Building in the 21st Century
Sustainable Designs for Emerging Energy and Movement Technologies

Man, Machine and Movement
people, architecture, urban design, energy, sustainability, transportation and their future synergies
RELATIONSHIPS SUPPORTING EACH OTHER
CREATING NEW COMMUNITY VISIONS

- Movement
- Power Sources
- Built Forms
- SYMBIOTIC RELATIONSHIP
- TECHNOLOGY
- Low/High
- INDIVIDUAL MACHINES
- NEW MACHINES
- GROUP MACHINES
- URBAN
- GLOBAL
- TRADITIONAL - HYBRID
- FUEL CELL - ELECTRIC
- WIND - SUN

Shannon Sanders McDonald, AIA

Copyright Shannon McDonald, 2004
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Only New Movement Technologies Can Change Design

Site Coverage for Typical Commercial Development (averages for Olympia, Washington)

- **BUILDING/FOOTPRINT**: 26%
- **STREETS**: 3%
- **SIDEWALKS**: 4%
- **LAWNS/LANDSCAPING**: 13%
- **PARKING**: 54%

“Infrastructure is Culture”
and the basis for the public realm –
movement sustains necessary connections
and is still the basis for modern design

The concept of the machine age in the twentieth century and its impact on our cities, buildings and lives has been connected to the complex typology of movement. In fact the architect LeCorbusier in the 1920’s said:
“A city made for speed is made for success”.
Architectural theory in the 21st century has been focused on the road with the parking garage building type minimally explored within this concept, while cars at REST have shaped our downtowns. The parking garage building type by its relationship to the ideas of technology, traffic, communication, landscape, functionality, and the idea of success leads the way in new sustainable visions.
Changing movement technologies such as energy sources, advanced transit, and the car will dramatically effect the way we design parking facilities and our environment. Through the use of fuzzy logic elevators can be programmed to operate three dimensionally allowing the traditional architectural/engineering notion of designing with a “core or shaft space” to change in complexity. This will also effect the structural, mechanical, and electrical relationships in building design. The car evolving into environmentally friendly technology power sources can now become symbiotic with powering the building. While the computer can explore the many 3-D permutations, many other architectural issues are involved. So, how will fuzzy logic, 3-D movement, energy, and transportation issues impact the design process? How can we prepare for this complexity?
How can we weave all of these aspects to create a healthier, safer, saner environment for all as technology continues to change?
“Infrastructure is Culture”
and the basis for the public realm –
movement sustains necessary connections
and is still the basis for modern design

Left: News Paper Ad, Revive Public Transit GE
What Do We Need To Embrace For A Longterm Sustainable Future?
How Do We Design For It?

Re-imagining the Future

BY

Focus Technology and Movement

Nuclear

Bloom Box Fuel Cell

Credit: Current - GEMcars.com
Dan Sturges original designer (trans2 Corp)

http://www.teslamotors.com/media/image_library.php

ULTra © ULTra Advanced Transport Systems Ltd.

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Shannon Sanders McDonald, AIA
## Only New Movement Technologies Can Change Design

### SMALL SCALE CHANGES
- Pay-On-Foot / Pay–On-Foot Solar
- Parking by Cell Phone
- Car - Sharing Programs

### LARGE SCALE CHANGES
- Automated Parking
- New Public Transportation Systems
- New Fuel and Energy Sources

### LOW TECH
- Walkable Communities
- Universal Design
- Utilizing Existing Infrastructure and Vacant and Unusual Lot Configurations
- Bicycle Connections

### HIGH TECH
- GIS – Geographic Information Systems
- GPS – Global Positioning System
- AVI – Automatic Vehicle Identification
- LPR – License Plate Recognition
- PGAS - Parking Guidance Automated Systems

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Electric Vehicles:

In 1898 the French considered us:

“The Edison Electric Garage, Boston, Mass.,” Horseless Age 31, no. 19 (May 7, 1913): 841842

“New York has no motor vehicle exhibition such as recently drew all of Paris to its doors, nor does she as yet count the motor vehicles in her streets by thousands, but she has something which even Paris, the mother of the motor vehicle, cannot boast—a complete electric cab installation.”

