Bamboo

Sustainable Architecture

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1.1 DEFINITION OF GREEN ARCHITECTURE

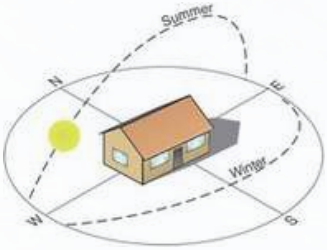
Green architecture (sustainable architecture) is an approach to design and construction that seeks to meet present needs without compromising the ability of future generations to meet theirs. It integrates environmental stewardship, social equity and economic viability so buildings perform responsibly across their life-cycle — from material selection, through construction and operation, to reuse or recycling at end of life. This conceptual framing echoes the Brundtland Commission's definition of sustainable development and positions buildings as systems that must balance ecological limits with human well- being.

1.2 CLASSIFICATION AND KEY PRINCIPLES

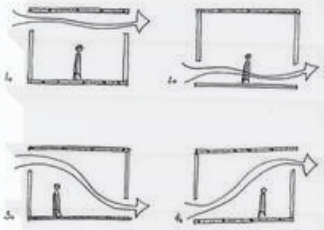
Classificationbyscale / strategy

Building-scale — passive strategies:

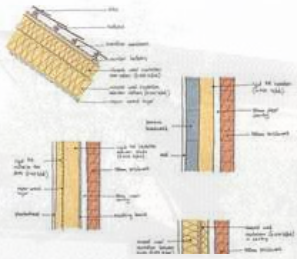
orientation



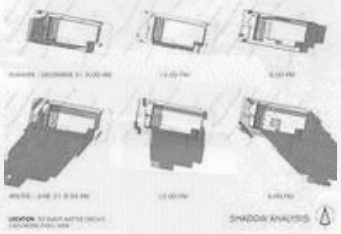
natural ventilation



insulation.



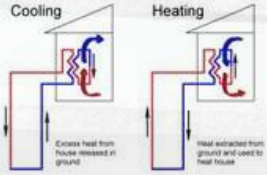
shading,



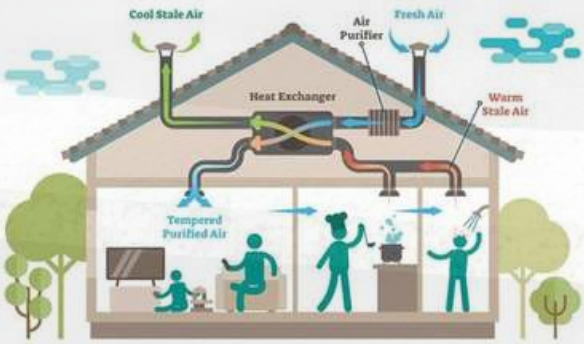
Building-scale — active systems:

photovoltaics,

heat pumps



mechanical ventilation with heat recovery.



Site / urban interventions:
green corridors,stormwater management, district energy and urban agriculture.

Material & waste strategies:

use of renewable/local materials, recycled content, design for disassembly.

Core design principles

- Userenewable&recyclablematerials (prefer local supply chains).
- Climate-responsive orientation & passive design (minimise heat gain, maximise daylight and cross-ventilation).
- Resource optimisation (energy, water, materials — reduce, reuse, recycle).
- Adaptability & longevity (design flexible spaces that can be reused).
- Integrate active systems where suitable (PV, geothermal, efficient HVAC).
- Social & participatory principles (quality of life, equity, public participation, precautionary planning).

1.3 Global Context and Importance

Drivers

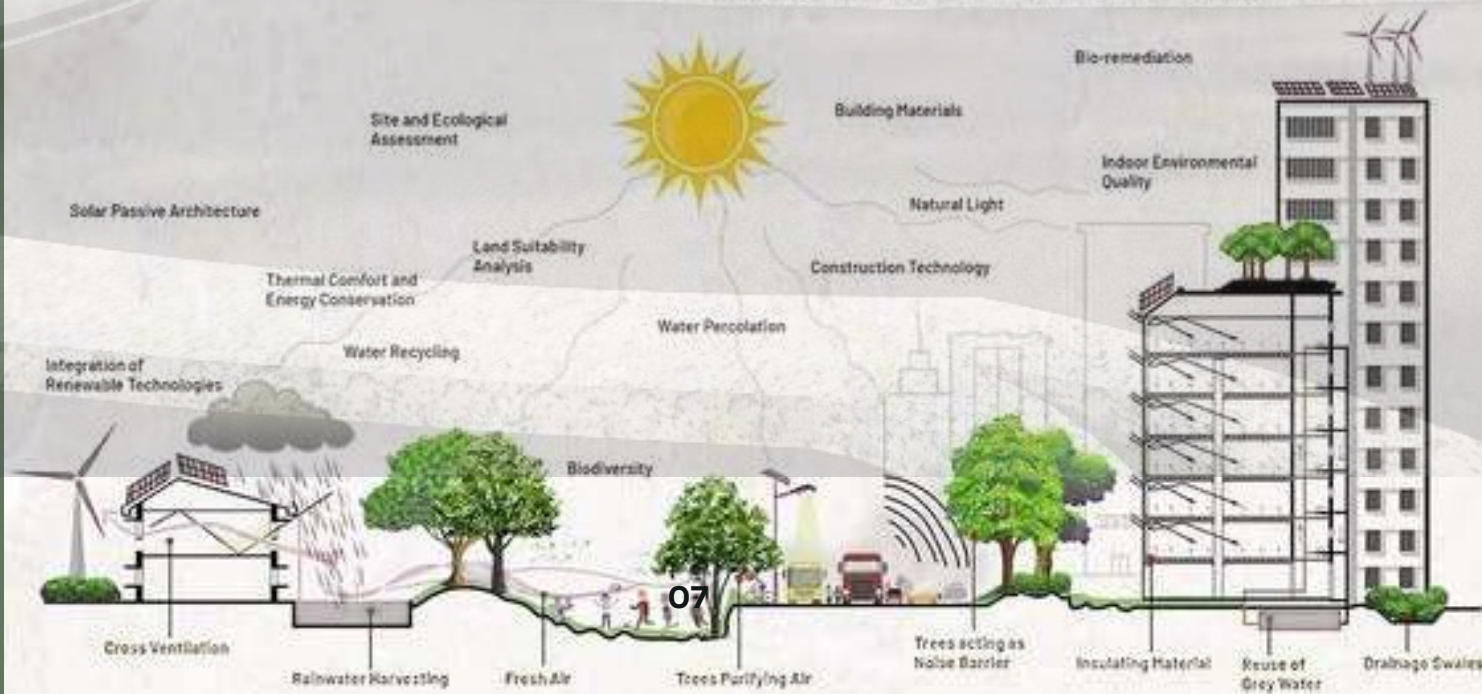
- Environmental pressures: resource depletion, biodiversity loss, and climate change.
- International frameworks: Brundtland Commission, Agenda 21 — global guidance for sustainable development.

