UNIQUE USE OF EXTERIOR WALL CAVITIES FOR THE DISTRIBUTION OF CONDITIONED AIR TO OFFSET HEAT GAIN AND LOSS, INCREASE OCCUPANT COMFORT AND PREVENT TYPICAL BOUNDARY CONDITION PROBLEMS SUCH AS CONDENSATION AND MOLD

December 12, 2019

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1. OVERVIEW

Funding Request:	$2,500,000
Project Duration:	18 Months
Project Abstract:	Unique use of exterior wall cavities for the distribution of heating and cooling air to avoid costly and leaky air ducts and increase efficiency of both energy use and distribution. Our goal is not only to distributed this conditioned air through the exterior wall cavities, but to also produce the conditioned air and domestic hot water locally and avoid building wide central systems.
Challenge Area:	Distributing air thru exterior walls presents numerous problems, including damage from condensation and mold and maintaining adequate boundary conditions. The solution for the conditioned air via existing electric VRF technology is straightforward but the production of locally generated domestic hot water in sufficient quantities is a challenge.
Technology Stage:	We are in late stage development on the exterior envelope solution. Our high performance exterior building envelope enclosure has already been granted US Patent #201913232331A1. We have small size mockups and research that supports our proposed solutions. We require full size mockups to test our “air hockey” type air delivery theory and to test adequate drainage of condensate. We are in early development stage of the HVAC side of the solution. There is existing HVAC “pod” technology that we can leverage and improve upon.

2. IMPACT

The current problems that this system addresses are numerous. One of the problems unique to large cities, but especially to a high rise city like New York City, is that developers want to provide more vision area than what is permitted by the applicable energy codes. Till now, the method by which design teams were able to include significant vision areas was by using energy modelling, which requires “energy tradeoffs” from the mechanical, lighting and opaque wall systems. Luckily, significant advances in mechanical and lighting system efficiencies have contributed to the allowance of many of these tradeoffs. Design teams have also been forced to increase the R values of the opaque areas and in many cases, these methods have led to significant condensation and mold problems. With the introduction of significant recent legislature that will severely increase even further the amount of carbon emissions reductions required, additional options for reducing carbon emissions will mean the further reduction of vision areas in exterior walls. Our unique solution will not only increase the R value of the opaque wall areas without the common problems such as condensation and mold, but it will allow for more efficient distribution of conditioned air. Our solution significantly delivers on the stated goal of a 40% reduction in GHG emissions by eliminating the requirements for fossil fuels and by decreasing the required energy to condition interior spaces

The completion of a successful HVAC “pod” will eliminate the need for central HVAC and domestic hot water generating systems. This saves tremendous cost on the part of the builder, by removing any central system equipment and also removing the piping between the central systems and the individual apartments. Developers have been trying for years to eliminate the central building systems, especially on rental buildings, but the

disadvantages of existing technologies, combined with industry pressure and legislative barriers with regard to tenant billing, have prevented the successful implementation of non fossil fuel generated domestic hot water strategies on a large scale.

3. INNOVATION

Portal Wall is a unique idea because of its simplicity. To date, exterior wall manufacturers have had to rely upon complex horizontal and vertical metal framing along with exterior and interior extruded gaskets, sealants, field installed air and vapor barriers, and other proven to be problematic strategies in order to achieve code required air exchange rates and thermal barrier requirements. Portal Wall eliminates all vertical metal framing, provides superior R value and simplicity of installation. The R value of the opaque wall, which can go as high as R50, is achieved without complicated field installed insulation layers and air and vapor barriers. This leads to a homogenous system that is simply not available by any other manufacturer in any system.

Portal Wall allows for passive or active methods to promote the evaporation of collected condensate within the wall cavity and to allow said condensate to exit to the exterior without impacting air exchange and thermal values.

Besides its unique R value and condensation removal properties, Portal Wall can be installed from within the floor plate, without the need for complicated and costly pipe scaffolding, tower cranes or floor cranes. This provides for tremendous savings in site logistics, man power and field labor insurances and also reduces risks associated with weather delays due to high winds and the like that is common with high winds.

The Portal Wall system is installed by first installing track to the top and bottom of the structural slab. All anchoring is pre-engineered and is either in shear or compression, never moment connections. Track is fastened to the structure using specialized inserts and common installation methods including mechanical fasteners and imbeds. Its ease of fabrication and assembly is revolutionary in its simplicity.

