

## Structural Design of a Relief Valve Considering Strength

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**Abstract :** A relief valve is a mechanical element to keep safety by controlling high pressure. Usually, the high pressure is relieved by using the spring force and letting the fluid to flow from another way out of system. When its normal pressure is reached, the relief valve can return to initial state. The relief valve in this study has been applied for pressure vessel, evaporator, piping line, etc. The relief valve should be designed for smooth operation and should satisfy the structural safety requirement under operating condition. In general, the structural analysis is performed by following fluid flow analysis. In this process, the FSI (Fluid-Structure Interaction) is required to input the force obtained from the output of the flow analysis. Firstly, this study predicts the velocity profile and the pressure distribution in the given system. In this study, the assumptions for flow analysis are as follows: • The flow is steady-state and three-dimensional. • The fluid is Newtonian and incompressible. • The walls of the pipe and valve are smooth. The flow characteristics in this relief valve does not induce any problem. The commercial software ANSYS/CFX is utilized for flow analysis. On the contrary, very high pressure may cause structural problem due to severe stress. The relief valve is made of body, bonnet, guide, piston and nozzle, and its material is stainless steel. To investigate its structural safety, the worst case loading is considered as the pressure of 700 bar. The load is applied to inside the valve, which is greater than the load obtained from FSI. The maximum stress is calculated as 378 MPa by performing the finite element analysis. However, the value is greater than its allowable value. Thus, an alternative design is suggested to improve the structural performance through case study. We found that the sensitive design variable to the strength is the shape of the nozzle. The case study is to vary the size of the nozzle. Finally, it can be seen that the suggested design satisfy the structural design requirement. The FE analysis is performed by using the commercial software ANSYS/Workbench.

**Keywords :** relief valve, structural analysis, structural design, strength, safety factor

**Conference Title :** ICMEAM 2014 : International Conference on Mechanical Engineering and Applied Mechanics

**Conference Location :** Barcelona, Spain

**Conference Dates :** October 27-28, 2014