REPORT ON DETERIORATING CONCRETE IN RESIDENTIAL FOUNDATIONS

State of Connecticut
Department of Consumer Protection

December 30, 2016

I. Introduction

Pursuant to Public Act 16-45, the Department of Consumer Protection ("DCP") hereby submits a report to the Planning and Development Committee of the General Assembly regarding the "potential cause or causes of failing concrete foundations." As discussed more fully below, following a detailed investigation into both the natural and potentially man-made causes of this issue, DCP and the Office of the Attorney General ("OAG") conclude that the deterioration of the concrete foundations – which are concentrated in northeastern Connecticut – is caused, at least in part, by a naturally existing mineral present in the concrete mix used to pour the foundations.

Presence of this mineral, pyrrhotite, is necessary in order to cause one of these foundations to fail. DCP and OAG are unable at this time to state the minimum level of pyrrhotite necessary to cause failure. Further, other conditions - such as the amount of water in concrete at time of installation, and exposure to ground water following installation - contribute to the failure or to the amount of time before failure. The extent of those contributions remains indeterminate.

DCP and OAG further conclude that there was insufficient evidence to commence an action by the State under the Connecticut Unfair Trade Practices Act ("CUTPA") against the companies involved. Accordingly, CUTPA is not an avenue to recover financial relief for affected homeowners.

At the request and under the leadership of Governor Dannel P. Malloy and Lieutenant Governor Nancy Wyman, DCP and OAG devoted significant monetary and personnel resources to perform a diligent and thorough investigation to arrive at these conclusions. While these conclusions may raise more questions, this investigation has helped us to develop a much deeper understanding of this tragic and unforeseen natural disaster.

The investigation has yielded significant insights which DCP believes will help this Committee and government officials, private industry, and homeowners going forward. Accordingly, this report will discuss DCP's investigatory process more fully. As always, the Department of Consumer Protection stands ready to assist the Committee and the Legislature on this issue.

II. Discussion

On July 27, 2015, Governor Malloy requested that Jonathan A. Harris, Commissioner of DCP, go to East Hartford, Connecticut to view a home with basement walls that were cracking and crumbling.[1] Commissioner Harris observed a unique pattern of cracks in the foundation known as "map-cracking" and large gaps in the concrete.[2] Some affected homeowners had already reported that these types of cracks were progressively expanding, lifting up the structure of the house and causing the concrete to crumble.

[1] A foundation for a residential structure consists of three essential parts. The footing provides the base which supports the foundation walls and the slab forms the floor. To date, DCP has no knowledge of failure in the basement floors, and all signs of deterioration have been found in walls.

[2] See Brochure at Appendix A.

On August 6, 2015, Governor Malloy requested that DCP and OAG investigate deteriorating concrete in residential foundations to determine whether the State could assert a CUTPA claim against anyone involved in the manufacture, sale or installation of defective concrete.[3] DCP and OAG immediately assembled a team dedicated to conducting the investigation.

The 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.[4] 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.[5] 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.

As noted above, the investigation is now complete and DCP and OAG have concluded that: (1) Our expert's research makes clear that the presence of the mineral pyrrhotite in the analyzed foundations is a necessary causal factor in their deterioration;

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[3] Under CUTPA, Sec. 42-110d, Conn Gen. Stat., the Commissioner of DCP has the authority to investigate any alleged unfair or deceptive business practices. As the attorneys representing DCP, OAG has derivative powers to conduct an investigation under CUTPA. Attorney General George Jepsen's letter to Gov. Malloy and Commissioner Harris dated July 7, 2016, regarding their legal analysis is available at Appendix B.

[4] Pursuant to Sec. 42-110b(a), Conn. Gen. Stat., "No person shall engage in unfair methods of competition and unfair or deceptive acts or practices in the conduct of any trade or commerce."

[5] The Department of Transportation reviewed state projects separately and determined that there were not any reports or indications of concrete failure.

and (2) There is insufficient evidence upon which to commence a CUTPA action.

