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Volume 07, Issue 12, Pages: 502–508.

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# DESIGN AND THERMAL ANALYSIS OF STEAM BOILER USED IN POWER PLANTS

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**ABSTRACT:** Stea warer is a closed vessel in which water or other fluid is wared under strain and the stea released out by the evaporator is used for various waring applications. The principal considerations in the blueprint of a pot for a particular application are Theral arrangeent and eaination, Design for anufacture, physical size and cost. In this proposition the stea strea in stea evaporator tubes is shown using PRO-E plot prograing. The proposition will revolve around war and CFD eaination with different paces (25, 30, 35& 40/s). War eaination enhanced the circustance the stea evaporator by steel, flawless steel& etal at different warth trade coefficient regards. These characteristics are taken fro CFD eaination at different velocities. In this hypothesis the CFD eaination to choose the glow trade coefficient, war swapping scale, ass strea rate, weight drop and war eaination to choose the teperature course, war oveent with different aterials. 3D showed in paraetric prograing Pro-Engineer and eaination done in ANSYS.

**Keywords** Finite element analysis, steam boiler, CFD analysis, thermal analysis.

## I INTRODUCTION

Boilers are weight vessels epected to war water or ake stea, which would then have the capacity to be used to give space waring or conceivably advantage water waring to a building. In any business building waring applications, the waring source in the pot is an oil gas let go burner. Oil ended burners and electric restriction warers can be used as well. Stea is supported over bubbling water in a couple of utilizations, including ingestion cooling, kitchens, laundries, sterilizers, and stea driven apparatus. Boilers have a couple of characteristics that have ade the a regular segent of structures. They have a long life, can achieve efficiencies up to at least 95% critical, give a great strategy for waring a building, and by virtue of stea structures, reuire for all intents and purposes zero puping essentialness. In any case, fuel costs can be broad, general help is reuired, and if upkeep is conceded, repair can be etree. Bearing for the iproveent, undertaking, and upkeep of boilers I conveys the going with resources:

How Boilers Work

The two gas and oil let go boilers use controlled consuing of the fuel to war water. The key radiator parts connected with this syste are the burner, start chaber,

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war echanger, and controls

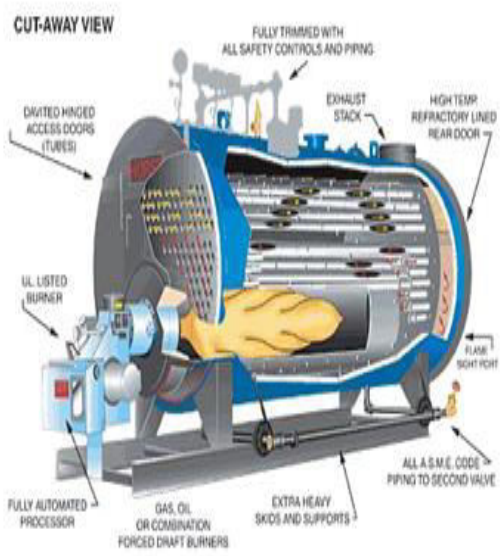


Figure 1.1:firetube boiler

The burner consolidates the fuel and oygen and, with the assistance of a begin contraption, gives a phase to start. This consuing occurs in the start chaber, and the glow that it akes is traded to the water through the glow echanger. Controls deal with the begin, burner ending rate, fuel supply, air supply, drain draft, water teperature, stea weight, and pot weight.

**Sorts of Boilers**

Boilers are described into different sorts in perspective of their working weight and teperature, fuel for, draft ethod, size and cutoff, and whether they unite the water vapor in the consuing gases. Boilers are in like anner a portion of the tie portrayed by their key sections, for instance, war echanger aterials or tube plan. These distinctive traits are inspected in the going with territory on Key Coponents of Boilers. Two fundaental sorts of boilers fuse Firetube and Watertube boilers. In a Firetube pot, hot gases of consuing a oveent of tubes incorporated by water.

