Connection B1

input data		
web length	44	cm
web thickness	1.5	cm
flange length	20	cm
flange thickness	2	cm
D (plate length)	55	cm
B (plate Width)	45	cm
N Normal force	177	ton
Qx	4	tons
Qy	1.8	tons
Q shear force	4.38634244	ton
concrete bearing capacity	77	kg/cm2
tp , plate thickness	2	cm
steel yield stress	3.6	ton/cm2
steel ultimate stress	5.2	ton/cm2
bolt diameter	10	mm
bolts count	2	count
flange weld thickness	2	cm
web weld thickness	0.4	cm
stiffeners count , m direction	0	stiffenere
stiffener thickness , m directio	2	cm
stiffener length , m direction	20	cm
stiffeners count , n direction	2	stiffenere
stiffener thickness , n directio	2	cm
stiffener length , n direction	20	cm

output data		
beam depth h	48	cm
d (effective depth)	45.6	cm
b (effective width)	16	cm
m	4.7	cm
n	14.5	cm
.....plate calculations.....		
plate Area	2475	cm2
plate section area , A1	90	cm2
plate inertia , I_{x1}	30	cm4
max allowable free length without stiffener	6.951648993	cm
.....moment calculations		
Moment /cm , n direction	7.518030303	ton.cm/cm
Moment /cm , m direction	0.789884848	ton.cm/cm
moment , n direction	413.4916667	ton.cm
moment , m direction	35.54481818	ton.cm
.....stresses calculations.....		
Applied concrete stress	0.071515152	ton/cm2
Concrete Bearing safty	safe	
steal allowable stress 0.72Fy	2.592	ton/cm2
center of gravity , m direction	1	cm
total inertia , Ix , m direction	30	cm4
Applied steel stress , m direction	1.184827273	ton/Cm1
center of gravity , n direction	6.789473684	cm
total inertia , Ix , n direction	7428.245614	cm4
Applied steel stress , n direction	0.055664781	ton/Cm2
safety	safe	

m direction stiffneres , flanges plan perpendicular stiffeners		
min stifferer plan length , Lst,min	no stiffeners required	cm
stiffeners length , bst	0	cm
stiffeners thickness min , tst,min	0	cm
stiffener thickness , tst	2	cm
stiffener weld thickness	2	cm
stiffener weld length	0	cm
Qy applied on stiffeners	15.12545455	ton
Qy per stiffener	#DIV/0!	ton
qy , shear stress on weld	#DIV/0!	ton / cm2
f , normal stress due to bending on weld	-1.184827273	ton / cm2
feq , equivalent stress	#DIV/0!	ton / cm2
stiffeners weld safety	#DIV/0!	
stiffeners area , A2	0	cm2
stiffeners inertia , Ix2	0	cm4

web plan perpendicular stiffeners , welded on flages		
min stifferer plan length , Lst,min	5.548351007	cm
stiffeners length , bst	20	cm
stiffeners thickness min , tst,min	1.25	cm
stiffener thickness , tst	2	cm
stiffener weld thickness	2	cm
stiffener weld length	40	cm
Qy applied on stiffeners	57.03333333	ton
Qy per stiffener	28.51666667	ton
qy , shear stress on weld	0.356458333	ton / cm2
f , normal stress due to bending on weld	0.735361057	ton / cm2
feq , equivalent stress	0.960178897	ton / cm2
stiffeners weld safety	safe	
stiffeners area , A2	50	cm2
stiffeners inertia , Ix2	833.3333333	cm4

shear bolts threaded bolts		
Area bolt	0.785398163	cm2
Rsh	2.336559536	tons
Rbear	10.608	tons
R max	2.336559536	tons
R max , all bolts	4.673119072	cm
bolt length	20	cm
safety	safe	cm

plate welding		
Fu,weld	1.04	t/cm2
flange weld length	73	cm
web weld length	84	cm
FN	0.985523385	t/cm2
FQ	0.024422842	t/cm3
Feq	0.986430823	t/cm4
safety	safe	

Connection B2

input data		
web length	30	cm
web thickness	1	cm
flange length	24	cm
flange thickness	2	cm
D (plate length)	44	cm
B (plate Width)	64	cm
N Normal force	215	ton
Qx	0.5	tons
Qy	0	tons
Q shear force	0.5	ton
concrete bearing capacity	77	kg/cm2
tp , plate thickness	2	cm
steel yield stress	3.6	ton/cm2
steel ultimate stress	5.2	ton/cm2
bolt diameter	10	mm
bolts count	2	count
flange weld thickness	2	cm
web weld thickness	0.4	cm
stiffeners count , m direction	0	stiffenere
stiffener thickness , m directio	1.5	cm
stiffener height , m direction	20	cm
stiffeners count , n direction	2	stiffenere
stiffener thickness , n directio	2	cm
stiffener height , n direction	24	cm