A. Scientific Study

The concrete used in the construction of residential foundations has four main ingredients: cement, chemical admixtures, water and stone aggregate. Prior to the investigation, it was hypothesized that pyrrhotite was contributing to the deterioration of foundations. While observations of foundations revealed the map-cracking and discoloration associated with pyrrhotite, in order to confirm the presence of pyrrhotite and identify if and how it was causing the failures, OAG and DCP retained Professor Kay Wille, Ph.D. to conduct a scientific investigation and literature review.[6] Dr. Wille and his assistant, Dr. Rui Zhong, Ph.D., dedicated over eight months to this study which included:

- Drilling and analyzing core samples from multiple parts of residential foundations poured with defective concrete;
- Conducting visual inspections of residential foundations;
- Testing the strength and failure pattern of the deteriorated concrete;
- Conducting a visual inspection of Becker's Quarry, the source of stone aggregate used by the concrete company, Joseph J. Mottes Company ("Mottes") in its manufactured concrete;
- Procuring and testing stone aggregate from Becker's Quarry; and

[6] Dr. Wille is an associate professor at the University of Connecticut and the director of UConn's Advanced Cementitious Materials and Composites (ACMC) Laboratory. In 2015, he earned the National Science Foundation CAREER award. Dr. Wille's research focuses on concrete mixture design and characterization of mechanical and durability properties.

- Reviewing all available literature on deteriorating foundations.

B. Connecticut Unfair Trade Practices Act

On August 6, 2015 and August 31, 2015, OAG and DCP issued comprehensive Civil Investigative Demands ("CID") to Mottes, the company that allegedly produced the defective concrete.[7] The CIDs required Mottes to answer questions and produce documents concerning its operations going back nearly four decades. The focus of the CIDs was to determine where, when and how Mottes operated and obtained materials for its concrete mixture used in Connecticut foundations and the company's concrete manufacturing process. In addition to the CIDs, OAG and DCP interviewed 10 and deposed three of Mottes' current and former employees.

While the primary target of the inquiry was Mottes, the investigation cast a much wider net and involved an extensive amount of work by DCP and OAG. These efforts fell into one of five categories: Data Analysis, Document Requests, Live Interviews and Depositions, Expert Consultations, and Public Communications. Some highlights of these efforts include:

- Issuing CIDs containing 43 separate requests for documents related to the manufacture and installation of concrete;
- Reviewing and analyzing thousands of produced documents;

[7] A civil investigative demand is similar to a subpoena and is used by consumer protection offices. "A CID tends to be expansive . . . . The scope is investigatory, broader than civil discovery. The CID often provides an extensive list of items or documents to produce and may pose interrogatories or testimony under oath. A lawsuit is not required; as the name implies, it is served during an investigation." See State AG's Issuing Subpoenas: The Whys and Wherefores of Civil Investigative Demands, by Jonathan Groux, American Bar Association State & Local Law News, Volume 37, No. 4 (2016).

- Interviewing 85 individuals involved in residential construction and the installation of foundations;
- Deposing three individuals involved with the home construction industry in northeastern Connecticut;
- Reviewing and analyzing over 450 complaints filed with DCP;[8]
- Attempting to contact all individuals who filed complaints;
- Interviewing most of the complainants and other parties connected with the complaints (e.g., home builders, engineers, subcontractors);
- Issuing 31 subpoenas under CUTPA to all insurance companies in Connecticut offering homeowner's insurance to procure relevant claims;
- Interviewing approximately 90 different builders identified by the complainants;
- Consulting with numerous structural engineers, concrete companies, contractors and laboratory testing centers;
- Conducting approximately 70 site visits to the homes of potentially affected consumers;
- Participating in informational meetings with officials in the municipalities affected by the defective concrete;
- Interviewing individuals from four condominium associations whose complexes are potentially affected;

[8] With regard to the scope of the problem, the number of complaints received is both under inclusive and over inclusive. Since not all of these foundations have been scientifically tested, they may not all contain pyrrhotite. Correspondingly, some homeowners whose homes are affected likely have not filed a complaint.

- Communicating with homeowners, construction professionals, real estate experts and others with knowledge relevant to the investigation;
- Issuing two advisories to home inspectors alerting them to the problem, and describing what the problem looks like in homes;
- Training home inspectors and contractors to increase the number of professionals in the field able to recognize and report the problem; and
- Reviewing literature and media accounts of similar occurrences outside of Connecticut.

