PHASE II

UNDER WATER BLAST ANALYSIS

A B. Tech Project Report Submitted in Partial Fulfillment of the Requirements for the

Degree of Bachelor of Technology

BY

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Under The Guidance Of

PROF NIRANJAN SAHOO

To the

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CERTIFICATE

This is to certify that the work contained in this thesis entitled **“Underwater blast analysis**” is a Bonafide work of **Nitin Kumar, Rajeev Sutrakar (Roll No.210103079, 210103088)** carried out in the Department of Mechanical Engineering, Indian Institute of Technology Guwahati under my supervision and that it has not been submitted elsewhere for a degree.

Supervisor: **Dr. Niranjan Sahoo**

Professor

MAY 2024

Department of Mechanical Engineering,

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DECRARATION

I certify that the writing I've submitted reflects my views in my own words, and when I've borrowed someone else's thoughts or words, I've properly acknowledged and referenced those sources. In addition, I affirm that I have followed all rules governing academic honesty and integrity and that I have not created or manipulated any idea, data, fact, or source in my work. I am aware that any violation of the aforementioned rules will result in Institute disciplinary action and may also result in penalties from the sources who were not properly cited or from whom proper permission was not obtained when required.

Nitin Kumar (210103079)

Rajeev Sutrakar (210103088)

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ABSTRACT

Under water explosion is key concept for various of multipurpose uses such as torpedo development and silt removal from sea ports etc. to learn more about underwater blast we take help of various simulating software's such as Ansys here in this project we have just began the basics of underwater explosion by learning the shock wave and its characteristics in shock tube. Further we will deep dive into the concepts of underwater explosion with the help of this knowledge.

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CHAPTER 1

INTRODUCTION

For having a better understanding of underwater bubble dynamics we should have a sound knowledge about how shock waves are formed in shock tube which finally travels into water and forms bubble. As we have studied shock tube earlier now we will be explicitly dealing with under water bubble dynamics. Here we will be learning about bubble propagation inside water and its various stages we will be simulating underwater bubble propagation through Ansys thus our Objective is

- To lean about underwater bubble dynamics
- To solve a simple multiphase problem of bubble propagation.

CHAPTER 2

BUBBLE DYNAMICS IN UNDER WATER

In under water explosion bubbles are formed due to High temperature and pressure created by explosive particles at its center.

2.1 EXPANSION PHASE:

High pressure and temperature forces bubble to expand radially outward as the pressure inside bubble is higher than water surround it, bubble expands and then comes one instant when pressure inside and outside of bubble is same but due to outward momentum it continues to expand till the point where the momentum of expansion is overcome by the imbalance of pressure inside and outside this point is called First bubble maximum.

2.2 CONTRACTION PHASE:

Pressure inside bubble is very small at the bubble maximum which leads to contraction of bubble. Eventually the bubble comes to the point where inside and outside pressure is same but it continues to contacts until it cannot contract further due incompressibility of gases inside the bubble .This expansion and contraction continues till the bubble reaches the water surface or All of the gas bubble energy is expended (for extremely deep detonation).

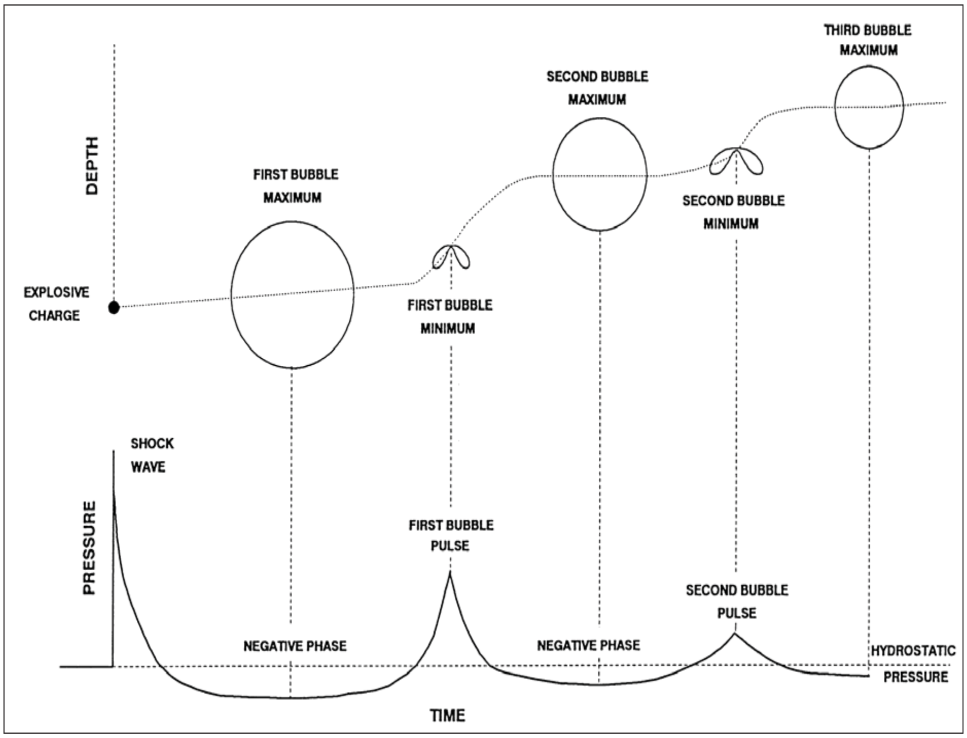


Figure 2.1

Figure 2.1 shows expansion and contraction phase in bubble propagation along with pressure inside bubble. When inside pressure is low in comparison to outside pressure then it is shown as negative phase while when bubble have high pressure than outside then it is shown as positive phase most of the time bubble is in negative phase. While moving upwards bubble also get effected by Drag and Buoyancy thus making movement relatively slow in first bubble maximum.

