

Structural system employed at the pantheon in rome essay sample



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The Pantheon stands today in the heart of Rome, exhibiting the grandeur of civilizations, the majesty of the emperors who established and the genius of the architects who evolved it, even after two hundred centuries it stands revered and magnificent of its beauty. The opulence of the material used, its exact proportions, the exercise of geometry and arithmetic in its construction, and the vastness of its space all combine together to form a spectacular of building ever built in the Roman world. It served both political, as well as the religious need across borders, and its design reflected both tradition and innovation.

Rome is a city, which magnificently and with great grandeur blends historical masterpieces along with the modern world brought by the globalization and the structural change faced most immensely by the architecture of the world. However, the Rome boasts over its mega structures and its pieces of arts, which it carries from the ancient times, through the medieval ages, Renaissance, to the present modern times. The vibrant cities offers the view of many historical buildings enthralling a pilgrimage of tourists from around the world year round, with greatest visitors seen atThe Colosseum, Roman Forum, Pantheon, Piazza del Campidoglio an the Museums, Piazza Navona, Trevi Fountain, Piazza di Spagna, Vatican City, and Castle Sant'Angelo (Stamper, pp. 184).

The Greek word Pantheon means, " Every God," or " to honor all gods," whose history can be divided into four distinct parts of ancient, medieval, renaissance, and modern, ranking to the reconstruction and reframing of the ancient tomb. Marcus Vipsanius Agrippa, son-in-law of Augustus Caesar, the first Roman emperor, first built it as a rectangular temple in 27 BC. The front <https://assignbuster.com/structural-system-employed-at-the-pantheon-in-rome-essay-sample/>

porch of the temple was destroyed by a conflagration in 80 AD, and thus, had to be restructured, with its designing reshaping a little under the commission of Emperor Hadrian during 118 to 125 AD.

The inscription on the bricks of the structure still adhere it to the Agrippa's origin, marked with the following words: " Marcus Agrippa, son of Lucius, Consul for the third time, built this" (Kleiner, pp. 287), but the building was repaired again in 202 AD, by Septimius Severus and Caracalla. However, most of the architects and researchers of today attribute this mighty structure to the brilliance of Hadrian, with the Pantheon as his " triumph of concrete technology." He is believed to be the most skilful Roman emperor, a man of many talents such as an amateur architect, painter, poet, administrator, and soldier. The Pantheon represented the culture and sophistication adapted by the kingdom under his rule, which was so majestic that it still stands boldfacing the world (Kleiner, pp. 287).

While it is impossible to identify the original builder and date of the Pantheon, it is believed that Agrippa created the portico, while the rotunda and the connection between the two were made during Hadrian's time. With the coming of the Medieval Era, the temple in 609 AD was given to Pope Boniface IV, by the Byzantine emperor Phocas, in order to convert it into a place of worship, as he was told to arid it from the demons of the world. However, many of the critics believe that its conversion into a church is one of the main reasons that it stands strong today, as it did not have to go through he destruction and spoliation faced by most of the buildings during this period (MacDonald, pp. 14).

The works of yellow marble inside the recesses of the tomb and much of its statues were removed during this time with the first two of the original three columns of the structure were swallowed by the growing population and the need of space. After Renaissance and until today, Pantheon is being served as a tomb, accommodating unique and artistic individuals, which includes painters such as Raphael, Annibale Carracci, and architect, Baldassare Peruzzi. During this time, the structure was decorated with numerous paintings, such as the Annunciation by Melozzo da Forlì. The greatest damage was however, placed by Pope Barberini when he ordered for the melting of the bronze ceiling of portico, which is estimated to weigh about 450, 251 pounds in order to make weapons and forts in 1625; but in reality it was mostly smuggled up to make the altar of St Peter's Basilica (Lanciani., pp 463).

The modern times have also seen it as a burial for many of the rich monarchs of Italy however; it is being safeguarded as the heritage of the world. The Pantheon, which is now also known as Santa Maria or the Martyres, is now being used as a Catholic Church, also left open for visitors from around the world. The Pantheon of Rome was structured to celebrate the dedication towards the Greek gods, its seven niches statue Apollo, Diana, Mars, Mercury, Jupiter, Venus, and Saturn while the inner dome was made in order to represent the heavens above, with its simplicity and symbolism inspiring every viewer. However, what inspires the engineers and architects today is as to how the structure, has been standing with its immense grandeur even after two millennium, while Michelangelo Buonarotti explains

that it is standing due to “ the angelic and not human design.” (Langmead, pp 237)

The structure was thought to be divided into three main parts by the architects of Hadrian when they first started designing its elaborate structure; the portico or the entrance, the interior rotunda or the vault , and a connection between the two; blending the exterior with the interior. This kind of approach to a building was first of its kind, providing a proper entrance to it, as the previous Roman structures were either freestanding or had peristyles around them.