How it translates locally

- Policy tools & programs: e.g., Local Agenda 21, municipal sustainability platforms (like MURNI.Net).
- From global to local: policies convert international commitments into local action and measurable indicators.

Why green architecture matters

- Resilience: buildings and infrastructure that withstand climate risks.
- Ecosystem protection: reduce impact on habitats and encourage regenerative site practices.
- Social equity & longevity: create healthy, inclusive, and long-lasting built environments.
- Not optional: green design is a necessary strategy — both technical and ethical — for future-proof development.



2.1 Environmental Benefits

Reduce greenhouse gas emissions

On-site renewables and lower fossil-fuel use cut CO_2 emissions.

Water conservation

Rainwater harvesting, efficient fixtures and reuse reduce potable demand.

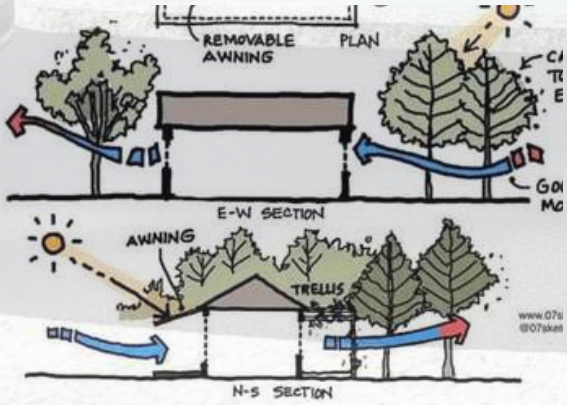
Waste minimisation & circularity

Reuse, recycling and on-site waste-to-resource strategies shrink landfill streams.

Protect and restore ecosystems

Native planting, habitat-friendly landscaping and permeable surfaces support biodiversity.

Microclimate improvement



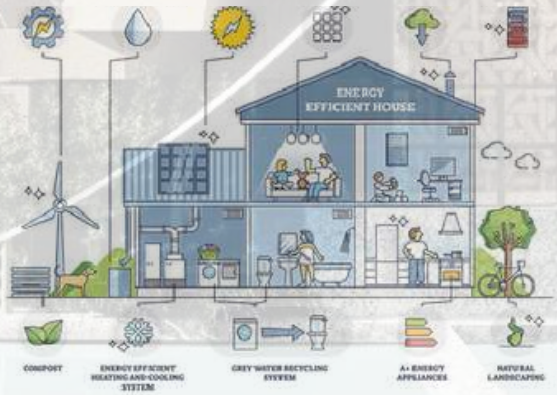
Climate-responsive design reduces urban heat island effects and improves local air quality

Encourage regenerative practices

Urban farming, green roofs and bioswales regenerate ecological functions on site.

2.2 Economic Benefits

- Lower operational costs
- Energy and water savings reduce utility bills and operating budgets.
- Increased asset value and resilience
- Efficient, adaptable buildings retain value longer and withstand climate risks.
- Stimulate green jobs and local economy
- Renovations, retrofitting and circular-economy activities create local employment.
- Market differentiation and revenue opportunities
- Green certification and products (e.g., bamboo goods) enhance marketability.
- Reduced lifecycle and retrofit costs
- Flexible design lowers future conversion/upgrade expenses.
- Hedge against energy price volatility
- Local energy production reduces exposure to fossil- fuel markets.



2.3 Social Benefits

- Improved health & comfort
- BetterIAQ,daylight, thermal comfortandacousticssupport wellbeing.
- Stronger community & social cohesion
- Public realms, workshops and participatory design foster social interaction.
- Educational & behavioral change
- Demonstration projects and training raise awareness and change consumer habits.
- Equity and accessibility
- Inclusive design and community programs provide wider social benefits.
- Place-making & cultural identity
- Local materials and narratives strengthen cultural continuity and civic pride.
- Safety & resilience
- Naturally resilient design reduces social vulnerability to climate events.

3. Case Study — Studio Project:

Bamboo Recycling Hub

RecyclingTransformationHub


Bamboo Recycling Hub
Recyc l i ng T r an s fo r ma t i on Hub

Project definition

Bamboo Recycling Transformation Hub — a waste-to-material hub that transforms agricultural bamboo waste and broken bamboo furniture into usable building materials and products, reducing the carbon impacts of construction waste and strengthening local circular economy.

Quick project summary

Purpose: Transform bamboo waste into durable materials and products to mitigate CO_2 emissions from building and furniture waste.

Program split (two main zones):

Processing (Building A):

receipt,sorting, washing, drying, cutting, chemical treatment, dust collection, briquetting and preliminary QC — produces ready material.

Using (Buildings C & D + public):

receives processed material and includes:
Education platform — hands-on training, public workshops, demonstrations.
Workshop — fabrication of traditional Malay craft, weaving, textile/fiber experiments and product prototyping.
Display / Shop — exhibition of process (before after), retail of recycled products.

→

Service spine (Building B):

a protected vein that transfers processed material from A to the workshops without crossing public circulation.

Environmental goal:

close the loop — waste → material → product → reuse — while using on-site processing (treatment + drying) and local labour/training to create resilient supply-chains.

