Living Systems

LIAT MARGOLIS // ALEXANDER ROBINSON

INNOVATIVE MATERIALS AND TECHNOLOGIES FOR LANDSCAPE ARCHITECTURE

Birkhäuser
Basel · Boston · Berlin

Graphic design, layout and cover
Miriam Bussmann, Berlin

This book is also available in a German edition:
ISBN 978-3-7643-7699-4

Bibliographic information published by The Deutsche Nationalbibliothek
The Deutsche Nationalbibliothek lists this publication in the Deutsche Nationalbibliografie; detailed bibliographic data are available in the Internet at http://dnb.ddb.de.

Library of Congress Control Number: 2007924187

Basel · Boston · Berlin
P.O.Box 133, CH-4010 Basel, Switzerland
Part of Springer Science+Business Media
Printed on acid-free paper produced from chlorine-free pulp. TCF ∞

Printed in Germany
ISBN 978-3-7643-7700-7

www.birkhauser.ch

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Preface

Innovation in material technologies has been at the forefront of design discourse over the last decade. This emergence is the culmination of a widespread professional and academic recognition that knowledge of material properties and processes is fundamental to innovation in design applications, and further, that cross-fertilization among professional fields, as well as access to data outside of conventional territories, may broaden and advance the scope of landscape architecture. As a result of this material culture, conceptual and practical approaches to design development and dialogue have shifted toward a research-driven design process in which the opportunities and constraints of materials and construction techniques become integral to design intent.

In recent years, research and consulting services, material libraries, online databases, books, magazines, conferences, and exhibitions have surfaced worldwide to focus on new methods of collection, categorization, and dissemination of material data. Such forums of exchange have cultivated a widespread interest in the re-adaptation of materials for unprecedented applications: to be high-performance, to be environmentally efficient, and so on.

This new research model facilitates knowledge transfer among diverse professional and academic fields, and inspires a collaborative design process. A broader base of material understanding and design methodologies is now introduced at a much earlier stage of design development. However, along with this new model comes a necessity to formulate a new language to synthesize multiple field-specific terminologies, and translate them into relevant and comprehensible terms. Thus publications and databases have focused on the configuration of new categorization systems, and the merging of distinct terminology.

Within the context of this emergent material emphasis, Living Systems positions itself as a survey of contemporary approaches to material technologies in the field of landscape architecture. Despite a large number of both advanced theoretical essays and technological innovations in landscape architecture, theory and practice have not been synthesized in a single publication. Our research and publication therefore discusses landscape materiality within the context of diverse design case studies to illustrate how technology becomes integral to the conceptual framework.

Our editorial work has been primarily invested in both the assemblage of terminology to represent the expanded scope of contemporary thought and practice, as well as the invention of categorization to explicitly describe the dynamic qualities of landscape systems. More specifically, landscape materials and constructions are discussed first in terms of performance criteria and operations that facilitate and adapt to the cyclical processes of natural systems, notably: exchange, flow, metabolism, and growth; and second as interdependent systems, analogous to biological/natural systems (i.e. human body).

The book's categorization is derived from landscape operations rather than landscape products. For example, ecology, urban fabric, and spatial experience are described as choreographed events, so that landscape is understood as infrastructure, an emergent (evolving) organism, or a successional (sequential) episode.

Living Systems calls for a shift away from the traditional design process that initially identifies a landscape's behaviors and performance criteria, and then offers a range of product/construction solutions that can accommodate such functions, toward a design process which integrates the function into the design from the outset. While we do not propose to discard conventional categorization systems or material specification guidelines, we promote an expansion of terminology to acknowledge the dynamic performance of the medium, and comply with high-performance rating systems (i.e. LEED; Leadership in Energy and Environmental Design), which establish high standards for environmental, economic and social improvements.

Living Systems retools the current professional and pedagogic vocabulary, and is also intended as a gateway for other design professionals, including architects, urban planners, construction managers, restoration ecologists, and geographic computation analysts to expand their perception and expectations to reflect the new scope of the field. With an increased interest in landscape within architecture, we aim to deepen the understanding of the complexity and operative potential of landscapes as mutable, working systems.

In order to illustrate the diversity of the professional field of landscape architecture as it is discussed and practiced today, this book includes an eclectic range of topics, case studies, scales and contexts; it underlines the collaboration between landscape architecture, architecture, science and engineering, as well as the blurring of boundaries between the conventional professional divisions. Living Systems is intended as a portal to a broad directory of expertise, including design firms, research institutes, consultants, and manufacturers.

Projects are divided into seven chapters, each focused on an operative aspect of landscape. After formulating the thesis statement and chapter topics for Living Systems, an international call for project submissions was distributed. Over 60 projects were submitted, out of which 36 were selected to illustrate a range of conceptual and technical ideas. The enthusiastic response from design firms worldwide is a testament to relevance of landscape materials to current practice and dialogue. Each chapter presents multiple scales and properties within each operation in order to point to the operation's conceptual spectrum, and to inspire further expansion.

The project locations range internationally, featuring twelve countries, including the USA, Switzerland, Germany, Puerto Rico, Australia, Spain, Italy, The Netherlands, Denmark, The United Kingdom, Canada, and Greece. All projects are either built works in the last decade, newly built work within the last year, projects in design development, or conceptual proposals.

To complement the projects, a compendium of twenty-three material products and technologies are featured in the back of the book, and cross-referenced to the seven chapters and case studies. Some of the material technologies or experiments represent recent discoveries which often require new ways of construction and integration into projects. However, in many cases, materials are not necessarily new, but rather demonstrate new discussions, definitions, potential applications or combinations.

