ADVISORY CIRCULAR

Subject	Issuance Date	AC Number	Version
Guidance Material on Eco-Design of Airport Buildings	1-September-2024	156-07	1.0

Note: This Advisory Circular is published to provide additional information and recommended actions that further elaborate on provisions or concepts prescribed in the GACAR-156.

1. Introduction

1.1 Purpose

The purpose of this advisory circular is to provide an overview on best practices and standards in eco-design of airport buildings.

1.2 Applicability

This advisory circular is applicable to all aerodrome developers.

1.3 Cancellation

This is the first official version of this advisory circular, and it cancels no other advisory circular on the subject matter.

1.4 Related regulatory references

a) GACAR Part-156.

1.5 Related reading materials and references

a) ICAO, The Eco Design of Airport Buildings Document, available at: https://www.icao.int/environmental-protection/Pages/Ecoairports.aspx

1.6 Approval

This advisory circular has been approved for publication by the Executive Vice President for Safety and Environmental Sustainability of the General Authority of Civil Aviation.

2. Introduction

Eco-designing airport buildings involves incorporating principles of sustainability and environmentally friendly practices into the planning, construction, operation, and demolition phases. This approach takes into account the entire life cycle of the building, including factors like resource efficiency, green building techniques, and minimizing the impact on the environment and human health. Given the complex nature of airports, with various facilities and stakeholders involved, eco-designing requires collaboration among all parties to achieve the common goal of reducing environmental impact. It is crucial to consider passenger and flight forecasts when planning and designing airport buildings, as they are long-lasting structures expected to accommodate future growth. Furthermore, in light of climate change, it is now essential to consider the resilience of airport buildings to future climate conditions over the long term.

The design and use of space at an airport is both an art and a science. Every airport is distinct, and there is no 'one size fits all' solution to eco-design of airport buildings. In addition, the layout and use of space are interconnected concepts. It is equally as important to look at the overall airport layout for 'eco-design' elements as it is to focus on the structures themselves. This Advisory Circular will stay limited, however, to some of the basic environmental considerations that should accompany airport building development, management, and modification. Considering the environment and minimizing environmental impacts can be worked into airport buildings at many levels.

2.1 Resources for Airport Building Design

Aerodrome designers and developers are ultimately expected to abide by the Saudi Building Code (SBC) such as the Saudi Green Construction Code (SBC 1001) however the objective of this Advisory Circular is to shed light on airport specific focus areas and resources that developers can leverage.

There are many resources available on general airport and terminal design, such as ICAO's Annex 14, Airport Planning Manual (Doc 9184), Airport Services Manual (Doc 9137), and Aerodrome Design Manual (Doc 9157). However, there are relatively few sources specific to environmental components of airport buildings. Guidance from the U.S. Federal Aviation Administration discusses the advantages of certain styles of concourses and gates in relation to runways and taxiways. Other sources focus on building materials and systems, such as:

- Airport Cooperative Research Program (ACRP) Report 25, Airport Passenger Terminal Planning and Design, Volumes 1 and 2;
- International Air Transport Association (IATA) Airport Development Reference Manual;
- ACRP Report 55, Passenger Level of Service and Spatial Planning for Airport Terminals; and
- ACRP Report 10, Innovations for Airport Terminal Facilities.

2.2 Application to Airport Buildings

In certain areas of the airport, particularly those on the airside, strict safety and operational guidelines must be followed in the design process. These guidelines often prioritize factors like ensuring a reliable energy supply for air navigation equipment. In such cases, the regulations may limit the extent to which environmental considerations can be incorporated. However, there are other buildings within the airport where eco-design principles can be applied to both the construction and ongoing operations. In these cases, there is more flexibility to prioritize environmentally friendly practices alongside meeting functional requirements. These typically include, inter alia:

- Airport Terminals
- Cargo terminal buildings and warehouses

- Air traffic control towers and back-up air traffic control centers
- Hangars and maintenance facilities
- Parking structures
- Offices buildings
- Fuel farms
- Fire stations and fire training areas

3. Focus areas to consider when planning eco-design of airport buildings

3.1 Energy Efficiency

Prioritize energy-efficient design features such as incorporating natural lighting, utilizing energy-efficient lighting systems, implementing energy management systems, and optimizing the use of renewable energy sources like solar panels or wind turbines.

Employing modern technology, many structures are designed to continually monitor energy use. Simple tools such as 'sub-metering,' allow the airport to identify, track and address areas of high energy use, and thus to correct inefficiencies. There are more elaborate systems as well. Computer controlled 'smart building technologies' with sensors and whole-building automation allow airport operators to monitor the building as a system, rather than focusing on individual energy-using devices. These systems will automatically track energy uses and make adjustments, such as in temperature or lighting control, as needed.

3.2 Aircraft Ground Energy Systems (AGES)

To reduce the consumption of fossil fuels and the emissions they generate, airport functions are switching to electricity use. This includes terminal gates that cater to aircraft electricity and ventilation needs. Aircraft Ground Energy Systems (AGES) at the gate can provide both electricity to the aircraft and pre-conditioned air to heat or cool the aircraft. This replaces the use of the aircraft's auxiliary power units (APUs). Fixed pre-conditioned air (PCA) units supply heated/cooled air to parked aircraft so that passengers are comfortable as they enplane and deplane. Ground power units provide power to aircraft for internal lighting and to ensure continuous power for the navigation systems. When employed together, the ground power units and PCA enable parked aircraft to forego the use of their APUs, resulting in significant reductions in fuel consumption and associated air emissions. In addition, many airport ground support vehicles are now electric, and airports are building charging stations in or near terminals to recharge these vehicles.

