
فصل 1

کلیات

مقدمه

در دوره کارشناسی مهندسی عمران بعد از گذراندن دروس سازه ای جهت جمع آوری و عمل اطلاعات پروژه های دوره کارشناسی انجام می شود که یکی از پروژه ها پروژه سازه های فولادی است

در درس پروژه سازه فولاد یک ساختمان 5 طبقه واقع در شهر تهران به صورت کامل از ابتدا نقشه های معماری تا انتهای خروجی های نقشه های اجرایی انجام می شود که ارتباط کامل بین دانش طراحی تا یک پروژه اجرایی به وجود می آید

معرفی پروژه

پروژه حاضر یک ساختمان مسکونی با تعداد طبقات 5 واحد واقع در شهر تهران می باشد

نوع کاربری ساختمان مسکونی می باشد

نوع سقف سازه کامپوزیت می باشد

تعداد طبقات 5 عدد می باشد تراز پایه پروژه روی تراز پی است

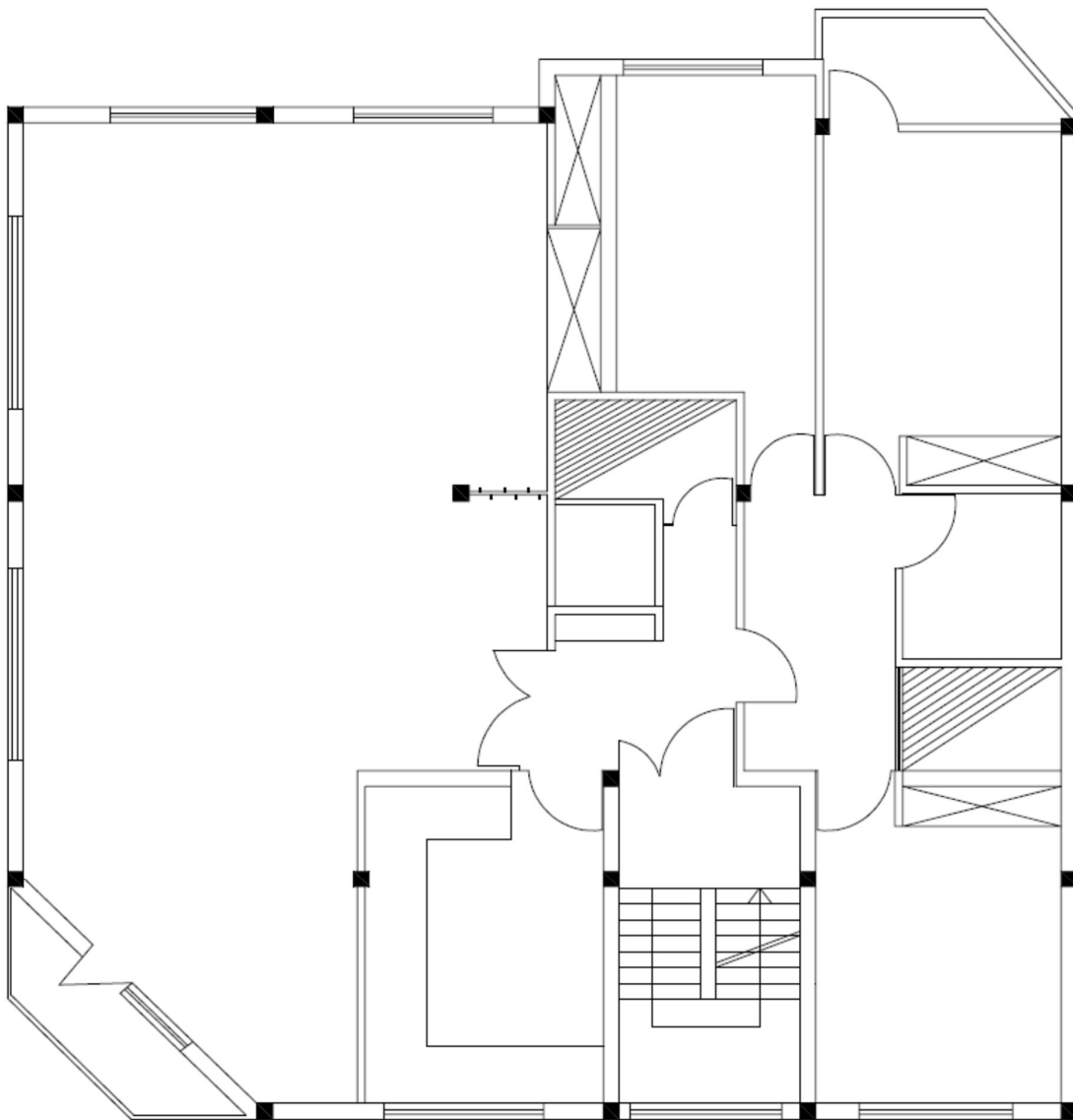
در جهت X سیستم قاب خمشی متوسط و Y مهاربند همگرا ویژه می باشد

Name	Height cm	Elevation cm
Story6	320	1920
Story5	320	1600
Story4	320	1280
Story3	320	960
Story2	320	640
Story1	320	320
Base	0	0

معماری طرح

در این ساختمان آشپزخانه در شمال و اتاق خواب ها در جنوب و شمال هستند . اتاق خواب ها به وسیله فضای خصوصی راه رو از هم جدا شده اند

ارتفاع معماری هر طبقه 2.9 متر است



ساخگاه

ساخگاه این پروژه در تهران است که مشخصات خاک و لرزه ای منطقه در جدول زیر شرح داده شده است

نوع خاک	تیپ 2
پهنه خطر	3.5
ضریب اهمیت	1

مصالص مصرفی

Name	Type	E kgf/cm ²	v	Unit Weight kgf/mm ³	Design Strengths
ST3	Steel	21000	0.3	8E-06	Fy=2400 kgf/cm ² , Fu=3700 kgf/cm ²
بتن آرمه	بتن	254690	0.3	2500	25MPA

نرم افزار ها

	برای تحلیل و مدل سازی
 	برای متره و نقشه کشی

مراجع

مراجع مورد استفاده به شرح زیر می باشند
مبحث 10 ویرایش 92 که بر گرفته از استاندارد
آیین نامه 2800
AISC360-05 می باشد

فصل 2

بارگذاری و
ترکیب بار

(سازه)

انواع بارهای وارد به سازه

Name	Type
Dead	بار مرده
Lr1.0	5 بار زنده و یا بیشتر KG/CM^2
Lr0.5	5 بار زنده یا کمتر KG/CM^2
LPART	بار تیغه بندی
LROOF	بار بام و خریشته
Wall	بار تصحیح جرم بام
EX	نیروی زلزله بدون خرج از مرکزیت x
ENX	خرج از مرکزیت منفی
EPX	خرج از مرکزیت مثبت
EY	نیروی زلزله بدون خرج از مرکزیت y
ENY	خرج از مرکزیت منفی
EPY	خرج از مرکزیت مثبت
NDX	بار جانبی فرضی متناظر با بار مرده
NDY	بار جانبی فرضی متناظر با بار مرده
NLr1.0X	بار جانبی فرضی متناظر با بار lr1.0
NLr1.0Y	بار جانبی فرضی متناظر با بار lr1.0
NLr0.5X	بار جانبی فرضی متناظر با بار lr0.5
NLr0.5Y	بار جانبی فرضی متناظر با بار lr0.5
NLPARTX	بار جانبی فرضی متناظر با بار part
NLPARTY	بار جانبی فرضی متناظر با بار part
NLROOFX	بار جانبی فرضی متناظر با بار roof
NLROOFY	بار جانبی فرضی متناظر با بار roof
S	بار برف
EZ	نیروی عمودی زلزله
ENX(DRIFT)	خرج از مرکزیت منفی (تحلیلی)
EPX(DRIFT)	خرج از مرکزیت مثبت (تحلیلی)
EZ2	نیروی عمودی زلزله

ترکیب بارها سازه

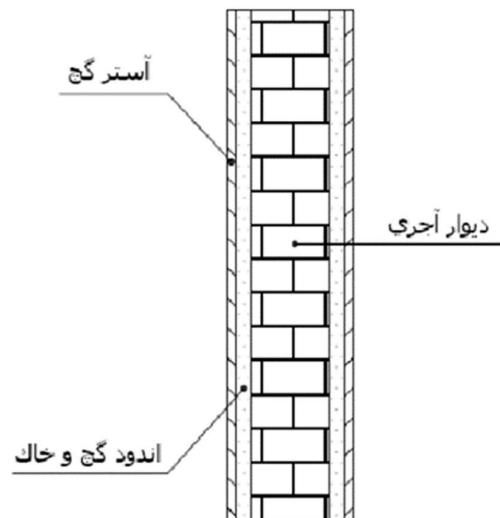
COMB01	1.4DEAD+1.4NDX
COMB02	1.4DEAD-1.4NDX
COMB03	1.4DEAD+1.4NDY
COMB04	1.4DEAD-1.4NDY
COMB05	1.2DEAD+1.6(Lr0.5+Lr1.0+LPART)+0.5LROOF+1.2NDX+1.6(NLr0.5X+NLr1.0X+NLPARTX)+0.5NLROOFX
COMB06	1.2DEAD+1.6(Lr0.5+Lr1.0+LPART)+0.5LROOF-1.2NDX-1.6(NLr0.5X+NLr1.0X+NLPARTX)-0.5NLROOFX
COMB07	1.2DEAD+1.6(Lr0.5+Lr1.0+LPART)+0.5LROOF+1.2NDY+1.6(NLr0.5Y+NLr1.0Y+NLPARTY)+0.5NLROOFY
COMB08	1.2DEAD+1.6(Lr0.5+Lr1.0+LPART)+0.5LROOF-1.2NDY-1.6(NLr0.5Y+NLr1.0Y+NLPARTY)-0.5NLROOFY
COMB09	1.2DEAD+(0.5Lr0.5+Lr1.0+LPART)+1.6LROOF+1.2NDX+(0.5NLr0.5X+NLr1.0X+NLPARTX)+1.6NLROOFX
COMB10	1.2DEAD+(0.5Lr0.5+Lr1.0+LPART)+1.6LROOF-1.2NDX-(0.5NLr0.5X+NLr1.0X+NLPARTX)-1.6NLROOFX
COMB11	1.2DEAD+(0.5Lr0.5+Lr1.0+LPART)+1.6LROOF+1.2NDY+(0.5NLr0.5Y+NLr1.0Y+NLPARTY)+1.6NLROOFY
COMB12	1.2DEAD+(0.5Lr0.5+Lr1.0+LPART)+1.6LROOF-1.2NDY-(0.5NLr0.5Y+NLr1.0Y+NLPARTY)-1.6NLROOFY
COMB13	1.2DEAD+(0.5Lr0.5+Lr1.0+LPART)+0.2S+(ENX+EY+EZ)
COMB14	1.2DEAD+(0.5Lr0.5+Lr1.0+LPART)+0.2S+(ENX-EY+EZ)
COMB15	1.2DEAD+(0.5Lr0.5+Lr1.0+LPART)+0.2S+(-ENX+EY+EZ)
COMB16	1.2DEAD+(0.5Lr0.5+Lr1.0+LPART)+0.2S+(-ENX-EY+EZ)
COMB17	1.2DEAD+(0.5Lr0.5+Lr1.0+LPART)+0.2S+(EPX+EY+EZ)
COMB18	1.2DEAD+(0.5Lr0.5+Lr1.0+LPART)+0.2S+(EPX-EY+EZ)
COMB19	1.2DEAD+(0.5Lr0.5+Lr1.0+LPART)+0.2S+(-EPX+EY+EZ)
COMB20	1.2DEAD+(0.5Lr0.5+Lr1.0+LPART)+0.2S+(-EPX-EY+EZ)
COMB21	1.2DEAD+(0.5Lr0.5+Lr1.0+LPART)+0.2S+(ENY+EX+EZ)
COMB22	1.2DEAD+(0.5Lr0.5+Lr1.0+LPART)+0.2S+(ENY-EX+EZ)
COMB23	1.2DEAD+(0.5Lr0.5+Lr1.0+LPART)+0.2S+(-ENY+EX+EZ)
COMB24	1.2DEAD+(0.5Lr0.5+Lr1.0+LPART)+0.2S+(-ENY-EX+EZ)
COMB25	1.2DEAD+(0.5Lr0.5+Lr1.0+LPART)+0.2S+(EPY+EX+EZ)
COMB26	1.2DEAD+(0.5Lr0.5+Lr1.0+LPART)+0.2S+(EPY-EX+EZ)
COMB27	1.2DEAD+(0.5Lr0.5+Lr1.0+LPART)+0.2S+(-EPY+EX+EZ)
COMB28	1.2DEAD+(0.5Lr0.5+Lr1.0+LPART)+0.2S+(-EPY-EX+EZ)
COMB29	0.9DEAD+(ENX+EY+EZ)
COMB30	0.9DEAD+(ENX-EY+EZ)
COMB31	0.9DEAD+(-ENX+EY+EZ)
COMB32	0.9DEAD+(-ENX-EY+EZ)
COMB33	0.9DEAD+(EPX+EY+EZ)
COMB34	0.9DEAD+(EPX-EY+EZ)
COMB35	0.9DEAD+(-EPX+EY+EZ)
COMB36	0.9DEAD+(-EPX-EY+EZ)
COMB37	0.9DEAD+(ENY+EX+EZ)
COMB38	0.9DEAD+(ENY-EX+EZ)
COMB39	0.9DEAD+(-ENY+EX+EZ)

COMB40	0.9DEAD+(-ENY-EX+EZ)
COMB41	0.9DEAD+(EPY+EX+EZ)
COMB42	0.9DEAD+(EPY-EX+EZ)
COMB43	0.9DEAD+(-EPY+EX+EZ)
COMB44	0.9DEAD+(-EPY-EX+EZ)
COMB45	1.2DEAD+(0.5Lr0.5+Lr1.0+LPART)+0.2S+(ENX+EY-EZ)
COMB46	1.2DEAD+(0.5Lr0.5+Lr1.0+LPART)+0.2S+(ENX-EY-EZ)
COMB47	1.2DEAD+(0.5Lr0.5+Lr1.0+LPART)+0.2S+(-ENX+EY-EZ)
COMB48	1.2DEAD+(0.5Lr0.5+Lr1.0+LPART)+0.2S+(-ENX-EY-EZ)
COMB49	1.2DEAD+(0.5Lr0.5+Lr1.0+LPART)+0.2S+(EPX+EY-EZ)
COMB50	1.2DEAD+(0.5Lr0.5+Lr1.0+LPART)+0.2S+(EPX-EY-EZ)
COMB51	1.2DEAD+(0.5Lr0.5+Lr1.0+LPART)+0.2S+(-EPX+EY-EZ)
COMB52	1.2DEAD+(0.5Lr0.5+Lr1.0+LPART)+0.2S+(-EPX-EY-EZ)
COMB53	1.2DEAD+(0.5Lr0.5+Lr1.0+LPART)+0.2S+(ENY+EX-EZ)
COMB54	1.2DEAD+(0.5Lr0.5+Lr1.0+LPART)+0.2S+(ENY-EX-EZ)
COMB55	1.2DEAD+(0.5Lr0.5+Lr1.0+LPART)+0.2S+(-ENY+EX-EZ)
COMB56	1.2DEAD+(0.5Lr0.5+Lr1.0+LPART)+0.2S+(-ENY-EX-EZ)
COMB57	1.2DEAD+(0.5Lr0.5+Lr1.0+LPART)+0.2S+(EPY+EX-EZ)
COMB58	1.2DEAD+(0.5Lr0.5+Lr1.0+LPART)+0.2S+(EPY-EX-EZ)
COMB59	1.2DEAD+(0.5Lr0.5+Lr1.0+LPART)+0.2S+(-EPY+EX-EZ)
COMB60	1.2DEAD+(0.5Lr0.5+Lr1.0+LPART)+0.2S+(-EPY-EX-EZ)
COMB61	0.9DEAD+(ENX+EY-EZ)
COMB62	0.9DEAD+(ENX-EY-EZ)
COMB63	0.9DEAD+(-ENX+EY-EZ)
COMB64	0.9DEAD+(-ENX-EY-EZ)
COMB65	0.9DEAD+(EPX+EY-EZ)
COMB66	0.9DEAD+(EPX-EY-EZ)
COMB67	0.9DEAD+(-EPX+EY-EZ)
COMB68	0.9DEAD+(-EPX-EY-EZ)
COMB69	0.9DEAD+(ENY+EX-EZ)
COMB70	0.9DEAD+(ENY-EX-EZ)
COMB71	0.9DEAD+(-ENY+EX-EZ)
COMB72	0.9DEAD+(-ENY-EX-EZ)
COMB73	0.9DEAD+(EPY+EX-EZ)
COMB74	0.9DEAD+(EPY-EX-EZ)
COMB75	0.9DEAD+(-EPY+EX-EZ)
COMB76	0.9DEAD+(-EPY-EX-EZ)

SCOMB01	DEAD
SCOMB02	DEAD+Lr0.5+Lr1.0+LPART+LROOF

انواع بار ها مرده

بار تیغه ها



وزن واحد سطح دیوارهای جدا کننده (تیغه ها):				
مصلح مصرفی	وزن مخصوص (kg/m ³)	ضخامت (m)	تعداد	شدت بار (kg/m ²)
آجرکاری با آجر مجوف و ملات ماسه سیمان	850	0.1	1	85
ملات گچ و خاک	1600	0.02	2	64
ملات گچ	1300	0.01	2	26
حاصل جمع		175		

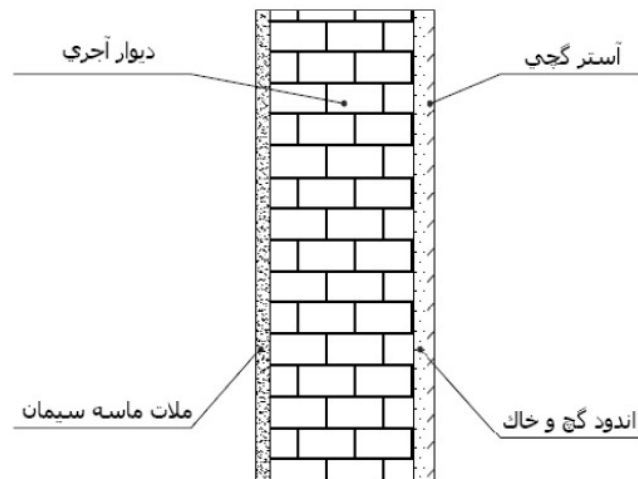
مساحت کل: 176 متر

طول کل تیغه ها: 40 متر

ارتفاع طبقه (معماری): 2.9

بار = 115kg /m

بار دیوار پیرامونی بدون نما

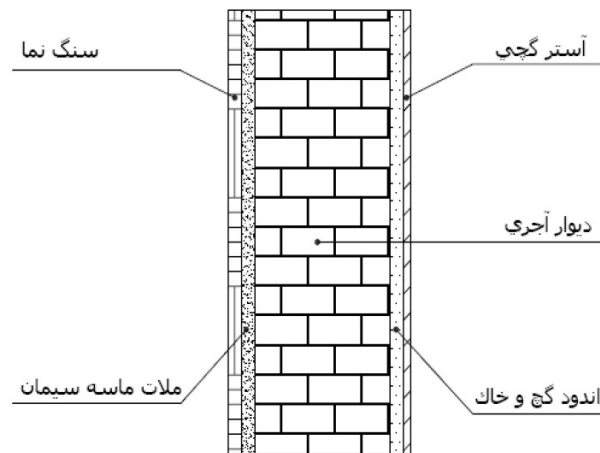


وزن واحد سطح دیوارهای محیطی مجاور همسایه				
شدت بار KG/CM^2	تعداد	ضخامت	وزن مخصوص KG/CM^3	مصلح مصرفی
170	1	0.2	850	آجرکاری با آجر مجوف و ملات سیمان
24	1	0.015	1600	ملات گچ و خاک
13	1	0.01	1300	ملات گچ
42	1	0.02	2100	ملات ماسه سیمان
249			حاصل جمع	

$$249 \times 2.9 = 722.1$$

$$KG/CM^2$$

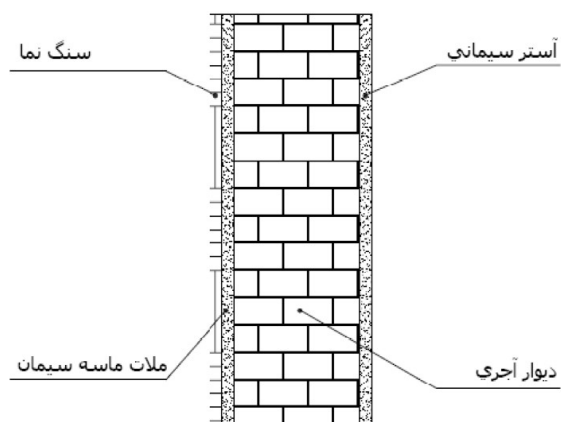
دیوار پیرامونی با نما



وزن واحد سطح دیوارهای محیطی مجاور همسایه				
شدت بار KG/CM^2	تعداد	ضخامت	وزن مخصوص KG/CM^3	مصارف مصرفی
170	1	0.2	850	آجرکاری با آجر مخوف و ملات سیمان
24	1	0.015	1600	ملات گچ و خاک
13	1	0.01	1300	ملات گچ
42	1	0.02	2100	ملات ماسه سیمان
56	1	0.02	2800	گرانیت
حاصل جمع			305	

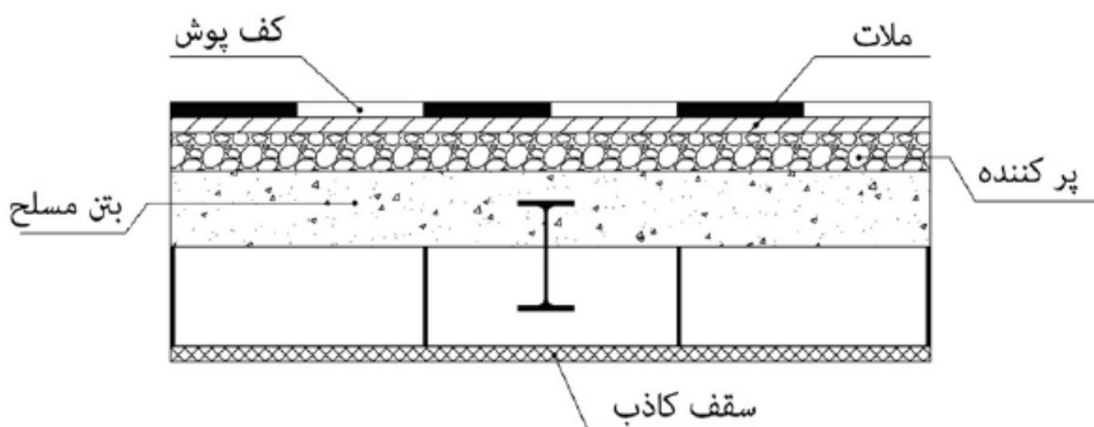
$$305 \times 2.9 \times 0.7 = 619.15 \text{ KG/CM}$$

با دیوار جان پناه



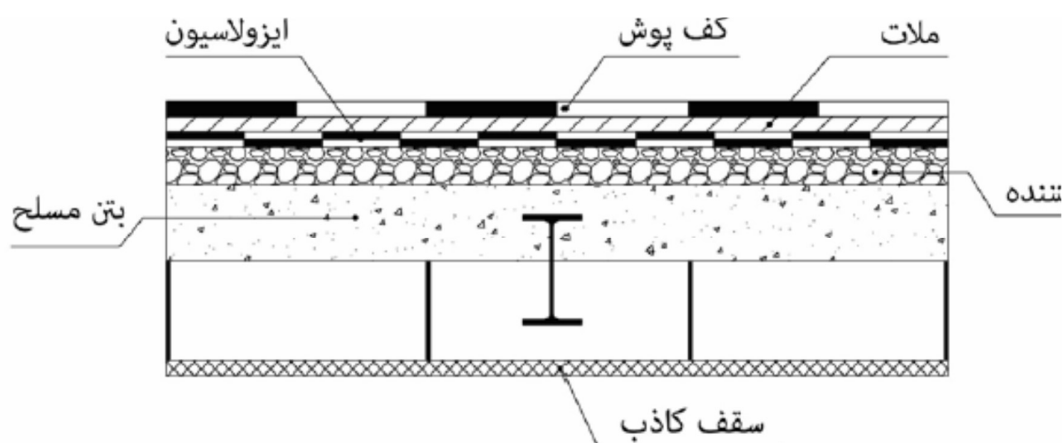
وزن واحد سطح دیوارهای محیطی مجاور همسایه				
شدت بار	تعداد	ضخامت	وزن مخصوص	مصلح مصرفی
KG/CM^2			KG/CM^3	
170	1	0.2	850	آجرکاری با آجر مجوف و ملات سیمان
24	1	0.015	1600	ملات ماسه سیمان
56	1	0.02	2800	گرانیت
250			حاصل جمع	

بار مرده کامپوزیت در طبقات



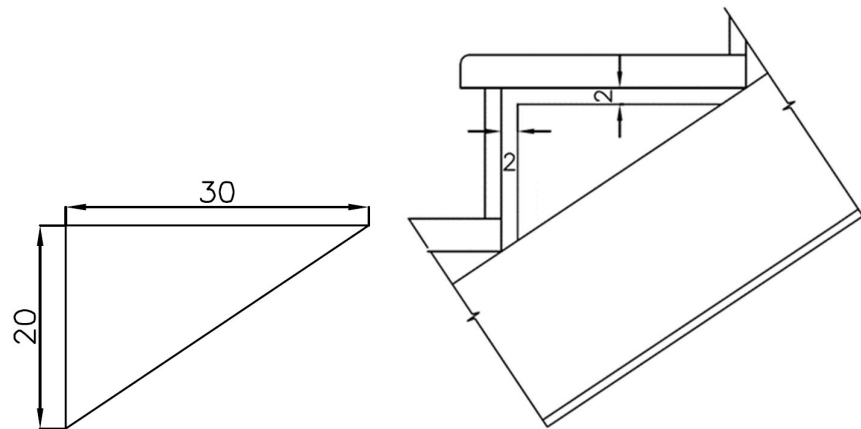
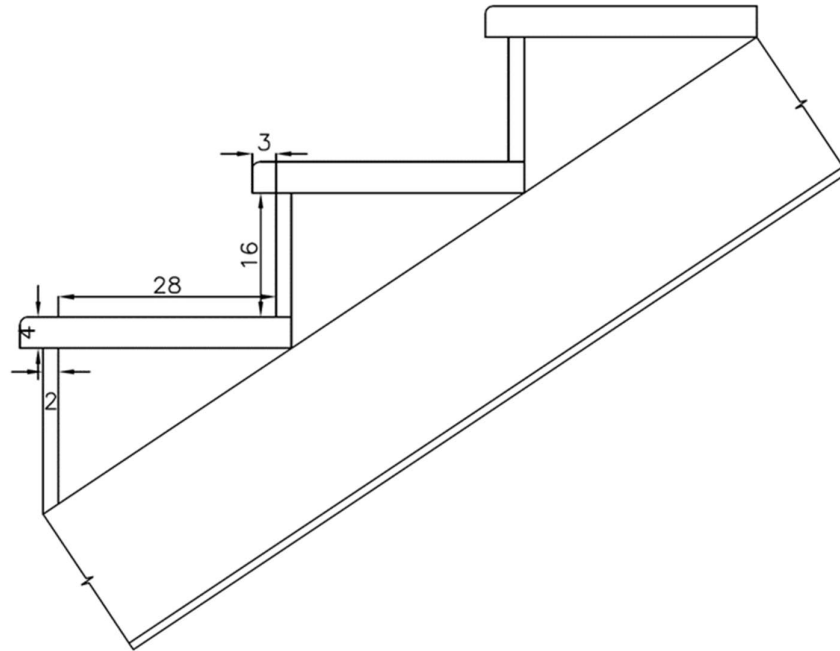
وزن واحد سطح اجزا و مصالح در طبقات				
شدت بار KG/CM^2	تعداد	ضخامت	وزن مخصوص KG/CM^2	مصالح مصرفی
250	1	0.1	2500	بتن آرمه
30	1	0.05	600	پوکه معدنی
63	1	0.03	2100	ماسه سیمان
21	1	0.01	2100	سرامیک کفی
50	***	***	50	سقف کاذب
18.8	**	***	18.8	IPE 180
50	***	**	50	تاسیسات
490			حاصل جمع با در نظر گرفتن وزن دال بتنی و تیر فلزی	

بار مرده کامپوزیت در بام



وزن واحد سطح اجزا و مصالح در طبقات				
شدت بار KG/CM^2	تعداد	ضخامت	وزن مخصوص KG/CM^2	مصالح مصرفی
250	1	0.1	2500	بتن آرمه
30	1	0.05	600	پوکه معدنی
42	1	0.02	2100	ماسه سیمان
24	1	0.01	2400	سنگ موزاییک
50	***	***	50	سقف کاذب
15	***	***	15	ایزوگام
18.8	***	**	18.8	IPE 180
50	**	**	50	تاسیسات
500			حاصل جمع با در نظر گرفتن وزن دال بتی و تیر فلزی	

بار پله



وزن یک پاخور پله برای یک متر از عرض پله				
نوع مصالح	وزن واحد حجم (kg/m ²)		مساحت (m ²)	وزن برای یک متر عرض پله (kg)
سنگ کف مرمریت	2700	0.35*0.04	0.014	37.8
ملات	2100	0.02*(0.2+0.3)	0.01	21
آجرکاری با آجر فشاری و ملات ماسه سیمان	1850	0.5*(0.14*0.26)	0.0182	33.67
				92.47

وزن واحد سطح پاخور kg/m ²	1/0.3*92.47=	308.233
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وزن کل شمشیری kg	وزن گچ زیر شمشیری kg	وزن شمشیری + پاخور kg	وزن پاخور kg	وزن دال شمشیری kg	وزن واحد حجم بتن kg/m ³	طول شمشیری m	ضخامت شمشیری m
2885.32	48.75	2836.57	961.69	1874.89	2500	(2.4^2+1.6^2)^0.5 = 2.88	0.20

وزن کل ۲ پاگرد kg	2058.42	609*1.3*1.3*2=
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وزن کل پله (بین طبقه و نیم طبقه)	4943.74
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وزن واحد سطح پاگرد			
نوع مصالح	وزن واحد حجم (kg/m ³)	ضخامت (m ²)	وزن واحد سطح (kg/m ²)
سنگ کف مرمریت	2700	0.02	54
ملات	2100	0.02	42
دال بتنی پاگرد	2500	0.2	500
گچ	1300	0.01	13
			609

بار مرده واحد طول تیرهای طبقه و نیم طبقه	kg/m	1901.44	$4943.74/(2 \times 1.3) =$
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18.65	KN/m
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فصل 3

مدل سازی و
تحلیل سازه

مدل سازی و تحلیل

نرم افزار های مورد استفاده
در این پروژه از سه نرم افزار استفاده شده است
که در زیر شرح داده می شوند

نام نرم افزار	مورد استفاده
	از نرم افزار طراحی و تحلیل سازه استفاده شده است برای

معرفی المان های مورد استفاده

Name	Material	TYPE
2UNP100-D10	ST37	BRACE
2UNP120-D10	ST37	BRACE
2UNP140-D12	ST37	BRACE
2UNP160-D12	ST37	BRACE
2UNP180-D15	ST37	BRACE
2UNP200-D15	ST37	BRACE
2UNP220-D15	ST37	BRACE
2UNP80-D8	ST37	BRACE
BOX150X10	ST37	COLUMN
BOX150X15	ST37	COLUMN
BOX200X20	ST37	COLUMN
IPE140	ST37	BEAM
IPE160	ST37	BEAM
IPE180	ST37	BEAM
IPE200	ST37	BEAM
IPE220	ST37	BEAM
IPE240	ST37	BEAM
IPE270	ST37	BEAM
IPE300	ST37	BEAM
P.BPX200*15	ST37	COLUMN
P.BPX200*25	ST37	COLUMN
P.BPX200*30	ST37	COLUMN
pg 20*10	ST37	BEAM
BOX250*15	ST37	COLUMN
BOX300*30	ST37	COLUMN
PLATE GRIDER 300*10+250*15	ST37	BEAM

روش تحلیل

روش تحلیل روش مستقیم است

نتایج تحلیل

دوره تناوب
نیروهای زلزله

	مهاربند همگرا ویژه	قاب خمی ساده
	Y	X
H	16	16
T(آیین نامه)	0.4	0.512
$T=\min(1.25T, T_{etabs})$	0.5	0.64
Ru	5.5	5
A	0.35	0.35
B1	2.17	1.69
N	1.015	1.047
B	2.2	1.77
I	1	1
C	0.14	0.12
	مهاربند همگرا ویژه	قاب خمی ساده
	Y	X

اصلاحیه!! دور تناوب در قاب خمشی در 0.8 ضرب شده است

T0	Ts	S	S0
0.1	0.5	1.5	1
	Y	X	
K	1	1.07	
v	14	12.676	

وزن هر طبقه			
Story	UX	UY	UZ
	tonf-s ² /m	tonf-s ² /m	tonf-s ² /m
Story6	0.82941	0.82941	0
Story5	18.55673	18.55673	0
Story4	17.77017	17.77017	0
Story3	17.9446	17.9446	0
Story2	18.1047	18.1047	0
Story1	18.21645	18.21645	0
Base	0.85262	0.85262	0
TOTAL	92.27	92.27	

وزن خریشته بیشتر از 0.25 درصد وزن بام است	FALSE
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Y	نیروی زلزله					
STORIES	Wi(ton)	Hi(m)	Hi ^k	w [*] h ^k	w [*] h/wah	fi
1	17.7643	3	3.00	53.29	0.06	0.903
2	17.68767	6.2	6.20	109.66	0.13	1.859
3	17.63249	9.4	9.40	165.75	0.20	2.809
4	17.59397	12.6	12.60	221.68	0.27	3.757
5	17.63005	15.8	15.80	278.55	0.34	4.721
				828.94	1	14

X	نیروی زلزله					
STORIES	Wi(ton)	Hi(m)	Hi^k	w*h^k	w*h/wah	fi
1	17.7643	3	3.240	57.553	0.059	0.745
2	17.68767	6.2	7.045	124.603	0.127	1.614
3	17.63249	9.4	10.996	193.892	0.198	2.511
4	17.59397	12.6	15.045	264.704	0.270	3.429
5	17.63005	15.8	19.167	337.922	0.345	4.377
				978.67	1	12.676

