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# Parametric Evaluation of Rubble Masonary Arch Bridges & R.C.C. Bridges by using ANSYS

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**Abstract –** *Arch bridges are one of the oldest types of bridges and have been surrounding for 300 + years. The ancient* ***Romans*** *learned the arch from the* ***Etruscans****, refined it and were the first builders to tap its full potential for above ground buildings: The* ***Romans*** *were the first builders in Europe, perhaps the first in the world, fully to appreciate the advantages of the arch, the vault and the dome. However, even today arc bridges remain in use, and with the help of modern materials, their arches can be build on much larger scales. Because of this design, stone and wood arch bridges become very popular during the Roman Empire, whose architects managed to build over 1000 stone arch bridges in Europe, Asia and North Africa. Many of those bridges remain standing even today, giving us the chance to personally see the wonders of the ancient architecture.*

*Arch bridges have great natural strength. They were originally built of stone or brick but these days are built of reinforced concrete or steel. The introduction of these new materials allows arch bridges to be longer with lower spans. Instead of pushing straight down, the load of an arch bridge is carried outward along the curve of the arch to the supports at each end. The weight is transferred to the supports at either end. These supports, called the abutments, carry the load and keep the ends of the bridge from spreading out. The objective of the present project is to analyze the parameters of rubble masonry arch bridges and RCC bridges.*

*The research comprised three stages:*

1. *Selection of bridge of a particular span & materials and modeling the same.*
2. *Applications of loads on a prepared model as loads applied or considered for a design of bridges.*
3. *Comparison of effect of loads on rubble masonry arch bridges and RCC bridges and accordingly conclude regarding strength, stability, durability, economy required and all other parameters*

1. *Strength 2. Durability 3. Life span 4. Economy 5.Maintenance*

**Keywords-** ***Arch, Bridges, Arch design, History, Concrete, concrete arch.anysy, modeling, nodes, loadings.***

## I- INTRODUCTION

Arch bridge is one of the most popular types of bridges, which came into use over 300 years ago and remained in height of popularity until industrial revolution and invention of advanced materials enabled architect to create other modern bridge designs. Arch bridges have great natural strength. They were originally built of stone or brick but these days are built of reinforced concrete or steel. The introduction of these new materials allows arch bridges to be longer with lower spans. Instead of pushing straight down, the load of an arch bridge is carried outward along the curve of the arch to the supports at each end. The weight is transferred to the supports at either end. These supports, called the abutments, carry the load and keep the ends of the bridge from spreading out.Without any resemblance of doubt, reinforced cement concrete construction has been the most revolutionary construction technique of modern times. Combining the high compressive strength of

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concrete with high tensile strength and elasticity of steel has resulted in a composite material that is strong, durable and economical. Moreover, it is time tested. But even after a hundred years of life rubble masonry bridges are still use as a diversions during the repair or maintenance of parallel RCC bridges at many places. Hence comparison of arch bridges and concrete bridges initialized.

**Loads acting on bridges**

Various loads acting on bridge structure are as fallows-
1) Dead load
2) Live load
3) Impact load
4) Wind load
5) Longitudinal load
6) Centrifugal load
7) Buoyancy load
8) Effect of Water Current
9) Thermal Effects
10) Deformation and horizontal Effects.
11) Errection stresses.
12) seismic loads.

Various material properties required for the loading conditions for modeling and analysis of rubble masonry bridge and RCC concrete bridges.

| Sr. no. | Mechanical properties | Rubble mesonary structure | RCC Concrete structure |
|---|---|---|---|
| 01 | Compressive strength<br>If load parallel to band-<br>If load perpendicular to band- | 20 to 115 Mpa<br>105 Mpa<br>86 Mpa | 20 to 40 Mpa |
| 02 | Flexural strength | 8 to 25 Mpa | 3 to 5 Mpa |
| 03 | Tensile strength | 4 to 6 Mpa | 2 to 5 Mpa |
| 04 | Modulus of elasticity | 70 to 90 Mpa | 14 to 41 Mpa |
| 05 | Permeability | 00.00 | 1 x $10^{-9cm}$ / sec |
| 06 | Coefficient. Of thermal expansion | 0.80 mm /Mk | $10^{-5}$ (5.5 x $10^{-6}$) |
| 07 | Drying shrinkage | 4 to 6 x $10^{-4}$ | 4 to 8 x $10^{-4}$ |
| 08 | Poisson ratio | 0.17 | 0.20 to 0.22 |
| 09 | Shear strength | 14 to 25 | 6 to 17 |
| 10 | Specific heat | 0.5 to 1.5 kj/kg | 0.75 kj/kg |

Various loads to be considered So consider maximum load 80 tones and minimum 20 tons for loading conditions.

