Soft House

Kennedy & Violich Architecture, Ltd.

Soft House

IBA Internationale Bauausstellung Hamburg

The SOFT HOUSE project in Hamburg, Germany is a winning competition entry designed by an American Architecture firm for the International BauAustellung (IBA). With federal, municipal and community support, the IBA is a prestigious German building tradition that began in 1901 and commissions built architecture as a means to explore new forms of urban development.

The 2013 IBA Hamburg focuses on new ideas for carbon neutral living on Wilhelmsburg Island, south of Hamburg Port. Completed in June, 2013, the 'Soft' House is a set of four live/work row housing units constructed with a traditional and locally made solid-wood structure that can be completely recycled at the end of the buildings' life. Each dwelling unit of 224 gross square meters has three points of entry, enabling owners to subdivide and rent the ground floor, or use it as a workplace. The four Soft House units will be sold by IBA development partners and occupied in late Fall 2013 at the conclusion of the exhibition.

The Soft House is an 'active' house that transforms timescales in architecture. In the Soft House , the architectural shell is simple, solid and enduring. Domestic clean energy, lighting, and space-making elements become more like furnishings—mobile, interactive, upgradable and connected to the wireless Soft House network, a smart building management system. The Soft House demonstrates how domestic infrastructure can become 'soft'—engaging carbon-neutral solid wood (brettstapel) construction, design for flexible living, and wireless building controls with a responsive textile infrastructure which establishes the new public identity of the architecture. The Soft House meets–and exceeds–rigorous German PassiveHaus environmental standards—and transforms the rigid Passivehaus typology to create an adaptable carbon neutral dwelling that can be personalized to meet changing homeowner needs.

Integration of Infrastructure & Architecture

The SOFT HOUSE energy harvesting façade is the first demonstration of a soft, two axis solar tracking architecture. Adjustments to the responsive façade are made seasonally and daily via the Soft House Building Management System. A pliable, spring-like structure of fiber reinforced composite boards adjusts to optimize the seasonal solar angle of thin-film flexible photovoltaics. Daily east-west sun tracking is achieved with textile 'twisters' rotated with a winch/servo, drawing upon the region's local maritime industries. Energy harvested from the soft façade is distributed inside the units for E-vehicle charging, pumping ground water in the radiant floors and powering energy efficient solid state lighting in interior curtain partitions. The material transformation of historically 'hard' energy infrastructure in the responsive soft façade creates a series of spatial and functional climate layers that are experienced from outside and inside the dwellings. A rich range of dynamic shade and sunlight effects are created from a very simple architectural elevation.

Flexible Living

The Soft House offers home owners the flexibility to adapt their homes to fit changing needs and comfort preferences. The energy harvesting textile façade adjusts to follow the sun and shade the building, allowing generous views to the south overlooking the canal. The design establishes a natural ventilation chimney as a central vertical spatial feature that connects living levels, and brings natural daylight deep into the row house floor plan. Homeowners can move reflective interior curtains with energy efficient solid state lighting (LEDs) to sub-divide space, and create local thermal micro-climates. Programmable LED light moves through the Soft House curtains in relation to real-time exterior wind levels-- creating a Visual Breeze— an ambient interior luminous expression of the external environment. The interior domestic 'landscape' of movable and luminous curtains is playful and engaging by design—allowing people to make new connections between the domestic and natural environments.

