



K3 Expansion Project

2022 Canadian Consulting Engineering Awards

HATCH

With headframes rising over 350 feet above surface, and shafts linking to the underground development 3350 feet below, Mosaic's K3 Expansion Project in Esterhazy, Saskatchewan is one of the most competitive underground potash mines in the world.

Hatch managed the engineering and construction of the shafts, headframes, and hoisting systems, deploying industry-leading techniques that successfully achieved project safety goals and enabled the final phase of the project to finish ahead of schedule and under budget.



Innovation

The greenfield K3 Expansion Project consisted of:

- Two 3500-foot production shafts
- Two 350-foot headframes
- Hoisting systems for production and personnel
- The surface infrastructure and underground development.

As part of Mosaic’s mandate to execute a safe and expedited project, Hatch deployed its construction and modulization groups to develop solutions that would minimize construction timelines. By leveraging knowledge gained from the conventional construction of the north shaft headframe, we implemented industry-leading modulization techniques in the south shaft headframe.

Structural steel pre-assembled modules (PAUs) were assembled into floor sections on ground level. After each floor was assembled, permanent equipment was installed, and construction materials were loaded. Once loaded, each of the six floors were raised as individual units on a proprietary-designed jacking system with over 1000 tons of lifting capacity. At elevation, the floor was pinned into the walls of the headframe.

In comparison to conventional stick-built construction, this innovative approach provided significant safety and production advantages, including:

- A significant reduction of direct hours working at height
- A reduced risk for falling objects
- Over 12 months of scheduling savings
- Significant execution costs savings.

The innovations were not only executed on the surface; they were done within the confines of the shafts. Despite the constraints of a 3500-foot shaft measuring only 20 feet in diameter, Hatch delivered an underground modular approach—something that had never been executed.

With an eye toward minimizing the risk of welding within the confines of a wet shaft, the team identified an opportunity and developed an ingenious solution:
To lower each of the 150-ton flasks in a single section.



“The scope was like any other structural erection, except it was happening 3,500 feet below surface with modules varying in height, weight, shape, and size, each requiring unique lift-and-rope management plans. Utilizing the existing shaft-sinking hoists required a high level of planning, teamwork, and communication.”

— Chris Congram, Project Manager

Together with multiple contractors, Hatch and Mosaic reviewed the feasibility plan and implemented key modifications to the execution strategy. All work was completed by a fully integrated team, with a successful outcome: Over 150 tons of steel was lowered and erected at shaft-bottom in less than one week without safety incident, saving 18 days of schedule. The success of the project gained industry-wide recognition, with plans to repeat a similar “fully-built flask” lowering process in other potash mines across Saskatchewan.

Complexity

Due to its continuous construction and reinforcement requirements, along with its scope and lack of internal structure, the south shaft headframe slipform was exceptionally complex.

The structure had to hold over 2000 tons of suspended structural flooring. With over 342 embedded plates, 43 block-outs, and 3 million pounds of rebar, the south shaft headframe was one of the most complex slipforms ever performed.

Every hour, over 2.5 tons of reinforcement was installed, and every day over 225 cubic meters of concrete was

poured. Extensive planning, constructability reviews, and re-engineering was required to coordinate the construction effort, which ran 24 hours per day. Complicating the challenge, the team had to execute the slipform during the pandemic, coordinating the mobilization of expertise from key resources across closed international borders.

The team successfully managed significant contractor commercial challenges, including a force majeure, and ultimately completed the slipform safely, under budget, and ahead of schedule.

**A true success story
for Hatch and Mosaic.**





Social and economic benefits

As a leading employer in Saskatchewan, the Mosaic K3 Expansion Project focused on the development of local business; specifically, vendors and contractors within the surrounding regions. With over 10 years of project execution including engineering, project management, and construction, the project provided over 12 million employment hours for a primarily Saskatchewan-based workforce.

Two key contractors—both major contributors to the project surface and underground works—established new permanent offices in the town of Esterhazy. With key management living and working in the area, the project can continue to provide employment opportunities for the local communities.

For the execution of the south shaft headframe slipform, a local concrete batch plant was awarded the scope. A massive undertaking for the local family-owned company, Hatch worked with them to develop procedures and prepare for the execution of the 5000m³, 22-day continuous pour. Despite challenges, the concrete was supplied safely and with exceptional quality. In addition, as part of the execution, Hatch was exceptionally proud of the diversity on this aspect of the project. With Hatch's support, the concrete supplier fielded an all-female crew for one of their two shifts during the execution of the slipform.



Environmental benefits

The project was designed to maximize efficiencies and minimize the use of energy and natural resources while reducing Mosaic's environmental footprint.

Throughout the design, construction, and operation of the K3 Expansion Project, avoidance and mitigation of environmental impacts was a key focus. Environmental impact studies were completed with the implementation of key mitigations, including the use of consultants in the field to provide guidance and leadership during the construction execution.

Replacing the existing K1 and K2 mines—now decommissioned due to the inflow of water underground—

the K3 Expansion Project was designed and constructed with a focus on state-of-the-art modernization and efficiency to avoid and mitigate any potential future environmental impacts.

Furthermore, detailed air quality studies and testing were completed to ensure minimal environmental impacts and compliance with permitted approvals.

Now in operation, the K3 Mine was constructed at a profound time, in-line with current demands for environmentally efficient food production. This world class project is a benefit to millions as a reliable source of fertilizer production to the agricultural industry for decades to come.

Meeting client needs

Mosaic's goal was the safe construction and operation of the largest, most competitive underground mine in the world. The K3 Expansion Project was intended to replace the existing K1 and K2 mines in the area. When the mines were decommissioned due to the water inflow, the team accelerated the final project phase, achieving operational milestones ahead of schedule. Now fully operational, the hoists are capable of lifting over 21 million short tons of potash to the surface each year.

The K3 Expansion Project signifies a commitment to the long-term sustainability of Mosaic's operations. Potash is an essential element in fertilizers, and the K3 Mine is Mosaic's flagship development in helping the world grow the food it needs.

In addition to meeting the client's needs, the K3 Expansion Project successfully implemented a modulization execution strategy, revolutionizing future mining construction concepts and projects.

- Equipment lowering, once a long and arduous process of assembled components underground, can now be optimized through the lowering of larger components.
- Modular approaches, like those utilized on the south shaft headframe, demonstrate new concepts that prioritize safety through the reduction of work at heights, while optimizing schedules and minimizing costs.

- Key components of the loading pocketing, including the flasks at the base of the mine shaft, can now be safely constructed outside the shaft barrel, and lowered as pre-assembled units.

With these advanced techniques in place, workers and production times are protected from the risks posed by conventional stick-built methodologies.



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