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The courtyard at 440 Alfred combines intensive and extensive planting and a variety of materials to achieve a dynamic amenity space. Source: Bedrock Detroit via HAA

LANDSCAPE SPACES ON STRUCTURES
KEY CONSIDERATIONS FOR SUCCESSFUL DESIGNS

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For landscape architects in Michigan, there are fewer opportunities to work on projects that include landscapes on structure than there are in milder climates or denser areas of the country. In the last several years, Hamilton Anderson Associates (HAA) has been fortunate to work on several such projects. In this article, I share the key considerations that have guided the design, coordination, and construction of these HAA projects, drawing also on my deeper experience working on such projects in the San Francisco Bay area.

Landscapes on structure offer myriad opportunities and benefits to architectural projects of all types. In dense areas or on constrained sites, they can help maximize site capacity by moving desired site amenities or required recreation or open space area onto the structure, allowing a larger overall building footprint. Landscapes on structures can increase access to green open space for building occupants and even the community. This can add value to developer-led projects whether through increased rents or sale prices or municipal incentives. Landscapes on structures can also support a number of sustainability practices including reduced heat island effect, improved biodiversity and habitat, stormwater runoff reduction and retention, and energy conservation.

In recent decades, extensive green roofs – commonly characterized by low-maintenance sedums and perennials that can root in soil depths of six inches or less – have become increasingly common, particularly in urban areas, thanks in large part to the advocacy of civic and sustainability leaders. Extensive green roofs are fairly straightforward to design and implement, particularly with the development of off-the-shelf products that simplify installation and maintenance. And, paired with simple lightweight pedestal pavers and contract furnishings, extensive green roofs can shape an economical landscape space on structure delivering many economic, social and environmental benefits.

Intensive green roofs, on the other hand, have soil depths over six inches and often exceeding 24 inches, allowing for the planting of trees, shrubs, and perennials typical to at-grade application. Successful intensive green roofs shape landscape spaces on structures that look and feel like landscapes spaces on grade. The design of these landscapes requires extensive multi-disciplinary coordination, not only with architects but also structural engineers, mechanical and electrical engineers, waterproofing consultants, and sometimes façade access consultants.

A number of considerations influence the programming and design of landscapes on structure which are not at play in landscapes at grade. These factors should be well understood by the landscape architect as they embark on programming and schematic design. Below I will highlight these considerations along with case studies of how they were handled on several HAA projects.

STRUCTURAL DESIGN CONSIDERATIONS

The most structurally challenging aspect of rooftop landscapes is not the additional load of people, structures, amenities, or even planting material. The greatest challenge is the potential water volume retained by the soil contained in the planting system. Early coordination with the structural engineer will ensure the structural design accommodates, as best the budget and building program allow, a robust landscape design. Key considerations to discuss with the architect and engineer include:

- Is the building steel or wood construction? A steel building structure has the capacity to bear significantly more saturated soil than does a wood structure, with less additional reinforcement and associated cost.
- What are the structural constraints on locating intensive roof planting and particularly trees? Depending on the construction type and cost to strengthen the structural design to support the landscape, planting may be limited to locations on or very near the structural grid.
- Are there key locations where the roof slab could be depressed, allowing trees and planting that feels less containerized or perhaps to accommodate a pool or spa? Such depressions can typically only be made where the building program below the structure can accommodate lower ceiling heights, such as over parking decks or utility rooms.
- In the absence of other information, structural engineers will assume standard soil specification to the full depth of planters indicated. As soon as possible, provide sectional details or specifications to the engineer that outline the types and depth of backfill. Tall planters can be backfilled with lightweight geofoam or expanded shale in addition to or in lieu of drain rock, reducing soil depth to the minimum required. Engineered soils designed for rooftop planting are not only lighter but also drain more quickly, helping to mitigate structural concerns.

