Design, Development and Performance Testing of Horizontal Split Case Pump

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ABSTRACT

Centrifugal pump is a hydrodynamic machine, in which rotating impeller continuously transmits mechanical work from the driving machine to fluid. The kinetic energy is converted into potential pressure energy.
The pump is an essential component of an irrigation system. Proper selection of pumping equipment that will provide satisfactory performance requires good understanding of existing conditions. Design restrictions, operating conditions of the irrigation system, and required flexibility in system operation must be understood before an efficient pump can be selected for a given system. Need of Design of Pump
Before a pump is selected it is necessary to determine the head (H) and discharge (Q) required by the system. The system head versus discharge relationship should be evaluated for the entire range of operating conditions. When the system head and/or discharge vary significantly, special attention must be given to selecting a pump (or set of pumps) that can satisfy all conditions. Since most pumps are not very efficient over wide ranges in operating heads, the most prevalent conditions should be determined and a pump that operates efficiently over this set of conditions, and can operate under all other possible conditions, should be selected.
Today's requirement regarding Pump is to satisfy specified duty point means required head and discharge, with less power consumption and with more efficiency. Now a day in most of the water service applications duty point requirements are between 150 m to 275 m head and 1000 m3/hr to 2500 m3/hr discharge.
A centrifugal pump can operate at a combination of head and discharge

Keyword : *Centrifugal pump, computational fluid dynamics, pump performance*

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1. INTRODUCTION

The various types of pumps like multistage pump, Vertical Turbine (VT) pump, mixed flow (MF) pump can be offered for present required duty of high head and discharge.

The Horizontal Split case pumps are more suitable for water supply scheme projects because of following reasons:

1)Simple in design as compare to multistage pump and Vertical turbine pump.
2)Less rotating components and easy to assemble.
3)Less cost of production.
4)Easy for maintenance.

As designed pump is used for water service applications, periodic maintenance is required to check the wear out parts like casing wear ring, impeller wear ring, shaft sleeves. In such case horizontal split case pumps are more suitable. For the horizontal split case pump there is no need to remove the suction and delivery piping, only by removing the top casing we can easily check the internal parts for wear out. The availability of horizontal split case pump in Indo Pump is up to 190 m head for given discharge 2100 m3/hr but as mentioned in pump operating point current requirement of head is 218 m.

1.1 PROJECT DEFINATION

Developed the new pump for water supply.

Discharge Q = 2100 m3/hr = 4623.011 GPM
Head H = 218 m = 715.2209 ft,
Speed N= 1490 rpm

1.2 OBJECTIVE

1) To design the volute type casing and impeller of centrifugal pump for required range of discharge and head.

2)The designed pump should have more efficiency with less power consumption.

