Renovating mill buildings of the northeastern US

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Extended Abstract

Few images offer a glimpse into America's short-lived manufacturing boom like the mill buildings lining the banks of many rivers throughout the Northeastern US. These vast structures of stone, brick, and timber, often vacated and neglected for decades, can be more than decrepit souvenirs of the region's industrial heritage. In recent times, adaptive reuse of these buildings has become more attractive to developers and real estate investors. Zoning and development trends favoring urban renewal, a widespread need for affordable rental housing, and economic incentives promoting green building practices are a few of the socioeconomic factors that favor mill building renovation.

While the stone and brick masonry elements comprising the foundation and exterior walls can often be relied on for continued service with little to no maintenance, the likelihood of sustained damaged to the wood components is generally much greater and warrants special attention. Without sustained efforts to maintain the building envelope, mill building timbers are particularly susceptible to water intrusion. The roofs are generally flat or very subtly pitched, and often times employ interior drain systems to mitigate rainwater. While managing rain water inside buildings in this manner can be viable when maintenance is kept up, this is rarely the case for mill buildings that have been vacant for long periods of time. Floor areas near drain and plumbing penetrations are often problematic. The large percentage of the walls dedicated to windows can also pose problems as they tend to leak, or worse, become open channels for rainwater and snow to enter the building through when vandalized. Once wet, wood in mill construction is unlikely to dry out, even if the water source is eliminated. The same details originally crafted to limit air circulation as a measure against spreading fire are equally effective at restricting the air flow required for drying.

In addition to mitigating deterioration of the timber framing, mill buildings being renovated need to be evaluated for their load-carrying capacity to support the new loading conditions associated with their reuse. Once the obvious repair needs are addressed, it is often necessary to determine allowable engineering design properties of the sound timbers. As the manufacture of timbers used to construct mill buildings predates the establishment of grading standards, the original construction was likely performed based on species-specific values published in city building codes. These values were often inconsistent from one city code to another, and often unrelated to the grade or quality of

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the wood. Thus, it's possible that the strength of timbers of the same size and species can vary significantly within the same building such that the lower grade timbers will require strengthening to provide the desired floor loading capacity.

Visual grading rules written by North American grading agencies cater to production and grading of lumber and timbers in the green, unseasoned condition. These grading rules account for the downgrade effects of seasoning by assigning conservatively reduced design properties. While using agency rules to grade existing seasoned timbers in-situ will result in safe and conservative grade assignments, this approach can result in excessively conservative results that drastically underestimate the actual strength of the members and result in inefficient use of their strength and stiffness. This is especially true of mill buildings where the timbers are typically high quality, sawn from old-growth trees. An alternative to grading agency rules is using ASTM D 245 as a guideline for in-situ visual stress grading. This standard allows the grader to account for the present condition of the seasoned timber without the penalties of future downgrading built into the grading agency rules. Furthermore, ASTM D 245 has flexibility in that discrete design values can be assigned to individual members as opposed to the stepwise design values associated with the incremental grades of the agency rules.

This paper presents a review of mill building construction details and common engineering challenges associated with mill building renovations. Objectives of condition surveys specific to timber construction, and the basic principles of visual stress grading of timbers are also presented.