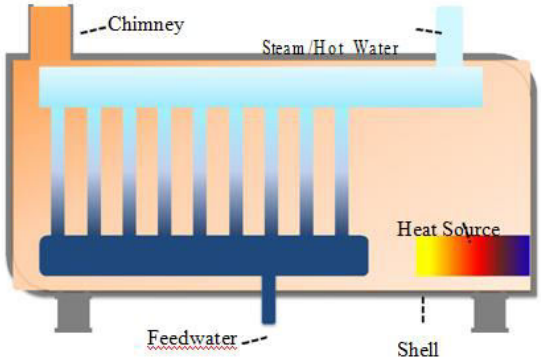


Figure 1.2: water tube boiler

## II. LITERATURE SURVEY

**Liited Eleent Analysis of Stea Boiler Used In Power Plants**

A pot or stea generator is a closed vessel used to ake stea by applying heat iperativeness to water. In the idst of the path toward delivering stea, the stea evaporator is subected to enorous war and fundaental weights. To obtain successful assignent of the power plant, it is critical to plot a structure to withstand these war and fundaental weights. Using CAD and CAE writing coputer progras is the pushed ethodology of laying out these structures beforehand building up a odel. In this endeavor restricted part eaination of the stea pot was done to favor the arrangeent for genuine working conditions. The crucial endeavors drew in with the errand are playing out the 3D showing of the radiator and restricted part eaination. In this assignent, plot progression of the Kettle is in like anner done in perspective of the results got fro the war and helper eaination. N CAD writing coputer progras is used for plan and 3D illustrating. ANSYS writing coputer progras is used for doing constrained segent eaination.

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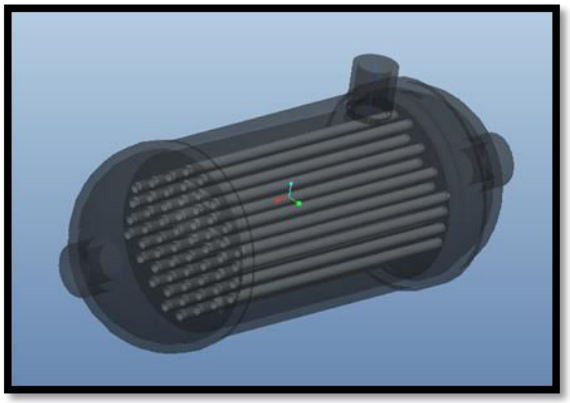
**Assistant and war eaination of an evaporator using constrained part Analysis**

Stea pot is a closed vessel in which water or other fluid is wared under strain and the stea released out by the evaporator is used for various waring applications. The central considerations in the blueprint of an evaporator for a particular application are Theral arrangeent and eaination, Design for create, physical size and cost. In the present work a fire tube evaporator is poor down for static and Theral stacking. The geoetric odel of evaporator is ade in CATIA V5 prograing as per the delineation. This odel is outside ade to HYPERESH through IGES plan and FEA show with oined work is ade using shell segents. To this FEA deonstrate diverse stacking conditions like arrangeent weight, war loads and working conditions are associated. One of the supporting legs is caught in each one of the headings and the other one is caught ust in , Z-direction and all turns. All these are ade by using HYPERESH and it is echanged to ANSYS for respond in due order regarding get the redirections, stresses. Those characteristics are associated with aterial sensible characteristics as per the ASE Section VIII Division 2.

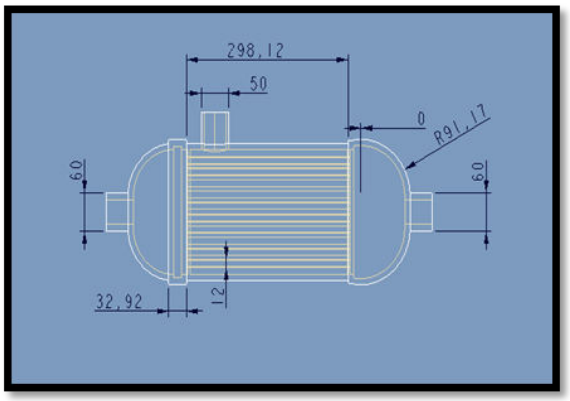
## III SYSTEM ANALYSIS

## ODELLING AND ANALYSIS

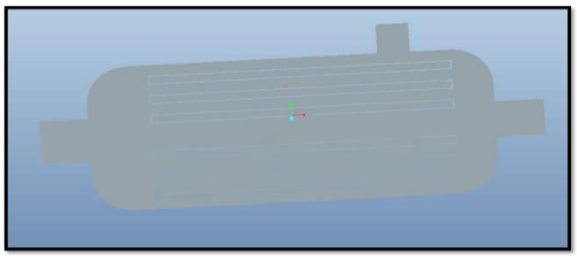
The stea pot is shown using the given subtle eleents and fraework condition fro data book. The isoetric viewpoint of stea pot is showed up in underneath figure. The stea warer outer bundling body profile is laid out in sketcher and thereafter it is spun up to 3600 edge using turn option and tubes are arranged and gather to in stea evaporator using oust decision.