The book is formatted in a way to facilitate cross-referencing between operations and relevant material products; it attempts to promote cross-fertilization between materials and projects by categorizing according to function, operation, and performance. This format highlights systems and constructions that are designed to be multi-operational and applicable to several categories of performance; similarly, products are cross-referenced to multiple chapters to illustrate their capacity to perform multiple operations. Please note that all converted measurements have been rounded off and are approximate.

The index is conceived as a search tool for landscape processes and properties. Instead of listing architectonic forms and programs of use, such as plaza, playground, riverfront, or wetland, the index facilitates site analysis in terms of its properties.

The index is organized into two major systems: environmental forces which the design addresses (i.e. flow, growth, energy), and properties of material structures, such as reinforcing, tensile, and biodegradable.

Environmental forces are further divided into two levels of information. The first subcategory lists the active elements that harness the force, such as water, wind, vegetation, solar. The second subcategory lists the techniques to manipulate the active elements into potential design solutions. Those include terms such as retain, infiltrate, reinforce, inhibit, treat, and filter.

Introduction

In a recent issue of *Architecture Boston (AB)*, featuring the 2006 design awards, the jury's comments for the category of Unbuilt Architecture stated that the text in almost every architectural submission referred to its sustainable content, typically citing green roofs, geothermal wells, and reuse of rainwater, as if these were boxes to be checked. These allusions indicate a growing awareness that sustainable buildings and landscapes are desirable, but little grasp of how this may affect design. This aspect of architectural thought remains remarkably lacking in material association or in appreciation of the quantitative aspects of energy flows, rainwater volume, or natural light and ventilation.[1]

Among the projects awarded was an Energy Farm[2] where fields of suspended heliptropic sky-pins generate energy and activate variable intensities of light, color and sound; and a Fog Harvester, An Ecosystem for Arid Farmland Highway Stops[3], where a steel-mesh structure leverages fog and wind dispersal to capture soil, seeds, and moisture to launch and self-propagate a landscape.

Seeing such imaginative ideas increasingly surface within design dialogue reinforces the relevance and timing of the publication of Living Systems. However, that this discussion exists mainly within the awards category of unbuilt works is indicative that the interest in landscape architecture as an operational infrastructure is in its formative years: still open to a reshaping of concept and materialization.

Living Systems points precisely to the theoretical and technical discussions of such emerging interests, which include urban ecologies, remediation of degraded sites, stormwater management, energy generation, and climate control, among others. This publication addresses contemporary approaches to landscape material technologies and specifications, as well as quantification of landscape systems.

Living Systems redefines and expands the conventional boundaries of landscape materiality, both conceptually and professionally. It looks toward an intersection between the fields of landscape and architecture by blurring inside-outside relations and functions, as in climate control and water recycling; between landscape and engineering, as in the potential for landscape to prevent flooding, process sewage, or retain stormwater runoff; between landscape and urban-regional planning; and between landscape and ecological conservation/rehabilitation.

Living Systems, however, does not focus exclusively on environmental/ecological issues, which are undoubtedly some of the most commonly discussed design performance criteria today. Rather, it expands the concept of landscape materiality to also discuss its phenomenological immateriality, as in atmospheric, volatile, and phase-changing events. This publication also suggests the potential to merge digital media and data collection as part of the constructed landscape to communicate, monitor, and provide interactive experiences. Beyond quantitative aspects, these immaterial systems are examined for their poetic/symbolic performances, experiential/ethereal manifestation, or informative/didactic engagement.

Within Living Systems, the term "materiality" is defined according to four principles. The first recognizes landscape architecture as an outdoor space, or as a medium that employs living materials (plants, water) operating within the realm of natural/biological systems, subject to their complex behaviors.

The second principle imagines landscape as a motion picture film, rather than a static framed image; landscape material technologies are not considered objects, but rather processes that occur in varying scales, time/cycle intervals, and spatial manifestations. From day to night, from season to season, or from drought to flood,

1 Architecture Boston, January/February, Awards Issue, pp 92
2 Designer: Future Cities Lab, pp 94
3 Designer: Liminal Projects, pp 96

landscape is a stage for cyclical and evolving processes. Materiality is hence defined in terms of capabilities: growth, decay, exchange, conversion, adaptation, retention, infiltration, and evaporation.

The third principle argues that since these systems are in a constant state of flux, exchange, and transformation, they must be conceived as interdependent systems rather than viewed as individual material components. Consequently, material specifications must be considered integral to the design intent and structuring of the landscape, rather than specified as a superficial veneer to clad the surface.

The fourth principle debunks a conventional notion of nature as strictly naturally occurring, and instead points to the alliance between nature and technology. Regardless of its context, nature/landscape is a constructed system, impacted and adapted by technology within the contemporary built environment.

Living Systems presents 36 built and unbuilt projects that have been selected to demonstrate a range of strategies for the publication's conceptual principles and proposed categorization. The dissection of each project is a precise slice, or a section cut through a single highlighted material system. Material technologies are discussed within the context of design projects in order to demonstrate how the design principles outlined in each chapter can apply to a variety of site conditions and scales.

The classification and terminology generated through the course of the writing of this book describes processes and properties, which is a departure from the conventional categorization by predetermined applications. Material technologies and projects then are grouped according to function, not product typology. This paradigm shift in the design process is intended to inspire innovative material and construction solutions that go beyond the performance of typical ones.

