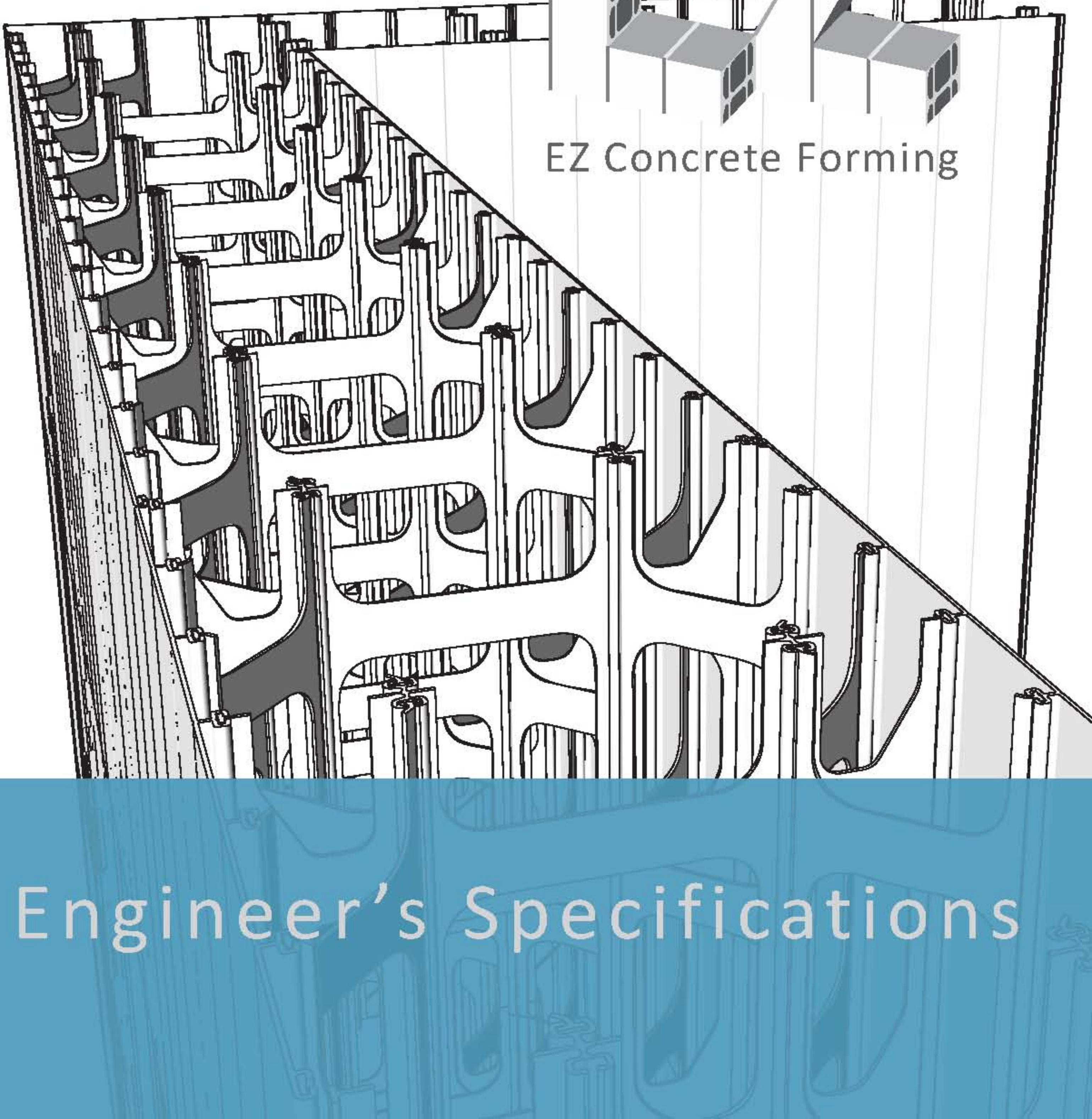
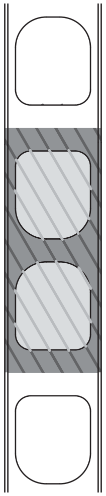
EZ Concrete Forming



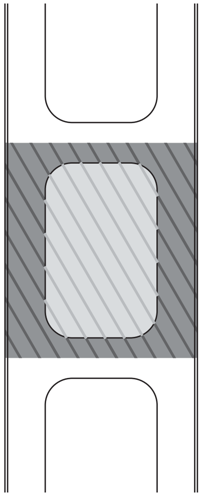
Engineer’s Specifications

TABLE OF CONTENTS

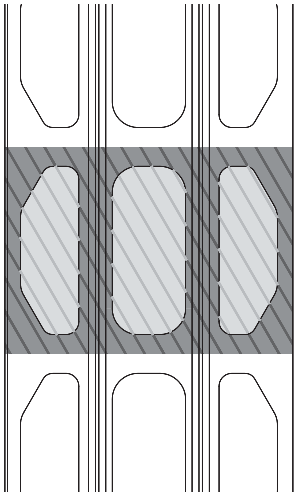
Percentage Hollow Areas Vs. Plastic Areas (Concrete Throughput)



2” Connector
49.0% Plastic
51.0% Throughput

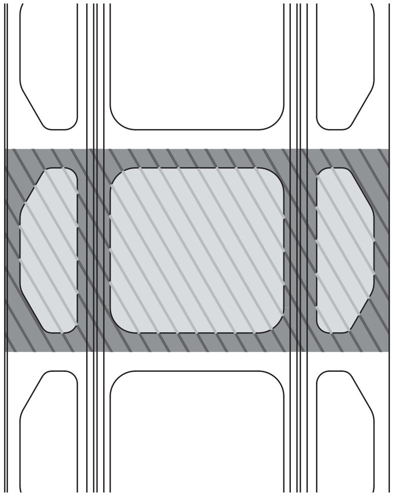


4” Connector
54.3% Plastic
45.7% Throughput

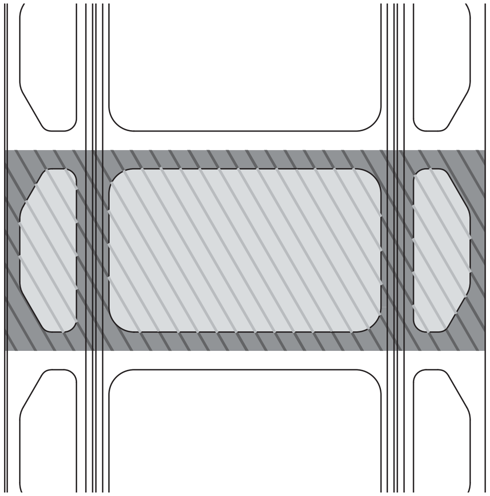


6” Connector
51.5% Plastic
48.5% Throughput

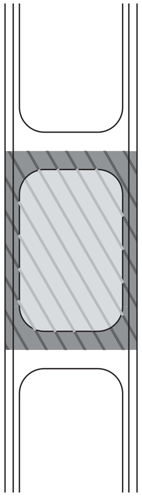
8” Connector
42.9% Plastic
57.1% Throughput