KVA mat

BUILDING TYPE
Row House
New Construction

LOCATION
Hamburg, Germany

DATE
2008 – April 2013

SIZE
920 sq. meters

SALE PRICE
€450,000 each unit

IBA Site Context

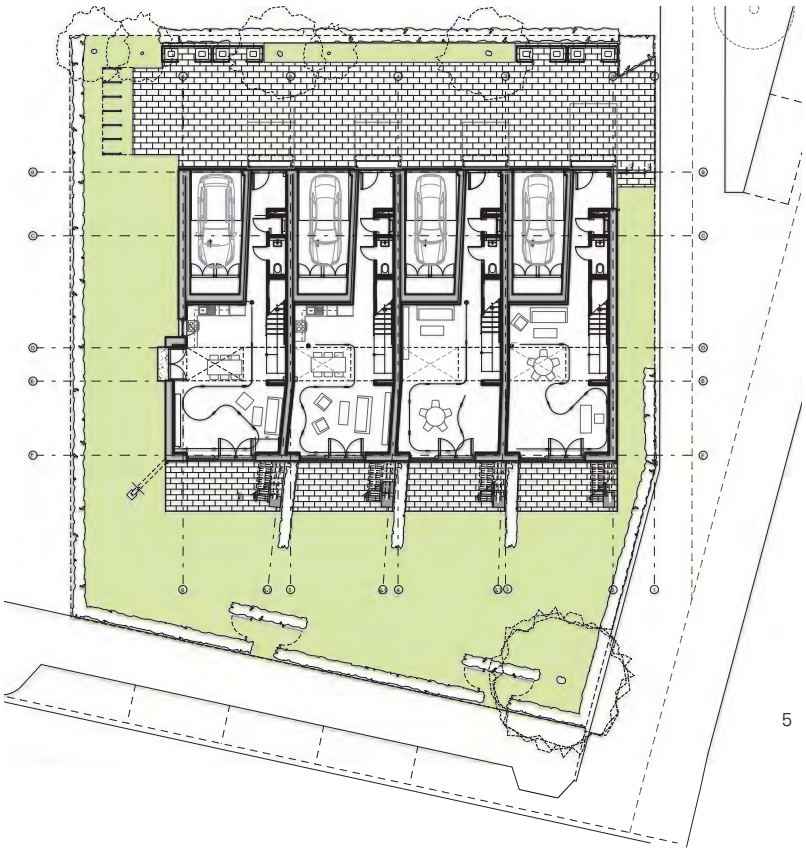
2

3

4

IBA Site Context
The site is located on the southern edge of Wilhelmsburg adjacent to a new canal and park lands. The Soft House site plan is based on the traditional linear polder (farm) and garden plot and includes parking for bicycles and EV's, a raised terrace overlooking the new Park lands and a vegetable garden. Access from garden and terrace, and from the rear enables flexibility for rental and working space.

The site layout adapts the traditional German polder – or linear farm – to support homegrown food production with Individual garden plots.



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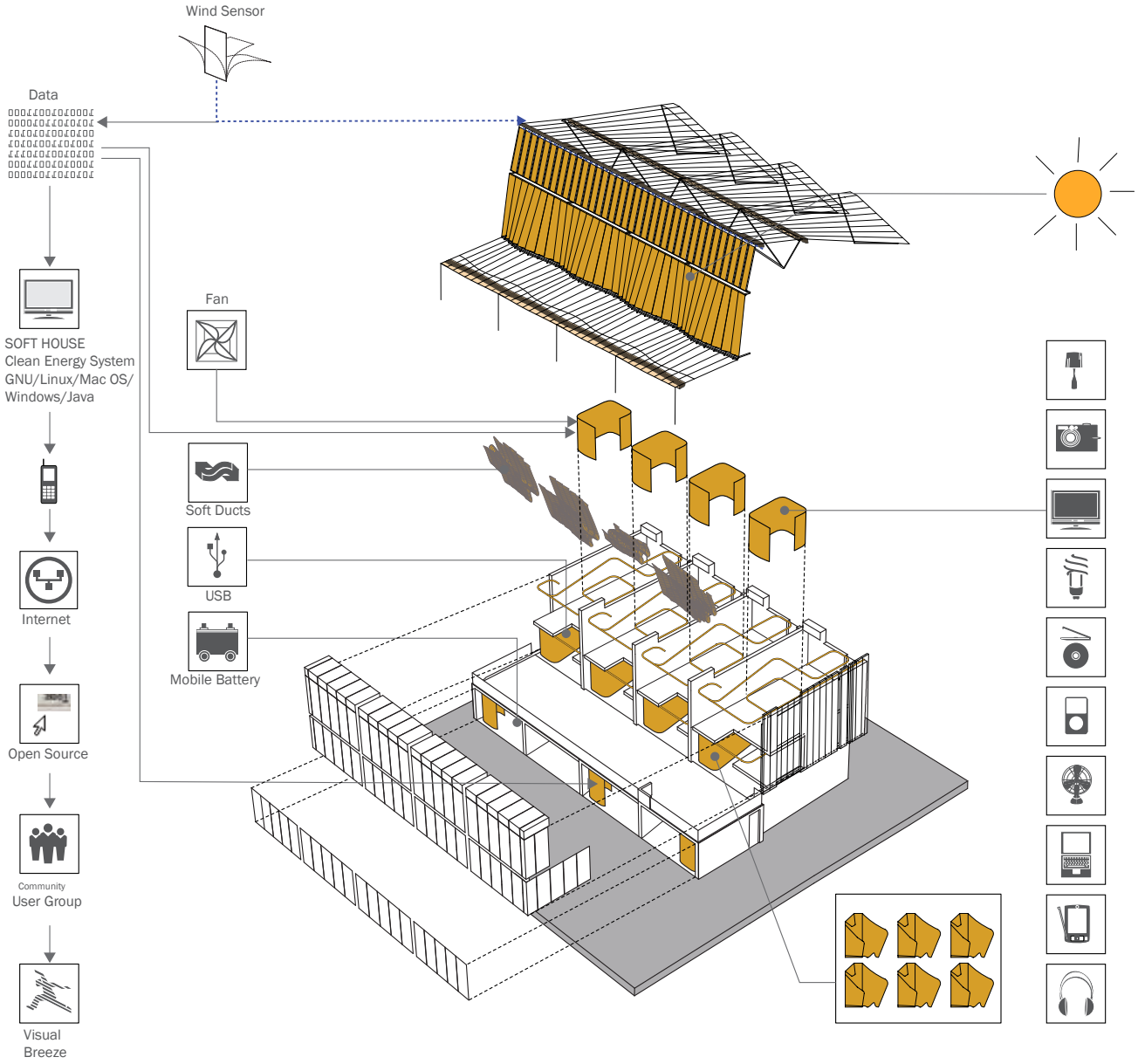
1 View of Soft House from the West
2 IBA Site Plan
3 Soft House Site Plan
4 Soft House at night from the canal
5 Ground Level Plan

