More sustainable stadiums

3rd technical report on the implementation of environmental, energy- and resource-efficient design solutions for the stadiums of the 2018 FIFA World Cup Russia™

Kazan Arena

Saint Petersburg Stadium

Fisht Stadium

Spartak Stadium

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This report was prepared in 2017 for the 2018 FIFA World Cup Local Organising Committee by Geoecology Engineering LLC.

1 Introduction

This Report is intended for the green building standards implementation description of four stadiums to be used for the 2018 FIFA World Cup Russia™ and 2017 FIFA Confederations Cup.

Kazan Arena

Saint Petersburg Stadium

Fisht Stadium

Spartak Stadium

2 List of Terms and Abbreviations

FIFA – Fédération Internationale de Football Association – the governing body of association football which ensures the coordination of football as a sport, and has been established and operates in accordance with the legislation of the country in which it is based.

Approach – a sequence of steps to collect, process and present information.

BREEAM – one of the most common green construction standards developed by Building Research Establishment Global (England).

LEED – a construction standard developed by United States Green Building Council (USA).

LOC – 2018 FIFA World Cup Local Organising Committee

RUSO – the Russian rating system for the certification of football stadiums.

Building Visitors – non-permanent visitors to the building who do not occupy work places at the stadium.

Building Staff (employees of the stadium) – people with permanent work places at the stadium.

3 Strategic vision of the preparation for the FIFA World Cup in the field of green construction

FIFA and the LOC have paid great attention to the implementation of concepts in the Sustainability Strategy of the 2018 FIFA World Cup™.

Compliance with these concepts and mechanisms for their implementation have laid the foundations for the strategy of the 2018 FIFA World Cup™ in Russia in the field of sustainable development. The implementation of this strategy will guarantee the minimisation of negative impacts during the preparation and hosting of the tournaments, and the full realisation of the possible positive impact of the tournaments on society, economy and the environment.

The key issues covered by the Sustainability Strategy are shown in Fig. 1. The environment is an integral part of the activities of the LOC and FIFA.

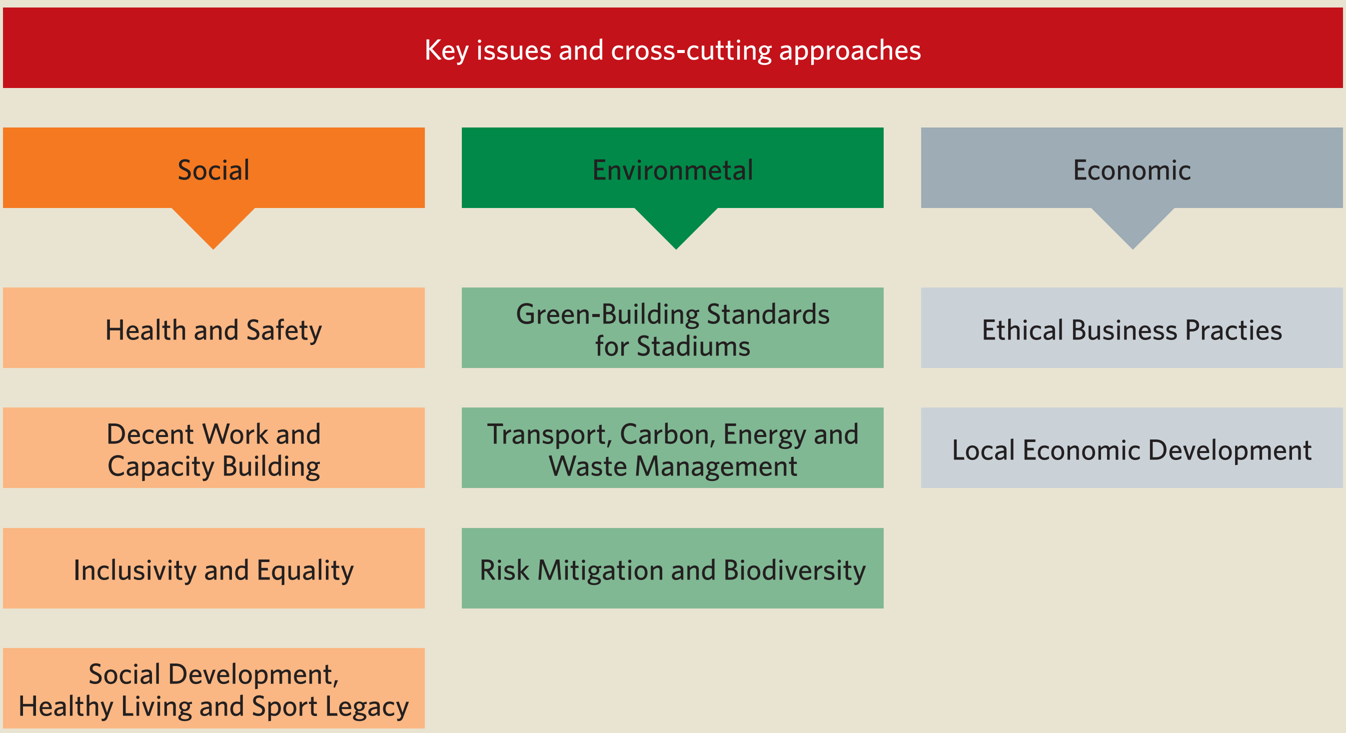

Fig. 1. The key issues covered by Sustainability Strategy

The key issues and objectives of the environmental field include:

1. Construction of stadiums in consideration of "green" standards
   - Ensuring the compliance of tournaments stadiums with the requirements of "green" construction standards
   - Development of stadium management practices in accordance with sustainable development concepts
2. Management of transport, greenhouse gas emissions, energy consumption and waste
   - Ensuring effective energy consumption and management of greenhouse gas emissions
   - Ensuring effective waste management within the framework of the tournaments
3. Minimisation of the impact of transport on the environment within the framework of the tournaments
   - Minimisation of environmental risks and preservation of biodiversity
   - Minimisation of environmental incident risks associated with the operating activities of the tournament
   - Ensuring the compliance of the operational activities of the tournament with legal requirements in the field of especially protected areas
   - Promoting environmental protection and the preservation of biodiversity in relation to the preparation and conduct of the tournament

These objectives not only reflect the main provisions of the environmental sphere of the Sustainability Strategy, but are also closely intertwined with the requirements of international and Russian green construction standards – BREEAM, LEED, RUSO and others.

The stadiums of the FIFA Confederations Cup Russia 2017 have been designed, constructed and are operated in compliance with green construction and energy effectiveness technology. This is confirmed by recognition of the stadiums according to the most accepted green construction standards (BREEAM and RUSO). Situation with certification status is described in the table below.