10” Connector
37.9% Plastic
62.1% Throughput

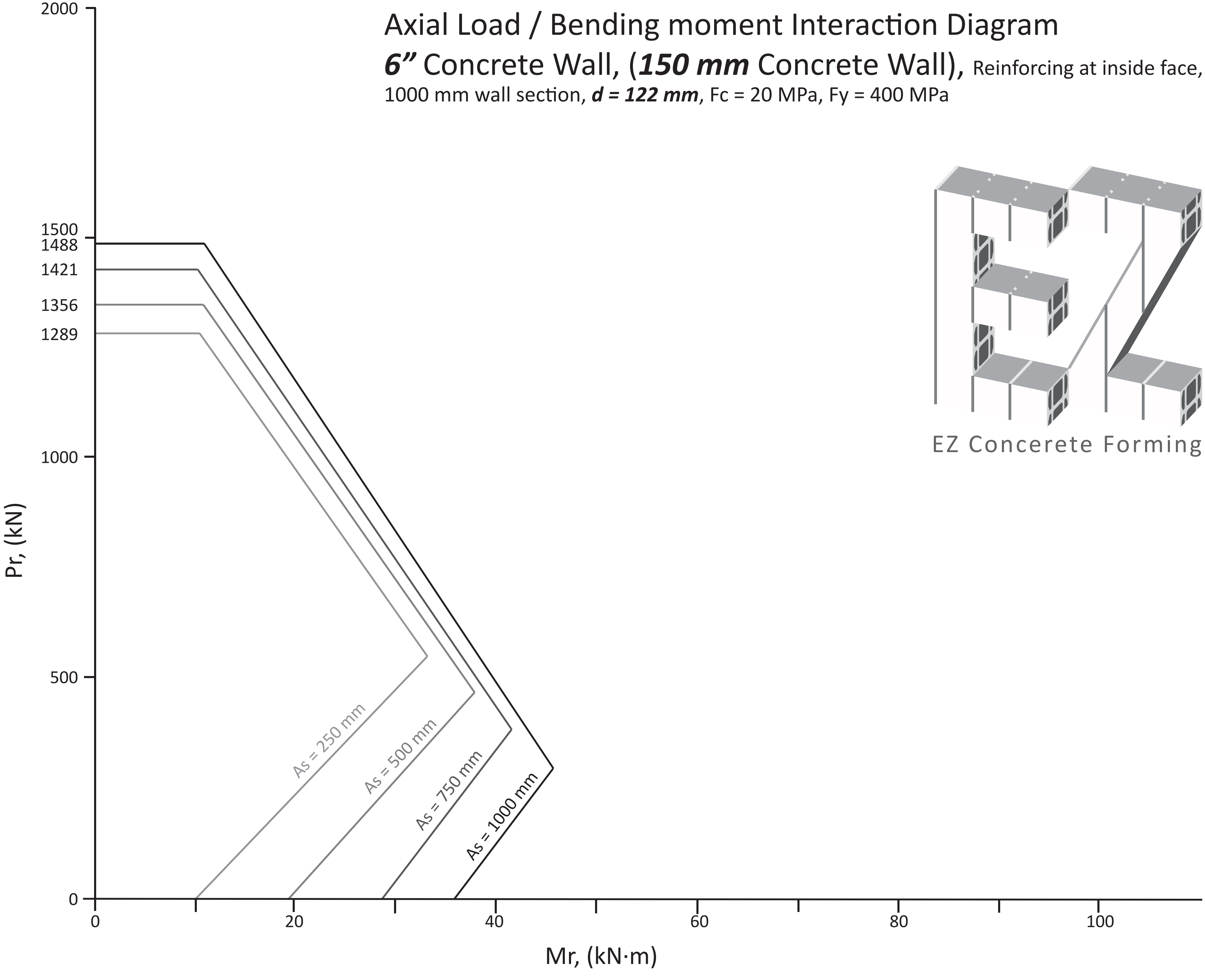


45° Connector
38.5% Plastic
61.5% Throughput



Axial Load / Bending moment Interaction Diagram

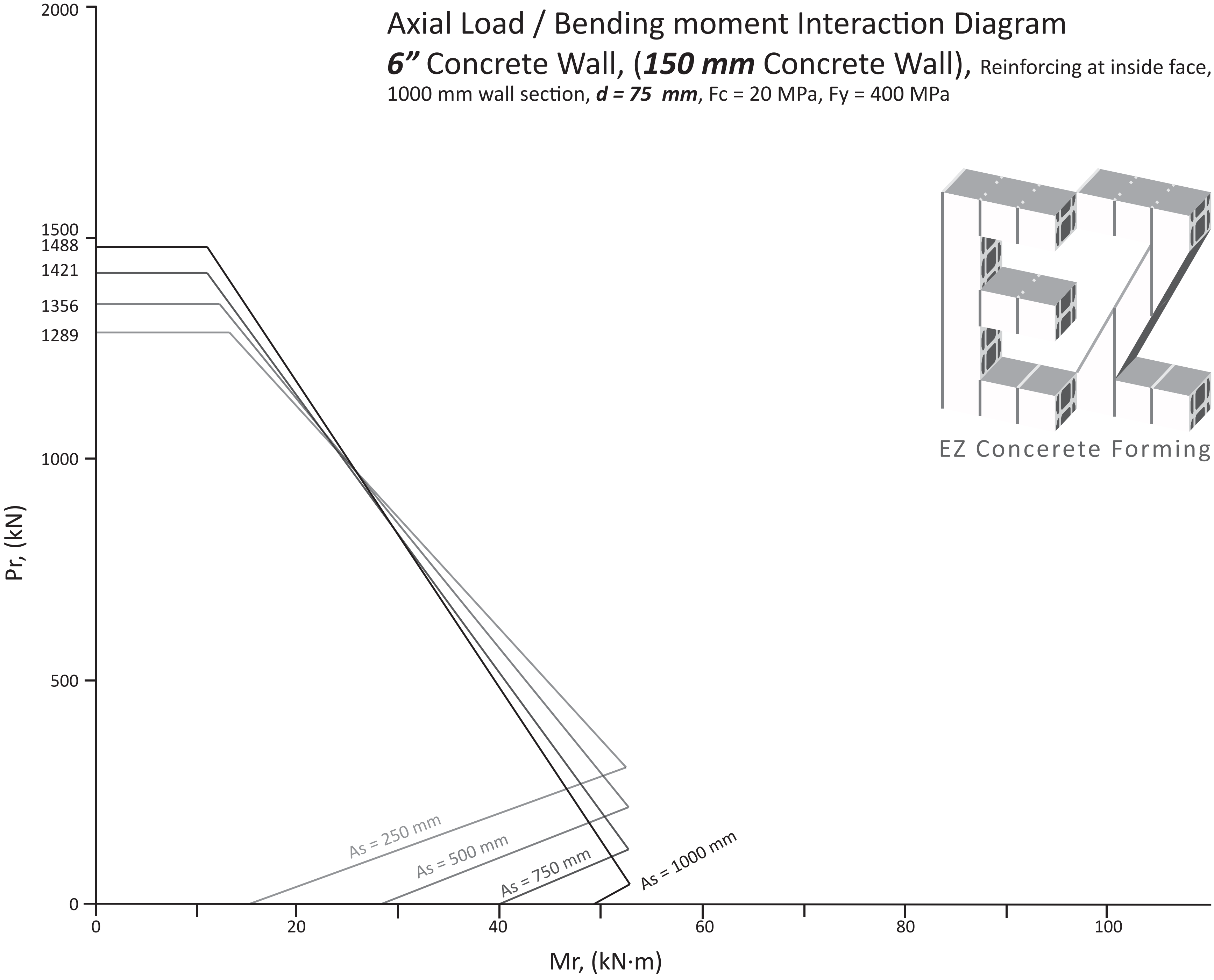
6” Concrete Wall, (***150 mm*** Concrete Wall), Reinforcing at inside face,
1000 mm wall section, ***d = 122 mm***, Fc = 20 MPa, Fy = 400 MPa



EZ Concrete Forming

Axial Load / Bending moment Interaction Diagram

6” Concrete Wall, (***150 mm*** Concrete Wall), Reinforcing at inside face,
1000 mm wall section, ***d = 75 mm***, Fc = 20 MPa, Fy = 400 MPa