4 فصل

طراحی

روش های طراحی

روش طراحی در این پروژه طبق آخرین نسخه از
مقررات ملی ساختمان است که چاپ گردید
و روش آن **LRFD** است

طراحی

تیر

ETABS 2016 Steel Frame Design

AISC 360-10 Steel Section Check (Strength Summary)

Element Details

Level	Element	Unique Name	Location (cm)	Combo	Element Type	Section	Classification
Story3	B32	349	10	Comb24	Special Moment Frame	PLATE GRIDER 300*10+250*15	Seismic HD

LLRF and Demand/Capacity Ratio

L (cm)	LLRF	Stress Ratio Limit
310.000	1	1

Analysis and Design Parameters

Provision	Analysis	2nd Order	Reduction
LRFD	Direct Analysis	General 2nd Order	No Modification

Stiffness Reduction Factors

$\alpha P_r / P_y$	$\alpha P_r / P_e$	τ_b	EA factor	EI factor
0	0	1	1	1

Seismic Parameters

Ignore Seismic Code?	Ignore Special EQ Load?	Plug Welded?	SDC	I	Rho	S_{DS}	R	Ω_0	C_d
No	No	Yes	D	1	1	1.05	5	3	4

Design Code Parameters

Φ_b	Φ_c	Φ_{TY}	Φ_{TF}	Φ_V	Φ_{V-RI}	Φ_{VT}
0.9	0.9	0.9	0.75	0.9	1	1

Section Properties

A (cm ²)	J (cm ⁴)	I_{33} (cm ⁴)	I_{22} (cm ⁴)	A_{v3} (cm ²)	A_{v2} (cm ²)
106	66.8	21086.5	3909.3	75	33

Design Properties

S_{33} (cm ³)	S_{22} (cm ³)	Z_{33} (cm ³)	Z_{22} (cm ³)	r_{33} (cm)	r_{22} (cm)	C_w (cm ⁶)
1278	312.7	1421	477	14.104	6.073	968994.1

Material Properties

E (kgf/cm ²)	f_y (kgf/cm ²)	R_y	α
2100000	2400	1.15	NA

Stress Check forces and Moments

Location (cm)	P_u (kgf)	M_{u33} (kgf-cm)	M_{u22} (kgf-cm)	V_{u2} (kgf)	V_{u3} (kgf)	T_u (kgf-cm)
10	0	-2302794.68	0	-17352.84	0	-10.89

Axial Force & Biaxial Moment Design Factors (H1-1b)

	L Factor	K₁	K₂	B₁	B₂	C_m
Major Bending	0.935	1	1	1	1	1
Minor Bending	0	1	1	1	1	1

Parameters for Lateral Torsion Buckling

L_{ltb}	K_{ltb}	C_b
0.01	1	1.917

Demand/Capacity (D/C) Ratio Eqn.(H1-1b)

D/C Ratio =	(P_r/2P_c) + (M_{r33}/M_{c33}) + (M_{r22}/M_{c22})
0.75 =	0 + 0.75 + 0

Axial Force and Capacities

P_u Force (kgf)	φP_{nc} Capacity (kgf)	φP_{nt} Capacity (kgf)
0	224316.4	228960

Moments and Capacities

	M_u Moment (kgf-cm)	φM_n (kgf-cm)	φM_n No LTB (kgf-cm)	φM_n Cb=1 (kgf-cm)
Major Bending	2302794.68	3069372.92	3069372.92	3069372.92
Minor Bending	0	1030307.08		

Shear Design

	V_u Force (kgf)	φV_n Capacity (kgf)	Stress Ratio
Major Shear	17352.84	42768	0.406
Minor Shear	0	97200	0

End Reaction Major Shear Forces

Left End Reaction (kgf)	Load Combo	Right End Reaction (kgf)	Load Combo
33305.28	SComb02	32498.52	SComb02

کنترل تیر

نام مقطع	plate girder 300*10,250*15		
مشخصات مقطع مورد نیاز			
d(CM)	30		
tf(CM)	1.5	cb	1.917
bf(CM)	25	cw	879592.5
tw(CM)	1	rts	7.2876
k	1	Mp	3410400
ry(CM)	6.073		
Sx(CM)	1278		
Sy(CM)	312.7		
Ix(CM)	21086.5		
Iy(CM)	3909.3		
Z(CM)	1421		
J(CM)	66.8		

محاسبات

Mu	2302794.68
Lb	310

$$L_p = \frac{1}{\sqrt{6}} r_y \sqrt{\frac{E}{F_y}}$$

Lp	308.469533
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$$L_r = \frac{1}{\sqrt{6}} r_{ts} \frac{E}{\sqrt{F_y}} \sqrt{\frac{Jc}{S_x h_o} + \sqrt{\left(\frac{Jc}{S_x h_o}\right)^2 + \frac{6}{\sqrt{6}} \left(\frac{\sqrt{F_y}}{E}\right)^2}}$$

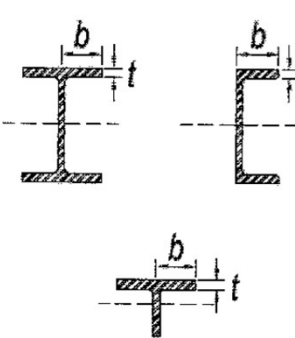
Lr	789.465708
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$$L_p < L_b \leq L_r$$

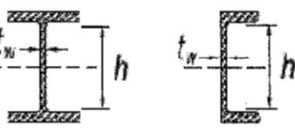
$$M_n = C_b \left[M_p - (M_p - 0.7 F_y S_x) \left(\frac{L_b - L_p}{L_r - L_p} \right) \right] \leq M_p$$

Mn	5877027.68	Mu < ΦMn	TRUE
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کنترل فشردگی

	$\lambda_p = \frac{b}{t} \sqrt{\frac{E}{F_y}}$	$\lambda_{pf} = 0.38 \sqrt{\frac{E}{F_y}}$	b/t	بال‌های مقاطع I شکل نورد شده، ناودانی‌ها و سپری‌ها
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$\frac{b}{t} < \lambda_p$	$8.33 < 10.96$	بال تیر فشرده است
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	$\lambda_p = \frac{h}{t_w} \sqrt{\frac{E}{F_y}}$	$\lambda_{pw} = 0.38 \sqrt{\frac{E}{F_y}}$	h/t_w	جان مقاطع I شکل با دو محور تقارن و جان مقاطع ناودانی
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$\frac{h}{t_w} < \lambda_{pw}$	$30 < 108.5$	جان تیر فشرده است
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ظرفیت برشی تیر	
Vu	17352.84
Cv	1
Aw	30
Vn	43200
$Vu < \Phi Vn$	TRUE

طراحی بادبند

ETABS 2016 Steel Frame Design

AISC 360-10 Steel Section Check (Strength Summary)

Element Details

Level	Element	Unique Name	Location (cm)	Combo	Element Type	Section	Classification
Story1	D6	41	268.002	Comb22	Special Moment Frame	2UNP120-D10	Seismic HD

LLRF and Demand/Capacity Ratio

L (cm)	LLRF	Stress Ratio Limit
536.004	1	1

Analysis and Design Parameters

Provision	Analysis	2nd Order	Reduction
LRFD	Direct Analysis	General 2nd Order	No Modification

Stiffness Reduction Factors

$\alpha P_r / P_y$	$\alpha P_r / P_e$	τ_b	EA factor	EI factor
0.33	0.234	1	1	1

Seismic Parameters

Ignore Seismic Code?	Ignore Special EQ Load?	Plug Welded?	SDC	I	Rho	S_{DS}	R	Ω_0	C_d
No	No	Yes	D	1	1	1.05	5	2	4

Design Code Parameters

Φ_b	Φ_c	Φ_{TY}	Φ_{TF}	Φ_V	Φ_{V-RI}	Φ_{VT}
0.9	0.9	0.9	0.75	0.9	1	1

Section Properties

A (cm ²)	J (cm ⁴)	I_{33} (cm ⁴)	I_{22} (cm ⁴)	A_{v3} (cm ²)	A_{v2} (cm ²)
34.8	8.4	752.4	734.3	14.9	12.1

Design Properties

S_{33} (cm ³)	S_{22} (cm ³)	Z_{33} (cm ³)	Z_{22} (cm ³)	r_{33} (cm)	r_{22} (cm)	C_w (cm ⁶)
125.4	122.4	149.8	148.7	4.65	4.593	

Material Properties

E (kgf/cm ²)	f_y (kgf/cm ²)	R_y	α
2100000	2400	1.15	NA

HSS Section Parameters

HSS Welding	Reduce HSS Thickness?
ERW	Yes

Stress Check forces and Moments

Location (cm)	P _u (kgf)	M _{u33} (kgf-cm)	M _{u22} (kgf-cm)	V _{u2} (kgf)	V _{u3} (kgf)	T _u (kgf-cm)
268.002	-27575.55	-4636.87	125.07	-59.12	-5.32	4.11

Axial Force & Biaxial Moment Design Factors (H1-1a)

	L Factor	K ₁	K ₂	B ₁	B ₂	C _m
Major Bending	0.5	1	1	1	1	1
Minor Bending	0.67	1	1	1	1	1

Parameters for Lateral Torsion Buckling

L _{ltb}	K _{ltb}	C _b
1	1	1.521

Demand/Capacity (D/C) Ratio Eqn.(H1-1a)

D/C Ratio =	$(P_r/P_c) + (8/9)(M_{r33}/M_{c33}) + (8/9)(M_{r22}/M_{c22})$
0.506 =	0.493 + 0.013 + 3.461E-04

Axial Force and Capacities

P _u Force (kgf)	φP _{nc} Capacity (kgf)	φP _{nt} Capacity (kgf)
27575.55	55892.22	75168

Moments and Capacities

	M _u Moment (kgf-cm)	φM _n (kgf-cm)	φM _n No LTB (kgf-cm)	φM _n Cb=1 (kgf-cm)
Major Bending	4636.87	323568	323568	323568
Minor Bending	125.07	321192		

Torsion Moment and Capacities

T _u Moment (kgf-cm)	T _n Capacity (kgf-cm)	φT _n Capacity (kgf-cm)
4.11	294435.43	264991.89

Shear Design

	V _u Force (kgf)	φV _n Capacity (kgf)	Stress Ratio
Major Shear	59.12	15692.75	0.004
Minor Shear	5.32	19308.59	2.757E-04

End Reaction Axial Forces

Left End Reaction (kgf)	Load Combo	Right End Reaction (kgf)	Load Combo
-27776.29	SComb02	-27513.92	SComb02

طراحی بادبند

$$\lambda_x = \frac{kL}{r_x} \leq 4,71 \sqrt{\frac{E}{f_y}}$$

57.63484<135.96

$$f_{ex} = \frac{f_y}{\left(\frac{\lambda_x}{\pi}\right)^2} \cdot \frac{1}{\left(\frac{1}{5936.345}\right)^2}$$

$\left(0.652^{\frac{f_y}{f_e}}\right) f_y$

2018.894

A_g

70257.52

λ_n

63231.77

$$\lambda_y = \frac{kL}{r_y} \leq 4,71 \cdot \sqrt{\frac{E}{f_y}}$$

81.74353<135.96

$$f_{ey} = \frac{f_y}{\left(\frac{\lambda_y}{\pi}\right)^2} \cdot \frac{1}{\left(\frac{1}{2951.09}\right)^2}$$

$f_{Cr} = \left(0.652^{\frac{f_y}{f_e}}\right) f_y$

1694.909

58982.85

λ_n

53084.56

Φ_{pnmin}

53084.56165

$RATIO \frac{p_u}{\phi p_n^{MIN}}$

0.519465

Kx	0.5	واحدھا بر حسب kg/cm	
KY	0.7	pu	27575.55
kz	1	l	536.004
		rx	4.65
		ry	4.59
		ag	34.8
		e	2000000
		fy/efx	0.404289
		y	0.813259
		ix	752.4
		iy	734.3
		d	12
		e	1.59
		FE MIN	2645.23
		FY/FEMIN	0.907294
		CW	24841.66
		J	8.4
		G	807700

کمانش پیچشی-خمشی

$$y_o = \frac{d^2}{4} \cdot \frac{e}{r_y^2} + e$$

4.306904

$$\bar{r}_o^{\text{r}} = x_o^{\text{r}} + y_o^{\text{r}} + \frac{I_x + I_y}{A_g}$$

61.27068

$$H = 1 - \frac{x_o^{\text{r}} + y_o^{\text{r}}}{\bar{r}_o^{\text{r}}}$$

0.697255

$$F_{ex} = \frac{\pi^{\text{r}} E}{\left(\frac{K_x L}{r_x}\right)^{\text{r}}}$$

5936.345

$$F_{ey} = \frac{\pi^{\text{r}} E}{\left(\frac{K_y L}{r_y}\right)^{\text{r}}}$$

2951.09

$$F_{ez} = \left[\frac{\pi^{\text{r}} E C_w}{(K_z L)^{\text{r}}} + GJ \right] \frac{1}{A_g \bar{r}_o^{\text{r}}}$$

14947436

$$F_e = \left(\frac{F_{ey} + F_{ez}}{r_H} \right) \left[1 - \sqrt{1 - \frac{r F_{ey} F_{ez} H}{(F_{ey} + F_{ez})^{\text{r}}}} \right]$$

2645.23

MIN 2645.23

FY TRUE

$$f_{Cr} = \left(0,652^{f_y/f_e} \right) \cdot \gamma_y$$

1628.093

FALSE

FE 2319.867

Ag 56657.65 γ_n 50991.88246

ratio $\frac{p_u}{\phi p_n^{MIN}}$ 0.540783

ETABS 2016 Steel Frame Design

AISC 360-10 Steel Section Check (Strength Summary)

Element Details

Level	Element	Unique Name	Location (cm)	Combo	Element Type	Section	Classification
Story2	D6	46	268.002	Comb22	Special Moment Frame	2UNP120-D10	Seismic HD

LLRF and Demand/Capacity Ratio

L (cm)	LLRF	Stress Ratio Limit
536.004	1	1

Analysis and Design Parameters

Provision	Analysis	2nd Order	Reduction
LRFD	Direct Analysis	General 2nd Order	No Modification

Stiffness Reduction Factors

$\alpha P_r / P_y$	$\alpha P_r / P_e$	τ_b	EA factor	EI factor
0.397	0.281	1	1	1

Seismic Parameters

Ignore Seismic Code?	Ignore Special EQ Load?	Plug Welded?	SDC	I	Rho	S_{DS}	R	Ω_0	C_d
No	No	Yes	D	1	1	1.05	5	2	4

Design Code Parameters

Φ_b	Φ_c	Φ_{TY}	Φ_{TF}	Φ_V	Φ_{V-RI}	Φ_{VT}
0.9	0.9	0.9	0.75	0.9	1	1

Section Properties

A (cm ²)	J (cm ⁴)	I_{33} (cm ⁴)	I_{22} (cm ⁴)	A_{v3} (cm ²)	A_{v2} (cm ²)
34.8	8.4	752.4	734.3	14.9	12.1

Design Properties

S_{33} (cm ³)	S_{22} (cm ³)	Z_{33} (cm ³)	Z_{22} (cm ³)	r_{33} (cm)	r_{22} (cm)	C_w (cm ⁶)
125.4	122.4	149.8	148.7	4.65	4.593	

Material Properties

E (kgf/cm ²)	f_y (kgf/cm ²)	R_y	α
2100000	2400	1.15	NA

HSS Section Parameters

HSS Welding	Reduce HSS Thickness?
ERW	Yes

Stress Check forces and Moments

Location (cm)	P _u (kgf)	M _{u33} (kgf-cm)	M _{u22} (kgf-cm)	V _{u2} (kgf)	V _{u3} (kgf)	T _u (kgf-cm)
268.002	-33127.42	-3768.91	323.34	-56.75	-11.84	-28.84

Axial Force & Biaxial Moment Design Factors (H1-1a)

	L Factor	K ₁	K ₂	B ₁	B ₂	C _m
Major Bending	0.5	1	1	1	1	1
Minor Bending	0.67	1	1	1	1	1

Parameters for Lateral Torsion Buckling

L _{ltb}	K _{ltb}	C _b
1	1	1.472

Demand/Capacity (D/C) Ratio Eqn.(H1-1a)

D/C Ratio =	$(P_r/P_c) + (8/9)(M_{r33}/M_{c33}) + (8/9)(M_{r22}/M_{c22})$
0.604 =	0.593 + 0.01 + 0.001

Axial Force and Capacities

P _u Force (kgf)	φP _{nc} Capacity (kgf)	φP _{nt} Capacity (kgf)
33127.42	55892.22	75168

Moments and Capacities

	M _u Moment (kgf-cm)	φM _n (kgf-cm)	φM _n No LTB (kgf-cm)	φM _n Cb=1 (kgf-cm)
Major Bending	3768.91	323568	323568	323568
Minor Bending	323.34	321192		

Torsion Moment and Capacities

T _u Moment (kgf-cm)	T _n Capacity (kgf-cm)	φT _n Capacity (kgf-cm)
-28.84	294435.43	264991.89

Shear Design

	V _u Force (kgf)	φV _n Capacity (kgf)	Stress Ratio
Major Shear	56.75	15692.75	0.004
Minor Shear	11.84	19308.59	0.001

End Reaction Axial Forces

Left End Reaction (kgf)	Load Combo	Right End Reaction (kgf)	Load Combo
-33335.91	SComb02	-33065.80	SComb02

طراحی بادبند

$$\lambda_x = \frac{kL}{r_x} \leq 4,71 \sqrt{\frac{E}{f_y}}$$

$\frac{57.63484}{135.96}$

$$f_{ex} = \frac{f_y}{\left(\frac{\lambda_x}{\pi}\right)^2} \frac{E}{f_y}$$

$\left(\frac{f_y}{f_{ex}} \right) f_y$ $\frac{2018.894}{1}$

A_g $\frac{70257.52}{1}$

λ_n $\frac{63231.77}{1}$

$$\lambda_y = \frac{kL}{r_y} \leq 4,71 \cdot \sqrt{\frac{E}{f_y}}$$

$\frac{81.74353}{135.96}$

$$f_{ey} = \frac{f_y}{\left(\frac{\lambda_y}{\pi}\right)^2} \frac{E}{f_y}$$

$f_{Cr} = \left(0,652 \frac{f_y}{f_{ey}} \right) f_y$ $\frac{1694.909}{1}$

$\frac{58982.85}{1}$

λ_n $\frac{53084.56}{1}$

Φ_{pnmin} $\frac{53084.56165}{1}$

RATIO $\frac{p_u}{\phi p_n^{MIN}}$ $\frac{0.519465}{1}$

Kx	0.5	واحدھا بر حسب kg/cm
KY	0.7	pu
kz	1	l
		rx
		ry
		ag
		e
		fy/efx
		y
		ix
		iy
		d
		e
		FE MIN
		FY/FEMIN
		CW
		J
		G

کمانش پیچشی-خمشی

$$y_o = \frac{d^2}{4} \cdot \frac{e}{r_y^2} + e$$

4.306904

$$\bar{r}_o^{\text{r}} = x_o^{\text{r}} + y_o^{\text{r}} + \frac{I_x + I_y}{A_g}$$

61.27068

$$H = 1 - \frac{x_o^{\text{r}} + y_o^{\text{r}}}{\bar{r}_o^{\text{r}}}$$

0.697255

$$F_{ex} = \frac{\pi^{\text{r}} E}{\left(\frac{K_x L}{r_x}\right)^{\text{r}}}$$

5936.345

$$F_{ey} = \frac{\pi^{\text{r}} E}{\left(\frac{K_y L}{r_y}\right)^{\text{r}}}$$

2951.09

$$F_{ez} = \left[\frac{\pi^{\text{r}} E C_w}{(K_z L)^{\text{r}}} + GJ \right] \frac{1}{A_g \bar{r}_o^{\text{r}}}$$

14947436

$$F_e = \left(\frac{F_{ey} + F_{ez}}{r_H} \right) \left[1 - \sqrt{1 - \frac{r F_{ey} F_{ez} H}{(F_{ey} + F_{ez})^{\text{r}}}} \right]$$

2645.23

MIN 2645.23

$$FY$$

TRUE

$$f_{Cr} = \left(0,652^{f_y/f_e} \right) \cdot \sigma_y$$

1628.093

FALSE

$$FE$$

2319.867

$$A_g$$

56657.65

γ_n 50991.88246

ratio $\frac{p_u}{\phi p_n^{MIN}}$ 0.540783

ETABS 2016 Steel Frame Design

AISC 360-10 Steel Section Check (Strength Summary)

Element Details

Level	Element	Unique Name	Location (cm)	Combo	Element Type	Section	Classification
Story3	D6	45	268.002	Comb22	Special Moment Frame	2UNP120-D10	Seismic HD

LLRF and Demand/Capacity Ratio

L (cm)	LLRF	Stress Ratio Limit
536.004	1	1

Analysis and Design Parameters

Provision	Analysis	2nd Order	Reduction
LRFD	Direct Analysis	General 2nd Order	No Modification

Stiffness Reduction Factors

$\alpha P_r / P_y$	$\alpha P_r / P_e$	τ_b	EA factor	EI factor
0.291	0.206	1	1	1

Seismic Parameters

Ignore Seismic Code?	Ignore Special EQ Load?	Plug Welded?	SDC	I	Rho	S_{DS}	R	Ω_0	C_d
No	No	Yes	D	1	1	1.05	5	2	4

Design Code Parameters

Φ_b	Φ_c	Φ_{TY}	Φ_{TF}	Φ_V	Φ_{V-RI}	Φ_{VT}
0.9	0.9	0.9	0.75	0.9	1	1

Section Properties

A (cm ²)	J (cm ⁴)	I_{33} (cm ⁴)	I_{22} (cm ⁴)	A_{v3} (cm ²)	A_{v2} (cm ²)
34.8	8.4	752.4	734.3	14.9	12.1

Design Properties

S_{33} (cm ³)	S_{22} (cm ³)	Z_{33} (cm ³)	Z_{22} (cm ³)	r_{33} (cm)	r_{22} (cm)	C_w (cm ⁶)
125.4	122.4	149.8	148.7	4.65	4.593	

Material Properties

E (kgf/cm ²)	f_y (kgf/cm ²)	R_y	α
2100000	2400	1.15	NA

HSS Section Parameters

HSS Welding	Reduce HSS Thickness?
ERW	Yes

Stress Check forces and Moments

Location (cm)	P _u (kgf)	M _{u33} (kgf-cm)	M _{u22} (kgf-cm)	V _{u2} (kgf)	V _{u3} (kgf)	T _u (kgf-cm)
268.002	-24303.93	-3690.45	141.47	-56.41	-9.62	-29.98

Axial Force & Biaxial Moment Design Factors (H1-1a)

	L Factor	K ₁	K ₂	B ₁	B ₂	C _m
Major Bending	0.5	1	1	1	1	1
Minor Bending	0.67	1	1	1	1	1

Parameters for Lateral Torsion Buckling

L _{ltb}	K _{ltb}	C _b
1	1	1.536

Demand/Capacity (D/C) Ratio Eqn.(H1-1a)

D/C Ratio =	$(P_r/P_c) + (8/9)(M_{r33}/M_{c33}) + (8/9)(M_{r22}/M_{c22})$
0.445 =	0.435 + 0.01 + 3.915E-04

Axial Force and Capacities

P _u Force (kgf)	φP _{nc} Capacity (kgf)	φP _{nt} Capacity (kgf)
24303.93	55892.22	75168

Moments and Capacities

	M _u Moment (kgf-cm)	φM _n (kgf-cm)	φM _n No LTB (kgf-cm)	φM _n Cb=1 (kgf-cm)
Major Bending	3690.45	323568	323568	323568
Minor Bending	141.47	321192		

Torsion Moment and Capacities

T _u Moment (kgf-cm)	T _n Capacity (kgf-cm)	φT _n Capacity (kgf-cm)
-29.98	294435.43	264991.89

Shear Design

	V _u Force (kgf)	φV _n Capacity (kgf)	Stress Ratio
Major Shear	56.41	15692.75	0.004
Minor Shear	9.62	19308.59	4.984E-04

End Reaction Axial Forces

Left End Reaction (kgf)	Load Combo	Right End Reaction (kgf)	Load Combo
-24508.3	SComb02	-24242.30	SComb02

طراحی بادبند

$$\lambda_x = \frac{kL}{r_x} \leq 4,71 \sqrt{\frac{E}{f_y}}$$

$\frac{57.63484}{135.96}$

$$f_{ex} = \frac{f_y}{\left(\frac{K_x L}{r_x}\right)^2}$$

$\left(\frac{K_y L}{r_y}\right)^2 f_y$ 2018.894

A_g 70257.52

λ_n 63231.77

$$\lambda_y = \frac{kL}{r_y} \leq 4,71 \cdot \sqrt{\frac{E}{f_y}}$$

$\frac{81.74353}{135.96}$

$$f_{ey} = \frac{f_y}{\left(\frac{K_y L}{r_y}\right)^2}$$

$f_{cr} = \left(0,652^{\frac{f_y}{f_e}}\right) f_y$ 1694.909

58982.85

λ_n 53084.56

Φ_{pnmin} 53084.56165

RATIO $\frac{p_u}{\phi p_n^{MIN}}$ 0.62405

Kx	0.5	واحدھا بر حسب kg/cm
KY	0.7	pu 33127.42
kz	1	l 536.004
		rx 4.65
		ry 4.59
		ag 34.8
		e 2000000
		fy/efx 0.404289
		y 0.813259
		ix 752.4
		iy 734.3
		d 12
		e 1.59
		FE MIN 2645.23
		FY/FEMIN 0.907294
		CW 24841.66
		J 8.4
		G 807700

کمانش پیچشی-خمشی

$$y_o = \frac{d^2}{4} \cdot \frac{e}{r_y^2} + e$$

4.306904

$$\bar{r}_o^{\text{r}} = x_o^{\text{r}} + y_o^{\text{r}} + \frac{I_x + I_y}{A_g}$$

61.27068

$$H = 1 - \frac{x_o^{\text{r}} + y_o^{\text{r}}}{\bar{r}_o^{\text{r}}}$$

0.697255

$$F_{ex} = \frac{\pi^{\text{r}} E}{\left(\frac{K_x L}{r_x}\right)^{\text{r}}}$$

5936.345

$$F_{ey} = \frac{\pi^{\text{r}} E}{\left(\frac{K_y L}{r_y}\right)^{\text{r}}}$$

2951.09

$$F_{ez} = \left[\frac{\pi^{\text{r}} E C_w}{(K_z L)^{\text{r}}} + GJ \right] \frac{1}{A_g \bar{r}_o^{\text{r}}}$$

14947436

$$F_e = \left(\frac{F_{ey} + F_{ez}}{r_H} \right) \left[1 - \sqrt{1 - \frac{r F_{ey} F_{ez} H}{(F_{ey} + F_{ez})^{\text{r}}}} \right]$$

2645.23

MIN 2645.23

$$FY$$

TRUE

$$f_{Cr} = \left(0,652^{f_y/f_e} \right) \cdot \sigma_y$$

1628.093

FALSE

$$FE$$

2319.867

$$A_g$$

56657.65

σ_n 50991.88246

ratio

$$\frac{p_u}{\phi p_n^{MIN}}$$

0.649661

ETABS 2016 Steel Frame Design

AISC 360-10 Steel Section Check (Strength Summary)

Element Details

Level	Element	Unique Name	Location (cm)	Combo	Element Type	Section	Classification
Story4	D6	44	268.002	Comb21	Special Moment Frame	2UNP120-D10	Seismic HD

LLRF and Demand/Capacity Ratio

L (cm)	LLRF	Stress Ratio Limit
536.004	1	1

Analysis and Design Parameters

Provision	Analysis	2nd Order	Reduction
LRFD	Direct Analysis	General 2nd Order	No Modification

Stiffness Reduction Factors

$\alpha P_r / P_y$	$\alpha P_r / P_e$	τ_b	EA factor	EI factor
0.223	0.158	1	1	1

Seismic Parameters

Ignore Seismic Code?	Ignore Special EQ Load?	Plug Welded?	SDC	I	Rho	S_{DS}	R	Ω_0	C_d
No	No	Yes	D	1	1	1.05	5	2	4

Design Code Parameters

Φ_b	Φ_c	Φ_{TY}	Φ_{TF}	Φ_V	Φ_{V-RI}	Φ_{VT}
0.9	0.9	0.9	0.75	0.9	1	1

Section Properties

A (cm ²)	J (cm ⁴)	I_{33} (cm ⁴)	I_{22} (cm ⁴)	A_{v3} (cm ²)	A_{v2} (cm ²)
34.8	8.4	752.4	734.3	14.9	12.1

Design Properties

S_{33} (cm ³)	S_{22} (cm ³)	Z_{33} (cm ³)	Z_{22} (cm ³)	r_{33} (cm)	r_{22} (cm)	C_w (cm ⁶)
125.4	122.4	149.8	148.7	4.65	4.593	

Material Properties

E (kgf/cm ²)	f_y (kgf/cm ²)	R_y	α
2100000	2400	1.15	NA

HSS Section Parameters

HSS Welding	Reduce HSS Thickness?
ERW	Yes

Stress Check forces and Moments

Location (cm)	P _u (kgf)	M _{u33} (kgf-cm)	M _{u22} (kgf-cm)	V _{u2} (kgf)	V _{u3} (kgf)	T _u (kgf-cm)
268.002	-18635.72	-2965.45	479.59	-53.56	8.32	28.2

Axial Force & Biaxial Moment Design Factors (H1-1a)

	L Factor	K ₁	K ₂	B ₁	B ₂	C _m
Major Bending	0.5	1	1	1	1	1
Minor Bending	0.67	1	1	1	1	1

Parameters for Lateral Torsion Buckling

L _{ltb}	K _{ltb}	C _b
1	1	1.429

Demand/Capacity (D/C) Ratio Eqn.(H1-1a)

D/C Ratio =	$(P_r/P_c) + (8/9)(M_{r33}/M_{c33}) + (8/9)(M_{r22}/M_{c22})$
0.343 =	0.333 + 0.008 + 0.001

Axial Force and Capacities

P _u Force (kgf)	φP _{nc} Capacity (kgf)	φP _{nt} Capacity (kgf)
18635.72	55892.22	75168

Moments and Capacities

	M _u Moment (kgf-cm)	φM _n (kgf-cm)	φM _n No LTB (kgf-cm)	φM _n Cb=1 (kgf-cm)
Major Bending	2965.45	323568	323568	323568
Minor Bending	479.59	321192		

Torsion Moment and Capacities

T _u Moment (kgf-cm)	T _n Capacity (kgf-cm)	φT _n Capacity (kgf-cm)
28.2	294435.43	264991.89

Shear Design

	V _u Force (kgf)	φV _n Capacity (kgf)	Stress Ratio
Major Shear	53.56	15692.75	0.003
Minor Shear	8.32	19308.59	4.31E-04

End Reaction Axial Forces

Left End Reaction (kgf)	Load Combo	Right End Reaction (kgf)	Load Combo
-18838.91	SComb02	-18574.09	SComb02

طراحی بادبند

$$\lambda_x = \frac{kL}{r_x} \leq 4,71 \sqrt{\frac{E}{f_y}}$$

$\frac{57.63484}{135.96}$

$$f_{ex} = \frac{f_y}{\left(\frac{K_x L}{r_x}\right)^2}$$

$\left(\frac{K_y L}{r_y}\right)^2 f_y$ 2018.894

A_g 70257.52

λ_n 63231.77

$$\lambda_y = \frac{kL}{r_y} \leq 4,71 \cdot \sqrt{\frac{E}{f_y}}$$

$\frac{81.74353}{135.96}$

$$f_{ey} = \frac{f_y}{\left(\frac{K_y L}{r_y}\right)^2}$$

$f_{cr} = \left(0,652^{\frac{f_y}{f_e}}\right) f_y$ 1694.909

58982.85

λ_n 53084.56

Φ_{pnmin} 53084.56165

RATIO $\frac{p_u}{\phi p_n^{MIN}}$ 0.62405

Kx	0.5	واحدھا بر حسب kg/cm
KY	0.7	pu 33127.42
kz	1	l 536.004
		rx 4.65
		ry 4.59
		ag 34.8
		e 2000000
		fy/efx 0.404289
		y 0.813259
		ix 752.4
		iy 734.3
		d 12
		e 1.59
		FE MIN 2645.23
		FY/FEMIN 0.907294
		CW 24841.66
		J 8.4
		G 807700

کمانش پیچشی-خمشی

$$y_o = \frac{d^2}{4} \cdot \frac{e}{r_y^2} + e$$

4.306904

$$\bar{r}_o^{\text{r}} = x_o^{\text{r}} + y_o^{\text{r}} + \frac{I_x + I_y}{A_g}$$

61.27068

$$H = 1 - \frac{x_o^{\text{r}} + y_o^{\text{r}}}{\bar{r}_o^{\text{r}}}$$

0.697255

$$F_{ex} = \frac{\pi^{\text{r}} E}{\left(\frac{K_x L}{r_x}\right)^{\text{r}}}$$

5936.345

$$F_{ey} = \frac{\pi^{\text{r}} E}{\left(\frac{K_y L}{r_y}\right)^{\text{r}}}$$

2951.09

$$F_{ez} = \left[\frac{\pi^{\text{r}} E C_w}{(K_z L)^{\text{r}}} + GJ \right] \frac{1}{A_g \bar{r}_o^{\text{r}}}$$

14947436

$$F_e = \left(\frac{F_{ey} + F_{ez}}{r_H} \right) \left[1 - \sqrt{1 - \frac{r F_{ey} F_{ez} H}{(F_{ey} + F_{ez})^{\text{r}}}} \right]$$

2645.23

MIN 2645.23

$$FY$$

TRUE

$$f_{Cr} = \left(0,652^{f_y/f_e} \right) \cdot \sigma_y$$

1628.093

FALSE

$$FE$$

2319.867

$$A_g$$

56657.65

σ_n 50991.88246

ratio $\frac{p_u}{\phi p_n^{MIN}}$ 0.649661

ETABS 2016 Steel Frame Design

AISC 360-10 Steel Section Check (Strength Summary)

Element Details

Level	Element	Unique Name	Location (cm)	Combo	Element Type	Section	Classification
Story5	D6	43	268.002	Comb21	Special Moment Frame	2UNP120-D10	Seismic HD

LLRF and Demand/Capacity Ratio

L (cm)	LLRF	Stress Ratio Limit
536.004	1	1

Analysis and Design Parameters

Provision	Analysis	2nd Order	Reduction
LRFD	Direct Analysis	General 2nd Order	No Modification

