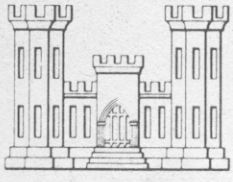
MISSOURI RIVER

TEMPERATURE EFFECTS IN THE TRANSITION FROM DUNES TO PLANE BED

PREPARED BY

U.S. GEOLOGICAL SURVEY
IN COOPERATION WITH
U.S. ARMY CORPS OF ENGINEERS



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SUMMARY AND CONCLUSION

When the flow regime is close to the transition zone, the temperature effects on the flow characteristics, sediment transport rate, bed configuration and its resistance to flow become quite significant. It is found in many cases that a decrease in temperature removes the dunes from the sand bed, decreases flow resistance and depth, and increases flow velocity and sediment transport rate.

Stability theory that includes the effect of temperature on the flow characteristics in alluvial channels was developed by Engelund and Fredsøe (1974). The theory shows qualitatively the temperature effects on the flow field. To quantitatively predict temperature effects, the idea of disturbed flow on bed forms developed from the stability theory is introduced to describe the form roughness. An equation relating the form drag to the disturbed shear stress is thus derived. This relation yields suitable form drag for low temperatures where the bed is smooth but not for high temperatures with a dune bed. A correction factor introduced in the equation indicates that the form drag is about twice as much as that evaluated from the stability theory.

A set of design curves is developed from the stability theory to estimate the flow resistance in terms of evaluation of flow depth and velocity including temperature as a major factor. The initial data required to apply the procedure are the unit water discharge, water temperature, energy slope, and particle size distribution of bed material.

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