INDEX

JUDUL	NO. DOKUMEN	SHEET
Data Perencanaan Konstruksi Baja	NOTE/TS/02	dataBj
Input dan Output Data	NOTE/TS/03	databtn03
Perhitungan Gording/Balok Anak	BJ/PPBBI/TS/01	Gording
GABLE FRAME		
Kontrol Batang WF	BJ/PPBBI/TS/02	Kontrolwf
Kontrol Batang Komposit	BJ/PPBBI/TS/02-1	komposit
Sambungan Las dan Baut	BJ/PPBBI/TS/03	sambWF
Sambungan balok dgn balok	BJ/PPBBI/TS/03-1	sambbalok
Perhitungan Kontrol Kolom	BJ/PPBBI/TS/04	kontrolkolom
Perhitungan Plat Kaki Kolom Pipa	BJ/PPBBI/TS/05-1	platkakipipa
Perhitungan Plat Kaki Kolom WF	BJ/PPBBI/TS/05-2	platkakiWF
TRUSS		
Kontrol Tegangan Rangka Baja	BJ/PPBBI/TS/06	tegtruss

LITERATURE

DAFTAR ISI

COVER

SHADING NET

Konsep Dasar Perencanaan Struktur Hal. A-1
Balok Anak Hal. A-2
Profil Kuda-kuda Hal. A-6
Perhitungan sambungan Hal. A-9

GUEST HOUSE

Konsep Dasar Perencanaan Struktur Hal. B-1
Gording Hal. B-2
Kuda-kuda Joint Atas Hal. B-4
Kuda-kuda Joint Bawah Hal. B-9
Dudukan Kolom Hal. B-12

Lampiran

KONSEP DASAR PERENCANAAN STRUKTUR

Dasar-Dasar Peraturan Perencanaan

- Peraturan Pembebanan Indonesia untuk Gedung - 1983
- Peraturan Perencanaan Bangunan Baja Indonesia

Material

Struktur Baja JIS G3010 Gr.SS400			
	fy	235 Mpa	
Baut ASTM HTB A325 N			
	Ft	44 Ksi	(Allowable Tension)
	Fv	21 Ksi	(Allowable Shear)
Baut Angker ASTM A307 U-7/8"			
	Ft	20 Ksi	(Allowable Tension)
	Fv	10 Ksi	(Allowable Shear)

Pembebanan

a. Beban Mati (DL)
Sesuai dengan Peraturan Pembebanan Indonesia dan berat jenis bahan yang dipakai.
b. Beban Hidup (LL)
c. Beban Angin (W)
d. Kombinasi Pembebanan

- Comb1	1.4 DL
- Comb2	1.2 DL + 0.5 LL
- Comb3	1.2 DL + 1.6 LL + 0.8 W
- Comb4	1.2 DL + 1.6 LL - 0.8 W

Analisa Struktur

- Analisa struktur memakai program bantu SAP 2000 NonLinier Versi 9.0.3.

Perencanaan Elemen Struktur

- Perhitungan elemen struktur berdasarkan pada peraturan yang berlaku

Dasar-Dasar Peraturan Perencanaan

Data Perencanaan

- Jarak antar kolom : max 3.5 meter
- Tinggi kolom : 3.25 meter
- Bahan atap : Galvalum
- Kemiringan atap : 26 derajat

Analisa Struktur

- Bangunan diidealisasikan dengan analisa 3 dimensi dengan elemen struktur kolom beton serta konstruksi rangka baja..
- Analisa struktur direncanakan terhadap beban vertikal berupa beban yang terbagi rata yang didistribusikan dalam konstruksi rangka baja. Selain itu juga direncanakan beban horisontal akibat gempa pada konstruksi rangka baja tersebut.
- Analisa struktur memakai program bantu SAP 9.2

Perencanaan Elemen Struktur

- Perhitungan elemen struktur berdasarkan pada peraturan yang berlaku..
- Prosedur perhitungan elemen struktur seperti flowchart terlampir

Deskripsi Bangunan

Nama Proyek : Pembangunan Gudang
Lokasi : Waru Gunung Surabaya

Type Struktur

a. Kolom : Konstruksi Baja
b. Balok : Konstruksi Baja
c. Atap : Konstruksi Baja
d. Pondasi : Tiang Pancang
(20 x 20, P ijin 1 TP = 20 ton)

Denah Sistem Struktur & Geometri

Properties

- Model : Portal 2D
- Design code : AISC - LRFD99
- Rangka Kuda-kuda : pipa galvanis
- Tinggi lantai : 3.25 meter
- Ukuran kolom : f 30 cm
- Ukuran gording : f 2" t=2.6 mm
- Ukuran frame : f 2" t=2.6 mm

(lihat gambar terlampir)

Judul Dokument	Input dan Output Data	No. Doc : NOTE/TS/03 Rev :

PROFIL KUDA-KUDA

Jarak antar kuda-kuda	=	3	m
Bentang kuda-kuda	=	6	m
Sudut kemiringan	=	66	°
Gording	=	D 2" t=2.6 mm	
Berat gording	=	3.69	kg/m'
Jarak antar gording	=	120	cm
Atap	=	Galvalum	
Berat atap	=	7.5	kg/m2
Tekanan angin	=	40	kg/m2

PEMBEBANAN

Beban yang diterima gording :

- Berat atap	= 7.5 x 1.2 x 6		=	54.00	kg
- Berat gording	= 3.69 x 6		=	22.14	kg
				76.14	kg
Lain-lain 10 %			=	7.61	kg
		DL	=	83.75	kg
- Berat air hujan	= 0.005 x 1000 x 6 x 1.2		=	36.00	kg
- Beban pekerja	= 2/5 x 100		=	40.00	kg
		LL	=	159.75	kg

- Beban angin kiri
  W = (0.02x66-0.4) x 1.2 x 3 x 40 = 132 kg
- Beban angin kanan
  W = 0.4 x 1.2 x 3 x 40 = 57.6 kg

Berat sendiri kuda-kuda akan dihitung otomatis oleh program SAP-2000
Selanjutnya untuk mencari gaya-gaya dalam dari rangka batang, digunakan program SAP2000

INPUT SAP2000

Beban mati (DL)

Beban hidup (LL)

Beban Angin (W)

Check bahan

OUTPUT SAP2000

Bentang kuda-kuda			=	6	m	
fijin	=	1/400 x 600	=	1.5	cm	
f sap	=	(point 1)	=	0.084	cm	
f	=	0.08 cm	<	1.5 cm		**OK**

