DESIGNING FOR PHYSICAL ACTIVITY

EXPLORING OPPORTUNITIES TO ENCOURAGE PHYSICAL ACTIVITY IN EVERYDAY LIFE

COVERED OUTDOOR SPACES
The Government’s ‘Sporting Future’ strategy was published in December 2015 with a clear focus on the benefits that sport can bring to people and to society, built around a simple set of outcomes: physical wellbeing, mental wellbeing, individual development, social and community development and economic development.

Sport England’s strategy ‘Towards an Active Nation’ was published in May 2016 with a vision that everyone, regardless of age, background or level of ability, can engage in physical activity.

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SEE OTHER GUIDANCE ON DESIGNING FOR PHYSICAL ACTIVITY COVERING:
- Activity Hubs
- Budget Costs
- Indoor Spaces
- Outdoor Spaces
- Routes and Wayfinding
- Other Topics

These and the associated Active Design General Principles and Case Studies are available at:
https://www.sportengland.org/facilities-planning/active-design/
ACTIVE DESIGN

ACTIVE DESIGN IS ROOTED IN SPORT ENGLAND’S AIMS AND OBJECTIVES TO PROMOTE THE ROLE OF SPORT AND PHYSICAL ACTIVITY IN CREATING HEALTHY AND SUSTAINABLE COMMUNITIES.

ACTIVE DESIGN IS SUPPORTED BY PUBLIC HEALTH ENGLAND AND IS PART OF OUR COLLABORATIVE ACTION TO PROMOTE THE PRINCIPLES SET OUT IN PUBLIC HEALTH ENGLAND’S ‘EVERYBODY ACTIVE, EVERY DAY’, TO CREATE ACTIVE ENVIRONMENTS THAT MAKE PHYSICAL ACTIVITY THE EASIEST AND MOST PRACTICAL OPTION IN EVERYDAY LIFE.

https://www.sportengland.org/facilities-planning/active-design/

The ten principles of Active Design - achieving as many of these as possible within an Active Environment will optimise opportunities for active and healthy lifestyles
PHYSICAL ACTIVITY AND SPORT

The term ‘physical activity’ can cover a wide range of informal, casual and recreational pursuits that maintain or enhance fitness, health and overall wellbeing. The term ‘sport’ is usually associated with more formal training or competition.

For all parts of the spectrum, easily accessed spaces that inspire and enable people of all ages to be physically active as they wish are a valuable community asset. Innovative approaches are advocated that remove barriers to participation and are proportionate and appropriate to customer needs.

Where there is a clear need for formal sports spaces, then the relevant prevailing guidance from national governing bodies of sport (NGBs), Sport England, Department for Education or Education Funding Agency should be followed. However, a distinction should be made between the formal requirements of spaces for sport and more informal spaces for physical activity, albeit that the underlying principles of any relevant prevailing guidance should not be disregarded.

Local context, potential users and site specific risk assessments \(^1\) are all important considerations during the design and briefing stages of a project. For further advice on good practice, visit the Sport England, The Royal Society for the Prevention of Accidents (RoSPA) and the Health and Safety Executive (HSE) websites.

COVERED OUTDOOR SPACES OVERVIEW

This document considers the use of lightweight covers to enhance physical activity spaces within a local community setting whether urban, suburban or rural. They can be multi-functional spaces that can meet the needs of a range of community activities - not just sport.

A creative approach is described that could range from a simple roof cover with open sides giving protection from the sun and rain, to more enclosed solutions with side panels for wind protection and retaining balls, to a full enclosure to create a basic internal environment.

Covered outdoor spaces can be created within the grounds of local schools, sports clubs and clubhouses, village or community halls and nearby parks. The structures can help to enhance the value and enjoyment of community places and generally promote more physical activity.

The guide covers the main construction techniques and general advantages and disadvantages along with issues such as the need for planning permission, building control, health and safety considerations and indicative costs within a project management context.

All facilities should be designed to be attractive, welcoming and have customer appeal. However, equally important as the space itself, research has highlighted that ‘convenience’ factors such as proximity to home or work, ease of booking and accessibility are also critical to encouraging participation.

