



Architecture Design of Stadium Facilities Between Ancient Times and Today

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ARTICLE INFO

ABSTRACT

Keywords:

- 1st Sports facilities
- 2nd Stadiums
- 3rd Architecture of Stadiums
- 4th Stadium Design
- 5th Ancient Stadium

Since the beginning of mankind, Physical activity, is an essential component of his life on earth, starting with hunting for the provision of food, fighting for survival, social entertaining, and building for the sake of shelter and habitat. Even in modern times, and after the evolving of organized societies, the need for physical activities increases. This need turned into organized sports, which in turn required an evolution in the design and architecture of sports facilities to satisfy such progress. Research work in this paper introduces comparisons between sports stadiums in ancient and modern times, to highlight architectural design key elements changing over time between ancient and modern stadiums.

Research work in this paper is divided into Four parts, the first part explores design of stadiums in ancient civilizations, the second part investigates stadium design in modern times, the third part concludes architectural derivations and concepts of modern stadium design. The fourth part redefines approaches in the design process of modern stadiums. The comparison between the ancient and modern stadium may help in finding new approaches in the design of stadium based on such comparison, and to redefine design constrains that highlights positive aspects and try to avoid negative ones.

Since there is no current consensus or a specific design criterion for designing stadiums that may be accredited as a standard stadium design manual by a recognized architectural body; The fourth part of the research proposes a compilation of most elements, factors, and design issues influencing the design of a modern stadium. Proposed data may be used by architects as a helpful design guide for a modern stadium design

1. Introduction

The increasing need for sports facilities that can accommodate large audiences and at the same time provides them with comfort and safety; have become the subject of competition between architects. Despite the

progress in technologies used in the construction of modern stadiums and the implementation of modern design theories, the modern stadium did not manage to fulfill ergonomic elements, and safety for audiences,

Most recent work done in the subject provides a timeline comparison, give examples of the most significant stadiums of the 20th-21st centuries, and

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studies the stadium from the aspect of construction technology

Sports facilities have experienced progress in shape, design, and performance. Sports stadiums in particular fall in the center of attention of such progress; they are the most crucial part of the built vicinity, since they deal directly with large masses of people resembled as audiences.

The goal of this research work is to highlight differences and changes in design aspects of sports stadiums within ancient civilizations, and modern times for the purpose of extracting architectural derivations and design aspects of stadiums, in order to redefine design constrains that highlights positive aspects and try to avoid negative ones. At first, the paper started with a briefing about the stadium as an architectural structure, afterwards, the paper divides introduced work into four parts, the first part explores design of stadiums in ancient civilizations, the second part investigates stadium design in modern times, the third part concludes architectural derivations and concepts of modern stadium design. The fourth part redefines a design criterion that highlights positive aspects of the stadium design

2. Stadium and Design Dilemma

In general, the “Stadium” is a built environment designated especially for accommodating large number of audiences, for the purpose of watching an organized sport activity. The architecture design takes in consideration many factors; most of these factors are for achieving maximum enjoyment of the sport event in action, however, the most crucial design factor is the one concerned with the safety of audiences.

To ensure a calm sport event without enthusiastic audiences is almost impossible. When fans overreact, it may turn into a riot at any moment, leading to a disaster that sometimes ends with life casualties. Even if a sport event ended safely, there still the problem of evacuating the stadium from this large number of audiences together and at the same time. A well experienced architect gives priority to these two issues in his/her design decisions list. A “Look-At-Me” architecture is a “No” substitute for a safe sport facility

3. PART II: STADIUM OF ANCIENT TIMES

3.1 The Pharaonic Stadium

Many scriptures and paintings of the Pharaohs show practice of ancient Egyptians for sports, competitions were held on religious occasions and social feasts, however, there were no built environment specifically for hosting sports players and/or audiences, as they

used to practice sports in city Plazas and in open air. [1], [2]



Fig. 1. Shows example of ancient Egyptians practiced sports, the lower part of king “Narmar” Tablet at the Egyptian museum shows ancient Egyptian’s athletes practicing running, [1]

Most of Ancient Egyptian sports were practiced in open-air, like Archery, fishing, rowing, javelin-throwing, boxing, wrestling, weightlifting, and gymnastics. Surprisingly it is even found that ancient Egyptians played “Field hockey” as a form of team sport. [3]



Fig. 2. Shows an ancient Egyptian Hocky ball Made of wood. Picture is of the British Museum trustee, [3]

Key Design Features: Ancient Egyptians did not have sports facilities, as sports were practiced in open squares, plazas' temples, and/or in the open air during special occasions and holidays.

Warfare sports were common in most ancient civilizations, as the expansion of their kingdoms depended on invasion and military force.