GORDING

Gording (CNP100.50.20.1,8), Trekstang 1 D10, Sag rog D10

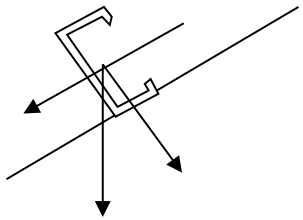
Perhitungan Gording

Data-data

- Jarak kuda-kuda max	=	**300**	cm	- kode(1-18)	**12**
- Bentang kuda-kuda	=	**550**	cm	- Gording	**1**
- Jarak Gording	=	**125**	cm		
- Berat penutup atap	=	**7**	kg/m2		
- Berat angin	=	**25**	kg/m2		
- Kemiringan kuda-kuda	=	**20**	derajat		
- Direncanakan Gording	**CNP 100 t=1.8 mm**		*(CNP100.50.20.1,8)*		

Wx	=	11.6635	cm3
Wy	=	4.2945	cm3
Ix	=	58.32	cm4
Iy	=	13.64	cm4
A	=	3.9	cm2
g	=	3.03	kg/m'

Peninjauan Searah Sumbu X - X



qx = q cos α
qy = q sin α

1. Berat sendiri = 3.03 x cos 20	=	2.84	kg
M1 = 1/8 x 2.84 x 3^2	=	*3.20*	kgm
2. Bs. Atap = 1.25 x 7 x cos 20	=	8.22	kgm
M2 = 1/8 x 8.22 x 3^2	=	*9.25*	kgm
3. Muatan Angin			
W = 0.02 x 20 - 0.4	=	0	

W1 = 0 x 1.25 x 25	=	0	kg/m'	
M3 = 1/8 x 0 x 3^2	=	*0.00*	kgm	
W2 = - 0.4 x 1.25 x 25	=	-12.5	kg/m'	
M4 = 1/8 x -12.5 x 3^2	=	*-14.06*	kgm	
3. Beban Berguna (P)	=	100	kg	
M5 = 1/4 x cos 20 x 100 x 3	=	*70.48*	kgm	
4. Kombinasi Muatan				
M1 + M2 + M3	=	12.45	kgm	
M1 + M2 + M5	=	82.93	kgm	

Peninjauan Searah Sumbu Y - Y

1. Berat sendiri = 3.03 x sin 20	=	1.03	kg/m'
M1 = 1/8 x 1.03 x 1.5^2	=	*0.29*	kgm
2. Bs Atap = 7 x sin 20	=	2.39	kg/m'
M2 = 1/8 x 2.39 x 1.5^2	=	*0.67*	kgm
3. Beban Berguna (P)	=	100	kg
M5 = 1/4 x sin 20 x 100 x 1.5	=	*12.83*	kgm
4. Kombinasi Muatan			
M1 + M2	=	0.96	kgm
M1 + M2 + M5	=	13.79	kgm

Kontrol Tegangan

Wx	=	11.6635	cm3	Bj. 33/37/41/44/50//52 ?		**37**
Wy	=	4.2945	cm3	s (ijin)	1600	kg/cm2
Mx	=	8293	kgcm			
My	=	1379	kgcm			

s = 8,293 / 11.6635 + 1,379 / 4.2945

= 1032.09 kg/cm2 < 1.3 x 1600 = 2080kg/cm2 **OK**

Jadi Gording CNP 100 t=1.8 mm (CNP100.50.20.1,8) Aman dipakai

Kontrol Lendutan

n	=	**2**	*(trestang 1 kolom antar gording)*
L	=	150	cm
Ix	=	58.32	cm4
Iy	=	13.64	cm4

f	=	1/400 x 150	=	0.375 cm	
qx	=	2.84 + 8.22 + 0	=	11.06 kg/m'	
qy	=	1.03 + 2.39	=	3.43 kg/m'	
Px	=	100 x cos 20	=	93.97 kg/m'	
Py	=	100 x sin 20	=	34.20 kg/m'	
fx	=	$\frac{5 \times 1106 \times 150^4}{384 \times 2100000 \times 58.3176}$	+	$\frac{93.97 \times 150^3}{48 \times 2100000 \times 58.3176}$	
	=	0.005955721951	+	0.053951	
	=	0.060 cm			
fy	=	$\frac{5 \times 0.03 \times 150^4}{384 \times 2100000 \times 13.6367}$	+	$\frac{34.20 \times 150^3}{48 \times 2100000 \times 13.6367}$	
	=	0.007892500052	+	0.0839761	
	=	0.092 cm			
ft	=	sqrt(0.060^2 + 0.092^2)			
	=	0.11 cm	<	0.375 cm	**OK**

Perhitungan San Rog dan Trestang

qy	=	3.43 x 1.5	=	5.14 kg	
Py			=	34.20 kg	
				39.35 kg x 2.34	
		Q	=	92.11 kg	

Dimensi sag rog yang diperlukan

Bj. 33/37/41/44/50//52 ? **37**

s (ijin) 1600 kg/cm2

s s	=	1.3 x 1600	=	2080 kg/cm2	
F	=	$\frac{92.11}{2080}$	=	0.04 cm2	
d	=	sqrt(4 x 0.04/3.14)	=	0.24 cm	**D = 1.0 cm**

Dipasang trestang (ikatan angin) n = 2

tg α	=	$\frac{1.25}{1.5}$	=	0.83	

a	=	39.8				
R	=	1/2 x 92.11	=	46.06 kg		
R	=	$\frac{46.06}{\sin 39.81}$	=	71.94 kg		
F	=	$\frac{71.94}{2080}$	=	0.03 cm2		
d	=	sqrt(4 x 0.03/3.14)	=	0.21 cm	~	**D = 1.0 cm**

maka dipasang trestang sebanyak 1 kolom antar gording dengan diameter 10 mm.

