Green Architecture and Environmental Design using Rapid-Prototyping Social-Networking Sandbox Tools, followed by Professional Architectural Software

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0223

The Asian Conference on Sustainability, Energy & the Environment 2013

Official Conference Proceedings 2013

Abstract

In 2012 the United Nations UN-Habitat's Sustainable Urban Development Network partnered with sandbox-game developers of the social-networking block-by-block building software Minecraft to upgrade 300 public spaces worldwide by 2016 by joining professional designers with local inhabitants in virtual-world simulations. This work is similar to the authors' research since early 2011 where a Minecraft server and concurrent database server were configured for peaceful architectural development by players worldwide, and in five college engineering and architectural courses. Students build green homes, plant gardens, and raise livestock in green villages, or on a virtual college campus within environments containing simulated weather, terrains, biomes, and AI-enhanced animals. Student avatars interact to design. Social-media scrolls across the screen so everybody can be heard. Student homes have active & passive solar, thermal mass, natural daylighting, mitigation of cold northern winds, and an overall architectural esthetic. Students create gardens, livestock areas, piazza's, markets, parks, and a wellness center with indoor pool and activity rooms. Credit is given for using the software's electrical, mechanical, and logic design features. Selected students are invited to develop professional architectural drawings. LEED (Leadership in Energy and Environmental Design) concepts are incorporated throughout. Future goals included implementing these methods in new architectural studio courses and at universities abroad; helping extend the UN/Minecraft concept to developed countries; and merging this research with the author's research in robotics & machine intelligence including interactive environmental maps communicating with real-time robots. Long-term goals include on-line virtual-reality classrooms and laboratories with real-time language translation and lifelike avatars.

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I. Introduction

The conceptual design phase of architectural and urban design projects should be rapid, with minimal constraints. Only main concepts and architectural elements should be explored so that a maximum number of design variations and decisions can be made. Figure 1 (and YouTube video: http://www.youtube.com/watch?v=6IuSOSjbJEE&feature=plcp) show a rendition of Frank Lloyd Wright's Robie House created in a few hours by Joseph John Wunderlich in 2011. Only simple images of the existing building [1] were viewed before the rendition was made using Minecraft, a sandbox game for building with the block primitives shown in figure 2 [2] (some of the original primitives, many more have been added). As of January 22, 2013, over 20 million copies of Minecraft have been sold across all platforms [3]. The United Nations began using Minecraft in 2012 for sustainable design of 300 sites worldwide; The U.N., architects, and planners use this multi-user, social-networking tool to allow the inhabitants of each site to become part of the design process [4].

Figure 1. Rendition of Frank Lloyd Wright's Robie House by Joseph John Wunderlich in 2011 (created in a few hours).

Figure 2. Minecraft block primitives [2].

II. Minecraft vs. Traditional Foam-Board Conceptual Design

The use of Minecraft for conceptual design can be much faster than traditional foam-board as shown in figures 3, 4, and 5 (including Minecraft models by Joseph John Wunderlich in 2013).

Figure 3. Structure before new architecture *(digging started in Photo #2)*, and foam-board model (2000).

Figure 4. Foam-board models for the Wunderlich residence renovation (several weeks of work).

Figure 4. Built architecture, and rapidly-created virtual models (façade created in minutes in 2013).

III. Rapid Prototyping of Cities

The speed of designing and building in Minecraft can enhance the relationships between buildings, plaza's, landmarks, pathways, and districts while improving the adherence to a common design style. The images in figure 5 show some of the 30+ buildings and gathering spaces built off-line by Joseph John Wunderlich in his "Joseph's Kingdom" in 2011.

