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THE SOCIAL HABITAT AND SUSTAINABILITY AWARD

SUSTAINABLE ARCHITECTURE AND ENERGY EFFICIENCY CATEGORY ANNEX

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BACKGROUND: CEELA PROJECT

The Swiss Agency for Development and Cooperation (SADC) intends to promote sustainable development in Latin America through the CEELA project to strengthen the technical capacities of professionals in the region in energy efficiency and thermal comfort as a strategy for mitigating climate change adapting to the challenges it imposes.

In the CEELA project implementation framework, an alliance had been created with the the Ecuadorian Association of Architects – Pichincha Province (Colegio de Arquitectos del Ecuador Provincia Pichincha, CAE-P) Within the Pan- American Quito Architecture Biennial BAQ and the BAQ Award. This alliance recognises the best architectural practice and contributions of professionals in buildings that incorporate sustainability practices during their design and construction, and energy efficiency and thermal comfort strategies during operation. Furthermore, projects from all over the world will be awarded through the new category of the BAQ Award, SUSTAINABLE AND ENERGY EFFICIENT ARCHITECTURE.

The following are the principles of energy efficiency and thermal comfort suggested by the experts of the CEELA project and the Swiss Agency for Development and Cooperation. The qualifying jury will consider partial or total incorporation of these criteria in evaluating the project.

01 ENERGY EFFICIENCY AND THERMAL COMFORT (EETC) IN BUILDINGS

1.1. DEFINITION

In construction, energy efficiency (EE) aims to reduce the amount of energy required to provide services such as air conditioning and lighting inside the building. However, this concept transcends the limits of energy provision services. Also, it encompasses what is required during the building construction process and incorporated in the materials used in this process, like that related to indirect services or benefits demanded by the building operations, such as drinking water consumption.

On the other hand, thermal comfort (TC) is defined as the subjective condition of the building users, which expresses satisfaction with parameters that influence the thermal condition of the environment (solar radiation, temperature, airspeed and humidity). It is understood that a comfort condition is obtained when other factors such as noise and air quality are also considered.

Thermal comfort is a fundamental factor in air conditioning systems and buildings per se. Since time immemorial, buildings have primarily sought to protect the occupant from the extreme outdoor climate conditions. Since the invention of air conditioning about 120 years ago, buildings have relied on technological discoveries to achieve that goal. However, such buildings and technologies (such as old air conditioning systems) have resulted in significant environmental problems due to their high energy consumption and relationship with carbon emissions.

At the meeting point between energy efficiency and thermal comfort (EETC), these principles emerge as a guide for architects, engineers, and related professionals to design and build new buildings, incorporating the highest possible standards of efficiency and comfort, adapted to their contexts. This series of criteria is specifically focused on the warm zones (humid and dry) of four countries in the Latin American region: Mexico, Peru, Colombia and Ecuador.

1.2. PRINCIPLES

This guide consists of 15 principles that allow the design, implementation and operation of buildings with a high EETC. These principles are divided into three types:

- Of a constructive nature
- Of a basic technical nature
- Of an advanced technical nature

1.2.1 CONSTRUCTIVE NATURE PRINCIPLES

PRINCIPLE 1. INTEGRATED DESIGN

A trans-disciplinary integrated architecture and engineering design are developed from the early and initial stages of the project.

DETAILS:
The integrated design seeks to optimise energy efficiency and thermal comfort, considering architectural and engineering parameters jointly. In addition, the integrated and trans-disciplinary design in the early stages of a project will have the advantage of verifying its technical, economic and cultural feasibility and possible sustainability strategies to be incorporated, such as technologies for local self-generation and energy saving.

MEASURES:
The architectural design team involves electrical and mechanical engineering consultants from the early design stages. Depending on the scope and project's complexity, a bioclimatic consultant is integrated into the process, and possibly other specialists. This integration allows considering and evaluating from different perspectives, aspects such as:

1. Potential energy consumption, given the orientation, heights, openings, enclosure and typology of the building.

2. Available surfaces and potential for energy self-generation.

3. Openings and potential for good ventilation and natural lighting within the building.

This process concludes with an extension report related to the project's complexity.

