

# GREEN WALLS and GREEN TOWERS



Presented by Randy Sharp,  
ASLA, CSLA, LEED® Accredited Professional  
Sharp & Diamond Landscape Architecture Inc.

# GREEN CITY VISIONS



Atlanta, GA  
[www.nasa.gov](http://www.nasa.gov)

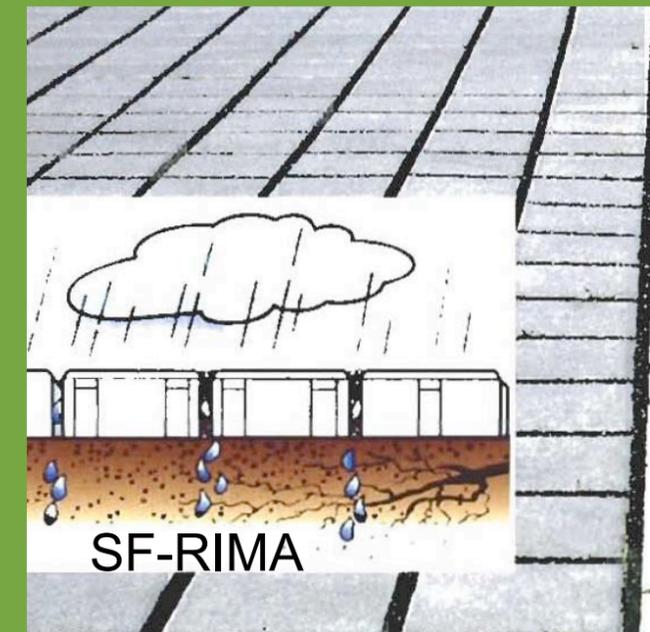


Chicago: Kennedy Expressway  
• Competition by Perkins and Will



Vancouver, BC: Pacific Boulevard, by Alan Jacobs  
• Green corridor with large urban trees for airflow  
• Green roofs and living walls control microclimate

# URBAN TREES and PERMEABLE PAVERS



- Porous pavements give urban trees the rooting space they need to grow to full size.  
(Bruce K. Ferguson, and R. France, Handbook of Water Sensitive Planning and Design, 2002)
- Large trees reduce ambient temperature by 9F (5C) by evapotranspiration and shading.

# COOL PAVERS and CONTINUOUS SOIL TRENCHES



Ithaca, New York: pavers with soil trench



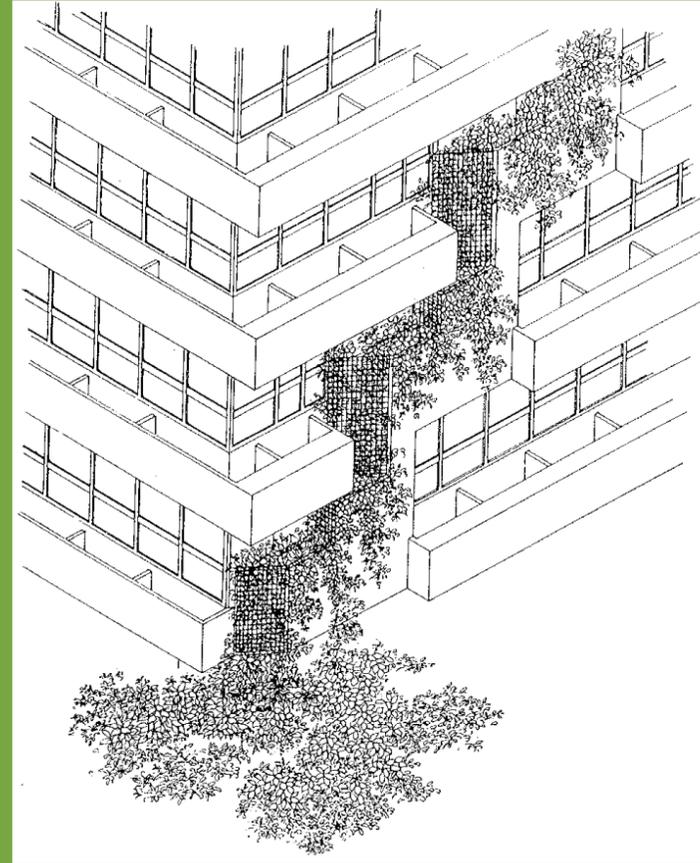
Berlin,  
by  
Daniel  
Roehr

- 5th Avenue, New York, trees are 100+ years. Trees store more than 2000 kg. of carbon.
- Durability and flexibility: These sidewalk pavers are 60+ years.
- Permeable pavers allow air, water and nutrients down to roots. Avoid sidewalk heaving.

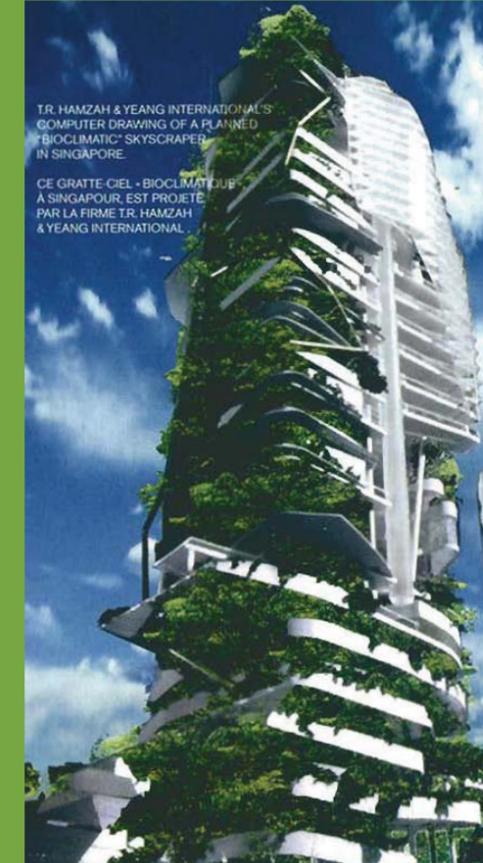
# BIOCLIMATIC SKYSCRAPERS, Ken Yeang, Architect



*Menara Mesiniaga, Malaysia, photo by Ken Yeang*



*IBM Plaza, Drawing by Ken Yeang*



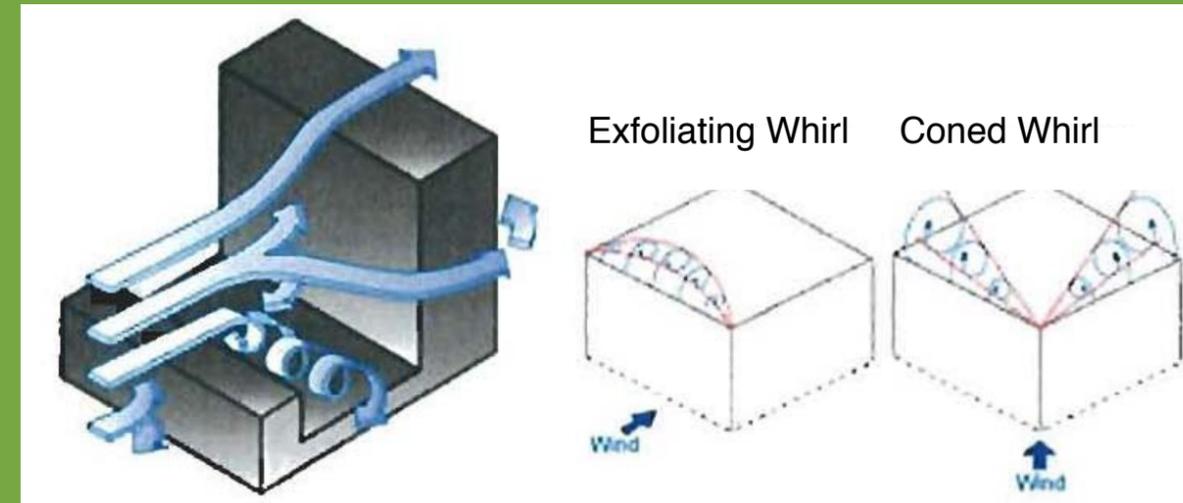
*Bioclimatic skyscraper by T.R. Hamzah & Yeang*

- T.R. Hamzah & Yeang design bioclimatic buildings for tropical and temperate zones.
- *Bioclimatic Skyscrapers* in Malaysia are a form of regional architecture.
- Lower building costs and energy consumption. Aesthetic and ecological benefits.
- Passive approach: sun shading, louvers, solar skycourts, terraces, wind catchers.
- Green roofs connected to the ground and to green corridors.
- Vertical gardens with water channels irrigate planters and green facades.