The original structure stood in the front as a rectangular courtyard, whose roof that was supported by three rows of 14 meters high pillars, which across it had held bronze sculptures of battles between the gods and the Titans. The front row of eight pillars or Corinthian columns, and the second row holding four pillars, was made out of Egyptian gray granite; while the last row out of Egyptian red granite. These columns represented the traditional design of structures, while the rest of the building was completely revolutionary and a unique masterpiece ever witnessed. The massive front doors of the temple are 6.3 meters high, with their fanlights were at that time gold plated.

The portico, or the entrance of the Pantheon, originally had a flight of steps, and stood at a narrow end of an enclosure, by which one advanced into the building under the portico, but with the changing surroundings and the way the surface has alleviated from around the steps are no longer present. The Corinthian columns, no matter traditional, but were the most difficult to be

structured as they were about 60 tones in weight each, they had to be transported along a large distance. First quarried out of the mine in Egypt, floated across the River Nile, through the Mediterranean, to the Roman Port of Ostia; and then transported to the location of Pantheon about 100 kilometers inland.

The interior of the Pantheon, the rotunda, which is formulated in a single volume, cylindrical in shape to the height of 43.3 meters, holds a semi-spherical dome at the top. The inner walls, which are around 4.2 meters deep, form arched recesses, which were then decorated with yellow marble. The magnificent dome, which remained as the largest ever built in the world, later up to thirteen centuries, after its initial structure, remains an overwhelming piece even today. The dome is 142 feet in diameter and is even 142 meter above its base point, with it thus being designed in such a way as to form an intersection between two circles, (horizontally and vertically), so that the interior is regarded as an orb of the earth and the dome as the vault of the heavens (Kleiner, pp. 268).

“ When the first wonderful creation of this species came into existence, the designer of this glorious dome appears to have himself shrunk back from it, and to have felt that it was not adapted to be the every-day residence of men, but to be a habitation for the gods...No one previously unacquainted with the edifice could form an idea, from the aspect of the portico, of that wonderful structure behind, which must ever be considered as one of the noblest triumphs of the human mind over matter in connection with the law of gravity.” (Lanciani., pp 475)

The dome rises to a height of 22 meters, and has a diameter of 43 meters; however, the most inquisitive fact of the tomb, which still prevails in the world, is how the mighty structure stands upon its own without any support. The two factors, which commence towards its strength, are the best quality of mortar used, as well as the vigilant selection of material such as making use of heavy basalt in the foundations and the base of the structure's walls, and entrusting in volcanic ash. Moreover, the drums of the walls, which are 6 feet thick, each, help strength the brick arches forming an architecturally designed support, adding to its grandeur. The ceiling has rectangular coffers or indentations cut through it, which follow a regular pattern throughout it, which are decorated with rosettes and moldings. The dome is made from rings of voussoirs, while eight vaults, standing behind the eight niches, carry its downward pressure, while its thickness ranges from about 6.4 meters at the base of the dome and 1.2 meters as it goes to the oculus.

The floor of the Pantheon, conventional in style is lit by a single opening at the centre of the dome, which is known as the "eye" or the "oculus." The grace which it endeavors to the structure makes it first of the buildings of the antiquity which favored the sophistication of the interior of the building rather than concentrating only towards the outside. In addition, the white exterior is contrasted by the usage of colored marbles to the inside of the tomb, elongated with seven recesses.

Moreover, the oculus forms the only source of light for the interior of the Pantheon, which during the daytime acts as a sundial; which is wrapped around with 28 coffers, which in early times had been lit by rosettes, and bronze stars. The Pantheon seems to be revolving with themes of circles and
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squares, whereby the floor of the tomb check board, while its ceiling is decorated with square coffers placed in a circular manner. Soon after Hadrian was made the emperor work began on the tomb, he is believed to be called the "Greekling," more due to his sophistication and the extent of elaborate work that he placed in his designs. Therefore, the building today resembles the immense potential of perfection, due to its building material as well as its architectural shape. For the construction of the Pantheon, a circular trench 8 meter wide and 4, 5 meters deep was dug out, which were lined with timber forms and pozzolana cement (made through grinding together lime and volcanic ash), making it hard enough to form its foundation.

The cylindrical drum of the rotunda was built level by level through using different compositions of concrete. The foundations were structured using extremely hard form of basalt, and the ingredients of the concrete were altered as they moved towards the top using lightweight pumice, which slowly replaced the stone, to keep its weight less at the top. The dome was built by pouring in an uninterrupted sequence of concrete rings against a hemispherical dome made out of wood.

