



## ***Pyrrhotite Contaminated Concrete – A Call for Collaboration***

By: Steven J. O'Neill, Attorney at Law

In Biblical fashion, more than 34,000 residential foundations in Connecticut and Massachusetts were built on sand between 1983 and 2016. Not literally, but many if not most residential concrete foundations containing pyrrhotite aggregate from Becker's Quarry in Willington, CT and mixed by JJ Mottes Concrete in Stafford Springs, CT will need to be repaired or replaced eventually. Those that contain pyrrhotite and have not (yet) shown evidence of failure will remain suspect and likely impact the value of the real estate. This article focuses on the single-family residential sector but the problem may be wider. Connecticut DOT asserted that pyrrhotite concrete has not impacted its structures. However, there is visual evidence that some commercial and multi-family residential structures are showing telltale signs of pyrrhotite deterioration.

What is known is that thousands of pyrrhotite foundations are crumbling in a slow-motion disaster. The cost of correction currently ranges from \$150,000 to \$350,000, for lifting and fully replacing foundations. The economic impact on the region is immense. Connecticut officials have already identified approximately 50 towns affected by pyrrhotite foundations. Only about 700 buildings have been officially reported to date in Connecticut. However, Governor Malloy estimates that over 34,000 homes might be affected. Massachusetts is quite behind the curve in determining the scope of the disaster. State and local officials in MA have no clear idea of how many homes contain pyrrhotite concrete, although the now defunct JJ Mottes Concrete company did extensive business in Massachusetts. One estimate used by CT officials is that as many as 10,000 homes in Massachusetts have pyrrhotite concrete.

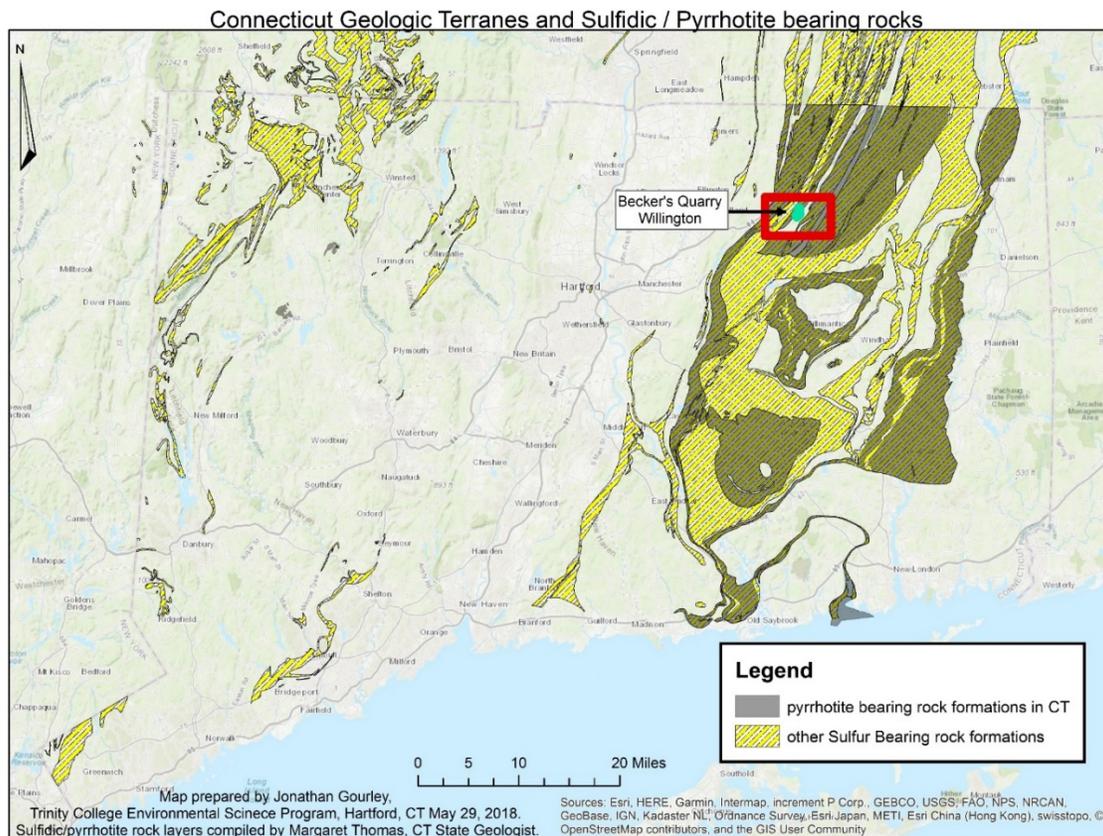
Owners, through no fault of their own, will lose their equity and perhaps default on mortgages. Even where a particular foundation shows no signs of the telltale pyrrhotite "map cracking" and horizontal cracks, insurers and lenders will redline properties containing pyrrhotite foundations. Buyers will seek disclosures and representations resulting in a loss of marketability. This is not speculation, some lenders in Massachusetts are already requiring a core sample test to prove the absence of pyrrhotite before closing a loan.