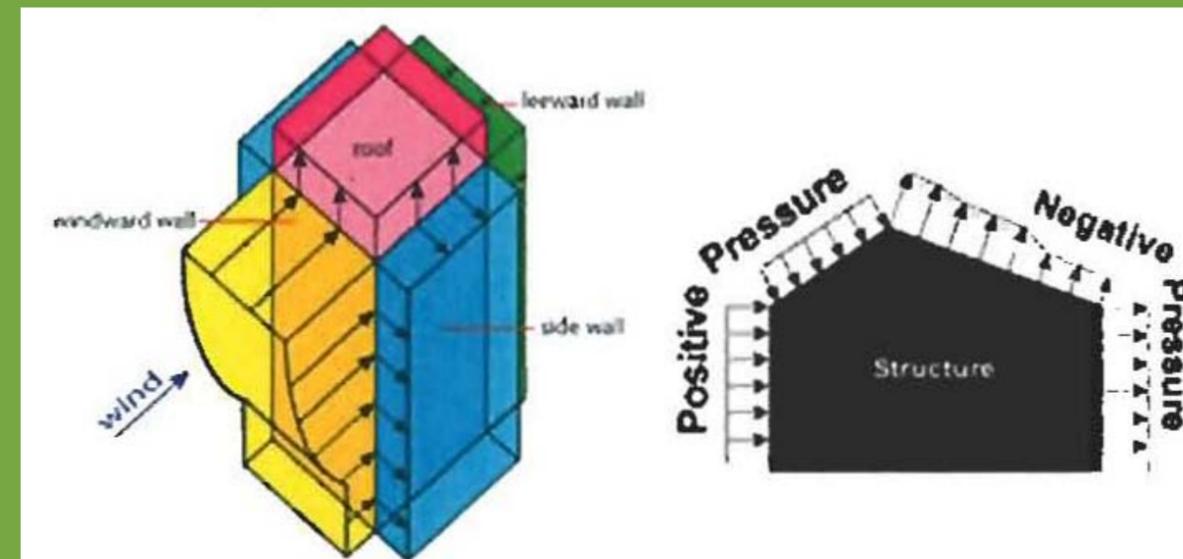
# WIND FLOW AND PRESSURE



Mumbai Residence, by Perkins and Will

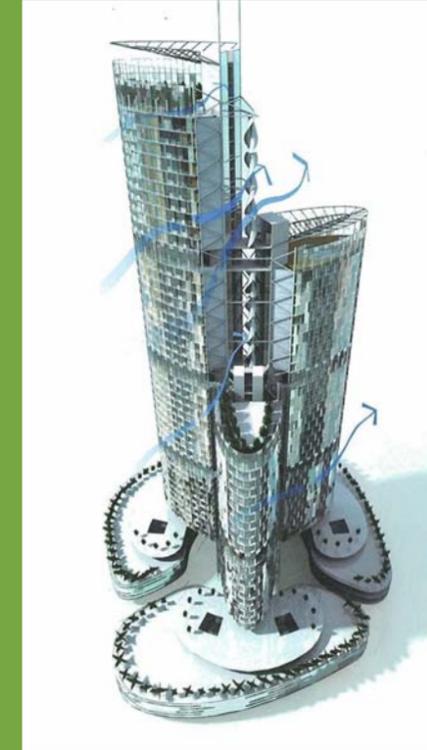
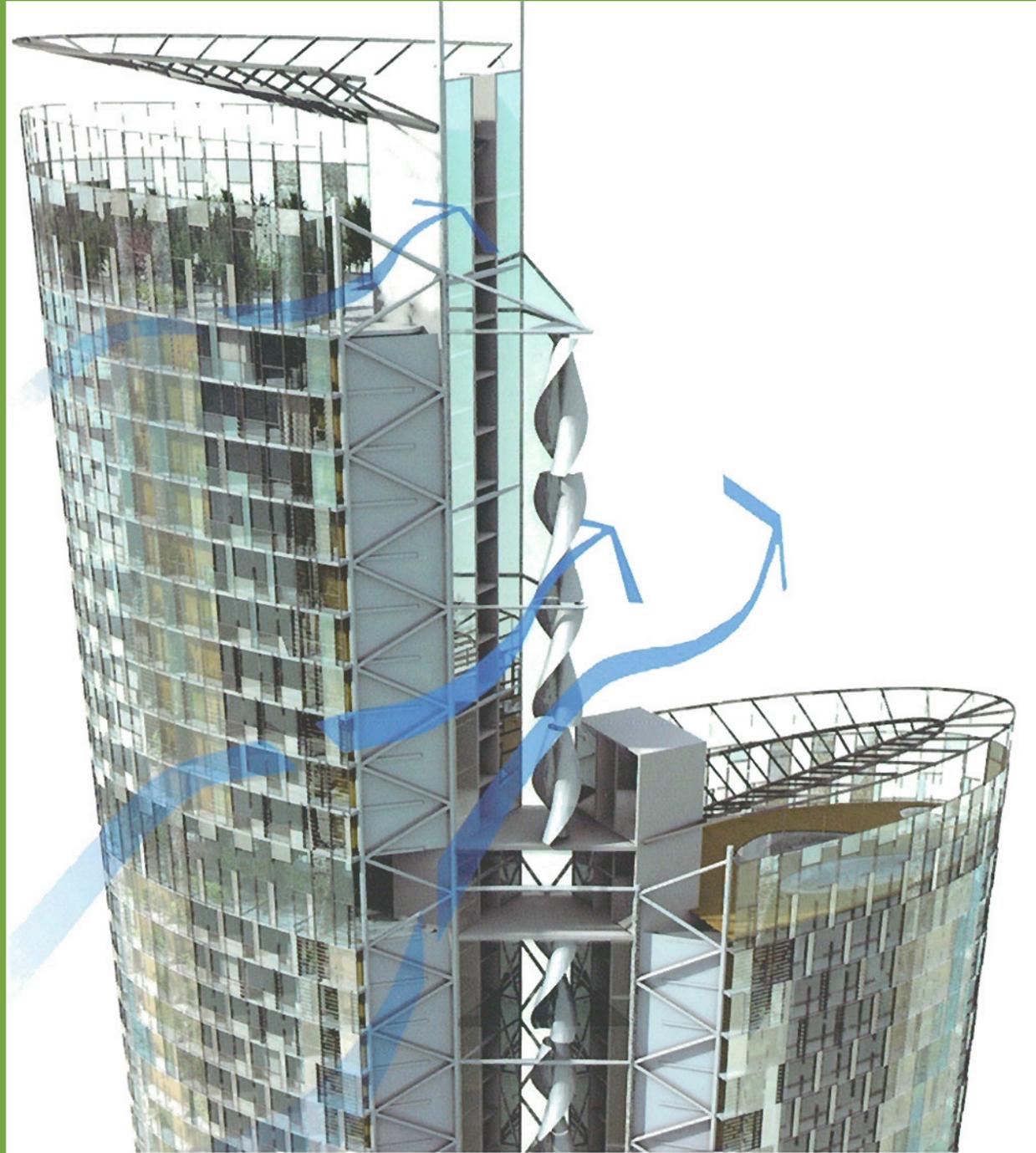


- Wind flow patterns around building
- Common problems that can fly objects off roofs



Pressure increases with altitude releasing thru roof and leeward walls Negative pressure strengthens the further it has to pass thru the bldg.

