Program Description I

Program Title UNSYMMETRICAL VERTICAL CURVES

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Program Description, Equations, Variables

Given the beginning and ending grades, distance from the PVC station to the PVI station and from the PVI station to the PVT station and either the PVC station and elevation or PVI station and elevation, this program will compute either the PVC or PVI station and elevation (whichever was not given), station ofhigh/low point and elevation at any station.

$e = l_1 l_2 A / 2 (l_1 + l_2)$ $\quad A = G_1 - G_2$

$y_1 = e (x_1 / l_1)^2$ $\quad y_2 = e (x_2 / l_2)^2$

$x \text{ to HP/LP} = G_a l_a^2 (l_1 + l_2) / (G_1 - G_2) l_1 l_2$

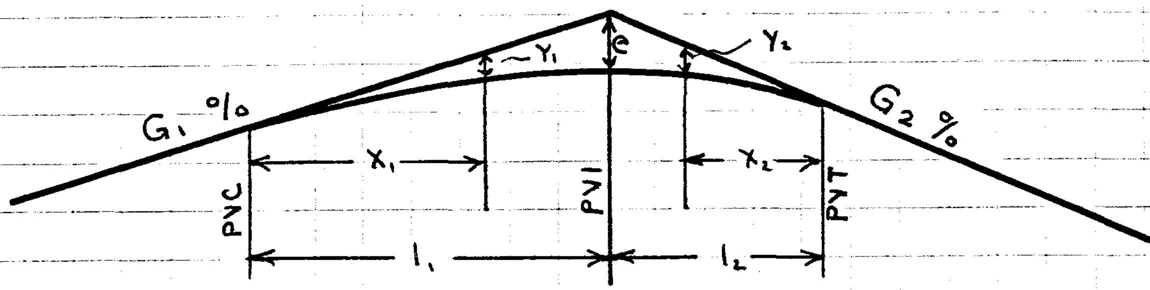
where the subscript a refers to the lesser absolute grade

Operating Limits and Warnings

Do not attempt to find a HP/LP if both grades are of the same sign.

03037D Program Description II

Sketch(es)



Sample Problem(s)

Given $G_1 = +2\%$ $G_2 = -3\%$

$l_1 = 150'$ $l_2 = 250'$

PVC Sta = 1000 PVC Elev = 97.00

Find PVI Sta PVI Elev

HP Sta HP Elev

elev @ Sta 1050

Solution(s)

```
    2.00 ENT↑
   -3.00 GSB A

    2.00  ***
   -3.00  ***
  150.00 ENT↑
  250.00 GSB B
  150.00  ***
  250.00  ***
 1000.00 ENT↑
   97.00 GSB C

 1000.00  ***
   97.00  ***
 1150.00  ***
  100.00  ***
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```
         GSB D

 1150.00  ***
         GSB E

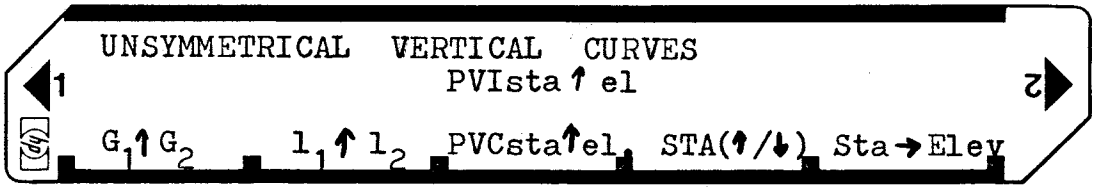
 1[illegible].00  ***
   97.[illegible]  ***
 1050.00 GSB E

 1051.00  ***
   97.74  ***
 1100.00 GSB E

 1100.00  ***
   97.50  ***
```

Reference(s) Design, Data Book for Civil Engineers, E. Seelye pg 12-25

User Instructions



STEP	INSTRUCTIONS	INPUT DATA/UNITS	KEYS	OUTPUT DATA/UNITS
1	enter G_1	G_1 %	↑	G_1 %
2	enter G_2	G_2 %	A	G_2 %
3	enter l_1	l_1 ft.	↑	l_1 ft.
4	enter l_2	l_2 ft.	B	l_2 ft.
	DO STEP 5a AND 6a OR 5b AND 6b			
5a	enter PVC Sta	PVC ft.	↑	PVC ft.
6a	enter PVC Elev	Elev	C	Elev
				PVI ft.
				Elev
				.
5b	enter PVI Sta	PVI ft.	↑	PVI ft.
6b	enterPVI Elev	Elev	f c	PVI Elev
				PVC ft.
				Elev
7	compute Station of high/low point		D	HP/LP
8	compute elev @ any station	Sta ft.	E	Sta
				Elev