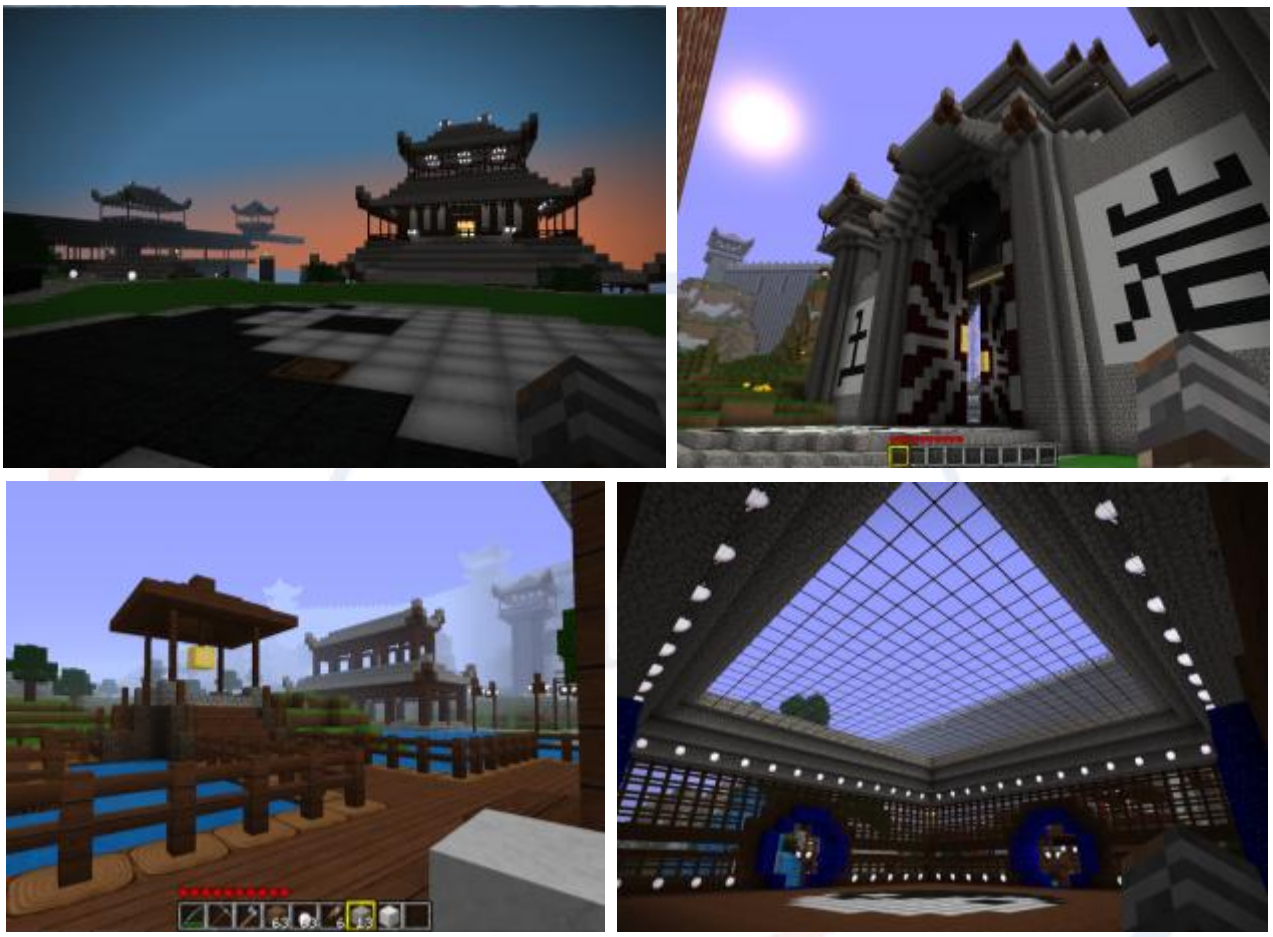

Figure 5. Rapidly-prototyped 30+ buildings in "Joseph's Kingdom" (created in a few weeks in 2011)

IV. Rapid Prototyping of Networked International Communities

Minecraft can also allow participants from around the world to create virtual civilizations; with governments, monetary systems, socio-economic hierarchies, and laws. The images in figures 6, 7 and 8 show some of the first (of hundreds) of buildings and gathering spaces built by Joseph John Wunderlich in 2011 in "Tsojin," our multi-world multiuser Minecraft server developed for players from around the world to create architecture, urban design, and civilizations in a peaceful setting. See YouTube Video: http://www.youtube.com/watch?v=Y1r1dL007YA

Figure 6. Town-center of our "Tsojin" server.

The original server organized a few of the most dedicated young designers from, who had worked together on less peaceful servers, to help administrate Tsojin: Joseph (USA), Eve (Canada), and Cameron (England). Dr. Wunderlich hosted the server on one of his computers and Joseph John designed a player-ranking system to allow incremental use of more powerful commands as players gain skills and trust. Dr. Wunderlich also configured a concurrently running database server to log all activity and allow administrators to undo damage by players (as shown in figure 7). He also implemented foul - language censorship, and disabled features such as fire-spread, placing lava, and TNT. Figure 9 shows part of the new Tsojin to be released in 2013.

Figure 7. A concurrent database server allows rollback of "griefing" so architecture and civilizations can be created in a peaceful setting.

Figure 8. Several hundred buildings have been created by Joseph John Wunderlich (avatar shown) in Tsojin and on other servers between 2011 and 2013. VIDEO: http://www.youtube.com/watch?v=Y1r1dL007YA

Figure 9. New Tsojin server to be released in 2013

To create a more powerful server, a third-party "Bukkit" server mod "CRAFTBUKKIT" [5] is used to allow the following features:

1) Player ranking; Ours was designed by Joseph John Wunderlich in 2011 with six ranks: *Guest, Builder, Architect, Master, Admin, and Grandmaster* -- each having many accumulated commands. Bukkit plug-ins "ESSENTIALS," "PERMISSIONS," "CHAT," and "GROUPMANAGER" were configured.
2) Concurrently running SQL database server [6] and plug-in "LOGBLOCK" configured with many tables for logging player activity to allow rolling-back of "griefing" (destruction or construction by un-invited or misbehaving players). The initial release of Tsojin was public with no restrictions on who could play. Unfortunately, due to griefing (including organized griefing teams) Tsojin was made private (with a "whitelist" of users vetted by us and trusted high-ranking players.
3) Multi-world plug-in to allow running many concurrent worlds (and teleportation & gateways between them). Tsojin has six worlds: the main world, two private worlds, "DigitalDesignWorld" (shown in Figure 10)," "FYSworld" for College freshman to build Green towns, and a survival world where all materials (and food) must be hunted or gathered (including mining) and tools and other materials are crafted as shown in figure 11.
4) Many other plug-ins (foul-language censorship, establishing monetary systems, allowing aircraft and vehicles to move, locking tool chests, sign-posting, etc.).