The math is stunning: 34,000 homes at \$225,000 repair cost = **\$7.65 billion**. In comparison, hurricane Irene caused damage of \$15.8 billion in New England and Superstorm Sandy caused damage of \$65 billion across a

large swath of the Northeast. The downstream consequences are even more alarming. Insurers have thus far maneuvered to avoid coverage on homeowners policies. Connecticut legislation has barred insurers from cancelling policies for pyrrhotite but Massachusetts has not. Banks will increasingly be saddled with foreclosed properties that have zero value. Municipalities will suffer revenue loss due to tax abatements and in many cases need to deal with permanently abandoned, deteriorating homes.

## Pyrrhotite Aggregate Geology

As the name suggests, Pyrrhotite (*/ˈpɪrəˌtɪt/*) is a naturally occurring iron sulfide ( $Fe_{1-x}S$ ). Most people in Western Massachusetts are familiar with Brimfield, the town famous for its massive antique shows. Fewer are familiar with a geologic feature called “Brimfield Schist.” According to the Geological Society of America, “rock aggregate in the failing concrete foundations was largely mined from a single quarry, working a stratified metamorphic unit in eastern CT mapped as **Ordovician Brimfield Schist**. The gray, rusty brown to orange yellow weathering rock, is a medium to coarse grained, interlayered schist and gneiss, composed of oligoclase, quartz, K-feldspar, biotite and commonly garnet, sillimanite, graphite, and **pyrrhotite**.” See *geologic map below*.



According to Trinity geologist Dr. Jonathan Gourley, in the presence of moisture/air and calcium, the sulphur in the pyrrhotite reacts and transforms to several secondary minerals, and associated changes in volume lead to a loss of structural integrity. While current science is unable to predict whether any given concrete foundation containing pyrrhotite will fail, recent developments relying upon the magnetic properties of pyrrhotite have greatly lowered the cost of accurate testing.

Dr. Gourley and Dr. Christoph Geiss, investigating methods for testing concrete samples for pyrrhotite, succeeded in developing a new thermo-magnetic test. The test is significantly less expensive and time

consuming than traditional petrographic analysis methods and is already available to homeowners, engineers, and others.

On September 17, 2018, Dr. Gourley presented some of his work at the Monson Public Forum on Crumbling Foundations. In terms of risk assessment, he identified 4 important factors: 1) the % of pyrrhotite; 2) the source of the aggregate; 3) the interaction of the foundation with water; and 4) the age of the foundation. He added that other factors may be in play including variability in the initial concrete quality, and the water added to the original mix (related to ultimate compressive strength). Until the predictive science advances, even very low percentages of pyrrhotite in aggregate from Becker's Quarry will place an economic cloud over tens of thousands of properties. There may be a safe level of pyrrhotite but that amount is not known yet.

The work by Drs. Gourley and Geiss is ongoing, including efforts to determine if there is a safe level of pyrrhotite and to develop improved risk assessment modeling. Once a scientific consensus is reached for a safe level of pyrrhotite, it will be important for policy makers to navigate how to deal with homes that fall below a given threshold but still contain pyrrhotite. In September the scientists travelled to the city of Trois Rivières in Quebec to meet with Canadian researchers and policy makers studying concrete failures in about 4,000 homes related to a pyrrhotite rich quarry there. A new publication authored by Geiss and Gourley on this issue is now in press entitled, "A Thermomagnetic Technique to Quantify the Risk of Internal Sulfur Attack due to Pyrrhotite", Cement and Concrete Research, 2018.

