TECHNICAL REPORT

of the

CHARLES JOHNSON FALL INCIDENT

May 20, 2009

Robson Forensic
Engineers, Architects, Scientists & Fire Investigators

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A. INTRODUCTION

On September 15, 2007, Charles Johnson (Johnson) was employed by Friendly Roofing, Inc. (Friendly Roofing) as a roofer on a roof system replacement project at a Tastes Like Cardboard, Inc. (Tastes Like Cardboard) plant roof in Anytown, PA. Friendly Roofing was a subcontractor on this project to roofing contractor Flat Roof Specialists, Inc. (Flat Roof). After their lunch break the Friendly Roofing crew was applying adhesive to the previously laid insulation and installing the new roof membrane when, without warning, a section of the roof structure beneath Johnson failed and he broke through the roof and fell about 20-30 feet to the plant floor below. He was injured as a result of this incident.

The purpose of my investigation is to determine if the actions of Tastes Like Cardboard created dangerous conditions which were a cause of Johnson's fall. My purpose also includes determining if Johnson's actions were unreasonable in a manner that contributed to his own fall.

B. MATERIALS AVAILABLE FOR REVIEW

1. Complaint
2. Deposition transcript of Frank Tillson, taken December 10, 2008.
3. Deposition transcript of Charles Johnson, taken December 22, 2008.
4. Deposition transcript of Bill Richard, taken December 18, 2008.
5. Plaintiff's Answers to Interrogatories
6. Flat Roof Specialists, Inc. contract with Tastes Like Cardboard.
7. Flat Roof Specialists, Inc. contract with Friendly Roofing
8. Report prepared by The Forensic Company dated December 15, 2007
9. FAX correspondence Oscar Millhouse to Mr. Cho dated September 30, 2007.
10. Photographs

C. BACKGROUND

At the time of Johnson's incident, Tastes Like Cardboard, Inc. owned and operated the plant building in Anytown, PA where this incident occurred. Tastes Like Cardboard has owned this operation since the 1990's [Richard: pp.-7-9]. According to their website www.tasteslikecardboard.com they are the world's largest privately held tasteless food company. In the US, they own this facility in Anytown, which includes administration and production operations, as well as a production facility in Spokane, WA. In addition, they lease warehouses throughout the US utilized in product storage and distribution [Richard: pp.-14, 15].

On September 18, 2006, the Board of Directors of Tastes Like Cardboard authorized the replacement of approximately 54,000 square feet of roof on the Anytown plant for an amount not to exceed $300,000. Oscar Millhouse is an engineer and was Director of Operations for Tastes Like Cardboard during the period of the planning and execution for the roof replacement work [Richard: p. 53].

A set of Roofing Specifications dated July 22, 2007 was prepared for the work. A Proposal/Contract with Roofer's Inc. was executed in August 2007. This contract included a unit price for the replacement of gypsum decking. Flat Roof Specialists entered into a subcontract agreement with Friendly Roofing, Inc. to provide the labor for the roof replacement work.

According to Johnson, the Friendly Roofing crew that he was a part of began work on the Tastes Like Cardboard roof in September 2007. The Friendly Roofing foreman was Andy Brown. After a week, they took a break and went home to Orlando. They spent two days in Orlando and returned to Anytown on the Friday prior to his incident. They started back on the Tastes Like Cardboard job on Sunday. His fall incident took place on Monday, September 15, 2007.

D. DESCRIPTION OF THE INCIDENT

The building was constructed in 1960 or 1961 [Richard: p. 162]. The structural roof deck is gypsum decking.

According to Johnson, as they removed the old roofing system, they would encounter holes in the decking. They would cover the smaller holes with the new insulation and mark the insulation and the new membrane with concentric circles. On larger holes, they would place plywood over the hole and then place and mark the insulation and membrane as they did with the small holes. The next day, Flat Roof Specialists would re-open the marked areas, repair or replace the gypsum deck, and then Friendly Roofing would patch the roof back in.

On the day of his incident, the crew encountered a deck section with a hole broken in the decking corner where it was supported by structure below. Johnson describes this

hole as being about the size of the bottom of a bottle [Johnson: p. 114]. They placed insulation over it and marked the insulation. After their lunch break, Johnson was walking across the roof carrying two full pails of "glue". He was walking on the recently laid insulation and at a spot, according to his estimation, which was about 6 feet away from the marked location of the bottle sized hole, he broke through the insulation and decking and fell to the floor below.

