

Eli and Edythe Broad Art Museum

East Lansing, MI



Team

Owner:

Michigan State University

Design Architect:

Zaha Hadid Architects, London, England

Architect of Record:

Integrated Design Solutions

Structural Engineer:

SDI Structures

Construction Manager:

Barton Malow

Concrete Contractor:

Grainger Construction

Reinforcing Bar Fabricator:

Harris Rebar

Total Project Cost:

\$35 million

Total Project Size:

40,000 sq ft

Floor System:

2-way Slab

Framing System:

Concrete Bearing Walls

Award:

2013 CRSI Award Winner –
Cultural & Entertainment Facilities Category

Photography:

Maconochie Photography

Philanthropist and art collector Eli Broad envisioned this new museum as a world-class venue for the display of modern art, to be designed by a world-class architect: the visionary Zaha Hadid of London, England. The architect imagined a high tech building skin wrapped around a frame of skewed and sloping exposed concrete walls. Central to that vision was a raw yet refined concrete finish that could be achieved only in self-consolidating concrete (SCC). There were however no known examples architecturally exposed SCC on dramatically sloping surfaces. Thus the design and construction team embarked on an extensive journey in uncharted realms of reinforced concrete construction.

STRUCTURAL FRAMING SYSTEM

The architect designed a building of uncommon complexity and maintained uncommonly high expectations for the execution of reinforced concrete walls that both formed the building's structure and provided texture and warmth to the building interior. The building frame is made up of a series of non-parallel, sloping, and skewed reinforced concrete walls that are architecturally exposed. The supported slabs are two-way reinforced concrete slabs.

UNIQUE STRUCTURAL AND/OR ARCHITECTURAL DESIGN FEATURES

Some innovation is guided by inspiration, while other achievements of innovation are arrived at by trial and error. This was a case of trial and error. From early in the project the team was committed to an extensive program of mockup production and innovation. Dozens of mockups of varying size were created to understand the interaction of numerous variables on the finish of the self-consolidating concrete. Reinforcing steel (rebar) placement and its impact on the placement of self-consolidating concrete, as well as its impact on crack control and the visibility of cracking, was among the many variable adjusted in the mockups.

REASONS FOR CHOOSING REINFORCED CONCRETE

The team was guided by a desire to use reinforced concrete following these five criteria:

- Blemish free exposed finish. First and foremost the team was committed a uniform finish that was smooth to touch immediately after the forms were stripped; free of visible pockets, bubbles and voids.
- Uniform sloped surfaces. The most dramatic surfaces, and most scrutinized surfaces, would be the faces of sloping walls, particularly in the stair and the café. It was imperative that those surfaces maintain uniformity regardless of whether the exposed surface was cast "up" or cast "down" facing to view.
- Crack free to the eye. Control joint were to be minimal in terms of placement and size. The team was committee to avoiding visible cracks in exposed walls away from control joints.
- All Seasons Construction. The project schedule provided no allowance to limit construction to good weather. Construction would proceed in the hottest days of late summer and the coldest days of mid-winter. Visual uniformity was expected in all weather.
- On-budget Construction. There was no room in the budget for unanticipated costs. The team needed to commit to an approach that was within the owner's budget.

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