BST Consulting Inc.

THE CITY OF COLD LAKE

NORTH ARENA

CONCRETE ARENA FLOOR AND HEADER / RETURN SYSTEM ASSESSMENT

BST Consulting Inc.

7908–18 Street NW, Edmonton, AB T6P 1Y7
PHONE: 780.461.6674 FAX: 780.401.3469

July 8th, 2020

The City of Cold Lake
5513 – 48 Avenue
Cold Lake, AB T9M 1A1

Attn: Mr. Glenn Barnes
General Manager of Community Services
City of Cold Lake

Re: **Cold Lake North Arena**
Concrete Arena Floor and Header/Return System Assessment

Introduction

On Tuesday June 30th 2020, a site visit to the Cold Lake North Arena was made by Stephane Dube of BST Consulting Inc. to inspect the arena slab. The purpose of the visit was to assess the overall condition of the slab, and to provide any suggestions regarding preventive maintenance or possible removal and reconstruction of the slab.

Methodology

Information was gathered by performing a visual walk through of the arena and recording a slab survey on approximate 20ft. gridlines. No destructive or non-destructive testing was carried out to the refrigerated floor assembly for under slab observation of in-situ conditions.

Disclaimer

Opinions in this report are based on visual inspection of the refrigerated floor and header/return trenches. BST Consulting Inc. claims no responsibility for property damage or personal injury that may result from any omission of a non-compliant building code or safety item.