2. METHODOLOGY

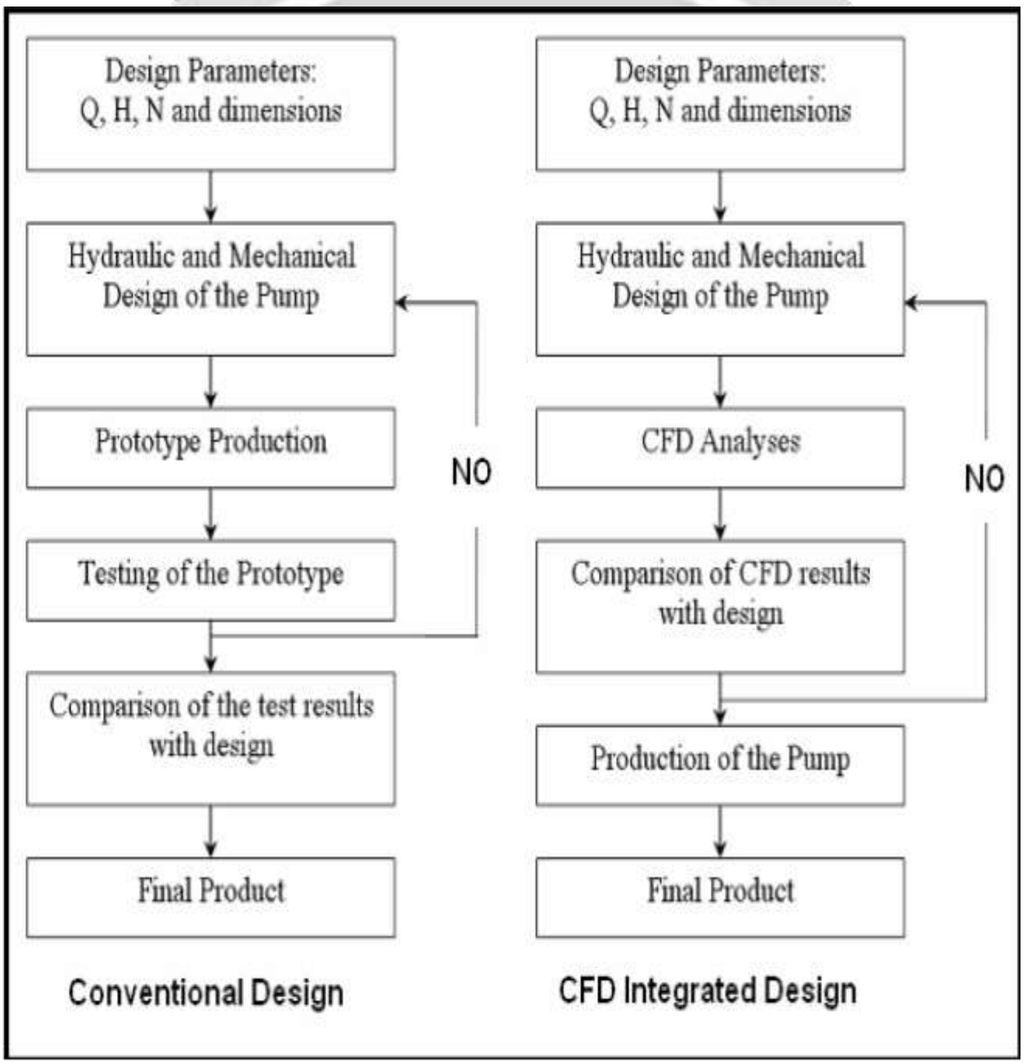


Figure 1.1 – Conventional and CFD integrated design procedures

3 DESIGN SUMMERY

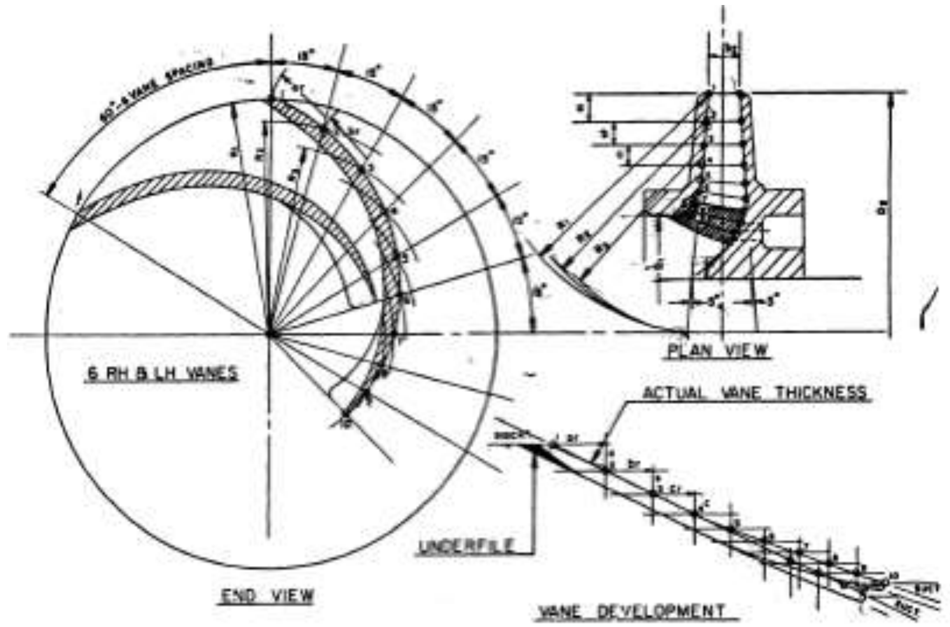


Figure 3-1. Impeller Layout

Step 1: Calculation of pump specific speed. *:- 732.5(USunit)*
Step 2: Selection of vane number and discharge angle.:- 23^0