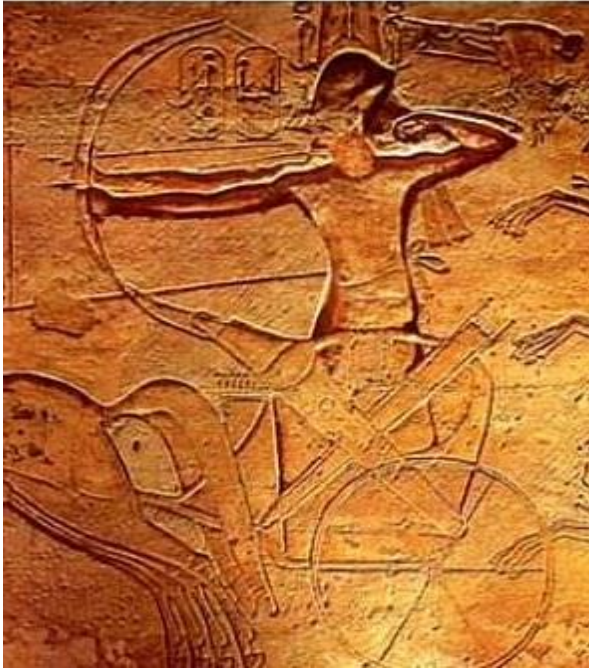


Fig. 3. Shows an ancient drawing of “Ramesses II” as a skilled “Archer” during his invasion of the “Hittite” army at the battle of “Kadesh”, [3]

3.2 The Greek Stadium

Ancient Greeks were fascinated by the strength of the human body, ancient Greeks were the first who invented organized sports events especially athletics, the first Olympic games were held in ancient Greece as a one-day event until 684 BC, afterwards, the time span of games were extended to cover running, long jump, shot put, javelin, boxing, and other equestrian sports. [4]

“Pentathlon” is a Greek word formed of two parts, “Pente” means (Five), and “Athlon” means (Competition). That is; a competition composed of five sports which are: “Running”, “Jumping”, “Discus Throw”, “Wrestling”, and “Boxing”. Such sports form the foundation that evolved afterwards to what is known as the “Olympic games”.^b Some of the ancient Greek

^b “Panathenaic” games are ancient Greek sports event that were held every four years, they may be considered as the father of modern Olympic Games. The “Panathenaic” Stadium was the first Greek stadium built in 330 BC for the “Panathenaic”. games, it is the only

sports were associated with Greek mythology and Greek Gods like for instance “Wrestling”, where ancient Greeks believed that their famous Gods “Hercules” and “Theseus” played a great role in developing such type of sport. [5], [6], [7], [8]

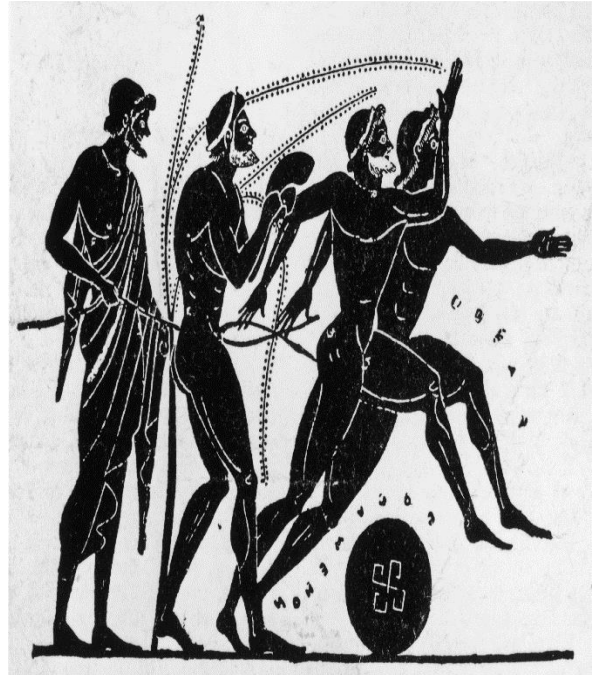


Fig. 4. Shows first Olympic Games in Ancient Greece. Ref.: [4]



Fig. 5. Shows “Discus-Throw” as one of the Greek “Pentathlon” sports. Ref.: [5]

stadium in the world that was entirely built with marble, it is considered as one of the largest Athens tourist attractions. [5]



Fig. 6. Shows “Wrestling” as one of the Greek “Pentathlon” sports. Ref.: [5]



Fig. 8. Shows the Panathenaic ancient Greek stadium. Ref.: [9]



Fig. 7. Shows the Panathenaic ancient Greek Stadium. Ref.: [6]

Key Design Features: The Panathenaic Stadium was initially designed in the form of a “U” shape with a straight open end, in addition to the audiences’ dedicated areas; the structure contains a running track, a wrestling hall, and a gymnastics room beneath

3.3 The Roman Stadium

Although the design of Roman stadiums was developed from Greek stadiums, there still some differences between both models, most roman stadiums tend to be circular or oval shaped, and smaller in the overall area with focus on the centre of the arena, since most of their sports were of a military nature. The most vivid example of the roman stadium is the old “Colosseum” at the centre of the city of Rome. [9]

Key Design Features: Most of the “Amphitheaters”^c were built in the second century BC, and at that time new forms of “Amphitheaters” were developed to receive a larger number of audiences, and as a result, squares with a full oval shape included two theaters linked together, which is the “Colosseum” building.

The architectural plan of the “Colosseum” shows the oval rows of seats, and the substructure with rooms underneath for athletes, and saloons and rest rooms for audiences with social status.

