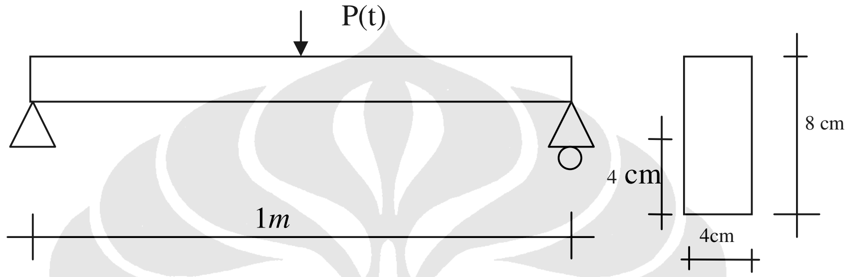
LAMPIRAN A

(Ket : merupakan hasil studi dari Ratna, 2007 [16])

1.1 Perhitungan Beban Impuls

Benda uji yang telah dibuat akan diuji dengan beban dinamik. Dalam hal ini beban dinamik yang diberikan adalah beban tumbukan.



Gambar 4.2.1. Permodelan struktur

F'c = $30 Mpa$

γbeton = $24 kN/m^3$

Berat sendiri beton per panjang = $0,04 m \times 0,08 m \times 24 kN/m^3 = 0,0768 kN/m$

massa beton per panjang = $\dfrac{76,8N}{10m/s^2} = 7,68 kg/m = 7,68 \times 10^{-3} kg/mm$

Inersia = $\dfrac{1}{12} bh^3 = \dfrac{1}{12} \times 40mm \times (80mm)^3 = 1706666,667 mm^4$

Mencari $E_{ci} = 4700\sqrt{fc'} = 4700\sqrt{30} = 25742,96 MPa$

$EI = 25742,96 MPa \times 1706666,667 mm^4 = 4,393 \times 10^{10} Nmm^2$

Frekuensi natural :

$$\omega_n = \frac{n^2\pi^2}{l^2}\sqrt{\frac{EI}{m}} = \frac{n^2\pi^2}{(1000mm)^2}\sqrt{\frac{4,393 \times 10^{10} Nmm^2}{7,68 \times 10^{-3} kg/mm}} = 23,581 n^2$$

$$\omega_1 = 23,581 rad/\sec$$

$$\omega_2 = 94,323 rad/\sec$$

$$\omega_3 = 212,229 rad/\sec$$

dan

$$T_1 = \frac{2\pi}{\omega_1} = \frac{2\times 3,14}{23,581} = 0,266\,\text{sec}$$

$$T_2 = \frac{2\pi}{\omega_2} = \frac{2\times 3,14}{94,323} = 0,06666\,\text{sec}$$

$$T_3 = \frac{2\pi}{\omega_3} = \frac{2\times 3,14}{212,229} = 0,0296\,\text{sec}$$

Persamaan lendutan dinamik:

$$y(x) = \frac{2F_1}{ml}\sum^{n}\frac{1}{\omega_n^2}\left(\sin\frac{n\pi c_1}{l}\right)(DLF)_n \sin\frac{n\pi x}{l}$$

dengan $c_1 = 500\ mm$ maka :

$$y_1(x) = \frac{2F_1}{7,68\times 10^{-3}\,kg/mm\times 1000mm}\times\frac{1}{23,581^2}\left(\sin\frac{1\times 180\times 500mm}{1000mm}\right)(DLF)_1 \sin\frac{1\times\pi x}{l}$$

$$= 4,683\times 10^{-4} F_1 (DLF)_1 \sin\frac{\pi x}{l}$$

$$y_2(x) = \frac{2F_1}{7,68\times 10^{-3}\,kg/mm\times 1000mm}\times\frac{1}{94,323^2}\left(\sin\frac{2\times 180\times 500mm}{1000mm}\right)(DLF)_2 \sin\frac{2\times\pi x}{l}$$

$$= 0$$

$$y_3(x) = \frac{2F_1}{7,68\times 10^{-3}\,kg/mm\times 1000mm}\times\frac{1}{212,229^2}\left(\sin\frac{3\times 180\times 500mm}{1000mm}\right)(DLF)_3 \sin\frac{3\times\pi x}{l}$$

$$= -5,782\times 10^{-6} F_1 (DLF)_3 \sin\frac{3\pi x}{l}$$

Faktor beban mati (DLF) dapat diambil dari grafik 2.4.1

$$\frac{td}{T_1} = \frac{0,1}{0,266} = 0,376 \rightarrow (DLF)_{1,\max} = 1,12$$

$$\frac{td}{T_2} = \frac{0,1}{0,0666} = 1,502 \rightarrow (DLF)_{2,\max} = 1,3$$

$$\frac{td}{T_3} = \frac{0,1}{0,0296} = 3,378 \rightarrow (DLF)_{3,\max} = 1,14$$