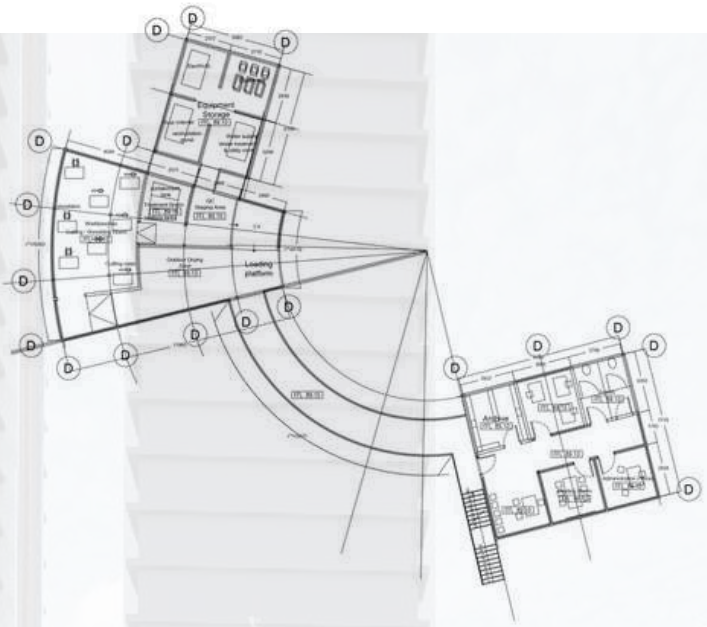
Bamboo-Leaf

The concept

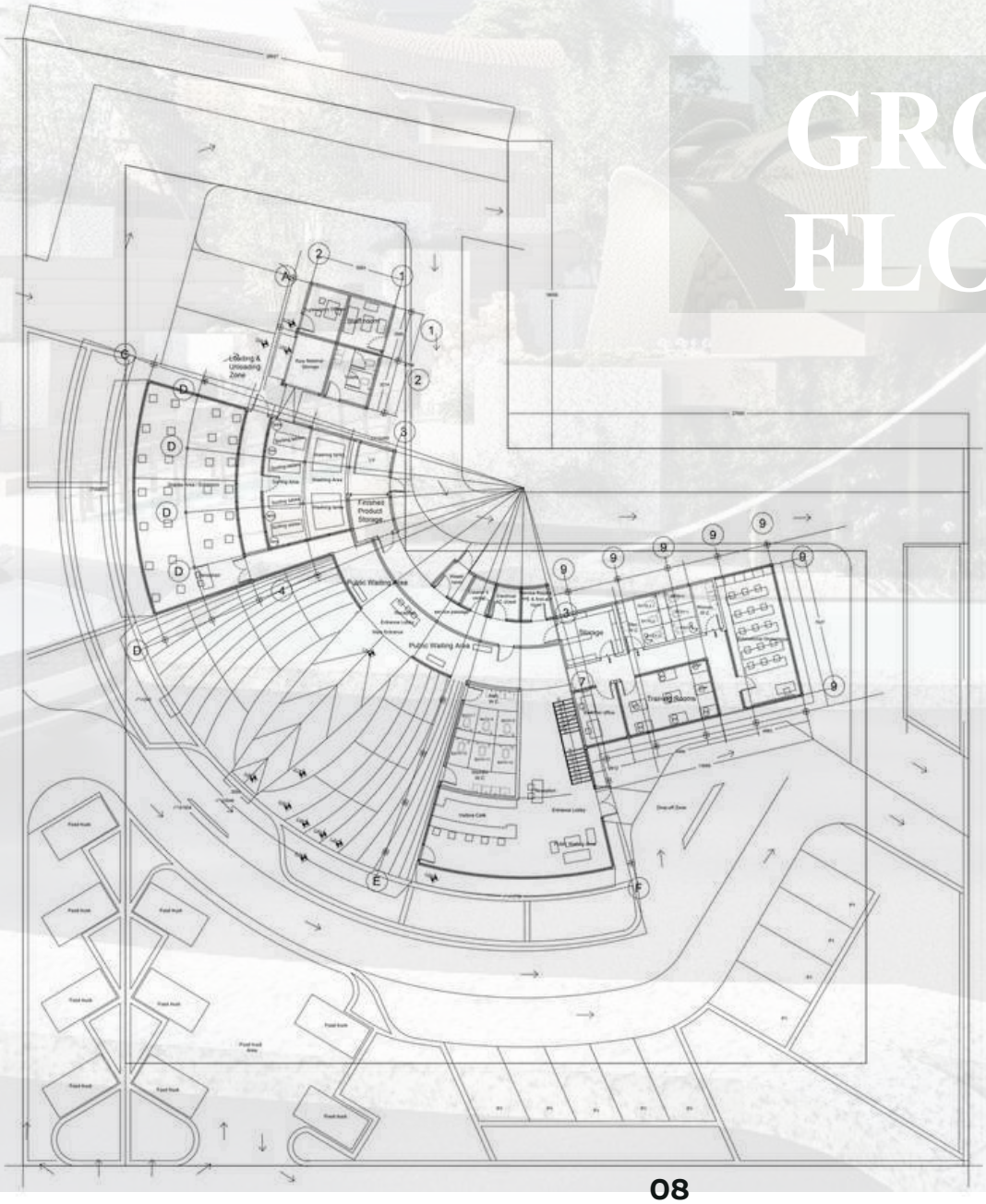
The project's formal and organisational logic is derived from the bamboo leaf metaphor: Building A is the root — the production engine; Building B is the vein — the service artery that feeds material to the creative zones; and Buildings C & D are the leaves — porous, light-filled learning and making spaces that convert material into cultural value. Just as a leaf collects sunlight and distributes energy through its veins, the "leaves" of the hub collect knowledge, people and light: they are oriented, articulated and glazed to invite daylight, cross-ventilation and public gathering, while remaining fed by the logistical root/vein system. The metaphor aligns program with form — circulation, material flows and environmental strategy become readable in plan and section.