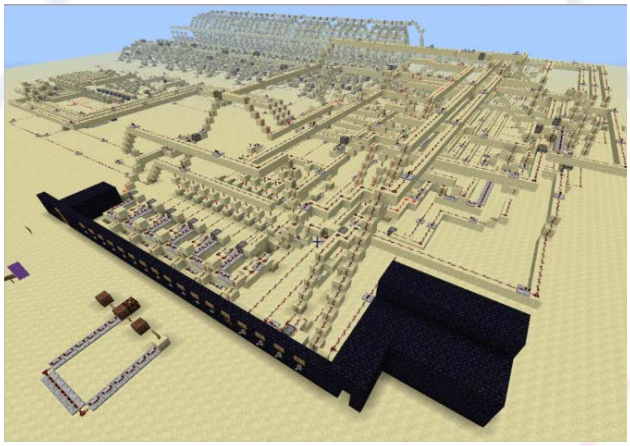

Figure 10. Tsojin "DigitalDesignWorld"– combination lock by student Tom Gorko

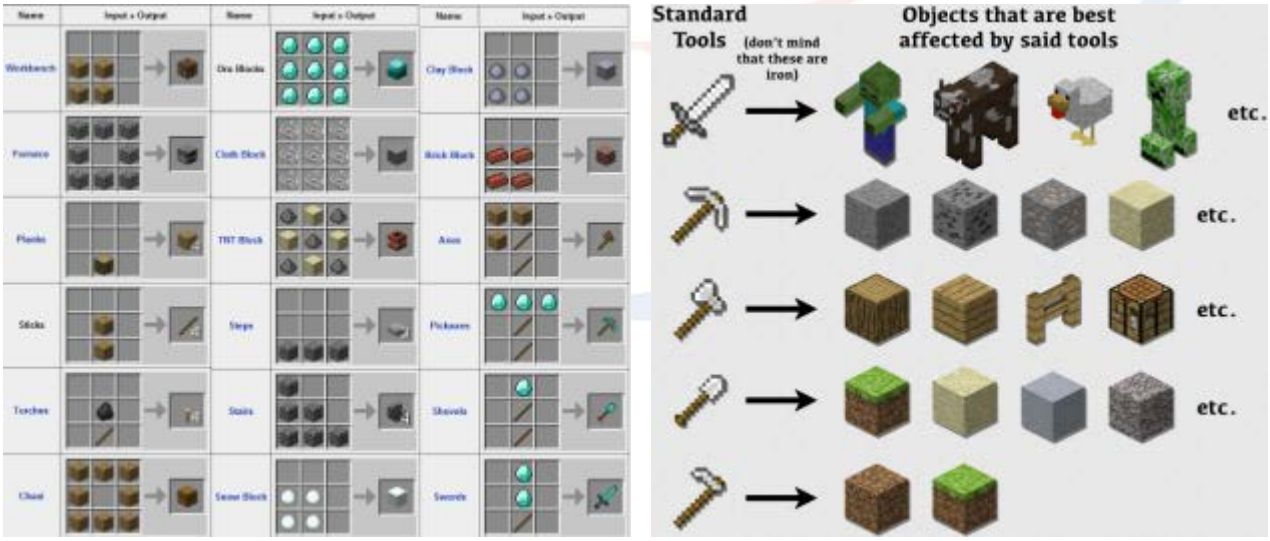

Figure 11. In Tsojin server "survival world" all materials (and food) must be hunted or gathered (including mining); and tools and other materials are crafted *(initial hunting and gathering is with no tools).*

V. Rapid Prototyping of College Campus Architecture

Minecraft can be used as an educational tool in Colleges and Universities. In 2012, classes of college students performed school assignments on Tsojin and on a sister-server hosted by Ricky Sturz, an EGR280 Engineering Research student of Dr. Wunderlich. The first initiative was to have 16 freshmen construct a facsimile of the Elizabethton College Hackman Apartments on the Strurz server running on a third-party secure computer in New York City, with added capacity to handle 40 players simultaneously (funded by Dr. Wunderlich). Four designated team leaders, who had developed skills on Tsojin during the summer before their Freshman year, set standards for the team-build, They also toured the actual buildings before the event. EGR280 Engineering Research student Ricky Sturz defined the footprint of the buildings. The results of this small-scale crowdsourcing activity can be seen in figure 12 and in the following YouTube video: http://www.youtube.com/watch?v=CNzKo3etfSU&feature=plcp -- plus more on Dr. Wunderlich's YouTube channel: http://www.youtube.com/channel/UC_kM_k93zreIu40CVwuHQzg?feature=watch

Figure 12. Model of Elizabethtown College Hackman apartments built BLOCK by BLOCK in two hours by Dr. Wunderlich's 16 students in course "Scientific Modeling for Sport" demonstrates emerging student research in small-scale crowdsourcing. **VIDEO:** http://www.youtube.com/watch?v=CNzKo3etfSU&feature=plcp
(Dr. Wunderlich's avatar shown on left)

Another college project was a team-build of Elizabethtown College's Masters Center for Science, Math, and Engineering; with participation from students in five courses (and results shown in figure 13):

Dr. Wunderlich's EGR280 Engineering Research student Ricky Sturz
Dr. Michael Silberstein's Cognitive Science Course (12 students)
Dr. Wunderlich's First Year Seminar Scientific Modeling for Sport (16 students, 2 TA's)
Dr. Wunderlich's EGR332 Computer Organization & Architecture course (16 students)
Dr. Wunderlich's EGR343 Green Architectural Engineering course (7 students)

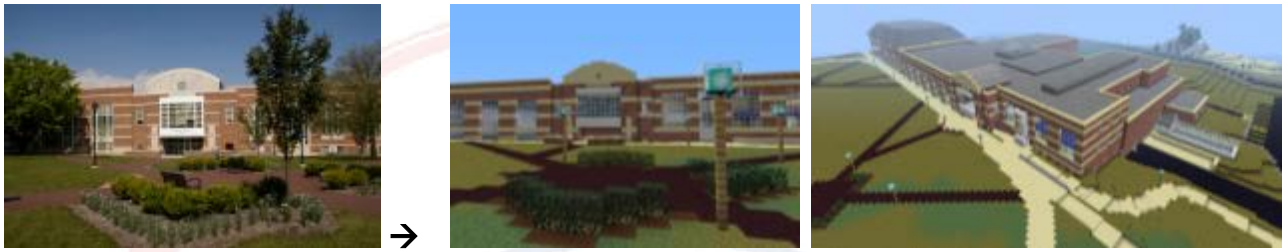

Figure 13. Elizabethtown College's Masters Center built BLOCK by BLOCK in 3 hours by students from five courses (footprint and partial facade established in advance by student Ricky Sturz).

