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Lampiran

Lampiran 1.

HARGA PEMBUATAN BLOK X DAN BRONJONG

Analisa harga satuan untuk 1 buah blok X

No	Pekerjaan			Harga Satuan (Rp)	Jumlah Harga (Rp)
A	Pekerjaan Blok X (Beton K-300)				
	Bahan				
	99,12	Kg	Semen	1.500,00	148.680,00
	0,11664	M3	Pasir	130.000,00	15.163,20
	0,18144	M3	Kerikil	150.000,00	27.216,00
	Upah				
	0,396	Oh	Pekerja	100.000,00	39.600,00
	0,066	Oh	Tukang	120.000,00	7.920,00
	0,00672	Oh	Kepala Tukang	150.000,00	1.008,00
	0,01992	Oh	Mandor	170.000,00	3.386,00
					239.587,00
B	Pekerjaan Pembesian				
	Bahan				
	33,60	Kg	Besi Polos	1.500,00	50.400,00
	0,48	Kg	Kawat Beton	130.000,00	62.400,00
	Upah				
	0,22	Oh	Pekerja	100.000,00	22.000,00
	0,22	Oh	Tukang	120.000,00	26.400,00
	0,022	Oh	Kepala Tukang	150.000,00	3.300,00
	0,013	Oh	Mandor	170.000,00	2.210,00
					164.500,00
C	Bekisting				
	5,04	M2	Bekisting	150.000,00	756.000,00
Jumlah A + B + C					1.160.087,20

Dengan data yang ada : Tinggi lereng 8m, Lebar 6m, Tebal 2m
Jumlah Blok X = 54 buah
Biaya untuk 54 buah blok X adalah
54 x 1.160.087,20 = 62.644,708,80

Biaya untuk 96 m3 batu adalah

96 x 200.000,00 = 19.200.000,00

Total biaya untuk perkuatan blok X adalah

62.644,708,80 + 19.200.000,00 = **81.844.708,80**

Analisa harga satuan untuk 1 buah bronjong

No	Pekerjaan			Harga Satuan (Rp)	Jumlah Harga (Rp)
A	Pekerjaan Bronjong				
	Bahan				
	1	Bh	Kawat Bronjong	340.000,00	340.000,00
	1,2	M3	Batu Kali/Belah	200.000,00	240.000,00
	Upah				
	0,67	Oh	Tukang Anyam	150.000,00	100.500,00
	2,03	Oh	Pekerja	120.000,00	243.600.000
	0,052	Oh	Mandor	170.000,00	8.840,00
					932940

Dengan data yang ada : Tinggi lereng 8m, Lebar 6m, Tebal 2m

Jumlah Bronjong yang digunakan adalah 96 buah bronjong

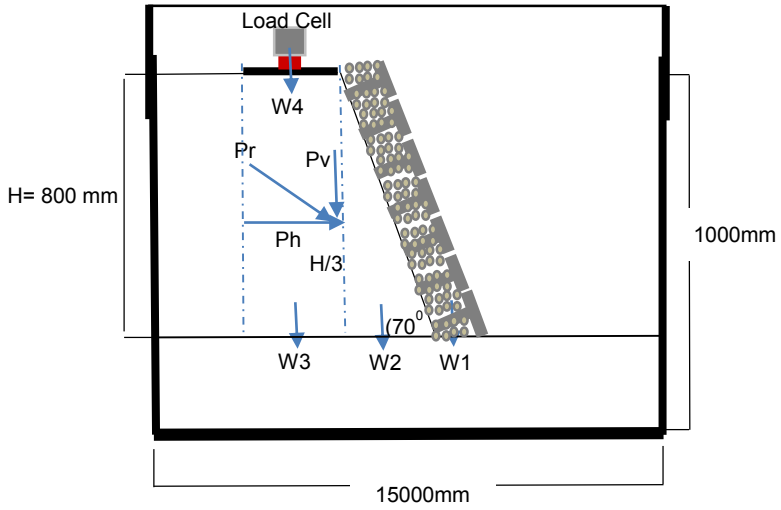
Biaya untuk keseluruhan adalah

96 x 932.940,00 = **89.562.240,00**

Lampiran 2

PERHITUNGAN SAFETY FAKTOR
(Stabilitas Guling)

A. Tanpa Presipitasi Blok X Tipe 1



$$Safety\ Factor\ (FS) = \frac{\Sigma\ \textbf{Momen Penahan}}{\Sigma\ \textbf{Momen Pendorong}}$$

Σ Momen Penahan = Σ Wixi + PvXv
Σ Momen Guling = Ph H/3
Pv = Pr Sin δ
Ph = Pr Cos δ
δ = (sudut gesek dinding dan tanah 2/3 ϕ (sudut gesek dalam)
ϕ = sudut gesek dalam (25,06)
β = sudut kemiringan lereng (70)
ɵ = sudut dinding dan belakang tanah (20)
ɣ = 1,1 gr/cm3 (10,79 kN/m3)
Berat jenis beton = 2,4 gr/cm3
Berat jenis Batu = 2,7 gr/cm3
Berat blok X tipe 1 = 28,08 kg
Berat batu untuk tipe 1 = 109 kg
Load keruntuhan Lereng = 7,4 kN
Load Blok X Tipe 1 = 18 kN

1. Koefisien tanah aktif

$$K = \frac{\cos 2\ (\phi - \theta)}{cos2\theta\ x\ \cos(\delta - \theta)[1 + \frac{\sqrt{\sin(\delta+\phi)x\ (\sin(\phi-\beta)}}{\sqrt{\cos(\delta+\theta)x\ (cos(\theta-\beta)}}]2}$$

K = 0.2

2. Tekanan tanah lateral
   Tekanan lateral akibat tanah
   Ps = $\frac{1}{2} K \gamma H^2$
   Ps = 0,5 x 0,2 x 10,79 kN/m^3 x 0,64 m^2
   = 0,71 kN/m

