Case Study
Chambers Hotel
Hennepin Avenue
Minneapolis, Minnesota

Here is an example of utilizing structural systems that do not use typical construction materials and methods. Innovative structural engineering actually paid the owner and also provided safer construction for the contractor.

Innovative concrete design last century


Carbon fiber after painting.

Innovation was everywhere at the turn of the last century, and nowhere was it more apparent than in technology used in buildings in Minnesota. In 1908 an engineer by the name of C.A.P. Turner acquired a patent for an innovative design using poured concrete and steel reinforcing for concrete slabs and "mushroom" columns. Concrete and "rebar" was very new, in fact, the American Concrete Institute, (ACI), was started in 1904. In 1908, the Fairmont Hotel at the corner of 9th St. S. and Hennepin Ave. had plans that called for 4 stories using this new construction method and materials. Although concrete using Portland cement had been around for centuries, it had not been used in conjunction with steel rebar in this fashion, which uses draped steel rebar on continuous thin spans in all directions, a 4-way slab as it was later known as. C.A.P. Turner is also the same engineer that designed the Duluth Lift Bridge and other "mushroom" slab buildings in the Midwest.

Save the 100 year old building

The system worked well enough for 100 years, certainly long enough for the owners to get full use of the building. But by the turn of the new century, the building was in need of repair for expanded use and functions. Because of the existing architecture, historic significance, and location in the city, both the owner and the city wanted to reinforce the existing building vs. tearing it down, especially since Minneapolis is still feeling the lingering effects of tearing down the Metropolitan Building in the 1950's.

The perimeter walls are constructed of multi-wythe brick and limestone foundation walls. In some cases, existing concrete slabs were sagging 6" with multiple cracks most likely due to creep and what we now know to be inadequate rebar design. Production methods of 20th century smooth rebar produced lower yield strength and required longer rebar laps since they were smooth.

MMY enjoys working on historical renovations because you won't find the solutions from software or out of the black box. Historical renovations requires actually being on site multiple times, good old fashion hand calculations, engineering judgment, and knowledge of historical building methods and materials.

A growing building

Another interesting phenomenon was causing other cracks. Limestone was a plentiful construction material 100 years ago in Minnesota, and most buildings at that time used limestone perimeter foundation walls. Like most construction materials, limestone has an environmental factor to consider. Overtime, when exposed to water, the calcium in the limestone reacts and turns into gypsum and expands. In the case of the Fairmont Hotel, this meant that the walls of the building actually grew upward and introduced tension cracks at the bottom of the main floor slab next to a column line near the foundation walls.

Challenge

Our challenge was not to only give this old gem new life, but to add a new 5th floor to the building and connect it with the adjacent building!

Our first task at hand was to figure out what to do with brittle cast iron columns that were supporting the existing perimeter loads, plus the new 5th floor loads. Over the years, the store front cast iron columns saw water and salt from the street and sidewalk which degraded them. The manufacturing process for columns like these did not produce a uniform product, thus, some failures around the turn of the 20th century occurred in buildings.

Our other critical structural challenge was providing reinforcement for the sagging floor slabs while keeping the existing low ceiling heights intact.

Split tube steel columns.

Split tube steel columns

The obvious solution was to build temporary shoring to allow the old columns to be removed and then new steel columns installed in their place. Challenged to come up with a cheaper and safer solution, MMY designed an innovative in field retro fit. Leaving the building columns in place the columns were encased by square tube steel columns. The new steel columns where split and placed around the existing cast iron columns and welded in place. This trick saved the owner over $50,000 in cost due to the massive amount of temporary shoring and labor required.

It seems only fitting that a 100 year old innovative building get an innovative remodel.

Carbon fiber

MMY developed a structural package of drawings using innovative carbon-based fiber reinforcing and new reinforced concrete topping to strengthen and stiffen the existing structural slabs on 3 floors while trying to maintain a ceiling height as high as possible. The existing floor to floor heights were short enough that any other structural system could not be used to reinforce the existing slabs. Composite Systems, Inc. used carbon-based Tyfo SCH-41 Composite System to increase the flexural capacity and aid in increasing the 4-way slab stiffness. The previous concrete innovations created a structure that lasted 100 years, the latest innovations we used on the building will hopefully make it last beyond the next 100 years.

Carbon fiber after installation.

The reinforced slab details

The carbon-based Tyfo SCH-41 Composite System that was applied to the bottom of the 4-way slabs was adhered with epoxy compounds in 2 directions while reinforced concrete topping was applied to the top of the rough slabs using bonding agents and small diameter rebar.

The result

The result was that maximum ceiling heights were maintained while providing stronger and stiffer slabs necessary to support the required loads of the new hotel and art gallery.