Board of Public Works
Staff Report

Project/Event:	Resolution to uphold the Modified Unsafe Order for the Johnson Creamery Smokestack
Petitioner/Representative:	HAND
Staff Representatives:	Michael Arnold, John Zody, Daniel Dixon
Date:	April 12, 2022

Report:

10 January 2022	Issued Original Order to Repair smokestack
1 March 2022	Received updated engineering study demonstrating repair at current height not possible.
11 March 2022	Issued Modified Unsafe Building Order requiring demolition to a height not to exceed 60 feet.

HAND received information related to spalling bricks falling free from the smokestack at the Johnson's Creamery building towards the end of 2021. This information, along with the visually obvious lean of the smokestack was very concerning to HAND and raised concerns about the safety of the smokestack. An inspection of the stack by HAND staff along with a review of a prior study completed by Arsee Engineering led HAND to determine the smokestack was unsafe under Indiana law. HAND issued an order to repair the smokestack and also closed off a portion of the adjacent B-Line trail.

On March 1, 2022, Arsee Engineering completed an updated study of the smokestack. That study revealed the smokestack was in a deteriorated condition and could not be repaired in its original configuration due to issues ranging from wall thickness, the lean of the stack, and foundation concerns. The engineering study indicated that the stack could be stabilized without additional intervention at a height of 60 feet. As a result of the study, HAND modified the unsafe order and

issued the current order to demolish the stack to a height not to exceed 60 feet. The order also requires the owner to comply with any historical preservation requirements that may be put in place in addition to removing the stack to 60 feet. An Order for demolition requires a Resolution from the Board of Public Works.

ARSEE ENGINEERS, INC.

CLIENT ORIENTED — BY DESIGN

Johnson Creamery Smokestack
for
Joseph Patrick
Peerless Development
105 S. York Street, Suite 450
Elmhurst, IL 60126

ARSEE ENGINEERS
CLIENT ORIENTED – BY DESIGN
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March 1, 2022

Joseph Patrick
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Peerless Development
105 S. York Street, Suite 450
Elmhurst, IL 60126

Re: Johnson Creamery Smokestack
Bloomington, Indiana

Mr. Patrick:

EXECUTIVE SUMMARY

We have completed our reassessment of the Johnson Creamery Smokestack in Bloomington, Indiana. This work has included a review of findings by others since our original assessment was performed in 2017. We have revisited the site and made comparisons to our earlier work to see how the deterioration is progressing. Using wall profiles determined by others in 2020, we have refined our structural analysis of the stability of the stack in design wind and seismic events as required by the current Building Code. Multiple options for repair have been considered.

Deterioration has progressed. New spalls are visible in at least 11 locations. One of the 38 steel straps observed in 2017 has either been removed or has fallen. Previous comments by ourselves in 2017 and others in 2020 regarding how much the stack leans were rough estimates based on visual observations. 3D point cloud analysis in 2022 reveals the stack is leaning 2'-3½" to the southeast.

Work by R & P in 2020 determined wall thicknesses and profiles throughout the height of the stack. This allowed us to refine our structural analysis and more accurately evaluate the stability of the stack with regard to the current Building Code. Our analysis has shown that even a new masonry stack built to the same height, configuration, wall thicknesses and profiles will fail in a design wind or seismic event. In its current configuration, the unreinforced brick masonry stack will have to be reduced in height to 60' to meet current Code requirements. Conceptually, the stack could be reduced to the height of 75' and meet the current Code by reinforcing the interior of the stack with concrete and enlarging and supplementing the existing foundation. Changes in the Building Code since the stack was constructed in 1949 simply make an unreinforced masonry stack of this height and wall construction impossible.

Our detailed observations and comments follow.

BACKGROUND OF THE STUDY

Arsee Engineers first assessed the smokestack in the fall of 2017 as part of a due diligence assessment for the City of Bloomington. Our report summarizing this work is attached as Appendix A and is hereby included into this report by reference.

