

Program Description I

Program Title UNSYMMETRICAL VERTICAL CURVES

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State MD

Zip Code 20840

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 of high/low point and elevation at any station.

$$e = l_1 l_2 A / 2 (l_1 + l_2)$$

$$A = G_1 - G_2$$

$$y_1 = e (x_1 / l_1)^2$$

$$y_2 = e (x_2 / l_2)^2$$

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

where the subscript a refers to the lesser absolute grade

Operating Limits and Warnings

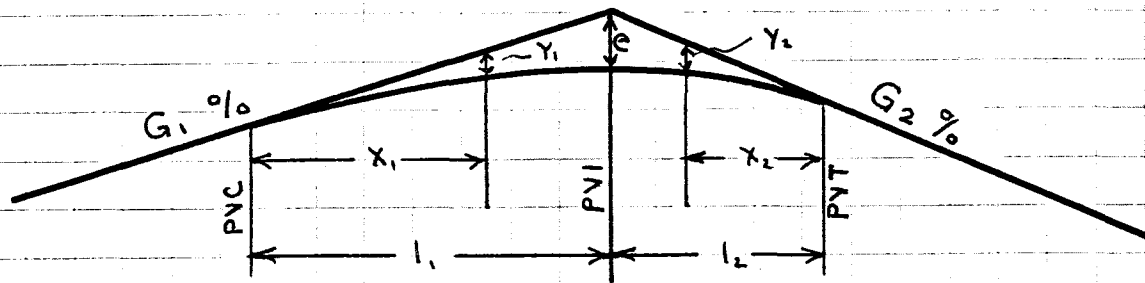
Do not attempt to find a HP/LP if both grades are of the same sign.

This program has been verified only with respect to the numerical example given in *Program Description II*. User accepts and uses this program material AT HIS OWN RISK, in reliance solely upon his own inspection of the program material and without reliance upon any representation or description concerning the program material.

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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)

	6880
	1050.00 ***
	6882
1.00 ENT	
-3.00 6884	1050.00 ***
	97.35 ***
	1050.00 6882
1.00 ***	
-3.00 ***	1050.00 ***
150.00 ENT	97.74 ***
100.00 6882	1100.00 6882
100.00 ***	
250.00 ***	1100.00 ***
1050.00 ENT	97.35 ***
97.00 6880	
1050.00 ***	
97.00 ***	
1150.00 ***	
100.00 ***	

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

UNSYMMETRICAL VERTICAL CURVES
PVista ↑ el
G₁ ↑ G₂ l₁ ↑ l₂ PVCsta ↑ el STA(↑/↓) Sta → Elev

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

STEP	KEY ENTRY	KEY CODE	COMMENTS	STEP	KEY ENTRY	KEY CODE	COMMENTS
001	*LELE	21 15	Sta → Elev	057		-35	
002	SPC	16-11		058		-24	
003	RTM	-14	Sta	059	CHS	-32	
004	ROLA	36 04		060	ROLT	36 07	
005		-45		061		-35	
006	STOC	35 09		062	ROLI	36 01	
007	ROLA	36 02		063	ROLA	36 12	
008	WET	16-35		064		-24	
009	STOC	23 16 15		065	ROLA	36 03	
010	ROLA	36 08	in range	066	ROLA	36 09	
011	ROLA	36 01	of 1,	067		-45	
012		-45		068		-35	
013	ROLA	36 03		069		-35	
014		-35		070	RTM	-14	Elev
015	ROLA	35 03		071	RTM	24	
016	WET	53		072	*LELA	21 11	
017		-35		073	CHS	-33 02	
018	ROLA	36 11		074	STOC	35 01	G ₂ %
019		-24		075	WET	-41	G ₁ %
020	ROLA	36 03		076	STOC	35 00	
021		-24		077	SPC	16-11	
022	ROLA	36 02		078	STC	16-11	
023	ROLA	36 03		079	RTM	-14	
024		-35		080	WET	-41	
025		-24		081	RTM	-14	
026	CHS	-32		082		01	
027	ROLA	36 07		083		03	
028		-35		084		02	
029	ROLA	36 08		085	STOC	35 12	
030	ROLA	36 13		086		02	
031		-24		087		-35	
032	ROLA	36 03		088	STOC	35 11	
033		-35		089	ROLA	36 01	
034		-35		090	RTM	24	
035	RTM	-14	Elev	091	*LELA	21 12	
036	RTM	24		092	STOC	35 03	
037	*LELA	21 16 15	if in range	093	WET	-41	l ₂
038	ROLA	36 02	of l ₂	094	STOC	35 02	l ₁
039	ROLA	36 07		095	RTM	-14	
040		-35		096	WET	-41	
041	ROLA	36 03		097	RTM	-14	
042		-45		098	RTM	24	
043	STOC	35 03		099	*LELA	21 13	PVC
044	WET	53		100	SPC	16-11	Elev
045	ROLA	36 02		101	STOC	35 05	
046		-35		102	WET	-41	Sta
047	ROLA	36 00		103	STOC	35 04	
048	ROLA	36 01		104	RTM	-14	
049		-45		105	WET	-41	
050		-35		106	RTM	-14	
051	ROLA	36 11		107	ROLA	36 04	
052		-24		108	ROLA	36 02	
053	ROLA	36 03		109		-35	
054		-24		110	STOC	35 07	
055	ROLA	36 02		111	RTM	-14	PVI Sta
056	ROLA	36 03		112	ROLA	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 200	B 100	C	D	E	I				

