The HólosHouse

A Case Study House for the 21st Century

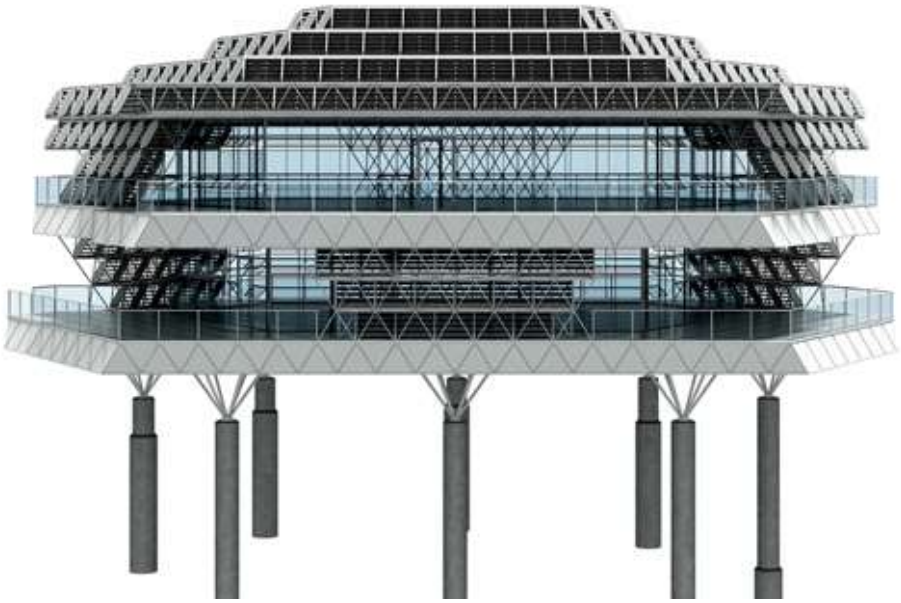
New Vocabulary for a New Vision

In the mid-1960's Peter Jon Pearce began developing a new vocabulary for the design of building structures. Even back then Pearce saw the need for a new way to build that would mitigate the inefficient use of material and the high energy costs so pervasive in building design, construction, and life cycle performance. This new building vocabulary is based upon least energy principles.

This led to the study of the geometry of structures in Nature. This included the morphological principles governing biological form and the geometries found in molecular structures. Since nature consistently follows patterns of least energy this seemed a most fruitful area of investigation.

The goal of this inquiry was to develop theoretical underpinnings for a more material efficient strategy for structural, spatial, and energy optimization in building design. This initial research is reported in Pearce's book, ***Structure in Nature is a Strategy for Design,*** The MIT Press, 1978, 1990.

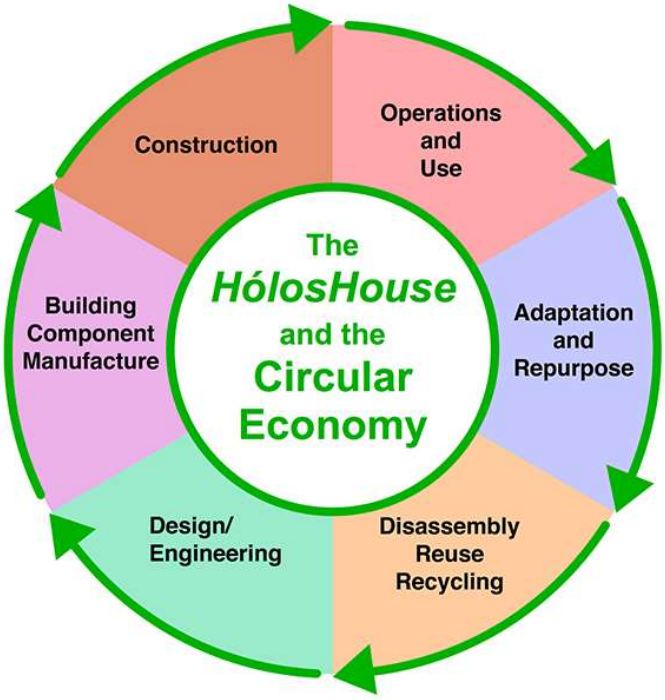
In Nature form is an agent of performance. Building design should be based on this principle. The *HólosHouse* is such a design. It demonstrates the effectiveness of form as an agent of performance, which becomes a strategy to achieve sustainability and resilience in the built environment.



