**AIM:**

The main object of this transportation project was that according to previous step for the designed road a vertical profile is being created.

**PROCEDURE:**

• We assigned 0+000.00 m to A. Then we computed true St.Km’s of PC and PT’s accordingly. St.Km B = St.Km PT2 + │PT2-B│realtarting from point A, we marked the stations at even 50 m on the map. For the stations on the curves, we used central angles, arc lengths and chord lengths to find the exact locations of the stations.

• We found the elevations of the stations by interpolation as shown on the figure. We presented them in a tabular form.

• Using the calculated elevations and St.Km’s, we drew the profile. The horizontal scale of our profile is 1/2000 and the vertical scale is 1/200.

• We modified the profile by drawing the grade lines (best lines for vertical alignment)

• We considered that’s lope of grade lines is less than gmax of our project.

• In addition, we tried to balance cuts & fills.

• y = (A / 200 / L ) x2 + (g1 / 100) x +elevation of PVC

• According to ‘Geometric Standards of Highways Table’ we read our SSD and computed length of your vertical curve. Since calculated L value is smaller than Lmin. ( Lmin = 0,6 \* Vd). We used Lmin.

• After that, we located our PVT and PVC as shown in the figure and we drew the parabolic curve by locating intermediate points using the offset distances.

**CALCULATIONS:**

Vd=70 km/hour

Lmin= 0.6\*Vd

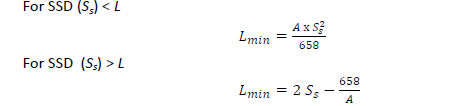
Lmin= 42 m

From Geometric Standards of Highways Table;

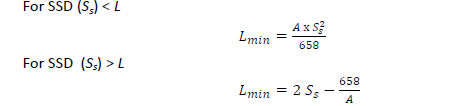
SSD= 105 m  
  
G1 = -0,736842

G2= -4,434786

A = | G1-G2 |



Lmin = 62 m ( smaller than SSD) We cannot use this value.



Lmin = 33 m ( smaller than our first Lmin value) We cannot use this value, either. Therefore, Lmin= 42 m.

LS1=45 m

LT1=11.25 m

(2/3LS+LT)1=41.25 m

LS2=48.5688 m

LT2=12.1422 m

(2/3LS+LT)2=44.52 m

LS and LT values are taken from the Step 1 & 2.   
Since (2/3LS+LT) distances are suitable, we can construct vertical curve between two horizontal curves.

|  |  |  |  |
| --- | --- | --- | --- |
|  | PVC | PVI | PVT |
| Elevation (m) | 183,1547 | 183 | 182,0694 |
| True St. Km. | 0+929.00 | 0+950.00 | 0+971.00 |

y = (G2-G1 / 200 / L ) x2 + (G1 / 100) x +elevation of PVC (eqn. 1)

y= -0.000433 x X2 + 0.00737 x X + 183.15

Highest point of the vertical curve

Xhp= |-G1|\*L/|G2-G1| = 8,368 m

From eqn.1

Yhp= 183,058 m

|  |  |  |
| --- | --- | --- |
| Offset Distances | | |
| Vertical Curve | | |
| x (m) | y (m) | Offset Dist. |
| 0,000 | 0,000 | 0,000 |
| 6,000 | -0,060 | 0,016 |
| 12,000 | -0,152 | 0,064 |
| 18,000 | -0,275 | 0,142 |
| 24,000 | -0,430 | 0,140 |
| 30,000 | -0,617 | 0,063 |
| 36,000 | -0,836 | 0,016 |
| 42,000 | -1,086 | 0,000 |
| obtained from autocad file | | |