E. ANALYSIS

Cause of the roof deck failure:

Gypsum concrete roof decks have been in use since the 1940's. They are thin (usually 2" – 3" thick), lightweight and fire resistant. Their application in new construction today is limited due to advances in steel roof decking with modern fireproofing systems and lightweight concrete decks.

Gypsum decks generally perform well unless exposed to water infiltration which can break down the gypsum, deteriorate the steel reinforcing and lead to deck failure. Tastes Like Cardboard was aware that the existing roof was leaking and exposing the gypsum deck to water infiltration. Bill Richard testified:

> We had many leaks from the roof. It was my understanding that the roof that was there at the time was old and it was leaking in quite a number of places, especially when it rained and when snow was sitting up there [Richard – p. 163].

The existing roof membranes on the roof, although never intended to perform a structural function, can contribute to the load carrying capacity of the roof by working with the deck to distribute roof load to the supports. The National Roof Deck Contractors Association recognizes this danger and in their publication NRDCA 500 – Gypsum Roof Deck Replacement Procedures and warns:

> CAUTION: The existing roofing membrane provides an element of support and safety for workers on a badly deteriorated gypsum deck. After removing the roofing membrane, the added safety provided by the membrane is lost and workmen become exposed to the increased hazard of falling through the roof.

In the photographs, the gypsum decking immediately adjacent to the panel that Johnson fell through exhibits signs of water infiltration and is cracked. Although the Friendly Roofing crew was covering actual holes through the deck with insulation and/or plywood, no one was inspecting and assessing the condition of the decking itself. When Johnson walked across the deck carrying two pails of roof mastic the deteriorated deck was unable to hold his weight and it failed suddenly.

Following the incident, Oscar Millhouse, in a fax to Mr. Cho dated September 30, 2007, establishes the conditions of the gypsum decking:

> After we took the old roof cover off, the following condition was found: Portions of the Gipson [gypsum] deck are so disintegrated that these must be replaced. The job is not finished now and we replaced already 150 square meters [1,615 square feet]. The cost increase on the project could be as much as 10%.

The decking collapse occurred because the area of deteriorated decking, stripped of its old roof membrane, was unable to support the normal and reasonably expected loads.

Actions of Tastes Like Cardboard:

Tastes Like Cardboard is the owner of this building and their Director of Operations, Oscar Millhouse, acted as the design professional and construction administrator. As such, Tastes Like Cardboard knew, or should have known, that areas of gypsum decking were deteriorated and unable to support anticipated loadings.

Millhouse prepared the specifications for the re-roofing project. When shown a copy of the re-roofing specifications, Richard testifies: "I would conclude that this is a bidding document that Oscar Millhouse put together" [Richard – p. 166]. Richard is not aware of any architect or engineer being engaged for the purpose of inspecting the roof or determining the soundness of the roof structure [Richard – p. 172].

Millhouse had hands-on involvement in the roof replacement process: "Mr. Millhouse was the managing person who would be up there every day. I worked with Oscar for many years. He's the type that manages every detail of this and it was his full responsibility. So he was the main contact and for the most part the only contact in regards to the actual physical work of replacement of the roof." "I don't know for certain if he was up there every day. But knowing Mr. Millhouse he most likely was up there every day." "He would have reviewed the job in detail very often" [Richard – pp. 53, 54]

Farmington County Building Code:

In 2001, Farmington County adopted the ICC International Building Code, 2000 Edition as the building code for Farmington County. This code was still in effect in 2007. The roof replacement and deck reconstruction work performed on the Tastes Like Cardboard building required a building permit. *Chapter 1, Administration, Section 105, Permits* requires:

> 105.1 Required. **Any owner** or authorized agent who intends to construct, enlarge, alter, **repair**, move, demolish, or change the occupancy of a building or a structure . . . or to cause any such work to be done, shall first make application to the building official and obtain the required permit. [emphasis added]
>
> 105.2.2 Repairs. Application or notice to the building official is not required for ordinary repairs to structures, replacement of lamps, or the connection of approved portable electrical equipment to approved permanently installed receptacles. Such

repairs shall not include the cutting away of any wall, partition or portion thereof, **the removal or cutting of any structural beam or load bearing support** . . . [emphasis added]

Section 109, Inspections requires:

109.1 General. Construction or work for which a permit is required shall be subject to inspection by the building official and such construction or work shall remain accessible and exposed for inspection purposes until approved. . .