The question of whether installation practices are responsible for or contribute to the widespread concrete failures is an open one. For instance, Dr. Gourley's lab has a backlog of pyrrhotite-tested core samples that have not yet been tested for compressive strength. (Compressive strength is related to the amount of water added to the concrete mix at the direction of the installation contractor.) In addition, possibly because the owner of Becker's Quarry is still under a state enforced moratorium, samples of the pyrrhotite aggregate have not been made available to scientists for testing. The data from sampling the actual vein of pyrrhotite aggregate used in the JJ Mottes concrete might allow scientists to develop improved models to help determine whether there is any safe level of pyrrhotite.

## Slow Motion Disaster . . . and Response

When the EF3+ tornado hit Western Massachusetts in 2011, first responders from neighboring towns were on site within the hour. The National Guard was deployed and Governor Patrick flew to Monson in a Blackhawk helicopter within days. A disaster declaration was issued and FEMA responded. Insurance money began to flow almost immediately. In contrast, this local disaster did not start making the news until 2014. Connecticut is at least two years ahead of Massachusetts in attempting to address this problem. Federal aid is uncertain other than a "safe harbor" tax provision for deducting pyrrhotite repair costs as a casualty loss. There has been no FEMA disaster declaration.

In August 2015, CT Governor Malloy ordered an investigation into reports of failing concrete foundations by the Department of Consumer Protection (DCP). According to the eventual [report](#) released on December 30, 2016, "(t)he purpose of the investigation was to determine whether consumer protection rules were violated, whether faulty concrete was knowingly poured and supplied to contractors, and whether there was any breach of a duty and consequent failure to notify homeowners and the State. DCP's investigation focused on residential foundations because there had been no complaints and no indication that this type of concrete failure had occurred in a commercial or public works setting." The investigation had two tracks: (1) An extensive inquiry to discover how, when, where and by whom the defective concrete was produced and installed; and (2) A complex scientific study seeking to ascertain the physical causes of the deteriorating concrete.

The investigation was thorough. A scientific [study](#) was conducted by Kay Wille and Rui Zhong in the Department of Civil and Environmental Engineering at UConn. In addition, approximately 70 potentially affected homes were inspected. Roughly 90 contractors identified by consumer complaint forms were interviewed. The DCP conducted 85 interviews with experts involved in residential construction and foundation installation. The investigation found that: 1) pyrrhotite must be present to result in the observed deterioration; 2) the minimum amount of pyrrhotite needed to trigger deterioration is not known; and 3) Becker's Quarry (the main source of aggregate used by JJ Mottes Concrete) is located in a vein of rock that contains significant amounts of pyrrhotite. JJ Mottes Concrete previously operated in Stafford Springs, CT, on the Massachusetts border.

A spokesperson for JJ Mottes told the Hartford Courant in 2016 that the problems result from bad installation. "We strongly believe that the current situation involving residential foundations in Eastern Connecticut is an installation issue, and we support an unbiased and comprehensive investigation of these foundation issues — including how the materials were placed and installed, in addition to remedial actions — so that homeowners can get the answers they deserve and meaningful help with solutions," said John Patton at the time. According to the [article](#), JJ Mottes leased its operations to Connecticut Ready Mix in 2016.

HartfordBusiness.com reported that in 2017, Paul Schmieder, principal of Connecticut Ready mix purchased the Mottes' real property for \$455,000 through an entity he also controlled called 10 Meadow Lane LLC. (10 Meadow Lane was the address for JJ Mottes.) Schmieder was quoted in the [article](#) as asserting that, "we never have, never will," use aggregate from Becker's Quarry.

