1 BUZ YÜKÜ BÖLGESİ 3 x 1/0 AWG-O (RAVEN)
15-34,5 kV. DEMİR DİREK HESABI

1 BUZ YÜKÜ BÖLGESİ 3 x 1/0 AWG-O (RAVEN)
15-34,5 kV. DEMİR DİREK RESMİ

(SATIŞ İÇİN BASTIRILMİŞTİR)
İLLER BANKASI

ENERJİ VE TABİİ KAYNAKLAR BAKANLIĞI'NIN 27/10/1980 TARİH 162-520-12498 SAVİLY YAZILI İLE ONANMIŞTIR.

<table>
<thead>
<tr>
<th>D E D İ S İ J L İ K</th>
<th>T A R İ H</th>
<th>İ M Z A</th>
</tr>
</thead>
<tbody>
<tr>
<td>a)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

I. BUZ YÜKÜ BÖLGESİ - 3×1/0 (RAVEN)
15 – 34,5 KV. DEMİR DİREK HESAPLARI

<table>
<thead>
<tr>
<th>PROJEYİ YAPANIN, ADI</th>
<th>İMZA</th>
<th>İMZA TARİHİ</th>
</tr>
</thead>
<tbody>
<tr>
<td>ELK.Y. MÜH. HÜSEVİN BODUR</td>
<td></td>
<td>1/6/1980</td>
</tr>
<tr>
<td>DİPLOMA NO: 2193</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

ÇİZEN: ATİLLA TÜRÜN6

2,60 m²

İLLER BANKASI
ENERJİ DAİRESİ BAŞKANLIĞI

PLAN NO: T.P. 6/106
ARŞİV KAYIT NO:
İÇİNDEKİLER

1) İLETKEN HESAPLARI .......... 3 ila 6...arası
2) İLETKENLERİN TERTİBİ .......... 7 .. 10 ..
3) TAŞIYICI DİREK HESABI .......... 11 .. 22 ..
4) DURDURUCU DİREK HESABI .......... 23 .. 32 ..
5) NİHAYET DİREK HESABI .......... 33 .. 35 ..
6) ZAVİYE DİREK HESABI .......... 36 .. 40 ..
1) İLETKEN ÖZELLİKLERİ:

İLETKEN CİNSİ : 1/0 (RAWEN) ST-AL.
TELİN ÇAPI (d) : 10,11 mm.
ISİ UZAMA KAT SAYISI (θ) : 19,2 \times 10^{-6} 1/C
MAX. GERİLME (-5° + BILL) : 9 kg/mm²
ARAÇ KOTU (en fazla) : 600 m.
ELASTİKİYET MODÜLÜ (E) : 8000 kg/mm²
KOPMA KUVVETİ (P₅₀) : 1945 kg.
KOPMA KUVVETİ % 70 i (P₂₅) : 1945 \times 0,7 = 1362 kg.
ORTALAMA MENZİL (a₀) : 200 m.

TELİN KESİTİ (S) : 62,44 mm²
TELİN ÇİPLAK AĞIRLIĞI (P₆₅) : 0,2162 kg/m.
RÜZGAR YÜKÜ (P₂₅) : 0,5338 kg/m
MAX. CER (Tₘₐₓ) : 561,96 kg.
İLETKEN + %100 R : P₀ = \sqrt{P₀² + P₁²} = 0,5758 kg/m.
P₀ = P₀ - P₁ = 0,5758 - 0,2162 = 0,3596
MAX. SİCALIKLIK : + 50°C
MİN. SİCALIKLIK (tᵢ) : - 10°C

2) KRİTİK SİCALIKLIK:

\[ t_{kr} = \sqrt{\frac{1}{E \theta} \times \frac{P_b}{P_o} + t_i} \]
\[ t_{kr} = 9 \times \frac{1}{8000 \times 19,2 \times 10^{-6}} \times \frac{0,3596}{0,5758} - 5 \]
\[ t_{kr} = 31,59°C + 50°C \]
MAX. SEHİM 50° MEYDANA GELİR

3) KRİTİK AÇIKLIK:

\[ a_{kr} = 2 \times T_{max} \sqrt{\frac{6 \theta (t - t₀)}{P_{o² - P_{n²}}} \times \frac{0,3596}{0,5758}} \]
\[ a_{kr} = 2 \times 561,96 \sqrt{\frac{6 \times 19,2 \times 10^{-6} (5 - 0,5) \times 3}{0,5758² - (0,2162)²}} \]
\[ a_{kr} = 1123,92 \sqrt{\frac{576 \times 10^{-6}}{0,2848}} \]
\[ a_{kr} = 50,54 m \ (200 m) \]
\[ a_{kr} - MAX GERİLME + 5° + %100 R YÜKÜNDEDIR. \]

4) İLETKEN RÜZGAR KUVVETİ:

a) 0 - 15 m. YÜKSEKLİK , \( a ≺ 200 m. HALİNDE \)
\[ W_i = c. p. d. \ a_w = 1,2 \times 44 \times 0,01011 \ a_w \]
\[ W_i = 0,5338 \ a_w \]
b) 0 - 15 m. \ \ \ a \ (200 m. H) \]
\[ W_i = c. p. d. \ (80 + 0,6 \ a_w) \]
\[ W_i = 1,2 \times 44 \times 0,01011 \ (80 + 0,6 \ a_w) \]
\[ W_i = 0,5338 (80 + 0,6 \ a_w) \]
c) 15 - 60 m. \ \ \ a \ (200 m. H) \]
\[ W_i = c. p. d. \ (80 + 0,6 \ a_w) \]
\[ W_i = 1,2 \times 53 \times 0,01011 \ (80 + 0,6 \ a_w) \]
\[ W_i = 0,543 \ (80 + 0,6 \ a_w) \]

5) SALINIM AÇISI:

\[ a \ (200 m. H), \ h (15 m) \]
+ 5°C + % 70 RÜZGAR HALİNDE \[ \tan \alpha_1 = \frac{0,7 \times 0,5338}{0,2162} = 1,7283 \ ; \ \alpha_1 = 59° 96' \]
+ 45°C + % 42 RÜZGAR HALİNDE \[ \tan \alpha_2 = \frac{0,42 \times 0,5338}{0,2162} = 1,037 \ ; \ \alpha_2 = 46° 04' \]
YÖNETMENLİĞE GÖRE, SALINIMDA \[ \alpha_1 = 50° \] YE KADAR OLAN HALLERDE \( \alpha_1 1/8 \)
\[ \alpha_1 = 50° \ 62° 30' \ HALİNDE 12° 30'/ 2 = 6° 15' ; 62° 30' \] DON BÜYÜK HALLERDE \( \alpha_1 / 10 \) ALINIR.
6) RÜZGARLI BİLEŞKE YÜKÜ:

\[ h \ (15 \text{ m.}) \quad a \ (200 \text{ m.}) \quad \text{HALİNDE} \quad P_W = \sqrt{P_T^2 + W_l^2} \]

\[ \% 100 \text{ RÜZGAR HALİNDE} \quad P_W \ 100 = \sqrt{0.2162^2 + 0.5338^2} = 0.57592 \text{ kg/m.} \]

\[ \% 70 \quad P_W \ 70 = \sqrt{0.2162^2 + (0.7 \times 0.5338)^2} = 0.4317 \text{ kg/m.} \]

\[ \% 42 \quad P_W \ 42 = \sqrt{0.2162^2 + (0.42 \times 0.5338)^2} = 0.311458 \text{ kg/m.} \]

7) GERİLME HESAPLARI:

MUHTELİF HALLERDE GERİLME VE SICAKLIKLAR AŞAĞIDAKİ GENEL HALLER DENKLEMI İLE HESAP EDILECEKTİR.

\[
\frac{S \cdot a^2 \cdot E \cdot Pn^2}{24 T_n^2} - T_n = \frac{S \cdot a^2 \cdot E \cdot Pn^2}{24 T_{\text{max}}^2} - T_{\text{max}} \cdot (t_n - t_0) \cdot S \cdot \Phi \cdot E
\]

YUKARDAKI FORMÜLÜN DEĞERLERİNI NESAP EDELİM.

\[
\frac{S \cdot a^2 \cdot E \cdot Pn^2}{24 T_{\text{max}}^2} = \frac{62.44 \times a^2 \times 8000 \times (0.5758)^2}{24 \times (561.96)^2} = 0.02185 a^2
\]

\[
(t_n - t_0) \cdot S \cdot \Phi \cdot E = (t_n - (-5)) \times 62.44 \times 1.92 \times 10^{-5} \times 8000 = (t_n + 5) \times 9.590784
\]

\[
\frac{S \cdot a^2 \cdot E \cdot Pn^2}{24 T_n^2} = \frac{62.44 \times a^2 \times 8000 \times Pn^2}{24 T_n^2} = 20813.33 \frac{Pn^2}{T_n^2} \cdot a^2
\]

GENEL HALLER DENKLEMI AŞAĞIDAKİ GIBİ BASİTEŞİR:

\[ 20813.33 a^2 \frac{Pn^2}{T_n^2} - T_n = 0.02185 a^2 - 561.91 + 9.590784 \ (t_n + 5) \]
7a) 50 °C HALİ:

\[ t_n = +50^\circ ; \quad P_n = 0,2162 ; \quad t = +5^\circ \]

\[ 20813,33 \cdot a^2 \times \frac{0.2162^2}{T_n^2} - T_n = 0,02185 \cdot a^2 - 561,96 + 9,5908 (50 - 5) \]

\[ \frac{972,885 \cdot a^2}{T_n^2} - T_n = 0,02185 \cdot a^2 - 130,374 \quad a = 250 \text{ m. ıçin} \]

\[ 50,804 \times 10^6 / T_n^2 - T_n = 1235,251 \]

\[ a = 200 \text{ m. ıçin} \]

\[ f = 1,315 \times 10^4 \cdot a^2 (a = 250 \text{ m. ıçin}) \]

\[ T_n = 205,43 \text{ BULUNUR.} \]

\[ 38,9146 \times 10^6 / T_n^2 - T_n = 743,526 ; \quad T_n = 202,78 \text{ BULUNUR.} \]

\[ f_{\text{max}} \leq \frac{a^2 \cdot P_e}{8 \times 202,78} = \frac{a^2 \cdot 0.2152}{8 \times 202,78} = 1,332 \times 10^{-4} \cdot a^2 = 5,328 \left( \frac{a}{2} \right)^2 \times 10^{-4} \]

**MAX. FLEŞ EĞRİSİ DEĞERLERİ:**

\[ (a = 200 \text{ m. ıçin}) \]

<table>
<thead>
<tr>
<th>a / 2 (m.)</th>
<th>20</th>
<th>40</th>
<th>50</th>
<th>60</th>
<th>70</th>
<th>80</th>
<th>90</th>
<th>100</th>
<th>120</th>
<th>140</th>
<th>160</th>
<th>180</th>
<th>200</th>
<th>220</th>
<th>260</th>
<th>300</th>
<th>340</th>
<th>380</th>
<th>420</th>
</tr>
</thead>
<tbody>
<tr>
<td>a / 2 - 1/2000 (mm.)</td>
<td>10</td>
<td>20</td>
<td>30</td>
<td>40</td>
<td>50</td>
<td>60</td>
<td>70</td>
<td>80</td>
<td>90</td>
<td>100</td>
<td>110</td>
<td>120</td>
<td>130</td>
<td>150</td>
<td>170</td>
<td>190</td>
<td>210</td>
<td></td>
<td></td>
</tr>
<tr>
<td>f_{\text{max}} (m.)</td>
<td>0,21</td>
<td>0,85</td>
<td>1,92</td>
<td>2,41</td>
<td>3,53</td>
<td>7,67</td>
<td>10,44</td>
<td>13,64</td>
<td>17,26</td>
<td>21,37</td>
<td>25,79</td>
<td>29,41</td>
<td>36,01</td>
<td>47,95</td>
<td>61,59</td>
<td>75,94</td>
<td>93,99</td>
<td></td>
<td></td>
</tr>
<tr>
<td>f_{\text{max}} - 1/400 (mm.)</td>
<td>0,92</td>
<td>2,13</td>
<td>4,8</td>
<td>6,53</td>
<td>13,32</td>
<td>19,17</td>
<td>26</td>
<td>34,1</td>
<td>63</td>
<td>53,75</td>
<td>64,48</td>
<td>90</td>
<td>119,9</td>
<td>154</td>
<td>192</td>
<td>235</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

**YUKarıDAKİ DEĞERLERİ GÖRE FLEŞ EĞRİSİ CİZİLDİ.**

7b) -10°C , BUZ YÜKSÜZ , RÜZGARSIZ HALİ:

\[ t_n = -10^\circ ; \quad P_n = 0,2162 ; \quad a_{\text{ort}} = 200 \text{ m.} \]

\[ 20813,33 \times 200^2 \times \frac{0.2162^2}{T_n^2} - T_n = 0,02185 \times 200^2 - 561,96 + 9,5908 (10 - 5) \]

\[ 3891,4632 \cdot 10^6 - T_n = 168,18 ; \quad T_n = 291 \text{ BULUNUR.} \]

\[ a^2 \cdot 10^{-4} = 0,928 ; \quad a^2 \cdot 10^{-4} = 3,712 \left( \frac{a}{2} \right)^2 \times 10^{-4} \]

**MİN. FLEŞ EĞRİSİ DEĞERLERİ:**

<table>
<thead>
<tr>
<th>a / 2 (m.)</th>
<th>20</th>
<th>40</th>
<th>50</th>
<th>60</th>
<th>70</th>
<th>80</th>
<th>90</th>
<th>100</th>
<th>120</th>
<th>140</th>
<th>160</th>
<th>180</th>
<th>200</th>
<th>220</th>
<th>260</th>
<th>300</th>
<th>340</th>
<th>380</th>
<th>420</th>
</tr>
</thead>
<tbody>
<tr>
<td>a / 2 - 1/2000 (mm.)</td>
<td>10</td>
<td>20</td>
<td>30</td>
<td>40</td>
<td>50</td>
<td>60</td>
<td>70</td>
<td>80</td>
<td>90</td>
<td>100</td>
<td>110</td>
<td>120</td>
<td>130</td>
<td>150</td>
<td>170</td>
<td>190</td>
<td>210</td>
<td></td>
<td></td>
</tr>
<tr>
<td>f_{\text{max}} (m.)</td>
<td>0,15</td>
<td>0,6</td>
<td>1,24</td>
<td>2,38</td>
<td>3,71</td>
<td>5,34</td>
<td>7,27</td>
<td>9,5</td>
<td>12,02</td>
<td>14,66</td>
<td>17,96</td>
<td>21,51</td>
<td>33,4</td>
<td>42,9</td>
<td>53,6</td>
<td>65,47</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>f_{\text{max}} - 1/400 (mm.)</td>
<td>0,38</td>
<td>1,5</td>
<td>3,3</td>
<td>5,95</td>
<td>9,3</td>
<td>13,4</td>
<td>18,17</td>
<td>24</td>
<td>30</td>
<td>37,12</td>
<td>44,9</td>
<td>63</td>
<td>84</td>
<td>107</td>
<td>134</td>
<td>164</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

7c) +5°C +%100 RÜZGAR HALİ:

\[ P_n = 0,57592 \text{ kg/m} ; \quad t_n = +5^\circ ; \quad a = 200 \text{ m.} \]

\[ 20813,33 \times 200^2 \times \frac{0.57592^2}{T_n^2} - T_n = 0,02185 \times 200^2 - 561,96 + 9,5908 (5 - 5) \]

\[ 276,137,770 / T_n^2 - T_n = 312,04 ; \quad T_n = 561,96 ; \quad f = \frac{a^2 \times 0,57592}{8 \times 561,96} = 1281,05 \cdot a^2 \]

7d) +5°C - BUZ YÜKSÜZ - RÜZGARSIZ HAL:

\[ P_n = 0,2162 ; \quad t_n = +5^\circ \]

\[ 20813,33 \times 200^2 \times \frac{0.2162^2}{T_n^2} - T_n = 0,02185 \times 200^2 - 561,96 + 9,5908 (5 - 5) \]

\[ 3891,4599 / T_n^2 - T_n = 312,04 ; \quad T_n = 250,7 \text{ kg} ; \quad f_{+5^\circ} = \frac{a^2 \times 0.2162}{8 \times 250,7} = 1,036 \times 10^{-4} \cdot a^2 \]
7 e) \( +5^\circ \) + \% RÜZGAR HALÎ : \[ P_n = 0.4317 \text{ kg/m} ; \quad t_n = +5^\circ \]

\[
20\times 33 \times 200^2 \times \frac{0.4317^2}{T_n^2} - T_n = 0.02185 \times 200^2 - 561.96 + 9.591 \quad (5 - 5)
\]

155,154,880 / \( T_n^2 \) - \( T_n = 312.04 \); \( T_n = 451 \) kg
\[ f_{+5+\%70} = \frac{a^2 \times 0.4317}{8 \times 451} = 1,936 \times 10^{-4} \cdot a^2 \]

7f) \( +50^\circ \) + \% 42 RÜZGAR HALÎ : \[ P_n = 0.311408 \text{ kg/m}. \quad t_n = +50^\circ \]

\[
20\times 33 \times 200 \times \frac{0.311458^2}{T_n^2} - T_n = 0.02185 \times 200^2 - 561.96 + 9.591 \quad (50 - 5)
\]

80750715 / \( T_n^2 \) - \( T_n = 743.52 \); \( T_n = 281 \)
\[ f_{+50+\%42} = \frac{a^2 \times 0.311458}{8 \times 281} = 1,385 \times 10^{-4} \cdot a^2 \]

I. BÖLGE:

HANÇER MENDİLE \( T_n > 291,75 \) kg \( (0.15 \cdot T_{\text{max}}) \) dir.

20813, 3 \[ a^2 \times \frac{0.2152^2}{291.75^2} - 291.75 = 0.02185 \cdot a^2 - 561.96 + 9.591 \times 10 \]

174.3 = 0.010104204 \( a^2 \), \( a = 129.38 \) m.

7h) \( +15^\circ \) - BUZ YÜKSÜZ - RÜZGARŞIZ HALÎ : \[ P_n = 0.2162 \quad t_n = +15^\circ \]

\[
20\times 33 \times 320^2 \times \frac{0.2162^2}{T_n^2} - T_n = 0.02185 \times 320^2 - 561.96 + 9.591 \quad (15 - 5)
\]

39914599 / \( T_n^2 \) - \( T_n = 407.95 \); \( T_n = 244.3 \) kg \( (\%15^\circ \times 1945 = 291.75 \) kg.

