Adaptive Reuse Of Existing Structures

Los Angeles Structural Design Requirements for Conversion To Joint Living and Work Quarters

By J. Gabriel Linares, P.E.

El Dorado

Along with the growth of the movie industry, so began the rise in development in the City of Los Angeles. In the 1920s and 1930s, the downtown area of the city saw the construction of five- to thirteen-story buildings to satisfy the growing need for new government, banking, and commercial offices, as well as light manufacturing facilities. These modern buildings of the time were primarily constructed of cast-in-place concrete, or steel frame with concrete or masonry infill walls.

With the end of the second World War, development activity and growth moved towards the city's surrounding undeveloped areas. As people moved to newer buildings in suburban areas, the less desirable downtown buildings, many of which are historical architectural edifices, became rundown and vacant. The loss of tax base, increasing social issues, and the growing cost of transportation development drew greater attention to improving the city's downtown core.

With the passage of the Artist-in-Residence regulations in the early 1980s, the city saw some of these older buildings used as artist lofts. Not until the mid 1990s did these buildings then take on more interest as residential lofts. And, on June 3, 1999, the City of Los Angeles made effective Ordinance 172571 establishing the adaptive reuse of existing buildings in the downtown area. The main goal of the ordinance is to facilitate the planning entitlement process when converting older commercial, economically distressed or historically significant buildings to new residential uses. Now the City of Los Angeles had an ordinance streamlining the planning process and opening doors to the revitalization of its downtown buildings.

Library Court

The affected buildings are typically unoccupied, medium hazard occupancies office and light manufacturing buildings. When a building occupancy is changed to a higher hazard group, in these cases to residential, the building code requires conformance to current code requirements for fire-life safety and seismic safety, posing many challenges to developers and engineers.

Along with numerous substandard fire- and life-safety conditions, typical buildings are also deficient from a seismic safety standpoint due to vertical structural irregularities, plan structural irregularities, unknown properties and inadequate to questionable structural systems. The current building code does not fully address all the possible seismic retrofit scenarios for existing deficient structural systems, forcing engineers to look for other documents that contain necessary provisions. Furthermore, the Building Code requires 100% seismic compliance, which is very difficult to impossible to achieve in some older buildings. The City was left with a dilemma; enforce the 100% seismic compliance and risk having the buildings remain vacant or lose the opportunity to structurally strengthen them to a reasonable level of life safety and help revitalize the City's downtown area.

Packard Lofts

The City of Los Angeles Department of Building and Safety (LADBS), working closely with the Structural Engineers Association of Southern California (SEAOSC), developed alternative structural guidelines. These alternative strengthening standards provide guidance towards achieving a reasonable structural life-safety level, but do not relieve the engineer from the difficult task of design and analysis. LADBS and SEAOSC have historically worked very closely together in development and implementation of a number of seismic requirements into the Los Angeles Building Code (LABC).

Past co-developments include Chapter 88, strengthening of un-reinforced Masonry (URM) buildings, Chapters 91 & 96, strengthening of concrete or masonry wall buildings with flexible diaphragms, Chapter 92, strengthening of wood cripple wall buildings, Chapter 93, strengthening of wood frame build-

ings with soft or weak story, Chapter 94, strengthening hillside homes, and Chapter 95, strengthening of concrete buildings with or without masonry infill walls. This strong alliance led to the development and adoption of Ordinance 176673 (LABC, Chapter 85, Alternative Building Standards for Joint Living and Work Quarters).

Chapter 85 is based on the California Health and Safety Code Section 17958.11, which allows any city or county to adopt alternative building regulations for the conversion of commercial or industrial buildings, or portions thereof, to joint living and work quarters. The Seismic provision of Chapter 85 recognizes all of the strengthening provisions developed by LADBS and SEAOSC (Chapters 88, 91, 92, 93, 94, and 95), and also allows Engineers to analyze buildings for a minimum of 75 percent of the Design Basis Ground Motion as defined in California Building Code section 1627 and as specified in section 1629.1. In no event is a reduction in the overall capacity of the building's existing seismic force resisting system allowed.

