

EFFECTIVE INTEGRATION OF BUILT ENVIRONMENT WITH URBAN RAMSAR WETLANDS: AN ENVIRONMENTALLY SUSTAINABLE DESIGN FRAMEWORK

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Abstract: Considering the increasing number of Urban Wetland Integrated Building Invasions that occur continuously in Sri Lanka, there is little scientific understanding of the optimal design strategies and their relative advantages for ecosystems and humans. The preservation of ecology while adding architectural interventions into sensitive places is a complex procedure, especially when dealing with highly sensitive eco-systems. To wisely integrate buildings with the natural environment of the wetlands, research on the design and application of integrating ESD standards is essential. The primary concept that applies the most to ESD recommendations for wetlands is the "environmental briefing system" (ESD), which is regarded as the most comprehensive and clearly expressed principles and strategies on ESD features. Furthermore, this research extends the framework to include strategies specific to RAMSAR wetlands, comprising 33 distinct methods organized within five primary rationales. This results in a comprehensive framework comprising 63 optional design measures tailored to conserve and protect urban RAMSAR wetlands effectively. In advance, the suggested framework could be used as a benchmark, an evaluation index, or an environmental assessment tool for projects that have already been completed. Additionally, it could be used as a fix-up tool, a checklist for design teams, or a benchmark for projects that are still in the pre-design stages.

Keywords: *Environmental briefing system, RAMSAR wetland, Built environment, Environmentally Sustainable Design*

1. Introduction

Wetlands are performing a vital role for humans and the environment. These ecosystems are dubbed "green lungs" and "the earth's kidneys" because of their major contributions to the production of oxygen and the absorption of carbon dioxide, and the ability of air and water purification. (Guidelines for Western Province Wetlands Zoning & Relevant Regulations for Application in Urban Development Plan Preparation, 2006). Nevertheless, the benefits of urban wetlands to nature and people remain underestimated (Gardner & Finlayson, 2018; IPBES, 2018; Ramsar Secretariat, 2012; Russi et al., 2013).

In the context of burgeoning urbanization and industrialization, there are numerous obstacles facing by urban wetland conservation and sustainable wetland usage. Thus, the planning and establishment of a harmonising approach to integrate wetland and built environment is a global challenge.

The key issue that emerges from the literature is the absence of an appropriate regulating body that should be used during the planning and designing phases. Local authorities are tasked with enforcing several regulatory norms with the aim of conserving environmentally sensitive sites, although on a very superficial level, with the fundamental notion of being "left alone" in any urban or rural setting. But a broader perspective on ecologically sustainable strategic planning standards in RAMSAR wetlands and the conventional method of integrating buildings with the natural habitats of wetlands must be derived from a multidisciplinary regulatory framework combining ecological and open space-related strategies in the field of landscape practices.

Additionally, as Hyde (2005) stated, it is preferable to involve all parties who oversee the design at an early stage of the decision-making process during the design phase. Table 1 shows the design phase classification presented by professional Institutes of Architects. Then, with the assistance of relevant specialists, environmental strategies and ecological design principles could be incorporated collaboratively into the traditional brief into a comprehensive, informative design brief which is theoretically defined as the "**Environmental Brief**".

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Table 1,Design phase classification; (Source: Hyde, 2005)

	Royal Institute of British Architects	American Institute of Architects
Pre-design	Inception, feasibility, outline proposals	Programming
Sketch	Scheme design	Schematic design
Detail	Detail design, production information, Bills of quantities, tender action, project planning, operation on site, completion	Design development, construction documentation
Post occupancy	Feedback	Bid, construction supervision, commissioning, post occupancy survey

1.1. ENVIRONMENTAL BRIEF

The " Environmental Briefing System" is the primary ESD approach that is studied and developed throughout the research. This concept is based on the experts' commitment to and understanding of environmental issues, as well as their expertise in ecological and energy-efficient design and the obstacles they believe to be most significant. The functional brief is the element that most architects believe to be most crucial for each project in the conventional profession of architecture. Hyde claims that only 30% of professionals place the utmost weight on environmental issues.

According to Hyde (2005), designing environmentally friendly buildings requires careful consideration of ESD principles throughout the whole design process. However, the factors considered, and choices made at the briefing stage of the design process have the most influence on whether ESD solutions are included.

Additionally, Dewulf et al. (2011) and Bragança, Susana, and Joana (2014) in their articles discussed the necessity of the design process on the sustainability performance of a building. A general-to-specific framework is used to organize the elements of the environmental briefing system connecting four stages are shown in Figure 1. Stage 1 to 4 consists of goals and objectives, parameters, strategies, and recommendations. Stages 1 and 2 with goals and filters present a descriptive mapping of project's issues. Stage 3 analytically refines the EBS's use as a tool by strategizing under critical and basic decision-making strategies.