The terminology is composed of verbs and adjectives that allude to the human/animal body and its complex life cycle. The terms are then cross-referenced within the chapters, product section, and index. The following seven chapter categories are not meant to be absolute, or exhaustive; they are merely a starting point for a new language of landscape definitions and terminology.

1. Launch investigates the rising interest in vertical landscapes, such as hanging gardens, tensile vine structures, and multi-tiered green façades. It also highlights a synthesis between landscape and architecture: for instance, where architectural façades are embedded with living materials to provide climate control. Launch capitalizes on the inherent plasticity of plants to adapt and redirect their growth. Much like a scaffolding structure for a building under construction, Launch points to an array of support structures that reinforce and guide the growth of the plants indefinitely, or until they reach stability. Both below-ground (i.e. geotextiles) and above-ground (i.e. tensile cables, trellis) structures are grouped together in order to imply a potential for a structural/formal continuity, and transcendence beyond typical placement. The structures featured in Launch can be transitional/biodegradable, permanent, or designed to evolve symbiotically, such as to adapt themselves to different stages of growth.

2. Stratify redefines the ground as a three-dimensional profile, and departs from the conventional separation between paving/surfaces and soil. Conceived as an epidermis-like structure, the stratified layers of the ground breathe, exchange nutrients, seal contaminants, drain/retain water, contain technological infrastructure,

sustain vegetation, and provide structural support. Modular systems are examined for their capability to seamlessly transition between softscape and hardscape, and between biologically active and non-active. For example, a paving system may be constructed to function not only as a travel surface, but also as infrastructure that retains and distributes water in order to irrigate surrounding trees and plants.

3. Fluid focuses on landscape structures designed to flexibly accommodate the cyclical and seasonal fluctuations of water flow in terms of its volume, frequency and velocity. From drought to flood, and from erosion to the conveyance of pollutants, the structures and materials featured in this chapter retain, infiltrate, redirect/redistribute, control-release, or attenuate flows.

4. Digestive examines the landscape as a metabolic system, where all materials and processes are inputs and outputs within a food cycle; they may be nutritious, innocuous, excessive, or harmful. Digestive features singular or ongoing processes that generate, retain, reshape, or biodegrade materials. Such processes may be physical, i.e. soil cut and fill, or bio-chemical, i.e. bioremediation via plants/fungus. Digestive promotes in-situ strategies for a zero waste approach, a departure from the conventional removal of pollutants or excess materials offsite to centralized systems, such as landfills, or sewage treatment plants.

5. Grooming redefines preconceived notions of maintenance. It broadens the scope of maintenance beyond post-construction management and includes site preparation and construction process as part of a continuum of actions within an overall design intent. It is imagined as a series of choreographed performances throughout the lifecycle of a landscape site that have distinct visual and experiential forms.

6. Translate introduces the function of conversion which encompasses the interpretation of collected data into various onsite displays of communication, as well as the adaptation of energy forces (wind, solar, tidal, circulation motion) into new mechanical uses. Since energy dynamics are immaterial, and not usually quantifiable by park visitors, Translate features structures that endow these forces with a communicative visual language, or convert them into useful functions. The collected data may pertain to the site's environmental, political, socio-economic, or professional context. It may be obtained remotely, or from on-site sensors; it then becomes synthesized, decoded, evaluated, and translated into informative displays, such as signage, lighting, and sound, to name a few.

7. Volatile considers how weather dynamics can be conceived as a tectonic landscape experience. The premise for the chapter is to question how atmospheric phenomena and immaterial substances that lack a stable form, such as wind, rain, fog, clouds, light, and sound, can be technically constructed and specified. Technologies featured in Volatile may visually reframe familiar weather phenomena into new settings, or recreate artificially choreographed weather events. These technologies highlight the multiple-phase, auditory, optical and kinesthetic properties of weather over time. They reinforce the fleeting and ethereal processes that order the landscape on a macro scale and point to larger pervasive patterns that operate globally, but activate the immediate site.

Although the case study projects are categorized according to the chapters outlined above, many of the material technologies overlap in terms of functionality; this suggests a more fluid logic of connectivity between systems that generates multi-functionality. Several projects exemplify what architects Weiss/Manfredi call "zones of intensity", a stacking of operations at different scales and sequences that build upon one another to achieve an economy of means, an efficient use of resources, and an overall improved performance. The Fiber Optic Marsh project, for example, featured on the book's cover, combines a Launch system that provides a support structure for plants and habitat; a Fluid system that reinforces coastal erosion control; as well as a Translate system that senses and communicates water pollution levels through an illuminated nighttime fiber optic display.

Launch

WHILE CABLE FRAMEWORKS ARE NOT TYPICALLY GROUPED WITH SUBSOIL REINFORCEMENT SYSTEMS, LAUNCH PROPOSES THE POTENTIAL TO MERGE BOTH BELOW- AND ABOVE-GROUND SUPPORT STRUCTURES IN A VERTICAL CONTINUUM: A UNIFIED SYSTEM THAT CAN REINFORCE AND DIRECT THE DEVELOPMENT OF THE PLANTS' ENTIRE COMPOSITION.

The growth of plants, from initial planting to maturation, is characterized by a continuous gain in height, mass, and strength over time. The challenge often lies in the plant's infancy stage where its structural fragility requires external support in order to withstand wind and erosive forces. The concept of Launch is a combination of living and nonliving systems: a progression of vegetal growth and its correspondent structural scaffolding that is required to guide the plant's form and trajectory until it reaches stability.

