



A STATE-OF-ART REVIEW ON OPTIMIZATION OF MATERIAL AND CONSTRUCTION COST OF AIR COOLED CONDENSER SUPERSTRUCTURE

Navroz¹, Suhasini Kulkarni²

¹PG Student, Department of Civil engineering, Parul University, Vadodara

²Assitant Professor, Department of Civil engineering, Parul University, Vadodara

Abstract- Air-cooled condensers were first popularized into the U.S. power industry, but only during the last decade has the number of establishments greatly elevated to a great extent in reaction to the increasing application being paid to atmospheric interest. The scope of the exploration is to study a mode to minimize weight of big and heavy columns of Air Cooled Condensers during initial design period. The aim of this paper is to identify a method to minimize the weight of supporting structure of Air Cooled Condensers using Genetic Algorithm. Literature survey is carried out to review various criteria which are to be considered for the structural design of supporting structures of Air cooled condensers and optimization of structures using Genetic Algorithm approach. Survey from various research papers has been carried out to support the present work.

Keywords- Air cooled condensers supporting columns; literature survey; optimization; genetic algorithms.

I. INTRODUCTION

Water requirements for thermal plants and mainly for steam generation can impart a meaningful stress on restricted local and sectional freshwater provisions. A way to minimize this cooling water requirements is the use of direct dry cooling, which need no wasteful use of water use and can minimize a power plants water requirements by 95 percent. Increasing requirements of water for both domestic and commercial use has procured a high result in use of Air cooled condensers.

A lot of study and research regarding the design optimization of supporting structures of Air cooled condensers is done in past decades. Many examples of supporting structure called modules sections are used in power plants. The weight optimization of supporting columns of Air cooled condensers is a critical and crucial issue in the field of power plants. The use of Genetic Algorithm method at initial design course can be very useful to attain a better project of mass reduction in the next administrative phase with money saving advantages. The following sections describes the study related to the structural optimization as well as genetic algorithm.

II. GENETIC ALGORITHMS

Genetic Algorithm is one type of evolutionary algorithm which is used for determining functions of optimization procedures. The execution of a genetic algorithms needs the definition of representation, fitness function, parent selection and survivor selection mechanisms as well as crossover and mutation operators. In particular, fitness is the value of the objective function in a minimization problem.

Selection: The GA used in this study proceeds by first generating a solution population in whatever way of a specific size. From this populace, the next generation of design is derived by performing three unique operations like replication, crossover and mutation. There are number of reproduction ways used in GA as these include ranking selection, tournament selection, steady state selection, etc.

Crossover: Crossover is one of the most extensive operators in GA. There are lots of crossover patterns; such as multi-point crossover and uniform crossover. Crossover is executed by isolating all substrings from an individual string with irregular crossover probability.

Mutation: Mutation is a genetic operator used to preserve genetic distinction from one generation of a population of genetic algorithm chromosomes to the next. Mutation flips one or more gene values in a chromosome from its beginning state. In mutation, the solution may advance exclusively from the preceding solution. Hence GA can come to superior result by using mutation.

III. LITERATURE REVIEW

Parag Mishra, Manoj Arya. (2015) "A Review of Literature on Air Cooled Steam Condenser (A Heat Exchanger used in Thermal Power Plants)" International Journal of Research in Aeronautical and Mechanical Engineering, p. 1-8

In this research paper, the author has discussed basics mode of condensers like Water cooled condensers, Air cooled condensers. The main focus is made on the Air cooled heat exchanger's consumption of auxiliary power.

The conclusion of the literature review shows that power savings can be obtained in Air cooled heat exchangers by proper working of fan, pumps, motor, etc.

Hatindera Singh, Hardeep Singh Rai, Jagbir Singh. (2014) "Discrete Optimization of One Way Slab using Genetic Algorithm" International Journal of Engineering, Business and Enterprise Application 9, p. 116-121.

