AKDN Green Building Checklist: New Construction

V. 4 | September 2021

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1 Introduction

The AKDN is committed to reducing the climate impacts from its activities and having net zero carbon operations well before 2030. The Network aims to be a leader in the development sector, implementing an ambitious decarbonisation strategy and leading by example in decarbonising activities across key sections of operation.

85% of AKDN's direct GHG emissions come from energy use in buildings. It is crucial that the Network decarbonises the operation of its building portfolio. Furthermore, new construction puts substantial additional strain on decarbonisation efforts, both in terms of increasing future energy demands in the overall property portfolio, as well as the embodied carbon in materials for the construction of buildings.

Climate risks to AKDN infrastructure is increasing each year. Our new buildings need to be adapted to the challenges of climate change throughout their lifetime, while existing buildings are already becoming unsuitable for the changing climate conditions and need to be retrofitted.

This document provides guidelines for incorporating climate change considerations across AKDN new construction, covering planning, design, construction, and end of life of buildings. The document aims to assist AKDN Agencies in meeting the AKDN Budget Guidance for Green building and addressing environmental and climate change impacts relevant to their operations in the built environment.

This is a live document, which AKDN Agencies can use as a guideline for planning for and designing new facilities. This guidance will be updated periodically, based on continuous feedback from Agencies.

Meeting any of these guidelines should not compromise meeting the overall minimum performance standards for the facility and its intended use.

AKAH's Role

This document is produced by AKAH and is intended to provide guidance to all AKDN Institutions in planning and designing new assets. Each Agency will own the responsibility to design and operate their facilities in a climate-friendly way.

1.1 Topics Covered

These guidelines cover the following topics:

- **Climate change mitigation** – carbon reduction and management throughout the project lifecycle;
- **Climate change adaptation** – designing for current and future climate;
- **Efficient design and operation** of facilities, focusing on efficiencies in usage of:
    - Energy;
    - Water; and
    - Materials.

It is acknowledged that there are wider environmental considerations relevant to AKDN operations. The selected topics aim to focus AKDN's efforts associated with the built environment and result in meaningful benefits for the community and environment. Additional topics may be considered on receiving inputs from various AKDN Agencies in subsequent iterations of this live document.

1.2 Audience

This document focuses on new facilities, and is organised around four steps depicted on Figure 1. The audience of each of these steps is different, as shown in the diagram.

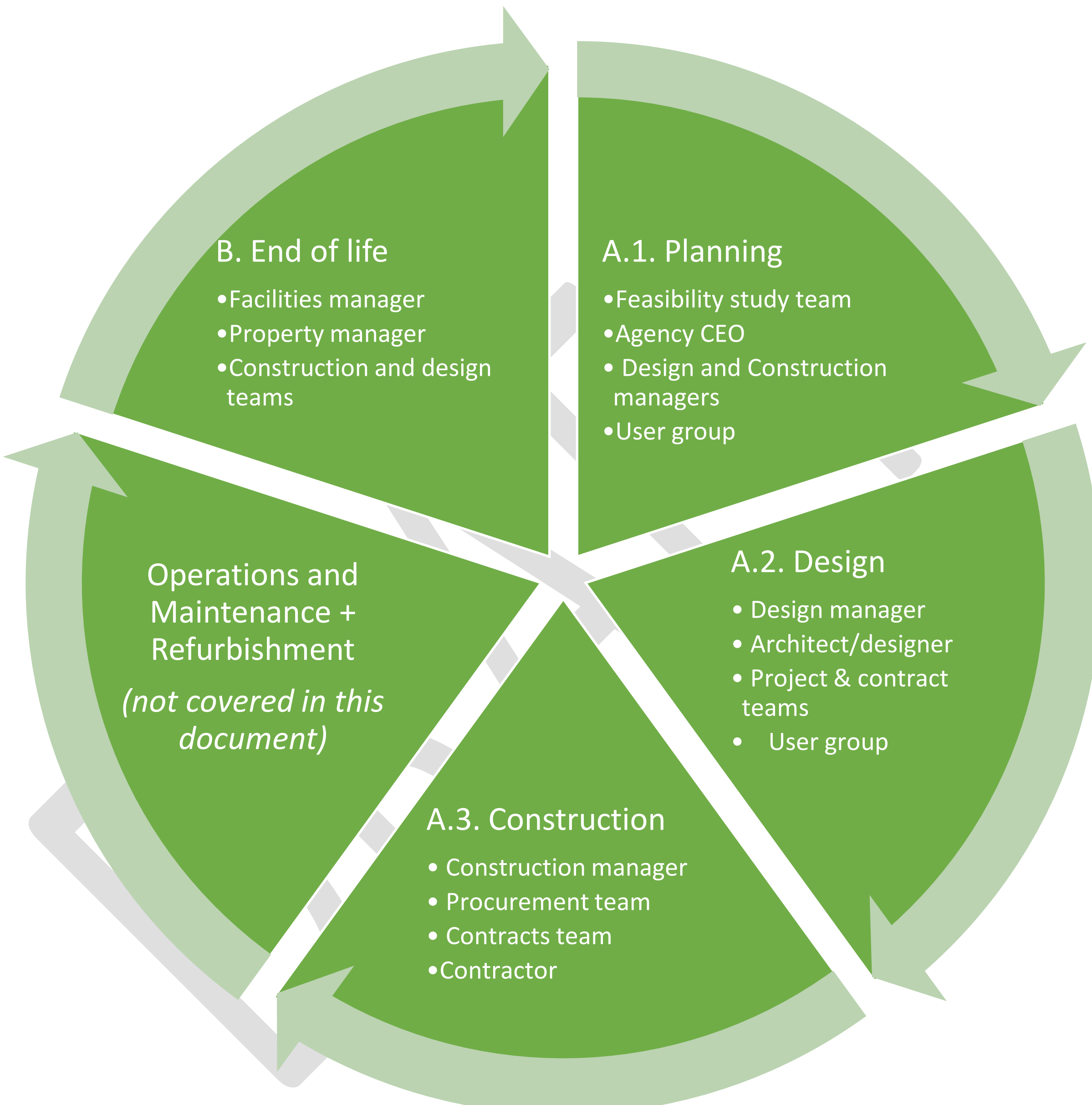


Figure 1 The lifecycle stages of a facility, along the section of this document that covers each. Guidelines for each of these lifecycle stages have a different audience, indicated as bullet points.

Facility Managers for existing facilities should refer to the AKDN Facility Management and Climate Change online training course[1], as well as the AKDN Facility Management manual [under development].

[1] https://akflearninghub.org/courses/climate-resilience/facility-management-and-green-house-gas-minimisation/

1.3 Relationship with Other Agency-specific Guidance

Guidance in this document focuses on the design and construction of AKDN buildings in a climate-friendly way. The document is relevant to all AKDN Agencies.

