft	Axial Load k		Bending Analysis k-ft						Utilization	
	X-X	Y-Y		Pu	$\Phi * P_n$	δx	$\delta x * M_{ux}$	δy	$\delta y * M_{uy}$	Alpha (deg)	δM_u	ΦM_n	Ratio
+1.40D		M2,min	14.32	79.79	614.55			1.000	7.38	90.000	7.38	57.00	0.130
+1.40D	M2,min		14.32	79.79	614.55	1.000	7.38			0.000	7.38	57.06	0.130
+1.20D+0.50Lr+1.60L		M2,min	14.32	334.08	614.55			1.000	30.90	90.000	30.90	57.00	0.543

Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. #: KW-06013597

DESCRIPTION: Fifth Floor Column

Governing Load Combination Results

Governing Factored Load Combination	Moment		Dist. from base ft	Axial Load k		Bending Analysis k-ft								Utilization	
	X-X	Y-Y		Pu	$\phi * P_n$	δx	$\delta x * M_{ux}$	δy	$\delta y * M_{uy}$	Alpha (deg)	δM_u	ϕM_n	Ratio		
+1.20D+0.50Lr+1.60L	M2,min		14.32	334.08	614.55	1.000	30.90			0.000	30.90	57.06	0.542		
+1.20D+1.60L+0.50S		M2,min	14.32	334.82	614.55			1.000	30.97	90.000	30.97	57.00	0.544		
+1.20D+1.60L+0.50S	M2,min		14.32	334.82	614.55	1.000	30.97			0.000	30.97	57.06	0.544		
+1.20D+1.60Lr+0.50L		M2,min	14.32	155.73	614.55			1.000	14.41	90.000	14.41	57.00	0.253		
+1.20D+1.60Lr+0.50L	M2,min		14.32	155.73	614.55	1.000	14.41			0.000	14.41	57.06	0.253		
+1.20D+1.60Lr		M2,min	14.32	73.17	614.55			1.000	6.77	90.000	6.77	57.00	0.119		
+1.20D+1.60Lr	M2,min		14.32	73.17	614.55	1.000	6.77			0.000	6.77	57.06	0.119		
+1.20D+0.50L+1.60S		M2,min	14.32	158.12	614.55			1.000	14.63	90.000	14.63	57.00	0.257		
+1.20D+0.50L+1.60S	M2,min		14.32	158.12	614.55	1.000	14.63			0.000	14.63	57.06	0.257		
+1.20D+1.60S		M2,min	14.32	75.56	614.55			1.000	6.99	90.000	6.99	57.00	0.123		
+1.20D+1.60S	M2,min		14.32	75.56	614.55	1.000	6.99			0.000	6.99	57.06	0.123		
+1.20D+0.50Lr+0.50L		M2,min	14.32	152.44	614.55			1.000	14.10	90.000	14.10	57.00	0.248		
+1.20D+0.50Lr+0.50L	M2,min		14.32	152.44	614.55	1.000	14.10			0.000	14.10	57.06	0.248		
+1.20D+0.50L+0.50S		M2,min	14.32	153.19	614.55			1.000	14.17	90.000	14.17	57.00	0.249		
+1.20D+0.50L+0.50S	M2,min		14.32	153.19	614.55	1.000	14.17			0.000	14.17	57.06	0.249		
+1.20D+0.50L+0.70S		M2,min	14.32	154.09	614.55			1.000	14.25	90.000	14.25	57.00	0.250		
+1.20D+0.50L+0.70S	M2,min		14.32	154.09	614.55	1.000	14.25			0.000	14.25	57.06	0.250		
+0.90D		M2,min	14.32	51.29	614.55			1.000	4.74	90.000	4.74	57.00	0.083		
+0.90D	M2,min		14.32	51.29	614.55	1.000	4.74			0.000	4.74	57.06	0.083		

Maximum Reactions

Note: Only non-zero reactions are listed.

Load Combination	X-X Axis Reaction		k	Y-Y Axis Reaction		Axial Reaction @ Base	My - End Moments k-ft		Mx - End Moments	
	@ Base	@ Top		@ Base	@ Top		@ Base	@ Top	@ Base	@ Top
D Only						56.991				
+D+L						222.111				
+D+Lr						59.981				
+D+S						61.471				
+D+0.750Lr+0.750L						183.074				
+D+0.750L+0.750S						184.191				
+0.60D						34.195				
Lr Only						2.990				
L Only						165.120				
S Only						4.480				

Maximum Moment Reactions

Note: Only non-zero reactions are listed.

Load Combination	Moment About X-X Axis			Moment About Y-Y Axis		
	@ Base	@ Top		@ Base	@ Top	
D Only			k-ft			k-ft
+D+L			k-ft			k-ft
+D+Lr			k-ft			k-ft
+D+S			k-ft			k-ft
+D+0.750Lr+0.750L			k-ft			k-ft
+D+0.750L+0.750S			k-ft			k-ft
+0.60D			k-ft			k-ft
Lr Only			k-ft			k-ft
L Only			k-ft			k-ft
S Only			k-ft			k-ft

Maximum Deflections for Load Combinations

Load Combination	Max. X-X Deflection		Distance		Max. Y-Y Deflection		Distance	
D Only	0.0000	in	0.000	ft	0.000	in	0.000	ft
+D+L	0.0000	in	0.000	ft	0.000	in	0.000	ft
+D+Lr	0.0000	in	0.000	ft	0.000	in	0.000	ft
+D+S	0.0000	in	0.000	ft	0.000	in	0.000	ft
+D+0.750Lr+0.750L	0.0000	in	0.000	ft	0.000	in	0.000	ft
+D+0.750L+0.750S	0.0000	in	0.000	ft	0.000	in	0.000	ft
+0.60D	0.0000	in	0.000	ft	0.000	in	0.000	ft

Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

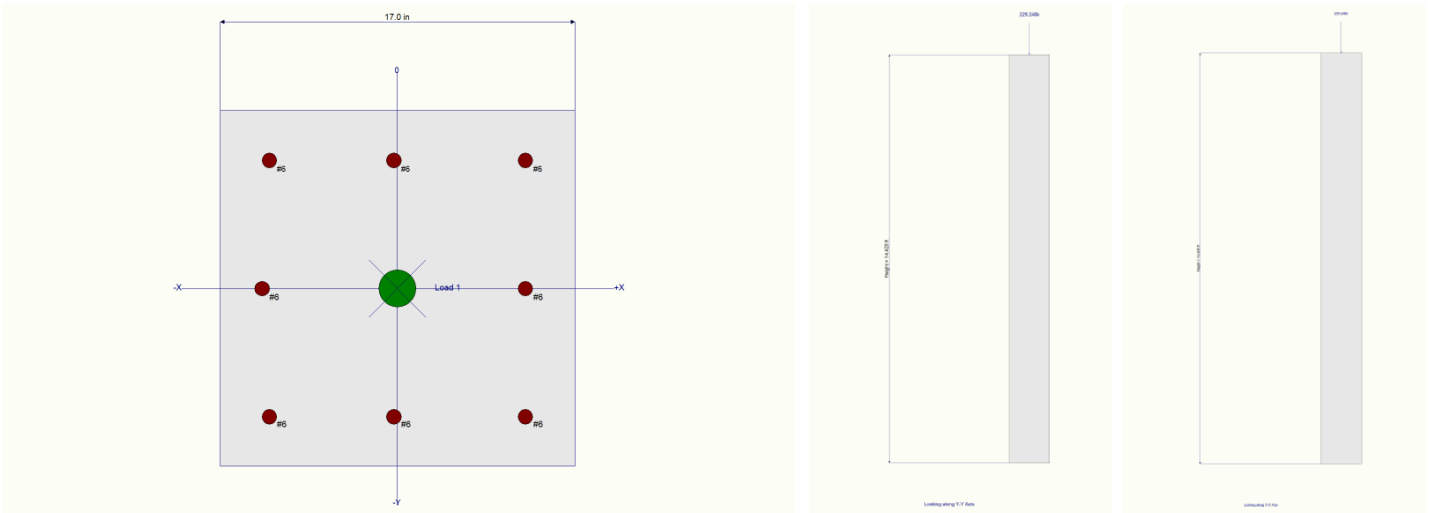
Lic. # : KW-06013597

DESCRIPTION: Fifth Floor Column

Maximum Deflections for Load Combinations

Load Combination	Max. X-X Deflection		Distance		Max. Y-Y Deflection		Distance	
Lr Only	0.0000	in	0.000	ft	0.000	in	0.000	ft
L Only	0.0000	in	0.000	ft	0.000	in	0.000	ft
S Only	0.0000	in	0.000	ft	0.000	in	0.000	ft

Sketches



Interaction Diagrams

Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Fifth Floor Column**

Concrete Column P-M Interaction Diagram



Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Fifth Floor Column**

Concrete Column P-M Interaction Diagram



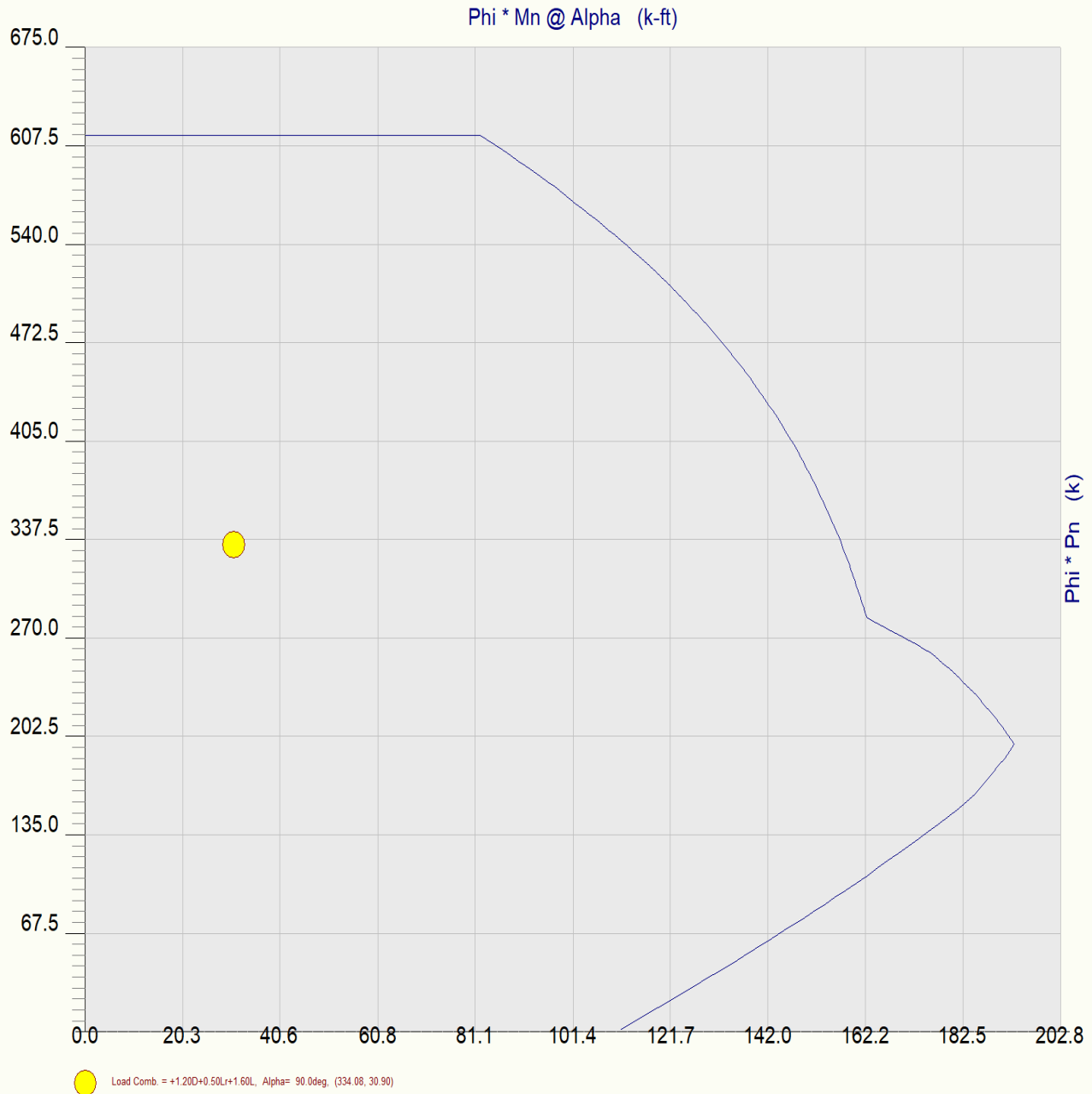
Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Fifth Floor Column**

Concrete Column P-M Interaction Diagram



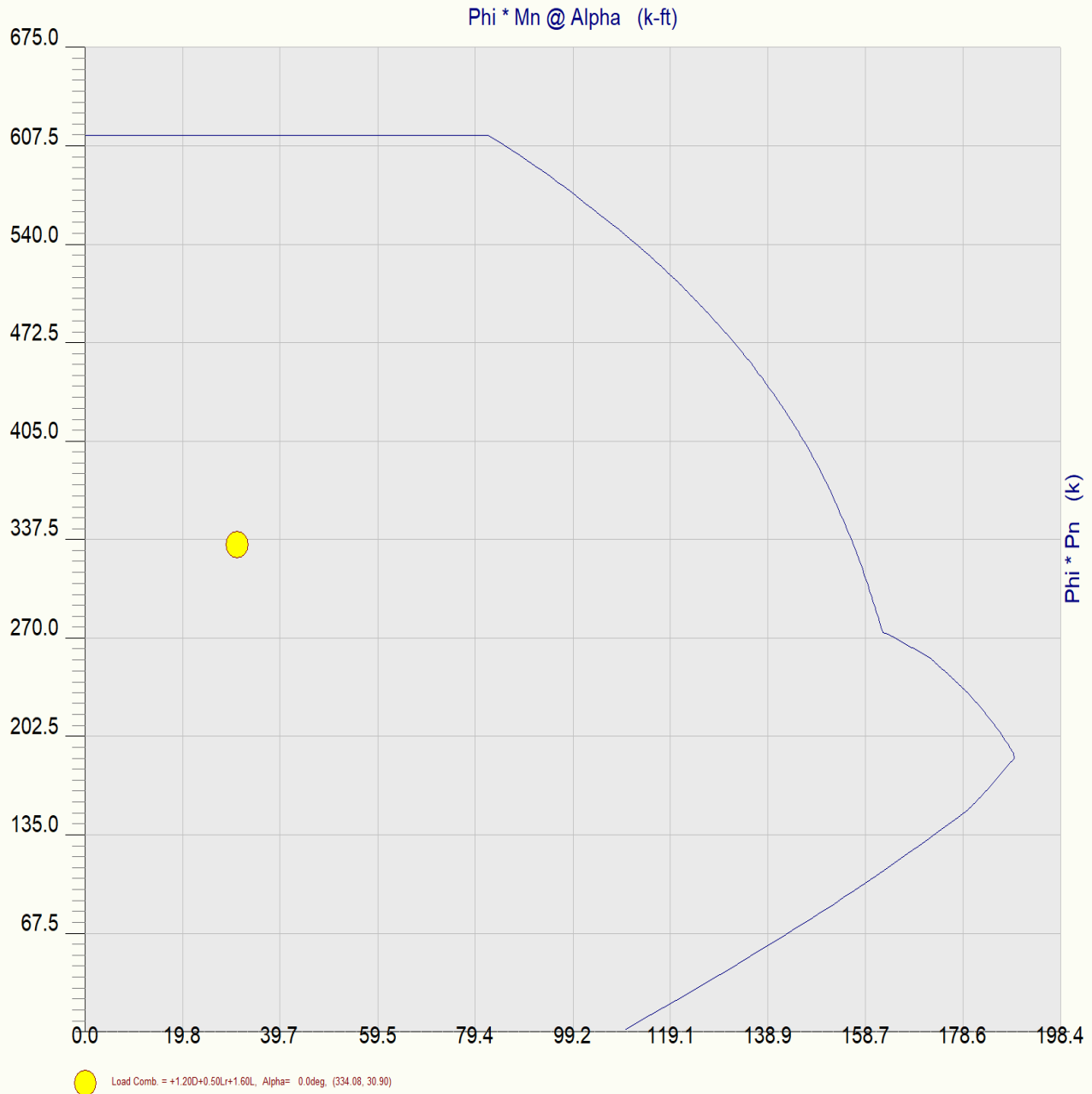
Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Fifth Floor Column**

Concrete Column P-M Interaction Diagram



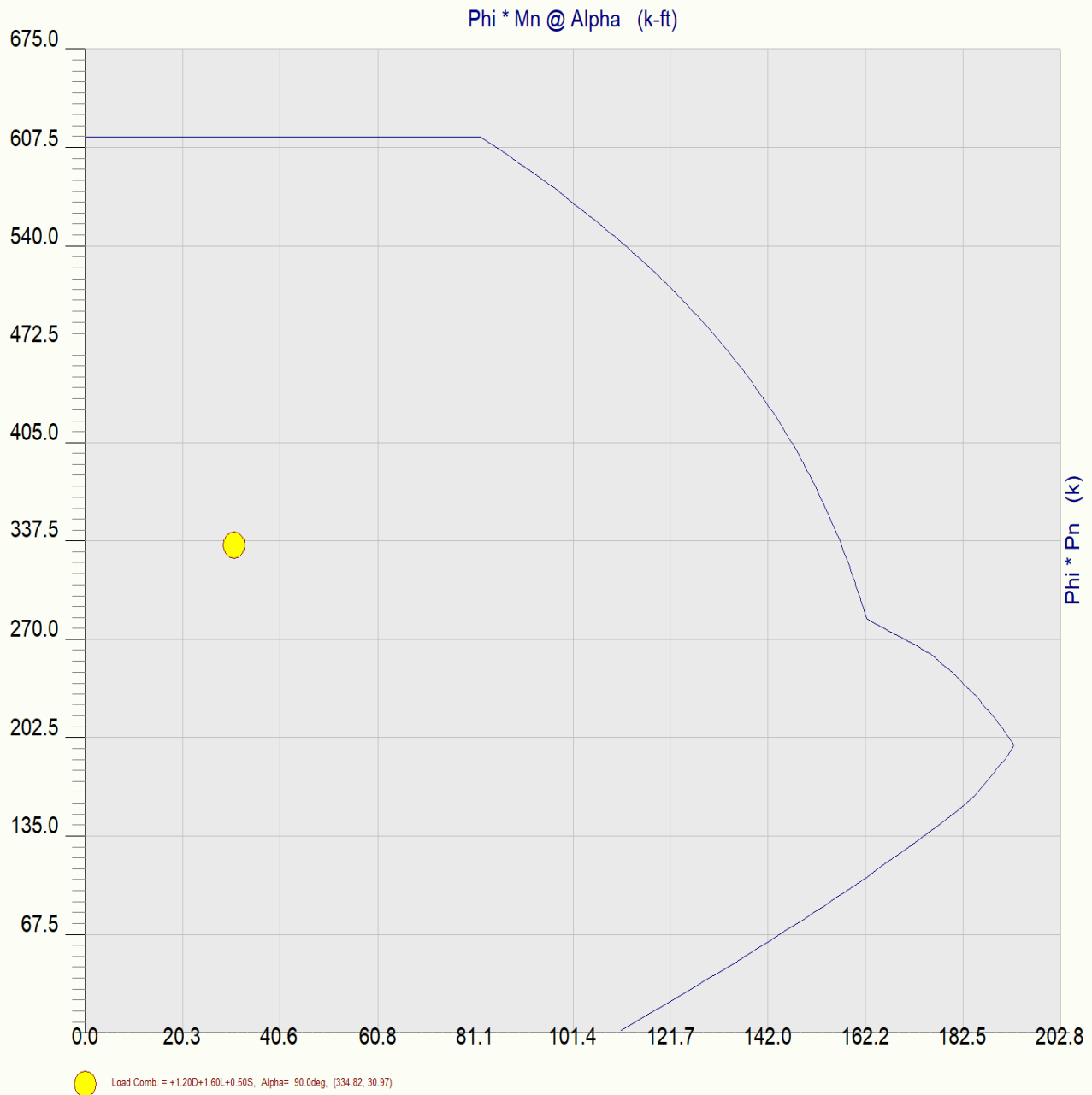
Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Fifth Floor Column**

Concrete Column P-M Interaction Diagram



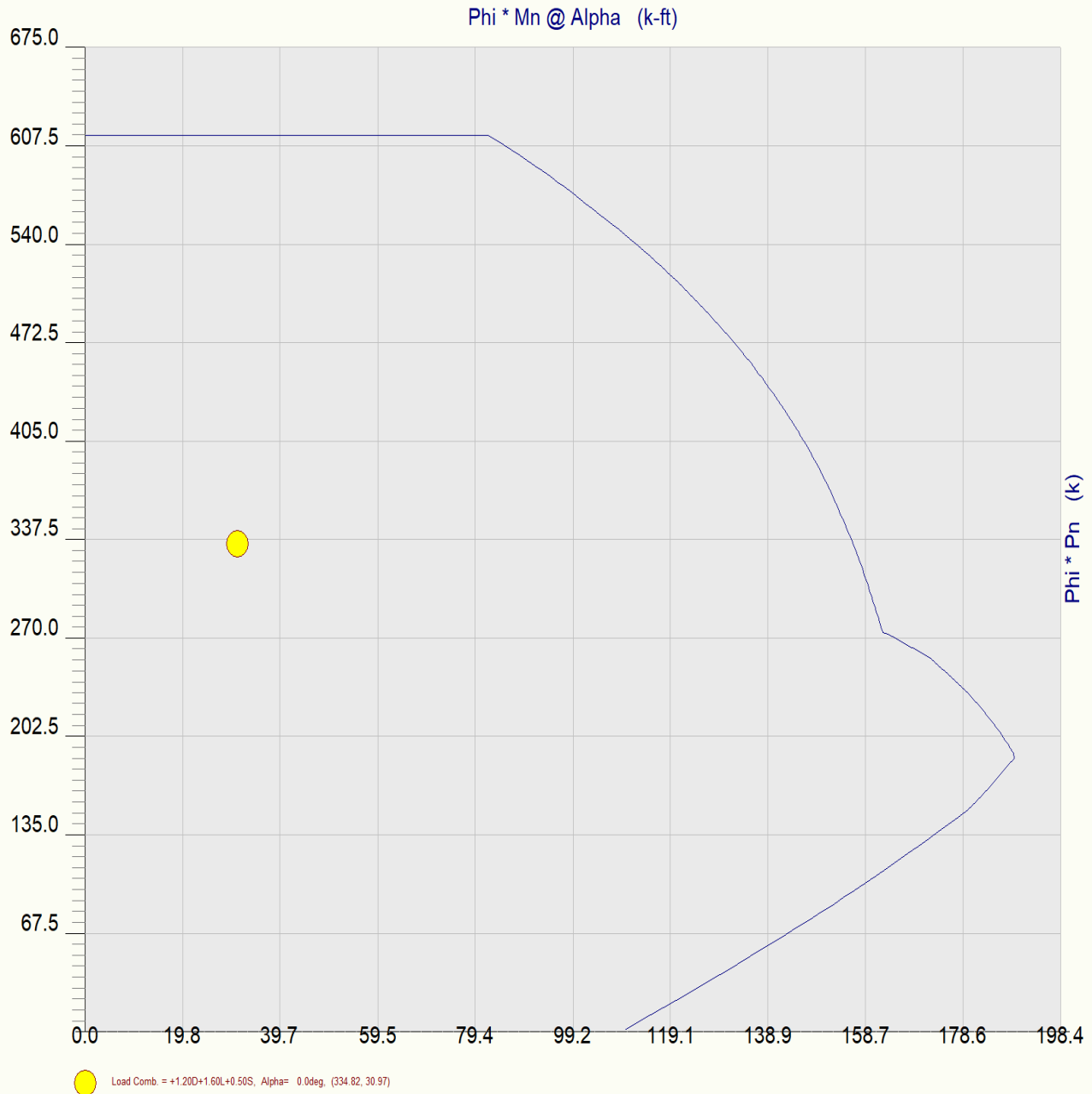
Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Fifth Floor Column**

Concrete Column P-M Interaction Diagram



Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Fifth Floor Column**

Concrete Column P-M Interaction Diagram



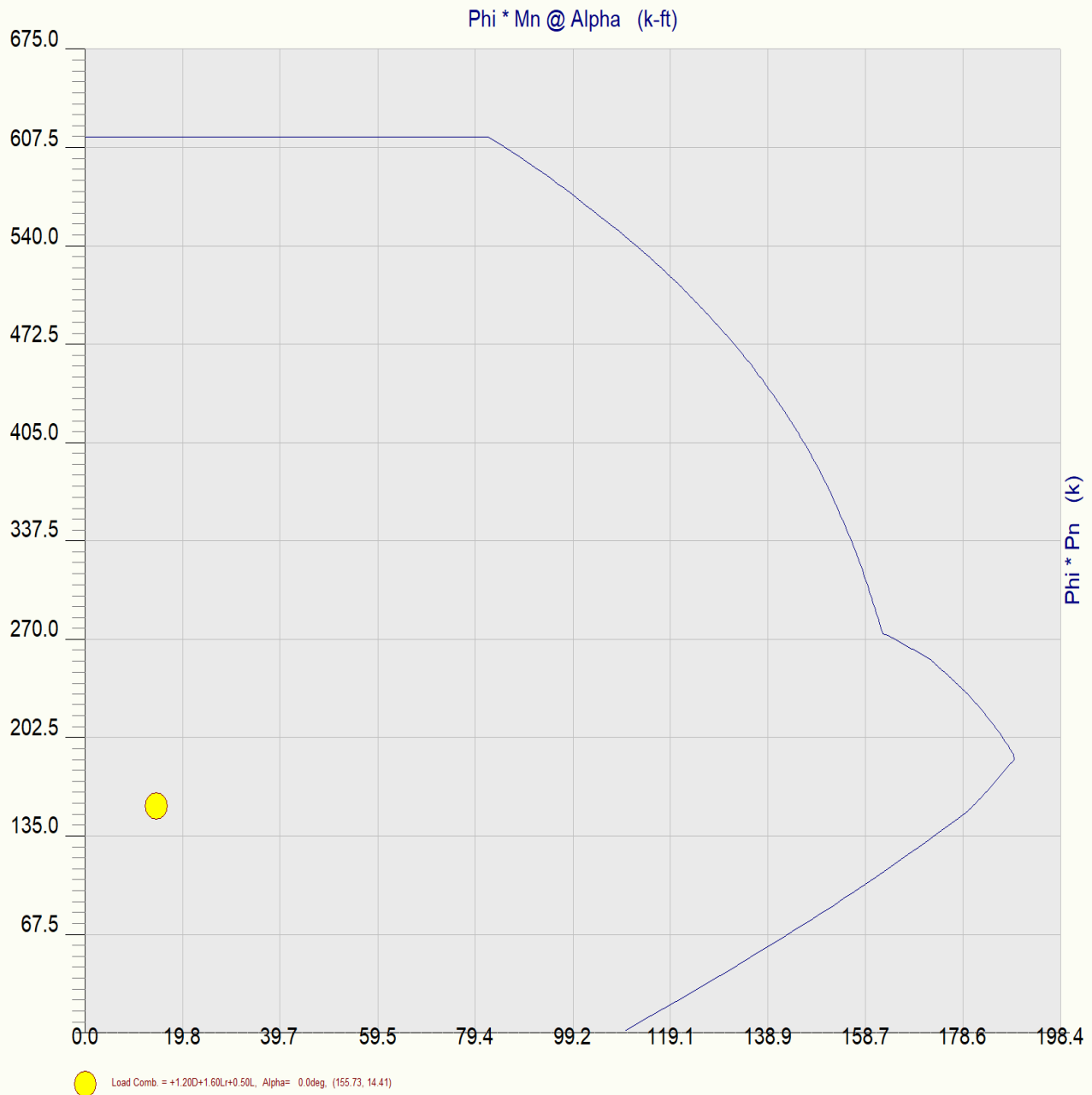
Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Fifth Floor Column**

Concrete Column P-M Interaction Diagram



Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Fifth Floor Column**

Concrete Column P-M Interaction Diagram



Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Fifth Floor Column**

Concrete Column P-M Interaction Diagram



Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Fifth Floor Column**

Concrete Column P-M Interaction Diagram



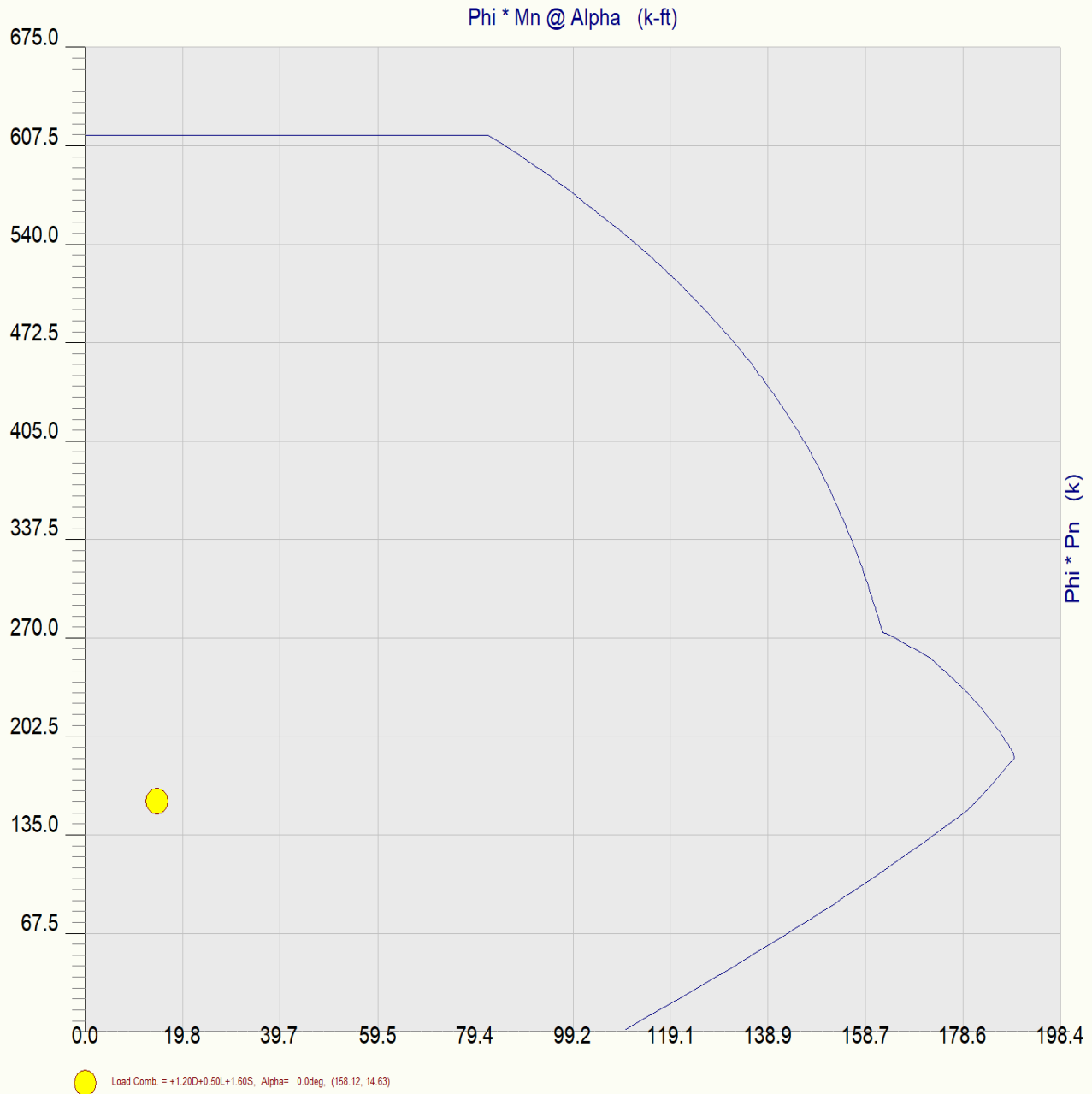
Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Fifth Floor Column**

Concrete Column P-M Interaction Diagram



Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Fifth Floor Column**

Concrete Column P-M Interaction Diagram



Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Fifth Floor Column**

Concrete Column P-M Interaction Diagram



Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Fifth Floor Column**

Concrete Column P-M Interaction Diagram



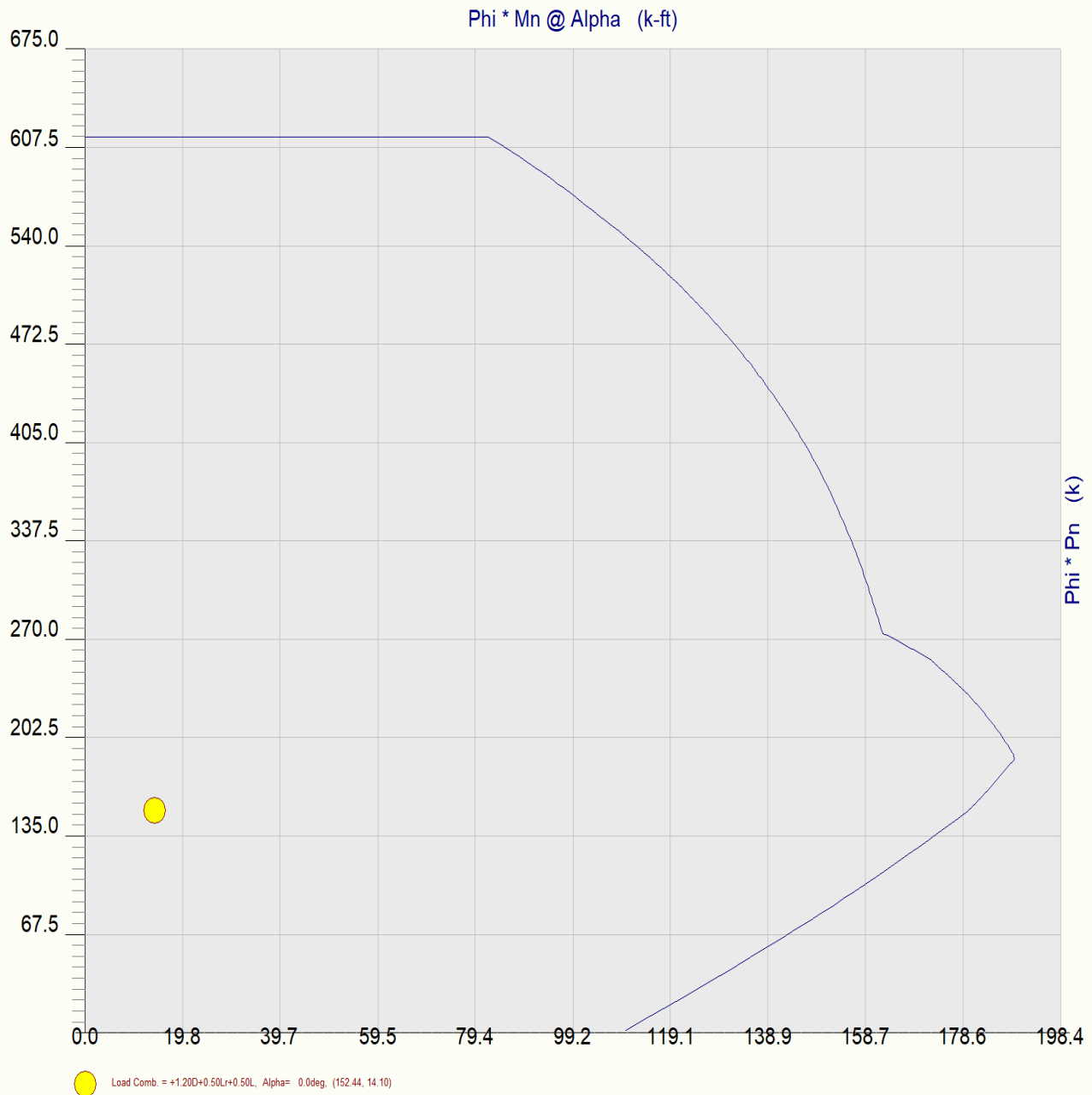
Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Fifth Floor Column**

Concrete Column P-M Interaction Diagram



Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. #: KW-06013597

DESCRIPTION: Fourth Floor Column

Code References

Calculations per ACI 318-14, IBC 2015, CBC 2016, ASCE 7-10
Load Combinations Used : IBC 2015

General Information

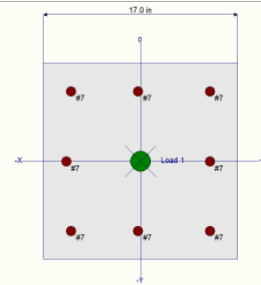
fc : Concrete 28 day strength = 4.0 ksi
E = 3,605.0 ksi
Density = 150.0 pcf
 β = 0.850
fy - Main Rebar = 60.0 ksi
E - Main Rebar = 29,000.0 ksi
Allow. Reinforcing Limits *ASTM A615 Bars Used*
Min. Reinf. = 1.0 %
Max. Reinf. = 8.0 %

Overall Column Height = 14.420 ft
End Fixity **Top & Bottom Pinned**
Brace condition for deflection (buckling) along columns :
X-X (width) axis :
Unbraced Length for buckling ABOUT Y-Y Axis = 14.420 ft, K = 1.0
Y-Y (depth) axis :
Unbraced Length for buckling ABOUT X-X Axis = 14.420 ft, K = 1.0

Column Cross Section

Column Dimensions : 17.0in Square Column, Column Edge to Rebar Edge Cover = 2.0in

Column Reinforcing : 4 - #7 bars @ corners,, 1 - #7 bars top & bottom between corner bars, 1 - #7 bars left & right between corner bars



Entered loads are factored per load combinations specified by user.

Applied Loads

Column selfweight included : 4,341.02 lbs * Dead Load Factor
AXIAL LOADS ...
Roof + Tower Loads: Axial Load at 14.420 ft above base, D = 75.680, LR = 2.990, L = 180.060, S = 4.480 k

DESIGN SUMMARY

Load Combination **+1.20D+1.60L+0.50S**
Location of max. above base **14.323 ft**
Maximum Stress Ratio 0.590 : 1
Ratio = $(P_u^2 + M_u^2)^{0.5} / (\Phi P_n^2 + \Phi M_n^2)^{0.5}$
Pu = **386.361 k** $\Phi * P_n$ = **652.23 k**
Mu-x = **0.0 k-ft** $\Phi * M_n-x$ = **0.0 k-ft**
Mu-y = **35.738 k-ft** $\Phi * M_n-y$ = **59.753 k-ft**
Mu Angle = **90.0 deg**
Mu at Angle = **35.738 k-ft** ΦM_n at Angle = **60.858 k-ft**

Pn & Mn values located at Pu-Mu vector intersection with capacity curve

Column Capacities ...