output data		
beam depth h	34	cm
d (effective depth)	32.3	cm
b (effective width)	19.2	cm
m	5.85	cm
n	22.4	cm
.....plate calculations.....		
plate Area	2816	cm2
plate section area , A1	128	cm2
plate inertia , I_{x1}	42.66666667	cm4
max allowable free length without stiffener	6.727968697	cm
.....moment calculations		
Moment /cm , n direction	19.15454545	ton.cm/cm
Moment /cm , m direction	1.306434215	ton.cm/cm
moment , n direction	842.8	ton.cm
moment , m direction	83.61178977	ton.cm
.....stresses calculations.....		
Applied concrete stress	0.076349432	ton/cm2
Concrete Bearing safty	safe	
steal allowable stress 0.72Fy	2.592	ton/cm2
center of gravity , m direction	1	cm
total inertia , Ix , m direction	42.66666667	cm4
Applied steel stress , m direction	1.959651323	ton/Cm1
center of gravity , n direction	7.882352941	cm
total inertia , Ix , n direction	14950.90196	cm4
Applied steel stress , n direction	0.056371181	ton/Cm2
safety	safe	

m direction stiffneres , flanges plan perpendicular stiffeners		
min stifferer plan length , bst,min	0	cm
stiffeners height , hst	0	cm
stiffeners thickness min , tst,min	0	cm
stiffener thickness , tst	1.5	cm
stiffener weld thickness	1.5	cm
stiffener weld length	0	cm
Qy applied on stiffeners	28.58522727	ton
Qy per stiffener	#DIV/0!	ton
qy , shear stress on weld	#DIV/0!	ton / cm2
f , normal stress due to bending on weld	-1.959651323	ton / cm2
feq , equivalent stress	#DIV/0!	ton / cm2
stiffeners weld safety	#DIV/0!	
stiffeners area , A2	0	cm2
stiffeners inertia , Ix2	0	cm4

n direction stiffners , web plan perpendicular stiffeners , welded on flages		
min stifferer plan length , bst,min	13.2720313	cm
stiffeners height , hst	24	cm
stiffeners thickness min , tst,min	1.5	cm
stiffener thickness , tst	2	cm
stiffener weld thickness	2	cm
stiffener weld length	48	cm
Qy applied on stiffeners	75.25	ton
Qy per stiffener	37.625	ton
qy , shear stress on weld	0.391927083	ton / cm2
f , normal stress due to bending on weld	0.908570799	ton / cm2
feq , equivalent stress	1.134161105	ton / cm2
stiffeners weld safety	safe	
stiffeners area , A2	72	cm2
stiffeners inertia , Ix2	1728	cm4

shear bolts threaded bolts		
Area bolt	0.785398163	cm2
Rsh	2.336559536	tons
Rbear	10.608	tons
R max	2.336559536	tons
R max , all bolts	4.673119072	tons
bolt length	20	cm
safety	safe	cm

plate welding		
Fu,weld	1.04	t/cm2
flange weld length	90	cm
web weld length	56	cm
stiffeners to plate weld area	42.47050017	cm2
FN	0.878015114	t/cm2
FQ	0.002041896	t/cm3
Feq	0.878022236	t/cm4
safety	safe	

Connection B3

input data			output data		
web length	20	cm	beam depth h	24	cm
web thickness	1	cm	d (effective depth)	22.8	cm
flange length	26	cm	b (effective width)	20.8	cm
flange thickness	2	cm	m	13.6	cm
D (plate length)	50	cm	n	14.6	cm
B (plate Width)	50	cm	.....plate calculations.....		
N Normal force	180	ton	plate Area	2500	cm2
Qx	1	tons	plate section area , A1	100	cm2
Qy	12	tons	plate inertia , I_{x1}	33.33333333	cm4
Q shear force	12.04159458	ton	max allowable free length without stiffener	6.92820323	cm
concrete bearing capacity	77	kg/cm2	.....moment calculations		
tp , plate thickness	2	cm	Moment /cm , n direction	7.67376	ton.cm/cm
steel yield stress	3.6	ton/cm2	Moment /cm , m direction	6.65856	ton.cm/cm
steel ultimate stress	5.2	ton/cm2	moment , n direction	383.688	ton.cm
bolt diameter	16	mm	moment , m direction	332.928	ton.cm
bolts count	2	count	.....stresses calculations.....		
flange weld thickness	2	cm	Applied concrete stress	0.072	ton/cm2
web weld thickness	0.4	cm	Concrete Bearing safty	safe	
stiffeners count , m direction	2	stiffenere	steal allowable stress 0.72Fy	2.592	ton/cm2
stiffener thickness , m direction	2	cm	center of gravity , m direction	5.475138122	cm
stiffener length , m direction	18	cm	total inertia , Ix , m direction	5601.971455	cm4
stiffeners count , n direction	2	stiffenere	Applied steel stress , m direction	0.863219896	ton/Cm1
stiffener thickness , n direction	2	cm	center of gravity , n direction	1.330275229	cm
stiffener length , n direction	6	cm	total inertia , Ix , n direction	178.9434251	cm4
			Applied steel stress , n direction	2.144186074	ton/Cm2
			safety	safe	

m direction stiffneres , flanges plan perpendicular stiffeners		
min stifferer plan length , Lst,min	6.07179677	cm
stiffeners height , bst	18	cm
stiffeners thickness min , tst,min	1.125	cm
stiffener thickness , tst	2	cm
stiffener weld thickness	2	cm
stiffener weld length	36	cm
Qy applied on stiffeners	48.96	ton
Qy per stiffener	24.48	ton
qy , shear stress on weld	0.34	ton / cm2
f , normal stress due to bending on weld	0.744358883	ton / cm2
feq , equivalent stress	0.949141795	ton / cm2
stiffeners weld safety	safe	
stiffeners area , A2	40.5	cm2
stiffeners inertia , Ix2	546.75	cm4