Stiffness Reduction Factors

$\alpha P_r / P_y$	$\alpha P_r / P_e$	τ_b	EA factor	EI factor
0.108	0.076	1	1	1

Seismic Parameters

Ignore Seismic Code?	Ignore Special EQ Load?	Plug Welded?	SDC	I	Rho	S_{DS}	R	Ω_0	C_d
No	No	Yes	D	1	1	1.05	5	2	4

Design Code Parameters

Φ_b	Φ_c	Φ_{TY}	Φ_{TF}	Φ_V	Φ_{V-RI}	Φ_{VT}
0.9	0.9	0.9	0.75	0.9	1	1

Section Properties

A (cm ²)	J (cm ⁴)	I_{33} (cm ⁴)	I_{22} (cm ⁴)	A_{v3} (cm ²)	A_{v2} (cm ²)
34.8	8.4	752.4	734.3	14.9	12.1

Design Properties

S_{33} (cm ³)	S_{22} (cm ³)	Z_{33} (cm ³)	Z_{22} (cm ³)	r_{33} (cm)	r_{22} (cm)	C_w (cm ⁶)
125.4	122.4	149.8	148.7	4.65	4.593	

Material Properties

E (kgf/cm ²)	f_y (kgf/cm ²)	R_y	α
2100000	2400	1.15	NA

HSS Section Parameters

HSS Welding	Reduce HSS Thickness?
ERW	Yes

Stress Check forces and Moments

Location (cm)	P _u (kgf)	M _{u33} (kgf-cm)	M _{u22} (kgf-cm)	V _{u2} (kgf)	V _{u3} (kgf)	T _u (kgf-cm)
268.002	-9014.29	-2921.26	264.81	-52.72	2.79	20.99

Axial Force & Biaxial Moment Design Factors (H1-1b)

	L Factor	K ₁	K ₂	B ₁	B ₂	C _m
Major Bending	0.5	1	1	1	1	1
Minor Bending	0.67	1	1	1	1	1

Parameters for Lateral Torsion Buckling

L _{ltb}	K _{ltb}	C _b
1	1	1.362

Demand/Capacity (D/C) Ratio Eqn.(H1-1b)

D/C Ratio =	$(P_r / 2P_c) + (M_{r33} / M_{c33}) + (M_{r22} / M_{c22})$
0.09 =	0.081 + 0.009 + 0.001

Axial Force and Capacities

P _u Force (kgf)	φP _{nc} Capacity (kgf)	φP _{nt} Capacity (kgf)
9014.29	55892.22	75168

Moments and Capacities

	M _u Moment (kgf-cm)	φM _n (kgf-cm)	φM _n No LTB (kgf-cm)	φM _n Cb=1 (kgf-cm)
Major Bending	2921.26	323568	323568	323568
Minor Bending	264.81	321192		

Torsion Moment and Capacities

T _u Moment (kgf-cm)	T _n Capacity (kgf-cm)	φT _n Capacity (kgf-cm)
20.99	294435.43	264991.89

Shear Design

	V _u Force (kgf)	φV _n Capacity (kgf)	Stress Ratio
Major Shear	52.72	15692.75	0.003
Minor Shear	2.79	19308.59	1.445E-04

End Reaction Axial Forces

Left End Reaction (kgf)	Load Combo	Right End Reaction (kgf)	Load Combo
-9215.28	SComb02	-8952.66	SComb02

طراحی بادبند

$$\lambda_x = \frac{kL}{r_x} \leq 4,71 \sqrt{\frac{E}{f_y}}$$

57.63484<135.96

$$f_{ex} = \frac{\pi^2 E}{(\frac{L}{r_x})^2} \left[\frac{I_x}{A} \right]$$

$$\left(\frac{f_y}{f_{ex}} \right) f_y$$

2018.894

$$A_g$$

70257.52

$$\lambda_n$$

63231.77

$$\lambda_y = \frac{kL}{r_y} \leq 4,71 \cdot \sqrt{\frac{E}{f_y}}$$

81.74353<135.96

$$f_{ey} = \frac{\pi^2 E}{(\frac{L}{r_y})^2} \left[\frac{I_y}{A} \right]$$

$$f_{Cr} = \left(0,652^{\frac{f_y}{f_e}} \right) f_y$$

1694.909

58982.85

$$\lambda_n$$

53084.56

$$\Phi_{pnmin}$$

53084.56165

$$RATIO \frac{p_u}{\phi p_n^{MIN}}$$

0.457834

Kx	0.5	واحدھا بر حسب kg/cm	
KY	0.7	pu	24303.93
kz	1	I	536.004
		rx	4.65
		ry	4.59
		ag	34.8
		e	2000000
		fy/efx	0.404289
		y	0.813259
		ix	752.4
		iy	734.3
		d	12
		e	1.59
		FE MIN	2645.23
		FY/FEMIN	0.907294
		CW	24841.66
		J	8.4
		G	807700

کمانش پیچشی-خمشی

$$y_o = \frac{d^2}{4} \cdot \frac{e}{r_y^2} + e$$

4.306904

$$\bar{r}_o^{\text{r}} = x_o^{\text{r}} + y_o^{\text{r}} + \frac{I_x + I_y}{A_g}$$

61.27068

$$H = 1 - \frac{x_o^{\text{r}} + y_o^{\text{r}}}{\bar{r}_o^{\text{r}}}$$

0.697255

$$F_{ex} = \frac{\pi^{\text{r}} E}{\left(\frac{K_x L}{r_x}\right)^{\text{r}}}$$

5936.345

$$F_{ey} = \frac{\pi^{\text{r}} E}{\left(\frac{K_y L}{r_y}\right)^{\text{r}}}$$

2951.09

$$F_{ez} = \left[\frac{\pi^{\text{r}} E C_w}{(K_z L)^{\text{r}}} + GJ \right] \frac{1}{A_g \bar{r}_o^{\text{r}}}$$

14947436

$$F_e = \left(\frac{F_{ey} + F_{ez}}{r_H} \right) \left[1 - \sqrt{1 - \frac{r F_{ey} F_{ez} H}{(F_{ey} + F_{ez})^{\text{r}}}} \right]$$

2645.23

MIN 2645.23

FY TRUE

$$f_{Cr} = \left(0,652^{f_y/f_e} \right) \cdot \sigma_y$$

1628.093

FALSE

FE 2319.867

Ag 56657.65 γ_n 50991.88246

ratio $\frac{p_u}{\phi p_n^{MIN}}$ 0.476624

ETABS 2016 Steel Frame Design

AISC 360-10 Steel Section Check (Strength Summary)

Element Details

Level	Element	Unique Name	Location (cm)	Combo	Element Type	Section	Classification
Story1	D6	41	268.002	Comb22	Special Moment Frame	2UNP120-D10	Seismic HD

LLRF and Demand/Capacity Ratio

L (cm)	LLRF	Stress Ratio Limit
536.004	1	1

Analysis and Design Parameters

Provision	Analysis	2nd Order	Reduction
LRFD	Direct Analysis	General 2nd Order	No Modification

Stiffness Reduction Factors

$\alpha P_r / P_y$	$\alpha P_r / P_e$	τ_b	EA factor	EI factor
0.33	0.234	1	1	1

Seismic Parameters

Ignore Seismic Code?	Ignore Special EQ Load?	Plug Welded?	SDC	I	Rho	S_{DS}	R	Ω_0	C_d
No	No	Yes	D	1	1	1.05	5	2	4

Design Code Parameters

Φ_b	Φ_c	Φ_{TY}	Φ_{TF}	Φ_V	Φ_{V-RI}	Φ_{VT}
0.9	0.9	0.9	0.75	0.9	1	1

Section Properties

A (cm ²)	J (cm ⁴)	I_{33} (cm ⁴)	I_{22} (cm ⁴)	A_{v3} (cm ²)	A_{v2} (cm ²)
34.8	8.4	752.4	734.3	14.9	12.1

Design Properties

S_{33} (cm ³)	S_{22} (cm ³)	Z_{33} (cm ³)	Z_{22} (cm ³)	r_{33} (cm)	r_{22} (cm)	C_w (cm ⁶)
125.4	122.4	149.8	148.7	4.65	4.593	

Material Properties

E (kgf/cm ²)	f_y (kgf/cm ²)	R_y	α
2100000	2400	1.15	NA

HSS Section Parameters

HSS Welding	Reduce HSS Thickness?
ERW	Yes

Stress Check forces and Moments

Location (cm)	P _u (kgf)	M _{u33} (kgf-cm)	M _{u22} (kgf-cm)	V _{u2} (kgf)	V _{u3} (kgf)	T _u (kgf-cm)
268.002	-27575.55	-4636.87	125.07	-59.12	-5.32	4.11

Axial Force & Biaxial Moment Design Factors (H1-1a)

	L Factor	K ₁	K ₂	B ₁	B ₂	C _m
Major Bending	0.5	1	1	1	1	1
Minor Bending	0.67	1	1	1	1	1

Parameters for Lateral Torsion Buckling

L _{ltb}	K _{ltb}	C _b
1	1	1.521

Demand/Capacity (D/C) Ratio Eqn.(H1-1a)

D/C Ratio =	$(P_r/P_c) + (8/9)(M_{r33}/M_{c33}) + (8/9)(M_{r22}/M_{c22})$
0.506 =	0.493 + 0.013 + 3.461E-04

Axial Force and Capacities

P _u Force (kgf)	φP _{nc} Capacity (kgf)	φP _{nt} Capacity (kgf)
27575.55	55892.22	75168

Moments and Capacities

	M _u Moment (kgf-cm)	φM _n (kgf-cm)	φM _n No LTB (kgf-cm)	φM _n Cb=1 (kgf-cm)
Major Bending	4636.87	323568	323568	323568
Minor Bending	125.07	321192		

Torsion Moment and Capacities

T _u Moment (kgf-cm)	T _n Capacity (kgf-cm)	φT _n Capacity (kgf-cm)
4.11	294435.43	264991.89

Shear Design

	V _u Force (kgf)	φV _n Capacity (kgf)	Stress Ratio
Major Shear	59.12	15692.75	0.004
Minor Shear	5.32	19308.59	2.757E-04

End Reaction Axial Forces

Left End Reaction (kgf)	Load Combo	Right End Reaction (kgf)	Load Combo
-27776.29	SComb02	-27513.92	SComb02

طراحی بادبند

$$\lambda_x = \frac{kL}{r_x} \leq 4,71 \sqrt{\frac{E}{f_y}}$$

57.63484<135.96

$$f_{ex} = \frac{f_y}{(\lambda_x)^2}$$

$\left(0,652^{\frac{f_y}{f_e}} \right) f_y$ 2018.894

A_g 70257.52

λ_n 63231.77

$$\lambda_y = \frac{kL}{r_y} \leq 4,71 \cdot \sqrt{\frac{E}{f_y}}$$

81.74353<135.96

$$f_{ey} = \frac{f_y}{(\lambda_y)^2}$$

$f_{Cr} = \left(0,652^{\frac{f_y}{f_e}} \right) f_y$ 1694.909

58982.85

λ_n 53084.56

Φ_{pnmin} 53084.56165

RATIO $\frac{p_u}{\phi p_n^{MIN}}$ 0.457834

Kx	0.5	واحدھا بر حسب kg/cm
KY	0.7	pu 24303.93
kz	1	l 536.004
		rx 4.65
		ry 4.59
		ag 34.8
		e 2000000
		fy/efx 0.404289
		y 0.813259
		ix 752.4
		iy 734.3
		d 12
		e 1.59
		FE MIN 2645.23
		FY/FEMIN 0.907294
		CW 24841.66
		J 8.4
		G 807700

کمانش پیچشی-خمشی

$$y_o = \frac{d^2}{4} \cdot \frac{e}{r_y^2} + e$$

4.306904

$$\bar{r}_o^{\text{r}} = x_o^{\text{r}} + y_o^{\text{r}} + \frac{I_x + I_y}{A_g}$$

61.27068

$$H = 1 - \frac{x_o^{\text{r}} + y_o^{\text{r}}}{\bar{r}_o^{\text{r}}}$$

0.697255

$$F_{ex} = \frac{\pi^{\text{r}} E}{\left(\frac{K_x L}{r_x}\right)^{\text{r}}}$$

5936.345

$$F_{ey} = \frac{\pi^{\text{r}} E}{\left(\frac{K_y L}{r_y}\right)^{\text{r}}}$$

2951.09

$$F_{ez} = \left[\frac{\pi^{\text{r}} E C_w}{(K_z L)^{\text{r}}} + GJ \right] \frac{1}{A_g \bar{r}_o^{\text{r}}}$$

14947436

$$F_e = \left(\frac{F_{ey} + F_{ez}}{r_H} \right) \left[1 - \sqrt{1 - \frac{r F_{ey} F_{ez} H}{(F_{ey} + F_{ez})^{\text{r}}}} \right]$$

2645.23

MIN 2645.23

FY TRUE

$$f_{Cr} = \left(0,652^{f_y/f_e} \right) \cdot \sigma_y$$

1628.093

FALSE

FE 2319.867

Ag 56657.65 γ_n 50991.88246

ratio $\frac{p_u}{\phi p_n^{MIN}}$ 0.476624

ETABS 2016 Steel Frame Design

AISC 360-10 Steel Section Check (Strength Summary)

Element Details

Level	Element	Unique Name	Location (cm)	Combo	Element Type	Section	Classification
Story2	D6	46	268.002	Comb22	Special Moment Frame	2UNP120-D10	Seismic HD

LLRF and Demand/Capacity Ratio

L (cm)	LLRF	Stress Ratio Limit
536.004	1	1

Analysis and Design Parameters

Provision	Analysis	2nd Order	Reduction
LRFD	Direct Analysis	General 2nd Order	No Modification

Stiffness Reduction Factors

$\alpha P_r / P_y$	$\alpha P_r / P_e$	τ_b	EA factor	EI factor
0.397	0.281	1	1	1

Seismic Parameters

Ignore Seismic Code?	Ignore Special EQ Load?	Plug Welded?	SDC	I	Rho	S_{DS}	R	Ω_0	C_d
No	No	Yes	D	1	1	1.05	5	2	4

Design Code Parameters

Φ_b	Φ_c	Φ_{TY}	Φ_{TF}	Φ_V	Φ_{V-RI}	Φ_{VT}
0.9	0.9	0.9	0.75	0.9	1	1

Section Properties

A (cm ²)	J (cm ⁴)	I_{33} (cm ⁴)	I_{22} (cm ⁴)	A_{v3} (cm ²)	A_{v2} (cm ²)
34.8	8.4	752.4	734.3	14.9	12.1

Design Properties

S_{33} (cm ³)	S_{22} (cm ³)	Z_{33} (cm ³)	Z_{22} (cm ³)	r_{33} (cm)	r_{22} (cm)	C_w (cm ⁶)
125.4	122.4	149.8	148.7	4.65	4.593	

Material Properties

E (kgf/cm ²)	f_y (kgf/cm ²)	R_y	α
2100000	2400	1.15	NA

HSS Section Parameters

HSS Welding	Reduce HSS Thickness?
ERW	Yes

Stress Check forces and Moments

Location (cm)	P _u (kgf)	M _{u33} (kgf-cm)	M _{u22} (kgf-cm)	V _{u2} (kgf)	V _{u3} (kgf)	T _u (kgf-cm)
268.002	-33127.42	-3768.91	323.34	-56.75	-11.84	-28.84

Axial Force & Biaxial Moment Design Factors (H1-1a)

	L Factor	K ₁	K ₂	B ₁	B ₂	C _m
Major Bending	0.5	1	1	1	1	1
Minor Bending	0.67	1	1	1	1	1

Parameters for Lateral Torsion Buckling

L _{ltb}	K _{ltb}	C _b
1	1	1.472

Demand/Capacity (D/C) Ratio Eqn.(H1-1a)

D/C Ratio =	$(P_r/P_c) + (8/9)(M_{r33}/M_{c33}) + (8/9)(M_{r22}/M_{c22})$
0.604 =	0.593 + 0.01 + 0.001

Axial Force and Capacities

P _u Force (kgf)	φP _{nc} Capacity (kgf)	φP _{nt} Capacity (kgf)
33127.42	55892.22	75168

Moments and Capacities

	M _u Moment (kgf-cm)	φM _n (kgf-cm)	φM _n No LTB (kgf-cm)	φM _n Cb=1 (kgf-cm)
Major Bending	3768.91	323568	323568	323568
Minor Bending	323.34	321192		

Torsion Moment and Capacities

T _u Moment (kgf-cm)	T _n Capacity (kgf-cm)	φT _n Capacity (kgf-cm)
-28.84	294435.43	264991.89

Shear Design

	V _u Force (kgf)	φV _n Capacity (kgf)	Stress Ratio
Major Shear	56.75	15692.75	0.004
Minor Shear	11.84	19308.59	0.001

End Reaction Axial Forces

Left End Reaction (kgf)	Load Combo	Right End Reaction (kgf)	Load Combo
-33335.91	SComb02	-33065.80	SComb02

طراحی بادبند

$$\lambda_x = \frac{kL}{r_x} \leq 4,71 \sqrt{\frac{E}{f_y}}$$

$$57.63484 < 135.96$$

$$f_{ex} = \frac{f_y}{\left(\frac{K L}{r_x} \right)^2} \left(\frac{f_y}{f_{ex}} \right)$$

$$\left(\frac{f_y}{f_{ex}} \right) f_y$$

$$2018.894$$

$$A_g$$

$$70257.52$$

$$\lambda_n = \frac{K L}{r_n} \left(\frac{f_y}{f_{ex}} \right)$$

$$63231.77$$

$$\lambda_y = \frac{kL}{r_y} \leq 4,71 \cdot \sqrt{\frac{E}{f_y}}$$

$$81.74353 < 135.96$$

$$f_{ey} = \frac{f_y}{\left(\frac{K L}{r_y} \right)^2} \left(\frac{f_y}{f_{ey}} \right)$$

$$2951.09$$

$$f_{Cr} = \left(0,652 \left(\frac{f_y}{f_{ey}} \right) \right)^2 f_y$$

$$1694.909$$

$$58982.85$$

$$\lambda_n$$

$$53084.56$$

$$\Phi_{pnmin} = \frac{p_u}{\phi p_{nmin}}$$

$$53084.56165$$

$$RATIO = \frac{p_u}{\phi p_{nmin}}$$

$$0.351057$$

Kx	0.5	واحدھا پر حسب kg/cm
KY	0.7	pu
Kz	1	l
		rx
		ry
		ag
		e
		fy/efx
		y
		ix
		iy
		d
		e
		FE MIN
		FY/FEMIN
		CW
		J
		G

$$18635.72$$

$$536.004$$

$$4.65$$

$$4.59$$

$$34.8$$

$$2000000$$

$$0.404289$$

$$0.813259$$

$$752.4$$

$$734.3$$

$$12$$

$$1.59$$

$$2645.23$$

$$0.907294$$

$$24841.66$$

$$8.4$$

$$807700$$



کمانش پیچشی-خمشی

$$y_o = \frac{d^2}{4} \cdot \frac{e}{r_y^2} + e$$

4.306904

$$\bar{r}_o^{\text{r}} = x_o^{\text{r}} + y_o^{\text{r}} + \frac{I_x + I_y}{A_g}$$

61.27068

$$H = 1 - \frac{x_o^{\text{r}} + y_o^{\text{r}}}{\bar{r}_o^{\text{r}}}$$

0.697255

$$F_{ex} = \frac{\pi^{\text{r}} E}{\left(\frac{K_x L}{r_x}\right)^{\text{r}}}$$

5936.345

$$F_{ey} = \frac{\pi^{\text{r}} E}{\left(\frac{K_y L}{r_y}\right)^{\text{r}}}$$

2951.09

$$F_{ez} = \left[\frac{\pi^{\text{r}} E C_w}{(K_z L)^{\text{r}}} + GJ \right] \frac{1}{A_g \bar{r}_o^{\text{r}}}$$

14947436

$$F_e = \left(\frac{F_{ey} + F_{ez}}{r_H} \right) \left[1 - \sqrt{1 - \frac{r F_{ey} F_{ez} H}{(F_{ey} + F_{ez})^{\text{r}}}} \right]$$

2645.23

MIN 2645.23

$$FY$$

TRUE

$$f_{Cr} = \left(0,652^{f_y/f_e} \right) \cdot \sigma_y$$

1628.093

FALSE

$$FE$$

2319.867

$$A_g$$

56657.65

γ_n 50991.88246

ratio $\frac{p_u}{\phi p_n^{MIN}}$ 0.365464

ETABS 2016 Steel Frame Design

AISC 360-10 Steel Section Check (Strength Summary)

Element Details

Level	Element	Unique Name	Location (cm)	Combo	Element Type	Section	Classification
Story3	D6	45	268.002	Comb22	Special Moment Frame	2UNP120-D10	Seismic HD

LLRF and Demand/Capacity Ratio

L (cm)	LLRF	Stress Ratio Limit
536.004	1	1

Analysis and Design Parameters

Provision	Analysis	2nd Order	Reduction
LRFD	Direct Analysis	General 2nd Order	No Modification

Stiffness Reduction Factors

$\alpha P_r / P_y$	$\alpha P_r / P_e$	τ_b	EA factor	EI factor
0.291	0.206	1	1	1

Seismic Parameters

Ignore Seismic Code?	Ignore Special EQ Load?	Plug Welded?	SDC	I	Rho	S_{DS}	R	Ω_0	C_d
No	No	Yes	D	1	1	1.05	5	2	4

Design Code Parameters

Φ_b	Φ_c	Φ_{TY}	Φ_{TF}	Φ_V	Φ_{V-RI}	Φ_{VT}
0.9	0.9	0.9	0.75	0.9	1	1

Section Properties

A (cm ²)	J (cm ⁴)	I_{33} (cm ⁴)	I_{22} (cm ⁴)	A_{v3} (cm ²)	A_{v2} (cm ²)
34.8	8.4	752.4	734.3	14.9	12.1

Design Properties

S_{33} (cm ³)	S_{22} (cm ³)	Z_{33} (cm ³)	Z_{22} (cm ³)	r_{33} (cm)	r_{22} (cm)	C_w (cm ⁶)
125.4	122.4	149.8	148.7	4.65	4.593	

Material Properties

E (kgf/cm ²)	f_y (kgf/cm ²)	R_y	α
2100000	2400	1.15	NA

HSS Section Parameters

HSS Welding	Reduce HSS Thickness?
ERW	Yes

Stress Check forces and Moments

Location (cm)	P _u (kgf)	M _{u33} (kgf-cm)	M _{u22} (kgf-cm)	V _{u2} (kgf)	V _{u3} (kgf)	T _u (kgf-cm)
268.002	-24303.93	-3690.45	141.47	-56.41	-9.62	-29.98

Axial Force & Biaxial Moment Design Factors (H1-1a)

	L Factor	K ₁	K ₂	B ₁	B ₂	C _m
Major Bending	0.5	1	1	1	1	1
Minor Bending	0.67	1	1	1	1	1

Parameters for Lateral Torsion Buckling

L _{ltb}	K _{ltb}	C _b
1	1	1.536

Demand/Capacity (D/C) Ratio Eqn.(H1-1a)

D/C Ratio =	$(P_r/P_c) + (8/9)(M_{r33}/M_{c33}) + (8/9)(M_{r22}/M_{c22})$
0.445 =	0.435 + 0.01 + 3.915E-04

Axial Force and Capacities

P _u Force (kgf)	φP _{nc} Capacity (kgf)	φP _{nt} Capacity (kgf)
24303.93	55892.22	75168

Moments and Capacities

	M _u Moment (kgf-cm)	φM _n (kgf-cm)	φM _n No LTB (kgf-cm)	φM _n Cb=1 (kgf-cm)
Major Bending	3690.45	323568	323568	323568
Minor Bending	141.47	321192		

Torsion Moment and Capacities

T _u Moment (kgf-cm)	T _n Capacity (kgf-cm)	φT _n Capacity (kgf-cm)
-29.98	294435.43	264991.89

Shear Design

	V _u Force (kgf)	φV _n Capacity (kgf)	Stress Ratio
Major Shear	56.41	15692.75	0.004
Minor Shear	9.62	19308.59	4.984E-04

End Reaction Axial Forces

Left End Reaction (kgf)	Load Combo	Right End Reaction (kgf)	Load Combo
-24508.3	SComb02	-24242.30	SComb02

طراحی بادبند

$$\lambda_x = \frac{kL}{r_x} \leq 4,71 \sqrt{\frac{E}{f_y}}$$

57.63484 < 135.96

$$f_{ex} = \frac{f_y}{\left(\frac{K L}{r_x} \right)^2}$$

$$\left(\frac{f_y}{f_{ex}} \right) f_y$$

2018.894

Ag

70257.52

$$\lambda_n = \frac{K L}{r_n}$$

63231.77

$$\lambda_y = \frac{kL}{r_y} \leq 4,71 \sqrt{\frac{E}{f_y}}$$

81.74353 < 135.96

$$f_{ey} = \frac{f_y}{\left(\frac{K L}{r_y} \right)^2}$$

2951.09

$$f_{Cr} = \left(0,652 \frac{f_y}{f_{ey}} \right) f_y$$

1694.909

58982.85

λ_n

53084.56

Φpnmin 53084.56165

$$\text{RATIO} = \frac{p_u}{\phi p_n^{MIN}}$$

0.351057

Kx	0.5	واحدھا پر حسب	kg/cm
KY	0.7	pu	18635.72
kz	1	l	536.004
		rx	4.65
		ry	4.59
		ag	34.8
		e	2000000
		fy/efx	0.404289
		y	0.813259
		ix	752.4
		iy	734.3
		d	12
		e	1.59
		FE MIN	2645.23
		FY/FEMIN	0.907294
		CW	24841.66
		J	8.4
		G	807700



کمانش پیچشی-خمشی

$$y_o = \frac{d^2}{4} \cdot \frac{e}{r_y^2} + e$$

4.306904

$$\bar{r}_o^{\text{r}} = x_o^{\text{r}} + y_o^{\text{r}} + \frac{I_x + I_y}{A_g}$$

61.27068

$$H = 1 - \frac{x_o^{\text{r}} + y_o^{\text{r}}}{\bar{r}_o^{\text{r}}}$$

0.697255

$$F_{ex} = \frac{\pi^{\text{r}} E}{\left(\frac{K_x L}{r_x}\right)^{\text{r}}}$$

5936.345

$$F_{ey} = \frac{\pi^{\text{r}} E}{\left(\frac{K_y L}{r_y}\right)^{\text{r}}}$$

2951.09

$$F_{ez} = \left[\frac{\pi^{\text{r}} E C_w}{(K_z L)^{\text{r}}} + GJ \right] \frac{1}{A_g \bar{r}_o^{\text{r}}}$$

14947436

$$F_e = \left(\frac{F_{ey} + F_{ez}}{r_H} \right) \left[1 - \sqrt{1 - \frac{r F_{ey} F_{ez} H}{(F_{ey} + F_{ez})^{\text{r}}}} \right]$$

2645.23

MIN 2645.23

FY TRUE

$$f_{Cr} = \left(0,652^{f_y/f_e} \right) \cdot \gamma_y$$

1628.093

FALSE

FE 2319.867

Ag 56657.65 γ_n 50991.88246

ratio $\frac{p_u}{\phi p_n^{MIN}}$ 0.365464

ETABS 2016 Steel Frame Design

AISC 360-10 Steel Section Check (Strength Summary)

Element Details

Level	Element	Unique Name	Location (cm)	Combo	Element Type	Section	Classification
Story4	D6	44	268.002	Comb21	Special Moment Frame	2UNP120-D10	Seismic HD

LLRF and Demand/Capacity Ratio

L (cm)	LLRF	Stress Ratio Limit
536.004	1	1

Analysis and Design Parameters

Provision	Analysis	2nd Order	Reduction
LRFD	Direct Analysis	General 2nd Order	No Modification

Stiffness Reduction Factors

$\alpha P_r / P_y$	$\alpha P_r / P_e$	τ_b	EA factor	EI factor
0.223	0.158	1	1	1

Seismic Parameters

Ignore Seismic Code?	Ignore Special EQ Load?	Plug Welded?	SDC	I	Rho	S_{DS}	R	Ω_0	C_d
No	No	Yes	D	1	1	1.05	5	2	4

Design Code Parameters

Φ_b	Φ_c	Φ_{TY}	Φ_{TF}	Φ_V	Φ_{V-RI}	Φ_{VT}
0.9	0.9	0.9	0.75	0.9	1	1

Section Properties

A (cm ²)	J (cm ⁴)	I_{33} (cm ⁴)	I_{22} (cm ⁴)	A_{v3} (cm ²)	A_{v2} (cm ²)
34.8	8.4	752.4	734.3	14.9	12.1

Design Properties

S_{33} (cm ³)	S_{22} (cm ³)	Z_{33} (cm ³)	Z_{22} (cm ³)	r_{33} (cm)	r_{22} (cm)	C_w (cm ⁶)
125.4	122.4	149.8	148.7	4.65	4.593	

Material Properties

E (kgf/cm ²)	f_y (kgf/cm ²)	R_y	α
2100000	2400	1.15	NA

HSS Section Parameters

HSS Welding	Reduce HSS Thickness?
ERW	Yes

Stress Check forces and Moments

Location (cm)	P _u (kgf)	M _{u33} (kgf-cm)	M _{u22} (kgf-cm)	V _{u2} (kgf)	V _{u3} (kgf)	T _u (kgf-cm)
268.002	-18635.72	-2965.45	479.59	-53.56	8.32	28.2

Axial Force & Biaxial Moment Design Factors (H1-1a)

	L Factor	K ₁	K ₂	B ₁	B ₂	C _m
Major Bending	0.5	1	1	1	1	1
Minor Bending	0.67	1	1	1	1	1

Parameters for Lateral Torsion Buckling

L _{ltb}	K _{ltb}	C _b
1	1	1.429

Demand/Capacity (D/C) Ratio Eqn.(H1-1a)

D/C Ratio =	$(P_r/P_c) + (8/9)(M_{r33}/M_{c33}) + (8/9)(M_{r22}/M_{c22})$
0.343 =	0.333 + 0.008 + 0.001

Axial Force and Capacities

P _u Force (kgf)	φP _{nc} Capacity (kgf)	φP _{nt} Capacity (kgf)
18635.72	55892.22	75168

Moments and Capacities

	M _u Moment (kgf-cm)	φM _n (kgf-cm)	φM _n No LTB (kgf-cm)	φM _n Cb=1 (kgf-cm)
Major Bending	2965.45	323568	323568	323568
Minor Bending	479.59	321192		

Torsion Moment and Capacities

T _u Moment (kgf-cm)	T _n Capacity (kgf-cm)	φT _n Capacity (kgf-cm)
28.2	294435.43	264991.89

Shear Design

	V _u Force (kgf)	φV _n Capacity (kgf)	Stress Ratio
Major Shear	53.56	15692.75	0.003
Minor Shear	8.32	19308.59	4.31E-04

End Reaction Axial Forces

Left End Reaction (kgf)	Load Combo	Right End Reaction (kgf)	Load Combo
-18838.91	SComb02	-18574.09	SComb02

طراحی بادبند

$$\lambda_x = \frac{kL}{r_x} \leq 4,71 \sqrt{\frac{E}{f_y}}$$

$\frac{57.63484}{135.96}$

$$f_{ex} = \frac{f_y}{\left(\frac{K_x L}{r_x}\right)^2}$$

$\left(\frac{f_y}{f_{ex}}\right) f_y$ 2018.894

A_g 70257.52

λ_n 63231.77

$$\lambda_y = \frac{kL}{r_y} \leq 4,71 \cdot \sqrt{\frac{E}{f_y}}$$

$\frac{81.74353}{135.96}$

$$f_{ey} = \frac{f_y}{\left(\frac{K_y L}{r_y}\right)^2}$$

$\left(\frac{f_y}{f_{ey}}\right) f_y$ 1694.909

58982.85

λ_n 53084.56

Φ_{pnmin} 53084.56165

RATIO $\frac{p_u}{\phi p_n^{MIN}}$ 0.16981

Kx	0.5	واحدھا بر حسب kg/cm
KY	0.7	pu
kz	1	l
		rx
		ry
		ag
		e
		fy/efx
		y
		ix
		iy
		d
		e
		FE MIN
		FY/FEMIN
		CW
		J
		G



کمانش پیچشی-خمشی

$$y_o = \frac{d^2}{4} \cdot \frac{e}{r_y^2} + e$$

4.306904

$$\bar{r}_o^{\text{r}} = x_o^{\text{r}} + y_o^{\text{r}} + \frac{I_x + I_y}{A_g}$$

61.27068

$$H = 1 - \frac{x_o^{\text{r}} + y_o^{\text{r}}}{\bar{r}_o^{\text{r}}}$$

0.697255

$$F_{ex} = \frac{\pi^{\text{r}} E}{\left(\frac{K_x L}{r_x}\right)^{\text{r}}}$$

5936.345

$$F_{ey} = \frac{\pi^{\text{r}} E}{\left(\frac{K_y L}{r_y}\right)^{\text{r}}}$$

2951.09

$$F_{ez} = \left[\frac{\pi^{\text{r}} E C_w}{(K_z L)^{\text{r}}} + GJ \right] \frac{1}{A_g \bar{r}_o^{\text{r}}}$$

14947436

$$F_e = \left(\frac{F_{ey} + F_{ez}}{r_H} \right) \left[1 - \sqrt{1 - \frac{r F_{ey} F_{ez} H}{(F_{ey} + F_{ez})^{\text{r}}}} \right]$$

2645.23

MIN 2645.23

$$FY$$

TRUE

$$f_{Cr} = \left(0,652^{f_y/f_e} \right) \cdot \sigma_y$$

1628.093

FALSE

$$FE$$

2319.867

$$A_g$$

56657.65

γ_n 50991.88246

ratio $\frac{p_u}{\phi p_n^{MIN}}$ 0.176779

ETABS 2016 Steel Frame Design

AISC 360-10 Steel Section Check (Strength Summary)

Element Details

Level	Element	Unique Name	Location (cm)	Combo	Element Type	Section	Classification
Story5	D6	43	268.002	Comb21	Special Moment Frame	2UNP120-D10	Seismic HD

LLRF and Demand/Capacity Ratio

L (cm)	LLRF	Stress Ratio Limit
536.004	1	1

Analysis and Design Parameters

Provision	Analysis	2nd Order	Reduction
LRFD	Direct Analysis	General 2nd Order	No Modification

Stiffness Reduction Factors

$\alpha P_r / P_y$	$\alpha P_r / P_e$	τ_b	EA factor	EI factor
0.108	0.076	1	1	1

Seismic Parameters

Ignore Seismic Code?	Ignore Special EQ Load?	Plug Welded?	SDC	I	Rho	S_{DS}	R	Ω_0	C_d
No	No	Yes	D	1	1	1.05	5	2	4