Step 3: Calculate impeller diameter.:- 820mm
Step4: Calculate impeller width b_2:- 4.57m/s
Step 5: Determine eye diameter.:- 300mm
Step 6: Determine shaft diameter under impeller eye.:- 2 in.
Step 7: Estimate impeller eye area. :-52184.58mm^2

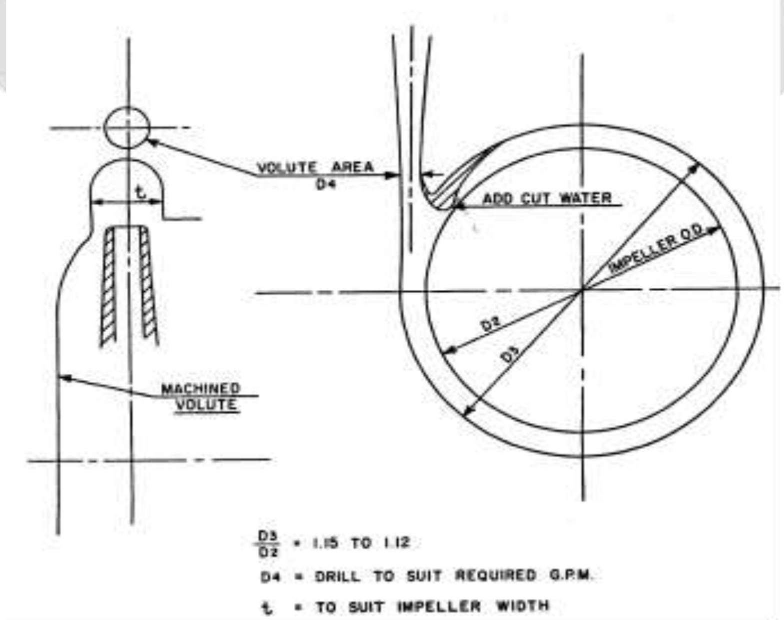


Figure 3-2. Typical layout for circular volute pump.

3.1 3D MODELLING:

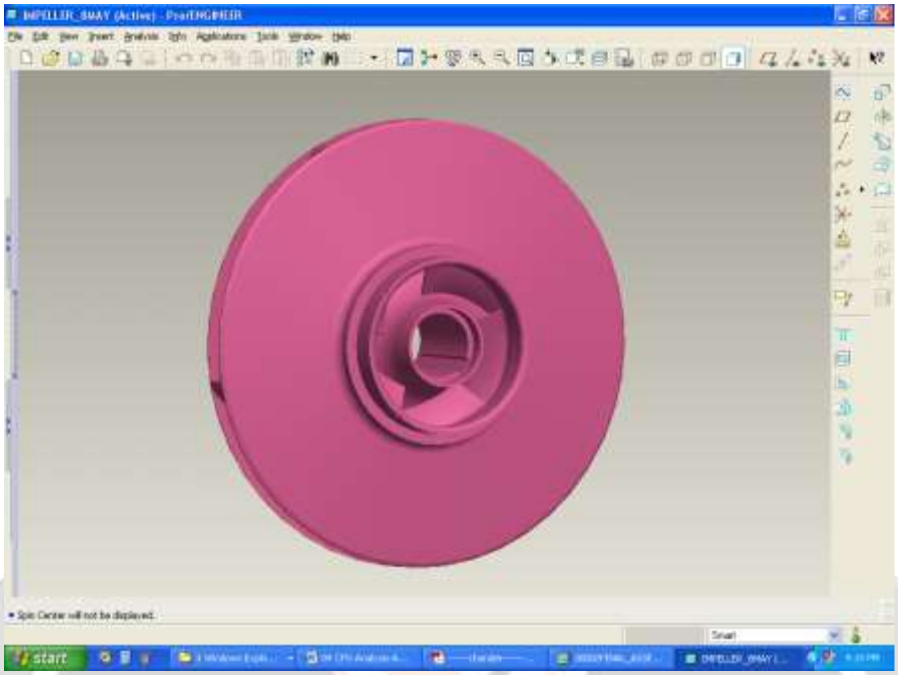
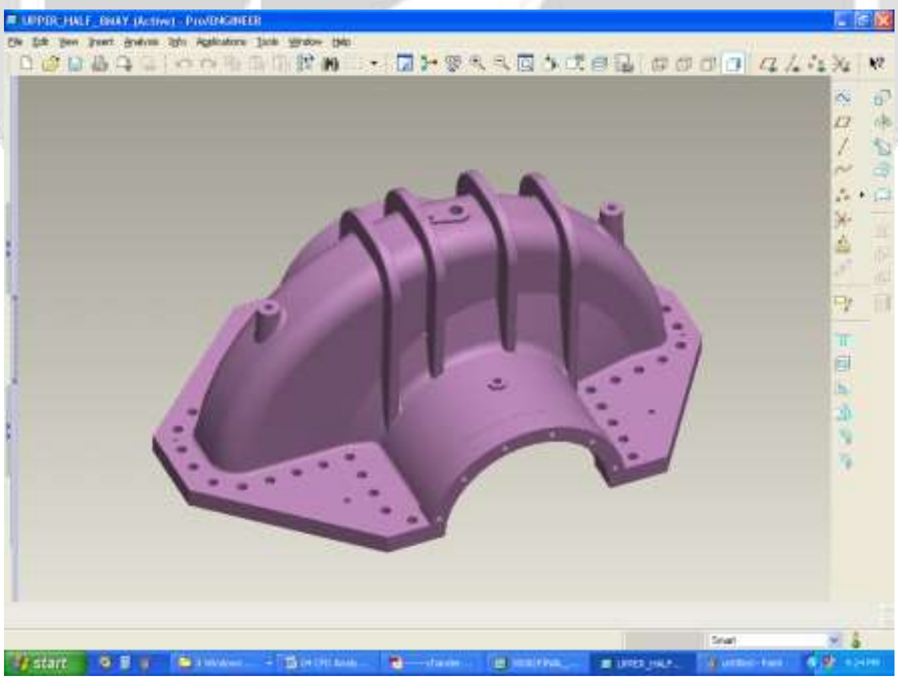