SITE PLAN

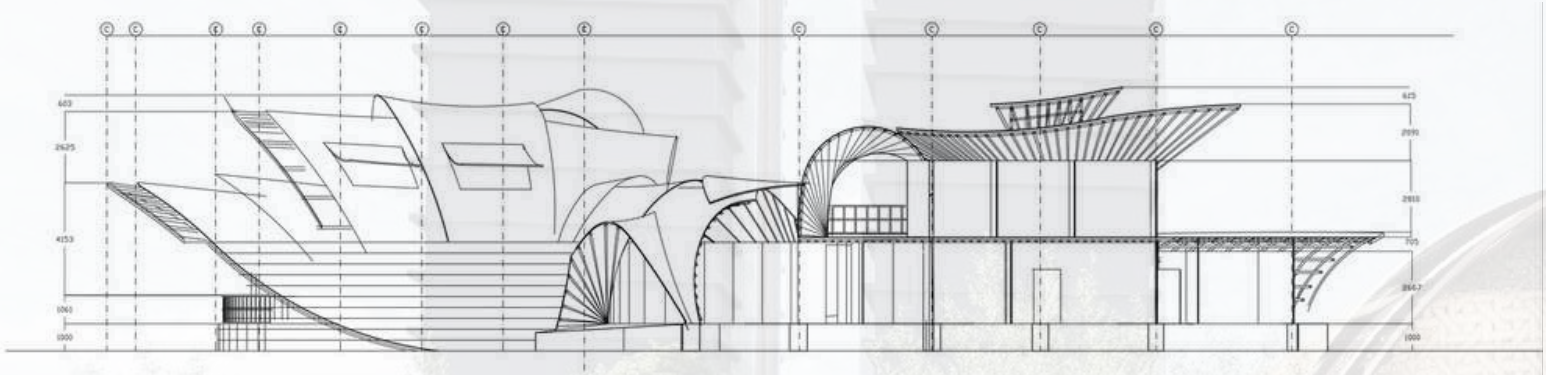
FIRST FLOOR



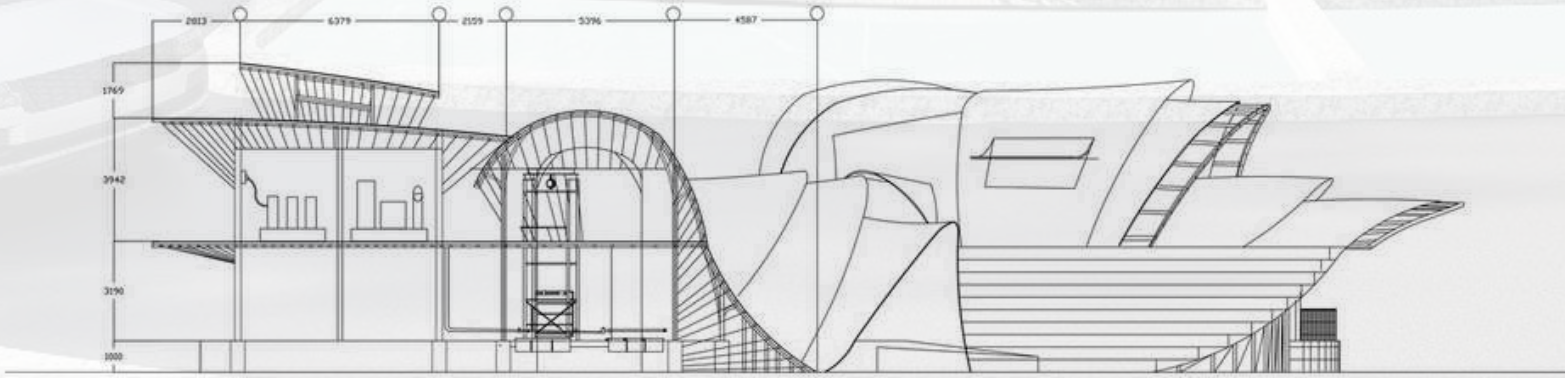
GROUND FLOOR



SECATION A-A



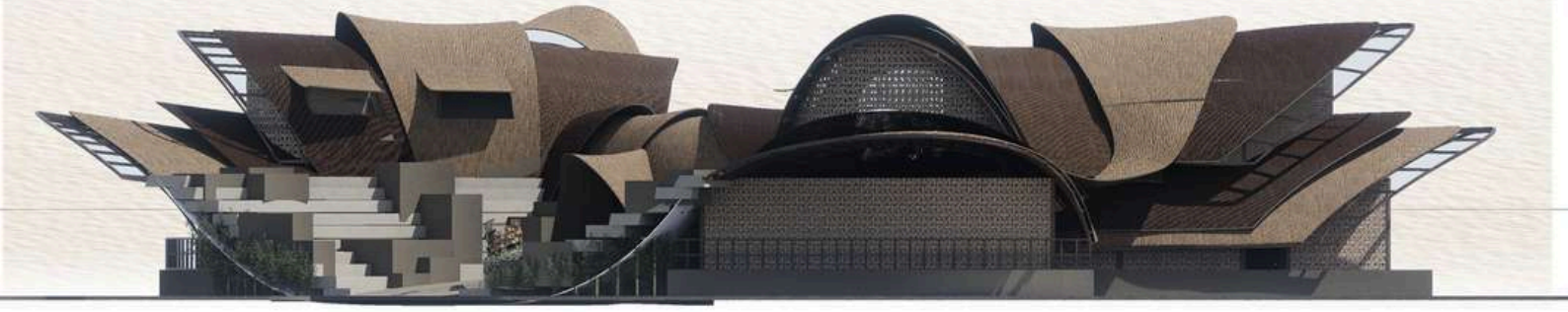
SECATION B-B



RIGHT ELEVATION

LEFT ELEVATION

FRONT ELEVATION



BACK ELEVATION

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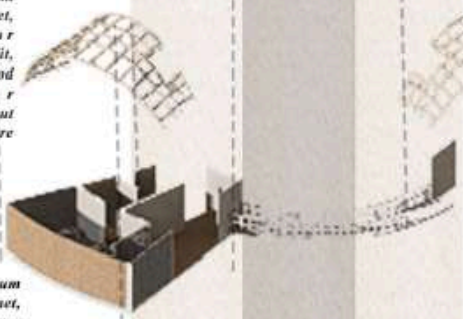

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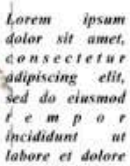

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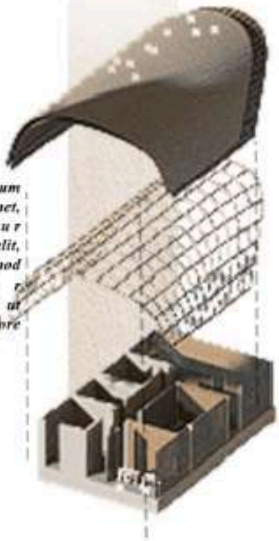