CHAPTER 3

SIMULATING UNDER WATER BUBBLE PROPAGATION

We have used Ansys to simulate a underwater bubble propagation We have solved a multiphase problem with volume of fluid method in Ansys. We have taken surrounding medium water with a constant surface tension of 0.072 N/M. while other parameters of water from Fluent data base.

3.1 GEOMETRY OF SIMULATION

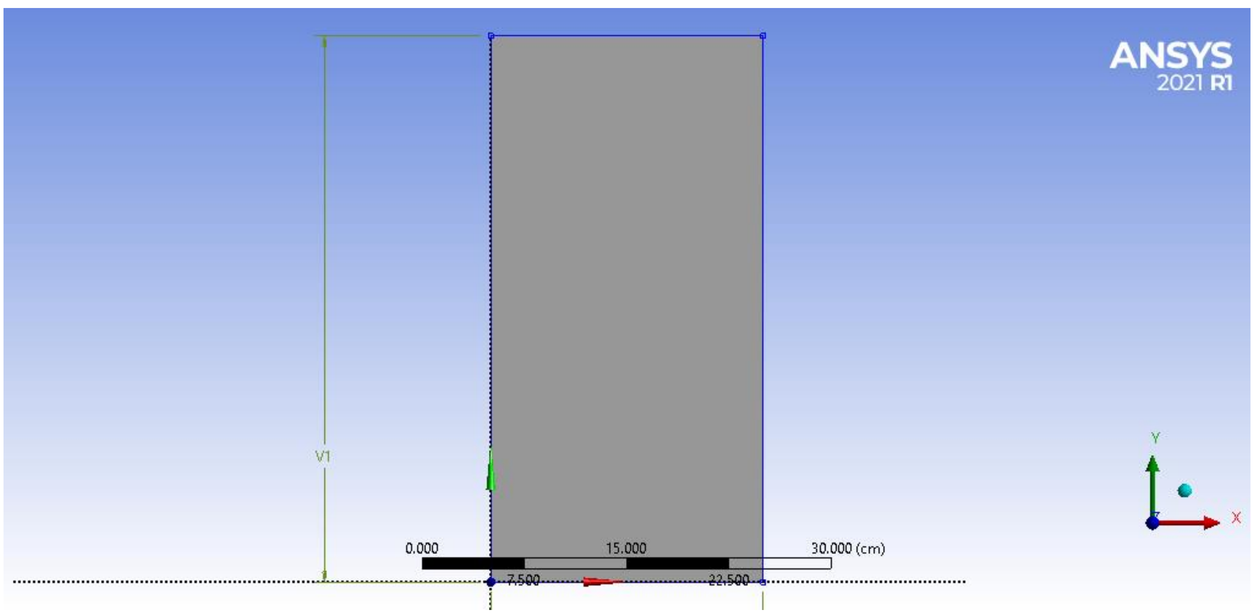


Figure 3.1

We have taken a rectangular geometry of following dimesnsions

Table 3.1

LENGTH V1	40 CM
WIDTH H2	20 CM

3.2 MESHING

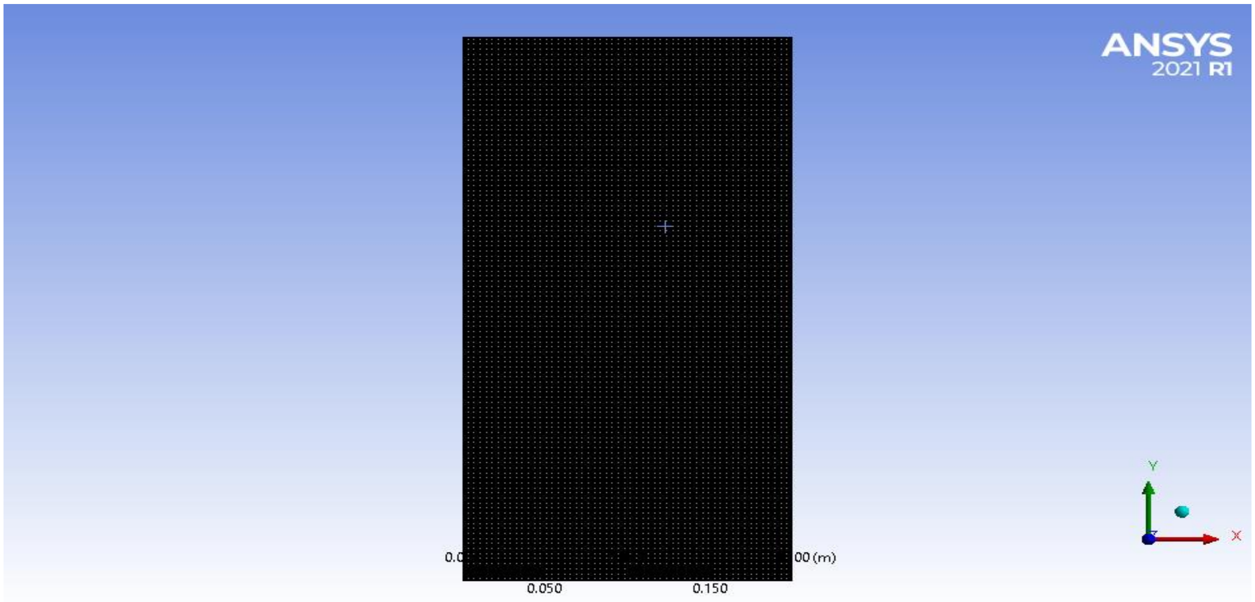


Figure 3.2

We have sized breath with 200 divisions and length with 400 divisions.

