Changing NEEDS

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Elegant, exposed steel moment-resisting frames replace a Cambridge, MA warehouse's crumbling CMU walls.

How can you adapt an old warehouse structure to meet the needs of an innovative company? That is the question architects Anmahian Winton of Cambridge, MA had to answer when approached by Orange, a Wire Free ™ Telecommunications company that needed a new space for their Cambridge office. The architects solved this puzzle by using steel moment-resisting frames to create an updated, light-filled space that met the owner's functional needs.

FUNCTIONAL DESIGN

The original structure consisted of five, single-story buildings arranged side by side and separated by alleyways which had been enclosed and abandoned. The alleyway walls were cracked and severely deteriorated. The roof structure was under-designed and not connected to the peripheral walls. The floor slab had been built on unsuitable soil and had settled in some areas up to 5" throughout most of the buildings. The interior steel columns had rusted at the base and some had tilted due to foundation problems.

To meet the requirements of the new building tenants, alleyway walls between the buildings were removed and replaced by glass atriums to create a garden visible from adjoining buildings. Skylights were created at the roof to provide more light, and a research meeting room—the "Imaginarium"—was created with custom steel-fabricated movable library walls to allow for easy conversion to a 100-person lecture hall.

ROOF STRUCTURE

The existing roof joists were 2x10 wood joists spaced 20" on center, span-

CMU walls dividing each building from an enclosed alley were replaced with new steel framing. The old alleys (the narrow area between the columns in this picture) became atriums.

ning 17' to 18' between steel girders. The roof joists were not adequate to accommodate the new loading conditions. To increase the load-carrying capacity of the roof, additional 2x10 joists were designed to be installed in alternate joist bays in the roof area.

There was no connection between the wood joists and the steel beams supporting the wood joists. New blocking was installed between the wood joists and bolted to the steel beams to stabilize the support condition and provide adequate lateral load transfer.

New steel roof members were added to support the new atrium structure, the skylights, and the new conference area. New steel dunnage structures were added to support the new mechanical roof top units. Two channels attached to either side of the new columns extended through the roof framing to support the base plates of the new dunnage columns. Finally, the existing roof deck was tied to the peripheral supporting members to transfer the lateral loads to the lateral-load carrying elements.

COLUMNS/WALLS

The structural system consists of 4"-diameter steel pipe columns in the interior, CMU and brick walls at the periphery of the buildings. Steel girders rest on steel columns, and are supported by CMU or brick walls at the end supports.

Since the CMU walls at the interior of the building were to be replaced by glass windows along the adjoining lines of the three buildings to create the atriums, new moment frames had to be added to replace the lateral load resistance of the CMU walls.

The allowable lateral shear stress and the corresponding lateral load in the existing un-reinforced CMU walls were calculated and used in the design of the moment frames. The final moment-frame member sizes of 6" wide-flange columns and 10" wide-flange steel girders helped to achieve the elegant look of the atrium. Use of bracing was not an option as it would have obstructed the views through the atriums.

In the "Imaginarium," the custom-fabricated movable library walls are supported by specially modified, steel moment frames designed to resist the lateral loads exerted by the moving walls.

COLUMN REPLACEMENT

During the progress of the project it became apparent that interior deteriorated columns and footings of the project would have to be replaced. There was no solid concrete foundation under the columns. The columns rested on two or three courses of brick with a 16"x16" dimension, supported in part by a 16"x16" concrete base that was 16" deep.

Some of the existing columns were observed to have rusted and deteriorated at the base. There were no anchor bolts attaching the column bases to the brick piers.

In the initial design, the structural drawings contained remedial details for reinforcing the column bases by placing concrete around the existing

The existing masonry dividing walls were in very poor condition.

Many existing column bases were deteriorated.

Channels attached to each side of the existing columns extend through the roof to support additional loads.

16”x16” footing, and tying the existing base plate to the new concrete by welding bent bars (to be embedded in new concrete) to the base plate. As the excavation continued and the existing slab was removed, it became apparent that the material under the slab had to be compacted for placement of the new slab. The contractor and the geotechnical engineer were concerned about the danger of separation and slippage of the columns from their existing foundations during vibration of the soil, and the possibility that the roof structure could collapse during compaction of the base material of the new slab. New 5”-diameter steel pipe columns were added throughout the building to replace existing deteriorated columns. New footings were designed for the new columns.

Due to cracks and un-evenness of the existing slab surfaces, the existing slabs were removed for installation of a new slab on grade. After removal of the slabs, the soil condition under the slab was not suitable for placing the subbase of the new slab. The existing soil was excavated to a depth of 2’ below the bottom of footing grade. The bottom of the excavation was then proofrolled by making five passes over the area with a vibratory plate compactor. Granular fill in loose lifts was placed and compacted to achieve 95 percent of the maximum dry density in accordance with ASTM D1557.

Due to the coordination of the architectural team, the creative approaches of the general contractors, and the quick response of the fabricators, construction was completed as scheduled by the owners. ★

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