Sehingga persamaan lendutan menjadi :

$$y_1(x) = 4,683\times 10^{-4} F_1 (DLF)\sin\frac{\pi x}{l} = 4,683\times 10^{-4} F_1 \times 1,12\times\sin\frac{\pi x}{l}$$

$$= 5,245\times 10^{-4} F_1 \sin\frac{\pi x}{l}$$

Maksimum modal momen bending didapat :

$$y_2(x) = 0$$

$$y_3(x) = -5,782\times10^{-6} F_1 (DLF)_3 \sin\frac{3\pi x}{l} = -5,782\times10^{-6} F_1 \times 1,14 \times \sin\frac{3\pi x}{l}$$

$$= -6,591\times10^{-6} F_1 \sin\frac{3\pi x}{l}$$

$$\mathfrak{M} = -EI\frac{\partial^2 y}{\partial x^2}$$

$$\mathfrak{M}_1 = 5,245\times10^{-4} F_1 \times \frac{\pi^2}{l^2} \times EI \times \sin\frac{\pi x}{l}$$

$$= 5,245\times10^{-4} F_1 \times \frac{3,14^2}{(1000mm)^2} \times 4,393\times10^{10}\, Nmm^2 \times \sin\frac{\pi x}{l}$$

$$= 227,178 F_1 \sin\frac{\pi x}{l}$$

$$\mathfrak{M}_2 = 0$$

$$\mathfrak{M}_3 = -6,591\times10^{-6} F_1 \times \frac{9\pi^2}{l^2} \times EI \times \sin\frac{3\pi x}{l}$$

$$= -6,591\times10^{-6} F_1 \times \frac{9\times3,14^2}{(1000mm)^2} \times 4,393\times10^{10}\, Nmm^2 \times \sin\frac{3\pi x}{l}$$

$$= -25,695 F_1 \sin\frac{3\pi x}{l}$$

dengan $x = 500mm$, maka :

$$\mathfrak{M}_1 = 227,178 F_1 Nmm$$

$$\mathfrak{M}_2 = 0$$

$$\mathfrak{M}_3 = -25,695 F_1 Nmm$$

Maksimum modal geser didapat dari :

$$V = \frac{\partial \mathfrak{M}}{\partial x}$$

$$V_1 = 4,121\times10^{-4} F_1 \times \frac{\pi^3}{l^3} \times EI \times \cos\frac{\pi x}{l} = 0,56 F_1 \cos\frac{\pi x}{l}$$

$$V_2 = 0$$

$$V_3 = -1,0581\times10^{-5} F_1 \times \frac{\pi^3}{l^3} \times EI_1 \cos\frac{3\pi x}{l} = -0,388 F_1 \cos\frac{3\pi x}{l}$$

1.2 Data Teknis Benda Uji Hasil Percobaan

Untuk pengecoran benda uji sebanyak 12 benda uji, dilakukan 4 kali pengecoran dengan data sebagai berikut :

Tabel. 1.2.1. Tanggal pengecoran dan nilai slump benda uji untuk kuat tekan

No	Tanggal Cor	Jenis Benda Uji	Slump
1	21 November 2006	Beton Tanpa Serat	7,8 cm
2	5 Januari 2007	Beton Serat 1%	7,6 cm
3	16 Februari 2007	Beton Prategang Tanpa Serat	7,7 cm
4	21 Maret 2007	Beton Prategang Berserat 1%	7,6 cm

Benda uji untuk pengetesan modulus elastisitas

Tabel 1.2.2. Tanggal pengecoran dan nilai slump benda uji untuk modulus elastisitas

No	Tanggal Cor	Jenis Benda Uji	Slump
1	24 Januari 2007	Silinder Tanpa Serat	7,8 cm
2	1 Februari 2007	Silinder Berserat 1%	8 cm

1.2.1. Kuat tekan beton

Benda uji yang diuji kuat tekannya adalah benda uji dengan jenis beton tanpa serat dan beton dengan serat. Masing – masing jenis diuji pada hari ke 28 dan hari ke 56. Masing- masing pengujian menggunakan 3 buah sampel. Sampel yang diuji adalah benda uji berbentuk kubus dengan ukuran 15 cm × 15 cm × 15 cm.

