SPEIGHT MARSHALL & FRANCIS
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# Technical Bulletin

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# Handrails - Part 1

## Guidelines you can lean on

## Introduction

Handrails for mezzanines, balconies, stairs, decks and other similar entities provide barriers critical to the safety of those using them; therefore, it is important the structure supporting handrails is designed to meet stress and serviceability (i.e. deflection and movement) requirements. Inadequate design of handrail systems and support structure may cause handrails to fail through bending or the perception that they are too "wobbly."

## Code Provisions

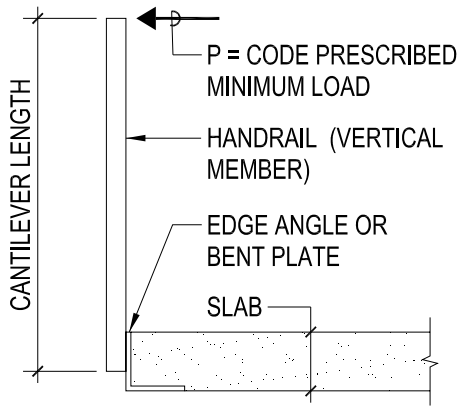
The International Building Code (IBC) provides specific minimum provisions for the design of handrails and supporting structure. According to the IBC, handrail assemblies and guards shall be designed to resist a minimum of either a uniform load of 50 pounds per linear foot (plf) or a concentrated load of 200 pounds applied in any direction at any point along the top of the handrail. The scenario producing the greater load effect shall be used in the design. Naturally, handrail assemblies must have support structure capable of transferring these loads to appropriate structural elements of the building. Examples of such structural elements include slab edge angles, bent plates and concrete slab systems.

## Handrail Design

Handrail assemblies must be designed to transfer the code-prescribed minimum loads to the supporting structure. Typical handrail systems are comprised of vertical and horizontal members working in unison to provide lateral restraint. Vertical and horizontal members may vary in size and type with the handrail selected, but are typically posts (vertical members) and rails (horizontal members).

As seen in the "Handrail Loading Diagram" below, the vertical member cantilevers from its point of support (slab edge angle, bent plate, etc.) once the load 'P' is applied. The structural integrity is dependent on the horizontal rails' capability to transfer the lateral load to the vertical posts. The size and material of the horizontal member will determine its ability to transfer the load; however, sizes of horizontal members are governed by provisions of the IBC. The IBC states that railings must be sized such that an occupant's hand can firmly grasp it, thus limiting its size to between 1¼" and 2" diameter. This means vertical members must be spaced so that the horizontal members are able to transfer the prescribed loading. In essence, the span limits of the horizontal rail will govern the spacing of the vertical posts. Consequently, spacing vertical members will affect the support structure design as the vertical members ultimately transfer the load to the support structure.

Handrail Loading Diagram




## Support Structure Design

Design of the support structure is the structural engineer's responsibility. The critical design element is the point of attachment of the handrail to the support structure. When the top of the handrail is loaded, it will induce a moment (or rotation) equal to the applied load 'P' multiplied by the cantilever length into the support structure. Therefore, the support structure at the point of attachment must resist the moment induced and must be designed properly to ensure that the entire handrail system meets the necessary stress and serviceability requirements. If the connection at the base of vertical members allows rotation, this may significantly magnify the lateral deflection and can make the rail feel "wobbly."

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## Conclusion

Handrails provide critical safety barriers for the occupants of a building; therefore, identifying the requirements of handrails, as well as the support structure, early in the design is imperative and will eliminate unnecessary (and costly) repairs. In our next Technical Bulletin (Handrails – Part 2) we will examine a lesson learned from support structure design and why the designer may want to exceed the minimum code requirements for serviceability considerations.

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