As one might expect, when a homeowner realizes that the foundation is cracking and appears to be failing, an insurance claim ensues. However, notwithstanding the various individual and class action lawsuits that have been filed in Connecticut, the slow-motion nature of pyrrhotite collapse has provided a robust defense to insurers. Few reported cases have made it past the motion to dismiss or motion for summary judgment stage, although recently the U.S. District Court certified a question to the CT Supreme Court regarding the meaning of collapse under Connecticut law (e.g., "substantial impairment of structural integrity"). In October 2015, the State of Connecticut Insurance Department issued a Notice to Insurers not to cancel or fail to renew homeowners policies for crumbling foundations, except in strict accordance with underwriting guidelines and rules on file. Not surprisingly, newer policy forms specifically exclude coverage for the type of slow-motion collapse caused by pyrrhotite, as stated by an affected homeowner at the Monson Forum.

Connecticut legislation and agency responses are far ahead of Massachusetts. Connecticut agencies such as the Department of Housing (DOH) and the Department of Consumer Protection have established informational web pages ([DOH site](#), [DCP site](#)). CT Public Act [16-45](#) provided for various measures including reporting of concrete sources for both residential and commercial buildings; rules for reassessment of property tax; and a seven year confidentiality rule to protect owners from disclosure of documentation, among other provisions.

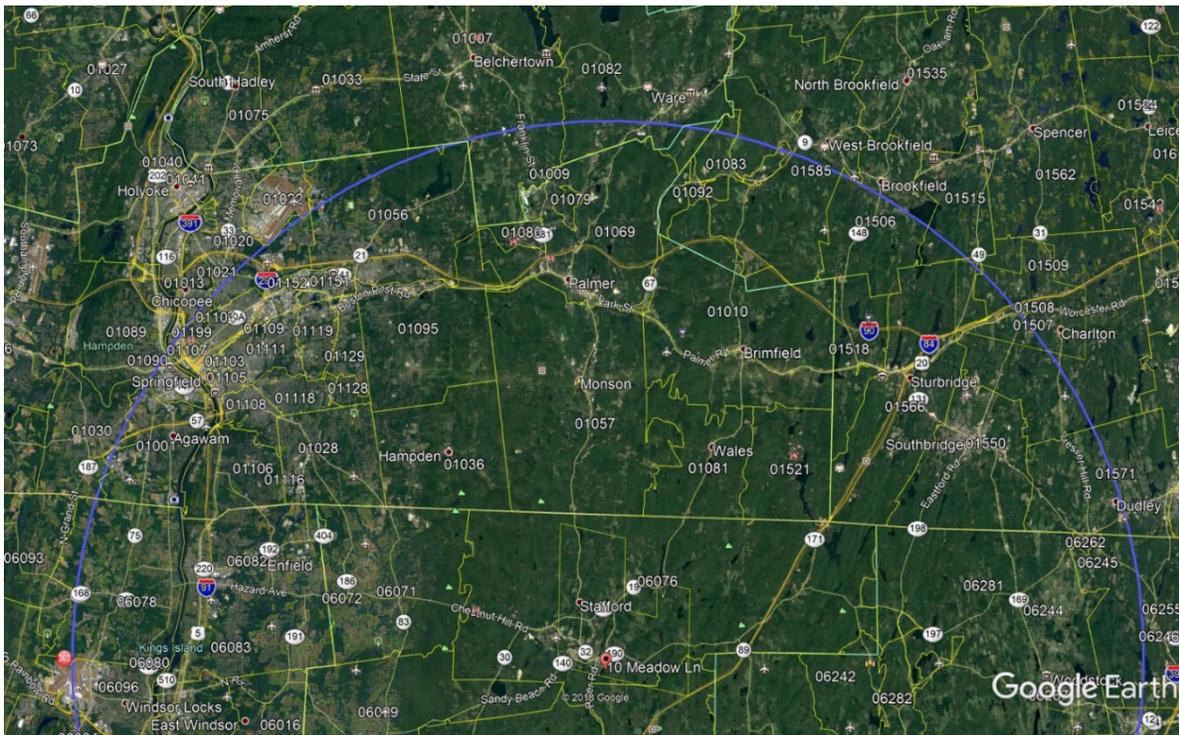
CT Public Act [17-2](#), §§ 335-348, created a captive insurance agency to assist pyrrhotite foundation owners; created a credit enhancements program; bans recycled material containing pyrrhotite; waives building permit fees; mandates residential property condition disclosures; and establishes a training program for contractors repairing or replacing foundations. CT Public Act [18-60](#) established a "healthy homes fund" and imposed a \$12 surcharge on all homeowners insurance policies issued, renewed, amended or endorsed from 2019 through 2029.