This document should be used alongside any further guidance covering Agency-specific operations, e.g. focusing on healthcare (AKHS, AKU), education (AKS, AKU, UCA), manufacturing, financial services, tourism (AKFED), to name a few. At the time of drafting this document such Agency-specific guidance is not available but planning for this is underway.

AKAH will work with other Agencies to ensure relevant processes and guidance are developed in parallel and are complementary to the green building guidelines.

1.4 Structure of the Document

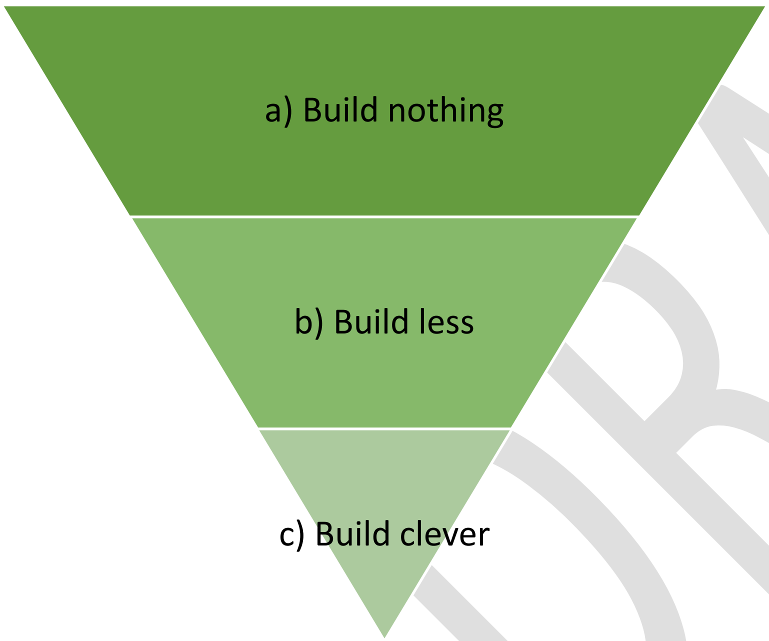
This document has four main sections.

- Section A.1: Planning
  Planning for a new facility, deciding to build, choosing the site and setting the design brief; ensuring incorporation of green principals from the earliest stages.
- Section A.2: Design
  Designing the new facility, following key green principles.
- Section A.3: Construction
  Embedding green considerations in the construction process – delivery and handling of materials and waste. Use of energy and water on site.
- Section B: End of life
  Decommissioning the building at the end of its useful life. Repurposing, disassembly and demolition. Waste and materials management, including reuse and recycling of the demolished debris.

Overall philosophy for new buildings

The earliest stages of planning and design for new buildings is when the greatest carbon reduction can be realised at the lowest cost.

For carbon minimisation and materials efficiency, the carbon hierarchy shown in Figure 2 should be promoted across AKDN during planning, design and construction of new facilities. This has been adapted from PAS 2080[2].



a) **Build nothing** - Challenge the need for new assets. Explore alternative approaches to achieve the desired outcome, e.g. can we re-purpose existing structures. How can we refurbish and extend the life of buildings, instead of demolishing and re-building? Minimize new construction required through maximizing use of existing assets.

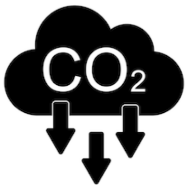
b) **Build less** - Optimize use of space to reduce the amount we build. Design multifunctional spaces. Efficient use of assets for multiple purposes to achieve desired outcomes with less. Optimize the use of material through efficient design.

c) **Build clever** - Use low-carbon materials. Streamline delivery and construction process to create efficiencies. Adopt new technologies and good practice to optimize use of energy, water and materials during construction and operation.

Figure 2 Carbon hierarchy, adapted from PAS 2080

[2] Publicly Available Specification (PAS) 2080: Carbon Management in Infrastructure. https://www.bsigroup.com/en-GB/our-services/product-certification/product-certification-schemes/pas-2080-carbon-management-in-infrastructure-verification/

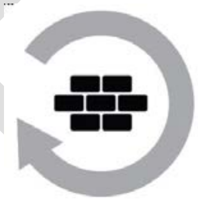
The checklist below supports the following themes:



Carbon Reduction

Energy Efficiency

Water Efficiency



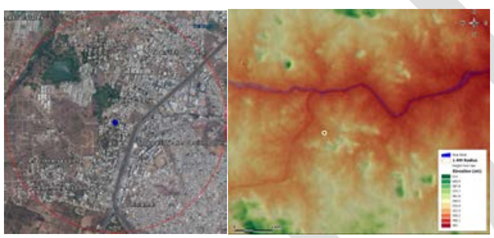
Embodied Energy Reduction

Climate Change Adaptation

A.1 Before the Project: Planning for New Facilities. Setting the Design Brief

Stakeholder:	**Feasibility study team** **Design and Construction managers** **Agency CEO** **User group**
Stage:	Feasibility study Reviewing the need for a new facility
Aim:	Challenge need for new assets: What is the greenest way we can meet our objective? Embed climate-smart principles from the outset of the project. Create a green Design Brief.

Theme	Checklist item	Details	✓/ x
	1.1. **Prepare a feasibility study: Should we build?**  *Repurposing of offices as Habitat Resource Centre in India and avoiding a new construction.*	Prepare a feasibility study with the carbon hierarchy at its core. Challenge the need for new construction during feasibility stage. (Key principles: ‘*Build nothing. Build less*.’) Thoroughly explore the alternatives to new construction. This should form a central part of any feasibility study for new facilities. Follow the carbon hierarchy. Questions to ask: ➢ How can we better utilise existing buildings? Where is the spare capacity that we can mobilise to reduce the need for new facilities? How can we repurpose existing buildings, instead of demolishing them? ➢ How can we use technology to partly meet the desired outcomes? ➢ How can we upgrade an existing facility to increase capacity? ➢ How can we ensure our facilities as flexible and suitable for multiple purposes? How can we combine requirements and ensure that multiple outcomes are met through a single facility? *Further reference:* [*https://www.kdkce.edu.in/pdf/Project%20Feasibility%20Study%20Checklist.pdf*](https://www.kdkce.edu.in/pdf/Project%20Feasibility%20Study%20Checklist.pdf)	✓