# CURVACIOUS BUILDING FORMS



Reading Sky House,  
Marks Barfield Architects

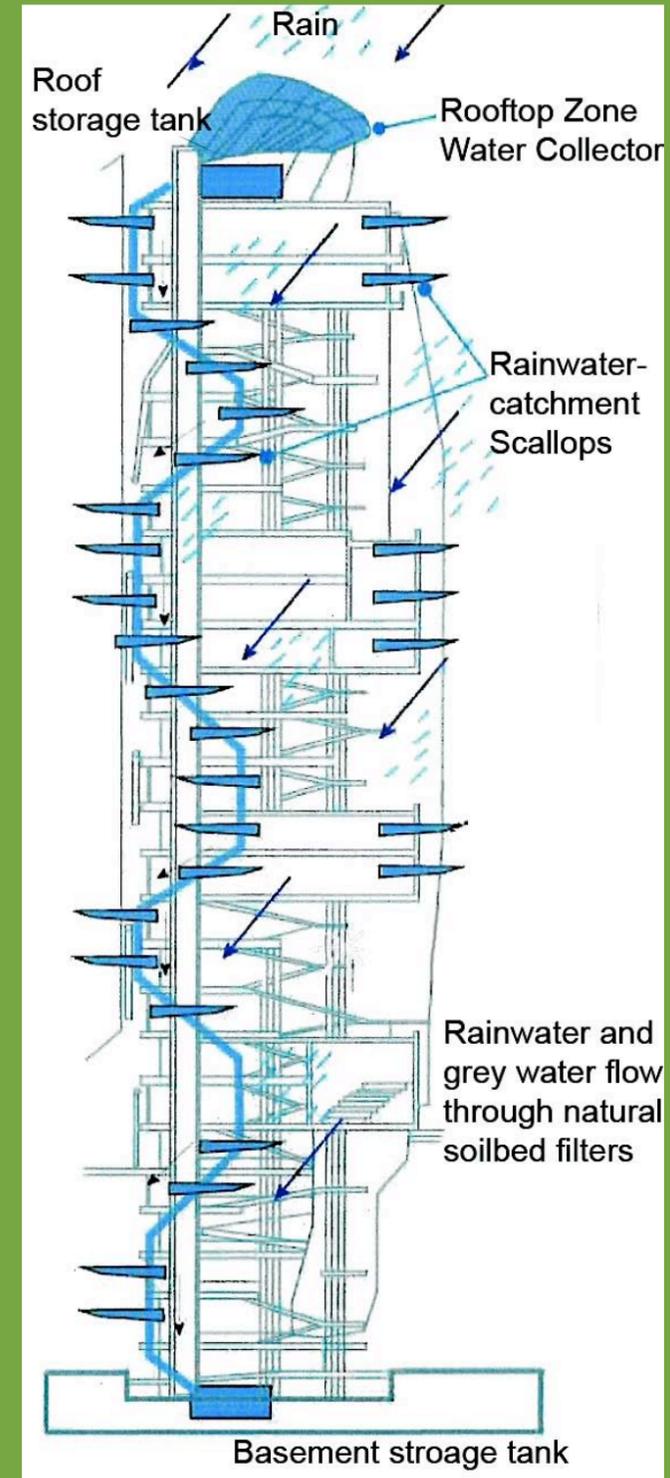


SkyZED William Dunster

# EDITT Building, Competition in Singapore



EDITT building, Hamzah & Yeang Architects



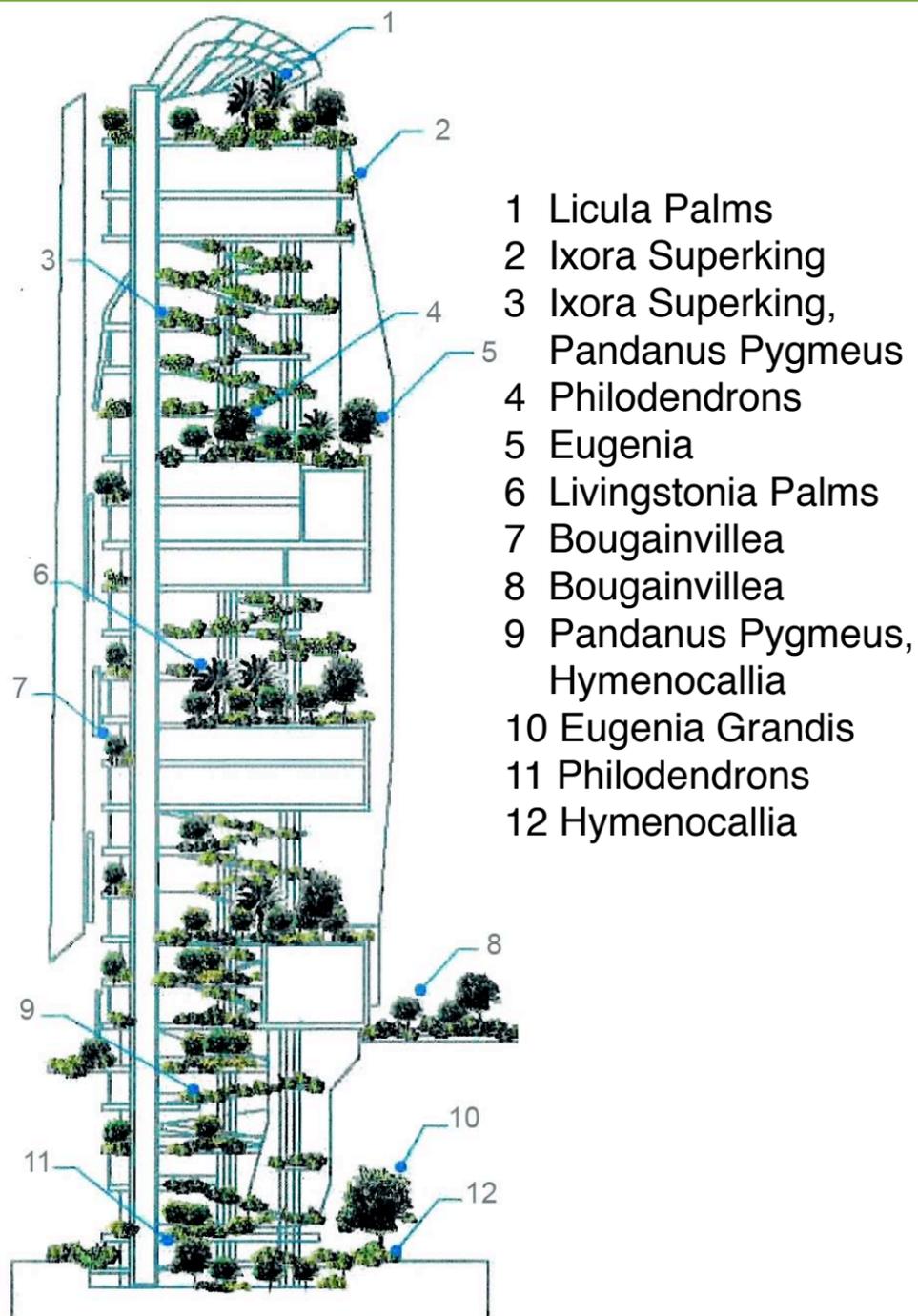
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# LIVING BREATHING BUILDINGS



EDITT, Hamzah & Yeang Architects



Living Machine by  
John Todd Ecological Design



Bougainvillea



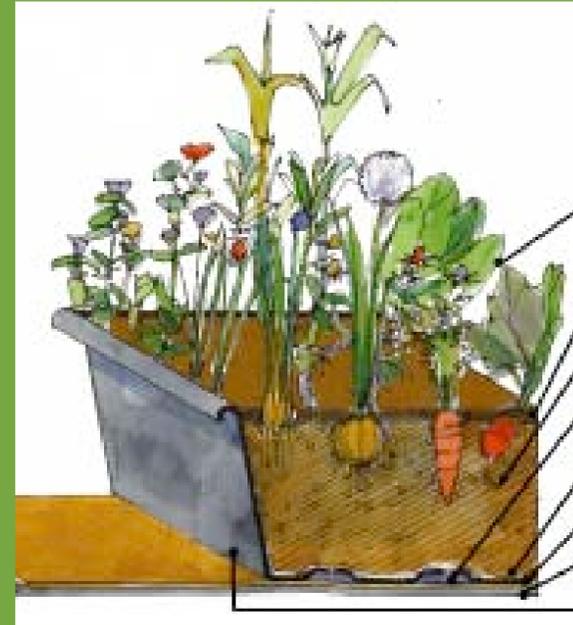
Philodendron

# URBAN AGRICULTURE / FOOD PRODUCTION



Atelier SoA Architects, AutoDesk display at greenbuild USGBC

Vegetables in Green Grid module with lightweight organic growing medium



Hot-house tomatoes on a vine



Lettuce on ELT Living Wall

# EXTENSIVE AND INTENSIVE GREEN ROOFS IN B.C.

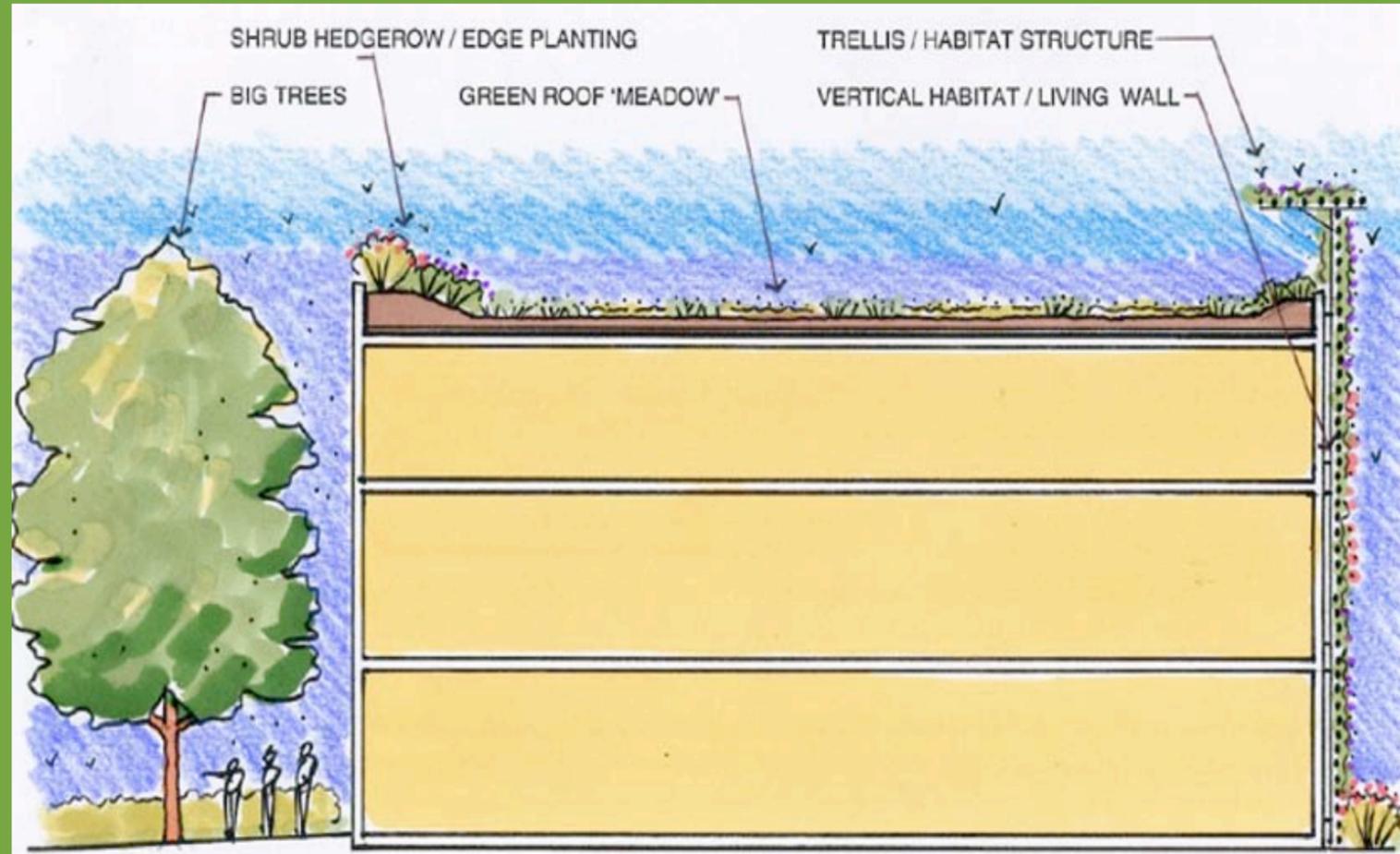


Top: Sechelt RCMP, Richmond Fire Hall

Bottom: Broadway Tech Centre, Vancouver



# GREEN ROOF CONNECTIONS / STRUCTURED HABITAT



- Vertical gardens, green facades and big trees.
- Green roof connected to ground and green corridors in the city.
- Shrub hedgerows and trellises support edge planting and habitat.
- Food, shelter and nesting for insects, songbirds, squirrels.
- Barren concrete walls with graffiti versus green walls.
- Sustainable methods are made visible.