1.2.1.1. Kuat Tekan Benda Uji Kubus

Data kuat tekan kubus dikonversi ke silinder dengan menggunakan rumus berasal dari SNI T-15-1991-03 dimana $fc' = \left[0.76 + 0.2^{10}\log\frac{fck'}{15}\right] fck'$

fck' merupakan kuat tekan benda uji kubus

A. Data Kuat Tekan Kubus Beton Tanpa Serat Usia 28 hari.

Tabel 1.2.3. Kuat tekan benda uji kubus tanpa serat usia 28 hari

No	Luas Penampang (mm²)	Berat(N)	Volume (m³)	Pu (N)	Kuat Tekan (MPa)	Berat Isi (N/m³)
1	22500	76.92	0.003375	800000	35.556	22791.111
2	22500	77.65	0.003375	750000	33.333	23007.407
3	22500	78.76	0.003375	590000	26.222	23336.296
				rata-rata	31.704	23044.938
				Dalam silinder	24.095	

B. Data Kuat Tekan Kubus Beton Tanpa Serat Usia 56 hari.

Tabel 1.2.4. Kuat tekan benda uji kubus tanpa serat usia 56 hari

No	Luas Penampang (mm²)	Berat(N)	Volume (m³)	Pu (N)	Kuat Tekan (MPa)	Berat Isi (N/m³)
1	22500	75.750	0.003375	1010000	44.889	22444.44
2	22500	77.290	0.003375	1150000	51.111	22900.74
3	22500	77.130	0.003375	1225000	54.444	22853.33
				rata-rata	50.148	22732.84
				Dalam silinder	38.112	

C. Data Kuat Tekan Kubus Berserat Usia 28 hari

Tabel 1.2.5. Kuat tekan benda uji kubus dengan serat usia 28 hari

No	Luas Penampang (mm²)	Berat(N)	Volume (m³)	Pu (N)	Kuat Tekan (MPa)	Berat Isi (N/m³)
1	22500	78.150	0.003375	740000	32.889	23155.55
2	22500	78.990	0.003375	690000	30.667	23404.44
3	22500	79.140	0.003375	700000	31.111	23448.88
				rata-rata	31.556	23336.29
				Dalam silinder	23.983	

D. Data Kuat Tekan Kubus Berserat Usia 56 hari

Tabel 1.2.6. Kuat tekan benda uji kubus dengan serat usia 56 hari

No	Luas Penampang (mm²)	Berat(N)	Volume (m³)	Pu (N)	Kuat Tekan (MPa)	Berat Isi (N/m³)
1	22500	76.980	0.003375	690000	30.667	22808.88
2	22500	76.020	0.003375	865000	38.444	22524.44
3	22500	76.250	0.003375	832500	37.000	22592.59
				rata-rata	35.370	22641.97
				Dalam silinder	22.311	

1.2.1.2 Kuat Tekan Benda Uji Silinder (Dari Uji Modulus Elastisitas)

Ukuran silinder dengan diameter 15 cm dan tinggi 30 cm

A. Data Kuat Tekan Silinder Tanpa Serat Usia 28 hari

Tabel 1.2.7. Kuat tekan benda uji silinder tanpa serat usia 28 hari

No	Luas Penampang (mm²)	Berat(N)	Volume (m³)	Pu (N)	Kuat Tekan (MPa)	Berat Isi (N/m³)
1	17662.5	118	0.0053	485000	27.4593	22269.4
2	17662.5	120.42	0.0053	477500	27.0347	22726.1
3	17662.5	118.46	0.0053	495000	28.0255	22356.2
4	17662.5	119.02	0.0053	440000	24.9115	22461.9
				rata-rata	26.8577	22450.6

B. Data Kuat Tekan Silinder Dengan Serat Usia 28 hari

Tabel 1.2.8. Kuat tekan benda uji silinder dengan serat usia 28 hari

No	Luas Penampang (mm²)	Berat(N)	Volume (m³)	Pu (N)	Kuat Tekan (MPa)	Berat Isi (N/m³)
1	17662.5	119.12	0.0053	435000	24.6285	22480.8
2	17662.5	118.56	0.0053	365000	20.6653	22375.1
3	17662.5	119.52	0.0053	400000	22.6469	22556.3
4	17662.5	120.51	0.0053	390000	22.0807	22743.1
				rata-rata	22.5053	22470.7