“Our Electric Cab Station,” Horseless Age 3, no. 6 (September 1898): 1.

One of his early visions, above, stored the automobile within each dwelling using an elevator system, multiple forms of transit and delivery were below grade and the entire structure was “ecologically balanced”.

What New Movement Technologies and Connections are Appropriate Ideas For Sustainable Practices
What New Movement Technologies and Connections are Appropriate Ideas For Sustainable Practices

John A. Beeler, *Report to the City of Atlanta on a Plan for Local Transportation* (New York: Foote and Davies, 1927).
Neighborhood garages

The elevator was used for vertical movement in all early multistory garages. The ramp first appearing in 1908 in a garage for cabs. The elevator remained the primary movement system, sometimes with the ramp for vehicle movement well into the 1920’s.

*The Horseless Age* (January 15, 1916): 76.
What New Movement Technologies and Connections are Appropriate Ideas For Sustainable Practices

The elevator garage is showing up again today, such as in this parking facility in Detroit.

Merchants Row Elevator Facility, Detroit, MI, 2004; photo Art Kress
Elevator facilities can allow for flat floor plate design. The can park cars more densely as well as allow for adaptive reuse.
In 1904 the Garage Rue de Ponthieu was opened in Paris, France. Designed by August Perret, this very early garage was experimenting with new mechanized systems. The elevator moved the automobile vertically and a platform moved it horizontally on tracks driven into the empty parking slot.

Notes from Paris,” Architectural Review 24 (1908).
And automation to make the most of our underground capabilities

Proposal for a mechanized underground parking system—
Automated Facilities

Parking machines advanced – again in the 1950 and 1960’s, some still functioning today.

Photo courtesy of Shannon Sanders McDonald Architects.
Automated Facilities

One of the greatest benefits is the reduction of air pollution: VOC’s reduced by 68%, carbon monoxide by 77%, nitrogen oxides by 81%, carbon dioxide by 83% and fuel savings of 83% when comparing a ramp to an automated facility of 350 spaces.

Automation appears again, today, this time all managed and controlled by a computer.

Hoboken Automated facility—Photo courtesy of Shannon Sanders McDonald Architects.
European solutions could find their way into our country

he Towson automated parking project with apartments, The Palisades, has been statistically compared in area and volume to a ramp facility with automation minimizing the amount of space required for parking and will potentially receive an Innovation in Design credit toward LEED certification.
Parking the car was part of the internal spatial procession of the building, 1929 in Budapest. This can become reality as the fuel source changes with the car powering the building and the building powering the car.

Multi-modal garages
Linking the train station and the newly expanding downtown

The parked car became the defining factor in new visions of living.

Bicycle shops were some of the first parking facilities. It was the APOC OA garage that encouraged the parking and bicycle connection once again in the 1970’s.

Bicycles and garages are being seen again today.

Bicycles even having their own garages.

Bikestation—Photos courtesy of Bikestation.
Will the bicycle become part of the American commute as it is in Tokyo?

Photos courtesy of Shannon Sanders McDonald Architects.
Once upon a time,

The landscaped roof was a popular solution for the top of a garage. The garden roof first appeared in Philadelphia at the Garden Court Garage in the late 1920’s.

Parking garages were designed with green roofs throughout their lifetime.

―Public-Private Corporation to Provide Park-Topped Garage‖, The American City, vol64 no4 (April 1950):89.
Now we have solar powering for the modern parking facilities needs and LEED certified parking facilities.

Stantec Architecture; David Wakley, photographer (formerly Chong Partners)
Will we wait another 30-40 years to understand the role of electric vehicles in a sustainable future? Some are integrating it again now. Using the technology where and when it is appropriate.

Commuting car and transit applications would be a good immediate first use.

Photo courtesy of Shannon Sanders McDonald with thanks to Emory University parking services.
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Photo courtesy of Shannon Sanders McDonald with thanks to Emory University parking services.
What New Movement Technologies and Connections are Appropriate Ideas for Sustainable Practices

New Interconnections
Complete linkages between transit, architecture, energy, parking, and urban planning
Environmentally sustainable solutions
Pedestrian and machine oriented environments
Totally integrated walkable land use decisions supported by new movement technology

PRT, GRT OR DUAL-MODE

As environmentally sustainable fuels sources have greater applications the electric automobile and the PRT system can refuel or be fueled by other generating sources such as solar panels and other renewable energy sources linked to the power grid.