   Tekanan lateral akibat beban
   Pb = q K H
   = 18 kN/m2 x 0,2 x 0,8 m
   = 2,88 kN/m

3. Resultan tekanan tanah lateral
   Pr = Ps + Pb
   = 0,71 + 2,88
   = 3,59 kN/m

4. Tekanan Lateral (Ph)
   Ph = Pr cos δ
   = 3,59 cos 16,7
   = 3,41

5. Tekanan Vertikal (Pv)
   Pv = Pr sin δ
   = 3,59 sin 16,7
   = 1,08

6. Momen Tahanan Blok X tipe 1

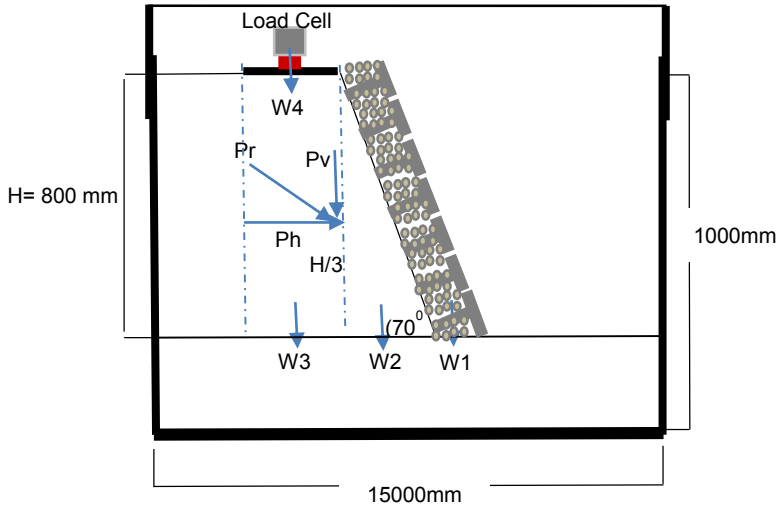
No	Berat (W)	Jarak	Momen
W1	1,37	0,1	0,14
W2	10,79 x 0,27 x 0,8 x 0,5	0,38	0,46
W3	10,79 x 0,2 x 0,8	0,57	1,01
W4	18 x 0,2	0,57	2,05
		Total	3,66

7. Momen Penahan (Blok X Tipe 1)
   = Σ Wixi + PvXv
   = 3,66 + (1,08 x 0,2)
   = 3,85

8. Momen guling = Ph H/3
   = 3,41 x 0,8/3
   = 1,29

9. Safety Faktor Blok X Tipe 1
   = 3,85/1,29
   = **2,98 (lebih besar dari 2)**

B. Tanpa Presipitasi Blok X Tipe 2



$$\textbf{\textit{Safety Factor}}\ (\textbf{\textit{FS}}) = \frac{\Sigma\ \textbf{Momen Penahan}}{\Sigma\ \textbf{Momen Pendorong}}$$

Σ Momen Penahan = Σ Wixi + PvXv
Σ Momen Guling = Ph H/3

Pv = Pr Sin δ
Ph = Pr Cos δ
δ = (sudut gesek dinding dan tanah 2/3 ϕ (sudut gesek dalam)
ϕ = sudut gesek dalam (25,06)
β = sudut kemiringan lereng (70)
ɵ = sudut dinding dan belakang tanah (20)
ɣ = 1,1 gr/cm3 (10,79 kN/m3)
Berat jenis beton = 2,4 gr/cm3
Berat jenis Batu = 2,7 gr/cm3
Berat blok X tipe 2 = 24,78 kg
Berat batu untuk tipe 2 = 104 kg
Load keruntuhan Lereng = 7,4 kN
Load Blok X Tipe 2 = 18 kN (300 kN/m^2)

1. Koefisien tanah aktif

$$K = \frac{\cos 2\ (\phi - \theta)}{cos2\theta\ x \cos(\delta - \theta)[1 + \frac{\sqrt{\sin(\delta+\phi)x\ (\sin(\phi-\beta)}}{\sqrt{\cos(\delta+\theta)x\ (cos(\theta-\beta)}}]2}$$

K = 0.2

2. Tekanan tanah lateral
   Tekanan lateral akibat tanah
   Ps = $\frac{1}{2} K \gamma H^2$
   Ps = 0,5 x 0,2 x 10,79 kN/m^3 x 0,64 m^2
   = 0,71 kN/m

3. Tekanan lateral akibat beban
   Pb = q K H
   = 18 kN/m2 x 0,2 x 0,8 m
   = 2,88 kN/m

4. Resultan tekanan tanah lateral
   Pr = Ps + Pb
   = 0,71 + 2,88
   = 3,59 kN/m

5. Tekanan Lateral (Ph)
   Ph = Pr cos δ
   = 3,59 cos 16,7
   = 3,41

6. Tekanan Vertikal (Pv)
   Pv = Pr sin δ
   = 3,59 sin 16,7
   = 1,08

Momen Tahanan Blok X tipe 1

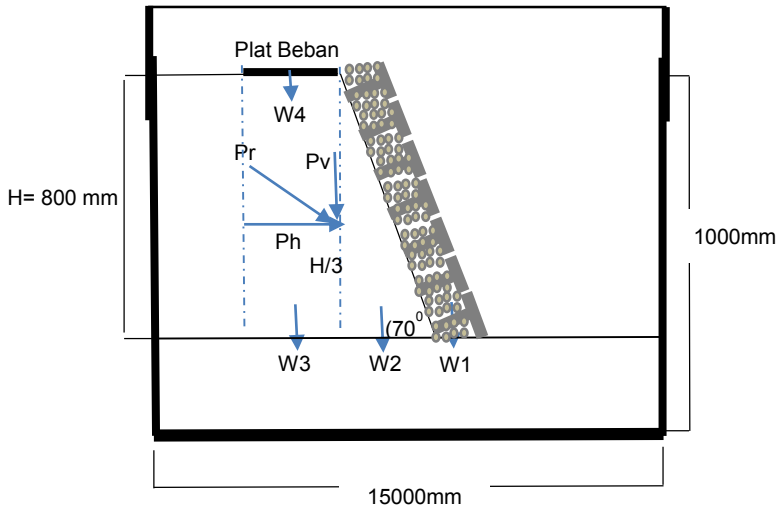
No	Berat (W)	Jarak	Momen
W1	1,29	0,1	0,13
W2	10,79 x 0,27 x 0,8 x 0,5	0,38	0,46
W3	10,79 x 0,2 x 0,8	0,57	1,01
W4	18 x 0,2	0,57	2,05
		Total	3,63