	1.2. As part of feasibility study, hold a stakeholder workshop on environment and climate change and the relevance to the project. 	Hold a workshop with relevant stakeholders and decision makers for the planning stage, incl. CEO, feasibility study team as well as other decision-makers. Consider inviting potential designers (3rd party) Introduce the carbon hierarchy and the green buildings philosophy from Figure 2. Explore strategic opportunity for carbon reduction, efficiency and adaptation. ➢ Review needs/desired outcomes ➢ Review existing assets and potential to utilise these, in accordance with carbon hierarchy. ➢ Introduce governing principles of CCA and resource efficiency. Make this central for design development. ➢ Identify key climate-related risks for the considered locations and the specific type of facility.	√
All	**2.1. Aligning with the AKAH Habitat Planning Framework**	For facilities, which are part of a larger re-development, refer to the AKAH Habitat Planning framework to support with setting up the process.	√
	2.2. Selecting the site: Undertake technical due diligence  *HVRA study of site for new housing in India. Google earth image. Digital Elevation Map Source: Shuttle Radar Topography Mission (SRTM), U.S. Geological Survey*	When selecting the site, follow the AKAH technical due diligence process, including climate change and environmental considerations. This should be included in the feasibility study report. ➢ A hazard, vulnerability and risk assessment (HVRA) for the site needs to be undertaken, if one doesn't exist. ➢ Consider cost, physical risk and carbon impacts on **whole-life basis** ➢ Consider availability of local materials and labour for the site. ➢ Consider possibility for green energy generation on site – e.g. solar, geothermal, hydro, wind *Further references:* https://www.wbdg.org/design-objectives/sustainable/optimize-site-potential https://www.designingbuildings.co.uk/wiki/Technical_due_diligence_for_development_sites	√

	2.3. Selecting the site: use of local resources, including energy, water and materials.	A review of local availability of energy, water and materials should be included in the feasibility study report. ➢ High-level review of possibility to source energy, water and materials locally. ➢ What local natural material (<50km) can be used as primary construction material? ➢ Necessary quantities of available materials should be assessed on a project-by-project basis ➢ Use whole-life costing for the basis of cost estimation *Further reference: https://www.wbdg.org/resources/life-cycle-cost-analysis-lcca*	✓
	3. Setting the Design brief: AKDN Green Building Section in the Design Brief Edge Excellence In Design For Greater Efficiencies 40%	The AKDN Standard TOR Environment Section should be added to the design brief – see the AKDN Budget Guidelines for Green Buildings 2021. This Environmental section of the design brief sets out the key requirements that need to be met by the design: - Minimum requirements for energy, water and materials, including IFC EDGE assessment and certification; - Requirements for climate resilience and adaptation; - Requirement for an environmental deliverable and environmental reporting mechanism.	✓

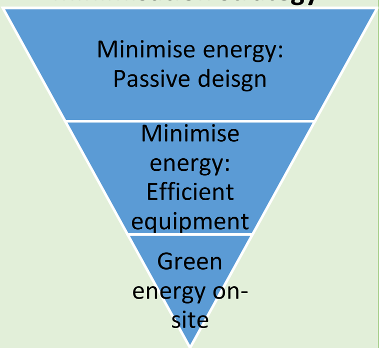
Before the project: Planning for New Facilities. Setting the Design Brief. Summary checklist

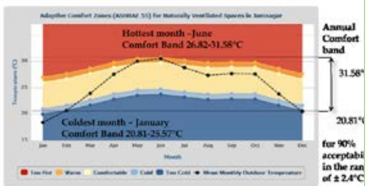
No.	Checklist item for Planning and setting the brief (A1)	✓/ x
1.1	Prepare a feasibility study: Should we build?	
1.2	As part of feasibility study, hold a stakeholder workshop on environment and climate change and the relevance to the project.	
2.1	Aligning with the AKAH Habitat Planning Framework	
2.2	Selecting the site: Undertake technical due diligence	
2.3	Selecting the site: use of local resources, including energy, water and materials	
3	Setting the Design brief: include the AKDN Green Building Section in the Design Brief	

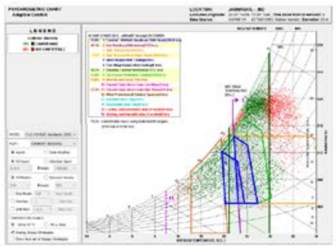
A.2 Design

Stakeholder:	**Design manager** **Architect/designer** **Project & contract teams** **User group**
Stage:	All stages of design – concept, scheme, detailed. More important in earlier stages
Aim:	Embed climate-smart principles from the outset of the project. QA/QC tool to ensure the green Design Brief is followed.

Theme	Checklist item	Details	✓/ x
	**1. Hold a cross-disciplinary design workshop in the first six weeks of the project** 	To help set environmental considerations in the project core, projects should hold a multi-disciplinary design workshop, co-led by the AKDN agency (client) and the design team. Different design disciplines should be involved, including architects, structural, MEP and façade. Introduce priorities and proposed approach and overall process for meeting the green building standards. The workshop should lay out the approach the project will take to meet the requirements for energy, water, materials and climate change adaptation. Carbon reduction and climate change adaptation should be pursued in parallel. Cross-disciplinary synergies should be identified and pursued, for example using heat generated from a server room to heat occupied spaces.	✓
	**2. Baselines: Set baselines for water, energy and embodied energy for materials**	Baselines and design improvements for energy, water and embodied energy of materials are to be defined in the EDGE tool. Steps: ➢ Create an account for IFC EDGE platform https://app.edgebuildings.com/ ➢ In the web application input building parameters, such as floor area and occupancy levels ➢ If values are unknown, use approximations or default values from the tool ➢ The tool will generate initial baselines for **water**, **energy** and embodied energy for **materials** The reduction targets from the AKDN Minimum Green Standards are relative to the defined baselines.	✓

	3.1. Follow an energy minimisation strategy  	The overall approach for meeting the energy performance standard is the following: Priority 1: Minimise energy use through passive design. Priority 2: Minimise energy through specifying efficient plant and equipment (only after passive design options have been included). Priority 3: Meet the energy demand with green energy generated on site (only after overall energy demand has been minimised). Indicative energy intensity values are shown below. Projects should use these as benchmarks for highly efficient buildings. For all types of buildings: Space heating demand 15 kWh/m^2/year Total energy consumption: Housing: 35 kWh/m^2/year Offices: 55 kWh/m^2/year Schools: 65 kWh/m2/year Jamatkhana: 55 kWh/m^2/year	√

<table>
<tr>
<td></td>
<td>3.2. Passive design: Adaptive thermal comfort[3]


Use of Adaptive Thermal Comfort Standard ASHRAE 55 to improve thermal comfort (AKAH)