Design Code Parameters

Φ_b	Φ_c	Φ_{TY}	Φ_{TF}	Φ_V	Φ_{V-RI}	Φ_{VT}
0.9	0.9	0.9	0.75	0.9	1	1

Section Properties

A (cm ²)	J (cm ⁴)	I_{33} (cm ⁴)	I_{22} (cm ⁴)	A_{v3} (cm ²)	A_{v2} (cm ²)
34.8	8.4	752.4	734.3	14.9	12.1

Design Properties

S_{33} (cm ³)	S_{22} (cm ³)	Z_{33} (cm ³)	Z_{22} (cm ³)	r_{33} (cm)	r_{22} (cm)	C_w (cm ⁶)
125.4	122.4	149.8	148.7	4.65	4.593	

Material Properties

E (kgf/cm ²)	f_y (kgf/cm ²)	R_y	α
2100000	2400	1.15	NA

HSS Section Parameters

HSS Welding	Reduce HSS Thickness?
ERW	Yes

Stress Check forces and Moments

Location (cm)	P _u (kgf)	M _{u33} (kgf-cm)	M _{u22} (kgf-cm)	V _{u2} (kgf)	V _{u3} (kgf)	T _u (kgf-cm)
268.002	-9014.29	-2921.26	264.81	-52.72	2.79	20.99

Axial Force & Biaxial Moment Design Factors (H1-1b)

	L Factor	K ₁	K ₂	B ₁	B ₂	C _m
Major Bending	0.5	1	1	1	1	1
Minor Bending	0.67	1	1	1	1	1

Parameters for Lateral Torsion Buckling

L _{ltb}	K _{ltb}	C _b
1	1	1.362

Demand/Capacity (D/C) Ratio Eqn.(H1-1b)

D/C Ratio =	$(P_r / 2P_c) + (M_{r33} / M_{c33}) + (M_{r22} / M_{c22})$
0.09 =	0.081 + 0.009 + 0.001

Axial Force and Capacities

P _u Force (kgf)	φP _{nc} Capacity (kgf)	φP _{nt} Capacity (kgf)
9014.29	55892.22	75168

Moments and Capacities

	M _u Moment (kgf-cm)	φM _n (kgf-cm)	φM _n No LTB (kgf-cm)	φM _n Cb=1 (kgf-cm)
Major Bending	2921.26	323568	323568	323568
Minor Bending	264.81	321192		

Torsion Moment and Capacities

T _u Moment (kgf-cm)	T _n Capacity (kgf-cm)	φT _n Capacity (kgf-cm)
20.99	294435.43	264991.89

Shear Design

	V _u Force (kgf)	φV _n Capacity (kgf)	Stress Ratio
Major Shear	52.72	15692.75	0.003
Minor Shear	2.79	19308.59	1.445E-04

End Reaction Axial Forces

Left End Reaction (kgf)	Load Combo	Right End Reaction (kgf)	Load Combo
-9215.28	SComb02	-8952.66	SComb02

طراحی بادبند

$$\lambda_x = \frac{kL}{r_x} \leq 4,71 \sqrt{\frac{E}{f_y}}$$

$\frac{57.63484}{135.96}$

$$f_{ex} = \frac{f_y}{\left(\frac{K_x L}{r_x}\right)^2}$$

$\left(\frac{f_y}{f_{ex}}\right) f_y$ 2018.894

A_g 70257.52

λ_n 63231.77

$$\lambda_y = \frac{kL}{r_y} \leq 4,71 \cdot \sqrt{\frac{E}{f_y}}$$

$\frac{81.74353}{135.96}$

$$f_{ey} = \frac{f_y}{\left(\frac{K_y L}{r_y}\right)^2}$$

$f_{cr} = \left(\frac{f_y}{f_{ey}}\right) f_y$ 1694.909

58982.85

λ_n 53084.56

Φ_{pnmin} 53084.56165

RATIO $\frac{p_u}{\phi p_n^{MIN}}$ 0.16981

Kx	0.5	واحدھا بر حسب kg/cm
KY	0.7	pu 9014.29
kz	1	l 536.004
		rx 4.65
		ry 4.59
		ag 34.8
		e 2000000
		fy/efx 0.404289
		y 0.813259
		ix 752.4
		iy 734.3
		d 12
		e 1.59
		FE MIN 2645.23
		FY/FEMIN 0.907294
		CW 24841.66
		J 8.4
		G 807700

کمانش پیچشی-خمشی

$$y_o = \frac{d^2}{4} \cdot \frac{e}{r_y^2} + e$$

4.306904

$$\bar{r}_o^{\text{r}} = x_o^{\text{r}} + y_o^{\text{r}} + \frac{I_x + I_y}{A_g}$$

61.27068

$$H = 1 - \frac{x_o^{\text{r}} + y_o^{\text{r}}}{\bar{r}_o^{\text{r}}}$$

0.697255

$$F_{ex} = \frac{\pi^{\text{r}} E}{\left(\frac{K_x L}{r_x}\right)^{\text{r}}}$$

5936.345

$$F_{ey} = \frac{\pi^{\text{r}} E}{\left(\frac{K_y L}{r_y}\right)^{\text{r}}}$$

2951.09

$$F_{ez} = \left[\frac{\pi^{\text{r}} E C_w}{(K_z L)^{\text{r}}} + GJ \right] \frac{1}{A_g \bar{r}_o^{\text{r}}}$$

14947436

$$F_e = \left(\frac{F_{ey} + F_{ez}}{r_H} \right) \left[1 - \sqrt{1 - \frac{r F_{ey} F_{ez} H}{(F_{ey} + F_{ez})^{\text{r}}}} \right]$$

2645.23

MIN 2645.23

$$FY$$

TRUE

$$f_{Cr} = \left(0,652^{f_y/f_e} \right) \cdot \sigma_y$$

1628.093

FALSE

$$FE$$

2319.867

$$A_g$$

56657.65

σ_n 50991.88246

ratio $\frac{p_u}{\phi p_n^{MIN}}$

0.176779

طراحي

ستون

ETABS 2016 Steel Frame Design

AISC 360-10 Steel Section Check (Strength Summary)

Element Details

Level	Element	Unique Name	Location (cm)	Combo	Element Type	Section	Classification
Story1	C1	86	0	Comb24	Special Moment Frame	P.BPX200*15	Seismic HD

LLRF and Demand/Capacity Ratio

L (cm)	LLRF	Stress Ratio Limit
320.000	0.818	1

Analysis and Design Parameters

Provision	Analysis	2nd Order	Reduction
LRFD	Direct Analysis	General 2nd Order	No Modification

Stiffness Reduction Factors

$\alpha P_r / P_y$	$\alpha P_r / P_e$	τ_b	EA factor	EI factor
0.217	0.03	1	1	1

Seismic Parameters

Ignore Seismic Code?	Ignore Special EQ Load?	Plug Welded?	SDC	I	Rho	S_{DS}	R	Ω_0	C_d
No	No	Yes	D	1	1	1.05	5	3	4

Design Code Parameters

Φ_b	Φ_c	Φ_{TY}	Φ_{TF}	Φ_V	Φ_{V-RI}	Φ_{VT}
0.9	0.9	0.9	0.75	0.9	1	1

Section Properties

A (cm ²)	J (cm ⁴)	I_{33} (cm ⁴)	I_{22} (cm ⁴)	A_{v3} (cm ²)	A_{v2} (cm ²)
120	13147.4	8945	8945	43.2	43.2

Design Properties

S_{33} (cm ³)	S_{22} (cm ³)	Z_{33} (cm ³)	Z_{22} (cm ³)	r_{33} (cm)	r_{22} (cm)	C_w (cm ⁶)
777.8	777.8	945	945	8.634	8.634	

Material Properties

E (kgf/cm ²)	f_y (kgf/cm ²)	R_y	α
2100000	2400	1.15	NA

HSS Section Parameters

HSS Welding	Reduce HSS Thickness?
ERW	Yes

Stress Check forces and Moments

Location (cm)	P _u (kgf)	M _{u33} (kgf-cm)	M _{u22} (kgf-cm)	V _{u2} (kgf)	V _{u3} (kgf)	T _u (kgf-cm)
0	-62537.75	-702868.16	-179397.39	0	0	2763.54

Axial Force & Biaxial Moment Design Factors (H1-1a)

	L Factor	K ₁	K ₂	B ₁	B ₂	C _m
Major Bending	0.931	1	1	1	1	0.485
Minor Bending	0	1	1	1	1	0.582

Parameters for Lateral Torsion Buckling

L _{ltb}	K _{ltb}	C _b
1	1	2.139

Demand/Capacity (D/C) Ratio Eqn.(H1-1a)

D/C Ratio =	$(P_r/P_c) + (8/9)(M_{r33}/M_{c33}) + (8/9)(M_{r22}/M_{c22})$
0.64 =	0.256 + 0.306 + 0.078

Axial Force and Capacities

P _u Force (kgf)	φP _{nc} Capacity (kgf)	φP _{nt} Capacity (kgf)
62537.75	244658.59	259200

Moments and Capacities

	M _u Moment (kgf-cm)	φM _n (kgf-cm)	φM _n No LTB (kgf-cm)	φM _n Cb=1 (kgf-cm)
Major Bending	702868.16	2041200	2041200	2041200
Minor Bending	179397.39	2041200		

Torsion Moment and Capacities

T _u Moment (kgf-cm)	T _n Capacity (kgf-cm)	φT _n Capacity (kgf-cm)
2763.54	1459746.63	1313771.97

Shear Design

	V _u Force (kgf)	φV _n Capacity (kgf)	Stress Ratio
Major Shear	0	56045.52	0.052
Minor Shear	0	56045.52	0.011

نام مقطع P.BP200*15

محاسبات

$$P_u \leq \phi P_n$$

$$P_n = F_{cr} \times A_g$$

$$\frac{F_y}{F_e} \leq 2/25 \text{ یا } \frac{KL}{r} \leq 4/71 \sqrt{\frac{E}{F_y}} \text{ اگر}$$

$$F_{cr} = \left[0.658 \sqrt{\frac{F_y}{F_e}} \right] F_y$$

$$\frac{F_y}{F_e} > 2/25 \text{ یا } \frac{KL}{r} > 4/71 \sqrt{\frac{E}{F_y}} \text{ اگر}$$

$$F_{cr} = 0.877 F_e$$

$$\lambda = \frac{kL}{r} \quad 37.0628 < 4/71 \sqrt{\frac{E}{F_y}}$$

Fe	14355.33804
Fcr	2237.800168
Pn	268536.0202

$$P_u \leq \phi P_n$$

TRUE

کنترل فشردگی

$$\frac{b}{t} < \lambda_p$$

TRUE

$$M_{cx} = M_{cy} = \phi F_y Z \quad 2041200$$

$$P_c = \phi P_n = 2E+05$$

$$\frac{P_u}{P_c} = >0.2$$

$$\frac{P_u}{P_c} + \frac{8}{9} \left(\frac{M_{ux}}{M_{cx}} + \frac{M_{uy}}{M_{cy}} \right) = 0.6391214$$

D/C Ratio =	$(P_u/P_c) + (8/9)(M_{ux}/M_{cx}) + (8/9)(M_{uy}/M_{cy})$
0.64 =	0.256 + 0.306 + 0.078

ETABS 2016 Steel Frame Design

AISC 360-10 Steel Section Check (Strength Summary)

Element Details

Level	Element	Unique Name	Location (cm)	Combo	Element Type	Section	Classification
Story2	C1	85	0	Comb24	Special Moment Frame	P.BPX200*15	Seismic HD

LLRF and Demand/Capacity Ratio

L (cm)	LLRF	Stress Ratio Limit
320.000	0.885	1

Analysis and Design Parameters

Provision	Analysis	2nd Order	Reduction
LRFD	Direct Analysis	General 2nd Order	No Modification

Stiffness Reduction Factors

$\alpha P_r / P_y$	$\alpha P_r / P_e$	τ_b	EA factor	EI factor
0.169	0.023	1	1	1

Seismic Parameters

Ignore Seismic Code?	Ignore Special EQ Load?	Plug Welded?	SDC	I	Rho	S_{DS}	R	Ω_0	C_d
No	No	Yes	D	1	1	1.05	5	3	4

Design Code Parameters

Φ_b	Φ_c	Φ_{TY}	Φ_{TF}	Φ_V	Φ_{V-RI}	Φ_{VT}
0.9	0.9	0.9	0.75	0.9	1	1

Section Properties

A (cm ²)	J (cm ⁴)	I_{33} (cm ⁴)	I_{22} (cm ⁴)	A_{v3} (cm ²)	A_{v2} (cm ²)
120	13147.4	8945	8945	43.2	43.2

Design Properties

S_{33} (cm ³)	S_{22} (cm ³)	Z_{33} (cm ³)	Z_{22} (cm ³)	r_{33} (cm)	r_{22} (cm)	C_w (cm ⁶)
777.8	777.8	945	945	8.634	8.634	

Material Properties

E (kgf/cm ²)	f_y (kgf/cm ²)	R_y	α
2100000	2400	1.15	NA

HSS Section Parameters

HSS Welding	Reduce HSS Thickness?
ERW	Yes

Stress Check forces and Moments

Location (cm)	P _u (kgf)	M _{u33} (kgf-cm)	M _{u22} (kgf-cm)	V _{u2} (kgf)	V _{u3} (kgf)	T _u (kgf-cm)
0	-48715.33	-804871.3	73301.64	0	0	2106.99

Axial Force & Biaxial Moment Design Factors (H1-1b)

	L Factor	K ₁	K ₂	B ₁	B ₂	C _m
Major Bending	0.931	1	1	1	1	0.28
Minor Bending	0	1	1	1	1	0.432

Parameters for Lateral Torsion Buckling

L _{ltb}	K _{ltb}	C _b
1	1	2.254

Demand/Capacity (D/C) Ratio Eqn.(H1-1b)

D/C Ratio =	$(P_r / 2P_c) + (M_{r33} / M_{c33}) + (M_{r22} / M_{c22})$
0.53 =	0.1 + 0.394 + 0.036

Axial Force and Capacities

P _u Force (kgf)	φP _{nc} Capacity (kgf)	φP _{nt} Capacity (kgf)
48715.33	244658.59	259200

Moments and Capacities

	M _u Moment (kgf-cm)	φM _n (kgf-cm)	φM _n No LTB (kgf-cm)	φM _n Cb=1 (kgf-cm)
Major Bending	804871.3	2041200	2041200	2041200
Minor Bending	73301.64	2041200		

Torsion Moment and Capacities

T _u Moment (kgf-cm)	T _n Capacity (kgf-cm)	φT _n Capacity (kgf-cm)
2106.99	1459746.63	1313771.97

Shear Design

	V _u Force (kgf)	φV _n Capacity (kgf)	Stress Ratio
Major Shear	0	56045.52	0.084
Minor Shear	0	56045.52	0.007

نام مقطع P.BP200*15

محاسبات

$$P_u \leq \phi P_n$$

$$P_n = F_{cr} \times A_g$$

$$\frac{F_y}{F_e} \leq 2/25 \text{ یا } \frac{KL}{r} \leq 4/71 \sqrt{\frac{E}{F_y}} \text{ اگر}$$

$$F_{cr} = \left[0.658 \sqrt{\frac{F_y}{F_e}} \right] F_y$$

$$\frac{F_y}{F_e} > 2/25 \text{ یا } \frac{KL}{r} > 4/71 \sqrt{\frac{E}{F_y}} \text{ اگر}$$

$$F_{cr} = 0.877 F_e$$

$$\lambda = \frac{kL}{r} \quad 37.0628 < 4/71 \sqrt{\frac{E}{F_y}}$$

Fe	14355.33804
Fcr	2237.800168
Pn	268536.0202

241682.4182

$$P_u \leq \phi P_n$$

TRUE

کنترل فشردگی

$$\frac{b}{t} < \lambda_p$$

TRUE

$$M_{cx} = M_{cy} = \phi F_y Z \quad 2041200$$



$$P_c = \phi P_n = \boxed{241682.4}$$

$$\frac{P_u}{P_c} = \boxed{>0.2}$$

$$\frac{P_u}{P_c} + \frac{8}{9} \left(\frac{M_{ux}}{M_{cx}} + \frac{M_{uy}}{M_{cy}} \right) = \boxed{0.5801645}$$

D/C Ratio =	$(P_r/2P_o) + (M_{r33}/M_{o33}) + (M_{r22}/M_{o22})$
0.53 =	$0.1 + 0.394 + 0.036$

ETABS 2016 Steel Frame Design

AISC 360-10 Steel Section Check (Strength Summary)

Element Details

Level	Element	Unique Name	Location (cm)	Combo	Element Type	Section	Classification
Story3	C1	84	0	Comb26	Special Moment Frame	BOX150X15	Seismic HD

LLRF and Demand/Capacity Ratio

L (cm)	LLRF	Stress Ratio Limit
320.000	0.983	1

Analysis and Design Parameters

Provision	Analysis	2nd Order	Reduction
LRFD	Direct Analysis	General 2nd Order	No Modification

Stiffness Reduction Factors

$\alpha P_r / P_y$	$\alpha P_r / P_e$	τ_b	EA factor	EI factor
0.158	0.037	1	1	1

Seismic Parameters

Ignore Seismic Code?	Ignore Special EQ Load?	Plug Welded?	SDC	I	Rho	S_{DS}	R	Ω_0	C_d
No	No	Yes	D	1	1	1.05	5	3	4

Design Code Parameters

Φ_b	Φ_c	Φ_{TY}	Φ_{TF}	Φ_V	Φ_{V-RI}	Φ_{VT}
0.9	0.9	0.9	0.75	0.9	1	1

Section Properties

A (cm ²)	J (cm ⁴)	I_{33} (cm ⁴)	I_{22} (cm ⁴)	A_{v3} (cm ²)	A_{v2} (cm ²)
90	5614.1	3915	3915	37.7	37.7

Design Properties

S_{33} (cm ³)	S_{22} (cm ³)	Z_{33} (cm ³)	Z_{22} (cm ³)	r_{33} (cm)	r_{22} (cm)	C_w (cm ⁶)
435	435	540	540	6.595	6.595	

Material Properties

E (kgf/cm ²)	f_y (kgf/cm ²)	R_y	α
2100000	2400	1.15	NA

HSS Section Parameters

HSS Welding	Reduce HSS Thickness?
ERW	Yes

Stress Check forces and Moments

Location (cm)	P _u (kgf)	M _{u33} (kgf-cm)	M _{u22} (kgf-cm)	V _{u2} (kgf)	V _{u3} (kgf)	T _u (kgf-cm)
0	-34115.22	-427649.67	26667.48	0	0	427.37

Axial Force & Biaxial Moment Design Factors (H1-1b)

	L Factor	K ₁	K ₂	B ₁	B ₂	C _m
Major Bending	0.931	1	1	1	1	0.216
Minor Bending	0	1	1	1	1	0.221

Parameters for Lateral Torsion Buckling

L _{ltb}	K _{ltb}	C _b
1	1	2.125

Demand/Capacity (D/C) Ratio Eqn.(H1-1b)

D/C Ratio =	$(P_r / 2P_c) + (M_{r33} / M_{c33}) + (M_{r22} / M_{c22})$
0.486 =	0.097 + 0.367 + 0.023

Axial Force and Capacities

P _u Force (kgf)	φP _{nc} Capacity (kgf)	φP _{nt} Capacity (kgf)
34115.22	176084.1	194400

Moments and Capacities

	M _u Moment (kgf-cm)	φM _n (kgf-cm)	φM _n No LTB (kgf-cm)	φM _n Cb=1 (kgf-cm)
Major Bending	427649.67	1166400	1166400	1166400
Minor Bending	26667.48	1166400		

Torsion Moment and Capacities

T _u Moment (kgf-cm)	T _n Capacity (kgf-cm)	φT _n Capacity (kgf-cm)
427.37	1157346.63	1041611.97

Shear Design

	V _u Force (kgf)	φV _n Capacity (kgf)	Stress Ratio
Major Shear	0	48813.84	0.055
Minor Shear	0	48813.84	0.003

نام مقطع	box150*15	
محاسبات		

$$P_u \leq \phi P_n$$

$$P_n = F_{cr} \times A_g$$

$$\frac{F_y}{F_e} \leq 2/25 \text{ یا } \frac{KL}{r} \leq 4/71 \sqrt{\frac{E}{F_y}} \text{ اگر}$$

$$F_{cr} = \left[0.658^{\frac{F_y}{F_e}} \right] F_y$$

$$\frac{F_y}{F_e} > 2/25 \text{ یا } \frac{KL}{r} > 4/71 \sqrt{\frac{E}{F_y}} \text{ اگر}$$

$$F_{cr} = 0.877 F_e$$

$$\lambda = \frac{kL}{r} \quad \boxed{48.5216} < 4/71 \sqrt{\frac{E}{F_y}}$$

Fe	8375.657986
Fcr	2128.750896
Pn	191587.5806

$$P_u \leq \phi P_n$$

TRUE

کنترل فشردگی

$$\frac{b}{t} < \lambda_p$$

TRUE

$$M_{cx} = M_{cy} = \phi F_y Z \quad \boxed{1166400}$$

$$P_c = \phi P_n = \boxed{172428.823}$$

$$\frac{P_u}{P_c} = \boxed{<0.2}$$

$$\frac{P_u}{2P_c} + \frac{m_u}{m_{cx}} + \frac{m_u}{m_{cy}}$$

$$\boxed{0.4884292}$$

D/C Ratio =	$(P_r / 2P_c) + (M_{r33} / M_{c33}) + (M_{r22} / M_{c22})$
0.486 =	$0.097 + 0.367 + 0.023$

ETABS 2016 Steel Frame Design

AISC 360-10 Steel Section Check (Strength Summary)

Element Details

Level	Element	Unique Name	Location (cm)	Combo	Element Type	Section	Classification
Story4	C1	83	0	Comb24	Special Moment Frame	BOX150X15	Seismic HD

LLRF and Demand/Capacity Ratio

L (cm)	LLRF	Stress Ratio Limit
320.000	1	1

Analysis and Design Parameters

Provision	Analysis	2nd Order	Reduction
LRFD	Direct Analysis	General 2nd Order	No Modification

Stiffness Reduction Factors

$\alpha P_r / P_y$	$\alpha P_r / P_e$	τ_b	EA factor	EI factor
0.095	0.022	1	1	1

Seismic Parameters

Ignore Seismic Code?	Ignore Special EQ Load?	Plug Welded?	SDC	I	Rho	S_{DS}	R	Ω_0	C_d
No	No	Yes	D	1	1	1.05	5	3	4

Design Code Parameters

Φ_b	Φ_c	Φ_{TY}	Φ_{TF}	Φ_V	Φ_{V-RI}	Φ_{VT}
0.9	0.9	0.9	0.75	0.9	1	1

Section Properties

A (cm ²)	J (cm ⁴)	I_{33} (cm ⁴)	I_{22} (cm ⁴)	A_{v3} (cm ²)	A_{v2} (cm ²)
90	5614.1	3915	3915	37.7	37.7

Design Properties

S_{33} (cm ³)	S_{22} (cm ³)	Z_{33} (cm ³)	Z_{22} (cm ³)	r_{33} (cm)	r_{22} (cm)	C_w (cm ⁶)
435	435	540	540	6.595	6.595	

Material Properties

E (kgf/cm ²)	f_y (kgf/cm ²)	R_y	α
2100000	2400	1.15	NA

HSS Section Parameters

HSS Welding	Reduce HSS Thickness?
ERW	Yes

Stress Check forces and Moments

Location (cm)	P _u (kgf)	M _{u33} (kgf-cm)	M _{u22} (kgf-cm)	V _{u2} (kgf)	V _{u3} (kgf)	T _u (kgf-cm)
0	-20537.51	-534051.85	25174.51	0	0	1119.78

Axial Force & Biaxial Moment Design Factors (H1-1b)

	L Factor	K ₁	K ₂	B ₁	B ₂	C _m
Major Bending	0.931	1	1	1	1	0.252
Minor Bending	0	1	1	1	1	0.433

Parameters for Lateral Torsion Buckling

L _{ltb}	K _{ltb}	C _b
1	1	2.258

Demand/Capacity (D/C) Ratio Eqn.(H1-1b)

D/C Ratio =	$(P_r / 2P_c) + (M_{r33} / M_{c33}) + (M_{r22} / M_{c22})$
0.538 =	0.058 + 0.458 + 0.022

Axial Force and Capacities

P _u Force (kgf)	φP _{nc} Capacity (kgf)	φP _{nt} Capacity (kgf)
20537.51	176084.1	194400

Moments and Capacities

	M _u Moment (kgf-cm)	φM _n (kgf-cm)	φM _n No LTB (kgf-cm)	φM _n Cb=1 (kgf-cm)
Major Bending	534051.85	1166400	1166400	1166400
Minor Bending	25174.51	1166400		

Torsion Moment and Capacities

T _u Moment (kgf-cm)	T _n Capacity (kgf-cm)	φT _n Capacity (kgf-cm)
1119.78	1157346.63	1041611.97

Shear Design

	V _u Force (kgf)	φV _n Capacity (kgf)	Stress Ratio
Major Shear	0	48813.84	0.067
Minor Shear	0	48813.84	0.003

نام مقطع	box150*15	
محاسبات		

$$P_u \leq \phi P_n$$

$$P_n = F_{cr} \times A_g$$

$$\frac{F_y}{F_e} \leq 2/25 \text{ یا } \frac{KL}{r} \leq 4/71 \sqrt{\frac{E}{F_y}} \text{ اگر}$$

$$F_{cr} = \left[0.658^{\frac{F_y}{F_e}} \right] F_y$$

$$\frac{F_y}{F_e} > 2/25 \text{ یا } \frac{KL}{r} > 4/71 \sqrt{\frac{E}{F_y}} \text{ اگر}$$

$$F_{cr} = 0.877 F_e$$

$$\lambda = \frac{kL}{r} \quad \boxed{48.5216} < 4/71 \sqrt{\frac{E}{F_y}}$$

Fe	8375.657986
Fcr	2128.750896
Pn	191587.5806

$$P_u \leq \phi P_n$$

TRUE

کنترل فشردگی

$$\frac{b}{t} < \lambda_p$$

TRUE

$$M_{cx} = M_{cy} = \phi F_y Z \quad \boxed{1166400}$$

$$P_c = \phi P_n = \boxed{172428.823}$$

$$\frac{P_u}{P_c} = \boxed{<0.2}$$

$$\frac{P_u}{2P_c} + \frac{m_u}{m_{cx}} + \frac{m_u}{m_{cy}} \quad \boxed{0.5390001}$$

D/C Ratio =	$(P_r/2P_c) + (M_{r33}/M_{c33}) + (M_{r22}/M_{c22})$
0.538 =	$0.058 + 0.458 + 0.022$

ETABS 2016 Steel Frame Design

AISC 360-10 Steel Section Check (Strength Summary)

Element Details

Level	Element	Unique Name	Location (cm)	Combo	Element Type	Section	Classification
Story5	C1	82	0	Comb24	Special Moment Frame	BOX150X10	Seismic HD

LLRF and Demand/Capacity Ratio

L (cm)	LLRF	Stress Ratio Limit
320.000	1	1

Analysis and Design Parameters

Provision	Analysis	2nd Order	Reduction
LRFD	Direct Analysis	General 2nd Order	No Modification

Stiffness Reduction Factors

$\alpha P_r / P_y$	$\alpha P_r / P_e$	τ_b	EA factor	EI factor
0.057	0.014	1	1	1

Seismic Parameters

Ignore Seismic Code?	Ignore Special EQ Load?	Plug Welded?	SDC	I	Rho	S_{DS}	R	Ω_0	C_d
No	No	Yes	D	1	1	1.05	5	3	4

Design Code Parameters

Φ_b	Φ_c	Φ_{TY}	Φ_{TF}	Φ_V	Φ_{V-RI}	Φ_{VT}
0.9	0.9	0.9	0.75	0.9	1	1

Section Properties

A (cm ²)	J (cm ⁴)	I_{33} (cm ⁴)	I_{22} (cm ⁴)	A_{v3} (cm ²)	A_{v2} (cm ²)
60	3674.7	2485	2485	26	26

Design Properties

S_{33} (cm ³)	S_{22} (cm ³)	Z_{33} (cm ³)	Z_{22} (cm ³)	r_{33} (cm)	r_{22} (cm)	C_w (cm ⁶)
292.4	292.4	352.5	352.5	6.436	6.436	

Material Properties

E (kgf/cm ²)	f_y (kgf/cm ²)	R_y	α
2100000	2400	1.15	NA

HSS Section Parameters

HSS Welding	Reduce HSS Thickness?
ERW	Yes

Stress Check forces and Moments

Location (cm)	P _u (kgf)	M _{u33} (kgf-cm)	M _{u22} (kgf-cm)	V _{u2} (kgf)	V _{u3} (kgf)	T _u (kgf-cm)
0	-8159.85	-335650.2	33745.01	0	0	468.71

Axial Force & Biaxial Moment Design Factors (H1-1b)

	L Factor	K ₁	K ₂	B ₁	B ₂	C _m
Major Bending	0.931	1	1	1	1	0.267
Minor Bending	0	1	1	1	1	0.222

Parameters for Lateral Torsion Buckling

L _{ltb}	K _{ltb}	C _b
1	1	2.263

Demand/Capacity (D/C) Ratio Eqn.(H1-1b)

D/C Ratio =	$(P_r/2P_c) + (M_{r33}/M_{c33}) + (M_{r22}/M_{c22})$
0.52 =	0.035 + 0.441 + 0.044

Axial Force and Capacities

P _u Force (kgf)	φP _{nc} Capacity (kgf)	φP _{nt} Capacity (kgf)
8159.85	116809.79	129600

Moments and Capacities

	M _u Moment (kgf-cm)	φM _n (kgf-cm)	φM _n No LTB (kgf-cm)	φM _n Cb=1 (kgf-cm)
Major Bending	335650.2	761400	761400	761400
Minor Bending	33745.01	761400		

Torsion Moment and Capacities

T _u Moment (kgf-cm)	T _n Capacity (kgf-cm)	φT _n Capacity (kgf-cm)
468.71	731717.52	658545.77

Shear Design

	V _u Force (kgf)	φV _n Capacity (kgf)	Stress Ratio
Major Shear	0	33747.84	0.06
Minor Shear	0	33747.84	0.007

نام مقطع	box150*10
محاسبات	

$$P_u \leq \phi P_n$$

$$P_n = F_{cr} \times A_g$$

$$\frac{F_y}{F_e} \leq 2/25 \text{ یا } \frac{KL}{r} \leq 4/71 \sqrt{\frac{E}{F_y}} \text{ اگر}$$

$$F_{cr} = \left[0.658^{\frac{F_y}{F_e}} \right] F_y$$

$$\frac{F_y}{F_e} > 2/25 \text{ یا } \frac{KL}{r} > 4/71 \sqrt{\frac{E}{F_y}} \text{ اگر}$$

$$F_{cr} = 0.877 F_e$$

$$\lambda = \frac{kL}{r} \quad \boxed{49.7203} < 4/71 \sqrt{\frac{E}{F_y}}$$

Fe	7976.665971
Fcr	2116.018632
Pn	126961.1179

$$P_u \leq \phi P_n$$

TRUE

کنترل فشردگی

$$\frac{b}{t} < \lambda_p$$

TRUE

$$M_{cx} = M_{cy} = \phi F_y Z \quad \boxed{761400}$$

$$P_c = \phi P_n = \boxed{114265.006}$$

$$\frac{P_u}{P_c} = \boxed{<0.2}$$

$$\frac{P_u}{2P_c} + \frac{m_u}{m_{cx}} + \frac{m_u}{m_{cy}}$$

$$\boxed{0.5208584}$$

D/C Ratio =	$(P_r / 2P_c) + (M_{r33} / M_{c33}) + (M_{r22} / M_{c22})$
0.52 =	$0.035 + 0.441 + 0.044$

طراحی اتصالات

اتصال گیردار

اتصال گبر طبق روش WFP آیین نامه طراحی گردیده است مشخصات ستون و تیر تیر

Area, cm2	87.8
AS2, cm2	32.2
AS3, cm2	57.5
I33, cm4	6802.7
I22, cm4	2005.2
S33Pos, cm3	632.8
S33Neg, cm3	632.8
S22Pos, cm3	200.5
S22Neg, cm3	200.5
R33, cm	8.805
R22, cm	4.78
Z33, cm3	728.3
Z22, cm3	310.4
J, cm4	67.5
Cw, cm6	200000