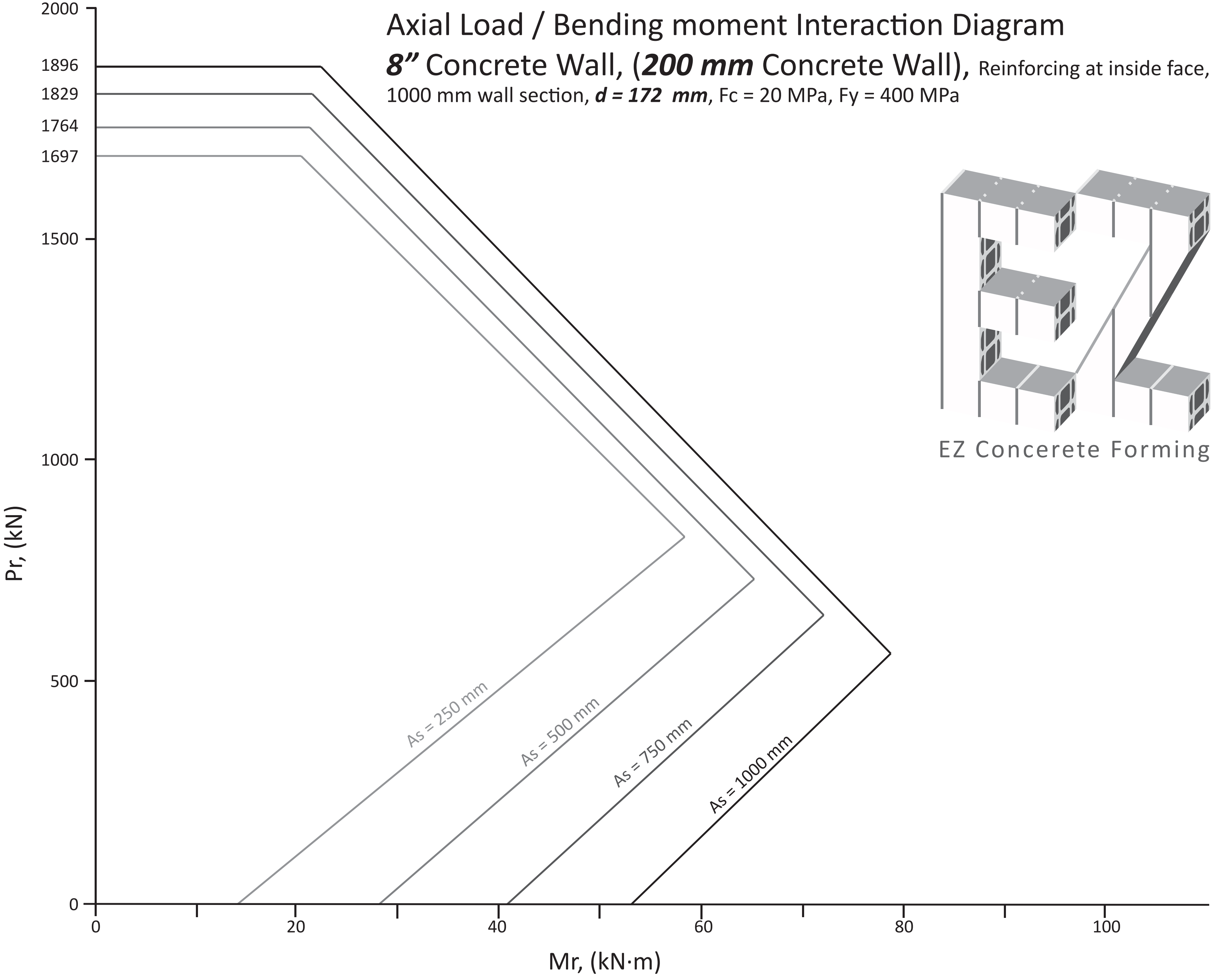


EZ Concrete Forming

Axial Load / Bending moment Interaction Diagram

8” Concrete Wall, (***200 mm*** Concrete Wall), Reinforcing at inside face,

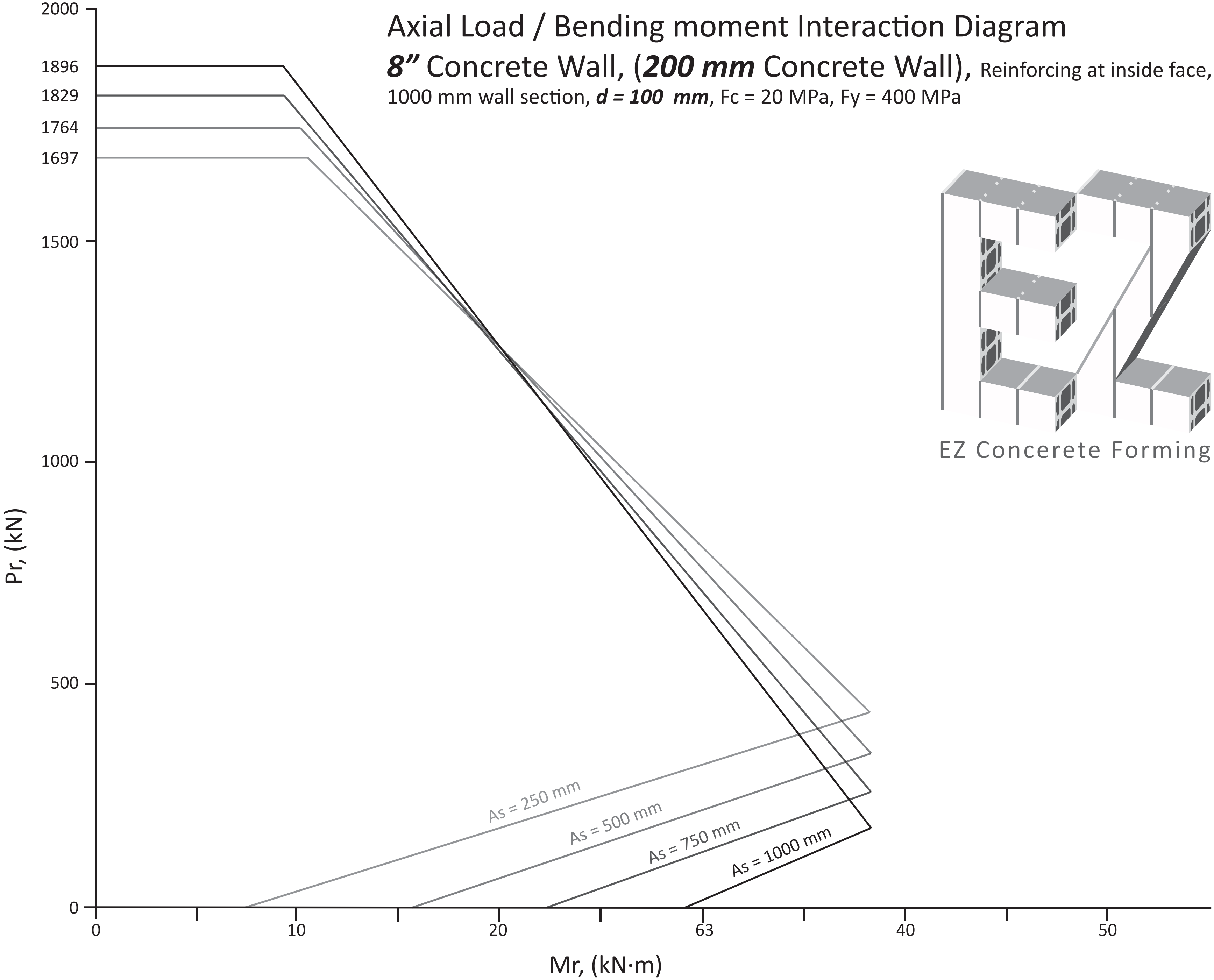
1000 mm wall section, ***d = 172 mm***, Fc = 20 MPa, Fy = 400 MPa



EZ Concrete Forming

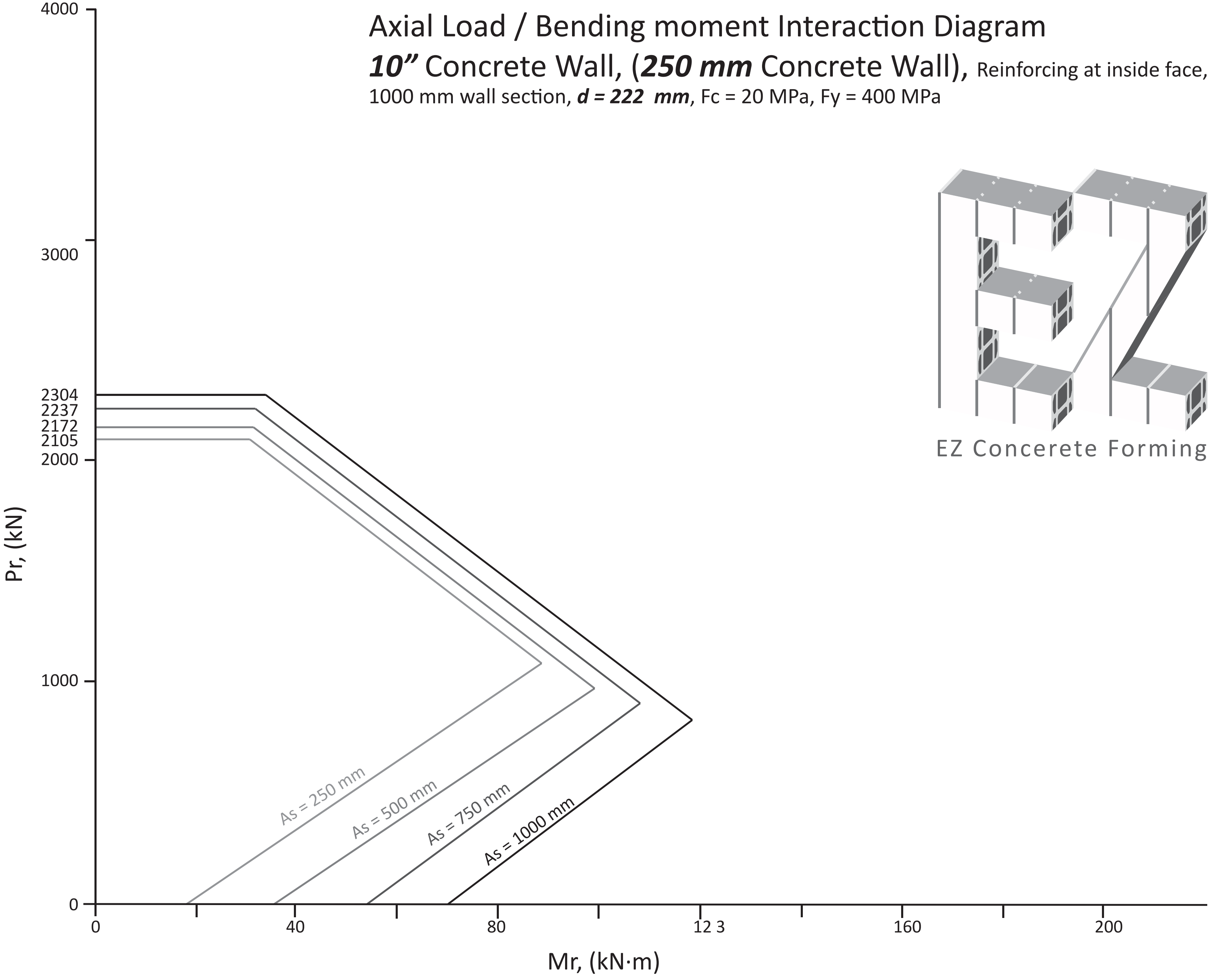
Axial Load / Bending moment Interaction Diagram