PRINCIPLE 2. CONTROL OF DIRECT SOLAR RADIATION

Elements are incorporated, or measures are considered to control direct solar radiation in the building windows for overheating protection.

DETAILS:
Direct solar radiation through windows is the primary source of overheating inside buildings located in hot climates. Consequently, measures to control direct radiation passing through building windows should be emphasised. In principle, the amounts of indirect, diffuse or reflected radiation from the openings could be prioritised. The latter can contribute to the natural lighting of the building and help to dispense with high use of artificial lighting during daylight hours. However, depending on local conditions, it may be desirable to allow some direct sunlight during the colder hours of the day.

MEASURES:
Control of solar radiation through the windows can be achieved - to a great extent and easily - with a physical element of rigid shading, such as canopies or brise-soleil. Another possibility is mobile external solar protection devices, such as blinds or sun protector pieces. On the other hand, filters applied in the windows and polarisations can help minimise direct radiation entry at

the cost of reducing natural lighting. Other measures include orientation and definition of the building heights to minimise the window surfaces that receive the sun's radiation between 2:00 p.m. and 4:00 p.m., which is the time range with the highest solar incidence in hot areas and therefore it should be avoided. In general, a solar radiation protection value of less than 0.2 SHGC (Solar Heat Gain Coefficient) should be achieved.

PRINCIPLE 3. EMBODIED ENERGY

Energy incorporated in the materials and construction processes of buildings is minimised.

DETAILS:
The minimisation of embodied energy (that used for materials, products and construction and deconstruction work) should be a goal in all phases of the construction process (extraction, manufacturing, mobilisation and delivery, processing and, finally, separability, reuse and recycling, in case of demolition and disposal). To achieve high energy efficiency performance in a building, it is essential to consider both the energy demand and the energy embodied in its materials (greenhouse gas emissions) throughout its life cycle. A well-thought-out optimisation strategy regarding embodied energy also helps mitigate the growing shortage of materials in the construction industry. Management of circular materials (recycling) is a critical tool in optimising this type of energy.

MEASURES:
The use of locally sourced materials will be preferred. Recycled materials and those with a high capacity to be recycled should be prioritised. In addition, reducing the use of materials such as concrete or steel will be considered as the structural design guidelines, and local construction processes allow it. The demand for embodied energy is highly influenced by the concept of design and construction, particularly by the construction system and the type of materials used for the final finishes of the building.

PRINCIPLE 4. THERMAL INSULATION OF THE ENCLOSURE

Thermal insulation is provided on ceilings and other surfaces that deserve it.

DETAILS:
Thermal insulation of the building enclosure (ceilings, walls, windows and floors in contact with the ground) is essential in energy efficiency and thermal comfort inside the building. However, the adequacy degree of thermal protection and the surfaces to be insulated is highly dependent on the local climate and exposure to direct solar radiation. For example, roofs highly subject to direct solar radiation in hot climates can reach temperatures above 80 Celsius degrees (depending on the surface) on a sunny day. This temperature creates an accelerated heat flow into the building that an effective thermal insulation system must avoid. Other surfaces such as windows and walls must, in principle, be thermally insulated and, at the same time, allow the surfaces to be cooled at night, especially in climatic zones with high-temperature differences between day and night.

MEASURES:
The adequacy of thermal protection is expressed in the form of a table of recommended thermal transmittance values (U), which distinguishes between the climatic region and the degree of exposure to solar radiation of the different components of the building enclosure. Priority is located on roofs due to their high exposure to solar radiation unless these are covered with solar panels or another insulating element. In the design and execution process, the insulations are oriented to reduce potential thermal bridges and improve the seals.

