RLM & Associates, LLC

October 9, 2012

RE: Report No. R-100812-01
Structural Inspection
Horse Riding Arena
[redacted]
Rolla, Missouri 65401

Dear Mr. [redacted],

As requested, RLM & Associates, LLC performed a preliminary structural inspection of the horse riding arena and attached structures referenced above on October 8, 2012. Our scope included a visual inspection of the existing arena and attached buildings, identifying any system or component which may be in need of repair, replacement or further investigation, and providing a written evaluation of these findings.

Description of Structure

The main building complex is composed of four connected buildings, all built in 2000.

- Building A – This office building, currently being used as a studio apartment, is a wooden framed building, approximately 13 feet long by 28feet wide.
- Building B – This building, containing stables and a grooming station, is a clear span ridged framed metal building, approximately 52 feet long by 84feet wide.
- Building C – This riding area is a clear span ridged framed metal building, approximately 175feet long by 120feet wide.
- Building D - This building, containing holding pens, is a clear span ridged framed metal building, approximately 38feet long by 56feet wide.

For the purpose of this report the building complex is oriented in an east-west direction with "Building A" located at the west end. An aerial view of the structure can be viewed, as Figure 1, in Appendix A located at the end of this report.

Document Review

The following documents were reviewed during the course of the investigation:

- Phelps County assessor's online GIS map located at www.phelpscomogis.com
- Soil Survey of Phelps County Missouri published by the United States Department of Agriculture
- ASCE 11-99 - Guideline for Structural Condition Assessment of Existing Buildings

Site Inspection Procedure

This inspection was conducted in a systematic approach, starting with walking the exterior perimeter and observing from a distance. The purpose of this phase of the inspection was to review the overall structure to note any building damage, settlement and/or missing components. A second exterior perimeter inspection was performed, up close, to observe drainage and visible foundation components. The final phase was an interior inspection of each building to observe visible primary and secondary structural members and connections.

Findings and Observations

- Gutters – Significant gutter damage was found along the north side of Building C. Water leaking from this gutter is saturating the soil next to the foundations of the main support girders. **(See Figures 2, 3, 4, 5, Appendix A)**
- Downspouts – Gutter downspouts discharge next to the foundation along the north side of Building B and along the south side of Buildings C and D. A moderate amount of erosion was observed at the support footings at the south side of Building C. **(See Figures 6 thru 14, Appendix A)**
- Damaged Girder – Girder G5R, on the south side of Building C, had impact damage about half way up the exterior leg of the ridged frame. The interior flange was displaced laterally about 3 inches with minor flange buckling on one side. No other damage associated with this impact was observed. **(See Figures 15, 16, 17, 18, Appendix A)**
- Bracing Cables – A few sidewall cable braces were loose and eye-bolt nuts on a few roof cable braces were near the end of the threads. **(See Figures 19, 20, 21, Appendix A)**
- Splice Bolts – Due to short bolts, most of the nuts are not fully engaged on the two splices near the center support on the main beam in Building B. **(See Figures 22, 23, Appendix A)**
- Rust & Corrosion - Many of the exposed structural steel members are developing surface rust. There were a few steel column base plates and anchor bolts covered with dirt and debris. Some of these base plates and anchor bolts have significant rust with some section loss. **(See Figures 24 thru 28, Appendix A)**

Summary and Recommendations

- Water discharge should be as far from the foundation as practical to prevent soil erosion and soil saturation near the foundation. Long term foundation problems can develop when building loads cause soft saturated clay soils to settle. I recommend a qualified contractor replace all damaged gutters and extend all downspouts, not connected to an underground drain system, 10 feet beyond the foundation.
- I recommend replacing the eroded soil around the girder foundations along the south side of Building C.
- Damage to the G5R girder appears to be localized and the offset in the flange would reduce the girder's ultimate plastic moment bending capacity by less than 5%, therefore straightening or repairing the damage is not recommended at this time. I do recommend painting the interior portion of these girders, above the side rail, with yellow and black stripes to warn equipment operators of clearance issues.
- Bracing cables are incorporated as part of the building's wind resistant design, therefore I recommend a qualified contractor tightening any loose cables and check for loose nuts on the roof cables. Special care should be taken not to over tighten these cables.
- Bolt lengths used in tension splices should be such that the end of the bolt extends beyond the end of the nut by 2 or 3 threads or is at least flush with the outer face of the nut when properly installed. Although the two splices in Building B show no signs of failure, the building may not have experienced the 90 mph wind loads used in its design. Since there are a limited number of bolts involved at one location, I recommend a qualified contractor replace these bolts with new longer bolts of equal strength.

