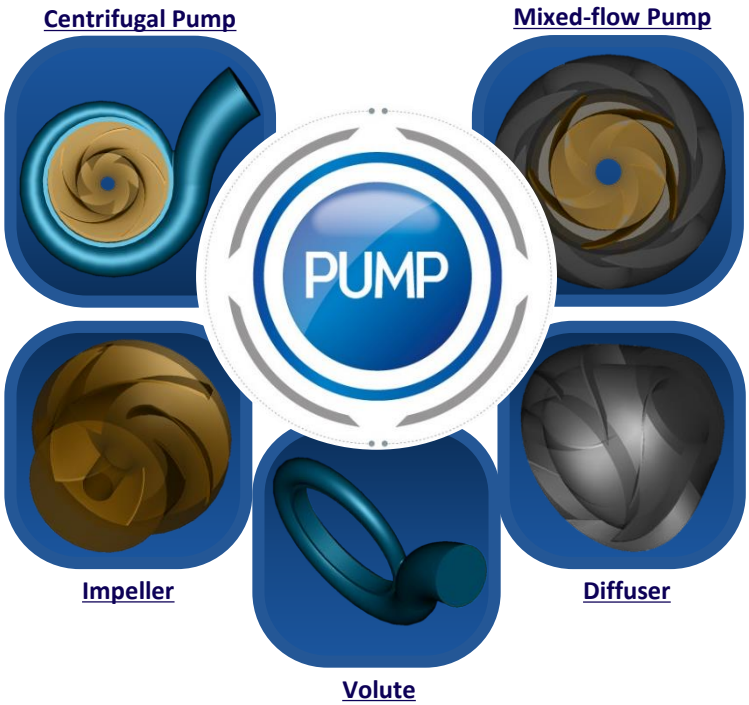
anflux

PumpON

Validation report



Contents

1. Introduction

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1-1 What is PumpON ?

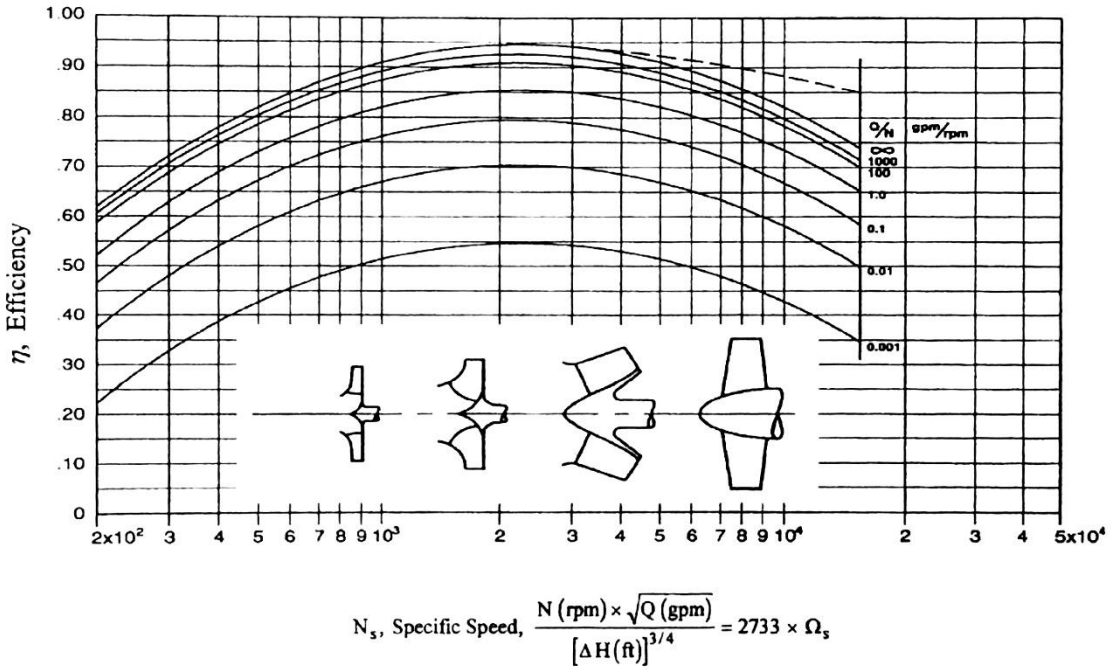
PumpON is a program that can design the hydraulic part of pump with just one-click using pump shape DataBase(D/B) which developed by verifying the optimal design and experiment of centrifugal and mixed-flow pump of 150 ~ 1200 specific speed.

The basis for PumpON's ability to design high-performance pumps in a short period of time is because it utilizes shape D/B of pumps that have proven performance through experiments and CFD carried out in the program development phase. Existing design methods require a significant time process in which repeated design changes through experiments and CFD analyses to improve the performance of pumps after performing basic designs based on previously well-known design equations in order to design highly efficient, high-suction performance.

PumpON uses the shape D/B of a reliable high-performance pump that has been certified by an authorized institution after five years of development of the national project(Project title: Development of design program for centrifugal and mixed-flow pump (Ns150 ~ 1200)) for optimal design, prototyping, and performance testing of hydraulic parts. This allows for the users to obtain a high-performance pump shape with one-click without additional time, and immediately check the three-dimensional shape visualized in PumpON.

This report shows the shape design process using PumpON and the CAD processing of the designed part and the CFD analysis process using them. The suitability of the PumpON design results was reviewed through a comparison review with the analysis results and the experimental results.