The scaffold may be a transitional structure, i.e. biodegradable; permanent; or designed to evolve symbiotically. The material systems include above-ground structures, such as a tensile cable, a mesh, and beam frameworks that allow for plant attachment, as well as subsoil materials, such as geotextiles. While cable frameworks are not typically grouped with subsoil reinforcement systems, Launch proposes the potential to merge both below- and above-ground support structures in a vertical continuum: a unified system that can reinforce and direct the development of the plants' entire composition.

Although fragile, plants can also be invasive and consuming, grafting themselves fiercely onto any surface. MAK t6 VACANT takes advantage of this proclivity, and uses an architectural structure as a host consumed by a parasitic Strangler Fig. The project mimics the natural process of the Strangler Fig as it slowly envelops, fuses, and decimates a tree, to become a structurally independent organism in the hollow shape of its host. In MAK t6, the original architectural form acts as a template that directs the voracious growth of the Fig tree to form new ramp and platform structures.

Launch demonstrates a rising interest in vertical landscapes. Within the fields of landscape and architecture, this interest in typologies such as hanging gardens, tensile vine structures, and multi-tiered green façades emerges from the desire to expand the definition of landscape solely as a horizontal ground plane, and capitalizes on the inherent plasticity of plants to adapt and redirect their growth toward any supporting surface or source of nutrition, light, and water.

Vertical landscapes also represent a conceptual shift toward a synthesis between landscape and architecture; building façades, as an example, can be embedded within emergent, active, and responsive skins. The nonliving architectural structure may provide support for vegetal growth, elevated circulation, and opportunities to integrate irrigation, lighting, and technology. In turn, the emergent vegetal epidermis regulates the building's temperature, air quality, light transmission, and seasonal color.

MFO Park and the Fire-Escape Ecosystem both exemplify a multi-tiered park. Composed of a highly articulated matrix of cables, loggias, walkways, stairs, and irrigation, MFO Park launches columns of vines and living walls. The building skin is a living, mutable entity that changes color seasonally and thickens over time. The Fire-Escape adapts its framework to integrate planters and irrigation to create a living façade for the London tenement building. Both projects blur the distinction between architectural spaces and landscape to transform divergent characteristics into complementary performance.

■ VERTICAL LANDSCAPES ALSO REPRESENT A CONCEPTUAL SHIFT TOWARD A SYNTHESIS BETWEEN LANDSCAPE AND ARCHITECTURE; BUILDING FAÇADES, AS AN EXAMPLE, CAN BE EMBEDDED WITHIN EMERGENT, ACTIVE, AND RESPONSIVE SKINS.

Both Palio de Bougainvilleas and the pergola in Parque de Diagonal Mar respond to contextual site conditions. The tensile and torqued Palio de Bougainvilleas vine armature responds to the local meteorological conditions and creates a twisted hyperbolic surface in order to resist the hurricane-force winds endemic to Puerto Rico. The pergola in Parque de Diagonal Mar integrates irrigation and misting systems into its tubular structure, in order to irrigate the suspended planters and cool park visitors on a hot summer day. Experienced from below and viewed from a passing car, these elevated structures define a new landscape ground plane.

The material products featured in relation to Launch include vertical growth systems, tensile structures, and geotextiles. Earth Cinch, for example, proposes a departure from the conventional use of subsoil geotextiles. Designed as temporary and biodegradable green tapestries in abandoned urban areas, these modular earth- and seed-embedded textile structures can be installed onto building façades or roofs.

Flexible growth medium (FGM), bonded fiber matrix (BFM), and various biodegradable erosion control geotextiles are designed as transitional soil stabilization systems. Whether hydraulically sprayed or anchored with stakes to the ground, the fiber (and seed) matrixes biodegrade within a prescribed amount of time, as newly planted vegetation establish their roots and provide long-term erosion protection.

G-Sky and Naturaire® systems offer the ability to construct vertical plantscapes. Similar in structure, they combine a metal framework and a perforated nonwoven textile fabric into which plants are inserted to create a solid green wall. Additionally, Naturaire® has been designed to filter indoor airborne contaminants through a specialized selection of plants that absorb or break down airborne chemicals. In terms of energy benefits, indoor air is cooled as it passes through the plants, and when distributed through the building's HVAC system, the cooled air can contribute to temperature regulation and conservation of cooling energy.

Multi-Tiered Vine Park //

Raderschall Landschaftsarchitekten AG + Burckhardt & Partner AG

MFO Park, Zurich, Switzerland

In MFO Park, the second of a series of four new parks planned for a major redevelopment area, Raderschall uses a complex open-air trellis to create a multi-tiered urban park. Referencing the neighborhood's industrial past, the steel cable tensile structure holds vegetation and park circulation in an architectonic form more than 100m (328ft) long and 17m (55.8ft) high. THROUGH AN ELABORATE NETWORK OF CABLES AND PLANTING TRENCHES, THE STRUCTURE EMPLOYS THE SIMPLE GROWING HABIT OF VINES TO CREATE A SERIES OF SPECTACULAR IMMERSIVE LIVING VOLUMES.

Two vegetal walls or skins envelope the interior and exterior perimeters of the steel matrix, defining the space of this unusual park. Situated between the vegetal skins, a circulation route of steel stairs and walkways allows access to the upper structure, which includes a sundeck and loggias. The wood-decked loggias are cantilevered internally, creating opportunities for viewing the central courtyard and for immersion within the filigree of vines and structure. Bounded by the vegetal structure, a courtyard of green glass aggregate contains seats, a fountain, and vine trellises shaped like inverted conical columns.