Fig:3.2 Impeller



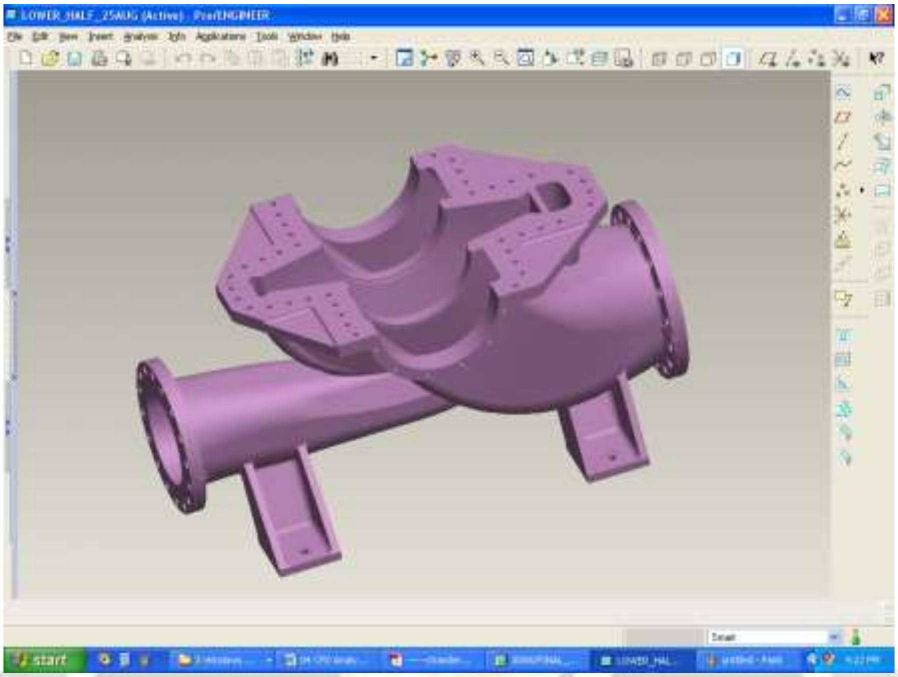
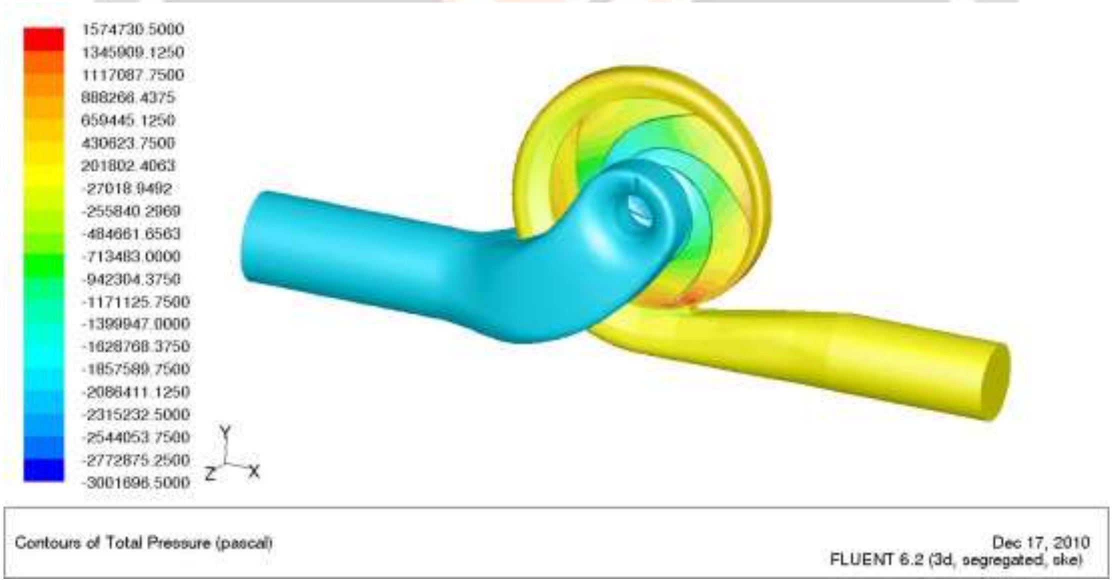


Fig 3.2. Casing Upper and lower Case



3.4.CFD Results

There are several considerations in the casing design process that apply to all volute types. These are as follows:

• The most important variable in casing design is the throat area. This area together with the impeller geometry at the periphery establishes the pump capacity at the best efficiency point. The throat area should be sized to accommodate the capacity at which the utmost efficiency is required, using Figure 3.8. Where several impellers in the same casing are to be considered, the throat area should be sized for the standard impeller and increased by 10% to maintain the efficiency of the high capacity impeller.

• Since significant energy conversion takes place in the diffusion chamber, the design of this element should be done with extreme care.

• The volute should be designed to maintain constant velocity in the volute sections.

• The overall shape of the volute sections should be as shown in Figures 3.2.The use of these figure will save the designer time and introduce consistency into the design process.
• The volute spiral from the cutwater to the throat should be a streamlined curve defined by no more than three radii.