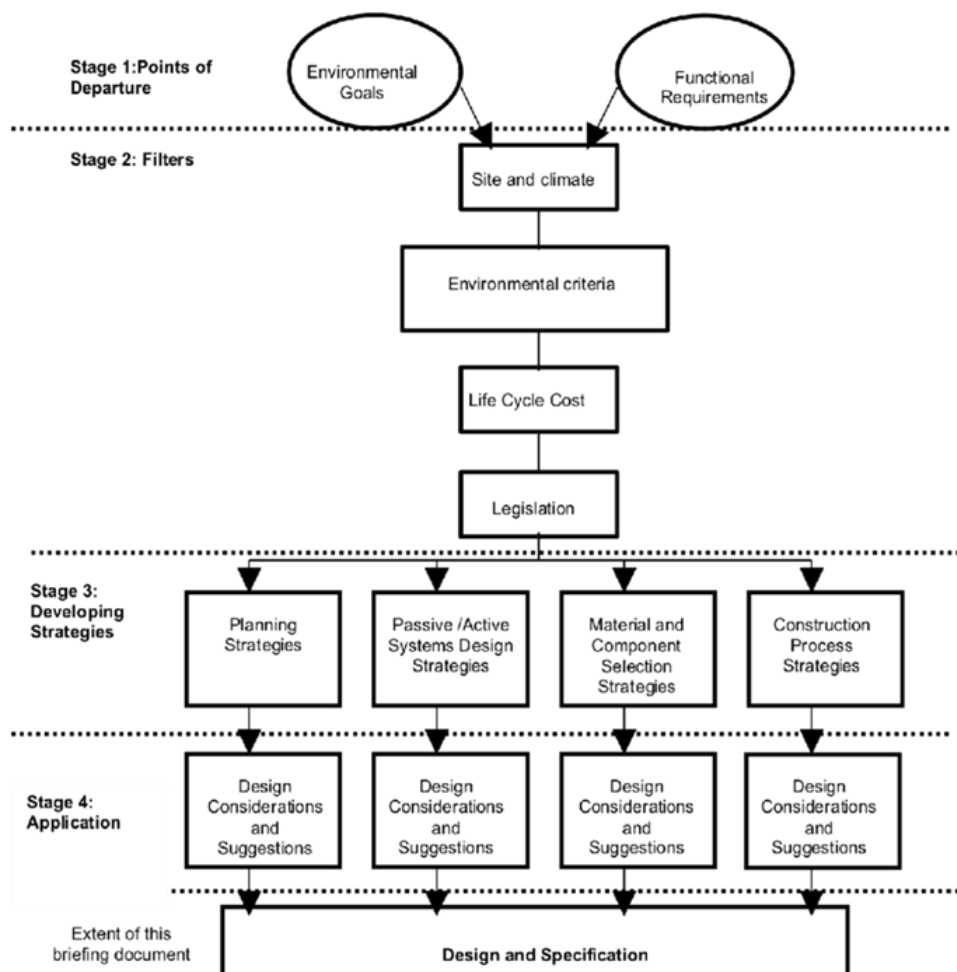


Figure 1, The environmental briefing system; (Source: (Hyde et al., 2006))

The environmental briefing system and the ESD qualities served as the framework's primary theoretical underpinnings. However, combining merely two theoretical foundations is not very practical in terms of real-world circumstances. It is necessary to consider local rules because of the varied physical, psychological, and social effects that built and open spaces have on people and their ecological characteristics too. Therefore, the potential impacts of the unified design techniques on open space utilization and ecological concerns were assessed when building the theoretical framework. Figure 2 visually demonstrates the integration of the extracted literature into the development process of a unified design framework.

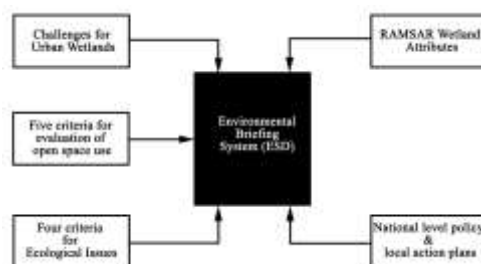


Figure 2, Conceptual integration of the unified design framework (Source: Author)

1.2. THE OPEN SPACE UTILIZATION CRITERION

In their studies, Rung, (2005), McCormack et al., (2010) and Van Hecke et al., (2018) discussed the literature on the use of open space, environmental concepts, and policy ideas that improve the physical, psychological, and social well-being of people. Six concepts—features, conditions, access, aesthetics, safety, and policies—were introduced by Rung, (2005) and Van Hecke et al., (2018). In line with McCormack et al.'s (2010) research, five key factors, namely features, conditions, accessibility, aesthetics, and safety, were identified as being closely associated with the utilization of open spaces and physical activity. Drawing inspiration from these findings, the RAMSAR wetland building intervention framework incorporated a selection of four criteria, which encompassed the following aspects: features, conditions, accessibility, and aesthetics. In four different areas—biodiversity concerns, enhancing water and soil quality, stormwater retention, and provision of natural habitat—Ruiz-Jaen & Mitchell Aide, (2005) proposed significant standards for urban wetland eco-systems.

