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Evacuation and Ejection Capsule for Submarines

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Abstract— The onset of era of undersea warfare with the invention of submarines has a long history of some devastating accidents that has claimed lives. Most of the accidents had a timeline for the crew to escape, unfortunately there were no rescue or evacuation systems devised. The system proposed is an ideal setup that has potential ability to either transfer personnel from one submarine to another or eject to the surface with the crew safely housed inside. There are about two capsules which can be launched one after another enabling all crew transfer. The capsule includes electromagnets for interlocking with the other submarine. The analysis of the shell was done under static and dynamic load conditions and the pressure exertion on the shell was found to be under safe limits.

Index Terms— evacuation capsule, underwater transfer, crew redemption, surface ejection

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1 Introduction

THERE has been a significant rise in fatalities involving submarines, this is due to the absence of a proper evacuation system that could save lives in the survival to death timeline. Most in sea submarine catastrophes are not fatal but if there is no proper system for decamping, the catastrophe could prove to be fatal. With the onset of nuclear submarines the crew could suffer radiation exposure in case of a mishap if not bailed out of the submarine at the right time. These events call in for the development of a rescue system that could transfer personnel from one submarine to another.

2 Conspectus Of The Evacuation System

The system proposed houses an escape capsule which can either be interconnected or ejected from the ill-fated submarine. The system can be interlocked with the other submarine providing a pathway for crew transfer. In the absence of a submarine within a close proximity, the escape capsule can be ejected. The rescue system has two capsules that can be ejected enabling the crew to rise to the sea surface. The capsule is contained in an outer shell which seals off from the rest of the submarine thereby preventing flooding during evacuation and ejection. The recue capsule is moved with the help of a double acting cylinder. The system is equipped with a laser guided interlocking module that assists the coupling process.

3 Evacuation Capsule

The evacuation capsule is fabricated of HY-100[1] hardened steel with a shell thickness of 70mm so as to withstand high pressure of 100 bar [2] at a depth of 1000 meter during evacuation. The capsule has a diameter of 2133.6mm (7 foot) and a span of 10,000mm. The clearance between inner capsule and outer shell is about 40mm. The capsule can house a maximum of 40-45 personnel at its core. The safe separation distance between the two submarines upon coupling is not to exceed 8metres. The capsule can be either ejected or interlocked with another submarine. The interlocked coupling is opened only after the pressure between the submarines is normalized. The outer shell is equipped with railing system on inner side at bottom for loading the second capsule after the successive ejection of first capsule. The door of outer shell is in accordance with the construction of camera shutter so as to minimize flooding upon ejection. The capsule mobility is made possible with the help of double acting cylinder.

3.1 Ejection and loading mechanism

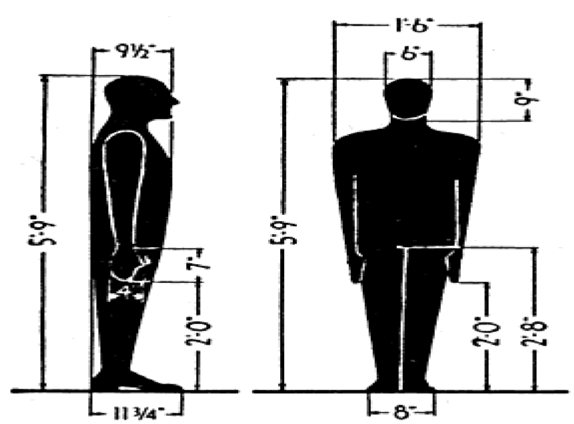
The ejection mechanism is provided with two capsules which can be ejected one after another with the help of double acting cylinder and railing system. The distance between the two capsules is about 8 meter. The horizontal sliding door is assembled on outer shell so that when one capsule is ejected the rest of the submarine can be cut off preventing flooding. The capsule door is secured to the body by a spherical hinge.