Name of stadium	Standard	Certification body	Certification type	Date of certification (as of 12.2017)
Spartak stadium	BREEAM In-Use 1.0.2015	BRE Global	Completed construction	January 2017
Saint-Petersburg stadium	RUSO.Football stadiums	RUSO	Project stage	April 2017
Kazan Arena	RUSO.Football stadiums	RUSO	Completed construction	April 2017
Fisht	BREEAM In-Use/ RUSO.Football stadiums	BRE Global/RUSO	Completed construction	---

4 Description of resource-efficient approaches and engineering solutions in stadium design and construction related to the "green" certification

4.1 Methodology

The green certification of stadiums is a requirement of FIFA described in Stadium technical requirement and presumes that every stadium shall choose any of "green" standards such as e.g. LEED, BREEAM, RUSO. Football stadiums. Stadium authorities shall achieve minimum level of certification equal to LEED level 40 -49 score. This report covers resource-efficient approaches and engineering solutions made on the stage of design and construction that lead to achievement of required level of certification.

Data collection for the description of resource-efficient approaches and engineering solutions in stadium design and construction was conducted for the following four stadiums: Fisht Stadium in Sochi, Kazan Arena in Kazan, Saint Petersburg Arena in Saint Petersburg, and Spartak Stadium in Moscow. The data was collected during visits to the stadiums and a review of the design documentation. Experts had 2-days visits on each of stadium in the period April-May 2017. The visit was performed based on a check-list and covered interior and exterior areas of stadiums, including office areas, engineering technical points, cooling facilities, ventilation facilities, heating facilities, water supply and metering facilities, control panel rooms, sanitary rooms, waste storage areas, oil and grease collection facilities, dispatching room. Spartak Stadium

4.1.1 Transport accessibility

Spartak Stadium boasts excellent transport accessibility due to the proximity to Spartak metro station, some 350m from the main entry to the stadium. The proximity of the metro station allows users of public transportation to reach the stadium in comfort without using personal vehicles. In addition, there is a bus stop within 500m of the stadium, which allows people to walk within this and neighbouring districts. There is a well-equipped multi-level, secured car park for visitors travelling in private vehicles.

The reduced number of trips via private vehicles relieves the traffic load on the stadium area in general and results in reduced exhaust emissions, including CO_2 and, subsequently, a reduced carbon footprint of the building operation.

The availability of a cash machine and a food court (restaurant and diner) in the building allows stadium staff and visitors to avoid additional unnecessary trips to such amenities and, therefore, prevents additional emissions from vehicle exhausts.
Thus, the transport accessibility of the Spartak Stadium ensures both convenience for visitors and decreased vehicle emissions due to the reduced number of trips using private vehicles.

Спартак
Spartak

Проектируемый пр-д№
Designed access way no.

Открытие Арена
Otkrytie Arena

Музей ФК Спартак
Museum of Spartak Football Club

Гладиатор
Gladiator

Fig. 2. Walking route to Spartak metro station

4.1.2 User comfort

A well-considered strategy of visual and thermal comfort results in saving energy on the heating and illumination of the premises.

A strategy of thermal comfort has been implemented at Spartak Stadium. Staff can adjust the velocity, temperature and intensity of the air flow in the working places. This is achieved by the use of control panels for the fan coils mounted in the ceiling.

Fig. 3. Fan coils with control panels

Fig. 4. Radiator with a thermostatic valve

If the heating is too intense, users of the building are prone to adjusting the air temperature by opening windows, which results in energy losses for heating the premises. To avoid this, all radiators at Spartak Stadium are fitted with thermostatic valves to adjust the temperature in a prompt manner.

Staff have a view out of the windows and access to daylight (approximately 30% of the stadium is glazed). Access to daylight is not only the part of user comfort, but a way to save costs by not using artificial lighting during daytime.

Fig. 5. Glazed facade of the stadium

Working areas near to windows can be affected by glare, therefore there are blinds and matte coating on the stadium windows. The outside of the stadium is illuminated with masts to provide comfort and safety for users at night. External lights are controlled automatically, helping to avoid ineffective use of energy.

Fig. 7. 1: Matte protection; 2: Blinds at Spartak Stadium

Conditions that enhance comfort in the building are provided for the staff. Sufficient clean water is supplied via 25 non-flowing coolers. Plastic containers for coolers are fully recycled by a dedicated water supply contractor, which avoids additional plastic waste.

Fig. 8. Drinking water supply at Spartak Stadium

There are also resting areas in the stadium with seats and dining tables. There are outside resting areas as well, which are also fitted with seats and night lights.

Fig. 9. 1: Seats in the restaurant area; 2: Resting area on the adjacent territory

Spartak Stadium has all of the facilities it needs for visits by various user groups. Disabled people and people with limited mobility can visit the stadium without constraints. For this purpose, there are dedicated spots in the car park, and lifts with doors wide enough for wheelchairs. Access to the stadium is on the level of the adjacent territory, and as such there are no ascending slopes or curbs so disabled people and people with limited mobility can move freely around the building. There are also toilet facilities equipped with wide doorways and alarm buttons.

Fig. 10. Stadium infrastructure for disabled people and people with limited mobility.
1: Hand rails and access on the level of the adjacent territory; 2: Width of lift doors

For visitors with children, there is a playroom equipped with TVs and drawing utensils.

Fig. 11. Children's playroom

4.1.3 Energy saving

Energy saving at Spartak Stadium has been implemented by the installation of state-of-art mechanical equipment with centralised automatic controls.

The stadium is heated by the district heating station Tushino-3, which generates energy from natural gas, which has an advantage over other combustible agents due to reduced atmospheric emissions during combustion. Heat transfer fluid (water) for the stadium building is obtained at the local central heating unit, which is then supplied to the floor heating system, local heaters, air-supply units and air curtains, and fan coils. The operation of the heating unit does not require the presence of permanent maintenance personnel. The following parameters are controlled automatically: water temperature in the hot water supply system, water temperature in the heating system (schedule is defined by the consumer according to the ambient temperature), ventilation system temperature (similar to heating).

Heat recovery is provided for the air ventilation and conditioning system. Waste warm air leaves the room via the air duct system and enters the heat exchanger, where the cold fresh outdoor air is heated and then enters the room at a more comfortable temperature. Using such a system allows the stadium to save up to 50% electricity.

The main elements of the cooling system are four chillers with the capability to adjust capacity between 25% and 100% according to the system load.

Significant electric energy savings are achieved by using LED lamps instead of fluorescent lamps. LED lamps have a longer service life, have no toxic agents, are easy to dispose of, and save up to 70% electricity when compared to other lamp types. Fluorescent lamps illuminate the stadium's utility rooms and are equipped with start control devices, which ensure blink-free illumination, improve the lamp service life and reduce electric energy consumption by 20% when compared to lamps without such devices.

Fig. 12. 1: LED lamps installed at the stadium; 2: Electronic start control device on fluorescent lamps

4.1.4 Water saving

Water is saved at the stadium through constant consumption monitoring and the installation of effective sanitary equipment.

The water supply is monitored by connecting a water meter to the single management system. Water consumption data at the dispatcher panel is accessed in real time and makes it possible to determine uncontrolled water consumption in a prompt manner.

Efficient sanitary equipment is installed at the stadium.