n direction stiffners , web plan perpendicular stiffeners , welded on flages		
min stifferer plan length , Lst,min	5.07179677	cm
stiffeners height , bst	6	cm
stiffeners thickness min , tst,min	0.375	cm
stiffener thickness , tst	2	cm
stiffener weld thickness	2	cm
stiffener weld length	12	cm
Qy applied on stiffeners	52.56	ton
Qy per stiffener	26.28	ton
qy , shear stress on weld	1.095	ton / cm2
f , normal stress due to bending on weld	10.01275882	ton / cm2
feq , equivalent stress	10.19080047	ton / cm2
stiffeners weld safety	unsafe	
stiffeners area , A2	4.5	cm2
stiffeners inertia , Ix2	6.75	cm4

shear bolts threaded bolts		
Area bolt	2.010619298	cm2
Rsh	9.57054786	tons
Rbear	16.9728	tons
R max	9.57054786	tons
R max , all bolts	19.14109572	tons
bolt length	30	cm
safety	safe	cm

plate welding		
Fu,weld	1.04	t/cm2
flange weld length	92.4	cm
web weld length	32	cm
stiffeners to plate v	29.25949933	cm2
FN	0.79344264	t/cm2
FQ	0.053079525	t/cm3
Feq	0.798751232	t/cm4
safety	safe	

Connection B3 (crane column)

input data		
web length	22	cm
web thickness	1	cm
flange length	15	cm
flange thickness	2	cm
D (plate length)	32	cm
B (plate Width)	30	cm
N Normal force	68	ton
Q shear force	0	ton
concrete bearing capacity	77	kg/cm2
tp , plate thickness	2	cm
steel yield stress	3.6	ton/cm2
steel ultimate stress	5.2	ton/cm2
bolt diameter	10	mm
bolts count	2	count
flange weld thickness	1	cm
web weld thickness	0.4	cm
stiffeners count , m direction	0	stiffenere
stiffener thickness , m direction	2	cm
stiffener length , m direction	10	cm
stiffeners count , n direction	2	stiffenere
stiffener thickness , n direction	2	cm
stiffener length , n direction	4	cm

output data		
beam depth h	26	cm
d (effective depth)	24.7	cm
b (effective width)	12	cm
m	3.65	cm
n	9	cm
.....plate calculations.....		
plate Area	960	cm2
plate section area , A1	60	cm2
plate inertia , I_{x1}	20	cm4
max allowable free length without stiffener	6.985026001	cm
.....moment calculations		
Moment /cm , n direction	2.86875	ton.cm/cm
Moment /cm , m direction	0.471838542	ton.cm/cm
moment , n direction	91.8	ton.cm
moment , m direction	14.15515625	ton.cm
.....stresses calculations.....		
Applied concrete stress	0.070833333	ton/cm2
Concrete Bearing safty	safe	
steal allowable stress 0.72Fy	2.592	ton/cm2
center of gravity , m direction	1	cm
total inertia , Ix , m direction	20	cm4
Applied steel stress , m direction	0.707757813	ton/Cm1
center of gravity , n direction	1.1875	cm
total inertia , Ix , n direction	56.41666667	cm4
Applied steel stress , n direction	1.62717873	ton/Cm2
safety	safe	

m direction stiffneres , flanges plan perpendicular stiffeners		
min stifferer plan length , Lst,min	0	cm
stiffeners height , bst	0	cm
stiffeners thickness min , tst,min	0	cm
stiffener thickness , tst	2	cm
stiffener weld thickness	2	cm
stiffener weld length	0	cm
Qy applied on stiffeners	7.75625	ton
Qy per stiffener	#DIV/0!	ton
qy , shear stress on weld	#DIV/0!	ton / cm2
f , normal stress due to bending on weld	-0.707757813	ton / cm2
feq , equivalent stress	#DIV/0!	ton / cm2
stiffeners weld safety	#DIV/0!	
stiffeners area , A2	0	cm2
stiffeners inertia , Ix2	0	cm4

n direction stiffners , web plan perpendicular stiffeners , welded on flages		
min stifferer plan length , Lst,min	0.514973999	cm
stiffeners height , bst	4	cm
stiffeners thickness min , tst,min	0.25	cm
stiffener thickness , tst	2	cm
stiffener weld thickness	2	cm
stiffener weld length	8	cm
Qy applied on stiffeners	20.4	ton
Qy per stiffener	10.2	ton
qy , shear stress on weld	0.6375	ton / cm2
f , normal stress due to bending on weld	4.576440177	ton / cm2
feq , equivalent stress	4.707762042	ton / cm2
stiffeners weld safety , fillet	unsafe	
stiffeners area , A2	2	cm2
stiffeners inertia , Ix2	1.333333333	cm4

shear bolts threaded bolts		
Area bolt	0.785398163	cm2
Rsh	2.336559536	tons
Rbear	10.608	tons
R max	2.336559536	tons
R max , all bolts	4.673119072	tons
bolt length	20	cm
safety	safe	cm

plate welding		
Fu,weld	1.04	t/cm2
flange weld length	10	cm
web weld length	44	cm
stiffeners to plate w	3.295833593	cm2
FN	0.744831361	t/cm2
FQ	0.021906805	t/cm3
Feq	0.745797212	t/cm4
safety	safe	