3.2 Final Stage

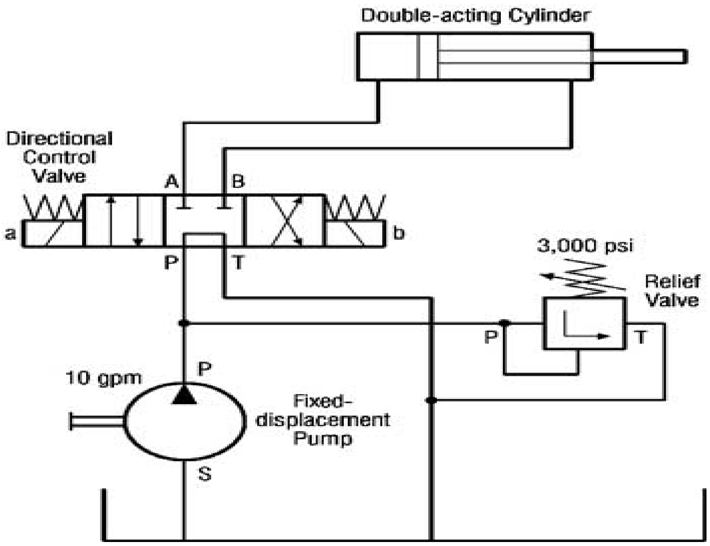
The use of KAITEN TYPE-4 [3] propulsion to propel the capsule to the surface has been suggested. The reason for this suggestion is that they provide a cover under SONAR as they do not tend to leave a trail of bubbles behind. The propulsive device is a fuel propelled piston engine torpedo with wet heater that allows the steam generated to be reused for providing additional thrust.

4 Figures and Tables

4.1 Average Measurements of a Human Body



4.2 Circuit diagram for Double-Acting Cylinder (capsule control)



4.3 Schematic figures of the Evacuation Capsule

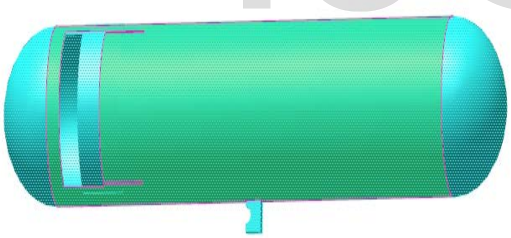


Fig 4.3.1

The above figure shows the inner shell along with the cylinder mountings along with horizontal sliding doors and its guide rails.

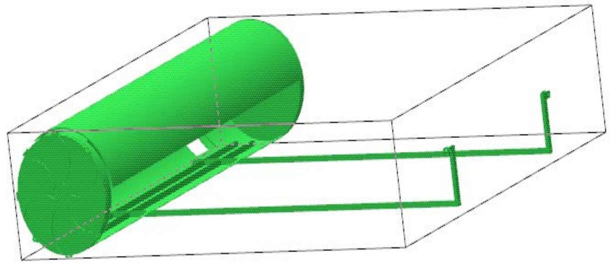


Fig 4.3.2

The enclosure that houses the inner capsule is shown along with the railings and shutter door. The vertical roll-over door is shown in open position. The guide tracks for shell loading are also shown.

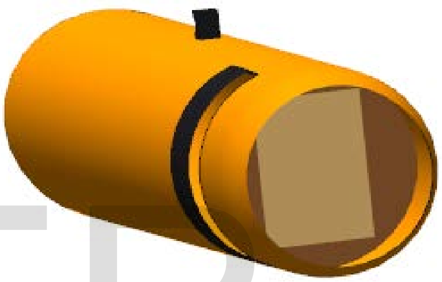


Fig 4.3.3

The inner shell's protective door that prevents flooding upon engaging with the other submarine is shown as a highlighted rectangular section.