8” Concrete Wall, (***200 mm*** Concrete Wall), Reinforcing at inside face, 1000 mm wall section, ***d = 100 mm***, Fc = 20 MPa, Fy = 400 MPa



Axial Load / Bending moment Interaction Diagram

10" Concrete Wall, (***250 mm*** Concrete Wall), Reinforcing at inside face, 1000 mm wall section, ***d = 222 mm***, Fc = 20 MPa, Fy = 400 MPa

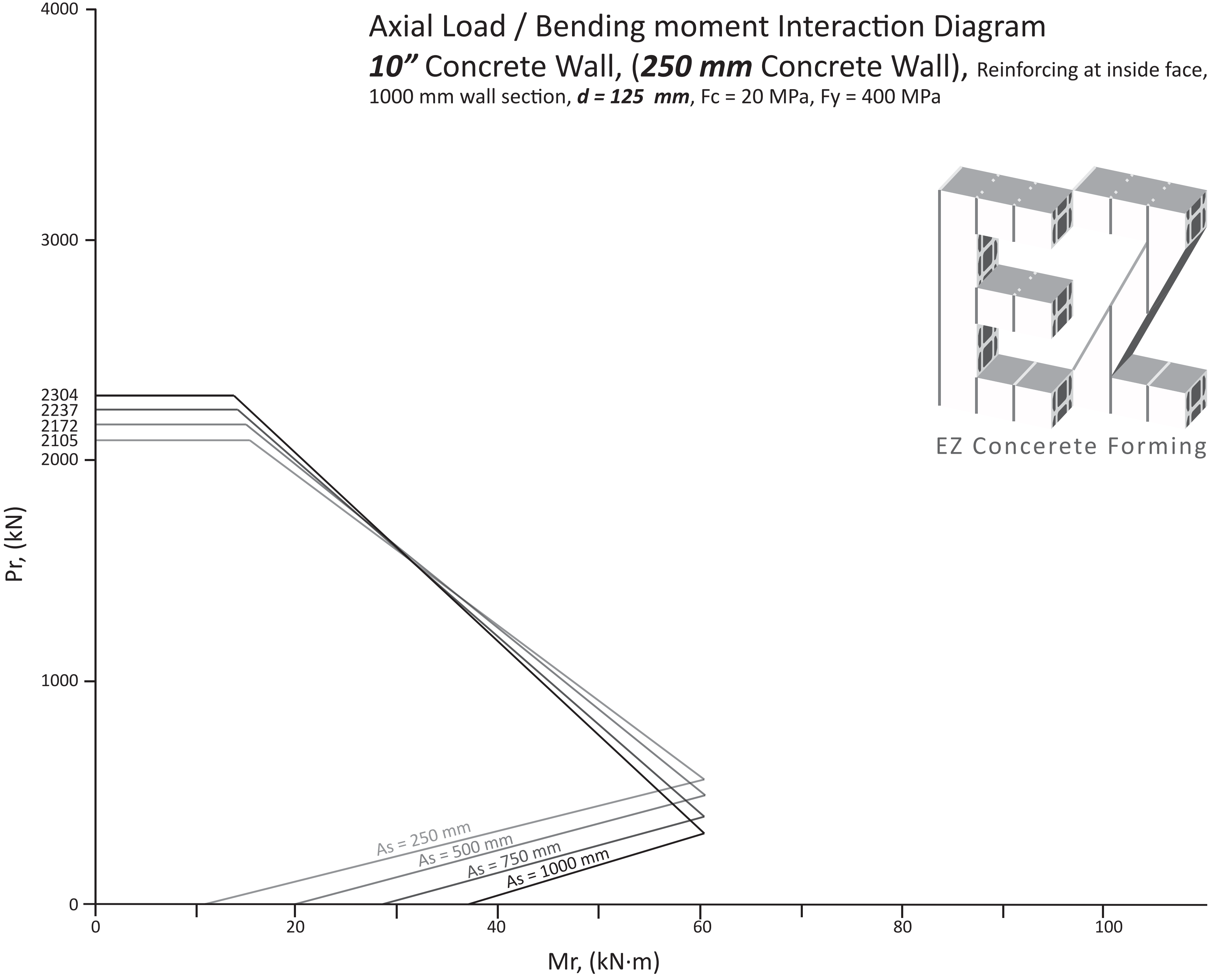


EZ Concrete Forming

Axial Load / Bending moment Interaction Diagram

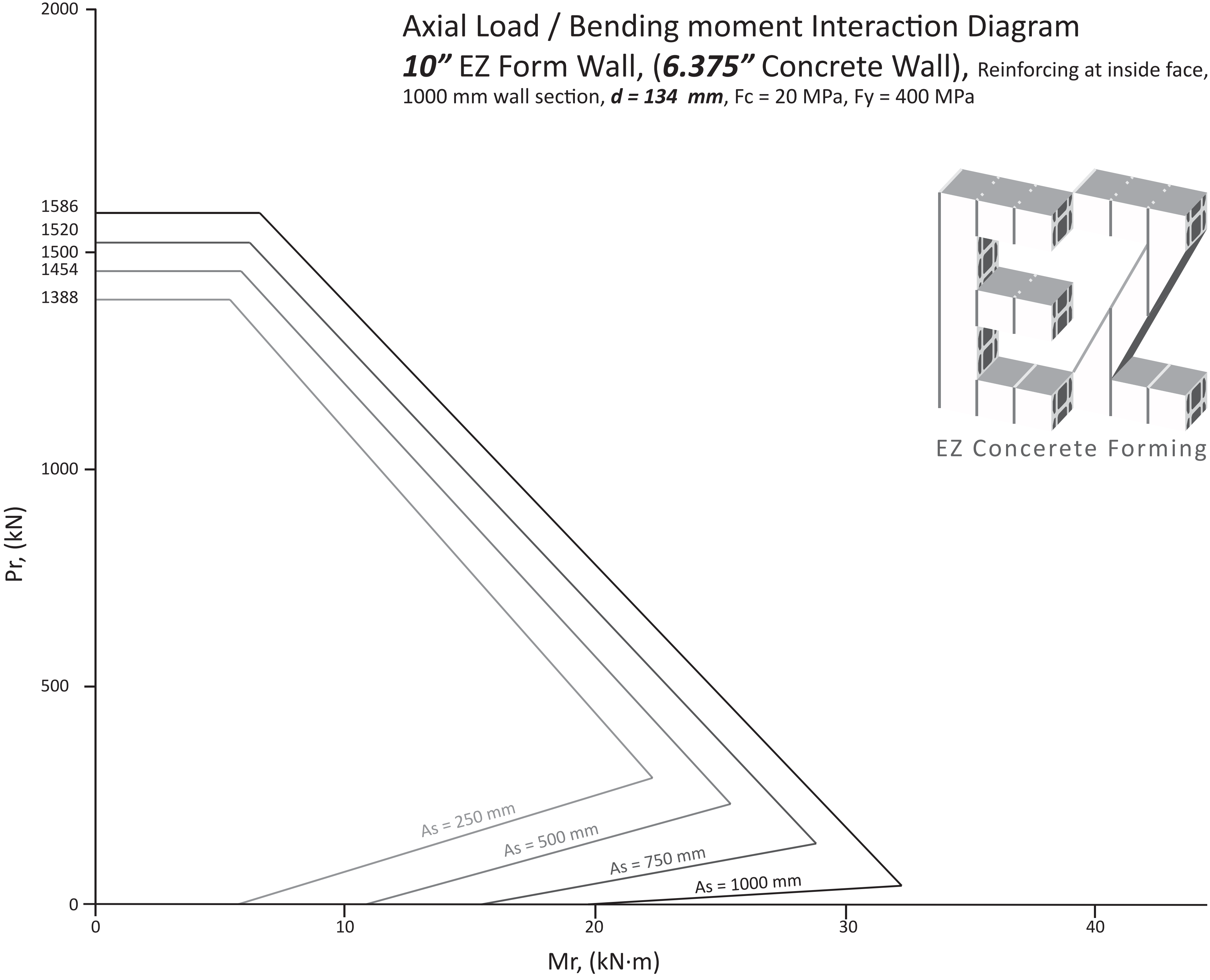
10” Concrete Wall, (***250 mm*** Concrete Wall), Reinforcing at inside face,