Connection B4 (crane column)

input data		
web length	22	cm
web thickness	1	cm
flange length	15	cm
flange thickness	2	cm
D (plate length)	50	cm
B (plate Width)	50	cm
N Normal force	180	ton
Qx	1	tons
Qy	0	tons
Q shear force	1	ton
concrete bearing capacity	77	kg/cm2
tp , plate thickness	2	cm
steel yield stress	3.6	ton/cm2
steel ultimate stress	5.2	ton/cm2
bolt diameter	10	mm
bolts count	2	count
flange weld thickness	2	cm
web weld thickness	1	cm
stiffeners count , m direction	3	stiffenere
stiffener thickness , m direction	2	cm
stiffener length , m direction	12	cm
stiffeners count , n direction	2	stiffenere
stiffener thickness , n direction	2	cm
stiffener length , n direction	8	cm

output data		
beam depth h	26	cm
d (effective depth)	24.7	cm
b (effective width)	12	cm
m	12.65	cm
n	19	cm
.....plate calculations.....		
plate Area	2500	cm2
plate section area , A1	100	cm2
plate inertia , I_{x1}	33.33333333	cm4
max allowable free length without stiffener	6.92820323	cm
.....moment calculations		
Moment /cm , n direction	12.996	ton.cm/cm
Moment /cm , m direction	5.76081	ton.cm/cm
moment , n direction	649.8	ton.cm
moment , m direction	288.0405	ton.cm
.....stresses calculations.....		
Applied concrete stress	0.072	ton/cm2
Concrete Bearing safty	safe	
steal allowable stress 0.72Fy	2.592	ton/cm2
center of gravity , m direction	4.132596685	cm
total inertia , Ix , m direction	2550.151013	cm4
Applied steel stress , m direction	1.114526854	ton/Cm1
center of gravity , n direction	1.689655172	cm
total inertia , Ix , n direction	420.8275862	cm4
Applied steel stress , n direction	1.544100295	ton/Cm2
safety	safe	

m direction stiffneres , flanges plan perpendicular stiffeners		
min stifferer plan length , $b_{st,min}$	5.07179677	cm
stiffeners height , Lst	12	cm
stiffeners thickness min , $t_{st,min}$	0.75	cm
stiffener thickness , t_{st}	2	cm
stiffener weld thickness	2	cm
stiffener weld length	24	cm
Qy applied on stiffeners	45.54	ton
Qy per stiffener	15.18	ton
q_y , shear stress on weld	0.31625	ton / cm2
f , normal stress due to bending on weld	0.888626114	ton / cm2
f_{eq} , equivalent stress	1.043886276	ton / cm2
stiffeners weld safety	safe	
stiffeners area , A2	27	cm2
stiffeners inertia , I_{x2}	108	cm4

n direction stiffners , web plan perpendicular stiffeners , welded on flages		
min stifferer plan length , $b_{st,min}$	10.57179677	cm
stiffeners height , Lst	8	cm
stiffeners thickness min , $t_{st,min}$	0.5	cm
stiffener thickness , t_{st}	2	cm
stiffener weld thickness	2	cm
stiffener weld length	16	cm
Qy applied on stiffeners	68.4	ton
Qy per stiffener	34.2	ton
q_y , shear stress on weld	1.06875	ton / cm2
f , normal stress due to bending on weld	9.74380531	ton / cm2
f_{eq} , equivalent stress	9.918085581	ton / cm2
stiffeners weld safety , fillet	unsafe	
stiffeners area , A2	8	cm2
stiffeners inertia , I_{x2}	21.33333333	cm4

shear bolts threaded bolts		
Area bolt	0.785398163	cm2
R_{sh}	2.336559536	tons
R_{bear}	10.608	tons
R max	2.336559536	tons
R max , all bolts	4.673119072	tons
bolt length	20	cm
safety	safe	cm

plate welding		
Fu,weld	1.04	t/cm2
flange weld length	42	cm
web weld length	36	cm
stiffeners to plate weld area	48.57437416	cm2
FN	1.067777952	t/cm2
FQ	0.0059321	t/cm3
Feq	1.067827385	t/cm4
safety	unsafe	

Connection B4

input data		
web length	68	cm
web thickness	2	cm
flange length	42	cm
flange thickness	2	cm
C1	5	cm
D (plate length)	145	cm
tp , plate thickness	2	cm
Straining actions		
N Normal force	189	ton
Qx	7.8	ton
Qy	14	tons
Q eq	16.03	ton
M moment	48	m . Ton
stiffiners		
stiffeners count	5	stiffenere for one flange
stiffener thickness , tst	2	cm
stiffener height , hst	24	cm
bolts		
bolts rows	2	rows
bolt diameter	22	mm
weld		
flange weld thickness	2	cm
web weld thickness	1	cm