Following Table shows the nodes and elements of mesh

Table 3.2

NODES	79401
ELEMENTS	78804

3.3 BOUNDARY CONDITIONS

We have used multiphase model volume of fluids for interface of air and water. Surface tension of a constant value. We are taking inlet type as pressure inlet with initial position of bubble as (10 cm,0.025 cm) with bubble radius of 0.025 cm.

CHAPTER 4

SIMULATIONS RESULTS

We have obtained following simulation of bubble propagation.

Figure 4.1 to Figure 4.7 shows position of bubble at different time steps.

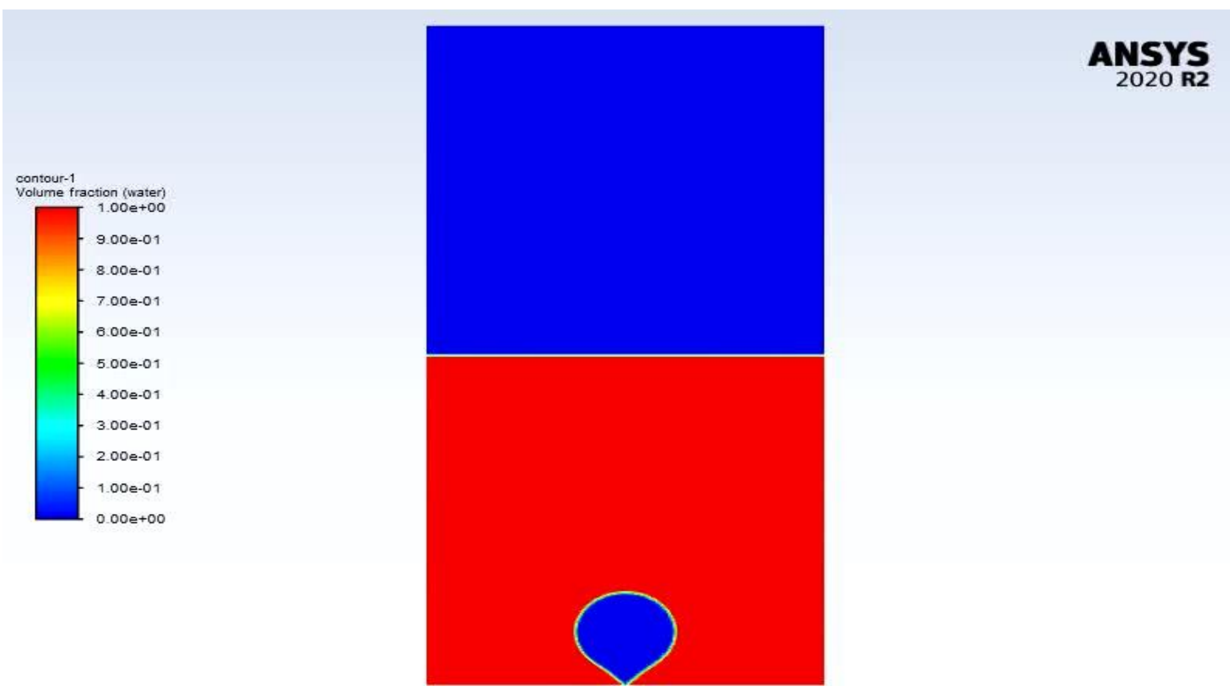
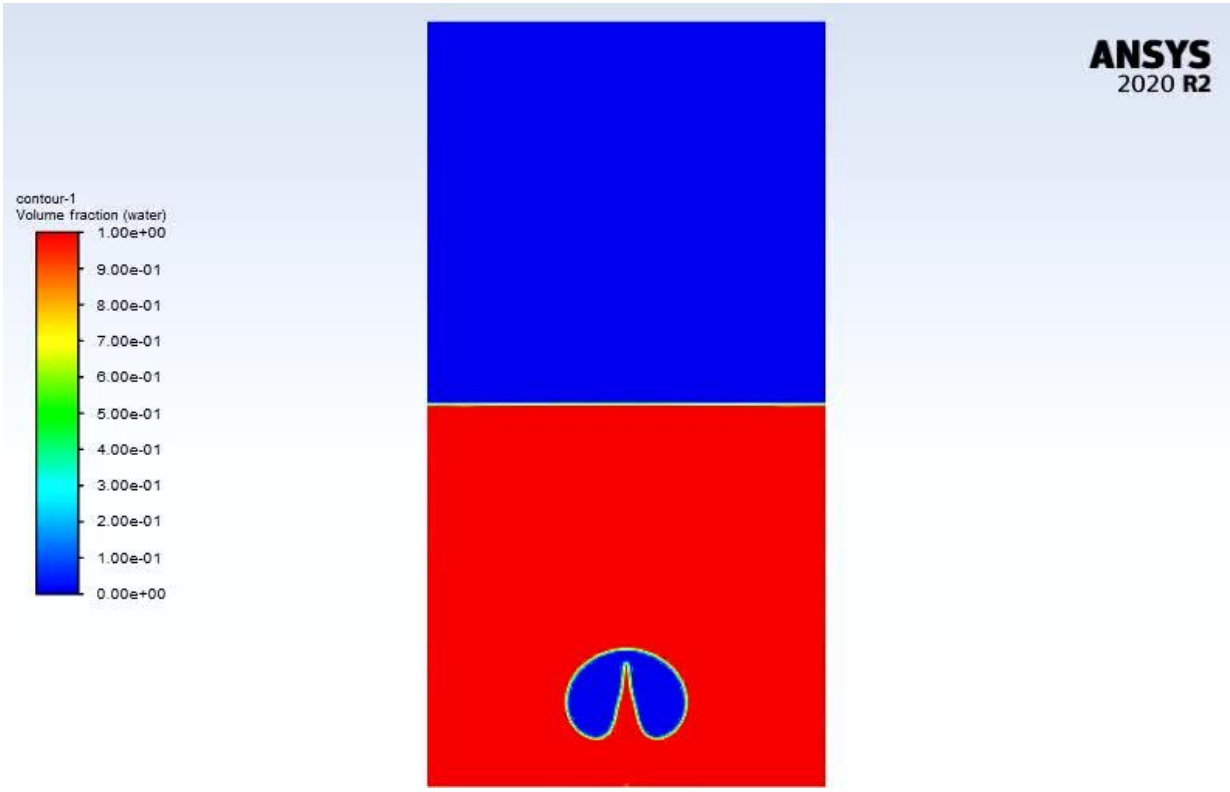
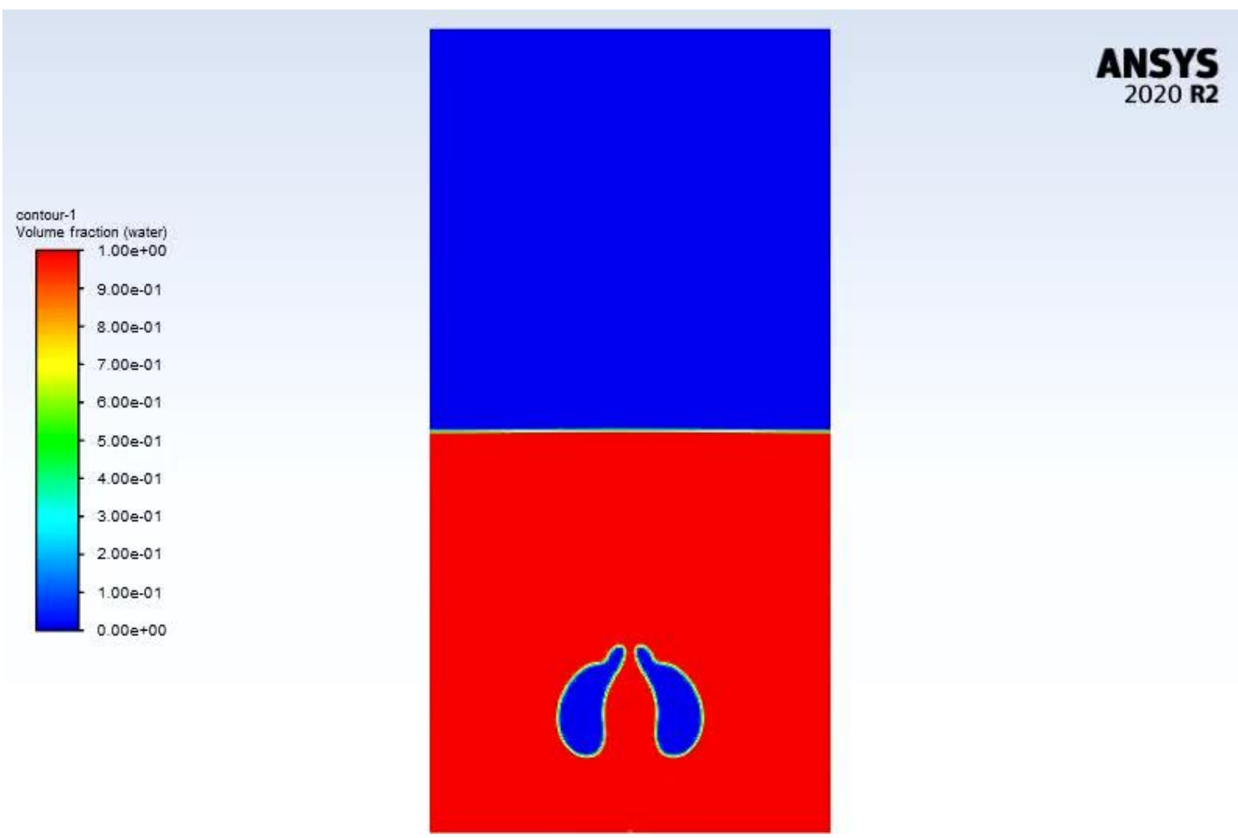


