Designing Urban Green Roofs for Modularity and Recyclability

Objective: Develop alternative designs for green roofs responsive to the special features of urban rooftops, evaluate the alternatives for optimized modularity and recyclability of materials, and design and build a prototype.

Background: The rooftops of New York City buildings are generally underutilized. They offer considerable potential in terms of diverse “harvestable” items: water, thermal absorption, solar irradiation—and the biomass that these can support. They provide superb views, an urban experience of nature (wind, sky, sunsets), and places for recreation or refuge. On the other hand, these buildings—like those of most cities—are aging and inadequately insulated. Retrofitting urban rooftops to give them good insulating qualities thus has a significant payoff in reduced heat loss and higher energy efficiency. However, current green roof proposals sometimes do not adequately take into account their unique settings, and the influences and limitations imposed by the actualities of urban rooftops. And they sometimes come up short with the respect to the full range of relevant sustainability considerations. This suggests a need for a refined approach to an urban green roof system that would thoroughly assess potential architectural challenges, e.g., structural adaptation, membrane limitations, planting methods, irrigation systems, maintenance issues, and climactic accommodations such as wind screening. Such an approach could also incorporate modular design concepts for application to a diversity of urban rooftop configurations. More emphasis could also be placed on the recyclability of materials in light of full life-cycle analyses, and selection of potential alternative materials.

Suggested Approaches: Perform comprehensive research into primary elements of green roof systems, e.g., planters, pavers, screens/trellises, greenhouses, rainwater collectors, irrigation systems, energy supply systems, and monitoring systems. From an architectural perspective, develop schematic green roof design alternatives, keeping in mind the goal of wide applicability to various urban rooftop configurations. From an engineering perspective, develop schematic mechanical systems that are consistent with the goal of extensive modularity. Define criteria for comparing and evaluating proposed design alternatives and mechanical systems, with emphasis on (i) cost-benefit analyses at various stages of the design process; and (ii) use of materials for which life-cycle analyses indicate satisfactory recyclability. Focus on the latter in particular, evaluating materials alternatives in light of structural, maintenance, energy management, thermal insulation, and urban agriculture performance needs. Integrating architectural, engineering, and sustainability perspectives, design and build a prototype urban green rooftop that optimizes modularity and materials recyclability. Prepare a report, with bibliography, that details both the developed prototype and the design process from which it emerged.