CT Public Act 18-179 includes, requiring disclosures on the building's structure and any improvements made to it, including questions on, among other things, the roof, exterior, driveway, and the types of testing, inspection, or repairs done to the foundation; and a new statement on concrete foundations that suggests prospective buyers have the concrete foundation inspected by a licensed professional who is a structural engineer for deterioration due to the presence of pyrrhotite.

Massachusetts legislators and agencies can study the efforts in Connecticut for guidance. Local State Senators Lesser and Gobi are active in this effort. In July, lawmakers overrode Governor Baker's budget veto of a \$50,000 program to help homeowners pay for inspections (compared to \$5 million in CT). Another provision created a commission to study the problem and develop solutions. The currently-forming commission would bring together the Massachusetts governor's office, lawmakers, state banking and insurance regulators, the attorney general's office, and others. Under the statute, Governor Baker is entitled to appoint 7 individuals to the commission. Senator Gobi and Representative Brian Ashe are to serve as co-chairs. The commission is expected to hold public meetings beginning in November.

The meager inspection fund is managed by the division of professional licensure and applies to residential foundations within 20-mile radius of JJ Mottes Concrete Company in Stafford Springs, Connecticut. Reimbursements shall be made at a rate of 100 per cent for visual testing conducted by a licensed professional engineer up to \$400 and a rate of 75 per cent for the testing of 2 core samples up to \$5,000.

As the map showing affected zip codes indicates, the blue 20-mile radius line reaches from Agawam to Charlton, ironically covering most of the 34-mile path of the 2011 tornado, which is still visible in satellite photographs.



## Risky Business

During the Monson Forum, Senator Gobi, who is heading the new commission, and Monson Town Administrator, Evan Brassard called for affected homeowners to come forward to inform state and local government officials if they suspect that their foundations are tainted by pyrrhotite. The government needs this data in order to build consensus for a political/legislative response. However, as illustrated by the small number of official complaints filed in CT (717 as of May 2018), homeowners should be concerned about telling all the world of the possibility that their home may be worthless – banks, insurers, and Realtors will be taking notes. The comparison to Connecticut is even more stark because the Massachusetts legislature did not

include confidentiality protections for homeowners who disclose information to government agencies as did §4 of CT Public Act 16-45. It is unclear whether the commission can adequately protect homeowner information at this time. The commission will be subject to open meeting laws.

In legal terms, the decision by owners to disclose pyrrhotite concerns publicly should be made carefully with a clear eye toward strategies for seeking tax abatements, as well initiating legal claims against prior sellers, contractors, Realtors, or others. Once this disclosure threshold is crossed it may be impossible to walk back a pyrrhotite taint, unless core testing establishes the complete absence of pyrrhotite.

In addition, the choice of experts also has enormous legal implications. For example, in the context of litigation, relying on the wrong expert could doom the odds of relief. Technical experts who cannot hold their ground when their opinions are attacked in a deposition by opposing counsel, can do more harm than good.

In litigation, *consulting* experts are distinguished from *testifying* experts. Civil litigation rules permit a party and counsel to evaluate consulting expert opinions before deciding which expert will be disclosed to testify in a lawsuit. Occasionally, a particular consulting expert may develop an opinion that is incompatible or inconsistent with the best theory of the case. In those circumstances, another expert can be retained and the unhelpful consulting expert's opinion kept confidential. Owners who might need to pursue insurance claims, tax abatements, or lawsuits should consult a lawyer before selecting experts. In technical and scientific cases, testifying experts are key.