1.3. RAMSAR WETLAND ATTRIBUTES

Under RAMSAR wetland attributes, the study is focused on the "wise use of wetlands" as a combined content for achieving the SDGs under the precautionary principle. According to the empirical data, the most significant of the formally accepted wetland conservation actions across the world is the RAMSAR Convention of 1971. However, policy analysts are arguing that RAMSAR principles are not yet fully practiced and applied in the implementation or design process in either first-world countries or developing countries (Bowman, n.d.). But it is difficult to design for wetland environment integration and set reference points for urban wetland governance without such information (HETTIARACHCHI et al., 2014).

Additionally, recent wetland policies in developing nations that ostensibly adhere to RAMSAR guidelines are frequently criticized as normative and unnecessary (HETTIARACHCHI et al., 2014). On the other hand, the RAMSAR Convention activates all the policies regarding the preservation of wetland areas, and the overall goal of the entire set of rules is to "Let them alone." To effectively integrate buildings with the wetlands' natural environment, research is required on the design and application of integrating ESD guidelines.

1.4. IDENTIFYING URBAN WETLAND DESIGN CHALLENGES.

Song et al., (2020a) mentions several important difficulties and demands, including "managing water pollution," "maintaining biodiversity," "maintaining wetland structural integrity," "practicing erosion regulation," "cutting flood risks," and "implementing stormwater management." Urban wetland parks with a variety of base and spatial shapes also face a variety of difficulties. The specific challenges associated with wetland preservation and management vary depending on factors such as the type of wetland and its surrounding environment. Table 2 provides a breakdown of these challenges, which have been summarized by Song et al. (2020a) and An et al. (2007), with respect to key issues in the context.

Table 2, Types of challenges for UWs; (Sources: Song et al., (2020a) & An et al., (2007))

Source/ reference	Key issues	Type of challenges
Challenges identified by Elmqvist et al. and IPBES (Intergovernmental science-policy platform on biodiversity and ecosystem services, China)	Overexploitation Water pollution Habitat changes Invasive species Climatic change	1. Increasing to connectivity of habitat 2. Controlling water pollution 3. Maintain biodiversity. 4. Controlling Invasive species

Challenges identified by RAMSAR secretariat	Wetland conservation Enhancing resilience to disasters Full participation	1. Maintaining structural integrity of wetlands 2. Encouraging full participation
Challenges identified by MOHURD (Ministry of Housing and urban-rural development, China)	Maintaining biodiversity Wetland structural integrity Naturalness High social benefit Meeting public recreational needs Meeting scientific education needs Diversity Uniqueness Protecting and restoring natural habitats Wetland area greater than 50% Reducing flood risks Stormwater management Controlling peak runoff Controlling water pollution Provisioning water Retentions of soils and sediments Preserving the cultural resources Necessary Park facilities Erosion regulations	1. Controlling water pollution 2. Maintaining biodiversity 3. Maintaining structural integrity of wetlands 4. Erosion regulations 5. Reducing flood risk 6. Stormwater management 7. Preserving the cultural resources 8. Providing necessary amenities 9. Encouraging full participation 10. Creating spaces for recreational activities 11. Providing opportunities for education
Challenges identified by An et al., (2007)	Reduction of water storage capacity Water pollution Biological invasion Loss of carbon storage	1. Misguided policy 2. Water diversion 3. Reclamation 4. Effective implementation of the national wetland action plan

2. Formulation of Framework

This unified framework has been created to be environmentally sustainable and will efficiently preserve the wetland's RAMSAR attributes. It contains knowledge to assist stakeholders in protecting the natural wetlands wisely within the framework of an environmentally sustainable strategy while transforming the standalone designated wetlands into wise building interventions. The framework supports both natural environmental norms and human needs in a way that is ecologically viable for wetland environments.

2.1. THE METHOD OF STUDY

The research methodology consists of reviewing literature and conducting studies on RAMSAR convention, ESDG, and EBS. The preferred methodology is a qualitative approach, with quantitative analysis for case study evaluation. The hybrid approach highlights objective and subjective domains, with a higher level of responsiveness. The results will be comprehensive and detailed, despite being non-illustrative. The research consists of three steps to address the research question and close the gap by evaluating the selected "Reference Study" and the case study.

