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Arch in Architecture; a Functional and Aesthetical solution to Building Construction and Design

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Abstract: *Building construction and Design has been point of interest for all Artists, Architects and Civil Engineers as observed through the world historic periods. All of these Artist, Architects and Civil Engineers were making their contribution in this field. Out of the building structural systems arches are one of the efficient forms of structural systems. Arch is a curved member designed to carry loads above any opening /s, which carrying the function of columns and beams. It gives attractive visual solution as single unit as well as repetitive unit. It was introduced as a structural member but also appeared as aesthetic member due to its visual qualities which added weightage to structural system and its appeal.*
My paper deals with the study of Arches, Historic background of Arches and its use in building architecture. The paper majorly focuses on study of Arch as functional and/ or aesthetical element in building architecture.
Keyword*: Arch, Architecture, Aesthetic Design, Function.*

I. Introduction

An arch is a curved structural form which carries loads above an opening, transfer it to the abutments. Arches have been a prominent feature in architecture since the time of the Ancient Greeks. The techniques involved in designing and constructing arches have been developed into many other structural forms, such as vaults, arcades, bridges, etc. Arches are compressive structures. They are self-supporting, stabilized by the force of gravity acting on their weight to hold them in compression. This makes them very stable and efficient, capable of larger spans, and supporting greater loads.

Components of Arch

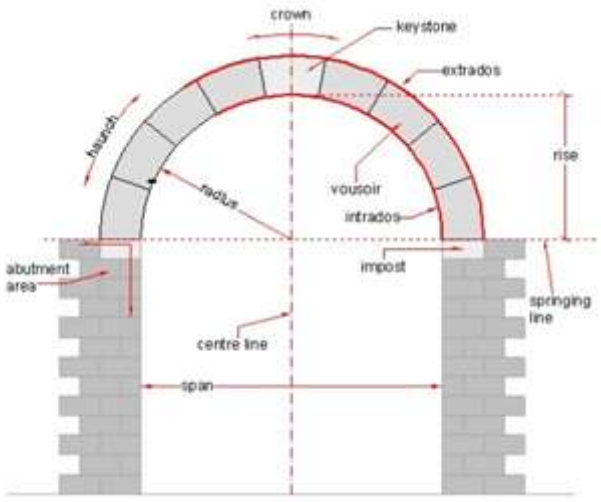

Fig. 1 Components of Arch

Arch in Architecture

History of Arch

The arch is one of the oldest structural elements of architecture. It is observed that from the ancient time the Arch is in use and still in wide use. The Arch has been found in many different cultures, as early as Mesopotamia. Arches appeared as early as 2nd millennium BC in Mesopotamia and their use started by Ancient Romans who were the first to apply the technique of using arches in a wide range of structures. The Egyptians were used it in tombs and vaults but they never use arch as a monumental architecture. The Greeks also used the arch solely for practical constructions, but many of the principles were later developed by the Romans.

The Arabs use pointed Arch and it was used in their mosques that the Arch first time acquired its religious implementation. The Arabs developed pointed, scalloped and horseshoe Arches, which was used in mosque and palaces.

Medieval Europe had great use of the pointed Arch which established the basic element in gothic architecture. In the middle ages, the segmental arch was introduced. This segmental arch and the elliptical arch had great value in bridge construction because they permitted mutual support by a row of arches, carrying the lateral thrust to the abutment at either end of a bridge.The Roman used the semicircular arch in bridges, aqueducts and large scale architecture. The Romans were the one

Who had done further development in the Arches. They combined arches to form a ceiling or roof called vaults. The Romans also used the Principles of Arch to form a hemispherical ceiling or roof called dome. An early example of a dome is the Roman pantheon. As a result Romans were able to build massive structures such as aqueducts.

Arches in India

It is observed that arch construction was brought to India by the Muslims. Whereas it is observed that Arches were rarely used in the pre-Islamic period. There is some literatures mention the possibility of arch bridges in Bangladesh before the Muslim conquest. The existence of arches in bridge and building was wide spread from the thirteenth century onwards.

In Vijayavittala temple of Hampi-Vijayanagara (Figure2), stone masonry arches have been extensively used.

Fig.2 Use of stone Arch in Vijayavittala Temple of Hampi-Vijayanagara

Figure 3 shows the use of arches in exterior walls of the Humayun's tomb in New Delhi.

Fig.3 Use of Arch in Humayun's Tomb

Functional and Aesthetical aspects of Arch in Building construction and Design

Arch is used in our day to day life sometimes as a functional and as an aesthetical purpose. Aesthetics are not only an addition to the any structure/building, but are an integral part of the design. Both structural and aesthetics must be considered together during conceptual stage of design. Designer should be conceptualizing the design to satisfy all structural and functional requirements with due consideration for aesthetics for that both Architect and Engineer should work together throughout the construction period.

It is necessary to design not only reliable, durable and economical but aesthetically pleasant structures. Arch bridges are considered as the most aesthetically pleasing type structure. The arch bridge and its shape clearly express its ability to carry loads across River or sea channel. Arch bridge is an integral part of the cultural heritage and also the powerful expression of social community. Despite small numbers of bridges in world heritage list, many other historic arch bridges have been recognized as beautiful structure and become true symbols for the city.

Fig.4 Use of Arch in Bridge

Roman aqueducts

Function: - Aqueducts supplying water to cities. It is a assembly of beams and Arch which are used to transport the water.

Fig.5 Roman aqueducts

Aesthetics: - The aqueducts follows principles of architecture i.e. repetition and balance which improve the appearance of the aqueduct.

Chartres Cathedral, France

Function: - In Chartres Cathedral they have used pointed arch for the entrance portico. This is one of the best examples of function of arch.

Fig.6 Chartres Cathedral, France

Aesthetics: - This cathedral follows the rhythm and the symmetry, which is recognized as beautiful structure.
Implementation of Arch in Islamic architecture
Function: - In fig.7 Arches serving the roll in not only for the openings but also the Arches are provided in a manner that it transfer the load.
Aesthetics: - It is possessing repetition of Arches which are having symmetry, Harmony in roof and facade and similarly in different size of arches.

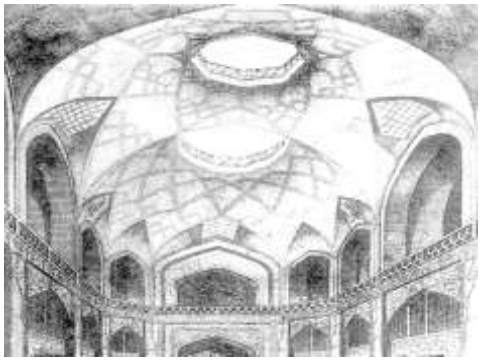

Fig.7 Implementation of Arch

This are some more examples of arches which possessing the functional and aesthetical aspects of arch in building construction and design.

Collosseum, Rome

Taj mahal , Agra


Pool of arches in Ramla


Arches used in fort , Delhi

II. Conclusion

Main challenge during the design stage of arch, bridge or in any structure is that it needs to work out by Civil Engineers, Architects and Artists. Because each of these has different perspective of structure in building construction and design. However to achieve the Aesthetics and Function we cannot copy the forms of ancient architecture, but through the analysis of their forms we can implement it in today's architecture. If we want quality in our lives, we should have quality in our environment. If we want quality in our environment, we as an Architect/Engineer should pay attention towards beauty of structure we construct.
So it is necessary to design Arch with both the aspects of design i.e. functional as well as aesthetical.

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