ستون

Area, cm2	160
AS2, cm2	80
AS3, cm2	80
I33, cm4	12373.3
I22, cm4	12373.3
S33Pos, cm3	1031.1
S33Neg, cm3	1031.1
S22Pos, cm3	1031.1
S22Neg, cm3	1031.1
R33, cm	8.794
R22, cm	8.794
Z33, cm3	1280
Z22, cm3	1280
J, cm4	17743.5

$$M_{pr} = ZF_y$$

$$M_{pr} = 2412129.6$$

$$L = 435 \text{ cm}$$

$$C_{pr} = 1.2$$

$$Sh = 80 \text{ cm}$$

$$L_h = L - 2Sh = 275$$

$$V_o = 17542.761$$

C_{pr} = ضریبی است که دربرگیرنده آثار عواملی از قبیل سخت‌شدگی، قیدهای موضعی و ملحقات موجود در اتصال تیر به ستون است و برای محاسبه حداکثر نیروی ایجاد شده در اعضا و وسایل اتصال به کار گرفته می‌شود. به جز در موردی که در بخش ۱۰-۳-۱۳-۶ برای C_{pr} عدد خاصی پیش‌بینی شده است، مقدار آن باید از رابطه زیر تعیین شود

$$1/1 \leq C_{pr} = \frac{(F_y + F_u)}{2F_y} \leq 1/2 \quad (1-8-3-10)$$

جدول ۱۰-۲-۳-۱۰ مقادیر R_y برای انواع تولیدات فولاد

R_y	نوع محصول
۱/۳۵	مقاطع لوله‌ای و قوطی شکل نوردشده
۱/۳۰	سایر مقاطع نوردشده شامل مقاطع I شکل، H شکل، ناودانی، نبشی و سپری
۱/۱۵	مقاطع ساخته‌شده از ورق، ورق‌ها و تسمه‌ها

$$M_u = M_{pr} + V_{pr}S_h + \frac{w_u S_h^2}{2}$$

$$M_u = 5086242.008 \text{ kg.cm}$$

$$T_u = C_u = M_u / h = 254312.1004 \text{ kg}$$

تعیین ابعاد ورق روسری و
زیرسری

چنانچه عرض کوچکتر ورق روسری با توجه
به عرض بال 17 سانتی متر در نظر گرفته
شود

$$T_u < \phi T_n$$

$$t_{top} * 3600 * 17 * 1 > 254312.1004$$

$$t_{top} = 4.2 = 5$$

و بهمین صورت ضخامت ورق زیر سری
بدست می آید

$$T_u < \phi T_n$$

$$254312.1004 < 1 * 27 * 3600 * t_{bottom}$$

$$T_{bottom} = 3$$

تعیین بعد جوش ورق روسری و زیر سری

$$T_u < \Phi R_n$$

$$254312.1004 < 0.9 * 0.85 * 0.6 * 4900 * 2 * 0.707 * L_w * a_w$$

$$L_w = 80$$

چون با Sh برابر است

پس درست است

$$a_w = 1 \text{ cm}$$

ابعاد ورق جان و جوش های آن

$$\phi V_n > V_u$$

$$17542.761 < 0.6 * 3600 * 2 * l_c$$

$$L_c > 4$$

ارتفاع ورق = 10 cm

عرض = 5 cm

فاصله تا بر ستون = 1.5 cm

$$A_w = 2 * 1.5 + 10 = 13 \text{ cm}^2$$

$$X_{\text{center}} = 0.2 \text{ cm}$$

$$I_x = 83.33 \text{ cm}^4$$

$$I_y = 13.47 \text{ cm}^4$$

$$jw = 96.81 \text{ cm}^4$$

$$Vu1 = 8771.38 \text{ kg}$$

$$Tu1 = 4233877 \text{ kg.cm}$$

تنش های برشی

$$F_{uvs} = 674.72 \text{ kg/cm}^2$$

$$F_{utx} = 2186.75 \text{ kg/cm}^2$$

$$F_{uty} = 1224.58 \text{ kg/cm}^2$$

$$F_{ur} = 782.4 \text{ kg/cm}^2$$

$$awe = 1.29 = 1.5 \text{ cm}$$

جوش های گوشه

$$Mu1 = 36839.79 \text{ kg}$$

$$F_{uv} = 877.13 \text{ kg/cm}^2$$

$$F_{ub} = 2210.38 \text{ kg/cm}^2$$

$$F_{ur} = 2378 \text{ kg/cm}^2$$

$$awe = 1.06 = 1.2 \text{ cm}$$



طراحی

اتصال

مفصلی

مشخصات تیر

Area, cm ²	28.5	IPE 200
AS ₂ , cm ²	11.2	
AS ₃ , cm ²	14.2	
I ₃₃ , cm ⁴	1943	
I ₂₂ , cm ⁴	142	
S ₃₃ Pos, cm ³	194.3	
S ₃₃ Neg, cm ³	194.3	
S ₂₂ Pos, cm ³	28.4	
S ₂₂ Neg, cm ³	28.4	
R ₃₃ , cm	8.257	
R ₂₂ , cm	2.232	
Z ₃₃ , cm ³	221	
Z ₂₂ , cm ³	44.6	
J, cm ⁴	6.9	
C _w , cm ⁶	12988.1	

مشخصات ستون

Area, cm ²	160
AS ₂ , cm ²	80
AS ₃ , cm ²	80
I ₃₃ , cm ⁴	12373.3
I ₂₂ , cm ⁴	12373.3
S ₃₃ Pos, cm ³	1031.1
S ₃₃ Neg, cm ³	1031.1
S ₂₂ Pos, cm ³	1031.1
S ₂₂ Neg, cm ³	1031.1
R ₃₃ , cm	8.794
R ₂₂ , cm	8.794
Z ₃₃ , cm ³	1280
Z ₂₂ , cm ³	1280
J, cm ⁴	17743.5

$$\begin{aligned}
 q &= \frac{8 * 0.9 * 2400 * 221}{430^2} \\
 &= 20.5 \text{ kg/cm} \\
 Vu &= \frac{20.5 * 430}{2} \\
 &= 4439.75 \\
 Ru &= Vu = 4439.75 \\
 N &= K = 2.05 \text{ cm}
 \end{aligned}$$

- در صورتی که $l_b/d \leq 0.2$ باشد:

$$R_n = 0.4 * t_w^2 \left[1 + 3 \left(\frac{l_b}{d} \right) \left(\frac{t_w}{t_f} \right)^{1/5} \right] \sqrt{\frac{E F_{yw} t_f}{t_w}} \quad (27-9-2-10)$$

- در صورتی که $l_b/d > 0.2$ باشد:

$$R_n = 0.4 * t_w^2 \left[1 + \left(\frac{l_b}{d} - 0.2 \right) \left(\frac{t_w}{t_f} \right)^{1/5} \right] \sqrt{\frac{E F_{yw} t_f}{t_w}} \quad (28-9-2-10)$$

$$\begin{aligned}
 0.10 &= \frac{N}{D} \\
 R_n &= 12407 \\
 Ru &< \Phi R_n
 \end{aligned}$$

انتخاب اول نبشی $10 * 100 * 100$ است

$$\begin{aligned}
 Mu &= 4439.75 (1.025 + 1.2 - 1 \\
 &\quad - 1.2)
 \end{aligned}$$

$$=110.99\text{kg.cm}$$

$$M_n = z F_y$$

$$M_n = 52473$$

$$M_n < \phi M_n$$

مناسب است

بنابراین از نبشی **L100*100*10** استفاده می شود

طراحی جوش

$$A_w = 20\text{cm}$$

$$I_w = 166.6$$

$$M_r = 9820.1 \text{ kg/cm}$$

$$F_{ut} = 294.7 \text{ kg/cm}^2$$

$$F_{uv} = 218.22 \text{ kg/cm}^2$$

$$F_{ur} = 366.6 \text{ kg/cm}^2$$

$$F_w = 0.75 * 0.6 * 4200 = 1890 \text{ kg/cm}^2$$

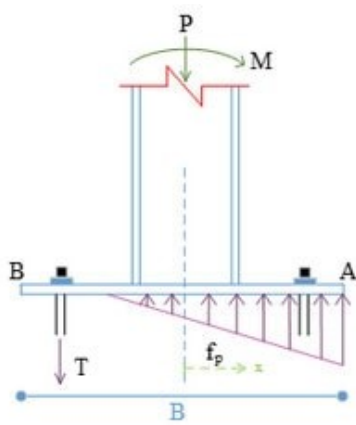
$$a_w = 6\text{mm}$$

طراحی

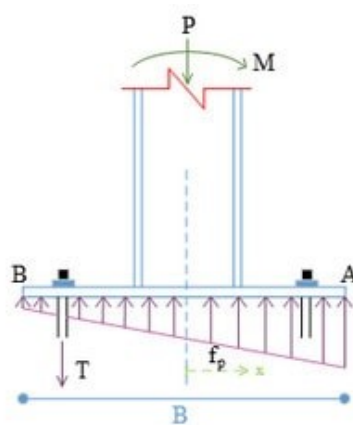
کف

ستون

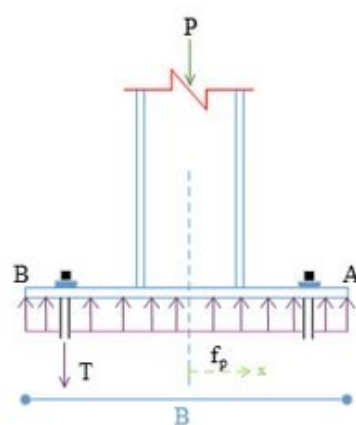
با سخت کننده



ب- بار محوری و لنگر خمشی $\left(e > \frac{B}{6}\right)$



ب- بار محوری و لنگر خمشی $\left(e \leq \frac{B}{6}\right)$



الف- بار محوری خالص

ابعاد 60×60

$$M_u = 36.82 \text{ t-m}$$

$$P_u = 168.34 \text{ ton}$$

$$30 \text{ cm} = \frac{H}{2}$$

$$10 \text{ cm} = \frac{H}{6}$$

$$21.8 = \frac{36.82 \times 10^5}{168.3 \times 10^3} = e = \frac{m}{p}$$

$$10 < 21$$

$$(f_{p_{max}}) = \frac{2P(e + f)}{xD\left(\frac{B}{2} + f - \frac{x}{3}\right)}$$

$$A_s=12.56\text{cm}$$

$$n=10$$

$$F=20$$

$$a_1=3(e-\frac{B}{2})=-24.6$$

$$a_2=\frac{6nA_s}{D}(f+e)=525$$

$$a_3=-a_2(\frac{B}{2}+f)=-25724.9$$

$$x^3 + a_1x^2 + a_2X + a_3 = 0$$

$$X=32$$

$$F_{pmax}=186.3$$

$$M = \alpha_1 q b^2$$

(۱۸) ناحیه چهار طرف متکی

$$M = \alpha_2 q c^2$$

(۱۹) ناحیه سه طرف متکی

$$M = q \times \frac{c \cdot h}{2} \times s$$

(۲۰) ناحیه دو طرف متکی

جدول ۱- ضریب α_1 برای نواحی چهارطرف متکی

چهارطرف متکی	$\frac{a}{b}$	نسبت a/b									
		۱	۱/۱	۱/۲	۱/۴	۱/۵	۱/۶	۱/۸	۱/۹	۲	>2
α_1		۰/۰۴۸	۰/۰۵۵	۰/۰۶۲	۰/۰۷۵	۰/۰۸۱	۰/۰۸۶	۰/۰۹۴	۰/۰۹۸	۰/۱۳۲	۰/۱۰۰

جدول ۲- ضریب α_2 برای نواحی سه طرف متکی

سه طرف متکی	$\frac{c}{d}$	نسبت c/d									
		۰/۵	۰/۶	۰/۷	۰/۸	۰/۹	۱/۰	۱/۲	۱/۴	۲	>2
α_2		۰/۰۶	۰/۰۷۴	۰/۰۸۸	۰/۰۹۷	۰/۱۰۷	۰/۱۱۲	۰/۱۲۰	۰/۱۲۶	۰/۱۳۲	۰/۱۳۳

محاسبه لنگر در ناحیه 4
طرف متکی

$$L1/L2=1$$

$$36*2(3/2)=33$$

$$M=0.048*186.3*33*33=9738.27kg.cm$$

محاسبه لنگر در ناحیه 3 طرف متکی

$$10.1/18.3=0.5$$

از روی جدول عدد مورد نظر را پیدامی
کنیم

$$m = 0.06 * 186.3 * 18.3^2 \\ = 3743.4kgcm$$

محاسبه لنگر دز ناحیه 2 طرف مtkی

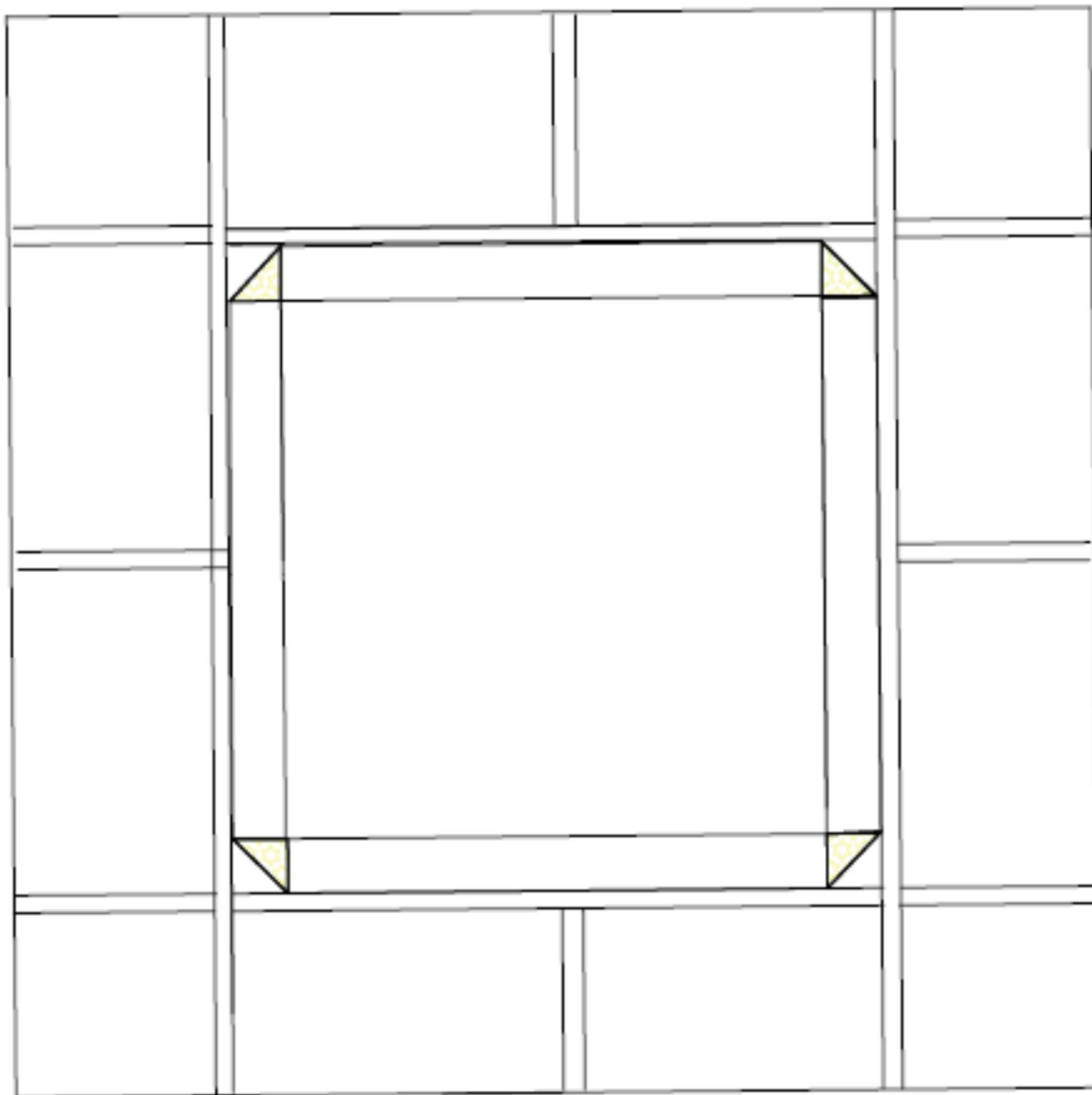
$$m = \frac{qL_2^2}{2} = 9691.3 \text{ kg.cm}$$

مقدار لنگر بیشینه در رابطه زیر ضخامت
بیس پلیت را می دهد

$$t > \sqrt{\frac{m}{0,225}} f_y$$

$$t > 4.2 = 4.5 \text{ cm}$$

آرایش لچکی ها



برای لچکی ها از ورقه های به ارتفاع
20 سانت و ضخامت 1 سانتی متر استفاده
میشود

$$F_p = 0,85 * 250 * \sqrt{\frac{180*180}{60*60}}$$

$$F_p = 637.5$$

$$F_{pmax} < \Phi F_p$$

$$186.3 < 0.65 * 637.5 \text{ ok}$$

$$T = P \frac{e + \frac{x}{3} - \frac{B}{2}}{\frac{B}{2} + f - \frac{x}{3}}$$

$$T = 168.3 * 10^3 \frac{21 + \frac{32}{3} - \frac{60}{2}}{\frac{60}{2} + 20 - \frac{32}{3}}$$

$$= 7131.35 \text{ kg}$$

$$T = 7131.35 \text{ KG}$$

$$F_{max} < \Phi F_p$$

$$f_s = \frac{T}{0.7 A_s} < 0.9 * f_y$$

$$f_s = \frac{7131.5}{0.7 * 12.56} < 0.9 * 4000$$

$$7131.3 < 3600 \text{ ok}$$

پس 12Φ20 استفاده می شود

کنترل استیفر ها

$$M_u < \phi M_n$$

$$A_c = A_t$$

$$(y \cdot 600) = ((45 - y) \cdot 600) + 3(10 \cdot 200)$$

$$Y = 23.025 \text{ mm}$$

$$Z = 4(200 \cdot 10) \left(\frac{200}{2} + 45 - \right.$$

$$\left. 23.025 \right) + (600 \cdot 23.025 \cdot 11.51)$$

$$Z = 11343810.65 \text{ mm}^2$$

$$Z = 1134381 \text{ cm}^2$$

$$9738 < 0.9 \cdot 2400 \cdot 1134381$$

$$14725 < 2450262960 \text{ ok}$$

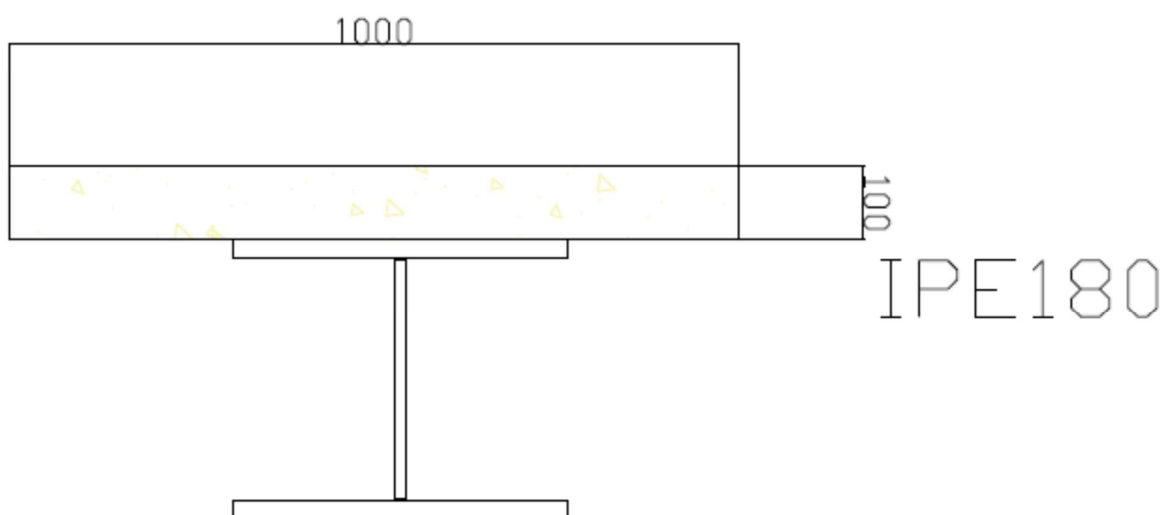
تیر

کامپوزیت

برای تیرهای فرعی **ipe 180** استفاده می
شود

$F_c=250\text{kg/cm}$

$n=10$



طول دهانه 470 سانتی متر

$$l/4=117.5\text{cm}$$

$$b_0=250\text{cm}$$

$$b_f+16.ts=201.1$$

$$b_e=b_0/n=11\text{cm}$$

$$H=18\text{CM}$$

$$b_f=9.1\text{CM}$$

$$A_g=23.9\text{CM}$$

$$I_x=1320\text{CM}^4$$

$$I_y=101\text{CM}^4$$

محاسبات

$$\bar{y} = \frac{\sum Ay}{\sum A}$$

$$y_1=20.63 \quad A=7.37$$

$$y_2=20.56 \quad A=7.44$$

$$y_3=20.56 \quad A=7.44$$

$$I_x=5875.57\text{CM}^4$$

$$Q_1=$$

$$370\text{kg/m}^2$$

$$Q2=$$

$$650\text{KG}$$

$$M1 = \frac{Q1L^2}{8}$$

$$M1 = 1.02\text{T.M}$$

$$M2 = \frac{Q2L^2}{8}$$

$$M2 = 1.79\text{T.M}$$

$$S = \frac{I}{c}$$

$$S_{COMPOSITE} = 286.3\text{CM}^3$$

$$F1 = \frac{m1}{S_{IPE}}$$

$$F1 = 698.3\text{KG/M}^2$$

$$F2 = \frac{m1}{S_{COMPOSITE}}$$

$$F2 = 625.2\text{KG/M}^2$$

$$F1 + F2 < \phi F_y = 0.66 * 2400$$

$$698.3 + 625.2 = 1325.5$$

$$1325.5 < 1580 \text{ ok}$$

کنترل لرزش و خیز

$$\frac{b_E}{n} = 33\text{cm}$$

$$n = 10/3 = 3.3$$

$$y = \frac{33 * 23 + 23.9 * 9}{23.9 + 33} = 17.1$$

$$I = 1320 + \frac{3.3}{12} * 10^3 + 23.9 * (17.1 - 9)^2 + 33 * (23 - 17.1)^2$$

$$I = 4311 \text{ CM}^4$$

$$\delta = \frac{5wL^4}{384EI} < \frac{L}{360}$$

$$\delta = \frac{5 * 2 * 472^2}{384 * 2 * 10^6 * 4311} = 0.14$$

$$0.14 < 1.32 \text{ OK}$$

$$\delta = \delta_1 + \delta_2 + \delta < \frac{L}{240}$$

$$\delta = \frac{5 * 3.7 * 472^4}{384 * 2 * 10^6 * 1326} + \frac{5 * 6.50 * 472^4}{384 * 2 * 10^6 * 4311} + 0.14$$

$$\delta = 0.95 + 0.51 + 0.14 = 1.6$$

$$1.6 < 1.9 \text{ OK}$$

طراحی برشگیر

$$F_c = 250 \text{ kg/cm}^2$$

$$A_s = 45.9 \text{ cm}^2$$

$$F_y = 3600 \text{ kg/cm}^2$$

$$A_c = b_e \cdot t$$

$$100 \cdot 10 = 1000 \text{ cm}^2$$

$$V_{hu} = \min(0.85 \cdot F_c \cdot A_c, A_s \cdot F_y)$$

$$V_h = (212500, 165240)$$

$$V_{hu} = 165240 \text{ kg}$$

$$Q_n = \min(0.5 A_s a \sqrt{f E_c}, R_g R_p A_s a F_u)$$

$$A_s a = 0.78 \cdot 1.6 \cdot 1.6 = 2.01 \text{ cm}^2$$

$$E_c = 254690 \text{ kg/cm}^2$$

$$Q_n = \min(8019, 6783)$$

$$Q_n = 6783$$

$$V_{hu} < \phi V_{hn} = N Q$$

$$165240 < 6783 \cdot N$$

$$N > 24.3$$

فاصله هر کدام از هم 30 سانتی متر است

کنترل ارتعاش

$$f = \frac{\pi}{2l^2} \sqrt{\frac{E_s I g}{q d}} > 5 \text{hz}$$

$$L=4.7\text{m}$$

$$g=9.81\text{m/s}^2$$

$$E=2*10^{11}\text{pa}$$

$$I=4311*10^{-8}$$

$$Q=6300\text{n/m}$$

$$f=8\text{hz ok}$$

طراحي

گاست

پليت

Section Properties

A (cm ²)	J (cm ⁴)	I ₃₃ (cm ⁴)	I ₂₂ (cm ⁴)	A _{v3} (cm ²)	A _{v2} (cm ²)
22.7	4.4	218.8	297.9	10.7	6.2

Design Properties

S ₃₃ (cm ³)	S ₂₂ (cm ³)	Z ₃₃ (cm ³)	Z ₂₂ (cm ³)	r ₃₃ (cm)	r ₂₂ (cm)	C _w (cm ⁶)
54.7	60.8	65.9	75.8	3.108	3.626	

Section Properties --- Unsymmetric Sections

I _{xy} (cm ⁴)	I _{max} (cm ⁴)	I _{min} (cm ⁴)	S _{max} (cm ³)	S _{min} (cm ³)	r _{max} (cm)	r _{min} (cm)	α (deg)
0	297.9	218.8	60.8	54.7	3.626	3.108	90

$$T = R_y \cdot F_y \cdot A_g$$

$$T = 130752 \text{ KG}$$

ضخامت ورق را 1.5 در نظر می گیریم

$$a = 0.65 \text{ cm}$$

$$T < \phi R_n$$

$$130752 < 0.75(5344.92 L_w)$$

$$L_w = 50$$

کنترل برش قالبی

$$T < 0.75 F_u \cdot b \cdot t + 0.9 F_y \cdot L_w \cdot t$$

$$218160 > 130752 \text{ ok}$$

کنترل تنش در عرض ورق
ویتمور

$$B_v = b + 2 L_w \cdot \tan 30$$

$$B_v = 62 \text{ cm} > 50 \text{ cm}$$

$$A_g = A_e = B_v \cdot t = 62 \cdot 1.5 = 74.4$$

$$R_u < \phi R_n = \min(0.9 f_y \cdot A_g, 0.75 \cdot F_u \cdot A_e)$$

$$(160704, 200880) \text{ OK}$$

محاسبه طول ورق وسطی در
مهاربند

$$2 \cdot 50 + 8 + 2 \cdot 1 = 110 \text{ CM}$$

کنترل کمانش موضعی ورق
وسطی در بادبند:

$$\frac{L_w}{t} < 1.4 \sqrt{\frac{E}{f_y}}$$

$$33.3 < 1.4(28.8) \text{ OK}$$

USE PLATE

$$110 \cdot 75 \cdot 1.5$$

طراحی اتصال بادبند تیر و
ستون

$$\alpha = \tan^{-1} \left(\frac{H}{L} \right)$$

H=320

L=536

$\alpha=30.8$

$$T_x = T \cos(\alpha)$$

$$T_y = T \sin(\alpha)$$

TX=112310.7KG

TY=66950.6KG

$$T_x < \phi R_n$$

112310 < 1302Lw

Lw > 86.2 = 90cm

$$T_y < \phi R_n$$

66950.6 < 1302Lw

Lw > 51.4 = 55cm

USE PLATE

90*55*1.5

کنترل
ها

کنترل خیز تیر ورق

PG20*10



محاسبه سطح بارگیری تیر
مورد نظر جهت محاسبه خدمت
پذیری
بار هر قسمت = 0.784 تن بر
مربع است

$$\frac{4,3}{2} \times 3,1 = 6.6 M^2$$

$$0.784 \times 6.6 = 5.17/M^2$$

$$5.17 T/M^2 = 51.7 KG/CM^2$$

کل باری که روی تیر است

$$\delta = \frac{5wL^4}{384EI} < \frac{L}{240}$$

$$OK \quad \delta = 0.000004 < 1.29$$

لرزش

$$f = \frac{\pi}{2l^2} \sqrt{\frac{E_s I g}{q}} > 5 \text{hz}$$

$$L=3.1\text{m}$$

$$g=9.81\text{m/s}^2$$

$$E=2*10^{11}\text{pa}$$

$$I=6802.7*10^{-8}$$

$$Q=24\text{KG/cm}^2$$

$$84 > 5 \text{ OK}$$

کنترل دریافت

DRIFT	Diaphragm Center of Mass Displacements			
ENX	Story	Diaphragm	Load Case/Combo	UX
				mm
	Story5	D1	ENX	66.895 0.00384
	Story4	D1	ENX	54.601 0.00469
	Story3	D1	ENX	39.603 0.00480
	Story2	D1	ENX	24.235 0.00489
	Story1	D1	ENX	8.598 0.00269

X	0.00500
Y	0.00571

	Diaphragm Center of Mass Displacements			
DRIFT	Story	Diaphragm	Load Case/Combo	UY
ENY				mm
	story5	D1	ENY	12.521 0.00060
	story4	D2	ENY	10.609 0.00079
	story3	D3	ENY	8.096 0.00090
	story2	D4	ENY	5.218 0.00088
	story1	D5	ENY	2.41 0.00075

	Diaphragm Center of Mass Displacements			
DRIFT	Story	Diaphragm	Load Case/Combo	UX
EPX				mm
	story5	D1	EPX	66.992 0.00383
	story4	D2	EPX	54.728 0.00471
	story3	D3	EPX	39.663 0.00481
	story2	D4	EPX	24.264 0.00489
	story1	D5	EPX	8.619 0.00269

	Diaphragm Center of Mass Displacements			
DRIFT	Story	Diaphragm	Load Case/Combo	UY
EPY				mm
	story5	D1	EPY	12.225 0.00059
	story4	D2	EPY	10.334 0.00077
	story3	D3	EPY	7.88 0.00088
	story2	D4	EPY	5.074 0.00085
	story1	D5	EPY	2.348 0.00073

Story	Load Case/Combo	Item	Max Drift	Avg Drift	Ratio	Label	Max Loc X	Max Loc Y	Max Loc Z
							mm	mm	mm
Story5	ENX	Diaph D1 X	0.003883	0.003849	1.009	35	3100	-1200	15800
Story4	ENX	Diaph D1 X	0.004694	0.004687	1.002	29	9900	13350	12600
Story3	ENX	Diaph D1 X	0.004837	0.004804	1.007	36	1100	-1200	9400
Story2	ENX	Diaph D1 X	0.004983	0.004891	1.019	36	1100	-1200	6200
Story1	ENX	Diaph D1 X	0.002705	0.002686	1.007	32	5800	0	3000

Story	Load Case/Combo	Item	Max Drift	Avg Drift	Ratio	Label	Max Loc X	Max Loc Y	Max Loc Z
							mm	mm	mm
Story5	ENY	Diaph D1 X	0	0	0	0	0	0	0
Story5	ENY	Diaph D1 Y	0.000678	0.000591	1.15	2	0	9150	15800
Story4	ENY	Diaph D1 Y	0.000931	0.000772	1.152	2	0	9150	12600
Story3	ENY	Diaph D1 Y	0.001077	0.000885	1.154	2	0	9150	9400
Story2	ENY	Diaph D1 Y	0.001069	0.000862	1.57	2	0	9150	6200
Story1	ENY	Diaph D1 Y	0.000904	0.000741	1.156	2	0	9150	3000



Story	Load Case/Com	Item	Max Drift	Avg Drift	Ratio	Label	Max Loc X	Max Loc Y	Max Loc Z
							mm	mm	mm
Story5	EPX	Diaph D1 X	0.003932	0.003807	1.033	29	9900	13350	15800
Story4	EPX	Diaph D1 X	0.00485	0.0047	1.032	29	9900	13350	12600
Story3	EPX	Diaph D1 X	0.004936	0.004807	1.027	29	9900	13350	9400
Story2	EPX	Diaph D1 X	0.004951	0.004886	1.013	29	9900	13350	6200
Story1	EPX	Diaph D1 X	0.002803	0.002698	1.039	29	9900	13350	3000

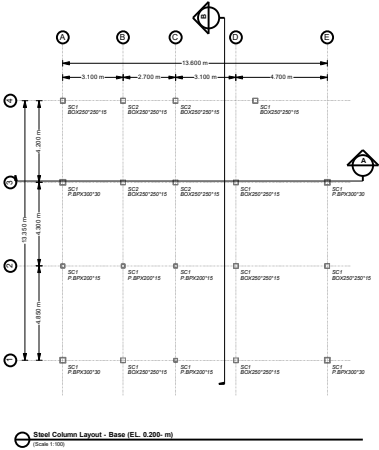
Story	Load Case/Combo	Item	Max Drift	Avg Drift	Ratio	Label	Max Loc X	Max Loc Y	Max Loc Z
							mm	mm	mm
Story5	EPY	Diaph D1 Y	0.000612	0.000593	1.033	22	13600	0	15800
Story4	EPY	Diaph D1 Y	0.000786	0.000765	1.027	2	0	9150	12600
Story3	EPY	Diaph D1 Y	0.000907	0.000875	1.037	2	0	9150	9400
Story2	EPY	Diaph D1 Y	0.0009	0.000848	1.062	2	0	9150	6200
Story1	EPY	Diaph D1 Y	0.000762	0.000732	1.041	2	0	9150	3000

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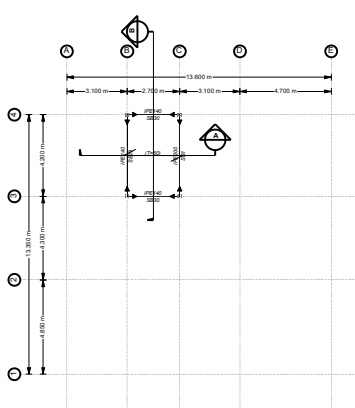
فاز 1



SCHEMATIC DRAWING
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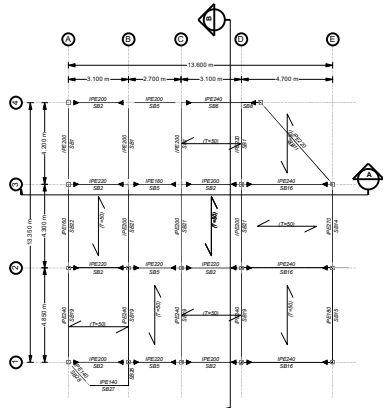
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DRAWING	
STEEL COLUMN LAYOUT	
STRUCTURE	
2	
PROJECT	
CLIENT	
CONSULTANT	
PROJECT NUMBER	
DATE	
DESIGNED BY	
CHECKED BY	
S-04	
SCALE	



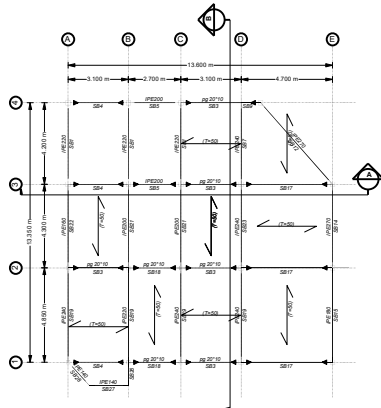
Floor Framing Plan - Storey (EL. 19.000 m)

(Scale 1:100)



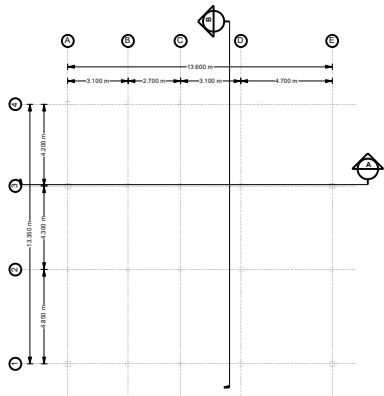
Floor Framing Plan - Storey (EL. 16.800 m)

(Scale 1:100)



Floor Framing Plan - Storey (EL. 3.000 m)

(Scale 1:100)



Floor Framing Plan - Base (EL. 0.200 m)

(Scale 1:100)

SCHEMATIC DRAWING
NOT FOR
CONSTRUCTION

NO	DESCRIPTION	DATE
5	NEW DRAWING GENERATED	2004/1/28

DRAWING

FLOOR FRAMING PLANS

STRUCTURE

2

PROJECT

CLIENT

CONSULTANT

PROJECT NUMBER

DATE

DESIGNED BY

CHECKED BY

S-02

SCALE



Column Elevation Table

COLUMN ID	SECTION	NET LENGTH (M)	NUMBERS	TOTAL LENGTH (M)	TOTAL WEIGHT (MTON)
SC1A	RCX250*250*15	6.400	15	96.000	7.292.00
SC1B	FBPXC200*15	9.800	15	146.800	8.730.40
SC2A	RCX250*250*15	6.400	4	25.600	1.944.50
SC2B	FBPXC200*15	9.800	4	38.400	2.333.40
SC2C	RCX150X10	3.200	4	12.800	388.91