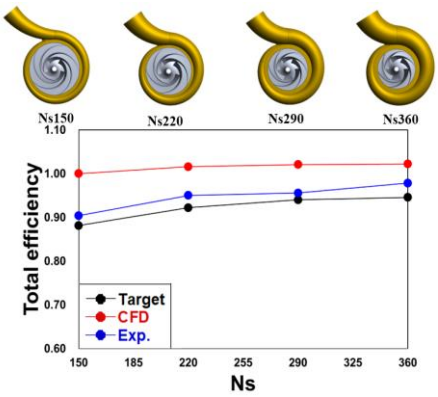
1-2 Development purpose



Standard performance curve (Pump Handbook – McGraw Hill, 2008, 4th edition)

PumpON aims to design more efficient pump than typically designed pump by one-click. In the figure above. The reference efficiency curve according to the specific speed and roughness given in the Pump Handbook is shown in the figure above. To obtain a pump that can be ensure higher efficiency than the efficiency shown above, PumpON applied optimized and verified pump data-base in wide range of specific speed through CFD analysis results and experimental results.

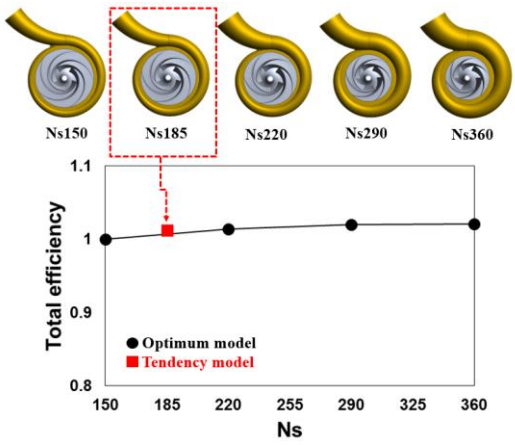
1-3 Database of optimal design of centrifugal pump



The above centrifugal pump shapes were certified through CFD and the experiments to secure optimized centrifugal pump D/B.

To achieve higher efficiency than the suggested target efficiency (higher than the standard performance curve), the optimal results of centrifugal pump with a specific speed of 150 ~ 360 were proved by the experiments

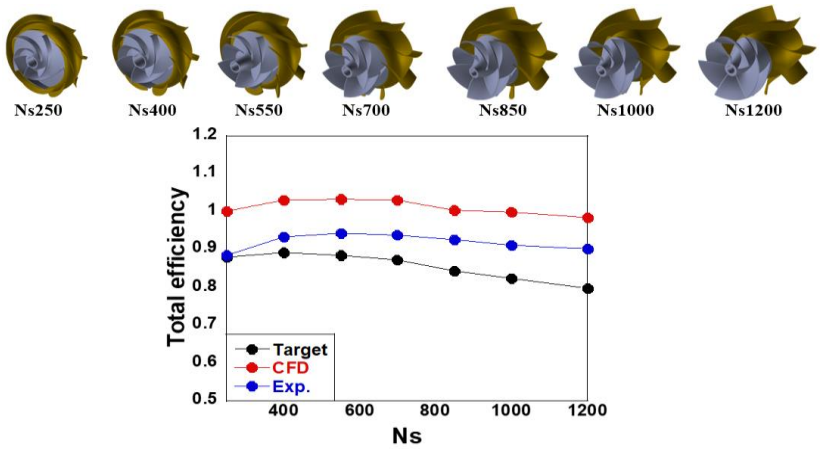
The results of CFD shows higher efficiency than the results of the experiments, since a possibility of Mechanical loss is not considered in the experiments.



It can be seen in the figure above that the results of a one-click design for any speed model with PumpON using the optimised pump geometry DB are taken on the same line as those obtained through CFD analysis and experimentation.

As described above, due to these optimized DBs are used, high-performance pump geometry can be designed quickly to reduce development time.

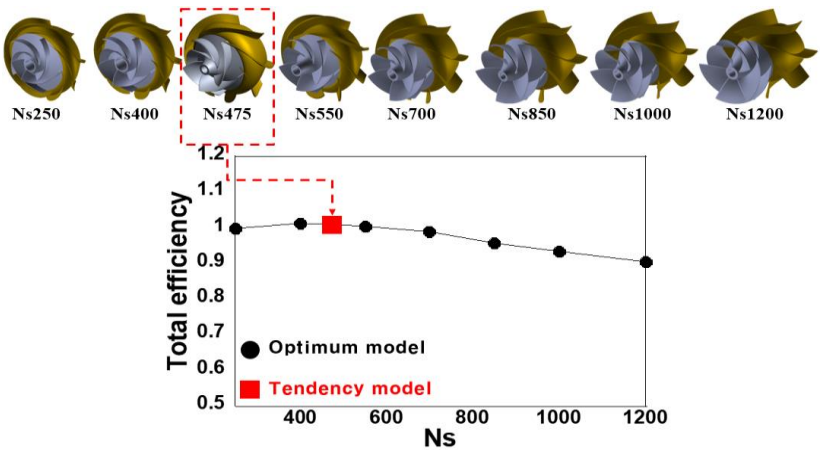
1-4 Database of optimal design of mixed-flow pump



The above mixed-flow pump shapes were certified through CFD and the experiments to secure optimized centrifugal pump D/B.