The vegetal skins are populated with multiple species of vines that grow upon the steel network of cables. The vine-growing nets are isolated from the main structure by about 50cm (20in) to prevent the vines from threatening the integrity of the structure. At the base, cables express the vine habit with radial bouquets extending upward, resulting in a form that both anticipates and abstracts naturalistic form. The form also consolidates the planting pits and creates more porous circulation on the ground plane.

To achieve a constant cover of foliage for the entire height of the 17m (55.8ft) structure, two strategies are employed. First, on the second level of the structure a series of trenches support a second tier of vines that are trained on a thinner network of cables. Secondly, vine varieties were chosen and distributed according to the height at which they grow and deploy foliage so that constant cover was achieved.

All together, 104 perennial vine varieties were chosen including vigorous woody vines, such as *Wisteria*, *Vitis*, *Ampelopsis*, and *Parthenocissus*. The symbiosis of structure and vegetation is reinforced by the assignment of a single species of vine to each vertical cable, such that the structure fades away, allowing the forms to be dominated by the dynamic character of the vines.

The vines are irrigated by a system that employs the site's internal watershed. The floor of the park is drained to the planting pits of the vines, which in turn are also drained to ensure that there is never standing water around the plants. The excess water that drains from the pits is collected in a cistern and then pumped to planting containers on the second level, ensuring that all plants on site benefit from the rain harvesting system. The cisterns also function to retain water on site during rain events and thus serve as a dry weather water source for site irrigation.

The cumulative load that the vines will eventually place on the structure is variable and difficult to calculate. Factors such as wind resistance, rate of growth, and structural integrity of woody vines create an ultimately unpredictable stress on the structure that prescribes a strategy of structural oversight. The structure will have to be periodically monitored to ensure that the skeletal structure is not overcome by the living system it is designed to support.

MFO Park's design hybridizes the dynamism of the vegetal medium with the scale and volumetric effect allowed by the matrix of steel cables. THE RESULTANT EFFECTS ARE MANY, BUT PERHAPS THE MOST DRAMATIC IS THE STRIKING TEMPORAL TRANSFORMATIONS THAT THE VEGETATED VOLUME EMBODIES AND WITHIN WHICH VISITORS ARE IMMERSED.

With each seasonal cycle the structure shifts from a bare steel armature into a spectacular display of foliage and flowers. With each year, the vegetation consumes more of the skeletal steel structure, which slowly recedes into breathing, rustling, color-shifting and growing materiality.

1 Two vegetal walls envelope the interior perimeter of the space and encase a steel staircase and walkways. **2** The east elevation demonstrates the relation between steel structures and vines.

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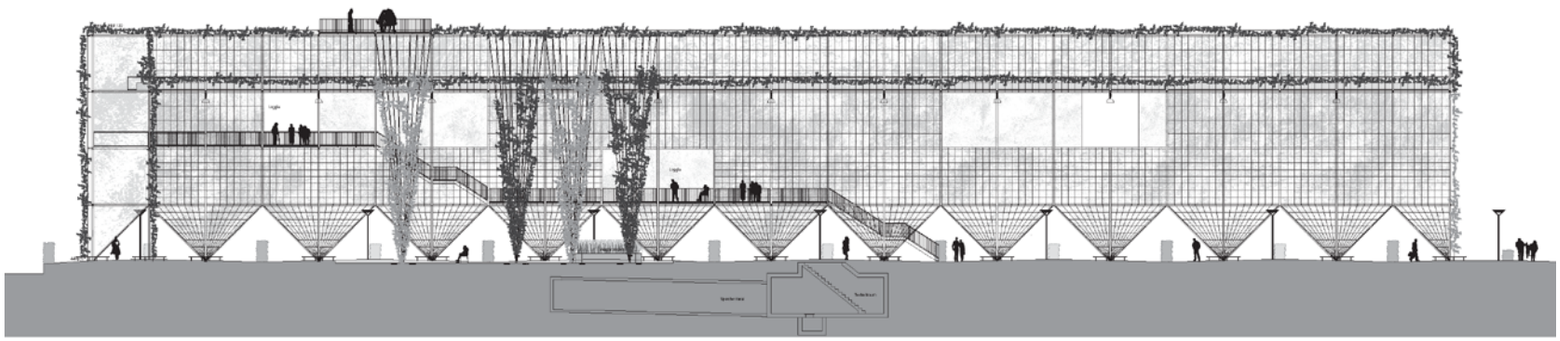

