THE RISK BASIS FOR HEIGHT AND AREA LIMITS IN NORTH AMERICAN BUILDING CODES

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ABSTRACT: This paper examines the development of the historical building height and area limits for North American building codes, identifying the risk factors upon which they were originally based and setting the stage for a re-examination of these factors in a current context. Height and area limits have developed over centuries, in conjunction with limits on types of construction, and were premised on a need to limit conflagrations and large loss of life. Over the last 80 years, these limits have remained relatively unchanged while technological advances and fire service capabilities have improved considerably. This paper covers the development of these limits from Nero’s Rome to the development of more current limits in the modern model codes.

KEYWORDS: Height and Area, Building Size, Risk

Historical records indicate that there was a need to regulate building construction in the City of Rome as a result of several conflagrations. The Annals of Tacitus note that the Great Fire of Rome occurred on July 9 in 64 AD and burned for 5 days, destroying 10 of fourteen districts. In order to limit the occurrence of future conflagrations, regulations limiting combustible construction, building height and separation were enacted. Over a millennium later, as the city of London expanded, several “Great Fires” occurred. One of the earliest occurred in 1087 and destroyed most of London including St. Paul’s Cathedral. Another occurred in 1135 and resulted in the destruction of most of the city. As a result of these large conflagrations, an ordinance termed the “Assize of Buildings” was issued, regulating combustible construction and an early version of today’s firewall.

The Great Fire of London in 1666 burned for 4 days and destroyed a large part of London. In response, an act was passed in 1667 for rebuilding the city, regulating the construction of exterior walls and roofs, basic occupancy differentiation, building height, types of construction and party walls.

As a result of the proliferation of warehouse fires, the City of London building regulations were revised in the late 1700’s to include area limits as a function of building construction. These regulations were further altered in the early 1800’s as a result of fires that would rapidly grow beyond the capabilities of the local fire brigade, putting the community at risk of conflagration. As a result, the building act of London revised the area limits into cubic capacity limits to control the volume of structures. These limits were further refined in the mid 1800’s to cover a broader group of structures and slightly greater volume of 216,000 cubic feet, which was the cube of 60 feet, considered to be within the capabilities of a properly equipped fire brigade at that time.

A proposal in the early 1870’s to increase the maximum cubic capacity to 300,000 cubic feet was considered in London, and permitted on a case-by-case basis for industrial facilities requiring greater space. At this same time, the Great Fire of Chicago and Great Fire of Boston occurred within a year of each other, resulting in significant losses for many insurance companies and bankruptcy in some cases. Following these conflagrations, the fire insurance industry banded together to establish a schedule of rates associated with an acceptable level of risk inherent to certain building characteristics, including height and area. The schedule of rates was intended to address the London based insurer’s concerns relative to the construction of buildings in the US. This schedule resulted in the definition of a “standard building”, to which basic rates were set. Any deviation from the standard was considered to increase the fire hazard of the building, resulting in higher rates. The height and area limits associated with a “standard Building” were 60 feet and 5,000 square feet respectively, which coincided with the capacity of 300,000 cubic feet being considered in London at that time.
Over the 20-30 year period following the establishment of a standard building, height and area limits were gradually incorporated into city level building ordinances. However, these limits were inconsistent causing hardship for the construction industry who pushed for uniform building regulations. A meeting of the Combined Committee on Building Ordinances was convened in New York on April 2 and 3, 1891 to discuss the framing and adoption of a model building law. The Committee was composed of seven delegates representing the American Institute of Architects, National Association of Builders, National Board of Underwriters, National Association of Building Inspectors and National Association of Fire Engineers. The meeting resulted in a draft of suggested ordinances combined from ordinances in force in various large cities, such as New York and Chicago, at the time.

A more successful attempt at drafting a model code occurred several years later (1893) by the National Board of Fire Underwriters, who had several decades of experience in drafting building ordinances for insurance purposes. This eventually became the National Board of Fire Underwriters (NBFU) Model Code published between 1893 and 1965. The 1905 NBFU Model Code was the first to include substantial height and area limits and variations of those limits as a function of occupancy type, construction type, streets facing and whether sprinklers were provided.

A report prepared in 1913 by Ira H. Woolson, Consulting Engineer for the National Board of Fire Underwriters, summarized the results of a study of allowable heights and areas for factory buildings in the United States. The study was based on a survey of fire marshals and fire chiefs in the United States representing cities of over 20,000 population. The results were consistent with those of the 1905 NBFU Model Code and the New York and Chicago City Ordinances.

Height and area limits were further developed by the National Fire Protection Association (NFPA) Committee on Fire Resistive Construction between 1913 and 1927. The committee was initially chaired by Woolson, and incorporated many of the same limitations established by NBFU and the survey conducted by Woolson in 1913.

Two groups continued development of height and area limits beyond 1927 including the Uniform Building Code (UBC) prepared by the International Conference of Building Officials, and the Recommended Minimum Requirements for Fire Resistance in Buildings (RMRFRB) prepared under the technical direction of the National Bureau of Standards by the Department of Commerce Building Code Committee. The RMRFRB was originally chaired by Woolson until his death in 1927. The UBC and RMRFRB had height and area limits consistent with those of the NBFU Code, NFPA limits and Large City ordinance limits and were a function of occupancy type, construction type, streets facing and sprinklering. The RMRFRB limits were used as the basis for the limits contained in the first Canadian Model Code published in 1941.

From 1927 onward, the height and area limits in the model codes in both the US and Canada underwent minor changes; however, the principles upon which they were based remained relatively unchanged. Since that time fire protection technologies and fire-fighting capabilities have improved significantly, outpacing the changes to the height and area limits suggesting a need to re-examine those limits in light of these improvements. As noted above, height and area limits in North American model codes have a long and complicated history of development. This paper follows the path of historical development to extract the original risk factors associated with the development of height and area limits. This work facilitates a re-evaluation of the risks in a current context to establish where alternative approaches to either the risk or corresponding hazard analysis can be evolved from this information.