1.2.2. Analisa Kuat Tekan

Dari data didapatkan bahwa kuat tekan pada usia 28 hari beton tanpa serat dan kuat tekan beton berserat pada ketiga benda uji diatas 30 MPa dalam kubus, sesuai dengan yang diharapkan. Kuat tekan antara beton serat dan beton tanpa serat pada benda uji kubus tidak mengalami perbedaan yang signifikan yaitu 0.469%. Kuat tekan beton tanpa serat mempunyai nilai yang lebih besar dari beton dengan serat.

Untuk kuat tekan beton 56 hari, pada benda uji kubus beton tanpa serat mempunyai kuat tekan sebesar 50.148 MPa dalam kubus, hal ini diluar dari ketentuan, dimana kuat tekan beton beton tidak mengalami peningkatan yang berarti jika sudah berusia diatas 28 hari, kemungkinan kesalahan pada prosedur pengujian. Pada benda uji kubus dengan serat terjadi peningkatan kuat tekan sebesar 12,086% dari umur 28 hari dan umur beton 56 hari

1.3. Modulus Elastisitas Beton

Untuk pengujian modulus elastisitas benda uji berbentuk kubus dengan ukuran diameter 15 cm dan tinggi 30 cm. Adapun komposisi benda uji antara lain :

1. Beton tanpa serat sebanyak 4 buah benda uji.
2. Beton dengan serat 1% sebanyak 4 buah benda uji.

Nilai koreksi untuk pembacaan dial deformasi horizontal : (pada gambar 3.4.1)

er=8,6 cm

eg=17 cm

maka nilai koreksi =8,6 cm/(8,6 cm+17 cm) = 0,33

Tabel 1.3.1 Modulus elastisitas beton tanpa serat

No	Jenis Sampel	Modulus elastisitas (MPa)
1	Beton Tanpa Serat 1	26263
2	Beton Tanpa Serat 2	25764
3	Beton Tanpa Serat 3	25858
	ME rata- rata	25961.667

Tabel 1.3.2 Modulus elastisitas beton dengan serat

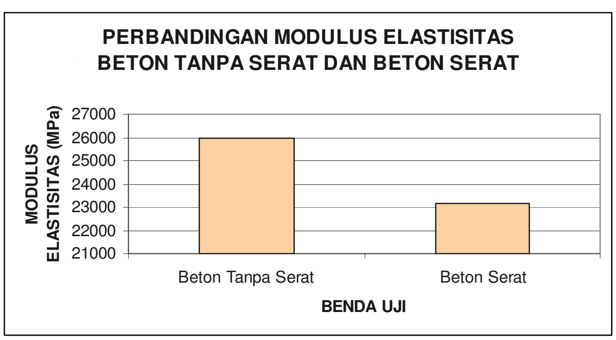
No	Jenis Sampel	Modulus Elastisitas (MPa)
1	Beton Serat 1	19171
2	Beton Serat 2	25161
3	Beton Serat 3	25168
	ME rata-rata	23166.667

Tabel 1.3.3 Nisbah poisson beton tanpa serat

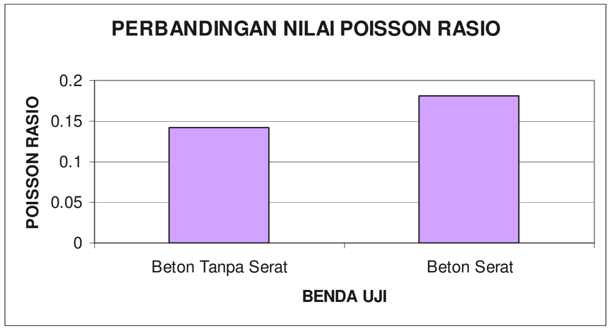
No	Jenis Sampel	Siklus 1	Siklus 2	Siklus 3	Rata-Rata
1	Beton Tanpa Serat 1	0.1191	0.1144	0.1268	0.1201
2	Beton Tanpa Serat 2	0.1423	0.1614	0.1637	0.1558
3	Beton Tanpa Serat 3	0.1564	0.1484	0.1484	0.151066667
				Poison rata- rata	0.142322222