In this paper, Searching method called Genetic Algorithms which reside higher class of evolutionary algorithms was totted out. Distinct variables are used in this study as variable in order to optimize the cost of the structure.

In the conclusion, the method of optimization shows how the designer to find finest design under assembly deliberations. The emerging assembly had minimum price and fascinated with strength and serviceability demands in accordance with IS 456.

Xiao Jianchun, Chen Jing, Li Q, Xia Shaoquan. (2012) "Shape and Cross section Optimization of Spatial Grid Structures using Genetic Algorithms" Advance Materials Research, p. 1463-1467.

In this paper the author described an approach to optimize a structure as the irregular quantities have various physical characteristics. Using constraints like structural deformation, stability of members, slenderness ratio, optimization of shape and spatial grid structures is performed using Genetic Algorithm.

The coding and scripting is done in GA Toolbox of MATLAB and the result shows that the program is decisive and the concurrence of algorithm is fast.

Ahmed. B. Senouci, Mohammed. S. Al-Ansari. (2009) "Cost Optimization of Composite Beams using Genetic Algorithm" Advances in Engineering Software 40, p. 1112-1118.

This study shows genetic algorithm approach for cost minimization of composite beams. Two construction examples are evaluated for validation purpose. The miniature production includes cost of different sections.

In the conclusion, it is shown that the result obtained through genetic algorithm approach gives better cost savings for high beam spans and different load conditions.

SenayAtabay. (2008) "Cost Optimization of Three Dimensional Beamless Reinforced Concrete Shear Wall Systems via Genetic Algorithm" Expert Systems with Applications 36, p. 3555-3561.

In the present research, cost optimization is performed for concrete structures using genetic algorithm approach. The shear wall parameters are considered as construction irregular quantities in order to minimize the material cost of shear wall. The checks are performed in accordance with Turkey codes. For a Thirteen storey beamless shear wall assembly, the conclusion shows that the suggested algorithm can be used to minimize the cost of the structure.

Huaguo Wang, Hiroshi Ohmori. (2013) "Elasto Plastic Analysis based Truss Optimization using Genetic Algorithm" Engineering Structures 50, p. 1-12.

In this paper, the collapsed load factor for truss configuration is anticipated by applying elasto plastic incremental method. The result obtained is integrated into Genetic Algorithm to develop an optimized section of truss. Two minimization problems were solved using this approach and the results shows the fortunate awareness of planned minimization system.

Maggie Kociecki, HojjatAdeli. (2013) "Two Phase Genetic Algorithm for Topology Optimization of Free From Steel Space Frame Roof Structures with Complex Curvatures" Engineering Applications of Artificial Engineering 32, p. 218-277.

In this research paper, two real life space roof structures are optimized using Genetic Algorithm approach. This study shows that hoe effective Genetic Algorithm approach is foe optimizing a structure with respect to its topology where both

the major axis and minor axis are governing the bending construction. The conclusion shows that there was a saving of 4% more economical than initial design.

Jose. R. Viller, Maria.S Fernandez, Pablo Vidal, Manuel Guaita. (2016) “Genetic Algorithm Optimization of Heavy Timber Trusses with Dowel Joints according to Euro code 5” Biosystems Engineering 144, 115-132.

In this paper, a genetic algorithm programming is done in MATLAB twenty four stiff miniature. Trusses with different number of nodes are calculated. In this study, the depth of the truss is optimized in order to achieve truss minimization. The relation is shown between truss economy and number of nodes of the truss.

The conclusion showed that irrespective of the volume of timber, the optimized section of truss can be obtained using genetic algorithm approach with least number of joints.

VedatTogan, Ayse. T. Daloglu. (2006) “Optimization of 3d Trusses with Adaptive Approach in Genetic Algorithms” Engineering Structures 28, p. 1019-1027.