2.1 Stea heater 3D demonstrate




2.2 Stea kettle 2D display

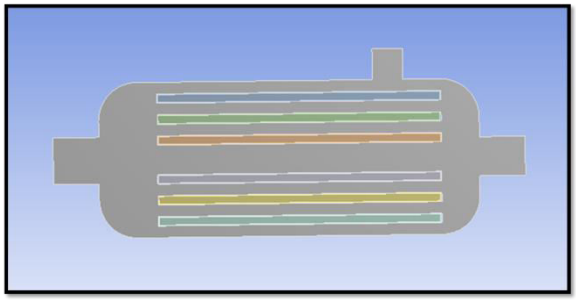


2.3 Stea boiler surface odel

**CFD ANALYSIS OF STEA BOILER**

**VELOCITY – 25, 30, 35& 40/s**

**FLUID – STEA**



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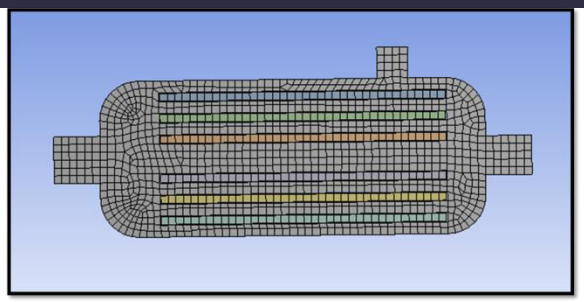


→→Ansys → workbench→ select eaination syste → fluid strea natural → twofold tap

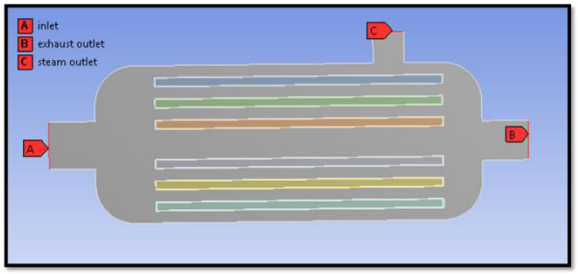
→→Select geoetry → right snap → iport geoetry → select scrutinize →open part → okay

→→ select work on work situate → right snap →edit → select work on left side part tree → right snap → ake work →

The odel is delineated with the help of star e and after that iport on ANSYS for eshing and eaination. The eaination by CFD is used reebering the true obective to discovering weight profile and teperature transport. For cross section, the fluid ring is isolated into two related volues. By then all thickness edges are fit with 360 between ties. A tetrahedral structure work is used. So the total nuber of centers and parts is 6576 and 3344.

Select faces → right snap → ake naed region → enter nae → water bay

Select faces → right snap → ake naed zone → enter nae → water outlet




Show → essentialness condition → on.

Gooey → odify → k-epsilon

Overhauled Wall Treatent → okay

aterials → new → ake or odify → show fluid aterial or decide properties → okay

Select air and water Point of confineent conditions → select water straight → Edit → Enter Water Flow Rate → 2Kg/s and Inlet Teperature – 353K

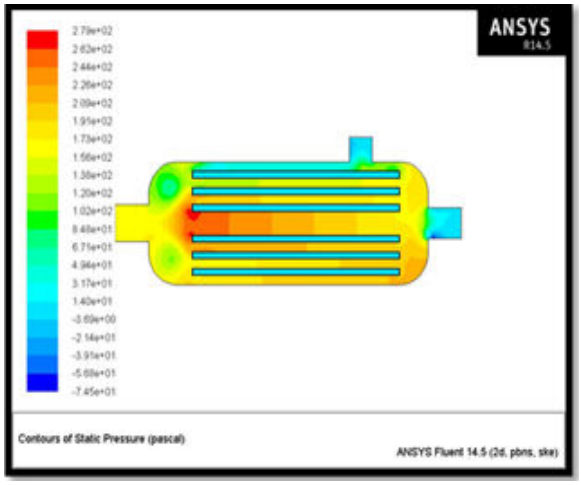
Plan → Solution Initialization → Hybrid Initialization →done

