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Sustainable Design Checklist

To be used by Architects during the various Design Stages of a Project

I – Preliminary Studies & Data Collection Phase

Site Selection

☐ Prefer brownfield (previously used) sites with low ecological value to greenfield sites, if possible.

☐ Establish if the site is contaminated and requires remedial measures.

Site Analysis

☐ **Macro-Climate:** Gather climatic and meteorological data for the site location, mainly: Year-round solar radiation, air temperatures – day & night, humidity levels, prevailing winds and speed, rainfall and precipitation patterns.

☐ **Micro-Climate**: Gather climatic data that are site-specific, such as local prevailing winds, wind gustiness, breeze from surrounding forest, etc.
This may involve site visits as well as interviewing the neighbourhood / prior occupants.

☐ **Site Orientation**: Determine the site orientation and surrounding elements for each North, South, East, and West orientations, as well as the sun path (sun diagram).

☐ **Site Topography and Natural Resources**: Identify the various topographical features of the site and recognize typical landform patterns, mainly: Relief, terrain, altitude, slopes, exposure, water streams and features, ground cover and vegetation, other ecological features, etc.

☐ **Site Surrounding**: Identify adjacent buildings or construction and their heights, and any adjacent features that may shelter, shade, or have an impact on the site – such as hills, valleys, forests, adjacent built-up areas, building densities, etc.

☐ **Other Site Environmental Factors**: Identify other local environmental factors that would need to be taken into account in design, such as: Noise, vibration, pollution sources, traffic, incoming services, etc.

II – Conceptual Design Phase

Building Environmental Goals

Based on the climatic data, establish the main environmental priorities and goals that the building design and building envelope should aim to achieve.

Attempt to answer questions such as the following:

- Is the priority to reduce internal temperatures most of the year?
- To minimize heat losses in winter?
- To protect from the prevailing winds, snow, or sand storms?
- To reduce internal noise due to close-by traffic or industrial plants?

Building Location & Orientation

In light of the site data gathered, undertake a thorough analysis to debate and determine the most suitable location to implant the building on-site location, as well as its general shape and orientation.

☐ **Orientation Relative to the Sun - Passive Solar Strategies**: Establish how the building should take advantage of the sun pattern to best achieve its environmental goals. Take into account exposure and surrounding features that could either shelter or on the contrary impede sun exposure. Ask yourself:

- Do we need to protect the building from the sun all year round?
- Do we need to maximize sun penetration in winter?
- Which facades will receive the most sun radiation and when during the year?
- Should the areas of some facades be minimized? Should most of the building face South?

☐ **Orientation Relative to the Wind:** Establish whether air velocities around the building should be increased or decreased. Determine which building on-site location, orientation, and angle are the most appropriate to take advantage of prevailing winds or on the contrary protect from unwanted winds.

☐ **Spacing:** Determine if, and how much, the building should be detached and spaced from adjacent buildings, its height relative to surrounding buildings, and how sun, daylight, and air movement around the buildings would be best affected.

Building Shape & Layout

☐ **Volumetric Shape - Surface area to volume ratio:** Determine whether a compact form should be favored for the building, and whether a higher building is advantageous.

☐ **Internal Layout:** Depending on the project's brief, building type, and usage, determine each internal zone, its main function, and what would be its ideal layout. Take into account:

- Ideal room orientation depending on its daily or seasonal usage (morning, afternoon, night, summer, winter…)
- Whether solar gains are beneficial or not, and when

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- Maximize daylight penetration using plan and section

☐ **Openings for Daylighting:** Determine the ideal amount of glazing required in each room, depending on its orientation, function, usage throughout the year, and internal conditions needed. Think about:

- Whether and when solar gains need to be minimized or maximized
- A good balance between obtaining natural daylighting and minimizing solar gains or heat losses via glazed openings (depending on the climate)
- Maximum use of indirect light and internally reflected light
- Minimum need for artificial lighting (electricity)

☐ **Openings for Ventilation:** If the building is to be naturally-ventilated, or relying on mixed-mode ventilation, determine the best strategy for positioning windows, roof vents, or openings for ventilation purposes. Think about:

- Creating air flows or cross-ventilation within rooms or zones
- Having dedicated openings for ventilation purpose only, such as low-level vents to introduce fresh air and high-level openings to extract warm air

☐ **Bioclimatic Design:** Think about integrating other bioclimatic solutions into your design, such as sun conservatories for winter usage, green roofs, night-time cooling, etc.

