

**NİVELMAN AĞLARININ
DAYALI VE SERBEST DENGELENMESİ**

DAYALI DENGELME

Ölçü sayısı = $n = 6$

Bilinmeyen sayısı = $u = 2$

$n > u$ Dengeleme yapılabilir.

VERİLEN

NN	Yükseklik $H_A (m)$
A	80.673 m
B	104.635

ÖLÇÜLER

BN	S N	Yükseklik Farkı $\Delta h_i(m)$	Geçki Uzunluğu $S_i(km)$
A	1	43.156	0.65
B	1	19.218	0.80
B	3	33.524	1.00
A	3	57.440	1.40
A	B	23.962	1.50
1	3	14.267	1.95

İSTENENLER: H_1, H_3 , ve m_{H_1}, m_{H_3}

1- STOKASTİK MODEL (AĞIRLIK MATRİSİ)

$$P_i = \frac{Sabit}{S_{i(km)}} = \frac{1}{S_{i(km)}}$$

$$P_1 = 1.54$$

$$P_2 = 1.25$$

$$P_3 = 1.00$$

$$P_4 = 0.71$$

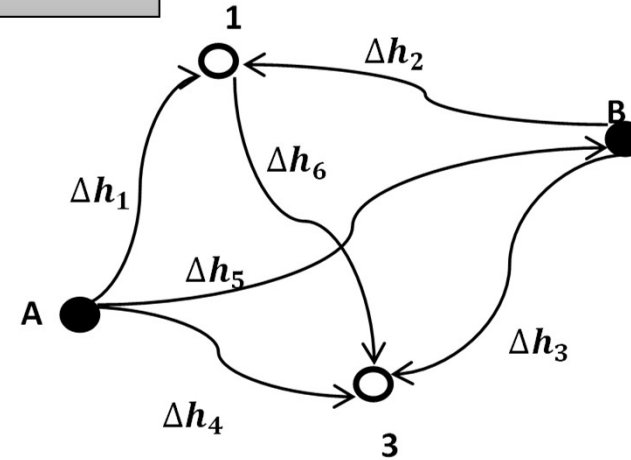
$$P_5 = 0.67$$

$$P_6 = 0.51$$

2- BİLİNMEYENLERİN SEÇİMİ

H_1

H_3



3- BİLİNMEYENLERİN YAKLAŞIK DEĞERLERİ

$$H_1 = H_{01} + dh_1$$

$$H_3 = H_{03} + dh_3$$

$$H_{01} = H_A + \Delta h_1 = 123.829m$$

$$H_{03} = H_A + \Delta h_4 = 138.113m$$

4- FONKSİYONEL MODEL (DÜZELTME DENKLEMLERİ)

Ölçü + Düzeltmesi = Bilinmeyenlerin Fonksiyonu

$$\Delta h_{ij} + v_{\Delta h_{ij}} = H_j - H_i$$

$$\Delta h_1 + v_{\Delta h_1} = H_1 - H_A$$

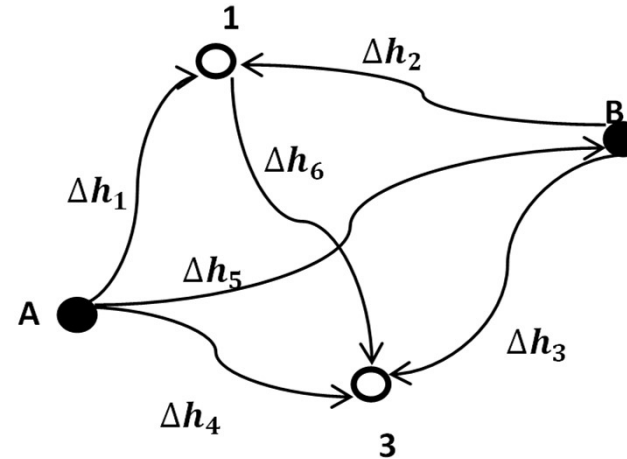
$$\Delta h_2 + v_{\Delta h_2} = H_1 - H_B$$

