MODEL ANALYSIS OF A THERMAL POWER PLANT COOLING TOWER

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ABSTRACT

Regular Draft Hyperbolic Cooling towers are the describing land signs of power station. They contribute both to a productive vitality yield and to a cautious equalization with our surroundings.

In this thesis the cooling towers modeling n CREO parametric software with different cooling tower thickness (200,250,300,400 & 500 mm) and analysis in ANSYS software. We find the analytical problems of cooling tower in thermal power plants static and modal analysis.

In this thesis the static analysis to determine the deformation, stress and strain and modal analysis to determine the deformations with respect to frequencies at different mode shapes.

Key words: Finite element analysis, cooling tower, CFD analysis, thermal analysis.

1. INTRODUCTION

A cooling tower is a heat rejection device that rejects waste heat to the atmosphere through the cooling of a water stream to a lower temperature. Cooling towers may either use the evaporation of water to remove process heat and cool the working fluid to near the wet-bulb air temperature or, in the case of closed circuit dry cooling towers, rely solely on air to cool the working fluid to near the dry-bulb air temperature.

Common applications include cooling the circulating water used in oil refineries, petrochemical and other chemical plants, thermal power stations and HVAC systems for cooling buildings. The classification is based on the type of air induction into the tower: the main types of cooling towers are natural draft and induced draft cooling towers.

History

A 1902 engraving of "Barnard's fanless self-cooling tower", an early large evaporative cooling tower that relied on natural draft and open sides rather than a fan; water to be cooled was sprayed from the top onto the radial pattern of vertical wire-mesh mats.

Cooling towers originated in the 19th century through the development of condensers for use with the steam engine. Condensers use relatively cool water, via various means, to condense the steam coming out of the cylinders or turbines. This reduces the back pressure, which in turn reduces the steam consumption, and thus the fuel consumption, while at the same time increasing power and recycling boiler-water. However the condensers require an ample supply of cooling water, without which they are impractical. The consumption of cooling water by inland processing and power plants is estimated to reduce power availability for the majority of thermal power plants by 2040–2069. While water usage is not an issue with marine engines, it forms a significant limitation for many land-based systems.

2. LITERATURE REVIEW

Hyperbolic Reinforced concrete cooling towers are effectively used for cooling large quantities of water in thermal power stations, refineries, atomic power plants, steel plants, air conditioning and other industrial plants. Cooling towers are subjected to its self-weight and the dynamic load such as an earthquake motion and a wind effects. In the absence of earthquake loading, wind constitutes the main loading for the design of natural draught cooling towers. A lot of research work was reported in the literature on the seismic &wind load on cooling tower [1 to 5]. G. Murali, Response of cooling tower to wind load. This paper deals with the study of two cooling towers of 122m and 200m high above ground level. They calculated the values like meridional forces and bending moments. A. M. El Ansary, Optimum shape and design of cooling tower, study is to develop a numerical tool that is capable of achieving an optimum shape and design of hyperbolic cooling towers based on coupling a non-linear finite element model developed in-house and a genetic algorithm optimization technique. Shailesh S Angalekar, Dr. A. B. Kulkarni, software package utilized towards a practical application by considering problem of natural draught hyperbolic cooling towers. The main interest is to demonstrate that the column supports to the tower could be replaced by equivalent shell elements so that the software developed could easily be utilized. Prashanth N, Sayeed sulaiman. This paper deals with study of hyperbolic cooling tower of varying dimensions and RCC shell thickness, for the purpose of comparison a existing tower is consider, for other models of cooling tower the dimensions and thickness of RCC shell is varied with respect to reference cooling tower.. N.Prabhakar (Technical Manager). The Paper describes briefly salient structural features and current practices adopted in the structural design of hyperbolic cooling towers. Cooling towers are undoubtedly exceptional structures which require special expertise both to design and construct.