\( a = 320 \) (SALINIM DIYAGRAMI İÇİN):

**+50° BUZ YÜKSÜZ VE RÜZGARŞIZ HALÎ :**

\[
20\times 33 \times 320^2 \times \frac{0.2162^2}{T_n^2} - T_n = 0.02185 \times 320^2 - 561.96 + 9.591 \quad (5 - 5)
\]

994372, 32 / \( T_n^2 \) - \( T_n = 1675,48 \); \( T_n = 228,56 \)
\[ f_{+5} = \frac{320^2 + 0.2162}{8 \times 228.56} = 12.10 \text{ m.} \]

**+5° + \%70 RÜZGARLI HALÎ :**

\[
20\times 33 \times 320^2 \times \frac{0.4317^2}{T_n^2} - T_n = 0.02185 \times 320^2 - 561.96 + 9.591 \quad (5 - 5)
\]

3979164, 9 / \( T_n^2 \) - \( T_n = 1675,48 \); \( T_n = 243.4 \)
\[ f_{+5+\%70R} = \frac{320^2 \times 0.4317}{8 \times 243.4} = 12.73 \]

**+50° HALÎ :**

\[
20\times 33 \times 320^2 \times \frac{0.2162^2}{T_n^2} - T_n = 0.02185 \times 320^2 - 561.96 + 9.591 \quad (50 - 5)
\]

99621374 / \( T_n^2 \) - \( T_n = 2107,05 \); \( T_n = 207,48 \)
\[ f_{+50} = \frac{320^2 \times 0.2162}{8 \times 207.48} = 13.33 \text{ m.} \]

**+50° + \%42 R HALÎ :**

\[
20\times 33 \times 320^2 \times \frac{0.3715^2}{T_n^2} - T_n = 0.02185 \times 320^2 - 561.96 + 9.591 \quad (50 - 5)
\]

206803260 / \( T_n^2 \) - \( T_n = 2107,05 \); \( T_n = 293.48 \) kg
\[ f_{+50+\%42R} = \frac{320^2 \times 0.3715}{8 \times 293.48} = 13.39 \]
İLETKENLERİN TERTİBİ

a) İZOLATÖR TİPLERİ:
İLETKENLERİN DIREKLERE TESBİTİ, TAŞYICI DİREKLERDE "MESNET, İZOLATÖRLER DURDURUCU DURDURUCU DİREKLERE "ÇM" ve "GERGI" İZOLATÖRLERİ İLE YAPILACAKTIR.

b) TRAVERS TİPLERİ:
ÜÇ İLETKENİN AYNI HİZADA OLMASI HALİNDE, TRAVERS TİPLERİ: T200, T250, T300
T350, T400
ÜÇGEN TERTİP HALİNDE İSE TÜ-300 VE TÜ-400 OLACAKTIR.

c) İLETKENLERİN YATAY - DÜŞEY MESAFELERİ:

<table>
<thead>
<tr>
<th>TIP</th>
<th>TRAVERS</th>
<th>İLETKENLER</th>
<th>ARASI YATAY MESAFE</th>
<th>(200-10) / 2 = 95 cm.</th>
</tr>
</thead>
<tbody>
<tr>
<td>T200</td>
<td>2</td>
<td>6</td>
<td>250-10 / 2 = 120 cm.</td>
<td></td>
</tr>
<tr>
<td>T250</td>
<td>2</td>
<td>6</td>
<td>300-10 / 2 = 145 cm.</td>
<td></td>
</tr>
<tr>
<td>T300</td>
<td>2</td>
<td>6</td>
<td>350-10 / 2 = 170 cm.</td>
<td></td>
</tr>
<tr>
<td>T350</td>
<td>2</td>
<td>6</td>
<td>400-10 / 2 = 195 cm.</td>
<td></td>
</tr>
</tbody>
</table>
| T400 | 2       | 6          | "Yatay 300-10 = 290 cm."
| TÜ-300| 2      | 6          | "Düseyl 300-10 = 290 cm."
| TÜ-400| 2      | 6          | "Yatay 400-10 = 390 cm."
|     |         |            | "Düseyl 300-10 = 390 cm."


d) TRAVERSLERİN KULLANILABİLECEKLERİ MAX. AÇIKLIK (a<sub>max</sub>):

**YONEMENLIK MADDE 44 GÖRE**

D = 0,50 \( \sqrt{f_{max} + l_0 + \frac{U}{150}} \)

**MAX. FLEŞ 50° %42 R HALİNDE DİR**

VE \( f_{max} = 1,385 \times 10^{-4} \times a^2 \) diir.

**MESNET İZOLATÖRLERİ**

\( l_0 = 0 \) dir.

D = 0,5 \( \sqrt{1,385 \times a^2 \times 10^{-4} + \frac{U}{150}} \) = 0,00588 a / U/150

AYNI SEVİYEDEKİ İLETKENLERİN \( \alpha / 8 \) VEYA \( \alpha / 10 \) YAKINLASMALARI HALİNDE

\( D_5 = \frac{U}{150} + 2f_5 \times \sin \frac{\alpha}{10} \) ; \( f_5 = 1,036 \times 10^{-4} \times a^2 \) idi

\( \sin \alpha / 10 = \sin 6° 15' = 0,10986 \) ; \( D_5 = U/150 + 2 \times 1,036 \times 10^{-4} a^2 \times 0,10986 \)

\( D_5 = \frac{U}{150} + 0,22556 a^2 \times 10^{-4} \)

**D İLE DS'İN AYNI OLDUĞU AÇIKLIŞI BULALIM**

\( 0,00588 a + \frac{U}{150} = \frac{U}{150} + 0,22556 a^2 \times 10^{-4} ; 0,00588 = 0,22556 a \times 10^{-4} \)

\( a = 261 m \) BULUNUR 261 m. YE KADAR FORMÜL, 261 m. DEN SONRA SALINIMA GÖRE HESAP YAPILACAKTIR.

**T-200 TRAVERS İÇİN:** \( a = 0,95 - 0,00588 a + U/150 \)

34,5 kV. \( a = (0,95 - 0,23) / 0,00588 = 122 m \)

15 kV. \( a = (0,95 - 0,10) / 0,00588 = 144 m \)

**T-250 TRAVERS İÇİN:** \( a = 1,2 - 0,00588 a + U/150 \)

34,5 kV. \( a = (1,20 - 0,23) / 0,00588 = 164 m \)

15 kV. \( a = (1,2 - 0,10) / 0,00588 = 187 m \)

**T-300 TRAVERS İÇİN**

34,5 kV. \( a = (1,45 - \frac{34,5}{150}) / 0,00588 = 207 m \)

15 kV. \( a = (1,45 - \frac{15}{150}) / 0,00588 = 229 m \)

**T-300 TRAVERS - SALINIMA GÖRE**

D = 1,45 \( = \frac{U}{150} + 0,22556 a^2 \times 10^{-4} \) 15kV. \( a \rightarrow 244 m \)

34,5 kV. \( a \rightarrow 232 m \)
I/8

**T-350** FORMÜLE GÖRE
34,5 kV. ta \((1,70 - 0,23)/0,00588 = 250 \text{ m.}\)
15 kV. ta \((1,70 - 0,10)/0,00588 = 272 \text{ m.}\)

**T-350 TRAVERS, SALINIMA GÖRE**
34,5 kV. ta \(D_s = 1,70 = \frac{34,5}{150} + 0,22556 \times 10^{-4}\)
\(a = 255 \text{ m.}\)
15 kV. ta \(a = (1,70 - 0,10)/0,22556 \times 10^{-4}\)
\(a = 266 \text{ m.}\)

**T400 TRAVERS, SALINIMA GÖRE**
34,5 kV. ta \(a = (1,95 - 0,23)/0,22556 \times 10^{-4}\)
\(a = 276 \text{ m.}\)
15 kV. ta \(a = (1,95 - 0,10)/0,22556 \times 10^{-4}\)
\(a = 286 \text{ m.}\)

**TÜ-300 TRAVERS - FARKLI SEVIYEDeki İLETKEN BAKIMINDAN**
\(D_1 = 3^2 + \left(\frac{2,90}{2}\right)^2 = 3,33 \text{ m.} \) FORMÜLE GÖRE
\(D = 3,33 = 0,00588a + U/150;\) 34,5 kV. ta \(a = (3,33 - 0,23)/0,00588a = 527 \text{ m.}\)

AYNI SEVIYEDeki İLETKENLER BAKIMINDAN VE FORMÜLE GÖRE
34,5 kV. ta \(a = (2,90 - 0,23)/0,22556 \times 10^{-4}\)
\(a = 344 \text{ m.}\)
15 kV. ta \(a = 352 \text{ m.}\)

SALINIM BAKIMINDAN \(a = 320 \text{ m.} \) ALINMİŞTİR.

**TÜ-300 TRAVERSİN SALINIM DIYAGRAMI ÇİZİLECEKTİR.**

\(a = 320 \text{ m.}\)
\(f_{+5} = 12,1 \text{ m.}\)
\(f_{+5}^{5\%\%70R.} = 12,73 \text{ m.}\)
\(\alpha_1 = 59^\circ 54'\)
\(\alpha_{1/5} = 12^\circ 30'\)

\(f_{+50^{\circ}+42R.}^{50^\circ} = 13,58 \text{ m.}\)
\(f_{50^\circ} = 13,33 \text{ m.}\)
\(\alpha_2 = 46^\circ 06'\)
\(\alpha_{2/4} = 11^\circ 30'\)

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**Diagram:**

- **295 m**
- **12,1 m**
- **D1 = 0,60 + 0,23**
- **+5\(^\circ\) + 70\% RÜZGAR HALİ**

- **295 m**
- **12,3 m**
- **D1 = 140 cm + 23 cm**
- **+50\(^\circ\) + 42 RÜZGAR HALİ**
a) Farklı seviyedeki iletkenler arası mesafe \( D_1 = \sqrt{3^2 + (3,9/2)^2} = 3,57 \text{ m.} \)

\[ = \text{bakanından formül göre} \quad D_1 = 2,57 = 0,00588 \alpha + U/150 \]

\[ 34,5 \text{ kV. to} \quad \alpha = 568 \text{ m.} \]

b) Aynı seviyedeği ikı iletkenin salınım bakanından hesabı:

\[ 34,5 \text{ kV. to} \quad \sigma^2 = (3,90 - 0,23) / 0,22556 \times 10^{-4}; \quad \alpha = 403 \text{ m.} \]

\[ 15 \text{ kV. to} \quad \sigma^2 = (3,90 - 0,10) / 0,22556 \times 10^{-4}; \quad \alpha = 410 \text{ m.} \]

Salinım diyagramı \( \alpha = 380 \text{ m.} \) için çizilecektir. (Salinım bakanından)

\( \alpha = 380 \text{ m. de salınım değerlerini hesap edelim.} \)

+ 5° - Buz Yüksüz Rüzgarsız Hal

\[ 20 813,33 \times 380^2 \times \frac{0,215^2}{T_n^2} - T_n = 0,02185 \times 380^2 - 561,96 + 9,591 (5 + 5) \]

\[ 1402220,3 \times 10^2 / T_n^2 - T_n = 2593,18 \quad T_n = 223,14 \text{ kg.} \]

\[ \beta = 380^2 \times 0,216 = 17,47 \text{ m.} \]

+ 5° + %70 Rüzgar Halı

\[ 20 813,33 \times 380^2 \times \frac{0,4317^2}{T_n^2} - T_n = 0,02185 \times 380^2 - 561,96 + 9,591 (5 - 5) \]

\[ 5601091,2 \times 10^2 / T_n^2 - T_n = 2593,18 \quad T_n = 430,4 \text{ kg.} \]

\[ \beta = 380^2 \times 0,4317 = 18,1 \text{ m.} \]

+ 50° Halı

\[ 20 813,33 \times 380^2 \times \frac{0,215^2}{T_n^2} - T_n = 0,02185 \times 380^2 - 561,96 + 9,591 (50 - 5) \]

\[ 1402220,3 \times 10^2 / T_n^2 - T_n = 3024,795 \quad T_n = 208,2 \quad \beta = 380^2 \times 0,215 = 18,74 \text{ m.} \]

+ 50° + %42 Rüzgar Halı

\[ 20 813,33 \times 380^2 \times \frac{0,3115^2}{T_n^2} - T_n = 0,02185 \times 380^2 - 561,96 + 9,591 (50 - 5) \]

\[ 29162 49,1 \times 10^2 / T_n^2 - T_n = 3024,795 \quad T_n = 296,3 \quad \beta = 380^2 \times 0,3115 = 18,98 \text{ m.} \]

Yukarıdaki değerlerle göre salınım diyagramı çizilecektir.

\( \alpha = 59° 54' \); \quad \alpha_1/5 = 12° 30' \); \quad \alpha_2 = 46° 04' \); \quad \alpha_3/4 = 11° 31' \)

\( \alpha = 380 \text{ m.} \); \quad \beta = 380 \text{ m.} \quad \beta = 380 \text{ m.} \)

\[ \beta = 380 \text{ m.} \]

\[ \beta = 380 \text{ m.} \]
TAŞIYICI DİREK HESABI

1) a-İNŞAATLAR GÖRE TAŞIYICI DİREĞİN HESAP KOŞULLARI ÅŞAĞIDA VERİLMIŞTİR.

\[ \begin{align*}
P_{wi} & \rightarrow Q \rightarrow Q \rightarrow Q \\
0.02 T_{\text{max}} & \rightarrow \frac{Q}{P_{wd}} \\
0.2 T_{\text{max}} = 69 \text{ kg.}
\end{align*} \]

VARSAYIM -1

HATTA DİK RÜZGAR KUVVETİ VE BUZSUZ AĞIRLIKLER

HAT DOĞRULTUSUNDA DİREĞE VE İZOLATÖRLERE GELEN RÜZGAR KUVVETİ İLETKENİN MAX ÇEKME KUVVETİNİN \( \% 2 \) İI

VARSAYIM -2

MESNET İZOLATÖRLERDE BİR İLETKEN İN T_{\text{max}}'ın 1/5 İI, ZINCİR İZOLATÖRLERDE 1/3'ÜNE EŞİT KUVVET + BUZLU AĞIRLIKLER.

VARSAYIM -3

b- KÖŞEDE TAŞIYICI DİREK HESAP KOŞULLARI:

YUKARIDAKI VARSAYILARLA İLAVETEN +5°C BİLEŞKE KUVVETİ ILE AÇI ORTAYINA PARALEL RÜZGAR KUVVETİ VE BUZSUZ AĞIRLIKLER.

2) DİREK BOYU KADEMELERİ T-10, T-12, T-14, T-16, T-18, T-20

3) TEMEL DERİNLİĞİ 1,50 m. DİREĞİN TOprağa GİREN BOYU 1,50 m.

4) a-TAŞIYICI DİREĞİN (h) 15 m. İÇİN RÜZGAR MENZİLİ \( a_{w} = 220 \) m. ALINMIŞTIR.

b- (h) 15 m. HALINDE RÜZGAR MENZİLİ \( 44/53 = 0,83 \) NİSPETİNDE AZALTILIP \( a_{w} = 182 \) m. ALINACAKTIR.

c- (h) 200 m. HALINDE, PROFİLDEN \( a_{w} = 0,6 \times 80 \) BULUNACAK \( a_{WH} = a_{w} \times 0,6 \times 80 \) HESAPLANACAK ve \( a_{WH} (200 \) m. OLACAKTIR.

5) İLETKEN RÜZGAR KUVVETİ:

\( a_{w} = 220 \) m.

1 İLET肯 İÇİN \( P_{wi} = 0,5338 \ a_{w} = 0,5338 \times 220 \ 

6) BUZLU AĞIRLIKLER:

\( a_{g} = 400 \) m. ALINDI

3 İLETKENIN BUZLU AĞIRLIĞI : \( 3 \times a_{g} \times P_{o} = 3 \times m \times \)

MEŞNET İZOLATÖRÜ \( = 260 \) kg.

TRAVERS AĞIRLIĞI \( = 45 \) kg.

MONTÖR VE MONTAJ AĞIRLIĞI \( = 70 \) kg.

TEPE DONANIMI BUZLU AĞIRLIĞI

\( G_{0} = - \) kg.

DİREĞİN 6 m. LİK KISIM AĞIRLIĞI VE BUZLU AĞIRLIKLAR \( G_{10} = 200 \)

\( \text{ve BUZSUZ} \)

\( = 675 \) kg.

\( = 755 \) kg.

\( = 755 \) kg.

\( = 975 \) kg.
7) **EK YERLERİNDE DİREK GENİŞLİĞİ:**

**TEPE 0,25 m, GENİŞLEME METREDE 0,085 m. ALINNIŞTIR.**

**DİKMELİ PROFİLİ 50x50x5 dır.**

1. **EKTE**
   - \( b_1 = 0,25 + 6 \times m \times 0,035 = 0,46 \) ;
   - \( b_{10} = 0,46 - 2 \times 0,014 = 0,432 \) m.

2. **/**
   - \( b_2 = 0,25 + 12 \times m \times 0,035 = 0,67 \) ;
   - \( b_{20} = 0,67 - 2 \times 0,014 = 0,642 \) m.

**DİKMELİ PROFİLİ 50x50x7**

3. **EKTE**
   - \( b_3 = 0,25 + 18 \times m \times 0,035 = 0,88 \) ;
   - \( b_{30} = 0,88 - 2 \times 0,014 = 0,8502 \) m.

8) **DİREĞE RÜZGAR KUVVETİ:** 3 **İZOLATÖRE RÜZGAR KUVVETİ** 5 kg.

- 10-6 m. nin **RÜZGAR KUVVETİ:**
  - **DİKMELİ:** \( 3,5 \times m \times 2 \times 0,05 \times 70 \times 2,8 = 69 \) kg.
  - **ÇAPRAZ:** \( 4 \times m \times 0,04 \times 70 \times 2,8 = 32 \) kg.
  - \( 3 \times m \times 0,04 \times 55 \times 2,8 = 19 \) kg.
  - \( 159 \) kg.

- 5-12 m. nin **RÜZGAR KUVVETİ:**
  - **DİKMELİ:** \( 6 \times m \times 2 \times 0,05 \times 55 \times 2,8 = 93 \) kg.
  - **ÇAPRAZ:** \( 8 \times m \times 0,04 \times 55 \times 2,8 = 50 \) kg.
  - \( 143 \) kg.

9) **EK YERLERİNDEKİ MOMENT:**

**DÜZ TERTİPTE:**

- **EK - 1 de**
  - \( M_1 = 358 \) kg. \times 6,35 + 159 kg \times 3 = 2750 kgm.

- **EK - 2 de**
  - \( M_2 = 358 \) kg \times 12,35 + 9 m \times 159 + 3 m \times 143 = 6281 kg.

- **EK - 3 de**
  - \( M_3 = 358 \) kg \times 18,35 + 15 m \times 159 + 9 m \times 143 + 3 m \times 155 = 10707 kg.

**1. EK VERİNDE:**

\[ S_1 = \frac{M_1}{2 \times b_{10}} + \frac{L_1}{4} \]

- \( S_1 = 2750 / 2 \times 0,432 + 675 / 4 = 3183 + 169 = 3352 \) kg.

- **L_1 = 144 cm.**
  - \( \lambda = \frac{L}{i_X} = \frac{144}{1,51} = 95,3 \) ;
  - \( W = 1,82 \) ;
  - \( \gamma = \frac{1,82 \times 3352}{4,8} = 1271 (1600) \)

**2. EK VERİNDE:**

\[ S_2 = \frac{6281}{2 \times 0,642} + \frac{755}{4} = 4892 + 169 = 5081 \] ;

- **L_2 = 110 cm** ;
  - \( \lambda = \frac{110}{1,51} = 73 \) ;
  - \( W = 1,45 \) ;
  - \( \gamma = \frac{1,45 \times 5081}{4,8} = 1535 (1600) \)

**3. EK VERİNDE**

\[ S_3 = \frac{10707}{2 \times 0,8502} + \frac{975}{4} = 6297 + 244 = 6541 \) kg.

- **L_3 = 118 cm.**
  - \( \lambda = \frac{118}{1,49} = 80 \) ;
  - \( W = 1,55 \) ;
  - \( \gamma = \frac{1,55 \times 6541}{6,56} = 1541 (1600) \)
T-14 DIREK HALİNDE \[ H = 14 - 1,5 + 0,35 = 12,85 \text{ m.} \]

\[ M = 12,85 \times 358 + 9,5 \times 159 + 3,5 \times 143 + 0,5 \times \frac{155}{6} - 0,25 = 6615 \]

\[ b_0 = 0,6975 - 0,028 = 0,6995 \text{ m.} \]

\[ S = \frac{6615}{2 \times 0,6995} + \frac{770}{4} = 5208; \quad L = 110; \quad \lambda = \frac{110}{1,51} = 73; \quad w = 1,45 \]

\[ Q = \frac{1,45 \times 5,208}{4,8} = 1574 \text{ (1600 kg/cm²)} \]

ÜÇGEN TERTİPTE MOMENT AZALDIĞI IÇİN AYRICA HESAP YAPILMAMIŞTIR.