$$\Delta h_3 + v_{\Delta h_3} = H_3 - H_B$$

$$\Delta h_4 + v_{\Delta h_4} = H_3 - H_A$$

$$\Delta h_5 + v_{\Delta h_5} = H_B - H_A$$

$$\Delta h_6 + v_{\Delta h_6} = H_3 - H_1$$



$$v_{\Delta h_1} = dh_1 - (\Delta h_1 - (H_{01} - H_A))$$

$$v_{\Delta h_2} = dh_1 - (\Delta h_2 - (H_{01} - H_B))$$

$$v_{\Delta h_3} = dh_3 - (\Delta h_3 - (H_{03} - H_B))$$

$$v_{\Delta h_4} = dh_3 - (\Delta h_4 - (H_{03} - H_A))$$

$$v_{\Delta h_5} = -(\Delta h_5 - (H_B - H_A))$$

$$v_6 = -dh_1 + dh_3 - (\Delta h_6 - (H_{03} - H_{01}))$$

$$v_{\Delta h_1} = dh_1 + 0$$

$$v_{\Delta h_2} = dh_1 - 24$$

$$v_{\Delta h_3} = dh_3 - 46$$

$$v_{\Delta h_4} = dh_3 + 0$$

$$v_{\Delta h_5} = +0$$

$$v_6 = -dh_1 + dh_3 + 17$$

5- DENGEME BİLİNMEYENLERİ

$$\begin{aligned}
 v_{\Delta h_1} &= dh_1 & + 0 \\
 v_{\Delta h_2} &= dh_1 & - 24 \\
 v_{\Delta h_3} &= & dh_3 - 46 \\
 v_{\Delta h_4} &= & dh_3 + 0 \\
 v_{\Delta h_5} &= & + 0 \\
 v_6 &= -dh_1 + dh_3 + 17
 \end{aligned}$$

P	a	b	-l	s
1.54	1	0	0	1
1.25	1	0	-24	-23
1.00	0	1	-46	-45
0.71	0	1	0	1
0.67	0	0	0	0
0.51	-1	1	17	17

$$\begin{aligned}
 [paa] &= 3.30 & [pab] &= -0.51 & -[pal] &= -38.67 & [pas] &= -35.88 \\
 & & [pbb] &= 2.22 & -[pbl] &= -37.33 & [pbs] &= -35.62 \\
 & & & & [pll] &= 2983.39 & -[pls] &= 2907.39
 \end{aligned}$$

$$\begin{aligned}
 3.30 dh_1 - 0.51 dh_3 - 38.67 &= 0 \\
 -0.51 dh_1 + 2.22 dh_3 - 37.33 &= 0
 \end{aligned}$$

Normal Denklemler

6. Normal Denklemlerin Çözümü (Dengeleme Bilinmeyenleri)

	dh_1	dh_3	sabit	Toplam
	3.30	-0.51	-38.67	-35.88
	-1	0.154545	11.718182	10.872727
$dh_3 = 20.23\text{mm}$		2.22	-37.33	-35.62
		2.141182	-43.306273	-41.165077
		-1	20.225405	19.225398
$dh_1 = 0.154545 * dh_3 + 11.718182$			2983.30	2907.39
$dh_1 = 14.84\text{mm}$			$[pvv] = 1654.360992$	$= 1654.361313$

Dengeleme Bilinmeyenleri

7. Bilinmeyenlerin Kesin Değeri

$$H_1 = H_{01} + dh_1 = 123.829\text{m} + 14.84\text{mm}$$

$$H_1 = 123.8432\text{m}$$

$$H_3 = H_{03} + dh_3 = 138.113\text{m} + 20.23\text{mm}$$

$$H_3 = 138.1332\text{m}$$

8. Bilinmeyenlerin Ters Ağırlık Matrisi

dx	dy	sabit	toplam
3.30	-0.51	-38.67	-35.88
-1	0.154545	11.718182	10.872727
	2.22	-37.33	-35.62
	2.141182	-43.306273	-41.165077
	-1	20.225405	19.225398
		2983.30	2907.39
		[pvv] = 1654.360992	= 1654.361313

$$Q = \begin{bmatrix} q_{H_1H_1} & q_{H_1H_3} \\ q_{H_1H_3} & q_{H_3H_3} \end{bmatrix} = \begin{bmatrix} 0.314 & 0.072 \\ 0.072 & 0.467 \end{bmatrix}$$