Paul-Lincke-Ufer, Berlin, Photo Manfred Koehler

# GREEN WALL CONNECTIONS

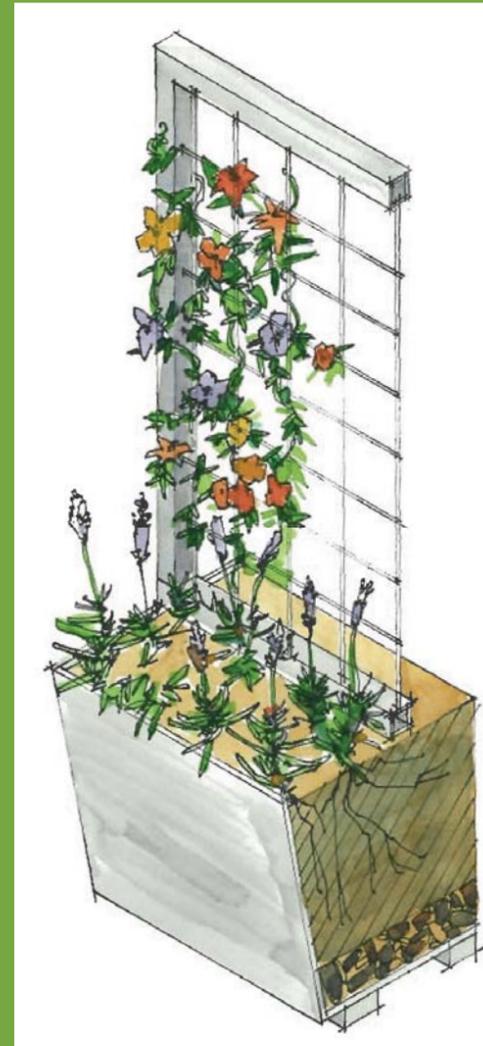


- Cables, metal structures and planters support climbers up to the green roof at Aldershof. Note permeable pavers at base.
- Pictures by Dr. Manfred Koehler, Univ. Applied Sciences, Neubrandenburg, Germany.

# FAÇADE GREENING



*Filderstadt parkade, Stuttgart*



*Living screen with planter*



*San Antonio Corporate Centre, Costa Rica Photo by Randy Sharp*

- Façade greening is a type of green cladding system.
- Structures or stainless steel cables hold plants away from the surface of the building.
- Climbers reduce solar heating, most effective on the walls that face the sun.
- Effective at trapping dust and pollutants in the air.

# CUSTOM STRUCTURES TO SUPPORT CLIMBING PLANTS



Glendale, California



River Rock Parkade, Richmond, BC

- By shading, climbers reduce daily temperature fluctuation by as much as 50%.
- A 10°F reduction on the wall saves energy for air-conditioning by 50 to 70 per cent.

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# GREEN WALL CONTAINERS



Photos courtesy of  
[www.G-SKY.com](http://www.G-SKY.com)

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# GREENSCREEN TRELLISING SYSTEM



Greenscreen is a three-dimensional, welded wire trellising system.

Photos by  
GREENSCREEN.com

- 1. Rockville, MD,
- 2. Tempe, AZ,
- 3. Orange Co, CA



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# GREENSCREEN INSTALLATION



[www.greenscreen.com](http://www.greenscreen.com)

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# GREENSCREEN PARKADE PLANTERS



[www.greenscreen.com](http://www.greenscreen.com)

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# GREENSCREEN 'TREES' FOR ROOFDECKS



GREEN WALLS and GREEN TOWERS



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# GREEN WALLS and WILDLIFE

[www.greenscreen.com](http://www.greenscreen.com)



PLANTING TO CREATE WILDLIFE HABITAT:

National Wildlife Center, Reston, VA



PLANTING TECHNIQUES TO DISCOURAGE WILDLIFE:

Avoid food source, shelter, woody debris, or standing water. Prune climbing plants every one or two years if required.



A 'clean' landscape with a gravel strip around the base of a building, and the use of rock mulch or decomposed hemfir bark generally do not attract wildlife. These techniques reduce maintenance, water consumption and potential fuel for fire.

# STAINLESS STEEL CABLES and WEBNETS



Jakob Inox: cable and webnet systems,  
[www.jakobstainlesssteel.com](http://www.jakobstainlesssteel.com)



Carl Stahl  
Decorcable: cables  
and webnets,  
[www.decorcable.com](http://www.decorcable.com)



## GREEN WALLS and GREEN TOWERS



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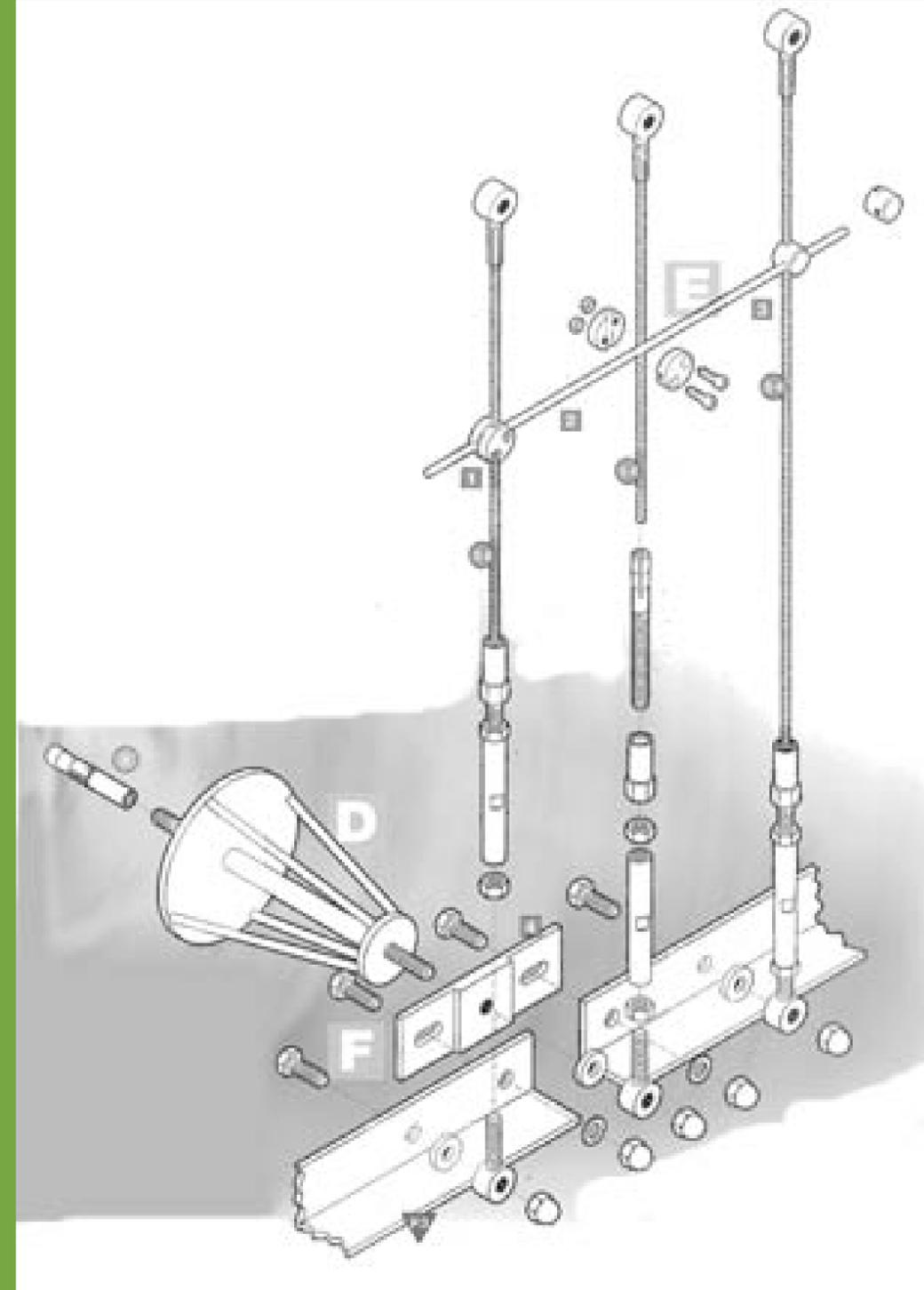
# STAINLESS STEEL CABLE SYSTEMS