Eventually the Starr Car System as envisioned by William Alden where the “personal automobile” links with other “personal automobiles” to form transit now called dual-mode can occur.
What New Movement Technologies and Connections are Appropriate Ideas For Sustainable Practices

PRT or GRT – Group Rapid Transit

Point To Point Service – no stops in-between like some elevator runs

Small vehicles

Off-line stations

On-demand

Automated Guideways

Networked system – not reliant on a corridor structure

Appropriate for dense historic urban environments.

Photograph complements of Stan Young, Kansas DOT, University of Maryland, Center for Advanced Transportation Technology
**What New Movement Technologies and Connections are Appropriate Ideas**

**For Sustainable Practices**

**PRT – Personal Rapid Transit**

Heathrow Airport with the first true PRT system now almost in operation will connect parking lots, facilities and the terminals. The use of this networked system is currently being studied in several British cities and by other countries such as Korea and Sweden.
A sustainable future for transport

Directorate – General for Energy and Transit
Courtesy Martin Lowson: © ULTra Advanced Transport Systems Ltd.
Sustainability

- Zero emissions at point of use
- Low external noise
- Low visual intrusion
- Low resource requirements
- Low embodied energy

Low energy use

<table>
<thead>
<tr>
<th></th>
<th>Mjoule per Passenger km</th>
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<tbody>
<tr>
<td>London bus</td>
<td>0.85</td>
</tr>
<tr>
<td>Underground</td>
<td>1.55</td>
</tr>
<tr>
<td>Urban Car</td>
<td>2.0</td>
</tr>
</tbody>
</table>

UK Data. Assumptions:
- Average passenger loads
- Well to wheel (darker shading direct electricity use only)

Courtesy Martin Lowson: © ULTra Advanced Transport Systems Ltd.
Advantages of ULTra

Low capital costs

<table>
<thead>
<tr>
<th></th>
<th>$m/mile</th>
</tr>
</thead>
<tbody>
<tr>
<td>Automatic People Movers (&quot;APM&quot;)</td>
<td>30 - 100</td>
</tr>
<tr>
<td>Light Rail</td>
<td>20 - 40</td>
</tr>
<tr>
<td>ULTra</td>
<td>10 - 15</td>
</tr>
</tbody>
</table>

Capacity

An ULTra system has the potential to carry as many people as a:

- Lane of high speed road traffic
- 200 seat light rail vehicle arriving every 5 minutes,
- 50 seat bus every 75 seconds.

Complementary to existing modes

- New solution for “last mile” problems

Courtesy Martin Lowson:© ULTra Advanced Transport Systems Ltd.
Application at Heathrow

- Connects Business Parking with T5
- 2.4 miles of single guideway
- 21 vehicles
- 3 stations
- 5min journey time

Traverses
2 rivers and 7 roads
Green belt land
Negotiates Aircraft surfaces
Bridges in-ground services
Conforms to T5 architecture
Looks “Intended”

Courtesy Martin Lowson:© ULTra Advanced Transport Systems Ltd.
Possible Future Phases

- 18 miles of track
- 80% elevated
- 350 vehicles
- 50 stations

Courtesy Martin Lowson:© ULTra Advanced Transport Systems Ltd.
"Isn’t it nice to find transport which is waiting for you rather than you waiting for it”
Russell Goodway, Lord Mayor of Cardiff

“The ideal transit technology is PRT: a) stations right where you are, within walking distance, b) no waiting.”
Peter Calthorpe

“If ULTra is as successful as I think it will be, this could be a big breakthrough in developing new kinds of totally personalised rapid transit, which could transform our cities in ways that we can't yet see.” Sir Peter Hall

“Fabulous idea” “Makes life a lot better” “Superb”
Comments from passengers at trials

“This is amazing — a well engineered, ready-to-go public transit system that can solve many urban transport problems [...] I am going back to tell my colleagues that they must come and see ULTra.”
Representative from a major transport agency

“The ULTra PRT system is clearly leading the world in this exciting and innovative technology”
Mike Clasper, CEO of BAA

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20 proven ways to save the earth

Tackling climate change may be daunting but it is entirely feasible using existing technology.