The *Hólos House*

Inspired by the book: ***Cradle to Cradle: Remaking the Way We Make Things*** by McDonough and Braungart, as well as others, the idea of a ***Circular Economy*** has been put forth by the Ellen McArthur Foundation in collaboration with the RPS Group and Arup Associates.“The circular economy refers to an industrial economy that is restorative by intention; aims to rely on renewable energy; minimises, tracks, and eliminates the use of toxic chemicals; and eradicates waste through careful design.” (Ellen MacArthur Foundation).

The ***HólosHouse*** anticipates the *Circular Economy* in a variety of important ways. This is summarized in the illustration below. The attributes of this project demonstrate a very high level of compatibility with the *Circular Economy*. Indeed the ***HólosHouse,*** like the *Circular Economy,* represents a radical departure from conventional sensibilities within the building arts. Its concept is inherently circular as it is designed from the perspective of a nature based design strategy. As such it is a paradigm shift reflecting a lifetime pursuit of a rational alternative for building implementation.



The ***HólosHouse*** takes green architecture and prefab building to new levels - *Beyond Green, Beyond Prefab* - facilitating a carbon neutral footprint and net-zero energy use on annualized basis. The ***HólosHouse*** is a case study demonstration project designed to achieve higher standards of energy efficiency in support of sustainability and resilience. Typical building methods are anachronistic and wasteful of material and labor. The marginal adaptations of current green designs are insufficient to mitigate the effects of global warming. This means looking at building design unconstrained by the limitations of style, sentimentality, and conventional architectural sensibilities. Establishing carbon neutral, sustainable building driven by a high performance design ethic requires a paradigm shift. The ***HólosHouse*** is such a paradigm shift as is the *Circular Economy*.

The ***HólosHouse*** is a performance-driven building system that takes advantage of well-understood 20th century materials (steel, aluminum and glass) coupled with 21st century design. It brings together historically proven high-performance materials with the most modern technical implementation - the embodiment of a holistic strategy. The building configuration and its environmental infrastructure are designed as an integrated product system – it's ***Hólos.***

CIRCULAR ECONOMY ATTRIBUTE LIST for *HólosHouse*

Design/Engineering
• Whole System Kit-of-Parts
• Reconfigurable
• Adaptive Configurations
• Climate Management
• Strength of Geometry
• High Strength to Weight
• Long Life Components
• Zero Waste
• Designed for Resilience
• Radiant Heating and Cooling

Building Component Manufacturing
• Components Factory Manufactured
• Long Life Materials
• Low Maintenance Building Materials
• High Performance Materials
• High Recycled Material Content
• 100% Recycled Materials
• Non-Combustible Materials

Construction
• Off Site Component Manufacturing
• Factory Component Finishing
• Site Assembly
• Components Bolted Together at Site
• Zero Waste and Trash at Site
• Integrated Product Systems
• Holistic Building Assembly

Operations and Use
• Open Plan Adaptive Spaces
• Passive Electrical Energy Source
• Passive Climate Management
• Natural Ventilation
• Natural Light
• Low Maintenance Materials
• Resistant to Extreme Weather Events

Adaptation and Repurpose
• Demountable Building Components
• Building Components Reconfigurable
• Repurposable Building Components
• Adaptive Reuse

Disassembly Reuse Recycling
• Disassembly of Components
• Components Reusable
• Building Components Easily Handled
• Minimum Waste During Disassembly
• All Materials 100% Recyclable

How many trees were cut down to build this one house?

There is a better way – without destroying our woodlands.