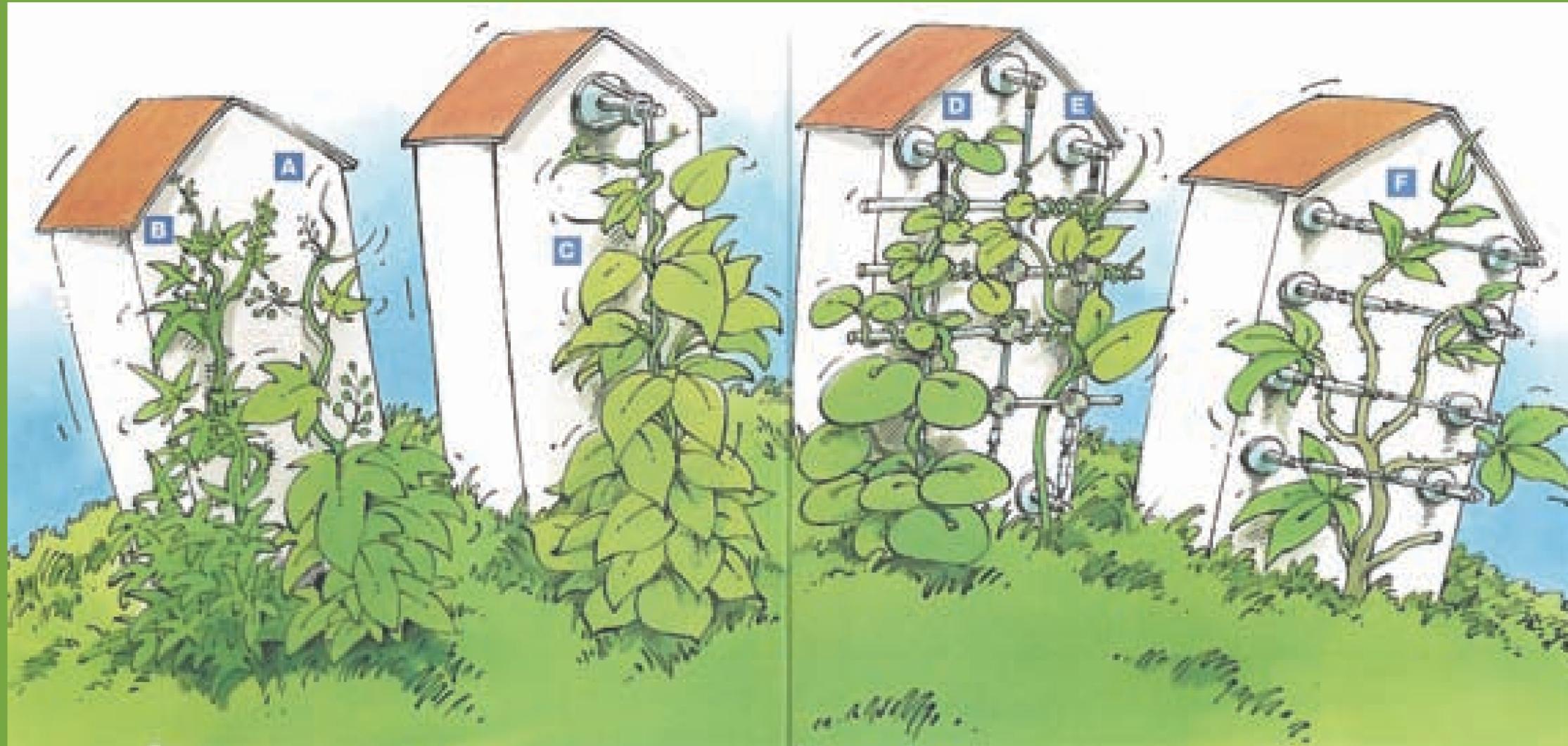
Horizontal rods combined with vertical wire ropes (stainless steel cables) result in well spaced training structures.



[www.jakobstainlesssteel.com](http://www.jakobstainlesssteel.com)



# JAKOB Climbing Patterns / Training Systems



[www.jakobstainlesssteel.com](http://www.jakobstainlesssteel.com)

**A** Adhesive-Sucker Climbers

**C** Vines

**D** Leaf-Stem Climbers

**E** Leaf Climbers

**F** Scrambling Plants

**B** Root Climbers

# CLIMBERS AND TRAINING SYSTEMS



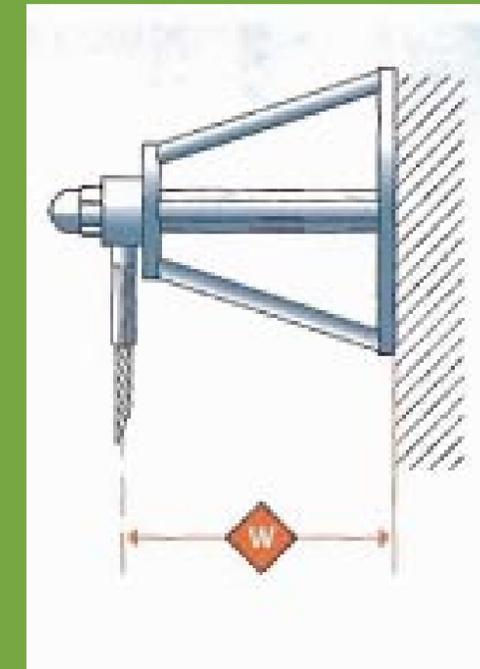
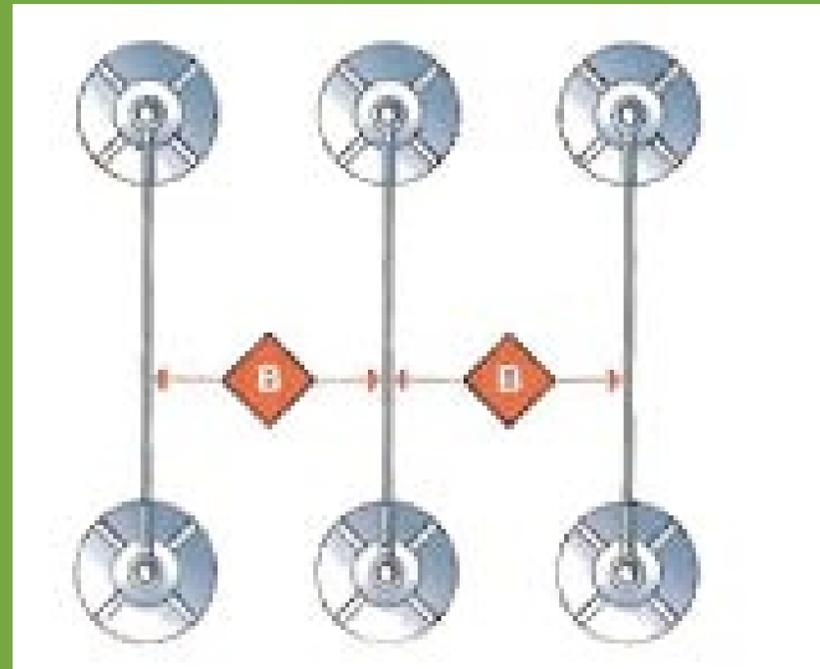
Wisteria  
Honeysuckle  
Hops



Clematis  
Nasturtiums

**C** Vines / Vigorous Climbers:  
Width (W) out from the wall is approximately 6" (150mm), spacing (B) is 16 - 32" (400 - 800mm)

**D** Leaf-Stem Climbers:  
Width (W) out from the wall is approximately 3" (80mm), spacing (B) is 8 - 16"



[www.jakobstainlesssteel.com](http://www.jakobstainlesssteel.com)