Judul Dokument	Kontrol Batang WF	No. Doc : BJ/PPBBI/TS/02 Rev :

KONTROL BATANG WF 400.200.8.13 (13 m)

Kuda-kuda A DETAIL A

Data-data

- Lokasi _____
- Type Kuda-kuda **A**
- Gambar **DETAIL A**
- Direncanakan WF 400.200.8.13 - kode(1-8 **8**

Wx	1190	cm3	h	40	cm
Wy	174	cm3	b	20	cm
Ix	23700	cm4	ts	1.3	cm
Iy	1740	cm4	tb	0.8	cm
A	84.12	cm2			
g	66	kg/m'			

Bentang l = **13** meter

- Nilai D, N, M diambil dari hasil perhitungan software SAP2000 NonLinier Versi 9.0.3

D	=	**1327.95**	kg
N	=	**2799.41**	kg
Mtum	=	**944.00**	kgm
Mlap	=	**950.25**	kgm
f	=	**0.732**	cm

Kesimpulan

Tegangan	**OK**	Lipat balok	**(OK)**
Lendutan	**OK**	KIP	**(OK)**
Geser	**(OK)**		

Kontrol Tegangan

Wx	=	1190	cm3	Bj. 33/37/41/44/50//52 ?		**37**
A	=	84.12	cm3	s (ijin)	1600	kg/cm2

P = 2799 kgcm
M = 95025 kgcm

s = 2,799 / 84.12 + 95,025 / 1190
= 113.13 kg/cm2 < 1600kg/cm2 **OK**

Kontrol Lendutan
L = 1300 cm
Ix = 23700 cm4

f ijin = 1/360 x 1300 = 3.61 cm

f = 0.732 cm < 3.61 cm **OK**

Kontrol Geser
h **40** cm b **20** cm
tb **0.8** cm ts **1.3** cm
Ls **1300** cm Ix **23700** cm4
Fe 310/360/430/510 ? **360**
s (ijin) 1600 kg/cm2

d x = (20 x 1.3){0.5 x (40-1.3)} + (0.8 x 18.7) x 9.35
= 642.98 cm3
D = **1327.95** kg
t = $\frac{(1{,}327.95 \times 642.98)}{0.8 \times 23700}$ = 45.03 kg/cm2 < 0.5 x 1600 = 928 kg/cm2 **(OK)**

Kontrol Lipat
s r = 3267 kg/cm2 bp = 20 cm
s d = **113.13** kg/cm2 tp = 1.3 cm

$\frac{20}{1.3}$ = 15.385 < 10 x sqrt(3267 / 113.13) = 53.74 **(OK)**

Kontrol Stabilitas KIP
h **40** cm b **20** cm
tb **0.8** cm ts **1.3** cm
Ls **1300** cm Iy **23700** cm4
Fe 310/360/430/510 ? **360**

s (ijin) 1600 kg/cm2

$\frac{400}{8}$ = 50.00 <= 75

$\frac{13000}{400}$ = 32.50 >= $\frac{1.25 \times 200}{13}$ = 19.23 **tidak berubah**

<u>Balok tidak berubah bentuk (KIP)</u> ---> Statis tertentu

- Badan balok diberi pengkau samping

- Statis tertentu

h	40	cm	b	20	cm	Mki	944.00 kgm
tb	0.8	cm	ts	1.3	cm	Mka	944.00 kgm
Ls	1300	cm	Iy	1740	cm4	Mjep	950.25 kgm
Fe 310/360/430/510	?		360			E	2100000 kg/cm2

s (ijin) 1600 kg/cm2

C1 = $\frac{1300 \times 40}{20 \times 1.3}$ = 2000

C2 = $\frac{0.63 \times (2100000)}{1600}$ = 826.88

2000 =< *250*

s kip = 1600 kg/cm2

250 < *2000* < *826.88*

s kip = 1600 - ((2,000.00 - 250) / (826.88 - 250) x 0.3 x 1600

= 143.88 kg/cm2

2000 > *826.88*

s kip = $\frac{826.88 \times 0.7 \times 1600}{2000}$ = 463.05 kg/cm2

Jadi

s kip = *463.05* kg/cm2 < 1600 kg/cm2 **(OK)**

Judul Dokument	Kontrol Batang Komposit	No. Doc : BJ/PPBBI/TS/02-1 Rev :

BATANG WF 400.200.8.13 (6m), Stud 2D19 - 115cm (h=75mm)

Kuda-kuda A DETAIL A

Data-data

- Lokasi _____
- Type Kuda-kuda **A**
- Gambar **DETAIL A**
- Direncanakan WF 400.200.8.13 - kode(1-8) **8**

Wx	1190	cm3	h	40	cm
Wy	174	cm3	b	20	cm
Ix	23700	cm4	ts	1.3	cm
Iy	1740	cm4	tb	0.8	cm
A	84.12	cm2			
g	66	kg/m'			

- Nilai D, N, M diambil dari hasil perhitungan software SAP2000 NonLinier Versi 9.0.3

	DL	LL
q	225	
plat	720	
Besi	66	
qtot	1011	1125
m	4549.5	5062.5
koe	1.2	1.6
Mdl	5459.4	8100

MDL	=	5459.4	kgm	tebal plat	=	**12**	cm
MLL	=	8100	kgm	L induk	=	**600**	cm
Es	=	2038902	kg/cm2	Lanak	=	**250**	cm
Ec	=	203943	kg/cm2				

$$n = \frac{Es}{Ec} = \frac{2038902}{203943} = 10$$

Lebar efektif

be	=	1/4 x 600	=	150 cm
	=	1/2 x 250	=	125 cm
	=	8 x 12	=	96 cm

dipakai be terkecil adalah 96 cm

K = 1

$$Ac = \frac{96x12}{1 \times 10} = 115$$

$$Kc = \frac{115}{115 + 84.12} = 0.578$$

Yc = (0.5x40+0.5x12)x0.578 = 15.03

Ic = [Yts=ec] Yc As + Ac T^2 / 12 + Is
= (0.5x40+0.5x12)15.03x84.12+115x(12x12)/12)+23700
= 57952.42153

Ytc = 0.5x40 - 15.03 = 4.97

Stc = Ic / Ytc
= 57,952.422 / 4.97 = 11657

Ybc = 0.5 x h + Yc
= 0.5 x 40 + 15.03 = 35.0

Sbc = Ic / Ybc
= 57,952.422 / 35.03 = 1654

Ycc = Ytc + tp
= 4.97 + 12 = 16.97

Scc = Ic / Ycc
= 57,952.422 / 16.97 = 3415

K = 3

Ac = $\frac{96x12}{3 \times 10}$ = 38

Kc = $\frac{38}{38 + 84.12}$ = 0.313

Yc = (0.5x40+0.5x12)x0.313 = 8.15

Ic = [Yts=ec] Yc As + Ac T^2 / 12 + Is
= (0.5x40+0.5x12)8.15x+38x(12x12)/12)+23700
= 24160.91989

