rHDS
Reactive Hygroscopic Design Simulation

Report

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Project Status

End of First Phase Development

rHDS (Reactive Hygroscopic Design Simulation) has reached its first major phase of development during this innovation and incubator cycle for Fall 2011. The first phase is designed to provide the framework for the future developments yet to take place.

The project is web-based and active. In its current form it presents the designer with a simple interface in an intuitive manner with all that is necessary to use it built-in.
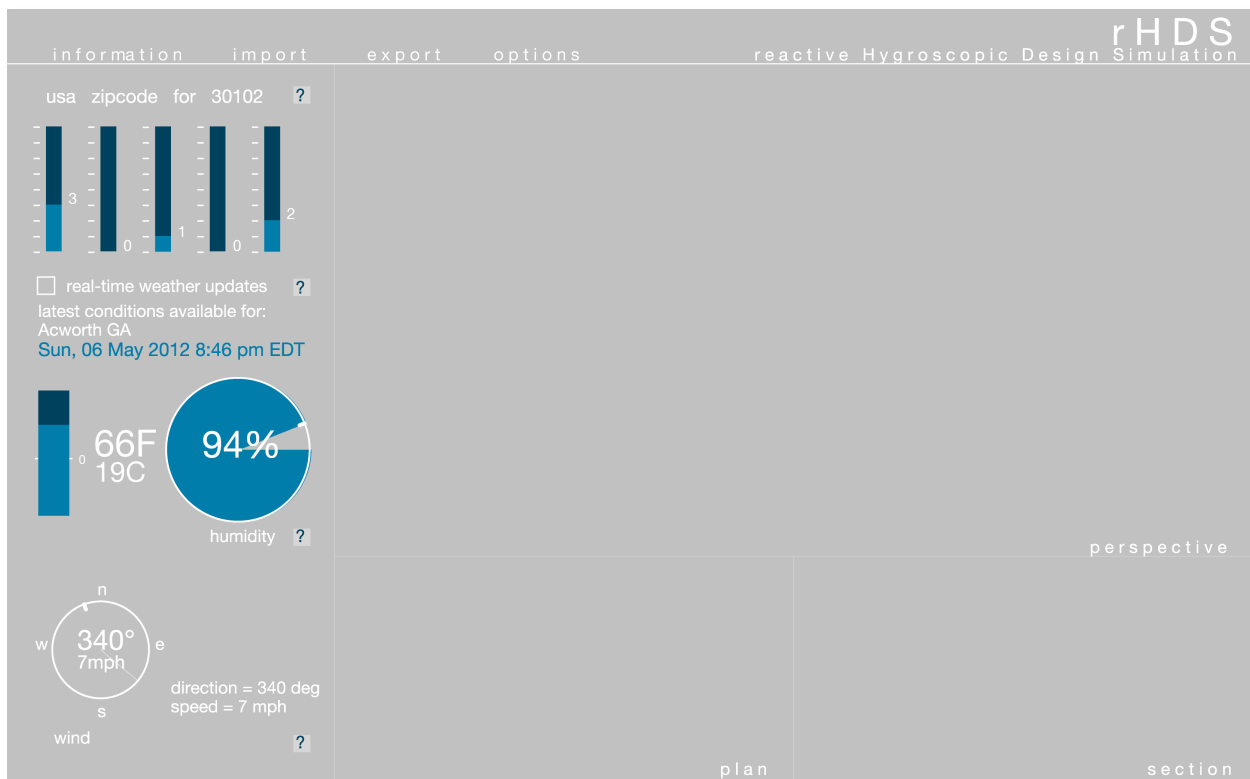
Intuitive Information System