There are toilet bowls with two different flush volumes (2l and 6l). This dual flushing option allows for savings of up to 3l of water on each flush (3 low-volume flushes per 1 high-volume flush, or 75% of low volume for each 4 flushes). The stadium hosted a total of 46 matches in 2016, and about 2,132,560 people visited the stadium (lower attendances for certain matches balanced out by attendances at concerts and other events). For calculation purposes, if one assumes that each visitor used a toilet bowl once, and if there were only one 6 l flush button, water consumption would amount to 12,795,360l. With two different flush volumes, this will amount to approximately 6,397,680 L or only half as much.

The flushing devices of the urinals in the stadium are controlled automatically at a signal from the sensor, avoiding water losses if the button is stuck.

The water-flow rate of the basin mixer taps is 6 l/min or 9 l/min. The mixer taps in the west wing are controlled via infrared sensors. Automatic control of the taps avoids water losses due to incompletely shut-off taps or taps left open after use. All mixer taps are equipped with aerators, which ensure the water flow rate as specified by the manufacturer.

Fig.13. The stadium's water-saving equipment.
1: Toilet flush with two buttons; 2: Urinal flush sensor; 3: Aerator in the manual tap

4.1.5 User safety

User safety is ensured by a round-the-clock security system and an automatic alarm. The building is protected by a private security company and a subdivision of the Ministry of Internal Affairs. All stadium premises are monitored by surveillance cameras, which transmit the records to the security console.

In case of an emergency, predefined evacuation plans and action plans for fire, acts of terrorism or natural disasters are implemented.

Protection of the building structure components avoids unscheduled repairs and saves on repair materials. There are door stops and protective metal sheets for trolley movement areas at the stadium, which save on finishing materials: tiles, plaster, door structures.

Fig. 14. Wall protection elements

4.1.6 Waste management

At the time of the inspection segregated waste collection was being implemented at Spartak Stadium. LOC Waste Management organised a pilot project before FCC at the family sector. Waste was segregated in the following flows: plastic bottles, aluminium cans, paper and other. Proper bins were installed across the one sector. Segregated waste collection makes it possible to collect waste without additional manpower, materials or energy resources, however up to 6 volunteers provided by LOC supported the pilot project. Therefore, the implementation of segregated waste collection reduces the stadium's environmental footprint.

Fig. 15. Litter bins for segregated waste collection

Fluorescent lamps in the stadium are collected separately and are disposed of as mercury-containing waste.

The central waste collection area is equipped with two containers – one for common waste and the other for food waste. This waste is segregated by a licensed contractor beyond the stadium premises. Each month, the waste management contractor forwards a certificate to the stadium operator specifying the amount of dispatched waste classified by waste flows.

There is a press compactor at the stadium for handling packaging and carton waste. Pressed carton waste can be processed further by the contractor in an easy manner with near to no additional preparations, whereas storage of carton and paper together with common waste would prevent their further processing.

Fig. 16. Press compactor for packaging materials

4.1.7 Biodiversity

Landscaping of the territory after completion of construction is part of the programme on the environmental impact compensation of the project. Spartak Stadium is surrounded by a large green area of 80,000m^2 out of 280,000m^2 of the total stadium territory. During landscaping, a habitat was created with plant species which only grow naturally in the central part of Russia. Therefore, a biocenosis was created which is similar to the natural communities of the surrounding areas.

The following species grow on the stadium territory: acer tataricum, Norway maple, buckeyes, tilia cordata, redhaw hawthorn, common lilac.

Fig. 17. Landscaping of Spartak Stadium

There are amenities for local fauna at the stadium, such as shelters (boxes) for insects, bats and birds. Insects are plant pollinators, and they also attract bats and birds. There are five species of bat in the Moscow area. They prefer to live under roof caps and other narrow spaces. Birdhouses in Moscow are usually inhabited by parus, true thrush, wagtail, leaf warblers and other bird species.

Fig. 18. Amenities for local fauna. 1: Bird house; 2: Bat box; 3: Insect box

4.1.8 Environmental protection

The following measures have been implemented at the stadium to reduce the adverse environmental impact:

- Installation of grease traps which prevent the restaurant kitchen's water contaminated with grease and oil from entering the common sewerage. Grease and oil are collected in a separate tank, and removed and disposed of by a dedicated contractor. In addition to the direct treatment of kitchen waste water, the grease trap ensures the proper performance of the sewerage system and prevents its premature repair and unreasonable unforeseen material costs.

Fig. 19. Industrial and local grease traps at Spartak Stadium

- Use of ozone-friendly R410a refrigerant in the air-conditioning and ventilation system. This refrigerant is chlorine-free, therefore it does not impact upon the ozone layer. As such, the use of R410a does not contribute towards climate change and fully complies with international environmental agreements, first of all, the Montreal Protocol (1989).

- Provision of a drainage system to prevent infiltration of precipitations into the ground. Precipitations in cities are often the source of agents causing adverse effects to greenery and the structures of buildings and facilities. These include dissolved exhaust gases from vehicles and suspended matter of industrial or construction areas. The infiltration of contaminated precipitations into the ground leads to their accumulation in soil horizons. The drainage system minimises the specified impacts and redirects the collected water volumes into the city sewerage.

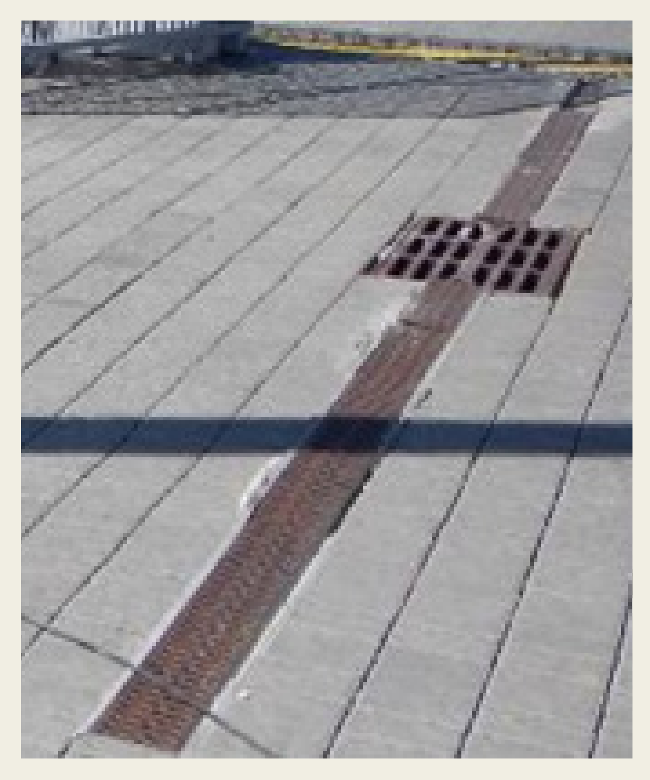

Fig. 20. Elements of the drainage system

4.1.9 Conclusions

Spartak Stadium has the following features, which ensure that it is classified as an environmentally friendly building by obtaining BREEAM In-Use certificate of "good" level in January 2017:

1. The stadium has a segregated waste collection system – four flows and a presser for carton waste.

2. The stadium has excellent transport accessibility (metro station less than 500m from the main access), which makes it possible to reduce the exhaust emissions of vehicles of stadium visitors and staff.

