Ministry of Climate Change
Government of Pakistan

Green Building Guideline
for Prime Minister's Five Million Naya Pakistan Housing Programme

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In collaboration with

switchasia

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2) The sketches and pictures contained herein are for conceptual purposes only, and are to be used as general visual aids in understanding the basic intent of Guideline. They are not meant to depict any actual lot or building design.
3) This is an introductory Guideline and is not a definitive source of legal information. It has been influenced by content from the Policy Guidelines for Green Building Code in Pakistan 2018, prepared for the Federal Ministry of Climate Change in collaboration with the EU Switch Asia programme, in collaboration with UN Habitat and NUST.
4) The Ministry of Climate Change and the EU SWITCH-Asia programme acknowledge and thank the Authors and Publishers of various documents and publications, from where the sketches and photographs have been included in present Guideline.

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Preface

The present Green Building Guideline for the Prime Minister's Five Million Naya Pakistan Housing Programme has been prepared to drive change in the housing and building practices in Pakistan. This Guideline is advisory in nature and aims to incorporate the lessons learnt in on green and eco-friendly practices of building design, construction & operation stages; besides, ensuring the sustainable utilization of construction materials to save energy, conserve water, improve indoor environmental quality and lower GHG emissions.

The Guideline is the first step towards achieving the goal of greening the building and housing sector. It is a means of driving continuous improvement and green innovations in housing and building which will improve the overall environment benefit as well as long term economic efficiency in the building sector.

The Guideline provides standards for key elements of design and construction to facilitate the development, construction and operation of green buildings in Pakistan. It will serve as a guideline to be used by the planners, architects, builders and the owners of green housing, and all other concerned stakeholders.

The Green Building Guideline will therefore facilitate adoption of green building practices in the Prime Minister's five Million Naya Pakistan Housing Programme.

Key principles of the Green Building Guideline

The Green Building Guideline is based on minimum performance levels in energy efficiency, carbon dioxide emissions; water conservation; site and household waste management; and use of construction materials. It complements conventional building design principles focusing on economy, durability, serviceability and comfort.

Green building principles prioritise the efficient use of water, optimize energy efficiency, conserve natural resources, generate less waste and seek to provide healthier spaces for occupants, as compared to conventional building standards.

Message from the Advisor to the Prime Minister on Climate Change

The sustainable future depends on dissemination of knowledge and participation of the people, as well as an understanding of the consequences of Climate Change. Building and construction activity has long been associated with the harmful effects to our mother earth due to increasing consumption of material and a major part of energy in buildings and their maintenance. A shift to green building is therefore the primary strategy to ensure greening of housing sector in Pakistan.

Green construction calls for a building which is designed, built, operated and maintained to protect occupant health, improve employee productivity, use wisely natural resources and reduce the environmental impact. Green building process focuses on the design, construction, operation and maintenance phases and considers design and development efficiency, energy and water efficiency, resource efficiency, indoor environmental quality, building-owner maintenance and the building's overall impact on the environment.

At present, Pakistan is inefficient in eco-friendly production and use of natural resources and materials. The adoption of a Green Building Guideline aims at ensuring resource efficiency in consumption of building materials, as well as water and energy use. Implementation of this guideline will result in substantial growth of greener construction activities throughout Pakistan and will lead to the successful implementation of the Prime Minister Five Million Naya Pakistan Housing Programme.

The concept of Green Housing as envisioned in the 'Policy Guidelines for Green Building Code' prepared by Ministry of Climate Change provides a new approach to save water, energy and material resources besides reducing the adverse impact of buildings on the environment and occupants. It is hoped that the guideline will serve as a base for developing Green Building Code for Pakistan and its implementation will result in greening the building construction sector in the country.

I acknowledge the valuable support provided by EU SWITCH-Asia Programme, UN Habitat and NUST through technical assistance provided by Mr. Jawed Ali Khan; Mr. Abdul Qayyum; and Dr. Bilal Sajid in developing the Green Building Guideline. I am sure this will go a long way in contributing to the adoption of Green Building Practices in Prime Minister Five Million Naya Pakistan Housing Programme as well as formulation of Green Building Code for Pakistan.

Mr. Malik Amin Aslam Khan
Advisor to the PM for Climate Change

Executive Summary

The “Green Building Guideline for Prime Minister’s Five Million Naya Pakistan Housing Programme” is the first-step towards achieving the goal of greening the housing sector. It is advisory in nature and aims to drive a change in the housing through eco-friendly practices of building's design, construction & operation stages; besides, ensuring the sustainable utilization of construction materials to save energy, conserve water, improve indoor environmental quality and lower GHG emissions. It will serve as a guideline to the planners, architects, builders and the owners of green buildings.

The Green Building Guideline will therefore facilitate adoption of green building practices in the pilot of Prime Minister’s Five Million Naya Pakistan Housing Programme. The lessons learnt from the pilot implementation of the Green Building Guideline will help in preparing for the Green Building Code for Pakistan which is being pursued by EU SWITCH-Asia SCP Facility for the Ministry of Climate Change, in collaboration with UN-Habitat and other concerned stakeholders.

The Guideline proposes minimum performance levels in energy efficiency, carbon dioxide emissions; water conservation; site and household waste management, optimize energy efficiency, conserve natural resources, generate less waste and provide healthy spaces for occupants. It complements the conventional building design focusing on economy, durability, serviceability and comfort.

The structure of the Guideline follows the Life Cycle approach, incorporating elements pertaining to the construction and performance of buildings. It emphasizes on adoption of site sustainability measures at the initiation of the green building construction process such as erosion and sedimentation control plan, open space utilization plan, siting of building as per wind and sun direction, building orientation, and other considerations.

With respect to building design, it requires ensuring measures for optimal utilization of natural ventilation and lighting, minimizing heat and glare. With regard to conserving energy, roof and walls insulation, sealing of doors and windows, and air leakage in the building envelop are of relevance. Further, achieving energy efficiency in water and lighting and other electrical applications and use of renewable energy for moving towards clean energy sources are important.

The Guideline also suggests measures for water conservation and management to achieve water efficiency through rain water harvesting, efficient water conservation practices and fixtures as well as recycling of gray water to reduce excessive burden and dependence on the public water supply system.

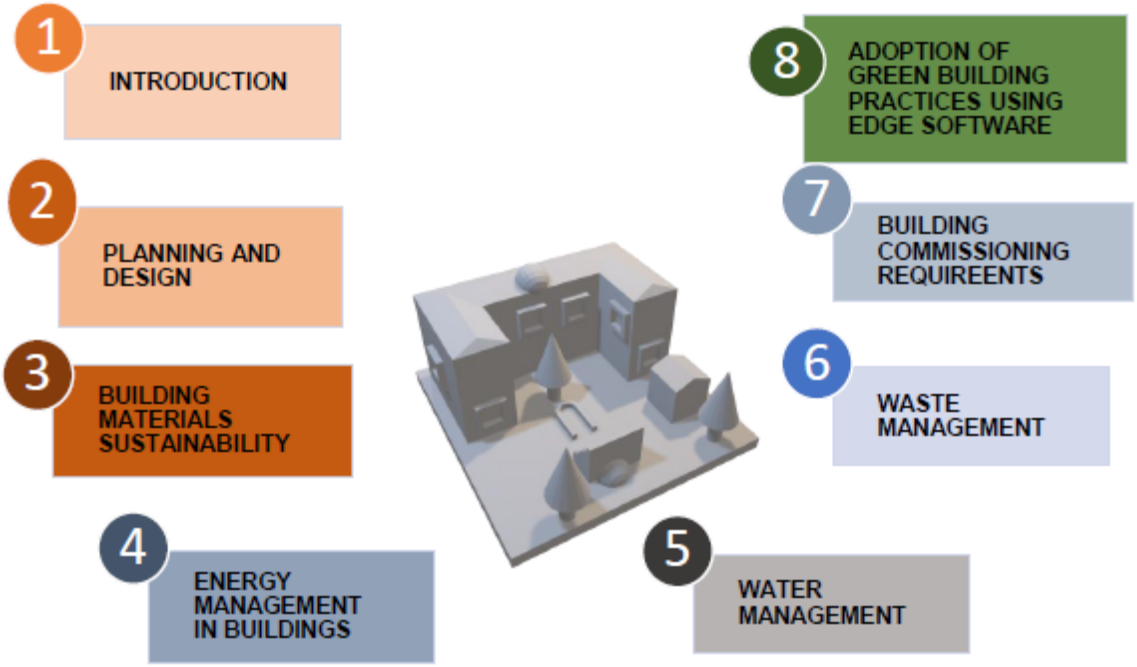
The Guideline also proposes development of Waste Management Plan for reduction of non-renewable resources, material recovery facility, establishment of integrated resource recovery centers for solid and liquid waste management and on-site waste water recycling.

To minimize environmental impacts, the Guideline suggests to investigate the existing environmental condition of the site, comprising local geography, hydrology, vegetation, existing infrastructure and cultural & historical assets to protect the environmental resources.
The green housing’s planning system also emphasizes on transition to a low carbon future in a changing climate, taking full account of varying conditions like heat waves, excessive rains, flood risk, etc. It should help to shape living places in ways that contribute to radical reductions in greenhouse gas emissions, minimize vulnerability and improve resilience; encourage the reuse of existing resources, including the conversion of existing buildings; and support renewable and low carbon energy

and associated infrastructure thus, all new buildings will result in improved building performance and a more sustainable built environment.

The Guideline recommends to use EDGE simulation software for assessment of resource efficiency features (energy, water and materials) for buildings constructed under the Prime Minister Housing Programme. The software EDGE allows for design and assessment of residential buildings for various income categories i.e. low, lower middle, upper middle and high as well as for apartments/flats. Any combination of resource efficiency measures can be selected according to local conditions and requirements. At present, EDGE in Pakistan includes seven (07) different climatic regions (Islamabad, Rawalpindi, Lahore, Karachi, Peshawar, Quetta, Gilgit) and this can easily be extended further. Since this is a very user-friendly software it does not necessarily require specialized expertise in engineering or architecture. Therefore, EDGE appears as an ideal choice for capacity building and training of various professionals and stakeholders involved in PM 5-million housing project. The steps involved in designing a residential building using EDGE are delineated.

The Guideline puts forward the adoption of a mechanism to undertake periodical review of building systems, including mechanical, electrical and plumbing, during construction and post-completion stages; as per the green building requirements and approved plan/design of green building. This ensures achieving the goals of greening the building and construction sector in Pakistan.



SECTION 1: INTRODUCTION

1.1 PRIME MINISTER FIVE MILLION NAYA PAKISTAN HOUSING PROGRAMME

Objective: To trigger planned development and socio-economic growth, through construction of safe, sustainable and affordable Five Million Housing, along with the mechanisms to accelerate production of housing; and regularize and upgrade Katchi Abadis throughout Pakistan.

The Prime Minister Five Million Naya Pakistan Housing Programme (**PM5MNPHP**) aims to:-

- develop conducive environment through adequate and enforceable codes, bylaws, standards and regulations in housing sector,
- identify suitable land for five million housing and compliance of land use and zoning regulations for sustainable area development,
- streamline building codes, bylaws, standards and regulations in-line with climate change adaptation and Carbon emissions control measures,
- standardize building components and fixtures through public-private partnerships,
- promote energy efficiency, water conservation and waste management, and
- develop primary and secondary housing finance markets, along with facilitative instruments to mobilize housing finance for low-income housing.

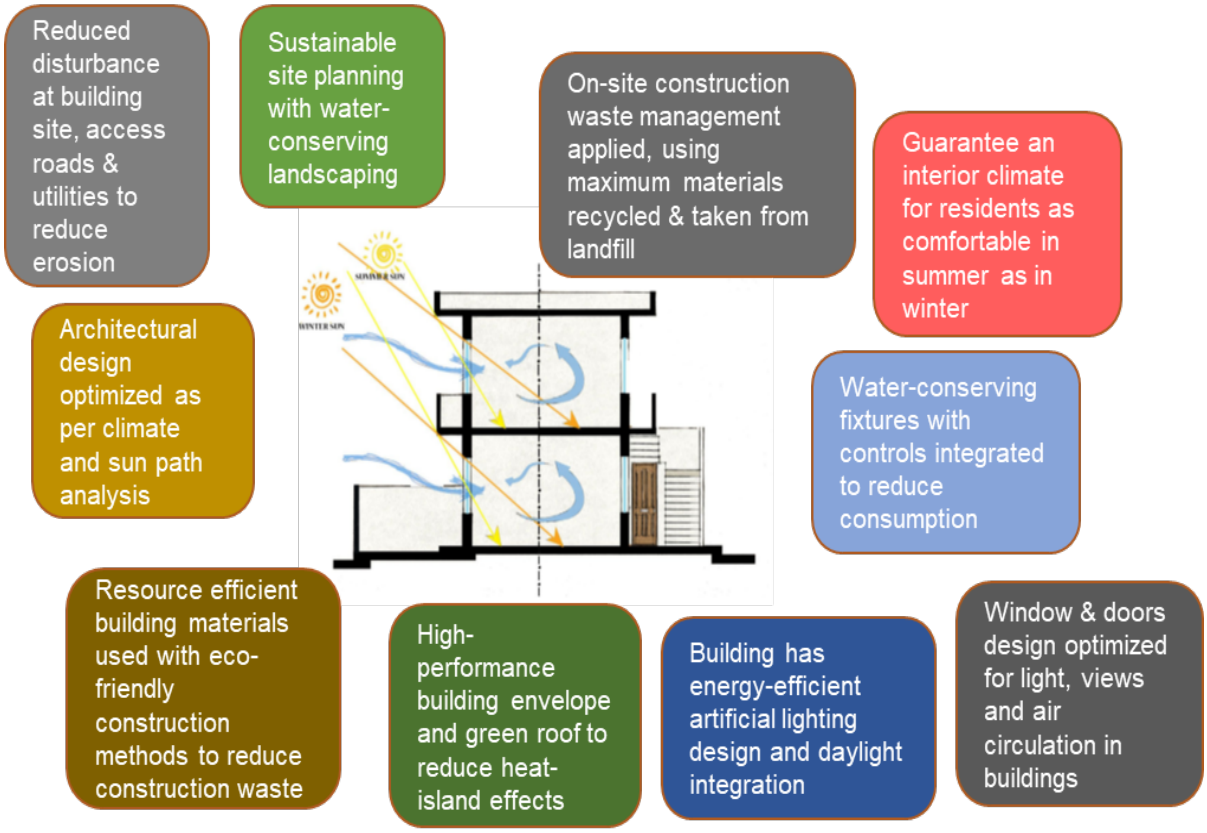
The implementation of PM5MNPHP will result in substantial growth of construction activities throughout Pakistan, and increase the resultant Carbon emissions besides the incremental consumption of environmental resources in shelter sector. Thus, the adoption of green building practices in this Programme will be a major step to minimize the negative impacts of construction activity on the environment. Present building codes and regulations alone are not sufficient to promote green buildings. Therefore, the awareness of adopting green building techniques among decision-makers, architects, engineers, planners and developers can play a pivotal role along with incentivizing the whole process.

The Ministry of Climate Change has developed present Green Building Guideline to disseminate an introduction of key concepts and practices essential for building and operating green homes; and to reduce the overall impact on built environment, human health and consumption of natural resources. It will supplement the Government initiatives towards adopting sustainable measures in Five Million Naya Pakistan Housing Programme; besides, minimizing the negative impact of buildings on environment.

The supply of large number (5 million) new homes can be best achieved through planning for larger-scale developments, and working with the local authorities to identify suitable locations for such projects. In doing so, the PM5MNPHP Authority should adopt this Guideline in planning, designing and construction of new housing and walk-up apartments up to 05 storey above ground level; and:

1. consider the opportunities presented by existing or planned investments in infrastructure, the area's economic potential & the scope for environmental gains;
2. ensure that their size & location will support a sustainable community, with easy access to services & employment opportunities within the development itself;

3. set clear expectations for the quality of development & how this can be maintained, and ensure that a variety of homes to meet the needs of different groups in the community will be provided;
4. make a realistic assessment of likely rates of delivery, given the lead-in times for large sites, and identify opportunities for supporting rapid implementation (such as through joint ventures or locally-led development corporates); and
5. establish Green Belt around or adjoining new developments along with quality open spaces for sports and recreation for health and well-being of communities.



GREEN BUILDING GUIDELINE

The Green Building Guideline supports the implementation of the Prime Minister's Five Million Housing Naya Pakistan Housing Programme (PM5MNPHP), and should be read as a whole and in conjunction with the Government Policies of Housing, Urban Development and Environment; and including the:

- **Infrastructure** for waste management, water supply, wastewater, flood risk, and the provision of building materials and energy;
- **Community Facilities** (such as health, education and cultural infrastructure);
- **Conservation** and enhancement of natural and built environment, including green infrastructure; and
- **Planning** measures to address climate change mitigation and adaptation.

Green Building

A green building is one, whose construction and lifetime operation assure the healthiest possible environment, while ensuring the most efficient and least disruptive use of land, water, energy and resources. Green housing and low-rise apartments to be built under the PM5MNPHP call for adopting a Green Guideline to ensure that the building is designed, constructed and operated at optimal standards. The key features of a green building including housing include the following:

- Sustainable site planning with water-conserving landscaping.
- Reduced disturbance at building site, access roads & utilities to reduce erosion.
- Architectural design optimized as per climate and sun path analysis.
- Resource efficient building materials used with eco-friendly construction methods to reduce construction waste.
- High-performance building envelope and green roof to reduce heat-island effects.
- Window & doors design optimized for light, views and air circulation in buildings.
- Building has energy-efficient artificial lighting design and daylight integration.
- Water-conserving fixtures with controls integrated to reduce consumption.
- Guarantee an interior climate for residents as comfortable in summer as in winter.
- On-site construction waste management applied, using maximum materials recycled & taken from landfill.

Who is this Guideline for?

This is a performance-based Guideline to provide guidance for developing the green residential developments in urban areas of Pakistan. Specifically, it:

- Guides developers, urban designers, architects, landscape architects, builders and other professionals when designing green housing and low-rise apartments.
- Assists planning professionals in local governments with strategic planning and in the preparation of local controls, design guidelines and the assessment of development proposals.
- Informs the community on the principles of green design and planning practices for the development of residential places.

1.2 GENERAL PROVISIONS

1.2.1 Title

This document shall be known as the “Green Building Guideline for Prime Minister’s Five Million Naya Pakistan Housing Programme”, hereinafter referred to as the “GBG”. This Guideline is a set of regulations setting minimum standards for compliance, and not intended to rate the compliance of green practices in buildings.

1.2.2 Objective

The “GBG” aims to protect the people of Pakistan against the harmful effects of climate change, and safeguard the environment, property and public health; and for this purpose, prescribes the acceptable set of standards and requirements for the residential buildings, by regulating their location, site-planning, design, quality of material, construction, indoor comfort, operation and maintenance.

1.2.3 Scope

The requirements contained in this Guideline are applicable to the residential buildings, and the buildings constructed in accordance with this Guideline are deemed to comply with these requirements.

1.2.4 Definition of Terms

The words, terms and phrases as used in this Guideline shall have the meaning or definition as indicated in the preceding Glossary.

1.2.5 Green Building Strategies

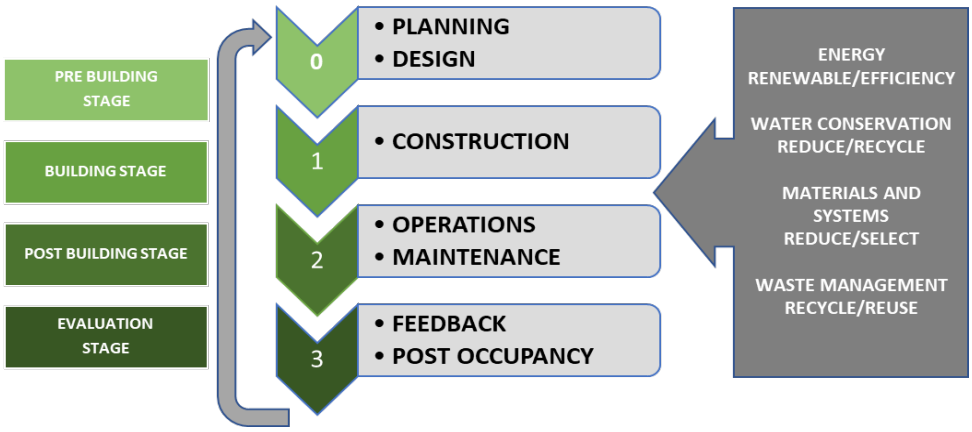
The green building strategies need to address the:

- adverse effects of climate change, by ensuring that housing is planned, designed, constructed, operated & maintained to the required efficiency level;
- resource scarcity and external costs arising from resource use; resources must be used efficiently to equitably meet the developmental and environmental needs of the present and future generations; and
- health and wellbeing implications of buildings, in particular housing: the occupants of green housing will benefit from improved the indoor environmental quality, which promotes higher productivity and better comfort.

