THE ART + SCIENCE OF COST-EFFECTIVE HIGH PERFORMANCE BUILDINGS:

HOW DATA INFORMS OUTCOMES
SESSION DESCRIPTION

Creating high-performance buildings requires a balance of art and science. Design decisions can no longer be guided by aesthetics and intuition alone; they require careful study to achieve desired outcomes. Using recent work in the Northeast, this session will show how data can be used to inform design decisions. Case studies will cover how data from both predictive analysis as well as post-occupancy evaluation was used to answer the following questions:

- Can we provide Harvard-recommended CO2 levels without increasing energy?
- How can sunshades be optimized to reduce system sizing and glare?
- What is the best affordable wall assembly for this climate?
- How does high-performance compare to code compliance in terms of cost?
- To what degree can we replace typical civil infrastructure with biosystems?
LEARNING OBJECTIVES

- Detail an energy-efficient wall assembly for the Northeast that minimizes moisture accumulation overtime.
- Design window systems that are optimized to reduce energy, improve daylight distribution, and minimize glare.
- Determine appropriate occupancy calculations to estimate CO2 levels.
- Investigate the cost of Biosystems in fulfilling local stormwater requirements against typical civil infrastructure.
AGENDA

INTRO

SITE

ENERGY + ENVELOPE

IEQ

CONCLUSIONS
How could data be used to inform design decisions?

Audience
Input
THE USE OF DATA

- Clients asking for it
- Garbage in / Garbage Out
- Misrepresentation (looking at the wrong thing)
- Holistic interpretation (systems integration vs. isolation)
Location: North Andover, MA
Use: High School Science
Square Footage: 32,000 sf
Floors: 2
Stage 1: Green roof slows water
Stage 2: Rainwater garden
Stage 3: detention
Stage 1: Green Roof

- Slows runoff
- Evapotranspiration
- Learning environment
Stage 2: Rainwater Garden

● Slows runoff
● Infiltration
● Storage
● Learning Environment
RAINWATER GARDEN
Stage 3: detention
- Not used
- Required by municipality

Results:
lack of sufficient modeling and education results in unnecessary costs
SUNY COLLEGE OF ENVIRONMENTAL SCIENCE AND FORESTRY

Location: Syracuse, NY
Use: Conference, Student Center, Admissions & Center
Square Footage: 52,000 sf
Floors: 3
STORMWATER STRATEGIES

- Slowing runoff.
- Parking lot converted.
- Creating Habitat
- Trees wells – infiltration
- Lengthening the path of the water – slowing and filtered
GREEN ROOF

Brooks School
Architerra, Dan Arons, Principal
Photograph, David Lamb
GREEN ROOF
LANGLEY TERRACE

Location: Newton, MA
Use: Residential – 20 units
Square Footage: 26,000 sf
Floors: 3 + parking under
SCHEMATIC DESIGN

New Building

65 Infiltration Chambers
CONSTRUCTION DOCUMENTS

Infiltration Basin

Rainwater Garden

Blue Roof

40 Infiltration Chambers
RAINWATER GARDEN
INfiltration Plaza

Langley Terrace
Perkins Eastman
**STORMWATER NETWORK**

**Existing**

**Improved Design**

**Initial Design**

- **Infiltration Basin**
- **Blue Roof**
- **Rainwater Garden**

- **ER2**
- **#302-#304 Roof**
- **ER3**
- **City Drain (John Street)**
- **E4**
- **Catch Basin (On Site)**
- **CD2**
- **ER1**
- **#402-#404 Roof**
- **South Abutler**
- **E3**
- **E5**

- **Rainwater Garden**
- **ER1**
- **#402-#404 Roof**
- **South Abutler**
- **ER5**
- **#306 Roof**

- **Blue Roof**
- **PR1**
- **#400 Pr Roof (portion)**
- **PL1**
- **Inf. System #2 43" Deep Root Sika Cell System**
- **AF-2**
- **BackWiper Valve**
- **Inf. System #2A 36" ADS R/P PIPE**
- **SMR-2**
- **PD1**
- **Driveway 1**
- **PD2**
- **Driveway 2**
- **PD3**
- **Driveway 3**
- **PD4**
- **Driveway 4**

- **PD1**
- **PD2**
- **PD3**
- **PD4**

- **Langley Road (West)**
- **#402-#404 Trench Drain (On Site)**
- **#350-#354 Roof**
- **City Drain (Langley Road)**
- **P1**
- **P2**
- **P3**
- **P4**
- **P5**
- **P6**
- **PA**

- **French Drain**
- **Driveway 2**
- **Driveway 3**

- **Int. System #1**
- **Int. System #2A 36" ADS R/P PIPE**
- **SMR-2**

- **Detention Pond**
- **Pond Area**

- **#402-#404 Roof**
- **P1**
- **P3**
- **P5**

- **ER2**
- **#302-#304 Roof**
- **ER3**
- **#306 Roof**
- **E3**
- **E5**

- **#402-#404 Trench Drain (On Site)**
- **City Drain (Langley Road)**
- **Langley Road (West)**
- **#402-#404 Roof**
- **South Abutler**
- **#306 Roof**
STORMWATER NETWORK

Infiltration Basin

Improved Design

Blue Roof

Rainwater Garden
RAINWATER GARDEN PERFORMANCE

2-Year Rainfall = 3.1”
Peak Outflow=0.06 cfs
Storage=1,069 cf
Discharge = 24 hours

10-Year Rainfall = 4.5”
Peak Outflow=0.07 cfs
Storage=1,652 cf
Discharge = 26 hrs

100-Year Rainfall = 8.8”
Peak Outflow=0.12 cfs
Storage=3,608 cf
Discharge=34 hrs
Blue roof, detention
  • Little cost add
  • 3” retention – no structural add
Rainwater garden – infiltration, biotranspiration
Terrace – collection and infiltration
“Cultec” chambers – infiltration and discharge
  • Adjust rainwater overflow for detention, standing water, chamber removal.

Architect must crawl through the hydrology model
Location: Cambridge, MA
Use: Preschool – Middle School
Square Footage: 168,000 sf
Floors: 4
● Local Stormwater Issue
  ● Limited Site
  ● Storm System Overload
  ● Charles River Watershed Pollutants
SYNERGIES & SYSTEMS THINKING
MLK / PUTNAM AVE SCHOOL, CAMBRIDGE MA

- Local Stormwater Issue
  - Storm System Overload
  - Charles River Watershed Pollutants
- Solutions
  - Infiltration: Bioswales & Turf Field
  - “Jelly fish” vs. Rainwater Capture