Responsive Energy Harvesting



Responsive Energy Harvesting

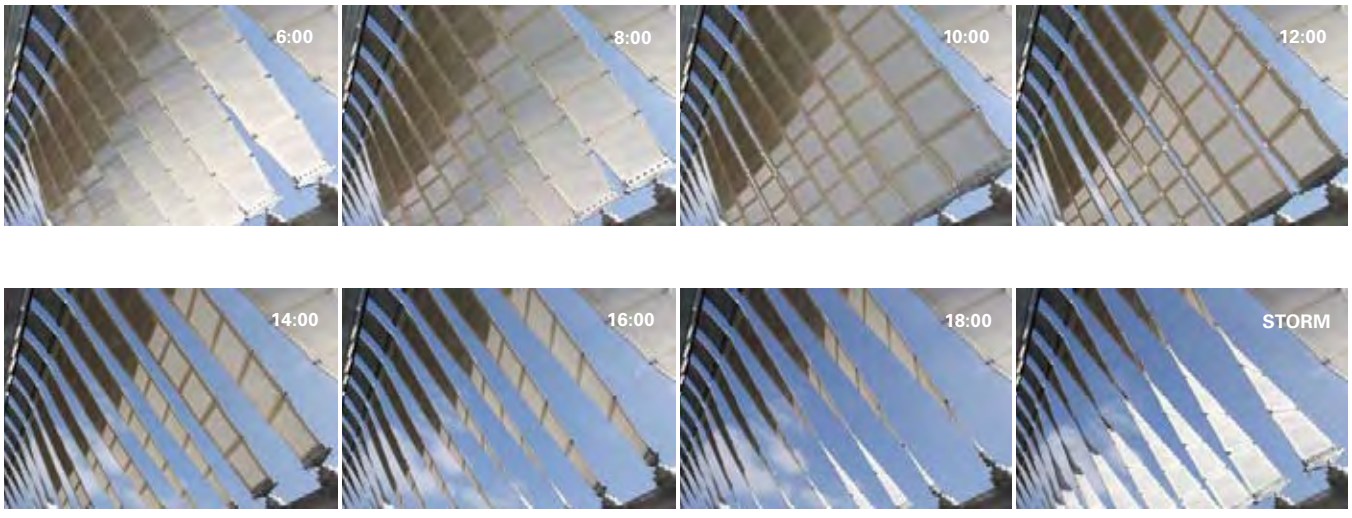
Like a sunflower, the Soft House façade moves to capture the maximum available solar energy to power the housing units. Flexible photovoltaics in textile 'twisters' are attached to flexible fiber composite boards on the roof, offering shape adaptation for daily and annual seasonal sun tracking –creating the first 2-axis soft solar tracking system. The clean energy is monitored by the Soft House smart building management system (BMS) in an innovative DC low voltage network that powers EV's, radiant floor water pumping and energy efficient LED lighting.

Above - Smart Building Systems Axon

Below - Model Timelapse of seasonal twister postions

Above - View of the Twisters from the upper terrace

Below - Twister positions throughout the day



Energy and Carbon Information

ENERGY METRICS

- Predicted Energy Use Intensity including on-site renewable energy: 95 kWh/m^2/yr
- Predicted Energy Use Intensity excluding on-site renewable energy contribution: 67 kWh/m^2/yr. The solar contribution is 28 kWh/m^2/yr
- A multifamily residence in the Northeastern United States has an average EUI of 182.3 kWh/m^2/yr
- Exceeds German Passivhaus energy and environmental standards (Passivhaus certified).

ADDITIONAL INFORMATION

Urban District-Level Clean Energy

- Wilhemsburg is powered by multi-source district-level renewable energy strategy initiated by the city. The Soft House block receives clean energy from a nearby landfill gas (methane) plant.
- Government initiated clean-energy development is now reduced due to the economic crisis. This makes on-site generation a more important component of carbon emission reduction.
- On-site power generation is flexible. Owners have the option to sell stored energy back to the grid at peak hours.