- Rust and corrosion of structural steel members is the most common problem that should be addressed in any maintenance plan for prefabricated steel structures. The red oxide primer paint applied at the factory only provides protection during shipping and erection of the building. Structural steel directly exposed to rain or in close contact to soil should be painted. I recommend a qualified painting contractor clean and paint all structural steel exposed to the weather. This recommendation includes sand blasting any column bases that have severe rust or section loss.
- All structural elements of Building A are hidden from view, therefore I recommend a qualified termite inspection company inspect this building. Wooden structures on concrete slabs are susceptible to termite damage.

Conclusion

Assuming a favorable termite report for Building A, the building complex was structurally sound at the time of this inspection. By incorporating the above recommendations along with a good annual maintenance plan, these structures should have several years of service life remaining.

Sincerely,

Randy L. Mayo, P.E.
President
Missouri PE License 20856

10/9/2012

APPENDIX A

Your report includes many photographs. Some pictures are intended as a courtesy and are added for your information only. Some are to help clarify where the engineer has been, what was looked at, and the condition of the system or component at the time of the inspection. Some of the pictures may be of deficiencies or problem areas. These are to help you better understand what is documented in this report and may allow you to see areas or items that you normally would not see. Some issues may be difficult to photograph or too numerous so not all problem areas or conditions will be supported with photographs.

