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# Architectural and Construction Development in Ancient Rome and Its influence on Contemporary Times.

Among the vastness of the history of Roman architectural approaches, given by the former empire's multi-cultural state, are three styles that served as fundamental parameters to develop buildings and, overall, urbanistic projects. Scholars conveniently classify these three Roman architectural styles among the three main Roman historical periods (Quenemoen & Ulrich). The Etruscan, Republican, and Imperial architectural styles are the cornerstones on which the development of Roman architecture flourished. In the same way, Romans introduced several elements of design and construction that accompanying us in actuality. Correspondingly, Ancient Romans, over their extensive history, reinvented and redefined architecture, and overall construction of buildings, through the implementation of revolutionary aesthetical, structural, and materialistic innovations that settled the foundation and influenced buildings for the following millennia, and consequently contemporary times.

The growth and development of Roman architecture were gradual through the timeline of the ancient Roman empire, since the early Etruscans and Italics to the last Roman emperor Constantine. At first, basic structures and designs intended to serve as shelter, religious places, and gathering spaces. As time elapses in the Roman empire's history, architectural compositions morphed into elaborate and complex structures. Quenemoen and Ulrich in their book *A Companion to Roman Architecture* synthesize the relevance of well-implemented architecture for

ancient Romans by stating "The extant structures have preserved a full spectrum of spaces that accommodated every aspect of Roman life- public to private, secular to sacred, high to low" (2). In retrospective, Roman architecture started as a blend of several other cultures' style and elements that consolidated as one as time passed and the empire grew. Firstly, parent cultures of the Romans, Italics or Etruscans especially, introduced fundamental components of architecture such as properties of materials and the notion of form and space (Quenemoen & Ulrich 2). Secondly, given by a cultural exchange between the two cultures, a relatively young city of Rome started to be bombarded with the ideals of the prominent Greek civilization of the eastern Mediterranean, and by default some other eastern cultures such as Egyptians. According to Quenemoen and Ulrich, such an exchange blended ancient Greek's reliable construction and architectural methods and designs with early roman's ancient Italic traditions in designs (2). The Greco-Roman exchange of values turned Roman ideas in the architectural compositions as were later known. This event defined the buildings of the empire through its history. Romans, fundamentally, based their architectural ideas on Greek architecture but expanded and improved it to meet the industrial-like demand of its vast empire. Nevertheless, it is the influence on later western architectural designs until contemporary times that ancient Romans are glorified nowadays. Quenemoen & Ulrich claim that "Roman architecture has provided the formal templates for reimagining western architecture for over the past 500 years" (2).

First, the Italic or Etruscan style is the earliest of Roman architecture. Rather than being considered Roman in essence, the Etruscan style is thought to be a prelude to Roman architecture as such. The article “Roman Architecture” by Khan Academy explains that this early stage of Roman architecture was introduced by the Etruscans, one of Romans’ parent civilizations. The scholar on Roman matters and Archeologist Frank E. Brown in his Journal Article defines the

Etruscan design as "... a fairly rudimentary architecture of temples and dwellings..." (106). Overall, these were basic structures that sought to satisfy basic needs of the population to subsist. Among the typical buildings of this period are the "Tuscan" religious temples, the atrium-house, and the dwelling (Brown 106). Religious temples, for instance, render the values of this early pre-Roman architectural design. According to Brown, the overall building, accessible only from the front, sat on a foundational podium; they counted with a front porch that usually reached the middle of the building yielding an in-depth shadowy environment (106). Furthermore, Etruscan temples were constructed out of terra-cotta and wood; this is the reason why we do not count with one example in actuality (Brown 106). Finally, the layout of the temple was simple. The following figure (Fig.1) depicts the usual arrangement of a standard Etruscan temple; notice the closed space in the middle, that can only be accessed from the front, and the front porch columns bearing the front roof to generate shadow underneath.