Transportation and Walkability

- The site is well served by public transportation within 150 ft, and a S-Bahn station within one-half mile.
- Each unit supports 4 bikes and one e-vehicle.
- The new IBA development has lifted the Walkscore of the Wilhelmsburg neighborhood to 80.
- The Soft House faces a traditional canal system which is used for recreation and transportaion.

Low-Carbon Flexible Photovoltaics

- Shared energy harvesting infrastructure provides 9,600 watts x 7 hours a day on average: over 24,000 kWh per year.
- Flexible Photovoltaics reduce emissions in manufacturing by 40% when compared to glass PVs, and save on carbon use because of the roll-to-roll production process.
- The larger solar aperture of flexible PV materials means that more energy is harvested in partly sunny of cloudy days.

Smart Shading Maximizes Energy and Views

- The daily motion of the twister system follows the sun, providing shading for the building and maximizing the energy harvested while preserving views.
- The translucent textile of the twisters diffuses high-angle sunlight in the summer and allows shallow winter light to pass below.
- By following the sun's daily East-to-West path and making seasonal adjustments, the efficiency of the PVs increases 15%.

Innovative Low-Power, Clean-Energy Direct Current (DC) Ring

- The responsive PVs power a DC grid that provides energy to Smart Curtains and other domestic appliances.
- By avoiding DC-to-AC converters, the grid design increases the total PV electrical output by 15%.
- The DC Ring is mounted on the wood ceiling rather than buil t into walls, eliminating material waste in infrastructure updates.

Energy Efficient Solid State Ambient Light

- The Smart Curtains and their integrated LED lighting can be moved to suit different activities, meaning fewer overall light fixtures are needed.
- Solid-state LED lighting can be twice as efficient as compact fluorescent light. This translates into a savings of 9 kg of CO^2 per 2000-lumen lightbulb per year.
- LEDs do not contain mercury and other toxic, non-recyclable materials that occur in fluorescent bulbs.

Carbon Neutral Construction

- The locally produced wood brettstapel structure reduces carbon emissions in transportation of building materials.
- The wood construction sequesters carbon that could enter the atmosphere, yielding a negative carbon footprint of approximately 180 metric tons of CO^2 (Hammond).
- A similar-sized concrete structure equates to an output of over 100metric tons of CO^2: a difference of 280 metric tons (Hammond).

Reduction of Structural Steel

- Solid wood structure sequesters carbon.
- The flexible FRC board which supports the roof PVs are formed to naturally return to the "up" position. The recyclable aluminum structure and tension piston used to lower it require much less material than a compression structure.

Longevity and Adaptability of Archtiectural Structure

- The long lifecycle of the building reduces carbon output from repair/replacement construction.
- The flexible floor plan can accommodate changes of program over time due to its open layout and multiple access points.
- The brettstapel structure can be easily recycled when the building reaches the end of its lifecycle because it contains no glue or nails.
- The solid wood structure is also a finish material, so drywall is drastically reduced saving the equivalent of over 6 metric tons of CO^2.