As mentioned earlier, the solution for the production of locally generated conditioned air via existing electric VRF technology is straightforward but the production of locally generated domestic hot water in sufficient quantities is a challenge. The technology for VRF to water heat exchangers is straightforward, but the strategies required to meet local capacity requirements is lacking. Combining localized VRF technology for both heating/air conditioning and domestic hot water with the Portal Wall technology for distribution of air is our strategy for eliminating antiquated building technologies.

This methodology will appeal very strongly to the construction community. The ability to provide high R value opaque walls with low cost and ease of installation, combined with the elimination of central building systems, is a tremendous benefit on many levels.

4. STATE OF THE ART

We have already discussed this product with many of our existing clients and colleagues. The high occurrence of condensation and mold in new high rise “glass” towers is not talked about openly but is well known in construction circles. The Portal Wall solution addresses this risk and is very appealing to those who have experienced condensation and mold issues.
The solution today to provide high R value opaque areas is faulty because it adds layers of insulation to existing walls and often traps moisture between layers of wall material thus leading to mold. Builders are often forced to do this in order to permit their desired levels of vision areas. They don’t think of the condensation and mold consequences until its too late. Often, walls have to be replaced and that can be very expensive both in terms of tenant disruption and construction costs.

On a typical high rise construction project, the savings to site logistics and crane operations can be in the millions of dollars. The fast rate at which the exterior wall enclosure can be installed increases that savings dramatically. And the ability to choose any vision product is also very appealing to developers since often the vision areas are bought together with the opaque areas as a single unit and this limits options.

	Cost	Installation	R value	Vision Areas
Portal Wall	Very low	From the interior	Ultra high	Any manufacturer
"Other" wall	Medium-High	Requires a crane	Low-Medium	Proprietary Requirements

5. RISKS AND CHALLENGES

The challenges and risks of the Portal Wall system are low in comparison to the high rewards due to cost and logistical savings. The technical challenges are to ensure that air can distributed thru the wall cavity and any condensate can drain way safely without causing any moisture buildup or lasting moisture on the interior surfaces of the wall that can lead to mold. Another challenge is whether we can raise the pressure inside the cavity high enough to allow for adequate and even air throw. The thought at this time is to create an "air hockey" type wall, that is continually porous. We have identified some wall materials that may be acceptable from an aesthetic viewpoint but we have to test them. It will also be challenging to provide the right material that may have to be painted. At the end of the day we will likely provide a strip for supply at the top and a strip for return at the bottom of the wall, but it will be more like a continuous ribbon rather than isolated rectangles. This is the essence of our challenge, to determine how the air will perform in a pressurized delivery scenario.

The installation of s single solution for the production of HVAC and locally generated domestic hot water is not only a challenge for technology but also a challenge for legislative reasons. Current legislation, especially for affordable housing, requires ownership to provide heating and domestic hot water in order to get the best rental rates. This discourages the elimination of the central systems because with the "pod" type system the tenant pays for all the heating, air conditioning and domestic hot water. There have been successful implementations of localized gas fired plants within each apartment for smaller multifamily projects. However, the challenge lies in the successful implementation of non fossil fuel generated localized plants within each apartment for larger high rise type projects.

6. TEAM

Yonatan Margalit, is the owner of all related IP including identifying the problems and detailing a solution using first principles, system details, patent granted and multiple patents pending. Yonatan has over 30 years of experience in the design, fabrication and installation of exterior wall systems. He invented Portal Wall after identifying the problems caused by conventional opaque systems and the costs involved with their complicated assembly and well as installation via crane.
https://youtu.be/rHjO61BjFyA

David Glickman P.E., LEED AP is the founder and managing partner of GEA Consulting Engineers (www.gea-pllc.com). GEA has been the MEP engineer for hundreds of new out of the ground residential and commercial buildings and has prepared the energy model for dozens of buildings and so he understands the energy tradeoffs required in meeting energy code. David is also on the mechanical codes committee of the NYC ACEC, which contributed greatly to Local Law 97 Climate Mobilization Act.

7. PROJECT PLAN

The proposed effort includes the generation of CFD and Therm models to allow the team to test different ideas for the delivery of the conditioned air thru the exterior wall cavity. Those ideas that are tested to be particularly effective will be included in a series of wall mockups to actually test the flow of air through the walls.

The proposed effort will also include working with existing VRF technologies to create a "pod" type unit that will allow for the localized production of HVAC and domestic hot water. The product of our efforts on the "pod" side will be merged with the product of our efforts on the Portal Wall side. The combination of the two innovative solutions will help modernize construction methods to achieve the ambitious goals set by both state and city wide ordinances.

Visualization of the proposed air flow through the Portal Wall exterior wall cavity

View of typical scaffolding used for the erection of exterior wall systems that will be eliminated with the introduction of Portal Wall Technologies