9) ÇAPRAZ HESABI:

HATTA DİK ÇAPRAZLARA İLETKENLERE VE DİREĞE RÜZGAR KUVVETLERİ GELMekteDİR.

\[ P = 3 w_1 + w_d \]

HATTA PARALEL ÇAPRAZLARA İSE BİR HATTIN CER KUVVETİNİN \( \frac{1}{5} \) I GELMEKTEDİR.

\[ P = \frac{687}{5} \cong 138 \text{ kg.} \]

9a) RÜZGAR KUVVETINE GÖRE ÇAPRAZ TAHKİK HESABI:

TRAVERSİN ALTINDAKİ (2) NO. LÜ ÇAPRAZIN HESABI:

\[ Q = 3 \times w_1 + w_{iz} = 3 \times 117,4 + 5 \cong 358 \text{ kg.} \]

\[ d_2 = 72 \text{ cm}; \quad b_2 = 28 \text{ cm}; \quad Q_2 = Q \times \frac{b_2}{b_1} = 358 \times \frac{28}{20} = 320 \text{ kg.} \]

\[ D_2 = Q_2 \times \frac{d_2}{b_2} = 320 \times \frac{72}{28} = 923 \text{ kg.} \]

\[ \lambda = \frac{d_2}{l_{min}} = \frac{72}{0,78} = 93; \quad \omega = 1,76; \quad Q = \frac{D \times \omega}{F} = \frac{923 \times 1,76}{3,08} = 471 \text{ (1600)} \]

1. BÖLÜMÜN ALTINDAKİ (9) NO. LÜ ÇAPRAZIN HESABI:

\[ Q = 3 \times w_1 + w_{iz} = 358 \text{ kg.} \quad Q_d = 159 \text{ kg.} \]

\[ d_9 = 80 \text{ cm}; \quad b_9 = 46 \text{ cm}; \quad Q = 358 \times \frac{25}{66} + 159 \times \frac{35,5}{66} = 318 \text{ kg.} \]

\[ D_9 = 318 \times \frac{80}{46} = 553 \text{ kg.} \]

\[ \lambda = \frac{d_9}{l_{min}} = \frac{80}{0,78} = 103; \quad \omega = 1,96; \quad Q = \frac{553 \times 1,96}{3,08} = 352 \text{ (1600)} \]

2. BÖLÜMÜN ALTINDAKİ (19) NO. LÜ ÇAPRAZIN HESABI:

\[ Q = 3 \times w_1 + w_{iz} = 358; \quad Q_{d1} = 159 \quad Q_{d2} = 145 \text{ kg.} \]

\[ d_1 = 90 \text{ cm}; \quad b_9 = 67 \text{ cm}; \quad Q_{18} = 358 \times \frac{25}{67} + 159 \times \frac{35,5}{67} + 143 \times \frac{56,5}{67} = 339 \text{ kg.} \]

\[ D_{18} = 339 \times \frac{90}{67} = 455; \]

\[ \lambda = \frac{90}{0,78} = 115 \quad \omega = 2,23; \quad Q = \frac{455 \times 2,23}{3,08} = 329 \text{ (1600)} \]
3. BÖLÜM ALTINDAKİ (20) NO. LU ÇAPRAZIN HESABI:

2. BÖLÜMDEKİ KUVVET 339 kg. idi. \( Q_{d3} = 155 \) kg.

\[
d_{28} = 104 \text{ cm. ; } b_{28} = 88 \text{ cm. ; } d_{28} = 339 \times \frac{67}{88} = 155 \text{ kg.}
\]

\[
C = 40 \times 40 \times 4 \text{ kg.}
\]

\[
\lambda = 104 / 0.78 = 133 \text{ ; } \omega = 2.99 \text{ . } C = \frac{467 \times 299}{3.08} = 454 \text{ (1600)}
\]

9b) BURULMAYA GÖRE ÇAPRAZ TAHKİK HESABI:

4 m. lik TRAVERS HALİNDE \( q_{\text{max}} \):

\[
q_{\text{max}} = \frac{Z.C}{2 \text{ Ba}} + \frac{Z}{2} = \frac{138 \times 1.95}{2 \times 0.25} + \frac{138}{2} = 507.2
\]

2 NO. LU ÇAPRAZIN TAHKIKI:

\[
Q_2 = 507.2 \times 25 \times \frac{25}{28} = 542 \text{ kg. } ; \text{ } D = 542 \times \frac{72}{28} = 1394 \text{ kg.}
\]

\[
C = \frac{1394 \times 1.76}{3.08} = 797 (1600 \text{ kg/cm}^2)
\]

28 NO. LU ÇAPRAZIN TAHKIKI:

\[
Q_2 = 607.2 \times 25 \times \frac{25}{88} = 173 \text{ kg. } ; \text{ } D = 173 \times \frac{104}{88} = 204 \text{ kg.}
\]

\[
C = \frac{204 \times 2.79}{3.08} = 185 (1600)
\]

b) 2. HALE GÖRE +5°C BİLEŞKE KUVVETİ VE AÇI ORTAYINA PARALEL RÜZGAR
KUVVETİ VE BUZSUZ AĞIRLIKLARA GÖRE HESAP EDILECEKTİR.

+5°C deki GERİLME (a) ORTALAMA OLAN 200 m. İÇİN 260,7 kg. BULUNMUŞTU
BIZ BUNU EMNİYET BAKIMINDAN 251 kg. ALACAĞIZ.

+5°C deki BİLEŞKE KUVVET \( Q_{+S} = 3 \times 261 \times 2 \times \cos \alpha / 2 \) dir. 170° İÇİN

\[
\cos \alpha / 2 = 0.0872 \text{ BULUNMUŞTU.}
\]

BURADAN \( Q_{+S} = 3 \times 261 \times 0.0872 \times 2 = 136 \) kg. BU KUVVET KAÇ METRELIK İLETKEN
RÜZGAR KUVVETINE EŞITTİR.

1 m. lik ÜÇ İLETKENIN RÜZGAR KUVVETİ 1,6014 kg. idi.

\[
Q_{+S} / 1,6014 = 136 / 1,6014 = 85 \text{ m. } \text{ } \alpha \text{ ye TEKABÜL EDEN RÜZGAR AÇIKLİĞI 85/10=8.5 m.}
\]

BULUNUR.

NETİÇE: KöŞEDE TAŞYICI DIREKTE, HER (DERECE) İÇİN RÜZGAR MENZİL
8,5 m. KISALIR.
T-400 TİPI TRAVERSİN STATİK HESABI:

TAŞYICI TRAVERS HESABINDA BÜZÜLU AĞIRLIKLER İLE UÇTAKI BİR İLETKENİN KOPMASI HALİNDE MESNET İZOLATÖRÜ DIİERLERİDE MAX CERRİN 1/5 İ KADAR BİR UFKİ KUVVET VE BURULMA MOMENTİ NAZARI İTİBARE ALINACAKTIR.

\[ G_0 = \text{BUZLU AĞIRLIĞI} : \]
\[ \alpha g = 400 \text{ m. HALİNDE İLETKENİN BUZLU AĞIRLIĞI} \]
400 m = 0,2152
izolatör ağirliği 20 kg
montör ağirliği 100/2
travers ağirliği 30/2

\[ \text{87 kg.} \]
\[ \text{50 kg.} \]
\[ \text{15 kg.} \]
\[ \text{172 kg.} \]

\[ G \text{ BUZSUZ AĞIRLIK VE Z5 UFKİ KUVVETLERİ DOLAYI ÜST ÇUBUK ÇEKMEYE VE ALT ÇUBUK BASIVA ÇALIŞIR VUKARADAKİ TERTİBE GÖRE ALT ÇUBUĞUN (A) NOKTASINDAKI ÇUBUK KUVVETİ VE GERİLMESİNİ HESAP EDELİM} \]

BUZSUZ AĞIRLIKLDARDAN DOLAYI : \[ M_0 = G \times l = 172 \times 1,20 = 207 \text{ kgm.} \]

\[ S_1 = \frac{M_0}{2b_2} = \frac{207}{2 \times 0,4} = 261 \text{ kgm.} \]

\[ \cos \alpha \_1 \]

\[ Z/5 \text{ KUVVETİNDEN DOLAYI} \]
\[ M_2 = \frac{Z}{5} \times l = \frac{562}{5} \times 1,20 = 135 \text{ kgm.} \]

\[ S_2 = \frac{M_2}{2b_1} = \frac{135}{2 \times 0,25} = 270 \text{ kgm.} \]

\[ S_1 \text{ VE S_2 KUVVETLERİ ALT ÇUBUKTA AYNI ANDA BASIVA ÇALIŞTIĞINDAN S} = S_1 + S_2 \]

\[ S = 261 + 270 = 531 \text{ kg.} \]

\[ d = 125 \text{ cm.} \]

\[ \lambda = 125/1,21 = 104 \text{ cm} ; \]

\[ \omega = 1,98 \]

\[ \theta = \frac{531 \times 1,98}{3,08} = \frac{562}{5} = 46 \text{ kgm.} \]

\[ Z/5 \text{ KUVVETİNIN İZOLATÖR BOYUNDAN DOLAYI HUSULE GELEN BURULMA MOMENTİ} \]
\[ M_C = Z/5 \times C = (0,35 + 0,12/2) \times 562 = 46 \text{ kgm.} \]

\[ M_C \text{ BURULMA MOMENTİNDEN DOLAYI ŞEKİLDE GÖRÜLDÜĞÜ} \]

\[ Q_1 \text{ ve Q_2 KUVVETLERİ DOĞRAMAKTADIR.} \]

\[ Q_1 = \frac{M_C}{2 \times b_1} = \frac{46}{2 \times 0,12} = 192 \text{ kg.} \]

\[ Q_2 = \frac{M_C}{2 \times b_2} = \frac{46}{2 \times 0,15} = 154 \text{ kg.} \]
ÜST YÜZEYDE BU KUVETLER  \( Q_{1_{\text{max}}} = Q_{1} + \frac{Z}{5 \times 2} = 192 + 57 = 249 \) kg.

ALT YÜZEYDE BU KUVETLER  \( Q_{2_{\text{max}}} = Q_{2} + \frac{Z}{5 \times 2} = 154 - 57 = 97 \) kg.

DÜŞEV YÜZEYDE İSE  \( Q_{3_{\text{max}}} = Q_{2} + \frac{G}{2} = 154 + \frac{172}{2} = 240 \) BULUNUR

BU KUVETLER ÇAPRAZLAR TARAFINDAN KARŞILANIR.

3. NO. LU ÇAPRAZIN BOYU  \( d = 60 \) cm.  \( \lambda = d / 0,78 = \frac{60}{78} = 77 \) cm.

\( w = 1,50 \);  \( Q = \frac{Q_{1_{\text{max}} \times w}}{F} = \frac{249 \times 1,5}{3,08} = 122 \) (1600 kg/cm²).

1 NO. LU ÇAPRAZIN BOYU  \( d = 72 \) cm.;  \( \lambda = 72 / 0,78 = 92 \);  \( w = 1,74 \)

\( Q_{3} = Q_{3_{\text{max}}} = \frac{0,12}{0,28} = 240 \times \frac{0,12}{0,28} = 103 \) kg.  \( Q = \frac{1,74 \times 103}{3,08} = 59 \) (1600 kg/cm²)

ÜST ÇUBUK ÇEKMEVE ÇALIŞMAK TAÐDIR.

(B) NOKTASINDAKI ÇUBUK KUVETİ  \( G \) den DOLAYI  \( S_{1} = \frac{1,70 \times 172}{2 \times 0,4} \)  \( = 366 \) kg.

\( Z / 5 \) den  \( \ddot{u} \).  \( S_{2} = \frac{1,7 \times 113}{2 \times 0,25} \)  \( = 385 \) kg.

\( S = S_{1} + S_{2} = 366 + 385 = 751 \) kg.  \( F = \frac{S}{751} = 244 \) (1600 kg)

CIVATA HESABI:  \( S = 244 \) kg. BULUNMUŞTU M12 KULLANILACAK TIR.

\( Q_{k} = \frac{751}{1,131} = 664 \) (1270)  \( Q_{e} = \frac{751}{0,4 \times 1,2} = 1565 \) (2 500)
I. TAŞIYICI DIREKLERİN KÖŞEDE TAŞIYICI OLARAK HESABI.

AŞAĞIDA HER BOYDARI DİREĞİN NET TEPE KUVVETİ DİREĞE RÜZGAR KUVVETİNİN TEPEYE İRÇA EDİLMİŞ DEREĞİ İLE "KÖŞEDE TAŞIYICI" OLARAK KULLANILMA AÇISI VE DÜZ ARAZİDE NİHAYİ \( q_w \) DEĞERLERİ HESAP EDİLECEKTİR.

**T-10 TİPI DİREK İÇİN:**

**DİREĞE RÜZGAR KUVVETİ**

1. **BÖLÜM DİKME** \( 6 \times 2 \times 0,05 \times 55 \times 2,8 = 93 \) kg.
   
   \[
   \text{ÇAPRAZ: } 7 \times 0,04 \times 55 \times 2,8 = \frac{475 + 200}{4} = 169 \text{ kg}.
   \]

2. **BÖLÜM DİKME** \( 2,5 \times 2 \times 0,05 \times 55 \times 2,8 = 39 \) kg
   
   \[
   \text{ÇAPRAZ: } 2,73 \times 0,04 \times 55 \times 2,8 = \frac{15}{136} \text{ kg}.
   \]

**DİREĞİN NET TEPE KUVVETİ** \( (q) \)

\[
\begin{align*}
FLAMBAY BOYU & \quad L = 110 \text{ cm.} \\
\lambda & \quad 110 / 1,51 = 73 \\
\omega & \quad 1,65 \\
b_o & \quad (0,25 + 8,5 \times 0,035) - 2 \times 0,014 = 0,5195 \\
S & \quad 1600 \times 4,8 / 1,43 = 5370 \text{ kg.} \\
G/4 & \quad \frac{475 + 200}{4} = 169 \quad (\text{ag = 400 m. için}) \\
S & \quad M / 2b_o + G/4 \\
M & \quad 2 \times 0,5195 (5370 - 169) = 5404 \text{ kgm.} \\
Q & \quad 5404 / 8,5 = 636 \text{ kg.}
\end{align*}
\]

İZOLATÖR UCUNA İNDİRGEMİŞ KUVVET \( q = 636 \times 8,5 / 8,85 = 611 \) kg.

**DİREĞE RÜZGAR KUVVETİ DÜŞÜLDÜKTE SONRAKİ DİREK TEPE KUVVETİ:**

\[
\begin{align*}
P_w' & \quad 636 - (136 + \frac{55}{8,5} + \frac{1,25}{8,5} + 6) = 524 \\
izolatör ucuna indirgenmiş \quad P_w & \quad 532 / 8,95 = 8,5 = 510 \text{ kg.}
\end{align*}
\]

**İLETKENLERİN SALINIMDAN DOLAYI \( \theta \) İLAVE EDİLDİĞİNDE \( \alpha = 171^\circ \)** BULUNUR.

DÜZ HATTA \( q_w \) DEĞERİ

\[
\begin{align*}
\alpha & \quad (532 / 1,6014 - 80) / 0,6 = 420 \text{ m. BULUNUR}
\end{align*}
\]

**T-12 TİPI DİREK İÇİN:**

**DİREĞE RÜZGAR KUVVETİ** \( (Yukaridan) \)

1. **BÖLÜM** \( (Yukaridan) \) = 136 kg.

2. **BÖLÜM DİKME** \( 4,5 \times 2 \times 0,05 \times 55 \times 2,8 = 69,3 \) \( \mu \)
   
   \[
   \text{ÇAPRAZ: } 6 \times 0,04 \times 55 \times 2,8 = \frac{37}{107} \text{ kg}.
   \]

\[
\begin{align*}
\text{q} & \quad \frac{136}{136} \text{ kg.}
\end{align*}
\]
DİRÈGÎN NET TEPE KUVVETİ (Q)

\[ L = 110 \text{ cm.} \quad S = 5370 \text{ kg. dir. (Yukarıdan)} \]

\[ b_o = (0,25 + 10,5 \times 0,035) - 2 \times 0,014 = 0,5895 \text{ m.} \]

\[ G/4 = \frac{475 + 330}{4} = 202 \text{ kg.} \]

\[ M = 2 \times 0,5895 (5370 - 202) = 6093 \]

\[ Q = M/H = \frac{6093}{10,5} = 580 \text{ kg.} \]

TEPE VE İRÇA EDİLMİŞ Q = 580 \times 10,5 /10,85 = 562 kg.

DİRÈGÎN RÜZGAR KUVVETİ DÜŞÜLDÜKten SONRAKI TEPE KUVVETİ

\[ P_w' = 552 \left(136 \times \frac{7,5}{10,5} + 107 \times \frac{2,25}{10,5} + 6 \right) = 436 \text{ kg.} \]

İZOLATÖR UCUNA İNDİRGENMİŞ KUVVET

\[ P_w = 436 \times \frac{10,5}{10,85} = 421 \text{ kg.} \]

\[ P_w = 421 = 2 \times 3 \times 552 \times \cos \alpha/2 ; \quad \cos \alpha/2 = 0,124 \quad \alpha = 166^\circ \]

SALINIMDAN DOLAVI \( \alpha = 174^\circ \) BULUNUR

DÜZ HATTA \( a_w \) DEĞERİ

\[ a_w = \frac{421}{1,6014 - 80} \times 0,6 = 304 \text{ m.} \]

T-14 TİPI DİREK İÇİN: (KONTROL YERİNDE YAPILACAKTIR.)

DİRÈGÎ RÜZGAR KUVVETİ

1. BÖLÜM (Yukarıdan) = 136 kg.

2. BÖLÜM DİKME 6m \times 2 \times 0,05 \times 55 \times 2,8 = 93 kg

ÇAPRAZ: 8m \times 0,04 \times 55 \times 2,8 = 50 kg

\[ \frac{143}{143 \text{ kg.}} \]

DİRÈGÎN NET TEPE KUVVETİ (Q)

\[ L = 110 \text{ cm.} \quad \lambda = 110 /1,51 = 73 \quad \omega = 1,45 \]

\[ S = 1600 \times 4,8 /1,45 = 5370 \text{ kg.} \quad G/4 = \frac{475 + 330}{4} = 217 \text{ kg.} \]

\[ b_o = (0,25 + 12 \times 0,035) - 2 \times 0,014 = 0,642 \text{ m.} \]

\[ M = 2 \times 0,642 (5370 - 217) = 6616 \text{ kg.} \quad Q = 6616 /12 = 552 \text{ kg.} \]

İZOLATÖR UCUNA İNDİRGENMİŞ Q = 552 \times 12 /12,35 = 536 kg.

DİRÈGÎ RÜZGAR KUVVETİ DÜŞÜLDÜKten SONRAKI DİREK TEPE KUVVETİ

\[ P_w' = 552 - (136 \frac{9}{12} + 143 \frac{3}{12} + 6) = 408 \text{ kg.} \]

İZOLATÖR UCUNA İNDİRGENMİŞ KUVVET

\[ P_w = 408 /12 = 391 \text{ kg.} \]

\[ P_w = 391kg = 2 \times 3 \times 552 \times \cos \alpha/2 ; \quad \cos \alpha/2 = 0,115 \quad \alpha = 157^\circ \]

İLETKEN SALINIMDAN DOLAVI 8 İLAVE EDİLDİĞİNDE \( \alpha = 175^\circ \) BULUNUR.

DÜZ HATTA \( a_w \) DEĞERİ

\[ a_w = \frac{391}{1,6014 - 80} / 0,6 = 273 \text{ m.} \]
T-16 TİPİ DİREK İÇİN:

DIREEĞİ RÜZGAR KUVVETİ

1. BÖLÜM (Yukaridan) = 136 kg.
2. BÖLÜM (Yukaridan) = 143 u
3. BÖLÜM - Dikme 2,5 m × 2 × 0,05 × 55 × 2,8 = 39 u
   Çapraz 3 m × 0,04 × 55 × 2,8 = 19 u
   ---
   58 kg.

DIREEGIN NET TEPE KUVVETİ : (Q)

L = 118 cm. ; λ = 118 / 1,49 = 79 ; w = 1,53
b₀ = 0,25 + 11,5 × 0,035 = 0,0149 = 0,6227 m.
S = 1600 × 6,56 / 1,53 = 6860 kg. G / 4 = 475 + 450 = 232 kg.
M = 2 × 0,6227 (6860 - 232) = 9255 ; Q = 9255 / 14,5 = 570 kg.
İZOLATÖR UCUNA İNDİRGENMİŞ Q = 570 × 14,5 / 14,5 = 556 kg.

DIREK RÜZGAR KUVVETİ DÜŞÜLDÜKTEN SONRA DIREEGIN TEPE KUVVETİ

\[ P_w = \frac{556 (136 \times \frac{17,5}{14,5} + 143 \times \frac{5,5}{14,5} + 58 \times \frac{125}{14,5} + 6)}{14,5} = 393 \text{ kg.} \]

İZOLATÖR UCUNA İNDİRGENMİŞ TEPE KUVVETİ

\[ P_w = \frac{393 \times 14,5}{14,5} = 374 \text{ kg} \]

DIREEGIN AÇIDA KULLANILMASI HALİ

\[ P_w = 374 = 2 \times 3 \times 562 \times \cos \alpha / 2 \cos \alpha / 2 = 0,110 \quad \alpha = 167,5^\circ \]

İLETKENİN SALINIMINDAN DOLAYI \( \alpha = 176^\circ \) BULUNUR.

DÜZ HAATA \( \sigma_w \) DEĞERİ

\[ \sigma_w = \left( \frac{374}{1,5014 - 80} \right) / 0,6 = 255 \text{ m.} \]

T-20 TİPİ DİREK İÇİN:

HESAP KONTROLU 3. EKTE YAPILACAĞTIR.