The design of the “Colosseum” may be considered the first architectural design scheme of the today’s modern stadium. [10], [11], [12]

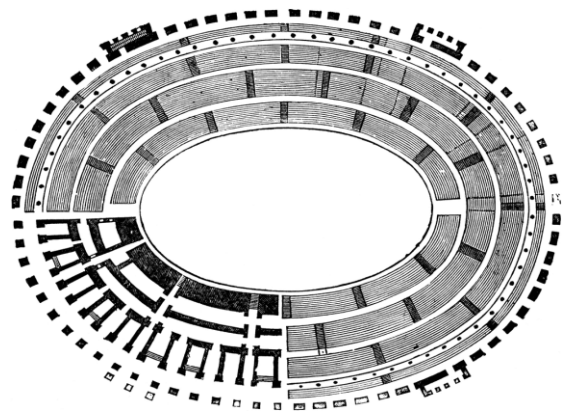


Fig. 9. Shows the architectural plan of the “Colosseum”. Ref.: [12]

^c The “Amphitheatre ” is usually a circular or oval shaped stadium with focus of the arena at the centre of the circle or ellipse

3.4. Stadium of Medieval Times and Beyond

In medieval times, military activities, invasion, and Christianity dominated the architectural trend, where the focus was on building churches, and practicing military sports in open plazas

3.4.1. Renaissance

“Jousting”^d and “Riding”^e were two of the most popular sports during the renaissance and medieval times, there were no built structures for such sports except long rectangular open air public parks used as arenas with seating for audiences at both sides [13]



Fig. 10. Shows a joust competition during the Renaissance-era. Ref.: [13]

A “Joust” competition commonly known among medieval historians as “Medieval Tournament” or a “Mêlée”; is a competition that were frequently organized across Europe where royal knights compete to show their military skills. During the 10th to 16th century such tournaments were a form of expressing honour, nobility, and strength of the royal families across Europe [14]

Key Design Features: In general, people of medieval times were not interested in building sports facilities, as their attention was directed towards religion, kingship, and invasion, their sports facilities were just: simple open-air arenas expressing martial sports, horse riding, and jousting. However, there are some forms of “Joust” arenas or small stadiums like that of “Camelot”^f [15], [16]

^d “Jousting” is a military medieval European sport where two knights race against each other, with each of them holding a long, large spear or stake in his hand, with intention to strike the competitor, to make him fall from over his horse

^e “Riding” or horse riding was, and still a royal European sport, with horse riders, and knights ride horses and jump hurdles, the sport was later enrolled in the Olympic games

^f “Camelot”, is a British medieval kingdom located in “Albion”, founded by the legendary king “Arthur”



Fig. 11. Shows two European knights competing In a joust competition. Ref.: [14]

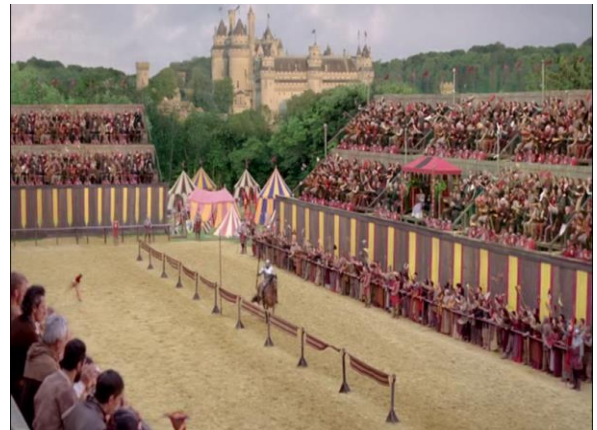


Fig. 12. Shows the first European tournament held in “Camelot” joust small Stadium. Ref.: [15]

3.4.2. The Islamic Stadium

Sports arenas in Islamic cities were in the form of open areas for training soldiers, and like other nations during medieval times with invasion and expansion in mind.

Physical activities in the Islamic society were also geared towards developing military skills rather than for the sake of entertainment, like “Archery”, “Cirit”^g, “Horse riding”, and “Wrestling” [17], [18]

Key Design Features: Like the mindset of medieval times, sports facilities in Islamic cities were just: simple open-air arenas expressing martial sports, horse riding, and other military skills. Some ancient Chinese “Kung-Fu” masters were Muslims.

^g “Cirit” is a Turkish military game where two teams of horse riders simulate a battlefield but using wooden stakes instead of swords

Their sport arena was that of a “Shaolin”^h temple or a Kung-Fu School. It was in the form of a large house with a wide open-air courtyard in the middle suitable for training, the house was also acting like a motel with many rooms accommodating Kung-Fu students [19], [20], [21]



Fig. 13. Shows “Horse Riding Polo” sport in Persia as part of a sport and training Persian knights for warfare. Ref.: [19]



Fig. 14. Shows “Murat II” the Ottoman sultan during his practice of “Archery”. The painting is from the Turkish museum in Istanbul. Ref.: [19]



Fig. 15. Shows a “Shaolin” Monastery with a senior monk at the back, Observing Kung-Fu Muslim masters. Ref.: [20]



Fig. 16. Shows a “Sumo” small Wrestling arena. Ref.: [22]

4. PART [II]: STADIUM OF MODERN TIMES

4.1. *First Modern Stadium*

Due to the growing need for enjoying organized sports by a massive number of people as means of entertainment; Stadiums in modern era were built with basic facilities, and with the capacity to hold maximum number of audiences.

