Green Engineering Conference

BIOFACADES

Next Generation Building Envelope Systems
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MEET THE PRESENTER

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‘Biofacades’, commonly referred to as ‘Vertical Garden’ represents controlled vegetated surfaces (using its thermal properties) in a building.

**Main elements of Biofacades:**

- Plants & Planting media
- Structural support for plant attachment to the building with irrigation system
## BIOFACADES BENEFITS

| Reduce Urban Heat Island Effect | 1) Promotes natural cooling  
| Improved Exterior Air Quality | 2) Reduced ambient temperature  
|                              | 3) Shading Surfaces  
| Improved Exterior Air Quality | 1) Captures airborne pollutants and atmospheric deposition  
|                              | 2) Filter noxious gases and particulate matter  
| Aesthetic Improvement | 1) Creates visual interest  
|                         | 2) Hides unsightly features  
|                         | 3) Increases property value  
|                         | 4) Provides interesting elements  
| Improved Energy Efficiency | 1) Traps a layer of air within the plant mass  
|                           | 2) Limits heat movement  
|                           | 3) Reduces ambient temperature  
|                           | 4) Creates buffer against wind  
|                           | 5) Interior applications reduce energy required for heating/cooling  

CASE STUDIES

In context to Qatar, Doha

Figure 04 – Ezdan Mall, Doha,
Source: Physical Site Visit

Figure 05 – Katara, Doha, Qatar
Source: Supplier Brochure

Figure 06 – Qatar Handball Association, Doha, Qatar; Source:
Supplier Brochure

Figure 07 – Banana Island Resort, Doha, Qatar
Source: Supplier Brochure

Figure 08 – Business Park, Doha, Qatar
Source: Supplier Brochure
BIOFACADES PROJECT
- Project studies the impact of the next generation facade on both indoor and outdoor environment
- 4 exterior Bio-façades walls on the ground level of the building with adjacent bare walls used as control facades
RESEARCH AIM

The design, development and use of innovative Bio-green facades:

- The evaluation of the effects of plants on urban microclimate
- The monitoring of the thermal performance in the hot climate of Qatar
- Creating Sustainable, Healthy Liveable Urban Environment & buildings in Qatar
- Provides well being for the individual, community and Society
Phase 1:

**Selection of test-bed location**
- Orientation to sunlight
- Wind direction
- Amount of shade received

**Biofacades installation**
- POD system
  - Plant selection
    - Nursery visits
    - Preliminary studies
      - Plant properties
      - Soil type
      - Size of plants

**Instrument installation**
- Weather station
- Data loggers
- Sensors

Thermal conditions at the bare and vegetated facades:
- Surface temperature at exterior and interior facades
- Air temperature at exterior and interior facades
- Relative humidity at exterior and interior facades
- Heat flux through the walls
- Solar radiation at the exterior walls
- Soil temperature of the planters
- Soil moisture content of the planters
Phase 2:

**Biofacades monitoring**
- Weekly basis of all walls

**Data collection and analysis**
- HOBOware software
- Data sheets
  - Watering records
  - Climatic conditions
  - Plant variations
- Monthly analysis charts

**Development of design guidelines**
- GSAS
- QCS
INSTALLATION PROCESS

Figure 03 – Installation of BioFaçades
Source: Photos taken on 15 Jan 2016

Figure 04 – Installation of instruments
Source: Photos taken on 31 Aug 2016

Figure 13 – Installation of micro-weather station and interior data loggers; Source: Photos taken on 01 Sept 2016
Figure 17. Plants Selected for Experimental Study
Figure 18. Arrangement of Plants in POD’s (October)
Phase 1: 2016

Figure 05. South-West: Wall1

Figure 06. North-East: Wall3

Figure 07. North-West: Wall2

Figure 08. South-East: Wall4
<table>
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<td>Figure 05. South-West: Wall1</td>
<td>Figure 06. North-East: Wall3</td>
<td>Figure 07. North-West: Wall2</td>
<td>Figure 08. South-East: Wall4</td>
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Phase 2: 2017
Monthly analysis charts developed using evaluation scoring systems for the plants

- Experimental results showed reduction in the facade exterior surface temperature and heat flux through the façade
- Biofacades reduce approx. 20% of energy consumption
- Change in ambient air temperature and relative humidity
- Most suitable plants in Qatar include Asparagus Ferns, Aloe Vera, Pennistum Rubrum, Green and Verigated Yucca
- Amount of required water consumption for different plant species
- The amount of maintenance required for the bio-green facades

![Wall 3 (North East) Plant Performance](figure26.png)

Legend:
1- Dead  2- Dying  3- Not Good  4- Fair  5- Good  6- Excellent

- Cyprus
- Portulaca Grandiflora
- Green Yacca
- Thymus Vulgaris
- Lampranthus Aureus
- Asparagus Ferns
- Wedelia Trilobata
- Aloe Vera
- Sweda Vermiculata
- Sessiuvium Potulacastrum
- Pennistum Rubrum
- Setcresea Purpurea

Figure 26. Wall3 Plant Performance
OUTCOMES

Enhance sustainability, reduce Urban Heat Island effect, improve exterior air quality, aesthetic improvement, and energy efficiency.

Formulate design guidelines:
- Using plants in buildings to improve their energy performance
- To be implemented in the industry

Recommendations:
- Usage of suitable plant species in hot arid regions

Use research results & guidelines as a platform to define facade greenery chapter in the GSAS and QCS.