CASE STUDY

Collapse of Harbour Cay Condominium

Cocoa Beach, Florida

by

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On March 27, 1981, Harbour Cay Condominium, a five-story flat-plate reinforced concrete building, collapsed as concrete was being placed for the roof slab. Eleven workers were killed and 23 others were injured. The photo below shows debris after collapse of the buildings.

According to the official report by the National Bureau of Standards[1]:

> "The structure had an overall length of 242 ft (74 m), a width of 58 ft (18 m) and contained nine bays. Slab concrete was placed on flying forms, consisting of preassembled plywood decks supported by aluminum trusses. Except for the roof, which was planned to be cast in one day, the floor slabs were cast in two separate operations, each covering one-half of the total floor area. At the time of the collapse, concrete had been placed on seven of the nine flying forms comprising the entire roof area.
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> An inspection team from the Occupational Safety and Health Administration (OSHA), Department of Labor, arrived at the site within one hour of the collapse and began an investigation. A team from the National Bureau of Standards (NBS) joined the OSHA team one day later."

During the study, NBS reviewed design and construction documents. The report cites the following findings [1] :

> "1) The structural design calculations consisted of 79 consecutively numbered pages. The first page specified the material strengths and loads assumed for the design. Pages 3 through 9 showed the axial loads in columns, computed on the basis of tributary areas. Pages 9 through 16 contained wind load calculations and the moments they produced in the assumed structure. Page 17 specified the preliminary column sizes based on the computed axial loads and assumed end moments. Pages 18 through 77 contained the slab moment calculations and sizing of the flexural reinforcement. Page 78 contained the pile cap designs and page 79 showed the final column schedule.
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> The design calculations were not examined in detail, but the following omissions were noted with regard to compliance with the provisions of the American Concrete Institute 318 Standard (hereafter referred to as the ACI Code) (2.1) which is part of the applicable local Code (2.2) for this structure.
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> (1) There were no calculations to indicate whether the deflection or minimum thickness provisions of the Code were met.
> (2) There were no calculations to indicate whether the punching shear and beam shear provisions of the Code were met.
> (3) There were no checks to determine if the column reinforcement would satisfy the necessary spacing requirements specified by the Code.
> (4) The steel area calculations for the flexural reinforcement in the slabs were based on ASTM Grade 40 steel. This is at variance with the Grade 60 steel specified in the structural drawings.
> (5) The effective depth of the slab in flexural reinforcement calculations was not defined explicitly but appeared as part of a constant multiplier of computed moments. Back calculations showed that the designer used the value of "around" 6.3 in (160 mm) for the effective depth in steel area calculations (effective

depth varies somewhat with the amount and size of steel bars; hence the use of the word “around”). For the 8-in (203-mm) slab, the effective depth used is consistent with the 3/4-in (19-mm) minimum cover specified by the ACI Code (sec. 7.5 of ref. 2.1.). Explanations of “effective depth” and “cover” appear later on in this section.

The above statements are cited for information purposes only. Insofar as this investigation is concerned, the structural drawings and specifications supersede the design calculations, and therefore, are the documents referenced in subsequent comments about the “design” of the structure. Thus, questions related to consistency of the design calculations with the contract documents are not discussed any further.”

On September 13, 1981, the Associated Press reported the following:

“Engineer in Building Collapse Gives Up His Florida License
The engineer who had primary responsibility for the Cocoa Beach, Fla., condominium that collapsed last spring, killing 11 construction workers, surrendered his license today and said he would never practice again.

Harold A. Meeler, the engineer, in giving up his license, told a state board that he would pay $3,000, the maximum fine, to avoid a hearing on the collapse of the five-story Harbour Cay Condominium.

The collapse, on March 27, also injured 23 workers.

Mr. Meeler, who is 59 years old, agreed to refrain from seeking another license unless all civil litigation related to the collapse is resolved in his favor.

Another engineer involved in the project, Augustus M. Allen, also gave up his license after the Florida Department of Professional Regulation took action against him. Charges are also pending against an architect and two contractors.”

Structural engineering is not simple. Every design that a structural engineer does involves life safety. Consequently, structural engineers need to be adequately educated, well experienced, and examined in structural design.

Errors, omissions and blunders cannot be prevented entirely. However, in the collapse of Harbour Cay Condominium, the accident was avoidable. The engineers involved were licensed and believed they were working within their areas of expertise. They had not been trained or examined in the area of structural concrete design. Consequently, they did not know they were deficient in knowledge needed to protect the public.

If Florida had required structural engineers to have a structural engineering education, obtain four years of structural engineering experience and pass the16-hour structural exam, the Harbour Cay engineers would have known to check for shear strength. The collapse would not have occurred if the structure had been designed for shear. Separate licensure of structural engineers in Florida would have prevented this fatal accident.

REFERENCES

1. Lew. H.S., Carino, N.J., Fattal, S.G. and Batts, M.F., “Investigation of Construction Failure of Harbour Cay Condominium in Cocoa Beach, Florida,” NBS Building Science Services 145, Aug. 1982, 135 pp.
2. Delatte, N.J., Jr., “Beyond Failure,” American Society of Civil Engineers, 2009, 390 pp.