How New Movement Technologies Can Assist with Seamless Access for All

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SUMMARY

New movement technology is currently becoming reality around the world. PRT (Personal Rapid Transit) now sometimes called ATN (Automated Transit Network) is currently available at Heathrow airport and Mazdar City, Abu Dhabi, United Arab Emirates. Systems are in various planning stages in Suncheon City, South Korea, Sam Mineta Airport, San Jose, CA, Ithica, NY and Amritsar, India. Technology that allows elevators to move three-dimensionally is currently applied in the Tower of Terror ride at Disneyland, Anaheim, CA. New automobiles are appearing highlighting electric power sources, smaller sizes and even collapsible -- such as the City Mobile car designed at MIT. All of these technologies offer one new important design feature – their ability to interface three-dimensionally both inside and outside of buildings. They can also simultaneously provide seamless accessible mobility and link multiple transit systems, changing transportations’ relationship with urban design and architecture.

These new technologies provide the opportunity to create fully accessible transit friendly environments by allowing more compact and interconnected ways to design and move through space. They have the ability to arrive more quickly to their destination – even more time-efficiently than a car and more time-efficient than the standard transit loop or line systems; therefore they can encourage and hopefully increase transit use. New integrated solutions that address multiple overlapping issues such as energy sources, the environment and handicap accessibility can also be addressed. Several key issues are involved in providing more accessible transit use and the solution lies in their interfaces and overlaps, not in their isolation. The issues are: (1) mode of transportation, (2) energy source/sustainability, (3) human interface, (4) physical location, and (5) actual design.

Integrating new forms of movement is a more sustainable solution that allows for stations within easy short distances creating accessibility. Initially these systems are being implemented in two areas – local existing environments such as airports and entirely new cities. This paper will examine the linkages for the Southern Polytechnic Campus of 2050 using one or all of these new technologies to create a more fully accessible sustainable campus design.

These newly emerging movement systems will allow easier access for all ages as station design can now be integrated within buildings at multiple levels. Navigating steep topography as well as connecting multiple other forms of transit to create a seamless system will allow faster and smoother access for all. Linking spaces and places in entirely new ways, the architects’ unique spatial training will become essential in allowing these new technologies to be implemented to their full potential.
The Southern Polytechnic University students’ analysis of existing campus conditions as well as their unique solutions to connections and interconnections will be presented along with a review of the technologies and their connections to automobiles and other forms of transit.

Key Words:
Universal Design; Automated Transit Network; Seamless Access Mobility; Intelligent Transportation System; Personal Vehicles

PURPOSE OF THE STUDY

The purpose of the study is to determine if all university students have accessibility to attend classes in a timely way. To then explore how new transportation technology could address the documented problems of movement around the campus, in order to create equitable, usable and economic solution that allows all students to access all buildings in an efficient manner to attend classes. The goal is to show how new intelligent transportation systems could be implemented in an urban environment to provide improved mobility for all.

MATERIALS AND/OR METHODS

The method of this work is within an architectural construct of the campus plan. The process is to first examine, analyze and document existing conditions to determine the problem(s), then to suggest architectural/physical solutions to the problem(s) identified. Mobility challenges can be found by first physically documenting existing conditions of accessibility to buildings and for navigation between buildings throughout the campus. Then to propose architectural solutions that apply new intelligent transportation technologies in order to create seamless mobility for all. These solutions will be shown in architectural drawings, charts and graphs.

RESULTS OR EXPECTED RESULTS

With the integration of new intelligent movement systems into architectural design timely fully accessible movement patterns can be created. When these new systems are implemented Universal Design and seamless accessibility can be achieved.

DISCUSSION

Universal Design is an approach that that seeks to create the greatest possible opportunities for the widest range of people without separate design strategies. This concept addresses the accessibility guidelines that have been evolving in the United States since 1961 with the American Standards Association (now ANSI) “A 117.1 – Making Buildings Accessible to and Usable by the Physically Handicapped”, to the ADA standards for Accessible Design and the 1996 Telecommunications Act of
today. Rehabilitation Engineering and Assistive Technology begun in the middle of the 20\textsuperscript{th} century after WWII and the visions of architect Michael Bednar in the 1970's who introduced the idea that “removing environmental barriers enhances everyone’s functional capacity” [ARISE, 2001] are now intersecting within the concepts of Universal Design to create products and environments to reduce barriers for people with and without disabilities to create accessibility for all without separate design.

In 1988, New York City's Museum of Modern Art Exhibit: Designs for Independent Living set the standard for products that were beautiful and functional for the aging and those with disabilities. [Story, Mueller & Mace, 1998] As we enter the 21\textsuperscript{st} century the majority of our population will be composed of baby boomers entering middle age, older adults and those with challenges; socially we are currently challenged to be more accepting of individual differences. Currently, cognitive disabilities are an area of study being addressed in the design world expanding our abilities to design inclusively. [Fischer & Sullivan, 2002] The principals of Universal Design provide us with a thinking process and structure that can achieve the seamless lifestyle and access that we all desire.