Figure 4.1


ANSYS
2020 R2
contour-1
Volume fraction (water)
1.00e+00
9.00e-01
8.00e-01
7.00e-01
6.00e-01
5.00e-01
4.00e-01
3.00e-01
2.00e-01
1.00e-01
0.00e+00


ANSYS
2020 R2
contour-1
Volume fraction (water)
1.00e+00
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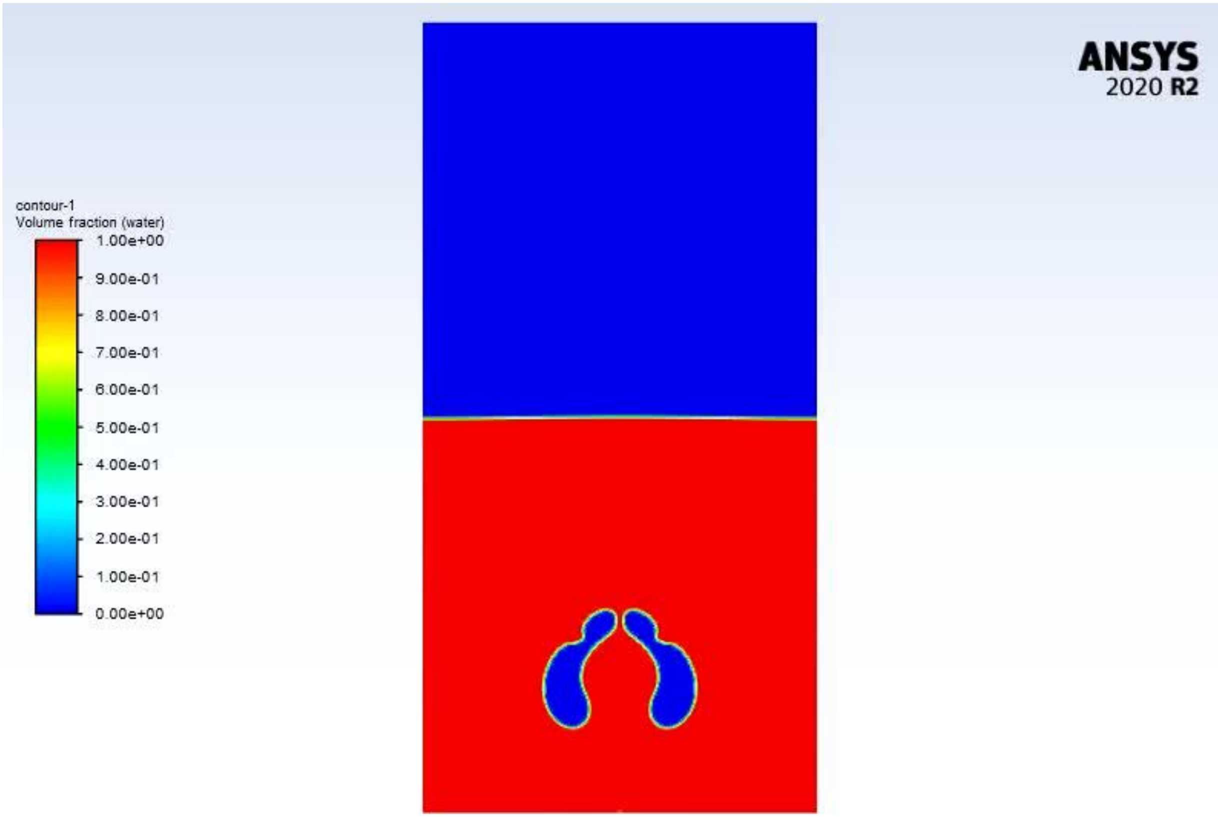
8.00e-01
7.00e-01
6.00e-01
5.00e-01
4.00e-01
3.00e-01
2.00e-01
1.00e-01
0.00e+00

Figure 4.2 & 4.3


ANSYS
2020 R2
contour-1
Volume fraction (water)
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8.00e-01
7.00e-01
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1.00e-01
0.00e+00