Tabel 1.3.4 Nisbah poisson beton dengan serat

No	Jenis Sampel	Siklus 1	Siklus 2	Siklus 3	Rata-Rata
1	Beton Serat 1	0.1652	0.1626	0.1504	0.1594
2	Beton Serat 2	0.1585	0.1731	0.1562	0.1626
3	Beton Serat 3	0.1571	0.2249	0.2915	0.2245
				Poison rata-rata	0.182166667



Gambar 1. Perbandingan Modulus Elastisitas



Gambar 2. Perbandingan Nilai Poisson Rasio

Tabel 1.3.5 Nisbah poisson beton dengan serat Perbandingan Modulus elastisitas dari pengukuran dan perhitungan kuat tekan

Benda Uji	$4700\sqrt{f'c}(MPa)$	Modulus Elastisitas Pengukuran (MPa)
Beton tanpa serat	24109.8181	25961.667
Beton dengan serat	24053.478	23166.667

1.3.1 Analisa Modulus Elastisitas Nisbah dan Poisson

Dari data diatas dapat dilihat bahwa nilai modulus elastisitas beton tanpa serat lebih tinggi dari beton serat sesuai dengan kuat tekannya. Perbedaan modulus elastisitas beton tanpa serat dan beton serat sebesar 12.065%.Untuk nisbah Poisson, penambahan serat meningkatkan nisbah poisson sebesar 27.99%. Sedangkan untuk nilai modulus elastisitas dari hasil kuat tekan dan pengukuran langsung untuk beton tanpa serat terjadi perbedaan 11.63% untuk beton dengan serat dan 12.648% untuk beton serat.

1.4. Frekuensi Alami Benda Uji

1.4.1 Uji Palu Eletrik

Tabel 1.4.1. Frekuensi alami benda uji BTS dari percobaan

NO	BTS1		BTS2		BTS3	
	FREKUENSI (Hertz)	T(ms)	FREKUENSI (Hertz)	T(ms)	FREKUENSI (Hertz)	T (ms)
1			68.359	14.628	87.891	11.378
			117.188	8.533	97.656	10.24
2	68.356	14.628	78.125	12.8	87.891	11.378
	126.953	7.876	97.656	10.24	97.656	10.24
3	68.359	14.628	78.125	12.8	87.891	11.378
	117.188	8.53	117.875	8.53	97.656	10.24

Tabel 1.4.2. Frekuensi alami benda uji BS dari percobaan

NO	BS1			BS2	
	FREKUENSI (Hertz)		T(ms)	FREKUENSI (Hertz)	T(ms)
1	F1	78.125	12.8	68.359	14.629
	F2	97.656	10.24	97.656	10.24
2	F1	87.89	11.37	78.125	12.8
	F2	97.656	10.24	97.656	10.24
3	F1	78.125	12.8	78.125	12.8
	F2	97.656	10.24	97.656	10.24

Tabel 1.4.3. Frekuensi alami benda uji BPTS dari percobaan

NO	BPTS1			BPTS2		BPTS3	
	FREKUENSI (Hertz)		T(ms)	FREKUENSI (Hertz	T(ms)	FREKUENSI (Hertz)	T(ms)
1	F1	87.891	11.378	87.891	11.378	87.891	11.378
	F2	97.656	10.24	97.656	10.24	97.656	10.24
2	F1	87.891	11.378	87.891	11.378		
	F2	97.656	1024	97.656	1024		
3	F1	87.891	11.378	87.891	11.378		
	F2	129.953	7.877	97.656	1024		

Tabel 1.4.4. Frekuensi alami benda uji BPS dari percobaan

NO	BPS1			BPS2		BPS3	
	FREKUENSI (Hertz)		T(ms)	FREKUENSI (Hertz)	T(ms)	FREKUENSI (Hertz)	T(ms)
1	F1	68.359	14.628	68.359	14.628	68.359	14.628
	F2	97.656	10.24	97.656	10.24	97.656	10.24
2	F1	58.593	17.0667	68.359	14.628	68.359	14.628
	F2	97.656	10.24	97.656	10.24	97.656	10.24
3	F1	58.593	17.066	78.125	12.8		
	F2	97.656	10.24	97.656	10.24		

Frekuensi dan periode yang diambil adalah frekuensi dan peroide yang sering muncul