3. The stadium is surrounded by a large green territory of 80,000m^2 out of 280,000m^2 of the total stadium territory, and is the only one among the stadiums in this report which has amenities for local fauna such as birds, insects and bats.

4. In addition to these specified features, there are commonly used resource-saving measures at the stadium, including highly automated engineering systems and sanitary equipment with low water consumption.

4.2 Saint Petersburg Stadium

4.2.1 Transport accessibility

The transport accessibility strategy of the facility was considered in detail at the design development stage and was implemented during the design execution to ensure visitors' comfort and reduce city traffic load. For this purpose, provision was made for the construction of a new transport hub (Novokrestovskaya metro station) and new routes to the stadium from the existing bus stops (bus routes to the stadium).

There are two metro stations – Krestovsky ostrov (operating) and Novokrestovskaya (under construction) within walking distance of the stadium. Krestovsky ostrov station is within 2km of safe walking, whereas Novokrestovskaya station is within 250m. For users' convenience, there are dedicated bus routes to the stadium from the Krestovsky ostrov, Petrogradskaya and Chkalovskaya metro stations.

A well-considered transportation strategy is the key to reducing the load on the city traffic with beneficial consequences for the environment:

- The accessibility and convenience of public transportation routes contributes towards the reduced use of private vehicles and lower CO^2 emissions;

- An organised network of public routes minimises traffic jams in the stadium's peak hours, which also contributes towards a reduction of exhaust emissions in the area;

- The advantage of public transportation over private vehicles has reduced the number of parking spaces at the stadium, and the vacated area was dedicated to development and landscaping.

Маршрут к станции метро «Крестовский остров»
Route to Krestovsky ostrov metro station

Маршрут к строящейся станции метро «Новокрестовская»
Route to Novokrestovskaya netro station under construction

Санкт Петербург
Saint Petersburg

Северная дорога
North Road

Южная дорога
South Road

Р. Малая Невка
Malaya Nevka river

Наб. Гребного канала
Grebnoy Channel Promenade

Футбольная ал.
Futbolnaya Alley

Теннисная ал.
Tennisnaya Alley

Велосипедная ал.
Velosipednaya Alley

Наб. Мартынова
Martynov Promenade

Северная ал.
Northern Alley

Южная ал
Southern Alley

Приморский парк победы
Primorsky Park Pobedy

Ул. Рюхина
Ryukhina Str.

Р. Чухонка
Chukhonka river

Fig. 21. Walking routes from the stadium to the nearest metro stations

For this purpose, there are access routes for private vehicles and a secure car park at the stadium premises.

Stadium visitors can use local amenities to reduce unnecessary trips by personal and public transportation. There is a cafeteria and cash machines in the stadium building. There is a hotel near the stadium which is convenient for foreign visitors and visitors from other cities, and eliminates the need to arrange additional transportation routes and cause exhaust emissions due to the routes.

4.2.2 User comfort

A comfortable stay in the stadium and the adjacent area ensures that visitors are satisfied and avoids unreasonable energy costs for lighting and heating.

The comfort of visitors to Saint Petersburg Stadium is ensured by various methods of air heating (or cooling) and the ability to adjust the air temperature locally. Areas are heated by radiators, with the temperature defined centrally. Users can locally control air parameters via the control panels of fan coils and air conditioners. Windows can also be opened. Windows under the roof open automatically, as required, to ventilate communal areas.

Fig. 22. 1: Fan coil; 2: Fan coil control panel

In terms of visual comfort, the work places of office areas have access to daylight and window views, which reduces costs for artificial lighting during daytime.

Stadium employees have access to clean drinking water in coolers in small staff kitchens. The plastic containers for the coolers are recycled by a drinking water supply contractor and are not an additional flow of plastic waste.

Fig. 23. Window view from stadium rooms

Fig. 24. 1: Water cooler in a kitchen;
2: Water cooler in a communal area

There are also rest areas outside the stadium with seats, bins and street lamps for illumination at night. These rest areas allow visitors to pass the time in comfort in the adjacent territory and fully enjoy the landscaping and development. Proper illumination at night ensures the safety of visitors.

Fig. 25. Rest areas outside the stadium

The stadium is equipped with the required infrastructure for people with limited mobility disabled people and people with limited mobility. Access to the stadium is on the level of adjacent territory, and there are lifts designed for wheelchairs. There are also special toilet facilities with wider doorways, handrails and alarm buttons. Directions in the stadium are also arranged accordingly for disabled people and people with limited mobility.

Fig. 26. Infrastructure for PLM at the stadium. 1: Ramps; 2: Sanitary facility

4.2.3 Energy saving

During an inspection in 2016 performed by independent agency OJSC KB VIPS, the stadium building was classified as A++ in terms of energy efficiency (very high) due to the thermal characteristics of the stadium's enclosing structures and the volumes of energy consumption in the building.

State-of-art engineering equipment and the ability to control it automatically reduces the energy costs of the stadium.

The stadium is heated by a local boiler house using natural gas as a main fuel, the combustion of which reduces the impact on the environment when compared to other combustible agents. The heat for the stadium is distributed by a fully automatic individual heat plant.

There is a mechanical ventilation system for the stadium rooms. The ventilation machines are fitted with air-flow control devices, which reduce the equipment capacity during the lowest load of the stadium and therefore avoids unreasonable energy consumption. The air temperature in the ventilation system is controlled automatically based on the outdoor air parameters, including daily temperature variations. Therefore, it is possible to avoid overheating or overcooling the room air and, subsequently, to avoid energy consumption due to additional air heating/cooling by central machines and in the working places. There is also an air recovery system, which uses the heat of exhaust air to reduce the amount of energy consumed by heating.

Significant energy savings are achieved by using LED lamps, which save up to 70% electricity when compared to other lamp types. Also, LED lamps do not contain hazardous substances and are easier to dispose of. LED lamps are installed in the majority of the stadium rooms. Utility rooms and some sport areas are illuminated by fluorescent lamps, which are equipped with start control devices to ensure blink-free illumination, to improve the lamp service life and to reduce electricity consumption by 20% when compared to lamps without such devices.

Fig. 27. Illumination by LED lamps

4.2.4 Water saving

Water is saved at the stadium by using state-of-art sanitary equipment and by monitoring water consumption.

Water meters are installed at each inlet to monitor the volume of water being consumed. Pulse leads of meters enable the instruments to be read automatically or remotely, to maintain a centralised metering of water consumption, to identify major consumers, and to correct costs based on the readings obtained.