$$q_{H_3H_3} = \frac{1}{2.141182} = 0.467$$

$$q_{H_1H_3} = 0.154545 * q_{yy} = 0.072$$

$$q_{H_1H_1} = \frac{1}{3.30} + 0.154545 * q_{xy} = 0.314$$

9. Düzeltmeler

$$P_1 = 1.54$$

$$P_2 = 1.25$$

$$P_3 = 1.00$$

$$P_4 = 0.71$$

$$P_5 = 0.67$$

$$P_6 = 0.51$$

$$v_{\Delta h_1} = dh_1 + 0 = 14.84mm$$

$$v_{\Delta h_2} = dh_1 - 24 = -9.16$$

$$v_{\Delta h_3} = dh_3 - 46 = -25.77$$

$$v_{\Delta h_4} = dh_3 + 0 = 20.23$$

$$v_{\Delta h_5} = +0 = 0$$

$$v_6 = -dh_1 + dh_3 + 17 = 22.38$$

10. Denetim İşlemleri

$$[pvv] = 1654.361$$

$$-[plv] = 1654.36099$$

$$[pll.2] = 1654.36099$$

11. Dengeli Ölçüler

$$\widehat{\Delta h}_i = \Delta h_i + v_{\Delta h_i}$$

$$\widehat{\Delta h}_1 = 43.1688m$$

$$\widehat{\Delta h}_2 = 19.2088m$$

$$\widehat{\Delta h}_3 = 33.4983m$$

$$\widehat{\Delta h}_4 = 57.4602m$$

$$\widehat{\Delta h}_5 = 23.9620m$$

$$\widehat{\Delta h}_6 = 14.2894m$$

12. Sonuç Denetimi

$$\widehat{\Delta h}_1 = \Delta h_1 + v_{\Delta h_1} = H_1 - H_A$$

$$\widehat{\Delta h}_2 = \Delta h_2 + v_{\Delta h_2} = H_1 - H_B$$

$$\widehat{\Delta h}_3 = \Delta h_3 + v_{\Delta h_3} = H_3 - H_B$$

$$\widehat{\Delta h}_4 = \Delta h_4 + v_{\Delta h_4} = H_3 - H_A$$

$$\widehat{\Delta h}_5 = \Delta h_5 + v_{\Delta h_5} = H_B - H_A$$

$$\widehat{\Delta h}_6 = \Delta h_6 + v_{\Delta h_6} = H_3 - H_1$$



$$\widehat{\Delta h}_1 = \Delta h_1 + v_{\Delta h_1} = H_1 - H_A$$

$$43.1688m = 123.8432m - 80.673m$$

$$43.1688m = 43.1702m$$

15- DUYARLIK HESAPLARI

Birim Ölçünün Ortalama Hatası

$$m_0 = \pm \sqrt{\frac{V^T P V}{n-u}} = \pm \sqrt{\frac{1654.361}{6-2}} = \pm 23.48 \text{ mm}$$

Ölçülerin Ortalama Hatası

$$m_i = \pm \frac{m_0}{\sqrt{P_i}}$$

$$m_1 = \pm 18.9 \text{ mm}$$

$$m_2 = \pm 21.0 \text{ mm}$$

$$m_3 = \pm 23.5 \text{ mm}$$

$$m_4 = \pm 27.9 \text{ mm}$$

$$m_5 = \pm 28.7 \text{ mm}$$

$$m_6 = \pm 32.9 \text{ mm}$$

Bilinmeyenlerin Ortalama Hatası

$$m_{x_i} = \pm m_0 \sqrt{q_{x_i x_i}} \quad \text{i. Bilinmeyenin ortalama hatası}$$

$$Q_{xx} = \begin{bmatrix} q_{H_1 H_1} & q_{H_1 H_3} \\ q_{H_1 H_3} & q_{H_3 H_3} \end{bmatrix} = \begin{bmatrix} 0.314 & 0.072 \\ 0.072 & 0.467 \end{bmatrix}$$

$$m_{H_1} = \pm m_0 \sqrt{q_{H_1 H_1}} = \pm 23.48 \sqrt{0.3142} = \pm 13.2 \text{ mm}$$

$$m_{H_3} = \pm m_0 \sqrt{q_{H_3 H_3}} = \pm 23.48 \sqrt{0.4670} = \pm 16.1 \text{ mm}$$