DIREEĞİ RÜZGAR KUVVETLERİ Sayfa 8' den ALINMİŞTIR.

Sayfa 8' den \( \omega = 1,53 \); \[ S = \frac{1600 \times 6,56}{1,53} = 6860 \text{ kg.} \]

\[ G / 4 = 475 + 630 / 4 = 277 \text{ kg.} \]

b₀ = (0,25 + 0,035 × 18) - 2 × 0,0149

\[ b_0 = 0,8502 \text{ m.} \]

M = 2 × 0,8502 (6860 - 277) = 1.1193 km. \[ Q = \frac{11193}{18} = 622 \text{ kg.} \]

İZOLATÖR UCUNA İNDİRGENMİŞ Q = 622 × 18 / 18,35 = 610 kg.

DIREEĞİ RÜZGAR KUVVETİ DÜŞÜLDÜKTEN SONRAKI DİREK TEPE KUVVETİ

\[ P_w = 622 - \left( \frac{159 \times 15}{18} + 143 \times \frac{9}{18} + 155 \times \frac{3}{18} + 6 \right) = 380 \text{ kg.} \]

İZOLATÖR UCUNA İNDİRGENMİŞ TEPE KUVVETİ

\[ P_w = 380 \times \frac{18}{18,35} = 378 \text{ kg.} \]
KÖŞEDE KULLANMA AÇısı

378 = 3 x 2 x 562 x Cos \( \alpha \)/2 \( \quad \cos \alpha/2 = 0,112 \quad \alpha = 167,5 \)

SALINIMDAN DOLAVI İLAVE EDİLDİĞİNDE \( \alpha = 176^\circ \) BULUNUR.

DÜZ HATTA RÜZGAR MENZİLİ \( a_w = \frac{378}{1,929} = 195 \) m.

İZOLATÖR DEMİRLERİNİN KÖŞEDE TAŞIYICI OLARAK KULLANILMA HESABI

34,5 kV. ve 15kV. luk İZOLATÖR DEMİRLERİNİN Max DAYANMA KUVVETLERİ TİP PROJELERDE VERİLMİŞTİR.

BURADA HER İZOLATÖR DEMİRİNİN KULLANILABİLECEĞİ AÇI HESAP EDILECEKTİR.

34,5 kV. Luk TAŞIYICI İZOLATÖR DEMİRİ

İZOLATÖR DEMİRİ 220 kg'a DAYANMAKTA'DIR.
\( Q = 220 \text{ kg} = 2 \times 562 \times \cos \alpha/2 \quad \cos \alpha/2 = 0,195 \quad \alpha = 158^\circ \)

34,5 kV. Luk DURDURUCU İZOLATÖR DEMİRİ

İZOLATÖR DEMİRİ 450 kg'a DAYANMAKTA'DIR.
\( Q = 450 \text{ kg} = 2 \times 562 \times \cos \alpha/2 \quad \cos \alpha/2 = 0,400 \quad \alpha = 133^\circ \)

15 kV. Luk TAŞIYICI İZOLATÖR DEMİRİ

İZOLATÖR DEMİRİ 200 kg'a DAYANMAKTA'DIR.
\( Q = 200 \text{ kg} = 2 \times 562 \times \cos \alpha/2 \quad \cos \alpha/2 = 0,177 \quad \alpha = 160^\circ \)

15 kV. Luk DURDURUCU İZOLATÖR DEMİR

İZOLATÖR DEMİRİ 340 kg'a DAYANMAKTA'DIR.
\( Q = 340 \text{ kg} = 2 \times 562 \times \cos \alpha/2 \quad \cos \alpha/2 = 0,302 \quad \alpha = 145^\circ \)

DAHA DAR AÇILAR İÇİN ÇİFT İZOLATÖR KULLANILACAK TIR.

ÇİFT 34,5 kV. Luk DURDURUCU İZOLATÖR
\( 900 = 2 \times 562 \times \cos \alpha/2 \quad \cos \alpha/2 = 0,800 \quad \alpha = 73^\circ \)

ÇİFT 15kV. Luk DURDURUCU İZOLATÖR
\( 400 = 2 \times 562 \times \cos \alpha/2 \quad \cos \alpha/2 = 0,355 \quad \alpha = 139^\circ \)
TAŞIYICI DİREKLERİN ($a_w$ rüzgar menziline) BAĞLI OLARAK TEMEL SEÇİMİ (normal arazi)

BLOK TEMELLERDE DÖNME NOKTASI TOPRAK SEVİYESİNDEN İTİBAREN $1/3$ YANI $1,6 \times 1/3 = 0,53$ m. dendir.

**T-20 DİРЕĞİNDE DÖNME NOKTASINA GÖRE M MOMENTİ.**

$$M = (20 - 0.97 + 0.35 \text{ izolatör ĐBVU}) \times (1,929 a_w + 5) +$$
$$\times (20 - 0.97 - 3) \times 159 \times (20 - 0.97 - 9) \times 143 \times (20 - 0.97 - 15) \times 155 =$$

$$M = 19,38 \times 1,929 a_w + 16,03 \times 159 + 10,03 \times 143 + 4,03 \times 155 + 19,38 \times 5 =$$

$$M = 39,377 a_w + 5 \times 706$$

TEMEL BROSÜRÜNDE $M_n$ TEMEL MOMENTLERİNE GÖRE TEMEL SEÇİLECEKTİR.

10 NOLU TEMEL $a = 1,60$ m. LiK TEMEL $13671 = 37,377 a_w + 706$ dan $a_w = 239$ m.

9 NOLU TEMEL $a = 1,50$ m. LiK $11998 = a_w + 195$ m.

8 NOLU TEMEL $a = 1,40$ m. LiK $10476 = a_w + 154$ m.

7 NOLU TEMEL $a = 1,30$ m. LiK $9100 = a_w + 117$ m. ye kullanılır.

**T-18 DİРЕĞİNDE**

$$M = (18 - 0.97 + 0.35) \times (1,929 a_w + 5) + (18 - 0.97 - 3) \times 159 + (18 - 0.97 - 9) \times 143 + 2,78 \times \left(155 \times \frac{4,5}{6}\right)$$

$$= 17,38 \times 1,929 a_w + 14,03 \times 159 + 9,03 \times 143 + 2,78 \times 155 + 17,38 \times 5 = 33,526 a_w + 3901$$

9 NOLU TEMEL $a = 1,50$ m. LiK TEMEL $11998 = 33,526 a_w + 3901 ; a_w = 241$ m.

8 NOLU TEMEL $a = 1,40$ m. LiK $10476 = a_w + 196$ m.

7 NOLU TEMEL $a = 1,30$ m. LiK $9100 = a_w + 155$ m.

6 NOLU TEMEL $a = 1,20$ m. LiK $7900 = a_w + 119$ m. ye kullanılır.

**T-16 DİРЕĞİNDE**

$$M = (16 - 0.97 + 0.35) \times (1,6014 a_w + 5) \times (16 - 0.97 - 3) \times 159 + (16 - 0.97 - 9) \times 143 + 1,78 \times \left(\frac{25}{6}\times 155\right)$$

$$= 15,38 \times 1,6014 a_w + 12,03 \times 159 + 6,03 \times 143 + 1,78 \times 65 + 15,38 \times 5$$

$$= 24,073 a_w + 2968$$

9 NOLU TEMEL $a = 1,50$ m. LiK TEMEL, $M_n = 11998 = 24,073 a_w + 2968 ; a_w = 366$ m.

8 NOLU TEMEL $a = 1,40$ m. LiK $10476 = a_w + 304$ m.

7 NOLU TEMEL $a = 1,30$ m. LiK $9100 = a_w + 248$ m.

6 NOLU TEMEL $a = 1,20$ m. LiK $7900 = a_w + 200$ m.

5 NOLU TEMEL $a = 1,10$ m. LiK $6797 = a_w + 155$ m. ye kullanılır.

(©) T-16 ye KADAR İLETKEN VE İZOLATÖRLERE RÜZGAR: $3 \times 0,5338 a_w + 5 = 1,6014 a_w + 5$

T-18 ve T-20 İÇİN İLETKEN VE İZOLATÖRLERE RÜZGAR: $3 \times 0,5338 \times \frac{53}{64} a_w + 5 = 1,929 a_w + 5$
**T-14 DİREĞİNDE**

\[
M = (14 - 0.97 + 0.35 \times 1.5014 \, a_w + 5) + (14 - 0.97 - 3) \times 159 + (14 - 0.97 - 9) \times 143 + 0.78 \times \left( \frac{0.5}{6} \times 155 \right) \\
= 13.38 \times (1.5014 \, a_w + 10.03 \times 159 + 4.03 \times 143 + 10 + 5) + 13.38 \\
= 21.43 \, a_w + 2248 \, kgm.
\]

7 NO.LU TEMEL  a = 1,30 m.lik TEMEL  M = 9100 = 2143 a_w + 2248 ,  a_w = 319 m.

5 6 2  a = 1,20 m.lik = 7900 = + +  a_w = 253 m.

4 5 3  a = 1,10 m.lik = 6797 = + +  a_w = 212 m.

3 4 2  a = 1,00 m.lik = 4506 = + +  a_w = 157 m.

2 3 1  a = 0,90 m.lik = 3848 = + +  a_w = 121 m.

1 2 0  a = 0,80 m.lik = 3227 = + +  a_w = 87 m. ye Kullanılabilir.

**T-12 DİREĞİNDE**

\[
M = (12 - 0.97 + 0.35 \times (1.5014 \, a_w + 5)) + (12 - 0.97 - 3) \times 159 + 2.78 \times (1.63 \times \frac{4.5}{10}) \\
= 18,224 a_w + 1632
\]

6 5 4 3 2  a = 1,20 m.lik TEMEL  M_n = 7900 = 18,224 a_w + 1632 ,  a_w = 343 m.

4 3 2 1 0  a = 1,10 m.lik = 6797 = + +  a_w = 283 m.

3 2 1 0 0  a = 1,00 m.lik = 4506 = + +  a_w = 157 m.

2 1 1 0 0  a = 0,90 m.lik = 3848 = + +  a_w = 121 m.

1 0 0 0 0  a = 0,80 m.lik = 3227 = + +  a_w = 87 m. BULUNUR.

**T-10 DİREĞİNDE**

\[
M = (12 - 0.97 + 0.35 \times (1.5014 \, a_w + 5)) + (10 - 0.97 - 3) \times 159 + 1.78 \times \frac{2.5}{6} \times 142 = \\
= 15,021 a_w + 1111
\]

2 1 0 0 0  a = 0,80 m.lik,  M_n = 3227 = 15,021 a_w + 1111 ,  a_w = 140 m.

1 0 0 0 0  a = 0,90 m.lik, = 3848 = + + ,  a_w = 182 m.

0 0 0 0 0  a = 1,00 m.lik, = 4506 = + + ,  a_w = 296 m.

0 0 0 0 0  a = 1,10 m.lik, = 6797 = + + ,  a_w = 378 m. kullanılabılır.

**KAYALIK ARAZİDE :**  t = 1,00 m. ALINACAĞI (**) İŞARETLER **  t = 1,25 m.

ÇÜKRÜK VE BATAKLİK ARAZİDE :  t = 1,90 m. ALINACAĞI.

TEMEL EBATLARI VE TIPLERİ AŞAĞIDA VERILmiştir.

<table>
<thead>
<tr>
<th>DİREK TİPİ</th>
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<th>T-10</th>
<th>T-12</th>
<th>T-12</th>
<th>T-12</th>
<th>T-12</th>
<th>T-14</th>
<th>T-14</th>
<th>T-16</th>
<th>T-16</th>
<th>T-18</th>
<th>T-18</th>
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<td>309</td>
<td><strong>(*)</strong></td>
<td><strong>(*)</strong></td>
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(D) DURDURUCU DİREK HESABI

a) DURDURUCU DİREK YÜKLENME KOŞULLARI:

3 İLETKEN HALİNDE
0,75 \( T_{\text{max}} \) + Q BUZSUZ
AŞIRILKAR + DİREĞE
RÜZGAR KUVVETİ

VARSAVIM - 1

VARSAYIM - 2

VARSAYIM - 3

VARSAYIM - 4

b) KÖSEDE DURDURUCU DİREK HALİNDE:

3 İLETKEN HALİNDE
0,25 \( T_{\text{max}} \) + Q BUZSUZ
AŞIRILKAR

VARSAVIM - 1

VARSAVIM - 2

VARSAVIM - 3

VARSAVIM - 4

2) DURDURUCU DİREK HESAP DEĞERLERİ:

\( q_g = 400 \) m,

IZOLATÖR CİNSİ : ZİNCİR ve MESNET OLMAK ÜZERE İKİ VARIYANLI
TEPE GENİŞLİĞİ : 0,50 mm., KALINLASMA : 0,045 m/m.
DİREK BOY KADEMELERİ : D-10 , D-12 , D-14 , D-16 , D-18 , D-20
TEMEL DERİNLİĞİ : 1,90 m. – DİREĞİN TEMELE GİREN KİSMI : 1,80 m.

3) ÜÇ İLETKEN MAX. CERRİNİN % 75'i :

\[ 3 \times 561,96 \times 0,75 = 1265 \text{ kg}. \]
5) **BUZSUZ AĞIRLIKLER**

3 İLETKEN İZOLATÖR MONTÜR VE TRAVERSIN BUZSUZ AĞIRLIĞI

(Sayıda: 7'den) = 475 kg.

1. **EK' e KADAR : 475 kg + 220 kg. DİREK AĞIRLIĞI = 695 #**

2. \( \text{\# \#} : 475 \# + 465 \# \# \# = 940 \# \)

3. \( \text{\# \#} : 475 \# + 765 \# \# \# = 1240 \# \)

6) **DIREĞİN EK YERLERİNDEN DIREK GENİŞLİĞİ :**

1. \( \text{EK te} \quad b_1 = 0,50 + 0,045 \times 6 = 0,77 \text{ m.} \quad b_{10} = 0,77 - 2 \times 0,0169 = 0,7362 \text{ m.} \)

2. \( \text{\#} \quad b_2 = 0,50 + 0,045 \times 12 = 1,04 \text{ m.} \quad b_{20} = 1,04 - 2 \times 0,0185 = 1,003 \text{ m.} \)

3. \( \text{\#} \quad b_3 = 0,50 + 0,045 \times 18 = 1,31 \text{ m.} \quad b_{30} = 1,31 - 2 \times 0,0197 = 1,2706 \text{ m.} \)

7) **EK YERLERİNDeki MOMENT :** (DIREĞE RÜZGAR MOMENTİ 5.20 den ALINMIŞTIR.)

**DIKME HESABI VARSAYIM 1'e GÖRE YAPILACAKTIR DANA BÜYÜK MOMENTLER VERDİĞİ İÇİN HESAP DÜZ TERTIBE GÖRE HESAPLANACAKTIR.**

1. **EKTEKİ MOMENT :** \( M_1 = 1265 \text{ kg} \times 6 + 182 \times 3 \text{ (DIREĞE rüzgar kuvveti ) = 8136 kgm.} \)

2. \( \text{\#} \quad M_2 = \text{\#} \times 12 + 182 \times 9 + 177 \times 3 = 17349 \# \)

3. \( \text{\#} \quad M_3 = \text{\#} \times 18 + 182 \times 15 + 177 \times 9 + 204 \times 3 = 27705 \# \)

8) **EK YERLERİNDeki ÇUBUK KUVVETİ :**

\[
S = \frac{M}{2b_o} + \frac{G_o}{L}
\]

1. **EK YERİNDE** \( S_1 = \frac{8136}{2 \times 0,7362} + \frac{695}{4} = 5700 \text{ kg.} \text{ EK tertibi : 4 M14 - LAMA : 60 \times 8} \)

2. \( \text{\#} \quad S_2 = \frac{17349}{2 \times 1,003} + \frac{960}{4} = 8884 \# \quad \text{\#} \quad 4 M15 - \# : 70 \times 8 \)

3. \( \text{\#} \quad S_3 = \frac{27705}{2 \times 1,2706} + \frac{1240}{4} = 11213 \# \quad 5 M15 - \# : 70 \times 8 \)

9) **DIKME FLANBAJ BOYU \((L_{max})\) :**

\[
\lambda = \frac{L}{i_n} \quad ; \quad G = \frac{w \cdot S}{F} \quad (1600)
\]

1. **EKTE PROFİL 60x60x6** \( L_{max} = 134 \text{ cm} \); \( \lambda = \frac{134}{1,82} = 74 \); \( w = 1,47 \quad G = \frac{1,47 \times 5700}{6,91} = 1212 (1600) \)

2. **EKTE PROFİL 65x65x7** \( L_{max} = 124 \text{ cm} \); \( \lambda = \frac{124}{1,96} = 64 \); \( w = 1,34 \quad G = \frac{1,34 \times 8884}{8,7} = 1368 (1600) \)

3. **EKTE PROFİL 70x70x7** \( L_{max} = 122 \text{ cm} \); \( \lambda = \frac{122}{2,12} = 58 \); \( w = 1,28 \quad G = \frac{1,28 \times 1213}{9,4} = 1527 (1600) \)
ÇAPRAZ HESABI:  (VARSAYIM 2’ye GÖRE)

EN UZUN TRAVERSİN C MESAFESİ : \( L = 0,1/2 = 1,95 \text{ m.} \)

Z KUVVETİ \( 552 \text{ kg} \times 0,75 = 412 \text{ kg.} \)

\( B_e = 0,50 \text{ m.} \)

\[ Q_{\text{max}} = \frac{Z \times C}{2B_o} + \frac{Z}{2} = \frac{412}{2 \times 0,5} \times 1,95 \text{ m.} \times \frac{412}{2} = 1034 \text{ kg.} \]

TRAVERS ALTINDAKİ (2) NO.ĽU ÇAPRAZIN HESABI:

\( d = 80 \text{ cm.} \quad B_o = 54 \text{ cm.} \quad Q = Q_{\text{max}} = \frac{B_e}{B_o} = \frac{1034 \times 0,60}{0,54} = 958 \text{ kg.} \)

\[ D = Q \times \frac{d}{B_o} = 958 \times \frac{80}{54} = 1419 \text{ kg.} \]

\[ \lambda = \frac{D}{l_n} = \frac{103}{0,78} = 131 \quad \omega = 1,96 \quad \zeta = \frac{w 	imes D}{F} = \frac{1,96 	imes 1419}{3,08} = 903 \times 1600 \text{ kg/cm}^2 \]

1. EKTEKİ 9 NO.ĽU ÇAPRAZIN HESABI:

\( d = 94 \text{ cm.} \quad B_o = 77 \text{ cm.} \quad Q = 1034 \times \frac{50}{77} = 672 \text{ kg.} \quad D = 672 \times \frac{94}{77} = 820 \text{ kg.} \)

\[ \lambda = \frac{94}{0,78} = 121 \quad \omega = 2,47 \quad \zeta = \frac{2,47 \times 820}{3,08} = 658 \times 1600 \text{ kg/cm}^2 \]

2. EKTEKİ 18 NO.ĽU ÇAPRAZIN HESABI:

\( d = 112 \text{ cm.} \quad B_o = 104 \text{ cm.} \quad Q = 1034 \times \frac{50}{104} = 498 \text{ kg.} \quad D = 498 \times \frac{112}{104} = 536 \text{ kg.} \)

\[ \lambda = \frac{112}{0,78} = 144 \quad \omega = 3,5 \quad \zeta = \frac{536 \times 3,5}{3,08} = 609 \times 1600 \]

3. EKTEKİ 28 NO.ĽU ÇAPRAZIN HESABI:

\( d = 137 \text{ cm.} \quad B_o = 131 \text{ cm.} \quad Q = 1034 \times \frac{50}{131} = 395 \text{ kg.} \quad D = 395 \text{ kg} \times \frac{137}{131} = 413 \text{ kg.} \)

\[ \lambda = \frac{137}{0,78} = 176 \quad \omega = 5,23 \quad \zeta = \frac{5,23 \times 4,13}{3,08} = 701 \times 1600 \]


(D) DIREÇİNİN KÖSEDE DURDURUCU OLARAK KULLANILMASI HESABI:

AŞAĞIDAKİ HESAPLARDAN GÖRÜLECEĞİ ÜZERE EN GAYRİ MÜSAİT DURUM
BİR TARAF TAKİ İLETKENLERİN %75 İ KOPMASI NALİ OLAN VORSAYIM - 1'a GÖRE
HESAP YAPILACAĞTIR. AYRICA DIREÇE RÜZGAR KUVVETİ ALINACAĞTIR.

\[ P_x = 3 \max \cos (90 - \alpha/2) - 0,25 \max (90 - \alpha/2) \]
\[ P_y = 3 \max \cos \alpha/2 + 0,25 \max \cos \alpha/2 \]
\[ P_y = 1,25 \times 3 \max \cos \alpha/2 \]

BU İKİ KUVVETİN DİKMEDE DOŞURCarlos ÇUBUK KUVVETİ TOPLANIQİNDAN

\[ Q = 3 \max (0,75 \sin \alpha/2 + 1,25 \cos \alpha/2) \] BULUNUR.
\[ Q/3 \max = 0,95 \sin \alpha/2 + 1,25 \cos \alpha/2 \]

DIREÇİN DAYANABILECEĞİ Q KUVVETİ HESAP EDİLİRSE BİLİNMEYEN \( \alpha \) DEĞERİ BULUNA-
BILİR.