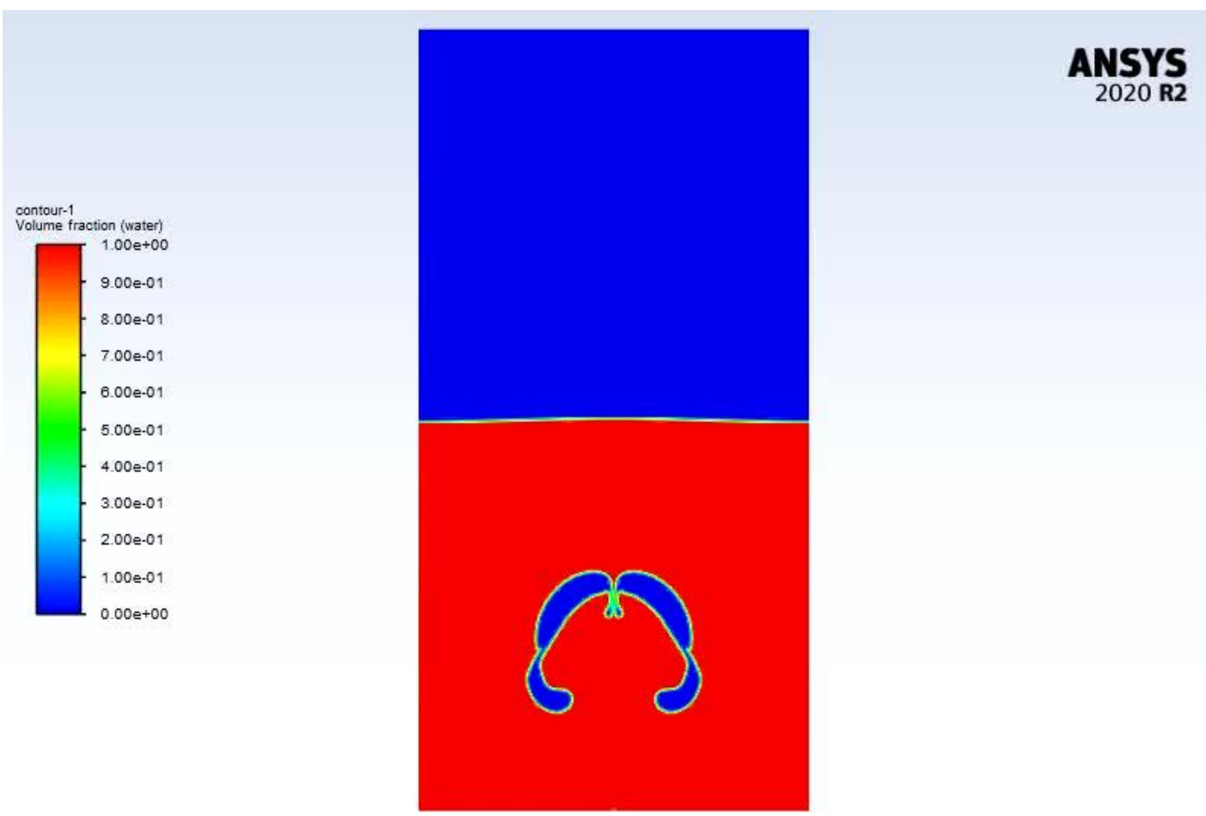
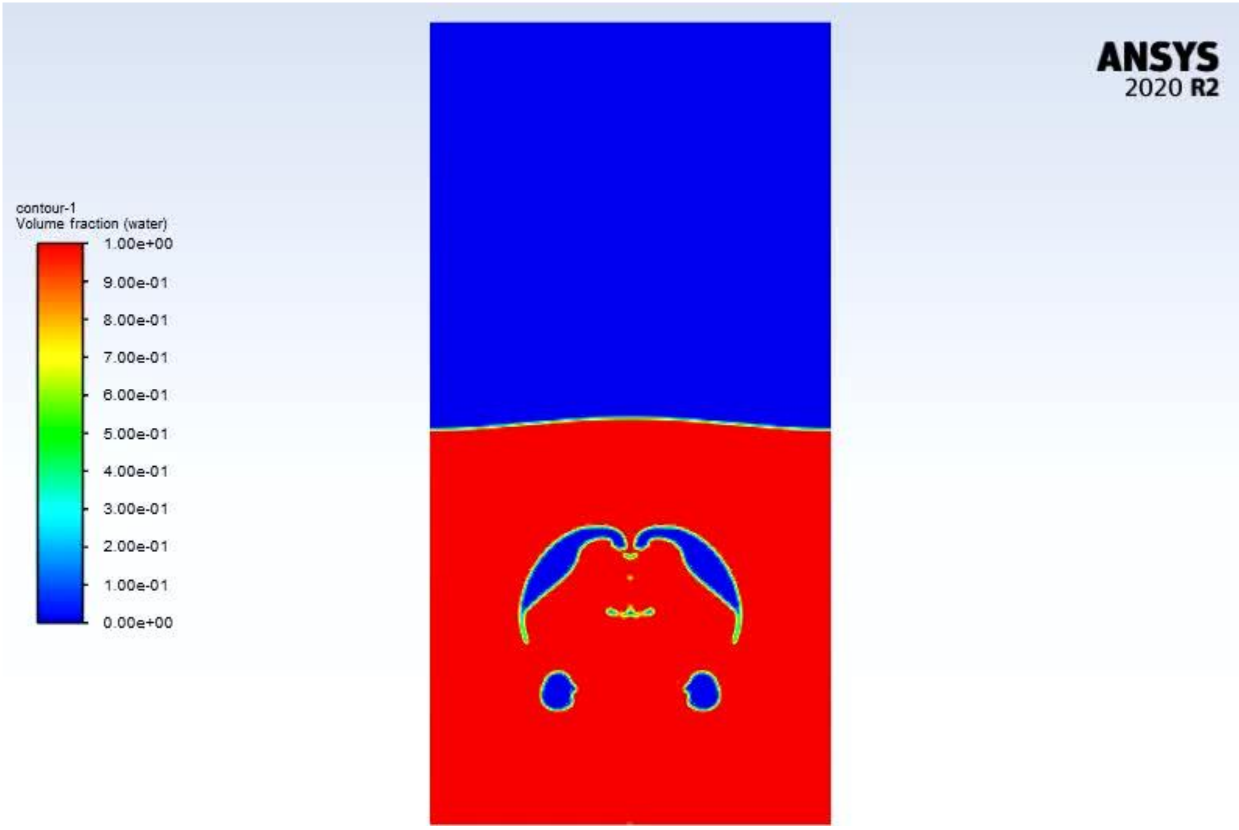

ANSYS
2020 R2
contour-1
Volume fraction (water)
1.00e+00
9.00e-01
8.00e-01
7.00e-01
6.00e-01
5.00e-01
4.00e-01
3.00e-01
2.00e-01
1.00e-01
0.00e+00

Figure 4.4 & 4.5


contour-1
Volume fraction (water)
1.00e+00
9.00e-01
8.00e-01
7.00e-01
6.00e-01
5.00e-01
4.00e-01
3.00e-01
2.00e-01
1.00e-01
0.00e+00
ANSYS
2020 R2

