

Advances in concrete design technology

By David A. Grundler Jr. and Michael E. Markovitz

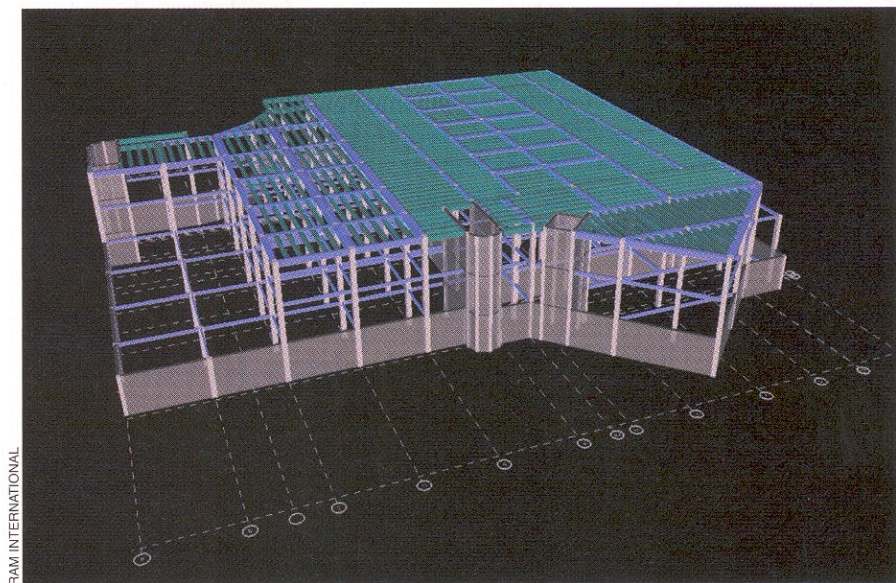
Designing buildings of reinforced concrete is more difficult than using structural steel. For more than 10 years, fully integrated design software has allowed engineers to design, price, and produce full preliminary design documents for structural steel in a day. Consequently some engineers lean towards using structural steel, especially with more detailed and impressive designs. In addition, thanks to its accuracy and completeness, there can be more accurate and aggressive pricing, making steel more competitive.

While reinforced concrete has long enjoyed its traditional role in certain building markets, such as hotels, condominiums, and parking structures, in many geographic regions it is has not garnered a major portion of the office and institutional markets.

Recently, however, new technologies have appeared that will help put reinforced concrete on an equal playing field with structural steel from the start of the design development stage all the way through construction. The choice of building material should be made on an objective investigation of the best performing structural system that most appropriately meets the owner's needs rather than on the difficulty of design. These new technologies promise to raise the competitiveness of reinforced concrete.

Why not reinforced concrete?

Software tools for designing reinforced concrete are far from state-of-the-art. Although many excellent software products are available to engineers, such as those produced by Adapt, Structural Concrete Software, the Concrete Reinforcing Steel Institute, and the Portland Cement



RAM INTERNATIONAL



APPLIED SYSTEMS ASSOCIATES

Above: New design software allows designers to look at the whole building. **Left:** Design software is now linked to estimating and detailing software for rebar fabricators.

Association, engineers are still faced with a lack of integration.

For reinforced concrete design today, an engineer generally employs one software tool to design lateral framing system, another to design mildly reinforced or post-tensioned beams and slabs, another to design columns, and then a CAD system to produce all construction documents. As a result, the engineering labor involved is significantly higher than a similar structural steel design. And when design changes are requested, the engineer refers back to the frame analysis software, column design software, and floor or beam design software, then laboriously traverses

through the structural design to ensure that the change has been thoroughly investigated. Several days later, in many cases, the architect gets the results, and significant costs must be either passed on or "swallowed" by the structural engineer. The problem is not with the tools, but with the lack of a complete building model.