The “Ireland Lansdowne Road Stadium” in “Dublin” may be considered as the first early stadium that was built in our modern era where the first Irish athletics Championship and the first Rugby match were held. [23]

^h A “Shaolin” temple or a Monastery is originally a Chinese Buddhist temple, however, “Shaolin” temples are known as “Kung-Fu” schools directed by monks



Fig. 17. Shows a drawing of the old “Ireland Lansdowne Road Stadium” by “Desmond McCarthy” Before its demolishing in 2007, to be replaced by a new stadium known as the “Aviva Stadium” That was opened in 2010. Ref.: [23]



Fig. 20. San Siro Stadium, Milan Italy, 80,018, Seats, Impressive for its size and Architectural design. Ref. [24]

4.2. Most Distinguished Modern Stadiums

The following series of images is a compilation of the most distinguished modern stadiums according to capacity, design concept, and other features. [24]



Fig. 18. Is of the Camp Nou, Barcelona, Spain, 99,354, Highest capacity, In Europe Seats. Ref. [24]



Fig. 21. Anfield Stadium, Anfield, Liverpool, England, 54,074 Seats, Famous for its legendary atmosphere and die-hard Liverpool fans. Ref. [24]



Fig. 19. Signal Iduna Park (Westfalen stadium) Dortmund, North Rhine Germany, 81,360 Standing & seated, Holds the European record for average Fan attendance. Ref. [24]



Fig. 22. The Allianz Arena, Munich, Bavaria, Germany, 75,000 Seats, first stadium in the world with a full colour changing exterior. Ref. [24]

5. PART [III]: ARCHITECTURAL DERIVATIONS AND STANDARDS

5.1. Geometrical Shapes

In general, in USA and Canada, the most popular geometrical shapes of stadiums are the (Open, oval, and horseshoe) while in Europe and New Zealand, (Rectangular and Square) shaped stadiums are more common. The following figure shows a collection of various types of sports stadiums with different geometrical shapes and sizes. [25], [26]



Fig. 23. Shows a collection of various types of Sports stadiums with different Geometrical Shapes and sizes. Ref.: [26]

5.2. Structure System

Modern stadiums are between two types; either fully, or semi covered. Modern structure systems are applied for covers like steel trusses, tensile, shell, tent, and vault structures. However, all former structure systems are coined as “Domes”. As a result, most stadium structures should satisfy covering spaces with large spans. [27]



Fig. 24. Shows New Orleans famous stadium that Has the largest dome cover Structure In the world. Ref.: [27]

5.3. Environmental Impact

Building stadiums acquire large amount of concrete and other building materials that have carbon emissions. Stadium buildings create transportation and traffic issues around them. People with homes living near stadiums are reported to have health issues as they are more exposed than others to carbon emissions, and pollution released due to dense traffic that is found around the stadium

5.4. Economic Impact

Large stadiums especially modern and national stadiums are mega projects. They also require large budgets that is usually provided by the state and not by private companies.

5.5. Social Impact

From the social perspective, the government or state should build stadiums for her football and other national sports fans and clubs. Cities, and/or countries with famous football teams, and national sports with a large social mass and fans should have stadiums as a mandatory option

5.6. Political Impact

National and international sports competitions are an integral element of political impact and influence between countries worldwide, hosting a world cup championship, Olympic games, and/or other sports events represent a sign of political and economic stability of the host country

6. PART [IV]: REDEFINING APPROACHES IN THE DESIGN PROCESS OF MODERN STADIUMS

6.1. The Old Architecture School Approach

The old design approach for designing a stadium was very blind and leaner and does not depend much on extensive studies of the impacts of external factors, the architect generates the design following the simple methods s/he used to learn in the university. In an old school student fashion, the architect starts with:

- Developing a design program based on capacity and required areas
- Creating a spatial zoning
- Sketching, sketching, and sketching...!
- Starts creating schematic plans, facades, and sectional drawings
- Creating a basic 3Dimensional presentation visualizing the architectural concept.

- Going through a linear process of modifying the design drawings
- And “Voi La” the design is finished

Unfortunately, this old school design methodology is still adopted in many universities and architecture schools around the world, ignoring that teaching design studio has gone into several methodsⁱ.

6.2. Two Different Design Approaches

6.2.1. A “Sum-of-Parts” Design Approach

The above design methodology may be defined as a “Sum-of-Parts” approach, that is as long as the architect’s mindset and thinking is busy with solving issues related to the relevance of spaces towards each other. In such case, this state of mind and state of design is a single process “Only” which is “Space assembly”, as if this is the only concern that will ensure the improvement of the quality of the final design. However, in modern days, especially with the growing complexity of factors influencing the built environment, the “Sum-of-Parts” approach may no longer satisfy and/or ensure a quality design in general, and stadium design in particular.

