



# PCL reduces layout costs by 86% at Vancouver Airport

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## Project background

- Description: Decorative feature to be constructed in the ceiling at large airport
- Name: Vancouver Airport
- Main Focus: Print layout for a decorative feature with over 3,280 feet of curved lines
- Layout Scope: 8,000 potential points
- Project Size: 3,280 ft (1,000 m) of curved lines over a 6,458 ft<sup>2</sup> area (600 m<sup>2</sup>)

## Highlights



86%  
cost reduction



40 times faster  
than the company's  
traditional process

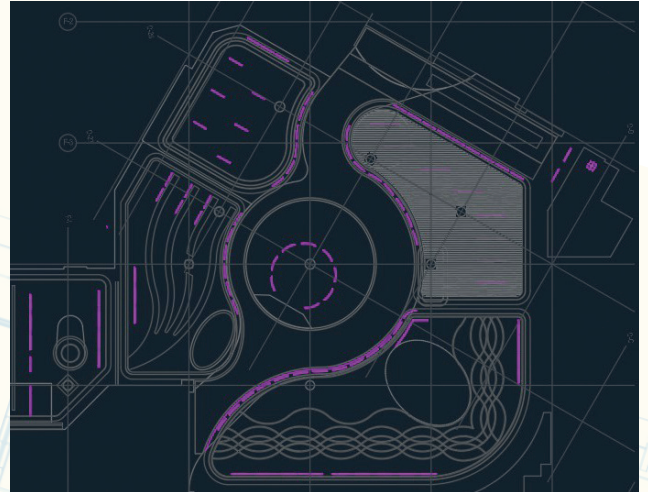
PCL Construction is one of the top-ranking general contractors in North America and ranked 13<sup>th</sup> on ENR's 2023 Top 400 Contractors List. PCL is a versatile contractor, working across a range of market sectors, including buildings, civil and industrial. They leverage strong industry relationships, self-perform work across a wide range of projects, and collaborate early and often with clients, to ensure schedule certainty. PCL sees a strategic advantage in consolidating layout as a single, self-perform task on their projects.

President and chief operating officer for PCL's US operations, Deron Brown noted that the past year has provided a tremendous opportunity for the company, while still presenting challenges related to the supply chain, inflation, and labour shortages. PCL traditionally self-performs layout tasks for buildings in their projects with the use of robotic total stations to mark points used to reference all building systems. While the approach is more efficient than manual layout, it still presents delays and complications for intricate designs.

# The Challenge

PCL typically uses robotic total stations to mark points that will be used as reference to locate all structural components. They also have a dedicated CAD and BIM department skilled in preparing the necessary data files for executing the layout with the total stations.

While this process works for simple gridline and penetration layouts, this efficiency drops as the complexity increases. Furthermore, finding skilled professionals to execute layouts is a challenge that can lead to delays. On top of the labour shortage, PCL is frequently tasked with laying out intricate shapes and curved architectural fixtures. These projects require marking points every 5 inches when using a robotic total station. Even with such precise marking procedures, they have a high potential for error.



The robot worked great on our project. We had several radius steel stud/drywall ceiling bulkheads and curved tile floor borders that would have been very difficult to accurately layout any other way.

- Jason Palichuk, YVR Project Superintendent



# The Solution

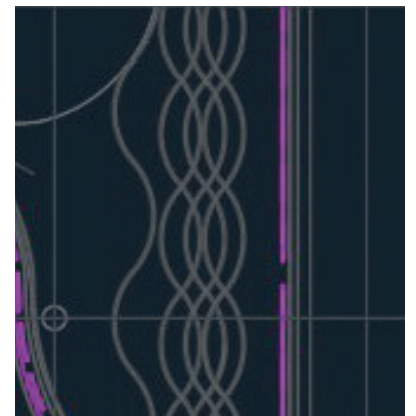
When PCL was contracted to perform layout tasks for building systems in the Vancouver Airport, they needed a solution that would allow them to lay out curved lines and intricate shapes more efficiently.