\(^1\) For example risk assessment considerations, see page 15 of ‘Indoor Spaces’ document
THE APPROACH CAN BE USED TO COVER AND PARTLY OR FULLY ENCLOSE PHYSICAL ACTIVITY SPACES THAT WOULD OTHERWISE BE EXPOSED TO THE VAGARIES OF THE WEATHER

2.0 CONSIDERATIONS

COMMUNITY NEEDS

Community consultation, whether in a small rural village or inner city neighbourhood, can often result in a comprehensive ‘wish list’ for new facilities that are disproportionate and unrealistic for a local community to achieve. Some of these requirements may be readily met by well-defined facility types that are only viable on a strategic basis. In contrast, some local needs may be satisfied by multi-use covered outdoor spaces. They could be used for example as a covered market, music performance area and for social gatherings as well as physical activities.

This document describes a group of building systems that can be used to cover and partly or fully enclose physical activity spaces that would otherwise be exposed to the vagaries of the weather. It can be compared to the creation of a ‘tent’ or ‘marquee’ that provides basic protection but without the internal environmental comfort associated with conventional buildings.

Such systems share one obvious characteristic - they are generally lighter in weight due to a range of construction techniques that can be adopted to span across extensive areas and a variety of lightweight materials that can be used for structural support, roof coverings, walls and screens. Continuous ‘membrane’ materials and/or lightweight sheet panelling systems are the main contributors to weight reduction of roof and wall elements. Consequently, such facilities tend to need less expensive foundations than conventional buildings and in some cases can be relatively quick to construct and dismantle. They also tend to have limited servicing and rarely have space heating. They can suffer from heat gain during summer periods and can run the risk of internal condensation occurring. External and/or internal lighting may also be provided.
RANGE OF PRODUCTS AND APPROPRIATE USE

There is a diverse range of manufacturers supplying enclosed structure systems that are available on the UK market and include inflatables as well as the more conventional frame fabric structures.

It should be noted that in terms of the requirements for competitive sport, Sport England and many NGBs do not consider structures which are not thermally insulated or heated to be ‘indoor’ courts or sports halls, and designate them as ‘covered outdoor courts’. However, the spaces created may be appropriate for many forms of physical activity and other community use.

Insulated and heated enclosed structures that may be considered to be indoor facilities normally achieve this by means of various thicknesses of insulation layers within the building envelope.

DEGREE OF ENCLOSURE

The degree of enclosure that is required can vary and should be identified before choosing a particular building system. Solutions can vary from simply a roof with fully-open sides, or partially enclosed using side screening or fencing, or a fully-enclosed spatial volume. The choice may depend on the:

- Type of physical activity (or sport) to be accommodated
- Degree of weather protection required
- Degree of natural surveillance required
- Environmental conditions required within the structure
- Budget cost allowances
- Other project site specific requirements.

The degree of permanence (see page 8) and local authority planning and building regulation requirements are also important considerations. A temporary destination may be required within a park area for a set length of time to creates a destination/focus for activities.
TEMPORARY OR PERMANENT

A distinction can also be made between temporary solutions, where enclosures are provided for sporting events that only take place on a periodic basis - say for a tournament or championship that takes place once a year, and permanent solutions where the lightweight structures are erected to remain in place.

TEMPORARY STRUCTURES

For temporary solutions, the ability for lightweight structures to be quickly erected and dismantled are key considerations. Some systems can be described as ‘pop-up’ and be deployed across a number of sites. In other cases, the temporary structure can be a way to extend the length of the playing season for sports such as tennis that would otherwise only be played in the summer.

Generally, inflatable structures are likely to be the more appropriate as temporary solutions - see Section 3.0 for further information.

PERMANENT STRUCTURES

For permanent solutions, lightweight structures can provide a cost-effective ‘half-way house’ compromise by giving a limited degree of protection to participants from the worst of the outside elements but without involving the full cost of a traditional building.

In most cases, frame and fabric structures are likely to be the more appropriate as permanent solutions - see Section 4.0 for further information.
3.0 LIGHTWEIGHT INFLATABLE STRUCTURES

CONCEPT

In the simplest form, a single continuous roof membrane can be inflated to create a large ‘bubble’ of space. To counteract uplift, the perimeter is anchored to a ring beam foundation or ground anchor system. This type of structure is sometimes referred to as an ‘air hall’ or ‘air dome’.