To achieve higher efficiency than the suggested target efficiency (higher than the efficiency curve), the optimal results of centrifugal pump with a specific speed of 250 ~ 1200 were proved by the experiments

The results of CFD shows higher effieciency than the results of the experiments, since a possibility of Mechanical loss is not considered in the experiments.



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As described above, due to these optimized DBs are used, high-performance pump geometry can be designed quickly to reduce development time.

2. Design procedure and validate with CFD

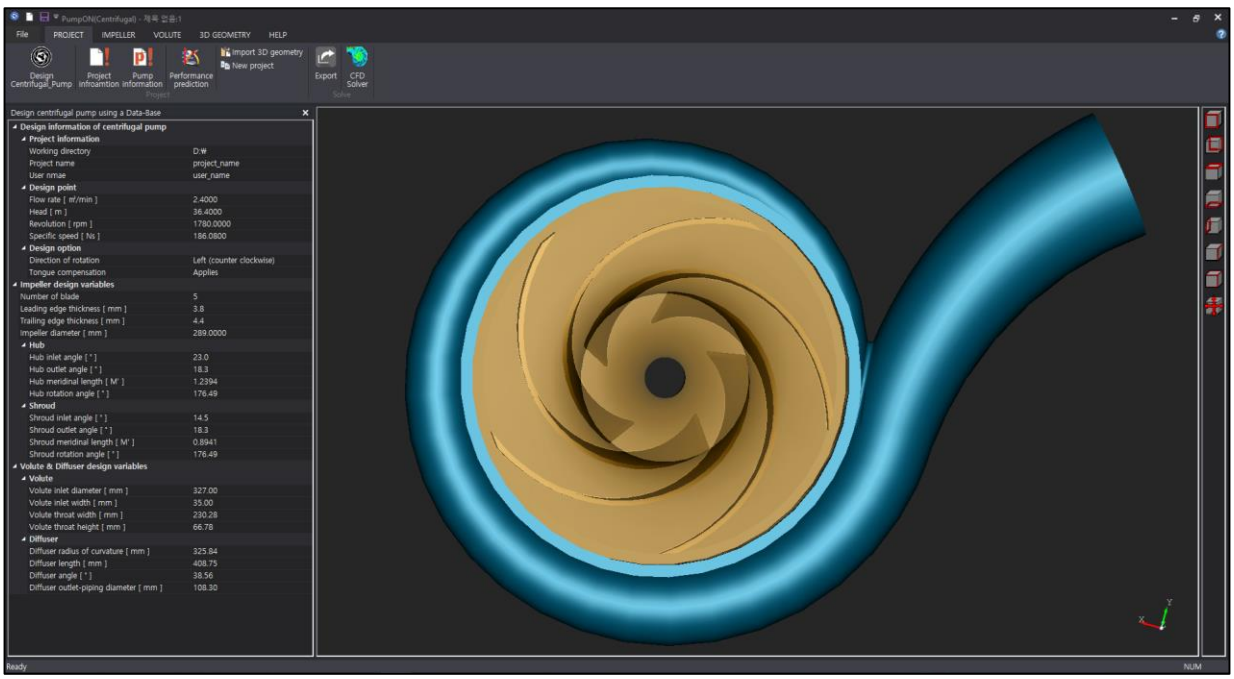
for centrifugal pump (Ns185)

2-1 Design specification

Specific speed	185
Rotation speed	1780 [rpm]
Flow rate	2.4 [㎥/min]
Head	36.4 [m]
Direction of rotation	Left (counter clockwise)
Number of impeller blade	5

2-2 Hydraulic design using PumpON

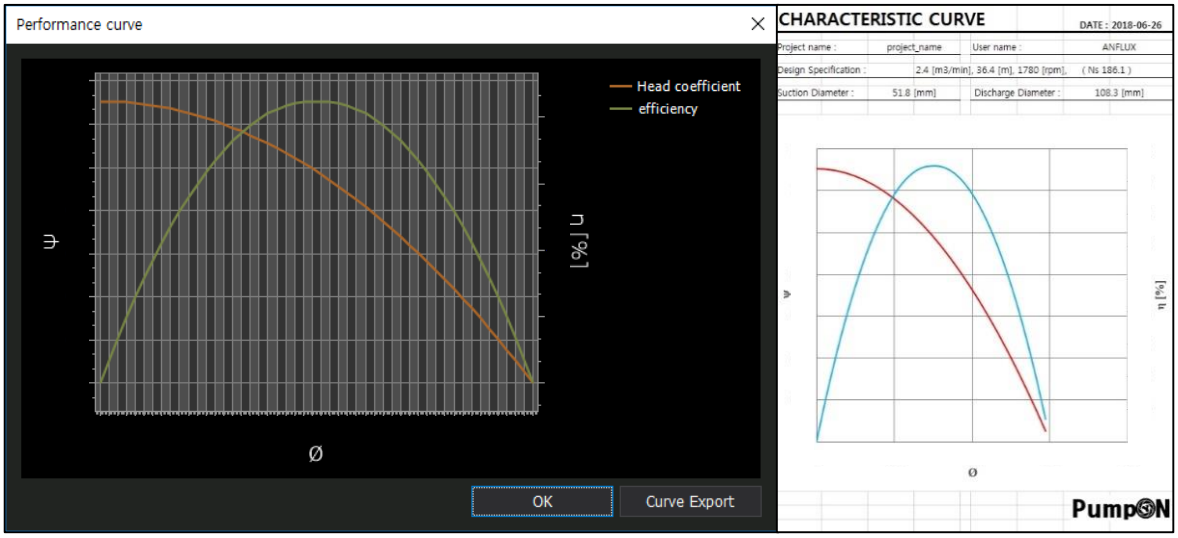
If user enter a flowrate of 2.4 [m3/min], Head 36.4 [m] , and rotational speed 1780 [rpm], you can output the results of the three-dimensional hydraulic shape design to the data related to the CAD and CFD analysis programs.