Pnmax : Nominal Max. Compressive Axial Capacity **1,254.28 k**
Pnmin : Nominal Min. Tension Axial Capacity **k**
 ΦP_n , max : Usable Compressive Axial Capacity **652.23 k**
 ΦP_n , min : Usable Tension Axial Capacity **k**

Maximum SERVICE Load Reactions ..

Top along Y-Y **0.0 k** Bottom along Y-Y **0.0 k**
Top along X-X **0.0 k** Bottom along X-X **0.0 k**

Maximum SERVICE Load Deflections ...

Along Y-Y **0.0 in** at **0.0 ft** above base
for load combination :
Along X-X **0.0 in** at **0.0 ft** above base
for load combination :

General Section Information $\phi = 0.650$ $\beta = 0.850$ $\theta = 0.80$

ρ : % Reinforcing **1.661 %** Rebar % Ok
Reinforcing Area **4.80 in²**
Concrete Area **289.0 in²**

Governing Load Combination Results

Governing Factored Load Combination	Moment		Dist from base ft	Axial Load k		Bending Analysis k-ft						Utilization	
	X-X	Y-Y		Pu	$\Phi * P_n$	δ_x	$\delta_x * M_{ux}$	δ_y	$\delta_y * M_{uy}$	Alpha (deg)	δM_u	ΦM_n	Ratio
+1.40D		M2,min	14.32	112.03	652.23			1.000	10.36	90.000	10.36	60.86	0.171
+1.40D	M2,min		14.32	112.03	652.23	1.000	10.36			0.000	10.36	60.91	0.171
+1.20D+0.50Lr+1.60L		M2,min	14.32	385.62	652.23			1.000	35.67	90.000	35.67	60.86	0.588

Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. #: KW-06013597

DESCRIPTION: Fourth Floor Column

Governing Load Combination Results

Governing Factored Load Combination	Moment		Dist from base ft	Axial Load k		Bending Analysis k-ft								Utilization	
	X-X	Y-Y		Pu	$\phi * P_n$	δx	$\delta x * M_{ux}$	δy	$\delta y * M_{uy}$	Alpha (deg)	δM_u	ϕM_n	Ratio		
+1.20D+0.50Lr+1.60L	M2,min		14.32	385.62	652.23	1.000	35.67			0.000	35.67	60.91	0.588		
+1.20D+1.60L+0.50S		M2,min	14.32	386.36	652.23			1.000	35.74	90.000	35.74	60.86	0.590		
+1.20D+1.60L+0.50S	M2,min		14.32	386.36	652.23	1.000	35.74			0.000	35.74	60.91	0.589		
+1.20D+1.60Lr+0.50L		M2,min	14.32	190.84	652.23			1.000	17.65	90.000	17.65	60.86	0.291		
+1.20D+1.60Lr+0.50L	M2,min		14.32	190.84	652.23	1.000	17.65			0.000	17.65	60.91	0.291		
+1.20D+1.60Lr		M2,min	14.32	100.81	652.23			1.000	9.32	90.000	9.32	60.86	0.154		
+1.20D+1.60Lr	M2,min		14.32	100.81	652.23	1.000	9.32			0.000	9.32	60.91	0.154		
+1.20D+0.50L+1.60S		M2,min	14.32	193.22	652.23			1.000	17.87	90.000	17.87	60.86	0.295		
+1.20D+0.50L+1.60S	M2,min		14.32	193.22	652.23	1.000	17.87			0.000	17.87	60.91	0.295		
+1.20D+1.60S		M2,min	14.32	103.19	652.23			1.000	9.55	90.000	9.55	60.86	0.157		
+1.20D+1.60S	M2,min		14.32	103.19	652.23	1.000	9.55			0.000	9.55	60.91	0.157		
+1.20D+0.50Lr+0.50L		M2,min	14.32	187.55	652.23			1.000	17.35	90.000	17.35	60.86	0.286		
+1.20D+0.50Lr+0.50L	M2,min		14.32	187.55	652.23	1.000	17.35			0.000	17.35	60.91	0.286		
+1.20D+0.50L+0.50S		M2,min	14.32	188.30	652.23			1.000	17.42	90.000	17.42	60.86	0.287		
+1.20D+0.50L+0.50S	M2,min		14.32	188.30	652.23	1.000	17.42			0.000	17.42	60.91	0.287		
+1.20D+0.50L+0.70S		M2,min	14.32	189.19	652.23			1.000	17.50	90.000	17.50	60.86	0.289		
+1.20D+0.50L+0.70S	M2,min		14.32	189.19	652.23	1.000	17.50			0.000	17.50	60.91	0.289		
+0.90D		M2,min	14.32	72.02	652.23			1.000	6.66	90.000	6.66	60.86	0.110		
+0.90D	M2,min		14.32	72.02	652.23	1.000	6.66			0.000	6.66	60.91	0.110		

Maximum Reactions

Note: Only non-zero reactions are listed.

Load Combination	X-X Axis Reaction		k	Y-Y Axis Reaction		Axial Reaction	My - End Moments		k-ft	Mx - End Moments	
	@ Base	@ Top		@ Base	@ Top		@ Base	@ Top		@ Base	@ Top
D Only						80.021					
+D+L						260.081					
+D+Lr						83.011					
+D+S						84.501					
+D+0.750Lr+0.750L						217.309					
+D+0.750L+0.750S						218.426					
+0.60D						48.013					
Lr Only						2.990					
L Only						180.060					
S Only						4.480					

Maximum Moment Reactions

Note: Only non-zero reactions are listed.

Load Combination	Moment About X-X Axis			Moment About Y-Y Axis		
	@ Base	@ Top		@ Base	@ Top	
D Only			k-ft			k-ft
+D+L			k-ft			k-ft
+D+Lr			k-ft			k-ft
+D+S			k-ft			k-ft
+D+0.750Lr+0.750L			k-ft			k-ft
+D+0.750L+0.750S			k-ft			k-ft
+0.60D			k-ft			k-ft
Lr Only			k-ft			k-ft
L Only			k-ft			k-ft
S Only			k-ft			k-ft

Maximum Deflections for Load Combinations

Load Combination	Max. X-X Deflection		Distance		Max. Y-Y Deflection		Distance	
				ft				ft
D Only	0.0000	in	0.000	ft	0.000	in	0.000	ft
+D+L	0.0000	in	0.000	ft	0.000	in	0.000	ft
+D+Lr	0.0000	in	0.000	ft	0.000	in	0.000	ft
+D+S	0.0000	in	0.000	ft	0.000	in	0.000	ft
+D+0.750Lr+0.750L	0.0000	in	0.000	ft	0.000	in	0.000	ft
+D+0.750L+0.750S	0.0000	in	0.000	ft	0.000	in	0.000	ft
+0.60D	0.0000	in	0.000	ft	0.000	in	0.000	ft

Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

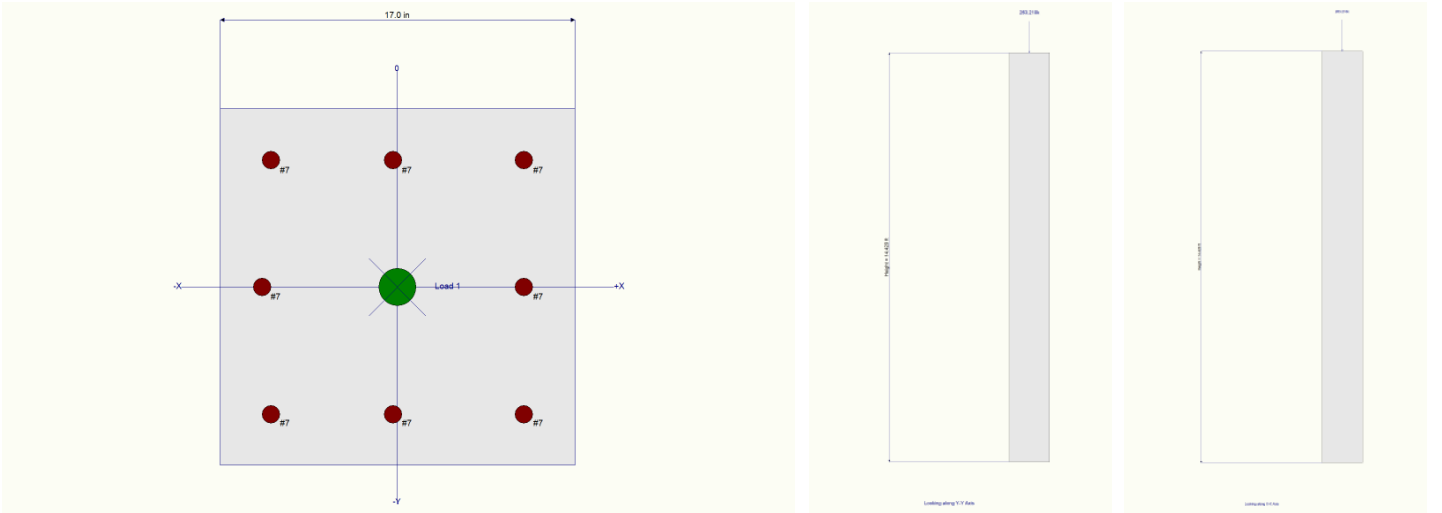
Lic. # : KW-06013597

DESCRIPTION: **Fourth Floor Column**

Maximum Deflections for Load Combinations

Load Combination	Max. X-X Deflection		Distance		Max. Y-Y Deflection		Distance	
Lr Only	0.0000	in	0.000	ft	0.000	in	0.000	ft
L Only	0.0000	in	0.000	ft	0.000	in	0.000	ft
S Only	0.0000	in	0.000	ft	0.000	in	0.000	ft

Sketches



Interaction Diagrams

Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Fourth Floor Column**

Concrete Column P-M Interaction Diagram



Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Fourth Floor Column**

Concrete Column P-M Interaction Diagram



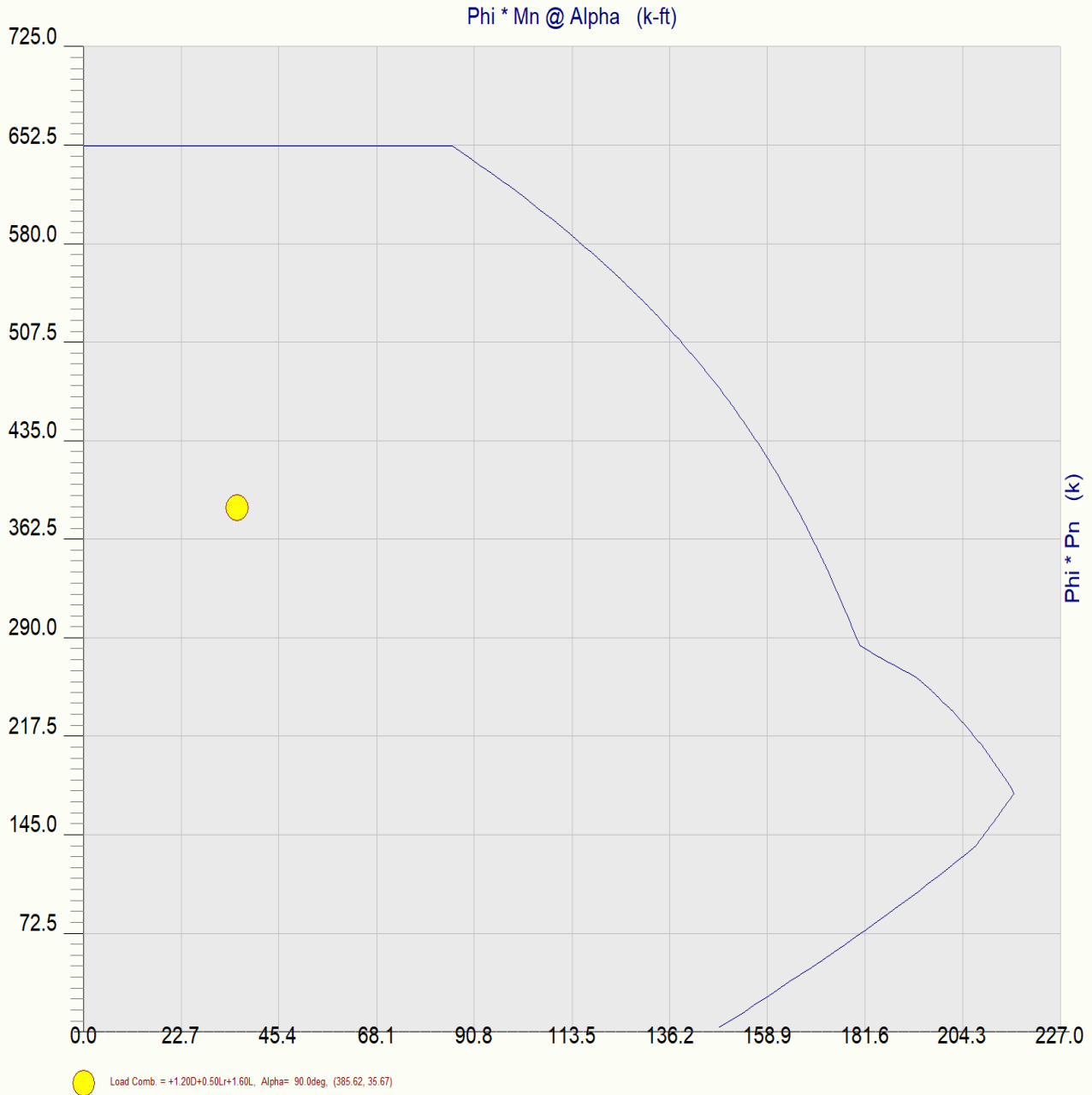
Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Fourth Floor Column**

Concrete Column P-M Interaction Diagram



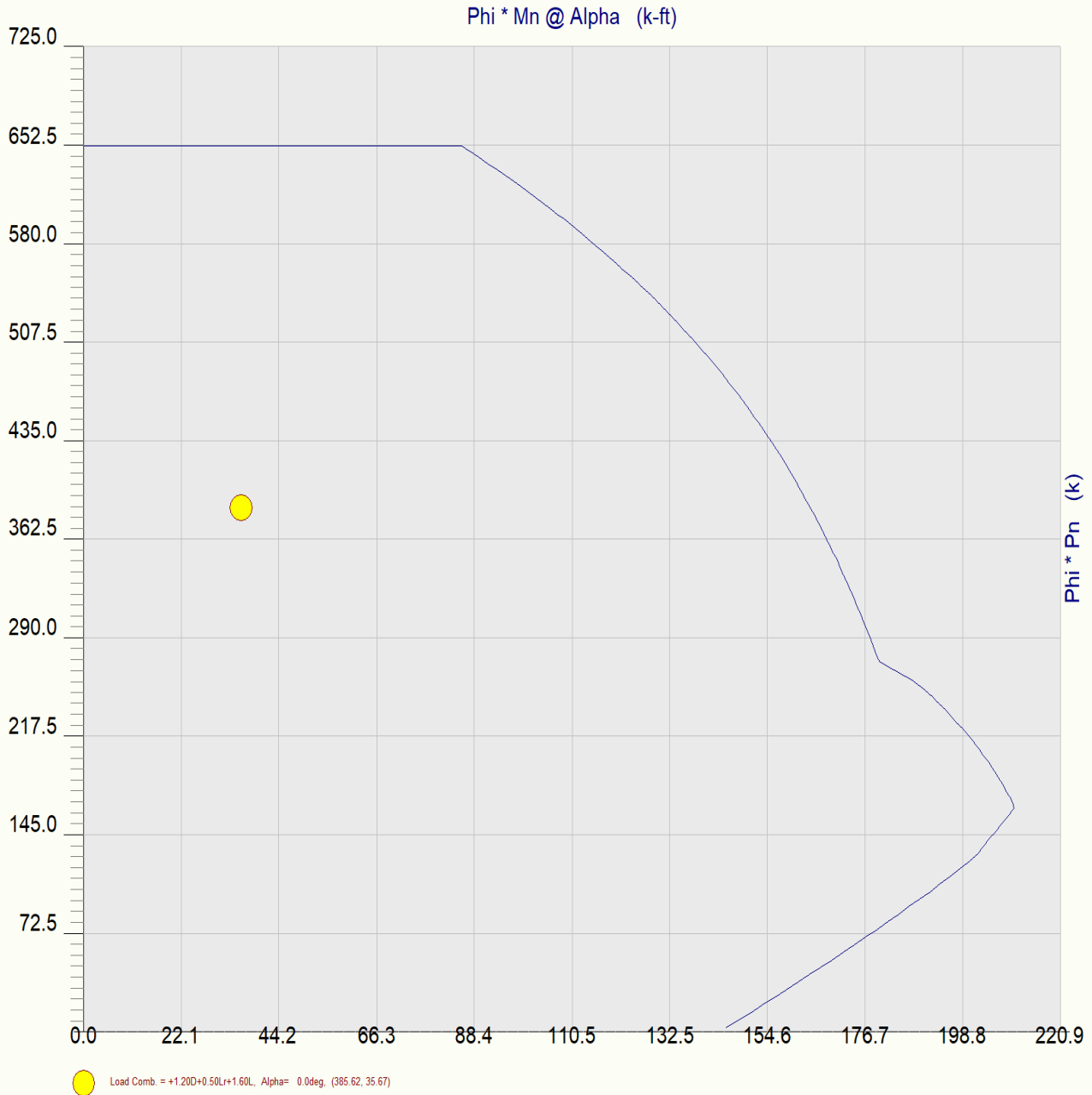
Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Fourth Floor Column**

Concrete Column P-M Interaction Diagram



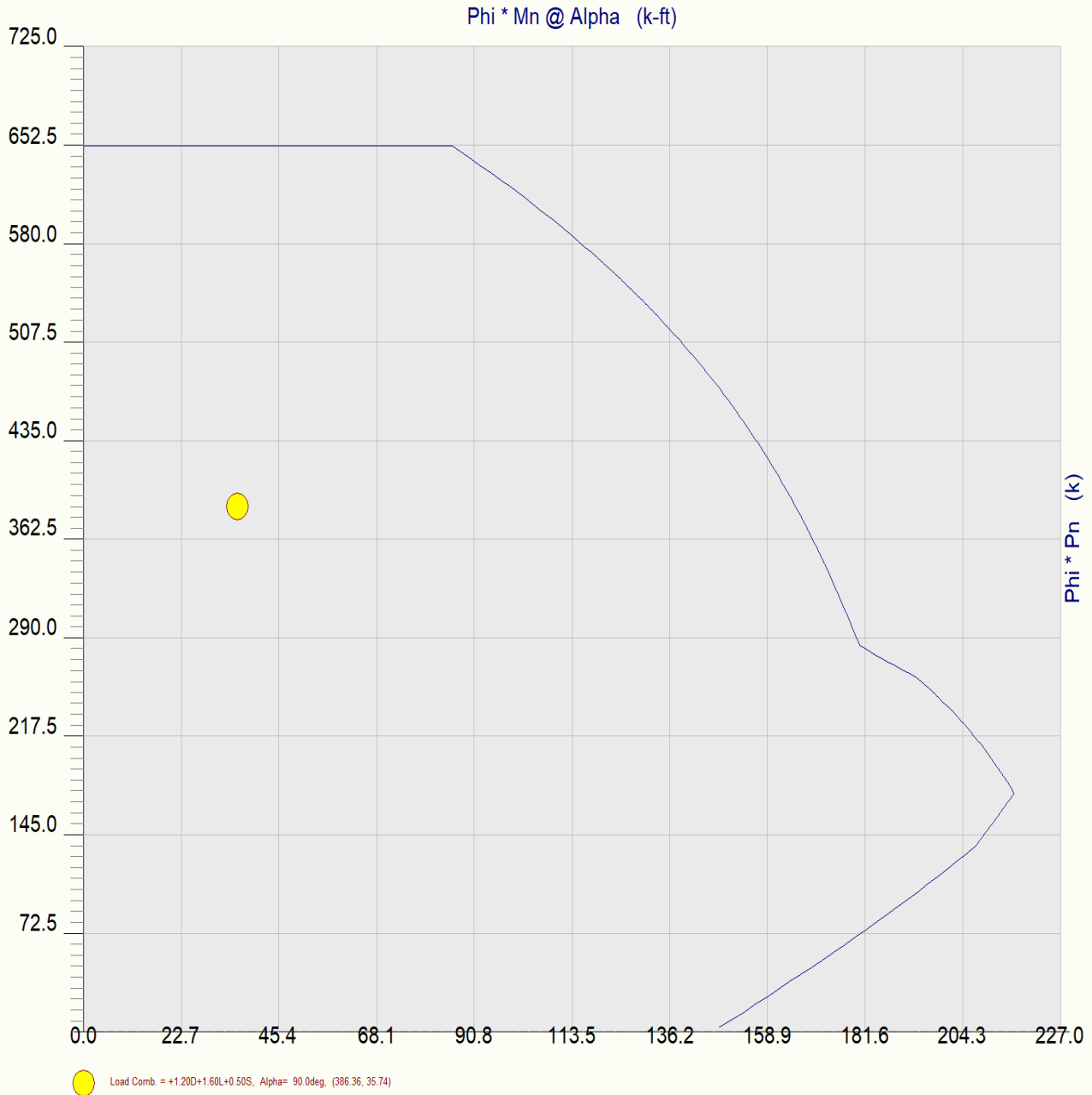
Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Fourth Floor Column**

Concrete Column P-M Interaction Diagram



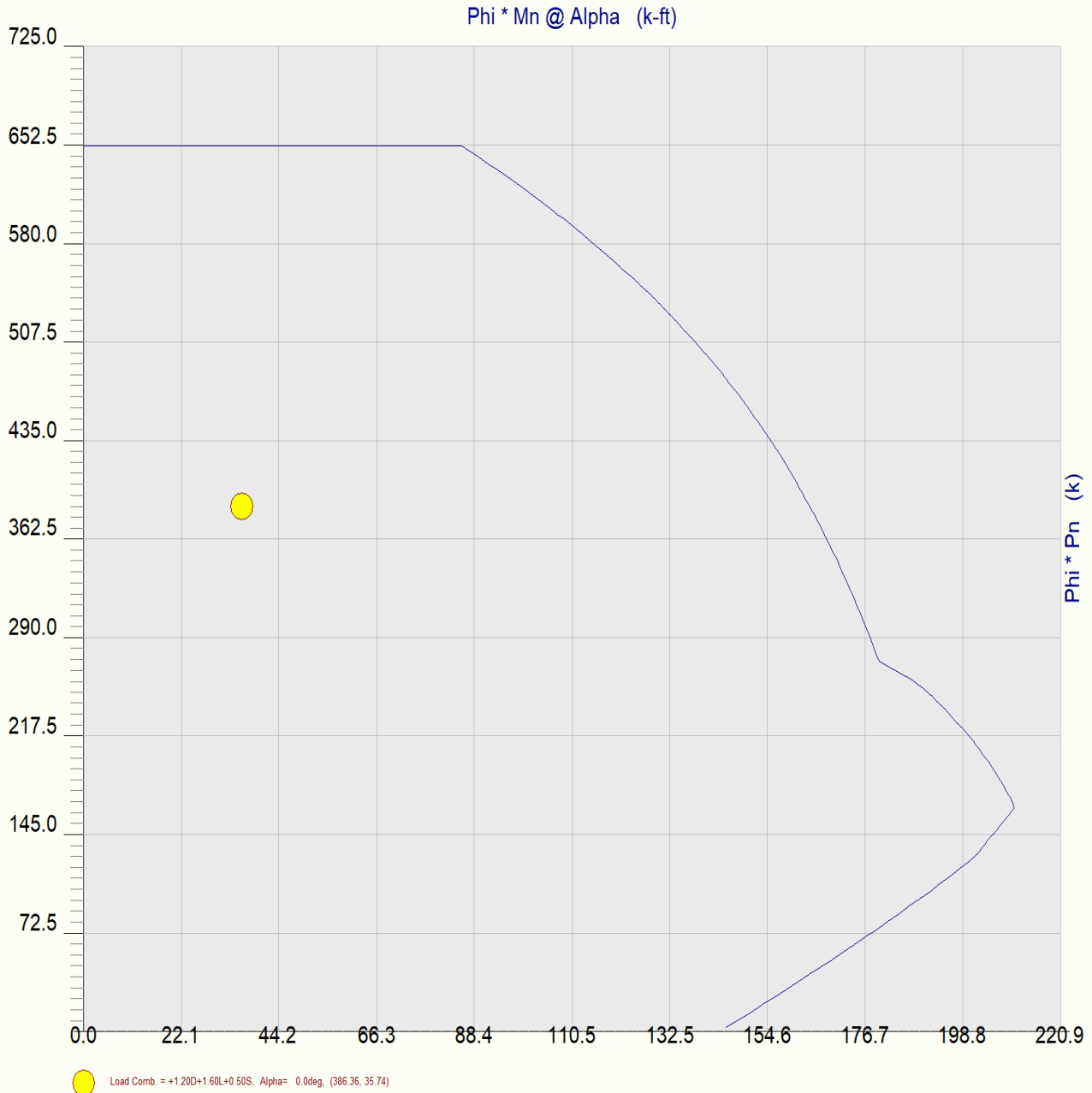
Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Fourth Floor Column**

Concrete Column P-M Interaction Diagram



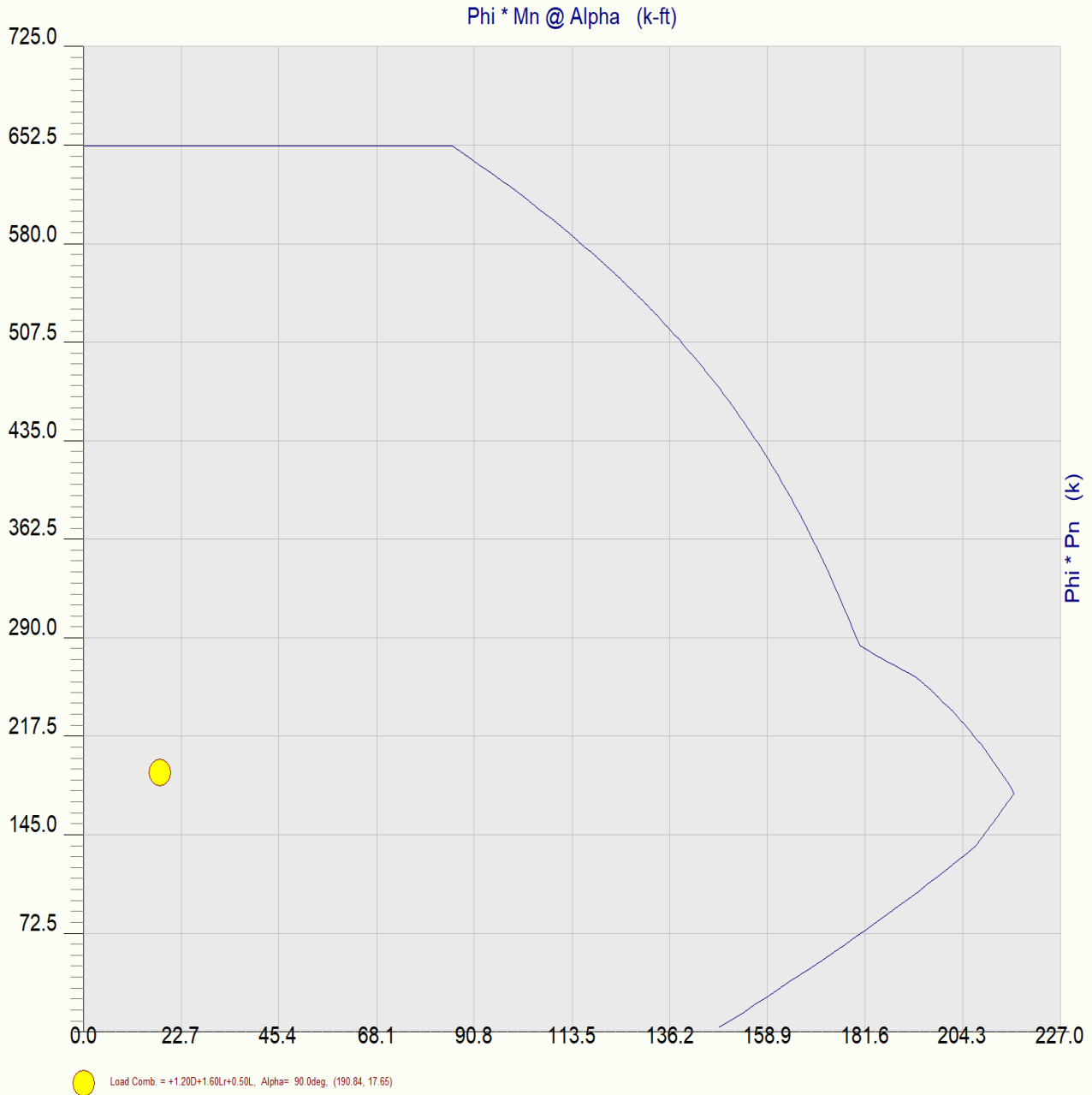
Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Fourth Floor Column**

Concrete Column P-M Interaction Diagram



Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Fourth Floor Column**

Concrete Column P-M Interaction Diagram



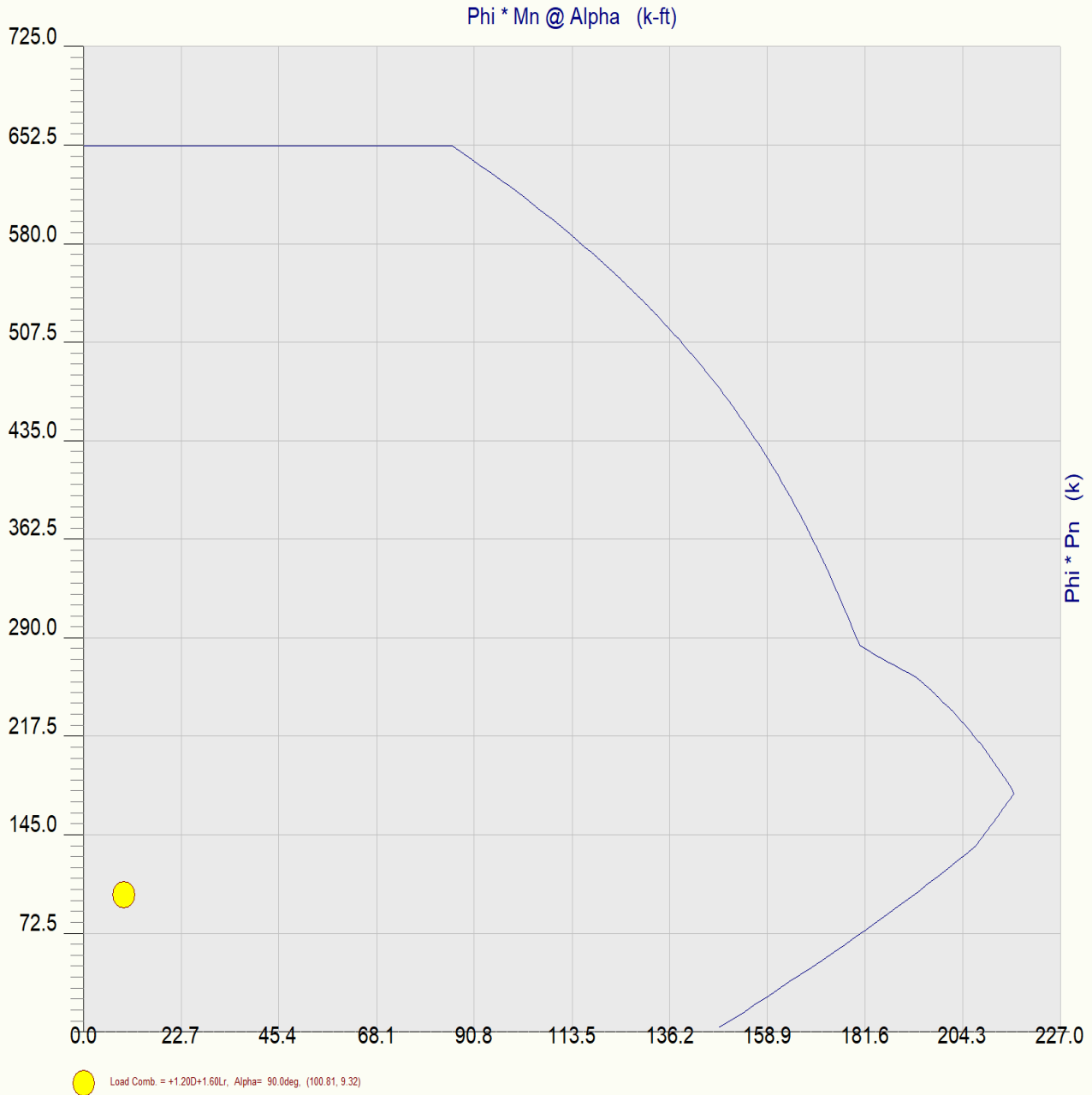
Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Fourth Floor Column**

Concrete Column P-M Interaction Diagram



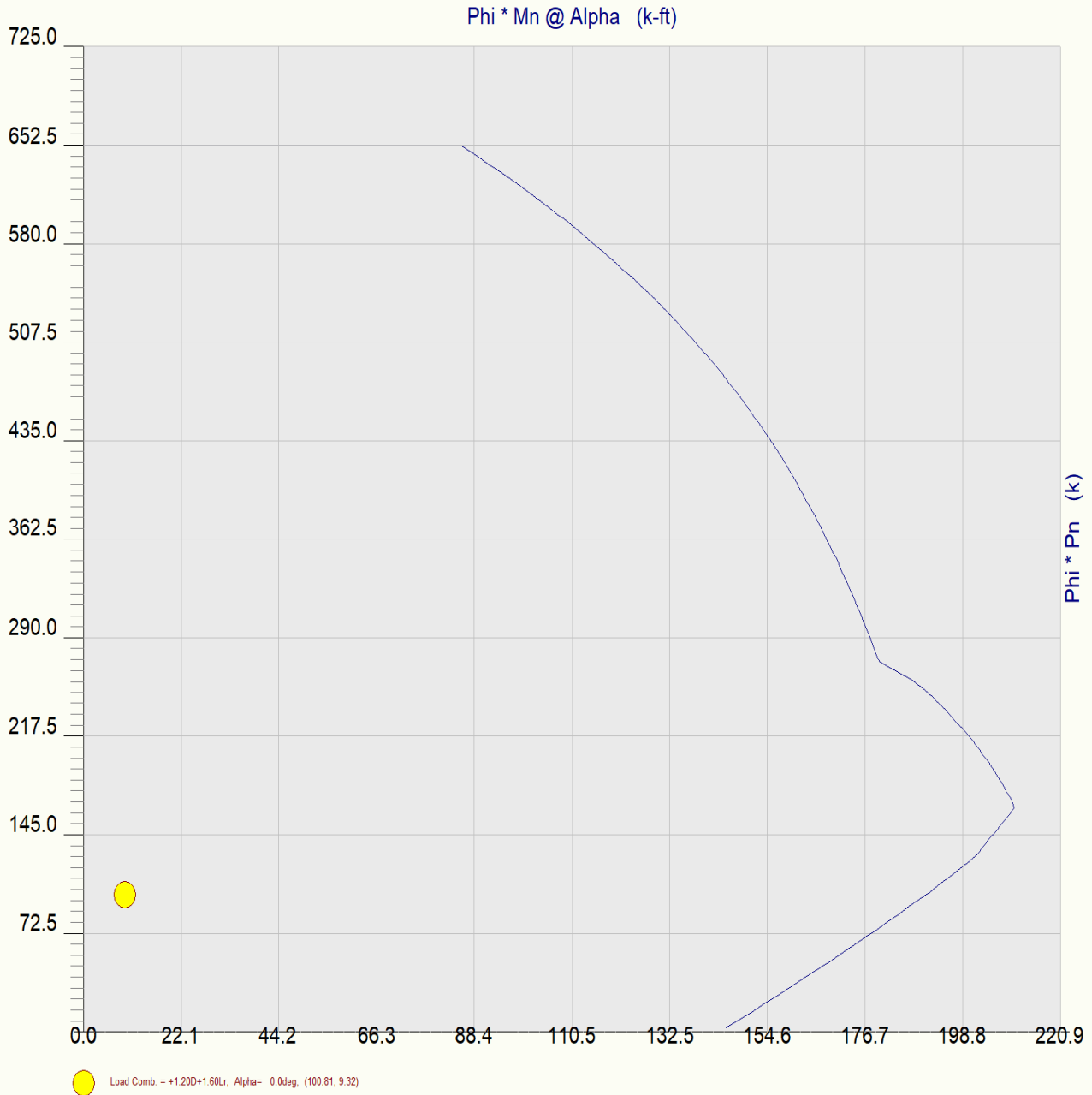
Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Fourth Floor Column**

Concrete Column P-M Interaction Diagram



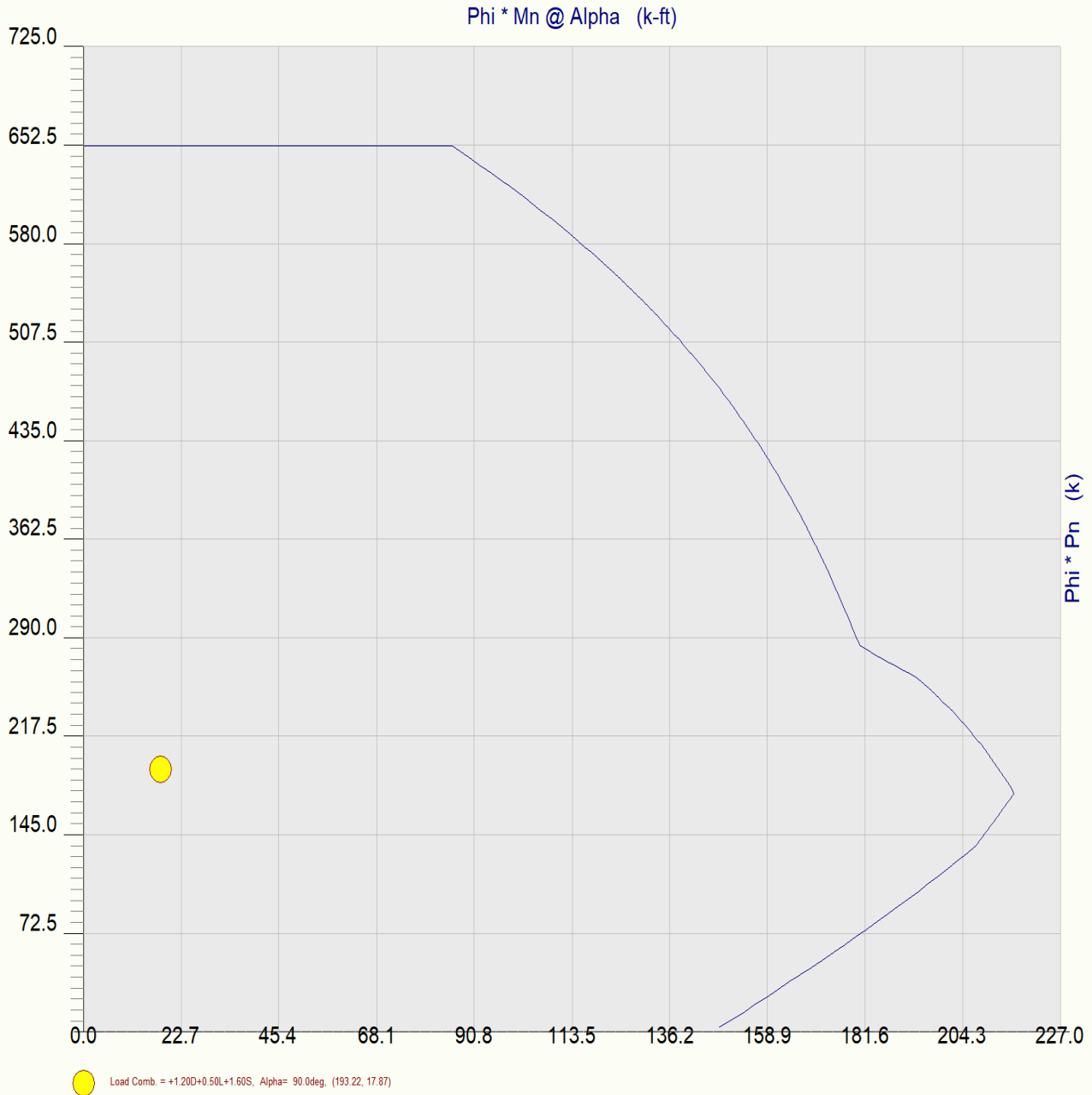
Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Fourth Floor Column**