109.3.4 Frame Inspection. Framing inspections shall be made after the **roof deck** or sheathing, all framing, fire blocking and bracing are in place and pipes, chimneys and vents to be concealed are complete and the rough electrical, plumbing, heating wires, pipes and ducts are approved.

Chapter 15, Roof Assemblies and Rooftop Structures, Section 1510 requires:

1510.1 General. . . . Roof repairs to existing roofs and roof coverings shall comply with the provisions of chapter 34 . . .

1510.2 Structural and construction loads. The structural roof components shall be capable of supporting the roof covering system and the material and equipment loads that will be encountered during installation of the roof covering.

Chapter 34, Existing Structures, Section 3402, Additions, Alterations or Repairs requires:

3402.1 Existing buildings or structures. Additions, alterations or repairs to any building or structure shall conform with the requirements of the code for new construction. . .

3402.2 Structural. . . . Where repairs are made to structural elements of an existing building, and uncovered structural elements are found to be unsound or otherwise structurally deficient, such elements shall be made to conform to the requirements for new structures.

Clearly, the adopted Building Code of Farmington County at the time of this roof replacement project required Tastes Like Cardboard to obtain a building permit, ensure that the roof deck was capable of supporting loads during construction, design the deck repairs to meet the structural requirements of the current Building Code, and have the deck repair/replacement work inspected by the building official.

Tastes Like Cardboard's failure to obtain a building permit and ensure that the structural rehabilitation/replacement work that was occurring on their roof structure met the requirements of the Building Code, exposed Johnson and his fellow workers to inadequate structural decking and was a cause of Johnson's fall through the roof.

Other Standards:

The American Society of Civil Engineers (ASCE) publishes various standards which engineers use in designing and assessing buildings, other structures, and their components. ASCE 30-00 – Guideline for Condition Assessment of the Building Envelope provides a standard for assessing building envelopes and their components:

1.1 Scope and Intent

The intent of this Standard is to provide a guideline and methodology for assessing the condition and performance of existing building envelope systems and components and identifying problematic and dysfunctional elements. It applies equally to a building's envelope or portion whose primary purpose may be to serve as the supporting structural system of the building. . . This standard may be a source of comprehensive information for clients such as building owners, prospective purchasers, tenants, regulatory officials, and others.

This Standard establishes an assessment procedure including investigation, testing methods, and a form for the report of the condition assessment.

1.2 Purpose of Assessment

Condition assessment of an existing building envelope may be undertaken for a number of purposes. These may include developing a performance report, establishing building serviceability, **planning for maintenance or repair**, code compliance, life safety, durability, historic preservation, or a number of special purposes bases on the specific building and its current or proposed occupancy or function. [emphasis added]

1.4.1 Personnel Qualifications

All personnel involved in the assessment shall possess the technical qualifications, including practical experience, education and professional judgment required to perform the individual technical tasks assigned. Interpretation of results and conclusions shall be performed by a design professional qualified in the appropriate discipline.

1.6 Definitions

Design Professional – An architect or engineer licensed/registered to practice in the governmental jurisdiction in which the building is located.

The previously referenced NRDCA 500 – Gypsum Roof Deck Replacement Procedures goes on to suggest:

The first step is to determine the sections requiring replacement. Conduct a moisture survey to determine high levels of moisture. Survey the deck underside for sagging form boards and areas of moisture staining and wetness. These are areas where the wire mesh may have rusted or no longer provides adequate load support. Look for areas of structural damage such as broken form boards or excessively cracked gypsum concrete. Based on the survey results, mark off the top surface of the roofing membrane to denote possible areas of concern.

This document provides best practices available to the industry, however a licensed structural engineer must review and approve of any modifications to an existing gypsum roof deck system.

The roofing system specified is a Firestone Building Products Company fully adhered TPO Membrane Roofing System. In their System Design Guide Adhered, Mechanically Attached, and Ballasted Firestone Ultraply TPO Roofing Systems, dated September 2000, the Firestone Design Guide states in *Section 1.04.1 Job Site Considerations (Cautions and Warnings):*

Special Considerations for Re-roof or Re-cover Applications:

2. Confirm the structural integrity of the existing deck, and specify repair or replacement as required.

Contractual Agreements:

The signed agreement between Flat Roof Specialists Inc. and Tastes Like Cardboard includes certain Terms and Conditions. In these Terms and Conditions, Tastes Like Cardboard agreed to be responsible for the structural condition of the building:

5. CUSTOMER'S RESPONSIBILITY. The customer [Tastes Like Cardboard] is solely responsible for structural suitability of the building in light of specifications of the roofing system to be applied pursuant to this work order, including, but not limited to, load bearing capacity. . .