## A Call for Collaboration – Love It or Lift It

Solutions to the pyrrhotite disaster puzzle have many moving parts: design, construction, science, financial, tax, legal, and more. As of September, the Massachusetts Office of Public Safety and Inspections was not aware of any working group of design and construction professionals formed to consider code exemptions, waivers, or modifications that could streamline the repairs to pyrrhotite foundations. The lack of effective action in response to a real disaster prompted this article as a call for collaboration.

Almost all news reports describing the necessary repairs state something to the effect that “currently the only solution is to **remove and replace the entire foundation.**” This appears to be the State of Connecticut's official position. According to the CT Department of Housing, the source of this recommendation was an analysis by the Army Corps of Engineers. Strangely though, the CT agency leading the pyrrhotite response has not been able to produce or cite any engineering reports from the Corps.

Lifting and full replacement might make sense once actual collapse begins. Some of the most dramatic photographs in the news show severely crumbling and bulging foundation walls. There are videos of homeowners crushing pyrrhotite concrete chunks with their bare hands. Where a foundation is no longer able to carry its design loads, any competent contractor or design professional would recommend immediate shoring. In such advanced cases of deterioration, the building may have already settled/shifted and would need to be lifted back into position. In such cases the only remedy may be full foundation replacement.

In other cases when pyrrhotite is present with telltale “map cracking” and horizontal cracks appearing, but where no significant settlement has occurred, less drastic repairs may be adequate to permanently preserve the building without the expense of full replacement. As an attorney who has litigated all manner of construction defect cases for the past 26 years, I am not alone in thinking that universal full replacement is overkill. Initial technical discussions for this article with two licensed professional engineers, an architect, and several experienced contractors suggest that other options exist to meet codes and provide the same service life as a new foundation – without removing the defective concrete.

There are several compelling reasons for design professionals, contractors, scientists, and building code officials to collaborate to find adequate repair solutions short of full replacement.

1. Most homeowners can neither afford repairs out of pocket nor borrow against a worthless asset. Insurance may not be available.
2. If all or part of a foundation can be permanently shored or repaired without lifting, the repair costs would be substantially lower.
3. Is it justifiable or is it economically wasteful to spend \$250,000 to repair a building with a \$250,000 market value?
4. If foundation repair plans and specifications are designed and stamped by a licensed professional engineer, if those plans fully function to meet relevant building code requirements, if the plans are executed by a competent contractor, and finally inspected by the design professional & code enforcement officer, **is the building still defective?**

The last question is critical. As mentioned above, the downstream economic consequences of this disaster are enormous. Further scientific study may develop accurate predictions of structural failure based on varying percentages of pyrrhotite and other measurable factors (e.g., compressive strength). Predictions and statistics alone may not remove the perception of defects. Aside from a complete government bailout, wherever possible we need to devise repair solutions that are economic, structurally sound, and durable. As professionals involved with the built environment, we must help drive the debate to convince the public that there are options short of throwing good money after bad.

As a former builder who had a hand in building more than 100 buildings, my humble opinion is that simple foundations, which have not yet lost structural integrity, can be left in place and used as the exterior form of a new concrete wall, poured on the inside, on new footings, and designed with sufficient reinforcement to resist all forces. A variety of techniques can be used to transfer loads from the sill plates, which would require careful detailing in conjunction with a structural engineer. In functional terms, the existing defective wall may or may not eventually fail – it becomes a form of backfill. For lack of a better term it should be coined as “**Becker’s Backfill**” material and left in place.

Solutions such as this do not require detachment and lifting of chimneys, loss of landscaping for a complete perimeter excavation, detachment of utilities, or myriad other costly complexities. The purpose of this article is to challenge people in the design and construction industry to find alternative ways to mitigate this disaster. I urge design and construction professionals to collaborate with universities, code authorities, insurers, lenders, and government officials to mitigate the impact of this slow-motion natural disaster.

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BIO – Steven J. O’Neill lives close to pyrrhotite ground-zero in Monson, MA and had front row seats to the 2011 tornado disaster. He practices construction and technology law in Massachusetts and Hartford, Connecticut. He can be reached at [sonneill@attorneyoneill.com](mailto:sonneill@attorneyoneill.com). For more information and ongoing updates on this topic see <https://attorneyoneill.com/pyrrhotite-foundations/>.

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