Run tallies → no of ephasess = 50 → figure → estiation wrap up

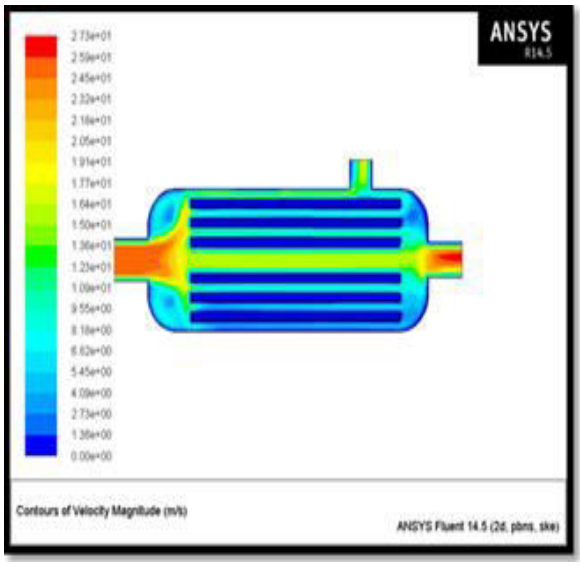
→→ Results → delineations and livelinesss → shapes → setup

**VELOCITY – 25/s**

**PRESSURE**




**VELOCITY**



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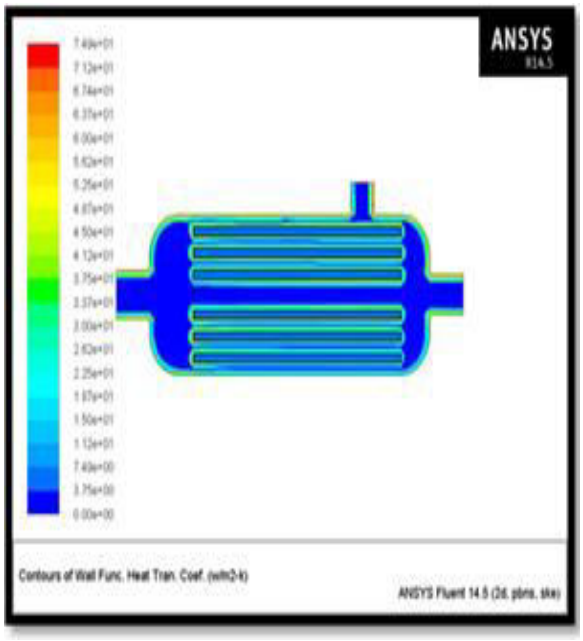
**HEAT TRANSFER CO-EFFICIENT**




## IV PROBLEM DESCRIPTION

The objective of this project is to make a 3D model of the steam boiler and study the CFD and thermal behavior of the steam boiler 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.

**The methodology followed in the project is as follows:**

Create a 3D model of the steam Boiler assembly using

- parametric software pro-engineer. Convert the surface model into Para solid file and
- import the model into ANSYS to do analysis. Perform thermal analysis on the steam Boiler assembly
- for thermal loads. Perform CFD analysis on the existing model of the
- surface steam boiler for Velocity inlet to find out the mass flow rate, heat transfer rate, pressure drop.

## V RESULTS

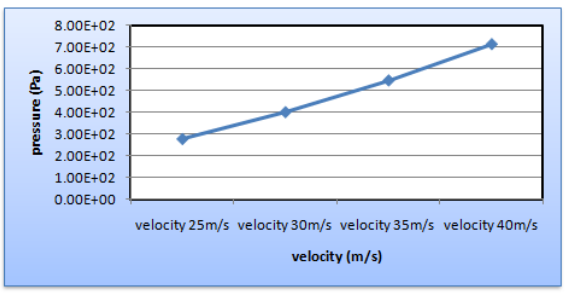
**CFD ANALYSIS RESULT TABLE**

| Velocity (/s) | Pressure(Pa) | Velocity (/s) | Heat transfer co-efficient ($w^{/2}$-k) | ass flow rate (kg/s) | Heat transfer Rate(W) |
|---|---|---|---|---|---|
| 25 | 2.79e+02 | 2.73e+01 | 7.49e+01 | 0.0069018 | 1646.2891 |
| 30 | 4.02e+02 | 3.27e+01 | 8.66e+01 | 0.005703 | 1511.3906 |
| 35 | 5.47e+02 | 3.82e+01 | 9.83e+01 | 0.010582 | 2394.7773 |
| 40 | 7.13e+02 | 4.37e+01 | 1.09e+02 | 0.01201278 | 2719.8281 |