III – Detailed Design & Technical Phase

Long-Lasting Building

☐ **Anti-seismic Structure:** Design a flexible structure that will be resistant to seismic occurrences. Take into account Lebanese and international regulations on anti-seismic building guidelines, as well as the risk and intensity of earthquakes depending on the project location.

☐ **Durability:** Favour long-lasting materials that would need less maintenance, repairs, and replacement over the life-time of the building.

☐ **Fire-resistance:** Make sure materials specified are fire-resistant and check if manufacturers have undertaken the necessary fire testing procedures, if applicable. Establish a fire evacuation plan within the building, with well-defined safety exits, as well as fire-extinction measures, detectors, and equipment in case of fire.

Sustainable Materials

☐ **Natural Materials:** Consider using natural and/or renewable materials which are usually less energy-intensive in producing, less toxic, less polluting, have a

lower environmental impact, are breathable, and are easily recycled or re-used. Specify insulation with zero Ozone Depletion Potential & low Global Warming Potential.

☐ **Regional Materials:** Favour local and regional materials which do not require lengthy transport to the construction site.

☐ **Reusability and Recyclability:** Favour materials than can be easily re-used or recycled at the end of the life of the building. Specify materials that have a certain content of recycled elements, or re-use materials such as crushed aggregates for the building foundation. When possible, renovate the previous old buildings' façades or structure rather than fully destroying it.

☐ **Certified Materials:** When specifying imported materials, select the ones which have a recognized label of responsible sourcing, such as the Forest Stewardship Council (FSC) certification for sustainable timber products, or ISO manufacturing accreditation.

☐ **On-site Construction Recycling:** Encourage contractors to adopt best practices during construction, including sorting and recycling construction waste, or using re-used temporary timber and other materials on-site.

☐ **Recycling during Occupancy:** Encourage recycling by providing dedicated external and internal storage spaces for recycling bins.

Energy-Efficiency

☐ **Insulation:** Depending on the climate, determine if, where, what type, and how much insulation is needed for each of the exposed building elements (external walls, roofs, ground floors). Carefully select windows and roof-lights depending on their technical performance and insulating properties, and to minimize summer solar gains as needed.

☐ **Shading devices:** Carefully decide, for each building façade and room, if shading devices or overhangs are needed for sun protection. Consider the sun pattern and room orientation to select the most appropriate external shading as well as the shading orientation: vertical, horizontal, at an angle, etc.

☐ **Planting:** Consider using plants and trees on and around the building to provide additional shading and cooling effect. Think about vegetated green roofs and living walls.

☐ **Low-energy Lighting:** Specify low-energy lighting such as Compact Fluorescent Lamps (CFLs) and tubular fluorescent lights (T4, T5, etc). In non-residential buildings, consider adding occupant sensors and daylighting sensors.

☐ **Energy-efficient HVAC:** Work with the engineers to specify energy-performing heating, ventilation, and air conditioning (HVAC) systems, if needed. If air conditioning is unavoidable, select refrigerants with zero Ozone Depletion Potential & low Global Warming Potential.

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☐ **Thermal Modelling and Simulations:** For large or complex buildings, consider hiring a specialist energy assessor to undertake thermal model analysis and simulations of the building. The model allows estimating the energy consumption of the building, and evaluating the impact of different design solutions and energy-efficiency measures.

☐ **Efficient Appliances & Equipment:** If applicable, specify energy-efficient household appliances certified by a recognized scheme, such as the EU Labelling scheme (A rated appliances), and low-energy equipment such as flat screens and laptops.