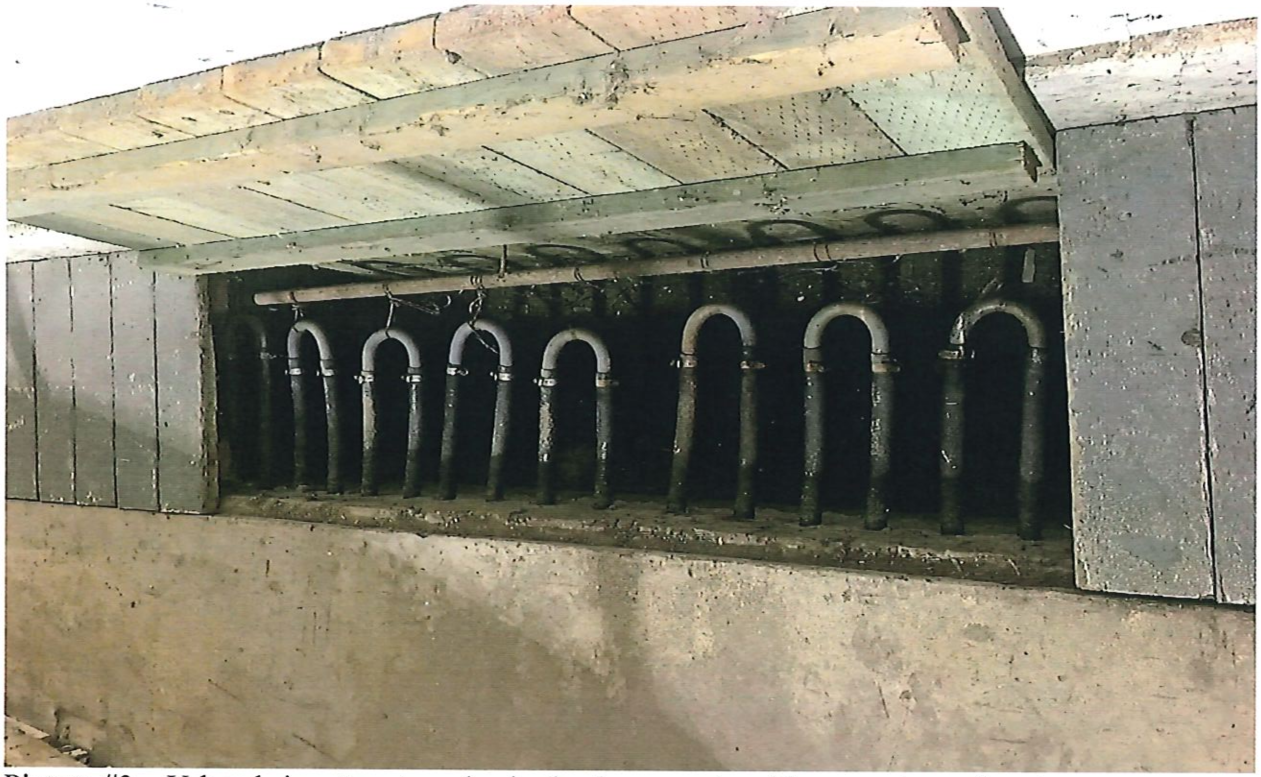
Project/Historical Information

The slab was built in 1968 using conventional LDPE (low density polyethylene) rink pipe clamped to headers of unknown material (likely steel as it was the most common of the day). However, these were replaced in the more recent past and the current headers are made of PVC plastic.

Visual Observations

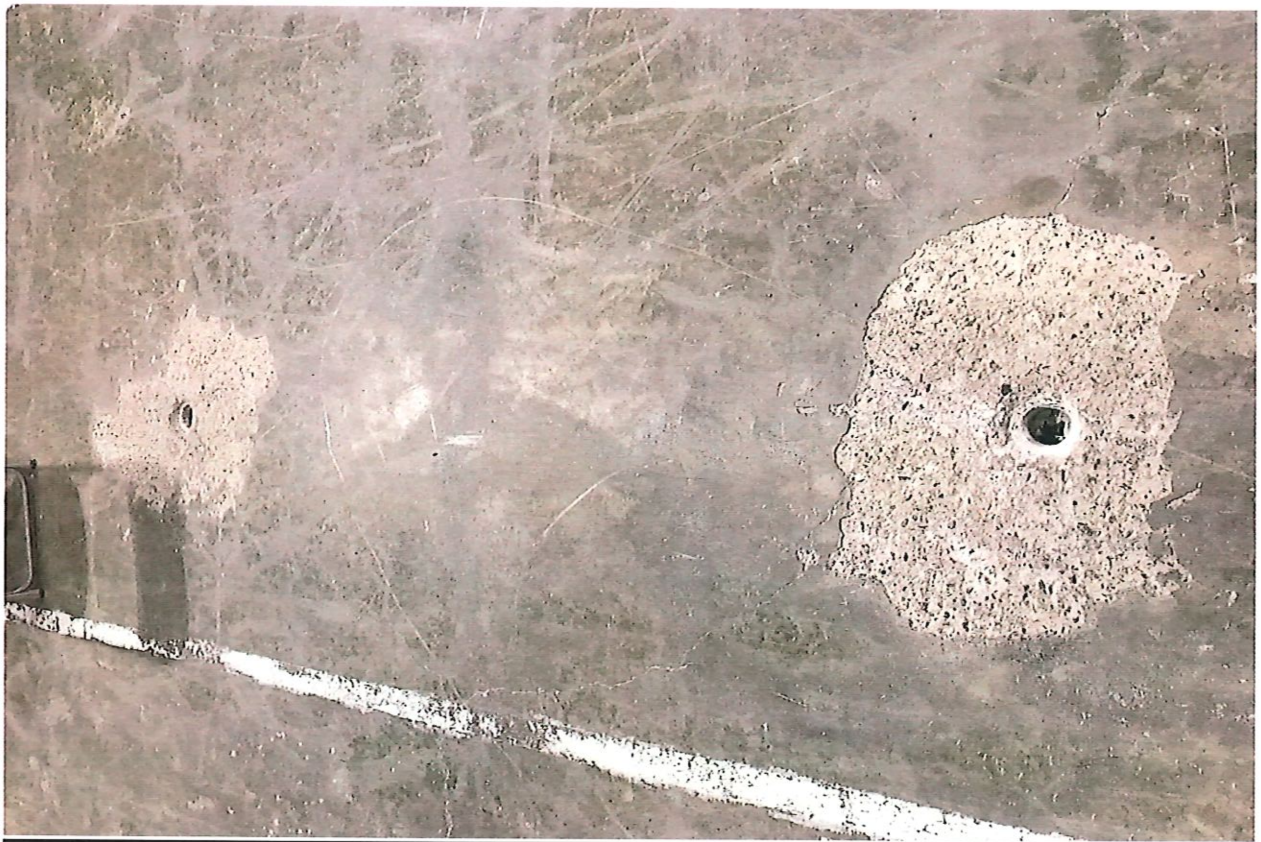
Picture #1 – PVC cooling headers in header trench seem to be in good condition

