ACP
Associated Construction Publications

Volume 116 Number 6 • JUNE 2010

Pacific Builder and Engineer

Edition

Serving Alaska, Idaho, Montana, Oregon and Washington Since 1902

WHEN CLOSE WON'T CUT IT

Layout surveying had to be on the money for this multi-faceted building

By Daniel C. Brown

If you're talking complex building layouts, consider the $1.6-million headquarters of New Day Inc., a youth counseling organization in Billings, Mont. The building is enclosed by two circular walls and multiple rectangular shapes that intersect and blend together around a central atrium.

Construction required exacting layout and super-accurate survey equipment to make sure that framing systems for each building component fit together, says Shane Swandal, an owner of Hulteng Inc., the Billings-based general contractor that built the building. "If one column would have been off at all, it would have caused a chain-reaction error into the other columns," says Swandal. "Then none of the steel frame would have fit together."

To stake the foundation, lay out the columns and generally handle surveying for the building, Hulteng turned to their Builder R200M total station from Leica Geosystems. Using a total station slashed surveying time in half, compared to using an auto level and steel tape, said Eric Hulteng, the contractor's co-owner. Plus, the total station provided superior accuracy and repeatability, compared to using batter boards and a stringline for control.

Note the curved radius wall, left, and the central atrium, right.

Central atrium

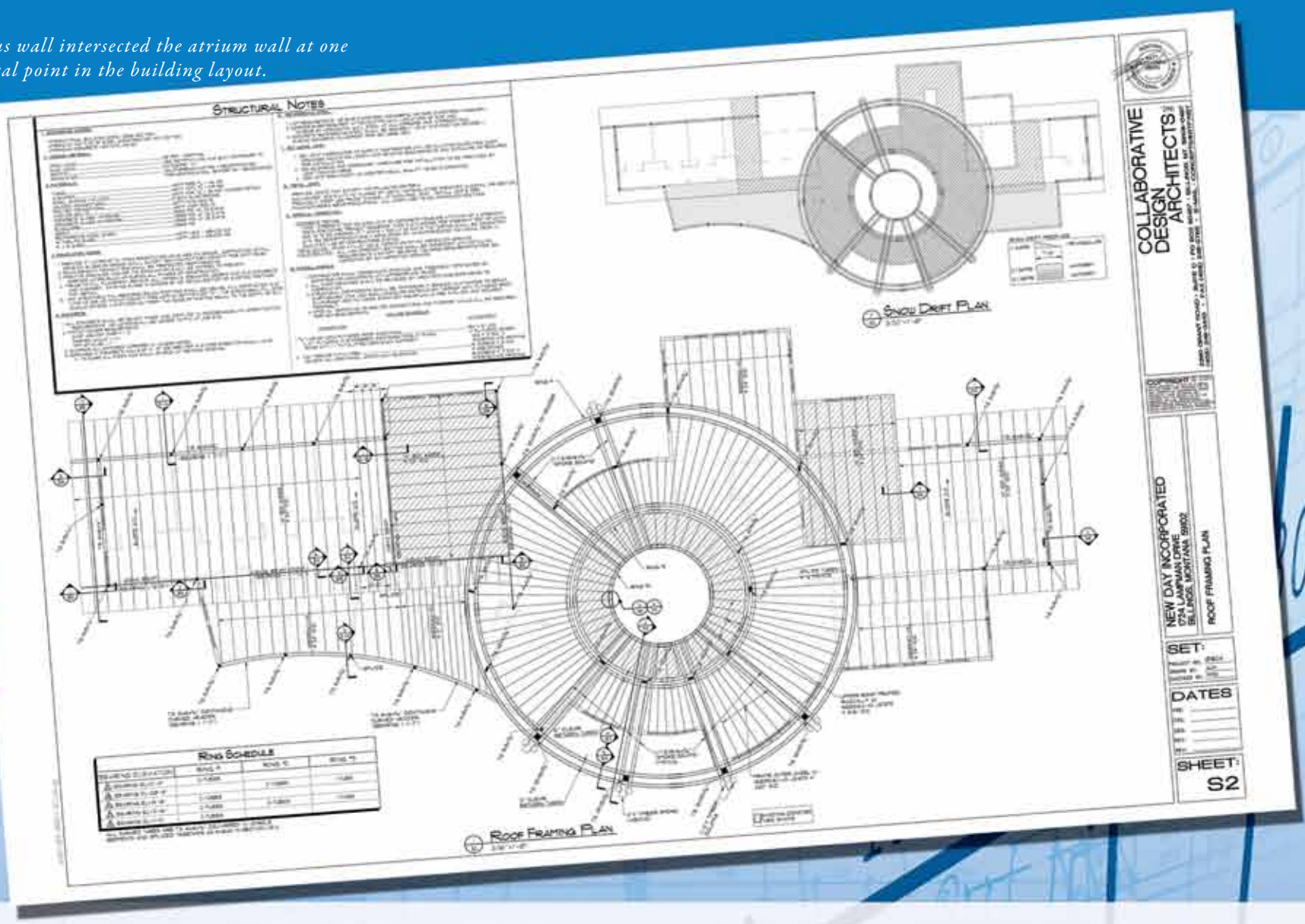
The building centers on a circular steel-framed atrium measuring 60 ft. in diameter. Spread concrete footings form the foundations for a series of 21 tubular steel columns, set around the atrium, that rise two stories to support the walls and roof. The columns are set at various spacings of typically 10 to 15 ft. apart. A series of eight rolled radius tubular steel rings encircle the atrium inside the columns. Those inner steel rings are matched by eight similar rolled radius steel rings that run outside the columns.