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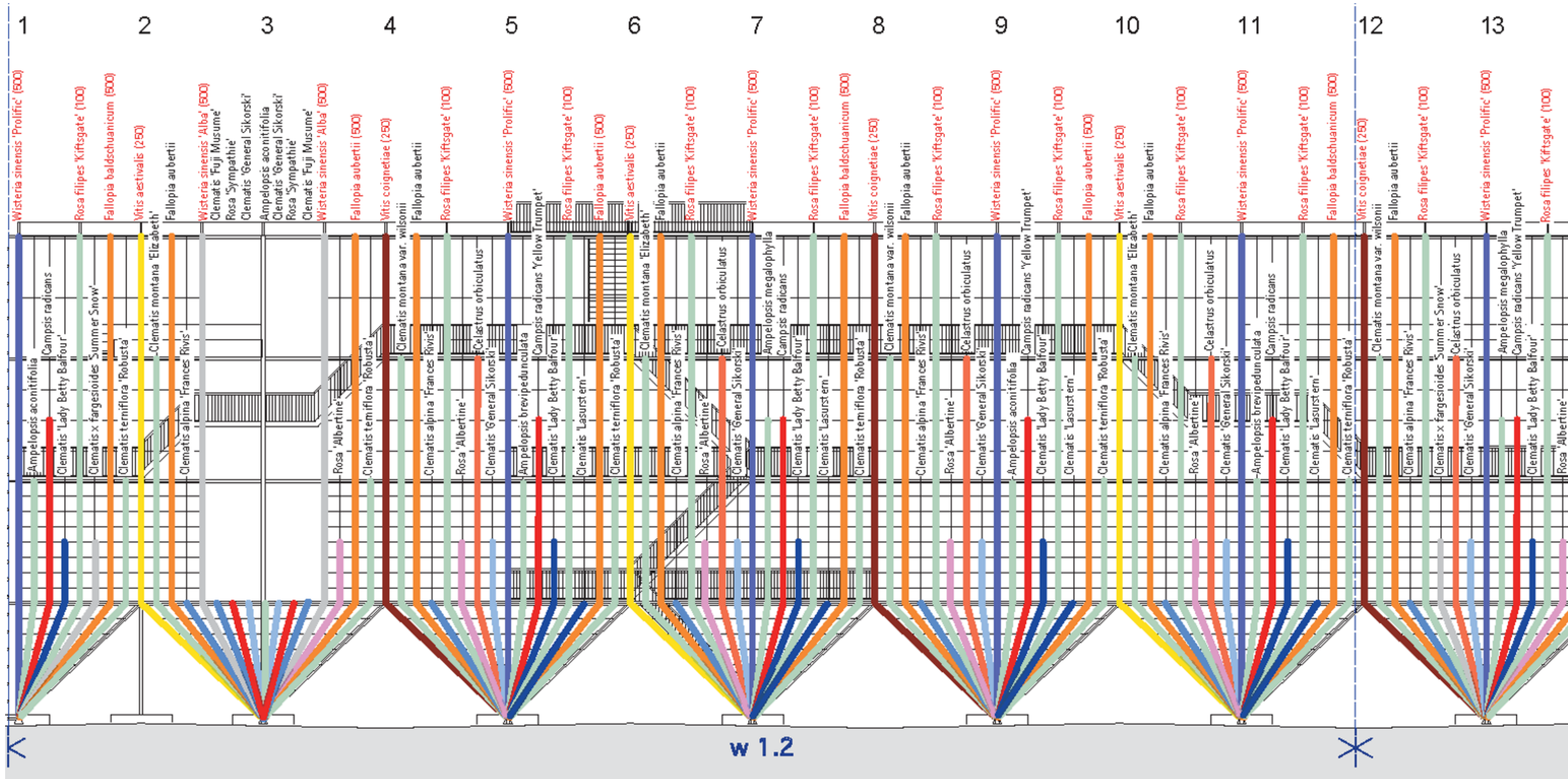
■ **1** Vertical planting plan shows 104 selected vine species, each assigned to a separate cable.



