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**Introduction**

In this essay I will seek to explain the concepts surrounding Civil engineering in modern times and how the historical engineering has an impact on future engineering. There are many concepts about engineering that seek to show how important this field has made our world that we live in today much more comfortable. As an engineering student I will seek to explain that engineering is indispensable to our lives. It has been the key to making human existence more comfortable. For example, the development of dams and water catchment areas has led to an increase in agricultural produce and available water for communities which has increased the standard of livening of these people. Engineering has also made affordable housing complexes for low income people as well.

This essay will be done in the form of answers to eight (8) questions and as recommended it will be presented in the form of 1 to 3 paragraphs per question. These questions are based on this Book & chapter: Introduction to Civil Engineering Systems, Chapter 1.

Deep thought and analysis will go into presenting this answers to provide a solid foundation for me as a Civil Engineer. I would like to become a person who will develop and design projects on my personal properties and properties that I will purchase and put developments such as housing, a complex with different business and a general consulting engineering firm. I will also offer my skills to available corporations, governments, building firms and other needed entities.

**Body of Assignment**

1. Discuss any two definitions of engineering and identify the systems engineering concepts that are found in these definitions.

Analysis

There are many different definitions of engineering found in different engineering books and different universities and institutions. In the following there are two definitions of engineering which are examined:

1. Engineering definition:

The application of science, mathematics and business and other fields to harness efficiently the resources of nature to develop structures and facilities that benefit the entire society at the current time and in the future.

2. Definition two, Engineering:

The science of economy, of conserving the energy, kinetic and potential, provided and stored up by nature for the use of humans... [Utilizing] this energy to the best advantage so that there may be the least possible waste (William Smith, 1908)

These are two definitions that I feel comfortable with explaining and analyzing.

Definition one:

In this definition the following systems engineering concepts were deducted:

a) Application of scientific tenants

b) Optimization of resources

The usage that engineering is a science is found in the above definition and this is a key systems engineering concept. Engineering is definably a science due to the level of scientific methodology involved. Science is technically part of everything but more importantly is part of engineering. This key systems engineering concept seeks to show that engineering has the natural aspects of science relating to analysis, investigation, observations, facts and inductive or deductive reasoning. This are reasons why engineering is described as a science. The role of science in civil engineering is evidenced in the definitions above through the use of such phrases as through the aid of science, utilization of the laws of nature, art of applying science, application of scientific laws, and systematic application of science are evidential of the role of science in civil engineering. Civil engineering is considered a science because its practice is consistent with the key characteristics of the classical scientific method—hypothesis setting and testing, replicability, refutability, and reductionism (Khisty and Mohammadi, 2001).

Definition two:

This definition seeks to utilize the optimization of resources and conservation of resources. This definition shows how Engineering optimizes resources and allocates resources economically in different projects. Engineers are able to use resources such as land, material and people in an efficient and economic manner. This definition has the system engineering concept of optimization of resources which means that in engineering engineers look to use all resources in an economic manner to reduce cost and waste and obtain the most of limited resources. Even if resources are abundant the engineer looks to get the most out of all resources.

2. Is civil engineering both an art and a science? Explain.

There are definitions that explain engineering as an art and as a science. Engineering is described as based on the facility that it intends to use. Some definitions which are related to the branch of engineering use systems engineering concepts and describe the following different branches of engineering including the following hydraulic,hydrologic,transportation,architectual,materials,construction,structural and Geomatic.

Definitions that describe engineering as an art are abundant Describing engineering as an art seeks to show that the engineer is an artist and he can create and design structures that will be considered art and be recognized as art. This doesn’t take away the science in engineering because engineering is both an art and a science.

Thus if I as an engineer were to design a wonderful custom made mansion to reflect who am I, it would be considered art but the constructive engineering wouldn’t be without mathematics, science, material analysis, structural engineering to know the stress on the beams for example and geotechnical engineering. Thus the view of engineering depends on the person who is doing the investigation.

Critically, there will be three sides to this question: One side involves the engineer who considers engineering an art. The other side is where an engineer considers engineering a science and the third side is where engineers decide to produce engineering that is both an art and science.