The seismic retrofitting of these types of buildings generally requires more advanced analysis techniques for determining capacities and predicting performance. Engineers are left to look at documents other than the CBC for guidance. Along with the 2001 edition of the CBC (1997 UBC), engineers are using the following for design:

- LABC, Chapter 95 (*Voluntary Earthquake Hazard Reduction* in existing reinforced concrete buildings and concrete frame buildings with masonry infill) which provides procedures for analyzing and modeling un-reinforced masonry infill.
- FEMA 356 (*Prestandard and Commentary for the Seismic Rehabilitation of Buildings*) at a Life Safety Performance Level, in general has been the goal for most engineers. This is a thorough document that covers different types of structural systems
- FEMA 351 for qualifying existing moment frame connections.
- GSREB (*Guidelines for Seismic Retrofit of Existing Buildings*), which covers seismic strengthening of several types of buildings.
- Performance-based design, with appropriate target level designs, as a method for evaluating existing buildings is reviewed by the city on a case-by-case process. The nonlinear analysis or pushover analysis is addressed in FEMA 356, FEMA 440 and ATC-40.

A typical "Adaptive Reuse" building could be described as a building from 4 to 12 stories, built in the early 1900s, with an existing gravity system consisting of a concrete deck supported by a concrete pan joist floor system spanning between concrete beams and concrete columns. The lateral force resisting system is usually a concrete frame with un-reinforced masonry infill. The foundations are usually concrete spread footings, and most of the time the as-built plans are non-existing. These buildings are typically found to be seismically inadequate and require the introduction of an additional lateral force resisting system. This is usually in the form of new concrete shear walls or special concrete moment frames.

A Structural Engineer's seismic evaluation will generally include the following:

1. Reviewing any available as-built drawings, prior engineering repair reports or any structural documents made available by the client.
2. Performing a thorough walk-through and visual survey to observe the quality of construction, as-built conditions, note any obvious deficiencies and confirm that the provided construction documents generally correspond with the actual conditions. Where possible perform nondestructive visual investigation of select structural elements, connections and foundations.
3. Development of a 3-dimensional computer model that incorporates all the elements contributing to the seismic structural system. All properties for existing elements shall be established from testing and/or verifiable documentation.
4. Identifying seismic force resisting elements, connections and any weak points or discontinuities in the building's seismic load path.
5. Referencing current building codes to establish the force level design or contact the local building official for alternative standards.
6. Preparing a written report summarizing the result of the structural evaluation, listing the building's deficiencies and the proposed retrofit options.

The Adaptive Reuse Ordinance and the alternative strengthening standards provide a cost effective means for rehabilitating the existing buildings into residential uses. The strengthening standards accomplish this by eliminating any irregularities and increasing the seismic performance of the building to a level that is safe for future occupants.

The Adaptive Reuse Program has been a great tool in the revitalization of City of Los Angeles's downtown areas, and for that reason the program has been expanded twice to encompass other parts of the city. The first expansion included areas such as Hollywood, Wilshire Center, Koreatown, Lincoln Heights, Chinatown and Central Avenue. With these areas also seeing a revitalization of their older underutilized buildings into much needed housing stock, the city has adopted the program citywide.

Since the start of the Adaptive Reuse program the City of Los Angeles Department of Building has worked with developers and engineers on over 150 buildings with a residential unit count of over 10,000 units. Currently about 30% of these buildings have completed construction and are safely occupied. Some of these buildings include the Historic Subway Terminal Building (417 Hill Street) **www.metro417.com**, Little Tokyo lofts (420 S. San Pedro) **www.littletokyolofts.com**, Santee Court (**www.santeecourt.com**). There are approximately 40% in the construction phase, such as the Pacific Electric Lofts (**www.pelofts.com**), 1100 WILSHIRE (**www.1100wilshirela.com**), 3800 Wilshire Boulevard. The remaining 30% are in the feasibility or design stage and should be receiving building permits in the near future. Figures One and Two depict buildings that are typical of these conversions.▪

Hellman Building

Flower Street Lofts

Little Tokyo Loft

Orpheum

Title Guarantee Building

J. Gabriel Linares P.E. is a Cal Poly SLO graduate and serves as a Structural Engineering Associate for the City of Los Angeles, Department of Building and Safety. He can be reached via e-mail at ***Gabriel.linares@lacity.org.***