7. Momen Penahan (Blok X Tipe 2)
   = Σ Wixi + PvXv
   = 3,63 + (1,08 x 0,2)
   = 3,84

8. Momen guling
   = Ph H/3
   = 3,41 x 0,8/3
   = 1,29

9. Safety Faktor Blok X Tipe 2
   = 3,84/1,29
   = **2,97 (lebih besar dari 2)**

C. Dengan Presipitasi Blok X Tipe 1



$$\textbf{Safety Factor } (\textbf{FS}) = \frac{\Sigma \textbf{ Momen Penahan}}{\Sigma \textbf{ Momen Pendorong}}$$

Σ Momen Penahan = Σ Wixi + PvXv
Σ Momen Guling = Ph H/3

Pv = Pr Sin δ
Ph = Pr Cos δ
δ = (sudut gesek dinding dan tanah 2/3 ϕ (sudut gesek dalam)
ϕ = sudut gesek dalam (18)
β = sudut kemiringan lereng (70)
ɵ = sudut dinding dan belakang tanah (20)
ɣ = 1,2 gr/cm3 (11,77 kN/m3)
q = 50 kg (0,94 kN/m^2)
Berat blok X tipe 1 = 28,08 kg
Berat batu untuk tipe 1 = 109 kg

1. Koefisien tanah aktif

$$K = \frac{\cos 2\,(\phi - \theta)}{cos2\theta\, x \cos(\delta - \theta)[1 + \frac{\sqrt{\sin(\delta+\phi)x\,(\sin(\phi-\beta)}}{\sqrt{\cos(\delta+\theta)x\,(cos(\theta-\beta)}}]2}$$

K = 0.57

2. Tekanan tanah lateral

Tekanan lateral akibat tanah

$$Ps = \frac{1}{2} K \gamma H^2$$

Ps = 0,5 x 0,47 x 11,77 kN/m^3 x 0,64 m^2
= 2,83 kN/m

Tekanan lateral akibat beban

Pb = q K H
= 0,94 kN/m2 x 0,568 x 0,8 m
= 0,427 kN/m

3. Resultan tekanan tanah lateral
Pr = Ps + Pb
= 2,83 + 0,427
= 3,26 kN/m

4. Tekanan Lateral (Ph)
Ph = Pr cos δ
= 3,26 cos 12
= 3,11

5. Tekanan Vertikal (Pv)
Pv = Pr sin δ
= 3,26 sin 12
= 0,65

6. Momen Tahanan Blok X tipe 1

No	Berat (W)	Jarak	Momen
W1	1,37	0,1	0,14
W2	11,77 x 0,17 x 0,8 x 0,5	0,285	0,23
W3	11,77 x 0,2 x 0,8	0,52	0,87
W4	0,94 x 0,2	0,52	0,18
		Total	1,42

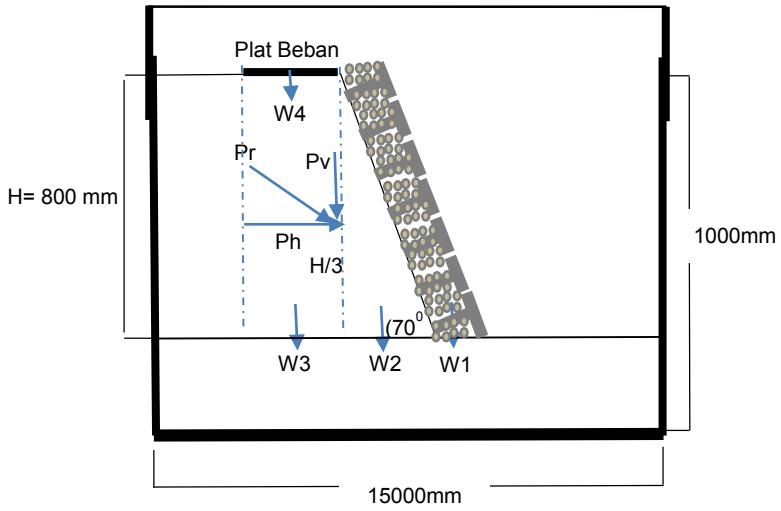
W1 = berat batu + berat blok X

7. Momen Penahan (Blok X Tipe 1)
= Σ Wixi + PvXv
= 1,42 + (0,65 x 0,2)
= 1,66

8. Momen guling = Ph H/3
= 3,11 x 0,8/3
= 0,78

9. Safety Faktor Blok X Tipe 1
= 1,66/0,78
= **2,13 (lebih besar dari 2)**

D. Dengan Presipitasi Blok X Tipe 2



$$\textbf{\textit{Safety Factor}}\ (\textbf{\textit{FS}}) = \frac{\Sigma\ \textbf{Momen Penahan}}{\Sigma\ \textbf{Momen Pendorong}}$$