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STEP	KEY ENTRY	KEY CODE	COMMENTS
001	*LBL E	21 15	Sta → Elev
002	SF0	16-11	
003	FRTN	-14	
004	RCL4	36 04	Sta
005	-	-45	
006	STO1	35 01	
007	RCL2	36 02	
008	RCL7	36-35	
009	STO1	22 16 15	
010	RCL0	36 00	in range
011	RCL1	36 01	of l_1
012	-	-45	
013	RCL3	36 03	
014	x	-35	
015	RCL1	36 01	
016	x²	53	
017		-35	
018	RCL4	36 04	
019	+	-24	
020	RCL2	36 02	
021	+	-24	
022	RCL2	36 02	
023	RCL3	36 03	
024		-35	
025		-24	
026	CHS	-22	
027	RCL7	36 07	
028	+	-55	
029	RCL0	36 00	
030	RCL2	36 02	
031	+	-24	
032	RCL7	36 07	
033	-	-45	
034	+	-55	
035	FRTN	-14	Elev
036	RTN	24	
037	*LBL E	21 16 15	if in range
038	RCL2	36 02	of l_2
039	RCL3	36 03	
040	+	-55	
041	RCL9	36 09	
042	-	-45	
043	STO9	35 09	
044	x²	53	
045	RCL2	36 02	
046		-35	
047	RCL0	36 00	
048	RCL1	36 01	
049	-	-45	
050		-35	
051	RCL4	36 04	
052	+	-24	
053	RCL3	36 03	
054	+	-24	
055	RCL2	36 02	
056	RCL3	36 03	
057	+	-55	
058	+	-24	
059	SF8	-22	
060	RCL7	36 07	
061	-	-55	
062	RCL1	36 01	
063	RCL2	36 12	
064	+	-24	
065	RCL0	36 00	
066	RCL2	36 02	
067	-	-45	
068		-35	
069		-55	
070	FRTN	-14	Elev
071	RTN	24	
072	*LBL A	21 11	
073	DSE2	-53 02	
074	STO1	35 01	G_2 %
075	INV	-41	
076	STO0	35 00	G_1 %
077	SF0	16-11	
078	SF1	16-11	
079	FRTN	-14	
080	INV	-41	
081	FRTN	-14	
082	1	01	
083	0	00	
084	0	00	
085	STO2	35 12	
086	1	02	
087		-55	
088	STOn	35 11	
089	RCL1	36 01	
090	RTN	24	
091	*LBL B	21 12	
092	STO2	35 02	l_2
093	INV	-41	
094	STO2	35 02	l_1
095	FRTN	-14	
096	INV	-41	
097	FRTN	-14	
098	RTN	24	
099	*LBL C	21 13	PVC
100	SF1	16-11	Elev
101	STO5	35 05	
102	INV	-41	
103	STO4	35 04	Sta
104	FRTN	-14	
105	INV	-41	
106	FRTN	-14	
107	RCL4	36 04	
108	RCL2	36 02	
109	+	-55	
110	STO3	35 03	
111	FRTN	-14	PVI Sta
112	RCL5	36 05	

REGISTERS

0 G_1 %	1 G_2 %	2 l_1	3 l_2	4 PVC Sta	5 PVC El	6 PVI Sta	7 PVI El	8 used	9 Sta-PVC
S0	S1	S2	S3	S4	S5	S6	S7	S8	S9

A	B	C	D	E	I
200	100				

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STEP	KEY ENTRY	KEY CODE	COMMENTS
113	RCL3	36 03	
114	RCL3	36 12	
115	+	-24	
116	RCL2	36 02	
117	×	-35	
118	(	-55	
119	STO7	35 07	
120	FRTN	-14	PVI Elev
121	RTN	24	
122	*LBL0	21 16 13	PVI
123	SF1	16-11	
124	STO7	35 07	Elev
125	(+/-)	-41	
126	STO1	35 01	
127	FRTN	-14	Sta
128	(+/-)	-41	
129	FRTN	-14	
130	RCL3	36 03	
131	RCL2	36 02	
132	-	-45	
133	STO4	35 04	
134	FRTN	-14	PVC Sta
135	RCL7	36 07	
136	RCL3	36 03	
137	RCL2	36 12	
138	+	-24	
139	RCL2	36 02	
140	×	-35	
141	-	-45	
142	STO5	35 05	
143	FRTN	-14	PVC Elev
144	RTN	24	
145	*LBL2	21 14	HP/LP
146	SF1	16-11	Sta
147	RCL2	36 02	
148	RCL3	36 03	
149	-	-35	
150	RCL2	36 02	
151	+	-24	
152	RCL3	36 03	
153	+	-24	
154	RCL2	36 02	
155	RCL1	36 01	
156	-	-45	
157	+	-24	
158	STO3	35 03	
159	RCL1	36 01	
160	ABS	16 31	check for
161	RCL0	36 00	lesser
162	ABS	16 31	absolute
163	x<y?	16-34	grade
164	GTO1	22 01	
165	RCL2	36 02	G1 < G2
166	V3	03	
167	)	-35	
168	RCL3	36 03	
169	×	-35	
170	RCL4	36 04	
171	-	-45	
172	FRTN	-14	HP/LP
173	RTN	24	
174	*LBL3	21 03	
175	(+/-)	-41	G2 < G1
176	RCL4	36 04	
177	(	-55	
178	)	-35	
179	RCL1	36 01	
180	×	-35	
181	SIN	-23	
182	RCL2	36 02	
183	+	-55	
184	RCL7	36 07	
185	-	-55	
186	RCL5	36 05	
187	+	-55	
188	FRTN	-14	HP/LP
189	RTN	24	
190			
200			
210			
220			

LABELS					FLAGS	SET STATUS		
A G_1 G_2	B l_1 l_2	C PVC	D Sta(↑/↓)	E Sta→El	0	FLAGS	TRIG	DISP
a	b	c PVI	d	e used	1	ON OFF 0 ☐ ☒ 1 ☐ ☒	DEG ☐	FIX ☒
0 used	1	2	3	4	2	2 ☐ ☒	GRAD ☐	SCI ☐
5	6	7	8	9	3	3 ☐ ☐	RAD ☐	ENG ☐ n=2