Accordingly, the present Guideline recommends an incremental approach, and it is subject to the periodic review by the Competent Authority to modify the existing provisions; or include new aspects and emerging efficient technologies; and to expand the coverage to other buildings use; or replace the outmoded measures.

1.2.6 When to apply Green Strategies?

At the **Annex 1**, a Table informs about various stages for applying green building strategies, highlighting as to when to consider major design issues, systems and components.



1.3 ENVIRONMENTAL PREREQUISITES

For ensuring the appropriate site selection and minimize the environmental impacts involving minimal depletion of natural resources, do not locate, plan and construct the green building or housing at following locations.

- In forests or land that requires extensive deforestation
- On un-drained soils
- Close to waterways and water bodies (rivers, riparian zones)
- One kilometer radius of critical wildlife habitats
- Steep slopes
- Hill or mountain tops (crest)

1.3.1 Environmental Impact Assessment

For all green buildings including the residential areas, investigate the existing environmental condition of the site, i.e. local geography, hydrology, vegetation, existing infrastructure and cultural & historical assets.

Undertake an Environmental Assessment of the project, including the following; and accordingly develop a strategy to protect the environmental resources.

- Environmental assessment scope, findings and implications to design
- Site Maps
- Climate & Hydrology
- Soil & Vegetation
- Previous Developments (If any)
- Human health and well being
- Photographs
- Any other requirements requested by Pakistan Environmental Protection Agency

1.3.2 Minimize Use of Depleting Resources

Byelaws for construction of new green housing should include the following.

- Minimize the use of fresh wood. Where necessary, the wood of fast regenerated trees be used.
- Set the annual carbon emission targets for all newly constructed buildings.
- Achieve a 20% reduction in GHG/Carbon emissions from dwellings and up to 25% from buildings other than dwellings.
- House-holders of new homes must curtail estimated energy costs for space heating, water heating, ventilation and lighting used in the dwelling.
- Building developers to make greater use of energy saving insulation, more efficient heating boilers and use low or zero carbon systems (solar panels, geothermal technology) to demonstrate the energy efficiency compliance.

1.3.3 Indoor Environmental Quality

The buildings' indoor environment contains more contaminants than the outside. Indoor air contaminants can cause health disorders. Indoor environmental quality in green housing be ensured through adopting efficient design and operation practices, which aim to improve the house-residents' living and health; e.g.

- Plan to provide appropriate fresh air ventilation throughout the green housing.
- Vent all fuel-fired combustion appliances in kitchens to the outdoors (including stoves, heaters and furnaces).
- Install and use exhaust fans vented to the outside when cooking.
- Avoid the use of unvented stoves, fireplaces or space heaters indoors.

Other indoor environmental factors that have particular influence on people's health, comfort and productivity include:

- Plan & geometry of the Housing and rooms
- Good design, materials and colour scheme
- Perceived room temperature
- Humidity in the room
- Air quality in the room (contents of the air in room/hazardous substances)
- External air ventilation/air circulation
- Natural and artificial lighting
- Building acoustics/noise emissions
- Technical/mechanical installations and furnishing

1.3.4 Landscape Design

Good landscape design integrates the green housing and apartments development with the existing ecology, enhances natural systems and contributes to tree canopy and biodiversity within the locality. It improves the amenity of pedestrians and building occupants, through the creation of open spaces, connection to nature, provision of shade and micro-climate benefits. The inclusion of landscape elements is therefore an important aspect of green housing design in highly-urbanized environments. Landscape design needs to incorporate the design of deep soil areas, other open space and planting areas located on podiums, terraces, walls and roofs.

Landscape design should respond to existing site and environmental conditions, taking advantage of views, topography, soil profiles and significant existing landscape features such as existing trees and drainage patterns. It should be environmentally sustainable, considering local environmental conditions and constraints. Consider appropriate plant selection, preferring the use of native or endemic species or non-invasive. Select water wise plants, minimizing the use of turf, unless sustainable water harvesting and reuse systems are used; including the use of sub-surface irrigation and irrigation systems with rain and soil moisture sensors. Go for maximized use of permeable surfaces to allow infiltration of rainwater and providing water efficient garden beds for residents to plant vegetables and herbs.

Landscape design can play an important role in enhancing the micro-climate and improving the thermal performance of buildings. Strategies may include the plant selection to suit winter and summer sun positions, consider the direction of prevailing winds, providing a balance of evergreen and deciduous trees to provide shading in summer and sunlight access in winter, make green roofs or green-walls/façades along with other vertical greenery to shade, cool the building by utilizing materials with high reflectivity, low heat conductivity, shade structures such as pergolas in open space, and closed-system water features that can cool through evaporation.

All gardens require maintenance. Allocate an area for this to be undertaken and allow the storage of gardening equipment.

Planting along internal courtyard walls help create a shaded-attractive space

1.3.5 Protecting Green Belts

The green housing initiative must attach great importance to the green belts, as this prevents the urban sprawl by keeping land permanently open; and serves the following purposes.

- Check the unrestricted sprawl of large built-up areas.
- Prevent neighbouring towns merging into one another
- Assist in safeguarding the countryside from encroachment.
- Preserve the setting and special character of historic towns.
- Assist in urban regeneration, by encouraging the recycling of derelict and other urban land.

1.3.6 Ground Conditions & Pollution

Green housing planning should ensure that new developments are appropriate for respective sites and/or locations, taking into account the likely effects of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of a site or wider area to the impacts that could arise from development.

The green housing planning & development should sustain and contribute towards the compliance of relevant limit values or Environment Policy objectives for pollutants, and the cumulative impacts from individual sites in local areas. Opportunities to improve air quality or mitigate impacts should also be identified, such as through traffic and travel management, and green infrastructure provision and enhancement.

1.3.7 Meeting Climate Change Challenges

The green housing's planning system should support the transition to a low carbon future in a changing climate, taking full account of varying conditions like heat waves, excessive rains, flood risk, etc. It should help to shape living places in ways that contribute to radical reductions in greenhouse gas

emissions, minimize vulnerability and improve resilience; encourage the reuse of existing resources, including the conversion of existing buildings; and support renewable and low carbon energy and associated infrastructure.

Green housing and apartment's development plans should take a proactive approach to mitigating and adapting to climate change, taking into account the long-term implications for flood risk, seasonal change, water supply, biodiversity and landscapes, and the risk of overheating from rising temperatures. Policies should support appropriate measures to ensure the future resilience of resident communities and infrastructure to climate change impacts, such as providing space for physical protection measures, or making provision for the possible future relocation of vulnerable development and infrastructure.

New physical developments in areas which are vulnerable should ensure that climatic risks can be managed through suitable adaptation measures, including the planning of green infrastructure; and reduce greenhouse gas emissions through their location, orientation and design. Any local requirement(s) for the sustainability of buildings should reflect the Government Policies for Environment and Climate Change.

1.3.8 Sustainable Future

To avert a climate disaster, it is the duty of housing development planners, architects & engineers, and the construction industry to act and lead the transition to a sustainable future that delivers the UN Sustainable Goals. Buildings take years to design & construct, and have a lifespan that goes on for years after that. Every single kilogram of Carbon Dioxide that is emitted in the making of materials for that building (the upfront carbon emissions) goes against that carbon budget, as do operating emissions and every liter of fossil fuel used to drive to that building.

Best practices trajectory for the construction professionals is to design buildings, which reduces the Operational energy demand; Embodied carbon; Potable water use; and Achieve all core health and wellbeing targets. The best place to start is to go **Passive first** i.e. Use a form, fabric and landscape, which optimizes the ambient:

- Lighting, heating, cooling and ventilation;
- Location, orientation, massing, protection and shading;
- Windows, day lighting, ventilation, solar and acoustic control; and
- Insulation, airtightness and thermal mass.

SECTION 2: PLANNING AND DESIGN

2.1 SITE SUSTAINABILITY

Site sustainability requires the adoption of planning, design, construction and operation practices that minimize the adverse impact of green buildings on the ecosystems and water resources.

2.1.1 Site Preparation & Earthworks

Site clearing, grading and excavation be planned at the start of construction to mitigate the pollution caused by erosion and sedimentation, taking into consideration the existing endemic foliage. All existing utilities and water bodies on the green housing project sites be protected and should not be disturbed.

Following site protection measures be put in place, before starting construction work.

- Building site erosion and sedimentation control plan, outlining measures to be applied to prevent soil, which can run-off at natural bodies of water & pollute water.
- Additional measures to mitigate the effect of pollution and safety on construction.
- Rainwater and Storm water Collection management plan, and structures or facilities for water collection.

2.1.2 Open Space Utilization

The inclusion of green areas or landscaped areas for indigenous or adaptable species of grass, shrubs and trees will help in providing more permeable surface for the building's open space, and also allow the re-charging of natural ground water reservoir; control storm water surface run-off; cool the building surroundings; and provide indoor to outdoor connectivity for the building occupants.

Maximum possible area of the Unpaved Surface Area (USA) around the green housing be vegetated with indigenous and adaptable species; preferably, a minimum of fifty percent (50%) of the required USA.

2.1.3 Buildings' Siting as per Wind Direction

Most of the locations have a general major direction from which the wind comes during different seasons and time of the year, depending upon local climate. Green housing need to be designed climatically responsive, in which the wind direction can be channelized through interiors.

Wind direction, frequency and speed influence the building design including weather tightness detailing, building entry locations, window size and placement, roof and wall cladding selection.

2.1.4 Building Orientation

Building orientation refers to the solar orientation, while a green housing is planned with respect to sun path. The orientation can refer to a particular room or most important, the building facade.

Basically, the positioning of a building be planned with respect to the sun, to maximize solar gain at the appropriate time of the year, when required in cold climate and to minimize solar gain in a hot climate. Best housing orientation can increase the energy efficiency of your home by making it more comfortable to live in and cheaper to run from energy consumption point of view.

As the sun is lower in the sky in winter than in summer, plan and construct buildings that capture that free heat in winter and reject the heat in summer. The design of housing should be in such a way that all rooms get the maximum benefit of the sunlight.

2.1.5 Openings & Sun Direction

In the internal planning of housing, the Courtyard Housing be preferred, and the windows be oriented keeping in view the prevalent wind direction or wind direction in summers, and also the solar axis.

For the housing windows & doors or openings on the South facade, small overhang or curtains can cut-off direct solar penetration during summer and allows it during winter. East and West facades receive maximum solar radiation during summer; while the West is a crucial orientation because high intensity of solar radiation is received during evening hours, when the internal temperatures are also at peak. Therefore, deep patio (verandas) or sunshades in the South and West facades are necessary to exclude the strong evening rays.

2.6 Landscaping & Orientation

While deciding the building orientation, we must take into consideration the location of landscape feature i.e. trees, planters, etc. which will affect the building depending on sun direction and sun path.

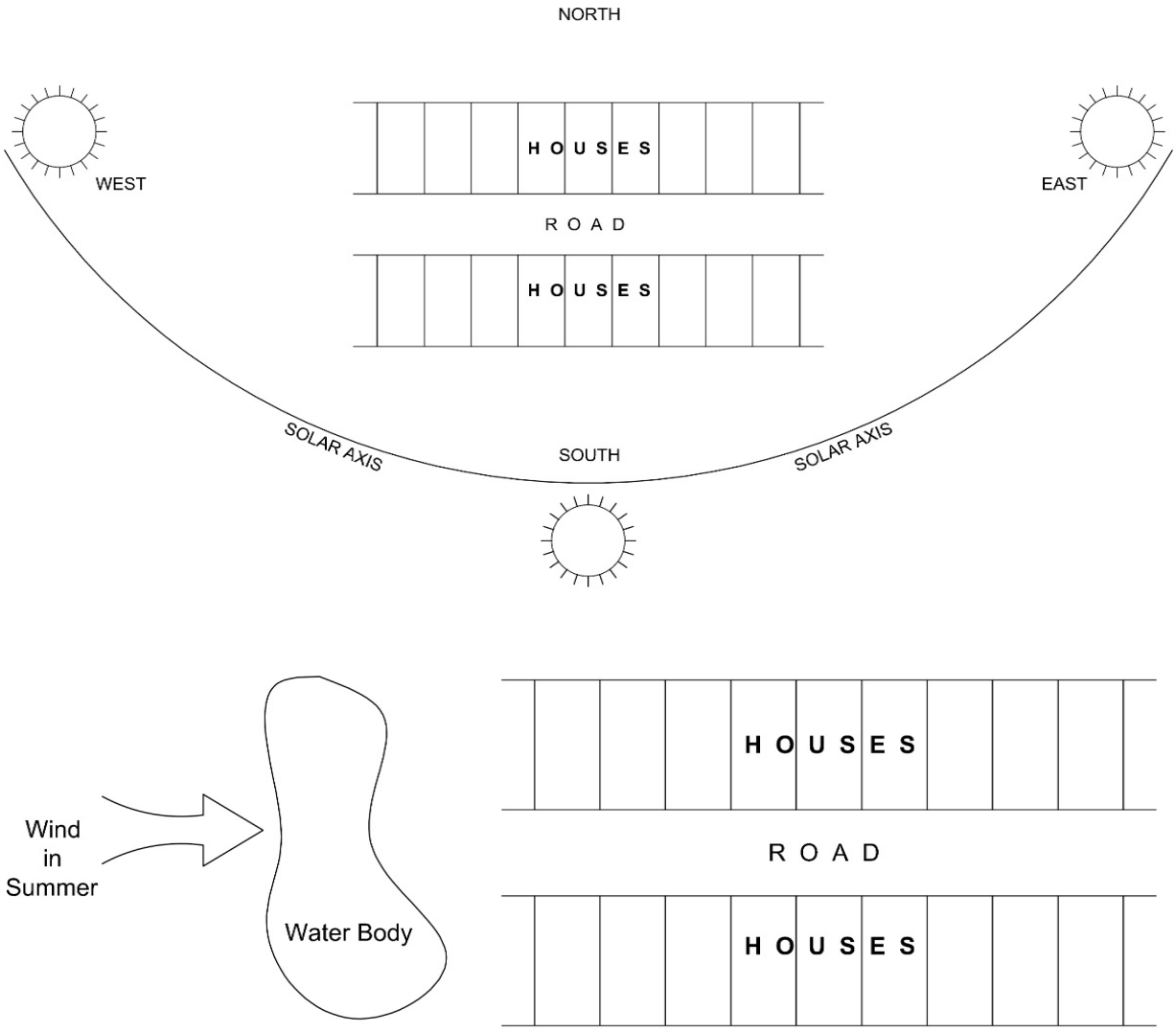
Trees and tall shrubs should be planted towards south and west of the housing to protect the inmates from the afternoon heat and to provide them with oxygen.

2.2. MASTER PLANNING & DESIGN

2.2.1 Orientation

In the master planning of green housing projects, it is necessary to minimize the direct sun-heat exposure. Building orientation influences the streetscape and directly affects residential amenity within the development and for neighbouring properties.

The layout of housings be preferably oriented towards North-South direction. Row housing protects the two-sides of building from direct solar heat gain. Also, locating the green pockets or water bodies around the housing will cool down the oncoming hot winds during summers.



The master plan should demonstrate how the green building's orientation seeks to balance and optimize the following considerations:

- Desired streetscape - character and relationship to the public realm.
- Climatic conditions - such as daylight & solar access and prevailing winds.
- Building orientation & height influence - for solar access to apartments and common open space.

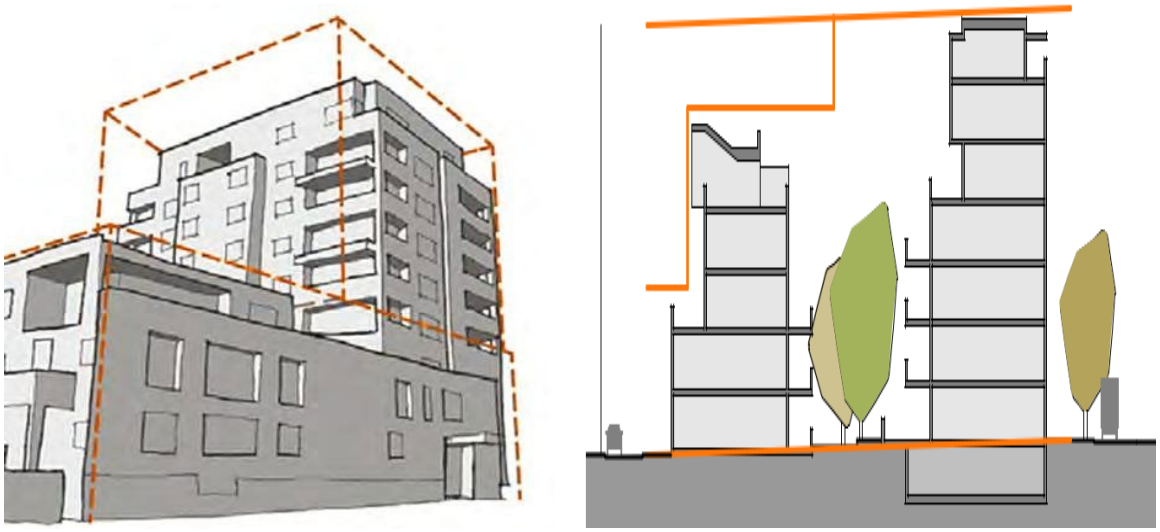
2.2.2 Green Planning

Good planning of green housing or apartment is a key aspect of sustainable development, to create better places to live and work in, and helps make the housings acceptable to communities. The residential areas planning should ensure that the housings development:

a) will function well and add to the overall quality of the area, not just for the short-term but over the lifetime of the development;

b) are sympathetic to local character, including the surrounding built environment and landscape setting;
c) establish or maintain a strong sense of place, using the arrangement of streets, spaces, building types and materials to create attractive places to live & work;
d) optimize the potential of the site to accommodate and sustain an appropriate amount and mix of development (including green and other public space) and support local facilities and transport networks; and
e) create places that are safe, inclusive and accessible and which promote health and well-being, with a high standard of amenity for existing and future users.

Also, important is the way, the green buildings are arranged on their sites. Site size and geometry, topography and configuration in relation to adjacent streets/roads, open space and other buildings are the important aspects of local identity; as well as the massing of apartments are significant factors in passive heating, cooling and day lighting, along with the shape and size of the buildings to optimize climatic performance and reduce energy demand.



2.2.3 Public Facilities

The green housing projects should have one or more of the following public facilities or amenities, where identified by the local government:

- Public open space
- Public car parking
- Public pedestrian access ways and site linkages

In case of apartments, an area of private open space be developed behind the building line, like smaller patio-type rear gardens or courtyard, to enable accessing the rear of all dwellings (by residents only). Roof gardens also offer a satisfactory alternative to courtyard.

Services such as fire utilities, rubbish collection areas and mailboxes should be easy to locate without being visually prominent in lobbies perpendicular to the street alignment or integrated into front fences where individual street entries are provided.

2.2.4 Making Effective Use of Land

Master planning of large housing projects should promote an effective use of land in meeting the need for homes and other uses, while safeguarding and improving the environment and ensuring safe and healthy living conditions. Strategic policies should set out a clear strategy for accommodating objectively assessed needs, in a way that makes as much use as possible of previously-developed land. Planning decisions should promote and support the:

- Development of under-utilized land and buildings, along with the desirability of promoting area regeneration and change;
- Upward extensions where the development would be consistent with the prevailing height and form of neighbouring properties/roads/streets;
- Compliance with local building standards (including safe access & egress for residents);
- Availability and capacity of infrastructure and services – both existing and proposed – as well as their potential for further improvement; and
- Achieve appropriate densities through efficient use of land, considering the identified need for different types of housing and other developments.

2.2.5 Access to Residential Buildings

In the residential premises, ensure that in the housings & apartments, the threshold at the main entrance doors is properly located, designed and levelled to enable the people, including those with disabilities, to have continued access to their dwelling, and easy exist during emergency. Also, in the access-areas, the doors and windows must be properly operational; along with adequate cold/thermal insulation and sound reduction against bad weather in with the outdoor.

2.2.6 Means of Escape

When installing the windows on the exterior side or in the building envelop, one window per room should be sized to provide an emergency exit/egress opening necessary for the purpose of escape, especially in case of high-rise apartments, as per the following general criteria:

- Width and Height - Either of these are not to be any less than 450 millimeter.
- Clear Open-able Area - No less than 0.33 square meter.
- Sill height - The bottom of open able egress area should be no more than 1100 millimeter above the floor level.

2.2.7 Sustainable Sanitation Options for Urban Housing

In the high density or low-income urban housing the provision of sanitation solutions is extremely challenging. Sanitation is considered to comprise of different aspects that include management of

human excreta, grey water, solid wastes and storm water. The main polluting constituents are pathogens that endanger public health and nutrients that may cause eutrophication and groundwater pollution.