4.RESULTS AND CONCLUSION :

The impeller of the existing closer range pump has been modified by increasing the diameter to 820 mm from 770 mm to suit the higher efficiency, required head and discharge. Considering economic incentive for operating range and efficiency is gained by better understanding of the influence of the tongue. Pump with higher efficiency and greater stable operating region is designed. The CFD analysis of the pump with modified impeller diameter is carried out to check the performance and efficiency of the pump. Efficiency of the pump from CFD results is coming 82 % and by actual performance test efficiency is coming 81.37%, by which it is confirmed that CFD analysis is clearly validated. Traditional volute design is based on two-dimensional analysis, and the emphasis is on collection (Impeller) and less on the diffusion (Volute) function. However, with the use of advanced fluid modeling tools, it is possible to design a volute using three-dimensional analysis. The volute design and analysis presented is indeed part of a new product in development at Indo Pump Limited. This shows that CAD and CAE tools are very useful in hydraulic design.

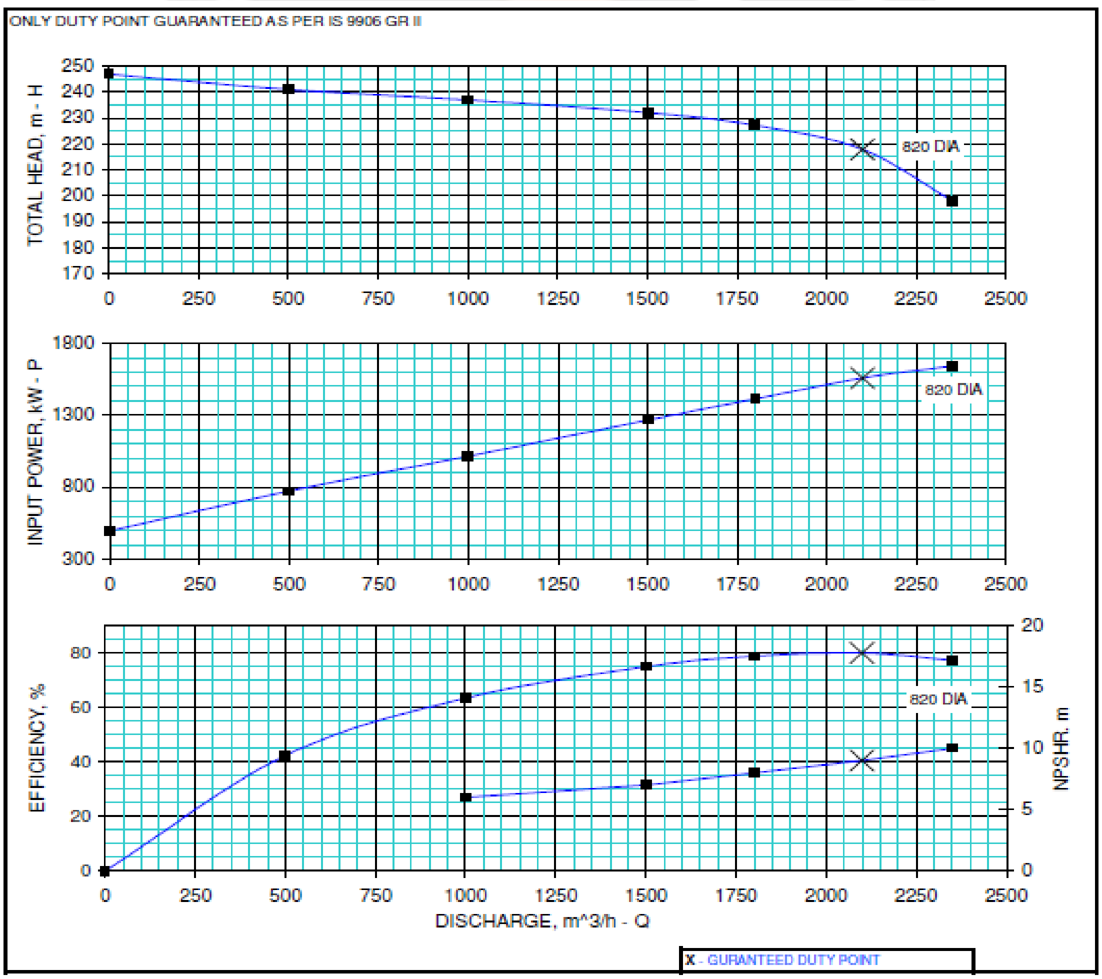


Fig.4.1. Performance result for Pump in CFD

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