1000 mm wall section, ***d = 125 mm***, Fc = 20 MPa, Fy = 400 MPa



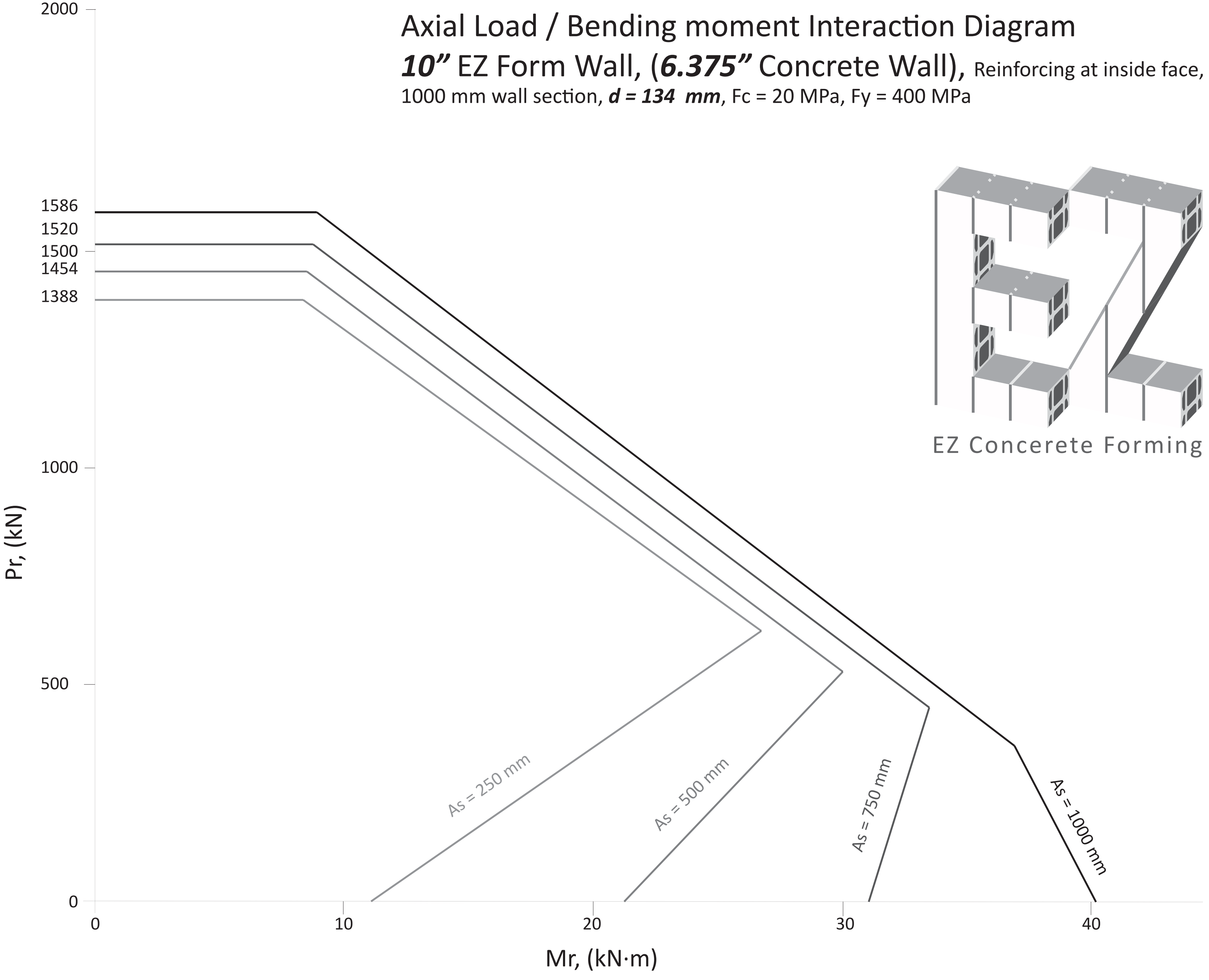
Axial Load / Bending moment Interaction Diagram

10” **EZ Form Wall, (*6.375”* Concrete Wall),** Reinforcing at inside face, 1000 mm wall section, ***d* = *134 mm***, Fc = 20 MPa, Fy = 400 MPa



Axial Load / Bending moment Interaction Diagram

10” EZ Form Wall, (***6.375”*** Concrete Wall), Reinforcing at inside face, 1000 mm wall section, ***d = 134 mm***, Fc = 20 MPa, Fy = 400 MPa



EZ FORM INTERACTION DIAGRAM CALCULATION:

REINFORCING STEEL AT WALL CENTERLINE

Wall width used for design	$b := 1000.0 \cdot \mathrm{mm}$
Input Units:	$N := kg \cdot 9.80665$ $kN := N \cdot 10^3$ $Pa := N/m^2$ $MPa := Pa \cdot 10^6$

Input Variables:

EZ Form Wall Concrete Thickness	$t := 125 \cdot \mathrm{mm}$
Area of Steel per lineal metre of wall	$As := 250 \cdot \mathrm{mm}^2$
Reinforcing steel diameter	$\varphi s := 15 \cdot \mathrm{mm}$
Distance from compression face to tension centre	

$$d := t/2$$

$$d = 62.5\ \mathrm{mm}$$

Material Properties and Constants:

Specified compressive strength of concrete	$fc := 20\ MPa$
Resistance factor for concrete	$\varphi c := 0.60$
Factor to account for low density concrete	$\lambda := 1.0$
Resistance factor for concrete	$\varphi s := 0.85$
Specified minimum steel yield strength	$fy := 400\ MPa$
Ratio of depth of compression block to neutral axis	$\beta 1 := 0.85$
Modulus of elasticity	$Es := 200{,}000$

STRENGTH UNDER AXIAL COMPRESSION:

$Ag := b \cdot t$

$Ag = 1.25 \times 10^{5}\ mm^{2}$

$Pro := 0.85 \cdot \phi c \cdot fc \cdot (Ag - As)\ MPa + \phi s \cdot fy \cdot MPa \cdot As$

$Pro = 1.357 \times 10^{3}\ kN$

STRENGTH UNDER PURE BENDING:

Reinforcing placed at wail centreline

Concrete force $Cc(c) := 0.85 \cdot \phi c \cdot fc \cdot MPa \cdot b \cdot 0.85 \cdot c$

Total tensile force $T := As \cdot \phi s \cdot fy \cdot MPa$

$T = 85\ kN$

$T(c) := Cc(c) - T$

$c := 1$

$soln := \surd(T(c), c)$

c is $soln = 9.804 \times 10^{-3}\ m$

Taking moments about tension steel

$Mro := 0.85 \cdot \phi c \cdot fc \cdot MPa \cdot b \cdot 0.85 \cdot soln \cdot m \cdot (d - 0.85 \cdot (soln \cdot m)/2)$

$Mro = 4.958\ kN \cdot m$

STRENGTH UNDER BALANCED STRAIN CONDITIONS;

$\varepsilon y := fy / Es$

$\varepsilon y = 2 \times 10^{-3}$

$xb := d \cdot (0.003 / (\varepsilon y + 0.003))$

$xb = 37.5$ mm

$a := 0.85 \cdot xb$

$a := 31.875$ mm

$Cc := 0.85 \cdot \phi c \cdot fc \cdot a \cdot b \cdot MPa$

$Cc = 325.125$ kN

$T := 0.85 \cdot As \cdot fy \cdot MPa$

$T = 85$ kN

$Prb := Cc - T$

$Prb = 240.125$ kN

Determine location of plastic centroid:

$C1 := b \cdot t \cdot 0.85 \cdot fc \cdot MPa$

$C1 = 2.125 \times 10^{3}$ kN

$Cs;= AS \cdot 0.85 \cdot fy \cdot MPa$

$Cs = 85$ kN

$Pn:= C1 + Cs$

$Pn = 2.21 \times 10^{3}$ kN

Moments along inside face of wall, distance to plastic centroid:

$x: (C1 \cdot (t/2) + Cs \cdot (t/2)) / Pn$

$x = 62.5$mm from inside face

Momemts about plastic centroid:

$Mrb := Cc \cdot ((t/2) - (a/2))$

$Mrb = 15.139$ kN $\cdot$ m

EZ FORM INTERACTION DIAGRAM CALCULATION:

REINFORCING STEEL AT WALL CENTERLINE

Wall width used for design	$b := 1000.0 \cdot mm$

Input Units:

$N := kg \cdot 9.80665$

$kN := N \cdot 10^3$

$Pa := N / m^2$

$MPa := Pa \cdot 10^6$

Input Variables:

EZ Form Wall Concrete Thickness	$t := 250 \cdot mm$
Area of Steel per lineal metre of wall	$As := 500 \cdot mm^2$
Reinforcing steel diameter	$\phi s := 15 \cdot mm$
Distance from compression face to tension centre	

concrete cover $co := (20 \cdot mm + (\phi s/2))$

$co = 27.5\ mm$

$d := t - co$

$d = 222.5\ mm$

Material Properties and Constants:

Specified compressive strength of concrete	$fc := 20\ MPa$
Resistance factor for concrete	$\phi c := 0.60$
Factor to account for low density concrete	$\lambda :\sim 1.0$
Resistance factor for concrete	$\phi s := 0.85$
Specified minimum steel yield strength	$fy := 400\ MPa$
Ratio of depth of compression block to neutral axis	$\beta 1 := 0.85$
Modulus of elasticity	$Es := 200000$

STRENGTH UNDER AXIAL COMPRESSION:

Ag := b · t

Ag = 2.5 x 10^5 mm^2

Pro := 0.85 · ϕc · fc · (Ag - As) MPa + ϕs · fy · MPa · As

Pro = 2.715 x 10^3 kN

STRENGTH UNDER PURE BENDING:

Concrete force Cc(c) := 0.85 · ϕc · fc · MPa · b · 0.85 · c

Total tensile force T := As · ϕs ·fy · MPa

T = 170 kN

T(c) := Cc(c) - T

c := 1

soln := √(T(e) , c)

c is soln = 0.02 m

Taking moments about tension steel

Mro := 0.85·ϕc·fc·MPa·b·0.85soln·m(d - 0.85·(soln·m)/2)

Mro = 36.408 kN · m

STRENGTH UNDER BALANCED STRAIN CONDITIONS:

$\varepsilon y := (fy / Es)$

$\varepsilon y = 2 \times 10^{-3}$

$xb := d \cdot (0.003 / (\varepsilon y + 0.003))$

$xb = 133.5\ mm$

$a := 0.85 \cdot xb$

$a = 133.5\ mm$

$Cc := 0.85 \cdot \phi c \cdot fc \cdot a \cdot b \cdot MPa$

$Cc = 1.157 \times 10^{3}\ kN$

$T := 0.85 \cdot As \cdot fy \cdot MPa$

$T = 170\ kN$

$Prb := Cc - T$

$Prb = 987.445\ kN$

Determine location of plastic centroid

$C1 := b \cdot t \cdot 0.85 \cdot fc \cdot MPa$

$C1 = 4.25 \times 10^{3\ kN}$

$Cs := As \cdot 0.85 \cdot fy \cdot MPa$

$Cs = 170\ kN$

$Pn := C1 + Cs$

$Pn = 4.42 \times 10^{3}\ kN$

Moments along inside face of wall, distance to plastic centroid:

$x := (C1 \cdot (t / 2) + Cs \cdot co) / Pn$

$x = 121.25\ mm$ from inside face

Moments about plastic centroid

$Mrb := Cc \cdot [((t/2)-(a/2))+((t/2)-X)]+T \cdot [(t/2) - co - ((t/2)-X)]$

$Mrb = 99.288\ kN \cdot m$

300 mm (***12"***) EZ FORM LINTEL SCHEDULE [1,2,3,4,5,6,7]
ALLOWABLE UNIFORMLY DISTRIBUTED LOAD kN/m

Lintel Span	**8.8" INSULATED EZ FORM WALL**		**10" INSULATED EZ FORM WALL**		**5.3" INTERIOR WALL**	
	No Stirrups	Stirrups	No Stirrups	Stirrups	No Stirrups	Stirrups
0.91 m	9.25 kN/m	30.0 max kN/m	8.44 kN/m	30.0 max kN/m	4.82 kN/m	30.0 max kN/m
1.22	6.90	30.00	6.30	30.00	3.60	30.00
1.52	5.52	30.00	5.05	30.00	2.88	30.00
1.83	4.60	30.00	4.20	30.00	2.40	30.00
2.13	3.95	26.66	3.60	28.38	2.06	26.66
2.44	3.45	23.27	3.15	24.77	1.80	23.27
2.74	3.07	20.72	2.80	22.06	1.60	20.72
3.05	2.76	18.62	2.52	19.82	1.44	18.62
3.66	2.30	15.51	2.10	16.51	1.20	15.51

[1] Actual concrete wall thickness
t = 135mm (5.3”), overall EZ Form wall thickness 223mm (8.8”).
t =162mm (6.37”), overall EZ Form wall thickness 254mm (10”).
t =135mm (5.3”), overall EZ Form wall thickness 135mm (5.3”).

[2] Lintel capacities shown are allowable superimposed uniformly distributed loads.

[3] Above table columns labeled with stirrups, indicate capacity with shear reinforcing consisting of single leg 6mm stirrups at spacing of ***125 mm.***

[4] This table is based on concrete f c= 20Mpa (2900 psi) and fy=400 Mpa (58,000psi).

[5] Reinforcement shown is based on least area of steel for strength requirements in accordance with CAN3-A23.3-M84. Other combinations of bar size and spacing which provide equivalent area of steel per foot of wall, may be substituted.

[6] Capacity shown considers only vertical gravity loads. Other loading conditions may have to be considered including wind, earthquake, axial compression or tension, etc. which requires analysis by a qualified engineer.

[7] These tables are intended to indicate lintel span capabilities only. Final design requirements are the responsibility of the design engineer.

450 mm (***18”***) EZ FORM LINTEL SCHEDULE [1,2,3,4,5,6,7]
ALLOWABLE UNIFORMLY DISTRIBUTED LOAD kN/m

Lintel Span	**8.8" INSULATED EZ FORM WALL**		**10" INSULATED EZ FORM WALL**		**5.3" INTERIOR WALL**	
	No Stirrups	Stirrups	No Stirrups	Stirrups	No Stirrups	Stirrups
0.91 m	13.80 kN/m	30.0 max kN/m	10.50 kN/m	30.0 max kN/m	7.20 kN/m	30.0 max kN/m
1.22	11.00	30.00	10.00	30.00	5.74	30.00
1.52	8.82	30.00	8.06	30.00	4.60	30.00
1.83	7.32	30.00	6.69	30.00	3.82	30.00
2.13	6.30	30.00	5.75	30.00	3.28	30.00
2.44	5.50	27.72	5.02	30.00	2.87	27.72
2.74	4.98	24.69	4.47	26.82	2.55	24.69
3.05	4.40	22.18	4.01	24.09	2.29	22.18
3.66	3.67	18.48	3.35	20.08	1.91	18.48

[1] Actual concrete wall thickness
t = 135mm (5.3”), overall EZ Form wall thickness 223mm (8.8”).
t =162mm (6.37”), overall EZ Form wall thickness 254mm (10”).
t =135mm (5.3”), overall EZ Form wall thickness 135mm (5.3”).

[2] Lintel capacities shown are allowable superimposed uniformly distributed loads.

[3] Above table columns labeled with stirrups, indicate capacity with shear reinforcing consisting of single leg 6mm stirrups at spacing of ***200 mm.***

[4] This table is based on concrete f c= 20Mpa (2900 psi) and fy=400 Mpa (58,000psi).

[5] Reinforcement shown is based on least area of steel for strength requirements in accordance with CAN3-A23.3-M84. Other combinations of bar size and spacing which provide equivalent area of steel per foot of wall, may be substituted.

[6] Capacity shown considers only vertical gravity loads. Other loading conditions may have to be considered including wind, earthquake, axial compression or tension, etc. which requires analysis by a qualified engineer.

[7] These tables are intended to indicate lintel span capabilities only. Final design requirements are the responsibility of the design engineer.

600 mm (***24”***) EZ FORM LINTEL SCHEDULE [1,2,3,4,5,6,7] ALLOWABLE UNIFORMLY DISTRIBUTED LOAD kN/m

Lintel Span	**8.8" INSULATED EZ FORM WALL**		**10" INSULATED EZ FORM WALL**		**5.3" INTERIOR WALL**	
	No Stirrups	Stirrups	No Stirrups	Stirrups	No Stirrups	Stirrups
0.91 m	13.80 kN/m	30.0 max kN/m	10.50 kN/m	30.0 max kN/m	7.20 kN/m	30.0 max kN/m
1.22	13.80	30.00	10.50	30.00	7.20	30.00
1.52	12.11	30.00	10.50	30.00	6.32	30.00
1.83	10.06	30.00	9.19	30.00	5.27	30.00
2.13	8.64	30.00	7.89	30.00	4.50	30.00
2.44	7.54	30.00	6.89	30.00	3.94	30.00
2.74	6.72	28.66	2.63	30.00	3.51	28.66
3.05	6.04	25.74	5.51	28.37	3.15	25.74
3.66	5.03	21.45	4.59	23.64	2.62	21.45

[1] Actual concrete wall thickness
t = 135mm (5.3”), overall EZ Form wall thickness 223mm (8.8”).
t =162mm (6.37”), overall EZ Form wall thickness 254mm (10”).
t =135mm (5.3”), overall EZ Form wall thickness 135mm (5.3”).

[2] Lintel capacities shown are allowable superimposed uniformly distributed loads.

[3] Above table columns labeled with stirrups, indicate capacity with shear reinforcing consisting of single leg 6mm stirrups at spacing of ***280 mm.***

[4] This table is based on concrete f c= 20Mpa (2900 psi) and fy=400 Mpa (58,000psi).