Concrete Column P-M Interaction Diagram



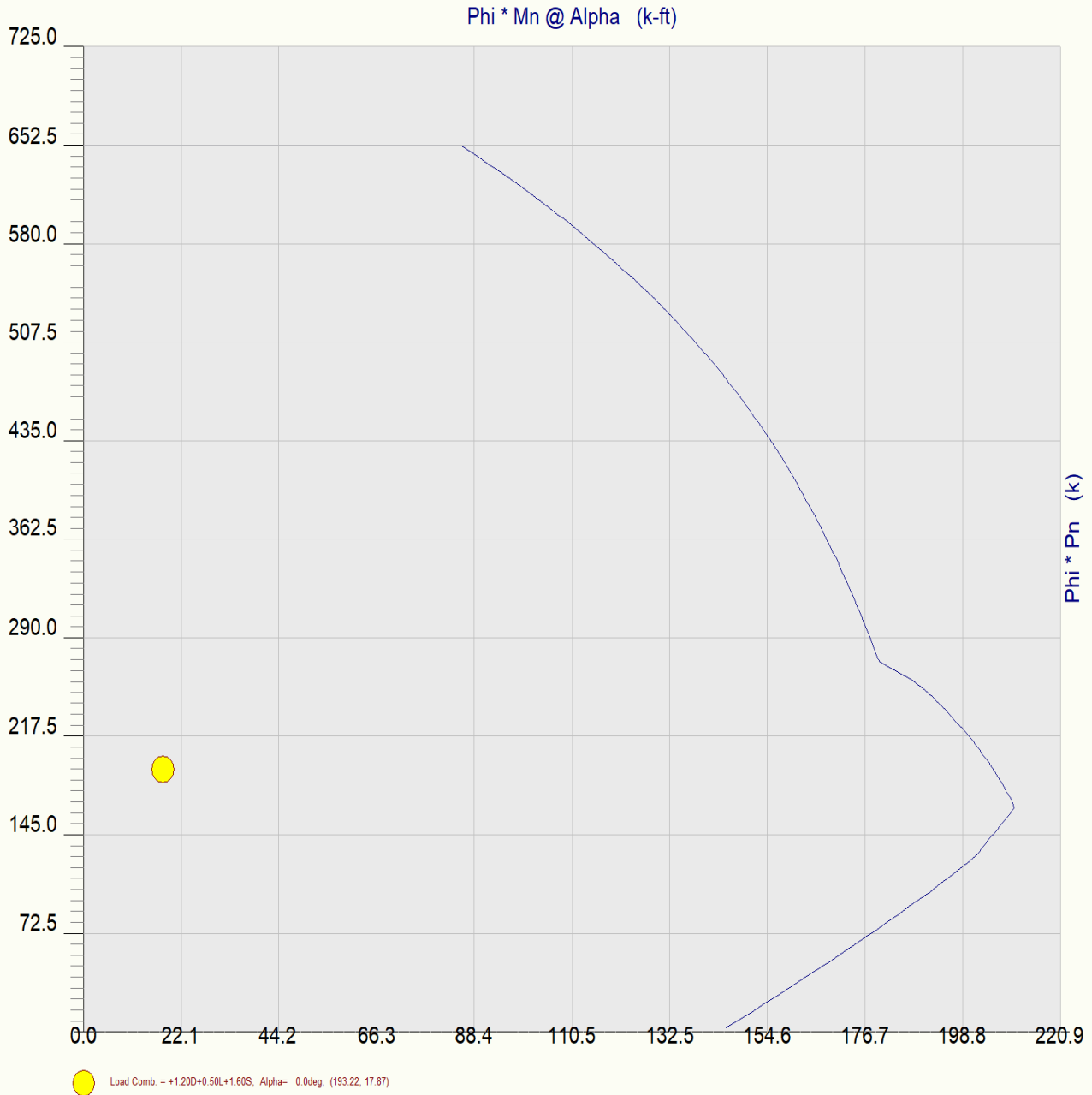
Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Fourth Floor Column**

Concrete Column P-M Interaction Diagram



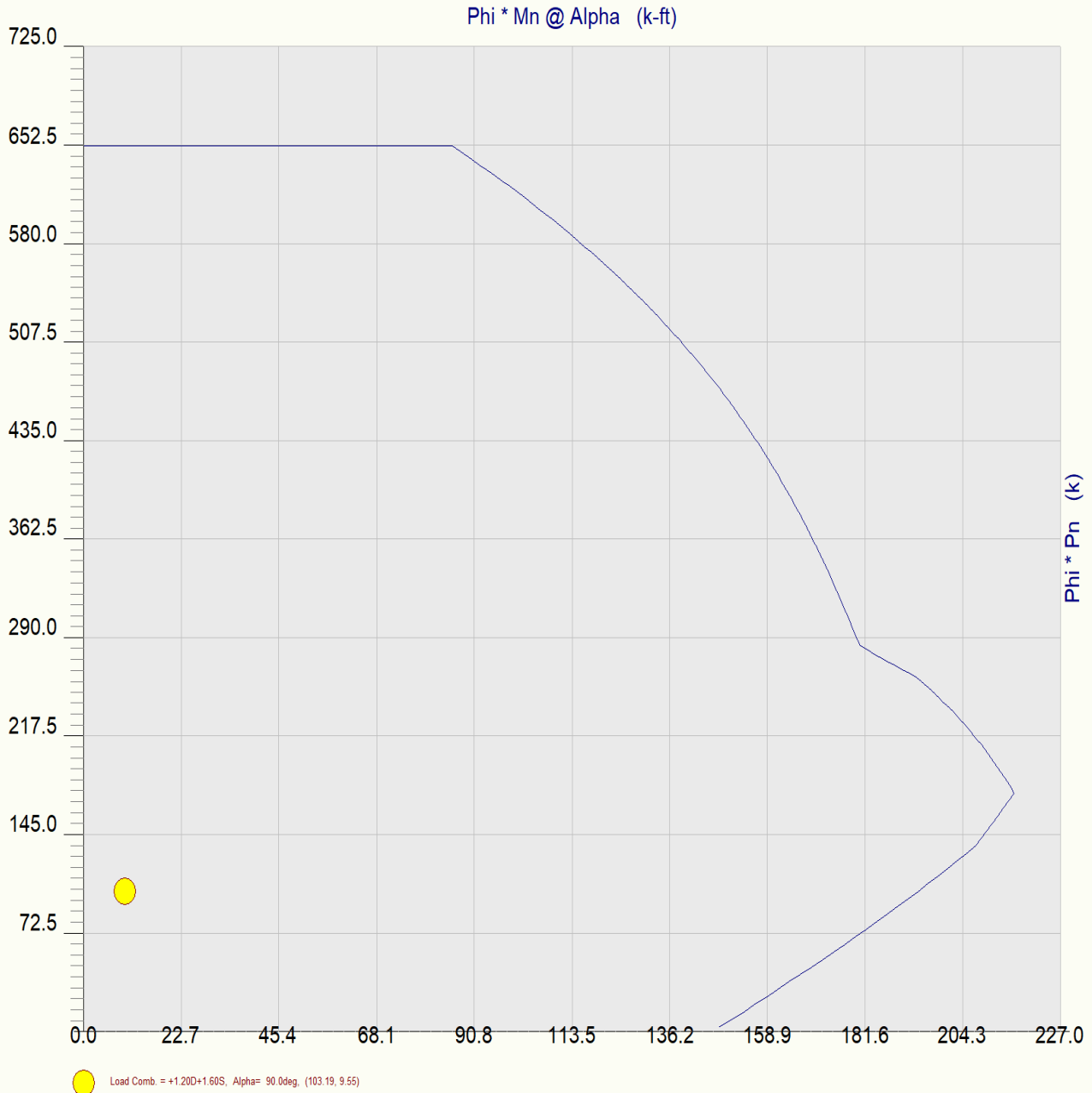
Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Fourth Floor Column**

Concrete Column P-M Interaction Diagram



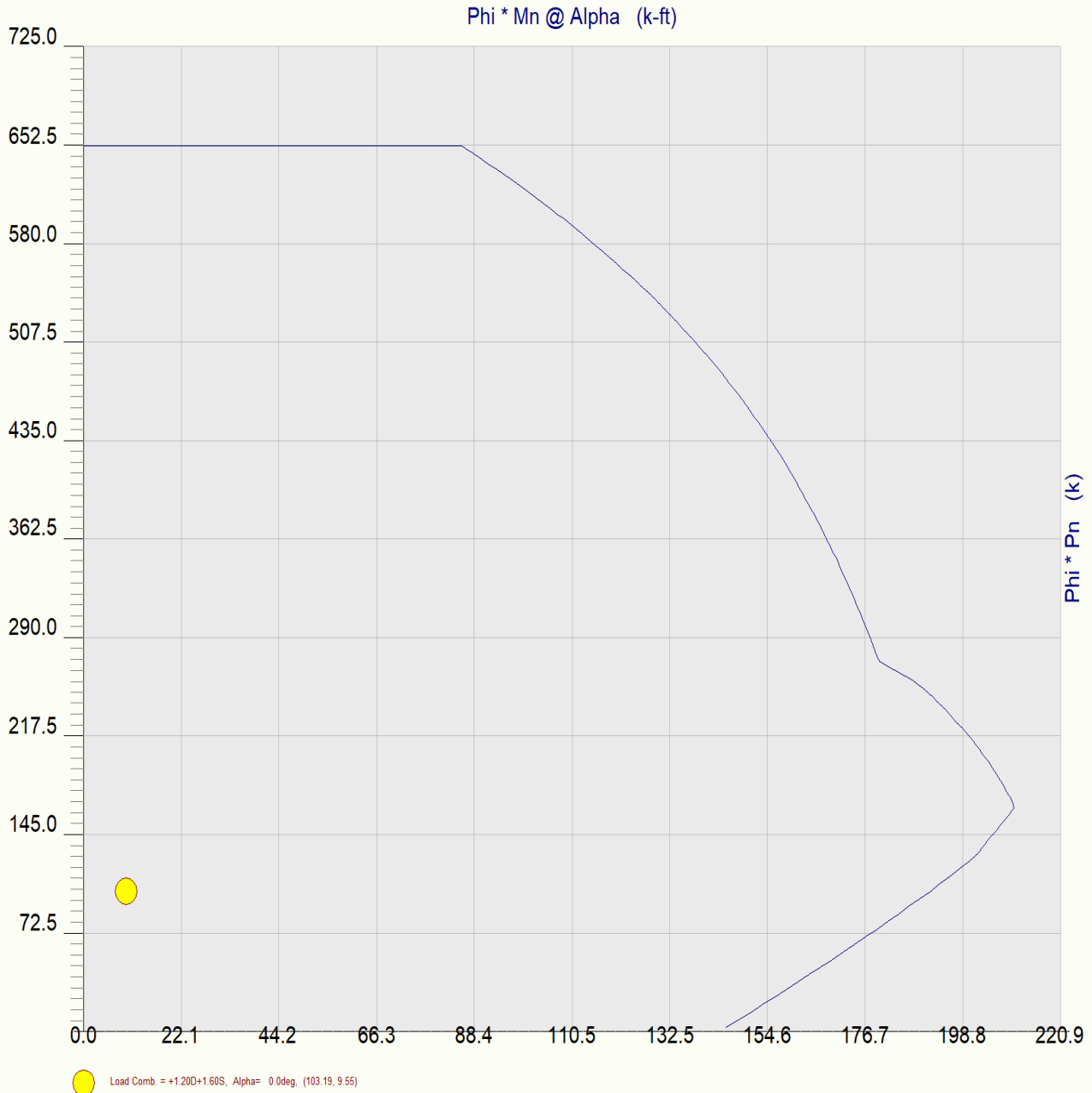
Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Fourth Floor Column**

Concrete Column P-M Interaction Diagram



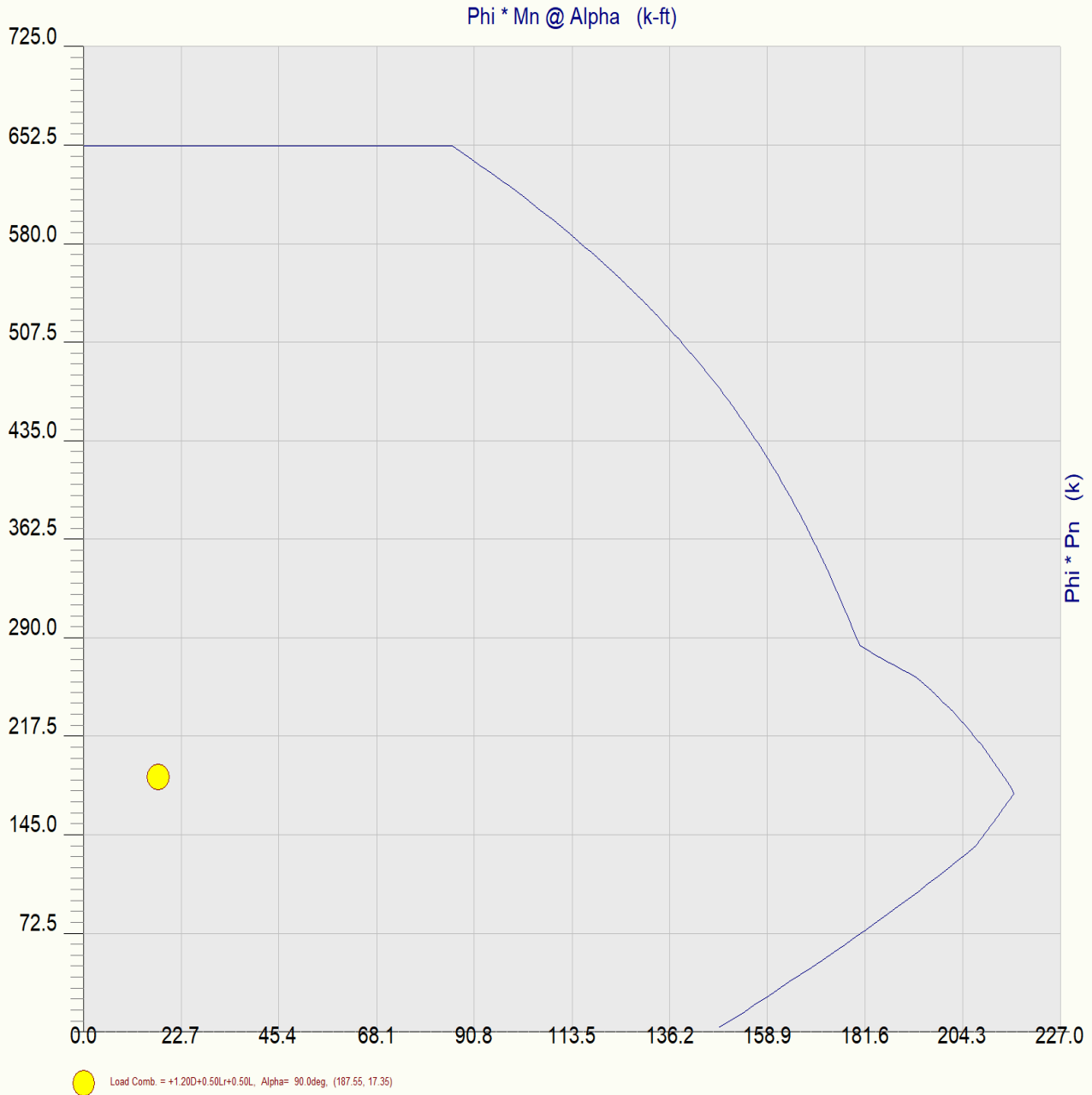
Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Fourth Floor Column**

Concrete Column P-M Interaction Diagram



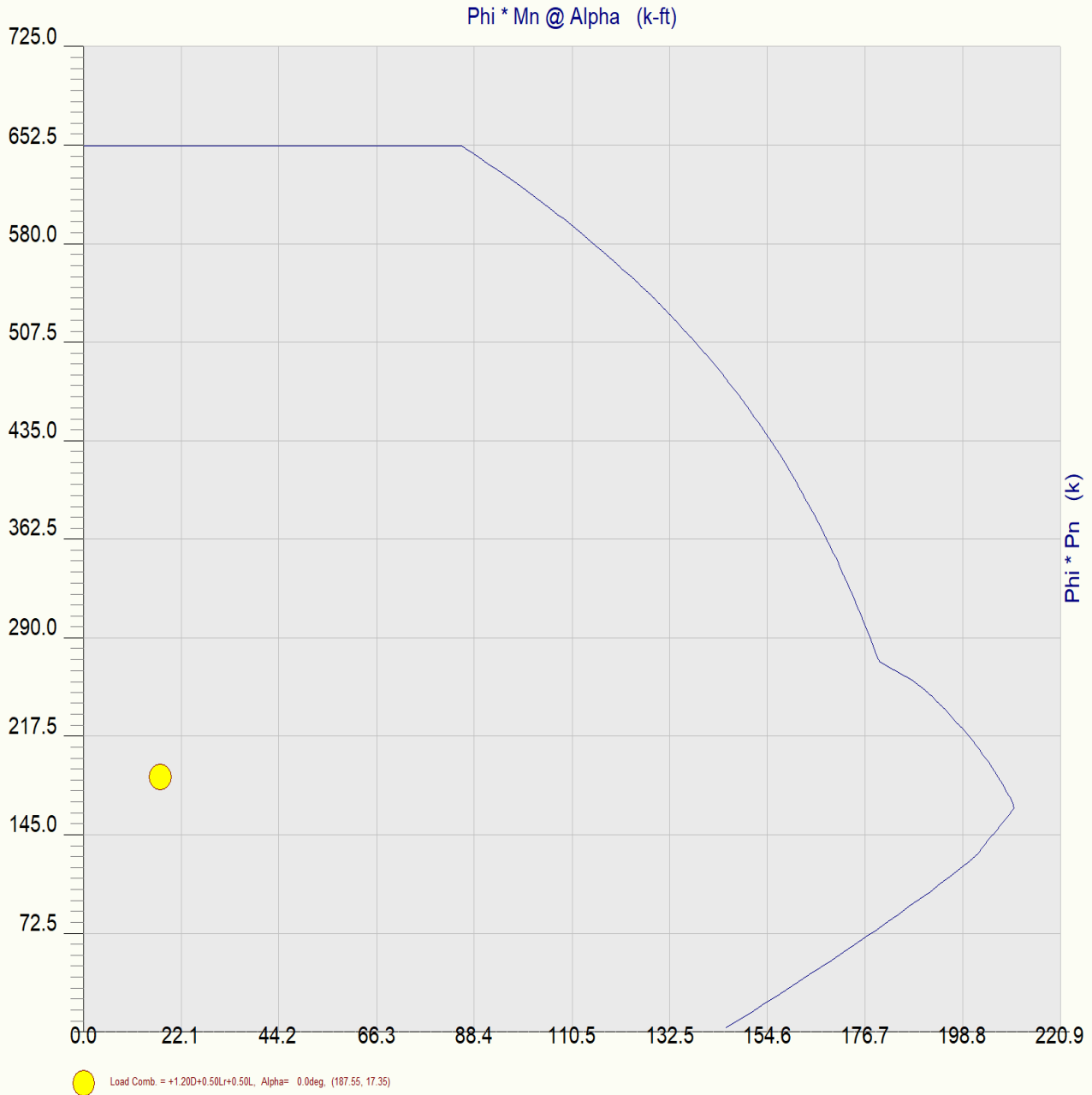
Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Fourth Floor Column**

Concrete Column P-M Interaction Diagram



Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. #: KW-06013597

DESCRIPTION: Third Floor Column

Code References

Calculations per ACI 318-14, IBC 2015, CBC 2016, ASCE 7-10

Load Combinations Used : IBC 2015

General Information

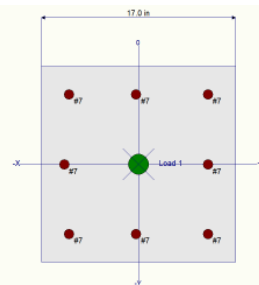
f'_c : Concrete 28 day strength = 4.0 ksi
E = 3,605.0 ksi
Density = 150.0 pcf
 β = 0.850
 f_y - Main Rebar = 60.0 ksi
E - Main Rebar = 29,000.0 ksi
Allow. Reinforcing Limits *ASTM A615 Bars Used*
Min. Reinf. = 1.0 %
Max. Reinf. = 8.0 %

Overall Column Height = 16.420 ft
End Fixity **Top & Bottom Pinned**
Brace condition for deflection (buckling) along columns :
X-X (width) axis :
Unbraced Length for buckling ABOUT Y-Y Axis = 16.420 ft, K = 1.0
Y-Y (depth) axis :
Unbraced Length for buckling ABOUT X-X Axis = 16.420 ft, K = 1.0

Column Cross Section

Column Dimensions : 17.0in Square Column, Column Edge to Rebar Edge Cover = 2.0in

Column Reinforcing : 4 - #7 bars @ corners,, 1 - #7 bars top & bottom between corner bars, 1 - #7 bars left & right between corner bars



Applied Loads

Entered loads are factored per load combinations specified by user.

Column self weight included : 4,943.10 lbs * Dead Load Factor

AXIAL LOADS ...

Roof + Tower Loads: Axial Load at 16.420 ft above base, D = 98.670, LR = 2.990, L = 194.990, S = 4.480 k

DESIGN SUMMARY

Load Combination **+1.20D+1.60L+0.50S**
Location of max. above base **16.310 ft**
Maximum Stress Ratio : 0.669 : 1
Ratio = $(P_u^2 + M_u^2)^{.5} / (\Phi P_n^2 + \Phi M_n^2)^{.5}$
 P_u = 438.560 k $\Phi * P_n$ = 652.23 k
 M_{u-x} = 0.0 k-ft $\Phi * M_{n-x}$ = 0.0 k-ft
 M_{u-y} = 40.567 k-ft $\Phi * M_{n-y}$ = 59.753 k-ft
 M_u Angle = 90.0 deg
 M_u at Angle = 40.567 k-ft ΦM_n at Angle = 60.858 k-ft

P_n & M_n values located at P_u-M_u vector intersection with capacity curve

Column Capacities ...

P_{nmax} : Nominal Max. Compressive Axial Capacity **1,254.28 k**
 P_{nmin} : Nominal Min. Tension Axial Capacity **k**
 ΦP_n , max : Usable Compressive Axial Capacity **652.23 k**
 ΦP_n , min : Usable Tension Axial Capacity **k**

Maximum SERVICE Load Reactions . .

Top along Y-Y **0.0 k** Bottom along Y-Y **0.0 k**
Top along X-X **0.0 k** Bottom along X-X **0.0 k**

Maximum SERVICE Load Deflections . .

Along Y-Y **0.0 in** at **0.0 ft** above base
for load combination :
Along X-X **0.0 in** at **0.0 ft** above base
for load combination :

General Section Information . Φ = 0.650 β = 0.850 θ = 0.80

ρ : % Reinforcing **1.661 %** Rebar % Ok
Reinforcing Area **4.80 in²**
Concrete Area **289.0 in²**

Governing Load Combination Results

Governing Factored Load Combination	Moment		Dist. from		Axial Load		Bending Analysis k-ft						Utilization	
	X-X	Y-Y	base	ft	Pu	ϕ * Pn	δ x	δ x * Mux	δ y	δ y * Muy	Alpha (deg)	δ Mu	ϕ Mn	Ratio
+1.40D		M2,min	16.31		145.06	652.23			1.000	13.42	90.000	13.42	60.86	0.221
+1.40D	M2,min		16.31		145.06	652.23	1.000	13.42			0.000	13.42	60.91	0.221
+1.20D+0.50Lr+1.60L		M2,min	16.31		437.81	652.23			1.000	40.50	90.000	40.50	60.86	0.668

Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: Third Floor Column

Governing Load Combination Results

Governing Factored Load Combination	Moment		Dist. from base ft	Axial Load k		Bending Analysis k-ft								Utilization	
	X-X	Y-Y		Pu	ϕ * Pn	δ x	δ x * Mu _x	δ y	δ y * Mu _y	Alpha (deg)	δ Mu	ϕ Mn	Ratio		
+1.20D+0.50Lr+1.60L	M2,min		16.31	437.81	652.23	1.000	40.50			0.000	40.50	60.91	0.668		
+1.20D+1.60L+0.50S		M2,min	16.31	438.56	652.23			1.000	40.57	90.000	40.57	60.86	0.669		
+1.20D+1.60L+0.50S	M2,min		16.31	438.56	652.23	1.000	40.57			0.000	40.57	60.91	0.669		
+1.20D+1.60Lr+0.50L		M2,min	16.31	226.61	652.23			1.000	20.96	90.000	20.96	60.86	0.346		
+1.20D+1.60Lr+0.50L	M2,min		16.31	226.61	652.23	1.000	20.96			0.000	20.96	60.91	0.346		
+1.20D+1.60Lr		M2,min	16.31	129.12	652.23			1.000	11.94	90.000	11.94	60.86	0.197		
+1.20D+1.60Lr	M2,min		16.31	129.12	652.23	1.000	11.94			0.000	11.94	60.91	0.197		
+1.20D+0.50L+1.60S		M2,min	16.31	229.00	652.23			1.000	21.18	90.000	21.18	60.86	0.349		
+1.20D+0.50L+1.60S	M2,min		16.31	229.00	652.23	1.000	21.18			0.000	21.18	60.91	0.349		
+1.20D+1.60S		M2,min	16.31	131.50	652.23			1.000	12.16	90.000	12.16	60.86	0.201		
+1.20D+1.60S	M2,min		16.31	131.50	652.23	1.000	12.16			0.000	12.16	60.91	0.201		
+1.20D+0.50Lr+0.50L		M2,min	16.31	223.33	652.23			1.000	20.66	90.000	20.66	60.86	0.341		
+1.20D+0.50Lr+0.50L	M2,min		16.31	223.33	652.23	1.000	20.66			0.000	20.66	60.91	0.341		
+1.20D+0.50L+0.50S		M2,min	16.31	224.07	652.23			1.000	20.73	90.000	20.73	60.86	0.342		
+1.20D+0.50L+0.50S	M2,min		16.31	224.07	652.23	1.000	20.73			0.000	20.73	60.91	0.342		
+1.20D+0.50L+0.70S		M2,min	16.31	224.97	652.23			1.000	20.81	90.000	20.81	60.86	0.343		
+1.20D+0.50L+0.70S	M2,min		16.31	224.97	652.23	1.000	20.81			0.000	20.81	60.91	0.343		
+0.90D		M2,min	16.31	93.25	652.23			1.000	8.63	90.000	8.63	60.86	0.142		
+0.90D	M2,min		16.31	93.25	652.23	1.000	8.63			0.000	8.63	60.91	0.142		

Maximum Reactions

Note: Only non-zero reactions are listed.

Load Combination	X-X Axis Reaction		k	Y-Y Axis Reaction		Axial Reaction @ Base	My - End Moments k-ft		Mx - End Moments	
	@ Base	@ Top		@ Base	@ Top		@ Base	@ Top	@ Base	@ Top
D Only						103.613				
+D+L						298.603				
+D+Lr						106.603				
+D+S						108.093				
+D+0.750Lr+0.750L						252.098				
+D+0.750L+0.750S						253.216				
+0.60D						62.168				
Lr Only						2.990				
L Only						194.990				
S Only						4.480				

Maximum Moment Reactions

Note: Only non-zero reactions are listed.

Load Combination	Moment About X-X Axis			Moment About Y-Y Axis		
	@ Base	@ Top		@ Base	@ Top	
D Only			k-ft			k-ft
+D+L			k-ft			k-ft
+D+Lr			k-ft			k-ft
+D+S			k-ft			k-ft
+D+0.750Lr+0.750L			k-ft			k-ft
+D+0.750L+0.750S			k-ft			k-ft
+0.60D			k-ft			k-ft
Lr Only			k-ft			k-ft
L Only			k-ft			k-ft
S Only			k-ft			k-ft

Maximum Deflections for Load Combinations

Load Combination	Max. X-X Deflection		Distance		Max. Y-Y Deflection		Distance	
D Only	0.0000	in	0.000	ft	0.000	in	0.000	ft
+D+L	0.0000	in	0.000	ft	0.000	in	0.000	ft
+D+Lr	0.0000	in	0.000	ft	0.000	in	0.000	ft
+D+S	0.0000	in	0.000	ft	0.000	in	0.000	ft
+D+0.750Lr+0.750L	0.0000	in	0.000	ft	0.000	in	0.000	ft
+D+0.750L+0.750S	0.0000	in	0.000	ft	0.000	in	0.000	ft
+0.60D	0.0000	in	0.000	ft	0.000	in	0.000	ft

Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

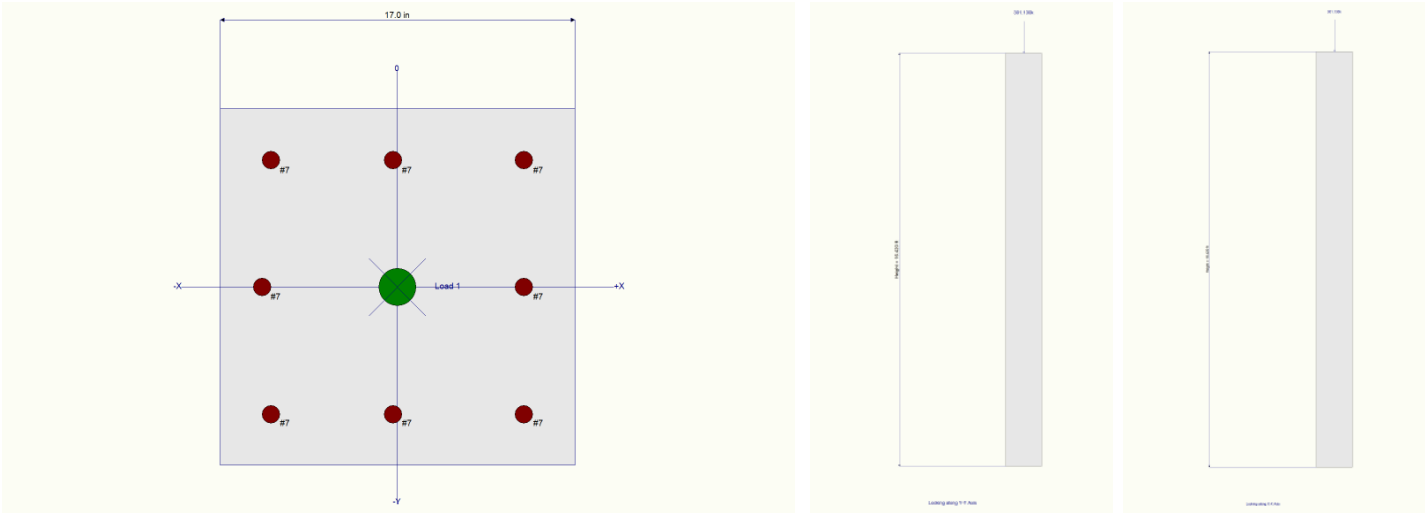
Lic. # : KW-06013597

DESCRIPTION: Third Floor Column

Maximum Deflections for Load Combinations

Load Combination	Max. X-X Deflection		Distance		Max. Y-Y Deflection		Distance	
Lr Only	0.0000	in	0.000	ft	0.000	in	0.000	ft
L Only	0.0000	in	0.000	ft	0.000	in	0.000	ft
S Only	0.0000	in	0.000	ft	0.000	in	0.000	ft

Sketches



Interaction Diagrams

Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Third Floor Column**

Concrete Column P-M Interaction Diagram



Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Third Floor Column**

Concrete Column P-M Interaction Diagram



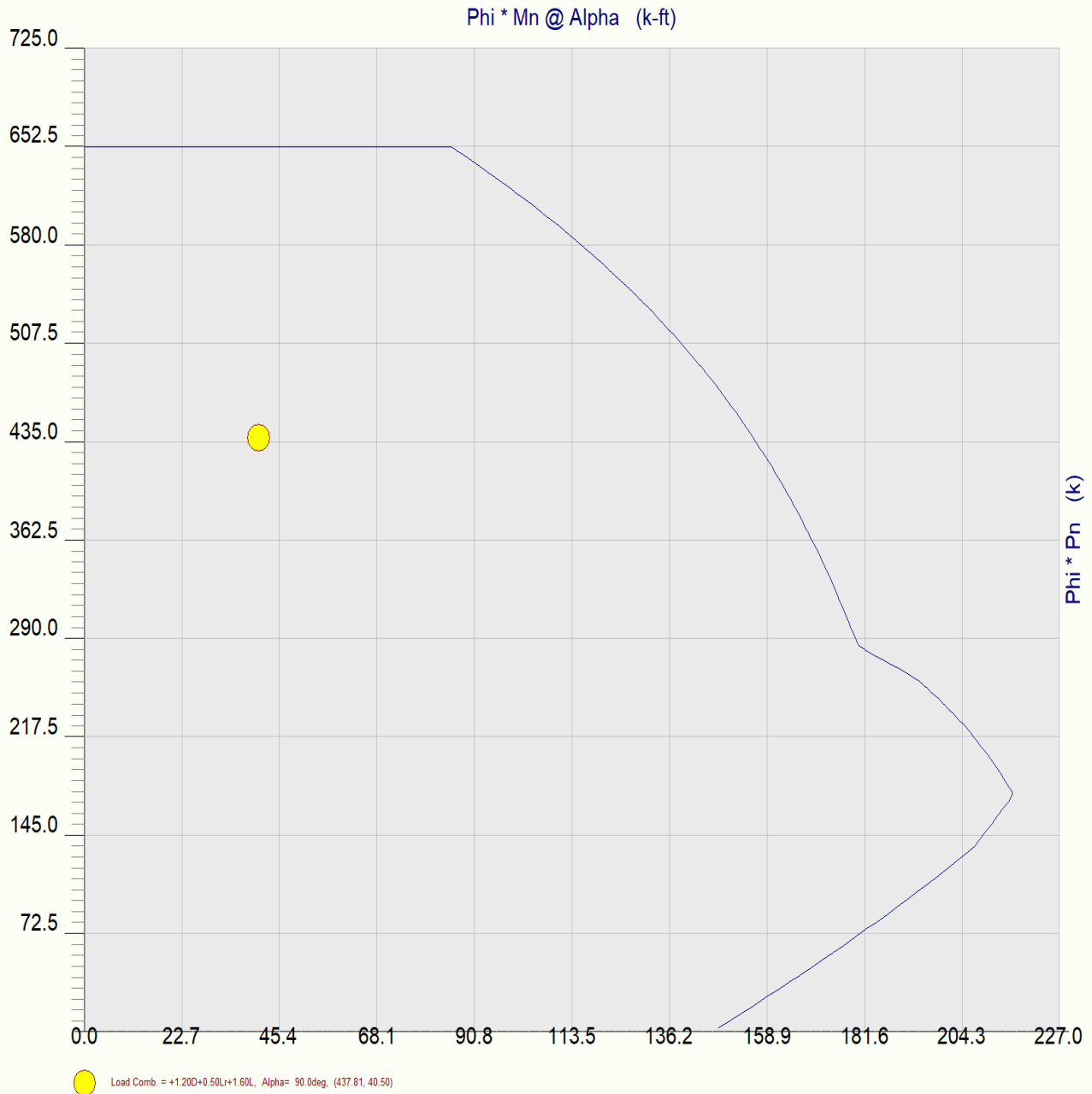
Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. #: KW-06013597