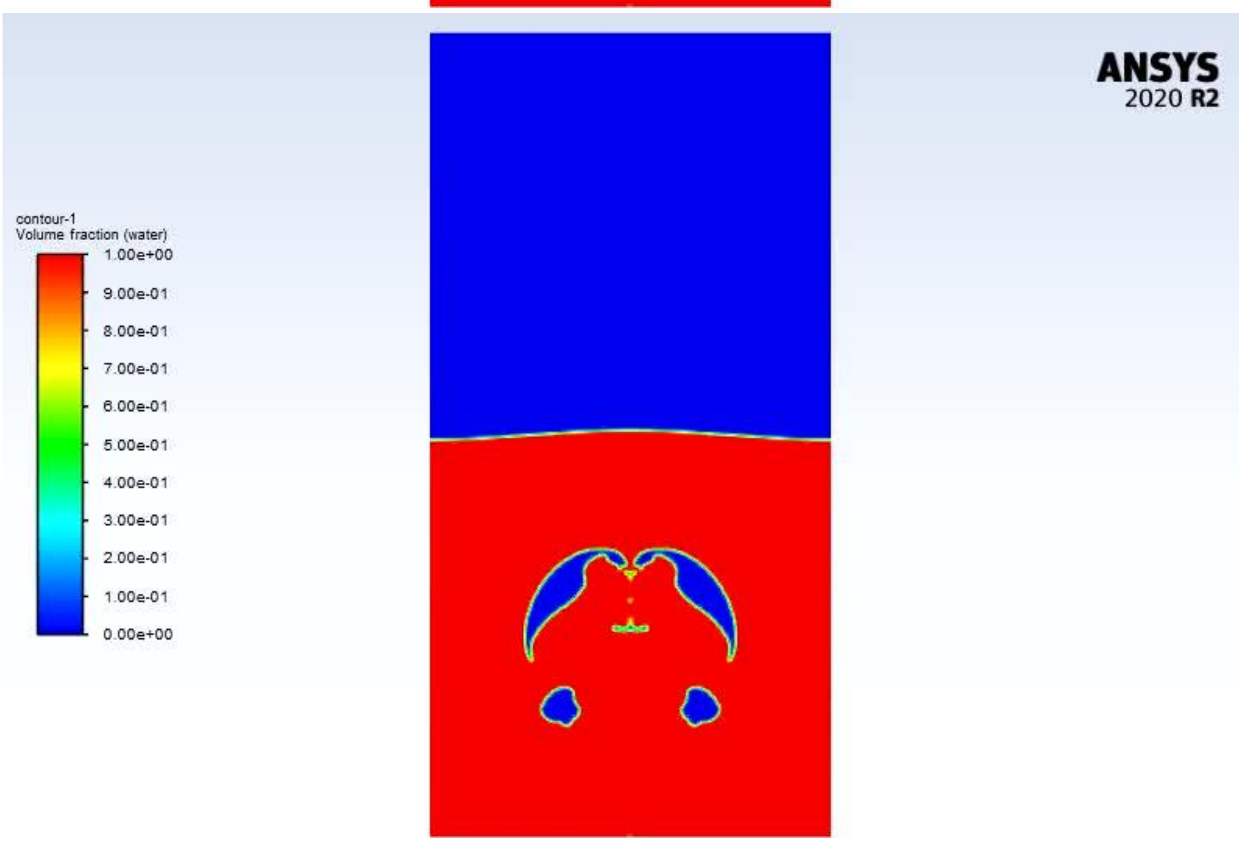

contour-1
Volume fraction (water)
1.00e+00
9.00e-01
8.00e-01
7.00e-01
6.00e-01
5.00e-01
4.00e-01
3.00e-01
2.00e-01
1.00e-01
0.00e+00
ANSYS
2020 R2

Figure 4.6 & 4.7

CHAPTER 5

SHOCK TUBE DESIGN

We have designed driver and driven section of shock tube in solid works.

