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Dam Safety Risk Assessment (Case Study: Flood Risk for Golestan Dam)

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ABSTRACT

In dam construction industry, the safety of dam is one of the most important challenges that should be considered in design, construction and operation phase. Recently, use of quantitative risk analysis, as a useful tool in dam safety risk management, is rapidly increasing. In this paper, first, risk assessment methods in dam safety are investigated and australian national committee on large dams (ANCOLD) guideline for dam safety risk assessment is detailed. Then, as a case study, safety of Goleastan dam, in northeast of Iran, is assessed considering risk analysis approach for upstream flood hazard. For calculating the probability of failure of dam, the various methods were assessed and finally event tree analysis (ETA), as most commonly method in dam safety risk analysis was used. The number of life losses due to flooding of Golestan dam break is estimated based on united states bureau of reclamation (USBR) methodology, known as DSO-99-06. Finally, according to calculated risk and comparing with different criteria for acceptable risk, it is obvious that the risk of Golestan dam break due to upstream flood is unacceptable and immediate risk reduction measures are necessary.

KEYWORDS:

Safety Risk Assessment, Golestan Dam, Evant Tree Analysis, Flood Hazard

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1- Introduction

The safety of dam is one of the most important issues in dam construction industry in design, construction and operation of phases. In dam safety, dam break is most threatening event for a dam. As dam break is associated with vulnerability and risk, risk analysis methods can be used for dams risk management. In recent years, importance and use of quantitative risk analysis is rapidly increasing.

In this paper, quantitative risk assessment of dam break is considered. For this purpose, risk analysis of Golestan dam, in north of Iran, due to upstream flood hazard is done by using ANCOLD guideline [1] and its results are evaluated.

2- Methodology, discussion and results

Risk assessment is a decision-making process that helps for risk management. It contains two main parts; risk analysis and risk evaluation phases. In this research, quantitative risk analysis method has been used for probability estimation of the event and its consequences. For risk assessment according to ANCOLD guideline steps has been done as shown in Fig. 1.

There are several methods for dam failure probability estimating. Here, event tree analysis (ETA) method, as commonly used method in dam safety risk analysis, is used for estimating and calculating the probability of Golestan dam failure because of upstream flood. According to this Method, total annual failure probability of Golestan dam caused by upstream flood is 3.97E-06.

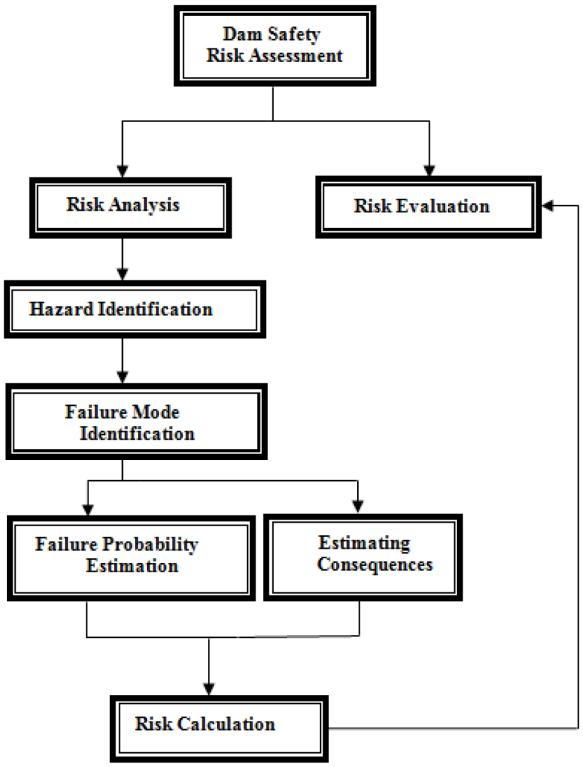

Fig. 1. Steps for dam safety risk assessment

The next part of algorithm is estimating consequences of dam failure. Here the loss of life caused by dam failure is considered and DSO-99-06 (USBR) instruction is used for calculating the number of fatality. For this, two cases are considered; dam failure in day and in night. According to flooded map, inundation area is determined, so number of people at risk can be obtained. Then the number of loss of life due to Golestan dam break, based on DSO-99-06 procedure, is estimated [2].

For estimating the risk, the definition of risk that presented by USBR is used as follow [4]:

$$\text{Risk} = P(\text{loading}) * P(\text{fail}|\text{loading}) * \text{Consequences} \quad (1)$$

where P (loading) is probability of a load range, P (fail|loading) is probability of failure of dam caused by that load range, and Consequence is the number of fatality caused by dam failure due to that load range.

According to this equation number of fatality in other words, the risk of Golestan dam failure because of upstream flood when dam break happen in day, is 5850 person and when dam break happen in night is 14300 persons.

Considering calculated risk, it would be possible to evaluate the importance of risk and classify it as "acceptable risk", "tolerable risk" or "unacceptable risk". In this research, importance of risk is evaluated by using of well-known criteria, namely Health and Safety Executive (HSE) triangle and f-N curve of USBR [3].

3- Conclusions

Dam safety evaluation is an important issue in dam industry and use of risk assessment methods in this field has been increased in recent years. In this paper, an instruction for dam safety evaluation was presented, considering risk analysis approach for upstream flood hazard. For definition failure process of dam and estimating the probability of failure, event tree analysis method was used. For estimating the number of life losses due to flooding of dam break the DSO-99-06 procedure was used. Golestan dam in northern district of Iran was considered as case study. With using available data, probability of failure

was estimated and associated risk was calculated for upstream flood. According to calculated risk and comparing with different criteria for acceptable risk, it is obvious that the risk of Golestan dam break due to upstream flood is unacceptable and immediate risk reduction measures are necessary.

4- References

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