VI. Rapid Prototyping of Green Communities

The semester project in 2012 Scientific Moderling for Sport course was: *"**Individual Green Home Architectural Builds, and Community-Development Environmental-Planning**"*
This assignment (with selected results shown in figures 14, 15, and 16) was defined as:

Build a Green home in Tsojin FYSworld in your designated village (one of four Green towns). Assume you're in a southeastern Pennsylvania climate. Your grade will be based on:
PASSIVE SOLAR: Without use of electrical or mechanical devices, let light into house to warm it in winter, but not overheat it in summer. Remember that the sun rises in the East, sets in the West, tracks across the sky at high angles during hot months, and at low angles during cold months. Since Minecraft doesn't yet have variable sun paths, just be aware of which direction is South – figure it out from the trajectory of the sun. Create overhangs on roofs to strategically shade windows (estimate dimensions), and note that too many west-facing windows may cause overheating. Also, have sun shine on interior thermal mass's to absorb heat during the day and release it at night. Assume thick masonry works very well, and water works even better but may be more difficult to implement (and maintain).
ACTIVE SOLAR: Simulate solar panels using a black material and place them on your house and around your site to maximize energy generation while not disrupting movement of people & animals. Creatively angle them towards the sun.
NATURAL DAYLIGHTING: Maximize entrance of sunlight into your house while not overheating the house in summer.
MITIGATE COLD NORTHERN WIND: Through site selection, placing of dirt & grass, and design of your building's northern elevation (including wall thickness and materials chosen), shield the house from cold Northern winds; but consider letting some light in for natural daylighting and preserving views.
COMMUNITY GARDEN: Help create a large community garden of eatable plants -- till/hoe ground; place water (in adjacent trenches) with water bucket. Plant carrots, potatoes, seeds, etc, and fertilize everything with bone meal.
COMMUNITY LIVESTOCK: Help create animal pens & shelters; and spawn many animals for meat and producing milk.
OVERALL ARCHITECTURAL ESTHETIC: House should not only be the ultimate sustainable habitat, but also must be livable and have a high-quality architectural esthetic on the interior and exterior -- so balance all criteria above while creating beautiful architecture. Your architecture should also be complimentary to all else in your village.
URBAN DESIGN and CITY PLANNING: Help create common-areas including piazza's, a central market, a central park, etc., -- and designate a large lot to be used by visiting high-school students to build a Wellness Center in your town (with indoor pool, large activity room, and lockers).
EXTRA CREDIT: Make something electromechanical, and operate it with circuits and logic gates.

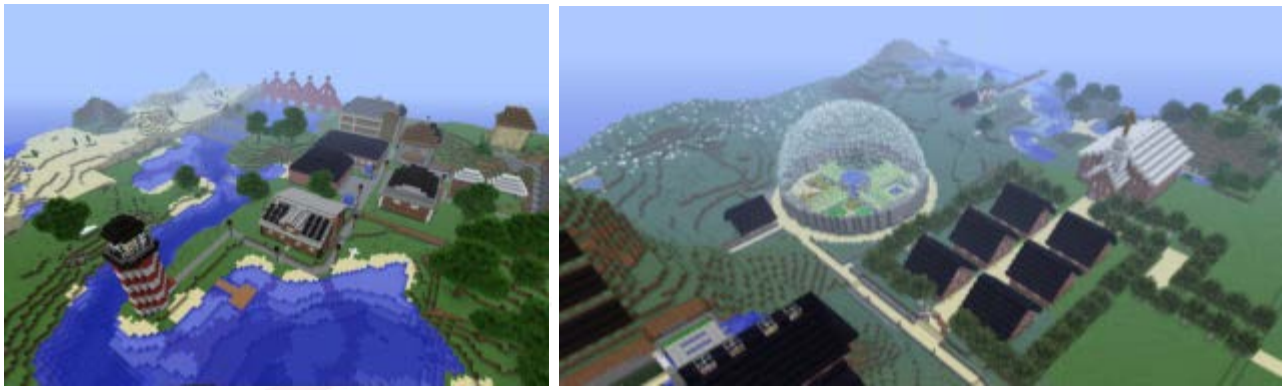

Figure 14. Two of the four Green towns in Tsojin FYSworld, including one with a bio-dome.
VIDEO: http://www.youtube.com/watch?v=HdCfW0tkWkc and http://www.youtube.com/watch?v=NDOyiYTJHpM

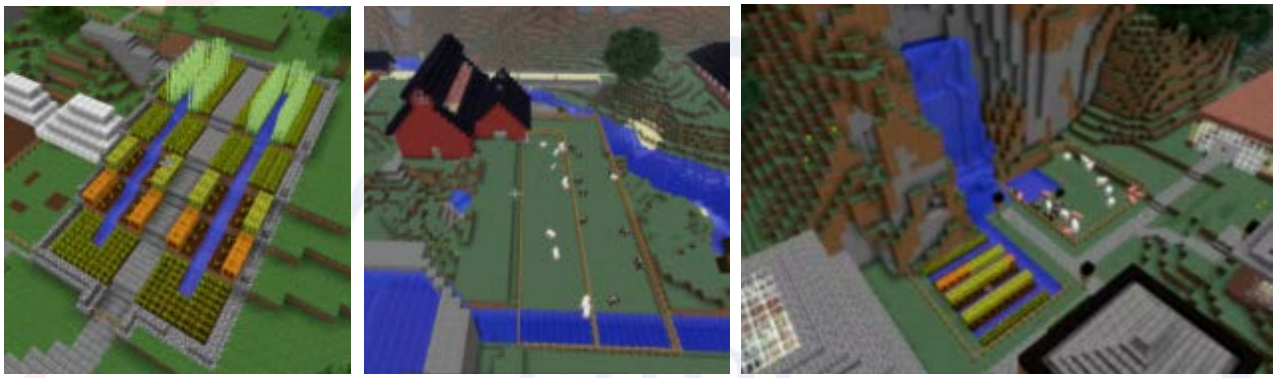

Figure 15. Community gardens and livestock required in all Green towns.
VIDEO: http://www.youtube.com/watch?v=HdCfW0tkWkc, http://www.youtube.com/watch?v=NDOyiYTJHpM and http://www.youtube.com/watch?v=Zh456JQxFJ0

Figure 16. Active & passive solar, maximum natural daylighting, and thermal mass in Green towns
VIDEO: http://www.youtube.com/watch?v=HdCfW0tkWkc

VII. Rapid Architectural Prototyping for Recruiting College Students

In 2012 Dr. Wunderlich organized a recruiting event as part of the college's Engineering & Physics Department-Day. Twenty-four visiting high school students built in Green towns in Tsojin FYSworld. In only one hour, each team of four built a Wellness Center in a town – with pool, activity room, and locker rooms. Figure 17 shows the winning designs judged from entries by all six competing teams.