Universal Design is identified by Seven Principals: Equitable Use, Flexibility in Use, Simple and Intuitive Use, Perceptible Information, Tolerance for Error, Low Physical Effort and Size and Space for Approach and Use. The holistic concepts of Universal Design have become universal. [NCSU, Center for Universal Design, 2012] But, also many countries have identified Universal Design principles that address their specific country. India has identified 5 principals that focus on Indianness and inclusivity as they relate to age, gender, disability, caste, class, religion, poverty and urban rural: Equitable, Usable, Cultural, Economic and Aesthetics. [Institute for Human Centered Design, 2011]

In a Transportation Research Board (TRB) paper titled Accessible Transportation and Mobility for A1E09: Committee on Accessible Transportation and Mobility, S. Ling Suen and C.G.B. Mitchell state that “accessible transportation is the passport to independent living for everyone.” Eight key areas for transportation are identified: Trip Chains, Access for All, Family of Services, Matching Supply to Demand, Accessible Vehicles, Accessible Infrastructure, Accessible Information and Human Studies. One of the key issues that they identify for sustainability of accessible improvements is Intelligent Transportation Systems. Two of their Millennium Priorities for research and development are: 1. Technologies and systems such as accessible personal vehicles for neighborhood travel and 2. Transfer systems in terminals and vehicles. [Suen & Mitchell, 2000] Looking at architecture and transportation as an interconnected system is an area for new studies that can create improvement for seamless accessibility for all. By focusing our study on a university campus we have explored some of the key concepts for seamless accessibility by synergizing architecture and transportation.

1. Southern Polytechnic State University Analysis

Currently on the Southern Polytechnic State University campus in Marietta, GA the topography and the campus design hinder seamless accessibility. The campus started in 1948 as a Technical Institute and by 1961 the campus had 120 acres of
land and 8 buildings. Today Southern Polytechnic State University has expanded and now encompasses more than 230 acres and 35 buildings. The campus is based upon a ring road structure with the main buildings of campus within the center creating a walkable campus. Sidewalks are provided on the campus and some are shaded under sidewalk canopies. However, this system relies on many stairs to form a complete movement path around the campus. (Figure 1)

Figure 1: Site Plan of Southern Polytechnic State University, Figure-Ground of Pedestrian Paths SPSU, Figure Ground Vehicle Movement, Focus Studio Fall 2009,

2. Student Analysis

Marietta, GA is in the northern part of the state and has between 50 and 70 hours of sunshine a month with a 4-5 inch monthly average of rain. It is located in Climate Region 10 with somewhat hot humid summers and is in a temperate zone. The site is a hilly terrain where the initial buildings were constructed parallel to the topography to take advantage of natural cooling due to their orientation. Subsequent buildings did not take into account the topography or the need to address cooling by natural means as these buildings were constructed with modern systems of air-conditioning. So, the campus plan presents challenges to mobility due to the amount of stairs
required to move between buildings and through campus. As well the parking lots for accessibility while located close to the entries of many buildings pose challenges of access and are parking spaces are very limited in number. A circular bus route has been added to the loop road, but it does not allow access to key points for accessibility. (Figure 2)

The path for accessibility requires that students drive up to each building where they have classes to access that particular building. So, in order to transfer between

![Accessibility Paths on Southern Polytechnic State University, Focus Studio Fall 2009, Omar Foster](image)

classes a slow indirect path through campus and/or a car is required. Driving is also not a solution to accessibility as the documentation below shows the access from this dedicated parking is less than ideal and is limited in amount. (Figure 3)

Given this analysis of the campus, providing accessibility is practically impossible for a student who wants to participate in normal student activities, let alone seamless access for all. So, looking at new movement technologies to see if they could address the mobility issues was the task for the architecture students. Personal Rapid Transit was chosen by many due to its unique features that address Universal Design Principals.

3. New Movement Technologies

Now new synergies between architecture and transportation can be explored thinking of them as one interconnected environment. Technology that allows elevators to move three-dimensionally is currently applied in the Tower of Terror ride at Disneyland, Anaheim, CA. New automobiles are appearing highlighting electric power sources, smaller sizes and even collapsible -- such as the City Mobile car designed at MIT. All of these technologies offer one new important design feature – their ability to interface three-dimensionally both inside and outside of buildings. They can also simultaneously provide seamless accessible mobility and link multiple
Figure 3: Parking for Accessibility Southern Polytechnic State University, Focus Studio Fall 2009, Omar Foster

transit systems, changing transportations’ relationship with urban design and architecture.