Picture #2 – Steel heating headers in header trench showing signs of rust



Picture #3 – U-bends in return trench, single clamps only with some signs of rust

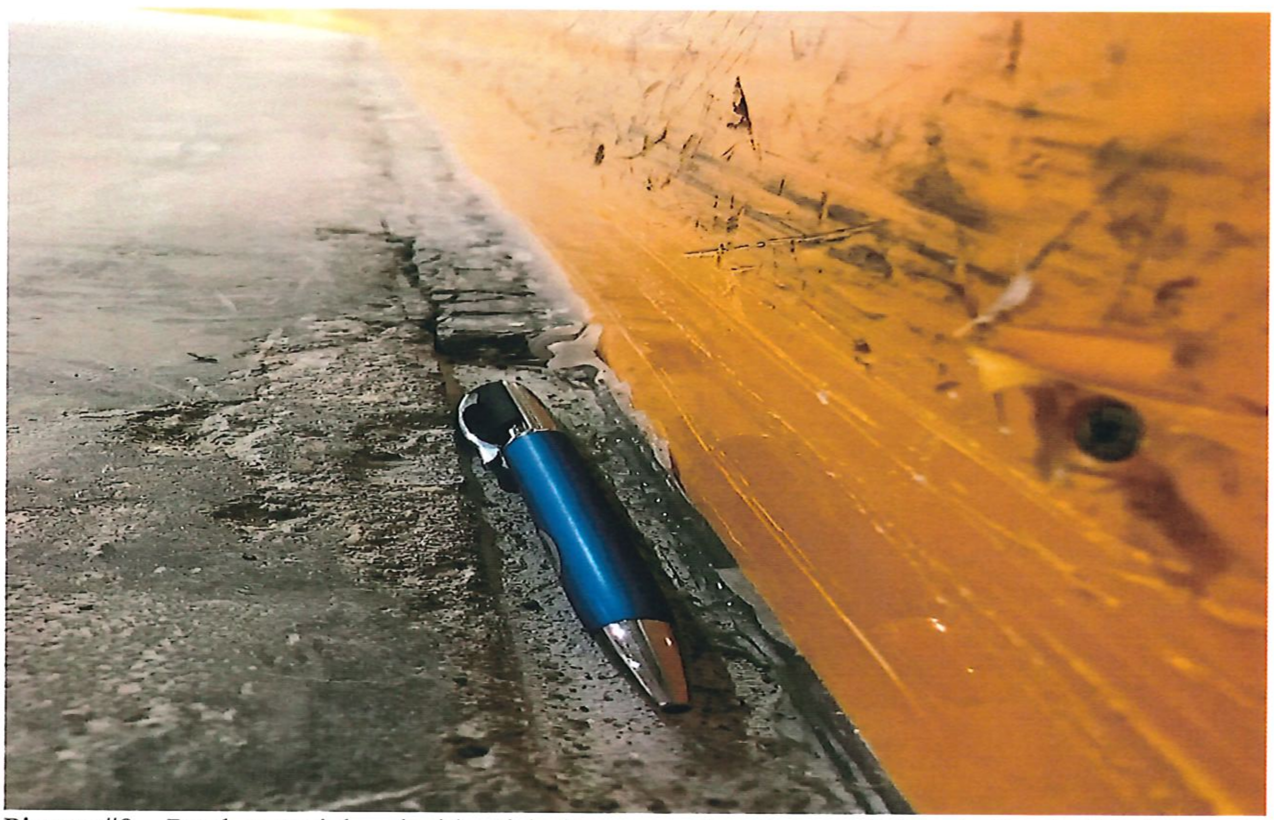
Picture #4 – Rusted clamps on header end pipe connections



Picture #5 –Advanced slab deterioration around goal post inserts

Picture #6 – Example of a shrinkage crack found in the floor

Picture #7 – Wire mesh exposed at surface of concrete



Picture #8 – Patch material on inside of dashers around perimeter of slab starting to deteriorate

Picture #9 – Rink pipe at bottom of slab on header end

Picture #10 – Rink pipe at bottom of slab on return end

Analysis

The average life expectancy of refrigerated concrete floors has been found to be 35 years with a few lasting to approximately 40 years (though not without signs of strain). As this floor was built around 1968, it is approximately 52 years old and has passed the end of its expected/intended life cycle.