[5] Reinforcement shown is based on least area of steel for strength requirements in accordance with CAN3-A23.3-M84. Other combinations of bar size and spacing which provide equivalent area of steel per foot of wall, may be substituted.

[6] Capacity shown considers only vertical gravity loads. Other loading conditions may have to be considered including wind, earthquake, axial compression or tension, etc. which requires analysis by a qualified engineer.

[7] These tables are intended to indicate lintel span capabilities only. Final design requirements are the responsibility of the design engineer.

LINTEL TESTING PROVES CODES EXCESSIVE

Research, Results, & Resources: HOMEBASE News

CONCRETE LINTEL TESTING PROVES EXISTING CODES CONSERVATIVE FOR ICFs

Recent NAHB Research Center tests on concrete lintels consisting of insulating Concrete Form (lCF Systems found that current code requirements regarding shear reinforcement are conservative. Shear reinforcements - steel bars placed vertically in a concrete beam - are difficult to install and provide little value in terms of lintel performance. Tensile, or bending, reinforcement must only be placed horizontally in the bottom of concrete lintels. Recommendations based on these recent tests include: (1) modification of span tables in the Prescriptive Method for ICFs; (2) elimination of shear reinforcement in spans up to 12 feet; and (3) reduction of the minimum tensile steel requirements. With code revisions, the use of concrete lintels without shear reinforcement and with minimal tensile reinforcement will lead to more practical and cost effective ICF construction.

ICFs are typically constructed of rigid foam plastic insulation, a composite of cement and foam insulation, or a composite of cement and wood chips. This type of system is inherently strong, monolithic, energy-efficient, quiet, and resistant to damage caused by termites and moisture. Builders who use ICFs tout their marketability due to these benefits over conventional wood-frame construction. There is generally a five to percent premium in the sales price of a home constructed with ICFs.

Current relevant standards for ICFs, such as the American Concrete Institute (ACI) 318-95, are typically based on tests involving large and complex commercial and high-rise residential structures. Therefore, applying these requirements to low-rise one- and two-family dwellings results in over-design and increased construction costs. More specifically, in residential applications, the prescribed minimum tensile steel reinforcing requirements in ACI 318-95 are overly-conservative for the low-loading conditions of an average residential building.

The 12-foot long ICF lintels included three design types-flat, waffle-grid, and screen-grid-and were all subjected to loading tests to determine shear and bending strength. A previous Research Center study (May 1998) that employed the same test conditions concluded that shear reinforcement was not necessary for ICF lintels spanning up to four feet, which are commonly used over door and window openings. This new study found that the same is true for longer spans used on openings such as those for garage doors.

In terms of system failure, bending failure is preferable to shear failure in that bending is a more gradual process, which allows for warning and repair; shear failure occurs suddenly and poses more risk of inhabitant injury. All longer span lintels experienced yielding of the tensile reinforcement before failure. Also under this type of loading, all but the flat wall design ultimately experienced shear failure. However, this failure occurred well into the yielding of the tensile reinforcement and after the maximum bending moment was exceeded. In every case, the maximum tested bending moment of the longer span ICF lintels without shear reinforcement exceeded the ACI 318-95 predictions.

The final report, “Lintel Testing for Reduced Shear Reinforcement in Insulating Concrete Form Systems,” will be complete and ready for distribution by August 1999. To receive a copy or for more information on ICF construction, visit the NAHB Research Center’s web site at www.nahbrc.org or call the HOMEBASE Hotline at (800) 898-2842.

http://www.nahbrc.org/ToolBase/rrr/newslttr/LINTEL.htm 15/10/2000

Results

The responses of all ICF lintel specimens to the third-point loading are shown in Table 4. The calculated ultimate load is based on the shear capacity of the section based on the ACI Equation (11-3). All of the specimens out performed the calculated ultimate.

Table 4
Results of ICF Lintel Tests

Test Specimen	Predicted Ultimate* (lbs.)	Predicted Ultimate (lbs.)	Ratio Tested/Predicted
FLAT1 4x12	8,459	17,172	2.03
FLAT2 4x12	8,459	17,830	2.11
FLAT1 4x24	18,609	37,170	2.00
FLAT1 8x12	16,917	21,030	1.24
FLAT2 8x12	16,917	22,600	1.34
FLAT1 8x24	37,219	44,210	1.19
FLAT1 4x12a	8,459	N/A[†]	N/A[†]
FLAT1 8x12a	16,917	64,750	3.83
WAFFLE1 6x8	2,538	12,130	4.78
WAFFLE2 6x8	2,538	11,980	4.72
WAFFLE1 6x16	5,921	31,260	5.30
WAFFLE2 6x16	5,921	31,820	5.37
WAFFLE1 8x16	5,815	35,620	6.13
WAFFLE2 8x16	5,815	37,120	6.38
SCREEN1 6x12	0[‡]	6,498	-
SCREEN2 6x12	0[‡]	7,052	-
SCREEN1 6x24	0[‡]	30,460	-
SCREEN2 6x24	0[‡]	31,520	-

For SI: 1 foot = 0.3048 m; 1 inch = 25.4 mm; 1 lb = 4.45 N.

*Ultimate load calculations are based on the ACI Equation (11-3).

[†] A tested value of 16,750 Ib was recorded. Premature failure was experienced due to the severe honeycombing caused by the two-#5 rebar which restricted the flow of the concrete into the bottom of the form.

[‡] ACI 318-95 does not provide a method to analyze beam cross sections with voids.

Flat Specimens

The ACI code under predicted the capacity of the flat specimens. 'The tested ultimate for the narrow sections was at least two times that of the predicted capacity in all cases. Failure of the flat specimens was due to tensile stresses induced in the beam by shearing forces that caused cracking inclined at 45° to the horizontal (Figure 6). Cracking also occurred between the form ties. This cracking occurred late in the testing.

ALLOWABLE SUPERIMPOSED UNIFORM LOADS ON ***12”*** DEEP EZ FORM LINTEL (plf)[1,2,3,4,5,6]

Lintel Span (ft)	4" w 1 #5	5.5" wall c/w 2 #5 bars		6" wall c/w 2 #5 bars		8" wall c/w 2 #5 bars	
	Without	Without	With	Without	With	Without	With
3	560	780	2,000	850	2,000	1,130	2,000
4	410	560	2,000	615	2,000	820	2,000
5	325	435	2,000	475	2,000	630	2,000
6	255	350	1,590	380	2,000	510	2,000
7	210	290	1,150	315	2,000	420	2,000
8	-	245	860	270	1,610	360	1,680
9	-	210	670	230	1,260	300	1,310
10	-	-	530	200	1,010	260	1,040
11	-	-	425	-	820	230	840
12	-	-	345	-	675	200	690

[1] This Table is based on Concrete f_c = 2,000 psi and F_y = 40,000 psi (#3 & #4 bars), F_y = 60,000 psi (#5 bars & larger)

[2] Lintel capacities shown are allowable superimposed uniformly distributed working stress loads (plf). Calculations utilized Ultimate Strength Design with a combined load factor = 1.65

[3] Columns labelled “With” indicate capacity with shear reinforcing consisting of #3 stirrups at d/2 spacing throughout lintel span. (spacing = ***5”*** for ***12”*** deep lintels)

[4] Columns labelled “Without” indicate capacity With no shear reinforcing.

[5] Capacity shown considers only vertical gravity loads. Other loading conditions may have to be considered, wind, earthquake, axial compression or tension, etc. which require analysis by a qualified engineer.

[6] These tables are intended to indicate standard concrete lintel capabilities only. No reductions in shear values have been made for EZ Form web connectors and shall be considered at the discretion of the designer. Final wall design requirements are the responsibility of the building designer. The maximum load considered for this lintel is ***2000 plf.***

ALLOWABLE SUPERIMPOSED UNIFORM LOADS ON *16”* DEEP EZ FORM LINTEL (plf)[1,2,3,4,5,6]

Lintel Span (ft)	**4" w 1 #5**	**5.5" wall c/w 2 #5 bars**		**6" wall c/w 2 #5 bars**		**8" wall c/w 2 #5 bars**	
	Without	Without	With	Without	With	Without	With
3	810	1,110	3,000	1,210	3,000	1,620	3,000
4	585	805	3,000	880	3,000	1,170	3,000
5	450	620	3,000	680	3,000	905	3,000
6	365	500	3,000	545	3,000	730	3,000
7	300	415	2,910	455	2,970	605	3,000
8	255	350	2,410	380	2,430	510	1,500
9	220	300	1,880	330	1,900	440	1,940
10	-	260	1,510	285	1,520	380	1,550
11	-	230	1,230	250	1,240	335	1,260
12	-	200	1,020	220	1,030	295	1,040

[1] This Table is based on Concrete f_c = 2,000 psi and F_y = 40,000 psi (#3 & #4 bars), F_y = 60,000 psi (#5 bars & larger)

[2] Lintel capacities shown are allowable superimposed uniformly distributed working stress loads (plf). Calculations utilized Ultimate Strength Design with a combined load factor = 1.65

[3] Columns labelled “With” indicate capacity with shear reinforcing consisting of #3 stirrups at d/2 spacing throughout lintel span. (spacing = ***7”*** for ***16”*** deep lintels)

[4] Columns labelled “Without” indicate capacity With no shear reinforcing.