The purpose of the current study has been to reassess the condition of the stack and offer recommendations on its stability and potential repair. In order to facilitate this effort, we have performed the following

- We have reviewed work performed by others since 2017.
  - Report prepared by R and P Industrial Chimney Company, Inc. (R & P) dated April 6, 2020.
  - Report prepared by Patriot Engineering dated January 7, 2021.
  - Proposals prepared by the Gerard Chimney Company for various repair options in 2021.
- We have revisited the site and performed the following:
  - Videotaped and took still photographs with a remote controlled aerial drone.
  - Created a 3D point cloud of the stack from videos taken by the drone.
  - Taken elevations of the exposed corners of the concrete foundation.
  - Developed montages of the stack for comparison with 2017 observations.
- We have updated our structural analysis of the stack using wall thicknesses and profiles reported by R & P in their 2020 report.

OBSERVATIONS

The Leaning of the Smokestack

The smokestack leans or tilts to the southeast. This is severe enough that it can be seen from ground level with the naked eye as shown in Photos 1 and 2. In 2017 we determined that the top of the stack was leaning 1 foot in every 10 and estimated that the overall tilt was in the order of several feet.

In their 2020 report, R & P estimated the chimney was leaning nearly 18 inches out of plumb. They further stated the curvature appeared to start at the 70 foot level but minor displacements were also observed below.

In the current study, we attempted to determine the lean or tilt of the stack in two ways. First we used a surveying transit to create a vertical “line” through the center of the stack in a direction approximately perpendicular to the lean. This is depicted photographically in Figure 1. This eliminates any potential parallax effect from the photograph. Comparing the proportions of the difference from the centerline to the width of the stack, we estimate the stack is 1’-9” out of plumb

from this vantage point. Figure 2 shows an image from our report in 2017 for comparison. This was created without the aide of a transit. A second method to determine the distortion used a remote controlled aerial drone to create a 3D point cloud of the stack. From this "measurements" can be made showing how far it is out of plumb. Figures 3 though 11A show pairs of aerial photographs and the 3D point cloud at various positions around the stack. The maximum distortion was found to be 2'-3½' where the stack leans to the southeast. The stack appears to start to curve or lean to the southeast just above the 25 foot level. If the stack were to fall in the direction of the lean, much like a tree being cut down, it would fall as shown in Figure 12. The overall radius of 140' from the center of the stack is also shown to get a sense of the danger zone.

Foundation of the Smokestack

The report prepared by Patriot Engineering investigated the foundation of the stack. Their report concluded that the concrete foundation is resting on bedrock and that bedrock is approximately 8.5 to 10.5 feet below grade level. They did not attempt to drill down into the rock to look for mud or clay seams.

Using a surveying level, elevations were taken at each of the eight corners of the octagonally shaped foundation. While one would not expect a foundation like this to be perfectly level there is a definite trend showing the foundation tilts to the southeast. See Figure 13. A 1 inch tilt in the 14 foot wide foundation corresponds to a 10 inch tilt out of vertical in the 140 foot tall stack. The apparent displacement of the concrete could be result of compression of a mud or clay seam in the bedrock in the southeast portion of the foundation causing it to "tilt" in that direction.

Visual Assessment Comparison

The drone was also utilized to create a series of vertical montages of the stack from different angles. The orientation of the montages attempted to copy a similar set of montages taken in 2017 so that the two sets could be compared. See Figures 14 through 16. In 2017 we observed 38 steel bands in the stack. The 2022 montages show band #35 down from the top is now missing. R & P reported only 37 steel bands when they performed their assessment in 2020 and noted there was evidence of one missing. Photos 3 and 4 show this location in 2017 and 2022. Rust stains and a bead of sealant are visible in the 2022 photo where the band was located.