1. Identifying urban wetland design challenges.
2. Developing an integrated design framework
3. Assessing impacts of integrated design guidelines

The methodology uses a qualitative data analysis method for literature surveys, knowledge gap analysis, and comparisons. The second stage involves creating an integrated design framework based on literature and Urban Development Authority's published regulatory documents. The framework testing phase involves selecting a reference study project and testing the framework, while the third stage involves applying the framework to assessments. The framework is developed as a "Scorecard" to evaluate both reference practices and case studies.

2.2. METHODOLOGY

The research process was comprehensively divided into three primary phases as, considering the aforementioned methodological concerns. These phases employ the qualitative method initially, followed by the mixed method, which integrates both qualitative and quantitative methods.

2.2.1 Methodology for justifying the need for research.

A literature review supported the study, but gaps existed between real-world scenarios and literature. An expert survey with architects and landscape architects addressed methodological problems, determining study area, and establishing research needs.

2.2.2 Methodology of preparing the theoretical research framework

The literature study was undertaken in two major theoretical phases throughout the construction of the theoretical framework as previously discussed.

2.2.3 Methodology of the research analysis

The research analysis will use a mixed method scorecard system, extending the "Integrated theoretical framework for RAMSAR wetland attributes," to assess its applicability in real-world situations. The evaluation tool utilized in the case studies, as depicted in Figure 3, consisted of a sample scorecard that encompassed EBS and ESD attributes, open space utilization criteria, and evaluation criteria. It employed a rating scale ranging from "Excellent" to "Not relevant / Not used." To assess the qualitative mapping, a quantitative approach was adopted, considering information from published papers, on-site observations, and field research.

	Design Strategies	Optional Design Measures	Rating					General comment
			100%	75%	50%	25%	25%>	
Principle: Open Space Usage	7. Integrating public	7.a. New human – inhabitant planes						
		7.b. Education & awareness						
		7.c. Science & research facilities						
		7.d. Monitoring labs						
		7.e. Gathering spaces						
		7.f. Social event grounds						
	23. Access	23.a. New human – inhabitant planes						
		23.b. Paths within the flood plains						
		23.c. Boardwalks near banks						
		23.d. Space per capita						
		23.e. Concrete/ paved paths						
		23.f. Natural gravel paths						
		23.g. Canopy lines						
	24. Condition	24.a. Promoting cross ventilation						
		24.b. Gaining high level of natural light						
		24.c. Promoting stack ventilation						
		24.d. Infrastructure						
		24.e. Safety						
	25. Feature & aesthetics	25.a. Borrowed views						
		25.b. Seating with direct views						
		25.c. Social event grounds						
		25.d. Bird friendly facades						
		25.e. Green roofs & walling						
		25.f. Courtyards						
		25.g. Indigenous plants in landscaping						
		25.h. Mitigation of alien invasive plants						

Rating

● 100% - Excellent ● 75% - Good ● 50% - Moderate ● 25% - Poor ○ 25%> - Not relevant

Figure 3, The grading system - Scorecard for principle one: Open Space Usage (six score cards were individually generated throughout the research for all the six principles) (Source: Author)

2.3. TARGET USER AND USE OF THE FRAMEWORK

Various stakeholders, including the construction industry, local communities, policymakers, extension professionals, commercial sectors, civil society organizations, research institutions, and the media, use the framework in the design process as shown in the figure 4. It underlines the need of addressing governing frameworks in a wetland and the need for wetland-integrated design approaches. Academics can also use the framework to ensure sustainable wetland management and use based on the best available evidence.

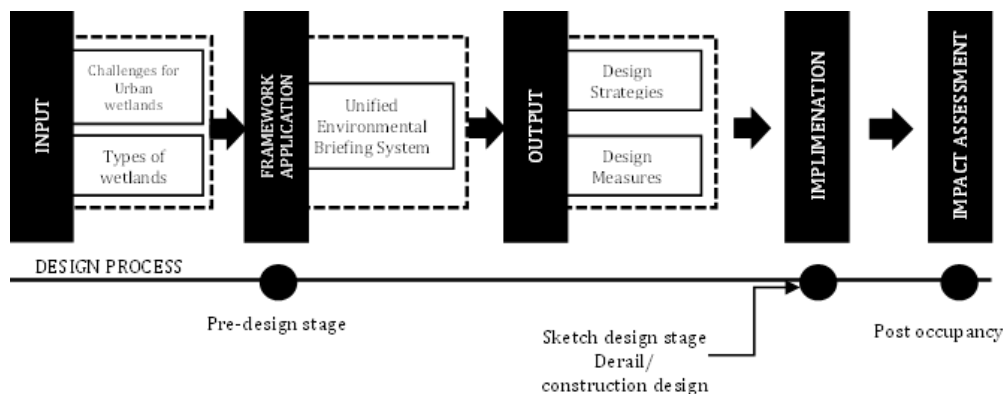


Figure 4, Framework Application (Source: Author)