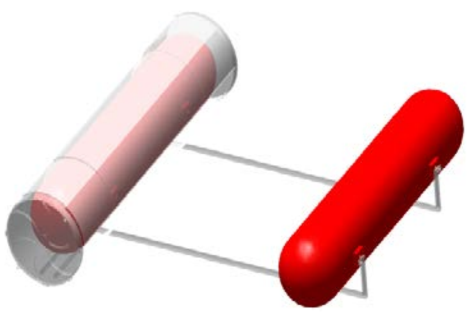


Fig 4.3.4

The capsule, enclosure and the loading mechanism is shown as a complete setup.

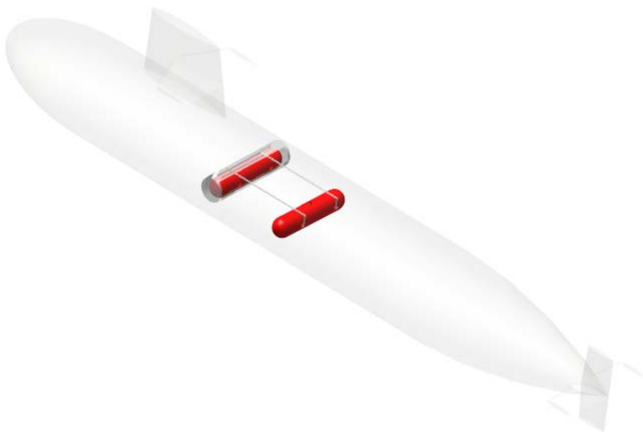


Fig 4.3.5
The see through view depicts the position of the rescue system inside a submarine.

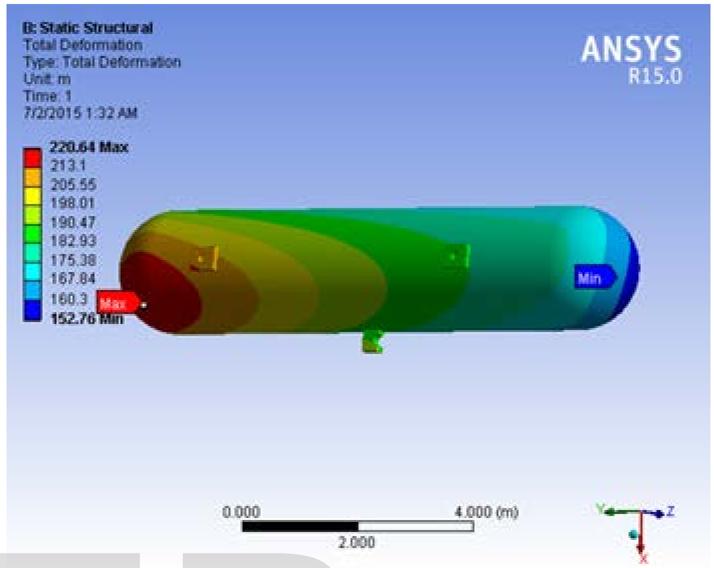
4.4 Material Properties

PROPERTIES OF HY-100 STEEL	
PROPERTIES	**VALUE**
TENSILE YIELD STRENGTH	793 Mpa
TENSILE ULTIMATE STRENGTH	895 Mpa
DENSITY	7850Kg/m^3
OPERATING TEMPERATURE(AT 1000m)	3^{O}C

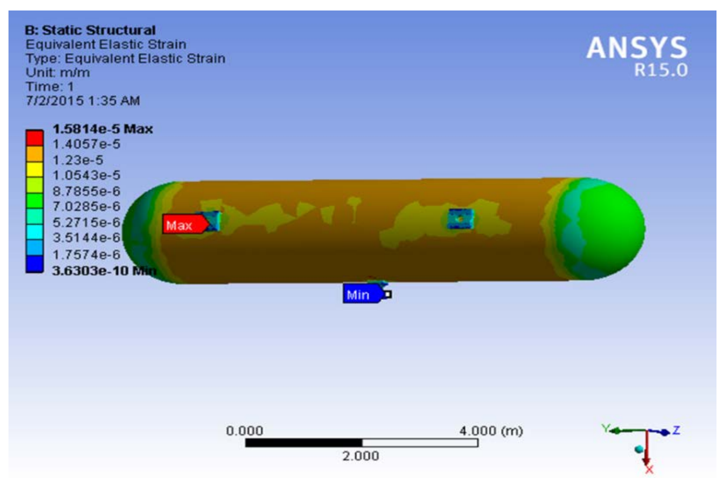
The material properties are based on the properties of the HY-100 steel[1] used in construction of the submarine hull and body.The values are based on test results conducted by Defense Science and Technology Organization, Melbourne.