3. METHODOLOGY AND PROBLEM DESCRIPTION

3. PROBLEM DESCRIPTION:

The objective of this project is to make a 3D model of the cooling tower and study the CFD and thermal behavior of the heat exchanger by performing the finite element analysis.3D modeling software
(PRO-Engineer) was used for designing and analysis software (ANSYS) was used for CFD and thermal analysis.

4. INTRODUCTION TO CAD/CAE:

Computer-aided design (**CAD**), also known as **computer-aided design and drafting** (**CADD**), is the use of computer technology for the process of design and design-documentation.

4.1. INTRODUCTION TO CREO

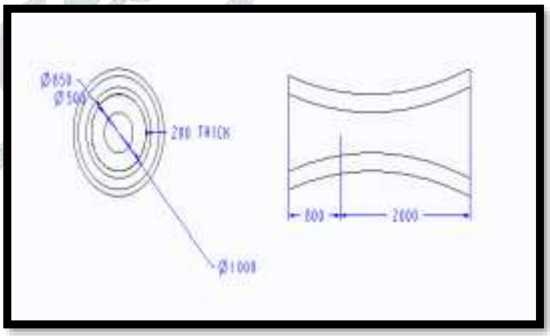
CREO is the standard in 3D product design, featuring industry-leading productivity tools that promote best practices in design while ensuring compliance with your industry and company standards. Integrated CREO CAD/CAM/CAE solutions allow you to design faster than ever, while maximizing innovation and quality to ultimately create exceptional products.

Different modules in CREO

Part design, Assembly, Drawing& Sheet metal.

3D MODEL

2D MODEL



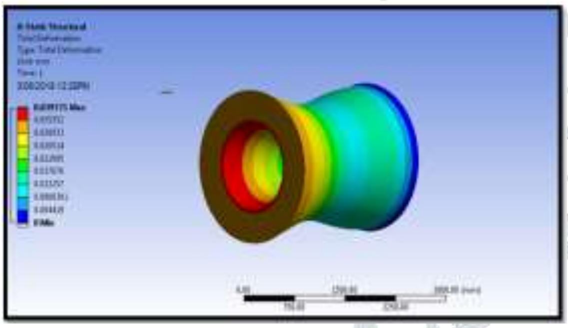
4.2. INTRODUCTION TO FINITE ELEMENT METHOD:

Finite Element Method (FEM) is also called as Finite Element Analysis (FEA). Finite Element Method is a basic analysis technique for resolving and substituting complicated problems by simpler ones, obtaining approximate solutions Finite element method being a flexible tool is used in various industries to solve several practical engineering problems. In finite element method it is feasible to generate the relative results.

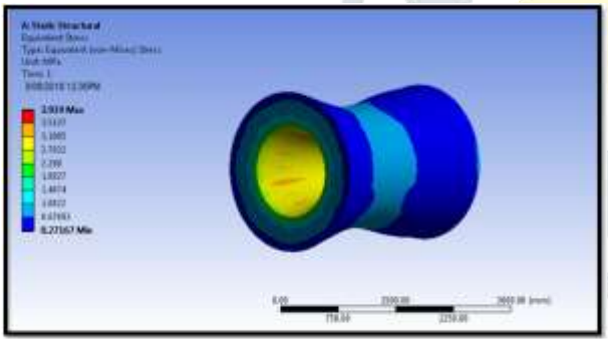
5. RESULTS AND DISCUSSIONS:

AT THICKNESS-500mm

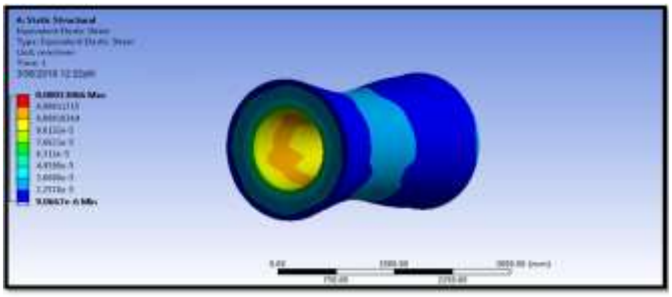
DEFORMATION



STRESS



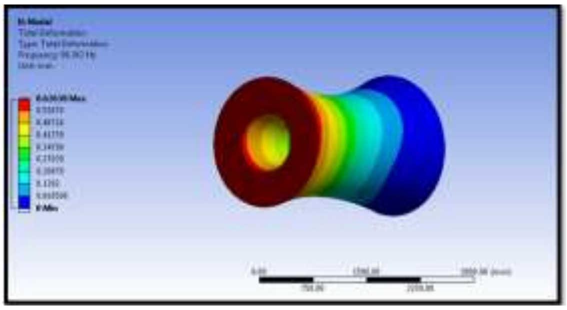
STRAIN



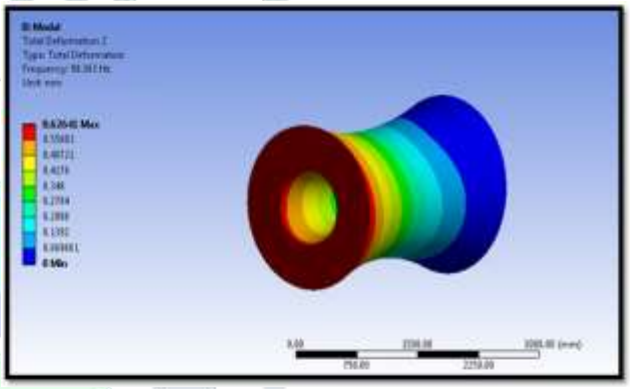
Modal analysis of cooling tower

AT THICKNESS-500mm

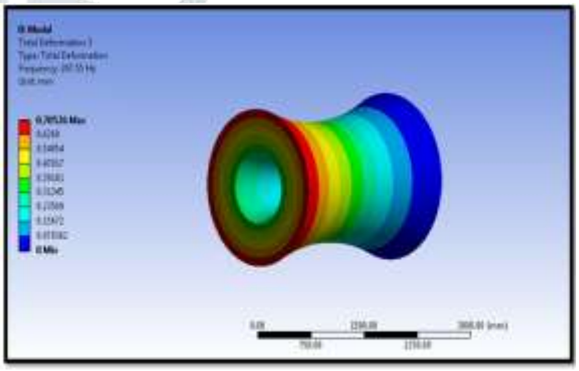
TOTAL DEFORMATION 1



TOTAL DEFORMATION 2



TOTAL DEFORMATION 3



RESULTS AND DISCUSSIONS

STATIC ANALYSIS RESULTS

Thickness (mm)	Deformation (mm)	Stress (N/mm^2)	Strain
200	0.11775	5.5502	0.00018508
250	0.089609	6.6074	0.00022117
300	0.07189	5.4121	0.00018055
400	0.050509	3.9687	0.0001329
500	0.039771	3.919	0.000013066

MODAL ANALYSIS RESULTS

Thickness (mm)	Frequency	Total deformation 1	Frequency	Total deformation 2	Frequency	Total deformation 3
200	72.64	1.1825	72.646	1.1826	197.3	1.3027
250	77.482	1.0234	77.484	1.0232	199.97	1.364
300	82.179	0.9054	82.18	0.90511	202.14	1.0108
400	91.11	0.7391	91.111	0.73911	205.38	0.83026
500	99.363	0.62638	99.36	0.62641	207.55	0.70524

7. CONCLUSION

Regular Draft Hyperbolic Cooling towers are the describing land signs of power station. They contribute both to a productive vitality yield and to a cautious equalization with our surroundings.

In this thesis the cooling towers modeling n CREO parametric software with different cooling tower thickness (200,250,300,400 & 500 mm) and analysis in ANSYS software. We find the analytical problems of cooling tower in thermal power plants static and modal analysis.

By observing the static analysis the stress increases by decreasing the cooling tower thickness.

Stress value is less for 500mm thickness of cooling tower.

By observing the modal analysis the deformations are increases by decreasing the cooling tower thickness.

So it can be concluded the 500mm thickness cooling tower is better model.

REFERENCES

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