Thus when one looks at the pyramids I Egypt they appear to be both art and dynamic engineering feats based on science and mathematics. In conclusion let’s try to remember that the work being done by the engineer can be interpreted as art or a science.

3. N. W. Dougherty stated: “The ideal engineer is a composite.… He is not a scientist, he is not a mathematician, he is not a sociologist or a writer; but he may use the knowledge and techniques of any or all of these disciplines in solving engineering problems.” Discuss.

I agree with this statement. An engineer is a dynamic individual who because he has to design can use knowledge and techniques of any or all the disciplines in solving engineering problems. For example, an engineer has to solve the water problem of a particular property. He would find out what is the population of the community, who has access to water and who needs water. Then the engineer may need to access the soil using geomatic techniques to verify the soil composition available in the area and what type of tools and materials can be used in that particular area.

Another example might be in the development of a skyscraper in a metropolitan area. The engineer may use macroeconomic analysis to determine what services people might want such as suites, restaurants, business space and apartments before doing the skyscraper. This information may be received in surveys and or questionnaires in the metropolitan area. This will provide the engineer with credible information to put a plan to implement a huge project.

In the past an engineer was mainly involved in military engineering and as such developed many designs for military purposes, however due to world and society changes the engineer evolved in to a civil engineer which meant that he only worked projects not of a military nature like roads, housing, water dams, buildings and other structures.

4. According to R. E. Hellmund, engineering “brings about the utilization of the materials and laws of nature for the good of humanity.” However, it can be a two-edged sword. Discuss how poor engineering practice could be harmful to society.

In my opinion there are many examples of poor engineering practice such as poor roads, poor highways, badly built overpasses, poorly constructed walls, weak dams, bad foundations, badly built ships and jetties. Engineers according to R.E.Hellmund brings about the utilization of the material and laws of nature for the good of humanity and this is very true. I agree with this statement.

Examples of great engineering feats include the pyramids in Egypt and the world’s tallest building in Dubai for example. Despite these remarkable feats there are many examples of poor engineering practices. The damage may not show right away but may show after use and due to wear and tear. Sometimes the workers may make mistakes which may go unnoticed which might make the structure weak and as a result cause accidents.

In developed countries engineering mistakes are not accepted and should not be accepted. Countries like the United States has legal means to hold the engineers responsible and this is a key part of the US the Constitution. In my home country of Dominica engineers have difficult jobs to do and so a critic may claim poor engineering as the reason for a serious accident. For example, during the hurricane season there are huge hurricanes that destroy roads, walls etc. near the sea. Thus when reconstructed for example a road it may be destroyed in the following hurricane season and thus critics may claim that the wall was no good. However because the Hurricane was so strong the wall was destroyed and as a result the engineers gets unnecessary blame. Thus, in this case poor engineering practice cannot be used to blame the collapse of the wall but a strong hurricane.

5. Discuss the sociological changes in prehistoric times that ultimately led to the need for civil engineering structures.

Labi(2014) states that engineering in has evolved from the time of nomads up till this year 2022.Lambi provides many examples as well to show this changes.

In prehistoric times specifically 4000 and 2000 BC Labi claims that humans wanted to change and started to move away from nomadic lifestyles searching for housing usually found in caves and then some form of permanent shelter. This resulted in humans starting to develop building skills and so started the engineering. This evolved. The reshaping of caves to protect humans from harsh weather and the use of tree trunks to cross water bodies were early practices related to civil engineering (Straub, 1964). Further development came in the need for transport because man now had homes and needed to transport food home thus boats were built to ride the rivers. Land travel was done used certain roads in the form of tracks.

These civil engineering structures further evolved in the form of utensils to cook and areas for cooking were developed as well. They were also able to develop very fertile land due to the engineering feats to bring water that made the lands fertile. Moving forward Archimedes was able to develop the laws of buoyancy and was able to raise the water levels. There are many more examples however the evolution of engineering has led to advances the world over.

6. It is desired to extend an existing rail transit line to serve outlying areas of a large city. Identify the various types of civil engineers who likely would be involved over the life of the system.

This type of project is a very important project and I have a perfect example where as I write this essay a project is going on to extend an existing rail transit line which as stated above is to serve the outskirts of the city.

