Undulating Steel Frames

GQ Contracting Fabricates the World’s First Steel Framing Used as Design for Frank Gehry’s New Creation in Cleveland

“When the general contractor first called and said he had an unusual job for us, and I asked what it was, he said take a piece of paper, roll it into a ball and squeeze it; what comes up on top is the roof,” recalls Ted Tereszczuk, president of GQ Contracting Company in Cleveland.

The structure referred to is the new Peter B. Lewis Building (for the Weatherhead School of Management) at Case Western Reserve University in Cleveland. The architect is the world-renowned Frank Gehry, who created his first sensation in Balboa, Spain. The Lewis building is his first U.S. endeavor.

What was most unusual for Tereszczuk was the requirement that he fabricate the steel
framing so that it became not simply the hidden part of the structural support, as is customary, but also functioned as an integral part of the design for Gehry’s curving, in fact, undulating surfaces.

But before addressing the challenges of incorporating steel framing as part of the design, let’s first look at the design from the architect’s point of view.

**What Gehry Saw**

The setting is an old line school in the heart of the city, with all kinds of historic buildings, including cathedrals and Tudor type designs. The Gehry building at once fits in and stands out. The façade of the five-story building is red brick, and so becomes a part of the traditional environment. But what projects it into the current century are design elements such as the facade sometimes appearing to recede into the building and sometimes pushing out, along with about six
pure white canopies high up on the building sticking out, like umbrellas, in contrast.

For the roof, Teresczuk says, “Visualize a number of mushrooms put together with a stainless steel finish.” Teresczuk adds, however, that what Gehry had in mind was more an image of waterfalls. This image corresponds to the interior, which Teresczuk says, “replicates sandstone washed out by a river through millions of years of erosion. Gehry seems to create canyons rather than rooms.”

There are 100,000 square feet of undulating walls within the 140,000 square feet of floor space. The school is divided into two sections. There are more than 150 offices in what Teresczuk calls the “semi-conventional” half, meaning conventional only in comparison to the other half. “These are very interesting offices,” Teresczuk says. “They might be 10 feet wide, 12 feet long, and 12 feet high, with wonderful cabinetry work, with very functional windows that either curve toward you or away from you. It’s an invigorating space in which to work.”

The second, atrium area, has two bul-

ous spaces called Buddhas, running about 95 feet from the lower to top level. There are two classrooms per Buddha.

“The classrooms are absolutely magnificent,” Teresczuk says. “Everything you look at is a work of art.”

This facility, says Teresczuk, “is the only building in the world that has light gauge steel framing as part of the design.” In theory, heavy-gauge steel could have been utilized in the same manner, Teresczuk adds, but the cost would be prohibitive. “So we used light-gauge steel to create all the shapes, with-

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out heavy structural steel, and this has never before been done in our industry”

**Steely Angles**

A steel stud, of course, is an upright post in the framework of a wall for supporting sheets of wallboard or similar material. These are invariably straight, vertical pieces, nothing mysterious about them, commodity items, in fact. But that’s not how it was at the Gehry building.

“When we first started to build it, to put a wall 80 feet up in the air, from the first starting point, it curved up, it curved down, and it curved sideways,” Teresczuk says. “It was amazing.” Instead of just putting up partitions, surveyors had to shoot dab points for angles to the side of the concrete slabs to determine where to attach the clips. Then, says Teresczuk, “We started raising the studs, but always at whatever angle the undulation called for. They were off center at all times; none were standing straight up and down.”

The next question was how to get the drywall to bend in two directions on the undulating framing. You couldn’t simply attach it with screws horizontally to the vertical framing the usual way. The drywall core had to be compatible with the undulated steel framing. If the core was too rigid, the board would not take the undulation. For this reason, the board was all 5/8-inch as opposed to 1/2-inch. USG manufactured special drywall to put on the undulation framing. And sometimes the backside had to be moistened to allow it to be bent into the accommodating shape.