PRINCIPLE 5. REDUCTION OF TOXIC MATERIALS

Materials and components that emit toxic materials that can affect the indoor air quality of the building are avoided.

DETAILS:
High thermal comfort in interior spaces loses relevance if, at the same time, the materials and finishes generate toxic emissions from the components that endanger the users' health. To avoid this, it seeks to reduce the use of polluting materials inside the building, meaning a presence or increase in the content of dust (PM 2.5) and volatile organic compounds (formaldehyde, among others).

MEASURES:
It should be avoided to preserve wood using biocide preservatives; likewise, a low formaldehyde content should be procured. Furthermore, paints or varnishes that con-

tain lead and solvents are not applied. Finally, materials that emit mineral particles (for example, mineral fibre insulating materials) should not contact the air indoors but instead include some insulation element.

PRINCIPLE 6. AIR MOVEMENT

It seeks to generate movements, and interior air flows to improve comfort and air quality in the internal spaces of the building.

DETAILS:
Air movement (or ventilation inside the building) is an effective means of improving comfort in hot environments. It is more effective when the air is dry. However, even when relatively humid, air flows are still perceived as pleasant. It is possible to use natural or mechanical ventilation to generate these flows. In the first case, it is essential to discourage air conditioning (if it exists) to avoid unnecessary energy expenditure. In addition to toxic materials (principle 5), air quality can be affected by the concentration of carbon dioxide by the occupants or the generation of mould in rooms with high humidity content, in dark areas and with inadequate ventilation.

MEASURES:
Depending on the outside weather situation, it is possible and convenient to create these air flows by cross ventilation when the air conditioner is not in use. With skilful structural precautions, chimney effects can also be achieved, leading to a natural increase in air velocity inside the building. On the other hand, it is possible to generate air flows using ceiling and floor fans without a centralised air conditioning system.

PRINCIPLE 7. REDUCTION OF FOSSIL FUELS

The use of fossil fuels is avoided.

DETAILS:
Whenever possible, burning fossil fuels in the building or on the premises should be avoided entirely. However, it is often unavoidable that locally available electricity is generated from fossil fuels. In this case, the objective should be that solar energy self-generation (principle 14) can compensate for the amount of electricity generated by fossil fuels throughout the year. On the other hand, indirect use of fossil fuels as an electrical component will be reduced whenever possible. Similarly, the low use of fossil fuels for food preparation or in the water and indoor heating system should be sought as it is technically feasible.

MEASURES:
Traditional cooking methods that heat through fossil fuels (e.g. gas) are replaced as economically feasible. Equipment for cooking, as well as for heating water and interior spaces using fossil fuels, will be limited as long as an indirect increase does not influence their replacement in the use of fossil fuels from the electricity matrix (for example, change to stoves or electric heaters whose energy matrix comes from combustion).

PRINCIPLE 8. NIGHT COOLING

In dry climates or with low humidity content, night-time cooling of the building is facilitated for thermal conditioning the next day.

DETAILS:
In dry climates with significant temperature differences between day and night (for example, a fluctuation greater than 10 ° C), it is appropriate to cool the building's interior thermal mass with cold outside air. This can also be applied to semi-humid climates (RH <70%). In the best of cases, this should be done to maintain fresh and cold air until the evening. It is not possible to cover more than one day-night cycle economically. In highly humid climates, direct night-time outdoor air exchange may not be favourable. The relative humidity cycle is generally higher at night due to the outside temperature drop. In this sense, external air can deteriorate the controlled humidity conditions that were maintained during the day in air-conditioned buildings in humid climates.

MEASURES:
Two complementary measures are necessary to use overnight cooling in dry climates effectively. First of all, it is needed to have a large part of the building's thermal mass (generally structural components such as columns and concrete or brick walls) in contact with the air. Second, cross ventilation or chimney effect facilitates a significant night air exchange.

PRINCIPLE 9. BIOCLIMATIC DESIGN OF OUTDOOR SPACES

Exterior spaces are optimised to facilitate better thermal comfort.