2.4. TOWARDS A FRAMEWORK OF UNIFIED - INTEGRATED DESIGN GUIDELINE

The criteria are employed to develop 33 optional design strategies and 63 optional design measures, as illustrated in Figure 5, highlighting their significant contribution to the integration of the Sustainable Development Goals (SDGs) within the RAMSAR conventional practice pertaining to wetlands. Using document and literature analyses, as well as reference case studies, each specific design measure is located. Design measures may range from small-

scale interventions such as boardwalk construction to hi-tech new inhabitant plains. As a result, the comprehensive unified framework can be adjusted or utilized as a “benchmark tool” or a “fix-up tool” for the pre-design stage of the design process decision-making process.

When addressing design issues linked to construction intervention in wetland areas, ecological enhancement, and shared open space use, the proposed unified integrated framework is practical. Several design challenges could be resolved by the framework, including protecting biodiversity and providing areas for human habitation and wellbeing as well as shared open space.



Figure 5, 33 Design Strategies & 63 Optional Design Measures (Source: Author)

3. Case study

The study aims to assess the effectiveness of naturally integrating wetlands into buildings using a comprehensive integrated design framework. Two existing case studies are selected: one is a "good practice" and compared to the "Reference Study" of the "Quinli Stormwater Park" in China. The second case study is from Sri Lanka, focusing on RAMSAR-designated wetlands in the Colombo wetland city. The research region was explored using maps and

resource experts, with the Kolonnawa wetland chain being the most heavily invaded habitat. The study area selection process is illustrated in the study area specification and limitation diagram.

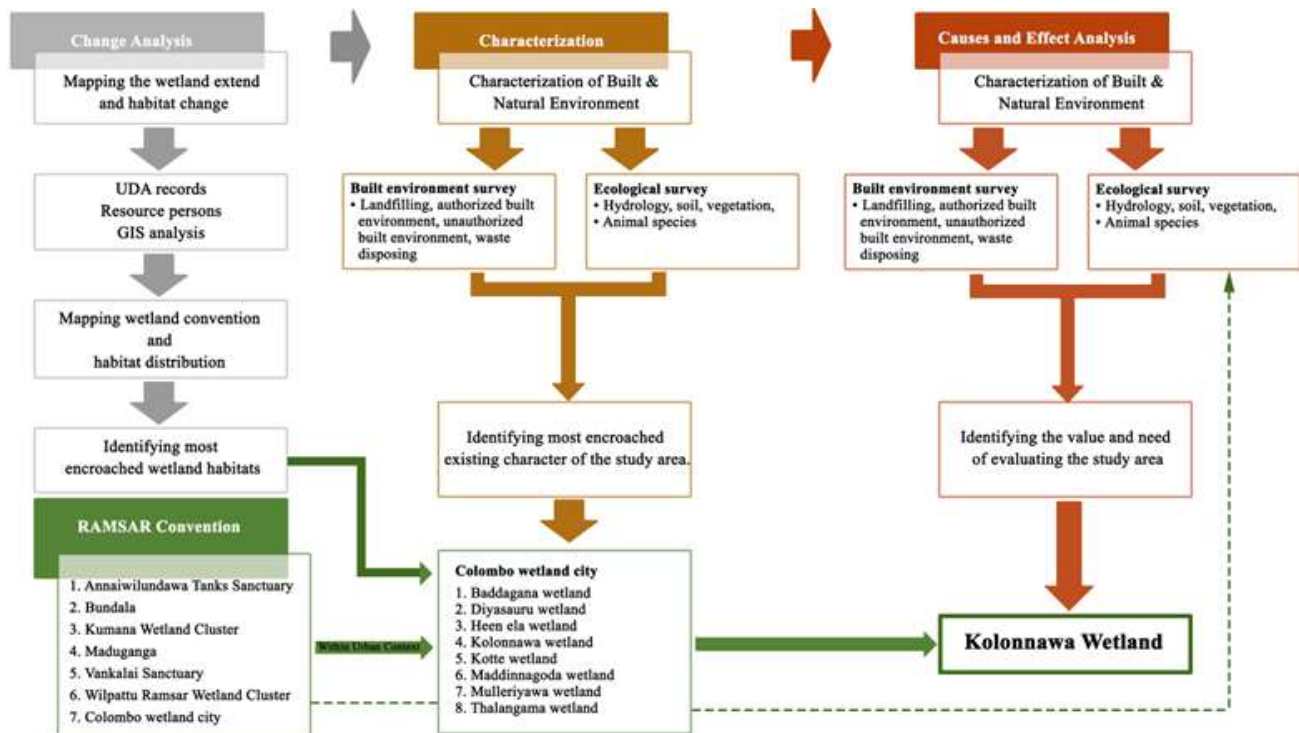


Figure 6, Case study specification & limitation Diagram (Source: Author)

3.1. CASE STUDY 01: REFERENCE STUDY- QUNLI NATIONAL WETLAND PARK IN HARBIN, CHINA

The reference case study, Qunli National Wetland Park in Harbin, China, serves as an exemplary model for integrating urban wetland principles and achieving sustainability from the beginning of the design process. Situated in a rapidly urbanizing city with significant water challenges, this project faced several design challenges that demanded innovative solutions.