A mechanical fan system is required to maintain a constant internal air pressure which exceeds the atmospheric air pressure outside. This is achieved by incorporating an air-tight seal at ground level and air-tight doors for access.

The membrane is typically reinforced with cables and/or a netting system. Following inflation, the skin becomes stressed and transfers this load through the cables to the ground anchorage system. Additional internal structure may also be required to provide a safe means of escape in the event that mechanical plant fails and the membrane starts to deflate.

Inflatable structures are often used under a temporary planning permission to extend the playing season into winter months for outdoor sports such as tennis or as temporary weather protection for championship show courts. They have also been used to cover swimming, riding school, rugby and outdoor training areas and football grounds.

There are three primary types of inflatable structure:

- Single-skinned roof membrane
- Double-skinned roof membrane to improve heat gain and heat loss
- Inflated individual elements to form structural ridges or panels

These types are discussed in more detail on page 11.
SUITABILITY

In comparison to traditional building constructional approaches, advantages of this type of structure include:

- speedy construction
- speedy demountability
- low cost
- simple design
- integrated equipment.

On the other hand, disadvantages can include:

- basic internal environmental conditions
- high levels of heat loss through the roof membrane
- overheating in the summer
- high relative humidity
- vulnerability to vandalism.

ENVELOPE AND MASSING

It is important to consider the envelope of the air dome and its ability to accommodate the required volume for the physical activities. This will confirm the overall required size of the inflatable structure in order to inform the facility location.

An air-supported structure is often a bespoke manufactured item which is usually rectangular in plan but includes a curved roof profile. The organic shape requires careful consideration to ensure it can enclose the volume of playing space.

The shape of the profile in comparison to the required playing space will confirm if the system offers a suitable enclosure.

The cross section profiles can range from c. 18 m wide x 9 m high to c. 80 m wide x 20 m high.
A dome’s cross-section tends to be 25-33% wider than the court width in order to provide a large enough arc to achieve a sufficiently clear height over the court area.

Refer to the particular NGB and Sport England guidance on comparative sizes of sports pitches and courts to clarify exact sizes of playing space including principal play area, run off, clear height, and any fittings that need to be incorporated in order to assess the suitability of manufacturers’ dome profiles.

An example may be an outdoor basketball court/recreational area requiring enclosure over winter to enable continued use. Considerations would include the need to enclose the court area including run off space and achieve a clear height of 7 m between the court and underside of any light or net fittings.

**TYPES**

**SINGLE MEMBRANE INFLATABLE STRUCTURES**

Definition: In its simplest form, a single roof membrane is inflated to form a large ‘bubble’ of space that is anchored down to a perimeter ring beam or ground anchor system.

A simple single-skin air dome structure will include a low material content, economic foundations and relatively uncomplicated inflation equipment. This allows the system to be demounted and stored easily in a suitable facility. Various manufacturers can provide storage sheds adjacent to a facility if needed.

The fabric cover can be reinforced with cables.

This type of system requires the least person days for erection and dismantling compared to other inflatable systems making it particularly useful for short periods of use.

**DOUBLE MEMBRANE INFLATABLE STRUCTURES**

Definition: An inflated structure with an intergrated second membrane to improve insulation and/or structural stability.

Double membrane inflatable structures expand on the same concept as a single membrane system but provide a more technologically advanced enclosure for a wider cross section of sports.

**INFLATED RIB STRUCTURES**

Definition: An inflated structure with the rib components jointed together to form a supporting framework.

The roof membrane can be reinforced by inflatable ribs in order to give more stability. Alternatively, the ribs can form continuous arches across the shortest span in order to form a complete structure. Such ribs can also improve the thermal characteristics of the structure.
4.0 LIGHTWEIGHT FRAME STRUCTURES

CONCEPT

Lightweight frames can be constructed in aluminium, steel, timber or composite materials. The superstructure can be self supporting or based on a concrete foundation depending on ground conditions. Lightweight systems can provide cost-effective enclosed spaces with fast construction methods and can be demountable.

The various types of lightweight frame structural systems are discussed in more detail on page 14.

