PART 1 – PROJECT NARRATIVE (REQUIRED)
(limit: 1,200 words – application will be discarded if violated)

1. BACKGROUND AND/OR LITERATURE REVIEW

The Ancient Romans are well known for their engineering and architecture. Modern scholarly studies are numerous. We even have a primary source, *De Architectura*, written by Vitruvius in the 1st century A.D. The invention of concrete (Lat. *caementum*) in the 2nd century B.C. enabled the construction of free standing, tall buildings and monumental ports. However, the fact that builders had to deal with some consistent environmental changes and structural upkeep, especially with installations that were located near rivers and seas, had not been studied to the same extent. Installations like ports were battling mostly silting of the sea and river deltas. But other installations, such as salt works, were battling rising sea levels.

Ports were considered a complex engineering project in Roman times. They were used to bring in food, raw materials and other imported goods to the citizens of Rome. Portus, built by Emperor Claudius in 46 A.D. and significantly enlarged by Emperor Trajan in early 2nd century A.D., was an extension of Ostia and was the main harbor for Rome during the Empire. It was one of the ports that struggled with keeping silting of the Mediterranean Sea at bay. It was also one of the largest engineering projects with its man-made harbor, that maximized the amount of ships that can enter and off load cargo.

The Portus Project, University of Southampton’s project for looking into the archaeology of Portus just outside of Rome, is one of the more beneficial sources in providing me with the most current understanding of the geophysical changes that were happening and what the Roman engineers did to help conquer the elements. The project offers geophysical survey information that looks into the soil and what lies beneath it. It also gives multiple different source materials that will be helpful when researching engineering upkeep and innovations.

In contrast to the complexity of ports that battled the land build-up and receding sea level, are the other sea installations, such as salt works, that were affected by the rising sea levels. Salt works are installations that were used to extract the salt from the sea by evaporation. These salt works, like ports, were built of stone and Roman cement but they were much less complex than ports were. Salt was important to the Empire because it was used as payment and in pastoral economy as well as used in the preservation of food. The Ostia Foundation will be another good project to examine when looking into the sea installations. This is because there is information on how salt works were being used, which will help better understand how they used engineering and architecture to harness the elements. My mentor is also working on a site that includes salt works, information will come from there as well.

2. RESEARCH QUESTION(S) AND OBJECTIVE
With all the knowledge on Roman engineering and the modern studies, we are lacking the understanding on how they dealt with environmental changes. There are many recently published studies on the ancient Mediterranean landscapes, environments and their historical changes. However, there are not as many studies on how ancient engineering responded to the ongoing environmental changes and structural upkeep due to those changes. My research will look at how engineering responded to the environment changes through maintaining installations important in the sea economy.

The questions that are the focus of this research are:

- How engineering responded to maintaining economic/sea installations (Portus, salt works, etc.) that depended on the environmental stability?
- Who were the main benefactors of the maintenance and who performed the maintenance?
- What were the reasons that maintenance was ceased and what is the condition of these sites today?

### 3. DESIGN, METHODOLOGY, AND/OR THEORETICAL APPROACH

This research will be conducted by using many different types of sources. There are different primary sources that were written during the era that will help understand how engineering was done in ancient times. Also, a good example of Roman salt works that was challenged by the rising sea is a part of a Roman island estate in Croatia that my mentor excavates. This salt work will be used in comparison to Portus and will look at the engineering issues due to it being submerged in a shallow bay today. To aid in the research, modern salt works located in Croatia on the Adriatic Sea will be examined. They are located in Ston and in Pag. Even though the existing salt works are not from antiquity they can still be used to see how they are maintained and how the engineering has helped with the battle against the environment.

The design methodology and approach are as follows:

1. Primary and secondary sources will be gathered that discuss the environment and engineering of Portus and specific salt works. Information on digs that are already happening will also be gathered.
2. This information will be filtered, and relevant information will be recorded to find engineering maintenance and architecture.
3. Information will then be analyzed and compared to modern day installations.