## II - ABOUT ANSYS

**Ansys full form**. **ANSYS** – Analysis of Systems.

**ANSYS software** is used to design products and semiconductors, as well as to create simulations that test a product's durability, temperature distribution, fluid movements, and electromagnetic properties. **ANSYS** develops and markets finite element analysis **software** used to simulate engineering problem.

**Ansys** Mechanical finite element analysis **software** is **used** to simulate computer models of structures, electronics, or machine components for analyzing strength, toughness, elasticity, temperature distribution, electromagnetism, fluid flow, and other attributes. **important** solution provided by **Ansys** is in the field of embedded software, which is a critical component in the development of automotive electronics. Moving parts, like the engine, of most new vehicles are controlled by software, and **Ansys** provides solutions in designing this embedded software.

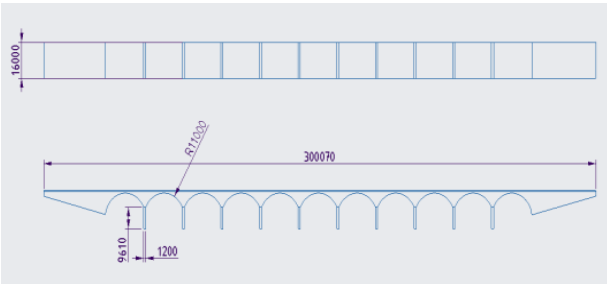
**TYPES OF ANSYS**

Fluids. **Ansys** BladeModeler. **Ansys** CFD Enterprise. ...
Structures. **Ansys** Mechanical
Enterprise. **Ansys** Mechanical Premium. ...
Electromagnetics. **Ansys** Electronics Desktop. ...
Semiconductors. **Ansys** Path FX. ...
Embedded Software. **Ansys** SCADE Architect. ...
Platform. **Ansys** Cloud. ...
3D Design. **Ansys** Discovery AIM. ...
Systems. **Ansys** Medini Analyze.

**Bridge Analysis for Rubble masonary and RCC bridges.**

**ARCH BRIDGES**

Material Properties
Density : 1200 kg/$m^3$
Youngs Modulus : 70 Mpa
Poisson's Ratio : 0.17
Tensile Yield Strength : 4MPa
Compressive Yield Strength : 105 Mpa



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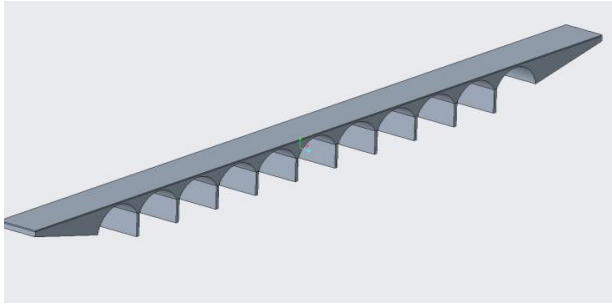
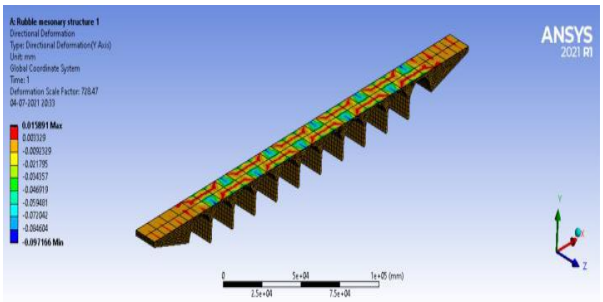
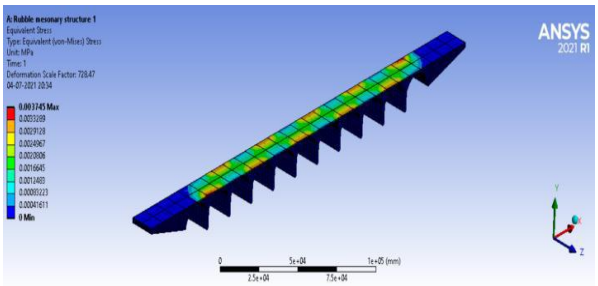