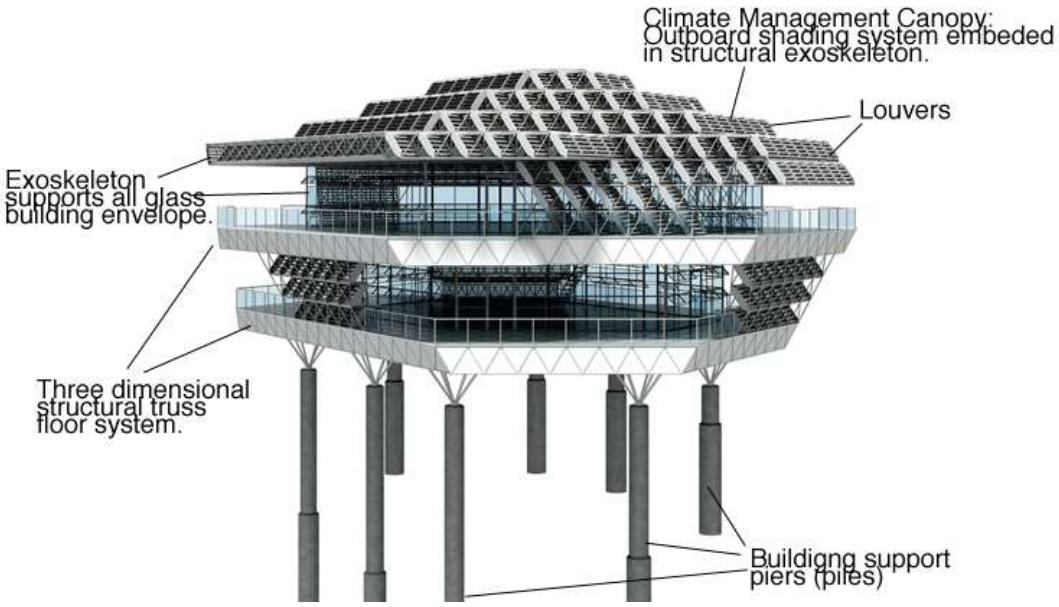
The *Hólos House.*

This case study demonstration project embondies a range of solutions that are applicable to a variety of building configurations, including residential and commercial structures. This prototype ***HólosHouse*** will function as a home/office/studio. It is configured as a two-story structure with residential space in the upper level and studio space in the lower level. As a prefabricated system the ***HólosHouse*** kit-of-parts can also be adapted to single level and multi-story buildings. Additionally it can adapt to varied and challenging site conditions. In this demonstration project the building is easily adapted to sites of complex topography.

Climate Management

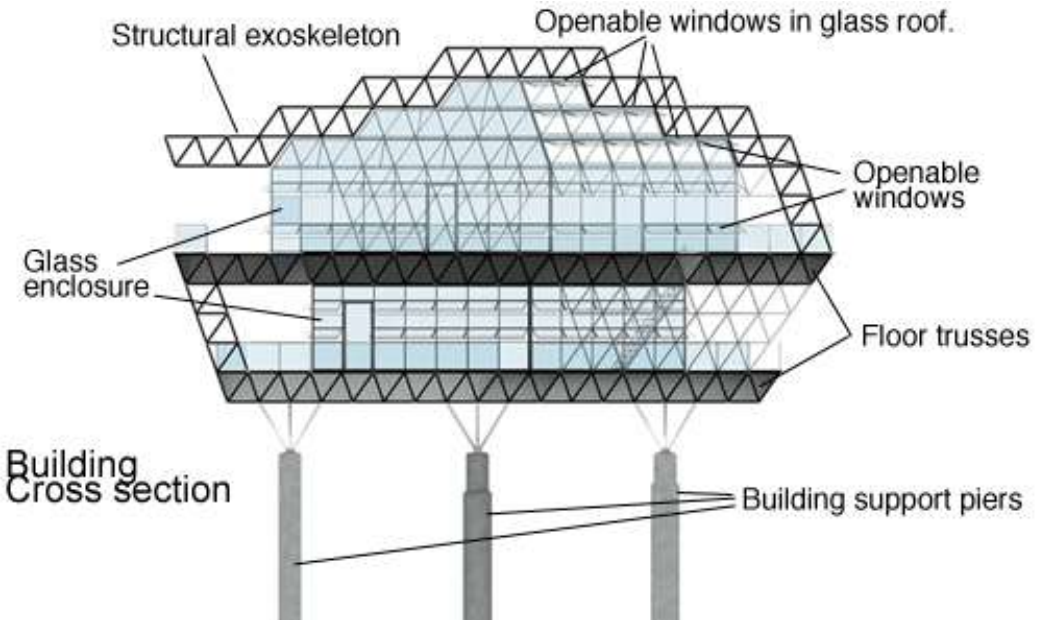
The most important fundamental function of building design is to establish and maintain a temperate environment. In conventional building solar radiation is a primary source of overheating. The building becomes uncomfortably warm to the point where it needs to be cooled. This cooling is usually accomplished by refrigerated air conditioning, which is a major use of energy in the United States and elswhere. The warming effect of solar radiation is mitigated by the ***HólosHouse*** without air conditioning. This is accomplished by a *Climate Management Canopy* – an outboard shading system of louvers embedded in an exoskeleton. In the hot summer months this passive system minimizes heat gain by intercepting solar radiation. Hence the need for refrigerated air conditioning is eliminated because the building enclosure is not directly warmed by the sun. The energy savings is obvious.

In the cold winter months the interior of the building is warmed by solar radiation. This is because the geometry of the louver system enables sunlight at its lower winter angle to infiltrate the interior.