Σ Momen Penahan = Σ Wixi + PvXv
Σ Momen Guling = Ph H/3

Pv = Pr Sin δ
Ph = Pr Cos δ
δ = (sudut gesek dinding dan tanah 2/3 ϕ (sudut gesek dalam)
ϕ = sudut gesek dalam (18)
β = sudut kemiringan lereng (70)
ɵ = sudut dinding dan belakang tanah (20)
ɣ = 1,2 gr/cm3 (11,77 kN/m3)
q = 50 kg (0,94 kN/m^2)
Berat blok X tipe 1 = 28,08 kg
Berat batu untuk tipe 1 = 109 kg

1. Koefisien tanah aktif

$$K = \frac{\cos 2\ (\phi - \theta)}{cos2\theta\ x \cos(\delta - \theta)[1 + \frac{\sqrt{\sin(\delta+\phi)x\ (\sin(\phi-\beta)}}{\sqrt{\cos(\delta+\theta)x\ (cos(\theta-\beta)}}]2}$$

K = 0.57

2. Tekanan tanah lateral
Tekanan lateral akibat tanah

$$Ps = \frac{1}{2} K \gamma H^2$$

Ps = 0,5 x 0,568 x 11,77 kN/m^3 x 0,64 m^2
= 2,83 kN/m

Tekanan lateral akibat beban
Pb = q K H

= 0,94 kN/m2 x 0,568 x 0,8 m
= 0,427 kN/m

3. Resultan tekanan tanah lateral
Pr = Ps + Pb
= 2,82 + 0,427
= 3,26 kN/m

4. Tekanan Lateral (Ph)
Ph = Pr cos δ
= 3,26 cos 12
= 3,11

5. Tekanan Vertikal (Pv)
Pv = Pr sin δ
= 3,26 sin 12
= 0,65

6. Momen Tahanan Blok X tipe 2

No	Berat (W)	Jarak	Momen
W1	1,29	0,1	0,13
W2	11,77 x 0,17 x 0,8 x 0,5	0,285	0,23
W3	11,77 x 0,2 x 0,8	0,52	0,87
W4	0,94 x 0,2	0,52	0,18
		Total	1,40

W1 = berat batu + berat blok X

7. Momen Penahan (Blok X Tipe 2)
= Σ Wixi + PvXv
= 1,40 + (0,65 x 0,2)
= 1,63

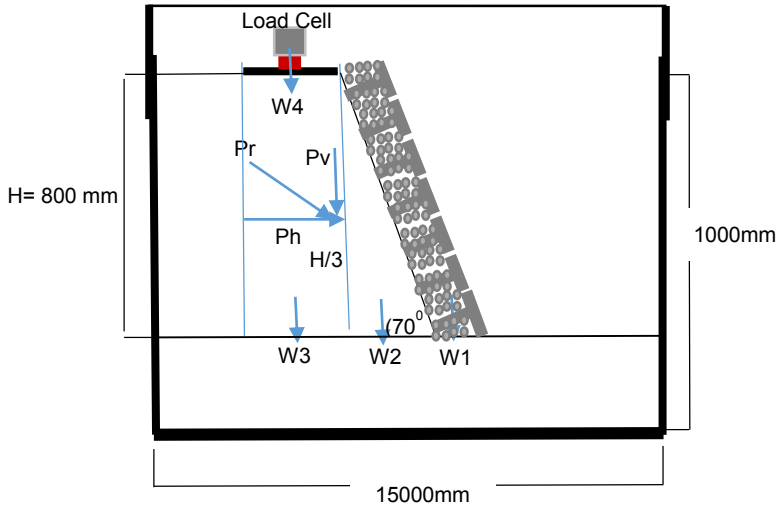
8. Momen guling = Ph H/3
= 3,11 x 0,8/3
= 0,78

9. Safety Faktor Blok X Tipe 2
= 1,63/0,78
= **2,08 (lebih besar dari 2)**

Lampiran 3

PERHITUNGAN SAFETY FAKTOR
(STABILITAS GESER)

A. Tanpa Presipitasi Blok X Tipe 1



$$\text{Safety Factor (FS)}_{\text{Sliding}} = \frac{Psl\ (resisting\ force)}{\text{Ph (driving force)}}$$

Psl = (ΣWi+Rv) tan δ + C B (kN/m2)
Ph = Pr cos δ
Pv = Pr Sin δ
Ph = Pr Cos δ
δ = (sudut gesek dinding dan tanah 2/3 ϕ (sudut gesek dalam)
C = ɣ beton (24 kN/m3)
B = lebar kaki (20 mm)
ϕ = sudut gesek dalam ($25{,}06^0$)
β = sudut kemiringan lereng (70^0)
ɵ = sudut dinding dan belakang tanah (20^0)
Berat jenis beton = 2,4 gr/cm3
Berat jenis Batu = 2,7 gr/cm3
Berat blok X tipe 1 = 29,08 kg
Berat batu untuk tipe 1 = 109 kg
Load keruntuhan Lereng = 7,4 kN
Load Blok X Tipe 1 = 18 kN

1. Koefisien tanah aktif

$$K = \frac{\cos 2\ (\phi - \theta)}{cos2\theta\ x\ \cos(\delta - \theta)[1+\frac{\sqrt{\sin(\delta+\phi)x\ (\sin(\phi-\beta)}}{\sqrt{\cos(\delta+\theta)x\ (cos(\theta-\beta)}}]2}$$

K = 0.2

2. Tekanan tanah lateral

Tekanan lateral akibat tanah

Ps = $\frac{1}{2} K \gamma H^2$

Ps = 0,5 x 0,2 x 10,79 kN/m^3 x 0,64 m^2

= 0,71 kN/m

Tekanan lateral akibat beban

Pb = q K H

= 18 kN/m2 x 0,2 x 0,8 m

= 2,88 kN/m

3. Resultan tekanan tanah lateral

Pr = Ps + Pb

= 0,71 + 2,88

= 3,59 kN/m

4. Tekanan Lateral (Ph)

Ph = Pr cos δ

= 3,59 cos 16,7

= 3,41

5. Tekanan Vertikal (Pv)

Pv = Pr sin δ

= 3,59 sin 16,7

= 1,08

6. Momen Tahanan Blok X tipe 1

No	Berat (W)	Jarak	Momen
W1	1,35	0,1	0,14
W2	10,79 x 0,27 x 0,8 x 0,5	0,38	0,46
W3	10,79 x 0,2 x 0,8	0,57	1,01
W4	18 x 0,2	0,57	2,05
		Total	3,66