Using tool Psychrometric chart for passive design strategies and comfort hours (AKAH).</td>
<td>Adaptive thermal comfort reduces dependence on energy-reliant heating and cooling by using mechanical equipment in a limited way. This is often developed through a creative, adaptive and responsive heating and cooling strategy which changes through the year. Adaptive thermal comfort is achieved with some level of user control (either centrally or locally set) which can adapt to changing climatic conditions.
In many parts of the world, mechanical heating and cooling is used to regulate indoor climates, with the aim of maintaining a uniform internal temperature. Constant heating and cooling of indoor spaces is energy intensive, yet often necessary due to human and social expectations. For building users already accustomed to highly mechanically regulated environments, the transition to adaptive thermal comfort should be considered.
Indoor thermal comfort depends on many factors including:

Air temperature (convective exchange)
Mean radiant temperature (radiative exchange)
Relative humidity
Air velocity (fans or natural breeze)
Metabolic rate
Inhabitants’ clothing level

Design teams should explore the most effective combinations of thermal comfort measures and passive solutions.</td>
<td>✓</td>
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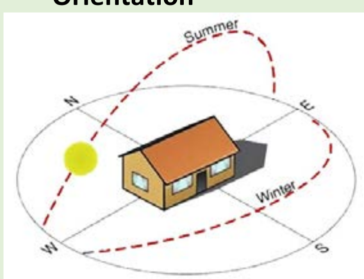
<td>3.3. Passive design: Orientation


Sun's Position in Summer & Winter</td>
<td>‘Building orientation’ is the positioning of a building with respect to the sun, usually done to maximise solar gain in cold climate and to minimise solar gain in a hot climate. Optimal building orientation can make it more comfortable and cheaper to run.

South orientation is desirable in climates requiring winter heating, as this can maximise solar gains in winter. Unwanted solar gains in summer can be avoided by shading devices. For hot climates building facing predominantly north use less energy than other orientations.</td>
<td>✓</td>
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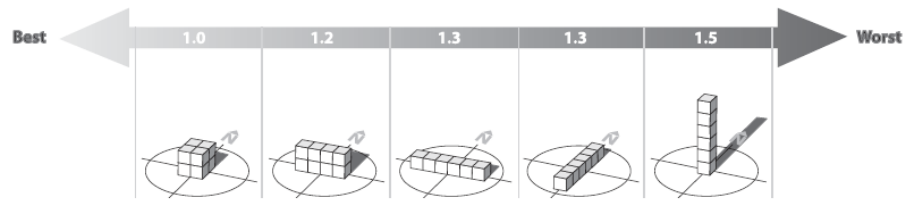
[3] Developed based on the work by Aga Khan Academies – Master Facilities Programme.

3.4. Passive design: Building form

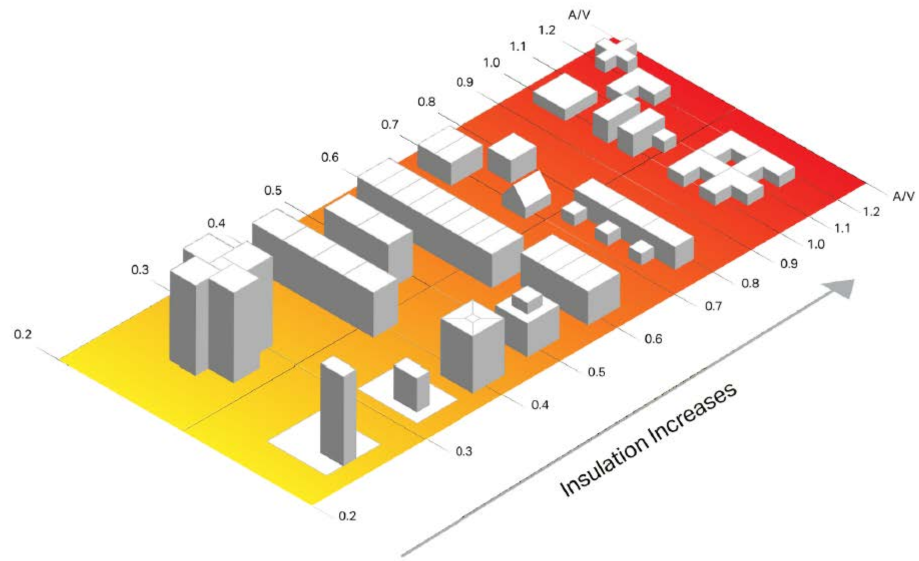
The compactness of a building is indicated by the ratio of external surface area (walls and roof) to building volume (A/V). This has an influence on the building energy demand.



Effect of A/V Ratio on energy efficiency (Source: PassiveDesignToolkit,Vancouver,2009)

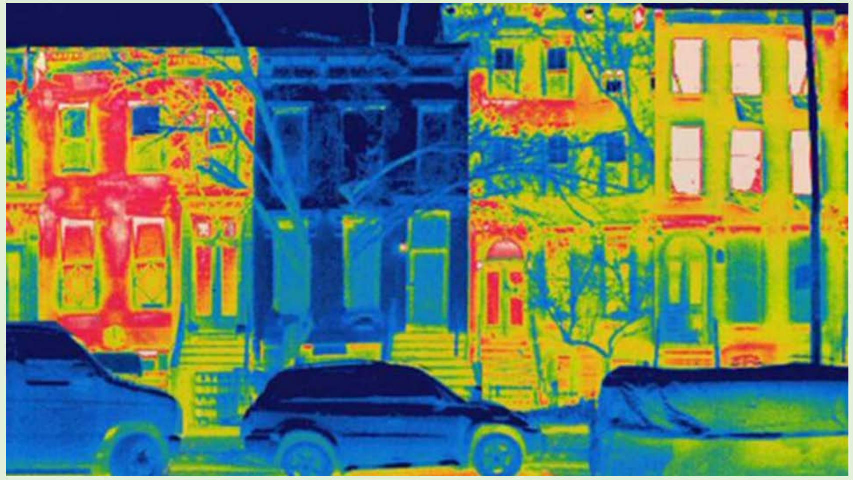
Simple shapes are more thermally efficient. The size of a building also influences the A/V ratio. Small buildings with an identical form have higher A/V ratios than their larger counterparts. It is therefore particularly important to design small detached buildings with a very compact form, whilst larger buildings offer the designer greater freedom to explore more complex geometries.

✓



3.5. Passive design: building envelope, insulation and glazing

Good insulation and glazing are essential for all new AKDN buildings. The economical solution to a warmer building in the winter and a cooler house in the summer is to insulate it well.



Spot the well-insulated building in the thermal image.

It is essential to identify and eliminate thermal bridges and ensure airtightness.