Radius track steel stud in-fill framing supports the building walls between the steel rings. The exterior finish on the wall is formed from Dryvit, which is insulation cladding and window glazing.

That's not all. A 50-ft.-long curved façade wall – concave to the outside – intersects the frame of the atrium at one column. That one 10-inch-sq. tubular steel column supports steel framing for both the curved façade wall and the atrium.

"The whole project comes together on the foundation footings and column anchor bolt layout," says Swandal. "We ordered the steel early in the project, then staked out the foundations. The foundation had to be accurate to receive the steel when it showed up."

The curved radius wall intersected the atrium wall at one column – a critical point in the building layout.



Accurate surveying

For control points, the surveyor used a property corner and points on two nearby buildings. "I could go out there, turn on my Leica Builder, center it over my hub, back sight to a building corner, then turn 90 degrees to another mark on a building," says Swandal. "It didn't have to be 90 degrees, it could be whatever turn you want.

"As long as I kept lining up on those two marks, that point was never going to change. If I ever turned and it was not 90 degrees to that mark on the building, it meant that the hub I set over had moved."

After assuring that the control point occupied by his Leica Builder had not moved, the surveyor could traverse into the center points of the atrium and the radius wall. "By making sure I am dead over my control point, that controls the two inner points in those radiuses," says Swandal. "The beauty of the total station is that the process was repeatable, even though those two center points had been knocked out by construction activities. Virtually every time I went out there to survey, I repeated that same process, and I could locate those two inner points in exactly the same place."

"When we installed all the gravel backfill and sub-base, and the concrete footings were in place, I went in and set a steel plate with a pinhole in it," says Swandal. "Then I could set the total station over the pinhole and shoot all of the radiuses."

To lay out the column anchor bolts, the surveyor would set up the instrument, shoot a known point on the arc, and set it at zero. Then he would turn an angle, say, 26 degrees, 2 minutes and 10 seconds and shoot a distance, which was 28 ft., 11 and 5/8 inches to the center of the first column. "Then I did the next radius and turned the radius to shoot all 21 of those interior columns," Swandal said.

Two-way accuracy

After turning the radiuses in one direction, he would turn his azimuth and shoot the columns back in the other direction. "You make sure you are closing back in on zero. That's a perfect layout. I did that for both arcs, and where the two arcs touch, they have a shared column. I mean that point had to be perfect," says Swandal.

"Where the Leica Builder shines is in its ability to accurately lay out complex structures efficiently," says Swandal. "I have worked with other total stations and what I do like about the Builder is the ease of inputting data and being able to convert that to measurements out in the field. You can put your data points in, download them directly into the total station's memory, go out and establish your point and turn it on and start shooting your points. They are spot-on accurate. The Builder is a seven-second machine."

Hulteng uses an Excel spreadsheet to store three-axis coordinates from the plan drawings. Next, the surveyor converts those coordinates into Leica's construction data manager software and uploads the coordinates into the instrument.

"Our Leica Builder helped us ensure that our layout would be spot-on," says Swandal. "We had to have that kind of accuracy because once the foundation is set, the steel has to fit. You can't change the dimensions of rolled radius tubular steel. And we did it! The building fit together just like Leg-O's."