Evidence of spalling was also compared between the 2017 and 2022 montages. There are 11 locations in 2022 where new spalling is visible. These generally occur in the south to southwest face of the stack between 60 and 100 foot levels. Examples are shown in Photos 5 and 6. Face shell spalling was also more evident at the foundation as shown in Photos 7 and 8.

STRUCTRUAL ANALYSIS

Using information reported by R & P from their investigation of the interior of the stack we were able to refine our previous structural analysis. In 2017 we assumed wall thicknesses based on previous experience with similar stacks. R & P cut a hole in the steel plate roof and lowered a camera to observe the condition of the masonry and determine a more accurate wall profile. Using the R & P wall profile we have re-evaluated the stability of the stack under current code

requirements for wind and seismic loads. Further assumptions used in the analysis are presented in Appendix B. Our findings can be summarized as follows

- The smokestack will go into tension at the base under the current Code required wind load.
- The smokestack will go into tension at the base under the current Code required seismic load.
- The stack would have to be shortened to the 100' level to eliminate tension at the base due to the current Code required wind load.
- The stack would have to be shortened to the 60' level to eliminate tension at the base due to the current Code required seismic load.

In other words, even in its original configuration (ie: undistorted) the stack does not meet the requirements of the current Building Code for either wind or seismic loads. A design wind (120 mph gust for a period of 3 seconds) or a design seismic event would theoretically cause severe damage up to and including potential collapse of the stack.

REPAIR OPTIONS

At the onset of this study three options were to be investigated as follows:

Option 1- Removal of the stack down to the 70 foot level and repair the remaining masonry down to grade.
Option 2- Same as Option 1, but also reconstructing the stack to a height of 100 feet.
Option 3- Same as Option 1 but reconstructing the stack to a height of 140 feet.

Given the results of the latest structural analysis – none of these options will meet current Code requirements and therefore are not feasible. Given the configuration of the masonry walls of the stack any option over 60 feet in height will not meet the requirements of the Building Code for seismic loads.

In light of all this, we believe there are two viable options at this point.

Option A

- Remove the entire structure down to the 60' above grade level. Salvage face shells from sound brick for spall repair below this level. Dispose of steel plate roof/beams and straps above 60' level.
- Remove the inner brick liner and all debris in the bottom of the stack.
- Inspect the remaining steel straps and repair as necessary.
- Remove spalled and/or cracked brick and patching material from previous spall repairs. Replace the entire face shell with brick salvaged from above. Assume a total of 250 of these will be repaired.
- Epoxy inject approximately 250 LF of cracks.
- Properly cut out and tuckpoint all of the remaining mortar joints.
- Install a new concrete roof system with venting.

Option A is the tallest configuration available to have the stack meet all current Building Code requirements without having to reinforce the base for seismic loads. By removing the upper 80 feet of the stack and reducing the load on the foundation we do not believe supplemental modifications to the foundation will be necessary.

Option B

- Remove the entire structure down to the 75' above grade level. Salvage face shells from sound brick for spall repair below this level. Dispose of steel plate roof/beams and straps above the 75' level.
- Inspect the remaining steel straps and repair as necessary.
- Remove spalled and/or cracked brick and patching material from previous spall repairs. Replace the entire face shell with brick salvaged from above. Assume a total of 300 of these will be repaired.
- Epoxy inject approximately 300LF of cracks.
- Properly cut out and tuckpoint all of the remaining mortar joints.
- Install a new concrete roof system with venting.
- Remove the inner brick liner and all debris in the bottom of the stack to expose the concrete foundation.
- Install a series of 1 inch diameter vertical reinforcing bars at 12 inches on center in a circle inside the stack. These will be epoxied into holes drilled into the top of the concrete foundation. Install a series of ½ inch diameter stainless steel all thread rods into the masonry walls on the inside face of the stack (approximately 300 rods) set in epoxy.
- Fill the bottom of the stack with concrete to a depth of approximately 20 feet. This would be performed in multiple pours so that the hydrostatic pressure of the wet concrete does not blow out or distort the walls of the stack.
- Excavate around the perimeter of the foundation down to bedrock. Install reinforcing bars into the sides of the foundation and pour a reinforced concrete "doughnut" to create a larger more stable foundation.