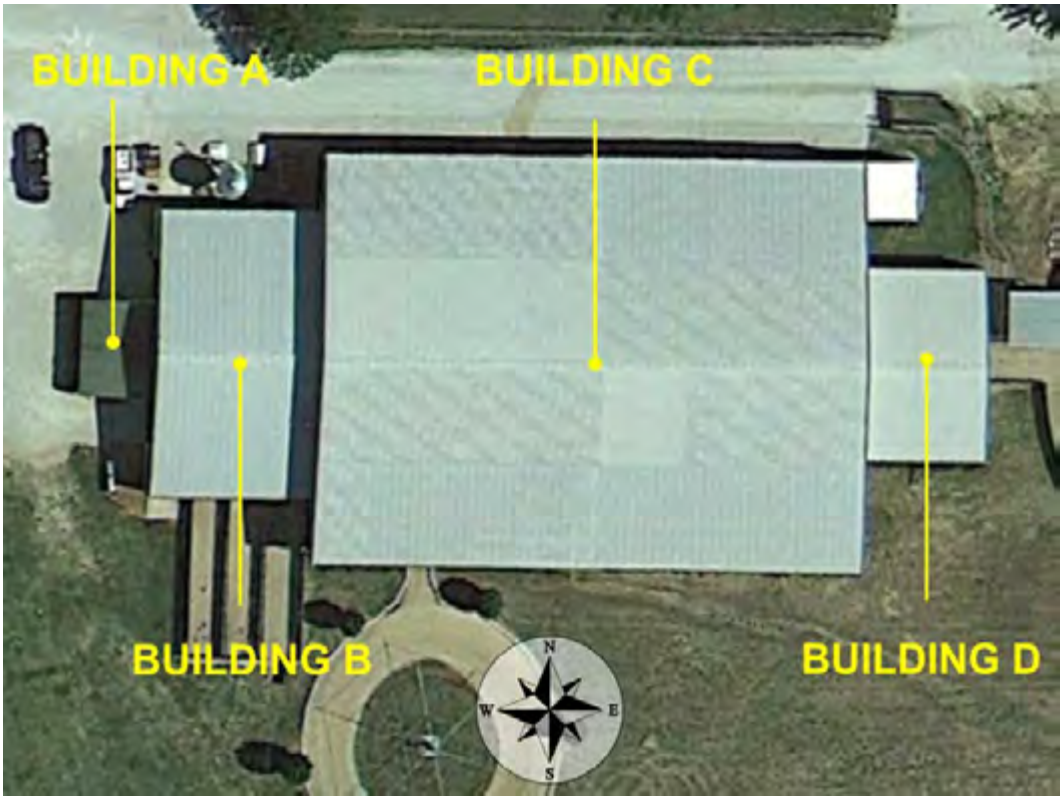

Figure 1 – Building reference and orientation

Figure 2 – Damaged gutter Building C, North side

Figure 3 – Close-up view of damaged gutter in Figure 2

Figure 4 – Close-up view of damaged gutter in Figure 2

Figure 5 – Close-up view of damaged gutter in Figure 2

Figure 6 – Downspout discharges next to foundation, South side of Building D

Figure 7 – Downspout discharges next to foundation, North side of Building B

Figure 8 – Downspout discharges next to foundation, North side of Building B

Figure 9 – Footing at girder G6R, Building C, South side.

Figure 10 – Footing at girder G5R, Building C, South side.

Figure 11 – Footing at girder G4R, Building C, South side.

Figure 12 – Footing at girder G3R, Building C, South side.

Figure 13 – Footing at girder G2R, Building C, South side.

Figure 14 – Footing at girder G1R, Building C, South side.

Figure 15 – Damaged G5R girder location, Building C, South side.

Figure 16 – Damaged G5R girder, Building C, side view.

Figure 17 – Damaged G5R girder, Building C, inside view.

Figure 18 – Damaged G5R girder, Building C, sideways displacement.

Figure 19 – Loose sidewall cable bracing, Building C, North side.

