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COVER STORY

A Geothermal Solution to Urban Blight in Detroit

A four-story home on a 30-foot by 90-foot lot is proving to the world just how flexible the geothermal heat pump industry can be.

By: Staff Writer

The plight of Detroit, Michigan, is common knowledge these days. Left in a state of severe urban decay, the residential streets of the once iconic Motor City are now lined with dilapidated and abandoned structures. Despite this grim situation, there is a glimmer of hope; for the first time since its founding in 1701 the city of Detroit is fundamentally a clean slate¬¬ ready and waiting for redevelopment, modernization, and rebirth. This clean slate is serving as an ideal proving ground for an alternative geothermal technology and ground-source design: the proprietary direct-exchange geothermal system created by EarthLinked Technologies Inc., of Lakeland, Florida.

VICTORIAN REHABILITATION

Jarmila Senkyrikova had been in Detroit for nearly a decade, residing in a gated community condominium style residence, when she decided she was ready for a house of her own. However, after beginning her search she quickly came to realize that all of the readily-livable homes in Detroit came attached to astronomical price tags, while the abandoned and blighted structures could be had at next to nothing. Detroit's unique and troubled housing market forced her hand; Senkyrikova made the decision to find one of the affordable but blighted structures she could turn into a project house and make her own.

A longtime member of the Michigan Urban Farming Initiative, Senkyrikova soon realized that an abandoned Victorian era home owned by the initiative at 256 Horton Street in the North End neighborhood of Detroit was due to be demolished, under the Detroit mayor's 2010 mandate to clean up urban blight within the city. She made the decision to rescue the decaying structure and turn it into an ultra energy-efficient and modern home for her family. After six months of negotiations she received a clear title to the property and began the rehabilitation and remodeling of the structure in September of 2015.

Located just blocks from the famous Fisher Building, and near one of the largest urban farms in the nation, 256 Horton Street is a 3,300 square foot, four-floor residence, with a full basement and finished attic. The structure had stood vacant for years before Senkyrikova came along, succumbing to the same blight and decay as countless other Detroit homes. Missing and broken windows, damaged walls, busted plumbing, and many more issues all provided ample work to be done before

256 Horton Street is built in the traditional Victorian row house style, creating unique space requirements for all structural rehabilitation activities.
Photo provided by: EarthLinked Technologies, Inc.

Drilling and loop installation activities took place over the course of a single work day.
Photo provided by: EarthLinked Technologies, Inc.

the home could be brought up not only to code and livability, but also to the stringent energy efficiency levels Senkyrikova demanded.

CONSUMER RESEARCH

The centerpiece of any energy-efficient residential building, especially in a heating dominant climate like Detroit's where the average annual high is 58 degrees, is the HVAC system. Senkyrikova knew this, and began to do her research into what the best options for the climate-control solution were. Extremely driven to accomplish her energy efficient rehabilitation goals, Senkyrikova spent many hours combing through data and sales pitches from the different HVAC system manufacturers online. She ruled out traditional HVAC systems almost immediately, due to their inefficiency and reliance on expensive and polluting fossil fuels. Through further investigation, Senkyrikova found geothermal and ground-source heat pumps to be the next logical step up in terms of efficiency and climate-control ability.

After a few exchanges with regional contractors and dealers, she was told geothermal was not feasible, due to the lack of physical space for the loop field and drilling activities. The property's extremely small size, only 30 feet wide and 90 feet long with the house covering most of the land, had thrown a wrench in Senkyikova's plans. But she was not to be easily deterred from her energy-efficient dreams; continuing her research she eventually stumbled upon the direct-exchange geothermal system design from EarthLinked. This system design boasts the smallest loop surface area and mechanical space footprint on the market; an aspect which immediately jumped out to Senkyikova as the solution to both her space issue and efficiency requirements. Upon reaching out to EarthLinked, she was immediately referred by the company to one of their Michigan-based dealer/contractors- Scott Roberts of Roberts' Geothermal Solutions. Based in Niles, Michigan, Roberts has been working with direct-exchange based geothermal systems since the late 1980s.

While Roberts was initially skeptical upon receiving the call to discuss a direct-exchange system for a blighted house in downtown Detroit, a three-hour drive outside his shop's normal range, it only took one consultation with the homeowner and viewing of the site before he jumped at the opportunity to be a part of the project. "Her passion about and commitment to this project are astounding... her drive to see this through is infectious," Roberts says of Senkyikova. Interestingly enough, during one of their initial planning meetings at a local restaurant Roberts happened to look across the street to see a familiar sight- drill rigs and coils of HDPE pipe. The building across the street from the meeting place was having a traditional commercial-sized geothermal system installed. Roberts was able to walk with Senkyikova over to view some of the work; enabling her to see with her own eyes

The high thermal conductivity of copper enables a small system footprint.
Photo provided by: EarthLinked Technologies, Inc.

the type of HVAC solution she had been researching, albeit at a much larger scale. This only solidified Senkyikova's decision to install a direct-exchange system, demonstrating to Roberts just how valuable job site visits can be to potential customers.