The world's largest solar power energy plant, Sanlucar la Mayor, Spain

World's first floating offshore wind turbine

The world's first Personal Rapid Transit (PRT) System, Heathrow Airport

Eco aircraft with unducted fan engines

Tidal Power Station, La Rance, Brittany, France

November 29, 2009

http://www.timesonline.co.uk/tol/news/environment/article6931775.ece

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Courtesy Martin Lowson:© ULTra Advanced Transport Systems Ltd.
What New Movement Technologies and Connections are Appropriate Ideas For Sustainable Practices

Future Movement Technologies Linking Many Movement Issues from Port to Destination
Now we have solar powering for the modern parking facilities needs and LEED certified parking facilities.

Santa Monica Civic Center Parking Structure; Design Architect: Moore Ruble Yudell Architects & Planners; Executive Architect: International Parking Design; Photo: John Linden
What New Movement Technologies and Connections are Appropriate Ideas for Sustainable Practices

Filter Garden—Leven Betts Studio.
What New Movement Technologies and Connections are Appropriate Ideas For Sustainable Practices

Multi-Directional, Fully-Networked, Spatial Multi-level Connections

University of Nebraska Student: Brandon Zahurba 2001  Montana State University Student: Matthew Killiam, 2002

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PRT can provide new ways to move within our urban fabric, automated parking facilities can provide the ability for the PRT vehicle to transfer easily to different levels and change direction within a single location. Having this flexibility requires less space and provides greater urban planning opportunities and can preserve Historic Communities while modernizing them. Social spaces can now be designed as part of the system similar to the experience of the great train halls.
What New Movement Technologies and Connections are Appropriate Ideas For Sustainable Practices

Advertisement, First National Bank—*Detroiter* (November 3, 1924)
What will the SPSU CAMPUS OF 2050 BECOME?

The context is Southern Polytechnic State University Campus as the place for the study for the application of new movement technologies; creating new architectural and planning solutions. Any building typology may be explored within the context of the University plan and may or may not integrate with the parking facility - as new architectural and urban design typologies definitions are created due to these technologies.

- Campus Analysis
- Urban Design
- Architectural Design
- Final Integration
Figure Ground with sidewalks

Figure Ground with roads
Landscape Survey – 1958
“Southern Technical Institute”

1948 - SPSU was founded as the Technical Institute
1958 - SPSU became the Southern Technical Institute
1961 - Hoyt McClure/ Acting Director led to the movement of building 8 buildings on 120 acres of land.
2009 - Southern Polytechnic State University expanded and now encompasses more than 230 acres and 35 buildings.

Carya illinoensis (Pecan)

Pecan trees are documented as the main type of vegetation that existed on the campus site of SPSU. The Pecan tree can grow to enormous heights, sometimes to 180 feet, and has an upright growing pattern. The bark is pale gray or whitish brown, scaly, and deeply furrowed. The heartwood is solid brown and black. The leaves grow in groups of 11-17. Each leaf is slightly pointed at the tip. The width of the leaves are approximately 3 inches. Each full grown leaf is about 5 inches top to bottom. The fruit of this tree is the easily recognized “pecan”.

Rendering – Topographical survey during 1958
ENIRONMENTAL ANALYSIS

SUNSHINE HOURS:

[Graph showing Sunshine Hours with two peaks and a valley, labeled with months from January to December]
Due to the hilly terrain of the campus in order for a disabled person to travel from North to South, he or she would need to travel vertically (Elevator) through some of the buildings.
AUTOMOTIVE RESEARCH LAB

2048 - SPSU Campus Plan
Student Pop - 32,000
60% On Campus
8% Auto Commute
32% Public Transit Commute

2048 - SPSU adopts a car-less campus policy. Transport around the campus is via automated smart trolleys. Along with the radical transport plan, the University creates a new transportation research facility.