Figure 20 – Roof cable bracing eye-bolt nut

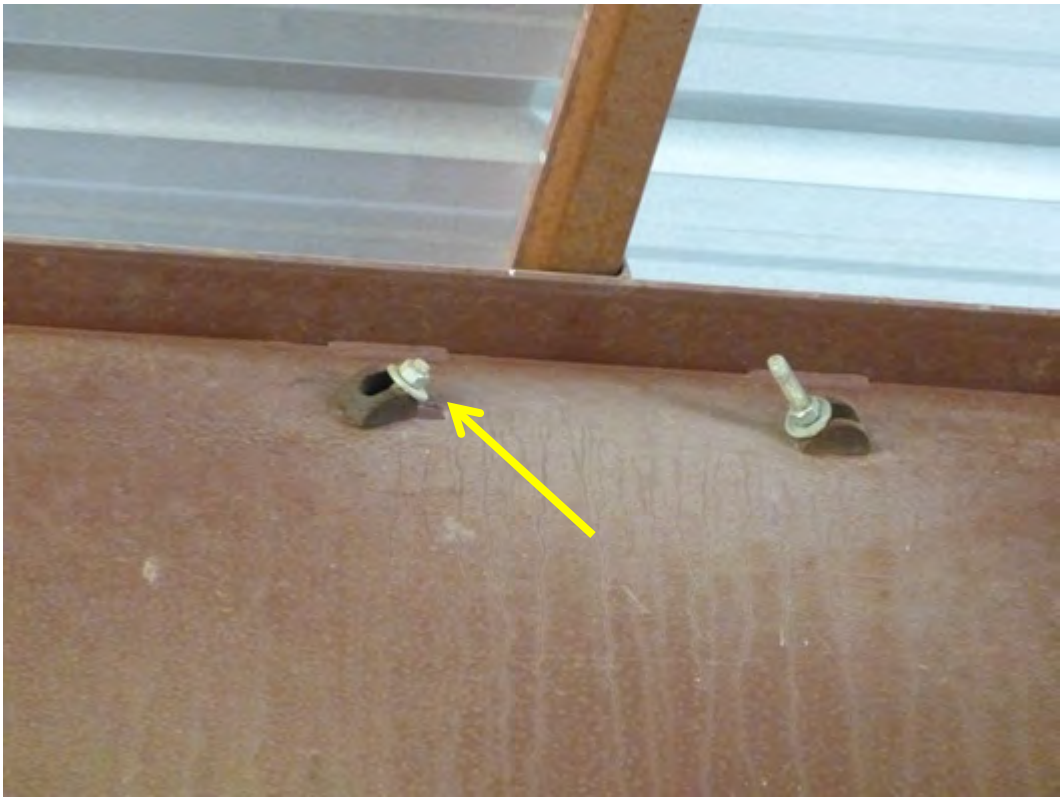

Figure 21 – Roof cable bracing eye-bolt nut

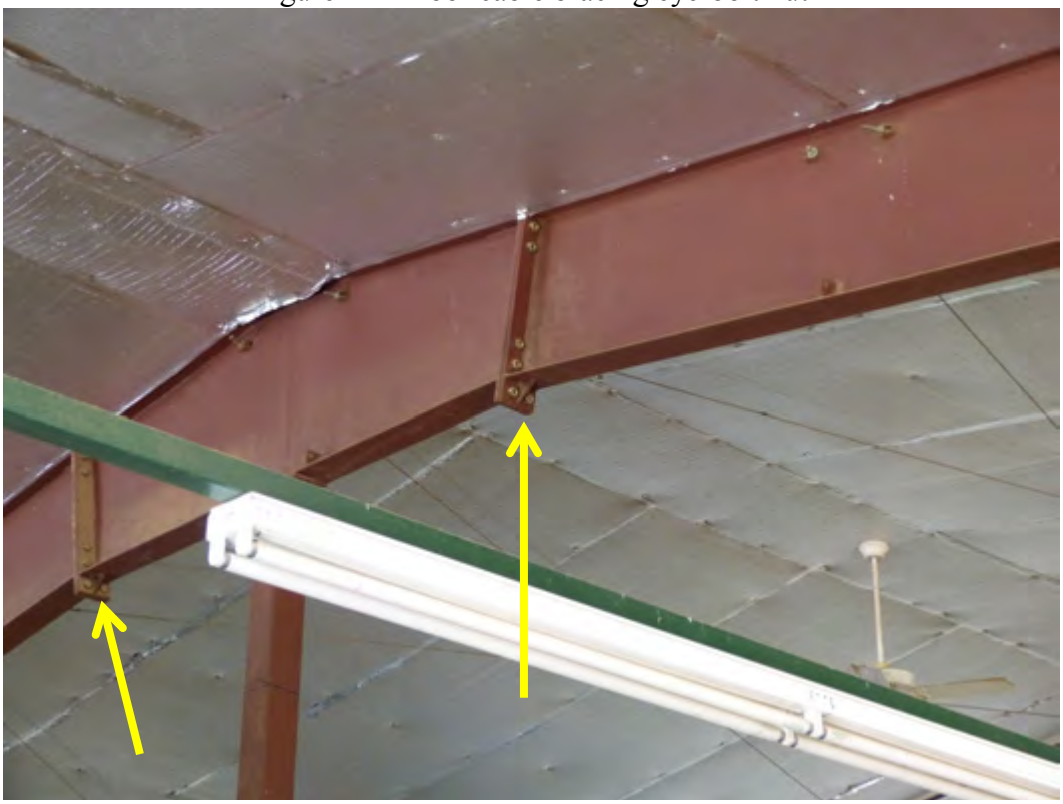

Figure 22 – Short splice bolts, Building B, center beam.

Figure 23 – Short splice bolts, Building B, center beam.

Figure 24 – Surface rust on exposed structural steel.

Figure 25 – Column base plate covered with soil.

Figure 26 – Rusted bolts in Figure 25 exposed.

Figure 27 – Rusted bolts and section loss at column base plate.

Figure 28 – Rusted bolts and section loss at column base plate.