A decorative feature to be constructed on the ceiling would require the team to print more than 3,280 ft of curved lines over an area of 6,459 ft<sup>2</sup> together with plumbing and electrical points. Completing the task using only a robotic total station would require workers to mark points every 5 inches, resulting in about 8,000 points. At an average marking rate of 50 points per hour, a skilled professional would require 160 hours to complete the job.

To reduce the extensive time requirement and diminish the potential for error, PCL decided to use the HP SitePrint robot to complete the complex layout. The SitePrint uses CAD files and the robotic total station PCL was already using to print the detailed layout directly on the floor. With features like obstacle avoidance and the ability to print intricate arcs and circumferences, the robot eliminates the most time-consuming parts of the project.

The robot printed the radius lines on the floor in two different colours for the ceiling and tiling contractors to follow. The ink printed on the floor was durable and after sealed with lacquer, we did not have to worry about the layout lines being erased by the other trade activities.

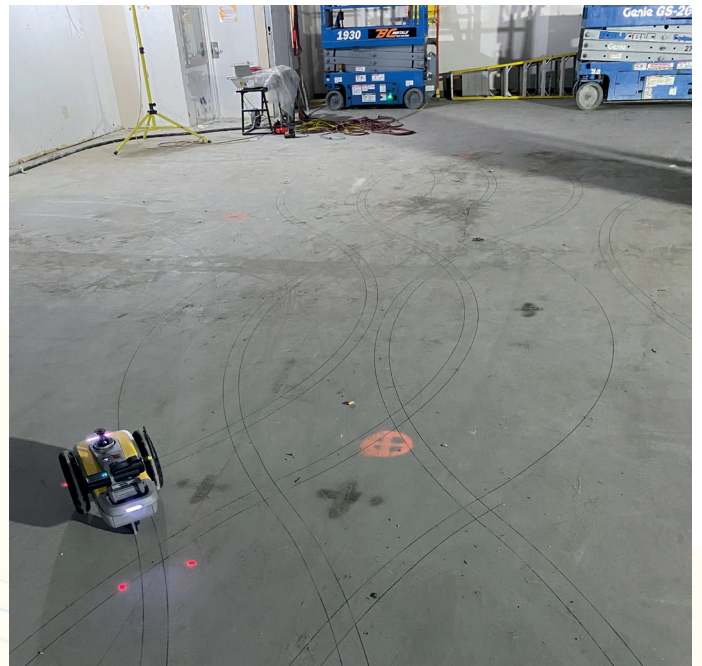
- Jason Palichuk, YVR Project Superintendent



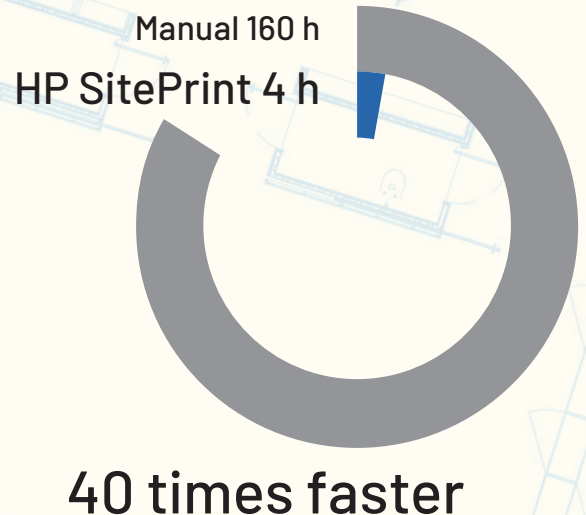
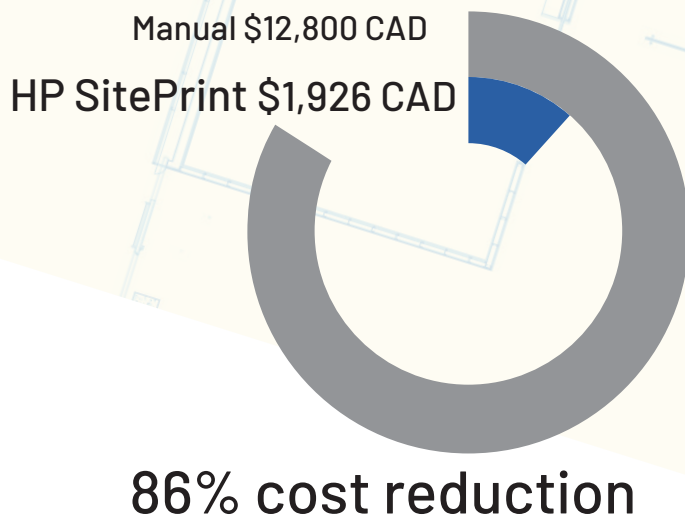
# The Results with HP SitePrint