The current need to increase sanitation coverage to meet the MDG sanitation target has triggered the ample provision of sanitation systems, but they can only be sustainable if they are developed to ensure an efficient recovery and reuse of nutrients contained in the excreta. Whereas, the sanitation technology selection method takes into account several sustainability criteria: social acceptance, technological and physical applicability, economical and institutional aspects, and the need to protect and promote human health.

While master planning the housing projects at different locations, the following sanitation challenges be attended to.

- Design and implementation of flood proof sanitation systems suitable for local conditions in slums,
- Recovery of organic nutrients to be used as a fertilizer,
- Optimization of use of sludge and organic solid waste (biomass) for renewable energy in form of biogas in slums,
- Comparative performance of improved mixed and separate excreta disposal systems to ascertain the attributes of the combinations with respect to pollution reduction in slums.

2.2.8 Fire Safety

Two aspects to be considered i.e. (1) Fire spread between properties through "unprotected areas", and (2) Means of escape in case of fire.

External doors and windows need to be fire resistance in the case of doors, be self-closing; and in the case of windows, be fixed shut to limit the risk of fire spread between adjacent habitable areas and properties. The “unprotected areas” i.e. walls, doors and windows need to have reduced fire resistance, and dependent on how close these elements are to the boundary of living premises.

Firefighting and access to services such as power and water meters require careful consideration in the design of the front façade. Consult early with relevant authorities to resolve functional requirements in an integrated design solution.

2.2.9 Parking Standards

Maximum parking standards for residential development be set, where there is a compelling justification, that they are necessary for managing the local road network, or for optimizing the density of development in city, urban centers or other locations well served by public transport. Local authorities should seek to improve the quality of parking so that it is convenient, safe and secure, alongside measures to promote accessibility for pedestrians to avoid unnecessary street clutter; besides, allowing for the efficient delivery of goods, and access by service and emergency vehicles.

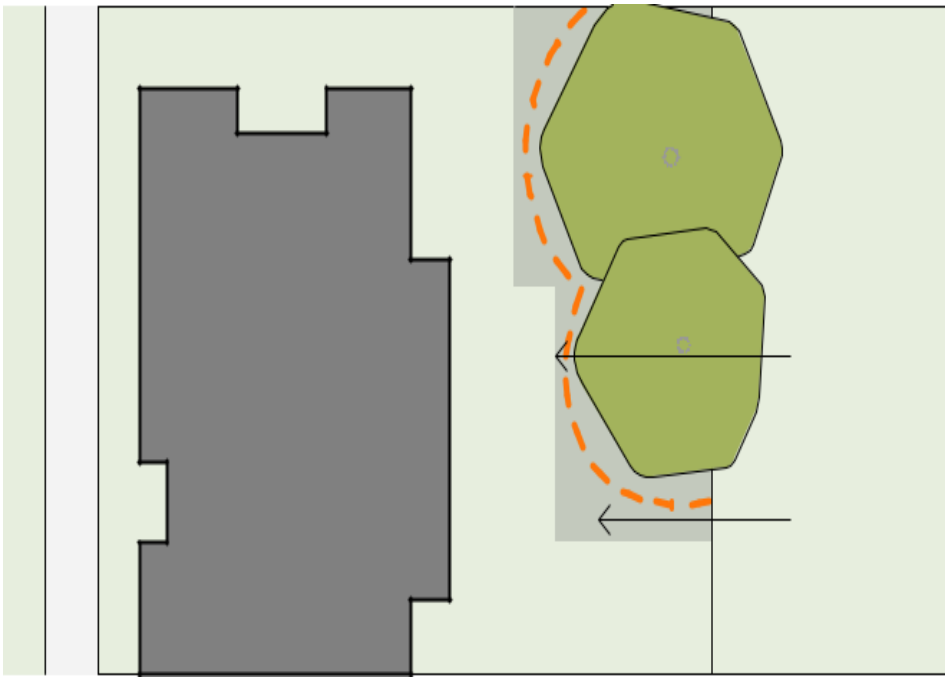
The Car and bikes parking standards need to be set at realistic levels in order to avoid the parked vehicles causing obstruction on the roads and streets in evenings or weekends. Also, the underground parking be considered in high-rise apartments and should be well lit and ventilated.

2.2.10 Retain Existing Trees

Existing and adjacent trees should be assessed during the site analysis phase for possible retention. Retain such trees and provide protection for adjacent trees. Where existing trees within the site or adjacent to the site boundary are identified for retention (or on site relocation), arboricultural advice should be obtained on the design of deep soil areas and management requirements to preserve the trees during and after construction.

Existing trees retention design should account for irrigation and for drainage pathways to reduce staining and ongoing maintenance of the planting infrastructure and the building fabric.

If extensive planting on structure is proposed, such as green walls or roofs, consider the use of an alternative water source, such as rainwater or recycled grey water.



2.2.11 Communal Open Space

In green housing schemes the size, location and design of communal space will vary depending on the site context and the scale of development. Design solutions should provide quality spaces that benefit residents, visitors and, where appropriate, the public should have regard for how communal needs are currently met within the walk-able catchment of the development and consider how the communal open space areas complement the public realm.

In case of apartments, the communal open space may include outdoor and semi-enclosed and/or partially covered areas located at ground level or on upper level podiums, terraces or useable flat roofs. Communal open space should be sized and designed to be functional, accessible and attractive.

Communal open space should be sited and designed to minimize the visual and aural impacts of services, such as ventilation duct outlets from basement car parks, air conditioning units, fire services, electrical substations and detention tanks.

Landscaping of this development enhances the amenity of the domain while providing visual privacy for residents.

2.2.12 Universal Design

Universal design is the:

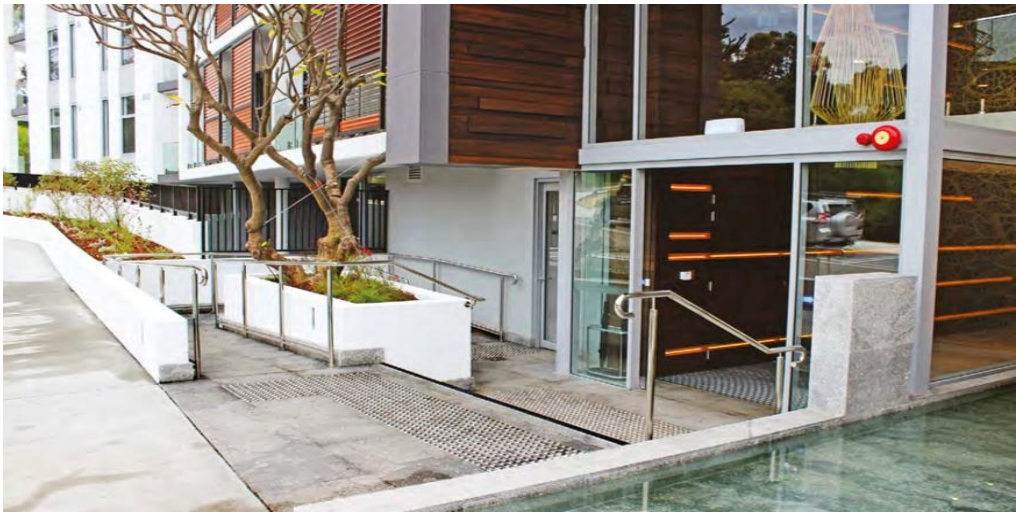
"creation of building, products and environments that is usable and effective for everyone, to the greatest extent possible without the need for adaptation or specialized design."

Universal design dwellings include additional features that are more adaptable to the changing needs of occupants, and that may be difficult and expensive to retrofit. In practice, the inclusion of these features improves the functionality of housing for all users, regardless of age or ability.

A step-free entrance is provided in this apartment block, taking into consideration universal access.

Development includes dwellings with universal design features providing dwelling options for people living with disabilities or limited mobility and/or to facilitate ageing in place.

Consider the provision of parking bays appropriate to the particular type of universal and adaptable dwellings provided in the development.



SECTION 3: BUILDING MATERIALS SUSTAINABILITY

Material sustainability governs all matters related to the resource efficiency and construction material selection, and requires their use with the least impact on the environment. The construction of green buildings must be undertaken by using higher quality materials to ensure the wellbeing of building occupants.

3.1 Recycled Materials

Utilize recycled materials in the project to promote circular economy and divert material from the landfills. The recycled material in the green housing project needs to be a specified percentage of total material, preferably by cost. Following recycled content, satisfying the relevant Specifications can be used in green buildings:

- Steel (reinforcing, structural)
- Cement
- Aggregate
- Composite wood
- Masonry blocks or bricks

3.2 Use Non-Toxic Materials

Non-Toxic building materials refer to building materials without hazardous or toxic chemicals that could cause Sick Building Syndrome (SBS) and eventually lead to Building Related Illness (BRI).

Paints, coatings, adhesives and sealants used indoors or non-ventilated areas must not contain Volatile Organic Compounds (VOC) or should be within levels tolerable to the housing-residents as specified in the standard permissible limits.

All other materials containing chemicals used in construction should not compromise and be deleterious to the health and safety of the workers and occupants of the building. The composite wood used in green houses should be free from the urea formaldehyde content.

3.3 Hazardous Materials

The use of hazardous materials must be prohibited to promote the wellbeing of greenhouse occupants. Ban the use of asbestos, formaldehyde, lead-based coatings, mercury and Polychlorinated Biphenyls (PCB) in the construction of green buildings.

The manufacturer’s data sheets and invoices must be obtained confirming that the products used in their products do not contain the prohibited hazardous substances.

SECTION 4: ENERGY MANAGEMENT IN BUIDINGS

4.1 BUILDING ENVELOP

Building envelope establishes a three-dimensional boundary within which the physical development may occur, and defined through a combination of:

- Building height,
- Street- setbacks, and
- Side- and rear-setbacks.

The building envelope also controls the maximum extent of development allocated to a site; alongside the managing the scale and impact of a development, with regard to the plot size, adjacent built forms, natural features and significant views.

The walls, roof assembly, floors, glazing and slabs on ground are the part of building envelop; provided that the window and glazed door area is not greater than 50 % of gross area of above-ground walls.

Building envelop must be planned and designed with specific details to ensure that the air tightness is maximized. Details should precisely include the joints, service entry points, windows and doors. This requires only increased attention to the construction details and it can be implemented at practically no cost.

4.1.1 Sealing of Building Envelop

Sealing is all about plugging the holes and cracks on the exterior of the housing during construction, by inspecting the exterior walls and seal the penetrations, especially where pipes come into the house, such as at meter locations. The openings and penetrations in the building envelop be properly sealed with materials, compatible with the construction materials and location. Joints and seams should be also sealed and taped or covered with moisture vapor-permeable wrapping material. Sealing materials spanning the joints between construction materials must allow for expansion and contraction of the construction materials.

4.1.2 Windows & Doors Installation

The requirements for mounting building components like windows and exterior doors as the external building components need not be material-specific, but function-oriented.

Windows and exterior doors are multifunctional building components, whose functions depend on the needs, and their performance in different climatic conditions. Their technically proper installation on and integration in the building envelop or external walls are important influencing factors for proper functionality and durability.

Based on the climate change and rising costs of energy, there must be statutory specifications for conserving energy, to be taken into account by the doors and windows manufacturers, assemblers and installers.

The placement, design and installation-requirements of the windows and external doors in the building shell must be finalized at the planning-stage, to avoid fixing-deficiencies and un-toward damage during fixing, insulation and sealing.

4.1.3 Air Leaks

Air seeps into and out of housing through the holes and cracks in exterior walls i.e. envelop, floors and ceilings. Most air leaks are of two types.

- **Direct leaks** are the crack around a door that allow outside air to come directly under the sill or around the frame.
- **Indirect leaks** represent most of the air leakage in a typical home. Indirect leaks occur where air penetrates the exterior at one location and the interior at another, such as where warm indoor air is sucked through plugs and switch plates.

The installation of windows or doors for buildings' exterior in hot and tropical climate be properly done, ensuring to seal all joints, holes, gaps and cracks; while complying with Green Building Code standards.

4.1.4 Glass Openings

The size of the openings in green housing (with or without glass) shall be in accordance with the approved Building Plan. Compared to wall assemblies, the glazing transfers more heat and hence, the following amount of glazing with respect to the wall is recommended, in order to reduce the internal heat gains.

- Requirement of Window to Wall Ratio (WWR) be balanced with the amount of daylight coming through the glazed area.
- Solar Heat Gain (SHG) requirement be adjusted by providing or installing the sun-breakers in the windows, as they stop the solar radiation before it enters the building, and doing so increase the cooling inside the house.
- External shading has the additional positive effect of improving the internal comfort, cutting part of the direct radiation on occupants.

The WWR be balanced with SHG to maintain the flexibility in green house or apartment design, because the higher the designed building WWR, the lower the required SHG in glass windows shall be and vise-versa.

4.1.5 Thermal Heat Loss

Dwellings are required to be energy efficient. A method of achieving greater energy efficiency in green housing is to take steps to control (i.e. reduce or increase) the amount of heat (measured as minimum and maximum U-Value), that is passing/transmitting through the glazing and external walls/fabric, including the both windows and doors.

4.1.6 Building Wall Specifications

Apply the thermal performance regulations to all external walls, including the openings and glazing, and other areas such as air supply and ventilation; safety-exits and escape-means.

On the Eastern side of green house, provide a 13½" thick brick wall. Whereas, on the Southern and Northern sides, construct 9" thick brick walls. On the Western side, provide brick cavity walls.

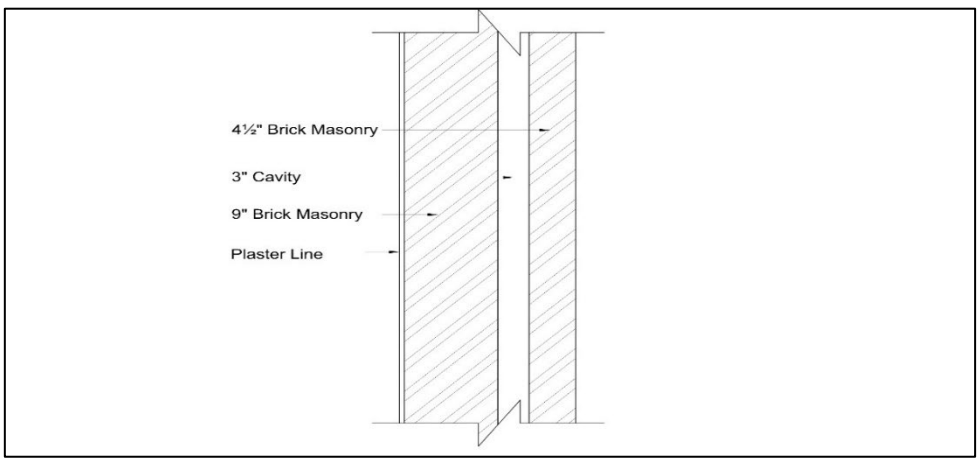
4.1.7 Protection against Bad Weather

The protection against bad weather prevents the ingress of rain water (driving rain) from outside to the maximum extent. Rainwater that has penetrated inside must be controlled and discharged outside directly. At the same time, the moisture from the functional area must be able to escape outside, through the external elements like a window-shade, projection, veranda, or roof-covering.

By meeting the physical construction-related requirements at the common-areas within the housing and apartment buildings, the benefits achieved enable the occupants to enjoy a comfortable and healthy room climate, and curtail/reduce the energy consumption.

4.2. NATURAL VENTILATION

This measure provides the building occupants a flexibility and opportunity to use natural ventilation for free cooling and fresh air in regularly occupied spaces. It also limits the tendency to create the glass-sealed box type buildings.



Windows and doors provide ventilation to rooms within a dwelling and rules apply to how much ventilation. The type and extent of ventilation will be dependent on the use and size of the room. For example, in rooms where steam will be produced (kitchens, bathrooms, utility rooms, etc.) should be provided with higher levels of ventilation (normally mechanical fans and windows) than other rooms, where suitably sized window openings and background ventilators may suffice.

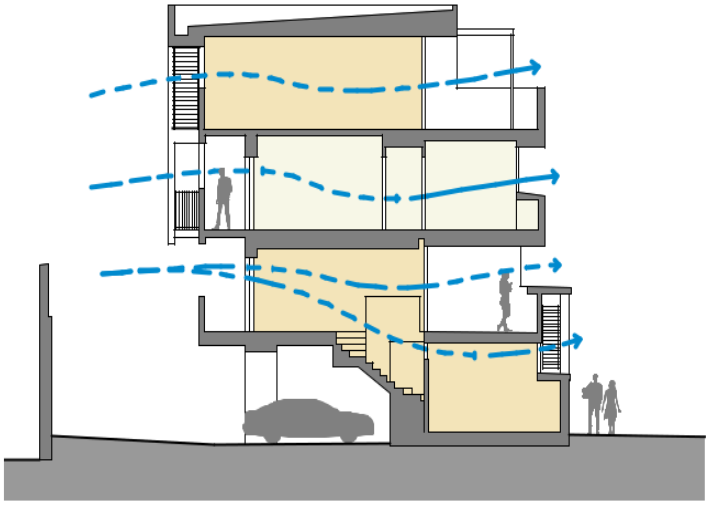
4.2.1 Natural Ventilation Strategies for Housing

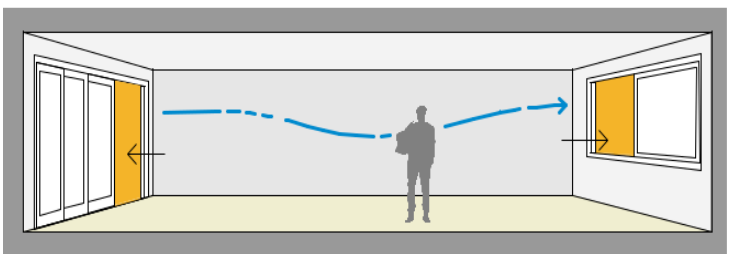
- Place the windows in walls facing prevalent wind direction of summer season.
- Install windows towards the open spaces on rear and front sides.
- Provide patios or small open-to-sky spaces in the building plans.
- No habitable room relies on light wells as the primary source of fresh-air.

Natural ventilation can be achieved by (1) Cross ventilation, which occurs when dwellings have openings in different orientations, so that breeze can flow through the room or building to flush out hot or stale air, or (2) Passive ventilation, which relies on the effect of rising hot air and requires high and low openings so that warm air is flushed from higher openings and cooler air, is drawn in through lower openings.

In the apartments, the door and window sizes on opposite sides of rooms influence cross ventilation performance (applicable to cross-through and cross-over apartments).

Open able windows in one or two storey housing be provided, and in case of walk-up apartments install the air-letting balcony-doors. All open able windows be provided with safety features for protection against strong winds, water penetration and protection for the building occupants including child safety and security.





4.2.2. Proper Ventilation

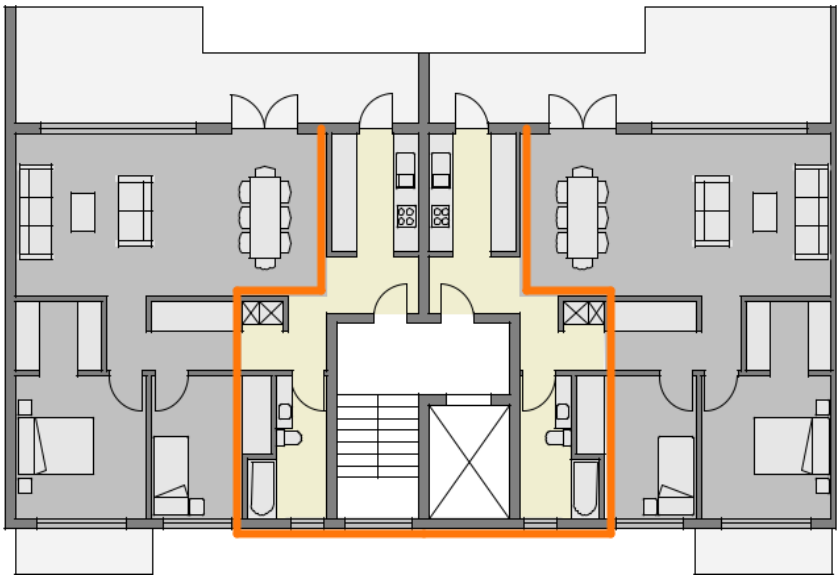
Green housing' planning must ensure the provision of indoor air quality, through the adequate ventilation in all habitable rooms, including the bath rooms and kitchens. In case of regularly occupied residential buildings, the minimum aggregate area of openings, excluding doors, is recommended as under.

- 12.5% of the Floor area for dry hot climate.
- 20% of the Floor area for humid hot climate.
- 15% of the Floor area for intermediate climate.
- 10%of the Floor area for cold climate.

4.2.3. Managing the Impact of Noise

Given the number of people living in close proximity in apartments and adjacent housing, the noise transfer within the buildings. Noise reduction between dwellings is critical to maintain the amenity and limit disturbances between neighbours. Noise impacts from external sources, such as major roads, flight paths or entertainment venues, should also be managed.