The concrete was poured in a way that would thicken and strengthen the dome by shifting in thickness, making this the support system for the dome, its thickness reducing as it nears the oculus. The coffers also helped reduce the weight of the dome, without weakening its structure. Empty clay patterns were embedded in the top of the structure to further give it a lighter feel. A temporary wooden structure may have been used, on which the designers laid down the concrete and the concentric rings, to maintain its <https://assignbuster.com/structural-system-employed-at-the-pantheon-in-rome-essay-sample/>

round structure, while some believe that the dome was supported by a hanging, while a tall tower in the middle is also thought of by a few.

Emperor Constantine the Second, in 603 AD, removed the tiles which had covered the exterior of the Pantheon, and covered it with lead sheets, of different widths, placed in neat rows, and are still in place today. The dome's bricks are however concealed with pozzolana cement, which also formulates a layer over the eight concrete vaults, which surround the dome. These rings were initially designed to add load to the side of the vault, while functioning as its supports; given it the required stability through the role of compression. The oculus also acts as the last concentric ring, as a means of the compression strand, which was built by creating two pieces of bipedale handmade bricks, 60 cm thick and 4 cm thick, which were laid edge wise in three courses, being shaped vertically. These rings, which form the dome, are responsible for the shallow bowl like appearance of the exterior of the dome.

There are two basic answers given to the usage of these rings in the dome. Firstly, these rings were used to structurally increase the load on the haunch in order to reduce the horizontal thrust of the vault by countering it with additional vertical force. Secondly, they were used as devices to help in the construction by allowing the workers to build in vertical increments than to have to shape the lower portions of the dome. The first being the purpose of these rings while the second only being an advantage to the construction. As the dome was free, standing these step rings helped spreading the counterweight evenly around the circumference of the drum so that the load was distributed efficiently round the structure.

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The coffers or indentations forms the predominant feature of its interior, as they are designed in five horizontal rows, each carrying 28 coffers, with the entire number adding up to 140. The first four horizontal rows consist of four recesses of consecutively diminishing size. Their maximum chords diminish gradually from 3.90 meters in the lowest row to 2.30 meters in the highest. The five concentric rings of the coffers represent the five planets orbiting around the sun, while their 28 number represents the number of days in the lunar month. The square panels of these coffers were surrounded by moldings of stucco, which were then painted and gilded in. (McGregor, pp. 94).

Underneath the dome, the veneer marble across the walls, the niches, and the floor still holds fast; but it is not the majesty of the walls, that enthralls a visitor, but it is actually the magic of the space, which surrounds one; enclosing them rather than imprisoning them. The vast rotunda is an open area left uninterrupted by any solid structure in between, with the oculus not only creating light but also creating an underscored aura for the interior symbolism. The entire hemisphere rests upon, two storey walls, about 21 meters high; the first segment holds the eight niches, (including the entrance) while the second segment holds the panels and blind windows.

The walls of the Pantheon act as a series of piers for the mighty structure being made thick in composition, separated by eight large niches, all equally spaced around the rotunda, comprising of many cavities and chambers throughout. In order to locate these niches, one needs to begin from 0 degrees, (reference on the circular plan and locate one every 45 degrees, clockwise, taking the first niche at 0), the next niche at the 45 degrees

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rotating clockwise, the next at 90, followed by 135 and so on until the eighth niche is found at 360. This magnificent use of geometry throughout the structure, and impeding it in a mighty structure such as that of the Pantheon, makes it a unique establishment not only for architects but also for mathematicians.

The niches form huge arches, with seven of them being semi-circular in shape, and the one, which covers the entrance door, is rectangular, while all the burials are placed within these niches. The niches, which are each 6.2 meters deep, are subdued into the thick walls, which exhibit their thickness and depth. Each niche is furthermore, elaborated with two columns of colored marble and alternates with a temple front, standing in front of the wall plane, crowned by segmented and triangular pediment.

The main problem of the weight of the dome on the lowest drum as well as that of the large niches was solved by adding vaults and arches, which distribute the weight upon eight piers. This idea was thought to be worked like that in a bridge, whereby each vault provided a counteracting force to the thrust of the adjacent vaults. The surface of the brick wall was then covered with a layer of plaster or stucco. Defining the vault and the combination of structure from around the world, Righini states,

“ Pantheon was the physical repository of universal tribute from subject lands: the granites and porphyries came from Egypt, the colored marbles from Africa and the white marble from Aegean. What held it together and gave it authority of a single minded conception was the Roman vaulted style, made possible by its medium concrete.” (Righini, pp. 65)

The eye or the oculus, in the midst of the dome, covers an area of 62.80 square meters, almost 4% of the base's surface area. The oculus has a vertical ring wall that originally carried a bronze cornice is now made with brick laid both vertically and in radial direction, which acts as a compression ring. It acts as a resistance against gravity and balances the forces created by the weight and position of the vault, which are directed towards the voids below. For Hadrian, the oculus had great significance, it was the point from where he could not only see his empire revolve, but for him also the heavens and the universe above.