Figure 17. Best activity room and pools built in one hour by competing visiting high school student teams.

VIII. Professional Architectural Software after Rapid-Prototyping

The complexity and effort needed to create "Working Drawings" and detailed construction specifications to build a building requires professional architectural software after the initial conceptual design phase is completed using rapid prototyping. In 2006, student Bryan Kuppe in one of Dr. Wunderlich's EGR280 Engineering Research courses developed with "Rhinoceros" and "Flamingo" software detailed renderings for the new Elizabethtown College Steinman Building Lobby Renovations as shown in figure 18, and in 2008, in another Wunderlich EGR280, developed renderings for the Robotics and Machine Intelligence Lab shown in figure 19. These drawings helped both these spaces become a reality. In 2012 and 2013 Revit software is being used by students in Wunderlich's EGR280's and EGR343 Green Architectural Engineering courses as shown in figure's 20 and 21 with the accomplishments of students Emily Vogel and Kaylee Werner.

Figure 18. 2006 student Bryan Kuppe used "Rhinoceros" and "Flamingo" software for Elizabethtown College Steinman Building Lobby Renovations.

Figure 19. 2008 student Bryan Kuppe used "Rhinoceros" and "Flamingo" software for Elizabethtown College's new Robotics and Machine Intelligence Lab.

Figure 20. 2012 student Emily Vogel used Revit software for LEED redevelopment of her family's New Jersey shore vacation property destroyed in 2012 by hurricane Sandy.

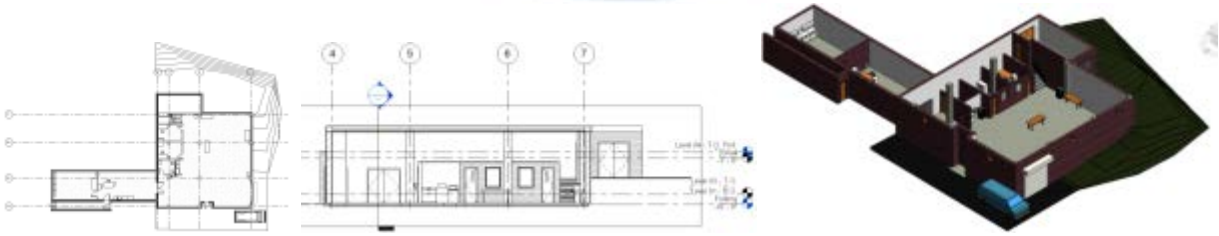

Figure 21. 2013 student Kaylee Werner used Revit software for proposed Engineering & Physics department shop extension ("Fabrication Lab")

IX. Prototyping to Promote Building New Field-House/Wellness-Center

In only one semester in 2012 Dr. Wunderlich's EGR280 Engineering Research student Ricky Sturz modeled the entire Elizabethtown College campus using Minecraft, then proposed a Field-House/Wellness-Center; Ricky has now begun using the professional architectural software Revit to continue this work. Images for some of these buildings are shown in Figure 22 and on YouTube: http://www.youtube.com/watch?v=YS38Cki7hck&feature=plcp. Previously, in 2009, student Bryan Kuppe in one of Dr. Wunderlich's EGR280 Engineering Research courses developed with "Rhinoceros" and "Flamingo" software proposed enhancements to the present Elizabethtown College athletic facilities as shown in figure 23. This work, although much more detailed than if done in Minecraft, required the entire semester to complete. Both the 2009 and 2012 prototyping initiatives hopefully contributed to the recent decision by the Elizabethtown College trustees to vote yes on spending many millions of dollars to build a large Field-House/Wellness-Center.

Figure 22. 2012 student Ricky Sturz modeled entire campus in only one semester using Minecraft, including his proposed Field-House/Wellness-Center that he's now using Revit software on.

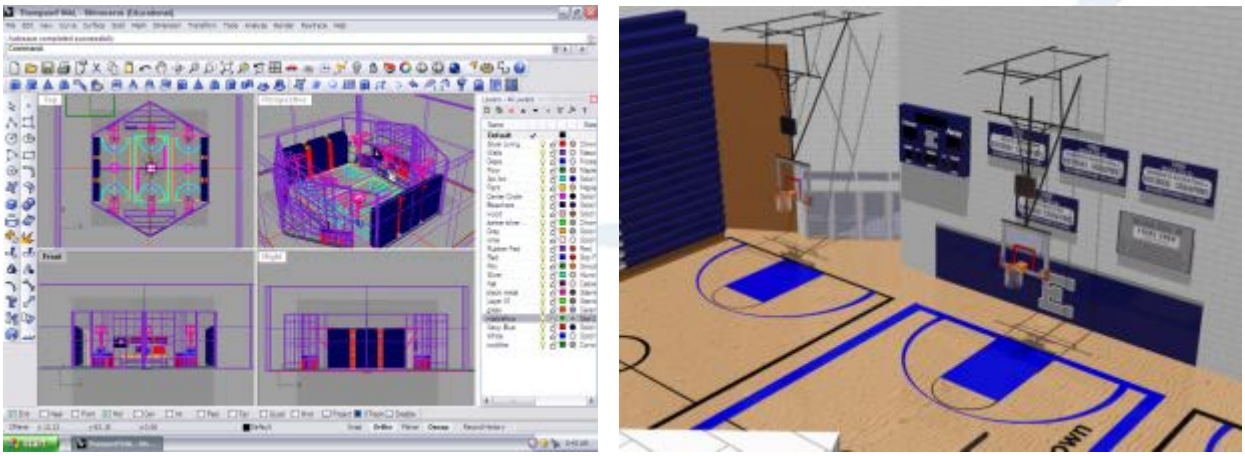

Figure 23. In 2009 student Bryan Kuppe used "Rhinoceros" and "Flamingo" software for proposed enhancements to the present athletic facilities. This work required the entire semester to complete.