Option B is the tallest configuration available assuming the brick from the original stack can be kept in place and (**with significant unseen modifications**) the refurbished stack can meet current Building Code requirements for wind and seismic loads.

Working with Gerard Chimney and Glenroy Construction (a local General Contractor) the following budgetary cost estimates have been developed. These are anticipated construction costs and do not include A/E fees, contingencies or other soft costs.

Option A – Remove stack down to 60' level Budgetary cost estimate	$ 350,000
Option B— Remove stack to down 75' level/reinforce Interior and modify foundation Budgetary cost estimate	$ 525,000

A key element in either option is the length of time it would take to demo the upper part of the smokestack down to the 75' or 60' so that the Farmer's Market could open in the nearby parking lot. Gerard Chimney believes this could be accomplished in approximately 4 weeks from the receipt of a Notice to Proceed.

TEMPORARY STABILIZATION

During the course of this work, the question has been raised as to whether the smokestack could be temporarily stabilized in place until more permanent repairs are undertaken.

Theoretically – the answer is yes.

We have investigated two schemes to "hold" the smokestack in place with a supplemental steel frame of some type.

1. Construction of pipe scaffolding that would completely encircle the stack. The scaffold would have to tie into the walls of the tower near mid height to use the self weight of the masonry to keep windward side of the scaffold from lifting off the ground in a lateral wind or seismic event.
2. A steel frame made of wide flange beams and columns that would encircle the stack. This frame would be bolted to new concrete foundations to hold the steel frame down in a wind or seismic event.

Huge challenges for either of these schemes involve the proximity of the two buildings to the east and southeast of the stack. The pipe scaffolding or steel frame would have to extend onto/into both of these structures. No attempt has been made to determine how this would be performed. Nothing is insurmountable – but either of these temporary stabilization schemes seems very impractical.

With the aide of Specialty Contractors for scaffolding and steel erection very rough cost estimates have been developed for these two schemes.

Pipe scaffolding (2 month rental)	$ 350,000
Steel Framing	$ 550,000

These do not include A/E fees, contingencies or other soft costs. The pipe scaffolding would take approximately 7 weeks to design and install assuming Scaffold King could be contracted directly and assist us in the design to expedite the overall process. The steel frame would take on the order of 10 weeks to order, fabricate and install if the work did not have to be publicly bid.

CONCLUSION

In our opinion, this re-evaluation of the smokestack has helped us develop a better understanding of 1) how it is constructed, 2) how it has deteriorated and 3) what options are truly available to stabilize and repair it.

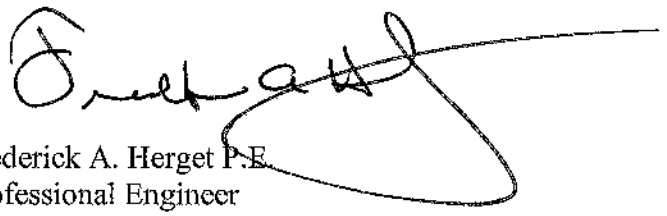
The concept of restoring it to its original height and appearance is understandable and obviously in the historical sense, desirable. The reality is the stack was constructed when the potential for

significant seismic forces was not considered in the Building Code used in Indiana. Masonry stacks typically do not fare well in seismic events and our scientific understanding of earthquakes has heightened concern enough that there are now Code provisions for them. In order for a 140 foot tall stack to meet the Building Code in this same location today it would have to be constructed from literally the ground up with different wall profiles and with a new foundation.

Lowering the stack to a level of 60 to 75 feet in height will preserve the original material to at least some degree.

This report will probably generate further questions and discussion. We are happy to try to answer them and help move this process along.

Your truly,



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