Extensive Natural Daylighting

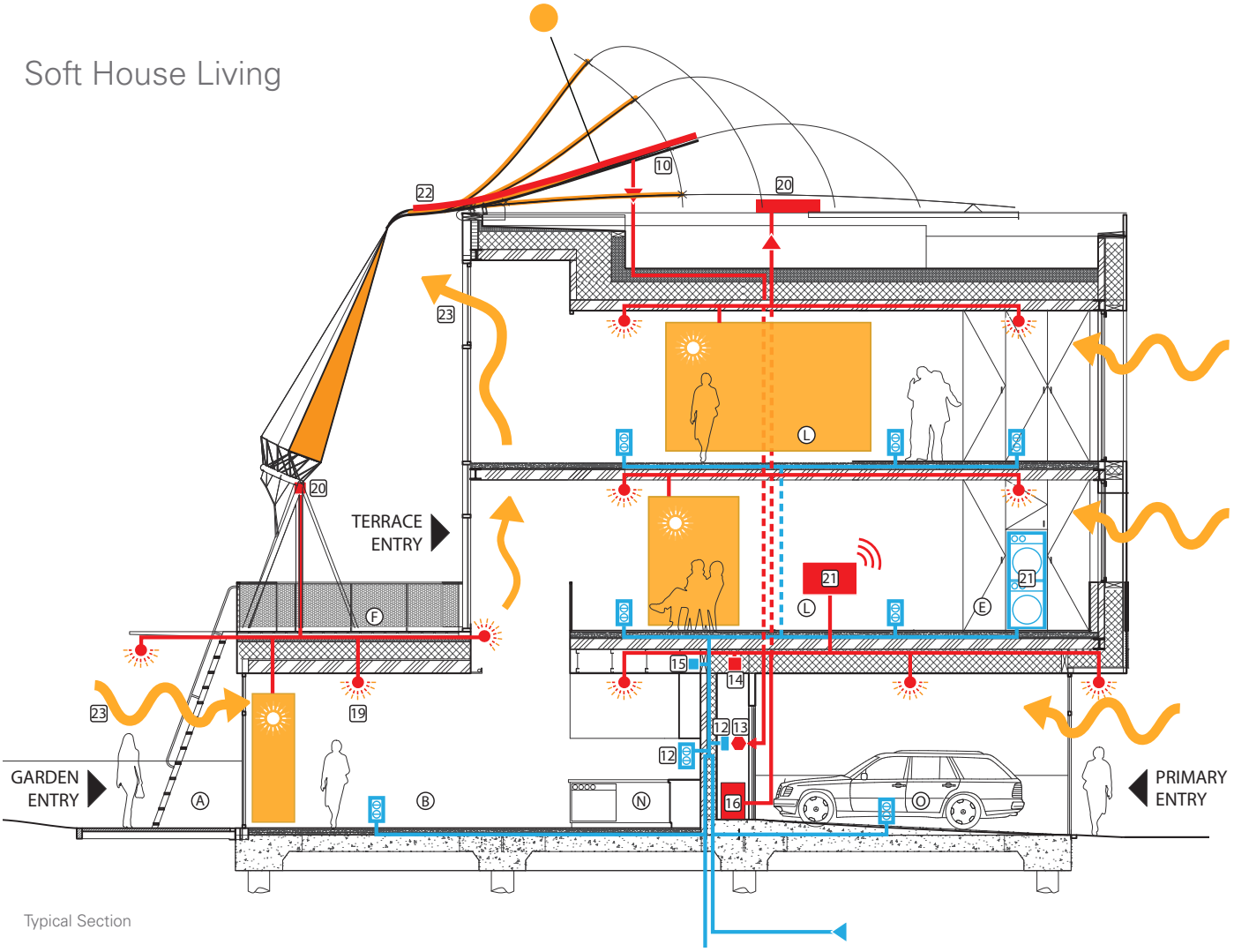
- The south-facing atrium transforms the row house footprint, allowing natural light to penetrate deep into the ground floor.
- The open screen along the stairs encourages shared daylight between levels.

Fawcett, Tina, Kevin Lane, and Brenda Boardman. *Carbon Futures for European Households: Country Pictures*. Rep. Oxford, 2000. Lower Carbon Futures. Environmental Change Institute, University of Oxford. Web. 19 Aug. 2013.

Hammond, G.P. and C.I. Jones, 2008, 'Embodied Energy and Carbon in Construction Materials', Proc. Instn Civil. Engrs: Energy, in press.

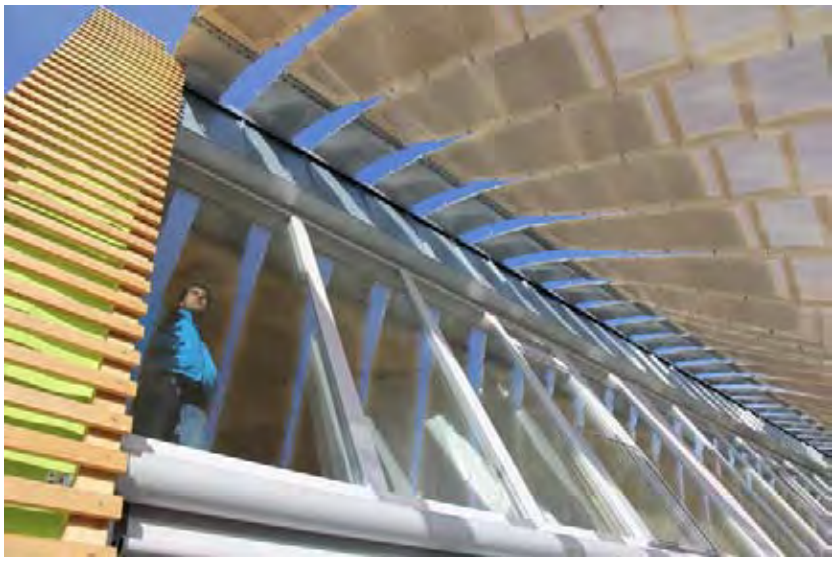
"Stromverbrauch Im Haushalt: Am Meisten Für Fernseher, Computer Und Co." www.energieagentur.nrw.de, ENergie Agentur.NRW, 09 Nov. 2012. Web. 19 Aug. 2013.