X. Green Standards for Architecture and Environmental Design

Although many countries have federal laws for maintaining very high green standards in architecture and environmental design throughout their country, the United States has a spectrum of laws that vary by state, county, township, city, and changing political tides; however the LEED standard (Leadership in Energy and Environmental Design) is becoming increasingly accepted throughout the U.S., and is followed on an increasing number of international projects. The project shown in figure 24 was designed to LEED standards by student Vaclav Hasik in Dr. Wunderlich's Green Architectural Engineering course. Figure 25 and 26 shows LEED analysis of the Wunderlich project "*WUNDERessin EAST"* which willlikely soon become a new laboratory for students.

Figure 24. 2012 student Vaclav Hasik used Revit software for LEED redevelopment of a Philadelphia, Pennsylvania city block.

XI. Future Work

Future goals include implementing these methods in new architectural studio courses required for the new Architectural Studies Minor and possibly at two universities in Italy; helping extend the UN/Minecraft concept to developed countries; merging this research with the author's research in robotics & machine intelligence including interactive environmental maps communicating with real-time robots; and possibly expanding research into an additional lab at *WUNDEResin EAST* shown in figure 25. The College's varied related initiatives shown in the appendix could lead to many new collaborations. Long-term goals include teaching a related Massive Open Online Course (MOOC), and creating on-line full-immersion virtual-reality classrooms and laboratories with real-time language translation and lifelike avatars.

Figure 25. Wunderlich project *WUNDERessin EAST* barn likely to become lab space for students.

LEED-NC v3.0 (2009) Preliminary Project Checklist
"*WUNDEResin EAST*" (J. Wunderlich Residence/Farmette, possible future Bed & Breakfast) **16-Oct-12**
Near Elizabethtown College, Pennsylvania **Preliminary Review Only - Subject to Change**

