SCRATCHING the SURFACE

The use of geophysical surveys to evaluate the condition of ice rinks

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The mind thinks in pictures, not words.

Using subsurface radar imaging technology and breakthroughs in computer modeling, it is now possible to conduct non-invasive and relatively low-cost geophysical surveys of ice rink floors and the ground underneath them in a 3D computer environment. These tools can be used to do advanced analysis of changes in the subsurface and to identify, coolant leaks, drainage issues, and the causes of rink floor heaving.

Geophysical surveys can reveal whether observed problems on the ice rink surface are caused by small, repairable failures, or endemic to poor construction methods. In the case of improper construction, geophysical investigation can mean the difference between paying exorbitant maintenance fees, and embarrassing cancellations and downtime, versus having the wisdom to plan a full rebuild much sooner.

1. Geophysical Survey Design

The survey method starts with regularly spaced scans of the entire ice rink floor using appropriate geophysical equipment and then employ targeted high-resolution scans with additional equipment over areas of concern. The resulting geophysical 3-D models are used to determine if evidence of fluid infiltration was caused via failed coolant system, burst pipes, or geological activity, and if there is non-uniformity in materials such as concrete or compacted grades.

2. Rink Floor Heaving

Ice rink floor heaving is a common problem for aging indoor ice arenas. When the complex systems for heating, cooling, and draining beneath the ice rink surface are compromised, heaving is a common result, which impacts ice quality and playability. Unless the source of heaving can be correctly identified, effective and efficient remediation efforts and measures are almost impossible.

The following example shows how a geophysical survey was able to identify the cause of an ice rink floor heaving problem at the University of Denver ice arena.

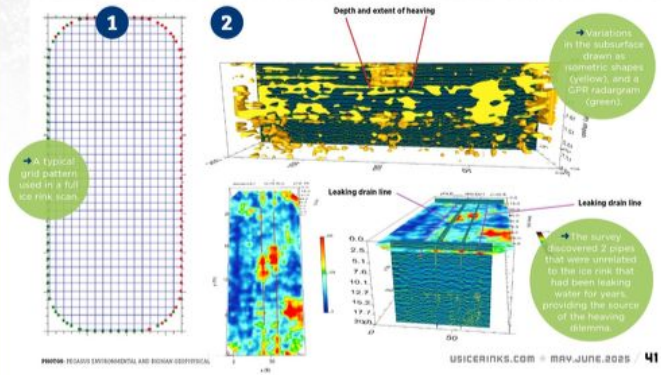
Near the center of the rink floor there was a small area the was being pushed upward, causing a very abruptly uneven playing surface. A geophysical survey was conducted and revealed a significant anomalous response located under the surface heaving area observed. The subsurface imagery found evidence of previously abandoned drain lines, which were totally unrelated to the ice rink construction, and unknown to the current managers. These pipes, despite being abandoned, allowed a buildup of moisture which had overwhelmed the drainage systems, and resulted in the formation subsurface ice buildup. The expansion of that pooling formed ice build-up and resulted in surface heaving. Using the results of the survey, the management of the University of Denver ice arena were able to plan for repairs in the off-season.

3. Ice Mat Failure

Ice rink floor construction that does not follow industry standards often results in failed piping. Geophysical investigations have discovered instances where flexible ice mat tubing systems designed for temporary ice rinks had been improperly used in the construction of permanent concrete ice rink floors. In these instances, geophysical scanning presented clear imagery of tubing encased in concrete that was clearly compromised.

4. Heating & Drainage Failure

Another common problem that geophysical investigations have had repeated success identifying, are failures in heating and drainage systems, which can also result in heaving and compromised ice quality. In these examples geophysical technology is used to examine the depths and layouts of



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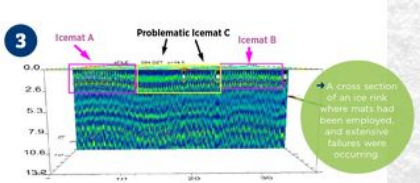
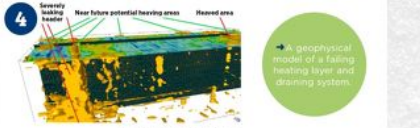
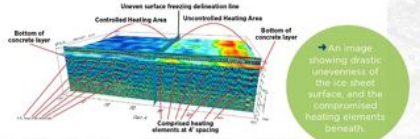
heating and draining systems, to determine if they are sufficient. Damages related to these systems inadequacies can also be imaged directly, and presented as 3D shapes in their positions underground. In many cases these damages are detectable to geophysical equipment before the ice surface has been affected.

An example of a geophysical survey that helped identify piping, heating system and drainage problems was in Taos, New Mexico. The survey revealed that mats designed for temporary ice structures such as toboggan runs and ski jumps had been encased in concrete during initial construction of the rink floor, and there was little to no heating zone unity nor drainage system beneath. The owners of the rink (City of Taos) had been unaware that sub-standard construction techniques were used. While the news of the poor-quality of the ice rink was certainly disheartening, the city council was glad to have been spared the embarrassment of watching the structure fail and be made unusable after applying repeated "band aid" attempts at remediation. The city lead engineer felt that the cost of the subsurface 3-D diagnostic evaluation was well worth it because it had brought to light the full scope of their problems, and enabled the city to make confident, informed decisions and prevent unnecessary expenditures.







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