12 STRUCTURAL SUITABILITY. Company [Flat Roof Specialists] assumes full responsibility for furnishing roofing materials and for their proper installation in accordance with the manufacturer's specifications. Company does not, either itself or through its representatives, practice architecture or engineering and offers no opinion on, and expressly disclaims any responsibility for, structural integrity, compliance with building codes or design. Opinions of competent structural engineers should be obtained by the customer as to the structural soundness of the roof deck and its ability to properly support normal roof construction equipment and the completed roof system. Company accepts no responsibility for any failure of the roof deck, its ability to support contemplated roof installation, or resultant damages.

Tastes Like Cardboard knew that there were numerous leaks on the existing roof system, and knew, or should have known that gypsum roof decks were prone to failure when exposed to water.

Tastes Like Cardboard's failure to survey the existing roof deck prior to construction and map out areas of known deterioration, as well as have a qualified person inspect the deck during roof stripping operations, did not comply with the applicable industry standard of care for building owners and designers and was a cause of Johnson's fall through the roof deck.

Actions of Charles Johnson:

Johnson was working as a roofer employed by a subcontractor on a major re-roofing project. At the time of his incident, he had about one year of roofing experience in Mexico and about one year of experience on roofing work in the US. There is no evidence that he had any training in jobsite safety or in inspecting, testing, evaluating or designing gypsum roof decks.

He and his fellow roof workers were stripping off an old roof and exposing the existing gypsum roof deck. He was doing what he was told to do by covering the gypsum deck with insulation board and when, by some unknown criteria, a "large" enough hole was discovered they would cover it with plywood and mark it.

On the morning of his fall incident, they discovered a broken corner "hole" at the corner support of a panel about the size of the bottom of a bottle. They covered it with insulation and marked it as was their normal procedure. It is clear from the photographs and from Johnson's testimony that the location where he broke through the deck was not above the marked hole. The hole was not the problem, the condition of the deck was the problem.

If the remainder of the deck was not deteriorated, it would have been reasonable for the crew to span the small hole with rigid insulation. This type of insulation is used regularly on corrugated metal deck roofs. On corrugated decks, the insulation bears on the high spots of the deck and spans, or bridges, across the low areas of the deck. Many types of metal decking have ridges that are wider than the bottom of a bottle and so it is reasonable to expect that the insulation would span the hole, which it did.

The decking did not fail at or near the hole at the edge of the deck. The likely location for the failure is near the center of the panel where the stresses are the highest, away from the marked hole location as described by Johnson and supported by the photographic evidence.

Charles Johnson's actions were reasonable and did not, in any way, contribute to or cause his fall incident.

The collapse occurred because Tastes Like Cardboard did not inspect the decking prior to construction and did not inspect the decking as it was being exposed by the roof stripping operation.

F. FINDINGS

Within the bounds of reasonable technical certainty, and subject to change if additional information becomes available, it is my professional opinion that:

1. The decking collapse occurred because the area of deteriorated decking, stripped of its old roof membrane, was unable to support the normal and reasonably expected loads.

2. Tastes Like Cardboard is the owner of this building and their Director of Operations, Oscar Millhouse, acted as the design professional and construction administrator. As such, Tastes Like Cardboard knew, or should have known, that areas of gypsum decking were deteriorated and unable to support anticipated loadings.

3. The adopted Building Code of Farmington County at the time of this roof replacement project required Tastes Like Cardboard to obtain a building permit, ensure that the roof deck was capable of supporting loads during construction, design the deck repairs to meet the structural requirements of the current Building Code, and have the deck repair/replacement work inspected by the building official.

4. Tastes Like Cardboard's failure to obtain a building permit and ensure that the structural rehabilitation/replacement work that was occurring on their roof structure met the requirements of the Building Code, exposed Johnson and his fellow workers to inadequate structural decking and was a cause of Johnson's fall through the roof.

5. Tastes Like Cardboard's failure to survey the existing roof deck prior to construction and map out areas of known deterioration, as well as have a qualified person inspect the deck during roof stripping operations, did not comply with the applicable industry standard of care for building owners and designers and was a cause of Johnson's fall through the roof deck.

6. Charles Johnson's actions were reasonable and did not, in any way, contribute to or cause his fall incident.