Dengeli Ölçülerin Ortalama Hatası

$$\widehat{\Delta h}_1 = \Delta h_1 + v_{\Delta h_1} = H_1 - H_A$$

$$\widehat{\Delta h}_2 = \Delta h_2 + v_{\Delta h_2} = H_1 - H_B$$

$$\widehat{\Delta h}_3 = \Delta h_3 + v_{\Delta h_3} = H_3 - H_B$$

$$\widehat{\Delta h}_4 = \Delta h_4 + v_{\Delta h_4} = H_3 - H_A$$

$$\widehat{\Delta h}_5 = \Delta h_5 + v_{\Delta h_5} = H_B - H_A$$

$$\widehat{\Delta h}_6 = \Delta h_6 + v_{\Delta h_6} = H_3 - H_1$$

$$Q = \begin{bmatrix} q_{H_1 H_1} & q_{H_1 H_3} \\ q_{H_1 H_3} & q_{H_3 H_3} \end{bmatrix} = \begin{bmatrix} 0.314 & 0.072 \\ 0.072 & 0.467 \end{bmatrix}$$

$$d\widehat{\Delta h}_1 = dh_1$$

$$q_{\widehat{\Delta h}_1 \widehat{\Delta h}_1} = q_{H_1 H_1} = 0.314$$

$$d\widehat{\Delta h}_2 = dh_1$$

$$q_{\widehat{\Delta h}_2 \widehat{\Delta h}_2} = q_{H_1 H_1} = 0.314$$

$$d\widehat{\Delta h}_3 = dh_3$$

$$q_{\widehat{\Delta h}_3 \widehat{\Delta h}_3} = q_{H_3 H_3} = 0.467$$

$$d\widehat{\Delta h}_4 = dh_3$$

$$q_{\widehat{\Delta h}_4 \widehat{\Delta h}_4} = q_{H_3 H_3} = 0.467$$

$$d\widehat{\Delta h}_5 =$$

$$q_{\widehat{\Delta h}_5 \widehat{\Delta h}_5} = 0$$

$$d\widehat{\Delta h}_6 = -dh_1 + dh_3$$

$$q_{\widehat{\Delta h}_6 \widehat{\Delta h}_6} = q_{H_1 H_1} - 2q_{H_1 H_3} + q_{H_3 H_3} = 0.637$$

$$m_{\widehat{\Delta h}_1} = \pm m_0 \sqrt{q_{\widehat{\Delta h}_1 \widehat{\Delta h}_1}} = \pm 23.48 \sqrt{0.314} = \pm 13.16 \text{ mm}$$

$$m_{\widehat{\Delta h}_2} = \pm m_0 \sqrt{q_{\widehat{\Delta h}_2 \widehat{\Delta h}_2}} = \pm 23.48 \sqrt{0.314} = \pm 13.16 \text{ mm}$$

$$m_{\widehat{\Delta h}_3} = \pm m_0 \sqrt{q_{\widehat{\Delta h}_3 \widehat{\Delta h}_3}} = \pm 23.48 \sqrt{0.467} = \pm 16.05 \text{ mm}$$

$$m_{\widehat{\Delta h}_4} = \pm m_0 \sqrt{q_{\widehat{\Delta h}_4 \widehat{\Delta h}_4}} = \pm 23.48 \sqrt{0.467} = \pm 16.05 \text{ mm}$$

$$m_{\widehat{\Delta h}_5} = \pm m_0 \sqrt{q_{\widehat{\Delta h}_5 \widehat{\Delta h}_5}} = \pm 23.48 \sqrt{0} = \pm 0 \text{ mm}$$

$$m_{\widehat{\Delta h}_6} = \pm m_0 \sqrt{q_{\widehat{\Delta h}_6 \widehat{\Delta h}_6}} = \pm 23.48 \sqrt{0.637} = \pm 18.74 \text{ mm}$$

Dengeli Ölçülerin Ort. Hat.

