*Chapter-6*

# GENERAL CONCLUSIONS AND SCOPE OF FURTHER STUDIES

## 6.0 General

The improved model for uplift pressure calculation in cracks under crack-wall motion is discussed with respect to result closer to experimental values available in the literature. The conclusions for various formulations and assumptions proceeds backward from the satisfactory result of dam-crown deflection.

The present mathematical models are subjected to various simplifying assumptions. After relaxing those assumptions and coupling the mathematical modeling for additional phenomenon, the scope of present modeling can be extended enormously.

## 6.1 Conclusions

The following conclusions may be drawn on the basis of the result of dam-crown deflections.

- Formulations of uplift pressure in the cracks of constant length almost accurately simulate the experimental result available in the literature. This formulation can also be applied in case of fast and slow moving crack walls under changing crack-mouth pressure.
- Assumed sinusoidal and exponential CMOD functions during opening and closing mode respectively under the effect of creep phenomenon in

FPZ is a good approximation. Its application in calculating the result for uplift pressure in cracks yields quite closer result to dam-crown deflections.

- Various assumptions in arriving at the result for uplift pressure calculation in cracks closely approximate the real phenomenon like crack interactions, crack propagation, fatigue etc.
- Two dimensional FEM formulations with triangular elements for dam-crown deflections with assumed boundary conditions give the convergent solution.
- Though at some points of dam-crown deflection curves, the differences between calculated and field values are large but overall very low values of RMSE reveals a closer results.
- Uplift pressure at the dam-foundation as recommended by USACE gives factor of safety against sliding varies very slowly with reservoir level. But when uplift pressure calculated from present model is applied, the factor of safety decreases very fast and tries to go below the value of one at the end of each cycle. This shows that a USACE criterion of uplift at the base of the foundation is less conservative in comparison to present model in calculating the factor of safety against sliding.
- Portion of the dam lying above the section taken along the crack located at slope changing point at the upstream face of the dam is more stable from present model in comparison to USACE criteria.
- From above point it may also be concluded that dam section lying above the dam foundations are more stable from present model than USACE criteria.

## 6.2 Scope of Further Study

Present model can be improved after taking into account the following factors.

- Uplift model in the cracks can be improved after taking into account the (i) the wall permeability, (ii) curvilinear crack walls, (iii) crack propagation, (iv) water compressibility, (v) cavitation, (vi) combining the sliding and tearing mode of crack tip displacement and (vii) Alkali-silica reactions etc.
- A detail investigation is required for studying the CMOD rate under the influence of creep in FPZ and it's up scaling for prototype application.
- There is a need of prototype determination of fracture toughness under various conditions like (i) constant/varying amplitude cyclic loads, (ii) uplift conditions and (iii) multiple crack interactions.
- Experimental and theoretical methods are required for determination of prototype crack geometry and its location.
- Modeling of dam-crown deflections after taking into account the creep phenomenon in dam-body.
- Calculation of FSS after taking into account the different loading conditions.
- Calculation of Factor of safety against overturning.