PRINCIPALLY THE SAME – TECHNICALLY DIFFERENT

The direct-exchange system from EarthLinked has been on the market for over 30 years now and has seen installation across all 50 states and in 16 different countries across the globe. This system design relies on the direct-exchange of heat between R-410A refrigerant and the Earth, facilitated through ½ inch or ¼ inch diameter copper tubes, which have a thermal conductivity rating of 231 BTU/(hr*ft**F). The other major difference between the traditional geothermal and direct-exchange systems is that direct-exchange circulates in the ground, which – contrary to water/glycol – goes through an isothermal phase change that allows for a higher temperature gradient and in turn for a higher capacity per foot of loop. Simply put, direct-exchange systems operate in the same manner as traditional air-source HVAC systems using the vapor-compression cycle, but with the Earth providing heat exchange duties rather than the outside air.

Each direct-exchange system is pre-engineered and pre-fabricated, to specification, at EarthLinked headquarters in Florida. Dealers and contractors like Roberts "crunch the numbers" using industry accepted software tools to determine the system capacity for the building size, soil conductivity, climate, and load trends. These calculations then allow EarthLinked to engineer a system designed specifically for the building, which is then shipped directly to the job site for assembly and installation. To facilitate this process, the corporate decision to utilize standard system dimensions across the board was made. All loops have a set diameter; vertical and diagonal loops have a ½ inch vapor line and a ¼ inch liquid line while horizontal loops have a ½ inch line all across. Loops also have a set length, regardless of orientation, which varies between 100 feet and 150 feet per nominal ton of system capacity.

AN INNOVATIVE SOLUTION

Roberts served as direct-exchange system salesman, designer, and installer for the project; a division of labor which is quite common with smaller residential-sized systems. Total system size for the home on Horton Street came out to five tons. The homeowner wanted a hybrid forced air/radiant floor system, so Roberts designed her a system which uses a high velocity air handler and two-inch ducts to deliver air everywhere but the basement, while also including radiant pipes that run through all four floors. This extensive radiant floor setup, an uncommon design for the region as most homes only have radiant floor systems in the basement, enables the house to have a large thermal mass; ensuring that if the home loses electricity for a few days during a storm or other outage, it will remain livable from a temperature standpoint. Direct-exchange lends itself to hybrid designs such as this, as all direct-exchange systems are split systems and can easily work with both radiant and forced air technology simultaneously. A five-ton PRIME series PSDH-060-1C combo unit was recommended by Roberts for the home. This feature-rich unit specifically enabled the hybrid system, radiant floor, and hot water assist all while meeting the home's space conditioning needs.

Drill contractor for the job, Buschur's Refrigeration out of Saint Henry, Ohio, completed the diagonal loop drilling and installation for the entire five-ton system in a mere 10-hour work day, all within a four-foot by eight-foot header pit. Buschur specializes in drilling within confined space for direct-exchange systems; using a small and highly maneuverable directional bore unit, the team was able to squeeze into the small backyard and complete the loop drilling process without

Direct-exchange systems are split systems by design, easily enabling forced air, radiant floor, and hot water assist technologies.
Graphic provided by: EarthLinked Technologies, Inc.

extensive disturbance to the surrounding area. Ten diagonal holes were drilled for the loop field, each at a depth of 75 feet, making each loop a total of 150 feet down-and-back. Header piping and the lines from the pit to the house are buried approximately five feet deep and enter the home at the box sill area, penetrating the home above grade and eliminating the possibility of foundation leakage.

To maximize her efficiency levels, Senkyrikova made the decision to have the walls stripped down to the studs and spray-foamed with insulation before replacing the walls. In fact, the home is sealed so tight that a heat-recovering ventilator is required to bring fresh air into the environment. LED lighting has been used throughout the house, as well as low-flow plumbing fixtures and gas filled windows. The direct exchange system is also linked to hot water production for the home, via an internal hot water assist setup. A solar array is in the works, with the hope being to be completely self-sufficient from an electricity generation standpoint by the end of 2017.

Direct-exchange geothermal has enabled Senkyrikova to realize her dreams of rehabilitating a blighted urban house into an ultra energy-efficient residence for her and her family. The direct-exchange system's high efficiency levels, coupled with unique space requirements, made it a perfect fit for this job and put geothermal on the map in downtown Detroit.

High-velocity 2.5 inch air delivery ducts are hidden inside a larger 6 inch duct facade and left exposed for an industrial look.
Photo provided by: EarthLinked Technologies, Inc.