rHDS is a bespoke technological digital apparatus where at the top is a simple row of menu items for information, import, export, and program options. Of these four items, only the "information" tab is currently available for use. When the mouse hovers over one of these tabs, more information is available and slides out from the bottom of the apparatus.
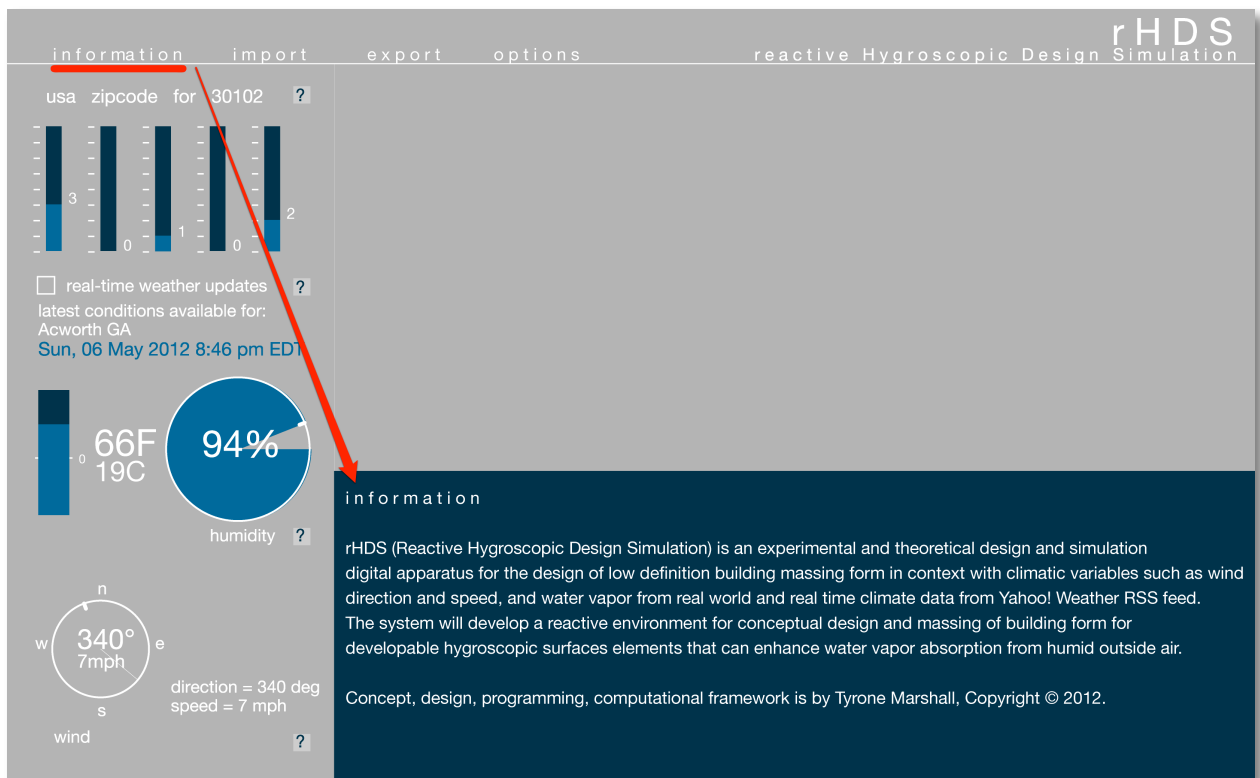

Figure 2 - information tab help screen-shot

i n f o r m a t i o n

rHDS (Reactive Hygroscopic Design Simulation) is an experimental and theoretical design and simulation digital apparatus for the design of low definition building massing form in context with climatic variables such as wind direction and speed, and water vapor from real world and real time climate data from Yahoo! Weather RSS feed. The system will develop a reactive environment for conceptual design and massing of building form for developable hygroscopic surfaces elements that can enhance water vapor absorption from humid outside air.

Concept, design, programming, computational framework is by Tyrone Marshall, Copyright © 2012.

Figure 3 - enlarged information help tab text screen-shot

The tabs for "import", "export", and "options" work similar to the manner in which the "information" help tab screen slides upwards from the bottom of the apparatus.

i m p o r t

The import component has not been enabled at this time in the development of rHDS.

re-click the "import" button to close this window.