BST Consulting Inc. performed a rough survey of the slab on an approximately 20' grid and confirmed there is approximately 1-1/4" variance from the highest to the lowest point on the slab. A copy of the survey is included at the end of this report for reference. The following paragraphs address the issues present with the floor in relation to the condition of the rink pipe & clamps and of the concrete slab itself.

A common sign of a floor at the end of its life cycle is the detection of leaking rink pipe, rusted headers and/or rusted clamps. The cooling headers were replaced some time ago with PVC and these seem to be in good working condition. The heat floor headers below are steel and in an advanced state of rust (see pictures #1 & #2 for reference). It is likely that all the rink pipe have experienced wear over the years from the constant flow of brine, and there is a high probability leaks may develop (in the near future) due to the resulting thinning of the pipe walls. The u-bends looked to be in reasonably good condition though several clamps showed signs of rust (on header and return ends) ranging from low to advanced (see pictures #3 & #4); this is indicative of leaks at these locations. (The common way to mitigate leaks at the clamps is to install two clamps at each location and install them with gears on opposite sides of the pipe.) Leaks may have been detected at some point and sealed by changing or adding additional clamps. This action can mitigate leaks at the header and return ends, however there are limited options for the pipe within the slab. Should a leak occur within the slab it will saturate the concrete and de-bond the ice which will then look opaque. There are chemical products that can be introduced into the brine solution that can plug the leak from within as long as the leak is pinhole sized or smaller, however these do not always work and may only provide a few weeks or months of time before failure can be experienced again. Should failure be experienced again after the introduction of the chemical, it is unlikely that it can be resealed using this method and complete replacement of the slab will be required. It is not uncommon for rink pipe circuits to begin leaking (randomly) around the 40 year mark. Should this occur mid-season, it may take upwards to 3-4 weeks to: remove the ice, jackhammer out the suspect part of the floor, repair the pipe, patch the floor, allow a bit of cure time for the patch, cool the floor back down to operating temperature, and finally make new ice. If the leak is related to the age of the pipe and consequent thinning of the pipe wall, it may not be possible to splice at all and the season may be lost.

The slab around the goal post inserts on one end is showing signs of accelerated deterioration (see picture #5). As the seal has been lost in this area, this is expected to continue as water pools in the inserts and freezes, thereby saturating the surrounding concrete and accelerating the deterioration. Additionally, the post anchors are nestled next to a cooling pipe, and as the anchors are drilled out (to remove ice build-up) over the years to make room for inserts the anchors thin with age. Eventually the drilling process wears through the anchor sidewall and the drill bit hits a newly exposed brine line thereby running the risk of causing a leak. This usually occurs during the operating season…for this reason (among others including minor league player safety concerns) the goal post anchors are typically reserved for Midget AAA and higher levels of hockey. Should the slab be replaced, we would advise against the installation of these inserts.

There are several small cracks in the floor, many of which look to be primarily due to the original concrete curing process (shrinkage cracks) and are not of significant concern (see picture #6). The usual guide for crack severity is measured by using the thickness of a dime. Anything thinner is not usually an issue and can simply be monitored to ensure it does not widen, while anything thicker should be addressed as soon as possible. Wider cracks can be filled with a hydraulic cementitious product in combination with a bonding agent, or injected with a rubberized epoxy.

There is surface wear on the slab in various places where the cleaning process has removed the seal off the floor thereby exposing the finer aggregates. These areas are not of any major concern and are at worst only unsightly blemishes in the floor, though they will deteriorate at a faster rate than the areas of the slab that are still sealed with cement. There are also areas where the wire mesh is exposed (see picture #7) and should it ever stick out of the surface will need to be cut out and the area patched. Given the age of the floor, replacement of the slab is likely to be required before this action is necessary.