plate calculations		
web length	68	cm
web thickness	2	cm
flange length	42	cm
flange thickness	2	cm
beam depth h	72	cm
C1	5	cm
C2	14	cm
D (plate length)	145	cm
B (plate Width)	70	cm
tp , plate thickness	2	cm
(D - beam depth h) / 2	36.5	cm
e	25.3968254	cm
stress core	24.1666667	cm
comp. and tension bolts spacing , h* , spacing bet. C.g. of stiffeners	103.5	cm
Compression force	140.876812	ton
Tension Force	48.1231884	ton
a (third comp. stress in case of tension existance)	20.75	cm
.....Plate Properties of area calculations.....		
plate surface Area	10150	cm2
plate surface inertia , Ix	17783645.83	cm4
plate section area , A1	140	cm2
plate section center of gravity	1	cm
plate section inertia	46.66666667	cm4
Applied moment on Plate , due to compression	54.30486278	ton cm
tp , plate thickness , required for compression	1.34	cm
plate thickness safety , for compression	safe	cm
.....M-section Properties of area calculations.....		
Area	380	cm2
center of gravity	9.21052632	cm
inertia	26509.8246	cm4
moment @ M-sec	2131.07732	ton cm
shear force @ M-sec	116.77136	tons
max normal stress	1.34967572	ton/cm2
shear stress	0.30729305	ton/cm2
combined stress	1.38421587	ton/cm2
section safety	safe	safety

stiffeners calculations		
stiffeners count	5	stiffenere
stiffeners spacing , center to center	9	cm
stiffeners clear spacing , X	7	cm
stiffener thickness , tst	2	cm
stiffener height , hst	24	cm
stiffeners length , bst	31.5	cm
buckling check bst / tst	15.75	buckling
buckling safety	safe	safety
.....section M , weld of stiffeners and plate section calculations.....		
stiffener weld length = hst - Sw	22	cm
stiffener weld thickness , sw	2	cm
area	580	cm2
center of gravity	10.10344828	cm
inertia	33087.12644	cm2
fn , normal stress on weld	0.89504981	ton/cm2
qy , shear stress on Weld	0.201329931	ton/cm2
feq , equivalent stress	0.960580755	ton / cm2
stiffeners weld safety	safe	safety

shear bolts threaded bolts , Anchor bolts		
bolts count	8	All bolts
construction condition , 3D , edge and flange spacing	safe	safety
construction condition , 3D , stiffeners spacing	safe	safety
Area bolt	3.801327111	cm2
Rsh	4.071221336	tons
Rbear	23.3376	tons
R max	4.071221336	tons
Q per Bolt	2.00375	tons
Tension allowable	6.746595356	tons
Tension per bolt	6.015398551	tons
circular equation	1.037221431	
bolt straining actions safety	unsafe	safety
.....bolts length		
bold stress for concrete	9	kg/cm2
required bolt length	50	cm
Area washer plate	37.73015355	cm2
washer plate length	6.14	cm
moment on washer plate	2.227952111	ton cm
washer plate thickness	1.444089519	cm

flanges and web welding		
Fu,weld	1.04	t/cm2
flange weld length	50	cm
web weld length	128	cm
stiffeners to plate weld area	252	cm2
weld area	480	cm2
weld inertia	496726.5417	cm3
FN	0.893823942	t/cm2
FQ	0.033395833	t/cm3
Feq	0.895693634	t/cm4
safety	safe	

Top Plate Design		
plate width	29.1	cm
moment on plate	27.06929348	ton cm
plate thickness required	1.63	cm

Resistance Stresses		
steel yield stress	3.6	ton/cm2
steel ultimate stress	5.2	ton/cm2
plate section allowable stress 0.58Fy	2.088	ton/cm2
plate section allowable stress 0.72Fy	2.592	ton/cm3
concrete bearing capacity	77	kg/cm2

Applied Stresses		
have tension ?	have tension	
max stress (concrete stress)	0.064659466	t/cm2
stress on concrete @ stiffeners edge	0.059465935	
stress on concrete @ bolt	0.043106311	t/cm2
stress concrete @ flange	0.026746687	t/cm2
average Concrete stress (max , @bolt)	0.055743904	t/cm2
average concrete stress (max , @flange)	0.045703076	t/cm2
concrete bearing safety	safe	safety

Connection B5

input data		
web length	50	cm
web thickness	1.5	cm
flange length	24	cm
flange thickness	2	cm
C1	5	cm
D (plate length)	120	cm
tp , plate thickness	2	cm
Straining actions		
N Normal force	56	ton
Qx	7.5	ton
Qy	4	tons
Q eq	8.5	ton
M moment	49	m . Ton
stiffiners		
stiffeners count	3	stiffenere
stiffener thickness , tst	2	cm
stiffener height , hst	22	cm
bolts		
bolts rows	3	rows
bolt diameter	22	mm
weld		
flange weld thickness	2	cm
web weld thickness	1	cm
stiffeners to plate weld thickness	1	cm