Ytc = 0.5x40 - 8.15 = 11.85

Stc = Ic / Ytc
= 24,160.920 / 11.85 = 2039

Ybc = 0.5 x h + Yc
= 0.5 x 40 + 8.15 = 28.2

Sbc = Ic / Ybc
= 24,160.920 / 28.15 = 858

Ybc = Ytc + tp
= 8.15 + 12 = 20.15

Sbc = Ic / Ycc
= 24,160.920 / 20.15 = 1199

	fc = $\frac{Mc}{k.n\ Scc}$	ft = $\frac{M}{Stc}$	fb = $\frac{M}{Sbc}$
Ds	0	0	0
Dc	= 5459.4x100/(3x10x1,199) = 15.18	= 5459.4x100/2,039 = 267.76	= 5459.4x100/858 = 636.0847
DL	= 8100x100/(1x10x3,415)	= 8100x100/1,654	= 8100x100/1,654.42

	= 23.73 / 38.91	= 489.60 / 757.35	= 489.5961 / 1125.68
	< 60 kg/cm2 **Aman**	< 1300 kg/cm2 **Aman**	< 1300 kg/cm2 **Aman**

Shear Connector

fc	=	**25**	Mpa
fy	=	**350**	Mpa
h	=	**75**	mm
d	=	**19**	mm
V	=	6408	kg
Ac	=	84.12	cm2
L	=	600	cm
Jml baris	=	**2**	

(75 / 19) < 4.2
3.947368 < 4.2 **--- > OK**

Q = 88 x 75 x 19 x sqrt(25)
= 627000 kN

V = 350 x 84.12 x 100
= 2944200 kN

1/2 n = 2944200 / 627000
= 4.70 bh. (1/2 bentang)

n = 4.7 x 2
= 9.4 bh (1 bentang)

sht = 600x2/(9.4+1)
= 115 cm (2 baris)

smin = 6 x 1.9 = 11.4 cm
smax = 70 x 1.9 = 133 cm

spakai = **115** cm

Judul Dokument	Sambungan Las dan Baut	No. Doc : BJ/PPBBI/TS/03 Rev :

SAMBUNGAN BAUT DAN LAS

Kuda-kuda A DETAIL A

Data-data

- Lokasi _____
- Type Kuda-kuda **A**
- Gambar **DETAIL A**
- Direncanakan WF 400.200.8.13 - kode(1-8) **8**

h	40 cm	ts	1.3 cm
b	20 cm	tb	0.8 cm

- Nilai D, N, M diambil dari hasil perhitungan software SAP2000 NonLinier Versi 9.0.3

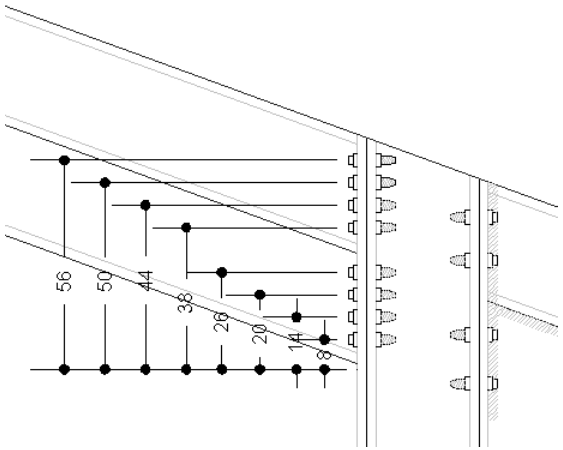
D	=	**1489.63** kg	h =	40	cm
N	=	**2739.15** kg	D =	2.2	cm
M	=	**1386.13** kgm	n =	*4*	
a	=	**20** derajat	s =	10.40 cm	>6.6ok

Perhitungan Kekuatan Baut

Data-data

D	=	1489.63 kg
N	=	2739.15 kg
M	=	1386.13 kgm

Sambungan [1] baut / [2] Paku keling ? 1
Dipakai D22
Fe 310/360/430/510 ? **360**
s (ijin) 1600 kg/cm2



Moment Inersia

- h dihitung dari jarak alat sambung pertama (h0)

diameter alat sambung (d) **2.2** cm

h	*h^2*

h1	**0.8**	cm		0.64	cm2
h2	**1.4**	cm		1.96	cm2
h3	**2**	cm		4	cm2
h4	**2.6**	cm		6.76	cm2
h5	**3.8**	cm		14.44	cm2
h6	**4.4**	cm		19.36	cm2
h7	**5**	cm		25	cm2
h8	**5.6**	cm		31.36	cm2
htot =	25.6	cm	A =	103.52	cm2

F = 1/4 x 3.14 x 2.2^2 = 3.80 cm2

Tegangan tarik max untuk satu Baut

$$N = \frac{138613 \times 5.6}{2 \times 103.52} = 3749.19 \text{ kg}$$

$$s = \frac{3749}{3.80} = 986.79 \text{ kg/cm2} < 0.7 \times 1600 = 1120 \text{ kg/cm2}$$

(OK)

Akibat gaya lintang dan gaya normal

N = 2739.15 kg a = 20

Q = 1489.63 kg

D = 1,489.63 x cos 20 + 2,739.15 sin 20

= 2336.64 kg

$$t = \frac{2336.64}{16 \times 3.80} = 38.44 \text{ kg/cm2} > 0.6 \times 1600 = 960 \text{ kg/cm2}$$

(OK)

Tegangan Idiil

Fe 310/360/430/510 ? **360**

s (ijin) 1600 kg/cm2

si = sqrt(986.79^2 + 1.56 x 38.44^2)

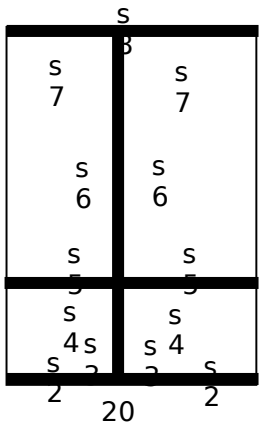
= 987.95 kg/cm2 < 1600 kg/cm2 **(OK)**

VERSI 1 UNTUK α > 0

Perhitungan Kekuatan Las

- Tebal plat	1.3 cm	- b	20	cm
- ts	1.3 cm	- h	40	cm
- tb	0.8 cm	a	20	

Tebal las badan = 1/2 x sqrt(2) x 0.8 = 0.57 cm
Tebal las sayab = 1/2 x sqrt(2) x 1.3 = 0.92 cm



