Lightweight concrete plays important role in

‘Construction Breakthrough’
in Chicago’s
Hancock Center

A 100-story building with unit costs comparable to
those of a building half its size is being hailed as
a major technological breakthrough in building con-
struction — and owes much of its economy to the use
of expanded shale lightweight concrete in a composite
design in its floor slabs.

Topped out in May of this year at 1,107 feet above
ground level — plus twin, 344-foot TV antennae — the
John Hancock Center on Chicago’s Near North Side is
the tallest combined residential-office building in the
world, and has a gross area of 2.8 million square feet. It
represents the largest single real estate investment in the
104-year history of John Hancock Mutual Life Insur-
ance Company.

A tower tapering on all four sides, from 50,000 square
feet at the base to 16,000 square feet at the summit, the
building represents a unique approach to architecture,
with the structure functioning as an integral part of the
exterior, using diagonals to provide stability and
strength. In effect, it is a bridge-type structure con-
sisting of a vertical truss.

In a perpendicular rather than tapering design, the
structural system could be extended to 150 stories, say
the architects.

The Hancock frame consists of vertical exterior col-
umns and diagonal members crossing the building face
several times in the full height. All of these members are
capable of functioning as compression and tension mem-
bers particularly when subjected to lateral loads during
extreme winds. Essentially, the frame is a braced rigid
vertical tube with dimensions equal to the exterior di-

Lightweight concrete was chosen for the slabs be-
cause of the great dead load savings involved in a struc-
ture of this magnitude. Additionally, the structural engi-
neers planned for the decks to provide diaphragm action
throughout the building, and it was determined that the
most economical way in which to do this was to use a
lightweight composite design. The deck was designed
so that the concrete slab was attached directly to the
steel support beams by means of headed stud shear con-
nectors — as opposed to concrete fill on a metal pan.

By specifying lightweight concrete, the designers re-
alized a great saving in concrete dead load, which re-
sulted in smaller, lighter weight steel beams. By utilizing
composite design, additional weight savings were gained
because smaller sections were required to carry the super-
imposed loads. These weight savings were also reflected
in column sizes and foundation costs.

The designers, in order to facilitate their studies of the
structural system, had a full size section of floor con-
structed and load tested to failure. The section of deck
was made up of two 14 WF 34 beams, 31 feet in length,
with 32 equally spaced 3/8” x 3” headed shear studs
welded to the center of the top flange. The two members
were spaced 10 feet apart, spanning 30 feet. A 5” thick
lightweight concrete slab was cast, 31 feet long and 20
feet wide (a 5 foot overhang beyond each beam) rein-
forced with one layer of 6x6-6/6 WWF top and bottom.

The initial load tests and vibration tests were carried
out at ambient temperatures ranging from 30 to 65
degrees. The test to failure was conducted at 15 days.
All of the test results were extremely satisfactory, with a
factor of safety of over 2.2 in the test unit.

Owner — John Hancock Mutual Life Insurance Company.
Architects — Skidmore, Owings & Merrill, Chicago.
Construction Consultant — Paul A. Kelm.
Ready-Mix Supplier — Material Service Division, General
Dynamics, Chicago.
Marlblehead Lime Company, a subsidiary of General Dynamics,
Chicago.

Contrasting vividly with Chicago’s historic Water Tower, the
John Hancock Center exhibits the bridge-type structure which
will enable it to withstand high lateral forces against its
1,107-foot height. Lightweight concrete in floor slabs played
important role in economy of structure, with unit costs com-
parable to those of buildings half its height.
Towering above nearby buildings, John Hancock Center tapers from 50,000 square feet at base to 16,000 square feet at summit. Twin, 344-foot TV antennae will extend building’s total height to 1,451 feet above ground level. Engineering studies indicated that the most economic way to meet structural requirements was through use of lightweight concrete in composite construction in which deck is “keyed” to support beams by headed shear stud connectors.