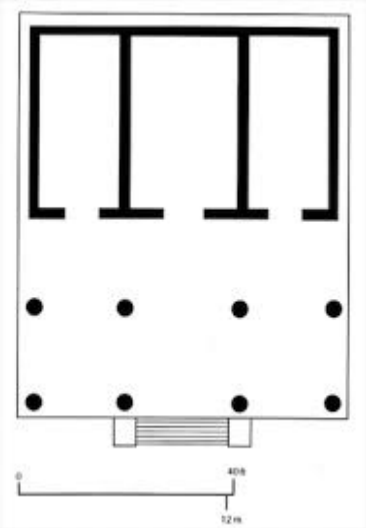

Fig.1 Layout of a standard Etruscan religious temple. Image from the web article “Temple of Minerva and the Sculpture of Apollo (Veii)” by Khan Academy.

Secondly, the Republican Roman's architecture might be safely described as a hybrid of Greek and Etruscan design. Queneomen and Ulrich remark that architectural development at this stage "…both derives power from and exerts power through its physical presence… Such visibility also had obvious advantages in an elective republic…" (27-28). As a consequence, we start to see elaborated temples buildings and at-large sculptures that imposed the power, wealth and reach of the Roman empire. These same public works were used as propaganda by politicians, victorious generals, consuls, praetors and magistrates (Queneomoen & Ulrich 28). "Roman territory was limited to Italy during the Early Republic (ca 500-250 BC), then expanded rapidly across Mediterranean lands during the Late Republic." (Essential Humanities). As Romans conquered new territory and civilizations, Roman culture started to blend with local customs and values; so did architectural styles. The most significant influence that molded the Republican Architecture, perhaps, was the classic Greek architecture. Quenemoen & Ulrich comment that " On increasing contact with Greek land over the third to second centuries BCE, the elegance, opulence, and programmatic quality of Greek architecture grew more and more attractive to Romans..." (28). The first temples of the Roman Republic, according to Quenemoen & Ulrich, due to the use of wooden materials, podium and general layouts, among other elements, "had a relatively consistent design, usually termed 'Italic'." (29). "Roman Architecture" by Khan Academy highlights that the early republican designs of buildings were still influenced by Etruscans. However, as the timeline of the Republican Rome moves forward, these elements started to be replaced. For example, the Temple of Victoria, commissioned by the politician Postumius Megellus dedicated to his political success, is considered to be one of the first temples that abandoned the Etruscan and Italic designs. Along with the Temple of Jupiter Optimus Maximus, it is the first Roman Hexastyle facade, i.e., six columns in the front facade

(Quenemoen & Ulrich 31). The use of a radically new facade means that the former in-depth front porch of the previous styles was replaced by the Hexastyle. In the same way, Quenemoen and Ulrich sustain that the proportions of the temple's composition changed to a "...slender, vertically accented appearance..." Also, intercolumniation appeared to be narrower by "two and a half (a very conservative estimate) and two times its lower column diameters." (31). The order that the Temple of Victoria is thought to be used for the temple is Ionic. As a result, the abstemious and thick Tuscan order was less used as time passed. However, other orders such as Corinthian or Doric were later used depending on the region (Brown). About materials, early Republican Romans used "Peperino" a sort of stone material that resembled Greek marble (Quenemoen and Ulrich 31). Nevertheless, according to “Roman Architecture” by Khan Academy, architects started to experiment with concrete and testing its properties to use in at-large projects. The Etruscan construction materials terracotta and wood, remained behind in the time line. Overall, the Republican times not only transformed but, also, expanded the elements of Roman architecture. According to Quenemoen and Ulrich "The new aesthetic was a direct imitation of Hellenic architecture in South Italy, Sicily, and Greek lands, beyond combined with the Italic penchant for a high podium and a frontal emphasis” (31). The clash between the early Roman culture and Greek ideals revolved the design in buildings, such as temples. The Roman republic can be considered as the mature stage of Roman architectural design that allowed the implementation of new structural elements, construction techniques, and materials during the Imperial period.