Şimdi her bölümnun dayanabileceği max. Q tepe kuvvetini bulalim.

1. BÖLÜMDE: L = 134 cm; \( \lambda = 134/1,82 = 74 \); \( \omega = 1,47 \); \( 1600 = \sqrt{679} \)
\[ S_1 = 7521 \text{ kg}; \ S_1 = 7521 \text{ kg} = \frac{M_1}{2x0,7302} + \frac{695}{4} \]
\[ M_1 = 10917 \text{ kg} = Q_1 \times 6 + 177 \times 3 \]
\[ Q_1 = 1714 \text{ kg} \]
\[ Q_1/\max = 1714/1686 = 1,014 \]
\[ Q_1 = 154^\circ \] BULUNUR.

D-14 TİPİ: L = 124 cm; \( \lambda = 124/1,96 = 63 \); \( \omega = 1,33 \); \( 1600 = \frac{133+52}{8,7} \)
\[ b_o = 0,50+12,2x0,045-0,037 \]
\[ b_o = 1,012 \text{ m} \]
\[ S_2 = 10466 \text{ kg}; \ 10466 = \frac{M_2}{2x1,012} + \frac{940}{4} \]
\[ M_2 = 20708 \text{ kgm} \]
\[ 20708 = Q_2 \times 122 + 157 \times 9,2 + 177 \times 3,2 \]
\[ Q_2 = 1532 \text{ kg} \]
\[ Q_2/\max = 1532/1686 = 0,908 \]
\[ Q_2 = 155^\circ \] BULUNUR.

D-20 TİPİ: L = 122 cm; \( \lambda = 122/2,12 = 58 \); \( \omega = 1,28 \); \( 1600 = \frac{128+53}{9,6} \)
\[ b_o = 0,50+18,2x0,045-0,0394 \]
\[ b_o = 1,2796 \text{ m} \]
\[ S_2 = 11750 \text{ kg}; \ 11750 = \frac{M_2}{2x1,2796} + \frac{1240}{4} \]
\[ M_2 = 29071 \text{ kgm} \]
\[ 29071 = Q_3 \times 18,2 + 182 \times 15,2 + 177 \times 9,2 + 204 \times 3,1 \]
\[ Q_3 = 1390 \]
\[ Q_3/\max = 1375/1686 = 0,8155 \]
\[ Q_3 = 174^\circ \] BULUNUR.

D-12: L = 124 S = 10 466 kg; \( b_o = 0,50+10,2x0,045-0,037 \)
\[ S = 10466 = \frac{M}{2x0,922} + 870 / 4; \ M = 18998 \text{ kgm} \]
\[ 18998 = Q \times 10,2 + 7,2 \times 6 + 177 + \frac{9,2 \times 2,1}{4}; \ Q = 1771 \]
\[ Q/\max = 1771/1686 = 1,018; \ \alpha = 154^\circ \]

D-16: L = 122 S = 11 750; \( b_o = 0,50+0,045 \times 16,2-0,0394 \)
\[ S = 11750 = \frac{M}{2x1,1966} + 760 + 475 / 4; \ M = 27200 \text{ kgm} \]
\[ 27200 = Q \times 15,2 + 157 \times 11,4 + 177 \times 3,5 + 2,1 \times 76; \ Q = 1578 \]
\[ Q/\max = 0,936; \ \alpha = 162^\circ \]

D-18: L = 122 S = 11750; \( b_o = 0,5 + 0,045 + 15,2 - 0,0394 \)
\[ 11750 = \frac{M}{2x1,1966} + 760 + 475 / 4; \ M = 27200 \text{ kgm} \]
\[ 27220 = Q \times 15,2 + 157 \times 13,2 + 177 \times 7,2 + 2,1 \times 143; \ Q = 1455 \]
\[ Q/\max = 1655; \ \alpha = 1686 = 0,06; \ \alpha = 170^\circ \]

D-10: L = 126 S = 10 466; \( b_o = 0,5 + 8,2 \times 0,045 \)
\[ S = 10466 = \frac{M}{2x0,045 + 745 / 4; \ M = 17463 \text{ kgm} \]
\[ 17463 = Q \times 6,2 + 157 \times 4,2 + 36 \times 0,6; \ Q = 2065 \]
\[ Q/\max = 2046/1666 = 1,2; \ \alpha = 130^\circ \]
(D) DİREĞİNİN KÖŞEDE TAŞIYICI OLARAK KULLANILMASI HESABI

D-16 TIPI DIREK İÇİN:

DIREĞE RÜZGAR KUVVETİ:

1. BÖLMÜ - DİKME : 6 m. x 2 x 0,06 x 55 x 2,8 = 111 kg.

ÇAPRAZ : 7,4 x 0,04 x 55 x 2,8 = 46 ii

157 kg.

2. BÖLMÜ - DİKME : 6 m. x 2 x 0,065 x 55 x 2,8 = 120 kg.

ÇAPRAZ : 9,3 m. x 0,04 x 55 x 2,8 = 57 ii

177 kg.

3. BÖLMÜ - DİKME : 2,5 m. x 2 x 0,07 x 28 x 5 = 54 kg.

ÇAPRAZ : 2,5 m. x 0,04 x 55 x 2,8 = 22 ii

76 kg.

DIREĞİN NET TEPE KUVVETİ (Q)

L = 122 cm.; \( \gamma = \frac{122}{2,12} \approx 58 \) \( \omega = 1,28 \) \( S = \frac{1600 \times 9,4}{1,28} = 11750 \) kg.

\( G/4 = (475 + 600)/4 = 269 \) kg.

\( b_o = (0,5 + 0,065 \times 14,5) - 2 \times 0,0197 = 1,1131 \)

\( M = 2 b_o ( \frac{5 - \frac{6}{4}}{4}) = 2 \times 1,1131 (11750 - 269) = 25.559 \) kgm.

\( Q' = M/14,5 = 25.559/14,5 = 1753 \) kg.

İZOLATÖR UCUNA İNDİRGENMİŞ Q = 1791 x 14,5/14,85 = 1749 kg.

DIREĞE RÜZGAR KUVVETİ DÜSÜLDÜKTEN SONRA DIREK TEPE KUVVETİ:

\( P_w' = 1753 - (\frac{157 \times 11,5}{14,5} + \frac{177 \times 55}{14,5} + \frac{176 \times 1,25}{14,5} + 6) = 1550 \) kg.

BU KUVVETİ İZOLATÖR UCUNA İNDİRİLEDİĞİMİZDE

\( P_w = 1550 \times \frac{14,5}{14,85} = 1513 \) kg.

KÖŞEDE TAŞIYICI OLARAK KULLANMA AÇISI:

\( G = 1513 = 2 x 3 x 562 x \cos \alpha/2 \quad \cos \alpha/2 = 0,449 \quad \alpha = 127^\circ \)

8° İLETKENIN SĂLINIM AÇISI İLAVE EDİLDİĞİNDE \( \alpha = 135^\circ \) BULUNUR

DÜZ HATTA \( \sigma_w \) DEĞERİ:

\( \sigma_w = \frac{1513/1.6016 - 60}{0,5} = 1442 \) m.
D-20 TIPI DİREK İÇİN:

DİREĞE RÜZGAR KUVVETİ

1. BÖLÜM - DİKME : 2 x 3,2 x 0,06 x 70 x 2,8 = 76 kg.
   ÇAPRAZ : 4 x 0,04 x 70 x 2,8 = 32 //
   DİKME : 2 x 2,8 x 0,06 x 55 x 2,8 = 52 //
   ÇAPRAZ : 3,5 x 0,04 x 55 x 2,8 = 22 //
   \[182\] kg.

2. BÖLÜM - DİKME : 2 x 6 x 0,065 x 55 x 2,8 = 120 kg.
   ÇAPRAZ : 9,24 x 0,04 x 55 x 2,8 = 57 //
   \[177\] kg.

3. BÖLÜM - DİKME : 2 x 6 x 0,07 x 55 x 2,8 = 130 //
   ÇAPRAZ : 12 x 0,04 x 55 x 2,8 = 74 //
   \[204\] kg.

DİREGİN NET TEPE KUVVETİ (Q)

\[
L = 122 \text{ cm.} ; \quad \lambda = \frac{122}{2,12} = 58 ; \quad \omega = 1,28 ; \quad \omega = \frac{1600 \times 9,6}{1,28} = 11750 \text{ kg.}
\]
\[
M = 2 b_o \left( 5 - 6/4 \right) ; \quad G/4 = \frac{800 + 475}{4} = 319 \text{ kg.}
\]
\[
b_o = ( 0,5 + 0,045 \times 18 ) - 2 \times 0,0197 = 1,2706 \text{ m.}
\]
\[
M = 2 \times 1,2706 \times ( 11750 - 319 ) = 29,049 \text{ kgm.}
\]
\[
G' = 29,049 / 18 = 1613 \text{ kg.}
\]

İZOLATÖR TEPESİNE İNDİRGENMİŞ Q = 1613 x \(18/18,25\) = 1583 kg.

DİREĞE RÜZGAR KUVVETİ DÜŞÜLDÜKтен SONRA DIREK TEPE KUVVETİ

\[
P'_w = 1613 - \left( -\frac{182}{18} \times 15 + \frac{177 \times 9}{18} + \frac{204 \times 3}{18} + 5 \right) = 1332 \text{ kg.}
\]

İZOLATÖR UCUNA İNDİRGENMİŞ TEPE KUVVETİ:

\[
P_w = 1332 \times \frac{18}{18,35} = 1306 \text{ kg.}
\]

KÖSEDE TAŞYICILAR OLARAK KULLANILMA AÇISI

\[
1306 = 2 \times 3 \times 562 = \cos \alpha_2 / 2 ; \quad \alpha = 135^\circ
\]

İLETKEN SALINIMDAN DOLAYI \(\alpha = 143^\circ\) BULUNUR

DÜZ NATTA \(q_w\) DEĞERİ

\[
q_w = (1308/1,929 - 80) / 0,6 = 996 \text{ m.}
\]
DURDURUCU TRAVERSLERİN HESABI.

ZİNCİR İZOLATÖRLÜ DURDURUCU TRAVERSLER BUZSUZ AĞIRLIKLAR ve İLETKENİN KÖPMAŞI HALİNDE Max. CER KUVVETİ İLE HESAP EDİLECEKTİR.

D-400 TİPİ İÇİN

BUZSUZ AĞIRLIKLAR (Bir iletken için) G:

İLETKEN AĞIRLIĞI : \( a_g \times p \) kg.
IZOLATÖR : \( 2 \times 20 \) kg. : 40
MONTÖR : \( 100/2 \) : 50
TRAVERS : \( 60/4 \) : 15

\[ G = a_g \times P + 105 \text{ kg.} \]

PAYANDANIN HESABI :  A NOKTASININ KONTROLUNU YAPALIM.

\[ l = 1.20 \text{ m.} ; \quad b_0 = 0.6 \times \frac{1.20}{1.65} = 0.435 \quad ; \quad b' = \frac{0.5 - 0.15}{(2 - 0.25 - 0.04)} \times 1.2 + 0.15 = 0.396 \]

\[ G_0 = \frac{6.6}{b_0 \cos \alpha_1} = \frac{6 \times 1.2}{2 \times 0.436 \times 0.97} = 1.418 \text{ g} = 1.418 (a_g \cdot P + 105) \]

Z ÇEKME KUVVETİNDEN DOLAVI \( S_2 \) KUVVETİ

\[ S_2 = \frac{2.6}{b' \cos \alpha_2} = \frac{562 \times 1.2}{2 \times 0.396 \times 0.99} = 860 \text{ kg.} \]

\[ S_1 = S_1 + S_2 = 1.418 (a_g \cdot P + 105) + 860 \text{ kg.} \]

\[ d = 110 \text{ cm} ; \quad \text{PAYANDA} 40 \times 40 \times 4 \text{ OLMASI HALİNDE} \quad \lambda = \frac{110}{0.78} = 141 ; \quad \omega = 3.35 \]

\[ \lambda = \frac{110}{0.99} = 112 ; \quad \omega = 2.18 \]
PAYANDA 40 x 40 x 4 OLMASI HALINDE \( \lambda = \frac{110}{0.77} = 143 \); \( w = 3.45 \)

**PAYANDA 40 x 40 x 4**

\[ \sigma = 1600 \times \frac{S \times w}{F} = \frac{[1.418 \text{ (ag. P + 105)} + 860]}{3.08} = 3.36 \]

\( 4928 = 4.764 \text{ ag. P} + 3390 \); \( 4.764 \text{ ag. P} = 1536 \); \( \text{ag} = \frac{222}{P} \)

\( P = 0.2152 \text{ kg/m. OLDUĞUNDAN ag} = 1.493 \text{ m. BULUNUR} \)

**PAYANDA 40 x 40 x 5**

\[ \sigma = 1600 \times \frac{S \times w}{F} = \frac{[1.418 \text{ (ag. P + 105)} + 860]}{3.79} = 3.65 \]

\( 6064 = 4.892 \text{ ag. P} + 3481 \); \( 4.892 \text{ ag. P} = 2583 \); \( \text{ag} = \frac{528}{P} \)

\( P = 0.2152 \text{ kg/m. OLDUĞUNDAN ag} = 2442 \text{ m. BULUNUR} \)

**PAYANDA - DİREK İRTİBAT ÇİVATASININ HESABI:**

ÇİVATA YERİNDE VANİ (B) NOKTASINDA \( S = S_1 + S_2 \) KUVVETİNİ HESAP ETMEMİZ LAZIMDIR.

\( \ell = 1.71 \text{ m.}; \ b_o = 0.60 \text{ m.}; \ b'_o = 0.50 \text{ m.} \) ALINMİŞTIR.

\[ S_1 = \frac{G \times \ell}{2b_o \cos \alpha_1} = \frac{G 	imes 1.71}{2 \times 0.5 \times 0.97} = 1.469 \text{ G} = 1.469 \text{ (ag. P + 105)} = 1.469 \text{ ag. P} + 154 \]

\[ S_2 = \frac{Z \times \ell}{2b_o \cos \alpha_2} = \frac{562 \times 1.71}{1 \times 0.99} = 971 \text{ kg} \]

\[ S_1 + S_2 = S = 1.469 \text{ g} \cdot P + 1124 \]

**PAYANDANIN 40 x 40 x 4 OLMASI HALINDE M_{12} KULLANILABİLİR**

\[ \sigma_k = \frac{S}{f_g} = 1270 = \frac{1.469 \text{ g} \cdot P + 1124}{1.131} \]; \( 1436 = 1.469 \text{ g} \cdot P + 1124 \)

\[ g = \frac{1.435 - 1124}{1.469 / P} = 212 / P \]

\( P = 0.2152 \text{ kg/m. OLDUĞUNDAN g} = 982 \text{ m. BULUNUR} \)

\[ \sigma_E = \frac{2500}{n \cdot d_t} = \frac{1.469 \text{ g} \cdot P + 1124}{1 \times 0.4 \times 1.2} \]; \( 1200 = 1.469 \text{ g} \cdot P + 1124 \)

\[ \text{ag} = \frac{S_1}{P} \]; \( P = 0.2152 \text{ kg/m. OLDUĞUNDAN ag} = 239 \text{ m. BULUNUR} \)
PAYANDANIN $40 \times 40 \times 5$ ve $50 \times 50 \times 5$ OLMASI HALİNDE M-14 KULLANILABILİR.

$$
\sigma_k = \frac{S}{n.f_s} = 1270 = \frac{1,469 \text{ g} \cdot P + 1124}{1,536} ; \quad 1950 = 1,469 \text{ g} P_0 + 1124
$$

$g_0 = 562 / P_0 ; \quad P_0 = 0,2162 \text{ kg/m. OLDUĞUNDAN} \quad g = 2600 \text{ m. BULUNUR.}$

$$
\sigma_e = 2500 = \frac{S}{n.d.f} = \frac{1,469 \text{ g} \cdot P + 1124}{1 \times 0,5 \times 1,4} ; \quad 1750 = 1,469 \text{ g} P + 1124
$$

$g = 438 / P \quad P = 0,2162 \text{ kg/m. OLDUĞUNDAN} \quad g = 2025 \text{ m. BULUNUR.}$

NETİCE : PAYANDA VE İRTİBAT ÇİVATASI M12 HALİNDE $a_g = 239 \text{ m. BULUNUR.}$

M14 $\quad a_g = 2025 \text{ m. BULUNUR.}$

TRIVERS ÜST ÇUBUĞUNUN HESABI

TRIVERS ÜST ÇUBUK ÇEKMEVE ÇALIŞACAKTIR (S) ÇUBUK KUVVETİ YUKARIDA İZAH EDİLDİĞİ ÜZERE $S = S_1 + S_2$ dir (C) NOKTASINDAKI S KUVVETİ (B) NOKTASINDA DAHA EVVEL HESAP EDİLEN S KUVVETİNE EŞİT ALINABILİR

$S = 1,469 \text{ g} \cdot P + 1124 \text{ BULUNMUŞTUR}

ÇEKME GERİLMESİ

$$
\sigma = 1600 = \frac{S}{F} = \frac{1,469 \text{ g} \cdot P + 1124}{F} \text{ BULUNUR}
$$

ÜST ÇUBUK $40 \times 40 \times 4$ OLMASI HALİNDE

$$
\sigma = 1600 = \frac{1,469 \text{ g} \cdot P + 1124}{3,08}
$$

$$
4928 = 1,469 \text{ g} \cdot P + 1124 ; \quad g = \frac{2589}{P}
$$

$P = 0,2162 \text{ kg/m. OLDUĞUNDAN} \quad g = 11977 \text{ m. BULUNUR.}$

TRIVERS ÇAPRAZLARININ HESABI

1. NO. LU DÜŞEY ÇAPRAZ $G_0$ DÜŞEY AĞIRLIKTA HESAP EDILECEKTIR.

$d (Çapraz boyu) = 80 \text{ cm} ; \quad b_0 = 50 \text{ cm.}$

$G = a_g \cdot P + 105 \text{ kg. BULUNMUŞTU}$

ÇAPRAZ KUVVETİ

$$
D = 6 \times \frac{d}{b_0} = (a_g \cdot P + 105) \times \frac{80}{50} = 1,6 a_g \cdot P + 168
$$

ÇAPRAZ $40 \times 40 \times 4$ OLMASI HALİNDE

$$
\lambda = \frac{80}{0,78} = 103 \quad \omega = 1,96
$$
\[ \varphi = \frac{1600 \times D \times w}{F} = \frac{(1.5 \times \text{ag} \cdot \text{P} + 168) \times 1.95}{3.08} \]

\[ 4928 = -3.136 \times \text{ag} \cdot \text{P} + 329 \]

\[ \text{ag} = \frac{1571}{\text{P}} \]

\[ \text{P} = 0,2162 \text{ kg/m. OLDUĞUNDAN ag} = 7255 \text{ m. BULUNUR.} \]

\[ \text{ag} = 400 \text{ m. HALİNDE } D = 1.6 \times \text{P} \times \text{g} + 168 = 1.6 \times 0.2162 \times 400 + 168 = 307 \text{ kg.} \]

**M 12 HALİNDE:**

\[ \varphi_k = \frac{D}{1.181} = \frac{307}{1.181} = 272 \times 1270 \]

\[ \varphi_e = \frac{D}{0.4 \times 1.2} = \frac{307}{0.48} = 640 \times 2500 \]
1) **SON DIREĞİ YÜKLENME KOŞULLARI:**

<table>
<thead>
<tr>
<th>VARSAYIM - 1</th>
<th>VARSAYIM - 2</th>
<th>VARSAYIM - 3</th>
</tr>
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<tbody>
<tr>
<td>( q_0 )</td>
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<td>( T_{\text{max}} )</td>
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İLETKENİN Max. CER KUVVETİ + BUZSUZ AĞIRLIKLAR + HAT İSTİKA-METİNDE DIREĞE RÜZGAR KUV- VETİ

UC'TAKİ BİR İLETKENİN KOPMASI ve BUZSUZ AĞIRLIKLAR

HAT DOĞRULTUSUNA DİK RÜZGAR ve +5°C de RÜZGAR ÇEKME KUVVETİ + BUZSUZ AĞIRLIKLAR

2) **SON DIREĞ HESAP DEĞERLERİ:**

\( a_g = 400 \text{ m} \)

İZOLATÖR CİNSİ: ZİNCİR ve MESNET OLMAK ÜZERE VARIYANLı

DIREĞ BOY KADEMELERİ: N-10, N-12, N-14, N-16, N-18, N-20

TEPE GENİŞLİĞİ: 0,50 m. KALINLAŞMA: 0,06 m/m.