Tabel 1.4.5. Frekuensi Awal Dari Benda Uji dari percobaan

No	Jenis Benda Uji	Frekuensi (Hertz)		T(ms)
1	Beton Tanpa Serat	F1	87.891	11.378
		F2	97.656	10.24
2	BetonSerat	F1	78.125	12.8
		F2	97.656	10.24
3	Beton Prategang Tanpa Serat	F1	87.891	11.378
		F2	97.656	10.24
4	Beton Prategang Berserat	F1	68.359	14.628
		F2	97.656	10.24

1.4.2 Perhitungan frekuensi alami dengan menggunakan rumus

Berat isi beton dengan serat =23336,96 N/m^3

Berat isi beton tanpa serat =23044.938 N/m^3

Volume beton $=0,04m \times 0.08m \times 1m = 0,0032m^3$

$$I = \frac{1}{12} \times 40mm \times (80mm)^3 = 1706667m^4$$

$$\text{massa beton tanpa serat} = \frac{23044.938N/m^3 \times 0,0032m^3}{9800mm/s^2} = 0,00752488Ns^2/mm$$

$$\text{massa beton serat} = \frac{23336,96N/m^3 \times 0,0032m^3}{9800mm/s^2} = 0,00762Ns^2/mm$$

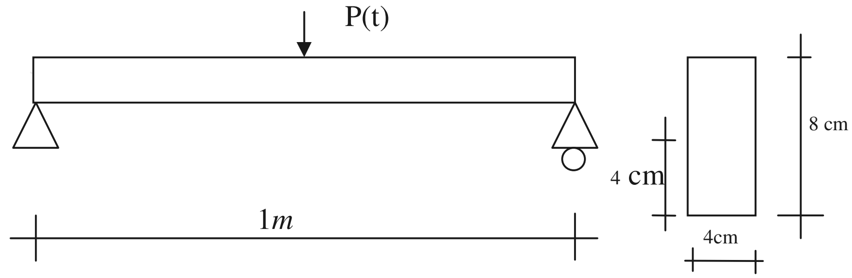
$$K\text{beton serat} = \frac{48EI}{L^3} = \frac{48 \times 25961.667\ MPa \times 1706667m^4}{(1000mm)^3} = 2126.78N/mm$$

$$K\text{beton serat} = \frac{48EI}{L^3} = \frac{48 \times 23166.667\ MPa \times 1706667m^4}{(1000mm)^3} = 1897.813N/mm$$

$$f_n\text{beton tanpa serat} = \frac{\omega_n}{2\pi} = \frac{\sqrt{\frac{k}{m}}}{2\pi} = \frac{\sqrt{\frac{2126.78N/mm}{0,00752488Ns^2/mm}}}{2 \times 3,14} = 84.655\,put/\det$$

$$f_n\text{beton serat} = \frac{\omega_n}{2\pi} = \frac{\sqrt{\frac{k}{m}}}{2\pi} = \frac{\sqrt{\frac{1897.813N/mm}{0,00762Ns^2/mm}}}{2 \times 3,14} = 79.466\,put/\det$$

1.5. Menentukan Tinggi Jatuh Hingga Benda Uji Mengalami Keruntuhan



1.5.1. Balok beton tanpa serat

$P = 6,6N$

$f'c = 24.095MPa$

$E = 25961.667Mpa$

A. Menentukan lendutan statik

$$\Delta_{st} = \frac{PL^3}{48EI} = \frac{6,6N \times (1000mm)^3}{48 \times 25961,667MPa \times \frac{1}{12} \times 40mm \times (80mm)^3} = 0.0031mm$$

$\sigma_d = 0.5 \times f'c = 0.5 \times 24,095MPa = 12.0475MPa$

B. Menentukan lendutan dinamik

$\Delta d = \Delta_{st} + \sqrt{(\Delta_{st})^2 + 2\Delta_{st} h}$ dan tegangan statis maksmum di tengah bentang adalah :

$$\sigma_{st} = \frac{M}{Z} = \frac{PL}{4Z}$$

maka :

$$\sigma_d = \sigma_{st} \frac{\Delta_d}{\Delta_{st}} = \frac{PL}{4Z}\left(\frac{\Delta_{st} + \sqrt{(\Delta_{st})^2 + 2\Delta_{st} h}}{\Delta_{st}}\right)$$

$$12,0475MPa = \frac{6.6N \times 1000mm}{4 \times \frac{1}{6} \times 40mm \times (80mm)^2}\left(\frac{0.0031mm + \sqrt{(0.0031mm)^2 + (2 \times 0.0031mm \times h)}}{0.0031mm}\right)$$