One of the primary challenges was how to coordinate the development of a wetland park with high ecological value. The solution involved leaving the natural core of the wetland untouched while creating an outer ring using the cut-and-fill technique. This approach allowed for the preservation of the wetland's essential ecological functions.

Another challenge was to prevent water loss and ensure sufficient water storage to restore the biological habitat. The project addressed this by transforming the wetland into a multipurpose stormwater park that could collect, filter, store, and infiltrate stormwater. This not only helped manage water resources effectively but also enhanced the biological system.

The design also focused on creating a favourable environment for different species to reproduce, emphasizing ecological responsiveness. Additionally, the project incorporated passive system design and adhered to legislations and policies, aligning with sustainability principles.

The analysis of this reference study using the scorecard system reveals its strengths in open space usage, responsiveness to ecological factors and wetland challenges, structural responsiveness, technology and site management, passive system design, and adherence to legislations and policies. It exemplifies a holistic approach to wetland integration and sustainability.

However, it's essential to note that the scorecard analysis also highlights certain areas for improvement and customization based on the specific nature and context of the project. The scorecards were structured into six distinct principles, each of which was independently assessed. Within these principles, 33 design strategies were considered, and they were further scrutinized using relevant design measures which are clearly illustrated in Figure 5. This suggests that while the reference study serves as a valuable benchmark, it should be adapted and tailored to suit different project types and regional considerations.

In summary, the Qunli National Wetland Park in Harbin, China, demonstrates the successful integration of urban wetland principles and sustainability from the outset of the design process. It provides valuable insights into the potential of such projects to harmonize with their natural surroundings while addressing urban challenges. The

analysis using the scorecard system underscores the need for a flexible and adaptable assessment tool that can accommodate various project contexts and specifications in the pursuit of sustainable wetland integration.

Table 3, Case study analysis with the Scorecard System - Qunli National Wetland Park in Harbin, China

Design Principle	Existing Situation	Discussion
Open Space Usage		<ul style="list-style-type: none"> The park's design prioritizes public integration, as seen by the analyses assessment of the project. The park's evaluation of the public integration strategy gives it a 75% rating. With an average rate of 80%, the accessibility element is also well established. However, information acquired through the reports shows that the park's maintenance and condition are quite bad, negatively hurting the park's operation. Although features and aesthetics are included during the design process, the "features and aesthetics" strategy receives a poor rating due to poor maintenance.
Responsiveness for Ecological factors & urban wetland challenges	<ul style="list-style-type: none"> Turenscape's strategy: to transform the dying wetland into a 'green sponge' - an urban stormwater park, which will not only rescue the disappearing wetland but will also provide multiple ecosystems services for the new urban community. Leave the nature core alone Many native species of flora and fauna have been spotted in the park In response to designing the stormwater park, the designers have addressed four main design strategies. <ul style="list-style-type: none"> ✓ Leave the natural core alone ✓ An outer ring is made using the cut-and-fill technique ✓ The path and platforms strategy ✓ Above the natural landscape, in the upper layer 	<ul style="list-style-type: none"> The park's design has been thoroughly concerned about the biodiversity of the area to be conserved. Overall, the study's findings demonstrate that all evaluated strategies performed well, proving that the park's design considerations are sensitive to ecological elements and urban wetland challenges. To overcome the challenges, the obvious response was to convert the wetland into a multipurpose stormwater park that can collect, filter, store, and infiltrate stormwater while also being productive and life-supporting and offering new recreational and aesthetic experiences for the city.
Structural Responsiveness & Material Practice		<ul style="list-style-type: none"> Because elevated levels for walkways and pavilions are maintained separately, the total tested result reveals a high number of evaluations based on the structural responsiveness of the park's-built environment—around 80% on the scorecard evaluation. Because of the elevated level, the selected earthen materials, and the more ecologically friendly materials, the building interventions have been more sustainable and ecological.
Design Principle	Existing Situation	Discussion
Responsiveness of Technology & Site Management	<ul style="list-style-type: none"> On stilted construction Use of prefabricated steel columns & beams Layering technique for screening Four main design strategies. <ul style="list-style-type: none"> ✓ Leave the natural core alone ✓ An outer ring is made using the cut-and-fill technique ✓ The path and platforms strategy ✓ Above the natural landscape, in the upper layer 	<ul style="list-style-type: none"> The pathways and pavilions are built on stilts, and most building innovations use prefabricated technology, which causes less damage and pulls fewer pollutants into the site because only the assembly is done on-site. The architects developed four primary design strategies with the overarching goal of improving site management while causing minimal harm to the existing ecology, uplifting the Hazards ecological, and protecting the park with a publicly built environment that is compatible with the existing ecology.