Soft House Living



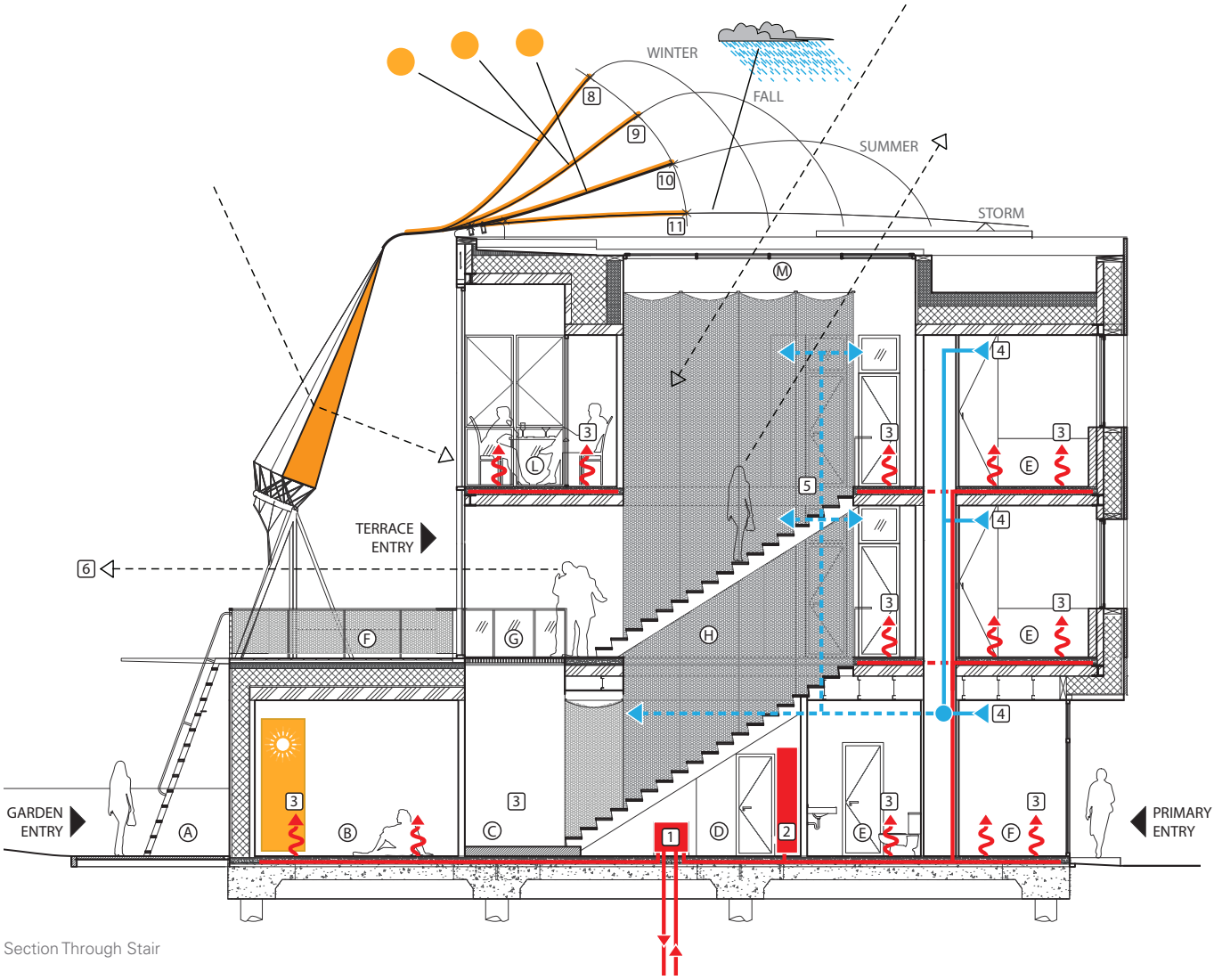
Typical Section

A	Terrace and Private Garden	F	Upper Terrace / Garden	M	Skylight with Reflectors	3	Radiant Cooling and Heating
B	Living	G	Bridge	N	Kitchen	4	Mech. Ventilation Return
C	Winter Garden	H	Stairwell with Wire Mesh	O	Garage	5	Mech. Ventilation Supply Beyond
D	Mech. Room	K	Twister with Reflectors	1	Geothermal Pump	6	Views to Park and Canal
E	Bath / Laundry	L	Room	2	Hotwater Tank	7	Views to Sky and Dynamic Membrane



Soft House Living

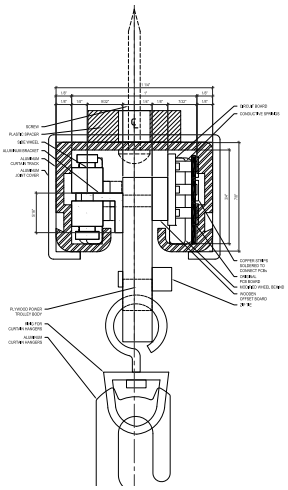
The living experience is based on natural daylight, garden access, and the simple aesthetic of wood—reducing the need for other interior finishes. The design provides multiple points of entry so units can be shared, rented or used for workspace. The stair well and ventilation 'chimney' pull daylight into the dwellings, providing a dynamic verticality in section and views of the textile infrastructure. A flexible, simple floor plan supports Urban Agriculture (garden plots) and Sustainable Transportation (E vehicle charging).