Figure 4 - enlarged import help tab text screen-shot

e x p o r t

The export component has not been enabled at this time in the development of rHDS.

re-click the "export" button to close this window.

Figure 5 - enlarged export help tab text screen-shot

o p t i o n s

The options component has not been enabled at this time in the development of rHDS.

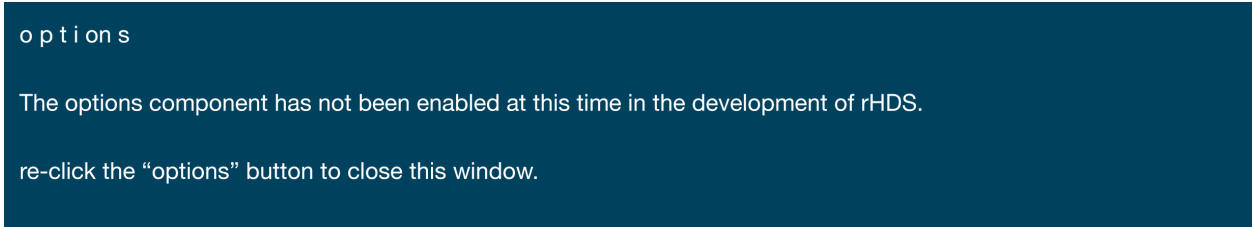re-click the "options" button to close this window.

Figure 6 - enlarged options help tab text screen-shot

Weather Conditions for USA Cities by Zip Code

The rHDS uses a computational design information system that receives Yahoo! Weather RSS feeds for current weather conditions for any city in the United States when information is available via the Internet. The RSS weather feed is gathered as a XML document and parsed by rHDS to present USA city location, local weather station temperature, humidity, wind direction and speed. These are the basic building block of design information that will be useful in the simulation portion of rHDS.

usa   zipcode   for   30102   ?

3

0   1   0   2

Acworth, GA. 30102

latest conditions available for:
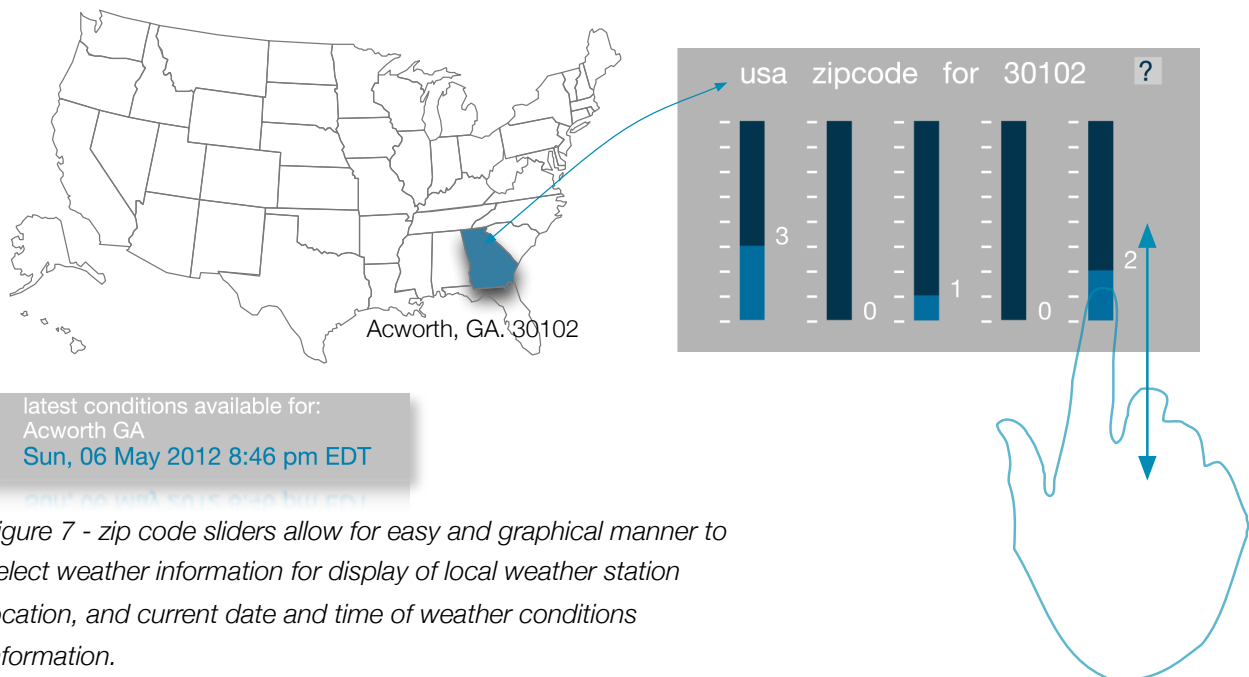Acworth GA
Sun, 06 May 2012 8:46 pm EDT

