Application of Electrical Analogy to Draw Flow Nets for Sudden Draw-down conditions in Earth Dams*

by

L.S. Joshi
A.P. Misra

1. G.C. Misra** and B.K. Mohanty***

Immediately after the sudden draw-down, the upstream face of the earthdam is a surface of seepage along which

$$\phi + ky = 0, \qquad \ldots (1)$$

Where ϕ is the potential function,

k = coefficient of permeability,

and y is the vertical co-ordinate. Therefore, the authors' assumption that the upstream face is a stream line, is not correct. Also the phreatic line of the steady state seepage condition, after the drawdown, is no longer a stream line as stated by the authors.

In order to analyse the draw down case by the use of electrical analogue the upstream face and the saturation line (phreatic line of the steady state case) should be connected seperately to potentiometers such that the difference in potentials between two consecutive points on them should be equal to the difference in their y co-ordinates. It is not correct to apply a potential to a point along the base of the dam as done by the authors. When the variable potentials along the upstream face and saturation line are applied by means of potentiometer, point A and the down-stream drain being connected to zero potential, the point p, which is the water-divide, is the location of maximum potential along the base.

With all these corrections it will be useful if the authors find out the flownet immediately after the sudden draw down for different upstream slopes and location of down-stream drain.

2. S.P. Brahmat****

The author, in this paper has demonstrated the use of electrical analogy method for obtaining flow nets for sudden drawdown conditions in earth

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** Lecturer, Civil Engg. R.E. Collge Rourkela.

*** Asst. Design Engineer, MECON (India) Ltd.
Rourkela site office, Rourkela.

**** Professor in Civil Engineering, B.E. College, Howrah, West Bengal.

dams, on the basis of the following unstated assumptions :

(*a*) a transient flow situation has been assumed as a steady state case for the duration of study.

and (*b*) the flow has been assumed to be unaffected by gravity.

About the first assumption it may be mentioned that the boundary of the flow region is changing with time and therefore this assumption itself introduces some error as the potential of the upstream boundary can be changed immediately in the laboratory setup while in actual case the lowering of head in reservoir will take some time. The suitability of using electrical analogy of the kind used by the author for cases where the potential will be affected by gravity is questionable and I quote "An additional limitation on the electrical model is that the electric potential is unaffected by gravity; hence the method requires a period that the flow system be confined" (Harr (1962).

It may be mentioned also that the problem of seepage characteristics of a soil mass with an inclined slope for rapid drawdown had been studied by Shestakov (Shestakov 1953). Later the writer had studied the development of the free surface in a homogeneous earth dam with any orientation of upstream slope and the history of reservoir level (Brahma & Harr 1962). Once the location of the free surface is known for a particular instant due to a rate of lowering of reservoir level, the equipotential lines or flow nets can be easily drawn assuming the flow to be steady at that moment.

References

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