STEP	KEY ENTRY	KEY CODE	COMMENTS	STEP	KEY ENTRY	KEY CODE	COMMENTS
113	ROLL	36 02		169		-35	
114	ROLL	36 12		170	ROLL	36 04	
115		-24		171		35	
116	ROLL	36 21		172	PTH	-14	HP/LP
117		-35		173	PTH	24	
118		-35		174	*LEL	21 01	
119	STRT	35 07	PVI Elev	175	PTH	-41	G ₂ < G ₁
120	PTH	-14		176	ROLL	36 07	
121	PTH	24		177		35	
122	*LEL	21 16 13	PVI	178		-35	
123	BFI	16-11	Elev	179	ROLL	36 02	
124	STRT	35 07		180		-35	
125	PTH	-41		181	PTH	-35	
126	STRT	35 06	Sta	182	ROLL	36 01	
127	PTH	-14		183		-35	
128	PTH	-41		184	ROLL	36 07	
129	PTH	-14		185		-35	
130	ROLL	36 06		186	ROLL	36 04	
131	ROLL	36 02		187		-35	
132		-45		188	PTH	-14	HP/LP
133	STRT	35 04		189	PTH	24	
134	PTH	-14	PVC Sta	190			
135	ROLL	36 07					
136	ROLL	36 02					
137	ROLL	36 11					
138		-24					
139	ROLL	36 02					
140		-35					
141		-41					
142	STRT	35 06	PVC Elev				
143	PTH	-14					
144	PTH	24		200			
145	*LEL	21 14	HP/LP				
146	BFI	16-11	Sta				
147	ROLL	36 01					
148	ROLL	36 00					
149		-35					
150	ROLL	36 02					
151		-24					
152	ROLL	36 03					
153		-24					
154	ROLL	36 02		210			
155	ROLL	36 01					
156		-45					
157		-24					
158	STRT	35 08					
159	ROLL	36 01					
160	ASS	16 31	check for				
161	ROLL	36 00	lesser				
162	ASS	16 31	absolute				
163	PTH	16-34	grade				
164	STRT	22 00		220			
165	ROLL	36 02	G ₁ < G ₂				
166		35					
167		-35					
168	ROLL	36 06					

LABELS					FLAGS	SET STATUS		
A G ₁ G ₂	B 1 ₁ 1 ₂	C PVC	D Sta(↑/↓)	E Sta→El	0	FLAGS	TRIG	DISP
a	b	c PVI	d	e used	1	ON OFF		
0 used	1	2	3	4	2	0 <input type="checkbox"/> <input checked="" type="checkbox"/>	DEG <input type="checkbox"/>	FIX <input checked="" type="checkbox"/>
5	6	7	8	9	3	1 <input type="checkbox"/> <input checked="" type="checkbox"/>	GRAD <input type="checkbox"/>	SCI <input type="checkbox"/>
						2 <input type="checkbox"/> <input checked="" type="checkbox"/>	RAD <input type="checkbox"/>	ENG <input type="checkbox"/>
						3 <input type="checkbox"/> <input type="checkbox"/>		n