Yes	?	No			
11			**Sustainable Sites**	26 Points	
Y			Prereq 1 **Construction Activity Pollution Prevention**	Required	
1			Credit 1 **Site Selection**	1	UNOBSTRUCTED SOUTHERN EXPOSURE,SHIELDED NORTHRN, A+ VIEWS
5			Credit 2 **Development Density & Community Connectivity**	5	COMPLIMENTS/PRESERVES FARM COMMUNITY ESTHETIC AND CULTURE
		N	Credit 3 **Brownfield Redevelopment**	1	not applicable, BUT RESTORATION OF 150-YEAR OLD STRUCTURES
		N	Credit 4. **Alternative Transportation**, Public Transportation Access	6	not applicable IN FARMING COMMUNITY
1			Credit 4. **Alternative Transportation**, Bicycle Storage & Changing Rooms	1	BIKES FOR EVERY FAMILY MEMBER
		N	Credit 4. **Alternative Transportation**, Low-Emitting and Fuel-Efficient Vehicl	3	NOT YET -- PLANNING HYBRID VEHICLE PURCHASE
		N	Credit 4. **Alternative Transportation**, Parking Capacity	2	not applicable IN FARMING COMMUNITY
1			Credit 5. **Site Development,** Protect of Restore Habitat	1	212 TREES PLANTED, FENCED-IN WILDLIFE, BIRD SANCTUARY CREATED
1			Credit 5. **Site Development,** Maximize Open Space	1	EXTENSIVE -- 3-1/2 Acres
1			Credit 6. **Stormwater Design,** Quantity Control	1	FRENCH DRAINS AROUND NEW CONSTRUCTION
		N	Credit 6. **Stormwater Design,** Quality Control	1	GREY-WATER SYSTEM BEING CONSIDERED
		N	Credit 7. **Heat Island Effect,** Non-Roof	1	not applicable IN FARMING COMMUNITY
		N	Credit 7. **Heat Island Effect,** Roof	1	not applicable IN FARMING COMMUNITY
1			Credit 8 **Light Pollution Reduction**	1	RECYCLE ALL PLASTIC AND PAPER, DONATE CLOTHES, ETC. TO POOR
3			**Water Efficiency**	10 Points	**Notes**
Y			Prereq 1 **Water Use Reduction,** 20% Reduction	Required	
1			Credit 1 **Water Efficient Landscaping**	2 to 4	MINIMAL IRRIGATION FOR TREES AND 3 TO 4 GARDENS PER YEAR
1			Credit 2 **Innovative Wastewater Technologies**	2	NEW DRAINFIELD
1			Credit 3 **Water Use Reduction**	2 to 4	LOW-PRESSURE WELL; DISHES: HAND-WASH + ENERGY-EFF DISHWSHR
7			**Energy & Atmosphere**	35 Points	**Notes**
Y			Prereq 1 **Fundamental Commissioning of the Building Energy Systems**	Required	
Y			Prereq 2 **Minimum Energy Performance**	Required	
Y			Prereq 3 **Fundamental Refrigerant Management**	Required	
6			Credit 1 **Optimize Energy Performance**	1 to 19	OIL + ELECTRIC ZONES WITH ARTIFICIAL INTELLIGENCE COMING
1			Credit 2 **On-Site Renewable Energy**	1 to 7	ACTIVE SOLAR, GROUND WATER LOOP, & WIND BEING CONSIDERED
		N	Credit 3 **Enhanced Commissioning**	2	not yet
		N	Credit 4 **Enhanced Refrigerant Management**	2	not yet
		N	Credit 5 **Measurement & Verification**	3	not yet
		N	Credit 6 **Green Power**	2	not yet
11			**Materials & Resources**		**Notes**
Y			Prereq 1 **Storage & Collection of Recyclables**	Required	
3			Credit 1. **Building Reuse**, Maintain Existing Walls, Floors & Roof	1 to 3	EXTENSIVE -- PRESERVATION OF 95% OF EXISTING STRUCTURES
1			Credit 1. **Building Reuse**, Maintain 50% of Interior Non-Structural Elements	1	EXTENSIVE - 90% MAINTAINED
2			Credit 2 **Construction Waste Management**	1 to 2	EXTENSIVE -- PRECISE MATERIAL ESTIMATES, NO DUMPSTERS
2			Credit 3 **Materials Reuse**	1 to 2	EXTENSIVE -- ALL POST & BEAMS, AND SIDING, AND STONES
	?		Credit 4 **Recycled Content**	1 to 2	SOME, BUT UNCERTAIN PERCENTAGE
2			Credit 5 **Regional Materials**	1 to 2	85% LOCAL BUILDING SUPPLIER w/in 10 miles, REUSE OF WOOD & STONE
1			Credit 6 **Rapidly Renewable Materials**	1	90% WOOD CONSTRUCTION
	?		Credit 7 **Certified Wood**	1	POSSIBLY SOME -- NEED TO CHECK RECORDS
11			**Indoor Environmental Quality**	15 Points	**Notes**
Y			Prereq 1 **Minimum IAQ Performance**	Required	
Y			Prereq 2 **Environmental Tobacco Smoke** (ETS) **Control**	Required	
		N	Credit 1 **Outdoor Air Delivery Monitoring**	1	
1			Credit 2 **Increased Ventilation**	1	ATTIC TEMP-CONTROLLED FANS, PLENUMS FOR OPTIMAL AIR-FLOW
1			Credit 3. **Construction IAQ Management Plan**, During Construction	1	MASKS,NEGTVE-PRESS CONTAINMENT, AND VENTILATION/FANS ALWAYS
1			Credit 3. **Construction IAQ Management Plan**, Before Occupancy	1	CONTAINMENT AND VENTILATION
1			Credit 4. **Low-Emitting Materials**, Adhesives & Sealants	1	WATER-BASED WHEN POSSIBLE
1			Credit 4. **Low-Emitting Materials**, Paints & Coatings	1	LOW-VOC'S (Volatile Organic Compounds), PAINTS WATER-BASED
1			Credit 4. **Low-Emitting Materials**, Flooring Systems	1	ALL-WOOD, MINIMAL VOC'S
	?		Credit 4. **Low-Emitting Materials**, Composite Wood & Agrifiber Products	1	ALWAYS ATTEMPTED MINIMAL VOC'S -- NEED TO CHECK RECORDS
1			Credit 5 **Indoor Chemical & Pollutant Source Control**	1	RADON TESTED, CO2 MONITORED, INCREASED VENTILATION
		N	Credit 6. **Controllability of Systems**, Lighting	1	NOT YET, BUT DAILY FAMILY LIGHTING-MINIMIZATION PLAN
1			Credit 6. **Controllability of Systems**, Thermal Comfort	1	SEVERAL PROGRAMMED ZONES (ARTIFICIAL INTELLIGENCE PLANNED)
1			Credit 7. **Thermal Comfort**, Design	1	PROGRAMMED ZONES, DEHUMIDIFICATION
		N	Credit 7. **Thermal Comfort**, Verification	1	NOT YET
1			Credit 8. **Daylight & Views**, Daylight 75% of Spaces	1	EXTENSIVELY OPTIMIZED
1			Credit 8. **Daylight & Views**, Views for 90% of Spaces	1	EXTENSIVELY OPTIMIZED
5			**Innovation & Design Process**	6 Points	**Notes**
1			Credit 1. **Innovation in Design**: Provide Specific Title	1	EXTRA INSULATION,Vapor & Moisture BARRIERS;Northern BUFFER SPACES
1			Credit 1. **Innovation in Design**: Provide Specific Title	1	OVERALL BUILDING HAS LOW SURFACE-AREA TO VOLUME RATIO
1			Credit 1. **Innovation in Design**: Provide Specific Title	1	STRUCTURAL REINFORCING OF OLD HOUSE WITH NEW FOUNDATIONS
1			Credit 1. **Innovation in Design**: Provide Specific Title	1	99% CONSTRUC BY OWNER W/ HAND-TOOLS, 70 YARDS DIRT W/SHOVEL
1			Credit 1. **Innovation in Design**: Provide Specific Title	1	212 NEW TREES: PASSIVE-SOLAR, WINDBLOCK, NOISE-CONTROL, BIRDS
		N	Credit 2 **LEED® Accredited Professional**	1	OWNER PREPARING TO TAKE LEED GA EXAM
2			**Regional Priority**	4 Points	**Notes**
1			Credit 1. **Regional Priority**: Provide Specific Title	1	PRESERVING EXISTING FARMHOUSES AND BARNS
1			Credit 1. **Regional Priority**: Provide Specific Title	1	3 TO 4 WORKING GARDENS PER YEAR -- AGRICULTURAL ZONING
			Credit 1. **Regional Priority**: Provide Specific Title	1	
			Credit 1. **Regional Priority**: Provide Specific Title	1	
50			**Project Totals (pre-certification estimates)**	110 Points	**ADD 15 POINTS WHEN SOLAR, WIND, & AI ZONES DONE**
Yes	?	No	Certified 40-49 points Silver 50-59 points Gold 60-79 points Platinum 80-110 points		

