

THE BEACH HOUSE JURY NARRATIVE: INNOVATION

BEACH is an acronym for Building Efficient, Affordable, and Comfortable Homes. This acronym was the foundation of the innovation process. The humidification/fresh air intake system is an affordable and intelligent design that maintains a comfortable environment. In addition, the system has the potential application as an evaporative cooler, reducing energy consumption of the house overall.

A NEW BEGINNING FOR AN OLD CITY

Daytona Beach, the “World’s Most Famous Beach,” is best known for its wide, white-sand beaches. These hard-packed sand beaches hosted car races in the 1920s which led to the foundation of NASCAR. Today the hard-packed beaches allow the unique experience of driving to your favorite surf spot. Nestled just north of Cape Canaveral on Florida’s east coast, the city boasts year-round mild weather with easy access to the Atlantic Ocean, the intracoastal river, and natural springs. Thousands of visitors come to Daytona Beach each year to enjoy the beautiful beaches, partake in the Daytona 500 experience, or cruise on historic A1A during Bike Week.

Daytona Beach’s primarily tourism driven economy was greatly affected by the economic recession of the 2010’s. An already aged infrastructure and the failing economy lead to the historic ocean and riverfront areas of the city becoming dilapidated. However, the economic lull provided an opportunity for

investors and city leaders to revitalize the city. Daytona Beach and the surrounding areas are in the midst of a master plan to breathe new life into the area. Daytona International Speedway has completed a \$400 million re-imaging of the speedway and has a 1.4 million square foot retail and entertainment center, Daytona One, under construction just north of the track. A multimillion rejuvenation of the historic waterfront areas including Beach Street and the Main Street Pier is underway that includes adding entertainment venues and rehabilitating classic hotels. The city also has plans to gentrify housing sections near the river and ocean, and an expansive 6900 home senior-living development, Latitude Margaritaville is in the construction phase. The city's revitalization is perfectly timed to coincide with the upcoming boom in housing for America's aging population.

As the Baby-Boomer generation ages, the need for senior friendly living arrangement increases. It is expected that the population of persons over the age of 65 years will grow by nearly 30 million in the next 20 years, resulting in one out of three households being led by a person in this age group. Nursing homes and other traditional senior-living arrangements are less sought after as in-home care gains popularity. These trends create a demand for single-family homes that are affordable and accessible.

Like many coastal Florida cities, Daytona Beach is a retirement destination. Florida has seen a 2.1-percent increase in persons 65 years-of-age and older between 2010 and 2014, giving a total of 4 million persons in this age bracket. Baby Boomers and Generation X are more likely to care about sustainability

and green living than past generations. As the need for senior housing increases, there should be a conscious effort to meet the green demands of the aging population. The goal of The BEACH House is to provide an energy-efficient and sustainable housing option for current and future seniors.

INNOVATION INTRODUCTION

One of the goals of The BEACH House is to ensure a comfortable and healthy environment for its residents. Humidity control is one of the most important aspects of this goal, while simultaneously being one of the least understood.

Typically, indoor air is cooled and dehumidified during summer, while heated and humidified during winter. In the southeast United States, these processes are mainly achieved through a heat pump system. These systems can operate in either cooling or heating modes based on the desired indoor temperatures. However, humidity control systems are usually handled as accessories, especially humidity addition. A whole residence humidity addition system (HAS), is generally implemented by the incorporation of a steam distribution unit or a wetted surface into the home HVAC system. These HAS can consume additional energy, such as steam units or become inefficient if the wetted surface is not maintained properly.

The BEACH House incorporates a new patented atomization technology called Flow Blurring®. This technology, with its own intelligent and independent control structure, will benefit The BEACH House environment during the winter months as a

humidification system, and potentially as an evaporative cooling system during other parts of the year.

THE NEED FOR HUMIDIFICATION

Suitable humidification is an important factor for a healthy environment. Improper humidity can be a source of:

HEALTH PROBLEMS

Dry air can aggravate asthma and allergies, as well promote sinus infections.

DISCOMFORT

Dry air can change the way you feel at normal temperature settings. Because of the air's low humidity level, it can hold more water. The air absorbs moisture from everything, including your skin. As the dry air evaporates this moisture from your skin, you feel cooler. Dry air can also cause painful, and sometimes damaging, static shocks.

HOME DAMAGE

The addition or reduction of moisture in the air drastically affects the qualities, dimensions, and weight of various materials, especially wood. As the relative humidity changes with the weather, wood absorbs and releases water. If the optimum relative humidity is not maintained, damage can be done to wood floors, trim, and furniture.