# CLIMBERS AND TRAINING SYSTEMS

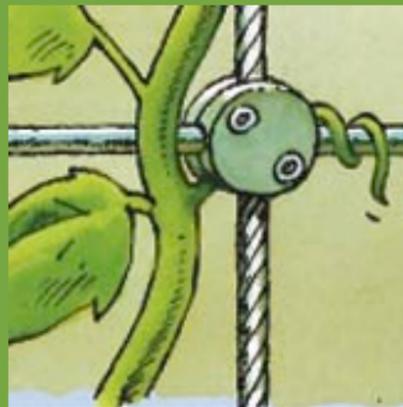


Passion flower  
Grape vine  
Ampelopsis

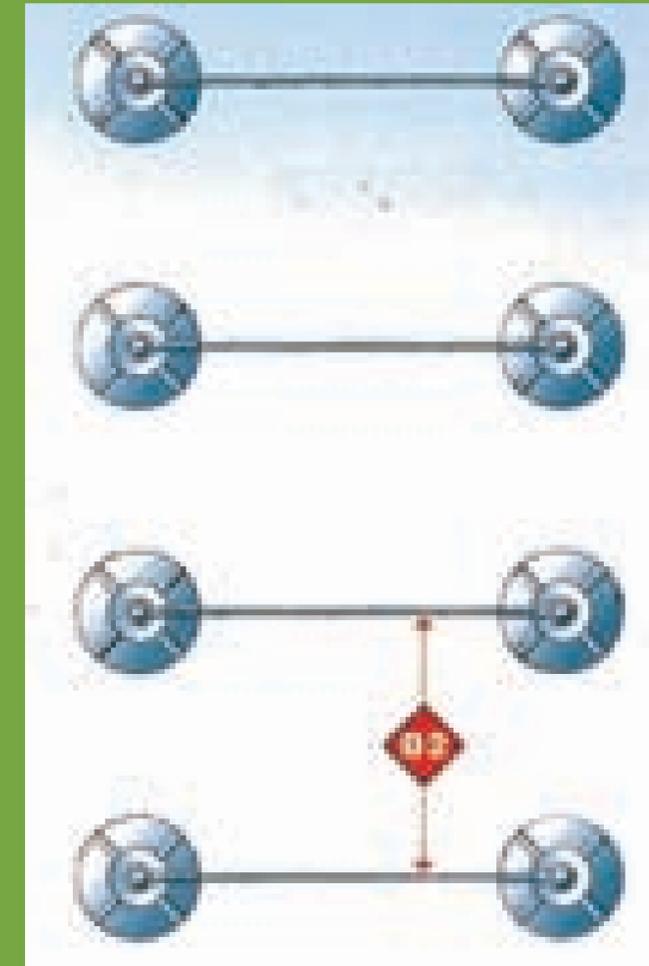
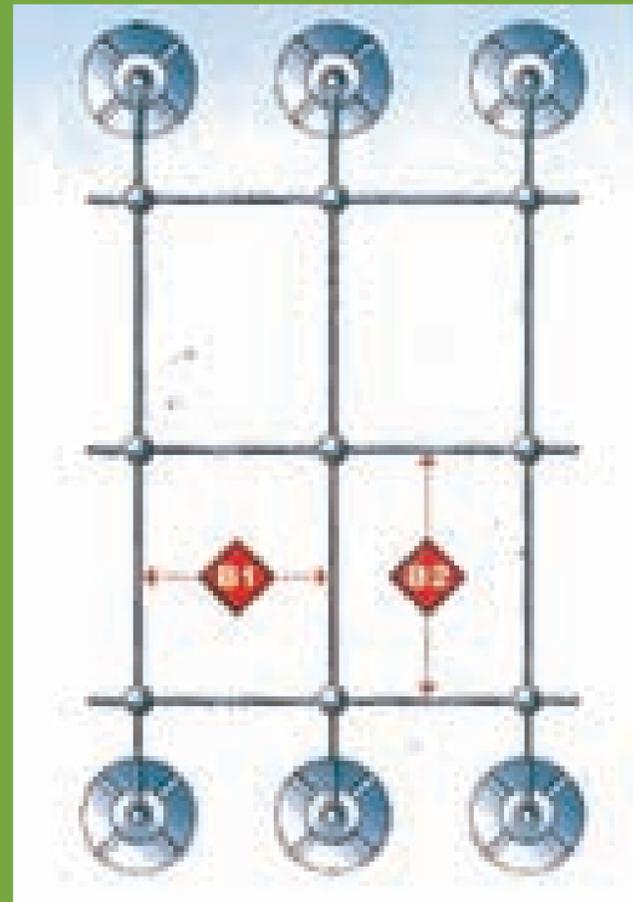


Roses  
Winter flowering  
jasmine

## E Leaf Climbers



## F Scrambling Plants

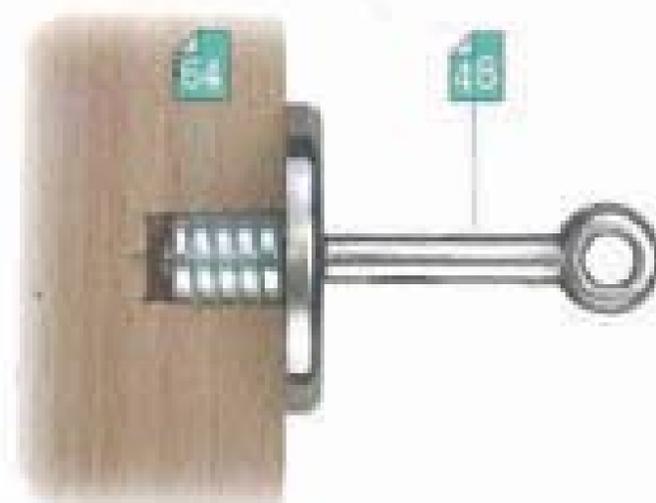


Source: [www.jakobstainlesssteel.com](http://www.jakobstainlesssteel.com)

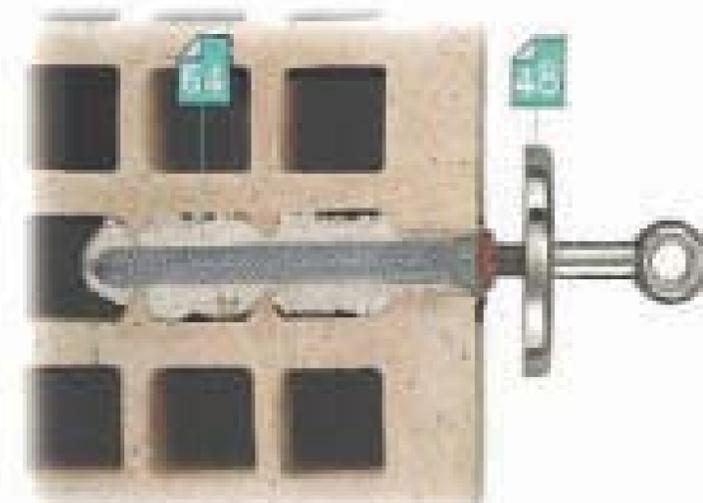
# INSTALLATION of Wall Mounting Spacers for Cable and Webnets



Through hole in wood



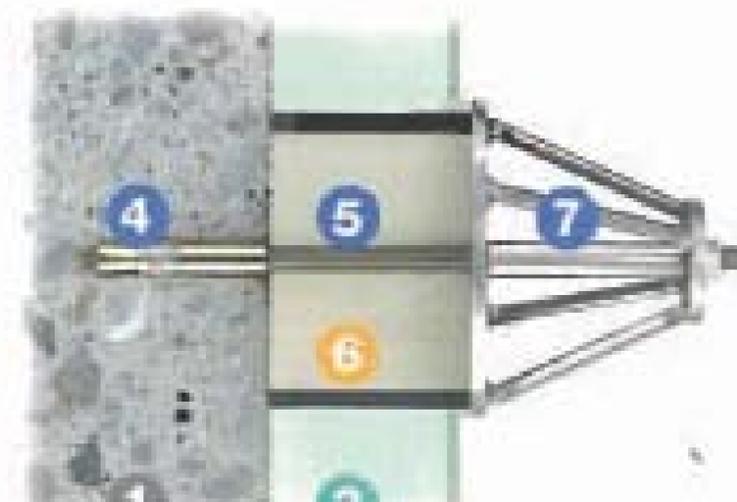
Screw in nut for wood



Perforated hollow wall anchor



Bolt anchor with internal thread



Externally insulated facades, seal gap with silicone putty

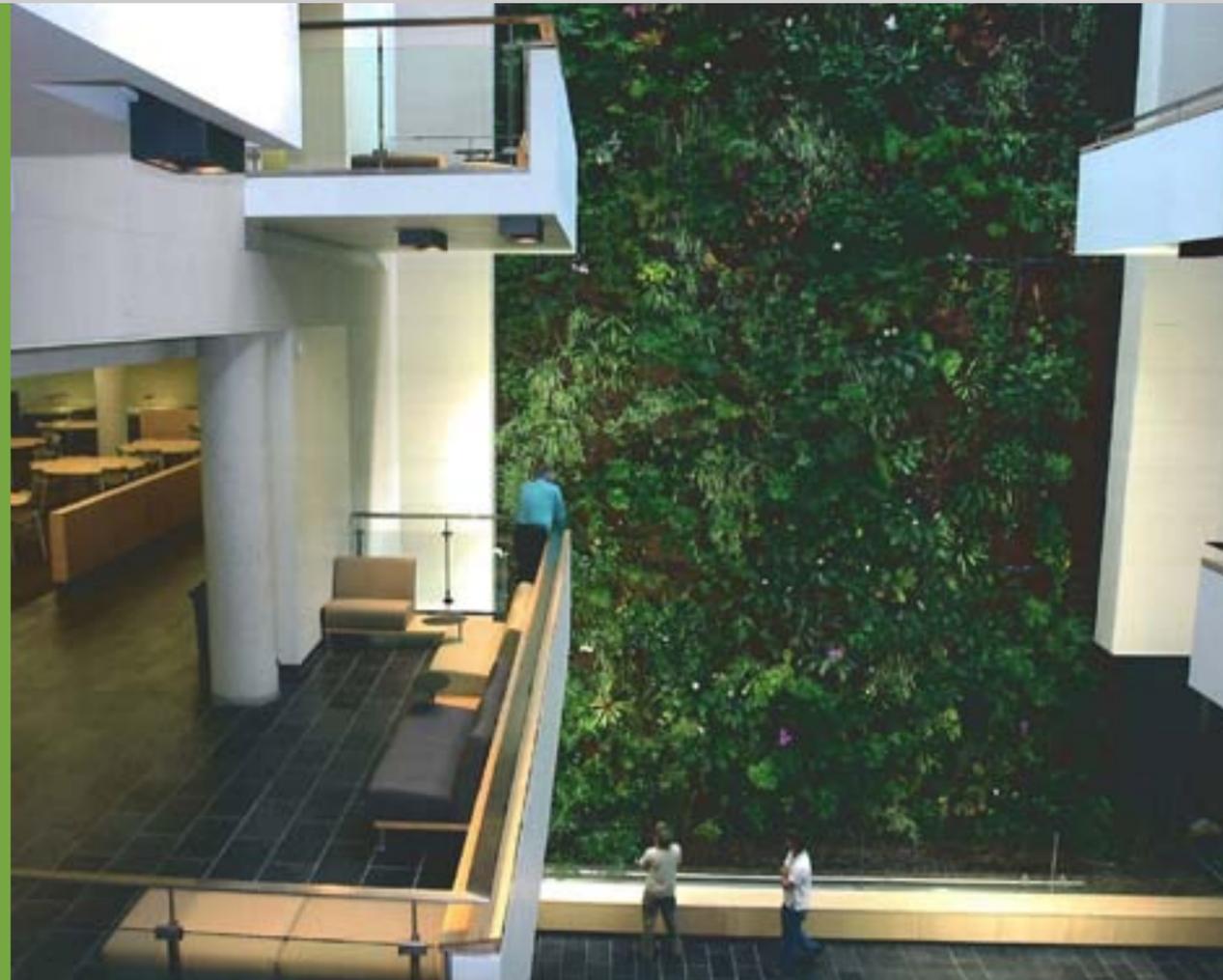
# LIVING WALL in PARIS by Patrick Blanc, Botanist