Indicative performance values are shown below (projects should use these as benchmarks)

Thermal conductivity

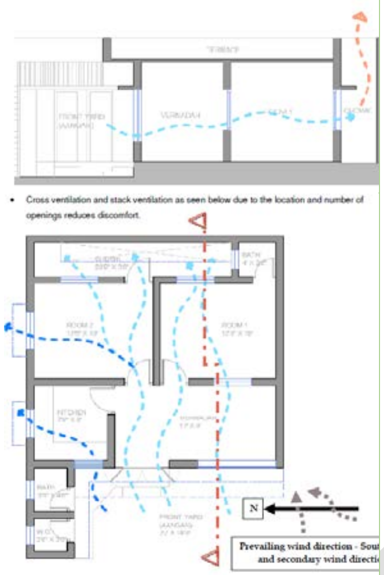
Walls: U value 0.12-0.15
Floor: U value 0.08-0.12
Roof: U value 0.10-0.12
Windows: U value 0.8-1.0 (triple glazing)
External doors: U value 1.0-1.2

Efficiency measures

Air tightness: <1 m^3/h. m^2@50Pa
Heat loss: Maximum 10 W/m2 peak heat loss (including ventilation)
Thermal bridging*: y-value less than 0.04 (total heat lost through thermal bridges)
**for further information on thermal bridging, see* https://www.zerocarbonhub.org/sites/default/files/resources/reports/ZCH-ThermalBridgingGuide-Screen_0.pdf

✓

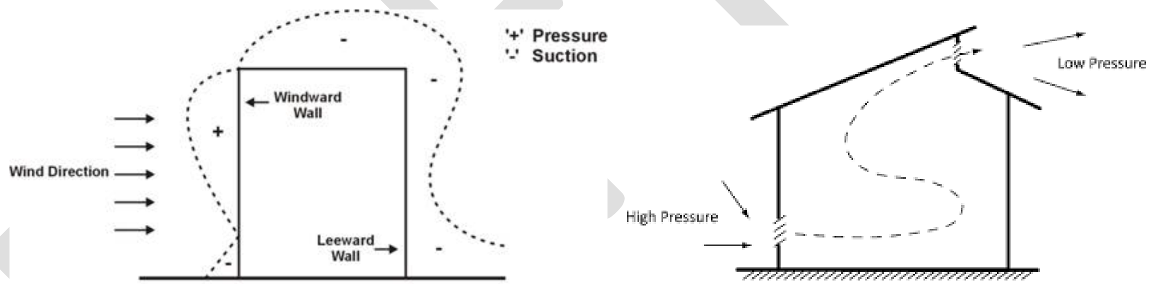
3.6. Passive design: Natural ventilation



Natural ventilation analysis, AKAH

Ventilation provides cooling by using air to carry heat away from the building and from the human body itself. Design allowing ventilation without the use of mechanical equipment (passive ventilation) reduces energy use, as well as cost for maintenance and replacement of mechanical systems.

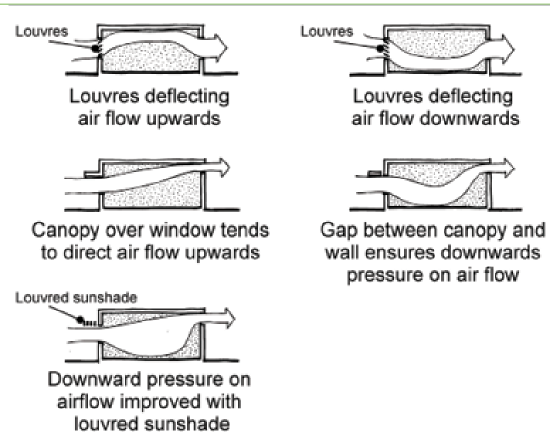
There are two main natural ventilation techniques. Wind-driven ventilation is caused by pressure differences caused by the wind. If there are openings on the windward and leeward walls of a building, fresh air will be able to pass through. Stack ventilation is caused by temperature differences within the building – hot air rises and exits through an opening relatively high in the building. Stack ventilation does not rely on the wind and it can take place with relatively stable air flow on hot summer days with no wind.



Left: Wind-driven ventilation. Right: Stack ventilation (Source: gbtech.emsd.gov.hk)

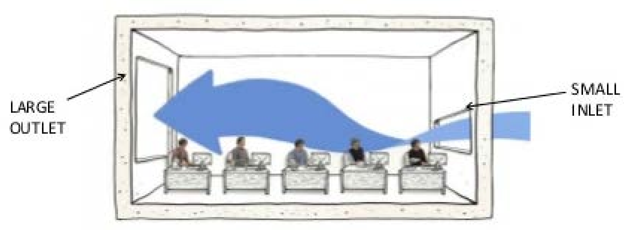
Position of openings directs air flow through the building. With cross ventilation, having openings not directly opposite each other helps mix the air and can achieve better ventilation. Openings should be at the occupants' level; when the inlet is at a high level, the air flow happens mostly along the ceiling, regardless of the outlet.

✓



https://www.yourhome.gov.au/passive-design/passive-cooling

Largest air velocity happens if the inlet is small and the outlet is large. The total force is acting on a small area and forcing air through the opening at a high pressure. If the inlet opening is large, air velocity will be low but the volume of air passing in unit time will be higher. Therefore, large inlet openings may be desirable when the wind direction is not constant, or airflow through the whole space is required.

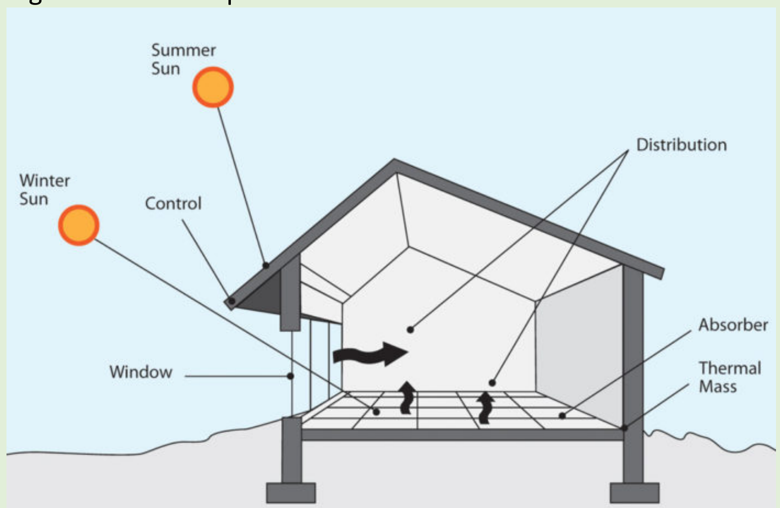


Source: Chikalgi, 2017

The design team should understand the prevailing wind patterns around the building, accounting for nearby vegetation and topography. A project-specific ventilation strategy should be developed for each type of space in the building. Natural ventilation designs should be reviewed in relation to noise and other pollutants in the air. In locations where natural ventilation is adequate for only part of the year, this period should be optimised in combination with a mixed mode mechanical ventilation system.