The green buildings layout should protect living areas and bedrooms from impacts of noise by avoiding adjacency between living spaces and the noisy circulation corridors. Potential noise sources such as driveways, service areas, plant rooms, mechanical equipment and refuse bins be located away from the external wall of habitable rooms or within 3 meters of a window to a bedroom.



4.3 ROOF INSULATION

Roof insulation can help reduce the heat gain in a building, thus improving the thermal comfort and also the acoustic quality inside the housing. In case of green housing, apply a range of options to provide roof insulation, as under.

- Durability with locally available building materials
- Functional aspects i.e. one can move, play & use roof as per life-routines
- Usage of thermally efficient materials, easy to install with lesser cost
- Ability to resist water seepage

4.3.1 Roof Design

Besides the roof insulation, the roof space on green housing and apartment structures can also be used to enhance the building amenity and sustainability, through the use of roof as open space, or making landscaped area, or accommodating the photovoltaic panels for solar energy generation, where possible.

4.3.2 Roof Insulation

In case of green house buildings, the thermal insulation of walls, doors and windows, also needs to include other elements like roofs or floors. Their construction must comply with the Green Building Code, and up to a reasonable standard.

4.3.3 RCC Flat Roof Insulation

The UN Habitat has conducted a project to improve the thermal performance of housing of reinforced cement concrete flat roof. It was concluded that the passive building measures alone can reduce the internal thermal comfort of housing, and also the electricity consumption. The techniques used included insulative, reflective and radiant barriers. All solutions improved indoor temperature in comparison to an unimproved house. Out of total tested 19 techniques, the 9 reduction measures reduced indoor temperature to below 34 degree, decreasing 4 degree on average (see **Annex 2**). The outcomes are available in a Guidebook printed by the Habitat, entitled “Energy Efficient Housing: Improvement of Thermal Performance of RC Slab Roofs 2010”. It is recommended that the construction of green housing roof be undertaken as per the methods and techniques, explained in this Guidebook.

The COMSAT University Islamabad has also undertaken a green roof project in their academic buildings. The roof of green housing can be heat-insulated through the application of their experimented cooling techniques, as explained in the self-explanatory drawings at **Annex 3**.

4.4 ENERGY EFFICIENCY

Energy efficiency starts with minimizing the energy demand, through the adoption of efficient practices, designs, methods and technologies that reduce energy consumption resulting in cost savings. The green buildings need to reduce the energy consumption; besides, reducing the burning of fossil fuels and emissions of GHG into the atmosphere. Initially, twenty percent (20%) in overall reduction/saving from baseline building energy consumption be planned in green housing, after their full occupation.

Following energy sources that occur naturally and repeatedly on the earth can be harnessed for the benefit of human being.

- Solar, wind and biomass
- Solar hot water and photovoltaic
- Wind and Geothermal energy
- Small hydros

4.4.1 Energy Saving

As energy demand and costs rise, so does the imperative to reduce the energy consumption of all dwellings, with benefits for residents, the community and the environment. Green design should go for constructing energy efficient dwellings that are attractive, healthy, and comfortable. Air-conditioning, water heating and lighting account for the majority of energy use, both in a typical house or apartment. Timely design decisions to improve thermal performance and select energy efficient fixtures can therefore have a significant impact on energy use.

Energy saving in green housing starts from master planning to architectural designing of buildings, through optimized building shape and form; improved building envelopes; efficient energy-using devices; and the cautious operation of building systems by the enlightened occupants. To help increase the use and supply of renewable and low carbon energy and heat, the green housing plans should take account of landform, layout, building orientation, massing and landscaping to minimize energy consumption; and:

a) provide a positive strategy for energy from these sources, that maximizes the potential for suitable development, while ensuring that adverse impacts are addressed satisfactorily (including cumulative landscape and visual impacts);
b) consider identifying suitable areas for renewable & low carbon energy sources, & supporting infrastructure, where this would help secure their development; and
c) identify opportunities for development to draw its energy supply from decentralized, renewable or low carbon energy supply systems and for co-locating potential heat customers and suppliers.

4.4.2 Energy-Conscious Building Envelop

Building envelope includes window-to-wall ratios, insulation levels of walls and roof, thermal resistance & solar heat gain coefficient of windows, degree of air tightness to prevent unwanted exchange of air between inside & outside, and presence or absence of open-able windows that connect to pathways for passive ventilation.

Provision of a high-performance envelope in buildings is the single most important factor in the design of green housing, not only because it reduces the HVAC loads; but also because it permits alternative (and low-energy) systems to achieve savings by using more efficient devices (such as boilers, fans, chillers and lamps).It has also been noted that the improved building envelopes and building systems often entail no greater construction cost than the conventional design while yielding significant annual energy-cost savings.

4.4.3 Daylight Provision

Green buildings be planned/designed to maximize use of natural light and minimize the use of artificial illumination. All regularly occupied spaces inside the house must have any combination of the Windows, Clerestory and/or Skylights features that can allow daylight into room space.

4.4.4 Energy Conscious Residences

The planning and layouts of green developments can achieve energy saving by making it mandatory that on the roof of the new green residences to be built on plot of size 10 Marla (250 square yards) and above, the solar power systems should be installed. In addition, following measures be taken to curtail the energy use.

- Plan dwellings with Northerly orientation and opportunities for natural ventilation,
- Achieving effective shading from summer sun,
- Use of thermal mass for passive heating and cooling,
- Improving the thermal performance and insulative properties of glazing, openings and the building fabric, particularly on West facing elevations, and
- Avoiding the use of electric storage systems as the primary domestic hot water system for individual dwellings.

Inside the green housing and apartments, the application of energy efficient initiatives be encouraged, i.e. installing the:

- Ceiling fans in all habitable rooms,
- Hot- water systems that are more energy efficient than electric storage units,
- Provision of an external clothesline to every dwelling, located in an area out of direct view on an external wall or in a breezeway,
- Use of a photovoltaic array for communal services, and
- Solar powered lighting of external open space, circulation areas/common spaces.

Apartments utilizing roof with installation of photovoltaic arrays to supplement power consumption of dwelling units

4.4.5 On-Site Renewable Energy

To reduce the burden on conventional energy sources i.e. electricity, diesel and natural gas, utilize renewable energy technologies like Solar photovoltaic systems, Wind energy systems or Biogas/Biomass (if feasible), in order to power the building and replace a percentage of the total building energy consumption.

4.4.6 Monitor Energy Consumption

Design the green building with meters that can measure the overall energy consumption at regular intervals. All sources of energy be then monitored to review the data and consider further saving in energy consumption. Utilize energy metering as an energy management tool that allows for ongoing performance and improvement in energy consumption.

4.4.7 Utilities

Energy utility networks and infrastructure are rapidly growing due to changes in technology, distribution networks and demand management. Proponents of the green residences should evaluate the current and emerging practice to ensure that design of utilities and demand management systems can meet the future needs of residents. All sites of green residences; besides, water, gas and fire services, must be serviced with power and telecommunications/broadband services that are fit and meet current performance and access requirements of service providers.

All utilities be located such that they are accessible for maintenance and do not restrict safe movement of vehicles or pedestrians. Utilities, such as distribution boxes, power meters are integrated into design of buildings so that they are not visually obtrusive from the street or open space within the development.

Utilities within individual dwellings are of a functional size and layout and located to minimize noise or air quality impacts on habitable rooms & balconies. Utilities that must be located within the front setback, adjacent to building entry or on visible parts of the roof be integrated into the design of green building, landscape and/or fencing such that they are accessible for servicing requirements but not visually obtrusive.

Hot water units and air-conditioning condenser units be located such that they can be safely maintained, are not visually obtrusive from the street and do not impact on functionality of outdoor living areas or internal storage.

Consider infrastructure solutions that can respond to future as well as present needs, including broadband internet, smart meters and distribution capacity for on-site power generation and storage, etc.

4.4.8 Interior Lighting Controls

To maximize the use of renewable natural resources in green buildings, the energy efficient equipment such as compact fluorescent lights and solar water heating systems etc. based on non-conventional energy resources be installed.

Each area enclosed by walls or floor-to-ceiling partitions to have at least one manual control for the lighting that area. The required controls be located within the house, through switches that identify the lights served and indicating their on/off status.

4.4.9 Light Reduction Controls

Each area in green housing, that is required to have a manual control, must also allow the occupant to reduce the connected lighting load in a reasonably uniform illumination pattern by at least 50 percent (50%). Lighting reduction shall be achieved by one of the following or other approved methods:

- Controlling all lamps or luminaries;
- Dual switching of alternate rows of luminaires, or alternate lamps;
- Switching the middle lamp luminaires independently of the outer lamps; and/or
- Switching each luminaire or each lamp.

The exceptions are for those areas that have only one luminaire, and the corridors, storerooms, or lobbies (if provided).

4.4.10 Occupancy Sensors for Lighting Control

In the walk-up apartments, we need to limit the use of electricity in unoccupied areas of green buildings. This requires installing the occupancy sensors linked to lighting (except for emergency and security lighting), and installed in the corridors, stairways and other similar areas i.e. covered car parks, stores, etc.

4.4.11 Lighting Power Density (LPD)

In order to design the green hoses' lighting system in a most efficient way and reduce the lighting and cooling load in the buildings, it is necessary to put a "limit on lighting power density". The maximum allowed LPD for various space types is in following Table, as specified in the "IIEE Manual on Practice of Efficient Lighting System" for the design of building lighting systems

Use / Occupancy Classification	Average LPD (Watt per Square Meter)
Residential Dwelling	10.8
Covered Parking	3.2
Open & Outdoor Parking	1.6
Exterior Façade	2.15
Entrance Lobby	10.8

When the power for exterior lighting is supplied through the energy service to the apartment buildings, the all exterior lighting, other than low-voltage landscape lighting, need to have a source efficacy of at least 45 lumens per Watt. Automatic switching or photocell controls be provided for all exterior lighting not intended for 24-hour operation.

4.4.12 Energy Saving Initiatives

Primary requirement of the green building design is to minimize and optimize the utilities and mechanical systems and their technical installations, through the correct choice of geometries and construction products. This can also substantially reduce construction and follow-up costs, and thereby environmental damages.

To reduce dependence on motorized systems to supply and distribute potable or non-potable water within the green buildings, and to reduce the energy consumption, the **"overhead or elevated water storage systems"** be used, to rely on gravity to distribute water within the building, without compromising on the required water demand as per specified standards.

Regarding the **"water heating systems"** in green buildings, encourage the use of solar water heating and/or heat pump for water heating. Such energy-efficient systems can reduce energy consumption due to heating of water, if automatic-circulating controls for hot-water system pumps are fitted, and could be conveniently turned off automatically or manually when the hot water system is not in operation.

For the **"solar water heating systems",** use the integrated solar photovoltaic for power generation i.e. solar home systems & generators, solar street and garden lights, solar water heating systems for bathing, washing, etc.

In case of **"cooling system",** if installed in green buildings, the efficiency of an air conditioning unit is of prime importance. It is important to procure an efficient cooling system (invertor units), which meet the minimum specified efficiency requirements, without increasing the bill, substantially.

Consider initiatives that future proof the development for changing energy environment, such as designing the roof, electrical distribution system and metering with capacity for future installation of systems such as a photovoltaic array or battery storage; besides, providing conduits and capacity in the electrical distribution system and metering for future provision of electric car charging.

4.5. HEAT ISLAND EFFECT

High temperature in the congested urban settlements than their surroundings is known as the Urban Heat Island (UHI) effect, which causes discomfort to the urban dwellers in summer time. Improper urban planning, tall buildings, dark surfaces and air pollution are increasingly growing the UHI phenomenon and it is accountable for human discomfort and a rise in surrounding temperature. In Pakistan, about seventy five percent (75%) of the roof surfaces of buildings have flat and low sloped roofs, which are subject to solar heat incidence, causing heat transmission in the surrounding environment.

4.5.1 Mitigation Strategies

In the green residential buildings, reduce the heat island effect and improve the dwellers' resilience to heat waves, through the following mitigation strategies.

- Increase shade around the housing i.e. develop urban forest by planting trees and vegetation to get shade and cooling through evapotranspiration; thus, reducing exposure to harmful ultra-violet radiation. They also, reduce storm water runoff and protect against erosion.
- Light-colored buildings' envelop can reduce heat transfer from the outside to the inside of the building, by having high solar reflective surfaces.
- Painting the rooftops white reduces the heat island effect, as it allows high solar reflectance and emission.
- Install green roofs, or rooftop garden, to reduce heat from the air through evapotranspiration, reducing temperatures of the roof surface; thus, reducing energy needed to provide cooling and heating (which decreases the energy bill), improving indoor comfort, and lowering heat stress associated with heat waves; besides, improving storm water management.
- Build cool pervious pavements, using paving materials on sidewalks, parking lots, and streets that remain cooler, by reflecting more solar energy and enhancing water evaporation; as well as reduce the storm water runoff.
- Develop green parking lots in residential areas, other than asphalt and vegetation to limit the impact urban heat island effect.
- Develop the rain or storm water bodies in urban residential areas as the potential UHI mitigation strategy.
- Where feasible, use light-colored concrete in hard surfaces & pavements, which reflect up to 50% more light than black asphalt and reduce ambient temperature.

4.5.2 Minimizing Heat & Glare

Simple sun shading device can be effective in minimizing heat and glare in the green house and apartment.

SECTION 5: WATER MANAGEMENT

5.1. WATER EFFICIENCY

In Pakistan, the average water usage in a 7-Members Family house ranges from 25 to 30 liter per person per day. Water used in toilet cisterns represents around 1/3rd of overall water consumption for an average household. Bath & shower form the next largest contribution followed by washing machine usage. The collection of rainwater and its use for water-closet toilet-flushing could result in approximately a 1/3rd reduction in the public water supply to a household. Other non-potable uses which may be curtailed are washing machine usage and outdoor uses e.g. garden watering and vehicle-washing.

The water use reduction requires adoption of efficient practices, designing, materials, fixtures and methods that reduce water consumption resulting in cost savings.

5.1.1 Water Management & Conservation

Water management is an important aspect of water sensitive urban design and plays a vital role in managing the water cycle, improving water quality, protecting ecosystems and improving urban amenity, through the efficiency of appliances and fittings, and support for positive water use behaviour. It also seeks the alternative water sources and storage opportunities, and understanding water in the landscape and the impact of multiple dwelling developments on the water cycle.

In addition, the green residence planning must consider the potential for major rainfall flooding and incorporate design responses to mitigate the impacts on occupants, buildings and the environment. In major rain events, the responses may include:

- Providing sufficient area for storm water detention/retention on-site,
- Making an overland flow path such that habitable spaces are not inundated, and
- Integrate storm water management systems in design of landscaping, open space and circulation areas.

5.1.2 Water Fixtures

Efficient water fixtures include the faucets, showerheads and water closets that use less water to perform the same function of cleaning as effectively as standard models. Water efficiency is an important aspect, especially as fresh water resources start getting depleted at a rate faster than they are replenished. The use of efficient plumbing fixtures, auto control valves, flow control and pressure-reducing devices in green housing can result in significant reduction in water consumption.

In the green housing, the recommended provision and installation of water fixtures need to comply with the following performance requirements.

Water Fixtures	Maximum Flow Rate
Dual Flush Water Closet	≤6 full liters / flushing cycle
Single Flush Water Closet	3 low to 4.9 liters / flushing cycle
Shower	≤9 (80 PSi) liters / minute
Urinals	≤1liter / flushing cycle
Lavatory taps	≤4.8 (60 PSi) liters / minute
Kitchen faucets	≤4.8 (60 PSi) liters / minute
Handheld bidet sprays	≤4.8 (60 PSi) liters / minute

5.1.3 Reduce Indoor Water Consumption

In green housing, the efforts be made to reduce water consumption by twenty percent (20%), below the baseline building consumption. This is possible through using the water-sense labelled fixtures and fittings in the bathrooms and kitchens.

Individual dwellings and apartments' metering of water is an effective way to transfer price signals to the occupants to assist with reducing potable water use. Green housing should consider the use of technology to enable remote reading.

5.1.4 Overhead or Elevated Water Storage

To reduce dependence on motorized systems to supply and distribute potable or non-potable water within the building, and to help reduce energy consumption, the overhead or elevated water storage systems be used in green housing projects; provided there is a twenty percent (20%) fire reserve over and above the average daily demand supply. Ideally, the elevated water storage be placed on an elevation or rooftop, and gravity to distribute water within the building spaces through gravity. Such systems should operate without compromising the required water volume and pressure based on the specified demand as per local Plumbing Standards.

5.1.5 Water Use Reduction – Outdoor

Reduce the use of potable water for landscaping and irrigation, around green housing, through applying the following strategies:

- Use recycled water to provide for at least 50% of outdoor irrigation requirements.
- Grey water from bathrooms be recycled to flush the toilets.
- Plant native or adaptive species that require little to no water for irrigation, and/or landscaping plan utilizing efficient irrigation systems that reduces irrigation requirements by 40% from the baseline for the total planted area.

5.1.6 Monitoring Water Consumption

Utilize bulk-metering option as a water management tool that allows for ongoing performance and improvement for overall water consumption in green housing or apartment complexes. To achieve this, measure the overall water consumption and monitor all sources of water at regular intervals, to review the data for further reduction in water usage.

5.2. RAINWATER HARVESTING

In the areas receiving regular or intermittent rainfalls, the rainwater is one of the purest sources of water available from the roofs and hardscape. It must be collected and reused for non-potable purposes. One of the best ways to incorporate the green initiatives is to make rainwater harvesting and groundwater recharge mandatory in all green housing programs, both during the construction and post-occupation of such buildings. The rainwater collected and stored is recommended to be used for non-potable purposes, such as toilet flushing, irrigation and cooling towers.

5.2.1 Rainwater Harvesting for Urban Housing

With centralized water and sewerage systems, most of the resources to collect, treat and deliver the water or wastewater come from fossil fuels. Around two-third of the cost of such urban centralized systems is for transportation. With decentralized arrangement of on-site water and wastewater systems, there are minimal transportation costs and the main power for treatment comes from natural sources, such as the sun; thereby preserving the depleting water resource. Rainwater tanks fill without any pumping, and on-site treatment systems can be designed to treat the sewage with few or even no moving parts. As well, there is no need to pump the water or wastewater many kilometers.

5.2.2 Rainwater Tanks

Residential water demand in urban areas can be managed cost effectively through the improved water use efficiency and design of water-wise rainwater tanks, and the following factors.

- **Age of the water supply infrastructure:** Rainwater tanks are more cost effective option in new urban green housing developments, where the water supply infrastructure is yet to be built. The rainwater tanks are more cost effective in new developments than building into the existing housing.
- **Connection to indoor use:** To maximize the water saving potential of a rainwater tank, it is important that the rainwater tank is connected to as many as possible indoor water uses, in addition to being connected to outdoor water use.
- **Storm water & flooding:** If an urban catchment is faced with the flooding of its storm water drains, then the rainwater tanks prove to be cost effective as they double up on-site detention system, providing flood control in addition to an additional source of water. The rainwater tanks also have the potential to contribute to improved storm water quality.

5.2.3 Sizing of Rainwater Storage

Generally, to maximize the water saving, the green building designers should:

- increase the size of the tank, where practicable,
- increase the contributing roof area, where practicable,
- increase the number of allowable water uses,
- Ensure at least some internal fixtures, such as toilets, are connected to the tank,
- Use a minimum size of 2,000 liters for toilet flushing only, or/and
- a minimum size of 5,000 liters for non-potable (non-drinking) domestic water uses (flushing toilet, washing machines/car, watering garden), and holding storm water.

5.2.4 Tank Site Design

Safety aspects should be incorporated into the design of rainwater harvesting systems, and the end-users should be supplied by gravity, if possible

Above-ground tanks should be used in preference to buried tanks, if possible; and located where possible, in a shady area (*e.g.* under a patio or the eaves), to avoid the possibility of light entering the tank (to avoid algae) and to reduce the temperature of water in storage. Such tanks must be away from overhanging branches and sources of debris.

When a buried tank is selected, the following design issues be considered to reduce the risk of human and animal wastes, or other contaminants entering the tank:

- Consideration be given to using multiple tanks in series in lieu of single water storage, especially where rainwater is considered for drinking water end uses.
- Multiple tanks connected in series may improve the biological quality of roof water; as the water moves from one tank to the next, its microbial activity decreases due to the reduced nutrient concentrations in the subsequent tank(s).

To improve the rainwater quality, consideration be given to using a “secondary water storage”, because the larger suspended particulates may already settle in the “primary water storage”, and the organic carbon load would also reduce by microorganisms in the “primary water storage”.

5.2.5 Features of Rainwater Tank

- Care should be taken to avoid rainwater tanks that are not opaque. There may be certain types of materials that allow light to enter through the walls, thus possibly creating an algal problem and larval growth.
- Tanks should be adequately ventilated. Consideration should be given to have at least two vents and/or other openings (covered with mosquito-proof mesh and protected against light intrusion), preferably at opposite ends of the tank, in order to improve the cross-ventilation.
- Drainage from the overflow pipe should be connected to the storm water drains, not the sewer lines. Also, the drainage pipes from the overflow pipe should be laid away from the base of tank and house foundations
- Labelling of rainwater pipework with necessary signage should be affixed at immediately visible places.