There are two primary types of lightweight roof/wall coverings:

- Various lightweight fabrics (e.g. PVDF coated polyester)
- Various lightweight panel materials (e.g. polycarbonate sheeting).

Membranes can allow natural light penetration to provide a uniform diffused level of daylighting whilst achieving low levels of glare. Additional internal membranes can be incorporated to provide insulation, acoustic damping and provide improved environmental conditions.

Floors can be permanent or demountable.

Internal spaces can range from 30 m to 80+ m in width and have practically no restrictions on length. A number of space forming structures can be combined to increase the internal volume.

Spaces may require heating and ventilation. Services and activity equipment can be supported from the main frame.

Ongoing service costs are moderate due to periodical membrane replacement costs.
SUITABILITY

In comparison to traditional building constructional approaches, advantages of this type of structure include:

- faster construction
- potential for demountability
- lower cost
- repetitive design
- integrated equipment
- potential to provide either ‘covered’ or ‘enclosed’ spaces.

On the other hand, disadvantages can include:

- basic internal environmental conditions
- high levels of heat loss through the roof membrane
- overheating in the summer.

In many ways, these forms of lightweight structures are similar to traditional buildings. However, the lighter weight of roofing materials is usually associated with lower levels of insulation as would be expected from a ‘tent’ or ‘marquee’ type of structure.

Care should be taken if such a lightweight structure may be seen as a first stage of a longer-term solution. A structure that is initially designed for a lightweight roof covering may not have sufficient load-bearing capacity to allow a more substantial roof covering with improved insulation to be added in the future.

The cost and availability of base materials are also likely to fluctuate with market conditions.

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2 Some ‘enclosed’ systems can be specified with improved levels of insulation to reduce heat losses and gains. However, these may or may not be sufficient for the structure to be designated as an indoor facility for acceptance by SE/NGBs for a particular activity.
TYPES

STRUCTURAL PROFILES
There is a variety of frame profiles and range of materials available. Common examples include:

- Arched (options in steel/ aluminium)
- Vaulted (options in steel/ aluminium)
- Pitched truss (options in steel/ aluminium/ glulam)
- Arched truss (options in steel/ aluminium/ glulam).

MATERIALS FOR FRAMES
- Steel: Generally regarded as the industry standard and available in galvanised or powdercoated finishes with optional fire protection treatment. However, some concerns over high-carbon footprint issues
- Aluminium: Generally lighter and easier to handle than steel but a more expensive structural solution. Less resistance to fire than steel
- Glulam: Generally regarded as a more environmentally-friendly material.

MATERIALS FOR CLADDING THE ENVELOPE
- Tensile: enclosures using technically advanced tensile fabric roof materials
- Modular panels: modular components exploit the benefits of prefabrication and provide an alternative to traditional building approaches by reducing on-site works but require a longer procurement route. However, such solutions are more likely to provide a longer-term solution than inflatables. Typical uses include 4-8 court sports halls, multi-use spaces, ice rinks, tennis and football centres
- Hybrid (tensile/modular panel) solutions: enclosures using technically advanced tensile fabric roof materials, prefabricated steel frame structure and modular building components. Requires limited ground support. Provides faster building procurement period. Typically used for the provision of a medium to longer term alternative solution to a traditional building construction approach. Uses include 4-court sports halls, multi-use spaces, ice rinks, tennis, football, rugby and basketball centres.
EARLY SITE ANALYSIS AND FEASIBILITY STUDIES CAN HELP ACHIEVE THE MOST COST-EFFECTIVE APPROACH FOR GROUNDWORKS FOR A PARTICULAR SITE AND THE CHOICE OF CONSTRUCTION SYSTEMS ADOPTED

5.0 CONSTRUCTION CONSIDERATIONS

GENERAL

ON-SITE OPERATIONS
Each site will have its own particular characteristics that should be investigated and understood at an early stage in a project. The ground levels and drainage may need to be adjusted to create a suitable playing area and underground services and soil conditions will need to be taken into account. Early site analysis and feasibility studies can help achieve the most cost-effective approach to creating suitable access and other site specific works.

PREFABRICATION
The construction of lightweight covers and enclosures offers considerable scope for prefabrication. For example the roof components, whether in steel, aluminium or glulam timber, can be fabricated into units that can be easily transported and then fixed together on site. Similarly, a membrane for an inflatable structure is usually fabricated in factory conditions and delivered to site as a single unit ready for inflation.