3.2 CASE STUDY 02: 14-STOREYED LUXURY APARTMENT, ETHUL RAJAGIRIYA, SRI LANKA.

The Sri Lankan case study, involving a 14-Storeyed Luxury Apartment in Ethul Kotte, Rajagiriya, reveals several significant findings and implications related to the integration of buildings with wetland natural ecosystems and the application of the Comprehensive Unified Integrated Design Framework (CUIDF).

Firstly, the transformation of the wetland context into a luxury apartment complex from 2004 to 2022 illustrates the rapid urbanization and encroachment into wetland areas, which is a common issue in many urban settings worldwide. This highlights the urgency of developing sustainable design principles and regulations to protect wetlands while accommodating urban growth.



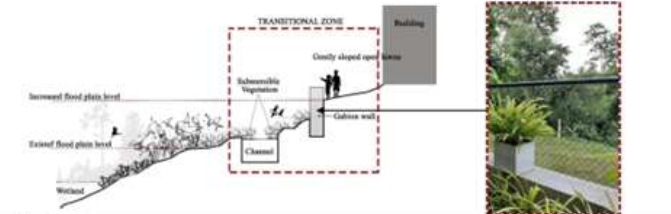

The analysis using the CUIDF scorecard reveals several weaknesses in the design and implementation of the luxury apartment complex. The low scores in various principles, especially in open space usage, ecological responsiveness, and technology management, indicate a lack of effective integration with the wetland environment. This suggests that the project did not adequately consider wetland attributes and sustainability principles from the beginning of the design process.

The study also underscores the importance of project-specific evaluation criteria within the CUIDF. The luxury apartment complex did not contribute significantly to integrating the public into the wetland, highlighting the need for tailored strategies for different types of projects, such as residential, commercial, or institutional.

Furthermore, the analysis shows the applicability of the CUIDF in assessing and identifying shortcomings in wetland-related building projects. It serves as a valuable benchmark for evaluating the success of such projects in terms of sustainability and wetland integration.

In summary, the Sri Lankan case study demonstrates the challenges and opportunities associated with integrating buildings into wetland ecosystems. It highlights the need for comprehensive design frameworks like the CUIDF to guide sustainable development and protect vital wetland environments in the face of urbanization pressures. Future research should focus on refining the framework, addressing project-specific considerations, and promoting sustainable wetland integration practices globally.

Table 4, Case Study Analysis for 14-Storeyed Luxury Apartment, Ethul Kotte Rajagiriya, Sri Lanka

Design Principle	Description	Discussion
Open Space Usage	<ul style="list-style-type: none"> The roof top level is designed and utilized as a public area for the homeowners to assemble for their social events such as parties, functions, events, and meetings, etc., taking into consideration optional strategies of gathering spaces and the social event grounds.  <ul style="list-style-type: none"> Infrastructural conditions are solely considered from the standpoint of the built environment. The ecological approach is deplorable. Paved paths and driveways serve as the primary access points for the sense of open space use. Other than that, two paired lifts, two stairways, and an elevator are used to offer access to all levels. 	<ul style="list-style-type: none"> Given that the project is a privately owned apartment complex, the incorporation of public spaces for open public use is obviously irrelevant in terms of how open space utilization is seen. However, it is conceivable for exterior park spaces to blend with the ecology that is seen from the vistas of the natural wetlands and the kids' play areas, allowing for open public meetings of residents Under the guiding principle of "open space usage," the state of the dwelling is evaluated. The technique to connect open space with the built environment, however, is considered under the heading "condition" in the built environment sense.
Responsiveness for Ecological factors & urban wetland challenges	<ul style="list-style-type: none"> The site's rear had the least amount of submersible vegetation, which served as the site's transition into the degraded wetland environment, but not on purpose. Due to the need to maximize built area on the site, brown filling was employed on the site itself. Because the building that will be occupied is an apartment complex, the site soil stabilization process is completed at the standard level during the pre-construction stage in accordance with the experts' directions. At the site's edge, a channel had been excavated as a water table tolerance strategy. The channel serves as a bed for submersible vegetation, which also functions as a water table tolerance method.  <ul style="list-style-type: none"> The ground-floor garden spaces are where planting and vegetation are primarily done. However, there is some vegetation on the top floors that was planted by the occupants and is not being used as a strategy. 	<ul style="list-style-type: none"> The rating for the evaluation index is typically around 50%. The framework's suggested strategies are not consistently implemented. The major methods for implementing the water table tolerance plan involve submersible vegetation and effective landscaping techniques, both of which are not frequently used on the site. Because their primary strategies have been landfilling and soil stabilization, the building would eventually collapse owing to the rising water table.
Design Principle	<ul style="list-style-type: none"> Designing transitional zones: The rear space reservation gap and the retaining gabion and channel is acting as the transitional zone between built space and the natural wetland eco-system area. 	
Passive System Design	<ul style="list-style-type: none"> Solar orientation Passive cooling: 	<ul style="list-style-type: none"> The long facade of the building faces northeast and southwest. As a result, neither the morning nor the evening sun directly touches the building. However, the building has received gentle exposure from the sun all day. By improving cross ventilation, which moves from the northeast with the wetland wind, the building is passively treated. Additionally, the landscaped areas produce pressure gardens and improve the thermal and ventilation equilibrium between interior and outdoor spaces. Alternatives for acquiring natural light that is well used, whereas others are less.
Legislations & Policies	<ul style="list-style-type: none"> As required by the local authority, a 6.5-meter reservation lot had been left at the rear of the property. That area is maintained as a gently sloping green lawn. 	<ul style="list-style-type: none"> According to the research report, which is based on onsite observations, there is a low level of compliance with prescribed regulations for brown filling and construction on a wetland.