STEEL BRACE MATERIAL LIST

BRACE ID	SECTION	NET LENGTH (M)	NUMBERS	TOTAL LENGTH (M)	TOTAL WEIGHT (MTON)
SBR1	2XAP10-D8	5.300	37	196.300	2.278.71
SBR2	2XAP10-D8	5.600	37	215.000	2.471.30
SBR3	2XAP120-D10	5.300	1	5.300	34.46
SBR4	2XAP120-D10	5.600	1	5.600	102.40
SBR5	2XAP10-D8	3.400	7	23.800	275.00
SBR6	2XAP120-D10	3.400	1	3.400	88.33

STEEL BEAM MATERIAL LIST

BEAM ID	SECTION	DEPTH (M)	NET LENGTH (M)	NUMBERS	TOTAL LENGTH (M)	TOTAL WEIGHT (MTON)
SBR1	IFC200	200 MM	4.000	1	4.000	45.16
SBR2	IFC200	200 MM	2.000	7	20.000	220.07
SBR3	IFC200*10	215 MM	2.000	24	59.600	3.080.72
SBR4	PLATE GIRDER SBR10-D200*15	200 MM	2.840	1	2.840	100.96
SBR5	IFC200	200 MM	2.400	10	23.980	340.88
SBR6	IFC240	240 MM	3.000	1	3.000	50.40
SBR7	IFC240	240 MM	3.940	4	15.800	312.05
SBR8	IFC240	240 MM	0.900	1	0.900	17.62
SBR9	IFC200*10	215 MM	0.900	3	2.700	119.06
SBR10	PLATE GIRDER SBR10-D200*15	200 MM	0.880	1	0.880	46.97
SBR11	IFC200	200 MM	5.400	1	5.400	91.29
SBR12	IFC270	270 MM	5.400	3	16.200	370.35
SBR13	IFC200*10	215 MM	0.360	1	0.360	226.72
SBR14	IFC270	270 MM	4.100	5	20.500	476.49
SBR15	IFC180	180 MM	4.940	5	23.240	281.39
SBR16	IFC240	240 MM	4.000	3	13.000	287.30
SBR17	PLATE GIRDER SBR10-D200*15	200 MM	4.480	10	44.800	2.386.64
SBR18	IFC200*10	215 MM	2.000	8	20.000	888.71
SBR19	IFC240	240 MM	4.000	17	70.800	1.580.18
SBR20	IFC270	270 MM	4.000	3	13.940	324.36
SBR21	IFC200	200 MM	4.100	10	40.100	630.86
SBR22	IFC180	180 MM	4.100	5	20.000	249.06
SBR23	IFC240	240 MM	4.100	4	16.400	324.72
SBR24	IFC200*10	215 MM	4.000	2	8.000	350.92
SBR25	IFC240	240 MM	2.000	2	5.000	90.00
SBR26	IFC140	140 MM	0.940	3	4.740	58.35
SBR27	IFC140	140 MM	1.700	3	5.400	70.38
SBR28	IFC140	140 MM	1.380	3	4.080	57.12
SBR29	IFC140	140 MM	4.000	1	4.000	30.47
SBR30	IFC140	140 MM	2.000	2	5.000	42.02

SCHEMATIC DRAWING
NOT FOR
CONSTRUCTION

NO	DESCRIPTION	DATE
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DRAWING	
STEEL BEAM/COLUMN SCHEDULES	
STRUCTURE	
2	
PROJECT	
CLIENT	
CONSULTANT	
PROJECT NUMBER	
DATE	
DESIGNED BY	
CHECKED BY	
S-03	
SCALE	

نقشه

های

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فاز 2

نام مهندس
محمدحسین پیران سولا

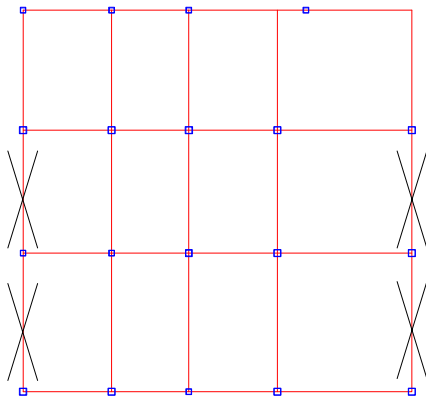
نقشه فاز 2

FOR CONSTRUCTION

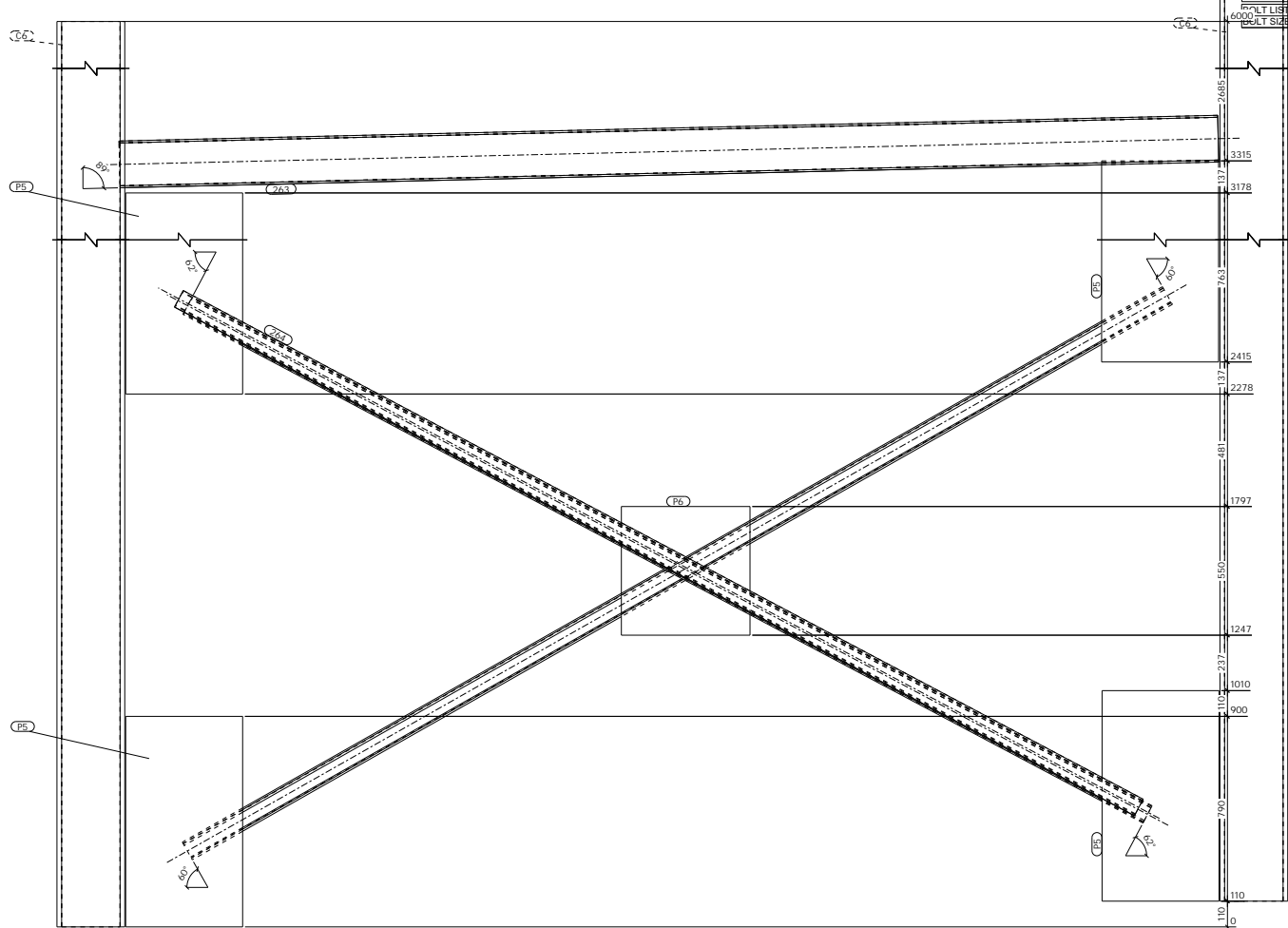
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نقشه جا نمای بادبند



GRID LOCATION											
C23	E-F/2										
		GENERAL NOTES: All Holes Are: 22.0 mm U.N.O All Welds Are: 6.0 mm U.N.O									
		MATERIAL LIST FOR ASSEMBLY C23 1 Nos. BQD									
Mark	Profile	Material	No.	Length	Area	Weight					
263	Assembly		1	4699	3.6	105.1					
264	Assembly		2	4645	1.4	80.2					
265	Assembly		1	4817	1.5	41.6					
C1	Assembly		1	6000	13.0	942.0					
C6	Assembly		1	6000	13.0	942.0					
P5	Assembly		4	900	0.9	212.0					
P6	Assembly		1	550	0.6	35.6					
			Total		38.4	2358.5					

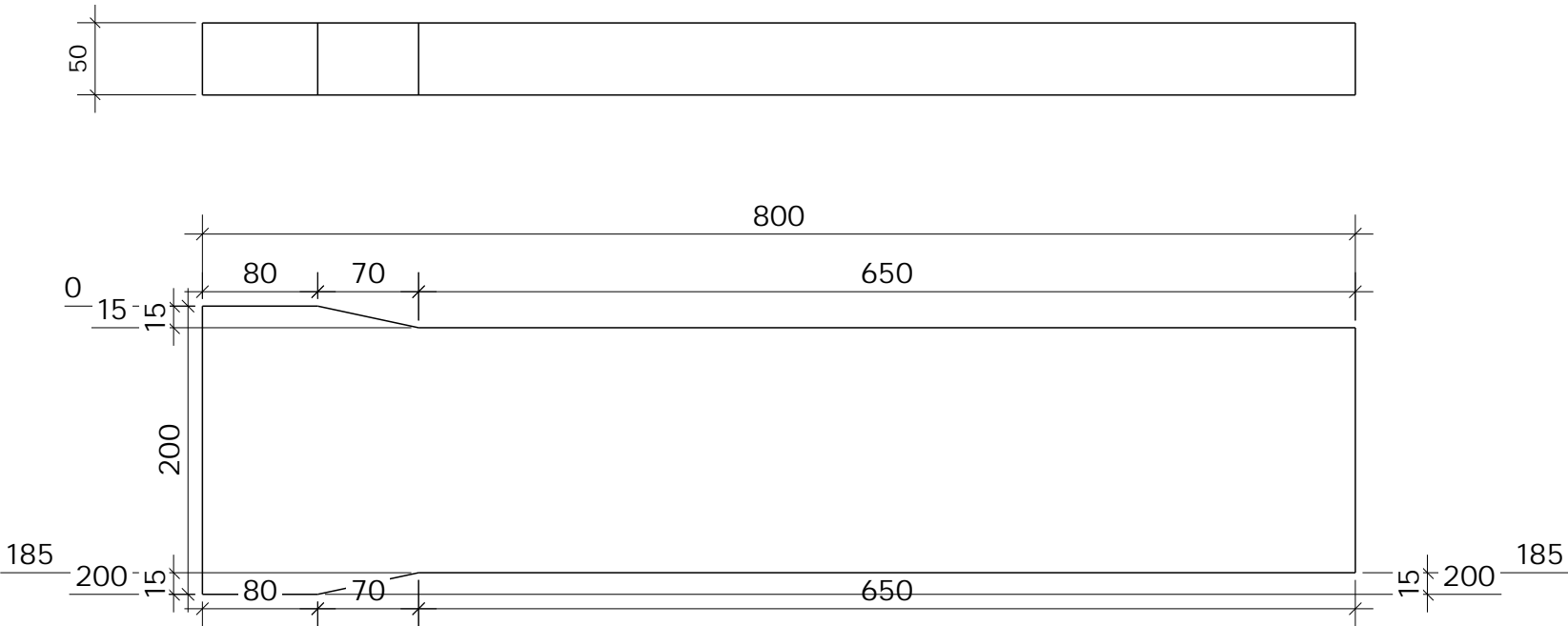


REV	DESCRIPTION	DWG	CHK	DATE
PROJECT: Tekla Model				
CONTRACTOR:		NO: 500-103		
CLIENT:		 		
				
TITLE:				
Title 1 Title 2 Title 3				
DWG NO: C.23		SCALE: 1:10		REV: A2

GRID LOCATION	
CONN10	D-E/1

GENERAL NOTES:		All Holes Are: 22.0		mm U.N	
		All Welds Are: 6.0		mm U.N	
MATERIAL LIST FOR ASSEMBLY					
CONN101 1 Nos. RC					
Mark	Profile	Material	No.	Length	Area
conn1	FLT50*200	S235JR	1	800	0.4
				Total	0.4

BOLT LIST FOR ONE ASSEMBLY		
BOLT SIZE	NOS.	CONNECTED

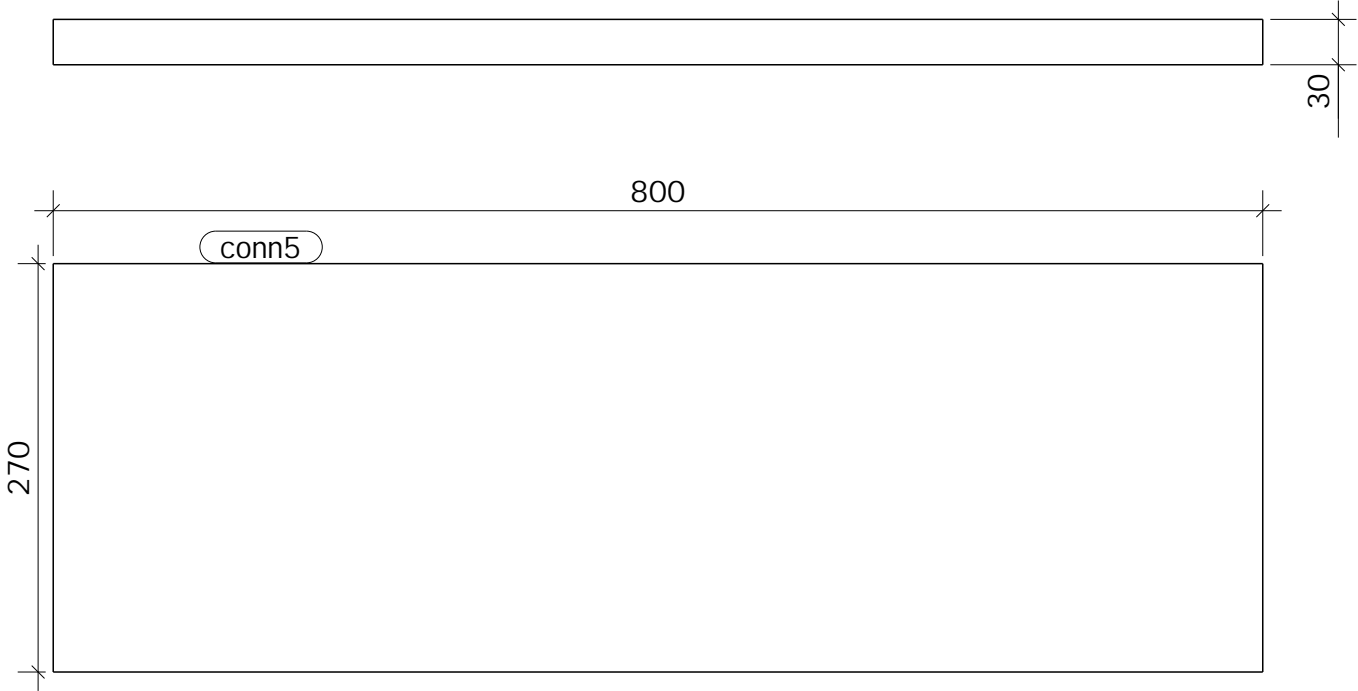


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PROJECTED	Edited with the demo version of Infix Pro PDF Editor			
		NO: 500-103		
CONTRACTOR:		CLIENT:		
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www.iceni.com/Unlock.htm				
TITLE:				

GRID LOCATION	
CONN10	D-E/1

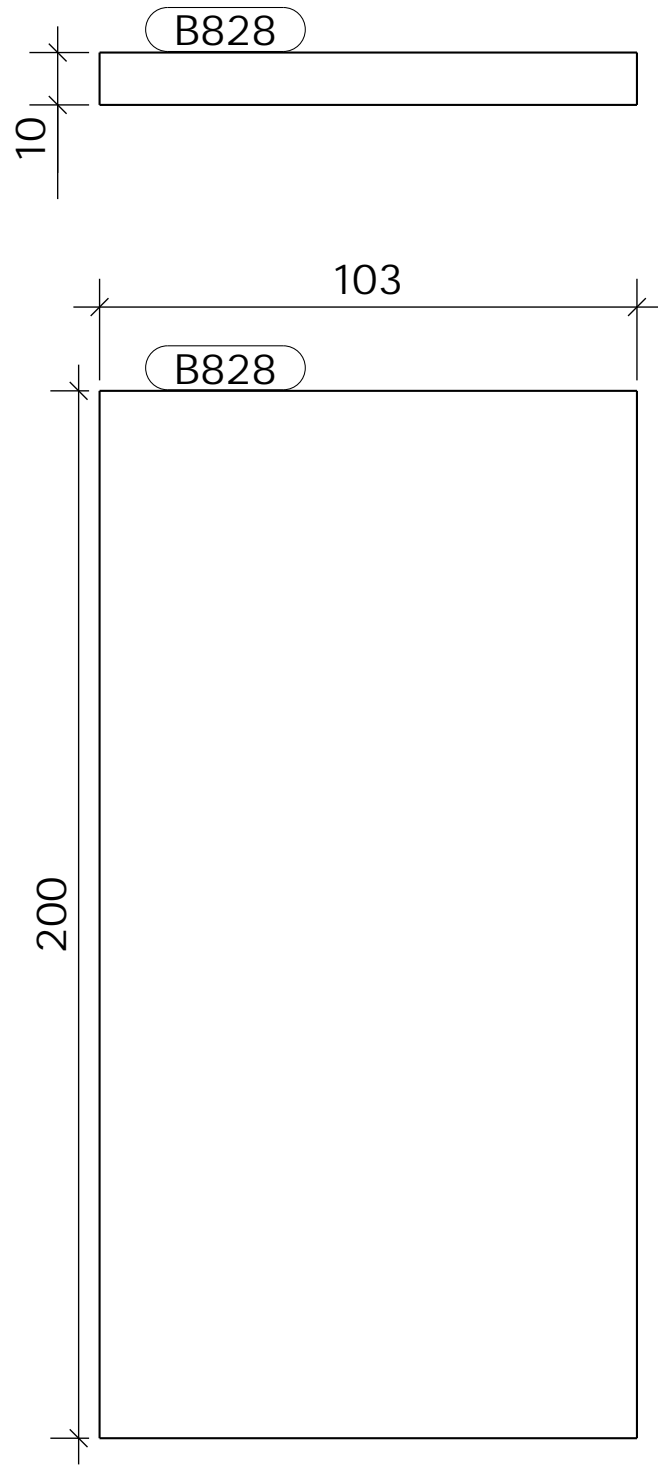
GENERAL NOTES:		All Holes Are: 22.0		mm U.N	
		All Welds Are: 6.0		mm U.N	
MATERIAL LIST FOR ASSEMBLY					
CONN105 1 Nos. RC					
Mark	Profile	Material	No.	Length	Area
conn5	30*270	St-37	1	800	0.5
				Total	0.5

BOLT LIST FOR ONE ASSEMBLY		
BOLT SIZE	NOS.	CONNECTED



REV	DESCRIPTION	DWN	CHK	D
PROJECTED WITH THE demo version of				
Infix Pro PDF Editor	NO: 500-103			
CONTRACTOR:	CLIENT:			
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TITLE:				

Tekla Structures





3 Nos. BEAM REQUIRED AS DRAWN MARKED B828

All holes are 22mm U.N.O Length & Area & Weight per piece

B828	FLT10*200	St-37	3	102.7	0.05	1.6
Mark	Profile	Grade	QTY	Length	Area	Weight

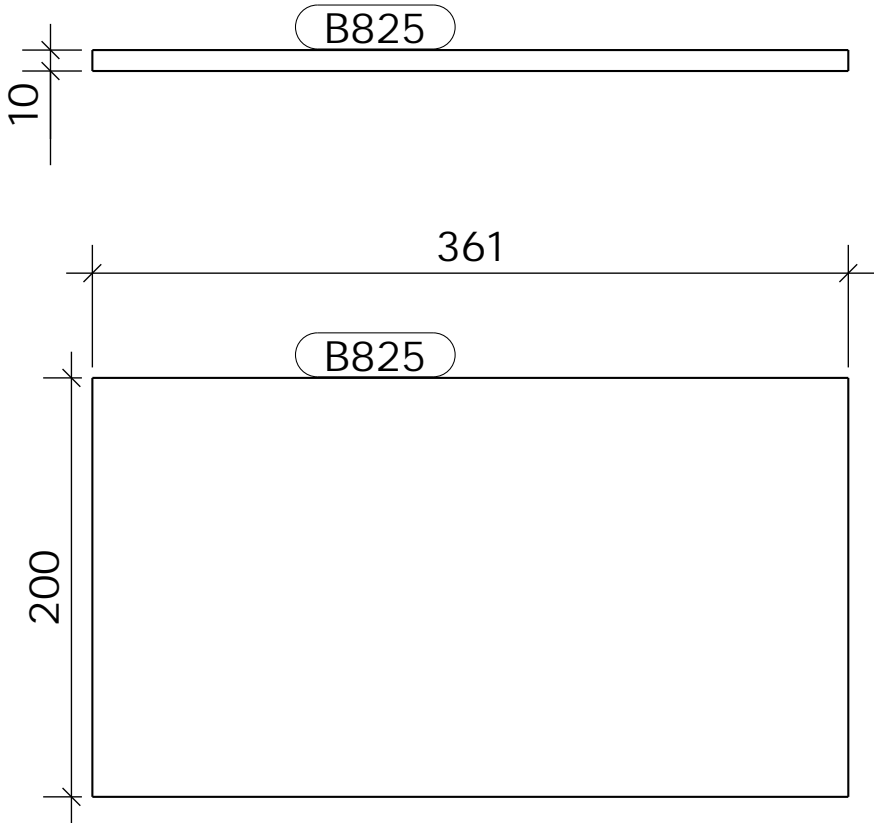
ALLOCATION TO ASSEMBLIES

Assembly Mark	Quantity
272	3
Total	3

REV	DESCRIPTION	DWN	CHK	DATE
PROJECT: Tekla Model		NO: 500-103		
CONTRACTOR:		CLIENT:		
<div>Powered by Tekla®</div> <div></div>		<div></div>		
TITLE:				
Title 1				
Title 2				
Title 3				
DWG NO: B8.28		SCALE: 1:2	REV:	A4

Tekla Structures



ALLOCATION TO ASSEMBLIES	
Assembly Mark	Quantity
269	2
Total	2



2 Nos. BEAM REQUIRED AS DRAWN MARKED B825

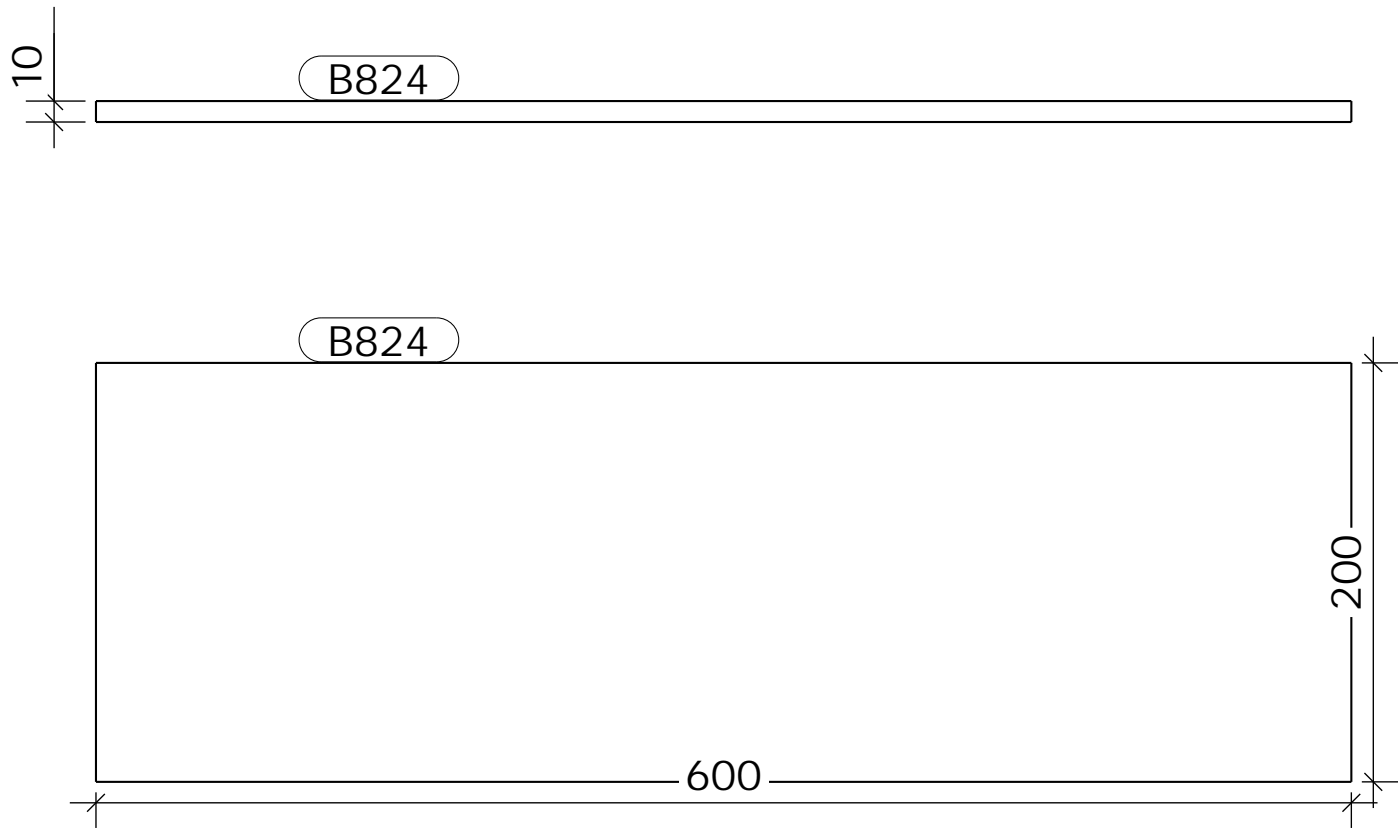
All holes are 22mm U.N.O Length & Area & Weight per piece

B825	FLT10*200	St-37	2	361.0	0.16	5.7
Mark	Profile	Grade	QTY	Length	Area	Weight

REV	DESCRIPTION	DWN	CHK	DATE
PROJECT: Tekla Model				
		NO: 500-103		
CONTRACTOR:		CLIENT:		
<div>Powered by Tekla® </div>		<div></div>		
TITLE:				
Title 1				
Title 2				
Title 3				
DWG NO: B8.25		SCALE: 1:5		REV: A4

Tekla Structures



ALLOCATION TO ASSEMBLIES	
Assembly Mark	Quantity
268	2
Total	2

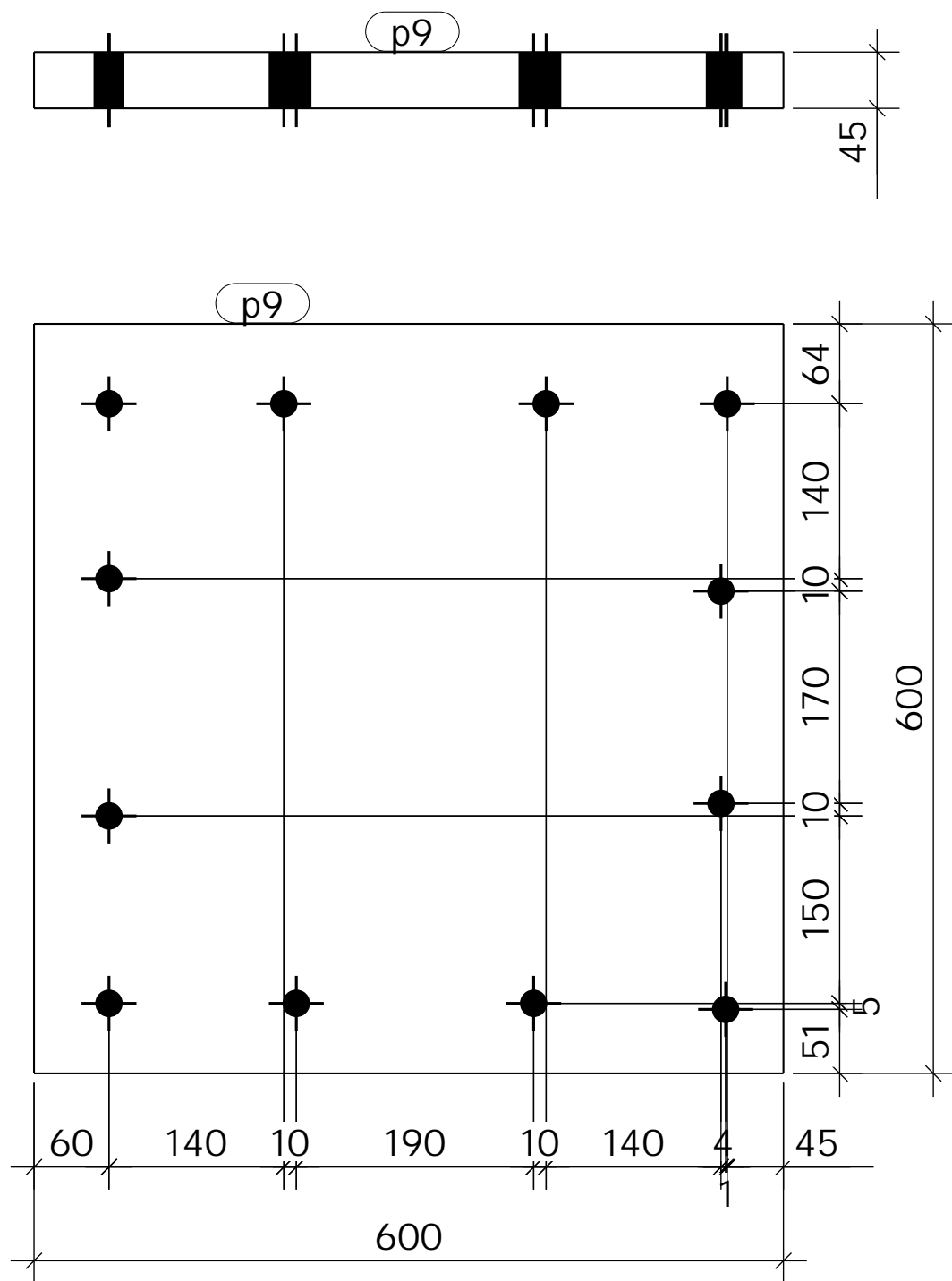


2 Nos. BEAM REQUIRED AS DRAWN MARKED B824

All holes are 22mm U.N.O Length & Area & Weight per piece

B824	FLT10*200	St-37	2	599.5	0.26	9.4
Mark	Profile	Grade	QTY	Length	Area	Weight

REV	DESCRIPTION	DWN	CHK	DATE
PROJECT: Tekla Model				
		NO: 500-103		
CONTRACTOR:		CLIENT:		
<div>Powered by Tekla® </div>		<div></div>		
TITLE:				
Title 1 Title 2 Title 3				
DWG NO: B8.24		SCALE: 1:5		REV: A4





1 Nos. PLATE REQUIRED AS DRAWN MARKED p9

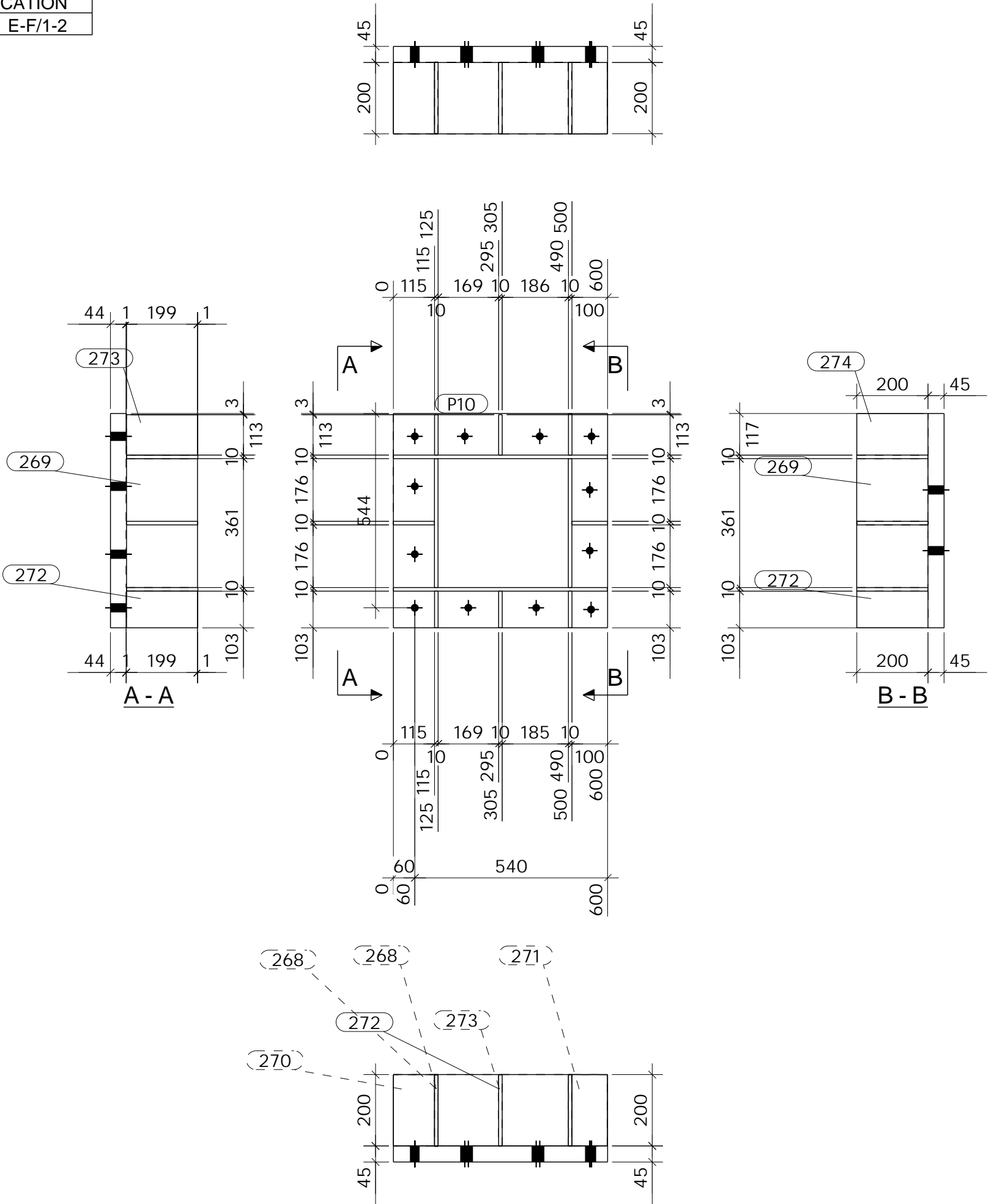
All holes are 22mm U.N.O Length & Area & Weight per piece

p9	FLT45*600	St-37	1	600.0	0.83	127.2
Mark	Profile	Grade	QTY	Length	Area	Weight

ALLOCATION TO ASSEMBLIES	
Assembly Mark	Quantity
P10	1
Total	1

REV	DESCRIPTION	DWN	CHK	DATE
PROJECT: Tekla Model		NO: 500-103		
CONTRACTOR:		CLIENT:		
<div>Powered by Tekla®</div>				
TITLE:		Title 1 Title 2 Title 3		
DWG NO: p.9		SCALE: 1:7.5	REV:	A4