DETAILS:
Plants, canopies and walls can facilitate the production of crucial shadows and airflows for outdoor spaces. These considerations can even lead to a positive effect on comfort within buildings.

MEASURES:
The key elements of the bioclimatic design of outdoor spaces (i.e. microclimate optimisation) are the orientation of the outdoor squares towards the sun path to create shade and the use of local main winds in combination with shade and fresh vegetation. In addition, pergolas serve as shading elements.

PRINCIPLE 10. HIGH EFFICIENCY ELECTRICAL AND LIGHTING EQUIPMENT

High efficiency (or low energy consumption) electrical equipment and luminaires are provided.

DETAILS:
Permanently installed electrical equipment and appliances include large appliances and auxiliary equipment in buildings such as pumps, fans, valves, etc. High-efficiency electrical equipment and luminaires (e.g. LEDs) have already become the most apparent technologies for economic reasons. The use of high-efficiency equipment must be specified since this influences energy consumption and the design of the systems and/or the air conditioning strategy.

MEASURES:
Equipment, devices and luminaires are selected regarding the value of their energy

labels. In any case, equipment specification and consistent selection with the Best Available Technology (BAT) is expected.

PRINCIPLE 11. USERS' BEHAVIOUR

Saving guidelines are established based on the behaviour of the building users or inhabitants.

DETAILS:
Much of the energy efficiency in buildings has to do with the correct use of electrical equipment and the use of hot water. On the other hand, air-conditioned areas can lead to energy expenditure if the conditions leading to tightness are not satisfied (windows and doors closed). Many of these factors can be prevented with simple awareness campaigns for building end-users.

MEASURES:
To incorporate visual elements that promote water and energy savings near taps, light and power switches, windows and doors in air-conditioned areas. To carry out dissemination campaigns on Saving and Energy Days in schools, such as informative videos, management and user guides, etc.

PRINCIPLE 12. CONSCIOUS WATER MANAGEMENT

Technical guidelines are established for efficient management and water saving.

DETAILS:
Together with Principle 13, technical guidelines for water management will include information on the sizing and selection of water-saving devices and accessories. In addition, the guidelines give information on the demand for water and its use in the building, the design principles of the system's and accessories installation, management

and possible use of rainwater, and grey and wastewater. Special attention is paid to hot water due to the higher energy demand.

MEASURES:
Information on size, the choice of appliances, accessories and installations (for example, the capacity of the toilet tank, the WC outlet limiter, etc.) and the expected water consumption for standard use. Besides, protection is proof against *legionella.*

1.2.2 PRINCIPLES OF ADVANCED TECHNICAL NATURE

PRINCIPLE 13. EFFECTIVE AIR CONDITIONING

A high energy-efficient air conditioning system is promoted in isolated areas.

DETAILS:
When artificial cooling (air conditioning) cannot be dispensed with, it should be carried out as efficiently as possible, and the cold produced should be carefully preserved in refrigerated premises. This is because, with air conditioning, an artificial indoor climate is created. A consistent delineation accompanies this between inside and outside through the building enclosure. This is also the prerequisite for carefully maintaining the generated cold, first of all through a thermally insulated building enclosure (principle 4) and shaded windows (principle 2); second, through a reasonably tight enclosure; and third, through energy recovery during air exchange.

MEASURES:
In addition to the measures required according to principles 2 and 4, the following applies (if the air conditioning system is used relatively frequently): a fair air exchange can only take place if there is an effective enthalpy exchange between the air in the used exhaust (internal cold) and fresh supply air (external hot). This process is associated with strong dehumidification of outside air in hot and humid areas. However, in dry areas that are not too hot, cooling the supply air with simple evaporative cooling may be sufficient.

PRINCIPLE 14. SELF-GENERATION OF RENEWABLE ELECTRICAL ENERGY

Available surfaces for self-generation of renewable electrical energy are maximised.