It is during the imperial stage of ancient Rome's history that architecture reaches an exceptional growth hardly achieved by other civilizations of the time. As the empire grew in wealth and territory, it was imperative to render its power and capability. Consequently, the

construction of innovative buildings, at-large projects, and overall, architectural design arouse during this period even though the development of Roman architecture as such was confined mostly to the capital, and scarcely seen through other relevant regions (Brown 108). Moreover, Quenemoen & Ulrich sustain that the Roman conquest of Hellenistic kingdoms and the propagandistic agenda of politicians during the late republic aggregated to the new authoritarian ruling of the Roman republic conceived a formidable development and innovation in buildings (45-46). Equally, this new building approach did not only serve for propagandistic purposes, but it was, also, multifunctional targeting religion, entertainment, education, recreation, and even hygiene (47-59). For instance, the Imperial Fora, developed by Caesar and Augustus, and the Campus Martius, which was a complex of public buildings and spaces commissioned by Pompey, had political, religious, and entertainment functions (47-48). Among some other noticeable developments is the Pantheon, with the first dome; and, the Domus Augusti, Augustus' residential complex; it counted with a Tuscan-style temple dedicated to Apollo among its gardens, a practice that was common among aristocratic houses (Quenemoen & Ulrich 51-57). The inclusion of Etruscan temples in Imperial Projects, and even more in Augustus' residence, implies that at least some appreciation from the earlier Etruscan and Italic styles was still present in architectural design as late as the imperial times. Furthermore, the aesthetics of the empire's architecture targeted the indoors and overall dimensional perception. Brown shortly defines and describes the aesthetics of the period as "...a style of manipulation of enclosed space... with which the designer consciously worked, structure, as merely the means of bounding or articulating space, light, as the means of shaping it [the space]." (107). Therefore, it is safe to assume that the Roman imperial architecture intends to create a notion of endless and universal vastness. Brown acknowledges the dome and the vault, innovations that were introduced during

this period in buildings such as the Pantheon, along with the careful use of light and darkness, as the renderers of a notion of "microcosm" in the indoors of some imperial buildings (107).

Furthermore, Roman construction and architecture are not only celebrated, nowadays, due to its ever-evolving complex styles but, also, due to their revolutionary contributions of innovative and functional architectural components, and new inventive ways of implement construction to serve the masses. Dustan in his book *Ancient Rom*e explains that the principal accomplishments of Roman architecture and construction elements were "the arch, vault, and dome." In the same way, he asserts that the success of these three elements would not have been possible without the use of "strong Roman concrete, which revolutionized architecture and made possible the rapid construction of economical buildings praised through the ages for their serviceability and grandeur." (121-122). Identically, these construction elements also allowed public works to benefit the population in general. Correspondingly, the aqueduct system developed by Ancient Romans to supply water from the outskirts of an urbanistic area to large cities was based on an arched structure to move the vital fluid. For example, the Roman aqueduct of Nîemes' bridge Pont du Gard, a declared world heritage place, renders the use of arches in three different levels being the top one the steeper, and the longest measuring 275 meters, allowing water to run slightly downwards (UNESCO). According to Dustan, Romans inspired by ancient Greek's water supply and sewage system, made of ground-level pipes overall, developed this water supply system that later became known as the Roman Aqueduct. He explains that such a system "...harnessed the force of gravity by employing a gentle downward slope that made the water along the entire length of the structure." (130). Ancient Romans, also, implemented complexes of buildings to satisfy shelter needs for the masses in large cities. The Insulae. i.e., apartment blocks became popular during the late second and early first centuries BCE due to an

urban population explosion (Dustan 127). Similarly, Quenemeen and Ulrich define the Insula, singular for Insulae, as "...a substantial, multi-storied apartment block that included commercial communal, and private residential spaces within a single structure." (325). Also, they describe the ancient Roman port city of Ostia, whose remaining were discovered in the first half of the 20th century. Ostia exemplifies that this creation was a by-product of economic and trade activity of the large urbanistic settings (Quenemoen & Ulrich 325). However, Quenemoen & Ulrich, also, highly the unhealthy and poor conditions of a common Insula focusing on the ones in Ostia (325-327). Finally, the system of roads implemented by Romans is another public, or at-large, construction development to highlight due to its optimal functionality hardly matched in the ancient world. Hitcher observes that the implementation of an elaborate network of roads that extended throughout the territory shortened distance, time and facilitated the trade of goods, and locomotion of people "across the Mediterranean region and beyond." (226).

Correspondingly, Romans revolved architecture and construction by implementing the arches, vault, dome, and concrete. These four innovations in construction allowed the developments of the Roman civilization because it helped to promote new public works such as the aqueducts, roads, new approaches on religious temples, and apartment complexes for the masses also known as Insulae. The influence of these construction innovations remains vivid in actuality. Therefore, it is crucial to further analyze the arch, vault, dome, and concrete as innovations of construction implemented by Romans.