GRID LOCATION	
P11	E-F/1-2



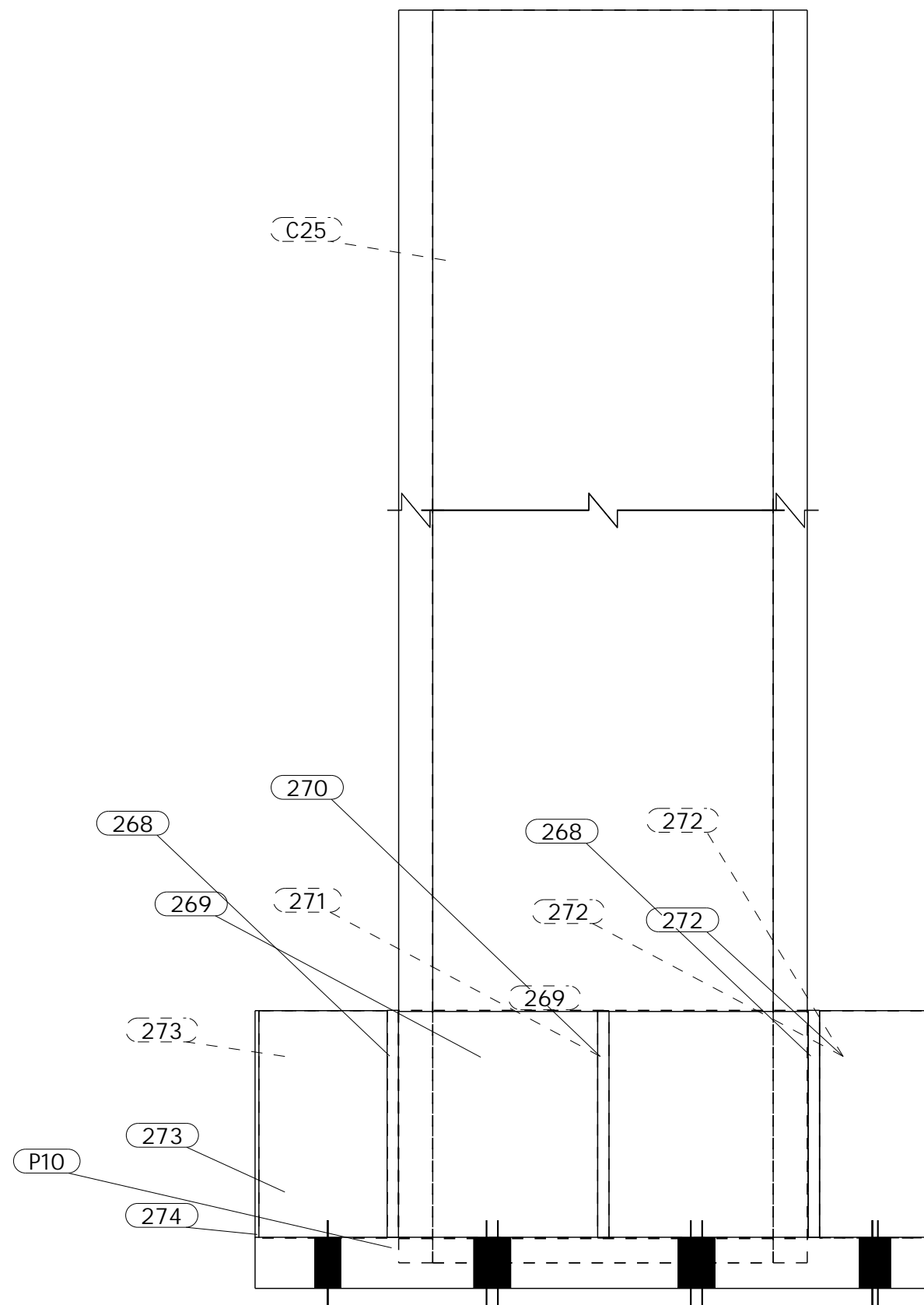
1 Nos. PLATE REQUIRED AS DRAWN MARKED P11

GENERAL NOTES:		All Holes Are: 22.0 mm U.N.O				
		All Welds Are: 6.0 mm U.N.O				
MATERIAL LIST FOR ASSEMBLY		P11	1	Nos. RQD		
Mark	Profile	Material	No.	Length	Area	Weight
268	Assembly		2	600	0.3	18.8
269	Assembly		2	361	0.2	11.3
270	Assembly		1	115	0.1	1.8
271	Assembly		1	100	0.0	1.6
272	Assembly		3	103	0.0	4.8
273	Assembly		2	113	0.1	3.5
274	Assembly		1	117	0.1	1.8
P10	Assembly		1	600	0.8	127.2
				Total	2.0	170.9

BOLT LIST FOR ONE ASSEMBLY		
BOLT SIZE	NOS.	CONNECTED ASSY.
BOLTM20*75-8.8XOX	12	Shop Bolts
+ NUTM20-GR8-HEX	12	
+ WASHERM20-FLAT-E	12	

REV	DESCRIPTION	DWN	CHK	DATE
PROJECT: Tekla Model				
		NO: 500-103		
CONTRACTOR:		CLIENT:		
<div>Powered by Tekla</div> <div> Trimble</div>		<div> Tekla®</div>		
TITLE:				
Title 1				
Title 2				
Title 3				
DWG NO: P.11		SCALE: 1:12.5	REV:	A4



GRID LOCATION	
C26	E-F/2



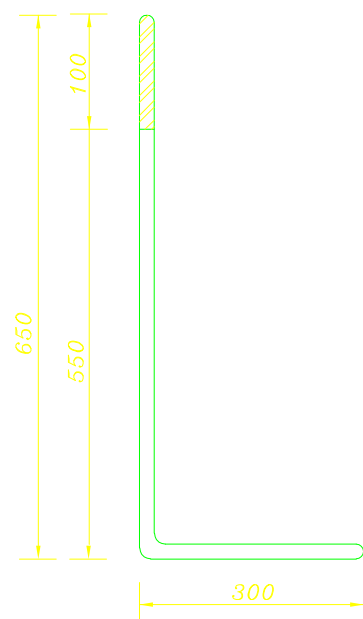
1 Nos. COLUMN REQUIRED AS DRAWN MARKED C26

GENERAL NOTES:		All Holes Are: 22.0 mm U.N.O		All Welds Are: 6.0 mm U.N.O		
MATERIAL LIST FOR ASSEMBLY C26				1	Nos. RQD	
Mark	Profile	Material	No.	Length	Area	Weight
266	Assembly		1	0	15.9	1695.6
268	Assembly		2	600	0.3	18.8
269	Assembly		2	361	0.2	11.3
270	Assembly		1	115	0.1	1.8
271	Assembly		1	100	0.0	1.6
272	Assembly		3	103	0.0	4.8
273	Assembly		2	113	0.1	3.5
274	Assembly		1	117	0.1	1.8
P10	Assembly		1	600	0.8	127.2
				Total	18.0	1866.5

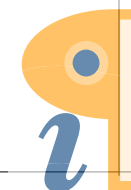
BOLT LIST FOR ONE ASSEMBLY		
BOLT SIZE	NOS.	CONNECTED ASSY.
BOLTM20*75-8.8XOX	12	Shop Bolts
+ NUTM20-GR8-HEX	12	
+ WASHERM20-FLAT-F	12	

REV	DESCRIPTION	DWN	CHK	DATE	
PROJECT: Tekla Model					
				NO: 500-103	
CONTRACTOR:			CLIENT:		
					
TITLE:					
<div> <div>Title 1</div> <div>Title 2</div> <div>Title 3</div> </div>					
DWG NO: C.26		SCALE: 1:5		REV:	A4

نام مهندس: محمد حسین
پیران سولا



دیتیل
اجرایی



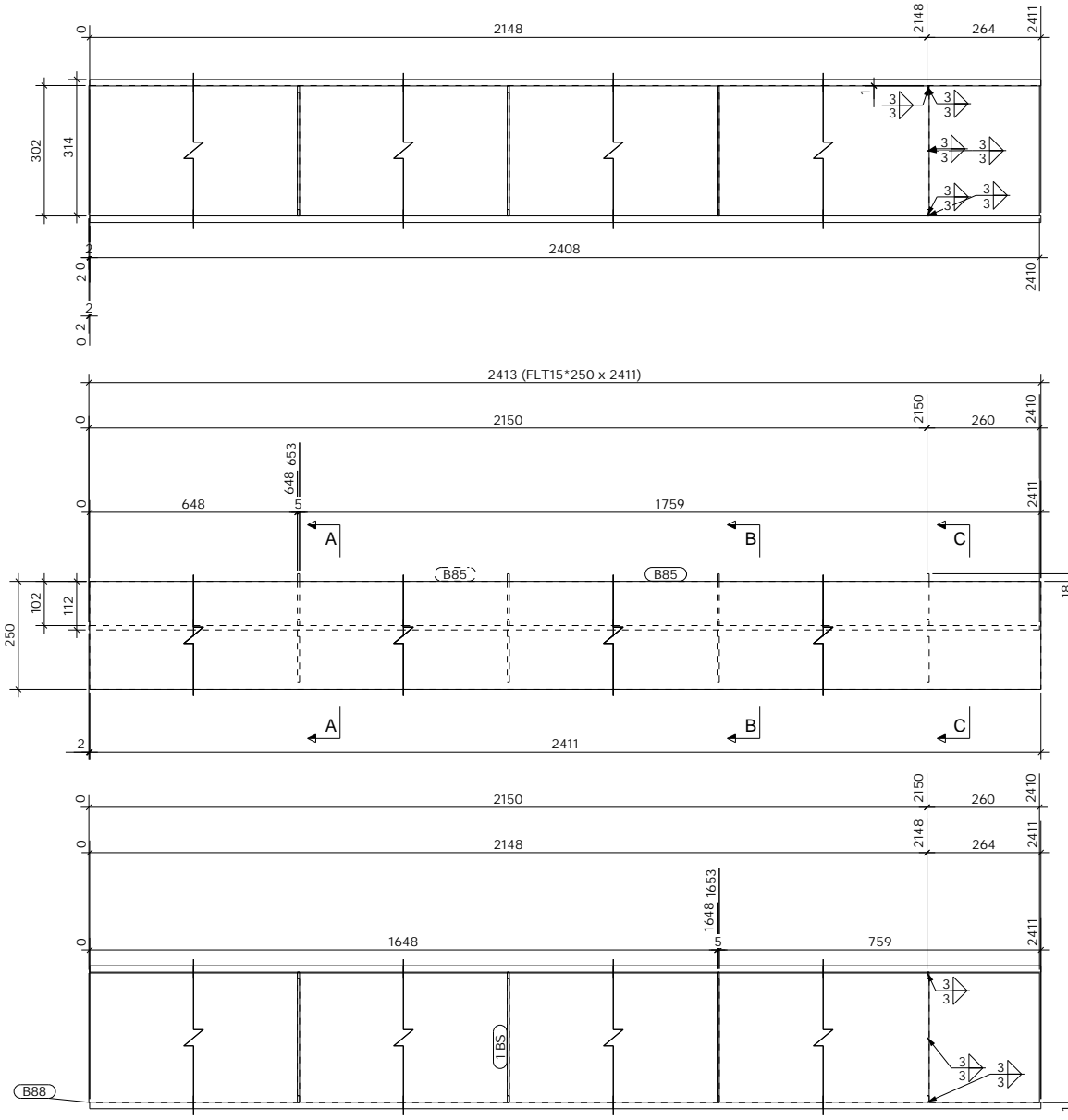
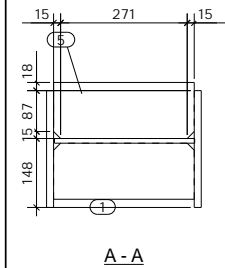
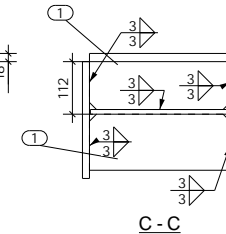
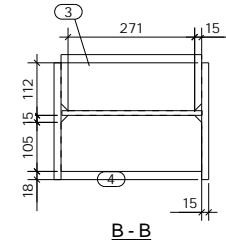
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Infix Pro PDF Editor

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GRID LOCATION	
2	B-C/1

GENERAL NOTES:		All Holes Are:	22.0	mm	U.N.O	
		All Welds Are:	6.0	mm	U.N.O	
MATERIAL LIST FOR ASSEMBLY		2	3	Nos.	ROD	
Mark	Profile	Material	No.	Length	Area	Weight
1	FLT5*120	St-37	2	301	0.2	2.8
B85	FLT15*250	St-37	2	2411	2.6	142.0
B88	FLT10*300	St-37	1	2410	1.5	56.8
4	Assembly		1	120	0.2	4.2
5	Assembly		1	120	0.2	4.2
				Total	4.7	210.0

BOLT LIST FOR ONE ASSEMBLY		NOS.	CONNECTED ASSY.
BOLT SIZE			

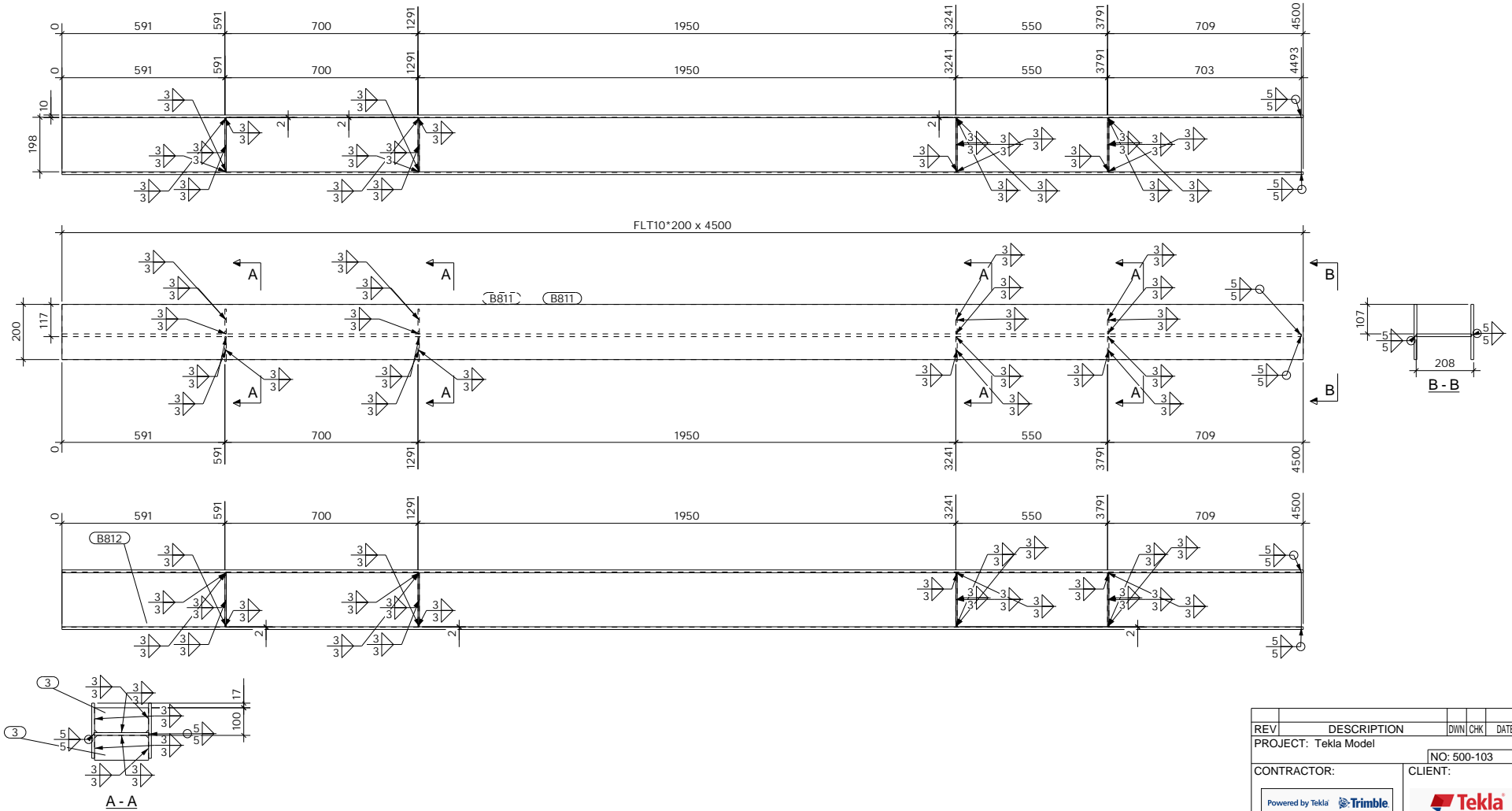


3 Nos. BEAM REQUIRED AS DRAWN MARKED 2



REV	DESCRIPTION	DWN	CHK	DATE
PROJECT: Tekla Model				
		NO: 500-103		
CONTRACTOR:		CLIENT:		
<div>Powered by Tekla</div> <div></div>		<div></div>		
TITLE:				
Title 1				
Title 2				
Title 3				
DWG NO: 2		SCALE: 1:7.5		REV: A3

GRID LOCATION	
248	E-F/3

GENERAL NOTES:		All Holes Are:	22.0	mm	U.N.O
		All Welds Are:	6.0	mm	U.N.O
MATERIAL LIST FOR ASSEMBLY			248	1	Nos. ROD
Mark	Profile	Material	No.	Length	Area Weight
3	FLT5*90	S275	8	196	0.3 5.5
B811	FLT10*200	St-37	2	4500	3.8 141.3
B812	FLT10*200	St-37	1	4493	1.9 70.5
			Total	6.0	217.3
BOLT LIST FOR ONE ASSEMBLY					
BOLT SIZE			NOS.	CONNECTED ASSY.	



1 Nos. BEAM REQUIRED AS DRAWN MARKED 248

REV	DESCRIPTION	DWN	CHK	DATE
PROJECT: Tekla Model				
CONTRACTOR:		NO: 500-103		
CLIENT:				
<div>Powered by Tekla</div> <div></div>		<div></div>		
TITLE:				
Title 1				
Title 2				
Title 3				
DWG NO: 248		SCALE: 1:10		REV: A3

GRID LOCATION		GENERAL NOTES: All Holes Are: 22.0 mm U.N.O All Welds Are: 6.0 mm U.N.O MATERIAL LIST FOR ASSEMBLY 281 1 Nos. RQD					
281	A-B/3-4						

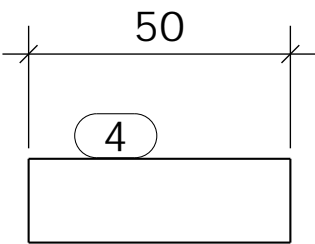
Mark	Profile	Material	No.	Length	Area	Weight
275	Assembly		1	3800	2.7	72.1
				Total	2.7	72.1

BOLT LIST FOR ONE ASSEMBLY		
BOLT SIZE	NOS.	CONNECTED ASSY.

REV	DESCRIPTION	DWN	CHK	DATE
PROJECT: Tekla Model				
NO: 500-103				
CONTRACTOR:		CLIENT:		
Powered by Tekla Trimble		Tekla		
TITLE:		Title 1 Title 2 Title 3		
DWG NO: 281		SCALE: 1:10		REV: A4

1 Nos. COMPOSITE BEAM REQUIRED AS DRAWN MARKED 281

Tekla Structures





ALLOCATION TO ASSEMBLIES	
Assembly Mark	Quantity
275	30
276	30
277	30
Total	90

90 Nos. NELSON REQUIRED AS DRAWN MARKED 4

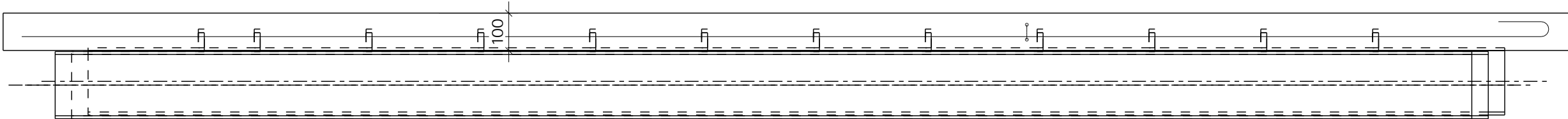
All holes are 22mm U.N.O Length & Area & Weight per piece

4	D16	S275	90	50.0	0.00	0.1
Mark	Profile	Grade	QTY	Length	Area	Weight

REV	DESCRIPTION	DWN	CHK	DATE
PROJECT: Tekla Model		NO: 500-103		
CONTRACTOR:		CLIENT:		
<div>Powered by Tekla®</div>				
TITLE:		Title 1 Title 2 Title 3		
DWG NO: 4		SCALE: 1:2	REV:	A4

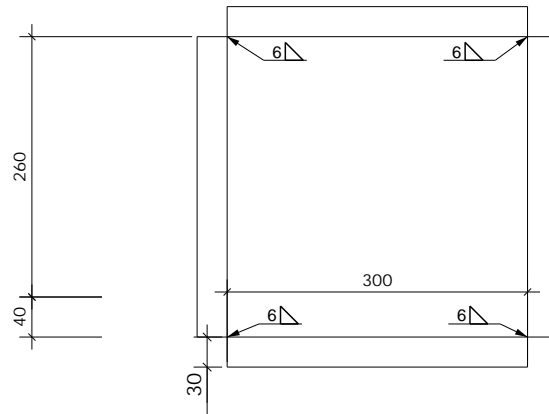
GRID LOCATION		<div>GENERAL NOTES: All Holes Are: 22.0 mm U.N.O All Welds Are: 6.0 mm U.N.O MATERIAL LIST FOR ASSEMBLY 284 1 Nos. RQD</div> <table><tr><th>Mark</th><th>Profile</th><th>Material</th><th>No.</th><th>Length</th><th>Area</th><th>Weight</th></tr><tr><td>276</td><td>Assembly</td><td></td><td>1</td><td>3800</td><td>2.7</td><td>72.1</td></tr><tr><td>277</td><td>Assembly</td><td></td><td>1</td><td>3800</td><td>2.7</td><td>72.1</td></tr><tr><td>281</td><td>Assembly</td><td></td><td>1</td><td>3800</td><td>2.7</td><td>72.1</td></tr><tr><td colspan="4"></td><td>Total</td><td>8.1</td><td>216.4</td></tr></table> <div>BOLT LIST FOR ONE ASSEMBLY</div> <table><tr><th>BOLT SIZE</th><th>NOS.</th><th>CONNECTED ASSY.</th></tr></table>					Mark	Profile	Material	No.	Length	Area	Weight	276	Assembly		1	3800	2.7	72.1	277	Assembly		1	3800	2.7	72.1	281	Assembly		1	3800	2.7	72.1					Total	8.1	216.4	BOLT SIZE	NOS.	CONNECTED ASSY.
Mark	Profile						Material	No.	Length	Area	Weight																																	
276	Assembly							1	3800	2.7	72.1																																	
277	Assembly		1	3800	2.7	72.1																																						
281	Assembly		1	3800	2.7	72.1																																						
				Total	8.1	216.4																																						
BOLT SIZE	NOS.	CONNECTED ASSY.																																										
284	A-B/3-4																																											

tor10@20

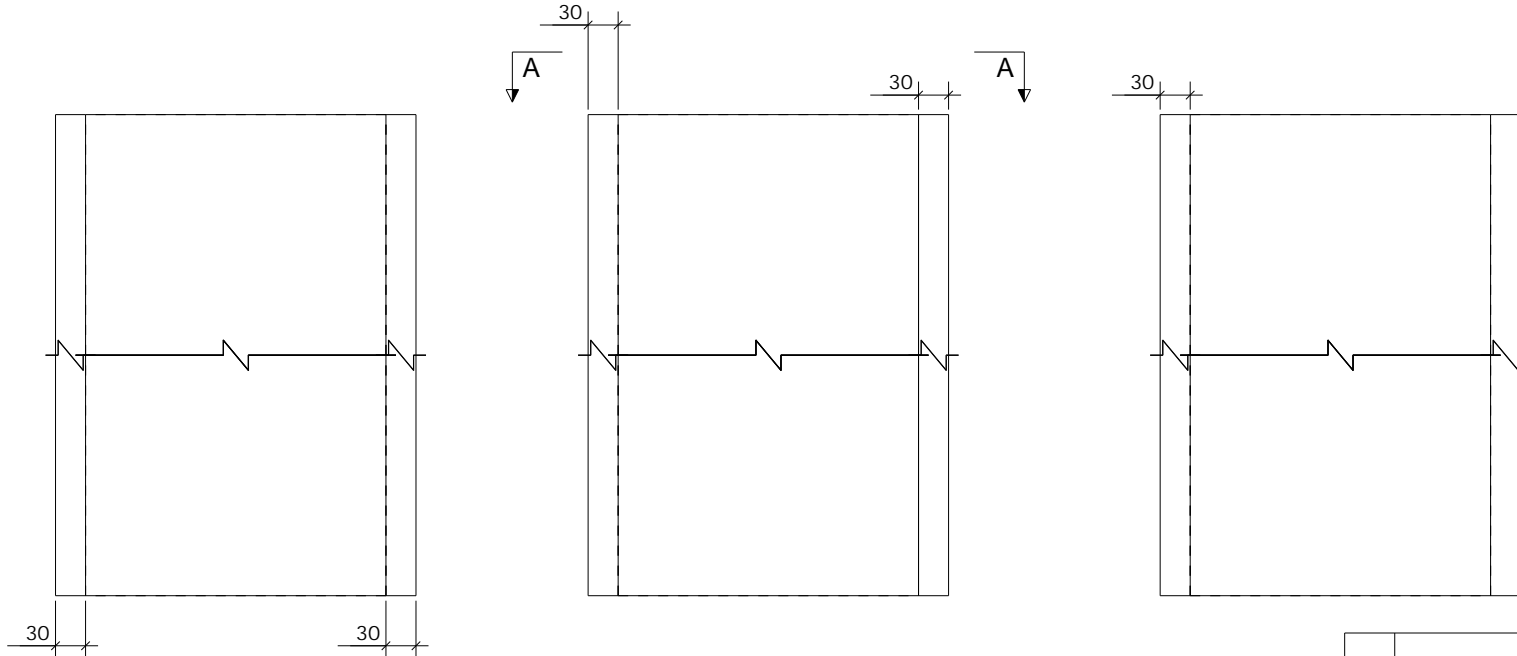


REV	DESCRIPTION	DWN	CHK	DATE
PROJECT: Tekla Model		NO: 500-103		
CONTRACTOR:		CLIENT:		
Powered by Tekla Trimble		Tekla		
TITLE:		Title 1 Title 2 Title 3		
DWG NO: 284		SCALE: 1:12.5	REV:	A4

GRID LOCATION	
C13	E/4





A - A



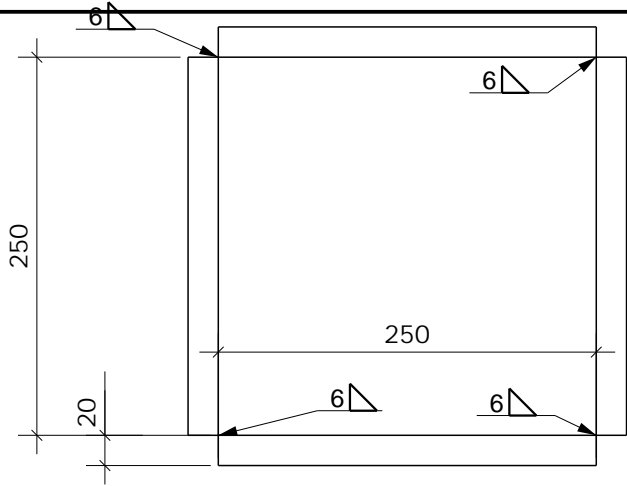
GENERAL NOTES:		All Holes Are:	22.0	mm	U.N.O	
		All Welds Are:	6.0	mm	U.N.O	
MATERIAL LIST FOR ASSEMBLY		C13	1	Nos.	RQD	
Mark	Profile	Material	No.	Length	Area	Weight
C14	Assembly		4	6000	4.0	1695.6
				Total	15.9	1695.6

BOLT LIST FOR ONE ASSEMBLY		
BOLT SIZE	NOS.	CONNECTED ASSY.

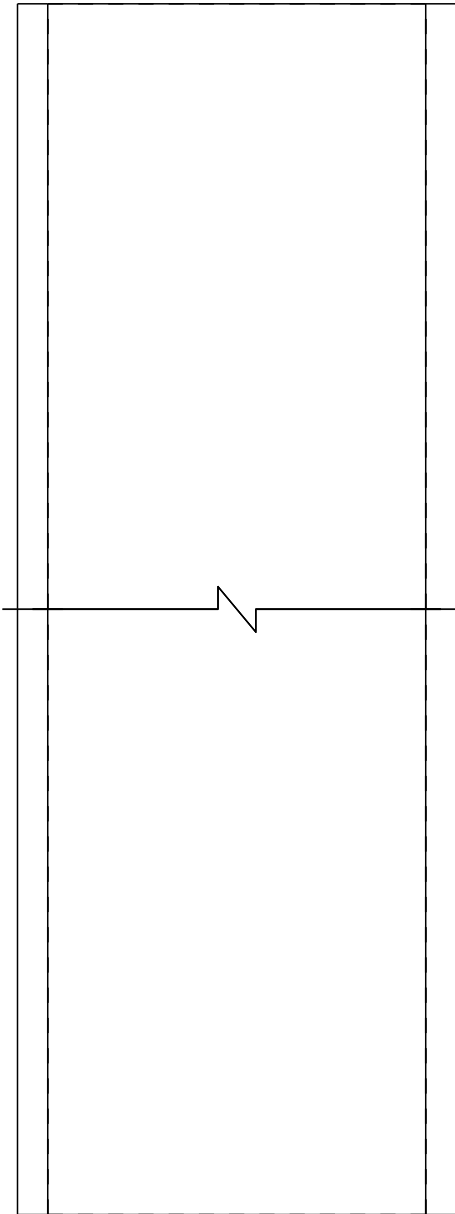
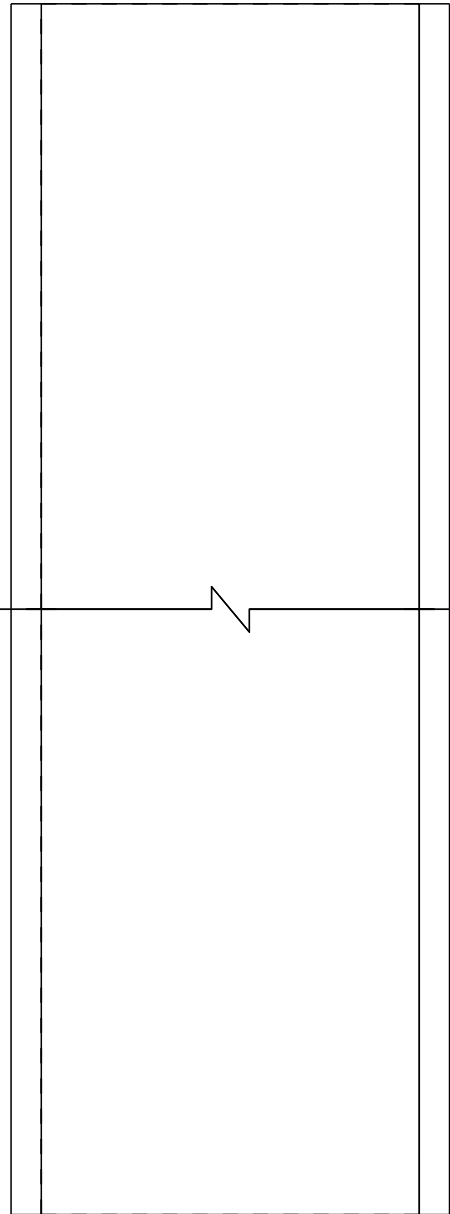
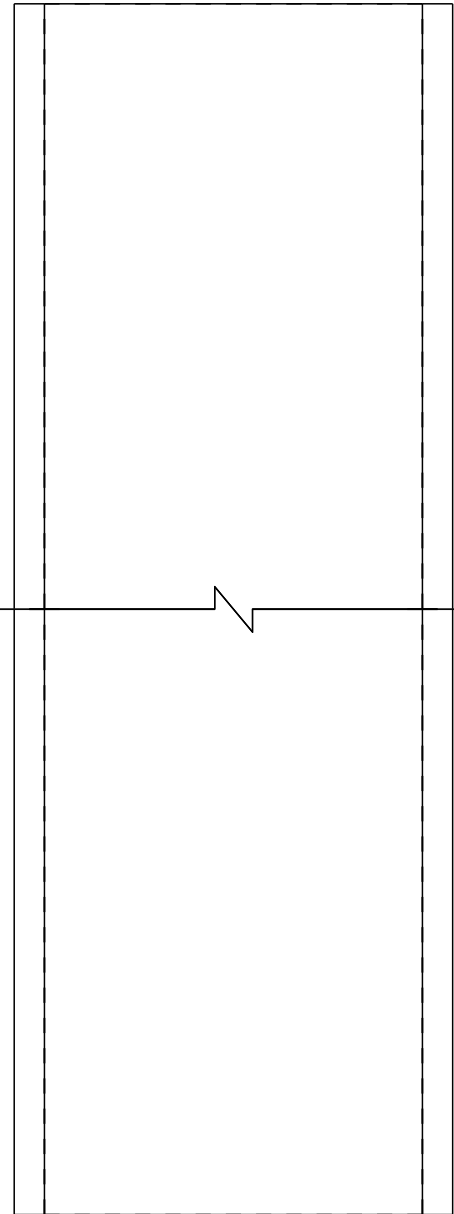
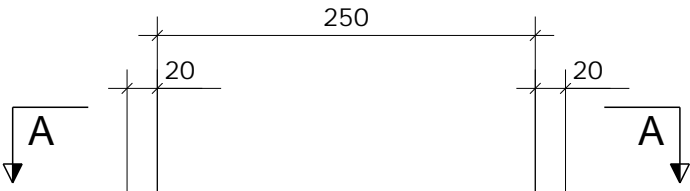
1 Nos. COLUMN REQUIRED AS DRAWN MARKED C13

REV		DESCRIPTION		DWN	CHK	DATE
PROJECT: Tekla Model						
				NO: 500-103		
CONTRACTOR:				CLIENT:		
<div>Powered by Tekla</div> <div> Trimble</div>				<div> Tekla</div>		
TITLE:						
Title 1						
Title 2						
Title 3						
DWG NO: C.13		SCALE: 1:5		REV:		A4

GRID LOCATION	
C1	B/2



A - A

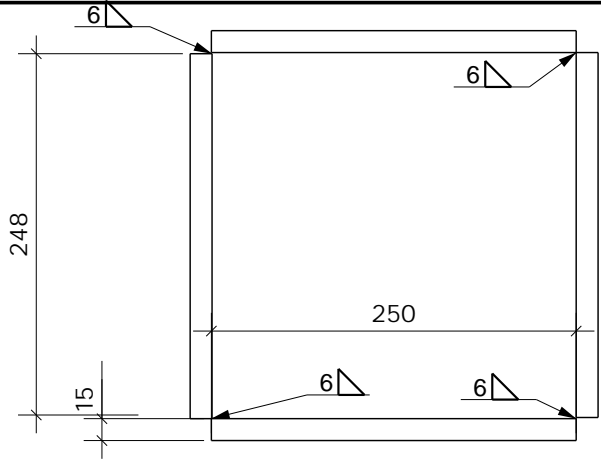


GENERAL NOTES:		All Holes Are: 22.0 mm U.N.O	
		All Welds Are: 6.0 mm U.N.O	
MATERIAL LIST FOR ASSEMBLY		C1	1 Nos. RQD
Mark	Profile	Material	No. Length Area Weight
C2	Assembly		4 6000 3.3 942.0
		Total	13.0 942.0
BOLT LIST FOR ONE ASSEMBLY			
BOLT SIZE		NOS.	CONNECTED ASSY.