This paper shows that the adaptive method impacts the output of genetic algorithm with the aim of optimizing space truss. The study describes that how the penalty function as well as mutation and crossover rates can be revised. Design restrictions like displacement and tensile stress can be useful to optimize the space truss using genetic algorithm.

In the conclusion it shows that organizing with each other along with adaptive method to enhance better minimizing results.

PurvaMajumdar, VasantMatsagar. (2015) “Design Optimization of Steel Members Using Openstaad and Genetic Algorithm” Advances in Structural Engineering, p. 233-244.

In this paper, two miniatures have been developed for analysis and minimization of steel members. The optimization of steel sections was done using genetic algorithm. First miniature was developed using STAAD Pro using OPENSTAAD function while second process took into consideration the optimization of same representative. In the second process, the developed model was optimized using GA Toolbox in MATLAB software in order to get highest utility ratio.

In the conclusion, it was observed that the genetic algorithm based result was established to be superior from both serviceable and pragmatic point of view.

IV. CONCLUSIONS

- From all the literature reviews shown in this paper, different ways can be identified to optimize the supporting structure of Air Cooled Condensers.
- Firstly the nature of the problem is to be identified like whether a problem is a Discrete constrained optimization problem, continuous constrained optimization problem, etc. Then Various Objective functions can be determined in order to reduce the weight of the structure using Genetic Algorithms.
- Different parameters can be considered as constant parameters while keeping one or two parameters as design variables. Many number of constraints can be developed for a particular objective function and if there is any violation in constraint, a penalty function has to be defined in order to get desired optimized results.
- Thus by evaluating different objective functions and considering different number of constraints as per Indian Standard specifications, the weight and construction cost of the structure can be optimized using Genetic Algorithms.

REFERENCES

1. Parag Mishra, Manoj Arya. (2015). A Review of Literature on Air Cooled Steam Condenser (A Heat Exchanger used in Thermal Power Plants). International Journal of Research in Aeronautical and Mechanical Engineering, p. 1-8.
2. Hatindera Singh, Hardeep Singh Rai, Jagbir Singh. (2014). Discrete Optimization of One Way Slab using Genetic Algorithm. International Journal of Engineering, Business and Enterprise Application 9, p. 116-121.
3. Xiao Jianchun, Chen Jing, Li Q, Xia Shaoquan. (2012). Shape and Cross section Optimization of Spatial Grid Structures using Genetic Algorithms. Advance Materials Research, p. 1463-1467.
4. Ahmed. B. Senouci, Mohammed. S. Al-Ansari. (2009). Cost Optimization of Composite Beams using Genetic Algorithm. Advances in Engineering Software 40, p. 1112-1118.
5. SenayAtabay. (2008). Cost Optimization of Three Dimensional Beamless Reinforced Concrete Shear Wall Systems via Genetic Algorithm. Expert Systems with Applications 36, p. 3555-3561.
6. Huaguo Wang, Hiroshi Ohmori. (2013). Elasto Plastic Analysis based Truss Optimization using Genetic Algorithm. Engineering Structures 50, p. 1-12.

7. Maggie Kociecki, HojjatAdeli. (2013). Two Phase Genetic Algorithm for Topology Optimization of Free From Steel Space Frame Roof Structures with Complex Curvatures. *Engineering Applications of Artificial Engineering* 32, p. 218-277.
8. Jose. R. Viller, Maria.S Fernandez, Pablo Vidal, Manuel Guaita. (2016). Genetic Algorithm Optimization of Heavy Timber Trusses with Dowel Joints according to Euro code 5. *Biosystems Engineering* 144, 115-132.
9. VedatTogan, Ayse. T. Daloglu. (2006) "Optimization of 3d Trusses with Adaptive Approach in Genetic Algorithms" *Engineering Structures* 28, p. 1019-1027.
- PurvaMajumdar, VasantMatsagar. (2015) "Design Optimization of Steel Members Using Openstaad and Genetic Algorithm" *Advances in Structural Engineering*, p. 233-244.