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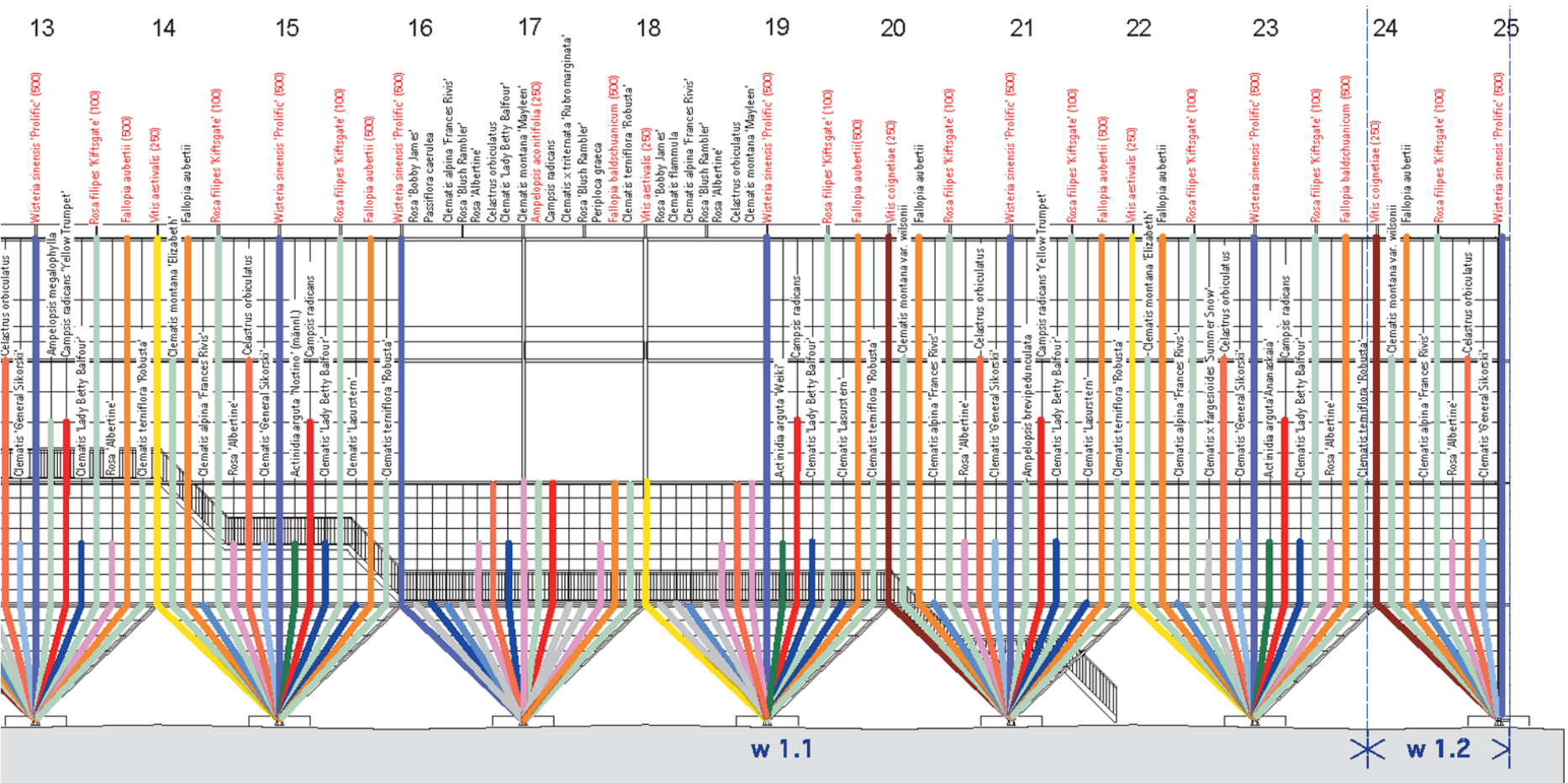
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Wisteria sinensis 'Prolific' (600)
Celastrus orbiculatus
Clematis 'General Sikorski'
Ampelopsis megalophylla
Campsis radicans 'Yellow Trumpet'
Clematis 'Lady Betty Balfour'
Rosa filipes 'Kiftsgate' (100)
Rosa 'Albertine'
Fallopia aubertii (600)
Clematis terniflora 'Robusta'
Vitis aestivalis (250)
Clematis montana 'Elizabeth'
Fallopia aubertii
Rosa filipes 'Kiftsgate' (100)
Clematis alpina 'Frances Rivis'
Rosa 'Albertine'
Celastrus orbiculatus
Wisteria sinensis 'Prolific' (600)
Clematis 'General Sikorski'
Actinidia arguta 'Nostino' (männl.)
Campsis radicans
Clematis 'Lady Betty Balfour'
Clematis 'Lauerstern'
Rosa filipes 'Kiftsgate' (100)
Fallopia aubertii (600)
Clematis terniflora 'Robusta'
Wisteria sinensis 'Prolific' (600)
Rosa 'Bobby James'
Passiflora caerulea
Clematis alpina 'Frances Rivis'
Rosa 'Blush Rambler'
Rosa 'Albertine'
Celastrus orbiculatus
Clematis 'Lady Betty Balfour'
Clematis montana 'Mayleen'
Ampelopsis aconitifolia (250)
Campsis radicans
Clematis x triternata 'Rubromarginata'
Rosa 'Blush Rambler'
Periploca graeca
Fallopia baldschuanicum (500)
Clematis terniflora 'Robusta'
Vitis aestivalis (250)
Rosa 'Bobby James'
Clematis flammula
Clematis alpina 'Frances Rivis'
Rosa 'Blush Rambler'
Rosa 'Albertine'
Celastrus orbiculatus
Clematis montana 'Mayleen'
Wisteria sinensis 'Prolific' (600)
Actinidia arguta 'Weiki'
Campsis radicans
Clematis 'Lady Betty Balfour'
Clematis 'Lauerstern'
Clematis terniflora 'Robusta'
Rosa filipes 'Kiftsgate' (100)
Fallopia aubertii(600)
Vitis coignetiae (250)
Clematis montana var. wilsonii
Fallopia aubertii
Clematis alpina 'Frances Rivis'
Rosa 'Albertine'
Rosa filipes 'Kiftsgate' (100)
Celastrus orbiculatus
Wisteria sinensis 'Prolific' (600)
Ampelopsis brevipedunculata
Campsis radicans 'Yellow Trumpet'
Clematis 'Lady Betty Balfour'
Clematis 'Lauerstern'
Clematis terniflora 'Robusta'
Rosa filipes 'Kiftsgate' (100)
Fallopia aubertii (600)
Vitis aestivalis (250)
Clematis montana 'Elizabeth'
Fallopia aubertii
Rosa filipes 'Kiftsgate' (100)
Clematis alpina 'Frances Rivis'
Clematis x fargesioides 'Summer Snow'
Celastrus orbiculatus
Clematis 'General Sikorski'
Wisteria sinensis 'Prolific' (600)
Actinidia arguta'Ananasnaya'
Campsis radicans
Clematis 'Lady Betty Balfour'
Rosa 'Albertine'
Rosa filipes 'Kiftsgate' (100)
Fallopia baldschuanicum (500)
Clematis terniflora 'Robusta'
Vitis coignetiae (250)
Clematis montana var. wilsonii
Fallopia aubertii
Rosa filipes 'Kiftsgate' (100)
Clematis alpina 'Frances Rivis'
Rosa 'Albertine'
Celastrus orbiculatus
Clematis 'General Sikorski'
Wisteria sinensis 'Prolific' (600)
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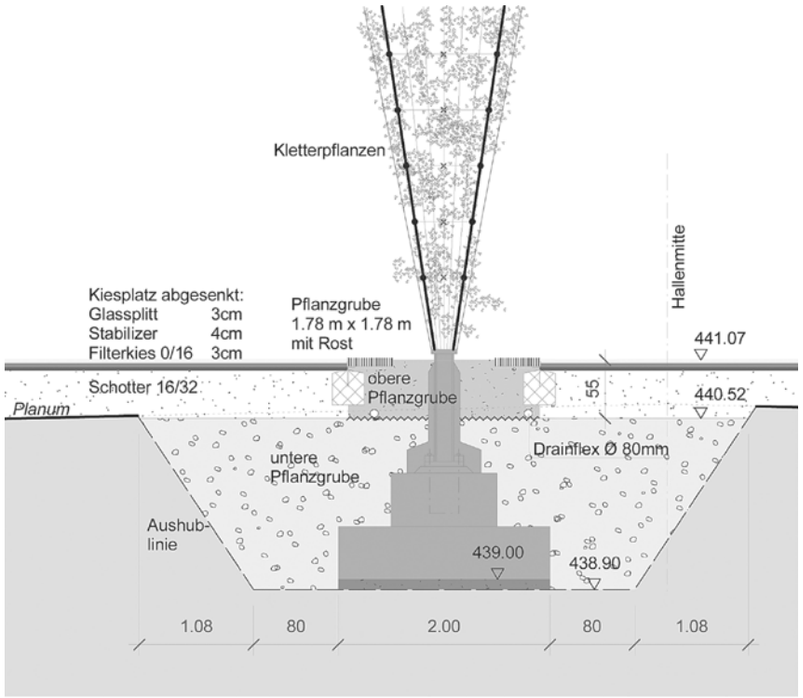