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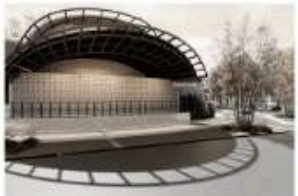
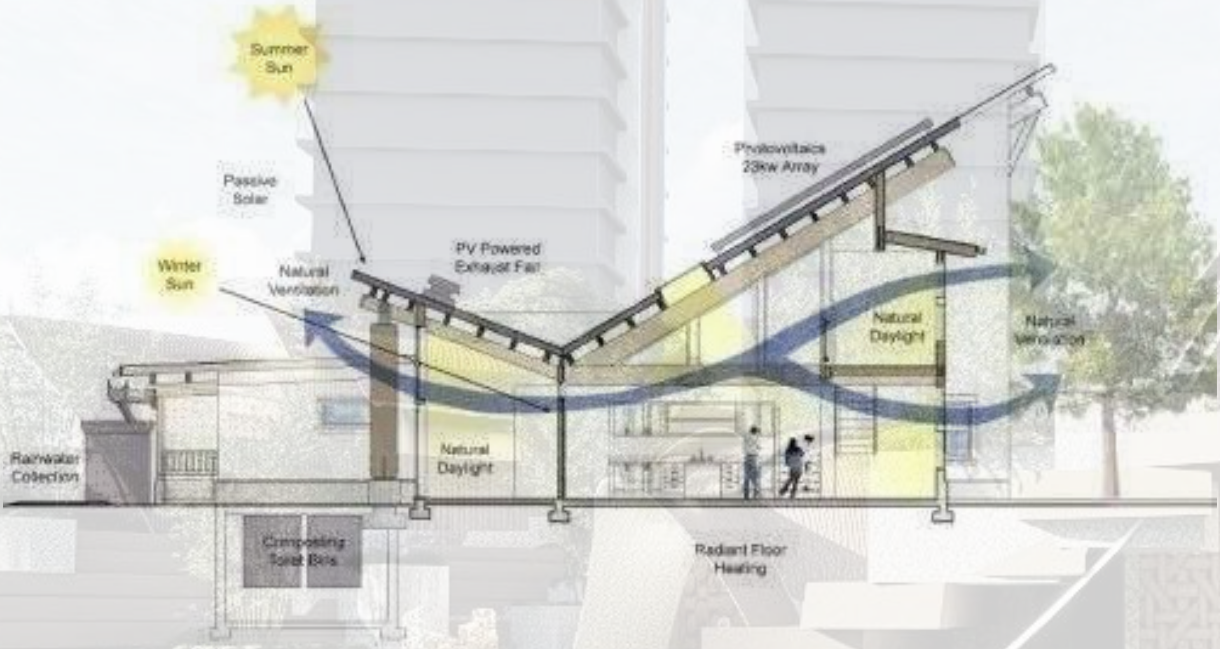


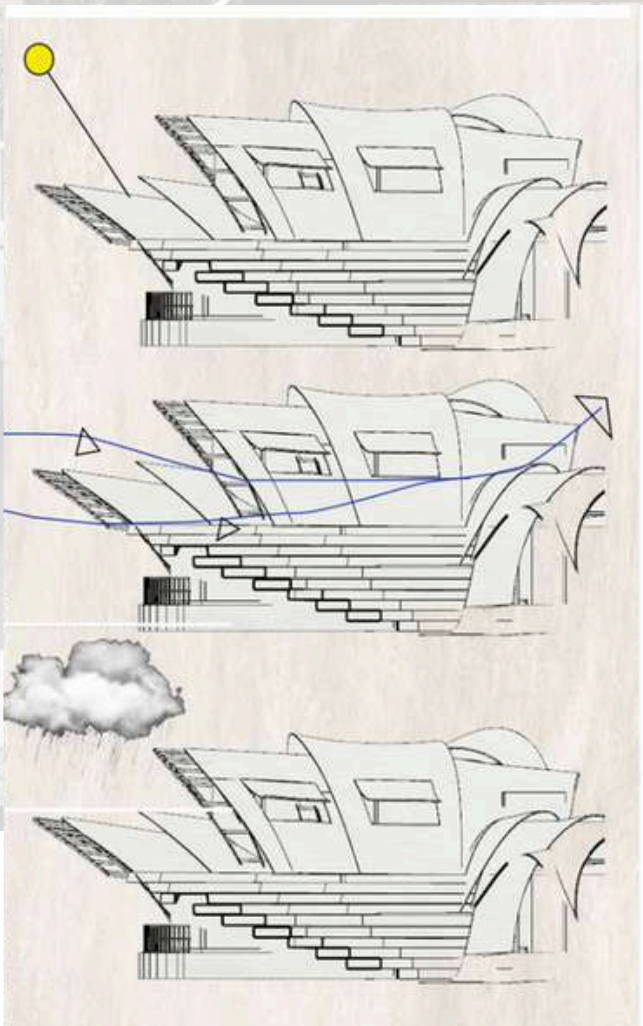
Design strategies

for sustainability

Orientation & ventilation

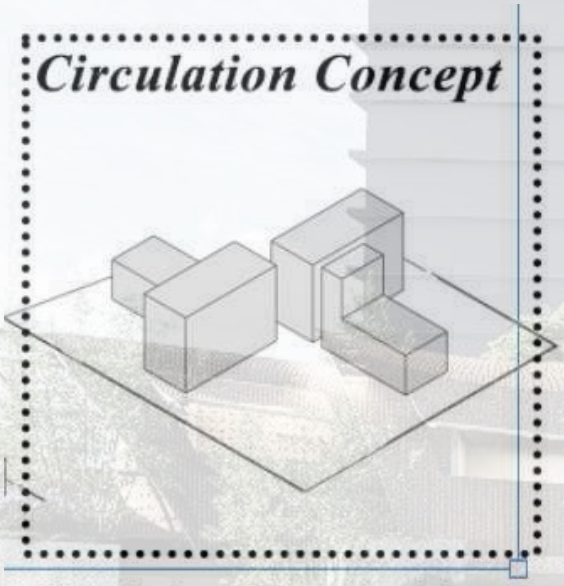
Main axis is east–west; primary natural ventilation is north↔south. Building form and openings are arranged to promote cross-ventilation and stack effect through clerestories and high exhausts. The first-floor link that would have connected C–D was removed to preserve uninterrupted airflow corridors. Drying yards and semi-open racks are oriented toward the sunnier south/south-east for passive solar drying.
Workshop bays incorporate low inlets (south face) and high exhausts (north clerestories) to draw air through cutting and dust-producing zones.