Section Through Stair

8	Winter Position	13	AC - DC Converter	18	Smart Curtain with Lighting and 20v. USB Connector	21	DC System Controller and Wireless Dimmer
9	Fall Position	14	DC Mech. Device	19	DC 30v. Lighting	22	Photovoltaic Cell
10	Summer Position	15	AC Mech. Device	20	DC Motors	23	Stacking Effect for Natural Ventilation
11	Hurricane Position	16	AC Receptacle				
12	Electrical Distribution Panel (AC)	17	AC Toner Appliance				

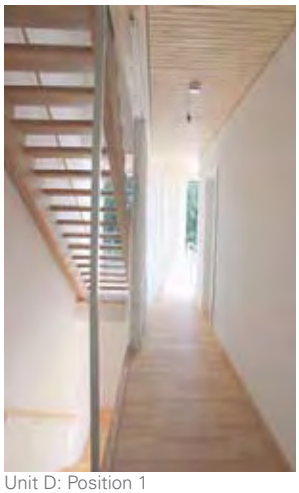
Smart Curtains: Domestic Infrastructure



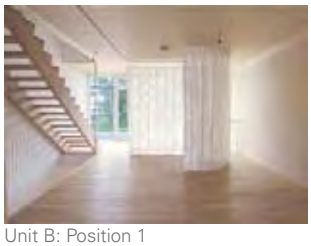
Above - Detail of the DC-powered smart curtain track, which transfers DC power and data to the smart curtain.

Left - The smart curtain shown in two different positions on the second floor of Unit B.