NİVELMAN AĞININ DAYALI DENGELEMESİ

MATRİS İLE ÇÖZÜM

1- STOKASTİK MODEL (AĞIRLIK MATRİSİ)

$$P_i = \frac{Sabit}{S_{i(km)}} = \frac{1}{S_{i(km)}}$$

$$P = \begin{bmatrix} P_1 & & & & & \\ & P_2 & & & & \\ & & P_3 & & & \\ & & & P_4 & & \\ & & & & P_5 & \\ & & & & & P_6 \end{bmatrix} = \begin{bmatrix} 1.54 & & & & & \\ & 1.25 & & & & \\ & & 1.00 & & & \\ & & & 0.71 & & \\ & & & & 0.67 & \\ & & & & & 0.51 \end{bmatrix}$$

2- FONKSİYONEL MODEL (DÜZELTME DENKLEMLERİ)

$$\begin{aligned}v_{\Delta h_1} &= dh_1 && + 0 \\v_{\Delta h_2} &= dh_1 && - 24 \\v_{\Delta h_3} &= &dh_3 &- 46 \\v_{\Delta h_4} &= &dh_3 &+ 0 \\v_{\Delta h_5} &= && + 0 \\v_6 &= -dh_1 + dh_3 + 17\end{aligned}$$

$$V = \begin{bmatrix} v_{\Delta h_1} \\ v_{\Delta h_2} \\ v_{\Delta h_3} \\ v_{\Delta h_4} \\ v_{\Delta h_5} \\ v_{\Delta h_6} \end{bmatrix}$$

$$A = \begin{bmatrix} 1 & 0 \\ 1 & 0 \\ 0 & 1 \\ 0 & 1 \\ 0 & 0 \\ -1 & 1 \end{bmatrix}$$

$$\begin{bmatrix} v_{\Delta h_1} \\ v_{\Delta h_2} \\ v_{\Delta h_3} \\ v_{\Delta h_4} \\ v_{\Delta h_5} \\ v_{\Delta h_6} \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 1 & 0 \\ 0 & 1 \\ 0 & 1 \\ 0 & 0 \\ -1 & 1 \end{bmatrix} \begin{bmatrix} dh_1 \\ dh_3 \end{bmatrix} - \begin{bmatrix} 0 \\ 24 \\ 46 \\ 0 \\ 0 \\ -17 \end{bmatrix}$$

$$x = \begin{bmatrix} dh_1 \\ dh_3 \end{bmatrix}$$

$$l = \begin{bmatrix} 0 \\ 24 \\ 46 \\ 0 \\ 0 \\ -17 \end{bmatrix}$$

$$V = Ax - l$$

3- DENGEME BİLİNMEYENLERİ

$V = Ax - l$ Fonksiyonel Model
 P Stokastik Model

$$A^T P A x - A^T P l = 0$$

$$N x - n = 0$$

Normal Denklemler

$$N = A^T P A = \begin{bmatrix} 3.30 & -0.51 \\ -0.51 & 2.22 \end{bmatrix}$$

$$n = A^T P l = \begin{bmatrix} 38.67 \\ 37.33 \end{bmatrix}$$

$$x = (A^T P A)^{-1} A^T P l$$

$$x = N^{-1} n = Q_{xx} n$$

Dengeleme Bilinmeyenleri

$$Q_{xx} = N^{-1} = (A^T P A)^{-1} = \begin{bmatrix} 0.3142 & 0.0722 \\ 0.0722 & 0.4670 \end{bmatrix}$$

$$x = \begin{bmatrix} dh_1 \\ dh_3 \end{bmatrix} = \begin{bmatrix} 14.84 \\ 20.23 \end{bmatrix} mm$$

Dengeleme Bilinmeyenleri

4- BİLİNMEYENLERİN KESİN DEĞERİ

$$X = X_0 + x$$

$$\begin{bmatrix} H_1 \\ H_3 \end{bmatrix} = \begin{bmatrix} H_{01} \\ H_{03} \end{bmatrix} + \begin{bmatrix} dh_1 \\ dh_3 \end{bmatrix}$$

$$\begin{bmatrix} H_1 \\ H_3 \end{bmatrix} = \begin{bmatrix} 123.829 \\ 138.113 \end{bmatrix} m + \begin{bmatrix} 14.84 \\ 20.23 \end{bmatrix} mm$$

$$\begin{bmatrix} H_1 \\ H_3 \end{bmatrix} = \begin{bmatrix} 123.8438 \\ 138.1332 \end{bmatrix}$$