plate calculations		
web length	50	cm
web thickness	1.5	cm
flange length	24	cm
flange thickness	2	cm
beam depth h	54	cm
C1	5	cm
C2	8	cm
D (plate length)	120	cm
B (plate Width)	40	cm
tp , plate thickness	2	cm
(D - beam depth h) / 2	33	cm
e	87.5	cm
stress core	20	cm
comp. and tension bolts spacing , h* , spacing bet. C.g. of stiffeners	82	cm
Compression force	87.7560976	ton
Tension Force	31.7560976	ton
a (third comp. stress in case of tension existance)	19	cm
.....Plate Properties of area calculations.....		
plate surface Area	4800	cm2
plate surface inertia , Ix	5760000	cm4
plate section area , A1	80	cm2
plate section center of gravity	1	cm
plate section inertia	26.66666667	cm4
Applied moment on Plate , due to compression	36.80137979	ton cm
tp , plate thickness , required for compression	1.46	cm
plate thickness safety , for compression	safe	cm
.....M-section Properties of area calculations.....		
Area	212	cm2
center of gravity	8.47169811	cm
inertia	11958.761	cm4
moment @ M-sec	1191.27079	ton cm
shear force @ M-sec	72.1982298	tons
max normal stress	1.54685025	ton/cm2
shear stress	0.34055769	ton/cm2
combined stress	1.58389559	ton/cm2
section safety	safe	safety

stiffeners calculations		
stiffeners count	3	stiffenere
stiffeners spacing , center to center	9	cm
stiffeners clear spacing , X	7	cm
stiffener thickness , tst	2	cm
stiffener height ,hst	22	cm
stiffeners length , bst	28	cm
buckling check bst / tst	14	buckling
buckling safety	safe	safety
.....section M , weld of stiffeners and plate section calculations.....		
stiffener weld length = hst - Sw	20	cm
stiffener weld thickness , sw	2	cm
area	320	cm2
center of gravity	9.25	cm
inertia	15286.66667	cm2
fn , normal stress on weld	0.993591535	ton/cm2
qy , shear stress on Weld	0.225619468	ton/cm2
feq , equivalent stress	1.067678122	ton / cm2
stiffeners weld safety	safe	safety

flanges and web welding		
Fu,weld	1.04	t/cm2
flange weld length	26.5	cm
web weld length	92	cm
stiffeners to plate weld area	312	cm2
weld area	457	cm2
weld inertia	311583.6667	cm3
FN	0.767308933	t/cm2
FQ	0.018599562	t/cm3
Feq	0.767984915	t/cm4
safety	safe	

Top Plate Design		
plate width	25.6	cm
moment on plate	35.72560976	ton cm
plate thickness required	2	cm

shear bolts threaded bolts , Anchor bolts		
bolts count	6	All bolts
construction condition , 3D , edge and flange spacing	safe	safety
construction condition , 3D , stiffeners spacing	safe	safety
Area bolt	3.801327111	cm2
Rsh	4.071221336	tons
Rbear	23.3376	tons
R max	4.071221336	tons
Q per Bolt	1.416666667	tons
Tension allowable	6.746595356	tons
Tension per bolt	5.292682927	tons
circular equation	0.736519103	
bolt straining actions safety	safe	safety
.....bolts length		
bold stress for concrete	9	kg/cm2
required bolt length	50	cm
Area washer plate	28.34423636	cm2
washer plate length	5.32	cm
moment on washer plate	1.449224392	ton cm
washer plate thickness	1.251230659	cm

Resistance Stresses		
steel yield stress	3.6	ton/cm2
steel ultimate stress	5.2	ton/cm2
plate section allowable stress 0.58Fy	2.088	ton/cm2
plate section allowable stress 0.72Fy	2.592	ton/cm3
concrete bearing capacity	77	kg/cm2

Applied Stresses		
have tension ?	have tension	
max stress (concrete stress)	0.076979033	t/cm2
stress on concrete @ stiffeners edge	0.070226486	
stress on concrete @ bolt	0.051319355	t/cm2
stress concrete @ flange	0.032412224	t/cm2
average Concrete stress (max , @bolt)	0.066174958	t/cm2
average concrete stress (max , @flange)	0.054695629	t/cm2
concrete bearing safety	safe	safety

Connection M1 and M2

Prying force calculations					welding			
w	10	cm	inverse prop.		steel ultimate stress	5.2	t/cm2	
a	6	cm	inverse prop.		allowable stress	1.04	t/cm2	
b	4	cm	direct prop.		Q	5	t	
As	4.59	cm2	direct prop.		Mx	30	tm	
tp	2	cm	inverse prop.		flange	20	cm	
Text,b	24	tons			flange thickness	2	cm	
Text,act	12.660198	tons			web	60	cm	
P	3.96212297	tons			web thickness	1	cm	
P%	0.312959005				web weld length	58	cm	
total applied	16.622321	tons			web weld thicnkess	0.4	cm	
tension req.	21.10033	tons	pass		flange upper weld length	20	cm	
ten+prying req.	20.7779012	tons	pass		flange lower weld length	17	cm	
					flange weld thickness	1.1	cm	
					Ix	91723.5	cm 3	
					A (axial stress)	1.01719	t/cm2	pass
					B (axial stress)	0.98121	t/cm2	pass
					web (shear stress)	0.10776	t/cm2	pass
					B (combined stress)	0.9988	t/cm2	pass