Zoning & circulation

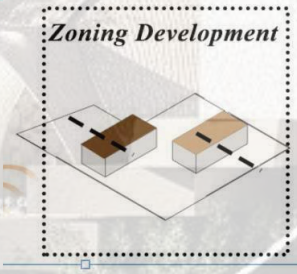
The site is split into two primary zones: a back service/production zone (A + service annexes) and a front user/educational zone (C + D + public landscape).
Circulation is dual: a service/logistics flow runs via Building B (the vein) from the public drop-off to production and from production to workshop; a public/student flow enters through C and D with separate student entrances and locker nodes at D.
Vertical material handling is by dedicated lifts (material up, finished material down), keeping visitor circulation visually separated from heavy logistics.



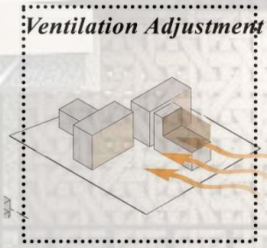
Circulation is inspired by the bamboo leaf: Building A as the root (factory), Building B as the vein (service transfer), and Buildings C and D as the leaves (public and workshops), uniting function and form.

The project is oriented along an east–west axis to maximize natural ventilation from the north–south direction, ensuring comfort and reducing energy use.

Following the Bauhaus philosophy, the recycling process is expressed through three parts: an education platform, a workshop, and a display area, complemented by a factory and dust collection zone.



The site is divided into two zones: the rear for recycling and factory functions, and the front for public use, workshops, and education, creating a clear functional hierarchy.



The first-floor link between Building C and D was removed to avoid blocking cross-ventilation, keeping airflow continuous across the site.

Materials (bamboo waste recycling)

The primary material strategy is reuse of broken bamboo: processed into laminated elements, composite boards, decorative plaster mixes and small prefabricated modules.
On-site treatment (boron/borax bath + controlled drying) and a dust-collection system ensure durability and pest resistance. Material testing and a small in-house lab produce documented performance data to support future specification and approvals.
Bamboo dust is captured and valorised (briquettes, composite fillers, plaster mixes) closing the material loop.

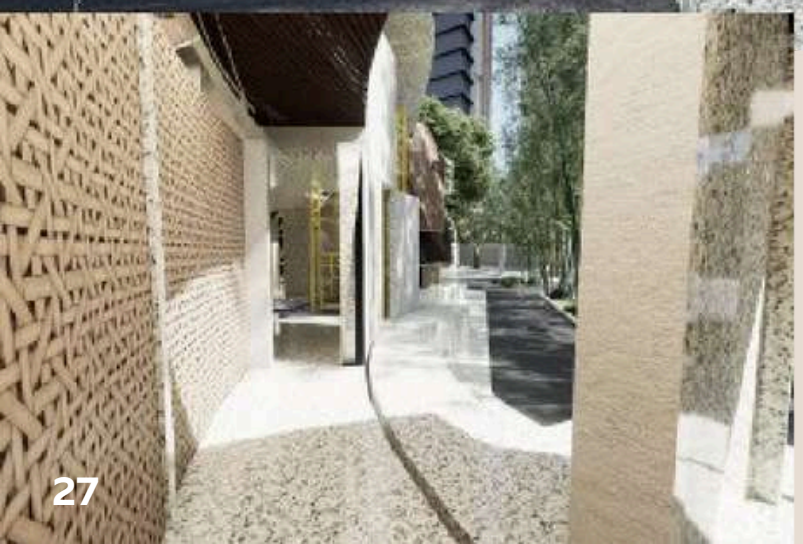
Energy strategies (dust → energy, daylighting, passive systems)

A pilot briquette→ gasifier → generator system consumes workshop dust and briquettes to produce on-site heat/electricity, reducing fossil fuel reliance for drying and small loads.

Passive strategies:

daylighting of non-exhibit spaces, north-lit gallery/display (in A), and shaded openings minimize artificial lighting and cooling demand. Roof terraces are proposed for PV where appropriate.

Rainwater harvesting is captured for washing/processing; greywater is treated and recycled for non-potable uses.



Community integration (food trucks, social landscape)

The public realm retains the food-truck culture: an open social plaza and amphitheatre terraces (roofs stepped to landscape) create seating and observation areas that connect visitors to the production story.
C and D host training, pop-up markets and retail of recycled products; programmed demos and workshops invite community learning and behavioral change.

Sustainable features

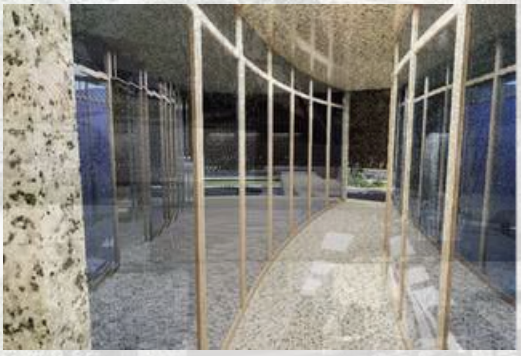
Building A — Processing & Display (the Root)

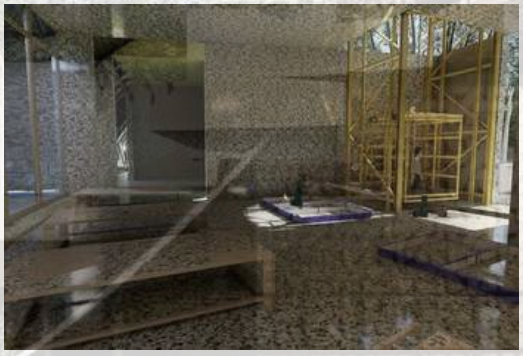
Ground floor:

drop-off / receiving, sorting conveyor/tables, heavy washing troughs and drain infrastructure, visible sorting/display zone for “before → after” education.