5.2.6 Rainwater Conveyance from Roof to Collection Tank

Any improvement in roof water quality due to first flush devices will generally not meet the drinking quality guidelines. A deflecting leaf-diverter should be installed, as a partial barrier, be used in guttering or downpipes in order to direct an increased proportion of roof water toward another downpipe in preference to the first downpipe.

Around the green housing, the landscaping should be designed to avoid branches overhanging roof and roof water gutters. For dwellings that are surrounded by tall trees that shed a high volume of leaf matter, the gutter-guards should be used as well as leaf diverters.

When the roof water is intended for drinking water end uses, the tank-manufacturers should ensure the suitability of its material for health-safe collection of rainwater for drinking water purpose; along with using the appropriate type of pipes and fittings. Preferably, a dual delivery plumbing arrangement be used.

The use of lead products should be avoided and using alternative products to metallic pipes be considered. Plastic downpipes and pipework are deemed to be suitable for contact with drinking water.

The various types/methods of rainwater harvesting for residential buildings are provided in the **Annex 3.**

SECTION 6: WASTE MANAGEMENT

Today, the buildings including housing are built out of concrete and brick, for a life of 100 years. During this period, a building can consume unimaginable quantities of resources and generate the waste, as under.

Resources Consumed by a Building during Construction

Resources	Forms of Consumable Elements
Land	Farms, forest, fertile land etc.
Soil	Earth, Clay, stone, Sand etc.
Trees	Wood, plywood, shuttering, etc.
Water	Construction, Landscape, Cooling, Pumping, etc.
Plastics	PVC, UPVC, PU, etc.
Metals	Steel, Iron, aluminium, Copper etc.
Electricity	Cooling/heating, lighting, pumping

6.1 Reduction of Non-Renewable Resources

The reduction of non-renewable resources is an important aspect of green design. Such reduction practices be encouraged, i.e.:

- **Utilization of Environmentally Preferable Building Materials**
  Environmentally preferable building materials such as non-virgin, renewable, and recyclable materials aid in the reduction of non-renewable resources.
- **Construction Waste Recycling Program**
  On-site recycling and/or donation of scrap materials to local charitable organizations greatly reduce construction waste.
- **Low-flow Water Fixtures**
  Low-flow water fixtures limit the amount of water used on a home basis.

6.2 Construction Waste Management Plan

At least 30% of the waste generated from construction activities be sent to the recycling or salvaging facilities for reuse; whereas, the left-over waste be sent to designated landfills or dumping grounds.

Waste Generated by a Building

Nature of waste	Damages/ Release/ Disposal of Materials
Site waste	Cut trees, vegetation, excavated stone, rubble, etc.
Construction waste	Metals, boxes/cans, broken bricks, shuttering, oils, etc.
Sewage/ sullage	Black water, grey water, etc.
Organic waste	Peels, vegetables, fruits, etc.
Inorganic waste	Recyclable wastage paper, glass, metals, etc.
Non-recyclable waste	Demolition debris, all plants, synthetic fibers, etc.
E-waste	CDs, electronics, hardware, etc.
Chemical waste	Adhesive, paints, etc.

The reuse of building materials and wastes resulting from the construction works must be clearly set out for utilization as recycled building materials. It is necessary to develop the "site-wise waste management plan(s)" regarding the following activities, in-advance.

- Recycling goal for the project
- Record all types of waste streams and waste recycled
- If more-than-one site: Prepare Site-wise Waste Logistics Plans
- Types of equipment and manpower that need to be deployed

6.3 Material Recovery Facility

At green housing project sites, the Material Recovery Facility **(MRF)** be provided for the collection and segregation of solid waste materials. Preferably, in the residential neighbourhood, a minimum area for the MRF @ One square meter waste storage space per 2,500 square meter Total Gross Floor Area plus 50% circulation space, be provided.

The Material Recovery Facility must be fully enclosed and easily accessible from within the building for easy collection of waste, and from the outside for easy sorting and disposal of waste. The solid waste containers should be provided for at least four (4) types of wastes:

- Compostable (biodegradable)
- Non-recyclable (to be disposed-off in the landfill)
- Recyclable (paper, cardboard, plastic, metal, wood, etc.)
- Special waste (for Incineration, etc.)

6.4 Utilize Recycled Material for Minimizing Building Cost

Building construction activities consume substantial water, wood, other materials and energy flow. The waste material (bricks, concrete, steel, etc.), if readily available, be reused in green buildings or recycled, thus prolonging the supply of natural resources and minimizing construction cost.

6.5 Post-Occupation Waste Management

Consider the appropriate waste management systems for the scale and nature of green housing developments; for instance, combined bulk receptacles for larger developments with on-site bin management. Consult early with the local governments or waste contractors to determine the right waste collection strategy for green residences development.

Design the site vehicle access and circulation areas to suit the required handling of bins, including the design of pedestrian access and circulation to allow bins to be easily maneuvered between storage and collection points.

Consider providing temporary storage for large bulk items such as mattresses, taking into account management of these areas and the control of vermin, odour and dust.

In larger i.e. apartments buildings, incorporating waste chutes increases the convenience of waste management for occupants. Communal recycling rooms/cupboards can also be located throughout

the development, coupled with an appropriate management regime to ensure regular removal of recyclables and management of the facility.

6.6 Integrated Resource Recovery Center (IRRC)

The UN Habitat in collaboration with Dr. Akhtar Hameed Khan Memorial Trust and the support of UN ESCAP; has developed the Integrated Resource Recovery Center Pilot-Project in Islamabad, to demonstrate the potential of community-based solid waste management to improve the public health and mitigate the climate change.

The IRRC is a decentralized community-based recycling and composting facility which can be built and operated at low costs by using limited mechanical technology, ensuring the low operational costs with minimal equipment breakdowns, while creating job opportunities. It is recommended that the builders of green housing, as well as the community living therein be enlightened to adopt the eco-friendly and low-cost efficient technology of IRRC.

The objective of IRRC is to recover a tangible value from the waste and provide livelihood opportunities to the urban poor. A Brief on the scope and methodology of IRRC is placed at **Annex 4**.

6.7 On-Site Water Recycling (Liquid Waste Management)

Water recycling is considered to reduce the urban dwellers' water consumption and relieve the pressure on existing water supply systems. However, the water recycling is only one element of the total water cycle in urban settlements and its integrated water resource management.

Re-cycling wastewater from residential areas assists in achieving the water reduction objective, as well as to reduce the sewer overflows if properly targeted. Recycling the rain and storm water on the other hand, achieves the water reduction objective, as well as potentially relieving the drainage infrastructure, especially in storm events.

Generally, the performance criteria for water cycle system in urban sites are based on the local environmental management objectives, reflecting the recycled water demand and distribution issues, the available water cycle infrastructure, and the water cycle quality needs of the different receiving environments; besides, the public health and downstream water infrastructure issues.

6.8 Regulation of Recycled Water

The recycled water produced on site can be reused for non-potable purposes, such as toilet flushing, plants' watering and pavement washing, etc. through a distinct and separate piping system from the potable water supply system/network.

However, it is necessary to ensure that recycled water being supplied to the urban residents is safe, environmentally sustainable and cost-effective. This can best be achieved by matching the quality of recycled water to its intended uses, both safely and cost-effectively.

Grey water Recycling System

6.9 Shared Urban Grey water Recycling Systems

Population growth, rapid urbanization, higher standards of living and climate change have influenced greatly the growth of urban water consumption. In case of green housing projects, two approaches can be adopted to ensure that the urban water supply and demand balance is met.

1. **Develop additional supplies,** locally where possible or nationally as required, for example: deep groundwater abstraction, new dams and reservoirs, seawater desalination and importing water from greater distances.
2. **Maintain existing supply sources** and reduce the potable water demands through (i) optimizing the existing water supply system (*i.e.* reducing leakage), installing water-saving devices, and changing public behaviour; (ii) water re-use; and (iii) water recycling.

The UN-Habitat with the support of Water and Sanitation Trust Fund has introduced a Constructed Wetland Technology in Pakistan. The Constructed Wetlands (CW) are engineered systems, designed and constructed to utilize the natural processes involving wetland vegetation, soils and the associated microbial assemblages to assist in treating the municipal or industrial wastewater, grey water or storm water runoff. Average land-area required for the treatment of 500,000 gallons per day wastewater for 3400 households is 0.25 Acre (= 9,000 Square Feet). This technology is relatively inexpensive to build and can be easily operated and maintained by the community.

For green housing in urban areas, the Constructed Wetlands can largely supplement increasing water demand, and also offset the use of energy intensive water treatment processes; because the CW does not require energy for its operation. It uses natural geochemical and biological processes in a wetland ecosystem to treat the metals, chemicals and other contaminants in wastewater. The details of the Constructed Wetland Technology are at **Annex 5**.

6.10 Urban Wastewater Management

The wastewater management should consider the sustainable management of wastewater from source to re-entry into the environment ('reuse/disposal' in the sanitation service chain), and not only concentrate on single or selected areas or segments of the service provision process.

The aim of treatment is to reduce the level of pollutants in the wastewater before its reuse or disposal into the environment, and to meet the standard of treatment required at a location and use-specific. The choice between centralized (sewer) or decentralized (on-site/neighbourhood-level) wastewater management systems depends upon a number of factors, but it is important that full consideration be given to the both options rather than the situation that has existed in the past, where sewerage has been considered to be the only 'proper' form of urban sanitation.

6.11 Urban Waste Management Rules (UWM Rules)

The Ministry of Climate Change and Pakistan Environmental Protection Agency have enacted the "Pakistan Environmental Protection Agency Ban on (Manufacturing, Import, Sale, Purchase, Storage and Usage) Polythene Bags Regulations, 2019". These regulations extend to the Islamabad Capital Territory (ICT); wherein, the use of polythene bags use has been banned and no person shall manufacture, import, sell, purchase, use, trade, supply, store and distribute polythene bags.

In order to ensure the effective waste management in urban areas, including all green housing projects, the Ministry of Climate Change needs to also notify the ***"Urban Waste Management Rules (management and handling of municipal wastes, including polythene bags, plastic, e-waste, biomedical, construction and demolition wastes)".*** To facilitate the enforcement of these Rules throughout Pakistan, these should be compatible and in harmony with the provisions of 8th Constitutional Amendment. At **Annex 7**, the draft Urban Waste Management Rules are placed for guidance and finalization as Rules, Regulations or Act by the Pakistan Environmental Protection Agency, in consultation with the concerned stakeholders. Following are the salient aspects of draft Rules.

Anticipating the future sprawl of urban developments around existing cities and towns, it is recommended that the new UWM Rules be also applicable beyond municipal areas and include notified industrial townships, areas under the control of Federal & Provincial Governments, including Pakistan Railways, airports, special economic zones, and the places of historical and heritage importance.

These rules should promote and incentivise the environment friendly waste collection and disposal management; along with imposing a penalty in case of poor implementation.
The UWM Rules to also mandate the waste generators to segregate and sorting the waste at source for recovery, reuse and recycle in to three streams - Biodegradables, Dry (plastic, paper, metal, wood, etc.) and Domestic waste (diapers, napkins, cleaning agents, etc.), before handing over to the segregated waste to waste collector or agency, as specified by the local authority.

All hotels and restaurants be required to segregate biodegradable waste and set up a system of collection to ensure that such food waste is utilized for composting or biomethanation. Further, the all residential communities with gated area of above 5,000 square meter to segregate waste at source into material like plastic, tin, glass, paper and others, and hand over the recyclable material either to waste-pickers or to the urban local body.

In case of construction and demolition waste, all generators of must segregate it into four categories– concrete, soil, steel and wood, plastics, bricks and mortar – and then either deposit it at collection centres set-up by the local authority or hand it over to processing/recyclers.

Large generators of construction and demolition wastes should prepare respective Environment Management Plan along with Waste Management Plan, detailing the environmental issues that can stem from the storage, transportation, disposal and reuse of such wastes; and get local authority

approval before starting any construction/demolition/renovation work; besides, the payment of relevant charge to service providers and contractors for collection, transport and disposal of construction and demolition waste.

In addition, to promote the reuse of construction and demolition waste, the Nation Building Departments be advised to incorporate a clause in their tenders, mandating that a certain percentage of recycled products from construction and demolition waste should be used in roads and non-structural works. Also, the making of waste recycling plants be encouraged, on public-private partnership basis.

Waste processing facilities be set up by all local bodies having a population of one million or more. For the towns with a population below one million or for all local bodies having a population of one-half million or more, the common, or stand-alone sanitary landfills be set up. Also, common sanitary landfills be set up on regional basis, by all local bodies and towns with a population below one-half million.

The UWM Rules to also consider the integration of rag and waste pickers (i.e. Raddi or Kabari-walas) from the informal-sector to the formal-sector by the Government.

The UWM Rules to also stipulate zero tolerance for throwing; burning, or burying the solid waste generated on streets, open public spaces outside the generator's premises, or in the drain, or water bodies.

The UWM Rules must advise that the bio-degradable waste should be processed, treated and disposed of through composting or biomethanation within the premises as far as possible, and the residual waste be given to the waste collectors or agency as directed by the local authority. The developers of all industrial estates must earmark at least five per cent of the total land/plot area for recovery and recycling facility.

The Urban Waste Management Rules must recommend the promotion of Waste to Energy Plants. The non-recyclable waste having the required calorific value or more be utilized for generating energy, either through waste not disposed of in landfills and utilized for generating energy either or through refuse derived fuel or by giving away as feed stock for preparing refuse derived fuel. High calorific wastes can also be used for the co-processing in cement or thermal power plants.

The local bodies should facilitate infrastructure creation for Waste to Energy plants and provide appropriate subsidy or incentives for such plants. The WAPDA should fix tariff or charges for the power generated from these plants based on solid waste, and ensure compulsory purchase of power generated by Waste to Energy plants.

The UWM Rules must push for adoption of a decentralized mechanism for solid waste management, by the all urban and peri-urban administrations. A massive awareness campaign in association along with the communities, NGOs, academia and concerned stakeholders needs to be planned to push for better implementation of these rules. The Rules need to focus on making solid waste management a people's movement by taking the issues, concerns and management of solid waste to citizens and grassroots.

SECTION 7: BUILDING COMMISSIONING REQUIREMENTS

Setting clear performance targets in the building commissioning for all new housing will not only make a significant contribution to reducing Carbon emissions, but will also reduce the fuel bills. This will result in improved building performance and a more sustainable built environment.

All building systems, including mechanical, electrical and plumbing, be reviewed and commissioned during the construction and post-completion stages; as per the Owner's Project requirements and approved plan/design of green building. In this connection, the following documents need to be prepared for reference:

- Owner's Project Requirements
- Basis of Design
- Design Reviews
- Commissioning Plan
- Commissioning Specifications
- Operation & Maintenance manuals
- Checklists used in the Commissioning Process
- Test-Logs & Issues
- Building Commissioning Report, including Mechanical, Electrical, Renewable Energy Systems and Lighting Control Systems.

SECTION 8: ADOPTION OF GREEN BUILDING PRACTICES BY USING EDGE GREEN BUILDING SOFTWARE

The Guideline recommends to use EDGE simulation software for assessment of resource efficiency features (energy, water and materials) for buildings constructed under the Prime Minister Housing Naya Pakistan Housing Programme. The software EDGE allows for design and assessment of residential buildings for various income categories i.e. low, lower middle, upper middle and high as well as for apartments/flats. Any combination of resource efficiency measures can be selected according to local conditions and requirements. At present, EDGE in Pakistan includes seven (07) different climatic regions (Islamabad, Rawalpindi, Lahore, Karachi, Peshawar, Quetta, Gilgit) and this can easily be extended further. Since, this is a very user-friendly software, therefore, it does not necessarily require specialized expertise in engineering or architecture. Therefore, EDGE appears as an ideal choice for capacity building and training of various professionals and stakeholders involved in PM 5-million housing project. The steps involved in designing a residential building using EDGE are delineated.

The Guideline put forward adoption of mechanism to undertake periodical review of building systems, including mechanical, electrical and plumbing, during construction and post-completion stages; as per the green building requirements and approved plan/design of green building to ensure achieving the goals of greening the building construction sector in Pakistan.

Relevance of using EDGE Green Building Software

International Finance Corporation (IFC), part of World Bank Group has developed a green building rating system to promote resource efficient buildings in developing countries. This green building rating system is called '*Excellence in Design for Greater Efficiencies (EDGE)*'. This rating system has addressed the numerous barriers associated with green buildings adoption in developing countries.

The EDGE software green building rating system and its accompanying free-of-cost simulation tool allows to quickly design resource efficient buildings according to local climatic conditions and construction practices i.e. local baseline. It focuses on energy efficiency, water efficiency and embodied heat of construction materials. This software is easy to use and includes twenty four (24) energy efficiency measures, eight (08) water efficiency measures and six (06) measures for embodied heat of construction materials. The energy efficiency covers measure for building envelope, HVAC systems, lighting, water heating and renewable energy resources. Water efficiency measures include use of water efficient fixtures as well as measures on rain water harvesting and recycling. Materials efficiency measures (embodied heat reduction) include assessment of roof, floor, internal walls, external walls, windows and insulation materials.

It is proposed that free-of-cost resources of EDGE should be adopted for preliminary assessments of buildings and capacity building of professionals. In future, most elaborate and complex simulations tools and green building rating systems can be promoted as per the market demand and requirement.

Unique challenges associated in adoption of Green Building Software

Wide scale adoption of building energy codes and green building rating systems in developing countries like Pakistan is obstructed due to numerous barriers. These challenges include:

- lack of implementation or non-existence of mandatory building energy codes;

- awareness of various stakeholders;
- lack of availability of qualified/certified green building professionals;
- technical complexities associated with green building certifications;
- lack of relevance with local/national construction industry practices;
- higher costs of hiring consultants for energy analysis, life cycle analysis, site sustainability, indoor air quality etc.;
- higher initial costs associated with green buildings construction techniques and building features;
- lack of third-party certified products and materials;
- lack of demand from customers and
- lack of competition among to developers for green building projects.

Requirements for Promoting Green Buildings

It is evident that green building codes and rating systems developed in advanced economies like USA, EU etc. cannot be easily adopted in developing countries on wide scale. Hence, can ideal green building rating systems should be able to effectively address the above mentioned issues and challenges.

Some of the most important features that should be present in a green building rating system for developing countries are:

- The technical documents and learning resources should be available online and free-of-cost;
- The rating system should be complimented with simplified simulation software packages and calculators for resource efficiency assessments;
- It should have major focus on resource efficiency features of green buildings i.e. energy, water and materials efficiency;
- Other aspects of green buildings e.g. location & transportation, site sustainability, indoor environmental quality etc. should be optional in the beginning;
- It should evaluate building features according to local/national construction practices;
- There should not any stringent or mandatory features that would be required to be incorporated in the building design;
- Buildings designers should be provided flexibility of using building features to meet a certain target of resource efficiency w.r.t. to existing local practices;
- There should be robust and transparent mechanism for green building certification system;
- The training events and certification exams should be available at national level and;
- Adopters of green building systems should be provided recognition and incentives (monetary / non-monetary).

Steps for Designing a Residential Building Using EDGE Software

1. Open the website (https://app.edgebuildings.com/project/homes) to access EDGE software for designing residential buildings.
2. Login to save record of projects.
3. Provide details about project and subproject.
4. Select project location (country and city).
5. Select appropriate income category for the project.
6. Provide information about size and features of building e.g. number of floors, rooms etc.

7. Provide information about presence / absence of space heating and/or cooling systems.

8. Input key information about baseline in the country (types and costs of fuels, typical values of building envelope and equipment features.

9. In 'Energy' tab, select a combination of desired energy efficiency features and their corresponding values. EDGE will calculate the predictive savings in operational energy usage. The results will be presented in the form of two bar graphs (base case and improved case).

10. Repeat the same procedure for 'Water' and 'Materials' efficiency measures.

11. The project design would be completed when a desired level of resource efficiency has been achieved. EDGE standard recommends 20% savings in each category (energy, water and materials).