DETAILS:
In many parts of the world, the renewable energy market has an economic parity with other forms of conventional energy. In particular, solar energy is one of the most technically and economically feasible alternatives for energy self-generation in homes, offices and schools. Self-generation with solar energy allows energy savings and carbon emissions reduction. For these energy sources, areas and surfaces of buildings must be adapted.

MEASURES:
The focus is on using suitable surfaces with photovoltaic solar energy since precisely the demand for air conditioning (powered by electrical energy) usually coincides with the greater supply of solar energy. In addition, solar thermal collectors help generate hot water. These collectors may cover the low demand for hot water (showers, sinks, etc.) in warmer areas.

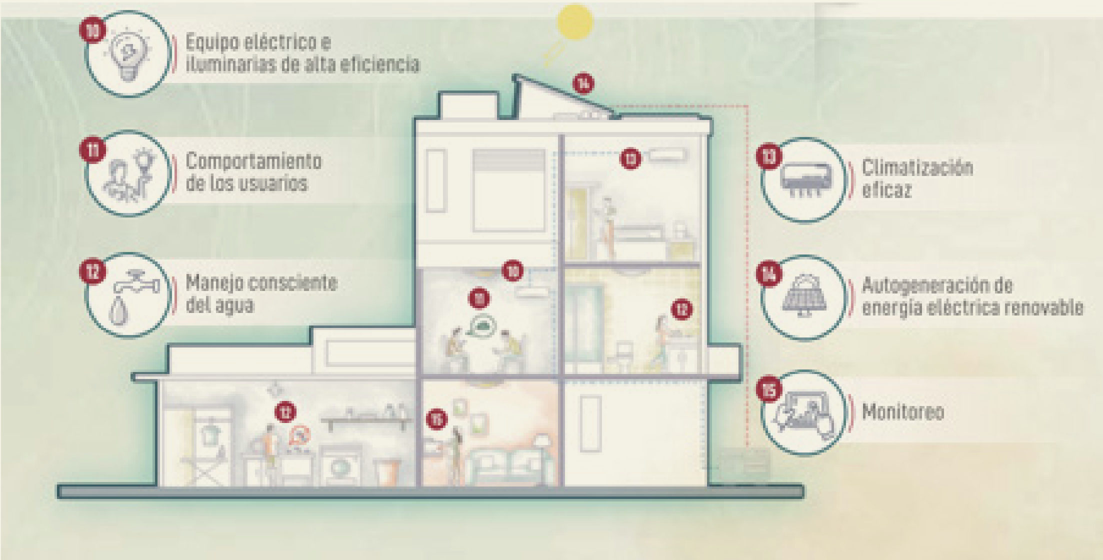
PRINCIPLE 15. MONITORING

A monitoring system is established for the main parameters that affect energy efficiency and thermal comfort.

DETAILS:
The key way to control and optimise energy efficiency and thermal comfort can only be recorded if measurement information is provided. Only then can building users and operators take specific action to improve these two parameters.

MEASURES:
The energy consumption of the most important energy services is recorded and displayed regularly (electrical equipment and lighting, air conditioning, cooking and hot water production). Parameters related to comfort are also measured, such as temperature, humidity level, level of CO2 and volatile particles in internal spaces. If no automatic data storage and processing is carried out, users at least get regularly one template for reading and manual evaluation.


Principios de diseño y construcción
1 Diseño integrado
2 Control de la radiación solar directa
3 Energía incorporada
4 Aislamiento térmico incorporado
5 Reducción de materiales tóxicos
6 Movimiento de aire
7 Reducción de combustibles fósiles
8 Enfriamiento nocturno
9 Diseño bioclimático de espacios exteriores


10 Equipo eléctrico e iluminarias de alta eficiencia
11 Comportamiento de los usuarios
12 Manejo consciente del agua
13 Climatización eficaz
14 Autogeneración de energía eléctrica renovable
15 Monitoreo