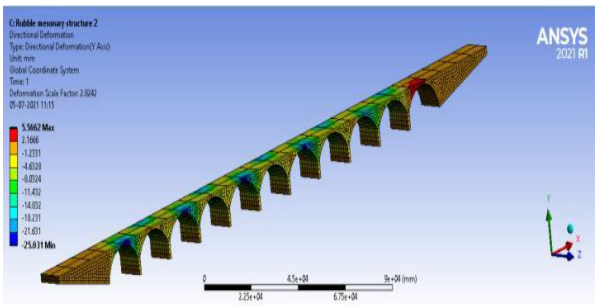
An arch bridge is a curved shaped bridge in which the load is carried out ward along the curve of the arch to the supports at each end, instead of pushing straight down. The weight is transferred to the supports at either end. These supports called the abutments carry the load and keep the ends of the bridge from spreading out. The inclined faces of the curved members of the arch bridges which are called skewbacks come in contact with the abutment.

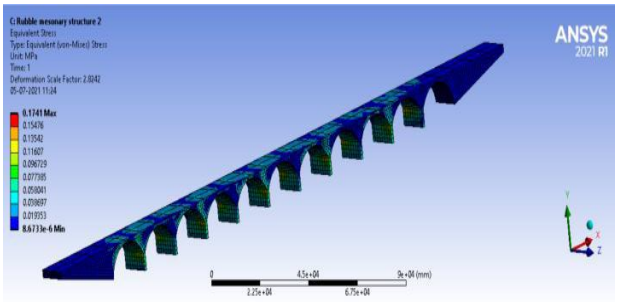



Type 1

Directional Deformation – 0.01589 mm.
Equivalent stress -0.003745 Mpa.



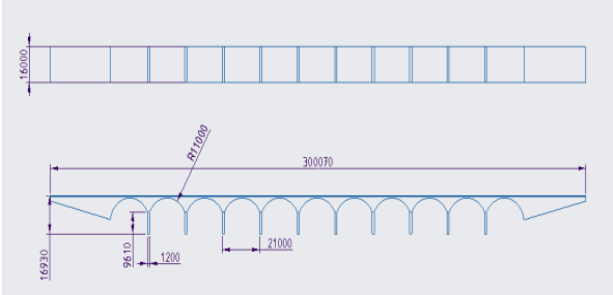



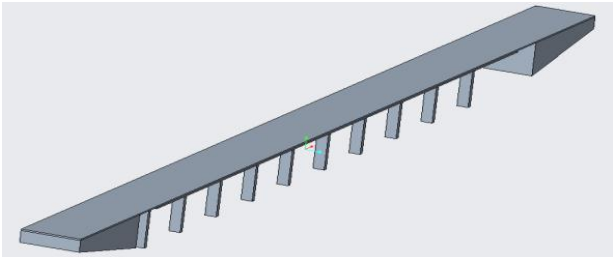

Type 2

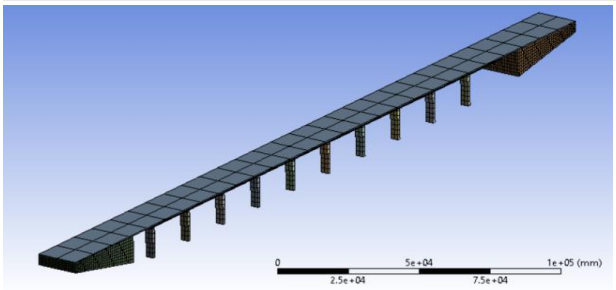
Directional Deformation – 5.5662 mm.
Equivalent stress -0.1741 Mpa.

**RCC BRIDGES**

The reinforced concrete building system is more durable than any other building system. Reinforced concrete, as a fluid material in the beginning, can be economically molded into a nearly limitless range of shapes. The maintenance cost of reinforced concrete is very low. In structure like footings, dams, piers etc. reinforced concrete is the most economical construction material. It acts like a rigid member with minimum deflection. As reinforced concrete can be molded to any shape required, it is widely used in precast structural components. It yields rigid members with minimum apparent deflection. Compared to the use of steel in structure, reinforced concrete requires less skilled labor for the erection of structure.