DESCRIPTION: **Third Floor Column**

Concrete Column P-M Interaction Diagram



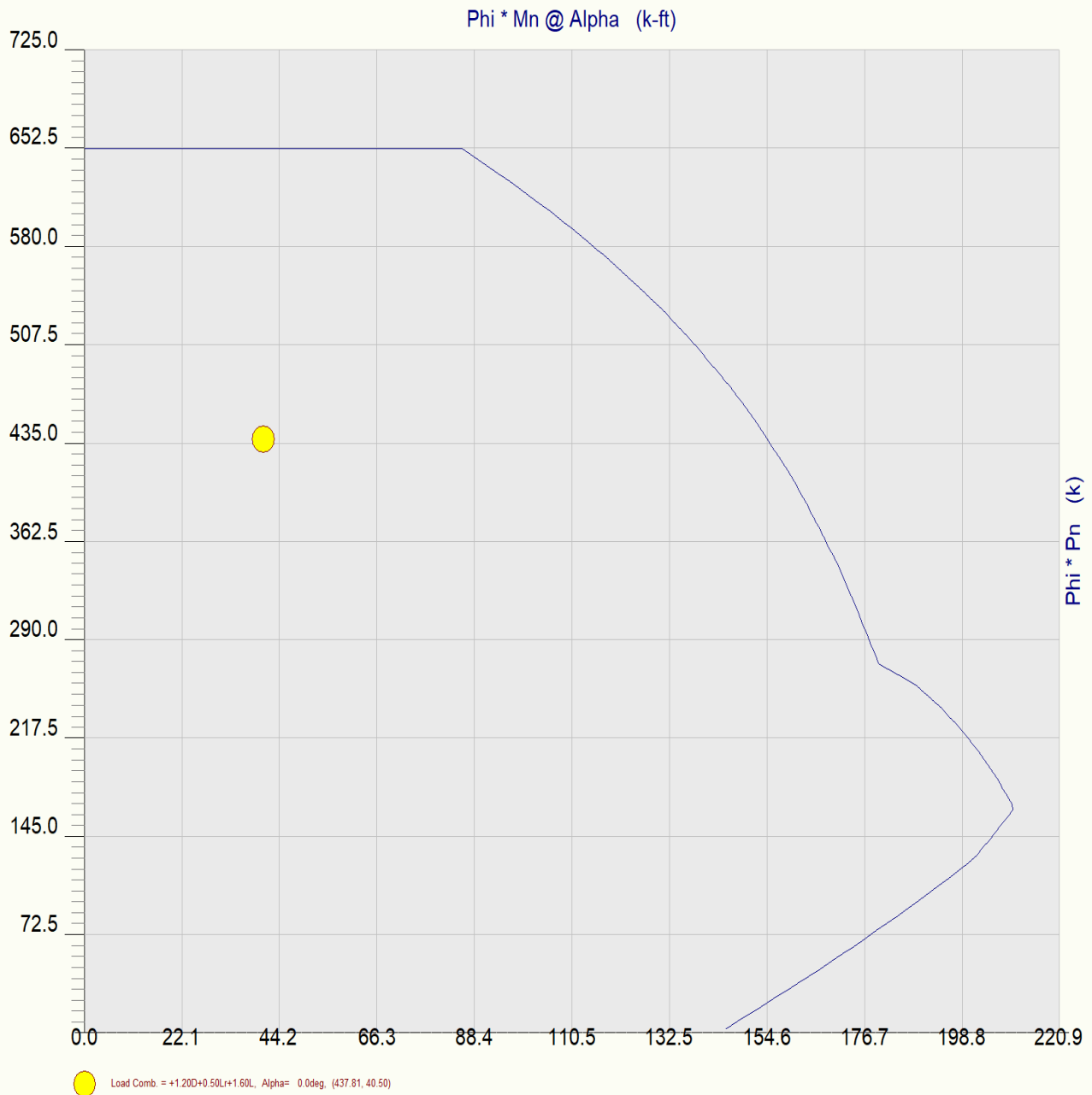
Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Third Floor Column**

Concrete Column P-M Interaction Diagram



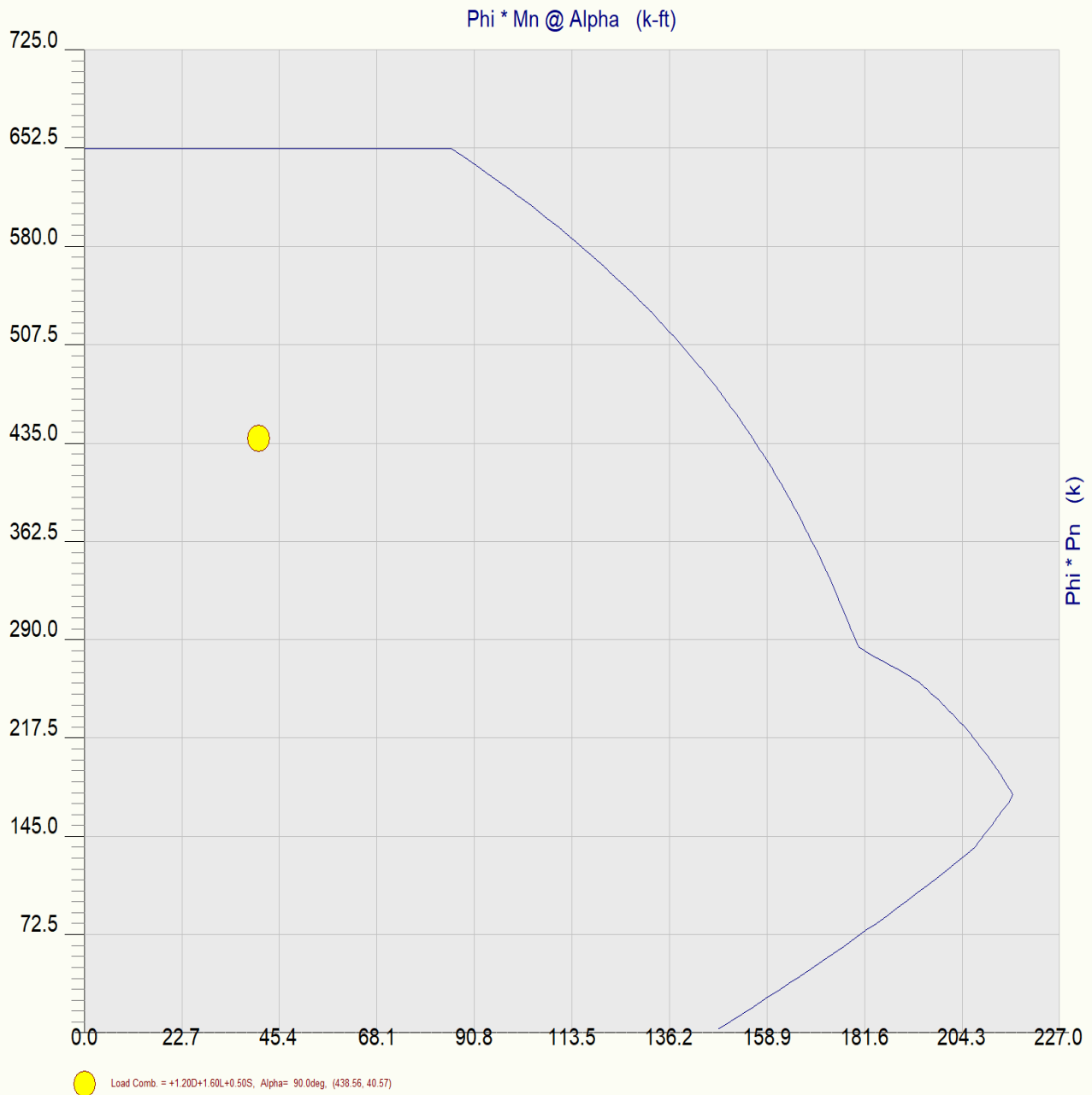
Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. #: KW-06013597

DESCRIPTION: **Third Floor Column**

Concrete Column P-M Interaction Diagram



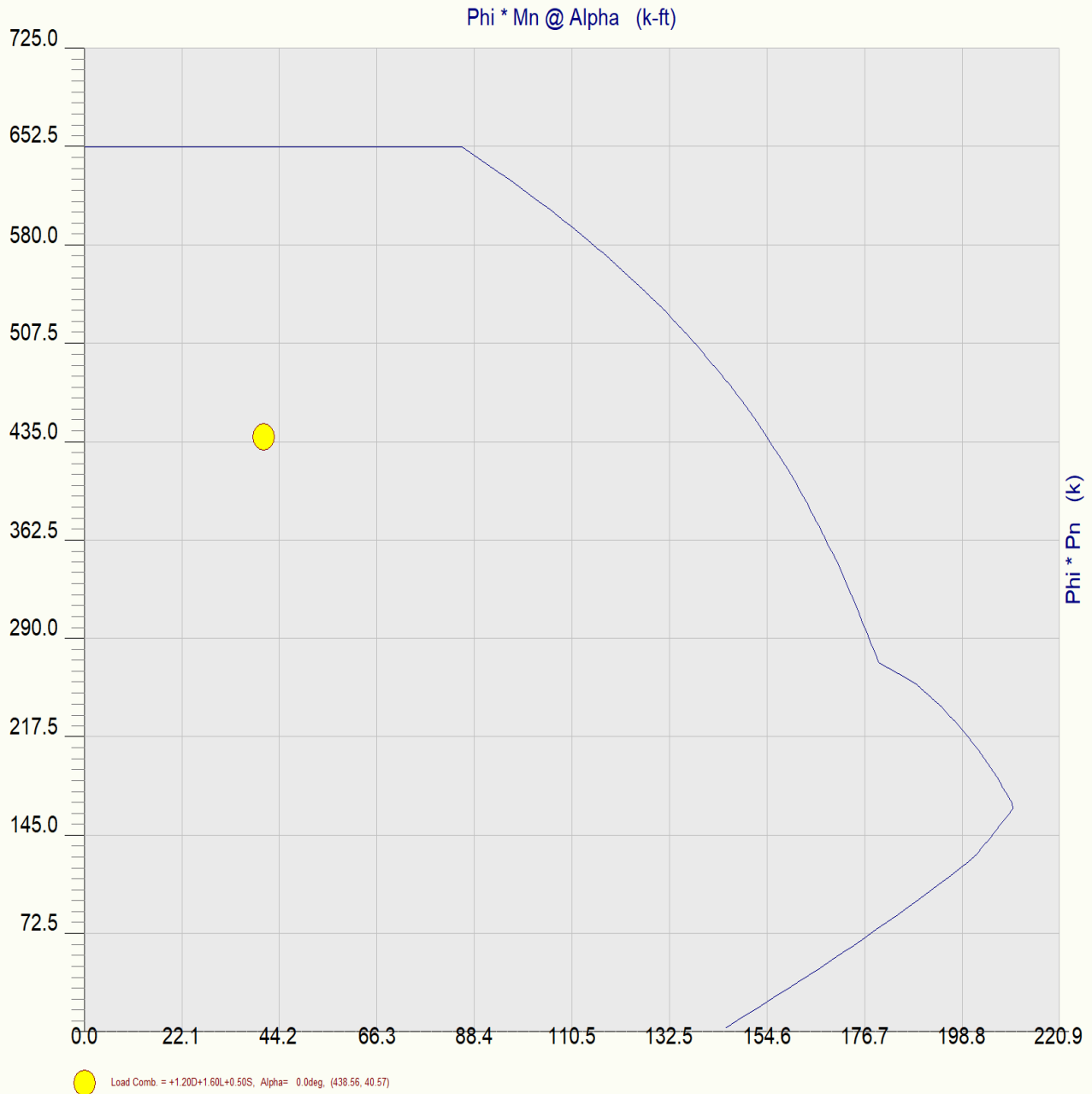
Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Third Floor Column**

Concrete Column P-M Interaction Diagram



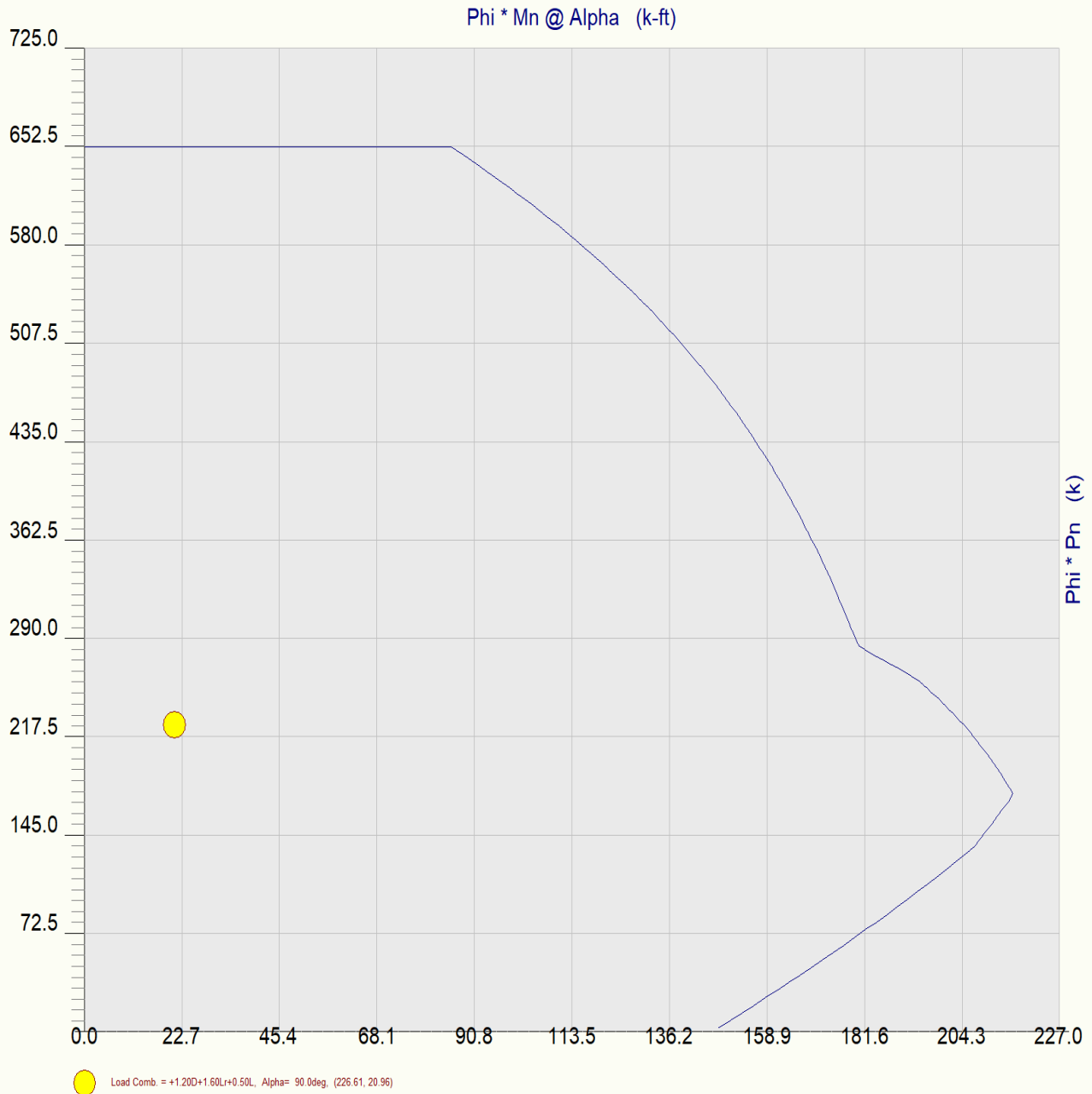
Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Third Floor Column**

Concrete Column P-M Interaction Diagram



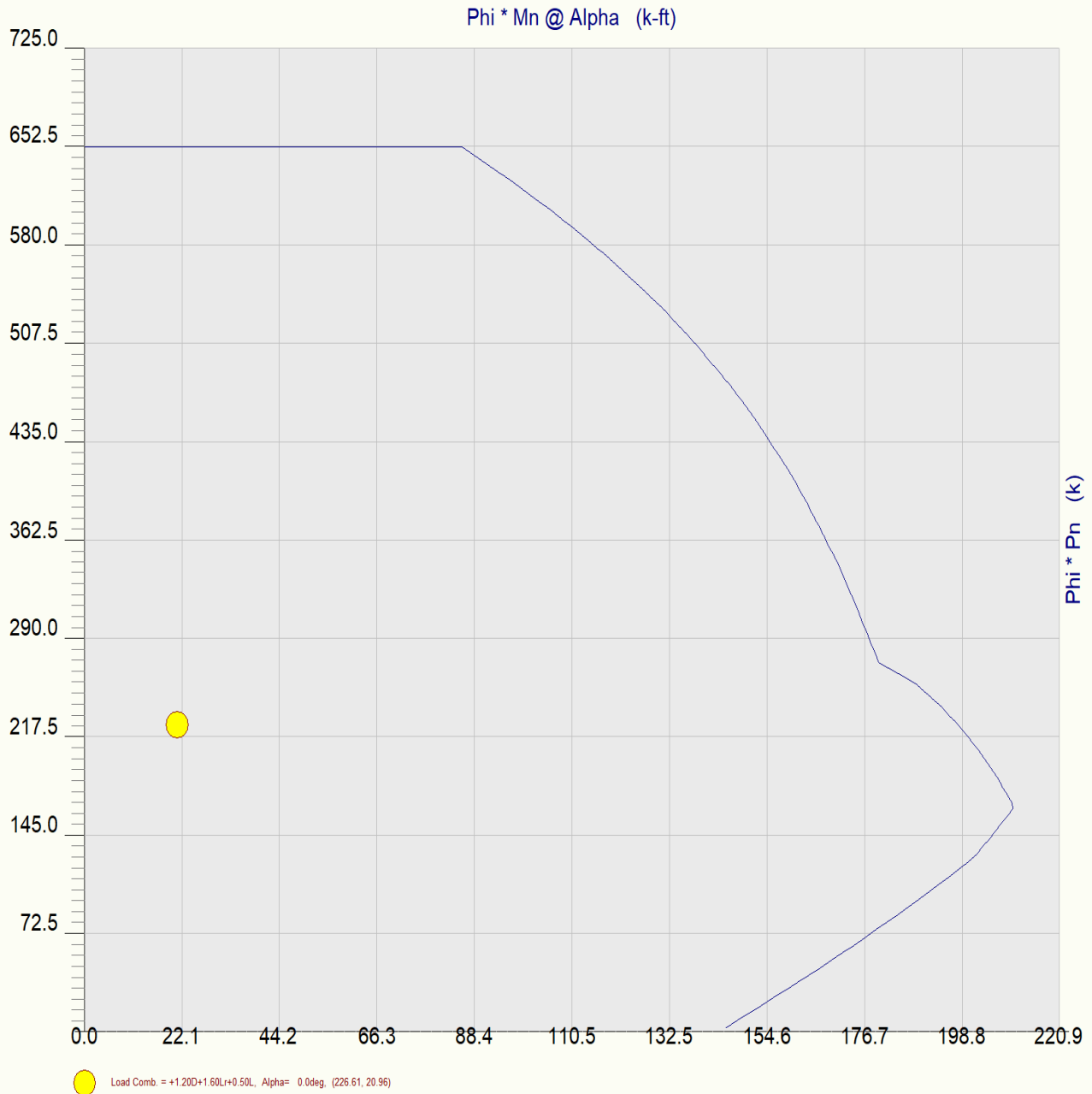
Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Third Floor Column**

Concrete Column P-M Interaction Diagram



Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Third Floor Column**

Concrete Column P-M Interaction Diagram



Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Third Floor Column**

Concrete Column P-M Interaction Diagram



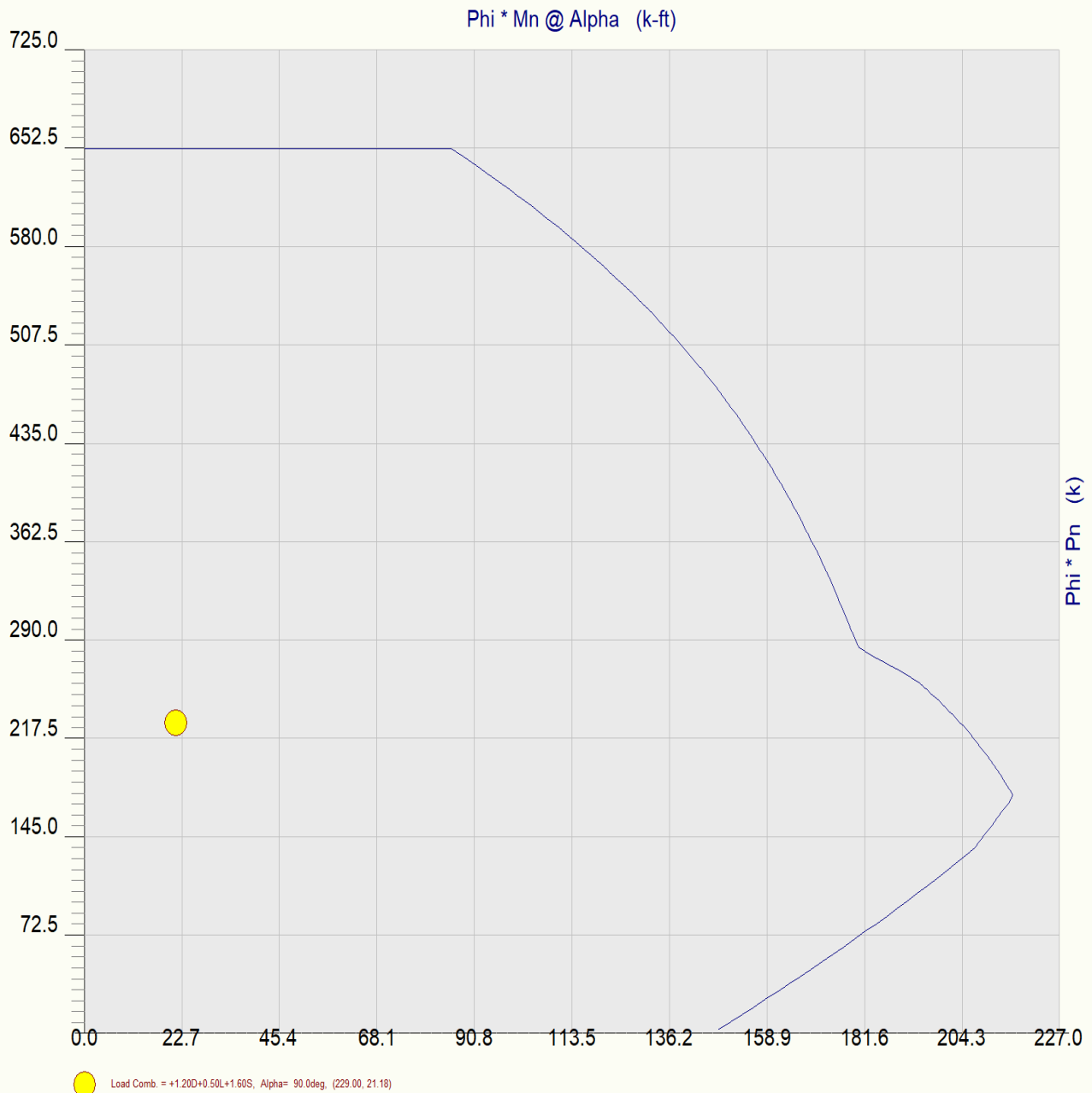
Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Third Floor Column**

Concrete Column P-M Interaction Diagram



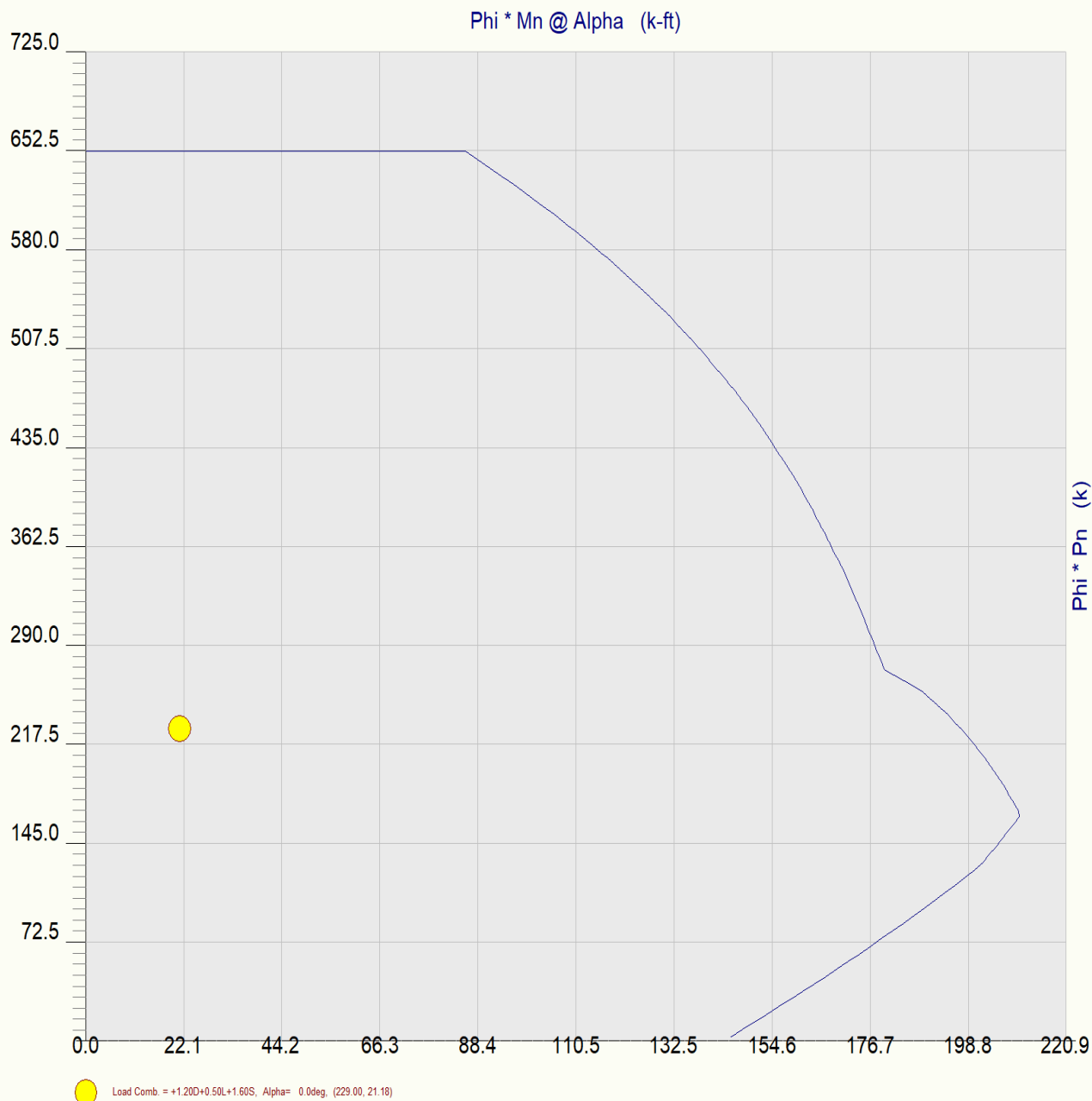
Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Third Floor Column**

Concrete Column P-M Interaction Diagram



Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Third Floor Column**

Concrete Column P-M Interaction Diagram



Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Third Floor Column**

Concrete Column P-M Interaction Diagram



Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Third Floor Column**

Concrete Column P-M Interaction Diagram



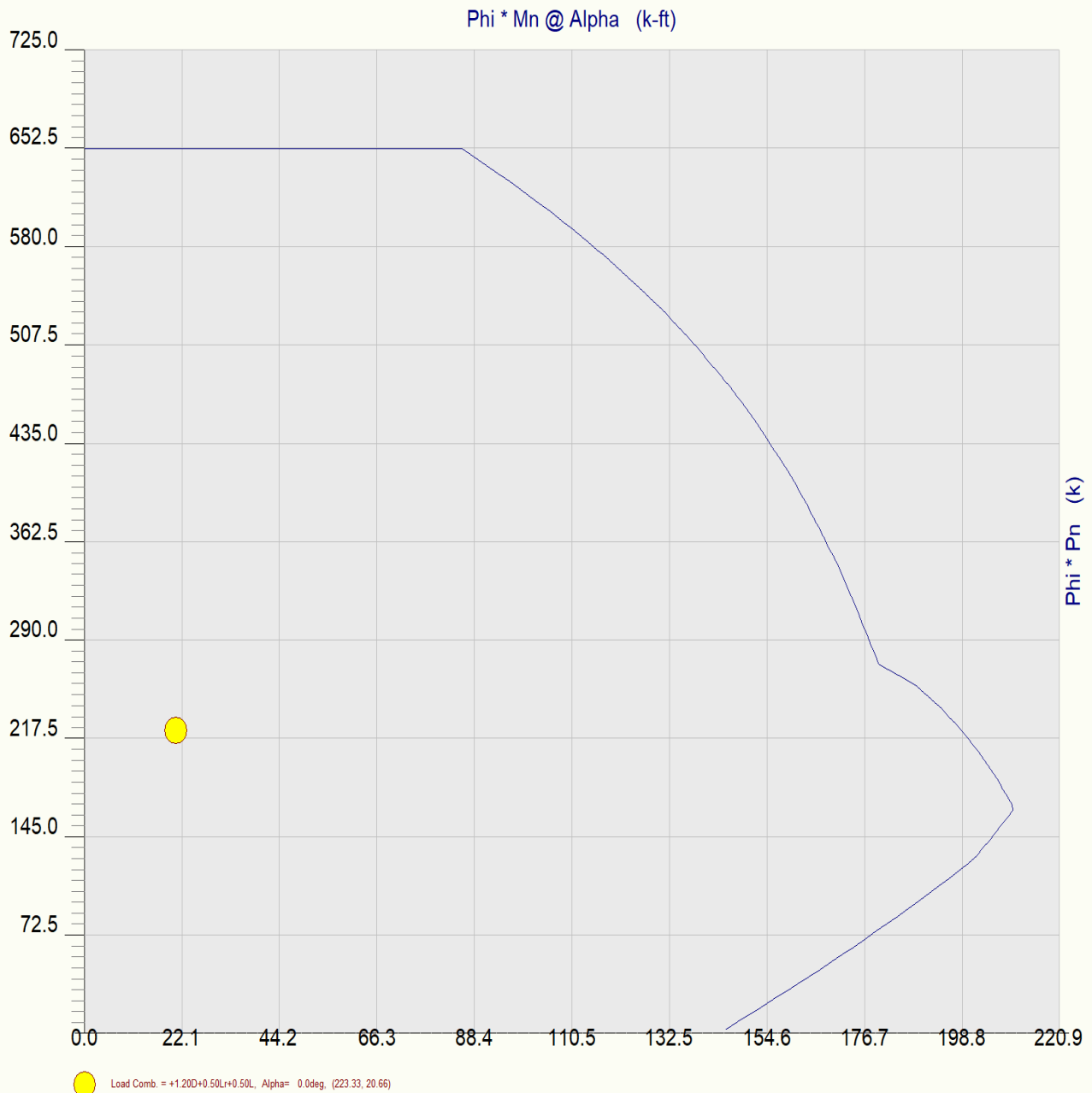
Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Third Floor Column**

Concrete Column P-M Interaction Diagram



Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. #: KW-06013597

DESCRIPTION: Second Floor Column

Code References

Calculations per ACI 318-14, IBC 2015, CBC 2016, ASCE 7-10

Load Combinations Used : IBC 2015

General Information

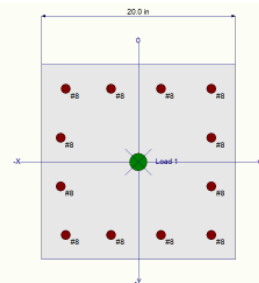
f'_c : Concrete 28 day strength = 4.0 ksi
 E = 3,605.0 ksi
 Density = 150.0 pcf
 β = 0.850
 f_y - Main Rebar = 60.0 ksi
 E - Main Rebar = 29,000.0 ksi
 Allow. Reinforcing Limits *ASTM A615 Bars Used*
 Min. Reinf. = 1.0 %
 Max. Reinf. = 8.0 %

Overall Column Height = 15.580 ft
 End Fixity **Top & Bottom Pinned**
 Brace condition for deflection (buckling) along columns :
 X-X (width) axis :
 Unbraced Length for buckling ABOUT Y-Y Axis = 15.580 ft, K = 1.0
 Y-Y (depth) axis :
 Unbraced Length for buckling ABOUT X-X Axis = 15.580 ft, K = 1.0

Column Cross Section

Column Dimensions : 20.0in Square Column, Column Edge to Rebar Edge Cover = 2.0in

 Column Reinforcing : 4 - #8 bars @ corners,, 2 - #8 bars top & bottom between corner bars, 2 - #8 bars left & right between corner bars



Applied Loads

Entered loads are factored per load combinations specified by user.

Column self weight included : 6,491.67 lbs * Dead Load Factor

AXIAL LOADS ...

Roof + Tower Loads: Axial Load at 15.580 ft above base, D = 122.290, LR = 2.990, L = 209.930, S = 4.480 k

DESIGN SUMMARY

Load Combination **+1.20D+1.60L+0.50S**
 Location of max. above base **15.475 ft**
Maximum Stress Ratio : 0.500 : 1
 $\text{Ratio} = (P_u^2 + M_u^2)^{.5} / (\Phi P_n^2 + \Phi M_n^2)^{.5}$
 $P_u = 492.666$ k $\Phi * P_n = 986.22$ k
 $M_{u-x} = 0.0$ k-ft $\Phi * M_{n-x} = 0.0$ k-ft
 $M_{u-y} = 0.0$ k-ft $\Phi * M_{n-y} = 0.0$ k-ft
 $M_u \text{ Angle} = 0.0$ deg
 $M_u \text{ at Angle} = 0.0$ k-ft $\Phi M_n \text{ at Angle} = 0.0$ k-ft

P_n & M_n values located at P_u-M_u vector intersection with capacity curve

Column Capacities ...

P_{nmax} : Nominal Max. Compressive Axial Capacity **1,896.57** k
 P_{nmin} : Nominal Min. Tension Axial Capacity k
 ΦP_n , max : Usable Compressive Axial Capacity **986.22** k
 ΦP_n , min : Usable Tension Axial Capacity k

Maximum SERVICE Load Reactions . .

Top along Y-Y **0.0** k Bottom along Y-Y **0.0** k
 Top along X-X **0.0** k Bottom along X-X **0.0** k

Maximum SERVICE Load Deflections . .

Along Y-Y **0.0** in at **0.0** ft above base
 for load combination :
 Along X-X **0.0** in at **0.0** ft above base
 for load combination :

General Section Information . $\Phi = 0.650$ $\beta = 0.850$ $\theta = 0.80$

ρ : % Reinforcing **2.370** % Rebar % Ok
 Reinforcing Area **9.480** in²
 Concrete Area **400.0** in²

Governing Load Combination Results

Governing Factored Load Combination	Moment		Dist. from base ft	Axial Load k		Bending Analysis k-ft						Utilization	
	X-X	Y-Y		Pu	ϕ * Pn	δ x	δ x * Mux	δ y	δ y * Muy	Alpha (deg)	δ Mu	ϕ Mn	Ratio
+1.40D			15.48	180.29	986.22					0.000			0.183
+1.20D+0.50Lr+1.60L			15.48	491.92	986.22					0.000			0.499
+1.20D+1.60L+0.50S			15.48	492.67	986.22					0.000			0.500

Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. #: KW-06013597

DESCRIPTION: Second Floor Column

Governing Load Combination Results

Governing Factored Load Combination	Moment		Dist. from base	ft	Axial Load k		Bending Analysis k-ft						Utilization	
	X-X	Y-Y			Pu	$\phi * P_n$	δx	$\delta x * M_{ux}$	δy	$\delta y * M_{uy}$	Alpha (deg)	δM_u	ϕM_n	Ratio
+1.20D+1.60Lr+0.50L			15.48		264.29	986.22					0.000			0.268
+1.20D+1.60Lr			15.48		159.32	986.22					0.000			0.162
+1.20D+0.50L+1.60S			15.48		266.67	986.22					0.000			0.270
+1.20D+1.60S			15.48		161.71	986.22					0.000			0.164
+1.20D+0.50Lr+0.50L			15.48		261.00	986.22					0.000			0.265
+1.20D+0.50L+0.50S			15.48		261.74	986.22					0.000			0.265
+1.20D+0.50L+0.70S			15.48		262.64	986.22					0.000			0.266
+0.90D			15.48		115.90	986.22					0.000			0.118

Maximum Reactions

Note: Only non-zero reactions are listed.

Load Combination	X-X Axis Reaction		k	Y-Y Axis Reaction		Axial Reaction	My - End Moments		k-ft	Mx - End Moments	
	@ Base	@ Top		@ Base	@ Top		@ Base	@ Top		@ Base	@ Top
D Only						128.782					
+D+L						338.712					
+D+Lr						131.772					
+D+S						133.262					
+D+0.750Lr+0.750L						288.472					
+D+0.750L+0.750S						289.589					
+0.60D						77.269					
Lr Only						2.990					
L Only						209.930					
S Only						4.480					

Maximum Moment Reactions

Note: Only non-zero reactions are listed.