Figure 26. 2012 academic LEED assessment of Wunderlich project "*WUNDERessin EAST.*"

XII. Conclusions

The United Nations is using Minecraft to include the inhabitants of 300 international sites in the design process [4]. This work is closely related to the work in this paper. College projects include green homes, green villages, and a virtual college campus in virtual worlds containing simulated weather, terrains, biomes, and AI-enhanced animals that can bring a new level of realism to the design process. Player avatars interact to collectively design and build (or in "survival mode," hunt, gather, and make tools). This group problem solving can be considered small-scale crowdsourcing or even an on-going charette. The social-media streaming dialog enhances collaboration. Student homes have passive solar, active solar, natural daylighting, mitigation of cold northern winds, and an overall architectural esthetic; each student contributes to a community garden, community livestock (barns and corrals), and overall urban design and city planning including piazza's, a central market, parks, and a wellness center with an indoor pool and large activity room. Credit is given for using digital logic circuit design and electromechanical devices. Selected students are invited to develop professional architectural construction drawings ("working drawings") and detailed specifications. LEED (Leadership in Energy and Environmental Design) architectural sustainability concepts are incorporated throughout. This educational methodology has enhanced interdisciplinary collegiality; with not only engineering and architectural student interest, but also interest from students in computer science, cognitive science, the arts, and the humanities; some of this can likely be attributed to the development of not only the built environment, but also the creation of virtual civilizations -- with governments, monetary systems, and laws. The youngest generation of students entering college are particularly interested. As of January 22, 2013, over 20 million copies of Minecraft have been sold [3]. Many in-coming college freshmen have been engaged by our Minecraft server Tsojin, and have perhaps been drawn into new possibilities for their academic and professional careers. The combining of rapid prototyping conceptual design with conventional professional architectural software is helping strengthen the college's relationships with outside organizations and architectural design firms. Recent student projects using standard professional architectural software have helped facilitate building renovations, a new robotics and machine intelligence lab, and an engineering shop extension. The proposed methodology of combining rapid-prototyping with professional tools for a new campus Field-House/Wellness-Center should help facilitate this large project. Future work includes extending this research to software developers, international universities, and the United Nations. An important aspect of the proposed methodology is the social dynamic of participants mentoring each other as shown in Figure 27, and the possibilities of having people of all ages, races, and beliefs collaborate from around the world regardless of design skills. This could have a positive impact on civilization; and our younger generations have already accepted the intense connectivity of our rapidly changing world.

Figure 26. 2012 students mentoring each other.

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Author Bio's:

Dr. Joseph Thomas Wunderlich has designed two neurocomputers and part of an IBM supercomputer operating system. His Ph.D. (U. Delaware) and M.Eng. (Penn State) are in Electrical and Computer Engineering. He's conducted robotics research and taught a Ph.D. course at the University of Trento in Italy. He's taught 31 courses including eight new ones. He also has a BS in Architectural Engineering (U. Texas) and an almost-completed 2nd BS in Urban-Planning/Environmental-Design (UCSD). He has Project Director experience for ~$70Milliion USD of architectural projects in Texas, California, and Pennsylvania; experience as a San Diego County Environmental Planner and as a San Francisco Engineering Consultant (including EPA certifications). Recently he created the Elizabethtown College Sustainable Design Engineering program and the Architectural Studies Minor.

Mr. Joseph John Wunderlich is the designer of several hundred buildings throughout many virtual worlds in Minecraft, and has presented his work on several occasions in Dr. Wunderlich's courses.

Appendix

2nd ANNUAL ELIZABETHTOWN COLLEGE SYMPOSIUM ON SUSTAINABILITY

Tuesday, April 23, 2013 Gibble Auditorium 9:30am to12:30pm *(Posters at 1:15pm in Lobby)*

----------*Session 1* ----------

#1 9:30 AM "High-end Phoenix Contact Technologies for International Green Initiatives" by James Kelly

#2 9:40 AM "Reflections from 16 Months of Interdisciplinary/Multicultural Collaboration on a West African Social Business Start-Up"
by Jillian Casey, Jennifer Hughes, Eleanor McCarthy, Joshua Rowlands, Emily Vogel, Julia Ward, and Nicholas Young

#3 10:00 AM "Next Steps in Continuing Work Toward West African Social Business Start-Ups – New Product Development"
by Anthony Fraccica, Joshua Frey, and Courtney Warlick

#4 10:15 AM "Family EcoRise"
by Vaclav Hasik

#5 10:30 AM "Proposed Design to Replace a New Jersey Vacation Home Destroyed by Hurricane Sandy"
by Emily Vogel

----------*Session 2* ----------

#6 11:00 AM "SWOT Analysis of a Sustainable Entrepreneurial Ecosystem in Costa Rica"
by Kyle McNulty and Derek Zmcic


#7 11:15 AM "Computer Controlled Hydroponic Gardens"
by Sean Flannigan and Andrew Khela

#8 11:30 AM "Analyzing the Hydrological Impacts of a Proposed Sports/Recreation/Fitness Center at Elizabethtown College"
by Deborah Bartyczak, Josh Rowlands, Emily Vogel, and Nick Young

#9 11:45 AM "FEAST(Future Energies and Sustainable Technologies) Club Activities"
by James Annab, Jack Hess, Matt Klempa, and Anthony Fraccica

#10 12:00 PM "Social-networking, Crowd-sourcing Teamwork to Rapidly-Prototype Green Architecture and Communities"
by Ricky Sturz

#11 12:15PM "Solar Decathlon Charette" *by* Vaclav Hasik

----------*Posters* ----------

*(1:15PM in Lobby): **"LEED (Leadership in Energy and Environmental Design) Architectural Design"***
by Shane Weller, Kyle Wilt, Meghan Donahue, Emily Vogel, and Vaclav Hasik

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