Water-saving sanitary equipment has also been installed. Toilet bowls and installations have two flush volumes (3 l for low volume, 6 l for high volume), which saves 2.25l per flush on average. To reduce water consumption further, the installations can be adjusted to lower flush volumes. There are mixers for manual taps with built-in aerators, ensuring water consumption as specified by the manufacturer. Part of the mixer taps are controlled automatically, which avoids tap leaking and water losses when users do not fully shut the taps. The urinal flushes are controlled automatically.

Fig. 28. Sanitary equipment of the stadium

4.2.5 User safety

The stadium is secured 24 hours a day by a specialist company. Security guards are on round-the-clock duty at the stadium. For more rapid response to various alarm situations and observations, the facility is equipped with a security/burglar alarm system. The system is a combination of hardware designed to promptly detect attempted or actual intrusions into the protected area.

Stadium staff and visitors are notified in the event of emergencies by:

- public address and evacuation control systems (type 4);
- radio relay systems;
- community television systems;
- radio communication and voice recording systems.

The parking areas are enclosed by mesh fences. In order to ensure safety and to prevent situations endangering the health of people in the stadium, the bases of the mesh fences are built into concrete slabs, creating the most effective barrier against collisions between visitors and uncontrolled vehicles.

4.2.6 Waste management

In the course of the FIFA Confederations Cup on the stadium was organized a segregated waste collection system (recyclables and non-recyclables in public areas, paper, used batteries, general waste in technical areas) by the LOC. No segregated waste management system is implemented as business as usual. However, the process of certification is going on and this situation will be changed.

4.2.7 Biodiversity

Landscaping is provided in the form of lawns, planting of ornamental trees and shrubs, and installation of flowerpots. Of the total development area of 120,318.40m^2, the landscaped areas are 30,093.80m^2 or 25%.

Landscaping is represented by the following elements:

- shrubs - shiny cotoneaster, ramanas rose, common lilac, Preston lilac, white cornelian cherry, Tatarian honeysuckle, sweet mock-orange;
- trees – small-leaved linden, Norway maple, blue spruce.
- rosaria;
- annual plants in flowerpots.

Fig. 29. Landscaping around the stadium

4.2.8 Environmental protection

To minimise the infiltration of rain water into the ground, there is a drainage system at the stadium. This system has been developed considering the design slopes of the stadium surfaces to avoid water stagnation.

Fig. 30. Grease trap

A reduced impact on the environment is achieved by lower discharges of significantly contaminated waters into the general sewerage. For this purpose, there is an industrial grease trap in the stadium which gathers grease and oil into special containers that are then disposed of.

The refrigerators at the stadium use chlorine-free and ozone-friendly refrigerant R134a.

4.2.9 Conclusions

Saint Petersburg Stadium is the most energy effective of these four stadiums, as confirmed by the energy inspection results. The stadium's energy effectiveness class is A++ (very high) whereas the other stadiums are classified as B (high) that was defined by independent agency OJSC KB VIPS.

Additional environmental features of the stadium:

1. Vast landscaped area with ten tree and shrub species, in an area equal to about 25% of the total building area.
2. Installation of water-saving sanitary equipment;
3. Preparation for the implementation of segregated waste collection system (four groups).

4.3 Kazan Arena

4.3.1 Transport accessibility

Kazan Arena has high transport accessibility. Visitors and personnel can reach it in the following ways:

- Public transportation: there is a bus stop within 150m of the stadium. The bus stop is served by 15 public transportation routes, which enable fast and easy travel to all city districts. The stop is sheltered and is fitted with a route description plate. The availability of a public urban transportation hub in the vicinity allows visitors to use this type of transportation and, therefore, reduce exhaust and CO^2 emissions from private vehicles.

- Personal vehicles: there is a secure car park for visitors arriving by personal vehicles.

- Bicycles: there is infrastructure for cyclists. There is a bicycle park as well as dedicated paths. Bicycles are parked in an illuminated, protected area providing safe bicycle storage. Bicycles infrastructure is a part of small and big “bicycle rings” of Kazan (3.4 and 24 km each). The paths connect main city sights and allows to reach most of them by bicycle.

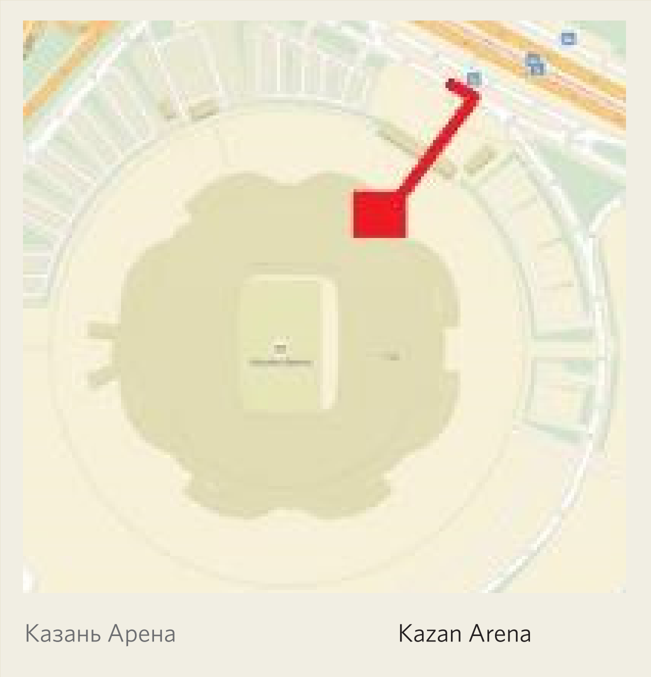

Fig. 31. Walking route to the nearest bus stop

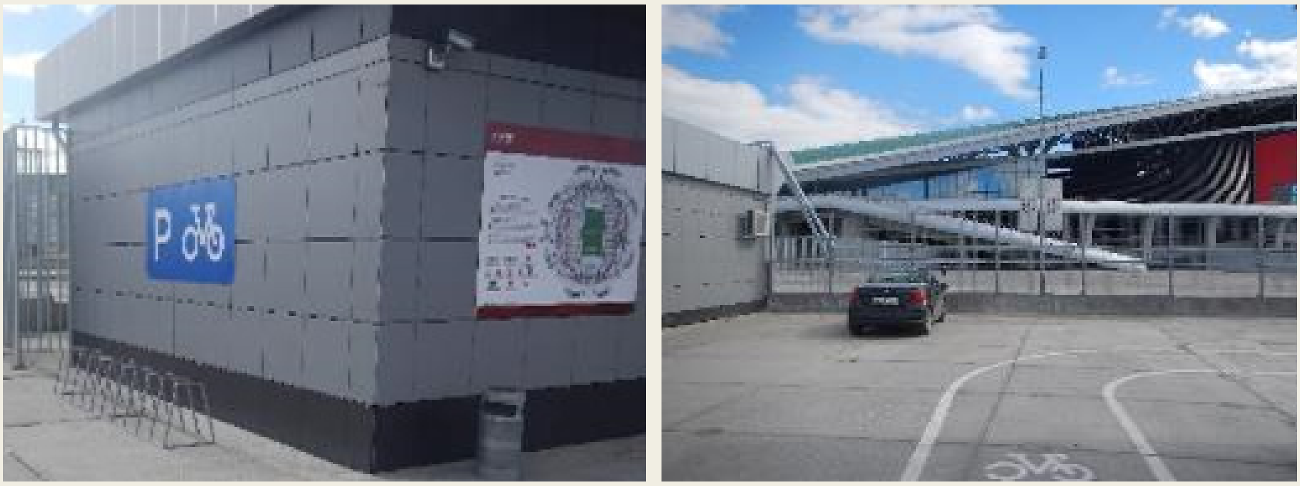

Fig. 32. 1: A bicycle park in the territory of the stadium; 2: Cycle paths

There are amenities in the stadium area which allow personnel and visitors to avoid unnecessary trips: cash machines, a cafeteria and vending machines. Daily trips by employees via personal vehicles and public transportation during lunch breaks can significantly increase the amount of CO2 emitted due to the stadium operations, and eating lunch in the building, for example, also reduces such emissions.