Reinforced concrete design, though, is on the way. In January 2003, RAM Concrete was added as a module to the RAM Structural System, one of the first systems to allow a full building model for reinforced concrete structures, from roof to base, for both gravity and lateral systems. The program produces ap-

proximate material takeoff quantities and weights as well as the automated production of preliminary structural drawings such as beam-and-column schedules, plans, and elevations—in about the same time as for structural steel. Preliminary design investigation is more complete, architectural changes are simplified, and the result is a more competitive environment for reinforced concrete.

One of the early adopters of this new technology was HDR, in Omaha. According to *Engineering News Record* (Feb. 10, 2003), on the preliminary design of a 750,000-square-foot, four-story hospital in Indiana, HDR project engineer Doug Sholl, used the RAM Structural System to investigate both steel and concrete options. It took Sholl “about a day” to investigate the reinforced concrete option. He went on to say, “I have not heard from the construction manager which way he wants to go, but I don’t think he’s ever seen this much detail so early on.”

The first release of RAM Concrete is primarily for the design of one-way concrete floor systems and concrete frames. Future development will expand RAM Concrete’s capabilities to accommodate virtually all types of concrete systems.

To fill the remaining gap of electronic data transfer, RAM International has teamed with Applied Systems Associates, Pittsburgh (aSa), a market leader in software for rebar fabricators. The two companies have signed an agreement to link electronically the reinforced concrete design information from RAM Concrete directly to aSa’s estimating and detailing software. One of the fabricator’s most time-consuming jobs is manually transcribing data found on beam-and-column schedules, a grueling and error-prone process. The goal of the electronic data link is to eliminate 90% of this transcription process, and, hence, a large portion of the bidding labor.

Within the next few years we expect the design gap between structural steel and reinforced concrete to diminish, and building materials to be chosen solely on their merits. These advances hold great promise. Industry leaders such as the Concrete Reinforcing Steel Institute have featured this new technology in seminars

throughout the United States. Efforts such as these are helping the concrete industry meet its goals of getting reinforced concrete investigated as a design option.

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Tough, lightweight forms speed the path to profits

By Ray I. Scroggins

Fox Excavating, an 8-year-old site-contracting firm had grown by concentrating on sewer lines, utilities, water lines, and road building. Looking for new ways to increase revenue and profits, owners Mike and Paul Fox reviewed the work they were subcontracting. Mike Fox says, “We had always done the heavy, difficult stuff, but were knocking ourselves out estimating and bidding jobs. Then, when we had won the bid, we’d hand over big dollars to the subcontractors, who got the business effortlessly.” Sidewalks were at the top of their list.

On-the-job testing proves forms’ value

One such project was a three-phase housing development near Sault St. Marie, Mich. Funded by the Bureau of Indian Affairs, the 177-home

project is called Odenaang, which means “land of many hearts” in the Ojibway language. It provided an opportunity for the company to include the sidewalk placement in its winning bid.

The owners began searching the Internet for the concrete forms they needed. Donna Smith, the office manager, located Metal Forms Corp., Milwaukee, which Mike Fox says was “one of the most interesting companies we found.” The form manufacturer’s capabilities extend beyond its name with its newest product, Poly Meta Forms, polyethylene forms for both straight and radius work. Fox explains, “Since they are made of polyethylene, they are light, and I knew that would be a big factor. But I didn’t realize how important that was until we got them on the job.”

“We estimated we would be profitable if we placed 500 feet of sidewalk per day,” Fox explains, “but when we got started, we were averaging 700 to 750 feet per day, easily, with an inexperienced crew. On our top day, we laid 975 feet of sidewalk, 5 feet wide and 4 inches thick.” He adds, “That means we can put down as much sidewalk or more than the big contractors, but we can bid with much lower overhead, which makes us very competitive.”

Better production with less cleanup

These forms are light enough to set, strip, and reset three times a day without wearing out the crew. “It



Poly Meta Forms are still in place on this sidewalk pour. Note their clean and simple construction and the lack of backfill or bracing.

METAL FORMS CORP.