12. The project can be shared directly with other stakeholders through EDGE software.

13. An elaborate and easy-to-understand PDF report can be automatically generated through the EDGE software.

Resource Efficiency Measures for Residential Units

Energy Efficiency Measures

Building Envelope:

1. HME01* Reduced Window to Wall Ratio – *(e.g. WWR of 20%)*
2. HME02 Reflective Paint/Tiles for Roof – (e.g. Solar Reflectivity (albedo) of 0.7)
3. HME03 Reflective Paint for External Walls –(*e.g. Solar Reflectivity (albedo) of 0.7*)
4. HME04 External Shading Devices – (e.g. Annual Average Shading Factor (AASF) of 0.5)
5. HME05 Insulation of Roof: *(e.g. U-value of 0.45)*
6. HME06 Insulation of External Walls: *(e.g. U-value of 0.44)*
7. HME07 Low-E Coated Glass: (e.g. U-value of 3 W/m².K and SHGC of 0.45)
8. HME08 Higher Thermal Performance Glass: (e.g. U-value of 1.9 W/m².K and SHGC of 0.28)

HVAC Systems:

1. HME09 Natural Ventilation
2. HME10 Ceiling Fans in All Habitable Rooms
3. HME11* Air Conditioning System – *(e.g. COP of 3.5)*
4. HME12 High-Efficiency Boiler for Space Heating – *(e.g. Efficiency of 95%)*
5. HMET3 Sensible Heat Recovery from Exhaust Air – *(e.g. Efficiency of 50%)*
6. HME13 High-Efficiency Boiler for Hot Water – *(e.g. Efficiency of 95%)*
7. HME14 Heat Pump for Hot Water – *(e.g. COP of 3)*
8. HME15 Energy-Efficient Refrigerators and Clothes Washing Machines

Lighting Systems:

1. HME16 Energy-Saving Light Bulbs - Internal Spaces
2. HME17 Energy-Saving Light Bulbs - Common Areas and External Spaces
3. HME18 Lighting Controls for Common Areas and Outdoors

Renewable Energy Solutions:

1. HME19 Solar Hot Water Collectors – *(e.g. 50% of Hot Water Demand)*
2. HME20 Solar Photovoltaics – (e.g. 25% of Total Energy Use)
3. HME21 Smart Energy Meters for Electrical Energy
4. HMET4 Consumption Based Energy Meters for Both Cooling and Heating Energy
5. HME22 Other Renewable Energy for Electricity Generation

Water Efficiency Measures

Water Efficient Fixtures:

1. HMW01* Low-Flow Showerheads – *(e.g. 8 L/min)*
2. HMW02* Low-Flow Faucets for Kitchen Sinks – *(e.g. 6 L/min)*
3. HMW03* Low-Flow Faucets in All Bathrooms – *(e.g. 6 L/min)*
4. HMW04* Dual Flush for Water Closets in All Bathrooms – *(6 L/first flush and 3 L/second flush)*
5. HMW05* Single Flush for Water Closets – *(e.g. 6 L/flush)*

Rainwater Harvesting and Recycling:

1. HMW06 Rainwater Harvesting System – (e.g. 50% of Roof Area Used for Rainwater Collection)
2. HMW07 Recycled Grey Water for Flushing
3. HMW08 Recycled Black Water for Flushing

Materials Efficiency Measures

1. HMM01* Floor Slabs
2. HMM02* Roof Construction
3. HMM03* External Walls
4. HMM04* Internal Walls
5. HMM05* Flooring
6. HMM06* Window Frames

Database of Construction Materials for Embodied Heat Calculations

List of Construction Materials for Floor/Roof

- In-Situ Reinforced Concrete Slab
- In-Situ Concrete with >25% GGBS
- In-Situ Concrete with >30% PFA
- Concrete Filler Slab
- Precast RC Planks and Joist System
- Concrete Filler Slab with Polystyrene Insulation
- In-Situ Trough Concrete Slab
- In-Situ Waffle Concrete Slab
- Hollow Core Precast Slab
- Composite slim slabs with Steel I-beams
- Composite in-situ concrete and steel deck (permanent shuttering)
- Precast concrete double tee floor/roof units
- Thin precast concrete deck and composite in-situ slab
- Timber floor construction
- Brick Panel Roofing System
- Light gauge steel floor cassette
- Ferro Cement Roofing Channels
- Re-use of existing floor slab
- Clay Roofing Tiles on Steel Rafters
- Clay Roofing Tiles on Timber Rafters
- Micro Concrete Tiles on Steel Rafters
- Micro Concrete Tiles on Timber Rafters
- Steel (zinc or galvanized iron) Sheets on Steel Rafters
- Aluminum sheets on Steel Rafters
- Aluminum sheets on Timber Rafters
- Copper Sheets on Steel Rafters
- Copper Sheets on Timber Rafters
- Asphalt shingles on Steel Rafters
- Asphalt shingles on Timber Rafters
- Aluminum-clad sandwich panel
- Steel-clad sandwich panel

List of Construction Materials for External / Internal Walls

- Common Brick Wall with internal & external plaster
- Cored (with holes) bricks with internal & external plaster
- Honeycomb Clay Blocks with internal & external plaster
- Medium Weight Hollow Concrete Blocks
- Solid Dense Concrete Blocks
- Autoclaved Aerated Concrete Blocks
- Fly-Ash Stabilized Soil Blocks
- Compressed Stabilized Earth Blocks
- GGBS Stabilized Soil Blocks
- Rammed Earth Blocks/Walls

- Precast Concrete Panels
- Straw Bale Blocks
- Facing Brick and Timber Stud
- Phosphogypsum Panel
- Ferrocement Wall Panel
- In-Situ Reinforced Wall
- Cellular Light Weight Concrete Blocks
- Stone Blocks
- FaLG Block
- Steel Profile Cladding
- Aluminum Profile Cladding
- Exposed Brick Wall with internal plaster
- Exposed Cored (with holes) bricks with internal plaster
- Facing Brick and Hollow Concrete Blocks
- Facing Brick and Solid Concrete Blocks
- Polymeric render on concrete block
- Polymeric render on Brick
- Precast Concrete Sandwich panel
- Brick faced precast concrete sandwich panel
- Stone faced precast concrete sandwich panel
- Glass fiber reinforced concrete cladding
- Stone Profile Cladding
- Cement Fiber Boards on Metal Studs
- Cement Fiber Boards on Timber Studs
- Timber Weatherboard on Timber Studs
- UPVC Weatherboard on timber studs
- Clay tiles cladding (or 'Terracotta rain screen cladding') on metal studs
- Plasterboards on timber studs
- Plasterboards on metal studs
- Curtain walling (opaque element)
- 3-D Wire panel with 'shot-crete' both sides
- Aluminum-clad sandwich panel
- Steel-clad sandwich panel
- Re-use of Existing Wall
- Stone Blocks – Hand Cut
- Stone Blocks – Machine Cut and Unpolished

Flooring:

- Ceramic Tile
- Vinyl Flooring
- Stone Tiles/Slabs
- Finished Concrete Floor
- Linoleum Sheet
- Terrazzo Tiles
- Nylon Carpets
- Laminated Wooden Flooring
- Terracotta Tiles

- Parquet / Wood Block Finishes
- Plant fiber (Seagrass, sisal, coir or jute) carpet
- Cork Tiles
- Re-use of Existing Flooring

Windows:

- Aluminum
- Steel
- Timber
- UPVC
- Aluminum clad timber
- Re-use of Existing Window Frames

Insulation:

- Polystyrene
- Mineral Wool
- Glass Wool
- Polyurethane
- Cellulose
- Cork
- Woodwool
- Air gap <100mm wide
- Air gap >100mm wide

CHECKLIST FOR EVALUATION OF INPUTS

A successful utilization of **Green Building Guideline for Prime Minister Five Million Naya Pakistan Housing Programme** relies on incorporation of all suggestions contained therein. This check list prepared as a series of questions is a culminating exercise for self-evaluation by readers and users of the guideline to avoid oversights. This undertaking will also reflect the readiness of the project for detailed evaluation as given in the Compendium to the guideline, to be provided separately, thus qualifying the project for acceptable green certification as may be approved by the government in the future. Please note that it is important that qualified professionals and experts should be engaged in all stages of the project and that evaluation and post occupancy review are also carried out with help of qualified experts.

Please Mark as appropriate

Sr. No's	CHECK THE FOLLOWING	Yes	No	Partially
1	Were the recommended green building strategies adopted for the project?			
2	Were the aspects of site sustainability integrated into planning and design stages?			
3	Were recommendation given for master planning and design followed in the process?			
4	Was the rule for building material sustainability adhered to in the selection, specification and construction stages?			
5	Has the building envelop designed and constructed as per recommendations?			
6	Is the building/project relying on natural ventilation?			
7	Has insulation been incorporated in the building skin?			
8	Does the design duly cater for the heat island effect in the project?			
9	Has water efficiency been considered in the project?			
10	Does the project have suitable provision for rainwater harvesting?			
11	Has due consideration been given to Energy Efficiency?			
12	Were the recommendations for waste management included in the project?			
13	Is compliance of environmental prerequisites integrated into the project stages?			
14	Has the mechanism of the building commissioning requirements been included in the project works?			
15	Has the checklist been reviewed prior to further action related to the project?			
16	Has the EDGE software used in the project?			

ANNEXURES

ANNEX 1: Stages for Applying Green Building Strategies

STAGE	ISSUES TO CONSIDER	
Land Planning	• Solar access • Transportation • Greyfield/brownfield/infill • Saving natural plants and areas • Mixed use • Reduced paving • Infrastructure	• Clustering • Community stormwater management • Wind buffers • Wildfire buffers • Buffers from adjacent development • Traditional neighborhood development
Site Planning	• Wind buffers • Porches and decks • Reduced site paving • Grading and site water management • Landscape and shading • Acoustical and visual buffers	• Basic space layout relative to sun, wind, views • Septic systems and wells • Utility service entries • Auto and pedestrian access • Parking
Construction Process Planning	• Construction waste management and recycling • Hazardous waste disposal	• Reduced site disturbance • Site construction access & storage • Storage and reuse of on-site excavation and soils
Basic Design	• Glazing and solar access • Provisions for efficient and energy saving duct layout • Mechanical equipment inside the conditioned envelope • Acoustical considerations	• Design for recycling by homeowners • Avoiding attached garage if possible • Avoiding excessive size • Incorporate natural lighting wherever possible • Structural systems
Specifications	Evaluate materials including: • Structural materials • Cladding and roofing • Insulation • Air-sealing materials and systems • Finish materials	• Cabinetwork and accessories • Plumbing and water heating • Mechanical equipment selection • Electrical and lighting
During Construction	• Changes that do not affect other elements and do not increase energy consumption or otherwise compromise green building objectives	• Photograph and record work that will be hidden
Post Construction	• Commission to ensure proper operation of green building elements and systems	• Home Energy Rating/Energy Star approval • Home buyer education and operating manual

ANNEX 2: Models for Heat Insulation

5.1 Model preparation

Mini models (1 ft x 1 ft) for each solution applied on the roof prepared to assist with photographs of the actual section or specification, and for demonstration, since after finishing the roof surfaces, visitors will not be able to see what has been done under the finished surface. Mini models can easily be transported for technical training and information campaigns.