6.2.2. A “Holistic” Design Approach

In general, A “Holistic” method means approaching a matter, subject, or a problem as “A Whole” or from an overall perspective and not as a sum of parts. The term “Holistic” is usually associated with medicine, it defines a medical treatment method that deals with the person as a whole and not only from the biological, physiological, and/or the physical human body aspects. In other words, it combines all the physical aspects of the human body with the wellbeing and psychological aspects and not only with illness or biological symptoms [28], [29]

A “Holistic” approach in architecture design considers issues – (That are not directly related to just designing nice architectural spaces) - as integral part of the design decision and process. For example: national goals of a specific country, political, social, and economical aspects of the building. Various attempts have been made in the field of architecture trying to establish a specific and standard criterion for a holistic architecture design method, there is no current consensus about the subject matter:

- Some holistic assumptions focus on creating building environments that have positive healing

effects over the users of the architectural spaces. This assumption considers wellbeing and health of architectural spaces users as the major and only criteria for a holistic design approach. [30]

- Other assumptions suggest that applying the effect of the natural environment or nature in the built environment is the major goal for a holistic design approach due to the positive effect of natural elements of the outdoor environment on personal wellbeing [31]
- Further assumptions consider “LEED” criteria defined by “USGBC”^j for creating buildings as a comprehensive criterion for a holistic design approach [32]
- More assumptions consider political, social, and economic impacts as integral parts of a holistic design criteria. [33]

As mentioned, there is no consensus about a standard criterion for a holistic design approach however, the idea in general revolves around integrating social, financial, economic, political, and other humanitarian aspects in design with typical architecture design process that usually focus on spatial relations and other traditional architectural studies.

6.3. What is a Design Manual?

Competition in modern age business world is ruthless, incorporations strive to increase their market share and segments, since operating in a business environment where “Customer Satisfaction” is the key to maintain position, status, and business expansion in an open competitive market, the concept of “Quality Service” has become the main factor that creates “Customer Satisfaction”, if a specific incorporation failed to offer quality service to its customers, it will rapidly lose its customer base and face the risk of getting out of business.

Architecture design is not safe from the effects of these market influences and forces. For example, famous world-hotel businesses like “Sheraton”, “Hilton”, “Marriott”, “Regency”, and others who are classified as five stars hotels has established specific design criteria for architects to follow when creating designs for their hotel facilities. Such brands may reject a whole design project if it fails to satisfy their design requirements.

Well-practiced architects use design manuals developed by such organizations when commissioned to create their facilities. Similarly, the concept of creating

ⁱ Teaching design studio has gone through extensive research among architecture scholars, more information about the subject matter is outside the scope of work introduced in this paper.

^j “USGBC” is the United States Green Building Council who invented the “LEED” process of evaluating buildings according to their definitions of what is known among the field of architecture as “Green Architecture”

design manuals for other types of buildings is rapidly growing worldwide, as it has become difficult to convince the customer of today to accept a service with low or unsatisfactory quality for money spent in return for such service

6.4. Modern Approaches in Stadium Design

In most cases, a stadium is not a private project, it is a governmental project for the purpose of accomplishing social, political, and economic initiatives specified by the country. The old school “Sum-of-Parts” design approach may not satisfy such goals, the “Holistic” design approach is more adequate for satisfying goals of building stadium as a national project.

Since there is no current consensus or a specific design criterion for designing stadiums that is accredited as a standard stadium design manual by a recognized architectural body.

The following table is compiled by the research collecting most elements, factors, and design issues influencing holistic design of a modern stadium.

The table is then followed by a brief description for each of the collected influences and factors. [34], [35], [36], [37]

Table 1. Compiles elements, factors, and design issues influencing the design of a modern Stadium. Ref.: [Research]

Factors/Impacts (Breakdown)	
Project Vision	<ul style="list-style-type: none"> • “Wants”? • “Needs”? • “Affords”?
Project Feasibility	<ul style="list-style-type: none"> • Funding options • Funding scenario • Construction budget constrains • Cash flow • Market analysis
Social Impact	<ul style="list-style-type: none"> • Social Club number • Spectator size • Social stress Negative energy channeling out • Fan Segmentation
Hedonic ^k Impact	<ul style="list-style-type: none"> • Riot size • Riot behavior • Riot control
Political Impact	<ul style="list-style-type: none"> • Political leaders • Target exposure • Potential goals
Environmental Impact	<ul style="list-style-type: none"> • Echo system • Climate change • Wildlife
Urban Impact	<ul style="list-style-type: none"> • Surrounding neighborhood

^k “Hedonic” is a Greek word means everything that creates a pleasurable feeling. A hedonic person is someone who seek everything that generates pleasure and minimize pain. Hedonism is not only a common attitude among atheists but also among todays’ modern man, where the individual work hard and play hard in the week ends. Hedonism is also used to define overwhelming emotions that may lead to aggressive, irresponsible, or uncontrolled behaviors.

	<ul style="list-style-type: none"> • Traffic & population • Building regulations
Structural Design	<ul style="list-style-type: none"> • Full indoor • Semi indoor • Building technology
Leed Assessment	<ul style="list-style-type: none"> • Green criteria • Leed certification • Green maintenance
Design Program	<ul style="list-style-type: none"> • Design goals • Design components • Design constrains
Unseen Design Issues	<ul style="list-style-type: none"> • Future Economic change • Future expansion • Force majeure

For a successful stadium design, the “Sum-of-Parts” design approach may no longer satisfy all the complex factors influencing the design of today’s modern stadium, since the above factors have become integral part of the design thinking, considerations, and process.