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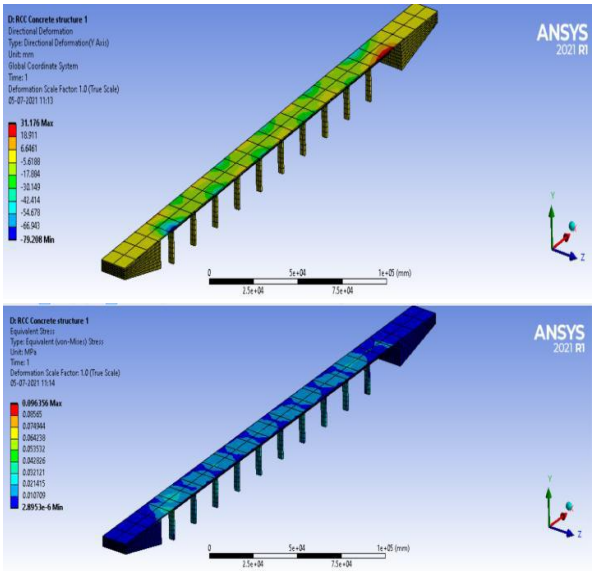
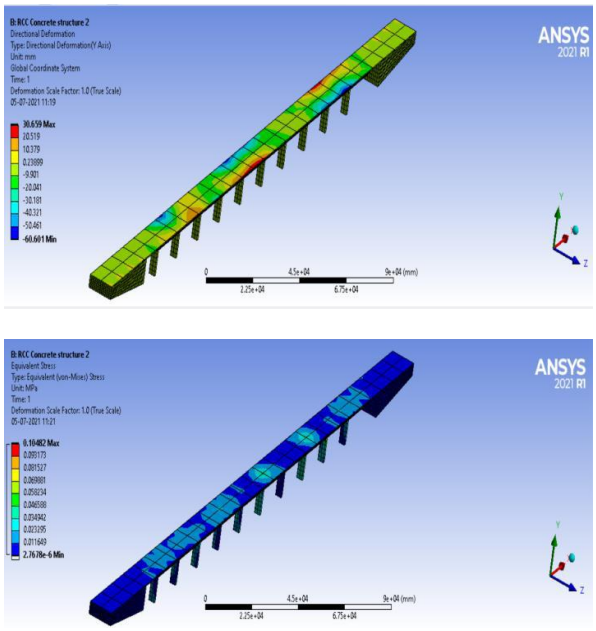
Reinforced concrete has a high compressive strength compared to other building materials.Due to the provided reinforcement, reinforced concrete can also withstand a good amount tensile stress.Fire and weather resistance of reinforced concrete is fair.




**Type 1**

Directional Deformation – 0.01589 mm.
Equivalent stress -0.003745 Mpa.




**Type 2**

Directional Deformation – 30.69 mm.
Equivalent stress -0.1048 Mpa.

## III- CONCLUSION

On the basis of ansys modeling and application of loads on the bridges with a varriying span and heights the Directional Deformation and Equivalent stress are obsured very low as compare to the RCC bridges. As the stone mesonary arch bridges are restricted for span as well as heights so reinforced concrete arch bridges are preferred.

Durability of rubble masonary is more than the RCC bridges is as the Rubble masonary bridges in british time still in good condition even after 100 years still as aoption while RCC Bridges are Under Maintainance. As the durability is more hence life span of Rubble masonary arch bridges is more Than RCC Bridges.

As Economy point of view Rubble Masonry bridges are costly as compare to RCC Bridges. It requires Good Quality of stone, skill labours are required. For RCC raw material is easily available and now a day's concrete technology is widely use and skill labours are also available. So concrete is economical than the Rubble masonry Bridges.

For the maintenance of rubble masonry bridges skill Mainantance persons are required and maintainance cost is also higher than the RCC bridges. as the design period of almost bridges is over and maintainance cost high hence construction of new RCC bridge is suitable for the situation. . As the stone mesonary arch bridges are restricted for span as well as heights so reinforced concrete arch bridges are preferred.

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