4. Results and Discussion

The research's findings have successfully expanded our understanding of how to include urban wetlands into sustainable building practices in Sri Lanka. First, it's important to understand the key design considerations that were determined based on the type of wetland and the surrounding environment, such as water pollution, biodiversity preservation, preserving the structural integrity of the wetland, erosion control, reducing flood risk, and storm water management. While there are already several developed landscape design strategies on wetland integrity specified extensively to achieve sustainability, there is still a clear need for developing building design-related strategies focusing on sustainability as required by policies and conventions combining global and Sri Lankan perspectives. Second, the suggested framework might be used as a "benchmark tool" or a "fix-up tool" for the pre-design stage of the design process decision-making process. Third, by succinctly illustrating and validating the function of design measures in architectural practice, as well as offering a frame of reference and suggestions for design practitioners, the effects of chosen design measures on ecological and open space use issues may be evaluated in real-world settings.

Based on the findings, a few recommendations for professionals can be given. First, current wetland-integrated developed environments should be regularly examined using the framework as a standard development scheme to identify inadequacies and potential for utilizing wetlands in a mutualistic approach that benefits both ecology and humankind. Additionally, it could be used as a fix-up tool, a checklist for design teams, or a benchmark for projects that are still in the pre-design stages. The 33 design strategies, 63 optional design measures based on the associated wetland types, and design options with various intensity levels in accordance with design intends may serve as a roadmap for future interventions.

The evaluation and summarization of design strategies are constrained by the short research timeframe, case study observations, and literature extractions, and do not consider all possibilities. The applicability of design principles and strategies when adapted to other urban wetland typologies as maritime environments is the other restriction. The adaptation of certain design ideas in other forms of urban wetlands, such as marine urban wetlands, may be further explored in future research.

This research benefits both people and the environment by offering a comprehensive, unified design framework and several design strategies that can simultaneously meet goals from multiple domains. The framework offers the potential to address several design issues, particularly the preservation of biodiversity and the creation of human space. Additionally, numerous specific multifunctional strategies have been identified. For example, water retention ponds contribute to the maintenance of a high level of biodiversity, reduce flood risk, create space for recreational activities through stormwater management, and generate a circular economy of primary infrastructure. Additionally, combining research and design cases into design guidelines has been beneficial in producing results that are applicable to practice, making it a vital technique for bridging science-practice gaps.

5. Conclusion

This study represents a crucial advancement in addressing the challenges of urbanization and the depletion of urban wetlands. It has introduced a "Comprehensive Unified-Integrated Design Framework" (CULDF) that guides architects and decision-makers in early integration of environmental and ecological factors into design. The development of the "IEBS scorecard" enhances this research by providing a systematic evaluation tool, assessing EBS principles, open space criteria, ecological concerns, and policy ideas. The study emphasizes the need to adapt global principles to local contexts and recognizes the diversity of projects. It highlights the importance of harmonizing-built environments with natural ecosystems for sustainable urban development. The "IEBS scorecard" has the potential to become a comprehensive tool for assessing Integrated Environmental Briefing Systems, contributing to sustainable urban development practices in Sri Lanka and beyond.

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