Fig. 33. 1: Cafeteria; 2: Vending machine

4.3.2 User comfort

Heating and illumination costs have been reduced by well-thought and implemented comfort strategies.

Visitors have access to daylight and views out of windows with glare control, and over 30% of the building is glazed. Daylight is often enough to ensure comfortable working conditions, and it also saves costs on artificial illumination.

Working areas which are exposed to glare due to daylight are fitted with blinds.

Fig. 34. Translucent structures of the stadium building

The temperatures in the stadium can be adjusted for air velocity, temperature and flow. These parameters in the building are set by radiators, fan coils or by opening windows. Heating radiators have thermostatic valves to adjust the temperature in a prompt manner, and fan coils in rooms are controlled via control panels, while windows can be opened. These measures avoid the ineffective use of energy to heat the premises.

Fig. 35. Fan coil control panel

Stadium employees also have access to clean water in water coolers.

Fig. 36. Water cooler for stadium employees

The stadium is accessible for people with limited mobility (PLM). Dedicated equipment and platforms for all categories of PLM, including ramps, lifts, bathrooms, etc., are installed for unobstructed movement throughout the entire territory of the stadium. Directions in the stadium are also arranged accordingly for PLM.

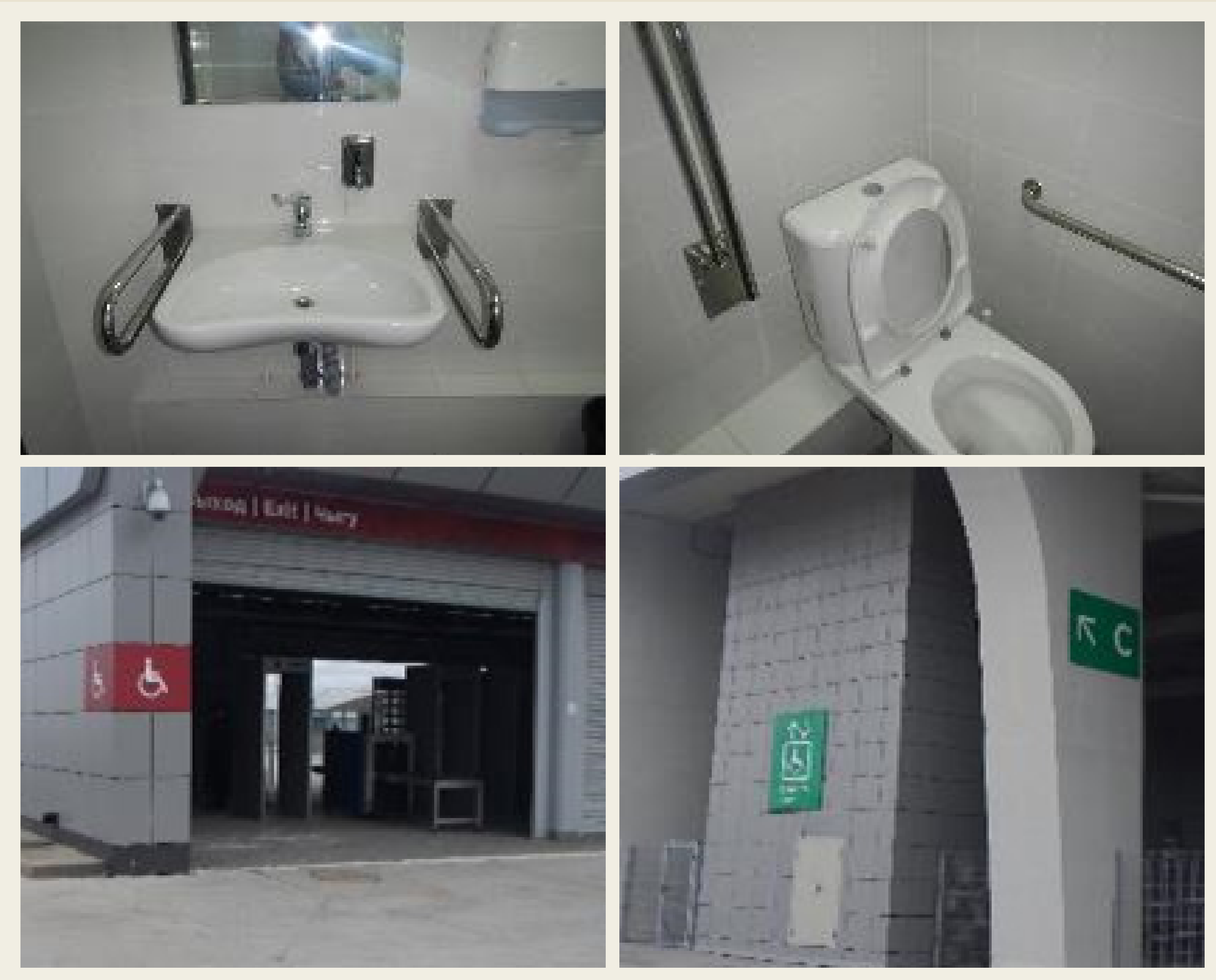

Fig. 37. Infrastructure for disabled people and people with limited mobility

4.3.3 Energy saving

Application of new hi-tech engineering equipment and its combination to a single system by automatic supervisory control makes it possible to use heat and power at the stadium in an effective manner.

Energo-Etalon LLC, which is a member of SRO-E-008 Assistance in the field of energy saving and energy efficiency of fuel and energy resources conducted an energy survey of the stadium in March 2015. Kazan Arena was awarded a high energy effectiveness class (B) during the energy inspection of the building based on the heat performance characteristics of the stadium's enclosing structures and the amount of energy consumed.

The building is heated by district boiler house Savinovo, which produces heat energy through the combustion of natural gas – the most environmentally friendly mineral fuel. Heat energy from the boiler house enters the individual heating plant of the stadium to be distributed across the heating system, the hot water supply, and the ventilation. The heating plant is operated automatically and does not require personnel.