THE BEACH HOUSE HUMIDIFICATION SYSTEM

The Beach House utilizes a zone based, ductless HVAC system. This system allows for a customized and accurate climate control with a pleasant aesthetic appeal. The lack of traditional duct work prevents the installation of customary steam or wetted surface systems. Humidification systems were evaluated to meet this requirement. One of the alternatives was the introduction of direct humidification into the living space via a water atomization system.

Existing residential atomization systems have a tendency to have clogging issues based on the hardness of local water. This recurrent problem is isolated to mineral deposits at the extremely small discharge orifice (Figure 1). In addition, they must operate at pressures between 55 to 69 bars, in order to produce small droplet sizes for proper evaporation inside the home.

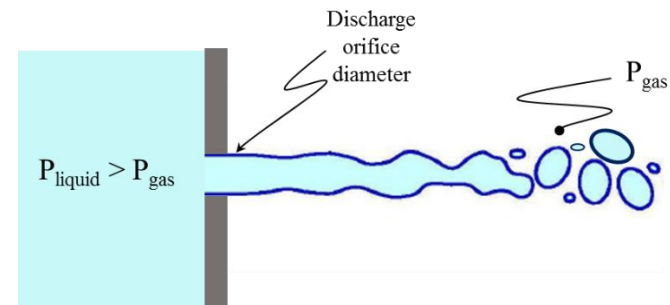


Figure 1: Water in contact with the exit orifice

The BEACH House’s humidification system is based on a patented pneumatic atomization process called Flow Blurring® (FB®). This novel atomization process produces droplet sizes similar to a high-pressure system; however, the FB®:

- Consumes less energy
- Uses lower operating pressures
- Prevents the discharge orifice from clogging

Figure 2 illustrates a typical cross section of the FB® atomizer. The discharged air surrounds multiple water threads, preventing the water from being in contact with the discharge orifice. The proposed FB® atomizer has a discharge orifice diameter of 600 µm, which is approximately three times larger than existing atomizers. The operating pressure are reduced to 0.68 to 1.38 bars.

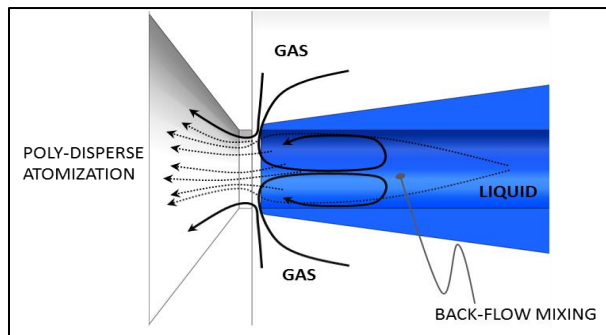


Figure 2. Typical Flow Blurring® Atomizer

The humidity system was integrated into the largest living area of the BEACH, Zone 1 as illustrated in Figures 3 and 4. This system is designed to be completely independent of the HVAC system in zone 1. This allows its operation when needed and not forced to work in conjunction with the HVAC unit in zone 1.

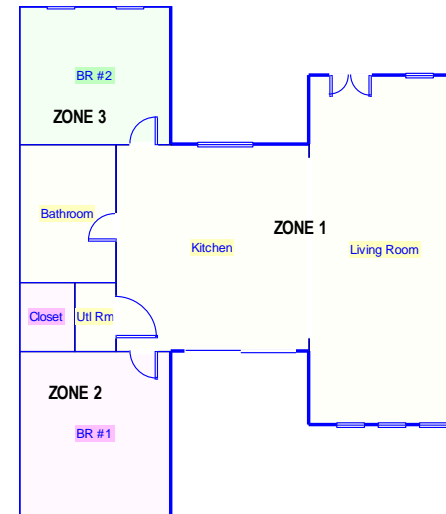


Figure 3. The BEACH House HVAC zones

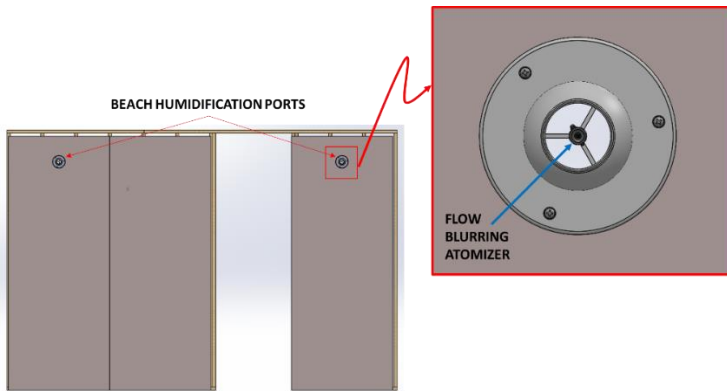


Figure 4. Humidity system ports on exterior bathroom wall

A simple line diagram of the humidity system is illustrated in Figure 5. Due to its low operating pressures the system can use push to connect fittings, polymer hoses (e.g., nylon, polyurethane or polypropylene), and requires minimal use of tools. The system can be designed and packaged as “do it yourself” for the weekend handyman or handywoman.