PCL's traditional approach of relying solely on a robotic total station and manual labour would require a layout team to mark 8,000 points and use those points to create curved lines. The layout alone would take 160 hours to complete and have a high potential for error. With the SitePrint, the team completed the job 40 times faster, reducing costs considerably.

- **Cost Reduction:** Using the SitePrint robot eliminated much of the manual labour requirements to complete the intricate layout for the decorative feature in the design. Assuming an hourly rate of \$80 CAD for a skilled layout professional, the total cost to complete this job manually would be \$12,800 CAD for 160 hours. In contrast, using SitePrint, the total cost would be only \$320 CAD for 4 hours of professional work and \$1,500 CAD for the support usage fee for the 6,458 ft<sup>2</sup> (600 m<sup>2</sup>) area, resulting in a total 86% cost reduction compared to the manual process.
- **Time Saved:** Since points must be marked every 5 inches to create curved lines, the project would have required 160 hours using a robotic total station. Using SitePrint took only 4 hours to complete the entire job with a detailed layout including lines and printed details. The project was completed a remarkable 40 times faster than the traditional process.



HP SitePrint has been highly efficient for repetitive layout and a great application on complex designs.  
- Amy Louie, Surveyor and SitePrint Operator





## Long Term Impact

PCL Construction frequently completes complex layouts for various construction projects. Using the HP SitePrint robot to complete layout tasks for building systems can substantially improve the company's efficiency when completing these jobs. It's the ideal solution to handle the challenges of labour shortages and the complexities of intricate layouts.

# Comparative Analysis

As a progressive company with a history of adopting modern technology and working toward improved sustainability, PCL is accustomed to recognizing the ROI of innovative tools.

However, the use of the HP SitePrint robot for complex design layout presented an astounding ROI on this project and shows great potential for the company's future. The advantages PCL Construction experienced with the SitePrint robot are easy to see.

			
PCL at Vancouver Airport		Robotic total station <sup>1</sup>	HP SitePrint <sup>2</sup>
Job Data	Printed floor area (m <sup>2</sup> )	600 m <sup>2</sup>	
	Curved lines marked (m)	-	1,000 m
	Points marked	8,000	
Labor cost rates	Layout crew size	1	1
	Layout professional cost/hour	\$80	\$80
	SitePrint support usage fee (CAD/ft <sup>2</sup> )	-	\$0.20/ft <sup>2</sup>
Time	Point marking rate (pts/h)	50 pts/h	
	Total time (h)	160 h	4 h
Total cost	Labor cost	\$ 12,800 CAD	\$ 320 CAD
	SitePrint support usage fee	-	\$ 1,500 CAD
	SitePrint D&A (1 week)		\$ 106 CAD
	<b>Total cost</b>	<b>\$ 12,800 CAD</b>	<b>\$ 1,926 CAD</b>

## Improving Productivity and Mastering Intricate Designs for Continued Success

PCL set out to address inefficiencies in its current layout process due to labour shortages and complex design requirements.

Using the HP SitePrint proved to be a valuable decision that exceeded expectations in eliminating the challenges experienced by the company.

Since complex layout tasks for building systems have increased requirements, the site printing robot substantially outperformed traditional processes. As a result, the company was able to surpass the expected productivity gains forty times over.

Site printing robots provide autonomous construction layouts with a variety of features to yield quality results across different areas of construction.

<sup>1</sup> The computation of time and cost is based on the customer's estimate of the duration it took to complete a similar project, along

with the average hourly rates of their layout teams.

<sup>2</sup> Data in the SitePrint scenario is gathered through robot telemetry.