2. Design procedure and validate with CFD for centrifugal pump (Ns185)

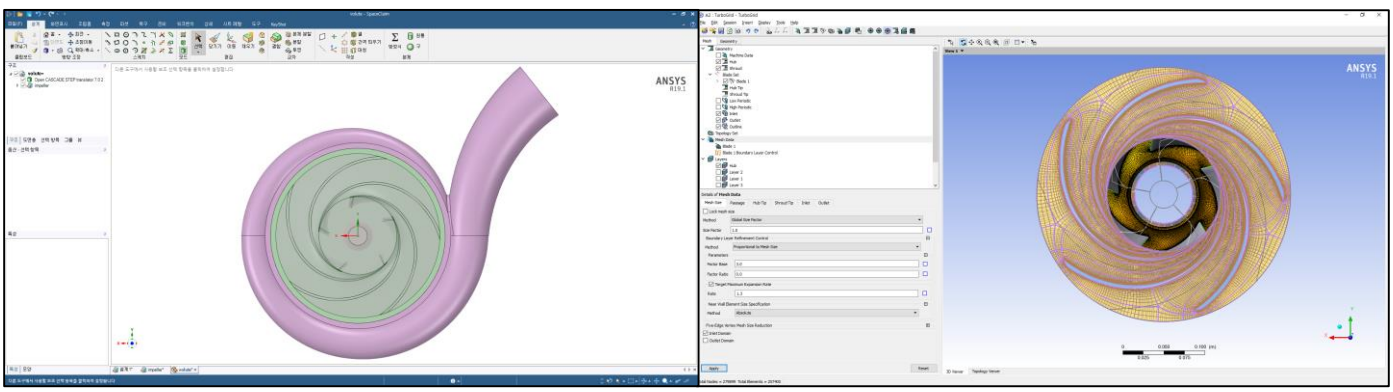
2-3 Performance prediction curve

PumpON provides preliminary curve so user can estimates Q-H, Q-efficiency performance for designed pump from it.



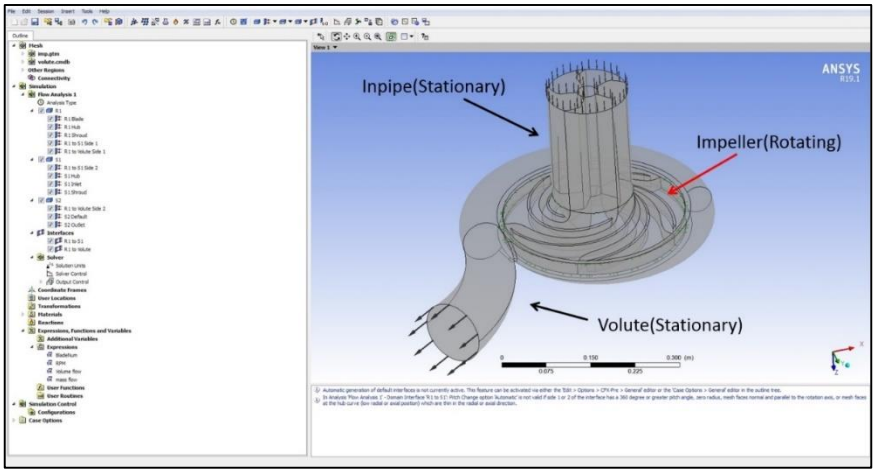
2-4 CAD file, TurboGrid curve file export

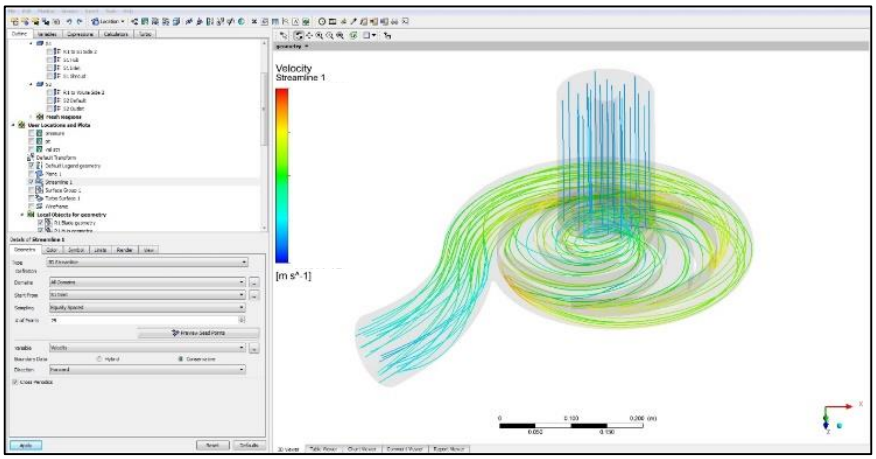
User can output CAD geometry to IGES, step and, STL, for CFD analysis or manufacturing pump. For CFD users, PumpON provides curve file that can be used in TurboGrid, the grid generator of ANSYS CFX.