TEMEL DERİNLİĞİ: 1,8 m. DİREĞİN TEMELE GİREN KİSMİ: 1,7 m.

3) **3 İLETKENİN Max. ÇERRİ:**

\[ z = 3 \times 561,95 = 1685 \text{ kg} \]

5) **BUZSUZ AĞIRLIKLAR:**

3 İLETKEN İZOLATÖR MONTÖR ve TRAVERSİN BUZLU AĞIRLIĞI (Soyfa:7'den) = 475 kg.

1. \( \text{EK'e KADAR} : 475 \text{ kg} + \text{DİREĞ AĞIRLIĞI} (250 \text{ kg}) = 725 \)

2. \( \text{# # #} + \text{#} + \text{#} (500 \text{ kg}) = 975 \)

3. \( \text{# # #} + \text{#} + \text{#} (600 \text{ kg}) = 1275 \)

6) **DİREĞİN EK YERLERİNE DİREĞ GENİŞLİĞİ:**

1. \( \text{EK'te} - b_1 = 0,5 + 0,06 = 6 = 0,85 \text{ m} ; \ b_{b1} = 0,86 - 2 \times 0,0159 = 0,8252 \text{ m} \)

2. \( \text{# - b}_2 = 0,5 + 0,06 = 12 = 1,22 \text{ m} ; \ b_{b2} = 1,22 - 2 \times 0,0183 = 1,183 \text{ m} \)

3. \( \text{# - b}_3 = 0,5 + 0,06 = 18 = 1,50 \text{ m} ; \ b_{b3} = 1,58 - 2 \times 0,0225 = 1,5348 \text{ m} \)

7) **EK YERLERİNDeki MOMENT:** DİKME NESABİ VARSAYIM -1'e GÖRE YAPILACAK-

TIR. DAHA BÜYÜK MOMENTLER VERDİĞİ İÇİN HESAP DÜZ TERTİBE VE MESNET İZOLATÖRE GÖRE YAPILACAKTIR. S.23 teki RÜZGAR KUVVETLERİNİN MOMENTLERİNE TOPLANACAKTIR.
I/34

1. EK YEＲİＮＤEKİ MOMENT : \( M_1 = 1686 \times 6 + 195 \times 3 = 10701 \text{ kgm} \)

2. \( M_2 = 12 \times 195 + 9 \times 191 \times 3 = 22550 \)

3. \( M_3 = 18 \times 195 + 15 \times 191 + 9 \times 209 \times 3 = 35629 \)

8) EK YERLERİNDEKİ CUBUK KUVVETİ:

\[ S = \frac{M}{2b_o} + \frac{6a}{L} \]

1. EK VERİNDE : \( S_1 = \frac{10701}{2 \times 0.8252} + \frac{192}{4} = 6658 \text{ kg} - \text{EK CİVATASI: 4 M 16 - EK LAMASI 60 x 8} \)

2. \( S_2 = \frac{22550}{2 \times 1.183} + \frac{224}{4} = 9779 \text{ kg} - \text{EK CİVATASI: 4 M 16 - EK LAMASI 65 x 8} \)

3. \( S_3 = \frac{35629}{2 \times 1.5348} + \frac{319}{4} = 11926 \text{ kg} - \text{EK CİVATASI: 6 M 16 - EK LAMASI 70 x 10} \)

9) DİKME Max FLAMBAJ BOYU:

\( \lambda = \frac{L}{l_x} \)

\( \zeta = \frac{w \cdot S}{F} \) (1600)

1. EK'te: PROFİL 60 x 60 x 6 - \( L_{\text{max}} = 121 \text{ cm} \)

\( \lambda = \frac{120}{182} = 67 \text{ cm} \)

\( \xi = \frac{1.33 \times 6658}{5,91} = 1282 \text{ cm} \)

2. \( 55 \times 55 \times 7 - L_{\text{max}} = 109 \text{ cm} \)

\( \lambda = \frac{109}{190} = 56 \text{ cm} \)

\( \xi = \frac{1.26 \times 9779}{6,7} = 1415 \text{ cm} \)

3. \( 80 \times 80 \times 8 - L_{\text{max}} = 191 \text{ cm} \)

\( \lambda = \frac{191}{2,42} = 79 \text{ cm} \)

\( \xi = \frac{1.54 \times 11926}{12,3} = 1493 \text{ cm} \)

10) ÇAPRAZ HESABI:

EN UZUN TRAVERSTE C MESAFEŞİ 4 m - 0,1/2 = 1,95 m (Şekil: den) BAKINIZ

Z KUVVETİ : 562 kg ; \( B_a = 0,50 \text{ m} \)

\( Q_{\text{max}} = \frac{Z \times C}{2 B_a} + \frac{Z}{2} \) (2x0,50

\( 2 = 1377 \text{ kg} \)

TRAVERS ALTINDAKİ 2 NO. LU ÇAPRAZIN HESABI:

\( d = 72 \text{ cm} ; B = 55 \text{ cm} \)

\( Q \times Q_{\text{max}} = \frac{801}{B_a} = 1377 \times \frac{50}{55} = 1252 \text{ kg} \)

\( d = 1252 \times \frac{72}{95} = 1639 \text{ kg} \)

ÇAPRAZ : 40 x 40 x 4 ; \( \lambda = \frac{72}{0.78} = 93 \text{ cm} \)

\( \xi = \frac{Q \times D}{F} = \frac{1.76 \times 1639}{3,08} = 936 \text{ (1600) cm} \)

1. EK'teki 10 NO. LU ÇAPRAZIN HESABI:

\( d = 102 \text{ cm} ; B_a = 86 \text{ cm} \)

\( Q = 1377 \times \frac{50}{86} = 801 \text{ kg} \)

\( D = 1252 \times \frac{102}{85} = 950 \text{ kg} \)

ÇAPRAZ : 40 x 40 x 4 ; \( \lambda = \frac{102}{0.78} = 131 \text{ cm} \)

\( \xi = \frac{Q \times D}{F} = \frac{2,90 \times 950}{3,08} = 894 \text{ (1600) cm} \)

2. EK'teki 22 NO. LU ÇAPRAZIN HESABI:

\( d = 130 \text{ cm} ; B_a = 122 \text{ cm} \)

\( Q = 1377 \times \frac{50}{122} = 555 \text{ kg} \)

\( D = 1252 \times \frac{130}{122} = 502 \text{ kg} \)

ÇAPRAZ : 40 x 40 x 4 ; \( \lambda = \frac{130}{0.78} = 167 \text{ cm} \)

\( \xi = \frac{Q \times D}{F} = \frac{4,71 \times 502}{3,08} = 920 \text{ (1600) cm} \)

3. EK'teki 29 NO. LU ÇAPRAZIN HESABI:

\( d = 172 \text{ cm} ; B_a = 158 \text{ cm} \)

\( Q = 1377 \times \frac{50}{158} = 436 \text{ kg} \)

\( D = \frac{172}{158} \times 436 = 475 \text{ kg} \)

ÇAPRAZ : 40 x 40 x 4 ; \( \lambda = \frac{172}{0.78} = 220 \text{ cm} \)

\( \xi = \frac{8,77 \times 475}{3,08} = 1259 \text{ (1600) cm} \)
VARSAVİM - 2 : TRAVERS HESABI (D) DİREKTE BU VARSAVIMA, GÖRE YAPILMISTIR.

N - 20 DİРЕĞINE RÜZGAR KUVVETİ:

DİРЕĞE RÜZGAR KUVVETİ :

1. BÖLÜM - DİKME - 2 x 3,2 x 0,06 x 70 x 2,8 = 75,26
   ÇAPRAZ - 5,52 x 0,06 x 70 x 2,8 = 44.06
   DİKME - 2 x 2,8 x 0,05 x 55 x 2,8 = 51,74
   ÇAPRAZ - 3,84 x 0,04 x 55 x 2,8 = 23,65
   \[ \frac{195 \text{ kg}}{191 \text{ kg}} \]

2. BÖLÜM - DİKME - 2 x 6 x 0,06 x 55 x 2,8 = 120,12
   ÇAPRAZ - 11,42 x 0,04 x 55 x 2,8 = 70,35
   \[ \frac{191 \text{ kg}}{209 \text{ kg}} \]

3. BÖLÜM - DİKME - 2 x 6 x 0,08 x 55 x 2,8 = 147,94
   ÇAPRAZ - 9,62 x 0,04 x 55 x 2,8 = 60,69
   \[ \frac{209 \text{ kg}}{} \]

(N) DİРЕĞİNİN KÖŞEDE DURDURUCU OLARAK KULLANILMASI HESABI:

(D) DİРЕĞİNDE YAPILDIĞI GİBİ HER BÖLÜMÜN DAYANACAĞI MAX TEPE KUVVETİNİ BULALIM

1. BÖLÜMDE
   \[ L = 120 \quad \lambda = 67 \quad w = 1,33 \quad 1500 = \frac{1,33 \times S_1}{5,91} \]
   \[ S_1 = 8313 \text{ kg} = \frac{M_1}{2 \times 0,8252} + \frac{725}{4} \quad M_1 = 13437 \text{ kg.m.} \]

   \[ M_1 = 13437 = G_1 \times 5 + 3 \times 195 \quad G_1 = 2142 \text{ kg.} \]

   \[ \frac{Q}{T_{max}} = 2142 / 1686 = 1,27 \quad \alpha = 122^\circ \]

   \[ N - 16 : \]
   \[ L = 109 \quad \lambda = 56 \quad w = 1.26 \quad 1600 = \frac{1.26 \times S_2}{8,7} \]
   \[ S_2 = 11048 \text{ kg} = \frac{M_2}{2 \times 1954} + \frac{979}{4} \quad M_2 = 25827 \text{ kg.m.} \]

   \[ M_2 = 25827 \quad Q_2 \times 12,2 + 9,2 \times 195 + 3,2 \times 191 \quad Q_2 = 1919 \text{ kg.} \]

   \[ \frac{Q_2}{T_{max}} = 1919 / 1686 = 1,138 \quad \alpha = 140^\circ \]

   \[ N - 20 : \]
   \[ L = 191 \quad \lambda = 79 \quad w = 1,54 \quad G = \frac{1.54 \times S_3}{12,3} \]
   \[ S_3 = 12779 = \frac{M_3}{2 \times 1,5582} + \frac{1275}{4} \quad M_3 = 38830 \text{ kg.m.} \]

   \[ M_3 = 38830 \quad Q_3 \times 18,2 + 15,2 \times 195 + 9,2 \times 191 + 3,2 \times 209 \quad Q_3 = 1837 \text{ kg.} \]

   \[ \frac{Q_3}{T_{max}} = 1837 / 1686 = 1,089 \quad \alpha = 146^\circ \]

N - 10 TİPİ
   \[ L = 109 \quad S_2 = 11048 \quad b_o = 0,9554 \quad S_2 = 11048 = M / 2 x 0,9554 + 903 / 4 \]
   \[ M = 20725 = 8,2A + 8,2 x 195 + 35 x 2,2 \quad 2333 \quad Q/P = 2333 / 1686 = 1,38 \quad \alpha = 100^\circ \]

N - 12
   \[ L = 109 \quad S = 11048 \quad b_o = 1,0754 \quad S_2 = 11048 = M / 2 x 1,0754 + 875 / 4 \]

N - 15
   \[ L = 191 \quad S_3 = 12779 \quad b_o = 1,0754 \quad S_3 = 12779 = M / 2 x 1,0754 + 1075 / 4 \]

N - 18
   \[ L = 191 \quad S_3 = 12779 \quad b_o = 1,4268 \quad S_3 = 12779 = M / 2 x 1,4268 + 1311 / 4 \]

   \[ M = 35668 = Q_{x15,2} + 13,2 \times 195 + 7,2 \times 191 + 147 \times 2,1 \quad Q = 1938 \]
   \[ Q/P = 1938 / 1686 = 1,149 \quad \alpha = 138^\circ \]
(Z) ZAVİYE DİREĞİ HESABI.

1) ZAVİYE DİREĞİ HESAP KOSULU:

**90° YE KADAR KULLANABİLECEK:** BİR ZAVİYE DİREĞİ PROJELENİRİLECEKTİR

**DAHA BÜYÜK AÇILARDA** 3 × 0 İLETKENİN (N) DİREĞİ KULLANILACAKTIR.

**VARSAYIM 1'e GÖRE 90° HALİNDE SAYFA 18 den.**

\[ Q = 3 \cdot T_{\text{max}} \left( 0,75 \sin \frac{90}{2} \pm 1/25 \cos \frac{90}{2} \right) \]

\[ = 3 \cdot T_{\text{max}} \left( 0,75 \times 0,707 + 1,25 \times 0,707 \right) \]

\[ = 1,686 \times 2 \times 0,707 = 2384 \text{ kg. BULUNUR} \]

**VARSAYIM 2'ye GÖRE 90° HALİNDE MAX CER KUVVETINİN BİLEŞKE KUVVETİ**

\[ Q = 3 \cdot T_{\text{max}} \times 2 \cos \frac{90}{2} = 1,686 \times 1,414 = 2384 \text{ kg.} \]

**HER İKİ VARSAYIMDADA 90° DE TEPE KUVVETİ 2384 KG. BULUNDU.**

2) ZAVİYE DİREĞİ HESAP DEĞERLERİ:

\[ \alpha = 400 \text{ m.} \]

**IZOLATÖR CİNSİ:** ŻINCİR

**DIREK BOY KADEMELERİ:** Z-10, Z-12, Z-14, Z-16, Z-18, Z-20

**TEPE GENİŞLİĞİ:** 0,50 m. 

**TEMEL DERİNLİĞİ:** 1,9 m. 

**DIREĞİN TEMELE GİREN KİSMI** 1,80 m.

3) **3 İLETKENİN MAX CERRİ:**

\[ Z = 1,686 \text{ kg. , AYRICA BİLEŞKEYE PARALEL} \]

**OLARAK DIREĞE RÜZGAR KUVVETİ HESABA KATILACAKTIR.**

4) **BUZLU AĞIRLIKLAR:**

**3 İLETKEN, İZOLATÖR, MONTOR VE TRAVERS BUZLU AĞIRLIĞI** (Sayfa: 7' den) = kg.

1. **EK'ye KADAR:** 300 kg ( \( 610 \text{ kg.} \) ) = 

2. **3**: 610 kg ( \( 1040 \text{ kg.} \) ) = 

3. **3**: 1040 kg = 

5) **BUZSUZ AĞIRLIKLAR:**

**3 İLETKEN İZOLATÖR MONTOR VE TRAVERS BUZSUZ AĞIRLIĞI** = 475 kg.

1. **EK'ye KADAR:** 475 kg (300 kg.) = 775 

2. **3**: 1040 kg = 

3. **3**: 1515 

6) **DIREĞİN EK YERINDE DIREK GENİŞLİĞİ:**

1. **EK' te - b₁ = 0,50 + 0,07 \times 5 = 0,92 m ;** 

\[ b_{\text{ej}} = 0,92 - 2 \times 0,0185 = 0,893 \text{ m.} \]

2. **- b₂ = 0,50 + 0,07 \times 12 = 1,34 m ;** 

\[ b_{\text{e2}} = 1,34 - 2 \times 0,0225 = 1,2948 \text{ m.} \]

3. **- b₃ = 0,50 + 0,07 \times 18 = 1,76 m ;** 

\[ b_{\text{e3}} = 1,76 - 2 \times 0,0226 = 1,7148 \text{ m.} \]

7) **EK YERLERİNDİE MOMENT:** DİKME HESABI DAHA BÜYÜK MOMENTLER VERDİĞİ İÇİN DÜZ TERTİBE VE MESNET İZOLATÖRE GÖRE VAPILACAK. RÜZGAR MOMENTİ İLAVE EDİLECEK

1. **EK YERINDE MOMENT:** 

\[ M₁ = 2384 \times 6 + 208 \times 3 = 14,928 \]

2. **3**: 

\[ M₂ = 2384 \times 12 + 208 \times 9 + 179 \times 3 = 31,015 \]

3. **3**: 

\[ M₃ = 2384 \times 18 + 208 \times 15 + 179 \times 9 + 190 \times 3 = 48,213 \]
8) EK YERLERİNDEKİ ÇUBUK KUVVETİ: \[ S = \frac{M}{2b_0} + \frac{g_0}{4} \]

1. EK YERİNDE: \[ S_1 = \frac{14,928}{2 \times 0,983} + \frac{775}{4} = 864,7 \text{ kg} \]

- EK ÇİVATASI: 4 M16 - EK LAMA 65 x 10

2. \[ S_2 = \frac{31,075}{2 \times 1,2948} + \frac{1085}{4} = 12,271 \text{ kg} \]

- 6 x M15 - EK LAMA 80 x 10

3. \[ S_3 = \frac{48,213}{2 \times 1,7148} + \frac{1515}{4} = 14,437 \text{ kg} \]

- EK ÇİVATASI: 6 x M20 - EK LAMA 80 x 10

9) DİKME Max FLAMBAY BOYU (\( L_{\text{max}} \)): \[ \lambda = \frac{L_{\text{max}}}{t_x} \]

1. EK'te PROFİL: \[ 65 \times 65 \times 7 - L_{\text{max}} = 123 \text{ cm} ; \lambda = \frac{123}{1,96} = 63 ; w = 1,33 ; \]

\[ \gamma = \frac{133 \times 9547}{87} = 1221 \text{ (1500)} \]

2. \[ 90 \times 80 \times 8 - L_{\text{max}} = 154 \text{ cm} ; \lambda = \frac{154}{2,42} = 64 ; w = 1,39 ; \]

\[ \gamma = \frac{139 \times 12249}{12,3} = 1384 \text{ (1500)} \]

3. \[ 80 \times 80 \times 10 - L_{\text{max}} = 185 \text{ cm} ; \lambda = \frac{186}{2,41} = 77 ; w = 1,5 ; \]

\[ \gamma = \frac{15 \times 14337}{15,1} = 1346 \text{ (1600)} \]

10) ÇAPRAZ HESABI:

EN UZUN TRAVERSTE C MESAFESİ: \[ 4m - 0,1/2 = 1,95 m \]

Z KUVVETİ \[ B_0 = 0,5 \text{ m} ; \]

\[ Q_{\text{max}} = \frac{Z \times C}{2 \times B_0} + \frac{Z}{2} = \frac{552 \times 1,95}{2 \times 0,5} + \frac{552}{2} = 1377 \text{ kg} \]

TRAVERS ALTINDAKİ (2) NO.LU ÇAPRAZ HESABI:

\[ d = 78 \text{ cm} ; B_0 = 55 \text{ m} ; Q = Q_{\text{max}} \times \frac{B_0}{B_0} = 1377 \times 0,5 = 1252 \text{ kg} \]

\[ D = Q \times \frac{d}{B_0} = 1252 \times \frac{78}{55} = 1776 \text{ kg} ; \lambda = \frac{D}{t_0} = \frac{78}{0,78} = 100 ; w = 1,9 \]

\[ \gamma = \frac{w \times D}{F} = \frac{1,9 \times 1775}{309} = 1095 < 1600 \]

1. EK'teki [10] NO.LU ÇAPRAZ HESABI:

\[ d = 104 \text{ cm} ; B_0 = 92 \text{ cm} ; Q = 1377 \times \frac{0,5}{0,92} = 749 \text{ kg} ; D = 749 \times \frac{104}{92} = 846 \text{ kg} \]

\[ \lambda = \frac{104}{0,78} = 133 ; w = 2,99 ; \gamma = \frac{865 \times 2,99}{3,08} = 822 < 1600 \]