**Tricks of the Trade**

There are two main techniques that allowed GQ Contracting to make straight steel beams sinuous, says Ed Sellers, chief of operations and project manager. The first is to find the isoparms, a geometric term that refers to the straight line within any shape. “Within any given shape, even a cone, you can find a straight line,” Sellers explains.

To find the isoparms, the principle method used was the CATIA computer system, which is a three dimensional engineering program, analogous to AutoCAD. CATIA stands for “computer-aided three-dimensional interactive application.” CATIA was originally used by the French to make their Mirage jets aircraft. The system has since been adapted by Boeing. But Gehry is the only architect who has adapted this system to his profession.
“It’s important to emphasize that, without CATIA, framing of this nature and of this magnitude would have been impossible,” Sellers says.

Naturally, when you estimate a job to try to reduce the number of unknowns. The more unknowns you make known, the better you can estimate your costs, and so better predict your profits. But Teresczuk knew he was sticking his neck out on this one.

“When looking at flat drawings, there is no way you can see all the details in the undulations,” Sellers says. “CATIA was not available to us at the time of the bidding, and I had to go out and visit with the architects some 18 to 20 times in order to get it all down. Each session lasted three to five days, and the architects are in Santa Monica, Calif?

There were 300 to 400 surfaces in the project, and none of them matched each other. But the CATIA program put each surface up on the screen and allowed it to be seen and analyzed from every possible angle.

“We had to custom make the framing members to produce the required
shapes,” Sellers says. “We would basically create and cut the shapes by extracting the data out of CATIA, dumping into an AutoCAD file, and then send it down to a CNC plasma cutter.”

Thus, instead of the studs being pre-formed commodity items, these were all totally custom pieces, no two alike, and assembled in the field. The company also created custom carriers for ceilings and soffits, made custom corner pieces to tie the undulating pieces together, and also came up with load-bearing custom corner pieces to transfer the load from the light-gauge framing to the corners.

**No Stranger to a Challenge**

The building costs $61.7 million, and GQ’s contract was for $9 million. GQ did 13,000 square feet of the exterior plaster, including the canopies, along with all the interior metal studs (180,000 If on lines of ruling and 25,000 If of custom studs), drywall (600,000 sq. ft. flat, 200,000 sq. ft. undulated), millwork, plaster and acoustical plaster, plus the BASWAphon, a unique sound absorption plaster system.

This was not the only challenging project GQ has handled. As but one other example, in the mid-1990s the company had a $5 million contract to build the $84 million, 150,000-square-foot Rock and Roll Hall of Fame & Museum designed by I.M. Pei.

Since this building extends over Lake
Erie, Sellers recalls, “We had to put scaffolds on barges and pay maritime rates to get the fireproofing, plastering and other material installed onsite.”

This was a modernistic pyramid type glass building, with literally thousands of feet of 4 by 4-foot metal panels with reveals, with all the metal panels on the exterior having to match those on the interior. “A very complex job,” Sellers says.

There have been many complex jobs. In fact, GQ’s completion of its $9 million contract for the Cleveland Browns Stadium was finished on time, in its 15-month schedule, about three years ago, and led directly to the Gehry project. “It’s the high quality, challenging projects that need to be done on time that our customers come to us for,” Sellers says.

**How It Began**

Teresczuk had been a drywall taper by trade when he started the company in 1960. The company started as General Drywall and Quality Taping, but was condensed to GQ as the company expanded. It started out doing residential drywall, but then grew into metal and stud framing, carpentry, insulation, acoustics and framing. The company still does apartments and condominiums, but is 90 percent commercial, also doing a lot of hospital, office and university work. A strong plastering background also has the company doing restoration work.

Sellers credits the company’s ability to rise to challenges like the Gehry project because of his loyal and highly experienced work force, some 220 in the field and about 20 estimators and project managers. Many are in their second generation of working for the company.

“Teresczuk will no doubt have many other difficult challenging project to contend with in the future, but, for the moment, he’s content with the role his company has played in the creation of Peter B. Lewis Building.

“It does not resemble architecture, it resembles sculpture,” Teresczuk says. “It’s absolutely beautiful.”