Discussion of "Improved Channel Cross Section with Two-Segment Parabolic Sides and Horizontal Bottom" by Said M. Easa

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Introduction

The discusser would like to thank the author for presenting a new and improved cross section with two-segment parabolic sides (TSPS) and would like to add a few points.

Though parabolic canals are built in some places, they are less accepted owing to the difficulty in their design and construction, as mentioned by Mironenko et al. (1984). Using a cross section with two-segment linear sides (TSLS) and a horizontal bottom, (a) the above-mentioned difficulties could be resolved, (b) the relationships for cross-sectional area and perimeter would be simplified, and (c) it could be shown that the TSLS and TSPS cross sections have approximately the same economical performance.

The economical performance is considered based on the (simple) economic design of the cross section, according to the original paper. Such a design is based only on the minimization of the total construction cost, which includes excavation costs and surface-lining costs per unit length of the channel.

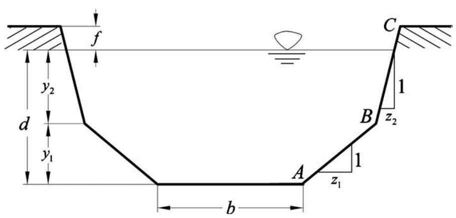

Fig. 1. Geometry of the TSLS cross section

Characteristics of the TSLS Cross Section

The geometry of the TSLS cross section is shown in Fig. 1. The cross section has a horizontal bottom with width b and two different linear sides (i.e., AB and BC). The height of the first segment is y_1, and its side slope is z_1. Similarly, the height of the second segment is y_2, and this segment has a side slope of z_2. To evaluate the cost performance of the TSLS cross section, the below equations are required

$$A=(b+z_1y_1)y_1+(b+2z_1y_1+z_2y_2)y_2 \tag{1}$$

$$P_s=y_1\sqrt{1+z_1^2}+y_2\sqrt{1+z_2^2} \tag{2}$$

$$A_f=(b+z_1y_1)y_1+(b+2z_1y_1+z_2y_2+z_2f)(y_2+f) \tag{3}$$

$$P_{sf}=y_1\sqrt{1+z_1^2}+(y_2+f)\sqrt{1+z_2^2} \tag{4}$$

$$T_f=b+2z_1y_1+2z_2(y_2+f) \tag{5}$$

In these equations, A=cross section area of flow; P_s=wetted length of the channel side; A_f=cross-sectional area, including the freeboard; P_{sf}=length of the channel side, including freeboard; and T_f=channel top width at the freeboard. As seen, the relationships for the TSLS cross-sectional area and perimeter are very simple.

Economical Performance Evaluation

To evaluate the cost performance of the TSLS cross section, the cases mentioned in the original paper are considered. These cases are divided in two groups. In the first group, the unit lining costs are assumed as $c_1=0.6$, $c_2=0.1$, $c_3=0.2$, $c_4=0.4$, and the corre-

Table 1. Optimal Dimensions of the TSLS Cross Section for Various Scenarios [Different Unit Lining Costs ($c_1=0.6$, $c_2=0.1$, $c_3=0.2$, and $c_4=0.4$) and Different Manning's Roughness Coefficients ($n_1=0.02$, $n_2=0.018$, and $n_3=0.015$)]

Optimization scenario[a]	y_1 (m)	y_2 (m)	d (m)	b (m)	z_1 (m/m)	z_2 (m/m)	f (m)	T_f (m)
ur, ffb	1.834	2.934	4.768	2.228	1.20	0.10	0.500	7.325
dc, ffb	1.410	2.090	**3.500**[b]	5.332	1.06	0.10	0.500	8.838
dc, ffb	0.082	1.918	**2.000**	13.116	6.23	0.30	0.500	15.591
sc, ffb	1.173	3.523	4.696	1.568	1.68	**0.40**	0.500	8.731
twc, ffb	1.774	2.796	4.570	2.094	1.33	0.18	0.500	**8.000**
Ur, ddfb	1.659	2.625	4.284	3.310	1.14	0.10	0.517	7.733
Dc, ddfb	1.428	2.072	**3.500**	5.300	1.07	0.10	0.468	8.850
Dc, ddfb	0.895	1.105	**2.000**	13.142	0.96	0.10	0.354	15.155
Sc, ddfb	0.929	3.187	4.116	2.798	1.69	**0.50**	0.507	9.635
twc, ddfb	1.481	3.302	4.783	2.883	1.13	0.10	0.547	**7.000**

[a]ur=unrestricted, ffb=fixed freeboard, dc=depth constrained, sc=slope constrained, twc=top width constrained, and ddfb=depth-dependent freeboard.
[b]The bold value is the constraint for the respective scenario.