All air-handling units are equipped with airflow adjustment devices, which allow the air exchange rate to be adjusted during the low load on the system to avoid unreasonable energy costs.

Air conditioning is provided by a group of multi-zonal air conditioners on the roof.

The inside areas of the stadium are mainly illuminated by LED lamps, which have a longer service life, no toxic agents, are easy to dispose of, and save up to 70% electricity when compared to other types of lamps. Fluorescent lamps in the stadium are equipped with start control devices which ensure blink-free illumination, improve the lamp service life, and reduce electricity consumption by 20% when compared to lamps without such devices.

Energy consumption is monitored by 12 metering devices which monitor the energy consumption of the main systems and functional areas, identify the major consumers, and correct energy consumption on a case-by-case basis.

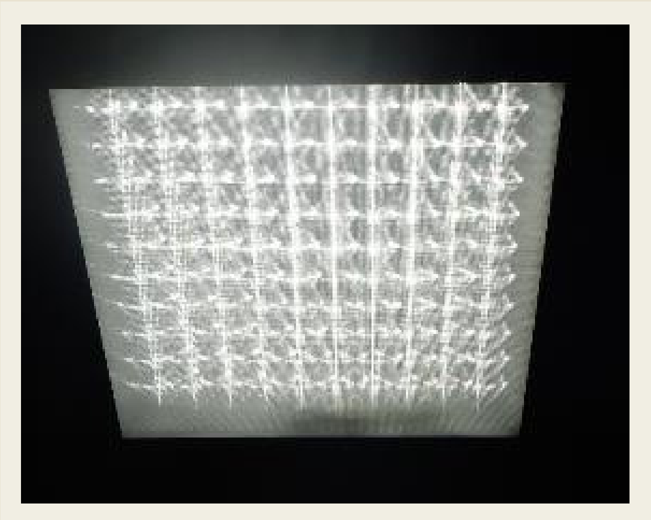

Fig. 38. Stadium illumination by LED lamps

4.3.4 Water saving

Water consumption is monitored and reduced by water-saving sanitary equipment. There are several types of toilet basin at the stadium, including types with two flush volumes – low (3 l) and high (6 l). One high-volume flush corresponds to three low-volume flushes, so it can be assumed that the two-button toilet basins have an advantage over one-button basins due to the saving of 2.25l of water for each flush on average. Factory aerators are installed in manual taps. Urinals in the stadium are also flushed manually.

Fig. 39. Sanitary equipment at the stadium

Another way to reduce the water consumption at the stadium is the rain water collection system, which directs precipitation from the roof into chutes and water collection risers, and accumulates it in dedicated tanks. There are two rain water collection tanks at the stadium, each with a capacity of 750 l. The standard amount of water required to water 1m^2 of the football pitch is 0.4 l per day. The stadium's football pitch measures 9,000 m^2. Therefore, one single pitch watering requires about 3,600l of water. 40% of this value can be covered by collected rain water, which can also be used for the watering and landscaping of the adjacent territory. One advantage of using this water is that it does not require any additional treatment. Considering that there are more than 15 precipitation days per month in Kazan in the period from May to October, and that the average daily amount of precipitation in this period is about 350 mm, the rain water collection system achieves significant savings in terms of watering resources.

Fig. 40. Pitch watered by rain water collection system

4.3.5 User safety

Security guards are on round-the-clock duty at the stadium. A video surveillance system has been implemented to ensure prompt responses.

There are escape plans and action plans in case of emergencies for stadium visitors. The escape plans have been prepared in accordance with the Fire Prevention Rules of the Russian Federation, Technical Regulation on Fire Safety Requirements and State standard (GOST).

4.3.6 Waste management

A segregated waste collection system has been implemented at Kazan Arena in administrative areas by LOC WAM coordinators. There are three segregated flows: plastic, glass and metal; paper; other waste. Dedicated containers for each flow can be found in several areas of the stadiums available only for stadiums personnel.

Fig. 41. Containers for segregated waste collection

4.3.7 Biodiversity

A landscaping programme has been implemented at the stadium, and lawns with an area of more than 4,000m^2 have been provided (the total stadium building area is 135,967m^2). The stadium is in the direct proximity of natural sites of the Kazanka river flood plain and the visitors have permanent access to the natural landscape.

Fig. 42. Satellite image of the stadium and adjacent natural sites

4.3.8 Environmental protection

The following measures have been implemented at the stadium to reduce its impact on the environment:

- Installation of an industrial grease trap to minimise discharges of oil and grease-contaminated waste from kitchens and to ensure the safe disposal of the collected grease

- Establishment of a drainage system to prevent the infiltration of liquid precipitations into the ground and stagnation, which can cause the destruction of materials

- Use of ozone-friendly R134a refrigerant in the air-conditioning system

Fig. 43. Elements of the drainage system at the stadium

4.3.9 Conclusions

Kazan Arena has the following features which have allowed it to be classified as an environmentally friendly building:

1. A thoroughly thought-out and implemented water saving strategy with water-saving sanitary equipment and the implementation of a rain water collection system. This rain water collection system is unique among the stadiums considered in this report.

2. Transport accessibility which considers all visitor groups, including cyclists. Kazan Arena is the stadium that has well developed bicycle infrastructure. The promotion of cycling is one of the ways to reduce the building's carbon footprint.

3. In addition to these specified features, commonly used resource-saving measures have also been implemented at the stadium – such as highly automated engineering systems and mainly LED illumination.

4.4 Fisht Stadium

4.4.1 Transport accessibility

Fisht Stadium has high transport accessibility. There is a bus stop within 240m of the main stadium entry. It is a sheltered stop that is equipped with seats. The stop is served by three public transportation routes, including the route from the stadium to Sochi Airport. The convenience and proximity of the bus stop allows visitors to use public transport rather than personal vehicles, which reduces exhaust emissions and traffic on Olympiysky avenue, especially during major events.

Fig. 44. Walking route to bus stop

There are bicycle parks and marked bicycle paths on the promenade alongside the stadium (the length is 5 km), allowing cyclists to reach the stadium in comfort. The moderate climate of Sochi means that people can use bicycles as urban transportation virtually throughout the year. The convenience and accessibility of bicycle infrastructure promotes the use of bicycles and therefore reduces the stadium's CO^2 emissions.

There is also a secure car park for visitors travelling in personal vehicles.

Fig. 45. Bicycle parking areas on the promenade

4.4.2 User comfort

Stadium users are guaranteed a comfortable stay as they can adjust the air temperature and levels of lighting.

The temperature in the stadium premises is adjusted with radiators, fan coils and local air conditioners. The radiators have thermostatic valves to quickly change the temperature, whereas fan coils and air conditioners are operated via local panels. The adjustment of air parameters according to the individual preferences of work place users avoids ineffective energy consumption for heating and air ventilation.