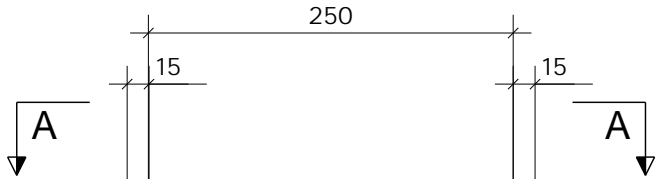
REV	DESCRIPTION	DWN	CHK	DATE
PROJECT: Tekla Model		NO: 500-103		
CONTRACTOR:		CLIENT:		
Powered by Tekla Trimble		Tekla		
TITLE:		Title 1 Title 2 Title 3		
DWG NO: C.1		SCALE: 1:5	REV:	A4

1 Nos. COLUMN REQUIRED AS DRAWN MARKED C1

GRID LOCATION	
C1	B/2



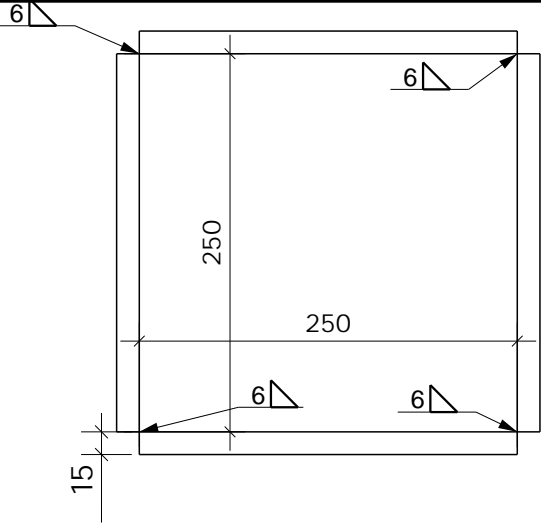
A - A



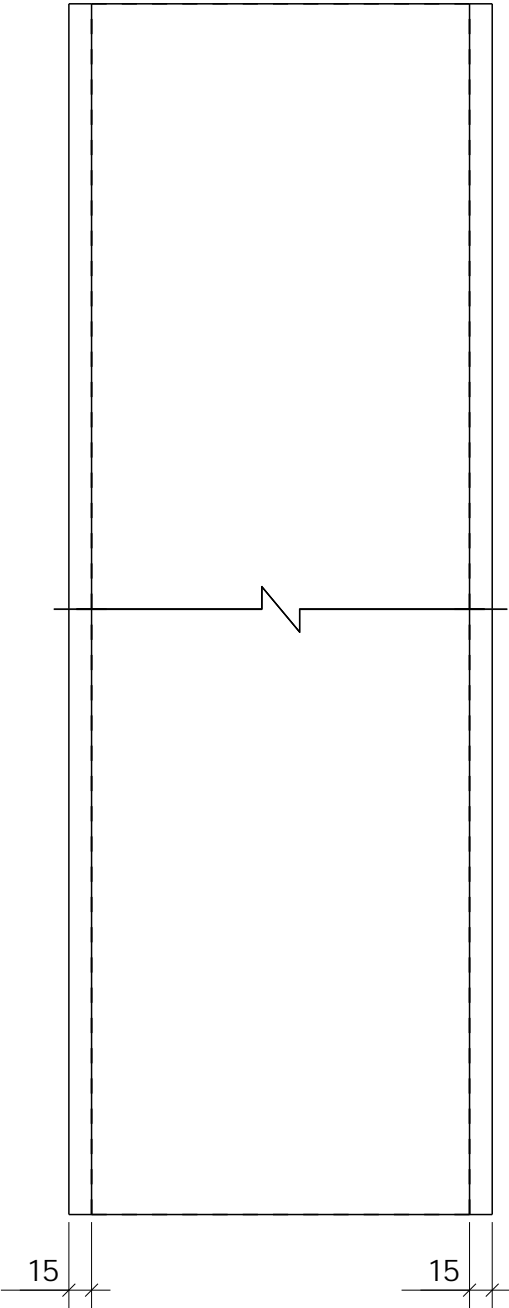
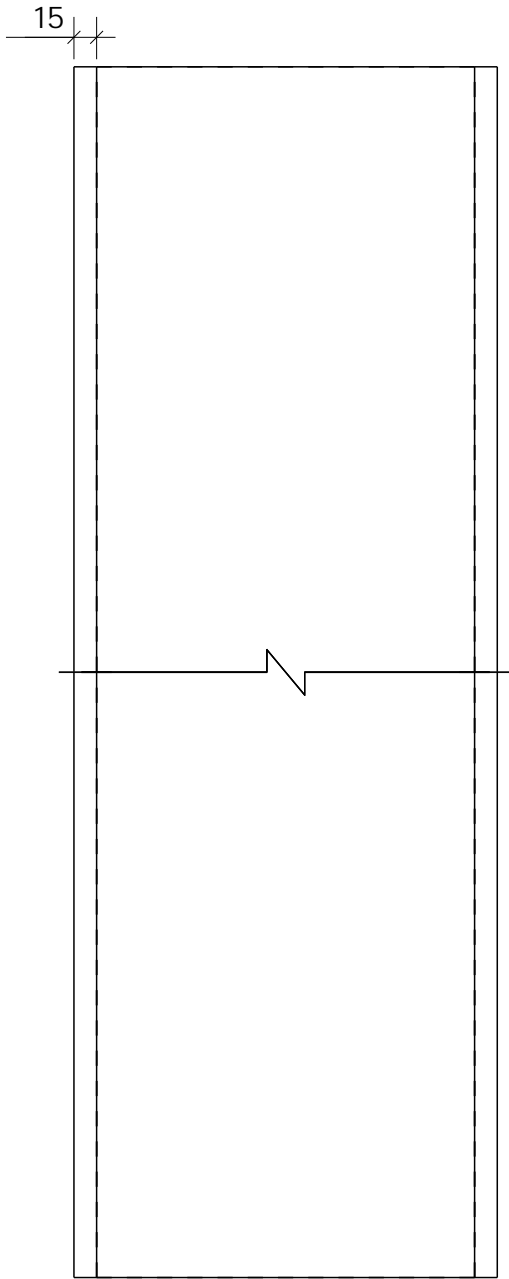
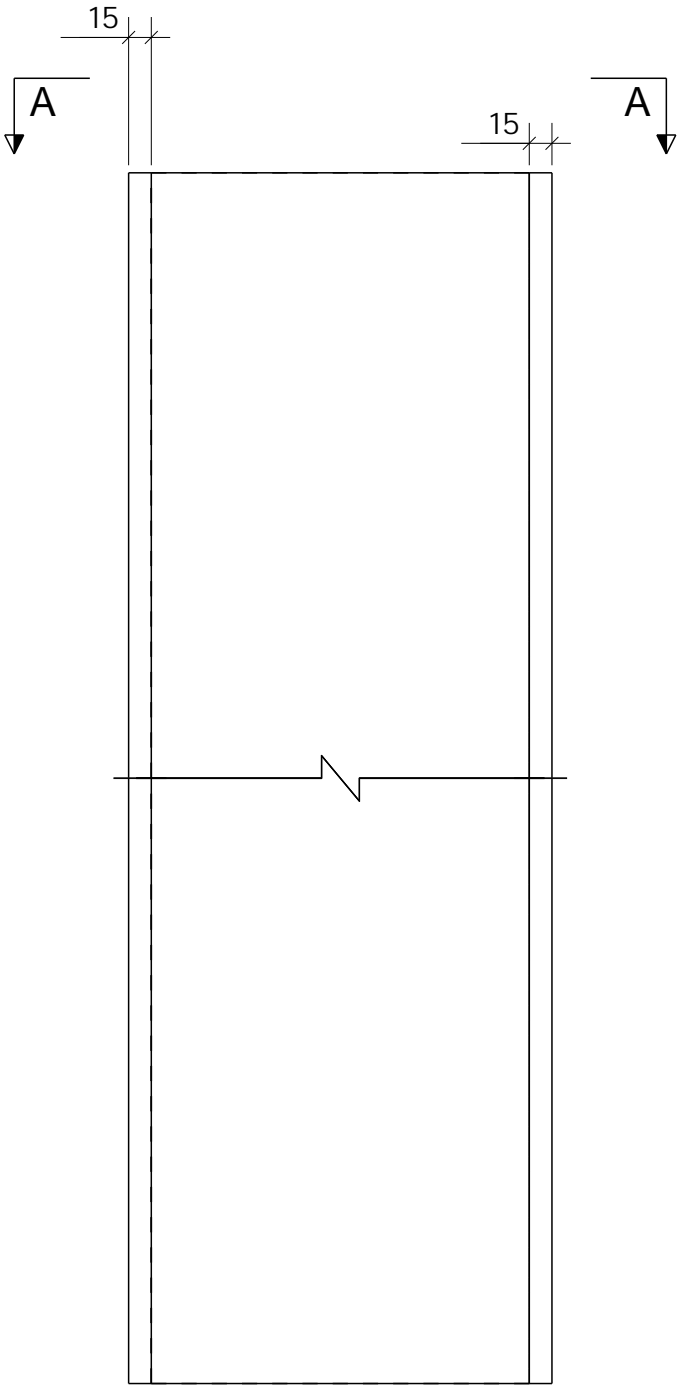
GENERAL NOTES:		All Holes Are: 22.0		mm U.N.O		
		All Welds Are: 6.0		mm U.N.O		
MATERIAL LIST FOR ASSEMBLY				C1	1	Nos. RQD
Mark	Profile	Material	No.	Length	Area	Weight
C2	Assembly		4	6000	3.2	706.5
				Total	12.8	706.5
BOLT LIST FOR ONE ASSEMBLY						
BOLT SIZE			NOS.	CONNECTED ASSY.		

REV	DESCRIPTION	DWN	CHK	DATE
PROJECT: Tekla Model		NO: 500-103		
CONTRACTOR:		CLIENT:		
Powered by Tekla® Trimble®		Tekla®		
TITLE:		Title 1 Title 2 Title 3		
DWG NO: C.1		SCALE: 1:5	REV:	A4

GRID LOCATION	
C1	B/2



A - A



GENERAL NOTES:		All Holes Are: 22.0		mm U.N.O		
		All Welds Are: 6.0		mm U.N.O		
MATERIAL LIST FOR ASSEMBLY				C1	1	Nos. RQD
Mark	Profile	Material	No.	Length	Area	Weight
C2	Assembly		4	6000	3.2	706.5
				Total	12.8	706.5
BOLT LIST FOR ONE ASSEMBLY						
BOLT SIZE			NOS.	CONNECTED ASSY.		

REV	DESCRIPTION	DWN	CHK	DATE
PROJECT: Tekla Model		NO: 500-103		
CONTRACTOR:		CLIENT:		
Powered by Tekla Trimble		Tekla		
TITLE:		Title 1 Title 2 Title 3		
DWG NO: C.1		SCALE: 1:5		REV: A4

1 Nos. COLUMN REQUIRED AS DRAWN MARKED C1

متره

(این متره صرفا برای پیش برآورد می باشد)

ASSEMBLY LIST

Tekla Structures

Page: 1

Contract No: 500-103

Contract Name: Tekla Model

Date: 05/02/2019

Ass Mk	Qty	Name	Profile	Phase	Lot	Area	Wt
0 (?)	8	BEAM	FLT15*250	1	0	0.0	0.0
1	10	PLATE	FLT5*120	1	0	0.8	14.1
2	3	BEAM	FLT15*250	1	0	14.0	630.0
3	3	PLATE	FLT5*120	1	0	0.5	8.5
4	3	PLATE	FLT5*120	1	0	0.7	12.7
5	3	PLATE	FLT5*120	1	0	0.7	12.7
6	5	BEAM	FLT15*250	1	0	41.0	1893.6
7	8	BEAM	FLT15*250	1	0	43.1	1958.2
8	2	BEAM	IPE300	0	0	2.0	69.6
9	1	BEAM	IPE200	0	0	0.7	0.0
10	1	BEAM	IPE270	0	0	0.9	0.0
11	1	BEAM	IPE200	0	0	3.0	84.5
12	3	BEAM	IPE220	0	0	9.9	295.9
13	1	BEAM	IPE220	0	0	3.3	0.0
14	1	BEAM	IPE140	0	0	1.6	0.0
15	1	BEAM	IPE200	0	0	2.2	61.0
16	1	BEAM	PLATE GRIDER	3	0	0.0	0.0
17	1	BEAM	PLATE GRIDER	3	0	0.0	0.0
18	1	BEAM	PLATE GRIDER	3	0	0.0	0.0
19	1	BEAM	IPE140	0	0	1.3	30.8
20	2	BEAM	IPE300	0	0	6.8	240.7
21	1	BEAM	IPE200	0	0	2.3	63.6
22	1	BEAM	IPE270	0	0	3.1	0.0
23	1	BEAM	IPE200	0	0	3.1	87.2
24	1	BEAM	IPE240	0	0	3.8	0.0
25	3	BEAM	IPE270	0	0	12.7	420.3
26	2	BEAM	IPE200	0	0	4.1	115.5
27	2	BEAM	IPE200	0	0	4.1	0.0
28	2	BEAM	IPE240	0	0	9.8	309.8
29	1	BEAM	IPE240	0	0	4.9	0.0
30	1	BEAM	IPE270	0	0	5.5	183.4
31	1	BEAM	IPE220	0	0	4.5	134.9
32	2	BEAM	IPE270	0	0	8.3	277.1
33	1	BEAM	IPE270	0	0	4.2	0.0
34	1	BEAM	IPE220	0	0	3.4	102.2
35	1	BEAM	IPE140	0	0	2.5	57.8
36	3	BEAM	IPE180	0	0	9.5	249.7
37	1	BEAM	IPE180	0	0	3.2	84.0
38	1	BEAM	IPE240	0	0	4.1	129.9
39	1	BEAM	PLATE GRIDER	3	0	0.0	0.0
40	1	BEAM	PLATE GRIDER	3	0	0.0	0.0
41	1	BEAM	PLATE GRIDER	3	0	0.0	0.0
42	1	BEAM	IPE300	0	0	3.3	114.4
43	1	BEAM	IPE300	0	0	3.3	0.0
44	1	BEAM	IPE200	0	0	2.2	61.0
45	1	BEAM	IPE180	0	0	2.0	52.0
46	1	BEAM	IPE300	0	0	2.8	99.8
47	1	BEAM	PLATE GRIDER	3	0	0.0	0.0
48	1	BEAM	PLATE GRIDER	3	0	0.0	0.0
49	1	BEAM	IPE180	0	0	1.7	44.7
50	1	BEAM	IPE140	0	0	1.5	35.3

ASSEMBLY LIST

Page: 2

Tekla Structures

Contract No: 500-103

Contract Name: Tekla Model

Date: 05/02/2019

Ass Mk	Qty	Name	Profile	Phase	Lot	Area	Wt
51	1	BEAM	IPE200	0	0	2.2	61.0
52	1	BEAM	PLATE GRIDER 3	0	0	0.0	0.0
53	1	BEAM	IPE180	0	0	2.0	52.0
54	1	BEAM	IPE240	0	0	4.2	134.3
55	1	BEAM	IPE270	0	0	4.9	162.6
56	2	BEAM	IPE270	0	0	9.5	315.1
57	1	BEAM	IPE270	0	0	4.8	158.9
58	1	BEAM	IPE220	0	0	4.0	118.7
59	2	BEAM	IPE220	0	0	7.7	230.1
60	2	BEAM	IPE220	0	0	7.8	232.1
61	1	BEAM	IPE200	0	0	3.1	0.0
62	3	BEAM	IPE200	0	0	9.2	257.3
63	1	BEAM	IPE200	0	0	3.1	86.6
64	1	BEAM	IPE140	0	0	2.2	50.9
65	3	BEAM	IPE160	0	0	7.5	183.2
66	1	BEAM	IPE160	0	0	2.5	0.0
67	1	BEAM	IPE140	0	0	2.2	49.6
68	1	BEAM	IPE200	0	0	3.0	84.5
69	3	BEAM	IPE220	0	0	9.9	295.9
70	1	BEAM	IPE220	0	0	3.3	0.0
71	1	BEAM	IPE140	0	0	2.2	49.6
72	1	BEAM	IPE200	0	0	3.0	84.5
73	3	BEAM	IPE220	0	0	9.9	295.9
74	1	BEAM	IPE220	0	0	3.3	0.0
75	1	BEAM	IPE200	0	0	3.1	0.0
76	1	BEAM	IPE200	0	0	3.1	0.0
77	2	BEAM	IPE200	0	0	6.2	171.5
78	1	BEAM	IPE200	0	0	3.1	86.6
79	1	BEAM	IPE200	0	0	3.5	98.4
80	1	BEAM	IPE220	0	0	3.9	0.0
81	1	BEAM	IPE220	0	0	4.0	118.7
82	1	BEAM	IPE220	0	0	3.9	115.0
83	1	BEAM	IPE220	0	0	3.9	116.0
84	1	BEAM	IPE200	0	0	3.5	98.4
85	1	BEAM	IPE220	0	0	3.9	0.0
86	2	BEAM	IPE220	0	0	7.7	230.1
87	1	BEAM	IPE220	0	0	3.9	116.0
88	1	BEAM	IPE200	0	0	3.1	86.6
89	2	BEAM	IPE240	0	0	7.4	234.1
90	1	BEAM	IPE240	0	0	3.7	0.0
91	1	BEAM	IPE240	0	0	3.7	0.0
92	1	BEAM	IPE300	0	0	3.3	0.0
93	2	BEAM	IPE270	0	0	5.9	194.2
94	1	BEAM	IPE270	0	0	3.0	98.5
95	1	BEAM	IPE220	0	0	2.4	71.9
96	1	BEAM	IPE300	0	0	2.8	98.2
97	1	BEAM	IPE270	0	0	2.5	83.3
98	1	BEAM	IPE270	0	0	2.5	0.0
99	1	BEAM	IPE270	0	0	2.6	0.0
100	1	BEAM	IPE220	0	0	2.1	61.8
101	1	BEAM	IPE300	0	0	3.3	114.4

ASSEMBLY LIST

Tekla Structures

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Contract No: 500-103

Contract Name: Tekla Model

Date: 05/02/2019

Ass Mk	Qty	Name	Profile	Phase	Lot	Area	Wt
102	1	BEAM	IPE270	0	0	2.9	0.0
103	1	BEAM	IPE270	0	0	3.0	0.0
104	1	BEAM	IPE220	0	0	2.4	71.9
105	1	BEAM	PLATE GRIDER 3	0	0	0.0	0.0
106	2	BEAM	IPE300	0	0	10.2	359.2
107	1	BEAM	IPE300	0	0	4.6	163.3
108	1	BEAM	IPE270	0	0	4.6	153.8
109	1	BEAM	IPE220	0	0	3.8	112.3
110	1	BEAM	PLATE GRIDER 3	0	0	0.0	0.0
111	1	BEAM	IPE200	0	0	3.4	95.2
112	3	BEAM	IPE240	0	0	12.2	386.2
113	1	BEAM	IPE240	0	0	4.1	0.0
114	1	BEAM	IPE300	0	0	3.3	114.4
115	1	BEAM	IPE200	0	0	2.2	0.0
116	1	BEAM	IPE240	0	0	2.6	82.0
117	1	BEAM	IPE270	0	0	2.9	97.1
118	1	BEAM	IPE160	0	0	1.8	43.4
119	1	BEAM	IPE140	0	0	1.3	30.8
120	1	BEAM	IPE300	0	0	2.8	98.2
121	1	BEAM	IPE240	0	0	2.3	0.0
122	2	BEAM	IPE270	0	0	5.0	166.5
123	1	BEAM	IPE270	0	0	2.6	84.6
124	1	BEAM	IPE300	0	0	3.3	114.4
125	1	BEAM	IPE300	0	0	3.3	0.0
126	1	BEAM	PLATE GRIDER 3	0	0	0.0	0.0
127	1	BEAM	PLATE GRIDER 3	0	0	0.0	0.0
128	1	BEAM	IPE160	0	0	1.8	43.4
129	1	BEAM	IPE140	0	0	0.7	15.1
130	2	BEAM	IPE140	0	0	1.2	26.5
131	2	BEAM	IPE140	0	0	1.2	27.0
132	5	BEAM	IPE140	0	0	5.5	125.6
133	1	BEAM	IPE140	0	0	0.9	20.5
134	2	BEAM	IPE140	0	0	1.6	37.3
135	2	BEAM	IPE140	0	0	1.7	37.8
136	1	BEAM	IPE200	0	0	2.1	57.8
137	1	COLUMN	BOX250*250*15	0	0	0.0	0.0
138	1	COLUMN	BOX250*250*15	0	0	0.0	0.0
139	1	COLUMN	BOX250*20	0	0	0.0	0.0
140	1	COLUMN	BOX250*20	0	0	0.0	0.0
141	1	COLUMN	BOX250*250*15	0	0	0.0	0.0
142	1	COLUMN	BOX250*250*15	0	0	0.0	0.0
143	1	COLUMN	BOX250*20	0	0	0.0	0.0
144	1	COLUMN	BOX250*20	0	0	0.0	0.0
145	1	COLUMN	BOX250*250*15	0	0	0.0	0.0
146	1	COLUMN	BOX250*250*15	0	0	0.0	0.0
147	1	COLUMN	BOX250*20	0	0	0.0	0.0
148	1	COLUMN	BOX250*20	0	0	0.0	0.0
149	1	COLUMN	BOX250*250*15	0	0	0.0	0.0
150	1	COLUMN	BOX250*250*15	0	0	0.0	0.0
151	1	COLUMN	BOX250*20	0	0	0.0	0.0
152	1	COLUMN	BOX250*20	0	0	0.0	0.0

ASSEMBLY LIST

Tekla Structures

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Contract No: 500-103

Contract Name: Tekla Model

Date: 05/02/2019

Ass Mk	Qty	Name	Profile	Phase	Lot	Area	Wt
153	1	COLUMN	BOX250*250*15	0	0	0.0	0.0
154	1	COLUMN	BOX250*250*15	0	0	0.0	0.0
155	1	COLUMN	BOX250*250*15	0	0	0.0	0.0
156	1	COLUMN	BOX250*20	0	0	0.0	0.0
157	1	COLUMN	BOX250*20	0	0	0.0	0.0
158	1	COLUMN	BOX250*250*15	0	0	0.0	0.0
159	1	COLUMN	BOX250*250*15	0	0	0.0	0.0
160	1	COLUMN	BOX250*250*15	0	0	0.0	0.0
161	1	COLUMN	BOX250*20	0	0	0.0	0.0
162	1	COLUMN	BOX250*20	0	0	0.0	0.0
163	1	COLUMN	BOX250*250*15	0	0	0.0	0.0
164	1	COLUMN	BOX250*250*15	0	0	0.0	0.0
165	1	COLUMN	BOX250*20	0	0	0.0	0.0
166	1	COLUMN	BOX250*250*15	0	0	0.0	0.0
167	1	COLUMN	BOX250*20	0	0	0.0	0.0
168	1	COLUMN	BOX250*250*15	0	0	0.0	0.0
169	1	COLUMN	BOX250*20	0	0	0.0	0.0
170	1	COLUMN	BOX250*250*15	0	0	0.0	0.0
171	1	COLUMN	BOX250*250*15	0	0	0.0	0.0
172	1	COLUMN	BOX250*250*15	0	0	0.0	0.0
173	1	COLUMN	BOX250*20	0	0	0.0	0.0
174	1	COLUMN	BOX250*20	0	0	0.0	0.0
175	1	COLUMN	BOX250*250*15	0	0	0.0	0.0
176	1	COLUMN	BOX250*250*15	0	0	0.0	0.0
177	1	COLUMN	BOX250*20	0	0	0.0	0.0
178	1	COLUMN	BOX250*20	0	0	0.0	0.0
179	1	COLUMN	BOX250*250*15	0	0	0.0	0.0
180	1	COLUMN	BOX250*250*15	0	0	0.0	0.0
181	1	COLUMN	BOX250*20	0	0	0.0	0.0
182	1	COLUMN	BOX250*250*15	0	0	0.0	0.0
183	1	COLUMN	BOX250*250*15	0	0	0.0	0.0
184	1	COLUMN	BOX250*250*15	0	0	0.0	0.0
185	1	COLUMN	BOX250*20	0	0	0.0	0.0
186	1	COLUMN	BOX250*20	0	0	0.0	0.0
187	1	COLUMN	BOX250*250*15	0	0	0.0	0.0
188	1	COLUMN	BOX250*250*15	0	0	0.0	0.0
189	1	COLUMN	BOX250*20	0	0	0.0	0.0
190	1	COLUMN	BOX250*20	0	0	0.0	0.0
191	1	COLUMN	BOX250*250*15	0	0	0.0	0.0
192	1	COLUMN	BOX250*250*15	0	0	0.0	0.0
193	1	COLUMN	BOX250*20	0	0	0.0	0.0
194	1	COLUMN	BOX250*250*15	0	0	0.0	0.0
195	1	COLUMN	BOX250*250*15	0	0	0.0	0.0
196	1	COLUMN	BOX250*20	0	0	0.0	0.0
197	1	COLUMN	BOX250*20	0	0	0.0	0.0
198	1	COLUMN	BOX250*250*15	0	0	0.0	0.0
199	1	COLUMN	BOX250*250*15	0	0	0.0	0.0
200	1	COLUMN	BOX250*20	0	0	0.0	0.0
201	1	COLUMN	BOX250*20	0	0	0.0	0.0
202	1	COLUMN	BOX250*250*15	0	0	0.0	0.0
203	1	COLUMN	BOX250*250*15	0	0	0.0	0.0

ASSEMBLY LIST

Tekla Structures

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Contract No: 500-103

Contract Name: Tekla Model

Date: 05/02/2019

Ass Mk	Qty	Name	Profile	Phase	Lot	Area	Wt
204	1	COLUMN	BOX250*20	0	0	0.0	0.0
205	1	COLUMN	BOX250*20	0	0	0.0	0.0
206	1	COLUMN	BOX250*250*15	0	0	0.0	0.0
207	1	COLUMN	BOX250*250*15	0	0	0.0	0.0
208	1	COLUMN	BOX250*20	0	0	0.0	0.0
209	1	COLUMN	BOX250*20	0	0	0.0	0.0
210	1	BRACE	2UNP80-D8	0	0	0.0	0.0
211	1	BRACE	2UNP80-D8	0	0	0.0	0.0
212	1	BRACE	2UNP80-D8	0	0	0.0	0.0
213	1	BRACE	2UNP100-D10	0	0	0.0	0.0
214	1	BRACE	2UNP100-D10	0	0	0.0	0.0
215	1	BRACE	2UNP80-D8	0	0	0.0	0.0
216	1	BRACE	2UNP80-D8	0	0	0.0	0.0
217	1	BRACE	2UNP80-D8	0	0	0.0	0.0
218	1	BRACE	2UNP80-D8	0	0	0.0	0.0
219	1	BRACE	2UNP80-D8	0	0	0.0	0.0
220	1	BRACE	2UNP80-D8	0	0	0.0	0.0
221	1	BRACE	2UNP80-D8	0	0	0.0	0.0
222	1	BRACE	2UNP80-D8	0	0	0.0	0.0
223	1	BRACE	2UNP80-D8	0	0	0.0	0.0
224	1	BRACE	2UNP80-D8	0	0	0.0	0.0
225	1	BRACE	2UNP80-D8	0	0	0.0	0.0
226	1	BRACE	2UNP80-D8	0	0	0.0	0.0
227	1	BRACE	2UNP80-D8	0	0	0.0	0.0
228	1	BRACE	2UNP100-D10	0	0	0.0	0.0
229	1	BRACE	2UNP100-D10	0	0	0.0	0.0
230	1	BRACE	2UNP80-D8	0	0	0.0	0.0
231	1	BRACE	2UNP80-D8	0	0	0.0	0.0
232	1	BRACE	2UNP80-D8	0	0	0.0	0.0
233	1	BRACE	2UNP80-D8	0	0	0.0	0.0
234	1	BRACE	2UNP80-D8	0	0	0.0	0.0
235	1	BRACE	2UNP80-D8	0	0	0.0	0.0
236	1	BRACE	2UNP80-D8	0	0	0.0	0.0
237	1	BRACE	2UNP80-D8	0	0	0.0	0.0
238	1	BRACE	2UNP80-D8	0	0	0.0	0.0
239	1	BRACE	2UNP80-D8	0	0	0.0	0.0
240	1	BRACE	2UNP80-D8	0	0	0.0	0.0
241	1	BRACE	2UNP80-D8	0	0	0.0	0.0
242	1	BEAM	FLT15*250	1	0	8.2	378.7
243	1	BEAM	FLT15*250	1	0	5.4	244.8
244	1	BEAM	FLT15*250	1	0	8.2	378.7
245	1	BEAM	FLT15*250	1	0	5.4	244.8
246	1	BEAM	FLT15*250	1	0	0.0	0.0
247	1	BEAM	FLT15*250	1	0	0.0	0.0
C0 (?)	16	COLUMN	FLT20*250	1	0	0.0	0.0
C1	1	COLUMN	FLT20*250	1	0	13.0	942.0
C2	2	COLUMN	FLT20*250	1	0	26.0	1884.0
C3	2	COLUMN	FLT20*250	1	0	26.0	1884.0
C4	1	COLUMN	FLT20*250	1	0	13.0	942.0
C5	3	COLUMN	FLT20*250	1	0	39.0	2826.0
C6	11	COLUMN	FLT20*250	1	0	143.0	10362.0

ASSEMBLY LIST							Page: 6
Tekla Structures		Contract Name: Tekla Model				Date: 05/02/2019	
Contract No: 500-103							
Ass Mk	Qty	Name	Profile	Phase	Lot	Area	W
C7	1	COLUMN	FLT20*250	1	0	0.0	0.0
C8	1	COLUMN	FLT15*250	1	0	6.8	376.8
C9	1	COLUMN	FLT15*250	1	0	0.0	0.0
C10	1	COLUMN	FLT15*250	1	0	0.0	0.0
C20(?)	7	COLUMN	FLT15*250	1	0	0.0	0.0
C22	1	COLUMN	FLT15*250	1	0	6.8	376.8
C23	1	COLUMN	FLT15*250	1	0	6.8	376.6
C24	61	COLUMN	FLT15*250	1	0	415.4	22969.7
Totals for report (432 Assemblies)						1280.5	59782.3

Tekla Structures

Date: 05/02/2019

Ass Mk	Qty	Name	Profile	Phase	Lot	Area	Wt
C7	1	COLUMN	FLT20*250	1	0	0.0	0.0
C8	1	COLUMN	FLT15*250	1	0	6.8	376.8
C9	1	COLUMN	FLT15*250	1	0	0.0	0.0
C10	1	COLUMN	FLT15*250	1	0	0.0	0.0
C20 (?)	7	COLUMN	FLT15*250	1	0	0.0	0.0
C22	1	COLUMN	FLT15*250	1	0	6.8	376.8
C23	1	COLUMN	FLT15*250	1	0	6.8	376.6
C24	61	COLUMN	FLT15*250	1	0	415.4	22969.7
Totals for report (432 Assemblies)						1280.5	59782.3

Type	Size (mm)	Length (m)	Cross Area (mm2)	Volume (cm3)	Weight (kg)
Above Line:					
Fillet	6.0	1332.69	36.0	47158.1	370.19
Fillet	3.0	56.88	9.0	512.0	4.019
Below Line:					
Fillet	6.0	89.61	0.0	1591.4	12.492
Fillet	3.0	56.88	9.0	511.9	4.018
Fillet	0.0	0.00	0.0	0.0	0.000
TOTAL:		1536.1		49773	390.721