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4005-SHP-L-01-02056-00

5 November 1985

Mr. Ted Johnson
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555
Mail Stop SS-623

Subject: UMTRA PROJECT - SHP
Shear Stress Coefficients for Erosion Protection Design

Dear Mr. Johnson:

During your meeting with G. R. Thiers in Denver on 31 October 1985 you asked for additional information regarding the shear stress coefficients used in calculations for erosion protection design for triangular and trapezoidal ditches for the Shiprock site. The coefficients used were obtained from National Cooperative Highway Research Program Report 108, "Tentative Design Procedure for Riprap-Lined Channels", 1970, as follows:

1. For triangular channels, Figure 10 gives a coefficient C_s, such that maximum shear stress = $C_s \gamma y S$.

2. For trapezoidal channels, Figure 12 gives a coefficient C_{Rb}, such that maximum shear stress = $C_{Rb} \gamma RS$.

Xerox copies of Figures 10 and 12 are attached. If you need additional information, please call.

Sincerely yours,

T. R. Wathen

T. R. Wathen, P.E.
Engineering & Design Manager

TRW:GRT:kfb

cc: J. G. Oldham

Attachments: As stated above.

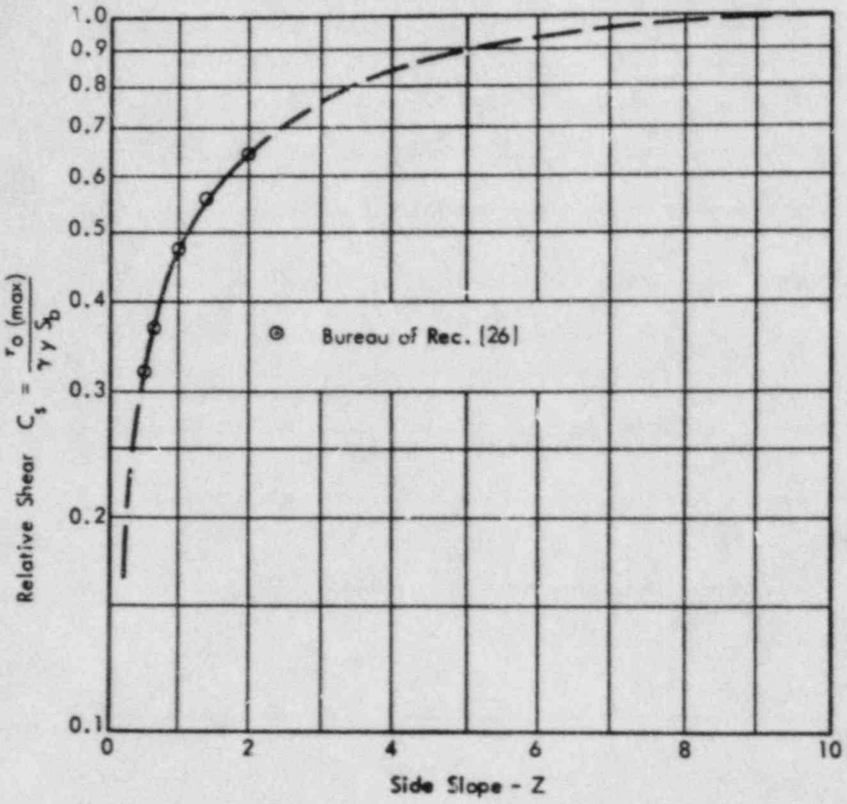

Figure 10. Maximum boundary shear stress on sides of triangular channels.

side slopes. As the channel gets narrower (less than 1:2) the shear on the bed decreases, whereas that on the sides tends to increase relative to the mean. Because the trapezoidal channels of interest have values of B/y greater than 2 and side slopes steeper than 1:4 the value of maximum shear can be conservatively approximated as

$$\tau_{o(max)} = 1.5\,\gamma R S_b \tag{23}$$

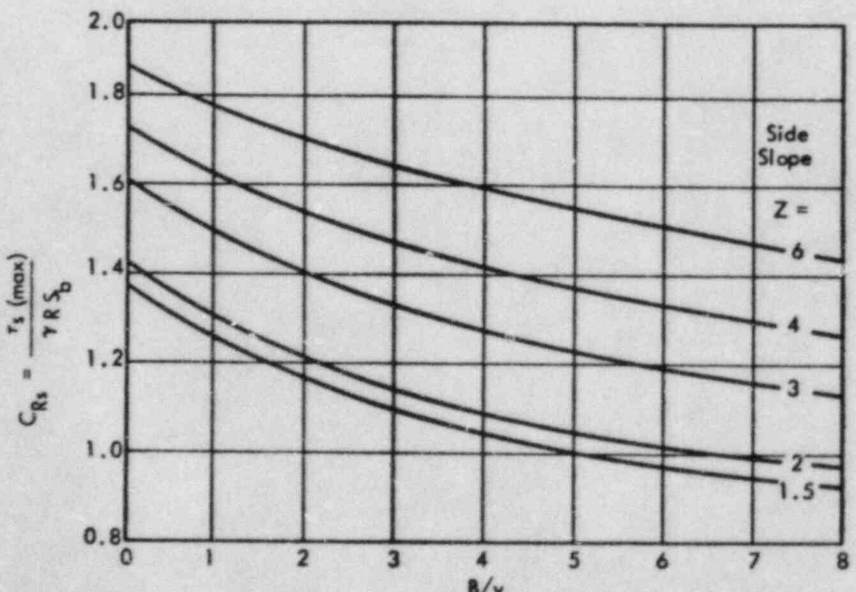

Figure 11. Maximum boundary shear stress on sides of trapezoidal channels.