The following series of diagrams summarize the design influences of modern stadium design following a holistic design thinking approach, and proposing a helpful design guide for a modern stadium design that may be used by architects:

6.4.1. Project vision

A clear project vision should be defined describing what do stakeholders¹ want from the project, need from the project, and what they can afford to finish the project. A project vision is essential for the architect to set the overall design philosophy of the general architectural concept

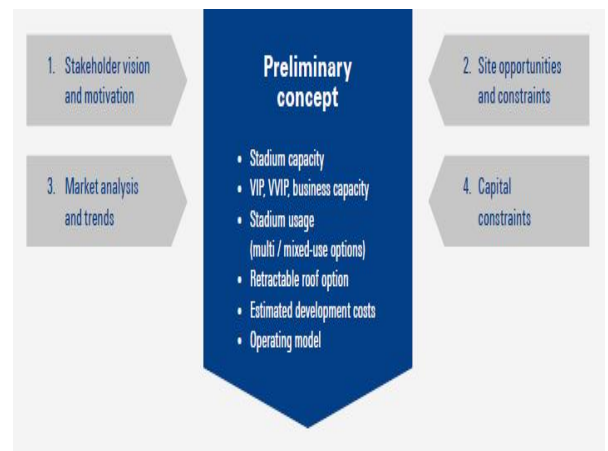


Fig. 25. A diagram showing elements for a clear vision of the design of a modern stadium. Ref.: [33]

¹ “Stakeholders” are all team players participating in the creation of an initiative, or a project. Stakeholders include but not limited to owners, consultants, contractors, government officials, municipalities, legal consultants, fans, audiences, and all other parties involved in, and participating in the project.

6.4.2. Project Feasibility

A clear financial plan should be developed describing the cost of various project parts and phases, including cost of future extension, repair, and upgrade of the stadium regarding investors’ financial goals and return on investment expectations. A project feasibility is essential for the architect to take in consideration what to add and what to exclude from various design elements and components

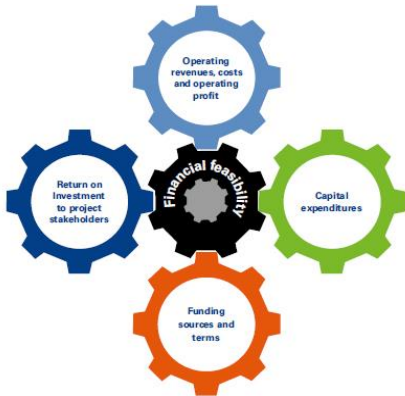


Fig. 26. A diagram showing various project feasibility elements required for the construction of a modern stadium design. Ref.: [33]

6.4.3. Social Impact

Existence of at least one stadium in every city has become a crucial factor for social stability, in today’s modern world people work hard from 7.00 am to 6.00 pm five times per week and may be more, watching football is a great means of absorbing psychological stress generated from the modern hectic life

If there will be no means of channelling out the individual’s stress negative energy, it will backfire on the community in the form of aggressive behaviour or social unrest.

A map of the national and community soccer clubs should be created. Stadium designers should take in consideration number and size of club spectators, fans, and number of soccer/football clubs in the city that the stadium will be hosting

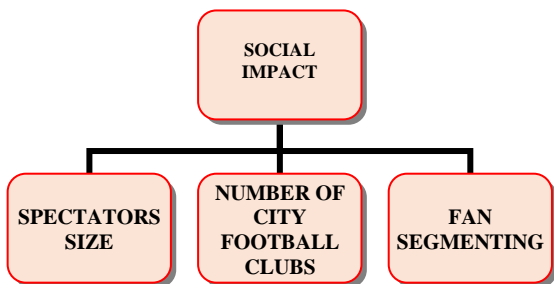


Fig. 27. A Diagram showing effects of spectator size, number of city football clubs, and fan segmentation per each club as means of social impacts that should be influencing modern stadium design. Ref.: [Research]

6.4.4. Hedonic Impact

The audience euphoria due to excitement and sensation of a hot match may rise to a level where they start acting aggressively, up to the point of having death casualties among them. Architects should plan their stadium design to ensure controlling such situations. Over reacting emotions from audiences towards the course of a match may result in irresponsible behavior that in some cases may reach the level of a riot. It is important for the architect to take in consideration in his/her design all possible measures to control riot behavior, and size just in case [38]

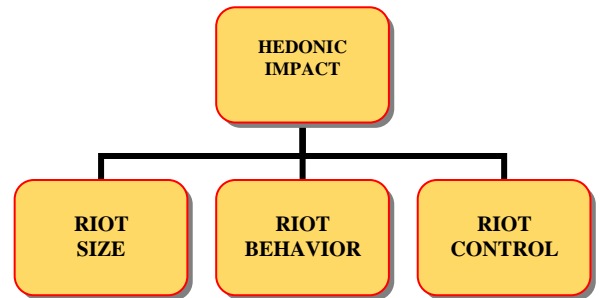


Fig. 28. A Diagram showing hedonic aspects that the architect should take in consideration to control Audience riots. Ref.: [Research]