5 Analysis of Inner Shell Under Stressed Conditions Analysis of the Shell

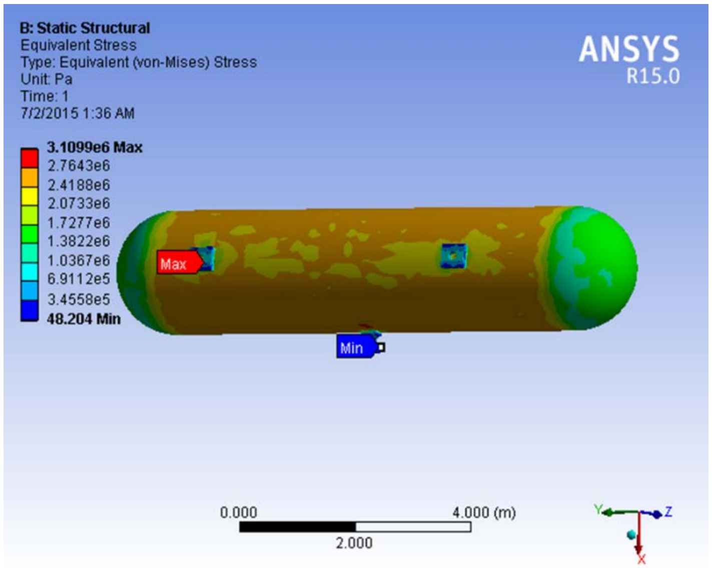
5.5.1 Subject: Analysis For Total Deformation Under Static Stress



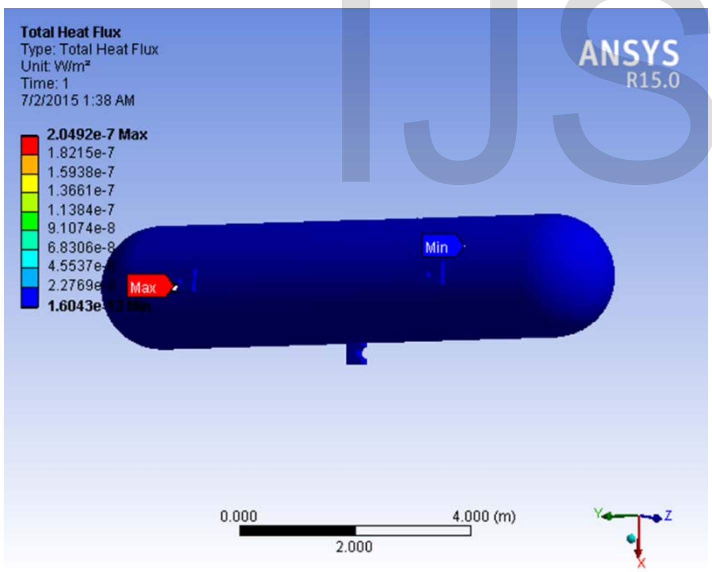
5.5.2 Subject: Analysis For Equivalent Elastic Strain (Von Mises Strain)



5.5.3 Subject: Analysis For Equivalent Elastic Stress (Von Mises Stress)



5.5.4 Subject: Analysis For Total Heat Flux (3°c undersea conditions)



6 Conclusion

Thus the proposed evacuation system which when implemented can save hundreds of life from mishaps occurring in nuclear submarines by allowing people to escape in a short time. The system is an effective alternative to diving suites which cause hypoxia when the diver is exposed to freezing waters for a long time.

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