Figure 7 - zip code sliders allow for easy and graphical manner to select weather information for display of local weather station location, and current date and time of weather conditions information.

? Tool tips "?" indication for zip code

TIP: Real-time conditions will update automatically as zip code changes.

Or click the box to the left to gather most current conditions information available.

Real-time Weather Update

rHDS automatically updates weather conditions whenever a change to the current zip code selection is made. An interactive area shown below will allow for instant update of weather conditions for when there is no change to the zip code. The interactive area will also allow the real-time update become inactive. Normally the real-time updates in five seconds time periods when it is active. A grey square indicates rHDS real-time weather update is inactive. A blue square indicates rHDS real-time weather is active.

Figure 8- inactive real-time weather update display

Figure 9 - active real-time weather update display

? *Tool tips indication for real-time weather:*

TIP: Real-time conditions will update automatically as zip code changes.

Or Click the box to the left to gather most current conditions information available.
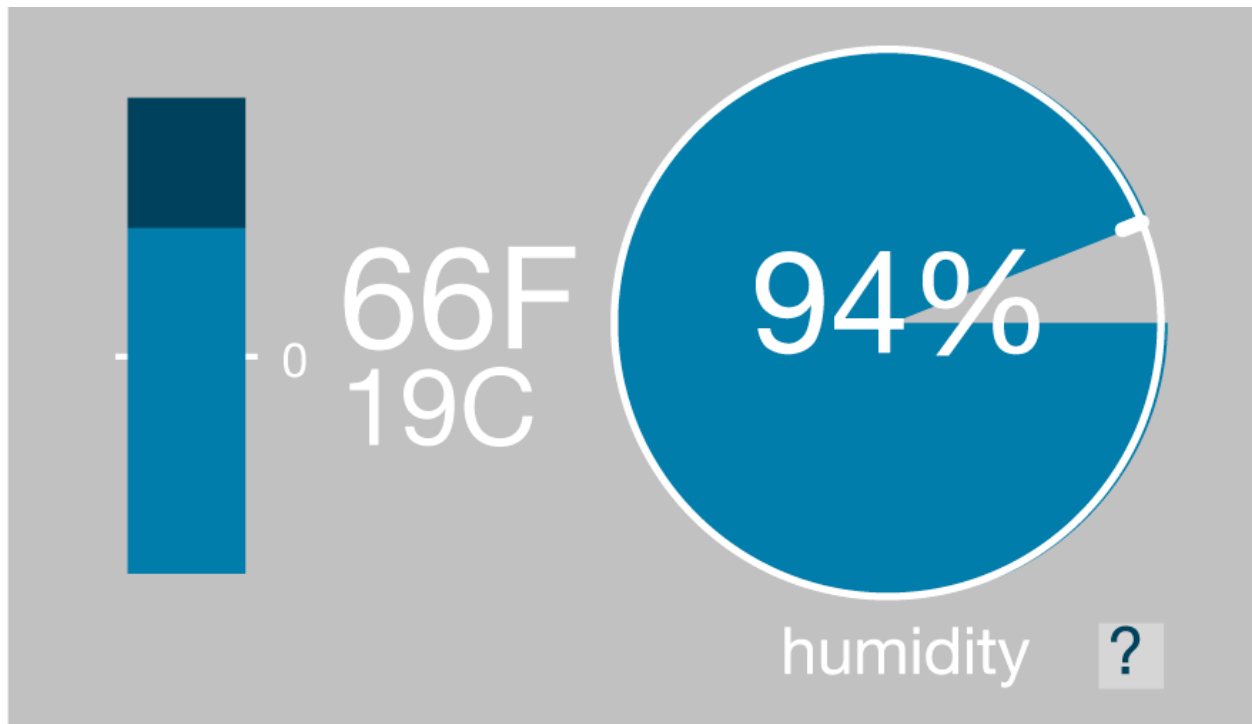
Temperature and Humidity Display