Fig. 46. 1: Fan coil control panel;
2: Radiator with a thermostatic valve

Visitors and work place users have access to daylight and glare control systems, as approximately 15% of the total facade of the building is glazed. Blinds have also been installed. People can adjust room illumination by zones – two-button switches are installed in certain rooms to ensure user comfort and to reduce power consumption when there are no persons in the illuminated area or if work places at windows are adequately illuminated by daylight.

Fig. 47. Blinds in one of the offices

Stadium employees have access to clean drinking water in coolers.

Fig. 47. A cooler with drinking water

The stadium can be accessed by all user groups. Certain measures have been implemented for people with limited mobility (PLM) which allow them to enter the building and move around it. In particular, there are special access routes, levelled height variations and sills, dedicated sanitary rooms and seats in stands.


Fig. 48. Stadium infrastructure for disabled people and people with limited mobility.
1: Elevation to the upper levels; 2: Levelled sill

4.4.3 Energy saving

The use of state-of-art engineering equipment and automation reduces energy costs and losses.

The heat energy source of the stadium is Adler CHP, which uses natural gas as the main fuel source. Heat for the stadium heating, ventilation and hot water supply is distributed by an individual heat plant.

All air-handling units are equipped with airflow control devices which reduce machine capacity during the lower loads on the system and prevent ineffective energy use.

Sochi's warmer climate makes it especially important to use an effective air-conditioning system that is capable of proper cooling of large air volumes during hot summer temperatures, keeping it at low energy consumption. For this purpose, a system of wet-cooling towers and chillers has been installed at Fisht Stadium. This system saves up to 50% of operational power costs when compared to monoblock chillers, at full function, and as quality air cooling in the premises.


Fig. 49. Cooling towers and chillers at the stadium

All installed engineering equipment is included in a remote control and supervisory control system. The microclimate of each individual room can be adjusted: the temperature and humidity of the air, the air exchange rate. Intelligent energy logic provides for energy consumption savings.

Significant energy savings are achieved by using LED lamps, which have an advantage over other lamp types as they are more energy effective, have a longer service life, are non-hazardous and are easy to dispose of. Fluorescent lighting fixtures are installed in utility rooms and certain rooms of the sports area (such as team warm-up rooms). Fluorescent lamps are equipped with start control devices which ensure blink-free illumination, improve the lamp service life and reduce electricity consumption by 20% when compared to lamps without such devices.

Fig. 50. 1: LED lighting fixture; 2: Fluorescent lighting fixture

4.4.4 Water saving

The following water-saving measures have been implemented at Fisht Stadium:

- Consumption monitoring for the entire building. The meters installed at the water inlets of the building have pulse outputs.
- Water-saving sanitary equipment. Manual taps with integral aerators which ensure water consumption as specified by the manufacturer are installed at the stadium. There are also automatic urinals controlled by infrared sensors, avoiding water losses due to leaking or sticking automatic flush buttons.

Fig. 51. 1: Tap with integrated aerator; 2: Urinal with sensor flushing system

4.4.5 User safety

The building is equipped with an automatic alarm system and is protected around the clock by a private security company. The stadium building and the outer territory are equipped with surveillance cameras. Escape plans and action plans for emergencies have been developed and are available in the stadium.

4.4.6 Waste management

The stadium is doing the first steps towards the implementation of segregated waste collection system. Bins for segregated collection of three waste flows (paper, plastic and food waste) are installed on the stadium floors during football matches. LOC organised segregated waste collection system on stadium during the FIFA Confederations Cup 2017.

Fig. 52. Marking of containers for segregated waste collection

4.4.7 Biodiversity

There are lawns in the territory adjacent to the stadium, with a total area of 3,000m^2 (the total stadium building area is 128,480m^2). These lawns have naturally growing grass species, creating a close-to-natural habitat which can attract insects during blooming, and birds.

Fig. 53. A lawn on the adjacent territory of the stadium

4.4.8 Environmental protection

The following measures have been implemented at Fisht Stadium to reduce the impact on the environment:

- Grease trap. This avoids discharge of waste water significantly contaminated by grease and oil from the kitchen into the general sewerage. These agents settle in the grease trap and are removed and disposed of separately.

- Drainage system on the stadium territory, which prevents infiltration of liquid precipitations, which are often contaminated, into the ground.

Fig. 54. Grease trap

Fig. 55. Venting holes in the territory adjoining the stadium

4.4.9 Conclusions

Fisht Stadium is a building which operates in an environmentally effective manner. Specifics of the stadium are:

1. An effective energy-cooling system based on the use of water cooling towers and chillers, which saves up to 50% of power when compared to equivalents.

2. A system for waste segregation in three flows.

3. The use of generally accepted resource-saving technology – sanitary equipment with low water consumption levels, advantage of LED lamps over fluorescent lamps, availability of infrastructure for cyclists in the direct proximity of the stadium.

5 Stadium certification status

The stadiums of the FIFA Confederations Cup Russia 2017 have been designed, constructed and are operated in compliance with green construction and energy effectiveness technology. This is confirmed by recognition of the stadiums according to the most accepted green construction standards (BREEAM and RUSO).

Three of the four stadiums described herein have already been certified or are in the process of certification. Spartak Stadium has been certified for compliance with the BREEAM In-Use international standard and has received a GOOD level of recognition. Saint Petersburg Stadium is in the process of certification and Kazan Arena has been certified according to Russian standard RUSO. Football Stadiums. Saint Petersburg Stadium is undergoing the final certification stage, whereas Kazan Arena has received the silver level of recognition. Fisht Stadium is in the process of selecting a certification standard.

Name of stadium	Standard	Certification body	Certification type	Date of certification (as of 12.2017)
Spartak stadium	BREEAM In-Use 1.0.2015	BRE Global	Completed construction	January 2017
Saint-Petersburg stadium	RUSO.Football stadiums	RUSO	Project stage	April 2017
Kazan Arena	RUSO.Football stadiums	RUSO	Completed construction	April 2017
Fisht	BREEAM In-Use/ RUSO.Football stadiums	BRE Global/RUSO	Completed construction	---

Conclusions

This Report describes the condition and efficiency of the implementation of green construction measures at stadiums hosting the FIFA Confederations Cup Russia 2017. When this report was drafted, three of the four stadiums had confirmed the implementation of green construction measures by completing ecological certification for compliance with the RUSO or BREEAM standards.

The following green construction measures which have been implemented at the stadiums, general for all four buildings, can be specified:

- a high level of engineering system automation;

- adjustment of air parameters “from the top” (centralised) and “from the bottom” (locally);

- selection of electricity and heat suppliers using natural gas as fuel;

- the advantage of using LED lighting fixtures;

- water consumption monitoring for the entire building;

- the advantage of using sanitary equipment with adjustable water consumption, and the use of two flushing volumes;

- implementation of a segregated waste collection system;

- drainage system;

- grease traps;

- the use of ozone-friendly refrigerants in the air-conditioning system.

These measures allow the stadium buildings to leave the minimum footprint on the environment and local natural ecosystems. The experience of the successful application of these measures can serve as a basis for the further application of green technology in the construction and operation of sports facilities and other facilities in Russia.

Impressum

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