Personal Rapid Transit (PRT) as a new concept in urban transport has been studied since the 1950’s. The first system was placed in operation, at West Virginia University in 1972 with a fully automated computer driven system. This system was well ahead of its time. It is currently still operational today and is under consideration for expansion. The basic concept of PRT is now being rediscovered around the world with the first modern system in place at Heathrow Airport. The approach is unique as small cars of 4-6 people are provided on demand and travel to the user’s destination on a point-to-point basis similar to a cab. Stations can be placed closer together due to off-line station configurations, smaller vehicle size and interconnectivity of the system. The transit “pods” can easily be accessed by the entire range of people from wheelchair bound to cognitive disabilities. [ultra, 2012] The user can have communication while in the vehicle and the navigation systems can implement the latest standards of talking kiosks. [Touch Graphics Inc., 2012] The computers of today have now caught up with the technological concept allowing
the new systems that have just been implemented to be quite cost effective compared to other transportation systems at 10-15 million dollars per mile while also addressing sustainability and accessibility. This form of transport has been named by the European Commission Directorate General for Energy and Transit as the Sustainable future of transit.

Since the vehicle is one of the examples of Universal Design the rest of the system connections need to also meet this high standard and it has the potential to do so. Another benefit to this system is its size and energy source. Because it is either electric or runs on batteries (and could be solar driven or use other alternative power sources) the ability of the transit vehicle to enter buildings can now become a reality. The vehicle can operate at grade, above/below grade and within buildings providing a level of interconnectivity and seamless access that we are rarely able to achieve in transit systems. As well due to the scale of the vehicle, elevators for vehicles (such as used in car parking) can be used to move the system vertically to navigate historic environments or other site conditions without any disruption. So, two Millennium priorities can be addressed using PRT technology. These systems are also seen as solving the “last mile” problem in transportation and as such could serve as accessible personal vehicles for neighborhood travel and as transfer systems in terminals such as the PRT system at Heathrow airport. [Young, Miller, McDonald, 2008] Integrating PRT and other new forms of movement such as electric vehicles

Figure 4: Photographs of PRT Systems and Market Area TL: Photograph complements of Stan Young, Kansas DOT, University of Maryland, Center for Advanced Transportation Technology, TR: Courtesy Martin Lowson:© ULTra Advanced Transport Systems Ltd, B: Conceptual comparison of modes in the Accessibility – Throughput Spectrum from Young, Miller, McDonald. 2007.
and elevators that can move in three dimensions within architectural building types along with the larger multi-modal stations is a more sustainable solution. (Figure 4)

4. Seamless Access Southern Polytechnic State University

Several key issues are involved in providing more accessible transit use and the solution lies in their interfaces and overlaps, not in their isolation. These architectural ideas relate to the eight key areas of transportation identified by S. Ling Suen and C.G.B. Mitchell. The issues are: (1) mode of transportation, (2) energy source/sustainability, (3) human interface, (4) physical location, and (5) actual design. Working to combine these multiple concepts can create fully seamless interconnectivity, but they all must be thought about as a whole design rather than the sum of the parts.

These newly emerging movement systems will allow easier access for all ages as station design can now be integrated within buildings. Navigating steep topography as well as connecting multiple forms of transit to create a seamless system will allow faster and smoother access for all. Linking spaces and places in entirely new ways, the architects’ unique spatial training will become essential in allowing these new technologies to be implemented to their full potential.

The architecture students at Southern Polytechnic State University explored a variety of solutions in different parts of the campus, but the main theme was to provide complete mobility to participate in the full academic activities of the campus. In order to achieve this goal the key issue that had to be addressed was the topography of the campus and its relationships to buildings. A system of movement was required that allowed complete independent flexibility of destination for each student in a timely fashion. Only a PRT system can meet this goal as it allows for access within new spatial constructs and provides the flexibility required by the academic setting.

Locating the stations, along with strategies for seamless movement became the focus of their results. Key linking stations were first located around campus after thorough analysis of pedestrian and car movement patterns. Once these key nodes were identified, multiple transit paths were identified through campus. The topography from each location had to be carefully studied to see where the proper location was – at grade, elevated and last choice below grade in relationship to the other stations – in other words how to spatially connect the system. A one approach fits all – that is all elevated versus all underground was not the simple solution that one first imagines, so working with the existing topography and building relationships provides a more seamless solution. (Figure 5)

So, the key for seamless solutions is thinking of the multiple spatial interconnections that can occur for the given area of design. Thinking abstractly the diagrams below express the endless possibilities that could occur due to the merger of new technologies and architecture when attempting to create seamless access for all. (Figure 6)
CONCLUSION

With the current development of modern transit systems such as PRT and other emerging movement technologies many new ways to connect and interconnect can now be explored. These potential relationships have the ability to address universal design principles: Equitable Use, Flexibility in Use, Simple and Intuitive Use, Perceptible Information, Tolerance for Error, Low Physical Effort and Size and Space for Approach and Use while also addressing the five Indian principles of Equitable, Usable, Cultural, Economic and Aesthetics. That is why the Indian government has started one PRT application and is considering several other locations for this emerging form of transit.
Figure 6: Abstract Spatial Diagrams  
L: University of Nebraska Student: Brandon Zahurba, 2001,  
R: Montana State University Student: Matthew Killiam, 2002

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