[5] Capacity shown considers only vertical gravity loads. Other loading conditions may have to be considered, wind, earthquake, axial compression or tension, etc. which require analysis by a qualified engineer.

[6] These tables are intended to indicate standard concrete lintel capabilities only. No reductions in shear values have been made for EZ Form web connectors and shall be considered at the discretion of the designer. Final wall design requirements are the responsibility of the building designer. The maximum load considered for this lintel is ***3000 plf.***

TABLE 11 - ALLOWABLE SUPERIMPOSED UNIFORM LOADS ON ***24”*** DEEP EZ FORM LINTEL (plf)[1,2,3,4,5,6]

Lintel Span (ft)	**4" w 1 #5**	**5.5" wall c/w 2 #5 bars**		**6" wall c/w 2 #5 bars**		**8" wall c/w 2 #5 bars**	
	Without	Without	With	Without	With	Without	With
3	1,310	1,800	4,000	1,970	4,000	2,620	4,000
4	945	1,300	4,000	1,420	4,000	1,890	4,000
5	730	1,000	4,000	1,090	4,000	1,460	4,000
6	590	810	3,970	880	4,000	1,170	4,000
7	490	670	3,370	730	3,480	970	3,910
8	410	565	2,930	620	3,020	825	3,390
9	355	490	2,580	530	2,660	710	2,980
10	310	425	2,300	460	2,370	615	2,570
11	270	370	2,080	405	2,080	540	2,090
12	240	330	1,720	360	1,730	480	1,720

[1] This Table is based on Concrete f_c = 2,000 psi and F_y = 40,000 psi (#3 & #4 bars), F_y = 60,000 psi (#5 bars & larger)

[2] Lintel capacities shown are allowable superimposed uniformly distributed working stress loads (plf). Calculations utilized Ultimate Strength Design with a combined load factor = 1.65

[3] Columns labelled “With” indicate capacity with shear reinforcing consisting of #3 stirrups at d/2 spacing throughout lintel span. (spacing = ***11”*** for ***24”*** deep lintels)

[4] Columns labelled “Without” indicate capacity With no shear reinforcing.

[5] Capacity shown considers only vertical gravity loads. Other loading conditions may have to be considered, wind, earthquake, axial compression or tension, etc. which require analysis by a qualified engineer.

[6] These tables are intended to indicate standard concrete lintel capabilities only. No reductions in shear values have been made for EZ Form web connectors and shall be considered at the discretion of the designer. Final wall design requirements are the responsibility of the building designer. The maximum load considered for this lintel is ***4000 plf.***

EZ FORM LINTEL REINFORCING CALCULATION:

EZ form lintel schedules are used in construction of concrete walls where desired openings create the requirement for additional reinforcing of the lintel section.

This application determines the allowable uniformly distributed load that can be placed on a selected lintel section, with or without stirrup reinforcing.

The required input for this application includes the strength of concrete and reinforcement, height of lintel and thickness of concrete. The allowable uniformly distributed load calculated is reduced for the weight of the concrete lintel.

Reinforcing bar number designations, diameters and areas

No_5 $d_b := 0.625 \cdot in$ $A_5 := 0.31 \cdot in^2$
$Av := O.22 \cdot in^2$

Input Variables

Lintel overall depth $h := 16 \cdot in$

Wall Thickness $b := 7.625 \cdot in$

Length of lintel span $L := 10 \cdot ft$

Units: $kip := lb \cdot 1000$

$ksi := (lb \cdot 1000)/(ft^2)$

Material Properties and Constants

Specified compressive strength of concrete $fc := 2000\ psi$

Specified yield strength of reinforcement $fy := 60000\ psi$

Calculation

Effective depth of reinforcing $d := h - (1.50 \cdot in + 0.375 \cdot in + d_b/2)$
$d = 13.81\ in$

For minimum lintel reinforcing use 2 - #5 bars
bottom bars As = 2 x 0.31 $As := 0.62 \cdot in^2$

Shear resistance of concrete lintel thickness
specified without any shear reinforcement $Vc := 1 \cdot \sqrt{f_c} \cdot lb/in^2\ b \cdot d$

$Vc = 4.71\ kip$

Ultimate Shear resistance where lintels are not
reinforced for shear $Vu := 0.85 \cdot Vc$

$Vu = 4\ kip$

Allowable shear $V := Vu / 1.65$
load without stirrup reinforcing
(Combined live & Dead load factors) $V = 2.43\ kip$

Unifomly distributed load: $W := V / (L/2 - d/(2 \cdot 12))$

$W = 0.49\ kip/ft$

Less lintel weight $Wlin := b/(12 \cdot in) \cdot h/(12 \cdot in) \cdot 150/ft \cdot lb$

$Wlin = 0.13\ kip/ft$

Allowable superimposed working load
without stirrups is: $Wa := W - Wlin$

$Wa = 0.36\ kip/ft$

Determine Moment Capacity $a := As \cdot fy/(0.85 \cdot fc \cdot b)$

$a = 2.87\ in$

Ultimate moment capacity: $Mu := 0.9 \cdot [As \cdot fy \cdot lb/in^2 \cdot (d - a/2)]$

$Mu = 34.53\ ft \cdot kip$

Unfactored Moment capacity: $M := Mu / 1.65$

$M = 20.93\ ft \cdot kip$

Allowable uniform load: $Wm := (8 \cdot M)/L^2$

$Wm = 1.67\ kip/ft$

Allowable Superimposed Load
Less Lintel Weight $Wma := Wm - Wlin$

$Wma = a.55\ kip/ft$

For shear capacity with stirrups, use #3 Stirrups

Stirrup spacing: $S := d/2$

$S = 6.91\ in$

Determine Shear Capacity: $Vc := 2 \cdot \sqrt{fc} \cdot lb/in^2$

$Vc = 9.42\ kip$

$Vs := (Av \cdot fy \cdot lb/in^2 \cdot d) / S$

$Vs = 26.4\ kip$

However, Vs Maximum $Vsmax := 4 \cdot \sqrt{fc} \cdot lb/in^2 \cdot b \cdot d$

$Vsmax = 18.84\ kip$

$Vu \leq Vs$ Where $\phi = 0.85$

$Vn := Vc + Vsmax$

Vn = 28.26 kip

Vcl := 0.85 · Vn

Vcl = 24.02 kip

Unfactored Shear Strength: Vc2 := Vc1/1.65

Vc2 = 14.56 kip

Uniformly Distributed Load Strength: W1 := Vc2 / (L/2 - d/(2 · 12))

W1 = 2.94 kip /ft

Less Lintel Weight:
Allowable superimposed uniformly distributed load W2 := W1 - Wlin

W2 = 2.81 kip/ft

The smaller of superimposed loads calculated
by moment capacity or shear strength will govern.

Outline Specifications For EZ Concrete Formwork:

1. EZ Concrete Forming system has been designed in accordance with requirements of CAN/CSA-S269.3 M92. “Concrete Formwork”

2. Design Capacity of EZ Concrete wall system is 57 kPa, based on a Rate of Concrete Placement of 3.0 m/hour at a concrete temperature of 20 (degrees) C.

3. Concrete formwork to be installed in accordance with EZ Concrete Forming assembly instructions.

4. Concrete and reinforcing steel placement to be in accordance with the building design structural engineer’s specifications.

5. EZ Concrete wall system formwork installation shall be supervised by a qualified supervisor experienced in the construction of temporary support structures and the use of EZ Concrete

6. Bracing and lateral support structural details necessary to maintain lateral stability and resist sideways and racking shall be designed and specified by the building design structural engineer.

7. The structural engineer for the building design shall be responsible for al field designs, details and changes including the effect they may have on the original design. Field designs and changes must be documented and must be available at the site before and during placement of concrete or other significant loading of the formwork or falsework.

Tests and Reports (available upon request)

ITS - Pilot Fire Test
ITS - Flame Spread Test
ITS - Water Tightness Test
ITS - Flammability Test
ITS - Ignition Temperature Test
ITS - Thermal Analysis
ITS - UBC Section 802.1
Chemical Resistance of PVC
Behavior of PVC Encased Concrete Walls

Vinyl Test - UL Yellow Card
Physical Properties of PVC Elements
Bending Moment Interaction Diagram
Painting and Staining of Vinyl
Adhesive Selection Guide

EZ Concrete Forming Systems Ltd.

9 Semana Crescent
Vancouver, B.C. V6N 2E1
Canada

p: 604.733.2597
f: 604.733.2545
c: 604.780.1702

info@ezconcreteforming.com
www.ezconcreteforming.com

EZ Concrete Forming