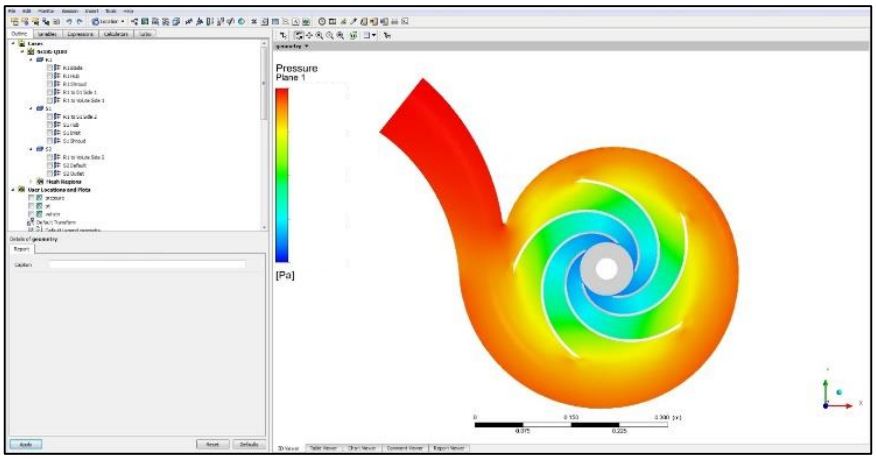


2-5 CFD analysis results using ANSYS CFX

The internal flow field for centrifugal pump was analyzed by the ANSYS CFX commercial software. As shown in the figure below, it shows smooth streamline distribution without flow separation at the design point.

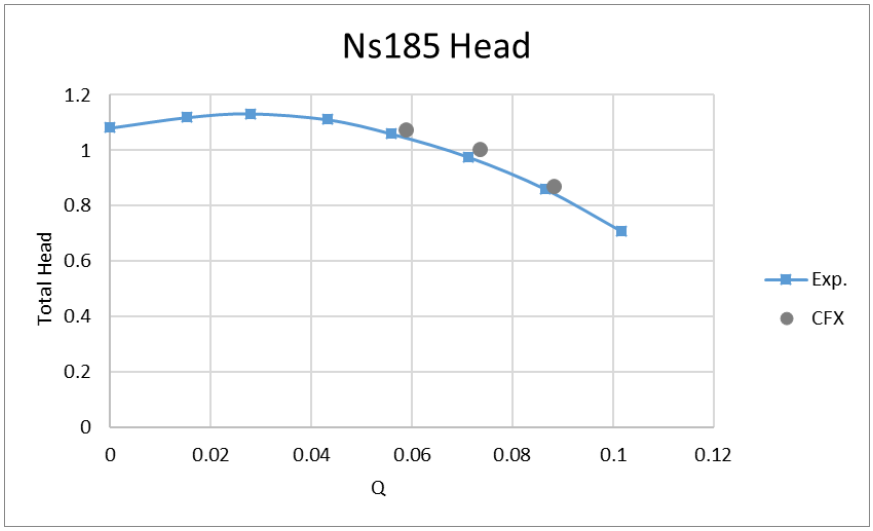


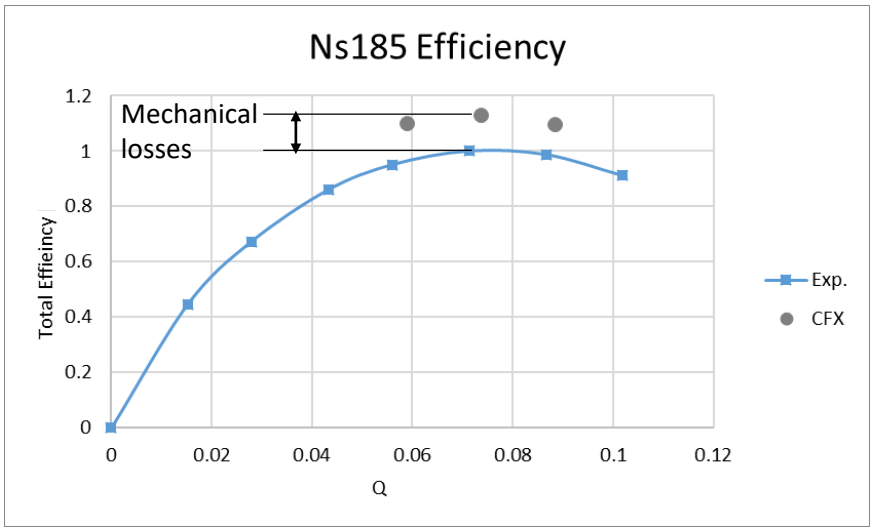




2-6 Comparison of pump performance by flowrate

The results of off-design points were validated by comparison with the experimental data. CFD results are in reasonable agreement with the experimental data. All parameter values were normalized, respectively, from their design point values. Especially Head coefficient results were highly similar. However, in the case of efficiency, a difference was appearing due to losses that not considered in CFD analysis. (such as leakage from wearing-ring, balance hole etc.)