3.7. Passive design: Thermal mass

Appropriate use of thermal mass can moderate internal temperature by averaging out diurnal (day–night) extremes. Materials with high thermal mass store heat during the day and re-radiate it at night. This is particularly beneficial where there is a big difference between day and night outdoor temperatures.

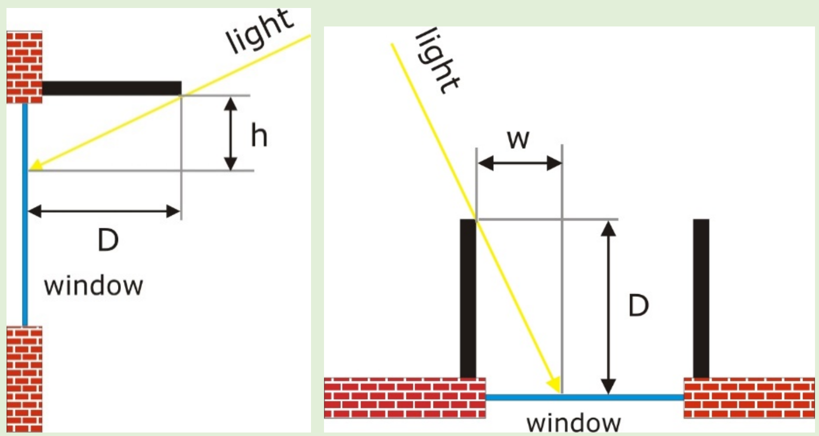


Thermal Mass (Source: homestylegreen.com)

The following characteristics determine thermal mass performance.
High density**:** Denser materials have higher thermal mass.
Good thermal conductivity**:** To be effective thermal mass should have the capacity to absorb and re-emit close to its full heat storage capacity in a single diurnal cycle.
Appropriate thermal lag: The rate at which heat is absorbed and re-released by uninsulated material is referred to as thermal lag. Lag is dependent on conductivity, thickness, insulation levels and temperature differences either side of the wall.

The designer should choose whether to use high thermal mass or low thermal mass material based on the function of the building and climate condition. Thermal mass shouldn't be covered with rugs or carpet, as this reduces the amount of heat the thermal mass can absorb.
Thermal mass should be kept away from cold, draughty areas such as entryways or unheated hallways, any poorly insulated spaces, as well as north-facing areas which do not get direct winter sun.

✓

	3.8. Passive design: Solar reflectivity	Use of reflective pain or materials can help minimise solar gains and reduce energy use in hot climates. This should be explored in places where summer cooling is needed. The solar reflectivity for a material, expressed as a fractional value between 0 and 1 or as a percentage, can be acquired from the product manufacturer.	✓
	3.9. Passive design: Shading	Shading is a very effective way to reduce solar gains in summer and avoid glare. This helps reduce cost, energy and increase occupant comfort. All new AKDN buildings should have appropriate shading. Different types of shading are available: on-glass, on-window-frame; external (e.g. trees). Design teams should ensure precise design of overhanging roofs and deep window reveals to shade building envelopes  *Shading Device, Left: Horizontal Shading, Right: Vertical Shading (Source:pvresources.com)*	✓

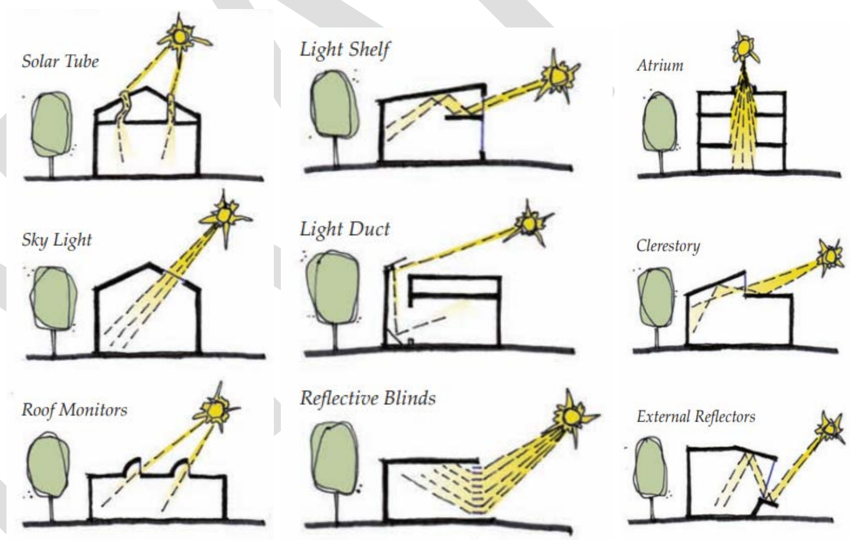
3.10. Passive design: Natural lighting

Daylight analysis of rural housing project in India (AKAH)

Building layout and orientation can maximise good daylighting and reduce the need for artificial lighting and energy consumption.

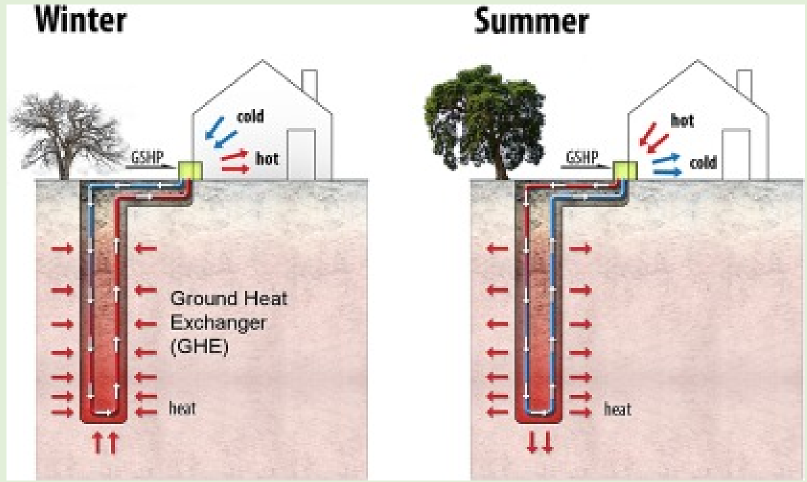
South facing windows provide lots of daylight, as well as solar gains, while windows facing the northern elevation can deliver diffused lighting with minimal solar gain. Although skylights can bring in lots of natural daylight, they are also a source of heat loss in the winter and heat gain in the summer.

Solar tubes are simple to install and provide daylight without the associated heat gain and a minimal amount of heat loss. Solar tubes are lined with reflective material to reflect and diffuse light to isolated areas.
A clerestory wall is a high wall with a row of overhead windows that can allow in light. When clerestory windows are opened they can also act to cool the room by creating convection currents which circulate the air.