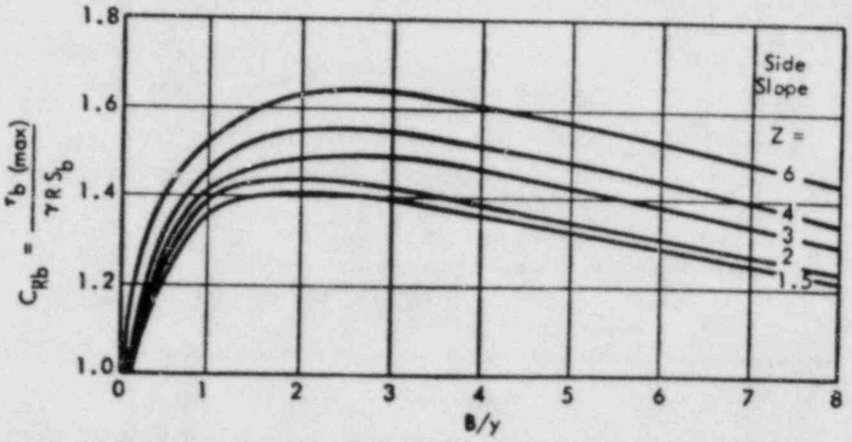

Figure 12. Maximum boundary shear stress on bottom of trapezoidal channels.

This is further substantiated by measurements (*28*) of the shear distribution in trapezoidal channels of relatively steep side slopes reproduced in Figure 13. The range of data for the several channels is included in the shaded portion. From this diagram it also appears that the maximum shear on the bed may be taken as 1.5 times the mean shear on the entire wetted perimeter.

The stability of the riprap lining of a trapezoidal channel implies that the riprap on the sloping sides of the channel will be as resistant to motion as that on the bottom. The ratio of the maximum shear on the sides to the maximum shear on the bed can be determined from Figures 11 and 12 for corresponding side slopes and values of B/y. These data are plotted in Figure 14, which further shows that except for the smaller values of B/y the maximum bed shear is greater than the maximum side shear. Again, considering the range of values of side slope and B/y of concern the ratio of these shears can be approximated by a single value as being representative of a large number of channels. This representative value can be taken, somewhat arbitrarily in view of the approximations used in establishing the curves, as

$$\frac{\tau_{s(max)}}{\tau_{b(max)}} = 0.8 \qquad (24)$$

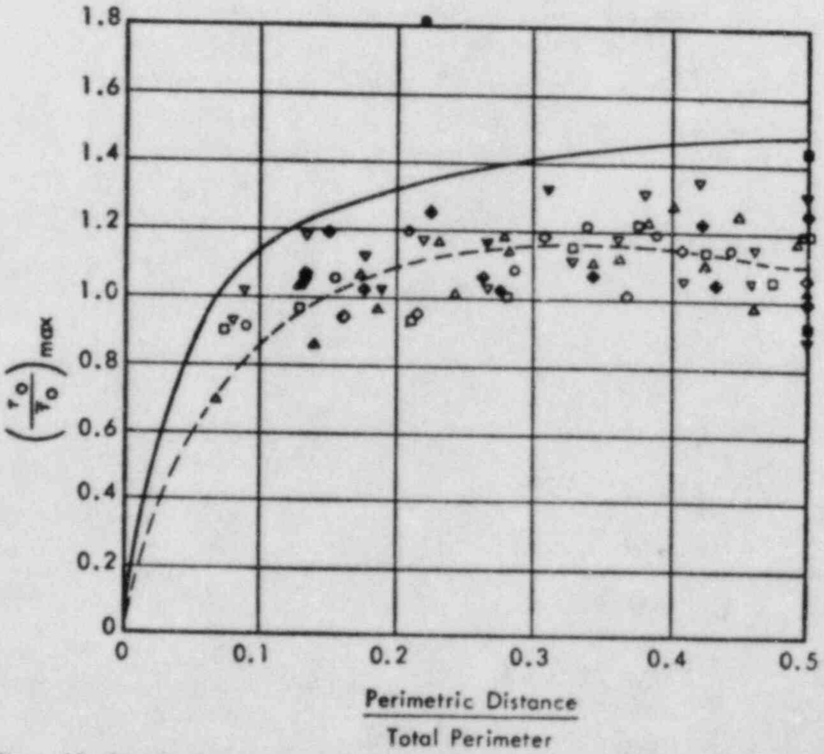

Figure 13. Distribution of boundary shear stress in trapezoidal channels.