SKATEBOARD TROLLEY

SKATEBOARD DELIVERY VEHICLE
NATURAL VENTILATION DIAGRAM
SPSU as Heterotopia

Campus

Green Space

Academia

Schlam
SPSU as Heterotopia
Connecting the Campus

In order for SPSU to be fully connected to other enclaves, it needs a space to serve as its outlet for commuting across multiple scales. Metropolitan Atlanta has so far failed to effectively create diverse methods of connection between its neighborhoods, districts, cities, counties. The primary transportation system is the road network. This system has the potential to operate across almost any distance, but it isn’t the most efficient at all scales.
Four Transportation Systems:
PRT, Road, Subway, Train

<table>
<thead>
<tr>
<th>System</th>
<th>Distance</th>
<th>Capacity (per hour)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRT</td>
<td>s, m, L</td>
<td>1-4 (maximum)</td>
</tr>
<tr>
<td>Road (local, rural, etc.)</td>
<td>s, m, L, xL</td>
<td>1-5 (max), 1-35 (peak)</td>
</tr>
<tr>
<td>Subway (mass rapid rail)</td>
<td>m, L</td>
<td>150 (intermediate per hour)</td>
</tr>
<tr>
<td>Train (national rail system)</td>
<td>L, xL</td>
<td>900 (average)</td>
</tr>
</tbody>
</table>
The concept of Agro-Tectonic is to associate the Academia, agricultural production, dwelling and activities in a single and vertical system.
The concept of **Agro-Tectonic** is to associate the Academia, agricultural production, dwelling and activities in a single and vertical system.
Pod- (Living Space)
2050
RYAN TOLLE
Southern Polytechnic Research University

Hornet’s Nest Station Section

Campus Transit Level – 14’
2050
OMAR MARTINEZ
VIEW FROM J BUILDING
PRT Station on Green Roof
Sixth floor
0 25 50 100 200 400

A
B
C

A
B
C
North elevation

South elevation
Section C-C
1. Transportation Hub (PRT and light rail)
2. Retail Shops
3. Party Rooms (Movable Room)
4. Gallery / Exhibition space
5. Suite level garden
6. Ballroom servery
7. Ballroom
8. Kitchen
9. Restaurant
10. Movable / loft restaurant platform
11. Bar
12. Check in and employee room
13. Entry Lobby
14. Movable conference room
15. Stairway to PRT station
16. Night club
17. PRT Station
18. Conference roof
19. Employee breakroom
20. Pathway to green roof w. pool
21. Storage
Concept:

By instigating the efficient and logical properties of a “network”, a series of walkways above ground is propose in an effort to unite the separate entities and academic disciplines within the campus.
AGID:: SPSU 2050

Architecture - Graphic - Interior Design Complex

Kira Melville - Focus Studio Fall 2009
SPSU’s PRT Stops

Main Nodes – 2 way movement
Main Loop – 1 way
Main Nodes – stops – 1 way
Minor Nodes – 1 way
Substations – 2 way – fast track
Elevations

[South – West – East]
SPSU Design Integrations in 2050:

1. Cross Ventilation

2. Building Orientation to Sun allowing most natural light possible

3. Solar arrays on orientations of all new constructions

4. Green roofs

5. Grand pedestrian walks between the center of all building layouts (Incorporation of major axis into building form)
Rather than isolating ourselves from the realities that we are now facing we need to embrace the new solutions and attempt to find ways to integrate them to address the emerging complex movement and environmental needs of our planet.

Or Perhaps
These visions of the future may become reality!

A recent review by the Engineering News Record states: "the parking garage is still a crucial building form that lies at the intersection of architecture, transportation, sustainability and urban design ... this groundbreaking book chronicles the evolution of parking garage innovation... how well-designed parking structures can positively affect both project success and the broader urban environment".
See [www.uli.org/parkinggarage](http://www.uli.org/parkinggarage) for an interactive time line by city, state, date, and key ideas of all parking facilities discussed in the book.

• Please feel free to contact me below with any questions and use of material. I am a licensed architect in the United States and have participated in award winning projects, teaching, and lecturing extensively.

• This talk is based on a book on the evolution of parking facilities in the United States published by the Urban Land Institute titled *The Parking Garage: Design and Evolution of a Modern Urban Form*.

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