6.4.5. Political Impact

No doubt stadiums have their share in the country’s impact on the political level. Building stadiums plays an important role on promoting the country’s image on the international, and political levels, for example, hosting a “FIFA” world cup in the country represents a major political gain. The architect should take in consideration decision of the political leaders, the required exposure, and the potential goals set by the government from building the stadium

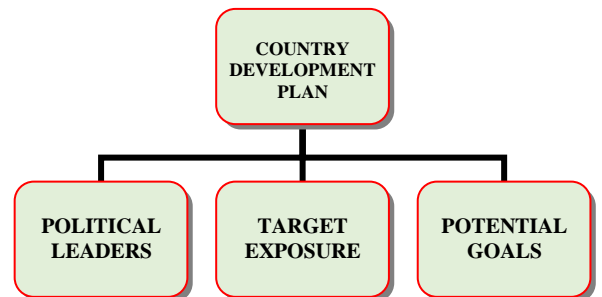


Fig. 29. A diagram showing political influences that the architect should take in consideration when designing a modern stadium. Ref.: [Research]

6.4.6. Environmental Impact

Stadium is a large facility by nature that usually occupies a large area, architects and designers should take in consideration factors that negatively affect the environment where the stadium is built, like how the building affects the existing echo system, the change in climate that may happen due to carbon emissions, and heat released from the stadium's large night led lights, and whether there were some forms of wild life that was wiped or removed in order to place the building instead [39]

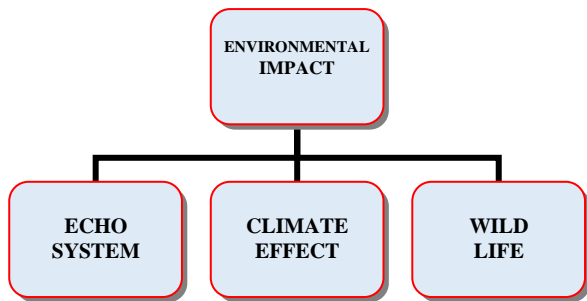


Fig. 30. A diagram showing factors that affect environment and surrounding environment of a stadium that the architect should take in consideration. Ref.: [Research]

6.4.7. Urban Impact

Stadium facilities have a large impact on its urban context and surroundings. Impacts affect near neighborhoods, create jams and traffic congestions around the stadium, parking incapacities, and may require some exceptions regarding municipal and building regulations, like for example exceeding building height limits, or enlargement of buffer areas separating the stadium from the surrounding neighborhood housing and other public buildings, and the “Accepted” distance between stadium location and the teams/clubs using such stadium for matches and other sports competitions. [40]

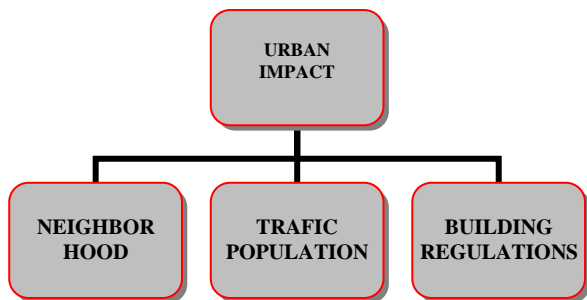


Fig. 31. A diagram showing factors that affect urban surrounding of a stadium that the architect should take in consideration. Ref.: [Research]

6.4.8. Structural Design

Stadiums are large sized facilities. Countries with high/low temperatures, are “Indoor” countries with harsh climates, this requires designing stadiums that may be fully covered with large span structures.

Outdoor countries with moderate temperatures are “Semi-Indoor”, A semi-indoor stadium may be semi covered. Each has a different type of structure involving various building technologies. The outdoor/indoor issue has a great influence on the overall design of the stadium

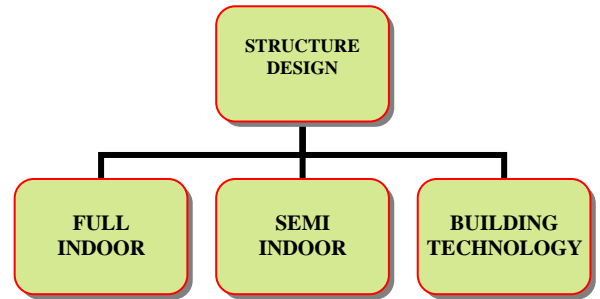


Fig. 32. A diagram showing factors affecting structural design of the modern stadium. Ref.: [Research]

6.4.9. Leed Assessment

In the next few years, it is expected that almost all buildings on the surface of this planet will be fulfilling the “Leed” green architecture criteria that is defined by the “United States Green Building Council – USGBC”, “Leed” criteria^m and green architecture design emerged from the need for sustainable solutions on an international scale.