$$12.0475MPa = 0.038MPa + \left(\frac{0.0031mm + \sqrt{(0.0031mm)^2 + (2 \times 0.0031mm \times h)}}{0.0031mm}\right)$$

$$12.0475MPa = 0.038MPa + \left(12,25 \times \sqrt{(0.0031mm)^2 + (0.0062mm \times h)}\right)$$

$$\sqrt{(0.0031mm)^2 + (0.0062mm \times h)} = \frac{12.0475MPa - 0.038MPa}{12.25} = 0.980$$

$$(0.0031mm)^2 + (0.0062mm \times h) = 0.9611$$

$$h = \frac{0.9611 - (0.0031mm)^2}{0.0062} = 155mm = 15.5mm$$

1.5.2. Balk beton berserat 1 %

$P = 6,6N$

$f'c = 23.983MPa$

$E = 23166,667Mpa$

A. Menentukan lendutan statik

$$\Delta_{st} = \frac{PL^3}{48EI} = \frac{6,6N \times (1000mm)^3}{48 \times 23166,667MPa \times \frac{1}{12} \times 40mm \times (80mm)^3} = 0.003477mm$$

$\sigma_d = 0.5 \times f'c = 0.5 \times 23.983MPa = 11.992MPa$

B. Menentukan lendutan dinamik

$\Delta d = \Delta_{st} + \sqrt{(\Delta_{st})^2 + 2\Delta_{st} h}$ dan tegangan statis maksmum di tengah bentang adalah :

$$\sigma_{st} = \frac{M}{Z} = \frac{PL}{4Z}$$

maka :

$$\sigma_d = \sigma_{st} \frac{\Delta_d}{\Delta_{st}} = \frac{PL}{4Z}\left(\frac{\Delta_{st} + \sqrt{(\Delta_{st})^2 + 2\Delta_{st} h}}{\Delta_{st}}\right)$$

$$11.992MPa = \frac{6.6N \times 1000mm}{4 \times \frac{1}{6} \times 40mm \times (80mm)^2}\left(\frac{0.0035mm + \sqrt{(0.0035mm)^2 + (2 \times 0.0035mm \times h)}}{0.0035mm}\right)$$

$$11.992MPa = 0.038MPa + \left(\frac{0.0035mm + \sqrt{(0.0035mm)^2 + (2 \times 0.0035mm \times h)}}{0.0035mm}\right)$$

$$11.992MPa = 0.038MPa + \left(10.857 \times \sqrt{(0.0035mm)^2 + (0.007mm \times h)}\right)$$

$$\sqrt{(0.0035mm)^2 + (0.007mm \times h)} = \frac{11.992MPa - 0.038MPa}{10.857} = 1.101$$

$$(0.0035mm)^2 + (0.007mm \times h) = 1.212$$

$$h = \frac{1.212 - (0.0035mm)^2}{0.007} = 173.183mm = 17.31mm$$

Berdasarkan perhitungan di atas, balok beton tanpa serat dapat mengalami keruntuhan pada beban tumbukan dengan tinggi jatuh 15.5 mm dan balok beton dengan serat dapat mengalami keruntuhan pada beban tumbukan dengan tinggi jatuh 17.31 mm.

LAMPIRAN B

FOSROC constructive solutions

Conbextra EP75

High strength, epoxy resin grout

Uses

Provides a free flowing grout, for use where physical properties and chemical resistance of the hardened grout are of utmost importance. It is suitable for a wide range of heavy duty applications including

- Underplate grouting to substantial structural elements
- Base plate grouting in dynamic load situations such as turbines and other reciprocating machinery.
- Heavy industrial applications in steelworks, refineries chemical plants and electroplating works
- Structural infill where very high strength is required
- Rail track applications, to support heavy cranes, or on transporter rails.

Advantages

- Excellent durability - high compressive, flexural and tensile strengths ensure a long working life.
- Cost effective - high early strength gain promotes minimum downtime and early commissioning of plant.
- User friendly - simple, full pack mixing to ensure that the performance characteristics are achieved.
- Versatile - suitable for a wide range of loading situations including repetitive dynamic loads.
- Excellent in service performance - non-shrink capability ensures full surface to surface contact.

Description

Conbextra EP75 is a solvent free epoxy resin grout designedfor grouting of gap widths of 10 to 75 mm. It is supplied as athree component system consisting of base, hardener andspecially graded aggregate. The components are supplied inthe correct mix proportions designed for whole pack mixingon site.