7. Momen Penahan (Blok X Tipe 1)

= (ΣWi + Pv) tan δ + C B)

= 3,66 + 1,08) tan 16,7 + (24 x 0,2)

= 6,22

8. Momen geser = Ph

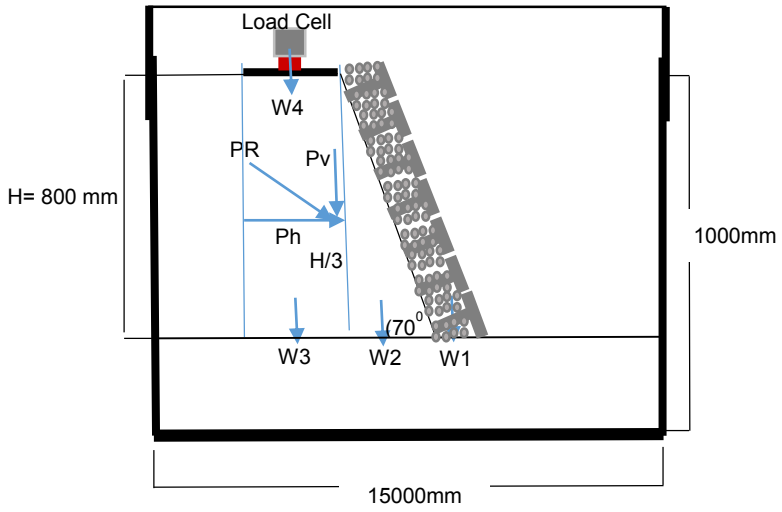
= 3,41

9. Safety Faktor Blok X Tipe 1

= 6,22/3,41

= **1,83 (lebih besar dari 1,5)**

B. Tanpa Presipitasi Blok X Tipe 2



$$\text{Safety Factor } (FS)_{Sliding} = \frac{\text{Psl (resisting force)}}{\text{Ph (driving force)}}$$

Psl = (ΣWi+Rv) tan δ + C B (kN/m^2)
Ph = Pr cos δ
Pv = PR Sin δ
Ph = PR Cos δ
δ = (sudut gesek dinding dan tanah 2/3 ϕ (sudut gesek dalam)
ϕ = sudut gesek dalam (25,06^0)
β = sudut kemiringan lereng (70^0)
ɵ = sudut dinding dan belakang tanah (20^0)
Berat jenis beton = 2,4 gr/cm^3
Berat jenis Batu = 2,7 gr/cm^3
Berat blok X tipe 2 = 24,78 kg
Berat batu untuk tipe 2 = 101 kg
Load keruntuhan Lereng = 7,4 kN
Load Blok X Tipe 2 = 16 kN

1. Koefisien tanah aktif

$$K = \frac{\cos 2\,(\phi - \theta)}{cos2\theta\, x\, \cos(\delta - \theta)[1+\frac{\sqrt{\sin(\delta+\phi)x\,(\sin(\phi-\beta)}}{\sqrt{\cos(\delta+\theta)x\,(cos(\theta-\beta)}}]2}$$

K = 0.2

2. Tekanan tanah lateral

Tekanan lateral akibat tanah

Ps = $\frac{1}{2} K \gamma H^2$

Ps = 0,5 x 0,2 x 10,79 kN/m^3 x 0,64 m^2

= 0,71 kN/m

Tekanan lateral akibat beban

Pb = q K H

= 18 kN/m2 x 0,2 x 0,8 m

= 2,88 kN/m

3. Resultan tekanan tanah lateral

Pr = Ps + Pb

= 0,71 + 2,88

= 3,59 kN/m

4. Tekanan Lateral (Ph)

Ph = Pr cos δ

= 3,59 cos 16,7

= 3,41

5. Tekanan Vertikal (Pv)

Pv = Pr sin δ

= 3,59 sin 16,7

= 1,08

6. Momen Tahanan Blok X tipe 1

No	Berat (W)	Jarak	Momen
W1	1,23	0,1	0,12
W2	10,79 x 0,27 x 0,8 x 0,5	0,38	0,46
W3	10,79 x 0,2 x 0,8	0,57	1,01
W4	18 x 0,2	0,57	2,05
		Total	3,63

7. Momen Penahan (Blok X Tipe 1)

= (ΣWi + Pv) tan δ + C B)

= 3,63 + 1,08) tan 16,7 + (24 x 0,2)

= 6,21

8. Momen geser = Ph

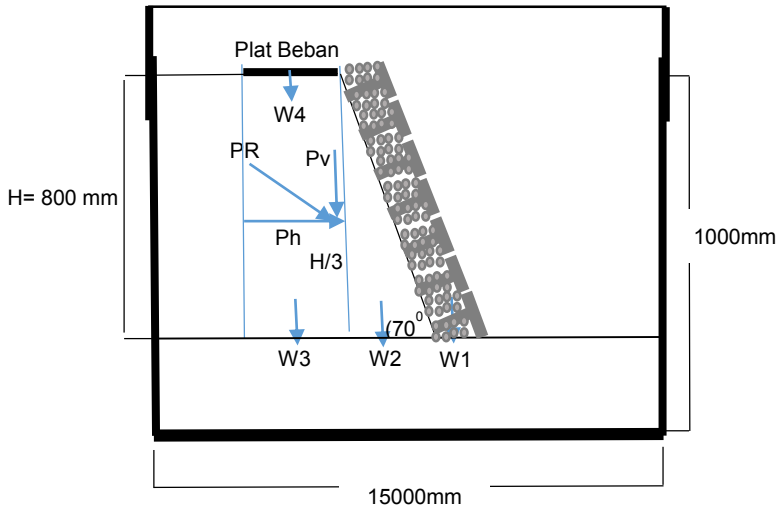
= 3,41

9. Safety Faktor Blok X Tipe 1

= 6,21/3,41

= **1,82 (lebih besar dari 1,5)**

C. Dengan Presipitasi Blok X Tipe 1



$$\text{Safety Factor (FS)}_{\text{Sliding}} = \frac{Psl\ (resisting\ force)}{\text{Ph (driving force)}}$$