Green Netting

Stabilized Mud

Mud with thermo pole

Jumbolon

Concrete Wizard

Sachal tile

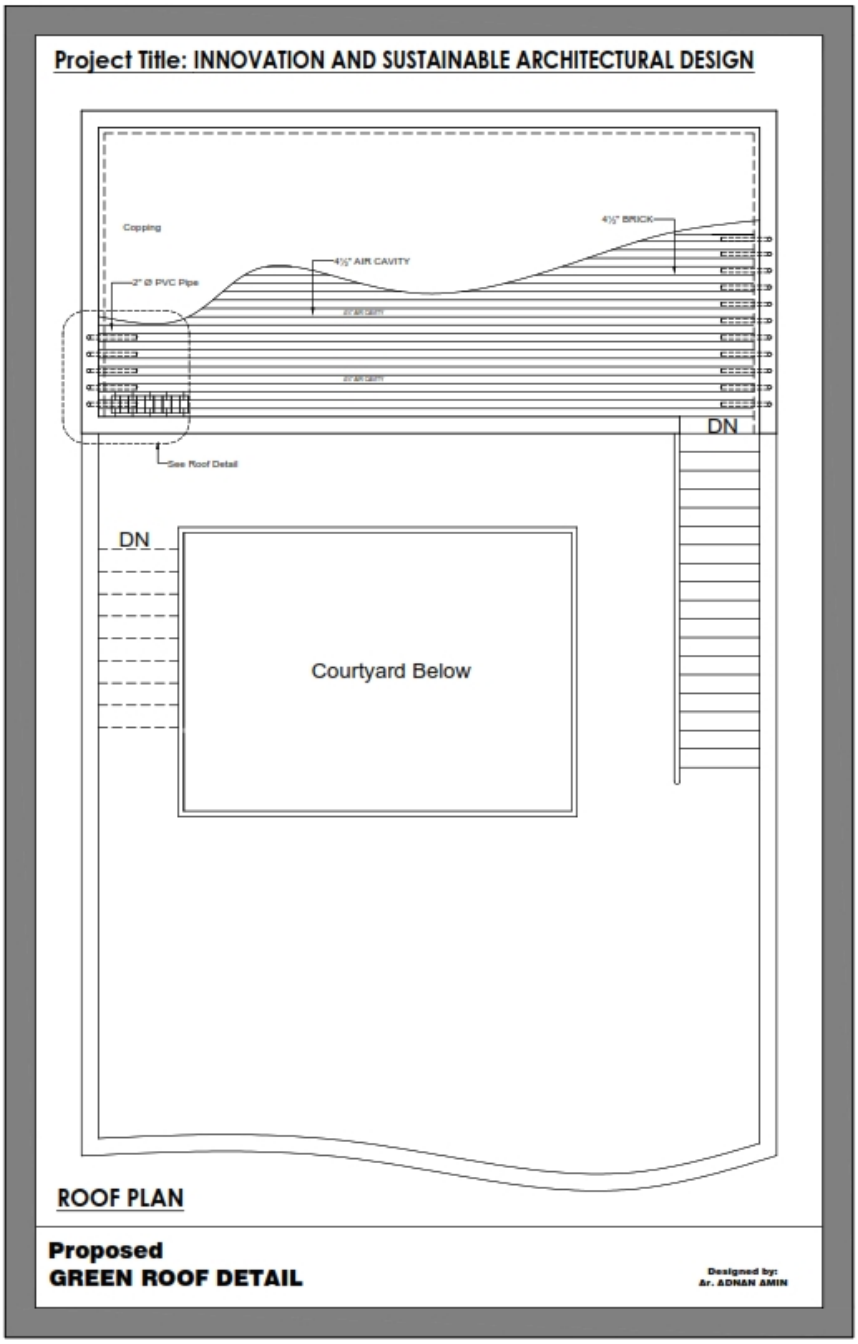
Smart Concrete

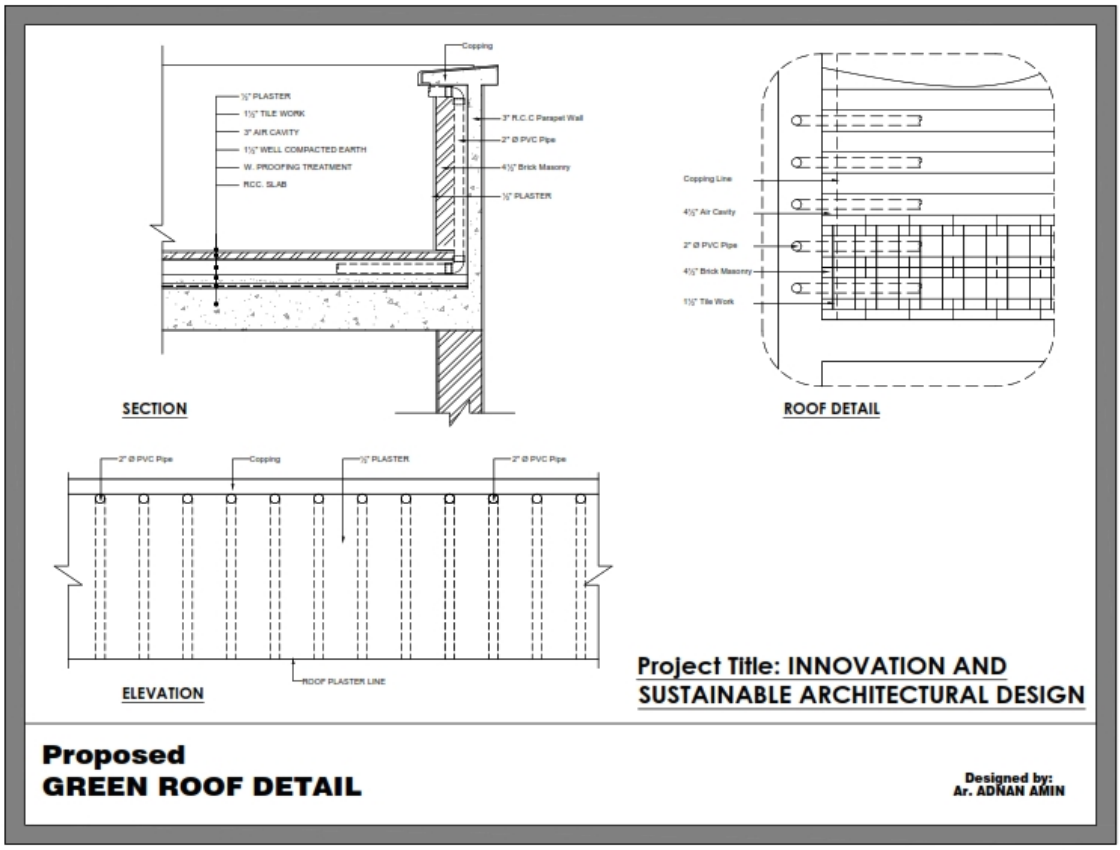
Munawar AC tile

Hollow Clay tile

ANNEX 3: COMSAT University Islamabad

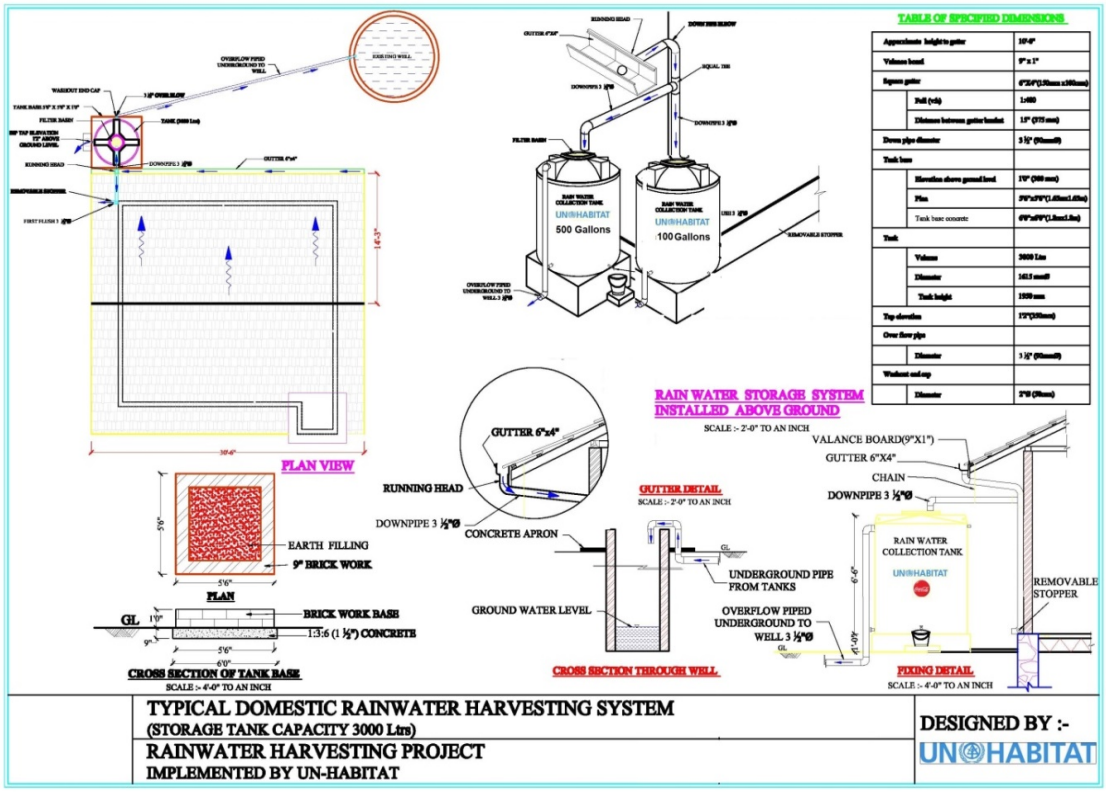
GREEN ROOF PROJECT IN ACADEMIC BUILDINGS

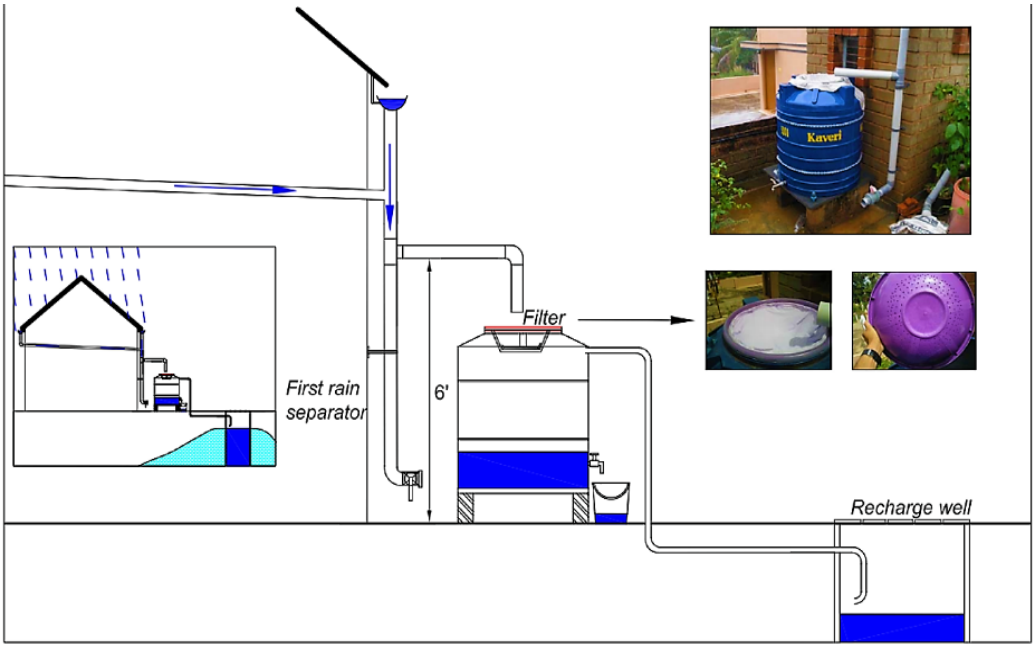


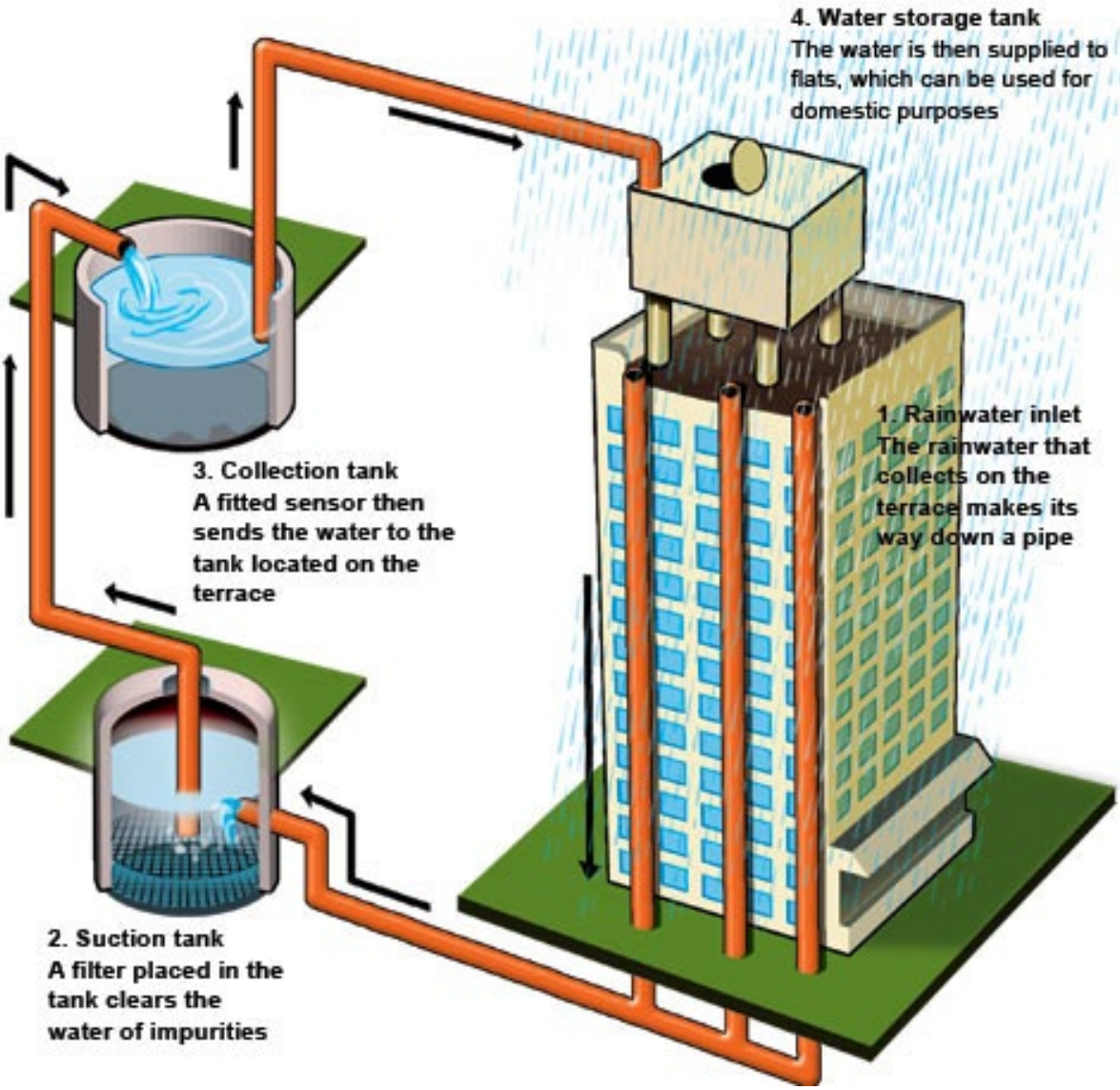

Coping
½" PLASTER
1½" TILE WORK
3" AIR CAVITY
1½" WELL COMPACTED EARTH
W. PROOFING TREATMENT
RCC. SLAB
3" R.C.C Parapet Wall
2" Ø PVC Pipe
4½" Brick Masonry
½" PLASTER
SECTION
Coping Line
4½" Air Cavity
2" Ø PVC Pipe
4½" Brick Masonry
1½" Tile Work
ROOF DETAIL
2" Ø PVC Pipe
Coping
½" PLASTER
2" Ø PVC Pipe
ROOF PLASTER LINE
ELEVATION
Project Title: INNOVATION AND SUSTAINABLE ARCHITECTURAL DESIGN
Proposed
GREEN ROOF DETAIL
Designed by:
Ar. ADNAN AMIN

ANNEX 4: Domestic Rainwater System

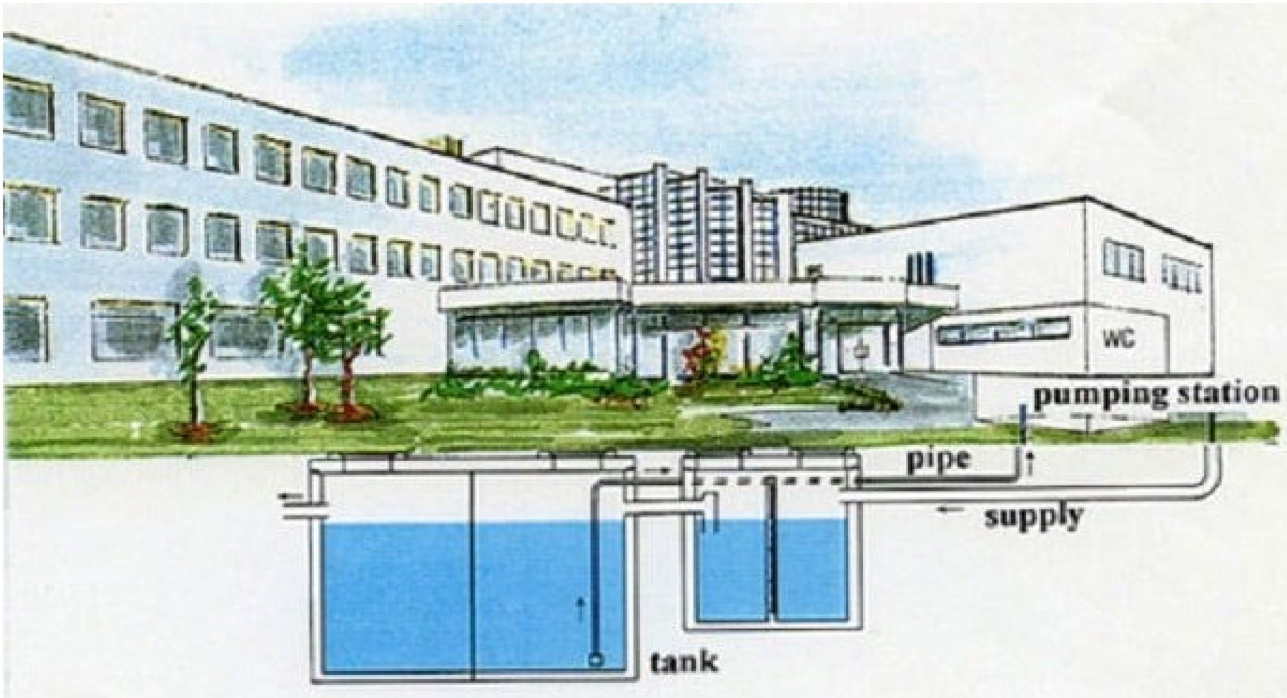
Rainwater Harvesting Unit Designs at Household Level






4. Water storage tank
The water is then supplied to flats, which can be used for domestic purposes
1. Rainwater inlet
The rainwater that collects on the terrace makes its way down a pipe
3. Collection tank
A fitted sensor then sends the water to the tank located on the terrace
2. Suction tank
A filter placed in the tank clears the water of impurities

بارش کے پانی کو محفوظ کر کے استعمال کرنے کے قابل بنانے کی تجاویزات
(First Flushing Diverting)
UN HABITAT
FOR A BETTER URBAN FUTURE



WC
pumping station
pipe
supply
tank

ANNEX 5: INTEGRATED RESOURCE RECOVERY CENTER

Open burning of waste is estimated about a quarter of Pakistan's reported carbon emissions. Dumped waste is also a major cause of diarrheal diseases. A community-based approach to waste management addresses these problems while also creating jobs. Integrated Resource Recovery Center (IRRC) is a decentralized community-based recycling & composting facility which can be built & operated at low costs by using limited mechanical technology, ensuring low operational costs with minimal equipment breakdowns, while creating job opportunities.

United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) has been promoting decentralized and Integrated Resource Recovery Centers (IRRCs) in secondary cities and small towns in Asia-Pacific, including Pakistan with the objective to recover value from waste and provide livelihood opportunities to the urban poor. UN Habitat provides technical assistance for establishment of IRRC.

IRRC in Islamabad

The first pilot IRRC in Pakistan was established in Sector G-15, Islamabad, in 2014 by UN Habitat in collaboration with Dr. Akhtar Hameed Khan Memorial Trust (AHKMT), and support of UNESCAP; following the model's success elsewhere in Asia. Before the IRRC was set up, the household waste was dumped outside housing & burned in G-15. The IRRC has the capacity to process waste from 3,000 households and is currently operating at half-capacity.

Some households separate waste at source, and this has been actively encouraged. The waste also undergoes further sorting post collection, at the center. The IRRC teams collect waste almost daily (necessary in tropical world). This averts insanitary conditions and also makes sorting easier. Waste is sorted by IRRC staff alongside employees from a contractor who pays a fee to the IRRC and in return receives all the plastic, metal and other recyclables collected. The IRRC keeps organic material to use as chicken feed and produce compost; and then sells a mixture of chicken manure & compost as a high-quality soil conditioner or fertilizer. Approximately 10% of waste collected cannot be recycled or composted, and disposed into a municipal landfill.

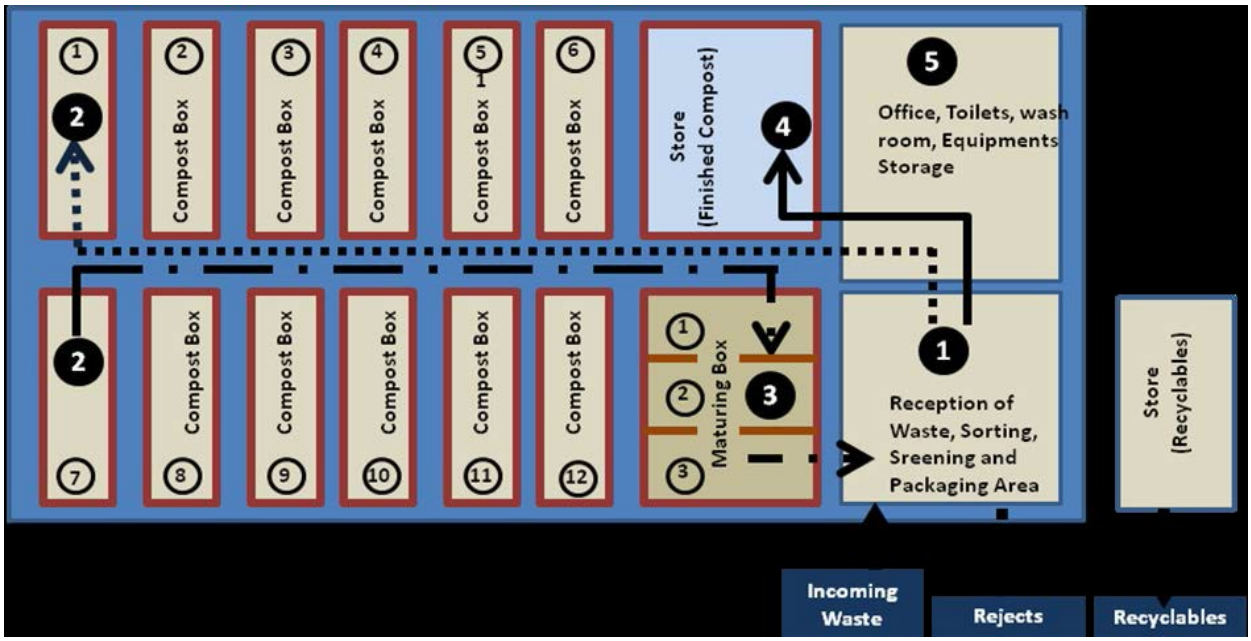
Replication Potential

The IRRC pilot in Islamabad demonstrates the potential for community-based waste management to improve public health, mitigate climate change and create safe jobs. Analysis suggests that for every dollar invested, the IRRC model offers USD 10 in benefits. The benefits are particularly significant in relation to improved public health and climate change mitigation, although employment creation also plays a part. The IRRC diverts 90 per cent of waste from centralized disposal and is a factor of ten cheaper than providing centralized disposal facilities.

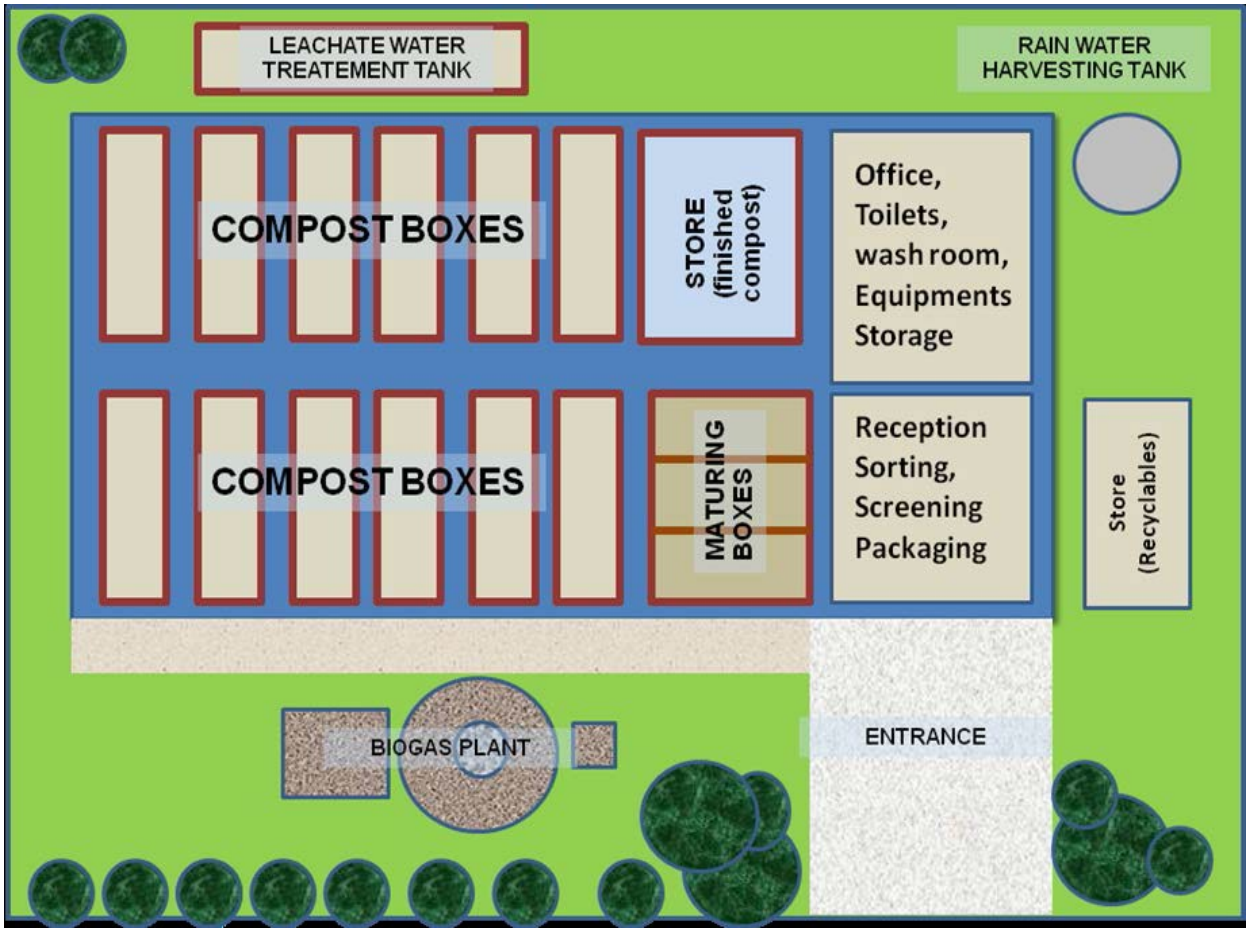
The analysis suggests that community-based waste management approaches offer a 'best solution for cleaner Pakistan and value for money solution for donors and Governments. It also helps to address multiple targets under Sustainable Development Goals, including SDG 3 (Good Health & Well-being), SDG 6 (Clean Water & Sanitation), SDG 11 (Sustainable Cities & Communities), SDG 12 (Sustainable Consumption & Production), SDG 13 (Climate Action), SDG 14 (Marine Life in settlements on the coast or major rivers) and SDG 15 (Life on Land). In the case of Islamabad, there is an urgent need for replication and up-scaling of this successful model to other areas. The IRRC appears to offer a highly cost-effective way of improving waste management in the fast-growing cities of Pakistan. Expansion

of IRRC will lead to establishment of large scale waste segregation and recycling facilities in the country.

Material Flow of Organic Waste Input in a Compost Plant



Schematic Layout of Box-Type Compost Plant IRR Design



ANNEX 6: CONSTRUCTED WETLANDS

Grey water (GW) recycling is not yet widely accepted in practice, partly because of the low economic benefit. The shared GW recycling system can carry lower economic costs in both high and low efficiency buildings. As the cost of water rises and increasing pressure is placed upon aging and deteriorating water and wastewater infrastructure, solutions that reduce water demand, such as greater use of grey water, become more viable financially. Given that utility service infrastructure for buildings has a design life of 20–40 years, the adoption of systems that might be marginally more expensive now, but deliver benefits in future, should be considered: possibly proving an immediate-selling point' for the development and a future means to avoid retrofitting costs.