2. EK'teki ( ) NO.LU ÇAPRAZ HESABI:

\[ d = 155 \text{ cm} ; B = 134 \text{ cm} ; Q = 1377 \times \frac{0,5}{1,34} = 514 ; D = 514 \times \frac{155}{134} = 595 \text{ kg} \]

\[ \lambda = \frac{155}{0,78} = 198 ; w = 6,52 ; \gamma = \frac{595 \times 6,52}{3,08} = 1279 < 1600 \]

3. EK'teki (30) NO.LU ÇAPRAZ HESABI:

\[ d = 185 \text{ cm} ; B_0 = 176 \text{ cm} ; Q = 1377 \times \frac{0,5}{1,76} = 392 ; D = 392 \times \frac{185}{1,76} = 412 \text{ kg} \]

\[ \lambda = \frac{185}{0,78} = 237 ; w = 9,49 ; \gamma = \frac{412 \times 9,49}{3,08} = 1257 < 1600 \]
VARSAYIM - 3 : HAT DOĞRUSUNA DİK RÜZGAR KUVVETİ ve +5° de RÜZGARLI ÇEKME KUVVETİ BUZSUZ AŞIRILIKLARA GÖRE HESAP
HATTA PARALEL OLARAK DİREĞE RÜZGAR KUVVETİ

(Z) DİREĞİNE GELEN RÜZGAR KUVVETLERİNİN HESABI:

1. BÖLÜM
   DİKME - 2 x 3,2 x 0,065 x 70 x 2,8 = 82
   ÇAPRAZ - 5,7 x 0,04 x 70 x 2,8 = 45
   DİKME - 2 x 2,8 x 0,065 x 59 x 2,8 = 56
   ÇAPRAZ - 4 x 0,04 x 55 x 2,8 = 25
   \[ \text{Toplam: } 208 \]

2. BÖLÜM
   DİKME - 2 x 6 x 0,065 x 55 x 2,8 = 120
   ÇAPRAZ - 9,57 x 0,04 x 55 x 2,8 = 59
   \[ \text{Toplam: } 179 \]

3. BÖLÜM
   DİKME - 2 x 6 x 0,07 x 55 x 2,8 = 130
   ÇAPRAZ - 9,56 x 0,04 x 55 x 2,8 = 60
   \[ \text{Toplam: } 190 \]
TEMEL SEÇİMİNE ESAS MOMENTLERİN HESABI:

(A) DÖNME NOKTASINA GÖRE MOMENTLER

20 m. lik DIREKLERDE: \( h = 20 - 1,16 = 18,84 \text{ m.} \)

\[
M_n = Q \times h + \omega_1 \left( h - 3 \right) + \omega_2 \left( h - 9 \right) + \omega_3 \left( h - 15 \right) + \omega_4 \left( h - 18,1 \right)
\]

\[
M_n = Q \times 18,84 + \omega_1 \times 15,84 + \omega_2 \times 9,84 + \omega_3 \times 3,84 +
\]

DURDURUCU DIREKLERDE:

\[ Q = 1265 \text{ kg} \ ; \ \omega_1 = 182 \text{ kg} \ ; \ \omega_2 = 177 \text{ kg} \ ; \ \omega_3 = 204 \text{ kg} \]

Z DIREKLERİNE:

\[ Q = 1586 \text{ kg} \ ; \ \omega_1 = 195 \ ; \ \omega_2 = 191 \text{ kg} \ ; \ \omega_3 = 209 \text{ kg} \]

18 m. lik DIREKLERDE:

\[ h = 18 - 1,16 = 16,84 \text{ m.} \]

\[
M_n = Q \times 15,84 + \omega_1 \times 13,84 + \omega_2 \times 7,84 + \omega_3 \times 1,84
\]

D-18 İçIN \( M_n = 1255 \times 15,84 + 182 \times 13,84 + 177 \times 7,84 + 204 \times 1,84 = 25586 \text{ kgm.} \)

N-18 \( M_n = 1685 \times 16,84 + 195 \times 3,84 + 191 \times 7,84 + 209 \times 1,84 = 32967 \text{ kgm.} \)

Z-18 \( M_n = 2384 \times 16,84 + 208 \times 13,84 + 179 \times 7,84 + 190 \times 1,84 = 44780 \text{ kgm.} \)

Z-18 (120° İçin) \( M_n = 2150 \times 15,84 + 208 \times 13,84 + 179 \times 7,84 + 190 \times 1,84 = 41008 \text{ kgm.} \)

16 m. lik DIREKLERDE:

\[
M_n = Q \times 14,84 + \omega_1 \times 11,84 + \omega_2 \times 5,84
\]

D-15 İçIN \( M_n = 1255 \times 14,84 + 182 \times 11,84 + 177 \times 5,84 = 21954 \text{ kgm.} \)

N-15 \( M_n = 1685 \times 14,84 + 195 \times 11,84 + 191 \times 5,84 = 28446 \text{ kgm.} \)

Z-15 \( M_n = 2384 \times 14,84 + 208 \times 11,84 + 179 \times 5,84 = 38888 \text{ kgm.} \)

Z-16 (120° İçin) \( M_n = 2150 \times 14,84 + 208 \times 11,84 + 179 \times 5,84 = 35564 \text{ kgm.} \)
14 m.lik DİREKLERDE: \[ h = 14 - 1,16 = 12,84 \text{ m.} \]

\[
M_n = Q \times 12,84 + w_1 \times 9,84 + w_2 \times 3,84
\]

\[ D-16 \text{ için} \quad M_n = 1265 \times 12,84 + 102 \times 9,84 + 177 \times 3,84 = 18714 \text{ kgm.} \]

\[ N-16 \quad \Rightarrow \quad M_n = 1685 \times 12,84 + 195 \times 9,84 + 191 \times 3,84 = 24302 \text{ kgm.} \]

\[ Z-16 \quad \Rightarrow \quad M_n = 2364 \times 12,84 + 208 \times 9,84 + 179 \times 3,84 = 33346 \text{ kgm.} \]

\[ Z-16 (120^\circ \text{ için}) = 2160 \times 12,84 + 208 \times 9,84 + 179 \times 3,84 = 30470 \text{ kgm.} \]

12 m.lik DİREKLERDE: \[ h = 12 - 1,16 = 10,84 \text{ m.} \]

\[
M_n = Q \times 10,84 + w_1 \times 7,84 + w_2 \times 1,84
\]

\[ D-12 \text{ için} \quad M_n = 1265 \times 10,84 + 102 \times 7,84 + 177 \times 1,84 = 15456 \text{ kgm.} \]

\[ N-12 \quad \Rightarrow \quad M_n = 1685 \times 10,84 + 195 \times 7,84 + 191 \times 1,84 = 20158 \text{ kgm.} \]

\[ Z-12 \quad \Rightarrow \quad M_n = 2364 \times 10,84 + 208 \times 7,84 + 179 \times 1,84 = 22804 \text{ kgm.} \]

\[ Z-12 (120^\circ \text{ için}) = 2160 \times 10,84 + 208 \times 7,84 + 179 \times 1,84 = 25375 \text{ kgm.} \]

10 m.lik DİREKLERDE: \[ h = 10 - 1,16 = 9,84 \text{ m.} \]

\[
M = Q \times 9,84 + w_1 \times 5,84
\]

\[ D-10 \text{ için} \quad M_n = 1265 \times 9,84 + 102 \times 5,84 = 12248 \text{ kgm.} \]

\[ N-10 \quad \Rightarrow \quad M_n = 1685 \times 9,84 + 195 \times 5,84 = 16044 \text{ kgm.} \]

\[ Z-10 \quad \Rightarrow \quad M_n = 2364 \times 9,84 + 208 \times 5,84 = 22290 \text{ kgm.} \]

\[ Z-10 (120^\circ \text{ için}) = 2160 \times 9,84 + 208 \times 5,84 = 20310 \text{ kgm.} \]
D, N ve Z DİREKLERİNİN TEMEL SEÇİMİ

BLOK TEMELLERDE DÖNME NOKTASI TOPRAK SEVİYESİNDEN İTİBAREN
\[ t/3 = 1,9/3 = 0,64 \text{ m.} \] dedir. DİREĞİ TAM BOYU H İSE TEMEL MOMENTİNE ESAS YÜKSEKLİĞİ
\[ h = H - 1,80 + 0,64 = H - 1,16 \text{ m.} \] dir.

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<tr>
<th>DİREK TİPİ</th>
<th>D-10</th>
<th>D-12</th>
<th>D-14</th>
<th>D-16</th>
<th>D-18</th>
<th>D-20</th>
<th>N-10</th>
<th>N-12</th>
<th>N-14</th>
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<td>14,84</td>
<td>16,84</td>
<td>18,84</td>
<td>8,84</td>
<td>10,84</td>
<td>12,84</td>
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<tr>
<td>M (kgm.)</td>
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<td>18714</td>
<td>21964</td>
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<td>347</td>
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<td>16,84</td>
<td>18,84</td>
<td>8,84</td>
<td>10,84</td>
<td>12,84</td>
<td>14,84</td>
<td>16,84</td>
<td>18,84</td>
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<td>M (kgm.)</td>
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<td>(a) TEMEL GENİŞLİĞİ</td>
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<td>(b) DİP GENİŞLİĞİ</td>
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(X) TEMEL DERİNLİĞİ KAYALIK ARAZİDE 1,5 m. ALINDI (XX) TEMEL DERYNLİĞİ 1,5 m.
ZAVİYE DİRÈŞİNDE 90° de Z = 2384 kg. BULUNMUS VE BUNA GÖRE TEMEL SEÇİLMİŞTİR.

BIZ ŞİMDİ 120° HALINDE Z DİRÈŞİ İÇİN TEMEL EBATI SEÇECEĞİZ 120° Z KUVVETINDEN BULALIM.

VARSAYIM I' E GÖRE \[ Z = 3 \times 552 \times \sin \frac{120}{2} + 1,25 \times \cos \frac{120}{2} = 3 \times 552 \times 1,280965 = 2160\text{kg.} \]

VARSAYIM II' E GÖRE \[ Z = 3 \times 552 \times 2 \cos \frac{120}{2} = 1686\text{kg.} \]

ŞİMDİ \[ Z = 2160 \text{kg'} \] GÖRE DİRÈK TEMELI SEÇECEĞİZ AYRICA DİRÈSE RÜZGAR KUVVETLERİ ALINACAKTIR.

<table>
<thead>
<tr>
<th>DİRÈK TİPİ</th>
<th>Z-10</th>
<th>Z-12</th>
<th>Z-14</th>
<th>Z-16</th>
<th>Z-18</th>
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<tbody>
<tr>
<td>h (m.)</td>
<td>8,84</td>
<td>10,84</td>
<td>12,84</td>
<td>14,84</td>
<td>16,84</td>
<td>18,84</td>
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<tr>
<td>Mₙ (kgm.)</td>
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<td>35564</td>
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<td>2,2</td>
<td>a = 1,9 m, a = 2,1 m, a = 2,2 m</td>
<td>b = 2,6 m, b = 2,8 m, b = 2,9 m</td>
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<td>37</td>
</tr>
<tr>
<td>ANBUATMAN GENİŞLİĞİ</td>
<td>0,5</td>
<td>0,5</td>
<td>0,5</td>
<td>0,5</td>
<td>0,5</td>
<td>0,5</td>
</tr>
</tbody>
</table>

(X) TEMEL DERİNLİĞİ 1,5 m. ALNDI (XX) TEMEL DERİNLİĞİ 1,5 m.
<table>
<thead>
<tr>
<th>DEĞİŞİKLİK</th>
<th>TARİH</th>
<th>İMZA</th>
</tr>
</thead>
<tbody>
<tr>
<td>a)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

I. BUZ YÜKÜ BÖLGESİ
15-34.5 kV  3 x 1/0 (RAVEN)
DEMİR DİREK RESİMLERİ
VE HESAP HÜLASASI

<table>
<thead>
<tr>
<th>PROJEYI YAPANIN, ADI</th>
<th>İMZA</th>
<th>İMZA TARİHİ</th>
</tr>
</thead>
<tbody>
<tr>
<td>ELK.Y. MÜH. HüSEYİN BODUR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ODA NO: 343</td>
<td></td>
<td></td>
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<tr>
<td>DİPL NO: 2193</td>
<td></td>
<td></td>
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<tr>
<td>CİZEN: HüSEYİN ÇOTUK</td>
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</tr>
</tbody>
</table>

İLLE R BANKASI
ENERJİ DAİRESİ
BAŞKANLIĞI

PLAN NO: T.P 6/107

ARŞİV KAYIT NO:
I. BUZ YÜKÜ BÖLGESİ - 3x1/0 (RAVEN) DEMİR DIREK PROJESİ
AÇIKLAMA RAPORU

1) I. BUZ YÜKÜ BÖLGESİ'NİN YAPILAN HESAPLARIN ÖZETİ DIREK RESİMLERİNİN SONUNDA VERILmiştir. BÖYLECE UZUN HESAPLARI TETKİK ETMEDEN ENERJİ NAKİL HATTı PROFİLİ İŞLEYİK VE KEŞİFİNİ YAPMAK MÜMKÜN OLACAKTIR.

2) BİR ENERJİ NAKİL HATTı DIREK ARASI MESAFA'Nı NE KADAR FAZLA OLMASı O KADAR EKONOMİK OLUR. ELEKTRİKLI D.D.Y ATłamAŞı'Nı İÇİNDE YÜKSEK DİREĞE İHTİYAÇ VARDIR BU BAKıMDAN 20 m BOYA KADAR DİREK HESAP EDİLMİŞTİR.

3) TAŞYICI VE DURDURUCU TRAVERSLER İÇİN DÜZ TERTİP 5 ADET VE ÜÇGEN TERTİP İÇİN 2 TRAVERS HESAP EDİLMİŞTİR. TAŞYICI TRAVERSLER MESNET DURDURUCU TRAVERSLERDE İSE ZİNCİR İZOLATÖR KULLANILMAYACAKTIR.

4) NORMAL TAŞYICI DIREKLERİN RÜZGAR MENZİLLERİ BOYA GÖRE DEĞİŞİKTİR. ANCAK BU DIREKLER NORMAL MENZİLDEN DAHA KÜÇÜK ARALIKLARDA KULLANILDIĞI TAKİRDEN DAHA KÜÇÜK TEMEL ALINACAĞI ŞEKİLDE HESAP YAPILMIŞTİR.

5) KÖŞEDE DURDURUCU OLARAK D ve N DİREKLERİNİN KULLANILMA AÇILARI LISTELERDE VERİLMİŞTİR.
90° DERECEYE KADAR KULLANILABİLECEK BİR (Z) DİREĞİ HESAP EDİLMİŞTİR.
(Z) DİREĞİ 120° ye KADAR KULLANILDIĞI ZAMAN AYRı TEMEL KULLANILMACAKTIR.

6) TAŞYICI DIREK (K.T) OLARAK CEDVELDEKİ AÇILARDA KULLANILMACAK KÖŞEDE TAŞYICI DIREĞİN RÜZGAR MENZİLİ HAT DERECE AÇI İÇİN 8.5 m KISALMAKTADIR.

7) GEREK TAŞYICI TRAVERSLERİN VE GEREKSE DURDURUCU TRAVERSLERİNİN TEK TARAFLI Max. AÇIKLIDI AÇI DARALDIKÇA AZALMAKTADIR. BU KATSAYI HESAP ÖZETİNDE VERİLMİŞTİR.

8) NORMAL ARAZİ, KAYALIK ARAZİ VE ÇÜRÜK ARAZİ İÇİN TEMEL HESABI YAPILMIŞTİR. KAYALIK ARAZİ TEMELLERİNDE TEMEL DERİNLİĞİ AZALMIŞ BAZEN ÇÜRÜK ARAZİ TEMELLERİNDE TEMEL ARTIRILMIŞTİR PROFİL İŞLENIŞKEN BU HUSUSA DİKKAD EDİLECEKTİR.

SAYGILAR İMLMA
ELK. YÜK. MÜH. HüSEYİN BODUR
1. BÖLGE - 3 xRAWEN - St-Al İLETKENLİ DEMİR DIREKLERİN KULLANMA İMKANLARI

**TAŞIYICI DIREKLER**

<table>
<thead>
<tr>
<th>T</th>
<th>α₀ (m)</th>
<th>a₀ (m)</th>
<th>K.T. (x)</th>
<th>iletkenis</th>
<th>Profilden</th>
<th>Ağrılık</th>
<th><strong>NORMAL ARAZİ TEMELİ</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Toprak mesafe</td>
<td></td>
<td></td>
<td><strong>TIPI</strong></td>
</tr>
<tr>
<td>T-10</td>
<td>420</td>
<td>4.00</td>
<td>171</td>
<td>8.75</td>
<td>22</td>
<td>268</td>
<td>BLOK</td>
</tr>
<tr>
<td>T-12</td>
<td>304</td>
<td>&quot;</td>
<td>174</td>
<td>10.75</td>
<td>27</td>
<td>331</td>
<td>&quot;</td>
</tr>
<tr>
<td>T-14</td>
<td>273</td>
<td>&quot;</td>
<td>175</td>
<td>12.75</td>
<td>32</td>
<td>393</td>
<td>&quot;</td>
</tr>
<tr>
<td>T-16</td>
<td>255</td>
<td>&quot;</td>
<td>176</td>
<td>14.75</td>
<td>37</td>
<td>476</td>
<td>&quot;</td>
</tr>
<tr>
<td>T-18</td>
<td>195</td>
<td>&quot;</td>
<td>16.75</td>
<td>42</td>
<td>552</td>
<td>&quot;</td>
<td>0.3</td>
</tr>
<tr>
<td>T-20</td>
<td>195</td>
<td>&quot;</td>
<td>18.75</td>
<td>47</td>
<td>631</td>
<td>&quot;</td>
<td>0.4</td>
</tr>
</tbody>
</table>

(x) KOŞE TAŞIYICI (KT) HALİNDE a₀ DEĞERİ HER BİR DERECESİ İÇİN m. KISALIR

(xx)-h = H - 1.5 TEMEL + 0.25 (İZALATÖR BOYU) (xxx) KAYALIK TEMELDE 1mm ARTIRILIR.

ÇÜRÜK ARAZİDE 1mm AZALTILIR. ÜÇGEN TERTİPE 7.5mm AZALTILIR.

