



Engineering Sciences Section - 2013

C37 Analysis of a Vinyl Railing System in a Second Story Fall Incident

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After attending this presentation, attendees will have been introduced to a case where a fall incident occurred from the second-story exterior rear deck of a vacation residence when a vinyl railing section suddenly and unexpectedly failed at the structural connection to the railing support vertical posts. The investigation into a lack of a proper and adequate railing system will be described.

This presentation will impact the forensic science community by illustrating the need for proper design, installation, inspection, and maintenance of secondary building components, such as railing systems, emphasizing the necessity to properly apply the requirements of adopted building and maintenance codes.

Building codes require that railings/guards have the proper connection devices to transfer load to the appropriate adjacent primary structural framing elements of the building. The railing section involved in this incident had never been inspected throughout its eight-year life span, during which time it was exposed to exterior weather elements.

This fall incident occurred from the second-story rear deck of a vacation residence. The tenant of the vacation residence placed his hand on the vinyl railing of the deck for support and the railing section suddenly and unexpectedly failed at the structural connections to the vertical support posts, thereby causing both the tenant and the railing section to fall to the ground below.

The vinyl railing involved in this incident was installed by the contractor during the original time of construction. An exemplar section of the vinyl railing section was removed from the deck area after the incident. The horizontal railing members of the vinyl rail system consisted of a wood core with a vinyl cover and were toe-nailed with galvanized screws. The manufacturer's instructions called for the installation of coated aluminum brackets fastened to the bottom rail and to the sleeved post.

The manufacturer's documentation specified that the wood cores of the horizontal members be fabricated of cedar wood; however, review of the exemplar railing section confirmed the upper horizontal member consisted of two varying wood sections finger-jointed together and the lower horizontal member consisted of a nonpressure-treated standard framing member. These as-built structural wood cores were not consistent with the specifications, nor were they suitable for the intended use.

The manufacturer's installation guide recommended cutting the vinyl covering of the horizontal handrail members shorter than the wood core to allow for expansion and contraction due to weather. This procedure created an area of vulnerability where the structural wood core was not protected. During inclement weather conditions, moisture would infiltrate the horizontal wood core to vertical post connection locations. This condition continued and was inadequately maintained over time, thereby allowing the significant deterioration to occur.

The jurisdiction where the property is located required a rental license for all rental properties. Although the jurisdiction inspected and reviewed the residence at the time of original construction, according to the jurisdiction's regulations for rental properties, annual inspections of the property are mandated in order to retain a rental license. The property owner never obtained the required rental license.

According to the municipal fire inspector, an annual inspection would have required the property to be compliant with the State Fire Prevention Code. The railing system was required by the building code at the time of original construction of the deck, and the fire prevention code required that all required means of egress safeguards be maintained in good working order. The fire prevention code further required that any exterior means of egress found in a state of deterioration or determined to be unsafe by the fire official be repaired immediately.

The railing system of this elevated exterior deck could not support the code-mandated and expected lateral forces encountered during its lifetime. An experienced contractor should have been aware that toe-nailed connections would not provide adequate structural support without the use of additional brackets or connection mounts. In addition, the galvanized connection screws were subject to deterioration given direct exposure to the weather elements. An experienced contractor should have been aware that no weather-resistant protection between the horizontal structural supports and the vertical wood posts provided a vulnerable place for moisture penetration.

Given the improper as-built construction of the vinyl railing system, the improper connection of the horizontal members to the vertical support posts, and the lack of maintenance and inspection by the owner, the structural connection of the horizontal members to the vertical posts failed under normal and code-required loading, thereby allowing the tenant of the residence to fall to the ground below. The design, configuration, construction, and installation of this railing system, as well as the improper maintenance and lack of inspection by the property owners, allowed this incident to occur. Had this residence been properly licensed as a rental property, the rental unit would have been annually inspected and this incident could have been prevented.

Weather Exposure, Maintenance, Railing Failure