Multi-Objective Optimization of Gravity Dams by Artificial Bee Colony Algorithm

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Abstract

An efficient methodology is proposed to find the optimal shape of gravity dams including fluid structure interaction subject to earthquake ground motion. In order to reduce the computational cost of optimization process, an adaptive artificial bee colony algorithm (ABC) is built to predict the dam effective response instead of directly evaluating it by a time-consuming finite element analysis (FEA). In this paper, a visual operation interface and a main program for computation are developed on the basis of constrained nonlinear complex optimization algorithm, Visual Studio programming language and parametric drawing techniques. They mainly help solve such problems as multi-state constraints and complexity of programs in optimal design of gravity dam section. The computing results show that the newly developed program is of high accuracy. While improving computation efficiency, it can also enhance human-computer interaction. In this research use SIMULIA Abaqus for gravity dam structural FEM analysis and C# programming for ABC algorithm by conducting data exchange by PARIS algorithm.

Keywords: gravity dam; optimization; artificial bee colony

1. INTRODUCTION

A concrete gravity dam is made up of multiple dam monoliths so as to fit itself in with deformation of the foundation, variation of temperature in concrete and feasibility of concreting, shown schematically in Fig. 1. These dam monoliths stand along the dam axis line, and any two neighboring monoliths are separated with a transverse joint. Therefore, each dam monolith is regarded as functioning independently.

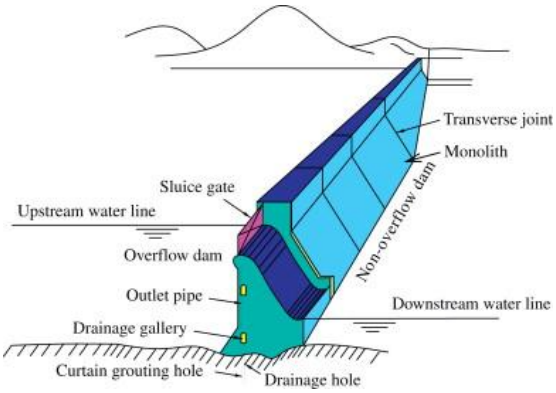

Fig.1 Sketch of gravity dams

In the last years, some progress has been made in the shape optimal design of gravity dams. The main difficulty associated with the optimization of gravity dams is the burden of much computational cost due to numerous time consuming dynamic analyses. In order to overcome this difficulty, some useful techniques