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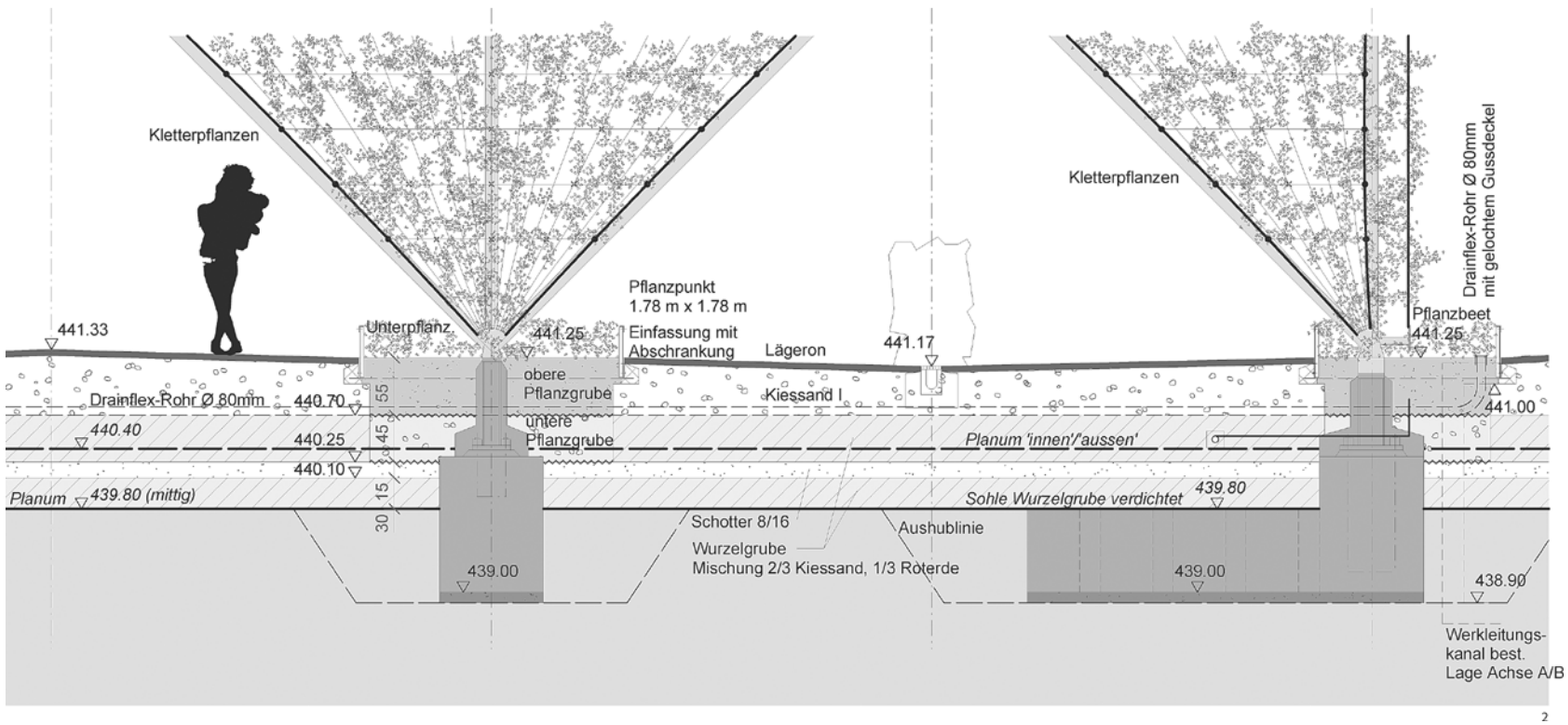
1 With each seasonal cycle the structure shifts from a bare steel armature into a spectacular display of foliage and flowers. **2** Detail sections of vine planting areas and structural foundation. **3** Detail of cable foundation. **4** Radial bouquets of tensile cables extend upward, allowing for porous circulation on the ground plane. **5** Detail of vine armature with a steel frame and tensile cables. **6** Circulation routes of steel stairs and walkways are situated between the vegetal walls.



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