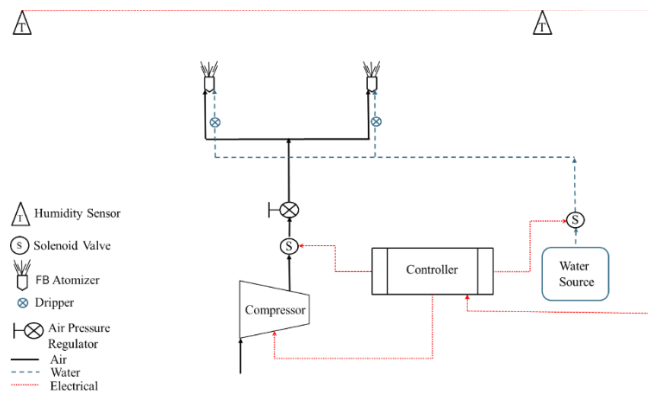


Figure 5. The BEACH House Humidity Control Diagram

A block diagram for the humidity system controller is illustrated in Figure 6. The system will use an ARDUINO UNO to control the start-up and shutdown sequences of the system.

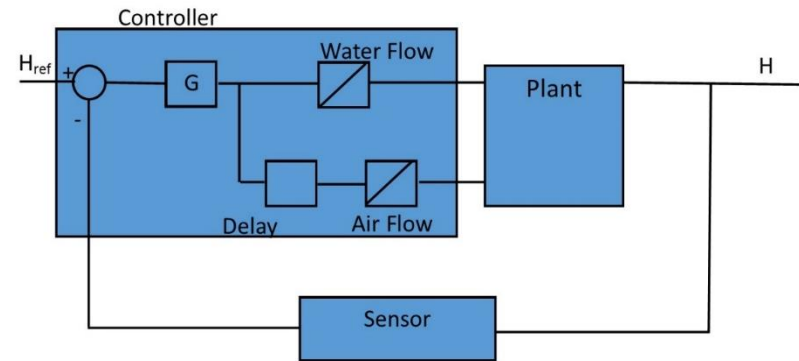


Figure 6. Block diagram of humidity system controller

The BEACH house humidification system will be integrated with an automatic fresh air clerestory window system. This window will operate in combination with the HVAC, humidity and CO₂ systems to maintain a healthy environment within the BEACH house. Figure 7. Illustrates a block diagram of the humidity and clerestory system integration.

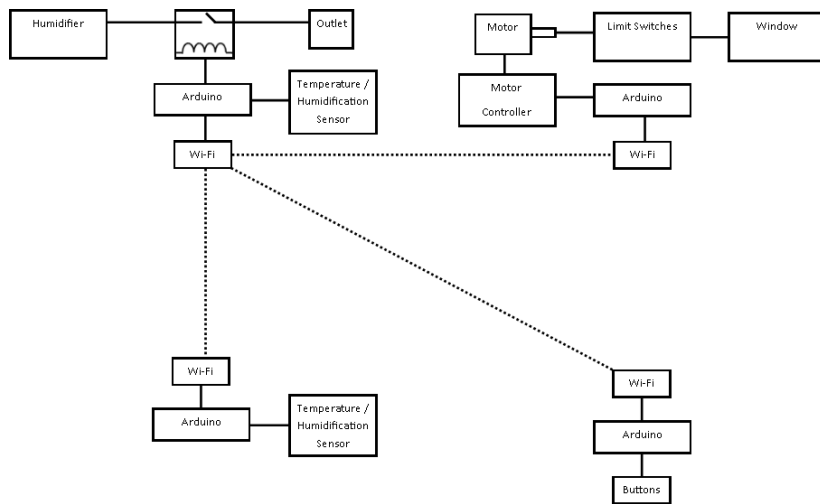


Figure 7. Block diagram for humidity and clerestory systems

OTHER USES FOR THE HUMIDIFICATION SYSTEM

The HVAC system is the largest energy user in every home. It is possible, based on the outdoor environmental condition, to utilize The BEACH House humidification system as an evaporative cooling system. When outdoor conditions are favorable, the clerestory window system can open to allow fresh and relatively drier air into the house. Water dispersed by the humidity system evaporates under proper conditions and the air temperature is reduced during the process.