Green Infrastructure & Stormwater Management
CASE STUDY

Marq2: Structural Cells with Trees for Stormwater

Location: Minneapolis, MN
Client: City of Minneapolis
Design Firm(s): SEH, URS - Kestrel Design Group was technical reviewer for Structural Cells
Landscape architect/Project contact: Bob Kost, ASLA
Email: bkost@sehinc.com
ASLA Chapter: Minnesota

Photo: SEH, Inc.

Project Specifications

Project Description: This project, developed in the Minneapolis Ten Year Transportation Plan, was intended to improve transit service by redefining lanes, lane widths, and sidewalk zones and widths. Structural Cells with Trees for Stormwater became part of the project in the design phase for the sidewalk and pedestrian space. The stakeholders requested trees and we sought a better way to plant trees in an urban environment and improve their overall health and longevity. It is estimated that the average urban tree only survives about 13 years, not nearly long enough to be able to provide the ecological and stormwater treatment services that they are able to provide at maturity. A primary reason for the shortened lifespan of urban trees is inadequate soil volume. Structural cells are modular structures that provide uncompacted soil volumes under paved surfaces and can support up to HS20 loading, making it possible to

provide urban trees with large soil volumes even in urban areas with little open space. The uncompacted soil volume in Structural Cells can also be used for stormwater treatment, creating a bioretention system under paved surfaces. Using structural cells with bioretention soil, stormwater becomes an asset as a way to water the trees. The trees in turn will help cleanse and abstract stormwater runoff.

Project Type:
Transportation corridor/streetscape
Part of a redevelopment project

Design features: Porous pavers, and structural cell infiltration system below grade combined with street trees.

This project was designed to meet the following specific requirements or mandates: To meet funding criteria

Impervious area managed: greater than 5 acres

Amount of existing green space/open space conserved or preserved for managing stormwater on site: There was no green space to begin with since this is in the heart of downtown.

The regulatory environment and regulator was supportive of the project.

Did the client request that other factors be considered, such as energy savings, usable green space, or property value enhancements? Yes - Energy savings via street and signal management system and LEDs in the signals.

Cost & Jobs Analysis

Estimated Cost of Stormwater Project: $1,000,000-$5,000,000 (Public funding: Federal, local - primarily federal grant)

Related Information: Structural Cells - $60 per cell for materials, $75 per deck for materials, $25 equipment and $50 Labor per cell; Trees $227 each installed; Average total installed cost per Tree with Structural Cells, average of 588 cubic foot per tree: $8,038

Was a green vs. grey cost analysis performed? No

Cost impact of conserving green/open space to the overall costs of the site design/development project: Not applicable

Cost impact of conserving green/open space for stormwater management over traditional site design/site development approaches (grey infrastructure)? Not applicable

Number of jobs created: Not applicable

Job hours devoted to project:

Planning and Design: 40,000
Construction: 80,000
Annual Maintenance: negligible

Performance Measures

Stormwater reduction performance analysis:

No stormwater modeling was done for the Structural Cells with Trees for Stormwater because regulatory stormwater requirements for this project were already met before sidewalk design began. Nevertheless, this project does provide significant stormwater management treatment in addition to the regulatory requirements.

- Structural cells with trees provide stormwater treatment in the following ways:
- Stormwater storage in the soil
- Stormwater infiltration into the underlying soil
- Stormwater interception by the tree canopy
- Evapotranspiration
- Stormwater cleansing by the trees and bioretention soil

The trees and structural cells in this project collect runoff from the sidewalks along 2 of Minneapolis' main downtown streets through pervious pavers that drain into the underlying structural cells. One of the structural cell groups also collects roof runoff from adjacent buildings. While the amount of runoff treated per tree varies from block to block and from tree to tree, on average, each tree pit collects runoff from about a 300 sq/ft watershed. With 167 trees, this adds up to an estimated 50,118 sq/ft, or 1.15 acres of sidewalk runoff captured. Each tree has on average 588 cubic feet of soil with an estimated 20% water storage capacity, so each tree provides about 118 cubic feet of stormwater storage. A 1" rainfall event on the average 300 sq/ft watershed produces 25 cubic feet of runoff. To fill up the average 118 cf of stormwater storage per tree from a 300 sq/ft watershed would take a 5" storm event. The soil in the structural cells therefore has enough capacity to capture runoff from a 1" rain event from 5 times as much impervious surface as it currently captures. In other words, the soil in the structural cells has capacity to capture 1" of rain from 5.75 acres of impervious surface.

The City of Minneapolis is reserving this extra soil stormwater holding and infiltration capacity for future use. As trees grow larger, they will also contribute more and more to stormwater capture through interception and evapotranspiration. It is estimated that a large (500 sq/ft canopy) tree in July in Minneapolis evapotranspires 8.5 cubic feet per day as long as transpirable soil moisture is at least at 1/3 of field capacity.

Community & economic benefits that have resulted from the project: The project improves transit operation and convenience for transit users. Property values will be positively affected with more organized efficient transit not only on Marquette and Second, but other streets downtown which now function better. The project also improves the pedestrian realm with wider sidewalks, dedicated furnishing and walking zones. 167 street trees and precast planters with native grasses and flowers add shade, greenery and color to the urban corridor. Trees could also positively affect existing businesses along Marquette and Second, as research shows that shoppers in well-landscaped business districts are willing to pay more for parking and up to 12% more for goods and services (Wolf, K. L. 1999. Nature and Commerce: Human Ecology in Business Districts. In: Kollins, C., ed. Building Cities of Green: Proceedings of the 9th National Urban Forest Conference.Washington, DC: American Forests.). Research has also shown that trees can significantly increase property values. Public art tree guards, tree grates and bike racks also create a street theme.

Project Recognition

MARQ2 project awards: ACEC Award, MSPE Award; Silva Cell Product awards: “Top 10 Green Building Product of 2009,” Architectural Record

Additional Information

Links to images: http://www.sehinc.com/portfolios/37/marq2-transitway-and-streetscape-%E2%80%94-minneapolis-minn http://www.deeproot.com/products/silva-cell/case-studies.html http://www.deeproot.com/products/silva-cell/silva-cell-overview.html

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