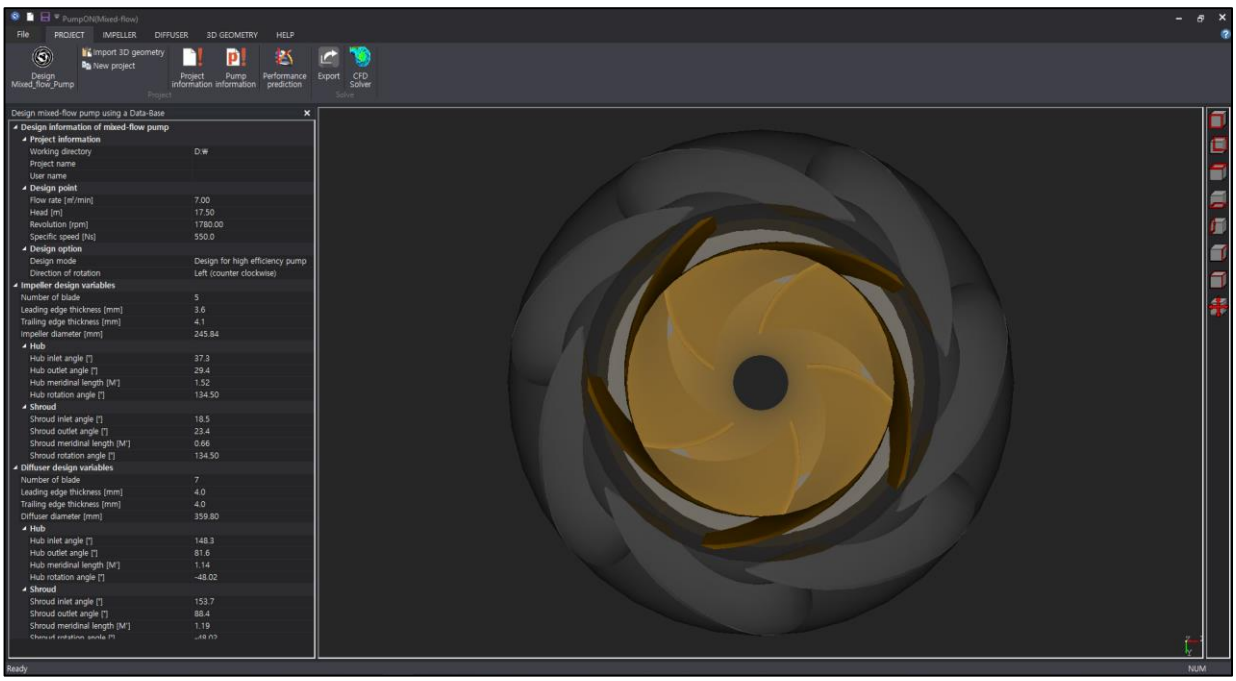
3. Design procedure and validate with CFD for mixed-flow pump (Ns550)

3-1 Design specification

Specific speed	550
Rotation speed	1780 [rpm]
Flow rate	7.0 [㎥/min]
Head	17.5 [m]
Direction of rotation	Left (counter clockwise)
Number of impeller blade | diffuser blade	5 | 7

3-2 Hydraulic design using PumpON

If user enter a flowrate of 7.0 [m3/min], Head 17.5 [m] , and rotational speed 1780 [rpm], you can output the results of the three-dimensional hydraulic shape design to the data related to the CAD and CFD analysis programs.



3. Design procedure and validate with CFD

for mixed-flow pump (Ns550)

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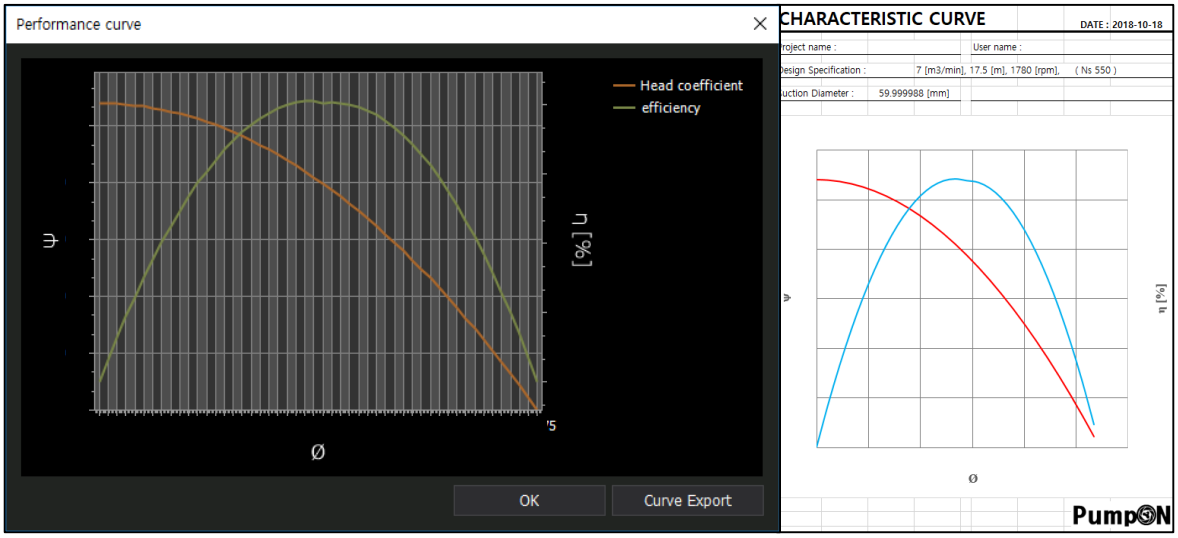