First floor:

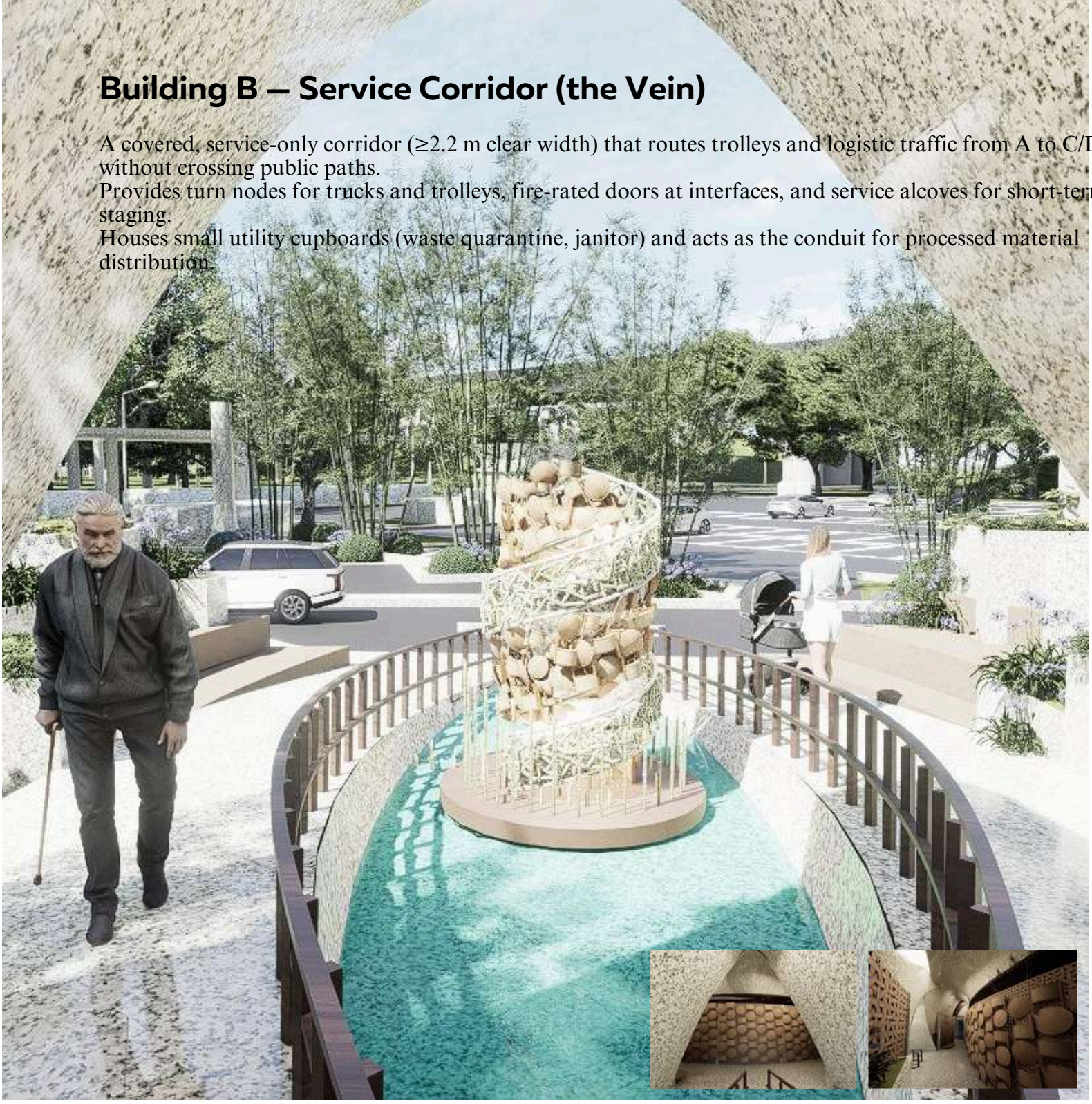
semi-open solar drying racks, cutting and splitting bays, dust collection with bagfilters, mechanical briquetting and small treatment tanks (boron bath), treatment/QC lab and a small tool/maintenance room.
Integrated briquette pilot and gasifier (sited in a semi-outdoor service yard with required safety setbacks) feed a small gas-engine generator.
Material reuse: composite panel production, plaster mixes with bamboo dust, and finished goods display adjacent to the public route for storytelling.





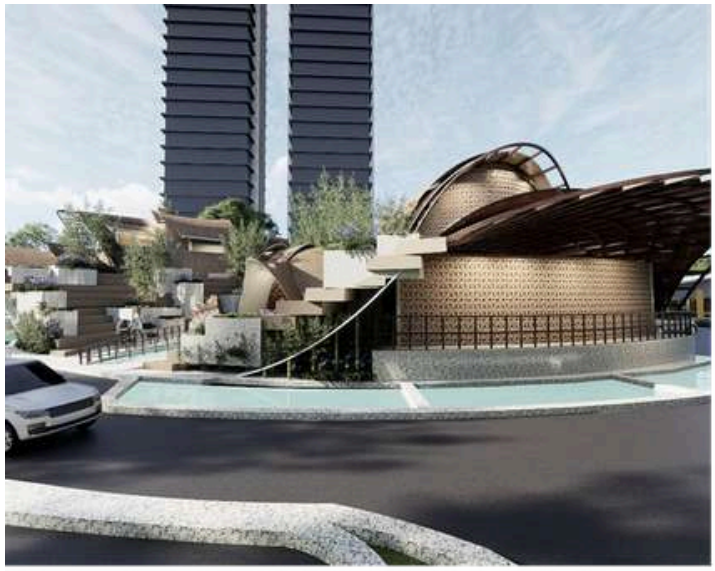
Building B — Service Corridor (the Vein)

A covered, service-only corridor (≥2.2 m clear width) that routes trolleys and logistic traffic from A to C/D without crossing public paths.
Provides turn nodes for trucks and trolleys, fire-rated doors at interfaces, and service alcoves for short-term staging.
Houses small utility cupboards (waste quarantine, janitor) and acts as the conduit for processed material distribution.