Q	5	t	straining actions										
M	30	tm			bolt yield stress	9	t/cm2						
Ix	9878400000	mm4	Plate inertia										
Y mm	stress t/cm2	w cm	h cm	applied force t	force / 0.6 t	bolt Diam.	T bolt	ratio	is safe	n	ps	Qall	
420	0.12755102	10	11.5	12.66019801	21.10033001	24	22.23041227	0.949165	pass	6	8.89216	22.96851	
305	0.092626336	10	8.5	6.776147959	11.29357993	20	15.4377863	0.731554	pass	4	6.17511	13.85862	
220	0.066812439	10	22	7.349368319	12.2489472	20	15.4377863	0.793439	pass	4	6.17511	12.94147	
		Qall		21.2423939	tons	pass							
		Flanges weld		1.1	cm								
		web weld		0.4	cm								

Connection M3 and M4

Prying force calculations			
w	8.75	cm	inverse prop.
a	6	cm	inverse prop.
b	4	cm	direct prop.
As	4.59	cm2	direct prop.
tp	2	cm	inverse prop.
Text,b	15.4377863	tons	
Text,act	7.72895592	tons	
P	2.42870412	tons	
P%	0.314234437		
total applied	10.15766	tons	
tension req.	12.8815932	tons	pass
ten+prying req.	12.6970751	tons	pass

welding			
steel ultimate stress	5.2	t/cm2	
allowable stress	1.04	t/cm2	
Q	5	t	
Mx	30	tm	
flange	24	cm	
flange thickness	2	cm	
web	70	cm	
web thickness	1	cm	
web weld length	68	cm	
web weld thicnkess	0.4	cm	
flange upper weld length	24	cm	
flange lower weld length	21	cm	
flange weld thickness	0.8	cm	
Ix	114692	cm 3	
A (axial stress)	0.93642	t/cm2	pass
B (axial stress)	0.9155	t/cm2	pass
web (shear stress)	0.09191	t/cm2	pass
B (combined stress)	0.92924	t/cm2	pass

Q	5	t	straining actions			
M	30	tm		bolt yield stress	9	t/cm2
Ix	17300000000	mm4	Plate inertia			

Y mm	stress t/cm2	w cm	h cm	applied force t	force / 0.6 t	bolt Diam.	T bolt	ratio	is safe	n	ps	Qall
470	0.08150289	8.75	12.5	7.728955925	12.88159321	20	15.4377863	0.83442	pass	6	6.17511	18.50119
345	0.05982659	15	10.5	7.988800578	13.31466763	20	15.4377863	0.862473	pass	4	6.17511	11.91838
240	0.041618497	15	24	7.49132948	12.48554913	20	15.4377863	0.808766	pass	4	6.17511	12.71433

Qall	43.133901	tons	pass
Flanges weld	0.8	cm	
web weld	0.4	cm	

Connection M5

Prying force calculations					welding			
w	6.5	cm	inverse prop.		steel ultimate stress	5.2	t/cm2	
a	6	cm	inverse prop.		allowable stress	1.04	t/cm2	
b	4	cm	direct prop.		Q	1.5	t	
As	4.59	cm2	direct prop.		Mx	10	tm	
tp	2	cm	inverse prop.		flange	120	cm	
Text,b	15.4377863	tons			flange thickness	2	cm	
Text,act	7.73620605	tons			web	65	cm	
P	2.44879137	tons			web thickness	1	cm	
P%	0.316536471				web weld length	63	cm	
total applied	10.1849974	tons			web weld thicnkess	0.4	cm	
tension req.	12.8936768	tons	pass		flange upper weld length	120	cm	
ten+prying req.	12.7312468	tons	pass		flange lower weld length	117	cm	
					flange weld thickness	0.4	cm	
					Ix	229799	cm 3	
					A (axial stress)	0.14317	t/cm2	pass
					B (axial stress)	0.14143	t/cm2	pass
					web (shear stress)	0.02976	t/cm2	pass
					B (combined stress)	0.15053	t/cm2	pass

Q	1.5	t	straining actions		bolt yield stress	9	t/cm2						
M	10	tm			plate width	120	mm						
Ix	2621440000	mm4	Plate inertia		plate length	640	mm						
Y mm	stress t/cm2	w cm	h cm	applied force t	force / 0.6 t	bolt Diam.	T bolt	ratio	is safe	n	ps	Qall	
320	0.122070313	6.5	12	7.736206055	12.89367676	20	15.4377863	0.835202	pass	4	6.17511	12.32253	
200	0.076293945	6.5	20	4.959106445	8.265177409	16	9.880183232	0.836541	pass	4	3.95207	7.873723	
					Qall		20.196251	tons	pass				
					Flanges weld		0.4	cm					
					web weld		0.4	cm					

Connection M6

Prying force calculations					welding			
w	10	cm	inverse prop.		steel ultimate stress	5.2	t/cm2	
a	0	cm	inverse prop.		allowable stress	1.04	t/cm2	
b	0	cm	direct prop.		Q	1	t	
As	4.59	cm2	direct prop.		Mx	5	tm	
tp	2	cm	inverse prop.		flange	200	cm	
$T_{ext,b}$	22.2304123	tons			flange thickness	2	cm	
$T_{ext,act}$	11.0294118	tons			web	25	cm	
P	#DIV/0!	tons			web thickness	1	cm	
P%	#DIV/0!				web weld length	23	cm	
total applied	#DIV/0!	tons			web weld thicnkess	0.4	cm	
tension req.	18.3823529	tons	pass		flange upper weld length	200	cm	
ten+prying req.	#DIV/0!	tons	#DIV/0!		flange lower weld length	197	cm	
					flange weld thickness	0.4	cm	
					Ix	59076.1	cm 3	
					A (axial stress)	0.10918	t/cm2	pass
					B (axial stress)	0.1058	t/cm2	pass
					web (shear stress)	0.05435	t/cm2	pass
					B (combined stress)	0.14161	t/cm2	pass