1.3
40.0
1.3
10
1.3

Statis Moment
las terhadap las bagian bawah

s2 =	2(9.6x0.92)2.5	=	44.58	cm3
s3 =	2(8.7x0.57)6.6	=	64.66	cm3
s4 =	2(9.6x0.92)10.3	=	181.90	cm3
s5 =	2(9.6x0.92)12.5	=	221.07	cm3
s6 =	2(38.7x0.57)31.4	=	1372.01	cm3
s7 =	2(9.6x0.92)50.6	=	892.70	cm3
s8 =	(20.0x0.92)52.5	=	965.07	cm3
			3741.99	cm3

A = 18.38 + 17.65 + 9.84 + 17.65 + 17.65 + 43.75 + 17.65 + 18.38
= 160.96 cm2

Yb =	3,741.99/160.96	=	23.25	cm
Ya =	53.87 - 23.25	=	30.62	cm

Inersia Las

Ix1 =	(1/12 x 20 x 0.92^3) + (18.38 x 22.64^2) =	9421.08	cm4
Ix2 =	2(1/12 x 9.6 x 0.92^3) + (17.65 x 20.72^2) =	7580.45	cm4
Ix3 =	2(1/12 x 0.57 x 8.70^3) + (9.84 x 16.30^2) =	2676.73	cm4
Ix4 =	2(1/12 x 9.60 x 0.92^3) + (17.64 x 12.64^2) =	2819.10	cm4
Ix5 =	2(1/12 x 9.60 x 0.92^3) + (17.64 x 10.72^2) =	2030.52	cm4
Ix6 =	2(1/12 x 0.57 x 38.67^3) + (43.74 x 8.00^2) =	8248.14	cm4
Ix7 =	2(1/12 x 9.60 x 0.92^3) + (17.64 x 28.09^2) =	13930.50	cm4
Ix8 =	(1/12 x 20 x 0.92^3) + (18.38 x 30.01^2) =	16554.10	cm4
	Ix =	63260.62	cm4

Momen Tahanan

Ix	=	63260.62	cm4
ya	=	30.62	cm
yb	=	23.25	cm

$$Wb = \frac{63260.62}{23.25} = 2721.08$$

$$Wa = \frac{63260.62}{30.62} = 2066.08$$

Kontrol Tegangan

M	=	138613	kgcm	Bj. 33/37/41/44/50//52 ?	**37**
W	=	2066.08	cm3	s (ijin)	1600 kg/cm2
D	=	2739	kg		
A	=	160.96	cm2		
N	=	1490	kg		

s a = 138,613 / 2,066.08
= 67.09 kg/cm2

s n = 2,739 / 160.96
= 17.02 kg/cm2

t = 1,490 / 160.96
= 9.25 kg/cm2

s b = 17.02 + 9.25

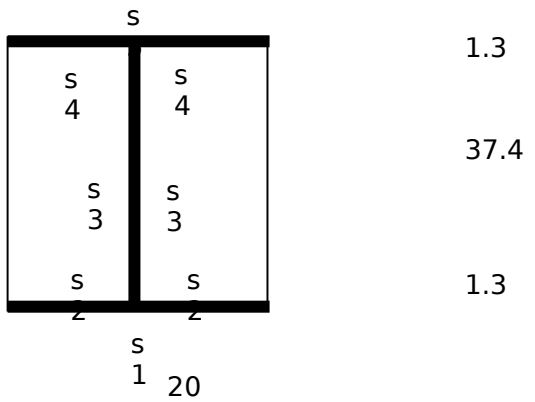
	=	26.27	kg/cm2			
s i	=	sqrt(67.09^2 + 3 x 26.27^2)				
	=	81.07	kg/cm2	<	1600kg/cm2	**(OK)**

VERSI 2 UNTUK α = 0

Perhitungan Kekuatan Las

- Tebal plat	1.3 cm	- b	20 cm
- ts	1.3 cm	- h	40 cm
- tb	0.8 cm		

Tebal las badan = 1/2 x sqrt(2) x 0.8 = 0.57 cm
Tebal las sayab = 1/2 x sqrt(2) x 1.3 = 0.92 cm



Moment Inersia

las terhadap las bagian bawah

- 2 x 0.92 x 20 x 21.91^2	=	17655.71	cm4
- 4 x 0.92 x 8.47 x 18.09^2	=	10186.92	cm4
- 2 x 0.57 x 35.56^3 : 12	=	4239.9894	cm4
Ix	=	32082.62	cm4

Luas Penampang Las

- 2 x 0.92 x 20	=	36.77	cm2

- 4 x 0.92 x 8.47			=	31.14	cm2
- 2 x 0.57 x 35.56			=	40.23	cm2
		F	=	108.14	cm2

Moment Tahanan

Wx = 32082.62 / 20.57 = 1560.01 cm3

Kontrol Tegangan

M	=	138613	kgcm	Bj. 33/37/41/44/50//52 ?		**37**
W	=	1560.01	cm3	s (ijin)	1600 kg/cm2	
P	=	1490	kg			
F	=	108.14	cm2			

s m = 138,613 / 1,560.01
= 88.85 kg/cm2

t m = 1,490 / 108.14
= 13.77 kg/cm2

s i = sqrt(88.85^2 + 3 x 13.77^2)
= 92.00 kg/cm2 < 1600kg/cm2 **(OK)**

Judul Dokument	Sambungan balok dgn balok	No. Doc : BJ/PPBBI/TS/03-1 Rev :

SAMBUNGAN BALOK INDUK DAN BALOK ANAK

Balok - WF 400.200.8.13

Data-data

- Lokasi _____
- Type **-**
- Gambar **WF 400.200.8.13**
- Nilai D, N, M diambil dari hasil perhitungan software SAP2000 NonLinier Versi 9.0.3

V1 = **7240** kg
M = **12857** kgm

Kontrol pengaruh geser

Data-data

V1 = 7240 kg Bj. 33/37/41/44/50//52 ? **37**
Plat = **10** mm s (ijin) 1600 kg/cm2
hplat = **400** mm

