Stadium design

By Bradley Lees
All projects should consider the following:

- Sustainability
- Structure
- Community
- Advantages of the project
- Disadvantages of the project
- Aesthetics
- Safety
- Accessibility
- Cost
A sustainable build is a build that has little or no effect to the environment and uses renewable or recycled building materials.

A sustainable structure should aim to:

- Use renewable building materials.
- Minimise negative impacts on the environment.
- Maximise usage.
- Limit dead space.
- Stand for a long time.

**Sustainability**
All builds need to consider sustainability.

Will it be energy efficient?

What impact will it have on the environment?

How long will it stand?

All of these questions should be taken into account.

Sustainability
How can a sports stadium be energy efficient?

- Use environmentally friendly ways of getting energy.

The main example of an energy efficient sports stadium is The National Stadium in Taiwan (also known as Kaohsiung Stadium). This uses 100% solar power and has a capacity of 55,000.
All structures should aim to keep environmental impacts to a minimum.

This means:

• Sourcing building materials as locally as possible.

• Using renewable building materials where possible.

• Using zero or little amounts of fossil fuels.

• An example of an environmentally friendly stadium is **Brasilia National Stadium**. This contains a rainwater harvesting and reuse system, has solar panels fitted and uses LED lighting.
This is an example of a previous project I have worked on for a sustainable classroom.

- This had a large south-facing window to produce natural light.
- Solar cells were placed on the roof to generate electricity in a sustainable way.

For a stadium, the amount of electricity needed would not be generated due to solar cells. For this design I used a building pad, this would need to be used in building a stadium too. This sets the length and width of the design and how far into the ground the foundations can go. It also makes a flat surface to build on, making it easier than building on the natural lie of the land.
This is an example of a previous project I have worked on for a sustainable hotel.

- I was the project manager for this project and designed the entire upper level.
- The main principles were similar to that of the classroom.
A good structure should:

- Be durable
- Be strong
- Be secure
- Be earthquake proof
- Have good foundations
All structures should aim to last for as long as possible.

How do you make a stadium long lasting?

- Reduce rusting and corrosion of metal by coating strong metal alloys such as steel with layers of more resistant metal such as aluminium.

- Use strong arches and/or pillars for the structure. This will ensure that the structure is strong enough to stand for a long time.
The best example for a long lasting stadium structure is the Roman Colosseum.

- Built in 80AD, the Roman Colosseum could hold up to an estimated 50,000 spectators at once and is considered to be one of the greatest examples of engineering in history.

- The Colosseum stood around 189m high and had a width of around 156m.

- The first three stories of the Colosseum each have 80 arches. This keeps the structure strong without adding extra weight.

- The Colosseum is ringed with 80 entrances/ exits. There were also 'vomituras' (these were passageways that opened into a tier of seating.) This enabled quick entry and evacuation to the arena. (This is very important with modern stadium design as well.)
All stadiums should empty quickly, safely and efficiently.

- Firstly, there should be lots of fire exits around the stadium
- Wide entrance tunnels
- Lots of staircases
- Example: New Wembley – 3 entrances/exits, North entrance, East entrance and West entrance

Accessibility
In my award winning hotel design, accessibility was key.

My hotel had 4 entrances and exit roads and was also located near a tube station, this maximised the accessibility of my hotel. This did not limit the means of transport that had to be used to get to the hotel. The entrance of the building is wide with a small, wide staircase. This means that more people can enter or exit the hotel at one time.
How do you make a building earthquake proof?

- Make sure the roof is as light as possible
- Use flexible foundations
- Avoid too much brick and concrete
- Wide base
- Low centre of gravity

Most modern stadiums are earthquake proof due to the very wide bases and good foundations.
Poland National Stadium (Kazimierz Górski)

Project data

Location: Warsaw, Poland

Football stadium for the European Championship 2012 with 55,000 seats

Construction period until opening: 2009 - 2012

Foundations Case Study
There were lots of different types of foundations used in the Poland national stadium.

- Trio panel formwork
- Domino panel formwork
- Multiflex girder slab formwork
- Quatro column formwork

Foundations Case Study
Foundations Case Study

**Trio Panel Formwork**

- Used both vertically and horizontally
- Can withstand up to 80 kN/m² of pressure from fresh concrete
- Made from aluminium for a strong, lightweight support
**Domino Panel Formwork**

- Used both vertically and horizontally
- Can withstand up to 60 kN/m² of pressure from fresh concrete
- Made from aluminium for a strong, lightweight support
Multiflex Girder Slab Formwork

- Cost efficient components that can be reused
- Can change to suit all slab thicknesses due to girders

Foundations Case Study
**Quatro Column Formwork**

- Can withstand up to 80 kN/m$^2$ of pressure from fresh concrete
Before the stadium is built, the local community should be consulted.

- The building needs to be advertised around the local area where it will be built. This maximises the awareness, allowing local people to voice their opinions.
- Meetings and polls should be taken to ensure that the best overall decisions are made for the community.
- The final decision should benefit the majority of the community and compromises may need to be made.

For my classroom design, I made a blog about my classroom. This was open to the community to access. This is a good way for the community to voice any concerns they have about the building and any issues that could be solved. I also created a blog for the extension to our school. This was open to the community to share their opinions on the new extension. This creates a dialogue between the community and the building designers which is vital for any design.
Overall, I think that this stadium should:

- Use sustainable building materials, if the building is built on a former industrial site, the building materials from the demolished buildings should be recycled in this project.
- Provide energy in a sustainable way, for example tidal or HEP.
- Use LED lighting rather than filament bulbs.
- Be made of a combination of arches and pillars to maximise strength and durability.
- The stadium should be around 40-60m high
- Earthquake proofing is not needed as much in the UK, however, in other parts of the world, this is a high priority.
- The stadium should have at least 3 entrances, ideally, 4. A North, East, South and West entrance.
- The stadium should benefit the community and have multiple possible uses.
- Have strong foundations to enable maximum stability and durability.
Thank you for Listening