In contrast, the construction of foundations and the installation of playing surfaces and services all require significant on-site operations that need careful planning and coordination, notwithstanding that some components will be prefabricated beforehand.

MODULAR CONSTRUCTION
Systems that maximise the off-site prefabrication approach to create large factory-built units (modules), that can then be carried by lorry and craned into position, can achieve rapid site erection times. The approach also minimises the risks from bad weather and improves build quality.
SUBSTRUCTURE AND FOUNDATIONS

Substructure or foundation requirements depend on the building system, size, and ground conditions. Small-scale inflatable or prefabricated systems may utilise ground anchors without permanent engineered foundations.

Larger inflatable and tensile structures can utilise a perimeter ground beam whereas larger-scale framed tensile and prefabricated systems may require additional support confirmed by a structural engineer or the system supplier. Activity surfaces may be raised above external levels and protected by a bund to avoid ground water ingress. Surfaces can be permanent or demountable and there are a variety of system types available.

DRAINAGE

The majority of lightweight structures require rainwater drainage to protect foundations or playing surfaces. Some small-scale demountable seasonal structures such a single-skin inflatable structure may not include any provision.

Where provided, surface water drainage should divert water away from the structural envelope and foundations by either perimeter channels around inflatable structures, or conventional gutter and downpipe systems on hybrid or prefabricated structures to a below ground drainage network.

Perimeter bunds may be incorporated to protect playing surfaces from ground water ingress and the superstructure external fabric.
PLAYING SURFACES

The playing surface under a lightweight structure should be in line with a suitable multi-activity standard or the recommendations of the NGBs of the particular activities concerned. The options range from artificial grass with or without a sand and/ or rubber filling, to tarmadam with various types of surface treatment. For further information, see Sport England publications available at:

https://www.sportengland.org/facilities-planning/design-and-cost-guidance/artificial-sports-surfaces/

For covers that are only partially protected from the weather, particular attention should be given to the risk that some sections of the activity surface may become wet due to rain penetration. This effect can be mitigated by varying degrees, for example, by incorporating extended roofing that overhangs well beyond the activity area.

WIND PROTECTION

Sites will have different degrees of exposure to the prevailing winds that can be mitigated by adjacent landscape features. For example, the site may be in the lee of a hill or have surrounding shrubs, trees and natural vegetation. Further protection can be provided by infill walls, fencing, screening and additional planting.

The variations in the monthly direction and strength of the prevailing wind for a particular location can be found at:

INTERNAL FIT-OUT AND EQUIPMENT

The proposed building choice should consider the requirements of the designated activities to be played and the suitability of the structure to allow the inclusion of the necessary equipment. The majority of equipment will be ground fixed such as goal posts, hoops, crash panels etc. However, division nets could be used in larger spaces to separate activities.

Proposed structures must be capable of supporting both nets and guides across the space whilst allowing for co-ordination with any necessary lighting and ventilation equipment.

HEATING AND VENTILATION

Some structures may require some form of natural or mechanical ventilation to provide air changes suitable for the playing space and the structure type. This can be provided by means of inflation plant as part of an inflatable structure, natural/ BMS controlled ventilation, or ducted mechanical air-handling systems. Background heating may be required to give protection to the structure from frost or condensation. Specialist professional support is essential to ensure that the design and installation is appropriate and conforms to relevant regulations and standards.
LIGHTING

There are recommended lighting levels for spaces specifically designed for sport with most starting from 200-300 lux of illuminance for community, recreational and training activities. This would also be suitable for the majority of indoor physical activities and be in line with the general standard for multi-use spaces.


SUSTAINABILITY

Subject to supply chain and manufacturing factors, some covered outdoor structural systems could have a lower environmental impact than traditional construction.

Depending on the system, a number of options may be available to further reduce environmental impacts such as passive natural ventilation through building management system (BMS) controlled vents, light and heat transmittance through tensile or inflated high-performance membrane fabrics, and structural frame materials such as glulam timber.

Due to their demountable nature, some systems offer opportunities for reuse and relocation. Therefore a structure could be leased or sold on following the end of the required usage period.