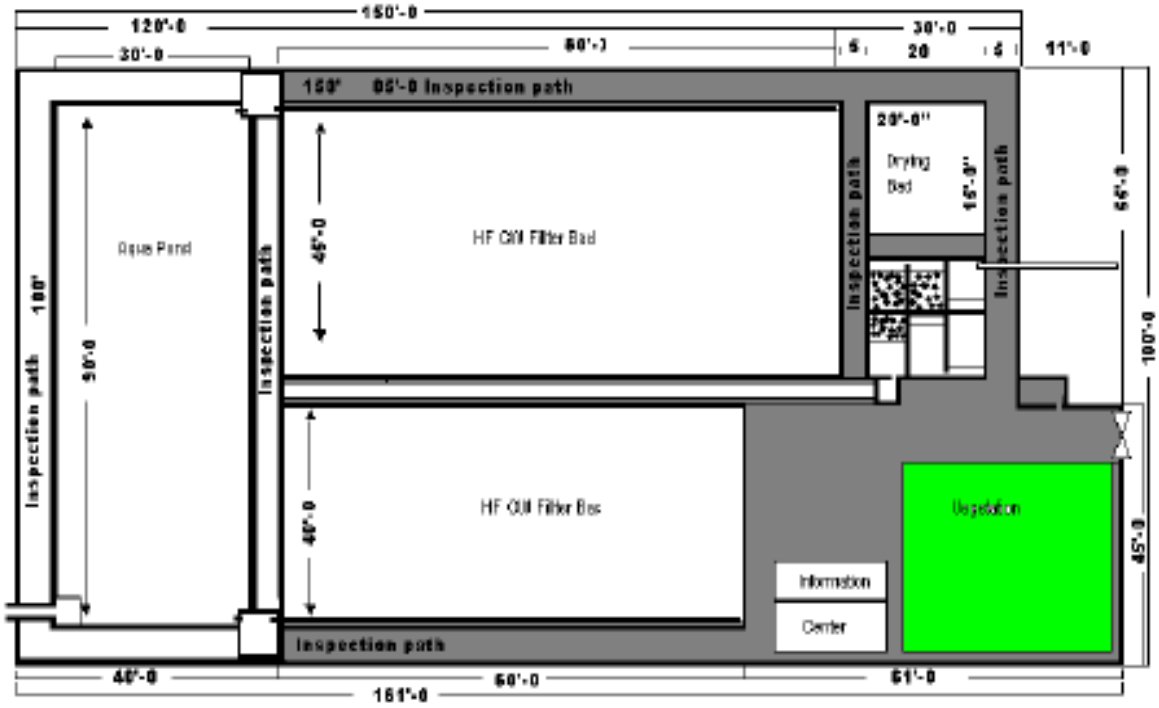
Rapid pace of urbanization in Pakistan has led to poor environmental sanitation as a major challenge, threatening the health and livelihood of the people. Mere provision of toilets is not enough to ensure good environmental sanitation. Excreta from toilets needs to be transported and disposed of safely without creating an environmental health hazard for improving primary health care particularly in slums, urban peripheries, towns and villages. In Pakistan, large quantities of wastewater are disposed into water bodies without any treatment. Conventional wastewater treatment systems comprising of energy intensive and mechanized treatment components require heavy investment and entail high operating costs.

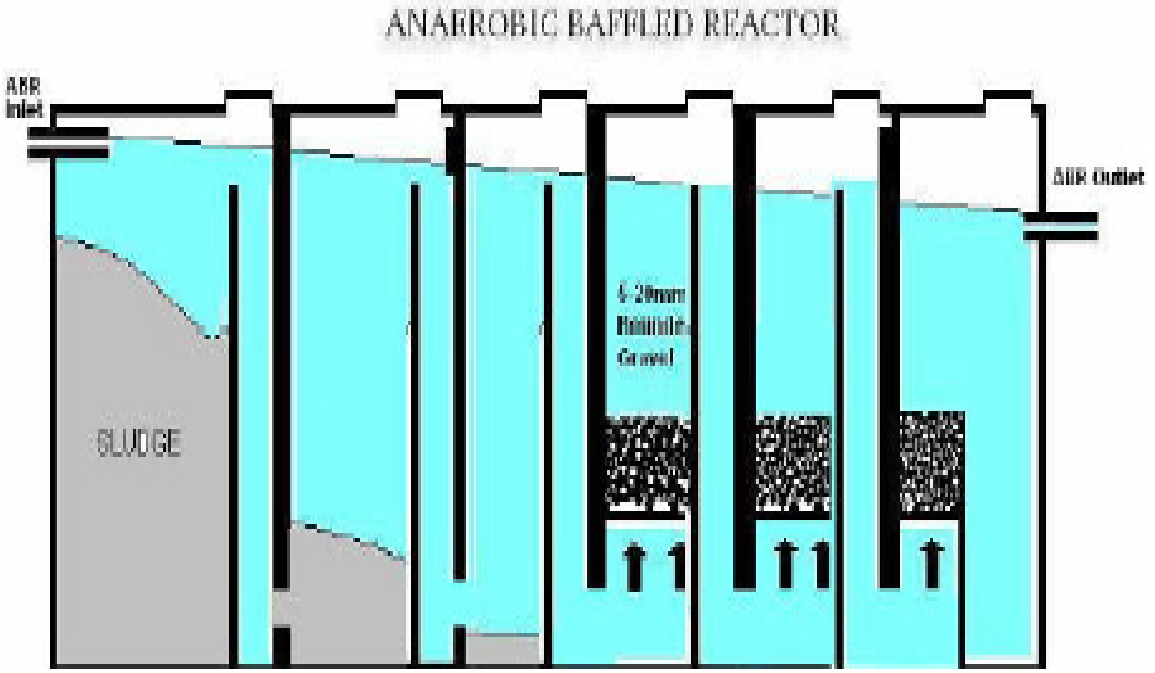
UN-Habitat with the support of the Water and Sanitation Trust fund has introduced the Constructed Wetland technology in Pakistan, India, and People's Republic of China, Nepal, Vietnam, Cambodia, and Indonesia. Constructed Wetlands(CW) are engineered systems that have been designed and constructed to utilize the natural processes involving wetland vegetation, soils and the associated microbial assemblages to assist in treating municipal or industrial wastewater, grey water or storm water runoff. Depending on the type of wastewater the design of the constructed wetland has to be adjusted accordingly. CW offer multiple benefits which include integration into parks and recreational facilities, wildlife habitat, aesthetic value and providing superior treated effluent that can be used for landscape irrigation and other non-drinkable purposes like construction and water intensive industrial processes etc. This can largely supplement increasing water demand with the rapidly growing urbanization in the country. Moreover, it will also offset use of energy intensive water treatment processes as CW does not require energy for its operation. This technology is relatively inexpensive to build and can be easily operated and maintained by the community.

A constructed wetland uses natural geochemical and biological processes in a wetland ecosystem to treat metals, explosives, and other contaminants in wastewater. Constructed wetland has three primary components: an impermeable layer (generally clay), a gravel layer that provides a substrate (i.e., an area that provides nutrients and support) for the root zone, and above surface vegetation zone. The impermeable layer prevents infiltration of wastes down into lower aquifers. The gravel layer and root zone is where water flows and bioremediation and de-nitrification take place. The above ground vegetative layer contains the plant material. Both aerobic and anaerobic systems (i.e., systems with and without oxygen) exist within the wetland, and these can be divided into separate cells. Wastewater is either pumped or allowed to naturally flow through the wetland. The anaerobic cell uses plants in concert with natural microbes to degrade the contaminant. The aerobic cell further improves water quality through continued exposure to the plants and the movement of water between cell compartments. Hence, the constructed wetland system ensures process stability. As per results from the constructed wetlands developed by UN Habitat and other partners in 2011, the average area required for treatment of 500,000 Gallons per day wastewater for 3400 Households is 0.25 Acres.

UN Habitat provides training and support to civil society organizations to disseminate the Constructed Wetland Technology in the country and has implemented it with WWF and Syndical Reforms Society. UN Habitat under the Clean and Green Pakistan Movement aims to upscale the successful model of Constructed Wetland technology for wastewater treatment by means of involving and articulating land owning and development agencies, municipalities, cantonment boards and private sector developers. UN Habitat will operationalize constructed wetland in a sustainable way through institutional capacity building, streamlining town planning and building regulations and demonstrating social, environmental, and economic viability of the Constructed Wetland technology at the grass root level.

Constructed Wetland Design







ANNEX 7: The Gazette of Pakistan

Extraordinary Published by Authority

Statutory Notifications (S.R.O)
GOVERNMENT OF PAKISTAN
Ministry of Climate Change
Pakistan Environmental Protection Agency
*****
Islamabad, the January, 2020.

NOTIFICATION

S.R.O. (__) 2020._ In exercise of the powers conferred by section 33 of the Pakistan Environmental Protection Act, 1997 (XXXIV of 1997), the Pakistan Environmental Protection Agency, with the approval of the Federal Government, is pleased to make the following regulations, namely:

Short Title, Application and Commencement

1. These regulations shall be called the:
   Pakistan Urban Waste Management Rules (Management and Handling of Municipal Wastes, including Polythene bags, Plastic, E-waste, Biomedical, Construction and Demolition Wastes), 2020.

   - These Rules are enforced in all urban areas of Pakistan, and are compatible and in harmony with the provisions of 8th Constitutional Amendment, as applicable in the cities and towns.
   - The application of these Rules extends beyond the municipal areas and include all notified industrial townships, areas under the control of Federal & Provincial Governments, including Pakistan Railways, airports, special economic zones, and the places of historical and heritage importance.
   - These regulations shall come into force at once.

2. **Definitions.** In these Rules, the **"Act"** means the Pakistan Environmental Protection Act, 1997(XXXIV of 1997).

   - **Authorized Officer** means the person authorized by the Federal Agency for implementation of these regulations;
   - **Local Bodies** means the Federal and Provincial Governments, including Islamabad Capital Territory Administration, City Authorities, Towns Administrations and Local Governments;
   - **All other words** and expressions used in these regulations but not defined herein shall have the same meanings as are assigned to them in the Act.

3. These Rules mandate the waste generators to segregate and sort the waste at source for recovery, reuse and recycle in to three streams

   - Biodegradables,
   - Dry (plastic, paper, metal, wood, etc.), and
   - Domestic waste (diapers, napkins, cleaning agents, etc.), before handing over to the segregated waste to waste collector or agency, as specified by the local authority.

4. The hotels and restaurants are required to segregate biodegradable waste and set up a system of collection, and ensure that food waste is utilized for composting or biomethanation.

5. All residential communities with gated area of above 5,000 square meter land to segregate waste at source into material like plastic, tin, glass, paper and others, and hand over the recyclable material either to waste-pickers or to the urban local body.

6. The generators of construction and demolition waste will segregate it into four categories– concrete, soil, steel and wood, plastics, bricks and mortar; and either deposit it at specified collection centers or hand it over to the waste recyclers. They will prepare Environment Management Plan along with Waste Management Plan, indicating the environmental issues that can stem from the storage, transportation, disposal and reuse of such wastes; and get local authority approval before starting any construction/demolition/renovation work.

7. Nation Building Departments will incorporate a clause in their tenders, mandating that a certain percentage of recycled products from construction and demolition waste should be used in roads and non-structural works.

8. The establishment of waste recycling plants shall be encouraged, on public-private partnership basis.

    - Waste processing facilities be set up by all local bodies having a population of one million or more.
    - For the towns with a population below one million or for all local bodies having a population of one-half million or more, the common, or stand-alone sanitary landfills be set up.
    - The common sanitary landfills be set up on regional basis, by all local bodies and towns with a population below one-half million.

9. The bio-degradable waste should be processed, treated and disposed of through composting or biomethanation, within the premises of waste generator as far as possible, and the residual waste be given to the waste collectors or an agency as directed by the local authority.

10. The developers of all industrial estates must earmark at least five (5) per cent of the total land/plot area for recovery and recycling facility.

11. The local bodies to facilitate in infrastructure creation for the development of Waste to Energy Plants. The non-recyclable waste having the required calorific value or more be utilized for generating energy, either through waste not disposed of in landfills, and can be utilized for generating energy either or through refuse derived fuel or by giving away as feed stock for preparing refuse derived fuel. High calorific wastes be also used for the co-processing in cement or thermal power plants.

12. The WAPDA should fix tariff or charges for the power generated from Waste to Energy Plants, and ensure compulsory purchase of power generated by these plants.

13. The local bodies to adopt a decentralized mechanism for solid waste management in the municipal and peri-urban areas, both.

14. These Rules also stipulate a zero tolerance for throwing; burning, or burying the solid waste generated on streets, open public spaces outside the generator's premises, or in the drain, or water bodies.

15. These Rules promote and incentivise the environment friendly waste collection and disposal management; along with imposing a penalty in case of poor implementation.

16. The awareness campaigns be launched by the local bodies in association along with the communities, NGOs, academia and concerned stakeholders to push for better implementation of the above Rules at the citizens' level and grass-roots.

17. **Compliance assessment -** The waste generators shall conduct due diligence to document their activities, and keep a record of quantities of waste materials generated, segregated, treated, recycled and disposed of; and submit regularly a Compliance Report of the present Rules to the Authorized Officer and/or Local Body; with whom they contact or arrange for a recycling collection location or collection, processing or transportation of wastes.

18. The Authorized Officer and/or Local Body shall post on its website the Rules, along with necessary Guidance Notes for better management and handling of municipal wastes, including polythene bags, plastic, e-waste, biomedical, construction and demolition wastes.

19. **Inspection -** Any Authorized Officer, subject to the provisions of these Rules, shall be responsible for inspection of facilities of waste generated, segregated, treated, recycled, disposed of, or sold, in order to ensure adherence to the provisions of present Rules; and subject to the provisions of the Rules, any Authorized Officer may enter and inspect and search at any reasonable time, any land, building, premises, vehicle or other place where or in which, there are reasonable grounds to believe that an offence under the Rules has been or is being committed.

20. **Engagement with Stakeholders.** The Authorized Officer, Local Body or Pakistan Environmental Protection Agency in consultations with the concerned Federal and Provincial Governments Offices, and other stakeholders can recommend changes/amendments/additions in these Rules; and provide guidance on the measures for better implementation to safeguard the environment from the wastes, which can be generated from the exempted uses or applications.

THE SCHEDULE No. ___

[See Rule No. _____]

Record keeping

Authorized Officer, Local Body, or Pakistan Environmental Protection Agency

Part-I DETAILS OF THE APPLICANT

Name (Individual/Firm/Company etc.) _____

Business Registration No. _____

Sale Tax No./NTN. _____

Address _____

_____

Telephone No. _____

Cell No. _____

E-mail _____

Part-II CATEGORY (Tick the relevant)

_____ (a) Manufacturer _____ (b) Importer

Nature of Waste Product (specify the details) _____

_____

Date of issue of authorization _____

Date of expiry of authorization _____

Quantity of the Waste generated, segregated, and recycled, etc. in the given year

_____

Destination of the disposed of waste material

_____

PART-III DECLARATION BY THE APPLICANT

I hereby certify that the particulars given above are correct and true to the best of my knowledge and belief.

Name _____

Designation/Position _____

CNIC _____ Signature _____

Date _____

Company or Entity Name and Seal and Stamp

_____

PART-V FOR OFFICIAL USE

Receiving Officer Name _____

Officer Designation _____ Signature _____

Date _____

Stamp

THE SCHEDULE No._____

[See Rule No. _____]

Sr. No.	Person violating the Rule	First violation	Second violation	More than two violations
1				
2				
3				

Annex 8: Glossary

Addition - any new construction which increases the height and/or floor area of existing buildings / structures

Air Conditioning - the process of treating air so as to control simultaneously its temperature, humidity, cleanliness, and distribution to meet the requirements of conditioned space

Building Related Illness (BRI) - diagnosable illness whose cause and symptoms can be directly attributed to a specific pollutant source within a building

Clerestory - high windows above eye level

Climate Change - refers to any significant change in measures of climate, such as temperature, precipitation, or wind, lasting for an extended period

Common Area - part of the building premises is used by the occupants, owners, tenants or other building users of which the landlord retains control and is responsible to maintain in a reasonably safe condition that includes spaces such as lobby, corridor, hallway, toilet, elevator or stairway

Compostable Waste - mixture of various organic substances that can be placed into a composition of decaying biodegradable materials which eventually turns into a nutrient-rich material, used for fertilizing soil

Construction - all on-site work done in the site preparation, excavation, foundation, assembly of all the components and installation of utilities, machineries and equipment of buildings / structures

Daylight - the natural light of day, which is a combination of all direct and indirect sunlight during the daytime

Drinking Water - Water that is suitable for human consumption, food preparation, utensil washing and oral hygiene

Dual Delivery - Specifically referring to delivering water to end uses – it is the plumbing arrangement where there are two sets of delivery pipes servicing the property, i.e. the rainwater tank deliver roof water to some end uses and the mains drinking water independently delivers to other end uses.

Government Agency - refers to any of the various units of the Government including a department, office, or Government owned or controlled corporation

Hazardous – anything that involves risk or danger to the safety & welfare of public

Heat Island Effect (HIE) - describes built up areas that are hotter than nearby areas

Heating, Ventilating and Air Conditioning (HVAC) - system that helps maintain good indoor air quality through adequate ventilation with filtration and provide thermal comfort.
Implementing Rules and Regulations (IRR) - rules and regulations necessary in the implementation of the provisions of Green Guideline

Indoor Environmental Quality (IEQ) - conditions inside the building that includes air quality, access to daylight and views, pleasant acoustic conditions, and occupant control over lighting and thermal comfort

Joint - a space between the adjacent surfaces of two bodies joined & held together

Light Scoop - south-facing skylight, that uses tilted panels of transparent glass to strategically bring daylight into an interior space.

Lighting Power Density (LPD) - amount of electric lighting, usually measured in watts per square foot, and used to illuminate a given space

Material Recovery Facility (MRF) - a facility designed to receive, sort, process, and store compostable and recyclable materials efficiently and in an environmentally sound manner

National Building Guide (NBC) 1986 - is a uniform building Guide in Pakistan, which embodies up-to-date and modern technical knowledge on building design, construction, use, occupancy and maintenance

Non-Drinking Water - Any water other than drinking water

Non-recyclable Waste - not able to be processed or treated for reuse in some form

Operable Window- a window with one or more leafs or units that can be opened for ventilation.

Rainwater - Water that falls as rain (it could be collected from a roof or the ground as surface run-off).

Rainwater Tank Connection Valve - An automatic valve, which enables a change of water supply between the rainwater tank supply and a regular water service to the designated fixtures and outlets.

Recyclable Waste - an item or material capable of being used again

Referral Guides – the applicable provisions of the various agency and technical professional Guides supplementary to the NBC and GB Guide

Regularly Occupied Space - areas where one or more individuals normally spend time (more than one hour per person per day on average) seated or standing as they work, study, or perform other focused activities inside a building

Sewage Treatment Plant (STP) - an industrial structure designed to remove biological or chemical waste products from water, thereby permitting the treated water to be used for other purposes

Sick Building Syndrome (SBS) – a building, whose occupants experience health or comfort effects, when living therein, but with no specific illness or cause identified.
Single Delivery - Specifically referring to delivering water to end uses – it is the plumbing arrangement, where all end uses are directly serviced from rainwater tank. The mains drinking water is only used as a back-up supply to the rainwater tank.

Storey – portion of a building included between the uppermost surface (or finish level) of any floor and the uppermost surface (or finish level) of the next floor above or below it. If the uppermost surface of

a floor/level above the uppermost surface of a basement, or unused under-floor space is more than 3.60 meters above established grade, such basement or unused under-floor space shall be considered a storey.

Sun breaker - a building feature used as external shading devices, which reduces heat gain within that building by deflecting solar rays to reduce energy cooling loads.

Sustainable Housing - aims to meet the needs of present without compromising the ability of future generations to meet their own needs. Achieving sustainability in shelter sector means that the planning system has following objectives, which being inter-dependent, need to be pursued in mutually supportive ways.

1. **Economic objective** – to help build a strong, responsive and competitive economy, by ensuring that sufficient land of the right types is available in the right places and at the right time to support growth, innovation and improved productivity; and by identifying and coordinating the provision of infrastructure.
2. **Social objective** – to support strong, vibrant & healthy communities, by ensuring that a sufficient number and range of homes can be provided to meet the needs of present and future generations; and by fostering a well-designed and safe built environment, with accessible services and open spaces that reflect current and future needs and support communities' health, social and cultural well-being.
3. **Environmental objective** – to contribute in protecting and enhancing natural, built and historic environment; including effective use of land, helping to improve biodiversity, using natural resources, minimizing waste & pollution, and mitigating and adapting to climate change, including moving to a low carbon economy.

Total Gross Floor Area (TGFA) - the total floor space within the main auxiliary buildings primarily consisting of the GFA and all other enclosed support areas together with all other usable horizontal areas/surfaces above and below established grade level that are all physically attached to the building/s which shall consists of the following: Covered areas used for parking and driveways, services and utilities.

Toxic Materials - substances that may cause harm to an individual if it enters the body through inhalation, skin contactor ingestion

Walls – The walls are of three types, i.e.:

- **Above-grade Walls.** The walls associated with the building envelop on the exterior of the building and completely above ground or the above-ground portion of a basement or first-storey wall, which is more than 15 % above-ground.
- **Below-grade Walls.** The walls covered by basement or first-story walls, associated with the exterior of the building, which are at least 85 % below grade.
- **Internal Walls.** The walls not on the exterior of the building and that separate conditioned and unconditioned space.

Wastewater – encompasses domestic, commercial, industrial, agricultural components and also feces sludge. It is "a combination of one or more of:

- Domestic effluent consisting of black water (excreta, urine and feces sludge) and grey water (kitchen and bathing wastewater);

- Water from commercial establishments and institutions, including hospitals; and industrial effluent, storm water and other urban run-off; and
- Agricultural, horticultural & aquaculture effluent dissolved or suspended matter.

Weather-Stripping - narrow piece of plastic, rubber, or metal, installed around doors & windows to protect an interior from external extremes in temperature.

Window to Wall Ratio (WWR) - ratio of the total area of a building facade, which is occupied by windows (glass area and frame)