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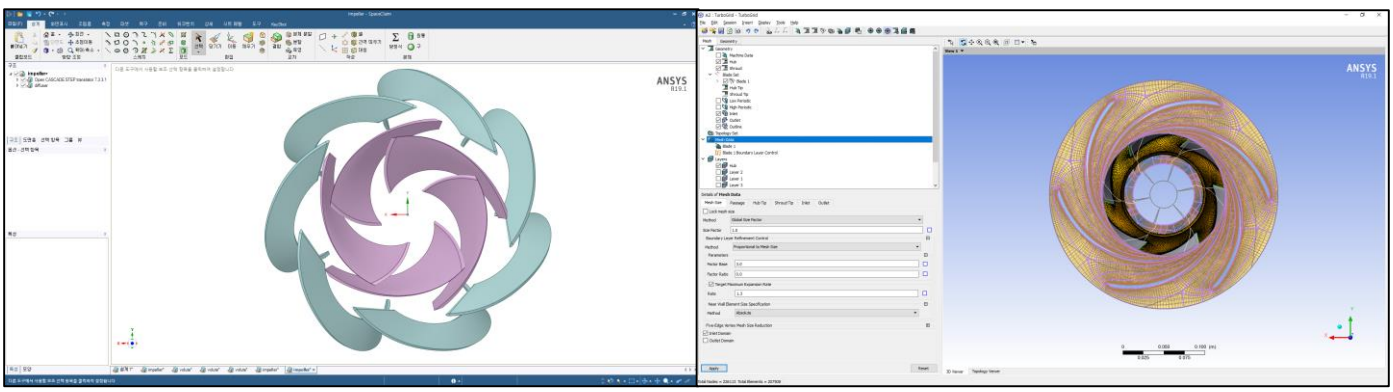

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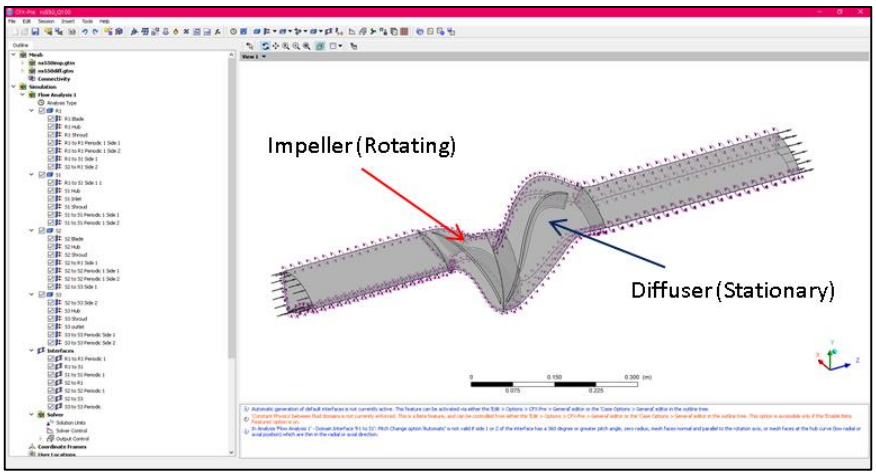