Aplat = 1 x 40 = 40 cm2

t ijin = 0.58 x 1600 = 928 kg/cm2

$$t = \frac{7240}{40} = 181 \text{ kg/cm2}$$

181 kg/cm2 < 928 kg/cm2 ***(OK)***

Sambungan plat dan badan balok

Hub. Balok induk dengan baja siku adalah samb. Iris tunggal

Data-data

P 7,240.00 kg Bj. 33/37/41/44/50//52 ? **37**
tebal plat sambung (δ) **1.00** cm s (ijin) 1600
diameter alat sambung (d) **1.90** cm - *sambungan iris* ***tunggal***

s (tp)	=	1.5 x 1600	=	2400	kg/cm2			
t (baut)	=	0.58 x 1600	=	928	kg/cm2			
s (t)	=	0.7 x 1600	=	1120	kg/cm2			

Jumlah alat sambung

Ngs =	1x0.25x3.14x1.9^2x928		=	2630	kg			
Ntp =	1.9 x 1 x 2400		=	4560	kg			
		Nmax	=	4560	kg			
n	=	7,240.00 / 4560	=	1.49	buah	~~~	**2**	buah
Jumlah baut			=	**4**	buah			

Kekuatan baut

Ppaku	=	4 x 4560	=	18240	kg	>	7,240	kg	(OK)

Sambungan las

Data-data

V1	=	7240	kg	Bj. 33/37/41/44/50//52 ?		**37**
M	=	12857	kgm			
Plat	=	**1**	cm	s (ijin)	1600	kg/cm2
hplat	=	**40**	cm			
bplat	=	**20**	cm			
tlas	=	**1**	cm			

Moment inersia las

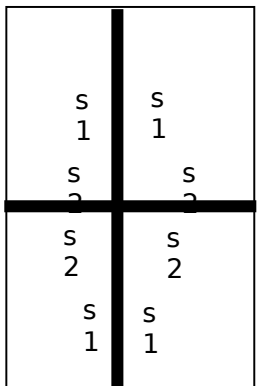
s1	=	4x(18.5x1)x(10.75)^2	=	8551.625	cm4	
s2	=	4x(8.5x1)x(5.75)^2	=	1124.125	cm4	
		Ix	=	9675.75	cm4	

Luas penampang las

s1	=	4x(18.5x1)	=	74	cm2	
s2	=	4x(8.5x1)	=	34	cm2	
		F	=	108	cm2	

Momen tahanan

Wx	=	9675.75 / 20	=	774060	cm3	





Kontrol tegangan

$$s_m = \frac{1285700}{774060} = 1.66098235 \text{ kg/cm2}$$

$$t = \frac{7240}{108} = 67.037037 \text{ kg/cm2}$$

$$s_t = \text{sqrt}(1.66^2 + 3 \times 67.04^2)$$

$$= 83.75 \text{ kg/cm2} < 1600 \text{ kg/cm2} \quad \textbf{(OK)}$$

Judul Dokument	Perhitungan Plat Kaki Kolom Pipa	No. Doc : BJ/PPBBI/TS/05-1 Rev :

PERHITUNGAN PLAT KAKI BULAT

Kolom A (D 3" t=3 mm) DETAIL A

Data-data

- Lokasi _____
- Type Kolom **A**
- Gambar **DETAIL A**
- Direncanakan **D 3" t=3 mm**
- kode(1-11) **8**

D luar pip = 88.7 mm
Tebal pipa = 3.00 mm

L = **3.5** m

- Nilai D, N, M diambil dari hasil perhitungan software SAP2000 NonLinier Versi 9.0.3

D = **3480** kg
N = **5199.83** kg

Pembebanan

Bs. P = = 5199.83 kg
Bs. Kolom Bj = 5199.83 x 3.5 = 18199.405 kg
Ptot = 23399.235 kg

M = 3480 x 3.5 = 12180 kgm

Kesimpulan

Tegangan las (OK)
Tegangan plat kaki (OK)
Dimensi plat D20 t= 5 mm
Angker 8 D22
Panjang angker 60 cm

Kontrol Kekuatan Las plat kaki

Perhitungan Kekuatan Las

Tebal las badan = 1/2 x sqrt(2) x 0.3 = 0.21 cm

Moment Inersia (I)
las terhadap las bagian bawah
- 2 x 3.14 x 4.435 x 4.435^2 = 548.10 cm4

Luas Penampang Las (F)
- 2 x 3.14 x 4.435 = 27.87 cm2

Moment Tahanan
Wx = 548.10 / 27.87 = 19.67 cm3

Kontrol Tegangan

M	=	12180	kgcm	Bj. 33/37/41/44/50//52 ?	**37**
W	=	19.67	cm3	s (ijin)	1600 kg/cm2
P	=	23399	kg		
F	=	27.87	cm2		

s m = 12,180 / 19.67
= 619.24 kg/cm2

t m = 23,399 / 27.87
= 839.71 kg/cm2

s i = sqrt(619.24^2 + 3 x 839.71^2)
= 1580.76 kg/cm2 < 1600kg/cm2 **(OK)**

Kontrol Kekuatan Plat Kaki

Dimensi Plat
D = 8.87 cm

B = 2 x 5 + 8.87 = 18.87 cm ~ **20** cm

W = 1/32 x 3.14 x 20^3 = 785.40 cm3

A = 0.25x 3.14 x 20 x 20 = 314.00 cm2

Kontrol Tegangan

Wx	=	785.40	cm3	Mutu beton	**K300**		
A	=	314.00	cm2	s (tekan)	= 0.33 x 300		
N	=	23399	kg		= 99	kg/cm2	
M	=	12180	kgcm	Bj. 33/37/41/44/50//52 ?			**37**
				s (ijin)	1600	kg/cm2	

s max = 23,399 / 314 + 12,180 / 785.40
= 90.03 kg/cm2 < 99 kg/cm2 **(OK)**

s min = 23,399 / 314 - 12,180 / 785.40
= 59.01 kg/cm2

tegangan min harus ditahan oleh angker

Statika

D = **2.2** cm

$$\frac{x}{20 - x} = \frac{-59.01}{12{,}180 / 785.40}$$

$$\frac{x}{20 - x} = \frac{-59.01}{15.51}$$

$$x = \frac{(-59.01 \times 20)}{(15.51 + -59.01)}$$

x = 27.13 cm

T = 27.13 x 20 x (1/2 x -59.01)
= -16009.62 kg

Perhitungan Plat Penyambung

T	16,010	kg	Bj. 33/37/41/44/50//52 ?	**37**
diameter alat sambung (d)	2.2	cm	s (ijin)	1600