Given the inherent tragedy of a natural disaster displacing people from their homes, DCP and OAG dedicated a huge amount of resources to this investigation. DCP and OAG regularly collaborated with Lieutenant Governor Wyman and others in the Malloy Administration to engage the public in this discussion and to share important information to those affected by the defective concrete. During the course of the investigation, DCP gleaned valuable information by listening to and learning directly from homeowners, builders, home inspectors, real estate professionals, federal office holders, legislators, and municipal and regional officials.

In addition to this direct communication with different stakeholders, DCP provided information distributed in hard copy, created a dedicated page on our website and disseminated information and updates through traditional and social media.

III. Findings

The following are the salient findings of the investigation:

- Since the early 1980's, Becker's Quarry was the primary source of the stone aggregate Mottes used to make its concrete;

- Mottes is the only company identified that produced the concrete connected to the deteriorating foundations;
- Becker's Quarry is located in a vein of rock that contains significant amounts of pyrrhotite;
- Pyrrhotite is present in Becker's Quarry in more than trace amounts;
- Pyrrhotite is a necessary factor in the chemical reaction leading to the deterioration of the concrete foundations;
- There may be other contributing factors that could also cause or accelerate the concrete failure;
- The chemical reaction that causes premature deterioration include oxidization of pyrrhotite in the presence of water and oxygen that lead to the formation of expansive mineral products;
- No foundations poured outside of 1983 to 2010 have been reported to DCP as having deteriorating concrete;[9]
- Given the uncertainty in predicting the time for the condition manifest itself, it is possible that the affected date range will expand; and
- Based on complaints received by DCP, the deteriorating residential foundations appear to be limited to homes and some condominium complexes located in 23 municipalities.[10]

[9] While not all of these claims have been substantiated, it does provide a basic range of time in which residential foundations poured with concrete produced by Mottes may be subject to deterioration and therefore require remediation.

[10] See Map of Impacted Municipalities Appendix C.

IV. Conclusion

At the end of August 2016, scientific experts completed their research and analysis, conclusively determining that the presence of pyrrhotite is necessary to cause the foundations to deteriorate.[11] Professor Wille and his team established a theory that:

> [P]yrrhotite in the aggregate oxidizes at the presence of water and oxidant (oxygen or ferric ions) which lead to the formation of expansive secondary mineral product such as ferrihydrite and the release of sulfate. The released sulfate promotes the reaction with aluminum containing phases in the cement...and results in the formation of expansive and thus deleterious secondary minerals such as ettringite. Furthermore, at the presence of carbon, either from the calcite in aggregate or from CO2 from environment, another deleterious mineral thaumasite can be formed. Both of these secondary minerals are expansive and might alternatively lead to the premature deterioration of the concrete foundation investigated in this research.[12]

The scientific study also raised questions to be explored going forward that should help people continue to build their understanding of the problem and create solutions.[13]

In the short run, the investigation has helped prevent the problem from spreading. DCP and OAG leveraged the investigation to secure an agreement with Mottes to cease using aggregate stone from Becker's Quarry in any concrete poured for residential foundations through June 30, 2017.[14] This important agreement temporarily halts any further production and installation of possibly defective concrete, and gives the public and private sectors more time to explore possible avenues of assistance for homeowners.

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[11] See Investigating the Deterioration of Basement Walls Made of Concrete in CT ("Scientific Report") at Appendix D.
[12] See Scientific Report at pg. 52.
[13] See Scientific Report at pg. 53.
[14] See Assurance of Voluntary Compliance dated May 5, 2016 at Appendix E.

It should be noted that the General Assembly and the Governor have already taken proactive and thoughtful action to protect the homeowners and communities affected. For example, Public Act 16-45 requires:

- Builders to produce additional documentation to obtain a certificate of occupancy for a new structure with a concrete foundation;
- Municipalities, at an owner's request, to reassess residential properties with foundation problems; and
- DCP and other State agencies to protect the confidentiality of information connected to a complaint regarding a failing residential foundation by preventing its disclosure for at least seven years after the complaint is filed.

The investigation produced enough information to build a baseline understanding of this issue. A cohort of industry and materials experts will be necessary to gain the knowledge required to answer three remaining questions: What can be done to prevent this problem from reoccurring; what methods exist to delay or stop the progression of this condition; and what is the most cost-effective method to remediate existing deterioration?

The investigation is now concluded. DCP remains willing to provide whatever information it can from the investigation and our expertise to assist others in finding remedies to the problem of deteriorating foundations in northeastern Connecticut.