There is a 1" (on average) gap around the perimeter of the slab on the inside of the dasher boards that has been patched with a cementitious product (likely grout). As it is uniform around the perimeter of the rink, and given the elevation differences found on the floor, it seems probable that the perimeter was ground down flat to accommodate a new dasher board system, and then the difference between the new boards and the old boards on the floor patched to make even. This patch is deteriorating in various places along the dasher boards as shown in picture #8 and is expected to continue as the slab ages.

As previously mentioned there is approximately 1-1/4" elevation variance in the floor at time of survey. The elevation variances are many and far sharper in nature than average, meaning the change from higher to lower elevation occurs in a shorter distance than for most slabs. This results in a slab that looks (from a survey perspective) a bit like an egg carton with many hills and valleys closely spaced together. This makes dry land operations less user friendly as well as increases the amount of water used to make ice under refrigerated load, thereby requiring more power from the plant to cool the brine solution in order to freeze the resulting thicker ice layer. The additional water and power requirements lead to increased maintenance costs, and require more time to make ice and to freeze "floodings" in between games. During tournament play, rapid transitions from back to back games has resulted (at least in other similar facilities) in poor performance (water pooling on slab in various areas) several minutes into each game.

Finally, the cooling pipe seem to have been installed at the bottom of the refrigerated slab as shown in pictures #9 & #10. Today's construction practices include installing the pipe in a pipe support system so as to keep the top of the pipe approximately 1-1/2" down (on average) from top of concrete rather than 4-5" down as in this case. Similar to the additional water required on the surface, the additional concrete on top of the pipe forces the plant to work harder to cool the surface down (requiring more power) as well as requiring more time to freeze the water. This results in increased maintenance requirements, power consumption costs, and may lead to delays in games due to pooling water.

Conclusion

These floors have typically lasted approximately 35-40 years with average use. At 52 years, the slab is demonstrating all the typical signs of wear commonly seen at the end of a slabs' life expectancy. Of greatest concern is the rink pipe wall thickness; historical precedence indicates that the pipe have outlived their expected life cycle and leaks (due to thinning of pipe wall) are likely in the near future. Most slabs start showing signs of leaks after 40 years, and this is the oldest slab we have inspected where this does not yet seem to have occurred. It may yet last a few years, or it may fail in the next season but this is virtually impossible to forecast. Additionally, the combination of rink pipe being at the bottom of the slab and concrete elevation differences requiring more water than average cause increased power consumption in the plant room due to thermal inefficiencies experienced in the slab. This slab shows an elevation variance of at least 34mm, whereas new slab construction aims for 6mm total variance. Consequently, we are of the opinion that the slab should be retrofitted as soon as possible to mitigate the risks of failure (especially during an event or season). An added benefit will be that maintenance costs and power consumption should decrease given the new pipe will be installed much closer to the surface of the concrete, and almost half as much water will be required to make ice thereby saving that natural resource as well as the labor involved to manufacture ice.

Additionally, there exists in todays' market the option to install a new refrigeration system with poly fusion refrigeration components; this system further limits Owner liability, improves plant power efficiency and minimizes maintenance requirements. It is known as an "HDPE (high density poly ethylene) fusion system", and has replaced the conventional clamped header trench system as the new way to build refrigerated slabs. This system completely eliminates the need for header and return trenches as the headers and u-bends are completely cast into the refrigerated floor. We are proponents of this system and support it for all the added benefits it provides including limiting Owner liability.

With todays' construction practices, we anticipate new floors to last beyond 50 years with proper maintenance. HDPE fusion systems have an unknown life span and are expected to outlive the building/slab.