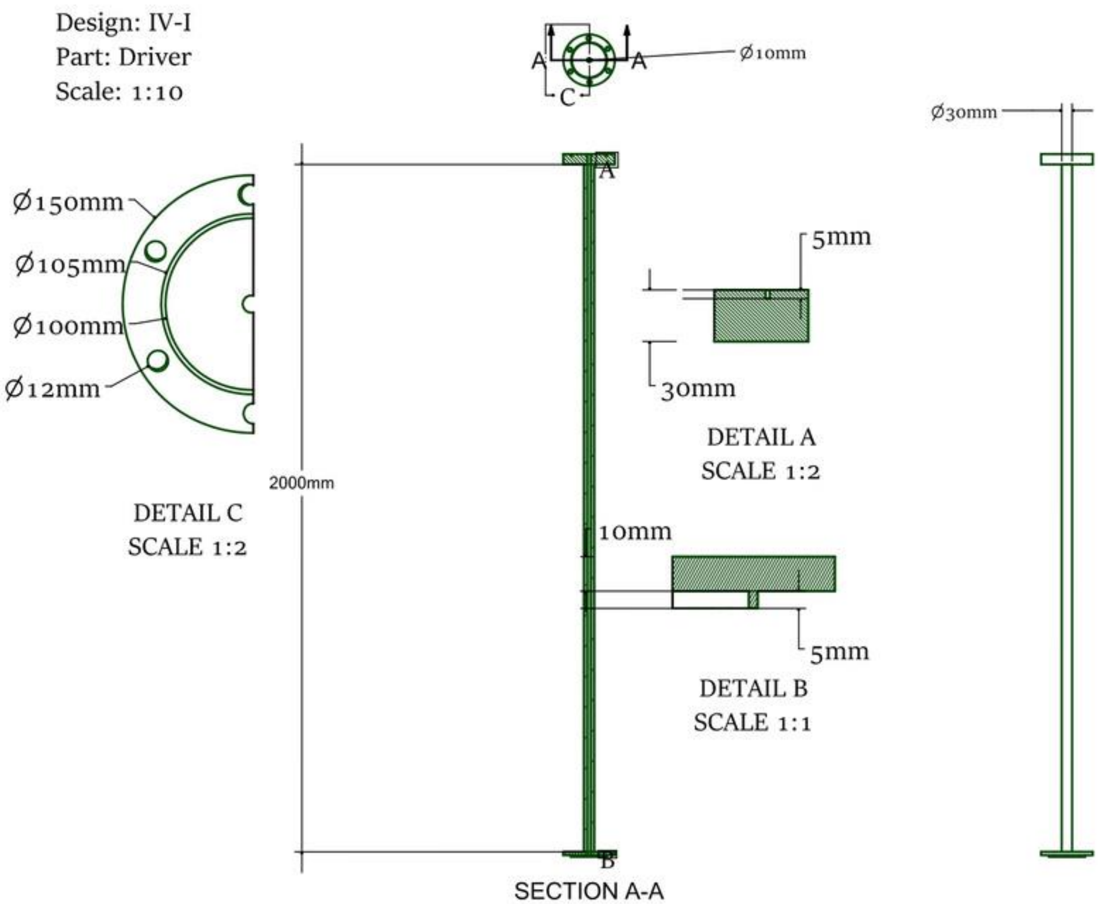


Figure 5.1

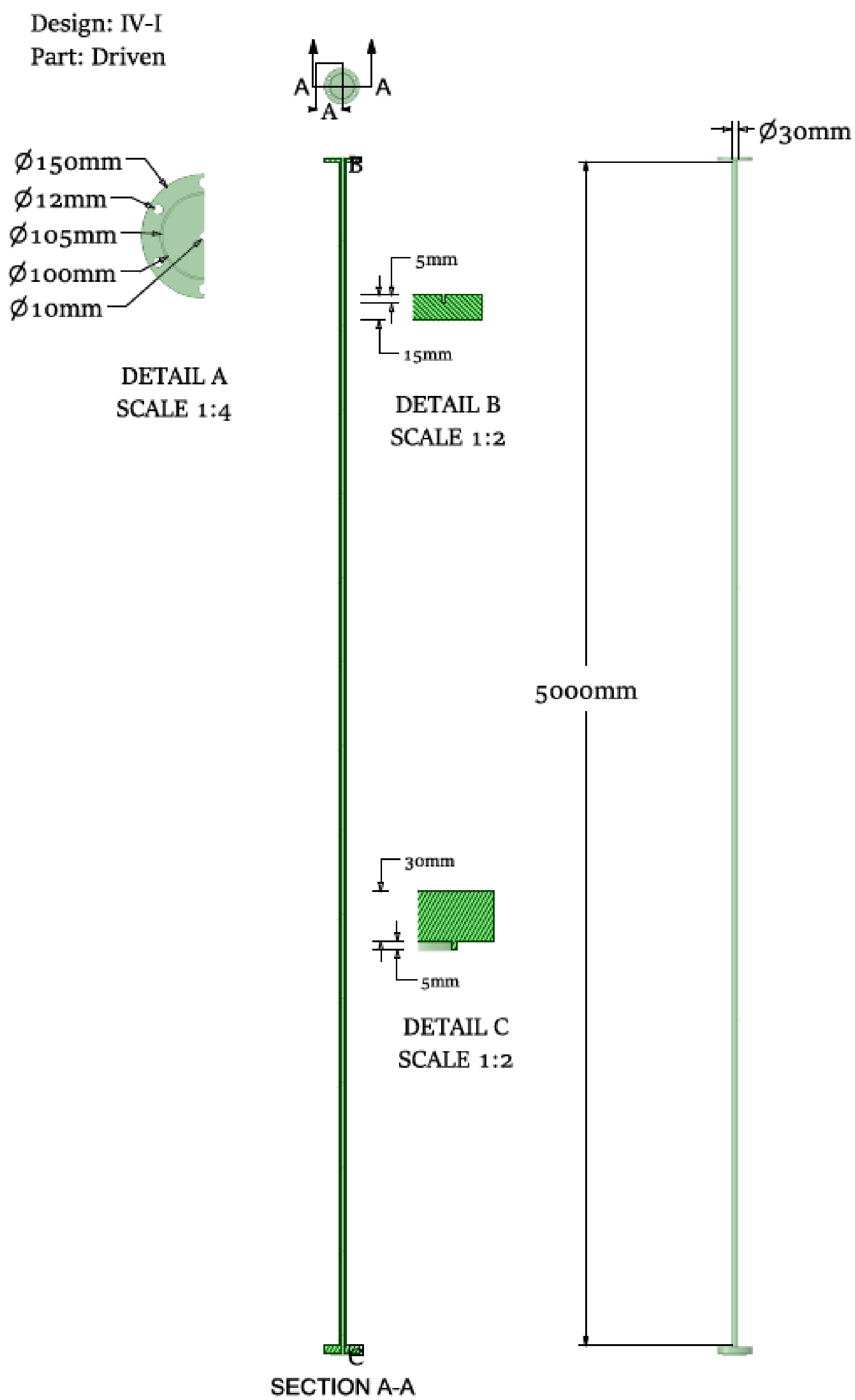

Design: IV-I
Part: Driven
A
A
A
Ø150mm
Ø12mm
Ø105mm
Ø100mm
Ø10mm
DETAIL A
SCALE 1:4
B
5mm
15mm
DETAIL B
SCALE 1:2
30mm
5mm
DETAIL C
SCALE 1:2
C
SECTION A-A
5000mm
Ø30mm

Figure 5.2

CHAPTER 6

FUTURE WORK

In experiments, calibration of the fabricated shock tubes shall be done and further, underwater blasts shall be performed.

In simulation, shock wave propagation in water medium and bubble dynamics after an underwater blast shall be studied.

CHAPTER 7

REFERENCES

- Underwater Explosion Phenomena and Shock Physics (research paper).pdf
- https://youtu.be/J1_IhXAq62E?si=cBxfL8-dKmX2hykz
- https://youtu.be/wN3FgN0cn2Q?si=DL_ur2V6wZMFQq4l
- To learn ansys software we follow the videos

  shttps://youtu.be/3FHk1_vCpkk?si=tZ1y4NOLtPROLxcI.

  https://youtu.be/t4J0RXuq9xk?si=FJqRPCyVjvcFzz5x.