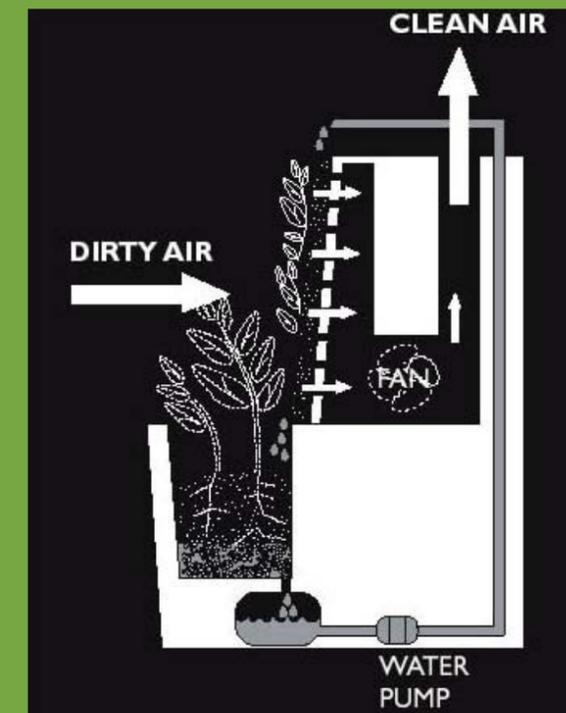
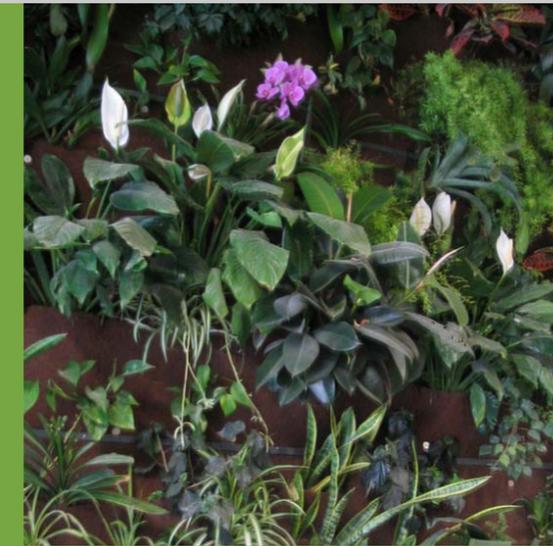
*Photos by Nick Page*

- Le Musée du Quai Branly features plant diversity and good coverage.
- The living wall is external to the structure of the building. PVC membrane behind.
- A felt blanket is attached to a steel face, with constant irrigation and nutrient supply.

# BIO WALL



Humber College,  
University of Guelph,  
Naturaire Systems



Images courtesy of  
Quality Air Solutions,  
[www.naturaire.com](http://www.naturaire.com)

- VOCs (volatile organic compounds) are released into the air by textiles, paints, wood finishes and electronic devices in buildings.
- By phytoremediation, the plants naturally break down benzene, tolyene and formaldehyde. Microbes in the biofilm around roots and on the synthetic fabric degrade pollutants.
- The fabric growing medium is porous and soil free. A fan draws air through the wall, Clean air is distributed by a mechanical ventilation system

# ELT Easy Green Living Wall System



Wall sections



Vertical gardening

Lighthouse Sustainable Building Centre, Granville Island

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# MOSS WALLS / FOAM CORE CLADDING SYSTEM

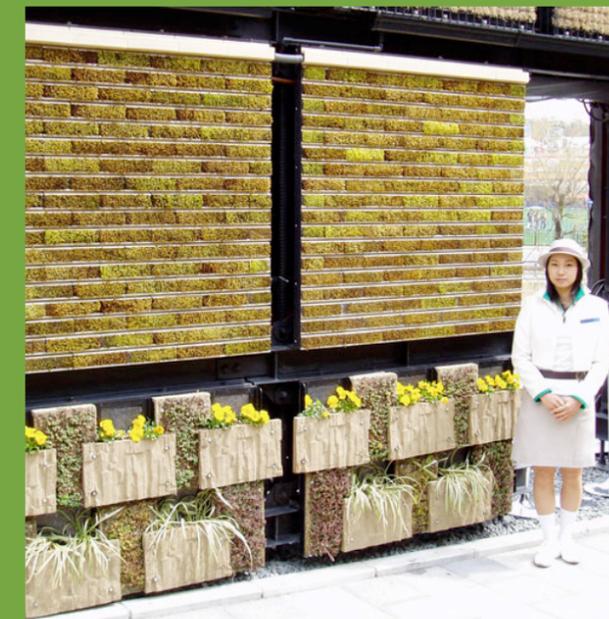


Illustration by Dick Bruna, [www.miffy.com](http://www.miffy.com)

Mos Wall at Bio Lung, Expo 2005, Aichi, Japan



Mos Wall



# BIO LUNG, World's Largest Green Wall

Expo 2005 in Aichi Japan featured the the 'Bio Lung'. 500' in length by 40' high, the double wall featured 30 systems by 18 companies.



Photos courtesy of  
[www.G-SKY.com](http://www.G-SKY.com)



# VANCOUVER AQUARIUM - A CASE STUDY

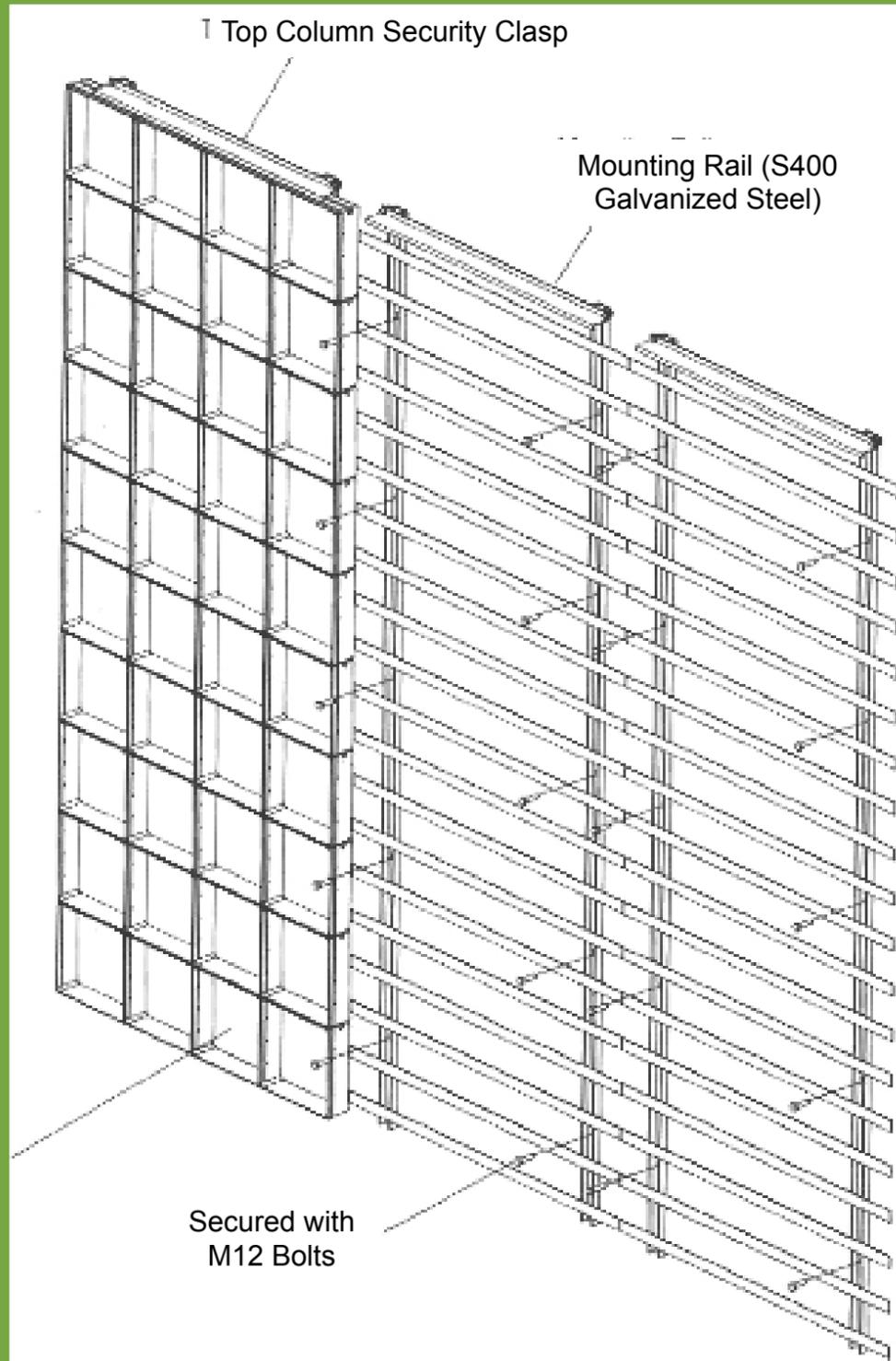


Rendering by Greg Davies, Vancouver Aquarium

- Aquaquest Learning Centre, Vancouver Aquarium
- Completion September, 2006 • LEED® Gold registered
- Rainwater is collected off the white TPO roof and stored in cistern for fresh water fish tanks, flushing toilets and supplemental irrigation for the Living Wall.