3.3 Emissions

Aircraft are the largest source of emissions at an airport, but the terminal buildings have several relationships to emissions, and can also influence aircraft ground emissions. In terms of the structure itself, the materials used for the terminal building can be selected strategically to minimize Greenhouse Gases (GHG) and other emissions. Use of recycled materials usually reduces the overall carbon footprint of building materials. As discussed above, the energy load that the building requires to operate, and the sources of energy, have links to emissions. A terminal designed with PCA and ground power for the aircraft can see significant reductions in airfield emissions. Finally, the siting and design of the building can be done to reduce emissions, for example minimizing the aircraft taxi distance from gate to runway. All of these factors, the building materials, the operation of the terminal, and how readily the terminal facilitates efficient airfield operations, all affect local air quality and atmospheric concentrations of Greenhouse Gases.

3.4 Water Management and Conservation

Implement water-efficient practices like rainwater harvesting, graywater recycling, and low-flow fixtures. Consider water conservation measures in landscaping and use sustainable irrigation systems.

3.5 Sustainable Materials

Choose sustainable and eco-friendly materials for construction, considering factors like recycled content, durability, and the environmental impact of sourcing and manufacturing processes.

3.6 Waste Management

Passenger terminals must be designed for materials to come in, and waste to go out. Planning for efficient waste management, such as through recycling or other processes, is a keyway to reduce environmental impacts. Airport operators should have a goal to maximize recycling, reuse, and waste reduction in both their terminal construction as well as its operation.

3.7 Sustainable Transportation

Design efficient transportation systems within the airport, such as electric vehicle charging stations, bicycle lanes, and pedestrian-friendly pathways. Promote public transportation access to reduce private vehicle use.

3.8 Indoor Environmental Quality

Ensure a healthy and comfortable indoor environment through proper ventilation, air quality control systems, natural ventilation strategies, and the use of low-emission building materials and furnishings.

3.9 Resilience to Climate Change

Consider the potential impacts of climate change on the airport's infrastructure and incorporate resilient design features to mitigate risks, such as flood-resistant design, stormwater management systems, and climate-responsive building design.

3.10 Noise and Air Pollution Mitigation

Employ noise reduction strategies, such as sound barriers and insulation, and implement measures to minimize air pollution from airport operations, such as emission control systems for vehicles and aircraft.

3.11 Circular Economy Considerations for Terminals

The circular economy provides a holistic approach on developing new economic business models (e.g. product-service systems) where the value of assets (e.g. terminal buildings) and services is maintained as high as possible. The circular economy involves all stages of a terminal development (design, construction, and operation). Terminal buildings should be designed for reuse, disassembly, refurbishment, and/or recycling. Airport operators should have a goal to minimize use of virgin materials and increase the opportunities for value creation in both their terminal construction as well as its operation.

As airports go through rapid changes, some are now planning buildings that can be repurposed for other uses in the future. Therefore, during the planning and design process, it is advisable to create a flexible structure that can be easily adapted for different purposes at a later stage.

4. Sustainability Rating System and Certification Providers

The systems listed in the following section are a sample of some of the largely accepted and widely used certification systems currently available on the market that may be applicable to or already used by airport operators. This list is not exhaustive, and ICAO and GACA do not endorse any specific system. They are provided here to give some examples of systems that could be used for the eco-design of airport buildings. These green building certification programs provide guidelines and standards to ensure that buildings are designed and operated in an environmentally responsible manner. By seeking certification from these programs, building owners and developers demonstrate their commitment to sustainability, energy efficiency, and occupant well-being, contributing to a greener and healthier built environment.

4.1 LEED (Leadership in Energy and Environmental Design)

LEED is one of the most widely recognized green building certification programs globally. It provides a framework for designing, constructing, operating, and maintaining sustainable buildings. LEED certification considers various aspects such as energy efficiency, water conservation, materials selection, indoor environmental quality, and sustainable site development.

4.2 BREEAM (Building Research Establishment Environmental Assessment Method)

BREEAM is a widely used certification scheme originated in the United Kingdom. It evaluates the environmental performance of buildings based on categories such as energy, water, materials, waste, and ecology. BREEAM encourages sustainable design, construction, and operation, considering both new and existing buildings.

4.3 Green Globes

Green Globes is an assessment and certification program that focuses on sustainable building design and operation. It uses a rating system to evaluate criteria including energy efficiency, water conservation, materials selection, indoor air quality, and site management. Green Globes offers a flexible and cost-effective approach to green building certification.

4.4 WELL Building Standard

The WELL Building Standard is a performance-based system that assesses and certifies the impact of buildings on human health and well-being. It focuses on factors like air quality, lighting, water quality, thermal comfort, and occupant comfort and promotes design strategies that enhance the health and wellness of building occupants.

4.5 Green Star

Green Star is an Australian certification program that promotes sustainable building practices. It assesses buildings based on categories such as energy efficiency, water conservation, materials selection, indoor environment quality, and innovation. Green Star offers different certification levels, encouraging continuous improvement in sustainability performance.

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