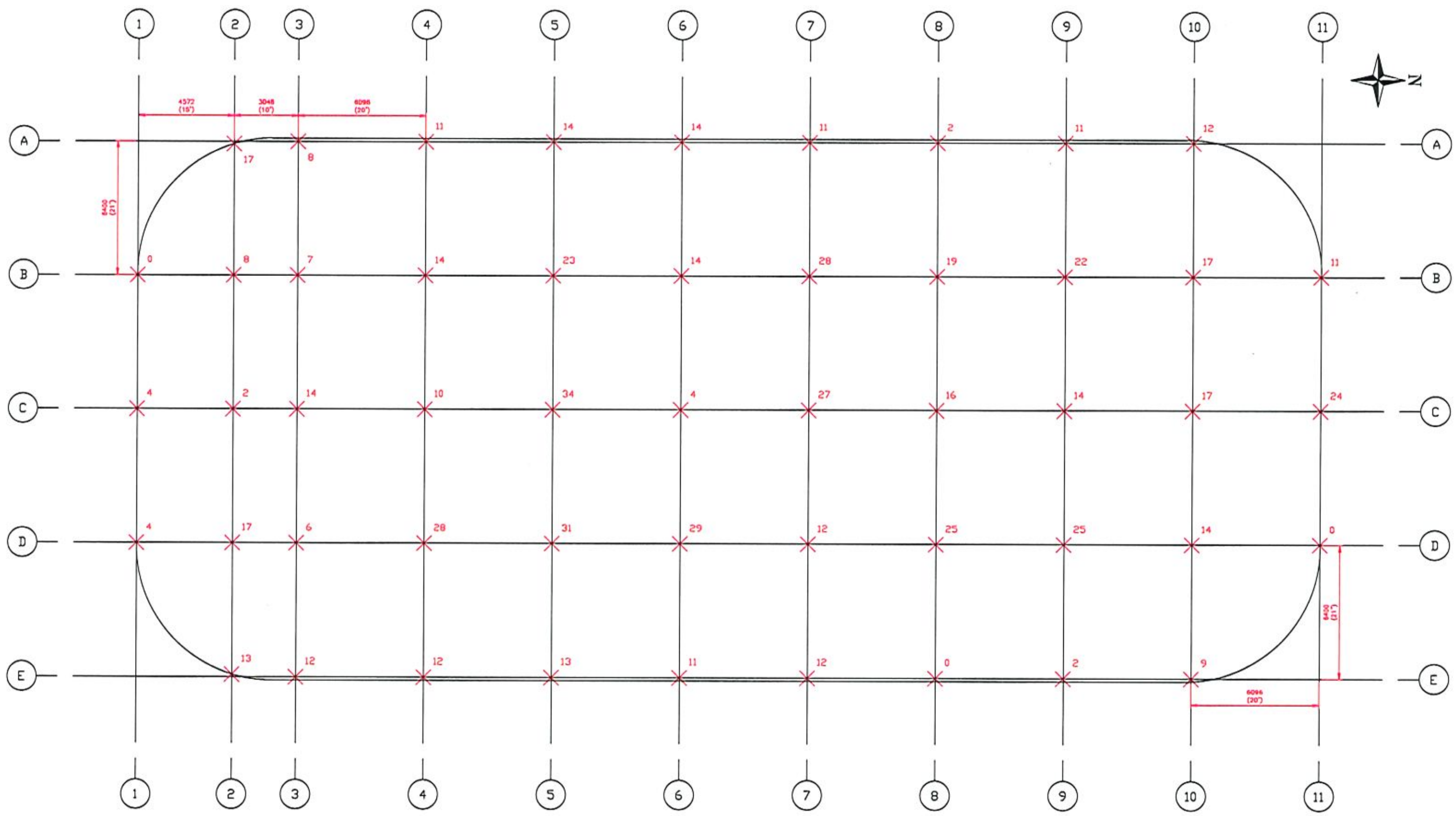
Using historical precedence as a benchmark, we would expect the retrofitting of the arena slab including new dasher boards to run somewhere between $800-850,000.00 + GST. (note; this assumes the sub-base material is not compromised in any meaningful way and there is no frost penetration.

Closing

I trust this report is satisfactory in its response to the concerns brought to our attention about the state of the North Side Arena in Cold Lake, AB. Should any more questions arise, please feel free to contact our office and speak to myself, or any one of our associates.

Yours truly,

Stephane Dube,
BST Consulting Inc.



BST CONSULTING INC

7909-18 Street
Edmonton, Alberta
T6P 1Y7 Canada
Tel: (780) 461-4734
Fax: (780) 462-0541

REVISION

JOB NO.:	DATE: 2020-07-08
PROJECT MGR.:	SCALE: N.T.S
CHECKED BY: S. DUBE	DESIGNED BY: BST CONSULTING
DRAWN BY: L. PORTAS	
JOB TITLE:	

DRAWING TITLE:

FLOOR SURVEY

DRAWING NO.: B-2.0