Specification

Where shown on the contract documents, the epoxy groutshall be Conbextra EP75 supplied by Fosroc. It shall providegood general chemical resistance, 7 day compressive strengthof at least 100 N/mm² and a compressive creep of 2.85N/mm² in accordance with ASTM C1181

Properties

Tensile Strength (ASTM D-638)	28 days	270 kg/cm²
Flexural Strength (ASTM D-790)	28 days	400 kg/cm²
Bond Strength		
To concrete,	28 days	>20 kg/cm² (concrete failure, over r
To steel,	28 days	>90 kg/cm² (steel surface blast clea
Compressive Strength (ASTM D-695)		
7 days		620 kg/cm²
28 days		640 kg/cm²
Modulus Of Elasticity		21.000 kg/cm²
Coefficient of thermal expansion (-20°C to +40°C)		89×10^{-6} per °C
Shelf Life		1 year when unopened

Instructions for use

Preparation

Underplate groutingThe unrestrained surface area of the grout must be kept to aminimum. Generally, the gap between the perimeter formwork and the plate edge should not exceed 75 mm on the pouring side and 25 mm on the opposite side. Formwork on the flank sides should bekept tight to the plate edge. Air pressure relief holes should be

Formwork

The formwork should be constructed to be leak proof as Conbextra EP75 is a free flow grout. This can be achieved by using foamrubber strip or mastic sealant beneath the constructed formwork and between joints.For free flow grout conditions, it is essential to provide a hydrostatic head of grout. To achieve this a feeding hopper should be used -please consult your local Fosroc office for more details.

Foundation surface

This must be free from oil, grease, or any loosely adherent material. If the concrete surface is defective or has laitence, it must be cutback to a sound base. Bolt holes or fixing pockets must be blown

Base plate

If delay is likely before placing steel base plates, it is recommended that the underside and edge are coated with Nitoprime 25* to preventrust formation and ensure bonding with the Conbextra EP75 grout.All metal surfaces should be cleaned to a bright finish in accordance with Swedish Standard SA 2½ or equal. Nitoprime 25 can be applied directly onto newly cleaned steel surfaces even if they are damp

Nitobond EC

FOSROC constructive solutions

Two-parts epoxy bonding agent

Uses

Adhesive compound is a specially formulated epoxy resin adhesive for anchoring, bonding prefabricated elements such as bridge segments.
Permanent installation of reinforcement starter bars, foundation bolt, railway track.

Advantages

- Excellent adhesive
- Fast cure
- Chemical resistance
- Easy to use

Description

Adhesive compound is an epoxy resin based products with special fine fillers. The components differ in colour thus allowing visual assessment of mixing.

Properties

Colour	Concrete Grey
Mix Ratio	Comp. A : B = 2 : 1
Mix Density	1.7 kg/ ltr
Pot Life 30°C	35 minutes
Tensile Strength (ASTM D-638) 28 days	130 kg/cm²
Flexural Strength (ASTM D-790) 28 days	320 kg/cm²
Bond Strength to Concrete (28 days)	> 20 kg/cm²
Bond Strength to Steel (28 days)	> 120 kg/cm²
Compressive Strength (ASTM D-695)	
7 days	505 kg/cm²
28 days	570 kg/cm²
Modulus Of Elasticity	43,000 kg/cm²
Coefficient of thermal expansion (-20°C to +40° C)	50×10^{4} per °C

Instruction For Use

Surface Preparation

Concrete should be mechanically sound, dry and free from oil or grease, laitance and dust. A dry grit blast surface is recommended for optimum adhesion.

Bar should be deformed. This will ensure good bond between bar and adhesive compound.

Bar should be degreased and any mill seak or flaky rust removed.

Mixing

The contents of hardener should be added to the base can and mixed for three minutes (minimum) with a paddle and slow speed heavy duty drill, ensuring the side are scraped down. A uniform grey colour should be obtained.

Application

Precast Element

The mix adhesive should be applied at the required thickness to both faying surfaces with a serrated trowel or other suitable spreader.

Anchoring

The mixed grout should be poured or pumped steadily into the prepared anchor holes. The anchor bar should then be pressed into the hole to the required depth. Slight agitation of the bar will greatly assist in achieving a complete bond.

The bar should be left undisturbed in the required position until the adhesive compound hardened fully.