WATERPROOFING & DRAINAGE CONSIDERATIONS

Of critical concern in every rooftop is the need to drain water quickly and prevent intrusion of water into the building. Roof decks will be waterproofed below the landscape installation. However, even over waterproofing, ineffective drainage of landscapes on structures can lead to leaks, especially in freeze-thaw climates. Key considerations to discuss with the architect and engineer include:

- Will containerized planters drain to the roof slab or will they drain independently a secondary set of drains? Note that drains within planters require inspection tubes to ensure ease of maintenance access.
- Basic freestanding planters generally only require drain mat to ensure movement of water. However complex planters and/or those tied into the roof structure will require additional attention and coordination with the architect to ensure adequate waterproofing of the planter itself. This may be carried in either the landscape architect or architect’s construction documentation.

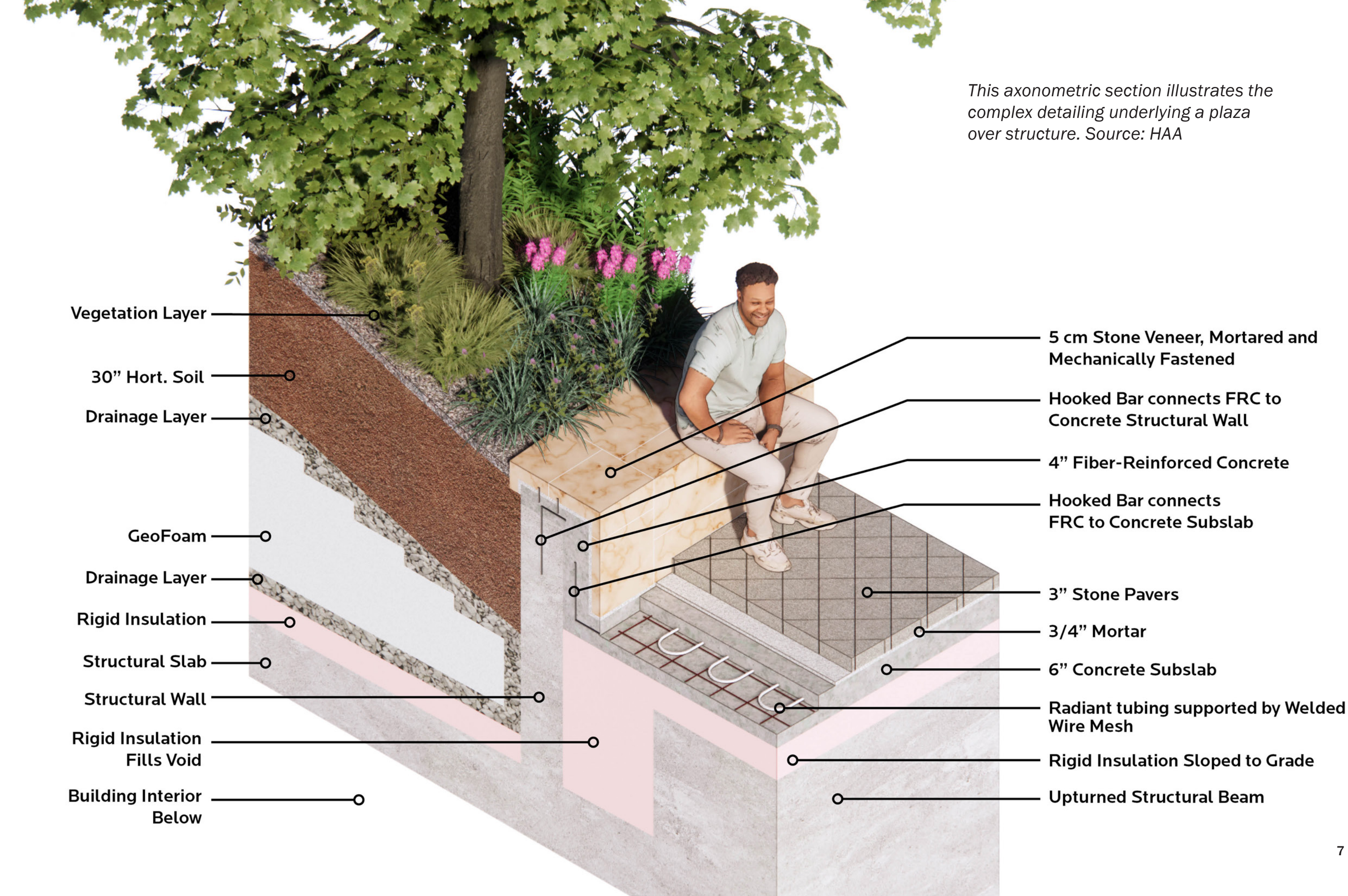
A related concern is the need to protect the integrity of waterproofing underlying the landscape. Generally, architects seek to minimize penetrations through the structural slab, as every penetration introduces an opportunity for water infiltration. However, some penetrations are unavoidable to achieve an effective landscape on structure. At a minimum, penetrations will be required to service electrical, plumbing, and irrigation needs of the landscape. However, landscapes on structure may include railings, shade structures, planter walls, and other structures that require structural tie-in to the roof slab. Key consideration to discuss with the architect and engineer include:

- What is the design team’s perspective on structural penetrations? Perspectives will vary based on the experience of the design team and waterproofing approach. Understanding these perspectives early on will mitigate surprises during design development and documentation.
- When structures require tie-in to the roof structure, there will typically be a curb - wood or concrete - to receive this connection. Curbs enable waterproofing to wrap up to extend above the drainage plane. Connections can then be made with post-welds to an embed plate or direct fastening, which may require additional waterproofing.

PAVING DESIGN CONSIDERATIONS

Rooftops, even ‘flat’ ones, slope to drain, either to rain leaders on the face of the building or to roof deck drains that conduct water through the building to the storm sewer. Most commonly, buildings with landscapes on structure will have drains dispersed across the rooftop, much like area drains across a plaza, with drainage areas formed by parapet walls and ridges in the roof deck itself. The relationship between the ridges and finish floor of adjacent interior spaces will establish the minimum depth for the paving profile. Key considerations to discuss with the architect and engineers include:

- What is the minimum depth available for the paving profile? This will determine which paving options and profiles are feasible. The thinnest profile can be achieved with a porcelain paver on a pedestal, with a total



This axonometric section illustrates the complex detailing underlying a plaza over structure. Source: HAA

height of just over 1 inch. Where more depth is available, paving options expand to include more conventional pedestal unit pavers, decomposed granite, decorative gravel, and wood decking.
- While concrete or mortar set paving on rooftops may be structurally feasible, it is generally discouraged outside of plaza settings due to the barriers it introduces in terms of maintenance and repairs to the roof deck.
- If possible, ensure sufficient depth below pavement, whether between pedestals or in a backfill layer, to run irrigation lines and conduits, as this will minimize penetrations of the slab and simplify installation.
- Can the roof structure support a leveling course of clean aggregate? Or will pedestals be required to set pavers? Eliminating pedestals can save cost in terms of both material and labor, while an aggregate base allows for irrigation and electrical infrastructure to run easily below.
- Will there be insulation on the top of the roof slab? Is protection board and/or drain mat required over the waterproofing membrane? These will impact the space available for the paving build up.
- Do the paving surface areas need to drain independently from the structural slab? Most typically, the paving system will be permeable, draining to the structural slab, in which case pavement can be absolutely level. However in some applications, particularly plazas at street level, a double drainage system is required, in which paving may be impervious and should slope to area or trench drains.

IRRIGATION AND OTHER MEP CONSIDERATIONS

In landscapes on structure, irrigation, water, gas and electrical supply are coordinated with building MEP engineers. Key considerations to discuss with the architect and engineer include:

- Where will the irrigation controller be located? Is it possible for control valves to be ganged together in that location, with lateral supplies running directly to each zone? Or will controllers be required at the roof level? Control valve boxes take up precious area in rooftop planters.
- Routing of water supplies and conduit to house control wires should ideally be located on MEP drawings, allowing the irrigation installer to pick up with a point of connection at the rooftop level. This ensures proper coordination and installation by the MEP trades at the appropriate phase of construction.
- Electrical and plumbing services to features such as sinks, grills or firepits must be carefully coordinated with engineers and may introduce constraints based on the location of chases within the building, particularly when there is not room for conduit and lines to run below pavers.
- Lighting design requires careful consideration, as conduits, footings and attachments must be fully coordinated with engineers. Wind loads on rooftops and associated structural requirements can limit lighting options.