Maximum offset distance = 0.1978 m (obtained from: drawing a line from PVI to vertical curve in the ACAD)

|  |  |  |  |
| --- | --- | --- | --- |
| **Points** | **Stational KMs** | **Ground Elevations (m)** | **Grade Elevations (m)** |
| **A** | 0+000.00 | 200 | 190,0 |
| ST1 | 0+050.00 | 204 | 189,6 |
| ST2 | 0+100.00 | 206,5 | 189,3 |
| ST3 | 0+150.00 | 208 | 188,9 |
| ST4 | 0+200.00 | 208,3 | 188,5 |
| ST5 | 0+250.00 | 205,6 | 188,2 |
| ST6 | 0+300.00 | 201,9 | 187,8 |
| ST7 | 0+350.00 | 198,5 | 187,4 |
| ST8 | 0+400.00 | 195,1 | 187,1 |
| ST9 | 0+450.00 | 191,1 | 186,7 |
| **PC1** | 0+457.75 | 190,2 | 186,6 |
| ST10 | 0+500.00 | 185,7 | 186,3 |
| ST11 | 0+550.00 | 183,5 | 185,9 |
| ST12 | 0+600.00 | 181,5 | 185,6 |
| ST13 | 0+650.00 | 180,6 | 185,2 |
| **PT1** | 0+676.90 | 180,5 | 185,0 |
| ST14 | 0+700.00 | 180,6 | 184,8 |
| ST15 | 0+750.00 | 181,5 | 184,5 |
| ST16 | 0+800.00 | 181,9 | 184,1 |
| ST17 | 0+850.00 | 181,5 | 183,7 |
| ST18 | 0+900.00 | 179,8 | 183,4 |
| **PVC** | 0+929.00 | - | 183,2 |
| ST19 | 0+950.00 | 177,8 | 183,0 |
| **PVT** | 0+971.00 | - | 182,1 |
| ST20 | 1+000.00 | 175,7 | 180,8 |
| ST21 | 1+050.00 | 173,9 | 178,6 |
| ST22 | 1+100.00 | 172,7 | 176,3 |
| ST23 | 1+150.00 | 171,3 | 174,1 |
| **PC2** | 1+168.76 | 170,9 | 173,3 |
| ST24 | 1+200.00 | 169,9 | 171,9 |
| ST25 | 1+250.00 | 166,9 | 169,7 |
| ST26 | 1+300.00 | 163,8 | 167,5 |
| ST27 | 1+350.00 | 161,6 | 165,3 |
| **PT2** | 1+357.48 | 161,2 | 164,9 |
| ST28 | 1+400.00 | 158,7 | 163,0 |
| ST29 | 1+450.00 | 156 | 160,8 |
| ST30 | 1+500.00 | 153,4 | 158,6 |
| **PC3-ST31** | 1+550.00 | 150,5 | 156,4 |
| ST32 | 1+600.00 | 147,9 | 154,2 |
| ST33 | 1+650.00 | 144,9 | 152,0 |
| ST34 | 1+700.00 | 141,3 | 149,7 |
| ST35 | 1+750.00 | 137,7 | 147,5 |
| ST36 | 1+800.00 | 138,5 | 145,3 |
| ST37 | 1+850.00 | 139,8 | 143,1 |
| ST38 | 1+900.00 | 139,6 | 140,9 |
| **PT3** | 1+904.10 | 139,5 | 140,7 |
| ST39 | 1+950.00 | 138,6 | 138,7 |
| ST40 | 2+000.00 | 138 | 136,4 |
| ST41 | 2+050.00 | 136,9 | 134,2 |
| ST42 | 2+100.00 | 135,7 | 132,0 |
| **B** | 2+147.83 | 135 | 129,9 |

**DISCUSSION OF RESULTS and CONCLUSION:**

In the third step of project there were some criteria for the creating of vertical alignment. We decided the length of curve whether is approiate for our horizontal curves. For this reason, either our horizontal curves’ PI points coincide with the vertical curve’s PVI points or before and after the vertical curve 2/3Ls+Lt distance has been considered.

Furthermore, to decide the sag or crest type of our vertical curves the geography of our map was an important factor. As a result of this, we used a crest type to our maps. We constructed one vertical curve between two horizontal curves which are suitable one for cut-fill balance of the road. Also, for driving safely the grade values were used smaller than 5 percent.

To sum up, similar to step 1 and 2 we started to project firstly calculating true station kilometers of our station points and according to these points we determined our ground elevation and grade elevation. While computing these values we also created our vertical curve with respect to Turkish Highway Standards.

Finally, in the light of our lecture knowledge and recitations we had a chance of applying the design criteria for a road. It was an amazing experience and a huge chance for our professional life.