Bilinmeyenlerin Kesin Değeri
(Dengeli Koordinatlar)

5- DÜZELTMELER

$$V = Ax - l$$

$$\begin{bmatrix} v_{\Delta h_1} \\ v_{\Delta h_2} \\ v_{\Delta h_3} \\ v_{\Delta h_4} \\ v_{\Delta h_5} \\ v_{\Delta h_6} \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 1 & 0 \\ 0 & 1 \\ 0 & 1 \\ 0 & 0 \\ -1 & 1 \end{bmatrix} \begin{bmatrix} 14.84 \\ 20.23 \end{bmatrix} - \begin{bmatrix} 0 \\ 24 \\ 46 \\ 0 \\ 0 \\ -17 \end{bmatrix}$$

$$V = \begin{bmatrix} v_{\Delta h_1} \\ v_{\Delta h_2} \\ v_{\Delta h_3} \\ v_{\Delta h_4} \\ v_{\Delta h_5} \\ v_{\Delta h_6} \end{bmatrix} = \begin{bmatrix} 14.84 \\ -9.16 \\ -25.77 \\ 20.23 \\ 0 \\ 22.38 \end{bmatrix}$$

6- DENGELİ ÖLÇÜLER

$$\widehat{\Delta h}_i = \Delta h_i + v_{\Delta h_i}$$

$$\widehat{\Delta h}_1 = 43.1688m$$

$$\widehat{\Delta h}_2 = 19.2088m$$

$$\widehat{\Delta h}_3 = 33.4983m$$

$$\widehat{\Delta h}_4 = 57.4602m$$

$$\widehat{\Delta h}_5 = 23.9620m$$

$$\widehat{\Delta h}_6 = 14.2894m$$

7- DUYARLIK HESAPLARI

Birim Ölçünün Ortalama Hatası

$$m_0 = \pm \sqrt{\frac{V^T P V}{n-u}} = \pm \sqrt{\frac{1654.361}{6-2}} = \pm 23.48 \text{ mm}$$

Ölçülerin Ortalama Hatası

$$m_i = \pm \frac{m_0}{\sqrt{P_i}}$$

$$m_1 = \pm 18.9 \text{ mm}$$

$$m_2 = \pm 21.0 \text{ mm}$$

$$m_3 = \pm 23.5 \text{ mm}$$

$$m_4 = \pm 27.9 \text{ mm}$$

$$m_5 = \pm 28.7 \text{ mm}$$

$$m_6 = \pm 32.9 \text{ mm}$$

Bilinmeyenlerin Ortalama Hatası

$$m_{x_i} = \pm m_0 \sqrt{q_{x_i x_i}} \quad \text{i. Bilinmeyenin ortalama hatası}$$

$$Q_{xx} = \begin{bmatrix} q_{H_1 H_1} & q_{H_1 H_3} \\ q_{H_1 H_3} & q_{H_3 H_3} \end{bmatrix} = \begin{bmatrix} 0.314 & 0.072 \\ 0.072 & 0.467 \end{bmatrix}$$

$$m_{H_1} = \pm m_0 \sqrt{q_{H_1 H_1}} = \pm 23.48 \sqrt{0.3142} = \pm 13.2 \text{ mm}$$

$$m_{H_3} = \pm m_0 \sqrt{q_{H_3 H_3}} = \pm 23.48 \sqrt{0.4670} = \pm 16.1 \text{ mm}$$

Dengeli Ölçülerin Ortalama Hatası

$$Q_{\hat{l}} = A Q_{xx} A^T =$$

0.3142	0.3142	0.0722	0.0722	0	-0.2420
0.3142	0.3142	0.0722	0.0722	0	-0.2420
0.0722	0.0722	0.4670	0.4670	0	0.3949
0.0722	0.0722	0.4670	0.4670	0	0.3949
0	0	0	0	0	0
-0.2420	-0.2420	0.3949	0.3949	0	0.6369