Psl = (ΣWi+Rv) tan δ + C B (kN/m2)
Ph = Pr cos δ

Pv = PR Sin δ
Ph = PR Cos δ
δ = (sudut gesek dinding dan tanah 2/3 ϕ (sudut gesek dalam)
= 12
ϕ = sudut gesek dalam (18)
β = sudut kemiringan lereng (70)
ɵ = sudut dinding dan belakang tanah (20)
ɣ = 1,2 gr/cm3 (11,77 kN/m^3)
q = 50 kg (0,94 kN/m^2)
Berat blok X tipe 1 = 29,08 kg
Berat batu untuk tipe 1 = 109 kg

1. Koefisien tanah aktif

$$K = \frac{\cos 2\ (\phi - \theta)}{cos2\theta\ x\ \cos(\delta - \theta)[1+\frac{\sqrt{\sin(\delta+\phi)x\ (\sin(\phi-\beta)}}{\sqrt{\cos(\delta+\theta)x\ (cos(\theta-\beta)}}]2}$$

K = 0.568

2. Tekanan tanah lateral
Tekanan lateral akibat tanah

Ps = $\frac{1}{2} K \gamma H^2$

Ps = 0,5 x 0,47 x 11,77 kN/m^3 x 0,64 m^2

= 2,83 kN/m

Tekanan lateral akibat beban

Pb = q K H

= 0,94 kN/m2 x 0,568 x 0,8 m

= 0,427 kN/m

3. Resultan tekanan tanah lateral

Pr = Ps + Pb

= 2,83 + 0,427

= 3,26 kN/m

4. Tekanan Lateral (Ph)

Ph = Pr cos δ

= 3,26 cos 12

= 3,11

5. Tekanan Vertikal (Pv)

Pv = Pr sin δ

= 3,26 sin 12

= 0,65

6. Momen Tahanan Blok X tipe 1

No	Berat (W)	Jarak	Momen
W1	1,35	0,1	0,14
W2	11,77 x 0,17 x 0,8 x 0,5	0,285	0,23
W3	11,77 x 0,2 x 0,8	0,52	0,87
W4	0,94 x 0,2	0,52	0,18
		Total	1,42

7. Momen Penahan (Blok X Tipe 1)

= (ΣWi + Pv) tan δ + C B)

= (1,42 + 0,65) tan 12 + (24 x 0,2)

= 5,24

8. Momen geser = Ph

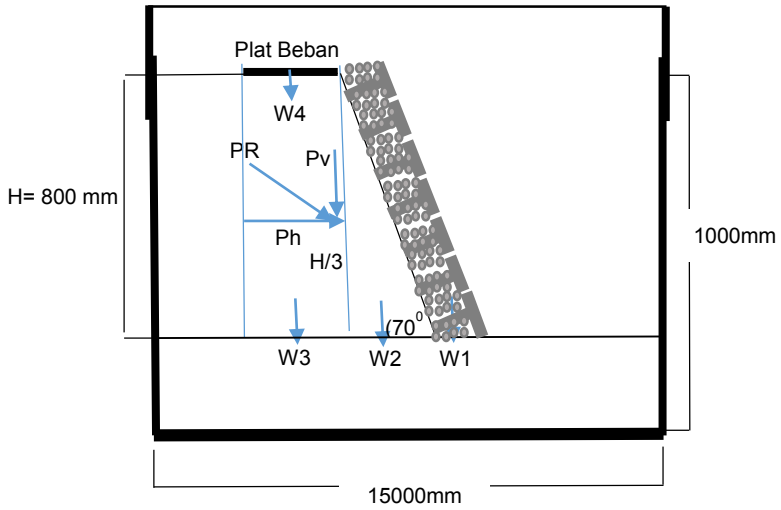
= 3,11

9. Safety Faktor Blok X Tipe 1

= 5,24/3,11

= 1,68 (lebih besar dari 1,5)

D. Dengan Presipitasi Blok X Tipe 2



$$\text{Safety Factor (FS)}_{\text{Sliding}} = \frac{Psl\ (resisting\ force)}{\text{Ph (driving force)}}$$

Psl = (ΣWi+Rv) tan δ + C B (kN/m2)
Ph = Pr cos δ

Pv = PR Sin δ
Ph = PR Cos δ
δ = (sudut gesek dinding dan tanah 2/3 ϕ (sudut gesek dalam)
= 12
ϕ = sudut gesek dalam (18)
β = sudut kemiringan lereng (70)
ɵ = sudut dinding dan belakang tanah (20)
ɣ = 1,64 gr/cm3 (16,08 kN/m3)
q = 50 kg (0,94 kN/m^2)
Berat blok X tipe 2 = 24,78 kg
Berat batu untuk tipe 2 = 104 kg

1. Koefisien tanah aktif

$$K = \frac{\cos 2\ (\phi - \theta)}{cos2\theta\ x\ \cos(\delta - \theta)[1+\frac{\sqrt{\sin(\delta+\phi)x\ (\sin(\phi-\beta)}}{\sqrt{\cos(\delta+\theta)x\ (cos(\theta-\beta)}}]2}$$