Stadium architects and designers take in consideration qualifying their modern stadiums for the “Leed” criteria, certification, and green maintenance [41]

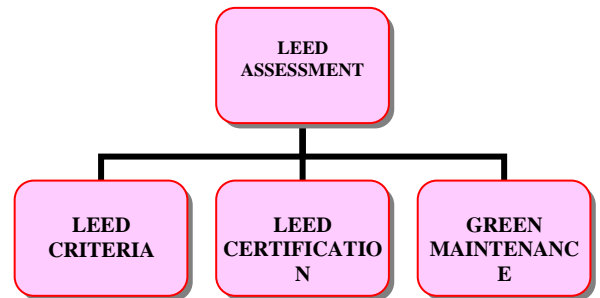


Fig. 33. A diagram showing factors that stadium designers/architects should take in consideration when designing a modern stadium to qualify for “Leed” assessment. Ref.: [Research]

^m “Green Architecture design and Leed Criteria” focus on: Energy efficiency, and renewable energy sources, water efficiency, use of environmentally friendly building materials and specifications, waste and toxic reduction, indoor air quality, smart growth, and sustainable development.

6.4.10. Design Program

As seen from the above; Stadium design involves many sources, research, studies, factors, and influences on both the national and international levels. The architect/stadium designer should take in consideration all the above-mentioned factors when setting a stadium design program: Goals, components, and constraints

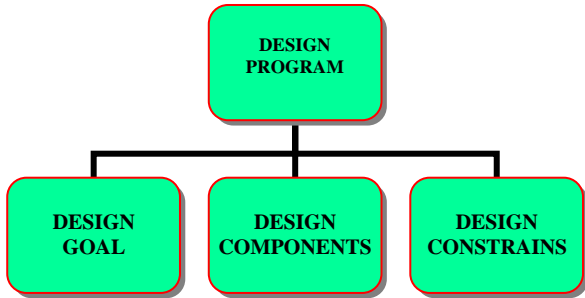


Fig. 34. A diagram showing factors that the architect should take in concern when setting a stadium design program.
Ref.: [Research]

6.4.11. Unseen Design Issues

There are always unseen issues that will come to the surface when the architect starts designing a modern stadium, since it is difficult to forecast future change in the economic situation of the country that may affect plans for future expansion of the designed sport facility, and/or even the effect of any type of unexpected “Force majeure”.

For example, designing and building a stadium facility in a location that is exposed to natural disasters like hurricanes may subject to special engineering and technical considerations that ensures the stadium ability to face such situations.

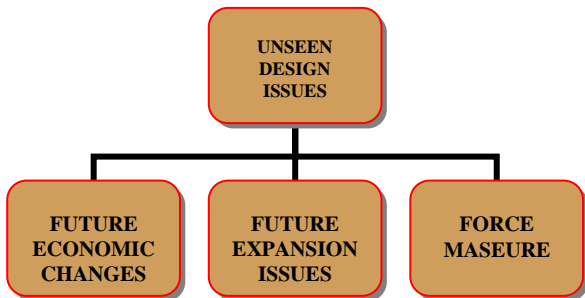


Fig. 35. A diagram showing unseen design issues that may affect the future of a designed modern Stadium.
Ref.: [Research]

7. Conclusions

- Ancient Egyptians did not have sports facilities, as sports were practiced in open squares, plazas?

temples, and/or in the open air during special occasions and holidays

- Panathenaic Stadium was initially designed in the form of a “U” shape with a straight open end, in addition to the audience’s dedicated areas; the structure contains a running track, a wrestling hall, and a gymnastics room beneath
- Most of the amphitheatres were built in the second century BC, and at that time new forms of amphitheatres were developed to receive a larger number of audiences, and as a result, squares with a full oval shape included two theatres linked together, which is the Colosseum building
- In general, people of medieval times were not interested in building sports facilities, as their attention was directed towards religion, kingship, and invasion, their sports facilities were just: simple open-air arenas expressing martial sports, horse riding, and jousting.
- Like the mindset of medieval times, sports facilities in Islamic cities were just: simple open-air arenas expressing martial sports, horse riding, and other military skills. Some ancient Chinese “Kung-Fu” masters were Muslims. Their sport arena was that of a “Shaolin” temple or a Kung-Fu School. It is in the form of a large house with a wide open-air courtyard in the middle suitable for training, the house is also big enough acting like a motel with many rooms accommodating Kung-Fu students
- The old “Sum-of-Parts” design approach for designing a stadium was very blind and leaner and does not depend much on extensive studies of the impacts of external factors, the architect generates the design following the simple methods s/he used to learn in the university.
- A “Holistic” approach in architecture design considers issues – (That are not directly related to just designing nice architectural spaces) - as integral part of the design decision and process.
- Modern Approaches in Stadium Design see a stadium as a national and governmental project for the purpose of accomplishing social, political, and economic initiatives specified by the country.
- The old school “Sum-of-Parts” design approach may not satisfy such goals, the “Holistic” design approach is more adequate for satisfying goals of building stadium as a national project.

8. Recommendations

The increasing need for sports facilities that can accommodate large audiences and at the same time provides them with comfort and safety; have become the subject of competition between architects.

It is important for architects to study culture difference and its strong impact on everything and every aspect of life; sports facilities have experienced progress in shape, design, and performance.

Sports stadiums in particular fall in the centre of attention of such progress; they are the most crucial part of the built vicinity, since they deal directly with large masses of people resembled as audiences.

A modern stadium design architect/designer should adopt all the complex factors influencing the design of today's modern stadium, and consider such factors as integral part of both design thinking and design decision processes

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