Tebal Plat Penyambung *L(cm)* = 20.00

$$F_{perlu} = \frac{16{,}010}{1600} = 10.006 \text{ cm2 (untuk 2 penampang profil)}$$

d = $\frac{10.006}{(20-2.2)}$

= 0.56 cm ~ **0.50** cm

Perhitungan baut angker

T	16,010 kg	Bj. 33/37/41/44/50//52 ?	**37**
tebal plat sambung (δ)	0.50 cm	s (ijin)	1600
diameter alat sambung (d)	2.2 cm	- *sambungan iris* ***ganda***	

Jumlah baut angker

1/4 x 3.14 x 2.2 = 1.73 cm > 0.5 cm *(tumpu menentukan)*

n = $\frac{16,010}{0.5x2.2x1.2x1600}$ = 7.58 -----> **8 D22** mm

Perhitungan Panjang Angker

Mutu beton	**K300**	Bj. 33/37/41/44/50//52 '	**37**
s b	300 kg/cm2	s a	1600 kg/cm2
s m	2080 kg/cm2		
D	2.2 cm	3.80 cm2	

Ln = $\frac{0.14 \times 3.80 \times 2080}{\text{sqrt}(300)}$ >= 0.013 x 2.2 x 2080 *(PBI '71 : 74)*

= 63.91 > 59.488 **(OK)**

~ **60** cm

Sehingga dipakai angker D2.2 - 60 cm.

Judul Dokument	Perhitungan Plat Kaki Kolom WF	No. Doc : BJ/PPBBI/TS/05-2 Rev :

PERHITUNGAN PLAT KAKI KOLOM WF

Kolom A (WF 300.150.6,5.9) DETAIL A

Data-data

- Lokasi _____
- Type Kolom **A**
- Gambar **DETAIL A**
- Direncanakan WF 300.150.6,5.9 - kode(1-8) **6**

Wx	481	cm3	h	30	cm
Wy	67.7	cm3	b	15	cm
A	46.78	cm2	ts	0.9	cm
g	36.7	kg/m'	tb	0.65	cm

- Nilai D, N, M diambil dari hasil perhitungan software SAP2000 NonLinier Versi 9.0.3

D = **3480** kg

N = **5199.83** kg

L = **3.5** m

Pembebanan

Bs. P =		=	5199.83	kg
Bs. Kolom Bj = 36.7 x 3.5		=	128.45	kg
	Ptot	=	5328.28	kg

M = 3480 x 3.5 = 12180 kgm

Kesimpulan

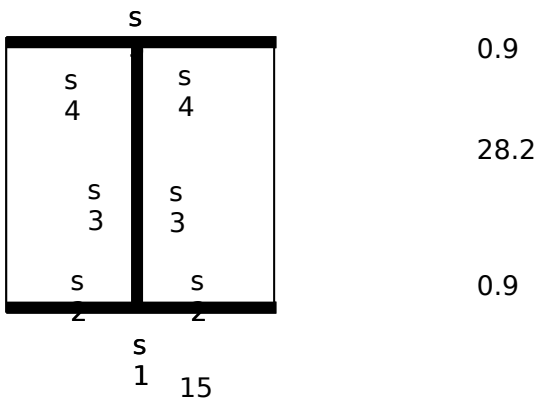
Tegangan las (OK)
Tegangan plat kaki (OK)
Dimensi plat 45 x 45 x 3 cm
Angker 7 D22
Panjang angker 60 cm

Kontrol Kekuatan Las plat kaki

Perhitungan Kekuatan Las

- Tebal plat	3.00 cm	- b	15 cm
- ts	0.9 cm	- h	30 cm
- tb	0.65 cm		

Tebal las badan = 1/2 x sqrt(2) x 0.65 = 0.46 cm
Tebal las sayab = 1/2 x sqrt(2) x 0.9 = 0.64 cm



Moment Inersia

las terhadap las bagian bawah

- 2 x 0.64 x 15 x 16.32^2		=	5087.64 cm4
- 4 x 0.64 x 6.26 x 13.68^2		=	2978.30 cm4
- 2 x 0.46 x 26.93^3 : 12		=	1495.61934 cm4
	Ix	=	9561.56 cm4

Luas Penampang Las

- 2 x 0.64 x 15			=	19.09	cm2
- 4 x 0.64 x 6.26			=	15.92	cm2
- 2 x 0.46 x 26.93			=	24.75	cm2
		F	=	59.77	cm2

Moment Tahanan

Wx = 9561.56 / 15.46 = 618.49 cm3

Kontrol Tegangan

M	=	12180	kgcm	Bj. 33/37/41/44/50//52 ?	**37**
W	=	618.49	cm3	s (ijin) 1600	kg/cm2
P	=	5328	kg		
F	=	46.78	cm2		

s m = 12,180 / 618.49
= 19.69 kg/cm2

t m = 5,328 / 46.78
= 113.90 kg/cm2

s i = sqrt(19.69^2 + 3 x 113.90^2)
= 198.26 kg/cm2 < 1600kg/cm2 **(OK)**

Kontrol Kekuatan Plat Kaki

Dimensi Plat

h	=	30	cm
b	=	15	cm
tb	=	0.5	cm
ts	=	0.8	cm

B = 2 x 5 + 15 = 25 cm ~ **45** cm
L = 2 x 5 + 30 = 40 cm ~ **45** cm

W = 1/6 x 45 x 45^2 = 15187.50 cm3
A = 45 x 45 = 2025.00 cm2

Kontrol Tegangan

Wx	=	15187.50	cm3	Mutu beton	**K300**
A	=	2025.00	cm2	s (tekan) =	0.33 x 300

N = 5328 kg = 99 kg/cm2
M = 1218000 kgcm Bj. 33/37/41/44/50//52 ? **37**
s (ijin) 1600 kg/cm2

s max = 5,328 / 2025 + 1,218,000 / 15,187.50
= 82.83 kg/cm2 < 99 kg/cm2 **(OK)**

s min = 5,328 / 2025 - 1,218,000 / 15,187.50
= -77.57 kg/cm2
tegangan min harus ditahan oleh angker

Statika
D = **2.2** cm

$$\frac{x}{45 - x} = \frac{77.57}{1{,}218{,}000 / 15{,}187.50}$$

$$\frac{x}{45 - x} = \frac{77.57}{80.20}$$

$$x = \frac{(77.57 \times 45)}{(80.20 + 77.57)}$$

x = 22.12 cm

T = 22.12 x 45 x (1/2 x 77.57)
= 38613.00 kg

Perhitungan Plat Penyambung
T 38,613 kg Bj. 33/37/41/44/50//52 ? **37**
diameter alat sambung (d) 2.2 cm s (ijin) 1600