Dengeli Ölçülerin
Ters Ağırlık Matrisi

$$m_{\hat{l}_i} = \pm m_0 \sqrt{q_{\hat{l}i i}}$$

Dengeli Ölçülerin Ortalama Hatası

$$m_{\hat{l}_1} = \pm 13.2 \text{ mm}$$

$$m_{\hat{l}_2} = \pm 13.2$$

$$m_{\hat{l}_3} = \pm 16.0$$

$$m_{\hat{l}_4} = \pm 16.0$$

$$m_{\hat{l}_5} = \pm 0$$

$$m_{\hat{l}_6} = \pm 18.7$$

Düzeltilmelerin Ortalama Hatası

$$Q_{vv} = Q_{ll} - A Q_{xx} A^T =$$

0.3352	-0.3142	-0.0722	-0.0722	0	0.2420
-0.3142	0.4858	-0.0722	-0.0722	0	0.2420
-0.0722	-0.0722	0.5330	-0.4670	0	-0.3949
-0.0722	-0.0722	-0.4670	0.9414	0	-0.3949
0	0	0	0	1.4925	0
0.2420	0.2420	-0.3949	-0.3949	0	1.3239

Düzeltilmelerin
Ters Ağırlık Matrisi

$$m_{vi} = \pm m_0 \sqrt{q_{vivi}}$$

Düzeltilmelerin Ortalama Hatası

$$m_{v_1} = \pm 13.6 \text{ mm}$$

$$m_{v_2} = \pm 16.4$$

$$m_{v_3} = \pm 17.1$$

$$m_{v_4} = \pm 22.8$$

$$m_{v_5} = \pm 28.7$$

$$m_{v_6} = \pm 27.0$$

8- SONUÇ DENETİMİ

$$\widehat{\Delta h}_1 = \Delta h_1 + v_{\Delta h_1} = H_1 - H_A$$

$$\widehat{\Delta h}_2 = \Delta h_2 + v_{\Delta h_2} = H_1 - H_B$$

$$\widehat{\Delta h}_3 = \Delta h_3 + v_{\Delta h_3} = H_3 - H_B$$

$$\widehat{\Delta h}_4 = \Delta h_4 + v_{\Delta h_4} = H_3 - H_A$$

$$\widehat{\Delta h}_5 = \Delta h_5 + v_{\Delta h_5} = H_B - H_A$$

$$\widehat{\Delta h}_6 = \Delta h_6 + v_{\Delta h_6} = H_3 - H_1$$



9- MODEL HİPOTEZİNİN TESTİ

$$s_0 = 20mm$$

Öncül Ortalama Hata (Seçildi)

$$T = \frac{m_0^2}{s_0^2} = \frac{23.48^2}{20^2} = 1.38$$

Test Büyüklüğü

$$f_m = n - u = 6 - 2 = 4$$

$$F_{f_m, f_s, 1 - \frac{\alpha}{2}} = F_{4, 4, 0.975} = 9.60$$

F_Tablo Değeri

$$T < \text{F-Tablo}$$

olduğundan model hipotezi geçerlidir.
Dengeleme modeli uygundur.

10- UYUŞUMSUZ ÖLÇÜLER TESTİ

$$T_i = \frac{|v_i|}{s_{0i}\sqrt{q_{vivi}}}$$

Test Büyüklüğü

$$\begin{aligned}T_1 &= 1.41 \\T_2 &= 0.59 \\T_3 &= 3.03 \\T_4 &= 1.03 \\T_5 &= 0 \\T_6 &= 0.94\end{aligned}$$

$$s_{0i} = \pm \sqrt{\frac{1}{f-1} ([pvv] - \frac{v_i^2}{q_{vivi}})}$$

$$s_{01} = \pm \sqrt{\frac{1}{4-1} (1654.361 - \frac{14.84^2}{0.3352})}$$

$$\begin{aligned}s_{01} &= \pm 18.23 \\s_{02} &= \pm 22.22 \\s_{03} &= \pm 11.66 \\s_{04} &= \pm 20.16 \\s_{05} &= \pm 23.48 \\s_{06} &= \pm 20.62\end{aligned}$$

$$t_{f-1,0.975} = t_{3,0.975} = 3.18$$

t-Tablo Değeri

$$T_{imax} = 3.03 < t - Tablo$$

olduğundan
Uyuşumsuz ÖLÇÜ YOK