Types of Natural Lighting (Source: PassiveDesignToolkit,Vancouver,2009)

✓

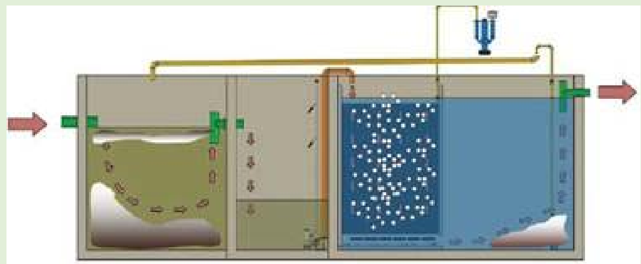
	3.11. Energy efficiency – heating and cooling	Before estimating heating and cooling requirements, maximise thermal comfort through passive design. If, after maximising passive design, thermal comfort requirements need to be met using mechanical equipment, ensure energy efficient equipment is specified and used. Heat pumps, incl. ground source heat pumps, should be explored, to reduce the energy demand for meeting thermal comfort requirements – both for heating and cooling.  *Ground source heat pumps performance in cooling and heating (Source: Lu et al. 2017)* All mechanical ventilation systems should have heat recover, target 90% efficiency, with less than 2m duct length from unit to external wall – both for heating and cooling. Where heating is needed, heat generated from server rooms, incinerators, generators, and others, should be recovered and used for space or water heating. Ensure heating and hot water generation is fossil fuel free. Use of solar heating and hot water should be explored before reverting to fuel or electric boilers. Any boilers to be at least 90% efficient. Designers should aim to reduce heating and hot water <u>peak</u> energy demand. Where cooling is needed, only highly efficient systems should be considered.	✓

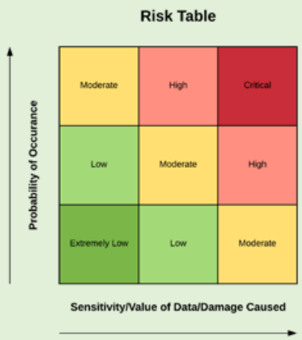
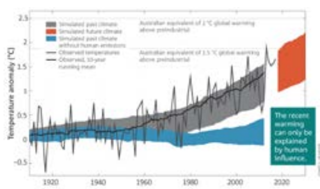
	3.12. Energy efficiency – hot water	Ensure heating and hot water generation is fossil fuel free. Use of solar hot water generation should be explored before reverting to fuel or electric boilers. Any boilers to be at least 90% efficient. Maximum dead leg of 1 litre for hot water pipework.	✓
	3.13. Energy efficiency – lighting and appliances  	Use only LED lights. Use occupancy sensors and daylighting controls in public and shared spaces. Only specify energy efficient appliances, including: ➢ Cooking equipment ➢ Washing equipment ➢ Refrigerators ➢ Small appliances ➢ Pumps	✓
	3.14. Gather and disclose data	Buildings should use smart energy meters. Data should be recorded at 30-min intervals. A thorough set of meter schematics and information on maintenance should be prepared. Buildings over 300kW energy demand must have a Building Management and Control System (BMCS)	✓

	3.15. Green energy generation  *Installation of net-metered on grid roof top solar system at a rural house in India*	Only after energy demand has been minimised through passive design and efficient systems, should renewable energy be explored. The project should strive to meet 100% of the energy demand through on-site renewables. On-site renewable energy generation results in reduction in whole-life cost, supports energy resilience and independence as well as reduce whole-life carbon emissions. ➢ Explore viability of different renewable energy sources including: o Solar o Micro hydro o Wind o Trigeneration. ➢ Refer back to preliminary studies during site-selection (if applicable). ➢ Complete a feasibility study, based on whole-life cost and environmental impacts ➢ Explore on-site capacity first. If sufficient on-site generation is not viable, off-site can be considered (reduced environmental benefit)	✓
	4.1. Embodied carbon: Build less	Reduce quantity of materials: focus on lean design. • Multifunctional spaces • Material efficiency review – are all materials proposed necessary? • Simplify design. • Reduce dead loads where possible – light materials, efficient design. • Can long spans be restricted?	✓

	4.2. Favour low-carbon materials  *Use of locally available limestone and pre-fab window frames in rural housing projects in India.*	➢ Further develop initial considerations of local materials, incl. rock, sustainable timber, bamboo, earth and other natural materials. Structural considerations for safety and stability to be always adhered to. ➢ Assess quantity of available materials vs. structural and non-structural material needs ➢ Use low-carbon materials for structural design. Consider: • Timber products, including cross-laminated timber or glue-laminated timber, where available. • Bamboo • Compressed stabilised earth blocks • Local stone blocks ➢ Use durable materials. All assessments should be based on whole-life cost and impacts. ➢ Identify opportunities to use local materials – surfaces, cladding, insulation, landscaping (booklet to be developed) ➢ If natural materials are not suitable or available, then: o Steel elements and reinforcement should be reused. Otherwise, steel with high recycled content should be used. o If concrete is used, cement replacement should be explored, including pulverised fly ash (PFA) and Ground Granulated Blast-furnace Slag (GGBS).	✓

	4.3. Design for deconstruction  	Aim: design allows building to be dismantled in such a manner, that its component parts can be reused Prepare a Design for Deconstruction (DfD) Plan • Statement of DfD strategy. • List building elements: provide inventory of elements, design life and technical characteristics. • Identify best option for reuse of elements. • Provide instruction on how to deconstruct elements. To support the DfD plan, design should: ➢ Strive for flexible spaces that can be suitable for multiple purposes at the design stage. ➢ Can the building be re-purposed in the future, e.g. to be used for homes, office, school, medical centre, shelter? ➢ Use standard elements that can be reused at end of life. ➢ Design for prefabrication and modular construction. ➢ Simplify and standardise connection details. ➢ Select fittings, fasteners, adhesives that allow for disassembly. ➢ Use durable materials. Design for Deconstruction: SEDA Design Guidelines for Scotland. Available online at https://static1.squarespace.com/static/5978a800bf629a80c569eef0/t/5aa999f7652deaa430532afd/1530223259684/Design+%26+Detailing+for+Deconstruction.pdf) *Further reference:* *https://www.ellenmacarthurfoundation.org/circular-economy/concept*	✓
	5.1. Minimise water use: Irrigation	Irrigation drives a major water demand. Design should include water-efficient landscaping, focusing on - Use of native species. Use of low-flow consuming irrigation systems, such as drip irrigation.	✓