Smart Curtains: Personal Microclimates

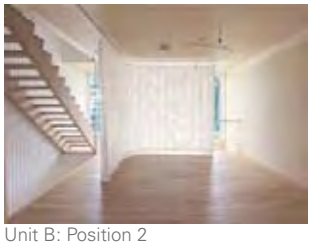

Unit D: Position 1


Unit C: Position 1

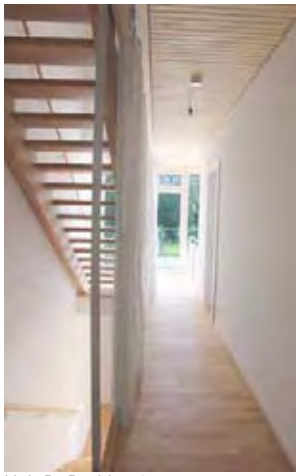

Unit B: Position 1


Unit A: Position 1


Unit C: Position 2


Unit B: Position 2


Unit A: Position 2

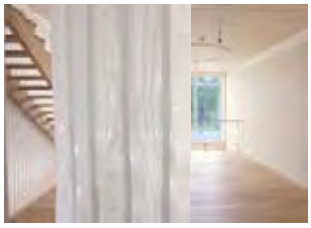

Unit D: Position 2


Unit C: Position 3


Unit B: Position 3

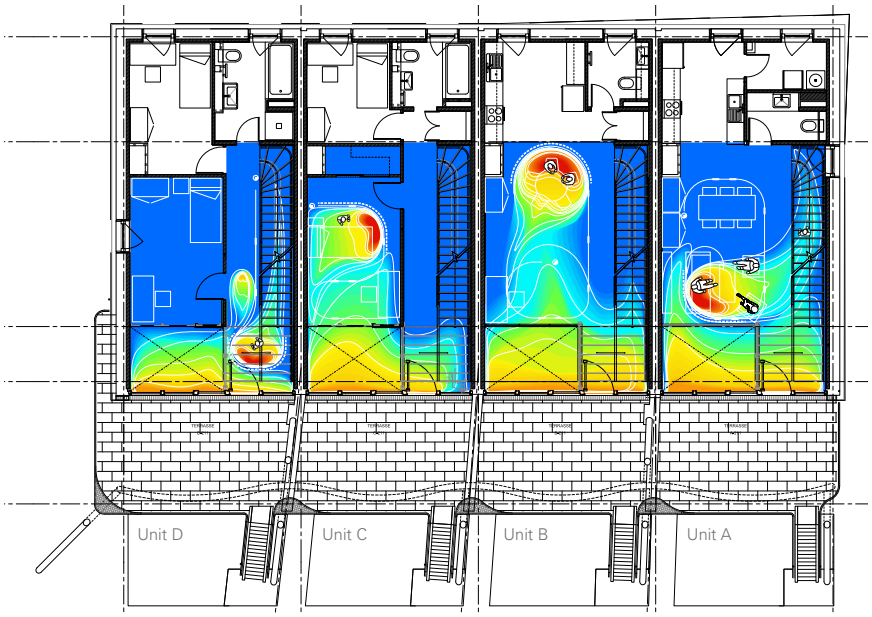

Unit A: Position 3


Unit C: Position 4

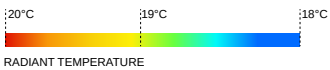

Unit B: Position 4


Unit A: Position 4

Primary Curtain Movement Position: Middle Floor



Interior Thermal Climate Diagram: Middle Floor



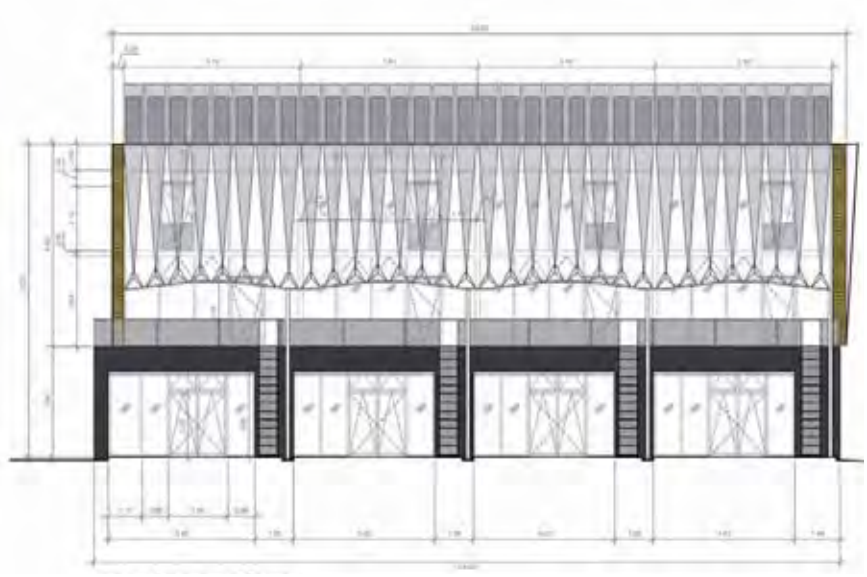
SMART CURTAINS

The Soft House design expands the traditional roles of the household curtain—to shade, insulate and provide privacy—creating a new multi-tasking soft infrastructure. Curtains can be moved into instant 'rooms' that concentrate zones of heating or cooling from the radiant floor. Smart curtain tracks mounted on the ceiling distribute low voltage DC power harvested by the exterior façade. Tracks can be reconfigured and upgraded without disrupting the solid wood structure. LEDs integrated in the movable curtains allow people to make new connections between the domestic and natural environments. The Visual Breeze, an ambient interior luminous expression of the wind, is one of many programmable modes for real time monitoring and visualization of outside wind and climate conditions.

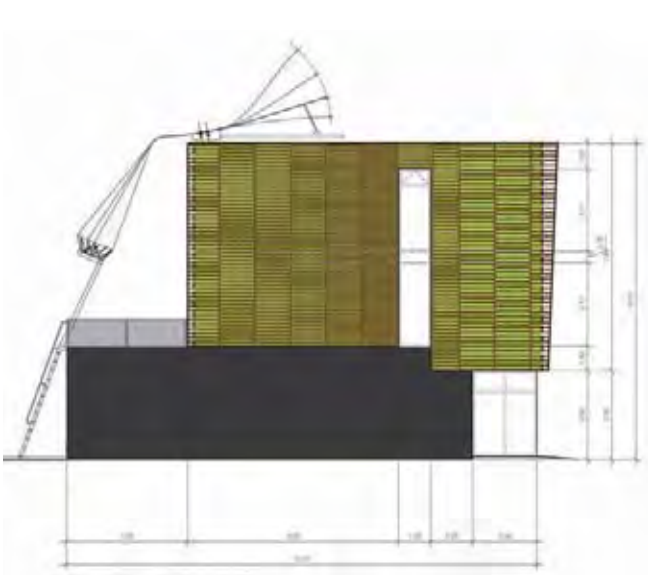
Carbon Neutral Wood Construction

All Wood Construction (Brettstapel)
The Soft House design features a traditional all wood structure that utilizes sustainable soft wood spruce pieces pegged together without glue or nails. Fabricated by a local builder, the solid wood panels were shipped to the site and lifted into place quickly. With solid wood walls and floors, the architecture becomes enduring and yet can be fully recycled at the end of its lifetime. Natural ventilation replaces ductwork, a single riser carries clean energy in section and the low voltage DC electrical network is distributed through curtain tracks on the ceiling. The infrastructure can be easily updated– leaving the solid wood walls undisturbed. The all-wood construction is expressed on the interior, and the green insulation membrane is revealed through wood slats on the exterior.

Wood Construction



South Facade



East Facade

North Facade

West Facade