Load Combination	Moment About X-X Axis			Moment About Y-Y Axis		
	@ Base	@ Top		@ Base	@ Top	
D Only			k-ft			k-ft
+D+L			k-ft			k-ft
+D+Lr			k-ft			k-ft
+D+S			k-ft			k-ft
+D+0.750Lr+0.750L			k-ft			k-ft
+D+0.750L+0.750S			k-ft			k-ft
+0.60D			k-ft			k-ft
Lr Only			k-ft			k-ft
L Only			k-ft			k-ft
S Only			k-ft			k-ft

Maximum Deflections for Load Combinations

Load Combination	Max. X-X Deflection		Distance		Max. Y-Y Deflection		Distance	
D Only	0.0000	in	0.000	ft	0.000	in	0.000	ft
+D+L	0.0000	in	0.000	ft	0.000	in	0.000	ft
+D+Lr	0.0000	in	0.000	ft	0.000	in	0.000	ft
+D+S	0.0000	in	0.000	ft	0.000	in	0.000	ft
+D+0.750Lr+0.750L	0.0000	in	0.000	ft	0.000	in	0.000	ft
+D+0.750L+0.750S	0.0000	in	0.000	ft	0.000	in	0.000	ft
+0.60D	0.0000	in	0.000	ft	0.000	in	0.000	ft
Lr Only	0.0000	in	0.000	ft	0.000	in	0.000	ft
L Only	0.0000	in	0.000	ft	0.000	in	0.000	ft
S Only	0.0000	in	0.000	ft	0.000	in	0.000	ft

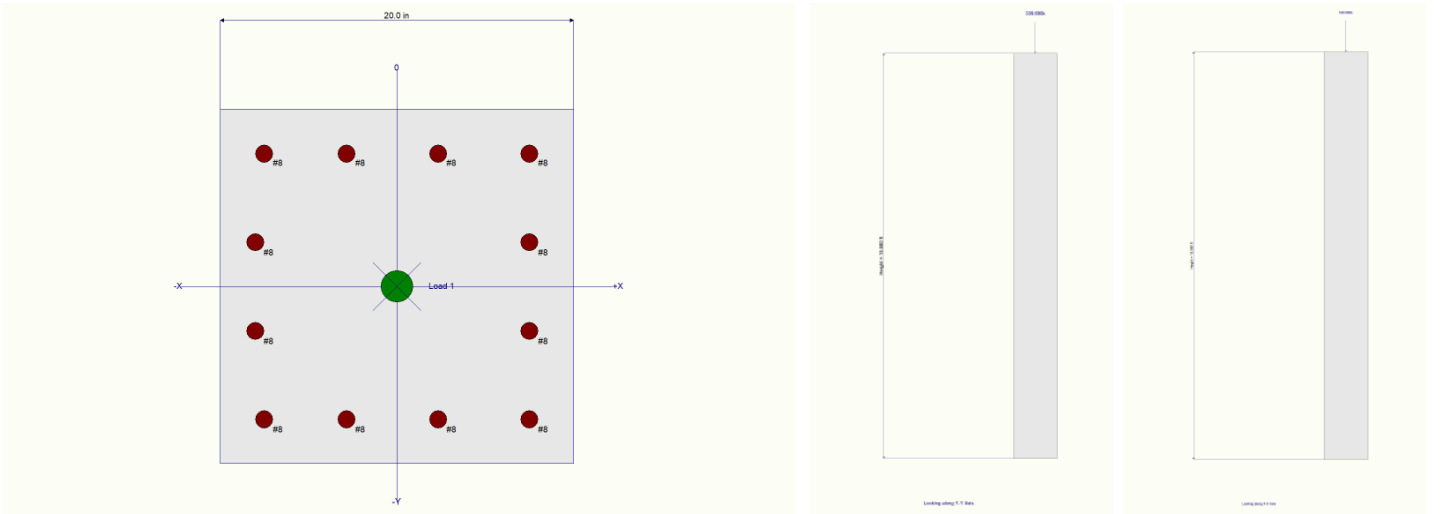
Concrete Column

Lic. # : KW-06013597

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

DESCRIPTION: **Second Floor Column**

Sketches



Interaction Diagrams

Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

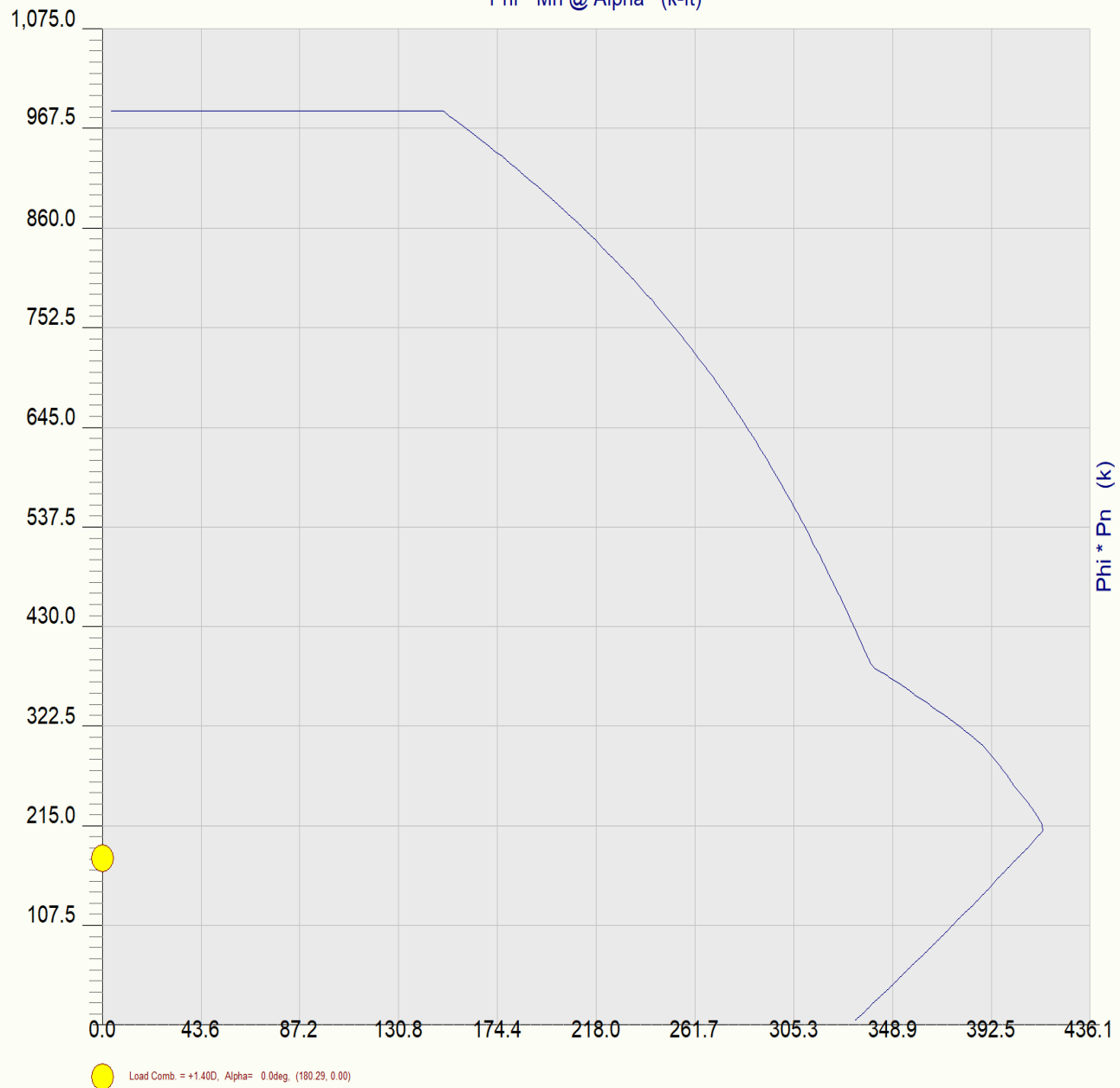
Lic. # : KW-06013597

DESCRIPTION: **Second Floor Column**

Concrete Column P-M Interaction Diagram

$\Phi * M_n @ \alpha$ (k-ft)

$\Phi * P_n$ (k)



Concrete Column

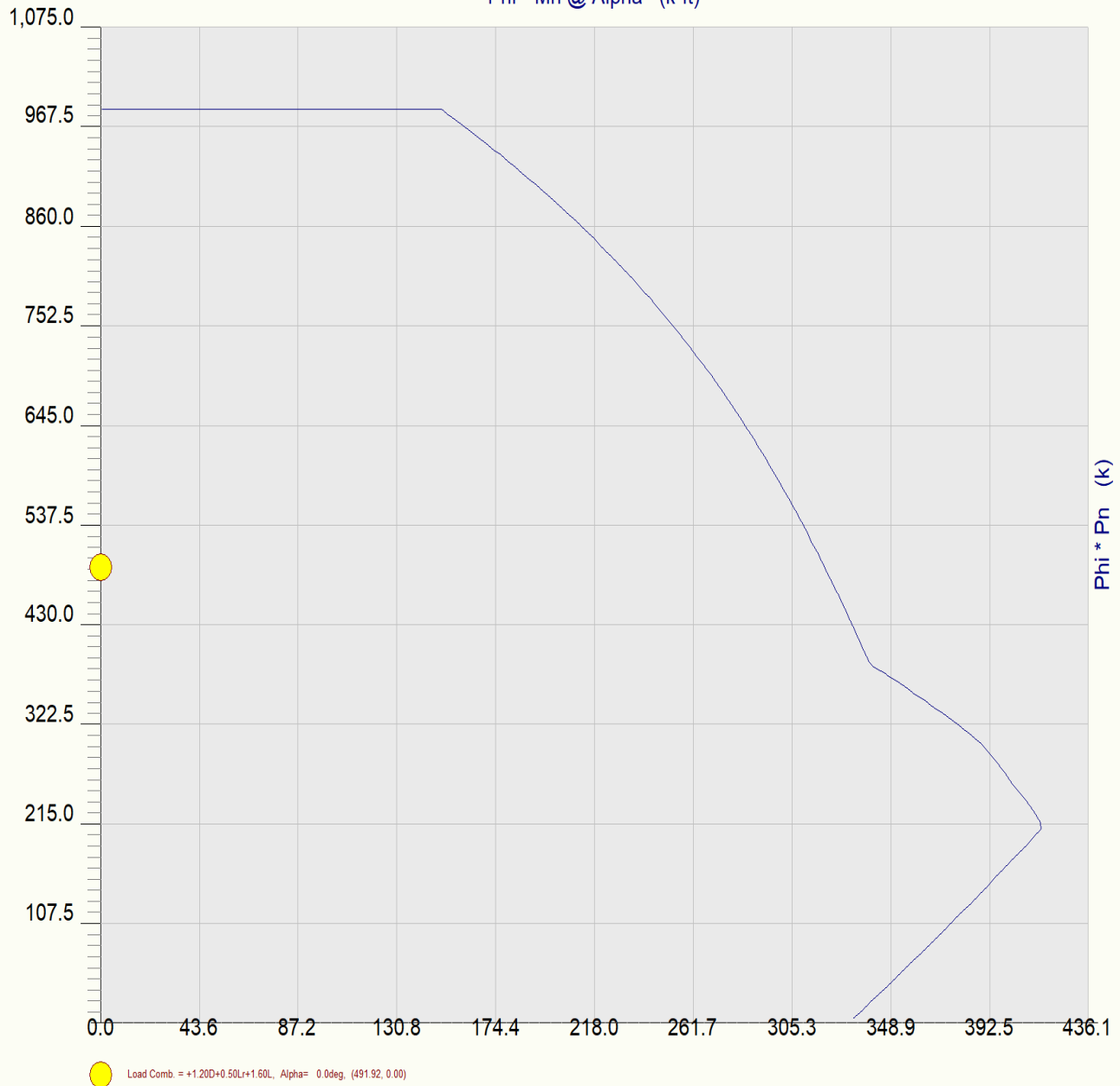
File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Second Floor Column**

Concrete Column P-M Interaction Diagram

Phi * Mn @ Alpha (k-ft)



Concrete Column

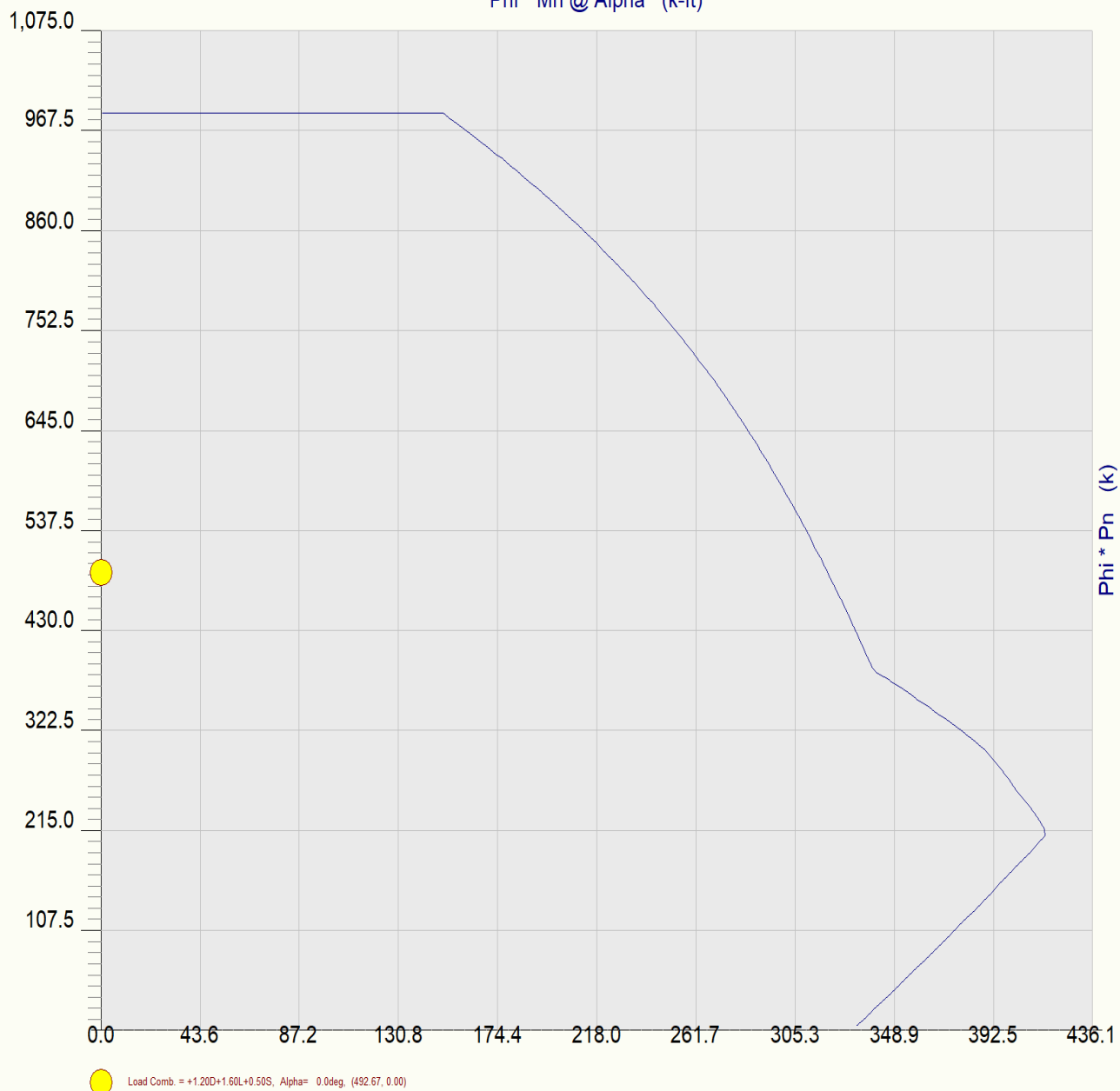
Lic. # : KW-06013597

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

DESCRIPTION: **Second Floor Column**

Concrete Column P-M Interaction Diagram

Phi * Mn @ Alpha (k-ft)



Concrete Column

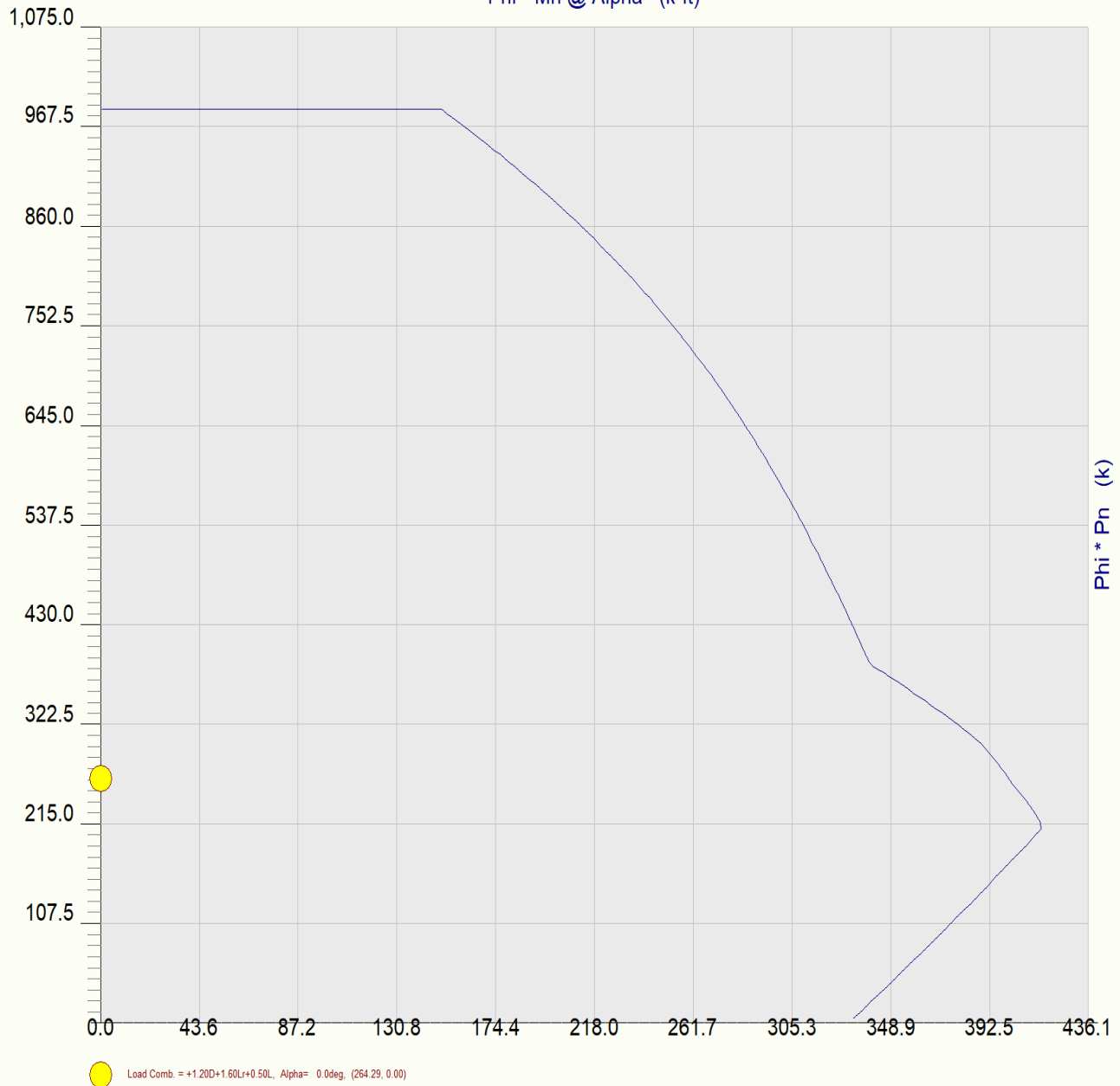
File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Second Floor Column**

Concrete Column P-M Interaction Diagram

Phi * Mn @ Alpha (k-ft)



Concrete Column

Lic. # : KW-06013597

File: 638283 Exterior Column Analysis.ec6

Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24

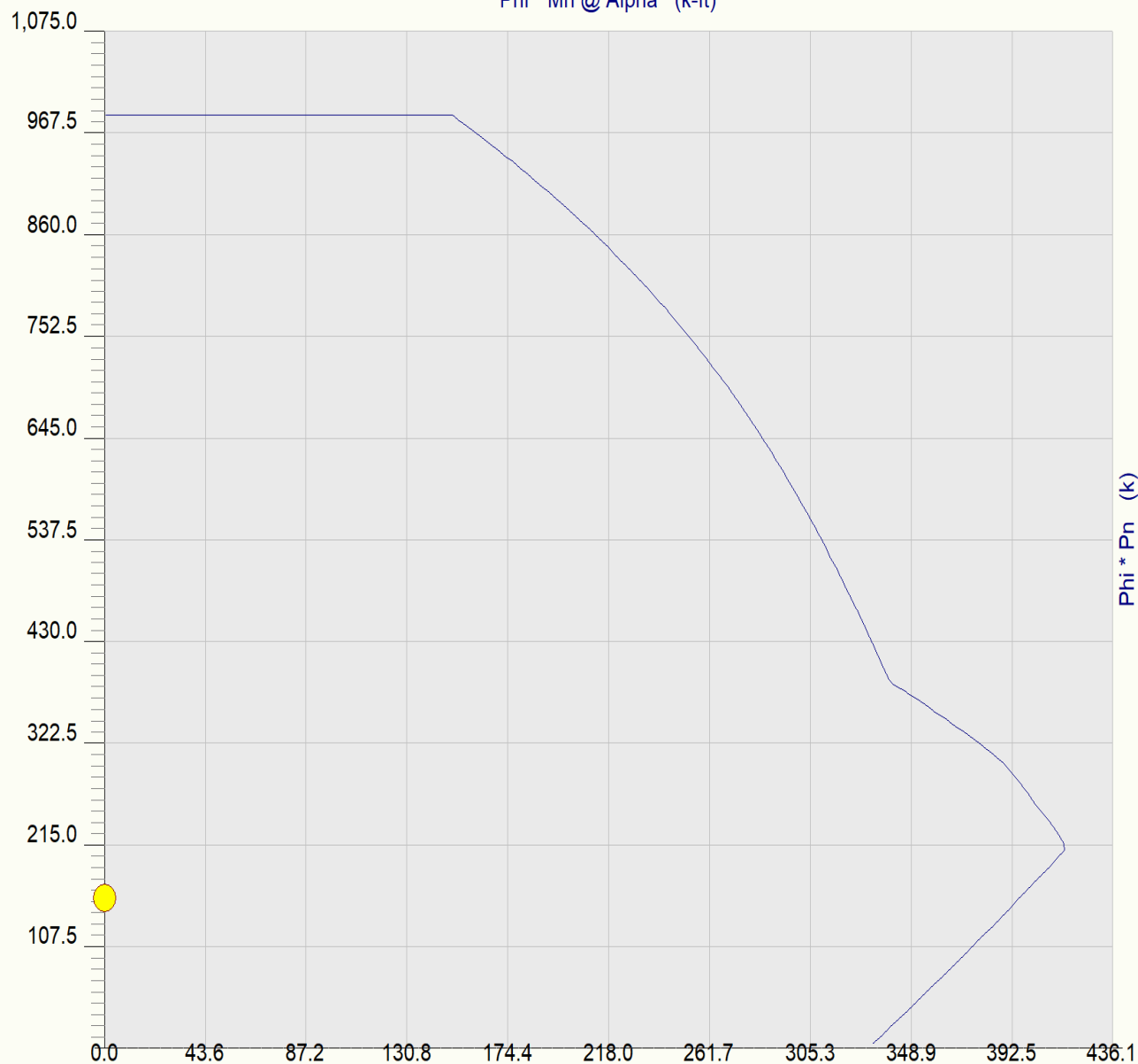
Centerline Communications

DESCRIPTION: **Second Floor Column**

Concrete Column P-M Interaction Diagram

Phi * Mn @ Alpha (k-ft)

Phi * Pn (k)



Load Comb. = +1.20D+1.60Lr, Alpha= 0.0deg, (159.32, 0.00)

Concrete Column

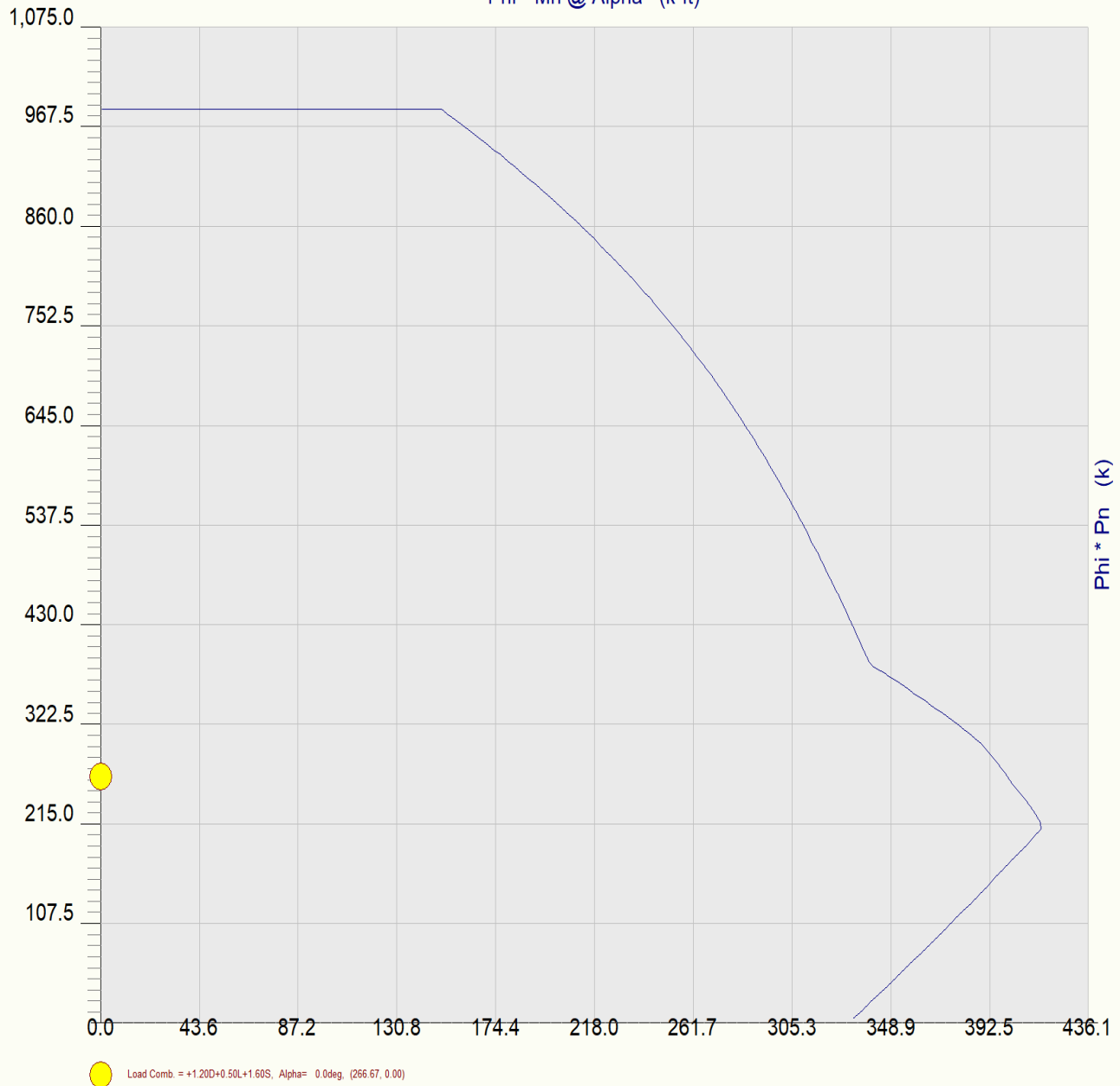
File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Second Floor Column**

Concrete Column P-M Interaction Diagram

Phi * Mn @ Alpha (k-ft)



Concrete Column

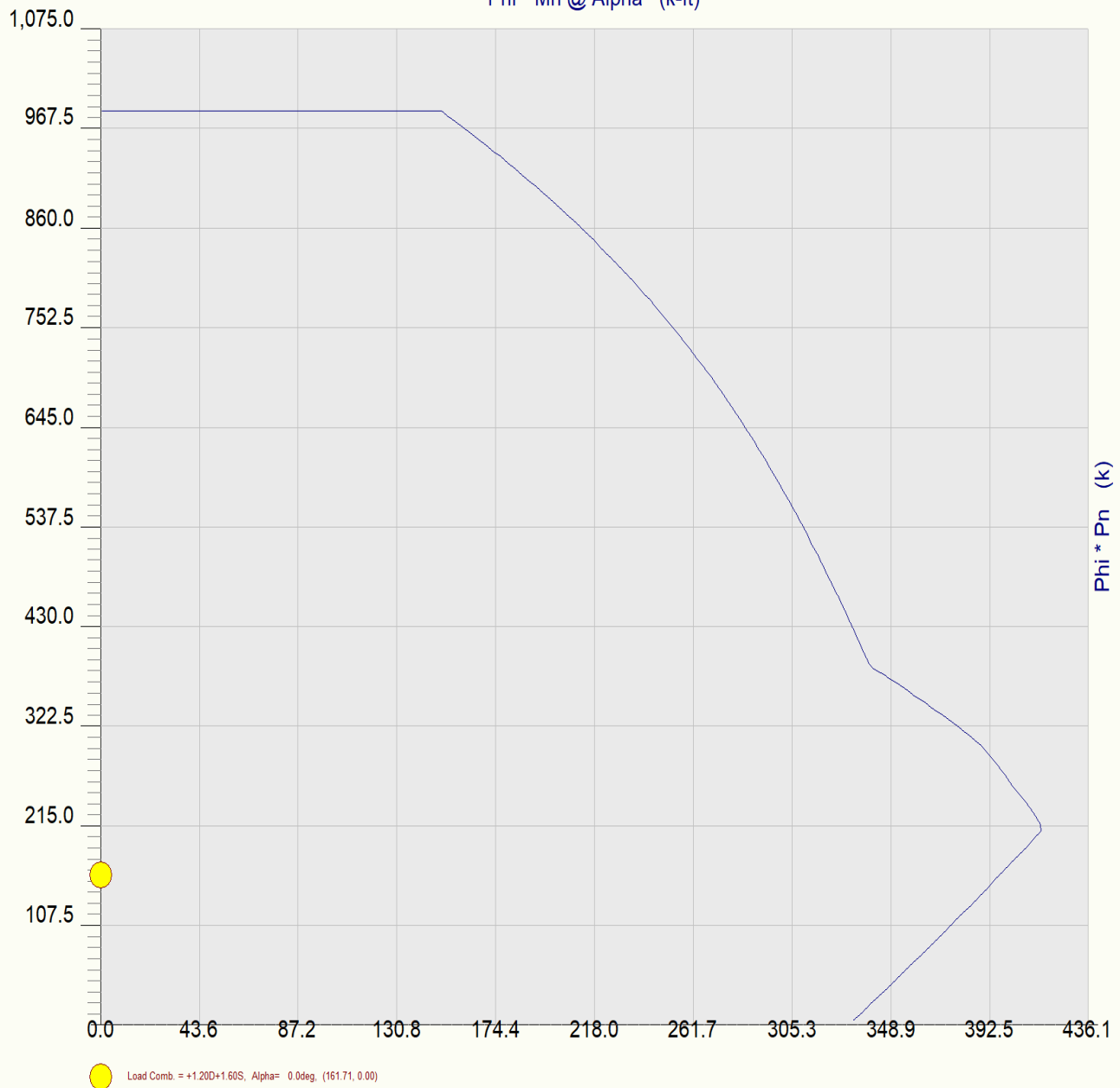
File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Second Floor Column**

Concrete Column P-M Interaction Diagram

Phi * Mn @ Alpha (k-ft)



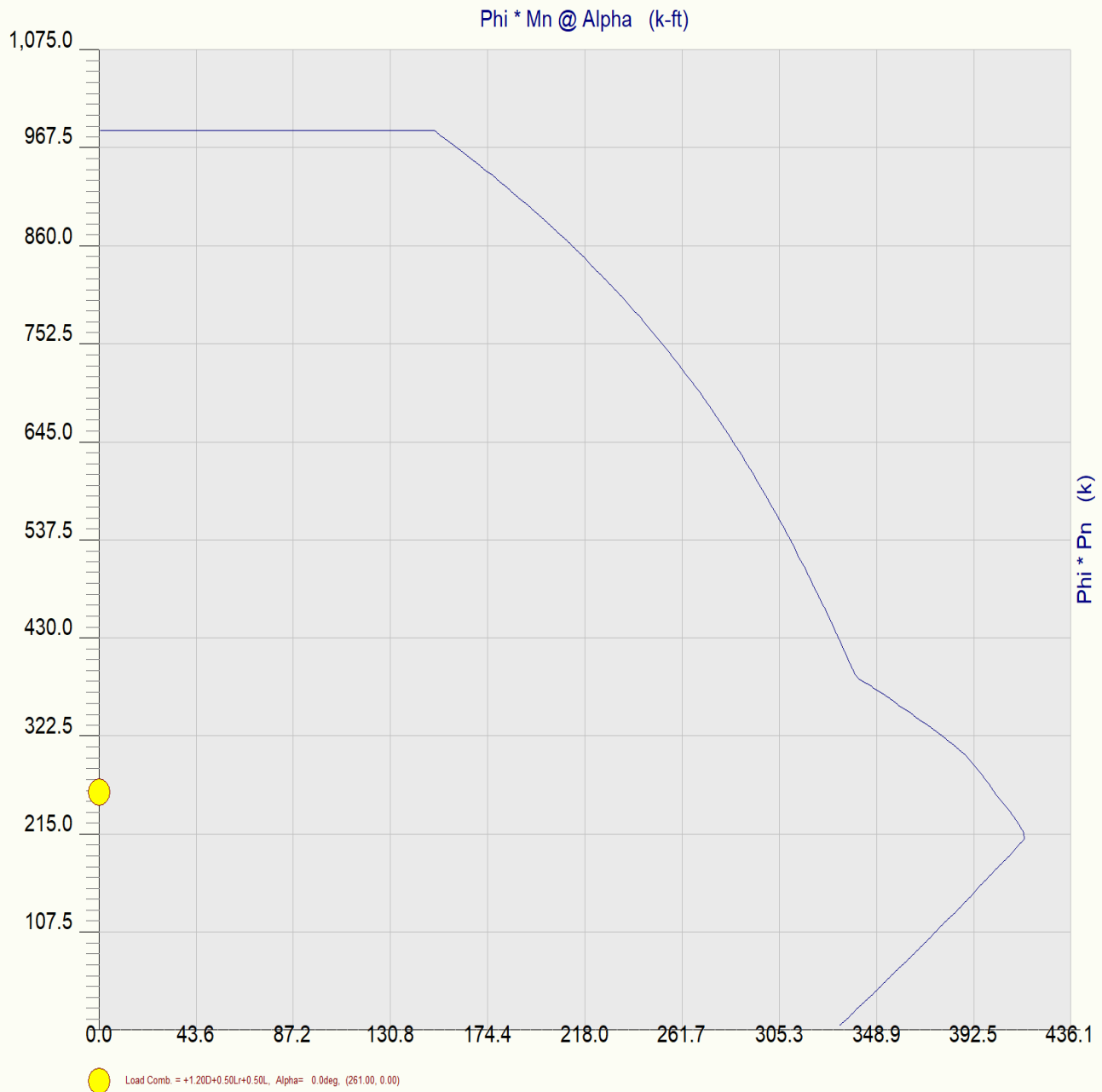
Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Second Floor Column**

Concrete Column P-M Interaction Diagram



Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

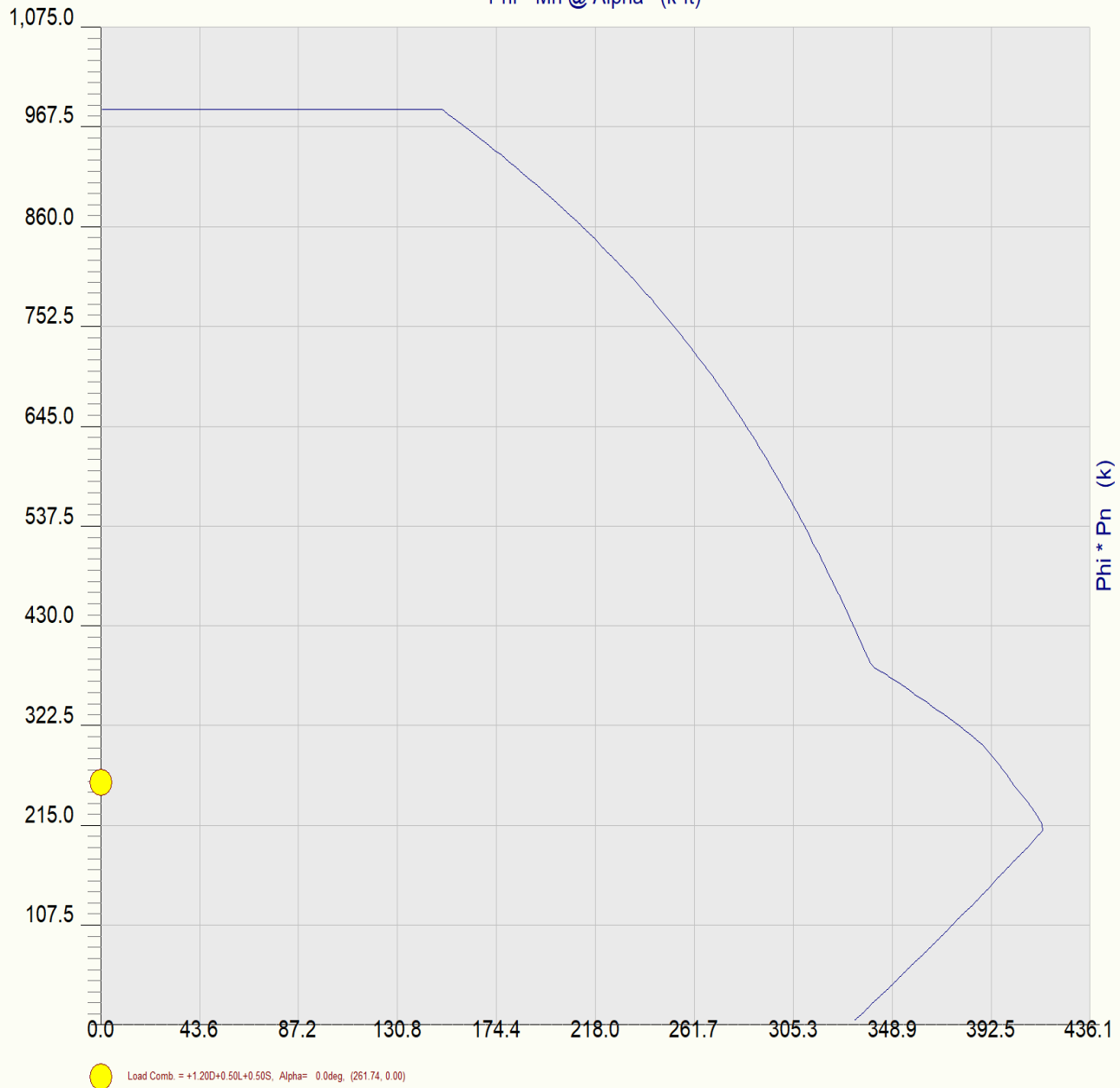
Lic. # : KW-06013597

DESCRIPTION: **Second Floor Column**

Concrete Column P-M Interaction Diagram

$\Phi * M_n @ \alpha$ (k-ft)

$\Phi * P_n$ (k)



Concrete Column

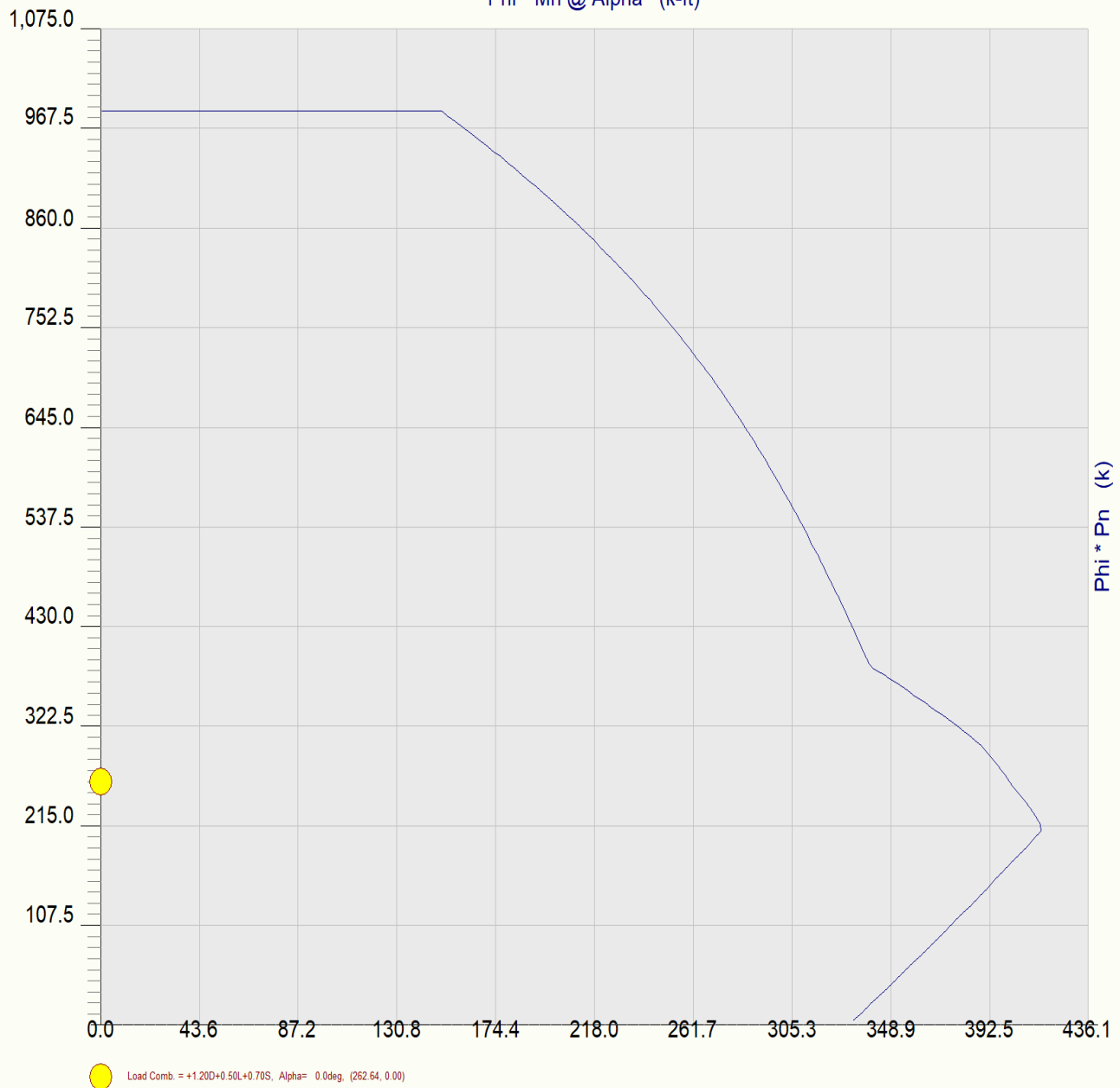
File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Second Floor Column**