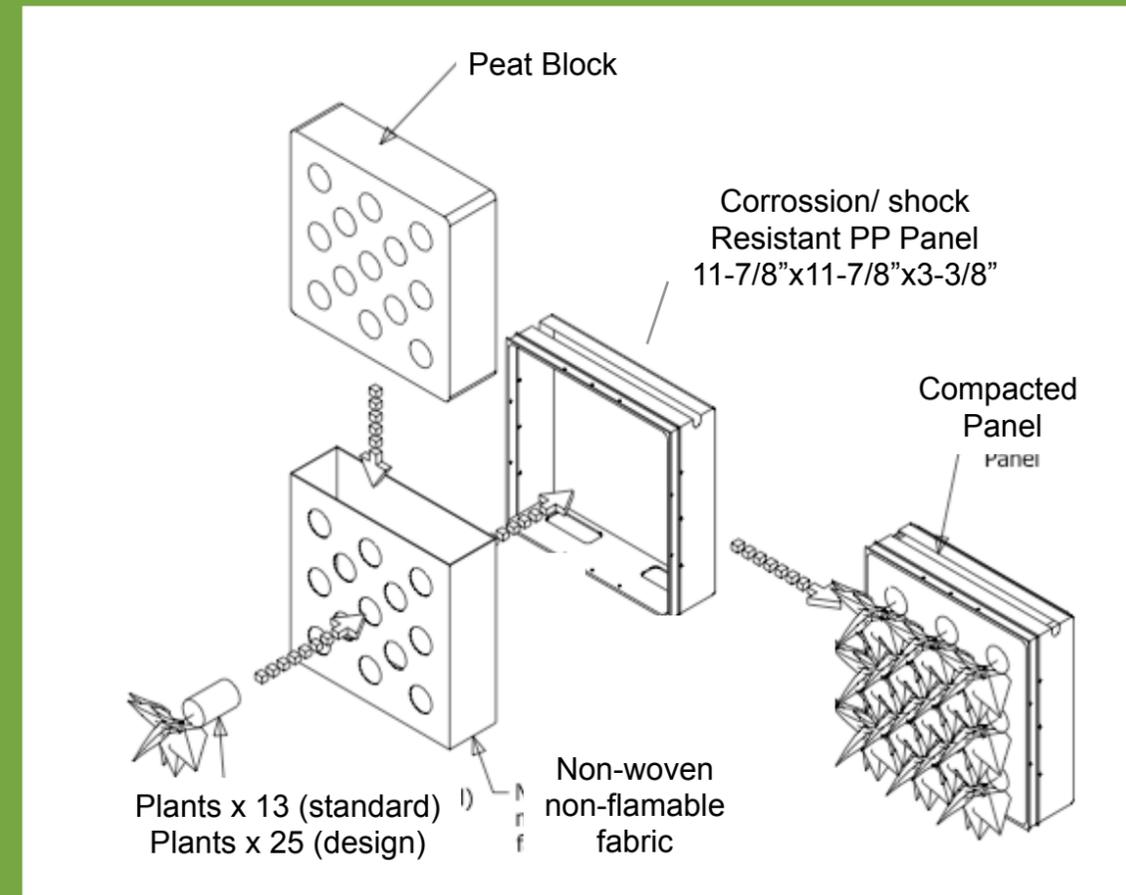
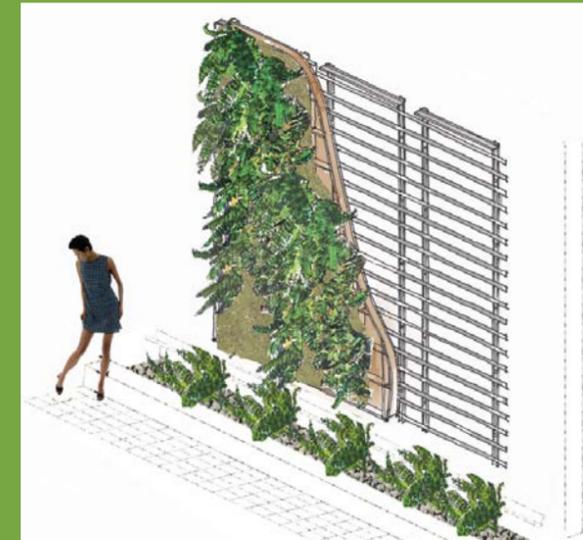


# GREEN WALL DETAILS



Diagrams courtesy of  
[www.G-SKY.com](http://www.G-SKY.com)

Photoshop / Sketch by  
Sharp & Diamond  
Landscape Architecture



# GREEN WALL PANELS IN THE GREENHOUSE



Peat block with non-woven fabric and straps



# GREEN WALL INSTALLATION



1. Fasten frame to wall

2. Deliver panels from Greenhouse

3. Place panel and 4. Drip irrigation

- Green wall installation at the Vancouver Aquarium east wall, Vancouver, BC
- 50' length, 10' height, 500 panels. Installed in two days, September, 2006

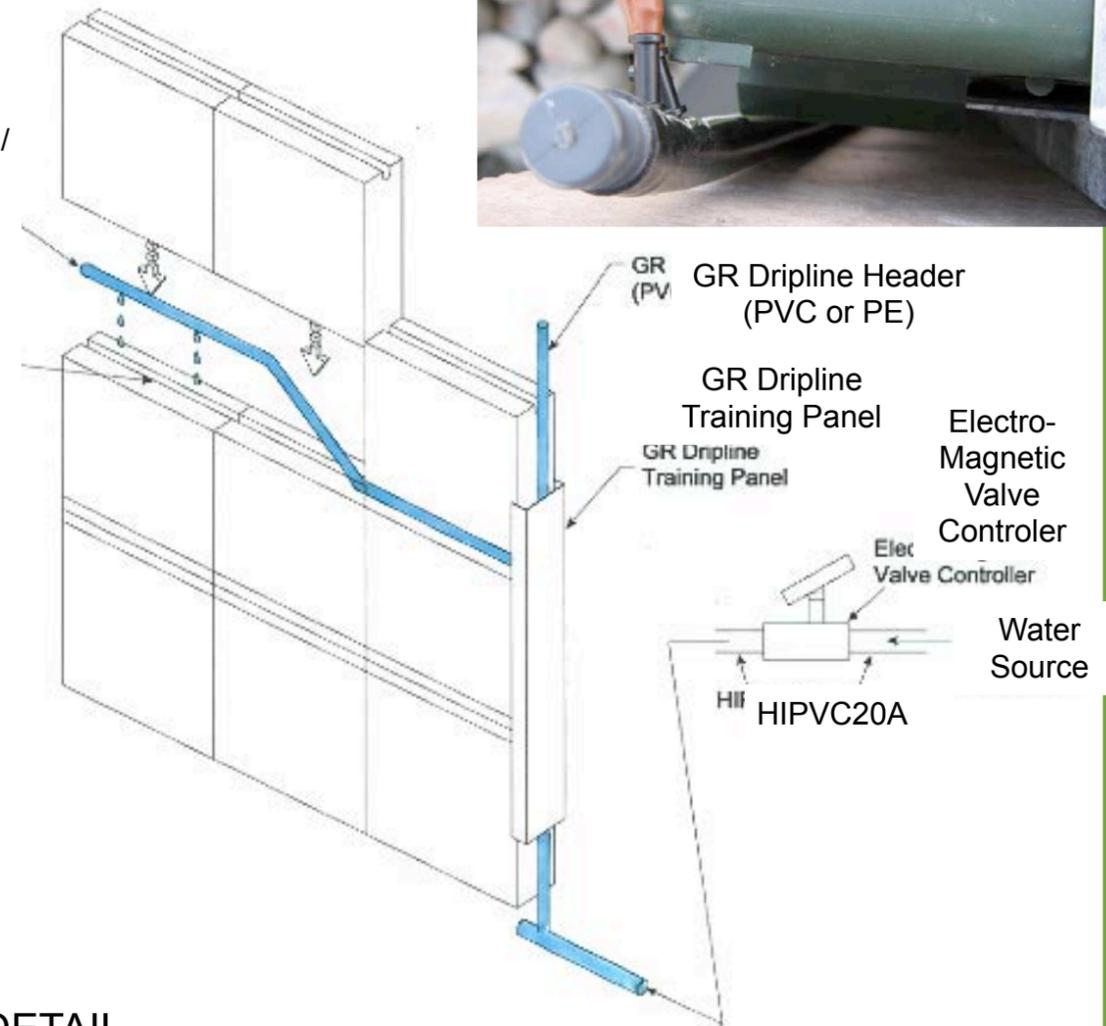
# GREEN WALL IRRIGATION SYSTEM



Diagram, Photos courtesy of  
[www.G-SKY.com](http://www.G-SKY.com)

GR Dripline  
dia 8 - 6.5mm  
Emitter every: 150mm/  
5-3/4"  
Flow rate: 0.9 GPH/  
2.7 LPH

Line is inserted  
along guidelines



IRRIGATION DETAIL

# GREEN WALL INSTALLATION



## Native Plant List:

Licorice Fern (Polypodium)  
Spiny Wood Fern (Dryopteris)  
Woodland Strawberry (Fragaria)  
Bleeding Heart (Dicentra)

Fringecup (Tellima)  
Foamflower (Tiarella)  
Wintergreen (Gaultheria)  
Evergreen Huckleberry (Vaccinium)

# GREEN WALL INSTALLATION



# LIVING WALL at the Vancouver Aquarium



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