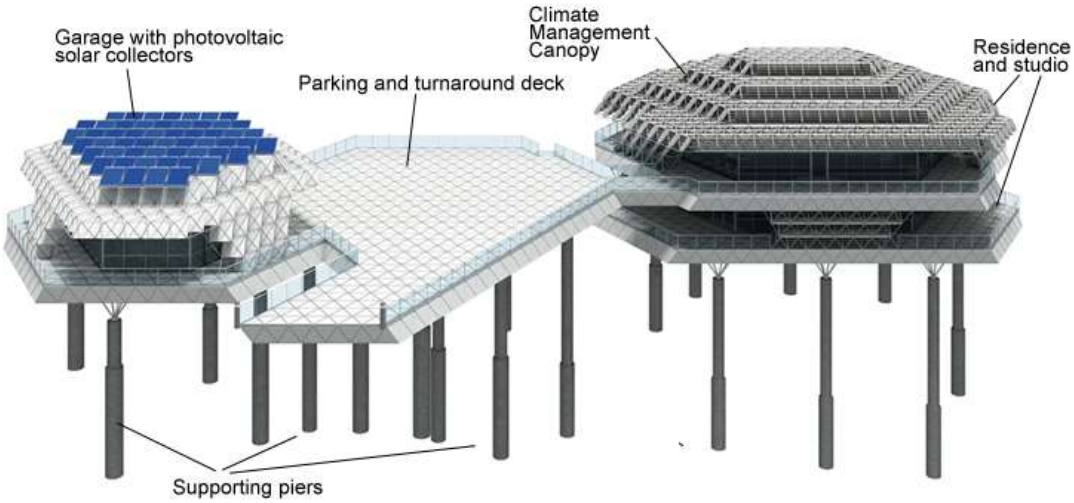
The *Climate Management Canopy's* exoskeleton is a key aspect of the of the ***HólosHouse*** structural system. It provides overhead support for the column-free, all-glass building envelope. Although shaded by the *Climate Management Canopy* the insulated glass enclosure provides abundant natural light to the building interior. This minimizes energy use for daytime lighting and eliminates the heat load induced by artificial lighting.
Natural ventilation is provided by arrays of operable windows in the glass enclosure. This provides fresh air enabling cooling to be further enhanced. In the summer months the sun heats the louvers of the *Climate Management Canopy*. This creates low-pressure zones causing convection currents to pull air through the open windows in the overhead glass enclosure. This enables additional cooling by enhancing natural ventilation. It is effectively solar cooling.

Extreme heat caused by global warming is an increasingly dangerous challenge for the residents of planet earth. This will have serious effects on the consumption of energy as communities resort to refrigerated air conditioning to mitigate stress on human health. Implementation of the *Climate Management Canopy* concept is an effective strategy to help address this issue.