Concrete Column P-M Interaction Diagram

Phi * Mn @ Alpha (k-ft)



Concrete Column

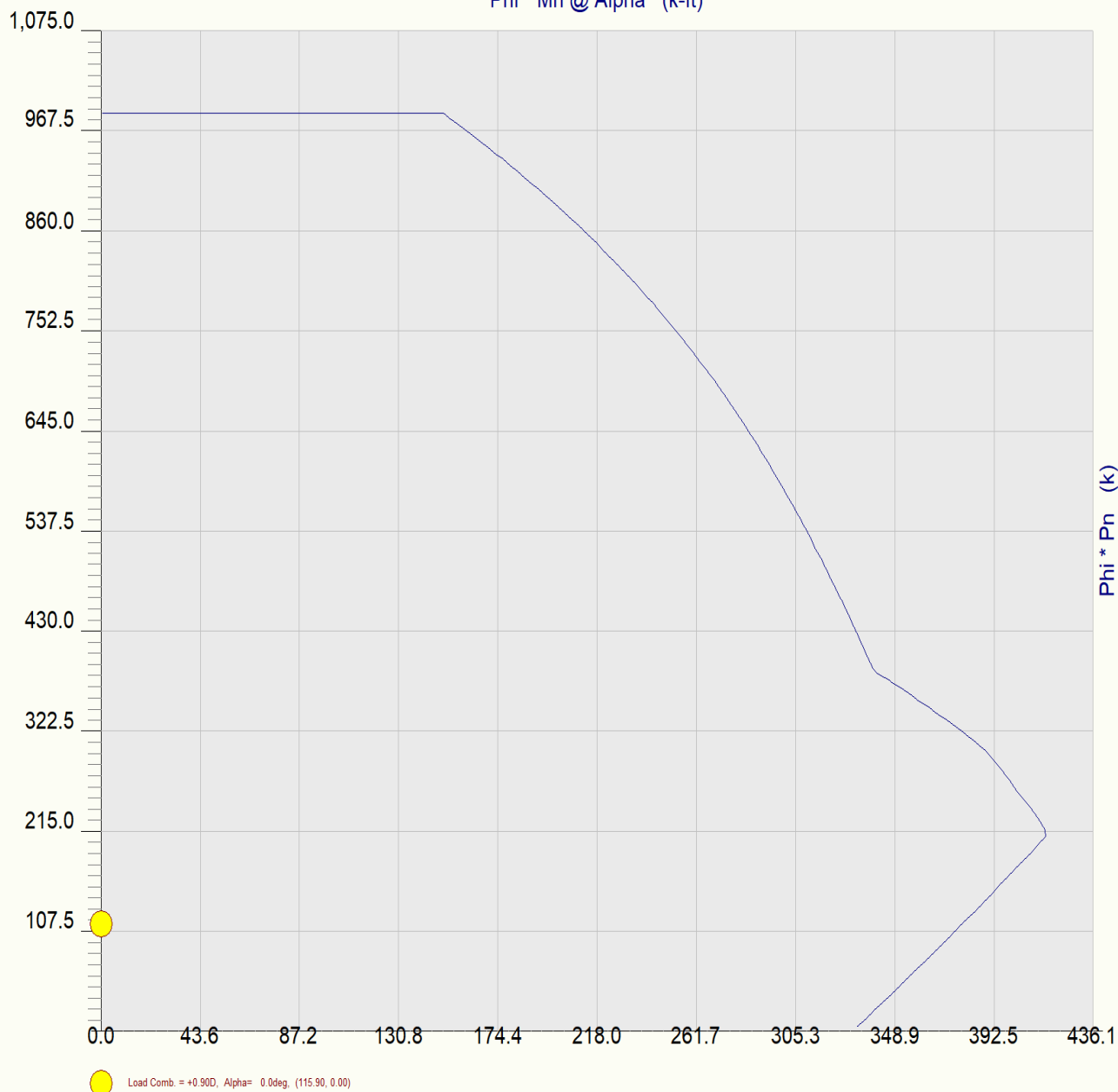
File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **Second Floor Column**

Concrete Column P-M Interaction Diagram

Phi * Mn @ Alpha (k-ft)



Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. #: KW-06013597

DESCRIPTION: First Floor Column

Code References

Calculations per ACI 318-14, IBC 2015, CBC 2016, ASCE 7-10
Load Combinations Used : IBC 2015

General Information

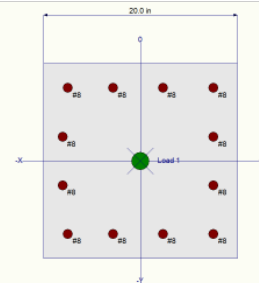
f'_c : Concrete 28 day strength = 4.0 ksi
 E = 3,605.0 ksi
Density = 150.0 pcf
 β = 0.850
 f_y - Main Rebar = 60.0 ksi
 E - Main Rebar = 29,000.0 ksi
Allow. Reinforcing Limits *ASTM A615 Bars Used*
Min. Reinf. = 1.0 %
Max. Reinf. = 8.0 %

Overall Column Height = 14.420 ft
End Fixity **Top & Bottom Pinned**
Brace condition for deflection (buckling) along columns :
X-X (width) axis :
Unbraced Length for buckling ABOUT Y-Y Axis = 14.420 ft, $K = 1.0$
Y-Y (depth) axis :
Unbraced Length for buckling ABOUT X-X Axis = 14.420 ft, $K = 1.0$

Column Cross Section

Column Dimensions : 20.0in Square Column, Column Edge to Rebar Edge Cover = 2.0in

Column Reinforcing : 4 - #8 bars @ corners,, 2 - #8 bars top & bottom between corner bars, 2 - #8 bars left & right between corner bars



Entered loads are factored per load combinations specified by user.

Applied Loads

Column self weight included : 6,008.33 lbs * Dead Load Factor
AXIAL LOADS . . .
Roof + Tower Loads: Axial Load at 14.420 ft above base, D = 147.450, LR = 2.990, L = 224.860, S = 4.480 k

DESIGN SUMMARY

Load Combination **+1.20D+1.60L+0.50S**
Location of max. above base **14.323 ft**
Maximum Stress Ratio 0.554 : 1
Ratio = $(P_u^2 + M_u^2)^{.5} / (\Phi P_n^2 + \Phi M_n^2)^{.5}$
 $P_u = 546.17$ k $\Phi * P_n = 986.22$ k
 $M_u - x = 0.0$ k-ft $\Phi * M_n - x = 0.0$ k-ft
 $M_u - y = 0.0$ k-ft $\Phi * M_n - y = 0.0$ k-ft
 M_u Angle = 0.0 deg
 M_u at Angle = 0.0 k-ft ΦM_n at Angle = 0.0 k-ft

P_n & M_n values located at P_u-M_u vector intersection with capacity curve

Column Capacities . . .

P_nmax : Nominal Max. Compressive Axial Capacity **1,896.57** k
P_nmin : Nominal Min. Tension Axial Capacity k
 ΦP_n , max : Usable Compressive Axial Capacity **986.22** k
 ΦP_n , min : Usable Tension Axial Capacity k

Maximum SERVICE Load Reactions . .

Top along Y-Y **0.0** k Bottom along Y-Y **0.0** k
Top along X-X **0.0** k Bottom along X-X **0.0** k

Maximum SERVICE Load Deflections . . .

Along Y-Y **0.0** in at **0.0** ft above base
for load combination :
Along X-X **0.0** in at **0.0** ft above base
for load combination :

General Section Information . $\phi = 0.650$ $\beta = 0.850$ $\theta = 0.80$

ρ : % Reinforcing **2.370** % Rebar % Ok
Reinforcing Area **9.480** in²
Concrete Area **400.0** in²

Governing Load Combination Results

Governing Factored Load Combination	Moment		Dist. from base ft	Axial Load k Pu	Bending Analysis k-ft						Utilization	
	X-X	Y-Y			$\phi * P_n$	δx	$\delta x * M_{ux}$	δy	$\delta y * M_{uy}$	Alpha (deg)	δM_u	ϕM_n Ratio
+1.40D			14.32	214.84	986.22					0.000		0.218
+1.20D+0.50Lr+1.60L			14.32	545.42	986.22					0.000		0.553
+1.20D+1.60L+0.50S			14.32	546.17	986.22					0.000		0.554

Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. #: KW-06013597

DESCRIPTION: First Floor Column

Governing Load Combination Results

Governing Factored Load Combination	Moment		Dist. from base ft	Axial Load k		Bending Analysis k-ft								Utilization	
	X-X	Y-Y		Pu	$\phi * P_n$	δx	$\delta x * M_{ux}$	δy	$\delta y * M_{uy}$	Alpha (deg)	δM_u	ϕM_n	Ratio		
+1.20D+1.60Lr+0.50L			14.32	301.36	986.22					0.000			0.306		
+1.20D+1.60Lr			14.32	188.93	986.22					0.000			0.192		
+1.20D+0.50L+1.60S			14.32	303.75	986.22					0.000			0.308		
+1.20D+1.60S			14.32	191.32	986.22					0.000			0.194		
+1.20D+0.50Lr+0.50L			14.32	298.08	986.22					0.000			0.302		
+1.20D+0.50L+0.50S			14.32	298.82	986.22					0.000			0.303		
+1.20D+0.50L+0.70S			14.32	299.72	986.22					0.000			0.304		
+0.90D			14.32	138.11	986.22					0.000			0.140		

Maximum Reactions

Note: Only non-zero reactions are listed.

Load Combination	X-X Axis Reaction		k	Y-Y Axis Reaction		Axial Reaction	My - End Moments		k-ft	Mx - End Moments	
	@ Base	@ Top		@ Base	@ Top		@ Base	@ Top		@ Base	@ Top
D Only						153.458					
+D+L						378.318					
+D+Lr						156.448					
+D+S						157.938					
+D+0.750Lr+0.750L						324.346					
+D+0.750L+0.750S						325.463					
+0.60D						92.075					
Lr Only						2.990					
L Only						224.860					
S Only						4.480					

Maximum Moment Reactions

Note: Only non-zero reactions are listed.

Load Combination	Moment About X-X Axis			Moment About Y-Y Axis		
	@ Base	@ Top		@ Base	@ Top	
D Only			k-ft			k-ft
+D+L			k-ft			k-ft
+D+Lr			k-ft			k-ft
+D+S			k-ft			k-ft
+D+0.750Lr+0.750L			k-ft			k-ft
+D+0.750L+0.750S			k-ft			k-ft
+0.60D			k-ft			k-ft
Lr Only			k-ft			k-ft
L Only			k-ft			k-ft
S Only			k-ft			k-ft

Maximum Deflections for Load Combinations

Load Combination	Max. X-X Deflection		Distance	Max. Y-Y Deflection		Distance
D Only	0.0000	in	0.000 ft	0.000	in	0.000 ft
+D+L	0.0000	in	0.000 ft	0.000	in	0.000 ft
+D+Lr	0.0000	in	0.000 ft	0.000	in	0.000 ft
+D+S	0.0000	in	0.000 ft	0.000	in	0.000 ft
+D+0.750Lr+0.750L	0.0000	in	0.000 ft	0.000	in	0.000 ft
+D+0.750L+0.750S	0.0000	in	0.000 ft	0.000	in	0.000 ft
+0.60D	0.0000	in	0.000 ft	0.000	in	0.000 ft
Lr Only	0.0000	in	0.000 ft	0.000	in	0.000 ft
L Only	0.0000	in	0.000 ft	0.000	in	0.000 ft
S Only	0.0000	in	0.000 ft	0.000	in	0.000 ft

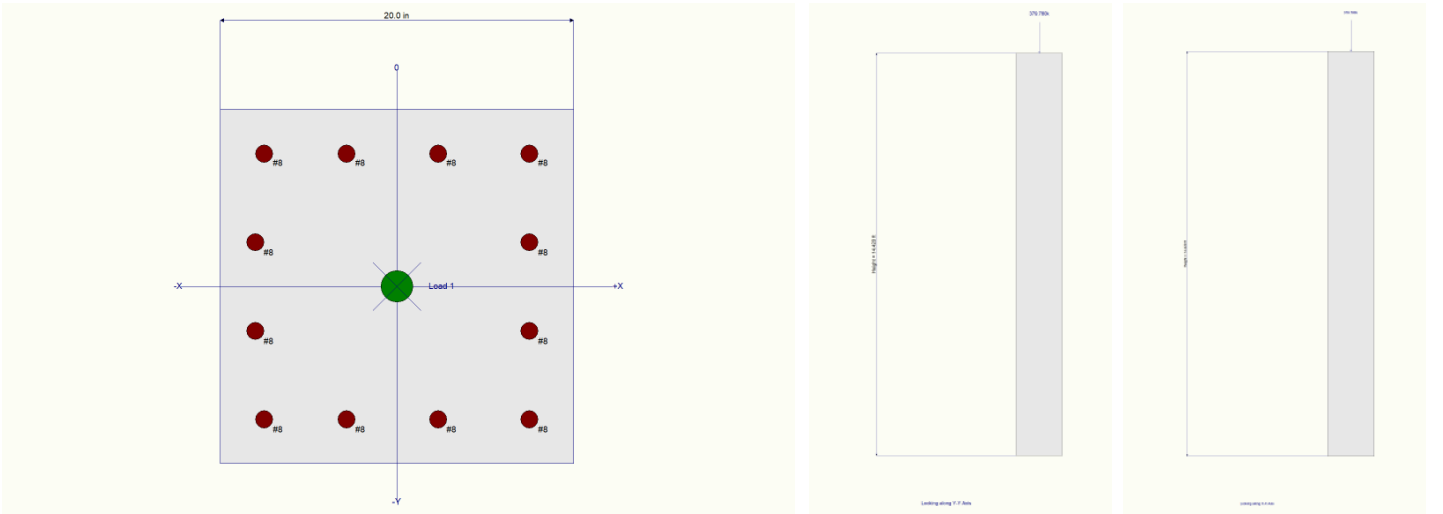
Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **First Floor Column**

Sketches



Interaction Diagrams

Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

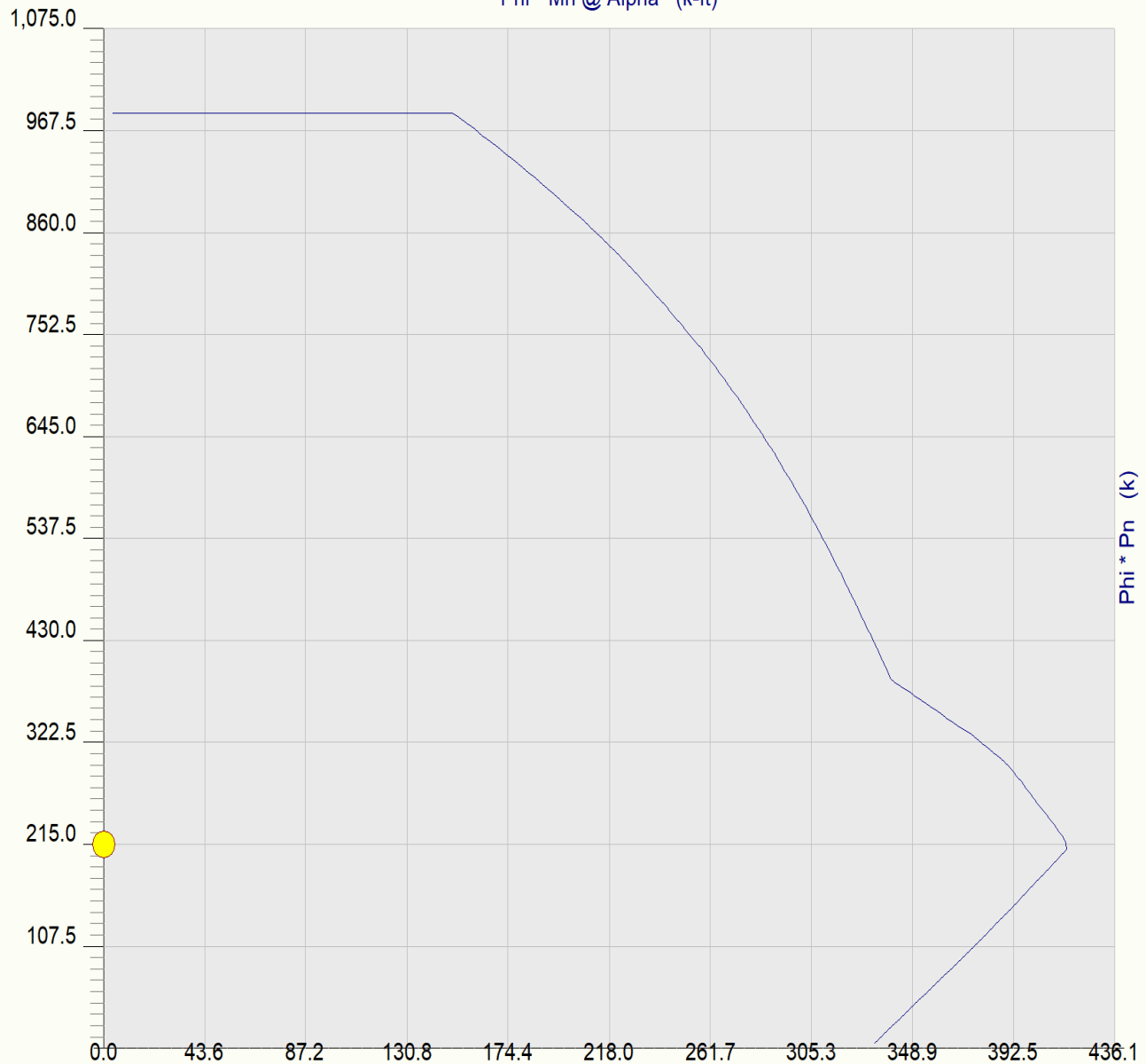
Lic. # : KW-06013597

DESCRIPTION: **First Floor Column**

Concrete Column P-M Interaction Diagram

$\Phi * M_n @ \text{Alpha}$ (k-ft)

$\Phi * P_n$ (k)



Load Comb. = +1.40D, Alpha= 0.0deg, (214.84, 0.00)

Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

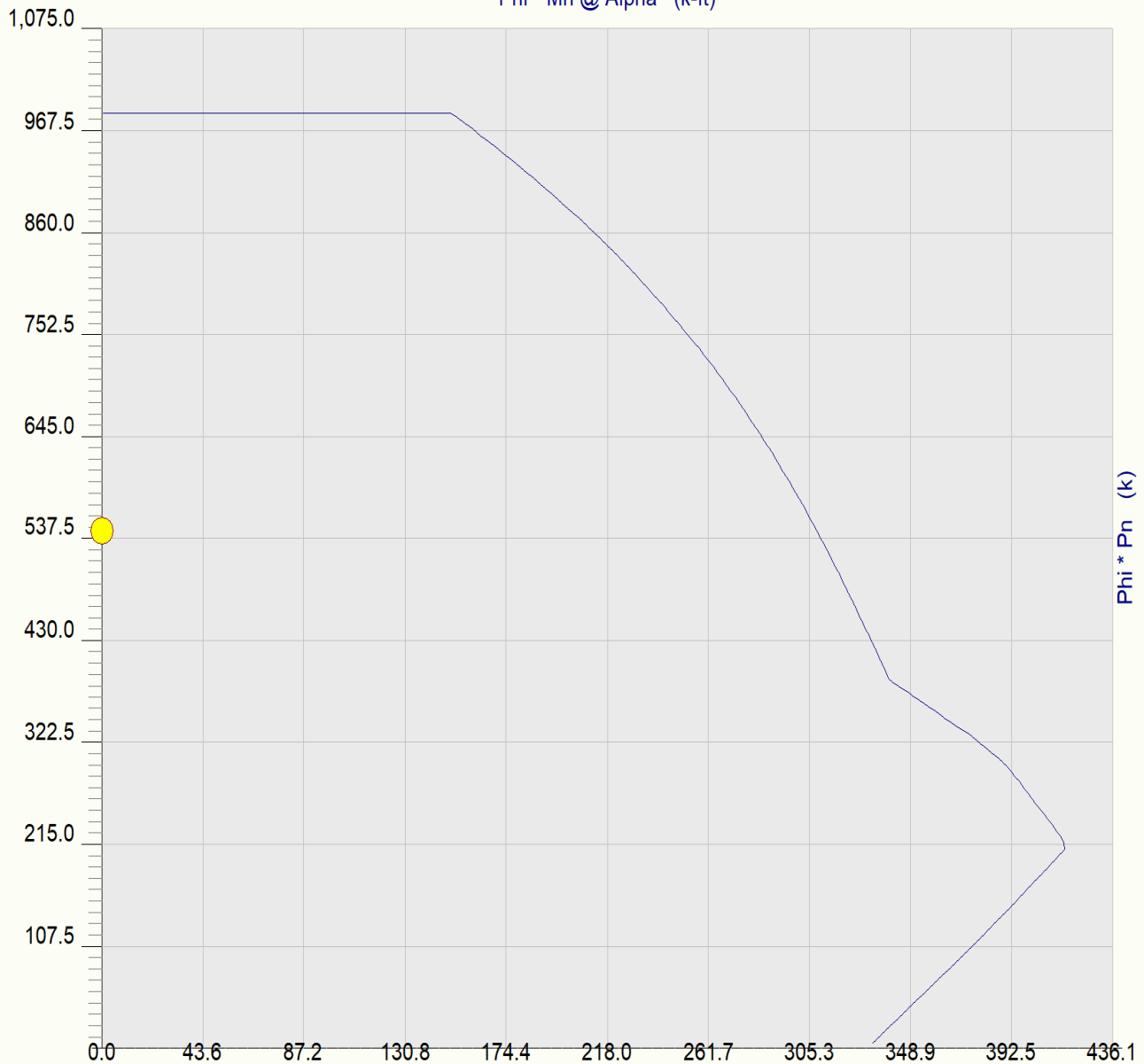
Lic. # : KW-06013597

DESCRIPTION: **First Floor Column**

Concrete Column P-M Interaction Diagram

$\Phi * M_n @ \text{Alpha}$ (k-ft)

$\Phi * P_n$ (k)



Load Comb. = +1.20D+0.50L+1.60L, Alpha= 0.0deg, (545.42, 0.00)

Concrete Column

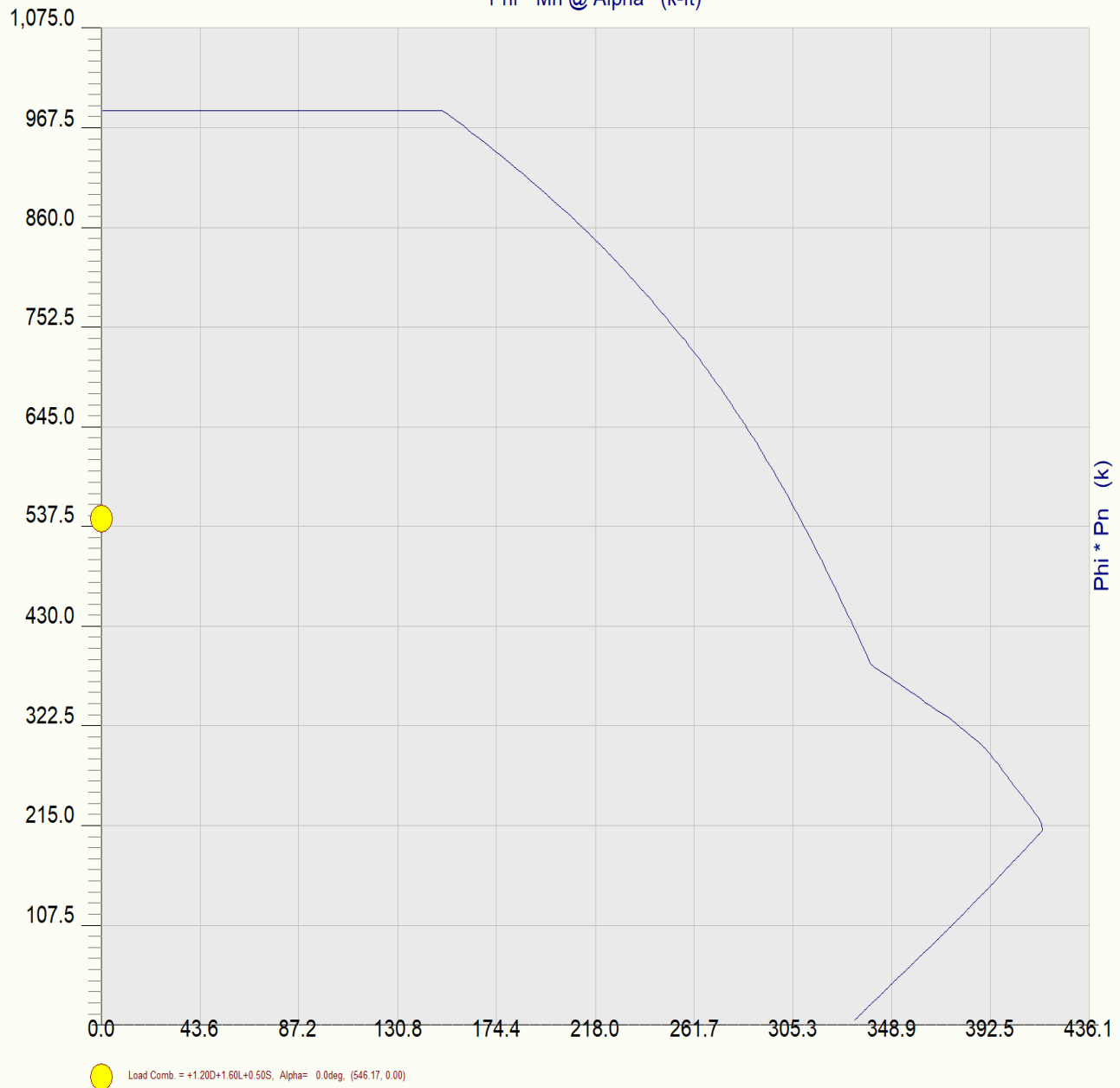
File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **First Floor Column**

Concrete Column P-M Interaction Diagram

Phi * Mn @ Alpha (k-ft)



Concrete Column

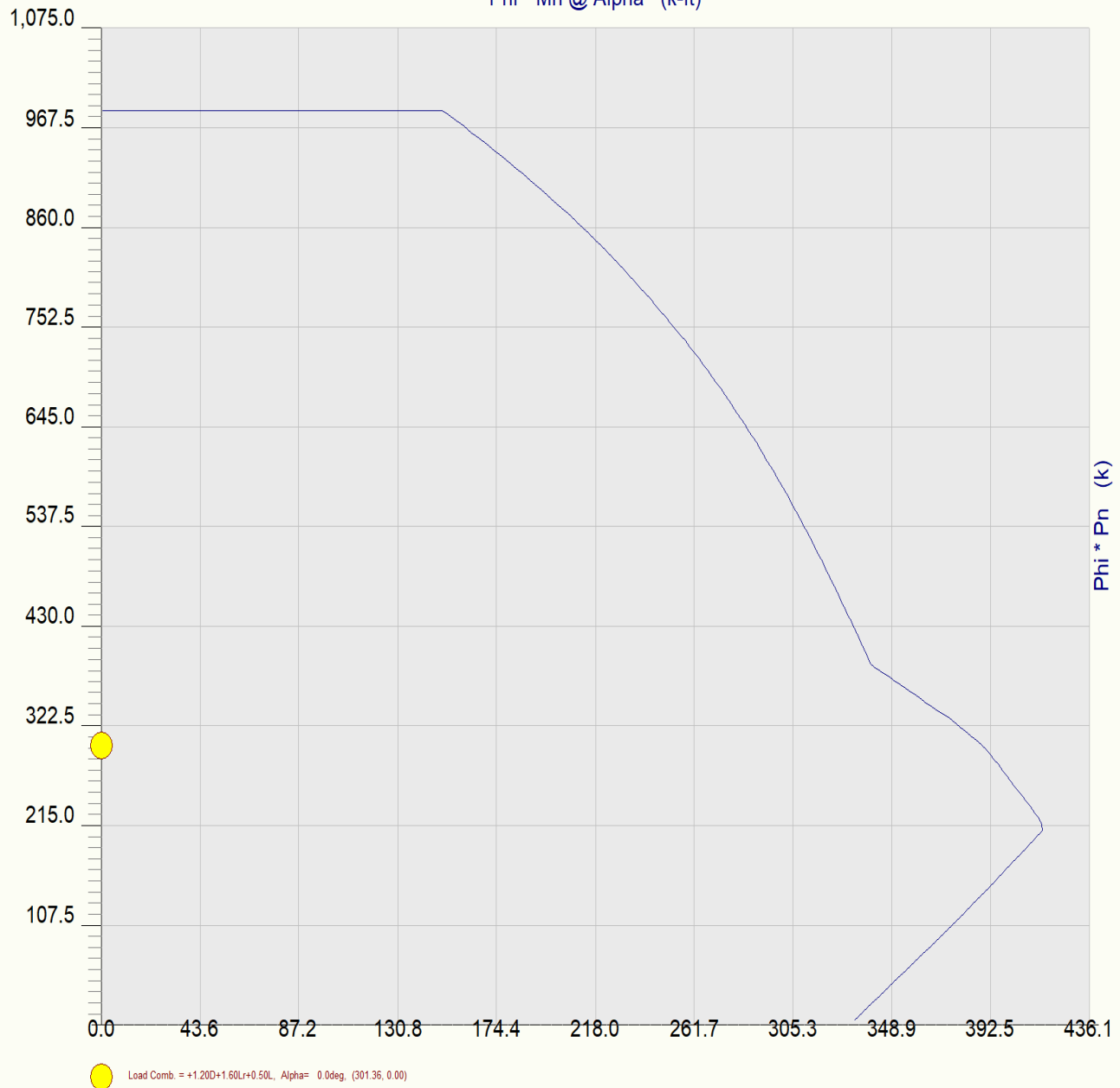
File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **First Floor Column**

Concrete Column P-M Interaction Diagram

Phi * Mn @ Alpha (k-ft)



Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

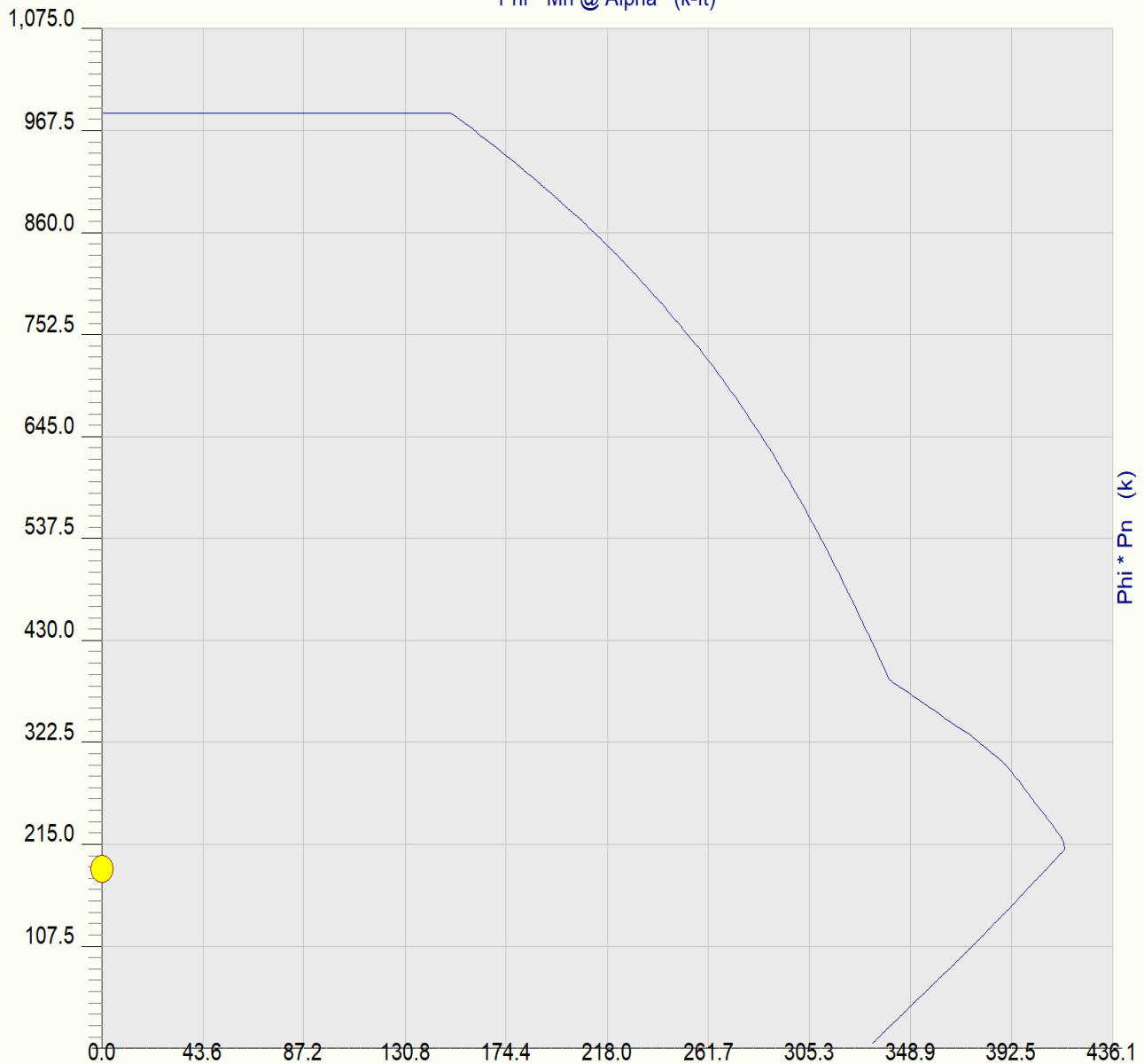
Lic. # : KW-06013597

DESCRIPTION: **First Floor Column**

Concrete Column P-M Interaction Diagram

Phi * Mn @ Alpha (k-ft)

Phi * Pn (k)



Load Comb. = +1.20D+1.60Lr, Alpha= 0.0deg, (188.93, 0.00)

Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

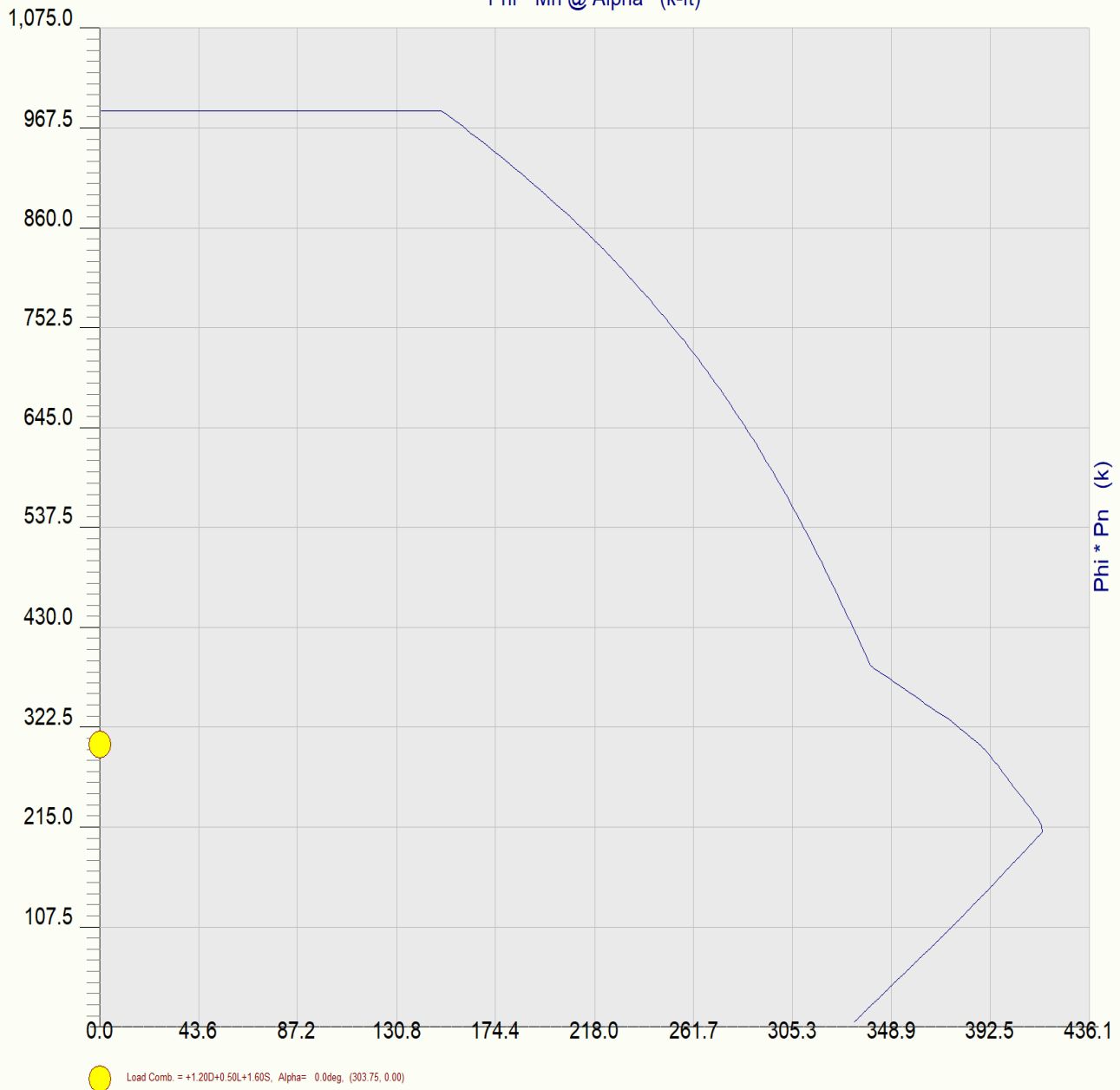
Lic. # : KW-06013597

DESCRIPTION: **First Floor Column**

Concrete Column P-M Interaction Diagram

Phi * Mn @ Alpha (k-ft)