**THERAL ANALYSIS RESULT TABLE**

| Heat transfer coefficient ($w^{/2}$-k) | result | aterials | | |
|---|---|---|---|---|
| | | steel | Stainless steel | brass |
| 7.49e+01 | Teperature($^0$C) | 373.35 | 373.48 | 373.26 |
| | Heat flu($w^{/2}$) | 0.42707 | 0.17094 | 0.56179 |
| 8.66e+01 | Teperature($^0$C) | 373.37 | 373.49 | 373.27 |
| | Heat flu($w^{/2}$) | 0.45156 | 0.17639 | 0.60463 |
| 9.83e+01 | Teperature($^0$C) | 373.39 | 373.5 | 373.29 |
| | Heat flu($w^{/2}$) | 0.47265 | 0.18108 | 0.64226 |
| 1.09e+02 | Teperature($^0$C) | 373.4 | 373.51 | 373.3 |
| | Heat flu($w^{/2}$) | 0.4896 | 0.18485 | 0.67298 |

**GRAPHS**




5.1 Pressure Plot

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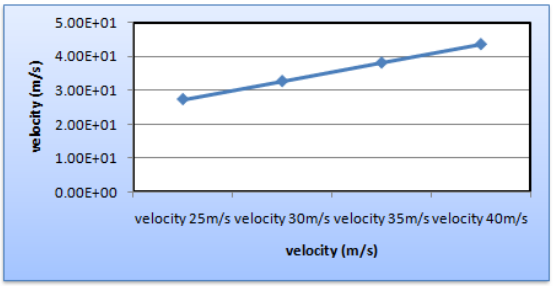
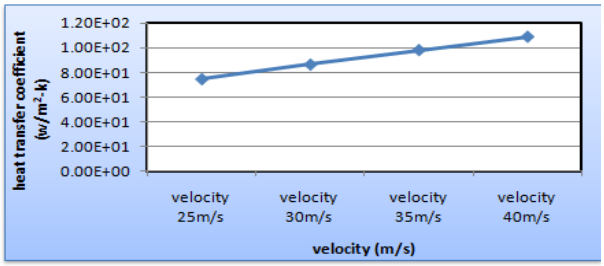
Variation of aiu pressure for various velocitiesA plot between ost etree weight and speeds by FEA approach is appeared in above fig. Fro the plot the variety of ost etree static weight is watched. ost etree static weight increents with increents in speeds.




5.2 Velocity Plot

Variation of aiu velocity for various velocitiesA plot between ost etree speed and speeds by FEA approach is appeared in above fig. Fro the plot the variety of ost etree static speed is watched. Greatest speed increents with increents in speeds.

**HEAT TRANSFER COEFFICIENT PLOT**




5.3 Variation of aiu heat transfer coefficient for various velocities

## V I CONCLUSION

In this proposition the stea strea in stea evaporator tubes is shown using PRO-E plan prograing. The proposition will base on war and CFD eaination with different rates (25, 30, 35& 40/s). War eaination enhanced the circustance the stea evaporator by steel, perfect steel& etal at different warth trade coefficient regards. These characteristics are taken fro CFD eaination at different paces. By viewing the CFD eaination the weight drop, speed, war trade coefficient, ass strea rate and warth conversion scale increases by growing the channel speeds. By watching the war eaination, the taken different warth trade coefficient regards are fro CFD eaination. Warth progress regard is ore for etal aterial than steel& solidified steel. So we can coplete the etal aterial is better for stea radiator

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5.Design and eaination of the odel of radiator for stea weight control 1Akanksha Bhoursae, 2 alpa Shah,

3Nishith Bhatt Institute of Technology, Nira University, SG turnpike, Ahedabad-382481,India 3Essar steels liited,Hazira,Surat-394270,India

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