K = 0.568

2. Tekanan tanah lateral

Tekanan lateral akibat tanah

Ps = $\frac{1}{2} K \gamma H^2$

Ps = 0,5 x 0,568 x 11,77 kN/m^3 x 0,64 m^2

= 2,83 kN/m

Tekanan lateral akibat beban

Pb = q K H

= 0,94 kN/m2 x 0,568 x 0,8 m

= 0,427 kN/m

3. Resultan tekanan tanah lateral

Pr = Ps + Pb

= 2,82 + 0,427

= 3,26 kN/m

4. Tekanan Lateral (Ph)

Ph = Pr cos δ

= 3,26 cos 12

= 3,11

5. Tekanan Vertikal (Pv)

Pv = Pr sin δ

= 3,26 sin 12

= 0,65

6. Momen Tahanan Blok X tipe 2

No	Berat (W)	Jarak	Momen
W1	1,23	0,1	0,12
W2	11,77 x 0,17 x 0,8 x 0,5	0,285	0,23
W3	11,77 x 0,2 x 0,8	0,52	0,87
W4	0,94 x 0,2	0,52	0,18
		Total	1,40

7. Momen Penahan (Blok X Tipe 2)

= (ΣWi + Pv) tan δ + C B)

= (1,40 + 0,65) tan 12 + (24 x 0,2)

= 5,21

8. Momen geser = Ph

= 3,11

9. Safety Faktor Blok X Tipe 2

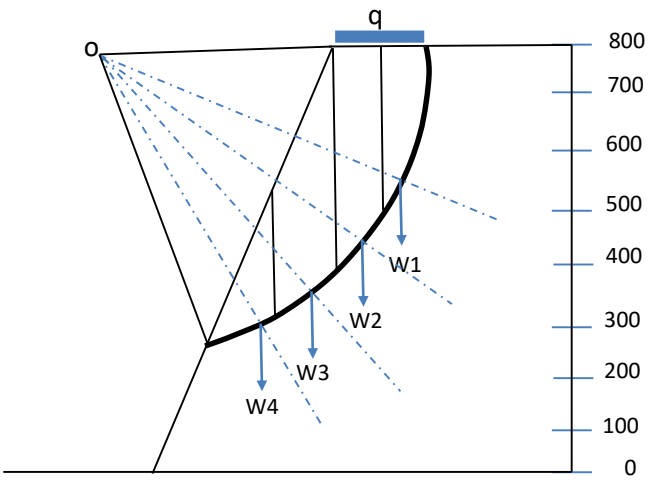
= 5,21/3,11

= **1,67 (lebih besar dari 1,5)**

Lampiran 4

PERHITUNGAN SAFETY FAKTOR (OVER ALL STABILITY)

A. Tanpa Perkuatan dan Tanpa Presipitasi



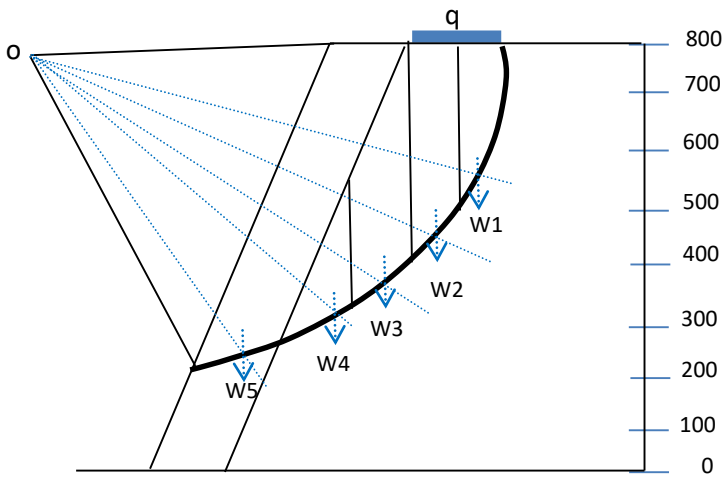
Data :
ɣ = 11,1 kN/m^3
C = 0,91 gr/cm^2
Φ = 25,06
q = 7,4 kN

No	Wn	αn	Sin αn	Cos αn	ΔIn	W Sin αn	W cos αn
1	13,3 + 20,72	63	0,89	0,45	2,5	18,44	9,32
2	37,9 + 40,99	51	0,63	0,63	1,7	31,97	25,82
3	23,5	40	0,64	0,77	1,1	15,03	18,08
4	9,8	30	0,50	0,87	1,2	4,89	8,51
					6,5	70,60	61,73

$$FS = \frac{\Sigma\ C\ \Delta In + Wn\ Cos\ \alpha n\ tg\ \phi}{\Sigma\ Wn\ Sin\ \alpha n}$$

$$= \mathbf{0,52}$$

B. Perkuatan dan Tanpa Presipitasi



Data :

γ = 11,1 kN/m^3

γ_{beton} = 24 kN/m^3

C = 0,91 gr/cm^2 (89 kN/m^2)