	5.2. Minimise water use: In the building	Minimise water use in the building: - Use low-flow showerheads – max 8 litres/min - Use low-flow water taps for washbasins – max 6 litres/min - Dual flush for all WCs – 6 litres first flush and 3 litres second flush - Waterless urinals - Recycled greywater for flushing	✓
	5.3. Sewage Treatment	Install an efficient sewage treatment plant. Treated water can be used for irrigation or toiled flushing. Compact sewage treatment plants can also provide fertilizer for plants.  *Example compact sewage treatment plant –WaterKube*	✓
	5.4. Rainwater harvesting	Design should include a rainwater harvesting system, collecting rainwater from the roof of the building. Aim for at least 50% of the roof area to be used for this purpose. Rainwater should be used for irrigation, toilet flushing or other purpose, reducing the water demand of the building.	✓

	6.1. Do a climate risk assessment  	Do a climate risk assessment covering relevant weather-related hazards. Hazards to consider include, where relevant: flooding (surface water, fluvial, coastal, groundwater), drought, slope failure, avalanche risk, as well as any other relevant risks. If a hazard, vulnerability and risk assessment (HVRA) exists for the site, this can be used. Further site-specific and project-specific risks to be identified during an exploratory workshop. If future climate data is available, this shall be used to assess climate risks over the lifetime of the development. If future climate data is not available, appropriate climate change factors shall be agreed with the client for relevant climate hazards at the start of the project. Types of climate change factors to be agreed with the client include: - Increased max daily temperatures by *X Deg C [values to be agreed with client]* - Increased design rainfall by *X% [values to be agreed with client]* - Increased design river flow by *X% [values to be agreed with client]*	✓
	6.2. Design for future climate 	Design should reflect findings from the climate risk assessment. Design of key systems, including mechanical and electrical, to be based on future climate over design life of the system. Through design workshops the design team should identify where systems can be upgraded later to adapt to future climate change – delaying additional investment (e.g. raising flood defences to cope with climate change)	✓
	6.3. Create a CCA Plan	Create a CCA plan ➢ Proactively plan for updates to key systems to cope with climate change ➢ Details of a managed adaptive approach, where investment is delayed until needed. See example and background at this link https://bit.ly/3gYZBK0 ➢ Include a review schedule for the plan, aligned with planned climate science updates ➢ Incorporate weather monitoring and asset performance monitoring to inform adaptation decisions Encourage design team to develop CCA and mitigation solutions in parallel, e.g. by holding joint workshops.	✓

Design: Summary checklist

No.	Checklist item for Design (A2)	✓/ x
1	Hold a cross-disciplinary design workshop in the first six weeks of the project	
2	Baselines: Set baselines for water, energy and embodied energy for materials	
3.1	Follow an energy minimisation strategy	
3.2	Passive design: Adaptive thermal comfort	
3.3	Passive design: Orientation	
3.4	Passive design: Building form	
3.5	Passive design: building envelope, insulation and glazing	
3.6	Passive design: Natural ventilation	
3.7	Passive design: Thermal mass	
3.8	Passive design: Solar reflectivity	
3.9	Passive design: Shading	
3.10	Passive design: Natural lighting	
3.11	Energy efficiency – heating and cooling	
3.12	Energy efficiency – hot water	
3.13	Energy efficiency – lighting and appliances	
3.14	Gather and disclose data	
3.15	Green energy generation	
4.1	Embodied carbon: Build less	

4.2	Favour low-carbon materials	
4.3	Design for deconstruction	
5.1	Minimise water use: Irrigation	
5.2	Minimise water use: In the building	
5.3	Sewage Treatment	
5.4	Rainwater harvesting	
6.1	Do a qualitative climate risk assessment	
6.2	Design for future climate	
6.3	Create a CCA Plan	

A.3 Construction

Stakeholder:	**Construction manager** **Procurement team** **Contracts team** **Contractor**
Stage:	Construction
Aim:	Climate-smart construction management

Theme	Checklist item	Details	✓/ x
	1. Create a construction waste and materials management plan  *Reusing construction debris on Site in rural housing construction*	Before construction begins, develop a detailed waste and materials management plan, following the waste hierarchy: ➢ Develop processes to sort and reuse or recycle waste on-site and off-site ➢ Plan material quantities ordered for efficiencies and to minimise waste ➢ Material storage to avoid soiling ➢ Include QA/QC process	✓
	2. Favour local material suppliers	Where available and feasible, local suppliers should be favoured. This would reduce cost and carbon from transportation.	✓

	3. Site Energy Plan	Create a Site Energy Plan to minimise energy use on site. Efforts should include using energy efficient plant and having a set of energy efficiency procedures: ➢ Use of energy efficient plant, security and lighting ➢ Optimise use of machinery and equipment to avoid idle running and wasting fuel ➢ Reducing and optimizing labour commuting	✓
	4. Consider early connection to the grid	Grid electricity is likely to be much less carbon intensive than generators. Alternatively, favour low-carbon fuels. Consider renewable energy (e.g. solar) which can be integrated in the building system as a backup.	✓
	5. On-site GHG reporting system	Establish an on-site GHG emission reporting system, to feed into the Agency's GHG emission management report. Refer to AKAH and AKF online GHG Management training for details.	✓
	6. **Site water use plan**	Create an efficient water use plan to minimise water use on site. This should include details of measuring, monitoring and justifying the usage.	✓
	7. Extreme weather plan	Create an extreme weather management plan for construction and implement as needed. Install weather monitoring system.	✓

Construction: Summary checklist

No.	**Checklist item for Construction (A3)**	✓/ x
1	Create a construction waste and materials management plan	
2	Favour local material suppliers	
3	Site Energy Plan	
4	Consider early connection to the grid	
5	On-site GHG reporting system	
6	Site water use plan	
7	Extreme weather plan	

B End of Life

The end of life stage provides an important opportunity to apply circular economy principles. Carbon emissions from the facility can be reduced by reusing and recycling suitable materials

Stakeholder:	- Facilities manager - Property manager - Construction and design teams
Stage:	End of life
Aim:	Promote circular economy. Reuse and recycle suitable materials.

Theme	Checklist item	Comment	✓/ x
	1. Deconstruction: Reuse	➢ Where a Design for Deconstruction (DoD) plan exists for the building, follow this to prepare building elements for re-use and recycling ➢ Where this does not exist, consult with a structural designer to identify which elements can be readily reused. Recover them and prepare them for re-use ➢ Undertake a market research exercise. o Who may need the materials? o How can the team maximise value for the community? o Can the materials be re-used locally within AKDN projects?	✓
	2. Deconstruction: Recycle	➢ After reusing all suitable elements, sort any recyclable materials ➢ Recycle, securing income and reducing carbon emissions for others.	✓

End of life: Summary checklist

No.	Checklist item for End of life (B3)	✓/ x
1	Deconstruction: Reuse	
2	Deconstruction: Recycle	