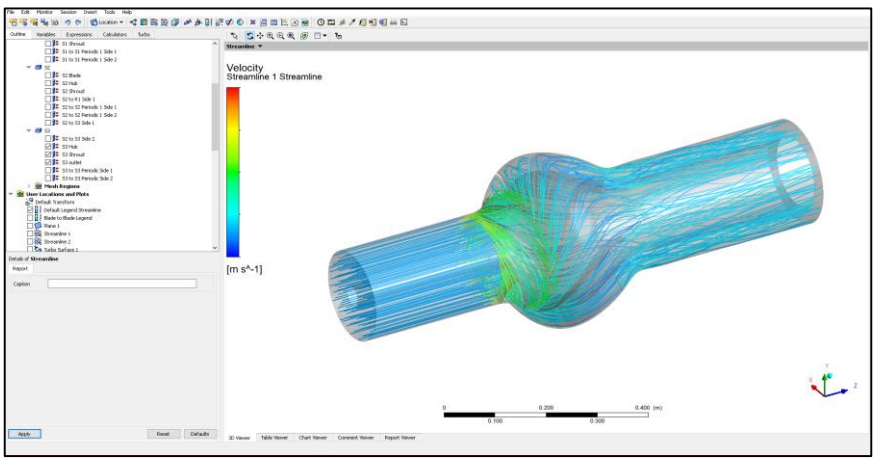

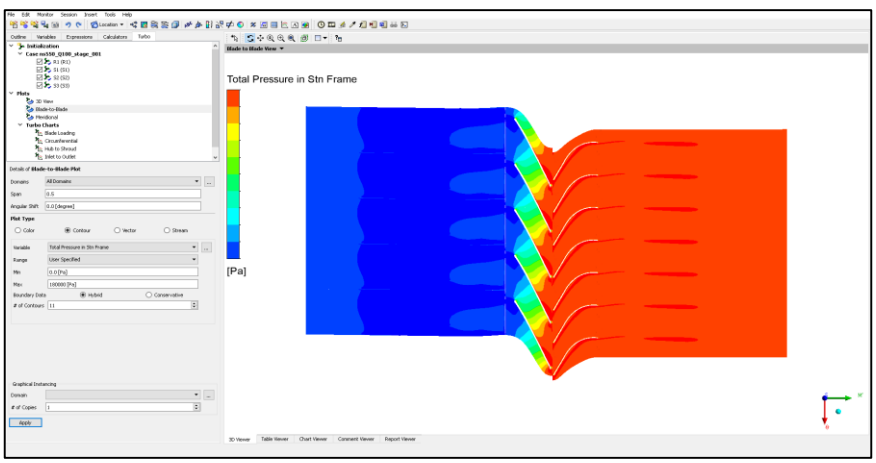

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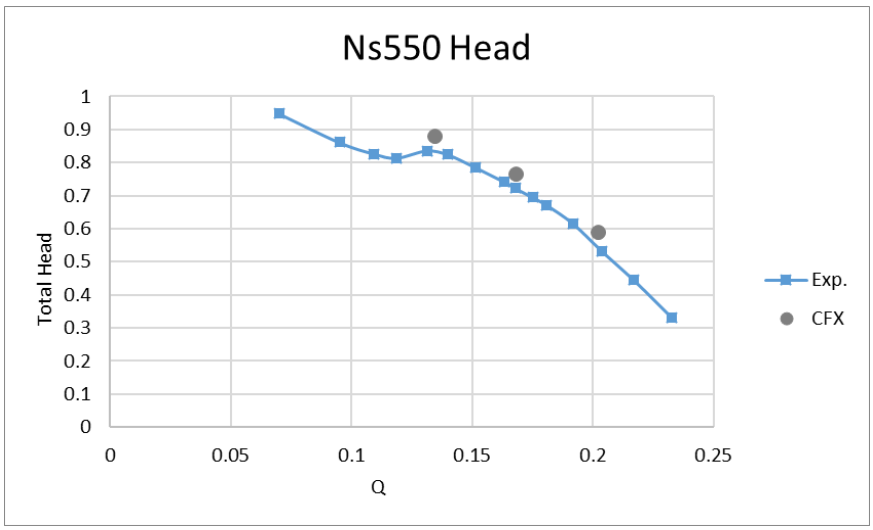

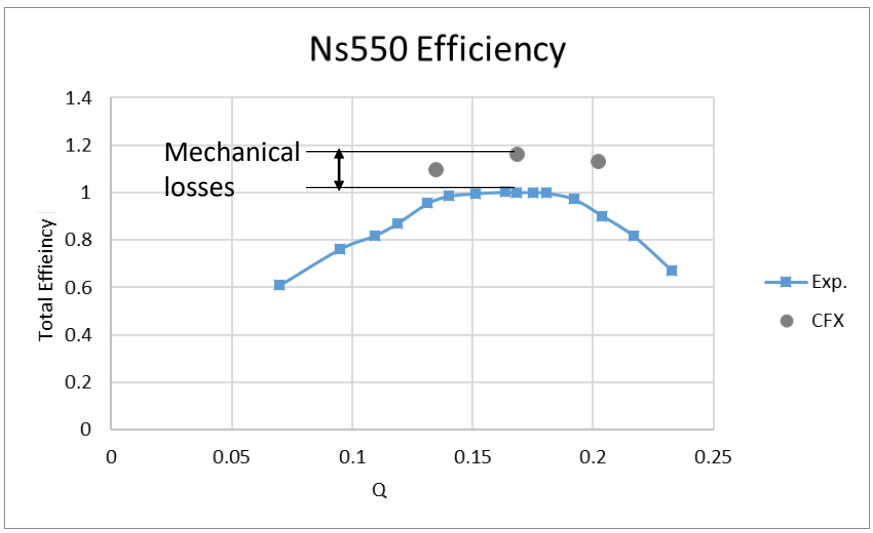

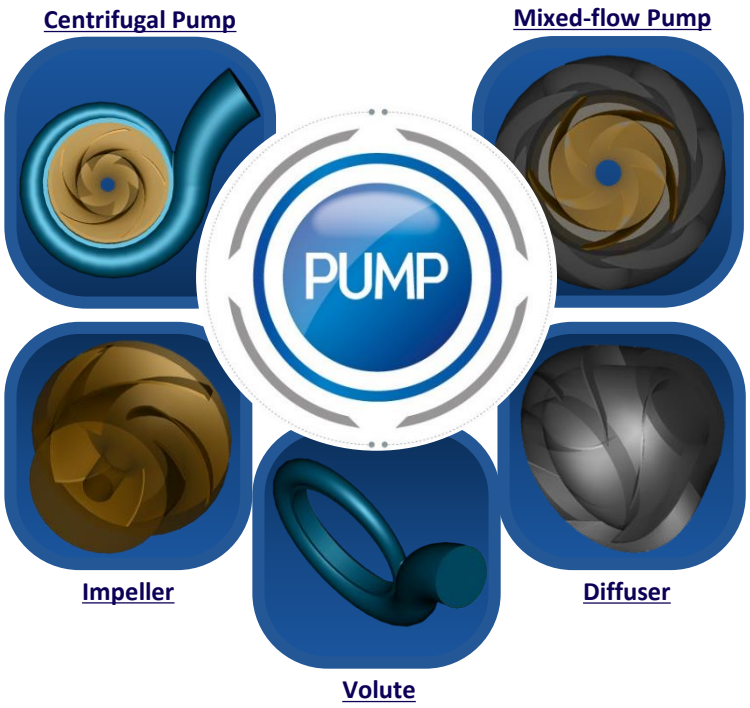

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