☐ **Renewable Energies:** Consider installing renewable technologies to produce on-site hot water, heating, or electricity. Start by studying the viability of the most cost-effective solutions, such as Solar Water Heating in hot climates.

Water Savings

☐ **Water Conservation:** Specify low-consumption sanitary fixings and water devices, such as low or dual flush toilets, push taps, showers with low flow rates, and water-efficient washing machines. In public or commercial buildings, consider adding proximity detection shut-off water systems to basins and WCs.

☐ **Rainwater Collection:** Depending on the climate, study the costs and technical viability of installing a rainwater collection system either for irrigation purposes or for internal re-use for toilet flushing.

☐ **Water Re-usage:** Study the applicability of implementing a grey water recycling system to re-use shower and tap water internally, for toilet flushing. Be careful about contamination issues and select an installer with recognized expertise.

Occupants' Comfort and Well-Being

☐ **Sound Insulation:** Specify acoustic insulation if needed, depending on the surrounding environment and neighbourhood.

☐ **Low-toxicity Paint:** Select water-based paint with a low content in Volatile Organic Compounds (which are cancerous), or plant-based paint.

☐ **Natural Daylighting and Glare Control:** Make sure your design allows for sufficient natural day-lighting in each occupied room, and make a provision for internal blinds to minimize glare in offices and work studios.

☐ **External Space:** Provide enough external space for all the building occupants, such as balconies, terraces, green roofs, private or communal gardens, etc

☐ **Lighting Controllability:** In offices and working spaces, favour occupant-controllable task lighting for each desk space and work station.

☐ **Thermal Controllability:** In offices and working spaces, favour occupant-controllable temperature controls, such as thermostatic radiator valves.

Ecology and Landscaping

☐ **Protection of Ecological Features:** Avoid removing existing old trees with ecological value. Minimize damage to existing on-site ecological features by specifying protective measures during construction, such as fencing around trees. Implement sedimentation and erosion control measures during construction.

☐ **Enhancement of Ecological Features:** Consult with a landscape architect or ecologist to implement a planting scheme that improves the ecology of the site. Favour native, non-imported plants and trees, to promote domestic biodiversity.

☐ **Attenuation of Water run-off:** Minimize hard landscaping and implement retention measures to reduce water run-off after storms.

IV - Validation Phase

Building Certification

Consider certifying your design under one of the internationally-recognized sustainability rating for buildings, such as the BREEAM or LEED schemes. These schemes provide a framework for sustainable design and a tool to assess the eco-friendliness and sustainability of a building.

☐ **BREEAM** (**B**uilding **R**esearch **E**stablishment **E**nvironmental **A**ssessment **M**ethod): Developed in the United Kingdom, with a "BREEAM International" customized certification available for all buildings outside the UK. The rating varies between: Pass, Good, very Good, Excellent, and Outstanding.

☐ **LEED** (**L**eadership in **E**nergy & **E**nvironmental **D**esign)**:** Developed in the United Stated and can be applied worldwide. The rating varies between: Certified, Silver, Gold, and Platinum.

☐ **Other Lebanese Standards: Libnor, etc**

Measurement & Commissioning

☐ **Commissioning:** In large buildings with complex HVAC systems, specify commissioning of the systems during the first year post-construction completion, to make sure that all systems have been properly installed and perform as specified.

☐ **Measurement & Verification:** In commercial and public buildings, consider installing electricity, water, and energy meters for the building to monitor usage, set energy-efficiency targets, and identify possible leakage.

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V – Website Links and References

- BREEAM: http://www.bre.co.uk/page.jsp?id=829
- EU energy labelling scheme: http://www.defra.gov.uk/Environment/consumerprod/energylabels/index.htm
- European Union Eco-label: http://ec.europa.eu/environment/ecolabel/index_en.htm
- Forest Stewardship Council: http://www.fsc.org/
- LEED: http://www.usgbc.org/DisplayPage.aspx?CategoryID=19
- Libnor - Liban Normes: http://www.libnor.org/