Phi * Pn (k)



Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

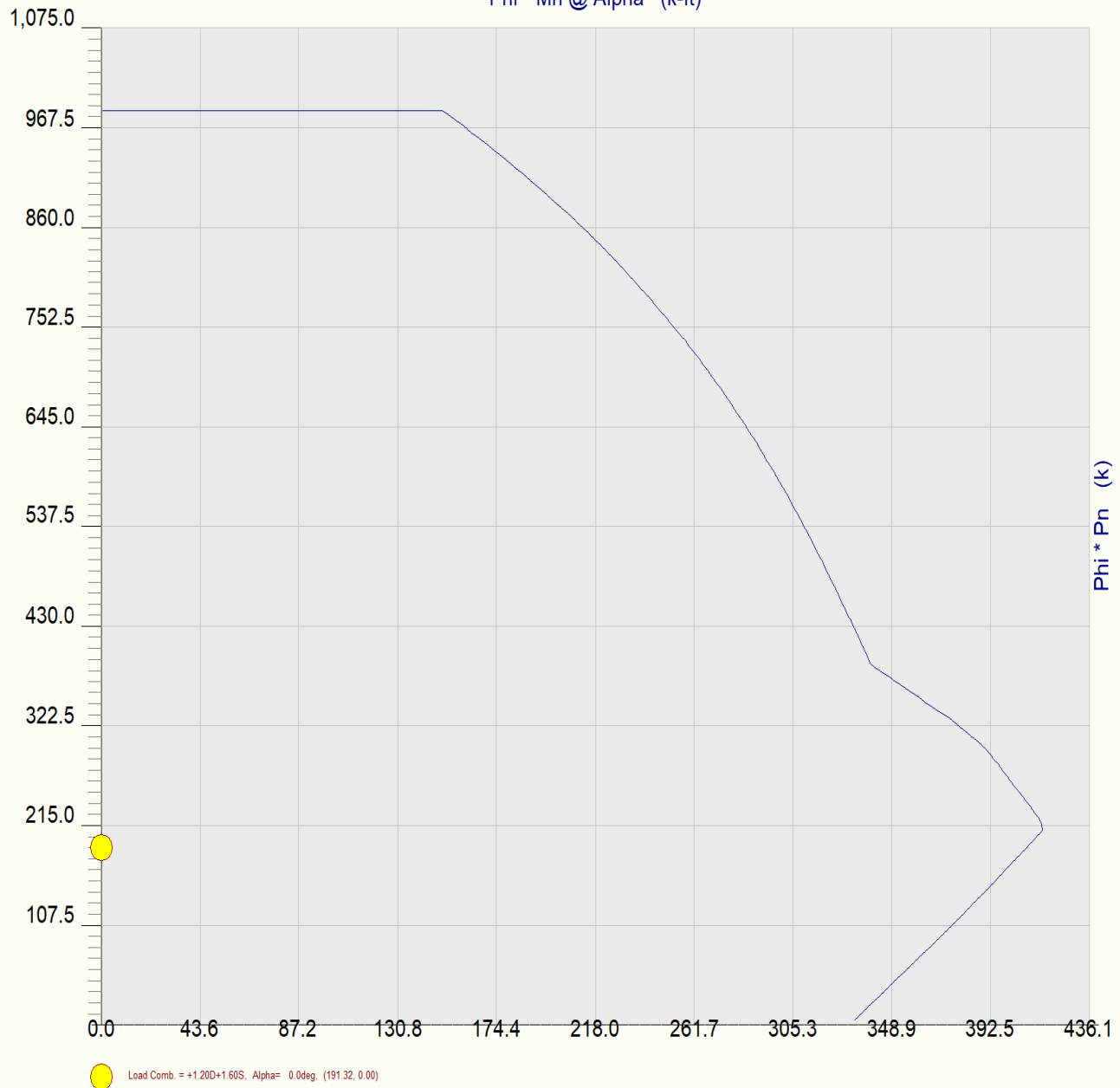
Lic. # : KW-06013597

DESCRIPTION: **First Floor Column**

Concrete Column P-M Interaction Diagram

Phi * Mn @ Alpha (k-ft)

Phi * Pn (k)



Concrete Column

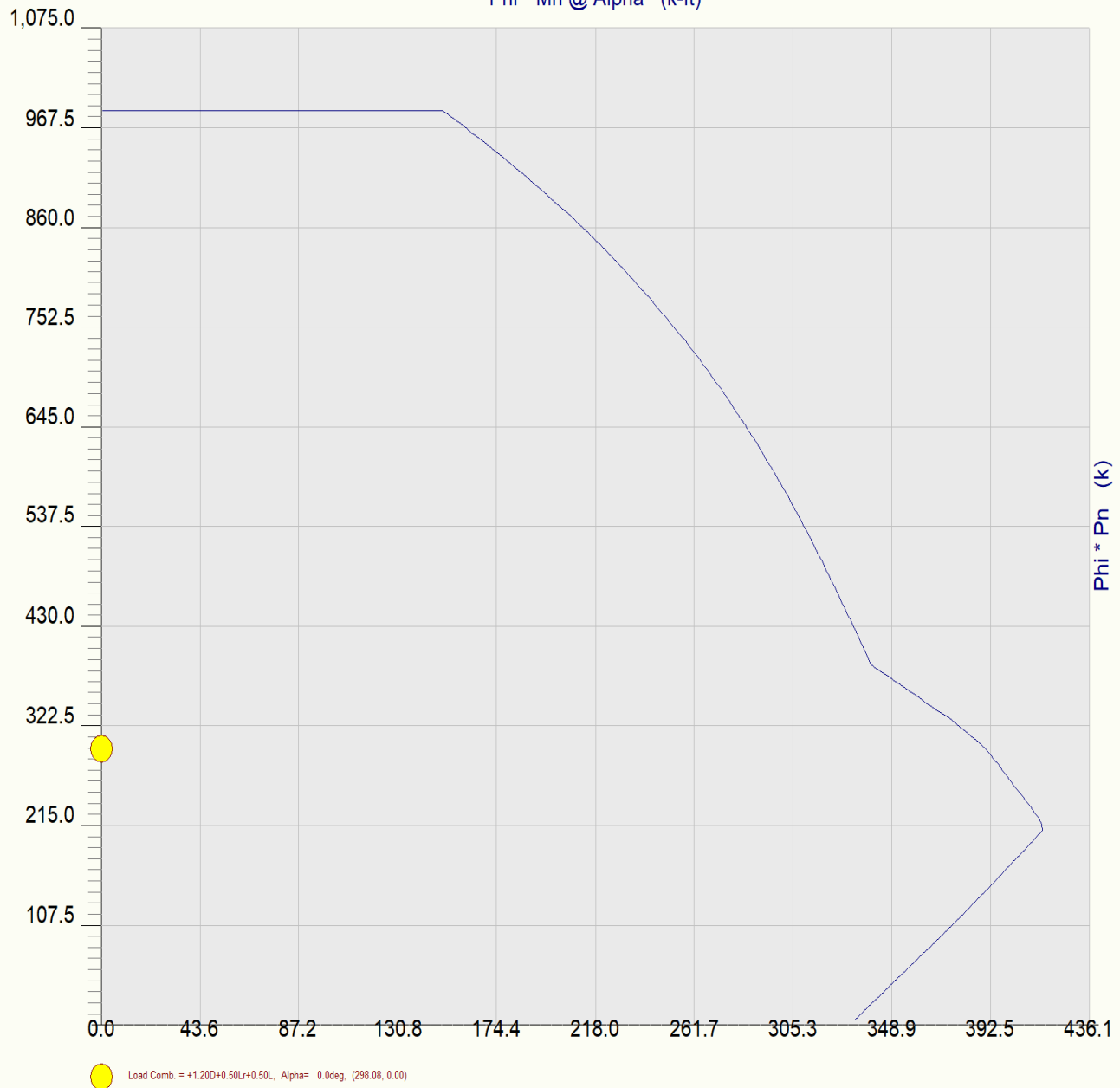
File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **First Floor Column**

Concrete Column P-M Interaction Diagram

Phi * Mn @ Alpha (k-ft)



Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

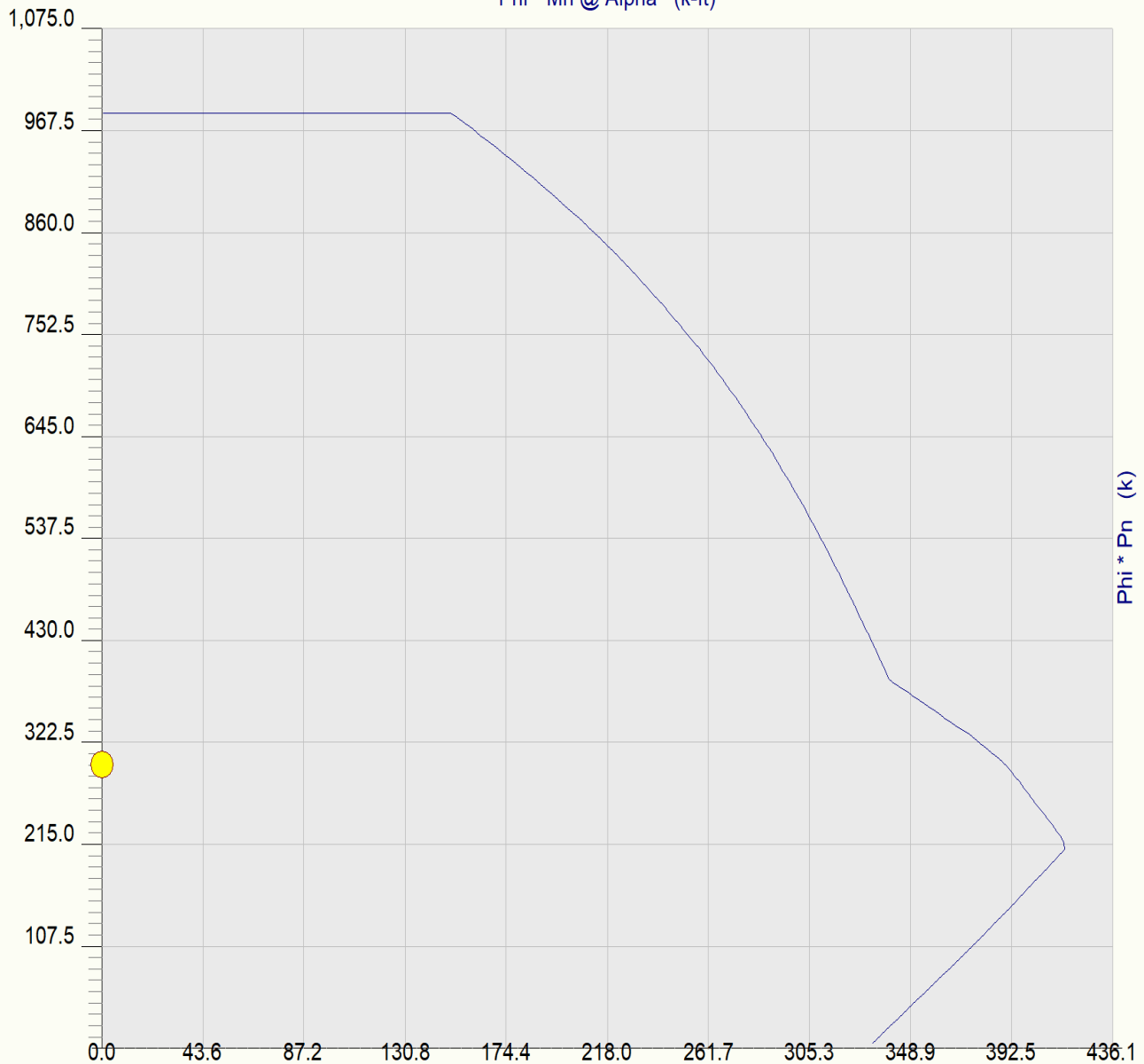
Lic. # : KW-06013597

DESCRIPTION: **First Floor Column**

Concrete Column P-M Interaction Diagram

$\Phi * M_n @ \alpha$ (k-ft)

$\Phi * P_n$ (k)



Load Comb. = +1.20D+0.50L+0.50S, Alpha= 0.0deg, (298.82, 0.00)

Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

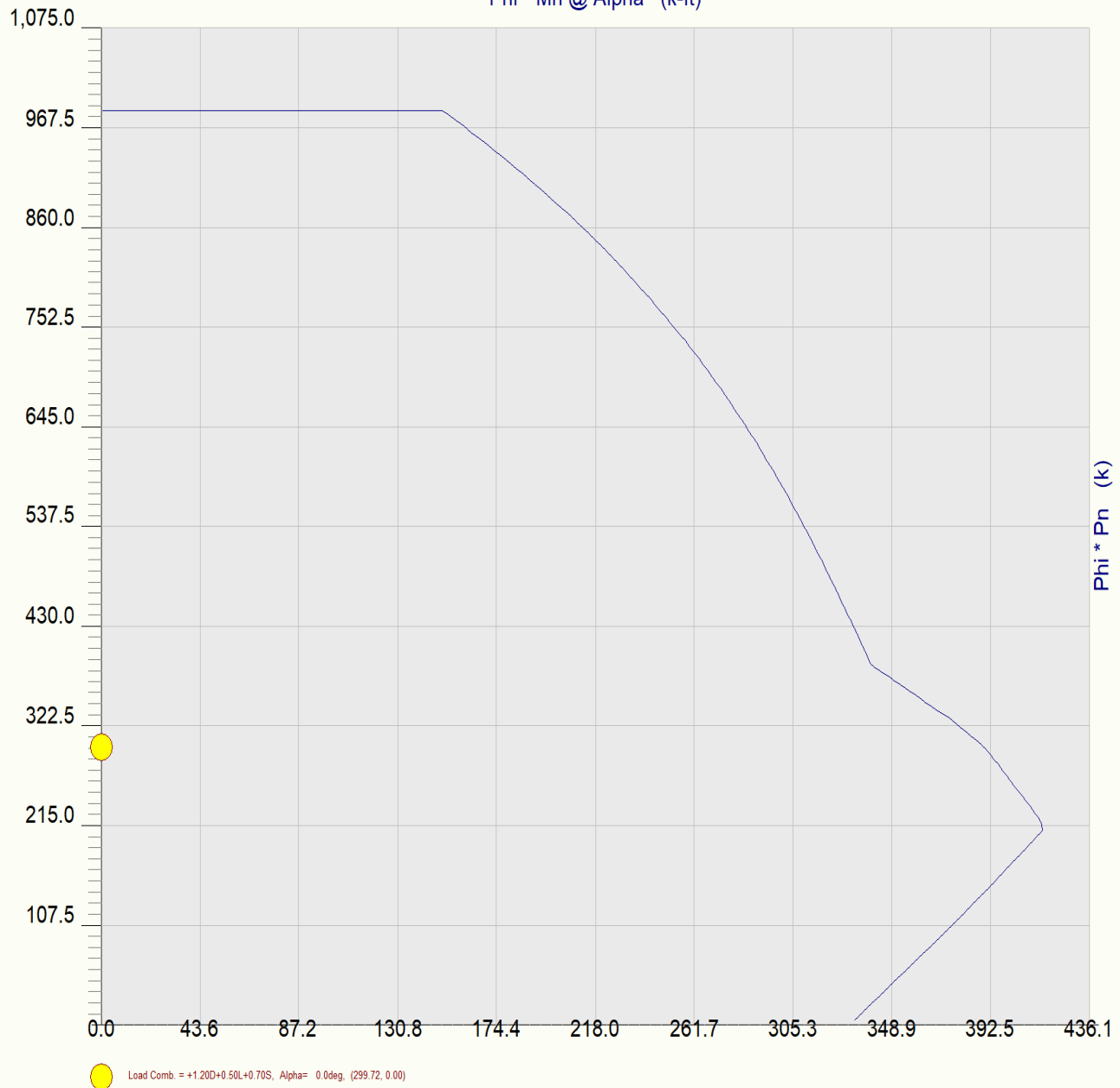
Lic. # : KW-06013597

DESCRIPTION: **First Floor Column**

Concrete Column P-M Interaction Diagram

Phi * Mn @ Alpha (k-ft)

Phi * Pn (k)



Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

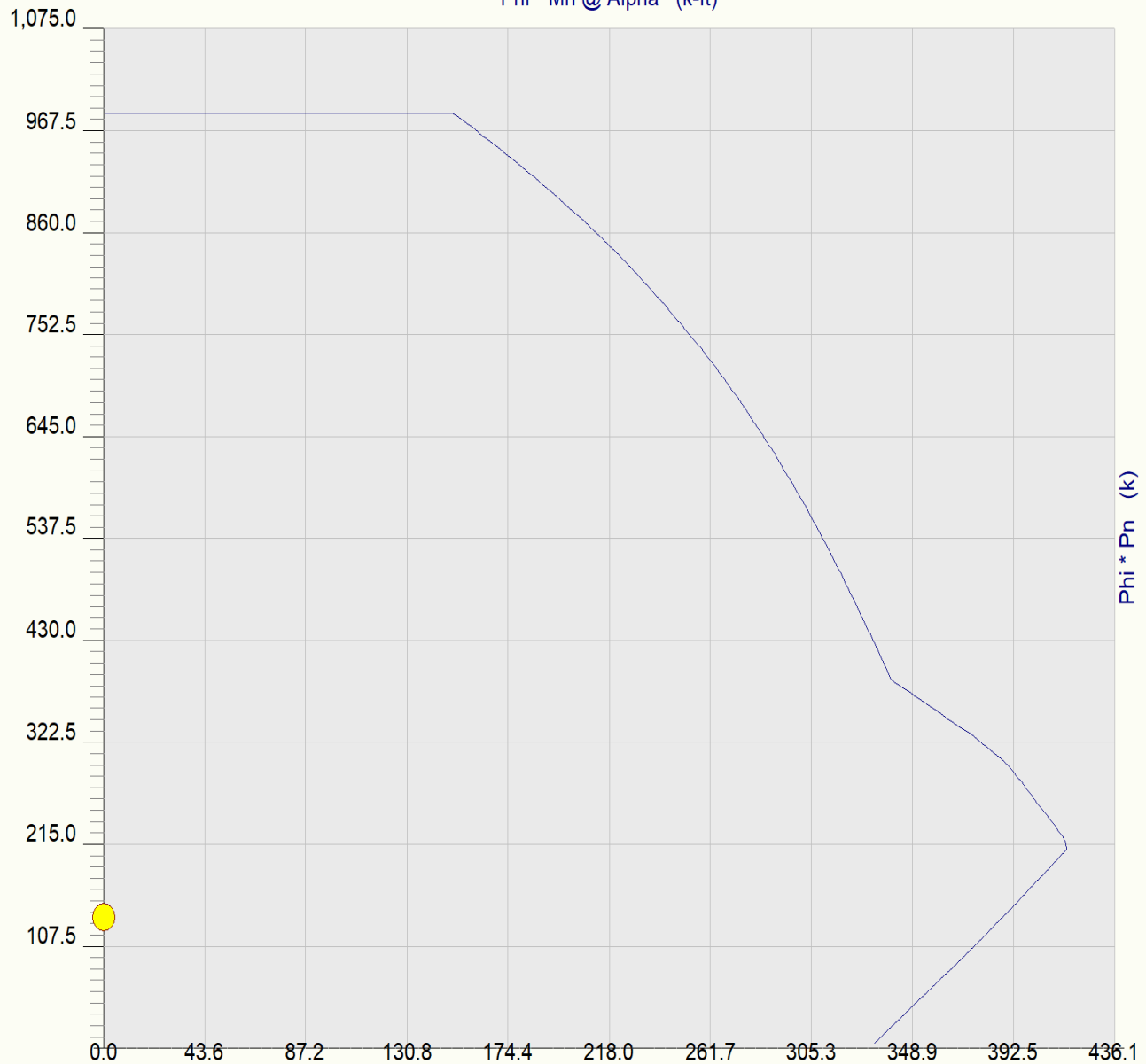
Lic. # : KW-06013597

DESCRIPTION: **First Floor Column**

Concrete Column P-M Interaction Diagram

$\Phi * M_n @ \text{Alpha}$ (k-ft)

$\Phi * P_n$ (k)



Load Comb. = +0.90D, Alpha= 0.0deg, (138.11, 0.00)

Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. #: KW-06013597

DESCRIPTION: G Floor Column

Code References

Calculations per ACI 318-14, IBC 2015, CBC 2016, ASCE 7-10
Load Combinations Used : IBC 2015

General Information

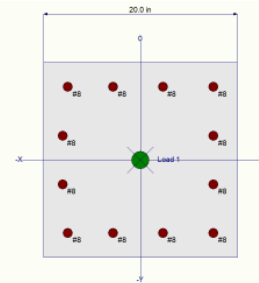
f'_c : Concrete 28 day strength = 4.0 ksi
E = 3,605.0 ksi
Density = 150.0 pcf
 β = 0.850
 f_y - Main Rebar = 60.0 ksi
E - Main Rebar = 29,000.0 ksi
Allow. Reinforcing Limits *ASTM A615 Bars Used*
Min. Reinf. = 1.0 %
Max. Reinf. = 8.0 %

Overall Column Height = 12.340 ft
End Fixity **Top & Bottom Pinned**
Brace condition for deflection (buckling) along columns :
X-X (width) axis :
Unbraced Length for buckling ABOUT Y-Y Axis = 12.340 ft, K = 1.0
Y-Y (depth) axis :
Unbraced Length for buckling ABOUT X-X Axis = 12.340 ft, K = 1.0

Column Cross Section

Column Dimensions : 20.0in Square Column, Column Edge to Rebar Edge Cover = 2.0in

Column Reinforcing : 4 - #8 bars @ corners,, 2 - #8 bars top & bottom between corner bars, 2 - #8 bars left & right between corner bars



Applied Loads

Entered loads are factored per load combinations specified by user.

Column self weight included : 5,141.67 lbs * Dead Load Factor
AXIAL LOADS ...

Roof + Tower Loads: Axial Load at 12.340 ft above base, D = 172.130, LR = 2.990, L = 239.80, S = 4.480 k

DESIGN SUMMARY

Load Combination **+1.20D+1.60L+0.50S**
Location of max. above base **12.257 ft**
Maximum Stress Ratio : 0.607 : 1
Ratio = $(P_u^2 + M_u^2)^{.5} / (\Phi P_n^2 + \Phi M_n^2)^{.5}$
 $P_u = 598.65$ k $\Phi * P_n = 986.22$ k
 $M_{u-x} = 0.0$ k-ft $\Phi * M_{n-x} = 0.0$ k-ft
 $M_{u-y} = 0.0$ k-ft $\Phi * M_{n-y} = 0.0$ k-ft
 M_u Angle = 0.0 deg
 M_u at Angle = 0.0 k-ft ΦM_n at Angle = 0.0 k-ft

P_n & M_n values located at P_u-M_u vector intersection with capacity curve

Column Capacities ...

P_nmax : Nominal Max. Compressive Axial Capacity **1,896.57** k
P_nmin : Nominal Min. Tension Axial Capacity k
 ΦP_n , max : Usable Compressive Axial Capacity **986.22** k
 ΦP_n , min : Usable Tension Axial Capacity k

Maximum SERVICE Load Reactions ...

Top along Y-Y **0.0** k Bottom along Y-Y **0.0** k
Top along X-X **0.0** k Bottom along X-X **0.0** k

Maximum SERVICE Load Deflections ...

Along Y-Y **0.0** in at **0.0** ft above base
for load combination :
Along X-X **0.0** in at **0.0** ft above base
for load combination :

General Section Information . $\Phi = 0.650$ $\beta = 0.850$ $\theta = 0.80$

ρ : % Reinforcing **2.370** % Rebar % Ok
Reinforcing Area **9.480** in²
Concrete Area **400.0** in²

Governing Load Combination Results

Governing Factored Load Combination	Moment		Dist. from		Axial Load	Bending Analysis						k-ft	Utilization		
	X-X	Y-Y	base	ft	Pu	ϕ	* Pn	δ x	δ x * Mu _x	δ y	δ y * Mu _y	Alpha (deg)	δ Mu	ϕ Mn	Ratio
+1.40D			12.26		248.18		986.22					0.000			0.252
+1.20D+0.50Lr+1.60L			12.26		597.90		986.22					0.000			0.606
+1.20D+1.60L+0.50S			12.26		598.65		986.22					0.000			0.607

Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. #: KW-06013597

DESCRIPTION: G Floor Column

Governing Load Combination Results

Governing Factored Load Combination	Moment		Dist. from base	ft	Axial Load k		Bending Analysis k-ft						Utilization	
	X-X	Y-Y			Pu	$\phi * P_n$	δx	$\delta x * M_{ux}$	δy	$\delta y * M_{uy}$	Alpha (deg)	δM_u	ϕM_n	Ratio
+1.20D+1.60Lr+0.50L			12.26		337.41	986.22					0.000			0.342
+1.20D+1.60Lr			12.26		217.51	986.22					0.000			0.221
+1.20D+0.50L+1.60S			12.26		339.79	986.22					0.000			0.345
+1.20D+1.60S			12.26		219.89	986.22					0.000			0.223
+1.20D+0.50Lr+0.50L			12.26		334.12	986.22					0.000			0.339
+1.20D+0.50L+0.50S			12.26		334.87	986.22					0.000			0.340
+1.20D+0.50L+0.70S			12.26		335.76	986.22					0.000			0.340
+0.90D			12.26		159.54	986.22					0.000			0.162

Maximum Reactions

Note: Only non-zero reactions are listed.

Load Combination	X-X Axis Reaction		k	Y-Y Axis Reaction		Axial Reaction	My - End Moments		k-ft	Mx - End Moments	
	@ Base	@ Top		@ Base	@ Top		@ Base	@ Top		@ Base	@ Top
D Only						177.272					
+D+L						417.072					
+D+Lr						180.262					
+D+S						181.752					
+D+0.750Lr+0.750L						359.364					
+D+0.750L+0.750S						360.482					
+0.60D						106.363					
Lr Only						2.990					
L Only						239.800					
S Only						4.480					

Maximum Moment Reactions

Note: Only non-zero reactions are listed.

Load Combination	Moment About X-X Axis			Moment About Y-Y Axis		
	@ Base	@ Top		@ Base	@ Top	
D Only			k-ft			k-ft
+D+L			k-ft			k-ft
+D+Lr			k-ft			k-ft
+D+S			k-ft			k-ft
+D+0.750Lr+0.750L			k-ft			k-ft
+D+0.750L+0.750S			k-ft			k-ft
+0.60D			k-ft			k-ft
Lr Only			k-ft			k-ft
L Only			k-ft			k-ft
S Only			k-ft			k-ft

Maximum Deflections for Load Combinations

Load Combination	Max. X-X Deflection		Distance		Max. Y-Y Deflection		Distance	
D Only	0.0000	in	0.000	ft	0.000	in	0.000	ft
+D+L	0.0000	in	0.000	ft	0.000	in	0.000	ft
+D+Lr	0.0000	in	0.000	ft	0.000	in	0.000	ft
+D+S	0.0000	in	0.000	ft	0.000	in	0.000	ft
+D+0.750Lr+0.750L	0.0000	in	0.000	ft	0.000	in	0.000	ft
+D+0.750L+0.750S	0.0000	in	0.000	ft	0.000	in	0.000	ft
+0.60D	0.0000	in	0.000	ft	0.000	in	0.000	ft
Lr Only	0.0000	in	0.000	ft	0.000	in	0.000	ft
L Only	0.0000	in	0.000	ft	0.000	in	0.000	ft
S Only	0.0000	in	0.000	ft	0.000	in	0.000	ft

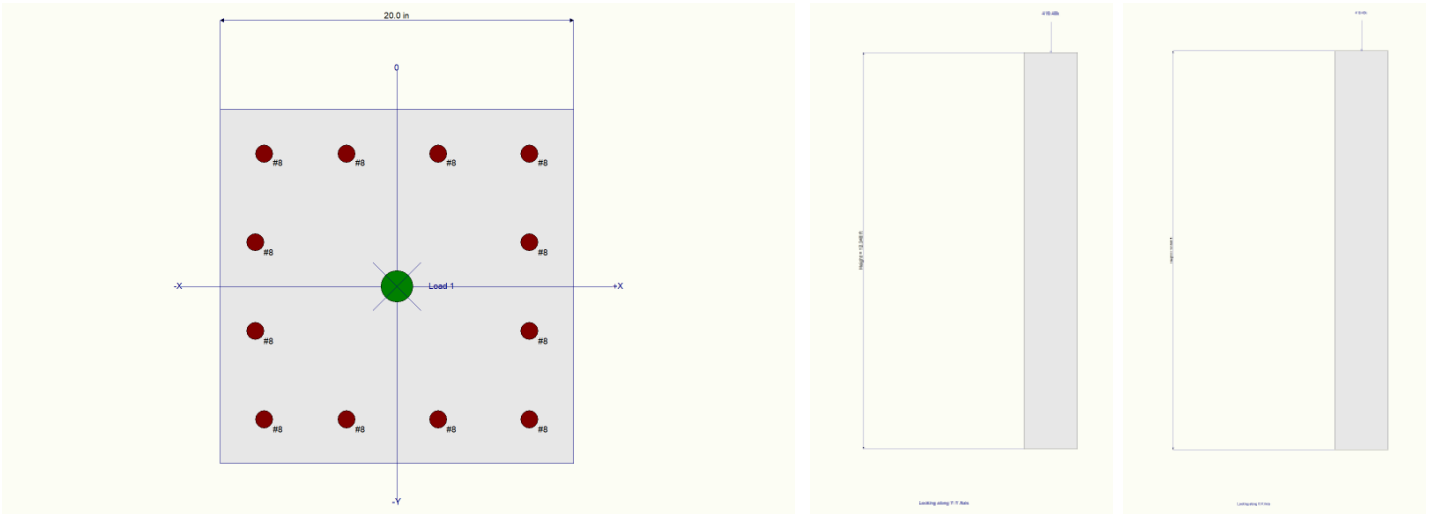
Concrete Column

Lic. # : KW-06013597

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

DESCRIPTION: G Floor Column

Sketches



Interaction Diagrams

Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

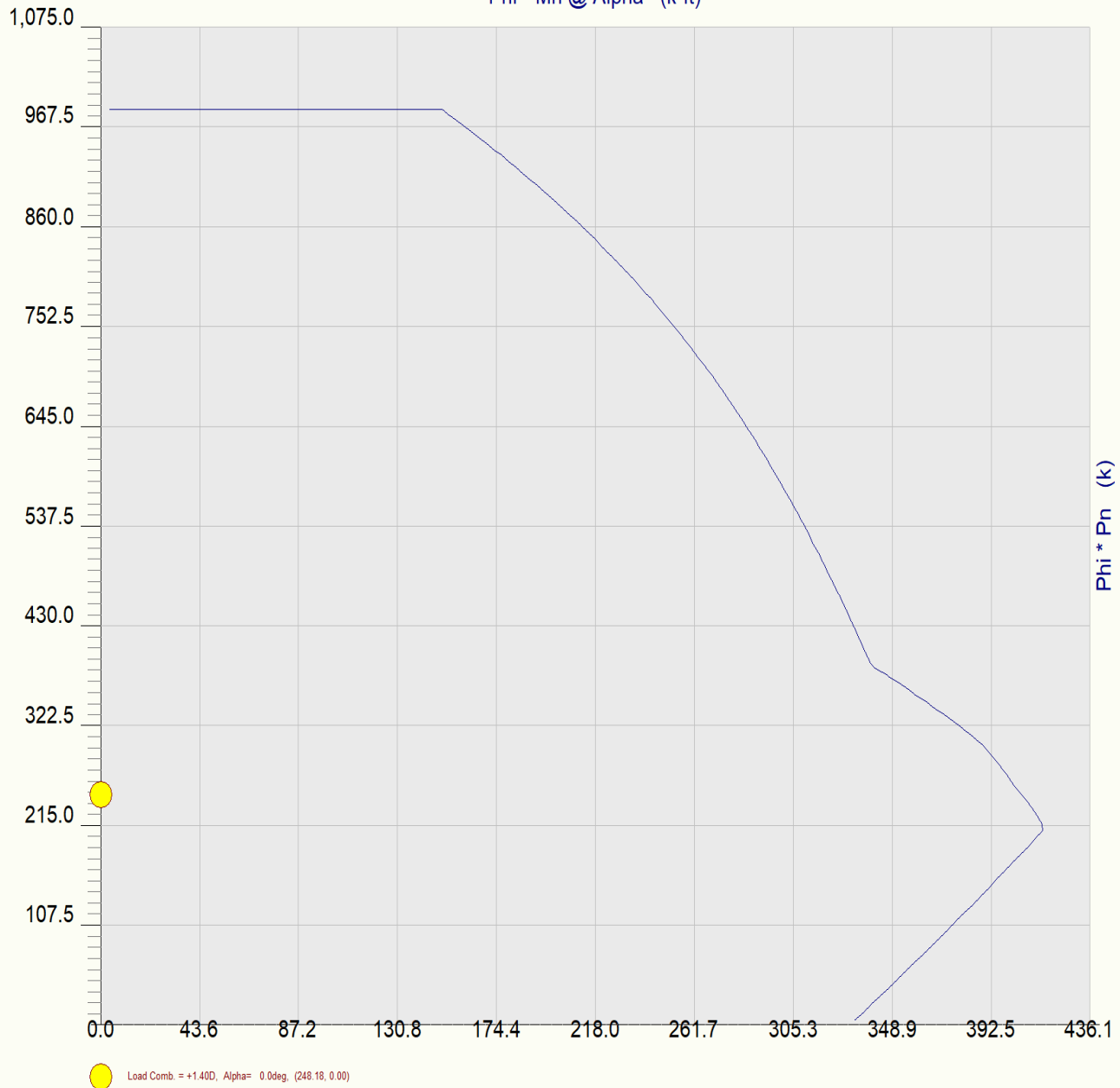
Lic. # : KW-06013597

DESCRIPTION: **G Floor Column**

Concrete Column P-M Interaction Diagram

Phi * Mn @ Alpha (k-ft)

Phi * Pn (k)



Concrete Column

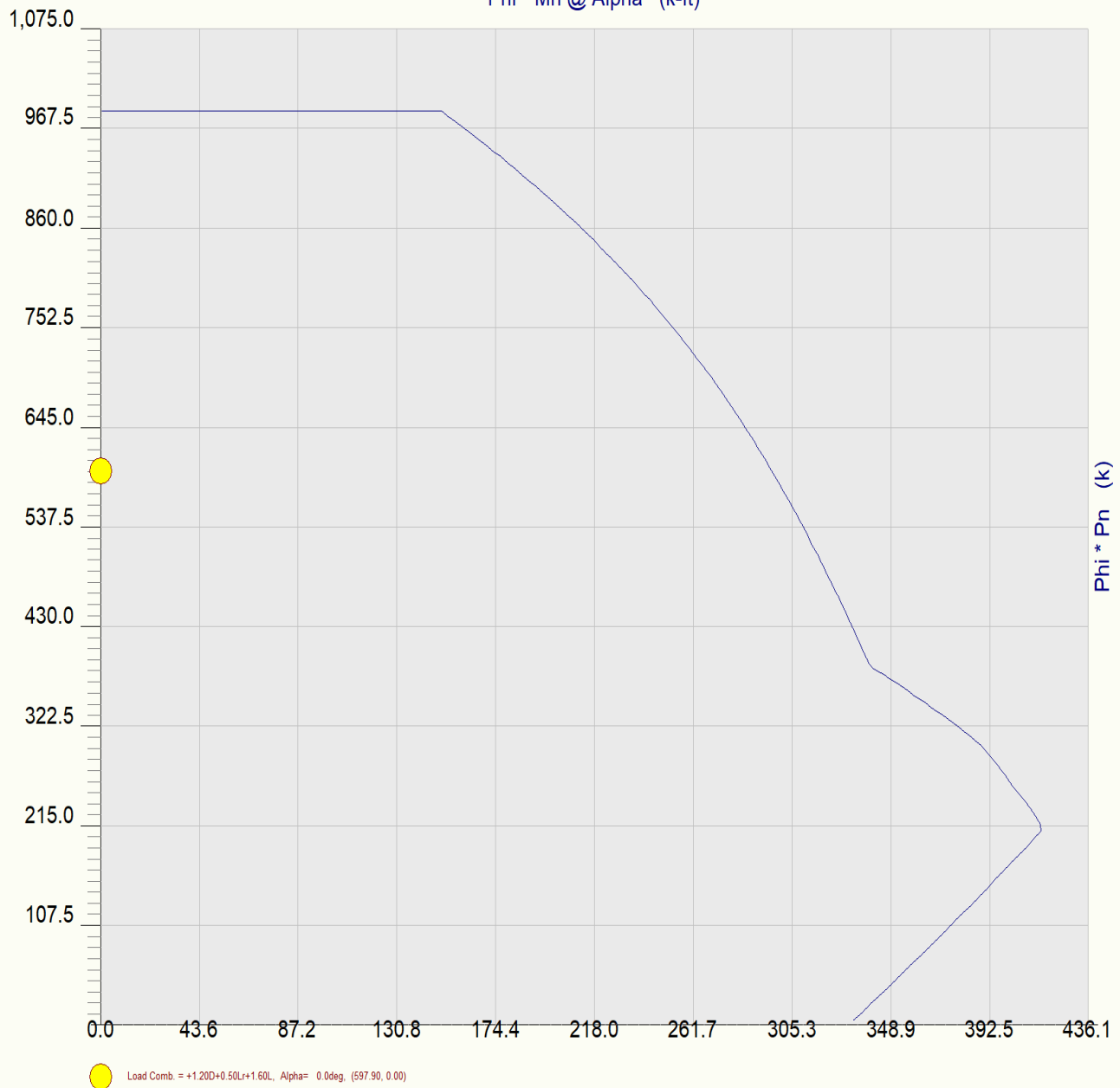
File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **G Floor Column**