The greatest problem, which was faced by the architects, was in assembling the vaulted building in a centralized structure. The Pantheon's internal cylindrical hall had massive width (30 feet diameter), and the heavy weight of the dome (4,535 metric tons), made construction in the ancient times even more tedious, as to comparison, the only such works available were that of Albano or Baia, which was childish in its analogy.

No matter the world today exhibits many such buildings from the past, showing the impudence and grandeur of those civilizations, but what makes The Pantheon of Rome special in today's time is its sustainability and endurance to the harsh atmospheres of the world, which keeps it invincible to the growing cruelty of the environment today. Thus as the Pantheon stands today as a model of awe and amazement for the historians around the globe, it also serves as a source of inspiration for the architects who look up to it for establishment of a sustainable and amiable living towards the life of constructions.

John Bickley, a consulting engineer, and a partner architect of the CN Tower, in his article "Green Concrete," states, "A secret to low-carbon, sustainable construction lies in the more than 2,000-year-old roof of Rome's Pantheon." He defines that an architect is awe-inspiring when it is sustainable as well as makes use of green concrete, which helps it stay alive against the emissions of carbon dioxide. He states that the secret ingredient used in its establishment is volcanic ash, which replaces the concrete and increases the cohesive properties required for a construction. This increases the structures durability and helps architects and engineers to theorize better materials and substances, which are more environmental friendly, as it was even theorized by designers with limited resources and knowledge thousands of years ago. (Bickley, 2009.)

Many architects believing in the theories of the Neopythagorean origin believe that the Pantheon's design is actually an arithmetically resolved solution to the theories and studies of the cosmos, created by the Greeks, which were made of amalgamation, geometry, and astronomy. Thus, this design tends to fuse together all these concepts of varying subjects into harmony, giving it a visual picture in the form of a structure for the worlds to appreciate and gain inspiration. Whereas many intellectuals and historians also relate it to Pythagorean cosmos, which means a living organism, which has a mathematically established soul and non-altering internal design with specified ratios. It was built in order to resemble the grace and impudence of the heavens and pay reverie to the gods, but for the present world, it is a symbol of mathematics and architecture splendor.

No matter the Great Pantheon was built almost two centuries ago, but it still stands grand and powerful, showing the amount of industrious work placed into its construction and the generic ideas put through that even today, after the technological swarm in architecture, it still stands as one of the most awe-inspiring structures ever created. The Pantheon is one the greatest masterpieces on earth and I am grateful to have the opportunity of learning about this wonderful space. The Pantheon being original, bold, many layered and the imminent structure of universality is a unique structure, which has left a stamp on the architecture of the world more than any other building ever erected. The force and the magical magnetism received by every visitor who enters in the rotunda, is far more magical than what had been initially planned by Hadrian and his architects.

Works Cited

Bickley, John A. Green Concrete, 2009. Retrieved on July 13, 2009 from [http://network.nationalpost.](http://network.nationalpost.com/np/blogs/fpcomment/archive/2009/07/02/green-concrete.aspx)

[com/np/blogs/fpcomment/archive/2009/07/02/green-concrete.aspx](http://network.nationalpost.com/np/blogs/fpcomment/archive/2009/07/02/green-concrete.aspx)

Burn, Robert M. A. Ancient Rome and its Neighborhood. George Bell and Sons Press, 1966.

Kleiner, F. Gardner's Art through Ages. Cengage Learning, 2005.

Lancaster, Lynne C. Concrete vaulted construction in Imperial Rome.

Cambridge University Press, 2005.

Lanciani, R. Pantheon. The Ruins and Excavations of Ancient Rome.

Retrieved on July 13, 2009 from <http://web.archive>.

<https://assignbuster.com/structural-system-employed-at-the-pantheon-in-rome-essay-sample/>

org/web/20070701023945/http://gmv.fdt.

net/~aabbema/Christmas/Pantheon.html

Langmead, Donald. Encyclopedia of architectural and engineering feats. ABC-CLIO, 2001.

MacDonald, William L. The Architecture of the Roman Empire. Connecticut: Yale University Press, 1965.

MacDonald, William L., Pinto. J. The Pantheon: Design, Meaning, and Progeny. Harvard University Press, 2002.

Marder, Tod A. "Alexander VII, Bernini, and the Urban Setting of the Pantheon in the Seventeenth Century." The Journal of the Society of Architectural Historians. Vol. 50, No. 3, 1991.

McGregor, James H. S. Rome from the ground up. The Belknap Press, 2005.

Righini, Paul. Thinking Architecturally. Juta and Company Limited, 2000.

Stamper, J. W. The Architecture of Roman Temples. Cambridge University Press, 2005.