There are many reasons for this type of development and one of the principal reasons is to reduce traffic congestion thus a transport engineer will be involved in this type of project. A Geomatic engineer will also be involved in this type of project to examine the geomatrics of the project. In this project there will first be use of environmental system engineering to view the environmental impact. The project will also use geotechnical engineering practices to analyze the use of earth materials as well. Also, there will be use of construction engineers to plan and manage the construction part and this part is critical a materials engineer to provide high quality material.

On completion of the project there will be electrical engineers and computer engineers to ensure the smooth running and maintenance or the railway especially the electrical component and the maintenance will be done by a structural engineer.

7. For any one branch of civil engineering, in your own words, discuss the evolution of that branch over the millennia and how developments in other fields fostered advancements in that branch.

As an Engineering student I would like to specialize in an engineering practice to develop myself and my people. In this answer I will focus on structural engineers systems. Labi(2014) claims that structural engineers design and analyze load-bearing architectural or civil engineering structures including:

a) Buildings

b) Towers

c) Tunnels

d) Dams

e) Retaining walls

f) Non civil structures; equipment and vehicles (land, air or sea)

g) Other structures (Safety and structural stability of integrity is critical for safety and serviceability)

This branch of engineering started according to historians for the need for basic services such as food, shelter, transport, water, hygiene. Humans started to live their nomadic lifestyles. The first form of structural engineering started with the development of structures. Humans started first using and remodeling caves. After caves there was a need for more space so humans started building shelter to house more people and to father children and women.

Structural engineering seeks to measure the load on any physical part. Thus this type of engineering has an important part in the planning of the structure to be built. Parts of the structure like the columns beams are analyzed to verify what will happen after construction. With the advancement in technology engineers are able to use computer systems to access these type of problems. Historically, labi(2014) claims that civilizations such as the Sumerians in ancient Mesopotamia designed layered platforms called ziggurats (6000-2000 BC).Then moving a bit forward in the 17th and 18th centuries there were advances in basic science that saw the rise of structural engineering. For example Galileo produced work on engineering materials and there strengths and was a pioneer of this type of engineering.

8. Discuss the differences between any two rival philosophies of civil engineering systems design, citing examples from past civilizations. Include a discussion of your preferred philosophy in the context of civil engineering systems resilience and sustainability.

For this question I will seek to explain two philosophies of civil engineering systems design and my preferred philosophy in the context of civil engineering resilience and sustainability.

The two philosophies of civil engineering are:

a) Transport System Engineering

b) Construction Engineering

In transport system engineering this involves the planning, development and implementation of a road network. Transport systems are done over land, sea and air as well. There are many forms of transport, however historically the first forms of transport were over water in the form of dug out trees to transport food and goods. Then with the advancement of technology travel by water was made more comfortable with the building of seaports such as Pearl Harbor in the United States and Portsmouth in the United Kingdom.

Other forms of transport were also developed on land in terms of trains which were set on railway lines. The first set of trains were powered by coal and then gas and electricity. With a railway transport system huge quantities of goods and people could be transported and this revolutionized an already progressive country.

Critical analysis of Construction Engineering includes it being one of the oldest engineering systems. In modern times it has led to making many people rich due to the technical applications in producing structures that assist making human lives better and comfortable. This type of engineering for example can be found in huge housing apartment projects where apartments are built such as eight apartments in one building with water and electricity. All the electrical connections are located on a master grid at the base of each building.

**Conclusion**

As a new engineering student but with experience in the technical field I am learning with an open mind. So far I have been able to learn a lot about engineering.

Some key concepts that I learned are:

1. The history of engineering

2. The branches of engineering

3. The importance of engineering

4. The development of engineering

5. Definitions of engineering

6. Why to specialize in engineering

7. Examples of great engineering feats in the ancient world

8. Examples of great engineering in Modern times.

All this examples have made me a understand why I am doing this type of work and how I will be able to design and make huge amounts of money in the future.

I have become to understand also that the quality of work is very important when addressing engineering problems in order to avoid poor engineering. As a result it is important when designing a project to do it the right way to save money and time as well.

**Bibliography**

**Labi, Sam. "Introduction to civil engineering systems." (2014).**