First, the arch and vault introduced by Romans allowed reinventing the structural composition of buildings. Arches permitted to arrange structures and create new designs in buildings. Dunstan explains that "Roman architects developed the potential of the arch and employed its curve to transfer the weight above an opening to walls, piers, or columns, and thus

managed to span far greater spaces than ever before realized" (123). According to Essential Humanities, Romans replaced the post-beam construction with the arches. Nevertheless, the process of creating an arch was far from being an ancient technique during Roman times. *Ancient Rome* describes the general process of construction of a conventional Roman structural arch, "...workers form an arch by fitting together a series of wedge-shaped blocks in a curve over a supporting wooden frame until locking them in place with a central, uppermost wedge-shaped block called keystone." (Dunstan 122). Lancaster emphasizes that the stress and force distribution of Roman arches as well as its elements such as the limestone, as the igniters of structural development in ancient Rome's construction, and leading to the development of the later Vault (6). The use of arches in the ancient empire of Rome was not only limited to structural purposes. The arch was implemented in public settings and sculptures such as the triumphal arches. *Principles of Roman Architecture* contains several renderings of the use of arches for propagandistic and decorative purposes such as the Arch of Constantine, among others. In the same way, the Colosseum, a public building for entertainment, counts with a structure and facade that rely on a series of arches arranged in levels (Jones 120-126). Furthermore, scholars also attribute the use of arches to Etruscans, Greeks and even ancient Babylonians, although Romans were the ones who mastered and popularized this structural element (Dustan 123). In particular, they developed and introduced the vault, which was based on the same structural principles of the arch (Dustan 123; Lancaster 6-7). However, the Vaulting system is far more complex than the arch. Lancaster in his book *Concrete Vaulted Construction in Imperial Rome: Innovation in Context* confirms that the arch was the basis and starting point for Romans to develop the later vaulting system (6). In the same way, Lancaster remarks that the weight stress distribution in the vaulting system is not transferred as in the arch; he attributed this

to the mortar, concrete, and the overall arrangement of the vault structure itself (7). A vault, in short, might be defined an "arch-shaped ceiling." (Essential Humanities). The vaulting system, however, counted with different variations. Lancaster mentions barrel, the simplest form of the vault which counts of two arches and a roof, and pavilion vaults, which is composed of two barrel vaults overlapping each other forming a cross when describing the Capitoline (5). Similarly, Dustan notices that the barrel vault is also called the tunnel vault, and the pavilion vault might be also called groin or crossed vault (123). Since the mass implementation of the arch and the development of the vaulting system in compositions, these two structural and aesthetical innovations have shaped construction and architecture until contemporary times. For instance, the indoors of the Union Station in Washington D.C, designed by architect Daniel Burham, relies on a barrel vaulting system to create a universe-like and immersive atmosphere worthy to be equalized with the aesthetics of any famous ancient Roman building.

Second, concrete is assuredly one of the most progressive and innovative contributions by ancient Romans to architecture and overall construction. *Ancient Rome* considers concrete as "The greatest Roman contribution to the architectural development..." (Dustan 122). Nevertheless, Romans did not inherit concrete as it later became to know; instead, they perfected already known rough techniques. Quenemoen and Ulrich sustain that Romans, in the past, had previously identified and used lower grades of concrete processing, mostly from Greeks. However, architects and engineers were persuaded to use cement after a fire that devastated Rome in 64 CE (63). As a result, concrete allowed urbanistic and architectural development through the empire. The mastery and bold use of concrete permitted Romans to render buildings using their new structural innovations, i.e., vault, arches, domes. *Concrete Vaulted Construction in Imperial Rome: Innovations in Context* comments that it is hard to think