Concrete Column P-M Interaction Diagram

Phi * Mn @ Alpha (k-ft)



Concrete Column

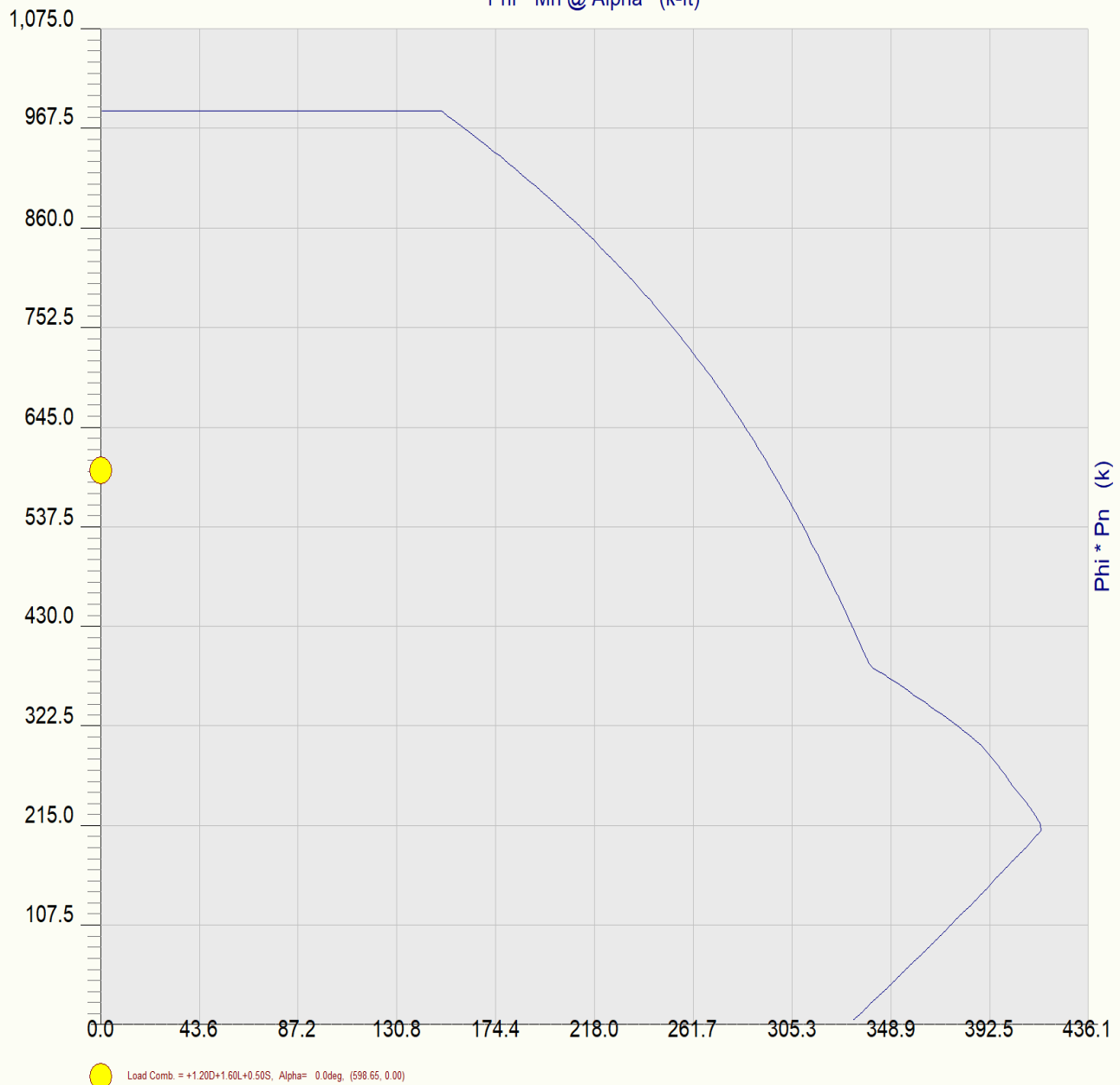
File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **G Floor Column**

Concrete Column P-M Interaction Diagram

Phi * Mn @ Alpha (k-ft)



Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

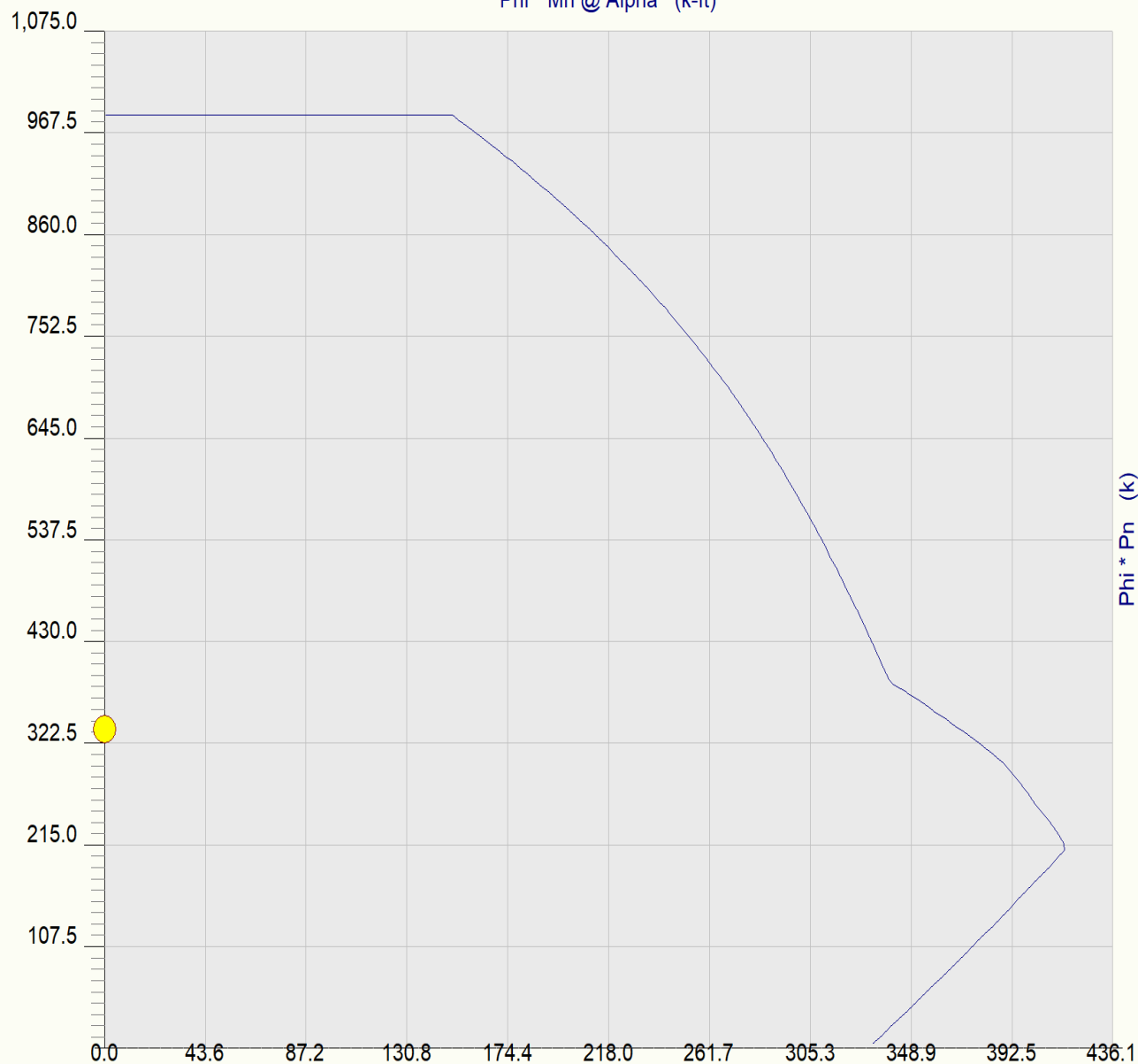
Lic. # : KW-06013597

DESCRIPTION: **G Floor Column**

Concrete Column P-M Interaction Diagram

Phi * Mn @ Alpha (k-ft)

Phi * Pn (k)



Load Comb. = +1.20D+1.60L+0.50L, Alpha= 0.0deg, (337.41, 0.00)

Concrete Column

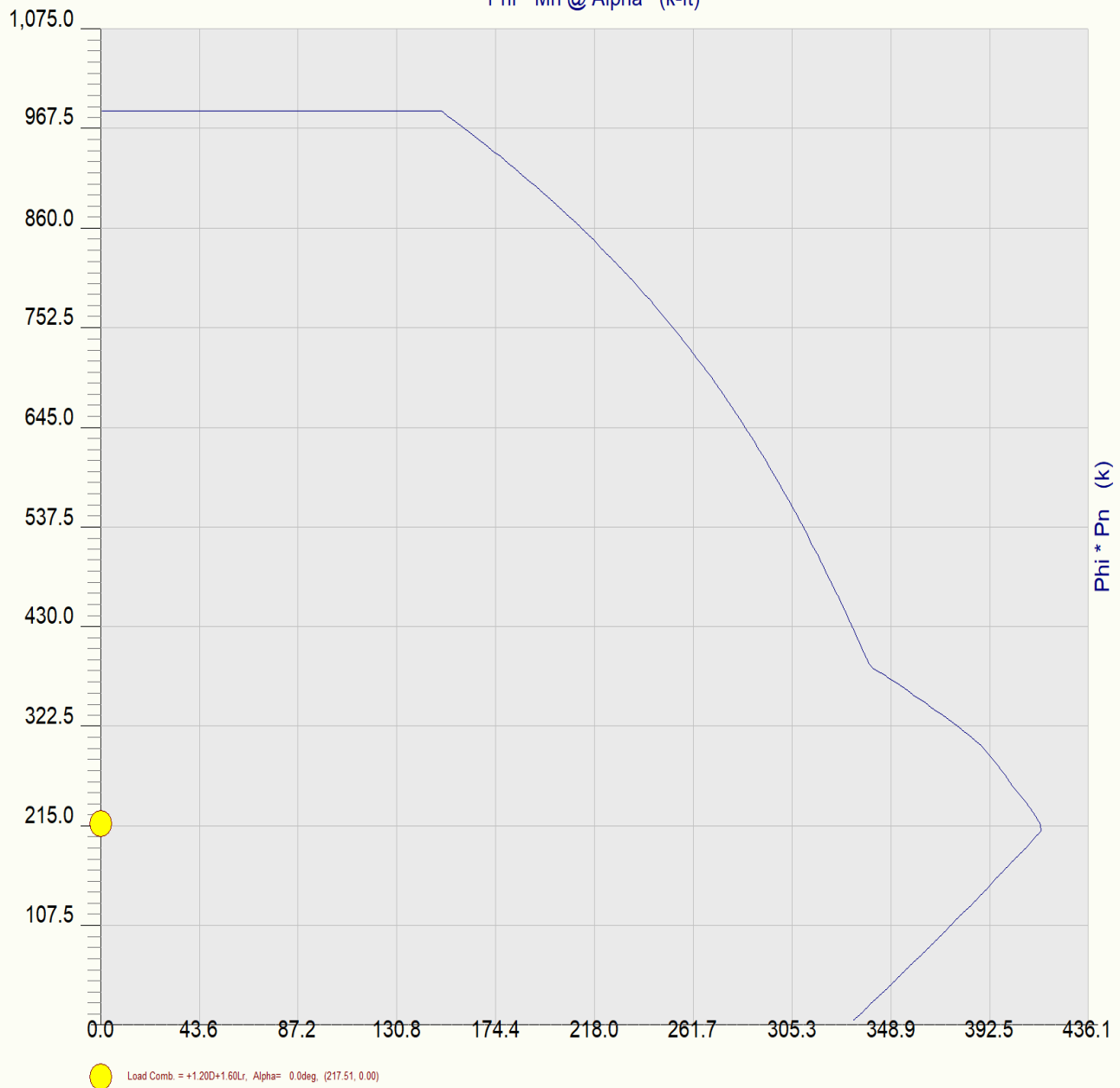
File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

Lic. # : KW-06013597

DESCRIPTION: **G Floor Column**

Concrete Column P-M Interaction Diagram

Phi * Mn @ Alpha (k-ft)



Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

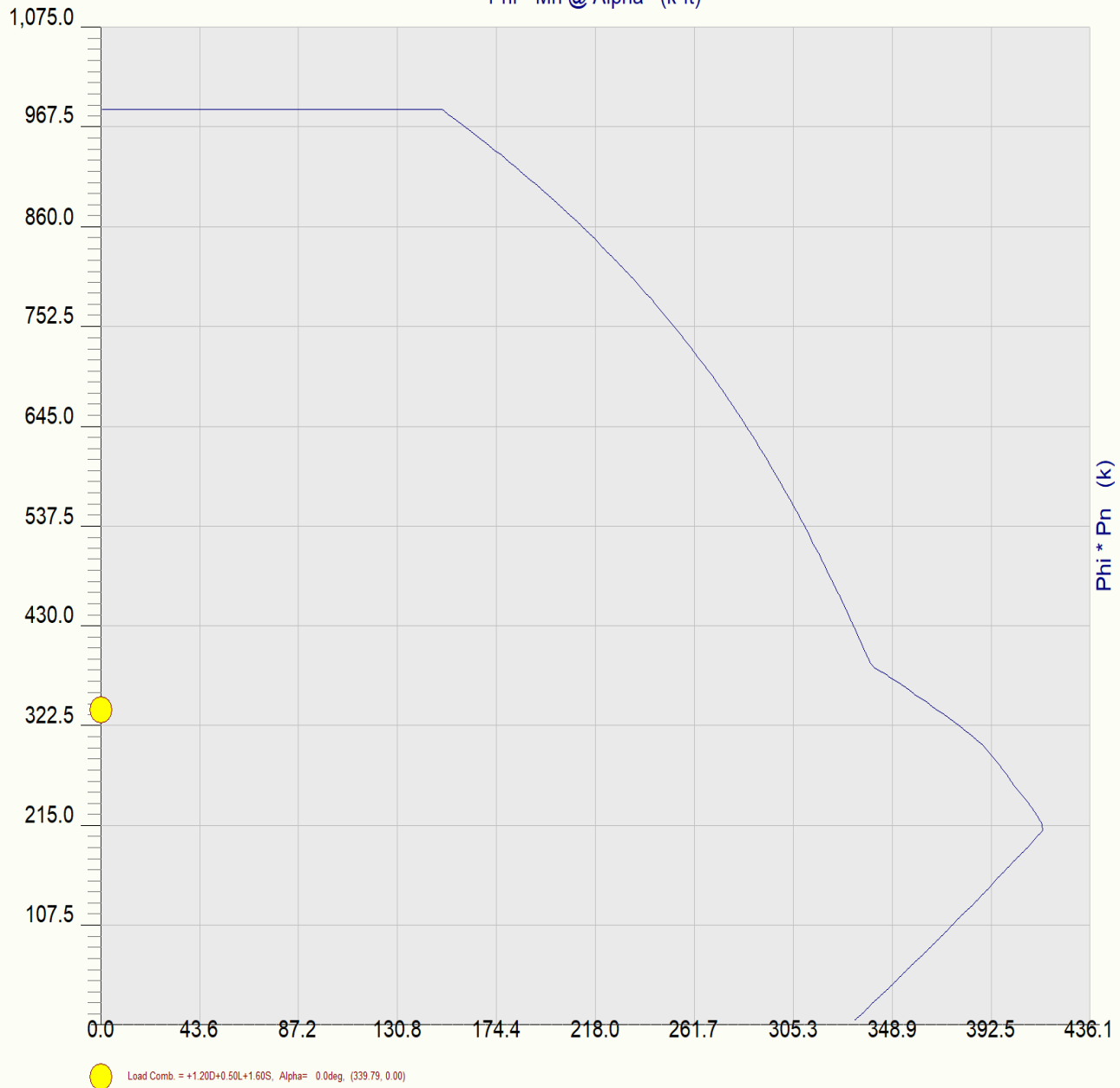
Lic. # : KW-06013597

DESCRIPTION: **G Floor Column**

Concrete Column P-M Interaction Diagram

Phi * Mn @ Alpha (k-ft)

Phi * Pn (k)



Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

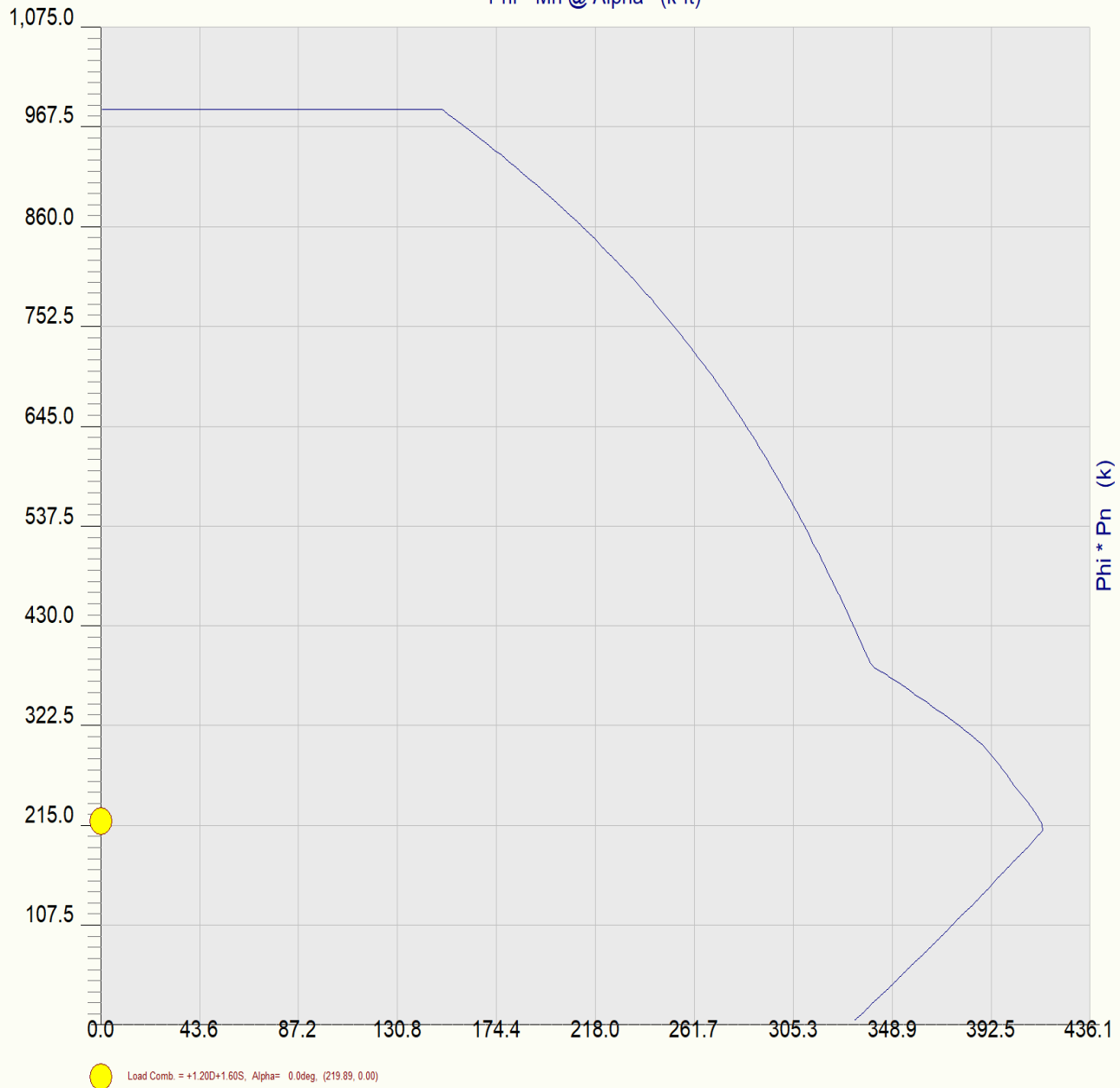
Lic. # : KW-06013597

DESCRIPTION: **G Floor Column**

Concrete Column P-M Interaction Diagram

Phi * Mn @ Alpha (k-ft)

Phi * Pn (k)



Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

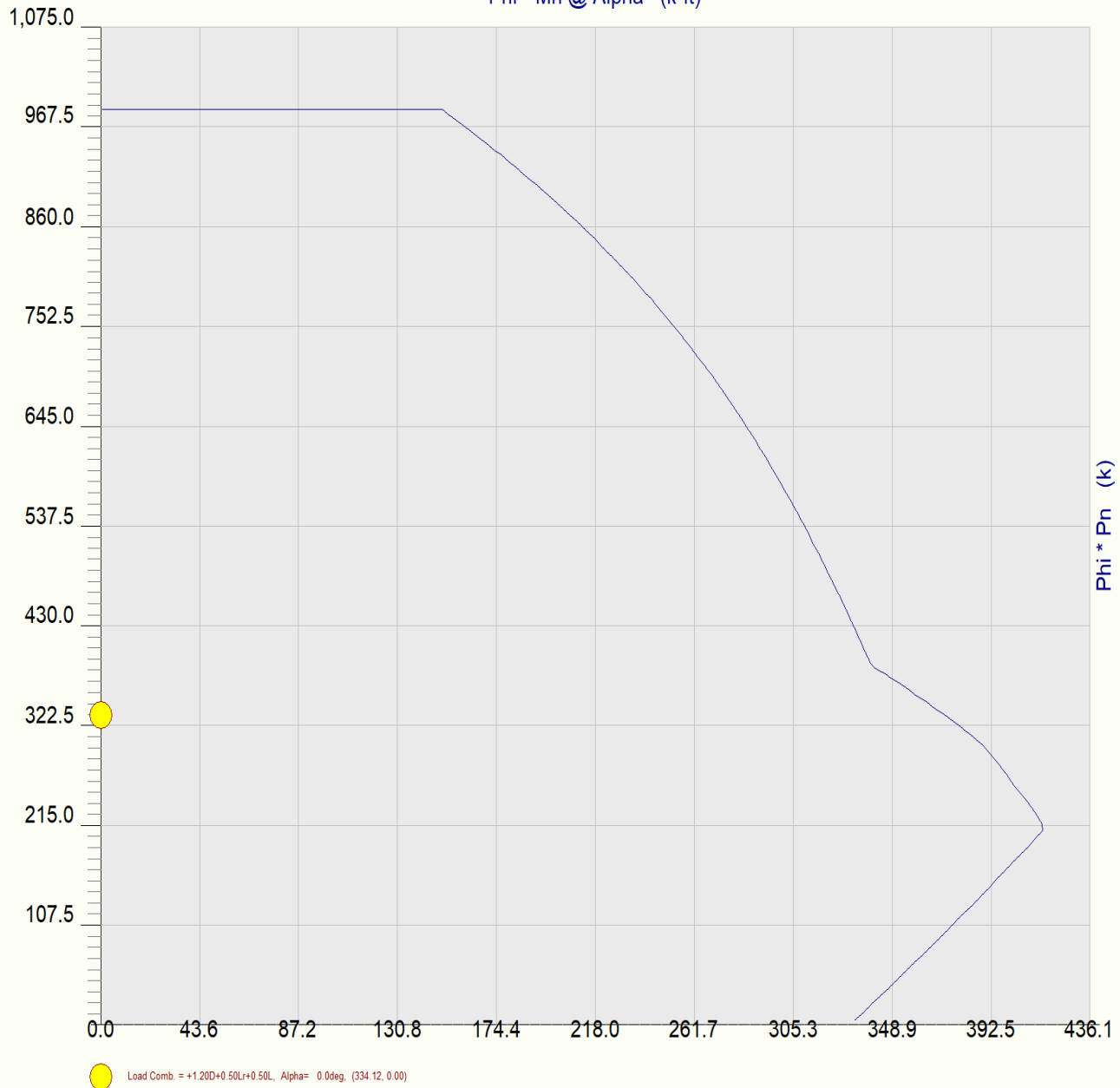
Lic. # : KW-06013597

DESCRIPTION: **G Floor Column**

Concrete Column P-M Interaction Diagram

Phi * Mn @ Alpha (k-ft)

Phi * Pn (k)



Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

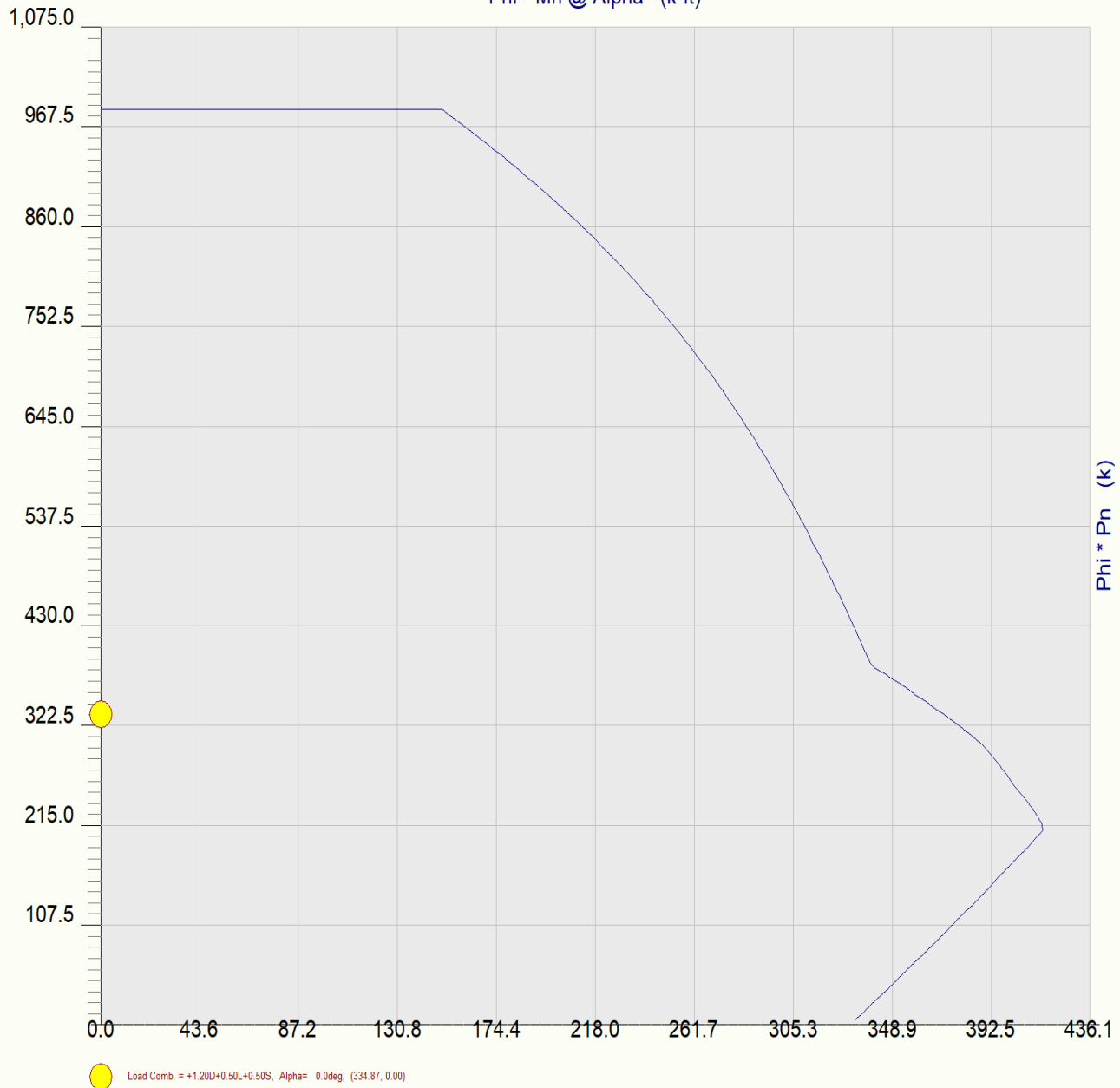
Lic. # : KW-06013597

DESCRIPTION: **G Floor Column**

Concrete Column P-M Interaction Diagram

Phi * Mn @ Alpha (k-ft)

Phi * Pn (k)



Concrete Column

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

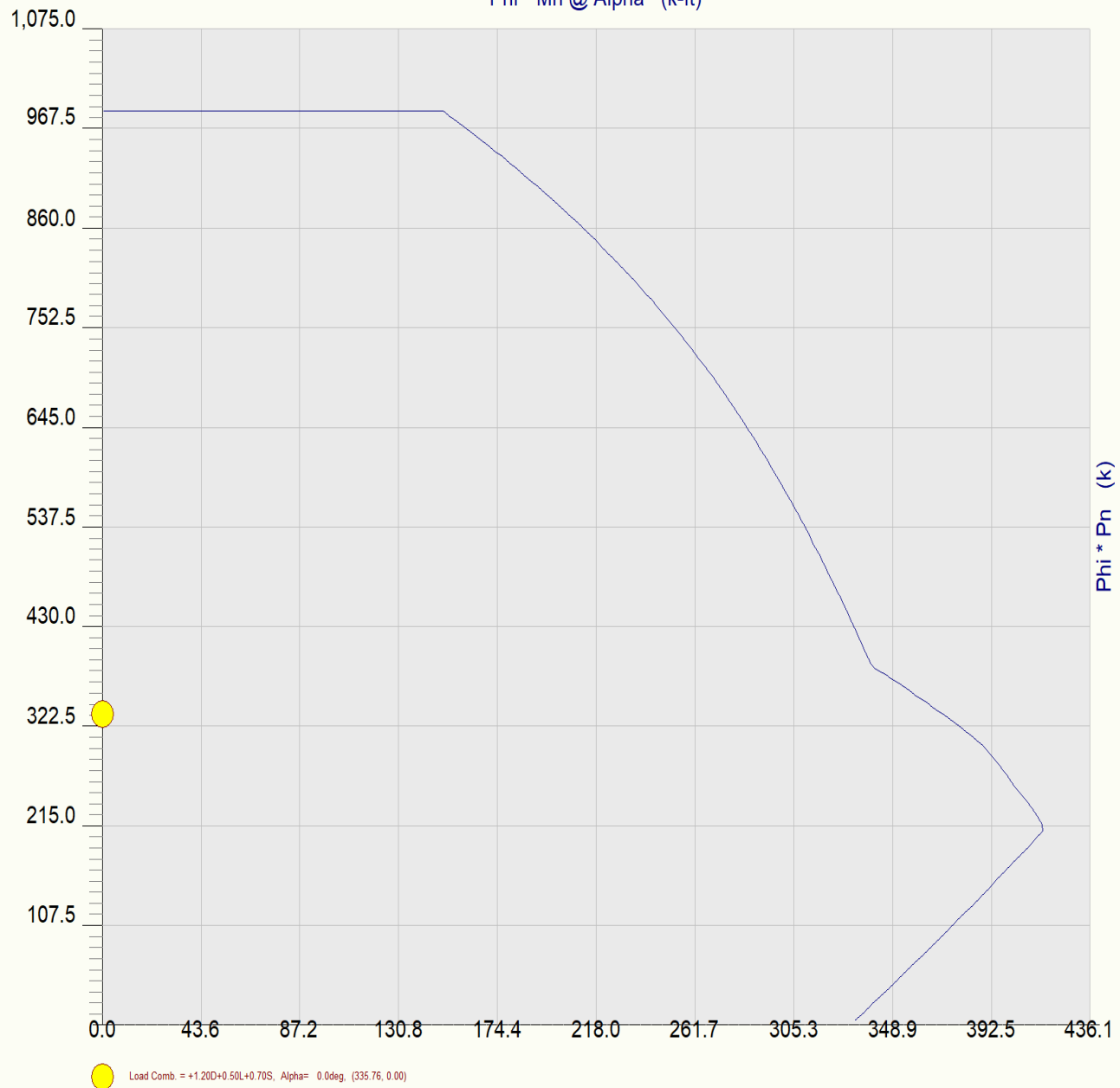
Lic. # : KW-06013597

DESCRIPTION: **G Floor Column**

Concrete Column P-M Interaction Diagram

$\Phi * M_n @ \alpha$ (k-ft)

$\Phi * P_n$ (k)



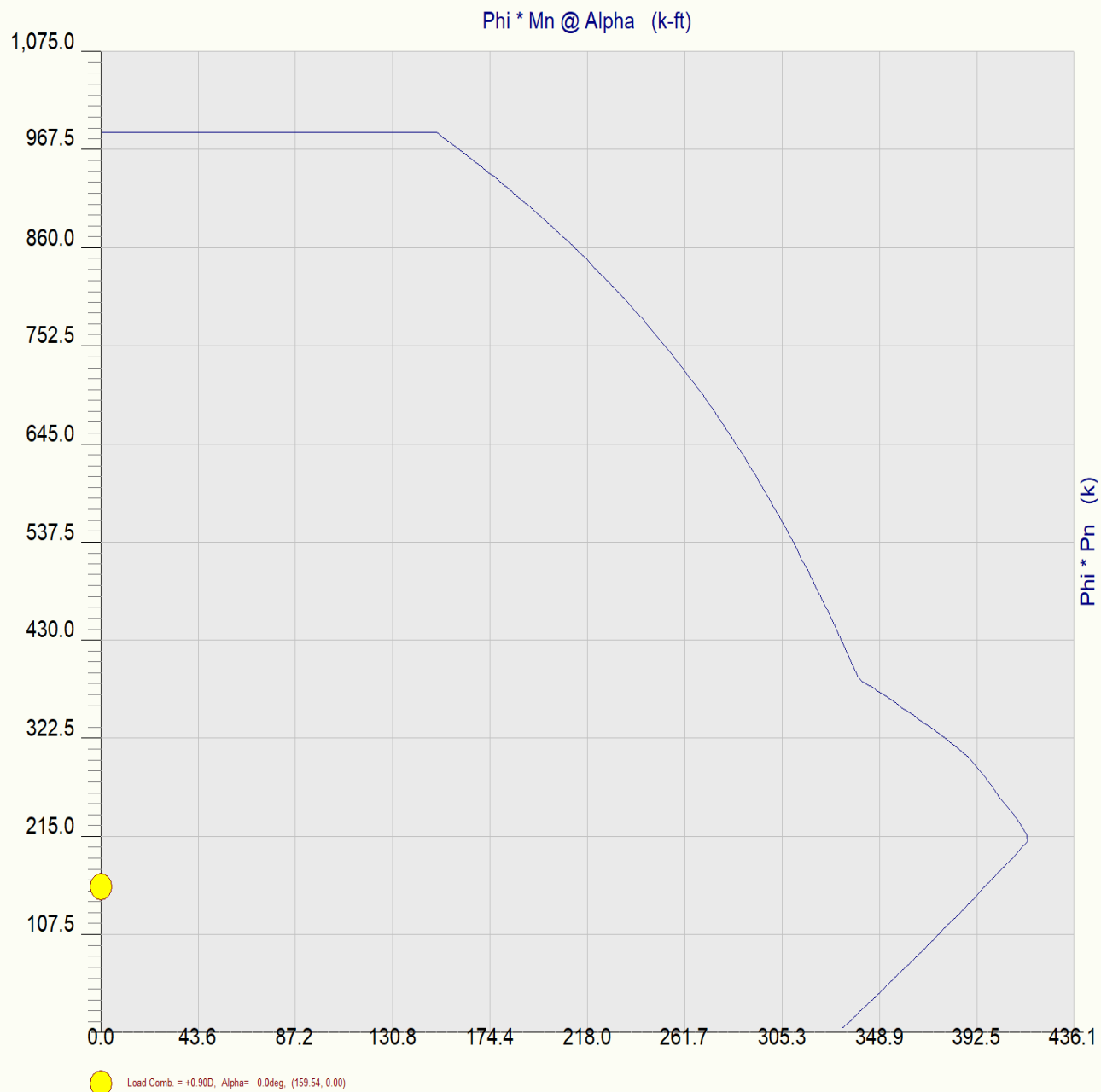
Concrete Column

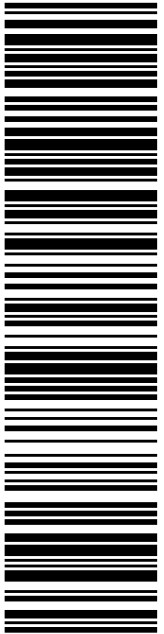
Lic. # : KW-06013597

File: 638283 Exterior Column Analysis.ec6
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
Centerline Communications

DESCRIPTION: **G Floor Column**

Concrete Column P-M Interaction Diagram



 UNITED STATES POSTAL SERVICE®		Click-N-Ship®	
P		usps.com US POSTAGE Flat Rate Env U.S. POSTAGE PAID Click-N-Ship®	
PRIORITY MAIL®		10/11/2022 Mailed from 01566 986780141556870	
DEBORAH CHASE NORTHEAST SITE SOLUTIONS STE 1 420 MAIN ST STURBRIDGE MA 01566-1359		Expected Delivery Date: 10/13/22 Ref#: CT11410-SA 0000	
 LISA MATTHEWS CT SITING COUNCIL 10 FRANKLIN SQ NEW BRITAIN CT 06051-2655		C006	
USPS TRACKING #			
9405 5036 9930 0368 6530 60			
Electronic Rate Approved #038555749			

Cut on dotted line.

Instructions

- Each Click-N-Ship® label is unique. Labels are to be used as printed and used only once. DO NOT PHOTO COPY OR ALTER LABEL.
- Place your label so it does not wrap around the edge of the package.
- Adhere your label to the package. A self-adhesive label is recommended. If tape or glue is used, DO NOT TAPE OVER BARCODE. Be sure all edges are secure.
- To mail your package with PC Postage®, you may schedule a Package Pickup online, hand to your letter carrier, take to a Post Office™, or drop in a USPS collection box.
- Mail your package on the "Ship Date" you selected when creating this label.

Click-N-Ship® Label Record

USPS TRACKING # :
9405 5036 9930 0368 6530 60

Trans. #: 573532004
Print Date: 10/11/2022
Ship Date: 10/11/2022
Expected Delivery Date: 10/13/2022

Priority Mail® Postage: **\$9.90**
Total: **\$9.90**

From: DEBORAH CHASE
NORTHEAST SITE SOLUTIONS
STE 1
420 MAIN ST
STURBRIDGE MA 01566-1359

Ref#: CT11410-SA

To: LISA MATTHEWS
CT SITING COUNCIL
10 FRANKLIN SQ
NEW BRITAIN CT 06051-2655

* Retail Pricing Priority Mail rates apply. There is no fee for USPS Tracking® service on Priority Mail service with use of this electronic rate shipping label. Refunds for unused postage paid labels can be requested online 30 days from the print date.



Thank you for shipping with the United States Postal Service!
Check the status of your shipment on the USPS Tracking® page at usps.com