Q	1	t	straining actions		bolt yield stress	9	t/cm2					
M	5	tm			plate width	200	mm					
Ix	655066666.7	mm4	Plate inertia		plate length	340	mm					
Y mm	stress t/cm2	w cm	h cm	applied force t	force / 0.6 t	bolt Diam.	T bolt	ratio	is safe	n	ps	Qall
170	0.129757785	10	17	11.02941176	18.38235294	24	22.23041227	0.826901	pass	4	8.89216	17.9216
		Qall		17.9216008	tons	pass						
		Flanges weld		0.4	cm							
		web weld		0.4	cm							

Connection M7 (All Mezanen Beams for first floor)

Prying force calculations					welding			
w	0	cm	inverse prop.		steel ultimate stress	5.2	t/cm2	
a	0	cm	inverse prop.		allowable stress	1.04	t/cm2	
b	0	cm	direct prop.		Q	8.5	t	
As	4.59	cm2	direct prop.		Mx	0	tm	
tp	0	cm	inverse prop.		flange	0	cm	
Text,b	9.88018323	tons			flange thickness	0	cm	
					web	29	cm	
					web thickness	1	cm	
					web weld length	27	cm	
					web weld thicnkess	0.4	cm	
					flange upper weld length	0	cm	
					flange lower weld length	-3	cm	
					flange weld thickness	0	cm	
					Ix	1312.2	cm 3	
					A (axial stress)	0	t/cm2	pass
					B (axial stress)	0	t/cm2	pass
					web (shear stress)	0.39352	t/cm2	pass
					B (combined stress)	0	t/cm2	pass

Q	8.5	t	straining actions	bolt yield stress	9	t/cm2	
M	0	tm		plate width	0	mm	
Ix	0	mm4	Plate inertia	plate length	0	mm	

Y mm	ess t/cr	w cm	h cm	lied for	force / 0.6 t	olt Dian	T bolt	ratio	is safe	n	ps	shear plans	Qall	allowable shear ratio
0	0	0	0	0	0	16	9.88018	0	pass	3	3.95207	1	11.85622	100

Bolts Qall	11.86	tons	pass	ratio	71.69233	%
Flanges weld	0	cm				
web weld	0.4	cm				
Notes	the shear in calculations is the applied shear on one angle , it is the half applied shear on beam					

Connection M8 (Mezanen Beam connection for Management floor)

Prying force calculations			
w	0	cm	inverse prop.
a	0	cm	inverse prop.
b	0	cm	direct prop.
As	4.59	cm2	direct prop.
tp	0	cm	inverse prop.
Text,b	9.88018323	tons	

welding			
steel ultimate stress	5.2	t/cm2	
allowable stress	1.04	t/cm2	
Q	10.5	t	
Mx	0	tm	
flange	0	cm	
flange thickness	0	cm	
web	29	cm	
web thickness	1	cm	
web weld length	27	cm	
web weld thicnkess	0.4	cm	
flange upper weld length	0	cm	
flange lower weld length	-3	cm	
flange weld thickness	0	cm	
Ix	1312.2	cm 3	
A (axial stress)	0	t/cm2	pass
B (axial stress)	0	t/cm2	pass
web (shear stress)	0.48611	t/cm2	pass
B (combined stress)	0	t/cm2	pass

Q	10.5	t	straining actions	bolt yield stress	9	t/cm2
M	0	tm		plate width	0	mm
Ix	0	mm4	Plate inertia	plate length	0	mm

Y mm	stress t/cm2	w cm	h cm	applied force t	force / 0.6 t	bolt Diam.	T bolt	ratio	is safe	n	ps	shear plans	Qall	allowable shear ratio
0	0	0	0	0	0	16	9.880183232	0	pass	3	3.95207	1	11.85622	100

Bolts Qall	11.8562199	tons	pass	ratio	88.56111	%
Flanges weld	0	cm				
web weld	0.4	cm				
Notes	the shear in calculations is the applied shear on one angle , it is the half applied shear on beam					

Stair Carriage Connection

Hinged – roller connection

Shear force = 2.5 tons

use bearing bolts connection for UBN200 and weld for beam B3 or B4

Weld calculations :

use weld thickness = S_W = 0.4 cm

weld length = L_{eff} = shear force / (0.2 x F_u x S_W) = 2.5 / (1.04 * 0.4) = 6 cm

actual length = L_{act} = L_{eff} + 2x S_W = 7 cm

Bolts calculations :

use Bearing Bolts M12 10.9

R_{sh} = 3.14 x 1.2^2 x 0.25 x 10.9 x 0.2 = 2.47 tons

$R_{bearing}$ = D x t x 0.6 x F_u = 1.2 x 1 x 0.6 x 5.2 = 3.74 tons

R_{max} = 2.47 tons

Use 2 Bolts M12 , 10.9

Use angle 60 x 60 x 6