Other considerations relate more to how building mechanical services will impact the landscape design, such as:

- Will rooftop mechanical equipment be adjacent to or visible from the amenity area and, if so, what constraints should inform their screening?
- Will there be vents or flues exiting the roof? To what height? Is there flexibility in those locations? On one project, the location of vents became a key driver shaping the design of the space. Some flues were able to be incorporated to features of the space, including a shade structure.

OTHER DESIGN FACTORS

Other factors to be considered in the programming and design of rooftop amenity spaces include:

- What is the egress strategy for the space? How many users can be accommodated and how does this translate to occupiable square footage? Non-occupiable planting area can reduce the occupiable square footage to bring the number of users in line with the egress strategy.
- If raised planters will be concrete or masonry, can they tie into the roof deck? Or will they need to be free-standing, bathtub-style planters?
- Will there be unoccupied areas of the roof visible from the amenity area? Roof membranes can cause glare and be unsightly. Can they be screened or concealed with an extensive green roof or lightweight crushed stone?
- What are the requirements for facade maintenance and window cleaning, and how will they inform the program and design?
- How will snow be cleared and removed in the winter?
- Will the space be utilized in the winter? Heat trace systems can provide snowmelt to pedestal pavers, while outdoor heaters can extend the seasonality of the space.

CASE STUDY: WOODWARD WEST, MIDTOWN DETROIT

Woodward West is a 5-story mixed use building located in Midtown, Detroit. The building, developed by The Platform, features an 1800 SF amenity terrace on the fifth floor, adjacent to the clubhouse. The clubhouse and terrace were located on the south side of the building to take advantage of views to downtown. The terrace design includes a 7-person spa hot tub, custom planters with integral lounge seating surrounding a custom fire pit, gas grill and outdoor kitchen, and a number of seating and lounge areas for small gatherings, dining, remote work, yoga and sunbathing.

The upper levels of the building are wood structure and the terrace is built over a wood deck topped with waterproofed rigid insulation that slopes to roof drains. A level pedestal paving system is used, allowing stormwater to permeate and flow to roof drains. Electric snow melt was considered but eliminated due to cost. Planting is achieved through aluminum raised planters and commercial-grade GFRC pots. Wood curbs support the hot tub and raised planters, while pots and cabinets for the grills and kitchen sit on the pedestal pavement.

HAA worked in close coordination with the structural engineer to calibrate the planter backfill and soil specification with the structural load allowances. The irrigation controller and valves are located in the fire pump room, with lateral lines running separately to service three control zones on the terrace. Electrical, gas and water connections are also stubbed from below the deck, directly to the fixtures.

Conceptual rendering of the terrace at Woodward West. Source: HAA

CASE STUDY: 440 ALFRED, MIDTOWN DETROIT

440 Alfred is a 5-story mixed-use building located in the City Modern development in Midtown, Detroit. The building features a generous 8400 SF amenity courtyard located on the second level and also accessible via a stair from street level. The courtyard, which is framed by building facade on three and a half sides, is accessible by the entire City Modern community. The design includes a gas grill with counter, firepit, five distinct lounge areas, and custom wood banquettes with under-lighting and integral planters. Six residential units open to the courtyard with enclosed patios.

The courtyard is located over a parking deck with steel structure. The floor-to-floor heights did not allow for recessed slabs. However the structural design permitted limited intensive planting with trees, provided these were located on or very near beams. This became a driver in the design of the space. To increase the planting area, and allow it to shape amenity spaces, HAA combined extensive green roof trays with trees and perennials strategically located in raised planters.

The waterproofed concrete roof slab below the courtyard slopes to slab drains. A pedestal system was considered for paving, however HAA opted to level the roof with a compacted 6A drain rock, to simplify installation of the various paving types and the green roof trays, reducing both material and labor cost. Paving, decking, green roof trays and raised planters all drain directly to the structural slab and roof drains.

Irrigation controllers are located in a mechanical room, with the mainline and control wire running to the courtyard, where control valves are located. Lateral irrigation lines run below the green roof trays and pavers to feed control zones. Electrical and plumbing, on the other hand, are routed below the deck and stubbed directly to the fixtures.