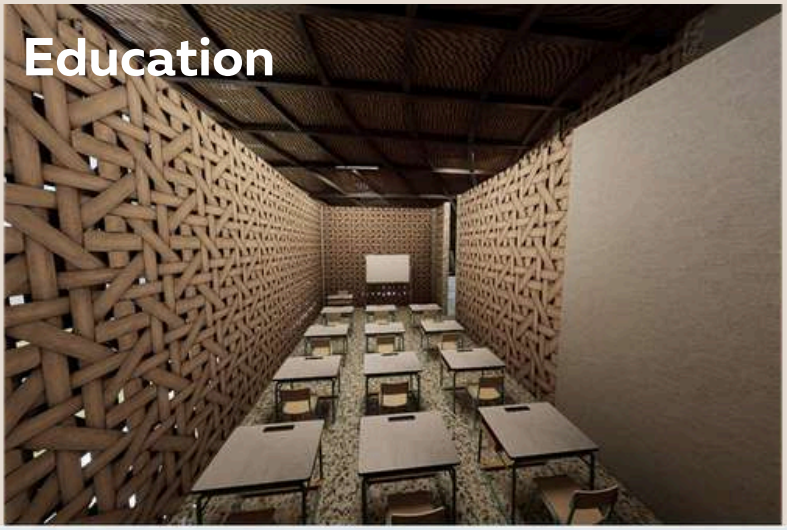


Building C — Reception & Admin (front leaf)

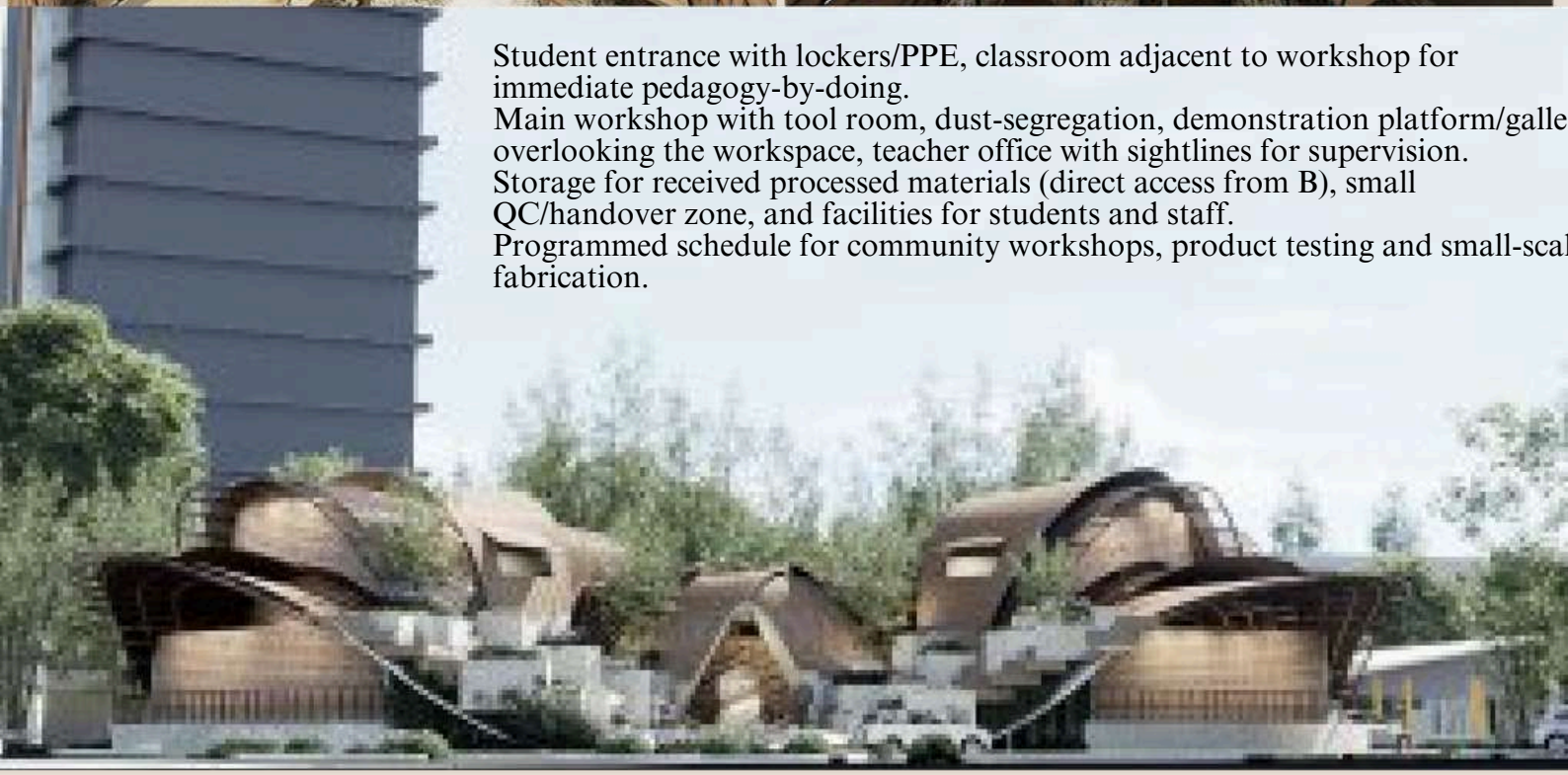
Ground floor reception, ticketing/retail shop for products, visitor WC and back-of-house retail storage.
First floor administration, meeting room and staff amenities.
Visual control points and an observation slit/glazed gallery allow supervised views into Building A's display sequence (but no direct public access to production zones).
Rainwater harvesting header and small plant room for central services.



Building D – Education & Workshop (public leaf)



Student entrance with lockers/PPE, classroom adjacent to workshop for immediate pedagogy-by-doing.
Main workshop with tool room, dust-segregation, demonstration platform/galle overlooking the workspace, teacher office with sightlines for supervision.
Storage for received processed materials (direct access from B), small QC/handover zone, and facilities for students and staff.
Programmed schedule for community workshops, product testing and small-scal fabrication.



Conclusion

6.1 Summary of Key Sustainable Strategies

TheBamboo Recycling TransformationHubapplies a full-cycle sustainability model:

- Material circularity: conversion of bamboo waste (agricultural residues, broken furniture) into usable building products and briquettes.
- Energy optimisation: use of bamboo dust briquettes in a pilot gasifier, passive solar drying, cross-ventilation and daylighting strategies to minimise operational energy.
- Water management: rainwater harvesting and greywater reuse for washing and processing.
- Climate-responsive design: east–west orientation for buildings, north–south ventilation corridors, and semi-open drying terraces.
- Community integration: education, workshop and display zones invite public participation, linking waste awareness with traditional Malay craft.

6.2 Reflection on Design Process

Thedesign processdevelopedfrom site climate analysis and zoning into a coherent metaphor — the bamboo organism. This guided spatial separation between processing (root), service corridor (vein), and public/educational functions (leaves). Iterative steps included:

- canceling upper floors where they obstructed ventilation,
- aligning circulation with separate user/service flows,
- integrating broken bamboo as both material and concept.
- The process shows how concept, environmental logic, and program can evolve together into a holistic architectural language.

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Thank
You!