of Roman buildings and constructions compositions that did not implement concrete since arch and the vaulting system was composed of concrete, or "caementa" as it was commonly known (Lancaster 6-7). For instance, Quenemoen and Urich highlight the Domus Aurea and the Pantheon as the tangible success given by the master use of concrete by Romans (63). The characteristics and practical usefulness of concrete made it a preferred mean of construction and the medium that supported development in Rome. Dustin states that Romans preferred concrete due to its flexibility, malleability, resistance, and durability once dried. In the same way, he claims that concrete was used as the primary material to build bridges and artificial harbors due to its permanence and impermeability (122). Thus, it is safe to assume that the concrete developed by Romans replaced the sole use of stone and other equivalent materials when contrasting. In actuality, concrete is still massively used in construction. Moreover, concrete itself has several variations depending on the intended use. For instance, the Burj Khalifa, currently the highest building on earth with a height of 2723 ft. to tip, used over 450000 cubic meters of reinforced concrete, a modern form of concrete widely used in heavy construction, to build its foundation (Burj Khalifa Website; The Global Tall Building Data Base). In essence, a process developed and mastered around two thousand years ago by ancient Romans has shaped the surroundings since then, until contemporary times.

Finally, the dome is perhaps the most impressive and superb constructional element introduced by the ancient Romans. The orbicular shape of the dome discords with architectural features of the time, which were rather rectilinear such as the designs on facades or the classic architectural orders. Brown in his Journal article describes the dome as a structural element that aims to create a sense of infinity in the interiors of the building (107). In the same way, Essential Humanities, briefly, defines the dome as an element that can cover a large circular area.

Moreover, and taking the two previous definitions into account, a dome can be safely described as a structural and orbicular element that is intended to generate a sense of depth in a building. Furthermore, Robertson, in his book *Greek and Roman Architecture,* explains that the dome is a sole accomplishment of the ancient Romans. He continues by remarking that other innovations of the time, i.e., the arch or the vault, already had some technical background when Romans decided to exploit them further; whereas, the knowledge of domes before Romans is uncertain and obscure (231-233). When successfully launched in the Pantheon, the dome became the Jewell on the crown of Roman architectonic and construction development. Mark and Hutchinson in their article “On the Structure of the Roman Pantheon” explain that the Pantheon's dome, which was the first successful dome constructed, has a span of 43.4 meters. Markedly, they stress the idea of other scholars that the building marked a peak point in an "architectural revolution" of Romans given as a result of the implementation of several innovations in construction, i.e., the vault, concrete, and arches (24). Precisely, Roman concrete granted the construction of domes, starting with the Pantheon. Roberson argues that not dome nor vault would have been possible if concrete had not been mastered at the time of ancient Romans (232). In the same fashion, Mark and Hutchison explain the adoption of high-quality concrete, during the first century CE, allowed the designing of "curvilinear architecture," such as the one appreciated in the Pantheon (24). Notably, the design of the dome in the Pantheon, along with the building itself, served a blueprint and influence for the next centuries and millenniums. According to Mark and Hutchinson, the proportions of the dome was not matched for at least a millennium. Also, they state that "The enormous influence of the Pantheon is easily traced through numerous buildings from the late Roman period, and again from the beginning of the Renaissance well into the twentieth century." (24). For example, the influence of the dome in

contemporary times can be appreciated in the U.S Capitol building. Even though the dome in the capitol differs due to the implementation of sophisticated modern construction techniques, it still renders the idea of infinite vastness and curvilinear architectural ideals introduced about two thousand years ago in the Pantheon by innovative Roman architects and engineers.

Whether there is one word that chiefly describes the modus-operandi of Roman architecture and construction through its history, it is innovation. The introduction and dominance of innovative construction elements allowed Romans to design new concepts in buildings not only for the common good, and satisfaction but also to expand their perception of their surroundings, where they developed their daily life. Also, it is during the Etruscan, republican and imperial periods that Roman architecture eventually morphed to become the cornerstone of construction that shaped the surrounding of Roman history and the centuries that followed until contemporary times. In the same way, the laborious development, improvement, and mastery of the arch, vaulting system, and domed structure, during these three periods, revolved buildings' aesthetics and structural designs, and overall construction, as rarely seen in other ancient cultures. Nevertheless, the innovation that allowed Romans to achieve substantial success in architecture and construction was concrete; it helped to render and put together the structures and facades of buildings. Several variations of concrete, as well as arches, vaults, and domes, are still used today in highly complex modern construction works. Therefore, it is safe to claim that innovative Roman components on construction and architecture have had a tremendous influence since the day that the same ones were developed, improved, and massively introduced by Romans.

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