Figure 10 - actual real-time output showing temperature and relative humidity information

Simple indications for temperature in Fahrenheit and Celsius and relative humidity in percent are interactive and easy to read.

Tool tips indication for temperature and relative humidity:

TIP: A graphical indication for temperature and humidity data is shown to the left. Humidity is a measure of water vapor in a gaseous state such as air.

Wind Display

Figure 11 - actual real-time output showing wind direction and speed information

Simple indications for wind direction in degrees and speed in miles per hour. The large tick on the circle indicates direction.

Tool tips indication for wind speed and direction:

TIP: A graphical indication for wind speed (mph) and direction is shown to the left. The dynamic data for wind presents a different kind of performance measurement that will be useful in hygroscopic building massing development.

Ideas for Future Development of rHDS

orientation and elevation	Building orientation and elevation affect hygroscopic building envelope performance. It is very common in hot and humid climates to raise the structure above ground level to allow ventilation of underside while taking advantage of lower temperature and pressure conditions.
design	Building mass to take advantage of wind speed and direction for natural ventilation, and manipulation of pressure changes over building surfaces.
simulation	Visual indication of theoretical performance that takes in consideration building orientation, building elevation, natural ventilation, and other building form design to use a hygroscopic fluid to modulate the absorption and release of water vapor that is available in hot and humid climates from outside air.

Areas of Research Exploration with rHDS

Computational Design Passive Modulation	Simplified potential of working with "real time" data to inform a later investigation of using a computational control algorithm that could be deployed throughout building envelope surfaces to passively modulate the dynamic external conditions for movement of a hygroscopic fluid to control the absorption and release of water vapor to dehumidify building interiors in a natural and passive manner
Computational Control System	Simplified computational control system that gathers real time weather conditions at the building envelope such as wind pressure, speed and direction to control building flaps that modulate local pressures at leeward facing sides to control natural ventilation.

Project Description

Goals

rHDS (Reactive Hygroscopic Design Simulation) is an experimental and theoretical design and simulation digital apparatus for the design of rough building massing form in context with climatic variables such as wind direction and speed, and water vapor from real world climate data. The system will develop a reactive environment for conceptual design and massing of building form for developable hygroscopic surfaces elements that can enhance water vapor absorption from humid outside air. rHDS is inspired by the potential application of a theoretical building envelope that enables innovative energy and water production by drawing water vapor out of the air to deliver new sources of water and lower indoor humidity below the outside air in hot and humid climates.

Methods

A design methodology that focuses on experimentation, exploration, discovery, simulation, feedback and generation of digital craft using real world environmental data to manifest design intent. rHDS will be a do-it-yourself innovation and invention that is closely related to the study of biomimetic design that is prevalent in nature but adapted to digital design, simulation, reaction, and feedback for the generation of useable real world results.

Anticipated Outcome

rHDS will be presented as a theoretical first approach process for designing a hygroscopic building massing form in hot and humid climates. The results will be intended to be useful in conjunction with parallel space planning and detailed project design development.