Passive Energy

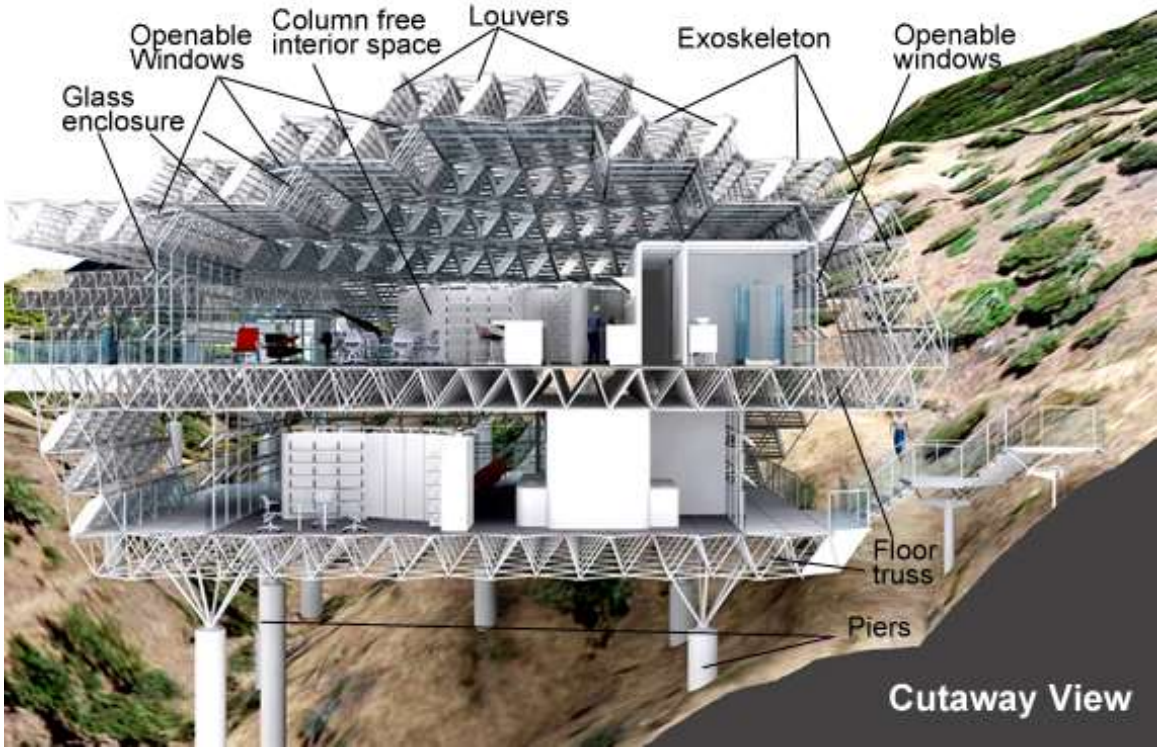
Passive energy strategies are also incorporated into the ***HólosHouse***. Photovoltaic (PV) solar panels generate electricity in this all-electric building. Decentralized (off the grid) electric power can be achieved with this strategy. The interior temperature is controlled using geothermal temperature transfer. Liquid (hydronic fluid) is pumped through an underground labyrinth of tubes. This maintains the temperature of the hydronic fluid at roughly 60 degrees, which is the approximate constant temperature underground at a depth of 6 feet or more. An electric heat pump adjusts the temperature of the hydronic fluid as it is pumped through radiant flooring to cool or heat the building interior. Since the geothermal heat pump only needs to heat or cool the hydronic fluid from 60 degrees rather than ambient temperature this is extremely energy efficient. This maintains a healthy, efficient, comfortable living space without the need of blowing warm or cool air as in conventional HVAC systems, which is extremely inefficient and unhealthy. The result of combining these technologies enables net zero energy use while facilitating a carbon neutral footprint.



Hólos House Building Complex

Prefabricated *Kit-of-Parts*

The ***HólosHouse*** is assembled from a family of integrated product systems, including structural, space enclosure, radiant floor system and climate management components. These components comprise a uniquely designed prefabricated *kit-of-parts.* From these components the entire building is manufactured off premises and assembled at the site. High performance materials including steel, aluminum, glass and synthetic stone are used to manufacture the prefinished, noncombustible components. The materials represent high-recycled content and attributes of long life and low maintenance.



Structural Autonomy

The ***HólosHouse*** is completely self-supporting. Its structural exoskeleton in concert with three-dimensional truss floor systems, results in a holistic structure of exceptional load resistance and inherent stability. The sophisticated geometry of this structural framework creates a building that exhibits structural autonomy. We call this strength of geometry. The building is structurally resolved as an entity without reference to any external support systems or conventional foundations.

This structural autonomy enables the ***HólosHouse*** to adapt to building sites of simple or complex topography and geology with minimum site intervention. Supporting piers (piles) are used to anchor the building to the earth. In this way the building is free of a conventional foundation.

Pearce's investigations and discoveries relating to three-dimensional triangulated networks led to a deep understanding of intrinsically stable high-strength to material weight structurally autonomous structures. Such structures offer material efficiencies while at the same time providing structural redundancies. The combination of the intrinsic stability and structural redundancy of these triangulated structures offers important advantages for the design of buildings. With this approach catastrophic failure due to any sort of locally concentrated external forces caused by earthquakes or high winds are mitigated. This results in safer and more resilient buildings.

Paradigm Shift

The ***HólosHouse*** is a case study demonstration project of unprecedented new standards for the design and project construction of residential and commercial building. It is a paradigm shift desperately needed to help reduce greenhouse gases while eliminating the dependency on fossil fuels. In addition to environmental sustainability this advanced building system, built from high performance, noncombustible materials, also offers unprecedented resilience against natural disasters, such as flooding, fires, earthquakes, and hurricane force winds. Driven by a high performance design ethic, the adoption of the principals implemented by the ***HólosHouse*** will make a significant contribution to the sustainability of the planet.

The ***HólosHouse*** is an indigenous building for the 21st century. It benefits from the history of material and manufacturing sciences, the knowledge of geometry and structure, and the holistic integration of these disciplines. These materials and knowledge have no national sovereignty and therefore are indigenous to the entire planet earth. The ***HólosHouse*** is designed without being constrained by the limitations of conventional thinking and traditions. It is a paradigm shift.