Φ = 25,06

q = 7,4 kN

Berat material tipe 1 = 138,08

Berat material tipe 2 = 124,78

Blok X Tipe 1

No	Wn	αn	Sin αn	Cos αn	∆ln	W Sin αn	W cos αn
1	13,3 + 20,72	63	0,89	0,45	2,0	18,44	9,32
2	37,9 + 40,99	51	0,63	0,63	1,2	31,97	25,82
3	23,5	40	0,64	0,77	1,1	15,03	18,08
4	9,8	30	0,50	0,87	1,2	4,89	8,51
5	138,08	18	0,30	0,95	2,2	38,4	121,6
					9,5	112,73	193,33

$$FS = \frac{\Sigma\ C\ \Delta ln + Wn\ Cos\ \alpha n\ tg\ \phi}{\Sigma\ Wn\ Sin\ \alpha n}$$

$$= \mathbf{1,81}$$

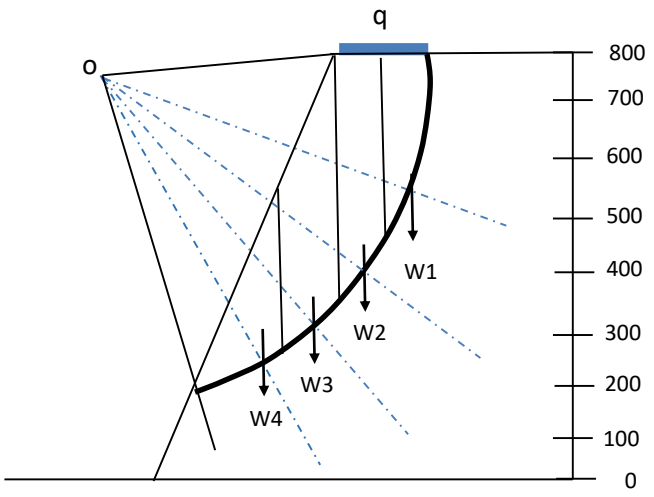
Blok X Tipe 2

No	Wn	αn	Sin αn	Cos αn	∆ln	W Sin αn	W cos αn
1	13,3 + 20,72	63	0,89	0,45	2,0	18,44	9,32
2	37,9 + 40,99	51	0,63	0,63	1,2	31,97	25,82
3	23,5	40	0,64	0,77	1,1	15,03	18,08
4	9,8	30	0,50	0,87	1,2	4,89	8,51
5	124,78	18	0,30	0,95	2,2	37,34	118,54
					9,5	110,93	180,27

$$FS = \frac{\Sigma\ C\ \Delta ln + Wn\ Cos\ \alpha n\ tg\ \phi}{\Sigma\ Wn\ Sin\ \alpha n}$$

$$= \mathbf{1,77}$$

C. Tanpa Perkuatan Dengan Presipitasi



Data :

ɣ = 16,08 kN/m^3

C = 0,58 gr/cm^2 (56,88 kN/m^2)

Φ = 18^0

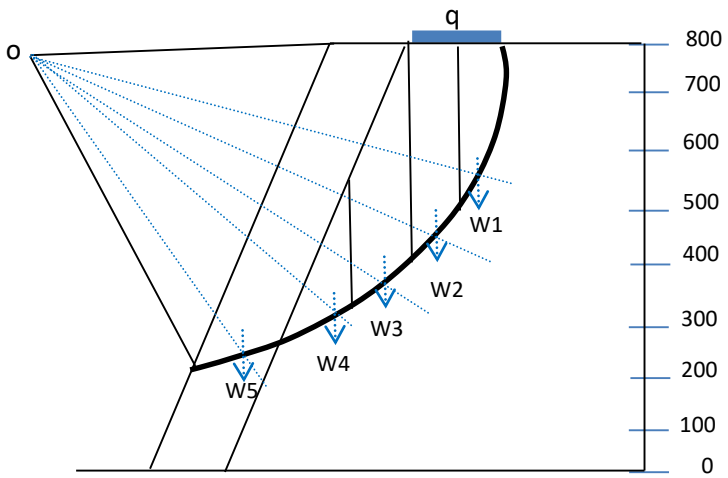
q = 50 kg

No	Wn	αn	Sin αn	Cos αn	∆ln	W Sin αn	W cos αn
1	20,1+8,2	60	0,88	0,50	2,2	24,91	14,15
2	52,3+9,02	50	0,76	0,64	1,9	46,60	39,24
3	49,5	42	0,67	0,73	1,0	33,17	36,13
4	24,0	31	0,50	0,86	1,2	12,00	20,64
					6,7	129,9	95,09

$$FS = \frac{\Sigma\ C\ \Delta ln + Wn\ Cos\ \alpha n\ tg\ \phi}{\Sigma\ Wn\ Sin\ \alpha n}$$

$$= \mathbf{0,48}$$

D. Perkuatan dengan Presipitasi



Data :

γ = 16,08 kN/m^3

γ_{beton} = 24 kN/m^3

C = 0,58 gr/cm^2 (56,9 kN/m^2)

Φ = 18^0

q = 50 kg

Berat material tipe 1 = 138,08

Berat material tipe 2 = 124,78

Blok X Tipe 1

No	Wn	αn	Sin αn	Cos αn	∆ln	W Sin αn	W cos αn
1	20,1+8,2	60	0,88	0,50	2,2	24,91	14,15
2	52,3+9,02	50	0,76	0,64	1,9	46,60	39,24
3	49,5	42	0,67	0,73	1,0	33,17	36,13
4	24,0	31	0,50	0,86	1,2	12,00	20,64
5	137,08	18	0,30	0,95	2,2	38,42	121,68
					9,5	125,08	257,84

$$FS = \frac{\Sigma\ C\ \Delta ln + Wn\ Cos\ \alpha n\ tg\ \phi}{\Sigma\ Wn\ Sin\ \alpha n}$$

$$= 1{,}52$$

Blok X Tipe 2

No	Wn	αn	Sin αn	Cos αn	∆ln	W Sin αn	W cos αn
1	20,1+8,2	60	0,88	0,50	2,2	24,91	14,15
2	52,3+9,02	50	0,76	0,64	1,9	46,60	39,24
3	49,5	42	0,67	0,73	1,0	33,17	36,13
4	24,0	31	0,50	0,86	1,2	12,00	20,64
5	124,78	18	0,30	0,95	2,2	37,43	118,54
					9,5	124,07	254,90

$$FS = \frac{\Sigma\ C\ \Delta ln + Wn\ Cos\ \alpha n\ tg\ \phi}{\Sigma\ Wn\ Sin\ \alpha n}$$

$$= \mathbf{1,51}$$