Project Deliverable

Documentation and Interactive Demonstration

Web based online design simulation apparatus for visualizing dynamic processes where a designer can make design changes to a building mass in reaction to a real-time particle system that represents wind direction and speed, and water moisture for a specific site location and climate.

rHDS is currently a demonstration apparatus. Use the link below to interact with rHDS:

---> click here <---

A short movie demonstration of rHDS can be viewed by using the following link:

---> click here <---

Project Relevance

Relevance to the work, culture, goals of Perkins+Will

This project aligns with Perkins+Will mission that design has the power to transform our lives through innovation in regenerative design, design driven research and technological innovation that creates positive change for communities and their environment.

The project will advance design sophistication, process, and sustainability for conceptual building massing form generation in potentially hot and humid climates. In these climates, the largest single use of energy is in providing air conditioning equipment to keep interior

spaces cool during hot and humid exterior conditions. It will advance the notion of a theoretical building envelope that draws water vapor out of outside air as a new source of water and at the same time lower indoor humidity below outside air in hot and humid climates. rHDS will provide an interactive and responsive environment for design and simulation of wind direction and speed, and water vapor in an interactive context with simple manipulative building massing form.
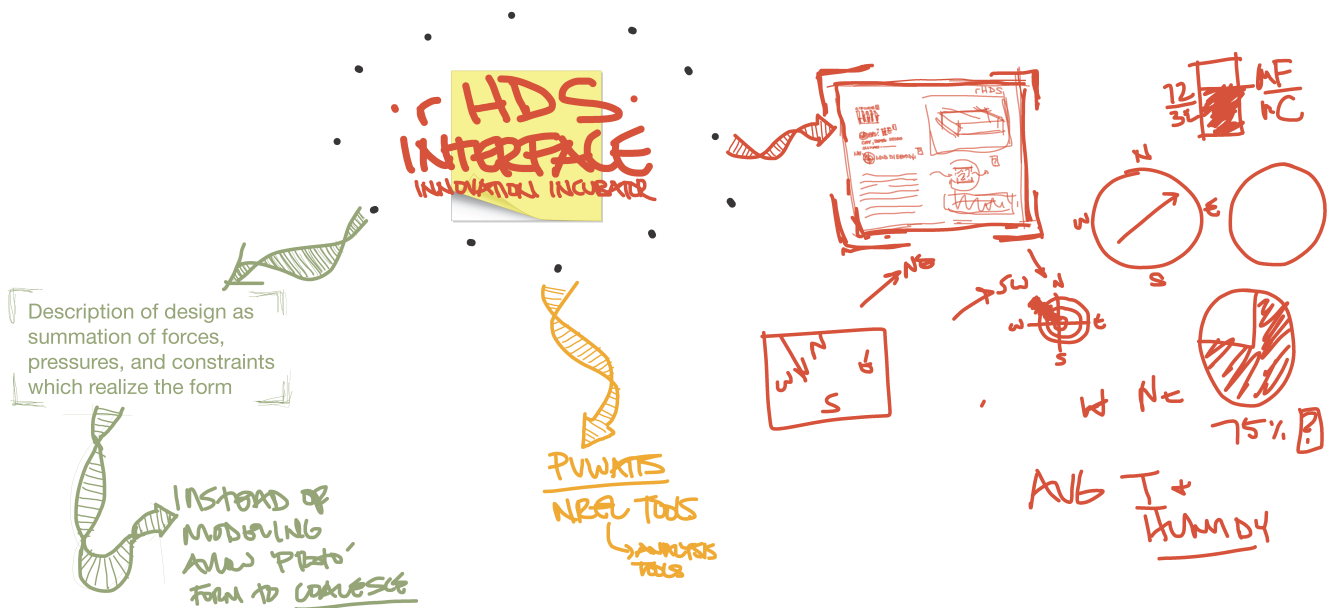

Figure 12 - digital Mind map sketch of rHDS early development from (iPad) 2012

An architect must be a craftsman. Of course any tools will do; these days, the tools might include a computer, an experimental model, and mathematics. However, it is still craftsmanship" the work of someone who does not separate the work of the mind from the work of the hand. It involves a circular process that takes you from the idea to a drawing, from a drawing to a construction, and from a construction back to idea."

Renzo Piano