Tebal Plat Penyambung *L(cm)* = 45.00
Fperlu = $\frac{38{,}613}{1600}$ = 24.133 cm2 (untuk 2 penampang profil)
d = $\frac{24.133}{(45\text{-}2.2)}$
= 0.56 cm ~ **3.00** cm

Perhitungan baut angker

T	38,613 kg	Bj. 33/37/41/44/50//52 ?	**37**	
tebal plat sambung (δ)	3.00 cm	s (ijin)	1600	
diameter alat sambung (d)	2.2 cm	- *sambungan iris* ***ganda***		

Jumlah baut angker

1/4 x 3.14 x 2.2 = 1.73 cm < 3 cm *(geser yang menentukan)*

n = 38,613 / 3x2.2x0.6x1600 = 6.09 -----> **7 D22** mm

Perhitungan Panjang Angker

s b	300 kg/cm2	s a	1600 kg/cm2
s m	2080 kg/cm2		
D	**2.2** cm	3.80 cm2	

Ln = 0.14 x 3.80 x 2080 / sqrt(300) >= 0.013 x 2.2 x 2080 *(PBI '71 : 74)*

= 63.91 > 59.488 **(OK)**

~ **60** cm

Sehingga dipakai angker D2.2 - 60 cm

Judul Dokument	Perhitungan Kontrol Kolom	No. Doc : BJ/PPBBI/TS/04 Rev :

KONTROL KEKUATAN KOLOM

Kolom A (D WF 500.200.10.0.16.0 t=20.3836 mm) DETAIL A

Data-data

- Lokasi _____
- Type Kolom **A**
- Gambar **DETAIL A**
- Direncanakan D WF 500.200.10.0.16. ---> Dluar =WF 500.200.10.16mm
- kode(1-19) 9

Wx	1841	cm3
Wy	213	cm3
ix	20.3836	cm4
iy	4.3919	cm4
A	110.8	cm2
g	87.0	kg/m'

- Nilai D, N, M diambil dari hasil perhitungan software SAP2000 NonLinier Versi 9.0.3

D = **3480** kg
N = **5199.83** kg

L = **3.5** m

Kesimpulan

Tegangan **(OK)**

Kontrol Kekuatan Kolom

Pembebanan

Bs. P =		=	5199.83	kg
Bs. Kolom Bj = 86.978 x 3.5		=	304.423	kg
	Ptot	=	5504.253	kg
M =	3480 x 3.5	=	12180	kgm

s b = $\frac{1218000}{1841}$ = 661.60 kg/cm2

s d = $\frac{5504.253}{110.8}$ = 49.68 kg/cm2

Cek interaksi kolom

s b (M/W)	=	**661.60**	kg/cm2	ix	=	**20.3836**	cm
s d(P/A)	=	**49.68**	kg/cm2	iy	=	**4.3919**	cm

$\frac{49.68}{661.60}$ = 0.08 < 1.5 *(V.O.S.B)* **(OK)**

l y = $\frac{1600}{4.39}$

l	=	364.31	Fe 310/360/430/510 ?		**360**
===>	w y =	7.720	s (ijin)	1600	kg/cm2

Kontrol Tegangan Kolom

Wx	=	**1841** cm3	Fe 310/360/430/510 ?		**360**
A	=	**110.8** cm3	s (ijin)	1600	kg/cm2
N	=	**5504** kg			
M	=	**12180** kgcm			
w	=	**7.720**			
Ls	=	**350** cm			

s = (7.72 x 5,504) / 110.8 + 12,180 / 1841

= 390.13 kg/cm2 < 1600kg/cm2 **(OK)**

Judul Dokument	Kontrol Tegangan Rangka Baja	

KONTROL TEGANGAN BATANG TEKAN DAN BATANG TARIK RANGKA BAJA

Macam Baja Fe 360 kode baja **2**

No. Btg	Gaya *Tarik* *Ptr* (kg)	Gaya *Tekan* *Ptk* (kg)	lk (cm)	Frofil dipakai	d frofil , d (cm)	*Moment inersia* Ix *(cm4)*	Iy *(cm4)*	s *(cm)*	D Alat sambung Diameter, D (cm)	Lubang Alat sambung, Lb (cm)	Fbr Ftabel (cm2)	Tebal Plat titk buhul,t *(cm)*	Fpakai, Fpk 2.Ftabel	Fnetto (cm2) *Fpk-2.d.Lb*
81	10617		141.6	2x70.70.7	2	42.4	42.4	2.97	1.1	1.3	9.4	1	18.8	13.6
82	9636		141.6	2x70.70.7	2	42.4	42.4	2.97	1.1	1.3	9.4	1	18.8	13.6
83	8403		141.6	2x70.70.7	2	42.4	42.4	2.97	1.1	1.3	9.4	1	18.8	13.6
84	7175		141.6	2x70.70.7	2	42.4	42.4	2.97	1.1	1.3	9.4	1	18.8	13.6
85	5925		141.6	2x70.70.7	2	42.4	42.4	2.97	1.1	1.3	9.4	1	18.8	13.6
129		70.27	40	2x70.70.7	2	42.4	42.4	2.97	1.1	1.3	9.4	1	18.8	13.6

No. Doc : BJ/PPBBI/TS/06
Rev :

Jari-jari inersia		Lamda	Wtabel	*Tegangan tekan*		Tegangan tarik		Ket
ix (cm)	iy (cm)			teg.tk <	teg.ijin.tk	teg.tr <	teg.ijin.tr	
sqr(2.Ix/Fpk)	sqr(2(Iy+Fbr.(s+t/2)^2)/ Fpk)	lk/min(ix;iy)		Ptk/Fpk	teg.ijin.tr/Wtabel	Ptr/Fnetto		
2.1238263	4.06835818210151	66.67212	1.412	0	1133.144476	780.654	1600	OK
2.1238263	4.06835818210151	66.67212	1.412	0	1133.144476	708.513	1600	OK
2.1238263	4.06835818210151	66.67212	1.412	0	1133.144476	617.872	1600	OK
2.1238263	4.06835818210151	66.67212	1.412	0	1133.144476	527.545	1600	OK
2.1238263	4.06835818210151	66.67212	1.412	0	1133.144476	435.683	1600	OK
2.1238263	4.06835818210151	18.83393	1	3.73777	1600	0	1600	OK