I am an engineering student and have been studying the Ancient Roman world and became interested in this particular subject when I visited Ostia as well as when I was researching for my final paper on the imperial harbor of Portus near Ostia. Portus is now an inland lake due to environmental changes since the antiquity. In that research I have learned that Roman builders and engineers of Portus faced the silting of the river Tiber. Ostia has also experienced the same phenomenon due to its location on mouth of the Tiber.

### 4. RESULTS/OUTCOME AND INTERPRETATION

The projected outcome of this research is to find how engineering was used to battle the environmental changes that were going on. This will be done by examining primary and secondary sources that focus on engineering and architecture and compare it to the physical evidence that is found on archaeological sites. Using this information, it can be discovered how installations were maintained and could show some background on why they were abandoned. This information can be used to help maintain sea installations that are undergoing environment changes today.

### 5. ANTICIPATED IMPACT OR IMPLICATIONS

This work can impact the historical field of study as well as the field of engineering by achieving a better understanding on why some installations, especially those involved with the sea, were abandoned. It can also help the engineering community because they can use this information of the environment to build better installations and find a way to better maintain them. It will also impact me as an individual because it would give me a better understanding on how my major and my minor can be combined and be able to do what I enjoy doing within the realm of history.
Contrary how well Ancient Romans are known for their engineering and architecture there are few scholarly studies done on how they have worked with the changes in the environment and keep the structure maintained. Installations that were located near rivers and seas have been affected more than others. Most of these installations were battling silting of the sea and rivers. But other installations were battling rising sea levels. The two cases that will be examined are ports, an installation that battled silting, and salt works which battled rising sea levels.

These cases will be examined and compared using textual sources written by people who were living during the time of these ports and salt works. Archaeological evidence that was found during the excavation of these locations will also be examined to see how things were built. Finally, projects that are going on currently will also be examined to help get a better understanding of both locations. The locations that will be under examination are salt works located within a Roman villa in Croatia and Portus, Rome’s main harbor for importing goods.

Both ports and salt works were important to Rome’s economy and both battled environmental issues. The engineering and maintenance of ports and salt works found through this research can be used to help maintain and understand how to protect ports and other installations from the environment today. A lot can be learned from the history of engineering and taking information from the past, we can prevent damages done by the environment.

### PART 3 – PROJECT LOGISTICS (REQUIRED)

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<thead>
<tr>
<th>1. TIMELINE</th>
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<tbody>
<tr>
<td>Week 1: Do research on Portus and the Roman island villa in Croatia and find more relevant sources.</td>
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<td>Week 2-3: Look for information on Portus on how they were constructed and what they were used for.</td>
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<td>Week 4-5 Discover how these installations are maintained and compare them to modern day installations.</td>
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<td>Week 6-7: Find out what environmental aspects could have caused abandonment of these installations.</td>
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<td>Week 8: Use environmental findings and engineering aspect to determine the maintenance of installations.</td>
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<td>Week 9-10: Finalize findings and write paper.</td>
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<th>2. FINAL PRODUCT</th>
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<td>This work seeks to gain a better understanding on how economic and sea installations were impacted by the environment and how humans overcome and use aspects of the environment to their advantage.</td>
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### DISSEMINATION PLAN

Paper submitted to UROP, poster presented at Inquiry at UST.

### PART 4 – ADDITIONAL APPENDICES

**Bibliography**


Urbanus, J., Rome’s Imperial Port, in *Archaeology*, March/April 2015, 26-33.


**Glossary of Terms**

- **De Architectura**: On Architecture.
- **Primary Source**: A text that is written during the era under examination or archaeological findings of a site pertaining to the era under examination.
- **Roman Concrete**: A combination of lime mortar and rubble aggregate with the addition of volcanic sand.
- **Secondary Source**: A document that relates to the information under examination but is not from the era or was presented elsewhere.
- **Silting**: Process of being blocked or filled with sediment.
- **Villa**: Latin word for a complex of buildings of a rural Roman estate.