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7955 DISCUSSION

A continuous method of analysis for the inflatable dam

R. D. PARBERY

Mr A. M. Stodulka, AM

The Author has filled a large gap in the mathematical analysis of the behavioural properties of the instability of inflatable dams in the region of critical pressures and/or upstream heads.

38. In reference 5 I observed conditions of instability in actual model cases, namely small perturbations, and/or the influence of end conditions which would determine the shape in the 'dual solution' cases. Normally minor turbulence in the water caused second solutions to occur (probably a state of lesser potential energy).

39. The mathematical analysis in the cross-sectional plane is inadequate to account for vee notching[6]—a phenomenon observed in the analysis of air or partial air/water inflated models of adequate length/perimeter ratio. This instability effect or vee notching effect occurred when F/H was less than or equal to $\frac{1}{2}$. The model changed shape from approximately the first solution to approximately the second solution at the centre, the ends maintaining the first solution shape. This trend appears to be confirmed by the change in volume between the two solutions in Fig. 7. The exact mechanism proposed in § 36 would usually not be observed due to end effects and the much greater severity of the collapse (Fig. 10).

40. The simple and fast string analogue solution[6] indicates the correct shape and tension in the membrane within constructional tolerances for all cases. The method is simple enough for most technicians to use and gives a good feel of the type of stability condition in which the membrane exists for a given set of conditions.

41. In spite of changing the Newton iteration method (used in the Harrison finite element analysis) to the Simplex iterative method[6] instability still occurred, albeit less frequently than before.

42. The results of Fig. 6 are questioned as Harrison's analysis, confirmed by experiment,[5] indicates a decreasing tension for an increasing head in the water inflated case.

Mr Parbery

I agree that the two-dimensional model of the cross-section does not give the comprehensive picture that could be obtained from a full three-dimensional model. However, I believe that it goes some way towards explaining observed phenomena which have not hitherto had a theoretical explanation. As Mr Stodulka points out, the vee notching phenomenon is effectively the local appearance of second solutions. The shape would, of course, be modified because of the three-dimensional nature of the deflexions, the hydrodynamic effects and end effects. The occurrence of surging or snaking oscillations which has been reported[1,6] both on models and full size structures appears to be

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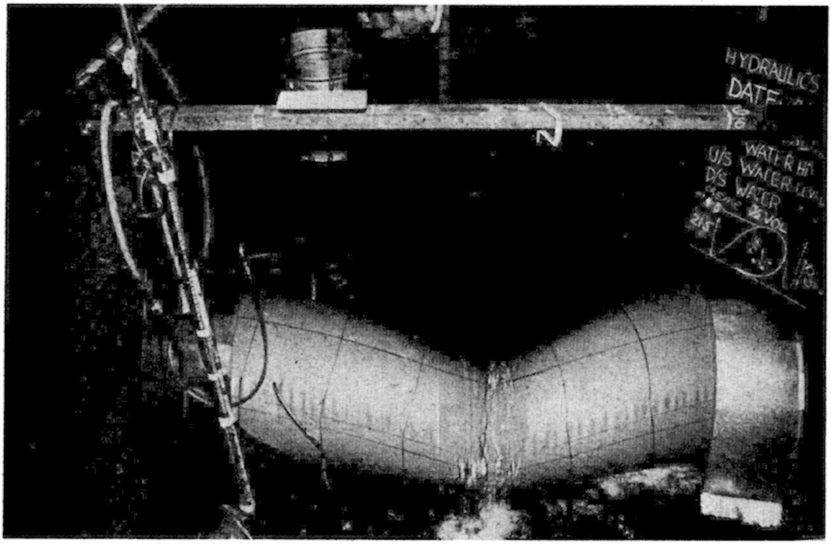

Fig. 10. 2ft × 8ft long model, constructed at the University of Sydney, when $F/H \simeq \frac{1}{2}$. The vee notch happened quite suddenly and in some cases the dam did not return to normal until the internal pressure was raised. Due to the unpredictable nature of the collapse it is recommended that in cases where life may be endangered downstream air inflated dams are not used and if they cannot be avoided F/H is greater than $\frac{1}{2}$

approximately the behaviour conjectured in § 36 on a localized scale, i.e. a local flip-flop action occurs between the two equilibrium positions. The solution would be affected by the factors already mentioned. It can now be seen that the localization of these effects might be reduced by the use of longitudinal stiffeners rather than transverse stiffeners or dampers.[5,7] It remains to be seen whether two equilibrium positions are indeed possible under hydrodynamic conditions.

44. It is difficult to understand the assertion that instability occurs when $F/H \simeq \frac{1}{2}$ because this depends on the air pressure. The example in Fig. 8 shows that it is possible to have no such instability even with air inflation only ($F=0$), at least in the static case.

45. The results of Fig. 6 are for an air inflated dam. The results for the water inflated dam (Fig. 9) agree well with those of Harrison.[3]

References

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