**KAYALIK ARAZİ TEMELİ**  

<table>
<thead>
<tr>
<th>TIPI</th>
<th>DERINLIK (m)</th>
<th>a = TEMEL GENİŞLİĞİ</th>
<th>BETON HACMI (m³)</th>
<th>ÇÜRÜK ARAZİ TEMELİ</th>
<th>BETON HACMI (m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T-10</td>
<td>BLOK</td>
<td>1</td>
<td>a₀ = 0.9</td>
<td>1</td>
<td>1.9</td>
</tr>
<tr>
<td>T-12</td>
<td>&quot;</td>
<td>&quot;</td>
<td>a₀ = 0.9</td>
<td>1</td>
<td>1.9</td>
</tr>
<tr>
<td>T-14</td>
<td>&quot;</td>
<td>&quot;</td>
<td>a₀ = 0.9</td>
<td>1</td>
<td>1.9</td>
</tr>
<tr>
<td>T-16</td>
<td>&quot;</td>
<td>&quot;</td>
<td>a₀ = 0.9</td>
<td>1</td>
<td>1.9</td>
</tr>
<tr>
<td>T-18</td>
<td>&quot;</td>
<td>&quot;</td>
<td>a₀ = 0.9</td>
<td>1</td>
<td>1.9</td>
</tr>
<tr>
<td>T-20</td>
<td>&quot;</td>
<td>&quot;</td>
<td>a₀ = 0.9</td>
<td>1</td>
<td>1.9</td>
</tr>
</tbody>
</table>

**TAŞIYICI TRAVERSLER**

<table>
<thead>
<tr>
<th>αMax (m)</th>
<th>a₀ (m)</th>
<th>Ağrılık (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>34.5 kV 15 kV</td>
<td>122 144</td>
<td>400 35</td>
</tr>
<tr>
<td>T-200</td>
<td>154</td>
<td>320</td>
</tr>
<tr>
<td>T-300</td>
<td>207 229</td>
<td>48</td>
</tr>
<tr>
<td>T-350</td>
<td>250 265</td>
<td>59</td>
</tr>
<tr>
<td>T-400</td>
<td>276 285</td>
<td>71</td>
</tr>
<tr>
<td>TÜ-300</td>
<td>320 320</td>
<td>49</td>
</tr>
<tr>
<td>TÜ-400</td>
<td>380 380</td>
<td>72</td>
</tr>
</tbody>
</table>

**TEMEL ŞEKİLLERİ**

- BLOK
- KADEME Lİ

![Diagram](attachment:diagram.png)
**TAŞIYICI DİREKLERİN Diğer KAREKTERİSTİKLERİ**

<table>
<thead>
<tr>
<th>TEPE GENİŞLİĞİ</th>
<th>DİP GENİŞLİĞİ</th>
<th>DİREK BOYU</th>
<th>DİKMELER</th>
<th>EK CİVATASI</th>
<th>EK LAMASI</th>
</tr>
</thead>
<tbody>
<tr>
<td>mm</td>
<td>mm</td>
<td>m</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T-10</td>
<td>250</td>
<td>600</td>
<td>10</td>
<td>50.50.5</td>
<td>40.40.4</td>
</tr>
<tr>
<td>T-12</td>
<td>250</td>
<td>670</td>
<td>12</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td>T-14</td>
<td>250</td>
<td>740</td>
<td>14</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td>T-16</td>
<td>250</td>
<td>810</td>
<td>16</td>
<td>50.50.5</td>
<td>&quot;</td>
</tr>
<tr>
<td>T-18</td>
<td>250</td>
<td>880</td>
<td>18</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td>T-20</td>
<td>250</td>
<td>950</td>
<td>20</td>
<td>&quot;</td>
<td>&quot;</td>
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</tbody>
</table>

**DURDURUCU DİREKLER**

DURDURUCU DIREKLER GERGİ İZOLATÖRLÜDÜR

<table>
<thead>
<tr>
<th>a(m) (m)</th>
<th>K.D HALİNDE αc°</th>
<th>K.T HALİNDE αc°</th>
<th>LETKEN MESAFESİ (m) x</th>
<th>PROFİL DE(tx) 1/400 (mm)</th>
<th>GERGİ İZOLATÖR</th>
<th>GERGİ İZOLATÖR</th>
<th>NORMAL ARAZİ TEMELLERİ</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D-10</td>
<td>400</td>
<td>154</td>
<td>135</td>
<td>10.2</td>
<td>20</td>
<td>376</td>
<td>BLOK 1.4 1.9 3.724</td>
</tr>
<tr>
<td>D-12</td>
<td>&quot;</td>
<td>154°</td>
<td>&quot;</td>
<td>10.2</td>
<td>25</td>
<td>465</td>
<td>&quot;</td>
</tr>
<tr>
<td>D-14</td>
<td>&quot;</td>
<td>165°</td>
<td>&quot;</td>
<td>12.2</td>
<td>30</td>
<td>566</td>
<td>1.7 5.491</td>
</tr>
<tr>
<td>D-16</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
<td>14.2</td>
<td>35</td>
<td>657</td>
<td>1.9 6.858</td>
</tr>
<tr>
<td>D-18</td>
<td>&quot;</td>
<td>170</td>
<td>143°</td>
<td>16.2</td>
<td>40</td>
<td>764</td>
<td>2 7.6</td>
</tr>
<tr>
<td>D-20</td>
<td>&quot;</td>
<td>174°</td>
<td>&quot;</td>
<td>18.2</td>
<td>45</td>
<td>880</td>
<td>2.1 8.377</td>
</tr>
</tbody>
</table>

h = h - 1.80 (GERGİ İZOLATÖRÜ) KAYALIK TEMELİ DE 2mm İLAVE EDILECEKTİR. ÜÇGEN TERTİPTE 6.25mm AZALTILIR

**KAYALIK TEMELİ**

<table>
<thead>
<tr>
<th>TİPİ</th>
<th>t (m)</th>
<th>a (m)</th>
<th>BETON m³</th>
<th>TİPİ</th>
<th>t</th>
<th>t1</th>
<th>a</th>
<th>b</th>
<th>BETON m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>D-10</td>
<td>BLOK</td>
<td>1.5</td>
<td>1.1</td>
<td>1.816</td>
<td>KADEMELİ</td>
<td>1.9</td>
<td>0.5</td>
<td>1.5</td>
<td>2.3</td>
</tr>
<tr>
<td>D-12</td>
<td>&quot;</td>
<td>&quot;</td>
<td>1.2</td>
<td>2.16</td>
<td>&quot;</td>
<td>&quot;</td>
<td>1.7</td>
<td>&quot;</td>
<td>2.4</td>
</tr>
<tr>
<td>D-14</td>
<td>&quot;</td>
<td>1.4</td>
<td>2.94</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
<td>1.9</td>
<td>2.6</td>
</tr>
<tr>
<td>D-16</td>
<td>&quot;</td>
<td>1.6</td>
<td>3.84</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
<td>2.1</td>
<td>2.8</td>
</tr>
<tr>
<td>D-18</td>
<td>&quot;</td>
<td>1.7</td>
<td>4.335</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
<td>2.2</td>
<td>2.9</td>
</tr>
<tr>
<td>D-20</td>
<td>&quot;</td>
<td>1.9</td>
<td>5.415</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
<td>2.4</td>
<td>3.1</td>
</tr>
</tbody>
</table>

(x) KöşeDE TAŞIYICI HALİNDE TAŞIYICI TRAVERS VE MESNET İZOLATÖRÜ KULLANILACAK.
**DURDURUCU TRAVERSLER:**

<table>
<thead>
<tr>
<th>TRAVERS TIPI</th>
<th>α_{max} 36.5 kV</th>
<th>α_{max} 15 kV</th>
<th>g (m)</th>
<th>G AĞIRLIK (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>D-200</td>
<td>122</td>
<td>144</td>
<td>400</td>
<td>42</td>
</tr>
<tr>
<td>D-250</td>
<td>154</td>
<td>187</td>
<td></td>
<td>47</td>
</tr>
<tr>
<td>D-300</td>
<td>207</td>
<td>229</td>
<td></td>
<td>56</td>
</tr>
<tr>
<td>D-350</td>
<td>250</td>
<td>265</td>
<td></td>
<td>77</td>
</tr>
<tr>
<td>D-400</td>
<td>276</td>
<td>286</td>
<td></td>
<td>95</td>
</tr>
<tr>
<td>DÜ-300</td>
<td>320</td>
<td>320</td>
<td></td>
<td>57</td>
</tr>
<tr>
<td>DU-400</td>
<td>380</td>
<td>380</td>
<td></td>
<td>96</td>
</tr>
</tbody>
</table>

**KÖSEDE (T) VE (D) TRAVERSLERDE TRAVERSLERİN α_{max}. DEĞERLERİ AŞİDADAKİ KATSAYILARLA ÇARPALARAK AZALTILACAĞTIR.**

<table>
<thead>
<tr>
<th>l°</th>
<th>K</th>
<th>l°</th>
<th>K</th>
<th>l°</th>
<th>K</th>
<th>l°</th>
<th>K</th>
</tr>
</thead>
<tbody>
<tr>
<td>169</td>
<td>0.99</td>
<td>144</td>
<td>0.95</td>
<td>120</td>
<td>0.86</td>
<td>95</td>
<td>0.74</td>
</tr>
<tr>
<td>160°</td>
<td>0.98</td>
<td>136</td>
<td>0.93</td>
<td>116</td>
<td>0.85</td>
<td>94°</td>
<td>0.73</td>
</tr>
<tr>
<td>152</td>
<td>0.97</td>
<td>128</td>
<td>0.90</td>
<td>113</td>
<td>0.83</td>
<td>92</td>
<td>0.72</td>
</tr>
<tr>
<td>148°</td>
<td>0.96</td>
<td>123</td>
<td>0.88</td>
<td>102</td>
<td>0.78</td>
<td>90°</td>
<td>0.709</td>
</tr>
</tbody>
</table>

**N (SON) VE Z (ZAVİYE) DİREKLERİ : HER İKİ DİREKTEDE α_{g} = 400 m dir. N VE Z DİREKLERİNDE ALT İLETKEN- TOPRAK MESAFEŞI (D) DİREKLERİNDEKİ GİBİDİR.**

### NORMAL ARAZİ TEMELİ

<table>
<thead>
<tr>
<th>AĞIRLIK KG</th>
<th>K.D</th>
<th>NORMAL ARAZI TEMELİ</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>α°</td>
<td>t (m)</td>
</tr>
<tr>
<td>N-10</td>
<td>400</td>
<td>122°</td>
</tr>
<tr>
<td>N-12</td>
<td>456</td>
<td>128°</td>
</tr>
<tr>
<td>N-14</td>
<td>600</td>
<td>140°</td>
</tr>
<tr>
<td>N-15</td>
<td>656</td>
<td></td>
</tr>
<tr>
<td>N-18</td>
<td>794</td>
<td></td>
</tr>
<tr>
<td>N-20</td>
<td>900</td>
<td>146°</td>
</tr>
<tr>
<td>Z-10°</td>
<td>499</td>
<td>90°</td>
</tr>
<tr>
<td>Z-12°</td>
<td>609</td>
<td>120°</td>
</tr>
<tr>
<td>Z-14 120°</td>
<td>742</td>
<td></td>
</tr>
<tr>
<td>Z-16 120°</td>
<td>874</td>
<td>KAĐEMELI</td>
</tr>
<tr>
<td>Z-18 120°</td>
<td>1031</td>
<td></td>
</tr>
<tr>
<td>Z-20 120°</td>
<td>1187</td>
<td></td>
</tr>
</tbody>
</table>

### KAYALIK ARAZİ TEMELİ

<table>
<thead>
<tr>
<th>KAYALIK ARAZİ TEMELİ</th>
</tr>
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<tbody>
<tr>
<td>BETON m³</td>
</tr>
<tr>
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</tr>
<tr>
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</tr>
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<tr>
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</tr>
<tr>
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<tr>
<td>N-20</td>
</tr>
<tr>
<td>Z-10°</td>
</tr>
<tr>
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<tr>
<td>Z-14 120°</td>
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<tr>
<td>Z-16 120°</td>
</tr>
<tr>
<td>Z-18 120°</td>
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<tr>
<td>Z-20 120°</td>
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### ÇÜRÜK ARAZİ TEMELİ

<table>
<thead>
<tr>
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<tbody>
<tr>
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</tr>
<tr>
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</tr>
<tr>
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</tr>
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<td>Z-12°</td>
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<tr>
<td>Z-14 120°</td>
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<tr>
<td>Z-16 120°</td>
</tr>
<tr>
<td>Z-18 120°</td>
</tr>
<tr>
<td>Z-20 120°</td>
</tr>
</tbody>
</table>

(*) Z DİREK AĞIRLIKLERİ 120° VE 90° İÇİN DEĞİŞMEYECEKTİR.
### α = 90° IÇİN (Z) DİREĞİNİN TEMEL EBATLARI

<table>
<thead>
<tr>
<th>Tipi</th>
<th>Normal Arazı Temeli</th>
<th>Kayalık Arazı Temeli</th>
<th>Çürek Arazı Temeli</th>
<th>Beton m³</th>
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<td></td>
<td>t (m)</td>
<td>a (m)</td>
<td>t (m)</td>
<td>d (m)</td>
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<tr>
<td>Z-10</td>
<td>BLOK 1.9</td>
<td>1.9</td>
<td>BLOK 1.5</td>
<td>1.5</td>
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<td>Z-12</td>
<td>&quot; 2.1</td>
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<td>&quot; 2.0</td>
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<tr>
<td>Z-18</td>
<td>&quot; a=2.1 b=2.8</td>
<td>10.945</td>
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<td>&quot; a=2.3 b=3</td>
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### (D), (N) ve (Z) DIREKLERİNİN DIĞER KARAKTERİSTİKLERİ

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<th>N-16</th>
<th>N-18</th>
<th>N-20</th>
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<tbody>
<tr>
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<td>500</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>500</td>
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<tr>
<td>Dip Genişliği (mm)</td>
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<td>1040</td>
<td>1130</td>
<td>1200</td>
<td>1310</td>
<td>1400</td>
<td>1100</td>
<td>1220</td>
<td>1360</td>
<td>1460</td>
<td>1580</td>
<td>1700</td>
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<tr>
<td>Tam Boy (m)</td>
<td>10</td>
<td>12</td>
<td>14</td>
<td>16</td>
<td>16</td>
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<td>10</td>
<td>12</td>
<td>14</td>
<td>16</td>
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<td>20</td>
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<table>
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<th>Z-14</th>
<th>Z-16</th>
<th>Z-18</th>
<th>Z-20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tepe Genişliği (mm)</td>
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<td>500</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>500</td>
</tr>
<tr>
<td>Dip Genişliği (mm)</td>
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<td>1340</td>
<td>1480</td>
<td>1620</td>
<td>1750</td>
<td>1900</td>
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<tr>
<td>Tam Boy (m)</td>
<td>10</td>
<td>12</td>
<td>14</td>
<td>16</td>
<td>18</td>
<td>20</td>
</tr>
</tbody>
</table>

**MESNET İZOLATÖR DEMİRLERİNİN (K.T) OLARAK KULLANILMASI HESABI.**

34.5 kV **Taşıyıcı Demir**: 158°
- Durdurucu "**: 139°
- Çift Durdurucu Demir**: 75°

15 kV **Taşıyıcı Demir**: 160°
- Durdurucu "**: 165°
- Çift Durdurucu Demir**: 139°
TAŞIYICI DIREKLERİN TENELE GİREN KİSİMLARI

ÖLÇEK : 1/40

NOT : TEMEL EBATLARI TEMEL CİNSİNE GÖRE HESAP HÜLASASINDAN ALINACAKTIR.

T-10 DİREĞİ

T-16 DİREĞİ

T-12 DİREĞİ

T-18 DİREĞİ

T-14 DİREĞİ

T-20 DİREĞİ
DUĞDURUCU DİREKLERİN TEMELE GİREN KISIMLARI

ÖLÇEK: 1/40

NOT: TEMEL EBATLARI TEMEL CİNSİNE GÖRE HESAP HÜLASASINDAN ALINACAKTIR.
NOT: TEMEL EBÂTLARI TEMEL CİNSİNE GÖRE HESAP HÜLASASINDAN ALINACAKTIR.
ZAVİYE DİREKLERİNİN TEMELE GİREN KİSİMLARI

NOT TEMEL EBAKLARI TEMEL CİNSİYİNE GÖRE HESAP HULASASINDAN ALINACAKTIR

Z-10 DİREĞİ

Z-12 DİREĞİ

Z-14 DİREĞİ

Z-16 DİREĞİ

Z-18 DİREĞİ

Z-20 DİREĞİ
NOT: TRAVERSLERİ EĞİM VERMEDEN DÜZ OLARAKTA YAPILABİLİR.
TÜ-300 tipi TRAVERS [ÜÇGEN TERTİP]

ölçek: 1/20

TAŞIYICI DİREKLERİN İZOLATÖR İRTİBATLARI

A - TAFSILATI
ölçek 1/5

B - TAFSILATI
ölçek: 1/5
TÜ-400 tipli TRAVERS [ÜÇGEN TERTİP]
(Mesnet İzolatörü için)

ÖLÇEK: 1/20
DÜ-300 tipi TRAVERS [ÜÇGEN TERTİP]

(Gergi izolatör için)

A DETAYI

ZINCİR
MESNET
ZINCİR

C-C KESİTİ

NOT B TAFSILAT İNDAKİ GERGI TAKIMI
A) TAFSILAT İNDAKİ GERGI TAKIMININ
AYNI OLDUGUNDA AYRICA CIZILMİSİR

B DETAYI

BU İRTİBAKLAR M 12 LİK CİVATA
İLE DE YAPILABİLİR.
DÜ - 400 tipi TRAVERS [ÜÇGEN TERTİP]

(Gergi izolatör için)

<table>
<thead>
<tr>
<th>(b)</th>
<th>(c)</th>
<th>(d)</th>
<th>(e)</th>
<th>(f)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DURDURUCU</td>
<td>760</td>
<td>660</td>
<td>600</td>
<td>740</td>
</tr>
<tr>
<td>NİHAYET</td>
<td>820</td>
<td>640</td>
<td>590</td>
<td>750</td>
</tr>
<tr>
<td>ZAVİVE</td>
<td>850</td>
<td>620</td>
<td>560</td>
<td>800</td>
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</table>

ÖLCÜLER (mm) dir.

ÖÇEK: 1:70
DIREKLERİN KAYNAKLARLA İRTİBAT DETAYI Ölçek: 1/25

<table>
<thead>
<tr>
<th>ÜST KÖŞEBENT (mm)</th>
<th>ALT KÖŞEBENT (mm)</th>
<th>EK KÖŞEBENT (mm)</th>
<th>L (mm)</th>
<th>KAYNAK KALINLIĞI (mm)</th>
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<tbody>
<tr>
<td>50x50x5</td>
<td>50x50x5</td>
<td>50x50x5</td>
<td>200</td>
<td>3</td>
</tr>
<tr>
<td>50x50x5</td>
<td>50x60x6</td>
<td>50x50x5</td>
<td>250</td>
<td>3</td>
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<tr>
<td>60x60x6</td>
<td>65x65x7</td>
<td>60x60x6</td>
<td>250</td>
<td>4</td>
</tr>
<tr>
<td>65x65x7</td>
<td>80x80x8</td>
<td>65x65x7</td>
<td>350</td>
<td>4</td>
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<tr>
<td>80x80x8</td>
<td>80x80x8</td>
<td>80x80x8</td>
<td>350</td>
<td>5</td>
</tr>
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</table>

KORKULUK DETAYI Ölçek: 1/20

DURDURUCU VE NİHAYET DIREKLER İÇİN

TAŞIYICI DIREKLER İÇİN

NOT: KORKULUKLAR VERDEN 5.5m MESAFADE MONTE EDİLECEĞİNE GÖRE (α) MESAFAŞI ALINACAKTIR.
DİKMELERİN İRTİBATI (CİVATALI) ÖLÇEK: 1/5

4 x M12 VE 4 x M14 İÇİN EK YERİ

6 x M16 VE 6 x M14 İÇİN EK YERİ

BİR ÇAPRAZIN BİR DİKMEYE İRTİBATI ÖLÇEK: 1/5

KAYNAK KALINLIĞI 3 mm
KAYNAK BOYU
1 - TAŞIYICILARDA 80 mm
2 DURDURUCULARDA 100 mm
3 NİHAYETLERDE 100 mm
4 ZAVİYELERDE 100 mm

NOT: EK YERİNE GELEN ÇAPRAZLAR DİKME İRTİBAT CİVATALARINDAN BİR TANESİYLE İRTİBATALANACAĞTIR.

TABAN KÖŞEBENTİ İRTİBATI ÖLÇEK: 1/5

KAYNAK KALINLIĞI 3 mm
KAYNAK BOYU ŞEKİLDE GÖSTERİLDİĞİ UZUNLUKTA OLACAĞTIR.
<table>
<thead>
<tr>
<th></th>
<th>T-10</th>
<th>T-12</th>
<th>T-14</th>
<th>T-16</th>
<th>T-18</th>
<th>T-20</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>kg/m</td>
<td>m</td>
<td>kg</td>
<td>m</td>
<td>kg</td>
<td>m</td>
</tr>
<tr>
<td>DİKMELER</td>
<td>50 x 50 x 5</td>
<td>3.77</td>
<td>4.0</td>
<td>151</td>
<td>4.8</td>
<td>181</td>
</tr>
<tr>
<td></td>
<td>60 x 60 x 6</td>
<td>5.42</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>65 x 65 x 7</td>
<td>6.83</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>70 x 70 x 7</td>
<td>7.36</td>
<td></td>
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<tr>
<td></td>
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<td>5.15</td>
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<td>80 x 10</td>
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<tr>
<td>TOPLAM</td>
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<td>331</td>
<td>393</td>
<td>476</td>
<td>592</td>
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<td>8</td>
<td>10</td>
<td>12</td>
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<th>D-14</th>
<th>D-16</th>
<th>D-18</th>
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<tbody>
<tr>
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<td>kg</td>
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<td>1.6</td>
<td>109</td>
<td>2.4</td>
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<td>7</td>
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<tr>
<td></td>
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<td>3</td>
<td>3</td>
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<tr>
<td>EK</td>
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<td>7.36</td>
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<td>8</td>
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<tr>
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<td>16</td>
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<td>22</td>
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</tr>
<tr>
<td>----------</td>
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<td>------</td>
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</tr>
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<td>110</td>
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<td>32</td>
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I. BÖLGE - 3 x 1/0 (RAWEN)

\[ \sigma = 9 \text{ kg/mm}^2 \]

1/400 - 1/2000