440 Alfred. Source: Bedrock Detroit via HAA

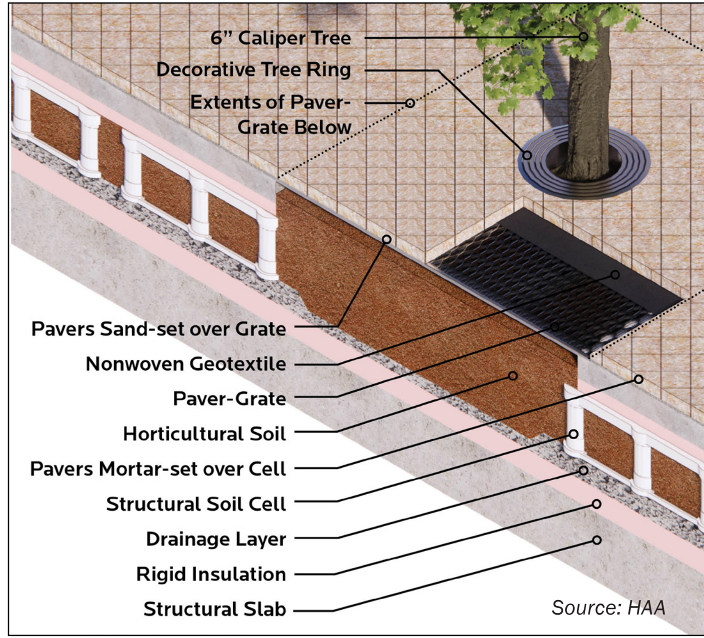
CASE STUDY: CONFIDENTIAL PROJECT, DOWNTOWN DETROIT

This mixed use project in Downtown Detroit includes a variety of landscape spaces on structure. The street-level plaza features dynamic stone-veneer planters and seat walls, areas for outdoor dining and retail display, and a flexible events space. The plaza is located over a parking deck with steel structure. We took advantage of the opportunity to recess the structural slab in key locations to allow intensive planting with 30-inch maximum soil depths. The recessed structure allows the finish grade of the planting area to drop to 4” above finish grade of the plaza. Structural soil cells are used in recessed slabs below paved areas to extend the soil volume supporting tree root growth. These are used in combination with paver grates to enable tree planting within the paving.

The plaza is paved with mortar set stone pavers laid over a 6-inch topping slab with integral snowmelt system. The topping slab slopes independently of the relatively level roof deck, thus it is laid over a build up of rigid insulation that is tapered to set the grading. The surface slopes to slot-style trench drains tied to the building stormwater system. Grade change over the plaza exceeds 1.5 feet. This grade change required stepping of the structural slab. And, despite a generally generous depth for the paving buildup, detailed sectional studies were required to coordinate the grading design with the structural system to ensure adequate depth for the paving buildup as well as insulation and waterproofing.

A unique feature of the plaza is a series of stone-clad planters that range in height from 4 to 30 inches, some with integral seat walls. Lightweight EPS Geofoam is used to backfill planters as required and create mounding forms in the landscape beds, to ensure the soil profile never exceeds 30 inches. Structural curbs and walls that tie to the structural deck form the majority of backing walls for the stone cladding. Geofoam is used in combination with lightweight fiber-reinforced concrete to form the planters and seat walls. Stone cladding is mortar-set, in combination with mechanical fastening, directly to both structural walls and the Geofoam/concrete build up. The planters drain directly to the structural deck with blockouts in structural walls strategically located to ensure adequate flow to deck drains.

The irrigation controller and valves are located in a utility room, with lateral lines stubbing into control zones on the plaza level. Electrical connections are also stubbed from below the deck, directly to light fixtures and power supplies. The plaza includes a snowmelt system that is embedded in the paving subslab.



CONCLUSION

As this overview of key considerations and case studies illustrate, landscapes on structure require an integrated approach and close coordination throughout the design process. For landscape architects who love creative problem solving and multi-disciplinary collaboration, they offer many rewarding challenges. And for tenants, building owners and communities alike, landscapes on structure offer many tangible and intangible benefits that make the additional effort and cost worthwhile. •

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